Pacific Oil & Gas Pty Limited

HUNT NO.1

EP10, NORTHERN TERRITORY

WELL COMPLETION REPORT

ONSHORE

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ONSHORE

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1. SUMMARY AND INTRODUCTION

Hunt 1 was the second of four petroleum exploration wells drilled by Pacific Oil and Gas Limited in the company's 1991 Georgina Basin drilling program. **Hunt 1** was designed to test for hydrocarbons in the Cambrian Georgina Basin section, specifically the Red Heart Dolomite, the Mt. Baldwin Formation, and the Arthur Creek Formation. **Hunt 1** was sited on an anticline identified in the 1990 Jinka Seismic Survey, which identified the structure as an uplifted fault block (associated with the Putta Putta Fault) coincident with indications of a very large east-west trending basement high. The target formations were identified as having reservoir potential in the nearby **Baldwin 1** exploration well. Stratigraphic control was provided by the Huckitta 1:250,000 geological map (Freeman, 1986) and by Pacific Oil & Gas seismic.

Water was supplied by a wellsite bore drilled by Gorey and Cole Drillers. Rockdril Rig 20 was rigged up and the well was spudded at 1500 hours on 15 May, 1991. An 8½" hole was hammered to 31.9m and 7" conductor was installed and cemented to surface.

6¼" hole was hammered to 237m where problems with the hammer resulted in cessation of air drilling. A suite of wireline logs was run from 237m to the 7" casing shoe. 5" casing was run in and the shoe was set at 236.5m.

The remainder of the hole was wireline cored (CHD101). After reaming through cement with a tricone bit, the core barrel was made up with a 4.35" bit and formation was drilled to 239m. Lost core was recovered by drilling over it. A Formation Integrity Test showed no leak-off at 560 psi, equivalent to 22.2ppg MWE.

Coring continued to 285.5m where a total loss of circulation occurred. After treating the mud with a pill of lost circulation material, core was cut to 292.4m, where problems were experienced with the seating of the tube. Ten stands of pipe were pulled back and one joint was replaced. Coring continued to 420.8m with lost circulation material pumped at 380.5m. At 420.8m New Bit No.6 was run and lost circulation was treated. Coring continued and TD of 493.05mDF was reached on 25 May, 1991.

The hole was logged at TD by BPB Australia and a velocity survey was shot by Velocity Data. Cement plugs were set over the porous sections of Red Heart Dolomite and Arthur Creek Formation (410-330m), the 5" casing shoe and at surface. Rockdril Rig 20 was released on 27 May, 1991.

Hunt 1 was spudded in a thin surface unit of silicified and ferruginised fine sandstone. This unit was shown on the HUCKITTA 1:250 000 map as the Eurowie Sandstone Member, with Arrinthrunga Formation underlying it. However, drilling and subsequent work has identified the surface unit as Tomahawk beds, with the Arthur Creek Formation disconformable beneath.

The Arthur Creek Formation (4.2-392.2m) was the dominant unit in this well. Interbedded siltstone, dolomite, limestone, and mudstone form the top 232m (the chipped section of the hole). In the cored section, 76m of finely laminated siltstone, limestone, and dolomite overlie 34.8m of pyritic and organic-rich limestone and siltstone, with a thin mineralised zone at the base. The basal 44.4m consists of shoal carbonates, sandstone, and redbeds with good secondary porosity in some zones.

Underlying the Arthur Creek Formation is the Red Heart Dolomite (392-411.5m), comprising shallow-water dolomite grainstones at the top, a middle section of fine sandstone, and basal thinly bedded dolomite. Significant secondary porosity occurs in the top interval.

The early Cambrian Mt Baldwin Formation (411.5-468.6m) is a coarse clastic deposit characterised by the presence of glauconite and feldspar. It overlies economic basement: the Adelaidean sediments of the Mopunga Group.

The formation tops in Hunt 1 were up to 276m higher than prognosed due to the absence of the Arrinthrunga Formation. The subsequent identification of the Arthur Creek Formation cropping out near the rig location has demonstrated inaccuracies in the HUCKITTA 1:250 000 map. The Tomahawk beds are here significantly unconformable over the Arthur Creek Formation and therefore considerable pre-Ordovician tectonic activity is indicated. The Mt Baldwin Formation is provenanced from the north or northeast and although it is coarse and sandy, its porosity is decreased by the presence of feldspar. Organic maturation in this area is extreme. The exploration potential of the central part of the basin is downgraded due to the very thin section, the gross overmaturity of the source rock, and the poor porosity in the Mt Baldwin Formation sandstones.

