

902536 052

APPENDIX 3 : SOURCE ROCK ANALYSIS

902536 053

MILDURA WEST 1

The following samples were forwarded to Amdel for Source Rock Analysis.

<u>Depth</u>	<u>Formation</u>
375 m	Monash Formation (Coombool Member)
405 m	Monash Formation (Coombool Member)

A report prepared by Amdel follows

902536 054

HYDROCARBON SOURCE EVALUATION OF THE  
MONASH FORMATION, MILDURA WEST NOS. 1 & 2,  
MURRAY BASIN

South Australian Oil & Gas  
Corporation Pty Limited

F4/454/2/0-5576/84      September 1983



**The Australian  
Mineral Development  
Laboratories**

Flemington Street, Frewville  
South Australia 5063  
Phone Adelaide 79 1662  
Telex AA82520

Please address all  
correspondence to  
P.O. Box 114 Eastwood  
SA 5063  
In reply quote:

amdel

902536 053

20 September 1983

F 4/454/2/0

South Australian Oil & Gas Corporation Pty Limited  
PO Box 470  
NORTH ADELAIDE SA 5006

Attention: Mr Richard Suttill

REPORT F 5576/84

YOUR REFERENCE: Purchase Order No. 4048  
MATERIAL: Cuttings  
LOCALITY: Mildura West Nos. 1 & 2  
IDENTIFICATION: As specified in report  
DATE RECEIVED: 15 July 1983  
WORK REQUIRED: Total organic carbon, Rock-Eval pyrolysis.  
Interpretation.

Investigation and Report by: Dr David M. McKirdy and Dr Robert E. Cox

Chief - Fuel Section: Dr Brian Steveson  
Manager, Mineral and Materials Sciences Division: Dr William G. Spencer

for Brian S. Hickman  
Managing Director

Head Office:  
Flemington Street, Frewville  
South Australia 5063  
Telephone (08) 79 1662  
Telex: Amdel AA82520  
Pilot Plant:  
Osman Place  
Thebarton, S.A.  
Telephone (08) 43 5733  
Branch Laboratories:  
Melbourne, Vic.  
Telephone (03) 645 3093  
Perth, W.A.  
Telephone (09) 325 7311  
Telex: Amdel AA94893  
Townsville  
Queensland 4814  
Telephone (077) 75 1377

caw

## 1. INTRODUCTION

802536 056

Six cuttings samples of the Monash Formation from Mildura West 1 & 2 (Table 1) were received for source rock analysis. Total organic carbon and Rock-Eval data on these samples, together with some preliminary interpretative comments were communicated by telex to R.J. Suttill on 20 August 1983. This report is the formal presentation of the abovementioned information.

## 2. ANALYTICAL PROCEDURE

### 2.1 Sample Preparation

Each cuttings sample (as received) was ground in a Siebtechnik mill for 20-30 secs.

### 2.2 Total Organic Carbon (TOC)

Total organic carbon was determined by digestion of a known weight (2-10 g) of powdered rock in 50% HCl to remove carbonates, followed by combustion in oxygen in the induction furnace of Leco IR-12 Carbon Determinator and measurement of the resultant CO<sub>2</sub> by infra-red detection.

### 2.3 Rock-Eval Analysis

A 100 mg portion of powdered rock was analysed by the Rock-Eval pyrolysis technique (Girdel IFP-Fina Mark 2 instrument; operating mode , Cycle 1).

## 3. RESULTS

TOC and Rock-Eval data are summarised in Table 2. Figures 1 and 2 illustrate the type and maturity of the organic matter present in these sedimentary rocks.

## 4. DISCUSSION

### 4.1 Maturity

The low T<sub>max</sub> values (415-422°C: Table 2) indicate that the Monash Formation at both well localities is thermally immature (equivalent vitrinite reflectance <0.5%: Figs. 1 & 2).

### 4.2 Source Richness

Four of the six samples examined contain in excess of 1% TOC (Table 2). However, only two of these samples possess fair or better source richness, indicated by potential hydrocarbon yields (S<sub>1</sub> + S<sub>2</sub>) of >2 kg/tonne, as follows:

302530 057

<u>Well</u>	<u>Depth (m)</u>	<u>TOC (%)</u>	<u>S<sub>1</sub> + S<sub>2</sub> (kg/tonne)</u>	<u>Source Richness</u>
Mildura West-1	507	2.70	2.9	Fair
Mildura West-2	537*	5.35	6.8	Good

\*Cuttings contain 30% Coal (Table 1).

