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Vitrinite reflectance data for Petro Canada *et al* North Leif I-05

M. P. Avery

2005

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OPEN FILE 4978

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Well information

G.S.C. Locality No.: D198 **Unique Well ID:** 300 I05 54300 55150 **Location:** 54.41082°N, 55.25294°W

R.T. Elevation: 12 **Water Depth:** 144 **Total Depth:** 3513

Sampled Interval: 430 - 3507 **Interval Studied:** 480-3410

Depth Units: Metres referenced to R.T. **Rig Release Date:** September 27, 1980

Introduction

Vitrinite reflectance has been determined on 23 rotary cutting samples from Petro Canada *et al* North Leif I-05, which was classified as an exploratory well located in the Hopedale Basin on the northern Labrador Shelf. Well status is Plugged and Abandoned.

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

Analysis of the well reveals thermal maturity levels given in Table I. Specific maturity levels, as set out in this report, are based on those of Snowdon and Powell (1984) with modified terminology (Appendix II).

Table I
Inferred Hydrocarbon Thermal Maturity Levels

Depth in metres	Vitrinite Reflectance* %Ro	Hydrocarbon generation levels** for type II or III kerogen
144[sea floor]	(0.20)	immature
1260	0.3	immature
2000	0.4	immature approaching maturity
2580	0.5	marginally mature
3050	0.6	onset of significant oil generation
3513[T.D.]	(.72)	peak maturity

**( )'s indicate Ro's or depths extrapolated from linear regression slope: 0.168 log Ro/km*
***Actual hydrocarbon products depend on type of organic matter present (Snowdon and Powell, 1984).*

Remarks

Sample coverage for vitrinite reflectance analysis (Figure 1, Table II) was reasonably complete over the section penetrated below 480 m at North Leif I-05. The data were plotted on a log Ro vs. linear depth scale. A regression line fitted through the data yielded a maturity slope of 0.168 log Ro/km. Because there is a variation in the number of readings for any given sample point (Table II) the regression line was weighted based on the 'n' value for each point fitted through the data . The relative size of the point symbol provides a graphical indication of the number of readings. The 'error bars' displayed on the maturity profile indicate one standard deviation on either side of the mean and may be deceivingly small for samples with very few readings.

The histogram display (Figure 2) shows the variability in the reflectance populations, which represent the maturity of the sediments with depth. 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 maturity of the lower section of North Leif I-05 is suitable to generate and preserve hydrocarbons within the drilled section, between 2580 and 3513 m (T.D.), provided potential source rocks of the proper organic matter type and traps are present.

Method

Most of the vitrinite reflectance data obtained for this report were measured on polished whole rock mounts which preserve, for the most part, the association of the organic matter with the mineral matrix. Three of the data points were measured on kerogen isolate mounts. Kerogen mounts use a concentration of organic matter with most of the mineral matrix removed. A discussion of the merits of both methods is beyond the scope of this report although it is interesting to note that in this well, measurements taken on samples prepared by the different methods are quite comparable (Table II, Figure 1). Whole rock sample labels have the prefix letter 'C' while kerogen sample labels have prefix letter 'K'.

Discussion

There is considerable scatter in the data for this well compared to recent reports on Gilbert F-53, Hekja O-72 and Gjoa G-37. This may be attributable to the reworked or recycled vitrinites in this well.

References

Powell, T. G. and Snowdon, L. R.
1983: A composite hydrocarbon generation model. Erdöl und Kohle, Erdgas, Petrochemie, v. 36, p. 163-170.

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Table II

Summary of whole rock and kerogen - based vitrinite reflectance

Sample* Labels	Depth in metres	Mean Ro (SD) non-rotated	Number of Readings Total	Edited
C560-04	480	0.23 (±0.05)	12	12
C561-04	750	0.21 (±0.03)	15	12
C562-04	810	0.22 (±0.04)	6	6
C563-04	850	0.29 (±0.03)	13	13
C564-04	980	0.28 (±0.03)	10	10
C565-04	1215	0.30 (±0.03)	9	9
C566-04	1275	0.27 (±0.03)	9	9
C567-04	1445	0.37 (±0.05)	13	13
C568-04	1580	0.32 (±0.03)	12	10
C569-04	1725	0.30 (±0.04)	12	12
C570-04	1880	0.44 (±0.05)	14	14
C571-04	2030	0.39 (±0.05)	9	9
K0197C	2265	0.43 (±0.05)	7	6
C572-04	2275	0.53 (±0.03)	10	7
K0198A	2385	0.45 (±0.05)	11	8
C573-04	2525	0.54 (±0.05)	13	13
C574-04	2630	0.55 (±0.08)	7	5
C575-04	2910	0.60 (±0.05)	11	9
C576-04	3080	0.54 (±0.06)	23	20
C579-04	3265	0.58 (±0.04)	19	16
C580-04	3340	0.59 (±0.04)	20	17
K0200C	3380	0.84 (±0.04)	14	8
C582-04	3410	0.78 (±0.06)	26	18

*Sample labels prefix: ‘C’ indicates whole rock stub prepared at GSC - Calgary and ‘K’ indicates kerogen stub prepared at GSC - Atlantic

Table III

Formation Tops (Moir, pers. comm.)

