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SHELL - AUSTRALIA E. & P. OIL AND GAS

SOURCE ROCK ANALYSES G.B. BARRACOUTA - 1.

SOURCE ROCK ANALYSES, BARRACOUTA-1

March 1982

RKER 82.059

DETERMINATION OF SOURCE ROCK QUALITY OF CORES AND CUTTINGS FROM WELL BARRACOUTA-1 , AUSTRALIA

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CONTENTS

I INTRODUCTION

A source rock evaluation has been carried out on core and cutting samples from well Barracouta_1 , offshore Victoria , Australia.

The approximate location is shown in Figure 1.

The samples are taken from the interval 2000 to 8701 ft (TD) , i.e. Tertiary to Upper 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).

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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 a,b (vitrinite reflectance histogram).
The results discussed in KSEPL report RKTR 80.202 are incorperated in this report as well.
They concern maceral descriptions of samples 3510 , 4346 , 4752 , 6450 , 7708 , 8250 and 8694 ft and a vitrinite reflectance measurement in sample 8694 ft.

III CONCLUSIONS

All cutting samples are fairly good to excellent source rocks for gas , except samples 7050 , 7200 and 8200 ft , which are marginal source rocks for gas.

Cores 3511 , 3513 and 5656 ft are respectively excellent , excellent and marginal source rocks for gas , while core 8695 ft is an excellent source rock for predominantly oil.

The presence of common suberinite and liptinites as sporinite , cutinite and resinite in especially cutting samples 3850 , 4200 , 4650 , 5850 , 6700 and core 3513 ft may be an indication that these samples are source rocks for some oil as well.

All samples are landplant derived source rocks , of which the landplant matter is more or less bacterially reworked.

A vitrinite reflectance measurement was carried out in sample 8695 ft and revealed a value of 0.70 (DOM 62/63). An estimation of the vitrinite reflectance in sample 4200 ft shows a value of 0.52 (DOM 57).

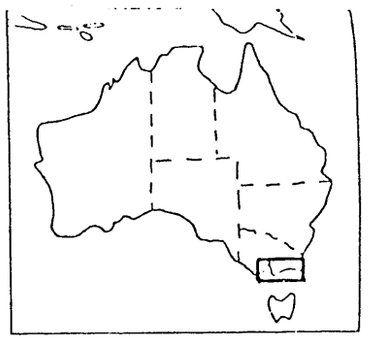
These results are in good agreement with former results (RKTR 80.202) , which also showed that the interval under consideration contains source rocks for gas , with the exception of samples 3510 and 8694 ft , which are source rocks for oil as well.

