



Kyalla 117 N2-1H ST2

*Well Completion Report
(Interpretive)*

*EP 117
Beetaloo Sub-basin
Northern Territory*

Origin Energy Resources Ltd

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Glossary

BHA	Bottom Hole Assembly
BOP	Blow Out Preventer
CVT	Constant Volume Trap
DF	Drill Floor
DFIT	Diagnostic Fracture Injection Test
DST	Drill Stem Test
EMW	Estimated Mud Weight
EP	Exploration Permit
FIT	Formation Integrity Test
Fm	Formation
ft	Feet
GVR	Geo-Vision Resistivity
HF	Hydraulic Fracturing
ID	Inner Diameter
JV	Joint Venture
KB	Kelly bushing
LOP	Leak Off Pressure
LOT	Leak Off Test
LWD	Logging While Drilling
m	Metre
MD	Measured Depth
mMD	metres, measured depth
mRT	Meters, Rotary table
mMDRT	Meters, measured depth, rotary table
MW	Mud Weight
MWD	Measurement While Drilling
OD	Outer Diameter
PDC	Polycrystalline Diamond Compact
POOH	Pull Out Of Hole
ppg	Pounds per Gallon
psi	pounds per square inch
RCJB	Reverse Circulation Junk Basket
RIH	Run in Hole
RSS	Rotary Steerable System
RT	Rotary Table
ST	Sidetrack
TD	Total Depth
WBM	Water based mud
XLOT	Extended Leak Off Test

1 WELL SUMMARY SHEET

Well Name	Kyalla 117 N2 1H	Petroleum Title	EP117	Basin	McArthur Basin (Beetaloo Sub-basin)		
Well Purpose	Appraisal	Status	Plugged and Abandoned	Parent Well Name, if any	Kyalla 117 N2-1		
Spud Date	30/11/2019	TD Date	04/12/2019	End of Well Date	06/12/2019		
Primary Objective	lower Kyalla shale			Rig(s) Name	Ensign 963		
Secondary Objective				100K Map Sheet	Warramban (5664)		
Total Depth	Driller	mMDRT	mTVDSS	Side-Track Kick-off Depth, if applicable	1288.33mMDRT		
	Logger	1628.79	-1323.45				
Location (GDA94 Datum with GRS80 Ellipsoid using MGA94 Grid)	Coordinates	Surface	Bottom Hole	Drill Datum <input type="checkbox"/> DF <input checked="" type="checkbox"/> RT <input type="checkbox"/> KB	GL Elevation: 269.92m Elevation Datum: Mean Sea Level Drill Datum Elevation: 277.15m		
	Latitude	16°50' 29.29" S	16° 50' 32.73" S		Seismic Station, if applicable	Survey / Line	Inline
Longitude	133°39' 06.752" E	133°39' 08.633" E	Mc92 – 123.				
Zone	Easting	356 370.07	356 426.48	Ma91 – 294.			
53	Northing	8 137 492.64	8 137 387.19				
Well Summary							
<p>Ensign Rig 963 was used to kick off the Kyalla 117 N2-1H wellbore from the vertical well Kyalla 117 N2-1. A Reed NOV Tricone bit, Pathfinder mudmotor and MWD tool suite was run in hole (RIH) and the cement kick-off plug was drilled from 1262 to 1288mMDRT. New formation was confirmed and the 12 ¼" intermediate build section was drilled ahead from 1288mMDRT as per the directional drillers instructions. At 1626 mMD on December 04, 2019 the ROP started to drop off. When attempting to pick BHA off bottom it was observed to be hanging up. Successfully got back on bottom but while attempting to slide erratic tool face was observed; hence commenced rotating ahead. A low ROP of 0.4 m/hr was observed on drill ahead. Whilst drilling ahead 3 torque spikes were observed. This coincided with pump failure on surface which resulted in erratic stand pipe pressure. The decision was made to cease drilling and pull out of hole (POOH). At surface it was observed that all three cones from the tri-cone bit had been left down hole. A reverse circulation junk basket (RCJB) and magnet were RIH to retrieve the cones, but fishing was unsuccessful. Operations ceased and Kyalla 117 N2-1H was plugged back to 1448.3mMDRT.</p>							

Hole and Casing Design (Drillers Depths)						Drilling Fluid	
Casing String	Hole Size (inches)	Casing Depth Range (mMDRT)	Casing Size (inches)	Casing Shoe Depth (mMDRT)	Casing Shoe Depth (mTVDSS)	Hole Size (inches)	Drilling Fluid Description
Civil Conductor/ Stove Pipe	NA	7.23-19	30"	NA	NA	NA	NA
Conductor	22"	19-194	18 ⅝"	193.7	83.45	22"	KCl polymer water-based drilling fluid
Surface	17 ½"	194-548	13 ⅝"	544.65	-267.5	17 ½"	KCl polymer water-based drilling fluid
Intermediate	12 ¼"	548-1628.79	NA	NA	NA	12 ¼"	KCl polymer water-based drilling fluid



Stratigraphy – Formation Tops (Loggers Depths)					Formation Evaluation			
Formation	Depth				Suite/ Run	Measurement	Depth Interval	
	mMDRT	mTVDRT	mTVDGL	mTVDSS			From (mMDRT)	To (mMDRT)
Undifferentiated Cretaceous	7.23	7.23	0	269.92				
Anthony Lagoon Formation	70	70	-62.77	207.1				
Gum Ridge Formation	191.4	191.4	-184.17	85.7				
Antrim Plateau Volcanics	399.5	399.5	-392.27	-122.4				
Bukalara Sandstone	499	499	-491.77	-221.9				
Hayfield Formation	506.7	506.7	-499.47	-229.6				
Jamison Sandstone	891.3	891.3	-883.77	-614.2				
Kyalla Formation	989	989	-981.77	-711.9				

Mud Logging	Formation Testing (DST)	DFIT	
Standard service including constant volume trap chromatograph mud gas analysis, drill cuttings collection, drill gas sampling with Isotubes™, headspace gas sampling with Isojars™	NIL		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
		Hydraulic Fracturing	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Conventional Coring	Hydrocarbon Shows		
NIL	Kyalla Formation		
Completion			
Plugged and Abandoned			



Well Name	Kyalla 117 N2 1H ST1	Petroleum Title	EP117	Basin	McArthur Basin (Beetaloo Sub-basin)		
Well Purpose	Appraisal	Status	Plugged and Abandoned	Parent Well Name, if any	Kyalla 117 N2-1H		
Spud Date	07/12/2019	TD Date	26/12/2019	End of Well Date	23/01/2019		
Primary Objective		lower Kyalla shale		Rig(s) Name	Ensign 963		
Secondary Objective				100K Map Sheet	Warramban (5664)		
Total Depth	Driller	mMDRT	mTV DSS	Side-Track Kick-off Depth, if applicable	1457mMDRT		
	Logger	2809.00	-1504.15				
Location (GDA94 Datum with GRS80 Ellipsoid using MGA94 Grid)	Coordinates	Surface	Bottom Hole	Drill Datum <input type="checkbox"/> DF <input checked="" type="checkbox"/> RT <input type="checkbox"/> KB	GL Elevation: 269.92m Elevation Datum: Mean Sea Level Drill Datum Elevation: 277.15m		
	Latitude	16°50' 29.29" S	16° 51' 04.97" S				
	Longitude	133°39' 06.752" E	133°39' 26.13" E	Seismic Station, if applicable	Survey / Line	Inline	Xline
Zone	Easting	356 370.07	356 950.96		Mc92 – 123.		
53	Northing	8 137 492.64	8 136 399.69		Ma91 – 294.		
Well Summary							

Ensign Rig 963 was used to kick off Kyalla 117 N2-1H ST1 from Kyalla 117 N2-1H. A backup Reed NOV Tricone bit, Pathfinder mud motor and measurement while drilling (MWD) tool suite was RIH, tagging the top of the cement side-track plug at 1448.3mMDRT. The side-track plug was drilled out to the kick-off depth of 1457mMDRT where 50% new formation was confirmed. The 12 ¼" intermediate build section was drilled ahead from 1457mMDRT to 1506mMDRT where the decision was made to POOH and switch from Tricone / Mud Motor BHA to a Ulterra's CF713 Polycrystalline Diamond Compact (PDC) bit in combination with the Powerdrive rotary steerable system (RSS) directional drilling assembly. The modified bottom hole assembly (BHA) was RIH drilling proceeded to a depth of 1745mMDRT. At 1745mMDRT the decision was made to POOH to swap the RSS for a mud motor due to insufficient inclination building rates. Using the modified BHA with NOV's TKC76 (PDC) bit in combination with the 7-3/4" mud motor directional drilling assembly, drilling proceeded to the 12 ¼" hole section total depth of 1990mMDRT. 9 ¾" intermediate casing was RIH and cemented; with the intermediate casing shoe set at 1984.88mMDRT. A USIT log was run and a good cement bond between the 9 ¾" casing and surrounding formation was confirmed. The shoe track was drilled out from and 3 meters of new formation drilled to 1993mMDRT and an Extended Leak Off Test (XLOT) with an equivalent mud weight (EMW) of 21.5ppg (LOP – 3064psi, MW 11.5ppg) was conducted. The 8 ½" production section was drilled ahead using a PDC bit, Powerdrive RSS, GVR and MWD directional assembly. As per the directional drillers instructions inclination was gradually built to 90° which was achieved at approximately 2114mMDRT. The section drilled ahead to 2454mMDRT. At this depth a high viscosity flocculated mud (3min/qt) was observed in the suction tank. The mud was circulated and conditioned until it reached 62 sec/qt. Drilling recommenced and continued ahead to 2710mMDRT. At 2710mMDRT a high viscosity mud (3min/qt) and reduced hole cleaning was identified out of hole. Shale cavings were observed at the shale shakers while at the same time the mud system was foaming at the mud tanks. A low viscosity sweep was pumped, the hole was circulated clean and a wiper trip was conducted back to the shoe where another low viscosity sweep was pumped. Five stands of drillpipe were pulled back inside the casing and the drag was recorded.

