

Vitrinite reflectance gradient of the NO 6603/5-1S well

A study carried out for A/S Norske Shell

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Confidential report

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1. Introduction

This report presents vitrinite reflectance (VR) measurements of 21 samples from the NO 6603/5-1S well drilled in the Voering Basin in the Norwegian Sea by A/S Norske Shell. The samples consist of ditch cuttings (Table 1). The lithology of the samples is generally described as shale/claystone by A/S Norske Shell.

The water depth at the drill site is 1446 m and kelly bushing elevation is 40 m. The measured depth of the samples have been corrected for 1486 m (water depth + kelly bushing elevation) and all reported depths in this report are thus meters below sea bed (mbsb) (Table 1). The samples cover the depth range 844–3744 mbsb, corresponding to 2330–5230 m measured depth below kelly bushing.

The objective of the study is to establish a VR gradient for the NO 6603/5-1S well.

2. Methods

2.1. Sample preparation

Pellets of the ditch cuttings suited for reflected light microscopy were prepared from the 21 samples. The ditch cuttings were sieved between 1 mm and 4 mm in order to get the analysis fraction. The analysis fraction from each sample was embedded in epoxy, and the epoxy pellets were ground and polished to obtain a smooth surface.

2.2. Vitrinite reflectance measurements

VR measurements (random, oil immersion) were conducted using a Leitz Orthoplan reflected light microscope equipped with a 32x objective and the Diskus Fossil system (Hilgers Technisches Buero, Germany). The VR readings were taken at 546 nm (monochromatic light). Before measurement the microscope was calibrated against a YAG 0.903% R_o standard with integrated optical zero standard or against a GGG 1.677% R_o standard. The average VR for each sample was calculated from a population selected from the total reflectance histograms (Appendix 1 and 2). The method of determining the reflectance of vitrinite follows ISO 7404-5¹.

¹International Organization for Standardization (ISO), 1994: Methods for the petrographic analysis of bituminous coal and anthracite – Part 5: Method of determining microscopically the reflectance of vitrinite. ISO 7404-5.

Table 1. List of analysed samples

GEUS lab. no.	Shell no.	Type	Lithology	Lower depth (mbkb)	Lower depth (mbsb)
19521	625/0001-2	cuttings	shale/claystone	2330	844
19522	625/0006-1	cuttings	shale/claystone	2480	994
19523	625/0010-1	cuttings	siltstone	2580	1094
19524	625/0013-1	cuttings	shale/claystone	2670	1184
19525	625/0017-1	cuttings	shale/claystone	2790	1304
19526	625/0029-1	cuttings	shale/claystone	3140	1654
19527	625/0032-1	cuttings	shale/claystone	3230	1744
19528	625/0038-1	cuttings	shale/claystone	3430	1944
19529	625/0043-1	cuttings	shale/claystone	3560	2074
19530	625/0047-1	cuttings	shale/claystone	3600	2114
19531	625/0055-1	cuttings	shale/claystone	3840	2354
19532	625/0063-1	cuttings	shale/claystone	4060	2574
19533	625/0071-1	cuttings	shale/claystone	4300	2814
19534	625/0077-1	cuttings	shale/claystone	4480	2994
19535	625/0083-1	cuttings	shale/claystone	4660	3174
19536	625/0087-1	cuttings	shale/claystone	4780	3294
19537	625/0091-1	cuttings	shale/claystone	4900	3414
19538	625/0093-1	cuttings	shale/claystone	4955	3469
19539	625/0095-1	cuttings	shale/claystone	5020	3534
19540	625/0098-1	cuttings	shale/claystone	5110	3624
19541	625/0102-1	cuttings	shale/claystone	5230	3744

mbkb: meter below kelly bushing (measured depth)

mbsb: meter below sea bed

Kelly bushing: 40 m

Water depth: 1446 m

Table 2. Average VR (random) of selected VR populations

GEUS lab. no.	Shell no.	Lower depth (mbkb)	Lower depth (mbsb)	VR	Std.	N
19521	625/0001-2	2330	844	0.28	0.043	26
19522	625/0006-1	2480	994	0.33	0.035	20
19523	625/0010-1	2580	1094	0.38	0.056	25
19524	625/0013-1	2670	1184	0.43	0.060	44
19525	625/0017-1	2790	1304	0.45	0.069	38
19526	625/0029-1	3140	1654	0.57	0.055	17
19527	625/0032-1	3230	1744	0.64	0.052	43
19528	625/0038-1	3430	1944	0.68	0.044	32
19529	625/0043-1	3560	2074	0.67	0.032	13
19530	625/0047-1	3600	2114	0.93	0.068	39
19531	625/0055-1	3840	2354	1.07	0.099	94
19532	625/0063-1	4060	2574	1.06	0.100	57
19533	625/0071-1	4300	2814	1.30	0.115	88
19534	625/0077-1	4480	2994	1.59	0.092	73
19535	625/0083-1	4660	3174	2.18	0.162	188
19536	625/0087-1	4780	3294	2.40	0.094	70
19537	625/0091-1	4900	3414	2.86	0.095	92
19538	625/0093-1	4955	3469	2.98	0.108	92
19539	625/0095-1	5020	3534	3.16	0.119	67
19540	625/0098-1	5110	3624	3.38	0.128	127
19541	625/0102-1	5230	3744	3.54	0.139	97

mbkb: meter below kelly bushing (measured depth)

mbsb: meter below sea bed

Kelly bushing: 40 m

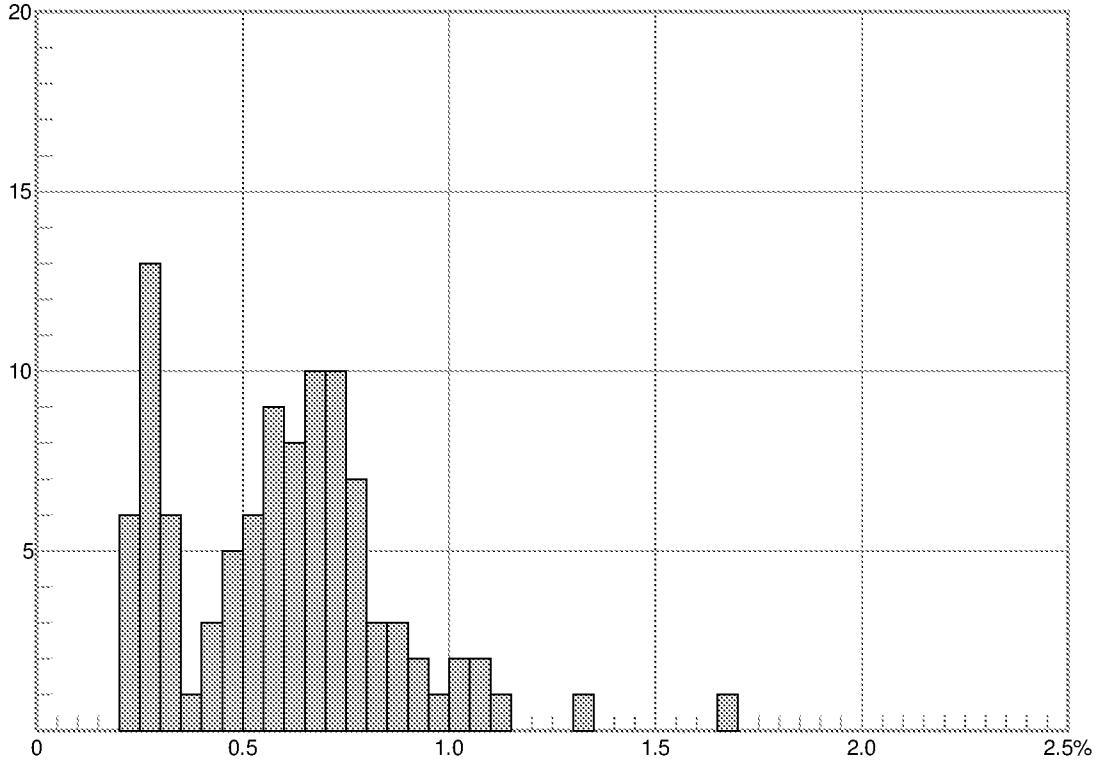
Water depth: 1446 m

Appendix 1

Total reflectance histograms

Sample : 19521

Activity no: 2011008; Standard: 0.903% Ro
 Sample number: 625/0001-2
 Well: NO 6603/5-1S; Depth 844 m
 Material: cuttings; Lithology: shale/claystone



Measure count = 100
 Reflectance Rr = 0.596 %
 s = 0.264 %

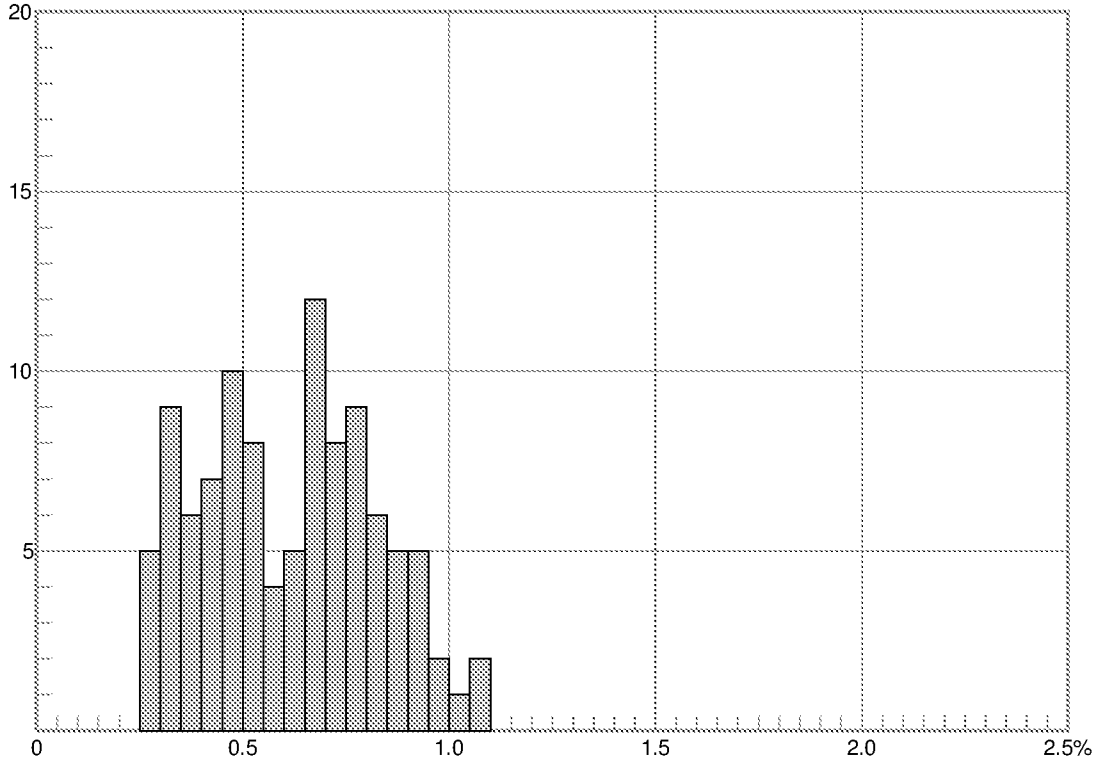
Date 7/22/2011 13:20
 Operator cgu
 Printed 7/25/2011

0.20 - 0.25 % R	6	0.75 - 0.80 % R	7
0.25 - 0.30 % R	13	0.80 - 0.85 % R	3
0.30 - 0.35 % R	6	0.85 - 0.90 % R	3
0.35 - 0.40 % R	1	0.90 - 0.95 % R	2
0.40 - 0.45 % R	3	0.95 - 1.00 % R	1
0.45 - 0.50 % R	5	1.00 - 1.05 % R	2
0.50 - 0.55 % R	6	1.05 - 1.10 % R	2
0.55 - 0.60 % R	9	1.10 - 1.15 % R	1
0.60 - 0.65 % R	8	1.15 - 1.20 % R	1
0.65 - 0.70 % R	10	1.20 - 1.25 % R	1
0.70 - 0.75 % R	10	1.25 - 1.30 % R	1
		1.30 - 1.35 % R	1
		1.35 - 1.40 % R	1
		1.40 - 1.45 % R	1
		1.45 - 1.50 % R	1
		1.50 - 1.55 % R	1
		1.55 - 1.60 % R	1
		1.60 - 1.65 % R	1
		1.65 - 1.70 % R	1

F=3.0.3195 D=4.80.6392

Sample : 19522

Activity no: 2011008; Standard: 0.903% Ro
 Sample number: 625/0006-2
 Well: NO 6603/5-1S; Depth 994 m
 Material: cuttings; Lithology: shale/claystone



Measure count = 104
 Reflectance Rr = 0.617 %
 s = 0.208 %

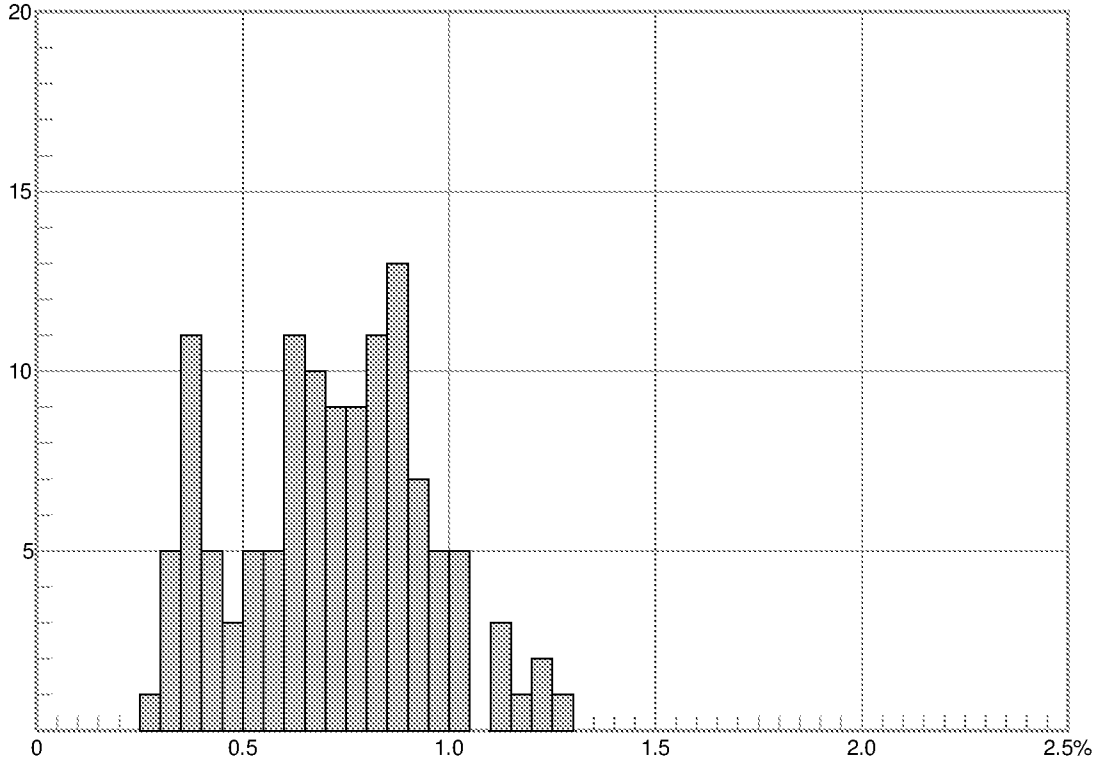
Date 7/25/2011 09:08
 Operator cgu
 Printed 7/25/2011

0.25 - 0.30 % R	5	0.70 - 0.75 % R	8
0.30 - 0.35 % R	9	0.75 - 0.80 % R	9
0.35 - 0.40 % R	6	0.80 - 0.85 % R	6
0.40 - 0.45 % R	7	0.85 - 0.90 % R	5
0.45 - 0.50 % R	10	0.90 - 0.95 % R	5
0.50 - 0.55 % R	8	0.95 - 1.00 % R	2
0.55 - 0.60 % R	4	1.00 - 1.05 % R	1
0.60 - 0.65 % R	5	1.05 - 1.10 % R	2
0.65 - 0.70 % R	12		

F=3.0.3195 D=4.80.6392

Sample : 19523

Activity no: 2011008; Standard: 0.903% Ro
 Sample number: 625/0010-1
 Well: NO 6603/5-1S; Depth 1094 m
 Material: cuttings; Lithology: siltstone



Measure count = 122
 Reflectance Rr = 0.714 %
 s = 0.230 %

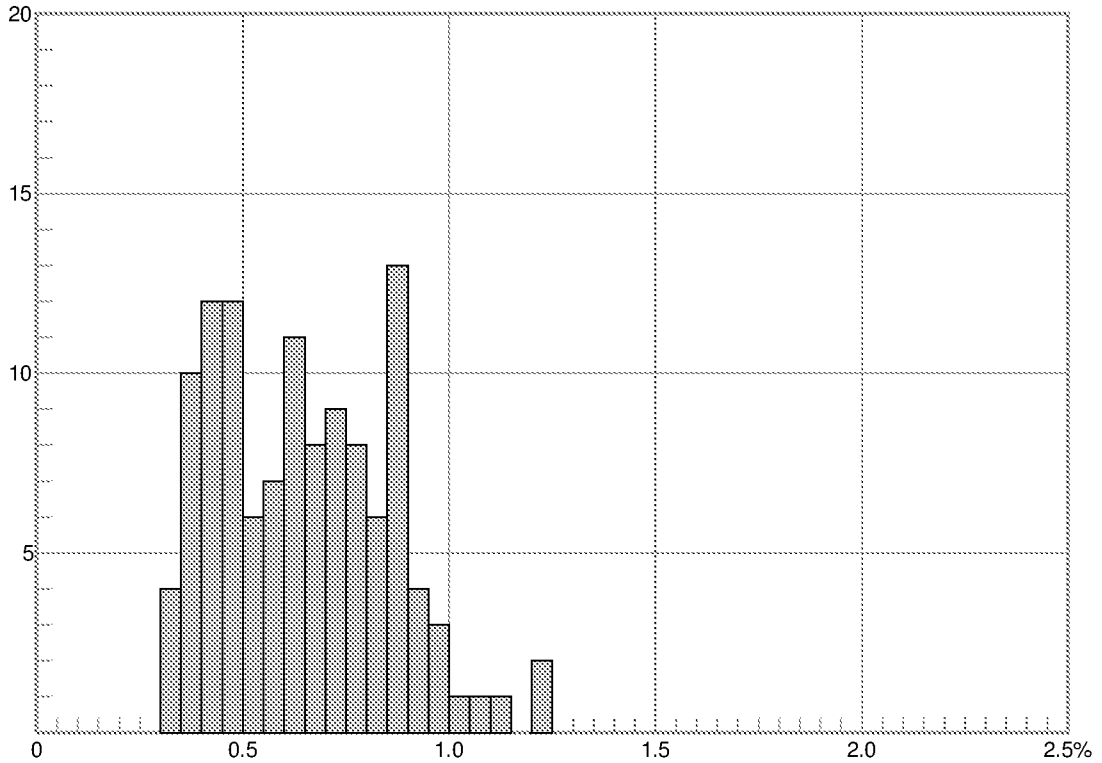
Date 7/25/2011 10:51
 Operator cgu
 Printed 7/25/2011

0.25 - 0.30 % R	1	0.75 - 0.80 % R	9
0.30 - 0.35 % R	5	0.80 - 0.85 % R	11
0.35 - 0.40 % R	11	0.85 - 0.90 % R	13
0.40 - 0.45 % R	5	0.90 - 0.95 % R	7
0.45 - 0.50 % R	3	0.95 - 1.00 % R	5
0.50 - 0.55 % R	5	1.00 - 1.05 % R	5
0.55 - 0.60 % R	5	1.10 - 1.15 % R	3
0.60 - 0.65 % R	11	1.15 - 1.20 % R	1
0.65 - 0.70 % R	10	1.20 - 1.25 % R	2
0.70 - 0.75 % R	9	1.25 - 1.30 % R	1

