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SHELL - AUSTRALIA E. & P. OIL AND GAS

SOURCE ROCK ANALYSIS. G.B. FLATHEAD-1.

C.2

March 1982

RKER 82.060

DATA ON SOURCE ROCK PROPERTIES OF CORES AND CUTTINGS FROM WELL FLATHEAD-1 , AUSTRALIA

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CONTENTS

I INTRODUCTION

A source rock evaluation has been carried out on cuttings and cores from well Flathead-1 , Gippsland Basin , Australia.

The approximate location of the well is shown in Figure 1.

The samples are taken from the interval 1350 to 3494 ft , i.e. Tertiary to Cretaceous.

Source rock evaluation commonly comprises determination of:

1. the presence (or absence) of hydrocarbons source material in the rock samples;
2. the quality of the organic matter as well as the distribution of its specific constituents;
3. the degree of organic metamorphism (= level of maturity).

A source rock is identified by measuring the amount of temperature reactive ("live") organic matter present, i.e. the amount of organic matter that yields hydrocarbons upon pyrolysis. The method excludes any ("dead") organic matter such as inertinites.

In addition, the total organic carbon content can be determined which gives the sum of "live" and "dead" organic carbon. Rocks containing less than 0.5 % organic carbon are not considered to have a potential for commercial oil accumulations.

The source rock indications (SRI), which are a measure of the amount of pyrolysable organic matter, are determined on the original samples and in certain cases also after extraction with organic solvents. A systematically lower value after extraction is due to the presence of extractable hydrocarbons. These may consist of trapped oil, oil generated in situ by a source rock, or e.g. gasoil used in the drilling fluid.

In general, samples with source rock indications of 30 or less do not represent (immature or mature) source rocks. Values between 30 and 100 generally indicate marginal source rocks, while values above 100 commonly indicate good source rocks.

Intervals or samples with high source rock indications are investigated under a microscope to ensure that the high values indicate genuine source rock properties and are not due to contaminants of an organic nature such as lost circulation material.

The <u>quality</u> of a source rock for oil/gas generation depends on the type of organic matter present. Five categories of organic matter can be distinguished, viz.: humic, mainly humic, mixed, mainly kerogenous, kerogenous. This classification

is based on the hydrogen content of the organic matter.

Source rocks with organic matter of kerogenous, mainly kerogenous and/or mixed type generate predominantly oil. Organic matter of humic type generates gas only. Strata with organic matter of mainly humic quality generate either gas, or gas and oil.

In addition to the type and the concentration of the organic matter, the source rock quality is also characterised by the distribution of the typical organic constituents, or macerals[1], in the sediments. The maceral distribution can be used to further qualify the source rock, especially when mainly humic quality is found. For this purpose a microscopic investigation on polished rock fragments is carried out.

The maturity of source rocks is expressed in terms of degree of organic metamorphism. With increasing degree of organic metamorphism the organic matter is gradually carbonised while generating hydrocarbons. With increased carbonification the light reflectance of vitrinite, one of the coal macerals, increases. The degree of organic metamorphism can be assessed by measuring this reflectance.

1) maceral: an organic constituent which can be recognised with the microscope (with objectives 25x to 50 x).

II RESULTS

The results are listed in Table I (source rock indications , type of organic matter , total organic carbon content) , Table II (maceral descriptions , comment lines) and Figure 2 (vitrinite reflectance histigram).
The results are summarised in Enclosure 1 (geochemical log).
This report incorporates the results discussed in KSEPL report 0117.76.

III DISCUSSION

Owing to contamination especially with walnuts the results of the cutting samples are unreliable. For these samples conclusions are mainly based on maceral descriptions.

Interval 1580 to 1646 ft (cores)

Considering the SRI-values of samples 1580 , 1624 , 1640 and 1646 ft , these samples are fairly good to excellent source rocks.
The maceral descriptions of samples 1624 and 1640 ft point to source rocks for gas , while the amount and habitat of the SOM (sapropelic organic matter) of samples 1580 and 1646 ft indicate that they are also source rocks for oil.

