SANTOS – TAMBORAN

COMPILED FOR

SANTOS LIMITED

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

MOUNTAIN VALLEY 1

INTERPRETED WELL COMPLETION REPORT

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August 2017

MOUNTAIN VALLEY 1

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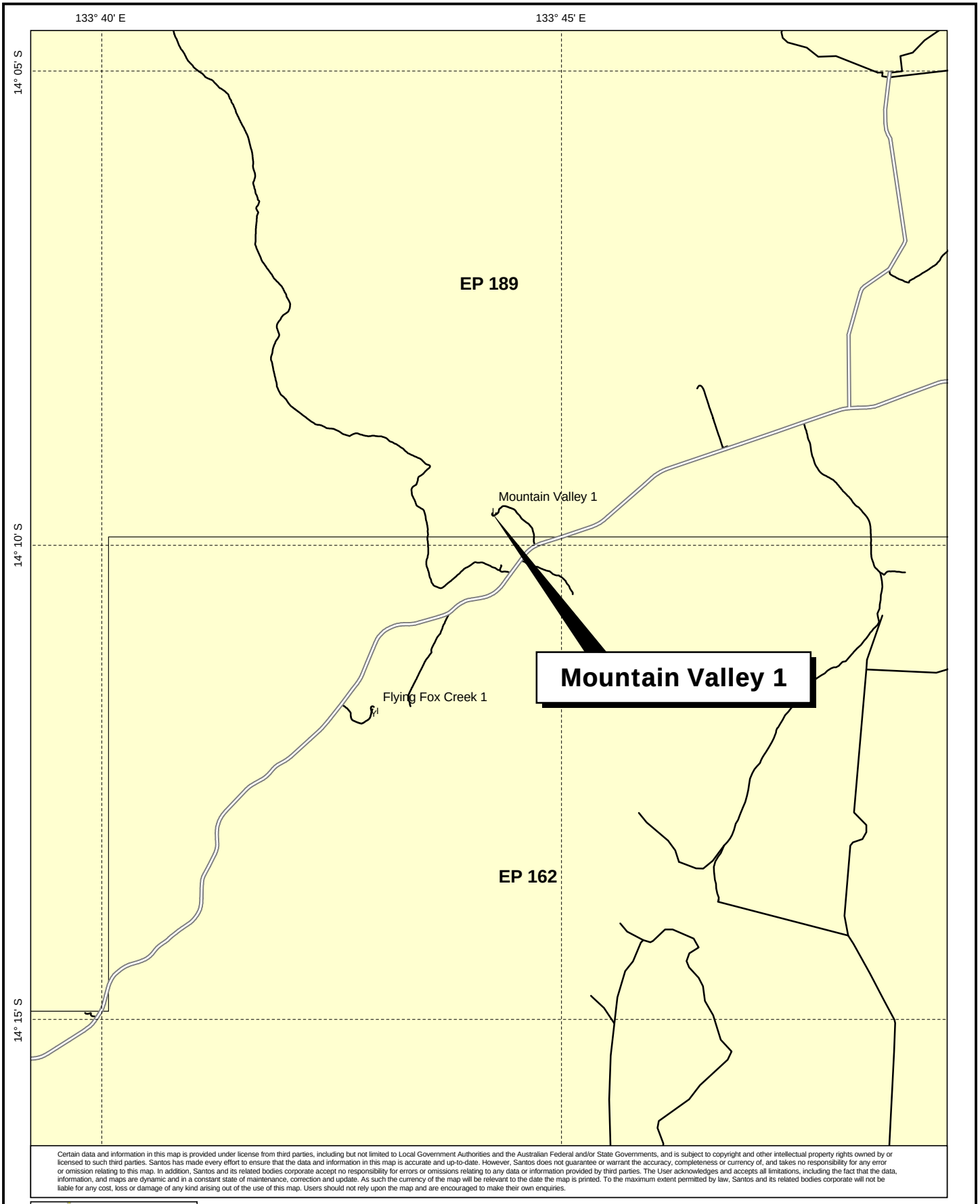
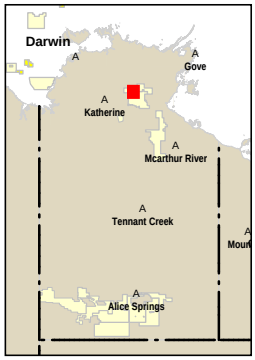
LOCATION MAP





