

2. GEOLOGICAL DATA

2.1 Geological Summary

Shortland 1 was designed to test a structural closure, apparently free from significant faulting, approximately 9 kilometres west north-west of the stratigraphic well **Jamison 1**. The well's primary objective was the "Jamison Sandstone" from which minor amounts of oil and gas were recovered in **Jamison 1**. A secondary objective existed within a sand of the lower part of the "Hayfield Mudstone". This secondary target flowed minor amounts of oil and gas in **Jamison 1**, minor gas in **Mason 1** and minor oil in **Balmain 1**, all of these wells lie within 20 kilometres of **Shortland 1**.

A 13 3/8" conductor was set at 9 metres through the soil horizon, a subsurface Tertiary laterite horizon and into the top of the Cretaceous Mullaman Beds. The mottled clay and siltstones of the Mullaman Beds continued past the 9 3/8" casing shoe set at 59.0 metres to a depth of 68.5 metres. Drilling progressed past this casing shoe using rotary air techniques. This unit was uncharacteristically hard and slow to drill, particularly where it became a little sandy in places.

The well then intersected a sequence of interbedded siltstones, limestones and medium to coarse sandstones of the Cambrian Jinduckin Formation. Circulation was lost at 90.5 metres when the first of many caverns were intersected. Drilling continued with no returns encountering a water table at approximately 120 metres. The Tindall Limestone was drilled between 124.0 metres and 355.5 metres, no samples of this formation were obtained.

It was inferred that the well intersected the Antrim Plateau Volcanics at 355.5 metres, where the drilling rate slowed, this was later confirmed by the wireline logs. Although returns were being lost into the caverns of the overlying limestone, one sample of the basalt was obtained from a blocked drill collar, at a depth of 477 metres. The sample was of a dark greenish black basalt.

The Cambrian Sandstone was interpreted from wireline logs to be present from 487.0 to 490.6m.

The Proterozoic sequence was encountered at a depth of 490.6 metres. Drilling continued without returns to a depth of 553.5 metres. 7" casing was run and cemented, with the casing shoe at 532.2 metres. The shoe, fill and one metre of new formation was drilled out with mud. Following a formation integrity test, rotary air drilling resumed. No sample was obtained until 573 metres when the borehole dried out. **Shortland 1** intersected a predominantly greyish green to brownish grey claystone and siltstone, with minor white very fine sandstones which become more common towards the base. The thickest of these sandstone units at 818 metres, the "Lower Hayfield Sand", 7.5 metre thick, exhibited moderate hydrocarbon fluorescence and elevated gas readings. A closed chamber drill stem test, with a nitrogen cushion was conducted over this zone and recovered 3.5 metres (8 litres) of formation water cut rat-hole mud. Gas was present in the hydraulic tool. The results of water and gas analyses are included in Appendix 4.

Drilling recommenced in the claystones of the basal "Hayfield Mudstone", which became increasing interbedded with thin, fine grained sandstones as the top of the "Jamison Sandstone" at 891.3 metres was approached.

The "Jamison Sandstone" can be subdivided into an upper facies between 891.3 and 910.0 metres which is made up of interbedded fine to very fine sandstones, siltstones and minor claystones, a middle facies between 910.0 and 921.5 metres consisting of fine to coarse quartz sandstone, and a lower facies between 921.5 and 981 metres which is dominated by fine to very fine grained sandstone.

The "Jamison Sandstone" exhibited poor hydrocarbon shows which consisted of several zones possessing weak dull pale yellow fluorescence with traces of bright pale yellow pin point fluorescence. Bitumen was observed within the pore space of several samples.

Beneath the "Jamison Sandstone", **Shortland 1** passed sharply into the medium grey claystones of the Kyalla Member of the McMinn Formation. The well reached a total depth of 1020 metres after cutting 39.0 metres of the Kyalla Member.

2.2 Well Objectives and Performance

Shortland 1 was designed to test a structural closure interpreted from seismic, approximately 9 kilometres west north-west of **Jamison 1**. The well came within expectations down to the base of the "Cambrian Sandstone".

