

OIL and GAS DIVISION

DEPT. NAT. RES & ENV  
PE906524

GIPPSLAND BASIN

SHELL REPORT RKER 80.044

"EVALUATION OF SOURCE ROCK  
PROPERTIES OF SEDIMENTS  
PENETRATED BY WELL MORWONG-1,  
AUSTRALIA."

BY

TH. E. FELDER

APRIL 1980.

FELDER, TH. E. APRIL 1980.

ATTACHMENT TO W.C.R.

W660  
Morwong

**OIL and GAS DIVISION**

April 1980

RKER 80.044

EVALUATION OF SOURCE ROCK PROPERTIES OF  
SEDIMENTS PENETRATED BY WELL  
MORWONG - 1, AUSTRALIA

by  
TH.E. FELDER

Investigation

95.14.74

This ~~CONFIDENTIAL~~ report is made available subject to the condition that the recipient will use the information contained therein for his own business only and will not divulge it to third parties without the written authority of the sponsoring party.

KONINKLIJKE / SHELL EXPLORATIE EN PRODUKTIE LABORATORIUM  
RIJSWIJK, THE NETHERLANDS

CONTENTS

2/16  
FELDER

I	Introduction	1
II	Results	4
III	Discussion and conclusions	6

Figure 1	Situation map
Figure 2	Vitrinite reflectance as a function of depth
Figures 3-6	Vitrinite reflectance histograms
Table I	Source rock properties
Enclosure 1	Geochemical log ✓

## I INTRODUCTION

Source rock investigations have been carried out on a suite of cutting samples and two core samples from the Australian well Morwong - 1, offshore Victoria (Gippsland Basin). The location of the well is indicated on the situation map (figure 1).

The samples, deriving from the Gippsland Formation (Miocene) and the Latrobe Group (Middle Paleocene - Early Eocene), are covering the interval 4990 - 7960 ft.

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 quality 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<sup>1</sup>, 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

<sup>6/16</sup>  
FELDER

The analytical results are detailed in table I and are displayed graphically on the geochemical log (enclosure 1). They can be resumed as follows:

a) Source rock indications (SRI)

The Gippsland Formation (samples 4990 - 5340 ft) is characterized by insignificant SRI values.

From the samples representing the Latrobe Group (samples 5450 - 7960 ft), the following groups with SRI values larger than 200 units can be differentiated:

- Samples 5450 - 5700 ft,
- samples 5850 - 6200 ft,
- samples 6450 - 6550 ft,
- samples 7100 - 7200 ft,
- samples 7450 - 7900 ft,
- samples 6850, 7000 and 7300 ft.

The remaining samples show marginal SRI values (predominantly in the sections 6350 - 6400 ft and 6600 - 6800 ft) or values between 100 and 200 units.

The interval 5400 - 7960 ft contains some extractable hydrocarbons.

b) Type of organic matter

The type of organic matter was determined as "mainly humic"; sample 7549 ft qualified as "mainly humic to mixed".

c) Organic carbon content

The organic carbon content has been determined in five samples.

The values vary between 9.5 % (sample 7150 ft) and 18.0 % (sample 7650 ft).

<sup>7</sup>/<sub>16</sub>  
FELDER

d) Maceral descriptions

Sample 5450 ft: Sapropelic organic matter (SOM) common;  
Vitrinite common;  
Few sporinite and resinite; rare cutinite;  
Liptodetrinite common;  
Rare sclerötinite;  
Few fusinite;  
Micrinite common.  
Vitrinite grades into SOM.  
SOM partly converted.

Sample 5850 ft: Few SOM;  
Vitrinite common;  
Few sporinite and liptodetrinite;  
Rare cutinite and resinite;  
Rare sclerotinite;  
Few fusinite;  
Micrinite common.  
Vitrinite grades into SOM.  
SOM partly converted.

Sample 6550 ft: SOM common;  
Vitrinite common;  
Few sporinite;  
Rare cutinite and resinite;  
Liptodetrinite common;  
Few fusinite;  
Micrinite common;  
Vitrinite grades into SOM.  
SOM partly converted.