Formation	Depth in metres
Saglek	319
Mokami	547.5
Mokami Upper Mb	547.5-934
Mokami Lower Mb	934
Kenamu	1476
Leif Mb	1524-1586.5
Gudrid Fm (upper Unit)	2141
Cartwright	2228
Gudrid Fm (lower Unit)	2326
Markland	2340
Bjarni	2721
Snorri Mb	2721-3280
Alexis	3393.5

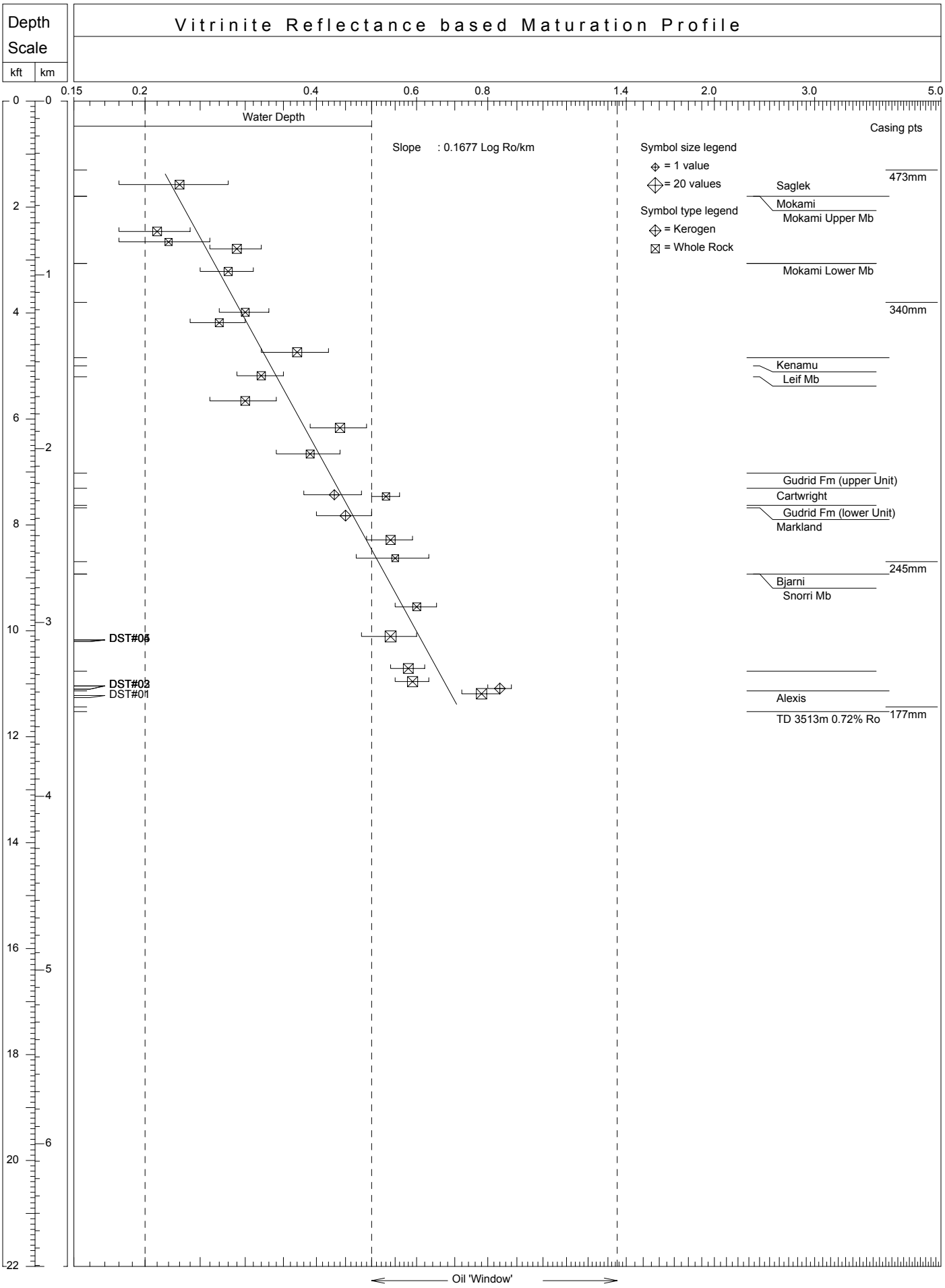


Figure 1. VR/Depth plot for North Leif I-05

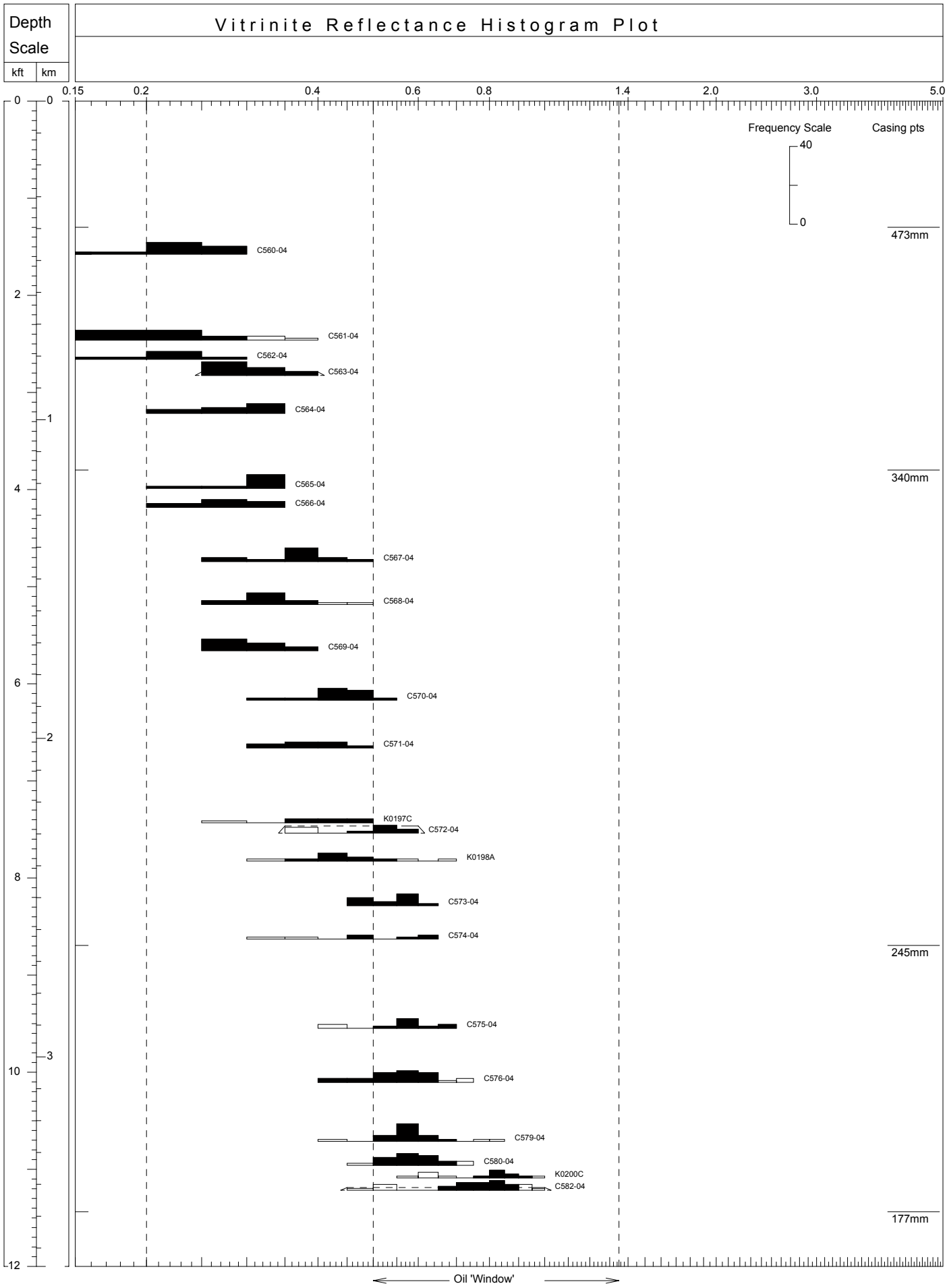


Figure 2. VR Histograms/depth plot for North Leif I-05

Appendix I

Sample Preparation Method

Kerogen concentrate sample preparation

Preliminary wash (preparation for drill 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.

