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

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SHELL - AUSTRALIA E. & P. OIL AND GAS

C2

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RKER 82.071

SOURCE ROCK ANALYSIS OF CORE AND CUTTING SAMPLES FROM WELL FLOUNDER-1 , AUSTRALIA

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CONTENTS

I. INTRODUCTION

A source rock evaluation has been carried out on core and cutting samples from well Flounder-1 , Gippsland Basin , Autralia.

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

The samples are taken from the interval 6000 to 11740 ft (TD) , i.e. Tertiary - 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).

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-h (vitrinite reflectance histograms).
The vitrinite reflectance as a function of depth is illustrated in Figure 3.
The results are summarised in Enclosure 1 (geochemical log).
This report incorporates the results discussed in report RKER 0125.76 as well.

III CONCLUSIONS

The majority of the samples from 6431 ft down to 11700 ft are marginal to excellent source rocks for gas.

Considering the habitat of the SOM (sapropelic organic matter) and/or the amount of liptinites present in cutting samples 6700 , 7450 , 9210 ft and cores 10395 , 11114 , 11335 , 11356 and 11690 ft , these samples are to be regarded as source rocks for oil as well.

This leads us to the conclusion that throughout interval 6431 to 10150 ft the majority of the samples are marginal to excellent source rocks for gas , while this interval occasionally contains source rocks for "gas and oil".
The majority of the microscopically examined samples from interval 10150 to 11700 ft , however , are source rocks for "oil and gas" . Therefore , this interval contains source rocks for "gas and oil". and source rocks for gas only.

The vitrinite reflectance has been measured on several samples of which samples 11670 and 11696 ft show values of 0.75 (DOM 63/64) and 0.76 (DOM 64). Therefore , the samples from 11670 ft down to 11740 ft (TD) are to be considered mature for oil generation.

Situation Map

Scale 1 : 2 000 000

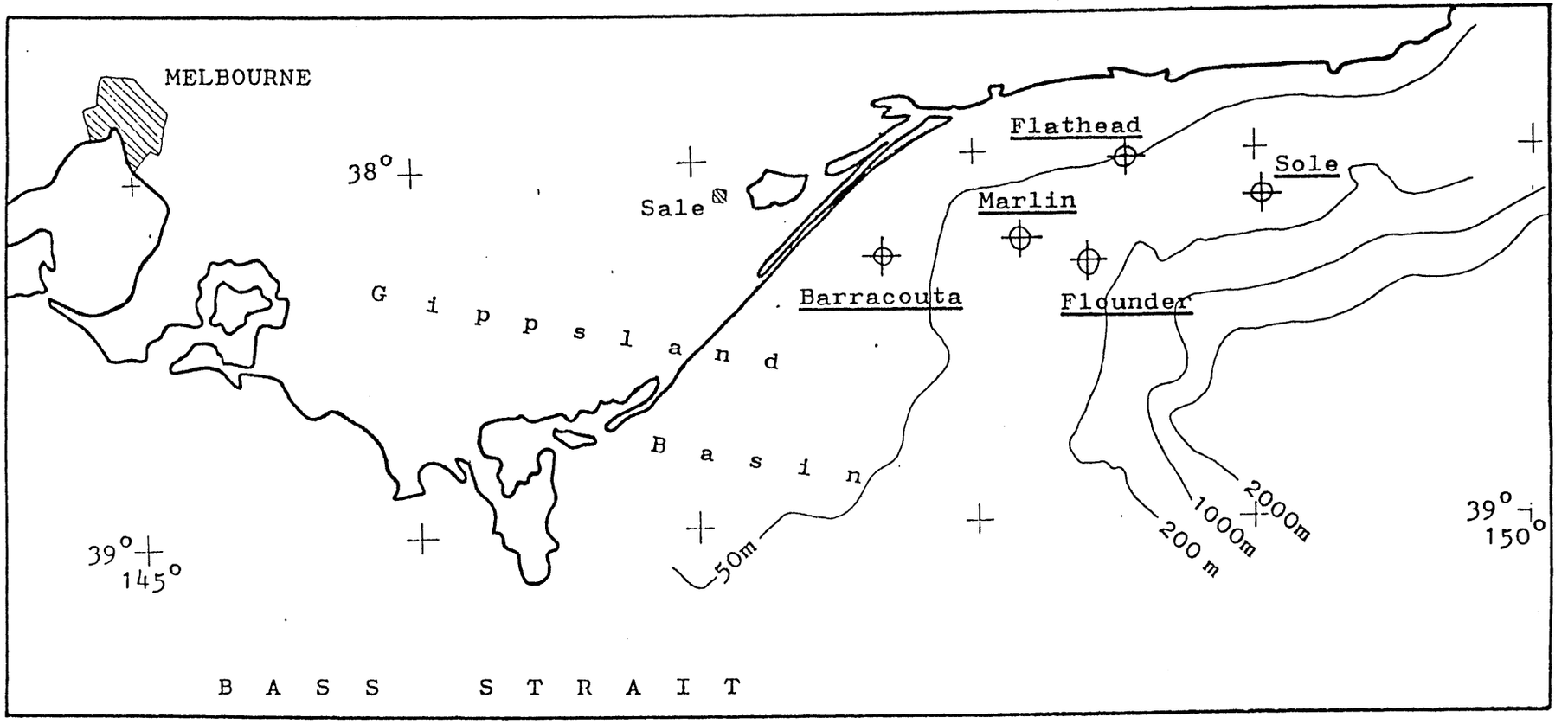

Figure 1

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VITRINITE REFLECTANCE

COUNTRY	: AUSTRALIA	MEAN	: 0.55
WELL/OUTCROP	: FLOUNDER A-1	DEVIATION	: 0.03
DEPTH/SAMPLE NR.	: 7450 F1	MODE	: 0.55
SAMPLE TYPE	: CUTTING SAMPLE	MEASUREMENTS	: 21