After observing no obstructions while passing through the avalanche zone the drill string was run back to bottom and the 8 ½" intermediate hole drilled ahead to 2786mMDRT. Drilling ceased to troubleshoot losses in stand pipe pressure (SPP) associated with aeration of the mud system. One stand of drill pipe was racked back and hydraulics testing of the short circulating system was conducted. After unsuccessfully attempting to recondition the mud and finding no issues with the mud pumps a decision was made to POOH to repair the mud system and change the BHA due to loss of signal to the Powerdrive RSS tool. The BHA was RIH, washing and reaming through tight spots from 2472mMDRT to current total depth of 2786mMDRT. Drilling recommenced and the 8 ½" intermediate hole section was drilled ahead to 2809mMDRT. While drilling several drops in SPP were encountered and aerated mud continued to be an issue. At 2809mMDRT the decision was made to POOH and swap to a new mud system. While back reaming out of the hole tight spots were encountered at 2440 and 2375mMDRT. The string packed off at 2375mMDRT. As a response the drill string was worked with no rotation, 100klbs was slacked off and torque was increased to 30kft-lbs which resulted in successfully re-establishing rotation and circulation. A low viscosity sweep was pumped and attempted to back ream from 2375mMDRT. A pressure drop from 1550psi to 580psi at 400gpm, a torque reduction from 1-9 kft-lbs at 120 rpm and reduced drag indicated that while attempting to free the string the drill pipe had twisted / backed off. Upon pulling out of hole it was observed that the BHA and 14 joints (238m) of drill pipe had been left in the hole. A cut pin screw-in sub fishing assembly was RIH on drill pipe and an attempt was made to engage the fish. After six unsuccessful attempts to retrieve the fish the assembly was POOH and switched to a 6 ¾" spiral grapple overshot assembly. After three attempts the pipe was successfully latched. While attempting to pass through the 9 ¾" casing shoe the drill collars became stuck resulting in losing the fish again along with 1.3m of the spiral grapple. A 7" magnet, bump sub and junk basket were RIH in an attempt to retrieve the grapple and any metal debris left in the hole. The top of the fish was tagged at 1771mMDRT however no significant recovery was observed on the magnet or basket when brought back to surface. An overshot and accelerator fishing assembly was RIH, tagging the top of the fish at 1771mMDRT. While attempting to latch on, the string was pushed down-hole to a depth of 2004.91mMDRT without a successfully latching. A skirt milling assembly was made up and RIH. The top of the fish was tagged at 2004.91mMDRT and was milled to 2007.14mMDRT. At this depth it was observed that the mill was no longer functioning and the assembly was POOH to surface. A new concave mill assembly was run in the hole, tagging the top of fish at 2007.14mMDRT and milling of the drill pipe commenced to a depth of 2029.72mMDRT, and the junk and swarf circulated out of the hole. An overshot assembly with basket grapple was run in the hole, washing and rotating through numerous tight spots to the top of the fish at 2027.91mMDRT. The string was pumped out of the hole back to 1371.0mMDRT, then pulled to surface, recovering the entire drill pipe and BHA. Once the entire fish was at surface the mud system was discarded and new 11.7ppg drilling mud was built up. A clean out assembly was RIH to a depth of 1964mMDRT (inside 9 ¾" casing) and the fresh mud was displaced. While running in hole to current TD a number of tight spots and pack offs were encountered which were treated with sweeps and reaming. At 2137mMDRT a carbide lag test was performed and the open hole from 1990 to 2137mMDRT was calculated to be 10.23" (approximately 17% over gauge). During the subsequent trip out of hole significant cavings were observed at the shakers. Due to these indications of well bore instability, along with the over gauge borehole being out of specification for future hydraulic fracture stimulation the decision was made to plug and abandon Kyalla 117 N2-1H ST1. A bridge plug was RIH and set inside the 9 ¾" casing at 1779.5mMDRT and subsequently pressure tested to 3,733psi / 10mins or 500psi above Leak off test pressure conducted on 9-5/8" casing shoe. This was followed by a cement plug set at a depth of 1779.5mMDRT and extending to 1585.5mMDRT. Cement plug correct placement was confirmed with a 2klbs tag weigh on bit (WOB). Operations on Kyalla 117 N2-1H ST1 ceased at 06:45 on January 24, 2020, switching to Kyalla 117N2-1H ST2.



Hole and Casing Design (Drillers Depths)						Drilling Fluid	
Casing String	Hole Size (inches)	Casing Depth Range (mMDRT)	Casing Size (inches)	Casing Shoe Depth (mMDRT)	Casing Shoe Depth (mTVDSS)	Hole Size (inches)	Drilling Fluid Description
Civil Conductor/ Stove Pipe	NA	7.23-19	30"	NA	NA	NA	NA
Conductor	22"	19-194	18 5/8"	193.7	83.45	22"	KCl polymer water-based drilling fluid
Surface	17 1/2"	194-548	13 3/8"	544.65	-267.5	17 1/2"	KCl polymer water-based drilling fluid
Intermediate	12 1/4"	1457-1990	9 5/8"	1984.88	-1513	12 1/4"	KCl polymer water-based drilling fluid
Production	8 1/2"	1990 - 2809	-	-	-	8 1/2"	KCl polymer water-based drilling fluid

Stratigraphy – Formation Tops (Loggers Depths)					Formation Evaluation			
Formation	Depth				Suite/ Run	Measurement	Depth Interval	
	mMDRT	mTVDRT	mTVDGL	mTVDSS			From (mMDRT)	To (mMDRT)
Undifferentiated Cretaceous	7.23	7.23	0	269.92	S1/R1	USIT	5	1800
Anthony Lagoon Formation	70	70	-62.77	207.1				
Gum Ridge Formation	191.4	191.4	-184.17	85.7				
Antrim Plateau Volcanics	399.5	399.5	-392.27	-122.4				
Bukalara Sandstone	499	499	-491.77	-221.9				
Hayfield Formation	506.7	506.7	-499.47	-229.6				
Jamison Sandstone	891.3	891.3	-883.77	-614.2				
Kyalla Formation	989	989	-981.77	-711.9				
Lower Kyalla Shale	1832	1755.64	1748.41	-1478.49				

Mud Logging	Formation Testing (DST)	DFIT
Standard service including constant volume trap chromatograph mud gas analysis, drill cuttings collection, drill gas sampling with Isotubes™, headspace gas sampling with Isojars™	NIL	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Conventional Coring	Hydrocarbon Shows	
NIL	Kyalla Formation	
Completion		
Plugged and Abandoned		



Well Name	Kyalla 117 N2 1H ST2	Petroleum Title	EP117	Basin	McArthur Basin (Beetaloo Sub-basin)		
Well Purpose	Appraisal	Status	Cased and Suspended	Parent Well Name, if any	Kyalla 117 N2-1		
Spud Date	24/01/2020	TD Date	13/02/2020	Rig Release Date	21/01/2019		
Primary Objective		lower Kyalla shale		Rig(s) Name	Ensign 963		
Secondary Objective				100K Map Sheet	Warramban (5664)		
Total Depth	Driller	mMDRT	mTVDS	Side-Track Kick-off Depth, if applicable	1457mMDRT		
	Logger	3809.0	-1501.47				
Location (GDA94 Datum with GRS80 Ellipsoid using MGA94 Grid)	Coordinates	Surface	Bottom Hole	Drill Datum <input type="checkbox"/> DF <input checked="" type="checkbox"/> RT <input type="checkbox"/> KB	GL Elevation: 269.92m Elevation Datum: Mean Sea Level Drill Datum Elevation: 277.15m		
	Latitude	16°50' 29.29" S	16° 49' 25.12" S				
Zone	Longitude	133°39' 06.752" E	133°38' 28.84" E	Seismic Station, if applicable	Survey / Line	Inline	Xline
53	Easting	356 370.07	355 234.30		Mc92 – 123.		
	Northing	8 137 492.64	8 139 457.32		Ma91 – 294.		
Well Summary							

Ensign Rig 963 was used to kick off Kyalla 117 N2-1HST2 from the vertical well Kyalla 117 N2-1. On January 24, 2020, a single trip whipstock and tri-mill assembly was prepared to be RIH. The UBHO in the whipstock BHA was scribed in the desired azimuth and the whipstock was RIH to 1202mMDRT. A Schlumberger wireline unit was rigged up to run a gyro to orientate the whipstock. The whipstock was orientated to 326.92°. After pulling the gyro tool out of hole the whipstock was pulled back from 1202m to the whipstock anchor set depth of 1199.6mMDRT.

Top of whipstock assembly: 1192mMDRT

Bottom of Anchor (set depth): 1199.6mMDRT Anchor Slips: 1198.45mMDRT

Whipstock final orientation: 326.92°

The milling BHA was RIH to the top of the whipstock, which was tagged at 1192mMDRT. Milling of the casing commenced from 1192 to 1200mMDRT. 10bbl high viscosity sweeps were pumped at regular intervals to clean the hole from metal swarf. Kyalla 117 N2-1H ST2 was kicked off in the Upper Kyalla Formation at a depth of 1196.42mMDRT. Altogether 199kg of metal swarf was collected from the ditch magnets in the possum belly while milling the casing. Two high viscosity sweeps were pumped to clear the hole of any remaining swarf before pulling the milling BHA out of hole to surface and running in hole with a magnet for a clean out trip.

A 8 ½" NOV 616 PDC bit, mud motor and the pathfinder directional drilling and MWD assembly was RIH and a Formation Integrity Test (FIT) was conducted with 10.5ppg mud to 1021psi, giving an equivalent mud weight of 15.5ppg. The 8 ½" production section was drilled ahead from 1200mMDRT to 1257mMDRT. The gyro tool was RIH on wireline to 1227.17mMDRT where it recorded a gyro survey at 1221.6mMDRT (357.1° azimuth, 6.28° inclination) confirming directional assembly tool face orientation.

The gyro tool was POOH to surface and the 8 ½" build section was drilled ahead to 1466mMDRT, taking surveys as per the directional drillers instructions. After pumping and circulating out High Viscosity (Hi-Vis) sweeps to clear the hole of any cuttings, spotted 20bbl of High Viscosity (Hi-Vis) pill at bottom prior to pull out the directional assembly to surface to change Bit and Stabilizer.

An Ulterra PDC bit with mud motor and pathfinder directional assembly and MWD tools were RIH to 1454mMDRT, then washed down to bottom to clear cuttings. The 8 ½" build section was drilled ahead, rotating and sliding as per the directional drillers instructions to 1696mMDRT. At 1696mMDRT a reduction in the rate of penetration (ROP) during sliding indicated the tool was getting hung up and unable to transfer weight to the bit. A lubricant (BDF-933) was added to the mud system but no improvement in ROP was observed. Drilling continued ahead in the 8 ½" build section, intersecting the Lower Kyalla Formation at a depth of 1710.9mMDRT with no improvement in ROP. A decision was made to POOH to change the BHA. High viscosity sweeps were pumped and circulated out of hole prior to pulling the BHA to surface.

An Ulterra PDC bit with mud motor and pathfinder directional assembly and MWD tools were RIH to 1685mMDRT, then washed down to bottom to clear cuttings. Commenced drill and slide ahead 8 ½" hole section to 1715mMDRT unable to get weight on Bit while sliding. At this stage decision made to POOH and replace directional motor to a PowerDrive RSS. After pumping and circulating out High Viscosity sweeps to clear the hole of any cuttings, spotted 20bbl of High Viscosity (Hi-Vis) pill at bottom prior to pull out the directional assembly to surface.

An Ulterra PDC bit with Powerdrive RSS and pathfinder directional assembly and MWD tools were RIH to 1685mMDRT, then washed down to bottom to clear cuttings. The 8 ½" build section was drilled ahead, rotating and sliding as per the directional drillers instructions from 1715mMDRT to 2090mMDRT where an inclination of 83.81° and an azimuth of 329.15° was reached. The total depth for the build section was called at 2090mMDRT. High viscosity sweeps were pumped and circulated out of hole prior to pulling the BHA to surface to pick up the GVR tool.

