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Organic Petrological analysis results for a suite of shale samples from Marmbulligan-1, Tarlee-S3 and Atree-2, the Beetaloo sub-basin, Northern Territory

For Northern Territory Geological Survey

Zhongsheng Li and Mohinudeen Faiz

15 December 2020

CSIRO Energy

Citation

Li Z and Faiz M (2020). Organic Petrological analysis results for a suite of shale samples from Marmbulligan-1, Tarlee-S3 and Atree-2, the Beetaloo sub-basin, Northern Territory.

Enquiries should be address to:

Zhongsheng Li

CSIRO Energy

11 Julius Avenus, North Ryde, NSW 2113, Australia

Telephone: +61 2 9490 8645

E-mail: Zhongsheng.Li@csiro.au

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Contents

Acknowledgments.....	3
1 Introduction.....	4
2 Results	5

Tables

Table 1 Summary of reflectance values of alginite and bitumen measured at the CSIRO North Ryde laboratory for samples from Tarlee S3, Beetaloo Sub-basin, Northern Territory.....	5
Table 2 Summary of reflectance values of alginite and bitumen measured at the CSIRO North Ryde laboratory for samples from Marmbulligan-1, Beetaloo Sub-basin, Northern Territory.....	7
Table 3 Summary of reflectance values of alginite and bitumen measured at the CSIRO North Ryde laboratory for samples from Altree-2, Beetaloo Sub-basin, Northern Territory.....	8
Table 4 Summary of reflectance values of thucolite and bituminite measured at the CSIRO North Ryde laboratory for samples from Marmbulligan-1, Altree2 and Tarlee S3, Beetaloo Sub-basin, Northern Territory.....	9

Acknowledgments

This data transmission presents a compilation of information from a project funded by the Onshore Gas Program in CSIRO Energy.

The authors acknowledge the following companies and individuals for their assistance:

- Northern Territory Geological Survey (NTGS) for providing access to samples at the core storage facility in Darwin, in particular, Darryl Stacey for organising and granting access to the NTGS Core Store, Shannon Walsh for taking out all the core pellets for viewing and sampling and putting back, Dorothy Close and others for discussions.

1 Introduction

The “Energy Resources Program” of CSIRO Energy conducted organic petrological analysis, as part of a research project to evaluate unconventional reservoirs within Mesoproterozoic shales of the Beetaloo Sub-basin (BSB). The analyses of samples collected from three exploration wells (Marmbulligan 1, Tarlee S3, and Atree-2) from the Northern Territory Geological Survey (NTGS) Core Store. were done at the CSIRO Energy’s organic petrology lab at North Ryde, NSW.

The reflectance analyses on a suite of shale samples from three wells Marmbulligan-1, Tarlee-S3, and Atree-2, were done on bitumen and alginite (Table 1 to 3) which are the main macerals present in the samples studied, along with some measurements from thucolite and bituminite (Table 4) if applicable in samples.

2 Results

Table 1 Summary of reflectance values of alginite and bitumen measured at the CSIRO North Ryde laboratory for samples from Tarlee S3, Beetaloo Sub-basin, Northern Territory.

Well Name	Sample #	Depth (m)	Formation	Bitumen Reflectance					Alginite Reflectance				
				R _{mran} %	Min	Max	N	σ	R _{mran} %	Min	Max	N	σ
Tarlee -S3	19158	1102.16	Upper Velkerri	1.82	1.12	2.30	31	0.29					
	19159	1139.20	Upper Velkerri	1.92	1.47	2.35	23	0.24					
	19160	1172.05	Upper Velkerri	1.35	0.98	2.13	39	0.30					
	19163	1237.70	Middle Velkerri	1.99	1.62	3.91	58	0.42					
	19165	1275.21	Middle Velkerri	1.90	1.73	2.18	6	0.17					
	19168	1360.56	Middle Velkerri	2.55	1.96	5.02	41	0.59					
	19169	1405.76	Middle Velkerri	2.56	1.91	3.28	61	0.34					
	19172	1469.15	Middle Velkerri	3.05	1.96	4.46	52	0.53					
	19173	1477.10	Middle Velkerri	3.39	2.61	4.65	47	0.47					

		Middle												
19174	1478.50	Velkerri	2.13	1.52	2.97	25	0.33							
		Middle												
19175	1479.08	Velkerri	5.49	4.16	7.61	51	0.70							
		Middle												
19176A	1480.80	Velkerri	4.95	4.01	7.27	52	0.64							19167A - Adjacent to intrusion
		Middle												
19176B	1480.80	Velkerri	4.58	1.85	8.56	11	2.58							19176B - Adjacent to intrusion
		Middle												
19177	1545.99	Velkerri	2.65	2.00	3.90	33	0.42							
		Middle												
19178	1559.88	Velkerri	5.90	2.30	9.10	72	2.04							
		Middle												
19181	1589.96	Velkerri	2.94	2.48	3.33	44	0.24							
		Lower												
19183	1618.80	Velkerri	2.35	1.93	2.97	39	0.19							
		Lower												
19185	1645.52	Velkerri	2.14	1.84	2.37	16	0.16	2.21	2.12	2.34	11	0.08		

$R_{m_{ran}}\%$ = Mean random reflectance of bitumen and alginite, measured in unpolarised light and under oil immersion.