Santos Exploration Permit

Santos

EP 189 - McArthur Basin

Mountain Valley 1

Location Map

0 1 2 3 4 5 Km

Scale: 1:100,000

25 August 2017, File No. MCARTHUR 061

GDA

WELL CARD

WELL DATA SUMMARY		
WELL: MOUNTAIN VALLEY 1	**WELL CATEGORY:** Stratigraphic **WELL INTENT:** Oil and Gas	**SPUD:** 24-08-2016, 15:30 Hours
		TD REACHED: 29-08-2016, 17:45 Hours.
		RIG RELEASED: 31-08-2016, 17:00 Hours.
SURFACE LOCATION: **LAT:** 14° 09' 37.16" S **LONG:** 133° 44' 15.43" E **(GDA94)** **NORTHING:** 8434175.55 **EASTING:** 363759.76 **(GDA94)**		**RIG:** Foraco 12
		STATUS: Plugged and Abandoned
SEISMIC STATION: N/A		**REMARKS:** Continuous HQ3 core cut from casing shoe to TD. TD called 10m below top of Jamberline Member, which came in 63.3 m high to prognosis. Well incurred considerable losses in Limmen Sandstone
ELEVATION GROUND LEVEL: 143.4m **AHD**		
RT DATUM ELEVATION: 143.4m (**Rig RT:** 0 m)		
BLOCK / LICENCE: EP-189, Maiwok Sub basin, Northern Territory		
TD: 153.1 m **(Logger – hung up on hole fill)**, 156.6 m **(Driller)**		
BASE OF PRODUCTION CEMENT: N/A		
TYPE STRUCTURE: No structure.		
TYPE COMPLETION: Plug & Abandon		
ZONE(S): N/A		

HOLE SIZE	CASING SIZE	SHOE DEPTH	TYPE
12 ¼"	9 ⅝"	8.0m	K 55, BTC, 36.0 lb/ft
8 ½"	4 ½"	49.1m	K 55, BTC, 11.6 lb/ft
96mm	P&A	156.6m	N/A

AGE	FORMATION OR ZONE TOPS	DEPTH (m)		THICKNESS TVD (m)	HIGH (H) LOW (L)
		MD	TVD SS		
MESOPROTEROZOIC	SURFICIAL DEPOSITS	0	143.4	4.0	
MESOPROTEROZOIC	MAINORU FORMATION	4.0	139.4	44.0	49.4 (H)
MESOPROTEROZOIC	NULLAWAN MEMBER	4.0	139.4	(44.0)	49.4 (H)
MESOPROTEROZOIC	LIMMEN SANDSTONE	48.0	95.4	25.3	50.6 (H)
MESOPROTEROZOIC	DOOK CREEK FORMATION	73.3	70.1	83.3	60.1 (H)
MESOPROTEROZOIC	PO_{O4} MEMBER	73.3	70.1	(71.8)	60.1 (H)
MESOPROTEROZOIC	JAMBERLINE SANDSTONE MEMBER	145.1	-1.7	(11.5)+	63.3 (H)
	TOTAL DEPTH	156.6	-13.2		

LOG INTERPRETATION (Interval Averages)				
FORMATION	INTERVAL (m)	NET SAND (m)	$Ø_T$%	SW %
No evaluation*				

PERFORATIONS	
FORMATION	INTERVAL (m)
N/A	

CORES CUT (m)				
FM.	NO.	INTERVAL	CUT	REC
	1	**50.2-156.6**	106.4	93.3%

*Porosity and water saturations were not able to be estimated due to insufficient logs.

WIRELINE

LOG	SUITE / RUN	INTERVAL (m)	COMMENTS
GR	1 / 1	150.4 – 5.0	Tool run within NQ string due to hole conditions. Hung up due to fill. GR response attenuated due to metal NQ pipe.
Verticality	1 / 2	153.0 – 5.0	Tool run within NQ string due to hole conditions. Azimuth data inaccurate due to run through metal string. Hung up due to fill.