On the assumption that the sandstone component of each cuttings sample listed in Table 1 is barren of dispersed organic matter, it is possible to calculate the aggregate richness of the more likely hydrocarbon source lithologies present (viz. claystone, siltstone, coal). These 'corrected' TOC values and potential hydrocarbon yields (S<sub>1</sub> + S<sub>2</sub>) are given in Table 3.

#### 4.3 Source Quality and Kerogen Type

Hydrogen indices in the range HI = 50-123 (Table 2) suggest that these rocks contain organic matter of humic Type III, tending to inertinitic Type IV, composition (Figs. 1 and 2). Such organic matter is gas-prone.

### 5. CONCLUSIONS

The Monash Formation at the Mildura West-1 and 2 well localities contains fair to good amounts of thermally immature, gas-prone, terrigenous organic matter.

TABLE 1: CUTTINGS SAMPLES SUBMITTED FOR SOURCE-ROCK ANALYSIS, MILDURA WEST - 1 & 2

Well	Depth (metres)	Formation/Member	Lithology*
Mildura West - 1	375	Monash/Coombool	60% sandstone, 40% claystone, trace coal
	405	Monash/Coombool	70% claystone, 20% sandstone, trace coal, trace dolomite
Mildura West - 2	498	Monash/Merreti	70% sandstone, 30% siltstone
	507	Monash/Merreti	70% sandstone, 30% siltstone, trace coal
	513	Monash/Pyap	60% sandstone, 30% siltstone, 10% coal
	537	Monash/Pyap	50% sandstone, 20% siltstone, 30% coal

\*Information supplied by client.

902536 058

TABLE 2: TOC AND ROCK-EVAL DATA, MONASH FORMATION, MILDURA WEST - 1 & 2

Well	Depth (m)	Tmax	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	PI	S <sub>2</sub> /S <sub>3</sub>	PC	TOC	HI	OI
Mildura West - 1	375	422	0.13	1.44	0.98	0.08	1.46	0.13	1.27	113	77
	405	415	0.02	0.22	39.0	0.08	0.00	0.02	0.44	50	8880
Mildura West - 2	498	-	-	-	-	-	-	-	0.18	-	-
	507	422	0.10	2.83	1.48	0.03	1.91	0.24	2.70	105	55
	513	420	0.03	0.88	1.71	0.03	0.51	0.07	1.44	61	119
	537	417	0.25	6.57	3.05	0.04	2.15	0.56	5.35	123	57

902536 059



KEY TO ROCK-EVAL PYROLYSIS DATA SHEET

<u>PARAMETER</u>	<u>SPECIFICITY</u>
T max	position of S <sub>2</sub> peak in temperature program (°C)
S <sub>1</sub>	kg hydrocarbons (extractable)/tonne rock
S <sub>2</sub>	kg hydrocarbons (kerogen pyrolysate)/tonne rock
S <sub>3</sub>	kg CO <sub>2</sub> (organic)/tonne rock
S <sub>1</sub> + S <sub>2</sub>	Potential Yield
PI	Production Index (S <sub>1</sub> /S <sub>1</sub> + S <sub>2</sub> )
PC	Pyrolysable Carbon (wt. percent)
TOC	Total Organic Carbon (wt. percent)
HI	Hydrogen Index (mg h'c (S <sub>2</sub> )/g TOC)
OI	Oxygen Index (mg CO <sub>2</sub> (S <sub>3</sub> )/g TOC)
	Maturity/Kerogen type
	Kerogen type/Maturity/Migrated oil
	Kerogen type/Maturity
	Kerogen type/Maturity *
	Organic richness/Kerogen type
	Maturity/Migrated Oil
	Organic richness/Kerogen type/Maturity
	Organic richness
	Kerogen type/Maturity
	Kerogen type/Maturity *

\*Also subject to interference by CO<sub>2</sub> from decomposition of carbonate minerals.