ANALIST: HDY D.D. : 14-APR-82

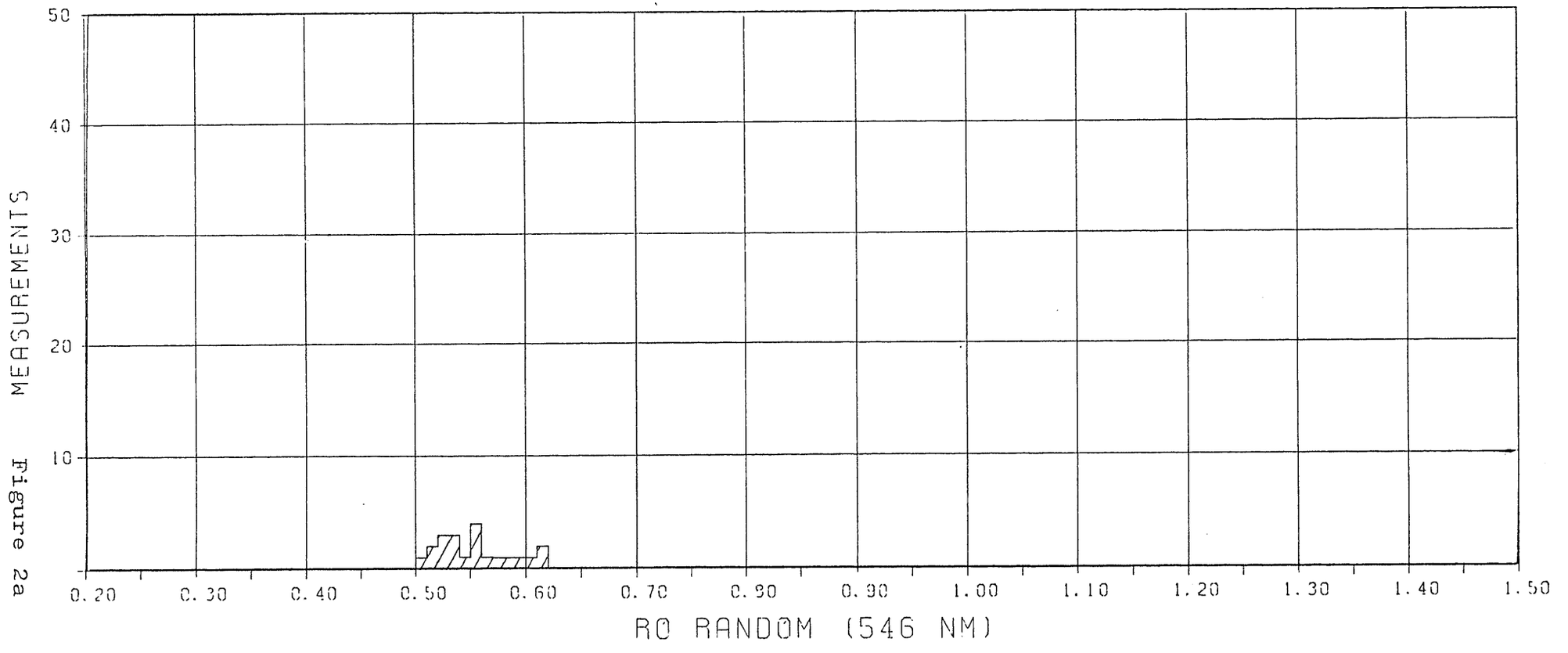

Figure 2a

VITRINITE REFLECTANCE HISTOGRAM

VITRINITE REFLECTANCE

		TOTAL	POP1	POP2
COUNTRY : AUSTRALIA	MEAN :	0.52	0.46	0.57
WELL/OUTCROP : FLOUNDER A-1	DEVIATION :	0.06	0.02	0.04
DEPTH/SAMPLE NR. : 7810 FT	MODE :	0.47	0.47	MULTI
SAMPLE TYPE : CUTTING SAMPLE	MEASUREMENTS :	50	22	28