MWD / LWD

LOG	SUITE / RUN	INTERVAL (m)	COMMENTS
No MWD/LWD logging was conducted on Mountain Valley 1			

FLOW TEST RESULTS
No Flow Tests were performed at Mountain Valley 1.

1. SUMMARY

Mountain Valley-1 was a stratigraphic well drilled by the Foraco 12 rig within permit EP 189, onshore Northern Territory. The well is located on the northern margin of the Maiwok Sub-basin approximately 25 km north-east of Pacific O&G Broughton-1 and 11 km west of the 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. Mountain Valley-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.

Mountain Valley-1 was successfully drilled and was plugged and abandoned as planned. The well met the pre-drill geological objectives and 106.4 m of continuous 61.3 mm diameter HQ3 core was retrieved at 93.3% recovery. The result provides additional stratigraphic constraints for the Maiwok Sub-basin and enables further regional correlation. However, resistivity and sonic logs were not able to be acquired due to hole conditions, which prevented conducting petrophysical analysis. Verticality and gamma ray (GR) logs quality was also compromised due to these logs being acquired through NQ drill string.

The Limmen Sandstone in Mountain Valley-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. 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. Based on core observations the Limmen Sandstone is considered to be a predominantly very poor quality reservoir within this area.

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. This analysis indicated that the Dook Creek Poo_4 Member siltstones are organically lean and do not have sufficient hydrocarbon generation potential to be considered a source rock. Based on the Flying Fox Creek-1 result, no further petroleum geochemistry analysis was conducted across the Dook Creek Poo_4 Member in Mountain Valley-1. 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.

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. Mountain Valley-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 Mountain Valley-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.

Mountain Valley-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 ~25 km south-west of Mountain Valley-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

Mountain Valley-1 is a stratigraphic well located on the northern margin of the Maiwok Sub-basin approximately 25 km north-east of Pacific O&G Broughton-1 well and 11 km west of the 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 Mountain Valley-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 Mountain Valley-1. Control was obtained using surface geology and the following offset wells (distance and direction relative to Mountain Valley-1 are indicated):

Broughton 1	25 km SW
Urapunga 1	11 km E

The Surface Location for Mountain Valley 1 is:

Location	Latitude:	14° 09’ 37.16” South
(GDA94)	Longitude:	133° 44’ 15.43” East
	Northing**:**	8434175.55 m
	Easting**:**	363759.76 m

3. RESULTS OF DRILLING

3.1 STRATIGRAPHY PROGNOSIS

The pre-drill vs actual stratigraphic sequence intersected in Mountain Valley-1 is shown in Table 1 below. Formation tops in Mountain Valley-1 were intersected high to prognosis and ranged from 49.4m high (Nullawan Member) to 63.3m high (Jamberline Sandstone Member). This is largely attributed to the absence of the Mountain Valley Limestone, which had been prognosed as 50m thick based on surface geology mapping.

The primary objectives, the Limmen Sandstone and Dook Creek Formation Poo_4 Member, were intersected 50.6m and 60.1m high, respectively. The well reached a total depth of 156.6m (logger) after penetrating 11.5m of the Jamberline Sandstone Member.

TABLE 1: SUMMARY OF STRATIGRAPHY

AGE	FORMATION	ACTUAL mRT	ACTUAL mTVDSS	HIGH (H) LOW (L)
MESOPROTEROZOIC	SURFICIAL DEPOSITS	0	143.4	
MESOPROTEROZOIC	MAINORU FORMATION	4.0	139.4	49.4 (H)
MESOPROTEROZOIC	NULLAWAN MEMBER	4.0	139.4	49.4 (H)
MESOPROTEROZOIC	LIMMEN SANDSTONE	48.0	95.4	50.6 (H)
MESOPROTEROZOIC	DOOK CREEK FORMATION	73.3	70.1	60.1 (H)
MESOPROTEROZOIC	Poo_4 MEMBER	73.3	70.1	60.1 (H)
MESOPROTEROZOIC	JAMBERLINE SANDSTONE MEMBER	145.1	-1.7	63.3 (H)
	TOTAL DEPTH (DRILLER)	156.6	-13.2	

3.2 STRATIGRAPHY & DEPOSITIONAL ENVIRONMENT (Drillers Depths)

A brief description of lithology and interpreted environments of deposition follows. More detailed descriptions can be found in Section 2.1 of the Basic Well Completion Report. The well reached total depth at 156.6m (driller) after penetrating 11.5m 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 Mountain Valley-1. The Nullawan Member was the only Mainoru Formation member intersected at Mountain Valley-1.

