PURRUMBETE-1

PE901678

Attachment to WCR.
Vitrinite Reflectance Report

Purrumbete-1
(W523)

REPORT

VITRINITE REFLECTANCE MEASUREMENTS AND THERMAL MODELLING OF SAMPLES FROM DRILL HOLES

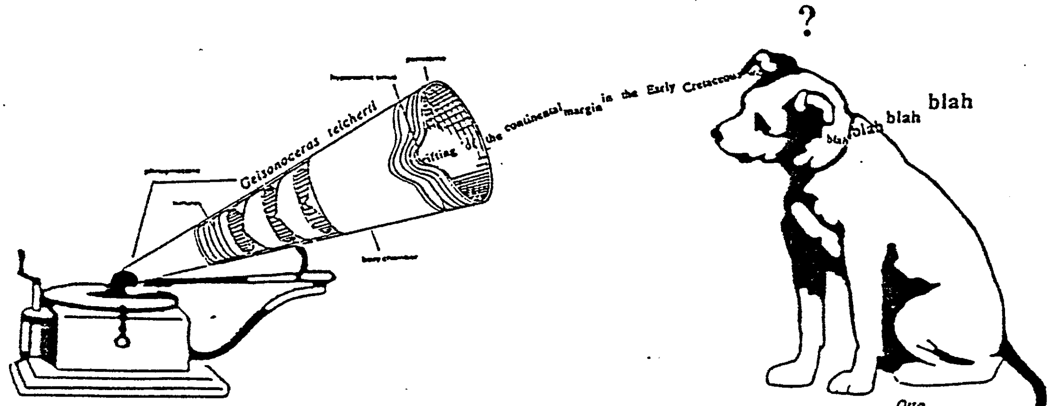
ROSS CREEK-1

PURRUMBETE-1

GARVOC-1

G.T. Cooper
22 July 1994

Unpublished Report 1994/14



CONFIDENTIAL

REPORT

VITRINITE REFLECTANCE MEASUREMENTS AND THERMAL MODELLING OF SAMPLES FROM DRILL HOLES

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PART 1

INTRODUCTION

1.1 Introduction and Aims

Vitrinite Reflectance (VR) and associated methods such as FAMM are the most commonly used methods of rank determination used in the oil exploration industry. The method is relatively inexpensive and non-destructive. When combined with modern kinetic modelling software it is a powerful tool in calculating the amount of succession uplifted and eroded; evaluating organic matter type and it's suitability for hydrocarbon production and determining the level of organic maturity.

The aims of this study were:

a) to measure the mean maximum reflectance of vitrinite (R_V Max %) of samples from drill holes Ross Creek-1, Purrumbete-1 and Garvoc-1.

b) to calculate the palaeothermal gradients and model the uplift histories of these wells using BasinMod™.

1.2 Method

Cuttings samples were collected from various depths in the following drill holes:-

a) Ross Creek-1 12 Samples

b) Purrumbete-1 9 Samples

c) Garvoc-1 7 Samples

Well completion reports for these wells did not contain any previous determinations of VR and no suitable core samples were availabe. Cuttings samples often pose problems due to cavings. In several samples cavings were identified and eliminated from the analysis.

Samples were bonded with cold setting resin and polished in accordance to AS 2061. Mean maximum reflectance (Rv Max%) was then determined using a Leitz MPV compact orthoplan microscope with Pol-vertical illuminator. A photomultiplier mounted on the top of the microscope measures incident light supplied by a 12 V, 100 W tungsten source which has been stabalised using an 8 A high-stability power supply.

The microscope was standardised using samples of known RI before R_V Max% measurements were conducted in accordance with AS 2486 and the guidelines stated in Cook and Kanstler (1982). Measurements were made in oil immersion using a 50X lens and RI oil 1.518. The polarizer was set at 45° and a minimum of 30 measurment per block was recorded, except where insufficient organic matter prevented this.

PART 2

VITRINITE REFLECTANCE AND ORGANIC PETROLOGY

2.1 Introduction

Coal and Dispersed Organic Matter (DOM) is composed of a number of macerals which are distinguished by the **type** of organic matter which constitutes them. The three main maceral groups are Liptinite, Vitrinite and Inertinite.

Liptinte (Type I and II Kerogen) is derived from the waxy, lipid-rich and resinous parts of plants. It has the lowest reflectivity and is considered to be excellent to good for oil generation.

Vitrinite (Type III Kerogen) is derived from cell walls, cell contents and precipitated gels. It has an intermediate reflectivity, moderate gas potentail and poor oil potential.

Inertinite (Type IV Kerogen) is derived from plant material oxidised and altered during the peat stage. It has none to poor hydrocarbon potential - it is inert.

As organic matter is exposed to increasing heat during burial, it undergoes low-grade metamorphism and increases in **rank**. Chemically the organic matter loses CH_4, C and H_2O which is characterised by increasing reflectivity. Hence the percentage of light reflected from the surface of a polished sample of vitrinite (R_V Max%) is proportional to the maximum temperature experienced by the sample.

2.2 Ross Creek-1

Determinations of R_V Max% for Ross Creek-1 are presented in table 2.1. Late Cretaceous and late Early Cretaceous samples are sub-bituminous in rank (immature) with a low maturity profile of 0.12 R_V Max%/km. This rapidly increase into high and medium volatile bituminous ranks in the lower Eumeralla Fm and Pretty Hill Sst with a maturity profile of 0.53 R_V Max%/km. This gradient is similar to the nearby Stoneyford-1 well (Struckmeyer 1988). Of note is the unusal decrease in reflectivity from sample RC1 (0.33%) to samples RC2-RC4 (0.29-0.32%). This rank change between the Late and Early Cretaceous may be related to faulting (see section 3.2.1).

TABLE 2.1

VITRINITE REFLECTANCE SUMMARY (R_V MAX%) FOR ROSS CREEK-1

Sample No (Cuttings)	*Depth (m)*	*Formation*	*Mean Max Reflectance (Rv Max %)*	*Range*	*Counts*	*STD Deviation*	*Ro % Equivalent*
RC1	722.4	Curdies	**0.33**	0.30-0.38	20	0.0240	0.31
RC2	954.0	Eumeralla	**0.29**	0.27-0.31	30	0.0125	0.27
RC3	1094.2	Eumeralla	**0.31**	0.26-0.35	6	0.0333	0.29
RC4	1240.5	Eumeralla	**0.32**	0.30-0.36	30	0.0129	0.30
RC5	1463.0	Eumeralla	**0.38**	0.32-0.47	23	0.0479	0.36
RC6	1655.1	Eumeralla	**0.49**	0.39-0.55	12	0.0594	0.46
RC7	1996.4	Eumeralla	**0.49**	0.43-0.55	30	0.0319	0.46
RC8	2350.0	Eumeralla	**0.57**	0.50-0.64	39	0.0354	0.53
RC9	2633.5	Eumeralla	**0.72**	0.63-0.79	37	0.0506	0.68
RC10	3029.7	Eumeralla	**0.85**	0.79-0.91	30	0.0278	0.80
RC11	3249.2	Eumeralla	**1.12**	1.02-1.20	33	0.0443	1.05
RC12	3557.0	Pretty Hill	**1.37**	1.30-1.42	20	0.0295	1.29

Organic matter is a mixture of coal fragments and DOM. Sub-bituminous coals are dominated by Humotelinite whereas bituminous coals contain Telocollinite and Desmocollinite. Most samples contain large amounts of Liptinite with Cutinite and Sporinite most prevalent. Liptodetrinite, minor Resinite and rare Bituminite are also present. The most dominant maceral group is Inertinite which comprises Fusinite, Semifusinite, Inertodetrinite and minor Sclerotinite.

Monomaceral microlithotypes include Fusite, Semifusite and Vitrite. The most common trimacerite is Clarodurite. Calcite and Ankerite are common, especially in the vicinity of faults mentioned in the well completion report. Samples from Ross Creek-1 contain the greatest amount of organic matter in comparison to Purrumbete-1 and Garvoc-1 and are particularly rich in Liptinite.

2.3 Purrumbete-1

Determination of R_V Max% for Purrumbete-1 are presented in table 2.2. Samples for the Eumeralla Fm are sub-bituminous in rank and progress steadily into high volatile bitumous ranks with a low maturity profile of 0.20 R_V Max%/km.

The Vitrinites are dominantly Telocollinite and Desmocollinite with minor Corpogelinite. Like Ross Creek-1, Liptinite is common to abundant with Cutinite and Sporinite the major macerals. Lesser amounts of Liptodetrinite and Resinite are present. Agian Inertinite is the most common maceral group with common Semifusinite, Fusinite, Inertodetrinite and Macronite. Calcite occurs in some samples.

Telite is the most common monomaceral micolithotype whereas Vitrinertite is the most common bimaceral. Clarodurite is also present.

2.4 Garvoc-1

Determinations of R_V Max% for Garvoc-1 are presented in table 2.3. Samples from the Eumeralla Fm are sub-bituminous in rank and barely progress into bitumous ranks in the Pretty Hill Sst. The maturity profile is low (0.15 R_V Max%/km) suggesting low rates of heating.

Organic matter in this well is abundant to poor and in places vitrinite is rare. Samples are dominated by Inertinite with Fusinite, Semifusinite and Inertodetrinite the most common macerals. Vitrinite is largely Humotelinite, Telocollinite and Desmocollinite.

TABLE 2.2

VITRINITE REFLECTANCE SUMMARY (R_v MAX%) FOR PURRUMBETE-1

Sample No (Cuttings)	*Depth (m)*	*Formation*	*Mean Max Reflectance (Rv Max %)*	*Range*	*Counts*	*STD Deviation*	*Ro % Equivalent*
P1	515.1	Eumeralla	**0.35**	0.30-0.38	30	0.0202	0.33
P2	576.1	Eumeralla	**0.31**	0.29-0.34	29	0.0115	0.29
P3	780.3	Geltwood Beach	**0.41**	0.31-0.45	18	0.0382	0.38
P4	899.2	Geltwood Beach	**0.45**	0.38-0.54	30	0.0456	0.42
P5	1085.1	Geltwood Beach	**0.42**	0.36-0.48	20	0.0279	0.39
P6	1252.7	Geltwood Beach	**0.49**	0.43-0.55	30	0.0287	0.46
P7	1450.8	Geltwood Beach	**0.47**	0.43-0.53	37	0.0242	0.44
P8	1588.0	Geltwood Beach	**0.52**	0.46-0.56	34	0.0221	0.49
P9	1810.5	Geltwood Beach	**0.61**	0.57-0.66	35	0.0261	0.57

TABLE 2.3

VITRINITE REFLECTANCE SUMMARY (R_V MAX%) FOR GARVOC-1

Sample No (Cuttings)	*Depth (m)*	*Formation*	*Mean Max Reflectance (Rv Max %)*	*Range*	*Counts*	*STD Deviation*	*Ro % Equivalent*
G1	759.9	Eumeralla	**0.37**	0.33-0.41	27	0.0245	0.35
G2	960.1	Eumeralla	**0.37**	0.33-0.40	30	0.0192	0.35
G3	1048.5	Geltwood Beach	**0.38**	0.33-0.42	30	0.0257	0.36
G4	1133.9	Geltwood Beach	**0.41**	0.34-0.57	16	0.0645	0.38
G5	1200.9	Geltwood Beach	**0.39**	0.36-0.42	20	0.0196	0.37
G6	1405.1	Pretty Hill	**0.40**	0.37-0.42	11	0.0138	0.38
G7	1475.2	Pretty Hill	**0.46**	0.42-0.54	30	0.0333	0.43

Liptinite is not as common in this well as in Ross Creek-1 and Purrumbete-1 but moderate amounts of Cutinite and lesser amounts of Sporinite and Liptodetrinite occur.