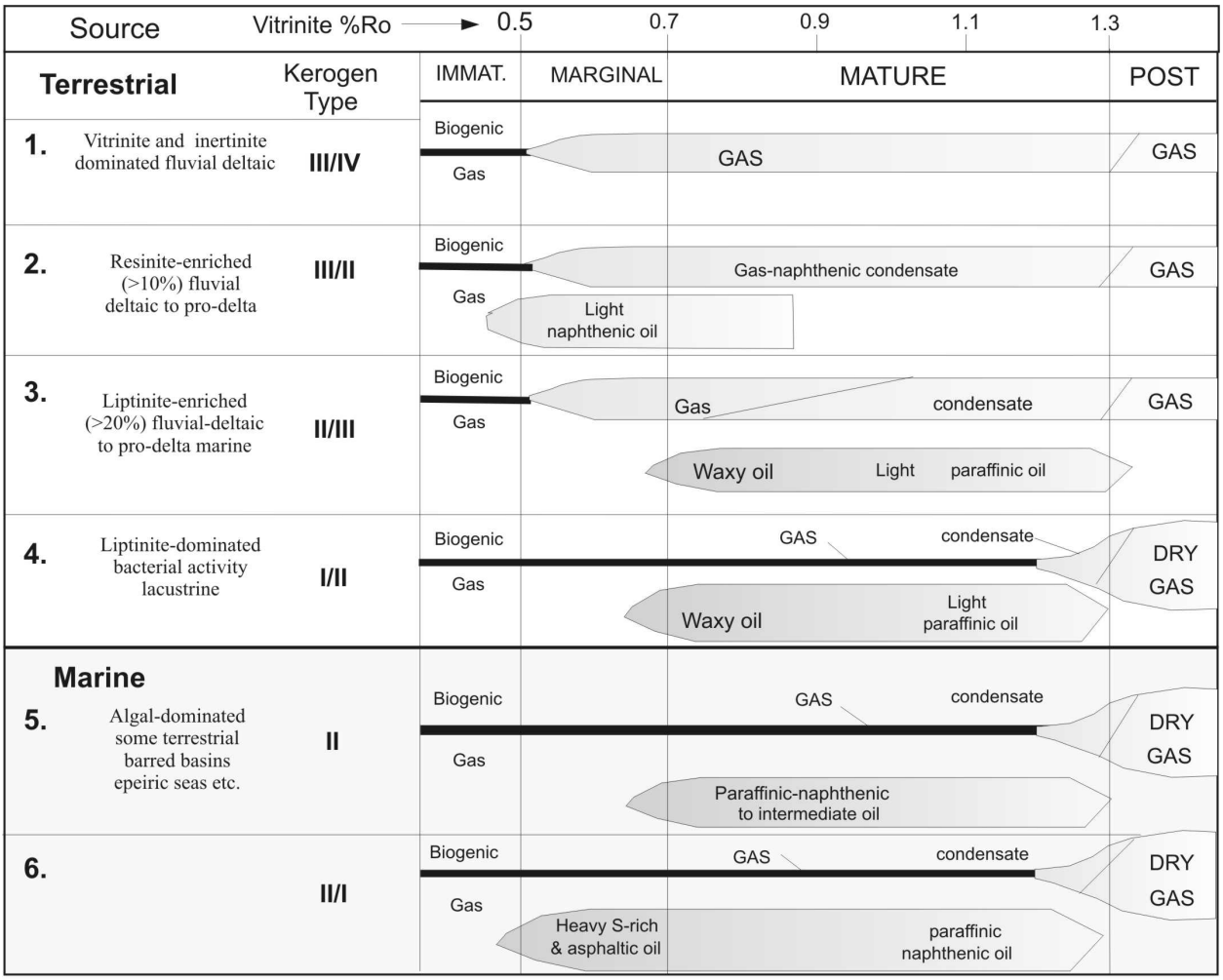
VITRINITE REFLECTANCE Lab preparation

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.

Whole rock sample preparation

Set washed drill cuttings in epoxy to form 2.5 cm (1") diameter plastic stubs to fit polisher.
Grind and polish to obtain low relief, scratch-free surface.
Examine under oil lens, incident light at approximately 1000x magnification.

Appendix II (Snowdon and Powell 1984)



Hydrocarbon generation model compiled from Snowdon and Powell (1984) illustrating the different thresholds of hydrocarbon generation and products as related to thermal maturity, kerogen type and paleodepositional environment.

Appendix III

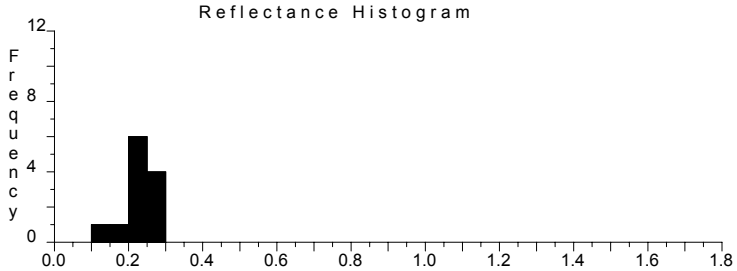
Data listings and basic statistics

Data listings and basic statistics for: North Leif I-05