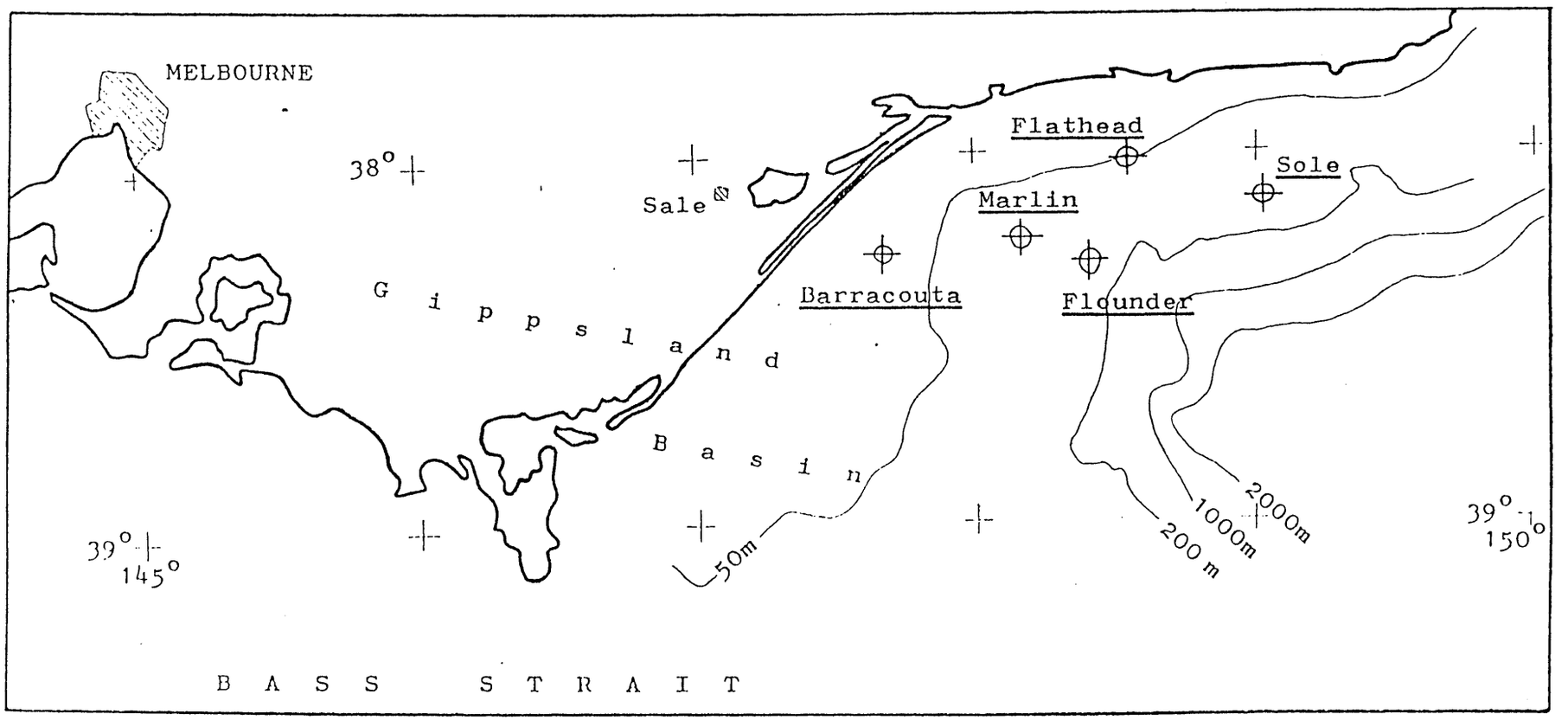
The final conclusion therefore should be that interval 3511 to 8600 ft contains source rocks for predominantly gas and samples 3510 ft and interval 8600 to 8701 (TD) contains source rocks for oil and gas.