F=3.0.3195 D=4.80.6392

Sample : 19524

Activity no: 2011008; Standard: 0.903% Ro
 Sample number: 625/0013-1
 Well: NO 6603/5-1S; Depth 1184 m
 Material: cuttings; Lithology: shale/claystone



Measure count = 118
 Reflectance Rr = 0.648 %
 s = 0.208 %

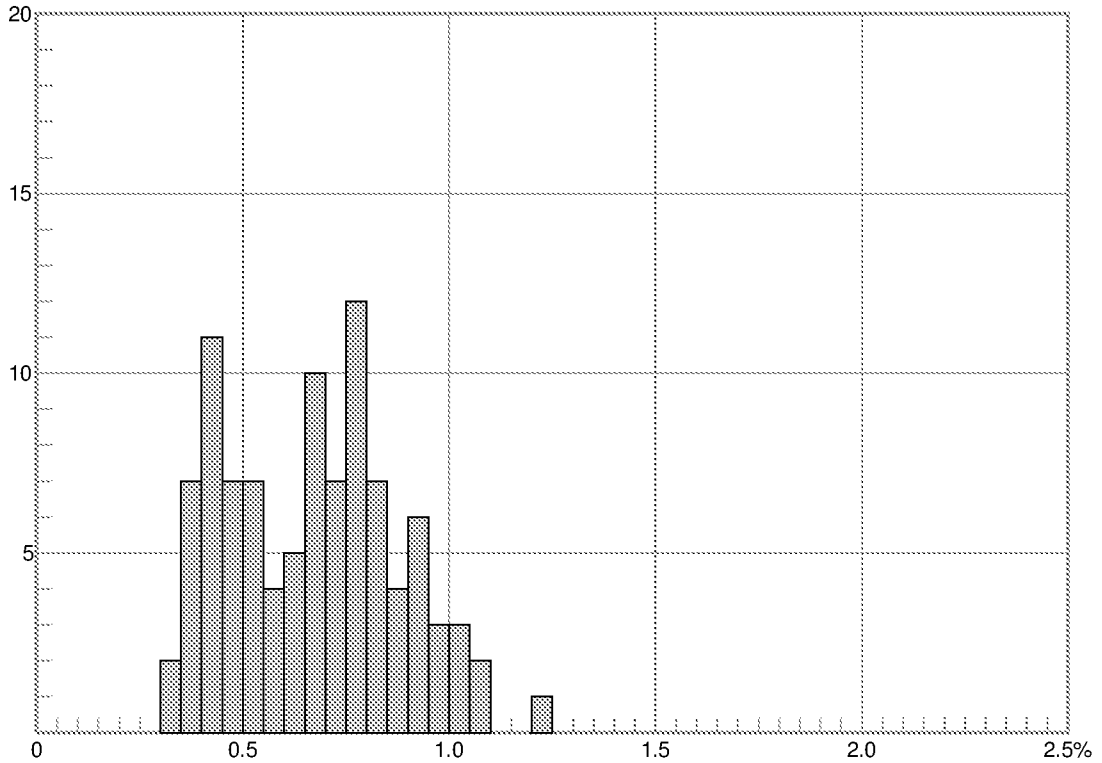
Date 7/25/2011 12:54
 Operator cgu
 Printed 7/25/2011

0.30 - 0.35 % R	4	0.75 - 0.80 % R	8
0.35 - 0.40 % R	10	0.80 - 0.85 % R	6
0.40 - 0.45 % R	12	0.85 - 0.90 % R	13
0.45 - 0.50 % R	12	0.90 - 0.95 % R	4
0.50 - 0.55 % R	6	0.95 - 1.00 % R	3
0.55 - 0.60 % R	7	1.00 - 1.05 % R	1
0.60 - 0.65 % R	11	1.05 - 1.10 % R	1
0.65 - 0.70 % R	8	1.10 - 1.15 % R	1
0.70 - 0.75 % R	9	1.20 - 1.25 % R	2

F=3.0.3195 D=4.80.6392

Sample : 19525

Activity no: 2011008; Standard: 0.903% Ro
 Sample number: 625/0017-1
 Well: NO 6603/5-1S; Depth 1304 m
 Material: cuttings; Lithology: shale/claystone



Measure count = 98
 Reflectance Rr = 0.671 %
 s = 0.207 %

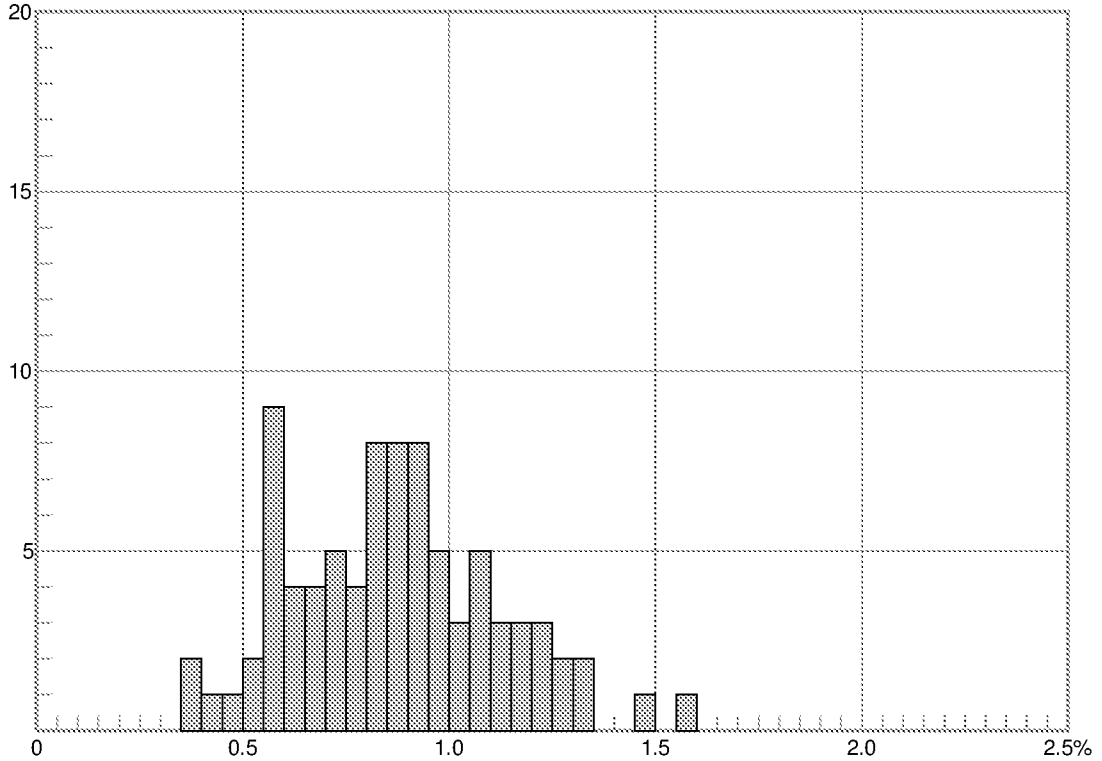
Date 7/25/2011 14:20
 Operator cgu
 Printed 7/25/2011

0.30 - 0.35 % R	2	0.75 - 0.80 % R	12
0.35 - 0.40 % R	7	0.80 - 0.85 % R	7
0.40 - 0.45 % R	11	0.85 - 0.90 % R	4
0.45 - 0.50 % R	7	0.90 - 0.95 % R	6
0.50 - 0.55 % R	7	0.95 - 1.00 % R	3
0.55 - 0.60 % R	4	1.00 - 1.05 % R	3
0.60 - 0.65 % R	5	1.05 - 1.10 % R	2
0.65 - 0.70 % R	10	1.20 - 1.25 % R	1
0.70 - 0.75 % R	7		

F=3.0.3195 D=4.80.6392

Sample : 19526

Activity no: 2011008; Standard: 0.903% Ro
 Sample number: 625/0029-1
 Well: NO 6603/5-1S; Depth 1654 m
 Material: cuttings; Lithology: shale/claystone



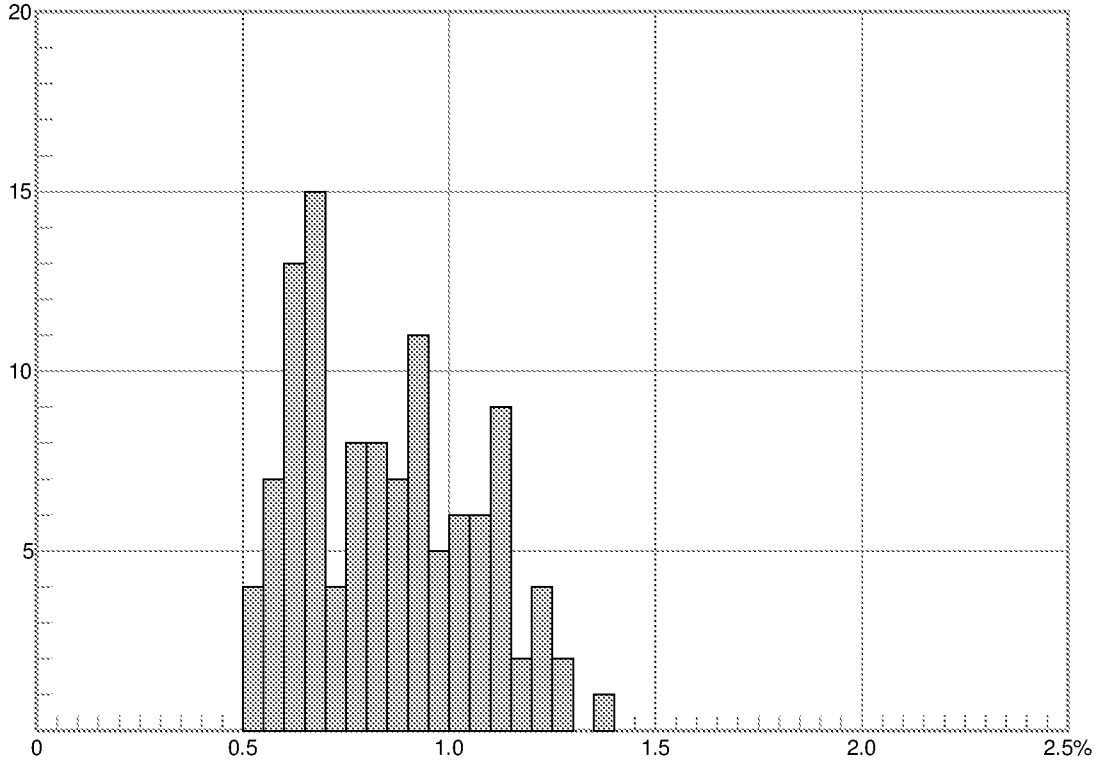
Measure count = 84
 Reflectance Rr = 0.870 %
 s = 0.248 %

Date 7/25/2011 15:48
 Operator cgu
 Printed 7/25/2011

0.35 - 0.40 % R	2	0.90 - 0.95 % R	8
0.40 - 0.45 % R	1	0.95 - 1.00 % R	5
0.45 - 0.50 % R	1	1.00 - 1.05 % R	3
0.50 - 0.55 % R	2	1.05 - 1.10 % R	5
0.55 - 0.60 % R	9	1.10 - 1.15 % R	3
0.60 - 0.65 % R	4	1.15 - 1.20 % R	3
0.65 - 0.70 % R	4	1.20 - 1.25 % R	3
0.70 - 0.75 % R	5	1.25 - 1.30 % R	2
0.75 - 0.80 % R	4	1.30 - 1.35 % R	2
0.80 - 0.85 % R	8	1.35 - 1.40 % R	2
0.85 - 0.90 % R	8	1.40 - 1.45 % R	1
		1.45 - 1.50 % R	1
		1.50 - 1.55 % R	1

Sample : 19527

Activity no: 2011008; Standard: 0.903% Ro
 Sample number: 625/0032-1
 Well: NO 6603/5-1S; Depth 1744 m
 Material: cuttings; Lithology: shale/claystone



Measure count = 112
 Reflectance Rr = 0.849 %
 s = 0.209 %

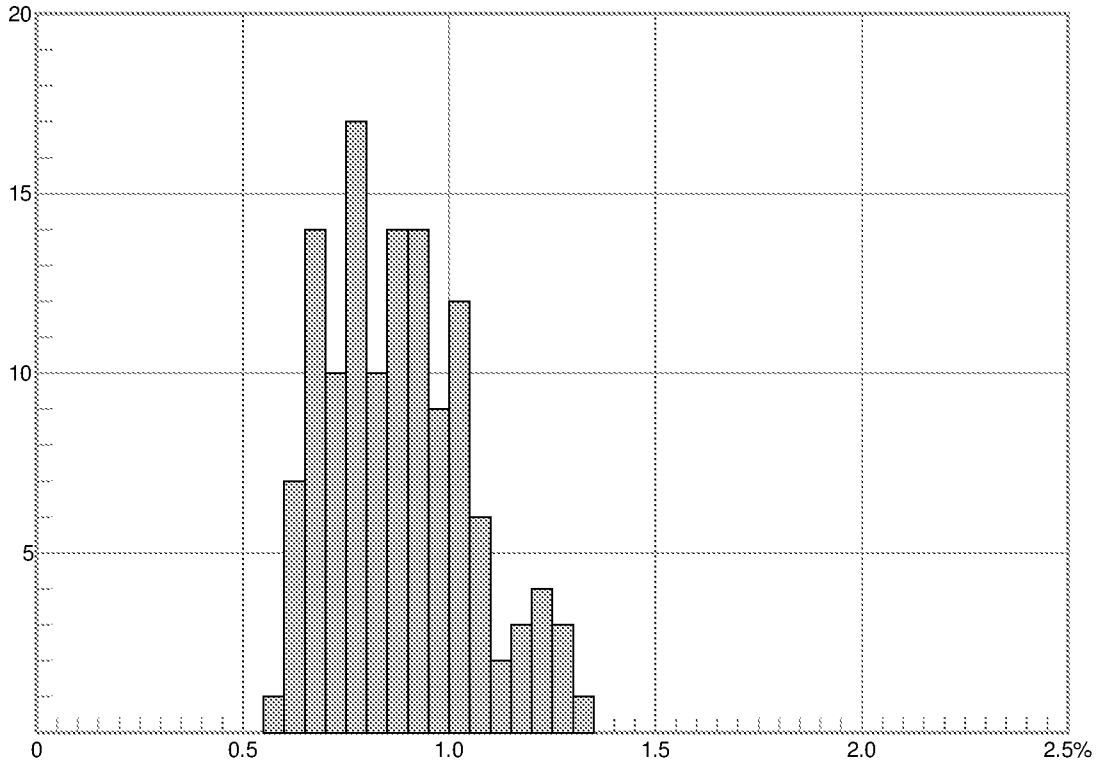
Date 7/26/2011 09:56
 Operator cgu
 Printed 7/26/2011

0.50 - 0.55 % R	4	0.95 - 1.00 % R	5
0.55 - 0.60 % R	7	1.00 - 1.05 % R	6
0.60 - 0.65 % R	13	1.05 - 1.10 % R	6
0.65 - 0.70 % R	15	1.10 - 1.15 % R	9
0.70 - 0.75 % R	4	1.15 - 1.20 % R	2
0.75 - 0.80 % R	8	1.20 - 1.25 % R	4
0.80 - 0.85 % R	8	1.25 - 1.30 % R	2
0.85 - 0.90 % R	7	1.35 - 1.40 % R	1
0.90 - 0.95 % R	11		

F=3.0.3195 D=4.80.6392

Sample : 19528

Activity no: 2011008; Standard: 0.903% Ro
 Sample number: 625/0038-1
 Well: NO 6603/5-1S; Depth 1944 m
 Material: cuttings; Lithology: shale/claystone



Measure count = 127
 Reflectance Rr = 0.878 %
 s = 0.169 %

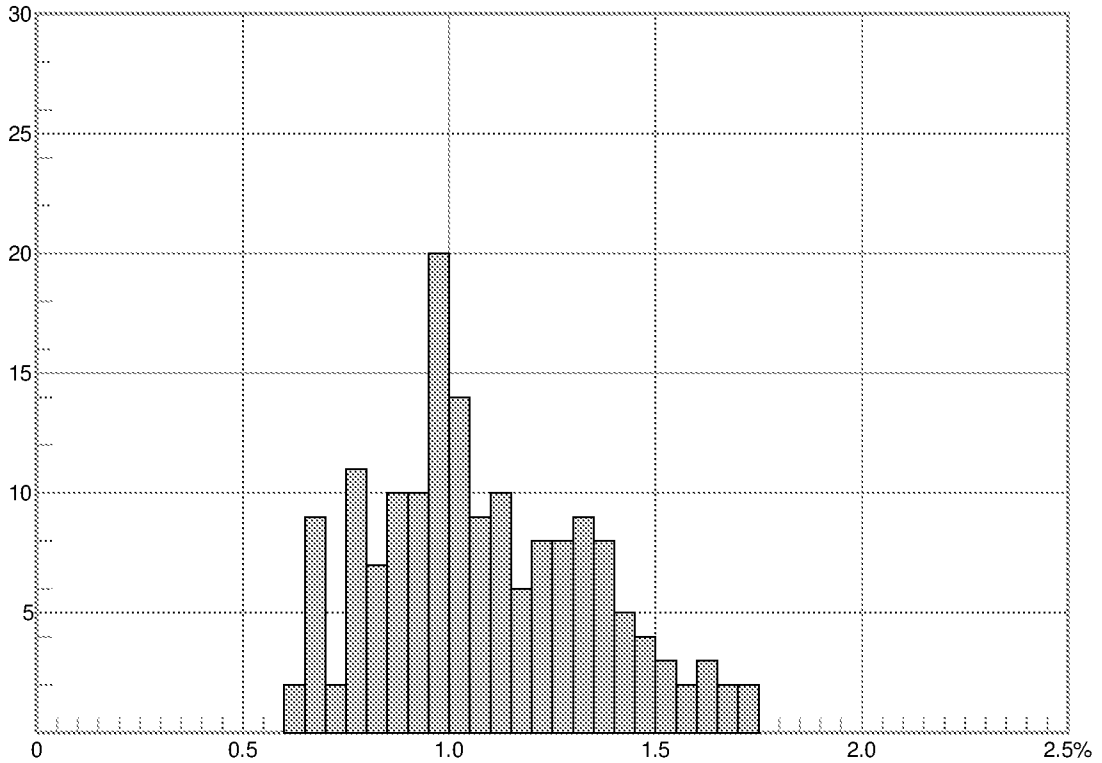
Date 7/26/2011 11:21
 Operator cgu
 Printed 7/26/2011

0.55 - 0.60 % R	1	0.95 - 1.00 % R	9
0.60 - 0.65 % R	7	1.00 - 1.05 % R	12
0.65 - 0.70 % R	14	1.05 - 1.10 % R	6
0.70 - 0.75 % R	10	1.10 - 1.15 % R	2
0.75 - 0.80 % R	17	1.15 - 1.20 % R	3
0.80 - 0.85 % R	10	1.20 - 1.25 % R	4
0.85 - 0.90 % R	14	1.25 - 1.30 % R	3
0.90 - 0.95 % R	14	1.30 - 1.35 % R	1

F=3.0.3195 D=4.80.6392

Sample : 19529

Activity no: 2011008; Standard: 0.903% Ro
 Sample number: 625/0043-1
 Well: NO 6603/5-1S; Depth 2074 m
 Material: cuttings; Lithology: shale/claystone