A NOV 616 PDC bit with Powerdrive RSS and pathfinder directional assembly, GVR and MWD suite were RIH to 1930mMDRT and commenced logging the 8 ½" build section to 2090mMDRT. Drilled ahead in the 8 ½" production section to 2093mMDRT before losing communication with the downhole tools resulting in the BHA being POOH for inspection. A low viscosity sweep was pumped, the well was circulated clean, a 50bbl high viscosity pill was spotted and a flow check was conducted (static) before the BHA was POOH.

The Powerdrive RSS was successfully tested at surface before being RIH with a NOV 616 PDC bit, pathfinder directional assembly, GVR and MWD suite to 2070mMDRT. From this depth the bottom hole assembly washed down to bottom to clear cuttings. The 8 ½" horizontal production section was drilled ahead as per the directional drillers instructions to a total depth of 3809.1mMDRT with 90.45° inclination. After pumping and circulating out high viscosity sweeps to clear the borehole of any cuttings the BHA was POOH on elevators. A tight spot was encountered at 3363mMDRT but was cleared by running in hole by one stand and reaming the tight hole section. POOH with the BHA continued on elevators and the BHA was laid out sideways at surface. The well was subsequently cased with 5 ½" production casing, cemented and suspended. The well suspension operations were successfully conducted with Tubing Head (B-Section) installed and tested at Kyalla 117 N2-1H ST2 on February 21, 2020 and the rig was released.



Hole and Casing Design (Drillers Depths)						Drilling Fluid	
Casing String	Hole Size (inches)	Casing Depth Range (mMDRT)	Casing Size (inches)	Casing Shoe Depth (mMDRT)	Casing Shoe Depth (mTVDSS)	Hole Size (inches)	Drilling Fluid Description
Civil Conductor/ Stove Pipe	NA	7.23-19	30"	NA	NA	NA	NA
Conductor	22"	19-194	18 5/8"	193.7	83.45	22"	KCl polymer water-based drilling fluid
Surface	17 1/2"	194-548	13 3/8"	544.65	-267.5	17 1/2"	KCl polymer water-based drilling fluid
Intermediate	12 1/4"	548-1196	9 5/8"	1984.88	-1513	12 1/4"	KCl polymer water-based drilling fluid
Production	8 1/2 "	1196 - 3809	8 1/2 "	3802.45	-1508	8 1/2 "	KCl polymer water-based drilling fluid

Stratigraphy – Formation Tops (Loggers Depths)					Formation Evaluation			
Formation	Depth				Suite/ Run	Measurement	Depth Interval	
	mMDRT	mTVDRT	mTVDGL	mTVDSS			From (mMDRT)	To (mMDRT)
Undifferentiated Cretaceous	7.23	7.23	0	269.92	S2/R2	CBL-VDL-MAP	7.47	1977.54
Anthony Lagoon Formation	70	70	-62.77	207.1				
Gum Ridge Formation	191.4	191.4	-184.17	85.7				
Antrim Plateau Volcanics	399.5	399.5	-392.27	-122.4				
Bukalara Sandstone	499	499	-491.77	-221.9				
Hayfield Formation	506.7	506.7	-499.47	-229.6				
Jamison Sandstone	891.3	891.3	-883.77	-614.2				
Kyalla Formation	989	989	-981.77	-711.9				
Lower Kyalla Shale	1945	1754	1746.77	-1477				

Mud Logging	Formation Testing (DST)	DFIT	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Standard service including constant volume trap chromatograph mud gas analysis, drill cuttings collection, drill gas sampling with Isotubes™, headspace gas sampling with Isojars™	NIL	Hydraulic Fracturing	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Conventional Coring	Hydrocarbon Shows		
NIL	Gas Shows - Kyalla Formation		
Completion			
Cased and Suspended for Multistage Hydraulic Fracture Stimulation			

2 INTRODUCTION

Kyalla 117 N2-1H ST2 was drilled within Exploration Permit 117(R) in the Northern Territory, Australia by the Origin Energy Resources Ltd and Falcon Oil and Gas Joint Venture (“JV”). The well is the second well of a two well exploration and appraisal campaign pertaining to Year 4 of the permit commitments. The primary objective of the well was to appraise the unconventional production potential of the organically enriched Lower Kyalla Shale within the Kyalla Formation.

EP117 is one of three permits held by the JV in which Origin Energy is the operator. The permits are located within the Beetaloo Sub-basin (“Beetaloo”) of the greater McArthur Basin. Recent studies regarding the hydrocarbon potential of the Beetaloo have indicated that the organically enriched source rock intervals within the Mesoproterozoic Kyalla Formation have potential as regional shale plays. The location of the Kyalla 117 N2 1 well was selected with the intent to intersect the thickest and deepest preserved section of the target Kyalla Formation within the JV permits, between known penetrations of prospective Kyalla Formation. The Kyalla 117 N2-1H ST2 well subsequently targeted the Lower Kyalla Shale which was found to have the highest reservoir potential from analysis of the offset Kyalla 117 N2-1 well.

Kyalla 117 N2-1H ST2 is located approximately 70 km southeast of the town of Daly Waters (Figure 1).

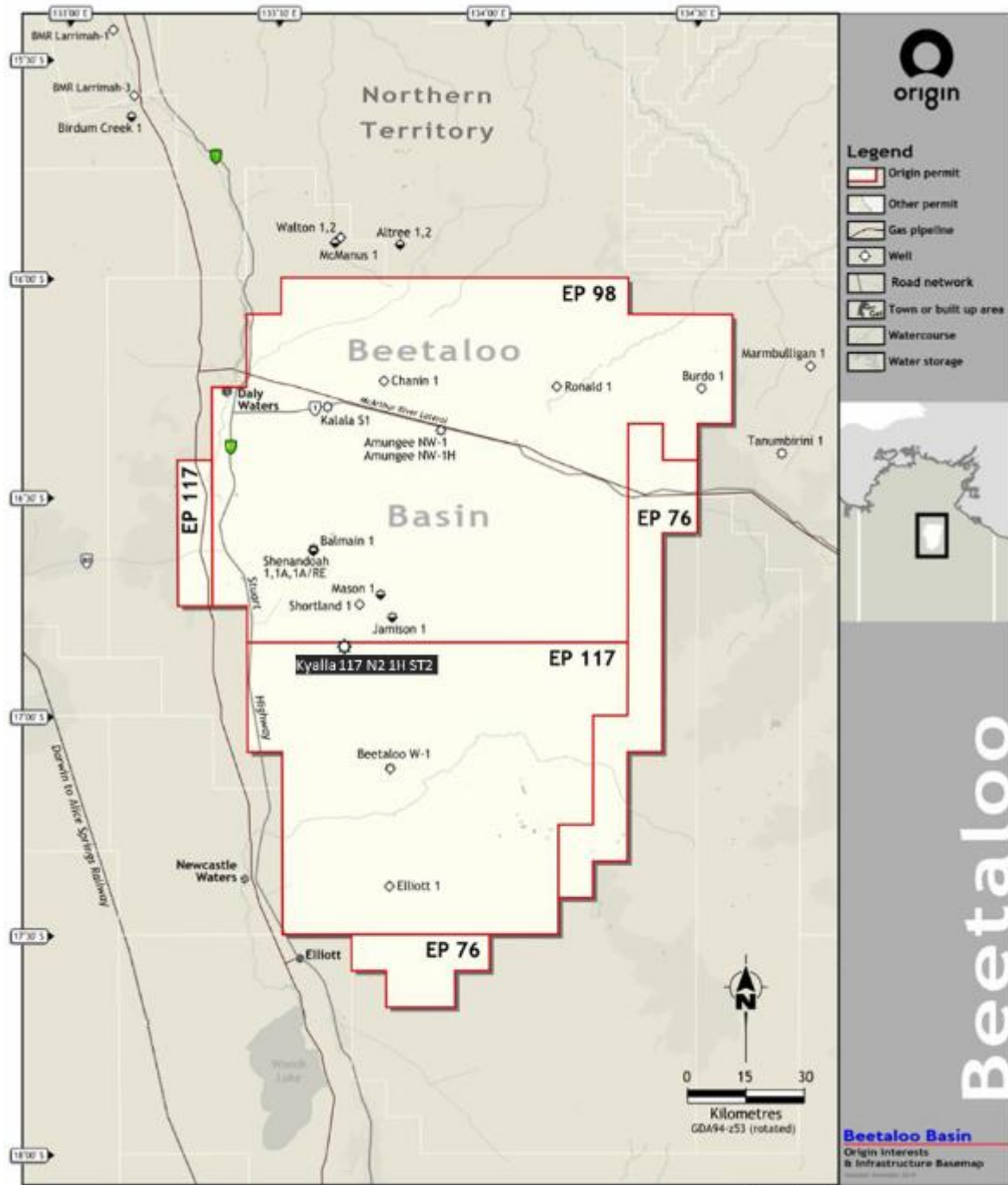


Figure 1. Kyalla 117 N2-1H ST2 Well Location and Permit Map

2.1 WELL OBJECTIVES

The primary aim of Kyalla 117 N2-1H ST2 was to appraise the production potential of the lower Kyalla shale. The well successfully met all of its well objectives, which included;

- Drill a >1000m lateral section within the Lower Kyalla Shale reservoir target unit
- Confirming the presence and reservoir quality of the Lower Kyalla Shale laterally away from offset Kyalla 117 N2-1
- Capturing a suite of LWD logs to enable the development of structural/stratigraphic models for evaluation of the reservoir

3 GEOLOGY

3.1 BEETALOO SUB-BASIN STRATIGRAPHY

The Beetaloo Sub-Basin of the Greater McArthur Basin contains thick, preserved intervals of Mesoproterozoic aged Roper Group sediments that were deposited in an interpreted large epeiric sea dubbed the Roper Seaway (Cox et al, 2016).

The Mesoproterozoic Roper Group (Figure 2) comprises progradational cycles of mudstone and sandstone units reaching thickness' greater than 3000 m with averages of 1500 m away from major depocenters (Abbott and Sweet, 2000). Even though the succession has yet to be fully penetrated in the deepest depocenters, individual formations show remarkable consistency in thickness and lateral continuity in seismic profiles enabling them to be traced across the basin (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 was deposited in a variety of settings within shallow-marine, and nearshore to shelf environments (Powell et al., 1987; Jackson et al., 1988; Abbott and Sweet, 2000) with organic enrichment confined to the Velkerri and Kyalla formations. Several units within the sequence have been recognised as having excellent hydrocarbon potential.

Detailed descriptions of stratigraphy intersected in Kyalla 117 N2-1H ST2 is discussed in Section 4.2 Lithostratigraphy.

