



PETROLEUM DIVISION

10 AUG 1987

Tirrengowa 1

Well Completion Report

W954. TIRRENGOWA-1. W.C.R.



Hartogen Energy Limited

Tirrengowa 1

Well Completion
Report

10 AUG 1987

TIRRENGOWA NO. 1

PEP 100

WELL COMPLETION REPORT

HARTOGEN ENERGY LIMITED
GAS AND FUEL EXPLORATION N.L.

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HARTOGEN ENERGY LIMITED

15 YOUNG STREET

SYDNEY

JULY 1987

WKM06R11

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SOURCE ROCK ANALYSIS

SOURCE ROCK EVALUATION, TIRRENGOWA-1
PEP-100, OTWAY BASIN

Hartogen Energy Limited

F3/1001/0-F6830/87

June 1987

30 June 1987

F 3/1001/0
F 6830/87

Hartogen Energy Limited
15 Young Street
SYDNEY NSW 2000

Attention: W.K. Morrison

REPORT F 6830/87

YOUR REFERENCE: Phone call from W.K. Morrison, 10 June 1987

TITLE: Source rock evaluation, Tirrengowa-1, PEP-100,
Otway Basin

MATERIAL: Sidewall cores

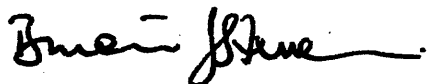
LOCALITY: TIRRENGOWA-1

IDENTIFICATION: As in Table 1 of report

DATE RECEIVED: 11 June 1987

WORK REQUIRED: TOC and Rock-Eval pyrolysis. Vitrinite
reflectance. Organic petrology. Interpretation.

Investigation and Report by: Dr David M. McKirdy and Brian L. Watson
Manager-Petroleum Services Section: Dr Brian G. Steveson



for Dr William G. Spencer
General Manager
Applied Sciences Group

cap

1. INTRODUCTION

Three sidewall cores from Tirrengowa-1 (Table 1) were received for source rock evaluation.

The aims of the investigation were to assess the hydrocarbon source potential (maturity, organic richness, kerogen type) of Otway Group shale and siltstones penetrated by the Tirrengowa-1 well.

Preliminary results were facsimiled to Hartogen's Sydney office on 26 June 1987.

2. RESULTS

Analytical data are summarised and presented herein as follows:

	<u>Table</u>	<u>Figure</u>	<u>Appendix</u>
TOC, Rock-Eval pyrolysis	2	1	-
Vitrinite reflectance	3	2	1
Dispersed organic matter (DOM)	4-6	-	2

3. DISCUSSION

3.1 Maturity

Vitrinite reflectance data (Fig. 2) indicate that sediments above 2570 feet depth in Tirrengowa-1 are thermally immature (VR < 0.5%). The lower half of the Eumeralla Formation and the upper 340 feet of the underlying Pretty Hill Sandstone are marginally mature for oil generation from terrestrial organic matter (VR = 0.5-0.7%).

There is good agreement between measured vitrinite reflectance and Rock-Eval Tmax for two of the samples analysed (Fig. 1). However, Tmax for SWC 19 (1965 feet) is anomalously high (452°C) with respect to its vitrinite reflectance value (VR = 0.49%). The reason for this discrepancy is not clear but may be related to the highly inertinitic character of the DOM (Table 4).

Production index, another maturation-dependent parameter, increases with increasing depth in the sequence (Table 2) as would be expected.

3.2 Organic Richness

Total organic carbon contents of these fine-grained clastics are fair to good (TOC = 0.60-1.07%), although considerably less than the worldwide average for shale source rocks (TOC = 2.0%).

Source richness is *poor* as indicated by low potential hydrocarbon yields ($S_1+S_2 < 2$ kg/tonne).

3.3 Source Quality and Kerogen Type

Siltstones from the Pretty Hill Sandstone (SWC 8) and the base of the Eumeralla Formation (SWC 11) have low hydrogen indices (HI = 113-159 mg S₂/g TOC) characteristic of poor quality Type III kerogen (Fig. 1).

Optical microscopy confirms the presence of terrestrial organic matter rich in inertinite (I = 90% of DOM : Table 4). The associated exinite (5% of DOM) is moderately to strongly oxidised. Such organic matter is a potential source of dry gas only.

Although containing similarly inertinitic DOM, shale from 1965 feet depth in the Eumeralla Formation (SWC 19) has an appreciably higher hydrogen index (HI = 252 mg S₂/g TOC). There is no obvious reason why this should be so.

4. CONCLUSIONS

1. Early Cretaceous sediments of the Otway Group below 2570 feet depth in Tirrengowa-1 are marginally mature (VR = 0.5-0.7%).
2. Such maturities are adequate for the initial phase of oil generation from terrestrial organic matter.
3. Representative shale and siltstones from the Eumeralla Formation and Pretty Hill Sandstone contain only moderate amounts of poor quality, oxidised, terrestrial organic matter at this well locality. Such organic matter is not capable of generating significant quantities of liquid hydrocarbons.

