SANTOS – TAMBORAN

COMPILED FOR

SANTOS LIMITED

(A.B.N. 80 007 550 923)

FLYING FOX CREEK 1

INTERPRETED WELL COMPLETION REPORT

PREPARED BY:
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M. ARCHER
August 2017

FLYING FOX CREEK 1

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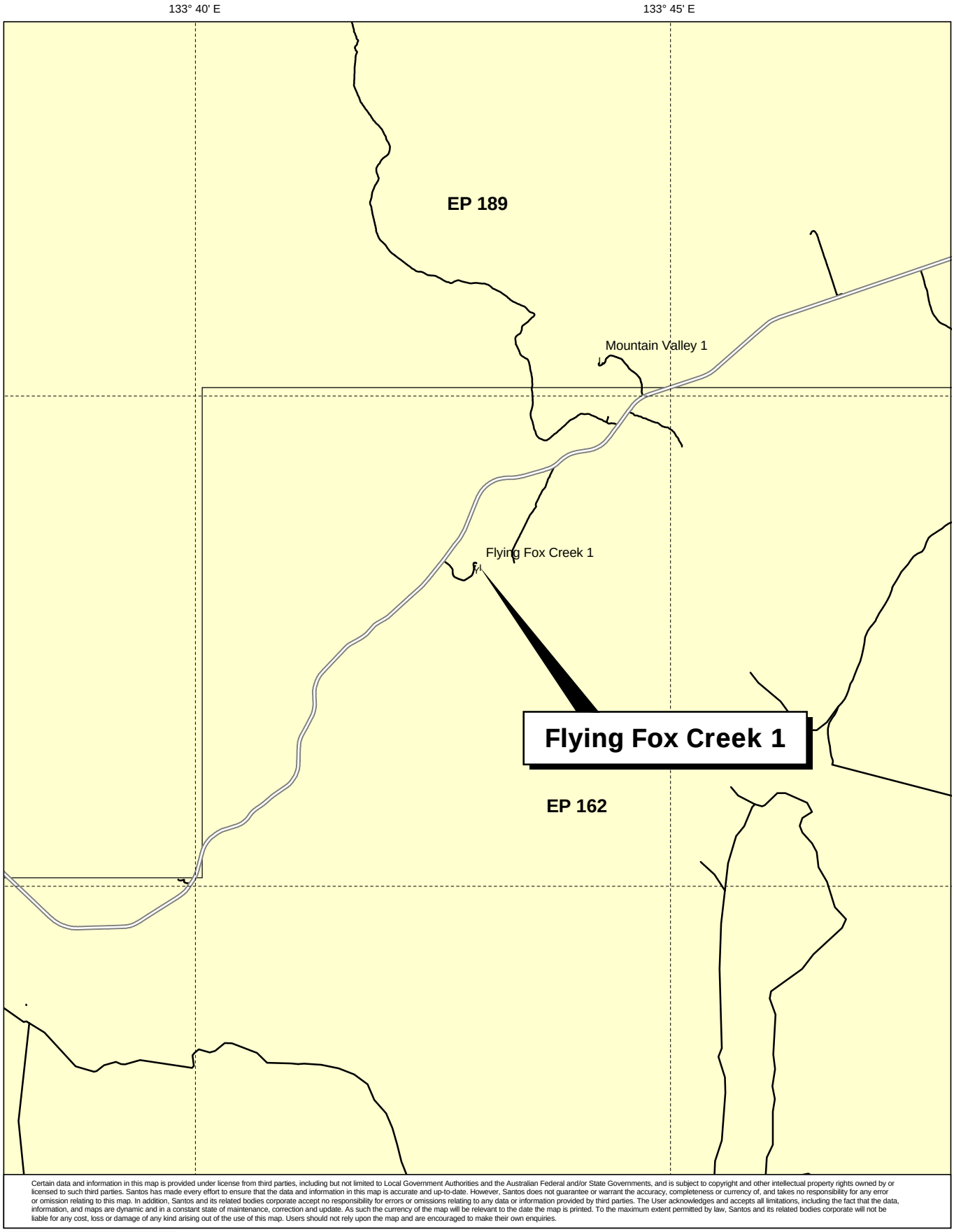
LOCATION MAP



Santos Exploration Permit

Santos

EP 162 - McArthur Basin

Flying Fox Creek 1

Location Map

0 1 2 3 4 5 Km

Scale: 1:100,000

25 August 2017, File No. MCARTHUR 052

GDA

WELL CARD

WELL: FLYING FOX CREEK 1	**WELL CATEGORY:** Stratigraphic **WELL INTENT:** Oil and Gas
SURFACE LOCATION: **LAT:** 14° 11' 43.85" S **LONG:** 133° 42' 59.96" E **(GDA94)** **NORTHING:** 8 430 270.22 **EASTING:** 361 518.27 **(GDA94)**	
SEISMIC STATION: N/A	
ELEVATION GROUND LEVEL: 126.82 m **AHD**	
RT DATUM ELEVATION: 126.82 m (**Rig RT:** 0 m)	
BLOCK / LICENCE: EP-162, Maiwok Sub basin, Northern Territory	
TD: 350.2 m **(Logger)**, 349.5 m **(Driller)**	
BASE OF PRODUCTION CEMENT: N/A	
TYPE STRUCTURE: No structure identified.	
TYPE COMPLETION: Plug & Abandon	
ZONE(S): N/A	

SPUD: 11:00 hours on the 12/08/2016
TD REACHED: 19:45 hrs on the 21/08/2016
RIG RELEASED: 11:00 hrs on the 23/08/2016
RIG: Foraco 12
STATUS: Plugged and Abandoned
REMARKS: Continuous HQ3 core cut from casing shoe to TD.

HOLE SIZE	CASING SIZE	SHOE DEPTH	TYPE
12 ¼"	9 ⅝"	9m	K 55, BTC, 36.0 lb/ft
8 ½"	4 ½"	71.8m	K 55, BTC, 11.6 lb/ft
96mm	P&A	349.5m	N/A

AGE	FORMATION OR ZONE TOPS	DEPTH (m)		THICKNESS TVD (m)	HIGH (H) LOW (L)
		MD	TVD SS		
MESOPROTEROZOIC	SURFACE	0.0	126.8	0.25	-
MESOPROTEROZOIC	MAINORU FORMATION	0.25	126.6	219.7	N.P.
MESOPROTEROZOIC	SHOWELL MEMBER	0.25	126.6	(18.8)	N.P.
MESOPROTEROZOIC	WOODEN DUCK MEMBER	19.0	107.8	(71.0)	22.2 (L)
MESOPROTEROZOIC	MOUNTAIN VALLEY LIMESTONE	90.0	36.8	(85.0)	63.2 (L)
MESOPROTEROZOIC	NULLAWAN MEMBER	175.0	-48.1	(45.0)	68.1 (L)
MESOPROTEROZOIC	LIMMEN SANDSTONE	220.0	-93.2	33.0	48.2 (L)
MESOPROTEROZOIC	DOOK CREEK FORMATION	253.0	-126.1	96.5+	51.1 (L)-
MESOPROTEROZOIC	Poo4 MEMBER	253.0	-126.1	(63.0)	51.1 (L)-
MESOPROTEROZOIC	JAMBERLINE SANDSTONE MEMBER	316.0	-189.1	(33.5)+	14.1 (L)
	TOTAL DEPTH (DRILLER)	349.5	-222.6		

LOG INTERPRETATION (Interval Averages)				
FORMATION	**INTERVAL (m)**	**NET SAND (m)**	**$Ø_T$%**	**SW %**
Limmen Sandstone	220 - 253	2.3	13.3	
Jamberline Sst Mbr	316 - 348	0.2	12.2	

PERFORATIONS	
FORMATION	**INTERVAL (m)**
N/A	

CORES CUT (m)				
FM.	**NO.**	**INTERVAL**	**CUT**	**REC**
	1	**72.8-349.5**	276.7	99.6%

WIRELINE

LOG	SUITE / RUN	INTERVAL (m)	COMMENTS
Dipmeter (XY Caliper)-Verticality-Temp-GR	1 / 1		43.0°C @ 350.2m
DIPMETER		350.2 – 70.0	
VERTICALITY		348.0 – 72.0	GR logged to surface
GR		349.6 – 5.0	
Dual Focus Resistivity-GR	1 / 2		GR logged to surface
RESISTIVITY		348.0 – 71.8	
GR		350.0 – 5.0	
Multi Channel Sonic – Temp	1 / 3		Thermometer failed during run.
SONIC		348.0 – 63.0	

MWD / LWD

LOG	SUITE / RUN	INTERVAL (m)	COMMENTS
No MWD/LWD logging was conducted on Flying Fox Creek 1			

FLOW TEST RESULTS
No Flow Tests were performed at Flying Fox Creek 1.

1. SUMMARY

Flying Fox Creek 1 was stratigraphic well drilled by the Foraco 12 rig within permit EP 162, onshore Northern Territory. The well is located on the northern margin of the Maiwok Sub-basin approximately 20.5 km north-east of Pacific O&G Broughton-1 and 13 km west of BMR Urapunga-1 well. The well is approximately 360 km south-east of Darwin, and 150km north of the Carpentaria Highway along the Central Arnhem Highway.

The petroleum systems of the McArthur Basin are poorly understood due to limited well penetrations, the age of the rocks, and multiple episodes of poorly constrained burial and inversion. There are potentially four petroleum systems in the basin, ranging from the Paleo-Proterozoic Tawallah Group to the Meso-Proterozoic Roper Group. Flying Fox Creek-1 is a stratigraphic well located on the northern margin of the Maiwok Sub-basin. The primary objectives of the well were to constrain the depositional environments and petroleum potential of the basal Roper and Mount Rigg groups and acquire core for stratigraphic and various geochemical analyses.

Flying Fox Creek-1 was successfully drilled and was plugged and abandoned as planned. The well met the pre-drill geological objectives and 276.7 m of continuous 61.3 mm diameter HQ3 core was retrieved at 99.6% recovery. The result provides additional stratigraphic constraints for the Maiwok Sub-basin and enables further regional correlation.

The Limmen Sandstone in Flying Fox Creek-1 consists predominantly of fine to medium grained quartz rich sandstone (with some very coarse to pebbly beds) and minor micaceous siltstone. It is highly fractured with both open and healed fractures. The Limmen Sandstone exhibited very poor reservoir quality with trace visible porosity as a result of inter-granular porosity being occluded by extensive siliceous cementing and common large re-crystalized quartz crystals throughout. Net sand of 2.3m and 0.2m was petrophysically determined within the Limmen Sandstone and Jamberline Sandstone Member respectively. However, this result remains highly uncertain within the Limmen Sandstone due to the presence of fractures and vuggy porosity.

No visible organic matter was observed within the Dook Creek Poo_4 Member. HAWK pyrolysis and TOC analysis was conducted on four dark siltstones from the lower Dook Creek Poo_4 Member in Flying Fox Creek-1, which were considered to be equivalent to the thicker organic rich siltstone intervals described and analysed in Broughton-1. The results of this analysis demonstrated that these siltstones are organically lean and do not have sufficient hydrocarbon generation potential to be considered a source rock. This lack of a source rock potential and lack of hydrocarbon shows in the overlying dolostone within the Dook Creek Poo_4 Member also indicate poor prospectively of Mount Rigg Group petroleum system within this area.

2. GEOLOGY

2.1 INTRODUCTION

The Palaeo- to Mesoproterozoic (1.4 - 1.6 billion year old) McArthur Basin is one of the oldest petroleum basins in the world. It extends over an area approximately 180,000 square kilometres across north-eastern Northern Territory, and comprises of a predominantly marine succession of unmetamorphosed sediments up to 10 kilometres thick. The McArthur Basin overlies the Pine Creek Orogen, Murphy Province and Arnhem Province and underlies the Georgina, Carpentaria and Arafura basins.

