Beetaloo W-1

Interpretative Well Completion Report

EP 117
Beetaloo Sub-Basin
Northern Territory

22nd July - 14th September 2016

Origin Energy Resources Ltd

Table of Contents

ABBREVIATIONS

%wt = percent by weight

AFTA = Apatite Fission Track Analysis

bbl = barrel

BCF = Billion Cubic Feet

BHA = Bottom Hole Assembly

BOP = Blowout Preventer

BTC = Buttress Thread Coupled

C1 = Methane

C2 = Ethane

C3 = Propane

$C6^+$ = Heavier Hydrocarbons

CHNOSFe = Carbon-Hydrogen-Nitrogen-Oxygen-Sulfur-Iron

CMR = Combinable Magnetic Resonance Tool

CO_2 = Carbon Dioxide

CRT = Casing Running Tool

DWC= Drill with Casing

E = East

EDS = Energy Dispersive X-Ray Spectroscopy

EDTC = Enhanced Digital Telemetry Cartridge

EMW = Equivalent Mud Weight

EP117(R1) = Exploration Permit 117 (Renewal Period 1)

FIT - Formation Integrity Test

FMI = Formation Microimager

FMST = Formation Micro-Scanner Tool

ft = feet

FTIR = Fourier-Transform Infrared Spectroscopy

g = grams

GDA94 = Geocentric Datum of Australia 1994

GL = Ground Level

GRI = Gas Research Institute

HCl = Hydrochloric Acid

HDRM = High Resolution Digital Microscope

HDRS = High Resolution Density and Micro-Resistivity Sonde

HGNS = High Resolution Gamma-Ray Neutron Sonde

HNGS = Hostile Natural Gamma-Ray Sonde

HRLT = High Resolution Laterolog Tool

hrs = hours

iC4 = Isobutane

iC5 = Isopentane

K = Thousand

KCl = Potassium Chloride

km = Kilometer

lb = pound

lb/gal = Pounds per gallon

LPG = Liquid Petroleum Gas

Ltd = Limited

M = Million

m/hr = meter per hour

Ma = Mega-annum or Million years

MAST = Multimode Array Sonic Tool

mD = millidarcy

MDRT = Measured Depth Rotary Table

mg/L = miligrams per litre

MGA94 = Map Grid of Australia 1994

min = Minute

mmscf = million standard cubic feet

MPI = Methylphenanthrene Index

MSCT = Mechanical Sidewall Coring Tool

MSL = Mean Sea Level

NaCl = Sodium Chloride

nC4 = normal Butane

nC5 = normal Pentane

NEXT = Elemental Capture Spectroscopy Tool

NMR = Nuclear magnetic resonance

NNW = North-Northwest

No. = Number

OD = Outer Diameter

PDC = Polycrystalline Diamond Compact

Pf / Mf = Phenolphthalein Alkalinity / Methyl Orange Alkalinity End Point

PJ = Petajule

POOH = Pulling Out of Hole

PPC = Power Positioning Device and Caliper Tool

ppg = Pounds per gallon

psi = Pounds per square inch

QC = Quality Control

RIH = Rigged in Hole

ROP = Rate of Penetration

RSWC = Rotary Sidewall Core

S = South

SDL = Surface Data Logging

SEM = Scanning Electron Microscopy

sg = specific gravity

SRR = Source Rock Reservoir

SWC = Sidewall Core

TD = Total Depth

TOC = Total Organic Carbon

TVD = True Vertical Depth

TVDSS = True Vertical Depth Sub-Surface

U-Pb SHRIMP = Uranium-Lead Sensitive High-Resolution Ion Microprobe

UV = Ultraviolet

Vre = Vitrinite Reflectance Equivalent

WOC = Wait on Cement

XLOT = Extended Leak Off Test

XRD = X-Ray Diffraction

XRF = X-Ray Fluorescence

1 WELL INDEX SHEET

Well Name:	Beetaloo W-1
Well Type Classification:	Exploration
Permit Details:	EP117(R1), Northern Territory
Well Path:	Vertical (1.47 deg deviation at TD)
Location:	Latitude: 17°07' 13.7338" S Longitude: 133°45' 42.4218" E Easting: 368 276.23 Northing: 8 106 697.56
Coordinate Reference System:	GDA94 / MGA94 Zone 53
Map Sheet Name:	1:1M Map Sheet: SE53 Newcastle Waters (5 min Graticule Number 958) 1:250K Map Sheet: SE5306 Beetaloo 1:100K Map Sheet: 5663 Beetaloo
Offset Wells:	Elliott-1 - 29.7 km (S, -180° from Beetaloo W-1) Jamison-1 - 38.3 km (N, 0.5° from Beetaloo W-1) Shortland-1 - 42.3 km (NNW, -11.0° from Beetaloo W-1) Mason-1 - 44 km (NNW, -3.5° from Beetaloo W-1) Shenandoah 1A - 58.7 km (NNW, -19.8° from Beetaloo W-1)
Seismic Control:	North-South Control: 2D Seismic Line - Ma91 – 103. Shot Point 3295
Elevation:	232 m (GL above MSL)
RT Elevation:	237.35 m (above MSL)
RT Height:	5.35 m (above GL)
Total Depth Driller:	3173 mMDRT
Total Depth Logger:	3165 mMDRT
Spud:	22-July-2016 @ 21:00 hrs
Reached TD:	6-September-2016 @ 04:00 hrs
Rig Released:	14-September-2016 @ 06:00 hrs
Drilling Time:	53 Days and 9hrs
Well Status:	Cased and Suspended
Suspended:	14-September-2016
PBTD:	3128 mMDRT
Permit Interests:	Origin Energy Resources Ltd (Operator - 35%) Sasol Petroleum International (35%) Falcon Oil & Gas (30%)
Rig Name/Type:	Saxon 185 / Land-Onshore

CONTRACTORS	
Drilling	Saxon
Drilling Fluids	Newpark Drilling Fluids
Mud Logging	Geoservices
Wireline Logging	Schlumberger
Cementing	Halliburton
Casing	Marubeni-Itochu Tubulars Oceania (MITO)
Wellheads	Cactus
Drilling Tools	Schlumberger
Running Casing	Drillquip

WIRELINE LOGS

SUITE No.	RUN No.	DEPTH (mMDRT)		DESCRIPTION	OPERATOR	REMARKS
		FROM	TO			
1	1	3167.86	1292.6	NEXT-HRLT-HDRS-HGNS-EDTC (PEX – Lithoscanner)	SLB	Repeat section: 3053.2 – 3174.3 mMD Gamma-ray, Density and Neutron run through casing to surface Micro-resistivity failure
1	2	3153	1290	CMR-HNGS-HDRS-HGNS-EDTC (CMR)	SLB	HDRS-HGNS run after failure of micro-resistivity in Run 1 Repeat section: 2565.5 – 2685.6 mMD
1	3	3137.7	940	FMST-MAST-PPC-EDTC (FMI - SonicScanner)	SLB	Repeat section: 1335.6 – 1504.8 mMD
1	4	3071.9	1521.25	Rotary Sidewall Coring (MSCT)	SLB	48 Cores attempted / 41 recovered

FORMATION EVALUATION WHILE DRILLING

HOLE SIZE (INCH)	INTERVAL (mMDRT)	LOGS ACQUIRED	REMARKS/SHOWS
None Taken			

FORMATION TOPS

<table>
<tr><th colspan="4" rowspan="2">FORMATION</th><th colspan="3">TOPS</th><th rowspan="2">REMARKS/SHOWS</th></tr>
<tr><th>mMDRT</th><th>mTVDSS</th><th>THICKNESS PENETRATED (mTVD)</th></tr>
<tr><td colspan="4">Undifferentiated Cretaceous</td><td>5.35</td><td>232</td><td>132.95</td><td></td></tr>
<tr><td colspan="4">Anthony Lagoon Formation</td><td>138.3</td><td>99.05</td><td>109.3</td><td></td></tr>
<tr><td colspan="4">Gum Ridge Formation</td><td>247.6</td><td>-10.25</td><td>189.27</td><td></td></tr>
<tr><td colspan="4">Antrim Plateau Volcanics</td><td>436.9</td><td>-199.52</td><td>137.07</td><td></td></tr>
<tr><td colspan="4">Chambers River Formation</td><td>574</td><td>-336.59</td><td>280.88</td><td></td></tr>
<tr><td colspan="4">Bukalorkmi Sandstone</td><td>854.9</td><td>-617.47</td><td>130.89</td><td></td></tr>
<tr><td colspan="4">Kyalla Formation</td><td>985.8</td><td>-748.36</td><td>786.63</td><td>Wet Gas Shows over organic-rich mudstones</td></tr>
<tr><td colspan="4">Moroak Sandstone</td><td>1772.55</td><td>-1534.99</td><td>452.14</td><td>Minor Dry Gas Shows over basal sandstone intervals</td></tr>
<tr><td rowspan="8">Velkerri Formation*</td><td colspan="3">upper Velkerri member</td><td>2224.8</td><td>-1987.13</td><td>367.9</td><td>Dry Gas shows over sandstone intervals</td></tr>
<tr><td rowspan="6">middle Velkerri member**</td><td rowspan="2">C Shale</td><td>Top</td><td>2592.7</td><td>-2354.97</td><td rowspan="2">35.89</td><td rowspan="2">Dry Gas Shows over organic-rich mudstones</td></tr>
<tr><td>Base</td><td>2628.6</td><td>-2390.86</td></tr>
<tr><td rowspan="2">B Shale</td><td>Top</td><td>2999.95</td><td>-2761.62</td><td rowspan="2">66.97</td><td rowspan="2">Dry Gas Shows over organic-rich mudstones</td></tr>
<tr><td>Base</td><td>3067</td><td>-2828.59</td></tr>
<tr><td rowspan="2">A Shale</td><td>Top</td><td>3132.8</td><td>-2894.37</td><td rowspan="2">15.5</td><td rowspan="2">Dry Gas Shows over organic-rich mudstones</td></tr>
<tr><td>Base</td><td>3148.3</td><td>-2909.87</td></tr>
<tr><td colspan="3">lower Velkerri member</td><td>3148.3</td><td>-2909.87</td><td>16.7</td><td>Not fully penetrated – 6 ¾” production hole terminated 16.7m into the lower Velkerri</td></tr>
<tr><td colspan="4">Loggers TD</td><td>3165</td><td>-2926.57</td><td></td><td></td></tr>
<tr><td colspan="4">Drillers TD</td><td>3173</td><td>-2934.56</td><td></td><td></td></tr>
</table>

*The Velkerri Formation was not fully penetrated at Beetaloo W-1. Total penetrated thickness: 939.44mTVD.
**middle Velkerri member total penetrated thickness: 554.9mTVD

CORE- CONVENTIONAL

CORE No.	INTERVAL (mMDRT)	CUT (m)	RECOVERED (m)	GEOLOGICAL FORMATION
1	1525.57 to 1563.1	37.53	36.12	Kyalla Formation

CORE – ROTARY SIDEWALL

SUITE No.	RUN No.	TYPE	INTERVAL (mMDRT)	PLANNED CUT RSWC	ATTEMPTED CUT RSWC	RECOVERED SWC
1	4	RSWC - MSCT	3071.9 – 1521.25	50	48	41

HOLE & CASING DETAILS

HOLE SIZE (INCH)	HOLE DEPTH (mMDRT)	CASING SIZE OD (INCH)	CASING SHOE SETTING DEPTH (mMDRT)	CASING GRADE	CASING THREAD	CASING WEIGHT (lb/ft)
20	205.72	16	205.72	K55	BTC	75
14 ¾	594.13	10 ¾	591.6	K55	BTC	40.5
9 ⅞	1308	7 ⅝	1289.82	P110	JFE FOX®	29.7
6 ¾	3173	4 ½	3164	P110	JFEBEAR®	15.1

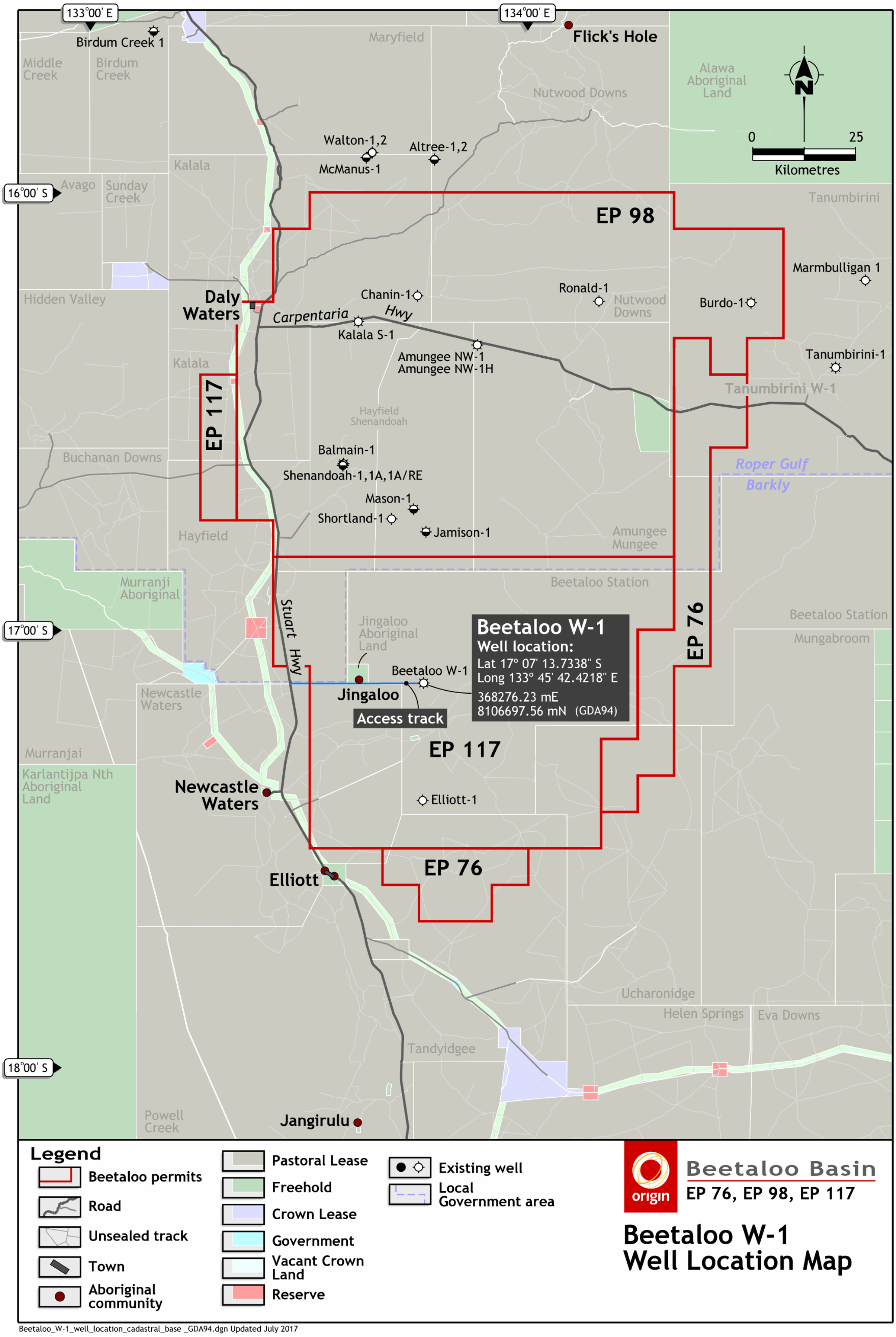

Figure 1 - Beetaloo W-1 well Location

2 WELL DESCRIPTION

2.1 INTRODUCTION

The Beetaloo W-1 well was originally planned as the third well in a three-well drilling exploration campaign in 2015 (Permit Year 2), and the first to be drilled in exploration permit 117 (EP117) in the southern Beetaloo Sub-Basin (Beetaloo) (Figure 1). The campaign aimed to test the presence, lateral continuity and reservoir quality of the primary target, the organic-rich mudstone units of the middle Velkerri member (middle Velkerri) of the Velkerri Formation as a potential source rock reservoir (SRR).

Positive petrophysical evaluation of the Amungee NW-1 well (second well of the campaign) resulted in the decision to defer Beetaloo W-1 and drill the horizontal well Amungee NW-1H (from the existing Amungee NW-1 wellbore) allowing for further evaluation and testing of the prospective middle Velkerri member B shale interval. The decision to drill Amungee NW-1H in lieu of Beetaloo W-1 was primarily driven by time constraints in the construction of the access track and pad lease at the Beetaloo W-1 location.

The Beetaloo W-1 well was successfully spudded on the 22 July 2016. The well reached TD within the lower Velkerri member on 6 September 2016 having met all its primary objectives. The well was cased and suspended, and the rig released on the 14 September 2016. The total drilling and operational time was 53 days and 9hrs.

2.2 LOCATION RATIONALE

The Beetaloo W-1 well is located in the central portion of EP117, approximately 32 km east of the Stuart Highway and 54 km northeast from the town of Elliott and the Stuart Highway in the Northern Territory (Figure 1). The location was selected based on pre-drill thermal maturity modelling which indicated dry gas and wet gas generation potential for the organic-rich mudstones of the middle Velkerri and the Kyalla Formation respectively. The well location also tested the southern stratigraphic extension of the middle Velkerri which had not yet been penetrated south of Shenandoah-1A (58.7 km north-northwest from Beetaloo W-1).

The well was placed on the north-south trending 2D Seismic Line Ma91–103 (shot point 3295) and between two stratigraphic wells (Jamison-1 and Elliott-1) providing seismic depth and stratigraphic control down to the top Moroak Sandstone.

Beetaloo W-1 was located along a pre-existing east-west access track allowing good access to the site from the Stuart Highway (Figure 1).

2.3 OBJECTIVES

The Beetaloo W-1 exploration well successfully met all its objectives, which included:

1. Confirming the presence and assessing the reservoir quality of the middle Velkerri SRR's within the central portion of EP117 in the southern Beetaloo.

2. Assessing the reservoir quality of the organic-rich mudstones of the Kyalla Formation as a potential secondary SRR target in the Beetaloo.

3. Cutting a conventional core over the Lower Kyalla SRR for rock property, geomechanics, petrographic and geochemical analysis, targeted to calibrate petrophysical and geomechanical models seeking to inform prospectivity of the Kyalla Formation SRR units.

4. Cutting infill rotary sidewall cores (RSWC) over the middle Velkerri and Kyalla SRRs, and other targets of interest for the calibration of petrophysical and geomechanical models.

3 REGIONAL GEOLOGY AND PROSPECT DESCRIPTION

3.1 REGIONAL GEOLOGY

The Beetaloo of the Greater McArthur Basin is an intra-cratonic Proterozoic depression concealed beneath Phanerozoic cover situated approximately 500 km southeast of Darwin in the Northern Territory (Figure 1). Two tectonic models have been proposed to explain the present configuration of the basin, but consensus on the precise formation mechanism(s) is yet to be established. Abbott and Sweet (2000) support an orogenic flexure mechanism based on the episodic nature of the stratigraphic accommodation cycles observed in the siliciclastic fill across the basin. Orogenic events speculated to have contributed to the orogenic flexure include the Isan Orogeny 1580-1480Ma (Connors and Page, 1995; Page and Sun, 1998) and Antmatjira Uplift 1500-1400Ma (Mayers et al., 1996), both dated synchronous to Roper Group sedimentation. The second tectonic model supports a combination of lithospheric extension and subsequent sagging as trigger for the increased accommodation at the time of Roper Group deposition (Betts and Giles, 2006; Foster and Ehlers, 1998; Spikings et al., 2001; Spikings et al., 2002).

The Basin is primarily defined by gravity and magnetotelluric data (Cull, 1982), deep seismic sounding data (Collins, 1983), exploratory drilling and 2D seismic data (Ahmad et al., 2013) which is well captured in the OZ SEEBASE™ depth-to-basement Proterozoic map (Pryer and Loutit, 2005) (Figure 2). The OZ SEEBASE™ depth-to-basement Proterozoic map structurally subdivides the Beetaloo into three preserved geographical areas referred to here as the Gorrie, Balmain and OT Downs Deeps from west to east respectively (Ronald-1 WCR 1993) (Figure 9). The preserved Deeps are separated by two north-south trending ridges, the structurally complex Daly Waters Arch (west) and the structurally benign Arnold Arch (east).

The tectonic evolution of the Daly Waters Arch, a 15-30 km wide fold thrust belt structure appears the result of regional, east-west directed compressional tectonic forces as inferred by 2D seismic interpretation. Despite poor 2D seismic quality over the structure, current interpretation suggests the Arch was likely the result of basin inversion and thin-skinned deformation with a décollement at or just below the base Roper Group erosional unconformity. Possible evidence of an underlying, older, thick-skinned extensional deformation event may also exist as indicated by a few trace seismic reflectors which appear to indicate normally faulted horst blocks underlying the thin-skinned deformation episode. Whether this thick-skinned deformation is real and whether it has helped to locally constrain or initiate the later thin-skinned deformation is unknown at this time. The Daly Waters Arch is interpreted to have been structurally active between the end of the Kyalla Formation deposition and the base Cambrian erosional event as per seismic and magnetic data interpretations. Minor structural reactivation since the Cambrian is also interpreted, but considered relatively minor. Like the Daly Waters Arch, the Arnold Arch is interpreted to have formed after an east-west trending, compressional tectonic event caused thin-skinned deformation; this may have been controlled by underlying structures. Poor seismic quality and coverage over the Arch, however, limits our understanding of the evolution of this structure.

Faulting and folding in the Beetaloo occurs primarily within discrete zones up to 10 km wide likely as result of reactivation of deep-seated faults, subsequent alignment of younger structures and gentle fold warping. Fault zones largely consist of wrench-related strike-slip and reverse faults producing en-echelon, antiformal (positive) flower structures (Lanigan et al., 1994). Due to limited regional tectonic activity during the Cambrian, the Antrim Plateau Volcanics and Gum Ridge Formation form a flat-lying drape over the more structured Proterozoic strata. Exceptions occur within the north-western and eastern margins of the Basin where faults extend into the Cambrian sequence (Fulton and Knapton, 2015).

The Roper Group sits unconformably on top of the Mount Rigg Carbonate sequence (Nathan Group Equivalent), as interpreted in 2D seismic profiles and well penetrations north of the Beetaloo Basin. The Roper Group is divided into two distinct depositional packages separated by a period of regionally significant deformation, with uplift and erosion likely driven by reactivation of deep-seated crustal faults. The lower package encompasses sediments from the Limmen Sandstone to the Kyalla Formation, and the upper package comprises the Bukalorkmi Sandstone and Chambers River Formation (Figure 9). It is hypothesized that the structural shape of the Beetaloo in the Balmain Deep today (i.e. 'bowl' shaped with steeply dipping flanks) was induced by a regional event separating the upper and lower Roper Group packages (Figure 4 and Figure 10). Another period of Basin restructuring and erosion took place following deposition of the Chambers River Formation (the last known preserved package of the Roper Group) and, due to its seemingly close alignment with that of the lower Roper Group package major structuring, it has been interpreted as being controlled by fault reactivation of a similar fault set. Regional erosion ceased by the Early Cambrian with the deposition and preservation of the Bukalara Sandstone and the Cambrian Kalkarindji Large Igneous Province (Kalkarindji Province) extrusion event.

The original extent of the Roper Group sedimentation across the Beetaloo remains unknown as numerous episodes of subsidence, uplift and erosion resulting in the formation of the younger Georgina and Carpentaria basins, has masked the original extend of the Roper Group. Within the vicinity of the Balmain Deep (Figure 4 and Figure 10), the Cambrian Barkly Group strata (Georgina Basin) and Undifferentiated Cretaceous sediments (Carpentaria Basin) completely conceal the Roper Group. In areas where the Barkly and Carpentaria sediments are absent deep lateritic weathering conceals almost all Roper Group outcrops, which hampers efforts to map the surface geology of the Roper Group.

Regional and local syn-depositional structuring of the Roper Group is not clear on 2D seismic. Regional, subtle thickening and thinning of sedimentary packages across the Beetaloo could be evidence of subtle regional syn-depositional sedimentation but could also be explained as variations progradation and sediment source proximity. Poor 2D seismic quality caused by the presence of shallow karstic limestone and laterally variable flood basalts likely mask subtle evidence for any local syn-depositional structuring if present. Timing of basin structuring has been chiefly identified from a combination of regional seismic interpretation and basin modelling of well point thermal maturity data, including organic petrology and apatite fission track analysis (AFTA).