Below the "Cambrian Sandstone" the well passed into the claystones and siltstones of the "Hayfield Mudstone". The section drilled from the top of the "Hayfield Mudstone" to total depth, is as expected, very similar to that drilled in the surrounding wells, with the data from **Mason 1** giving very good geological control whilst drilling **Shortland 1**, once several correlatable features had been intersected.

The observation that the well was approximately 84 metres low to prognosis at the top "Jamison Sandstone" level indicates a questionable seismic interpretation over this prospect. At the time of writing this report a post drilling review of the seismic data was underway. Conclusions as to the relative absence of hydrocarbon cannot be drawn.

2.3 Stratigraphy

Appendix 6 contains a full description of cuttings from **Shortland 1**. The description also includes a record of mud gas readings and observed fluorescence. A comparison of the intersected formations against those prognosed is shown in PetNTcw4843, while PetNTcw4842 illustrates the section drilled in the wells **Jamison 1**, **Mason 1**, **Shortland 1** and **Balmain 1**.

Undifferentiated (Tertiary/Cretaceous)

Surface to 63.5 metres. (60.5 metres thick)

White, very pale orange, light brown, dark yellowish orange, greyish red and purple claystone and siltstone. Iron stained planar joint and irregular fracture surfaces common. Minor loose quartz grains, medium to coarse, subrounded to rounded.

Jinduckin Formation (Cambrian)

63.5 to 124.0 metres. (60.5 metres thick)

Finely laminated to massive greyish orange pink, pale red, dark yellowish orange and light brown, claystone, siltstone and grey, orange crystalline limestone. Top of unit identified by Ironstone, blackish red siltstone, minor medium to coarse quartz grains. Very well indurated, leached, 10% dissolution porosity.

Tindall Limestone (Cambrian)

124.0 to 355.5 metres. (231.5 metres thick)

This formation was drilled without returns. From nearby wells the Tindall Limestone is off-white to light grey and locally brown/orange; fine to coarse crystalline limestone.

Antrim Plateau Volcanics (Cambrian)

355.5 to 487.0 metres. (131.5 metres thick)

This formation was drilled without returns although a sample was recovered from a blocked drill collar. The sample was of a dark greenish grey, fine grained basalt.

"Cambrian Sandstone"

487.0 to 490.6 metres. (3.6 metres thick)

This formation was drilled without returns. In a nearby well this unit consists of a light brown and grey, poorly sorted, friable, labile sandstone.

"Hayfield Mudstone" (Proterozoic)

490.6 to 891.3 metres. (400.7 metres thick)

490.6 to 818.0 metres. Predominantly greyish green to brownish grey claystone and siltstone, with minor white very fine sandstones which became more common towards the base.

818.0 to 825.5 metres. Very fine to fine grained light grey sandstone. Moderately well sorted, sub-rounded with abundant clay matrix and quartz cement. Increasing medium light grey siltstone and dark grey claystone interbeds towards the base.

825.5 to 891.3 metres. Greyish green to brownish grey claystone with minor interbeds of light grey siltstone and very fine sandstone becoming more abundant towards the base of the unit.

"Jamison Sandstone" (Proterozoic)

891.3 to 981.0 metres. (89.7 metres thick)

891.3 to 910.0 metres. Interbedded medium light grey to very light grey, fine and very fine grained sandstone, well sorted, sub-rounded with abundant clay matrix and quartz cement, with siltstone and minor claystone.

910.0 - 921.5 metres. Very light grey, fine to coarse quartz sandstone. Moderately well sorted sub-angular to sub-rounded with minor clay matrix and abundant quartz cement.

921.5 to 981.0 metres. Yellow grey to very light grey very fine to fine grained quartz sandstone. Moderately well sorted, sub-rounded with abundant clay matrix and quartz cement.

McMinn Formation Kyalla Member (Proterozoic)

981.0 to 1020 metres Total Depth (39.0 metres cut).

Interbedded medium grey, non-calcareous claystone with minor micaceous siltstone.