C560-04, 480m

Col >	1	2	3	4	5	6	7	8	9	0
Row	(0.22)	(0.26)	(0.23)	(0.28)	(0.28)	(0.21)	(0.21)	(0.16)	(0.21)	(0.24)
1	(0.14)	(0.28)								

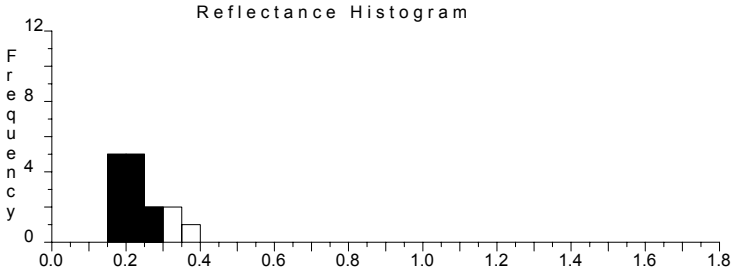
	Mean	Stand Dev	Pts	Min	Max	Sum
Total	0.23	0.05	12	0.14	0.28	2.72
(Edit)	0.23	0.05	12	0.14	0.28	2.72



C561-04, 750m

Col >	1	2	3	4	5	6	7	8	9	0
Row	(0.18)	0.33	0.30	(0.18)	(0.20)	(0.21)	(0.19)	(0.18)	(0.23)	(0.26)
1	(0.18)	(0.26)	0.39	(0.22)	(0.22)					

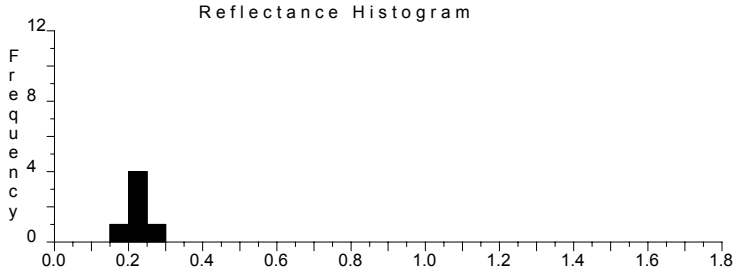
	Mean	Stand Dev	Pts	Min	Max	Sum
Total	0.24	0.06	15	0.18	0.39	3.53
(Edit)	0.21	0.03	12	0.18	0.26	2.51



C562-04, 810m

Col >	1	2	3	4	5	6
Row	(0.16)	(0.23)	(0.20)	(0.20)	(0.28)	(0.24)

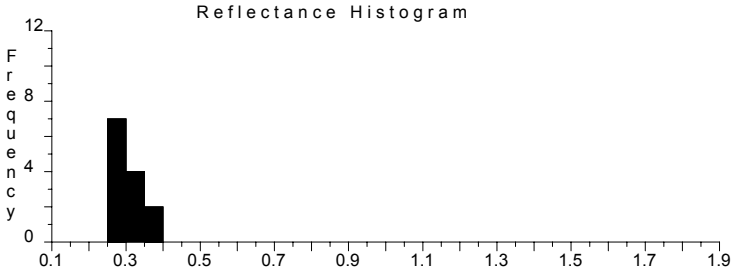
	Mean	Stand Dev	Pts	Min	Max	Sum
Total	0.22	0.04	6	0.16	0.28	1.31
(Edit)	0.22	0.04	6	0.16	0.28	1.31



