

SECTION 2 - GEOLOGICAL DATA

2.1 Geological Summary

Walton-1,2 was designed as an exploration well to test the presence of hydrocarbons in a large thrust-faulted anticline in the Proterozoic Roper Group section (Figure 3) of Exploration Permit 24. The well location lies along the northern margin of the Beetaloo Sub-Basin (inferred from gravity and magnetics) and is approximately 50km south west of the Mallapunyah Fault. In the following discussion Walton-1 will not be referred to as it showed a similar section to that encountered in Walton-2.

The well spudded in Cretaceous claystones that have a highly developed lateritic soil profile. The claystones become sandier towards the base of the section, immediately above the Cambrian/Cretaceous unconformity, which was penetrated at 36 metres (14 metres higher than prognosed, see Table 4). Below the unconformity the well intersected the Cambrian Tindall Limestone, prior to losing circulation at 39.7 metres. The well was drilled without returns to 50 metres, where stiff foam injection brought some cuttings to surface.

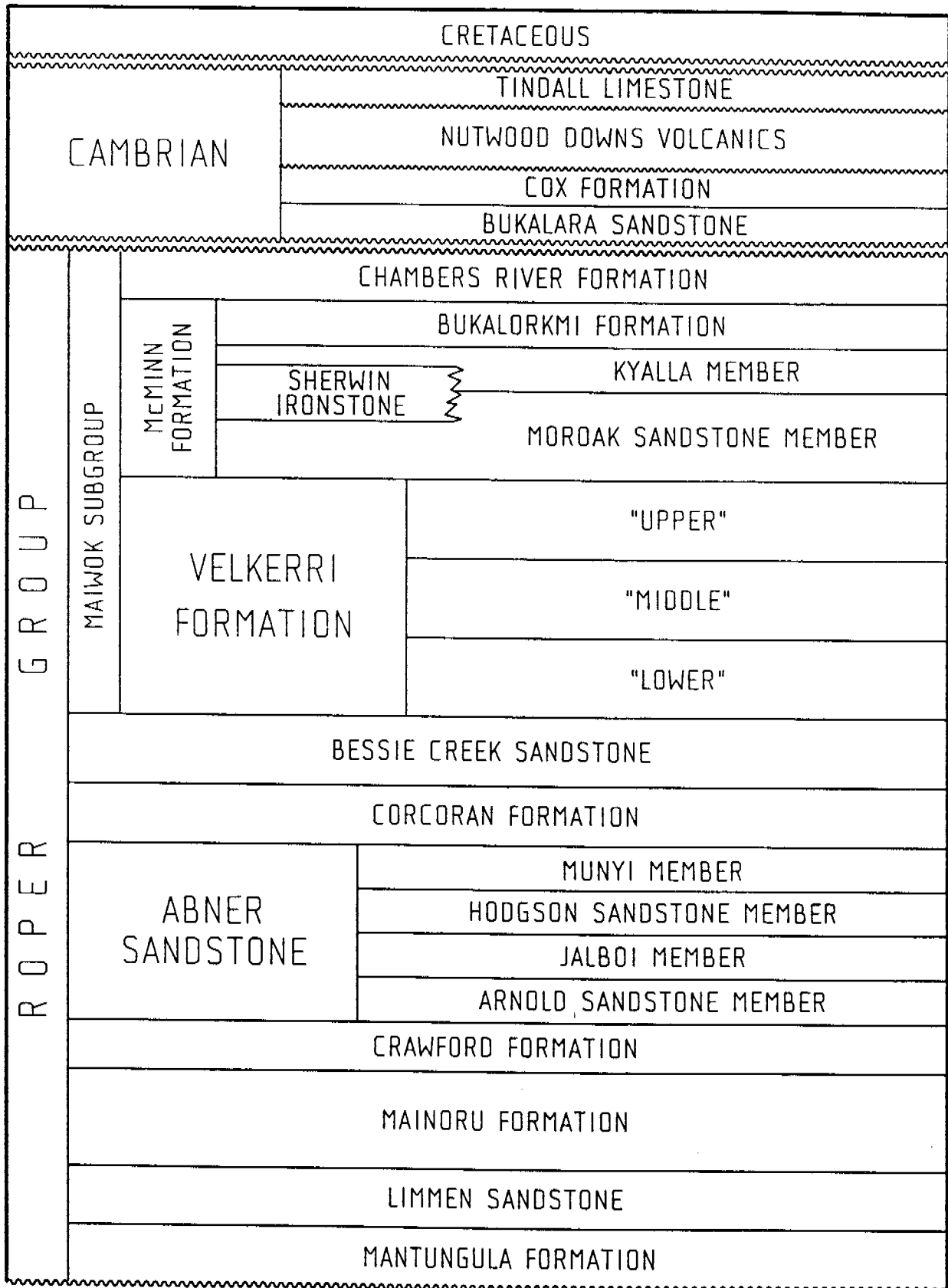
From the rate of penetration it appears that the well intersected the Cambrian Nutwood Downs Volcanics at 86.0 metres. Seven inch casing was set at 50.4m when it could not be reamed to bottom. After drilling the seven inch casing shoe a six inch hammer was run and the hole drilled to 191.7m with a strong water flow (at 120 metres) displacing the initial stiff foam mud system. The six inch hammer was tripped and five inch casing run, set and cemented at 191.6m. The five inch casing shoe was drilled out and basalt was drilled to 198.2 metres.