2. WELL HISTORY

2.1 GENERAL DATA

Well Name:	Hunt 1
CRAE Number:	RD/DD91GB19
Well Type:	Wildcat
Interest Holders:	Pacific Oil & Gas Pty Limited - 100%
Permit:	EP10, Northern Territory
Operator:	Pacific Oil & Gas Pty Ltd., 826 Whitehorse Road BOX HILL, VIC, 3128
Water Supply:	Onsite waterbore, 2l/s approx. for details see Appendix II

Map References:	Huckitta (SF53-11) 1:250 000 sheet Arapunga (6053) 1:100 000 sheet
Surveyed Location: (AGD 66)	Latitude: 22° 09' 39.28" S Longitude: 135° 56' 28.14" E
AMG Co-ordinates: (Zone 53)	597 039.9 East 7 549 053.0 North
Surveyed Elevation: (AHD)	Ground Level: 370.9m Drill Floor: 375.1m
Total Depth:	Driller: 493.1m Logger: 493.2m
Primary Objectives:	Red Heart Dolomite Mt Baldwin Formation
Secondary Objectives:	Arthur Creek Formation
Status:	Plugged and Abandoned as dry hole.
Well Cost:	A$308 145.00

2.2 DRILLING DATA

Dates and Duration

Rig 20 spudded:	1500 hrs, 15 May 1991
TD reached:	1300 hrs, 26 May 1991
Rig Released:	0600 hrs, 27 May 1991
Drilling Time to TD:	11 days, 23 hrs
Contractors:	Rockdril Contractors P/L 1 Jijaws Street Sumner Park QLD 4074
Drilling Rigs:	Rockdril Rig 20
Rig Details:	Longyear HD600 Coremaster (modified for petroleum exploration). Complete specifications for Rockdril Rig 20 can be found in Appendix IV, "Rig Specifications".

2.3 DRILLING SUMMARY

A complete drilling record for **Hunt 1**, including Drilling Parameters Plot (PetNTcw3496) and Mud Parameters Plot (PetNTcw3497) is given in Appendix V. The Actual Time-Depth Curve and Hole Diagram (PetNTcw3495) appears at the end of this seciton.

The following summarised sequence of events is based on information extracted from IADC drilling reports and the Wellsite Geologists' morning reports.

2.3.1 8 1/2" Hole Section

Rockdrill Rig 20 arrived on location on 15/5/91 and rigged up. Hunt 1 was spudded at 1500 hours on 15 May, 1991 and hole was air-hammered to 31.9m, with a Copco 8 1/2" flat-faced hammer bit. 2 joints of 24 lb/ft 7" conductor were run in and landed at 29.8m. Conductor was cemented with 2.5bbls (16 sacks) of 15.6ppg class A cement. After 15 3/4 hours, the BOPs were nippled up and function tested.

2.3.2 6 1/4" Hole Section

A 6 1/4" Austex hammer (Bit no.2) was made up and RIH. Cement and casing shoe were drilled out, and formation drilled to 103.0m. Slow rate of penetration was explained by the discovery of a hole in the radiator on the compressor. This was repaired but the compressor was left at low power. Formation was drilled to 199.25m, then POOH, break down and service hammer. RIH and hammer to 237m. POOH, strip and sharpen the hammer bit, and reassemble it, but hammer was not firing properly. On disassembly, the piston was found to be broken. After waiting on parts, the hammer was picked up, stripped, serviced, surface checked, and RIH; but the hammer would not start downhole. POOH, rig up BPB Australia and run geophysical logs. Pick up hammer, RIH for wiper trip, condition and circulate hole, and POOH. Twenty-three joints of 5" 13ppf FL4S casing were run in with the shoe set at 236.5m. Casing was cemented with 11 bbls of 15.6 ppg Class A cement including 10% excess with 0.05% CFR-3. No cement was returned to surface. Mix and pump 4 bbls 15.6 ppg Class A neat slurry with 13.5 lb/bbl LCM. No cement was returned to surface. Caliper logs indicate a cavernous zone at around 35m.