Durite is a common microlithype with Fusinite and Cutinite the major constituents. Clarododurite is also present. Ankerite is abundant in many of the samples.

PART 3

THERMAL MODELLING

3.1 Introduction and Method

Kinetic modelling of VR data allows the determination of palaeothermal gradients and the amount of succession uplifted and eroded. Fission Track data can be used to determine the timing of cooling events, but in the absence of AFTA™ data for these wells, palynology and reflection seismic data has been utilised.

Current geothermal gradients for wells in the Port Campbell Embayment-Colac Trough area range between 23 and 33°C/km. Palaeothermal gradients for the three wells in this study have been determined using the kinetic EASYRo% method (Burnham & Sweeney 1989) which is used in the BasinMod™ programme (referred to as the LLNL method).

BasinMod™ has been used to model the depositional and uplift history of each well using the measured reflectance data and calculated palaeothermal gradient. R_V Max% has been converted to random reflectance (Ro%) using the relationship stated in Ting (1978). BasinMod™ utilises the thermal properties of rocks, palaeothermal gradients and depositional and uplift history to kinetically calculate the maturity (Ro%) of a well. Depositional and thermal history can then be manipulated so that the calculated maturity coincides with measured maturity.

3.2 Thermal history

3.2.1 Ross Creek-1

Ross Creek-1 was drilled on a small anticlinal feature above a series of north-dipping extensional faults (Fig. 3.1). The well intersects Santonian-Coniacian Sherbrook Group rocks and TD's in Lower Cretaceous Pretty Hill Sst. The well contains a complete section of Eumeralla Fm (*P. pannosus* to *P. notensis*) suggesting no significant uplift prior to Sherbrook deposition. Likewise seismic data (Fig. 3.1) shows a near conformable relationship between the Eumeralla Fm and Sherbrook Group. A minor unconformity at the base Wangerrip Group (~65 Ma) can be seen in figure 3.1.

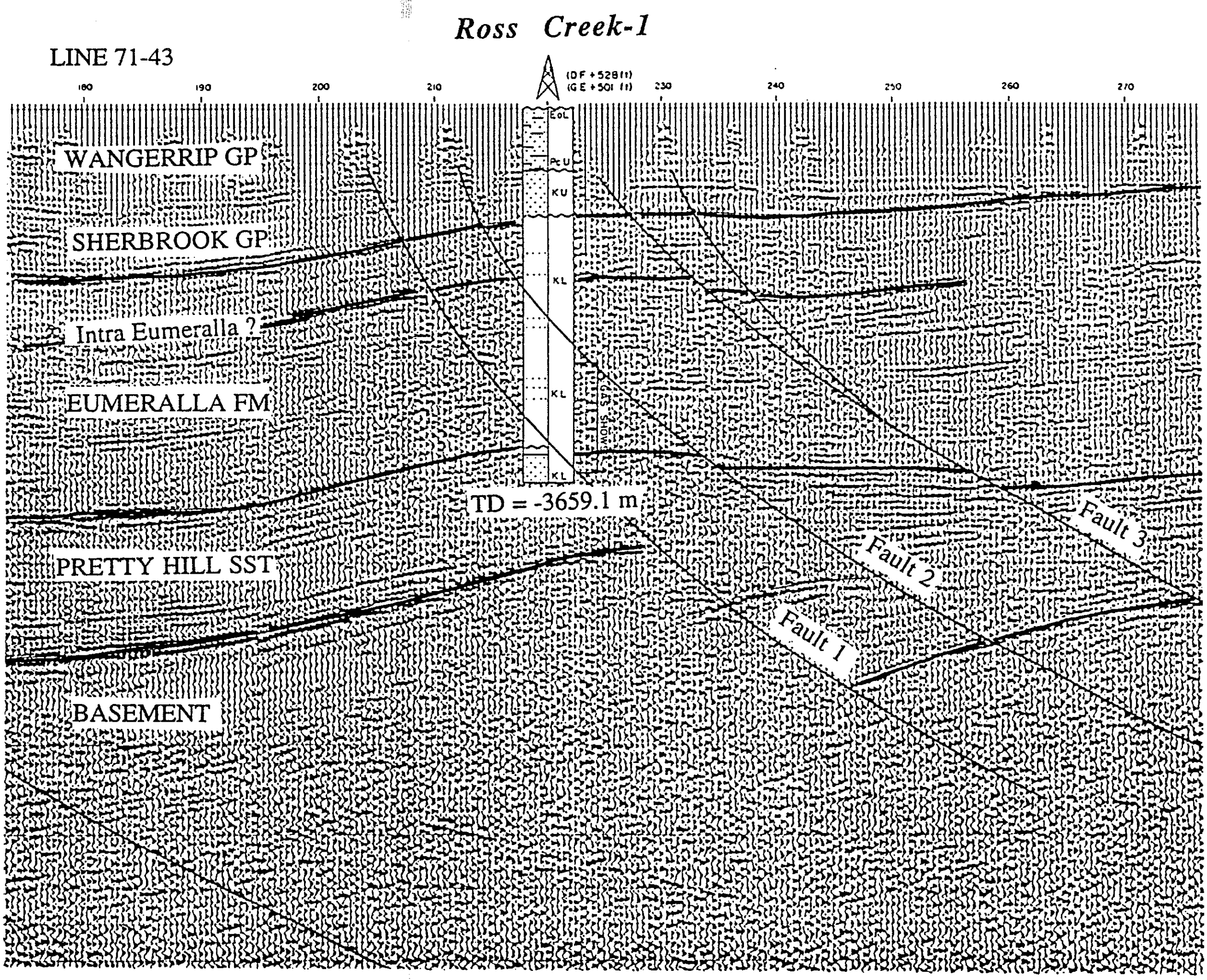

Fig. 3.1 Seismic line 71-43 showing the location of Ross Creek-1. Faults 1 and 2 cut the well but only Fault 1 is detected in the drill log at ~3100 m. Interpretation of Fault 3 is not well constrained and this fault may cut the well near the top of the Eumeralla Fm. Note the near conformable relationship between the Eumeralla Fm and the Sherbrook Group. Seismic line from well completion report.

The Early Cretaceous geothermal gradient has been calculated as ~52°C/km. The well has been modelled without any uplift events (Fig. 3.2) to produce a good fit for the observed maturity (Fig. 3.3). Ross Creek-1 enters the oil generation window in the Eumeralla Fm at 2100 m and departs the oil generation window in the Pretty Hill Sst at 3150 m.

Closer inspection of figure 3.3 shows that the maturity profile can be divided into 3 segments each of which show some minor deviation from the calculated profile. This is probably due to faulting. Figure 3.1 shows two extensional faults cutting the well. Fault 1 is documented in the well completion report at ~3100 m depth. This fault can be seen to displace VR samples RC7, RC8, RC9? and RC10 by ~200 m. Samples RC11 and RC12 are in the footwall block.

Addition of 200 m to the base Eumeralla Formation using Delta Thickness in BasinMod™ can counter the effect of Fault 1 (Fig. 3.4). This results in a decrease in geothermal gradient to ~50°C/km. Figure 3.4 also shows the possible positions of two other faults in the section, although their presence is difficult to justify on seismic data.

Samples RC2, RC3 and RC4 are significantly lower than the calculated maturity and may be suppressed due to late stage marine incursion (cf. Port Campbell-4 in Ellacott *et al.* 1994). However it is more likely that these samples are effected by normal faulting. This would suggest that movement on faults 1, 2 and 3 occurred after maturation was complete and when the geothermal gradient had significantly decreased.

All three wells in this study have been modelled with a dramatic relaxation of the geothermal gradient in the Late Cretaceous (to present day conditions). This decrease in geothermal gradient coincides with the onset of thermal sag after continental breakup in the Cenomanian. This event has been documented from AFTA™ data in Eumeralla Fm sandstone from the Otway Ranges where a dominant cooling/uplift event occurred at ~90 Ma (Cooper *et al.* 1993; Hill K.C. *et al.* 1994a; Hill K.C. *et al.* 1994b).

3.2.2 Purrumbete-1

Purrumbete-1 was drilled on a basement high and intersects Wangerrip Group and TD's in Pretty Hill Sandstone at 1803.3 m (Fig. 3.5). The Eumeralla Fm comprises zones *C. paradoxa* to *P. notensis* suggesting possible uplift and erosion prior to deposition of the overlying Wangerrip Group. Seismic line 181 (Fig. 3.5) shows that although Sherbrook Group does not occur in the well, further south the Sherbrook Group can be seen to unconformbaly overlie the Eumeralla Fm.