Below the basalt the hole intersected a sandstone unit believed to be the Cambrian Bukalara Sandstone. The boundary between the Sandstone and the basalt is sharp, although not necessarily an erosional unconformity. At 259.6 metres the sandstones pass unconformably down into organic-rich mudstones of the Middle Velkerri Formation in which three altered igneous units (262.0 - 262.9, 264.39 - 264.53 and 284.16 - 288.54m) were encountered. The Lower Velkerri Formation was intersected at 555.5 metres and was found to contain two thin dolerite lenses (662.1 - 666.3m and 724.15 to 724.35m) and numerous oil shows over the interval 758.6 - 798 metres.

A thicker dolerite sill was intersected from 843.95 - 952.80m.. No shows were seen in the dolerite and metamorphosed zones were evident for approximately 40m on both sides of the intrusion. Some of this thermally altered Lower Velkerri Formation was drilled before entering the primary target. The Bessie Creek Sandstone was intersected at 969.7 metres and contained numerous poor to very poor shows in the 30 metres above total depth (T.D.), although no visual porosity was evident. Walton-2 was terminated at 1014.45m in the Bessie Creek Sandstone.

Wireline logs were run over the interval 192 metres (five inch casing shoe) to T.D.

ROPER GROUP STRATIGRAPHY



PetNTcw4741

Figure 3.

TABLE 4

ACTUAL Vs PROGNOSED FORMATION TOPS

WALTON-2

Age	Formation	Actual	Prognosed	Difference (m)
Cretaceous	Undifferentiated	Surface	Surface	0
Cambrian	Tindall Limestone	36	50	14 high
	Nutwood Downs Volcanics	86	100	14 high
	Bukalara Sandstone	198.2	Not	
Proterozoic	Middle Velkerri Formation	259.6	Not	
	Lower Velkerri Formation	555.5	320	235.5 low
	Dolerite Sill	844.0	Not	
	Bessie Creek Sandstone	969.7	475	494.7 low
	TOTAL DEPTH	1014.45	1200	185.55 high

2.2 Well Objectives and Performance

Walton-1,2 was designed as an exploration test to assess the hydrocarbon potential of sedimentary rocks along the northern margin of the Beetaloo Sub-Basin, defined as a broad gravity depression interpreted to contain a thick section of Proterozoic Roper Group. Prior to the drilling of Atree-2, the nature of the sediments below the Cambrian Nutwood Downs Volcanics was unknown.

The results from Atree-2 indicated that the Beetaloo Sub-Basin gravity expression is a result of a thickened Roper Group section below the Cambrian unconformity. In particular the intersection of the Moroak Sandstone (now believed to be the Cambrian Bukalara Sandstone), Velkerri Formation and Bessie Creek Sandstone indicate that the most prospective part of the Roper Group is within drillable depth in EP24 and contains excellent source potential and favourable reservoir potential. The occurrence of oil shows throughout the Velkerri Formation indicate the unit to be oil generative, adding to the potential of the area.