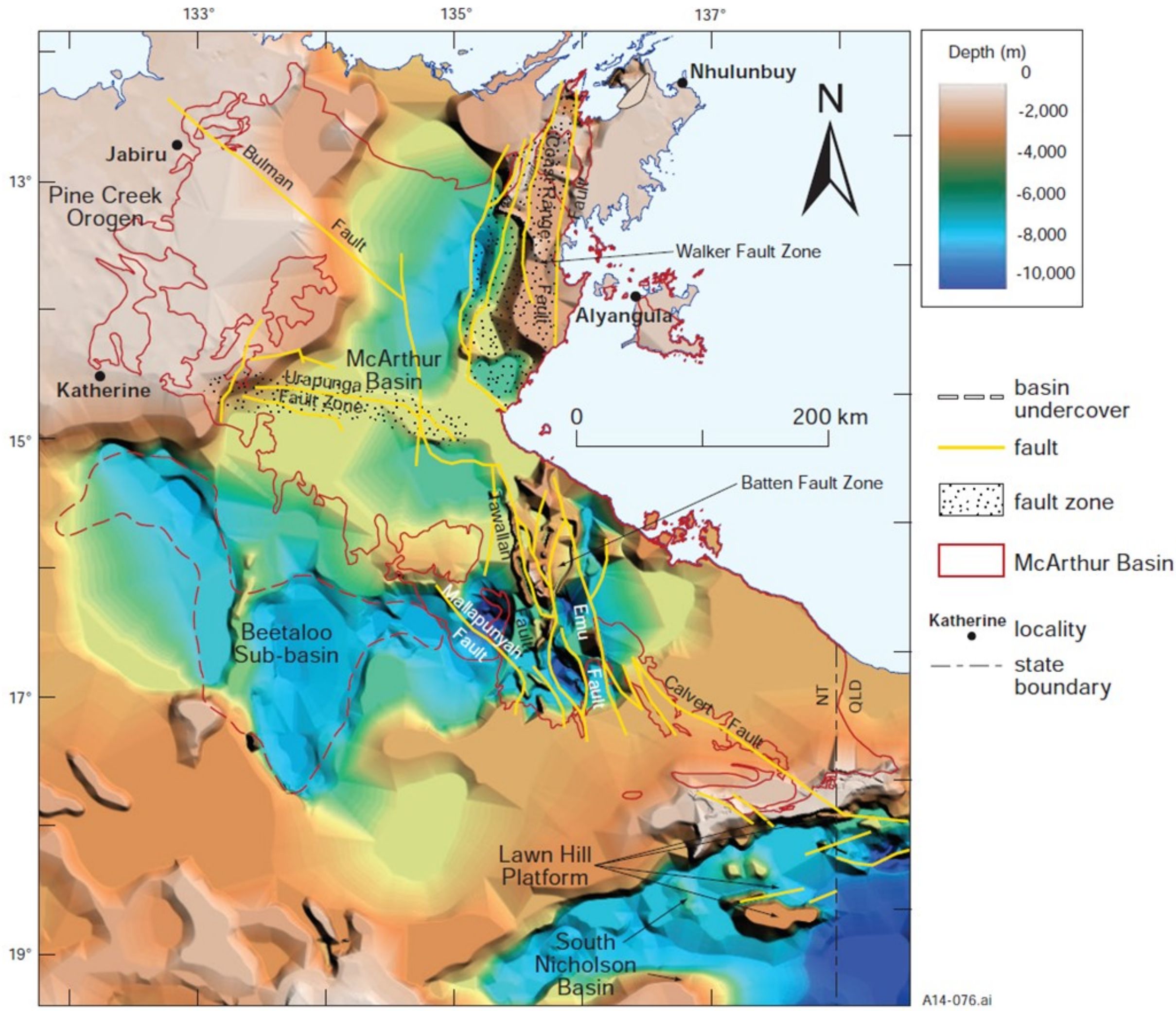

Figure 2 - FrogTech Geoscience, Proterozoic OZ SEEBASETM depth-to-basement image (Pryer and Loutit, 2005) showing interpreted location of the McArthur Basin (red solid line) and other associated basins in the Northern Territory. The extent of the Beetaloo Basin is outlined in red dashed line (after Munson, 2014). Note the regional extent of interpreted Roper Group sediments extends beyond the Basin margin as defined by Munson (2014). Recent well penetrations into the Nathan group equivalent strata in the Gorrie Deep indicate the limits of the McArthur Basin extend southwest.

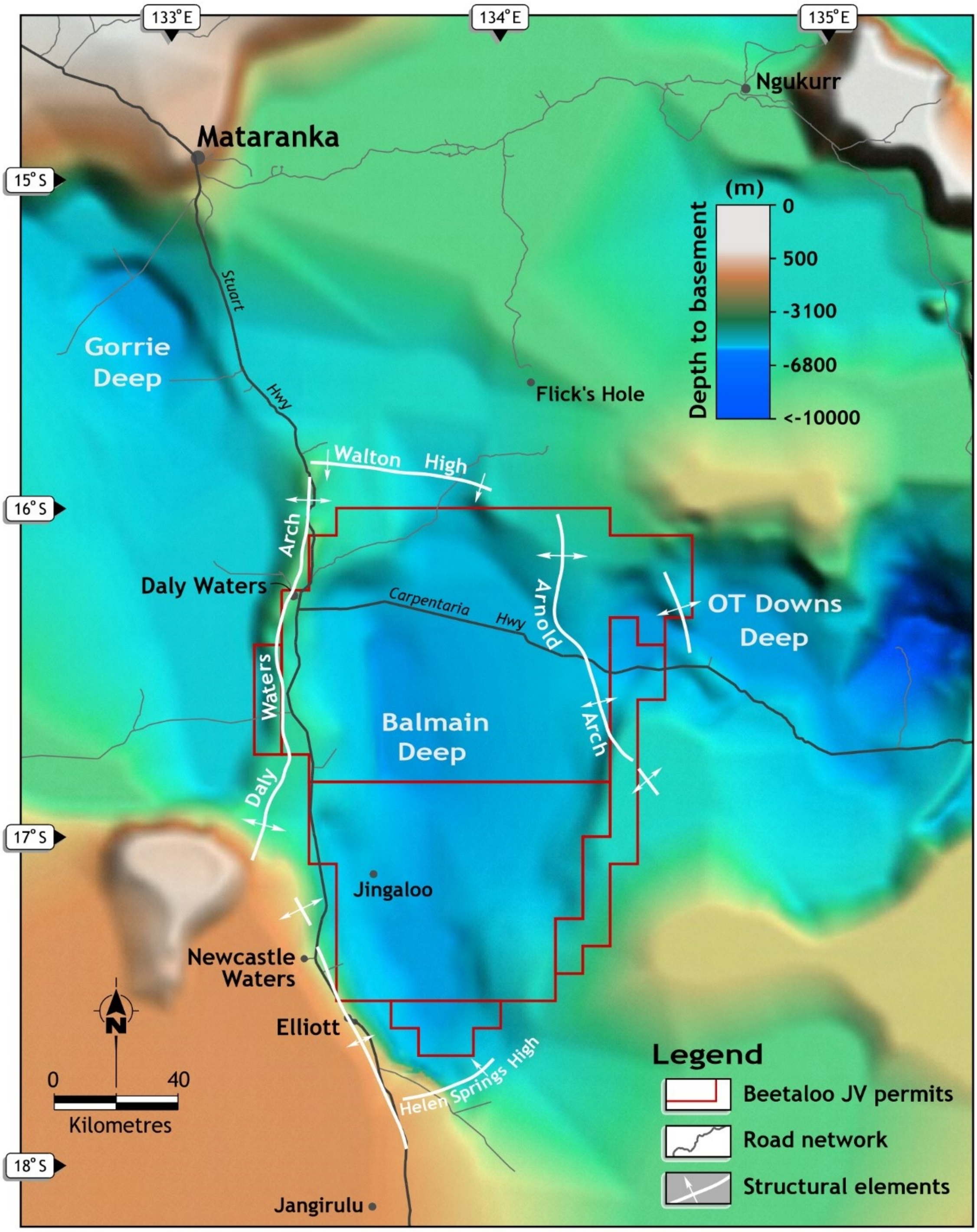

Figure 3 - Structural and tectonic elements of the Beetaloo. The location of the Beetaloo JV permits is outlined in red. Background is OZ SEEBASE™ depth-to-basement image (Pryer and Loutit, 2005)

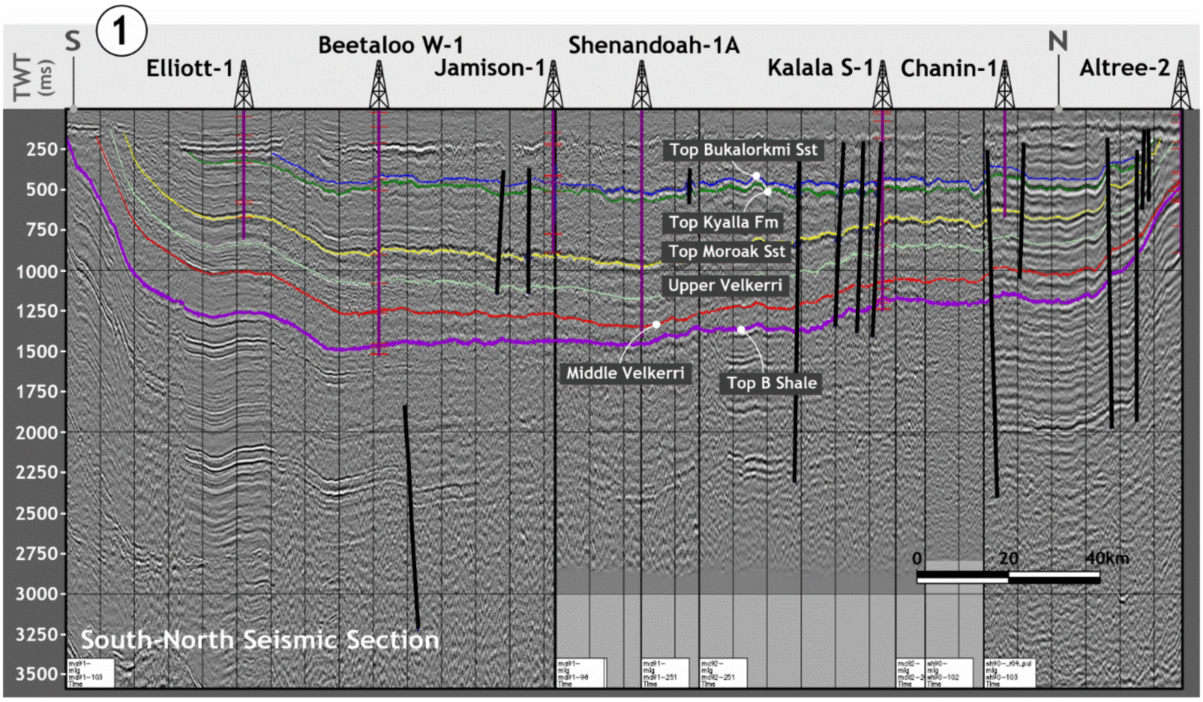

Figure 4 - North to South seismic composite section through the Beetaloo. The composite section displays 2D seismic lines as shown in Figure 8.

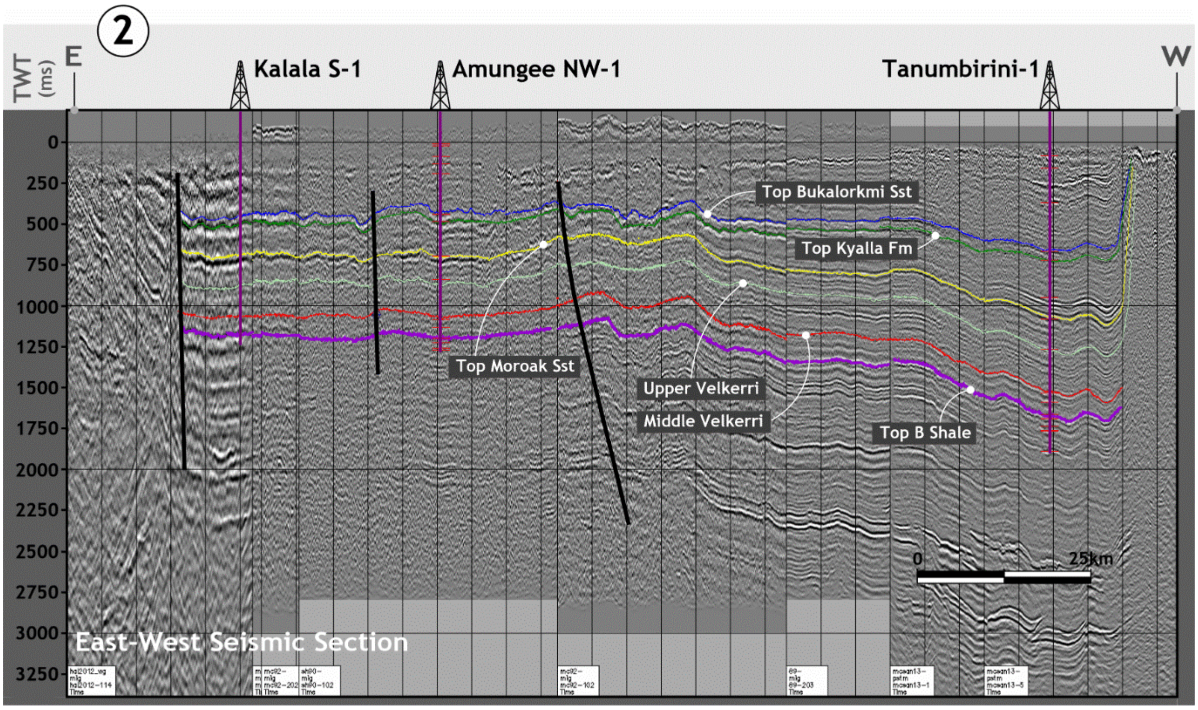

Figure 5 - West to East seismic composite section through the Beetaloo. The composite section displays 2D seismic lines as shown in Figure 8.

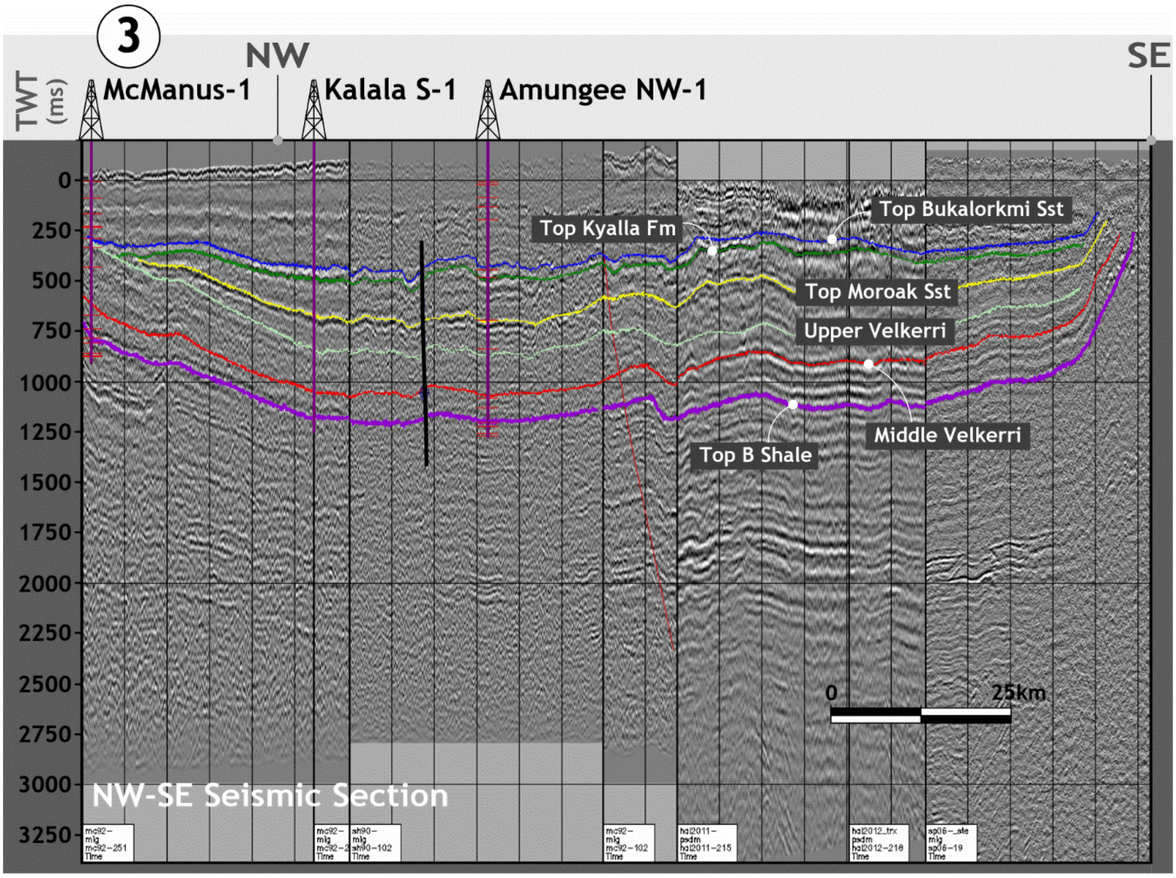

Figure 6 – Northwest to Southeast seismic composite section through the Beetaloo. The composite section displays 2D seismic lines as shown in Figure 8.

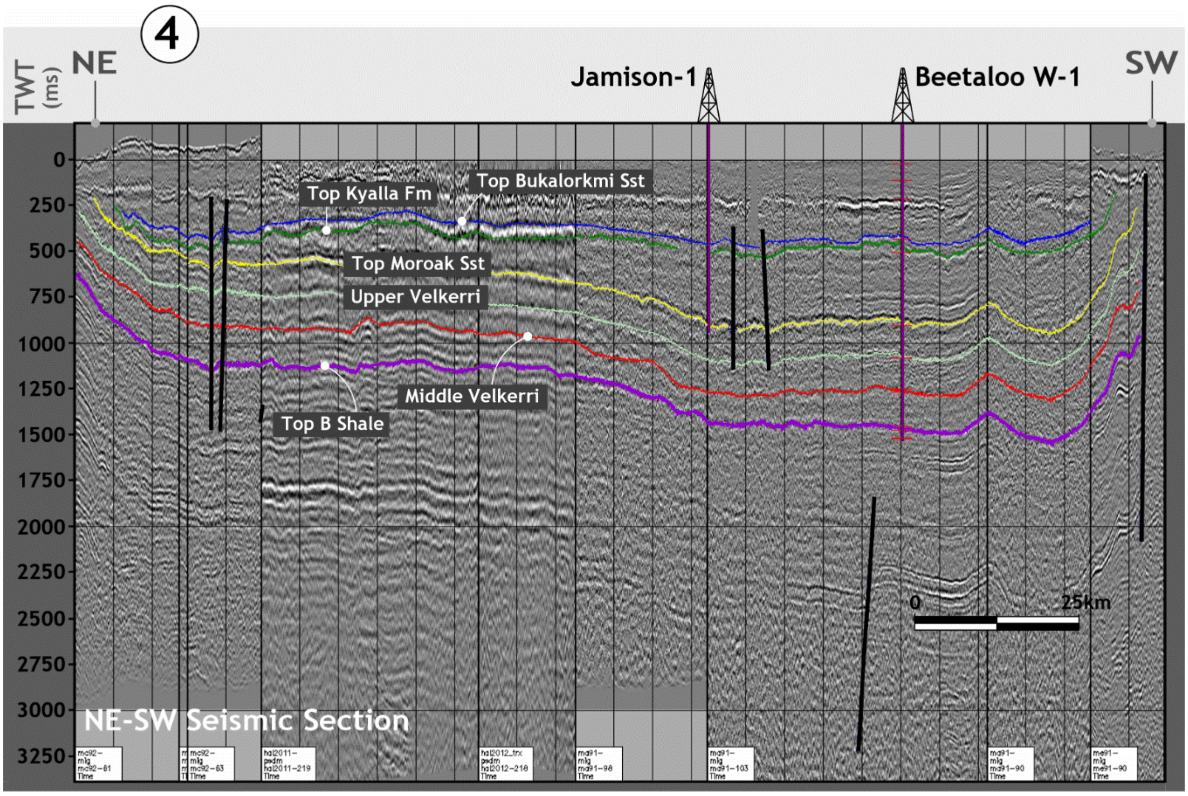

Figure 7 – Northeast to Southwest seismic composite section through the Beetaloo. The composite section displays 2D seismic lines as shown in Figure 8.

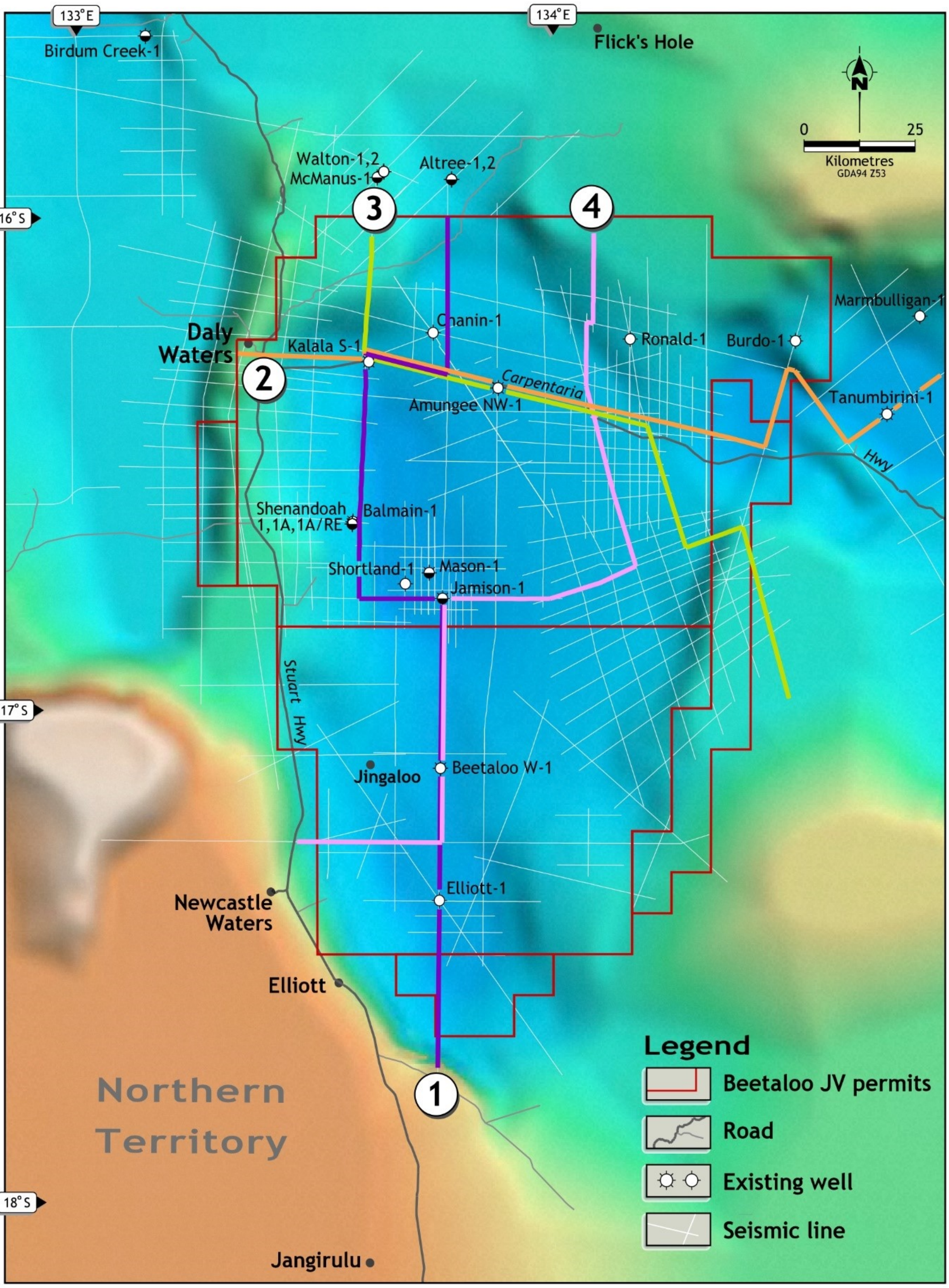

Figure 8 - Location of 2D seismic composite sections from Figure 4, Figure 5, Figure 6 and Figure 7.

3.2 REGIONAL STRATIGRAPHY

The Mesoproterozoic Roper Group comprises dominantly progradational cycles of mudstone, siltstone and sandstone units reaching preserved thickness' greater than 6000 m and averages of 1500 m away from major preserved intra-basinal deeps. Even though the succession has yet to be fully penetrated within the deepest preserved basinal deeps, individual formations can be traced across the basin showing remarkable thickness consistency and lateral continuity (Figure 4 to Figure 8) (Munson, 2014).

The first detailed stratigraphic study of the Roper Group was presented by Jackson et al. (1988) and furthered by detailed investigations from Jackson and Raiswell (1991) and Warren et al. (1998) who supplemented the pre-existing framework with additional regional and local stratigraphic, sedimentological and geochemical information. The Roper Group succession is inferred to have been deposited in a variety of settings within shallow-marine, nearshore and shelf environments (Powell et al., 1987; Jackson et al., 1988; Abbott and Sweet, 2000) with organic enrichment confined to the Velkerri and Kyalla formations. Common oil and gas shows within sandstone reservoirs and self-sourcing intervals, including the Velkerri and Kyalla SRR's attest to the excellent exploration potential of the Basin sedimentary packages.

The Velkerri Formation, comprising green, grey and black mudstone and siltstone sits conformably on the Bessie Creek Sandstone, often showing a gradational contact with the overlying Moroak Sandstone (Figure 9). The formation is subdivided into three informal units – lower, middle and upper members generally based upon total organic content (TOC) and wireline gamma ray response (Warren et al., 1998). The prospectivity of the Formation is greatest in the organic-rich mudstones of the middle member – informally subdivided by Origin into 'A', 'B', and 'C' shales (from oldest to youngest) (Figure 11). These organic-rich mudstones are typically separated by organic-lean siltstones. Detailed sedimentological analysis describes the unit as marine facies displaying superimposed laminated black-grey, organic-rich (TOC ~4-10%) and grey-green, organic-lean (TOC <2%) mudstone and siltstone with minor fine glauconitic sandstone that transition up-section to the planar to cross-bedded sandstones of the Moroak Sandstone (Abbott et al. 2001, Jackson and Raiswell 1991, Warren et al. 1998).

Dolerites intruding the Roper Group at various stratigraphic levels have collectively been named the Derim Derim Dolerite. U-Pb SHRIMP dating of baddeleyite from a sample of the dolerite has yielded an age of 1324 ± 4Ma (Abbott et al., 2001), however ages of 1280 Ma have also been reported (Dutkiewicz et al., 2004). Dolerites typically intrude laterally along boundaries of mechanical weakness in the north and west of the Beetaloo, reaching a maximum thickness of 120 m to the west before apparently thinning and terminating towards the centre of the basin. Planes of mechanical weakness often include the boundary between the Bessie Creek Sandstone and the Velkerri Formation and laminated intervals throughout the Velkerri Formation. Limited, deep wellbore penetration into the Velkerri and Bessie Creek Sandstone in the centre of the Basin hampers the ability to determine the exact lateral distribution of the dolerite sills.

The Moroak Sandstone sits conformably on the Velkerri Formation, displaying a gradual transition from basinal/deltaic slope environments - displaying intermittent coarse clastic sedimentation over a background of predominantly fine grained sediments – to a shore face or delta front, high energy environment. The sandstone package thins towards the north (Lady Penrhyn-1) and west (Tarlee-S3), and thickens in the southern (Beetaloo W-1, Elliott-1) and eastern (Tanumbirini-1) portions of the Basin. Broad thickness distribution suggests a paleo-shoreline towards the south-east.