2.3.3 CHD101 Hole Section

After waiting on cement for 6 1/2 hours, RIH with tricone bit (Bit No. 3) and drill on cement . Pressure-test BOP, all choke and kill valves, choke manifold, and floor manifold to 1500 psi, and annular preventer to 1000 psi. The kill valves were found to be leaking, and were removed, stripped, reassembled, replaced, and tested to 1500 psi for 5 minutes. RIH with tricone, drill out cement, POOH, make up core barrel with Bit No. 4 (Longyear Series 6 4.35"), RIH, and displace hole to mud.

Ream through casing shoe and drill to 238.95, where the tube would not seat. POOH, with the core hung up in the drilling pipe; redrill over lost core to recover it. A Formation Integrity Test showed no leak-off at 560 psi, equivalent to a fracture gradient of 1.15 psi/ft or 22.2 ppg mud weight equivalent. Coring continues to 271.25m, where the fluid pressure increased sharply. The tube was pulled and reseated but the pressure rose again when it tagged bottom. It was suspected that the bit waterways were worn.

POOH, break out the old bit and fit Bit No. 5 (Longyear Series 6 103mm), RIH and core to 285.5m. A total loss of circulation occurred; driller pulled back 2 stands to the casing shoe, pulling against tight hole. Mix, pump, and circulate 4 bbls of lost circulation material. Ream to bottom and core to 292.35m. Tube not seating, pull tube out, core stuck in drill pipe. Pull back 10 stands and replace one joint of drill pipe. RIH, seat tube, and run deviation survey (1° at 280m). Continue coring to 380.45m, where lost circulation was treated with a pill of lost circulation material. Continue coring to 420.75m. Deviation survey run at 400m shows 1.5° deviation at 400m.

POOH, break out old bit and fit Bit No. 6 (Longyear Series 6 103mm), RIH and treat lost circulation. Coring continued until TD was reached at 493.05m at 1330 hours on 25 May 1991. A deviation survey at 489m showed hole deviation of 3/4°. POOH for logging, rig up BPB and run wireline logs from 1630 25 May to 0400 26 May. From 0400-0630, Velocity Data were rigged up and a velocity survey was shot at 15 levels.

Rig down BPB, run in open-ended to 410m and circulate 2bbl of lost circulation material. Cement plugs were placed from 410-330m and from 270-200m. After waiting on cement for 8 3/4 hours, the drill pipe was run in and tagged plug no. 2 at 205m with 3000 lbs. Nipple down BOPs and set plug no. 3 from 50m to surface. Rockdril Rig 20 was released at 0600 hour on 27 May 1991.

2.3.4 Time Distribution

A total of 11 days, 23 hours was spent from the commencement of operations to rig release. This was distributed as follows:

OPERATION	TIME (DAYS)
Drilling, retube, bit trips	6.6
Evaluation and logging	0.9
BOPs, casing, and plugs	3.1
Hole problems	0.3
Rig repair	1.0
TOTAL	11.9

2.3.5 Water Supply

Water for drilling and camp purposes was obtained from a water bore (DD/RD91GB18) drilled by Gorey and Cole Drillers on 21-22 March 1991. It was not possible to record the water supply due to lost circulation, but the driller's estimate was a supply of over 2 litres per second. Measured TDS of the water was 947 mg/l. The major cations were sodium and calcium, and major anions were bicarbonate and chloride (Amdel report appended).

2.3.6 Deviation Surveys

Deviation surveys were run using a Totco downhole survey tool. The results are shown below and also appear on the Actual Time-Depth Curve and Hole Diagram, the Pacific Oil & Gas Composite Log and the Exlog mudlog (Enclosures I and II respectively).

280m	1°
400m	1.5°
489m	0.75°

2.3.7 Completion Summary

Hunt 1 was plugged and abandoned as a dry well on 27 May 1991. Three abandonment plugs were set: over the porous zones in the top of the Red Heart Dolomite and the base of the Arthur Creek Formation, over the 5" casing shoe, and at surface. Plug and casing depths as shown in the Time-depth Curve and Hole Diagram are as follows:

Plug No. 1:	410-330mDF	5.5bbl Class A cement, 15.5ppg, with 0.05% CFR2 & 9 lb mica with 15% excess
Plug No. 2:	270-200mDF	5bbl 15ppg Class A cement with 10% excess
Plug No. 3:	50m-surface	6.5bbl 15.5ppg Class A cement

2.4 FORMATION EVALUATION

2.4.1 Mudlogging

Mudlogging services were provided by Exploration Logging Pty Ltd. 24 hour monitoring of ROP, gas, gas chromatography, H_2S, pump rate, depth and pit level were provided.