Figure 1

Situation Map

Scale 1 : 2 000 000



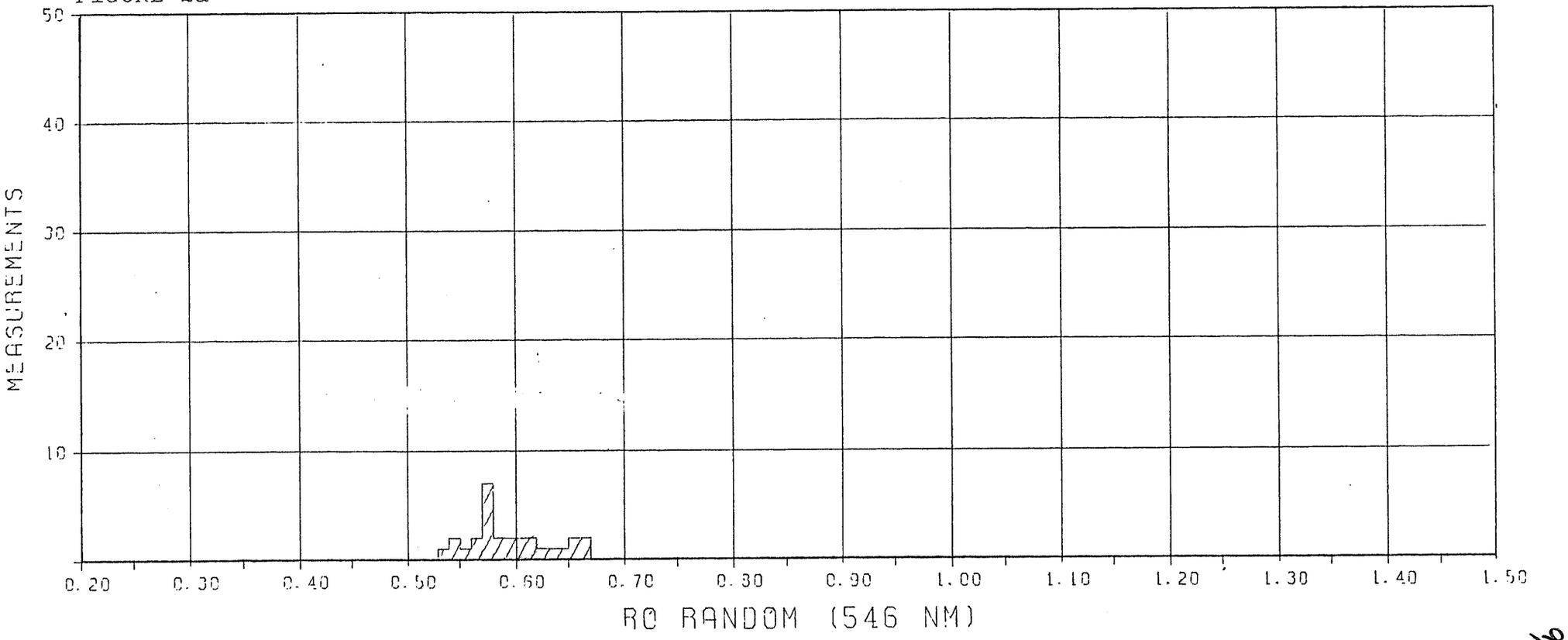


VITRINITE REFLECTANCE

COUNTRY	: AUSTRALIA	MEAN	: 0.59
WELL/OUTCROP	: BARRACOUTA A-1	DEVIATION	: 0.04
DEPTH/SAMPLE NR.	8694 F1	MODE	: 0.57
SAMPLE TYPE	: CORE SAMPLE	MEASUREMENTS	: 28