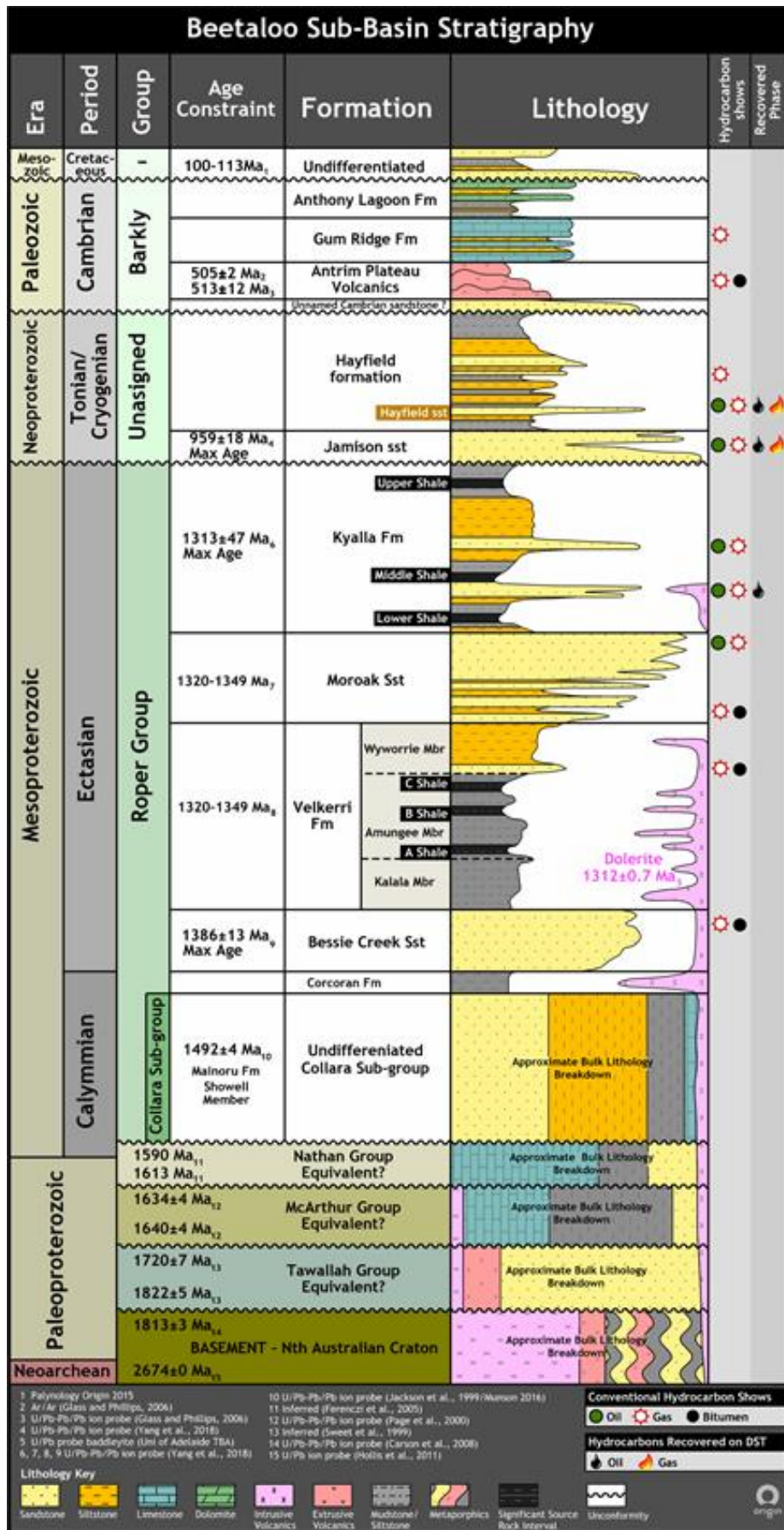


Figure 2. Beetaloo Sub-Basin Stratigraphy

3.2 PROSPECT DESCRIPTION

The Roper Group is often interpreted as having excellent potential for unconventional hydrocarbon production due to the presence of several organic-rich shale units. Currently, the intervals with the greatest recognised potential are the Velkerri and Kyalla Formations (Altmann et al, 2018). Within the area of the Beetaloo JV permits (EP117, EP98 and EP76) thick intervals of organically enriched Velkerri (4-8% ave. TOC %wt) and Kyalla (2-5% ave. TOC %wt) Formation source rocks are present and are currently being explored for unconventional hydrocarbon resources.

The Kyalla Formation is dominated by grey and black siltstone and mudstone, with regionally variable sandstone content. The unit conformably overlies the Moroak Sandstone, and exhibits a sharp, erosional and disconformable contact with the overlying Neoproterozoic Jamison sandstone (Figure 2).

Although dispersed organic matter exists throughout the Kyalla Formation, there are three known and identified intervals of organically enriched mudstone which have been historically (Karajas & Flavelle 1995) and more recently (Altmann et al 2018) considered as potential reservoir target shale plays. From deepest to shallowest, these three intervals have been informally named by Origin Energy as the lower, middle and upper Kyalla shales (Figure 2). Of these three intervals, the lower Kyalla shale has been identified as having the greatest hydrocarbon storage capability due to its regionally consistent reservoir thickness and quality (Altmann et al 2018). Historic exploration in the Beetaloo Sub-basin has observed oil bleeds and gas shows, good shale reservoir properties, and minor gas to surface from the Kyalla Formation which support the model for a shale resource play. The target reservoir for Kyalla 117 N2-1H ST2 was the Lower Kyalla Shale Kyalla Formation.

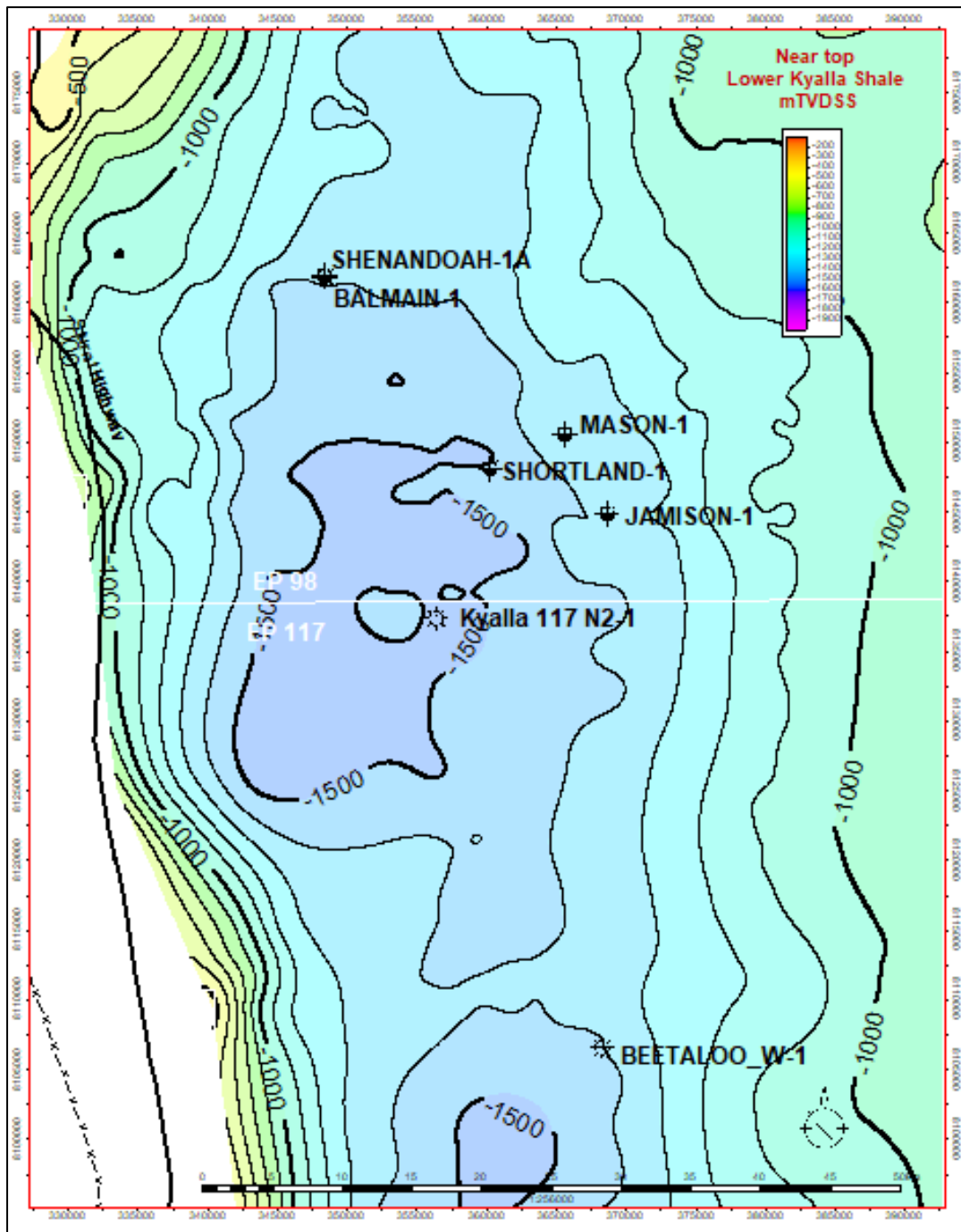


Figure 3. Post-drill structural map showing the near top of the Lower Kyalla Shale mTVDSS. Contour interval is 100m. Location of Kyalla 117 N2-1/1H ST2 in EP 117 is shown.

4 RESULTS OF DRILLING

4.1 INTERSECTED STRATIGRAPHY AND PROGNOSIS

The stratigraphic sequence intersected in Kyalla 117 N2-1H, Kyalla 117 N2-1H ST1, & Kyalla 117 N2-1H ST2 is summarized in Section 1. WELL SUMMARY SHEET.

4.2 LITHOSTRATIGRAPHY

Below is a summary of the lithostratigraphy of Kyalla 117 N2-1H ST2. For detailed drilling cutting lithology refer to Appendix 5.

Kyalla 117 N2-1H ST2 was spudded into middle of the Kyalla Formation, comprising light to medium grey argillaceous shale with minor interbedded very fine, light grey to medium greyish-brown sandstone.

The **Middle Kyalla shale** was intersected at 1570mMDRT. The unit comprised interbedded medium light grey, medium grey and dark grey shale and siltstone with minor sandstone. In increase in drilling gas was also observed when drilling this unit. No fluorescence was observed in samples.

A cleaner sandstone unit, historically referred to as the '**Elliott Sandstone Member**', was intersected at 1633mMDRT. This sandstone was comprised of yellowish grey, very fine grain to medium grain, dominantly fine grain, clear to frosted, sub-rounded, subspherical, minor carbonaceous flecks, cemented aggregates and loose grains. Fluorescence was observed in the sandstone from 1626-1632mMDRT, with moderate bright pale yellow, diffuse fluorescence in grain aggregates, nil to very faint diffuse cut. Very faint, very pale-yellow ring residue.

At 1654mMDRT the base of the 'Elliott Sandstone Member' was penetrated, and lithology changed to interbedded medium light grey, medium grey and medium dark grey shale and siltstone with minor sandstone interbeds. Mudgas steadily increased at the base of the interval, assisting in the identification of the top lower Kyalla shale.

The **lower Kyalla shale** was intersected at 1945mMDRT, and the wellbore remained within the unit to well total depth of 3809mMDRT. The Lower Kyalla Shale comprised dark grey to greyish-black shales with minor interlaminated to thinly interbedded siltstone and very-fine grained sandstone. Shale cuttings were highly carbonaceous and contained trace amounts of pyrite. The medium to dark grey siltstones were described as hard, argillaceous and commonly micaceous. A strong increase in drill gas was observed when drilling the unit. No fluorescence was observed.