ANALIST: HDY D.D. 14-APR-82

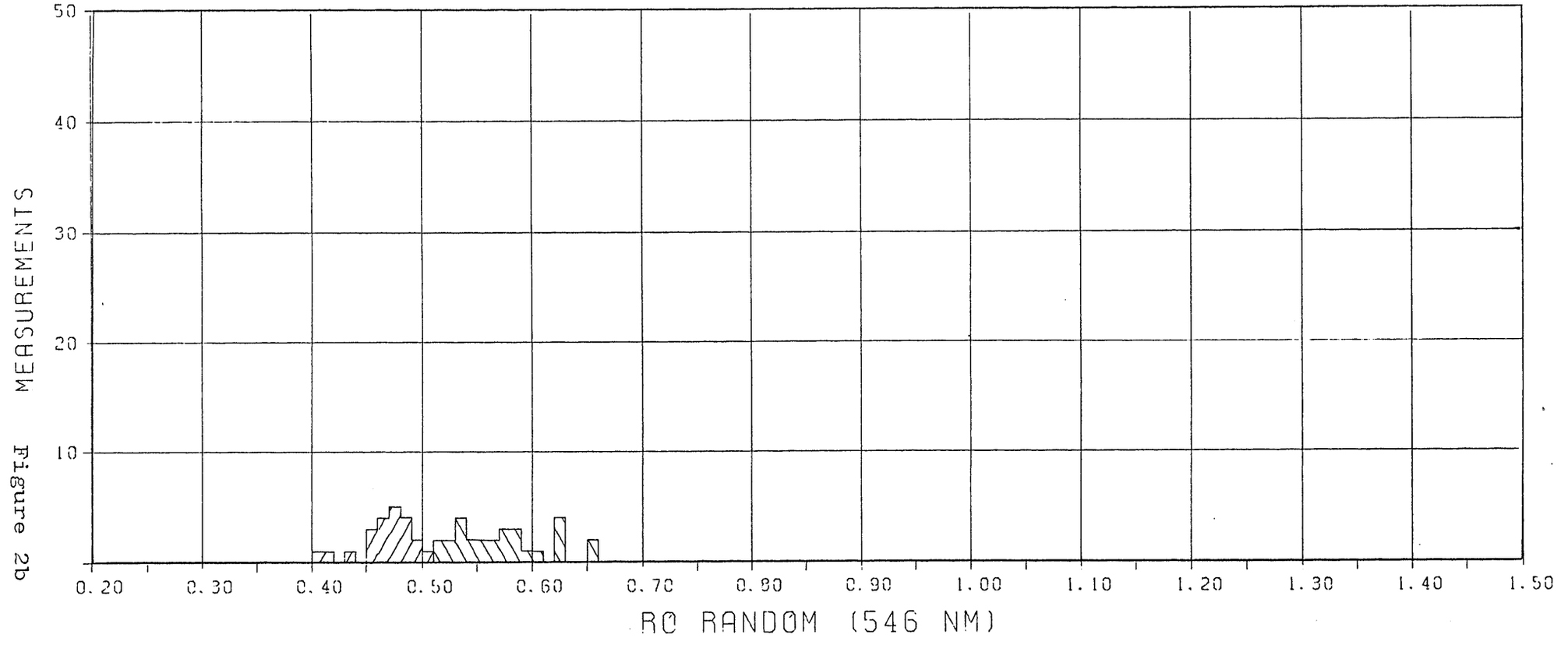

Figure 2b

VITRINITE REFLECTANCE HISTOGRAM

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VITRINITE REFLECTANCE

COUNTRY	: AUSTRALIA	MEAN	: 0.67
WELL/OUTCROP	: FLOUNDER A-1	DEVIATION	: 0.01
DEPTH/SAMPLE NR.	: 8790 FT	MODE	: 0.66
SAMPLE TYPE	: CORE SAMPLE	MEASUREMENTS	: 100

ANALIST: LHT D.D. : 04-MAR-82

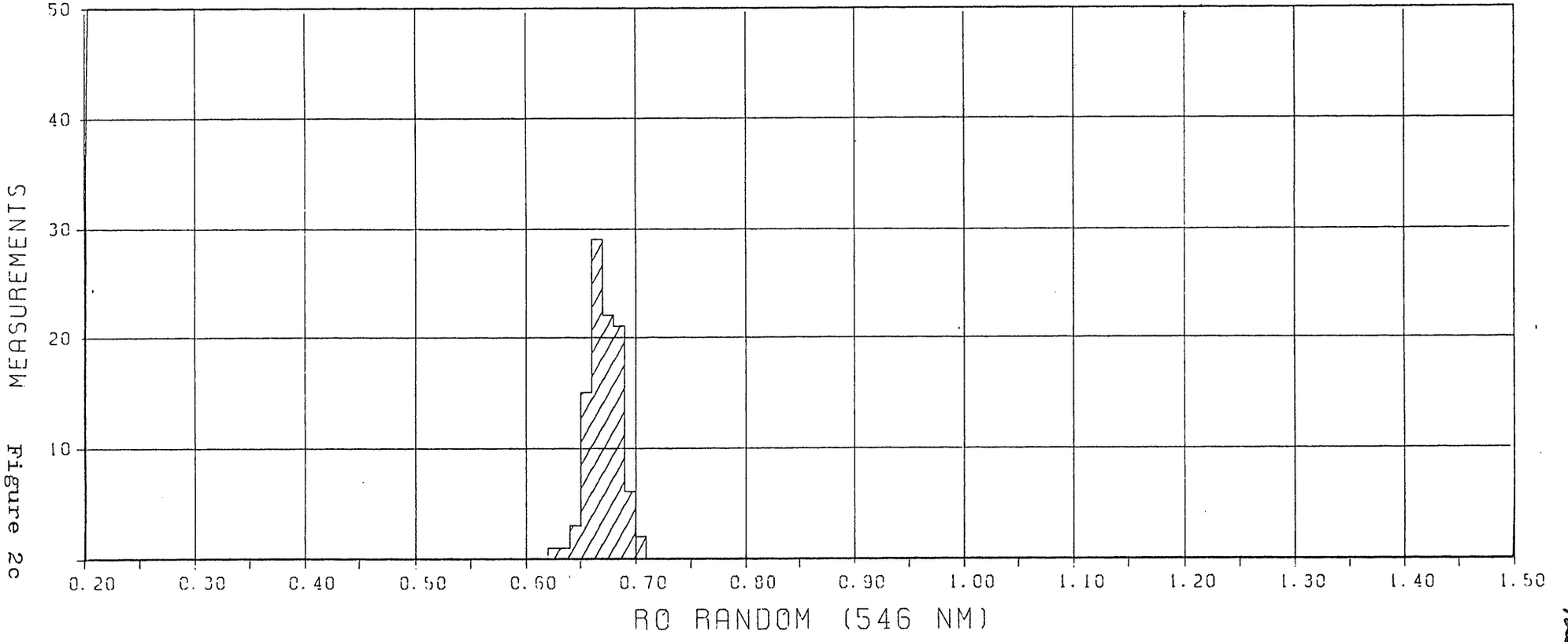

Figure 2c

VITRINITE REFLECTANCE HISTOGRAM

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VITRINITE REFLECTANCE

COUNTRY	: AUSTRALIA	MEAN	: 0.61
WELL/OUTCROP	: FLOUNDER A-1	DEVIATION	: 0.03
DEPTH/SAMPLE NR.	: 9210 FT	MODE	: 0.63
SAMPLE TYPE	: CUTTING SAMPLE	MEASUREMENTS	: 35