FIGURE 2a

ANALIST: VBS D.D. 27-OCT-80



VITRINITE REFLECTANCE HISTOGRAM

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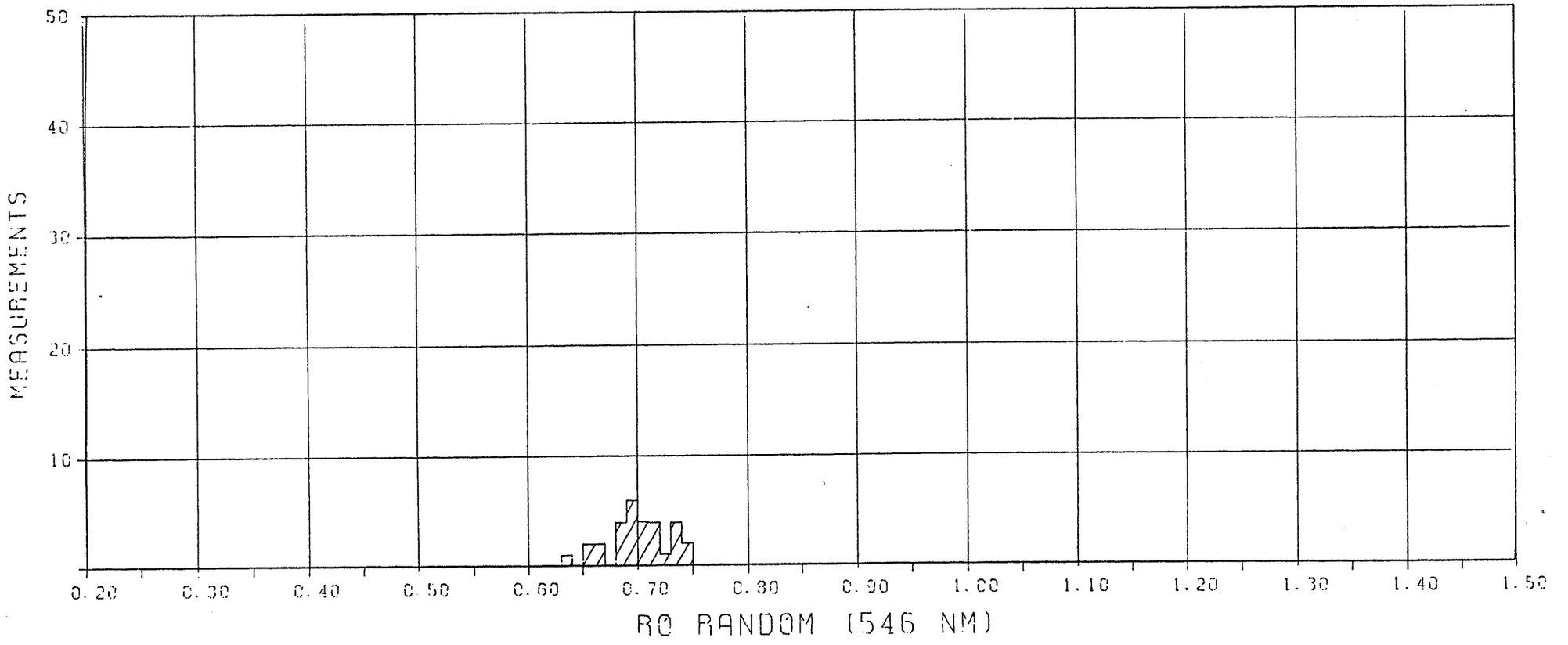
VITRINITE REFLECTANCE

COUNTRY	: AUSTRALIA	MEAN	: 0.70
WELL/OUTCROP	: BARRACOUTA A-1	DEVIATION	: 0.03
DEPTH/SAMPLE NR.	8695 FT	MODE	: 0.69
SAMPLE TYPE	: CORE SAMPLE	MEASUREMENTS	: 30

FIGURE 2b ANALIST: BTX D.D. 29-MAR-82



VITRINITE REFLECTANCE HISTOGRAM

TABLE I (PART 1) WELL: PARRACOUTA-1

DEPTH F	TYPE OF SAMPLE	SOURCE ROCK INDICATION BEFORE EXTR.	SOURCE ROCK INDICATION AFTER EXTR.	TYPE OF ORGANIC MATTER	ORGANIC CARBON CONTENT %W
2000	C	10	-		-
2036	R	10	-		-
2050	C	10	-		-
2100	C	10	-		-
2150	C	10	-		-
2200	C	10	-		-
2250	C	10	-		-
2350	C	10	-		-
2400	C	10	-		-
2450	C	10	-		-
2500	C	10	-		-
2550	C	10	-		-
2600	C	10	-		-
2650	C	10	-		-
2700	C	10	-		-
2750	C	10	-		-
2900	C	20	-		-
2950	C	20	-		-
3100	C	10	-		-
3300	C	10	-		-
3349	R	5	-		-
3350	R	5	-		-
3400	C	10	-		-
3450	C	5	-		-
3500	C	> 900	> 900		-
3510	R	> 900	-		-
3511	R	550	400		-
3513	R	> 900	> 900	M	65.7
3513	R	> 900	> 900		61.4
3550	C	330	315		-

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TABLE I (PART 2) WELL: BARRACOUTA-1

