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Vitrinite reflectance (Ro) of dispersed organic matter
from
ESSO PAREX *et al* Baccalieu I-78

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2002

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Vitrinite reflectance (Ro) of dispersed organic matter from ESSO PAREX *et al* Baccalieu I-78

G.S.C. Locality No.: D273 Unique Well ID: 300 I78 48000 46000

Location: 47.96167°N, 46.18079°W

R.T. Elevation: 24 m Water Depth: 1092.8 m

Total Depth: 5134.5 m

Sampled Interval: 1600 - 5135 m

Interval Studied: 1845.4-5135 m

Depth Units: Metres referenced to R.T.

Rig Release Date: September 14, 1985

Vitrinite reflectance has been determined on 12 rotary cuttings and 4 conventional core samples from ESSO PAREX *et al* Baccalieu I-78, which was classified as an exploratory well and is located on the Flemish Pass, northern Grand Banks, approximately 490 km east-northeast of St. John's, Newfoundland. Well status is Plugged and Abandoned.

Sample preparation followed the procedures listed in Appendix I. Data acquisition and manipulation was done with a Zeiss Photometer III system with a custom interface to a microcomputer for data storage and statistical summaries.

Analysis of the well reveals thermal maturity intervals given in Table I. Specific maturity levels, as set out in this report, are based on those of Dow (1977) with modified terminology (Appendix II).

Table I
Inferred Hydrocarbon Thermal Maturity Levels*

Depth in metres**	Vitrinite Reflectance** %Ro	Hydrocarbon generation levels*
530 [Sea floor]	(0.24)	immature
1770	0.3	immature
2640	0.4	immature approaching maturity
3320	0.5	marginally mature
3880	0.6	onset of significant oil generation
4760	0.8	peak of oil generation
5134 [T.D.]	(.91)	within oil window
5430	1.00	peak of wet gas generation

* *Actual hydrocarbon products depend on type of organic matter present.*

** ()'s indicate Ro's or depths extrapolated from linear regression (0.143 log Ro/km).

Remarks

Sample coverage for vitrinite reflectance analysis (Figure 1, Table II) was adequate over the section penetrated below 3015m at Baccalieu I-78. Above this, only two samples were available although they were both from core samples; this should eliminate a number of problems normally associated with kerogen obtained from rotary drilled cuttings. These problems mostly derive from various contamination sources including cavings, recycling drilling fluids and drilling fluid additives. The data were plotted on a log Ro vs. linear depth scale and a regression line was calculated and plotted (Figure 1). The 'error bars' displayed on the maturity profile indicate one standard deviation on either side of the mean and may be deceptively small for samples with very few readings. The slope of the maturity line is 0.143 log Ro/km.

The histogram display shows the variability in the reflectance populations, which represent the maturity of the sediments with depth (Figure 2). Plotting reflectance histograms on a log scale may help reveal any trends present in the Ro data. It also can help to demonstrate the effects of cavings, geology, casing points and other influences on the vitrinite reflectance populations.

These vitrinite reflectance data show that the thermal regime of the lower section of Baccalieu I-78 is suitable to generate and preserve liquid hydrocarbons within the drilled section, between 2840 and 4520 m (T.D.), provided potential source rocks and traps are present.

Discussion

The vitrinite reflectance maturity profile for this Flemish Pass well benefits from the availability of kerogen material from four conventional cores. These core samples are identified by their single depth value recorded with 0.1 m precision (Table II).

The slope of the maturity profile of this well shows a strong similarity to that established for Gabriel C-60 well (Avery, 1985) also drilled in the Flemish Pass and at an almost identical water depth but on the opposite, west, side of the pass. The slope of the Gabriel well is 0.158 log Ro/km compared to 0.143 log Ro/km of this well. Despite the similarity in slopes the wells are significantly different in maturity. The Baccalieu well reaches a higher maturity (0.32 Ro at 2000 m) sooner than Gabriel (.24 Ro at 2000 m). Similarly, Baccalieu reaches the standard 'oil window' (0.5 Ro) at 3320 and Gabriel at 3940. At TD Baccalieu attains 0.91 Ro, Gabriel only 0.78 Ro.

This difference may be partly explained by stratigraphic variations between the wells. Baccalieu reaches Nautilus Shale and Whiterose Shale at 1712 and 1845 m respectively while at Gabriel these were penetrated at 2505 and 4554 m.

Another aspect of this maturity profile is the section below approximately 3800 m which is slightly shifted towards a lower maturity (Figure 1). This closely coincides with an interval of overpressure in this section of the well (Wielens and Jauer, 2000).

