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A PETROLEUM GEOCHEMICAL EVALUATION OF SELECTED SAMPLES FROM TEN WELLS

by

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CONTENTS

SUMMARY

A total of fifty-six samples were received representing ten wells drilled in Australia. Subsequent organic carbon determinations (using the Leco WR 12 carbon analyser) and pyrolysis analyses (using the Girdel 'Rock Eval' Mk II) showed that all wells were generally both lean in organic material with only a few relatively 'rich' horizons and also that much of the kerogen is inertinite. No significant source rocks were identified, however horizons in the Ammaroo-1 and BMR-13 wells showed some potential as a minor gas source.

I

INTRODUCTION

A total of fifty-six samples from ten wells were received for total organic carbon and 'Rock Eval' pyrolysis determination. The batch of samples was made up as follows:

ERLDUNDA-1	32 samples
EXOIL LUCY CREEK-1	3 samples
EXOIL HUCKITTA-1	3 samples
FARMOUNT DRILLERS AMMAROO-1	3 samples
BMR-13	5 samples
BMR HUCKITTA-1	1 sample
BMR HUCKITTA-6	2 samples
BMR HUCKITTA-7	4 samples
BMR ELKEDRA-5	1 sample
BMR HAY RIVER-10	2 samples

A variety of geological information was provided including available well completion reports.

The results of the analyses carried out are given in Table 1 (a-j).

II

RESULTS AND DISCUSSION

(1) Organic Richness and Pyrolysis Results (Table 1 (a-j))

All samples received were prepared for total organic carbon analysis. Those samples with an organic carbon content of a suitable magnitude (normally greater than 0.5%) were selected for further analysis. A discussion of the results, well by well is given below.

(a) ERLDUNDA-1 (Table 1(a))

Thirty-two samples were received from this well covering the interval 2070' to 4185'. The analysed section, when viewed overall, is organically lean with all samples showing below average organic carbon contents. Many of the organic carbon determinations are below 0.3%, however, at several horizons particularly below 3000', some relatively rich samples (i.e. greater than 0.5% TOC) are identified and these have been further analysed by 'Rock Eval' pyrolysis. The pyrolysis results for this well section are characterised by low hydrogen indices and consequently very poor potential yields. The low hydrogen indices can most probably be attributed to inertinite as the dominant kerogen type. The potential yield values indicate that the rocks encountered in the analysed section have no significant source potential. High production indices are a phenomena of the lean nature of the samples and do not necessarily indicate the presence of significant oil staining.

(b) EXOIL LUCY CREEK-1 (Table 1(b))

Three samples, one core and two cuttings were received for analysis. The organic carbon analysis indicate that the core sample is of average organic content whereas the two cutting samples are of only fair organic content. All three samples were further analysed, using pyrolysis methods. The potential yield values indicated by pyrolysis analyses are below those normally expected of a commercial source rock. Hydrogen indices, although higher than the previous well indicate that the rocks probably contain a mixture of inertinite and vitrinite and therefore may be marginally gas-prone. No source potential is envisaged for these rocks. Production indices are high for sample depths 3524' and 3490'-4530' indicating the presence of minor oil staining.

(c) EXOIL HUCKITTA-1 (Table 1(c))

Three cutting samples covering the depth range 2100' to 2690' were received for analysis. Organic carbon determination revealed that only the uppermost sample (2100'-2120') was of rich enough quality to be further analysed. The lower two samples were organically very lean. Pyrolysis hydrogen index data indicate that the sample from depth 2100'-2120' probably contains a mix of inertinite and vitrinite giving a low to moderate hydrogen index of 131. The potential yield is however low and therefore no significant source potential is envisaged. The production index is relatively high indicating minor oil staining. It is not possible to comment, however, on the origin of this hydrocarbon stain from the data available.