DEPTH F	TYPE OF SAMPLE	SOURCE ROCK INDICATION BEFORE EXTR.	SOURCE ROCK INDICATION AFTER EXTR.	TYPE OF ORGANIC MATTER	ORGANIC CARBON CONTENT %W
3700	C	605	580		-
3850	C	> 900	> 900	MH/M	60.2
3850	C	> 900	> 900	MH/M	58.9
3950	C	> 900	> 900		-
4050	C	> 900	> 900		-
4100	C	> 900	> 900		-
4150	C	> 900	> 900		-
4200	C	> 900	> 900	M	37.4
4250	C	> 900	> 900		-
4346	R	> 900	-	M	-
4350	C	> 900	> 900		-
4500	C	> 900	> 900		-
4550	C	500	495		-
4600	C	310	315		-
4650	R	> 900	> 900	M /MH	44.2
4750	C	450	380		-
4752	R	> 900	-	MH /M	-
4900	C	> 900	> 900		-
4950	C	> 900	> 900		-
5000	C	> 900	> 900	MH	40.1
5050	C	> 900	700		-
5100	C	705	605		-
5200	C	> 900	> 900		-
5264	R	5	-		-
5300	C	> 900	> 900		-
5350	C	> 900	700		-
5400	C	> 780	700		-
5450	C	> 795	745		-
5500	C	440	440		-
5550	C	320	265		-

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TABLE I (PART 3) WELL: BARRACOUTA-1

DEPTH F	TYPE OF SAMPLE	SOURCE ROCK INDICATION BEFORE EXTR.		SOURCE ROCK INDICATION AFTER EXTR.	TYPE OF ORGANIC MATTER	ORGANIC CARBON CONTENT %W
5600	C	160		135		-
5650	C	215		200		-
5656	R	75		65		-
5683	R	5		-		-
5700	C	255		280		-
5750	C	775		775		-
5800	C	450		410		-
5850	C	900	>	900	M	18.5
5850	C	900	>	900	M	17.8
5900	C	300		215		-
5950	C	490		550		-
6000	C	165		165		-
6050	C	290		305		-
6100	C	145		115		-
6124	R	15		-		-
6200	C	435		350		-
6300	C	450		290		-
6350	C	340		265		-
6450	R	80		-		-
6452	R	35		15		-
6550	C	290		175		-
6600	C	175		95		-
6650	C	130		95		-
6700	C	650		485	M	9.6
6749	R	5		-		-
6780	R	5		-		-
7050	C	50		35		-
7200	C	100		75		-
7300	C	550		485	M/MH	-
7450	C	730		675		-

TABLE I (PART 4) WELL: BARRACOUTA-1

DEPTH F	TYPE OF SAMPLE	SOURCE ROCK INDICATION BEFORE EXTR.	SOURCE ROCK INDICATION AFTER EXTR.	TYPE OF ORGANIC MATTER	ORGANIC CARBON CONTENT %W
7500	C	> 900	> 900		-
7550	C	705	510		-
7600	C	790	490		-
7708	R	25	-		-
7800	C	715	530		-
7850	C	310	215		-
7900	C	175	165		-
8050	C	400	430		-
8100	C	305	315	MH	8.3
8150	C	225	225		-
8200	C	65	65		-
8250	C	65	-		-
8251	C	320	-		-
8400	C	255	200		-
8450	C	170	115		-
8550	C	350	275		-
8600	C	225	175		-
8690	R	5	-		-
8694	R	> 900	-		-
8695	R	570	570	MK	13.5

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 19 SAMPLES FROM WELL BARRACOUTA -1