4.3 RESERVOIR DESCRIPTION AND DEPOSITIONAL ENVIRONMENT

4.3.1 Kyalla Formation

The Kyalla Formation is a silty mudstone with thin planar interbeds of siltstone and sandstone. Intervals of fine to medium grained sandstone, up to 70 m thick have also been recorded in the lower half of the formation (Lanigan et al, 1994) with southern and eastern well penetrations (Beetaloo W-1, Elliott-1, Tanumbirini-1) to date indicating better developed intra-formational sands. This variation has been hypothesised to be associated to differences in well proximity to the paleo-sediment source at the time of Kyalla deposition. Prospective horizons within the Kyalla Formation consist of organically enriched shale intervals, with three identified prospective intervals informally referred to by Origin as the lower, middle and upper Kyalla shales.

The Kyalla Formation is extensive across the Beetaloo Sub-Basin but has been variably eroded by the base Jamison Sandstone (Base Neoproterozoic) unconformity across the broad anticlinal Arnold Arch structure and towards the edges of the Beetaloo Sub-basin. The formation is shown from 2D seismic lines and well penetrations to be best preserved within current day Beetaloo Sub-basin deeps where the least base Neoproterozoic erosion has taken place. Prior to Kyalla 117 N2-1 the thickest penetrations to date within these Basin deeps have been intersected at Tanumbirini-1 (835 m) and Beetaloo W-1 (796.6 m). The Kyalla Formation was 808 m thick at Kyalla 117 N2-1, with the formation intersected from 989 to 1851 mMDRT. The Kyalla Formation conformably overlies the Moroak Sandstone (Fulton and Knapton, 2015).

The Kyalla Formation is interpreted to have been deposited in a storm-dominated, marine shelf environment (Munson, 2016). This interpretation is supported through the presence of interbedded and interlaminated mudstone, siltstone and very fine sandstone along with the identification of tool marks, gutter casts, flute casts, and hummocky and swaley cross-stratification in exposures of the unit within road cuttings and open cut mines.

4.4 RESERVOIR PROPERTIES ANALYSIS

4.4.1 Core Analysis

No core was collected at Kyalla 117 N2-1H ST2

4.4.2 Drill Cuttings Analysis

Cuttings analysis was aimed at trialling the applicability of bulk mineralogical or rock property determination from drill cuttings such that mineralogical or rock property models could be determined and applied along lateral wells within the Lower Kyalla Shale. Results from the lab analysis can be found in Appendix 10.

4.4.3 Gas Analysis

Gas analysis was aimed at providing a controlled lab analysis constraining points for continuous drill gas analysis data that was collected at the wellsite. Analysis also yielded a C6+ component which is not available from the wellsite gas chromatograph that was run at Kyalla 117 N2-1H ST2. This C6+ component provides an indication of the condensate fraction of gases.

In addition to gas chromatographic analysis, carbon and deuterium isotopic analysis was undertaken on gas samples in order to give insight into maturity and reservoir gas history.

Results from the lab analysis can be found in Appendix 10.

4.5 GEOCHEMICAL INTERPREATION

From analysis of geological samples of Kyalla 117 N2-1 and Kyalla 117 N2-1H ST2, the organic matter contained within the Lower, Middle and Upper Kyalla shales is interpreted to be composed of cyanobacteria (blue-green algae) based on organic petrological analysis. The organic matter is interpreted to be highly oil prone when immature, with Immature hydrogen indexes of >700 interpreted based on rock pyrolysis results. Significant gas potential late gas cracking of kerogen and intermediary bitumen products, along with wet gases and oils is also interpreted based on drill gas carbon isotopic analysis results.

The source rocks of the Lower Kyalla Shale are interpreted to have reached a maximum maturity of 1.6% Vitrinite Reflectance Equivalent, indicating a late wet gas to early dry gas generative maturity.

4.6 PETROPHYSICAL INTERPRETATION

LWD logs collected in the Kyalla 117 N2-1H ST2 lateral were not sufficient to produce a petrophysical model of the formation.

Analysis of image resistivity LWD data was completed. Digital data, prints, and interpretation report can be found in Appendix 11. Interpretation of the data indicated an abundance of natural fractures within the lateral wellbore, which may enhance system permeability of the Lower Kyalla Shale play.

4.7 HYDROCARBON INDICATIONS

4.7.1 GAS DETECTION WHILST DRILLING

Continuous Mud Gas monitoring and chromatographic breakdown of hydrocarbon gases (C₁ – C₅, CO₂ H₂S) were performed by Geoservices in Kyalla 117 N2-1. A summary of notable gas peaks whilst drilling is shown in Table 1, Table 2 & Table 1. For digital data on mud gas see Appendix 6.

Table 1. Summary of mud gas peaks recorded while drilling wellbore Kyalla 117 N2-1H

GAS TYPE	Depth (mMDRT)	Peak (TGAS%)	Background (TGAS%)	C1 (%)	C2 (%)	C3 (%)	C4 (%)	C5 (%)
Drilled Fm	1258.5	1.61	0.40	56	23	25	2	4
Drilled Fm	1358.5	1.62	0.6	56	23	15	2	4
Drilled Fm	1370.5	2.36	1.0	64	21	7	4	4
Drilled Fm	1562.0	4.10	0.8	54	21	14	7	4
Drilled Fm	1567.0	4.60	3.2	51	22	15	8	4
Drilled Fm	1580.0	6.74	0.64	34	17	18	16	15
Drilled Fm	1613.5	6.43	3.5	57	22	13	2	6
Drilled Fm	1621.0	7.59	4.0	51	22	14	8	5

Table 2. Summary of mud gas peaks recorded while drilling wellbore Kyalla 117 N2-1H ST1

GAS TYPE	Depth (mMDRT)	Peak (TGAS%)	Background (TGAS%)	C1 (%)	C2 (%)	C3 (%)	C4 (%)	C5 (%)
Drilled Fm	1549.0	3.30	1.8	59	21	13	5	2
Drilled Fm	1558.0	4.67	2.8	59	21	13	5	2
Drilled Fm	1563.0	5.50	3.0	57	22	13	6	2
Drilled Fm	1612.0	5.17	1.1	56	23	12	6	3
Drilled Fm	1648.0	1.73	1.0	59	25	11	2	3
Drilled Fm	1662.0	5.08	1.0	62	23	11	1	3
Drilled Fm	1663.0	6.66	1.2	67	21	9	1	2
Drilled Fm	1672.5	4.52	3.0	59	24	12	1	4
Drilled Fm	1678.5	5.72	3.5	63	22	11	1	3
Drilled Fm	1686.5	4.63	3.0	57	23	13	2	5



Drilled Fm	1691.0	4.69	3.0	54	23	15	2	6
Drilled Fm	1735.0	2.90	0.5	47	23	15	9	6
Drilled Fm	1743.0	3.60	0.99	49	23	15	8	5
Drilled Fm	1755.0	8.00	1.8	56	23	13	6	2
Drilled Fm	1757.5	11.0	5.8	56	23	13	6	2
Drilled Fm	1761.0	7.10	3.1	53	24	14	7	2
Drilled Fm	1774.5	7.40	2.5	55	23	14	6	2
Drilled Fm	1778.5	11.1	2.7	53	23	14	7	3
Drilled Fm	1782.5	7.60	2.0	52	23	15	7	3
Drilled Fm	1785.0	12.80	4.5	52	24	15	7	2
Drilled Fm	1795.5	10.0	3.2	56	23	13	6	2
Drilled Fm	1811.0	12.90	5.6	52	24	14	7	3
Drilled Fm	1817.0	10.6	8.7	55	23	13	6	3
Drilled Fm	1835.0	5.7	3.4	55	22	12	7	4
Drilled Fm	1852.5	8.6	1.5	52	25	14	6	3
Drilled Fm	1910.0	14.49	3.2	52	24	15	7	3
Drilled Fm	1938.5	6.41	4.2	49	22	15	10	4
Drilled Fm/ CG /Swab	1950.5	9.90	3.1	58	22	11	6	3
Drilled Fm/ CG /Swab	1970.5	6.50	5.1	51	21	14	9	5
Drilled Fm/ CG /Swab	1990.0	6.78	4.4	52	24	15	7	2
B/U Gas from 1993.0 XLOT	1993.5	5.6	2.0	72	15	8	4	1
Drilled Fm	2012.5	12.5	7.8	58	23	12	5	2
Drilled Fm	2016.0	27.6	10.0	59	23	11	5	2
Drilled Fm	2029.0	13.0	7.7	58	22	12	6	2
Drilled Fm	2035.0	18.2	7.9	58	23	12	5	2
Drilled Fm	2050.0	17.5	6.4	58	23	12	5	2
Drilled Fm	2068.0	20.8	14.3	58	23	12	5	2
Drilled Fm	2092.5	21.2	13.0	57	23	12	6	2
Drilled Fm / CG?	2100.5	19.0	13.5	58	22	12	6	2
Drilled Fm / CG?	2131.5	22.1	11.9	57	23	12	6	2
Drilled Fm	2150.0	17.3	9.0	57	22	12	6	3
Drilled Fm	2160.0	16.6	9.3	57	22	12	6	3
Drilled Fm	2214.0	15.9	15.9	56	22	12	7	3
Drilled Fm	2243.5	13.6	13.6	57	22	12	6	3
Drilled Fm	2290.0	20.8	6.9	61	22	10	5	2
Drilled Fm	2319.0	30.1	13.8	62	21	10	5	2
Drilled Fm	2341.0	20.8	11.5	62	21	10	5	2
Drilled Fm	2370.0	20.7	13.1	61	21	11	5	2
Drilled Fm	2378.5	23.1	17.3	61	21	11	5	2
Drilled Fm	2403.0	22.7	13.0	59	21	11	6	3
Drilled Fm	2438.5	26.1	12.3	58	22	11	6	3
Drilled Fm	2446.0	27.5	22.2	58	22	11	6	3
Drilled Fm	2461.0	22.6	9.0	60	22	11	5	2

Drilled Fm	2476.5	19.8	16.2	60	22	11	5	2
Drilled Fm	2497.5	19.5	9.0	59	22	11	6	2
Drilled Fm	2519.5	31.3	17.9	59	22	11	6	2
Drilled Fm	2547.0	23.5	14.8	57	22	12	6	3
Drilled Fm	2558.0	21.4	7.9	59	22	11	6	2
Drilled Fm	2579.0	22.2	9.0	58	22	11	6	3
Drilled Fm	2674.0	22.0	15.3	60	22	11	5	2
Drilled Fm	2701.5	16.0	8.2	60	22	11	5	2
Drilled Fm	2750.0	18.5	3.8	61	21	11	5	2
Drilled Fm	2779.5	17.6	8.7	58	22	11	6	3

Table 3. Summary of mud gas peaks recorded while drilling wellbore Kyalla 117 N2-1H ST2