References

- Avery, M.P., 1985. Vitrinite Reflectance (Ro) of dispersed organics from Esso Voyager Gabriel C-60. Geological Survey of Canada Open File Report 1206.
- Dow, W.G., 1977. Kerogen studies and geological interpretations. Journal of Geochemical Exploration, no. 7, p.77-99.
- Wielens, H. and Jauer, C., 2000. Overpressure, thermal maturity, temperature and log responses in basins of the Grand Banks of Newfoundland. Geological Survey of Canada Open File Report 3937.

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Table II

Summary of kerogen - based vitrinite reflectance

Sample Labels	Depth in metres	Mean Ro (SD) non-rotated	Number of Readings	
			Total	Edited
K0926A	1845.4	0.29 (± 0.03)	16	16
K0926B	2171.1	0.34 (± 0.04)	15	15
K0922A	3005-3045	0.51 (± 0.06)	13	13
K0922B	3185-3220	0.47 (± 0.05)	14	13
K0926C	3288.9	0.51 (± 0.06)	15	14
K0922C	3350-3360	0.48 (± 0.05)	14	14
K0922D	3605-3645	0.60 (± 0.07)	16	16
K0923A	3765-3805	0.64 (± 0.08)	10	10
K0923B	3945-3985	0.59 (± 0.08)	19	19
K0926D	4135.7	0.62 (± 0.05)	18	18
K0923D	4305-4345	0.70 (± 0.06)	21	20
K0924A	4485-4525	0.73 (± 0.07)	20	20
K0924B	4665-4735	0.76 (± 0.07)	19	19
K0924C	4875-4915	0.82 (± 0.07)	13	13
K0924D	4995-5035	0.89 (± 0.06)	13	13
K0925A	5105-5135	0.92 (± 0.07)	19	19

Table III

Formation Tops (McAlpine, pers. comm.)

Formation	Depth in metres
Banquereau	in casing
(unconformity)	1712
Nautilus shale	1712
(unconformity)	1845
Whiterose Shale	1845
Hibernia	3190
Fortune Bay Shale	3274
Jeanne D'arc	3431
(unconformity)	3648
Rankin	3648
(unconformity)	3807
Egret Mb	4208
Voyager	4561
Downing	4975
Total Depth	5134.5