Although core sample 1607 ft contains some organic matter (see maceral description) , the SRI-value indicates that this sample should not be considered a source rock. The low SRI-value is most probably caused by oxidation.

The conclusion is that this interval contains source rocks for "gas and oil" and "gas only".

Interval 1950 to 3400 ft (cuttings)

The maceral descriptions of samples 2450 , 2700 , 2800 and 3150 ft and the observed SRI-value of samples 2000 , 2750 , 2850 , 2900 and 2950 ft (which seem not to be contaminated) indicate that this interval contains (very-) marginal source rocks for gas.

Interval 3472 to 3494 ft (cores)

Samples 3472 , 3490 and 3494 ft show , in addition to good to excellent SRI-values , a maceral description which point to source rocks respectively for "gas and oil" , "gas" and "gas and oil".

The vitrinite reflectance has been measured in sample 1646 ft and shows a value of 0.44 (DOM 54). This means that the samples in interval 1580 to 1646 ft are immature for oil generation.

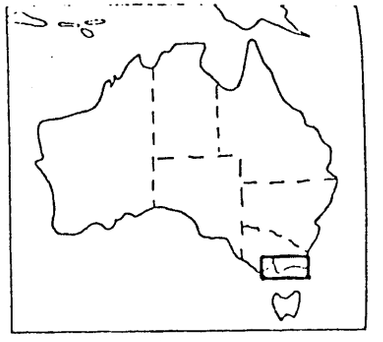
IV CONCLUSIONS

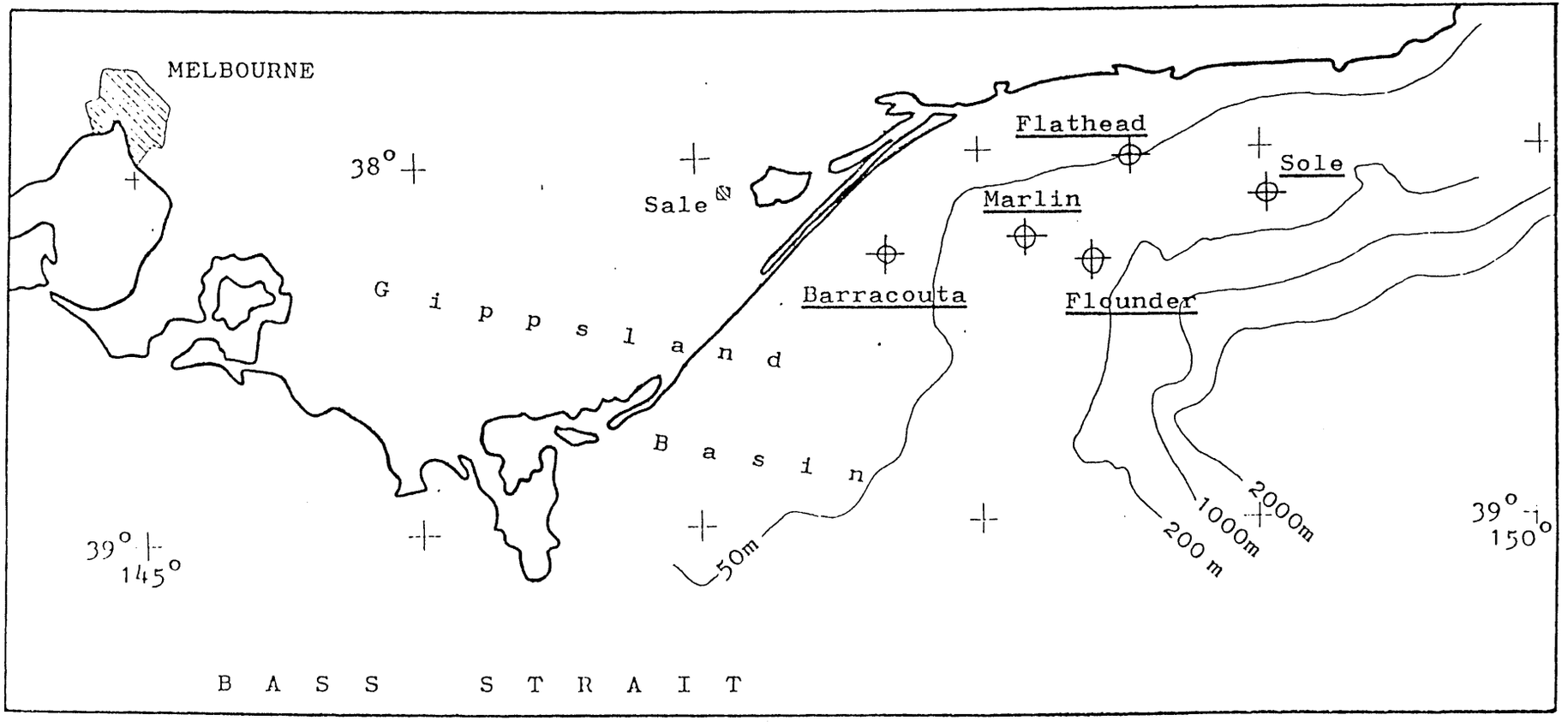
Interval 1580 to 1646 ft contains source rocks for "gas and oil" and "gas only".
Interval 1950 to 3400 ft contains (very-) marginal source rocks for gas.
Interval 3472 to 3494 ft contains source rocks for "gas and oil" as well as "gas only".
The samples in interval 1580 to 1646 ft are still immature for oil generation.