ANALIST: HDY D.D. 14-APR-82

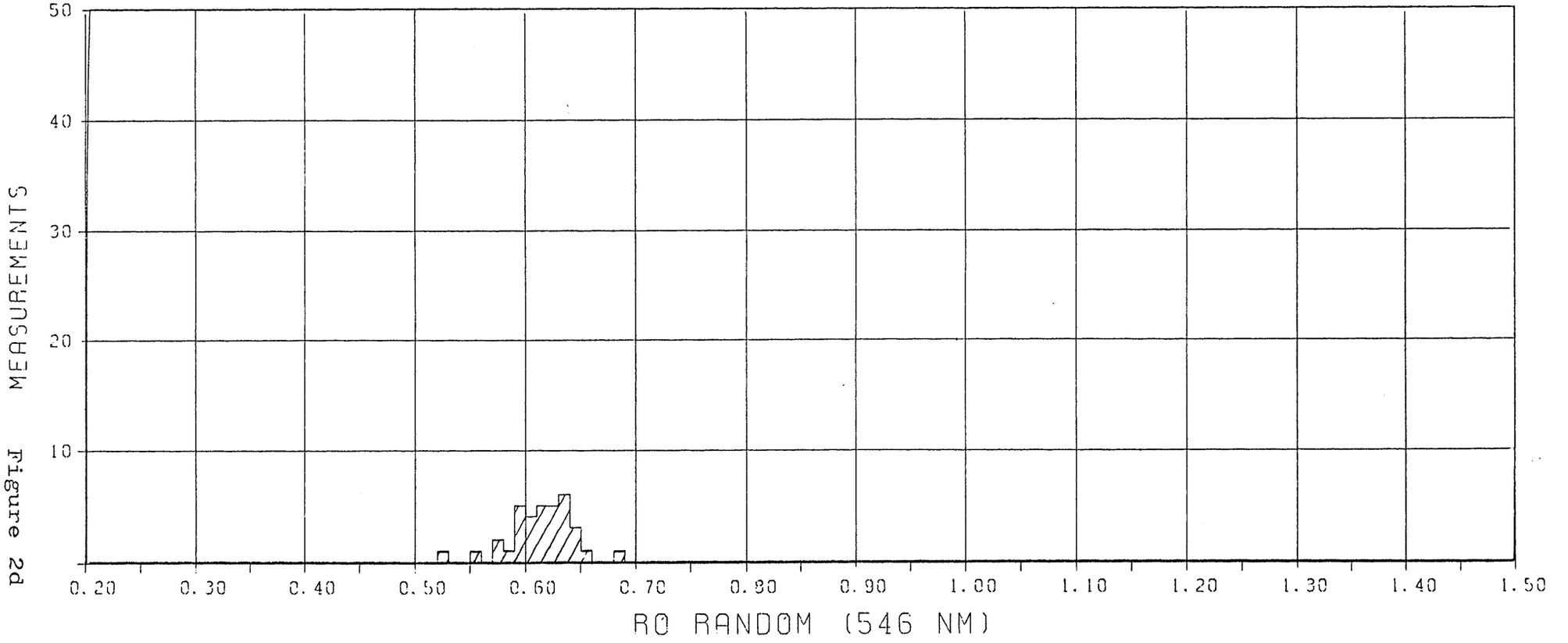

Figure 2d

VITRINITE REFLECTANCE HISTOGRAM

12/25

VITRINITE REFLECTANCE

COUNTRY	: AUSTRALIA	MEAN	: 0.68
WELL/OUTCROP	: FLOUNDER A-1	DEVIATION	: 0.02
DEPTH/SAMPLE NR.	: 11142 F1	MODE	: 0.69
SAMPLE TYPE	: CORE SAMPLE	MEASUREMENTS	: 45