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 Nullawan Member is interpreted as a non-marine mudstone deposited in a fluvial floodplain.

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 Mountain Valley-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). Mountain Valley-1 intersected the Unit 4 (Poo_4) 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 fine to medium grained quartz sandstone with common thin siltstone interbeds. 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)

Mountain Valley-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.

Resistivity and sonic logs were not acquired due to an obstruction at 62m in the Limmen Sandstone. Verticality and gamma ray (GR) logs were acquired through the NQ drill string resulting in a subdued GR response and an invalid azimuth recorded by the verticality log. A lithology track was interpreted from GR and mudlog lithology, petrophysical analysis was not able to be performed without resistivity and sonic logs.

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 Mountain Valley 1.					

TABLE 3: SUMMARY OF NET SAND IN MOUTAIN VALLEY 1

FORMATION	INTERVAL (m)	NET SAND(m)	$Ø_T$ %	SW %	FLUORESCENCE / COMMENTS
No evaluation					

3.4 RESERVOIR PROPERTIES AND QUALITY

The Limmen Sandstone in Mountain Valley-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. 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. Based on core observations the Limmen Sandstone is considered to be a predominantly very poor quality reservoir within this area.

3.5 EXPLORATION RELEVANCE

The Mountain Valley-1 well provides additional stratigraphic constraints for the Maiwok Sub-basin and enables further regional correlation. Mountain Valley-1 intersected the Nullawan Member of the Mainoru Formation below a thin veneer of surficial sediments. The surface location is mapped as Mountain Valley Limestone on the Urapunga and Roper River Special 250k mapsheet, which is absent at Mountain Valley-1.

The Nullawan Member is similar thickness to the intervals intersected in Broughton 1 and Flying Creek-1 suggesting that while the Mountain Valley Limestone has been completely eroded the Nullawan Member has been preserved at Mountain Valley-1. Similar to Flying Fox Creek-1, the Dook Creek Poo_4 Member was thinner than in Broughton-1, due to additional section having been eroded below the Roper Group unconformity. A general thinning of the Limmen Sandstone is observed from Broughton 1 toward Flying Fox Creek-1 and Mountain Valley-1; (Figure 1).

No hydrocarbon shows were observed within the Limmen Sandstone. The Limmen Sandstone intersected in Mountain Valley-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 Mountain Valley-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 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. 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 Poo_4 Member siltstones are organically lean and do not have sufficient hydrocarbon generation potential to be considered a source rock. Based on the Flying Fox Creek-1 result, no further petroleum geochemistry analysis was conducted across the Dook Creek Poo_4 Member in Mountain Valley-1. 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.