The McArthur Basin is an erosional remnant of a previously more aerially-extensive basin. A series of prominent sub-basins, primarily defined by potential field data, make up the present day McArthur Basin morphology. One of these sub-basins, the Maiwok Sub-Basin, was one of the primary focus areas for petroleum exploration activities during the 1980s through to the 1990s. In total, 15 wells were drilled targeting the Roper Group. Whilst all failed to find commercial accumulations, an effective petroleum system was proven.

The petroleum systems of the McArthur Basin are poorly understood due to limited well penetrations, the age of the rocks, and multiple episodes of poorly constrained burial and inversion. There are potentially four petroleum systems in the basin, ranging from the Paleo-Proterozoic Tawallah Group to the Mesoproterozoic Roper Group. Flying Fox Creek-1 is a stratigraphic well located on the northern margin of the Maiwok Sub-basin. The primary objectives of the well were to constrain the depositional environments and petroleum potential of the basal Roper and Mount Rigg groups and acquire core for stratigraphic and various geochemical analyses.

Limited data is available in the Maiwok Sub-basin other than gravity and magnetic datasets, limited seismic and well data, and surface geology maps. The location of Flying Fox Creek-1 has been selected within an area of outcropping Mainoru Formation in order to increase confidence in penetrating and capturing data from the Limmen Sandstone and underlying units. In addition, regional magnetic data was utilised in order to avoid areas of extensive magnetic high anomalies typically associated with dolerite intrusives common throughout the region.

2.2 FIELD DESCRIPTION

The Maiwok Sub-basin is a Proterozoic depocentre covering an area of approximately 29,000 sq. km in the northern region of the McArthur Basin. The Sub-basin is bounded by a number of faults; the Diljin Hill Fault to the north-east, Parsons Range Fault to the east and the Mallapunyah Fault Zone to the south. The Urapunga Fault zone forms the major W-E tranpressional feature within the sub-basin. In contrast to the Gorrie and Beetaloo sub-basins, the Maiwok Sub-basin is more structurally complex with highly variable erosion of the Roper Group.

The preserved sediment package within the Maiwok Sub-basin is up to 5,000 m thick, comprising the Vizard Group (McArthur Group equivalent), Mt Rigg Group (Nathan Group equivalent) and the Roper Group, all of which can be identified in outcrop on the eastern side of the sub-basin. The Maiwok Sub-basin has widespread surface exposure of the Roper Group which shows a general younging of the Roper Group stratigraphy to the south-east. One of the most noticeable features of the region is the pervasive occurrence of the Derim Derim Dolerite, typically intruding as sills within organic rich zones or along bedding contacts. These dolerite intrusives can be readily identified on magnetic data as high frequency shallow features and are evident in the subsurface as high amplitude events on vintage 2D seismic.

Flying Fox Creek-1 targeted the Limmen Sandstone of the Roper Group and the Dook Creek Formation, Poo_4 member within the Mt Rigg Group.

The Limmen Sandstone of the lower Roper Group is a fine to very coarse and granule-rich quartz sandstone featuring minor micaceous siltstone beds. Broughton-1, a petroleum exploration well drilled by Pacific Oil & Gas Pty Ltd in 1989, is located ~27 km south-west of Flying Fox Creek-1. Oil bleeds from core over a 2.5 metre interval (450.18m to 452.73m), with a minor increase in total gas readings as well as live oil on the surface of the core, were reported from the Limmen Sandstone intersected in Broughton-1. However porosity was reported as occluded.

The Dook Creek Formation Poo_4 member intersected at Broughton-1 and FFD-1, comprised of interbedded laminated chert, dolostone, mudstone and sandstone. Core chips analysed using Rock-Eval yielded TOC up to 3.18 wt% over dolomicrite intervals, suggesting higher organic carbon is associated with the carbonate facies. Visual inspection of the Broughton-1 core identified vuggy porosity with residual bitumen inferring it was once a part of an active petroleum system.

2.3 WELL LOCATION

Flying Fox Creek-1 is a stratigraphic well located on the northern margin of the Maiwok Sub-basin approximately 20.5 km North-East of Pacific O&G Broughton-1 well and 13 km west of the vintage BMR Urapunga-1 well. The well is approximately 360 km south-east of Darwin, and 150km north of the Carpentaria Highway along the Central Arnhem Highway.

The Flying Fox Creek-1 well location is situated on the down-thrown side of the Diljin Hill Fault, on the outcrop fairway of the basal Roper Group succession, providing a location for shallow intersection of the underlying Mt Rigg Group. The local geology is characterised by pervasive dolerite outcrop forming low relief ridges, and high fault density. Potential field data were utilised in selecting the well location to avoid the dolerites and faults. On the up-thrown side of the Diljin Hill Fault the Mt Rigg Group is at outcrop.

There is no seismic coverage at Flying Fox Creek-1. Control was obtained using surface geology and the following offset wells (distance and direction relative to Flying Fox Creek-1 are indicated):

Broughton-1	20.5 km SW
Urapunga-1	13 km E

The Surface Location for Flying Fox Creek-1 is:

Location (GDA94)	Latitude:	14° 11’ 43.85” South (GDA94)
	Longitude:	133° 42’ 59.96” East
	Northing**:**	8 430 270.22
	Easting**:**	361 518.27

3. RESULTS OF DRILLING

3.1 STRATIGRAPHICAL PROGNOSIS

The pre-drill vs actual stratigraphic sequence intersected in Flying Fox Creek-1 is shown in Table 1 below. Formation tops in Flying Fox Creek-1 were intersected low to prognosis and ranged from 68.1m low (Nullawan Member) to 14.1m low (Jamberline Sandstone Member). This can largely be attributed to the intersection of 18.8m of unprognosed Showell Member at surface and intersection of a full Mountain Valley Limestone interval which was 41m thicker than the original prognosis. The original prognosis assumed a large proportion of the Mountain Valley Limestone had been eroded at surface.

The primary objectives, the Limmen Sandstone and Dook Creek Formation Poo_4 Member, were intersected 48.2m and 51.1m low, respectively. The well reached a total depth of 350.2m (logger) after penetrating 34.2m of the Jamberline Sandstone Member.

TABLE 1: SUMMARY OF STRATIGRAPHY

AGE	FORMATION	ACTUAL mRT	ACTUAL mTVDSS	HIGH (H) LOW (L)
MESOPROTEROZOIC	SURFICIAL DEPOSITS	0	126.8	
MESOPROTEROZOIC	MAINORU FORMATION	0.25	126.6	N.P
MESOPROTEROZOIC	SHOWELL MEMBER	0.25	126.6	N.P
MESOPROTEROZOIC	WOODEN DUCK MEMBER	19.0	107.8	22.2 (L)
MESOPROTEROZOIC	MOUNTAIN VALLEY LIMESTONE	90.0	36.8	63.2 (L)
MESOPROTEROZOIC	NULLAWAN MEMBER	175.0	-48.1	68.1 (L)
MESOPROTEROZOIC	LIMMEN SANDSTONE	220.0	-93.2	48.2 (L)
MESOPROTEROZOIC	DOOK CREEK FORMATION	253.0	-126.1	51.1 (L)
MESOPROTEROZOIC	Poo4 MEMBER	253.0	-126.1	51.1 (L)
MESOPROTEROZOIC	JAMBERLINE SANDSTONE MEMBER	316.0	-189.1	14.1 (L)
MESOPROTEROZOIC	TOTAL DEPTH (LOGGER)	**350.2**	**-223.3**	

3.2 STRATIGRAPHY & DEPOSITIONAL ENVIRONMENT (Logger's Depths)

A brief description of lithology and interpreted depositional environments follows. More detailed lithological descriptions can be found in Section 2.1 of the Basic Well Completion Report. The well reached total depth at 350.2m (logger extrapolated) after penetrating 34.2m into the Jamberline Sandstone Member.

The **MAINORU FORMATION** is divided into the Gibb, Wadjeli Sandstone, Nullawan, Mountain Valley Limestone, Wooden Duck, and Showell members. The Gibb and Wadjeli Sandstone members were not present at Flying Fox Creek-1.

The **SHOWELL MEMBER** conformably overlies the Wooden Duck Member. The lower section of the Showell Member was intersected at Flying Fox Creek-1 and consists of massive light to medium grey to dull olive grey siltstone overlain by a 3m section of interbedded light grey green siltstone and white to cream mudstone. The deposition environment of the Showell Member is interpreted as a distal to storm dominated shelf.

The **WOODEN DUCK MEMBER** conformably overlies the Mountain Valley Limestone and consists of dark grey to greenish grey, finely laminated siltstone interbedded with off-white to light grey slightly calcareous siltstone and minor very fine to fine-grained sandstone. Gutter casts, hummocky beds, rip up clasts, slump structures, and dewatering sedimentary structures are common. The deposition environment of the Wooden Duck Member is interpreted as a storm dominated shelf.

The **MOUNTAIN VALLEY LIMESTONE** consists of green laminated mudstones and siltstones interbedded with off white to light grey intraclastic limestone. Mudstone rip up clasts are common throughout the limestone beds and limestone intraclasts also present in the mudstone and siltstone beds. The Mountain Valley Limestone conformably overlies the Nullawan Member and is interpreted as deposited in a shallow marine to tidal flat environment.

The **NULLAWAN MEMBER** is a reddish brown massive to finely laminated mudstone with green reduction beds and spots which disconformably overlies the Limmen Sandstone. The base of the Nullawan Member contains Limmen Sandstone pebble sized rip up clasts and lag deposits overlain by three ~30cm fining up cycles from very coarse grained sandstone and gravel bases.

The **LIMMEN SANDSTONE** unconformably overlies the Dook Creek Formation and consists of fine to medium grain size quartz rich sandstone (with some very coarse to pebbly grain size beds) and minor micaceous siltstone. The Limmen Sandstone intersected at Flying Fox Creek-1 is highly fractured with both open and healed fractures. The depositional environment of the Limmen sandstone is interpreted as a fluvial to a shallow marine shoreline setting.

The DOOK CREEK FORMATION is divided into four lithological members, Unit 1 (Poo_1), Unit 2 (Poo_2), Jamberline Sandstone (Poo_3), and Unit 4 (Poo_4). Flying Fox Creek-1 intersected the Unit 4 (Poo4) and reached TD in the upper Jamberline Sandstone Member.

The **DOOK CREEK FORMATION Poo_4 MEMBER** conformably overlies the Jamberline Sandstone Member and consists of off white to grey dolostone with frequent mud drapes and minor interbedded dark grey to black mudstone and dark green grey siltstones. The Poo_4 Member is interpreted as occurring in a tidal to shallow marine environment.

The **JAMBERLINE SANDSTONE MEMBER** conformably underlies the Poo_4 Member. It consists predominantly of light grey to light grey pink medium to coarse grained and pebbly quartz sandstone, chert and limestone clast conglomeritic sandstone with minor dolomitic siltstone. The contact with the Poo_4 Member is gradational. The Jamberline Sandstone Member is interpreted as proximal fluvial environment transition to shallow marine prior deposition of the Poo_4 Member. The change in environment is presented in the gradational contact with the overlying Poo_4 Member.

3.3 HYDROCARBON SUMMARY (Logger's MDRT Depths)

Flying Fox Creek-1 was a stratigraphic well drilled without mud gas monitoring equipment. Hand held gas detectors were used. No hydrocarbon shows were observed from the core or cuttings.