Sample 7549 ft: SOM common;  
Few vitrinite;  
Few sporinite;  
Rare resinite and cutinite;  
Liptodetrinite common;  
Rare sclerotinite.  
Vitrinite grades into SOM.  
No conversion of SOM observed.

e) Vitrinite reflectance measurements

Vitrinite reflectance measurements could be carried out in four samples. The histograms are given in figures 3 - 6. On figure 2 the results are plotted versus depth.



### III DISCUSSION AND CONCLUSIONS

8/6  
FELDER

The Gippsland Formation (above 5422 ft) is barren of source rocks.

Rather high organic carbon contents (up to 18.0 % in sample 7650 ft) and relatively high SRI values confirm the presence of genuine source rocks in the intervals 5422 - 6300 ft, 6450 - 6550 ft and 7000 - 7960 ft (Latrobe Group). Marginal source rock indications predominate in the sections 6350 - 6400 ft and 6600 - 6900 ft. The type of organic matter was determined as "mainly humic" ("mainly humic to mixed" in sample 7549 ft).

The maceral composition with SOM and vitrinite as main constituents favours the generation of oil and gas. The amount and the habitat of the organic matter in sample 5850 ft suggest that these source rocks will yield only a minor amount of oil.

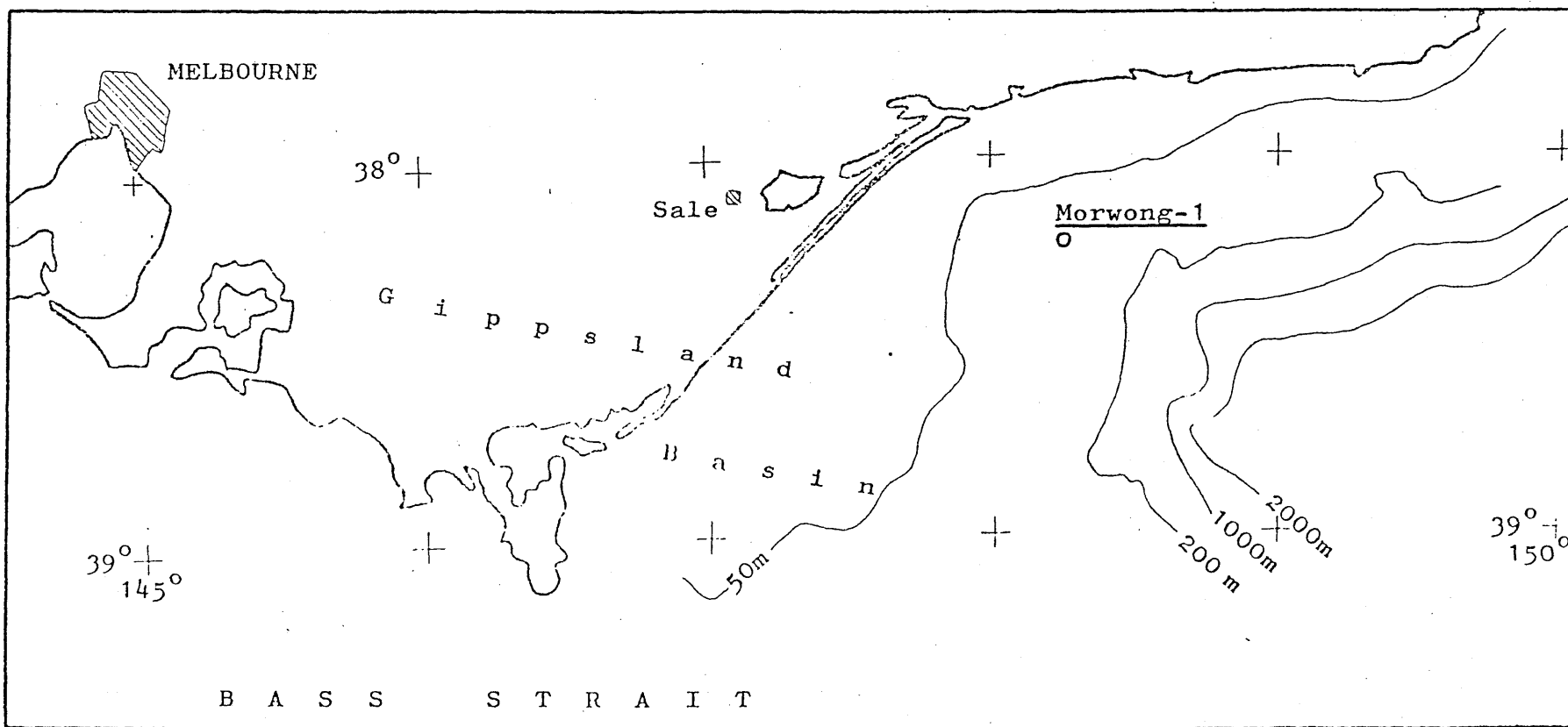
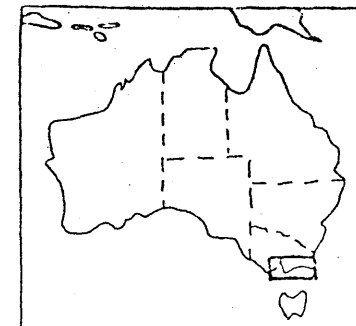
The vitrinite reflectance measurements, as well as the presence of cutinites and resinites in all samples, indicate that the whole section penetrated is still in an immature stage for oil generation.