902536 060

902300 001

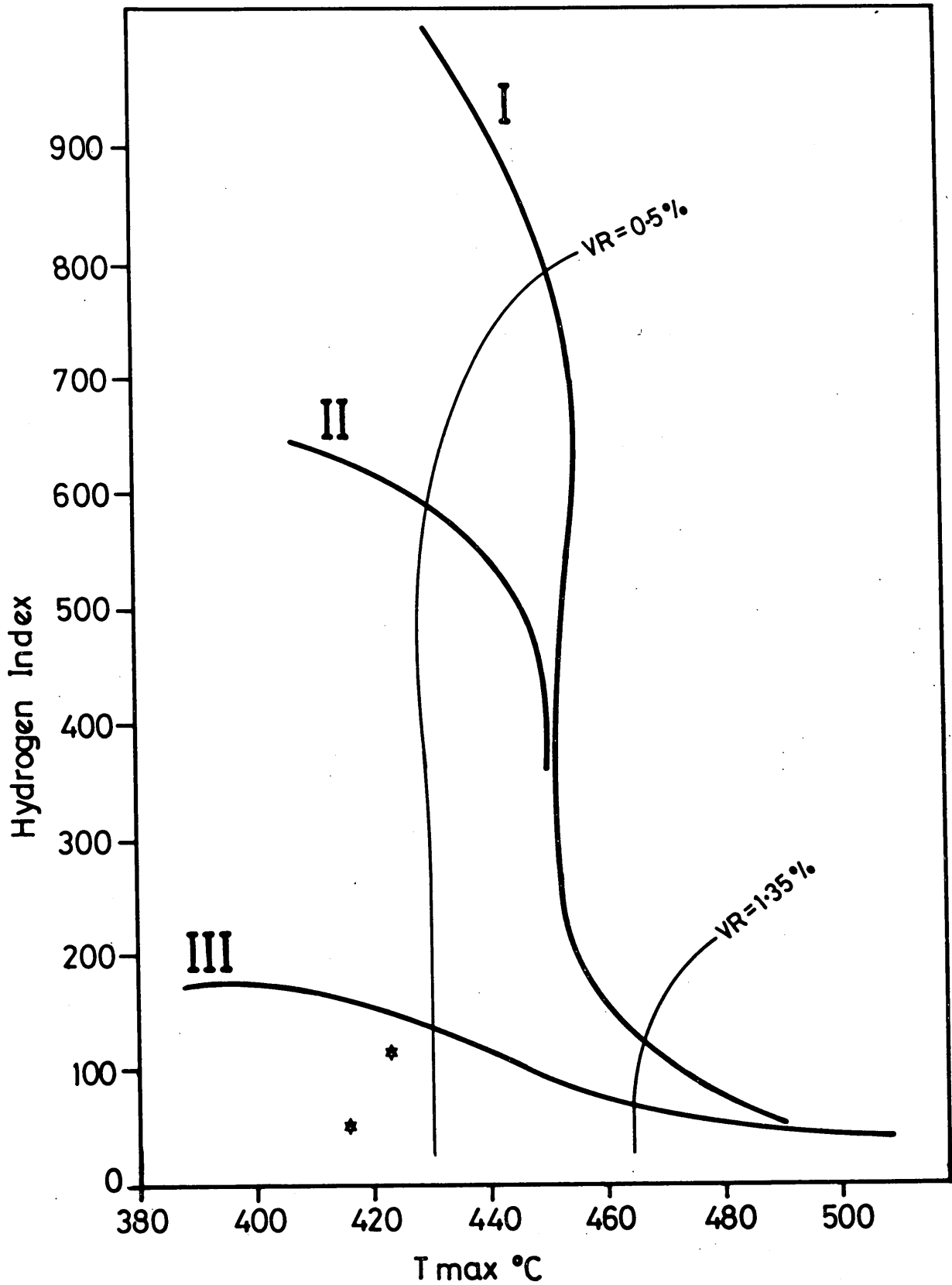
TABLE 3: SOURCE RICHNESS OF MONASH FORMATION CUTTINGS AFTER CORRECTION FOR PRESENCE OF BARREN SANDSTONE

Well	Depth	TOC	S <sub>1</sub> + S <sub>2</sub> (kg/tonne)	Source Richness
Mildura West - 1	375	3.2	3.9	fair
	405	0.6	0.3	poor
Mildura West - 2	498	0.6	-	poor
	507	9.0	9.8	good
	513	3.6	2.3	fair
	537	10.7	13.6	good