Min = minimum value; Max = maximum value; N = Number of reflectance readings; σ = standard deviation.

Table 2 Summary of reflectance values of alginite and bitumen measured at the CSIRO North Ryde laboratory for samples from Marmbulligan-1, Beetaloo Sub-basin, Northern Territory.

Sample #	Depth (m)	Formation	Bitumen Reflectance				Alginite Reflectance					
			R _{mran} %	Min	Max	N	σ	R _{mran} %	Min	Max	N	σ
19134	109.6	Upper Velkerri	0.56	0.46	0.71	9	0.09	0.39	0.19	0.66	46	0.11
19137	191.3	Middle Velkerri	0.32	0.15	0.58	29	0.11					
19139	254.99	Middle Velkerri	0.46	0.36	0.56	7	0.08	0.30	0.18	0.46	27	0.09
19141	311.11	Middle Velkerri	0.60	0.35	0.98	42	0.11	0.45	0.22	0.76	50	0.15
19144	363.7	Middle Velkerri	0.62	0.40	0.80	25	0.10	0.49	0.34	0.72	14	0.11
19146	432.61	Middle Velkerri	0.59	0.32	0.82	62	0.11	0.49	0.22	0.71	53	0.13
19147	467.83	Middle Velkerri	0.82	0.58	1.02	14	0.13	0.71	0.36	0.97	14	0.16
19148	506.03	Lower Velkerri	0.87	0.42	1.16	46	0.15	0.76	0.42	1.05	41	0.14
19149	544	Lower Velkerri	1.30	1.02	1.69	12	0.21	1.19	1.15	1.22	2	0.06
19150	596	Lower Velkerri	1.32	1.08	1.66	29	0.15	1.44	1.02	1.63	6	0.22
19151	635.33	Lower Velkerri	1.44	1.23	1.84	33	0.13	1.50	1.19	1.87	21	0.14

$R_{m_{ran}}\%$ = Mean random reflectance of bitumen and alginite, measured in unpolarised light and under oil immersion.
 Min = minimum value; Max = maximum value; N = Number of reflectance readings; σ = standard deviation.

Table 3 Summary of reflectance values of alginite and bitumen measured at the CSIRO North Ryde laboratory for samples from Atree-2, Beetaloo Sub-basin, Northern Territory.

Sample #	Depth (m)	Formation	Bitumen Reflectance					Alginite Reflectance				
			$R_{m_{ran}}\%$	Min	Max	N	σ	$R_{m_{ran}}\%$	Min	Max	N	σ
19186	573.60	Upper Velkerri	0.48	0.35	0.65	4	0.15	0.44	0.20	1.03	32	0.19
19189	681.60	Middle Velkerri	0.46	0.33	0.56	9	0.07	0.38	0.24	0.62	66	0.09
19198	1060.00	Lower Velkerri	1.33	1.04	1.81	24	0.18	1.39	1.15	1.66	16	0.16
19200	1126.20	Lower Velkerri	1.19	0.72	3.07	33	0.50	1.15	0.84	1.63	20	0.20

$R_{m_{ran}}\%$ = Mean random reflectance of bitumen and alginite, measured in unpolarised light and under oil immersion.
 Min = minimum value; Max = maximum value; N = Number of reflectance readings; σ = standard deviation.


Table 4 Summary of reflectance values of thucolite and bituminite measured at the CSIRO North Ryde laboratory for samples from Marmbulligan-1, Atree2 and Tarlee S3, Beetaloo Sub-basin, Northern Territory.

Sample #	Depth (m)	Formation	Thucolite Reflectance					Bituminite Reflectance				
			R _{mran} %	Min	Max	N	σ	R _{mran} %	Min	Max	N	σ
19134	109.6	Upper Velkerri	0.69	0.50	1.18	14	0.19					
19137	191.3	Middle Velkerri						0.16	0.14	0.17	2	0.02
19139	254.99	Middle Velkerri	0.79	0.79	0.79	1						
19141	311.11	Middle Velkerri						0.32	0.25	0.43	20	0.05
19144	363.7	Middle Velkerri	0.61	0.61	0.61	1						
19146	432.61	Middle Velkerri										
19147	467.83	Middle Velkerri										
19148	506.03	Upper Velkerri	0.99	0.99	0.99	1						
19159	1139.20	Upper Velkerri	1.59	1.13	2.23	16	0.34					

		Upper						
19186	573.60	Velkerri	0.70	0.46	1.28	14	0.23	
		Middle						
19189	681.60	Velkerri	0.61	0.37	0.92	5	0.21	

$Rm_{ran}\%$ = Mean random reflectance of thucolite and bituminite measured in unpolarised light and under oil immersion.

Min = minimum value; Max = maximum value; N = Number of reflectance readings; σ = standard deviation.



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Contact us

1300 363 400
+61 3 9545 2176
csiroenquiries@csiro.au
www.csiro.au

For further information

CSIRO Energy
Zhongsheng Li
+61 2 **9490 8645**
Zhongsheng.Li@csiro.au
csiro.au/Energy