Figure 1

Situation Map

Scale 1 : 2 000 000





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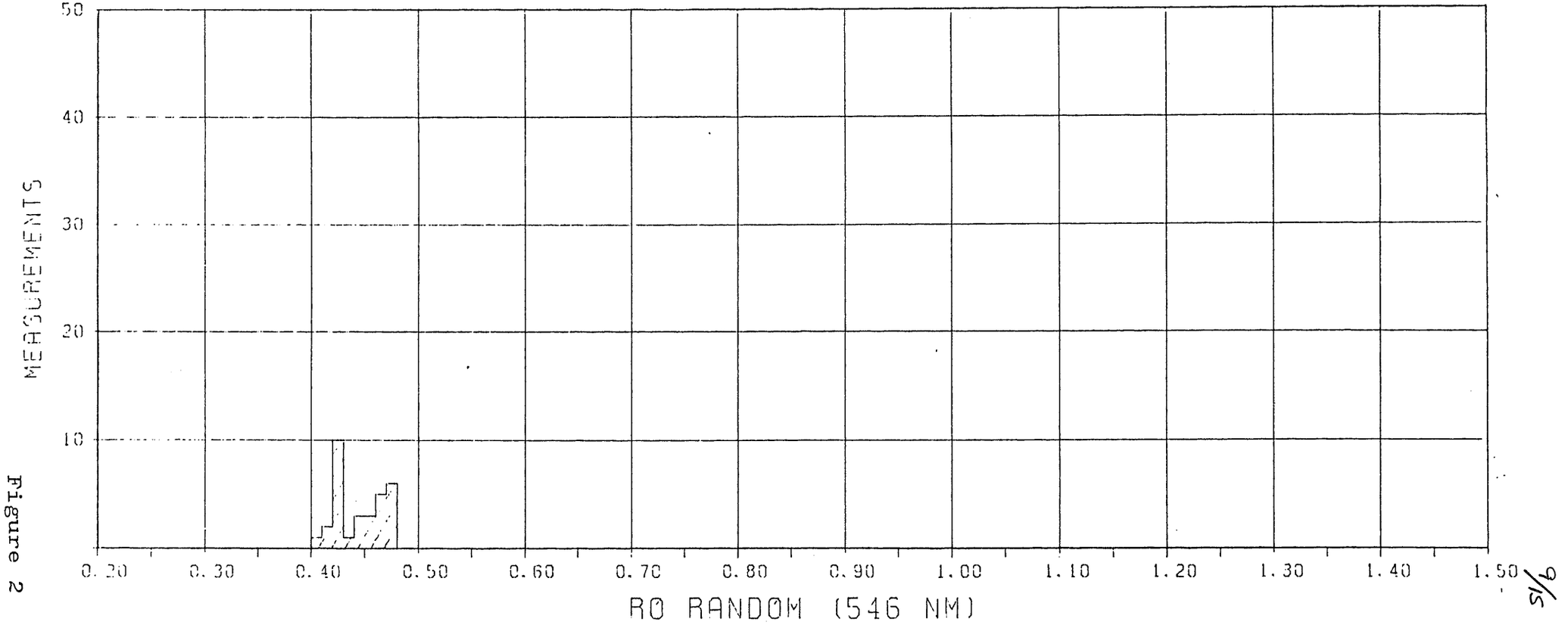
VITRINITE REFLECTANCE