ANALIST: LHT D.D. 04-MAR-82

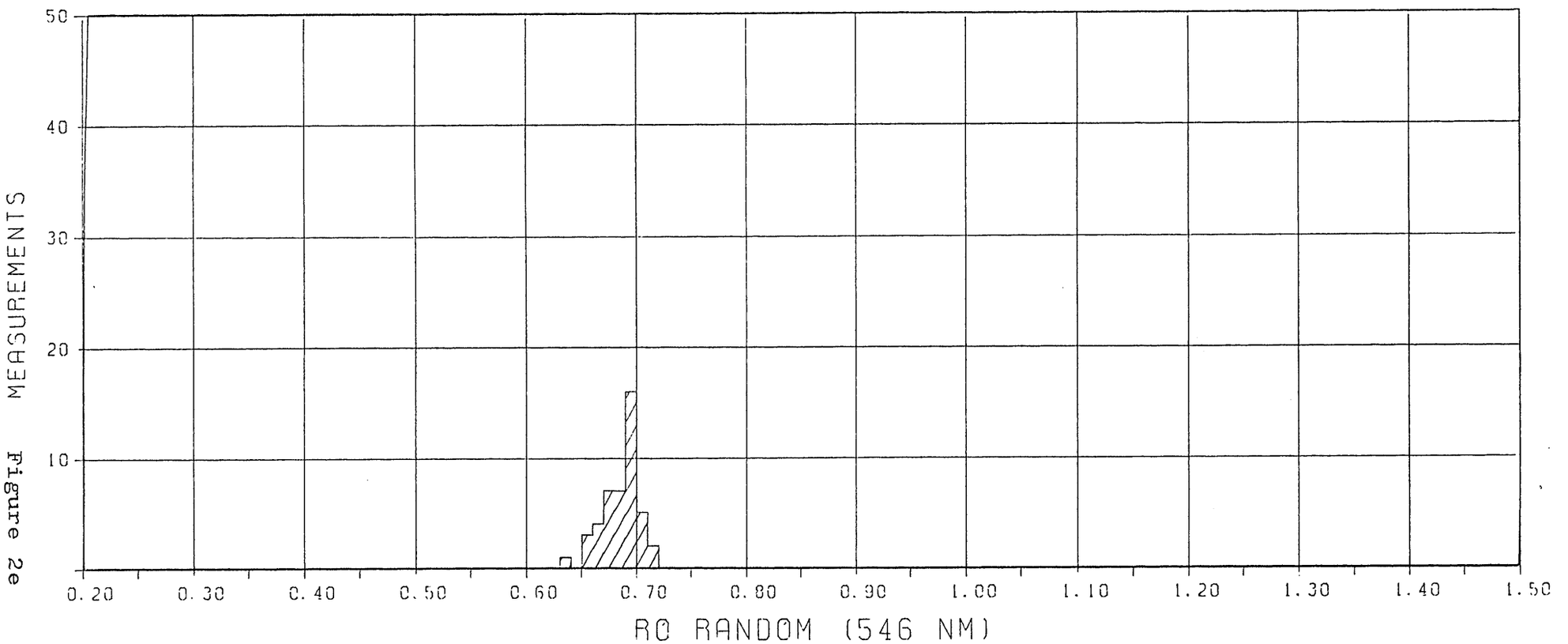

Figure 2e

VITRINITE REFLECTANCE HISTOGRAM

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VITRINITE REFLECTANCE

COUNTRY	: AUSTRALIA	MEAN	: 0.73
WELL/OUTCROP	: FLOUNDER A-1	DEVIATION	: 0.04
DEPTH/SAMPLE NR.	: 11356 F1	MODE	: 0.70
SAMPLE TYPE	: CORE SAMPLE	MEASUREMENTS	: 31

ANALIST: LHT D.D. : 04-MAR-82

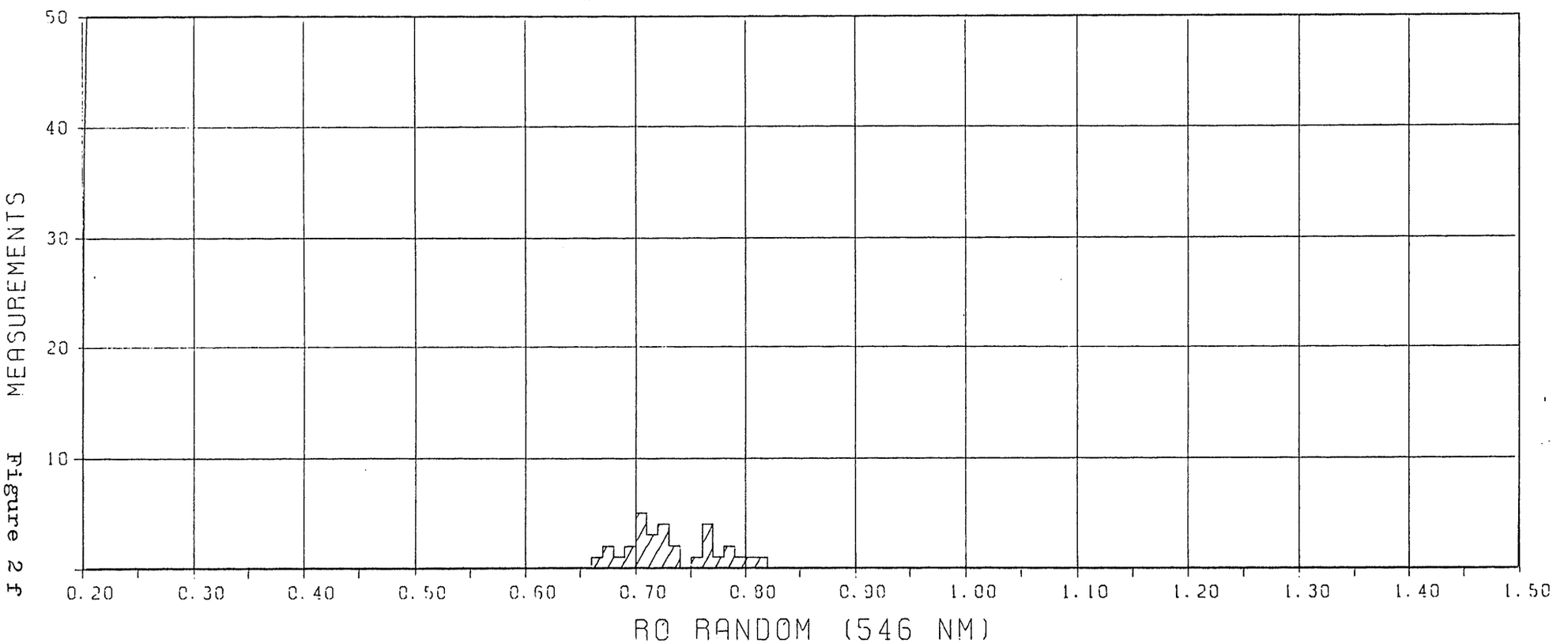

Figure 2 f

VITRINITE REFLECTANCE HISTOGRAM

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VITRINITE REFLECTANCE

COUNTRY	: AUSTRALIA	MEAN	: 0.75
WELL/OUTCROP	: FLOUNDER A-1	DEVIATION	: 0.02
DEPTH/SAMPLE NR.	: 11670 FT	MODE	: 0.76
SAMPLE TYPE	: CORE SAMPLE	MEASUREMENTS	: 8