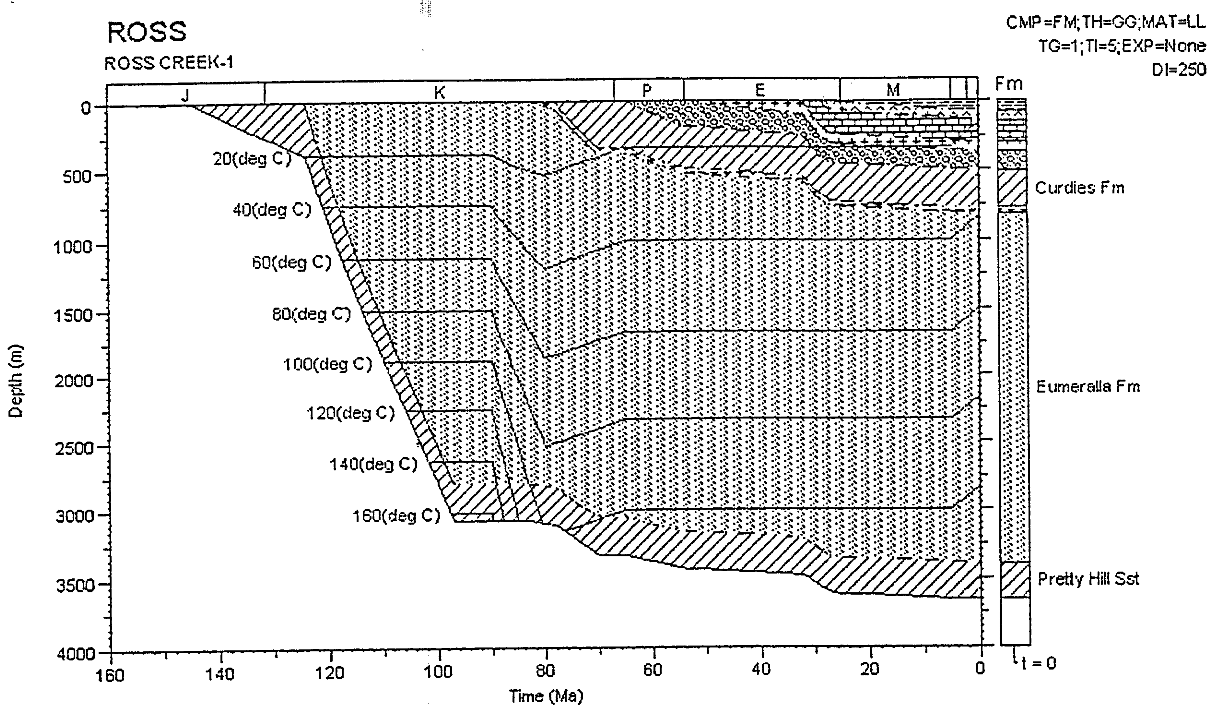

Fig. 3.2 Burial history for Ross Creek-1. No uplift events have been inferred.

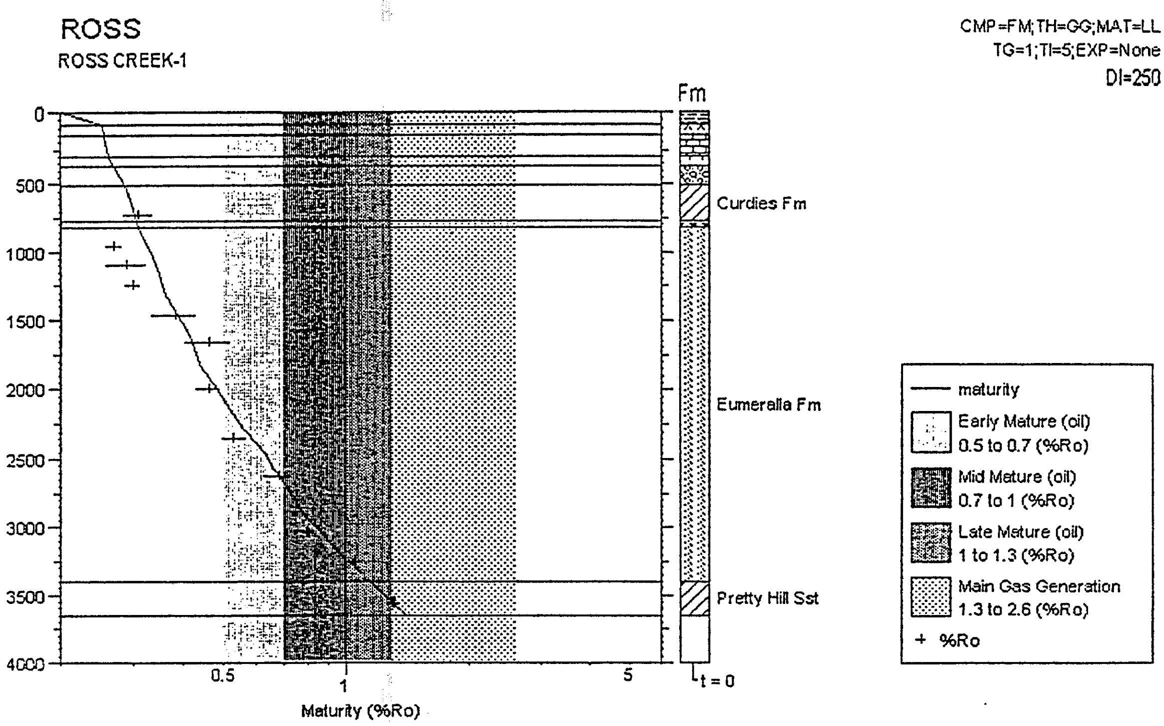

Fig. 3.3 Maturity plot for Ross Creek-1 using an Early Cretaceous geothermal gradient of 52°C/km. Note minor offset of samples RC7-RC10 at base due to Fault 1 (see Fig 3.2). Samples RC2-RC4 may also be offset due to faulting. Samples RC11 and RC12 are in the footwall of Fault 1.

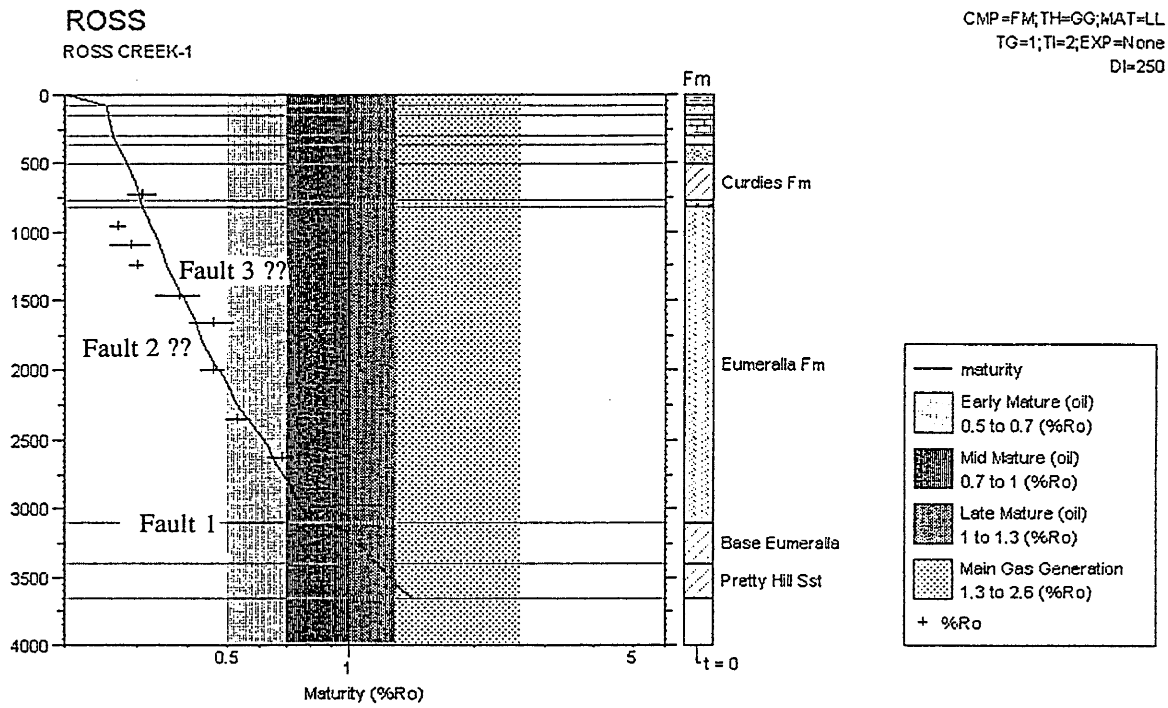

Fig. 3.4 Maturity plot for Ross Creek-1 using an Early Cretaceous geothermal gradient of 50°C/km and a 200 m correction for downthrown movement on Fault 1. Possible positions of two other faults are also indicated.

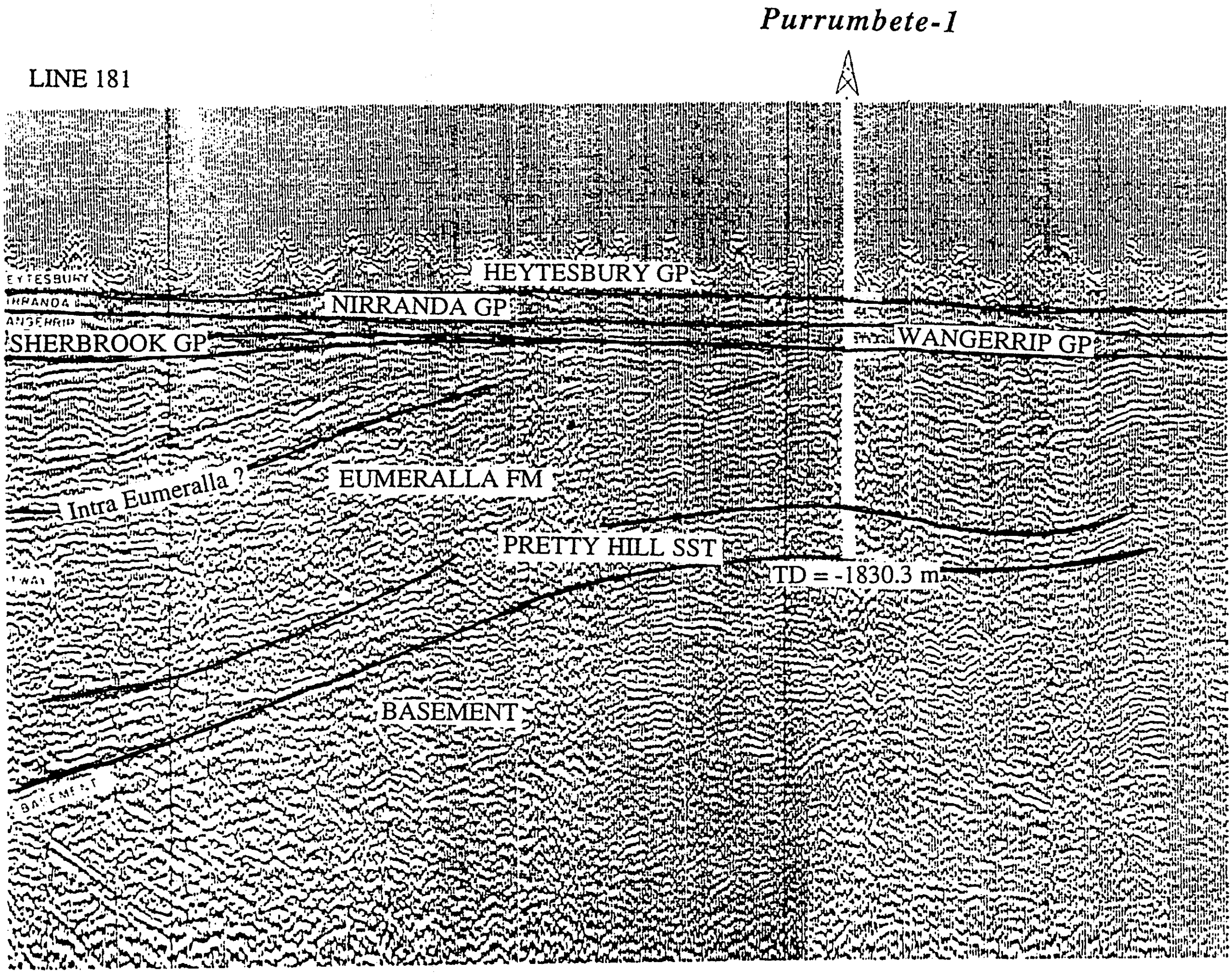

Fig. 3.5 Seismic line 181 showing the location of Purrumbete-1. Note major angular unconformity at the base Sherbrook Group and the base Wangerrip Group. Seismic line from well completion report.