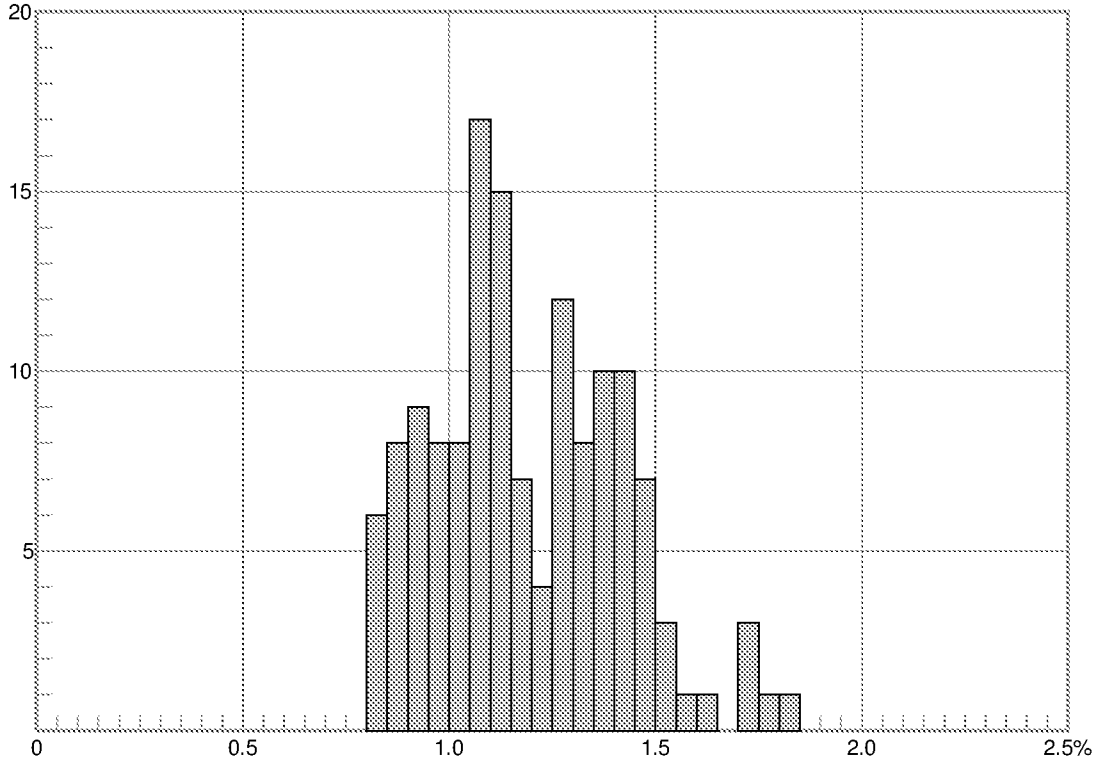
Measure count = 164
 Reflectance Rr = 1.086 %
 s = 0.260 %

Date 7/26/2011 13:03
 Operator cgu
 Printed 7/26/2011

0.60 - 0.65 % R	2	1.20 - 1.25 % R	8
0.65 - 0.70 % R	9	1.25 - 1.30 % R	8
0.70 - 0.75 % R	2	1.30 - 1.35 % R	9
0.75 - 0.80 % R	11	1.35 - 1.40 % R	8
0.80 - 0.85 % R	7	1.40 - 1.45 % R	5
0.85 - 0.90 % R	10	1.45 - 1.50 % R	4
0.90 - 0.95 % R	10	1.50 - 1.55 % R	3
0.95 - 1.00 % R	20	1.55 - 1.60 % R	2
1.00 - 1.05 % R	14	1.60 - 1.65 % R	3
1.05 - 1.10 % R	9	1.65 - 1.70 % R	2
1.10 - 1.15 % R	10	1.70 - 1.75 % R	2
1.15 - 1.20 % R	6		

Sample : 19530

Activity no: 2011008; Standard: 0.903% Ro
 Sample number: 625/0047-1
 Well: NO 6603/5-1S; Depth 2114 m
 Material: cuttings; Lithology: shale/claystone



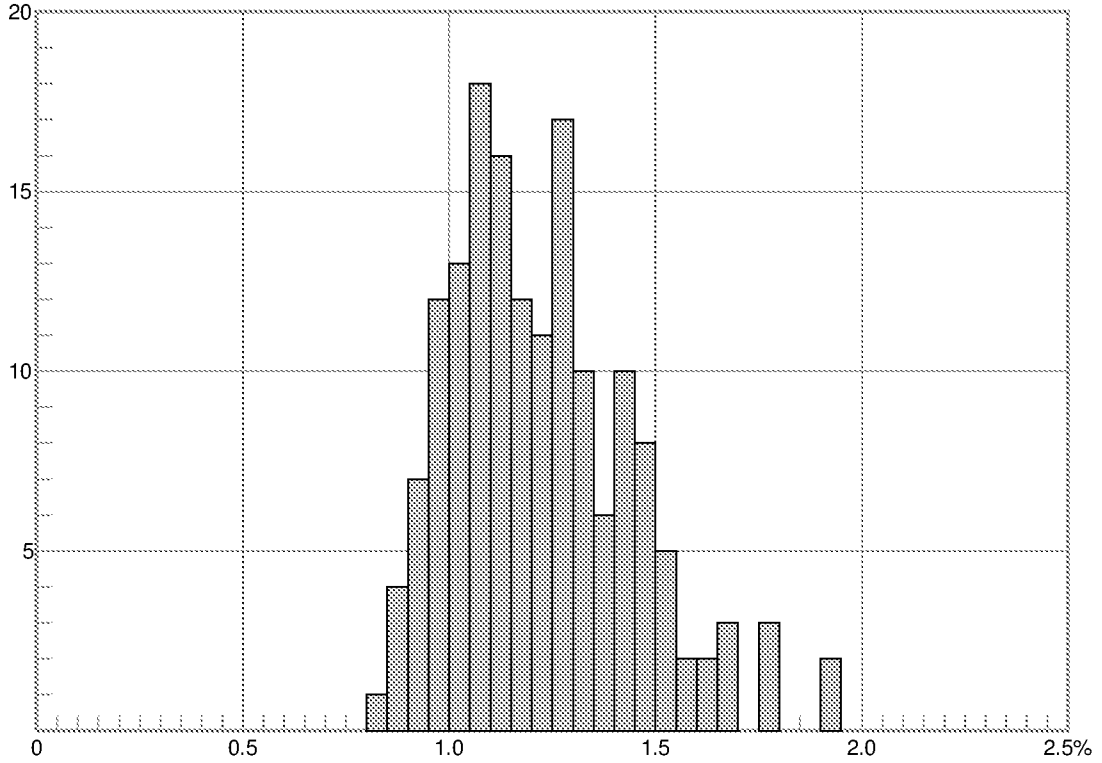
Measure count = 139
 Reflectance Rr = 1.190 %
 s = 0.225 %

Date 7/26/2011 15:07
 Operator cgu
 Printed 7/26/2011

0.80 - 0.85 % R	6	1.30 - 1.35 % R	8
0.85 - 0.90 % R	8	1.35 - 1.40 % R	10
0.90 - 0.95 % R	9	1.40 - 1.45 % R	10
0.95 - 1.00 % R	8	1.45 - 1.50 % R	7
1.00 - 1.05 % R	8	1.50 - 1.55 % R	3
1.05 - 1.10 % R	17	1.55 - 1.60 % R	1
1.10 - 1.15 % R	15	1.60 - 1.65 % R	1
1.15 - 1.20 % R	7	1.70 - 1.75 % R	3
1.20 - 1.25 % R	4	1.75 - 1.80 % R	1
1.25 - 1.30 % R	12	1.80 - 1.85 % R	1

Sample : 19531

Activity no: 2011008; Standard: 0.903% Ro
 Sample number: 625/0055-1
 Well: NO 6603/5-1S; Depth 2354 m
 Material: cuttings; Lithology: shale/claystone



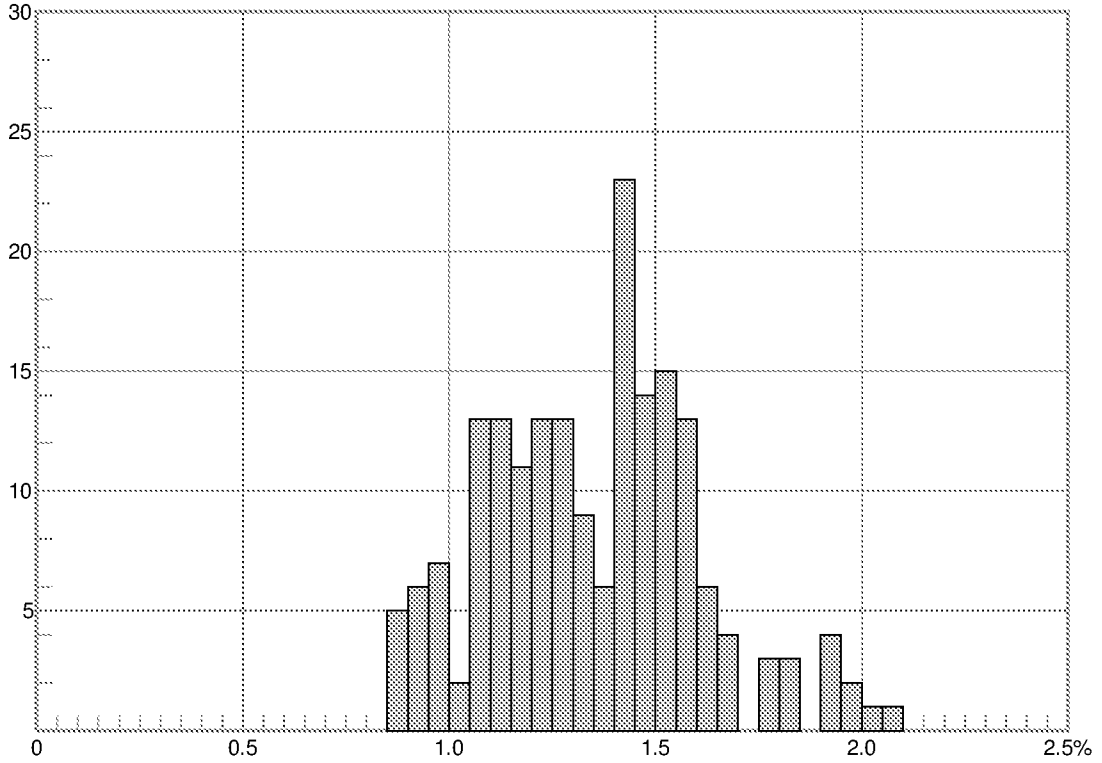
Measure count = 162
 Reflectance Rr = 1.223 %
 s = 0.218 %

Date 7/27/2011 09:18
 Operator cgu
 Printed 7/27/2011

0.80 - 0.85 % R	1	1.30 - 1.35 % R	10
0.85 - 0.90 % R	4	1.35 - 1.40 % R	6
0.90 - 0.95 % R	7	1.40 - 1.45 % R	10
0.95 - 1.00 % R	12	1.45 - 1.50 % R	8
1.00 - 1.05 % R	13	1.50 - 1.55 % R	5
1.05 - 1.10 % R	18	1.55 - 1.60 % R	2
1.10 - 1.15 % R	16	1.60 - 1.65 % R	2
1.15 - 1.20 % R	12	1.65 - 1.70 % R	3
1.20 - 1.25 % R	11	1.75 - 1.80 % R	3
1.25 - 1.30 % R	17	1.90 - 1.95 % R	2

Sample : 19532

Activity no: 2011008; Standard: 0.903% Ro
 Sample number: 625/0063-1
 Well: NO 6603/5-1S; Depth 2574 m
 Material: cuttings; Lithology: shale/claystone



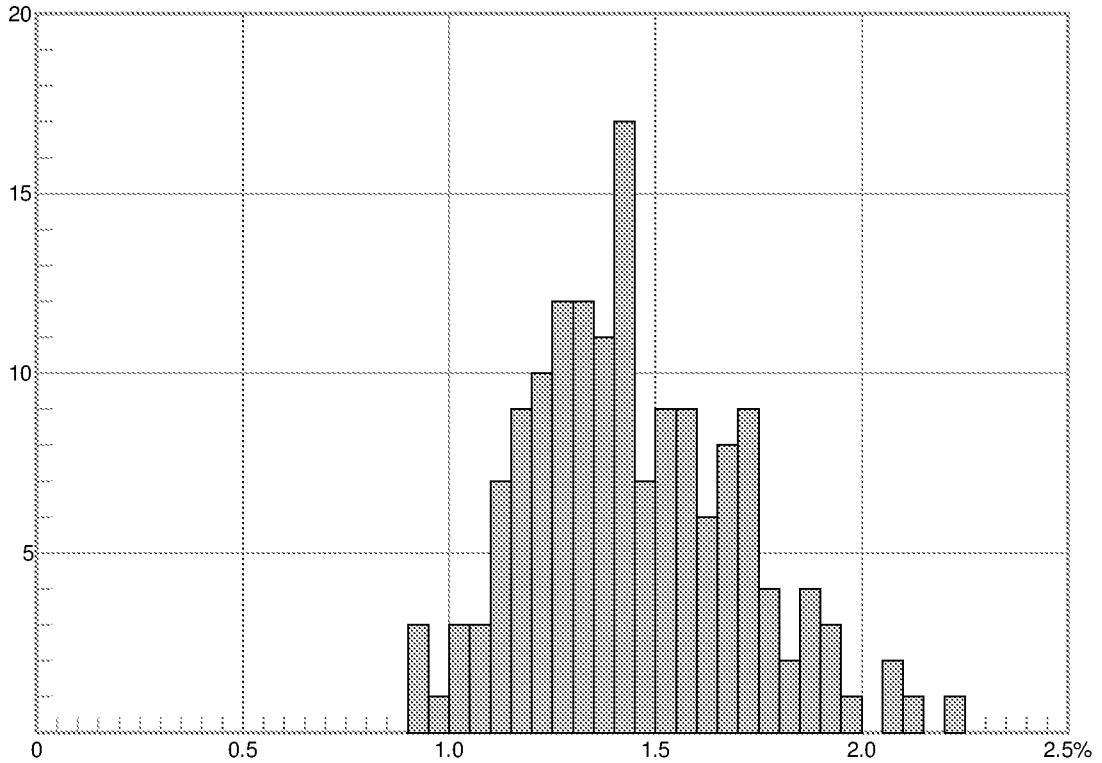
Measure count = 187
 Reflectance Rr = 1.351 %
 s = 0.256 %

Date 7/27/2011 11:09
 Operator cgu
 Printed 7/27/2011

0.85 - 0.90 % R	5	1.45 - 1.50 % R	14
0.90 - 0.95 % R	6	1.50 - 1.55 % R	15
0.95 - 1.00 % R	7	1.55 - 1.60 % R	13
1.00 - 1.05 % R	2	1.60 - 1.65 % R	6
1.05 - 1.10 % R	13	1.65 - 1.70 % R	4
1.10 - 1.15 % R	13	1.75 - 1.80 % R	3
1.15 - 1.20 % R	11	1.80 - 1.85 % R	3
1.20 - 1.25 % R	13	1.90 - 1.95 % R	4
1.25 - 1.30 % R	13	1.95 - 2.00 % R	2
1.30 - 1.35 % R	9	2.00 - 2.05 % R	1
1.35 - 1.40 % R	6	2.05 - 2.10 % R	1
1.40 - 1.45 % R	23		

Sample : 19533

Activity no: 2011008; Standard: 0.903% Ro
 Sample number: 625/0071-1
 Well: NO 6603/5-1S; Depth 2814 m
 Material: cuttings; Lithology: shale/claystone



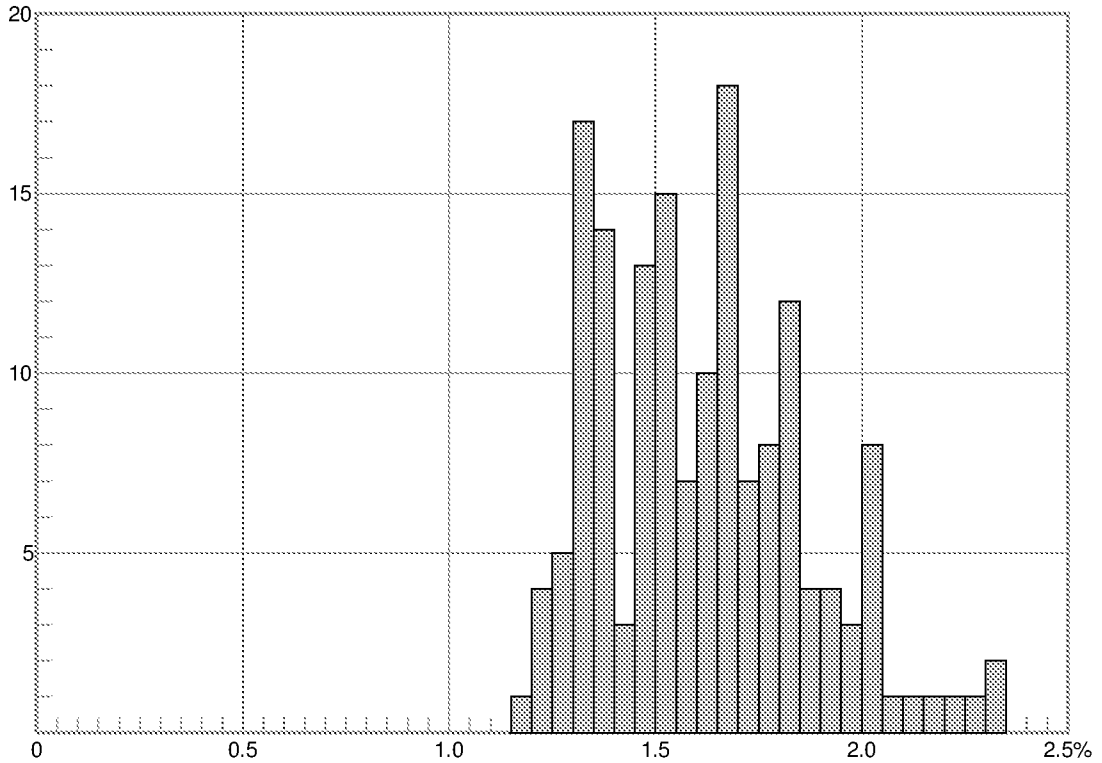
Measure count = 154
 Reflectance Rr = 1.443 %
 s = 0.257 %

Date 7/27/2011 13:09
 Operator cgu
 Printed 7/27/2011

0.90 - 0.95 % R	3	1.55 - 1.60 % R	9
0.95 - 1.00 % R	1	1.60 - 1.65 % R	6
1.00 - 1.05 % R	3	1.65 - 1.70 % R	8
1.05 - 1.10 % R	3	1.70 - 1.75 % R	9
1.10 - 1.15 % R	7	1.75 - 1.80 % R	4
1.15 - 1.20 % R	9	1.80 - 1.85 % R	2
1.20 - 1.25 % R	10	1.85 - 1.90 % R	4
1.25 - 1.30 % R	12	1.90 - 1.95 % R	3
1.30 - 1.35 % R	12	1.95 - 2.00 % R	1
1.35 - 1.40 % R	11	2.05 - 2.10 % R	2
1.40 - 1.45 % R	17	2.10 - 2.15 % R	1
1.45 - 1.50 % R	7	2.20 - 2.25 % R	1
1.50 - 1.55 % R	9		

Sample : 19534

Activity no: 2011008; Standard: 0.903% Ro
 Sample number: 625/0077-1
 Well: NO 6603/5-1S; Depth 2994 m
 Material: cuttings; Lithology: shale/claystone