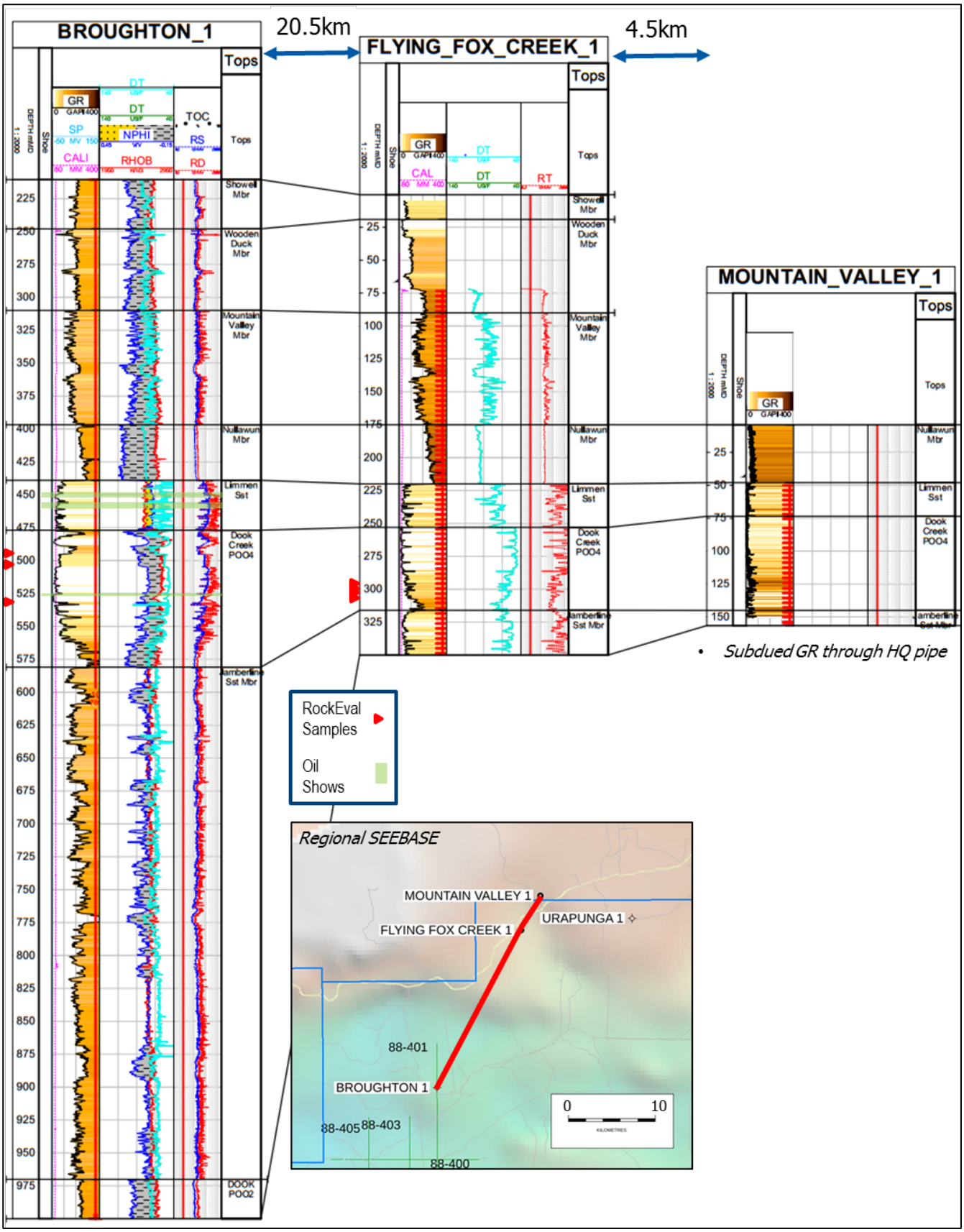


Figure 1 Stratigraphic correlation, flattened on the Nullawan Member, between Broughton-1, Flying Fox Creek-1, and Mountain Valley-1 showing the location of Broughton-1 oil shows and RockEval/HAWK samples in Broughton-1 and Flying Fox Creek-1.

3.6 CONCLUSION

Mountain Valley-1 was successfully drilled as a stratigraphic well and was plugged and abandoned as planned. The well met the pre-drill geological objectives and 106.4 m of continuous 61.3 mm diameter HQ3 core was retrieved at 93.3% recovery. However, petrophysical analysis was not able to be performed without resistivity and sonic logs, which were not acquired due to an obstruction at 62m in the Limmen Sandstone. Verticality and gamma ray (GR) logs quality was also compromised due to being were acquired through the NQ drill string. No hydrocarbon shows were observed from the core or cuttings.

Mountain Valley-1 intersected the Nullawan Member of the Mainoru Formation below a thin veneer of surficial sediments. The surface location is mapped as Mountain Valley Limestone on the Urapunga and Roper River Special 250k mapsheet, which is absent at Mountain Valley-1. The primary targets, the Limmen Sandstone and Dook Creek Formation Poo_4 Member, were intersected 50.6m and 60.1m high, respectively. This is largely attributed to the absence of the Mountain Valley Limestone, which had been prognosed as 50m thick based on surface geology mapping. The Nullawan Member is similar thickness to the intervals intersected in Broughton 1 and Flying Creek-1 suggesting that while the Mountain Valley Limestone has been completely eroded the Nullawan Member has been preserved at Mountain Valley-1. A general thinning of the Limmen Sandstone is also observed from Broughton 1 toward Flying Fox Creek-1 and Mountain Valley-1.