Logging commenced after the installation of the 7" conductor at 30m. Samples were caught, washed and described at 3m intervals from 20m to 5" casing shoe (237m). All cuttings samples were examined under ultraviolet (UV) light for the presence of hydrocarbons. Cuttings descriptions may be found in Appendix VI.

Calcimetry was performed on the 3m cuttings samples and on the 5m elemental analysis grinds. Results are in Appendix XIII, and displayed graphically on the Actual Section (PetNTcw3502).

ROP, mud gas and lithology are summarised graphically on the 1:500 scale mudlog (Enclosure II). Splits of the cuttings have been retained for:

(a) Pacific Oil & Gas Pty Limited
(b) Northern Territory Department of Mines & Energy.

2.4.2 Coring

The well was continuously cored at CHD101 size from 237m to 493.5mTD. Total meterage cored was 256.1m, recovered 255.3m (99.7%). All core was examined under UV light for hydrocarbon fluorescence. Detailed lithological descriptions are given in Appendix VI. Results of core analysis, and palaeontology are given in Appendices VII and VIII respectively. All core is stored at the Pacific Oil & Gas office in Alice Springs and will be despatched to the Northern Territory Department of Mines and Energy core store on completion of studies.

2.4.3 Electric Logging

Electric logging services were provided by BPB using truck V333. A set of petrophysical data was acquired from Hunt 1 comprising Neutron Porosity, Dual Resistivity, Caliper, Density, Gamma and Sonic. Logs are included as Enclosure III. An intermediate suite was run from 237m to 30m and a final suite from TD to 237m.

2.4.4 Geothermal Gradient

An approximate geothermal gradient of 3.46°C per 100m (34.6°C per km) has been calculated using the maximum observed bottom hole temperatures recorded during the two logging suites (PetNTcw3393).

2.4.5 Velocity Survey

A velocity survey was run at total depth (493m) from 31st Jan to 1st February, by Velocity Data Services using the BPB logging unit. AN-60 explosive was used as an energy source. Data quality was considered to be good. The results are attached as Enclosure IV.

2.4.6 Synthetic Seismogram

A synthetic seismogram has been generated by ENCOM Technology (Vic) Pty Ltd based on the density data derived from the Density and Sonic logs and the well seismic survey. The synthetic seismogram and data listings are included in Enclosure V.

2.4.7 Magnetic Susceptibility

Magnetic Susceptibility readings of all core recovered from Hunt 1 were taken and averaged at 1m intervals. This data has been incorporated into a Magnetic Susceptibility Plot which is included in the Actual Section (PetNTcw3502). The raw data is appended in Appendix XII.

2.4.8 Elemental Analysis

Bulk samples of ground rock were obtained at 3m intervals over the chipped section of Hunt 1, and at 5m intervals over the cored section, using a "Goldfields" core grinder. A total of 122 samples of around 100g weight were sent to Australian Laboratory Services Pty Ltd in Brisbane for analysis of 20 different elements. Analytical

methods used were: Fire Assay for Au, Pt and Pd; ICP for Cu, Pb, Zn, Ag, Fe, As, Co, Ti, P, S, V, Ca, Al, Ni, Mg, K, Ba. Somewhat elevated levels of Zn, Ni, V, P and Ba were recorded from the carbonaceous rocks between 313-347.8m. Results are appended in Appendix XI.

2.4.9 Other Analyses

Samples of core have been analysed for organic geochemistry, porosity/permeability, and palaeontology. The results are contained in Appendices VIII, VII and IX respectively.

3. GEOLOGY

3.1 REGIONAL SETTING AND STRUCTURE

The Georgina Basin is the largest of the lower Palaeozoic intracratonic basins in central and northern Australia. The Basin trends north-west from latitude 25°S in western Queensland into the east-central portion of the Northern Territory at about 18°S (plan PetNTcw3471; Smith 1972). It is about 1000km long, 500km wide and has an area of approximately 325 000 km^2. Most of the surrounding and underlying rocks of the Georgina Basin are Precambrian, and range in age from Archaean to Adelaidean. The present margins of the Georgina Basin are tectonic in origin, commonly faulted, and often identified as unconformities (Draper et al., 1978). The southern part of the Basin where significant thicknesses of sediment remain, is a preservational rather than depositional margin.