No net pay was ascribed by log analysis, as expected given this is a stratigraphic well. Based on an effective porosity (PHIE) cutoff of 8%, 2.3m and 0.2m of net sand was petrophysically determined within the Limmen Sandstone and Jamberline Sandstone Member respectively. High log porosity peaks are associated with fractures (neither true matrix, nor true fracture porosity) and these have subsequently been excluded when determining the reservoir summary. Due to the limited logging suite (GR, DT, and Resistivity) further analysis regarding vuggy and fracture porosity cannot be performed. Hence reported porosity carries an increased degree of uncertainty.

TABLE 2: HYDROCARBON SUMMARY FOR EACH FORMATION

FORMATION OR ZONE	LOGGERS DEPTH (m)		TOTAL GAS (Units)	GAS RATIO (%)	FLUORESCENCE / COMMENTS
	FROM	TO			
No Hydrocarbon shows were observed in Flying Fox Creek 1.					

TABLE 3: SUMMARY OF NET SAND IN FLYING FOX CREEK 1

FORMATION	INTERVAL (m)	NET SAND(m)	$Ø_T$ %	SW %	FLUORESCENCE / COMMENTS
Limmen Sandstone	220 - 253	2.3	13.3		
Jamberline Sst Mbr	316 - 348	0.2	12.2		

3.4 RESERVOIR PROPERTIES AND QUALITY

The Limmen Sandstone in Flying Fox Creek-1 consists predominantly of fine to medium grain size quartz rich sandstone (with some very coarse to pebbly grain size beds) and minor micaceous siltstone. It is highly fractured with both open and healed fractures. The Limmen Sandstone exhibits very poor reservoir quality with trace visible porosity as a result of inter-granular porosity being occluded by extensive siliceous cementing and common large re-crystalized quartz crystals throughout. The presence of galena, common throughout some mineralised sections, was also confirmed via petrological analysis of a sample collected from brecciated fracture fill at 252.10m. Given the reservoir degradation observable during core logging and the difficulty in obtaining a competent routine core analysis (RCA) plug due to brittleness of the Limmen Sandstone, quantification of reservoir parameters by RCA has not been conducted. Without calibration to RCA results the petrophysically determined net sand (PHIE>8%), which has been ascribe across three <1m intervals, remains highly uncertain. The Limmen Sandstone is considered to be a predominantly very poor quality reservoir within this area.

3.5 EXPLORATION RELEVANCE

The Flying Fox Creek-1 well provides additional stratigraphic constraints for the Maiwok Sub-basin and enables further regional correlation. Flying Fox Creek-1 intersected the Showell Member of the Mainoru Formation below a thin veneer of surficial sediments. The surface location is mapped as undifferentiated Mainoru Formation on the Urapunga and Roper River Special 250k mapsheet.

The upper section of the Showell Member has been eroded at Flying Fox Creek-1, but the remaining Mainoru Formation members are a similar thickness to those intersected in Broughton-1 (Figure 1). The Dook Creek Poo_4 Member was thinner in Flying Fox Creek-1 than in Broughton-1, due to additional section eroded below the Roper Group unconformity in Flying Fox Creek-1 (Figure 1). Based on gamma ray charactered the lower section of the Dook Creek Poo4 Member also appears less developed in Flying Fox Creek 1.

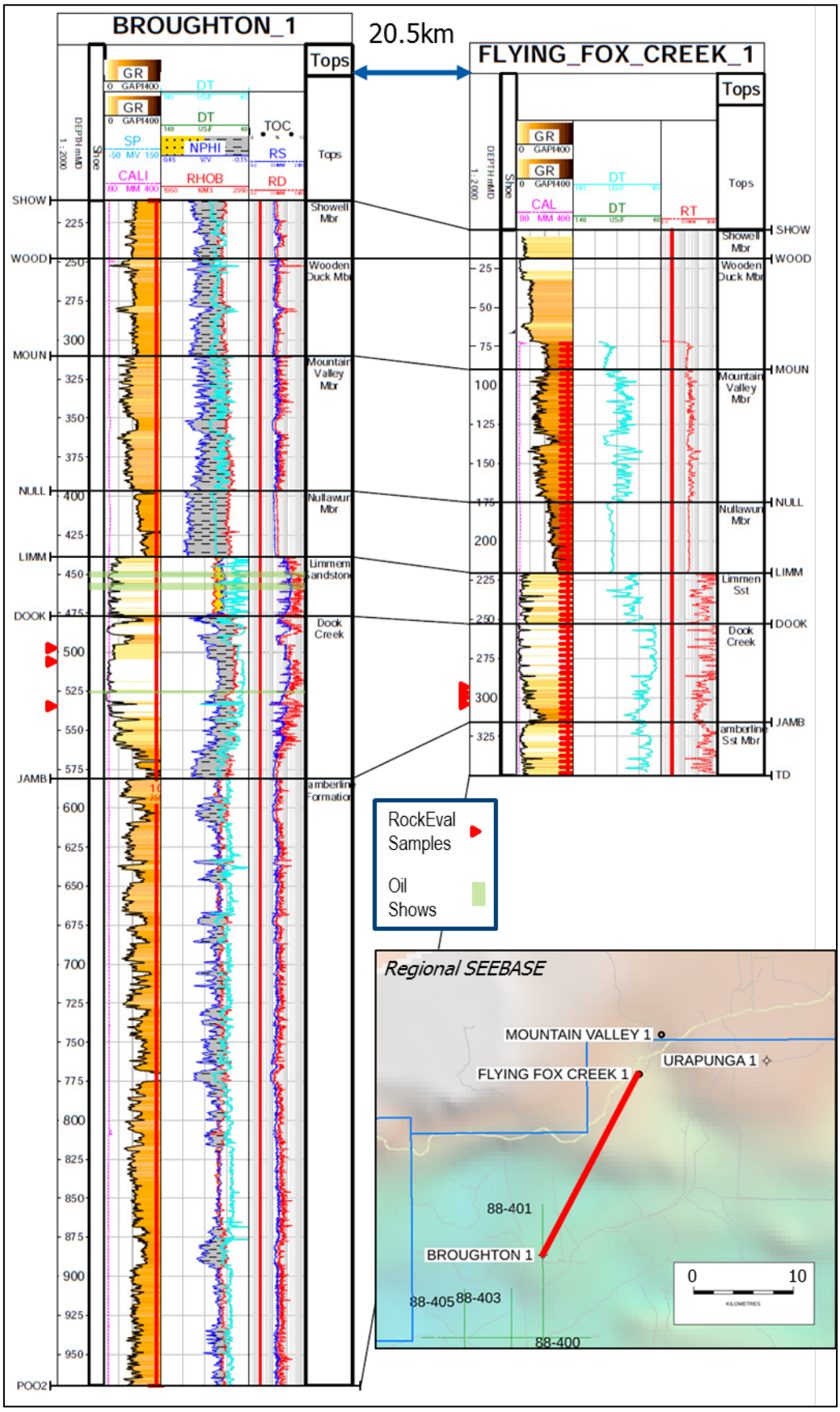


Figure 1 Stratigraphic correlation, flattened on the Wooden Duck Member, between Broughton-1 and Flying Fox Creek-1 showing the location of Broughton-1 oil shows and RockEval/HAWK samples from both wells.

No hydrocarbon shows were observed within the Limmen Sandstone. The Limmen Sandstone intersected in Flying Fox Creek-1 exhibits very poor reservoir quality with trace visible porosity as a result of inter-granular porosity being occluded by extensive siliceous cementing and common large re-crystalized quartz crystals throughout. Poor reservoir quality was reported in Broughton-1. However, the Limmen Sandstone at Flying Fox Creek-1 also has a high density of open and annealed fractures.

No visible organic matter was observed within the Dook Creek Poo_4 Member. HAWK pyrolysis and TOC analysis was conducted on four dark siltstones from the lower Dook Creek Poo4 Member in Flying Fox Creek-1, which were considered to be equivalent to the thicker organic rich siltstone intervals described and analysed in Broughton-1. In particular this is the interval in Broughton-1 where a TOC value of 3.18 wt% was recorded. TOC values were low showing a maximum result of 0.65 wt% and an average of 0.34wt%, which indicate that the Dook Creek Poo4 Member siltstones are organically lean and do not have sufficient hydrocarbon generation potential to be considered a source rock. Lack of a source rock potential and lack of hydrocarbon shows in the overlying Dook Creek Poo_4 Member dolostone indicate poor prospectively of Mount Rigg Group petroleum system within this area.

3.6 CONCLUSION

Flying Fox Creek-1 was successfully drilled as a stratigraphic well and was plugged and abandoned as planned. The well met the pre-drill geological objectives and 276.7 m of continuous 61.3 mm diameter HQ3 core was retrieved at 99.6% recovery. No net pay was ascribed by log analysis as expected given this is a stratigraphic well.

Flying Fox Creek-1 intersected the Showell Member of the Mainoru Formation below a thin veneer of surficial sediments. The surface location is mapped as undifferentiated Mainoru Formation on the Urapunga and Roper River Special 250k mapsheet. The primary targets, the Limmen Sandstone and Dook Creek Poo_4 Member were intersected 48.2m low and 51.1 low respectively. This can largely be attributed to the intersection of 18.8m of unprognosed Showell Member at surface and intersection of a full Mountain Valley Limestone interval which was 41m thicker than the original prognosis. The Mainoru Formation members below the Showell Member were a similar thickness to those intersected in Broughton-1.

Lack of a source rock potential and lack of hydrocarbon shows in the overlying Dook Creek Poo4 Member dolostone indicate poor prospectivity of Mount Rigg Group petroleum system within this area. In addition poor quality reservoir quality indicate poor prospectivity of the Limmen Sandstone within this area.

Rig Foraco 12 was released on the 23rd of August 2016 to Mountain Valley-1.

3.7 SAMPLES COLLECTED

Cuttings

Depth (m)	Sampled Interval (m)
Spud – 72	3

Missed Bulk Samples

None missed.

Underweight Bulk Samples

None underweight.

Full Hole Cores

Continuous 61.3mm HQ3 core was taken from 72.8m to 349.5m (TD); 276.7m cut, 275.51m recovered, 99.6% recovery.

Sidewall Cores

No sidewall cores were acquired in Flying Fox Creek 1.

Other Samples

N/A

Date / Time	Composition	Depth (m)

4. REFERENCES

SANTOS, 2016	FLYING FOX CREEK-1 Well Proposal, prepared for SANTOS Ltd, (unpublished).
S.DUNSTAN, 2016	FLYING FOX CREEK-1 Basic Well Completion Report, prepared for SANTOS Ltd, (unpublished).
SANTOS, 2016	FLYING FOX CREEK-1 Petrophysics Report, prepared for SANTOS Ltd, (unpublished).
SANTOS, 2016	FLYING FOX CREEK-1 PRELIM POST-WELL LOOK-BACK, prepared for SANTOS Ltd, (unpublished).
SANTOS, 2016	FLYING FOX CREEK-1 Drilling Program, prepared for SANTOS Ltd, (unpublished).
NORTHERN TERRITORY GEOLOGICAL SURVEY, 2001	ROPER REGION: URAPUNGA and ROPER RIVER Special SD 53-10 11, 250k Map Sheet Explanatory Notes, prepared for Norther Territory Government, (Published, 2001).

APPENDIX I: ELECTRIC LOG INTERPRETATION REPORT

PETROPHYSICAL FORMATION EVALUATION

Well Name: Flying Fox Creek 1

Basin: McArthur

Rig Release Date: 23-Aug-2016

Flying Fox Creek 1

Flying Fox Creek 1 was drilled as vertical stratigraphic exploration well to a total depth of 349.5 mRT. A 12 ¼" hole was drilled with a 9 5/8" casing set at 9 mRT. A 8 ½" hole was then drilled with a KCl polymer mud to TD. Wire line logging was carried out by Weatherford as described below (table 1).

Flying Fox Creek 1 was cored continuously from 72.8 – 349.5 mRT with a total recovery of 99.6%.