TABLE 1: SIDEWALL CORES SUBMITTED FOR SOURCE ROCK ANALYSIS,
TIRRENGOWA-1

SWC	Depth ft	Formation	Rock Type
19	1965	Eumeralla	Shale
11	3600	Eumeralla	Siltstone
8	3885	Pretty Hill	Siltstone

AMDEL

ROCK-EVAL PYROLYSIS

24/06/87

Client HARTOGEN ENERGY LTD

Well TIRRENGOWA-1

SWC No.	DEPTH (ft)	T MAX	S1	S2	S3	S1+S2	PI	S2/S3	PC	TOC	HI	OI
19	1965	452	0.07	1.51	0.62	1.58	0.04	2.43	0.13	0.60	252	103
11	3600	442	0.21	1.45	2.14	1.66	0.13	0.67	0.13	0.91	159	235
8	3885	442	0.19	1.21	1.99	1.40	0.14	0.60	0.11	1.07	113	186

KEY TO ROCK-EVAL PYROLYSIS DATA SHEET

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

*Also subject to interference by CO₂ from decomposition of carbonate minerals.

TABLE 3: SUMMARY OF VITRINITE REFLECTANCE MEASUREMENTS, TIRRENGOWA-1

Depth (ft)	Mean Maximum Reflectance (%)	Standard Deviation	Range	Number of Determinations
1965	0.49	0.05	0.42-0.56	4
3600	0.57	0.09	0.40-0.74	25
3885	0.72	0.08	0.59-0.86	6

TABLE 4: PERCENTAGE OF VITRINITE, INERTINITE AND EXINITE IN DISPERSED ORGANIC MATTER, TIRRENGOWA-1

Depth (ft)	Vitrinite	Percentage of Inertinite	Exinite
1965	<5	90	5*
3600	5	90	<5*
3885	<5	90	5*

*Exinite is moderately to strongly oxidised.

TABLE 5: ORGANIC MATTER TYPE AND ABUNDANCE, TIRRENGOWA-1

Depth (ft)	Relative Maceral Group Proportions	Estimated Volume of DDM	Volume of Exinites	Exinite Macerals
1965	I>>E>V	1-2	Ra	phyto,spo,?oil
3600	I>>V>E	=1	Vr	lipto,phyto,spo
3885	I>>E>V	1-2	Vr	?oil,phyto,spo

TABLE 6: EXINITE MACERAL ABUNDANCE AND FLUORESCENCE CHARACTERISTICS,
TIRRENGOWA-1

Depth (ft)	Exinite Macerals	Lithology/Comments
1965	phyto(Ra;m0-nof1),spo(Vr;m0-nof1),?oil(Tr;iY)	Shale; exinite is moderately to strongly oxidised. ?Oil is associated with the larger mineral grains and is likely to have migrated to this location.
3600	lipto(Vr;m0-d0),phyto(Vr;d0-nof1),spo(Tr;d0-nof1)	Siltstone; exinite is strongly oxidised.
3885	?oil(Vr;iY-i0),phyto(Vr;d0-nof1),spo(Vr;d0-nof1)	Siltstone; exinite as above. ?Oil is generally associated with the larger mineral grains and is likely to have migrated into this unit. Two distinct fluorescence colours indicate the possibility of two families of oil.

KEY TO DISPERSED ORGANIC MATTER DESCRIPTIONS

HACERAL GROUPS

V Vitrinite
I Inertinite
E Exinite

EXINITE MACERALS

spo Sporinite
cut Cutinite
res Resinite
sub Suberinite
lipto Liptodetrinite
fluor Fluorinite
terp Terpenite
exs Exsudatinite
phyto Phytoplankton
tela Telalginite
lama Lamalginite
bmite Bituminite
bmen Bitumen
thuc Thucholite

ABUNDANCE (by vol.)