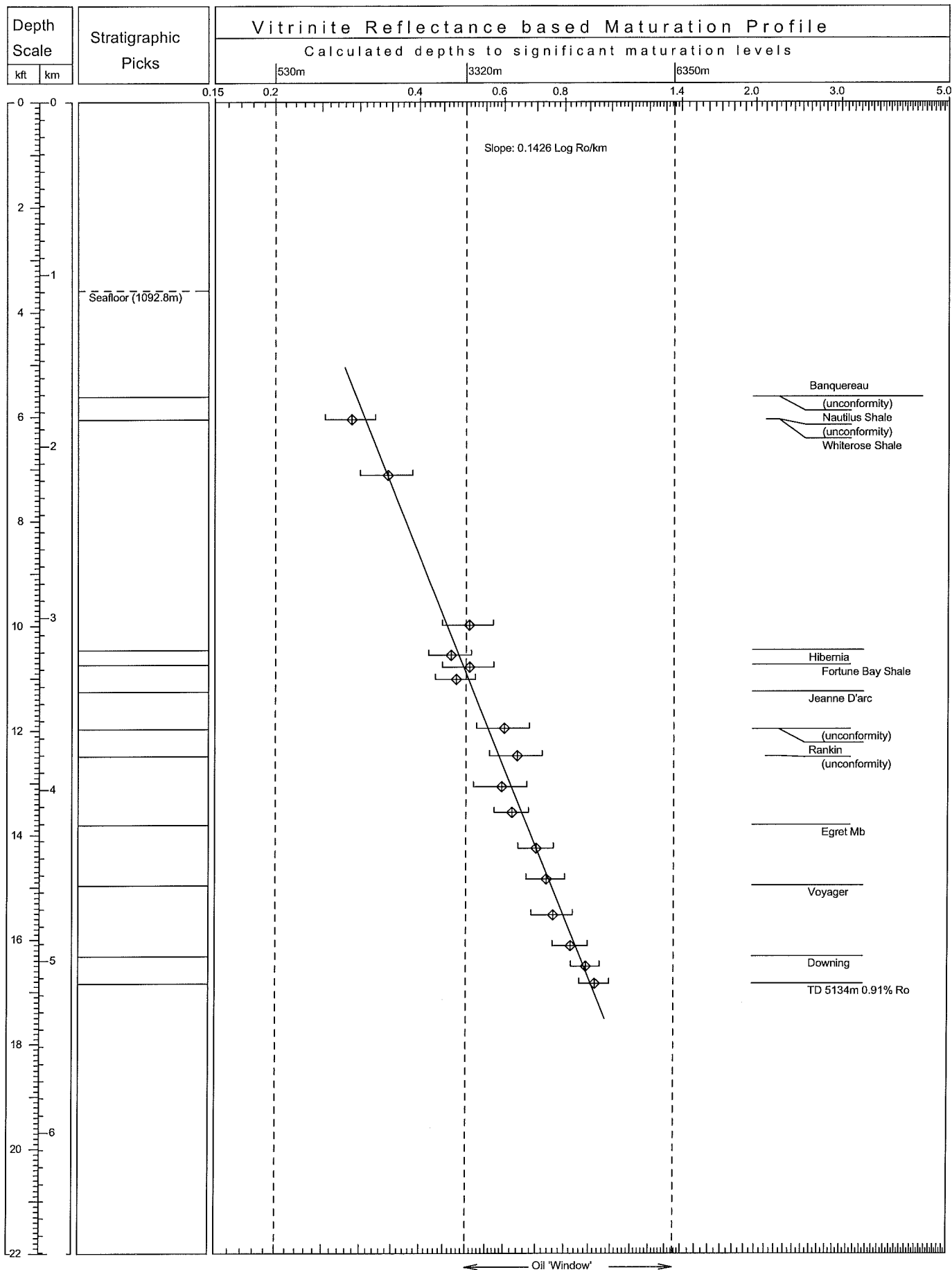


Fig. 1 Baccalieu I-78

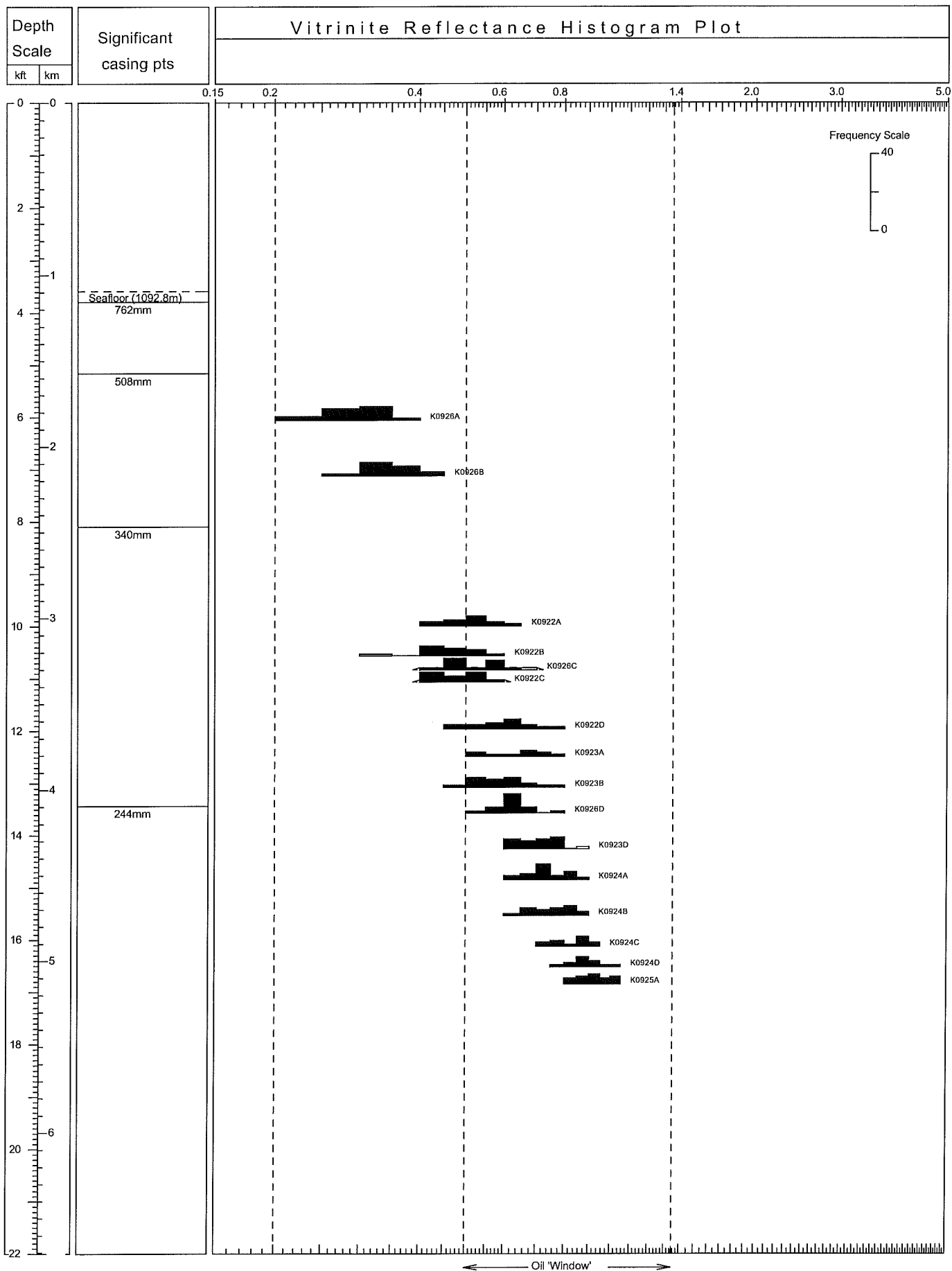


Fig. 2 Baccalieu I-78 <Histograms>

Appendix I

Sample Preparation Method

Kerogen Concentrate

Preliminary wash (preparation for cuttings)

Dry samples in oven (25°C)

PALYNOLOGY Lab preparation

Place 20-30 grams in 250 ml plastic beaker.

Add 10% HCl till reaction ceases (removes carbonates).

Rinse 3 times.

Immerse in hot concentrated HF overnight (removes silicates).

Rinse 3 times.

Heat (60-65°C) in concentrated HCl (removes fluorides caused by HF).

Rinse 3 times.

Transfer to 15 ml test tube with 4-5 ml 4% Alconox.

Centrifuge at 1500 rpm for 90 sec.

Decant.