COUNTRY	: AUSTRALIA	MEAN	: 0.44
WELL/OUTCROP	: FLATHEAD-1	DEVIATION	: 0.02
DEPTH/SAMPLE NR.	: 1646 FT	MODE	: 0.42
SAMPLE TYPE	: CORE SAMPLE	MEASUREMENTS	: 31

ANALIST: VBS D.D. : 24-OCT-80



VITRINITE REFLECTANCE HISTOGRAM

Figure 2

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TABLE 1 (PART 1) WELL: FLATHEAD-1

DEPTH F	TYPE OF SAMPLE	SOURCE ROCK INDICATION BEFORE EXTR.	SOURCE ROCK INDICATION AFTER EXTR.	TYPE OF ORGANIC MATTER	ORGANIC CARBON CONTENT %W
1350	C	5	5		-
1400	C	5	5		-
1417	R	5	-		-
1450	C	5	5		-
1550	R	5	5		-
1558	R	270	10		.4
1558	R	270	10		.5
1569	R	15	-		-
1576	R	5	-		-
1580	R	> 900	770	MH/H	24.2
1580	R	> 900	770	MH/H	24.5
1583	R	5	-		-
1598	R	5	-		-
1607	R	5	-		-
1611	R	5	-		-
1621	R	5	-		-
1624	R	320	265		-
1640	R	125	125		1.7
1646	R	> 900	> 900	MH	-
1651	R	25	-		-
1663	R	15	-		-
1672	R	10	5		-
1673	R	5	-		-
1687	R	25	20		-
1705	R	100	-		.5
1950	C	270 W	270 W		-
2000	C	185	155		-
2250	C	> 900 W	> 900 W		-
2400	C	> 900 W	675 W		-
2450	C	> 900 W	> 900 W		-

TABLE I (PART 2) WELL: FLATHEAD-1

DEPTH F	TYPE OF SAMPLE	SOURCE ROCK INDICATION BEFORE EXTR.	SOURCE ROCK INDICATION AFTER EXTR.	TYPE OF ORGANIC MATTER	ORGANIC CARBON CONTENT %W
2500	C	> 900 W	> 900 W		-
2600	C	700 W	715 W		-
2650	C	540 C	515 C		-
2700	C	265 C	210 C		-
2750	C	80	155		-
2800	C	80 W	55 W	H	1.7
2850	C	80	65		-
2900	C	80	70		-
2950	C	60	45		-
3000	C	120 W	110 W		-
3050	C	225 W	125 W		-
3150	C	175 W	195 W		-
3200	C	130 W	145 W		-
3250	C	100 W	60 W		-
3300	C	30 W	15 W		-
3400	C	105 W	95 W		-
3472	R	> 900	> 900		-
3484	R	5	-		0.5
3490	R	535	500	MH	6.3
3490	R	535	500	MH	6.6
3494	R	> 900	> 900		22.8