Purrumbete-1 was therefore exposed to uplift prior to Sherbrook Group deposition and prior to the deposition of the Wangerrip Group. The well has been modelled with a major uplift in Cenomanian (coinciding with uplift and thermal relaxation in the Otway Ranges at ~90 Ma) and a smaller event at 70 Ma (Fig. 3.6).

The Early Cretaceous geothermal gradient for Purrumbete-1 has been calculated as ~42°C/km. A total of ~1100 m of uplift is required to achieve a fit with the measured maturity (Fig. 3.7). This has been modelled at 90 Ma and second event (~500 m uplift) has been modelled at 70 Ma. Purrumbete-1 enters the oil generation window in the Eumeralla Fm at 1550 m.

3.2.3 Garvoc-1

Garvoc-1 was drilled on a basement high and TD's in basement at 1514.9 m. The well intersects Nirranda Group which unconformably overlies Eumeralla Fm consisting of zones *C. paradoxa* to *P. notensis*. The absence of the *P. pannosus* zone, Sherbrook Group and Wangerrip Group suggests uplift prior to Eocene deposition of the Nirranda Group.

The Early Cretaceous geothermal gradient for Garvoc-1 has been calculated at 31°C/km which is much the same as average present day geothermal gradients for the region. Although it is feasible that uplift may have occurred earlier, Garvoc-1 has been modelled with uplift at 70 Ma coinciding with the regional Late Cretaceous-Early Tertiary event (Fig. 3.8).

Garvoc-1 requires ~1300 m of uplift to achieve a good fit with the measured maturity (Fig. 3.9). The well failed to intersect the oil generation window.

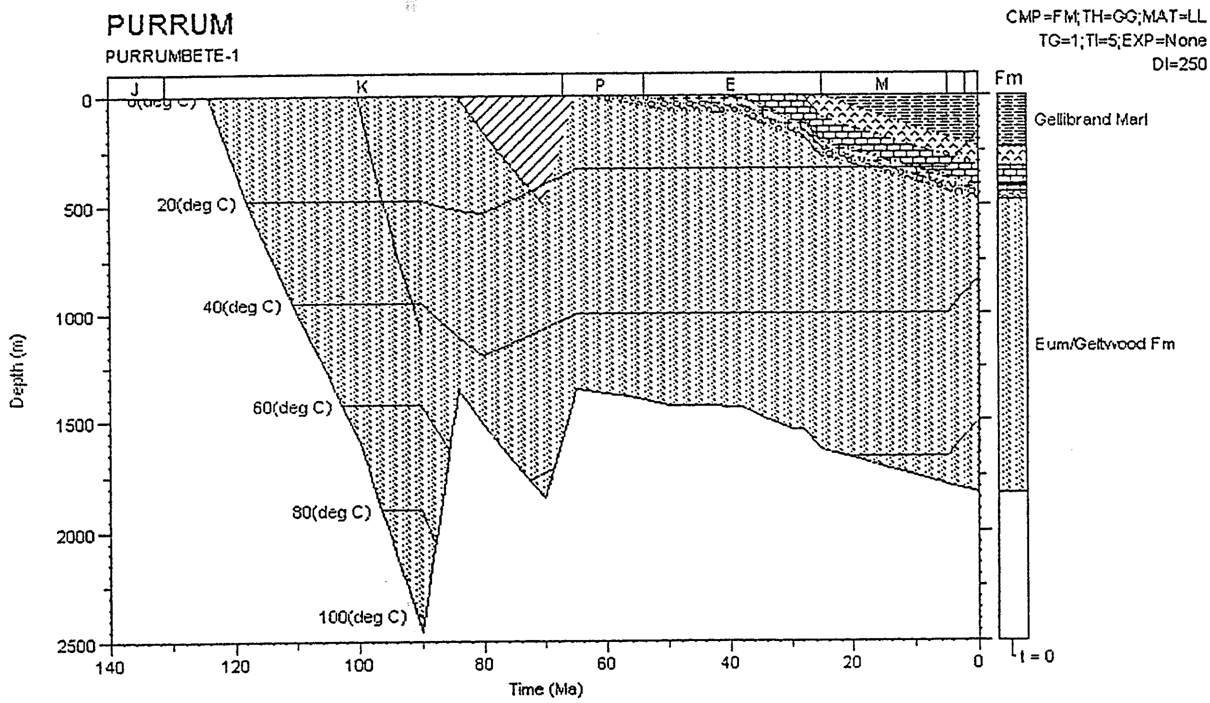

Fig. 3.6 Burial history for Purrumbete-1 with 1100 m of uplift at 90 Ma and 500 m of uplift at 70 Ma. The amount of uplift at 70 Ma is not well constrained.

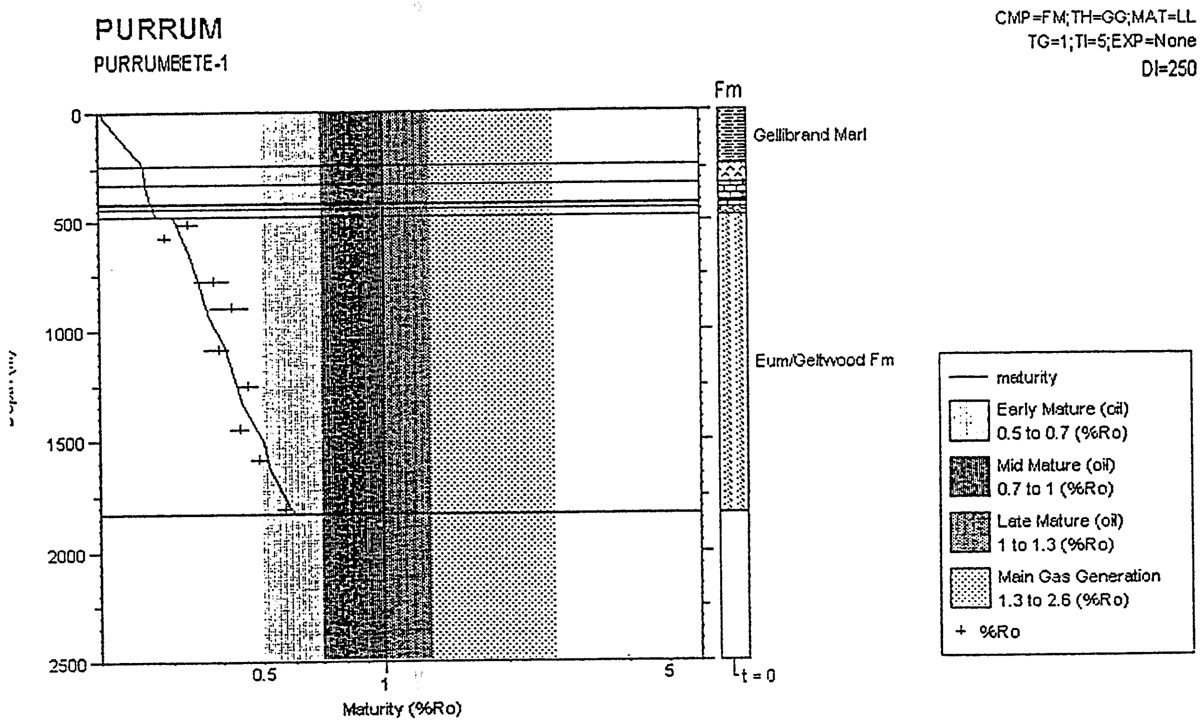

Fig. 3.7 Maturity plot for Purrumbete-1 using an Early Cretaceous geothermal gradient of 42°C/km and the burial history described in Fig. 3.6.

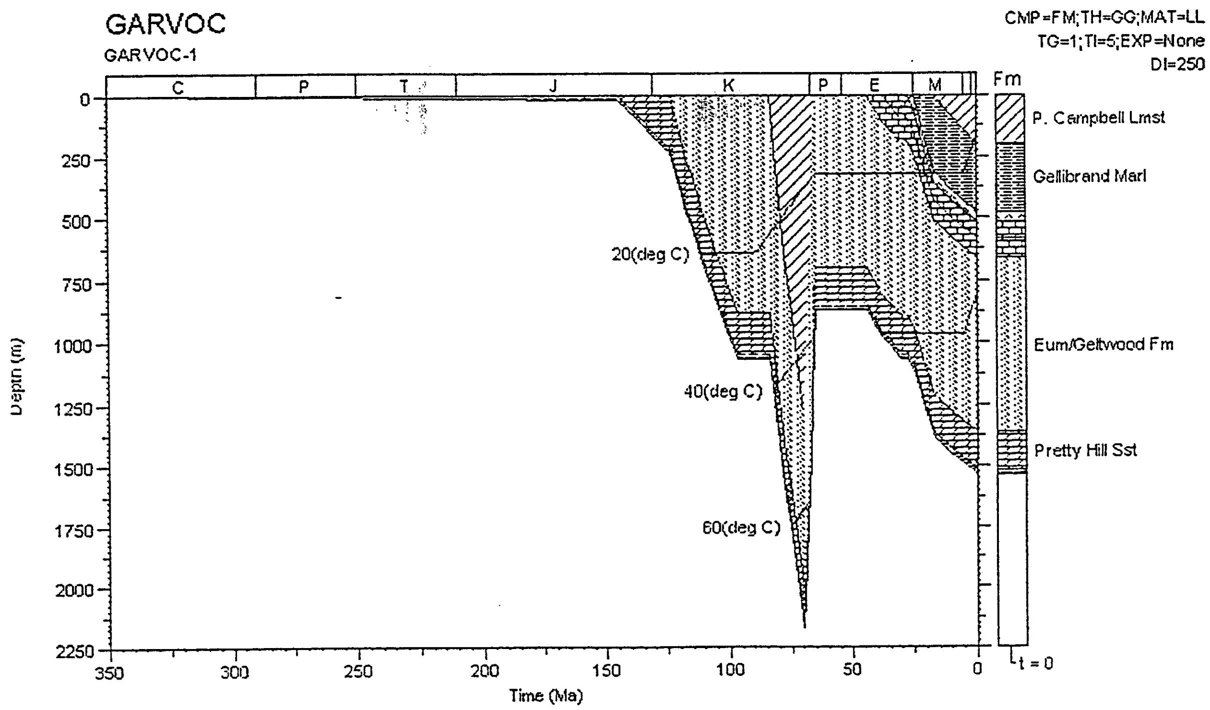

Fig. 3.8 Burial history for Garvoc-1 with 1300 m of uplift at 70 Ma.