Flying Fox Creek 1 wire line logs were analysed over the Mountain Valley Member, Nullawun Member, Limmen Sandstone, Dook Creek Formation and Jamberline Sandstone.

Flying Fox Creek 1 has been plugged and abandoned.

Discussion

No organic rich shales were encountered in Flying Fox Creek 1.

The reservoir quality of Limmen and Jamberline Sandstone is moderate to poor with no indication of hydrocarbons.

Logs Acquired

8 ½'' hole

LOG	SUITE / RUN	INTERVAL (m)	COMMENTS
Dipmeter (XY Caliper)-Verticality-Temp-GR	1 / 1		43.0°C @ 350.2m
DIPMETER		350.2 – 70.0	GR logged to surface
VERTICALITY		348.0 – 72.0	
GR		349.6 – 5.0	
Dual Focus Resistivity-GR	1 / 2		GR logged to surface
RESISTIVITY		348.0 – 71.8	
GR		350.0 – 5.0	
Multi Channel Sonic – Temp	1 / 3		Thermometer failed during run.
SONIC		348.0 – 63.0	

Table 1: Logging programme in Flying Fox Creek 1.

Mud Parameters

8 ½ “” hole

Mud Type	KCl Polymer, 6%
Mud Density	1.08 ppg
Rm	0.087 ohmm @ 25ºC
Rmf	0.08 ohmm @ 25ºC
Rmc	0.13 ohmm @ 25ºC
MRT	43ºC

Remarks

- Net flags are based on an effective porosity cut-off of 8% (Cat 1) and 4% (Cat 2). Pay flags have an additional Swt cut-off of Swt<70%.
- Water Salinity was determined with a Pickett Plot over all water bearing sands, resulting in an Rw of 2.74 ohmm @ 25degC (figure 1). This is equivalent to a salinity of 1877 ppm NaCl equv.

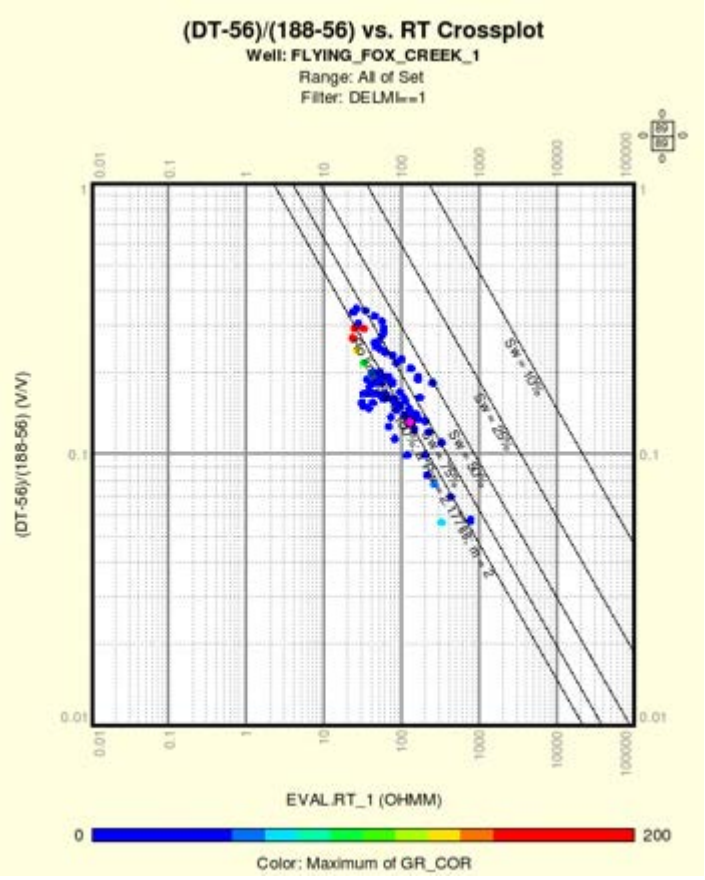


Figure 1: Pickett Plot to determine Rw.

Log Processing

- The GR was corrected for KCl effects using measurements from the caliper.
- No corrections were applied to the Resistivity curves as no correction algorithm is available for these slimhole tools
- Flying Fox Creek 1 was evaluated using the deterministic modules in © Geolog.

Interpretation Procedures & Parameters

- A shale volume curve was derived from the borehole and environmentally corrected GR responses (GR_COR) using the following relationship.

  $V_{sh} = (GR - GR_{ma})/(GR_{sh} - GR_{ma})$

  Where:

  V_{sh} = volume of shale
  GR = measured gamma ray response
  GR_{ma} = GR response in 100% clean matrix
  GR_{sh} = GR response in 100% shale

- Porosity has been calculated from the sonic responses using the Wyllie time average equation as follows.

  $PHIE = (DT - DT_{ma}) / (DT_{fl} - DT_{ma}) - V_{sh} * (DT_{sh} - DT_{ma}) / (DT_{fl} - DT_{ma})$

  and,

  $PHIT = PHIE + (V_{sh} * PHIT_{sh})$

  Where:

  DT = Measured sonic response time
  DT_{fl} = Fluid sonic response time
  DT_{ma} = Matrix sonic response time
  DT_{sh} = Shale sonic response time
  PHIE = Effective porosity
  PHIT = Total porosity
  $PHIT_{sh}$ = Shale total porosity
  V_{sh} = Volume of shale

  A compaction correction ($100/DT_{sh}$) has been applied to the calculated Wyllie porosity.

- A shale corrected total porosity (PHIE to be used in the Archie equation) was calculated as follows:

  if $V_{sh} < V_{shSt}$…….. PHIE = PHIT
  elseif $V_{shSt} < V_{sh} < V_{shCO}$… PHIE = a proportional percentile correction from PHIT to (PHIT – (V_{sh} * PHI_{sh}))
  elseif $V_{sh} > V_{shCO}$ …… PHIE = PHIT - (V_{sh} * PHI_{sh})

  Where:

  V_{shSt} =The start of the sliding scale Vsh correction.
  V_{shCO} =Shale volume cut-off.
  V_{sh} = Shale volume.
  $PHIT$ = Total porosity.
  PHI_{sh} = Apparent shale porosity.

- Water saturations were calculated using a pseudo-Archie equation.

$$SW = \sqrt[n]{\frac{aRw}{\phi^m Rt}}$$

where: R_w = Resistivity of formation water at formation temperature.
RT = True resistivity, i.e. resistivity of the non-invaded reservoir (i.e. Deep reading resistivity).
PHIT= Input as shale corrected PHIE (derived above).
a = Porosity coefficient (default = 1).
m = Cementation exponent as per below.
n = Saturation exponent as per below.

Interpretation Parameters

Following are tabulations of the analysis parameters utilised in each of the interpreted intervals in the well.

Parameter	Mountain Valley Mbr	Nullawun Mbr	Limmen Sst
R_w (ohmm) @ 75°F	2.74	2.74	2.74
a	1	1	1
m	2.2	2.2	2.2
n	2	2	2
GR_{ma} (API)	10	10	10
GR_{sh} (API)	220	220	230
DT_{sh} (us/f)	105	-	105
DT_{ma} (us/f)	56	70	60

Parameter	Dook Creek Fm	Jamberline Sst
R_w (ohmm) @ 75°F	2.74	2.74
a	1	1
m	2.2	2.2
n	2	2
GR_{ma} (API)	10	10
GR_{sh} (API)	254	254
DT_{sh} (us/f)	105	105
DT_{ma} (us/f)	44	56

Pay Summary

The definitions of 'Cat1' and 'Cat2' as utilised in this analysis, are as follows:

- Grossand = PHIE>2%
- Grossvsh = VSH<30%
- Cat1 Netsand = PHIE>8%
- Cat1 Pay = PHIE>8% & SWT<70%
- Cat2 Netsand = PHIE>4%
- Cat2 Pay = PHIE>4% & SWT<70%

Following are tabulations of the netsand intervals with different cut-offs interpreted in the Flying Fox Creek 1 well.

Cat1; Netsand = PHIE>8%

Depth in metres

FORMATION	INTERVAL		GROSS VSH	GROSS SAND	NETSAND Cat1	AVG PHIT	AVG PHIE
	from	to					
	m	*m*	*m*	*m*	*m*	*%*	*%*
Mountain Valley Lst	90	175	0	0	0	-	-
Nullawan Mbr	175	220	0	0	0	-	-
Limmen Sst	220	253	26.8	9.8	2.3	13.3	9.6
Dook Creek – POO4 Mbr	253	316	49.1	4.6	0	-	-
Jamberline Sandstone Mbr	316	348	28.4	2.8	0.2	12.2	8.8

Cat2; Netsand = PHIE>4%

Depth in metres

FORMATION	INTERVAL		GROSS VSH	GROSS SAND	NETSAND Cat1	AVG PHIT	AVG PHIE
	from	to					
	m	*m*	*m*	*m*	*m*	*%*	*%*
Mountain Valley Lst	90	175	0	0	0	-	-
Nullawan Mbr	175	220	0	0	0	-	-
Limmen Sst	220	253	26.8	9.8	5.6	11.4	7.5
Dook Creek – POO4 Mbr	253	316	49.1	4.6	0	-	-
Jamberline Sandstone Mbr	316	348	28.4	2.8	1.1	9.6	6.3

Conclusions

- No significant organic rich intervals were found in Flying Fox Creek 1
- 2.3 m and 0.2 m of cat1 sand were intersected in the Limmen Sst and Jamberline Mbr respectively
- 5.6 m and 1.1 m of cat2 sand were intersected in the Limmen Sst and Jamberline Mbr respectively
- High log porosity peaks are associated with fractures (neither true matrix, nor true fracture porosity) and not included in the reservoir summary
- Due to the limited logging suite (GR, DT, Resistivity) further analysis regarding vuggy and fracture porosity cannot be performed hence reported porosity carries an increase degree of uncertainty.
- The Limmen Sandstone has a sand column of ~ 26.8 m out of which only 2.3 m hit the 8% cut-off and only 9.8 m the 2% cut-off. This interpreted tightness is in close agreement to the core description
- The Jamberline member has a sand column of ~ 28.4 m out of which only 0.2 m hit the 8% cut-off and only 2.8 m the 2% cut-off. This interpreted tightness is in close agreement to the core description
- No indication of hydrocarbons has been found
- Flying Fox Creek 1 has been plugged and abandoned.

Flying Fox Creek 1 analysis results have been graphically presented in the well evaluation summary (WES) plot.

APPENDIX II: MDT PRESSURE SURVEY REPORT AND DATA

No MDT Pressure Surveys were run in Flying Fox Creek 1.

APPENDIX III: HYDROCARBON SHOW REPORT

No Hydrocarbon Shows were observed in Flying Fox Creek 1.