Thus, the Latrobe Group contains immature source rocks (genuine ones in the sections 5422 - 6300 ft, 6450 - 6550 ft and 7000 - 7960 ft; mainly marginal ones in the intervals 6350 - 6400 ft and 6600 - 6900 ft) for gas and oil.

Figure 1

Situation Map

Scale 1 : 2 000 000



FELDER  
9/6



# VITRINITE REFLECTANCE

COUNTRY : AUSTRALIA  
WELL/OUTCROP : MORWONG-1  
DEPTH/SAMPLE NR. : 5450 FT  
SAMPLE TYPE : CUTTING SAMPLE

MEAN : 0.42  
DEVIATION : 0.02  
MODE : 0.40  
MEASUREMENTS: 32

ANALIST: VBS D.D. : 17-APR-80

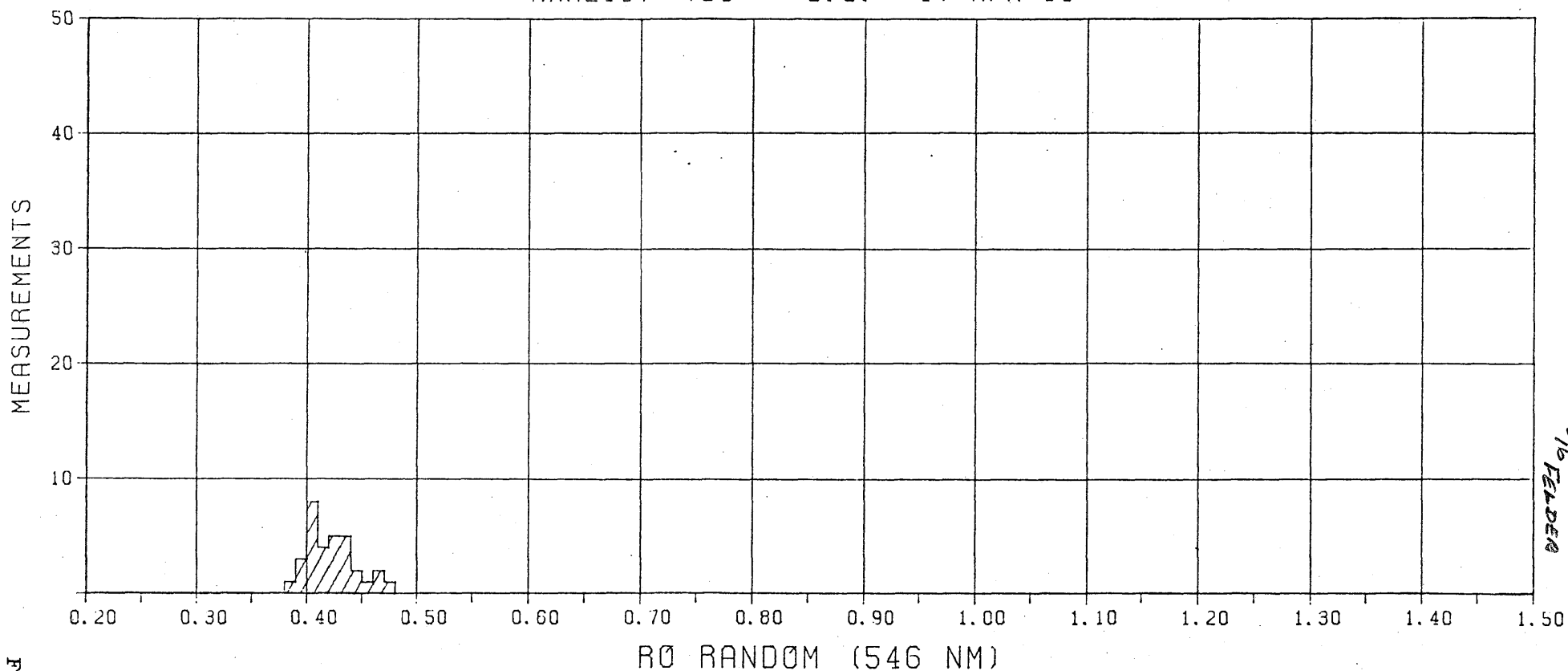


Fig. 3

VITRINITE REFLECTANCE HISTOGRAM

# VITRINITE REFLECTANCE

COUNTRY : AUSTRALIA

MEAN : 0.44

WELL/OUTCROP : MORWONG-1

DEVIATION : 0.02

DEPTH/SAMPLE NR. : 5850 FT

MODE : 0.45