ANALIST: LHT D.D. : 04-MAR-82

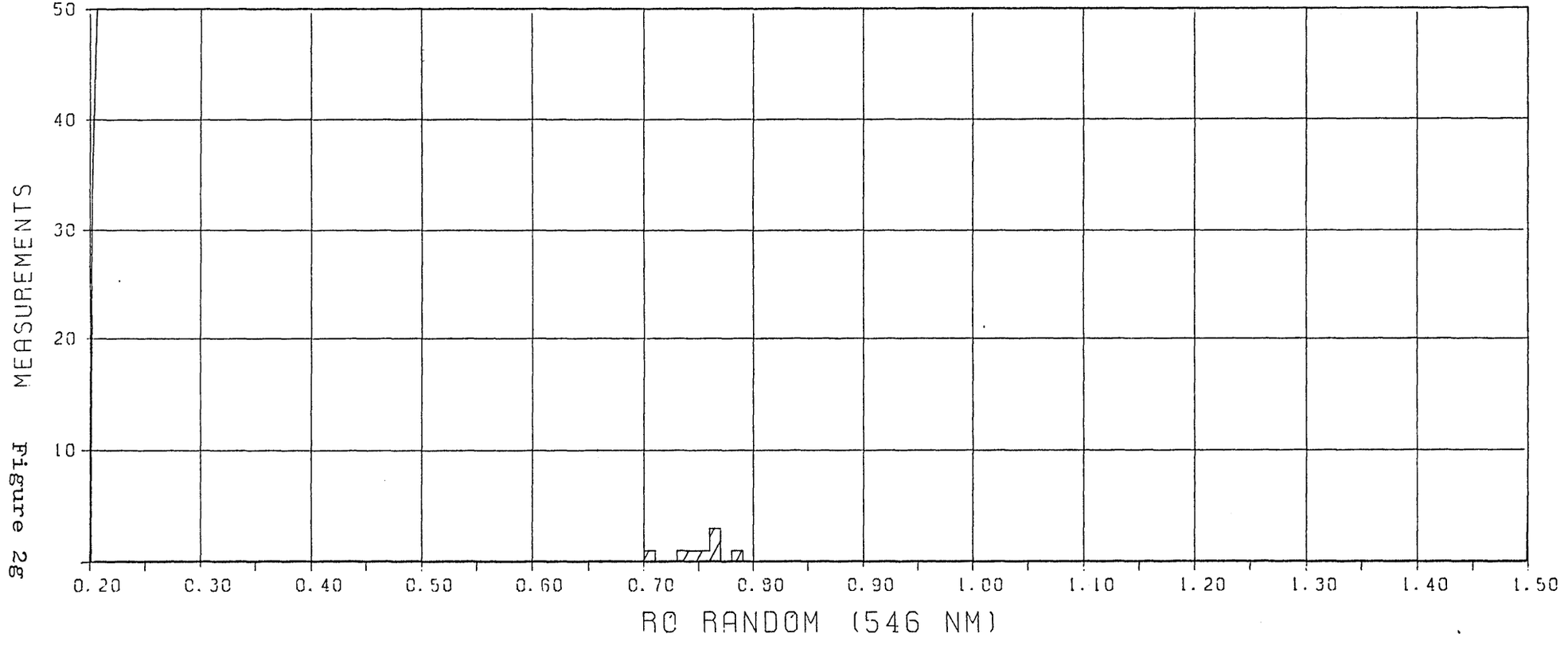


Figure 2g

VITRINITE REFLECTANCE HISTOGRAM

VITRINITE REFLECTANCE

COUNTRY	: AUSTRALIA	MEAN	: 0.76
WELL/OUTCROP	: FLOUNDER A-1	DEVIATION	: 0.04
DEPTH/SAMPLE NR.	: 11696 FT	MODE	: 0.77
SAMPLE TYPE	: CORE SAMPLE	MEASUREMENTS	: 32