Rinse and centrifuge 3 times.

Float off organic fraction using 2.0 S.G. ZnBr solution.

Centrifuge at 1000 rpm for 8 min.

Float fraction into second test tube.

Wash and centrifuge 3 times.

Make kerogen smear slide.

Remaining kerogen material is made available to Organic Petrology Lab.

VITRINITE REFLECTANCE Lab preparation

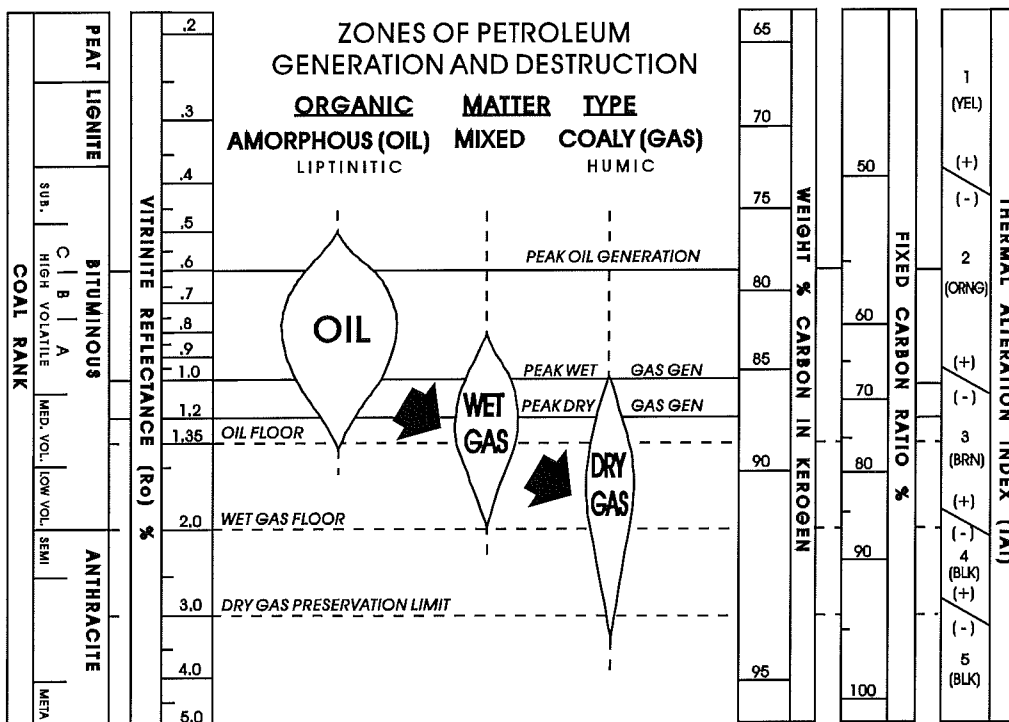
Pipette off excess water and prepare as 2.5 cm (1") diameter plastic stubs to fit polisher.

Freeze dry and fix material for polishing with epoxy resin.

Polish with diamond-based suspension to obtain low relief, scratch-free surface.

Examine under oil lens, incident light at approximately 1000x magnification.