C563-04, 850m

Col >	1	2	3	4	5	6	7	8	9	0
Row	(0.35)	(0.35)	(0.30)	(0.28)	(0.31)	(0.28)	(0.31)	(0.27)	(0.29)	(0.30)
1	(0.28)	(0.25)	(0.26)							

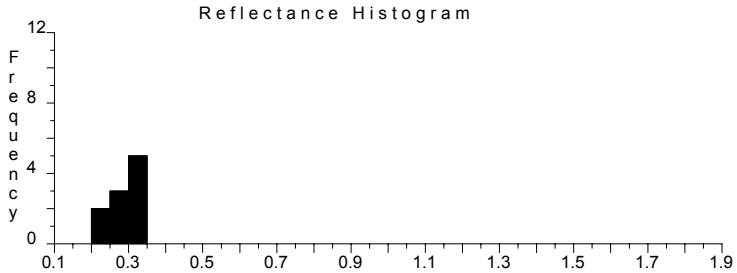
	Mean	Stand Dev	Pts	Min	Max	Sum
Total	0.29	0.03	13	0.25	0.35	3.83
(Edit)	0.29	0.03	13	0.25	0.35	3.83



C564-04, 980m

Col >	1	2	3	4	5	6	7	8	9	0
Row	(0.27)	(0.33)	(0.29)	(0.30)	(0.27)	(0.23)	(0.31)	(0.24)	(0.30)	(0.30)

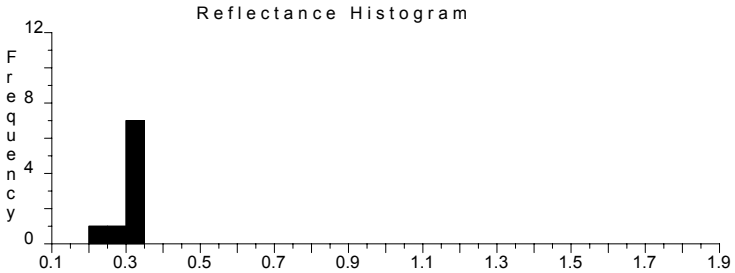
	Mean	Stand Dev	Pts	Min	Max	Sum
Total	0.28	0.03	10	0.23	0.33	2.84
(Edit)	0.28	0.03	10	0.23	0.33	2.84



C565-04, 1215m

Col >	1	2	3	4	5	6	7	8	9
Row	(0.31)	(0.24)	(0.31)	(0.28)	(0.31)	(0.30)	(0.34)	(0.31)	(0.31)

	Mean	Stand Dev	Pts	Min	Max	Sum
Total	0.30	0.03	9	0.24	0.34	2.71
(Edit)	0.30	0.03	9	0.24	0.34	2.71

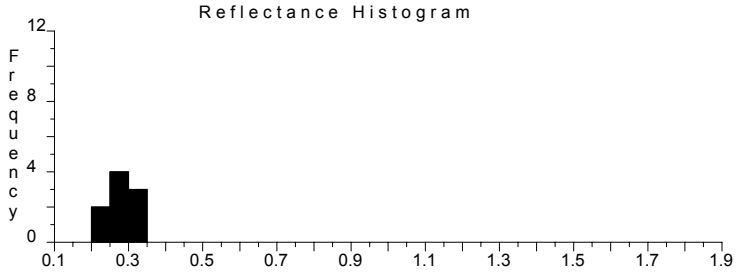


Data listings and basic statistics for: North Leif I-05

C566-04, 1275m

Col >	1	2	3	4	5	6	7	8	9
Row	(0.24)	(0.24)	(0.26)	(0.25)	(0.30)	(0.31)	(0.28)	(0.31)	(0.28)

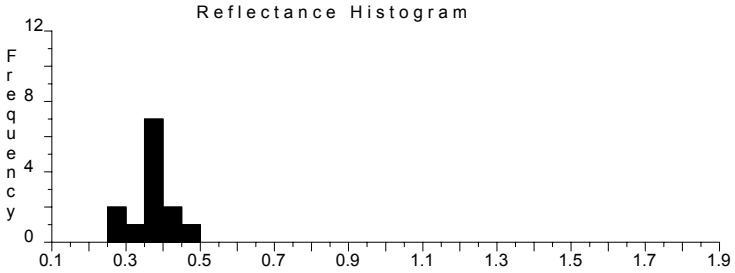
	Mean	Stand Dev	Pts	Min	Max	Sum
Total	0.27	0.03	9	0.24	0.31	2.47
(Edit)	0.27	0.03	9	0.24	0.31	2.47



C567-04, 1445m

Col >	1	2	3	4	5	6	7	8	9	0
Row	(0.45)	(0.28)	(0.35)	(0.38)	(0.38)	(0.39)	(0.38)	(0.42)	(0.27)	(0.36)
1	(0.43)	(0.31)	(0.36)							

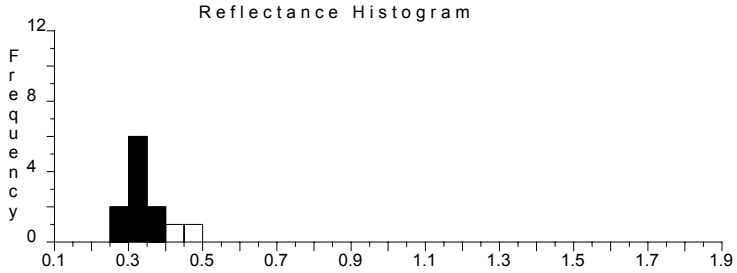
	Mean	Stand Dev	Pts	Min	Max	Sum
Total	0.37	0.05	13	0.27	0.45	4.76
(Edit)	0.37	0.05	13	0.27	0.45	4.76