The original Basin was considerably more extensive and contiguous with the northern Amadeus Basin for much of its history, but is now separated from it by the Arunta Block to the south. To the west and north-west of the Georgina Basin the Davenport Range, comprising older deformed Lower Proterozoic sediments, and the Tennant Creek Block, divide it from the contiguous Wiso and Daly River Basins (Freeman et al., 1990). It is bounded by the Proterozoic Mt Isa Block to the east, while to the north the Basin extends as thin cover rocks and overlies the Antrim Plateau Volcanics and the Proterozoic McArthur Basin. Mesozoic rocks of the Eromanga Basin conceal the southeastern margin of the Georgina Basin (Draper et al., 1978).

The Basin has been deformed by minor to moderate folding and faulting throughout, especially in the east and south, with moderate to severe folding, faulting and some extensive overthrusting along the southern margin (Freeman et al., 1990). Most of the structural deformation took place during an Upper Devonian to Early Carboniferous orogeny (the Alice Springs Orogeny). Although large areas in the interior of the Basin appear not to have been disturbed tectonically, work by Pacific has shown that the mainly flat-lying Ordovician sediments which unconformably overlie the Cambrian sequence in the southern part of the Basin have disguised some early structuring.

The most prominent tectonic elements in the Basin are the Dulcie and Toko Synclines, both of which are asymmetric folds with steep dips on their south-western flanks (Smith, 1967), and which contain the greatest thicknesses of preserved sediments; the "GM1" linear, identified from gravity and magnetics, which is thought to be a fundamental basement feature which exerted some control on early Palaeozoic sedimentation; and the "Jinka Feature", another gravity-magnetic linear, whose surface expression occurs in the Lucy Creek - Mt. Playford - Ooratippra Fault Zones.

The Georgina Basin comprises a sequence of sedimentary rocks of Late Proterozoic to Devonian age (Draper et al., 1978), which were deposited in a series of subtidal to supratidal environments, in part of an extensive epicontinental shelf which covered most of eastern Australia. The sedimentary sequence of the Georgina Basin proper has not been metamorphosed or intruded by igneous rocks (Smith, 1972). The Lower Palaeozoic sediments are considered to be the most prospective part of the stratigraphy for hydrocarbons. A detailed correlation of stratigraphic units across the Georgina Basin is shown in plan PetNTcw3430.

Basement is an irregular surface of granitic ridge and depression topography, subdued by Upper Proterozoic to Lower Cambrian sequences. Magnetic basement contours suggest a general northwest-southeast structural trend, which is reflected in Cambrian and earlier sediments in most areas, except in the northern part of the basin, where the trend becomes east-west.

For simplicity, the Georgina Basin sequence can be divided into three broad divisions. The lowest group comprises Vendian (Late Adelaidean) rocks which form the base of the sequence in the southern portion of the Basin and correlate with equivalent units above the Bitter Springs Formation in the Amadeus Basin. Deposition during the Late Proterozoic was confined to grabens and half-grabens (Walter, 1980). A rift basin developed between the "Amadeus" and "Georgina" areas in the Late Adelaidean due to SW-NE oriented tensional stress. Normal faults, down-thrown to the south-west, formed half-grabens in which siliciclastics of terrestrial origin were deposited with minor carbonate rocks.

The middle group of sediments is considered the most prospective for hydrocarbons and is Cambrian in age. Sediments are predominantly carbonates deposited in a wide range of shallow marine environments. The Early Cambrian sediments consist of siliciclastics with minor carbonates (Draper et al, 1978). Middle to Upper Cambrian shelf sediments comprise carbonates in the north and east, and mixed carbonate and terrigenous rocks in the west (Radke, 1981). The lowest part of this group consists of Early Cambrian arkosic sandstones and minor conglomerates deposited as fan deltas in half-grabens adjacent to the Lucy Creek Fault (the Mt Baldwin Formation) with non-marine fluvial sandstones deposited in channels to the north west (the Andagera Formation). These sands are overlain by the Red Heart Dolomite, a high energy dolomite shoal deposited in the remaining basinal depressions as the supply of terrigenous material dwindled. Finally as conditions became increasingly restricted, a thin unit of shallow-water evaporites was deposited.