Lack of a source rock potential and lack of hydrocarbon shows in the overlying Dook Creek Poo_4 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 31st of August 2016 to Marmbulligan-1.

3.7 SAMPLES COLLECTED

Cuttings

Depth (m)	Sampled Interval (m)
Spud – 50.2	3

Missed Bulk Samples

None missed.

Underweight Bulk Samples

None underweight.

Full Hole Cores

Continuous 61.3mm HQ3 core was taken from 50.2m to 156.6m (TD); 106.4m cut, 99.3m recovered, 93.3% recovery.

Sidewall Cores

No sidewall cores were acquired in Mountain Valley-1.

Other Samples

N/A

Date / Time	Composition	Depth (m)

4. REFERENCES

SANTOS, 2016	MOUNTAIN VALLEY 1 Well Proposal, prepared for SANTOS Ltd, (unpublished).
S.DUNSTAN, 2016	MOUNTAIN VALLEY 1 Basic Well Completion Report, prepared for SANTOS Ltd, (unpublished).
SANTOS, 2016	MOUNTAIN VALLEY 1 Petrophysics Report, prepared for SANTOS Ltd, (unpublished).
SANTOS, 2016	MOUNTAIN VALLEY 1 1 PRELIM POST-WELL LOOK-BACK, prepared for SANTOS Ltd, (unpublished).
SANTOS, 2016	MOUNTAIN VALLEY 1 Final Well Report, 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 EVALUATION RESULTS

PETROPHYSICAL FORMATION EVALUATION

Well Name: Mountain Valley1

Basin: McArthur

Rig Release Date: 31-Aug-2016

Mountain Valley1

Mountain Valley1 was drilled as vertical stratigraphic exploration well to a total depth of 156.6 mRT. A 12 ¼" hole was drilled with a 9 5/8" casing set at 8 mRT. A 8 ½" hole was then drilled with air to TD. Wire line logging was carried out by Weatherford as described below (table 1).

Mountain Valley1 was cored continuously from 50.2 – 156.6 mRT with a total recovery of 93.3%.

Mountain Valley1 has been plugged and abandoned.

Discussion

No adequate logging suite was acquired in Mountain Valley 1 to perform petrophysical analysis.

Logs Acquired

8 ½'' hole

Wireline Logging Summary					
Log	Suite / Run	Depth Interval (m MD)		BHT / TIME	Remarks
		From	To		
GR	1 / 1	150.4m	5m		Tool run within NQ string due to hole conditions. Hung up due to fill. GR response attenuated due to metal NQ pipe.
Verticality	1 / 2	153.0m	5m		Tool run within NQ string due to hole conditions. Azimuth data inaccurate due to run through metal string. Hung up due to fill.

Table 1: Logging programme in Mountain Valley 1.

Mud Parameters

8 ½ “” hole
Mud Type Air

Interpretation Procedures & Parameters

- Only GR and verticality have been logged in Moutain Valley 1 hence the only interpretation possible was a Volume of Shale
- 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 = 4
GR_{sh} = GR response in 100% shale = 70

Conclusions

- No estimate of porosity or water saturation can be given due to the lack of adequate logs
- Calculated Vsh in line with lithologies described from cuttings
- Mountain Valley1 has been plugged and abandoned.

Mountain Valley1 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 Mountain Valley 1.

APPENDIX III: HYDROCARBON SHOW REPORT

No Hydrocarbon Shows were observed in Mountain Valley 1.

APPENDIX IV: GEOTHERMAL GRADIENT

No bottom hole temperatures were recorded on Mountain Valley 1. A bottom hole temperature of 43°C (at 350.2m MDRT) was calculated from wireline temperature data on Flying Fox Creek 1 (based on suite 1 of wireline logs) which enabled a geothermal gradient of 6.37°C /100m to be calculated and it is assumed to be similar at Mountain Valley 1. A surface temperature of 21°C was assumed.