C568-04, 1580m

Col >	1	2	3	4	5	6	7	8	9	0
Row	(0.27)	(0.33)	(0.35)	0.45	0.41	(0.32)	(0.34)	(0.32)	(0.36)	(0.30)
1	(0.30)	(0.26)								

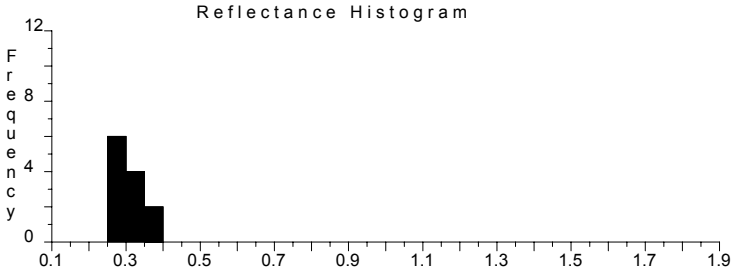
	Mean	Stand Dev	Pts	Min	Max	Sum
Total	0.33	0.05	12	0.26	0.45	4.01
(Edit)	0.32	0.03	10	0.26	0.36	3.15



C569-04, 1725m

Col >	1	2	3	4	5	6	7	8	9	0
Row	(0.28)	(0.26)	(0.36)	(0.30)	(0.32)	(0.29)	(0.25)	(0.38)	(0.29)	(0.33)
1	(0.31)	(0.25)								

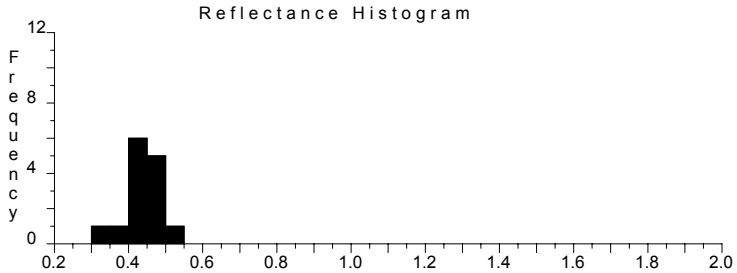
	Mean	Stand Dev	Pts	Min	Max	Sum
Total	0.30	0.04	12	0.25	0.38	3.62
(Edit)	0.30	0.04	12	0.25	0.38	3.62



C570-04, 1880m

Col >	1	2	3	4	5	6	7	8	9	0
Row	(0.46)	(0.46)	(0.49)	(0.39)	(0.44)	(0.50)	(0.43)	(0.43)	(0.40)	(0.33)
1	(0.42)	(0.48)	(0.49)	(0.42)						

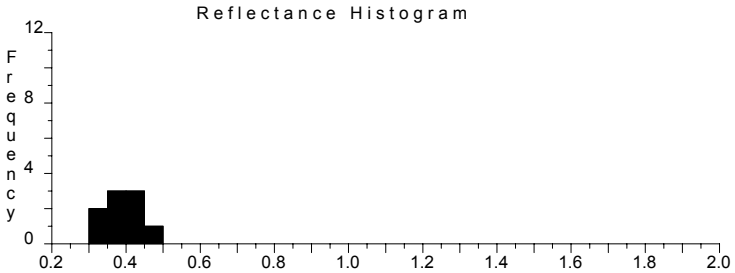
	Mean	Stand Dev	Pts	Min	Max	Sum
Total	0.44	0.05	14	0.33	0.50	6.14
(Edit)	0.44	0.05	14	0.33	0.50	6.14



C571-04, 2030m

Col >	1	2	3	4	5	6	7	8	9
Row	(0.38)	(0.30)	(0.41)	(0.45)	(0.39)	(0.40)	(0.36)	(0.44)	(0.34)

	Mean	Stand Dev	Pts	Min	Max	Sum
Total	0.39	0.05	9	0.30	0.45	3.47
(Edit)	0.39	0.05	9	0.30	0.45	3.47

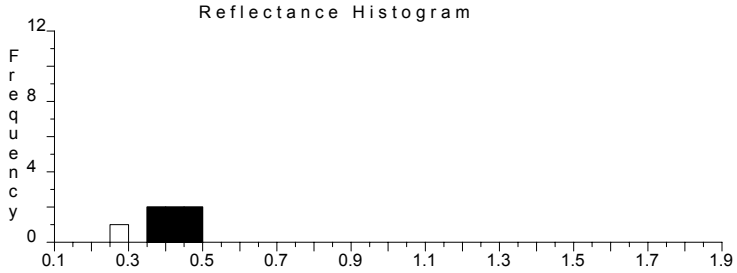


Data listings and basic statistics for: North Leif I-05

K0197C, 2265m

Col >	1	2	3	4	5	6	7
Row	0.29	(0.38)	(0.49)	(0.48)	(0.38)	(0.42)	(0.42)