ANALIST: LHT D.D.: 04-MAR-82

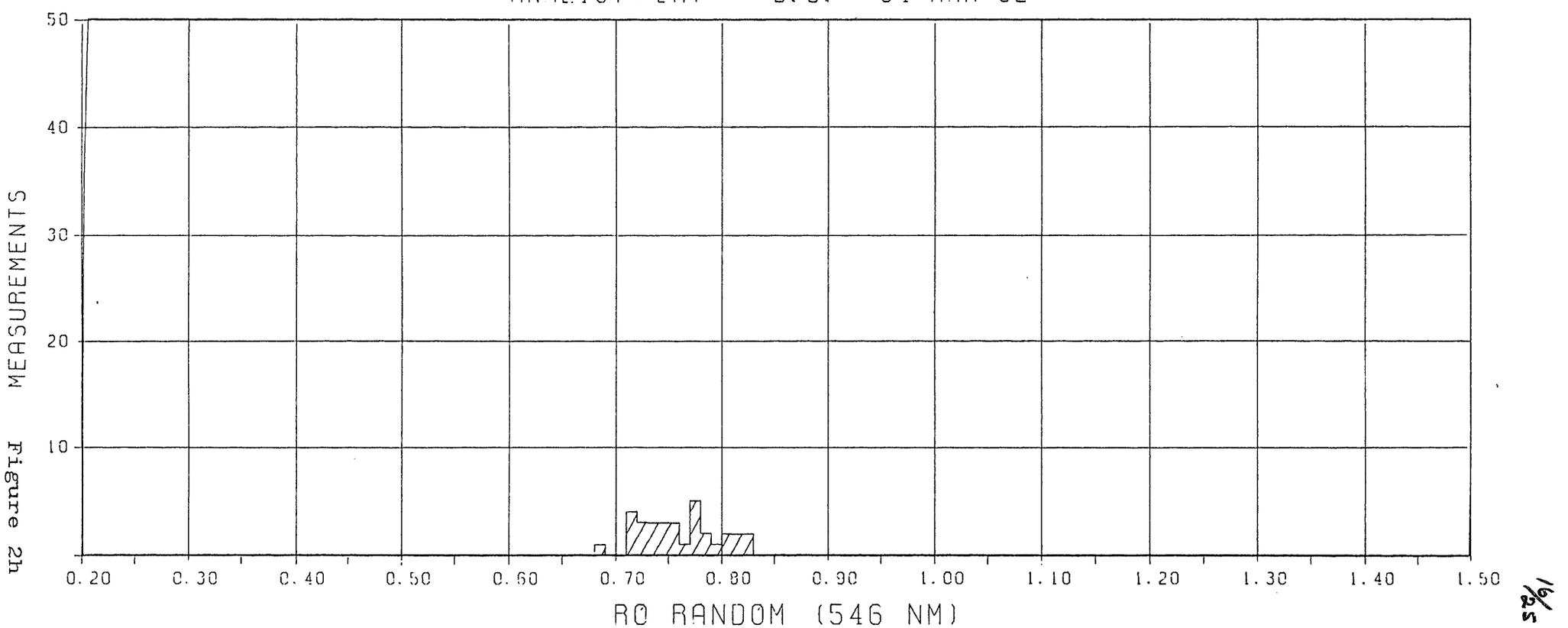


Figure 2h

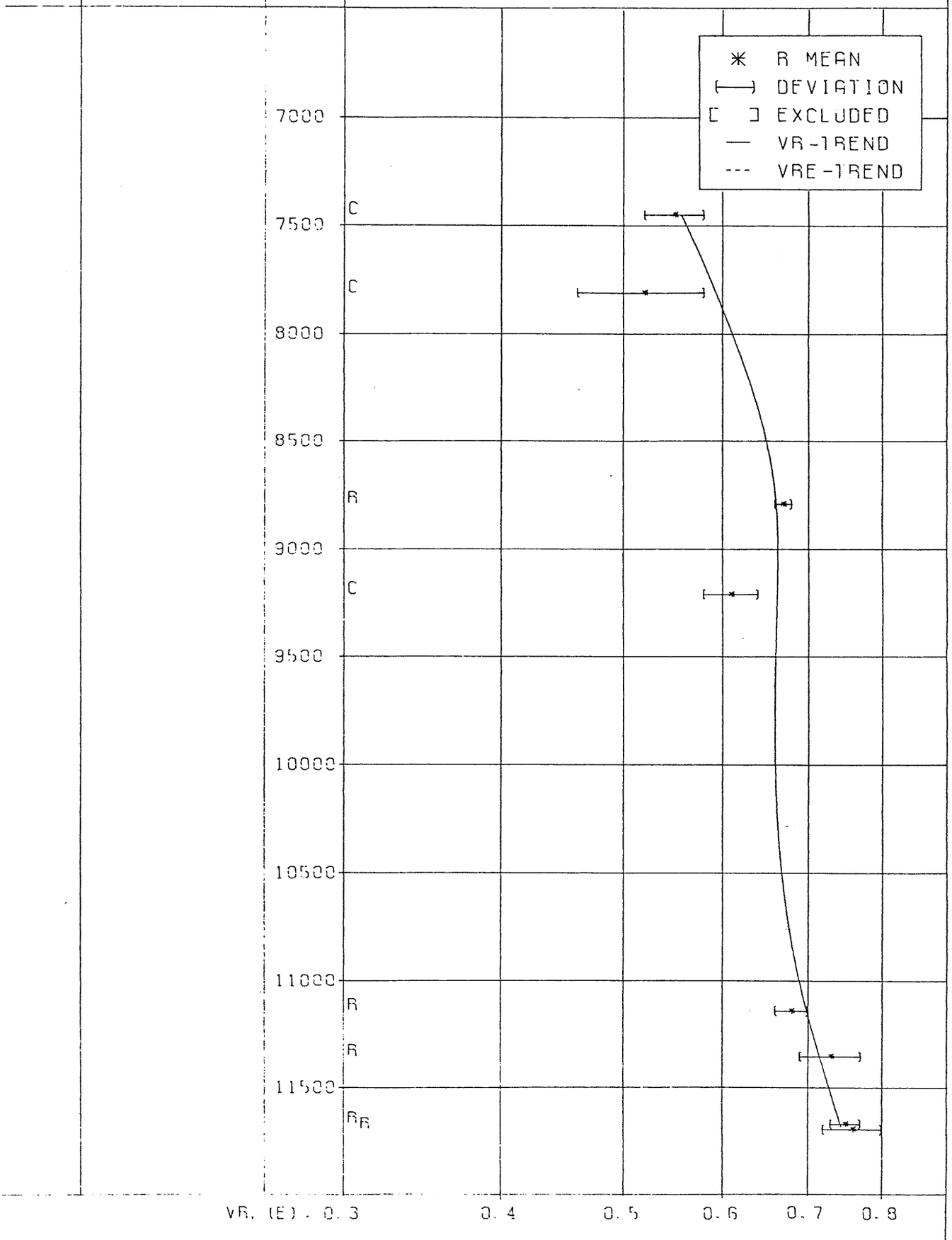
VITRINITE REFLECTANCE HISTOGRAM

12/6/82

AGE	FORMATION	DEPTH FEET BDF.

WELL . FLOUNDER A-1

COUNTRY . AUSTRALIA



VITRINITE REFLECTANCE (OR EQUIVALENT) AS A FUNCTION OF DEPTH

FIG. 3

TABLE I (PART 1) WELL: FLOUNDER A-1

DEPTH F	TYPE OF SAMPLE	SOURCE ROCK INDICATION BEFORE EXTR.	SOURCE ROCK INDICATION AFTER EXTR.	TYPE OF ORGANIC MATTER	ORGANIC CARBON CONTENT %W
6425	R	25	-		-
6431	R	35	30		-
6437	R	35	45		-
6440	R	40	25		-
6443	R	30	80	MH	-
6449	R	45	55		-
7197	R	115	95	M	-
7202	R	95	95		-
7211	R	65	65		-
7214	R	55	40		-
8088	R	20	-		-
8100	R	15	-		-
8118	R	35	35	M	-
8115	R	40	25		-
8775	R	5	-		-
8780	R	75	40	H	-
8781	R	115	-		-
8782	R	> 900	> 900		-
8790	R	> 900	> 900		-
8792	R	> 900	> 900	MH	-
9499	R	320	140		-
9510	R	455	170		-
9516	R	550	340	M	-
9520	R	100	95	M	2.6
9521	R	355	170		-
10395	R	780	480	M	-
10400	R	180	100		-
10407	R	115	50		-
11105	R	605	380		-
11114	R	525	380		-

TABLE I (PART 2) WELL: FLOUNDER A-1

DEPTH F	TYPE OF SAMPLE	SOURCE ROCK INDICATION BEFORE EXTR.	SOURCE ROCK INDICATION AFTER EXTR.	TYPE OF ORGANIC MATTER	ORGANIC CARBON CONTENT %W
11140	R	585	285	MH	-
11142	R	> 900	> 900	M	12.6
11148	R	325	130		-
11154	R	40	20		-
11154	R	195	95		-
11335	R	250	100		-
11347	R	95	35		-
11356	R	705	550	M	4.5
11357	R	815	600	MH	-
11673	R	175	65		-
11682	R	> 900	> 900		-
11690	R	> 900	> 900	MH	15.0
11696	R	> 900	> 900		-
11697	R	> 900	> 900		-
11699	R	> 900	> 900		-
6000	C	30	15		-
6100	C	35	15		-
6200	C	30	10		-
6300	C	30	10		-
6400	C	30	15		-
6500	C	40	25		-
6600	C	50	35		-
6700	C	220	200	MH/M	4.7
6790	C	70	70		-
6900	C	30	20		-
7000	C	25	25		-
7130	C	25	15		-
7200	C	30	30		-
7260	C	540	380		-
7300	C	280	175		-