Client : SAOGC  
Well : MILDURA WEST - #1  
Interval : Monash Formation

FIGURE 1

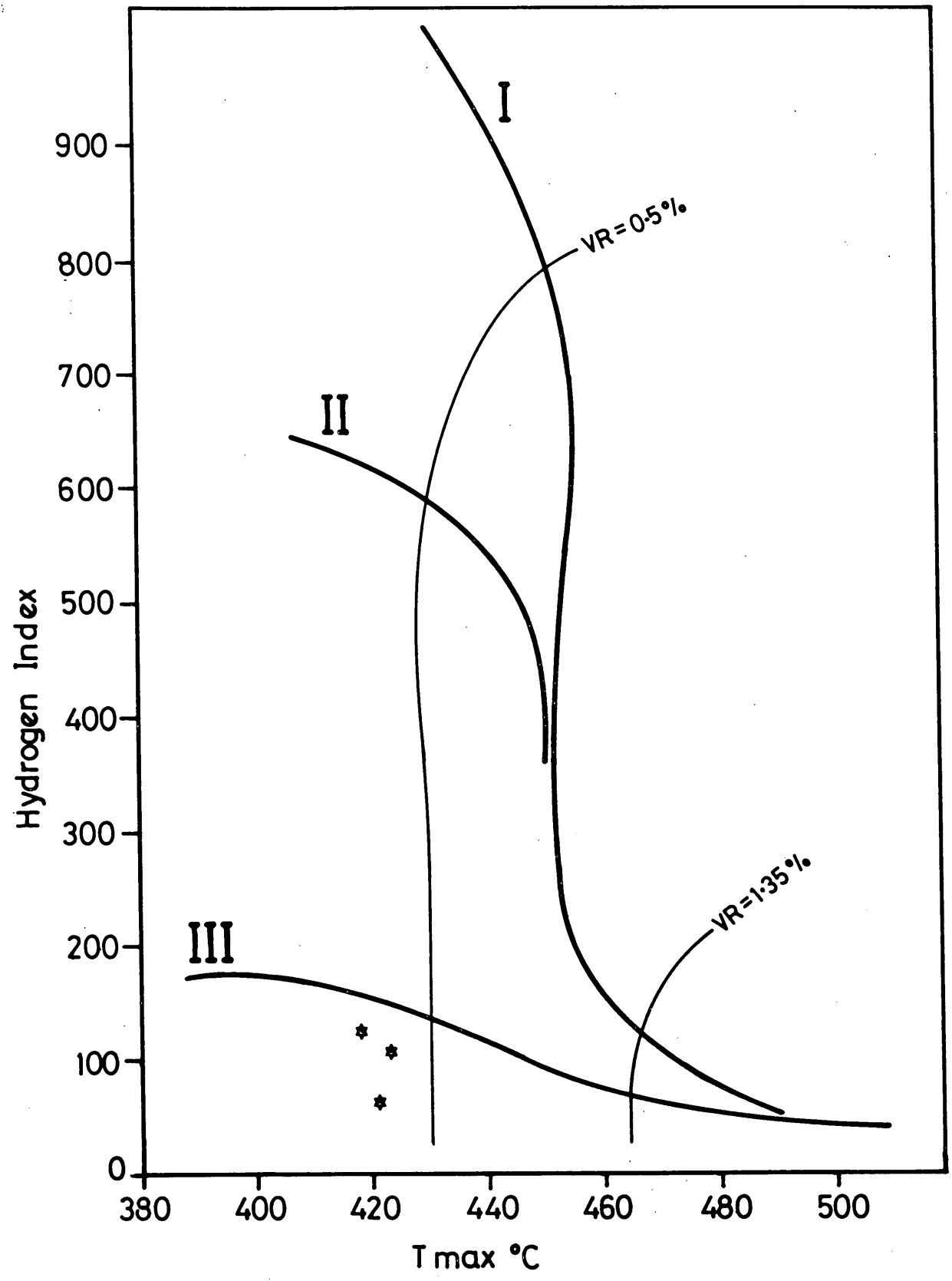
902536 062



Client : SAOGC  
Well : MILDURA WEST - #2  
Interval : Monash Formation

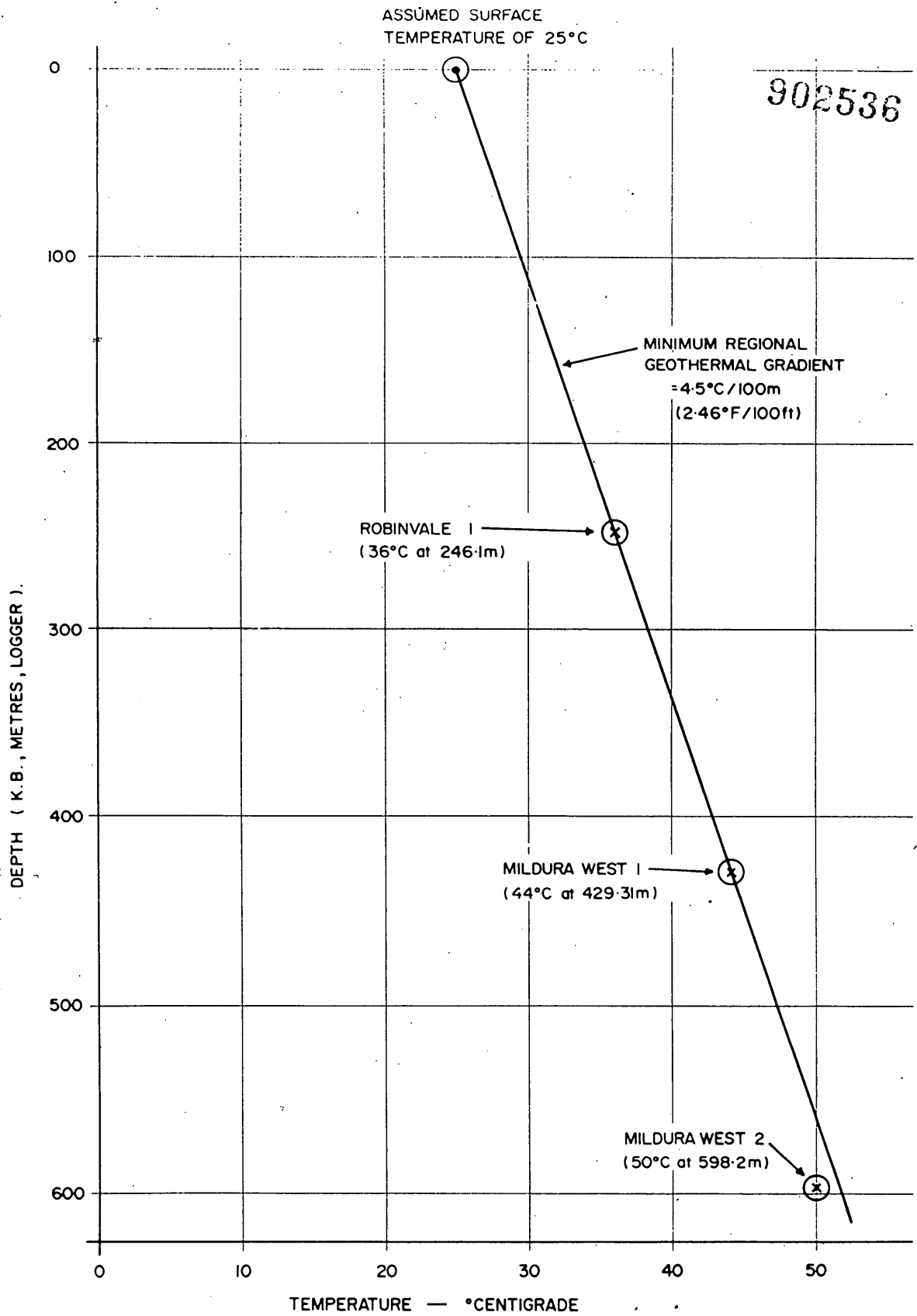
FIGURE 2

902536 063



902536 064

APPENDIX 4 : DEPTH VS TEMPERATURE



SOUTH AUSTRALIAN OIL & GAS CORP. PTY. LTD.		
<b>Mildura West 1 &amp; 2, Robinvale 1</b>		
<b>GEOTHERMAL GRADIENT</b>		
Interp. R.SUTTILL	Date JULY 83	MAW000.2939
Drawn. C.KAY	Scale AS SHOWN	FIG.2