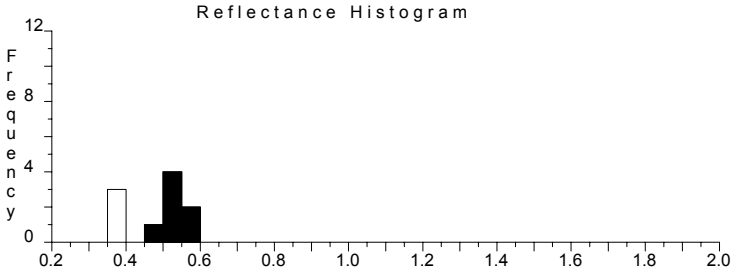
	Mean	Stand Dev	Pts	Min	Max	Sum
Total	0.41	0.07	7	0.29	0.49	2.86
(Edit)	0.43	0.05	6	0.38	0.49	2.57



C572-04, 2275m

Col >	1	2	3	4	5	6	7	8	9	0
Row	(0.52)	(0.57)	0.35	0.35	(0.52)	0.35	(0.49)	(0.53)	(0.51)	(0.56)

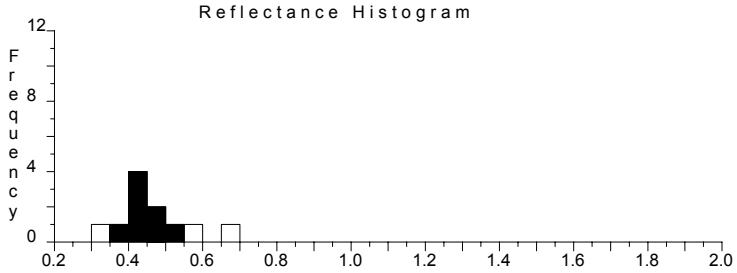
	Mean	Stand Dev	Pts	Min	Max	Sum
Total	0.48	0.09	10	0.35	0.57	4.75
(Edit)	0.53	0.03	7	0.49	0.57	3.70



K0198A, 2385m

Col >	1	2	3	4	5	6	7	8	9	0
Row	(0.44)	(0.49)	(0.43)	0.31	(0.37)	0.69	0.58	(0.44)	(0.40)	(0.51)
1	(0.49)									

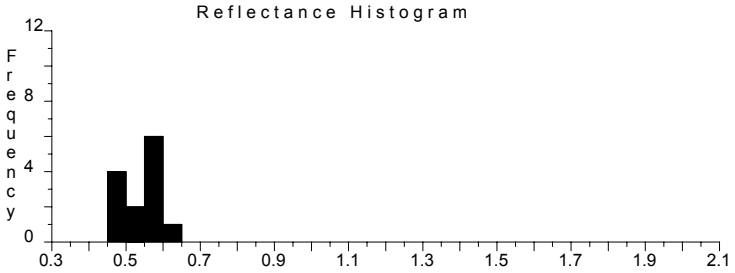
	Mean	Stand Dev	Pts	Min	Max	Sum
Total	0.47	0.10	11	0.31	0.69	5.15
(Edit)	0.45	0.05	8	0.37	0.51	3.57



C573-04, 2525m

Col >	1	2	3	4	5	6	7	8	9	0
Row	(0.53)	(0.58)	(0.48)	(0.60)	(0.57)	(0.50)	(0.58)	(0.57)	(0.48)	(0.49)
1	(0.46)	(0.56)	(0.58)							

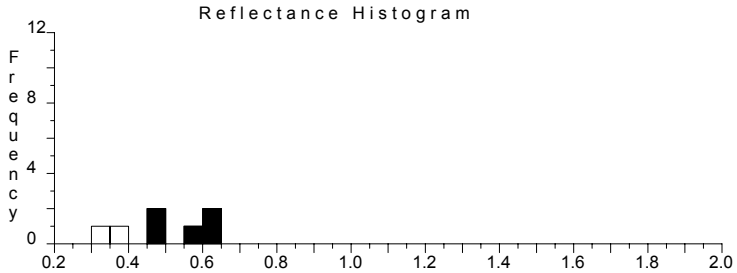
	Mean	Stand Dev	Pts	Min	Max	Sum
Total	0.54	0.05	13	0.46	0.60	6.98
(Edit)	0.54	0.05	13	0.46	0.60	6.98



C574-04, 2630m

Col >	1	2	3	4	5	6	7
Row	(0.62)	(0.55)	(0.62)	0.33	(0.47)	0.39	(0.47)

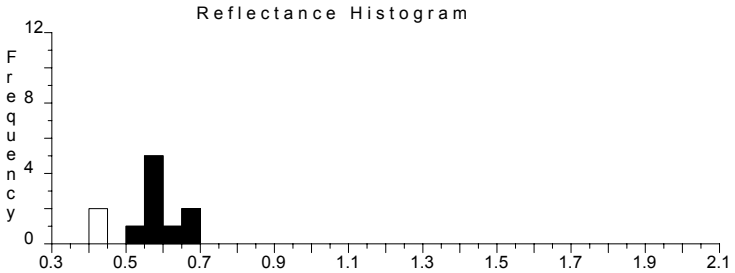
	Mean	Stand Dev	Pts	Min	Max	Sum
Total	0.49	0.11	7	0.33	0.62	3.45
(Edit)	0.55	0.08	5	0.47	0.62	2.73



C575-04, 2910m

Col >	1	2	3	4	5	6	7	8	9	0
Row	(0.67)	(0.57)	(0.59)	(0.55)	(0.62)	(0.54)	0.42	(0.68)	0.43	(0.57)
1	(0.58)									

	Mean	Stand Dev	Pts	Min	Max	Sum
Total	0.57	0.08	11	0.42	0.68	6.22
(Edit)	0.60	0.05	9	0.54	0.68	5.37