Following a break in sedimentation, epeirogenic subsidence resulted in the Middle Cambrian Arthur Creek Formation being deposited over a wide area of the Basin. As the sea transgressed over the previously uplifted areas, laterally extensive stromatolitic dolomite and phosphatic intraclast grainstone shoals were deposited. Continuing subsidence led to the development of anaerobic bottom conditions in several areas of the epeiric sea, resulting in the deposition of organic-rich silty limestones and shales. Broad regional gentle uplift in the Amadeus Basin at this time resulted in shallow-water to subaerial conditions developing in the western Georgina Basin, and led to the eastward regression of clastics and sabkha evaporites of the Chabalowe Formation. These rocks interdigitate with and regress over the Arthur Creek Formation which coarsens upwards to nodular bedded and occasionally shoaly limestones. Considerable lateral facies variation is apparent in this section.

In the Upper Cambrian a thick carbonate sequence developed from a series of shoals which prograded from the western shelf eastwards. These shoals, the Arrinthrunga Formation, grade from a basal peloid grainstone shoal through to peritidal carbonates. Some minor intraformational clastic units occur in the west of the basin (the Eurowie Sandstone Member). This depositional cycle was terminated by uplift due to the Delamerian Orogeny.

The third group consists of sediments deposited post Delamerian Orogeny in the Ordovician and Devonian. Lower to Middle Ordovician sediments are progressively more restricted in extent than the underlying Cambrian carbonates, occurring along the southern margin and in the Toko syncline. They become more siliciclastic with decreasing age and are of shallow marine origin. Post Delamerian subsidence formed the broad Larapintine seaway through the southern part of the Georgina Basin and an extensive marine transgression resulted in the deposition of interbedded glauconitic sandstones and siltstones (the Tomahawk beds) in the west, and a carbonate barrier bar system in the east (the Ninmaroo Formation). A thick sequence of Middle Ordovician sediments developed in the Toko Syncline as the area subsided.

Devonian sandstones of freshwater (alluvial fan, braided stream and lacustrine) and aeolian origin are restricted to the southern part of the Basin (Smith, 1967). These sediments, the Dulcie Sandstone, derived from the rising Arunta Block during the early stages of the Alice Springs Orogeny and are limited to the core of the Dulcie Syncline.

3.2 OBJECTIVES

Hunt 1 is located on the crest of a seismically defined culmination with a fault-dependent closure. The primary objectives of the well were possible reservoirs in the Red Heart Dolomite and the Mt Baldwin Formation. The secondary objective was the shoals which may be developed within the Arthur Creek Formation.

3.3 STRATIGRAPHIC TABLE

FORMATION	PROGNOSED TOP mDF	ACTUAL TOP mDF	UNIT THICKNESS
Qa	2.5 (Surface)	-	-
Arrinthrunga Fmn	17.5	--	-
Tomahawk Beds	NP	0	5
Arthur Creek Formation	144.5	5	387.2
Red Heart Dolomite	657.5	392.2	19.3
Mt. Baldwin Formation	687.5	411.5	57.1
Adelaidean basement	737.5	468.6	24.45
TD	902.5	493.05	

3.4 STRATIGRAPHY & DEPOSITIONAL ENVIRONMENT

Mopunga Group Adelaidean 468.6-493.05 mDF Dlr
469-493 Lgr

The Mopunga Group in this well consists of grey to greenish grey thinly laminated sandstone and siltstone, white sandstone, and grey massive to very finely laminated siltstone. Laminations are parallel, wavey to slumped in places. The sandstone is quartzose, fully silicified, and stylolitic, with a bedding plane fault at 486m.

Mt. Baldwin Formation Early Cambrian 411.5-468.6 mDF Dlr
411.5-469 Lgr

The Mt. Baldwin Formation is a coarse clastic deposit formed by fan-delta deposition along the edge of basement uplift in the central Basin. In Hunt No. 1, coarse sandstones, granule conglomerates, and some siltstones are characterised by the presence of glauconite and feldspar. The glauconite may be a trace or as a lag deposit, but is generally abundant. The sandstones are cemented by dense silica cement and by hematite cement. Dolomite is present in the top 6.5m of the formation, as dolomitic siltstone interlaminated with coarse sandstone in cm-scale fining upwards cycles. Sandstone decreases and dolomite increases towards the top of this interval. Porosity was generally poor to absent throughout the Mt Baldwin Formation.