APPENDIX IV: GEOTHERMAL GRADIENT

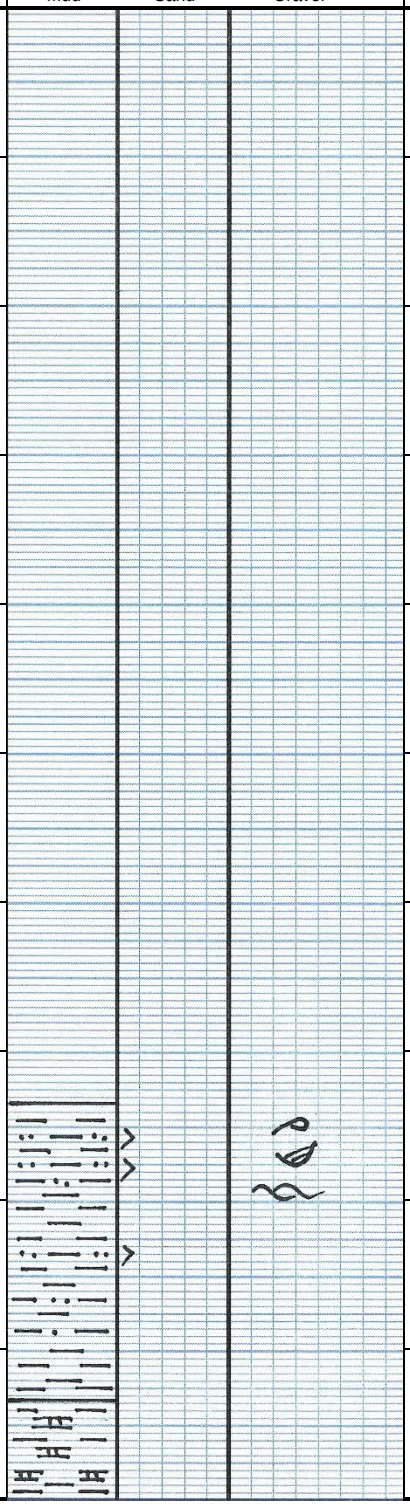
A Bottom Hole Temperature of 43°C (350.2mMDRT) was calculated from wireline temperature data (based on suite 1) which enabled a geothermal gradient of 6.37°C /100m to be calculated. A surface temperature of 21°C was assumed.

APPENDIX V: SEDIMENTOLOGICAL LOG

SANTOS LIMITED

CORE DESCRIPTION

Date	December 2016		Page	1	of 4
Well Name	Flying Fox Creek 1		CORE No	1	

DEPTH metres	Graphic Sedimentological Log	LITHOFACIES CODES	DESCRIPTION
	Mud Sand Gravel		
0			
10			
20			
30			
40			
50			
60			
70		Fl Fm Fd	Top of core - 73.44m MD Gutter casts, hummocky beds, rip up clasts, slump structures, dewatering structures
80		Sh Ss Sd	Wooden Duck Member Dark grey – greeny grey siltstone interbedded with slightly calcareous off-white – light grey siltstone and vf/f-grained sandstone beds
90		Fl Fm Fd	Mountain Valley Limestone

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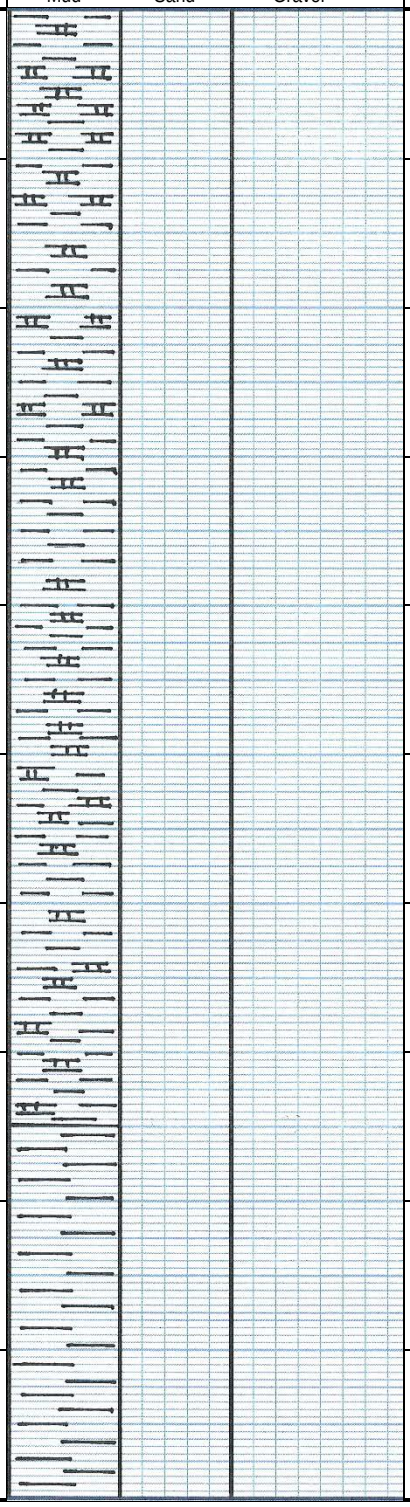
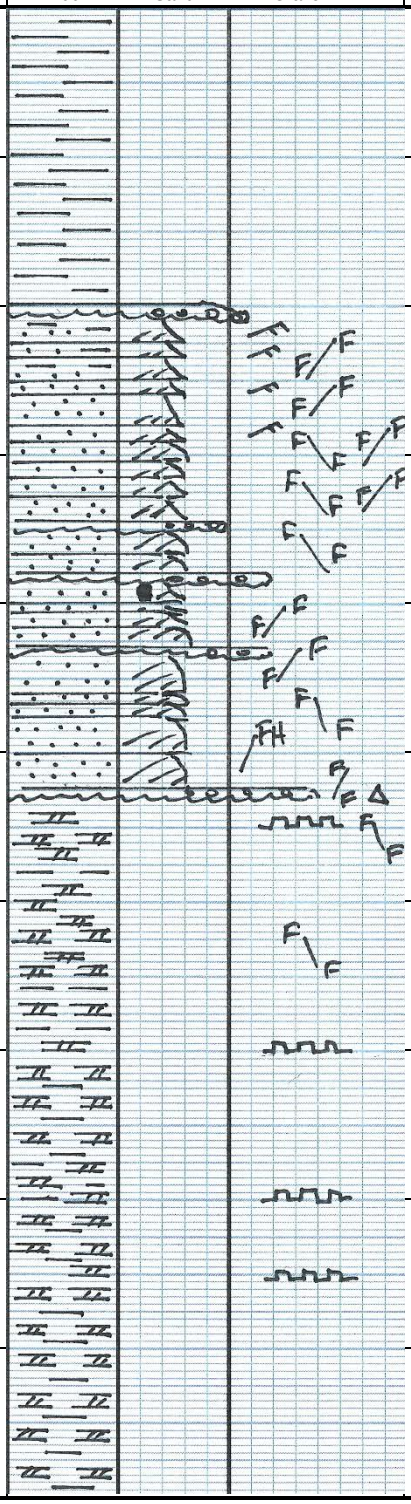
CORE DESCRIPTION

Date	December 2016		Page	2 of	4
Well Name	Flying Fox Creek 1		CORE No	1	

DEPTH metres	Graphic Sedimentological Log	LITHOFACIES CODES	DESCRIPTION
	Mud Sand Gravel		
100		Fl Fm Fd	
110		Fl Fm Fd	
120		Fl Fm Fd	
130		Fl Fm Fd	Mountain Valley Limestone Green laminated mudstones/siltones interbedded with off white to light grey intraclastic
140		Fl Fm Fd	limestone. Rip up clasts of mudstone present in the limestone beds and limestone intraclasts also present in the mudstone/siltstone beds.
150		Fl Fm Fd	
160		Fl Fm Fd	
170		Fl Fm	
180		Fl Fm	Nullawun Member Reddish brown massive to finely laminated mudstone with green reduction beds and spots.
190		Fl Fm	

CORE DESCRIPTION

Date	December 2016		Page	3 of	4
Well Name	Flying Fox Creek 1		CORE No	1	

DEPTH metres	Graphic Sedimentological Log	LITHOFACIES CODES	DESCRIPTION
	Mud Sand Gravel		
200		Fl Fm	Nullawun Member
210		Fl Fm	Base of Nullawun Member interval contains initial Limmen Sst pebble-sized rip up clast/lag interval followed by three further ~30cm fining up cycles each with very coarse sand/gravel bases.
220		Sh Sr St	
230			Limmen Sandstone Comprises predominantly fine to medium grain size qtz Sst (with some very coarse to pebbly grain size beds) and minor micaceous siltstone.
240			Highly fractured – with both open and healed fracture sets Highly re-mineralised with large pyrite and qtz crystals evident within fractures.
250		Fl Fm	Unconformity at base of Limmen Sandstone (boundary between Roper and Mt Rigg Groups)
260		Fl	
270		Fl	Dook Creek Formation – PO_4 unit Off white - grey Dolostone (with minor interbedded dark grey-black silt/mud layers) Plus dark green grey siltstone beds
280		Fl	
290		Fl	

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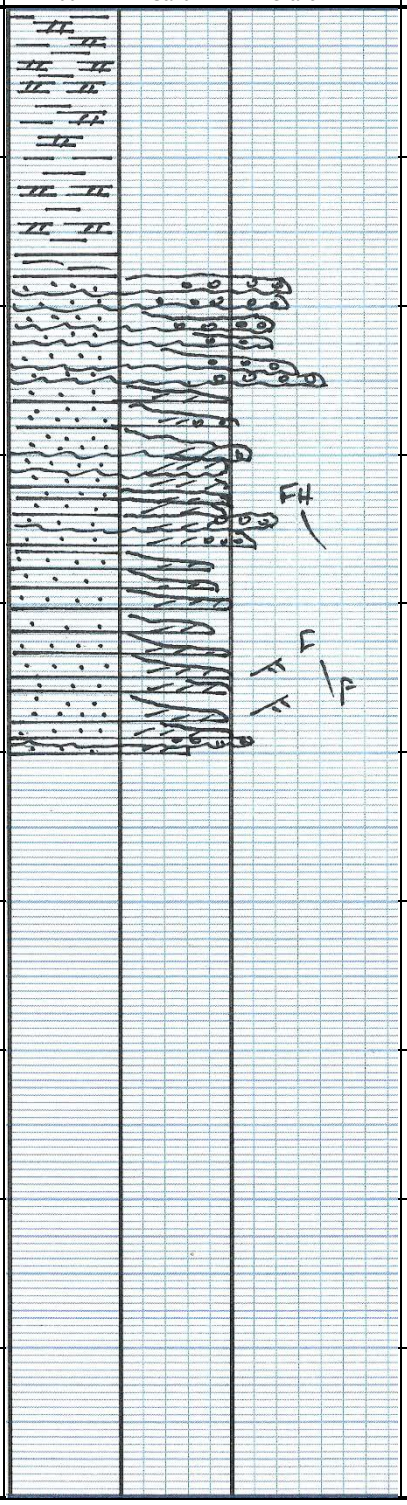
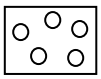
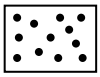
CORE DESCRIPTION

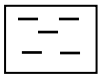
Date	December 2016		Page	4 of	4
Well Name	Flying Fox Creek 1		CORE No	1	

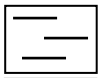
DEPTH metres	Graphic Sedimentological Log	LITHOFACIES CODES	DESCRIPTION
	Mud Sand Gravel		
300		Fl Fm	Dook Creek Formation - PO_4 unit
310		Fl Fm Sh St G	
320		Sh St G G	
330		Fl Sh St G St	Jamberline Sst Member Medium to coarse (and pebbly) qtz Sst, Chert and limestone clast conglomerate Minor dolomitic siltstone
340		Fl Fm Sh Sr St Sh G	
350			Base of core - 350m MD
360			
370			
380			
390			