The Kyalla Formation, dominated by grey and black siltstone and mudstone with localised sandstone intervals sits conformably on the Moroak Sandstone (Figure 9). The formation has historically been informally subdivided into an upper and lower unit with organic richness generally confined to the lower unit and base of the upper unit. Evaluation of vintage and recent exploration penetrations suggests this informal subdivision is overly simplistic as it fails to account for regional variations.

Oil shows and gas bleeds through the lower Kyalla Formation support its potential as an unconventional SRR play. The Formation exhibits a sharp, erosional, disconformable to angular unconformable contact with the overlying Bukalorkmi Sandstone, a thin to medium bedded, trough cross-stratified, fine grained, quartz sandstone. Detrital zircon dating from the Bukalorkmi Sandstone indicates a maximum depositional age of 1106 ± 22 Ma and 1086 ± 47 Ma, however, it has been suggested to be as young as Neoproterozoic (Lanigan et al., 1994), with recent work on inter-basinal correlations by Hoffman 2016 also supporting a possible Neoproterozoic age.

Conformably overlying the Bukalorkmi Sandstone is the thin to medium bedded, laminated, micaceous, brown-grey, oxidised red and reduced green claystone and siltstone of the Chambers River Formation. Interbeds of fine grained, feldspar-rich sandstone with variable hydrocarbon shows from the Chambers River Formation are common across the basin. A notable sandstone package in this interval is informally referred to as the Chambers River Sandstone. The Chambers River Formation represents the youngest unit of the Roper Group in the Beetaloo. Like the underlying Bukalorkmi Sandstone, the Chambers River Formation has been suggested to potentially be Neoproterozoic (Lanigan et al., 1994, Hoffman 2015). If the interpretation of these formations as Neoproterozoic is correct, then the extent of the Centralian Super-Basin and the inclusion of the Bukalorkmi Sandstone and Chambers River Formation into the Roper Group will both come under question.

A significant downward erosional disconformity / angular unconformity typically separates the Chambers River Formation from the Cambrian Barkly Group sediments of the Georgina Basin. The base Cambrian unconformity variably erodes the Chambers River Formation, Bukalorkmi Sandstone, Kyalla Formation, Moroak Sandstone and Velkerri Formation depending on location within the Basin.

The Aeolian Bukalara Sandstone (Flavelle., 2017) forms the base of the Cambrian Barkly clastic succession. The regional thickness and distribution of the Sandstone are variable based on well penetrations. Evidence of lateral thickness variations in preserved dune fields defined on regional magnetic profiles suggest variability is likely the result of the terrestrial to paralic nature of the dune forming depositional processes.

Conformably overlying the Bukalara Sandstone are the tholeiitic basalt flows of the mid-late Cambrian Kalkarindji Large Igneous Province (Kalkarindji Province). Where the Bukalara Sandstone is absent, the basalt unconformably overlies the eroded Roper Group. The flows are known as the Antrim Plateau Volcanics in the Beetaloo (Munson, 2014). Core observations shows evidence of sand injectites intruding the Antrim Plateau Volcanics, suggesting flood basalt flowed over unconsolidated Bukalara Sandstone sediments.

The Gum Ridge Formation, a shallow water carbonate succession conformably overlies the Antrim Plateau Volcanics and grades as interfingering limestone and brown to oxidised red claystone into the Anthony Lagoon Formation. Where the Antrim Plateau Volcanics is absent, the Formation lies on top of the Bukalara Sandstone or unconformably on the eroded Roper Group. The Gum Ridge Formation is composed predominately of white to cream limestone with minor interbeds of siltstones and mudstone. The Formation is a regional aquifer and serves as the primary domestic and agricultural water source in areas where it can be tapped by surface water bores. The limestone is variably karstic across the Basin forming sinkholes and caverns in the subsurface.

Conformably overlying the Gum Ridge Formation is the paralic, dolomitic-siliciclastic siltstone and mudstone of the Anthony Lagoons Formation. The Anthony Lagoons Formation is the youngest preserved member of the Barkly Group in the Beetaloo region; however, thermal maturity modelling using organic geochemistry, organic petrology and Apatite Fission Track Analysis (AFTA) indicate deposition of younger Cambrian and possibly Ordovician / Devonian sediments also occurred across the Beetaloo region (as per better preserved sections in the southern Georgina Basin), but were subsequently eroded as indicated by a regional unconformity at the base of the Cretaceous section. Thermal maturity modelling additionally suggests that maximum burial and thermal heating of the Velkerri and Kyalla source rock intervals occurred as a result of the Cambrian / Ordovician / Devonian sedimentation and subsidence.

An Undifferentiated Cretaceous section caps the regional stratigraphy of the Beetaloo. The sequence forms a continuous veneer across the Basin except in the south-west margin. Recent palynological studies have dated the base of the Cretaceous unit between ~100-113 Ma. Following cessation of Cretaceous sedimentation, intermittent periods of erosion have continued to present day.

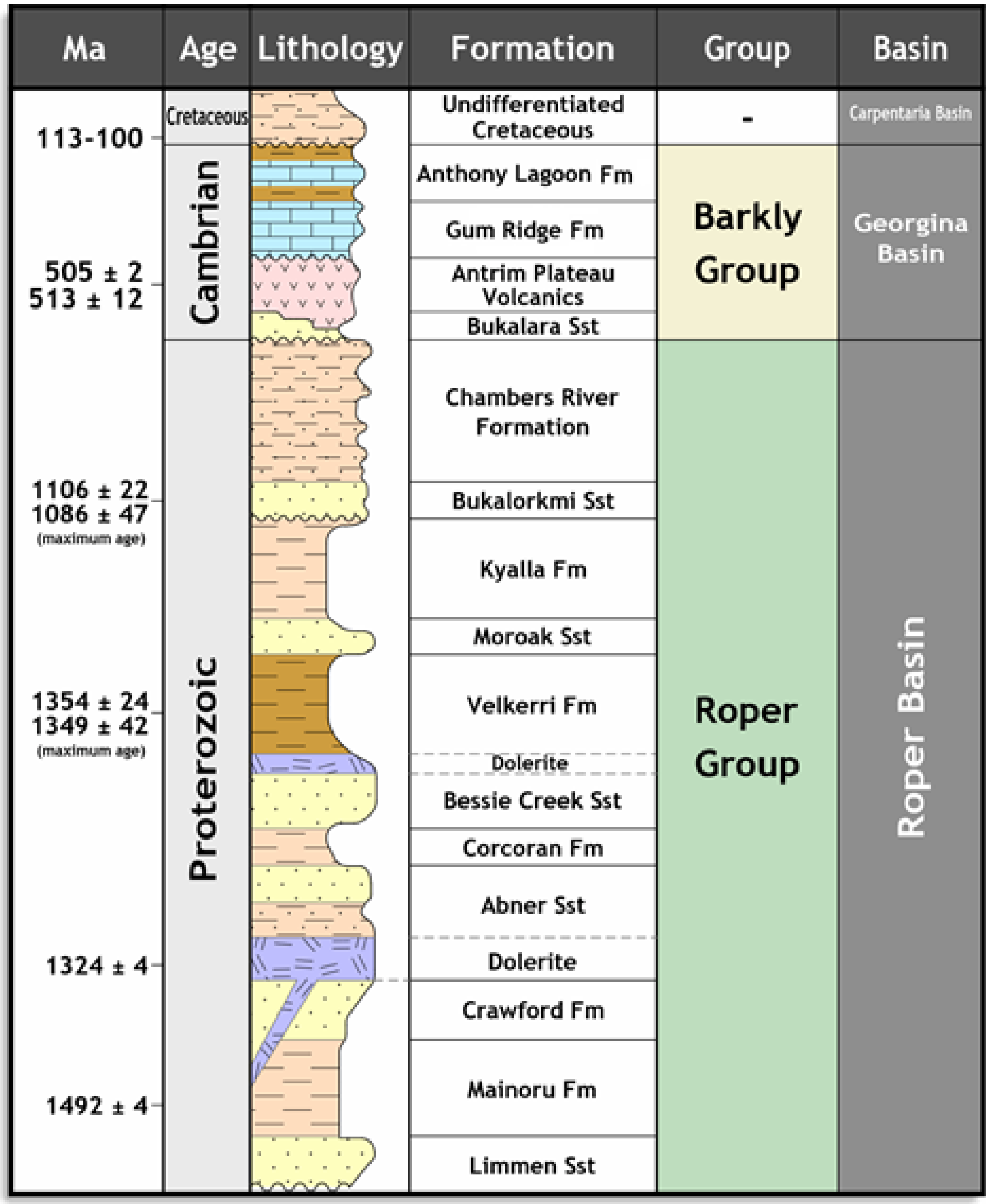

Figure 9 - Beetaloo Basin generalized stratigraphic section

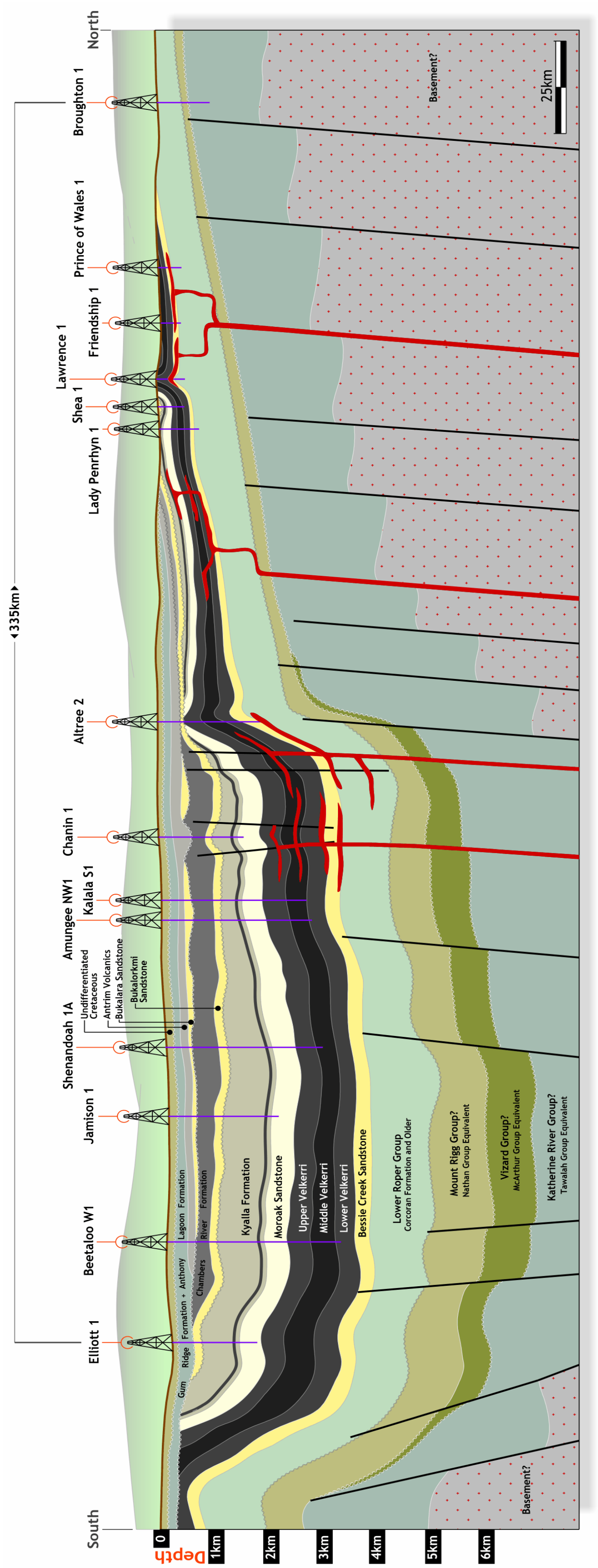

Figure 10 - South to North schematic cross section across the Beetaloo Sub-Basin.

3.3 PROSPECT DESCRIPTION

At Beetaloo W-1 the organic-rich mudstone units of the middle Velkerri member of the Velkerri Formation (primary target) and the Kyalla Formation (secondary target) are considered viable SRR targets.

The middle Velkerri typically comprises three organic-rich, mudstone and siltstone units separated by organic-lean, finely interbedded, variable mud, siltstone and sandstone rich intervals. The organic-rich units are informally referred to as the middle Velkerri A, B and C shales (from oldest to youngest) (Figure 11). Pre-drilling evaluation indicated the intervals are within the dry gas to over-mature hydrocarbon generation window based on measured alginite and bitumen reflectance data, and basin modelling. The A, B and C shales were interpreted to be saturated with dry gas (>90% C1).

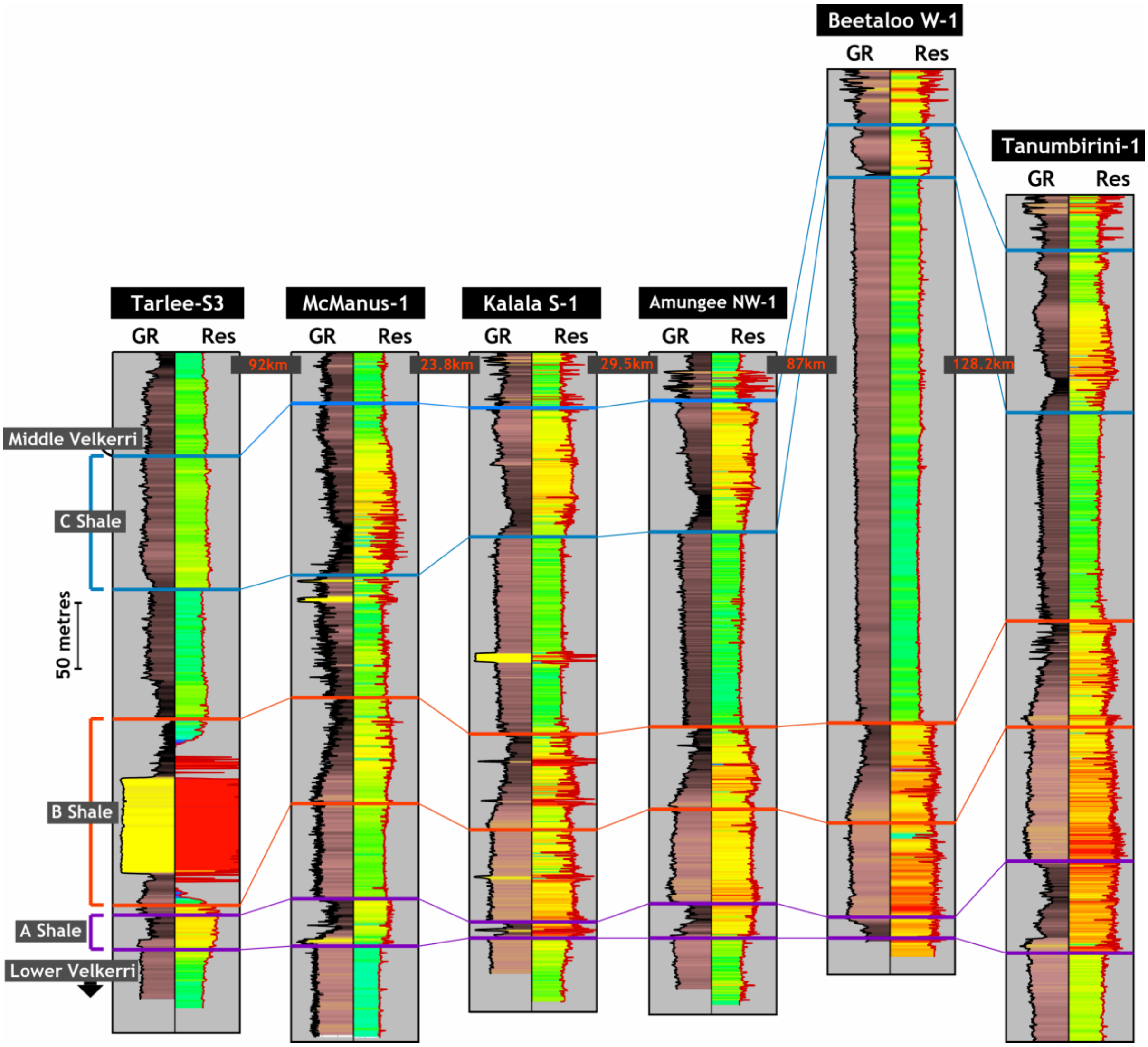

Figure 11 –Middle Velkerri A, B and C shales at Beetaloo W-1 and major offset Beetaloo Sub-Basin wells.

The Kyalla Formation displays a thick sequence of predominantly silty and micaceous mudstone with thin interbeds of siltstone and sandstone. Intermittent supply of course siliciclastic material also resulted in the formation of isolated packages of bedded sandstones. Three prospective SRR intervals have been identified within the gross Kyalla Formation package and informally referred by Origin as the "Upper Kyalla", "Middle Kyalla", and "Lower Kyalla" (Figure 12). Thermal maturity indicators including Methylphenanthrene (MPI) Index with vitrinite reflectance equivalent (Vre 0.66%) at Jamison-1 suggest the upper Kyalla lies primarily within the late stage of early oil generation window, whereas the middle and lower Kyalla fall within the late condensate gas to early dry gas generation window (MPI index equivalent to a vitrinite reflectance of 1.3-1.6%).

Only the Middle and Lower Kyalla SRR's are considered prospective at Beetaloo W-1 given the low maturity of the upper Kyalla SRR in combination with low pore pressures and nano-darcy range matrix permeability.

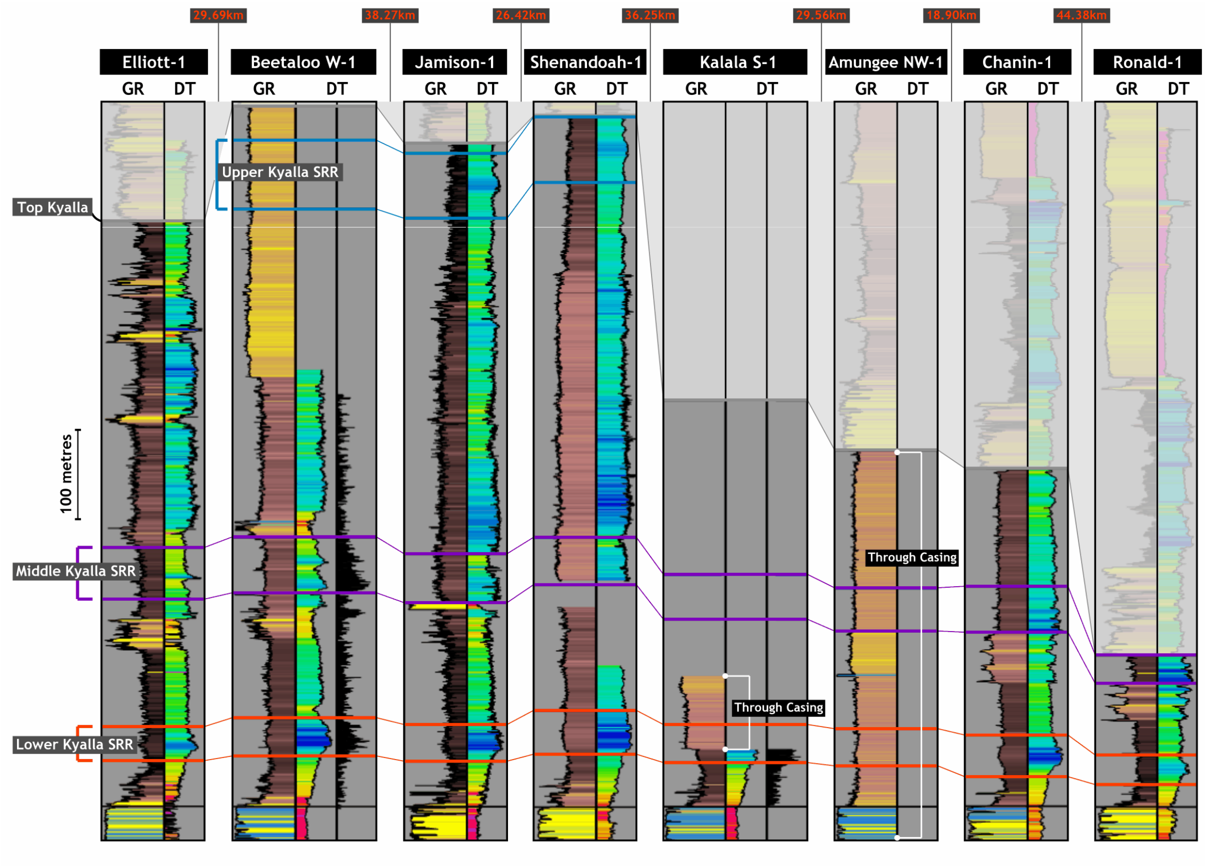

Figure 12 –Upper, Middle and Lower Kyalla SRR's at Beetaloo W-1 and major offset Beetaloo Sub-Basin wells.

4 ENGINEERING DATA

4.1 DRILLING OPERATIONS SUMMARY

Saxon Rig 185 was mobilized to the Beetaloo W-1 well location and the well effectively ‘spudded’ on the 22 July 2016 at 21:00 hrs.

A 20" ‘drill with casing’ (DWC) polycrystalline diamond compact (PDC) bit was made up to the first joint of 16" casing. Drilling with a Volant ‘casing running tool’ (CRT) commenced from 17 mMDRT and continued to 113 mMDRT before experiencing complete ‘loss of circulation’. Drilling with water continued to a section TD of 205.7 mMDRT. The 16" casing was cemented through the DWC PDC bit with ~162 bbls without returns to surface during either mixing and displacement. The cementing top plug was bumped as per program and the casing successfully pressure tested. A follow up ~64 bbls cement ‘top up’ job also failed to bring slurry back to surface. The 22" riser and 16" conductor were cut and removed. A further ‘top up’ job consisting of ~29 bbls of slurry successfully brought returns to surface with no slurry fall back.

A 14 ¾" tri-cone tooth bit was made up with two ‘junk’ subs in the bottom hole assembly (BHA) and rigged in hole (RIH). The top plug, float collar, shoe track and DWC bit were drilled out and approximately 2m of new hole was drilled before pulling out of hole (POOH).

A new 14 ¾" tri-cone insert bit was run in to ~ 208 mMDRT and air/mist drilling progressed to 278 mMDRT. Formation water was produced from the aquifer while drilling the interval. Operations were temporarily suspended but drilling resumed shortly after following addition of polymers to aid in wellbore cleaning. The bit was tripped and replaced at ~565 mMDRT due to torque spikes. A wireline survey at 551 mMDRT resulted in an inclination of 1.25°. Drilling continued to section TD at ~ 594 mMDRT.

10 ¾" casing was run in to ~592 mMDRT and successfully cemented. The slurry was displaced, with slurry returns observed at surface, top plug bumped and the casing pressure tested to 2,000 psi as per program. The BOPs were installed and pressure tested.

A 9 ⅞" drill out BHA and PDC bit was used to drill out the float collar at ~568 mMDRT, followed by 31m of new formation to ~599 mMDRT. A Formation Integrity Test (FIT) was completed to 2,500 psi applied pressure (EMW ~ 33.5 lb/gal). The 9 ⅞" hole was then drilled to section TD at 1308 mMDRT. Following a wireline survey (misrun), the drilling BHA was pulled from the well. The 7 ⅝" intermediate casing was run in the hole to 1304 mMDRT and cemented. The slurry was displaced, with slurry ‘returns’ observed at surface and the top plug bumped as per program.

The 6 ¾" production hole PDC bit and drill out BHA (with motor) was RIH and the float collar tagged at ~ 1255 mMDRT. A pipe tally error resulted in the float collar been tagged ~14 metres higher than expected. The casing was then successfully pressure tested to 5,000 psi.

The shoe track was drilled out and ~9m of new formation drilled to 1317 mMDRT. An extended leak off test (XLOT) was pumped at this depth with 9.6 lb/gal mud with the formation breaking down at 1,340 psi. The bit drilled down to 1525 mMDRT and was then pulled to cut conventional core. Core was cut over the interval 1525.57 – 1563.1 mMDRT (37.53m) before stopping due to very low rate of penetration (ROP).

The core barrel was POOH and a new PDC bit (Ulterra) was made up with a fluid torsional hammer mechanism (Torkbuster). The bit drilled the interval from 1563.1 – 1900 mMDRT and tripped out due to low ROP in the Moroak Sandstone. The blowout preventer (BOP) was pressure tested after the bit was tripped. A second new Ulterra PDC bit (without the Torkbuster) was RIH drilling the interval 1900 – 2118.5 mMDRT before being pulled on low ROP. Last, PDC bit (Smith) was RIH successfully drilling to well TD at 3173 mMDRT. The mud weight throughout the 6 ¾" section was held at 9.6 lb/gal.

Beetaloo W-1 reached TD on 6 September 2016 at 04:00hrs. The well was displaced to a low salinity logging pill prior to running wireline logs.

Schlumberger wireline was rigged up to run the following logs:

1. NEXT-HRLT-HDRS-HGNS-EDTC (PEX – Lithoscanner)
2. CMR-HNGS-HDRS-HGNS-EDTC (CMR)
3. FMST-MAST-PPC-EDTC (FMI – SonicScanner)
4. MSCT (planned 50, attempt 48, and recover 41)

The 4 ½" production casing was run, washed to bottom and cemented successfully with slurry evident at surface during displacement. After wait on cement (WOC), the casing was successfully pressure tested to 5,000 psi. The BOPs were nippled down, removed and the tubing spool and master valve installed and tested as per program. The rig was released from Beetaloo W-1 on 14 September 2016 at 0600 hours.