APPENDIX V: SEDIMENTOLOGICAL LOG

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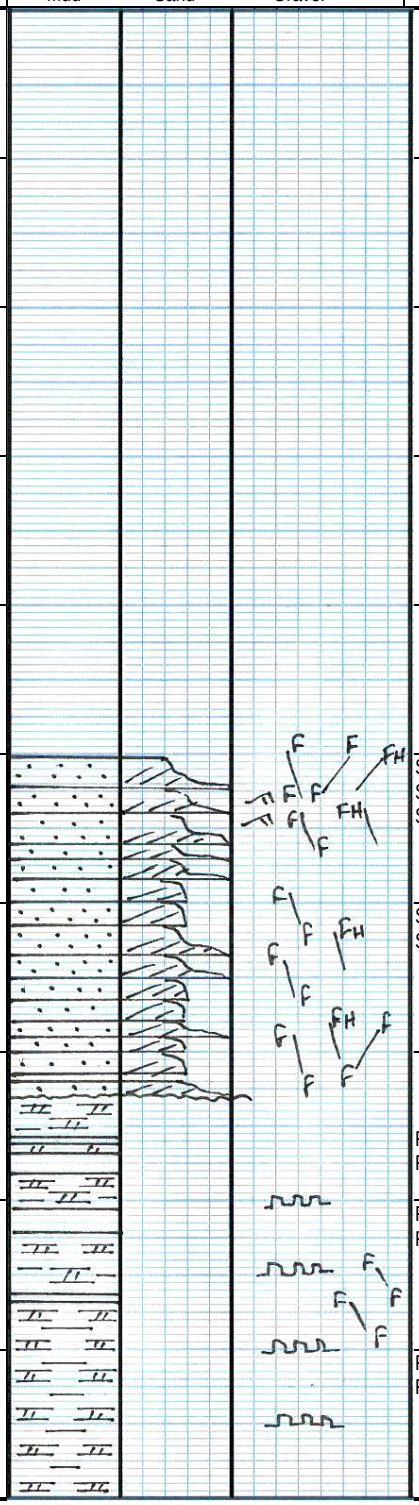
CORE DESCRIPTION

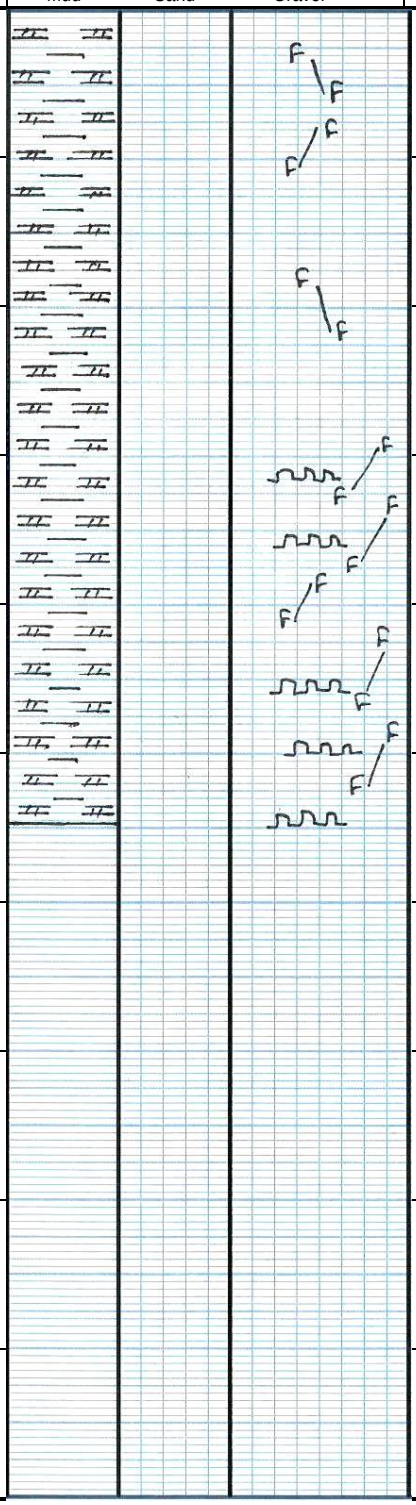
Date	December 2016		Page	1 of	2
Well Name	Mountain Valley 1		CORE No	1	