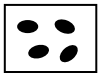
LEGEND


conglomerate

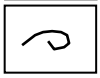

sandstone

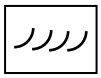

siltstone


claystone, shale


mud intraclasts


coaly wisps

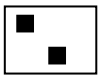

slump

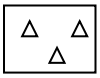

cross bedding


ripples

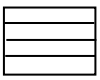

shell

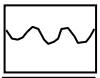

climbing ripples

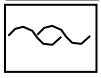

pyrite

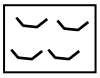

breccia


scour fill

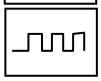

horizontal beds

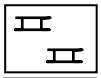

scour surface

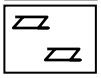

hummocky bedding


dish structures


dewatering tubes

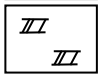

stylolites

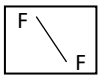

calcareous


dolomitic

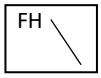

flaser bedding


linsen bedding


siderite cement



fracture

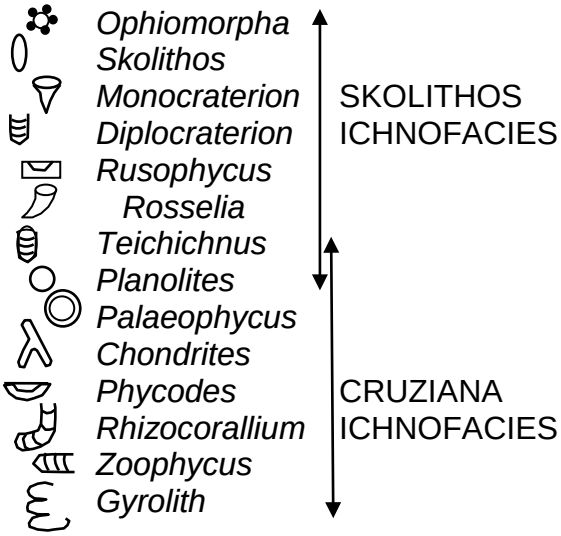


fracture - healed

LITHOFACIES CODES

Fl	mud, laminated
Fm	mud, massive
Fb	mud bioturbated
Fd	mud, deformed
Sm	sand, massive
Sh	sand, horizontal bedding
Sp	sand, planar cross bedding
St	sand, trough cross bedding
Sr	sand, rippled
Sd	sand, deformed
Sb	sand, bioturbated
Ss	sand, storm influenced
C	coal
G	gravel

ICHNOFACIES



This logging scheme divides sediments into mud, sand and gravel with further subdivisions based on the Wentworth scale, plotted increasing to the right. The mud column also serves to illustrate lithology while the sand column doubles for graphic representation of sedimentary structures. The graphic log is backed up by lithofacies codes after Miall (1978)

APPENDIX VI: PALYNOLOGY REPORT

No Palynology Report available for Flying Fox Creek 1.

APPENDIX VII: SEM ANALYSIS REPORT

SEM-EDS analyses
Flying Fox Creek 1

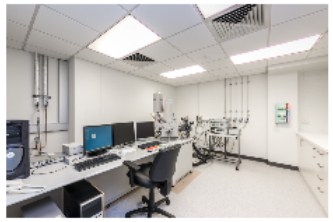
Dr Tennille Mares
Sedimentology and Petrology

Santos

June 2017

Philips XL30 Field Emission Scanning Electron Microscope (FESEM)

- Field emission electron source offers high-resolution imaging
- Solid state backscattered electron detector for mean atomic number imaging
- X-ray analysis with thin film EDS detector allowing light element detection
- Electron Backscattered Diffraction Pattern imaging with HKL EBSP camera and control
- Low kV imaging for non-coated or insulating materials



Work completed using the XL30 machine

Adelaide Microscopy

The University of Adelaide.

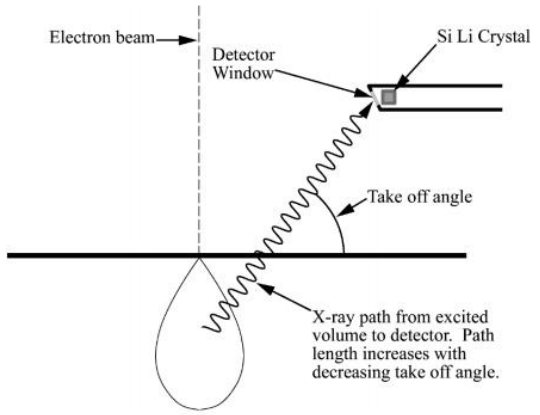
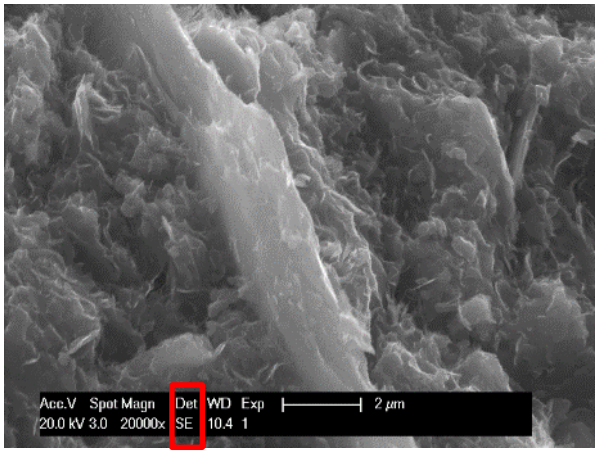
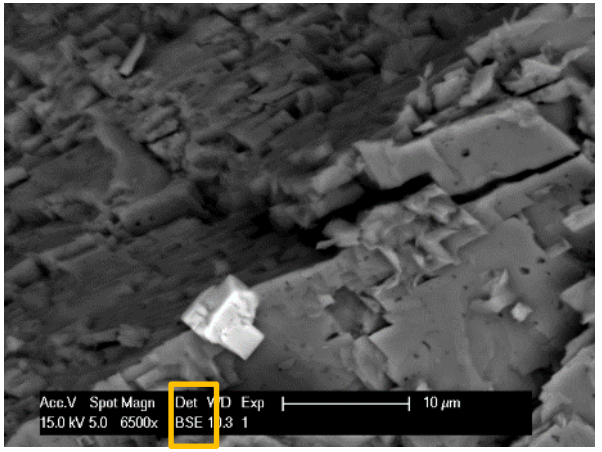


Figure 2.3. X-ray path length through specimen and take off angle.



Secondary electron mode (SE) is used to obtain high resolution images of the sample surface (topography).



Backscatter electron mode (BSE) is used to visualise compositional differences.

Method

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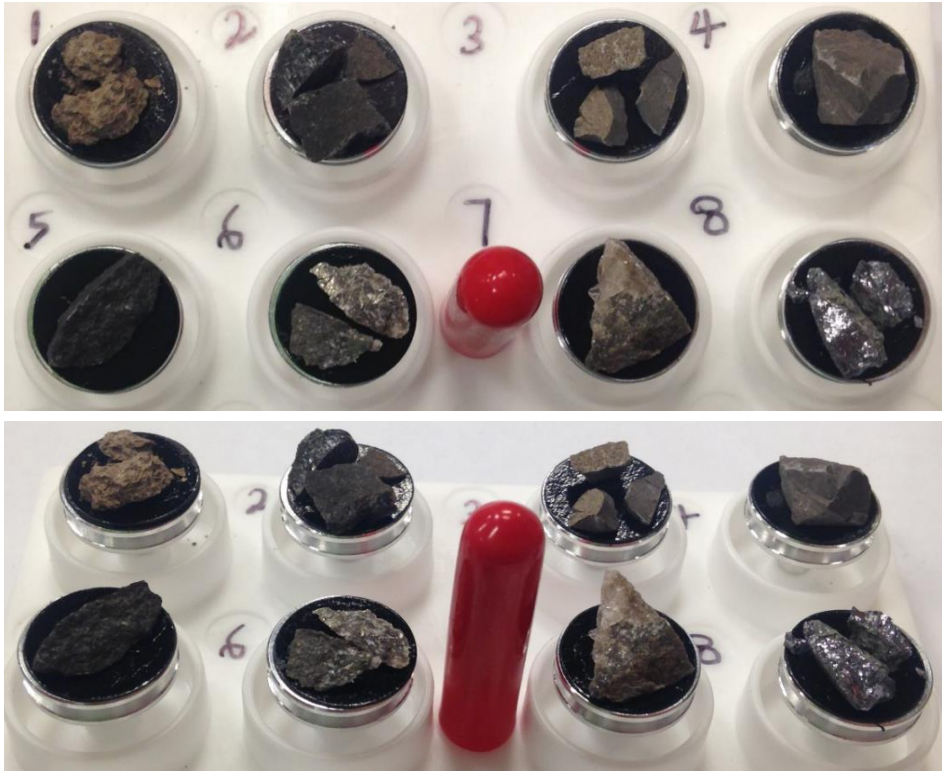
SEM analysis is a useful technique for answering key questions with respect to determining the habit and composition of rock samples. The generated elemental spectra are point analyses (not representative or quantitative like XRD) from which mineral composition can be suggested.

- 8 samples selected by the asset team were supplied to the Sedimentology and Petrology team with a request to investigate the mineralogy.
- 7 samples were from Marmbulligan 1 (MB) and 1 from Flying Fox Creek 1 (FFC).
- All samples were photographed at the macro and micro scale prior to analysis.
- Small chips were broken from the supplied samples with pliers then mounted on aluminium stubs with double sided carbon tabs.
- Prepared samples were carbon coated and analysed using the XL30 SEM at Adelaide Microscopy by Santos staff.



Samples:

1. MB 338.55m
2. MB 336.70m
3. MB 330.50m
4. MB 330.20m
5. MB 382.92m
6. MB 512.97m
7. MB 518.53m
8. FFC 252.1m

Flying Fox Creek 1 252.10m

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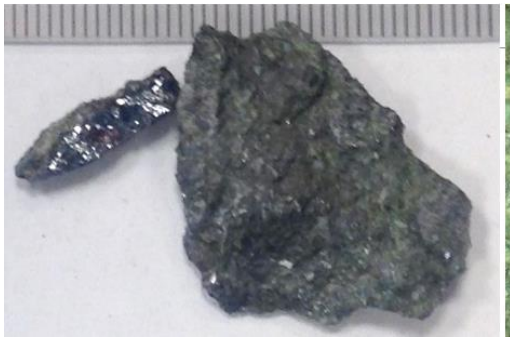
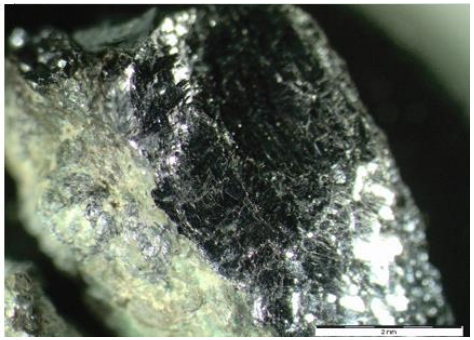
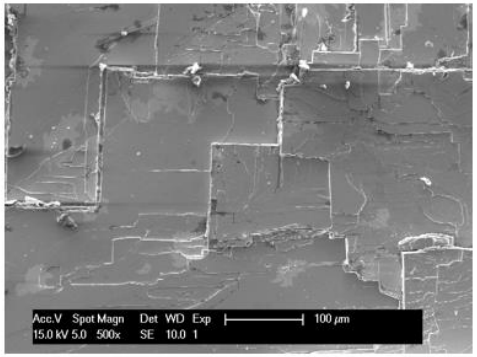
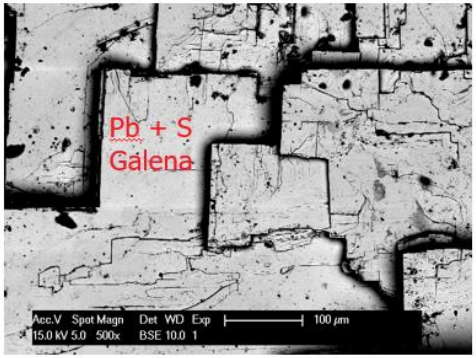
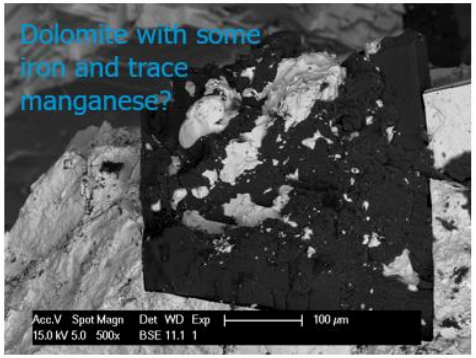
This sample was collected from brecciated fracture fill in the Limmen Sandstone. The clast/fragment was dense, dark grey with a slightly metallic lustre. Analysis found the sample was predominately Galena.