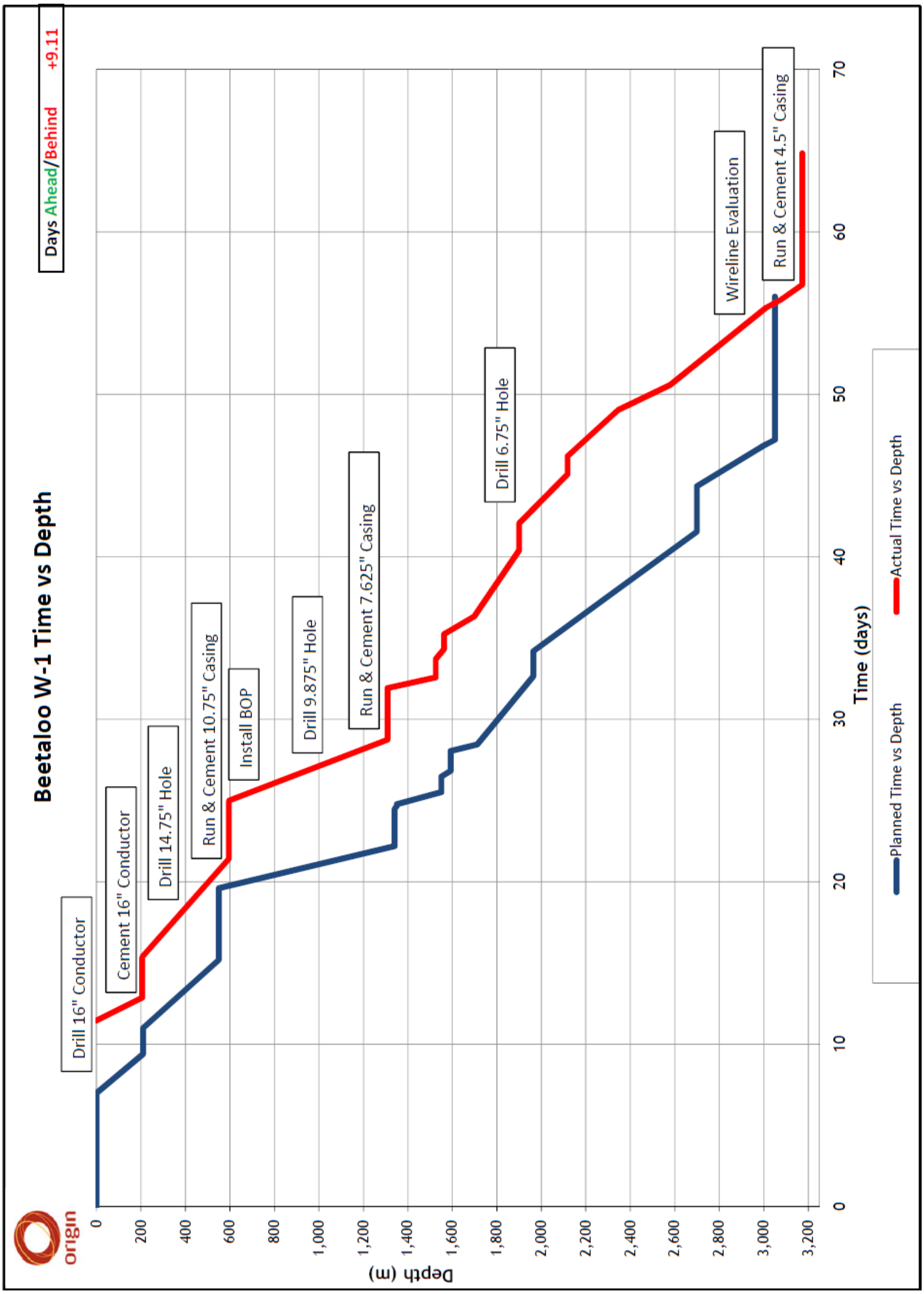

Figure 13 - Beetaloo W-1 Time vs Depth Chart

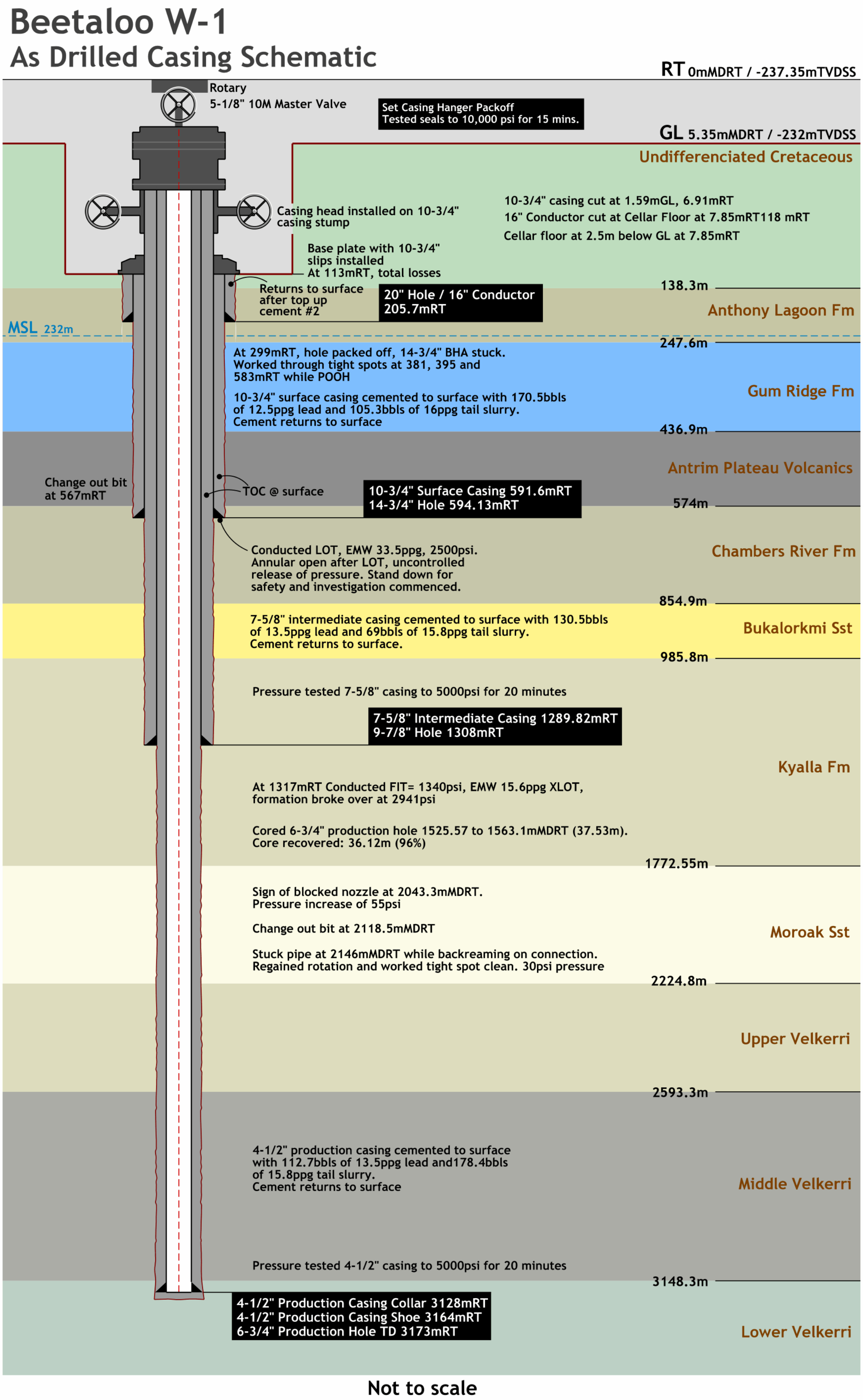

Figure 14 - Beetaloo W-1 As Drilled Well Schematic.

4.2 DRILLING RIG

The Saxon Energy Services Australia Rig 185 was used to drill Beetaloo W-1. This rig is a 1200 hp AC hydraulic drive rig with a 178,000 daN (400,000 lbf) pull capacity. The rig has two AC/VFD HongHua HHF-1000 triplex pumps powered by AmeriMex Dominator 1150 hp AC electric motors. An air package consisting of two screw compressors rated for 1400 CFM at 350 psi and a booster unit capable of 2800 CFM at 1600 psi. The mud system consists of three trailer mounted mud tank units rated for 767 bbl capacity complete with two Derrick FLC 504 shale shakers, a Derrick Vac-Flo 500 vacuum degasser and a Derrick DE-1000 FHD centrifuge. The BOP system comprises a 2M Drill Master Elite RFCD-2000, a 5M T3-Energy 11" Annular, a 5M T3-Energy Double Gate Ram (Blind & VBR), a 5M Drilling Spool with 3-1/8" Choke Line and 2-1/16" Kill Line, a 5M Cameron Choke Manifold, and a Control Technology 7 Station 14 Bottle Accumulator.

4.3 DRILLING MUD

Newpark Drilling Fluids was contracted to supply and maintain drilling fluids in Beetaloo W-1. A daily summary of drilling fluids operations and End of Well Report can be found as an appendix in the Beetaloo W-1 Basic Well Completion Report.

KCl Polymer Spud mud (8.7 ppg) and pre-hydrated Bentonite (Gel) mud (8.6 ppg) were made up to commence operations on Beetaloo W-1. The 14-3/4" surface section was air/mist rotary drilled with 8.5 ppg mist fluid down to 295 mMDRT where significant flow of formation fluid was encountered. At this point air drilling was ceased and conventional polymer mud drilling continued to section TD at 594.13 mMDRT.

NaCl Polymer mud was used for the remainder of the well. Drilling of the 9-7/8" intermediate hole commenced at 594.13 mMDRT with an 8.8 ppg, NaCl Polymer mud increasing slightly to 9.0 ppg while drilling to section TD at 1308 mMDRT. Mud was then weighted up to 9.5 ppg for the 6-3/4" section increasing slightly to 9.6 ppg in preparation to coring activities. Following coring retrieval, the well continue drilling with 9.6 ppg polymer mud down to well TD at 3173 mMDRT. The hole was then cleaned and displaced to a 9.6 ppg low salt Polymer mud in preparation for wireline operations.

4.4 WATER SUPPLY

Water for drilling operations at Beetaloo W-1 was sourced from a bore on the lease. The pre-drill field analysis of this water is shown in Table 1.

Density (sg)	1.04
Pf / Mf	0.02 / 0.52
Chlorides (mg/L)	300
Hardness (mg/L)	200
pH	8

Table 1 - Beetaloo W-1 lease water bore water properties

4.5 BIT AND DEVIATION RECORDS

4.5.1 BIT RECORDS

The bit records and drilling parameters are provided in Appendix 3.

4.5.2 DEVIATION SURVEY

A wireline deviation survey was run by Schlumberger during wireline logging Suite #1, Run #3 (FMST-MAST-PPC-EDTC) with measurements continuously acquired from well TD to surface. The wireline deviation survey is provided in Appendix 5.

4.6 TIME DISTRIBUTION

A daily summary of drilling operations can be found as an appendix in the Beetaloo W-1 Basic Well Completion Report. The drilling progress depth vs time is shown in Figure 13. The overall time breakdown for Beetaloo W-1 activities is summarized in Figure 15 and Table 2.

OPERATION	Total Time (Hrs)	Time (% of Total)
Drilling	644.75	51.20%
Tripping	167	13.30%
Wireline Logging	65	5.20%
Rig Up / Rig Down	62.75	5.00%
Running Casing	45.25	3.60%
Blowout Preventer Equipment	44	3.50%
Cementing	43.25	3.40%
Circulation	39	3.10%
Drilling with Casing	33.75	2.70%
Service Rig	28	2.20%
Conventional Coring Operations	15	1.20%
Safety	15.5	1.20%
Pick up / Lay Down	13.25	1.10%
Rig Repair	14	1.10%
Nipple Up / Nipple Down	12	1.00%
Slip and Cut	4.25	0.30%
Wait on Cement	4	0.30%
Leak Off Testing	2	0.20%
Observe Well Fluid Flow	2	0.20%
Pressure Testing	3	0.20%
Deviation Survey	1.75	0.10%
Reaming	0.5	0.00%
	1260	100.0%

Table 2 - Beetaloo W-1 drilling operations time distribution

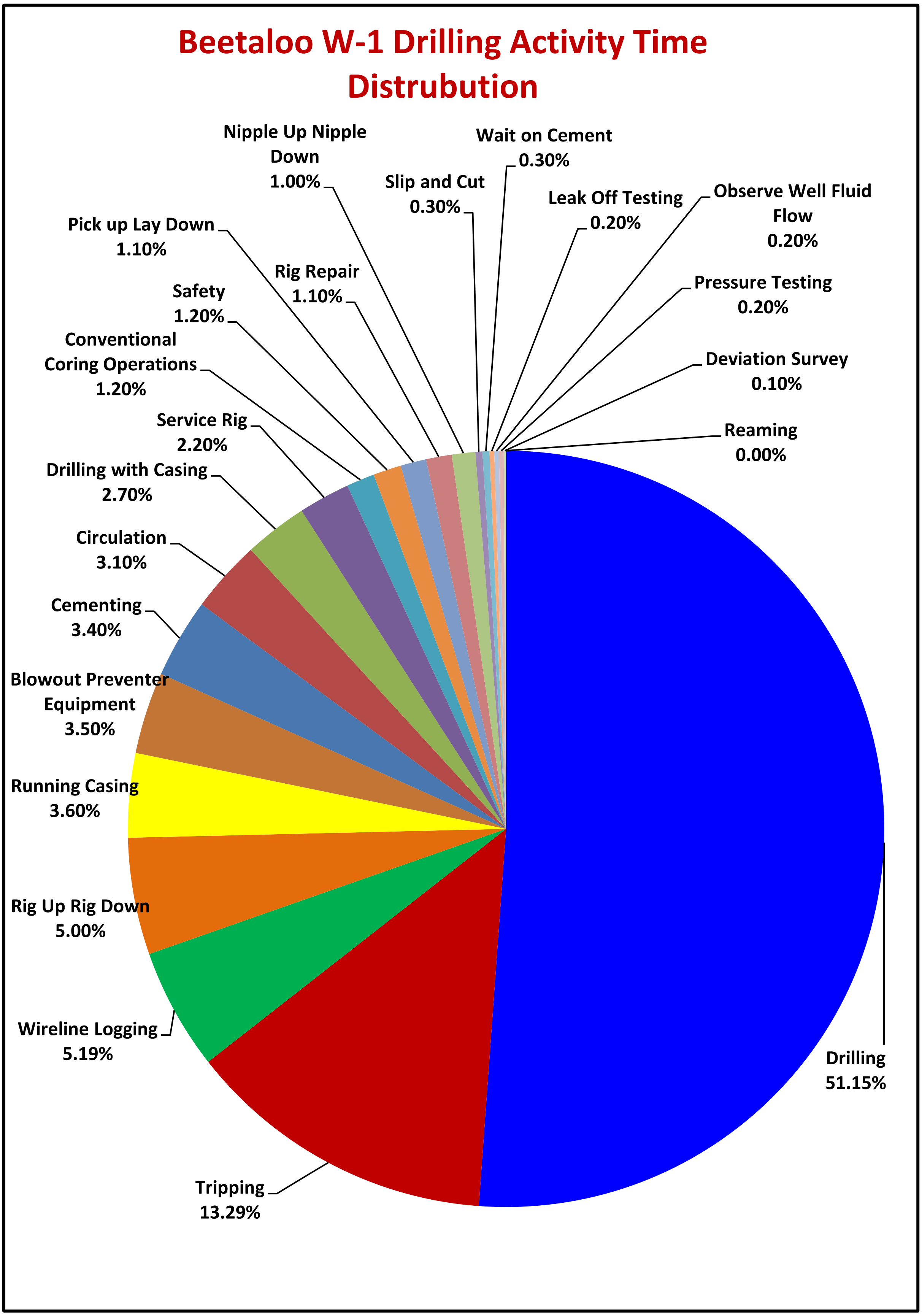

Figure 15 - Beetaloo W-1 drilling operations time distribution

5 GEOLOGICAL DATA

5.1 GEOLOGICAL SUMMARY

Beetaloo W-1 was spudded in weathered, undifferentiated Cretaceous sediments consisting of oxidised yellow (goethite) and red (haematite) stained interbedded mudstone, siltstone and sandstone. From 50-60m the Cretaceous basal sandstone was penetrated, which is commonly present at the base of the Cretaceous sequence throughout the Beetaloo Sub-Basin, and is sporadically used as an aquifer. It consists of clear to light pink, loose, moderately sorted and rounded sandstone. Circulation was lost at 113mMDRT within the interpreted Cretaceous section while drilling sandstone. A drilling break from 23-34.5m/hr preceded the lost circulation event which may indicate permeability streak through which drilling fluid was lost. Circulation was not recovered until the setting of the 16" conductor casing at 205.7mMDRT within a mudstone interval in the lower Anthony Lagoon Formation. In the absence of recovered drilling cuttings to surface, the top of the Anthony Lagoon Formation was picked based on a sharp decline in the rate of penetration, which was interpreted as a transition from poorly cemented, 'soft' sandstone to 'hard' limestone/ dolomite/ chert streaks of the Anthony Lagoon Formation. Following renewal of drilling in the 14 ¾" hole, interfingering limestone/dolomites and red-brown mudstones and siltstones of Anthony Lagoon Formation were penetrated, with increasing limestone beds occurring down towards the conformable transition to the Gum Ridge Formation Limestone. The top Gum Ridge Formation was picked primarily on the wireline gamma through casing which has a very good correlation to the offset well Elliott-1. Massive limestone of the Gum Ridge Formation was drilled down to the top of the thoeilitic flood basalts of the Antrim Plateau Volcanics at 436.9mMDRT from the diagnostic sharp but small increase in gamma through casing. First identification of basalt within the drill cuttings was at 430-440mMDRT. Small isolated inter-beds of brown to dark grey, clay rich to calcareous rich mudstone and siltstone, were identified throughout the Gum Ridge Formation in both drilling cuttings and small but sharp increases in the wireline gamma through casing. These interbeds have commonly been used in regional correlation exercises within the Gum Ridge Formation due to their regional consistency.

Massive flood basalts of the Antrim Plateau Volcanics were drilled down to 574mMDRT where the Proterozoic Chambers River Formation was intersected. Consistent low rates of penetration throughout the Antrim Plateau Volcanics, suggests that no notable, vesicular flow tops of individual flood basalt flows were identified at Beetaloo W-1. From 574mMDRT to 701mMDRT finely bedded red-brown to medium grey mudstone and siltstone was encountered. A thin interval from 608.5 – 613.3mMDRT contained thinly interbedded limestone and siltstone/mudstone. This is a regionally correlative interval within the Chambers River Formation and may represent a basin wide sequence boundary or depositional event.

At 701mMDRT interbeds of very fine to fine sandstone become increasingly common which is interpreted to be thinly interbedded with dark grey siltstones and mudstones. During drilling of this interval, a small amount of wet mudgas was observed at the surface which is interpreted to be reservoired within the tight sandstone interbeds. Sandstone volume within the bulk drill cuttings diminished by 733mMDRT correlating with a sharp drop in the wet mudgas gas response. From 733-

755mMDRT a thin interval of mudstone was penetrated and at 755mMDRT sandstone interbeds were encountered where a very small increase in wet content was observed in mudgas. Sandstone content in the drill cuttings decreased by 780mMDRT and the wet content on mudgas sharply decreased at 786mMDRT. From 780m to the top of the Bukalorkmi Sandstone at 854.9mMDRT consisted of predominantly mudstone with minor very fine to fine grained sandstone interbeds which became increasingly common towards the conformable contact with the underlying Bukalorkmi Sandstone. This conformable contact was very sharp, as is the case throughout the Beetaloo Sub-Basin. The Bukalorkmi Sandstone was drilled from 854.9mMDRT to 985.8mMDRT with only minor to trace dry mudgas being measured at surface, indicating the sandstone is predominantly water saturated. Drill cuttings and wireline gamma through casing indicated thickly bedded sandstone over the entire interval with thin interbeds of siltstone and mudstone. Correlation between the wireline gamma curves of Beetaloo W-1 and the offset well Elliott-1 (located 29.7km to the south of Beetaloo W-1) show remarkable similarities, including overall thickness. Individual sandstone beds and mudstones along with sandstone packages within the Bukalorkmi Sandstone are readily correlated between the Beetaloo W-1 and Elliott-1 indicating that depositional processes were more regionally pervasive in the Southern Beetaloo Sub-Basin. Less correlation is apparent with Jamison-1 located 38.3km to the north of Beetaloo W-1, although general trends in depositional sandstone packages are still very evident.

The Kyalla Formation was encountered at 985.9mMDRT with a sharp change in drill cutting lithology from the very fine to medium grained sandstone of the base Bukalorkmi Sandstone to the medium light grey to medium grey mudstone with variable very fine to fine sandstone interbeds of the upper Kyalla Formation. This sharp change represents a significant, regionally extensive erosional unconformity. A trace to minor wet gas show was observed in mudgas over the interval 1024-1116mMDRT. Trace to minor dull yellow fluorescence shows were also observed in drill cuttings. This interval is interpreted to be a self-sourcing interval composed of finely interbedded organically enriched mudstone/siltstone with vertically variable very tight, very fine to fine, sandstone interbeds. A correlative interval is present at offset wells, Shenandoah-1A, Balmain-1, Jamsion-1, Shortland-1 and Mason-1 within the central portion of the Balmain Deep. Between 1116 and 1435 mMDRT predominantly finely interbedded mudstone and siltstone with vertically variable very fine to fine, thinly bedded sandstones was penetrated. Small amounts of wet mudgas were detected while drilling this interval with a slight increase in gas towards the base of the drilled interval; this correlates with a darkening of the mudstone and siltstone cuttings possibly due to increased organic matter content. An increase in the sand content from 1435 mMDRT indicated the short downward gradational change from predominantly mudstone and siltstone to fine to coarse, poorly sorted, strongly siliceous cemented sandstone interbedded with minor mudstone and siltstone at 1451.3 mMDRT. Clean sandstones persisted until 1462 mMDRT with a downward increase in mudstone content from 1462 – 1470 mMDRT. Small wet mudgas peaks over the clean sandstone beds indicated very tight reservoir potential which was confirmed by petrophysical analysis.

From 1470 to 1533 mMDRT, medium to dark grey, organically enriched mudstone was penetrated, along with moderate to strong wet mudgas content. Petrophysical interpretation confirmed the presence of a SRR over this interval with future appraisal potential. Conventional coring began at 1525.57 mMDRT in response to strong wet mudgas shows (Cored interval 1525.57-1563.1 mMDRT).

A 2.3 m thick, clean, fine to medium grained, planar to trough cross-bedded sandstone was penetrated from 1533-1535.3 mMDRT. No notable change in mudgas response along with very low wireline deep resistivity and petrophysical analysis collectively indicate this zone is water saturated. UV photography of the slabbed conventional core over the sandstone interval however shows layer and cross-bed localised, blue to cyan fluorescence indicating hydrocarbon migration has occurred at a period in the past. At this time due to limited core analysis (two core plugs) and the vertical resolution of the logs it is not completely clear if the UV fluorescence corresponds with enhanced permeability but from the limited data it does look possible.

From 1535.3 to 1550.4 mMDRT predominantly mudstone strata was drilled with minor and sparse, thin, interbeds of fine to very fine sandstone. 1550.4 mMDRT marked the transition into interbedded siderite rich sandstone and organically enriched mudstone. Both petrophysics and mudgas response indicate little to no SRR potential from 1554.8 to 1560.3 mMDRT within the organically enriched mudstone beds. Although data limited within the sandstone beds over this interval, a comparison of the core grain density and porosity measurements and the petrophysically derived corresponding values indicate that there is a significant disconnect between the core analysis data and the petrophysical model. If this potential tight gas sand interval is considered an important interval for future exploration, more work, including the analysis of further core samples is needed to determine the validity of the petrophysical model.

At 1560.3 mMDRT the sandstone content increases and petrophysical modelling suggest favourable tight gas reservoir potential. Core samples are not available over this interval and therefore reconciling the petrophysical analysis, particularly saturation is not possible as information such as pore water salinity, cementation, pore structure and laminations are unknown which will all effect the resistivity response from which the petrophysical saturation is derived. ROP normalised mudgas concentrations while drilling this sandstone package support gas reservoir potential. If this sand package with interbedded siltstone and mudstone is of future exploration interest, future wells should aim to core and complete detailed saturation analysis to validate any tight gas sand accumulation of economic interest.

At 1584.3 mMDRT a sharp transition to laminated mudstone with minor sandstone occurred. Petrophysically derived TOC averaged between 0.5 and 1% by weight, with moderate mudgas concertation indicating that the interval has very low SRR potential, confirmed by petrophysical interpretation, and therefore of no economic interest at Beetaloo W-1. Sandstone content in drill cuttings disappeared by 1672 mMDRT which coincided with the beginning of a SRR interval of significant economic interest at 1673 mMDRT.

Organically enriched, micaceous mudstone was penetrated from 1673 to 1715.8 mMDRT. Total organic carbon ranged between 1-4% weight with an average of approximately 1.5% weight. Significant wet gas shows were recorded over the SRR interval, with later laboratory gas chromatographic analyses indicating the reservoired wet gas could yield significant Liquid Petroleum Gas (LPG) and condensate fractions. Sand was absent over this interval in drill cuttings, with the first reappearance of very fine to fine sand in the cuttings sample 1719-1722 mMDRT. Petrophysical logs over the SRR interval confirmed its excellent potential for future appraisal.

Sand content increased down to 1770-1773 where 100% sandstone was recorded in parallel with decreasing gas, with the top of the Moroak Sandstone picked from wireline log correlations with offset wells at 1772.55 mMDRT. Increasing sandstone bed frequency indicate the interfingering transition down into the clean, quartz, medium to course grained and heavily silica cemented, mature, shoreface, upper Moroak Sandstone.

Massive sandstone beds with minor and rare mudstone interbeds were penetrated until 1878 mMDRT where a subtle change in the sedimentology was observed from wireline logs. This break is interpreted as the boundary in which thick shoreface sands above transition to thinner sandstone beds with an increased frequency and overall thickness of mudstone interbeds. This is interpreted to indicate a gentle and gradational downward transition to a more distal shelfal depositional environment where background energy was decreased but punctuated by periods of increased water energy from increased storm activity or avulsion of delta frontal lobes. From 2081 mMDRT mudstone replaces sandstone as the most common lithology. At 2224.8 mMDRT the top of the Velkerri Formation is interpreted at the base of the last significant sandstone marking the transition from a dominantly shelfal or delta front to a deeper marine depositional environment beyond significant clastic input. The exact boundary between the Moroak Sandstone and Velkerri Formation is ambiguous as the Moroak to Velkerri transition across much of the Beetaloo is gradational.