In light of the above, the results from Atree-2 were seen as very encouraging for exploration in EP24. Walton-2 has shown similarly encouraging results for source potential in the Middle Velkerri. A better result was achieved in the quality of oil shows developed in sandstones within the Lower Velkerri Formation. The intra-Lower Velkerri sands developed in Walton-2 have good oil bleeds with bright yellow-white fluorescence and immediate streaming cuts. However, the oil did not flow upon testing. The interpreted lack of permeability was confirmed by core analysis, showing the silty sandstones to be essentially impermeable, although possessing up to 12% porosity. There is potential for these reservoirs to flow if they can be successfully stimulated and this possibility has yet to be evaluated.

The Bessie Creek Sandstone in Walton-2, which was the primary target, had patchy, very poor shows developed throughout. The porosity had been occluded to less than five percent by late diagenetic silicification. There was no thinning of any Roper Group unit, which would be anticipated if the structure was early in origin. As a result the Walton-2 structure is not interpreted as being early, and as such the optimum conditions for hydrocarbon accumulation have not been adequately tested.

2.3 Stratigraphy

Undifferentiated Cretaceous:

Surface to 36 metres (36 metres thick)

0-24 metres

Lateritic gravel - light brown to reddish brown, hard to very hard, subangular fragments, weathered.

24-36 metres

Claystone - grey/yellow/medium yellow, soft, very silty, sandstone towards base. (Mullaman Beds?)

Tindall Limestone:

36 - 86 metres (40 metres thick)
Drilled with only intermittent returns.

Limestone with minor claystone, sandstone and chert bands/nodules. Limestones are light brown to off white, blocky, hard. Sandstones and claystones are as described above and may represent caving from that unit.

Nutwood Downs Volcanics:

86 - 198.2 metres (112.2 metres thick)

Basalt - dark brown/black/dark green-grey, very fine to cryptocrystalline texture, vesicular in places, usually infilled with white zeolites. Some calcite veins (occasionally with associated pyrite) towards base, as well as rare intercalations of thin, light brown, poorly indurated, fine to medium sandstone.

Bukalara Sandstone

198.2 - 259.6 metres. (61.4 metres thick)

Sandstone with interbedded siltstone and minor claystone. Sandstone is predominantly light grey to medium light grey, fine to medium grained, subangular to subrounded, moderately to well sorted, and hard (well indurated). Bedding is mostly massive to weakly thin bedded (occasionally cross-bedded) with intervals of deformed or slumped beds, usually highlighted by laminae of finer grained sediments. Fine siltstones and claystones are olive to light green and mostly occur as thinly interbedded laminations, often wavy and/or discontinuous, and rarely as thicker units which are massive or chaotically bedded.

Middle Velkerri Formation

259.6 - 555.5 metres (295.9 metres thick)

Mudstone- brownish black to black, very organic rich. Common pyrite nodules. Occasionally strongly to moderately fractured. Laminated, with occasional calcite lenses and veins in fractures. Interlaminated micaceous siltstone with claystone. Patchy dull yellow fluorescence, weak to moderate crush cut. Sharp basal contact marked by lessening of organic content and glauconite-rich layer.

Lower Velkerri Formation

555.5 - 843.95 metres (286.95 metres thick)

557 - 758.6 metres - Claystone, grading to siltstone in parts, light bluish grey to medium bluish grey and medium dark grey at base. Occasional interbeds of dark grey to greyish black claystone. Occasionally grades to siltstone, contains minor flecks of organic matter disseminated throughout.

758.6 - 762.2 metres - Sandstone, dark grey occasionally light grey, very fine to fine grained, with abundant siltstone and claystone matrix. Highly micaceous. Occasional fining upward patterns evident in thin interbeds. Hydrocarbon shows between 1128.5 and 1129.5 metres. Live oil on core and strong hydrocarbon odour. No fluorescence but a weak blue-white crush cut. Core evolved small amounts of gas on removal from tube.

762.2 - 843.95 metres - Interbedded medium dark grey to dark grey claystone to light grey very fine sandstone. Small scale fining upward features evident.