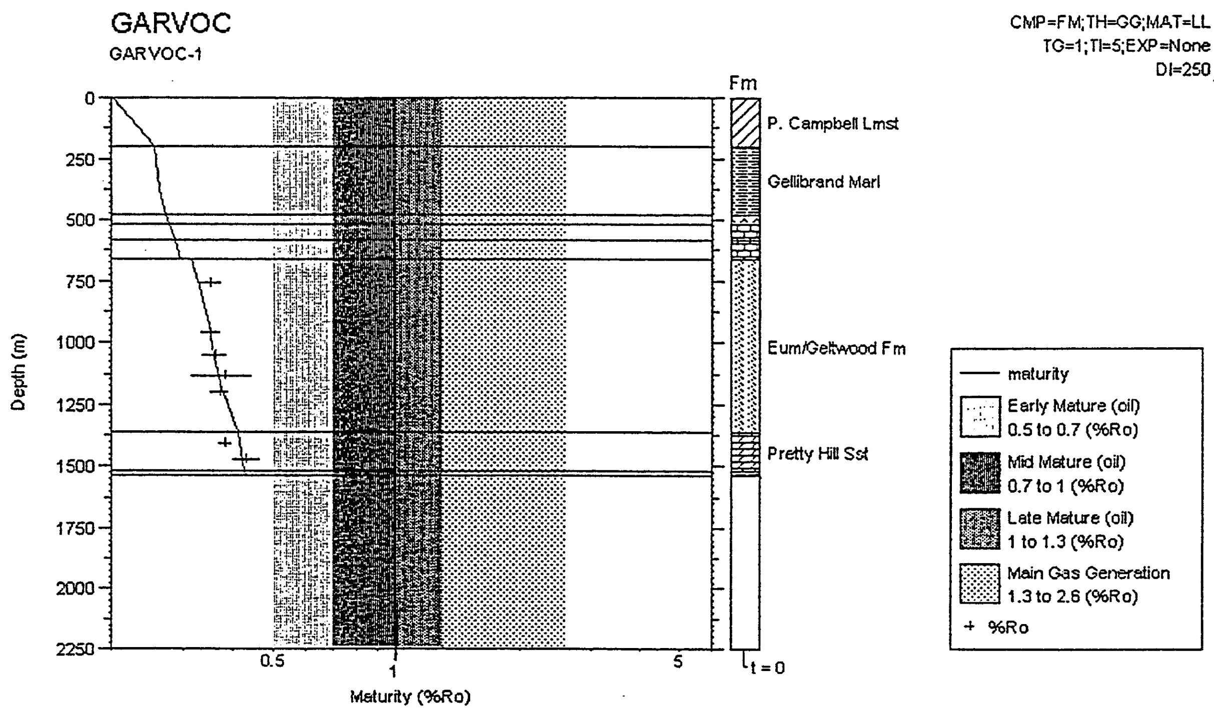

Fig. 3.9 Maturity plot for Garvoc-1 using an Early Cretaceous geothermal gradient of 31°C/km and the burial history described in Fig. 3.8.

PART 4

CONCLUSIONS

4.1 Maturity and organic matter

All three wells contained abundant to poor amounts of Liptinite and Vitrinite (Types I to III Kerogen). Ross Creek-1 contains the greatest amount of Liptinite within the oil generation window but lacks a suitable trap. Purrumbete-1 contains a good quantity of Liptinite but the well is terminated fairly early within the oil gerneration window and a siutable reservoir above the Eumeralla Fm is not present. Garvoc-1 has moderate amounts of Liptinite but is dominated by Inertinite and more importantly the well fails to reach the oil generation window (Table 4.1).

It can be seen from table 4.1 that in most cases the Pretty Hill Sandstone and base Eumeralla Formation were capable of early oil generation prior to uplift in the Cenomanian and prior to the deposition of a suitable reservoir and seal.

TABLE 4.1

TIME TO EARLY OIL MATURITY WINDOW Ro% = 0.50

BASINMOD™

Well	*Time at which oil window reached (Ma)*		
	Base P. Hill	*Top P. Hill & Base Eumeralla*	*TopEumeralla*
Ross Ck-1	108 Ma	99 Ma	Not reached
Purrumbete-1	N/A	98 Ma	Not reached
Garvoc-1	Not reached	Not reached	Not reached

4.2 Uplift determination

The thermal history and proposed uplift events of each well are described in Table 4.2. Whilst VR can be used to calculate palaeothermal gradients and the amount of succession uplifted and eroded, the timing of these events requires further constraint. Fission Track studies on these wells, especially Garvoc-1, will help constrain cooling events and the timing of trap formation.

TABLE 4.2

THERMAL AND UPLIFT HISTORIES

Well	*Palaeothermal*	*Cretaceous*		*Tertiary*	
	Gradient (E. Cret)	*Uplift time*	*Erosion*	*Uplift time*	*Erosion*
Ross Ck.-1	~50°C/km	N/A	Nil	N/A	Nil
Purrumbete-1	~42°C/km	90 Ma	~1100 m	70 Ma	~500 m
Garvoc-1	~31°C/km	N/A	Nil	?70 Ma	~1300 m

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APPENDIX 1

Individual Vitrinite Counts

Ross Creek-1

MEAN MAXIMUM REFLECTANCE (R_V Max)

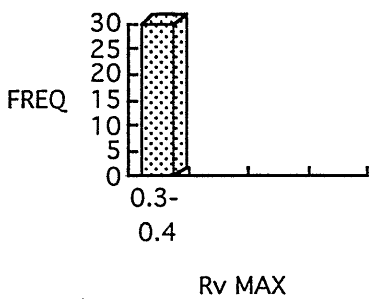
Sample No: RC1
Age: L. Cret.
Depth: 722.4 m
Operator: G.T. Cooper

Type: Cuttings
Well: Ross Creek-1
Date: 18 JUL 94

VITRINITE		VITRINITE		INERTINITE		LIPTINITE	
0.31	Telo						
0.32	"						
0.30							
0.32							
0.32							
0.34							
0.30							
0.34							
0.33							
0.37							
0.35							
0.33							
0.31							
0.34							
0.32							
0.31							
0.33							
0.35							
0.38							
0.38							

REFLECTANCE SUMMARY

	Mean Max %	Range %	Counts (n)	STD. DEV.
Vitrinite	0.33	0.30-0.38	20	0.0240
Inertinite				
Liptinite				



Notes: Humotelinite, Fusinite & Semifusinite.

MEAN MAXIMUM REFLECTANCE (R_V Max)

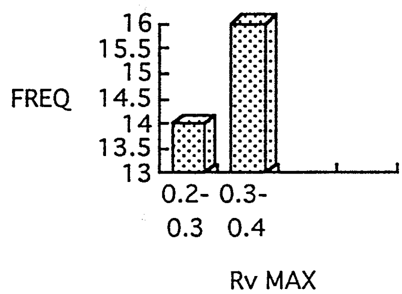
Sample No: RC2
Age: E. Cret.
Depth: 954.0 m
Operator: G.T. Cooper

Type: Cuttings
Well: Ross Creek-1
Date: 18 JUL 94

VITRINITE		VITRINITE		INERTINITE		LIPTINITE	
0.30	Telo	0.28	Telo				
0.31	"	0.28	"				
0.29		0.30					
0.30		0.28					
0.30		0.28					
0.31		0.29					
0.31		0.28					
0.29		0.28					
0.30		0.27					
0.31		0.28					
0.31							
0.28							
0.30							
0.30							
0.30							
0.30							
0.30							
0.29							
0.29							
0.32							

REFLECTANCE SUMMARY

	Mean Max %	Range %	Counts (n)	STD. DEV.
Vitrinite	0.29	0.27-0.31	30	0.0125
Inertinite				
Liptinite				



Notes: Humotelinite.

MEAN MAXIMUM REFLECTANCE (R_V Max)

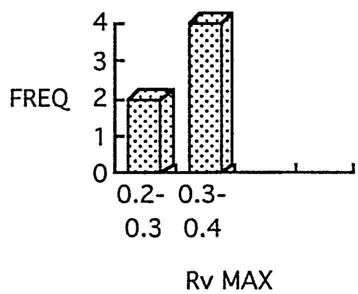
Sample No: RC3
Age: E. Cret.
Depth: 1094.2 m
Operator: G.T. Cooper

Type: Cuttings
Well: Ross Creek-1
Date: 18 JUL 94

VITRINITE		VITRINITE		INERTINITE		LIPTINITE	
0.32	Telo						
0.35	"						
0.30							
0.33							
0.26							
0.28							

REFLECTANCE SUMMARY

	Mean Max %	Range %	Counts (n)	STD. DEV.
Vitrinite	0.31	0.26-0.35	6	0.0333
Inertinite				
Liptinite				



Notes: Mainly Fusinite. Minor Humotelinite.

MEAN MAXIMUM REFLECTANCE (R_V Max)

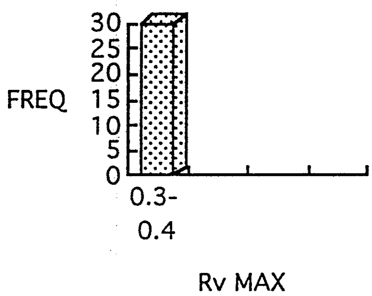
Sample No: RC4
Age: E. Cret.
Depth: 1240.5 m
Operator: G.T. Cooper

Type: Cuttings
Well: Ross Creek-1
Date: 18 JUL 94

VITRINITE		VITRINITE		INERTINITE		LIPTINITE	
0.33	Telo	0.31	Telo				
0.34	"	0.30	"				
0.33		0.33					
0.32		0.31					
0.33		0.31					
0.32		0.33					
0.36		0.33					
0.33		0.31					
0.34		0.32					
0.33		0.32					
0.33							
0.33							
0.33							
0.32							
0.31							
0.32							
0.32							
0.31							
0.34							
0.30							

REFLECTANCE SUMMARY

	Mean Max %	Range %	Counts (n)	STD. DEV.
Vitrinite	0.32	0.30-0.36	30	0.0129
Inertinite				
Liptinite				



Notes: Mainly Fusinite. Common Ankerite/Calcite.