TABLE I (PART 3) WELL: FLOUNDER A-1

DEPTH F	TYPE OF SAMPLE	SOURCE ROCK INDICATION BEFORE EXTR.	SOURCE ROCK INDICATION AFTER EXTR.	TYPE OF ORGANIC MATTER	ORGANIC CARBON CONTENT %W
7400	C	520	440		-
7450	C	620	505	MH/M	8.8
7450	C	620	505	MH/M	8.6
7540	C	230	165		-
7620	C	130	80		-
7650	C	150	100		-
7710	C	750	520		-
7760	C	> 900	> 900		-
7810	C	> 900	> 900	M/MK	-
7960	C	755	755		-
8000	C	150	110		-
8120	C	190	155		-
8150	C	320	265		-
8240	C	30	15		-
8330	C	75	75		-
8410	C	> 900	> 900		-
8460	C	> 900	> 900		-
8490	C	> 900	> 900	M	11.8
8540	C	300	300		-
8600	C	310	310		-
8650	C	175	175		-
8690	C	680	680		-
8780	C	> 900	> 900	H	-
8785	C	> 900	> 900		-
8820	C	> 900	> 900		-
8880	C	180	180		-
8930	C	> 900	> 900		-
8990	C	> 900	> 900		-
9070	C	> 900	> 900		-
9130	C	> 900	> 900		-

TABLE I (PART 4) WELL: FLOUNDER A-1

DEPTH F	TYPE OF SAMPLE	SOURCE ROCK INDICATION BEFORE EXTR.	SOURCE ROCK INDICATION AFTER EXTR.	TYPE OF ORGANIC MATTER	ORGANIC CARBON CONTENT %W
9210	C	> 900	> 900	M,	13.8
9360	C	450	450		-
9420	C	175	175		-
9480	C	225	225		-
9590	C	265	265		-
9640	C	60	60		-
9680	C	180	180		-
9710	C	255	255		-
9750	C	340	340		-
9840	C	390	390		-
9900	C	> 900	> 900		-
9980	C	250	250		-
10070	C	175	175		-
10150	C	> 900	> 900		-
10200	C	> 900	> 900		-
10250	C	> 900	> 900		-
10330	C	> 900	> 900		-
10410	C	> 900	> 900		-
10490	C	> 900	> 900		-
10530	C	> 900	> 900		-
10580	C	650	650		-
10620	C	> 900	> 900		-
10680	C	> 900	> 900		-
10740	C	> 900	> 900		-
10820	C	> 900	> 900		-
10880	C	> 900	> 900		-
10920	C	> 900	> 900		-
10970	C	> 900	> 900		-
11010	C	> 900	> 900		-
11150	C	> 900	> 900		-

TABLE I (PART 5) WELL: FLOUNDER A-1

DEPTH F	TYPE OF SAMPLE	SOURCE ROCK INDICATION BEFORE EXTR.	SOURCE ROCK INDICATION AFTER EXTR.	TYPE OF ORGANIC MATTER	ORGANIC CARBON CONTENT %W
11230	C	> 900	> 900		-
11300	C	> 900	> 900		-
11350	C	> 900	> 900		-
11400	C	> 900	> 900		-
11450	C	> 900	> 900		-
11500	C	> 900	> 900		-
11550	C	> 900	> 900		-
11600	C	> 900	> 900		-
11650	C	80	80		-
11700	C	715	715		-

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 17 SAMPLES FROM WELL FLOUNDER-1

DEPTH IN FT	SAMPLE TYPE
6700.0	CTGS
7450.0	CTGS
7810.0	CTGS
8490.0	CTGS
8780.0	CORE
8790.0	CORE
9210.0	CTGS
9516.0	CORE
10395.0	CORE
11114.0	CORE
11142.0	CORE
11335.0	CORE
11356.0	CORE
11356.0	CORE
11690.0	CORE
11696.0	CORE
11696.0	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

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

COMMENT LINES

6700.0 F : Vitrinite grades into SOM associated with framboidal pyrite

7450.0 F : Vitrinite shows oxidation features
Vitrinite grades into SOM associated with framboidal pyrite
Rare suberinite

7810.0 F : Few suberinite
Vitrinite grades into SOM associated with framboidal pyrite
Initial conversion SOM
Migration of suberinite

8490.0 F : Vitrinite shows oxidation features
Initial conversion SOM
Vitrinite grades into SOM associated with framboidal pyrite

8790.0 F : Initial conversion SOM

9210.0 F : Contaminated
Vitrinite shows oxidation features
Rare suberinite
Resin shows migration features
Sample partly /severely oxidised
Initial conversion SOM
Vitrinite grades into SOM associated with framboidal pyrite

9516.0 F : Sample slightly oxidised
Initial conversion SOM

11114.0 F : Vitrinite grades into SOM associated with framboidal pyrite
Initial conversion SOM

11142.0 F : Initial conversion SOM

11335.0 F : Vitrinite grades into SOM
Initial conversion SOM

11356.0 F : Initial conversion SOM
Sample slightly oxidised

11690.0 F : Initial conversion SOM

TABLE II

COMMENT LINES

11356.0 F : Initial conversion SOM
Vitrinite grades into SOM
11696.0 F : Sample slightly oxidised
Initial conversion SOM
11696.0 F : Sample slightly oxidised
Initial conversion SOM

SOM = Sapropelic Organic Matter

Table II