

4. Geology

4.1 Pre-Spud Geological Well Prognosis

Well Name: Myrtle Basin #1

Target Formation(s): Barney Creek and Coxco Dolomite

Table 6: Geologic description of the prognosed formations:

Formation	Top [m]	Probable Content
Lynott Formation Undifferentiated	Surface	Thin bedded dolomitic siltstone and shale, in part carbonaceous and pyritic; silty dololomite, dololomite; minor fine grained dolarenite and lenses of slump breccia; uncommon ripples and evaporate mineral casts.
Reward Dolomite	430	Dololomite, stromatolitic dololomite, silty dololomite and dolarenite with lesser sandy dolarenite, dolerudite and sandstone; laminated, thin to massive bedded, cross-bedded, brecciated and slumped; pseudomorphs softer sulphate evaporates; onkoids, ooids, small silica spheroids; pseudomorphs after pyrite (pyritohedron).
Barney Creek Formation	450	Thin bedded to laminated, dolomitic, carbonaceous and pyritic shale and siltstone, dololomite, rare breccia and sandstone; occasional gypsum casts; talus slope breccia adjacent to Emu Fault.
Teena Dolomite	600	Grey crystalline dololomite with radiating, needle-like gypsum crystal pseudomorphs normal to bedding; rare conical stromatolites; thin intervals of dolomitic shale and siltstone.

4.2 Along Hole and True Vertical Depth of Seismic Marker and Reservoir Horizons

Table 7: Well log formation tops for Myrtle Basin #1, TD = 861.5 m

Geologic Tops	Drilling Depth [m]	Structural Tops (KB:51m) [m]
Lynott Formation - Undifferentiated	Surface	51
Reward Dolomite	272	-221
Barney Creek Formation	798	-747
Coxco Dolomite	Not penetrated	-

Lower Teena Dolomite

Not penetrated

-

4.3 Geological Interpretation of the Well Data

4.3.1 Log Adjusted Lithology Description

Lynott Formation: The Lynott Formation, a unit of dololomite, dolarenite and dolomitic siltstone and sandstone, is generally the thickest and most widespread of the formations which make up the Batten Subgroup. This formation is comprised of the Donnegan, Hot Spring and Caranbirini Members as you progress down stratigraphy, respectively. The Lynott Formation is seen as a regressive sequence.

Donnegan Member: Typically comprises buff to red-brown, thin bedded, often ferruginous, fine-grained dolomitic sandstone with interbeds of dolomitic siltstone and dololomite. A characteristic feature of the Donnegan Member is the presence of botryoidal quartz nodules (cauliflower cherts) which have probably formed by replacement of anhydrite nodules. The quartz nodules range from a few millimetres up to 10 cm in diameter, often have an enterolithic structure, and exhibit displacive growth along fractures and bedding planes. Pseudomorphs after gypsum and mud cracks are common at various levels.

Hot Spring Member: The base of the member is taken to be either the first coarse sandstone bed or prominent stromatolitic dolostone bed in the conformable succession with the Caranbirini Member. It ranges up to about 350 m in thickness, although exposures in the southeast are poor and shallow-dipping, making it difficult to estimate true thickness. The Hot Spring Member is a variable unit including dolomitic siltstone, silty dololomite, stromatolitic dolostone, dolarenite, sandy dolarenite and dolomitic quartz sandstone and thin beds of intra-clast breccia. The most common rock type is thin-bedded dolomitic siltstone which is often deeply weathered and silicified. Sedimentary structures include cross-bedding, ripple marks and rare mud cracks. Stromatolitic horizons are silicified and form prominent beds of blue-grey, often banded, chert.

Caranbirini Member: The Caranbirini Member is typically a poorly exposed unit of very thin-bedded to laminated, buff to yellow and grey, dolomitic siltstone and shale with interbeds of massive and laminated dololomite, similar in appearance to the Barney Creek Formation. It is usually deeply weathered and leached and occurs in low, rubbly, often flaggy outcrops. Pink to dark red and purple weathered pyritic shales, sometimes with small nodules of iron oxides after pyrite, form in the upper parts of the unit, whereas white, weathered, bituminous shales are common lower in the unit. There are rare, thin inter-beds of fine-grained, cross-bedded sandstone and dolarenite, but coarse sandstone and stromatolitic dolostone are absent. The upper part of the unit is more dolomitic and is characterised by small, vertical to inclined, chert and calcite-filled irregular fenestrae which may represent evaporate casts. Emergent, evaporitic conditions at this level are indicated by the presence of ripple marks, mud cracks, hopper halite casts, small chert spheroids and tepee structures.

In Myrtle Basin #1 well, the Lynott Formation appears to be represented by the Caranbirini Member only. Typically, as grey to minor green DOLOMITE, hard, cryptocrystalline, fine siltstone bands, grey to dark grey, hard, blocky. Trace pyrite in part, possible bituminous blebs in part, minor calcite

veining, trace pyrite on fresh surfaces, dark fine grained bands in dolomite, minor green tuffaceous bands in part.

Umbolooga Subgroup

The top of the Umbolooga Subgroup consists of the Reward Dolomite, Barney Creek Formation (HYC Pyritic Shale Member, W-Fold Shale Member), Coxco Dolomite and Teena Dolomite progressing down stratigraphy, respectively.