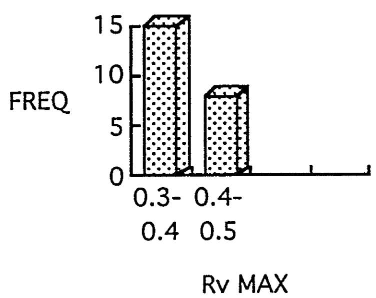
MEAN MAXIMUM REFLECTANCE (R_V Max)

Sample No:	RC5	Type:	Cuttings
Age:	E. Cret.	Well:	Ross Creek-1
Depth:	1463.0 m	Date:	18 JUL 94
Operator:	G.T. Cooper		

VITRINITE		VITRINITE		INERTINITE		LIPTINITE	
0.32	Desmo	0.47	Desmo				
0.34	"	0.40	"				
0.36		0.47					
0.35							
0.40							
0.37							
0.33							
0.35							
0.36							
0.34							
0.43							
0.37							
0.47							
0.44							
0.41							
0.36							
0.35							
0.37							
0.33							
0.33							

REFLECTANCE SUMMARY

	Mean Max %	Range %	Counts (n)	STD. DEV.
Vitrinite	0.38	0.32-0.47	23	0.0479
Inertinite				
Liptinite				



Notes: Fusinite (bogan). Abundant Cutinite, Sporinite and rare Bituminite.

MEAN MAXIMUM REFLECTANCE (R_V Max)

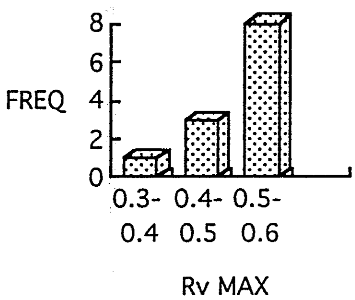
Sample No: RC6
Age: E. Cret.
Depth: 1655.1 m
Operator: G.T. Cooper

Type: Cuttings
Well: Ross Creek-1
Date: 18 JUL 94

VITRINITE		VITRINITE		INERTINITE		LIPTINITE	
0.52	Desmo						
0.51	"						
0.44							
0.41							
0.40							
0.53							
0.55							
0.54							
0.54							
0.50							
0.51							
0.39							

REFLECTANCE SUMMARY

	Mean Max %	Range %	Counts (n)	STD. DEV.
Vitrinite	0.49	0.39-0.55	12	0.0594
Inertinite				
Liptinite				



Notes: Fusinite. Common Cutinite & minor Sporinite. Calcite present.

MEAN MAXIMUM REFLECTANCE (R_V Max)

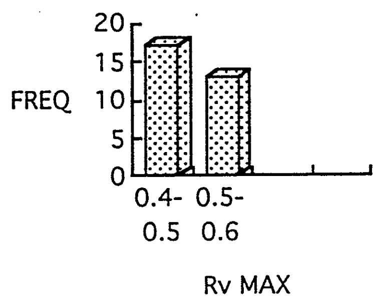
Sample No: RC7
Age: E. Cret.
Depth: 1996.4 m
Operator: G.T. Cooper

Type: Cuttings
Well: Ross Creek-1
Date: 18 JUL 94

VITRINITE		VITRINITE		INERTINITE		LIPTINITE	
0.46	Telo	0.51	Telo				
0.51	"	0.47	"				
0.46		0.50					
0.48		0.49					
0.49		0.48					
0.43		0.51					
0.50		0.51					
0.44		0.49					
0.43		0.45					
0.46		0.55					
0.46							
0.51							
0.50							
0.54							
0.50							
0.55							
0.49							
0.51							
0.48							
0.45							

REFLECTANCE SUMMARY

	Mean Max %	Range %	Counts (n)	STD. DEV.
Vitrinite	0.49	0.43-0.55	30	0.0319
Inertinite				
Liptinite				



Notes:

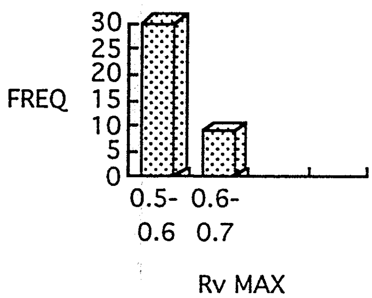
MEAN MAXIMUM REFLECTANCE (R_V Max)

Sample No:	RC8	Type:	Cuttings
Age:	E. Cret.	Well:	Ross Creek-1
Depth:	2350 m	Date:	18 JUL 94
Operator:	G.T. Cooper		

VITRINITE		VITRINITE		INERTINITE		LIPTINITE	
0.61	Desmo	0.55	Desmo				
0.50	"	0.60	"				
0.53		0.52					
0.54		0.53					
0.61		0.52					
0.55		0.58					
0.64		0.53					
0.60		0.56					
0.51		0.54					
0.54		0.57					
0.57		0.54					
0.54		0.55					
0.59		0.57					
0.58		0.58					
0.60		0.57					
0.56		0.61					
0.56		0.64					
0.57		0.64					
0.55		0.58					
0.55							

REFLECTANCE SUMMARY

	Mean Max %	Range %	Counts (n)	STD. DEV.
Vitrinite	0.57	0.50-0.64	39	0.0354
Inertinite				
Liptinite				



Notes: Abundant Sporinite. Minor Cutinite & Liptodetrinite. Common Fusinite.

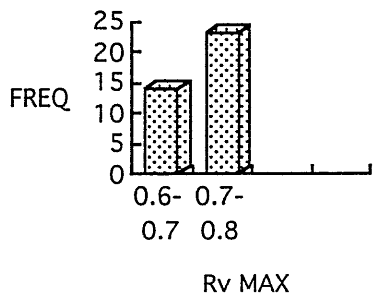
MEAN MAXIMUM REFLECTANCE (R_V Max)

Sample No:	RC9	Type:	Cuttings
Age:	E. Cret.	Well:	Ross Creek-1
Depth:	2633.5 m	Date:	18 JUL 94
Operator:	G.T. Cooper		

VITRINITE		VITRINITE		INERTINITE		LIPTINITE	
0.79	Telo	0.74	Telo				
0.74	"	0.72	"				
0.79		0.71					
0.79		0.72					
0.62		0.72					
0.73		0.70					
0.69		0.69					
0.79		0.63					
0.65		0.67					
0.63		0.74					
0.63		0.75					
0.73		0.74					
0.65		0.77					
0.69		0.79					
0.77		0.75					
0.69		0.69					
0.68		0.69					
0.70							
0.73							
0.79							

REFLECTANCE SUMMARY

	Mean Max %	Range %	Counts (n)	STD. DEV.
Vitrinite	0.72	0.63-0.79	37	0.0506
Inertinite				
Liptinite				



Notes: Cutinite, Liptodetrinite & Sporinite. Abundant Fusinite, Inertodetrinite and minor Sclerotinite.

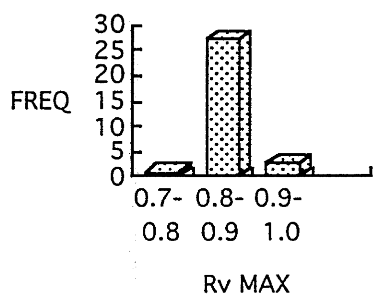
MEAN MAXIMUM REFLECTANCE (R_V Max)

Sample No:	RC10	Type:	Cuttings
Age:	E. Cret.	Well:	Ross Creek-1
Depth:	3029.7 m	Date:	18 JUL 94
Operator:	G.T. Cooper		

VITRINITE		VITRINITE		INERTINITE		LIPTINITE	
0.87	Desmo	0.89	Desmo				
0.87	"	0.81	"				
0.83		0.83					
0.83		0.81					
0.84		0.90					
0.84		0.87					
0.82		0.88					
0.85		0.91					
0.82		0.83					
0.79		0.84					
0.83							
0.86							
0.84							
0.84							
0.85							
0.84							
0.86							
0.84							
0.87							
0.88							

REFLECTANCE SUMMARY

	Mean Max %	Range %	Counts (n)	STD. DEV.
Vitrinite	0.85	0.79-0.91	30	0.0278
Inertinite				
Liptinite				



Notes: Inertodetrinite and minor Liptodetrinite. Common Calcite.

MEAN MAXIMUM REFLECTANCE (R_V Max)

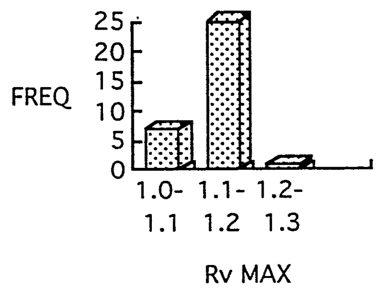
Sample No: RC11
Age: E. Cret.
Depth: 3249.2 m
Operator: G.T. Cooper

Type: Cuttings
Well: Ross Creek-1
Date: 18 JUL 94

VITRINITE		VITRINITE		INERTINITE		LIPTINITE	
1.10	Desmo	1.09	Desmo				
1.12	"	1.13	"				
1.02		1.04					
1.17		1.11					
1.15		1.07					
1.18		1.11					
1.19		1.15					
1.20		1.15					
1.14		1.11					
1.19		1.16					
1.15		1.13					
1.11		1.11					
1.12		1.11					
1.13							
1.14							
1.12							
1.12							
1.08							
1.03							
1.06							

REFLECTANCE SUMMARY

	Mean Max %	Range %	Counts (n)	STD. DEV.
Vitrinite	1.12	1.02-1.20	33	0.0443
Inertinite				
Liptinite				



Notes: Inertodetrinite & Fusinite.

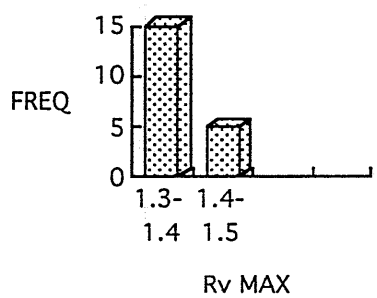
MEAN MAXIMUM REFLECTANCE (R_V Max)

Sample No:	RC12	Type:	Cuttings
Age:	E. Cret.	Well:	Ross Creek-1
Depth:	3557.0 m	Date:	18 JUL 94
Operator:	G.T. Cooper		

VITRINITE		VITRINITE		INERTINITE		LIPTINITE	
1.36	Telo						
1.38	"						
1.38							
1.35							
1.36							
1.37							
1.37							
1.30							
1.40							
1.37							
1.41							
1.42							
1.33							
1.40							
1.36							
1.38							
1.39							
1.35							
1.42							
1.38							

REFLECTANCE SUMMARY

	Mean Max %	Range %	Counts (n)	STD. DEV.
Vitrinite	1.37	1.30-1.42	20	0.0295
Inertinite				
Liptinite				



Notes: Fusinite and common Ankerite.