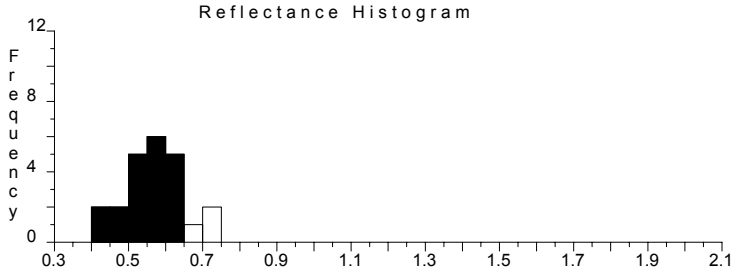


Data listings and basic statistics for: North Leif I-05

C576-04, 3080m

Col >	1	2	3	4	5	6	7	8	9	0
Row	(0.42)	(0.51)	(0.45)	(0.56)	(0.60)	(0.54)	(0.60)	0.70	0.68	(0.59)
1	(0.55)	(0.59)	(0.54)	(0.52)	(0.47)	(0.62)	(0.55)	(0.62)	(0.42)	(0.53)
2	0.74	(0.61)	(0.57)							

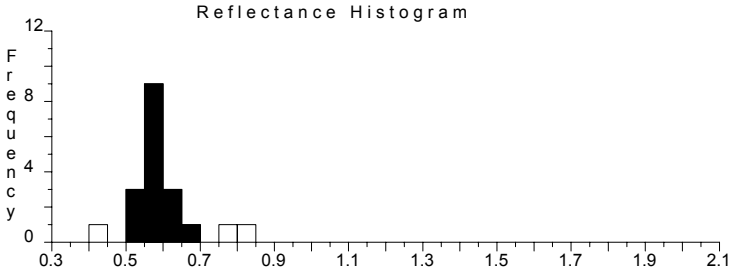
	Mean	Stand Dev	Pts	Min	Max	Sum
Total	0.56	0.08	23	0.42	0.74	12.98
(Edit)	0.54	0.06	20	0.42	0.62	10.86



C579-04, 3265m

Col >	1	2	3	4	5	6	7	8	9	0
Row	(0.54)	(0.58)	(0.57)	(0.52)	(0.64)	0.40	(0.65)	(0.58)	(0.58)	(0.56)
1	(0.53)	(0.58)	0.81	(0.63)	(0.60)	(0.56)	(0.58)	0.78	(0.58)	

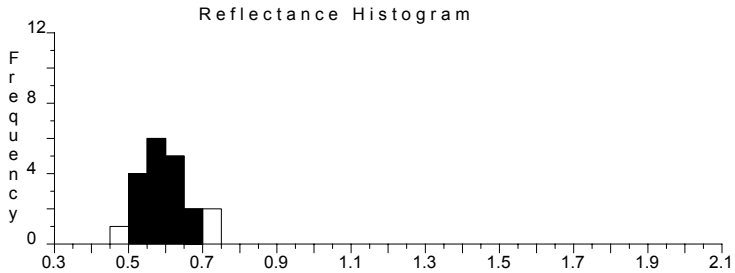
	Mean	Stand Dev	Pts	Min	Max	Sum
Total	0.59	0.09	19	0.40	0.81	11.27
(Edit)	0.58	0.04	16	0.52	0.65	9.28



C580-04, 3340m

Col >	1	2	3	4	5	6	7	8	9	0
Row	(0.54)	(0.54)	(0.60)	(0.56)	(0.59)	(0.56)	0.46	(0.64)	(0.59)	(0.61)
1	(0.52)	(0.66)	(0.61)	(0.53)	(0.59)	(0.62)	(0.66)	0.71	0.74	(0.56)

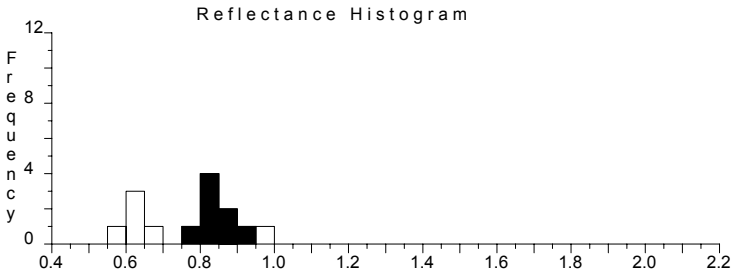
	Mean	Stand Dev	Pts	Min	Max	Sum
Total	0.59	0.07	20	0.46	0.74	11.89
(Edit)	0.59	0.04	17	0.52	0.66	9.98



K0200C, 3380m

Col >	1	2	3	4	5	6	7	8	9	0
Row	0.97	0.59	(0.84)	(0.87)	0.64	(0.76)	0.62	(0.83)	(0.83)	(0.84)
1	0.66	0.64	(0.90)	(0.88)						

	Mean	Stand Dev	Pts	Min	Max	Sum
Total	0.78	0.12	14	0.59	0.97	10.87
(Edit)	0.84	0.04	8	0.76	0.90	6.75



C582-04, 3410m

Col >	1	2	3	4	5	6	7	8	9	0
Row	0.49	0.52	0.90	(0.79)	(0.79)	(0.83)	0.96	(0.78)	(0.70)	(0.82)
1	(0.74)	0.90	(0.78)	(0.86)	(0.81)	(0.71)	0.90	(0.85)	(0.66)	(0.83)
2	(0.71)	(0.80)	(0.69)	(0.85)	0.50	0.53				

	Mean	Stand Dev	Pts	Min	Max	Sum
Total	0.76	0.13	26	0.49	0.96	19.70
(Edit)	0.78	0.06	18	0.66	0.86	14.00