DEPTH metres	Graphic Sedimentological Log (Mud / Sand / Gravel)	LITHOFACIES CODES	DESCRIPTION
0			
10			
20			
30			
40			
50		Sh Sr St	Top of core – 50.2m MD
60		Sh St	Limmen Sandstone Comprises predominantly fine to medium grain size qtz Sst (with some very coarse to pebbly grain size beds) and minor micaceous siltstone. Highly fractured – with both open and healed fracture sets
70		Fl Fm	Lost core: 0.4m (71.6-72.0m) Unconformity at base of Limmen Sandstone (boundary between Roper and Mt Rigg Groups) Lost core: 0.4m (75.75-76.15m), 1.8m (76.65-78.45m)
80		Fl Fm	Lost core: 1.7m (80.5-82.2m), 0.5m (86.2-86.7m) 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
90		Fl Fm	

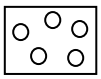
SANTOS LIMITED

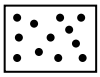
CORE DESCRIPTION

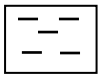
Date	December 2016		Page	2	of 2
Well Name	Mountain valley 1		CORE No	1	

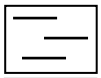
DEPTH metres	Graphic Sedimentological Log	LITHOFACIES CODES	DESCRIPTION
	Mud Sand Gravel		
100		Fl Fm	
110		Fl Fm	
120		Fl Fm	Dook Creek Formation - PO_4 unit Off white - grey Dolostone (with minor interbedded dark grey-black silt/mud layers)
130		Fl Fm	Plus dark green grey siltstone beds Remnant stromatolite column Rip up clasts of mudstone present in the dolomitized limestone beds and limestone intraclasts also present in the mudstone/siltstone beds.
140		Fl Fm	Galena mineralisation present in styolites Minor pyrite mineralisation
150		Fl Fm	Base of core – 154.8m MD
160			
170			
180			
190			

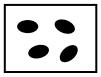
LEGEND


conglomerate

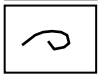

sandstone

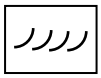

siltstone


claystone, shale


mud intraclasts


coaly wisps

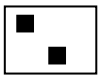

slump

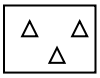

cross bedding


ripples

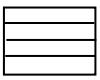

shell

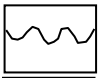

climbing ripples

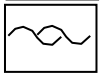

pyrite

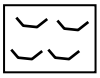

breccia


scour fill

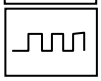

horizontal beds

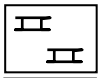

scour surface

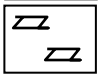

hummocky bedding


dish structures


dewatering tubes

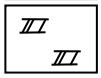

stylolites

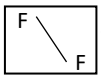

calcareous


dolomitic

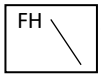

flaser bedding


linsen bedding


siderite cement



fracture

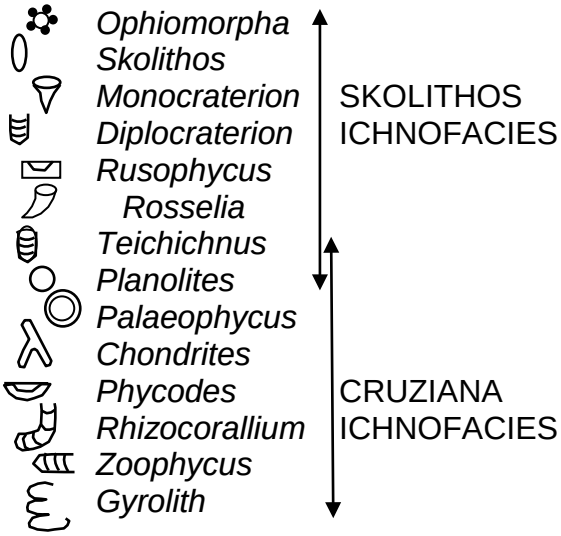


fracture - healed

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 is available for Mountain Valley 1.

APPENDIX VII: WATER ANALYSIS

No Water Analysis was performed on Mountain Valley 1

APPENDIX VIII: PRODUCTION TEST RESULTS

No Production Tests were performed at Mountain Valley 1.

ENCLOSURE I: LITHOLOGY LOG

ENCLOSURE II: WELL EVALUATION SUMMARY PLOT