Appendix II (Dow, 1977)

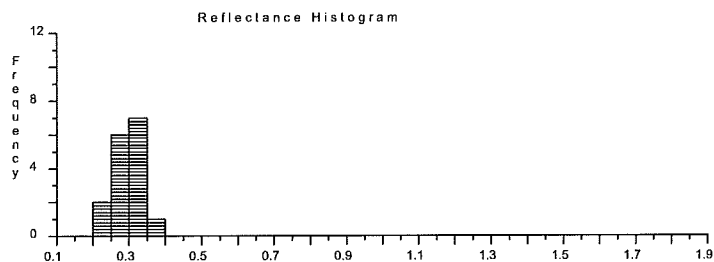


Note: In this report, the terminology used to describe the various maturity levels has been modified. The ‘peak’ designation, as used in this figure, has been changed to ‘onset of significant’ and 0.8 %Ro is herein used as the ‘peak of oil generation’ (Table I, Figure 1).

Appendix III
Reflectance Histograms

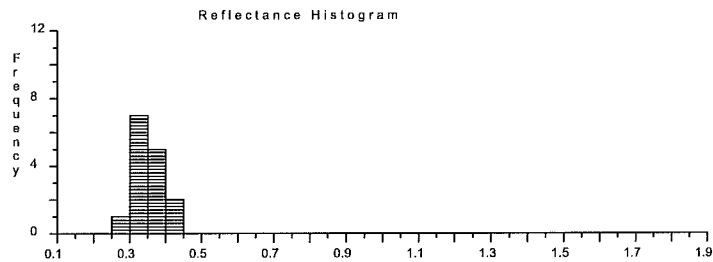
K0926A, 1845.4-1845.4m

Col >	1	2	3	4	5	6	7	8	9	0
Row 1	(0.30)	(0.31)	(0.27)	(0.25)	(0.24)	(0.30)	(0.23)	(0.28)	(0.30)	(0.31)
	(0.31)	(0.28)	(0.37)	(0.28)	(0.26)	(0.32)				
Total	Mean 0.29	Stand Dev 0.03	Pts 16	Min 0.23	Max 0.37	Sum 4.61				
(Edit)	0.29	0.03	16	0.23	0.37	4.61				



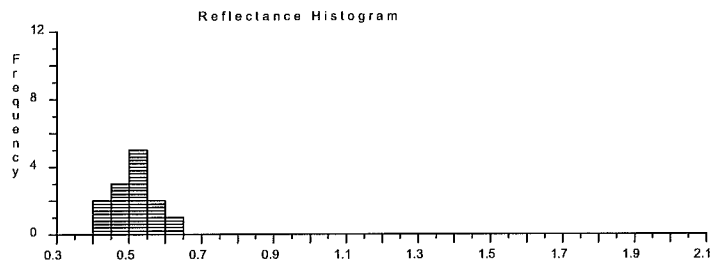
K0926B, 2171.1-2171.1m

Col >	1	2	3	4	5	6	7	8	9	0
Row 1	(0.31)	(0.35)	(0.32)	(0.35)	(0.34)	(0.29)	(0.31)	(0.35)	(0.37)	(0.43)
	(0.32)	(0.31)	(0.35)	(0.31)	(0.44)					
Total	Mean 0.34	Stand Dev 0.04	Pts 15	Min 0.29	Max 0.44	Sum 5.15				
(Edit)	0.34	0.04	15	0.29	0.44	5.15				



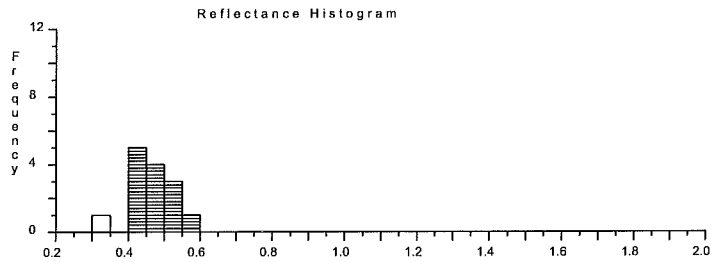
K0922A, 3005-3045m

Col >	1	2	3	4	5	6	7	8	9	0
Row 1	(0.44)	(0.45)	(0.41)	(0.46)	(0.51)	(0.52)	(0.53)	(0.50)	(0.63)	(0.48)
	(0.56)	(0.59)	(0.52)							
Total	Mean 0.51	Stand Dev 0.06	Pts 13	Min 0.41	Max 0.63	Sum 6.60				
(Edit)	0.51	0.06	13	0.41	0.63	6.60				