GAS TYPE	Depth (mMDRT)	Peak (TGAS%)	Background (TGAS%)	C1 (%)	C2 (%)	C3 (%)	C4 (%)	C5 (%)
Drilled Fm	1369.0	2.87	0.45	57	22	13	3	2
Drilled Fm	1486.0	2.53	0.83	55	23	14	6	2
Drilled Fm	1512.0	2.86	1.48	55	23	14	6	2
Drilled Fm	1567.0	7.25	0.98	56	22	14	6	2
Drilled Fm	1581.0	3.95	1.60	53	23	14	7	3
Drilled Fm	1603.0	3.08	1.10	55	23	13	6	3
Drilled Fm	1615.0	6.07	0.89	58	23	12	5	2
Drilled Fm	1665.0	2.30	0.40	59	24	11	4	2
Drilled Fm	1682.5	4.91	0.51	61	24	10	4	1
Drilled Fm	1705.5	6.41	1.33	64	21	10	4	1
Drilled Fm	1739.0	6.12	2.18	57	23	13	5	2
Drilled Fm	1799.0	2.88	1.91	51	24	15	7	3
Drilled Fm	1810.5	3.1	2.0	51	24	15	7	3
Drilled Fm	1837.0	4.1	1.61	52	24	14	7	3
Drilled Fm	1842.5	4.26	2.9	52	24	14	7	3
Drilled Fm	1850.0	5.0	3.6	51	24	15	7	3
Drilled Fm	1860.0	5.15	3.2	50	22	16	8	3
Drilled Fm	1945.0	6.20	2.7	52	24	14	7	3
Drilled Fm	1958.0	9.5	5.1	52	24	14	7	3
Drilled Fm	1968.5	12.4	4.6	56	23	13	6	2
Drilled Fm	1985.0	10.7	4.6	53	23	14	7	3
Drilled Fm	2007.5	13.3	3.6	56	23	13	6	2
Drilled Fm	2025.0	14.7	3.6	53	23	14	7	3
Drilled Fm	2031.0	16.0	7.6	55	23	13	6	3
Drilled Fm	2092.5	9.8	2.55	59	22	12	5	2
Drilled Fm	2107.5	11.23	2.74	58	23	12	5	2
Drilled Fm	2136.5	10.57	4.37	57	22	13	6	2
Drilled Fm	2153.5	14.82	4.19	57	22	13	6	2
Drilled Fm	2230.0	6.92	3.31	67	17	9	5	2
Drilled Fm	2354.5	6.86	1.74	72	16	7	3	2
Drilled Fm	2326.0	14.1	4.02	63	20	10	5	2
Drilled Fm	2344.5	20.2	5.58	62	20	11	5	2
Drilled Fm	2380.0	14.1	8.36	58	22	12	6	2



Drilled Fm	2406.0	16.2	5.32	57	23	12	6	2
Drilled Fm	2427.0	14.0	3.59	57	23	12	6	2
Drilled Fm	2469.0	18.0	4.97	58	23	12	5	2
Drilled Fm	2492.0	19.3	5.25	56	23	13	6	2
Drilled Fm	2521.0	17.2	10.2	57	23	12	6	2
Drilled Fm	2543.0	22.14	7.64	55	24	13	6	2
Drilled Fm	2555.0	18.4.0	13.2	55	24	13	6	2
Drilled Fm	2570.0	23.9.0	7.70	56	24	12	6	2
Drilled Fm	2627.0	18.21	5.20	59	23	11	5	2
Drilled Fm	2638.0	23.94	5.40	59	23	11	5	2
Drilled Fm	2666.0	30.12	6.59	57	24	12	5	2
Drilled Fm	2702.5	24.77	5.98	54	24	13	6	3
Drilled Fm	2723.5	22.72	3.19	56	24	12	6	2
Drilled Fm	2755.0	29.50	9.37	57	23	12	6	2
Drilled Fm	2820.5	36.20	6.45	56	24	12	6	2
Drilled Fm	2857.5	21.40	5.2	55	23	13	6	3
Drilled Fm	2922.0	13.80	5.4	54	23	13	7	3
Drilled Fm	2982.5	28.70	9.27	56	23	12	6	3
Drilled Fm	3013.0	30.74	6.79	59	23	11	5	2
Drilled Fm	3032.5	31.40	9.33	58	23	12	5	2
Drilled Fm	3065.5	32.00	9.44	59	23	11	5	2
Drilled Fm	3221.5	16.78	6.75	57	23	12	6	2
Drilled Fm	3246.0	21.60	14.24	57	23	12	6	2
Drilled Fm	3266.0	18.60	8.42	57	23	12	6	2
Drilled Fm	3306.0	16.71	3.59	57	23	12	6	2
Drilled Fm	3380.0	20.63	9.25	55	23	13	6	3
Drilled Fm	3385.0	24.64	9.25	54	24	13	6	3
Drilled Fm	3394.0	24.70	10.90	60	21	12	5	2
Drilled Fm	3409.0	23.70	8.46	57	21	12	7	3
Drilled Fm	3419.5	23.60	15.16	57	21	12	7	3
Drilled Fm	3456.0	28.70	14.68	64	19	10	5	2
Drilled Fm	3470.0	20.50	7.48	65	18	10	5	2
Drilled Fm	3538.5	18.90	9.53	66	18	9	5	2
Drilled Fm	3642.0	18.97	9.62	65	19	9	5	2
Drilled Fm	3665.0	18.11	9.02	57	22	12	6	2
Drilled Fm	3753.0	17.40	3.12	48	25	13	10	4
Drilled Fm	3802.5	17.90	4.44	41	28	20	7	4
Drilled Fm	3538.5	18.90	9.53	66	18	9	5	2
Drilled Fm	3642.0	18.97	9.62	65	19	9	5	2
Drilled Fm	3665.0	18.11	9.02	57	22	12	6	2
Drilled Fm	3753.0	17.40	3.12	48	25	13	10	4
Drilled Fm	3802.5	17.90	4.44	41	28	20	7	4

4.7.2 FLUORESCENCE

Cuttings samples were examined for hydrocarbon fluorescence using a fluoroscope UV box.

Fluorescence was constrained to sandstone lithologies in Kyalla 117 N2-1H, Kyalla 117 N2-1H ST1 & Kyalla 117 N2-1 ST2. In addition all three wellbores observed fluorescence from a cleaner sandstone unit between the Lower and Middle Kyalla Shales, which has been noted has having hydrocarbon shows elsewhere in the Beetaloo Sub-Basin. This Sandstone bed belongs to a unit known informally and historically as the 'Elliott Sandstone Member'.

Fluorescence descriptions are summarised below:

4.7.3 Kyalla 117 N2-1H

1623 –1626mMDRT

10% Shale: light medium grey to medium dark grey, homogenous, micro mica, common silty laminations, tr carbonaceous flecks, moderately hard to hard, sub-blocky to sub-fissile.

40% Siltstone: medium dark grey to dark grey, argillaceous, micro-mica, thin SHALE laminations, moderately hard to hard, sub-blocky to blocky.

50% Sandstone: light grey to medium light grey, translucent quartz grains, very fine to fine, well-sorted, sub-rounded to rounded, occasionally spherical quartz, strong siliceous cement, quartz overgrowths, moderate hard to hard, tight visual porosity. **FLUORESCENCE: trace moderately bright yellow even fluorescence, very slow direct cut with very thin dull yellow ring residual.**

1626 –1629mMDRT

10% Shale: light medium grey to medium dark grey, homogenous, micro mica, common silty laminations, tr carbonaceous flecks, moderately hard to hard, sub-blocky to sub-fissile.

10% Siltstone: medium dark grey to dark grey, argillaceous, micro mica, thin SHALE laminations, moderately hard to hard, sub-blocky to blocky.

80% Sandstone: off white to light grey, clear to translucent quartz, very fine to fine, well sorted, sub-rounded, strong siliceous cement, common quartz overgrowths, minor silt sized quartz matrix, poor visual porosity. **FLUORESCENCE: trace moderately bright yellow even fluorescence, very slow direct cut with very thin dull yellow ring residual.**

4.7.4 Kyalla 117 N2-1H ST1

1620 –1632mMDRT

10% Shale: light medium dark grey, homogenous, micro mica, common silty laminations, common carbonaceous flecks, moderately hard to hard, sub-blocky to sub-fissile

30% Siltstone: dark grey, very finely arenaceous, micro-mica, moderately hard to hard, sub-blocky to blocky.

60% Sandstone: off white, clear to translucent quartz, very fine, sub-angular to sub-rounded, very well sorted, strong siliceous cement, quartz overgrowths, hard, tight visual porosity.

FLUORESCENCE: trace-5% moderately bright yellow even fluorescence, very slow crush cut with very thin dull greenish yellow ring residual.

2008 –2011mMDRT

95% Shale: medium dark grey to dark grey, silty carbonaceous, common micro mica flecks, moderately hard, sub-blocky to blocky

5% Sandstone: off white to white, very fine grain, well sorted, sub-rounded, strong calcareous cement, trace off white argillaceous and siliceous matrix, tight inferred visual porosity.

FLUORESCENCE: Pale Yellow Fluorescence, moderate crush cut, moderate ring residue

2011–2014mMDRT

100%Shale: medium dark grey to dark grey, silty carbonaceous, common micro mica flecks, moderately hard, sub-blocky to blocky. Trace disseminated pyrite

Tr Sandstone: off white to white, very fine grain, well sorted, sub-rounded, strong calcareous cement, trace off white argillaceous and siliceous matrix, tight inferred visual porosity.

FLUORESCENCE: Pale Yellow Fluorescence, slow crush cut, moderate ring residue

2014 –2017mMDRT

95% Shale: medium dark grey to dark grey, silty carbonaceous, common micro mica flecks, moderately hard, sub-blocky to blocky. Trace disseminated pyrite

5%Siltstone: medium grey to dark grey, argillaceous, common very finely arenaceous, micro mica, common lithic and carbonaceous specks, moderately hard, sub-blocky to blocky

Tr Sandstone: off white to white, very fine grain, well sorted, sub-rounded, strong calcareous cement, trace off white argillaceous and siliceous matrix, tight inferred visual porosity.

FLUORESCENCE: Pale Yellow Fluorescence, slow crush cut, moderate ring residue

2017–2020mMDRT

85% Shale: medium dark grey to dark grey, silty carbonaceous, common micro mica flecks, moderately hard, sub-blocky to blocky. Trace disseminated pyrite

10% Siltstone: medium grey to dark grey, argillaceous, common very finely arenaceous, micro mica, common lithic and carbonaceous specks, moderately hard, sub-blocky to blocky

5% Sandstone: White to off white, clear to translucent quartz, strong siliceous cement, tight inferred visual porosity. **FLUORESCENCE Trace Pale Yellow**

2041–2044mMDRT

95% Shale: Medium dark grey to dark grey, silty, carbonaceous, common micro mica flecks, moderately hard, sub blocky to blocky.