Of interest within the Moroak Sandstone is the transition at 1968-1971 mMDRT between dominantly red oxidised iron-rich mudstones of the upper Moroak, and the medium to dark grey mudstones of the lower Moroak. This abrupt transition can be clearly observed in high resolution digital images (HDRM) (Appendix 2). The exact cause of this boundary is not fully resolved but working hypotheses include; water depth related redox potential from shoreface upper Moroak to deeper shelfal middle to lower Moroak, or the penetration depth of oxygen rich paleo-meteoric waters from onshore to offshore through the permeable shoreface sands. More work is required to understand this. Also of interest was a minor dry mud gas show detected within the lower Moroak sands. Wireline logging indicated, however, that the sands have poor commercial reservoir potential, which was confirmed from thin sections where porosity is limited to secondary porosity from the dissolution of siderite and/or chlorite.

Predominately interbedded mudstone and siltstone was drilled from 2224.8 – 2360 mMDRT with minor, localised sandstone intervals associated with minor dry mud gas, indicating some reservoir potential, albeit very thin and not of economic interest. Below 2364 mMDRT only minor to trace amounts of sandstone were detected in drill cuttings, with the formation consisting of interbedded mudstone and siltstone. The downward disappearance of sandstone is currently interpreted as a decrease in depositional energy to a more distal offshore depositional environment. Mudgas remained low throughout this interval.

Wireline logs indicate that minor sandstone interbeds re-appear at 2500 mMDRT, but increased sandstone content was only identified in drill cutting samples at 2541 mMDRT, just above a thicker and cleaner sandstone interval. Interfingering sandstone and mudstone/siltstone persists until 2577.35 mMDRT, below which wireline logs indicate an absence of log resolution sandstone beds. Sandstone beds within this interval are poorly understood in both a local and reginal context. Log character as well as current stratigraphic and depositional environment models could indicate these sands are deep basinal fan sands or turbidites. Reconciling the depositional nature of the sandstones is difficult as there is currently no conventional core over the sands where they are present within the Beetaloo Sub-Basin to observe and log subtle bedform characteristics that may give insights to their deposition. Image logs over the sands at Beetaloo W-1 show the top and base of the sand beds are extremely sharp with no discernible internal structure, in which we interpret to support discrete depositional events in deep marine fans or turbidites. While drilling the sand beds good dry mudgas shows were detected, along with very small increases in rate of penetration. Two rotary side wall cores collected over the best sandstone intervals measured total porosity 6.3 and 8.4%, with permeability of 0.01 and 0.018mD under ambient conditions in a clean dry state. Preliminary results from the limited core analysis and petrophysics indicates that there is reservoir potential within these sands of possible economic interest.

The middle Velkerri and top of the C Shale was penetrated at 2592.7 mMDRT, picked from wireline logs in line with the current regional top middle Velkerri interpretation.

Organically enriched, very dark grey to black mudstone with minor siltstone was penetrated down to the base of the interpreted C Shale at 2628.6 mMDRT. Good dry mudgas shows along with positive petrophysics (Appendix 6) results confirm that portions of this interval are prospective as a SRR. The C Shale at Beetaloo W-1 was 33.96m thinner than observed in the central Beetaloo (Shenandoah-1A).

From 2628.6 to 2999.95 mMDRT organically lean mudstone with minor siltstone and sandstone was penetrated. Trace to very low dry mudgas was detected over this interval, reflective of the low organic content of the mudstones/siltstones and no SRR potential. The C to B shale inter-burden (371.05m) was 227.79m thicker than any previous penetration within the Beetaloo (previous thickest Tanumbirini-1 143.26m). Regional 2D seismic data (Figure 4) confirms this interval thickens to the south. Pre-drill seismic interpretation was not able to distinguish which units within the middle Velkerri thickened north to south and one of the major discoveries of Beetaloo W-1 was the dramatic thickening of the C-B inter-burden but little thickness variation in the primary target, the B Shale.

Following penetration of the B shale a sharp increase in the dry mudgas and a darkening of the drilling cuttings indicated penetration of the organically enriched B Shale mudstones. Very dark grey to black organically enriched mudstones were penetrated down to the interpreted base of the B Shale at 3067 mMDRT. Subsequent petrophysical analysis over this interval showed significant SRR potential of economic quality (Appendix 6). Intervals within the B Shale represent the best SRR appraisal targets within the middle Velkerri like Amungee NW-1 and Tanumbirini-1. Beetaloo W-1 demonstrated that the B Shale thickness and SRR quality is remarkably consistent over large distances (>100km) across the Beetaloo.

Very dark grey to black mudstone continued to be penetrated from 3067 mMDRT to the top of the A Shale at 3132.8 mMDRT. Petrophysical analysis shows that this interval has moderate to minor SRR potential and may be of economic interest and is generally TOC poor relative to the B Shale.

At 3132.8 mMDRT the A Shale was penetrated, marked by a sharp increase in mud gas. The change however was not immediately apparent based on drill cuttings alone, being a similar, organically enriched, very dark grey to black mudstone as the above strata (Figure 36, Figure 37). The organically enriched mudstones of the A Shale persist until 3148.3 mMDRT where the lower Velkerri was penetrated with a sharp decrease in mud gas and a distinctive lightening of the mudstone drill cuttings due to a marked decrease in total organic content (Figure 37, Figure 38). Although petrophysical analysis indicates the A Shale from 3132.8 to 3148.3 mMDRT has moderate SRR potential.

Beetaloo W-1 reached total depth within the lower Velkerri at a drillers depth of 3173 mMDRT following confirmation of complete penetration of the primary exploration target, the middle Velkerri, and providing enough ‘rat hole’ for the wireline logging suite to log the A shale.

5.2 WELL STRATIGRAPHY

The prognosed and actual intersected stratigraphy in Beetaloo W-1 is shown in Table 3.

<table>
<tr><th colspan="4" rowspan="2">FORMATION</th><th colspan="2">PROGNOSED</th><th colspan="2">ACTUAL</th><th rowspan="2">DIFFERENCE (MTVD) (+ DEEP / - SHALLOW)</th><th rowspan="2">COMMENTS</th></tr>
<tr><th>mMDRT</th><th>mTVDSS</th><th>mMDRT</th><th>mTVDSS</th></tr>
<tr><td colspan="4">Undifferentiated Cretaceous</td><td>5.35</td><td>232</td><td>5.35</td><td>232</td><td>0</td><td>No returns from 113 to 205.72 mMDRT</td></tr>
<tr><td colspan="4">Anthony Lagoon Formation</td><td>85</td><td>152.35</td><td>138.3</td><td>99.05</td><td>53.3</td><td>No returns from 113 to 205.72 mMDRT</td></tr>
<tr><td colspan="4">Gum Ridge Formation</td><td>238</td><td>-0.65</td><td>247.6</td><td>-10.25</td><td>9.6</td><td></td></tr>
<tr><td colspan="4">Antrim Plateau Volcanics</td><td>447</td><td>-209.65</td><td>436.9</td><td>-199.52</td><td>-10.13</td><td></td></tr>
<tr><td colspan="4">Bukalara Sandstone</td><td>495</td><td>-257.65</td><td colspan="4">Not present</td></tr>
<tr><td colspan="4">Chambers River Formation</td><td>520</td><td>-282.65</td><td>574</td><td>-336.59</td><td>53.94</td><td></td></tr>
<tr><td colspan="4">Bukalorkmi Sandstone</td><td>790</td><td>-552.65</td><td>854.9</td><td>-617.47</td><td>64.82</td><td></td></tr>
<tr><td colspan="4">Kyalla Formation</td><td>900</td><td>-662.65</td><td>985.8</td><td>-748.36</td><td>85.71</td><td></td></tr>
<tr><td colspan="4">Moroak Sandstone</td><td>1700</td><td>-1462.65</td><td>1772.55</td><td>-1534.99</td><td>72.34</td><td></td></tr>
<tr><td rowspan="8">Velkerri Formation</td><td colspan="3">upper Velkerri member</td><td>2285</td><td>-2047.65</td><td>2224.8</td><td>-1987.13</td><td>-60.52</td><td></td></tr>
<tr><td rowspan="6">middle Velkerri member</td><td rowspan="2">C Shale</td><td>Top</td><td>2620</td><td>-2382.65</td><td>2592.7</td><td>-2354.97</td><td>-27.68</td><td rowspan="2">Wireline Interpretation</td></tr>
<tr><td>Base</td><td>---</td><td>---</td><td>2628.6</td><td>-2390.86</td><td>---</td></tr>
<tr><td rowspan="2">B Shale</td><td>Top</td><td>---</td><td>---</td><td>2999.95</td><td>-2761.62</td><td>---</td><td rowspan="2">Wireline Interpretation</td></tr>
<tr><td>Base</td><td>---</td><td>---</td><td>3067</td><td>-2828.59</td><td>---</td></tr>
<tr><td rowspan="2">A Shale</td><td>Top</td><td>---</td><td>---</td><td>3132.8</td><td>-2894.37</td><td>---</td><td rowspan="2">Wireline Interpretation</td></tr>
<tr><td>Base</td><td>---</td><td>---</td><td>3148.3</td><td>-2909.87</td><td>---</td></tr>
<tr><td colspan="3">lower Velkerri member</td><td>2995</td><td>-2757.65</td><td>3148.3</td><td>-2909.87</td><td>152.22</td><td></td></tr>
<tr><td colspan="4">Loggers TD</td><td></td><td></td><td>3165</td><td>-2926.57</td><td>---</td><td></td></tr>
<tr><td colspan="4">Drillers TD</td><td>3045</td><td>-2807.65</td><td>3173</td><td>-2934.56</td><td>126.91</td><td></td></tr>
</table>

Table 3 - Prognosed and Actual intersected well stratigraphy in Beetaloo W-1

5.2.1 WELLSITE LITHOLOGY DESCRIPTION SUMMARY

Below is a generalised summary of the drill cutting lithology as described by the wellsite geologists. For a complete set of sample by sample detailed drill cutting lithology descriptions see Appendix 2.

Undifferentiated Cretaceous - 5.35 to 138.3 mMDRT (132.95 metres penetrated)

17-30mMDRT: Claystone with variable siltstone and sandstone

Claystone (70-100%) - medium yellow, orange to orange yellow, minor off white, kaolinitic, trace lithics, silty in part, hard, blocky to sub blocky. **Siltstone (0-20%)** - red to red brown, orange, arenaceous to argillaceous, common lithics, firm to moderately hard, occasionally very hard. **Sandstone (0-10%)** - light yellow orange, clear to translucent, iron staining, fine to medium, moderately sorted, sub angular to sub rounded, nil cement, trace light yellow orange argillaceous matrix, minor lithics, occasionally friable to mod hard aggregates, poor visual porosity, no fluorescence.

30-113mMDRT: Sandstone with variable claystone

Sandstone (70-100%) - clear to translucent, light yellow orange, moderately red orange, light yellow grey, very fine to coarse, trace very coarse grains, moderately sorted, sub rounded to round, trace weak siliceous cement, common light yellow orange silty matrix, minor friable to minor moderately hard aggregates, generally loose grains, poor visual porosity, good inferred porosity, no fluorescence. **Claystone (0-20%)** - light to medium red, light yellow orange, minor off white, light to medium purple in part, silty in part, minor locally siliceous, minor lithics, firm to occasionally dispersive, sub blocky to occasionally amorphous.

113-138.3mMDRT: Total Lost Circulation

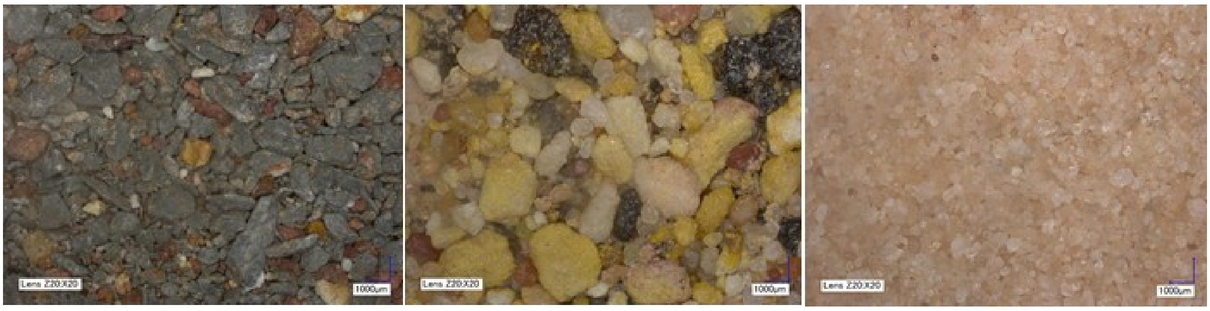

Figure 16 - Undifferentiated Cretaceous sediments from Beetaloo W-1 at depths of 17-20 mMDRT (left), 40-50 mMDRT (centre), and 70-80 mMDRT (right)

Anthony Lagoon Formation – 138.3 to 247.6 mMDRT (109.3 metres penetrated)

138.3-205.7mMDRT: Total Lost Circulation

205.7-230mMDRT: Siltstone with variable Limestone and Sandstone

Siltstone (60-90%) - Medium red brown, occasionally light brown, arenaceous, trace micro micaceous, minor to rare lithics, moderately hard to hard, blocky to sub blocky. **Limestone (0-30%)** - Off white, very light yellow, very light grey, light brown grey, micritic to lutitic, argillaceous, microcrystalline to occasionally crystalline, hard to very hard. **Sandstone (10%)** - light brown, rare off white, fine to occasionally very fine, well sorted, sub angular to minor sub rounded, moderately calcareous cement, occasionally to rare off white argillaceous matrix, minor dark lithics, moderately hard to hard, very poor visual porosity, no fluorescence.

230-247.6mMDRT: Limestone and Siltstone with minor Sandstone

Limestone (40-90%) - Off white, very light yellow, very light grey, light brown grey, micritic to lutitic, argillaceous, microcrystalline to minor crystalline, hard to very hard. **Siltstone (10-50%)** - Medium red brown, rare light brown, arenaceous, trace micro mica, rare lithics, moderately hard to hard, blocky to sub blocky. **Sandstone (0-10%)** - Light grey, rare off white, fine to very fine, well sorted, sub angular to sub rounded, moderately calcareous cement, occasional to rare off white argillaceous matrix, moderately hard to hard, very poor visual porosity, no fluorescence.

Figure 17 - Anthony Lagoon Formation from Beetaloo W-1 at depths of 200-210 mMDRT (left), 210-220 mMDRT (centre), and 220-230 mMDRT (right)

Gum Ridge Formation – 247.6 to 436.9 mMDRT (189.3 metres penetrated)

247.6-436.9mMDRT: Limestone with minor Siltstone

Limestone (70-100%) - Dominantly light yellow brown, tan in part, occasionally translucent yellow brown, minor off white, micritic to sparitic, argillaceous to occasionally arenaceous, rare dark inclusions, minor calcite grains, microcrystalline to occasionally crystalline, hard to very hard, dull yellow mineral fluorescence. **Siltstone (0-30%) -** Medium red brown, medium to light orange red, light to medium grey, very light grey to occasionally off white, dolomitic, argillaceous in part, trace lithics, hard, blocky to sub blocky.

Figure 18 - Gum Ridge Formation from Beetaloo W-1 at depths of 270-280 mMDRT (left), 300-310 mMDRT (centre), and 410-420 mMDRT (right)

Antrim Plateau Volcanics – 436.9 to 574 mMDRT (137.1 metres penetrated)

436.9-460mMDRT: Basalt with Variable Limestone (cavings?)

Basalt (50-90%) - Dark to very dark brown grey, dark grey black, minor dark to very dark brown red, very fine to occasionally fine, occasional to common black phenocrysts, minor feldspar phenocrysts, hard to very hard, blocky to minor sub blocky, massive. **Limestone (10-50%)** - light yellow brown, occasionally translucent yellow brown, rare off white, micritic to dominantly sparitic, argillaceous to commonly arenaceous, locally common dark inclusions, crystalline to cryptocrystalline, hard to very hard, minor dull yellow mineral fluorescence.

460-574mMDRT: Basalt

Basalt (100%) - dark to very dark brown grey, dark grey black, minor dark brown red, medium green in part, medium, fine to coarse in part, locally common feldspar phenocrysts, minor dark phenocrysts, rare green inclusions, hard to dominantly very hard, blocky to minor sub blocky, massive.

Figure 19 - Antrim Plateau Volcanics from Beetaloo W-1 at depths of 480-490 mMDRT (left), 520-530 mMDRT (centre), and 540-550 mMDRT (right)

__Chambers River Formation – 574 to 854.9 mMDRT (280.9 metres penetrated)__

574-592mMDRT: Siltstone with deceasing Basalt (cavings?)

Siltstone (60-80%) - Dark red purple, occasionally light yellow, minor light grey, argillaceous, dominantly siliceous, locally micro micaceous, minor dark lithics, hard to very hard, blocky to sub blocky. **Basalt (20-40%) -** Dark grey, dark grey green, dark grey brown, very fine, minor fine to medium, occasional rock flour, hard to dominantly very hard, blocky to minor sub blocky, massive.

592-594mMDRT (14.75" Hole Section TD @ 594mMDRT): Siltstone and Claystone

Siltstone (40-70%) - Dark to occasionally medium red brown, dark red purple in part, minor light yellow orange, argillaceous, locally grading to Claystone in part, micro micaceous, hard, sub fissile to sub blocky, occasionally blocky. **Claystone (30-60%)** - Medium to occasionally light red brown, silty, grading to Siltstone in part, hard, sub blocky to blocky, minor sub fissile.

594-610mMDRT: Claystone and Limestone (cement from casing shoe?)

Claystone (40-60%) - Medium to dark reddish brown, slightly silty, trace micro mica, moderately hard to predominantly hard, sub fissile to sub blocky. **Limestone (cement from casing shoe?) (40-60%)** - White, translucent, very light grey, occasionally red brown stain, fine to medium grained, moderately sorted, angular, strong calcareous cement, trace very fine quartz grains, moderately hard to hard, tight visual porosity, no fluorescence. Dissolves vigorously in 10% HCl.

610-670mMDRT: Claystone with minor Siltstone and Sandstone

Claystone (80-100%) - Medium grey, greenish grey to dark greenish grey, minor reddish brown, trace micro mica, moderately hard, sub blocky to sub fissile. **Siltstone (0-20%)** - Medium to dark reddish brown, argillaceous grading to silty claystone, trace micro mica, moderately hard to hard, sub blocky to sub fissile. **Sandstone (0-10%)** - Clear – translucent, very fine to fine, moderately sorted, sub angular to sub rounded, weak calcareous cement, minor silty matrix, trace nodular pyrite, hard, poor visual porosity, no fluorescent.

670-700mMDRT: Interbedded Siltstone and Claystone with minor Sandstone beds

Claystone (20-90%) - Greenish grey to light greenish grey, trace micro mica, moderately hard, sub fissile to sub blocky. **Siltstone (0-80%)** - Medium to dark reddish brown, argillaceous, micro mica, moderately hard to hard, sub fissile to sub blocky. **Sandstone (0-40%)** - clear to translucent, light grey, very fine to fine, well sorted, sub angular to sub rounded, weak calcareous cement, moderately strong siliceous cement, argillaceous matrix, moderately hard, very poor visual porosity, no fluorescent.

700-785mMDRT: Interbedded Sandstone and Claystone with variable Siltstone beds

Sandstone (10-60%) - Clear, translucent, light grey, white, very fine to fine, well sorted, sub angular to sub rounded, moderately strong siliceous cement, local calcareous cement, minor light grey argillaceous matrix, tight visual porosity, no fluorescence. **Claystone (10-80%) -** Medium grey, medium greenish grey, silty, in parts grading to argillaceous siltstone trace micro mica, moderately hard, sub blocky to sub fissile. **Siltstone (0-80%)** - predominantly medium to dark grey brown, common arenaceous grading to very fine sandstone, moderately hard to hard, blocky to sub blocky, sub fissile in part.

785-810mMDRT: Claystone

Claystone (100%) - Medium to dark grey, greenish grey, minor brownish grey, rare light grey, arenaceous grading to very fine SILTSTONE in part, trace micro-mica, moderately hard to hard, blocky to sub fissile.

810-854.9mMDRT: Claystone with Sandstone and Siltstone Interbeds

Claystone (20-80%) - Light to medium grey, light to medium greenish grey, silty in part occasionally grading to siltstone, trace micro mica, moderately hard to hard, blocky to sub fissile. **Sandstone (10-80%) -** White, translucent, clear, very light grey, very fine to predominantly fine grained, weak sorted, sub angular to sub round, moderately strong siliceous cement, trace calcareous cement, minor white argillaceous matrix, moderately hard to hard, very poor visual porosity, no fluorescence. **Siltstone (0-20%) -** Light to medium grey, slightly arenaceous, trace micro mica, moderately hard to hard, blocky to sub fissile.

Figure 20 - Chambers River Formation from Beetaloo W-1 at depths of 620-630 mMDRT (left), 720-725 mMDRT (centre) and 800-805 mMDRT (right).

<u>**Bukalorkmi Sandstone – 854.9 to 985.8 mMDRT (130.9 metres penetrated)**</u>

854.9-875mMDRT: Sandstone with minor siltstone and claystone interbeds

Sandstone (80-90%) - White, very light grey, translucent, clear, very fine to medium grained, trace coarse, poor sorting, sub angular to sub round, moderately strong siliceous cement, common white argillaceous matrix, moderately hard, very poor visual porosity, no fluorescence. **Siltstone (0-10%) -** Light to medium grey, very finely arenaceous grading to very fine sandstone, trace micro mica, moderately hard, blocky to sub blocky. **Claystone (0-10%)** - light to medium grey, slightly silty in part, rare micro mica, moderately hard, sub blocky to sub fissile.

875-915mMDRT: Sandstone

Sandstone (100%) - Translucent, clear, white, fine to coarse grained, predominantly medium, sub angular to predominantly sub round, fair to moderately sorted, minor siliceous cement, trace white argillaceous matrix, friable to moderately hard aggregates, poor to fair visual porosity, no fluorescence.

915-935mMDRT: Sandstone with minor siltstone beds

Sandstone (80-90%) - Translucent, clear, white, fine to coarse grained, sub angular to predominantly sub round, poorly sorted, minor siliceous cement, trace white argillaceous matrix, friable to moderately hard aggregates, poor to fair visual porosity, no fluorescence. **Siltstone (10-20%)** - Light to medium grey, medium greenish grey, rare micro mica, trace lithics, moderately hard to hard, fissile to sub fissile.

935-985.8mMDRT: Sandstone

Sandstone (100%) - Translucent, clear, white, fine to medium grained, trace coarse, moderately sorted, sub angular to sub round, minor siliceous cement, rare white argillaceous matrix, friable to moderately hard aggregates, predominantly disaggregated quartz grains, poor to fair inferred porosity, no fluorescence.

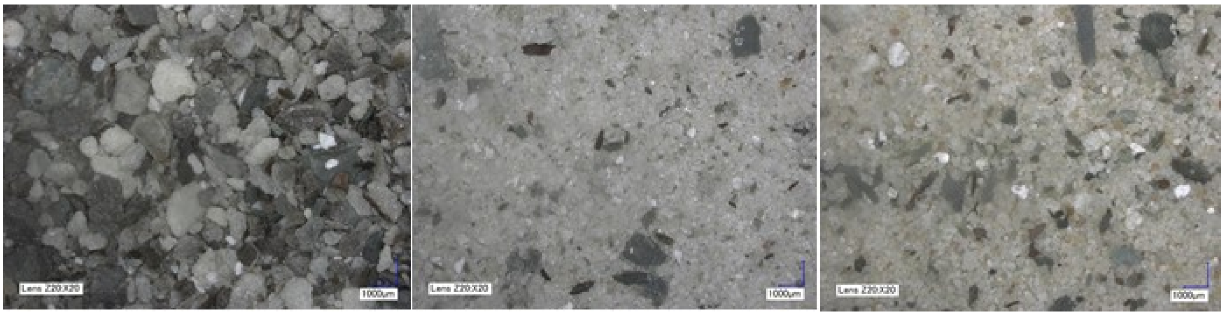

Figure 21 - Bukalorkmi Sandstone from Beetaloo W-1 at depths of 870-875 mMDRT (left), 900-905 mMDRT (centre), and 960-965 mMDRT (right)

<u>**Kyalla Formation – 985.8 to 1772.55 mMDRT (786.75 metres penetrated)**</u>

985.8-1145mMDRT: Claystone with variable Sandstone Interbeds

Claystone (30-100%) - Medium grey, medium dark grey, medium brownish grey, very finely arenaceous, trace micro mica, moderately hard, sub blocky to sub fissile. **Sandstone (0-70%)** - White, very light grey, rare translucent, very fine to fine grained, sub angular to sub round, moderately well sorted, moderately strong siliceous cement, common white argillaceous matrix, moderately hard aggregates, very poor visual porosity. **Fluorescence: 1028mMDRT (Spot sample) - 5% very dull yellow spotted, no direct cut, very faint white thin ring residue. 1045-1050mMDRT - Trace dull yellow spotted, no cut or crush cut, trace faint white residue. 1055-1065mMDRT - Trace very dull yellow spotted, no cut, slow faint white crush cut, very faint white film residue.**

1145-1355mMDRT: Claystone with variable interbedded sandstones

Claystone (60-90%) - Dark to medium grey, medium light grey to light grey, minor light brown to trace light olive grey, trace to minor silty grad to siltstone, trace micro mica, firm to trace moderately hard, sub fissile, minor sub blocky, trace fissile. **Sandstone (10-40%)** - Translucent to minor clear, off white to very light grey, trace white, very fine to fine, trace medium, moderately well sorted, minor weak to moderately siliceous cement, common off white argillaceous matrix, rare black lithics, friable to moderately hard, hard aggregates, tight to very poor visual porosity, poor inferred porosity, no fluorescence.

1355-1400mMDRT: Interbedded Claystone and Sandstone

Claystone (20-70%) - Medium grey to medium dark grey, trace micro mica, moderately hard to hard, sub blocky to sub fissile. **Sandstone (20-80%)** - Very light grey, translucent, clear, very fine to fine grained, sub angular to sub round, moderately well sorted, moderately strong siliceous cement, minor off white argillaceous matrix, tight to very poor visual porosity, no fluorescence.