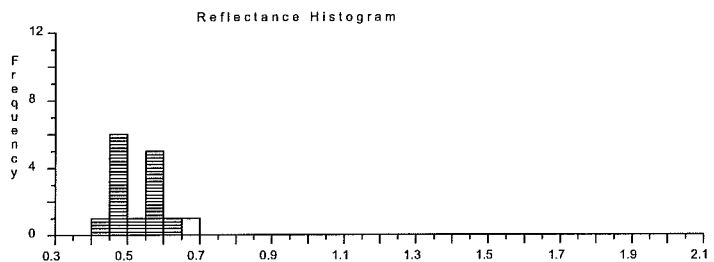
K0922B, 3185-3220m

Col >	1	2	3	4	5	6	7	8	9	0
Row 1	0.31	(0.45)	(0.40)	(0.43)	(0.46)	(0.44)	(0.48)	(0.44)	(0.47)	(0.50)
	(0.40)	(0.51)	(0.50)	(0.57)						
Total	Mean 0.45	Stand Dev 0.06	Pts 14	Min 0.31	Max 0.57	Sum 6.36				
(Edit)	0.47	0.05	13	0.40	0.57	6.05				



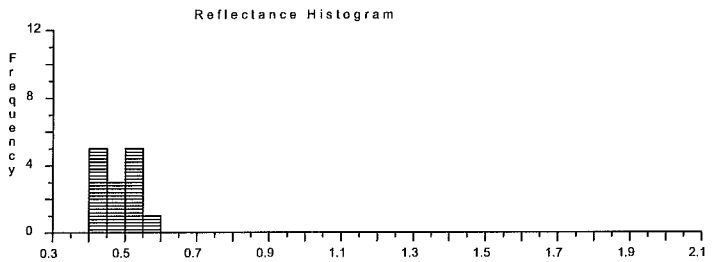
K0926C, 3288.9-3288.9m

Col >	1	2	3	4	5	6	7	8	9	0
Row 1	(0.45)	(0.58)	(0.50)	(0.59)	(0.55)	0.68	(0.45)	(0.45)	(0.55)	(0.46)
	(0.42)	(0.60)	(0.57)	(0.46)	(0.49)					
Total	Mean 0.52	Stand Dev 0.07	Pts 15	Min 0.42	Max 0.68	Sum 7.80				
(Edit)	0.51	0.06	14	0.42	0.60	7.12				



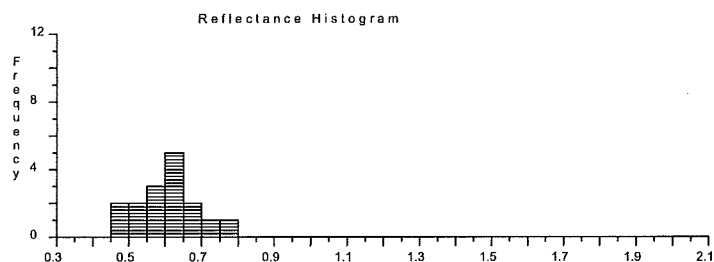
K0922C, 3350-3360m

Col >	1	2	3	4	5	6	7	8	9	0
Row 1	(0.52)	(0.51)	(0.41)	(0.44)	(0.44)	(0.50)	(0.52)	(0.40)	(0.55)	(0.43)
	(0.49)	(0.48)	(0.48)	(0.51)						
Total	Mean 0.48	Stand Dev 0.05	Pts 14	Min 0.40	Max 0.55	Sum 6.68				
(Edit)	0.48	0.05	14	0.40	0.55	6.68				



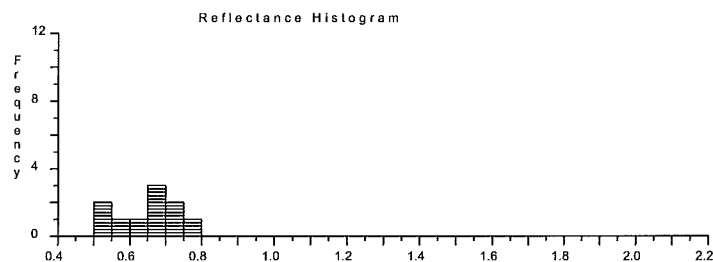
K0922D, 3605-3645m

Col >	1	2	3	4	5	6	7	8	9	0
Row	(0.70)	(0.53)	(0.53)	(0.63)	(0.64)	(0.63)	(0.49)	(0.64)	(0.61)	(0.48)
1	(0.55)	(0.75)	(0.56)	(0.65)	(0.58)	(0.65)				
Total	Mean	Stand Dev	Pts	Min	Max	Sum				
(Edit)	0.60	0.07	16	0.48	0.75	9.62				
	0.60	0.07	16	0.48	0.75	9.62				