5% Sandstone: off white to white, very fine, well sorted, sub rounded, strong siliceous cement, trace of white argillaceous and siliceous matrix, tight inferred visual porosity **FLUORESCENCE: Rare to trace Pale Yellow**

2119–2125mMDRT

95%Shale: Medium dark grey to dark grey, silty, carbonaceous, common micro mica flecks, trace pyrite, moderately hard, sub blocky to blocky.

5% Sandstone: Off white to white, very fine, well sorted, sub rounded, strong siliceous cement, trace of white argillaceous and siliceous matrix, tight inferred visual porosity. **FLUORESCENCE: Rare to trace Pale Yellow**

2197–2203mRT

100% Shale: Medium dark grey to dark grey, silty, carbonaceous, common micro mica flecks, trace pyrite, moderately hard, sub blocky to blocky.

Tr% Sandstone: off white to white, very fine, well sorted, sub rounded, strong siliceous cement, trace of white argillaceous and siliceous matrix, tight inferred visual porosity. **FLUORESCENCE: Rare to trace Pale Yellow**

4.7.5 Kyalla 117 N2-1H ST2

1626 –1632mMDRT

50% Shale: medium dark grey, moderately hard to hard, sub-blocky to sub-fissile, carbonaceous flecks.

5% Siltstone: medium grey, hard, argillaceous, sucrosic, angular.

45% Sandstone: yellowish grey, very fine grain to medium grain, dominantly fine grain, clear to frosted, sub-rounded, subspherical, minor carbonaceous flecks, cemented aggregates and loose grains. **FLUORESCENCE: mod bright pale yellow, diffuse fluorescence in grain aggregates, nil to very faint diffuse cut. Very faint, very pale-yellow ring residue.**

4.8 TRAP INTEGRITY

The Kyalla Formation is an unconventional shale play. As such trap integrity is not applicable to this type of petroleum system.

4.9 Seismic Well Tie Update

No faulting was intersected during the drilling of the side track laterals Kyalla 117 N2-1H, Kyalla 117 N2-1H ST1 and Kyalla 117 N201H ST2 from the Kyalla 117 N2-1 vertical well. As such there was no updated to seismic interpretation and/or well tie from the Kyalla 117 N2-1. See Figure 4 for post drill interpretation of north to south composite section of 2D seismic lines MC92-123 and ME91-123. See Figure 5 for final detailed Kyalla 117 N2-1 seismic well tie.

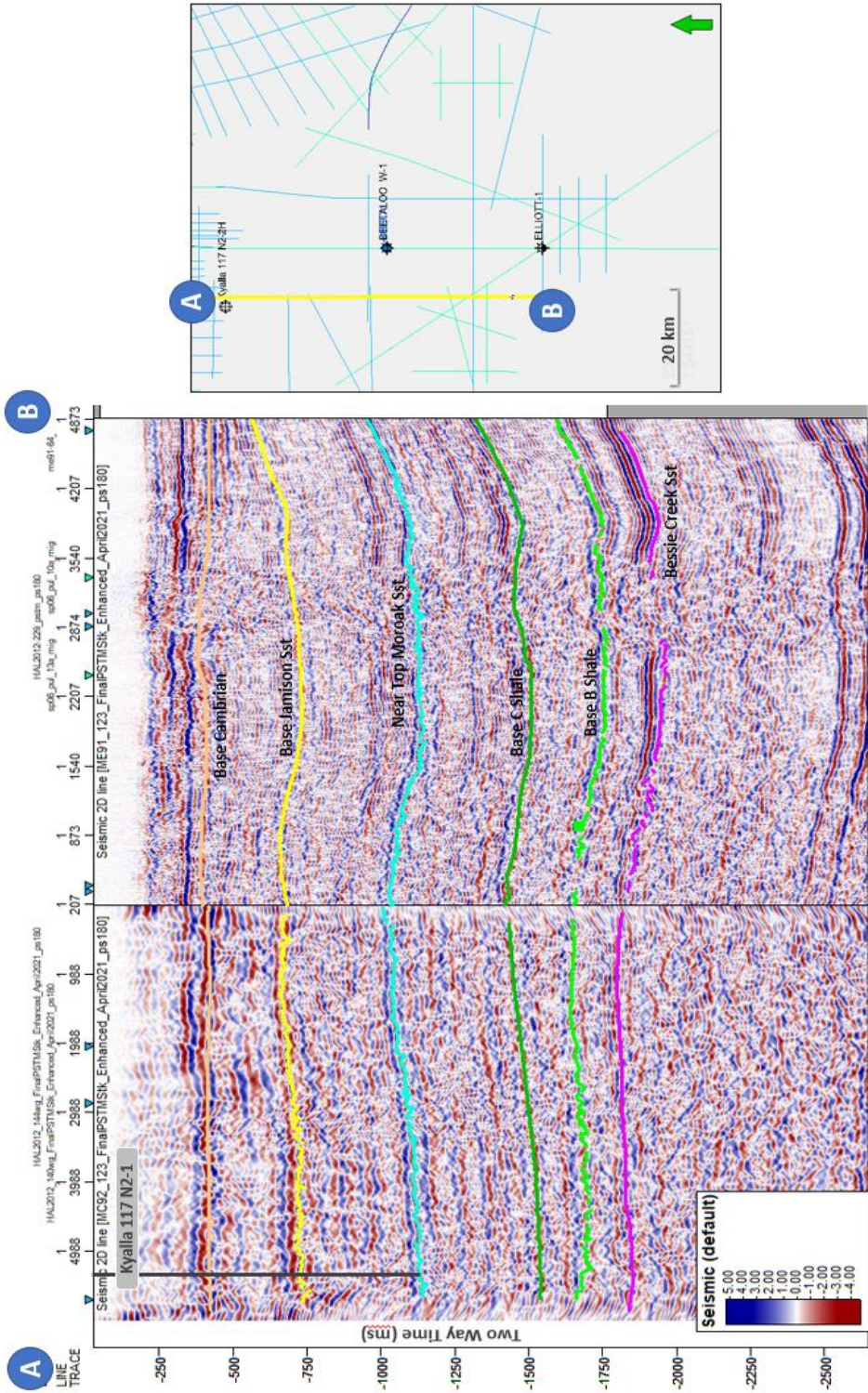


Figure 4 - Interpreted Seismic section from Kyalla 117 N2-1 (projected onto line)

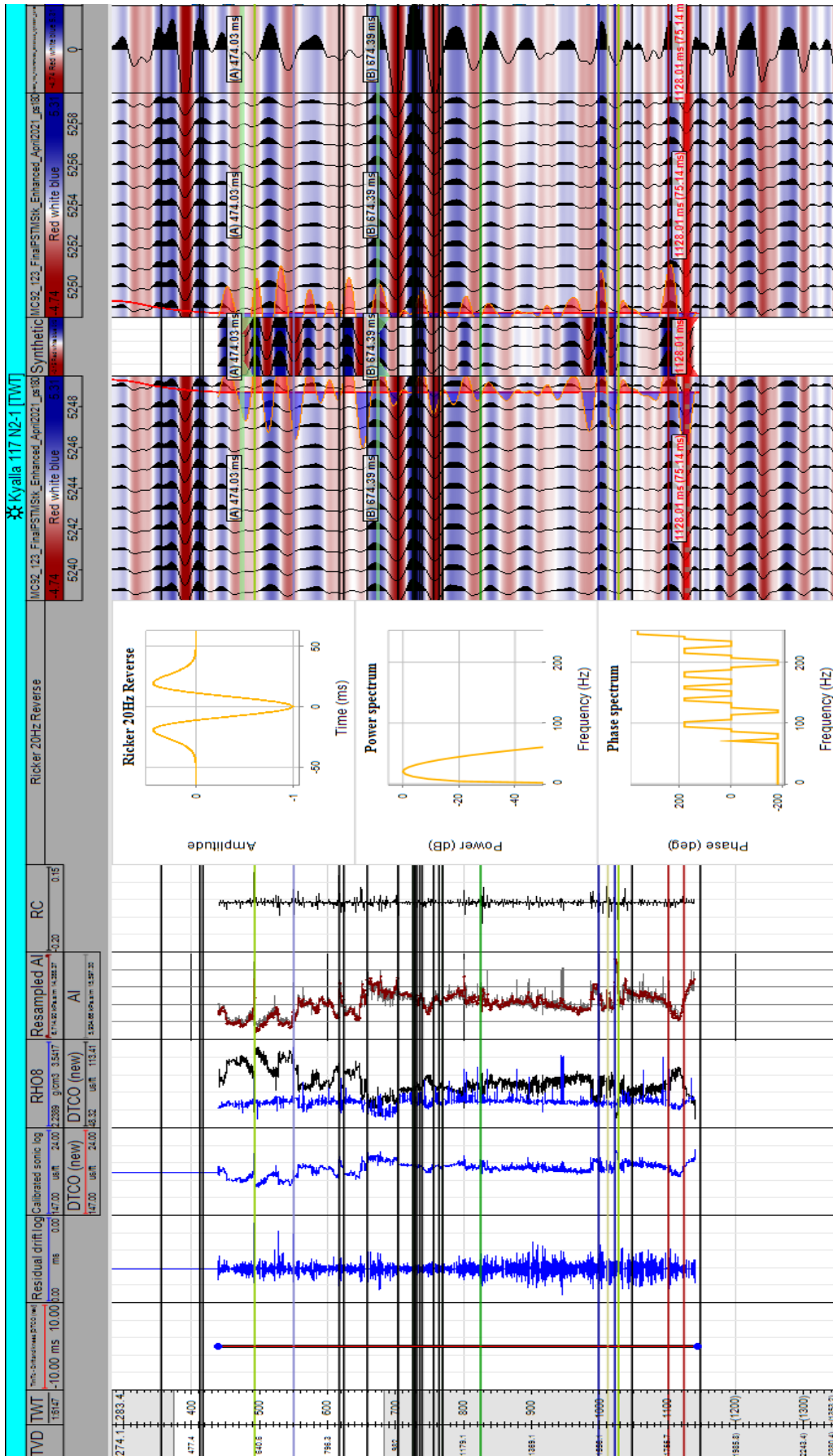


Figure 5 - Kyalla 117 N2-1 Seismic well tie

5 WELL EVALUATION

5.1 WIRELINE LOGGING

Table 4 summarizes the wireline logs that were run by Schlumberger (SLB). Field data, processed data, deviation survey and log displays for all wireline logs are provided in Appendix 7.

WIRELINE LOGGING					
SUITE/ RUN #	Depth (mMDRT)		Description	Operator	Remarks
	From	To			
S1/R1	5	1800	CBL-VDL-USIT	Schlumberger	Kyalla 117 N2-1H ST1
S2/R1	7.47	1977	CBL-VDL-MAP	Schlumberger	Kyalla 117 N2-1H ST2

Table 4. Summary of Wireline Logs

5.2 LOGGING WHILE DRILLING (LWD) / MEASUREMENTS WHILE DRILLING (MWD)

Summary of LWD / MWD acquired can be found in Table 5. Field data, processed data and log displays for all LWD / MWD logs are provided in Appendix 8. The Final Geodetic Survey Report is also attached in Appendix 8. A composite logs for wellbores Kyalla 117 N2-1H, Kyalla 117 N2-1H ST1, and Kyalla 117 N2-1H ST2 can be found in appendix 12.