1400-1440mMDRT: Claystone with variable Sandstone interbeds

Claystone (80-100%) - Medium dark grey to dark grey, trace micro mica, moderately hard to hard, blocky to sub fissile. **Sandstone (0-40%)** - Translucent, very light grey, clear, very fine to fine grained, sub angular to sub rounded, moderately sorted, strong siliceous cement in fine grained aggregates, rare white argillaceous matrix, moderately hard to hard, tight to very poor visual porosity, no fluorescence.

1440-1470mMDRT: Sandstone with variable claystone interbeds

Sandstone (60-100%) - Translucent, clear, very light grey, fine to coarse predominantly medium, poor sorting, sub angular to sub rounded, strong siliceous cement in fine grained aggregates, minor white argillaceous matrix, trace pyrite, moderately hard aggregates, medium to coarse grains are dis-aggregated, tight to very poor visual porosity, no fluorescence. **Claystone (0-40%)** - Medium dark grey to dark grey, rare micro mica, moderately hard, blocky to sub fissile.

1470-1551mMDRT: Claystone with minor sandstone interbeds

Claystone (80-100%) - Very dark grey black, silty in part grading to siltstone, rare micro mica, hard, blocky to sub blocky occasionally sub fissile**. Sandstone (0-20%)** - Translucent, clear, white, very fine to fine grained, trace medium, moderately sorted, sub angular, minor moderately strong siliceous cement, common white argillaceous matrix, rare quartz overgrowths, friable to moderately hard, tight visual porosity, no fluorescence.

(Conventional Core Cut 1525-1563.1mMDRT)

1551-1561mMDRT: Claystone with variable Sandstone interbeds

Claystone (60-100%) - Dark grey black, very dark grey, silty in part grading to siltstone, rare micro mica, hard, blocky to sub fissile. **Sandstone (0-40%) -** Translucent, clear, white, fine to occasionally medium grained, moderately sorted, sub angular to sub rounded, moderately strong siliceous cement in fine grained aggregates, minor white argillaceous matrix, very poor to poor visual porosity, no fluorescence.

1561-1590mMDRT: Sandstone with interbedded Claystone

Sandstone (30-70%) - Light brown to translucent light brown, translucent to trace clear, minor off white, very fine to fine, rare medium, moderately sorted, sub angular to minor sub rounded, trace angular, common moderately to trace strong siliceous cement, common light brown argillaceous matrix, minor black lithics, moderately hard to hard, minor disaggregated grains, tight to very poor visual porosity, no fluorescence. **Claystone (30-70%)** - Dark brownish black to greyish black, dark grey, silty grade to SILTSTONE in part, common micro mica, rare pyrite nods, moderately hard to hard, sub fissile to trace fissile, common sub blocky

1590-1671mMDRT: Claystone with minor sandstone interbeds

Claystone (70-100%) - Very dark grey to dark grey black, very finely arenaceous in part, rare micro mica, moderately hard to hard, blocky to sub fissile. **Sandstone (0-30%) -** Very light grey, light brownish grey, very fine to fine grained, moderately well sorted, sub angular to sub rounded, strong siliceous cement, common light brownish grey argillaceous matrix, moderately hard to hard, tight to very poor visual porosity, no fluorescence.

1671-1722mMDRT: Claystone

Claystone (100%) - Very dark grey to very dark grey black, silty in part, common micro mica, trace nodular pyrite, hard, blocky to sub blocky, occasionally sub fissile.

1722-1731mMDRT: Claystone with minor sandstone interbeds

Claystone (80-90%) - Dark grey to grey black, trace very dark grey brown, trace medium light grey, silty in parts, grading to siltstone, common micro mica, moderately hard to hard, sub blocky to occasionally sub fissile. **Sandstone (10-20%)** - Light grey to medium light grey, translucent to trace opaque, very fine, trace fine, moderately well sorted, sub angular to trace sub rounded, common strong siliceous cement, common light argillaceous matrix, common black lithics, hard to trace very hard, nil to tight visual porosity, no fluorescence.

1731-1772.55mMDRT: Interbedded Claystone and Sandstone

Claystone (40-80%) - Dark grey, brownish grey, medium dark grey in parts, silty in parts, com micro mica, moderately hard to hard, sub fissile to minor sub blocky. **Sandstone (20-60%)** - Light grey, off white, translucent, trace medium light grey, very fine to trace fine, moderately well sorted, sub angular to angular, minor sub rounded, common strong siliceous cement, common off white to light brown argillaceous matrix, moderately hard to hard, nil to trace visual porosity, no fluorescence.

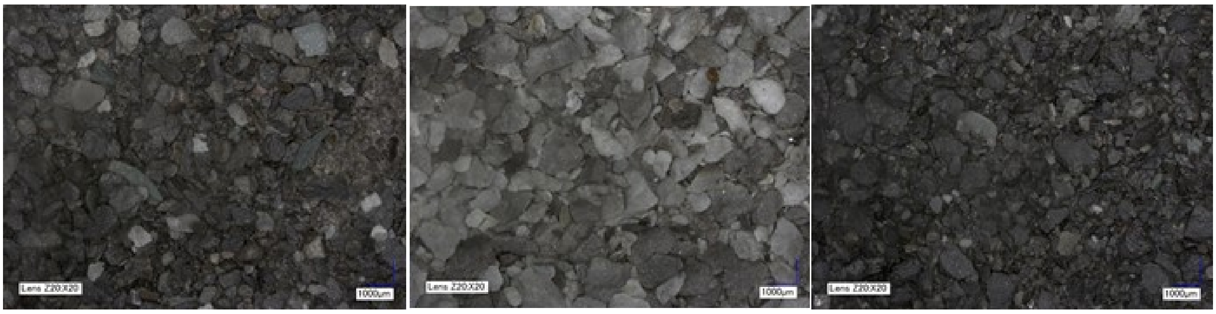

Figure 22 - Kyalla Formation from Beetaloo W-1 at depths of 1060-1065 mMDRT (left), 1130-1135 mMDRT (centre), and 1240-1245 mMDRT (right)

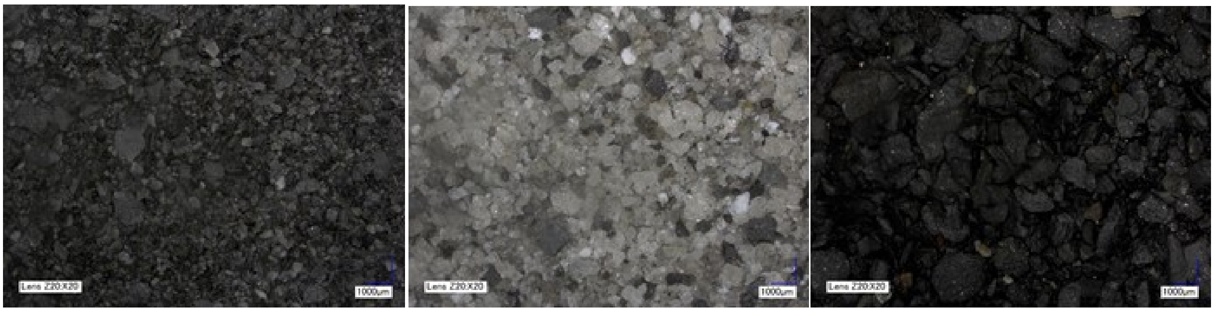

Figure 23 - Kyalla Formation from Beetaloo W-1 at depths of 1400-1405 mMDRT (left), 1455-1460 mMDRT (centre), and 1526-1527 mMDRT (right)

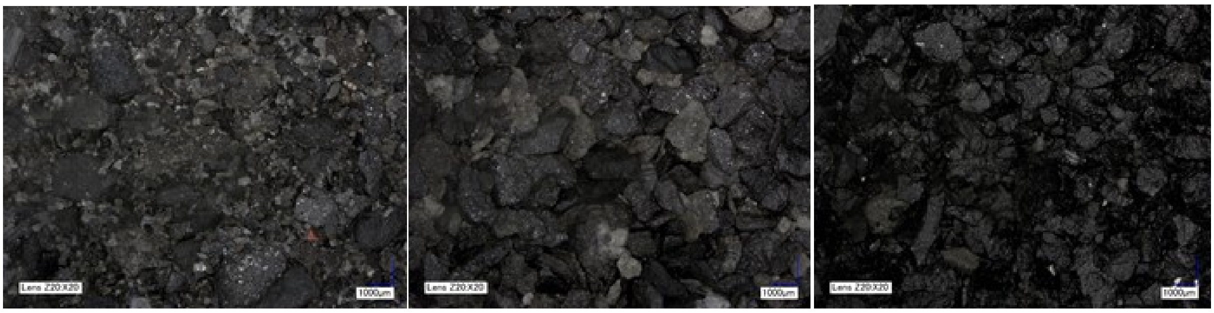

Figure 24 - Kyalla Formation from Beetaloo W-1 at depths of 1560-1563 mMDRT (left), 1617-1620 mMDRT (centre), and 1698-1701 mMDRT (right)

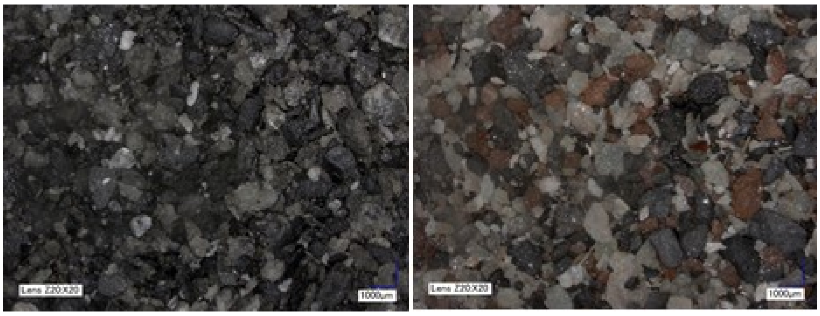

Figure 25 - Kyalla Formation from Beetaloo W-1 at depths of 1737-1740 mMDRT (left) and 1767-1770 mMDRT (right)

Moroak Sandstone – 1772.55 to 2224.8 mMDRT (452.25 metres penetrated)

1772.55-1863mMDRT: Sandstone with rare thin siltstone beds

Sandstone (90-100%) - Translucent, clear, white, variable trace to common red pink stain, fine to coarse, predominately medium, minor very fine, rare very course, poor sorting, angular to sub angular, minor strong siliceous cement, minor white argillaceous matrix, hard aggregates common disaggregated quartz grains, tight to very poor inferred porosity, no fluorescence. **Siltstone (0-10%)** – Moderately reddish brown to moderately red, medium grey to medium dark grey, trace dark grey, trace dark red brown, argillaceous grading to silty claystone in part, minor very fine arenaceous, firm to trace soft, sub blocky to minor sub fissile.

1863-1968mMDRT: Sandstone with variable thin Siltstone interbeds

Sandstone (40-100%) - Clear to translucent, occasionally off white, minor red brown, light to medium grey in part, medium to coarse, minor fine, moderately sorted, angular to occasionally sub angular, strong siliceous cement, minor red brown silty matrix, occasional localised dark lithics, disaggregated quartz grains, hard to moderately hard in part, very poor inferred porosity, no fluorescence. **Siltstone (0-60%)** - Reddish brown to dark reddish brown, moderately red orange to orange brown, trace dark brownish grey, arenaceous to argillaceous, grading to silty claystone in part, minor lithics, moderately hard, minor soft to firm, sub blocky to minor sub fissile.

1968-2079mMDRT: Sandstone with variable interbedded Siltstone beds

Sandstone (20-100%) - Clear to translucent, off white to very light grey in part, fine, occasionally medium to rare very fine, dominantly medium, moderately sorted, sub angular to dominantly angular, strong siliceous cement, minor to locally common off white argillaceous matrix, minor silty inclusions, dominantly disaggregated quartz grains, moderately hard to dominantly hard, very poor visual porosity, poor inferred porosity, no fluorescence. **Siltstone (0-80%)** - Dark grey, dark grey brown, minor medium grey, dominantly argillaceous, grading to CLAYSTONE in part, minor arenaceous, common micro mica, hard to moderately hard, minor dispersive, sub fissile to sub blocky.

2079-2112mMDRT: Siltstone with minor Sandstone interbeds

Siltstone (40-90%) - Dark to medium grey, dark grey brown, rare dark grey black, argillaceous, minor grading to Claystone, occasionally arenaceous, minor to locally common micro mica, rare nodular pyrite, hard to moderately hard, sub fissile to sub blocky. **Sandstone (10-60%)** - Off white to light grey, pale brown grey in part, clear to translucent, fine to medium, well sorted, angular to sub angular, occasionally sub rounded, strong siliceous cement, minor pale brown grey argillaceous matrix, rare disseminated pyrite, friable to moderately hard, clean loose disaggregated quartz grains in part, very poor visual porosity, poor inferred porosity, no fluorescence.

2112-2169mMDRT: Sandstone with variable siltstone interbeds

Sandstone (50-100%) - Off white, light grey, minor clear to translucent, rare medium grey brown, medium to occasionally coarse, fine in part, moderately sorted, angular to sub angular, strong siliceous cement, occasional to locally common off white argillaceous matrix, occasional dark lithics, hard to occasionally very hard, minor disaggregated quartz grains, very poor to tight visual and inferred porosity, no fluorescence. **Siltstone (0-50%)** - Dark grey, minor dark grey brown, arenaceous, minor argillaceous, common to abundant micro mica, occasional mica flakes, hard to occasionally moderately hard, sub blocky to sub fissile.

2169-2187mMDRT: Siltstone with minor sandstone interbeds

Siltstone (40-90%) - Dark grey to occasionally grey brown, very dark grey in part, arenaceous in part, common to abundant micro micaceous, minor mica flecks, firm to hard, sub blocky, minor blocky to sub fissile. **Sandstone (10-60%)** - Light grey to occasionally off white, minor light brown, light grey, rare clear to translucent, very fine to fine, occasionally medium, moderately sorted, sub angular, trace angular, strong siliceous cement, minor off white argillaceous matrix, rare glauconite grains, trace dark lithics, occasional rock flour, hard to very hard in part, occasional disaggregated grains, tight to very poor visual porosity, very poor inferred porosity, no fluorescence.

2187-2196mMDRT: Sandstone with minor siltstone interbeds

Sandstone (70-90%) - Light grey, clear to translucent, off white in part, medium to occasionally fine, moderately sorted, angular to occasionally sub angular, strong siliceous cement, trace off white argillaceous matrix, rare glauconite grains, hard to very hard, loose disaggregated grains in part, tight to very poor visual porosity, very poor inferred porosity, no fluorescence. **Siltstone (10-30%)** - Dark to very dark grey, occasionally dark grey brown, minor arenaceous, common micro micaceous, minor mica flecks, moderately hard to hard, sub blocky, minor blocky.

2196-2214mMDRT: Siltstone with minor sandstone interbeds

Siltstone (50-90%) - Dark to very dark grey, occasionally dark grey brown, minor argillaceous, occasional to common micro micaceous, rare disseminated pyrite, moderately hard to dominantly hard, sub blocky. **Sandstone (10-50%)** - Off white to light grey brown, rare clear to translucent, fine to occasionally medium, moderately sorted, angular to occasionally sub angular, strong siliceous cement, trace off white argillaceous matrix, rare mica flakes, minor localised dark lithics, hard to very hard, loose disaggregated grains in part, tight to very poor visual porosity, very poor inferred porosity, no fluorescence.

2214-2224.8mMDRT: Sandstone with minor siltstone interbeds

Sandstone (90-95%) - Off white, translucent, clear, minor light to very light grey, fine to minor medium, trace very fine, rare coarse, moderately sorted, angular to sub angular, minor sub rounded, strong siliceous cement, minor off white argillaceous matrix, hard to minor very hard, common disaggregated grains, tight to very poor visual porosity, poor to very poor inferred porosity, no fluorescence. **Siltstone (5-10%)** - Dark grey to brownish grey, arenaceous, minor argillaceous, common micro mica, moderately hard to hard, sub fissile to minor sub blocky.

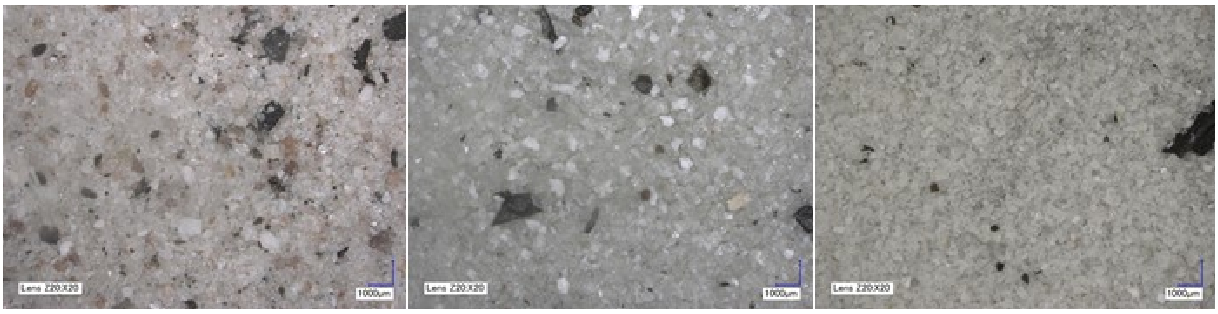

Figure 26 - Moroak Sandstone from Beetaloo W-1 at depths of 1776-1779 mMDRT (left), 1812-1815 mMDRT (centre), and 1845-1848 mMDRT (right)

Figure 27 - Moroak Sandstone from Beetaloo W-1 at depths of 1863-1866 mMDRT (left), 1911-1914 mMDRT (centre), and 1983-1986 mMDRT (right)

Figure 28 - Moroak Sandstone from Beetaloo W-1 at depths of 2010-2013 mMDRT (left), 2073-2076 mMDRT (centre), and 2175-2178 mMDRT (right)

Figure 29 - Moroak Sandstone from Beetaloo W-1 at depths of 2217-2220 mMDRT

Velkerri Formation

Upper Velkerri - 2224.8 - 2593.3 mMDRT (368.5 metres penetrated)

2224.8-2232mMDRT: Sandstone with downward increasing siltstone interbeds

Sandstone (60-95%) - Off white, translucent, clear, minor light to very light grey, fine to minor medium, trace very fine, rare coarse, moderately sorted, angular to sub angular, strong siliceous cement, minor off white argillaceous matrix, hard to minor very hard, common disaggregated grains, tight to very poor visual porosity, poor to very poor inferred porosity, no fluorescence. **Siltstone (5-40%) -** Dark grey, olive grey, medium grey in part, minor brownish grey, argillaceous, minor arenaceous, micro mica in part, moderately hard to hard, sub fissile to sub blocky.

2232-2256mMDRT: Siltstone with minor interbedded sandstone

Siltstone (80-100%) - Dark to occasionally medium brown grey, dark grey, arenaceous, locally common micro mica, rare pyrite nodules, moderately hard to hard, sub blocky to minor sub fissile. **Sandstone (0-20%)** - Light to medium grey, fine to medium, trace very fine, moderately sorted, angular to sub angular, strong siliceous cement, minor off white argillaceous matrix, hard to minor very hard, common disaggregated grains, tight to very poor visual porosity, poor to very poor inferred porosity, no fluorescence.

2256-2268mMDRT: Interbedded Sandstone and Siltstone

Sandstone (40-70%) - Off white to light grey, minor translucent, minor light brown grey, fine to occasionally medium, moderately well sorted, angular to sub angular, moderately strong siliceous cement, occasional off white argillaceous matrix, trace glauconite grains, minor dark lithics, dominantly disaggregated loose grains, friable to hard in part, poor to very poor visual porosity, poor inferred porosity, no fluorescence. **Siltstone (30-60%)** - Medium to dominantly dark grey, dark brown grey, dominantly arenaceous, common micro mica, minor mica flakes, hard to occasionally very hard, sub blocky to blocky.

2268-2292mMDRT: Siltstone with minor Sandstone Interbeds

Siltstone (80-100%) - Dark grey, dark brown grey, trace very dark grey, arenaceous, minor argillaceous, minor to locally common micro mica, trace disseminated and nodular pyrite, moderately hard to hard, sub fissile to sub blocky. **Sandstone (0-20%)** - Light brown grey, very fine to fine, occasionally medium, well sorted, angular to sub angular, moderately strong siliceous cement, occasional off white argillaceous matrix, rare disseminated pyrite, minor dark lithics, silty in part, dominantly disaggregated loose grains, friable to hard in part, poor to very poor visual porosity, poor inferred porosity, no fluorescence.

2292-2304mMDRT: Interbedded Sandstone and Siltstone

Sandstone (30-60%) - Light grey to off white, medium light grey in part, translucent to frosted, dominantly fine, trace very fine, trace medium grains, moderately to moderately well sorted, sub angular to minor sub rounded, strong siliceous cement, trace off white argillaceous cement, moderately hard to hard, trace very hard, common disaggregated grains, tight to very poor visual porosity, very poor inferred porosity, no fluorescence. **Siltstone (40-70%) -** Dark grey to medium dark grey, brown grey, trace medium grey, dominantly arenaceous, minor argillaceous, minor locally common micro mica, moderately hard to hard, trace very hard, sub fissile to sub blocky.

2304-2325mMDRT: Siltstone with minor Sandstone interbeds

Siltstone (80-100%) - dark grey, medium grey to medium dark grey, dark grey brown, dominantly argillaceous, minor arenaceous, trace micro mica, trace disseminated pyrite, moderately hard to hard, sub blocky to sub fissile. **Sandstone (0-20%) -** light grey to medium light grey, off white, translucent, fine to minor very fine, moderately to moderately well sorted, sub angular to sub rounded, strong siliceous cement, trace off white argillaceous matrix, moderately hard to hard, minor very hard, occasional disaggregated grains, tight to very poor visual porosity, very poor inferred porosity, no fluorescence.

2325-2340mMDRT: Interbedded Sandstone and Siltstone

Sandstone (30-60%) - Light grey, minor medium grey, very fine, grading to arenaceous Siltstone in part, well sorted, sub angular to occasionally sub rounded, moderate to strong calcareous and siliceous cement, occasional off white argillaceous matrix, locally common dark specks, disaggregated grains, dominantly friable to moderately hard, very poor to tight visual porosity, poor inferred porosity, no fluorescence. **Siltstone (40-70%)** - Dark to medium grey, dark grey brown in part, arenaceous, grading to very fine Sandstone in part, occasional micro mica, rare pyrite nodules, hard to occasionally moderately hard, sub blocky to minor sub fissile.

2340-2364mMDRT: Siltstone interbedded with minor sandstone

Siltstone (80-95%) - Light to medium grey, minor dark grey, arenaceous, commonly grading to very fine Sandstone, siliceous, rare micro mica, hard, sub blocky to blocky. **Sandstone (5-20%)** - Light grey, minor medium grey, minor clear to translucent, very fine to rare fine, grading to arenaceous Siltstone in part, well sorted, sub angular to angular, moderate to strong calcareous cement, minor off white argillaceous matrix, trace dark lithics, dominantly hard, very poor to tight visual porosity, no fluorescence.

2364-2499mMDRT: Siltstone with rare, thin sandstone interbeds

Siltstone (95-100%) - Medium to dark grey, light grey, light grey brown, argillaceous to arenaceous, occasionally grading to very fine Sandstone, occasionally to locally common micro micaceous, minor mica flakes, trace disseminated pyrite, trace lithics, moderately hard to hard, sub blocky to sub fissile, minor fissile**. Sandstone (0-5%)** - Off white to light grey, very fine, commonly grading to arenaceous Siltstone, well sorted, sub angular to sub rounded, moderate to occasionally strong siliceous cement, minor to occasional off white argillaceous matrix, moderately hard, tight visual porosity, no fluorescence.

2499-2535mMDRT: Siltstone with minor, thin sandstone interbeds

Siltstone (95-100%) - Medium grey, minor dark to light grey, arenaceous to minor argillaceous, minor grading to Claystone in part, locally common micro mica, trace disseminated pyrite, moderately hard to dominantly hard, sub fissile, occasionally sub blocky to fissile. **Sandstone (0-5%)** - Off white to light grey brown, very fine to occasionally fine, grading to arenaceous Siltstone in part, well sorted, sub angular, strong to moderately siliceous cement, rare off white argillaceous matrix, hard to very hard, tight visual porosity, no fluorescence.

2535-2571mMDRT: Siltstone with interbedded sandstone

Siltstone (80-95%) - Dark grey, minor medium grey, dominantly arenaceous, commonly grading to very fine Sandstone, locally micro micaceous, locally common disseminated pyrite, locally common dark specks, moderately hard to hard, sub blocky to occasionally sub fissile. **Sandstone (5-20%)** - Medium to dark mottled grey, light grey, very fine to minor fine, grading to arenaceous

Siltstone in part, well sorted, sub angular, strong to moderate siliceous and minor calcareous cement, rare off white argillaceous matrix, common dark specks, disaggregated grains, hard to very hard, tight visual porosity, very poor inferred porosity, no fluorescence.

2571-2593.3mMDRT: Interbedded Siltstone and Claystone

Siltstone (30-80%) - Medium grey, occasionally light to dark grey, minor medium grey brown, arenaceous, grading to very fine Sandstone in part, minor argillaceous, locally micro micaceous, moderately hard to dominantly hard, sub blocky, minor sub fissile. **Claystone (20-70%)** - Very dark to medium grey, occasionally light grey, silty in part, occasional to common disseminated pyrite, micro micaceous in part, firm to moderately hard, occasionally hard to very hard, sub blocky to occasionally sub fissile.