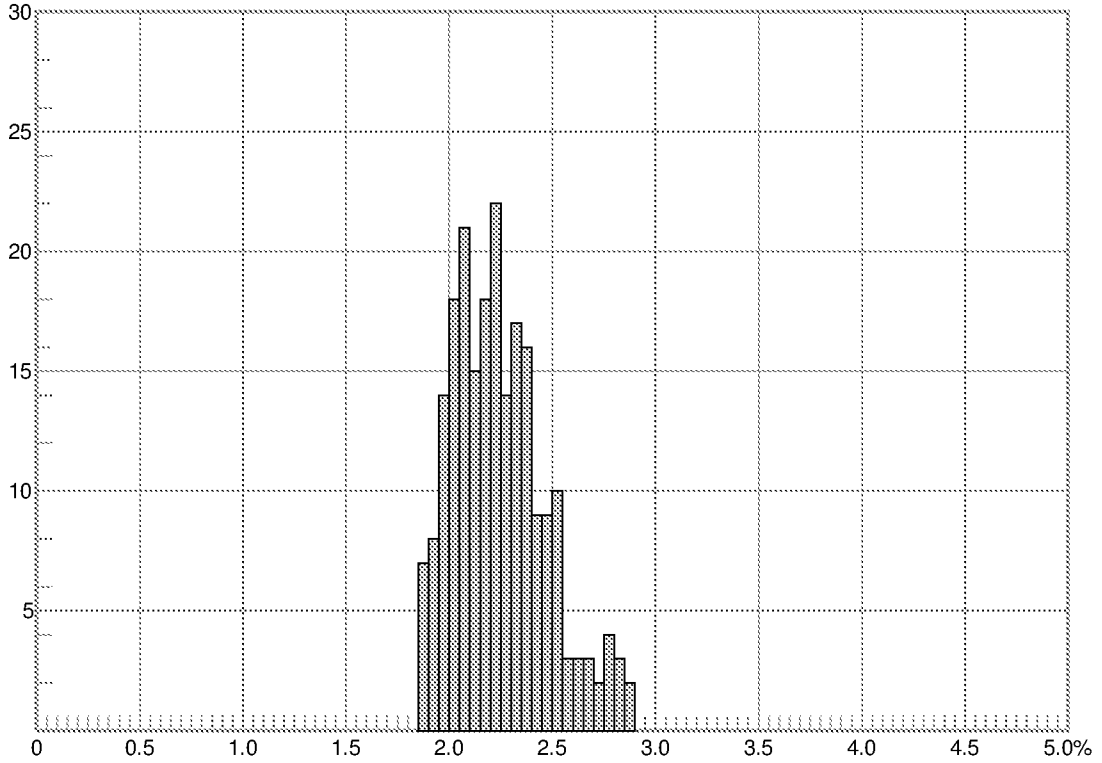
Measure count = 160
 Reflectance Rr = 1.621 %
 s = 0.251 %

Date 7/27/2011 14:51
 Operator cgu
 Printed 7/27/2011

1.15 - 1.20 % R	1	1.75 - 1.80 % R	8
1.20 - 1.25 % R	4	1.80 - 1.85 % R	12
1.25 - 1.30 % R	5	1.85 - 1.90 % R	4
1.30 - 1.35 % R	17	1.90 - 1.95 % R	4
1.35 - 1.40 % R	14	1.95 - 2.00 % R	3
1.40 - 1.45 % R	3	2.00 - 2.05 % R	8
1.45 - 1.50 % R	13	2.05 - 2.10 % R	1
1.50 - 1.55 % R	15	2.10 - 2.15 % R	1
1.55 - 1.60 % R	7	2.15 - 2.20 % R	1
1.60 - 1.65 % R	10	2.20 - 2.25 % R	1
1.65 - 1.70 % R	18	2.25 - 2.30 % R	1
1.70 - 1.75 % R	7	2.30 - 2.35 % R	2

Sample : 19535

Activity no: 2011008; Standard: 1.677% Ro
 Sample number: 625/0083-1
 Well: NO 6603/5-1S; Depth 3174 m
 Material: cuttings; Lithology: shale/claystone



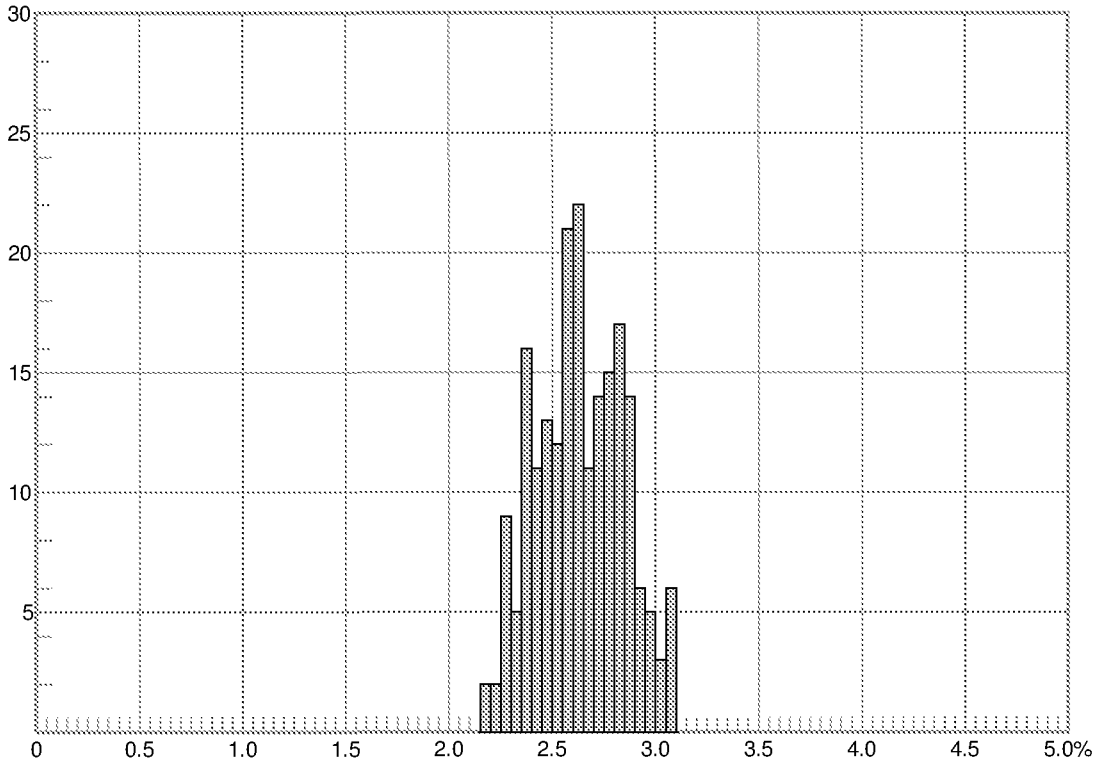
Measure count =	218	Date	7/28/2011 10:55
Reflectance Rr =	2.243 %	Operator	cgu
s =	0.227 %	Printed	7/28/2011

1.85 - 1.90 % R	7	2.40 - 2.45 % R	9
1.90 - 1.95 % R	8	2.45 - 2.50 % R	9
1.95 - 2.00 % R	14	2.50 - 2.55 % R	10
2.00 - 2.05 % R	18	2.55 - 2.60 % R	3
2.05 - 2.10 % R	21	2.60 - 2.65 % R	3
2.10 - 2.15 % R	15	2.65 - 2.70 % R	3
2.15 - 2.20 % R	18	2.70 - 2.75 % R	2
2.20 - 2.25 % R	22	2.75 - 2.80 % R	4
2.25 - 2.30 % R	14	2.80 - 2.85 % R	3
2.30 - 2.35 % R	17	2.85 - 2.90 % R	2
2.35 - 2.40 % R	16		

F=3.0.3195 D=4.80.6392

Sample : 19536

Activity no: 2011008; Standard: 1.677% Ro
 Sample number: 625/0087-1
 Well: NO 6603/5-1S; Depth 3294 m
 Material: cuttings; Lithology: shale/claystone



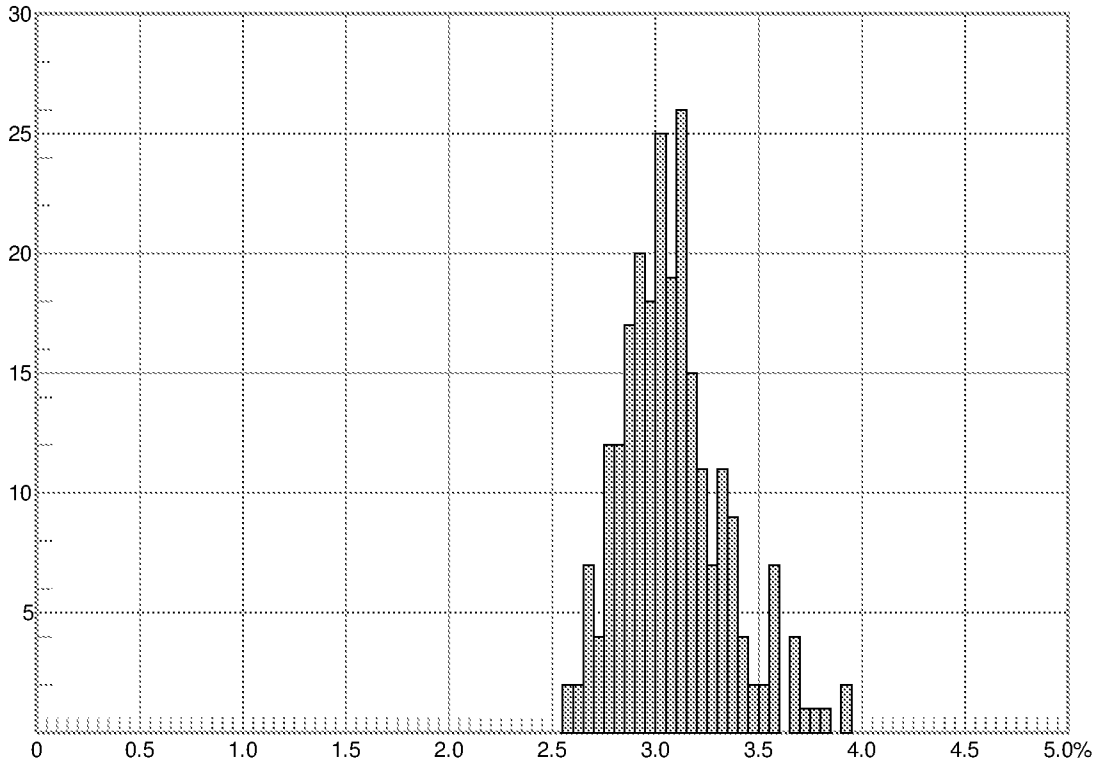
Measure count =	204	Date	7/28/2011 13:00
Reflectance Rr =	2.634 %	Operator	cgu
s =	0.210 %	Printed	7/28/2011

2.15 - 2.20 % R	2	2.65 - 2.70 % R	11
2.20 - 2.25 % R	2	2.70 - 2.75 % R	14
2.25 - 2.30 % R	9	2.75 - 2.80 % R	15
2.30 - 2.35 % R	5	2.80 - 2.85 % R	17
2.35 - 2.40 % R	16	2.85 - 2.90 % R	14
2.40 - 2.45 % R	11	2.90 - 2.95 % R	6
2.45 - 2.50 % R	13	2.95 - 3.00 % R	5
2.50 - 2.55 % R	12	3.00 - 3.05 % R	3
2.55 - 2.60 % R	21	3.05 - 3.10 % R	6
2.60 - 2.65 % R	22		

F=3.0.3195 D=4.80.6392

Sample : 19537

Activity no: 2011008; Standard: 1.677% Ro
 Sample number: 625/0091-1
 Well: NO 6603/5-1S; Depth 3414 m
 Material: cuttings; Lithology: shale/claystone



Measure count = 241
 Reflectance Rr = 3.082 %
 s = 0.252 %

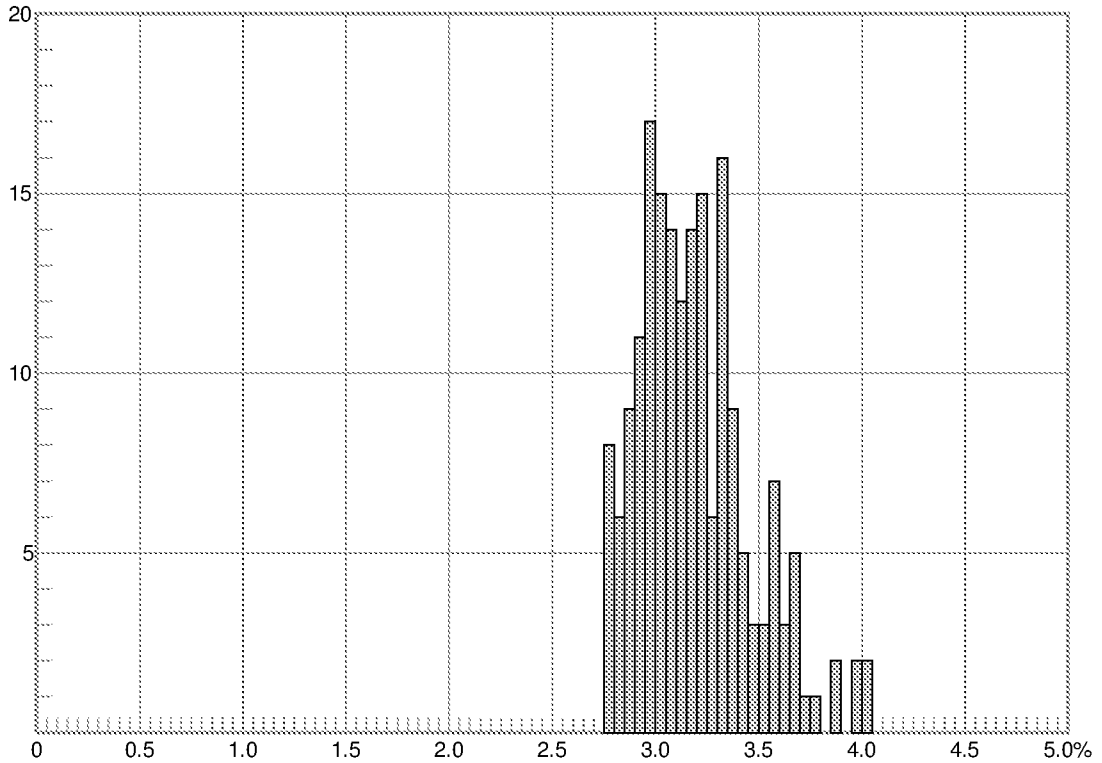
Date 7/28/2011 15:17
 Operator cgu
 Printed 7/28/2011

2.55 - 2.60 % R	2	3.20 - 3.25 % R	11
2.60 - 2.65 % R	2	3.25 - 3.30 % R	7
2.65 - 2.70 % R	7	3.30 - 3.35 % R	11
2.70 - 2.75 % R	4	3.35 - 3.40 % R	9
2.75 - 2.80 % R	12	3.40 - 3.45 % R	4
2.80 - 2.85 % R	12	3.45 - 3.50 % R	2
2.85 - 2.90 % R	17	3.50 - 3.55 % R	2
2.90 - 2.95 % R	20	3.55 - 3.60 % R	7
2.95 - 3.00 % R	18	3.65 - 3.70 % R	4
3.00 - 3.05 % R	25	3.70 - 3.75 % R	1
3.05 - 3.10 % R	19	3.75 - 3.80 % R	1
3.10 - 3.15 % R	26	3.80 - 3.85 % R	1
3.15 - 3.20 % R	15	3.90 - 3.95 % R	2

F=3.0.3195 D=4.80.6392

Sample : 19538

Activity no: 2011008; Standard: 1.677% Ro
 Sample number: 625/0093-1
 Well: NO 6603/5-1S; Depth 3469 m
 Material: cuttings; Lithology: shale/claystone



Measure count = 186
 Reflectance Rr = 3.192 %
 s = 0.273 %

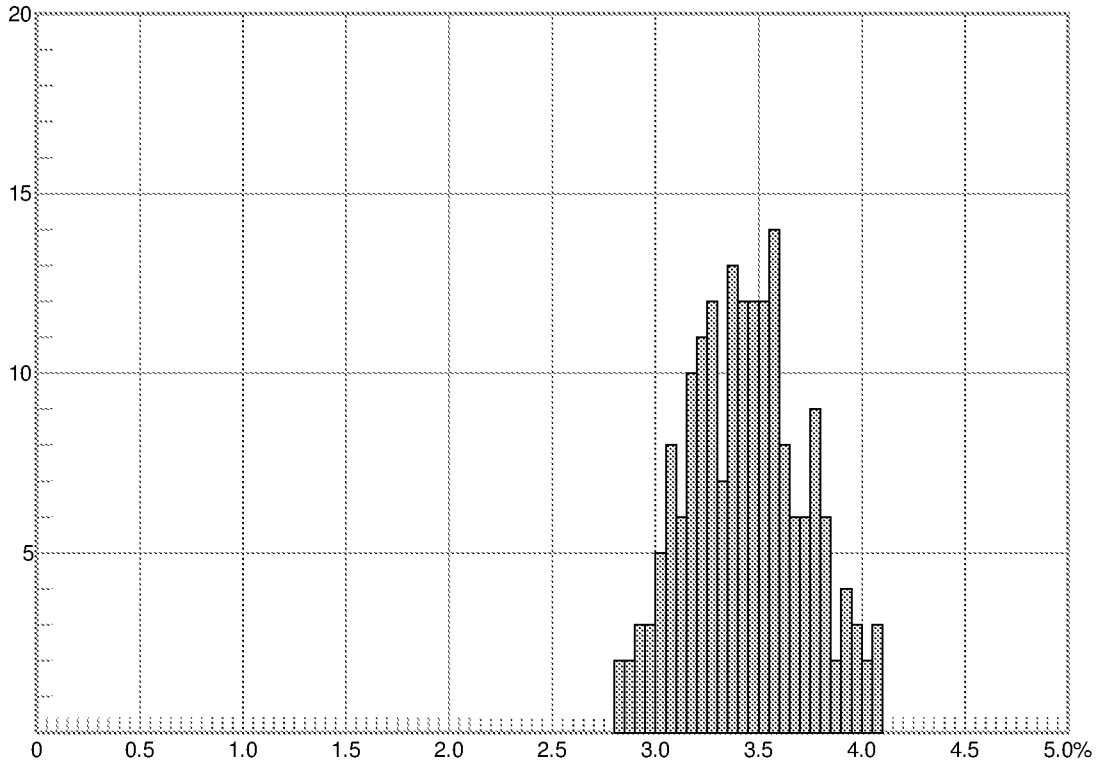
Date 7/29/2011 10:18
 Operator cgu
 Printed 7/29/2011

2.75 - 2.80 % R	8	3.35 - 3.40 % R	9
2.80 - 2.85 % R	6	3.40 - 3.45 % R	5
2.85 - 2.90 % R	9	3.45 - 3.50 % R	3
2.90 - 2.95 % R	11	3.50 - 3.55 % R	3
2.95 - 3.00 % R	17	3.55 - 3.60 % R	7
3.00 - 3.05 % R	15	3.60 - 3.65 % R	3
3.05 - 3.10 % R	14	3.65 - 3.70 % R	5
3.10 - 3.15 % R	12	3.70 - 3.75 % R	1
3.15 - 3.20 % R	14	3.75 - 3.80 % R	1
3.20 - 3.25 % R	15	3.85 - 3.90 % R	2
3.25 - 3.30 % R	6	3.95 - 4.00 % R	2
3.30 - 3.35 % R	16	4.00 - 4.05 % R	2

F=3.0.3195 D=4.80.6392

Sample : 19539

Activity no: 2011008; Standard: 1.677% Ro
 Sample number: 625/0095-1
 Well: NO 6603/5-1S; Depth 3534 m
 Material: cuttings; Lithology: shale/claystone