Red Heart Dolomite Early Cambrian 392.2-411.5 mDF Dlr
392.5-411.5 Lgr

The Red Heart Dolomite at Hunt 1 consists of 19.3m of pale grey/green/pink or white dolomite and minor sandstone, representing shallow water deposition after the end of major clastic input.

A low-energy deposit of thinly bedded dolomite (1.9m thick) with bioturbation and algal laminae forms the base of the Red Heart Dolomite. This is overlain by 4.6m of fine quartzose sandstone densely cemented by dolomite. The remaining 12.8m consists of coarse

to very coarse dolomite grainstones, deposited in a high energy environment. Vuggy porosity is present both in the dolomite grainstones and in the sandstone.

Arthur Creek Formation Middle Cambrian 4.2-392.2 mDF Dlr
4.2-392.5 Lgr

The Arthur Creek Formation in **Hunt 1** was chipped from 5-237m and cored from 237-392.2m. The cored section is divisible into 44.4m of shoal and redbed deposits at the base, 34.8m of carbonaceous and mineralised limestone and siltstone, and a further 76m of silty limestone. The chipped section consists of 232m of siltstone, dolostone, and limestone.

6.8m of bioturbated quartzose fine sandstone overlies the Red Heart Dolomite with an eroded contact. The sandstone is densely cemented with silica, and contains thin interbeds of recrystallised dolostone. Thinly bedded dolomites and silty dolomites deposited in an exposed redbed environment overlie the sandstone. The redbeds here correlate with a similar lithology in **Baldwin 1**. In **Hunt 1** the anhydrite and some carbonate has been removed by severe dissolution, leaving a very porous and fragmented remnant of dolomite and siltstone. The remaining 19.1m of the basal section consists of shoal deposits dolomite grainstone and brecciated dolostone. A 2cm mineralised zone at the top contact contains silica, pyrite, and minor galena.

Above the mineralised contact, 11.6m of black carbonaceous dolomitic siltstone has a strong sulphurous and petroliferous odour. The interval shows a trace of pyrite and a network of fine anhydrite-filled fractures. This is overlain by a black to very dark grey carbonaceous silty limestone with interbeds of grainstone and occasional pyrite. The grainstones, medium grey in colour, consist of black ooids and siltstone intraclasts in a dolomite and anhydrite cement.

From 313m up to 237m, differing proportions of silt, calcite, and dolomite form silty calcareous dolomite, silty dolomitic lime grainstone, and calcareous dolomitic siltstone. Bedding is finely laminated and frequently consists of darker siltstone or dolomite mildly deformed around diagenetic nodules of paler limestone. Calcite veins and fine anhydrite-filled fractures occur.

The remaining Arthur Creek Formation (237-4.2m, chipped) consists of interbeds of siltstone, dolomite, limestone and mudstone, with traces of chert. The siltstone is generally grey to black, calcareous and/or dolomitic, and often grades to silty dolostone.

Towards the top of the section, a brown, grey-green or greyish orange siltstone also appears, which is micromicaceous and contains minor quartz sand clasts. The dolomite is dark grey to black, crystalline to microcrystalline, sometimes silty and/or grading to dolomitic siltstone. The limestone is medium to dark grey, crystalline, and often dolomitic; or pale to medium grey wackestone, with particles and fossil fragments bound by lime mud, and occasionally arenaceous. Traces of greyish-orange silty mudstone also occur.

Tomahawk beds Late Cambrian-Early Ordovician 0-4.2m Lgr

The Tomahawk beds form a flat-lying thin sheet of outcrop in the area of Hunt 1. They were not logged in detail at wellsite. A composite sample from the 8.5" section of hole was described by Exlog as a fine-grained orangy-yellow sandstone with a weak calcite cement. The unit crops out in the area as extensively silicified and ferruginised fine to medium grained sandstone, pale yellow to very dark brown in colour. The outcrop style is rubbly and bedding and many original textures are no longer preserved. However, ripple bedding, weathered-out rounded shale clasts, and possible bioturbation are still visible.