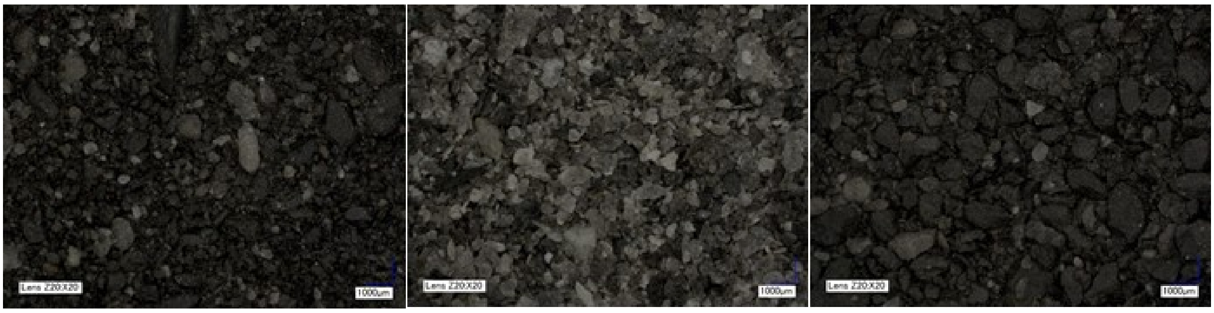

Figure 30 - Upper Velkerri from Beetaloo W-1 at depths of 2238-2241 mMDRT (left), 2331-2334 mMDRT (centre), and 2394-2397 mMDRT (right)

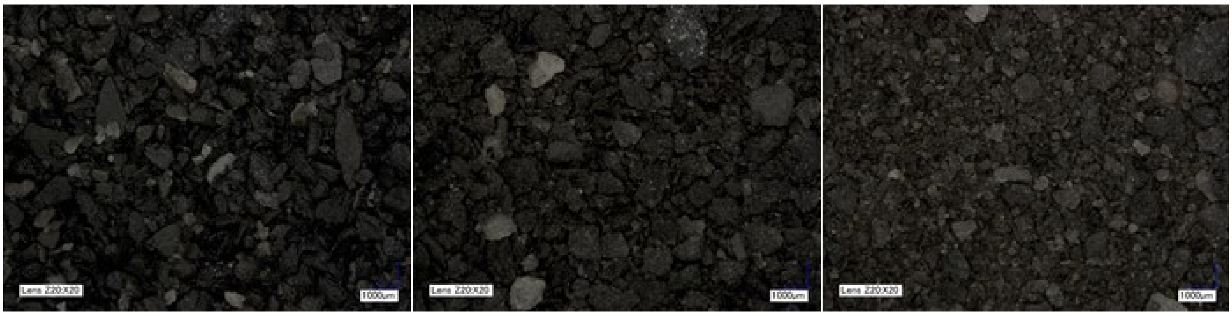

Figure 31 - Upper Velkerri from Beetaloo W-1 at depths of 2493-2496 mMDRT (left), 2544-2547 mMDRT (centre), and 2562-2565 mMDRT (right)

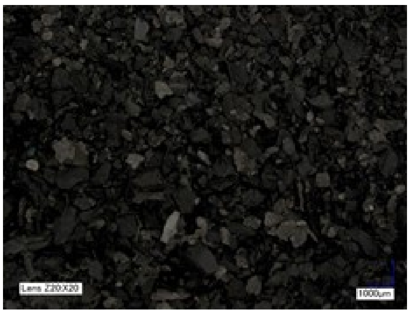

Figure 32 - Upper Velkerri from Beetaloo W-1 at depths of 2580-2583 mMDRT

Middle Velkerri – 2593.3-3148.3 mMDRT (555 metres penetrated)

C Shale

2593.3-2601mMDRT: Interbedded Siltstone and Claystone

Siltstone (50-90%) - Dark to medium grey, trace dark brownish grey, commonly argillaceous, minor grading to silty Claystone, arenaceous in part, occasionally micro micaceous, moderately hard to dominantly hard, sub blocky, trace sub fissile. **Claystone (10-90%) -** Dark grey to very dark grey, silty in part, minor disseminated pyrite, trace micro mica, moderately hard to hard, sub fissile to occasionally sub blocky.

2601-2616mMDRT: Organically enriched Claystone with interbedded Organically enriched Siltstone

Claystone (40-80%) - Very dark grey to black, dark grey black in part, very dark grey brown, minor silty in part, rare nodular pyrite, occasional to locally common micro mica, hard to occasionally very hard, dominantly sub fissile to occasionally sub blocky. **Siltstone (20-60%)** - Dark to dominantly very dark grey, trace dark brownish grey, dominantly argillaceous, commonly grading to Claystone, occasionally micro micaceous, hard to occasionally very hard, minor moderately hard, sub blocky to sub fissile.

2616-2628mMDRT: Organically enriched Claystone with interbedded Organically enriched Siltstone

Claystone (70-100%) - Very dark grey to black, dark grey black in part, very dark grey brown, minor dark grey, locally occasionally silty, rare disseminated pyrite, occasional to locally common micro mica, hard to occasionally very hard, sub fissile to occasionally fissile, minor sub blocky. **Siltstone (0-30%)** - Medium to occasionally light grey, minor dark grey, dominantly argillaceous, grading to Claystone in part, minor siliceous, occasionally micro micaceous, minor disseminated pyrite, hard to occasionally very hard, minor moderately hard, sub fissile to occasionally sub blocky.

2628-2697mMDRT: Claystone with minor siltstone interbeds

Claystone (70-95%) - Dark grey, minor medium grey, medium grey brown in part, locally silty, rare localised disseminated pyrite, occasional to locally common micro mica, moderately hard to hard, minor firm, sub blocky to occasionally sub fissile, minor blocky. **Siltstone (5-30%) -** Light to medium grey, arenaceous in part, grading to very fine Sandstone in part, locally common micro micaceous, minor mica flakes, rare disseminated pyrite, hard to occasionally moderately hard, sub blocky to commonly blocky.

2697-2724mMDRT: Claystone with minor to absent Siltstone interbeds

Claystone (90-100%) - Dark grey, medium dark grey to medium grey, trace very dark grey, silty in part, minor micro mica, moderately hard to hard, trace firm, sub blocky, trace sub fissile. **Siltstone (0-10%) -** Medium to medium light grey, trace light grey, argillaceous minor grading to silty Claystone, trace arenaceous, minor micro mica, moderately hard to hard, sub blocky, trace sub fissile.

2724-2736mMDRT – Claystone with minor to trace Limestone interbeds

Claystone (90-100%) - Dark grey to medium dark grey, silty in part, micro micaceous, moderately hard to hard, trace firm, sub blocky, trace sub fissile. **Limestone (0-10%)** - Off white to very light grey, soft to firm, dominantly lutitic, argillaceous in part, microcrystalline, trace disseminated pyrite.

2736-2745mMDRT: Claystone

Claystone (100%) - Medium dark grey to dark grey, common micro mica, trace carbonaceous specks, arenaceous in part, hard, sub blocky to sub fissile.

2745-2946mMDRT: Claystone with minor vertically heterogeneously distributed Sandstone Interbeds

Claystone (80-100%) - Medium dark grey, medium grey, slightly silty, common micro mica, trace disseminated pyrite, moderately hard, blocky to sub fissile. **Sandstone (0-20%) -** Very light grey to light grey, off white, very fine to occasionally fine grained, moderately well sorted, strong calcareous and siliceous cement, common very light grey to off white argillaceous matrix, moderately hard, tight to very poor visual porosity, no fluorescence.

2946-2964mMDRT: Claystone

Claystone (100%) - Medium dark grey, medium grey, trace dark grey, trace micro mica, moderately hard, blocky to sub fissile.

2964-3000mMDRT: Claystone increasingly organically enriched

Claystone (100%) - Very dark grey, very dark grey black, common micro mica, moderately hard to occasionally hard, blocky to sub blocky, occasionally sub fissile.

B Shale

3000-3060mMDRT: Claystone organically enriched with trace Sandstone interbeds

Claystone (100%) - Very dark grey, grey black, trace disseminated pyrite, rare to trace micro mica, hard to very hard, sub blocky, trace sub fissile.

3060-3066mMDRT: Claystone organically enriched with trace Sandstone interbeds

Claystone (100%) - Very dark grey, grey black, trace disseminated pyrite, rare to trace micro mica, hard to very hard, sub blocky, trace sub fissile. **Sandstone (Trace) -** Off white, light grey, very light grey, translucent, trace clear, fine to medium, trace very fine, poor sorting, sub angular, strong siliceous cement, off white argillaceous matrix, hard to very hard, poor to fair visual porosity, no fluorescence.

3066-3132mMDRT: Claystone moderately organically enriched

Claystone (100%) - Very dark grey black, very dark grey, trace micro mica, trace disseminated pyrite, hard, blocky to sub blocky, minor sub fissile.

A Shale

3132-3148.3mMDRT: Claystone organically enriched

Claystone (100%) - Very dark grey black, very dark grey, trace micro mica, hard, blocky to sub blocky, minor sub fissile.

3141-3148.3mMDRT: Claystone interbedded with sandstones

Claystone (70-80%) - Medium grey, occasional medium light grey, trace calcareous fragments, moderately hard to hard, sub blocky to sub fissile. **Sandstone (20-30%)** - Off white, translucent, trace light grey to very light grey, minor opaque, very fine to fine, sub rounded to trace sub angular, common calcareous cement, off white argillaceous cement, moderately hard, tight to very poor visible porosity, no fluorescence.

Figure 33 - Middle Velkerri from Beetaloo W-1 at depths of 2604-2607 mMDRT (left), 2616-2619 mMDRT (centre), and 2625-2628 mMDRT (right)

Figure 34 - Middle Velkerri from Beetaloo W-1 at depths of 2655-2658 mMDRT (left), 2805-2808 mMDRT (centre), and 2955-2958 mMDRT (right)

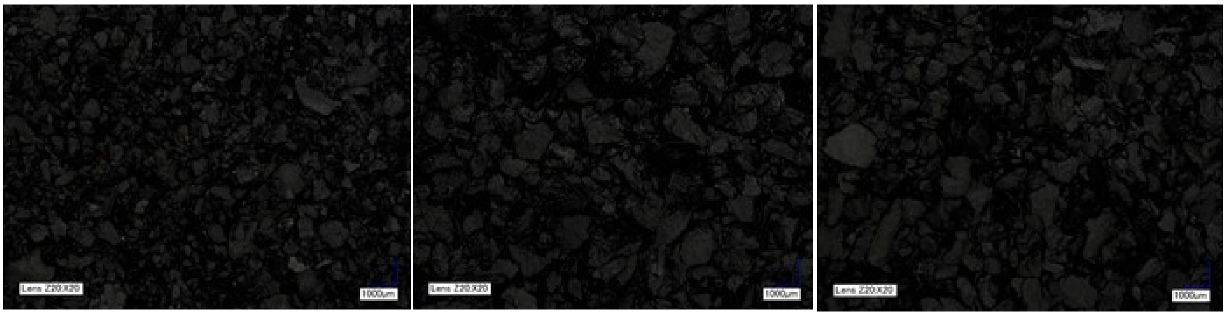

Figure 35 - Middle Velkerri from Beetaloo W-1 at depths of 3003-3006 mMDRT (left), 3027-3030 mMDRT (centre), and 3063-3066 mMDRT (right)

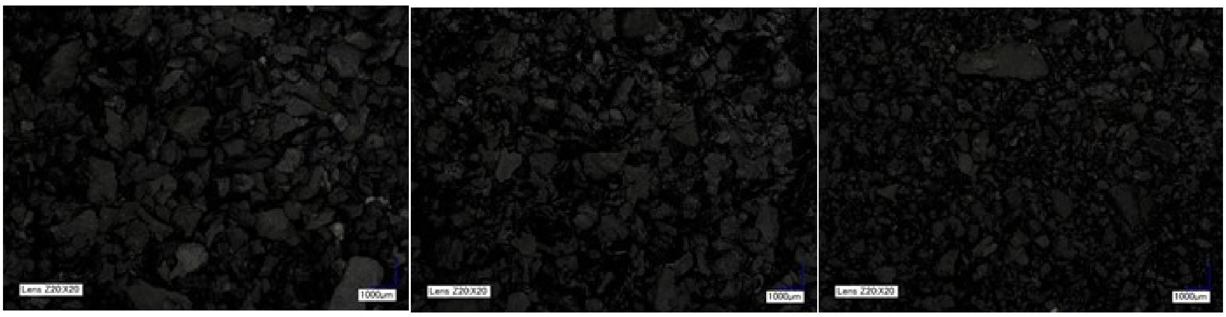

Figure 36 - Middle Velkerri from Beetaloo W-1 at depths of 3072-3075 mMDRT (left), 3099-3102 mMDRT (centre), and 3126-3129 mMDRT (right)

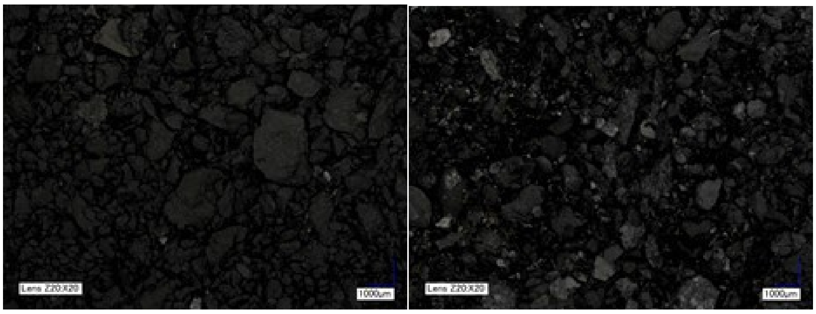

Figure 37 - Middle Velkerri from Beetaloo W-1 at depths of 3135-3138 mMDRT (left) and 3141-3144 mMDRT (right)

<u>**Lower Velkerri - 3148.3 to TD at 3173 mMDRT driller's depth (24.7 metres penetrated)**</u>

3148.3-3173mMDRT: Claystone

Claystone (100%) - Medium grey to light grey, very light grey in part, trace medium dark grey, trace micro mica, hard to minor very hard, sub blocky to occasional sub fissile.

Figure 38 - Lower Velkerri from Beetaloo W-1 at depths of 3147-3150 mMDRT (left), 3156-3159 mMDRT (centre), and 3171-3173 mMDRT (right)

6 WELL EVALUATION

6.1 MUD LOGGING

Geoservices provided mud logging services at Beetaloo W-1. The Geoservices Schlumberger ALS-3B Mudlogging Unit provided a full Surface Data Logging (SDL) network for the job. This included real time and lagged data acquisition, data processing, data storage and transmission, data presentation, high resolution digital microscope (HRDM) and X-ray fluorescence analyser (XRF). SDL commenced when the well was spudded at 21:00 hrs on 22 July 2016 and continued for the duration of the well. (until 6 September 2016).

A record of the mudlogging data, XRF data, drill cutting lithology descriptions, and the Geoservices End of Well Report can be found in Appendix 2.

6.2 WIRELINE LOGGING

A total of four wireline logging runs, including one rotary side wall coring run (RSWC) were attempted at Beetaloo W-1 over the 6 ¾" reservoir hole section (Table 4). A summary of runs is provided in Table 4. Raw and processed wireline log data are included in Appendix 5.

SUITE No.	RUN No.	DEPTH (mMDRT)		DESCRIPTION	OPERATOR	REMARKS
		FROM	TO			
1	1	3167.86	1292.6	NEXT-HRLT-HDRS-HGNS-EDTC (PEX – Lithoscanner)	SLB	Repeat section: 3053.2 – 3174.3 mMD Gamma-ray, Density and Neutron (HGNS-EDTC) run through casing to surface. Micro-resistivity failure
1	2	3153	1290	CMR-HNGS-HDRS-HGNS-EDTC (CMR)	SLB	HDRS-HGNS run after failure of micro-resistivity in Run 1 Repeat section: 2565.5 – 2685.6 mMD EDTC run to surface
1	3	3137.7	940	FMST-MAST-PPC-EDTC (FMI - SonicScanner)	SLB	Repeat section: 1335.6 – 1504.8 mMD
1	4	3071.9	1521.25	Rotary Sidewall Coring (MSCT)	SLB	50 planned / 48 attempted / 41 recovered

Table 4 - Beetaloo W-1 Summary of Wireline Logging Runs

7 FORMATION SAMPLING

7.1 CUTTINGS SAMPLING

500g of bulk drill cuttings were collected at regular intervals (as per Table 5), washed and air dried, and then partitioned into 2x 250g splits (one for the operator Origin Energy and one for the Northern Territory Government as per regulations) and heat sealed into foil bags. From 2250 to 3173 mMDRT an additional 100g (350g total) was collected for the operator, Origin's Energy's split as per the pre-drill programme. A small portion of the freshly washed drill cutting sample was described by the wellsite geologist with support from Geoservices, and then placed into one Samplex tray set.

Wellsite lithology descriptions are summarised in Appendix 2.

Following total depth, the Northern Territory Government drill cuttings split was transported to the Northern Territory Geological Survey core store in Darwin. The Origin Energy drill cuttings split was transported to the Brendale Weatherford Lab, in Brisbane, Queensland.

Cuttings Interval mMDRT	Sample Rate (mMD)	Comments
17 – 205.72	10	No returns from 113 to 205.72 mMDRT (Samples 110 – 205.72mMDRT not recovered)
205.72 – 600	10	Sample 205.7-210mMDRT – 4.3m interval
600 – 1525	5	As per Programme
1525 - 1531	1	Cuttings while coring – Origin Energy Operations Geologist Directive
1531 - 1533	2	Cuttings while coring – Origin Energy Operations Geologist Directive
1533 – 3171	3	As per Programme
3171 - 3173	2	Total depth sample

Table 5 - Beetaloo W-1 Drill Cuttings Interval and Sampling Rate Summary

7.2 CORING

7.2.1 CONVENTIONAL CORING

Conventional core was cut in the Kyalla Formation from 1525.57 to 1563.1 mMDRT (37.53 metre interval) with 36.12m successfully recovered (96.24% recovery).

The core point was called on 12 August 2016 following a significant increase in mudgas, coupled with a darkening of the mudstone drill cuttings, indicating the presence of a prospective SRR. This SRR was initially thought at the time to be the primary coring target in the lower Kyalla SRR as per the programme plan, but following wireline logging it became clear that the middle Kyalla SRR had been cored. The 3.5” diameter core was cut utilising a 42 m, 5 ¾” heavy duty core barrel and full-moon aluminium liners. Following core recovery at surface, the full-moon aluminium liners containing the core were laid out using a laydown cradle, cut into one metre lengths, capped with rubber end seals, and preserved in nitrogen purged core Protec™ sleeves. The preserved one metre lengths were then stacked inside a core container with foam inserts along with a Lithotrack™ device. The core container was transported in a refrigerated trunk (for enhanced core preservation) to the Brendale Weatherford lab facility in Brisbane, Queensland.

A detailed record of the conventional coring operation along with the Lithotrack™ report is documented in the Corepro ALS Oil & Gas End of Well Report in Appendix 4.

7.2.2 ROTARY SIDEWALL CORING

Schlumberger's rotary sidewall coring tool (MSCT – max capacity: 50 units) was run over the interval from 3071.9 to 1521.3 mMDRT recovering 41 plugs from the 48 attempted. Table 6 summarises the recovered, attempted and planned sidewall cores and the core condition upon inspection. A summary of sidewall core depths, wellsite photographs and general wellsite lithology description are Included in Appendix 4.

Upon tool retrieval and inspection at surface following the rotary side wall coring run, it was noted the upper end of the core barrel was slightly bent (Figure 39). Damage of the core barrel is thought to be responsible for the poor recovery, failure and jamming in cores 41-48 planned RSWC's. RSWC's 49 and 50 were not attempted following continuous downhole issues

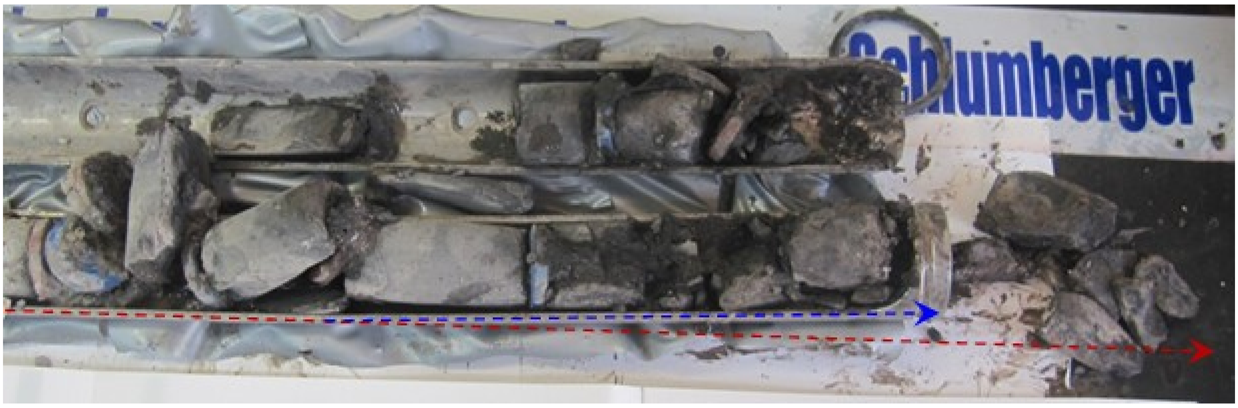

Figure 39 - MSCT Tool - Observed bent in the upper end of core barrel (blue dashed line) upon retrieval and processing of RSWC core at surface.

SUITE NO.	RUN NO.	SIDEWALL CORE INTERVAL (MMDRT)	RECOVERY
1	4	3071.5 – 1521.25	50 PLANNED / 48 ATTEMPTED / 41 RECOVERED

SUITE NO.	RUN NO.	CORE NUMBER	SIDEWALL CORE DEPTH (mMDRT)	CUT LENGTH (mm)	CUT DIAMETER (mm)	RECOVERED LENGTH (mm)	GEOLOGICAL FORMATION	COMMENT
1	4	1	3071.9	50	23	49	Velkerri Formation - Middle Velkerri	
1	4	2	3063.9	50	23	50	Velkerri Formation - Middle Velkerri	
1	4	3	3052.6	50	23	47	Velkerri Formation - Middle Velkerri	
1	4	4	3052.4	50	23	42	Velkerri Formation - Middle Velkerri	
1	4	5	3042.7	50	23	48	Velkerri Formation - Middle Velkerri	
1	4	6	3042.5	50	23	49	Velkerri Formation - Middle Velkerri	
1	4	7	3038.2	50	23	47	Velkerri Formation - Middle Velkerri	
1	4	8	3038	50	23	45	Velkerri Formation - Middle Velkerri	
1	4	9	3031.1	50	23	45	Velkerri Formation - Middle Velkerri	
1	4	10	3030.9	50	23	45	Velkerri Formation - Middle Velkerri	
1	4	11	3028.7	50	23	45	Velkerri Formation - Middle Velkerri	

1	4	12	3027.6	50	23	45	Velkerri Formation - Middle Velkerri	
1	4	13	3027.4	50	23	50	Velkerri Formation - Middle Velkerri	
1	4	14	3018.6	50	23	46	Velkerri Formation - Middle Velkerri	
1	4	15	3018.4	50	23	47	Velkerri Formation - Middle Velkerri	
1	4	16	3006.7	50	23	45	Velkerri Formation - Middle Velkerri	
1	4	17	3006.5	50	23	35	Velkerri Formation - Middle Velkerri	
1	4	18	2996.45	50	23	50	Velkerri Formation - Middle Velkerri	
1	4	19	2626.35	50	23	47	Velkerri Formation - Middle Velkerri	
1	4	20	2626.13	50	23	45	Velkerri Formation - Middle Velkerri	Split
1	4	21	2618.7	50	23	46	Velkerri Formation - Middle Velkerri	
1	4	22	2618.58	50	23	53	Velkerri Formation - Middle Velkerri	
1	4	23	3046.48	50	23	50	Velkerri Formation - Middle Velkerri	
1	4	24	3046	50	23	49	Velkerri Formation - Middle Velkerri	
1	4	25	3002.2	50	23	45	Velkerri Formation - Middle Velkerri	
1	4	26	3002	50	23	47	Velkerri Formation - Middle Velkerri	
1	4	27	2554.04	50	23	48	Velkerri Formation - Upper Velkerri	Broken
1	4	28	2547.7	50	23	45	Velkerri Formation - Upper Velkerri	
1	4	29	2546.5	50	23	47	Velkerri Formation - Upper Velkerri	
1	4	30	2546.3	50	23	46	Velkerri Formation - Upper Velkerri	
1	4	31	2218.2	50	23	Rubble	Moroak Sandstone	Rubble
1	4	32	2216.65	50	23	49	Moroak Sandstone	
1	4	33	2189.8	50	23	Rubble	Moroak Sandstone	Rubble
1	4	34	1775.2	50	23	Rubble	Moroak Sandstone	Rubble
1	4	35	1735.25	50	23	46	Kyalla Formation	Lost Marker Disk
1	4	36	1710.55	50	23	41	Kyalla Formation	
1	4	37	1710.35	50	23	48	Kyalla Formation	
1	4	38	1702.25	50	23	30	Kyalla Formation	Broken Core
1	4	39	1702.05	50	23	20	Kyalla Formation	
1	4	40	1700.2	50	23	20	Kyalla Formation	Broken Core
1	4	41	1698.35	50	23	Rubble	Kyalla Formation	Rubble
1	4	42	1698.15	50	23	No Recovery	Kyalla Formation	Not Recovered
1	4	43	1688.3	50	23	No Recovery	Kyalla Formation	Not Recovered
1	4	44	1688.1	50	23	No Recovery	Kyalla Formation	Not Recovered
1	4	45	1681.95	50	23	No Recovery	Kyalla Formation	Not Recovered
1	4	46	1681.75	50	23	No Recovery	Kyalla Formation	Core Jammed. Not Recovered
1	4	47	1521.45	50	23	No Recovery	Kyalla Formation	Core Jammed. Not Recovered
1	4	48	1521.25	50	23	No Recovery	Kyalla Formation	Core Jammed Off. Not Recovered
1	4	49	1512	50	23	Not Attempted	Kyalla Formation	Planned but Not Attempted
1	4	50	1511.8	50	23	Not Attempted	Kyalla Formation	Planned but Not Attempted