The **Reward Dolomite** is a widespread, highly variable dolostone unit which marks the top of the Umbolooga Subgroup. The thickness ranges from a few tens of metres in the west to several hundred metres in the vicinity of the McArthur River mine. The contact with the Barney Creek Formation is generally conformable and often gradational. The lower part of the formation consists of pink, buff and grey, laminated and thin bedded dololomite with interbeds of dolomitic siltstone and sandstone, sandy dolarenite and sandy intraclast breccia. Dolomitic beds often contain small chert spheroids. Thin beds of potassium-rich, pink, siliceous, possibly tuffaceous material occur at some levels. The upper part of the formation is marked by a zone of intense silicification. In the west it is deeply weathered, silicified, chaotic breccia containing large, unsorted, angular dolostone clasts in a coarse, poorly sorted sandstone matrix with thin interbeds of dololomite and dolomitic sandstone. The Reward Dolomite often contains minor base metal mineralisation along the disconformity where the dololomite is black and has a bituminous odour when broken. The Reward Dolomite was deposited in an environment similar to the Barney Creek Formation, very shallow water to emergent conditions under which sediments accumulated in small bodies of standing water.

In the Myrtle Basin #1 well the Reward Dolomite consists of DOLOMITIC CLAYSTONE and SILTSTONES brownish grey to medium dark grey, minor light grey, hard, blocky massive, cryptocrystalline dolomitised, calcareous, minor calcite fragments & veins, rare pyrite, trace calcite fluorescence - no cut, no visible porosity.

The **Barney Creek Formation** is a unit of dolomitic shale, siltstone and dololomite which is usually only poorly exposed in low, discontinuous rubbly ridges in the west, northeast and southeast of the McArthur River Region. The formation is usually less than 150 m thick but thickens to about 700m near the Emu Fault Zone near the McArthur River deposits. The formation is divided into three members: the HYC Pyritic Shale Member, W-Fold Shale Member and the Cooley Dolomite Member. The Cooley Dolomite is restricted to the HYC Sub-basin to the west of the Western Fault, and 20 km north, near the Caranbirini Waterhole so is unlikely to be found in this well.

HYC Pyritic Shale Member: The HYC Pyritic Shale Member mainly consists of very thin-bedded to laminated dolomitic siltstone characterised by high carbonaceous content. Pyrite is the major sulphide component with galena and sphalerite present in the HYC deposit. Sedimentary structures include scour marks, flame structures, soft sediment slumping and graded bedding. Sedimentary breccias are recognised in the areas around the HYC deposit in close proximity to the Emu Fault Zone.

W-Fold Shale Member: The lowermost member, W-Fold Shale Member, consists of green and red, dolomitic siltstone and shale with interbeds of green vitric tuff. The proportion of tuffaceous material increases toward the top of the member.

In the Myrtle Basin #1 the Barney Creek Shale is largely a DOLOMITIC SILTSTONE, light grey to medium dark grey, hard blocky, laminated in part, cryptocrystalline dolomitized, minor calcite veining, very weak fluorescence no cut with DOLOMITE, grey to brown, hard, blocky, cryptocrystalline, trace very fine grained disseminated pyrite, with PYRITIC SILTSTONE, black, very fine grained laminated, very fine grained pyrite in part.

The **Coxco Dolomite Member** is almost certainly evaporitic and is a massive, dark grey, sometimes vaguely bedded dololomite unit. It contains numerous interbeds of pink, buff or orange-weathering, potassium rich, possibly tuffaceous, and mudstones in the area adjacent to the McArthur River deposits. The Coxco Dolomite Member is characterised by the presence of acicular crystal casts which typically take the form of radiating aggregates of needles, rarely more than 2 mm in diameter and up to 6cm long. Minor disseminated sphalerite, galena and chalcopyrite have been noted at several localities in the Coxco Dolomite Member.

In the Myrtle Basin #1 the Coxco Dolomite Member was not penetrated.

The **Teena Dolomite** is a recessive dolostone unit with the upper part of the formation called the Coxco Dolomite Member. The Formation is up to 70 m thick in the southern McArthur River Region.

In the Myrtle Basin #1 the Coxco Dolomite Member was not penetrated.

4.3.2 Reservoir Quality

At the Myrtle Basin #1 the Coxco Dolomite was not penetrated and was deeper than originally prognosed. The Reward Dolomite was water bearing or otherwise breached.

4.3.3 Source Rock Quality

Only the very top of the Barney Creek source was penetrated in the hole. Cuttings appear to be consistent with an algal rich source rock.

4.3.4 Hydrocarbon Indications

The chromatograph recorded intermittent gas while drilling. There were no significant gas shows. A slight increase in predominately C1 gas was recorded at connections. Very weak residual oil ring cuts were recorded on the mudlog.

4.3.5 Trap integrity

The well did not penetrate any structural or stratigraphic traps.

4.4 Discussion of the relevance of the Well Data to the Evaluation of the Hydrocarbon Potential of the Area

The Myrtle Basin #1 well did not meet the geological objectives of the prognosis. The well has been suspended and the wellbore has been setup to be cored out at a later date.