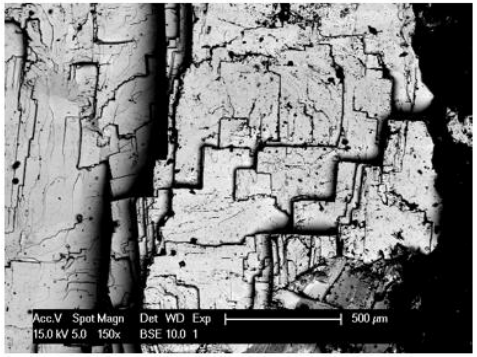


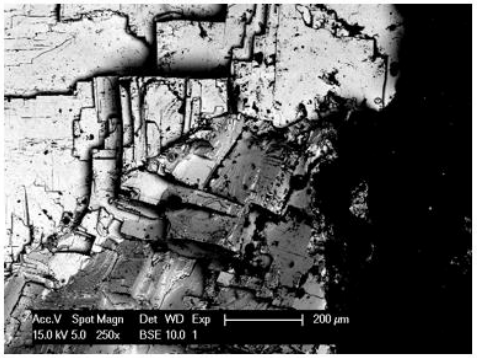


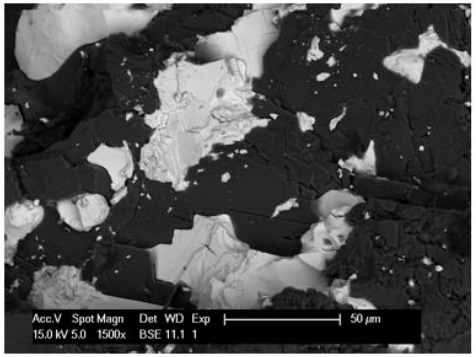












Flying Fox Creek 1 252.10m

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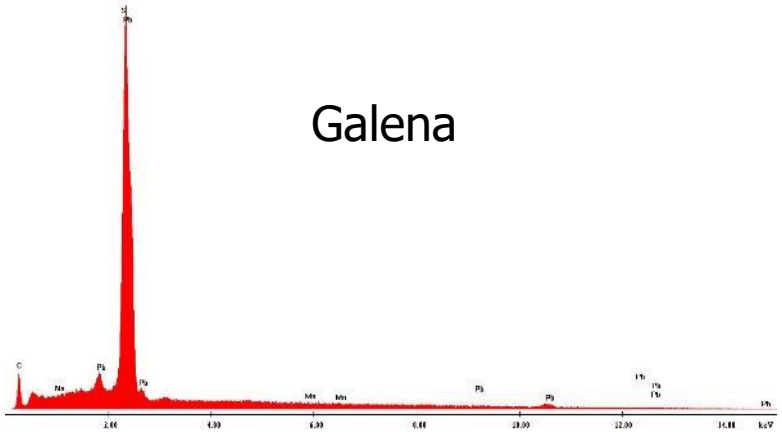
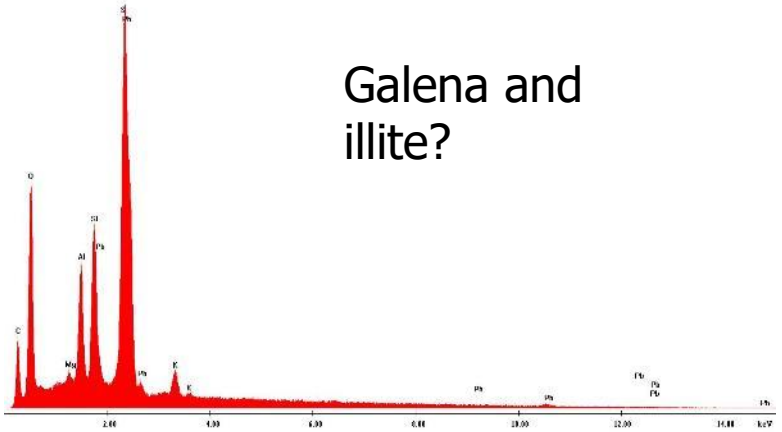
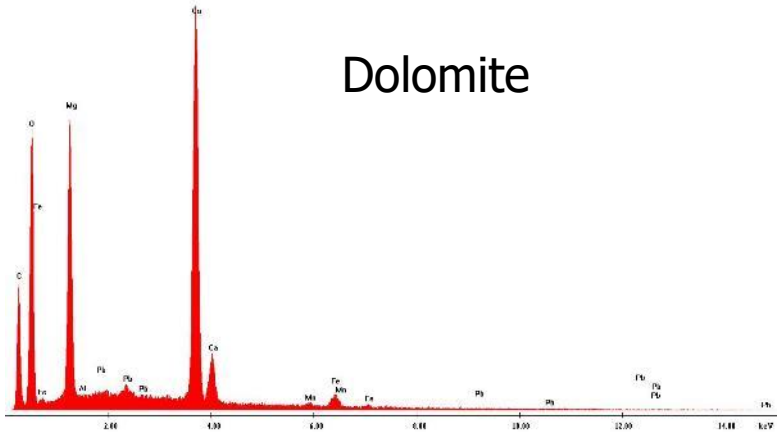
Collected spectra



Galena



Galena and illite?



Dolomite

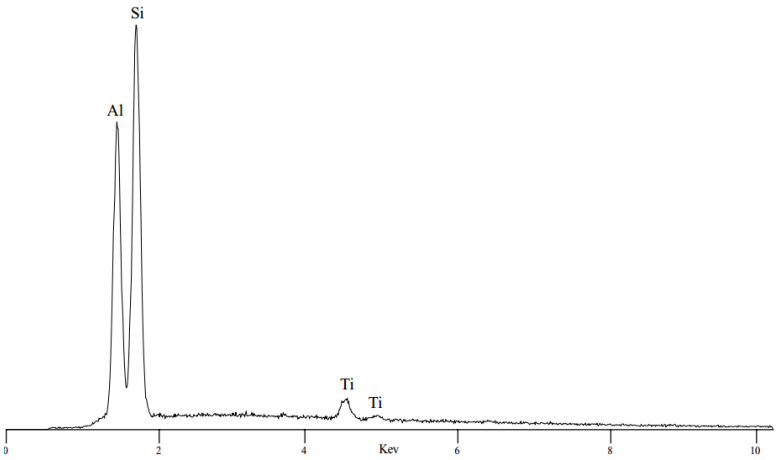
Reference Spectra - clays

Santos

1. AAPG ME4 SEM Petrology Atlas
2. Energy dispersive spectrometry of common rock forming minerals (Severin, 2004)

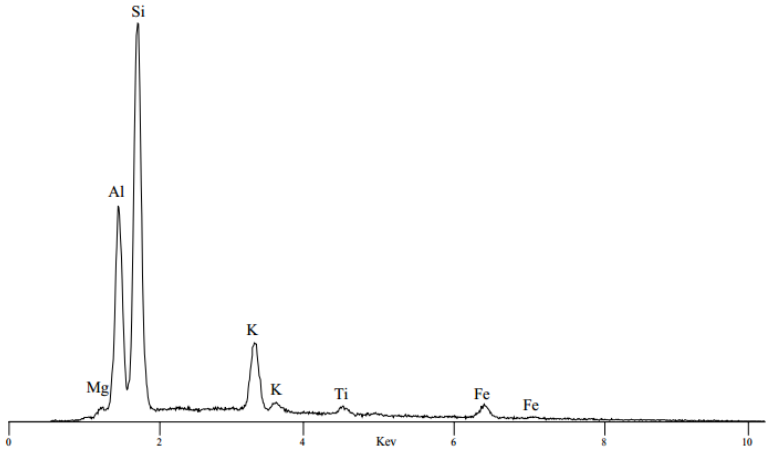
Kaolinite $Al_4[Si_4O_{10}](OH)_8$

Clay



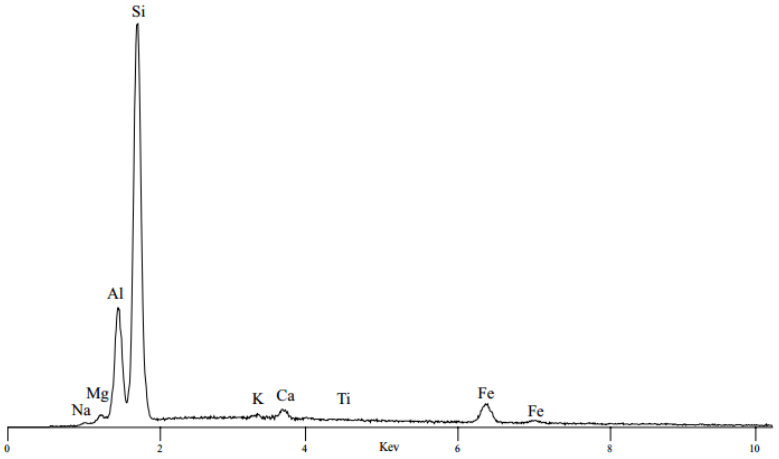
Illite $K_{1-1.5}Al_4[Si_{7-6.5}Al_{1-1.5}O_{20}](OH)_4$

Clay

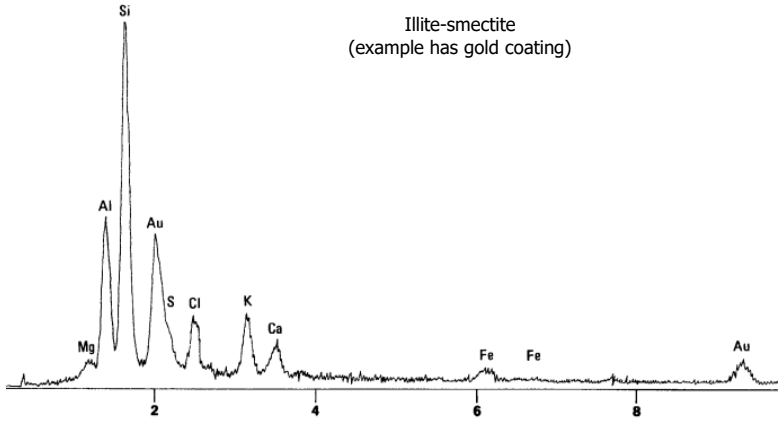


Montmorillonite (Smectite) $(½Ca,Na)_{0.7}(Al,Mg,Fe)_4[(Si,Al)_8O_{20}](OH)_4 \cdot nH_2O$

Clay



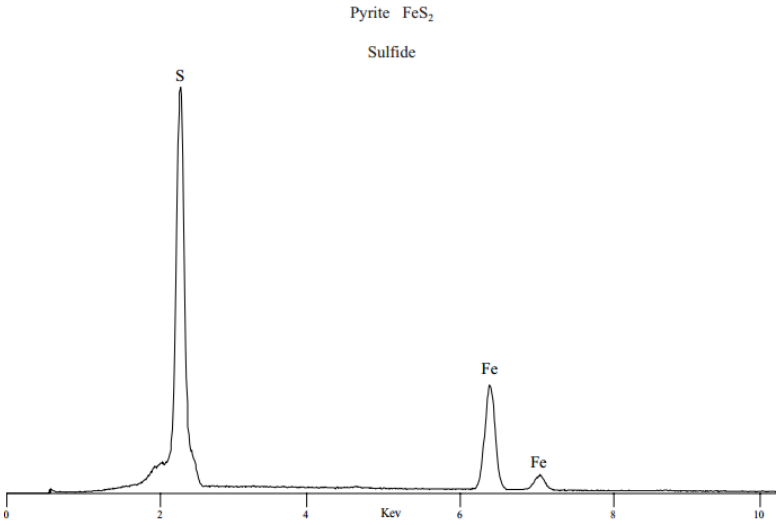
Illite-smectite
(example has gold coating)