Table 6 - Rotary Sidewall Core Summary

8 HYDROCARBON SUMMARY

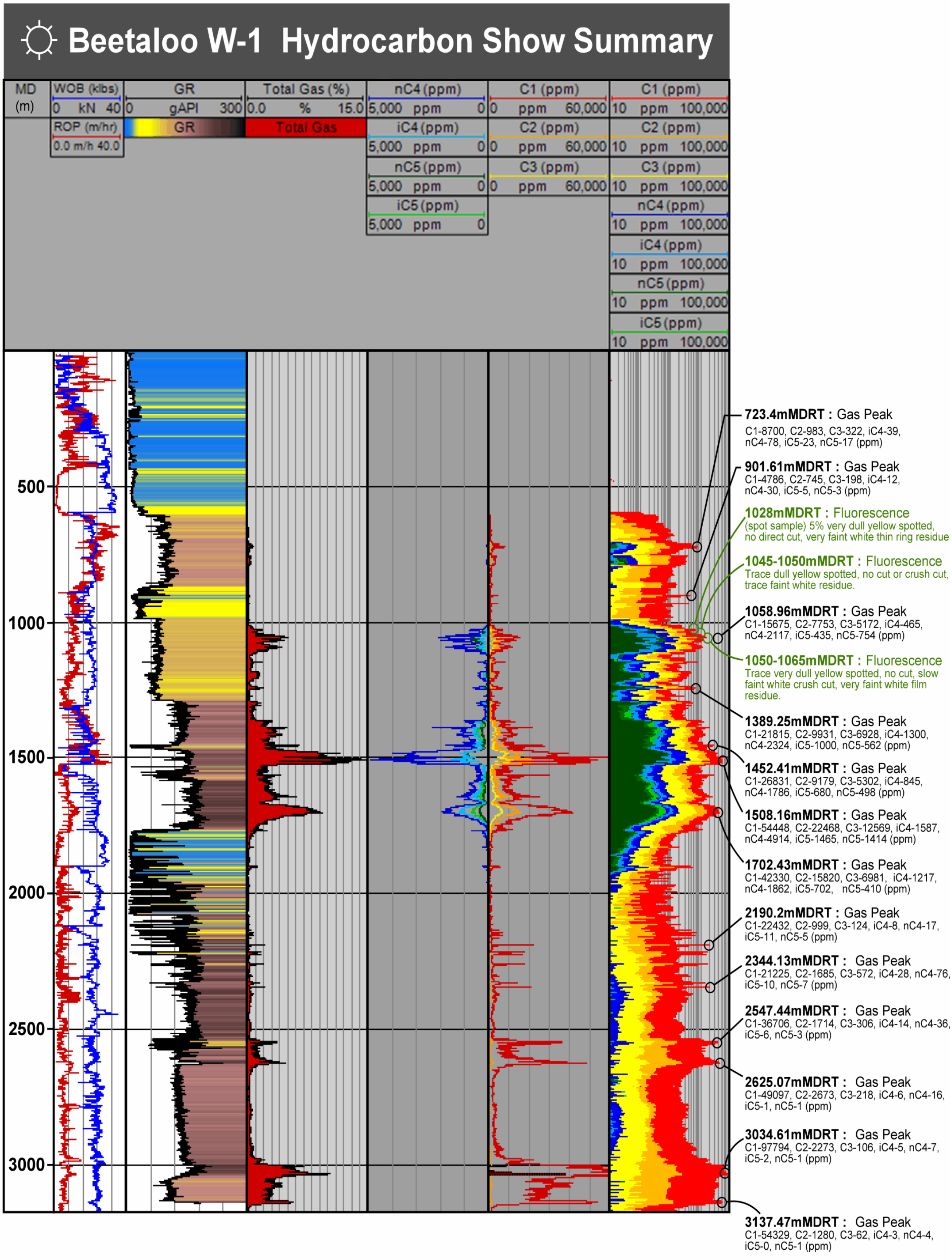

Figure 40 - Beetaloo W-1 hydrocarbon show summary

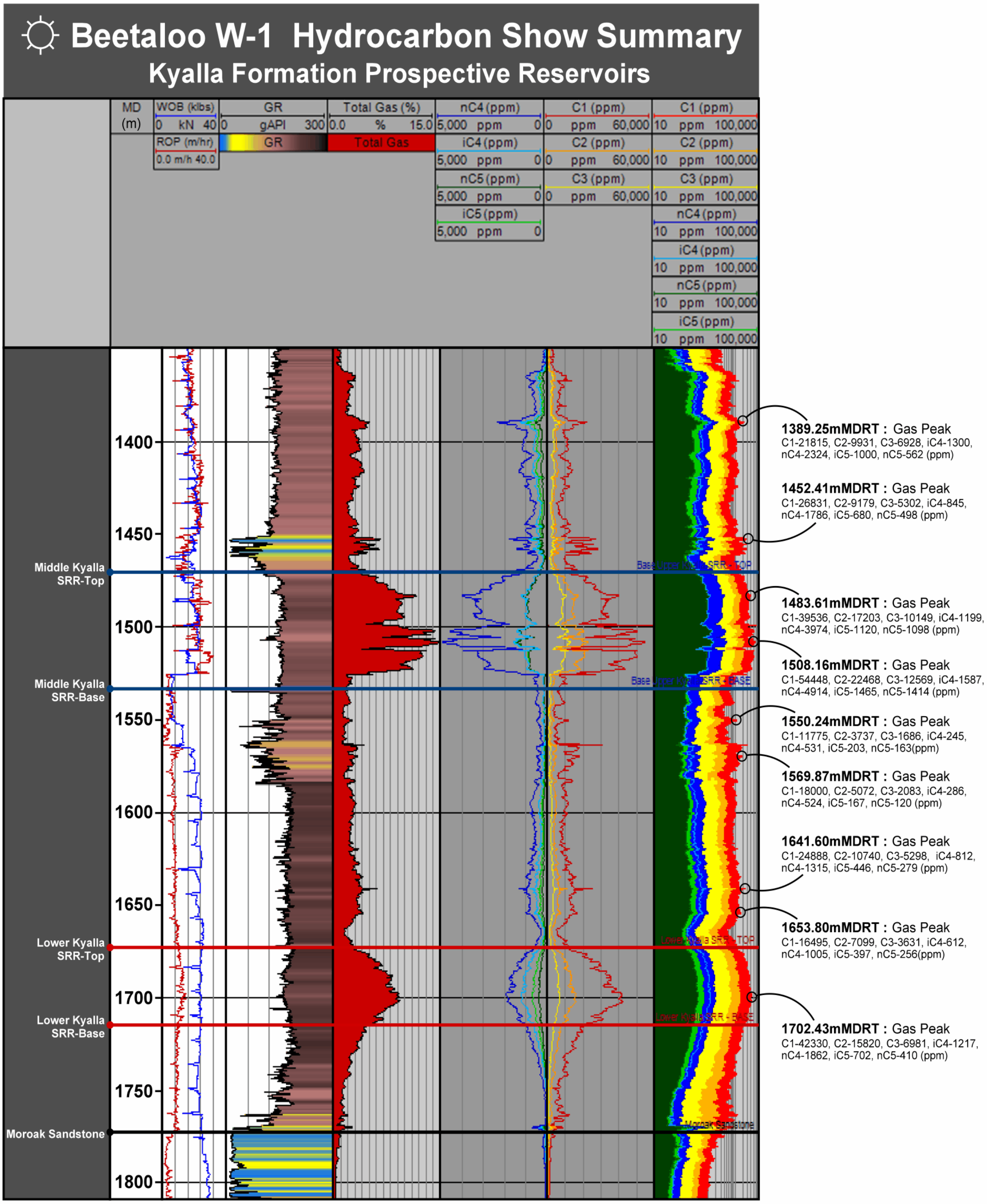

Figure 41 - Beetaloo W-1 Kyalla Formation reservoir target hydrocarbon shows.

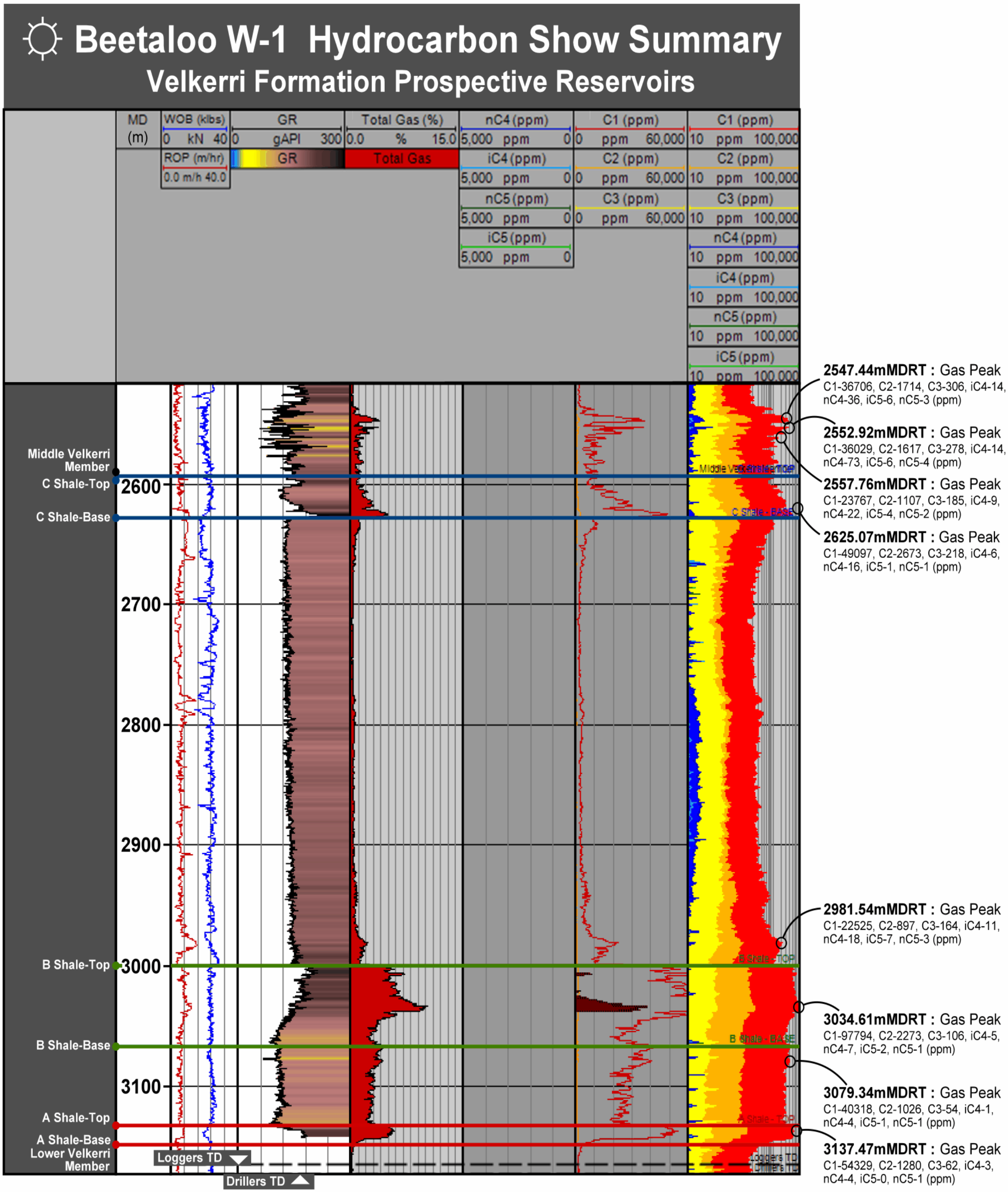

Figure 42 - Beetaloo W-1 middle Velkerri reservoir target hydrocarbon shows.

9 RESERVOIR EVALUATION

9.1 Petrophysical Analysis

Both the primary (middle Velkerri) and secondary (Kyalla Formation) source rock reservoir targets were developed at Beetaloo W-1 and a full open hole wireline evaluation suite acquired.

Core and cutting samples acquired in Beetaloo W-1 were sent for lab analyses detailed in Appendix 6. The results of the analyses were incorporated prior to undertaking a final petrophysical review of Beetaloo W-1. The core data provide calibration and constraints for the interpreted porosity, organic carbon content, mineral fractions and water saturation.

Petrophysical analysis of the primary target, the middle Velkerri was performed by Origin, however, the final petrophysical analysis of the secondary target, the Kyalla Formation was performed by a third-party contractor.

Petrophysical interpretation of shale reservoirs is primarily undertaken using a model of the matrix constituents. For Beetaloo W-1 a mineral model derived using a combination of; the processed Lithoscanner multispectral logs and triple combo logs. The minerals forming the shale matrix were determined from lab measured XRD on core material. These point data were used in conjunction with the Lithoscanner output and measured TOC to derive a continuous, calibrated mineral model for the reservoir horizons. The calibrated mineral model was subsequently used to derive a continuous grain density log which was then combined with the bulk density and neutron logs to determine total porosity. Lab measured grain density and total porosity measured by helium injection on crushed and solvent extracted core samples were used to QC the input grain density and resultant total porosity models derived from the wireline analysis.

After determination of the total pore volume, a fluid distribution model was derived using a combination of resistivity and NMR logs. The fluid model was calibrated using lab measured pore volume saturations acquired through solvent extraction.

Empirical analysis of the mudgas ratios for both formations in addition to the measured liquid hydrocarbon pore saturations from recovered core samples suggest that at Beetaloo W-1 the Velkerri SRR intervals are dry gas prone whilst the Kyalla SRR interval contains a wet gas.

The petrophysical assessment of Beetaloo W-1 identifies three prospective SRR intervals within the middle Velkerri formation - the A, B and C shales (oldest to youngest) (Figure 11). These three intervals are correlative to the prospective SRR's intersected elsewhere in the Beetaloo (Figure 11). The prospectivity of the B Shale horizon has been proven by the offsetting production test at Amungee NW-1H. In addition to the SRR's of the middle Velkerri, an additional two prospective SRR intervals were identified in the Kyalla Formation. These targets have been informally subdivided based on into the 'lower Kyalla' and 'middle Kyalla'. Similar to the Velkerri these prospective intervals are correlative in the offsetting wells (Figure 12).

Complete Petrophysical model outputs for both the Velkerri and Kyalla are included in Appendix 6.

9.2 Geological Sample Analysis

A selection of conventional core, rotary sidewall core, drill cuttings, Isotube™ (drilling mudgas) and Isojar™ (drill cutting headspace gas) samples from Beetaloo W-1 were sent to Weatherford Labs and Terratek Labs in Brisbane, Australia for various analyses.

Complete laboratory sample analysis results are enclosed in Appendix 7.

Core Analysis Conducted	Core Analysis Lab / Contractor
X-Ray Diffraction (XRD)	Weatherford Labs
Fourier Infra-Red Spectroscopy (FTIR)	Terratek Schlumberger
Modified GRI (crushed rock) and Retort	Weatherford Labs
Pyrolysis and Total Organic Carbon (TOC)	Weatherford Labs
Soxhlet Extraction / Medium Pressure Liquid Chromatography / Gas Chromatography of Aromatic and Saturate Fraction	Weatherford Labs
Adsorption Isotherms – Methane and Ethane	Weatherford Labs
Rock Mechanics	Weatherford Labs
Capillary Suction Time / Cation Exchange Capacity	Weatherford Labs
Organic Petrology	Energy Resources Consulting
Thin Sections	Weatherford Labs
Argon-ion Milled SEM / with EDS Mapping	Macquarie University
Isolated Kerogen CHNOSFe Elemental Analysis	Weatherford Labs
Isotube™ and Isojar™ Bulk Gas Chromatography with selected Carbon and Deuterium Isotopes	Weatherford Labs

10 FORMATION TESTING

10.1 Extended Leak-off Test

None Completed

10.2 Fluid Sampling

None Completed

10.3 Production Testing

None Completed

11 DISCUSSION AND CONTRIBUTIONS TO GEOLOGICAL KNOWLEDGE

Complete penetration and formation evaluation following wireline logging and coring of the middle Velkerri provided the following insights into the unconventional SRR play potential of the Velkerri Formation at Beetaloo W-1:

- Confirmation that the organically enriched middle Velkerri mudstone units are present and prospective in the central portion of EP117.
- Stratigraphic thinning of the middle Velkerri C shale continues south from Shenandoah-1A. The C Shale intersected at Beetaloo W-1 was the thinnest yet penetrated in the Beetaloo.
- The B shale shows remarkable thickness consistency across the known Beetaloo Basin within the OT Downs and Balmain Deep (Figure 11).
- Confirmation that the B shale source rock reservoir quality and mechanical properties conducive to hydraulic fracture stimulation continues into the southern Beetaloo and is a viable exploration and appraisal target within the central portion of EP117. Like other fully logged wells Amungee NW-1 and Tanumbirini W-1, the B Shale was again the most prospective SRR target within the middle Velkerri (at Kalala S-1 the C shale was the most prospective due to thin dolerite sill intrusions into the B Shale). (Figure 11)
- The A Shale that was penetrated at Beetaloo W-1 was the second thinnest A Shale yet penetrated anywhere within the Beetaloo (15.5mTVD), Figure 11).
- Confirmation that Shenandoah-1A did not fully penetrate the middle Velkerri, having only penetrated the C Shale and a portion of the mudstones between the C Shale and underlying B shale.
- The B Shale to C Shale inter-burden thickens considerably (Beetaloo W-1: 370.76mTVD) from the north of the Core Area and the OT Downs Area (Amungee NW-1: 132.35mTVD, Tanumbirini-1: 143.17TVDm, Mcmanus-1: 83.34mTVD) (Figure 11).

Beetaloo W-1 provides evidence to suggest that the base upper Velkerri Sands appear to coalesce and become better developed towards the southern margin of the preserved extent of the Beetaloo. This is evidenced from the increased frequency of the sand beds with less mudstone deposited between each bed as interpreted on wireline logs.

Being saturated with gas across the extent of the known Beetaloo, these sand beds could form a viable unconventional tight gas target if these sand beds can be found in a portion of the basin to be sufficiently stacked. Prospective areas for exploration for such a play within the Balmain Deep should be targeted towards the south and south east where observed regional sedimentary package trends indicate a general thickening and coalescing of sands.

The Kyalla Formation, the secondary target of the Beetaloo W-1 exploration well, was for the first time in the Beetaloo Balmain Deep fully logged with multi-spectral logs with core-calibrated petrophysical interpretations completed. Additionally, the first whole core rock mechanical testing on preserved core was undertaken over the Kyalla Formation to calibrate a geomechanical modelling.

Petrophysical results indicate that the Kyalla SRR intervals have good to excellent SRR potential, with high free gas porosity and moderate gas saturations (See section 9. Reservoir Evaluation). Lab analysis of wellsite sampled formation gas from the lower Kyalla SRR as well as extracted liquid hydrocarbon volumes from crushed rock retort analysis indicate the a Kyalla gas stream could yield natural gas liquids. Calculated yields of LPG and condensate per million standard cubic feet of gas production was calculated from the mol fraction lab gas analysis to attempt to approximate potential in place LPG and condensate (Table 7). CO_2 was calculated from air removed and normalised gas samples at 5.4% mol.

Sample Information			Inerts	Sales Gas		Liquid Yield	
Well Name / Interval	Sample Type	Expected Reservoir Phase Window	CO_2 (mol %)	Heating Value (C1-C4) PJ/Raw BCF	Heating Value (C1-C2) PJ/Raw BCF	LPG (bbl/mmscf)	Condensate (bbl/mmscf)
Beetaloo W-1 / Lower Kyalla SRR	Drill Gas Isotube™ Samples	Gas Condensate	5.4	1.40788	1.0017	96.63	23.81

Table 7 - Lower Kyalla SRR Calculated LPG and condensate yields

Kyalla SRR static geomechanical core testing results indicate that the Kyalla SRR intervals, have properties that are conducive to fracture stimulation (Static Poisson's ratio 0.15-0.24, Static Young's Modulus 2.15-5.26 x 10^6 psi). This new data challenges the previously held notion that the Kyalla SRR intervals were too high in clay content to be viable targets due to the expected ductile deformation characteristics traditionally aligned with high clay content (>30-50% volume).

Kyalla core from legacy wells illustrate that a significant portion of the rock appears to consist of visible platelets of muscovite. Historic X-ray diffraction data was not able to differentiate the difference between the bulk volume of illite and mica (including muscovite) due to the limitations of the technique. To better characterise the volume of muscovite within the samples Fourier infra-red spectroscopy (FTIR) was undertaken for bulk mineralogy of the Kyalla Formation samples. Results confirm muscovite is abundant (10-24%) in Kyalla Formation mudstones, particularly within the lower SRR.

There are statistically significant differences between XRD and FTIR results on exact sample splits with: XRD measuring greater feldspar content than FTIR, FTIR measuring more kaolinite than XRD and XRD measuring higher total quartz than FTIR. These differences are related to the technique differences. Work is ongoing to determine the best overall technique going forward into future core analysis on the Kyalla Formation.

Wet gas shows (peaking at C1-8356, C2-950, C3-316, nC4-75, iC4-39, nC5-17, iC5-23) were measured while drilling through an interval showing 60% very fine to fine grained, well sorted, sub-angular to sub-rounded, siliceous and calcareous cemented, with tight visual porous sandstone in drill cuttings in the Chambers River Formation. These wet gas shows demonstrate that migration into the Chambers River Formation has occurred within the central portion of EP117 but that reservoir quality and thickness is apparently lacking. It is likely that if reservoir sands of a thickness and porosity that are able to host economic hydrocarbon quantities can be located nearby, then these sands are likely to be hydrocarbon charged and will present a possible prospective unconventional tight gas play as penetrated at Amungee NW-1.

Arguably the most critical results from the Beetaloo W-1 well are:

1. The presence and consistent lithological characteristics of the middle Velkerri source rocks has been extended substantially south in the Beetaloo
2. The substantial thickening in the C Shale to B Shale interburden provides insights into basin geometry and/or processes at the time of the middle Velkerri deposition that were previously not known. The thickening is either indicative of changes in clastic source(s) in the Basin or of increased accommodation (subsidence) in the southern Beetaloo during deposition of this interburden interval.
3. The Kyalla Formation is prospective as a SRR in the southern Beetaloo Basin.

REFERENCES

Abbott S.T. and Sweet I.P., 2000, Tectonic control on third-order sequences in a siliciclastic ramp-style basin: an example from the Roper Superbasin (Mesoproterozoic), northern Australia. Australian Journal of Earth Sciences 47(3), p637-657.

Abbott, S.T., Sweet, I.P., Plumb, K.A., Young, D.N., Cutovinos, A., Ferenczi, P.A., Brakel, A., Pietsch, B.A., 2001, Roper Region: Urapunga and Roper River Special, Northern Territory (Second Edition), Sheets SD 53-10, SD53-11, 1:250 000 Geological Map Series Explanatory Notes Northern Territory Geological Survey, 100p.

Ahmad, M., Dunster, J.N., Munson, T.J., 2013, McArthur Basin IN 'Geology and mineral resources of the Northern Territory', Ahmad M. and Munson T.J. (compilers) Northern Territory Geological Survey. Special Publication 5, 15:1-72.

Appelo, C.A.J. and Postma, D., 2005, Geochemistry, Groundwater and Pollution, 2nd Edition, CRC Press, 688p.

Betts, P.G., and Giles, D., 2006, The 1800–1100 Ma tectonic evolution of Australia. Precambrian Research, 144, 92-125.

Collins, C.D.N., 1983, Crustal structure of the southern McArthur Basin, northern Australia, from deep seismic sounding. BMR Journal of Australian Geology and Geophysics 8(1), p19-34.

Connors, K.A and Page, R.W., 1995. Relationships between magmatism, metamorphism and deformation in the western Mount Isa Inlier, Australia. Precambrian Research, 71, 131-153.

Cull, J.P., 1982, Magnetotelluric profiles in the McArthur Basin of northern Australia. BMR Journal of Australian Geology and Geophysics 7(4), p275-286.

Dutkiewicz, A., Volk, H., Ridley, J., George, S.C., 2007, Precambrian inclusion oils in the Roper Group: a review. IN Munson, T.J. & Ambrose G.J. (eds) ' Proceedings of the Central Australian Basins Symposium', Alice Springs 16-18 Aug 2005. Northern Territory Geological Survey. Special Publication 2, p326-348.

Flavelle, A., 2017, Personal correspondence.

Foster, D.A., Ehlers, K., 1998, 40Ar/39Ar thermochronology of the southern Gawler Craton, Australia; implications for Mesoproterozoic and Neoproterozoic tectonics and reconstruction of East Gondwana and Rodinia. Journal Geophysics Research, 103, 10177– 10194.

Fulton, S., and Knapton A., 2015, Beetaloo Basin Hydrogeological Assessment. Cloud GMS Report (unpublished propriety report Origin Energy on behalf of Beetaloo Joint Venture), 66p.

Hoffman, T.W., 2016, Roper Basin burial history modelling: Inferences for the timing of hydrocarbon generation. AGES 2016 Proceedings, NT Geological Survey, 100-107.

Jackson, M.J., Sweet, I.P., Powell, T.G., 1988, Studies on petroleum geology and geochemistry, Middle Proterozoic, McArthur Basin northern Australia I: Petroleum potential. APEA Journal 28(1), p283-302.

Jackson, M.J., and Raiswell R., 1991, Sedimentology and carbon-sulphur geochemistry of the Velkerri Formation, a mid-Proterozoic potential oil source in northern Australia. Precambrian Research 54(1), p81-108.

Lanigan, K., Hibbird, S., Menpes, S., Torkington, J., 1994, Petroleum Exploration in the Proterozoic Beetaloo Sub-basin, Northern Territory. APEA Journal 34(1), p674 –691.

Loelinger, M., 1988, The diagenesis of sandstone reservoir rocks in the upper Roper Group of the Proterozoic McArthur Basin, Northern Territory. Honors Thesis – National Centre for Petroleum Geology and Geophysics – Adelaide University.

Myers, J.S., Shaw, R.D., and Tyler, I.M., 1996, Tectonic evolution of Proterozoic Australia. Tectonics, 15, 1431-1446.

Page, R.W., and Sun, S.S., 1998., Aspects of geochronology and crustal evolution in the Eastern Fold Belt, Mt. Isa Inlier. Australian Journal of Earth Sciences, 45, 343-361.

Ronald-1 Well Completion Report., 1993.

Spikings, R.A., Foster, D.A., Kohn, B.P., and Lister, G.S., 2002, Post-orogenic (<1500 Ma) thermal history of the Palaeo-Mesoproterozoic, Mt. Isa province, NE Australia. Techonophysics, 349, 327-365.

APPENDICES

Appendix 1: Composite Log
Appendix 2: Mudlogging
Appendix 3: Drilling
Appendix 4: Coring
Appendix 5: Wireline Logs
Appendix 6: Petrophysics
Appendix 7: Geological Sample Analyses