TYPE OF SAMPLE C = CUTTINGS, R = CORE, S = SIDEWALL SAMPLE

CONTAMINATION : W = WALNUT FRAGMENTS OR SOME SIMILAR PRODUCT, E = CELLOPHANE SHREDS, F = FIBRES, P = PLASTIC OR PAINT AND C = CONTAMINATED BUT KIND NOT SPECIFIED

A DASH (-) INDICATES TEST NOT MADE, ASTERISKS INDICATE THE ORGANIC CARBON CONTENT IS THE AVERAGE FOR THE SAMPLES CONCERNED

MACERAL DESCRIPTION OF 12 SAMPLES FROM WELL FLATHEAD-1

DEPTH IN FT	SAMPLE TYPE
1580.0	CORE
1607.0	CORE
1624.0	CORE
1640.0	CORE
1646.0	CORE
2450.0	CTGS
2700.0	CTGS
2800.0	CTGS
3150.0	CTGS
3472.0	CORE
3490.0	CORE
3494.0	CORE

ORGANIC																			INORG.			
	VITR.			LIPTINITE					ALGAE				INERT.									
SAPROPALIC ORG. MATTER	TELOCOLLINITE	TELINITE	DESMOCOLLINITE	SPORINITE	CUTINITE	RESINITE	LIPTODETRINITE	BOTRYOCOCCUS	TASMANITES	OTHER ALGAE	MICROPLANKTON	EXSUDATINITE	SCLEROTINITE	FUSINITE	MACRINITE	MICRINITE	UNDEFINED MINERALS	FRAMBOIDAL PYRITE	AGGREGATES OF PYRITE	CRYSTALS OF PYRITE
+			*	/	+	+	+							-		+	*			
/			/	/	-		/							-			*			-
-			+	/	/	/	+							/			*			
-			-	-			-					/		-			*			-
+	/	/	*	/	-	+	+							+		/	+			
-	-		/	/	/	-	/							/			*		-	/
-			/	/	-	-	-							/		-	*		-	
-			/	-	-		-							/		-	*			
-			/	-			-							/		/	*			
+			/	/	/	+	+					/		/		+	*			
/	-	-	+	/	/		/					/		/		-	*			
+	-		+	+	/	/	/					/		-		+	*			-

TABLE II (part 1)

LEGEND	
*	ABUNDANT
+	COMMON
/	FEW
-	RARE

COMMENT LINES

1580.0 F : Sample partly oxidised
SOM (sapropelic organic matter) partly converted
Micrinite = oxymicrinite ?

1607.0 F : Sample oxidised

1624.0 F : Sample partly oxidised

1640.0 F : Sample partly oxidised

1646.0 F : Vitrinite grades into SOM
Initial conversion SOM
Large resin nodules

2450.0 F : Contaminated
Few suberinite
Abundant contamination with walnuts
Common liptinite-rich coal particles

2700.0 F : Contaminated
Sample slightly oxidised
Rare liptinite-rich coal particles
Few contamination with walnuts

2800.0 F : Initial conversion SOM
Sample partly oxidised
Contaminated
Rare walnuts contamination

3150.0 F : Contaminated
Sample slightly oxidised
Initial conversion SOM
Few contamination with walnuts

3472.0 F : Sample oxidised
Vitrinite grades into SOM
SOM converted
Micrinite = oxymicrinite ?
Large resin nodules

3490.0 F : Sample slightly oxidised
Initial conversion SOM
Vitrinite grades into SOM
Inhomogenous sample
Mineral matter+liptinite rich coal particles

TABLE II (part 2)

3494.0 F : Vitrinite grades into SOM
Sample partly oxidised
Vitrinite shows oxidation features
Initial conversion SOM
Inhomogenous sample
Fluid inclusions , migration hydrocarbons

TABLE II (part 3)

INITIAL DISTRIBUTION

4 copies area