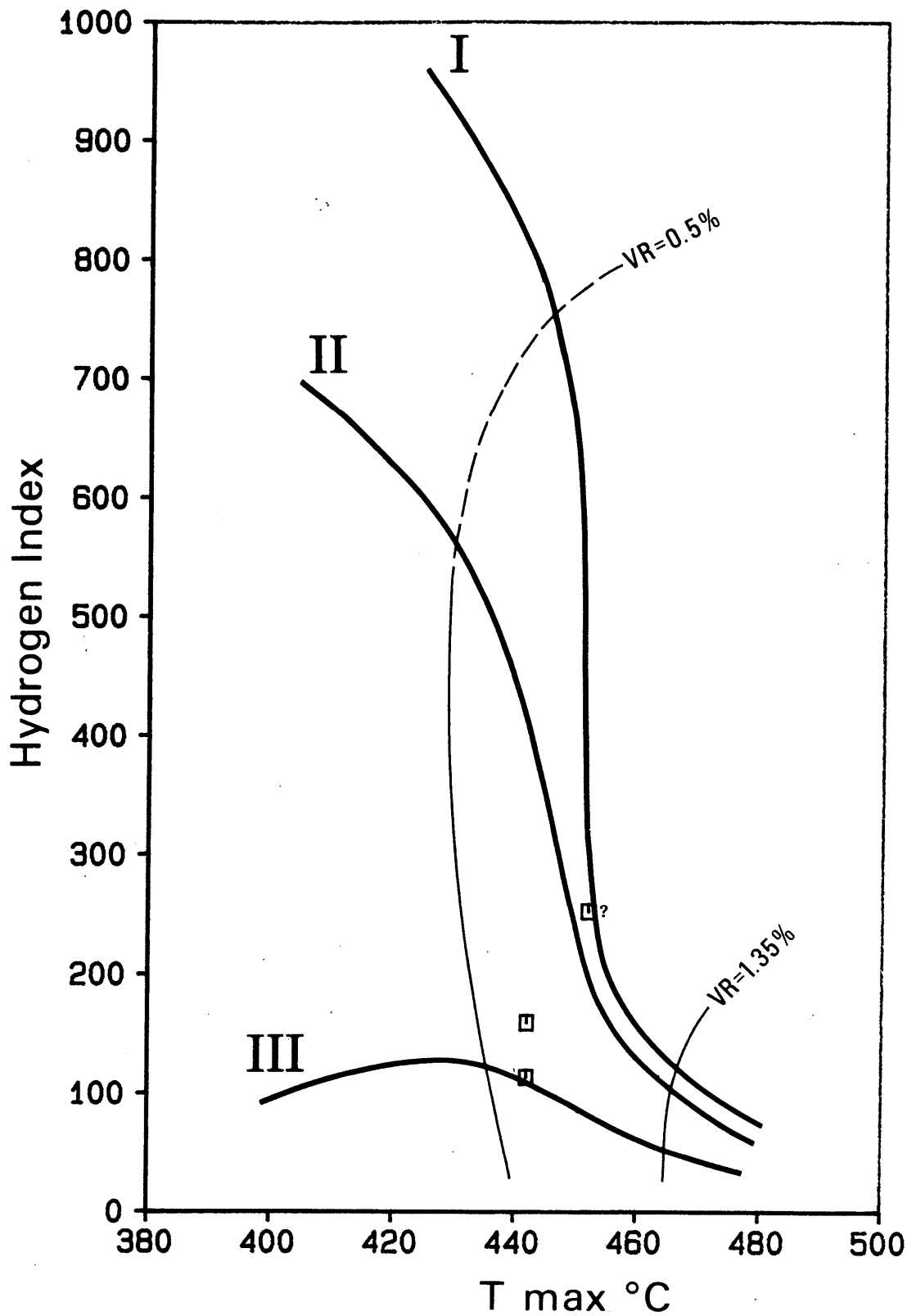
Ma Major >15%
Ab Abundant 2-15%
Co Common 1-2%
Sp Sparse 0.5-1%
Ra Rare 0.1-0.5%
Vr Very Rare \approx 0.1%
Tr Trace <0.1

FLUORESCENCE COLOUR AND INTENSITY

G Green
Y Yellow
O Orange
B Brown
i Intense
m Moderate
d Dull
nofl No Visible Fluorescence

FIGURE 1

Client : HARTOGEN ENERGY
Well name : TIRRENGOWA-1



APPENDIX 1

HISTOGRAM PLOTS OF VITRINITE REFLECTANCE
MEASUREMENTS, TIRRENGOWA-1

TIRRENGOWA-1

1965 FT ; SMC 19

SORTED LIST

.42 .45 .51 .56

Number of values= 4

MEAN OF VALUES .485

STD DEVIATION .054

HISTOGRAM OF RESULTS

Values are reflectance multiplied by 100

42 - 46	████
47 - 51	██
52 - 56	██

TIRRENGOWA-1

3600 FT ; SWC 11

SORTED LIST

.4 .42 .43 .46 .48 .5 .5 .54 .54 .56
.57 .58 .58 .58 .58 .59 .62 .62 .64 .64
.66 .67 .69 .7 .74

Number of values= 25

MEAN OF VALUES .572

STD DEVIATION .089

HISTOGRAM OF RESULTS

Values are reflectance multiplied by 100

40 - 44	██████
45 - 49	█████
50 - 54	████████
55 - 59	██████████
60 - 64	████████
65 - 69	██████
70 - 74	█████

TIRRENGOWA-1

3885 FT ; SWC 8

SORTED LIST

.59 .68 .72 .72 .72 .86
Number of values= 6

MEAN OF VALUES .715
STD DEVIATION .08

HISTOGRAM OF RESULTS

Values are reflectance multiplied by 100

59 - 63	■
64 - 68	■
69 - 73	■■■■
74 - 78	
79 - 83	
84 - 88	■