2.4 Mud Logging

Mud logging services were provided by Halliburton SDL. Their personnel were responsible for the collection of cuttings samples every 3 metres during the upper, air drilled part of the well and every 2 to 3 metres during the rotary mud part of the well where greater control was necessary. Each sample was lightly washed and dried, evaluated for hydrocarbon shows and described. Each sample was divided into two with one sample being sent to the Northern Territory Department of Mines and Energy and the other being stored at Pacific Oil and Gas Pty. Limited's Alice Springs office. A small portion of each cutting sample was placed in a Samplex Tray which was also retained by Pacific Oil and Gas. Rate of penetration, total gas, gas chromatography, pump strokes, calcimetry, and H₂S concentration were monitored and plotted on a continuous mud log at a scale of 1:500. A copy of the Formation Evaluation Log is included in this report, PetNTcw4890.

2.5 Geophysical Logging

2.5.1 Velocity Survey

Velocity Data rigged up at the completion of the 12 1/4" hole and entered the hole. Bad ground was encountered from a depth of 15 metres to 38 metres. Velocity Data spent some time attempting to penetrate a blockage at 38 metres which was unsuccessful. The weight drop survey was run from 38.0 to 12.0 metres, with measurements made at two metre intervals. The weight drop unit was rigged down and was released on the 13/11/92.

At the completion of the 8 1/2" hole at 553.5 metres Velocity Data rigged up and conducted a velocity survey using explosives as an energy source. Due to bad hole conditions, Velocity Data could not penetrate past 316.0 metres. 11 shots in total were recorded, at six different depths from 316.0 to 38.0 metres. Velocity Data rigged down and was released on the 22/11/92.

Schlumberger Seaco rigged up at the completion of running wireline logs to T.D. and conducted a 20 shot velocity survey from 67.7 to 1010 metres. Again the energy source was explosives. Schlumberger rigged down on 2/12/92 and were released the same day.

2.5.2 Wireline Logging

After drilling the 12 1/4" hole to 59.0 metres BPB Slimline Services rigged up and ran the RR1 Dual Focused Resistivity tool from 13.5 to 54 metres, which included a repeat section from 20 to 40 metres. At the completion of the 8 1/2" hole at 553.5 metres, BPB again rigged up and attempted to run intermediate logs over this zone. Several attempts were made to run BPB to the bottom of the hole through drill pipe to avoid bad ground, but the dummy tool could not penetrate cavings blocking the hole. The intermediate logging run was abandoned. BPB Slimline Services assisted Velocity Data in the velocity survey prior to rigging down. BPB was released from the well on the 21/11/92.

On reaching total depth the hole was circulated clean and Schlumberger Seaco rigged up and ran the following tools,

DLL-GR-BHC-MSFL-SP	1515.5 to 50.0 metres (GR to 50 metres)
LDL-CNL-NGS	1017.0 to 532.0 metres
DIL	1016.0 to 532.0 metres

2.5.3 Bottom Hole Temperature

Bottom hole temperatures were recorded on both total depth logging runs. Using the temperature data recorded from the DLL-GR-BHC-MSFL-SP and the LDL-CNL-NGS logs gives a bottom hole temperature of 58.3° Celsius at 1020 metres.

2.5.4 Synthetic Seismogram

The sonic log recorded in **Shortland 1** was drift corrected using check shot data and along with the density log was used to generate several synthetic seismograms for **Shortland 1**. The synthetic seismogram is included as PetNTcw4899.

2.6 Contributions to Geological Knowledge

Shortland 1 has provided an additional intersection through the Cambrian and upper Roper Group sections in this region. It has identified variation in the sub-facies of the "Jamison Sandstone" and lowermost "Hayfield Mudstone". This will assist in the development of depositional environment and sequence stratigraphy models that will enable a greater understanding of the basins geology. With this should come a greater ability to predict in which areas of the basin hydrocarbon exploration will have the best chance of success.

KEYWORDS

Petroleum, Proterozoic, Rotary Drilling, Hydrocarbon Potential, McArthur Basin, Roper Group, Drill Stem Test, Well Logs, Petrology

LOCATION

Approximately 30 kilometres east southeast of Dunmarra.

AMG: Zone 53
360077.0E
8148003.6N

Latitude 16.44'47.924" South
Longitude 133.41'14.354" East

1:100,000 Sheet Warramban 5664
1:250,000 Sheet Tanumbirini SE53-2

LIST OF DPO'S

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