This area was mapped as a ridge of the Eurowie Sandstone Member overlying Arrinthrunga Formation in the Huckitta 1:250,000 map sheet (Freeman, 1986). However, the outcrop at Hunt No. 1 has been established as Tomahawk beds, with Arthur Creek Formation downhill and stratigraphically underneath, on the basis of lithology, TM imagery and field relationships (D. Morris pers. comm., CRA Report pending).

3.5 POROSITY & HYDROCARBON INDICATIONS

No oil shows were noted in Hunt 1. Minor gas peaks were recorded from 260-380m, in the lower one-third of the Arthur Creek Formation. The largest gas peak, at 266.5m, had no obvious source in the core, but may have been bleeding from a calcite vein.

Occasional moldic porosity is noted in fossiliferous limestones near the top of the Arthur Creek Formation, although it is not interconnected. In the interbedded silty carbonates fractures are associated with pinhole porosity (283-287m), but elsewhere fractures are filled with anhydrite (@ 300 and 400m). The basal shoal of the Arthur Creek formation showed vuggy, cavernous and fracture porosity in the top dolomite grainstones (6% average porosity, calculated from electric logs) and in grainstone layers within the redbeds. The vugs and fractures are lined with sparry dolomite. Abundant secondary microporosity is also present in the recrystalised redbed dolomites. Porosity in the redbeds varies between 10% and 26% (approximately; as calculated from electric logs), over a 16m interval.

Dolomite grainstone at the top 12.8m of the Red Heart Dolomite shows large vuggy porosity, although intergranular porosity and some of the vuggy porosity is cemented by dolomite and anhydrite. Sandstones in the next 4.6m show large solution cavities and fractures.

There are two intervals of poor or poor to moderate visual porosity in the Mt. Baldwin Formation (420-445m and 452.5-460m). Although the Mt Baldwin Formation sediments are coarser and less silty in Hunt 1 than they were in Baldwin 1, porosity was nonetheless poorer due to increased silica and hematite cement and a less mature sandstone (more feldspathic). Porosity in 30 core samples from the Mt Baldwin Formation averaged 8.3% (range 4.8-12.3%) and permeability averaged 0.15md (range <0.01 to 1.15md).

3.6 CONTRIBUTIONS TO EXPLORATION

The presence of the Tomahawk beds and absence of the Arrinthrunga Formation in the area of **Hunt 1** indicates that the Tomahawk beds are unconformable over the Arthur Creek Formation to a much greater degree than has been recognised in the past. This identifies the possibility of significant pre-Ordovician tectonic activity. In particular, the Putta Putta fault and associated smaller faults may have moved prior to the Ordovician; they did not solely originate during the Alice Springs Orogeny.

Source rock analysis indicates that hydrocarbon maturation levels are extreme. Downhole temperature measurements have confirmed the existance of high geothermal gradients for this part of the basin. The high maturation levels and the shallow depths of the target formations has severely downgraded the exploration potential for the central part of the basin.

The petrology of the Mt. Baldwin Formation in **Hunt 1**, compared with that of **Baldwin 1**, indicates a probable north or northeast provenance for the sandstone. Although the Mt Baldwin Formation in **Hunt 1** is coarser and sandier than in **Baldwin 1**, it nonetheless displays less porosity and permeability. This is probably due to the presence of labile components. This indicates that porosity and permeability trends in the Mt Baldwin Formation are not easily reflected in grainsize/provenance trends. While diagenetic alteration of feldspar may have produced reservoir porosity in some areas, this will be difficult to predict or explore for.

The results of this drilling have cast considerable doubts on the accuracy of the Huckitta 1:250,000 geological map (Freeman, 1986), at least insofar as it applies to the central part of the Georgina Basin.

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KEYWORDS AND LOCALITY

Petroleum, Hydrocarbons, Carbonate, Redbeds, Conglomerate, Sandstone, Black shale, Facies Marine Shallow, Palaeozoic, Cambrian, Upper Proterozoic, Assays geochem, Analysis source rock, Drill diamond, Drill rotary, Sampling, Drilling mud, Palaeontology, Petrology, Reservoir, Porosity, Permeability.

Hunt 1, EP10, Coralippa, HUCKITTA SF53-11, ARAPUNGA 6053, Georgina Basin, Northern Territory.