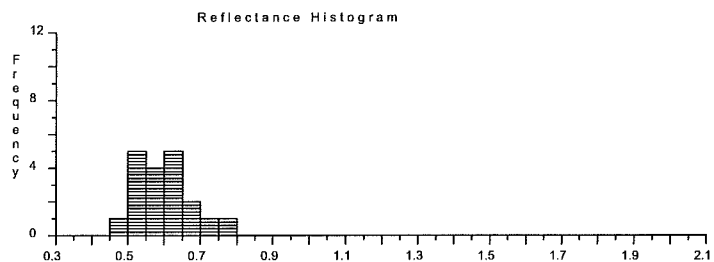
K0923A, 3765-3805m

Col >	1	2	3	4	5	6	7	8	9	0
Row	(0.56)	(0.75)	(0.52)	(0.68)	(0.68)	(0.53)	(0.70)	(0.66)	(0.70)	(0.61)
Total	Mean	Stand Dev	Pts	Min	Max	Sum				
(Edit)	0.64	0.08	10	0.52	0.75	6.39				
	0.64	0.08	10	0.52	0.75	6.39				



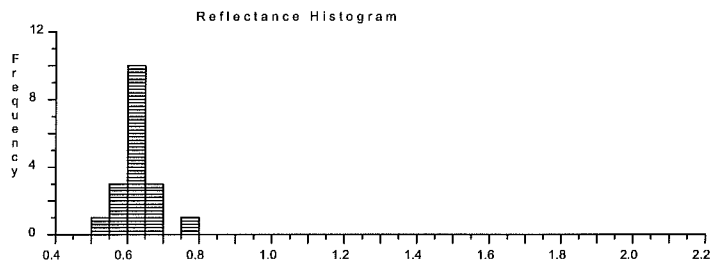
K0923B, 3945-3985m

Col >	1	2	3	4	5	6	7	8	9	0
Row	(0.61)	(0.56)	(0.72)	(0.68)	(0.48)	(0.53)	(0.57)	(0.57)	(0.67)	(0.51)
1	(0.63)	(0.62)	(0.64)	(0.62)	(0.53)	(0.50)	(0.54)	(0.75)	(0.55)	
Total	Mean	Stand Dev	Pts	Min	Max	Sum				
(Edit)	0.59	0.08	19	0.48	0.75	11.28				
	0.59	0.08	19	0.48	0.75	11.28				



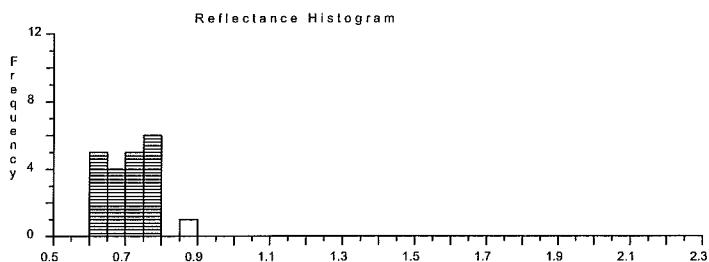
K0926D, 4135.7-4135.7m

Col >	1	2	3	4	5	6	7	8	9	0
Row	(0.64)	(0.61)	(0.57)	(0.75)	(0.68)	(0.62)	(0.63)	(0.63)	(0.59)	(0.65)
1	(0.60)	(0.64)	(0.52)	(0.69)	(0.62)	(0.60)	(0.60)	(0.58)		
Total	Mean	Stand Dev	Pts	Min	Max	Sum				
(Edit)	0.62	0.05	18	0.52	0.75	11.22				
	0.62	0.05	18	0.52	0.75	11.22				



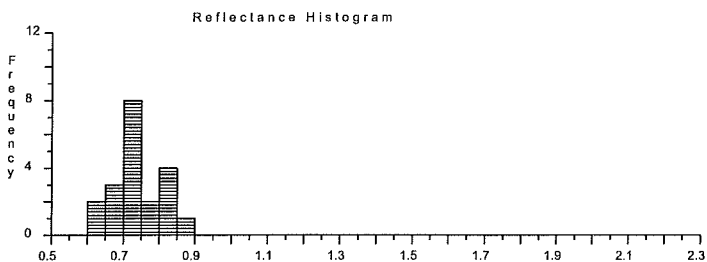
K0923D, 4305-4345m

Col >	1	2	3	4	5	6	7	8	9	0
Row	(0.77)	(0.64)	(0.62)	(0.74)	(0.66)	(0.65)	(0.73)	(0.66)	(0.71)	(0.75)
1	(0.67)	(0.72)	(0.63)	(0.78)	(0.76)	(0.63)	(0.76)	(0.70)	(0.62)	0.89
2	(0.79)									
Total	Mean	Stand Dev	Pts	Min	Max	Sum				
(Edit)	0.71	0.07	21	0.62	0.89	14.88				
	0.70	0.06	20	0.62	0.79	13.99				