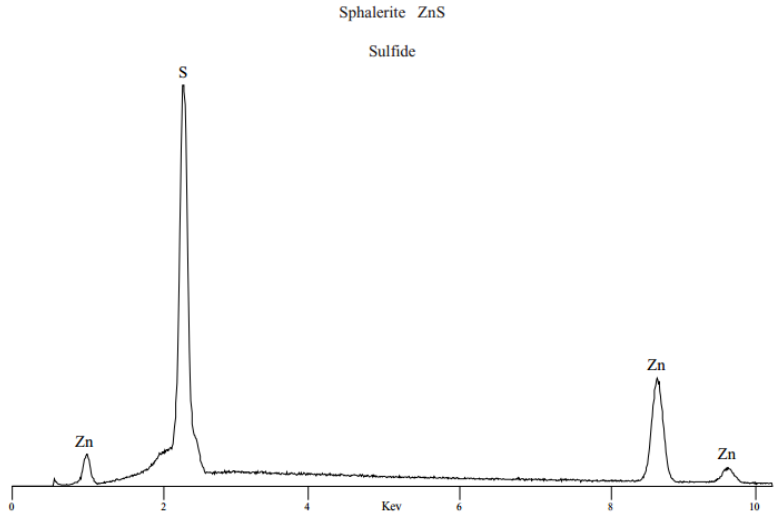


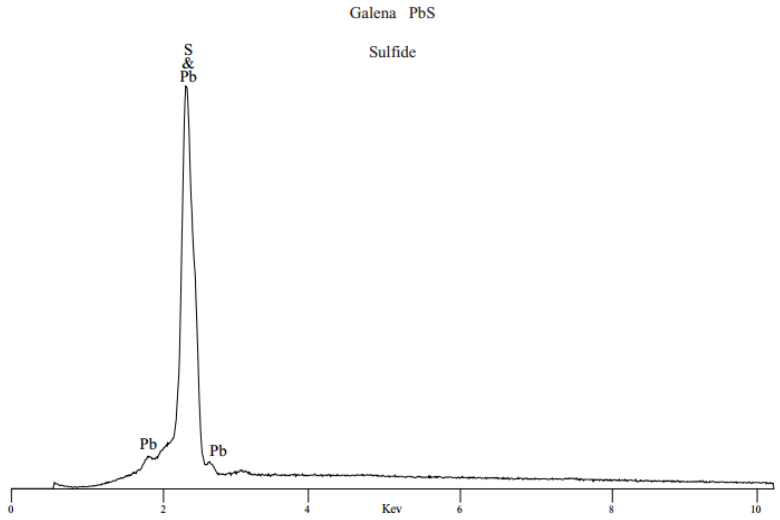
Reference Spectra - sulphides

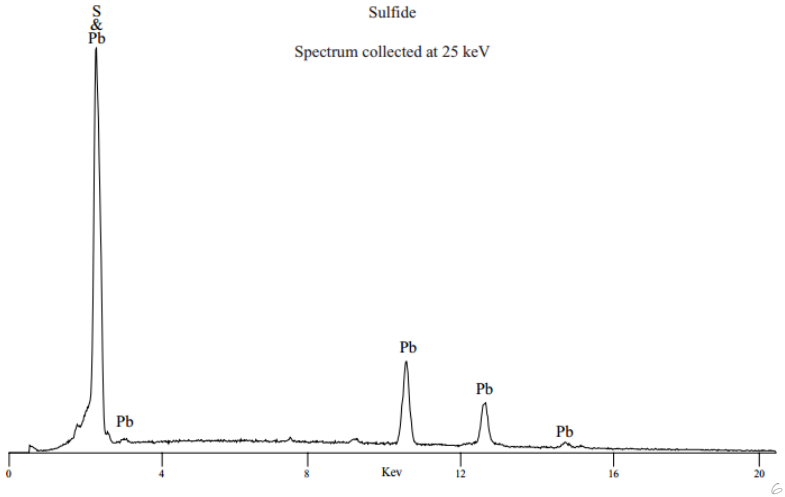
Santos

1. AAPG ME4 SEM Petrology Atlas
2. Energy dispersive spectrometry of common rock forming minerals (Severin, 2004)





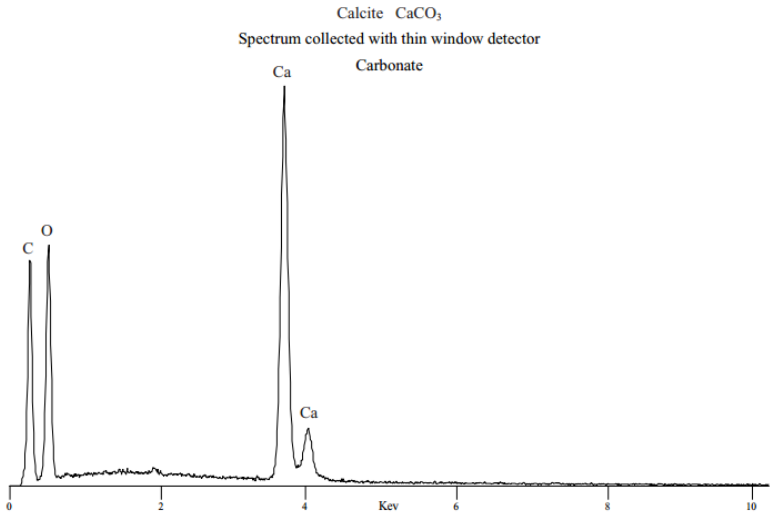


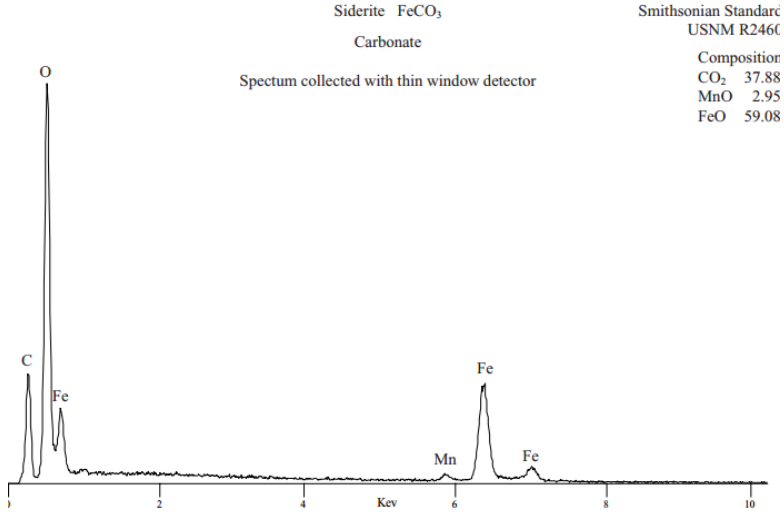


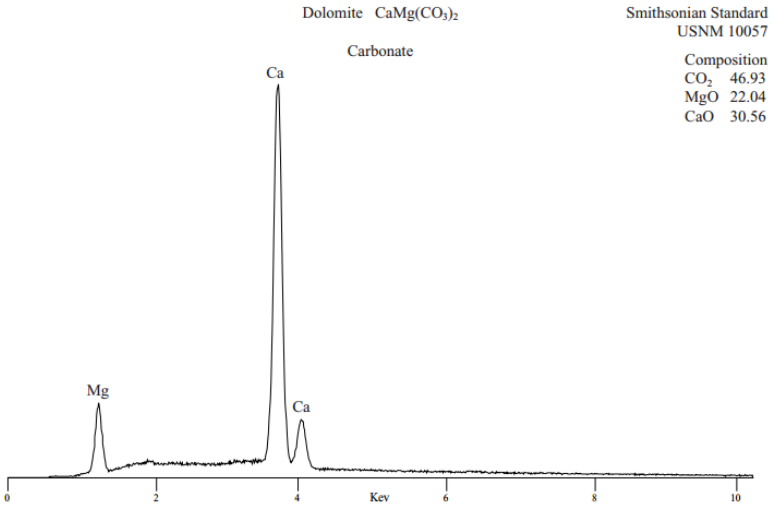
Reference Spectra - carbonates

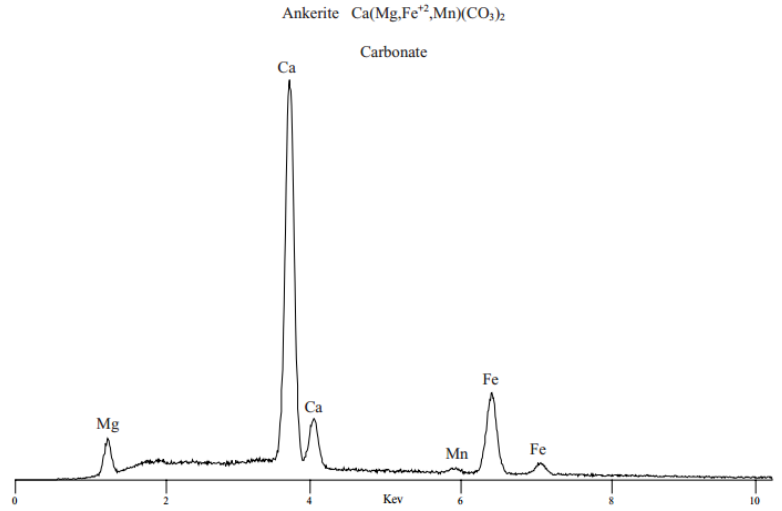
Santos

1. AAPG ME4 SEM Petrology Atlas
2. Energy dispersive spectrometry of common rock forming minerals (Severin, 2004)





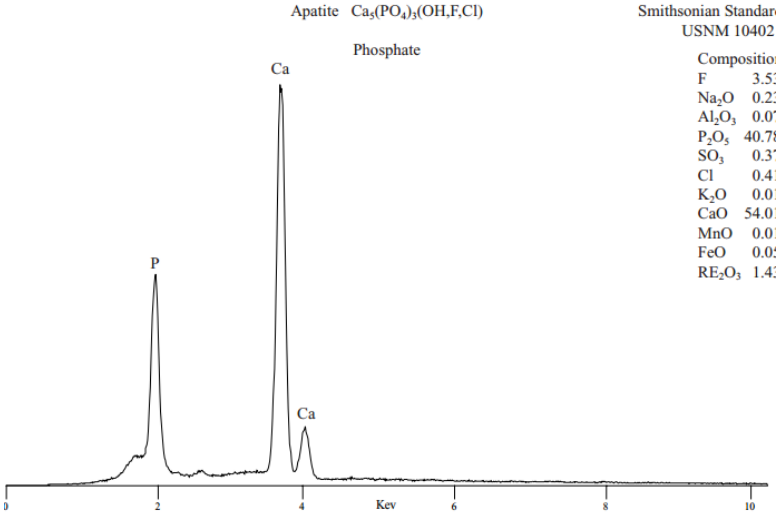




Reference Spectra - other

Santos

1. AAPG ME4 SEM Petrology Atlas
2. Energy dispersive spectrometry of common rock forming minerals (Severin, 2004)



APPENDIX VIII: WATER ANALYSIS

No Water Analysis available for Flying Fox Creek 1

APPENDIX IX: PRODUCTION TEST RESULTS

No Production Tests were performed at Flying Fox Creek 1.

ENCLOSURE I: LITHOLOGY LOG

ENCLOSURE II: WELL EVALUATION SUMMARY PLOT

ENCLOSURE III: SOURCE ROCK ANALYSIS REPORT