Depth (mMDRT)		Description	Logging Company	Remarks
From	To			
1260	1628	HDS1L-SGS-AGR-DPM-HHOP-PDX-AWR-GVR	Pathfinder	Kyalla 117 N2-1H
1255	2809	HDS1L-SGS-AGR-DPM-HHOP-PDX-AWR-GVR	Pathfinder	Kyalla 117 N2-1H ST1
1180	3809	HDS1L-SGS-AGR-DPM-HHOP-PDX-AWR-GVR	Pathfinder	Kyalla 117 N2-1H ST2

Table 5. Summary of LWD / MWD logs.

5.3 MUDLOGGING

Geoservices (Schlumberger) provided mudlogging services for the drilling of Kyalla 117 N2-1. These included standard mud logging service, constant volume trap (CVT) mud gas chromatographic analysis (C₁-C₅, CO₂, H₂S) and monitoring, real time and lagged data acquisition and live streaming from wellsite, data storage and transmission and digital imaging of cuttings. Mudlogging data and log displays are enclosed in Appendix 6.

6 FORMATION SAMPLING

6.1 DRILL CUTTINGS

Drill cutting samples were collected during the drilling of the Kyalla 117 N2-1H, Kyalla 117 N2-1H ST1, and Kyalla 117 N2-1H ST2 wellbores. Sampling intervals are summarised in Table 6 below.

Detailed drill cuttings lithological descriptions are enclosed in Appendix 5.

Wellbore Name	Cuttings Interval		Sample Rate (m)	Comments
	From (mMDRT)	To (mMDRT)		
Kyalla 117 N2-1H	1288	1628	3	12 ¼ " Hole Section
Kyalla 117 N2-1H ST1	1457	1990	3	12 ¼ " Hole Section
Kyalla 117 N2-1H ST1	1990	2101	3	8 ½ " Hole Section
Kyalla 117 N2-1H ST1	2101	2809	6	8 ½ " Hole Section
Kyalla 117 N2-1H ST2	1200	1263	3	8 ½ " Hole Section
Kyalla 117 N2-1H ST2	1263	1284	6	8 ½ " Hole Section
Kyalla 117 N2-1H ST2	1284	1290	3	8 ½ " Hole Section
Kyalla 117 N2-1H ST2	1290	3809	6	8 ½ " Hole Section

Table 6. Drill Cuttings Interval and Sampling Rate Summary

6.2 CONVENTIONAL CORE

No Conventional core was collected at Kyalla 117 N2-1H ST2

6.3 SIDEWALL CORES

No side wall cores were collected at Kyalla 117 N2-1H ST2

6.4 MUD GAS

A total of 106 drill cutting headspace gas samples (Isojars™) and 110 drill gas samples (Isotubes™) were collected between Kyalla 117 N2-1H, Kyalla 117 N2-1H ST1 and Kyalla 117 N2-1H ST2. A detailed summary of mudgas sample collection depths is enclosed in Appendix 6.

Table 7. Kyalla 117 N2-1H, Kyalla 117 N2-1H ST1, and Kyalla 117 N2-1H ST2 Well site gas sample collection

Wellbore Name	Isojars (Cuttings Headspace Gas)	Isotubes (Mudgas)	Comments
Kyalla 117 N2-1H	7	7	
Kyalla 117 N2-1H ST1	42	46	
Kyalla 117 N2-1H ST2	57	57	

7 FORMATION TESTING

7.1 Formation Integrity Test (FIT)

Wellbore: Kyalla 117 N2-1H ST2

Test Date	Test Type	Test Depth (mMDRT)	Tested Formation	Fluid Density (ppg)	Fluid Type
29/01/2020	FIT	1200	Kyalla Formation	10.6	WBM
Leak Off Equivalent Fluid Density (ppg)				Surface Pressure (psi)	
15.6				697	

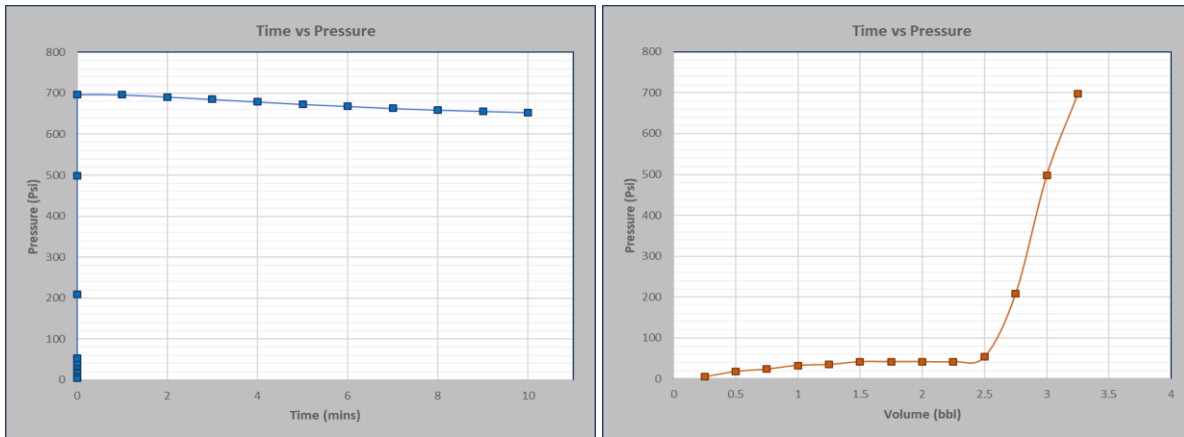


Figure 6. Graphical summary of FIT Results

7.2 Extended Leak Off Test (XLOT)

Wellbore: Kyalla 117 N2-1H ST1

Test Date	Test Type	Test Depth (mMDRT)	Tested Formation	Fluid Density (ppg)	Fluid Type
19/12/2019	XLOT	1993	Kyalla Formation	11.5	Brine
Leak Off Equivalent Fluid Density (ppg)				Leak Off Pressure (psi)	
21.5				3064	

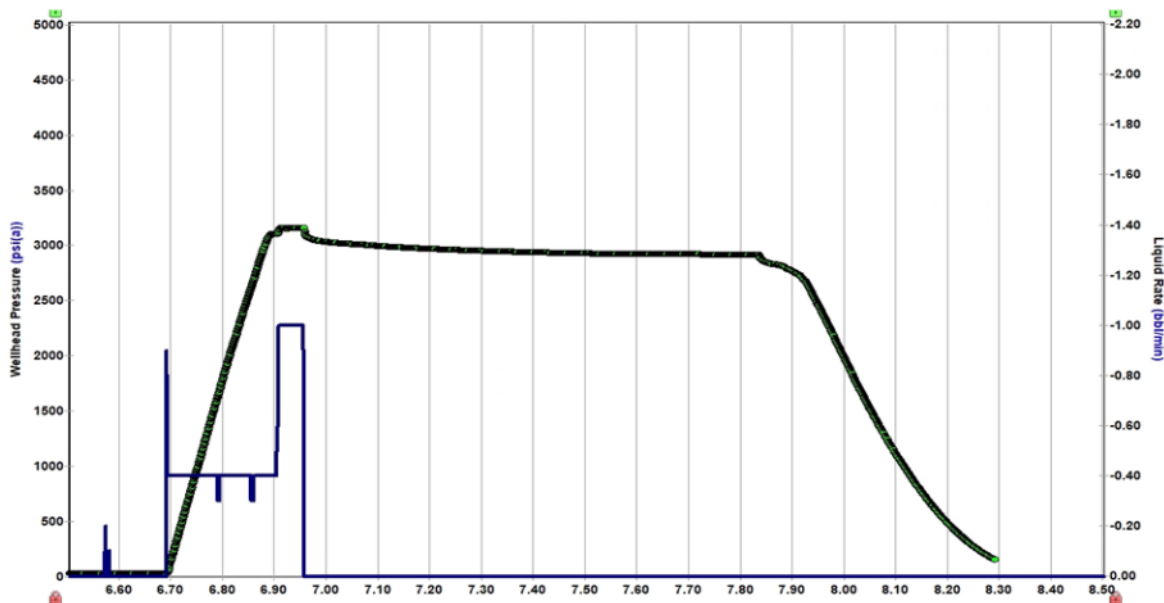


Figure 7. Graphical summary of XLOT data

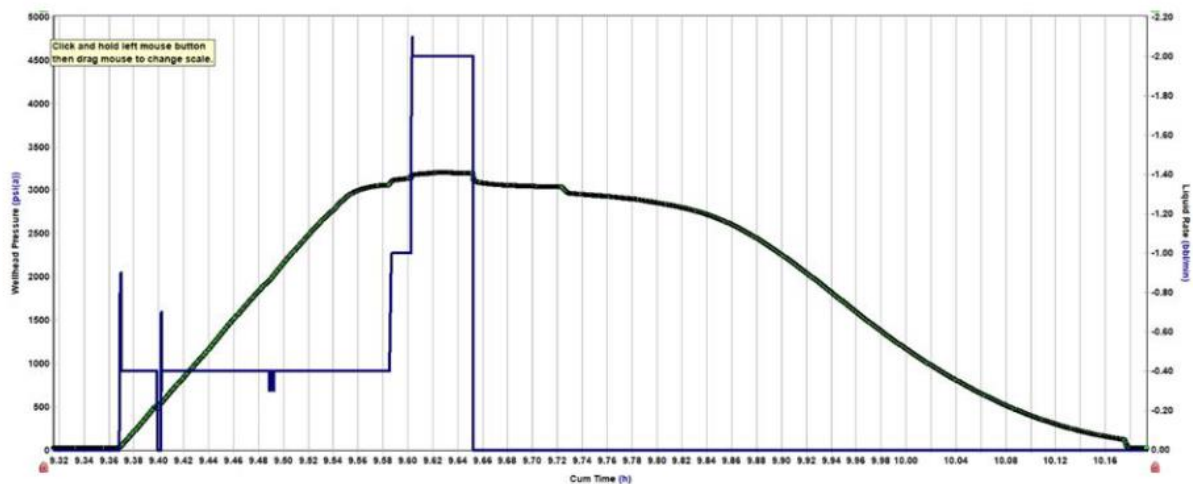


Figure 8. Graphical summary of XLOT data

REFERENCES

Munson TJ (2016). Sedimentary characterisation of the Wilton package, greater McArthur Basin, Northern Territory. Northern Territory Geological Survey (NTGS) Record 2016-003. Darwin. Viewed 06 August 2021, <https://geoscience.nt.gov.au/gemis/ntgsjspui/handle/1/83806>

APPENDICES

- Appendix 1: Casing Reports
- Appendix 2: Cementing Reports
- Appendix 3: Bit Records
- Appendix 4: Drilling Fluids Reports
- Appendix 5: Lithological Cuttings Descriptions
- Appendix 6: Mudlogging
- Appendix 7: Wireline
- Appendix 8: LWD MWD Logs
- Appendix 9: XLOT Data
- Appendix 10: Geological Sample Analysis
- Appendix 11: Image Log Study
- Appendix 12: Composite Logs