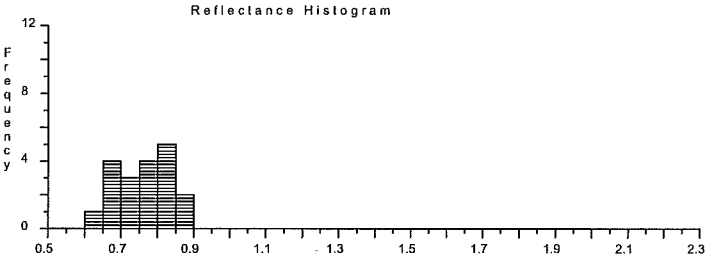
K0924A, 4485-4525m

Col >	1	2	3	4	5	6	7	8	9	0
Row	(0.70)	(0.73)	(0.81)	(0.67)	(0.65)	(0.70)	(0.80)	(0.80)	(0.64)	(0.84)
1	(0.72)	(0.63)	(0.70)	(0.78)	(0.87)	(0.74)	(0.67)	(0.76)	(0.73)	(0.74)
Total	Mean	Stand Dev	Pts	Min	Max	Sum				
(Edit)	0.73	0.07	20	0.63	0.87	14.68				
	0.73	0.07	20	0.63	0.87	14.68				



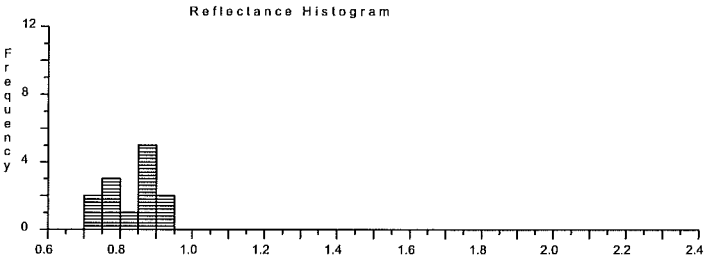
K0924B, 4665-4735m

Col >	1	2	3	4	5	6	7	8	9	0
Row 1	(0.67)	(0.73)	(0.69)	(0.66)	(0.83)	(0.76)	(0.71)	(0.89)	(0.77)	(0.71)
	(0.83)	(0.87)	(0.81)	(0.69)	(0.77)	(0.81)	(0.62)	(0.77)	(0.80)	
Total	Mean	Stand Dev	Pts	Min	Max	Sum				
(Edit)	0.76	0.07	19	0.62	0.89	14.39				



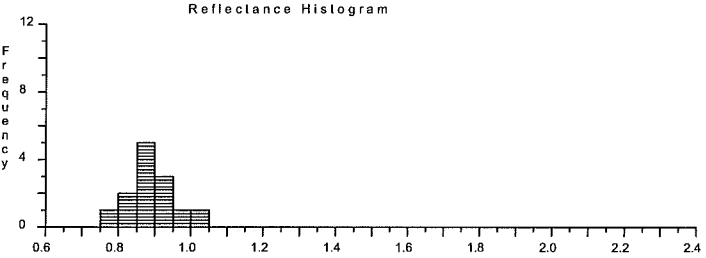
K0924C, 4875-4915m

Col >	1	2	3	4	5	6	7	8	9	0
Row 1	(0.94)	(0.71)	(0.81)	(0.72)	(0.87)	(0.85)	(0.78)	(0.85)	(0.77)	(0.78)
	(0.90)	(0.87)	(0.86)							
Total	Mean	Stand Dev	Pts	Min	Max	Sum				
(Edit)	0.82	0.07	13	0.71	0.94	10.71				



K0924D, 4995-5035m

Col >	1	2	3	4	5	6	7	8	9	0
Row 1	(0.86)	(0.91)	(0.95)	(0.84)	(0.86)	(1.02)	(0.77)	(0.87)	(0.89)	(0.92)
	(0.88)	(0.90)	(0.84)							
Total	Mean	Stand Dev	Pts	Min	Max	Sum				
(Edit)	0.89	0.06	13	0.77	1.02	11.51				



K0925A, 5105-5135m

Col >	1	2	3	4	5	6	7	8	9	0
Row 1	(1.01)	(0.96)	(1.00)	(0.98)	(0.89)	(0.85)	(0.93)	(0.93)	(0.84)	(0.97)
	(1.01)	(0.85)	(0.83)	(0.89)	(0.93)	(1.03)	(0.82)	(0.91)	(0.93)	
Total	Mean	Stand Dev	Pts	Min	Max	Sum				
(Edit)	0.92	0.07	19	0.82	1.03	17.56				