Dolerite

843.95 - 952.8 metres (108.85 metres thick)

Dolerite, brownish grey to brownish black, cryptocrystalline chilled margin over upper 0.5 metre. Grades from fine to medium grained at bottom of hole. Occasional sub-vertical fractures.

Lower Velkerri Formation

952.8 - 969.7 metres - (16.9 metres thick)

952.8 - 961.85 metres

Interbedded light green to dark green mudstone and siltstone, non-carbonaceous, internally massive, occasionally pyritic with sparse upward-fining units.

961.85 - 969.7 metres

Interbedded mudstone, siltstone and sandstone rapidly coarsening down to 962.5 metres. Medium to coarse sandstone, occasionally fine, highly silicified, no visible sedimentary structures. Some greywackes, poorly sorted with grey mudstone matrix, also highly silicified. Basal 4-5 metres is thin flaser-like interbedding of dark grey mudstone with medium-fine quartz sandstone showing abundant scour-and-fill and upward fining current laminae.

Bessie Creek Sandstone:

969.7 - 1014.45 metres (44.75 metres thick)

Light grey, medium to mostly fine grained quartz sandstone, coarsening upward with abundant light green/grey mudstone rip-up clasts at the base of beds in the top two metres. Mostly very silicified and stylolized, with abundant vertical to subvertical fractures, which are commonly open and displaying euhedral quartz and pyrite crystals with relict bitumen. Occasional bitumen staining is observed and sparse pinpoint fluorescence.

2.4 Mud Logging

Mud logging services were provided by Exlog Pty Ltd. Rate of penetration, total gas detection, gas chromatograph, pump stroke counter, fluorescence and H₂S detection services were provided, as well as lag monitoring and the preparation of a continuous mud log at a scale of 1:500. A copy of the mud log is included in this report as Enclosure 1. Mud logging personnel assisted Pacific Oil and Gas staff in the handling, marking and description of core.

2.5 Wireline Logging

The downhole wireline logs run by Century Geophysical Pty Ltd are listed in Table 5.

TABLE 5

WIRELINE LOGS

WALTON-2

Log	Run	Interval (m)	Date
<u>Suite 1</u>			
Gamma, S.P, Temperature	1	17.6 - 1019.2	22/09/89
Gamma, Caliper, Density	2	182 - 1017	22/09/89
Gamma, Neutron, Resistivity	3	145 - 1017.4	22/09/89
Sonic	4	158.70 - 1015.50	22/09/89
Magnetic Susceptibility	5	17.5 - 1019.2	22/09/89
Dual Porosity	6	145 - 1017.6	22/09/89

As well as the geologically annotated Composite Well Log (Enclosure 3) copies of well logs are included with this report as Enclosures, Nos. 5 - 10. A bottom hole temperature of 72°C was recorded at 1014.45 metres.

A 20 level velocity survey was conducted by Velocity Data, with the results being processed by Velseis Pty. Ltd. The velocity survey report is included in this report as Enclosure 4.

2.6 Formation Sampling

2.6.1 Ditch Cuttings:

Rotary drill cuttings from Walton-2 were collected at three metre intervals from the surface to 40.0 metres where circulation was lost. The well was drilled without returns to 86m where circulation was regained and then hammer drill-cuttings were recovered to 192 metres, where five inch casing was run.

A washed sample of all cuttings was described and a portion submitted to the Northern Territory Department of Mines and Energy.

2.6.2 Slimhole Core

Walton-2 was fully cored from the five inch casing shoe at 192.5 metres to the well's total depth of 1014.45 metres. The core was logged and chip samples taken at two metre intervals for microscopic examination. A detailed description of the core is given in Appendix 5.

The core from Walton-2 is stored at the CRA Exploration Pty Ltd yard in Darwin.

2.7 Hydrocarbon Shows

Below 215 metres the Bukalara Sandstone began exhibiting pin-point black bitumen staining and patchy dull gold fluorescence which increased in abundance and intensity to spotty light brown oil stains/bleeds and bright gold fluorescence with a streaming, straw yellow cut and strong hydrocarbon odour at the base of the formation. Patchy fluorescence (mostly dull yellow) continues down into the Middle Velkerri and is occasionally associated with hydrocarbon odour and minor oil stains to about 320 metres. Below that depth only patchy, dull yellow fluorescence was observed down to about 545 metres, where sparse pin-point medium brown oil bleeds and minor gas was reported to emanate from the core over about ten metres, with hydrocarbon odour persisting to about 586 metres.