Measure count = 181
 Reflectance Rr = 3.439 %
 s = 0.285 %

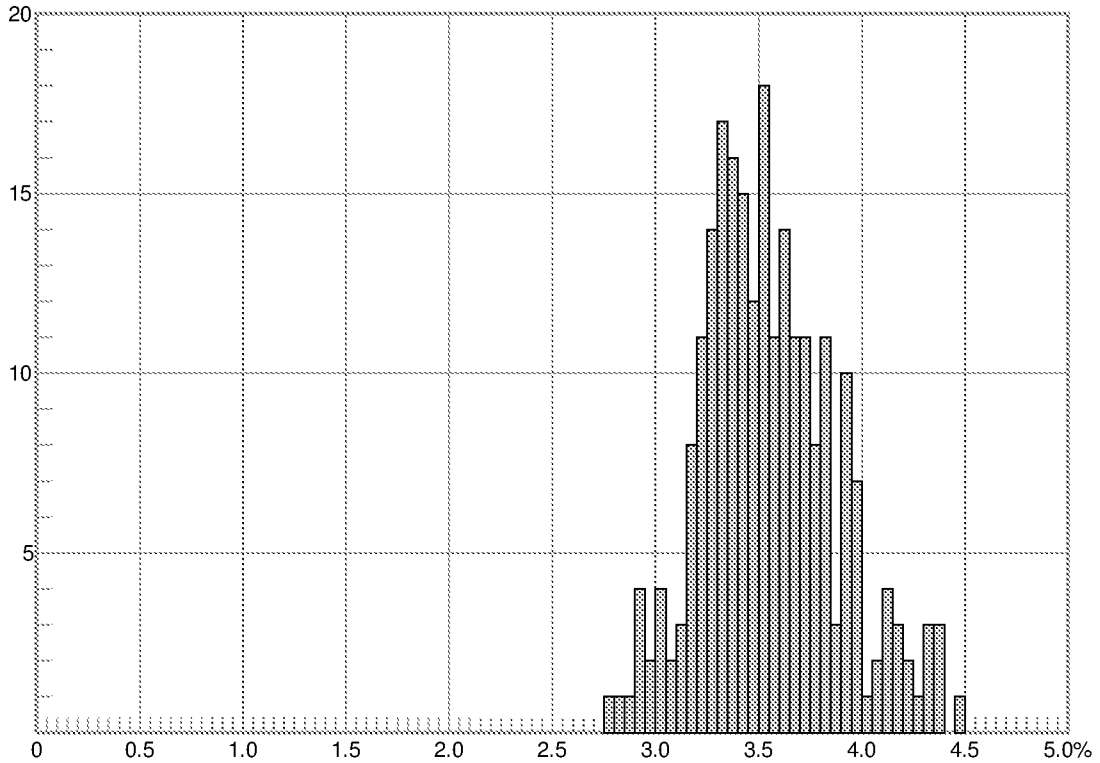
Date 7/29/2011 11:35
 Operator cgu
 Printed 7/29/2011

2.80 - 2.85 % R	2	3.45 - 3.50 % R	12
2.85 - 2.90 % R	2	3.50 - 3.55 % R	12
2.90 - 2.95 % R	3	3.55 - 3.60 % R	14
2.95 - 3.00 % R	3	3.60 - 3.65 % R	8
3.00 - 3.05 % R	5	3.65 - 3.70 % R	6
3.05 - 3.10 % R	8	3.70 - 3.75 % R	6
3.10 - 3.15 % R	6	3.75 - 3.80 % R	9
3.15 - 3.20 % R	10	3.80 - 3.85 % R	6
3.20 - 3.25 % R	11	3.85 - 3.90 % R	2
3.25 - 3.30 % R	12	3.90 - 3.95 % R	4
3.30 - 3.35 % R	7	3.95 - 4.00 % R	3
3.35 - 3.40 % R	13	4.00 - 4.05 % R	2
3.40 - 3.45 % R	12	4.05 - 4.10 % R	3

F=3.0.3195 D=4.80.6392

Sample : 19540

Activity no: 2011008; Standard: 1.677% Ro
 Sample number: 625/0098-1
 Well: NO 6603/5-1S; Depth 3624 m
 Material: cuttings; Lithology: shale/claystone



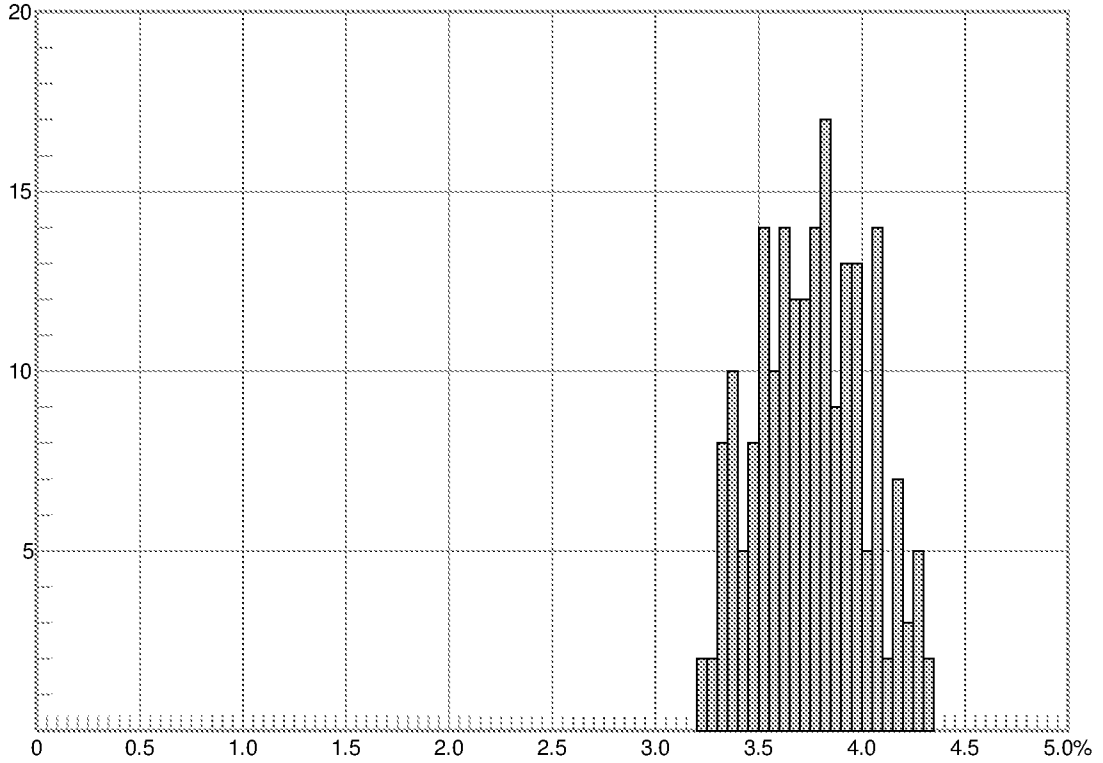
Measure count = 235
 Reflectance Rr = 3.552 %
 s = 0.327 %

Date 7/29/2011 13:27
 Operator cgu
 Printed 7/29/2011

2.75 - 2.80 % R	1	3.60 - 3.65 % R	14
2.80 - 2.85 % R	1	3.65 - 3.70 % R	11
2.85 - 2.90 % R	1	3.70 - 3.75 % R	11
2.90 - 2.95 % R	4	3.75 - 3.80 % R	8
2.95 - 3.00 % R	2	3.80 - 3.85 % R	11
3.00 - 3.05 % R	4	3.85 - 3.90 % R	3
3.05 - 3.10 % R	2	3.90 - 3.95 % R	10
3.10 - 3.15 % R	3	3.95 - 4.00 % R	7
3.15 - 3.20 % R	8	4.00 - 4.05 % R	1
3.20 - 3.25 % R	11	4.05 - 4.10 % R	2
3.25 - 3.30 % R	14	4.10 - 4.15 % R	4
3.30 - 3.35 % R	17	4.15 - 4.20 % R	3
3.35 - 3.40 % R	16	4.20 - 4.25 % R	2
3.40 - 3.45 % R	15	4.25 - 4.30 % R	1
3.45 - 3.50 % R	12	4.30 - 4.35 % R	3
3.50 - 3.55 % R	18	4.35 - 4.40 % R	3
3.55 - 3.60 % R	11	4.45 - 4.50 % R	1

Sample : 19541

Activity no: 2011008; Standard: 1.677% Ro
 Sample number: 625/0102-1
 Well: NO 6603/5-1S; Depth 3744 m
 Material: cuttings; Lithology: shale/claystone



Measure count = 201
 Reflectance Rr = 3.760 %
 s = 0.260 %

Date 7/29/2011 15:02
 Operator cgu
 Printed 7/29/2011

3.20 - 3.25 % R	2	3.80 - 3.85 % R	17
3.25 - 3.30 % R	2	3.85 - 3.90 % R	9
3.30 - 3.35 % R	8	3.90 - 3.95 % R	13
3.35 - 3.40 % R	10	3.95 - 4.00 % R	13
3.40 - 3.45 % R	5	4.00 - 4.05 % R	5
3.45 - 3.50 % R	8	4.05 - 4.10 % R	14
3.50 - 3.55 % R	14	4.10 - 4.15 % R	2
3.55 - 3.60 % R	10	4.15 - 4.20 % R	7
3.60 - 3.65 % R	14	4.20 - 4.25 % R	3
3.65 - 3.70 % R	12	4.25 - 4.30 % R	5
3.70 - 3.75 % R	12	4.30 - 4.35 % R	2
3.75 - 3.80 % R	14		

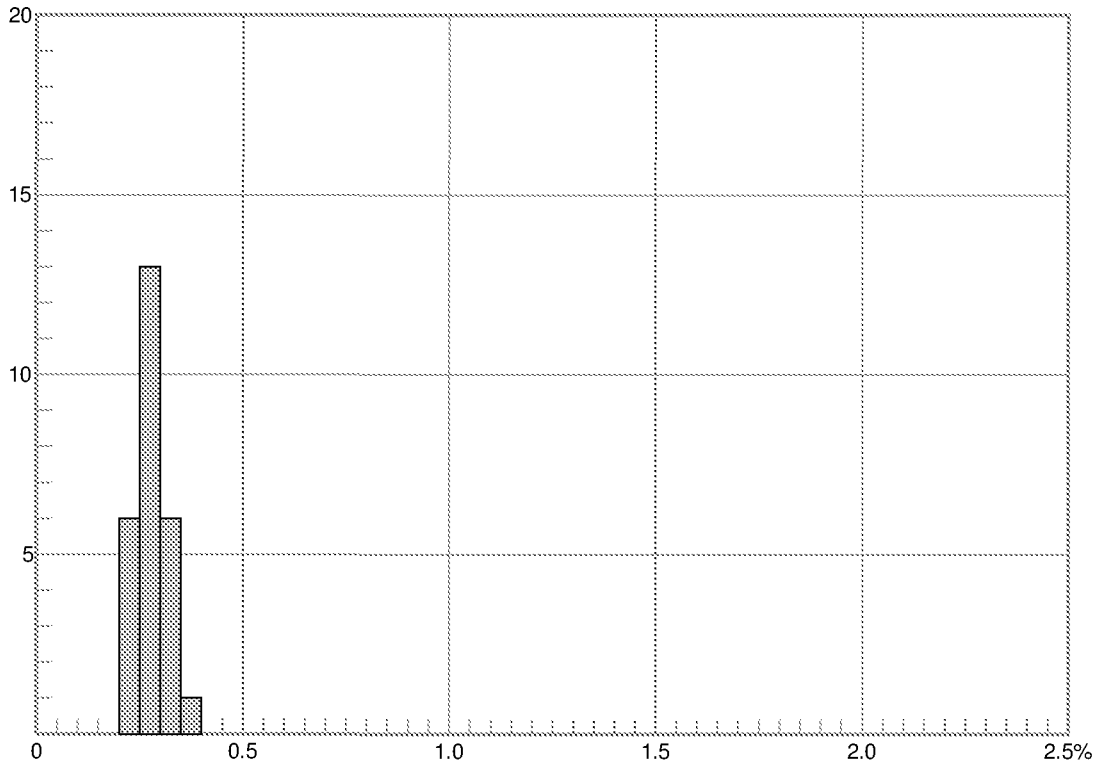
F=3.0.3195 D=4.80.6392

Appendix 2

Selected vitrinite reflectance populations

Sample : 19521

Activity no: 2011008; Standard: 0.903% Ro
Sample number: 625/0001-2
Well: NO 6603/5-1S; Depth 844 m
Material: cuttings; Lithology: shale/claystone



Measure count = 26
Reflectance Rr = 0.276 %
s = 0.043 %

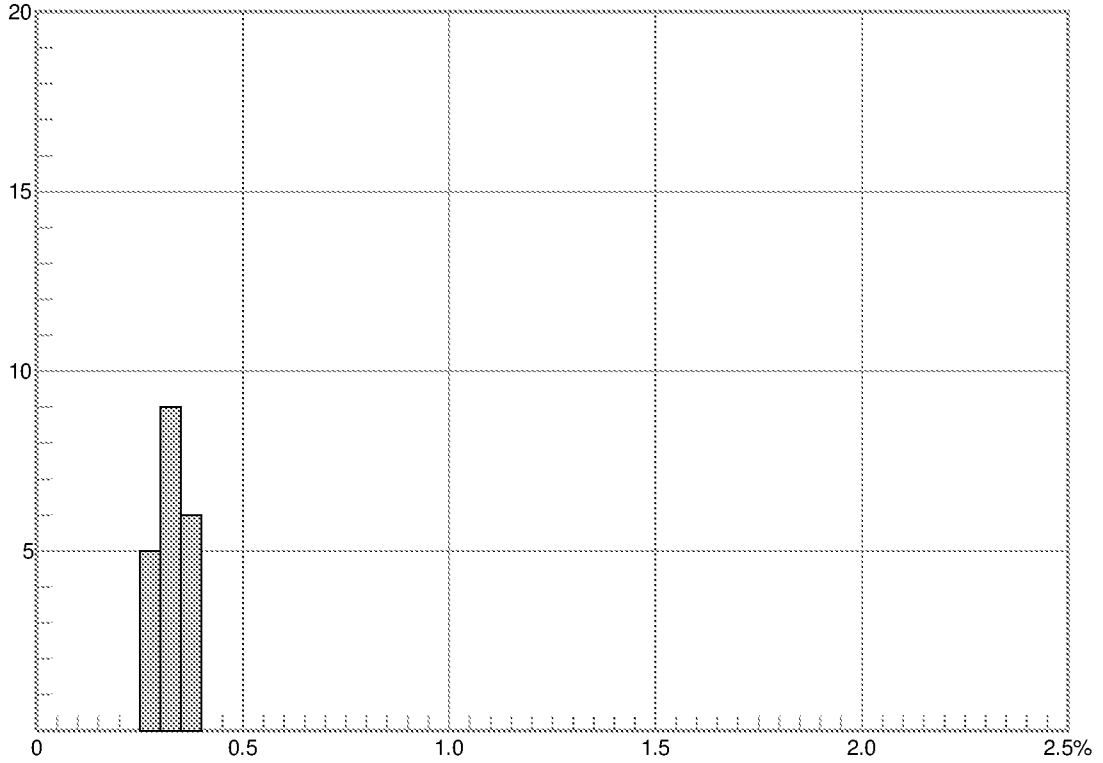
Date 7/22/2011 13:20
Operator cgu
Printed 8/17/2011

0.20 - 0.25 % R	6	0.30 - 0.35 % R	6
0.25 - 0.30 % R	13	0.35 - 0.40 % R	1

F=3.0.3195 D=4.80.6392

Sample : 19522

Activity no: 2011008; Standard: 0.903% Ro
Sample number: 625/0006-1
Well: NO 6603/5-1S; Depth 994 m
Material: cuttings; Lithology: shale/claystone



Measure count = 20
Reflectance Rr = 0.330 %
s = 0.035 %

Date 7/25/2011 09:08
Operator cgu
Printed 8/17/2011

0.25 - 0.30 % R 5
0.30 - 0.35 % R 9

0.35 - 0.40 % R 6

F=3.0.3195 D=4.80.6392

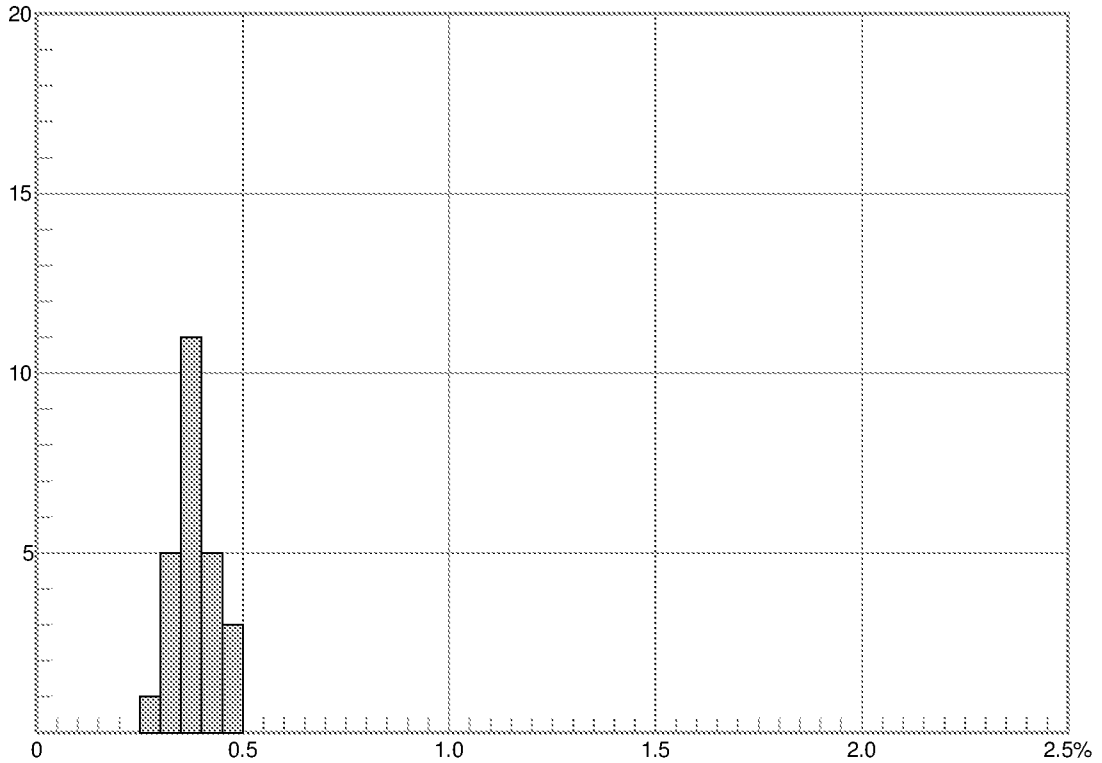
Sample : 19523

Activity no: 2011008; Standard: 0.903% Ro

Sample number: 625/0010-1

Well: NO 6603/5-1S; Depth 1094 m

Material: cuttings; Lithology: siltstone



Measure count = 25

Reflectance Rr = 0.382 %

s = 0.056 %

Date 7/25/2011 10:51

Operator cgu

Printed 8/17/2011

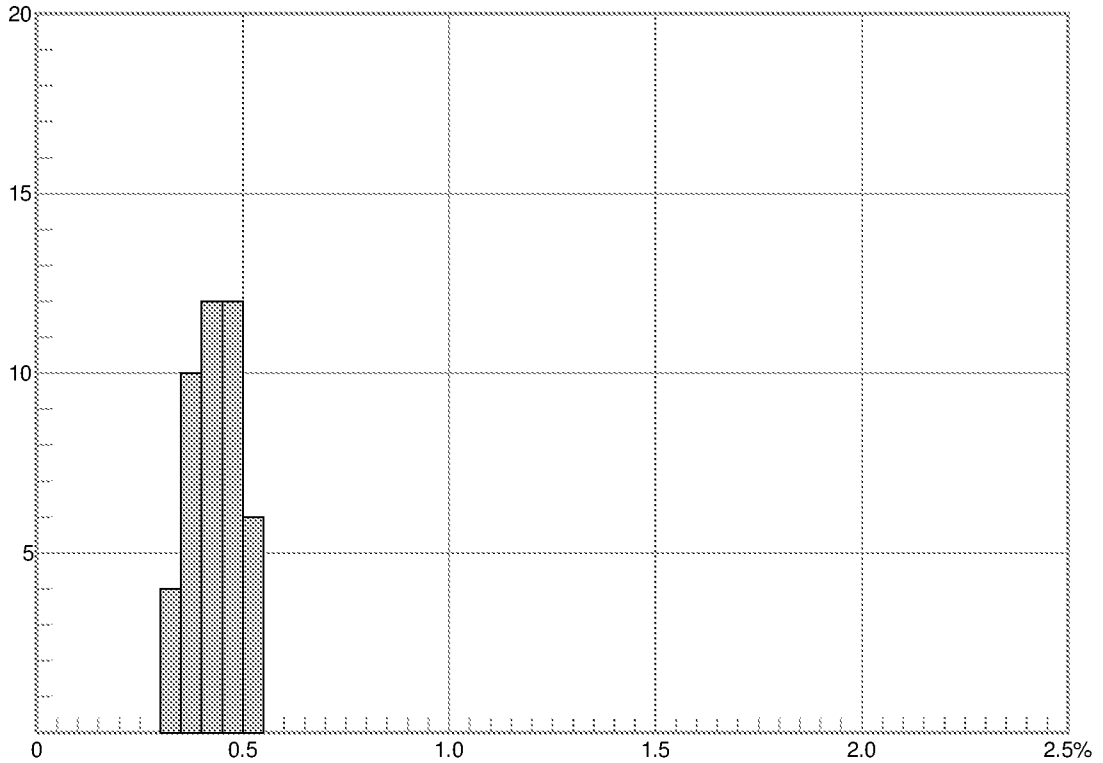
0.25 - 0.30 % R	1
0.30 - 0.35 % R	5
0.35 - 0.40 % R	11

0.40 - 0.45 % R	5
0.45 - 0.50 % R	3

F=3.0.3195 D=4.80.6392

Sample : 19524

Activity no: 2011008; Standard: 0.903% Ro
Sample number: 625/0013-1
Well: NO 6603/5-1S; Depth 1184 m
Material: cuttings; Lithology: shale/claystone



Measure count = 44
Reflectance Rr = 0.431 %
s = 0.060 %

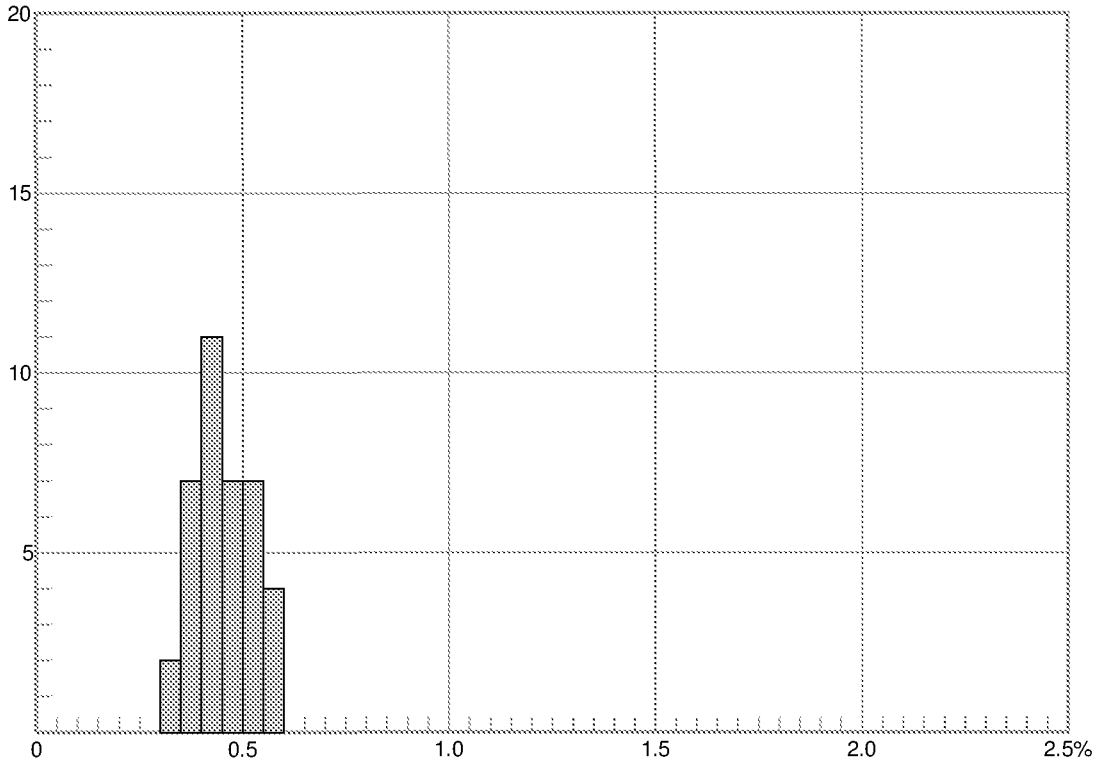
Date 7/25/2011 12:54
Operator cgu
Printed 8/17/2011

0.30 - 0.35 % R	4	0.45 - 0.50 % R	12
0.35 - 0.40 % R	10	0.50 - 0.55 % R	6
0.40 - 0.45 % R	12		

F=3.0.3195 D=4.80.6392

Sample : 19525

Activity no: 2011008; Standard: 0.903% Ro
Sample number: 625/0017-1
Well: NO 6603/5-1S; Depth 1304 m
Material: cuttings; Lithology: shale/claystone



Measure count = 38
Reflectance Rr = 0.453 %
s = 0.069 %

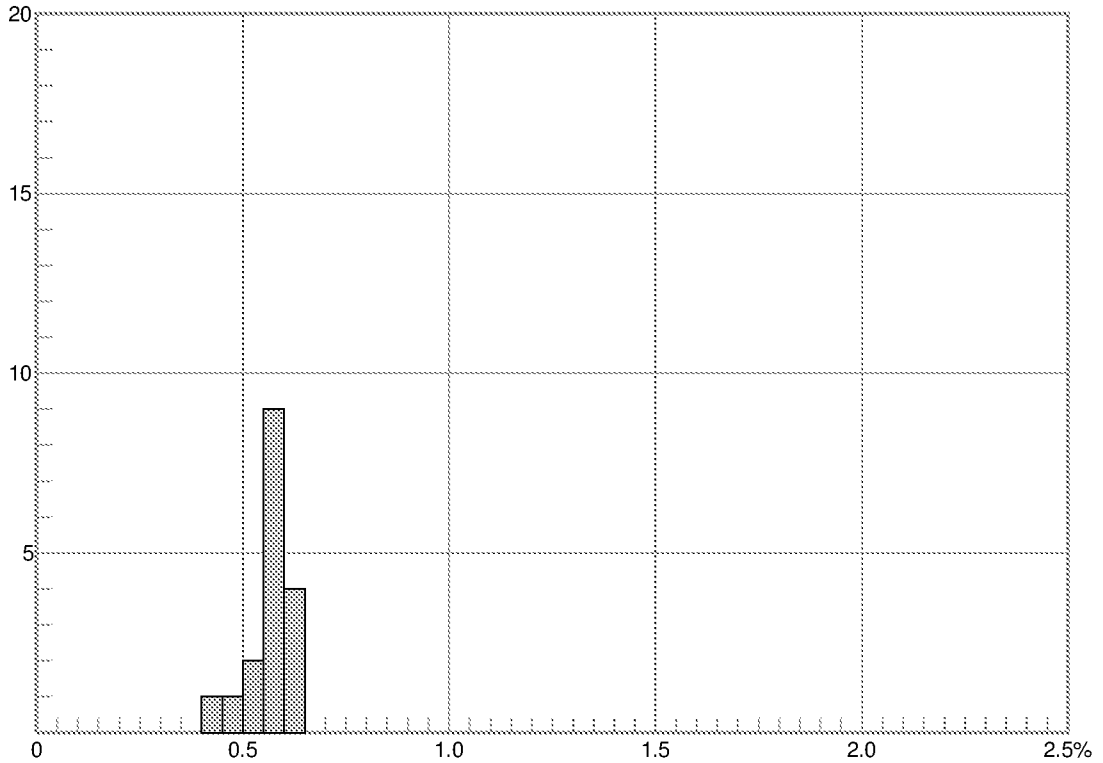
Date 7/25/2011 14:20
Operator cgu
Printed 8/17/2011

0.30 - 0.35 % R	2	0.45 - 0.50 % R	7
0.35 - 0.40 % R	7	0.50 - 0.55 % R	7
0.40 - 0.45 % R	11	0.55 - 0.60 % R	4

F=3.0.3195 D=4.80.6392

Sample : 19526

Activity no: 2011008; Standard: 0.903% Ro
Sample number: 625/0029-1
Well: NO 6603/5-1S; Depth 1654 m
Material: cuttings; Lithology: shale/claystone



Measure count = 17
Reflectance Rr = 0.568 %
s = 0.055 %

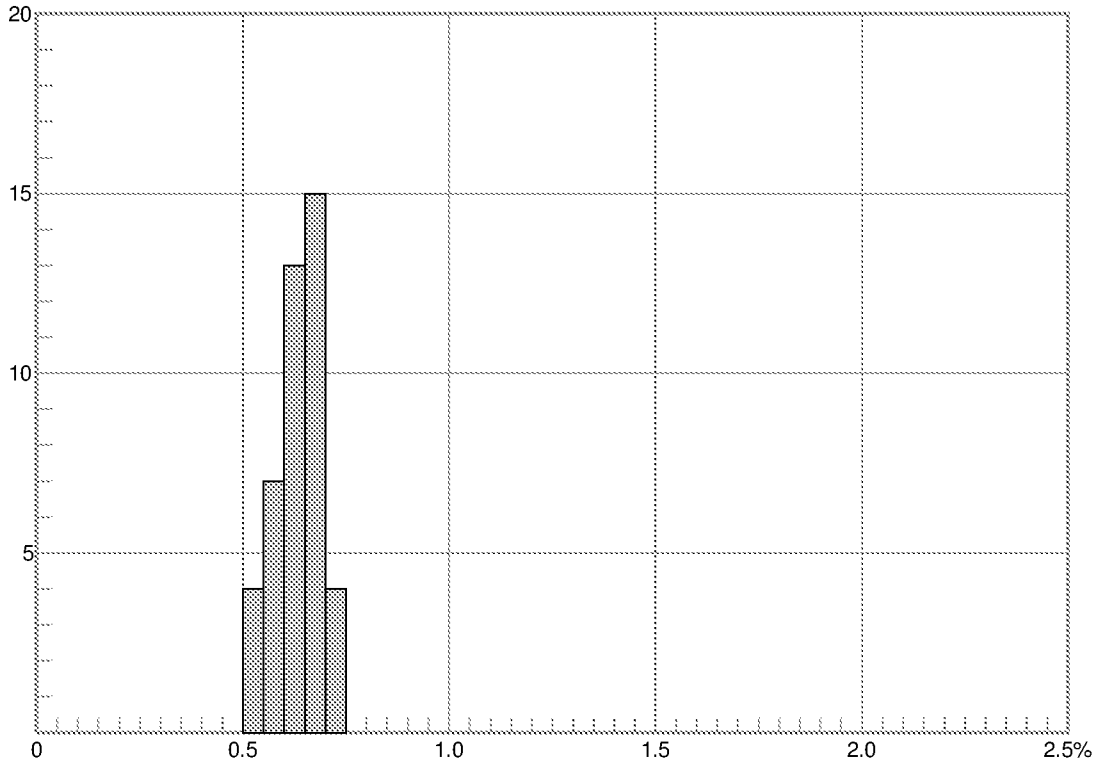
Date 7/25/2011 15:48
Operator cgu
Printed 8/17/2011

0.40 - 0.45 % R	1	0.55 - 0.60 % R	9
0.45 - 0.50 % R	1	0.60 - 0.65 % R	4
0.50 - 0.55 % R	2		

F=3.0.3195 D=4.80.6392

Sample : 19527

Activity no: 2011008; Standard: 0.903% Ro
Sample number: 625/0032-1
Well: NO 6603/5-1S; Depth 1744 m
Material: cuttings; Lithology: shale/claystone



Measure count = 43
Reflectance Rr = 0.635 %
s = 0.052 %

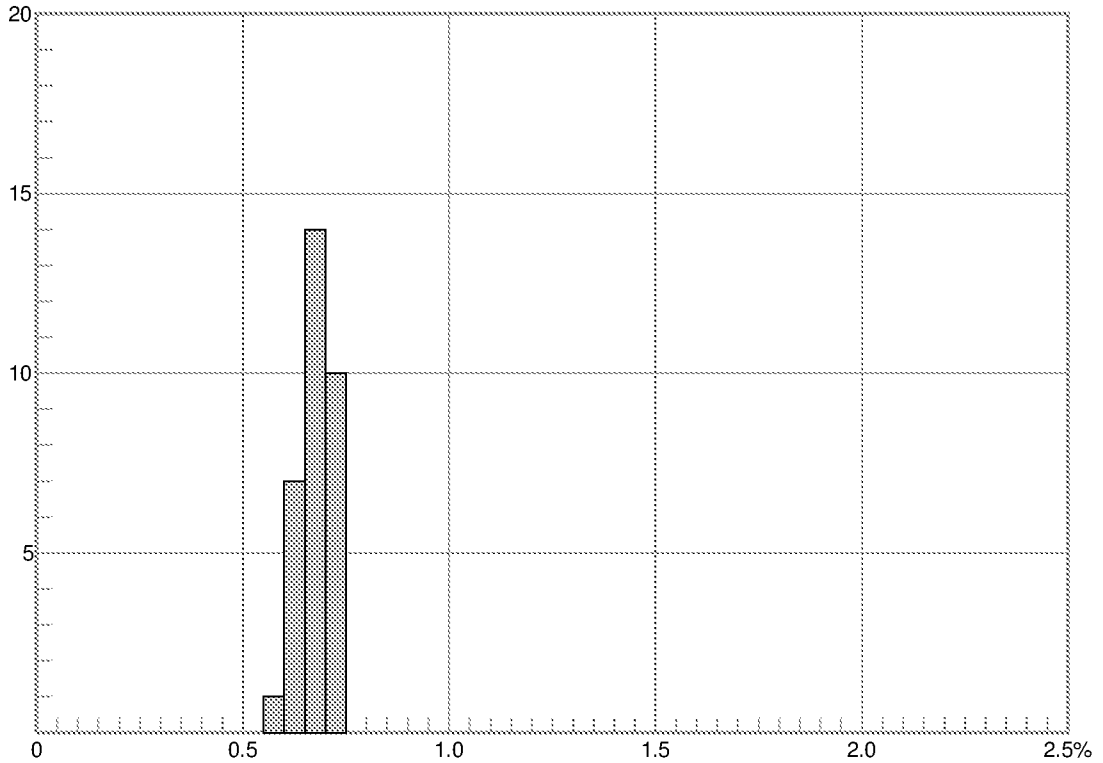
Date 7/26/2011 09:56
Operator cgu
Printed 8/17/2011

0.50 - 0.55 % R	4	0.65 - 0.70 % R	15
0.55 - 0.60 % R	7	0.70 - 0.75 % R	4
0.60 - 0.65 % R	13		

F=3.0.3195 D=4.80.6392

Sample : 19528

Activity no: 2011008; Standard: 0.903% Ro
Sample number: 625/0038-1
Well: NO 6603/5-1S; Depth 1944 m
Material: cuttings; Lithology: shale/claystone



Measure count = 32
Reflectance Rr = 0.677 %
s = 0.044 %

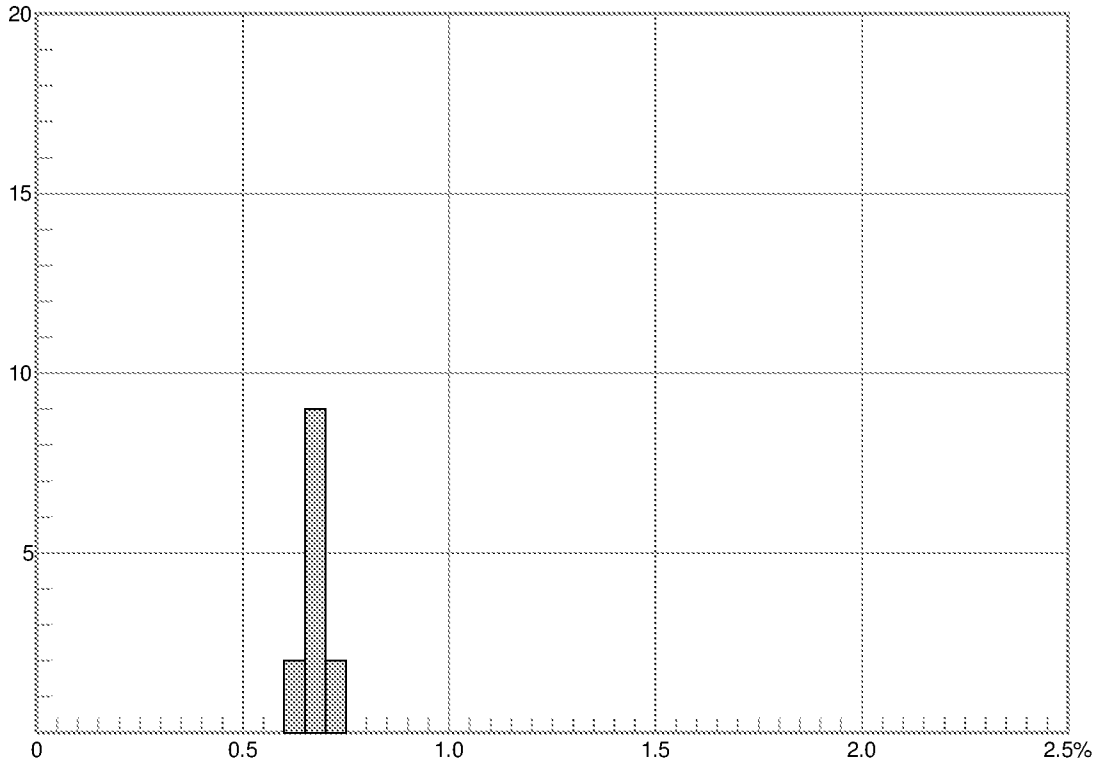
Date 7/26/2011 11:21
Operator cgu
Printed 8/17/2011

0.55 - 0.60 % R	1	0.65 - 0.70 % R	14
0.60 - 0.65 % R	7	0.70 - 0.75 % R	10

F=3.0.3195 D=4.80.6392

Sample : 19529

Activity no: 2011008; Standard: 0.903% Ro
Sample number: 625/0043-1
Well: NO 6603/5-1S; Depth 2074 m
Material: cuttings; Lithology: shale/claystone



Measure count = 13
Reflectance Rr = 0.674 %
s = 0.032 %

Date 7/26/2011 13:03
Operator cgu
Printed 8/17/2011

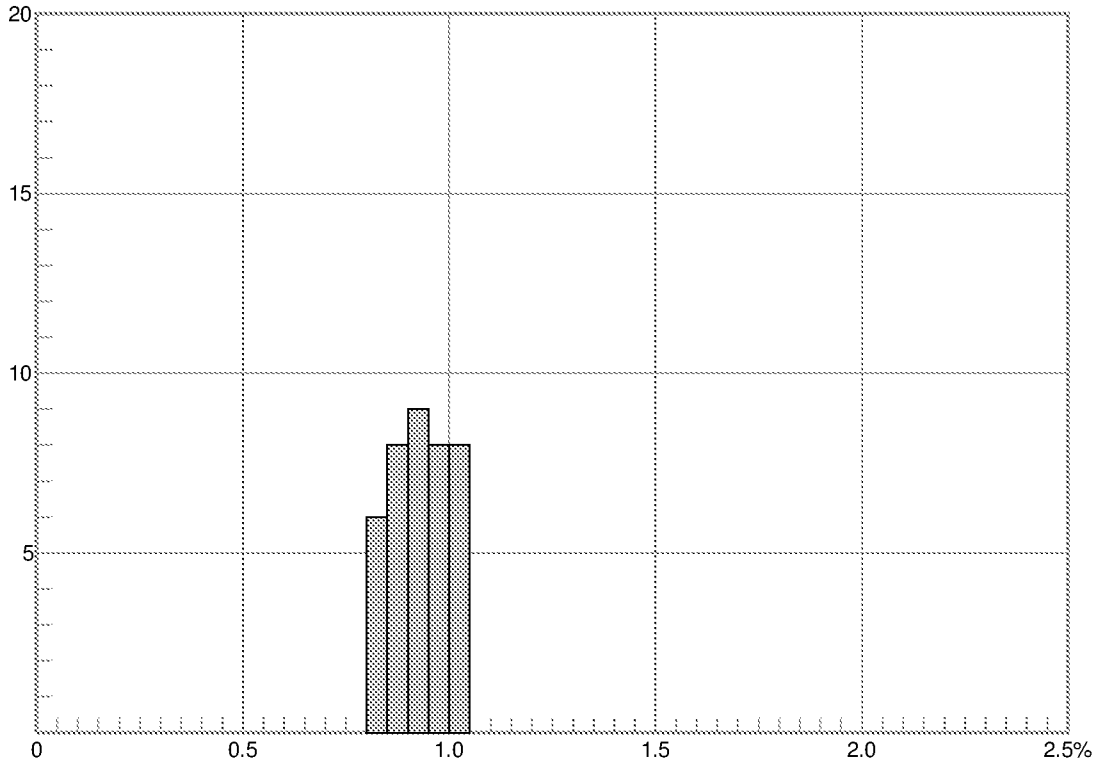
0.60 - 0.65 % R	2
0.65 - 0.70 % R	9

0.70 - 0.75 % R	2
-----------------	---

F=3.0.3195 D=4.80.6392

Sample : 19530

Activity no: 2011008; Standard: 0.903% Ro
Sample number: 625/0047-1
Well: NO 6603/5-1S; Depth 2114 m
Material: cuttings; Lithology: shale/claystone



Measure count = 39
Reflectance Rr = 0.931 %
s = 0.068 %

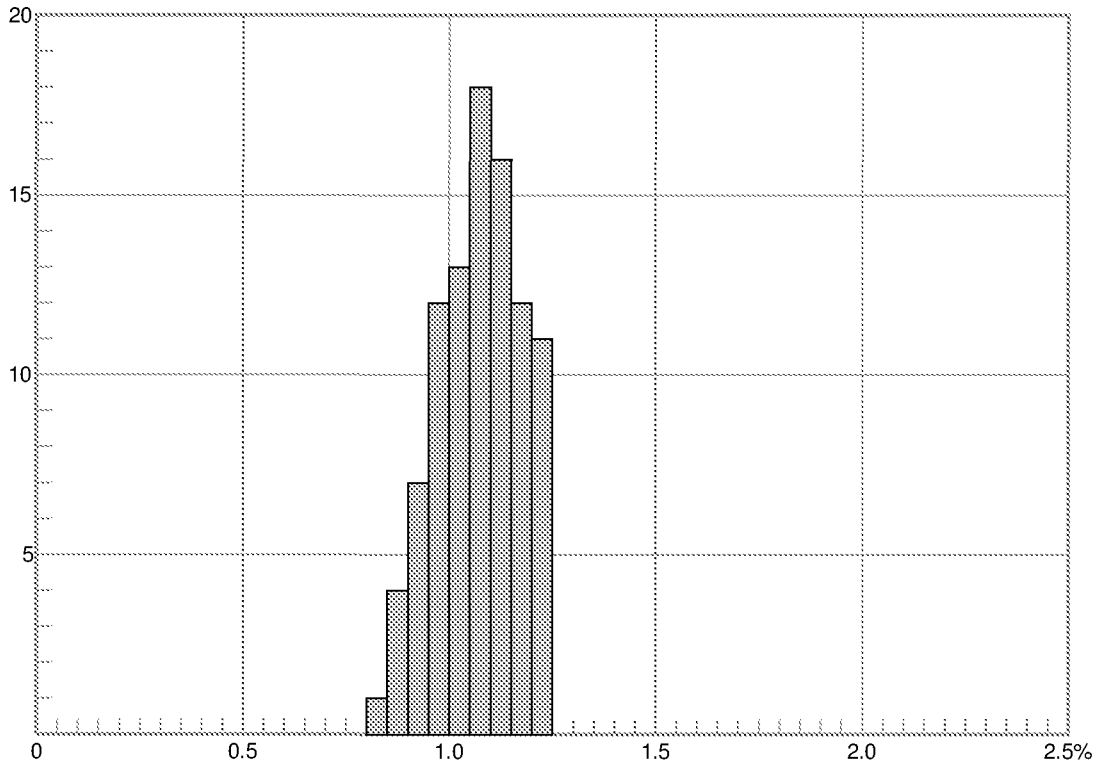
Date 7/26/2011 15:07
Operator cgu
Printed 8/17/2011

0.80 - 0.85 % R	6	0.95 - 1.00 % R	8
0.85 - 0.90 % R	8	1.00 - 1.05 % R	8
0.90 - 0.95 % R	9		

F=3.0.3195 D=4.80.6392

Sample : 19531

Activity no: 2011008; Standard: 0.903% Ro
Sample number: 625/0055-1
Well: NO 6603/5-1S; Depth 2354 m
Material: cuttings; Lithology: shale/claystone



Measure count = 94
Reflectance Rr = 1.073 %
s = 0.099 %

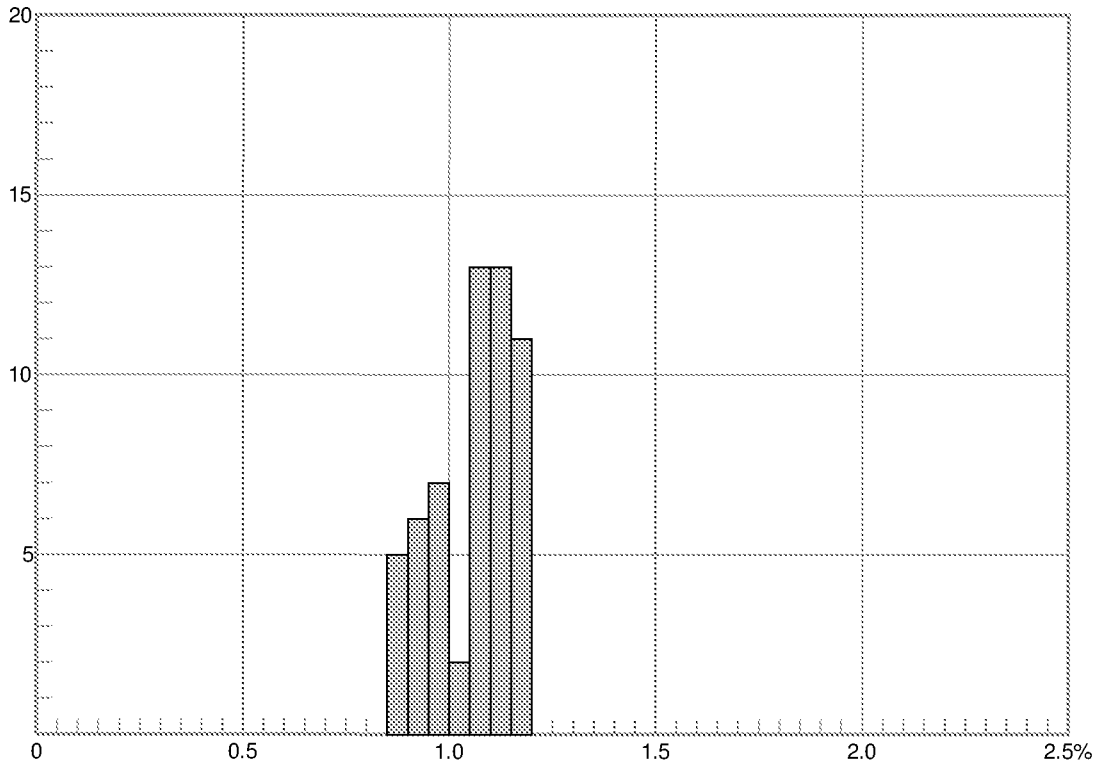
Date 7/27/2011 09:18
Operator cgu
Printed 8/17/2011

0.80 - 0.85 % R	1	1.05 - 1.10 % R	18
0.85 - 0.90 % R	4	1.10 - 1.15 % R	16
0.90 - 0.95 % R	7	1.15 - 1.20 % R	12
0.95 - 1.00 % R	12	1.20 - 1.25 % R	11
1.00 - 1.05 % R	13		

F=3.0,3195 D=4.80,6392

Sample : 19532

Activity no: 2011008; Standard: 0.903% Ro
Sample number: 625/0063-1
Well: NO 6603/5-1S; Depth 2574 m
Material: cuttings; Lithology: shale/claystone



Measure count = 57
Reflectance Rr = 1.061 %
s = 0.100 %

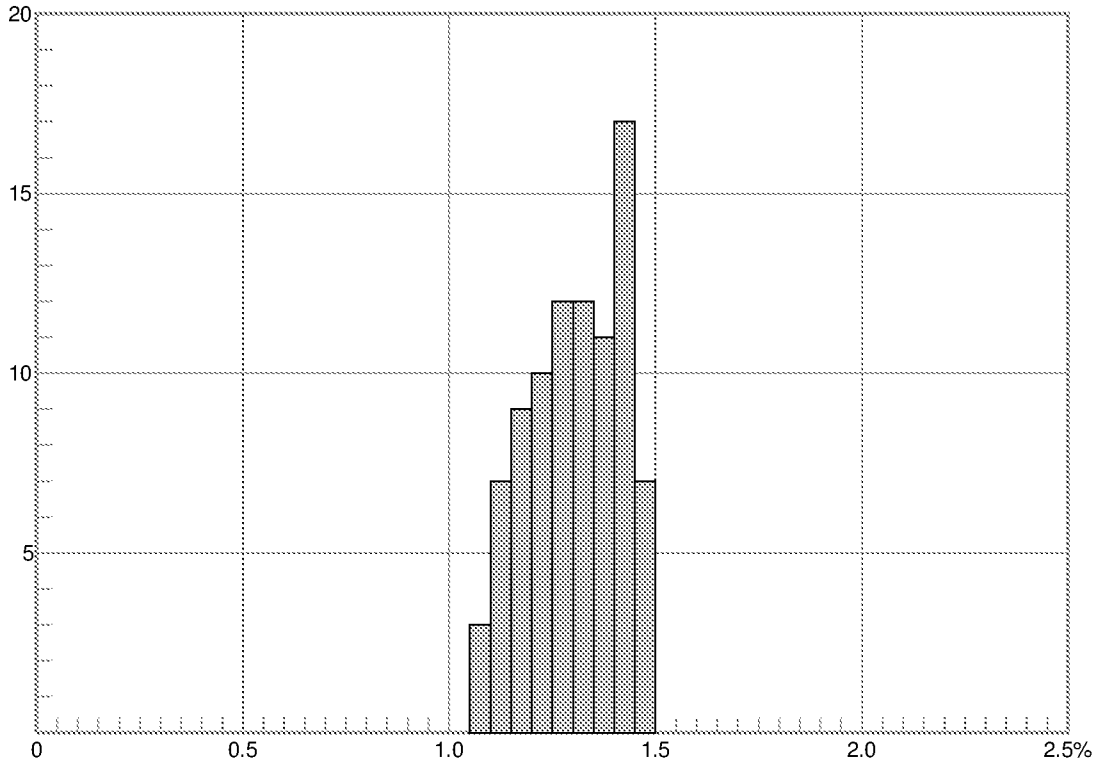
Date 7/27/2011 11:09
Operator cgu
Printed 8/17/2011

0.85 - 0.90 % R	5	1.05 - 1.10 % R	13
0.90 - 0.95 % R	6	1.10 - 1.15 % R	13
0.95 - 1.00 % R	7	1.15 - 1.20 % R	11
1.00 - 1.05 % R	2		

F=3.0,3195 D=4.80,6392

Sample : 19533

Activity no: 2011008; Standard: 0.903% Ro
 Sample number: 625/0071-1
 Well: NO 6603/5-1S; Depth 2814 m
 Material: cuttings; Lithology: shale/claystone



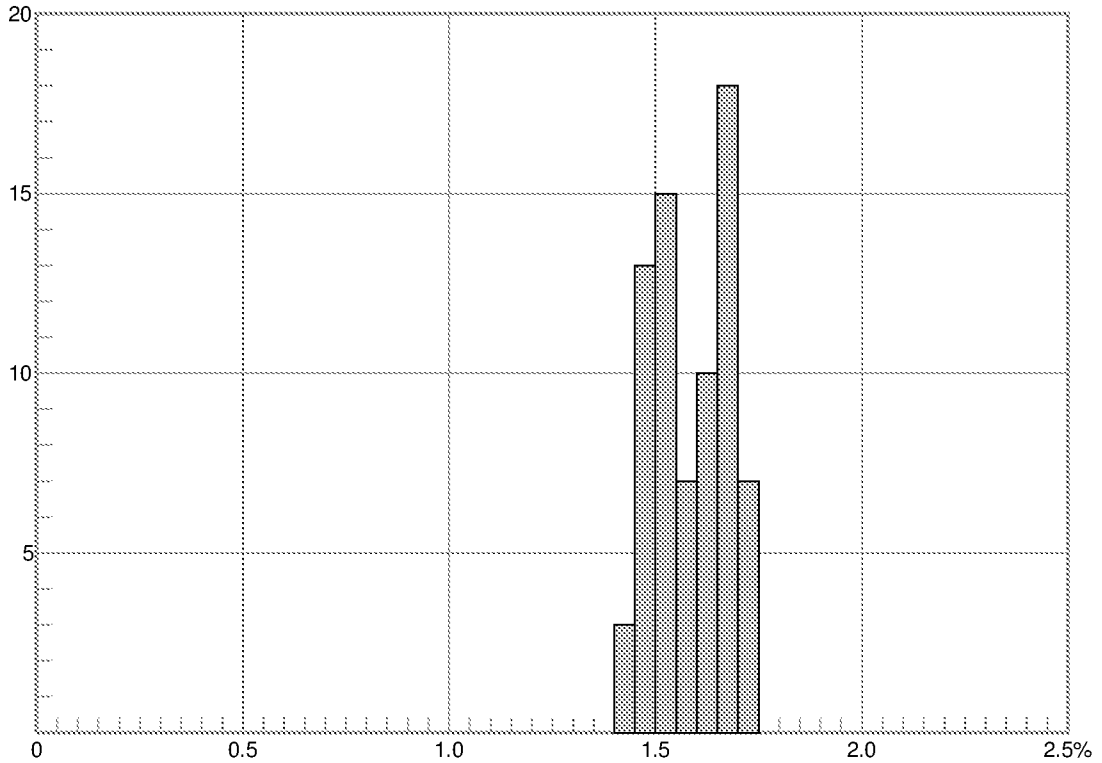
Measure count =	88	Date	7/27/2011 13:09
Reflectance Rr =	1.303 %	Operator	cgu
s =	0.115 %	Printed	8/17/2011

1.05 - 1.10 % R	3	1.30 - 1.35 % R	12
1.10 - 1.15 % R	7	1.35 - 1.40 % R	11
1.15 - 1.20 % R	9	1.40 - 1.45 % R	17
1.20 - 1.25 % R	10	1.45 - 1.50 % R	7
1.25 - 1.30 % R	12		

F=3.0,3195 D=4.80,6392

Sample : 19534

Activity no: 2011008; Standard: 0.903% Ro
Sample number: 625/0077-1
Well: NO 6603/5-1S; Depth 2994 m
Material: cuttings; Lithology: shale/claystone



Measure count = 73
Reflectance Rr = 1.588 %
s = 0.092 %

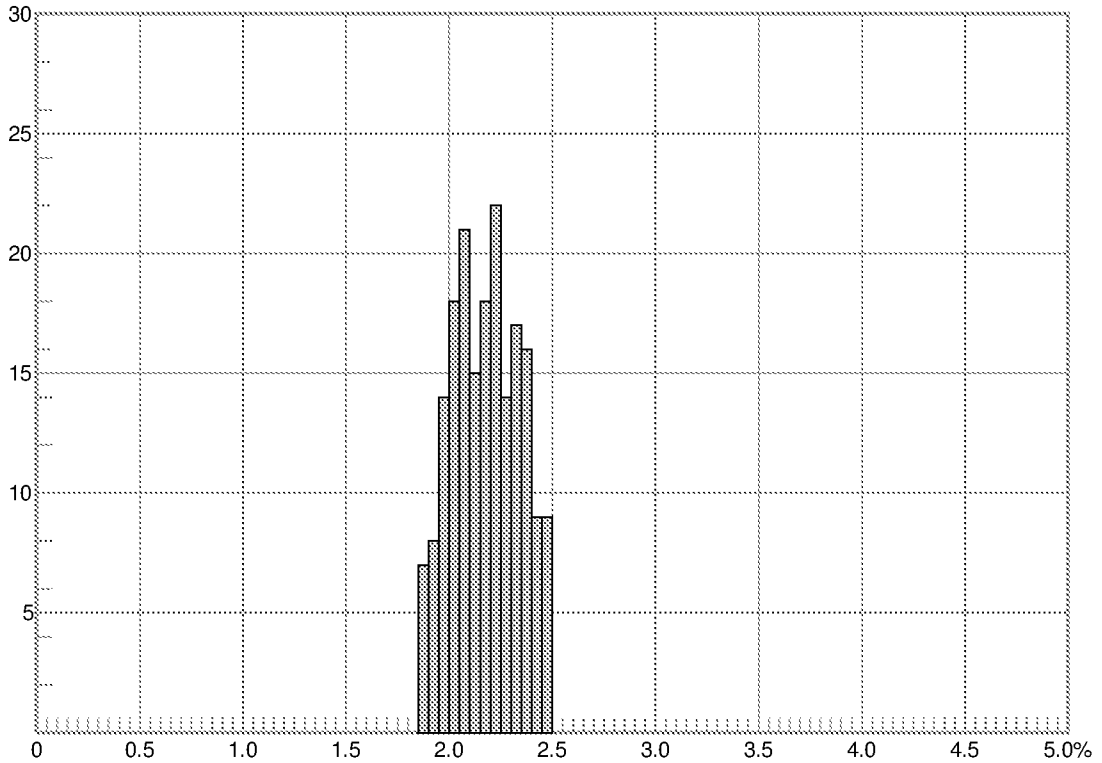
Date 7/27/2011 14:51
Operator cgu
Printed 8/17/2011

1.40 - 1.45 % R	3	1.60 - 1.65 % R	10
1.45 - 1.50 % R	13	1.65 - 1.70 % R	18
1.50 - 1.55 % R	15	1.70 - 1.75 % R	7
1.55 - 1.60 % R	7		

F=3.0,3195 D=4.80,6392

Sample : 19535

Activity no: 2011008; Standard: 1.677% Ro
 Sample number: 625/0083-1
 Well: NO 6603/5-1S; Depth 3174 m
 Material: cuttings; Lithology: shale/claystone



Measure count = 188
 Reflectance Rr = 2.178 %
 s = 0.162 %

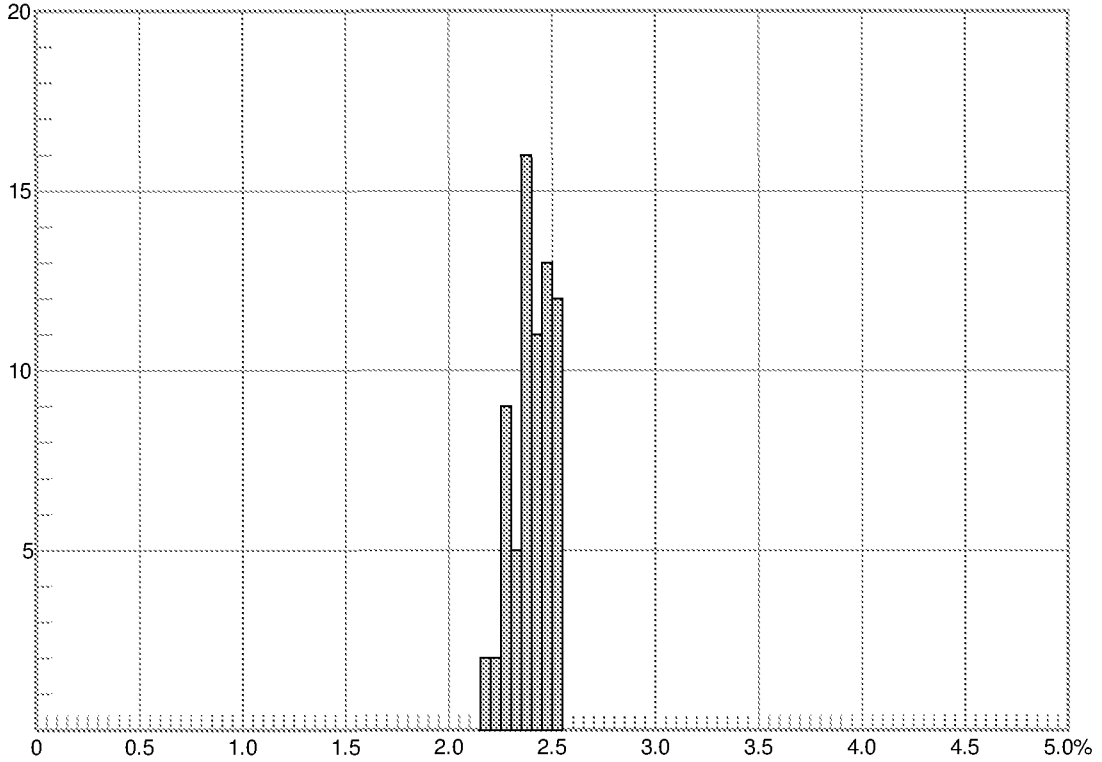
Date 7/28/2011 10:55
 Operator cgu
 Printed 8/17/2011

1.85 - 1.90 % R	7	2.20 - 2.25 % R	22
1.90 - 1.95 % R	8	2.25 - 2.30 % R	14
1.95 - 2.00 % R	14	2.30 - 2.35 % R	17
2.00 - 2.05 % R	18	2.35 - 2.40 % R	16
2.05 - 2.10 % R	21	2.40 - 2.45 % R	9
2.10 - 2.15 % R	15	2.45 - 2.50 % R	9
2.15 - 2.20 % R	18		

F=3.0.3195 D=4.80.6392

Sample : 19536

Activity no: 2011008; Standard: 1.677% Ro
 Sample number: 625/0087-1
 Well: NO 6603/5-1S; Depth 3294 m
 Material: cuttings; Lithology: shale/claystone



Measure count = 70
 Reflectance Rr = 2.402 %
 s = 0.094 %

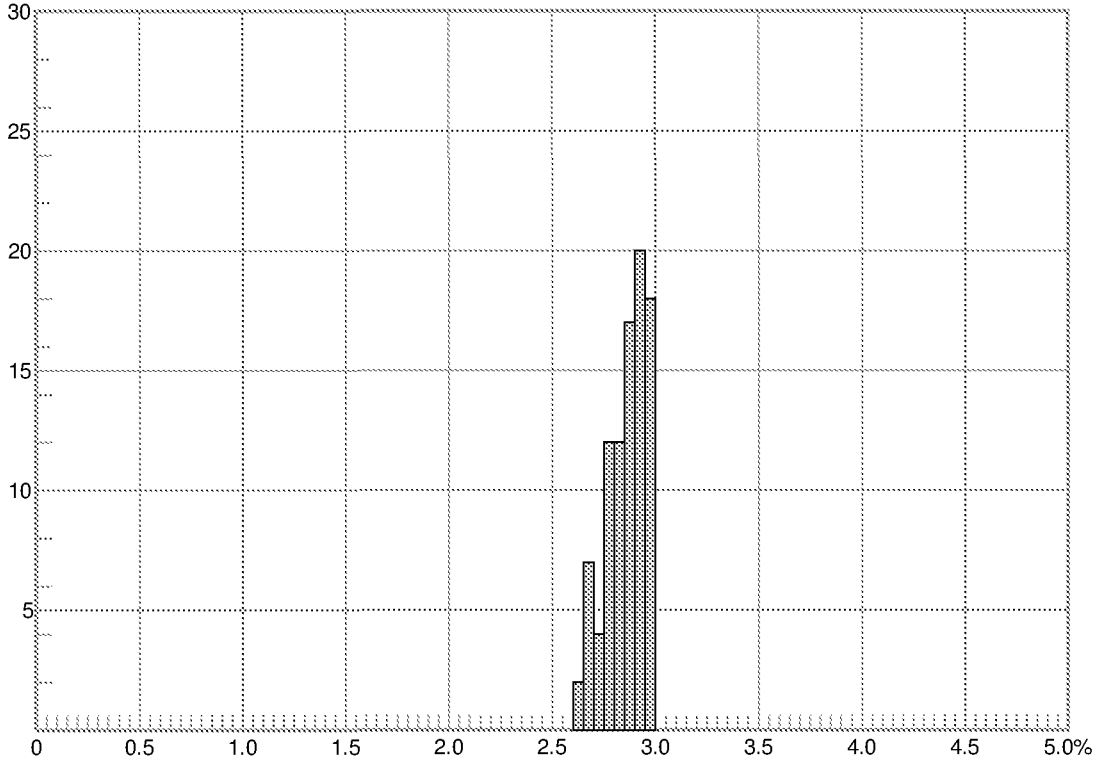
Date 7/28/2011 13:00
 Operator cgu
 Printed 8/17/2011

2.15 - 2.20 % R	2	2.35 - 2.40 % R	16
2.20 - 2.25 % R	2	2.40 - 2.45 % R	11
2.25 - 2.30 % R	9	2.45 - 2.50 % R	13
2.30 - 2.35 % R	5	2.50 - 2.55 % R	12

F=3.0.3195 D=4.80.6392

Sample : 19537

Activity no: 2011008; Standard: 1.677% Ro
Sample number: 625/0091-1
Well: NO 6603/5-1S; Depth 3414 m
Material: cuttings; Lithology: shale/claystone



Measure count = 92
Reflectance Rr = 2.856 %
s = 0.095 %

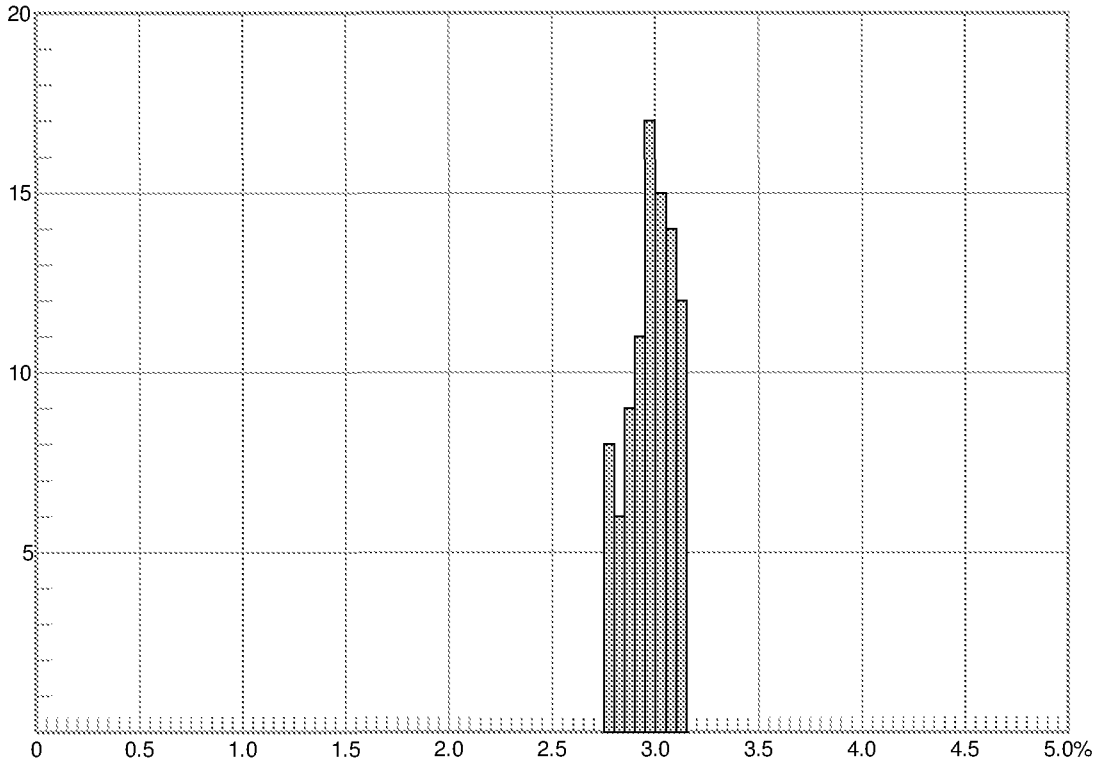
Date 7/28/2011 15:17
Operator cgu
Printed 8/17/2011

2.60 - 2.65 % R	2	2.80 - 2.85 % R	12
2.65 - 2.70 % R	7	2.85 - 2.90 % R	17
2.70 - 2.75 % R	4	2.90 - 2.95 % R	20
2.75 - 2.80 % R	12	2.95 - 3.00 % R	18

F=3.0.3195 D=4.80.6392

Sample : 19538

Activity no: 2011008; Standard: 1.677% Ro
Sample number: 625/0093-1
Well: NO 6603/5-1S; Depth 3469 m
Material: cuttings; Lithology: shale/claystone



Measure count = 92
Reflectance Rr = 2.977 %
s = 0.108 %

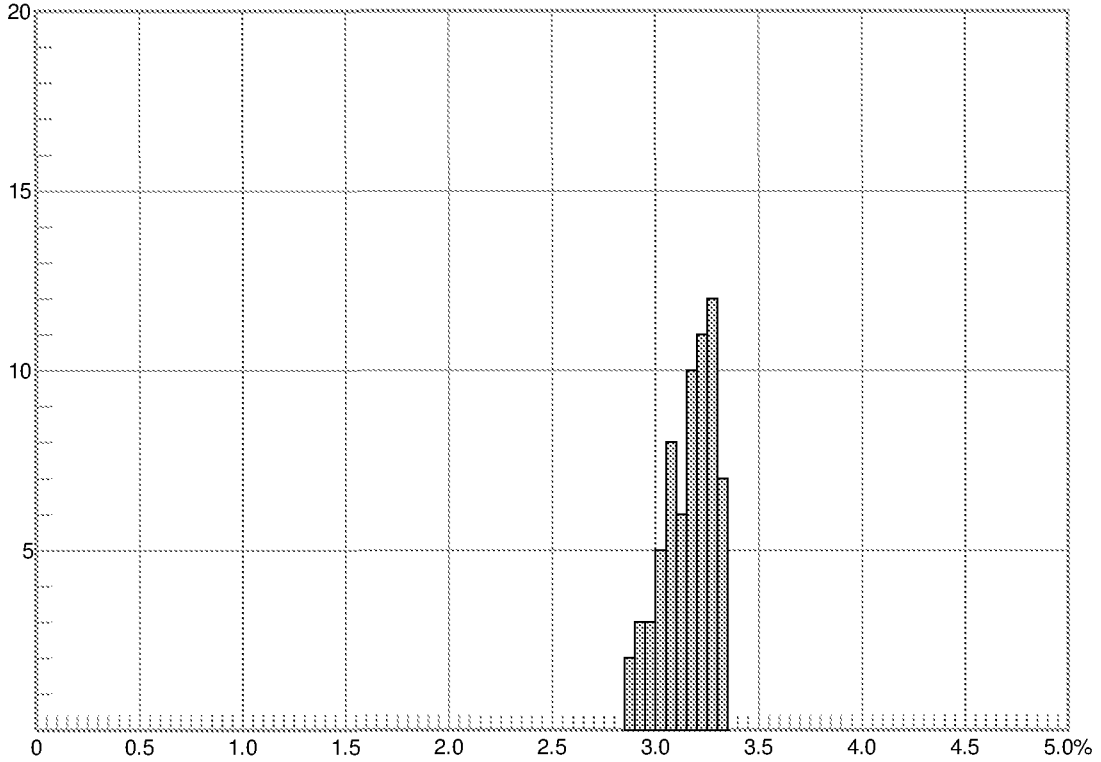
Date 7/29/2011 10:18
Operator cgu
Printed 8/17/2011

2.75 - 2.80 % R	8	2.95 - 3.00 % R	17
2.80 - 2.85 % R	6	3.00 - 3.05 % R	15
2.85 - 2.90 % R	9	3.05 - 3.10 % R	14
2.90 - 2.95 % R	11	3.10 - 3.15 % R	12

F=3.0.3195 D=4.80.6392

Sample : 19539

Activity no: 2011008; Standard: 1.677% Ro
 Sample number: 625/0095-1
 Well: NO 6603/5-1S; Depth 3534 m
 Material: cuttings; Lithology: shale/claystone



Measure count = 67
 Reflectance Rr = 3.157 %
 s = 0.119 %

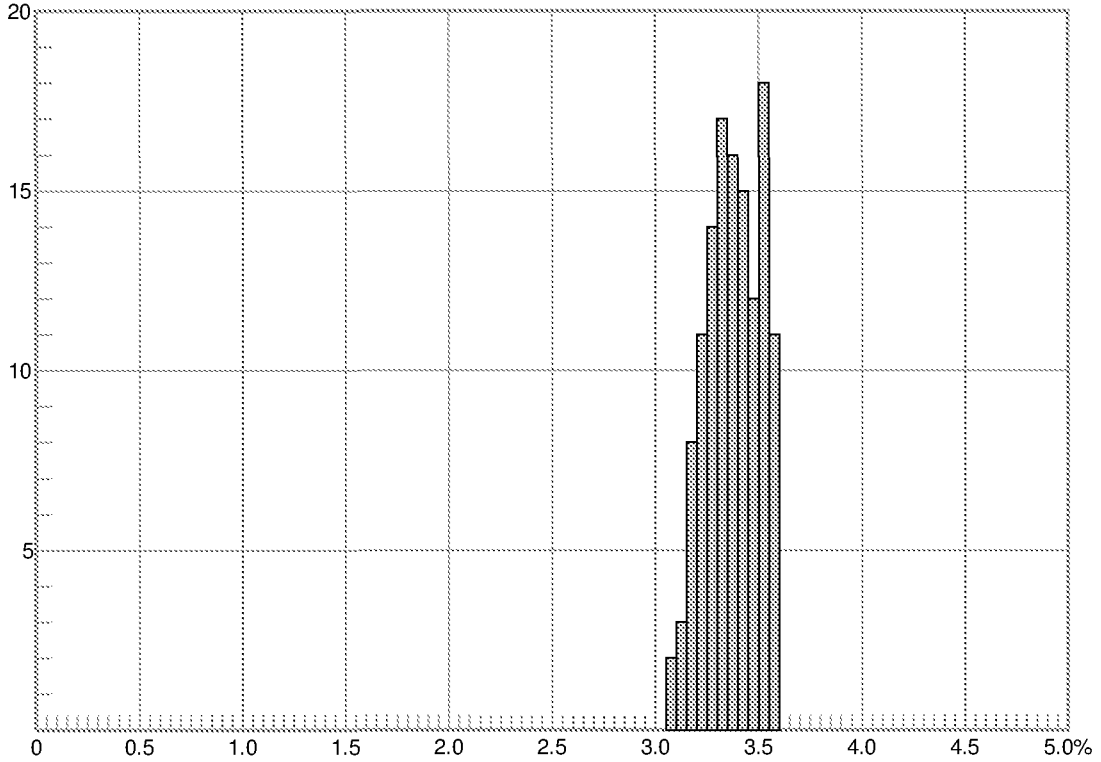
Date 7/29/2011 11:35
 Operator cgu
 Printed 8/17/2011

2.85 - 2.90 % R	2	3.10 - 3.15 % R	6
2.90 - 2.95 % R	3	3.15 - 3.20 % R	10
2.95 - 3.00 % R	3	3.20 - 3.25 % R	11
3.00 - 3.05 % R	5	3.25 - 3.30 % R	12
3.05 - 3.10 % R	8	3.30 - 3.35 % R	7

F=3.0,3195 D=4.80,6392

Sample : 19540

Activity no: 2011008; Standard: 1.677% Ro
 Sample number: 625/0098-1
 Well: NO 6603/5-1S; Depth 3624 m
 Material: cuttings; Lithology: shale/claystone



Measure count = 127
 Reflectance Rr = 3.375 %
 s = 0.128 %

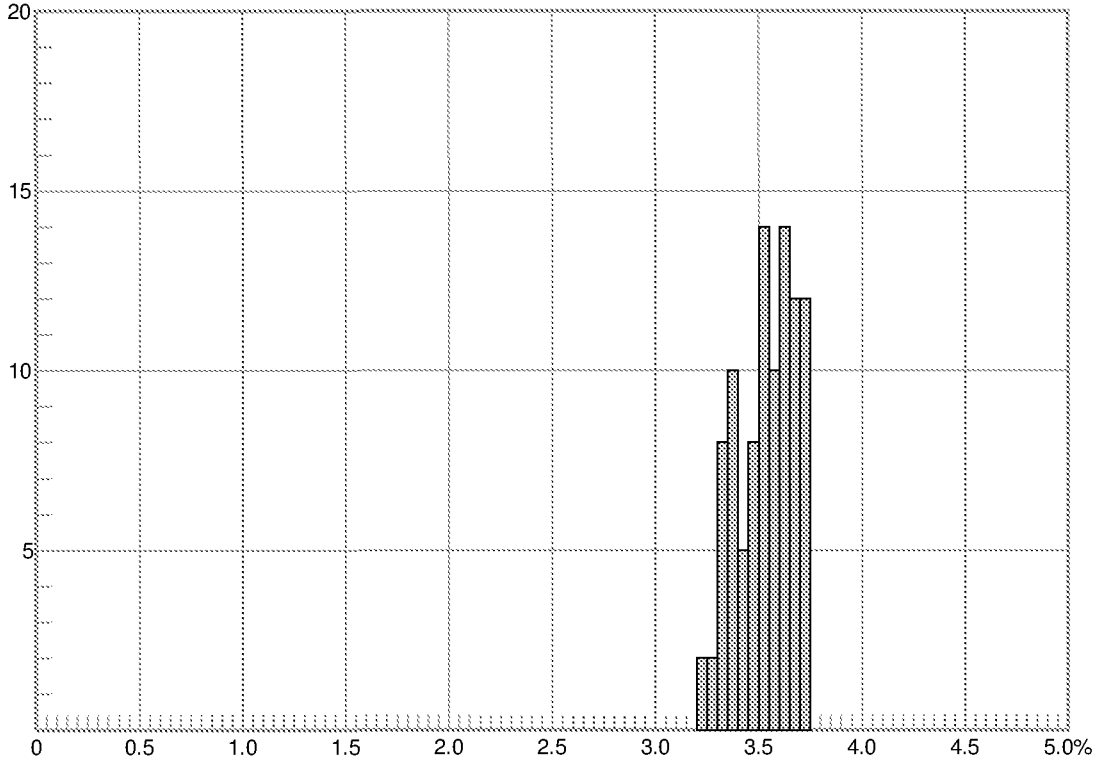
Date 7/29/2011 13:27
 Operator cgu
 Printed 8/17/2011

3.05 - 3.10 % R	2	3.35 - 3.40 % R	16
3.10 - 3.15 % R	3	3.40 - 3.45 % R	15
3.15 - 3.20 % R	8	3.45 - 3.50 % R	12
3.20 - 3.25 % R	11	3.50 - 3.55 % R	18
3.25 - 3.30 % R	14	3.55 - 3.60 % R	11
3.30 - 3.35 % R	17		

F=3.0.3195 D=4.80.6392

Sample : 19541

Activity no: 2011008; Standard: 1.677% Ro
 Sample number: 625/0102-1
 Well: NO 6603/5-1S; Depth 3744 m
 Material: cuttings; Lithology: shale/claystone



Measure count = 97
 Reflectance Rr = 3.536 %
 s = 0.139 %

Date 7/29/2011 15:02
 Operator cgu
 Printed 8/17/2011

3.20 - 3.25 % R	2	3.50 - 3.55 % R	14
3.25 - 3.30 % R	2	3.55 - 3.60 % R	10
3.30 - 3.35 % R	8	3.60 - 3.65 % R	14
3.35 - 3.40 % R	10	3.65 - 3.70 % R	12
3.40 - 3.45 % R	5	3.70 - 3.75 % R	12
3.45 - 3.50 % R	8		

F=3.0.3195 D=4.80.6392