(d) FARMOUNT DRILLERS AMMAROO-1 (Table 1(d))

Three core samples from depths 185', 214' and 218' were analysed. The organic carbon determinations indicate an average content in the two upper samples and a lean content in the lower sample. Subsequent pyrolysis analysis on the core samples from depths 185' and 214' has revealed that kerogen types are probably predominantly inertinite in the 185' sample (hydrogen index 52), with a possibility of some vitrinite in the sample taken from 214 (i.e. hydrogen index 155). Both samples show relatively high production indices suggesting possible oil staining. The potential yield of the sample from 214' suggests it may be considered as a poor to fair source rock, probably a source of minor gas only.

(e) BMR-13 (Table 1(e))

Four ditch cuttings and one core sample were analysed. These covered a depth range 560' to 3230'. The core sample proved to be organically lean and no further analysis was carried out. The ditch cutting samples showed fair (0.55%-0.66%) organic carbon contents and further analyses were carried out using pyrolysis methods. The results indicate a mixture of kerogen types, probably inertinite and vitrinite. Potential yields indicate that none of the analysed horizons have any significant source potential.

(f) BMR HICKITTA-1 (Table 1(f))

One core sample from 203' was analysed. Organic carbon determination proved to be lean and no further analyses were carried out.

(g) BMR HUCKITTA-6 (Table 1(g))

Two core samples taken at 365' 6½" and 437' were analysed for organic carbon content. The uppermost sample was organically lean and no further analyses were carried out. The lower sample indicated an average organic carbon content (1.17% TOC) and was subjected to further pyrolysis analysis. The pyrolysis hydrogen index suggests that the kerogen of the sample is composed mainly of inertinite. Although the potential yield is low and therefore the rock cannot be considered to be a source of hydrocarbons, the production index is high suggesting slight oil staining.

(h) BMR HUCKITTA-7 (Table 1(h))

Four core samples were analysed from this well section covering a depth range 101' to 404'. Only the sample located at 148' was considered organically rich enough for further analysis. The results of the pyrolysis analysis strongly suggest that inertinite is the dominant kerogen type within this sample. No source rock potential is envisaged for the analysed section of this well.

(i) BMR ELKEDRA-5 (Table 1(i))

One core sample from this well was analysed for total organic carbon. The result showed that the sample was organically lean and therefore no further analyses were carried out.

(j) BMR HAY RIVER-10 (Table 1(j))

Two core samples from depths 82' and 99' were analysed. The 99' sample had an average total organic carbon content (1.24% TOC)

and was subjected to further analysis using pyrolysis, the 82' sample was organically lean and no further analyses were performed. The pyrolysis results suggest a poor gas-prone source probably containing a mixture of vitrinitic and inertinitic kerogen.

The potential yield is just 'fair' (2.7 kg/ton) and therefore the 99' sample may provide a minor gas source at full thermal maturity.

III

CONCLUSIONS

On the basis of the organic carbon and 'Rock Eval' pyrolysis data the following conclusions have been reached:

- Samples in the ten wells analysed have organic carbon contents ranging from lean (TOC $\leq$ 0.5%) through fair (0.5%1.0% TOC) to average (1.0%-2.0% TOC). The majority of samples are however, organically lean.

- On the basis of pyrolysis evidence only the dominant kerogen type in each well is inertinite with secondary ?vitrinite/?liptinite in some wells (particularly BMR-13, Exoil Lucy Creek-1).

- No significant hydrocarbon source rocks have been identified, possible minor gas sources are postulated in BMR Hay River-10 (99.5'-99.55') and Farmount Drillers Ammaroo-1 (214').