SAMPLE TYPE : CUTTING SAMPLE

MEASUREMENTS: 35

ANALIST: VBS D. D. : 17-APR-80

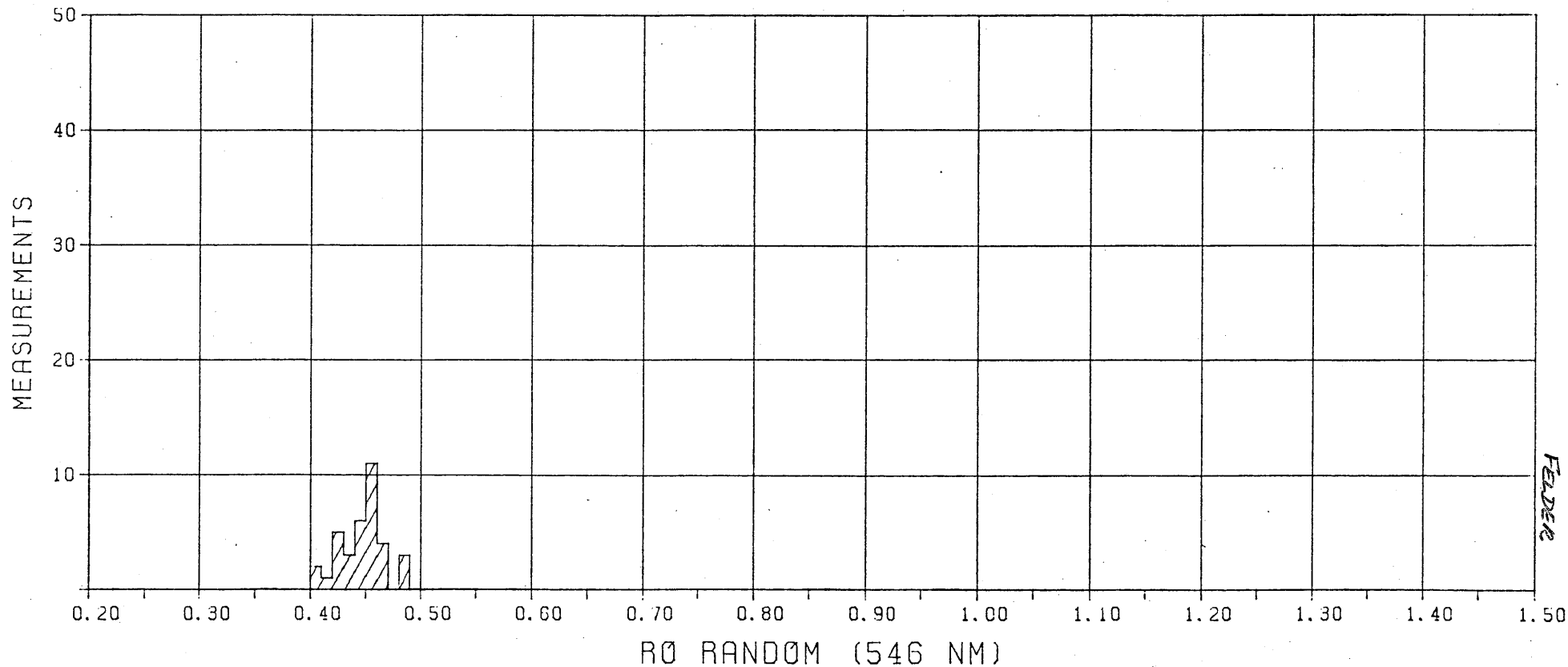


FIG. 4

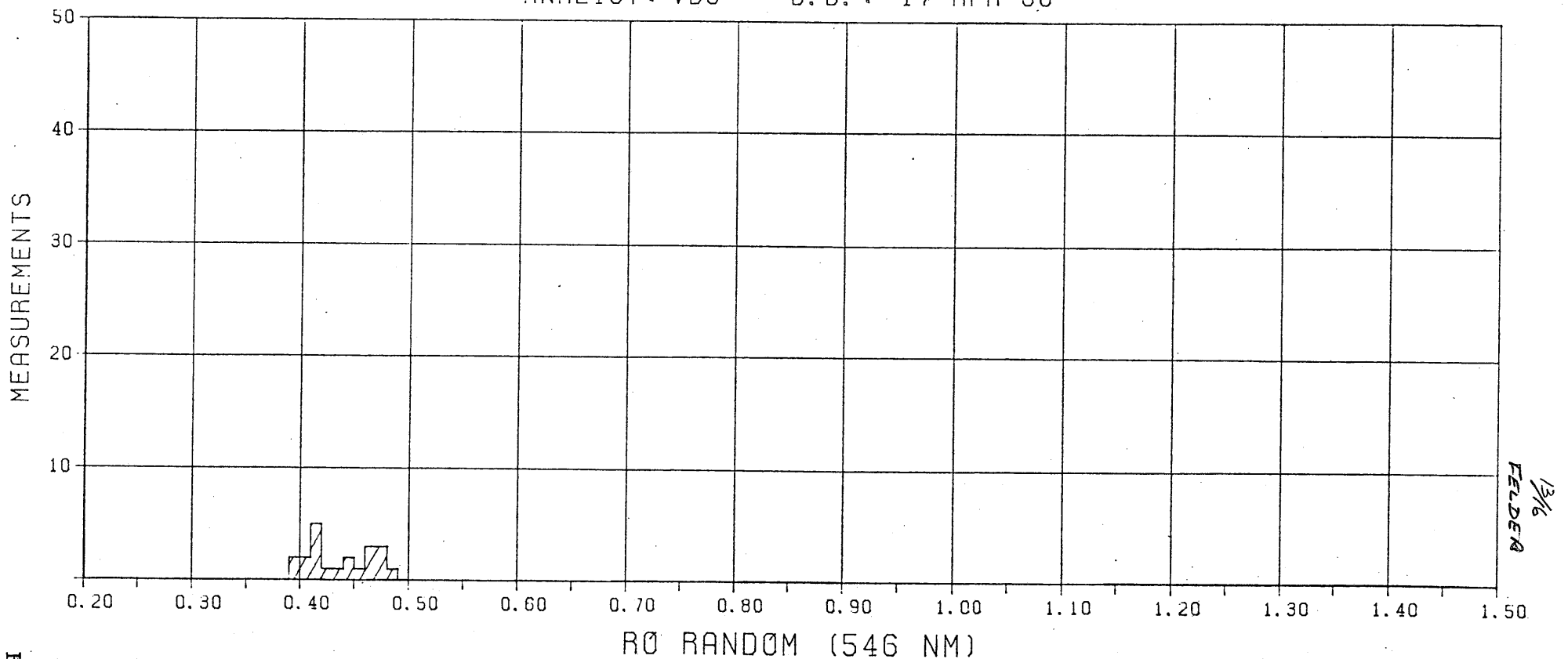
VITRINITE REFLECTANCE HISTOGRAM

# VITRINITE REFLECTANCE

COUNTRY : AUSTRALIA  
WELL/OUTCROP : MORWONG-1  
DEPTH/SAMPLE NR. : 6550 FT  
SAMPLE TYPE : CUTTING SAMPLE

MEAN : 0.43  
DEVIATION : 0.03  
MODE : 0.41  
MEASUREMENTS : 21

ANALIST : VBS D.D. : 17-APR-80



13/6  
FELDER

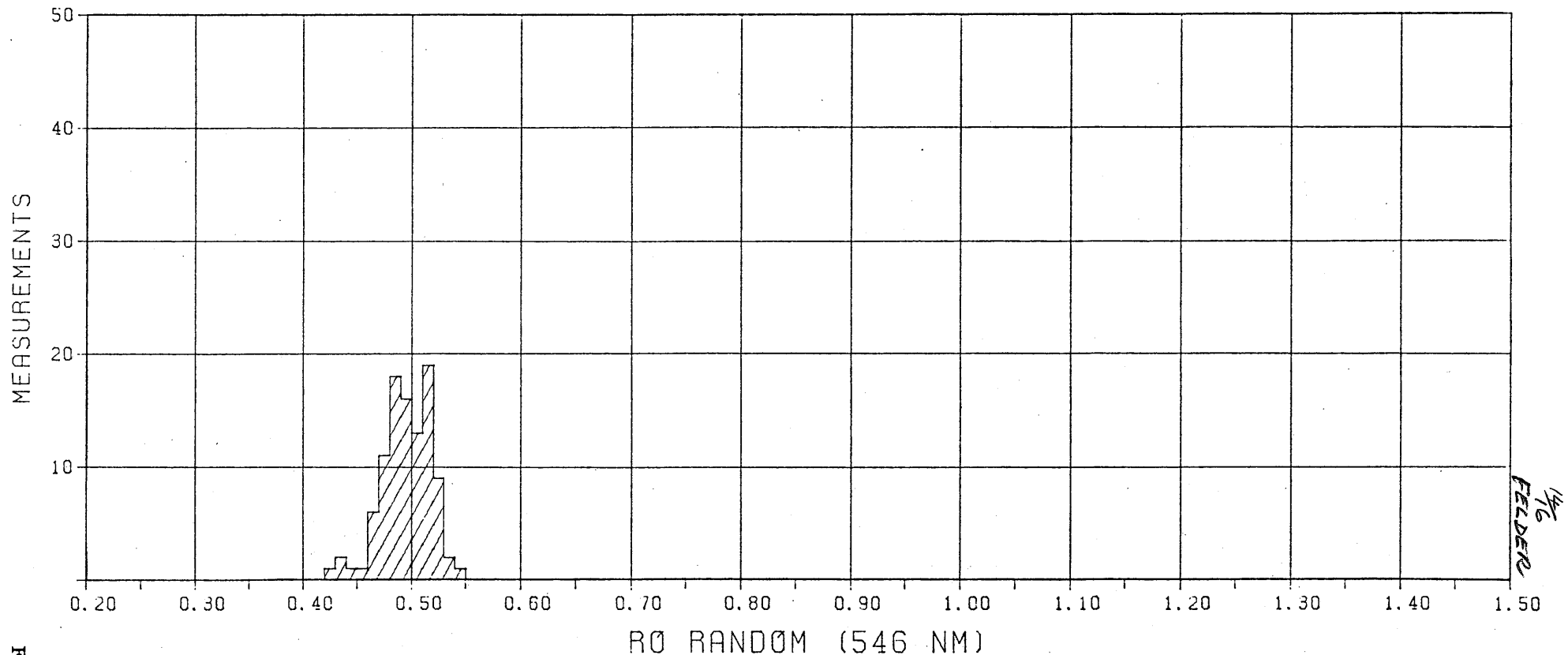
VITRINITE REFLECTANCE HISTOGRAM

# VITRINITE REFLECTANCE

COUNTRY : AUSTRALIA  
WELL/OUTCROP : MORWONG-1  
DEPTH/SAMPLE NR. : 7549 FT  
SAMPLE TYPE : CORE SAMPLE

MEAN : 0.49  
DEVIATION : 0.02  
MODE : 0.51  
MEASUREMENTS: 100

ANALIST: VBS D. D. : 17-APR-80