Patchy yellow/orange fluorescence continued intermittently throughout most of the Lower Velkerri, becoming more abundant and brighter around 650 to 660 metres and 760 to about 800 metres, in both cases associated with minor oil and gas bleeds and staining, especially in the deeper interval.

Apart from patchy, minor (pin-point) fluorescence in discrete zones and traces of relict bitumen in open fractures no traces of hydrocarbons were reported from the Bessie Creek Sandstone.

2.8 Source Rock Geochemistry

A total of 30 core samples from Walton-2 were collected from selected potential source units throughout the Velkerri Formation and subjected to Total Organic Carbon (TOC) and Rock-Eval pyrolysis analyses. The results are included as Appendix 6.

2.9 Core Analysis

Twenty one core plugs were analysed from the Bukalara Sandstone and the Lower Velkerri Formation in Walton-2. Analyses were conducted for permeability, helium-injected porosity, grain density and residual oil and water saturation. The results of these analyses are given in Table 6.

TABLE 6

CORE ANALYSIS

LOWER VELKERRI FORMATION

WALTON-2

Sample No.	Depth Metres	Permeability Millidarcys K.A.	Porosity % He inj	Residual Saturation % Pore		Grain Density
				Oil	Water	
1369265	200.4	5.1	4.4			2.68
1369264	200.5	24	20.7			2.66
1369263	211.6	20	12.5			2.66
1369938	214.6	896	11.3	1.4	0.6	
1369262	220.5	22	17.8			2.65
1369261	235.2	27	17.1			2.63
1369260	249.2	11	12.2			2.55
769909	758.85	0.26	12.3	46.9	23.5	2.36
769910	760.05	0.12	8.9	49.1	22.3	2.45
769908	760.80	0.12	7.1	38.0	27.2	2.45
769907	761.50	0.03	6.8	61.8	21.5	2.45
769906	761.80	0.01	4.8	42.9	49.0	2.47
769905	763.15	0.04	6.6	48.4	36.3	2.53
769911	765.20	0.03	5.6	52.1	41.7	2.52
769912	766.30	0.01	11.3	32.8	36.1	2.34
769913	768.65	0.02	2.8	31.8	31.8	2.58
1369941	769.65	0.01	5.6			2.64
769914	777.40	0.01	8.6	47.4	28.4	2.48
769915	777.90	0.06	10.1	60.1	30.1	2.45
1369949	778.58	0.01	8.3			2.64
1369950	784.6	0.01	8.4			2.60

2.10 Magnetic Susceptibility

Magnetic susceptibility measurements were made at one metre intervals along the entire length of core recovered from Walton-2 using a hand held meter. The resulting magnetic susceptibility log is included as Enclosure 2 and the downhole equivalent recorded by Century Geophysical is included as Enclosure 9.

2.11 Contributions to Geological Knowledge

Walton-2 has added significantly to our knowledge of the Beetaloo Sub-Basin in EP24 as well as having wider implications for extension of Roper Group sediments south beneath the Georgina Basin.

The Velkerri Formation preserved beneath the Proterozoic/Cambrian unconformity in Walton-2 is of comparable thickness and character to the equivalent section in Atree-2 and has demonstrated a continuation of the excellent source potential characteristic of this interval.

Drilling of this pronounced anticlinal structure revealed a larger hiatus beneath the Cambrian section than was previously anticipated, resulting in the complete absence of the McMinn Formation and Upper Velkerri section, as well as the uppermost Middle Velkerri.

Also, this well helped provide clarification of the stratigraphy of the region, so that the sandstone which had been labelled the "Moroak Sandstone" in Atree-2 is now interpreted to be the Cambrian Bukalara Sandstone.

Keywords

Petroleum, Proterozoic, Cambrian, Drill Stratigraphic, Hydrocarbon Potential.

Location

Walton-1 & 2, Maryfield 1:100,000 Map Sheet, EP24, McArthur Basin, Northern Territory.

List of DPO's

48226, 48233, 48236, 49456