DEPTH IN FT	SAMPLE TYPE	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	UNDIFFINED MINERALS	FRAMBOIDAL PYRITE	AGGREGATES OF PYRITE	CRYSTALS OF PYRITE
3510.0	CORE	+			+	-			-					+	-	-		/	*	/		/
3513.0	CORE		-		*	/		+	/						/	/			/			-
3850.0	CTGS		/		*	+		+	+						/	/			/			/
4200.0	CTGS	/	-		*	+	/	+	+						/	/		/	+	-	-	/
4346.0	CORE	-	-		*	+	-	+	+						-	/			/		/	-
4550.0	CTGS	/	-		+	/	/	/	+					/	-	/		/	*	-	-	/
4650.0	CTGS	+	/		*	+	/	+	+					-	/	/		/	*	-	-	/
4752.0	CORE	-	+		*	+	-	/	+					/		/			+			/
5000.0	CTGS	-	/		*	/	-	-	/					-	/	/			/			-
5656.0	CORE	/			-	/			/							/		/	*	-	-	/
5850.0	CTGS	/	/		*	+	/	+	+					-	-	-		/	*	-	-	/
6450.0	CORE	-			-	/			/										*			-
6700.0	CTGS	/	/		+	+	/	/	+							-		+	*	-	/	/
7300.0	CTGS	/	/		+	/	-	-	/						-	/		/	*	-	-	/
7708.0	CORE	/			/	-	-		/					+		-			*	/	/	/
8100.0	CTGS	/	/		+	/	-		-					-		/		/	*	-	-	/
8250.0	CTGS	-	-		/	/	-		/							-			*	/	/	/

TABLE II (part 1)

LEGEND	
*	ABUNDANT
+	COMMON
/	FEW
-	RARE

DEPTH IN FT	SAMPLE TYPE
8694.0	CORE
8695.0	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 2)

LEGEND	
*	: ABUNDANT
+	: COMMON
/	: FEW
-	: RARE

COMMENT LINES

3510.0 F : Initial conversion SOM (sapropelic organic matter)
Vitrinite grades into SOM
SOM resembles partly solid hydrocarbons

3513.0 F : Common suberinite
Sample slightly oxidised

3850.0 F : Vitrinite shows oxidation features
Sample partly/severely oxidised

4200.0 F : Few suberinite
Sample slightly oxidised
Initial conversion SOM
Vitrinite grades into SOM
Micrinite = oxymicrinite ?

4346.0 F : Abundant suberinite

4550.0 F : Rare suberinite
Vitrinite shows oxidation features
Contaminated
Initial conversion SOM
Sample partly/severely oxidised
Vitrinite grades into SOM
Micrinite = oxymicrinite ?
Rare walnuts contamination

4650.0 F : Few suberinite
Initial conversion SOM
Sample partly oxidised
Vitrinite shows oxidation features
Vitrinite grades into SOM
Micrinite = oxymicrinite?

4752.0 F : Vitrinite shows oxidation features
Sample partly oxidised

5000.0 F : Vitrinite shows oxidation features
Sample partly/severely oxidised

5656.0 F : Initial conversion SOM

5850.0 F : Sample partly/severely oxidised
Vitrinite shows oxidation features
Few suberinite
Initial conversion SOM
Vitrinite grades into SOM
Micrinite = oxymicrinite ?
Migration suberinite

TABLE II (part 3)

6700.0 F : Contaminated
Vitrinite shows oxidation features
Sample partly/severely oxidised
Initial conversion SOM
Vitrinite grades into SOM
Micrinite = oxymicrinite ?
Rare contamination with walnuts

7300.0 F : Vitrinite shows oxidation features
Vitrinite grades into SOM
Sample severely oxidised
Initial conversion SOM
Micrinite = oxymicrinite ?

7708.0 F : Vitrinite grades into SOM

8100.0 F : Vitrinite shows oxidation features
Sample severely oxidised
Vitrinite grades into SOM
Initial conversion SOM
Micrinite = oxymicrinite ?

8250.0 F : Vitrinite shows oxidation features
Pyrite shows oxidation features
Vitrinite grades into SOM
Contaminated

8694.0 F : Rare suberinite
Initial conversion SOM
Sample slightly oxidised

8695.0 F : Sample slightly oxidised
Pyrite shows oxidation features
Vitrinite grades into SOM
Initial conversion SOM

TABLE II (part 4)

INITIAL DISTRIBUTION

4 copies area