146  
FELDER

FIG. 6

VITRINITE REFLECTANCE HISTOGRAM

TABLE I (PART 1)

WELL:

15/16  
FELDER  
MORWONG-1

DEPTH	TYPE OF SAMPLE	SOURCE	SOURCE	TYPE OF ORGANIC MATTER	ORGANIC CARBON CONTENT %W
		ROCK INDICATION	ROCK INDICATION		
F		BEFORE EXTR.	AFTER EXTR.		
7549	R	930	620	MH/M	-
7550	R	240	205		-
4990	C	25	-		-
5050	C	20	-		-
5110	C	15	-		-
5170	C	10	-		-
5230	C	5	-		-
5290	C	10	-		-
5340	C	15	-		-
5400	C	70	65		-
5450	C	900	340	MH	14.3
5500	C	755	635		-
5550	C	490	430		-
5600	C	685	665		-
5650	C	300	280		-
5700	C	220	210		-
5750	C	115	115		-
5800	C	205	190		-
5850	C	575	530	MH	-
5900	C	305	300		-
5950	C	230	225		-
6000	C	360	295		11.8
6050	C	400	375		-
6100	C	300	290		-
6150	C	230	220		-
6200	C	410	390		-
6250	C	190	165		-
6300	C	150	145		-
6350	C	80	70		-
6400	C	50	45		-



TABLE I (PART 2)

10/6  
FELDER

WELL:

MORWONG-1

DEPTH F	TYPE OF SAMPLE	SOURCE ROCK INDICATION	SOURCE ROCK INDICATION	TYPE OF ORGANIC MATTER	ORGANIC CARBON CONTENT %W
		BEFORE EXTR.	AFTER EXTR.		
6450	C	385	275		-
6500	C	655	590		-
6550	C	900	900	MH	11.4
6600	C	120	90		-
6650	C	95	85		-
6700	C	135	130		-
6750	C	35	35		-
6800	C	70	65		-
6850	C	240	235		-
6900	C	65	60		-
7000	C	250	210		-
7050	C	190	170		-
7100	C	240	215		-
7150	C	465	435		9.5
7200	C	235	230		-
7250	C	195	190		-
7300	C	255	240		-
7350	C	80	80		-
7400	C	150	135		-
7450	C	590	505		-
7500	C	600	540		-
7550	C	750	620		-
7600	C	225	210		-
7650	C	870	750		17.8
7650	C	870	750		18.0
7700	C	510	460		-
7750	C	680	585		-
7800	C	360	255		-
7850	C	405	310		-
7900	C	370	325		-
7960	C	125	110		-

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

PE604603

This is an enclosure indicator page.  
The enclosure PE604603 is enclosed within the  
container PE906524 at this location in this  
document.

The enclosure PE604603 has the following characteristics:

ITEM\_BARCODE = PE604603  
CONTAINER\_BARCODE = PE906524  
NAME = Geochemical Log  
BASIN = GIPPSLAND  
PERMIT = VIC/L4  
TYPE = WELL  
SUBTYPE = WELL\_LOG  
DESCRIPTION = Geochemical Log of Morwong-1  
REMARKS =  
DATE\_CREATED = 30/04/80  
DATE\_RECEIVED =  
W\_NO = W660  
WELL\_NAME = MORWONG-1  
CONTRACTOR = SHELL AUSTRALIA  
CLIENT\_OP\_CO = ESSO AUSTRALIA LIMITED

(Inserted by DNRE - Vic Govt Mines Dept)