APPENDIX 2

Individual Vitrinite Counts

Purrumbete-1

MEAN MAXIMUM REFLECTANCE (R_V Max)

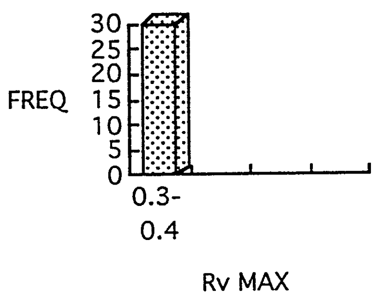
Sample No: P1
Age: E. Cret.
Depth: 515.1 m
Operator: G.T. Cooper

Type: Cuttings
Well: Purrumbete-1
Date: 15 JUL 94

VITRINITE		VITRINITE		INERTINITE		LIPTINITE	
0.37	Telo	0.36	Telo				
0.38	"	0.38	"				
0.37		0.38					
0.35		0.36					
0.34		0.37					
0.33		0.34					
0.35		0.35					
0.31		0.36					
0.32		0.33					
0.36		0.35					
0.35							
0.35							
0.36							
0.35							
0.30							
0.32							
0.35							
0.34							
0.33							
0.34							

REFLECTANCE SUMMARY

	Mean Max %	Range %	Counts (n)	STD. DEV.
Vitrinite	0.35	0.30-0.38	30	0.0202
Inertinite				
Liptinite				



Notes: Sub-bituminous. Humotelinite.

MEAN MAXIMUM REFLECTANCE (R_V Max)

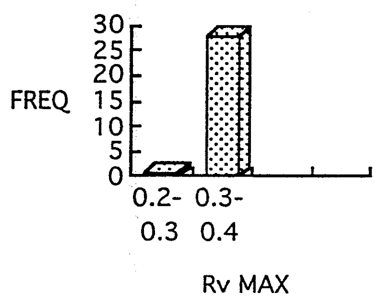
Sample No: P2
Age: E. Cret.
Depth: 576.1 m
Operator: G.T. Cooper

Type: Cuttings
Well: Purrumbete-1
Date: 15 JUL 94

VITRINITE		VITRINITE		INERTINITE		LIPTINITE	
0.31	Telo	0.31	Telo				
0.33	"	0.33	"				
0.29		0.32					
0.31		0.31					
0.31		0.31					
0.33		0.31					
0.31		0.33					
0.32		0.31					
0.34		0.32					
0.32							
0.32							
0.31							
0.30							
0.30							
0.32							
0.31							
0.31							
0.30							
0.30							
0.30							

REFLECTANCE SUMMARY

	Mean Max %	Range %	Counts (n)	STD. DEV.
Vitrinite	0.31	0.29-0.30	29	0.0115
Inertinite				
Liptinite				



Notes: Sub-bituminous. Humotelinite.

MEAN MAXIMUM REFLECTANCE (R_V Max)

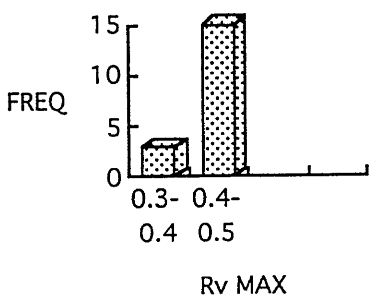
Sample No: P3
Age: E. Cret.
Depth: 780.3 m
Operator: G.T. Cooper

Type: Cuttings
Well: Purrumbete-1
Date: 15 JUL 94

VITRINITE		VITRINITE		INERTINITE		LIPTINITE	
0.40	Telo						
0.40	"						
0.42							
0.42							
0.44							
0.43							
0.44							
0.42							
0.41							
0.42							
0.41							
0.42							
0.43							
0.45							
0.42							
0.31							
0.33							
0.35							

REFLECTANCE SUMMARY

	Mean Max %	Range %	Counts (n)	STD. DEV.
Vitrinite	0.41	0.31-0.45	18	0.0382
Inertinite				
Liptinite				



Notes: Sporinite, Cutinite, Liptodetrinite. Large amounts of Semifusinite and Fusinite.

MEAN MAXIMUM REFLECTANCE (R_V Max)

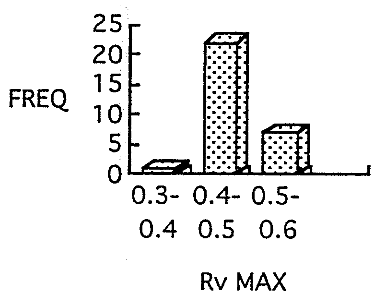
Sample No: P4
Age: E. Cret.
Depth: 899.2 m
Operator: G.T. Cooper

Type: Cuttings
Well: Purrumbete-1
Date: 15 JUL 94

VITRINITE		VITRINITE		INERTINITE		LIPTINITE	
0.42	Telo	0.52	Telo				
0.42	"	0.52	"				
0.45		0.50					
0.38		0.52					
0.46		0.51					
0.46		0.53					
0.45		0.54					
0.44		0.44					
0.41		0.41					
0.42		0.41					
0.44							
0.43							
0.41							
0.41							
0.41							
0.40							
0.41							
0.41							
0.41							
0.44							

REFLECTANCE SUMMARY

	Mean Max %	Range %	Counts (n)	STD. DEV.
Vitrinite	0.45	0.38-0.54	30	0.0456
Inertinite				
Liptinite				



Notes: Large amounts of Cutinite. Minor Resinite and Liptodetrinite. Fusinite (Bogan), Inertodetrinite and Macronite.

MEAN MAXIMUM REFLECTANCE (R_V Max)

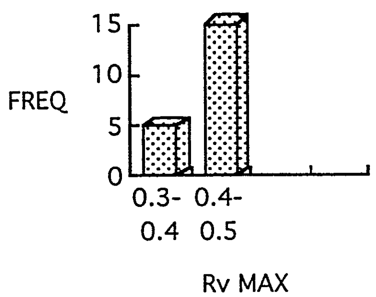
Sample No: P5
Age: E. Cret.
Depth: 1085.1 m
Operator: G.T. Cooper

Type: Cuttings
Well: Purrumbete-1
Date: 15 JUL 94

VITRINITE		VITRINITE		INERTINITE		LIPTINITE	
0.41	Telo						
0.39	"						
0.36							
0.42							
0.42							
0.44							
0.42							
0.42							
0.37							
0.42							
0.43							
0.38							
0.43							
0.42							
0.45							
0.43							
0.39							
0.43							
0.48							
0.40							

REFLECTANCE SUMMARY

	Mean Max %	Range %	Counts (n)	STD. DEV.
Vitrinite	0.42	0.36-0.48	20	0.0279
Inertinite				
Liptinite				



Notes: Large amounts of Cutinite & Sporinite. Fusinite, Inertodetrinite, Liptodetrinite and Calcite present.

MEAN MAXIMUM REFLECTANCE (R_V Max)

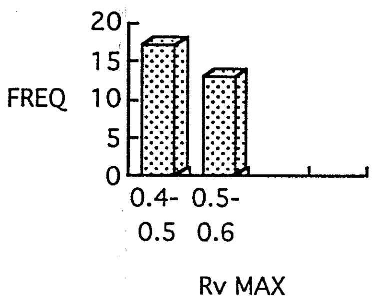
Sample No: P6
Age: E. Cret.
Depth: 1252.7 m
Operator: G.T. Cooper

Type: Cuttings
Well: Purrumbete-1
Date: 15 JUL 94

VITRINITE		VITRINITE		INERTINITE		LIPTINITE	
0.45	Telo	0.55	Telo				
0.49	"	0.54	"				
0.49		0.51					
0.50		0.47	Desmo				
0.50		0.48	"				
0.48		0.49					
0.48		0.47					
0.45		0.54					
0.43		0.50					
0.50		0.47					
0.51							
0.46							
0.45							
0.50							
0.46							
0.50							
0.52							
0.51							
0.48							
0.46							

REFLECTANCE SUMMARY

	Mean Max %	Range %	Counts (n)	STD. DEV.
Vitrinite	0.49	0.43-0.55	30	0.0286
Inertinite				
Liptinite				



Notes: Cutinite, Sporinite, Liptodetrinite & Resinite. Large amounts of Inertodetrinite, Fusinite and Macronite.

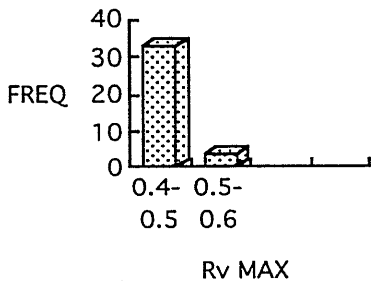
MEAN MAXIMUM REFLECTANCE (R_V Max)

Sample No:	P7	Type:	Cuttings
Age:	E. Cret.	Well:	Purrumbete-1
Depth:	1450.8 m	Date:	15 JUL 94
Operator:	G.T. Cooper		

VITRINITE		VITRINITE		INERTINITE		LIPTINITE	
0.44	Desmo	0.45	Telo				
0.44	"	0.45	"				
0.43		0.45					
0.48		0.48					
0.45		0.46					
0.47		0.45					
0.47		0.50					
0.49		0.46					
0.44		0.46					
0.53	Telo	0.49					
0.48	"	0.47					
0.49		0.46					
0.53		0.48					
0.45		0.49					
0.48		0.51					
0.49		0.47					
0.47		0.49					
0.45							
0.46							
0.44							

REFLECTANCE SUMMARY

	Mean Max %	Range %	Counts (n)	STD. DEV.
Vitrinite	0.47	0.43-0.53	37	0.0242
Inertinite				
Liptinite				



Notes: Large amounts of Sporinite. Cutinite & Liptodetrinite also present. Semifusinite and Inertodetrinite.

