

APPENDIX 1

ROBERTSON RESEARCH (SINGAPORE) PRIVATE LIMITED

Report No. 1101

A PETROLEUM GEOCHEMICAL EVALUATION OF
SELECTED SAMPLES FROM NINE WELLS

by

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Project No. S/II/823/9
May 1982

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SUMMARY

A total of twenty-four samples were received representing nine 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 twenty-four samples from nine wells was received for total organic carbon and 'Rock eval' pyrolysis determination. The batch of samples was made up as follows:

EXOIL LUCY CREEK-1	3 samples
EXOIL HUCKITTA-1	3 samples
FARMOUT DRILLERS AMMAROO-1	3 samples
BMR SANDOVER-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-i).

II
RESULTS AND DISCUSSION

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

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

Three samples, one core and two cuttings were received for analysis. The organic carbon analyses 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 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 1074m (3524') and 1064-1380m (3490'-4530') indicating the presence of minor oil staining.

(b) EXOIL HUCKITTA-1 (Table 1(b))

Three cutting samples covering the depth range 640 to 820m (2100' to 2690') were received for analysis. Organic carbon determination revealed that only the uppermost sample 640-646m (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 640-646m (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.

(c) FARMOUT DRILLERS AMMAROO-1 (Table 1(c))

Three core samples from depths 56, 65 and 66m (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 56m (185') and 65m (214') has revealed that kerogen types are probably predominantly inertinite in the 56m (185') sample (hydrogen index 52), with a possibility of some vitrinite in the sample taken from 65m (214') (i.e. hydrogen index 155). Both samples show relatively high production indices suggesting possible oil staining. The potential yield of the sample from 65m (214') suggests it may be considered as a poor to fair source rock, probably a source of minor gas only.

(d) BMR SANDOVER-13 (Table 1(d))

Four ditch cuttings and one core sample were analysed. These covered a depth range 171-985m (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.

(e) BMR HUCKITTA-1 (Table 1(e))

One core sample from 62m (203') was analysed. Organic carbon determination proved to be lean and no further analyses were carried out.

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

Two core samples taken at 111m (365' 6½") and 133m (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 content (1.17% TOC) and

was subjected to further 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.

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

Four core samples were analysed from this well section covering a depth range 31-123m (101' to 404'). Only the sample located at 45m (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.

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

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.

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

Two core samples from depths 25m and 30m (82' and 99') were analysed. The 30m (99') sample had an average total organic carbon content (1.24% TOC) and was subjected to further analysis using pyrolysis, the 25m (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 30m (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 nine wells analysed have organic carbon contents ranging from lean (TOC > 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 Sandover-13 and Exoil Lucy Creek-1).
- . No significant hydrocarbon source rocks have been identified, possible minor gas sources are postulated in BMR Hay River-10 30.3m (99.5') and Farmount Drillers Ammaroo-1 65.2m (214').

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LOCATION: AUSTRALIA

SAMPLE DEPTH (feet)	ANALYSED LITHOLOGY	TOC %	T max C	HI (mg/g TOC)	OI (mg/g TOC)	PYROLYSIS		DATA		
						SI BOUND HYDROCARBON (mg/g of rock)	SI BOUND HYDROCARBON (mg/g of rock)	S3 Co ₂ (mg/g of rock)	PRODUCTION INDEX	POTENTIAL YIELD (kg/ton)
<u>EXOIL LUCY CREEK-1 (Table 1(a))</u>										
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
<u>EXOIL HUCKITTA-1 (Table 1(b))</u>										
2100-2120	sltst, med dk gy shly	0.70	444	131	31	0.24	0.92	0.22	0.21	1.2
2120-2150	slt, gy-blk	0.18								
2660-2690	sh, blk	0.25								
<u>FARMOUNT DRILLERS AMMAROO-1 (Table 1(c))</u>										
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								
<u>BMR SANDOVER-13 (Table 1(d))</u>										
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
<u>BMR HUCKITTA-1 (Table 1(e))</u>										
203'-203' 1"	mdst, med gy, carb., sny	0.33								
<u>BMR HUCKITTA-6 (Table 1(f))</u>										
365' 6½"	mdst, gy, sny	0.26								
437' 4"-6"	a/a	1.17	441	60	19	0.32	0.71	0.23	0.31	1.0

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LOCATION: AUSTRALIA

SAMPLE DEPTH (feet)	ANALYSED LITHOLOGY	TOC %	T max C	HI (mg/g TOC)	OI (mg/g TOC)	PYROLYSIS DATA		S3 Co ₂ (mg/g of rock)	PRODUCTION INDEX	POTENTIAL YIELD (kg/ton)
						S1 BOUND HYDROCARBON (mg/g of rock)	S1 BOUND HYDROCARBON (mg/g of rock)			
<u>BMR HUCKITTA-7 (Table 1(g))</u>										
101'9 $\frac{1}{2}$ "-102'1 $\frac{1}{2}$ "	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								
404'1 $\frac{1}{2}$ "	a/a	0.26								
<u>BMR ELKEDRA-5 (Table 1(h))</u>										
286'1 3/4"-31 $\frac{1}{2}$ "	sltst, lt gy	0.49								
<u>BMR HAY RIVER-10 (Table 1(i))</u>										
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-i): 'ROCK EVAL' PYROLYSIS DATA AND ORGANIC RICHNESS OF NINE WELLS ANALYSED