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SAMPLE DEPTH (feet)	ANALYSED LITHOLOGY	TOC %	PYROLYSIS DATA								REMARKS
			T max C	HI (mg/g TOC)	OI (mg/g TOC)	S1 FREE HYDROCARBON (mg/g of rock)	S1 BOUND HYDROCARBON (mg/g of rock)	S3 CO_2 (mg/g of rock)	PRODUCTION INDEX	POTENTIAL YIELD (kg/ton)	
ERLDUNDA-1 (Table 1(a))											
2070-2110	sh, brn-blk	0.73	509	19	19	0.03	0.14	0.14	0.19	0.2	
2110-2150	sh, brn-blk, calc.	0.27									
2150-2190	slt, gy-blk, calc.	0.33									
2190-2240	sh, brn-blk	0.16									
2240-2270	a/a	0.11									
2270-2310	sh, blk, slty	0.22									
2310-2340	a/a	0.22									
2350-2370	a/a	0.44									
2370-2420	sh, blk, calc.	0.25									
2440-2470	a/a	0.29									
2470-2520	a/a	0.37									
2520-2570	sh, blk/bl-blk	0.29									
2570-2610	sh, blk, calc	0.11									
2620-2670	sh, brn-blk	0.74	454	10	24	0.05	0.08	0.18	0.42	0.1	
2670-2720	sh, blk/brn-blk	0.18									
2730-2780	sh, blk calc.	0.20									
2780-2830	sh, blk/brn-blk	0.20									
2830-2880	sh, blk	0.18									
2880-2930	sh, blk/brn-blk	0.12									
3090-3140	sh, blk/gy-blk	0.18									
3140-3190	sh, blk, slty	0.70	N.D.	38	34	0.67	0.27	0.24	0.71	0.9	
3190-3240	sh, blk	0.31									
3270-3280	a/a	0.28									
3320-3340	a/a	0.57	443	15	38	0.02	0.09	0.22	0.20	0.1	
3500-3510	sh, blk, calc.	0.39									
3580-3620	a/a	0.64	474	15	26	0.02	0.10	0.17	0.17	0.1	
3630-3650	sh, brn-blk, calc.	0.43									
3750-3770	sh, blk, calc.	0.76	433	10	25	0.03	0.08	0.o9	0.30	0.1	
4050-4100	sh, med dk gy	0.33									
4110-4130	sh, blk	0.31									
4130-4150	a/a	0.31									
4180-4185	a/a	0.65	458	13	21	0.03	0.09	0.14	0.25	0.1	
EXOIL LUCY CREEK-1 (Table 1(b))											
3524'3"-4"	sh, med dk gy	1.14	440	68	11	0.35	0.78	0.13	0.31	1.1	
3220-3270	sh, blk	0.57	446	170	50	0.07	0.97	0.29	0.07	1.0	
3490-3530	a/a	0.64	445	121	32	0.22	0.78	0.21	0.22	1.0	
EXOIL HUCKITTA-1 (Table 1(c))											
2100-2120	sltst, med dk gy shly	0.70	444	131	31	0.24	0.92	0.22	0.21	1.2	
2120-2150	sltst, gy-blk	0.18									
2660-2690	sh, blk	0.25									

TABLE 1(a-j): 'ROCK EVAL' PYROLYSIS DATA AND ORGANIC RICHNESS OF TEN WELLS ANALYSED

COMPANY: ROBERTSON RESEARCH (AUSTRALIA) PTY. LTD. LOCATION: AUSTRALIA

SAMPLE DEPTH (feet)	ANALYSED LITHOLOGY	TOC %	PYROLYSIS DATA								REMARKS
			T max C	HI (mg/g TOC)	OI (mg/g TOC)	S1 FREE HYDROCARBON (mg/g of rock)	S2 BOUND HYDROCARBON (mg/g of rock)	S3 CO_2 (mg/g of rock)	PRODUCTION INDEX	POTENTIAL YIELD (kg/ton)	
FARMOUNT DRILLERS AMMAROO-1 (Table 1(d))											
185 (core)	sh, brn-blk, slty	1.21	444	52	33	0.33	0.64	0.40	0.34	1.0	
214 (core)	sh/sltst, blk	1.21	440	155	26	0.76	1.88	0.32	0.29	2.6	
218 (core)	sh, blk	0.47									
BMR-13(Table 1(e))											
560- 570 (core)	sh, ol-gy/gn-gy	0.59	446	154	72	0.06	0.91	0.43	0.06	1.0	
1344' 4"	sh, med gy	0.31									
2612-2620	a/a	0.59	443	177	42	0.07	1.05	0.25	0.06	1.1	
3000-3040	sh, dk gy/med gy	0.66	449	92	56	0.20	0.61	0.37	0.25	0.8	
3220-3230	slt, lt gy/blk	0.55	446	174	45	0.06	0.96	0.25	0.06	1.0	
BMR HUCKITTA-1 (Table 1(f))											
203'-203' 1"	mdst, med gy, carb., sndy	0.33									
BMR HUCKITTA-6 (Table 1(g))											
365' 6½"	mdst, gy, sndy	0.26									
437' 4"-6"	a/a	1.17	441	60	19	0.32	0.71	0.23	0.31	1.0	
BMR HUCKITTA-7 (Table 1(h))											
101'9½"-102' ¼"	sltst/mdst, med gy	0.30									
148'9" - 148'10"	sltst, lt gy	1.14	443	53	14	0.35	0.61	0.16	0.36	1.0	
151' 3"	sltst, med gy	0.38									
404' ¼"	a/a	0.26									
BMR ELKEDRA-5 (Table 1(i))											
286' 1¾" - 3½"	sltst, lt gy	0.49									
BMR HAY RIVER-10 (Table 1(j))											
82.51-82.57	mdst, gy/blk coaly	0.43									
99.5-99.55	a/a	1.24	439	147	23	0.90	1.83	0.29	0.33	2.7	

TABLE 1(a-j): 'ROCK EVAL' PYROLYSIS DATA AND ORGANIC RICHNESS OF TEN WELLS ANALYSED

APPENDIX

ABBREVIATIONS USED IN ANALYTICAL DATA SHEETS

-	-	Sample not analysed
*	-	No results obtained
N.D.P.	-	No Determination Possible
N.O.F.	-	No Organic Fluorescence
N.D.O.F.	-	No Determination Organic Fluorescence

LITHOLOGY

Aren	-	Arenaceous
Arg	-	Argillaceous
Calc	-	Calcareous
Carb	-	Carbonaceous
Cmt	-	Cement
Chk	-	Chalk
Cht	-	Chert
Cly	-	Clay
Clyst	-	Claystone
Crs	-	Coarse
Cgl	-	Conglomerate
Dol	-	Dolomite
Fer	-	Ferruginous
F	-	Fine
Frags	-	Fragments
Hd	-	Hard
Lam	-	Laminae/laminated
Lig	-	Lignite
Lmst	-	Limestone
Med	-	Medium
Mic	-	Micaceous
Mnr	-	Minor
Mdst	-	Mudstone
Musc	-	Muscovite
Ool	-	Oolitic
Pyr	-	Pyrite/pyritic
Qtz	-	Quartz
Snd	-	Sand
Sst	-	Sandstone
Sndy	-	Sandy
Sh	-	Shale
Shly	-	Shaley
Sil	-	Siliceous
Slt	-	Silt
Sltst	-	Siltstone
Slty	-	Silty
Sft	-	Soft
Tr	-	Trace

COLOUR

Blk	-	Black
Bl	-	Blue
Brn	-	Brown
Dk	-	Dark
Gn	-	Green
G	-	Gold
Gy	-	Grey
Lt	-	Light
Mtl	-	Mottled
Ol	-	Olive
O	-	Orange
Ppl	-	Purple
Rd	-	Red
Wht	-	White
Y	-	Yellow
Vgt	-	Variegated
Pk	-	Pinkish

GENERAL

Ctg	-	Ditch cuttings
L.C.M.	-	Lost Circulation Material
S.W.C.	-	Sidewall Core
Sl	-	Slightly
V	-	Very
Occ	-	Occasional

Gy-gn	-	Greyish green
Gn/gy	-	Green and/to grey
Gn-gy	-	Greenish grey