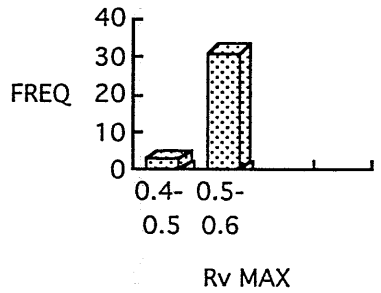
MEAN MAXIMUM REFLECTANCE (R_V Max)

Sample No: P8 | Type: Cuttings
Age: E. Cret. | Well: Purrumbete-1
Depth: 1588.0 m | Date: 15 JUL 94
Operator: G.T. Cooper

VITRINITE		VITRINITE		INERTINITE		LIPTINITE	
0.51	Desmo	0.54	Telo				
0.55	"	0.52	"				
0.54	Telo	0.54					
0.52	"	0.54					
0.52		0.56					
0.49		0.54					
0.46	Desmo	0.54					
0.49	Telo	0.56					
0.52	"	0.53					
0.50		0.54					
0.51		0.56					
0.50		0.52					
0.51		0.53					
0.53		0.55					
0.50							
0.52							
0.53							
0.52							
0.51							
0.53							

REFLECTANCE SUMMARY

	Mean Max %	Range %	Counts (n)	STD. DEV.
Vitrinite	0.52	0.46-0.56	34	0.0221
Inertinite				
Liptinite				



Notes: Sporinite, major Cutinite & minor Resinite. Inertodetrinite, Fusinite and minor Corpogelinite

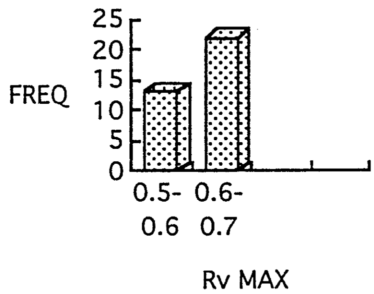
MEAN MAXIMUM REFLECTANCE (R_V Max)

Sample No: P9
Age: E. Cret.
Depth: 1810.5 m
Operator: G.T. Cooper
Type: Cuttings
Well: Purrumbete-1
Date: 15 JUL 94

VITRINITE		VITRINITE		INERTINITE		LIPTINITE	
0.57	Telo	0.59	Telo				
0.58	"	0.62	"				
0.58	Desmo	0.63					
0.59	"	0.59					
0.60		0.58					
0.59		0.64					
0.62		0.66					
0.58		0.60					
0.62	Telo	0.62					
0.62	"	0.65					
0.60		0.62					
0.59		0.63					
0.59		0.63					
0.59		0.62					
0.63		0.63					
0.64							
0.66							
0.61							
0.67							
0.59							

REFLECTANCE SUMMARY

	Mean Max %	Range %	Counts (n)	STD. DEV.
Vitrinite	0.61	0.57-0.66	35	0.0261
Inertinite				
Liptinite				



Notes: Abundant Cutinite. Semifusinite, Fusinite & Inertodetrinite.

APPENDIX 3

Individual Vitrinite Counts

Garvoc-1

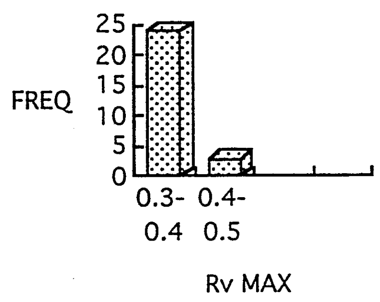
MEAN MAXIMUM REFLECTANCE (R_V Max)

Sample No:	G1	Type:	Cuttings
Age:	E. Cret.	Well:	Garvoc-1
Depth:	759.9 m	Date:	15 JUL 94
Operator:	G.T. Cooper		

VITRINITE		VITRINITE		INERTINITE		LIPTINITE	
0.41	Telo	0.32	Telo				
0.40	"	0.35	"				
0.34		0.34					
0.35		0.36					
0.37		0.36					
0.39		0.40					
0.38		0.38					
0.33							
0.37							
0.38							
0.39							
0.38							
0.38							
0.38							
0.33							
0.33							
0.38							
0.38							
0.37							
0.35							

REFLECTANCE SUMMARY

	Mean Max %	Range %	Counts (n)	STD. DEV.
Vitrinite	0.37	0.33-0.41	27	0.0245
Inertinite				
Liptinite				



Notes: Mainly Fusinite & Semifusinite.

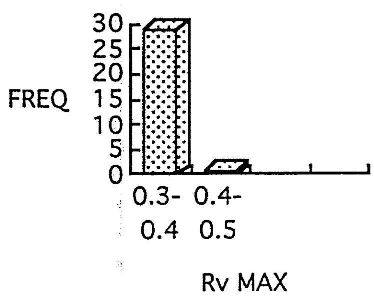
MEAN MAXIMUM REFLECTANCE (R_V Max)

Sample No:	G2	Type:	Cuttings
Age:	E. Cret.	Well:	Garvoc-1
Depth:	960.1 m	Date:	15 JUL 94
Operator:	G.T. Cooper		

VITRINITE		VITRINITE		INERTINITE		LIPTINITE	
0.39	Telo	0.37	Telo				
0.40	"	0.38	"				
0.37		0.36					
0.37		0.34					
0.36		0.35					
0.33		0.37					
0.35		0.33					
0.36		0.37					
0.38		0.38					
0.40		0.38					
0.39							
0.36							
0.36							
0.34							
0.35							
0.37							
0.37							
0.34							
0.38							
0.39							

REFLECTANCE SUMMARY

	Mean Max %	Range %	Counts (n)	STD. DEV.
Vitrinite	0.37	0.33-0.40	30	0.0192
Inertinite				
Liptinite				



Notes:

MEAN MAXIMUM REFLECTANCE (R_V Max)

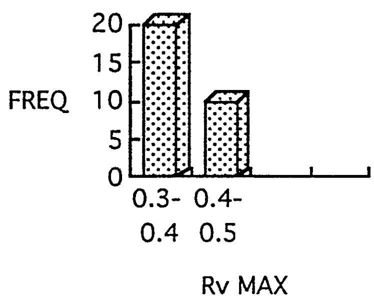
Sample No: G3
Age: E. Cret.
Depth: 1048.5 m
Operator: G.T. Cooper

Type: Cuttings
Well: Garvoc-1
Date: 15 JUL 94

VITRINITE		VITRINITE		INERTINITE		LIPTINITE	
0.38	Desmo	0.38	Desmo				
0.39	"	0.39	"				
0.33		0.41					
0.35		0.41					
0.43	Telo	0.41					
0.38	"	0.41					
0.35	Desmo	0.36					
0.35	"	0.37					
0.41		0.37					
0.41		0.42					
0.35							
0.39							
0.40							
0.39							
0.36							
0.35							
0.37							
0.36							
0.40							
0.37							

REFLECTANCE SUMMARY

	Mean Max %	Range %	Counts (n)	STD. DEV.
Vitrinite	0.38	0.33-0.42	30	0.0257
Inertinite				
Liptinite				



Notes: Predominantly Fusinite interbedded with Cutinite. Minor Sporinite, Semifusinite and Inertodetrinite.

MEAN MAXIMUM REFLECTANCE (R_V Max)

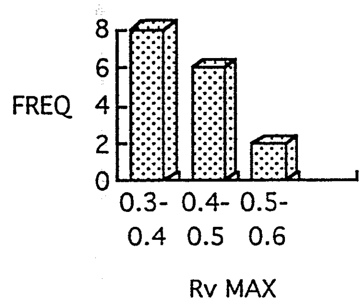
Sample No: G4
Age: E. Cret.
Depth: 1133.9 m
Operator: G.T. Cooper

Type: Cuttings
Well: Garvoc-1
Date: 15 JUL 94

VITRINITE		VITRINITE		INERTINITE		LIPTINITE	
0.44	Desmo						
0.38	"						
0.53	Telo						
0.57	"						
0.36							
0.34							
0.40							
0.38							
0.39							
0.40							
0.46							
0.40							
0.45							
0.39							
0.35							
0.35							

REFLECTANCE SUMMARY

	Mean Max %	Range %	Counts (n)	STD. DEV.
Vitrinite	0.41	0.34-0.57	16	0.0645
Inertinite				
Liptinite				



Notes: Abundant Cutinite. Liptodetrinite and Fusinite.

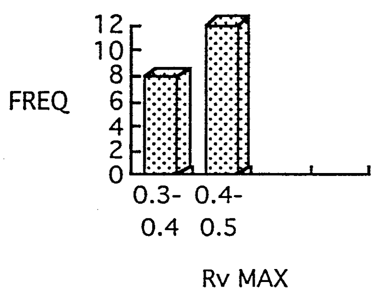
MEAN MAXIMUM REFLECTANCE (R_V Max)

Sample No: G5 | Type: Cuttings
Age: E. Cret. | Well: Garvoc-1
Depth: 1200.9 m | Date: 15 JUL 94
Operator: G.T. Cooper

VITRINITE		VITRINITE		INERTINITE		LIPTINITE	
0.42	Telo						
0.43	"						
0.41							
0.38							
0.36							
0.37							
0.40							
0.41							
0.41							
0.38							
0.38							
0.36							
0.39							
0.40							
0.40							
0.40							
0.40							
0.41							
0.37							
0.40							

REFLECTANCE SUMMARY

	Mean Max %	Range %	Counts (n)	STD. DEV.
Vitrinite	0.39	0.36-0.42	20	0.0196
Inertinite				
Liptinite				



Notes: Cutinite & Inertodetrinite. Abundant Ankerite and microfolds in vitrinite.

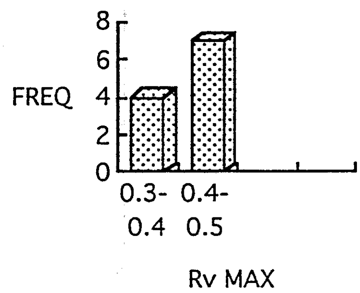
MEAN MAXIMUM REFLECTANCE (R_V Max)

Sample No:	G6	Type:	Cuttings
Age:	E. Cret.	Well:	Garvoc-1
Depth:	1405.1 m	Date:	15 JUL 94
Operator:	G.T. Cooper		

VITRINITE		VITRINITE		INERTINITE		LIPTINITE	
0.42	Telo						
0.39	"						
0.39							
0.37							
0.40							
0.40							
0.39							
0.41							
0.41							
0.40							
0.41							

REFLECTANCE SUMMARY

	Mean Max %	Range %	Counts (n)	STD. DEV.
Vitrinite	0.40	0.37-0.42	11	0.0138
Inertinite				
Liptinite				



Notes: Mainly Fusinite & Inertodetrinite. Minor Sporinite.

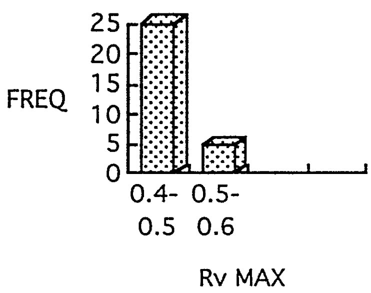
MEAN MAXIMUM REFLECTANCE (R_V Max)

Sample No:	G7	Type:	Cuttings
Age:	E. Cret.	Well:	Garvoc-1
Depth:	1475.2 m	Date:	15 JUL 94
Operator:	G.T. Cooper		

VITRINITE		VITRINITE		INERTINITE		LIPTINITE	
0.45	Telo	0.41	Telo				
0.47	"	0.48	"				
0.48		0.44					
0.46		0.49					
0.49		0.54					
0.42		0.52					
0.43		0.51					
0.42		0.45					
0.46		0.51					
0.43		0.44					
0.48							
0.46							
0.50							
0.43							
0.43							
0.44							
0.47							
0.47							
0.49							
0.43							

REFLECTANCE SUMMARY

	Mean Max %	Range %	Counts (n)	STD. DEV.
Vitrinite	0.46	0.42-0.54	30	0.0333
Inertinite				
Liptinite				



Notes: