A303 Amesbury to Berwick Down

Applicant's provision of technical reports supporting the Environmental Information Review

Ground Investigation - Phase 6 & 7 Factual Report
Appendix C

Document reference: Redetermination 2.12

Planning Act 2008

The Infrastructure Planning (Examination Procedure) Rules 2010

February 2022

APPENDIX C -
IN-SITU TESTING

(i) Standard Penetration Test (SPT) Summary Sheets

(ii) SPT N value and N_{60} versus Elevation Plots

(iii) Falling Head Test Results

(iv) Packer Test Results

(v) GCPT Log

(vi) Pressuremeter Test Report

(vii) Optical Televiewer and Downhole Geologging Logs

(viii) Constant Rate Pumping Test Reports

STANDARD PENETRATION TEST SUMMARY TABLE

Exploratory Position ID	Depth (m)	Hole Dia (mm)	Casing Depth (m)	Water Depth (m)	Seating Drive		Test Drive			Hammer ID	Calibration Date	Energy Ratio (%)	N_{60}	Comments
					Blows	Pen (mm)	Blows	R (mm)	Result					
R608	3.00		1.00	DRY	2,5	150	6,9,9,8		N=32	ADP06-2018	04/01/2018	74	39	
	5.80		1.00	DRY	2,5	150	5,4,4,6		N=19	ADP06-2018	04/01/2018	74	23	
R619	7.50	145.6	7.50	5.20	3,10	150	16,20,14+	200	3,10/16,20,14	SC.01	20/05/2017	79		
									for 50mm					
	9.50	145.6	9.50	5.20	7,11	150	9,7,6,9		N=31	SC.01	20/05/2017	79	41	
R71805	2.60	146.3	2.60	DRY	5,10	150	11,11,15,17		N=54	H4-2018	18/01/2018	68	61	
	5.60	146.3	5.60	DRY	11,13	150	12,14,13,12		N=51	H4-2018	18/01/2018	68	58	SPT(c)
	8.60	146.3	8.60	DRY	12,11	150	15,17,16,18		N=66	H4-2018	18/01/2018	68	75	SPT(c)
	11.60	146.3	11.60	DRY	19,6	80	18,22,20,20		N=80	H4-2018	18/01/2018	68	91	SPT(c)
	14.60	146.3	14.60	DRY	21,4	78	27,29,26,18+	235	21,4/27,29,26,18	H4-2018	18/01/2018	68		SPT(c)
									for 10mm					
	17.60	146.3	17.60	DRY	25	11	29,28,29,14+	232	25/29,28,29,14	H4-2018	18/01/2018	68		SPT(c)
									for 7mm					
	20.60	146.3	20.60	DRY	11,12	150	21,23,24,22		N=90	H4-2018	18/01/2018	68	102	
	23.60	146.3	23.60	DRY	18,7	94	20,25,29,26+	236	18,7/20,25,29,26	H4-2018	18/01/2018	68		
									for 11mm					

Notes:
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3. Where full test drive was not achieved, actual penetration (R) and total test drive blows are reported.
4. Tests carried out using a split spoon sampler unless noted as SPT(c) (denotes use of solid cone method) in the comments column.
5. Entries in the water depth column reflects the measured water depth at time of test.

N_{60} = (Measured hammer energy ratio / 60) x N value

STRUCTURAL SOILS
The Old School
Stillhouse Lane
Bedminster
Bristol BS3 4EB

Compiled By: [redacted] **KJOHNSTONE**
Date: **11.4.19**
Contract Ref: **733442**
Contract: **A303 Stonehenge Phase 6 & 7 Ground Investigation**

STANDARD PENETRATION TEST SUMMARY TABLE

Exploratory Position ID	Depth (m)	Hole Dia (mm)	Casing Depth (m)	Water Depth (m)	Seating Drive		Test Drive			Hammer ID	Calibration Date	Energy Ratio (%)	N_{60}	Comments
					Blows	Pen (mm)	Blows	R (mm)	Result					
R71805	25.60	146.3	26.60	DRY	22,3	77	29,29,28,14+	234	22,3/29,29,28,14	H4-2018	18/01/2018	68		
									for 9mm					
	29.60	146.3	29.60	27.45	25	10	43,40,17+	162	25/43,40,17	H4-2018	18/01/2018	68		
									for 12mm					
	32.60	146.3	32.60	32.50	25	12	49,51+	97	25/49,51	H4-2018	18/01/2018	68		SPT(c)
									for 22mm					
	35.60	146.3	35.60	DRY	25	13	47,53+	95	25/47,53	H4-2018	18/01/2018	68		SPT(c)
									for 20mm					
	37.60	146.3	38.60	DRY	25	18	31,44,25+	159	25/31,44,25	H4-2018	18/01/2018	68		SPT(c)
									for 9mm					
	41.60	146.3	41.60	36.60	18,7	80	37,44,19+	163	18,7/37,44,19	H4-2018	18/01/2018	68		SPT(c)
									for 13mm					
R71809	3.50	146.3	1.50	DRY	4,7	150	14,14,10,7		N=45	JT01-2018	20/05/2018	64	48	
	6.50	146.3	1.50	DRY	9,10	150	11,12,14,14		N=51	JT01-2018	20/05/2018	64	54	
	9.50	146.3	1.50	DRY	2,2	150	14,13,10,9		N=46	JT01-2018	20/05/2018	64	49	
	12.50	146.3	1.50	DRY	1,2	150	6,9,9,12		N=36	JT01-2018	20/05/2018	64	38	
	15.50	146.3	1.50	DRY	6,7	150	11,13,12,10		N=46	JT01-2018	20/05/2018	64	49	
	20.00	146.3	1.50	DRY	8,10	150	12,12,11,10		N=45	JT01-2018	20/05/2018	64	48	

Notes:
1. Tests carried out in general accordance with BS EN ISO 22476-3:2005, including amendment A1 (2011).
2. Reported blows are for 75mm penetration unless indicated "+".
3. Where full test drive was not achieved, actual penetration (R) and total test drive blows are reported.
4. Tests carried out using a split spoon sampler unless noted as SPT(c) (denotes use of solid cone method) in the comments column.
5. Entries in the water depth column reflects the measured water depth at time of test.

N_{60} = (Measured hammer energy ratio / 60) x N value

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Compiled By: [redacted] **KJOHNSTONE**
Date: **11.4.19**
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Contract: **A303 Stonehenge Phase 6 & 7 Ground Investigation**

AGS

STANDARD PENETRATION TEST SUMMARY TABLE

Exploratory Position ID	Depth (m)	Hole Dia (mm)	Casing Depth (m)	Water Depth (m)	Seating Drive		Test Drive			Hammer ID	Calibration Date	Energy Ratio (%)	N_{60}	Comments
					Blows	Pen (mm)	Blows	R (mm)	Result					
R71809	23.00	146.3	1.50	DRY	2,9	150	12,12,14,15		N=53	JT01-2018	20/05/2018	64	57	
	26.00	146.3	1.50	DRY	7,6	150	9,11,13,14		N=47	JT01-2018	20/05/2018	64	50	
	29.00	146.3	1.50	DRY	9,12	150	14,17,16,17		N=64	JT01-2018	20/05/2018	64	68	
	32.00	146.3	1.50	DRY	11,14	135	14,12,11,12		N=49	JT01-2018	20/05/2018	64	52	
	35.00	146.3	1.50	DRY	6,16	150	19,31,50+	205	6,16/19,31,50	JT01-2018	20/05/2018	64		
									for 55mm					
	38.00	146.3	1.50	DRY	5,14	150	15,18,33,34+	285	5,14/15,18,33,34	JT01-2018	20/05/2018	64		
									for 60mm					
	41.00	146.3	1.50	DRY	6,14	150	19,27,54+	210	6,14/19,27,54	JT01-2018	20/05/2018	64		
									for 60mm					
	44.00	146.3	1.50	DRY	5,12	150	20,45,35+	190	5,12/20,45,35	JT01-2018	20/05/2018	64		
									for 40mm					
R71817	3.90	146.3	3.90	DRY	6,6	150	7,8,9,9		N=33	H4-2018	18/01/2018	68	37	
	6.90	146.3	6.90	DRY	5,15	150	10,15,75+	197	5,15/10,15,75	H4-2018	18/01/2018	68		
									for 47mm					
	9.60	146.3	9.60	DRY	25	18	33,45,22+	168	25/33,45,22	H4-2018	18/01/2018	68		SPT(c)
									for 18mm					
	12.90	146.3	12.90	DRY	10,12	150	15,15,20,31		N=81	H4-2018	18/01/2018	68	92	SPT(c)

Notes:
1. Tests carried out in general accordance with BS EN ISO 22476-3:2005, including amendment A1 (2011).
2. Reported blows are for 75mm penetration unless indicated "+".
3. Where full test drive was not achieved, actual penetration (R) and total test drive blows are reported.
4. Tests carried out using a split spoon sampler unless noted as SPT(c) (denotes use of solid cone method) in the comments column.
5. Entries in the water depth column reflects the measured water depth at time of test.

N_{60} = (Measured hammer energy ratio / 60) x N value

STANDARD PENETRATION TEST SUMMARY TABLE

Exploratory Position ID	Depth (m)	Hole Dia (mm)	Casing Depth (m)	Water Depth (m)	Seating Drive		Test Drive			Hammer ID	Calibration Date	Energy Ratio (%)	N_{60}	Comments
					Blows	Pen (mm)	Blows	R (mm)	Result					
R71817	15.90	146.3	15.90	DRY	10,15	150	24,23,24,29+	243	10,15/24,23,24,29	H4-2018	18/01/2018	68		SPT(c)
									for 18mm					
	18.90	146.3	18.90	DRY	12,10	150	13,14,28,27		N=82	H4-2018	18/01/2018	68	93	SPT(c)
	21.90	146.3	21.90	DRY	25	20	27,25,26,22+	240	25/27,25,26,22	H4-2018	18/01/2018	68		SPT(c)
									for 15mm					
	24.90	146.3	24.90	DRY	10,12	150	31,52,17+	165	10,12/31,52,17	H4-2018	18/01/2018	68		SPT(c)
									for 15mm					
	27.40	146.3	37.40	DRY	25	12	37,39,24+	160	25/37,39,24	H4-2018	18/01/2018	68		SPT(c)
									for 10mm					
	30.90	146.3	30.90	DRY	25	15	39,38,23+	162	25/39,38,23	H4-2018	18/01/2018	68		SPT(c)
									for 12mm					
	33.90	146.3	33.90	DRY	25	12	44,43,13+	159	25/44,43,13	H4-2018	18/01/2018	68		SPT(c)
									for 9mm					
	36.90	146.3	36.90	DRY	25	14	54,46+	94	25/54,46	H4-2018	18/01/2018	68		SPT(c)
									for 19mm					
	39.90	146.3	39.90	DRY	25	11	61,39+	91	25/61,39	H4-2018	18/01/2018	68		SPT(c)
									for 16mm					
	42.90	146.3	42.90	DRY	25	12	66,34+	92	25/66,34	H4-2018	18/01/2018	68		SPT(c)

Notes:
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2. Reported blows are for 75mm penetration unless indicated "+".
3. Where full test drive was not achieved, actual penetration (R) and total test drive blows are reported.
4. Tests carried out using a split spoon sampler unless noted as SPT(c) (denotes use of solid cone method) in the comments column.
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STANDARD PENETRATION TEST SUMMARY TABLE

Exploratory Position ID	Depth (m)	Hole Dia (mm)	Casing Depth (m)	Water Depth (m)	Seating Drive		Test Drive			Hammer ID	Calibration Date	Energy Ratio (%)	N_{60}	Comments
					Blows	Pen (mm)	Blows	R (mm)	Result					
									for 17mm					
	45.90	146.3	42.90	DRY	25	10	72,23+	89	25/72,23	H4-2018	18/01/2018	68		SPT(c)
									for 14mm					
R71822	2.20	146.3	0.00	DRY	1,1	150	2,5,6,5		N=18	JT01-2018	20/05/2018	64	19	
	4.45	146.3	1.50	DRY	5,5	150	8,7,6,11		N=32	JT01-2018	20/05/2018	64	34	
	8.20	146.3	1.50	DRY	8,10	150	15,12,7,8		N=42	JT01-2018	20/05/2018	64	45	
	10.45	146.3	1.50	DRY	25	65	25,25+	125	25/25,25	JT01-2018	20/05/2018	64		
									for 50mm					
	14.20	146.3	1.50	DRY	10,14	150	18,136,29+	220	10,14/18,136,29	JT01-2018	20/05/2018	64		
									for 70mm					
	16.45	146.3	1.50	DRY	10,15	150	15,11,10,14+	285	10,15/15,11,10,14	JT01-2018	20/05/2018	64		
									for 60mm					
	20.20	146.3	1.50	DRY	25	75	25,26,49+	200	25/25,26,49	JT01-2018	20/05/2018	64		
									for 50mm					
	23.20	146.3	1.50	DRY	10,15	150	25,75+	140	10,15/25,75	JT01-2018	20/05/2018	64		
									for 65mm					
	26.20	146.3	1.50	DRY	8,8	150	11,13,30,21		N=75	JT01-2018	20/05/2018	64	80	
	29.20	146.3	1.50	DRY	9,10	150	10,11,15,21		N=57	JT01-2018	20/05/2018	64	61	

Notes:
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2. Reported blows are for 75mm penetration unless indicated "+".
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4. Tests carried out using a split spoon sampler unless noted as SPT(c) (denotes use of solid cone method) in the comments column.
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STANDARD PENETRATION TEST SUMMARY TABLE

Exploratory Position ID	Depth (m)	Hole Dia (mm)	Casing Depth (m)	Water Depth (m)	Seating Drive		Test Drive			Hammer ID	Calibration Date	Energy Ratio (%)	N_{60}	Comments
					Blows	Pen (mm)	Blows	R (mm)	Result					
R71822	32.20	146.3	1.50	DRY	8,12	150	14,18,23,20		N=75	JT01-2018	20/05/2018	64	80	
	35.20	146.3	1.50	DRY	10,10	150	10,10,11,12		N=43	JT01-2018	20/05/2018	64	46	
	38.20	146.3	1.50	DRY	12,12	150	41,59+	115	12,12/41,59	JT01-2018	20/05/2018	64		
									for 40mm					
	41.20	146.3	1.50	DRY	25	75	76,24+	95	25/76,24	JT01-2018	20/05/2018	64		
									for 20mm					
R72003	4.00	146.3	1.50		5,5	150	2,3,2,4		N=11	H4-2018	18/01/2018	68	12	
	9.00	146.3	1.50		12,7	150	10,10,12,11		N=43	H4-2018	18/01/2018	68	49	
	13.50	146.3	1.50		12,13	150	11,12,12,13		N=48	H4-2018	18/01/2018	68	54	
	18.00	146.3	1.50		3,9	150	17,23,24,24		N=88	H4-2018	18/01/2018	68	100	
	22.50	146.3	1.50		9,8	150	9,13,11,13		N=46	H4-2018	18/01/2018	68	52	
	27.00	146.3	1.50		10,11	150	14,13,14,15		N=56	H4-2018	18/01/2018	68	63	
	31.50	146.3	1.50		6,11	150	22,20,30,28		N=100	H4-2018	18/01/2018	68	113	
	39.80	146.3	1.50		12,11	150	17,14,16,26		N=73	H4-2018	18/01/2018	68	83	
	45.00	146.3	1.50		12,14	150	16,18,18,18		N=70	H4-2018	18/01/2018	68	79	

Notes:
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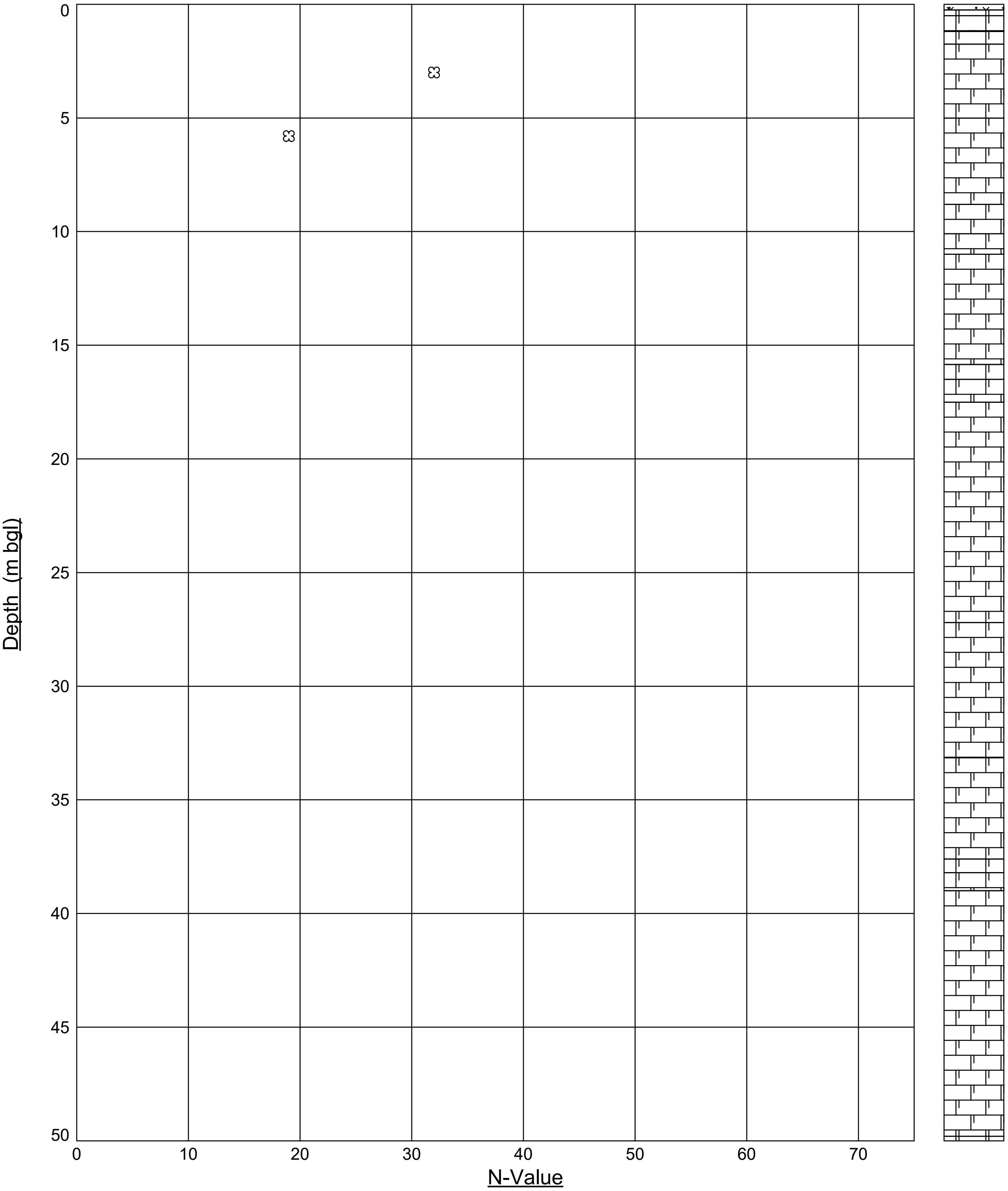
4. Tests carried out using a split spoon sampler unless noted as SPT(c) (denotes use of solid cone method) in the comments column.
5. Entries in the water depth column reflects the measured water depth at time of test.

N_{60} = (Measured hammer energy ratio / 60) x N value

STANDARD PENETRATION TEST (SPT N-Value) vs DEPTH

Exploratory Hole : **R608**.

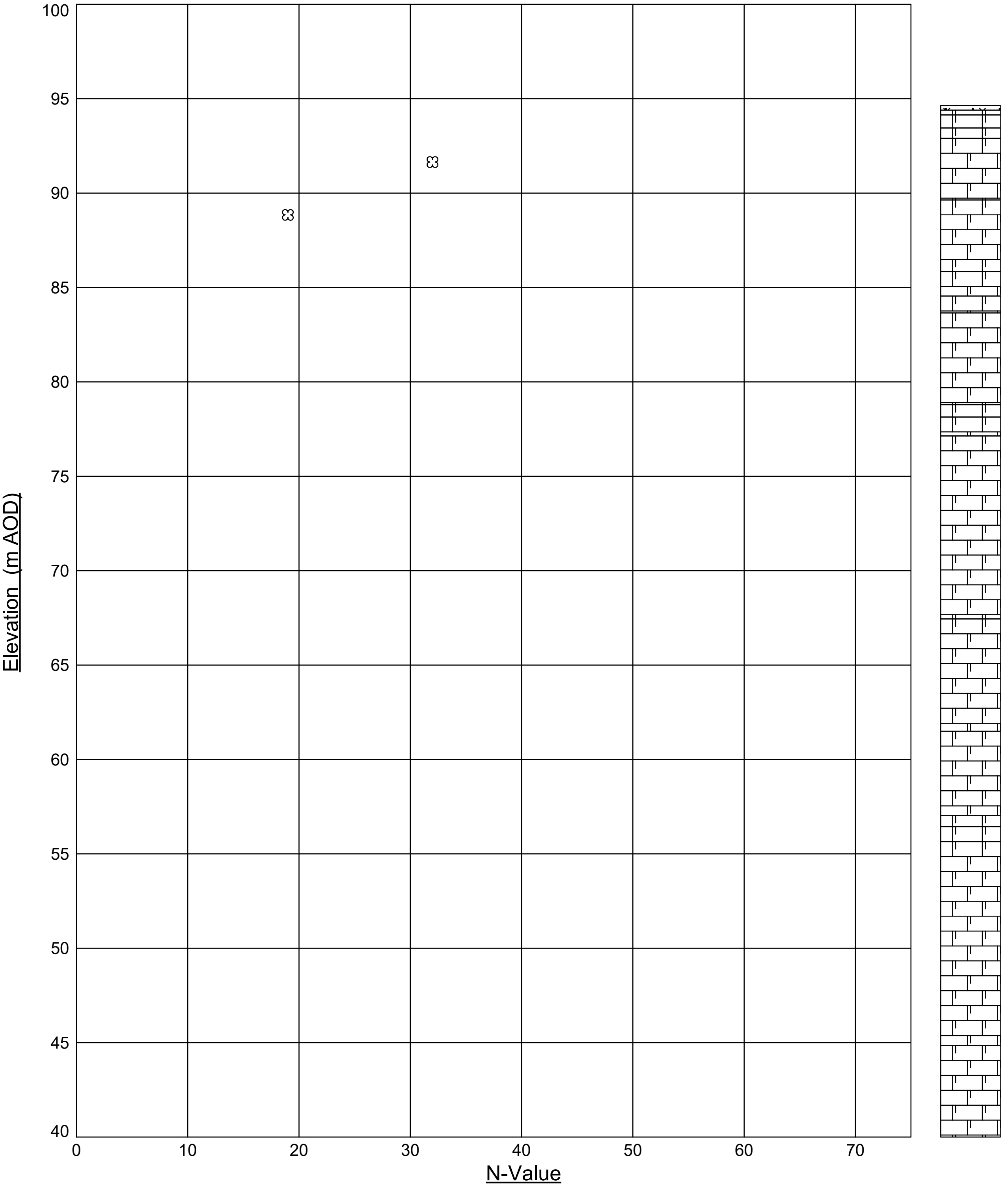


STRUCTURAL SOILS
The Old School
Stillhouse Lane
Bedminster
Bristol BS3 4EB

Contract	Date	Compiled By
A303 Stonehenge Phase 6 & 7 Ground Investigation	**12.12.18**	[redacted]
Client	Contract Ref:	
Highways England	**733442**	AGS

STANDARD PENETRATION TEST (SPT N-Value)
vs
ELEVATION

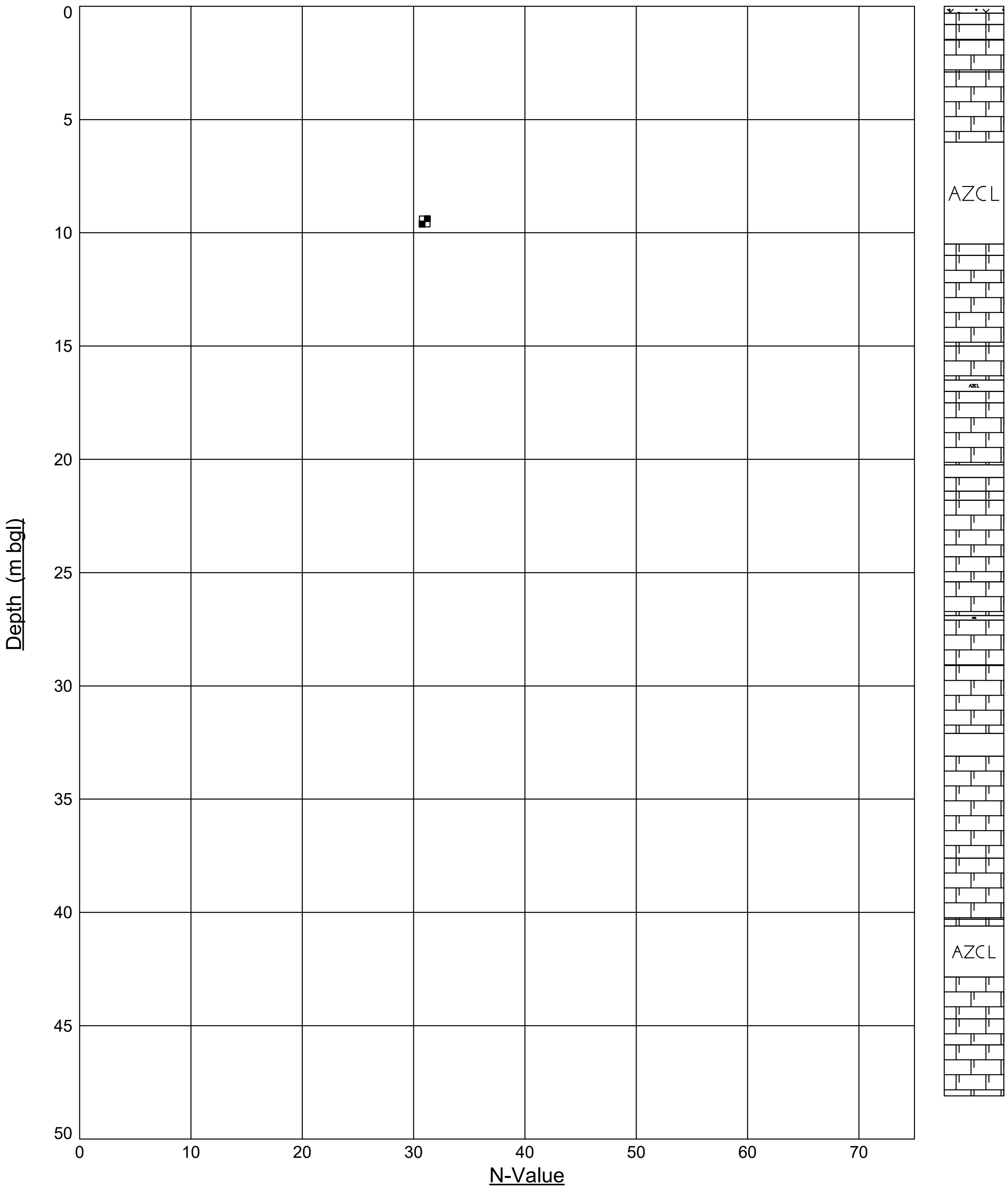
Exploratory Hole : **R608**.



STRUCTURAL SOILS The Old School Stillhouse Lane Bedminster Bristol BS3 4EB	Contract **A303 Stonehenge Phase 6 & 7 Ground Investigation**	Date **12.12.18**	Compiled By [redacted]
	Client **Highways England**	Contract Ref: **733442**	AGS

STANDARD PENETRATION TEST (SPT N-Value)
vs
DEPTH

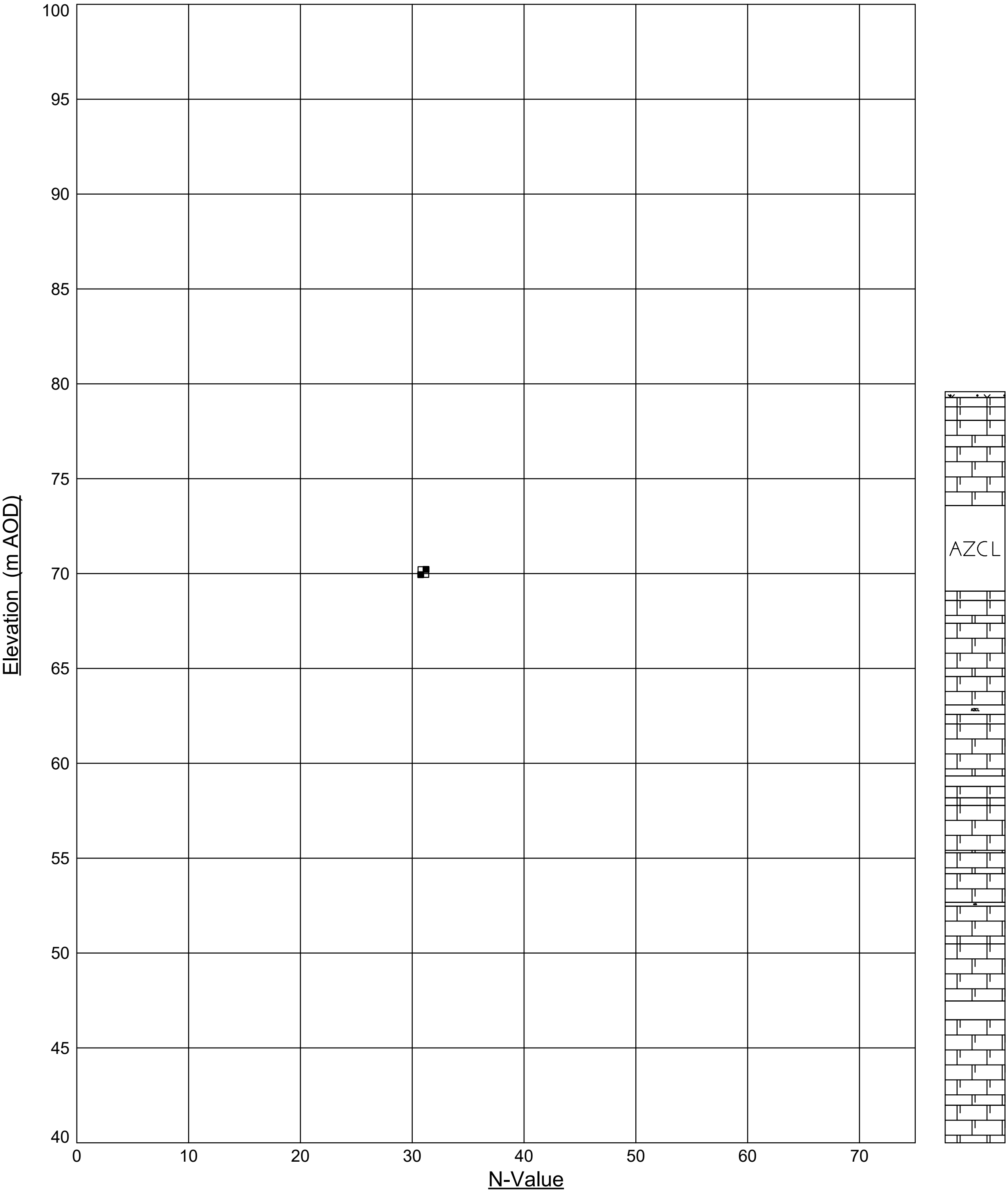
Exploratory Hole : **R619.**



STRUCTURAL SOILS The Old School Stillhouse Lane Bedminster Bristol BS3 4EB	Contract **A303 Stonehenge Phase 6 & 7 Ground Investigation**	Date **12.12.18**	Compiled By [redacted]
	Client **Highways England**	Contract Ref: **733442**	

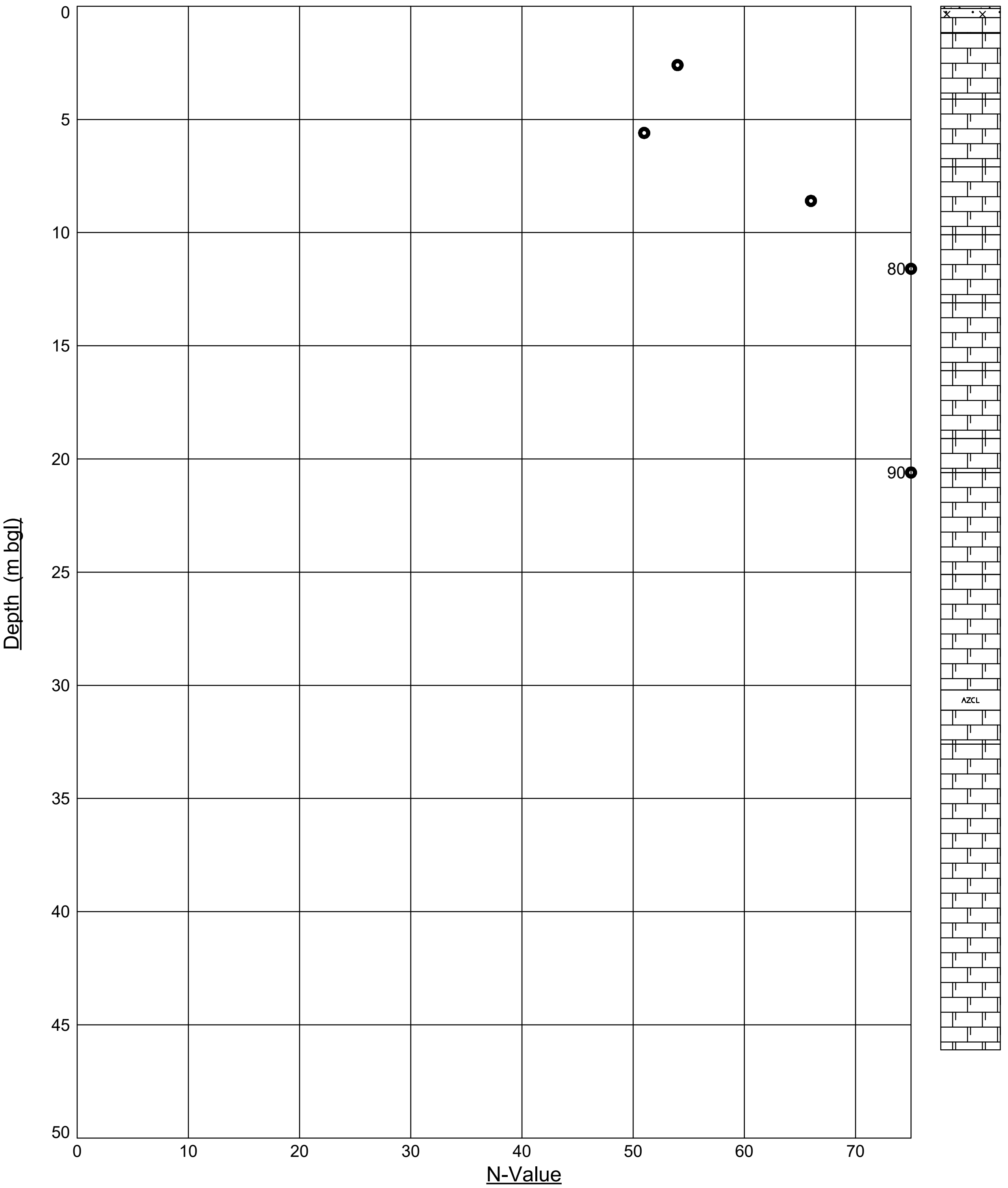
STANDARD PENETRATION TEST (SPT N-Value) vs ELEVATION

Exploratory Hole : **R619.**



STANDARD PENETRATION TEST (SPT N-Value)
vs
DEPTH

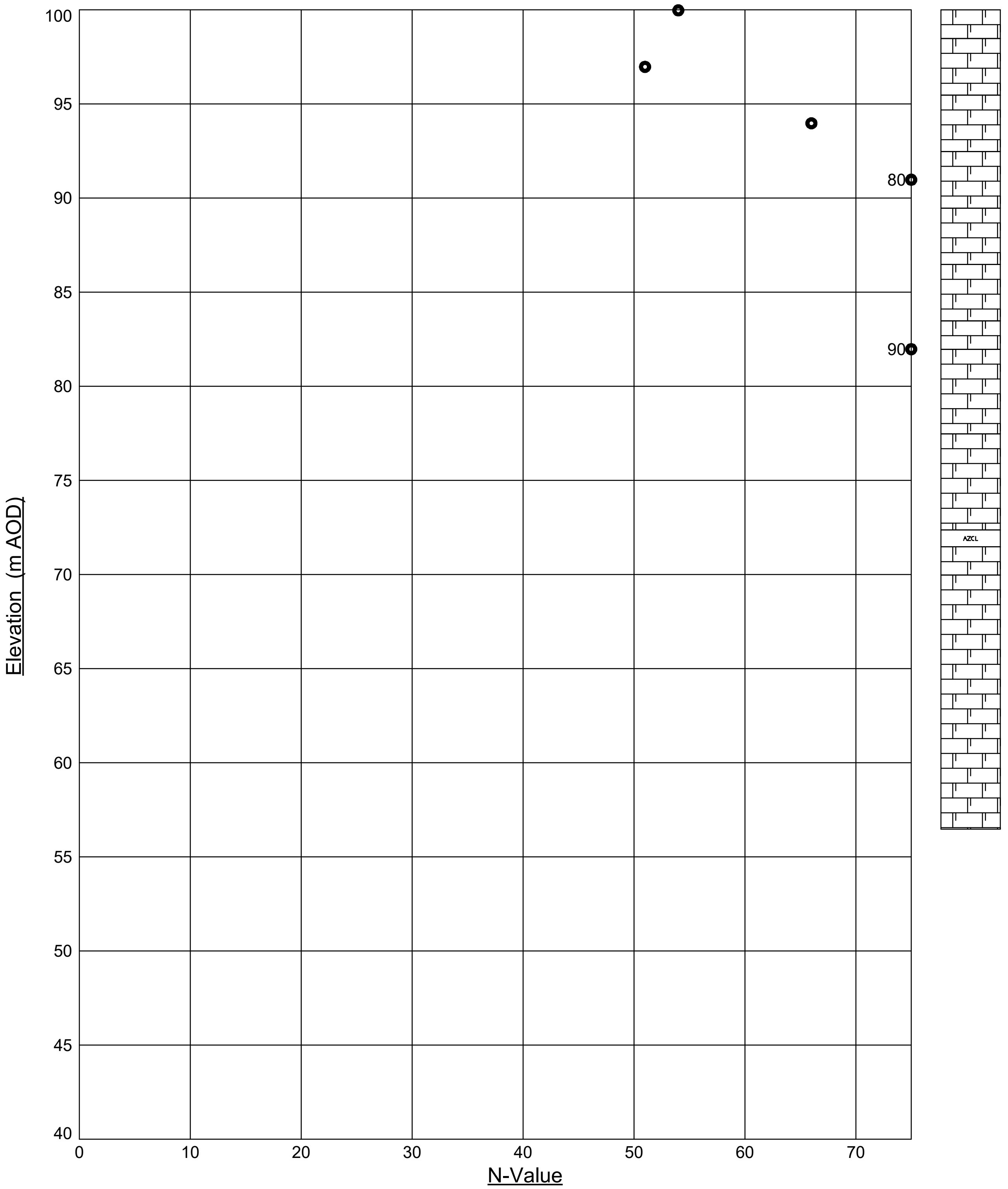
Exploratory Hole : **R71805.**



STRUCTURAL SOILS The Old School Stillhouse Lane Bedminster Bristol BS3 4EB	Contract **A303 Stonehenge Phase 6 & 7 Ground Investigation**	Date **12.12.18**	Compiled By [redacted]
	Client **Highways England**	Contract Ref: **733442**	AGS

STANDARD PENETRATION TEST (SPT N-Value)
vs
ELEVATION

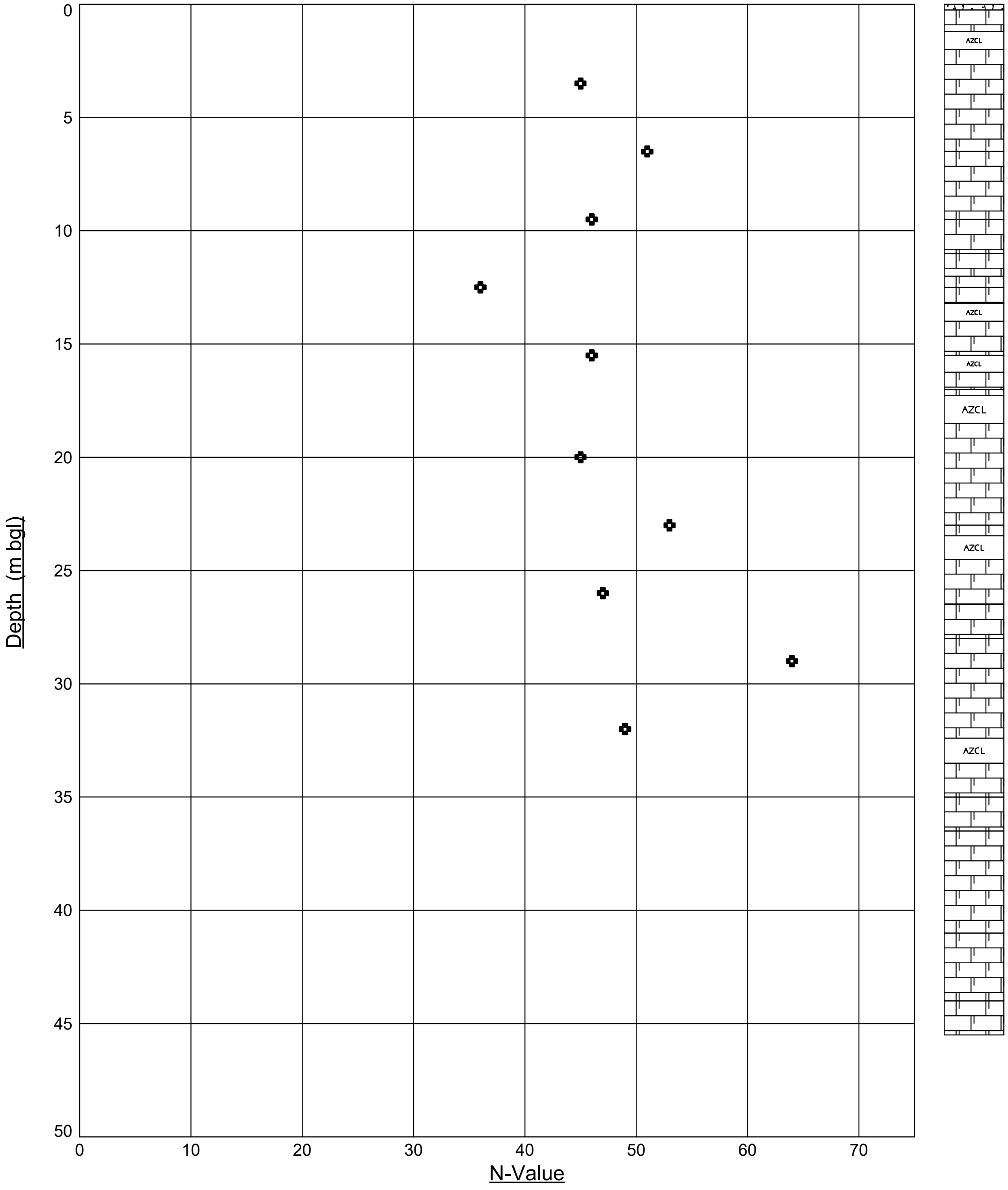
Exploratory Hole : **R71805**.



	Contract	Date	Compiled By
STRUCTURAL SOILS The Old School Stillhouse Lane Bedminster Bristol BS3 4EB	**A303 Stonehenge Phase 6 & 7 Ground Investigation**	**12.12.18**	[redacted]
	Client	Contract Ref:	
	Highways England	**733442**	

STANDARD PENETRATION TEST (SPT N-Value)
vs
DEPTH

Exploratory Hole : **R71809.**



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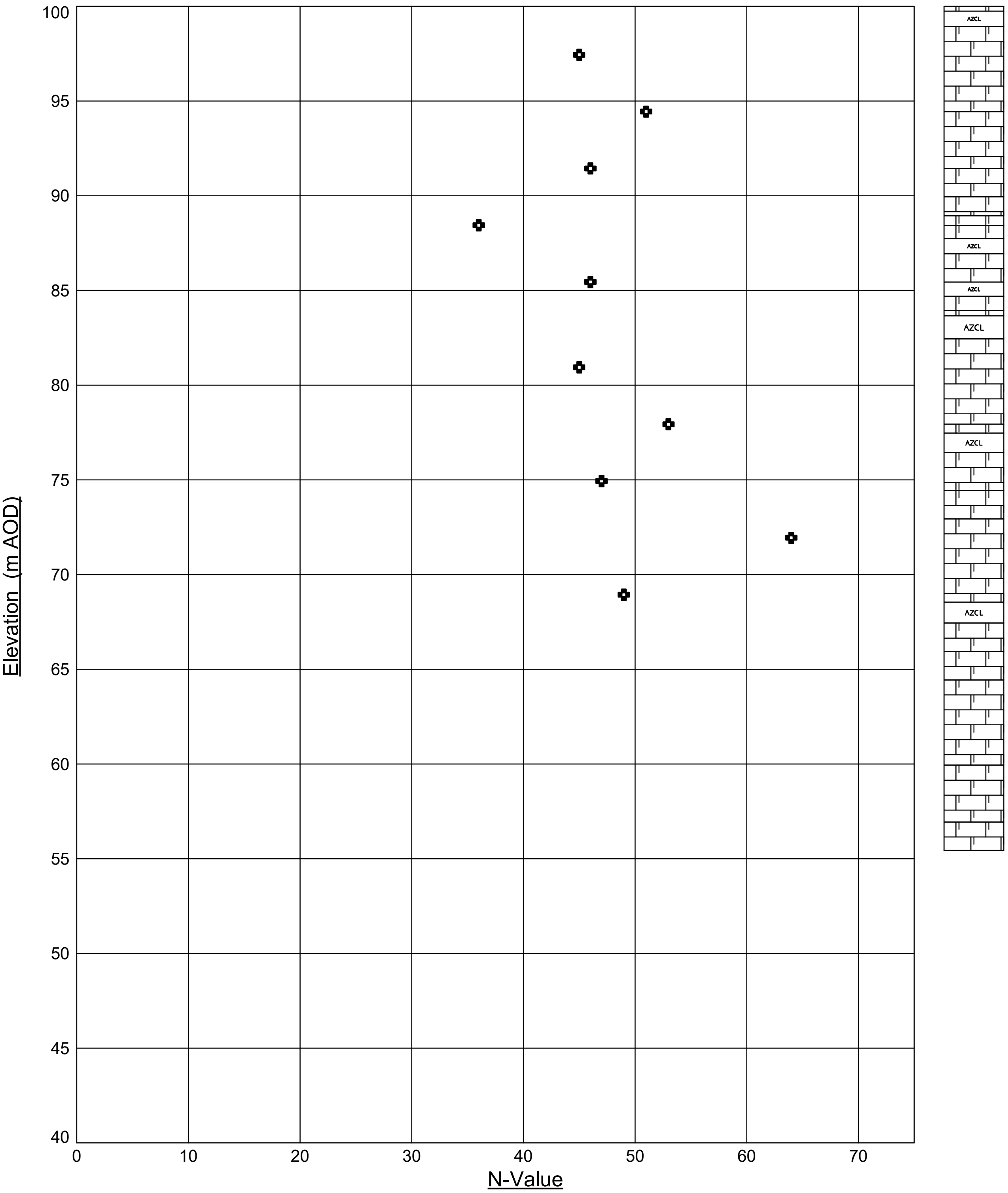
Contract	Date	Compiled By
A303 Stonehenge Phase 6 & 7 Ground Investigation	**12.12.18**	[redacted]
Client	Contract Ref:	
Highways England	**733442**	

STANDARD PENETRATION TEST (SPT N-Value) vs ELEVATION

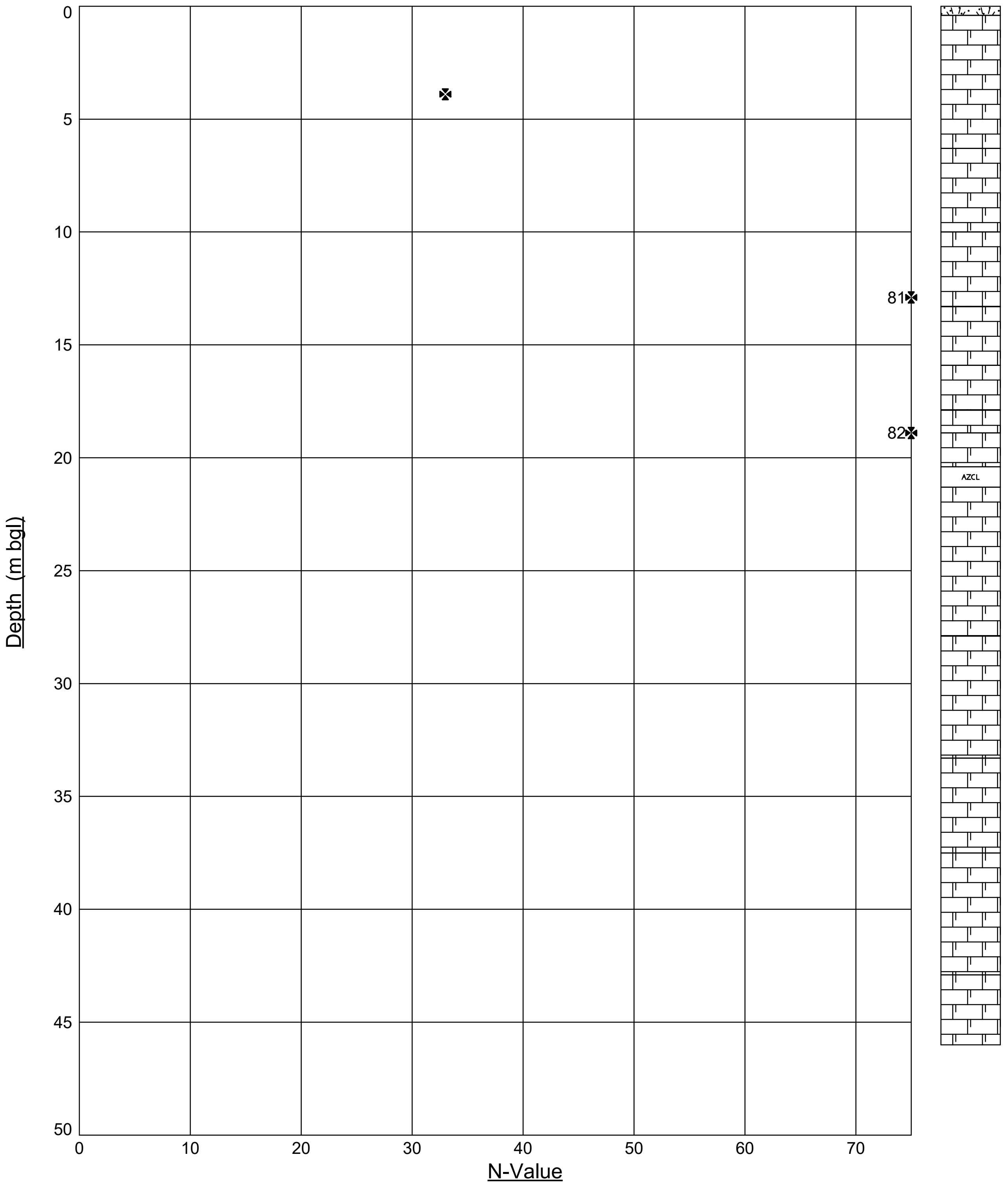
Exploratory Hole : **R71809**.



STRUCTURAL SOILS The Old School Stillhouse Lane Bedminster Bristol BS3 4EB	Contract **A303 Stonehenge Phase 6 & 7 Ground Investigation**	Date **12.12.18**	Compiled By [redacted]
	Client **Highways England**	Contract Ref: **733442**	

STANDARD PENETRATION TEST (SPT N-Value)
vs
DEPTH

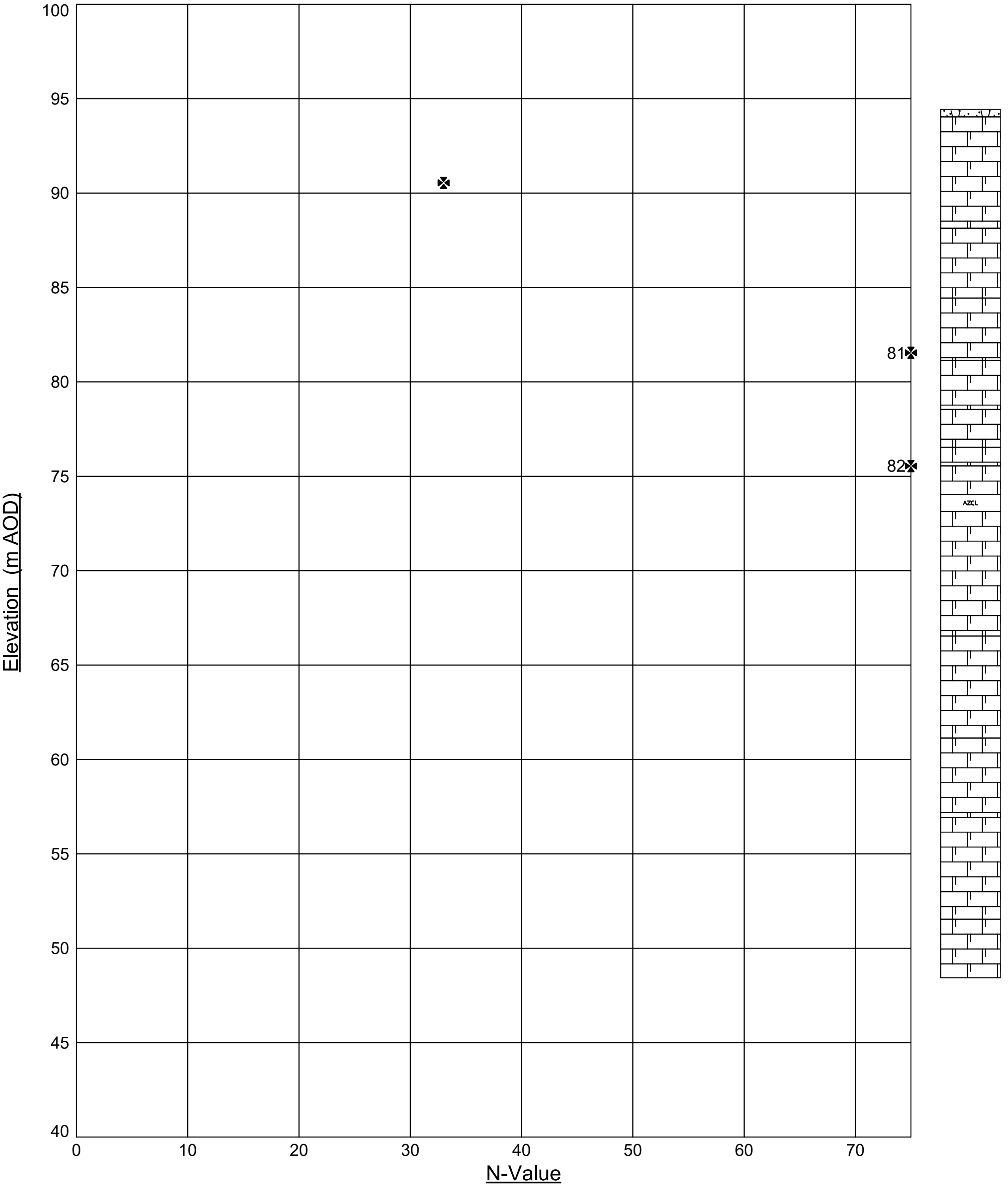
Exploratory Hole : **R71817**.



STRUCTURAL SOILS The Old School Stillhouse Lane Bedminster Bristol BS3 4EB	Contract **A303 Stonehenge Phase 6 & 7 Ground Investigation**	Date **12.12.18**	Compiled By [redacted]
	Client **Highways England**	Contract Ref: **733442**	

STANDARD PENETRATION TEST (SPT N-Value) vs ELEVATION

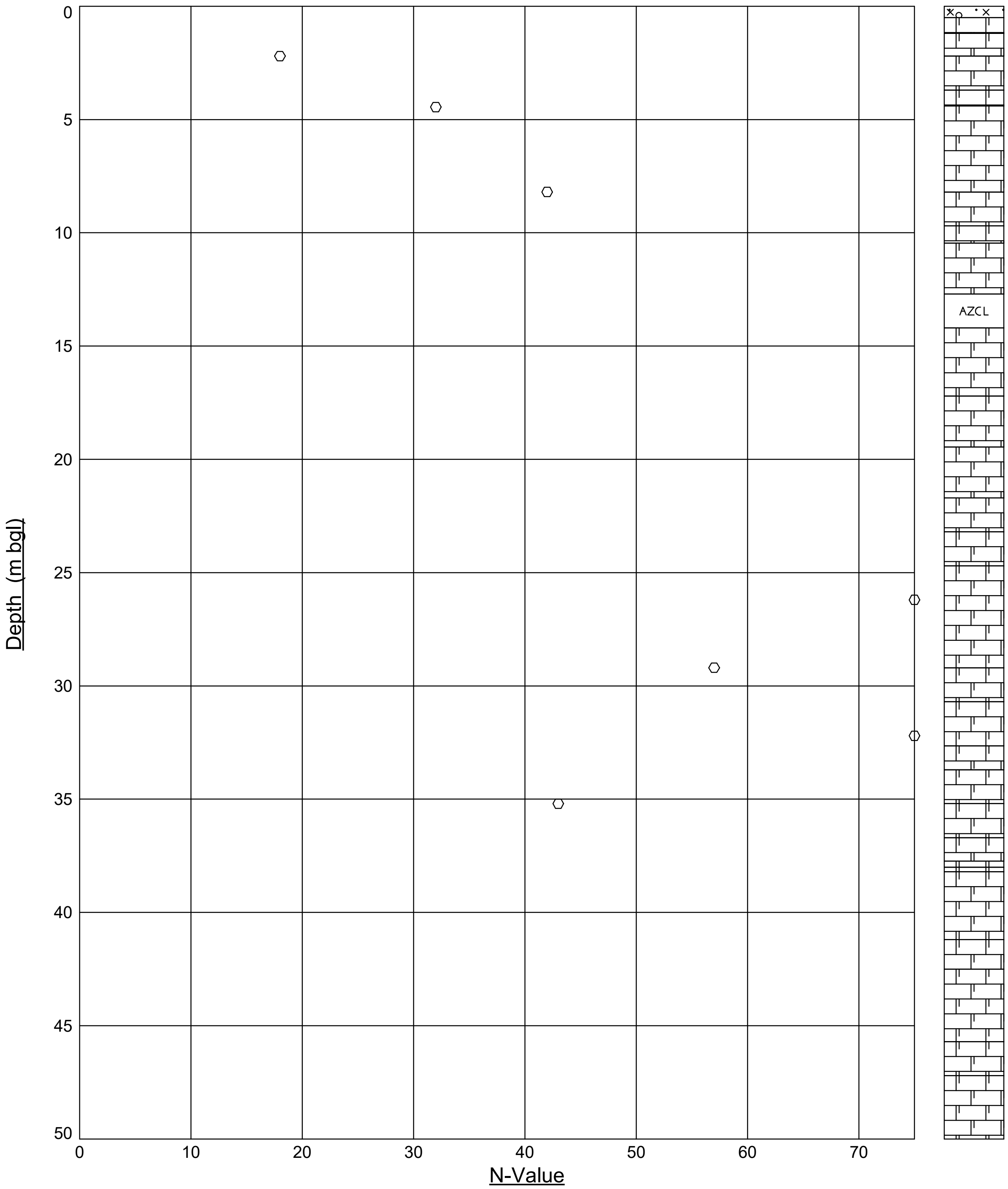
Exploratory Hole : **R71817**.



STRUCTURAL SOILS The Old School Stillhouse Lane Bedminster Bristol BS3 4EB	Contract **A303 Stonehenge Phase 6 & 7 Ground Investigation**	Date **12.12.18**	Compiled By [redacted]	
	Client **Highways England**	Contract Ref: **733442**		

STANDARD PENETRATION TEST (SPT N-Value) vs DEPTH

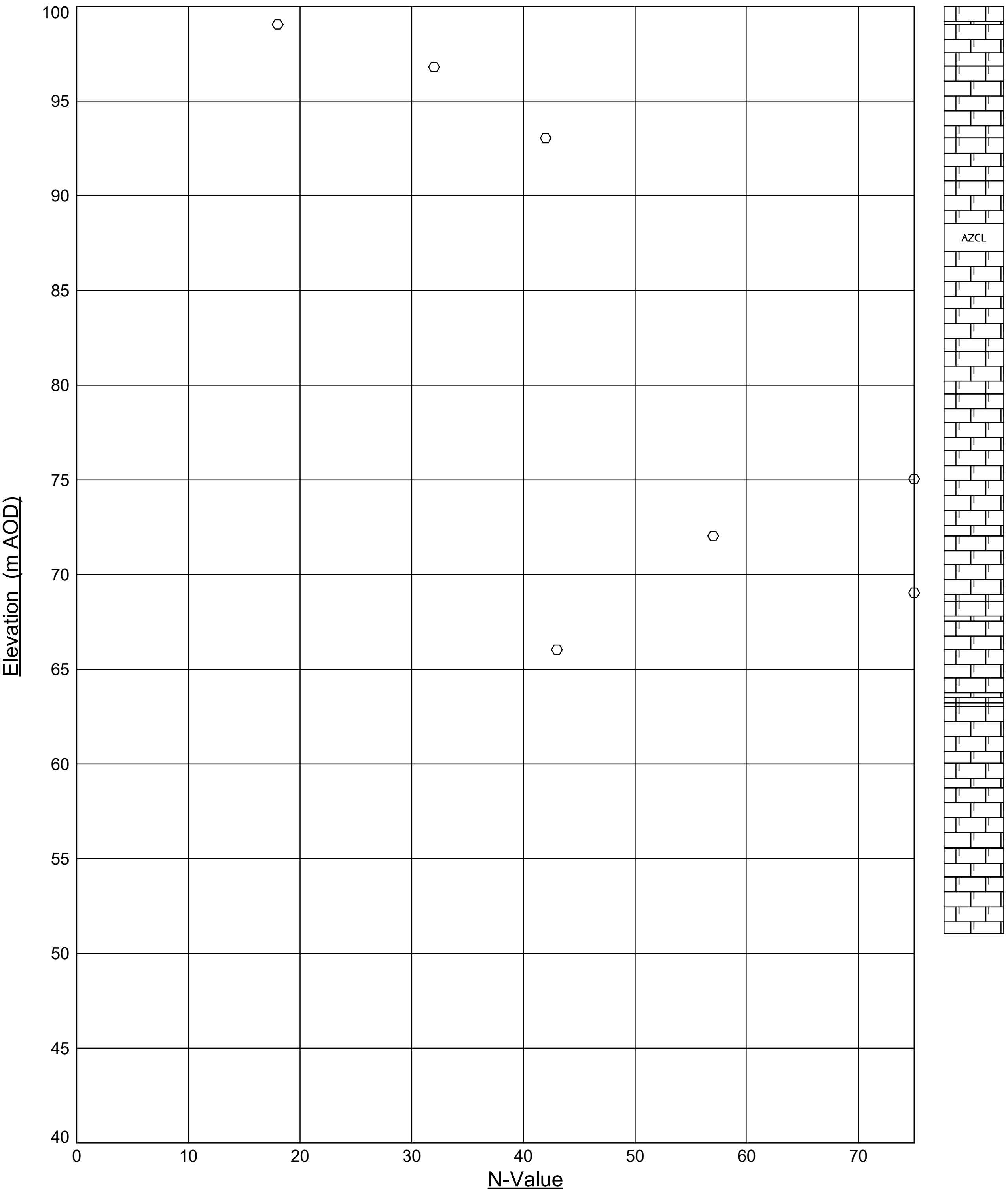
Exploratory Hole : **R71822.**



STRUCTURAL SOILS The Old School Stillhouse Lane Bedminster Bristol BS3 4EB	Contract **A303 Stonehenge Phase 6 & 7 Ground Investigation**	Date **12.12.18**	Compiled By [redacted]
	Client **Highways England**	Contract Ref: **733442**	

STANDARD PENETRATION TEST (SPT N-Value)
vs
ELEVATION

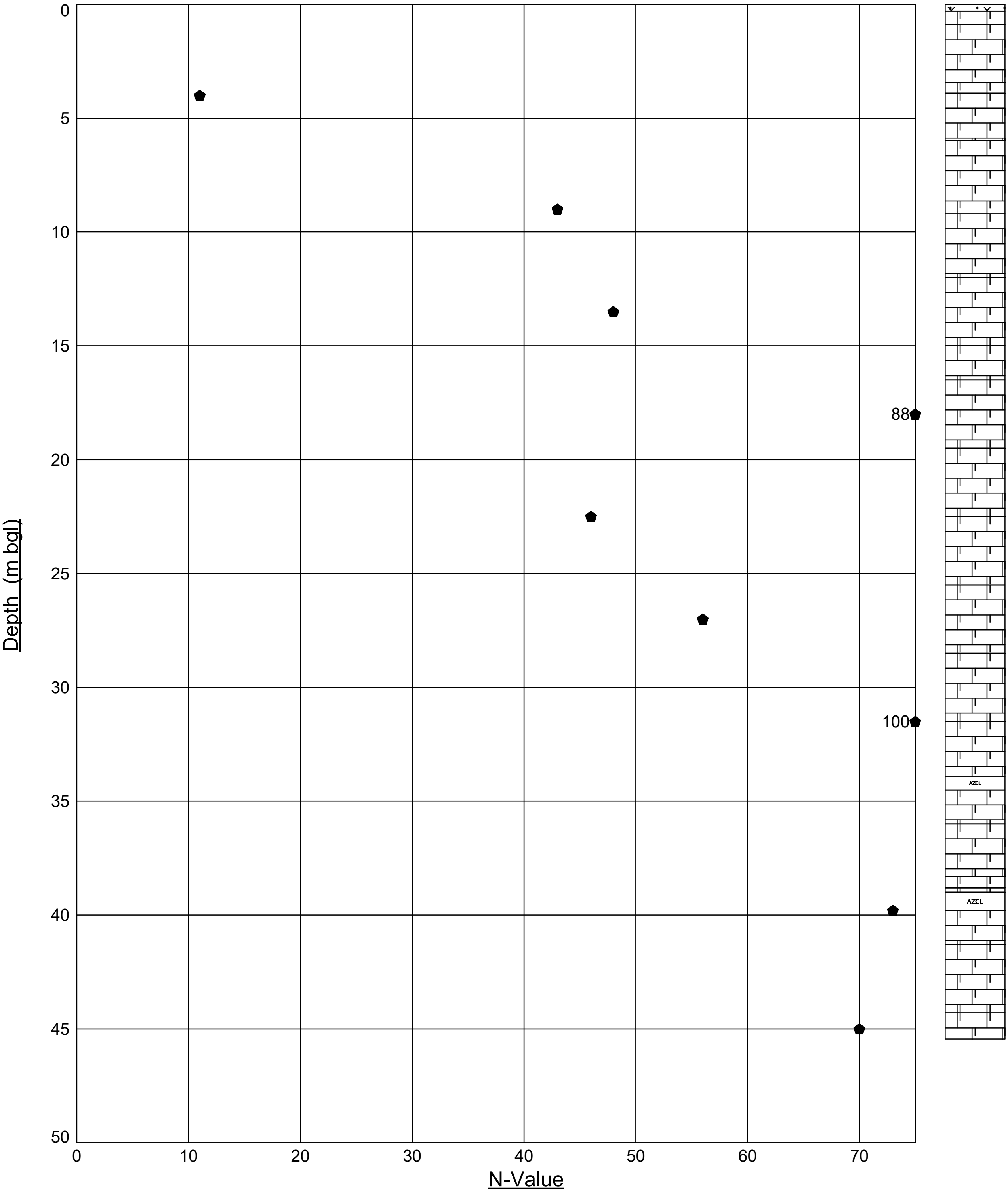
Exploratory Hole : **R71822.**



	STRUCTURAL SOILS The Old School Stillhouse Lane Bedminster Bristol BS3 4EB	Contract **A303 Stonehenge Phase 6 & 7 Ground Investigation**	Date **12.12.18**	Compiled By [redacted]
		Client **Highways England**	Contract Ref: **733442**	AGS

STANDARD PENETRATION TEST (SPT N-Value) vs DEPTH

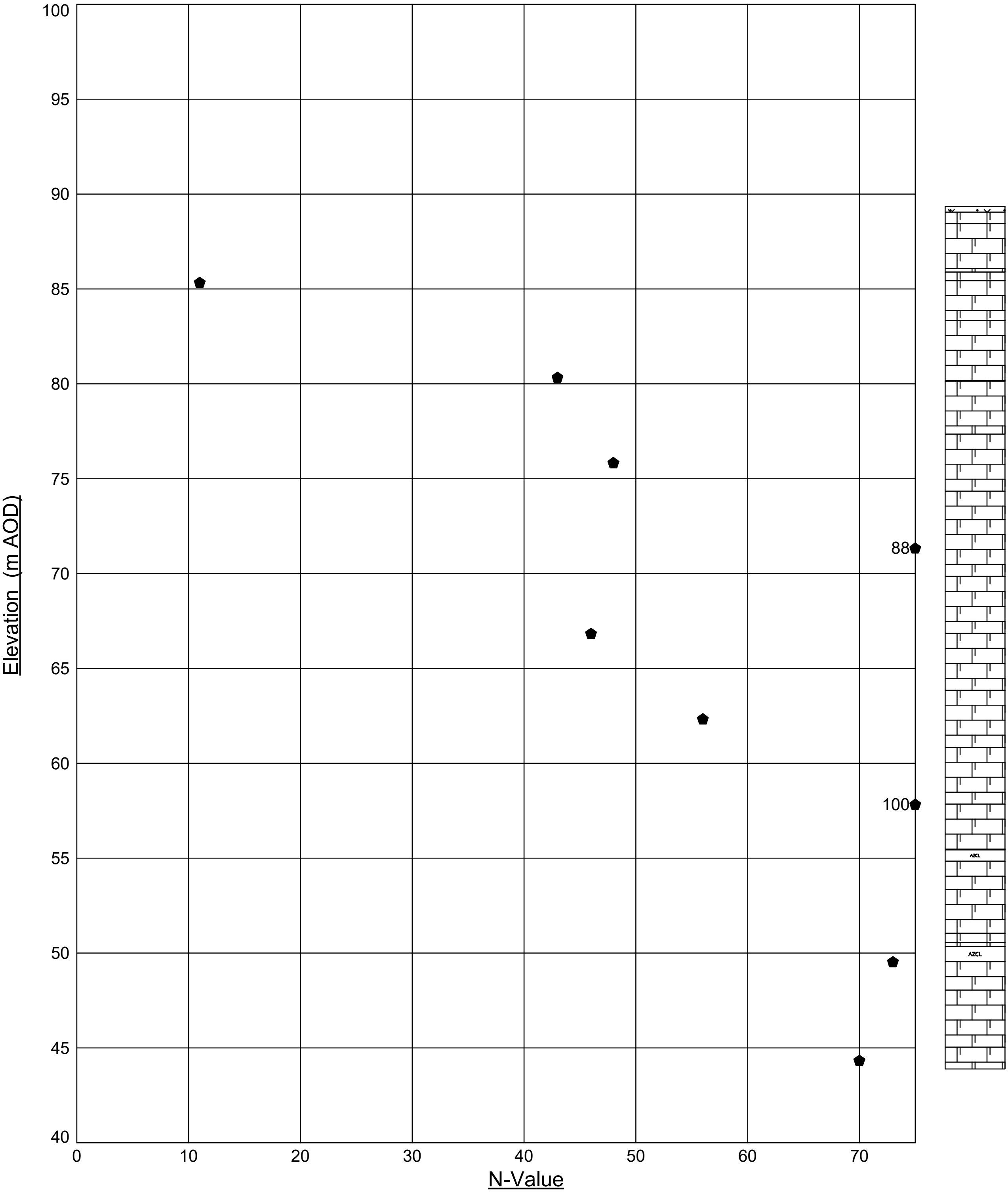
Exploratory Hole : **R72003.**



STRUCTURAL SOILS The Old School Stillhouse Lane Bedminster Bristol BS3 4EB	Contract **A303 Stonehenge Phase 6 & 7 Ground Investigation**	Date **12.12.18**	Compiled By [redacted]
	Client **Highways England**	Contract Ref: **733442**	AGS

STANDARD PENETRATION TEST (SPT N-Value)
vs
ELEVATION

Exploratory Hole : **R72003.**



STRUCTURAL SOILS The Old School Stillhouse Lane Bedminster Bristol BS3 4EB	Contract **A303 Stonehenge Phase 6 & 7 Ground Investigation**	Date **12.12.18**	Compiled By [redacted]
	Client **Highways England**	Contract Ref: **733442**	

IN-SITU PERMEABILITY TEST - FALLING HEAD
In accordance with BS EN ISO 22282-2:2012

Position ID : **R616** Depth (m below GL): **22.43-26.73** Test Number: **1**

Test Date: **14/06/2018 10:03:00** Test Supervisor: **MJJones**

Ground Level: **91.52** National Grid Co-ordinates: **E:412596.9 N:141916.0**

TEST SETUP DETAILS

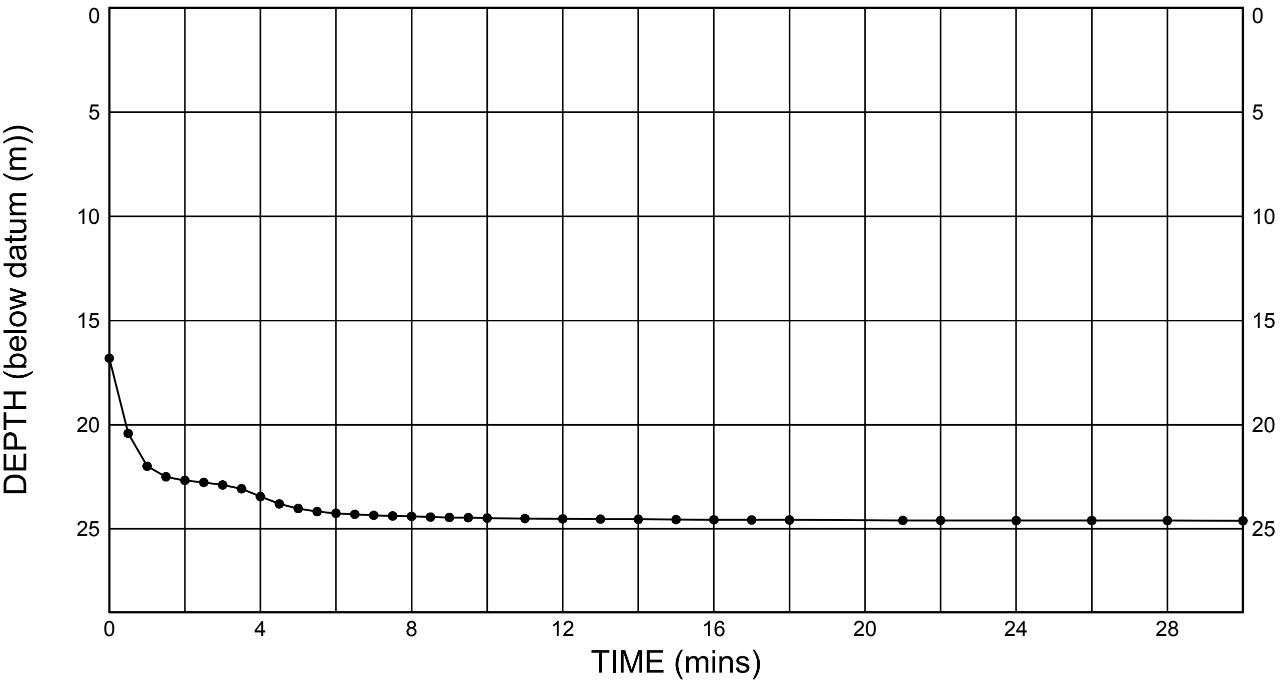
Depth measurements recorded from top of casing (top of casing 1.57m above GL).

Depth to top of response zone:	**24.00** m	Borehole diameter:	**146** mm
Depth to base of response zone:	**28.30** m		
Length of response zone:	**4.30** m	Depth to base of casing:	**24.00** m
Initial groundwater level prior to test:	**24.64** m	Casing diameter:	**146** mm
Depth to base of borehole at start of test:	**28.30** m		
Depth to base of borehole at completion of test:	**28.30** m	Weather:	**Drizzle**

TEST MEASUREMENTS

Time (mins)	Water depth (m)	Head (m)	H/Ho	Time (mins)	Water depth (m)	Head (m)	H/Ho	Time (mins)	Water depth (m)	Head (m)	H/Ho	Time (mins)	Water depth (m)	Head (m)	H/Ho
00:00:00	16.81	7.83	1.00	00:05:00	24.02	0.62	0.08	00:10:00	24.48	0.16	0.02	00:22:00	24.59	0.05	0.01
00:00:30	20.42	4.22	0.54	00:05:30	24.17	0.47	0.06	00:11:00	24.50	0.14	0.02	00:24:00	24.60	0.04	0.01
00:01:00	21.99	2.65	0.34	00:06:00	24.25	0.39	0.05	00:12:00	24.52	0.12	0.02	00:26:00	24.60	0.04	0.01
00:01:30	22.50	2.14	0.27	00:06:30	24.30	0.34	0.04	00:13:00	24.53	0.11	0.01	00:28:00	24.60	0.04	0.01
00:02:00	22.67	1.97	0.25	00:07:00	24.35	0.29	0.04	00:14:00	24.54	0.10	0.01	00:30:00	24.61	0.03	0.00
00:02:30	22.77	1.87	0.24	00:07:30	24.38	0.26	0.03	00:15:00	24.55	0.09	0.01				
00:03:00	22.89	1.75	0.22	00:08:00	24.40	0.24	0.03	00:16:00	24.56	0.08	0.01				
00:03:30	23.07	1.57	0.20	00:08:30	24.43	0.21	0.03	00:17:00	24.57	0.07	0.01				
00:04:00	23.45	1.19	0.15	00:09:00	24.45	0.19	0.02	00:18:00	24.57	0.07	0.01				
00:04:30	23.80	0.84	0.11	00:09:30	24.46	0.18	0.02	00:21:00	24.59	0.05	0.01				

PLOT OF WATER DEPTH AGAINST TIME



	Compiled By	Date	Checked By	Date
STRUCTURAL SOILS The Old School Stillhouse Lane Bedminster Bristol BS3 4EB	[redacted]	**09/08/18**	[redacted]	**09/08/18**
	Contract **A303 Stonehenge Phase 6 Ground Investigation**		Contract Ref: **733442**	

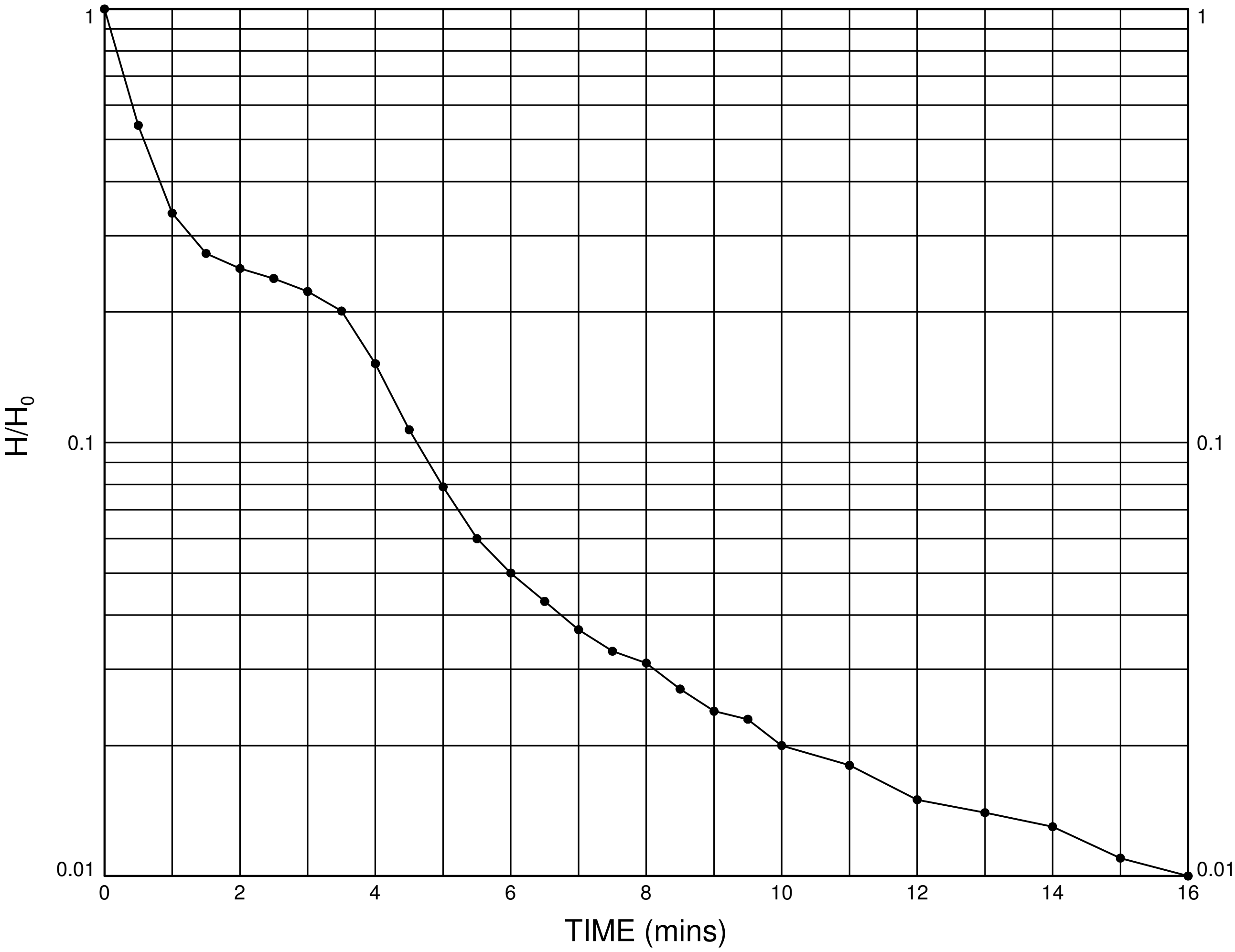
AGS

IN-SITU PERMEABILITY TEST - FALLING HEAD
In accordance with BS EN ISO 22282-2:2012

Position ID : **R616** Depth (m below GL): **22.43-26.73** Test Number: **1**
Test Date: **14/06/2018 10:03:00** Test Supervisor: **MJJones**

Ground Level: **91.52** National Grid Co-ordinates: **E:412596.9 N:141916.0**

PLOT OF H/Ho AGAINST TIME



Diameter of Test Section, D	=	**0.146**	m
Cross Sectional Area of Liaison Tube, A	=	**0.01674**	m^2
Test Section Length, L	=	**4.3**	m
Shape Factor, F	=	**6.63**	m
Time, $t - t_0$	=	**-**	sec
In-situ Permeability, k	=	**-**	m/sec

Notes : **Calculation of permeability value does not form part of BS EN ISO 22282-2 test report. No calculation of permeability possible as test section spans saturated and unsaturated zone.**

Sheet 2 of 2

STRUCTURAL SOILS The Old School Stillhouse Lane Bedminster Bristol BS3 4EB	Compiled By	Date	Checked By	Date
	[redacted]	**09/08/18**	[redacted]	**09/08/18**
	Contract: **A303 Stonehenge Phase 6 Ground Investigation**		Contract Ref: **733442**	

IN-SITU PERMEABILITY TEST - FALLING HEAD
In accordance with BS EN ISO 22282-2:2012

Position ID : **R616** Depth (m below GL): **25.20-38.40** Test Number: **2**
Test Date: **14/06/2018 15:31:00** Test Supervisor: **MJJones**
Ground Level: **91.52** National Grid Co-ordinates: **E:412596.9 N:141916.0**

TEST SETUP DETAILS

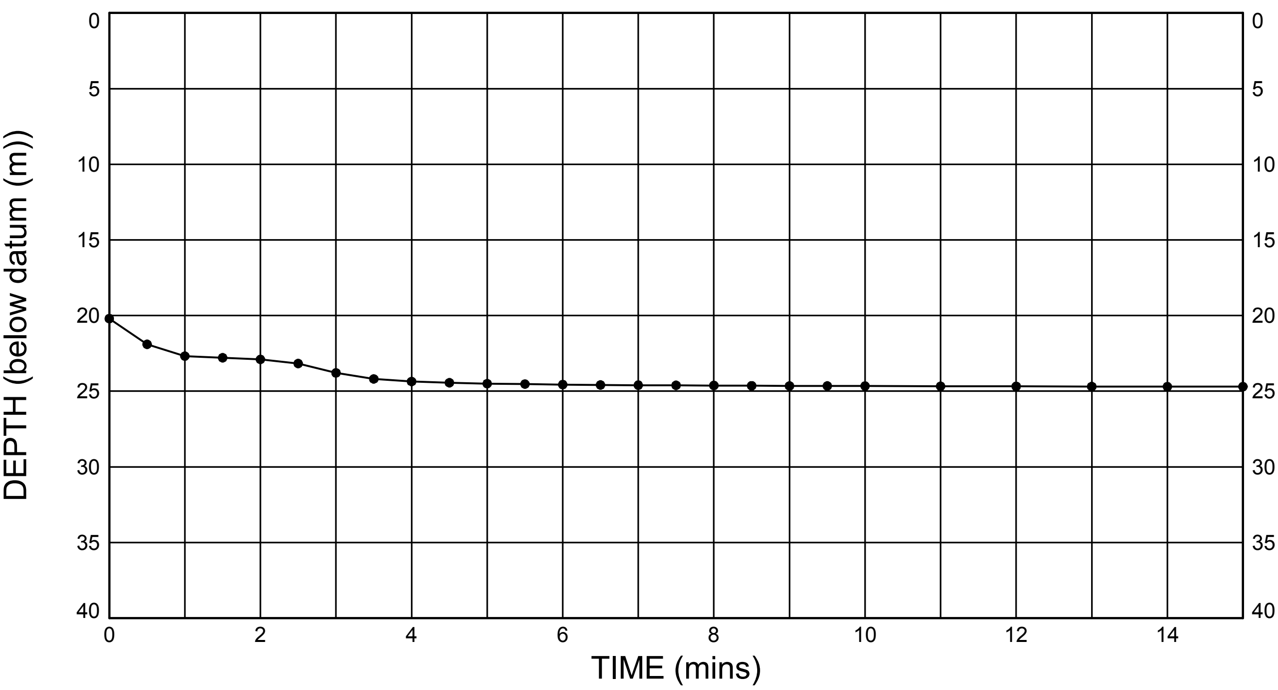
Depth measurements recorded from top of casing (top of casing 1.60m above GL).

Depth to top of response zone:	**26.80** m	Borehole diameter:	**146** mm
Depth to base of response zone:	**40.00** m		
Length of response zone:	**13.20** m	Depth to base of casing:	**26.80** m
Initial groundwater level prior to test:	**24.50** m	Casing diameter:	**146** mm
Depth to base of borehole at start of test:	**40.00** m		
Depth to base of borehole at completion of test:	**40.00** m	Weather:	**Sunny**

TEST MEASUREMENTS

Time (mins)	Water depth (m)	Head (m)	H/Ho	Time (mins)	Water depth (m)	Head (m)	H/Ho	Time (mins)	Water depth (m)	Head (m)	H/Ho	Time (mins)	Water depth (m)	Head (m)	H/Ho
00:00:00	20.20	4.30	1.00	00:05:00	24.50	0.00	0.00	00:10:00	24.66	-0.16	-0.04				
00:00:30	21.90	2.60	0.61	00:05:30	24.53	-0.03	-0.01	00:11:00	24.67	-0.17	-0.04				
00:01:00	22.68	1.82	0.42	00:06:00	24.56	-0.06	-0.01	00:12:00	24.68	-0.18	-0.04				
00:01:30	22.79	1.71	0.40	00:06:30	24.59	-0.09	-0.02	00:13:00	24.69	-0.19	-0.04				
00:02:00	22.90	1.60	0.37	00:07:00	24.60	-0.10	-0.02	00:14:00	24.70	-0.20	-0.05				
00:02:30	23.17	1.33	0.31	00:07:30	24.61	-0.11	-0.03	00:15:00	24.70	-0.20	-0.05				
00:03:00	23.79	0.71	0.17	00:08:00	24.62	-0.12	-0.03								
00:03:30	24.19	0.31	0.07	00:08:30	24.64	-0.14	-0.03								
00:04:00	24.36	0.14	0.03	00:09:00	24.65	-0.15	-0.04								
00:04:30	24.44	0.06	0.01	00:09:30	24.65	-0.15	-0.04								

PLOT OF WATER DEPTH AGAINST TIME



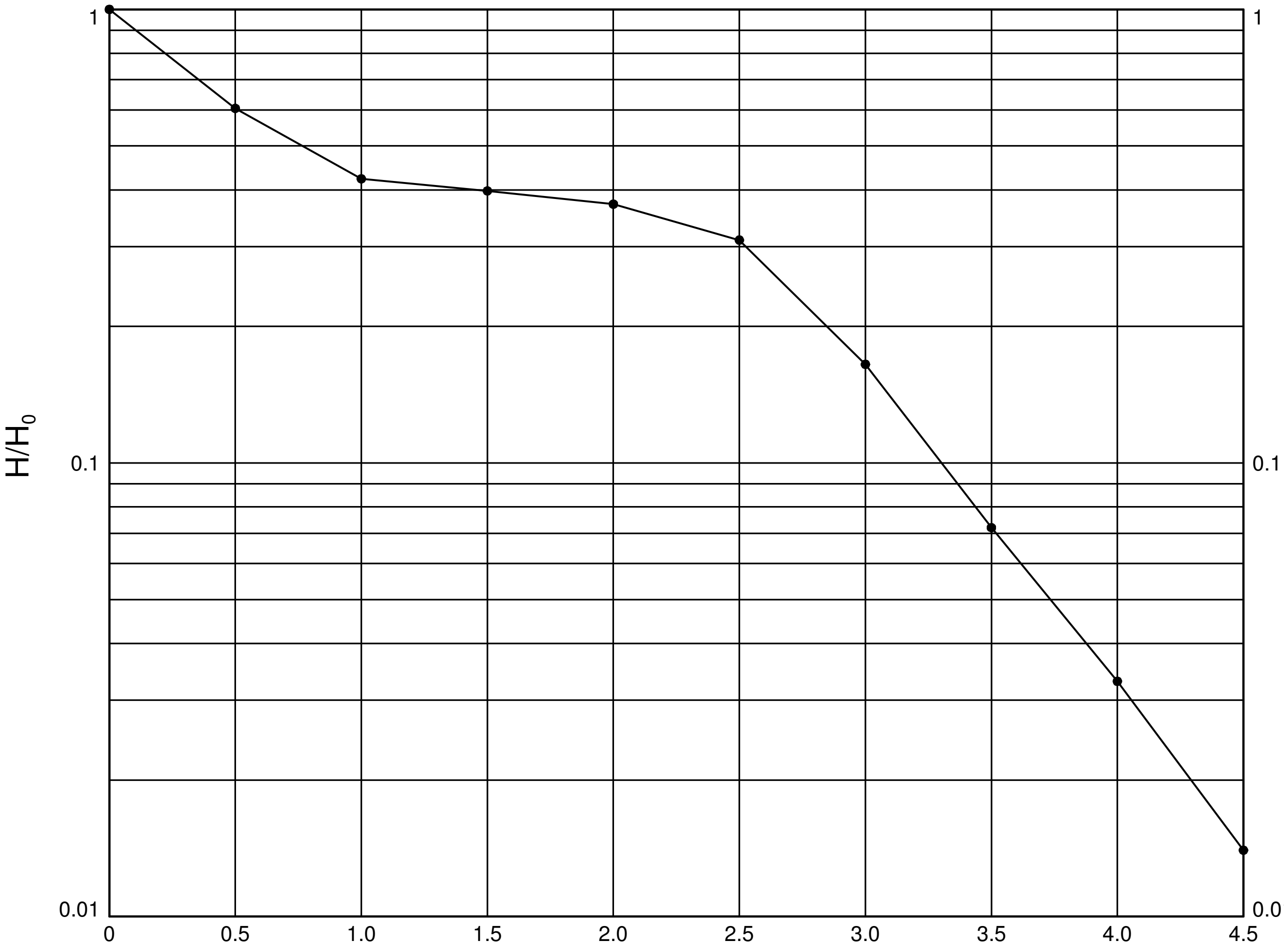
	Compiled By	Date	Checked By	Date
STRUCTURAL SOILS The Old School Stillhouse Lane Bedminster Bristol BS3 4EB	[redacted]	**09/08/18**	[redacted]	**09/08/18**
	Contract: **A303 Stonehenge Phase 6 Ground Investigation**		Contract Ref: **733442**	

IN-SITU PERMEABILITY TEST - FALLING HEAD
In accordance with BS EN ISO 22282-2:2012

Position ID : **R616** Depth (m below GL): **25.20-38.40** Test Number: **2**
Test Date: **14/06/2018 15:31:00** Test Supervisor: **MJJones**

Ground Level: **91.52** National Grid Co-ordinates: **E:412596.9 N:141916.0**

PLOT OF H/Ho AGAINST TIME



Diameter of Test Section, D	=	**0.146**	m
Cross Sectional Area of Liaison Tube, A	=	**0.01674**	m^2
Test Section Length, L	=	**13.2**	m
Shape Factor, F	=	**15.96**	m
Time, $t - t_0$	=	**-**	sec
In-situ Permeability, k	=	**-**	m/sec

Notes : **Calculation of permeability value does not form part of BS EN ISO 22282-2 test report.**

Sheet 2 of 2

STRUCTURAL SOILS The Old School Stillhouse Lane Bedminster Bristol BS3 4EB	Compiled By	Date	Checked By	Date
	[redacted]	**09/08/18**	[redacted]	**09/08/18**
	Contract: **A303 Stonehenge Phase 6 Ground Investigation**		Contract Ref: **733442**	

AGS

IN-SITU PERMEABILITY TEST - FALLING HEAD
In accordance with BS EN ISO 22282-2:2012

Position ID : **R616** Depth (m below GL): **25.62-38.82** Test Number: **3**
Test Date: **15/06/2018 09:17:00** Test Supervisor: **MJJones**
Ground Level: **91.52** National Grid Co-ordinates: **E:412596.9 N:141916.0**

TEST SETUP DETAILS

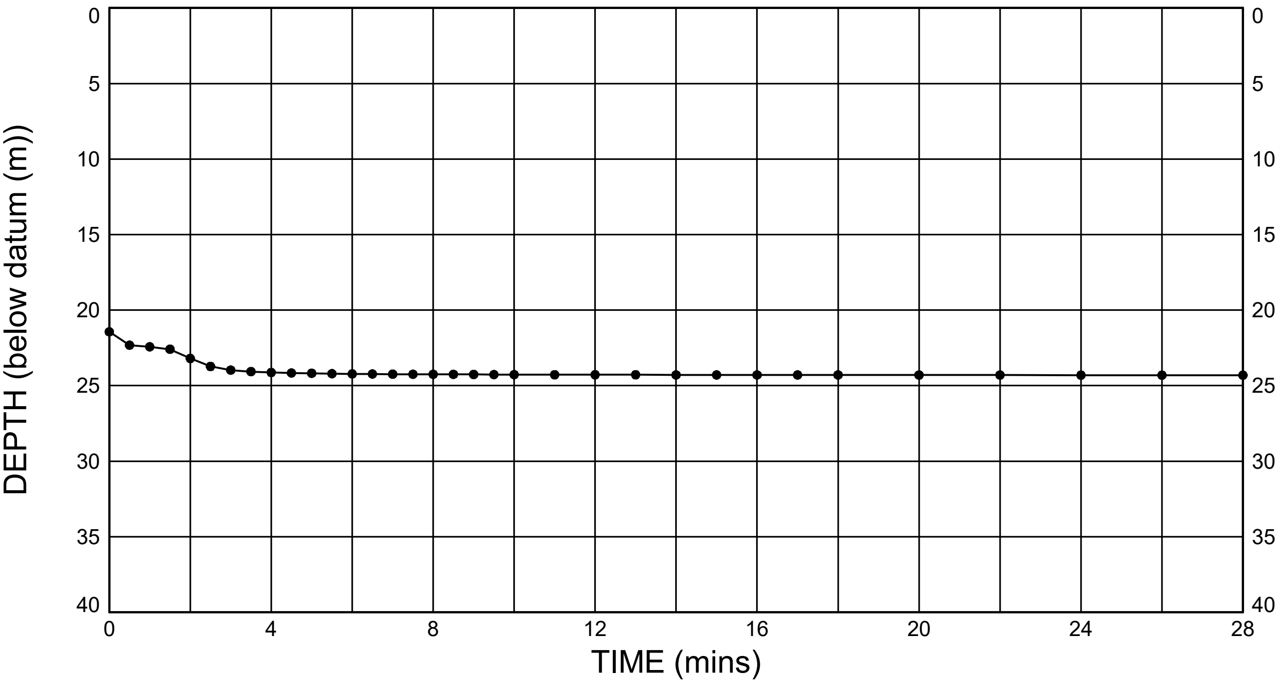
Depth measurements recorded from top of casing (top of casing 1.18m above GL).

Depth to top of response zone:	**26.80** m	Borehole diameter:	**146** mm
Depth to base of response zone:	**40.00** m		
Length of response zone:	**13.20** m	Depth to base of casing:	**26.80** m
Initial groundwater level prior to test:	**24.31** m	Casing diameter:	**146** mm
Depth to base of borehole at start of test:	**40.00** m		
Depth to base of borehole at completion of test:	**40.00** m	Weather:	**Sunny**

TEST MEASUREMENTS

Time (mins)	Water depth (m)	Head (m)	H/Ho	Time (mins)	Water depth (m)	Head (m)	H/Ho	Time (mins)	Water depth (m)	Head (m)	H/Ho	Time (mins)	Water depth (m)	Head (m)	H/Ho
00:00:00	21.44	2.87	1.00	00:05:00	24.18	0.13	0.05	00:10:00	24.27	0.04	0.01	00:22:00	24.30	0.01	0.00
00:00:30	22.32	1.99	0.69	00:05:30	24.21	0.10	0.04	00:11:00	24.28	0.03	0.01	00:24:00	24.31	0.00	0.00
00:01:00	22.43	1.88	0.66	00:06:00	24.22	0.09	0.03	00:12:00	24.28	0.03	0.01	00:26:00	24.31	0.00	0.00
00:01:30	22.59	1.72	0.60	00:06:30	24.23	0.08	0.03	00:13:00	24.28	0.03	0.01	00:28:00	24.31	0.00	0.00
00:02:00	23.20	1.11	0.39	00:07:00	24.24	0.07	0.02	00:14:00	24.29	0.02	0.01				
00:02:30	23.73	0.58	0.20	00:07:30	24.25	0.06	0.02	00:15:00	24.29	0.02	0.01				
00:03:00	23.97	0.34	0.12	00:08:00	24.25	0.06	0.02	00:16:00	24.29	0.02	0.01				
00:03:30	24.07	0.24	0.08	00:08:30	24.26	0.05	0.02	00:17:00	24.29	0.02	0.01				
00:04:00	24.13	0.18	0.06	00:09:00	24.26	0.05	0.02	00:18:00	24.29	0.02	0.01				
00:04:30	24.16	0.15	0.05	00:09:30	24.27	0.04	0.02	00:20:00	24.30	0.01	0.00				

PLOT OF WATER DEPTH AGAINST TIME



STRUCTURAL SOILS The Old School Stillhouse Lane Bedminster Bristol BS3 4EB	Compiled By	Date	Checked By	Date
	[redacted]	13/12/18	[redacted]	13/12/18
	Contract **A303 Stonehenge Phase 6 Ground Investigation**		Contract Ref: **733442**	

AGS

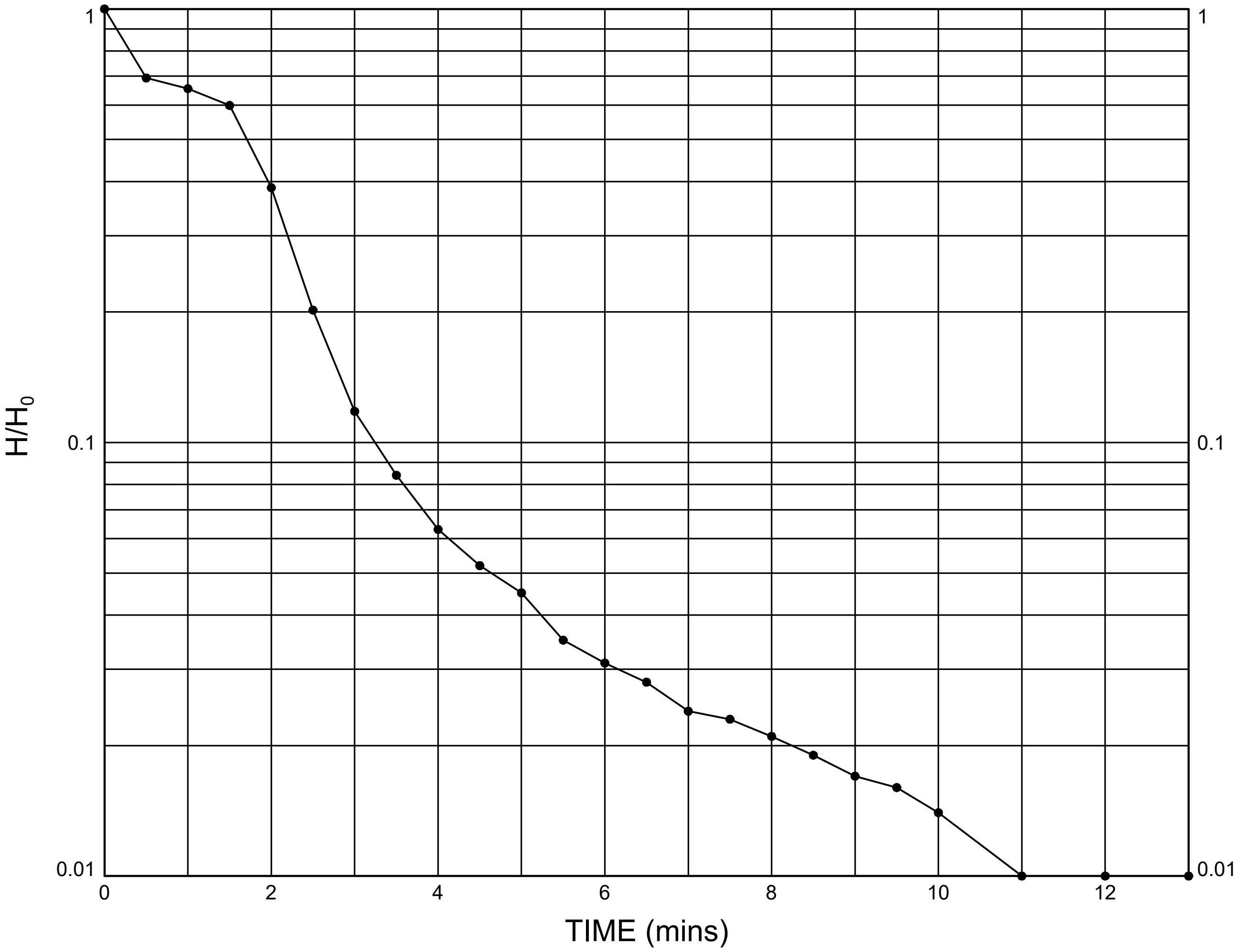
IN-SITU PERMEABILITY TEST - FALLING HEAD
In accordance with BS EN ISO 22282-2:2012

Position ID : **R616** Depth (m below GL): **25.62-38.82** Test Number: **3**
Test Date: **15/06/2018 09:17:00** Test Supervisor: **MJJones**

Ground Level: **91.52** National Grid Co-ordinates: **E:412596.9 N:141916.0**

PLOT OF H/Ho AGAINST TIME

Time used for t0 = 0 (s) Time used for t = 30 (s)



Diameter of Test Section, D	=	**0.146**	m
Cross Sectional Area of Liaison Tube, A	=	**0.01674**	m^2
Test Section Length, L	=	**13.2**	m
Shape Factor, F	=	**15.96**	m
Time, $t - t_0$	=	**-**	sec
In-situ Permeability, k	=	**-**	m/sec

Notes : Calculation of permeability does not form part of BS EN ISO 22282-2 test report

Sheet 2 of 2

STRUCTURAL SOILS The Old School Stillhouse Lane Bedminster Bristol BS3 4EB	Compiled By	Date	Checked By	Date
	[redacted]	**13/12/18**	[redacted]	**13/12/18**
	Contract **A303 Stonehenge Phase 6 Ground Investigation**		Contract Ref: **733442**	AGS

IN-SITU WATER PRESSURE TEST - SINGLE PACKER
In accordance with BS EN ISO 22282-3 (2012)

Borehole No.: R607 **Test No.:** 1 **Test Depth Range (m):** 24.00 to 28.90 **Test Date:** 18/05/2018 **Test Time:** 10:55

Ground Level (m AOD): 93.94 National Grid Coordinates: E: 412276.0 N: 141893.0 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

INSTALLATION DETAILS

BOREHOLE DETAILS	
Borehole Drilling Method	Rotary coring
Diameter of borehole in test section, d (mm)	150
Depth to base of borehole casing (m)	19.90
Depth to base of borehole at start of test (m)	28.90
Inital groundwater level (m bgl)	21.42
Height of groundwater above mid-point of test section, Hg (m)	5.03

TEST DETAILS	
Depth BGL to top of test section (m)	24.00
Depth BGL to midpoint of test section (m)	26.45
Depth BGL to base of test section (m)	28.90
Length of test section, L (m)	4.90
Rock type under test	CHALK
Weather during test	Sunny

EQUIPMENT DETAILS

Packer Type	Pneumatic
Serial No.	Not recorded
Length (m)	1.30
Inflation Pressure (bar)	10.0

Flowmeter type	Paddle wheel
Flowmeter serial number	Not recorded

Water Pump Type	Drill Rig Mounted
Water Pump Serial Number	Not recorded
Injection Water Temperature (^oC)	Not recorded

Test Pressure Measurement Method	Above ground pressure gauge
Gauge Height above GL (m)	0.50
Gauge Height above mid-point of test section, H (m)	26.95
Pressure Loss between pump and test section, Hf (m head)	0.00

IN-SITU WATER PRESSURE TEST - SINGLE PACKER

In accordance with BS EN ISO 22283-3 (2012)

Borehole No.: R607 **Test No.:** 1 **Test Depth Range (m):** 24.00 to 28.90 **Test Date:** 18/05/2018 **Test Time:** 10:55

Ground Level (m AOD): 93.94 National Grid Coordinates: E: 412276.0 N: 141893.0 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

SUMMARY OF KEY INSTALLATION DETAILS

Diameter of borehole in test section, D (m)	0.150
Depth to base of borehole casing (m)	19.90
Depth to base of borehole at start of test (m)	28.90
Inital groundwater level (m bgl)	21.42
Initial hydrostatic pressure in mid-point of test zone (bar)	0.50

Depth BGL to top of test section (m)	24.00
Depth BGL to midpoint of test section (m)	26.45
Depth BGL to base of test section (m)	28.90
Length of test section, L (m)	4.90

TEST READINGS

Stage	Gauge (over) pressure, P (bar)	Test Increment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Average flow, Q (litres/min)
1	1.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**131.37**
		Flowmeter readings (litres)	0.000	141.800	284.600	427.900	568.200	716.300	847.200	986.500	1119.100	1246.500	1359.500	1471.200	1592.300	1706.900	1829.400	1970.600					
		Water Take (litres)	0.000	141.800	142.800	143.300	140.300	148.100	130.900	139.300	132.600	127.400	113.000	111.700	121.100	114.600	122.500	141.200					
2		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**0.00**
		Flowmeter readings (litres)																					
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000					
3		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**0.00**
		Flowmeter readings (litres)																					
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000					
4		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**0.00**
		Flowmeter readings (litres)																					
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000					
5		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**0.00**
		Flowmeter readings (litres)																					
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000					

TEST REMARKS	1. Test abandonned at 11:30 at instruction of AECOM.
	2
	3

STRUCTURAL SOILS LTD **The Old School** **Stillhouse Lane,** **Bedminster** **BRISTOL, BS3 4EB**	Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	**Contract Ref:**	**733442**
	Stuart Pearce	21/05/2018	Adam Lumber	[redacted]	08/08/2018	Adam Lumber	[redacted]	08/08/2018		
	Contract:		**A303 Phase 6 Ground Investigation**		**Client**	**Highways England**			**Page**	**2 of 3**

IN-SITU WATER PRESSURE TEST -SINGLE PACKER

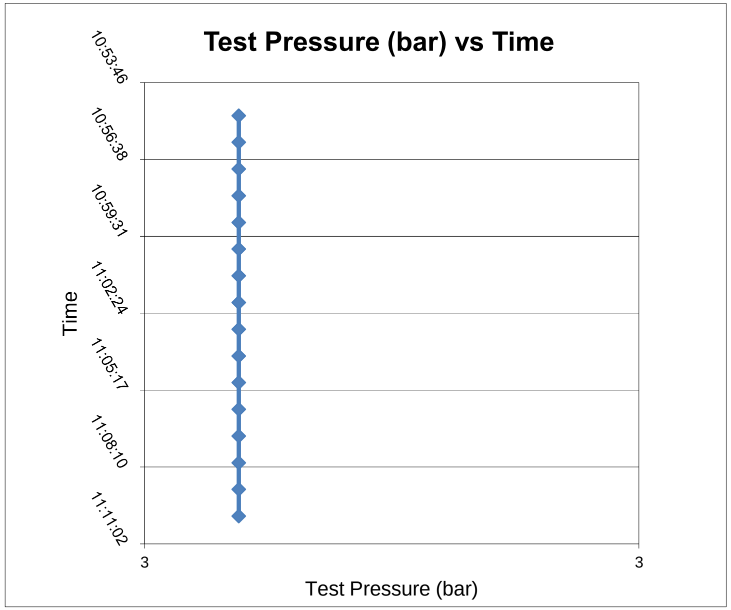
In accordance with BS EN ISO 22282-3 (2012)

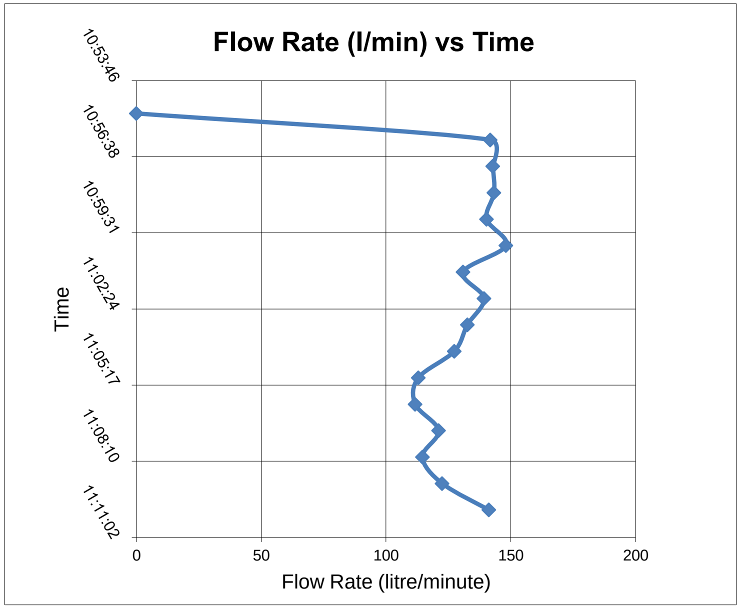
BH N R607 **Test No.:** 1 **Test Depth Range (m):** 24.00 to 28.90 **Test Date:** 5/18/2018 **Test Time:** 10:55

Ground Level (m AOD) 93.94 National Grid Coordinates: E: 412276.0 N: 141893.0 Borehole Inclination: (degrees from vertical) 0 Borehole Orientation: (degrees) Not applicable

Run	Measured Gauge pressure, P (bar)	Measured Gague Pressure, P (m head)	Effective test pressure causing flow into rock, m head ρ_T (= P + (H-Hg) - Hf)	Effective test pressure ρ_{Tb} (bar)	Effective test pressure rT (MPa)	Flow rate, Q1 (litres/min)	Injected Flow, Q2 per metre (litres/min/m) [=Q1 / L]	Flow Q3 (m^3/s)
1	1.00	10.00	31.9	3.192	0.319	131.37	26.81	0.002190

Note: Test pressure (gauge) monitored visually and not data logged during test. Test pressure therefore presented as constant, for each stage, in





STRUCTURAL SOILS LTD The Old School Stillhouse Lane Bedminster BRISTOL, BS3 4EB	Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	Contract Ref:	733442
	Stuart Pearce	5/21/2018	Adam Lumber	[redacted]	8/8/2018	Adam Lumber	[redacted]	8/8/2018		
	Contract:		A303 Phase 6 Ground Investigation		Client	Highways England			Page	3 of 3

IN-SITU WATER PRESSURE TEST - SINGLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

Borehole No.: R607 **Test No.:** 2 **Test Depth Range (m):** 26.40 to 28.90 **Test Date:** 18/05/2018 **Test Time:** 11:50

Ground Level (m AOD): 93.94 National Grid Coordinates: E: 412276.0 N: 141893.0 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

INSTALLATION DETAILS

BOREHOLE DETAILS

Borehole Drilling Method	Rotary coring
Diameter of borehole in test section, d (mm)	150
Depth to base of borehole casing (m)	19.90
Depth to base of borehole at start of test (m)	28.90
Inital groundwater level (m bgl)	21.45
Height of groundwater above mid-point of test section, Hg (m)	6.20

TEST DETAILS

Depth BGL to top of test section (m)	26.40
Depth BGL to midpoint of test section (m)	27.65
Depth BGL to base of test section (m)	28.90
Length of test section, L (m)	2.50
Rock type under test	CHALK
Weather during test	Sunny

EQUIPMENT DETAILS

Packer Type	Pneumatic
Serial No.	Not recorded
Length (m)	1.30
Inflation Pressure (bar)	10.0

Flowmeter type	Paddle wheel
Flowmeter serial number	Not recorded

Water Pump Type	Drill Rig Mounted
Water Pump Serial Number	Not recorded
Injection Water Temperature (^oC)	Not recorded

Test Pressure Measurement Method	Above ground pressure gauge
Gauge Height above GL (m)	0.50
Gauge Height above mid-point of test section, H (m)	28.15
Pressure Loss between pump and test section, Hf (m head)	0.00

IN-SITU WATER PRESSURE TEST - SINGLE PACKER

In accordance with BS EN ISO 22283-3 (2012)

Borehole No.: R607 **Test No.:** 2 **Test Depth Range (m):** 26.40 to 28.90 **Test Date:** 18/05/2018 **Test Time:** 11:50

Ground Level (m AOD): 93.94 National Grid Coordinates: E: 412276.0 N: 141893.0 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

SUMMARY OF KEY INSTALLATION DETAILS

Diameter of borehole in test section, D (m)	0.150
Depth to base of borehole casing (m)	19.90
Depth to base of borehole at start of test (m)	28.90
Inital groundwater level (m bgl)	21.45
Initial hydrostatic pressure in mid-point of test zone (bar)	0.62

Depth BGL to top of test section (m)	26.40
Depth BGL to midpoint of test section (m)	27.65
Depth BGL to base of test section (m)	28.90
Length of test section, L (m)	2.50

TEST READINGS

Stage	Gauge (over) pressure, P (bar)	Test Increment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Average flow, Q (litres/min)
1	1.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**129.54**
		Flowmeter readings (litres)	0.000	139.100	276.500	413.900	550.300	657.200	763.800	886.800	1024.900	1162.200	1300.500	1425.900	1559.300	1677.300	1815.700	1943.100					
		Water Take (litres)	0.000	139.100	137.400	137.400	136.400	106.900	106.600	123.000	138.100	137.300	138.300	125.400	133.400	118.000	138.400	127.400					
2		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**0.00**
		Flowmeter readings (litres)																					
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000					
3		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**0.00**
		Flowmeter readings (litres)																					
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000					
4		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**0.00**
		Flowmeter readings (litres)																					
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000					
5		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**0.00**
		Flowmeter readings (litres)																					
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000					

TEST REMARKS	1. Test abandonned at 12:15 at instruction of AECOM.
	2
	3

STRUCTURAL SOILS LTD
The Old School
Stillhouse Lane,
Bedminster
BRISTOL, BS3 4EB

Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	**Contract Ref:**	**733442**
Stuart Pearce	21/05/2018	Adam Lumber	[redacted]	08/08/2018	Adam Lumber	[redacted]	08/08/2018		
Contract:		**A303 Phase 6 Ground Investigation**		**Client**	**Highways England**			**Page**	**2 of 3**

IN-SITU WATER PRESSURE TEST -SINGLE PACKER

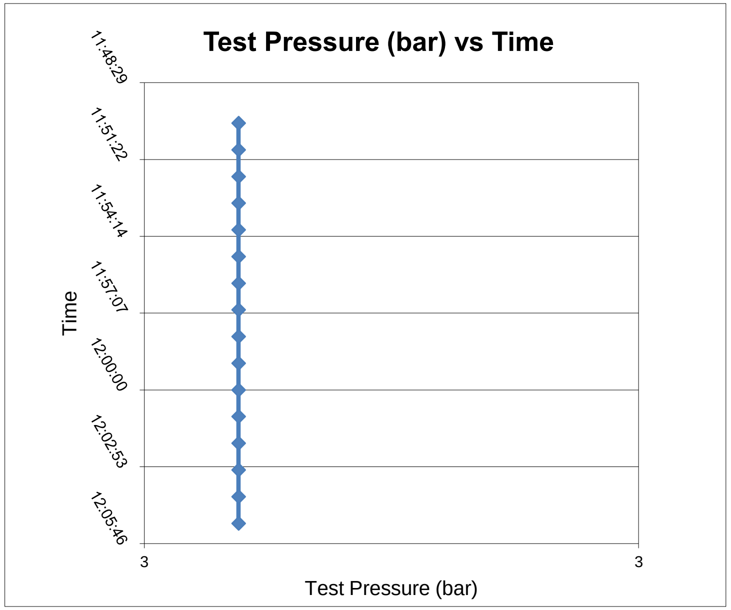
In accordance with BS EN ISO 22282-3 (2012)

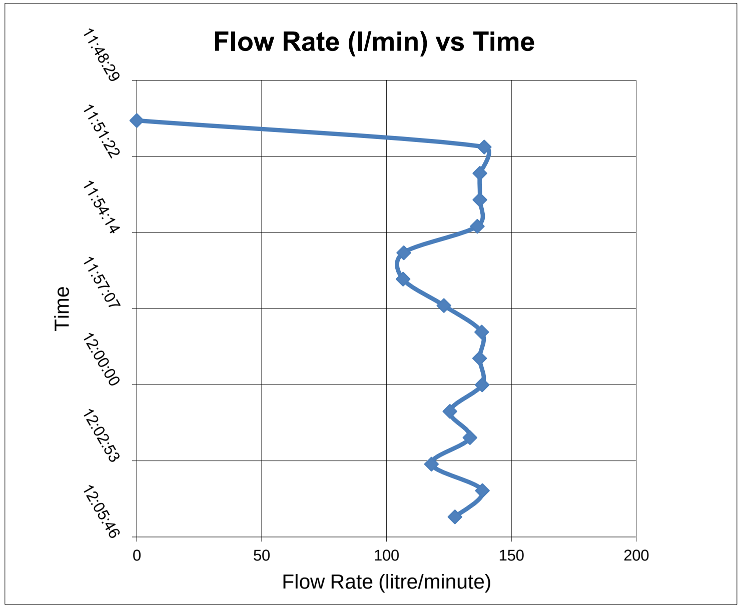
BH No R607 **Test No.:** 2 **Test Depth Range (m):** 26.40 to 28.90 **Test Date:** 5/18/2018 **Test Time:** 11:50

Ground Level: (m AOD) 93.94 National Grid Coordinates: E: 412276.0 N: 141893.0 Borehole Inclination: (degrees from vertical) 0 Borehole Orientation: (degrees) Not applicable

Run	Measured Gauge pressure, P (bar)	Measured Gague Pressure, P (m head)	Effective test pressure causing flow into rock, m head ρ_T (= P + (H-Hg) - Hf)	Effective test pressure ρ_{Tb} (bar)	Effective test pressure rT (MPa)	Flow rate, Q1 (litres/min)	Injected Flow, Q2 per metre (litres/min/m) [=Q1 / L]	Flow Q3 (m^3/s)
1	1.00	10.00	32.0	3.195	0.320	129.54	51.82	0.002159

Note: Test pressure (gauge) monitored visually and not data logged during test. Test pressure therefore presented as constant, for each stage, in Test Pressure vs





STRUCTURAL SOILS LTD The Old School Stillhouse Lane Bedminster BRISTOL, BS3 4EB	Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	Contract Ref:	733442
	Stuart Pearce	5/21/2018	Adam Lumber	[redacted]	8/8/2018	Adam Lumber	[redacted]	8/8/2018		
	Contract:		A303 Phase 6 Ground Investigation		Client	Highways England			Page	3 of 3

IN-SITU WATER PRESSURE TEST - SINGLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

Borehole No.: R607 **Test No.:** 3 **Test Depth Range (m):** 23.90 to 28.90 **Test Date:** 21/05/2018 **Test Time:** 10:39

Ground Level (m AOD): 93.94 National Grid Coordinates: E: 412276.0 N: 141893.0 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

INSTALLATION DETAILS

BOREHOLE DETAILS	
Borehole Drilling Method	Rotary coring
Diameter of borehole in test section, d (mm)	150
Depth to base of borehole casing (m)	19.90
Depth to base of borehole at start of test (m)	28.90
Inital groundwater level (m bgl)	21.90
Height of groundwater above mid-point of test section, Hg (m)	4.50

TEST DETAILS	
Depth BGL to top of test section (m)	23.90
Depth BGL to midpoint of test section (m)	26.40
Depth BGL to base of test section (m)	28.90
Length of test section, L (m)	5.00
Rock type under test	CHALK
Weather during test	Sunny

EQUIPMENT DETAILS	
Packer Type	Pneumatic
Serial No.	Not recorded
Length (m)	1.30
Inflation Pressure (bar)	10.0
Flowmeter type	Paddle wheel
Flowmeter serial number	Not recorded
Water Pump Type	Drill Rig Mounted
Water Pump Serial Number	Not recorded
Injection Water Temperature (^oC)	Not recorded
Test Pressure Measurement Method	Above ground pressure gauge
Gauge Height above GL (m)	0.50
Gauge Height above mid-point of test section, H (m)	26.90
Pressure Loss between pump and test section, Hf (m head)	0.00

STRUCTURAL SOILS LTD The Old School Stillhouse Lane, Bedminster BRISTOL, BS3 4EB	Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	Contract Ref:	733442
	Stuart Pearce	21/05/2018	Adam Lumber	[redacted]	08/08/2018	A.Lumber	[redacted]	08/08/2018		
	Contract:		A303 Phase 6 Ground Investigation		Client	Highways England			Page	1 of 3

IN-SITU WATER PRESSURE TEST - SINGLE PACKER

In accordance with BS EN ISO 22283-3 (2012)

Borehole No.: R607 **Test No.:** 3 **Test Depth Range (m):** 23.90 to 28.90 **Test Date:** 21/05/2018 **Test Time:** 10:39

Ground Level (m AOD): 93.94 National Grid Coordinates: E: 412276.0 N: 141893.0 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

SUMMARY OF KEY INSTALLATION DETAILS

Diameter of borehole in test section, D (m)	0.150
Depth to base of borehole casing (m)	19.90
Depth to base of borehole at start of test (m)	28.90
Inital groundwater level (m bgl)	21.90
Initial hydrostatic pressure in mid-point of test zone (bar)	0.45

Depth BGL to top of test section (m)	23.90
Depth BGL to midpoint of test section (m)	26.40
Depth BGL to base of test section (m)	28.90
Length of test section, L (m)	5.00

TEST READINGS

Stage	Gauge (over) pressure, P (bar)	Test Increment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Average flow, Q (litres/min)
1	1.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**138.23**
		Flowmeter readings (litres)	0.000	138.200	279.000	412.800	551.400	689.600	828.200	967.600													
		Water Take (litres)	0.000	138.200	140.800	133.800	138.600	138.200	138.600	139.400													
2	2.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**144.47**
		Flowmeter readings (litres)	0.000	141.800	290.100	433.300	579.100	726.100	871.100	1011.300													
		Water Take (litres)	0.000	141.800	148.300	143.200	145.800	147.000	145.000	140.200													
3	3.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**159.06**
		Flowmeter readings (litres)	0.000	157.100	317.900	483.600	641.400	789.600	951.200	1113.400													
		Water Take (litres)	0.000	157.100	160.800	165.700	157.800	148.200	161.600	162.200													
4	2.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**141.91**
		Flowmeter readings (litres)	0.000	140.500	281.500	411.600	557.800	703.000	848.400	993.400													
		Water Take (litres)	0.000	140.500	141.000	130.100	146.200	145.200	145.400	145.000													
5	1.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**129.04**
		Flowmeter readings (litres)	0.000	131.200	257.200	383.000	514.100	644.100	775.000	903.300													
		Water Take (litres)	0.000	131.200	126.000	125.800	131.100	130.000	130.900	128.300													

TEST REMARKS	1. 7000 litres of water used.
	2 Duration of each test stage reduced to 7 minutes on client's instruction.
	3

STRUCTURAL SOILS LTD
The Old School
Stillhouse Lane,
Bedminster
BRISTOL, BS3 4EB

Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	**Contract Ref:**	**733442**
Stuart Pearce	21/05/2018	Adam Lumber	[redacted]	08/08/2018	A.Lumber	[redacted]	08/08/2018		
Contract:		**A303 Phase 6 Ground Investigation**		**Client**	**Highways England**			**Page**	**2 of 3**

IN-SITU WATER PRESSURE TEST -SINGLE PACKER

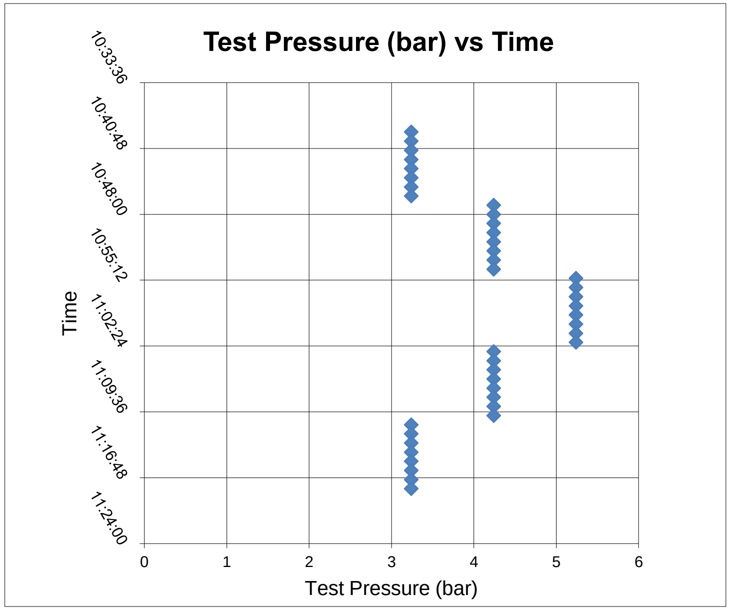
In accordance with BS EN ISO 22282-3 (2012)

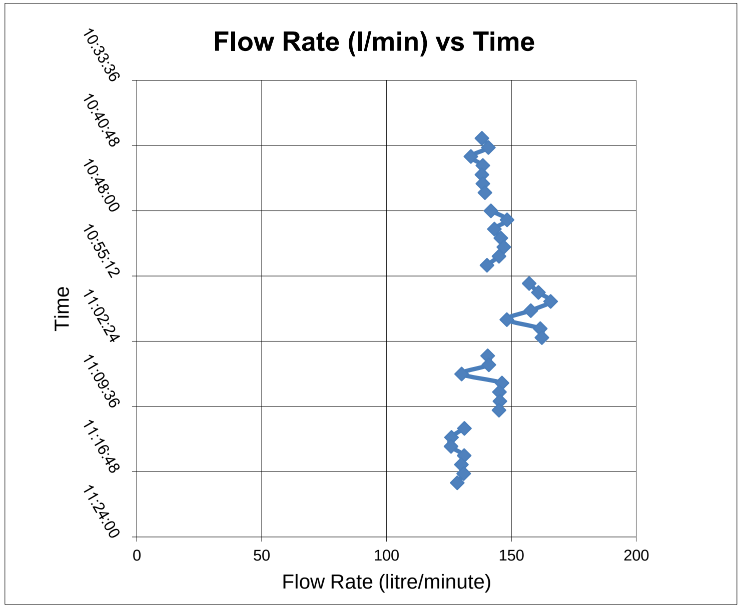
BH No R607 **Test No.:** 3 **Test Depth Range (m):** 23.90 to 28.90 **Test Date:** 5/21/2018 **Test Time:** 10:39

Ground Level: (m AOD) 93.94 National Grid Coordinates: E: 412276.0 N: 141893.0 Borehole Inclination: (degrees from vertical) 0 Borehole Orientation: (degrees) Not applicable

Run	Measured Gauge pressure, P (bar)	Measured Gague Pressure, P (m head)	Effective test pressure causing flow into rock, m head $\rho_{T\,(=P+(H\text{-}Hg)-Hf)}$	Effective test pressure ρ_{Tb} (bar)	Effective test pressure rT (MPa)	Flow rate, Q1 (litres/min)	Injected Flow, Q2 per metre (litres/min/m) [=Q1 / L]	Flow Q3 (m^3/s)
1	1.00	10.00	32.4	3.24	0.324	138.23	27.65	0.002304
2	2.00	20.00	42.4	4.24	0.424	144.47	28.89	0.002408
3	3.00	30.00	52.4	5.24	0.524	159.06	31.81	0.002651
4	2.00	20.00	42.4	4.24	0.424	141.91	28.38	0.002365
5	1.00	10.00	32.4	3.24	0.324	129.04	25.81	0.002151

Note: Test pressure (gauge) monitored visually and not data logged during test. Test pressure therefore presented as constant, for each stage, in





STRUCTURAL SOILS LTD The Old School Stillhouse Lane Bedminster BRISTOL, BS3 4EB	Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	Contract Ref:	733442
	Stuart Pearce	5/21/2018	Adam Lumber	[redacted]	8/8/2018	A.Lumber	[redacted]	8/8/2018		
	Contract:		A303 Phase 6 Ground Investigation		Client	Highways England			Page	3 of 3

IN-SITU WATER PRESSURE TEST - SINGLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

Borehole No.: R607 **Test No.:** 4 **Test Depth Range (m):** 32.40 to 34.90 **Test Date:** 21/05/2018 **Test Time:** 00:00

Ground Level (m AOD): 93.94 National Grid Coordinates: E: 412276.0 N: 141893.0 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

INSTALLATION DETAILS

BOREHOLE DETAILS

Borehole Drilling Method	Rotary coring
Diameter of borehole in test section, d (mm)	150
Depth to base of borehole casing (m)	28.90
Depth to base of borehole at start of test (m)	34.90
Inital groundwater level (m bgl)	22.14
Height of groundwater above mid-point of test section, Hg (m)	11.51

TEST DETAILS

Depth BGL to top of test section (m)	32.40
Depth BGL to midpoint of test section (m)	33.65
Depth BGL to base of test section (m)	34.90
Length of test section, L (m)	2.50
Rock type under test	CHALK
Weather during test	Sunny

EQUIPMENT DETAILS

Packer Type	Pneumatic
Serial No.	Not recorded
Length (m)	1.30
Inflation Pressure (bar)	10.0

Flowmeter type	Paddle wheel
Flowmeter serial number	Not recorded

Water Pump Type	Drill Rig Mounted
Water Pump Serial Number	Not recorded
Injection Water Temperature (^oC)	Not recorded

Test Pressure Measurement Method	Above ground pressure gauge
Gauge Height above GL (m)	0.50
Gauge Height above mid-point of test section, H (m)	34.15
Pressure Loss between pump and test section, Hf (m head)	0.00

IN-SITU WATER PRESSURE TEST - SINGLE PACKER

In accordance with BS EN ISO 22283-3 (2012)

Borehole No.: R607 **Test No.:** 4 **Test Depth Range (m):** 32.40 to 34.90 **Test Date:** 21/05/2018 **Test Time:** 00:00

Ground Level (m AOD): 93.94 National Grid Coordinates: E: 412276.0 N: 141893.0 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

SUMMARY OF KEY INSTALLATION DETAILS

Diameter of borehole in test section, D (m)	0.150
Depth to base of borehole casing (m)	28.90
Depth to base of borehole at start of test (m)	34.90
Inital groundwater level (m bgl)	22.14
Initial hydrostatic pressure in mid-point of test zone (bar)	1.15

Depth BGL to top of test section (m)	32.40
Depth BGL to midpoint of test section (m)	33.65
Depth BGL to base of test section (m)	34.90
Length of test section, L (m)	2.50

TEST READINGS

Stage	Gauge (over) pressure, P (bar)	Test Increment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Average flow, Q (litres/min)
1	1.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**69.84**
		Flowmeter readings (litres)	0.000	69.800	138.500	209.700	277.600	349.300	419.900	488.900													
		Water Take (litres)	0.000	69.800	68.700	71.200	67.900	71.700	70.600	69.000													
2	2.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**76.07**
		Flowmeter readings (litres)	0.000	75.600	151.600	227.700	303.800	380.400	456.500	532.500													
		Water Take (litres)	0.000	75.600	76.000	76.100	76.100	76.600	76.100	76.000													
3	3.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**87.19**
		Flowmeter readings (litres)	0.000	87.300	174.500	261.500	348.800	436.000	523.400	610.300													
		Water Take (litres)	0.000	87.300	87.200	87.000	87.300	87.200	87.400	86.900													
4	2.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**78.70**
		Flowmeter readings (litres)	0.000	79.600	158.300	237.200	316.200	394.700	472.900	550.900													
		Water Take (litres)	0.000	79.600	78.700	78.900	79.000	78.500	78.200	78.000													
5	1.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**71.73**
		Flowmeter readings (litres)	0.000	72.100	114.100	216.000	288.100	356.100	428.000	502.100													
		Water Take (litres)	0.000	72.100	42.000	101.900	72.100	68.000	71.900	74.100													

TEST REMARKS	
	1 Duration of each test stage reduced to 7 minutes to reduce volume of water used, on client's instruction.
	2
	3

STRUCTURAL SOILS LTD The Old School Stillhouse Lane, Bedminster BRISTOL, BS3 4EB	Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	**Contract Ref:** 733442
	Stuart Pearce	21/05/2018	Adam Lumber	[redacted]	08/08/2018	A.Lumber	[redacted]	08/08/2018	
	Contract:		**A303 Phase 6 Ground Investigation**		**Client**	**Highways England**		**Page**	**2 of 3**

IN-SITU WATER PRESSURE TEST -SINGLE PACKER

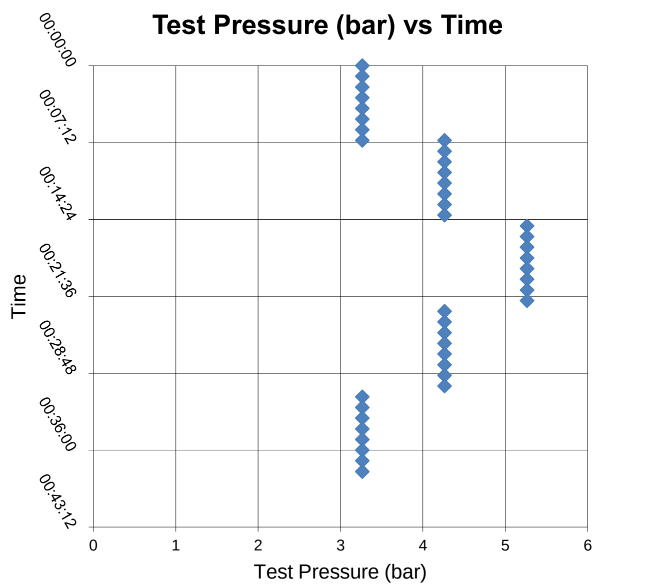
In accordance with BS EN ISO 22282-3 (2012)

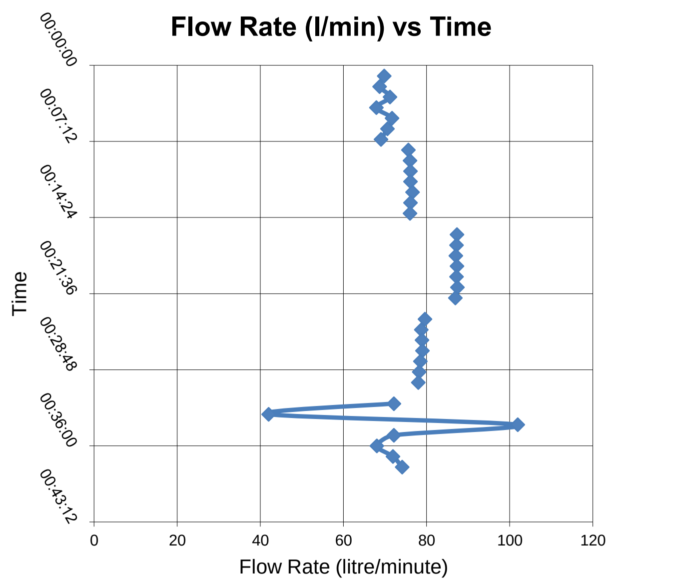
BH No R607 **Test No.:** 4 **Test Depth Range (m):** 32.40 to 34.90 **Test Date:** 5/21/2018 **Test Time:** 0:00

Ground Level: (m AOD) 93.94 National Grid Coordinates: E: 412276.0 N: 141893.0 Borehole Inclination: (degrees from vertical) 0 Borehole Orientation: (degrees) Not applicable

Run	Measured Gauge pressure, P (bar)	Measured Gague Pressure, P (m head)	Effective test pressure causing flow into rock, m head ρ_T (= P + (H-Hg) - Hf)	Effective test pressure ρ_{Tb} (bar)	Effective test pressure rT (MPa)	Flow rate, Q1 (litres/min)	Injected Flow, Q2 per metre (litres/min/m) [=Q1 / L]	Flow Q3 (m^3/s)
1	1.00	10.00	32.6	3.264	0.326	69.84	27.94	0.001164
2	2.00	20.00	42.6	4.264	0.426	76.07	30.43	0.001268
3	3.00	30.00	52.6	5.264	0.526	87.19	34.87	0.001453
4	2.00	20.00	42.6	4.264	0.426	78.70	31.48	0.001312
5	1.00	10.00	32.6	3.264	0.326	71.73	28.69	0.001195

Note: Test pressure (gauge) monitored visually and not data logged during test. Test pressure therefore presented as constant, for each stage, in Test Pressure vs





IN-SITU WATER PRESSURE TEST - SINGLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

Borehole No.: R607 **Test No.:** 5 **Test Depth Range (m):** 39.90 to 42.40 **Test Date:** 22/05/2018 **Test Time:** 09:35

Ground Level (m AOD): 93.94 National Grid Coordinates: E: 412276.0 N: 141893.0 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

INSTALLATION DETAILS

BOREHOLE DETAILS

Borehole Drilling Method	Rotary coring
Diameter of borehole in test section, d (mm)	150
Depth to base of borehole casing (m)	36.40
Depth to base of borehole at start of test (m)	42.40
Inital groundwater level (m bgl)	22.33
Height of groundwater above mid-point of test section, Hg (m)	18.82

TEST DETAILS

Depth BGL to top of test section (m)	39.90
Depth BGL to midpoint of test section (m)	41.15
Depth BGL to base of test section (m)	42.40
Length of test section, L (m)	2.50
Rock type under test	CHALK
Weather during test	Sunny

EQUIPMENT DETAILS

Packer Type	Pneumatic
Serial No.	Not recorded
Length (m)	1.30
Inflation Pressure (bar)	10.0

Flowmeter type	Paddle wheel
Flowmeter serial number	Not recorded

Water Pump Type	Drill Rig Mounted
Water Pump Serial Number	Not recorded
Injection Water Temperature (^oC)	Not recorded

Test Pressure Measurement Method	Above ground pressure gauge
Gauge Height above GL (m)	0.50
Gauge Height above mid-point of test section, H (m)	41.65
Pressure Loss between pump and test section, Hf (m head)	0.00

IN-SITU WATER PRESSURE TEST - SINGLE PACKER

In accordance with BS EN ISO 22283-3 (2012)

Borehole No.: R607 **Test No.:** 5 **Test Depth Range (m):** 39.90 to 42.40 **Test Date:** 22/05/2018 **Test Time:** 09:35

Ground Level (m AOD): 93.94 National Grid Coordinates: E: 412276.0 N: 141893.0 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

SUMMARY OF KEY INSTALLATION DETAILS

Diameter of borehole in test section, D (m)	0.150
Depth to base of borehole casing (m)	36.40
Depth to base of borehole at start of test (m)	42.40
Inital groundwater level (m bgl)	22.33
Initial hydrostatic pressure in mid-point of test zone (bar)	1.88

Depth BGL to top of test section (m)	39.90
Depth BGL to midpoint of test section (m)	41.15
Depth BGL to base of test section (m)	42.40
Length of test section, L (m)	2.50

TEST READINGS

Stage	Gauge (over) pressure, P (bar)	Test Increment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Average flow, Q (litres/min)
1	1.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**53.74**
		Flowmeter readings (litres)	0.000	51.900	105.600	163.700	216.900	270.400	323.500	376.200													
		Water Take (litres)	0.000	51.900	53.700	58.100	53.200	53.500	53.100	52.700													
2	2.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**56.76**
		Flowmeter readings (litres)	0.000	56.900	113.900	170.000	227.100	284.000	340.800	397.300													
		Water Take (litres)	0.000	56.900	57.000	56.100	57.100	56.900	56.800	56.500													
3	3.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**62.60**
		Flowmeter readings (litres)	0.000	63.200	127.600	188.300	250.800	313.400	375.700	438.200													
		Water Take (litres)	0.000	63.200	64.400	60.700	62.500	62.600	62.300	62.500													
4	2.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**55.30**
		Flowmeter readings (litres)	0.000	56.100	111.700	167.000	222.300	277.400	331.300	387.100													
		Water Take (litres)	0.000	56.100	55.600	55.300	55.300	55.100	53.900	55.800													
5	1.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**51.37**
		Flowmeter readings (litres)	0.000	51.700	103.600	155.300	207.100	258.700	310.300	359.600													
		Water Take (litres)	0.000	51.700	51.900	51.700	51.800	51.600	51.600	49.300													

TEST REMARKS	
	1 Duration of each test stage reduced to 7 minutes to reduce volume of water used, on client's instruction.
	2
	3

STRUCTURAL SOILS LTD The Old School Stillhouse Lane, Bedminster BRISTOL, BS3 4EB	Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	**Contract Ref:** 733442
	Stuart Pearce	22/05/2018	Adam Lumber	[redacted]	08/08/2018	A.Lumber	[redacted]	08/08/2018	
	Contract:		**A303 Phase 6 Ground Investigation**		**Client**	**Highways England**		**Page**	**2 of 3**

IN-SITU WATER PRESSURE TEST -SINGLE PACKER

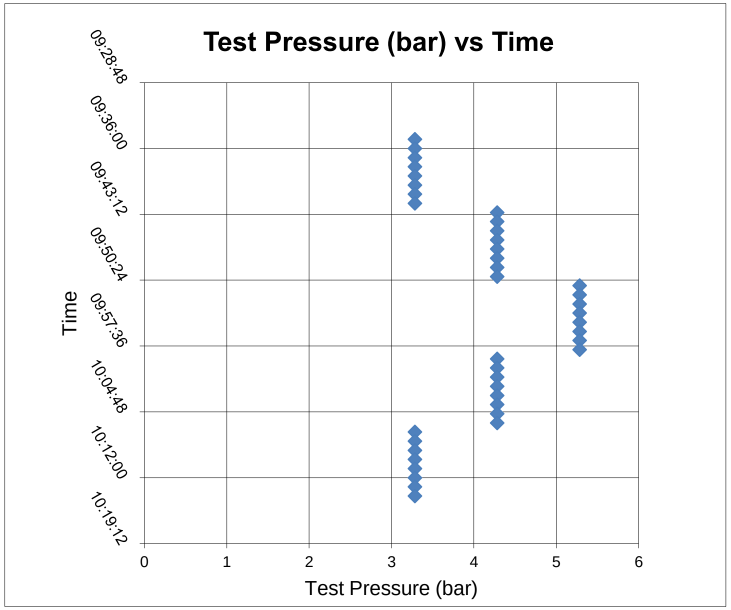
In accordance with BS EN ISO 22282-3 (2012)

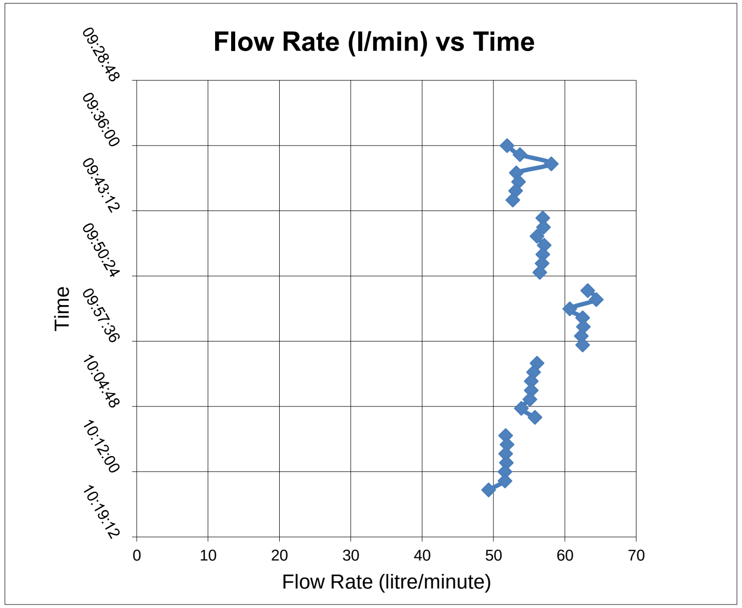
BH No R607 **Test No.:** 5 **Test Depth Range (m):** 39.90 to 42.40 **Test Date:** 5/22/2018 **Test Time:** 9:35

Ground Level: (m AOD) 93.94 National Grid Coordinates: E: 412276.0 N: 141893.0 Borehole Inclination: (degrees from vertical) 0 Borehole Orientation: (degrees) Not applicable

Run	Measured Gauge pressure, P (bar)	Measured Gague Pressure, P (m head)	Effective test pressure causing flow into rock, m head $\rho_{T\ (=P+(H\text{-}Hg)-Hf)}$	Effective test pressure ρ_{Tb} (bar)	Effective test pressure rT (MPa)	Flow rate, Q1 (litres/min)	Injected Flow, Q2 per metre (litres/min/m) [=Q1 / L]	Flow Q3 (m^3/s)
1	1.00	10.00	32.8	3.283	0.328	53.74	21.50	0.000896
2	2.00	20.00	42.8	4.283	0.428	56.76	22.70	0.000946
3	3.00	30.00	52.8	5.283	0.528	62.60	25.04	0.001043
4	2.00	20.00	42.8	4.283	0.428	55.30	22.12	0.000922
5	1.00	10.00	32.8	3.283	0.328	51.37	20.55	0.000856

Note: Test pressure (gauge) monitored visually and not data logged during test. Test pressure therefore presented as constant in Test





IN-SITU WATER PRESSURE TEST - SINGLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

Borehole No.: R607 **Test No.:** 6 **Test Depth Range (m):** 47.40 to 49.90 **Test Date:** 22/05/2018 **Test Time:** 12:35

Ground Level (m AOD): 93.94 National Grid Coordinates: E: 412276.0 N: 141893.0 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

INSTALLATION DETAILS

BOREHOLE DETAILS	
Borehole Drilling Method	Rotary coring
Diameter of borehole in test section, d (mm)	150
Depth to base of borehole casing (m)	43.90
Depth to base of borehole at start of test (m)	49.90
Inital groundwater level (m bgl)	24.14
Height of groundwater above mid-point of test section, Hg (m)	24.51

TEST DETAILS	
Depth BGL to top of test section (m)	47.40
Depth BGL to midpoint of test section (m)	48.65
Depth BGL to base of test section (m)	49.90
Length of test section, L (m)	2.50
Rock type under test	CHALK
Weather during test	Sunny

EQUIPMENT DETAILS	
Packer Type	Pneumatic
Serial No.	Not recorded
Length (m)	1.30
Inflation Pressure (bar)	10.0
Flowmeter type	Paddle wheel
Flowmeter serial number	Not recorded
Water Pump Type	Drill Rig Mounted
Water Pump Serial Number	Not recorded
Injection Water Temperature (^oC)	Not recorded
Test Pressure Measurement Method	Above ground pressure gauge
Gauge Height above GL (m)	0.50
Gauge Height above mid-point of test section, H (m)	49.15
Pressure Loss between pump and test section, Hf (m head)	0.00

IN-SITU WATER PRESSURE TEST - SINGLE PACKER

In accordance with BS EN ISO 22283-3 (2012)

Borehole No.: R607 **Test No.:** 6 **Test Depth Range (m):** 47.40 to 49.90 **Test Date:** 22/05/2018 **Test Time:** 12:35

Ground Level (m AOD): 93.94 National Grid Coordinates: E: 412276.0 N: 141893.0 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

SUMMARY OF KEY INSTALLATION DETAILS

Diameter of borehole in test section, D (m)	0.150
Depth to base of borehole casing (m)	43.90
Depth to base of borehole at start of test (m)	49.90
Inital groundwater level (m bgl)	24.14
Initial hydrostatic pressure in mid-point of test zone (bar)	2.45

Depth BGL to top of test section (m)	47.40
Depth BGL to midpoint of test section (m)	48.65
Depth BGL to base of test section (m)	49.90
Length of test section, L (m)	2.50

TEST READINGS

Stage	Gauge (over) pressure, P (bar)	Test Increment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Average flow, Q (litres/min)
		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					
1	1.00	Flowmeter readings (litres)	0.000	129.200	259.100	387.900	516.400	646.900	771.200	902.400													**128.91**
		Water Take (litres)	0.000	129.200	129.900	128.800	128.500	130.500	124.300	131.200													
		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					
2	2.00	Flowmeter readings (litres)	0.000	141.600	282.600	442.500	563.300	704.300	844.800	983.600													**140.51**
		Water Take (litres)	0.000	141.600	141.000	159.900	120.800	141.000	140.500	138.800													
		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					
3	3.00	Flowmeter readings (litres)	0.000	147.800	307.900	469.100	628.900	789.800	905.200	1109.000													**158.43**
		Water Take (litres)	0.000	147.800	160.100	161.200	159.800	160.900	115.400	203.800													
		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					
4	2.00	Flowmeter readings (litres)	0.000	144.900	287.300	428.100	569.800	710.400	851.900	993.100													**141.87**
		Water Take (litres)	0.000	144.900	142.400	140.800	141.700	140.600	141.500	141.200													
		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					
5	1.00	Flowmeter readings (litres)	0.000	132.200	265.000	397.800	531.200	664.000	786.200	907.400													**129.63**
		Water Take (litres)	0.000	132.200	132.800	132.800	133.400	132.800	122.200	121.200													

TEST REMARKS	1 Duration of each test stage reduced to 7 minutes to reduce volume of water used, on client's instruction.
	2
	3

STRUCTURAL SOILS LTD The Old School Stillhouse Lane, Bedminster BRISTOL, BS3 4EB	Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	**Contract Ref:**	**733442**
	Stuart Pearce	23/05/2018	Adam Lumber	[redacted]	08/08/2018	A.Lumber	[redacted]	08/08/2018		
	Contract:		**A303 Phase 6 Ground Investigation**		**Client**	**Highways England**			**Page**	**2 of 3**

IN-SITU WATER PRESSURE TEST -SINGLE PACKER

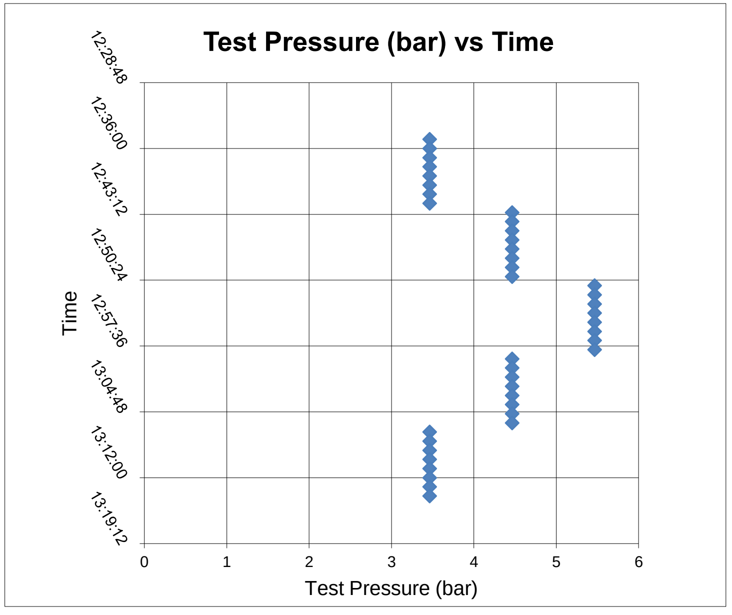
In accordance with BS EN ISO 22282-3 (2012)

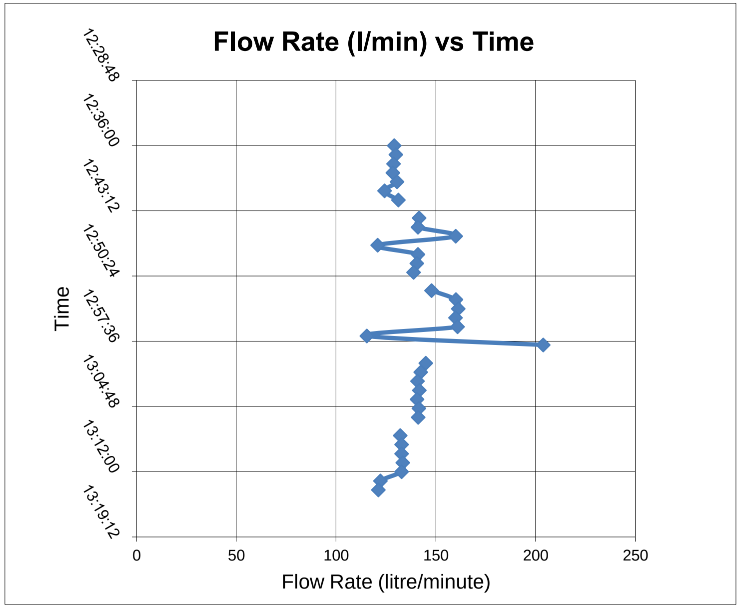
BH No R607 **Test No.:** 6 **Test Depth Range (m):** 47.40 to 49.90 **Test Date:** 5/22/2018 **Test Time:** 12:35

Ground Level: (m AOD) 93.94 National Grid Coordinates: E: 412276.0 N: 141893.0 Borehole Inclination: (degrees from vertical) 0 Borehole Orientation: (degrees) Not applicable

Run	Measured Gauge pressure, P (bar)	Measured Gague Pressure, P (m head)	Effective test pressure causing flow into rock, m head $\rho_{T\ (=P+(H-Hg)-Hf)}$	Effective test pressure ρ_{Tb} (bar)	Effective test pressure rT (MPa)	Flow rate, Q1 (litres/min)	Injected Flow, Q2 per metre (litres/min/m) [=Q1 / L]	Flow Q3 (m^3/s)
1	1.00	10.00	34.6	3.464	0.346	128.91	51.57	0.002149
2	2.00	20.00	44.6	4.464	0.446	140.51	56.21	0.002342
3	3.00	30.00	54.6	5.464	0.546	158.43	63.37	0.002640
4	2.00	20.00	44.6	4.464	0.446	141.87	56.75	0.002365
5	1.00	10.00	34.6	3.464	0.346	129.63	51.85	0.002160

Note: Test pressure (gauge) monitored visually and not data logged during test. Test pressure therefore presented as constant, for each stage in Test Pressure vs Time





IN-SITU WATER PRESSURE TEST - SINGLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

Borehole No.: R607 **Test No.:** 7 **Test Depth Range (m):** 55.00 to 60.00 **Test Date:** 23/05/2018 **Test Time:** 09:55

Ground Level (m AOD): 93.94 National Grid Coordinates: E: 412276.0 N: 141893.0 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

INSTALLATION DETAILS

BOREHOLE DETAILS	
Borehole Drilling Method	Rotary coring
Diameter of borehole in test section, d (mm)	150
Depth to base of borehole casing (m)	52.50
Depth to base of borehole at start of test (m)	60.00
Inital groundwater level (m bgl)	22.27
Height of groundwater above mid-point of test section, Hg (m)	35.23

TEST DETAILS	
Depth BGL to top of test section (m)	55.00
Depth BGL to midpoint of test section (m)	57.50
Depth BGL to base of test section (m)	60.00
Length of test section, L (m)	5.00
Rock type under test	CHALK
Weather during test	Sunny

EQUIPMENT DETAILS	
Packer Type	Pneumatic
Serial No.	Not recorded
Length (m)	1.30
Inflation Pressure (bar)	10.0
Flowmeter type	Paddle wheel
Flowmeter serial number	Not recorded
Water Pump Type	Drill Rig Mounted
Water Pump Serial Number	Not recorded
Injection Water Temperature (^oC)	Not recorded
Test Pressure Measurement Method	Above ground pressure gauge
Gauge Height above GL (m)	0.50
Gauge Height above mid-point of test section, H (m)	58.00
Pressure Loss between pump and test section, Hf (m head)	0.00

IN-SITU WATER PRESSURE TEST - SINGLE PACKER

In accordance with BS EN ISO 22283-3 (2012)

Borehole No.: R607 **Test No.:** 7 **Test Depth Range (m):** 55.00 to 60.00 **Test Date:** 23/05/2018 **Test Time:** 09:55

Ground Level (m AOD): 93.94 National Grid Coordinates: E: 412276.0 N: 141893.0 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

SUMMARY OF KEY INSTALLATION DETAILS

Diameter of borehole in test section, D (m)	0.150
Depth to base of borehole casing (m)	52.50
Depth to base of borehole at start of test (m)	60.00
Inital groundwater level (m bgl)	22.27
Initial hydrostatic pressure in mid-point of test zone (bar)	3.52

Depth BGL to top of test section (m)	55.00
Depth BGL to midpoint of test section (m)	57.50
Depth BGL to base of test section (m)	60.00
Length of test section, L (m)	5.00

TEST READINGS

Stage	Gauge (over) pressure, P (bar)	Test Increment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Average flow, Q (litres/min)
		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					
1	1.00	Flowmeter readings (litres)	0.000	0.500	0.800	1.000	1.100	1.200	1.400	1.500													0.21
		Water Take (litres)	0.000	0.500	0.300	0.200	0.100	0.100	0.200	0.100													
		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					
2	2.00	Flowmeter readings (litres)	0.000	0.400	0.800	1.100	1.700	2.000	2.200	2.500													0.36
		Water Take (litres)	0.000	0.400	0.400	0.300	0.600	0.300	0.200	0.300													
		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					
3	3.00	Flowmeter readings (litres)	0.000	1.200	2.100	3.300	4.700	6.200	7.500	9.000													1.29
		Water Take (litres)	0.000	1.200	0.900	1.200	1.400	1.500	1.300	1.500													
		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					
4	2.00	Flowmeter readings (litres)	0.000	0.800	1.600	2.500	3.500	4.500	5.500	6.500													0.93
		Water Take (litres)	0.000	0.800	0.800	0.900	1.000	1.000	1.000	1.000													
		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					
5	1.00	Flowmeter readings (litres)	0.000	0.600	1.200	1.900	2.500	3.100	3.800	4.500													0.64
		Water Take (litres)	0.000	0.600	0.600	0.700	0.600	0.600	0.700	0.700													

TEST REMARKS	
	1 Duration of each test stage reduced to 7 minutes to reduce volume of water used, on client's instruction.
	2
	3

STRUCTURAL SOILS LTD
The Old School
Stillhouse Lane,
Bedminster
BRISTOL, BS3 4EB

Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	Contract Ref:	733442
Stuart Pearce	23/05/2018	Adam Lumber	[redacted]	08/08/2018	A.Lumber	[redacted]	08/08/2018		
Contract:		**A303 Phase 6 Ground Investigation**		**Client**	**Highways England**			**Page**	**2 of 3**

IN-SITU WATER PRESSURE TEST -SINGLE PACKER

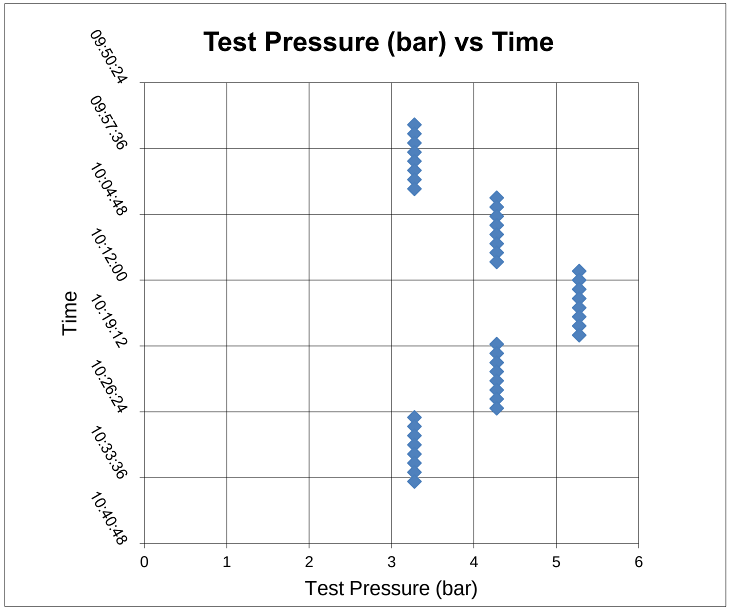
In accordance with BS EN ISO 22282-3 (2012)

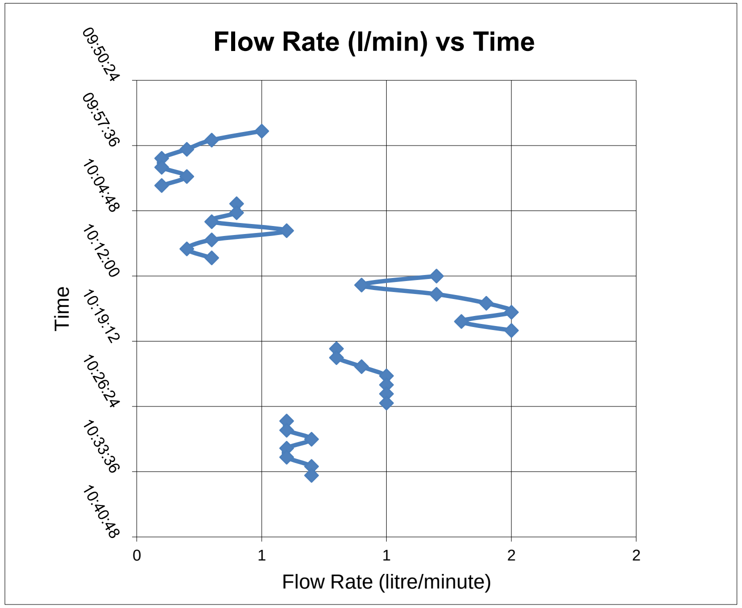
BH No R607 **Test No.:** 7 **Test Depth Range (m):** 55.00 to 60.00 **Test Date:** 5/23/2018 **Test Time:** 9:55

Ground Level: (m AOD) 93.94 National Grid Coordinates: E: 412276.0 N: 141893.0 Borehole Inclination: (degrees from vertical) 0 Borehole Orientation: (degrees) Not applicable

Run	Measured Gauge pressure, P (bar)	Measured Gague Pressure, P (m head)	Effective test pressure causing flow into rock, m head $\rho_{T\,(=P+(H-Hg)-Hf)}$	Effective test pressure ρ_{Tb} (bar)	Effective test pressure rT (MPa)	Flow rate, Q1 (litres/min)	Injected Flow, Q2 per metre (litres/min/m) [=Q1 / L]	Flow Q3 (m^3/s)
1	1.00	10.00	32.8	3.277	0.328	0.21	0.04	0.000004
2	2.00	20.00	42.8	4.277	0.428	0.36	0.07	0.000006
3	3.00	30.00	52.8	5.277	0.528	1.29	0.26	0.000021
4	2.00	20.00	42.8	4.277	0.428	0.93	0.19	0.000015
5	1.00	10.00	32.8	3.277	0.328	0.64	0.13	0.000011

Note: Test pressure (gauge) monitored visually and not data logged during test. Test pressure therefore presented as constant, for each stage in Test Pressure vs Time





STRUCTURAL SOILS LTD The Old School Stillhouse Lane Bedminster BRISTOL, BS3 4EB	Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	Contract Ref:	733442
	Stuart Pearce	5/23/2018	Adam Lumber	[redacted]	8/8/2018	A.Lumber	[redacted]	8/8/2018		
	Contract:		A303 Phase 6 Ground Investigation		Client	Highways England			Page	3 of 3

IN-SITU WATER PRESSURE TEST -SINGLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

Borehole No.: R619 **Test No.:** 1 **Test Depth Range (m):** 36.00 to 39.00 **Test Date:** 29/04/2018 **Test Time:** 11:40

Ground Level (m AOD): 79.63 National Grid Coordinates: E: 412786.0 N: 141969.0 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

INSTALLATION DETAILS

BOREHOLE DETAILS	
Borehole Drilling Method	Rotary coring
Daimeter of borehole in test section, d (mm)	150
Depth to base of borehole casing (m)	12.00
Depth to base of borehole at start of test (m)	39.00
Inital groundwater level (m bgl)	5.28
Initial hydrostatic pressure in test zone (from VW2, bar)	3.37

EQUIPMENT DETAILS	Packer 1 (Upper)	Packer 2 (lower)
Packer Type	Pneumatic	
Serial No.	Not recorded	
Length (m)	1.30	
Inflation Pressure (bar)	8.0	

TEST DETAILS	
Depth BGL to top of test section (m)	36.00
Depth BGL to midpoint of test section (m)	37.50
Depth BGL to base of test section (m)	39.00
Length of test section, L (m)	3.00
Rock type under test	Chalk
Weather during test	Overcast

Flowmeter type	Paddle wheel
Flowmeter serial number	2903
Water Pump Type	Rig Pump
Water Pump Serial Number	MOG
Injection Water Temperature (^oC)	14.0

Pressure Transducer		Distance from centre of test section (m bgl)	Depth m bgl)	Manufacturer	Serial Number
VW1	TOP - Above Test Section	NA	NA	NA	NA
VW2	MIDDLE - Within Test Section	1.20	37.80	GeoSense	330541
VW3	BASE - Below Test Section	NA	NA	NA	NA
		(Distances BELOW centre to be entered as negative)			

STRUCTURAL SOILS LTD The Old School Stillhouse Lane, Bedminster BRISTOL, BS3 4EB	Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	Contract Ref:	733442
	Matthew Jones	23/04/2018	Matthew Jones		24/04/2018	Adam Lumber	[redacted]	08/08/2018		
	Contract:		**A303 Stonehenge Phase 6 Ground Investigation**		**Client**	**Highways England**			**Page**	**1 of 2**

IN-SITU WATER PRESSURE TEST -SINGLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

Borehole No.: R619 **Test No.:** 1 **Test Depth Range (m):** 36.00 to 39.00 **Test Date:** 29/04/2018 **Test Time:** 11:40

Ground Level (m AOD): 79.63 National Grid Coordinates: E: 412786.0 N: 141969.0 Borehole Inclination: (degrees from vertical) 0 Borehole Orientation: (degrees) Not applicable

SUMMARY OF KEY INSTALLATION DETAILS

Daimeter of borehole in test section, D (m)	0.150
Depth to base of borehole casing (m)	12.00
Depth to base of borehole at start of test (m)	39.00
Inital groundwater level (m bgl)	5.28
Initial hydrostatic pressure in test zone (from VW2)	3.37

Depth BGL to top of test section (m)	36.00
Depth BGL to midpoint of test section (m)	37.50
Depth BGL to base of test section (m)	39.00
Length of test section, L (m)	3.00

TEST READINGS

Stage	Gauge over pressure, P (bar)	Test Increment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Average flow, Q (litres/min)
		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					
1	1.00	Flowmeter readings (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000										0.00
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000										
		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					
2	2.00	Flowmeter readings (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000										0.00
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000										
		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					
3	3.00	Flowmeter readings (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000										0.00
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000										
		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					
4	4.00	Flowmeter readings (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000										0.00
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000										
		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					
5	NA	Flowmeter readings (litres)																					0.00
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000										

TEST REMARKS	1. 28.34l of water pumped through the systemto purge air prior to commencement.
	2. Zero flow recorded over first 3 stages. Hydrogeologist on-site instructed to increase test pressure to 4 Bar, still no flow recorded.
	3. Standing water level held constrant at 5.28m bgl during test. 4. Flow/pressure/time data not presented graphically as no flow recorded in this test.

STRUCTURAL SOILS LTD The Old School Stillhouse Lane, Bedminster BRISTOL, BS3 4EB	Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	**Contract Ref:** 733442
	Matthew Jones	23/04/2018	Matthew Jones		24/04/2018	Adam Lumber	[redacted]	08/08/2018	
	Contract:		**A303 Stonehenge Phase 6 Ground Investigation**		**Client**	**Highways England**		**Page**	2 of 2

IN-SITU WATER PRESSURE TEST -SINGLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

Borehole No.: R619 **Test No.:** 2 **Test Depth Range (m):** 39.00 to 42.00 **Test Date:** 26/04/2018 **Test Time:** 16:00

Ground Level (m AOD): 79.63 National Grid Coordinates: E: 412786.0 N: 141969.0 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

INSTALLATION DETAILS

BOREHOLE DETAILS	
Borehole Drilling Method	Rotary coring
Daimeter of borehole in test section, d (mm)	150
Depth to base of borehole casing (m)	12.00
Depth to base of borehole at start of test (m)	42.00
Inital groundwater level (m bgl)	5.89
Initial hydrostatic pressure in test zone (calculated, bar)	3.33

EQUIPMENT DETAILS		
	Packer 1 (Upper)	Packer 2 (lower)
Packer Type	Pneumatic	
Serial No.	Not recorded	
Length (m)	1.30	
Inflation Pressure (bar)	8.0	

TEST DETAILS	
Depth BGL to top of test section (m)	39.00
Depth BGL to midpoint of test section (m)	40.50
Depth BGL to base of test section (m)	42.00
Length of test section, L (m)	3.00
Rock type under test	Chalk
Weather during test	Overcast

Flowmeter type	Paddle wheel
Flowmeter serial number	2903
Water Pump Type	Rig Pump
Water Pump Serial Number	Uni Mog
Injection Water Temperature (^oC)	14.0

Pressure Transducer		Distance from centre of test section (m bgl)	Depth m bgl)	Manufacturer	Serial Number
VW1	TOP - Above Test Section	NA	NA	NA	NA
VW2	MIDDLE - Within Test Section	1.25	39.25	GeoSense	330484
VW3	BASE - Below Test Section	NA	NA	NA	NA
		(Distances BELOW centre to be entered as negative)			

STRUCTURAL SOILS LTD The Old School Stillhouse Lane, Bedminster BRISTOL, BS3 4EB	Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	Contract Ref:	733442
	Matthew Jones	26/04/2018	Matthew Jones		01/05/2018	Adam Lumber	[redacted]	08/08/2018		
	Contract:		A303 Stonehenge Phase 6 Ground Investigation		Client	Highways England			Page	1 of 2

IN-SITU WATER PRESSURE TEST -SINGLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

Borehole No.: R619 **Test No.:** 2 **Test Depth Range (m):** 39.00 to 42.00 **Test Date:** 26/04/2018 **Test Time:** 16:00

Ground Level (m AOD): 79.63 National Grid Coordinates: E: 412786.0 N: 141969.0 Borehole Inclination: (degrees from vertical) 0 Borehole Orientation: (degrees) Not applicable

SUMMARY OF KEY INSTALLATION DETAILS

Daimeter of borehole in test section, D (m)	0.150
Depth to base of borehole casing (m)	12.00
Depth to base of borehole at start of test (m)	42.00
Inital groundwater level (m bgl)	5.89
Initial hydrostatic pressure in test zone (calculated, bar)	3.33

Depth BGL to top of test section (m)	39.00
Depth BGL to midpoint of test section (m)	40.50
Depth BGL to base of test section (m)	42.00
Length of test section, L (m)	3.00

TEST READINGS

Stage	Effective over pressure, P (bar)	Test Increment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Average flow, Q (litres/min)
1	1.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**119.87**
		Flowmeter readings (litres)	0.000	112.000	234.000	363.000	480.000	602.000	720.000	839.000	959.000	1079.000	1198.000	1317.000	1436.000	1554.000	1676.000	1798.000					
		Water Take (litres)	0.000	112.000	122.000	129.000	117.000	122.000	118.000	119.000	120.000	120.000	119.000	119.000	119.000	118.000	122.000	122.000					
2	1.80	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**133.86**
		Flowmeter readings (litres)	0.000	141.000	273.000	403.000	534.000	666.000	797.000	937.000													
		Water Take (litres)	0.000	141.000	132.000	130.000	131.000	132.000	131.000	140.000													
3	NA	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**0.00**
		Flowmeter readings (litres)																					
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000										
4	NA	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**0.00**
		Flowmeter readings (litres)																					
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000										
5	NA	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**0.00**
		Flowmeter readings (litres)																					
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000										

TEST REMARKS	
	1. 740l of water pumped through the system to purge air prior to commencement and achieve stage 1 pressure.
	3. Stage 2 target pressure could not be achieved. Test pressure of 1.8 bar held for 1 minute then dropped to 1.4 bar the 1 bar after 2 minutes. Test abandoned.
	3. Standing groundwater level remained constant throughout. 4. Flow/pressure/time data not presented graphically as test abandonned.

STRUCTURAL SOILS LTD The Old School Stillhouse Lane, Bedminster BRISTOL, BS3 4EB	Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	**Contract Ref:**	**733442**
	Matthew Jones	26/04/2018	Matthew Jones		01/05/2018	Adam Lumber	[redacted]	08/08/2018		
	Contract:		**A303 Stonehenge Phase 6 Ground Investigation**		**Client**	**Highways England**			**Page**	**2 of 2**

IN-SITU WATER PRESSURE TEST -SINGLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

Borehole No.: R619 **Test No.:** 3 **Test Depth Range (m):** 42.00 to 45.00 **Test Date:** 27/04/2018 **Test Time:** 11:15

Ground Level (m AOD): 79.63 National Grid Coordinates: E: 412786.0 N: 141969.0 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

INSTALLATION DETAILS

BOREHOLE DETAILS	
Borehole Drilling Method	Rotary coring
Daimeter of borehole in test section, d (mm)	150
Depth to base of borehole casing (m)	12.00
Depth to base of borehole at start of test (m)	45.00
Inital groundwater level (m bgl)	5.89
Initial hydrostatic pressure in test zone (from VW2, bar)	3.76

EQUIPMENT DETAILS

	Packer 1 (Upper)		Packer 2 (lower)
Packer Type	Pneumatic		
Serial No.	Not recorded		
Length (m)	1.30		
Inflation Pressure (bar)	8.0		

TEST DETAILS	
Depth BGL to top of test section (m)	42.00
Depth BGL to midpoint of test section (m)	43.50
Depth BGL to base of test section (m)	45.00
Length of test section, L (m)	3.00
Rock type under test	Chalk
Weather during test	Overcast

Flowmeter type	Paddle wheel
Flowmeter serial number	2903
Water Pump Type	Rig Pump
Water Pump Serial Number	Uni Mog
Injection Water Temperature (^oC)	14.0

Pressure Transducer		Distance from centre of test section (m bgl)	Depth m bgl)	Manufacturer	Serial Number
VW1	TOP - Above Test Section	NA	NA	NA	NA
VW2	MIDDLE - Within Test Section	1.25	42.25	GeoSense	330484
VW3	BASE - Below Test Section	NA	NA	NA	NA
		(Distances BELOW centre to be entered as negative)			

STRUCTURAL SOILS LTD The Old School Stillhouse Lane, Bedminster BRISTOL, BS3 4EB	Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	Contract Ref:	733442
	Matthew Jones	27/04/2018	Matthew Jones		01/05/2018	Adam Lumber	[redacted]	08/08/2018		
	Contract:		A303 Stonehenge Phase 6 Ground Investigation		Client	Highways England			Page	1 of 2

IN-SITU WATER PRESSURE TEST -SINGLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

Borehole No.: R619 **Test No.:** 3 **Test Depth Range (m):** 42.00 to 45.00 **Test Date:** 27/04/2018 **Test Time:** 11:15

Ground Level (m AOD): 79.63 National Grid Coordinates: E: 412786.0 N: 141969.0 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

SUMMARY OF KEY INSTALLATION DETAILS

Daimeter of borehole in test section, D (m)	0.150
Depth to base of borehole casing (m)	12.00
Depth to base of borehole at start of test (m)	45.00
Inital groundwater level (m bgl)	5.89
Initial hydrostatic pressure in test zone (from VW2)	3.76

Depth BGL to top of test section (m)	42.00
Depth BGL to midpoint of test section (m)	43.50
Depth BGL to base of test section (m)	45.00
Length of test section, L (m)	3.00

TEST READINGS

Stage	Effective over pressure, P (bar)	Test Increment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Average flow, Q (litres/min)
1	1.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**123.19**
		Flowmeter readings (litres)	0.000	106.000	229.800	352.600	473.500	595.700	719.600	844.100	969.300	1096.200	1223.100	1349.800	1457.600	1601.300	1721.100	1847.900					
		Water Take (litres)	0.000	106.000	123.800	122.800	120.900	122.200	123.900	124.500	125.200	126.900	126.900	126.700	107.800	143.700	119.800	126.800					
2	1.50	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**150.96**
		Flowmeter readings (litres)	0.000	178.300	323.700	469.200	610.900	754.800															
		Water Take (litres)	0.000	178.300	145.400	145.500	141.700	143.900															
3	NA	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**0.00**
		Flowmeter readings (litres)																					
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000										
4	NA	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**0.00**
		Flowmeter readings (litres)																					
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000										
5	NA	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**0.00**
		Flowmeter readings (litres)																					
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000										

TEST REMARKS	
	1. 106l of water pumped through the system to purge air prior to commencement and achieve stage 1 pressure.
	2. Stage 2 target pressure could not be achieved. 1.5 bar held for 1 minute then dropped to 1 bar. Test abandoned.
	3. Standing groundwater level remained constant throughout. 4. Flow/pressure/time data not presented graphically as test abandonned.

STRUCTURAL SOILS LTD The Old School Stillhouse Lane, Bedminster BRISTOL, BS3 4EB	Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	**Contract Ref:**	**733442**
	Matthew Jones	27/04/2018	Matthew Jones		01/05/2018	Adam Lumber	[redacted]	08/08/2018		
	Contract:		**A303 Stonehenge Phase 6 Ground Investigation**		**Client**	**Highways England**			**Page**	**2 of 2**

IN-SITU WATER PRESSURE TEST -SINGLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

Borehole No.: R619 **Test No.:** 4 **Test Depth Range (m):** 45.00 to 48.00 **Test Date:** 30/04/2018 **Test Time:** 11:20

Ground Level (m AOD): 79.63 National Grid Coordinates: E: 412786.0 N: 141969.0 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

INSTALLATION DETAILS

BOREHOLE DETAILS	
Borehole Drilling Method	Rotary coring
Diameter of borehole in test section, d (mm)	150
Depth to base of borehole casing (m)	12.00
Depth to base of borehole at start of test (m)	48.00
Inital groundwater level (m bgl)	5.90
Initial hydrostatic pressure in test zone (from VW2)	4.06

EQUIPMENT DETAILS	Packer 1 (Upper)	Packer 2 (lower)
Packer Type	Pneumatic	
Serial No.	Not recorded	
Length (m)	Not recorded	
Inflation Pressure (bar)	6.0	

TEST DETAILS	
Depth BGL to top of test section (m)	45.00
Depth BGL to midpoint of test section (m)	46.50
Depth BGL to base of test section (m)	48.00
Length of test section, L (m)	3.00
Rock type under test	Chalk
Weather during test	Cold Overcast

Flowmeter type	Paddle wheel
Flowmeter serial number	2903
Water Pump Type	Rig Pump
Water Pump Serial Number	Uni Mog
Injection Water Temperature (^oC)	11.0

Pressure Transducer		Distance from centre of test section (m bgl)	Depth m bgl)	Manufacturer	Serial Number
VW1	TOP - Above Test Section	NA	NA	NA	NA
VW2	MIDDLE - Within Test Section	1.25	45.25	GeoSense	330484
VW3	BASE - Below Test Section	NA	NA	NA	NA
		(Distances BELOW centre to be entered as negative)			

STRUCTURAL SOILS LTD The Old School Stillhouse Lane, Bedminster BRISTOL, BS3 4EB	Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	Contract Ref:	733442
	Matthew Jones	30/04/2018	Matthew Jones		01/05/2018	Adam Lumber	[redacted]	08/08/2018		
	Contract:		**A303 Phase 6 Ground Investigation**		**Client**	**Highways England**			**Page**	**1 of 2**

IN-SITU WATER PRESSURE TEST -SINGLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

Borehole No.: R619 **Test No.:** 4 **Test Depth Range (m):** 45.00 to 48.00 **Test Date:** 30/04/2018 **Test Time:** 11:20

Ground Level (m AOD): 79.63 National Grid Coordinates: E: 412786.0 N: 141969.0 Borehole Inclination: 0 Borehole Orientation: Not applicable
(degrees from vertical) (degrees)

SUMMARY OF KEY INSTALLATION DETAILS

Daimeter of borehole in test section, D (m)	0.150
Depth to base of borehole casing (m)	12.00
Depth to base of borehole at start of test (m)	48.00
Inital groundwater level (m bgl)	5.90
Initial hydrostatic pressure in test zone (from VW2)	4.06

Depth BGL to top of test section (m)	45.00
Depth BGL to midpoint of test section (m)	46.50
Depth BGL to base of test section (m)	48.00
Length of test section, L (m)	3.00

TEST READINGS

Stage	Effective over pressure, P (bar)	Test Increment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Average flow, Q (litres/min)
1	1.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					18.11
		Flowmeter readings (litres)	0.000	18.700	37.100	55.600	74.600	93.300	111.800	130.100	147.200	166.200	184.000	201.800	219.500	237.100	254.400	271.700					
		Water Take (litres)	0.000	18.700	18.400	18.500	19.000	18.700	18.500	18.300	17.100	19.000	17.800	17.800	17.700	17.600	17.300	17.300					
2	2.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					28.31
		Flowmeter readings (litres)	0.000	31.600	60.300	88.400	116.700	144.800	173.000	201.200	229.700	257.300	285.300	313.200	341.100	369.000	396.700	424.700					
		Water Take (litres)	0.000	31.600	28.700	28.100	28.300	28.100	28.200	28.200	28.500	27.600	28.000	27.900	27.900	27.900	27.700	28.000					
3	3.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					33.14
		Flowmeter readings (litres)	0.000	35.500	69.200	102.600	135.700	168.900	201.800	234.600	267.500	299.900	333.200	366.200	398.500	431.400	464.700	497.100					
		Water Take (litres)	0.000	35.500	33.700	33.400	33.100	33.200	32.900	32.800	32.900	32.400	33.300	33.000	32.300	32.900	33.300	32.400					
4	2.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					27.90
		Flowmeter readings (litres)	0.000	29.500	58.900	87.800	116.000	144.100	171.900	199.600	227.200	254.700	282.100	309.400	336.700	363.900	391.700	418.500					
		Water Take (litres)	0.000	29.500	29.400	28.900	28.200	28.100	27.800	27.700	27.600	27.500	27.400	27.300	27.300	27.200	27.800	26.800					
5	1.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					19.61
		Flowmeter readings (litres)	0.000	19.800	39.500	58.900	78.700	98.400	118.300	137.900	157.500	176.700	196.200	216.100	235.700	255.200	274.400	294.100					
		Water Take (litres)	0.000	19.800	19.700	19.400	19.800	19.700	19.900	19.600	19.600	19.200	19.500	19.900	19.600	19.500	19.200	19.700					

TEST REMARKS	1. 14.93l of water pumpped through system to purge air prior to commencement.
	2. Standing water level remained constant throughout.

STRUCTURAL SOILS LTD
The Old School
Stillhouse Lane,
Bedminster
BRISTOL, BS3 4EB

Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	Contract Ref:	732863
Matthew Jones	30/04/2018	Matthew Jones		01/05/2018	Adam Lumber	[redacted]	03/05/2018		
Contract:		**A303 Stonehenge Phase 6 Ground Investigation**		**Client**	**Highways England**			**Page**	**2 of 2**

IN-SITU WATER PRESSURE TEST - SINGLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

Borehole No.: R71907 **Test No.:** 1 **Test Depth Range (m):** 36.80 to 39.80 **Test Date:** 16/08/2018 **Test Time:** 09:45

Ground Level (m AOD): 98.35 National Grid Coordinates: E: 412939.1 N: 141968.9 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

INSTALLATION DETAILS

BOREHOLE DETAILS	
Borehole Drilling Method	Rotary coring
Diameter of borehole in test section, d (mm)	150
Depth to base of borehole casing (m)	1.60
Depth to base of borehole at start of test (m)	39.80
Inital groundwater level (m bgl)	31.75
Height of groundwater above mid-point of test section, Hg (m)	6.55

TEST DETAILS	
Depth BGL to top of test section (m)	36.80
Depth BGL to midpoint of test section (m)	38.30
Depth BGL to base of test section (m)	39.80
Length of test section, L (m)	3.00
Rock type under test	CHALK
Weather during test	Raining

EQUIPMENT DETAILS	
Packer Type	Pneumatic
Serial No.	Not recorded
Length (m)	1.30
Inflation Pressure (bar)	16.0
Flowmeter type	Paddle wheel
Flowmeter serial number	Not recorded
Water Pump Type	Drill Rig Mounted
Water Pump Serial Number	Not recorded
Injection Water Temperature (^oC)	Not recorded
Test Pressure Measurement Method	Above ground pressure gauge
Gauge Height above GL (m)	1.00
Gauge Height above mid-point of test section, H (m)	39.30
Pressure Loss between pump and test section, Hf (m head)	0.00

IN-SITU WATER PRESSURE TEST - SINGLE PACKER

In accordance with BS EN ISO 22283-3 (2012)

Borehole No.: R71907 **Test No.:** 1 **Test Depth Range (m):** 36.80 to 39.80 **Test Date:** 16/08/2018 **Test Time:** 09:45

Ground Level (m AOD): 98.35 National Grid Coordinates: E: 412939.1 N: 141968.9 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

SUMMARY OF KEY INSTALLATION DETAILS

Diameter of borehole in test section, D (m)	0.150
Depth to base of borehole casing (m)	1.60
Depth to base of borehole at start of test (m)	39.80
Inital groundwater level (m bgl)	31.75
Initial hydrostatic pressure in mid-point of test zone (bar)	0.66

Depth BGL to top of test section (m)	36.80
Depth BGL to midpoint of test section (m)	38.30
Depth BGL to base of test section (m)	39.80
Length of test section, L (m)	3.00

TEST READINGS

Stage	Gauge (over) pressure, P (bar)	Test Increment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Average flow, Q (litres/min)
1	1.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					81.43
		Flowmeter readings (litres)	0.000	90.600	178.600	267.100	348.600	431.600	512.500	591.900	670.800	750.000	829.000	907.400	986.200	1065.000	1143.600	1221.500					
		Water Take (litres)	0.000	90.600	88.000	88.500	81.500	83.000	80.900	79.400	78.900	79.200	79.000	78.400	78.800	78.800	78.600	77.900					
2	2.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					89.23
		Flowmeter readings (litres)	0.000	95.500	189.200	280.000	369.100	458.600	548.400	637.700	727.000	816.500	902.800	991.700	1072.500	1155.400	1247.000	1338.400					
		Water Take (litres)	0.000	95.500	93.700	90.800	89.100	89.500	89.800	89.300	89.300	89.500	86.300	88.900	80.800	82.900	91.600	91.400					
3	3.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					108.97
		Flowmeter readings (litres)	0.000	111.500	221.200	331.400	442.600	551.400	661.800	776.700	891.800	993.300	1100.300	1209.200	1318.400	1427.600	1522.300	1634.600					
		Water Take (litres)	0.000	111.500	109.700	110.200	111.200	108.800	110.400	114.900	115.100	101.500	107.000	108.900	109.200	109.200	94.700	112.300					
4		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					0.00
		Flowmeter readings (litres)																					
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000					
5		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					0.00
		Flowmeter readings (litres)																					
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000					

TEST REMARKS	1. Test stopped 10:40 after Stage 3 as more water required. Re-started test Stage 4 at 11:50.
	2. Unable to maintain target overpressure of 2 Bar in system for Stage 4.
	3. Client instructed that test be stopped, packer remove and drilling continued in preparation for next test.

STRUCTURAL SOILS LTD
The Old School
Stillhouse Lane,
Bedminster
BRISTOL, BS3 4EB

Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	Contract Ref:	733442
Stuart Pearce	16/08/2018	Adam Lumber	[redacted]	14/12/2018	Adam Lumber	[redacted]	14/12/2018		
Contract:		**A303 Phase 6 and 7 Ground Investigation**		**Client**	**Highways England**			**Page**	2 of 3

IN-SITU WATER PRESSURE TEST -SINGLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

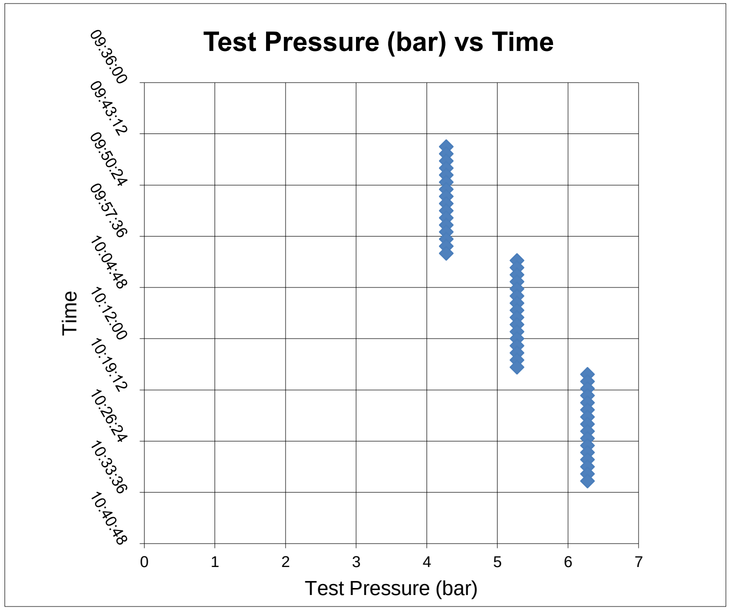
BH No R71907 **Test No.:** 1 **Test Depth Range (m):** 36.80 to 39.80 **Test Date:** 8/16/2018 **Test Time:** 9:45

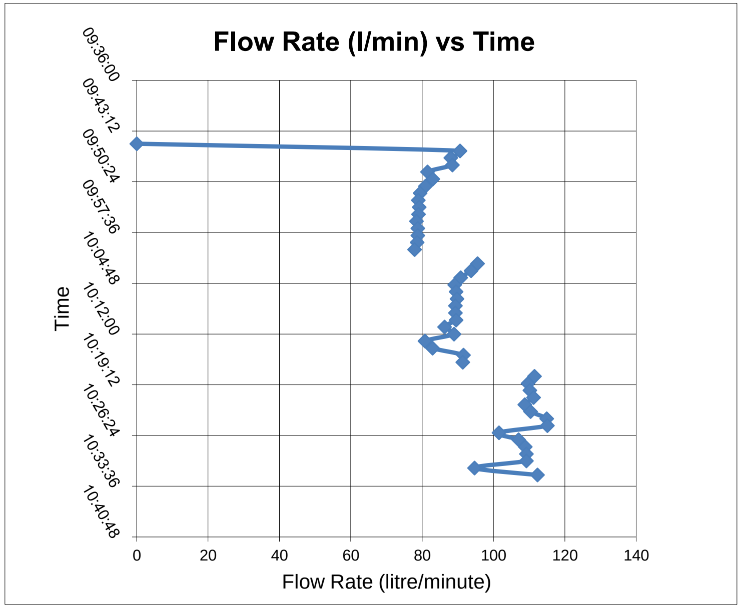
Ground Level: (m AOD) 98.35 National Grid Coordinates: E: 412939.1 N: 141968.9 Borehole Inclination: (degrees from vertical) 0 Borehole Orientation: (degrees) Not applicable

Run	Measured Gauge pressure, P (bar)	Measured Gague Pressure, P (m head)	Effective test pressure causing flow into rock, m head ρ_T (= P + (H-Hg) - Hf)	Effective test pressure ρ_{Tb} (bar)	Effective test pressure rT (MPa)	Flow rate, Q1 (litres/min)	Injected Flow, Q2 per metre (litres/min/m) [=Q1 / L]	Flow Q3 (m^3/s)
1	1.00	10.00	42.8	4.275	0.428	81.43	27.14	0.001357
2	2.00	20.00	52.8	5.275	0.528	89.23	29.74	0.001487
3	3.00	30.00	62.8	6.275	0.628	108.97	36.32	0.001816
4	0.00	0.00	32.8	3.275	0.328	0.00	0.00	0.000000
5	0.00	0.00	32.8	3.275	0.328	0.00	0.00	0.000000

Note:

Note: Test pressure (gauge) monitored visually and not data logged during test. Test pressure therefore presented as constant, for each stage in Test Pressure vs Time





STRUCTURAL SOILS LTD The Old School Stillhouse Lane Bedminster BRISTOL, BS3 4EB	Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	Contract Ref:	733442
	Stuart Pearce	8/16/2018	Adam Lumber	[redacted]	12/14/2018	Adam Lumber	[redacted]	12/14/2018		
	Contract:		A303 Phase 6 and 7 Ground Investigation		Client	Highways England			Page	3 of 3

IN-SITU WATER PRESSURE TEST - SINGLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

Borehole No.: R71907 **Test No.:** 2 **Test Depth Range (m):** 42.80 to 45.80 **Test Date:** 16/08/2018 **Test Time:** 08:30

Ground Level (m AOD): 98.35 National Grid Coordinates: E: 412939.1 N: 141968.9 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

INSTALLATION DETAILS

BOREHOLE DETAILS	
Borehole Drilling Method	Rotary coring
Diameter of borehole in test section, d (mm)	150
Depth to base of borehole casing (m)	1.60
Depth to base of borehole at start of test (m)	45.80
Inital groundwater level (m bgl)	31.20
Height of groundwater above mid-point of test section, Hg (m)	13.10

TEST DETAILS	
Depth BGL to top of test section (m)	42.80
Depth BGL to midpoint of test section (m)	44.30
Depth BGL to base of test section (m)	45.80
Length of test section, L (m)	3.00
Rock type under test	CHALK
Weather during test	Overcast

EQUIPMENT DETAILS	
Packer Type	Pneumatic
Serial No.	Not recorded
Length (m)	1.40
Inflation Pressure (bar)	20.0
Flowmeter type	Paddle wheel
Flowmeter serial number	2903
Water Pump Type	Drill Rig Mounted
Water Pump Serial Number	MOG
Injection Water Temperature (^oC)	14.0
Test Pressure Measurement Method	Above ground pressure gauge
Gauge Height above GL (m)	1.00
Gauge Height above mid-point of test section, H (m)	45.30
Pressure Loss between pump and test section, Hf (m head)	0.00

IN-SITU WATER PRESSURE TEST - SINGLE PACKER

In accordance with BS EN ISO 22283-3 (2012)

Borehole No.: R71907 **Test No.:** 2 **Test Depth Range (m):** 42.80 to 45.80 **Test Date:** 16/08/2018 **Test Time:** 08:30

Ground Level (m AOD): 98.35 National Grid Coordinates: E: 412939.1 N: 141968.9 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

SUMMARY OF KEY INSTALLATION DETAILS

Diameter of borehole in test section, D (m)	0.150
Depth to base of borehole casing (m)	1.60
Depth to base of borehole at start of test (m)	45.80
Inital groundwater level (m bgl)	31.20
Initial hydrostatic pressure in mid-point of test zone (bar)	1.31

Depth BGL to top of test section (m)	42.80
Depth BGL to midpoint of test section (m)	44.30
Depth BGL to base of test section (m)	45.80
Length of test section, L (m)	3.00

TEST READINGS

Stage	Gauge (over) pressure, P (bar)	Test Increment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Average flow, Q (litres/min)
1	1.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					0.00
		Flowmeter readings (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000										
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000					
2	2.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					0.00
		Flowmeter readings (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000										
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000					
3	3.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					0.00
		Flowmeter readings (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000										
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000					
4		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					0.00
		Flowmeter readings (litres)																					
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000					
5		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					0.00
		Flowmeter readings (litres)																					
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000					

TEST REMARKS	
	1. 28.34 litres of water flow completed to purge the air from the system.
	2. Water Level held constant at 5.28 m below ground level throughout test.
	3. Zero flow recorded over Stage 1, 2 and 3. Hydrogeologist onsite instructed increase in pump pressure to 4 Bar; no flow recorded, test halted.

STRUCTURAL SOILS LTD The Old School Stillhouse Lane, Bedminster BRISTOL, BS3 4EB	Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	Contract Ref:	733442
	Stuart Pearce	20/08/2018	Adam Lumber	[redacted]	14/12/2018	Adam Lumber	[redacted]	14/12/2018		
	Contract:		A303 Phase 6 and 7 Ground Investigation		Client	Highways England			Page	2 of 3

IN-SITU WATER PRESSURE TEST -SINGLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

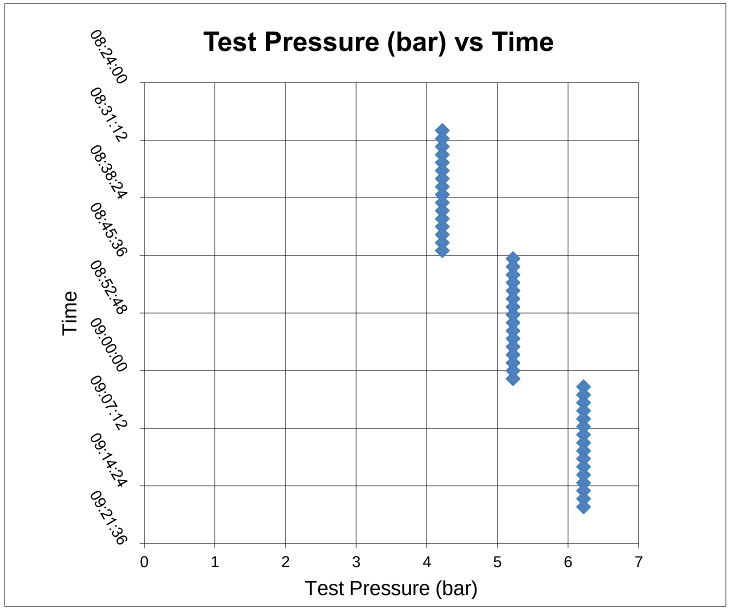
BH No R71907 **Test No.:** 2 **Test Depth Range (m):** 42.80 to 45.80 **Test Date:** 8/16/2018 **Test Time:** 8:30

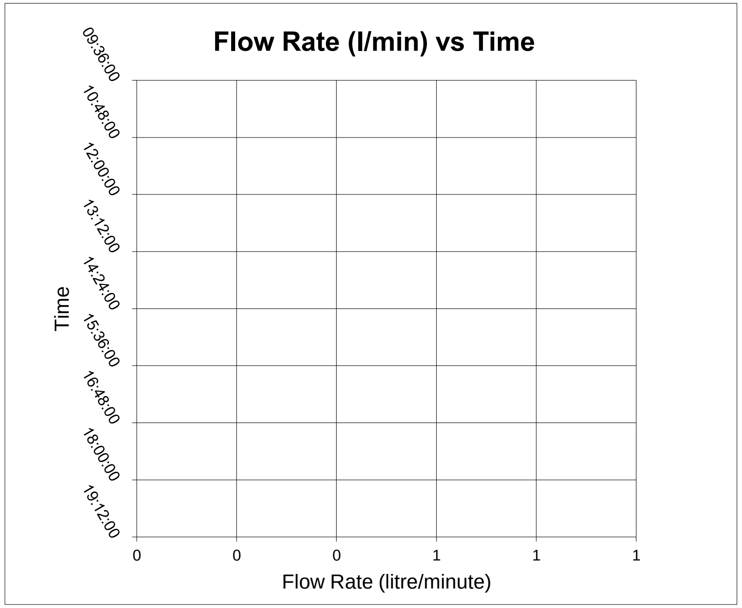
Ground Level: (m AOD) 98.35 National Grid Coordinates: E: 412939.1 N: 141968.9 Borehole Inclination: (degrees from vertical) 0 Borehole Orientation: (degrees) Not applicable

Run	Measured Gauge pressure, P (bar)	Measured Gague Pressure, P (m head)	Effective test pressure causing flow into rock, m head $\rho_{T\ (=P+(H-Hg)-Hf)}$	Effective test pressure ρ_{Tb} (bar)	Effective test pressure rT (MPa)	Flow rate, Q1 (litres/min)	Injected Flow, Q2 per metre (litres/min/m) [=Q1 / L]	Flow Q3 (m^3/s)
1	1.00	10.00	42.2	4.22	0.422	0.00	0.00	0.000000
2	2.00	20.00	52.2	5.22	0.522	0.00	0.00	0.000000
3	3.00	30.00	62.2	6.22	0.622	0.00	0.00	0.000000
4	0.00	0.00	32.2	3.22	0.322	0.00	0.00	0.000000
5	0.00	0.00	32.2	3.22	0.322	0.00	0.00	0.000000

Note:

Note: Test pressure (gauge) monitored visually and not data logged during test. Test pressure therefore presented as constant, for each stage in Test Pressure vs Time





IN-SITU WATER PRESSURE TEST - SINGLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

Borehole No.: R71907 **Test No.:** 3 **Test Depth Range (m):** 48.80 to 51.80 **Test Date:** 20/08/2018 **Test Time:** 14:30

Ground Level (m AOD): 98.35 National Grid Coordinates: E: 412939.1 N: 141968.9 Borehole Inclination (degrees from vertical): 0 Borehole Orientation (degrees): Not applicable

INSTALLATION DETAILS

BOREHOLE DETAILS	
Borehole Drilling Method	Rotary coring
Diameter of borehole in test section, d (mm)	150
Depth to base of borehole casing (m)	1.60
Depth to base of borehole at start of test (m)	51.80
Inital groundwater level (m bgl)	32.60
Height of groundwater above mid-point of test section, Hg (m)	17.70

TEST DETAILS	
Depth BGL to top of test section (m)	48.80
Depth BGL to midpoint of test section (m)	50.30
Depth BGL to base of test section (m)	51.80
Length of test section, L (m)	3.00
Rock type under test	CHALK
Weather during test	Overcast

EQUIPMENT DETAILS	
Packer Type	Pneumatic
Serial No.	Not recorded
Length (m)	1.40
Inflation Pressure (bar)	9.0
Flowmeter type	Paddle wheel
Flowmeter serial number	Not recorded
Water Pump Type	Triplex
Water Pump Serial Number	Not recorded
Injection Water Temperature (^oC)	MOG
Test Pressure Measurement Method	Above ground pressure gauge
Gauge Height above GL (m)	1.00
Gauge Height above mid-point of test section, H (m)	51.30
Pressure Loss between pump and test section, Hf (m head)	0.00

IN-SITU WATER PRESSURE TEST - SINGLE PACKER

In accordance with BS EN ISO 22283-3 (2012)

Borehole No.: R71907 **Test No.:** 3 **Test Depth Range (m):** 48.80 to 51.80 **Test Date:** 20/08/2018 **Test Time:** 14:30

Ground Level (m AOD): 98.35 National Grid Coordinates: E: 412939.1 N: 141968.9 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

SUMMARY OF KEY INSTALLATION DETAILS

Diameter of borehole in test section, D (m)	0.150
Depth to base of borehole casing (m)	1.60
Depth to base of borehole at start of test (m)	51.80
Inital groundwater level (m bgl)	32.60
Initial hydrostatic pressure in mid-point of test zone (bar)	1.77

Depth BGL to top of test section (m)	48.80
Depth BGL to midpoint of test section (m)	50.30
Depth BGL to base of test section (m)	51.80
Length of test section, L (m)	3.00

TEST READINGS

Stage	Gauge (over) pressure, P (bar)	Test Increment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Average flow, Q (litres/min)
1	1.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					11.89
		Flowmeter readings (litres)	0.000	12.900	26.400	39.500	52.100	64.400	76.600	88.200	99.400	110.700	122.100	133.300	144.400	155.600	166.900	178.300					
		Water Take (litres)	0.000	12.900	13.500	13.100	12.600	12.300	12.200	11.600	11.200	11.300	11.400	11.200	11.100	11.200	11.300	11.400					
2	2.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					19.87
		Flowmeter readings (litres)	0.000	19.400	38.700	58.000	77.300	96.800	116.100	135.700	155.200	175.100	195.000	215.300	235.700	256.100	277.200	298.100					
		Water Take (litres)	0.000	19.400	19.300	19.300	19.300	19.500	19.300	19.600	19.500	19.900	19.900	20.300	20.400	20.400	21.100	20.900					
3	3.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					58.38
		Flowmeter readings (litres)	0.000	59.100	118.300	176.600	234.400	292.300	350.700	409.100	467.900	526.900	584.400	642.600	700.900	759.600	818.400	875.700					
		Water Take (litres)	0.000	59.100	59.200	58.300	57.800	57.900	58.400	58.400	58.800	59.000	57.500	58.200	58.300	58.700	58.800	57.300					
4	2.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					24.97
		Flowmeter readings (litres)	0.000	26.200	51.800	75.900	99.300	123.600	147.800	172.800	197.900	222.500	247.700	273.100	298.400	323.900	349.300	374.600					
		Water Take (litres)	0.000	26.200	25.600	24.100	23.400	24.300	24.200	25.000	25.100	24.600	25.200	25.400	25.300	25.500	25.400	25.300					
5	1.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					13.87
		Flowmeter readings (litres)	0.000	15.100	29.100	43.200	57.200	71.200	85.100	98.900	112.700	126.700	140.300	154.000	167.500	180.900	194.300	208.000					
		Water Take (litres)	0.000	15.100	14.000	14.100	14.000	14.000	13.900	13.800	13.800	14.000	13.600	13.700	13.500	13.400	13.400	13.700					

TEST REMARKS

STRUCTURAL SOILS LTD
The Old School
Stillhouse Lane,
Bedminster
BRISTOL, BS3 4EB

Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date		
Stuart Pearce	20/08/2018	Adam Lumber	[redacted]	14/12/2018	Adam Lumber	[redacted]	14/12/2018	**Contract Ref:**	**733442**
Contract:		**A303 Phase 6 and 7 Ground Investigation**		**Client**	**Highways England**			**Page**	**2 of 3**

IN-SITU WATER PRESSURE TEST -SINGLE PACKER
In accordance with BS EN ISO 22282-3 (2012)

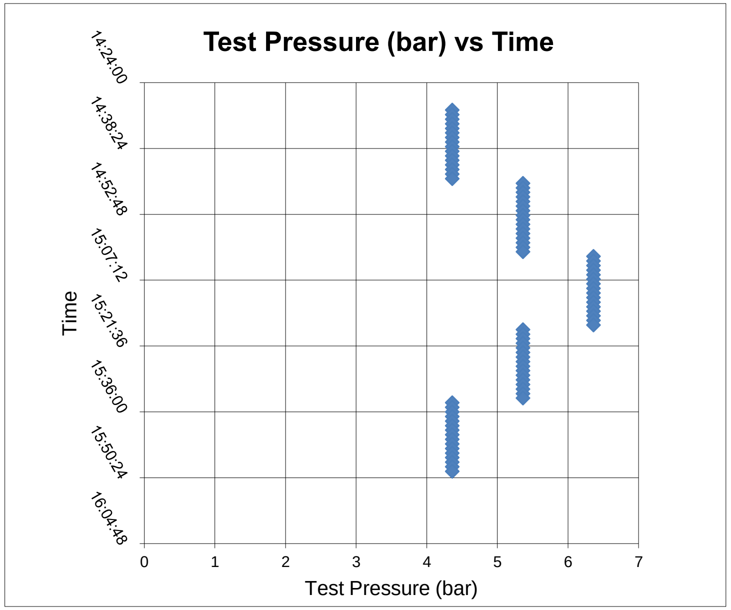
BH No R71907 **Test No.:** 3 **Test Depth Range (m):** 48.80 to 51.80 **Test Date:** 8/20/2018 **Test Time:** 14:30

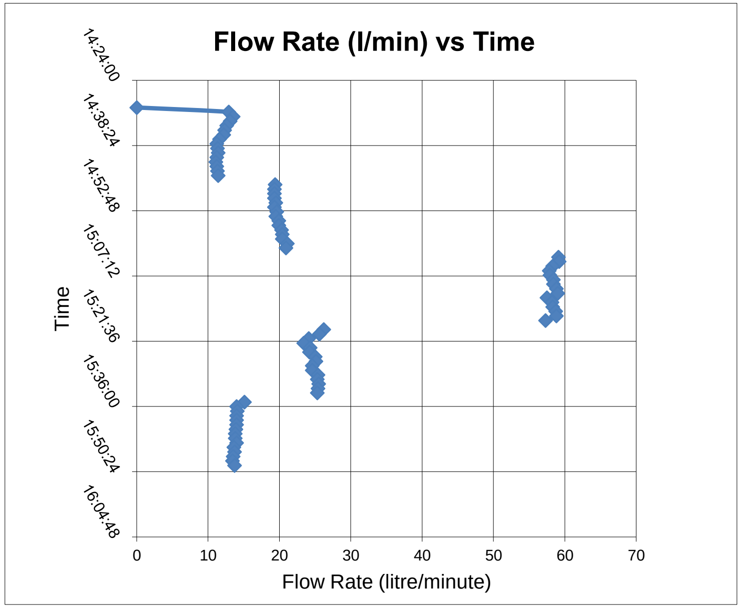
Ground Level: (m AOD) 98.35 National Grid Coordinates: E: 412939.1 N: 141968.9 Borehole Inclination: (degrees from vertical) 0 Borehole Orientation: (degrees) Not applicable

Run	Measured Gauge pressure, P (bar)	Measured Gague Pressure, P (m head)	Effective test pressure causing flow into rock, m head $\rho_{T\,(=P+(H\text{-}Hg)-Hf)}$	Effective test pressure ρ_{Tb} (bar)	Effective test pressure rT (MPa)	Flow rate, Q1 (litres/min)	Injected Flow, Q2 per metre (litres/min/m) [=Q1 / L]	Flow Q3 (m^3/s)
1	1.00	10.00	43.6	4.36	0.436	11.89	3.96	0.000198
2	2.00	20.00	53.6	5.36	0.536	19.87	6.62	0.000331
3	3.00	30.00	63.6	6.36	0.636	58.38	19.46	0.000973
4	2.00	20.00	53.6	5.36	0.536	24.97	8.32	0.000416
5	1.00	10.00	43.6	4.36	0.436	13.87	4.62	0.000231

Note:

Note: Test pressure (gauge) monitored visually and not data logged during test. Test pressure therefore presented as constant, for each stage in Test Pressure vs Time





IN-SITU WATER PRESSURE TEST - SINGLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

Borehole No.: R71909 **Test No.:** 1 **Test Depth Range (m):** 42.00 to 45.00 **Test Date:** 10/09/2018 **Test Time:** 09:00

Ground Level (m AOD): 105.81 National Grid Coordinates: E: 413091.7 N: 142003.2 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

INSTALLATION DETAILS

BOREHOLE DETAILS

Borehole Drilling Method	Rotary coring
Diameter of borehole in test section, d (mm)	150
Depth to base of borehole casing (m)	1.60
Depth to base of borehole at start of test (m)	45.00
Inital groundwater level (m bgl)	39.20
Height of groundwater above mid-point of test section, Hg (m)	4.30

TEST DETAILS

Depth BGL to top of test section (m)	42.00
Depth BGL to midpoint of test section (m)	43.50
Depth BGL to base of test section (m)	45.00
Length of test section, L (m)	3.00
Rock type under test	CHALK
Weather during test	Clear

EQUIPMENT DETAILS

Packer Type	Pneumatic
Serial No.	Not recorded
Length (m)	1.30
Inflation Pressure (bar)	10.0

Flowmeter type	Paddle wheel
Flowmeter serial number	Not recorded

Water Pump Type	Drill Rig Mounted
Water Pump Serial Number	Not recorded
Injection Water Temperature (^oC)	Not recorded

Test Pressure Measurement Method	Above ground pressure gauge
Gauge Height above GL (m)	1.00
Gauge Height above mid-point of test section, H (m)	44.50
Pressure Loss between pump and test section, Hf (m head)	0.00

IN-SITU WATER PRESSURE TEST - SINGLE PACKER

In accordance with BS EN ISO 22283-3 (2012)

Borehole No.: R71909 **Test No.:** 1 **Test Depth Range (m):** 42.00 to 45.00 **Test Date:** 10/09/2018 **Test Time:** 09:00

Ground Level (m AOD): 105.81 National Grid Coordinates: E: 413091.7 N: 142003.2 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

SUMMARY OF KEY INSTALLATION DETAILS

Diameter of borehole in test section, D (m)	0.150
Depth to base of borehole casing (m)	1.60
Depth to base of borehole at start of test (m)	45.00
Inital groundwater level (m bgl)	39.20
Initial hydrostatic pressure in mid-point of test zone (bar)	0.43

Depth BGL to top of test section (m)	42.00
Depth BGL to midpoint of test section (m)	43.50
Depth BGL to base of test section (m)	45.00
Length of test section, L (m)	3.00

TEST READINGS

Stage	Gauge (over) pressure, P (bar)	Test Increment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Average flow, Q (litres/min)
1	1.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**6.13**
		Flowmeter readings (litres)	0.000	6.900	14.500	19.400	24.900	29.600	35.800	42.100	48.600	54.700	61.000	67.200	73.400	79.600	85.700	91.900					
		Water Take (litres)	0.000	6.900	7.600	4.900	5.500	4.700	6.200	6.300	6.500	6.100	6.300	6.200	6.200	6.200	6.100	6.200					
2	2.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**15.58**
		Flowmeter readings (litres)	0.000	14.800	30.100	45.600	61.400	77.400	93.300	109.300	125.900	142.200	158.800	173.400	188.300	203.200	218.400	233.700					
		Water Take (litres)	0.000	14.800	15.300	15.500	15.800	16.000	15.900	16.000	16.600	16.300	16.600	14.600	14.900	14.900	15.200	15.300					
3	3.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**33.99**
		Flowmeter readings (litres)	0.000	27.600	56.000	84.600	113.300	142.300	172.400	203.400	237.600	272.100	310.700	350.600	390.300	429.900	469.900	509.900					
		Water Take (litres)	0.000	27.600	28.400	28.600	28.700	29.000	30.100	31.000	34.200	34.500	38.600	39.900	39.700	39.600	40.000	40.000					
4	2.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**26.48**
		Flowmeter readings (litres)	0.000	26.800	52.600	78.500	104.600	130.700	157.000	183.400	209.800	236.600	262.700	289.200	316.000	343.000	370.100	397.200					
		Water Take (litres)	0.000	26.800	25.800	25.900	26.100	26.100	26.300	26.400	26.400	26.800	26.100	26.500	26.800	27.000	27.100	27.100					
5	1.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**19.40**
		Flowmeter readings (litres)	0.000	19.400	38.400	57.500	76.500	95.600	114.700	133.700	152.700	171.600	191.200	210.900	230.800	250.800	270.800	291.000					
		Water Take (litres)	0.000	19.400	19.000	19.100	19.000	19.100	19.100	19.000	19.000	18.900	19.600	19.700	19.900	20.000	20.000	20.200					

TEST REMARKS	
	1
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STRUCTURAL SOILS LTD
The Old School
Stillhouse Lane,
Bedminster
BRISTOL, BS3 4EB

Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	Contract Ref:	733442
Stuart Pearce	10/09/2018	Adam Lumber	[redacted]	14/12/2018	Adam Lumber	[redacted]	14/12/2018		
Contract:		A303 Phase 6 and 7 Ground Investigation		Client	Highways England			Page	2 of 3

IN-SITU WATER PRESSURE TEST -SINGLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

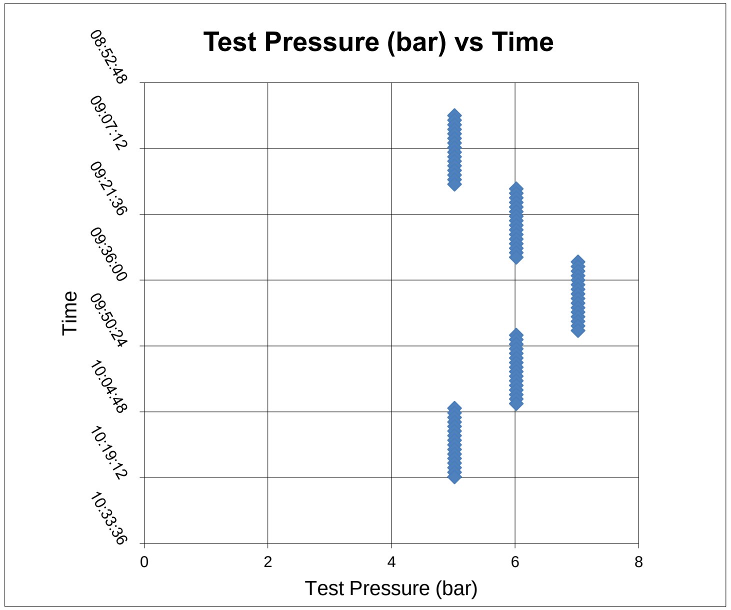
BH No R71909 **Test No.:** 1 **Test Depth Range (m):** 42.00 to 45.00 **Test Date:** 9/10/2018 **Test Time:** 9:00

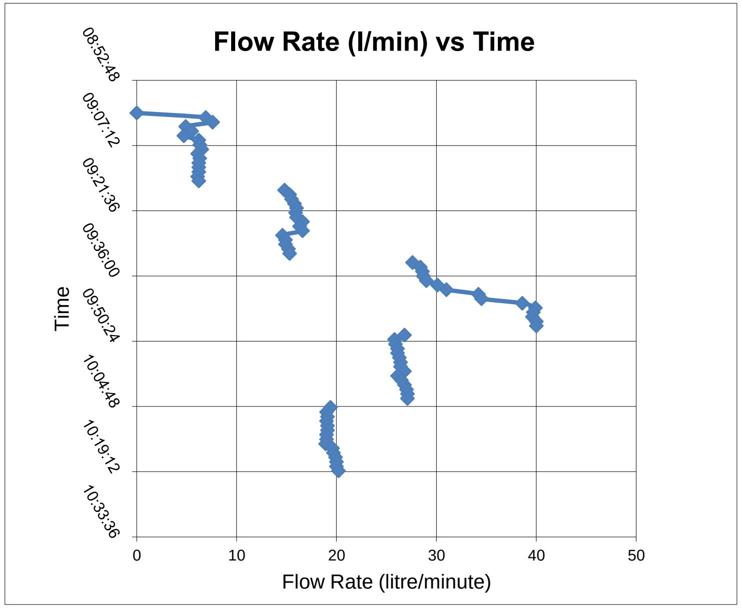
Ground Level: 105.81 (m AOD National Grid Coordinates: E: 413091.7 N: 142003.2 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

Run	Measured Gauge pressure, P (bar)	Measured Gague Pressure, P (m head)	Effective test pressure causing flow into rock, m head $\rho_{T\ (=P+(H\text{-}Hg)-Hf)}$	Effective test pressure ρ_{Tb} (bar)	Effective test pressure rT (MPa)	Flow rate, Q1 (litres/min)	Injected Flow, Q2 per metre (litres/min/m) [=Q1 / L]	Flow Q3 (m^3/s)
1	1.00	10.00	50.2	5.02	0.502	6.13	2.04	0.000102
2	2.00	20.00	60.2	6.02	0.602	15.58	5.19	0.000260
3	3.00	30.00	70.2	7.02	0.702	33.99	11.33	0.000567
4	2.00	20.00	60.2	6.02	0.602	26.48	8.83	0.000441
5	1.00	10.00	50.2	5.02	0.502	19.40	6.47	0.000323

Note:

Note: Test pressure (gauge) monitored visually and not data logged during test. Test pressure therefore presented as constant, for each stage in Test Pressure vs Time





IN-SITU WATER PRESSURE TEST - SINGLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

Borehole No.: R71909 **Test No.:** 2 **Test Depth Range (m):** 48.00 to 51.00 **Test Date:** 11/09/2018 **Test Time:** 08:00

Ground Level (m AOD): 105.81 National Grid Coordinates: E: 413091.7 N: 142003.2 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

INSTALLATION DETAILS

BOREHOLE DETAILS	
Borehole Drilling Method	Rotary coring
Diameter of borehole in test section, d (mm)	150
Depth to base of borehole casing (m)	1.60
Depth to base of borehole at start of test (m)	51.00
Inital groundwater level (m bgl)	39.32
Height of groundwater above mid-point of test section, Hg (m)	10.18

TEST DETAILS	
Depth BGL to top of test section (m)	48.00
Depth BGL to midpoint of test section (m)	49.50
Depth BGL to base of test section (m)	51.00
Length of test section, L (m)	3.00
Rock type under test	CHALK
Weather during test	Clear

EQUIPMENT DETAILS	
Packer Type	Pneumatic
Serial No.	Not recorded
Length (m)	1.30
Inflation Pressure (bar)	10.0
Flowmeter type	Paddle wheel
Flowmeter serial number	Not recorded
Water Pump Type	Drill Rig Mounted
Water Pump Serial Number	Not recorded
Injection Water Temperature (^oC)	Not recorded
Test Pressure Measurement Method	Above ground pressure gauge
Gauge Height above GL (m)	1.00
Gauge Height above mid-point of test section, H (m)	50.50
Pressure Loss between pump and test section, Hf (m head)	0.00

IN-SITU WATER PRESSURE TEST - SINGLE PACKER

In accordance with BS EN ISO 22283-3 (2012)

Borehole No.: R71909 **Test No.:** 2 **Test Depth Range (m):** 48.00 to 51.00 **Test Date:** 11/09/2018 **Test Time:** 08:00

Ground Level (m AOD): 105.81 National Grid Coordinates: E: 413091.7 N: 142003.2 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

SUMMARY OF KEY INSTALLATION DETAILS

Diameter of borehole in test section, D (m)	0.150
Depth to base of borehole casing (m)	1.60
Depth to base of borehole at start of test (m)	51.00
Inital groundwater level (m bgl)	39.32
Initial hydrostatic pressure in mid-point of test zone (bar)	1.02

Depth BGL to top of test section (m)	48.00
Depth BGL to midpoint of test section (m)	49.50
Depth BGL to base of test section (m)	51.00
Length of test section, L (m)	3.00

TEST READINGS

Stage	Gauge (over) pressure, P (bar)	Test Increment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Average flow, Q (litres/min)
1	1.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**27.75**
		Flowmeter readings (litres)	0.000	72.920	143.740	214.760	277.510	0.000	0.000	0.000	0.000	0.000	0.000										
		Water Take (litres)	0.000	72.920	70.820	71.020	62.750	0.000	0.000	0.000	0.000	0.000	0.000										
2	2.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**0.00**
		Flowmeter readings (litres)	0.000	0.000	0.000	0.000	0.000																
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000															
3	3.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**0.00**
		Flowmeter readings (litres)	0.000	0.000	0.000	0.000	0.000																
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000															
4		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**0.00**
		Flowmeter readings (litres)																					
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000					
5		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**0.00**
		Flowmeter readings (litres)																					
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000					

TEST REMARKS	1. Flow ceased after 4 minutes in Stage 1. Stage 1 continued for a further 5 minutes with no flow.
	2. Stages 2 and 3 run for 5 minutes - no flow achieved. Test halted.
	3

STRUCTURAL SOILS LTD The Old School Stillhouse Lane, Bedminster BRISTOL, BS3 4EB	Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	**Contract Ref:** 733442
	Stuart Pearce	11/09/2018	Adam Lumber	[redacted]	14/12/2018	Adam Lumber	[redacted]	14/12/2018	
	Contract:		**A303 Phase 6 and 7 Ground Investigation**		**Client**	**Highways England**			**Page** 2 of 3

IN-SITU WATER PRESSURE TEST -SINGLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

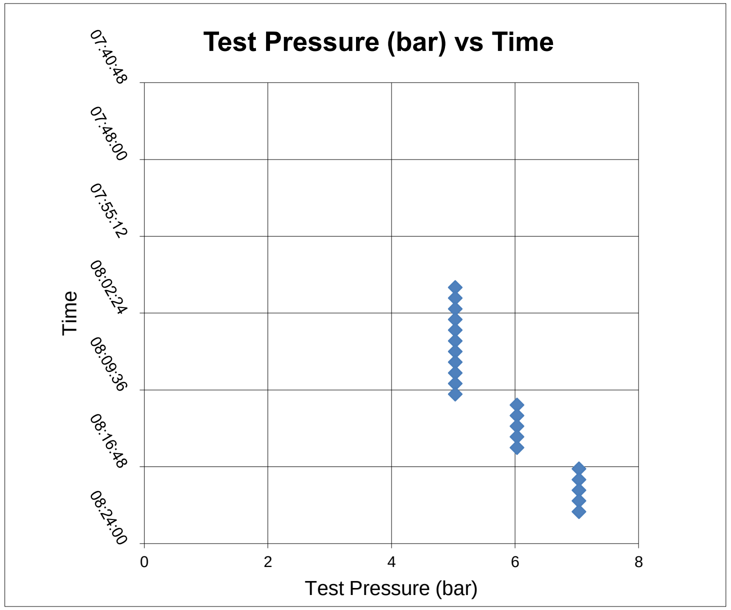
BH No R71909 **Test No.:** 2 **Test Depth Range (m):** 48.00 to 51.00 **Test Date:** 9/11/2018 **Test Time:** 8:00

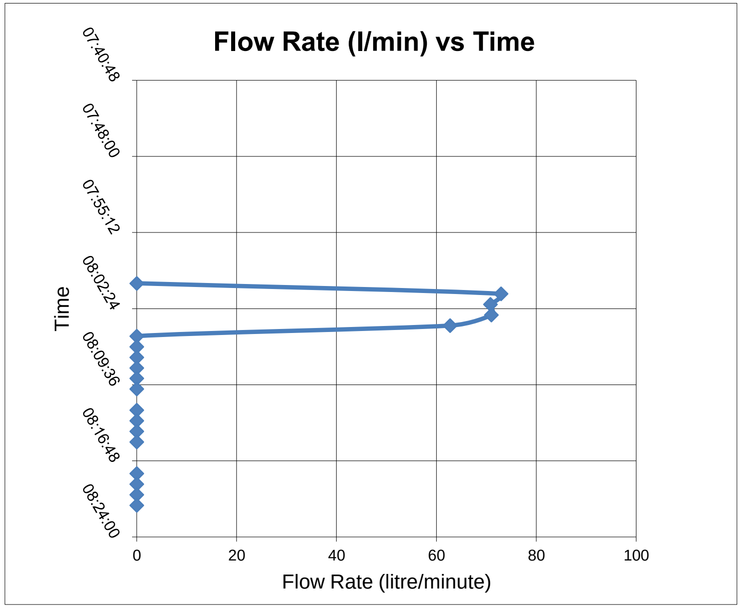
Ground Level: (m AOD) 105.81 National Grid Coordinates: E: 413091.7 N: 142003.2 Borehole Inclination: (degrees from vertical) 0 Borehole Orientation: (degrees) Not applicable

Run	Measured Gauge pressure, P (bar)	Measured Gague Pressure, P (m head)	Effective test pressure causing flow into rock, m head $\rho_{T\,(=P+(H-Hg)-Hf)}$	Effective test pressure ρ_{Tb} (bar)	Effective test pressure rT (MPa)	Flow rate, Q1 (litres/min)	Injected Flow, Q2 per metre (litres/min/m) [=Q1 / L]	Flow Q3 (m^3/s)
1	1.00	10.00	50.3	5.032	0.503	27.75	9.25	0.000463
2	2.00	20.00	60.3	6.032	0.603	0.00	0.00	0.000000
3	3.00	30.00	70.3	7.032	0.703	0.00	0.00	0.000000
4	0.00	0.00	40.3	4.032	0.403	0.00	0.00	0.000000
5	0.00	0.00	40.3	4.032	0.403	0.00	0.00	0.000000

Note:

Note: Test pressure (gauge) monitored visually and not data logged during test. Test pressure therefore presented as constant, for each stage in Test Pressure vs Time





STRUCTURAL SOILS LTD The Old School Stillhouse Lane Bedminster BRISTOL, BS3 4EB	Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	Contract Ref:	733442
	Stuart Pearce	9/11/2018	Adam Lumber	[redacted]	12/14/2018	Adam Lumber	[redacted]	12/14/2018		
	Contract:		A303 Phase 6 and 7 Ground Investigation		Client	Highways England			Page	3 of 3

IN-SITU WATER PRESSURE TEST - SINGLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

Borehole No.: R71909 **Test No.:** 3 **Test Depth Range (m):** 54.00 to 57.00 **Test Date:** 11/09/2018 **Test Time:** 12:30

Ground Level (m AOD): 105.81 National Grid Coordinates: E: 413091.7 N: 142003.2 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

INSTALLATION DETAILS

BOREHOLE DETAILS	
Borehole Drilling Method	Rotary coring
Diameter of borehole in test section, d (mm)	150
Depth to base of borehole casing (m)	1.60
Depth to base of borehole at start of test (m)	57.00
Inital groundwater level (m bgl)	39.50
Height of groundwater above mid-point of test section, Hg (m)	16.00

TEST DETAILS	
Depth BGL to top of test section (m)	54.00
Depth BGL to midpoint of test section (m)	55.50
Depth BGL to base of test section (m)	57.00
Length of test section, L (m)	3.00
Rock type under test	CHALK
Weather during test	Clear

EQUIPMENT DETAILS	
Packer Type	Pneumatic
Serial No.	Not recorded
Length (m)	1.30
Inflation Pressure (bar)	10.0
Flowmeter type	Paddle wheel
Flowmeter serial number	Not recorded
Water Pump Type	Drill Rig Mounted
Water Pump Serial Number	Not recorded
Injection Water Temperature (^{o}C)	Not recorded
Test Pressure Measurement Method	Above ground pressure gauge
Gauge Height above GL (m)	1.00
Gauge Height above mid-point of test section, H (m)	56.50
Pressure Loss between pump and test section, Hf (m head)	0.00

IN-SITU WATER PRESSURE TEST - SINGLE PACKER

In accordance with BS EN ISO 22283-3 (2012)

Borehole No.: R71909 **Test No.:** 3 **Test Depth Range (m):** 54.00 to 57.00 **Test Date:** 11/09/2018 **Test Time:** 12:30

Ground Level (m AOD): 105.81 National Grid Coordinates: E: 413091.7 N: 142003.2 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

SUMMARY OF KEY INSTALLATION DETAILS

Diameter of borehole in test section, D (m)	0.150
Depth to base of borehole casing (m)	1.60
Depth to base of borehole at start of test (m)	57.00
Inital groundwater level (m bgl)	39.50
Initial hydrostatic pressure in mid-point of test zone (bar)	1.60

Depth BGL to top of test section (m)	54.00
Depth BGL to midpoint of test section (m)	55.50
Depth BGL to base of test section (m)	57.00
Length of test section, L (m)	3.00

TEST READINGS

Stage	Gauge (over) pressure, P (bar)	Test Increment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Average flow, Q (litres/min)
1	1.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**4.73**
		Flowmeter readings (litres)	0.000	5.400	10.700	15.700	20.600	25.300	29.900	34.600	39.200	43.800	48.400	52.800	57.300	61.900	66.500	71.000					
		Water Take (litres)	0.000	5.400	5.300	5.000	4.900	4.700	4.600	4.700	4.600	4.600	4.600	4.400	4.500	4.600	4.600	4.500					
2	2.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**7.01**
		Flowmeter readings (litres)	0.000	6.500	13.100	19.800	26.600	33.400	40.300	47.300	54.300	61.400	68.600	75.800	83.100	90.400	97.800	105.200					
		Water Take (litres)	0.000	6.500	6.600	6.700	6.800	6.800	6.900	7.000	7.000	7.100	7.200	7.200	7.300	7.300	7.400	7.400					
3	3.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**20.23**
		Flowmeter readings (litres)	0.000	19.700	39.500	59.600	79.700	99.800	119.800	139.900	160.100	180.500	201.100	221.500	241.900	262.400	282.800	303.400					
		Water Take (litres)	0.000	19.700	19.800	20.100	20.100	20.100	20.000	20.100	20.200	20.400	20.600	20.400	20.400	20.500	20.400	20.600					
4	2.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**10.28**
		Flowmeter readings (litres)	0.000	10.400	20.700	31.000	41.200	51.700	61.800	72.200	82.400	92.500	102.800	113.100	123.300	133.800	144.000	154.200					
		Water Take (litres)	0.000	10.400	10.300	10.300	10.200	10.500	10.100	10.400	10.200	10.100	10.300	10.300	10.200	10.500	10.200	10.200					
5	1.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**7.38**
		Flowmeter readings (litres)	0.000	7.600	15.100	22.600	30.000	37.500	44.800	52.200	59.500	66.900	74.200	81.500	88.300	96.100	103.400	110.700					
		Water Take (litres)	0.000	7.600	7.500	7.500	7.400	7.500	7.300	7.400	7.300	7.400	7.300	7.300	6.800	7.800	7.300	7.300					

TEST REMARKS	
	1
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IN-SITU WATER PRESSURE TEST -SINGLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

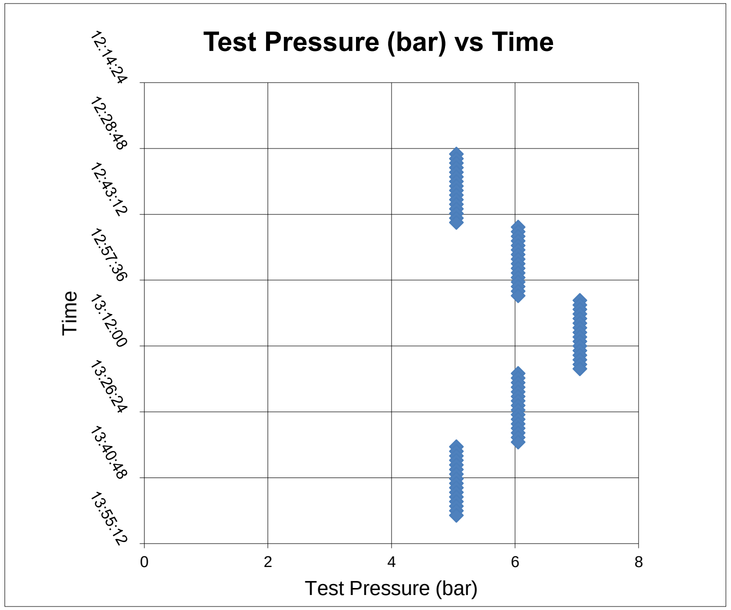
BH No R71909 **Test No.:** 3 **Test Depth Range (m):** 54.00 to 57.00 **Test Date:** 9/11/2018 **Test Time:** 12:30

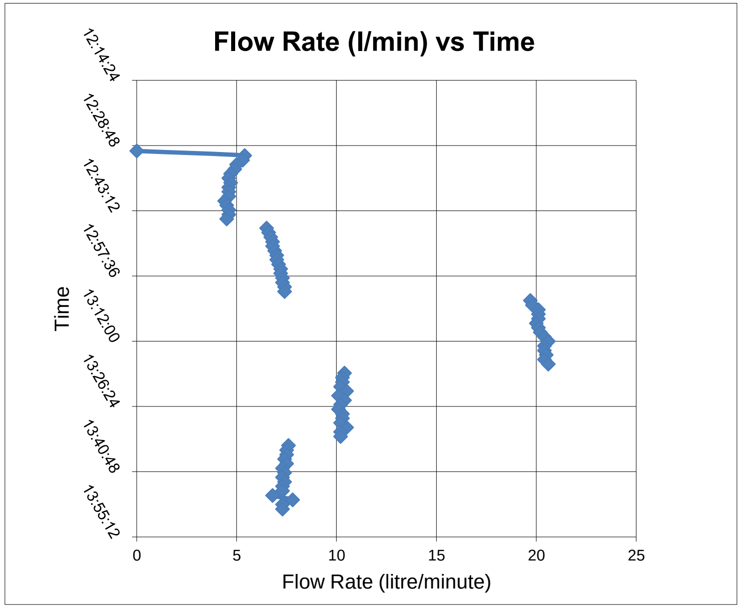
Ground Level: (m AOD) 105.81 National Grid Coordinates: E: 413091.7 N: 142003.2 Borehole Inclination: (degrees from vertical) 0 Borehole Orientation: (degrees) Not applicable

Run	Measured Gauge pressure, P (bar)	Measured Gague Pressure, P (m head)	Effective test pressure causing flow into rock, m head $\rho_{T} (= P + (H-Hg) - Hf)$	Effective test pressure ρ_{Tb} (bar)	Effective test pressure rT (MPa)	Flow rate, Q1 (litres/min)	Injected Flow, Q2 per metre (litres/min/m) [=Q1 / L]	Flow Q3 (m^3/s)
1	1.00	10.00	50.5	5.05	0.505	4.73	1.58	0.000079
2	2.00	20.00	60.5	6.05	0.605	7.01	2.34	0.000117
3	3.00	30.00	70.5	7.05	0.705	20.23	6.74	0.000337
4	2.00	20.00	60.5	6.05	0.605	10.28	3.43	0.000171
5	1.00	10.00	50.5	5.05	0.505	7.38	2.46	0.000123

Note:

Note: Test pressure (gauge) monitored visually and not data logged during test. Test pressure therefore presented as constant, for each stage in Test Pressure vs Time





IN-SITU WATER PRESSURE TEST - SINGLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

Borehole No.: R71911 **Test No.:** 1 **Test Depth Range (m):** 46.50 to 49.50 **Test Date:** 12/09/2018 **Test Time:** 12:30

Ground Level (m AOD): 109.38 National Grid Coordinates: E: 413441.5 N: 141975.5 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

INSTALLATION DETAILS

BOREHOLE DETAILS

Borehole Drilling Method	Rotary coring
Diameter of borehole in test section, d (mm)	150
Depth to base of borehole casing (m)	1.60
Depth to base of borehole at start of test (m)	49.50
Inital groundwater level (m bgl)	46.40
Height of groundwater above mid-point of test section, Hg (m)	1.60

TEST DETAILS

Depth BGL to top of test section (m)	46.50
Depth BGL to midpoint of test section (m)	48.00
Depth BGL to base of test section (m)	49.50
Length of test section, L (m)	3.00
Rock type under test	CHALK
Weather during test	Clear

EQUIPMENT DETAILS

Packer Type	Pneumatic
Serial No.	Not recorded
Length (m)	1.30
Inflation Pressure (bar)	8.0

Flowmeter type	Paddle wheel
Flowmeter serial number	Not recorded

Water Pump Type	Drill Rig Mounted
Water Pump Serial Number	Not recorded
Injection Water Temperature (^oC)	Not recorded

Test Pressure Measurement Method	Above ground pressure gauge
Gauge Height above GL (m)	1.00
Gauge Height above mid-point of test section, H (m)	49.00
Pressure Loss between pump and test section, Hf (m head)	0.00

IN-SITU WATER PRESSURE TEST - SINGLE PACKER

In accordance with BS EN ISO 22283-3 (2012)

Borehole No.: R71911 **Test No.:** 1 **Test Depth Range (m):** 46.50 to 49.50 **Test Date:** 12/09/2018 **Test Time:** 12:30

Ground Level (m AOD): 109.38 National Grid Coordinates: E: 413441.5 N: 141975.5 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

SUMMARY OF KEY INSTALLATION DETAILS

Diameter of borehole in test section, D (m)	0.150
Depth to base of borehole casing (m)	1.60
Depth to base of borehole at start of test (m)	49.50
Inital groundwater level (m bgl)	46.40
Initial hydrostatic pressure in mid-point of test zone (bar)	0.16

Depth BGL to top of test section (m)	46.50
Depth BGL to midpoint of test section (m)	48.00
Depth BGL to base of test section (m)	49.50
Length of test section, L (m)	3.00

TEST READINGS

Stage	Gauge (over) pressure, P (bar)	Test Increment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Average flow, Q (litres/min)
1	1.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**6.59**
		Flowmeter readings (litres)	0.000	5.900	12.000	18.100	24.700	31.200	37.900	44.600	51.100	57.300	63.800	70.400	77.400	84.500	91.700	98.900					
		Water Take (litres)	0.000	5.900	6.100	6.100	6.600	6.500	6.700	6.700	6.500	6.200	6.500	6.600	7.000	7.100	7.200	7.200					
2	2.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**27.05**
		Flowmeter readings (litres)	0.000	26.600	53.200	79.700	106.500	133.200	160.200	187.100	214.600	241.800	268.600	295.900	323.400	350.700	378.400	405.800					
		Water Take (litres)	0.000	26.600	26.600	26.500	26.800	26.700	27.000	26.900	27.500	27.200	26.800	27.300	27.500	27.300	27.700	27.400					
3	3.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**43.67**
		Flowmeter readings (litres)	0.000	43.200	87.000	130.700	174.600	218.800	261.600	305.200	348.900	392.900	435.900	479.700	523.500	567.200	611.100	655.000					
		Water Take (litres)	0.000	43.200	43.800	43.700	43.900	44.200	42.800	43.600	43.700	44.000	43.000	43.800	43.800	43.700	43.900	43.900					
4	2.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**31.91**
		Flowmeter readings (litres)	0.000	32.200	58.300	86.000	115.000	145.900	177.200	209.400	242.700	275.900	309.300	342.700	376.500	410.200	444.200	478.600					
		Water Take (litres)	0.000	32.200	26.100	27.700	29.000	30.900	31.300	32.200	33.300	33.200	33.400	33.400	33.800	33.700	34.000	34.400					
5	1.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**17.84**
		Flowmeter readings (litres)	0.000	18.200	35.900	53.300	70.800	88.500	106.200	123.800	141.600	159.400	177.300	195.000	212.900	231.000	249.200	267.600					
		Water Take (litres)	0.000	18.200	17.700	17.400	17.500	17.700	17.700	17.600	17.800	17.800	17.900	17.700	17.900	18.100	18.200	18.400					

TEST REMARKS	
	1
	2
	3

STRUCTURAL SOILS LTD The Old School Stillhouse Lane, Bedminster BRISTOL, BS3 4EB	Test Operator: Stuart Pearce 12/09/2018	Compiled by: Adam Lumber [redacted]	Date: 14/12/2018	Checked by (the Responsible Expert): Adam Lumber [redacted]	Date: 14/12/2018
Contract Ref:	**733442**				
Contract:	**A303 Phase 6 and 7 Ground Investigation**	**Client**	**Highways England**	**Page**	**2 of 3**

IN-SITU WATER PRESSURE TEST -SINGLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

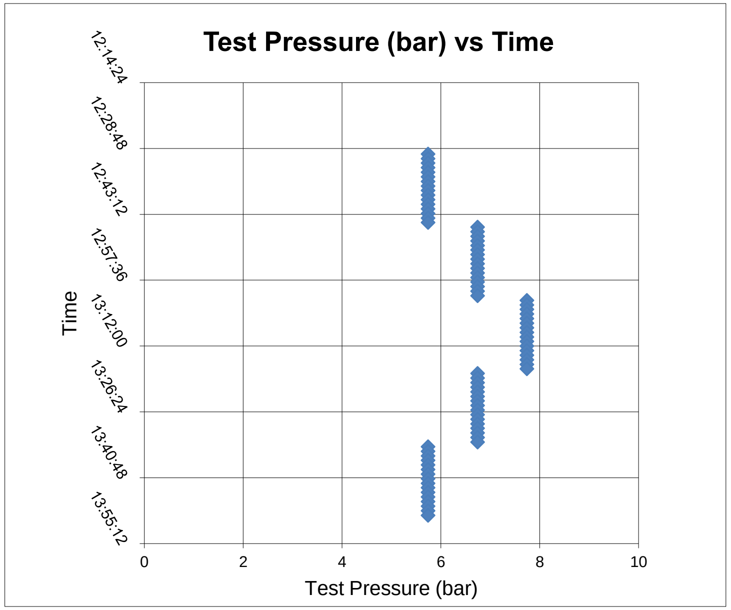
BH No R71911 **Test No.:** 1 **Test Depth Range (m):** 46.50 to 49.50 **Test Date:** 9/12/2018 **Test Time:** 12:30

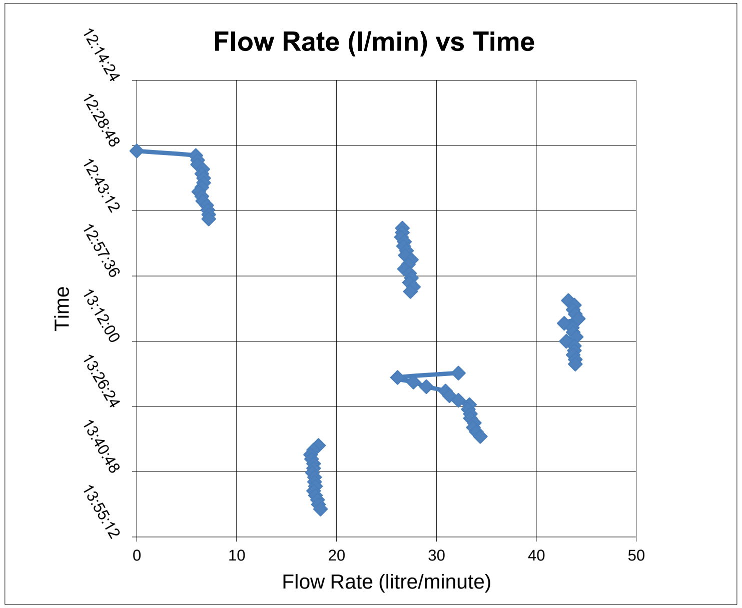
Ground Level: (m AOD) 109.38 National Grid Coordinates: E: 413441.5 N: 141975.5 Borehole Inclination: (degrees from vertical) 0 Borehole Orientation: (degrees) Not applicable

Run	Measured Gauge pressure, P (bar)	Measured Gague Pressure, P (m head)	Effective test pressure causing flow into rock, m head ρ_T (= P + (H-Hg) - Hf)	Effective test pressure ρ_{Tb} (bar)	Effective test pressure rT (MPa)	Flow rate, Q1 (litres/min)	Injected Flow, Q2 per metre (litres/min/m) [=Q1 / L]	Flow Q3 (m^3/s)
1	1.00	10.00	57.4	5.74	0.574	6.59	2.20	0.000110
2	2.00	20.00	67.4	6.74	0.674	27.05	9.02	0.000451
3	3.00	30.00	77.4	7.74	0.774	43.67	14.56	0.000728
4	2.00	20.00	67.4	6.74	0.674	31.91	10.64	0.000532
5	1.00	10.00	57.4	5.74	0.574	17.84	5.95	0.000297

Note:

Note: Test pressure (gauge) monitored visually and not data logged during test. Test pressure therefore presented as constant, for each stage in Test Pressure vs Time





STRUCTURAL SOILS LTD The Old School Stillhouse Lane Bedminster BRISTOL, BS3 4EB	Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	Contract Ref:	733442
	Stuart Pearce	9/12/2018	Adam Lumber	[redacted]	12/14/2018	Adam Lumber	[redacted]	12/14/2018		
	Contract:		**A303 Phase 6 and 7 Ground Investigation**		**Client**	**Highways England**			**Page**	3 of 3

IN-SITU WATER PRESSURE TEST - SINGLE PACKER
In accordance with BS EN ISO 22282-3 (2012)

Borehole No.: R71911 **Test No.:** 2 **Test Depth Range (m):** 52.50 to 55.50 **Test Date:** 12/09/2018 **Test Time:** 16:00

Ground Level (m AOD): 109.38 National Grid Coordinates: E: 413441.5 N: 141975.5 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

INSTALLATION DETAILS

BOREHOLE DETAILS

Borehole Drilling Method	Rotary coring
Diameter of borehole in test section, d (mm)	150
Depth to base of borehole casing (m)	1.60
Depth to base of borehole at start of test (m)	55.50
Inital groundwater level (m bgl)	46.54
Height of groundwater above mid-point of test section, Hg (m)	7.46

TEST DETAILS

Depth BGL to top of test section (m)	52.50
Depth BGL to midpoint of test section (m)	54.00
Depth BGL to base of test section (m)	55.50
Length of test section, L (m)	3.00
Rock type under test	CHALK
Weather during test	Clear

EQUIPMENT DETAILS

Packer Type	Pneumatic
Serial No.	Not recorded
Length (m)	1.30
Inflation Pressure (bar)	8.0

Flowmeter type	Paddle wheel
Flowmeter serial number	Not recorded

Water Pump Type	Drill Rig Mounted
Water Pump Serial Number	Not recorded
Injection Water Temperature (^oC)	Not recorded

Test Pressure Measurement Method	Above ground pressure gauge
Gauge Height above GL (m)	1.00
Gauge Height above mid-point of test section, H (m)	55.00
Pressure Loss between pump and test section, Hf (m head)	0.00

IN-SITU WATER PRESSURE TEST - SINGLE PACKER

In accordance with BS EN ISO 22283-3 (2012)

Borehole No.: R71911 **Test No.:** 2 **Test Depth Range (m):** 52.50 to 55.50 **Test Date:** 12/09/2018 **Test Time:** 16:00

Ground Level (m AOD): 109.38 National Grid Coordinates: E: 413441.5 N: 141975.5 Borehole Inclination: 0 Borehole Orientation: Not applicable
(degrees from vertical) (degrees)

SUMMARY OF KEY INSTALLATION DETAILS

Diameter of borehole in test section, D (m)	0.150
Depth to base of borehole casing (m)	1.60
Depth to base of borehole at start of test (m)	55.50
Inital groundwater level (m bgl)	46.54
Initial hydrostatic pressure in mid-point of test zone (bar)	0.75

Depth BGL to top of test section (m)	52.50
Depth BGL to midpoint of test section (m)	54.00
Depth BGL to base of test section (m)	55.50
Length of test section, L (m)	3.00

TEST READINGS

Stage	Gauge (over) pressure, P (bar)	Test Increment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Average flow, Q (litres/min)
1	1.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					0.85
		Flowmeter readings (litres)	0.000	3.400	0.000	0.000	0.000																
		Water Take (litres)	0.000	3.400	0.000	0.000	0.000																
2	2.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					0.00
		Flowmeter readings (litres)	0.000	0.000	0.000	0.000	0.000																
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000																
3	3.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					21.23
		Flowmeter readings (litres)	0.000	20.900	42.500	62.800	82.500	102.400	122.500	142.900	163.600	185.400	207.300	229.200	251.100	273.400	295.900	318.400					
		Water Take (litres)	0.000	20.900	21.600	20.300	19.700	19.900	20.100	20.400	20.700	21.800	21.900	21.900	21.900	22.300	22.500	22.500					
4	2.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					4.78
		Flowmeter readings (litres)	0.000	5.000	9.700	14.400	19.100	23.700	28.200	32.900	37.600	42.400	47.000	51.900	56.700	61.600	66.600	71.700					
		Water Take (litres)	0.000	5.000	4.700	4.700	4.700	4.600	4.500	4.700	4.700	4.800	4.600	4.900	4.800	4.900	5.000	5.100					
5	1.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					0.00
		Flowmeter readings (litres)	0.000	0.000	0.000	0.000	0.000																
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000																

TEST REMARKS	
	1. Only 3.4 litres of flow occurred in Stage 1 and no flow in Stage 2 2, each of which were each run for 5 minutes.
	2. Flow occurred in Stages 3 and 4.
	3. No flow occurred on Stage 5, which was run for 5 minutes.

STRUCTURAL SOILS LTD The Old School Stillhouse Lane, Bedminster BRISTOL, BS3 4EB	Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	Contract Ref:	733442
	Stuart Pearce	12/09/2018	Adam Lumber	[redacted]	14/12/2018	Adam Lumber	[redacted]	14/12/2018		
	Contract:		A303 Phase 6 and 7 Ground Investigation		Client	Highways England			Page	2 of 3

IN-SITU WATER PRESSURE TEST -SINGLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

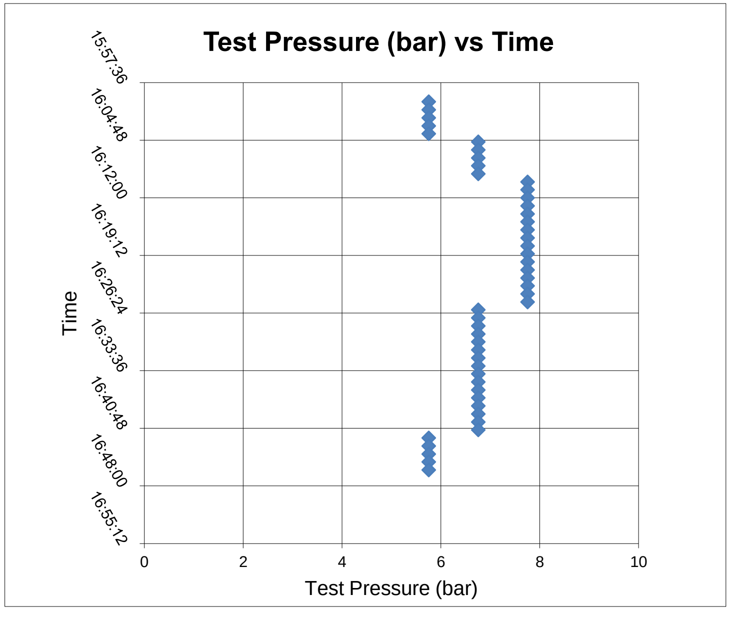
BH No R71911 **Test No.:** **2** **Test Depth Range (m):** 52.50 to 55.50 **Test Date:** 9/12/2018 **Test Time:** 16:00

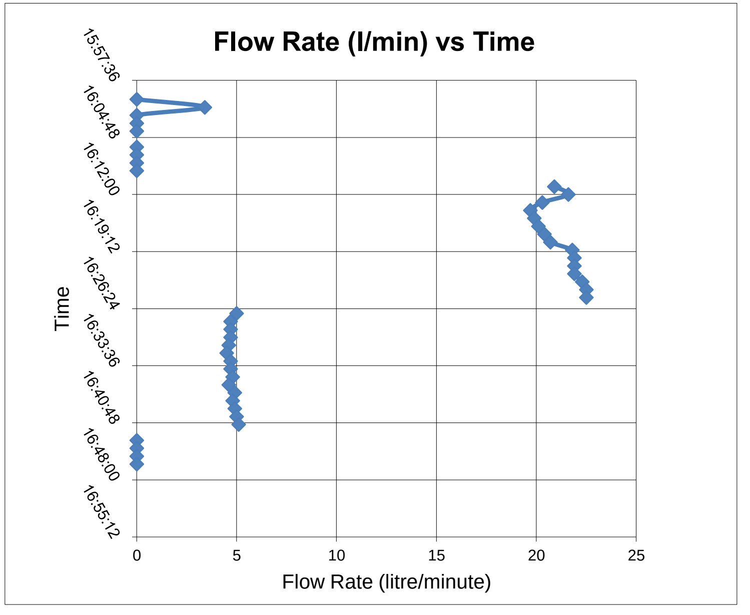
Ground Level: (m AOD) 109.38 National Grid Coordinates: E: 413441.5 N: 141975.5 Borehole Inclination: (degrees from vertical) 0 Borehole Orientation: (degrees) Not applicable

Run	Measured Gauge pressure, P (bar)	Measured Gague Pressure, P (m head)	Effective test pressure causing flow into rock, m head $\rho_{T\,(=P+(H-Hg)-Hf)}$	Effective test pressure ρ_{Tb} (bar)	Effective test pressure rT (MPa)	Flow rate, Q1 (litres/min)	Injected Flow, Q2 per metre (litres/min/m) [=Q1 / L]	Flow Q3 (m^3/s)
1	1.00	10.00	57.5	5.754	0.575	0.85	0.28	0.000014
2	2.00	20.00	67.5	6.754	0.675	0.00	0.00	0.000000
3	3.00	30.00	77.5	7.754	0.775	21.23	7.08	0.000354
4	2.00	20.00	67.5	6.754	0.675	4.78	1.59	0.000080
5	1.00	10.00	57.5	5.754	0.575	0.00	0.00	0.000000

Note:

Note: Test pressure (gauge) monitored visually and not data logged during test. Test pressure therefore presented as constant, for each stage in Test Pressure vs Time





IN-SITU WATER PRESSURE TEST - SINGLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

Borehole No.: R71911 **Test No.:** 3 **Test Depth Range (m):** 58.50 to 61.50 **Test Date:** 13/09/2018 **Test Time:** 09:45

Ground Level (m AOD): 109.38 National Grid Coordinates: E: 413441.5 N: 141975.5 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

INSTALLATION DETAILS

BOREHOLE DETAILS	
Borehole Drilling Method	Rotary coring
Diameter of borehole in test section, d (mm)	150
Depth to base of borehole casing (m)	1.60
Depth to base of borehole at start of test (m)	61.50
Inital groundwater level (m bgl)	58.50
Height of groundwater above mid-point of test section, Hg (m)	1.50

TEST DETAILS	
Depth BGL to top of test section (m)	58.50
Depth BGL to midpoint of test section (m)	60.00
Depth BGL to base of test section (m)	61.50
Length of test section, L (m)	3.00
Rock type under test	CHALK
Weather during test	Clear

EQUIPMENT DETAILS	
Packer Type	Pneumatic
Serial No.	Not recorded
Length (m)	1.30
Inflation Pressure (bar)	8.0
Flowmeter type	Paddle wheel
Flowmeter serial number	Not recorded
Water Pump Type	Drill Rig Mounted
Water Pump Serial Number	Not recorded
Injection Water Temperature (^oC)	Not recorded
Test Pressure Measurement Method	Above ground pressure gauge
Gauge Height above GL (m)	1.00
Gauge Height above mid-point of test section, H (m)	61.00
Pressure Loss between pump and test section, Hf (m head)	0.00

IN-SITU WATER PRESSURE TEST - SINGLE PACKER

In accordance with BS EN ISO 22283-3 (2012)

Borehole No.: R71911 **Test No.:** 3 **Test Depth Range (m):** 58.50 to 61.50 **Test Date:** 13/09/2018 **Test Time:** 09:45

Ground Level (m AOD): 109.38 National Grid Coordinates: E: 413441.5 N: 141975.5 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

SUMMARY OF KEY INSTALLATION DETAILS

Diameter of borehole in test section, D (m)	0.150
Depth to base of borehole casing (m)	1.60
Depth to base of borehole at start of test (m)	61.50
Inital groundwater level (m bgl)	58.50
Initial hydrostatic pressure in mid-point of test zone (bar)	0.15

Depth BGL to top of test section (m)	58.50
Depth BGL to midpoint of test section (m)	60.00
Depth BGL to base of test section (m)	61.50
Length of test section, L (m)	3.00

TEST READINGS

Stage	Gauge (over) pressure, P (bar)	Test Increment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Average flow, Q (litres/min)
1	1.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**0.00**
		Flowmeter readings (litres)	0.000	0.000	0.000	0.000	0.000																
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000																
2	2.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**0.00**
		Flowmeter readings (litres)	0.000	0.000	0.000	0.000	0.000																
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000																
3	3.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**30.65**
		Flowmeter readings (litres)	0.000	30.000	60.200	90.600	121.000	151.300	181.600	212.500	243.400	273.400	304.000	334.800	366.200	397.200	428.400	459.700					
		Water Take (litres)	0.000	30.000	30.200	30.400	30.400	30.300	30.300	30.900	30.900	30.000	30.600	30.800	31.400	31.000	31.200	31.300					
4	2.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**2.88**
		Flowmeter readings (litres)	0.000	4.100	8.300	12.400	16.500	20.800	25.300	29.800	34.600	37.100	38.100	39.000	39.800	40.800	41.900	43.200					
		Water Take (litres)	0.000	4.100	4.200	4.100	4.100	4.300	4.500	4.500	4.800	2.500	1.000	0.900	0.800	1.000	1.100	1.300					
5	1.00	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**0.00**
		Flowmeter readings (litres)	0.000	0.000	0.000	0.000	0.000																
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000																

TEST REMARKS	1. No flow occurred in Stages 1 and 2, each of which were each run for 5 minutes.
	2. Flow occurred in Stages 3 and 4; flow rate dropped towards end of Stage 4.
	3. No flow occurred on Stage 5, which was run for 5 minutes.

STRUCTURAL SOILS LTD The Old School Stillhouse Lane, Bedminster BRISTOL, BS3 4EB	Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	**Contract Ref:** 733442
	Stuart Pearce	13/09/2018	Adam Lumber	[redacted]	14/12/2018	Adam Lumber	[redacted]	14/12/2018	
	Contract:		**A303 Phase 6 and 7 Ground Investigation**		**Client**	**Highways England**		**Page**	2 of 3

IN-SITU WATER PRESSURE TEST -SINGLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

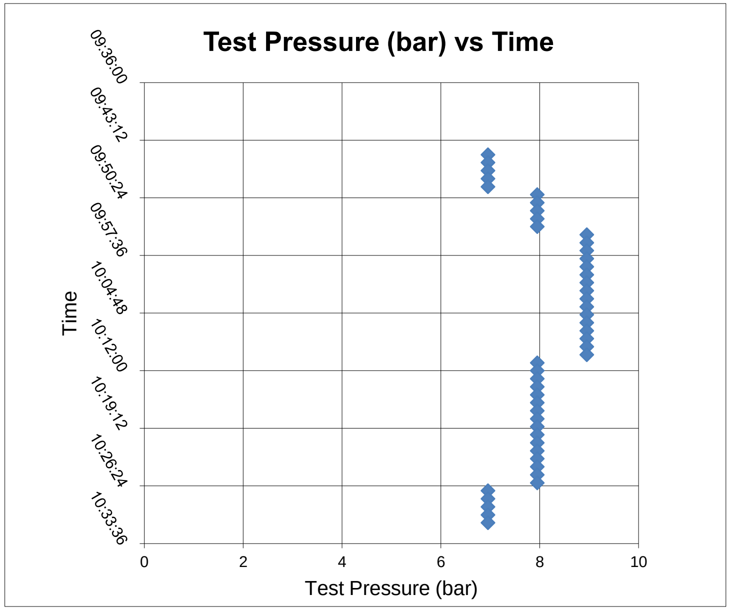
BH No R71911 **Test No.:** 3 **Test Depth Range (m):** 58.50 to 61.50 **Test Date:** 9/13/2018 **Test Time:** 9:45

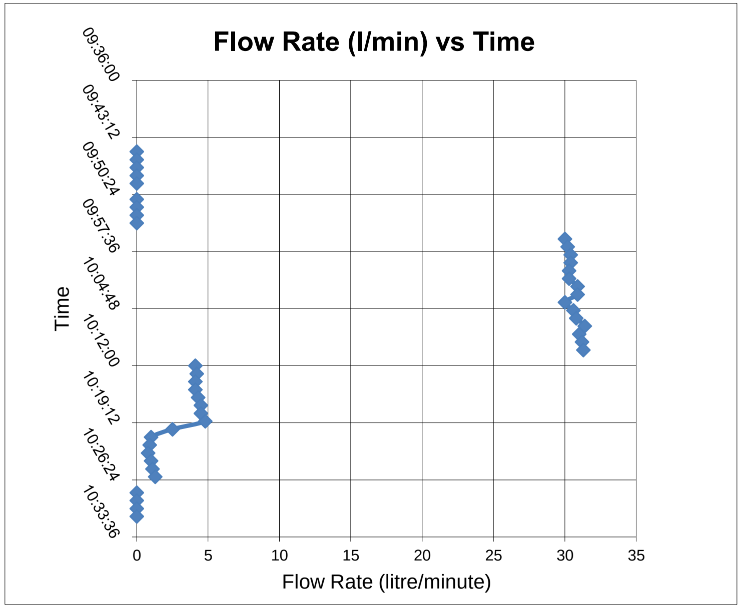
Ground Level: (m AOD) 109.38 National Grid Coordinates: E: 413441.5 N: 141975.5 Borehole Inclination: (degrees from vertical) 0 Borehole Orientation: (degrees) Not applicable

Run	Measured Gauge pressure, P (bar)	Measured Gague Pressure, P (m head)	Effective test pressure causing flow into rock, m head $\rho_{T\ (=P+(H-Hg)-Hf)}$	Effective test pressure ρ_{Tb} (bar)	Effective test pressure rT (MPa)	Flow rate, Q1 (litres/min)	Injected Flow, Q2 per metre (litres/min/m) [=Q1 / L]	Flow Q3 (m^3/s)
1	1.00	10.00	69.5	6.95	0.695	0.00	0.00	0.000000
2	2.00	20.00	79.5	7.95	0.795	0.00	0.00	0.000000
3	3.00	30.00	89.5	8.95	0.895	30.65	10.22	0.000511
4	2.00	20.00	79.5	7.95	0.795	2.88	0.96	0.000048
5	1.00	10.00	69.5	6.95	0.695	0.00	0.00	0.000000

Note:

Note: Test pressure (gauge) monitored visually and not data logged during test. Test pressure therefore presented as constant, for each stage in Test Pressure vs Time





IN-SITU WATER PRESSURE TEST - SINGLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

Borehole No.: R71913 **Test No.:** 1 **Test Depth Range (m):** 43.00 to 46.00 **Test Date:** 17/09/2018 **Test Time:** 14:00

Ground Level (m AOD): 102.28 National Grid Coordinates: E: 413839.1 N: 142051.1 Borehole Inclination: (degrees from vertical) 0 Borehole Orientation: (degrees) Not applicable

INSTALLATION DETAILS

BOREHOLE DETAILS	
Borehole Drilling Method	Rotary coring
Diameter of borehole in test section, d (mm)	150
Depth to base of borehole casing (m)	1.70
Depth to base of borehole at start of test (m)	46.00
Inital groundwater level (m bgl)	37.70
Height of groundwater above mid-point of test section, Hg (m)	6.80

TEST DETAILS	
Depth BGL to top of test section (m)	43.00
Depth BGL to midpoint of test section (m)	44.50
Depth BGL to base of test section (m)	46.00
Length of test section, L (m)	3.00
Rock type under test	CHALK
Weather during test	Clear

EQUIPMENT DETAILS	
Packer Type	Pneumatic
Serial No.	Not recorded
Length (m)	1.30
Inflation Pressure (bar)	8.0
Flowmeter type	Paddle wheel
Flowmeter serial number	Not recorded
Water Pump Type	Drill Rig Mounted
Water Pump Serial Number	Not recorded
Injection Water Temperature (^oC)	Not recorded
Test Pressure Measurement Method	Above ground pressure gauge
Gauge Height above GL (m)	1.00
Gauge Height above mid-point of test section, H (m)	45.50
Pressure Loss between pump and test section, Hf (m head)	0.00

IN-SITU WATER PRESSURE TEST - SINGLE PACKER

In accordance with BS EN ISO 22283-3 (2012)

Borehole No.: R71913 **Test No.:** 1 **Test Depth Range (m):** 43.00 to 46.00 **Test Date:** 17/09/2018 **Test Time:** 14:00

Ground Level (m AOD): 102.28 National Grid Coordinates: E: 413839.1 N: 142051.1 Borehole Inclination: (degrees from vertical) 0 Borehole Orientation: (degrees) Not applicable

SUMMARY OF KEY INSTALLATION DETAILS

Diameter of borehole in test section, D (m)	0.150
Depth to base of borehole casing (m)	1.70
Depth to base of borehole at start of test (m)	46.00
Inital groundwater level (m bgl)	37.70
Initial hydrostatic pressure in mid-point of test zone (bar)	0.68

Depth BGL to top of test section (m)	43.00
Depth BGL to midpoint of test section (m)	44.50
Depth BGL to base of test section (m)	46.00
Length of test section, L (m)	3.00

TEST READINGS

Stage	Gauge (over) pressure, P (bar)	Test Increment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Average flow, Q (litres/min)
1		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					
		Flowmeter readings (litres)																					
		Water Take (litres)																					
2		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					
		Flowmeter readings (litres)																					
		Water Take (litres)																					
3		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					
		Flowmeter readings (litres)																					
		Water Take (litres)																					
4		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					
		Flowmeter readings (litres)																					
		Water Take (litres)																					
5		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					
		Flowmeter readings (litres)																					
		Water Take (litres)																					

TEST REMARKS	1. 132 litres of water pumped through system to purge air.
	3. Pump then run at maximum output of 132 litres per minute for 5 minutes to try and achieve pressure.
	3. No test pressure could be achieved at maximum flow rate. Test halted.

IN-SITU WATER PRESSURE TEST - DOUBLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

Borehole No.: RX624 **Test No.:** 1 **Test Depth Range (m):** 43.00 to 46.00 **Test Date:** 23/04/2018 **Test Time:** 13:40

Ground Level (m AOD): 108.15 National Grid Coordinates: E: 413356.0 N: 141334.0 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

INSTALLATION DETAILS

BOREHOLE DETAILS	
Borehole Drilling Method	Rotary coring
Diameter of borehole in test section, d (mm)	150
Depth to base of borehole casing (m)	3.00
Depth to base of borehole at start of test (m)	70.00
Inital groundwater level (m bgl)	39.64
Initial hydrostatic pressure in test zone (from VW2, bar)	0.54

TEST DETAILS	
Depth BGL to top of test section (m)	43.00
Depth BGL to midpoint of test section (m)	44.50
Depth BGL to base of test section (m)	46.00
Length of test section, L (m)	3.00
Rock type under test	Chalk
Weather during test	Overcast

EQUIPMENT DETAILS

	Packer 1 (Upper)	Packer 2 (lower)
Packer Type	Pneumatic	Pneumatic
Serial No.	Not recorded	Not recorded
Length (m)	1.30	1.30
Inflation Pressure (bar)	8.0	8.0

Flowmeter type	Paddle wheel
Flowmeter serial number	2903
Water Pump Type	Triplex
Water Pump Serial Number	PU 1
Injection Water Temperature (^{o}C)	14.0

Pressure Transducer		Distance from centre of test section (m bgl)	Depth m bgl)	Manufacturer	Serial Number
VW1	TOP - Above Test Section	3.51	40.99	GeoSense	330541
VW2	MIDDLE - Within Test Section	1.25	43.25	GeoSense	330484
VW3	BASE - Below Test Section	-3.05	47.55	GeoSense	330527
		(Distances BELOW centre to be entered as negative)			

IN-SITU WATER PRESSURE TEST - DOUBLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

Borehole No.: RX624 **Test No.:** 1 **Test Depth Range (m):** 43.00 to 46.00 **Test Date:** 23/04/2018 **Test Time:** 13:40

Ground Level (m AOD): 108.154 National Grid Coordinates: E: 413356.0 N: 141334.0 Borehole Inclination: (degrees from vertical) 0 Borehole Orientation: (degrees) Not applicable

SUMMARY OF KEY INSTALLATION DETAILS

Daimeter of borehole in test section, D (m)	0.150
Depth to base of borehole casing (m)	3.00
Diameter of borehole in test section, d (mm)	70.00
Inital groundwater level (m bgl)	39.64
Initial hydrostatic pressure in test zone (from VW2, bar).	0.54

Depth BGL to top of test section (m)	43.00
Depth BGL to midpoint of test section (m)	44.50
Depth BGL to base of test section (m)	46.00
Length of test section, L (m)	3.00

TEST READINGS

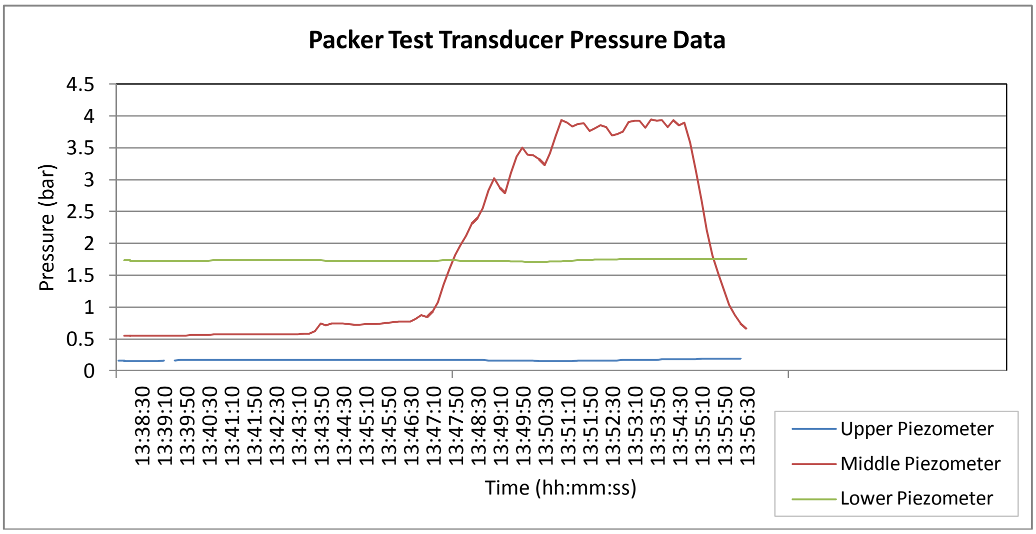
Stage	Effective test pressure, P (bar)	Test Increment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Average flow, Q (litres/min)
1	See remarks	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					97.74
		Flowmeter readings (litres)	0.000	101.650	193.600	287.200	382.200	479.600	580.160	684.200													
		Water Take (litres)	0.000	101.650	91.950	93.600	95.000	97.400	100.560	104.040													
2		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					0.00
		Flowmeter readings (litres)																					
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000										
3		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					0.00
		Flowmeter readings (litres)																					
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000										
4		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					0.00
		Flowmeter readings (litres)																					
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000										
5		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					0.00
		Flowmeter readings (litres)																					
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000										

TEST REMARKS

1. 179l of of water pumped through system to purge air prior to commencement, and to try to acheive initial test pressure.
2. Unable to achieve test section pressure equal to theoretical hydrostatic pressure of water in injection pipe (GL to 39.64m, ~ 4 bar) plus hydrostatic GW level above test section (0.54 bar).
3.Maximum pressure achieved in test section was 3.96 bar, water flowing out too quickly to generate test pressure. Standing water level rose by 10mm during test.

IN-SITU WATER PRESSURE TEST - DOUBLE PACKER
In accordance with BS EN ISO 22282-3 (2012)

Borehole: RX624 **Test No:** 1 **Test Depth Range:** 43.00 to 46.00 **Date:** 23/04/2018



Initial pressure: 0.54 bar

Required overpressure:	5.00	6.00	7.00	6.00	5.00	bar
Test pressure:	5.54	6.54	7.54	6.54	5.54	bar
Max allowed:	6.04	7.14	8.24	7.14	6.04	bar
Min allowed:	5.04	5.94	6.84	5.94	5.04	bar

Start time:	13:38:00	
End time:	13:56:30	
Duration:	00:18:30	
Average pressure:	2.67	bar
Exceedance:	*-52*	*%*
Maximum pressure:	3.95	bar
Exceedance:	*48*	*%*
Minimum pressure:	0.72	bar
Exceedance:	*-269*	*%*
Average overpressure:	2.13	bar

Comparison of measured (from vibrating wire) and calculated hydrostatic pressures

Vib Wire Position	**Test Section m bgl Top**	**Test Section m bgl Bottom**	**Distance from mid'**	**Expected depth**	Initial GW level m bgl	**Vib wire pressure bar**	**Vib wire pressure m head**	Hydrostatic head m	Difference (m head)	**Pass/Fail**
Top	43.00	46.00	3.51	40.99	39.64	0.16	1.61	1.35	0.26	Pass
Middle			1.25	43.25		0.54	5.40	3.61	1.79	Fail
Bottom			-3.05	47.55		1.73	17.32	7.91	9.41	Fail

Note: Middle and Bottom Vib. Wire hydrostatic measurements deviate from calculated hydrostatic pressure.

IN-SITU WATER PRESSURE TEST - DOUBLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

Borehole No.: RX624 **Test No.:** 2 **Test Depth Range (m):** 53.00 to 56.00 **Test Date:** 23/04/2018 **Test Time:** 12:30

Ground Level (m AOD): 108.15 National Grid Coordinates: E: 413356.0 N: 141334.0 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

INSTALLATION DETAILS

BOREHOLE DETAILS	
Borehole Drilling Method	Rotary coring
Diameter of borehole in test section, d (mm)	150
Depth to base of borehole casing (m)	3.00
Depth to base of borehole at start of test (m)	70.00
Inital groundwater level (m bgl)	39.69
Initial hydrostatic pressure in test zone (from VW2, bar)	1.51

EQUIPMENT DETAILS		
	Packer 1 (Upper)	Packer 2 (lower)
Packer Type	Pneumatic	Pneumatic
Serial No.	Not recorded	Not recorded
Length (m)	1.30	1.30
Inflation Pressure (bar)	8.0	8.0

TEST DETAILS	
Depth BGL to top of test section (m)	53.00
Depth BGL to midpoint of test section (m)	54.50
Depth BGL to base of test section (m)	56.00
Length of test section, L (m)	3.00
Rock type under test	Chalk
Weather during test	Overcast

Flowmeter type	Paddle wheel
Flowmeter serial number	2903
Water Pump Type	Triplex
Water Pump Serial Number	PU 1
Injection Water Temperature (^oC)	14.0

Pressure Transducer		Distance from centre of test section (m bgl)	Depth m bgl)	Manufacturer	Serial Number
VW1	TOP - Above Test Section	3.51	50.99	GeoSense	330541
VW2	MIDDLE - Within Test Section	1.25	53.25	GeoSense	330484
VW3	BASE - Below Test Section	-3.05	57.55	GeoSense	330527
		(Distances BELOW centre to be entered as negative)			

IN-SITU WATER PRESSURE TEST - DOUBLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

Borehole No.: RX624 **Test No.:** 2 **Test Depth Range (m):** 53.00 to 56.00 **Test Date:** 23/04/2018 **Test Time:** 12:30

Ground Level (m AOD): 108.15 National Grid Coordinates: E: 413356.0 N: 141334.0 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

SUMMARY OF KEY INSTALLATION DETAILS

Daimeter of borehole in test section, D (m)	0.150
Depth to base of borehole casing (m)	3.00
Depth to base of borehole at start of test (m)	70.00
Inital groundwater level (m bgl)	39.69
Initial hydrostatic pressure in test zone (from VW2)	1.51

Depth BGL to top of test section (m)	53.00
Depth BGL to midpoint of test section (m)	54.50
Depth BGL to base of test section (m)	56.00
Length of test section, L (m)	3.00

TEST READINGS

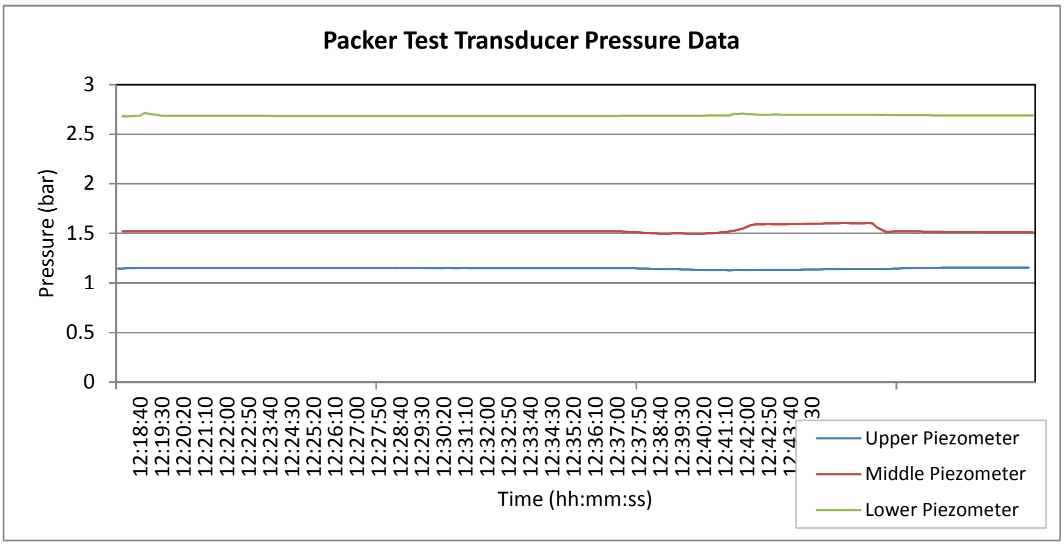
Stage	Effective test pressure, P (bar)	Test Increment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Average flow, Q (litres/min)
1	See Remarks	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					0.00
		Flowmeter readings (litres)																					
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000										
2		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					0.00
		Flowmeter readings (litres)																					
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000										
3		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					0.00
		Flowmeter readings (litres)																					
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000										
4		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					0.00
		Flowmeter readings (litres)																					
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000										
5		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					0.00
		Flowmeter readings (litres)																					
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000										

TEST REMARKS

1. 914l of of water pumped through system to purge air prior to commencement, and to try to acheive pressure. Could not achieve any increase in test section pressure.
2. No increase in test section pressure could be achieved - water flowing out too quickly to generate test pressure.
3. Standing water level rose by 10mm over 8 minute test.

IN-SITU WATER PRESSURE TEST - DOUBLE PACKER
In accordance with BS EN ISO 22282-3 (2012)

Borehole: RX624 **Test No:** 2 **Test Depth Range:** 53.00 to 56.00 **Date:** 23/04/2018



Initial pressure: 1.51 bar

Required overpressure:	1.00	2.00	3.00	2.00	1.00	bar
Test pressure:	2.51	3.51	4.51	3.51	2.51	bar
Max allowed:	2.61	3.71	4.81	3.71	2.61	bar
Min allowed:	2.41	3.31	4.21	3.31	2.41	bar

Start time: 12:18:00
End time: 12:53:00
Duration: 00:35:00
Average pressure: 1.52 bar
Exceedance: *-39 %*
Maximum pressure: 1.52 bar
Exceedance: *0 %*
Minimum pressure: 1.52 bar
Exceedance: *0 %*
Average overpressure: 0.01 bar

Comparison of measured (from vibrating wire) and calculated hydrostatic pressures

Vib Wire Position	Test Section m bgl Top	Test Section m bgl Bottom	Distance from mid'	Expected depth	Initial GW level m bgl	Vib wire pressure bar	Vib wire pressure m head	Hydrostatic head m	Difference (m head)	Pass/Fail
Top	53.00	56.00	3.51	50.99	39.69	1.15	11.50	11.30	0.20	Pass
Middle			1.25	53.25		1.51	15.10	13.56	1.54	Pass
Bottom			-3.05	57.55		2.69	26.87	17.86	9.01	Pass

Note: Middle and Bottom Vib. Wire hydrostatic measurements deviate from calculated hydrostatic pressure.

IN-SITU WATER PRESSURE TEST - SINGLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

Borehole No.: RX627 **Test No.:** 1 **Test Depth Range (m):** 62.00 to 70.00 **Test Date:** 03/05/2018 **Test Time:** 00:00

Ground Level (m AOD): 111.99 National Grid Coordinates: E: 413449.0 N: 141282.0 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

INSTALLATION DETAILS

BOREHOLE DETAILS	
Borehole Drilling Method	Rotary coring
Diameter of borehole in test section, d (mm)	150
Depth to base of borehole casing (m)	4.00
Depth to base of borehole at start of test (m)	70.00
Inital groundwater level (m bgl)	44.08
Height of groundwater above mid-point of test section, Hg (m)	21.92

TEST DETAILS	
Depth BGL to top of test section (m)	62.00
Depth BGL to midpoint of test section (m)	66.00
Depth BGL to base of test section (m)	70.00
Length of test section, L (m)	8.00
Rock type under test	CHALK
Weather during test	Sunny

EQUIPMENT DETAILS	
Packer Type	Pneumatic
Serial No.	Not recorded
Length (m)	1.30
Inflation Pressure (bar)	10.0
Flowmeter type	Paddle wheel
Flowmeter serial number	Not recorded
Water Pump Type	Drill Rig Mounted
Water Pump Serial Number	Not recorded
Injection Water Temperature (^oC)	Not recorded
Test Pressure Measurement Method	Above ground pressure gauge
Gauge Height above GL (m)	0.50
Gauge Height above mid-point of test section, H (m)	66.50
Pressure Loss between pump and test section, Hf (m head)	0.00

IN-SITU WATER PRESSURE TEST - SINGLE PACKER

In accordance with BS EN ISO 22283-3 (2012)

Borehole No.: RX627 **Test No.:** 1 **Test Depth Range (m):** 62.00 to 70.00 **Test Date:** 03/05/2018 **Test Time:** 00:00

Ground Level (m AOD): 111.998 National Grid Coordinates: E: 413449.0 N: 141282.0 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

SUMMARY OF KEY INSTALLATION DETAILS

Diameter of borehole in test section, D (m)	0.150
Depth to base of borehole casing (m)	4.00
Depth to base of borehole at start of test (m)	70.00
Inital groundwater level (m bgl)	44.08
Initial hydrostatic pressure in mid-point of test zone (bar)	2.19

Depth BGL to top of test section (m)	62.00
Depth BGL to midpoint of test section (m)	66.00
Depth BGL to base of test section (m)	70.00
Length of test section, L (m)	8.00

TEST READINGS

Stage	Gauge (over) pressure, P (bar)	Test Increment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Average flow, Q (litres/min)
		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					
1	1.00	Flowmeter readings (litres)	0.000	16.300	32.100	47.400	63.000	78.400	93.600	108.600	123.700	138.600	153.600	168.600	183.800	198.800	213.800	228.600					**15.24**
		Water Take (litres)	0.000	16.300	15.800	15.300	15.600	15.400	15.200	15.000	15.100	14.900	15.000	15.000	15.200	15.000	15.000	14.800					
		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					
2	2.00	Flowmeter readings (litres)	0.000	19.200	38.600	58.100	77.100	96.300	116.100	135.500	155.200	174.700	194.400	214.400	234.100	254.400	274.200	293.600					**19.57**
		Water Take (litres)	0.000	19.200	19.400	19.500	19.000	19.200	19.800	19.400	19.700	19.500	19.700	20.000	19.700	20.300	19.800	19.400					
		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					
3	3.00	Flowmeter readings (litres)	0.000	24.800	50.500	77.800	104.800	131.700	158.600	185.400	212.200	239.100	265.900	292.800	320.000	347.000	374.000	400.900					**26.73**
		Water Take (litres)	0.000	24.800	25.700	27.300	27.000	26.900	26.900	26.800	26.800	26.900	26.800	26.900	27.200	27.000	27.000	26.900					
		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					
4	2.00	Flowmeter readings (litres)	0.000	23.800	47.400	70.900	94.500	118.100	141.600	165.100	188.600	212.200	235.700	259.200	282.700	306.200	329.700	353.100					**23.54**
		Water Take (litres)	0.000	23.800	23.600	23.500	23.600	23.600	23.500	23.500	23.500	23.600	23.500	23.500	23.500	23.500	23.500	23.400					
		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					
5	1.00	Flowmeter readings (litres)	0.000	20.200	40.000	59.900	79.700	99.400	119.200	139.000	158.900	179.700	199.000	218.300	238.000	257.700	277.200	296.800					**19.79**
		Water Take (litres)	0.000	20.200	19.800	19.900	19.800	19.700	19.800	19.800	19.900	20.800	19.300	19.300	19.700	19.700	19.500	19.600					

TEST REMARKS	1
	2
	3

STRUCTURAL SOILS LTD The Old School Stillhouse Lane, Bedminster BRISTOL, BS3 4EB	Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	**Contract Ref:** 733442
	Stuart Pearce	09/05/2018	Adam Lumber	[redacted]	08/08/2018	Adam Lumber	[redacted]	08/08/2018	
	Contract:		**A303 Phase 6 Ground Investigation**		**Client**	**Highways England**		**Page**	**2 of 3**

IN-SITU WATER PRESSURE TEST -SINGLE PACKER
In accordance with BS EN ISO 22282-3 (2012)

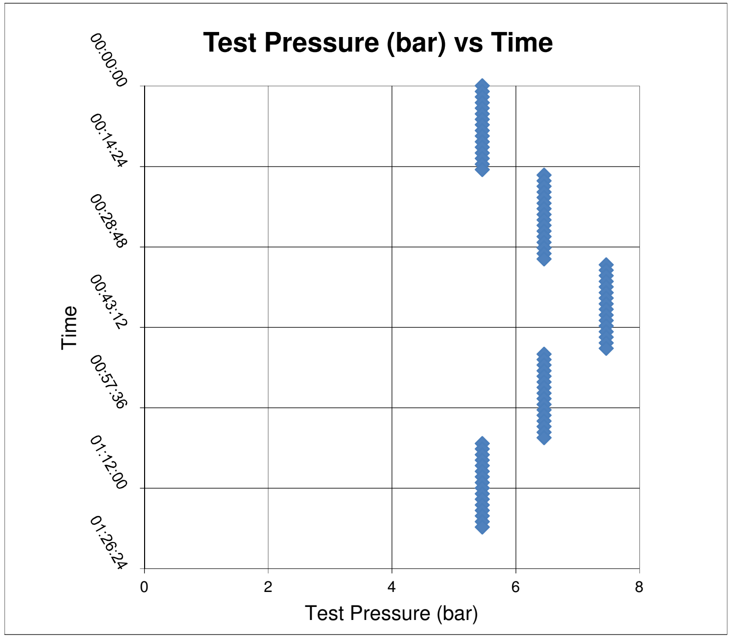
BH No RX627 **Test No.:** 1 **Test Depth Range (m):** 62.00 to 70.00 **Test Date:** 03/05/2018 **Test Time:** 00:00

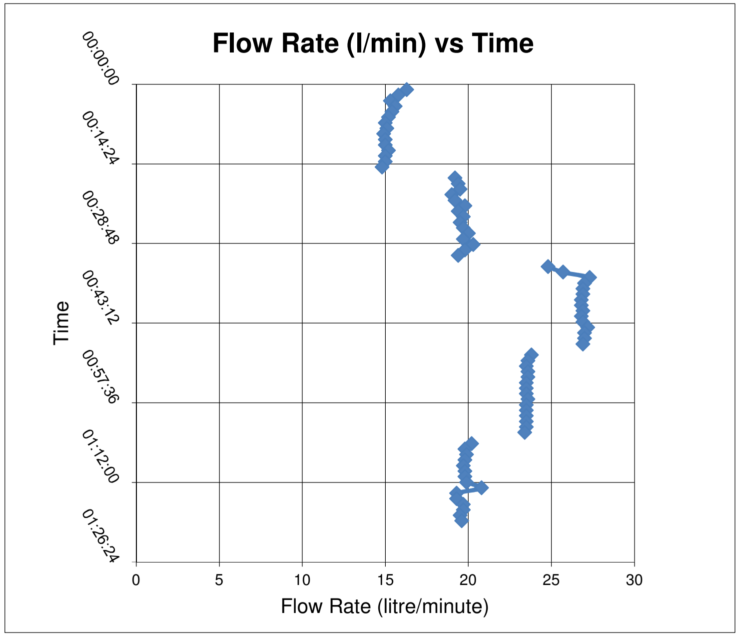
Ground Level: 111.998 (m AOD) National Grid Coordinates: E: 413449.0 N: 141282.0 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

Run	Measured Gauge pressure, P (bar)	Measured Gague Pressure, P (m head)	Effective test pressure causing flow into rock, m head $p_{T\,(=P+(H\text{-}Hg)-Hf)}$	Effective test pressure p_{Tb} (bar)	Effective test pressure rT (MPa)	Flow rate, Q1 (litres/min)	Injected Flow, Q2 per metre (litres/min/m) [=Q1 / L]	Flow Q3 (m^3/s)
1	1.00	10.00	54.6	5.458	0.546	15.24	1.91	0.000254
2	2.00	20.00	64.6	6.458	0.646	19.57	2.45	0.000326
3	3.00	30.00	74.6	7.458	0.746	26.73	3.34	0.000445
4	2.00	20.00	64.6	6.458	0.646	23.54	2.94	0.000392
5	1.00	10.00	54.6	5.458	0.546	19.79	2.47	0.000330

Note:

Note: Test pressure (gauge) monitored visually and not data logged during test. Test pressure therefore presented as constant, for each stage in Test Pressure vs Time plot.





STRUCTURAL SOILS LTD The Old School Stillhouse Lane Bedminster BRISTOL, BS3 4EB	Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	Contract Ref:	733442
	Stuart Pearce	09/05/2018	Adam Lumber	[redacted]	08/08/2018	Adam Lumber	[redacted]	08/08/2018		
	Contract:		**A303 Phase 6 Ground Investigation**		**Client**	**Highways England**			**Page**	3 of 3

IN-SITU WATER PRESSURE TEST - DOUBLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

Borehole No.: RX627 **Test No.:** 2 **Test Depth Range (m):** 46.00 to 51.00 **Test Date:** 04/05/2018 **Test Time:** 14:00

Ground Level (m AOD): 111.99 National Grid Coordinates: E: 413449.0 N: 141282.0 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

INSTALLATION DETAILS

BOREHOLE DETAILS	
Borehole Drilling Method	Rotary coring
Daimeter of borehole in test section, d (mm)	147
Depth to base of borehole casing (m)	4.00
Depth to base of borehole at start of test (m)	70.00
Inital groundwater level (m bgl)	43.62
Initial hydrostatic pressure in test zone (from VW2)	0.47

EQUIPMENT DETAILS	Packer 1 (Upper)	Packer 2 (lower)
Packer Type	Pneumatic	Pneumatic
Serial No.	Not recorded	Not recorded
Length (m)	Not recorded	Not recorded
Inflation Pressure (bar)	12.0	12.0

TEST DETAILS	
Depth BGL to top of test section (m)	46.00
Depth BGL to midpoint of test section (m)	48.50
Depth BGL to base of test section (m)	51.00
Length of test section, L (m)	5.00
Rock type under test	CHALK
Weather during test	Sunny

Flowmeter type	Paddle wheel
Flowmeter serial number	Not recorded
Water Pump Type	Not recorded
Water Pump Serial Number	Not recorded
Injection Water Temperature (^oC)	Not recorded

Pressure Transducer		Distance from centre of test section (m bgl)	Depth m bgl)	Manufacturer	Serial Number
VW1	TOP - Above Test Section	3.51	44.99	Not recorded	Not recorded
VW2	MIDDLE - Within Test Section	1.25	47.25	Not recorded	Not recorded
VW3	BASE - Below Test Section	-3.05	51.55	Not recorded	Not recorded
		(Distances BELOW centre to be entered as negative)			

IN-SITU WATER PRESSURE TEST - DOUBLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

Borehole No.: RX627 **Test No.:** 2 **Test Depth Range (m):** 46.00 to 51.00 **Test Date:** 04/05/2018 **Test Time:** 14:00

Ground Level (m AOD): 111.998 National Grid Coordinates: E: 413449.0 N: 141282.0 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

SUMMARY OF KEY INSTALLATION DETAILS

Daimeter of borehole in test section, D (m)	0.147
Depth to base of borehole casing (m)	4.00
Depth to base of borehole at start of test (m)	70.00
Inital groundwater level (m bgl)	43.62
Initial hydrostatic pressure in test zone (from VW2)	0.47

Depth BGL to top of test section (m)	38.70
Depth BGL to midpoint of test section (m)	40.30
Depth BGL to base of test section (m)	41.90
Length of test section, L (m)	3.20

TEST READINGS

Stage	Effective test pressure, P (bar)	Test Increment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Average flow, Q (litres/min)
1	4.81	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**5.93**
		Flowmeter readings (litres)	0.000	6.400	13.600	20.400	27.100	33.000	39.100	45.000	50.600	56.200	62.000	67.400	72.900	78.700	83.900	89.000					
		Water Take (litres)	0.000	6.400	7.200	6.800	6.700	5.900	6.100	5.900	5.600	5.600	5.800	5.400	5.500	5.800	5.200	5.100					
2	5.99	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**17.56**
		Flowmeter readings (litres)	0.000	15.400	33.700	51.200	68.400	86.000	104.100	121.500	139.200	157.000	174.400	192.200	210.300	227.500	245.700	263.400					
		Water Take (litres)	0.000	15.400	18.300	17.500	17.200	17.600	18.100	17.400	17.700	17.800	17.400	17.800	18.100	17.200	18.200	17.700					
3	6.73	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**26.73**
		Flowmeter readings (litres)	0.000	24.800	50.500	77.800	104.800	131.700	158.600	185.400	212.200	239.100	265.900	292.800	320.000	347.000	374.000	400.900					
		Water Take (litres)	0.000	24.800	25.700	27.300	27.000	26.900	26.900	26.800	26.800	26.900	26.800	26.900	27.200	27.000	27.000	26.900					
4	6.05	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**23.54**
		Flowmeter readings (litres)	0.000	23.800	47.400	70.900	94.500	118.100	141.600	165.100	188.600	212.200	235.700	259.200	282.700	306.200	329.700	353.100					
		Water Take (litres)	0.000	23.800	23.600	23.500	23.600	23.600	23.500	23.500	23.500	23.600	23.500	23.500	23.500	23.500	23.500	23.400					
5	4.95	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**19.79**
		Flowmeter readings (litres)	0.000	20.200	40.000	59.900	79.700	99.400	119.200	139.000	158.900	179.700	199.000	218.300	238.000	257.700	277.200	296.800					
		Water Take (litres)	0.000	20.200	19.800	19.900	19.800	19.700	19.800	19.800	19.900	20.800	19.300	19.300	19.700	19.700	19.500	19.600					

TEST REMARKS	1
	2
	3

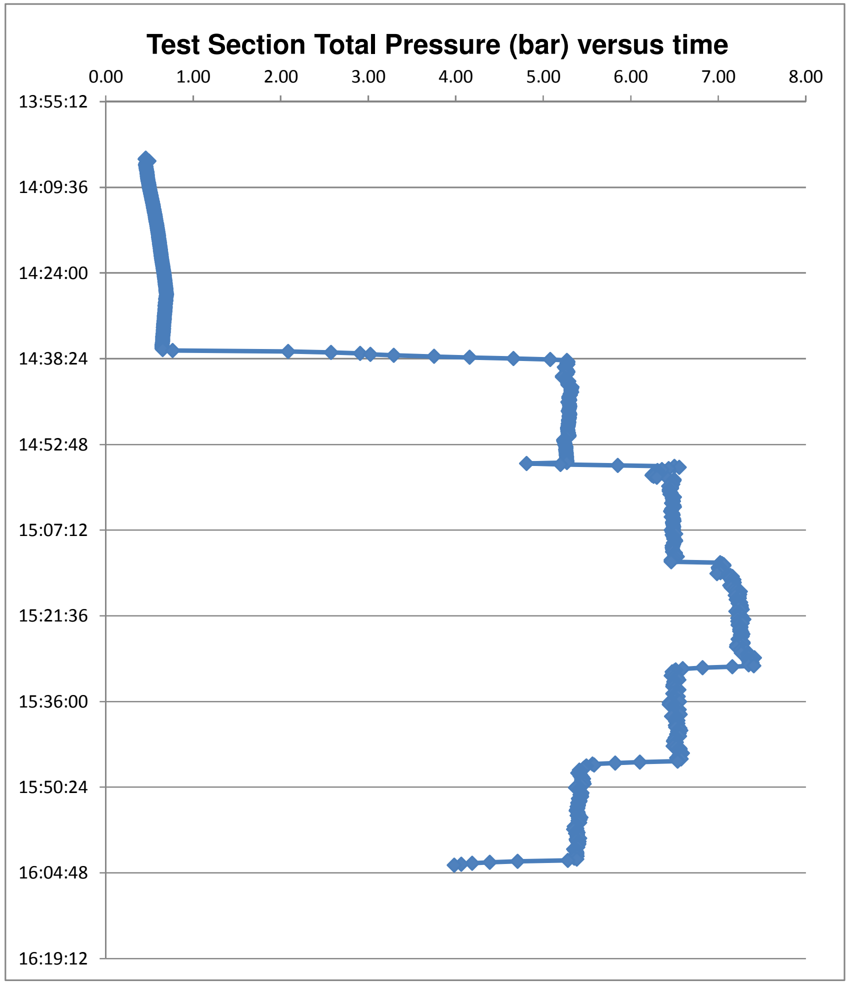
STRUCTURAL SOILS LTD The Old School Stillhouse Lane, Bedminster BRISTOL, BS3 4EB	Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	**Contract Ref:** **733442**
	Stuart Pearce	04/05/2018	Matt Jones		08/05/2018	Adam Lumber	[redacted]	08/08/2018	
	Contract:		**A303 - Phase 6 Ground Investigation**		**Client**	**Highways England**			**Page** 2 of 4

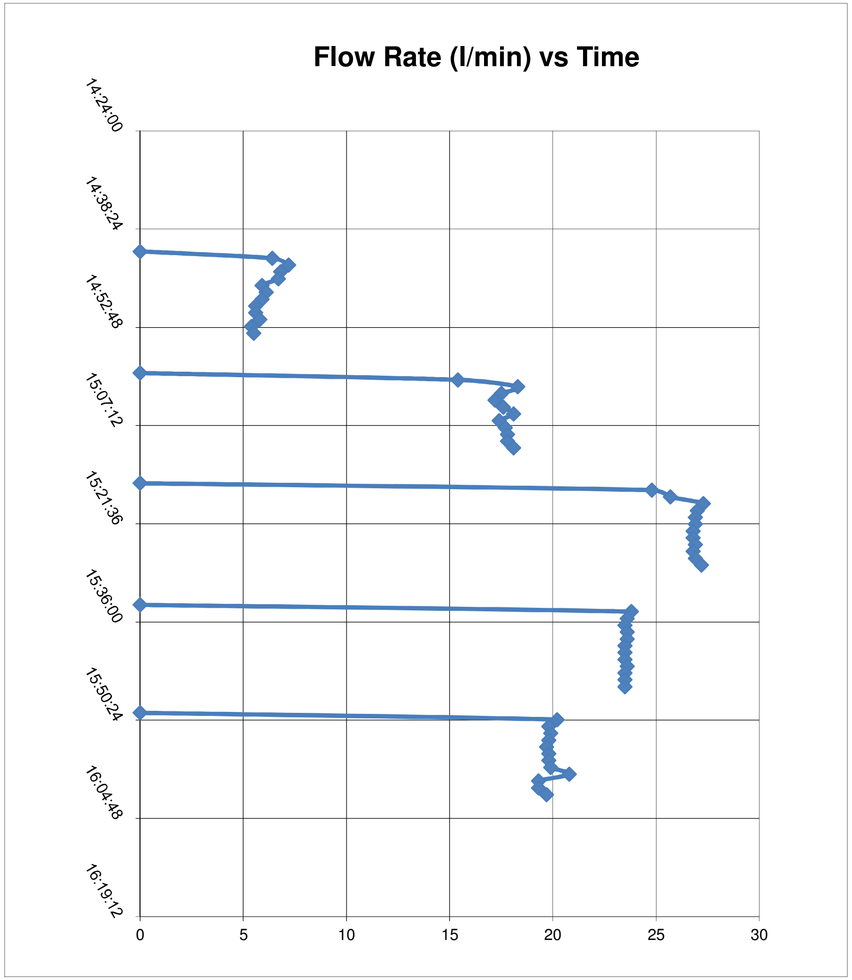
IN-SITU WATER PRESSURE TEST - DOUBLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

BH No RX627 **Test No.:** **2** **Test Depth Range (m):** 46.00 to 51.00 **Test Date:** 04/05/2018 **Test Time:** 14:00

Ground Level: (m AOD) 111.998 National Grid Coordinates: E: 413449.0 N: 141282.0 Borehole Inclination: (degrees from vertical) 0 Borehole Orientation: (degrees) Not applicable

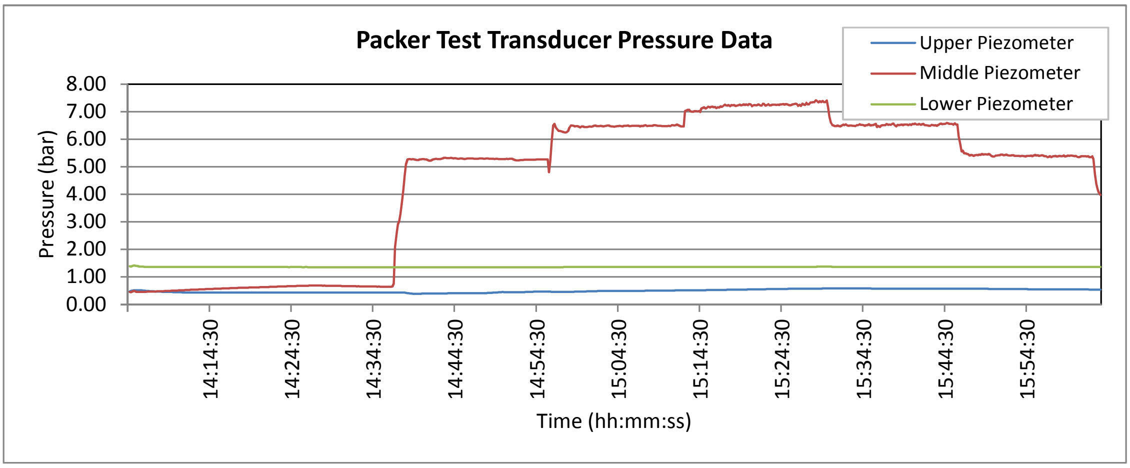




STRUCTURAL SOILS LTD The Old School Stillhouse Lane Bedminster BRISTOL, BS3 4EB	Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	Contract Ref:	733442
	Stuart Pearce	04/05/2018	Matt Jones		08/05/2018	Adam Lumber	[redacted]	08/08/2018		
	Contract:		A303 - Phase 6 Ground Investigation		Client	Highways England			Page	3 of 4

IN-SITU WATER PRESSURE TEST - DOUBLE PACKER
In accordance with BS EN ISO 22282-3 (2012)

Borehole: RX627 **Test No:** 2 **Test Depth Range:** 46.00 to 51.00 **Date:** 04/05/2018



Initial pressure: 4.00 bar Initial Pressure plus Hydrostatic Head: 4.42

Required overpressure:	1.00	2.00	3.00	2.00	1.00	bar
Test pressure:	5.42	6.42	7.42	6.42	5.42	bar
Max allowed:	5.52	6.62	7.72	6.62	5.52	bar
Min allowed:	5.32	6.22	7.12	6.22	5.32	bar

Start time:	14:38:40	14:56:30	15:12:40	15:30:30	15:46:20	
End time:	14:53:40	15:11:30	15:27:40	15:45:30	16:01:20	
Duration:	00:15:00	00:15:00	00:15:00	00:15:00	00:15:00	
Average pressure:	5.28	6.46	7.20	6.52	5.41	bar
Exceedance:	*-3*	*1*	*-3*	*2*	*0*	*%*
Maximum pressure:	5.33	6.55	7.32	6.59	5.82	bar
Exceedance:	*1*	*1*	*2*	*1*	*7*	*%*
Minimum pressure:	5.22	6.24	6.98	6.44	5.35	bar
Exceedance:	*-1*	*-3*	*-3*	*-1*	*-1*	*%*
Average overpressure:	1.28	2.46	3.20	2.52	1.41	bar

Comparison of measured (from vibrating wire) and calculated hydrostatic pressures

Vib Wire	**Test Section m bgl**		**Distance**	**Expected**	Initial GW	**Vib wire pressure**		Hydrostatic	Difference (m	**Pass/Fail**
Position	**Top**	**Bottom**	**from mid'**	**depth**	level m bgl	**bar**	**m head**	head m	head)	
Top	46.00	51.00	3.51	44.99	43.62	0.49	4.95	1.37	3.58	Fail
Middle			1.25	47.25		0.47	4.69	3.63	1.06	Pass
Bottom			-3.05	51.55		1.37	13.67	7.93	5.74	Fail

IN-SITU WATER PRESSURE TEST - DOUBLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

Borehole No.: RX627 **Test No.:** 3 **Test Depth Range (m):** 46.00 to 51.00 **Test Date:** 09/05/2018 **Test Time:** 10:30

Ground Level (m AOD): 111.99 National Grid Coordinates: E: 413449.0 N: 141282.0 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

INSTALLATION DETAILS

BOREHOLE DETAILS	
Borehole Drilling Method	Rotary coring
Daimeter of borehole in test section, d (mm)	150
Depth to base of borehole casing (m)	4.00
Depth to base of borehole at start of test (m)	70.00
Inital groundwater level (m bgl)	43.86
Initial hydrostatic pressure in test zone (from VW2)	0.37

TEST DETAILS	
Depth BGL to top of test section (m)	46.00
Depth BGL to midpoint of test section (m)	48.50
Depth BGL to base of test section (m)	51.00
Length of test section, L (m)	5.00
Rock type under test	CHALK
Weather during test	Sunny

EQUIPMENT DETAILS

	Packer 1 (Upper)	Packer 2 (lower)
Packer Type	Pneumatic	Pneumatic
Serial No.	Not recorded	Not recorded
Length (m)	1.30	1.30
Inflation Pressure (bar)	16.0	16.0

Flowmeter type	Paddle wheel
Flowmeter serial number	Not recorded
Water Pump Type	Triplex
Water Pump Serial Number	Not recorded
Injection Water Temperature (^oC)	Not recorded

Pressure Transducer		Distance from centre of test section (m bgl)	Depth m bgl)	Manufacturer	Serial Number
VW1	TOP - Above Test Section	3.51	44.99	Not recorded	Not recorded
VW2	MIDDLE - Within Test Section	1.25	47.25	Not recorded	Not recorded
VW3	BASE - Below Test Section	-3.05	51.55	Not recorded	Not recorded
		(Distances BELOW centre to be entered as negative)			

STRUCTURAL SOILS LTD The Old School Stillhouse Lane, Bedminster BRISTOL, BS3 4EB	Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	Contract Ref:	733442
	Stuart Pearce	09/05/2018	Matt Jones		10/05/2018	Adam Lumber	[redacted]	08/08/2018		
	Contract:		A303 - Phase 6 Ground Investigation		Client	Highways England			Page	1 of 4

IN-SITU WATER PRESSURE TEST - DOUBLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

Borehole No.: RX627 **Test No.:** 3 **Test Depth Range (m):** 46.00 to 51.00 **Test Date:** 09/05/2018 **Test Time:** 10:30

Ground Level (m AOD): 111.998 National Grid Coordinates: E: 413449.0 N: 141282.0 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

SUMMARY OF KEY INSTALLATION DETAILS

Daimeter of borehole in test section, D (m)	0.150
Depth to base of borehole casing (m)	4.00
Depth to base of borehole at start of test (m)	70.00
Inital groundwater level (m bgl)	43.86
Initial hydrostatic pressure in test zone (from VW2)	0.37

Depth BGL to top of test section (m)	38.70
Depth BGL to midpoint of test section (m)	40.30
Depth BGL to base of test section (m)	41.90
Length of test section, L (m)	3.20

TEST READINGS

Stage	Effective test pressure, P (bar)	Test Increment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Average flow, Q (litres/min)
1	4.64	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**12.51**
		Flowmeter readings (litres)	0.000	12.700	25.500	38.100	50.500	62.900	75.100	87.500	100.300	112.600	125.100	137.300	149.600	161.700	174.100	187.600					
		Water Take (litres)	0.000	12.700	12.800	12.600	12.400	12.400	12.200	12.400	12.800	12.300	12.500	12.200	12.300	12.100	12.400	13.500					
2	6.05	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**25.74**
		Flowmeter readings (litres)	0.000	25.100	50.500	75.600	101.300	127.900	152.900	178.700	204.700	230.900	257.400										
		Water Take (litres)	0.000	25.100	25.400	25.100	25.700	26.600	25.000	25.800	26.000	26.200	26.500										
3	6.99	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**30.02**
		Flowmeter readings (litres)	0.000	50.100	100.300	150.100	200.100	250.000	300.200														
		Water Take (litres)	0.000	50.100	50.200	49.800	50.000	49.900	50.200	0.000	0.000	0.000	0.000										
4	6.96	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**29.90**
		Flowmeter readings (litres)	0.000	49.200	99.100	149.200	199.000	249.100	299.000														
		Water Take (litres)	0.000	49.200	49.900	50.100	49.800	50.100	49.900	0.000	0.000	0.000	0.000										
5		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**0.00**
		Flowmeter readings (litres)																					
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000										

TEST REMARKS	1. Initial packer inflation pressure was 10 bar, but unable to achieve target test pressure/seal for stages 1 and 2.
	2. Test stage 2 was terminated early at client's instruction due to water level rise of 0.4m.
	3. Stage 3 attempted twice to increase packer inflation pressure from 14 bar to 16 bar. Both stages terminated early, and test finally terminated early at 1130 all at client's instruction.

STRUCTURAL SOILS LTD
The Old School
Stillhouse Lane,
Bedminster
BRISTOL, BS3 4EB

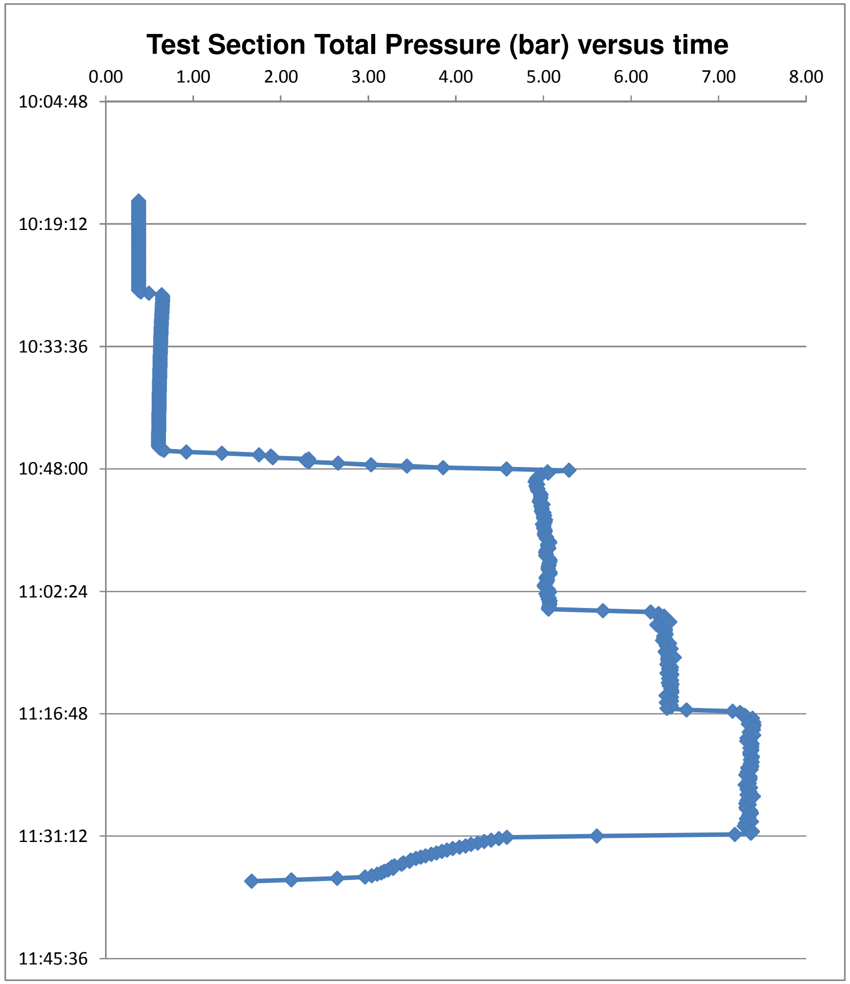
Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	Contract Ref:	733442
Stuart Pearce	09/05/2018	Matt Jones		10/05/2018	Adam Lumber	[redacted]	08/08/2018		
Contract:		**A303 - Phase 6 Ground Investigation**		**Client**	**Highways England**			**Page**	**2 of 4**

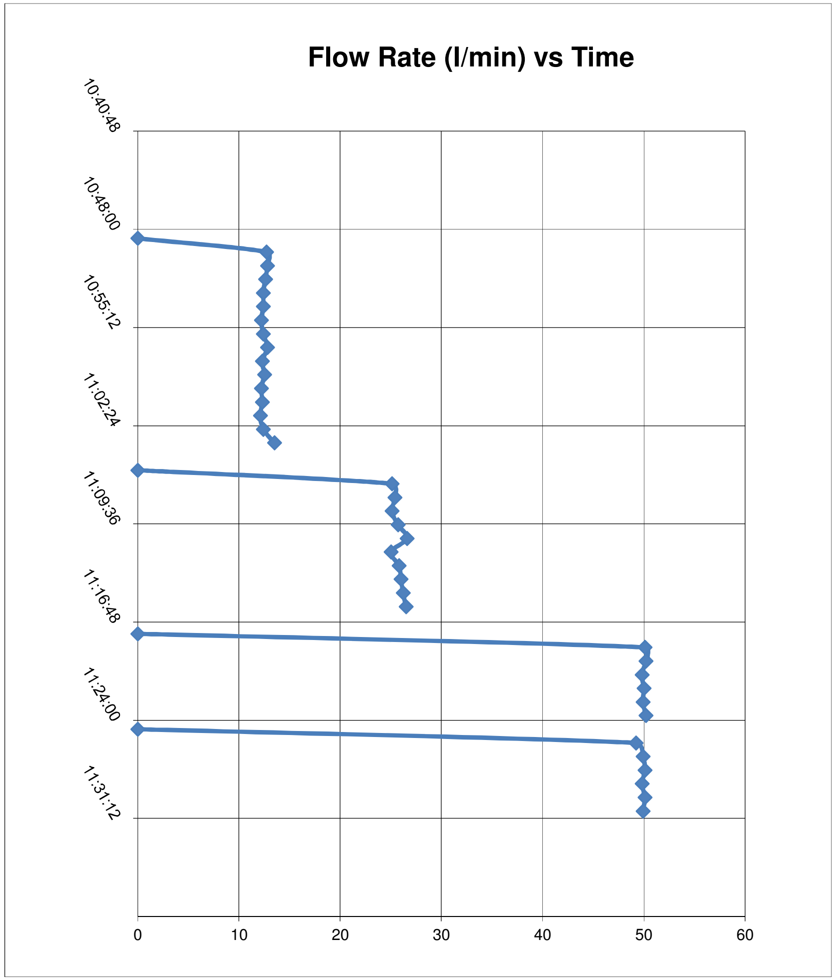
IN-SITU WATER PRESSURE TEST - DOUBLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

BH No RX627 **Test No.:** 3 **Test Depth Range (m):** 46.00 to 51.00 **Test Date:** 09/05/2018 **Test Time:** 10:30

Ground Level: (m AOD) 111.998 National Grid Coordinates: E: 413449.0 N: 141282.0 Borehole Inclination: (degrees from vertical) 0 Borehole Orientation: (degrees) Not applicable

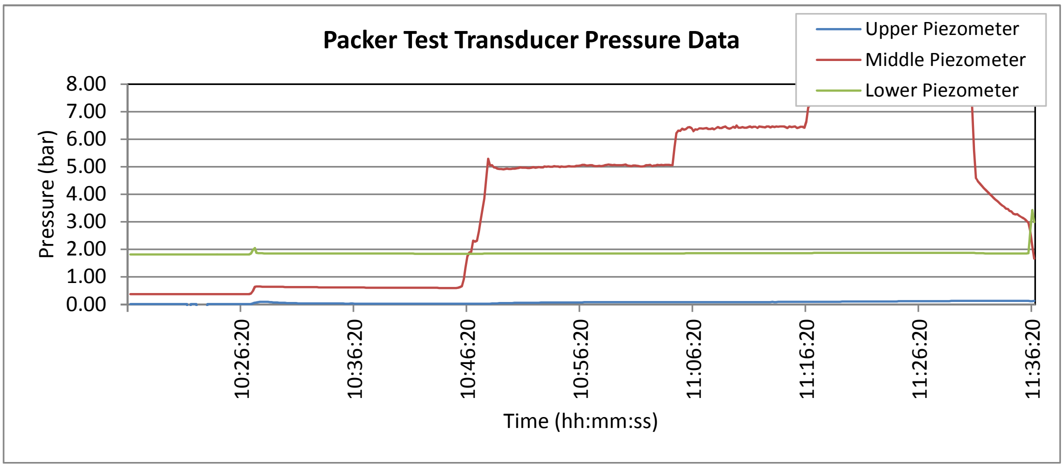




STRUCTURAL SOILS LTD The Old School Stillhouse Lane Bedminster BRISTOL, BS3 4EB	Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	Contract Ref:	733442
	Stuart Pearce	09/05/2018	Matt Jones		10/05/2018	Adam Lumber	[redacted]	08/08/2018		
	Contract:		A303 - Phase 6 Ground Investigation		Client	Highways England			Page	3 of 4

IN-SITU WATER PRESSURE TEST - DOUBLE PACKER
In accordance with BS EN ISO 22282-3 (2012)

Borehole: RX627 **Test No:** 3 **Test Depth Range:** 46.00 to 51.00 **Date:** 09/05/2018



Initial pressure: 4.00 bar

Required overpressure:	1.00	2.00	3.00	3.00	bar
Test pressure:	5.00	6.00	7.00	7.00	bar
Max allowed:	5.10	6.20	7.30	7.30	bar
Min allowed:	4.90	5.80	6.70	6.70	bar

Start time:	10:48:40	11:05:40	11:17:40	11:24:40	
End time:	11:04:30	11:16:20	11:24:20	11:31:00	
Duration:	00:15:50	00:10:40	00:06:40	00:06:20	
Average pressure:	5.02	6.43	7.36	7.34	bar
Exceedance:	*0*	*7*	*5*	*5*	*%*
Maximum pressure:	5.08	6.63	7.40	7.40	bar
Exceedance:	*1*	*3*	*1*	*1*	*%*
Minimum pressure:	4.90	6.29	7.31	7.18	bar
Exceedance:	*-2*	*-2*	*-1*	*-2*	*%*
Average overpressure:	1.02	2.43	3.36	3.34	bar

Comparison of measured (from vibrating wire) and calculated hydrostatic pressures

Vib Wire	Test Section m bgl		Distance from mid'	Expected depth	Initial GW level m bgl	Vib wire pressure		Hydrostatic head m	Difference (m head)	Pass/Fail
Position	Top	Bottom				bar	m head			
Top	46.00	51.00	3.51	44.99	43.86	0.02	0.17	1.13	-0.96	Pass
Middle			1.25	47.25		0.37	3.75	3.39	0.36	Pass
Bottom			-3.05	51.55		1.81	18.14	7.69	10.45	Fail

IN-SITU WATER PRESSURE TEST - DOUBLE PACKER
In accordance with BS EN ISO 22282-3 (2012)

Borehole No.: RX627 **Test No.:** 4 **Test Depth Range (m):** 48.00 to 53.00 **Test Date:** 09/05/2018 **Test Time:** 12:40

Ground Level (m AOD): 111.99 National Grid Coordinates: E: 413449.0 N: 141282.0 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

INSTALLATION DETAILS

BOREHOLE DETAILS	
Borehole Drilling Method	Rotary coring
Daimeter of borehole in test section, d (mm)	150
Depth to base of borehole casing (m)	4.00
Depth to base of borehole at start of test (m)	70.00
Inital groundwater level (m bgl)	44.02
Initial hydrostatic pressure in test zone (from VW2)	0.58

TEST DETAILS	
Depth BGL to top of test section (m)	48.00
Depth BGL to midpoint of test section (m)	50.50
Depth BGL to base of test section (m)	53.00
Length of test section, L (m)	5.00
Rock type under test	CHALK
Weather during test	Sunny

EQUIPMENT DETAILS

	Packer 1 (Upper)	Packer 2 (lower)
Packer Type	Pneumatic	Pneumatic
Serial No.	Not recorded	Not recorded
Length (m)	1.30	1.30
Inflation Pressure (bar)	16.0	16.0

Flowmeter type	Paddle wheel
Flowmeter serial number	Not recorded
Water Pump Type	Not recorded
Water Pump Serial Number	Not recorded
Injection Water Temperature (^oC)	Not recorded

Pressure Transducer		Distance from centre of test section (m bgl)	Depth m bgl)	Manufacturer	Serial Number
VW1	TOP - Above Test Section	3.51	46.99	Not recorded	Not recorded
VW2	MIDDLE - Within Test Section	1.25	49.25	Not recorded	Not recorded
VW3	BASE - Below Test Section	-3.05	53.55	Not recorded	Not recorded
		(Distances BELOW centre to be entered as negative)			

STRUCTURAL SOILS LTD The Old School Stillhouse Lane, Bedminster BRISTOL, BS3 4EB	Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	Contract Ref:	733442
	Stuart Pearce	09/05/2018	Matt Jones		10/05/2018	Adam Lumber	[redacted]	08/08/2018		
	Contract:		A303 - Phase 6 Ground Investigation		Client	Highways England			Page	1 of 4

IN-SITU WATER PRESSURE TEST - DOUBLE PACKER

In accordance with BS EN ISO 22282-3 (2012)

Borehole No.: RX627 **Test No.:** 4 **Test Depth Range (m):** 48.00 to 53.00 **Test Date:** 09/05/2018 **Test Time:** 12:40

Ground Level (m AOD): I11.998 National Grid Coordinates: E: 413449.0 N: 141282.0 Borehole Inclination: 0 (degrees from vertical) Borehole Orientation: Not applicable (degrees)

SUMMARY OF KEY INSTALLATION DETAILS

Daimeter of borehole in test section, D (m)	0.150
Depth to base of borehole casing (m)	4.00
Depth to base of borehole at start of test (m)	70.00
Inital groundwater level (m bgl)	44.02
Initial hydrostatic pressure in test zone (from VW2)	0.58

Depth BGL to top of test section (m)	38.70
Depth BGL to midpoint of test section (m)	40.30
Depth BGL to base of test section (m)	41.90
Length of test section, L (m)	3.20

TEST READINGS

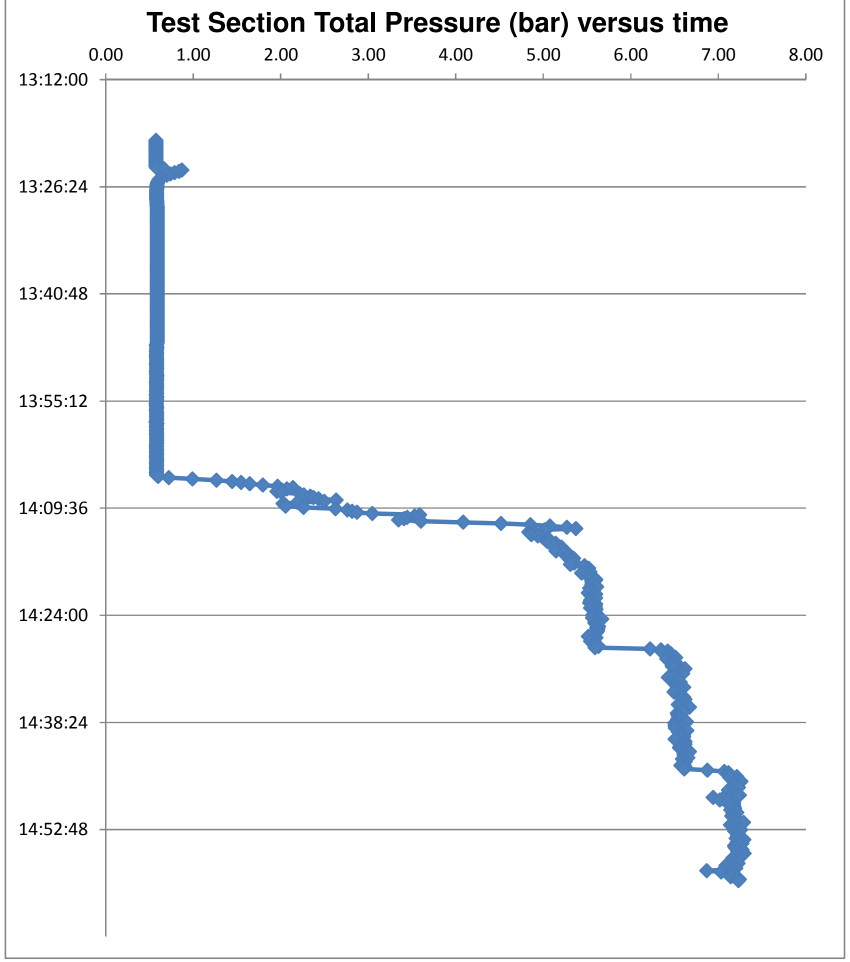
Stage	Effective test pressure, P (bar)	Test Increment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Average flow, Q (litres/min)
1	4.89	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**46.89**
		Flowmeter readings (litres)	0.000	44.300	90.400	135.500	180.700	226.000	272.900	319.900	366.700	416.000	464.400	512.300	560.200	608.000	655.800	703.300					
		Water Take (litres)	0.000	44.300	46.100	45.100	45.200	45.300	46.900	47.000	46.800	49.300	48.400	47.900	47.900	47.800	47.800	47.500					
2	5.98	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**58.73**
		Flowmeter readings (litres)	0.000	58.000	117.900	177.600	236.300	294.900	353.300	412.000	470.400	528.700	586.900	646.300	705.100	763.800	822.400	880.900					
		Water Take (litres)	0.000	58.000	59.900	59.700	58.700	58.600	58.400	58.700	58.400	58.300	58.200	59.400	58.800	58.700	58.600	58.500					
3	6.60	Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**70.73**
		Flowmeter readings (litres)	0.000	72.200	144.100	219.100	287.100	358.800	429.900	500.100	570.400	641.100	711.900	782.800	852.900	922.100	990.300	1060.900					
		Water Take (litres)	0.000	72.200	71.900	75.000	68.000	71.700	71.100	70.200	70.300	70.700	70.800	70.900	70.100	69.200	68.200	70.600					
4		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**0.00**
		Flowmeter readings (litres)																					
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000										
5		Time (min)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15					**0.00**
		Flowmeter readings (litres)																					
		Water Take (litres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000										

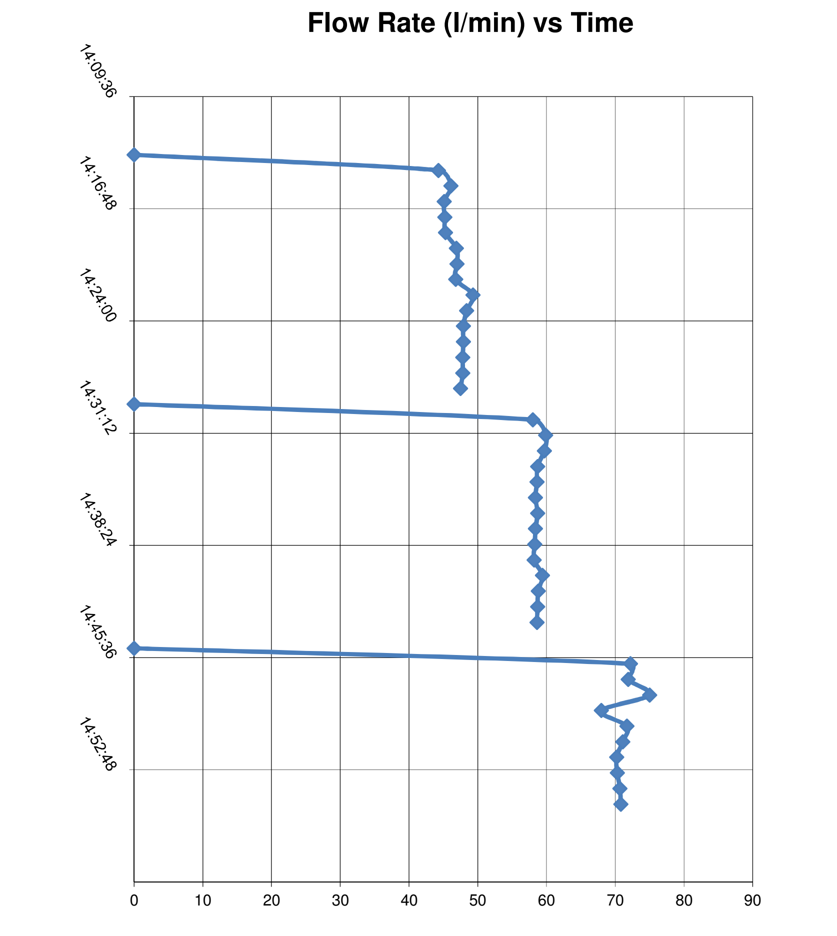
TEST REMARKS	
	1. 16 bar inflation pressure maintained from beginning of test.
	2. Test terminated at 15:00 at client's instruction due to water level rise of 4m.
	3

STRUCTURAL SOILS LTD The Old School Stillhouse Lane, Bedminster BRISTOL, BS3 4EB	Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	**Contract Ref:**	**733442**
	Stuart Pearce	09/05/2018	Matt Jones		10/05/2018	Adam Lumber	[redacted]	08/08/2018		
	Contract:		**A303 - Phase 6 Ground Investigation**		**Client**	**Highways England**			**Page**	**2 of 4**

IN-SITU WATER PRESSURE TEST - DOUBLE PACKER
In accordance with BS EN ISO 22282-3 (2012)

BH No RX627	**Test No.:**	**4**	**Test Depth Range (m):**	48.00	to	53.00	**Test Date:**	09/05/2018	**Test Time:** 12:40
Ground Level: 111.998 (m AOD)	National Grid Coordinates:	E:	413449.0	N:	141282.0	Borehole Inclination: (degrees from vertical)	0	Borehole Orientation: (degrees)	Not applicable

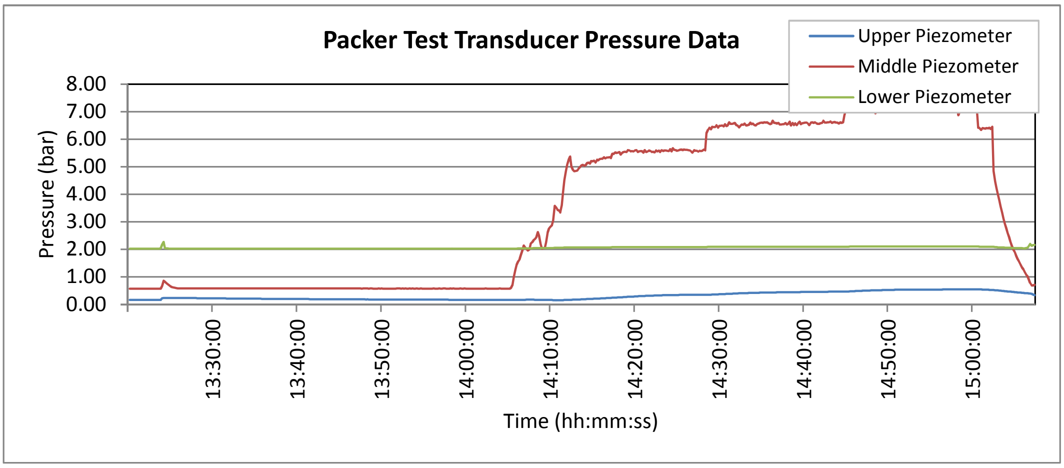




STRUCTURAL SOILS LTD **The Old School** **Stillhouse Lane** **Bedminster** **BRISTOL, BS3 4EB**	Test Operator		Compiled by		Date	Checked by (the Responsible Expert)		Date	**Contract Ref:**
	Stuart Pearce	09/05/2018	Matt Jones		10/05/2018	Adam Lumber	[redacted]	08/08/2018	**733442**
	Contract:		**A303 - Phase 6 Ground Investigation**		**Client**	**Highways England**			**Page** 3 **of** 4

IN-SITU WATER PRESSURE TEST - DOUBLE PACKER
In accordance with BS EN ISO 22282-3 (2012)

Borehole: RX627 **Test No:** 4 **Test Depth Range:** 48.00 to 53.00 **Date:** 09/05/2018



Initial pressure:	4.50 bar		
Required overpressure:	1.00	2.00	3.00 bar
Test pressure:	5.50	6.50	7.50 bar
Max allowed:	5.60	6.70	7.80 bar
Min allowed:	5.40	6.30	7.20 bar
Start time:	14:13:20	14:29:20	14:45:00
End time:	14:28:20	14:44:20	15:00:30
Duration:	00:15:00	00:15:00	00:15:30
Average pressure:	5.47	6.56	7.18 bar
Exceedance:	*-1*	*1*	*-4 %*
Maximum pressure:	5.67	6.67	7.29 bar
Exceedance:	*4*	*2*	*2 %*
Minimum pressure:	4.94	6.41	6.87 bar
Exceedance:	*-11*	*-2*	*-5 %*
Average overpressure:	0.97	2.06	2.68 bar

Comparison of measured (from vibrating wire) and calculated hydrostatic pressures

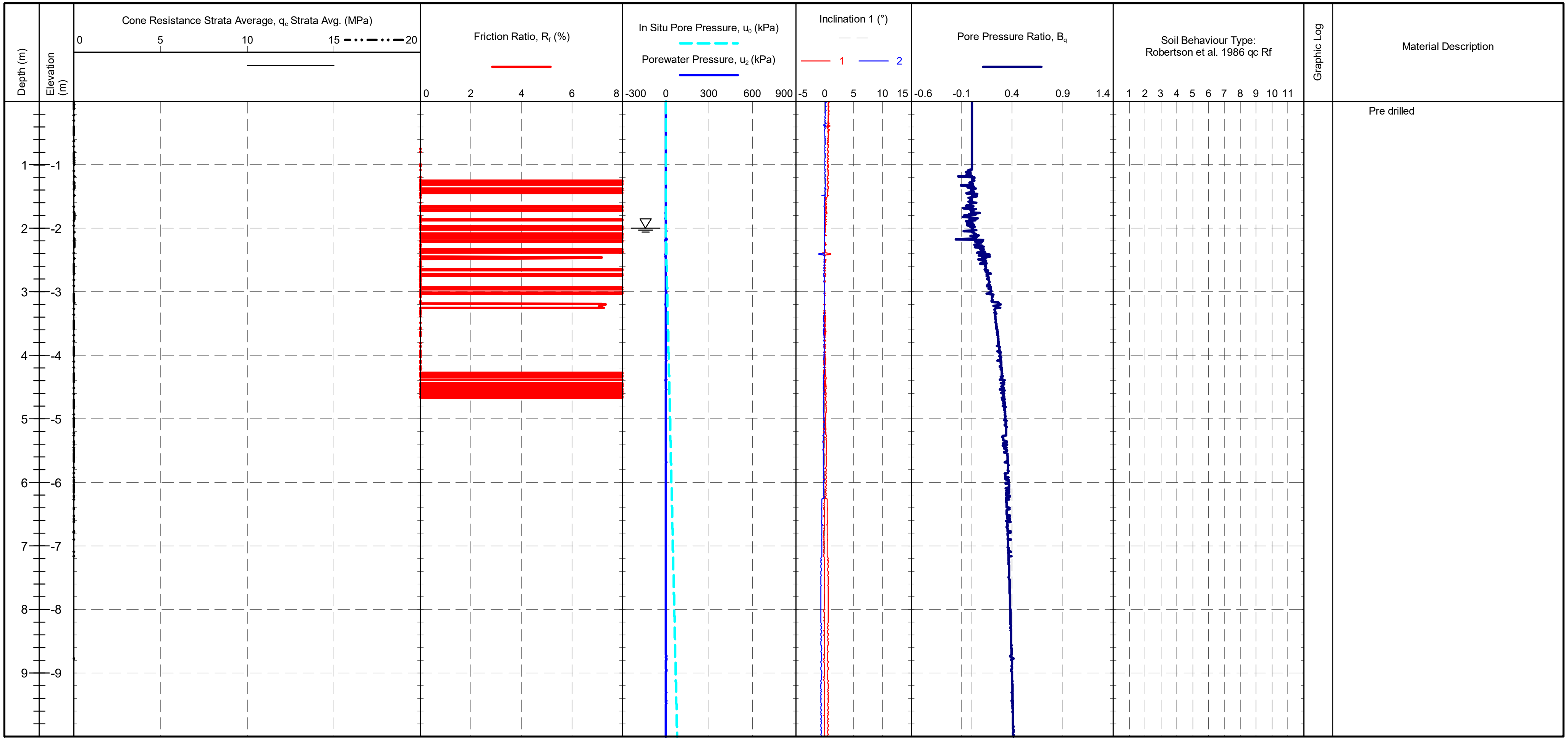
Vib Wire Position	Test Section m bgl Top	Test Section m bgl Bottom	Distance from mid'	Expected depth	Initial GW level m bgl	Vib wire pressure bar	Vib wire pressure m head	Hydrostatic head m	Difference (m head)	Pass/Fail
Top	48.00	53.00	3.51	46.99	44.02	0.17	1.72	2.97	-1.25	Pass
Middle			1.25	49.25		0.58	5.78	5.23	0.55	Pass
Bottom			-3.05	53.55		2.04	20.43	9.53	10.90	Fail

IN SITU SITE INVESTIGATION Working with: STRUCTURAL SOILS LTD

CPT LOG 01

PointID **GC605 - CPT01**

CLIENT : Highways England PROJECT : A303 LOCATION : A303 PROJECT No. : 1180279	EASTING : 412297.0 NORTHING : 141864.0 ELEVATION : 92.81 CHECKED BY : LD TERMINATION REASON : Refusal	Remark : Test refused on total pressure.	SHEET : 1 OF 2 STATUS : Final TEST DATE : 07/06/2018 PLOT DATE : 14/06/2018 METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1485 CONE AREA : 15cm² CONE AREA RATIO : 0.79 FILTER POSITION : u2 FILTER TYPE : HDPE FRICTION REDUCER : None	TEST TYPE : TE2 APPLICATION CLASS : 2 RIG : CPT 007 OPERATOR : DW & AG FILE NAME : 1180279-CPT 01 WEATHER : Overcast & Hot	CPTU ZERO VALUES	METHOD: Robertson et al. 1986 qc Rf

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
Tip	285 mV	282 mV	-0.033 MPa
Sleeve	249 mV	248 mV	-0.001 kPa
Pore Pressure 2	206 mV	214 mV	0.002 kPa
X-Y Inclinometer	2538 mV	2502 mV	

METHOD: Robertson et al. 1986 qc Rf

1 - Sensitive fine grained material
2 - Organic material
3 - CLAY
4 - Silty CLAY to CLAY
5 - Clayey SILT to silty CLAY
6 - Sandy SILT to clayey SILT
7 - Silty SAND to sandy SILT
8 - SAND to silty SAND
9 - SAND
10 - Gravelly SAND to SAND
11 - Very stiff fine grained
12 - SAND to clayey SAND

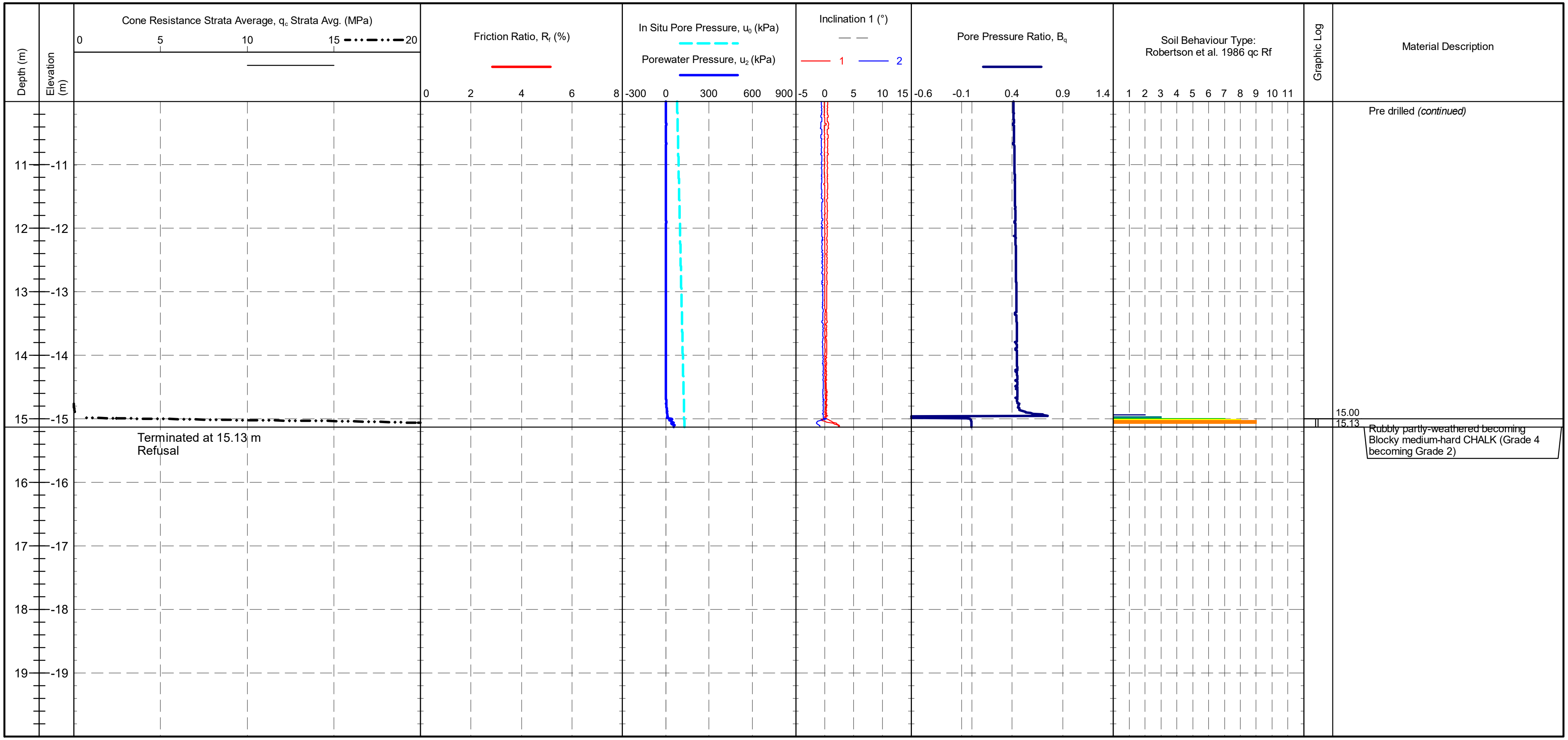
Groundwater Level
Dissipation Test

IN SITU SITE INVESTIGATION Working with: STRUCTURAL SOILS LTD

CPT LOG 01

PointID **GC605 - CPT01**

CLIENT : Highways England PROJECT : A303 LOCATION : A303 PROJECT No. : 1180279	EASTING : 412297.0 NORTHING : 141864.0 ELEVATION : 92.81 CHECKED BY : LD TERMINATION REASON : Refusal	Remark : Test refused on total pressure.	SHEET : 2 OF 2 STATUS : Final TEST DATE : 07/06/2018 PLOT DATE : 14/06/2018 METHOD : ISO 22476-1:2012



CONE ID : S15-CFIP.1485 CONE AREA : 15cm² CONE AREA RATIO : 0.79 FILTER POSITION : u2 FILTER TYPE : HDPE FRICTION REDUCER : None	TEST TYPE : TE2 APPLICATION CLASS : 2 RIG : CPT 007 OPERATOR : DW & AG FILE NAME : 1180279-CPT 01 WEATHER : Overcast & Hot	CPTU ZERO VALUES	METHOD: Robertson et al. 1986 qc Rf

CPTU ZERO VALUES

Transducer	Pre	Post	Difference
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1 - Sensitive fine grained material
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8 - SAND to silty SAND
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10 - Gravelly SAND to SAND
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Groundwater Level
Dissipation Test

A303 STONEHENGE
GROUND INVESTIGATION

Results of pressuremeter testing carried out by Cambridge Insitu Ltd

AECOM project reference:	**60547200**
Structural Soils reference	**733442**
Cambridge Insitu reference:	**CIR1417/18**
Original report date:	**July 2018**
Version:	**1.0**

Volume 1 of 2

TEXT REPORT WITH A SUMMARY OF THE RESULTS

CAMBRIDGE INSITU LTD
Little Eversden
Cambridge
ENGLAND
CB23 1HE

Tel: +44 1223 262361
Fax: +44 1223 263947
Email: cam@cambridge-insitu.com
[redacted]

TASKS	RESPONSIBLE	AFFILIATION
Initial calibration (HPD 'WALLY')	Kyle Clarkson	Cambridge Insitu Ltd
Pocket preparation	*Various*	Structural Soils
Field work	Robert Whittle	Cambridge Insitu Ltd
Preliminary analysis	Robert Whittle	Cambridge Insitu Ltd
Final analysis	Robert Whittle	Cambridge Insitu Ltd
Final reporting	Robert Whittle	Cambridge Insitu Ltd

PREFACE - EQUATIONS FOR MODULUS

Shear modulus G, where τ is shear stress and γ is shear strain: $G = \tau/\gamma$ [P.1]

G in terms of cavity strain ε_c and cavity pressure p_c: $2G = \delta p_c / \delta\varepsilon_c$ [P.2]

This is valid for a linear elastic response and a small strain alteration

Linear elastic Young's modulus E in terms of G, where v is Poisson's ratio: $E = 2(1+v)G$ [P.3]

Non-linear secant shear modulus G_s: $G_s = \alpha\gamma^{\beta-1}$ [P.4]

where α is the shear stress constant and β is the exponent of linearity obtained from fitting the reloading response in shear stress/shear strain space with a power function. γ is plane shear strain.

Non-linear secant Young's modulus E'_s using invariant shear strain γ_α: $E'_s = 2\alpha[1+v][\sqrt{3}\gamma_\alpha]^{\beta-1}$ [P.5]

Multiplying by $\sqrt{3}$ converts γ_α to γ assuming no volumetric strains are involved.

Non-linear tangential shear modulus G_t: $G_t = \alpha\beta\gamma^{\beta-1}$ [P.6]

Plane shear strain at failure, undrained case, c_u is undrained shear strength: $\gamma_f = [c_u/\alpha]^{1/\beta}$ [P.7]

Secant shear modulus at failure, in terms of stress: $G_s = \alpha[c_u/\alpha]^{(\beta-1)/\beta}$ [P.8]

For secant shear modulus at mobilised stress levels less than failure, introduce n where $0 < n \leq 1$: $G_n = \alpha[nc_u/\alpha]^{(\beta-1)/\beta}$ [P.9]

For the special case of G_{50} at half of the ultimate shear strength: $G_{50} = \alpha[c_u/2\alpha]^{(\beta-1)/\beta}$ [P.10]

Finding G_{max} using the modified hyperbolic function (Fahey & Carter, 1993) $G_s/G_{max} = 1-f[\tau/\tau_f]^g$ [P.11]

G_s is secant shear modulus at a given fraction of mobilised shear stress. f and g are shape factors discovered by finite element modelling.

Table of Contents

VOLUME 2 DATA FOR BOREHOLE SBP604 AND CALIBRATIONS

A303 STONEHENGE – GROUND INVESTIGATION

1 INTRODUCTION

Cambridge Insitu Ltd (CI) was contracted by Structural Soils Ltd (the Contractor) to carry out pressuremeter testing at a single location adjacent to Stonehenge. This testing forms part of the feasibility study into the possibility of tunnelling sections of the A303. The material at this location is chalk, potentially phosphatic, and the purpose of the pressuremeter testing was obtaining engineering parameters for strength, stiffness, and if possible data for estimating the insitu stress state.

The Client was Highways England, and their representative was Aecom, who instructed and supervised the pressuremeter operation.

The field work took place between the 1st and 5th June 2018. Seven successful tests were made between 18 and 36 metres below surface. The sixth test was ended by the membrane rupturing but not before a reasonable quantity of data had been recorded. The type of pressuremeter used was a 95mm High Pressure Dilatometer (HPD) that is placed in a pre-bored cavity. The cavity wall is completely unloaded prior to the pressuremeter test commencing and this gives some alteration of the insitu stress state. A less disruptive type of pressuremeter test had been specified, using a self-boring probe. The chalk itself could almost certainly be self-bored but if flint was encountered then the test would be severely affected. Pre-boring using conventional rotary coring techniques was the compromise adopted.

This report is concerned only with the presentation of the pressuremeter test results. Any preliminary results are now superseded by the values reported here.

For details of the material, borehole locations etc refer to the report issued by Structural Soils Ltd (their reference 733442).

1.1 Instrument

The 95mm diameter Cambridge High Pressure Dilatometer is based on a smaller design by Dr J.M.O Hughes and was developed to carry out a pressuremeter test in soft to weak rock. In use the instrument is lowered into a nominal 101mm pocket, usually made by a rotary coring rig. Once in position, oil or gas pressure is applied down an umbilical and inflates a membrane covering the central third of the probe, so loading the borehole wall. The expansion of the membrane is monitored by sensitive feelers or 'arms' and the pressure applied is measured by transducers in the probe. The output of the probe is digital data; when converted to engineering units this gives a pressure/displacement curve of the horizontally orientated loading test. It is a complex instrument by normal site standards, uses strain gauged transducers throughout and incorporates a microprocessor controlled data acquisition system.

Although developed to test ground of the strength of weak rock, the pressure and displacement resolution of the instrument is such that it can operate at two extremes of ground conditions. The first is moderately weak rock, where it is likely the ground will only deform elastically and the pressure capability of the instrument will determine the end of the test. The second condition is typically stiff clay or dense sand, when the material will experience substantial plastic deformation at relatively modest pressures, and the strain range of the probe decides the limit of the test.

1.2 Analysis - general

The pressuremeter loading curve can be solved directly using mathematical expressions for the expansion of a cylindrical cavity. The solution conventionally is quoted in terms of stiffness and strength parameters for the material, specifically shear modulus, shear strength or friction angle as appropriate, and the insitu lateral stress. A number of simplifying assumptions are made about the nature of the test and the ground. For example it is assumed that the material is fully saturated, homogenous, isotropic and behaving as a continuum that fails in shear only and that the length of the pressuremeter is sufficient for the test to be modelled as a plane strain expansion.

It is also assumed that the cavity expands as a circle and hence the results have been obtained by analysing the curve derived from the average of all displacement followers as this gives the best representation of a circular expansion. The pressuremeter expands in an approximately circular manner, even if the resulting circle is offset with respect to the pressuremeter axis. Cavity expansion theory usually demands a circular expansion, so a plot of average displacement versus applied pressure is used in the analysis procedure.

The pressuremeter test gives data for the total radial stress and radial displacements of the cavity wall. The displacements are directly related to the hoop strain. In order to solve the boundary problem represented by a cavity expansion the radial strain and circumferential stress must also be known. If it is assumed that the test is undrained (as it usually is for clays) then the loading takes place without generating volumetric strains. This means that radial and shear strains are derived easily from circumferential strain. If the expansion is drained then a more complex solution is required, with shear and volumetric strains derived using assumptions about the dilatant behaviour of the material.

1.3 Analysis – specific parameters

These tests in chalk appear to be drained events in material showing yield for a relatively modest loading stress. They have therefore been treated as cavity expansions in a soil-like material. The decision about which type of analysis is appropriate is guided by the response of the unload/reload cycles, as these indicate if the mean effective stress is changing with the expansion.

For tests in high permeability material the solution proposed by Hughes et al (1977) has been used to identify values for the internal angle of friction and dilation. These estimates, together with other parameters, are used as input for a curve comparison routine based on Carter et al (1986). Some additional information (not directly measured by the HPD) is also required, such as the ambient pore water pressure and the critical state or constant volume friction angle. In general these have to be estimated, although there are techniques for guiding the interpretation.

Values for cavity reference pressure are obtained in the first instance using the construction due to Marsland & Randolph (1978). This method is sensitive to insertion disturbance, and the values quoted in the results have been derived predominantly from the curve optimisation process. On some tests we have experimented with the 'balance point check' technique as an alternative method of deriving insitu lateral stress estimates (Hoopes & Hughes, 2013) and this is explained in Part 5 of this report.

By estimating the overburden and likely pore water profile, and assuming that the best estimate of cavity reference pressure represents the total insitu lateral stress, the co-efficient of earth pressure at rest, k_o, can be derived.

Modulus data are obtained from the local slope of parts of the pressure/strain test curve, or preferable from small cycles of unloading and reloading. The initial slope will be influenced by disturbance - unload/reload cycles avoid this problem and are able to give consistent and repeatable descriptions of stiffness characteristics. In particulate material these cycles appear hysteretic and this non-linearity allows the degradation of stiffness with increasing strain to be described (Bolton & Whittle, 1999).

Pressuremeters shear the material and so the modulus obtained is shear modulus G. If Young's modulus E is required then provided the material is isotropic the relationship $E = 2G(1+\mu)$ can be used where μ is Poisson's ratio. Shear modulus from a horizontally oriented cavity expansion is G_{HH} and will probably need adjustment when used to calculate vertically influenced deformation.

Modulus parameters are also stress dependent. In drained material the mean effective stress and hence the modulus increases throughout the loading and a more complex procedure is required to find the equivalent modulus at the insitu stress state. A modified version of the Bellotti et al (1989) approach has been adopted and the results are given in Table 3.4. An attempt has also been made to estimate the maximum shear modulus and threshold elastic shear strain, using an approach suggested by Fahey & Carter (1993). These results are given in Table 3.5 and are speculative. If comparable data are available from small strain stiffness tests or seismic profiling it may be possible to fine tune our results.

1.4 Report layout

Although it is necessary to make judgments when analysing the data, this remains a factual report. The parameters derived represent what seems a reasonable choice having applied a particular analysis. Other choices are possible and the intention is that this report provides a full description of the tests and analytical methods employed so that the choices made here can be checked or modified. Section three of this volume contains tables of all the results with some figures showing parameters plotted against depth. There are some comments on the tests in section 5.

Appendix D is a guide to the analyses that have been applied, and uses examples from the tests on this contract to show how choices are made and the implications.

The header used on every page of this text report refers to the contract and the approximate date of the field work. The footer (intended for CI internal use only) refers to the document name and version number.

All the test data plots are given in Volume 2 of this report. The raw test data are` also available as files of readings in engineering units in a format easily accessed by several common spreadsheet programs.

1.5 Notation

The data collection system employed on site utilises a limited keyboard that restricts the options for describing a test. In particular it stores tests in the form B*** T** where *** must be a number. The 'B', which may be modified, is intended to refer to the borehole and the 'T' refers to the individual test. The location tested was designated SBP604 so a typical test reference used here is S604T2 – the second test in borehole SBP604. This is a limitation of the data collection software only, the analysed data uses different software and the full test reference.

Calibration tests to evaluate membrane stiffness and system compliance are reported in a similar manner, but using a test number that cannot be confused with an actual test.

1.6 Units

Pressure is quoted throughout in pascals. The smallest increment of pressure quoted is 0.1 kPa. Displacements are quoted in millimetres up to 4 decimal places. Once an estimate of the insitu lateral stress has been made, so allowing the original cavity diameter to be inferred, then displacements are converted to percent cavity strain.

2. DETAILS OF THE WORK CARRIED OUT

Table 2.1 Tests included

Test Name	Internal Ref.	Depth	Date	Max Press.	HPD Probe	Oper.	Transducer calibration	Membrane calibration	Stiffness calibration
SBP604		**(mBGL)**		**(kPa)**					
Test 1	S604T1	18.25	01-Jun-18	5094	Wally	RWW	23-May-18	Z2305T28	Z2305T18
Test 2	S604T2	21.10	01-Jun-18	5001	Wally	RWW	23-May-18	Z2305T28	Z2305T18
Test 3	S604T3	25.05	04-Jun-18	6411	Wally	RWW	23-May-18	Z2305T28	Z2305T18
Test 4	S604T4	27.25	04-Jun-18	6264	Wally	RWW	23-May-18	Z2305T28	Z2305T18
Test 5	S604T5	30.75	04-Jun-18	7286	Wally	RWW	23-May-18	Z2305T28	Z2305T18
Test 6	S604T6	34.05	05-Jun-18	7331	Wally	RWW	23-May-18	W0606T1	W0506T1
Test 7	S604T7	37.20	05-Jun-18	7890	Wally	RWW	23-May-18	W0606T1	W0506T1

Notes:

1. Depth is metres below ground level to the centre point of the expanding membrane. For the HPD the membrane is 0.6m long, so ±0.3m of the quoted depth is loaded during the test.
2. 'Max Press' is the maximum pressure reached during the test.
3. Probe – One probe was used for all tests, a 95mm diameter High Pressure Dilatometer (HPD) known as 'Wally'.
4. The probe has a calibration for its transducers, and additional calibrations for the membrane being used. The transducer calibrations are only carried out occasionally, the membrane calibrations are performed every time a membrane is changed.
5. 'Oper.' Is the operator. The tests were carried out by Robert Whittle of Cambridge Insitu Ltd.

3. SUMMARY OF RESULTS

Table 3.1 Initial stress state -

Test	Date	Depth (mBGL)	Origin (mm)	u_o (kPa)	σ_{ho} (kPa)	σ_{vo} (kPa)	k_o	k_o (M&K)	OCR
SBP604 Test 1	01-Jun-18	18.25	103.8	0	616	365	1.69	1.40	8.0
SBP604 Test 2	01-Jun-18	21.10	108.2	0	612	422	1.45	1.34	7.2
SBP604 Test 3	04-Jun-18	25.05	105.5	25	727	501	1.47	1.40	7.9
SBP604 Test 4	04-Jun-18	27.25	104.7	47	622	545	1.15	1.29	6.6
SBP604 Test 5	04-Jun-18	30.75	105.8	81	743	615	1.24	1.28	6.7
SBP604 Test 6	05-Jun-18	34.05	102.7	113	833	681	1.27	1.18	6.3
SBP604 Test 7	05-Jun-18	37.20	106.2	144	993	744	1.42	1.07	5.3

Notes on table 3.1

1. **Depth** is the distance below ground level to the centre of the pressuremeter measuring section.
2. **Origin** is the estimated diameter of the cavity when insitu conditions are restored. The cavity was initially cored at 101mm diameter.
3. $\mathbf{u_o}$ is the ambient pore water pressure based on an assumed water table at 22.5mBGL.
4. σ_{ho} is our best estimate of the lateral insitu stress. A number of techniques are available for identifying the lateral stress, and curve matching has been used to justify the choice made.
5. The pressuremeter cannot determine the total vertical stress, and so the table gives our best estimate. This affects k_o **(**the coefficient of earth pressure at rest) and OCR (the over-consolidation ratio).
6. $\mathbf{k_o}$ is the coefficient of earth pressure at rest, being the ratio of the effective lateral stress to the effective vertical stress, using the results in previous columns.
7. $\mathbf{k_o}$ **(M&K)** is the coefficient of earth pressure obtained from the correlation suggested by Mayne & Kulhawy (1983) that combines the internal friction angle and the over consolidation ratio.
8. **OCR** is over consolidation ratio, a quasi-result using the ratio of the observed effective yield stress to the effective overburden stress.

Table 3.2 Parameters associated with strength

Test	Date	Depth	p_f (obs)	p_f (calc)	p_{lim}	c′	τ_f	ϕ'	ψ	ϕ'_{cv}
		(mBGL)	(kPa)	(kPa)	(kPa)	(kPa)	(kPa)	(°)	(°)	(°)
SBP604 Test 1	01-Jun-18	18.25	2929	1295	22688	58	416	36.9	10.4	28.0
SBP604 Test 2	01-Jun-18	21.10	3023	1176	13881	22	331	30.7	3.1	28.0
SBP604 Test 3	04-Jun-18	25.05	3786	1441	27006	166	526	33.5	6.4	28.0
SBP604 Test 4	04-Jun-18	27.25	3341	1122	15805	46	327	29.9	2.1	28.0
SBP604 Test 5	04-Jun-18	30.75	3663	1528	26328	98	448	33.6	6.6	28.0
SBP604 Test 6	05-Jun-18	34.05	3671	2118	38144	566	892	38.8	12.9	28.0
SBP604 Test 7	05-Jun-18	37.20	3311	2117	46951	248	718	38.0	11.9	28.0

Notes on table 3.2

1. $\mathbf{p_f}$ (obs) is observed yield stress, the point where the loading response becomes noticeably curved.
2. $\mathbf{p_f}$ (calc) is calculated yield stress, the point where the curve fitting procedure indicates the loading response first becomes fully plastic.
3. $\mathbf{p_l}$ is limit pressure, derived from curve fitting. Because at some strain the chalk is prone to suffering a pore collapse these will be optimistic.
4. **c′** is drained cohesion, obtained from curve fitting. It is not possible to say from the pressuremeter results only whether these are reasonable values.
5. τ_f is mobilised shear stress at first yield, being $p'_o \sin\phi' + c' \cos\phi'$.
6. ϕ' is the peak angle of internal friction from the slope of the plot of log effective radial stress vs log cavity strain (Hughes et al, 1977).
7. ψ is dilation angle and is derived in the same way as the friction angle. The procedure requires that ϕ_{cv} be known. We have assumed 28°.

Table 3.3 Linear and non-linear parameters for deriving shear modulus

Test name SBP604	Depth (mBGL)	G_i (MPa)	Loop No.	G_{ur} (MPa)	Constant α (MPa)	Exponent β	G_s for $\gamma = 10^{-4}$ (MPa)	G_s for $\gamma = 10^{-3}$ (MPa)	G_s for $\gamma = 10^{-2}$ (MPa)	E_s for $\gamma = 10^{-4}$ (MPa)	E_s for $\gamma = 10^{-3}$ (MPa)	E_s for $\gamma = 10^{-2}$ (MPa)
Test 1	18.25	129	1	207	132.120	0.950	209	187	166	489	436	388
			2	361	189.219	0.935	344	296	255	797	687	591
			3	742	196.114	0.843	833	580	404	1833	1277	890
			4	1070	219.198	0.813	1227	798	519	2657	1728	1123
			5	901	146.644	0.758	1362	780	447	2862	1640	939
Test 2	21.10	114	1	407	172.786	0.903	422	338	270	961	768	615
			2	693	222.471	0.861	800	581	422	1780	1292	938
			3	770	136.672	0.775	1086	647	385	2303	1372	817
			4	660	95.133	0.727	1176	627	334	2429	1295	691
Test 3	25.05	231	1	1012	553.333	0.935	1007	867	746	2332	2008	1729
			2	1204	299.337	0.838	1331	917	631	2922	2012	1386
			3	1164	291.729	0.830	1396	944	638	3052	2064	1395
			4	974	296.273	0.834	1367	933	636	2994	2043	1394
Test 4	27.25	148	1	818	564.047	0.969	750	699	651	1771	1649	1535
			2	1025	161.864	0.768	1371	804	471	2897	1698	995
			3	1032	128.443	0.751	1273	717	404	2664	1501	846
			4	957	150.607	0.758	1399	801	459	2940	1684	965
Test 5	30.75	172	1	744	668.041	0.996	693	687	680	1660	1645	1630
			2	1074	570.812	0.929	1098	932	792	2534	2152	1827
			3	1101	403.056	0.878	1240	936	707	2783	2101	1587
			4	969	124.533	0.724	1582	838	444	3263	1728	915
Test 6	34.05	266	1	1032	173.706	0.814	963	628	409	2088	1360	886
			2	1350	252.510	0.807	1494	958	614	3224	2068	1326
			3	1341	289.798	0.812	1637	1062	689	3544	2299	1491
Test 7	37.20	306	1	1158	504.909	0.929	971	825	700	2241	1903	1616
			2	1371	466.978	0.875	1477	1107	830	3309	2481	1861
			3	1481	240.215	0.775	1908	1137	677	4047	2411	1436
			4	1471	268.535	0.779	2056	1236	743	4370	2627	1579

Notes on table 3.3

1. G_i is secant shear modulus from the initial slope. It is affected by insertion disturbance, so a comparison between this value and that from the first unload/reload cycle may be a useful indicator of the degree of disturbance.

2. G_{ur} is modulus obtained by taking the slope of the chord bisecting a cycle of unloading and reloading. This can only be shear modulus if the material response over the strain range of the cycle is linear elastic.
3. In practice, the strain behaviour of particulate material before achieving the peak strength (yield) is highly non-linear, a response which can be described by a power law. Secant shear modulus is given by a power law of the form $G_s=\alpha\gamma^{\beta-1}$ where α and β are discovered from a plot of reloading data on log scales.
4. If the response were linear elastic then β = 1 and α would be identical to G_{ur}.
5. Tangential modulus G_t is given by a power law of the form $G_t=\alpha\beta\gamma^{\beta-1}$
6. For comparison purposes, secant shear modulus parameters are given at three plane shear strain levels, γ of $1x10^{-2}/10^{-3}/10^{-4}$, but any value of shear strain can be used in the range 10^{-4} to 10^{-2}. All these modulus values are G_{hh}.
7. To quote values for secant Young's modulus E_s in the *axial* strain range 10^{-4} to 10^{-2} use the following relationship: $E_s = 2\alpha(1+v)\ (\gamma\sqrt{3})^{\beta-1}$ where *v* is Poisson's ratio. The last 3 columns give the undrained Young's modulus calculated in this way (using a *v* of 0.2).

Table 3.4 Stress adjusted parameters for deriving shear modulus

Test name SBP604	Depth (mBGL)	ϕ' (Deg)	c' (kPa)	Loop No.	Start Pressure (kPa)	σ'_{av} (MPa)	Janbu exponent	α_{adj} (MPa)	β	Best choice α^*_{adj} (MPa)	Best choice β
Test 1	18.25	36.9	58	1	540	0.309	0.637	205.161	0.950	89.437	0.805
				2	907	0.538		206.307	0.935		
				3	2014	1.230		126.276	0.843		
				4	4020	2.483		90.212	0.813		
				5	5094	3.154		51.822	0.758		
Test 2	21.10	30.7	22	1	1024	0.665	0.380	167.388	0.903	97.828	0.788
				2	2033	1.334		165.414	0.861		
				3	4063	2.677		77.952	0.775		
				4	5001	3.298		50.119	0.727		
Test 3	25.05	33.5	166	1	1522	0.875	0.053	546.871	0.935	274.941	0.834
				2	3079	1.878		284.053	0.838		
				3	4570	2.839		270.810	0.830		
				4	6411	4.026		269.961	0.834		
Test 4	27.25	29.9	46	1	1928	1.229	0.084	529.179	0.969	126.822	0.759
				2	4048	2.644		142.383	0.768		
				3	5270	3.459		110.459	0.751		
				4	6264	4.122		127.623	0.758		
Test 5	30.75	33.6	98	1	2114	1.257	0.300	551.388	0.996	390.954	0.934
				2	4091	2.529		382.088	0.929		
				3	6019	3.770		239.387	0.878		
				4	7287	4.586		69.747	0.724		
Test 6	34.05	38.8	566	1	2209	1.017	0.454	148.480	0.814	148.651	0.811
				2	4070	2.161		153.287	0.807		
				3	6004	3.350		144.186	0.812		
Test 7	37.20	38.0	248	1	2078	1.076	0.267	473.944	0.929	229.771	0.840
				2	4141	2.353		355.692	0.875		
				3	6156	3.600		163.328	0.775		
				4	7890	4.673		170.291	0.779		

Notes on Table 3.4

1. Stiffness in soil is stress and strain dependent. Because the tests are drained events every unload/reload cycle is taken at a different mean effective stress and gives a different result. From knowing some points on the stiffness/mean effective trend it is possible to correct or adjust to a reference stress level. For these tests the chosen reference stress is the effective horizontal stress, σ'_{ho} (see Table 3.1).
2. The data in table 3.3 are used to obtain from each loop a value for shear modulus at 0.1% shear strain, $G_{0.1\%}$
3. Estimate the mean effective stress at the cavity wall for each loop, σ'_{av}. The pressure at the start of each cycle can be used to give the radial effective stress p'_c and an approximation of σ'_{av} is then given by $[p'_c /(1+\sin\phi_{pk})] - [c'\cos\phi_{pk} /(1+\sin\phi_{pk})]$ where ϕ_{pk} and c' are peak angle of internal friction and drained cohesion
4. Plot $G_{0.1\%}$ values against σ'_{av} values and use this trend to obtain the exponent *n* of the power curve that best fits the response (Janbu, 1963). This describes the stress dependency.
5. For each loop calculate a stress adjusted or reference version of α (the shear stress constant) $\alpha_{adj} = \alpha[\sigma_{ho}/ \sigma'_{av}]^n$.
6. Thereafter stress adjusted values of shear modulus are obtained from $G_{ref} = \alpha_{ref}\gamma^{\beta-1}$ where γ is any value of shear strain in the range 10^{-4} to 10^{-2}.
7. To quote values for secant Young's modulus E_s in the *axial* strain range 10^{-4} to 10^{-2} use the following relationship: $E_s = 2\alpha_{ref}(1+v)(\gamma\sqrt{3})^{\beta-1}$ where *v* is Poisson's ratio.
8. Because 0.1% shear strain has been used to derive the stress dependency exponent *n*, the adjusted data is optimised for this strain. The exponent is itself strain dependent, and ideally the steps 2 and 4 should be repeated if a different strain required.
9. The procedure was developed for drained tests in sand, and its applicability to this material is therefore speculative. Some data selection are necessary to produce the 'best fit' results. The first cycle in the test may be too close to the origin to be representative. It can be difficult to determine the relevant local stress for a cycle taken on the final contraction.

Table 3.5 Estimating G_{max} –using Fahey & Carter, 1993.

Test	Depth (mBGL)	α^*_{adj} (MPa)	β	τ_f (kPa)	G_{max} (MPa)	γ_{elas}	G_{50} (MPa)	G_{100} (MPa)	γ_f **(%)**
SBP604 Test 1	18.25	89.437	0.805	416	672	3.3×10^{-5}	390	329	0.13
SBP604 Test 2	21.10	97.828	0.788	331	965	2.1×10^{-5}	546	453	0.07
SBP604 Test 3	25.05	274.941	0.834	526	1817	1.1×10^{-5}	1097	956	0.06
SBP604 Test 4	27.25	126.822	0.759	327	1937	1.2×10^{-5}	1049	842	0.04
SBP604 Test 5	30.75	390.954	0.934	448	973	9.4×10^{-7}	661	629	0.07
SBP604 Test 6	34.05	148.651	0.811	892	984	4.6×10^{-5}	576	490	0.18
SBP604 Test 7	37.20	229.771	0.840	718	1300	2.0×10^{-5}	790	692	0.10

Notes on table 3.5

1. This table gives the results of a speculative analysis to find the limits of the shear modulus parameters from the pressuremeter tests.
2. It is straightforward to rewrite the Bolton & Whittle 1999 result to give shear modulus in terms of the fraction of yielding shear stress : $G_n = \alpha[n\tau_f/\alpha]^{(\beta-1)/\beta}$. Here, n is the fraction and lies between zero and 1. The α value is α^*_{adj}.
3. Fahey & Carter (1993) use the following expression that relates the ratio of the current shear modulus to the maximum shear modulus (G/G_{max}) to the current fraction of mobilised shear stress, τ/τ_f: $G/G_{max} = 1-f[\tau/\tau_f]^g$ where f and g are shape factors decided by computer modelling. For sand, for example, the Authors suggest 0.9 and 0.25 for *f* and g respectively. For the chalk we have used 0.85 and 0.7 by experiment (see remarks in Part 5 of this report).
4. There is a mismatch between the Fahey & Carter modified hyperbolic function and the power curve. However for more than 50% of the available range there is reasonable agreement about the value of G_{max}.
5. The threshold shear strain is obtained by inserting the derived value for G_{max} into the power curve expression.
6. Quoting values for G_{50} and G_{100} where the numbers refer to the % of mobilised shear stress uses the relationship given in [2] above.

Fig 3.1 Cavity Reference Pressure (P_o) vs Depth

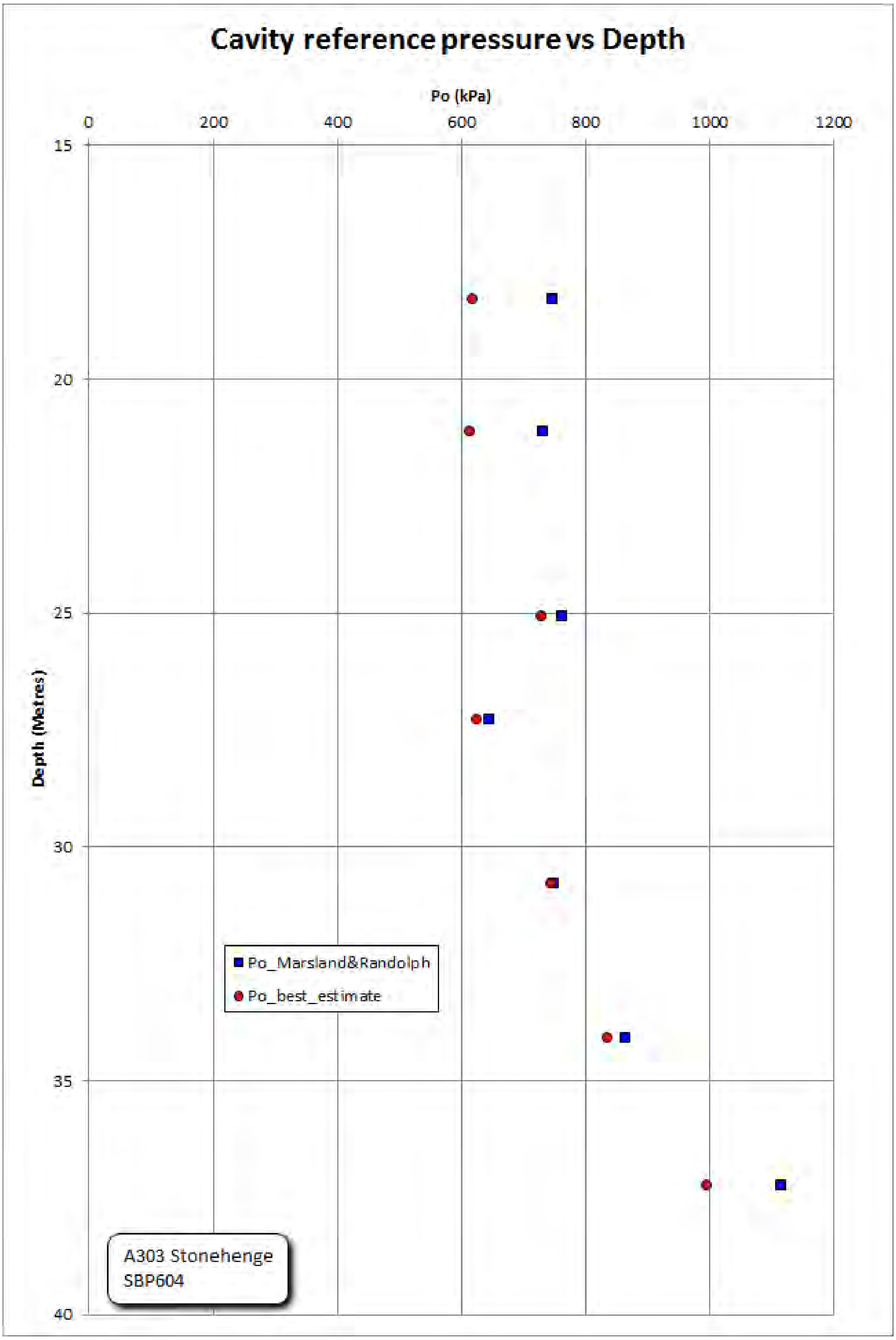


Fig 3.2 Coefficient of Earth Pressure at Rest (K_o) vs Depth

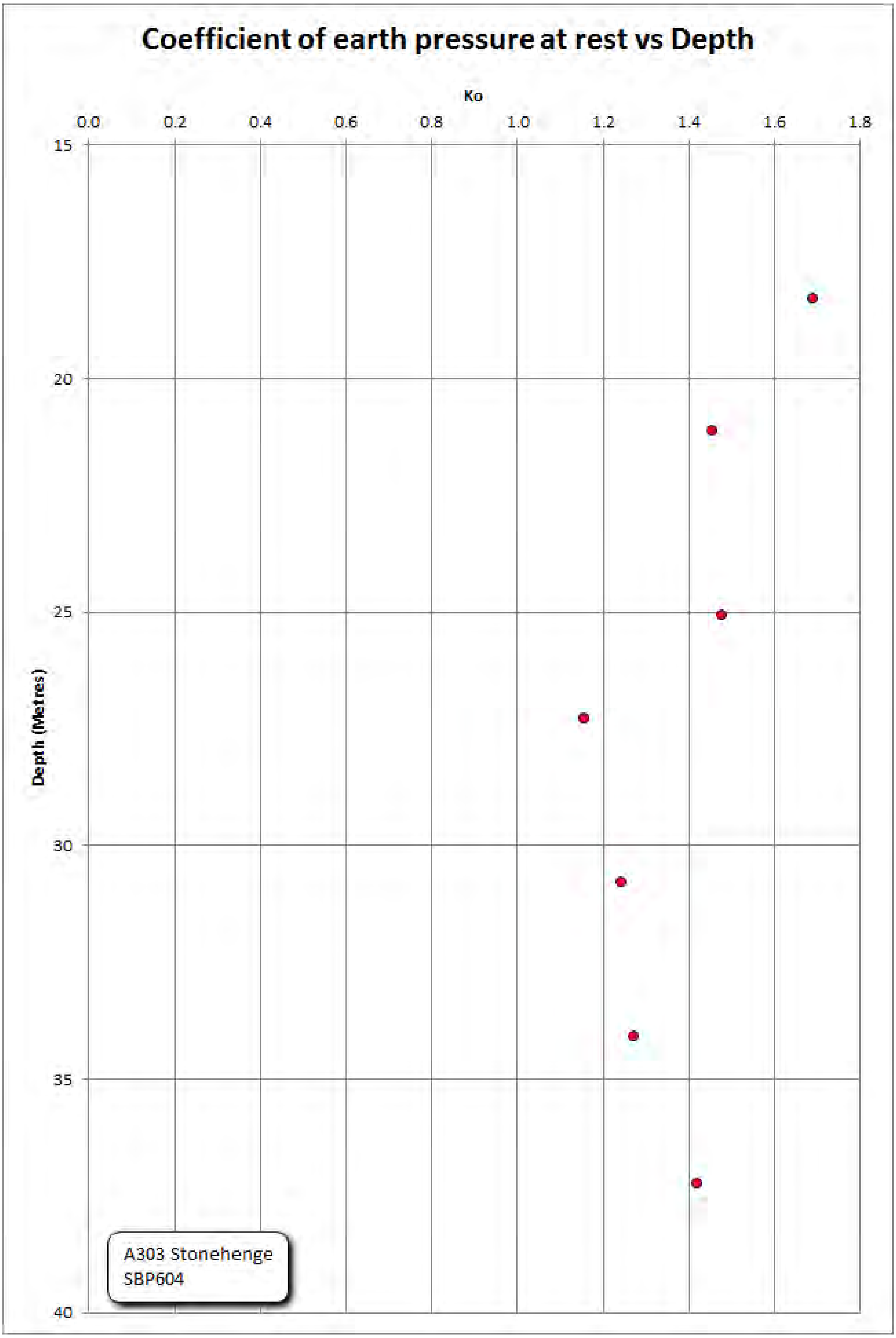


Fig 3.3 Friction and dilation angles vs Depth

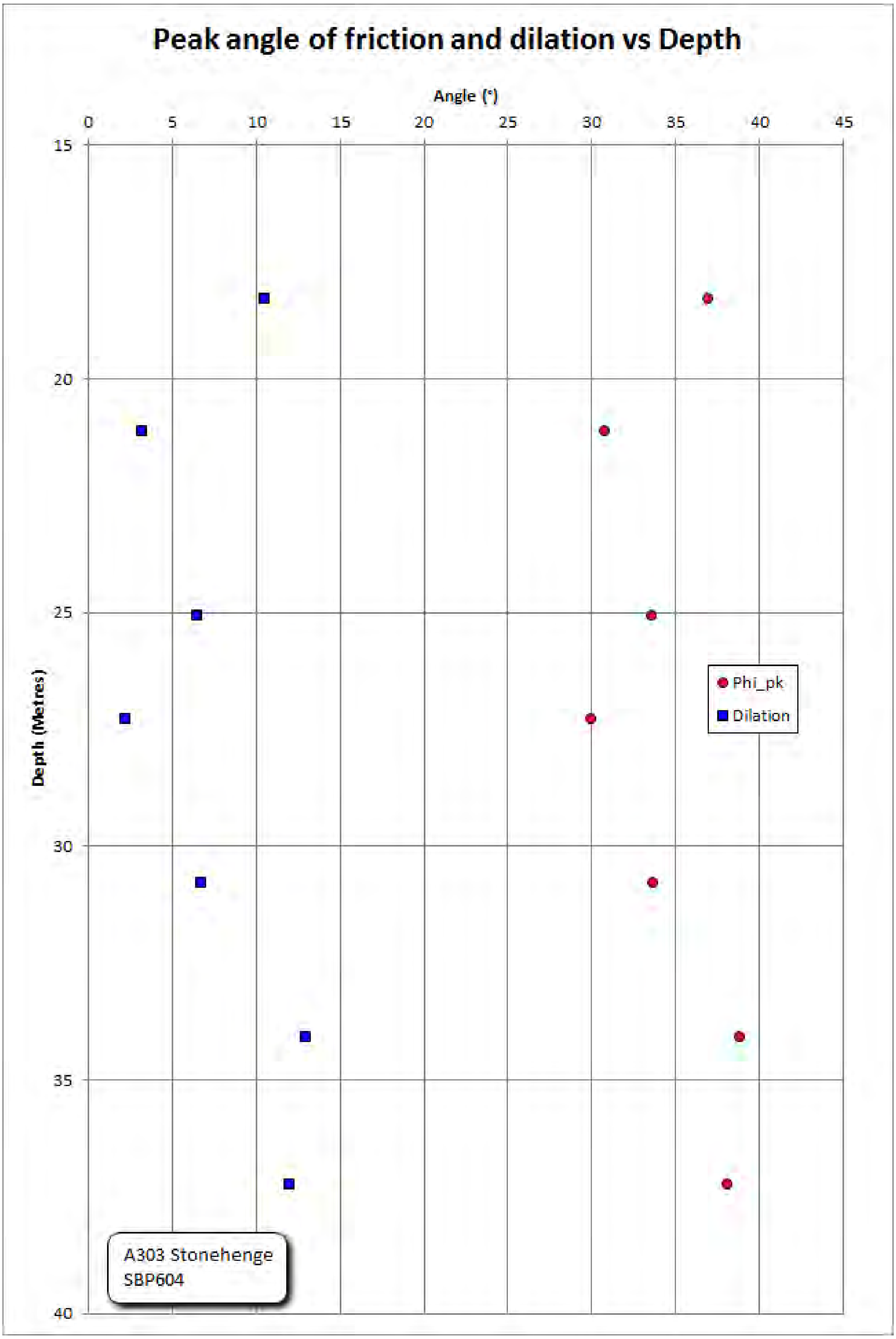


Fig 3.4 Observed and calculated yield stress vs Depth

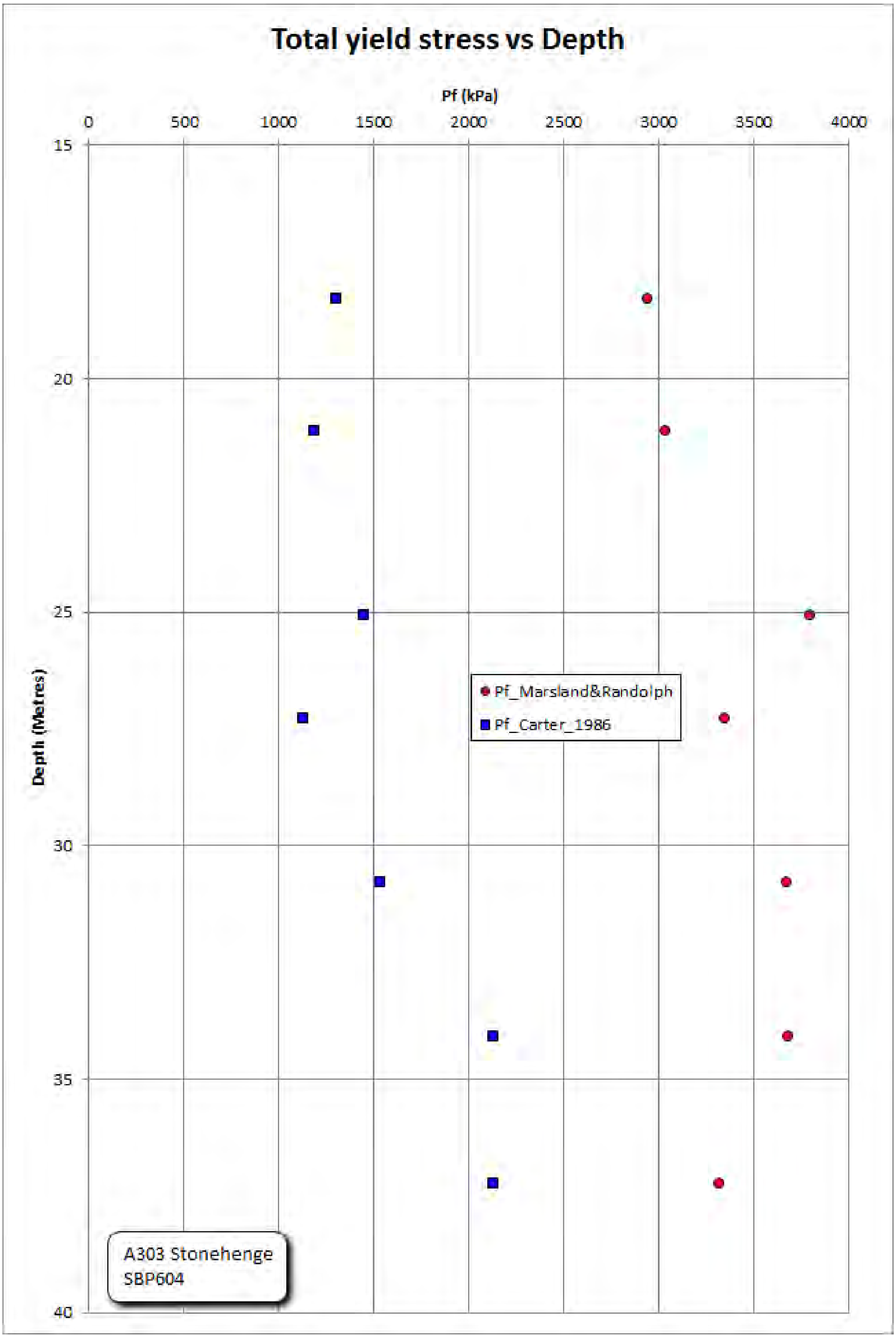


Fig 3.5 Total Limit Pressure (P_{lim}) vs Depth

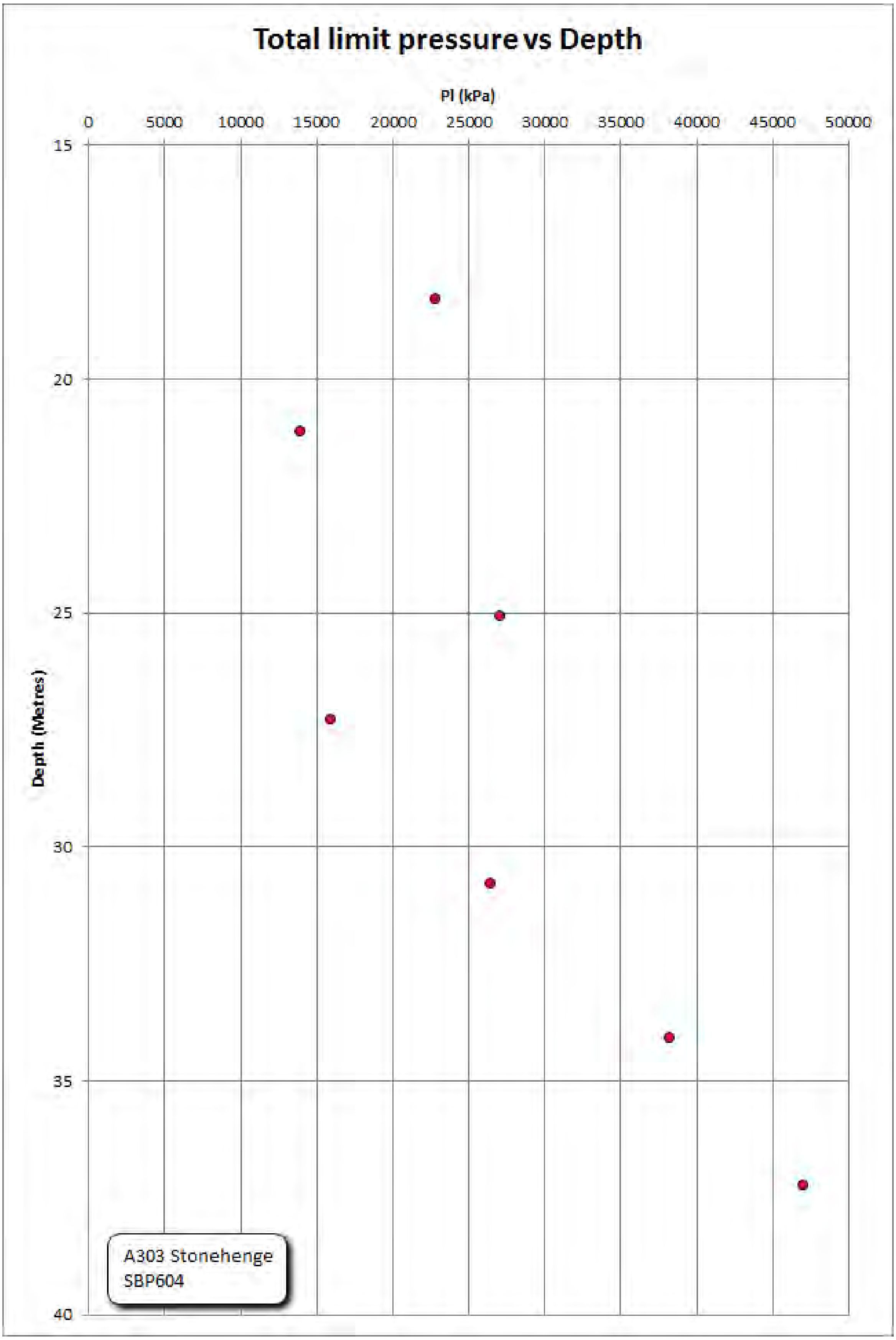
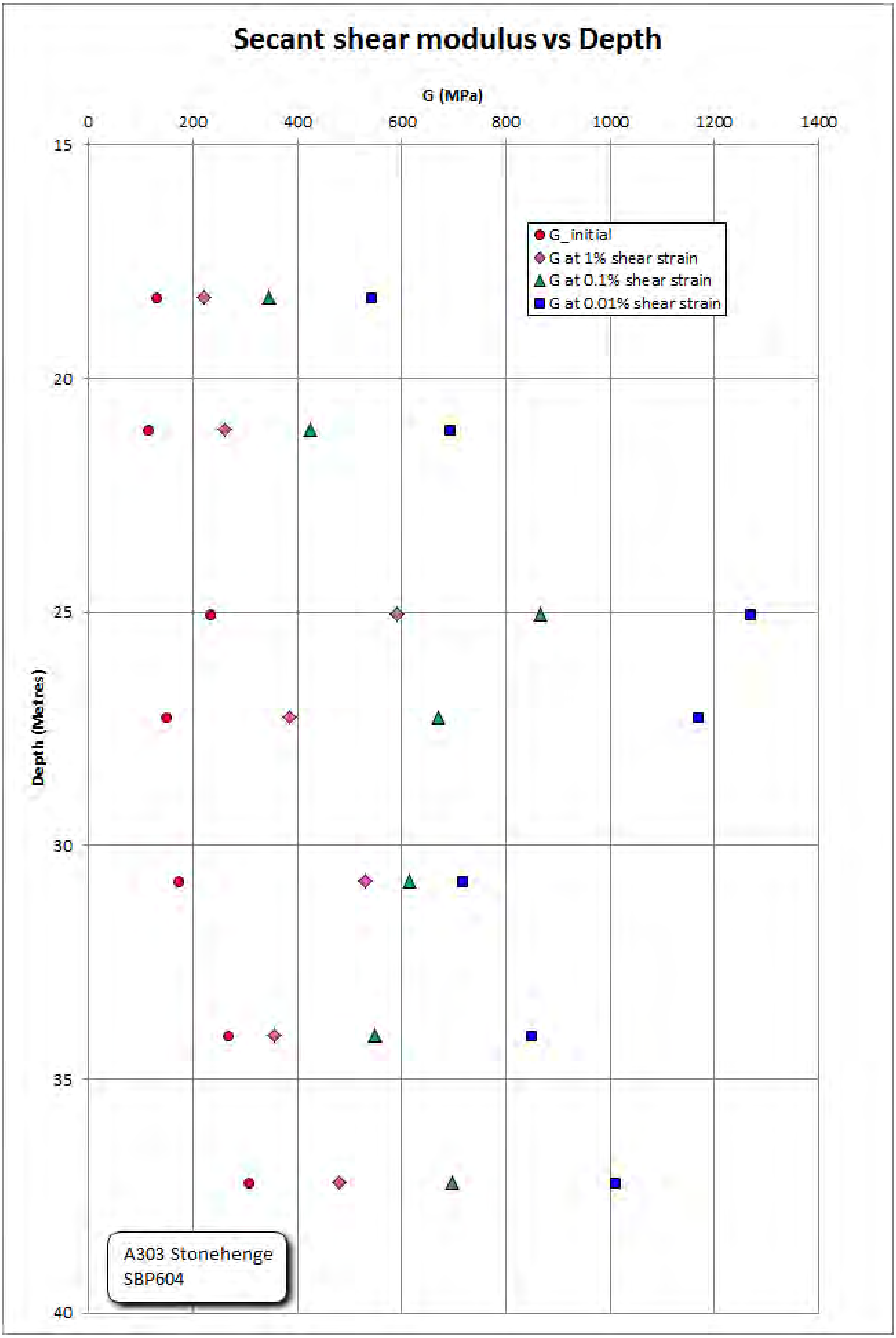
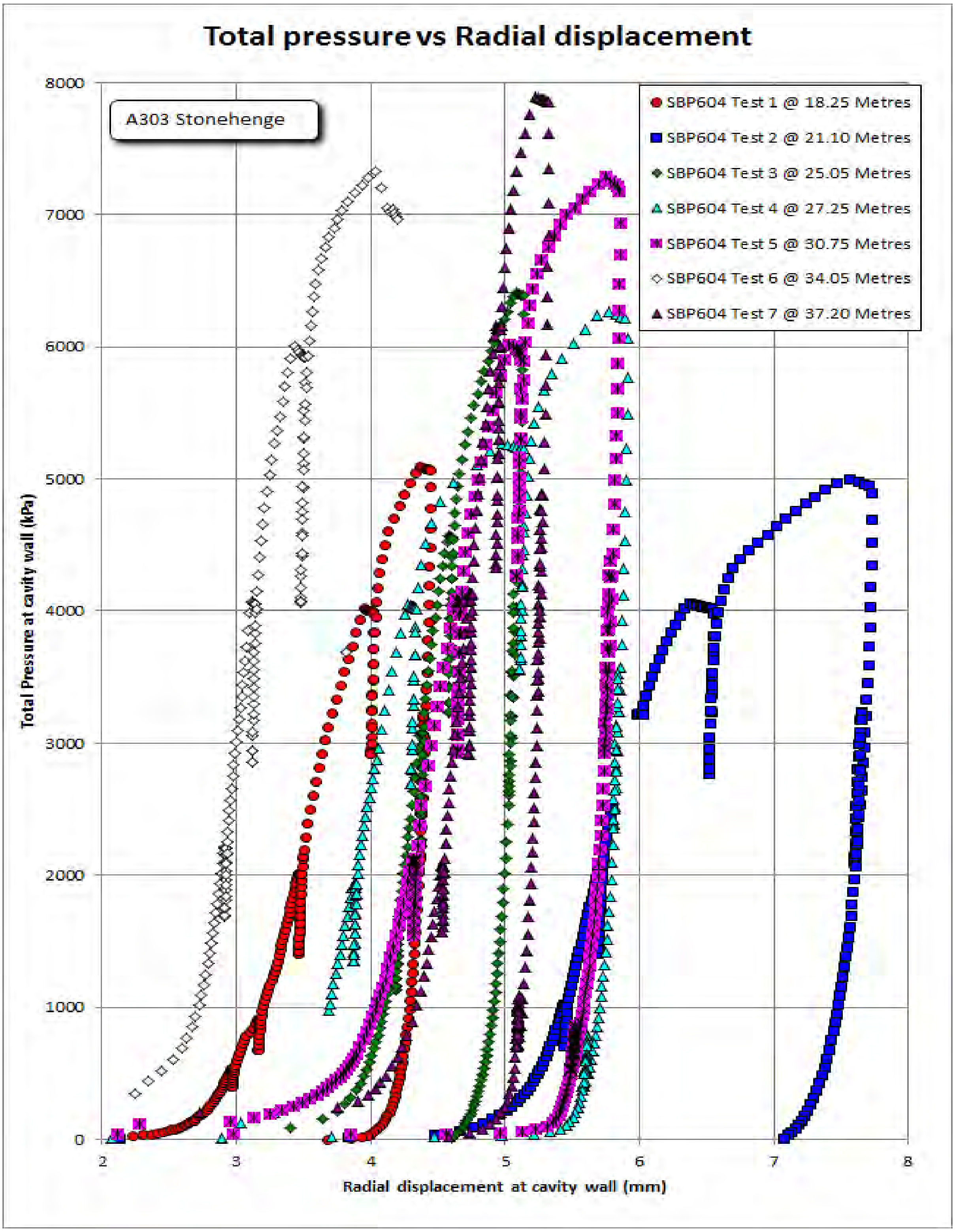


Fig 3.7 Secant shear modulus vs Depth



4. FIELD CURVES

Fig. 4.1All tests in SPB604 on common axes

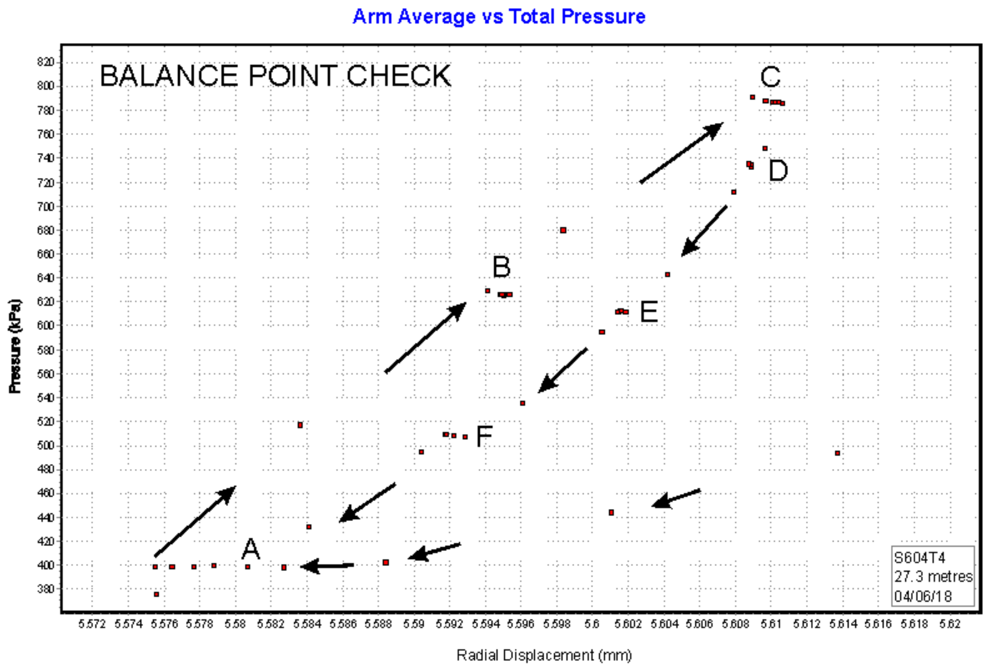


5. COMMENTS ON THE TESTS

This section collects together remarks and comments by the analyst that may be helpful when reviewing the data.

5.1 Balance Point Check

Fig 5.1 Balance Point Check example



Hoopes & Hughes (2013) give a method for finding the cavity reference pressure (p_o) from the contraction phase of a pressuremeter test. The pressure in the probe is lowered to a value likely to be less than any plausible estimate of p_o and is then raised in small steps, monitoring the change in displacement for each step. In fig 5.1 the pressure has been unloaded to a point A then held for a few seconds – the creep is comparatively large and is inward. The pressure is raised to point B and held. There is a small outward creep. It is raised to point C. There is a greater outward creep. These two readings imply that the pressure inside the probe at point C exceeds p_o. hence the pressure is lowered to D. Here there is negligible creep, so the external pressure must be above p_o. The internal pressure is further reduced to point E, about the same pressure as point B. There is a tiny inward creep, so the internal and external pressure are approximately balanced. One more reading at point F confirms this, as the creep inward increases suggesting the internal pressure is below the cavity reference pressure. Hence the conclusion is that p_o is about 620kPa. It happens that for this test, from other analyses, p_o was identified as 622kPa.

This may be fortuitous, and it is not quite clear why the method should work. At first sight it would appear to be the same procedure that is a standard part of the Ménard test, the taking of creep readings throughout the loading. This is well-known to give sometimes very misleading estimates when the reference pressure is used to represent the insitu lateral stress.

What is different is the condition of the material at the time the readings are made. The initial part of the loading takes place when the material has suffered reverse plastic failure, so the gradient of the loading is significantly less than the true stiffness of the material. All displacements and creep readings from this part of the test will be large by comparison with what is seen in fig 5.1 because they are plastic. Here the loading phase of the test has erased the stress history of the insertion process, and the cavity contraction is a controlled process starting from a known origin. The contraction has been taken far enough to see reverse failure but when the direction of loading is reversed (point A) the material has to respond elastically, albeit with a non-linear characteristic. All the data in fig 5.1 is part of a reload/unload cycle with stress increments passing through the insitu lateral stress. The only *plastic* creep interval is point A, showing the largest creep. This seems to be why the creep readings are sensitive to the far field stress.

Test 5 also included a balance point check (BPC). Here p_o is identified as about 750kPa. Other analyses suggested 743kPa. The procedure was also applied to Test 7. Here the BPC suggested p_o is about 970kPa. Other analyses suggested 993kPa.

5.2 Estimating G_{max} and γ_{elas}.

It is not possible to measure the maximum shear modulus directly with the pressuremeter due to the mechanical limitations of the displacement measuring system. It may be possible to form an estimate by adapting the procedure suggested by Fahey & Carter, 1993.

The Bolton & Whittle 1999 analysis for the decay of secant shear modulus is normally written as follows (the equations below are also given in the preface to this report):

Non-linear secant shear modulus G_s: $G_s = \alpha\gamma^{\beta-1}$ [P.4]

α and β are the constant and exponent of a power curve in shear stress:shear strain space and γ is plane shear strain. It is straightforward to rewrite [P.4] in terms of the fraction of mobilised shear stress at first failure, τ_f :

For secant shear modulus at mobilised stress levels less than failure, introduce *n* where $0 < n \leq 1$ $G_n = \alpha[n\tau_f/\alpha]^{(\beta-1)/\beta}$ [P.9a]

If n is 1 then G_s refers to the first failure stress. If n is 0.5 then G_s is that which applies when 50% of the available shear stress is mobilised. The corresponding shear strains can be found by re-arranging [P.4]. Both these values depend on a reasonable estimate of τ_f.

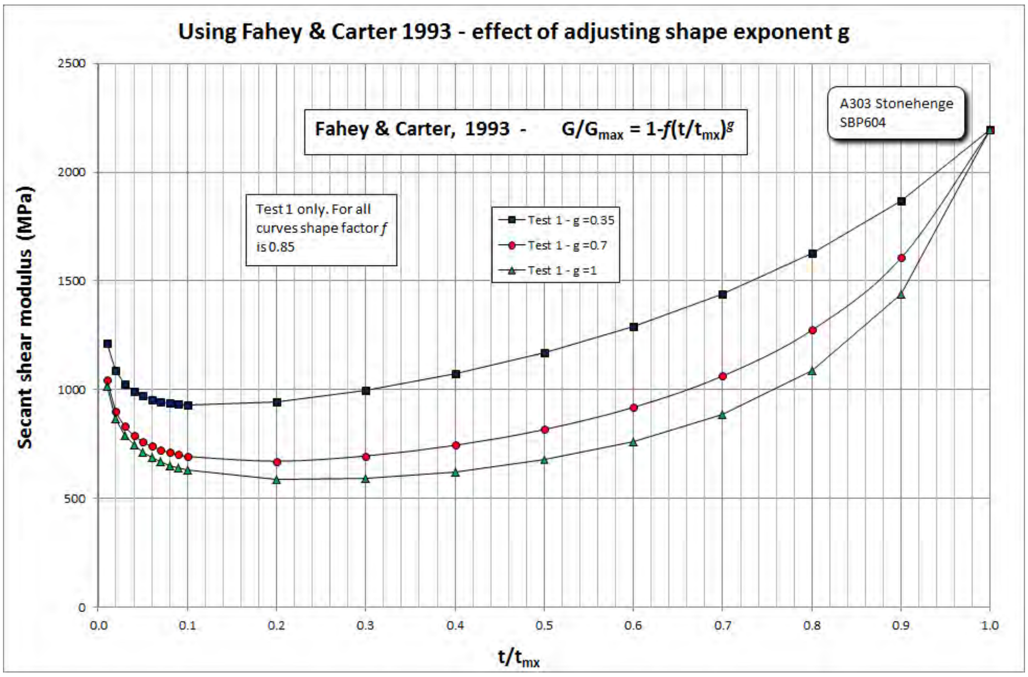
From [P.9a] we can obtain a number of estimates that relate G_s and n. These in turn can be inserted into the Fahey & Carter modified hyperbolic function (repeated below):

Fahey & Carter, 1993 $G_s/G_{max} = 1\text{-}f[\tau/\tau_f]^g$ [P.11]

f and *g* are shape factors. Deciding appropriate values involves judgement. The multiplier *f* is required otherwise the hyperbolic function predicts infinite strain when $\tau = \tau_f$. Nevertheless it will obviously be a number approaching unity and 0.85 has been chosen to give the widest plateau of consistent agreement.

The shape exponent *g* is more problematic. Fahey & Carter use a range of values including some greater than 1. In the case of these tests g=2 would make the elastic threshold shear strain γ_{elas} greater than 1 $\times 10^{-4}$ for several tests, which seems implausible. The first value of g that gives consistent results for γ_{elas} is 1, and 0.7 has been chosen as the best compromise but of course this is speculative. Figure 5.2 shows the results of some experimentation.

Fig 5.2 Modifying the shape exponent g



There will always be a mis-alignment of data because the hyperbolic function predicts infinite strain to reach the failure stress, and the power law predicts infinite stiffness at zero strain. Our values are taken to be when the trend is at a minimum, which from fig 5.2 would appear to be when $\tau/\tau_f = 0.2$.

APPENDIX A – DESCRIPTION OF THE EQUIPMENT

1 OUTLINE

Fig 1 The 95mm High Pressure Dilatometer

The 95mm High Pressure Dilatometer (95HPD) is a pre-bored hole pressuremeter for testing a 101mm diameter pocket. When a test is required it is lowered into a pocket in the ground conventionally formed by an H size barrel. On completion of a test it is removed from the borehole which is then extended by conventional drilling techniques.

The instrument is 2 metres long. The central third of the instrument is covered by a 6mm thick reinforced rubber membrane. Pressure is applied to the inside of the instrument and the membrane expands, pressing against the borehole wall. The radial displacement of the inside boundary of the membrane is measured at six points equally distributed around the centre of the expanding section. It is up to 95mm in diameter at the ends of the membrane and 94mm diameter at the centre of the membrane where displacements are sensed.

This displacement, and the pressure necessary to cause the movement, are continuously monitored by strain gauged transducers contained within the instrument. Also within the instrument is the analogue and digital electronic circuitry necessary to condition the signals from the transducers. Every ten seconds a set of readings from all the measuring circuits are transmitted to the surface as an RS232 data stream which may be connected directly to the serial port of a microcomputer. Plotting these readings of displacement against pressure produces a loading curve for the material being tested. A number of mathematical analyses are available for translating this loading curve to fundamental strength and stiffness parameters for the ground.

Because the instrument has six strain arms there is some redundancy in the measurement of strain, and this enables the user to carry out a successful test even if one of the arms are defective. In order to give a similar level of reliability to the pressure measuring system a second pressure cell is included in the HPD-MPX, and its readings provide a check of the performance of the first transducer.

The HPD can apply up to 30MPa of pressure to the ground, and can expand from an initial diameter of 95mm to nearly 150mm. It will resolve movements of less than 1 micron and pressure changes of less than 1kPa. Hence although it was developed to test weak rock it can make a test at two extremes of ground conditions - stiff clays, which yield at pressures below 1MPa, and weak rock with a shear modulus greater than 4GPa.

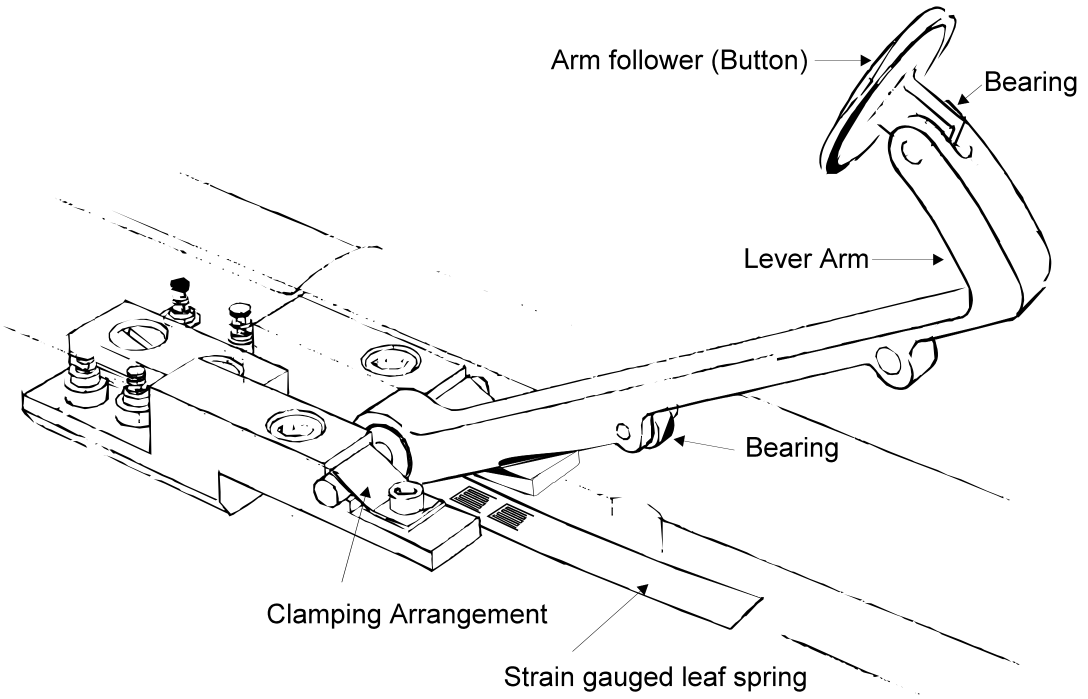


Fig 2 Displacement sensor of the 95mm HPD

The instrument is based on a smaller device (the 73mm HPD) that has had a long and successful history of site work and has been used worldwide. It is a development of an instrument invented by Dr J.M.O. Hughes in 1978. Although internally complex by the standards normally applied to instrumentation of this kind, it is reliable and robust, and the routine maintenance is straightforward. Because all the signal conditioning electronics is contained in the probe itself , the instrument is unaffected by external changes such as replacing the cable.

An additional feature of this pressuremeter is an electronic compass module fitted to the foot of the instrument. This gives a continuous reading of the orientation of a fixed reference on the instrument with respect to magnetic North. The compass consists of two magneto-resistive sensors at right angles to each other. The output of the compass therefore is two signals which are the sine and cosine of the angle made with the Earth's magnetic field. The quotient of these gives an unambiguous direction.

Like all expansion pressuremeters in commercial use the HPD has one significant uncertainty- the loading curve which it produces is derived from following the movement of the *inside* boundary of an elastic membrane. This is different from the movements of the *outside* boundary of the membrane, and hence the movements in the material itself. For the

Fig 3 – Under the membrane of an HPD 95

majority of the tests for which the HPD is used, this uncertainty is not significant. However for a small number of tests it is critical; for this reason the calibration procedure described in Appendix B necessarily is complex in order to reduce the margin of uncertainty and set limits to it.

The instrument and all associated electronics for capturing the data are powered from a 12volt vehicle battery.

2 THE MEMBRANE

The membrane itself is a nitrile rubber sleeve. Because the behaviour of the membrane has an influence on the derived displacements it is kept relatively thin (8mm for the standard probe) so that its contribution is small. By its very nature there is a gap between the instrument and the borehole and steps have to be taken to prevent the membrane extruding axially. This is achieved by stiffening the ends of the membrane with rings of stainless steel fingers known because of their appearance as 'Christmas Trees'.

There is a version of the membrane which carries local reinforcement at the ends consisting of kevlar strands. When the applied pressures are fairly modest (no more than about 50% of the available range) then this membrane can be used without Christmas trees.

The entire length of the of rubber membrane is covered with a sheath of eighteen stainless steel strips which are axially stiff but free to expand radially. This sheath protects the membrane from sharp edges, and is known as a 'Chinese Lantern'. The individual strips do not overlap in the closed position.

3 THE PRESSURISING SYSTEM

The instrument is inflated by oil or gas. A strong hose connects the instrument to the pressure source, either a manually operated hydraulic pump or a pneumatic control system.

Fig 4 – The control system

The passage down the centre of the hose is large enough to incorporate a steel logging cable with four electrical conductors. Three of these conductors are used; one carries the digital signals output by the instrument, and two carry power to the instrument from a conventional 12 volt vehicle battery. The power consumption of the pressuremeter is small; up to 500 metres of hose and cable could be connected to the instrument with only minor modification.

The advantages of the oil inflation are that it is inherently safe, requires very little equipment and because it is re-cycled the consumable costs are low. However if the instrument is on a long cable it takes time for the oil to return to the surface and in a dry hole it will never return unaided.

When working over water, it is normal to fill the probe itself with oil but surcharge it with air. Should the membrane become punctured the oil will keep the water out of the probe.

4 ELECTRONIC INTERFACE UNIT (EIU)

All pressuremeter hardware is powered by a single 12 volt vehicle battery. The battery is connected to the EIU, which introduces some protection and distributes the power to a number of outlets, including one for the pressuremeter. The returning signals from the pressuremeter connect to the same socket. The digital signals pass through an opto-isolation circuit and are then made available on two identical sockets for connection to the serial port of a computer. There is also an analogue signal which represents the output of TPC A.

The unit has a panel meter which can be switched either to read the battery volts or to read the analogue signal representing pressure in the probe.

5 DATA LOGGING / ANALYSIS SOFTWARE

Software developed by Cambridge Insitu is used to log the data during the test, and for analysing the results subsequently.

The logging software stores the incoming data, displays the pressure/expansion curve in real time, and provides a text file output of the test data in engineering units. This file is read directly by the analysis program, but can also be read by any of the common spreadsheet programs.

The analysis software provides routines which implement a number of standard analyses. The analyses tend to be graphically driven, meaning that the analyst identifies and marks significant parts of the curve, either for breakpoints or slope. The final screen for the analysis is then output as hardcopy backup for the decisions made.

APPENDIX B THE CALIBRATION PROCEDURES

INTRODUCTION

There are nine aspects to the calibration of the pressuremeter:

1. Scale factors
2. The displacement measuring system
3. Pressure measuring transducers
4. Reference (‘zero’) outputs
5. Membrane stiffness
6. Instrument compliance
7. Membrane thinning
8. Repeatability (or how much effort should be devoted to calibrations)
9. Orientation

1. Scale Factors

The transducers in the probes are based on full bridge strain gauge circuits. Any such transducer produces an output dependent on the voltage being applied to it, the stress deflecting it and the amplification or buffering between it and the recording system.

The instruments contain electronic devices that provide a regulated voltage to the transducers and amplification of the resulting output signals. Because this electronic conditioning is a fixed part of the system it is not mentioned when presenting calibrations. The electrical output of the transducer, in volts, is quoted only as a function of the deflecting stress. This function is termed 'sensitivity' and gives the scale factor for deriving pressure or displacement from the transducer electrical output.

Although the output of the transducers is quoted in volts, the true output of the system is a digital data stream of ASCII encoded numbers representing volts. This signal can be connected directly to the serial port of a small computer. All variables associated with producing the final digital output from the strain gauge signals are a function of the pressuremeter itself, and are independent of external changes such as replacing the cable.

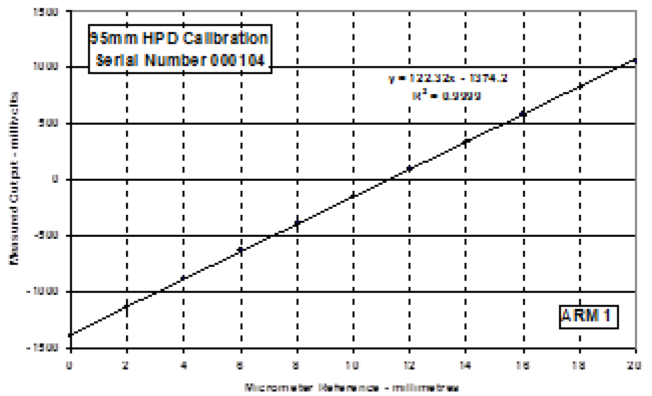
When using the sensitivity calibrations to convert readings from volts into engineering units we make two important assumptions about this output; that it is linear and that the hysteresis is negligible. The calibration procedure needs to provide evidence that these assumptions are reasonable.

2. The Displacement Measuring System

The displacement measuring devices used on the HPD are often referred to as 'the arms'. The arms are calibrated by mounting a micrometer above each in turn and recording the output for a given deflection. When calibrating the instrument it is necessary to plot these readings for both an increasing and reducing deflection. The difference at a given point between increasing readings and reducing readings is a measure of the hysteresis. The worst case figure is noted, and corrective action is taken if the hysteresis is outside an acceptable limit - normally 0.5% of the sensitivity.

The slope of the best fit straight line through all the points is used to quote the arm sensitivity - as an output for a given deflection in units of millivolts per millimetre (mV/mm). See fig B.1. A typical figure is 120mV/mm for a 95mm HPD. The arms have a range of 24mm so the output swing is about 3 volts.

Fig B.1 An HPD arm calibration example

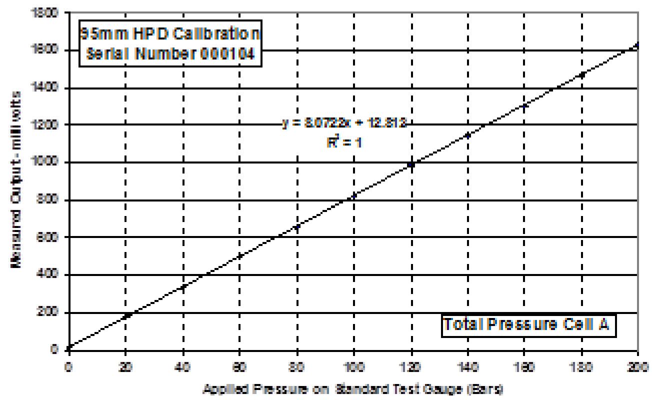


3. Pressure Measuring Transducers

For pressure measuring circuits the maximum possible sensitivity is desirable, the only requirement is that the sensitivity be known and be linear and stable.

The sensitivity of internal pressure transducers is determined by placing a large metal cylinder over the probe and applying a known pressure to the inside of the instrument. The pressure being applied is measured by a standard test gauge. As with the arms, readings are plotted, the hysteresis noted, and the best fit straight line drawn through the plotted points.

Fig B.2 An HPD pressure cell calibration example



Pressure sensitivities are quoted in units of millivolts per MegaPascal and a typical figure for the 95mm HPD is 80mV/MPa. See fig B.2.

4. Reference ('zero') outputs

The other parameter that the transducers have is a known output for an 'at rest' position. This is the value of the outputs produced by the circuits with atmospheric pressure both inside and outside the instrument, and any displacement measuring system at the initial radius position. This is called a little misleadingly 'zero'.

The absolute value of this figure is normally unimportant - it is not necessary that the figure be zero volts for zero displacement or stress, just that it be known. For practical purposes, as the analogue to digital converter outputs a number between –3.2767 and +3.2767 volts, the 'at rest' readings for the arms are set to be about -2 volts to allow a large output range with a margin for gradual drift over time.

A similar situation applies to the pressure cells – the absolute value of the 'zero' output is unimportant provided it allows the full pressure of the system to be resolved. However an exception is made for cell A. It is convenient to have an analogue representation of the pressure and a buffered output from cell A is taken to the surface via a spare way in the cable. Interpreting the output is easier if zero pressure reads as zero volts and this is arranged in the probe. This output is primarily used when making maintained load tests in softer ground where the resolution of a test gauge is not sufficient to see if the pressure is changing.

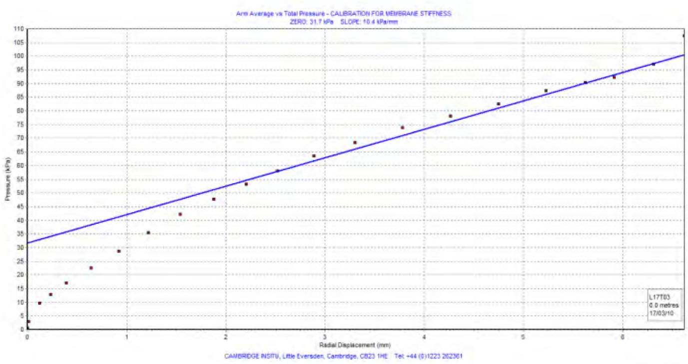
Adjustment positions using 1% metal film resistors are provided in the instruments for setting all 'zero' outputs.

It is normal to take zero readings both at ground level and also immediately prior to carrying out a test. A significant change between zero readings must be investigated. 'Significant' would mean a change of 30 millivolts from the last set of zero readings. It is not unusual for shifts of a few millivolts to occur from day to day. It is important that the zero readings be stable when viewed over a period of a few minutes.

Note that when using oil to inflate the probe, ground level readings are the preferred reference because once in the borehole the pressure transducers will read the head of oil. For gas inflation it is probably better to use the zero readings when the probe is in place in the borehole, because it will then be at the temperature most applicable to the test.

5. Membrane stiffness

Fig B.3 An HPD membrane stiffness calibration



The membrane that is expanded by the HPD has its own initial tension requiring a finite pressure to move it. The readings measured by the stress cells need to be reduced by this pressure in order to determine the net stress being applied to the ground.

The membrane correction has two components - the pressure to move the membrane from its position at rest on the instrument, and a second component dependent on the radial expansion.

The technique for obtaining the correction data is to pressurise the instrument in free air, ideally using similar rates of expansion as would be applied during a test. For preference, ‘free air’ is actually inside a large cylinder that fits closely at the ends of the membrane but allows a large expansion elsewhere. This is partly for safety, but also because the ends of the membrane are usually reinforced by the Christmas trees and it is important that these are not over extended.

The slope and the intercept on the pressure axis of the graph produced by this test give the membrane correction information for each arm. See fig B.3.

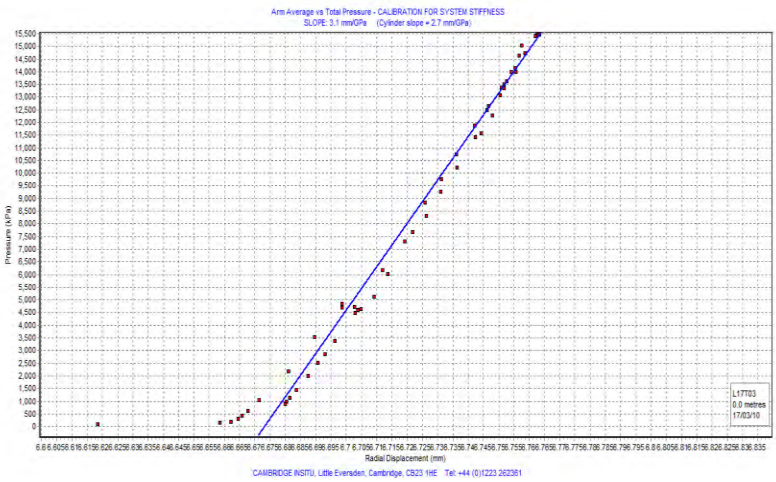
Knowing that the membrane does not necessarily possess isotropic properties, it has been customary to derive a different set of figures for each arm position. However recent work indicates that an unconfined inflation in air exaggerates any variation in membrane properties; an average correction factor is more appropriate.

The membrane correction data is quoted as a pressure in kPa to move the membrane from its rest position together with a second pressure in units of kPa/mm representing the pressure increase necessary to maintain the inflation. Typical correction figures might be 45kPa and 15kPa/mm.

6. Instrument compliance

The instrument will deform as a consequence of the pressure being internally applied. Put simply, the instrument stretches. Because the displacement measuring system uses the body of the instrument as a reference, movements of the body are seen as apparent displacements of the membrane; some ingenuity is needed to immunise the displacement measuring system from this problem. This system compliance has implications for the measurement of shear modulus, and it can become a significant source of error when measuring very high modulus values.

Fig B.4 An HPD system compliance calibration



There are a number of effects to consider but they are collectively determined using a single procedure. The correction figure which results is known somewhat inappropriately as 'membrane compression'.

The procedure normally suggested to obtain correction data for 'membrane compression' is to inflate the pressuremeter inside a number of cylinders of different bores; by comparing these known bores with the displacements actually obtained from the pressuremeter then a correction curve can be obtained. Because the correction has been assumed to be a function of membrane thickness, then it is expected that the effect reduces as the membrane thins. In other words, it is treated as a strain dependent variable, and a change in membrane means a new correction curve must be derived.

For the Cambridge family of pressuremeters real membrane compression, that is the membrane changing in thickness as a direct result of the pressure differential across it, is almost too small to be measurable. There are a number of other factors to consider of significantly greater magnitude than membrane compression.

Inflating the instrument inside a metal cylinder will in theory provide data on the magnitude of these effects. However a separate source of error, which is a function of the calibration procedure itself, then becomes apparent. The membrane is able to expand axially by a small amount, and as a result experiences a change in thickness which may not occur in the ground. Although steps can be taken to keep this axial movement to a minimum, it cannot be easily eliminated.

As a consequence of the poor fit of a calibration cylinder, and also of the relatively low coefficient of friction between the membrane and the steel by comparison with the membrane and the ground, the instrument will move about in the cylinder - its centre will not be the same as the centre of the cylinder. Only average radial movement can be derived from this calibration process, and it is not possible to obtain good data for each arm.

Much of the apparent correction is due to the Chinese lantern strips taking up the form of the cylinder, a process that would only occur in the ground if the material was good rock.

This is the explanation for much of the initial curvature that occurs when an assembled probe is inflated inside a metal sleeve - it is a serious error to attempt to derive a correction factor from this part of the loading.

Taking account of all the above, the following method is used to calibrate the 95mm HPD. The Chinese lantern is removed, and an aluminium cylinder of known properties with close fitting ends is placed over the membrane of the instrument. It is the same cylinder as is used to do membrane correction tests, and in fact a single test can be used to obtain all membrane parameters. The instrument is inflated slowly until the membrane contacts the wall of the cylinder. This data are used for membrane correction. Now the test continues, either as a gentle continuous inflation or in discrete steps of 10 bars. Each step is held briefly to ensure maximum accuracy. The probe is pressurised up to 200 bars, its safe maximum working pressure. The pressure is then reduced, also in steps of 10 bars. Some users prefer the unloading should be down to 20 bars, then the probe should be reloaded again to maximum pressure and unloaded to zero, in effect doing a large unload/reload cycle. In a good calibration, all loading and unloading slopes will be similar, but it sometimes happens that the probe moves with respect to the cylinder and this will affect the data. In this event doing the second reloading would give the best correction information.

The calibration is obtained by plotting the pressure/displacement data on a large scale, and finding the best fit slope through the points. The slope ought to be the known expansion of the cylinder for a change of 200 bars. In practice it is always a little more, the difference being the ‘membrane compression’ figure. We quote the figure in terms of ‘mm/GPa’ a typical compression being 3mm/GPa. The cylinder normally used to carry out the compression test has an elastic slope of 2.7mm/GPa. See fig B.4.

Quoting the compression in this manner allows the software to calculate the appropriate error for every step of pressure and to make the necessary adjustment to the measured displacements.

To put the correction in context, a slope of 5mm/GPa (a relatively large correction) is equivalent to a modulus greater than 4GPa. However, because the calibration is highly repeatable, with an uncertainty of less 0.5mm/GPa, it is reasonable to quote modulus parameters of up to 20GPa.

7. Membrane thinning

During a test the pressuremeter membrane changes in thickness as a consequence of being stretched. This change in thickness can be calculated by assuming to a first approximation that the cross-section area of the membrane remains constant. The calculation is incorporated into the program that converts raw data into engineering units.

Note that the term 'membrane' includes the stainless steel protective sheath, and that the measurement made by the arms is the radial distance to the inside of the membrane.

Definition of Terms

a	is the internal radius of the membrane at rest
b	is the external radius of the membrane at rest
c	is the internal radius of the membrane expanded
r	is the external radius of the membrane expanded
t	is the thickness of the stainless steel sheath strips
d	is the measured movement of the strain arm
E	is the actual expansion of the membrane

Calculation

At rest the cross-section area of rubber $= \pi(b-t)^2 - \pi a^2$

The expanded cross-section area of rubber $= \pi(r-t)^2 - \pi c^2$

Because the rubber is incompressible, these must be equal:-

Therefore $(b-t)^2 - a^2 = (r-t)^2 - c^2$

Now:- $c = a + d$

and:- $r = b + E$

hence $(b-t)^2 - a^2 = [(b+E)-t]^2 - (a+d)^2$

$$\therefore [(b-t)+E]^2 = (b-t)^2 - a^2 + (a+d)^2$$

$$(b-t)^2 + d(2a+d)$$

$$(b-t)+E = \sqrt{[(b-t)^2 + d(2a+d)]}$$

$$E = \sqrt{[(b-t)^2 + d(2a+d)]} - (b-t)$$

This is the form in which the calculation is commonly applied to the data, with 2*a*, 2*b* and *t* being known from the manufacturer's data, and *d* being the measurement made by the displacement sensors during the test.

Typical dimensions for the 95HPD:-

	95mm HPD (mm)
2*a*	81.00
2*b*	95.00
t	0.5334

To apply the correction at a given expansion the *average* radius of the expanding membrane is calculated. This average is then entered into the equation and the ratio between the corrected average and the raw average is expressed as a scale factor (it turns out to be about 0.88 for a 95mm HPD at all expansions). The scale factor is then applied to the individual arm displacement outputs.

8. Repeatability (or how much effort should be devoted to calibrations)

Although it is important regularly to check the sensitivities of the strain gauge circuits, it is unusual for them to change markedly. Indeed it is common for the hysteresis to improve with use. 90% of the performance of a strain gauge bridge application can be predicted from its design; the calibration removes the uncertainty due to manufacturing tolerances, and can give early warning of impending problems in a particular circuit.

The expansion test for example is concerned with making relative measurements, not absolute measurements. The HPD displacement measuring system will resolve movements of less than 0.5 microns over a range of 24 millimetres; the pressure measuring system will resolve changes of 0.5 kPa over a range of 20MPa. This resolution is considerably higher than can be seen with a standard micrometer or test gauge. To put it into context, 0.3 microns is approximately the wavelength of ultraviolet light. Obviously there is no practical possibility of checking by measurement a movement so small.

Hence the term 'calibrating' is inappropriate. What is done in practice is to check that the various sensors are linear over a number of relatively coarse steps or intervals. We assume that this linear behaviour will be true for very much smaller changes.

For this reason alone, without considering additional sources of error such as the skill of the operator carrying out the calibration, the accuracy of the standard used to derive this linearity is of secondary importance. We expect successive calibrations on the same sensor to be within 2% and investigate a difference greater than 3%.

We also ignore secondary sources of error in this assumption of linearity, such as temperature change. The full bridge configuration is relatively insensitive to temperature variation provided the strain gauges used are matched to the characteristics of the surface to which they are bonded. When critical measurements are being made during a test, for example when taking a reload loop, it is reasonable to assume the temperature remains constant. The ground is usually at a constant temperature whenever a test is carried out, but sometimes there are problems - the temperature of the gas being supplied to the downhole tool can have an influence especially if the gas bottle reservoir is lying outside in direct sunlight.

A spread sheet is used to to present the results of the calibrations for sensitivity. One benefit of this is that gradients can be calculated by linear regression routines; this ensures different operators given the same set of data will derive identical calibration factors. The calibrations are presented as a tabulation of transducer output against a known reference, with the linearity and hysteresis quoted for each calibration step.

The membrane correction of the HPD seldom changes greatly and the type of material it is used to test means that for the most part any errors in the magnitude of the correction are of minor importance. The total contribution of the correction is less than 200kPa to a typical test.

In general, if the material is weak (shear strength less than 100kPa) then membrane stiffness is important. If the material is extremely stiff (shear modulus greater than 1GPa) then correcting for instrument compliance is important. In between these two extremes the influence of the imperfections of the machine on the derived parameters is negligible.

9 Orientation

The electronics module fitted at the lower end of the instrument contains an electronic compass that can be used to identify the orientation of the probe with respect to magnetic north. The compass consists of two sensors whose output is proportional to the Earth's magnetic field. The sensors are fitted at right angles to each other, each giving a maximum output when that sensor is in line with magnetic north. The consequence is that that at any time the sensors give the sine and cosine of the angle made with magnetic north, permitting an unambiguous direction to be inferred.

To calibrate the sensors, the instrument is rotated slowly through 360 degrees whilst the output of the sensors are logged. From this, the maximum and minimum output of each sensor is derived and is stored. Thereafter, selecting an option ‘Heading’ in the logging software uses the derived maximum and minimum values and the current data line to determine a direction.

The sensors are hidden inside the electronics module container. A mark on the outside indicates the position of the Cos sensor, and the electronics module fits to the instrument so that this stud is in line with arm 1. The direction that the compass produces, therefore, is the angle of arm 1 with respect to magnetic north.

In practice we note the *mis*-alignment or offset of arm 1 with respect to the cos sensor and introduce a correction later. We also try to identify the declination at the current location so that the final orientation is expressed as a bearing with respect to true north.

The calibration has to be carried out away from any metal such as drill rigs or casing.

APPENDIX C THE TEST PROCEDURE

Before the pressuremeter is deployed it must be fully calibrated. This can be done prior to arrival on site. However if the compass is required then a local calibration has to be done as near the borehole as possible but away from any metal work.

C.1 Making a pocket for the pre-bored test

This part of the test is outside of the control of the pressuremeter operator. The HPD makes a test in a 98-101mm pocket made with a rotary coring rig using a T6H barrel or equivalent. As far as the pressuremeter is concerned a minimum 2-3m section of borehole is required of 100mm diameter in order to have sufficient material to contain the probe safely and leave a sump below the probe for any remaining detritus. How the borehole is formed prior to the coring of the pocket has no consequence for the test.

For deeper tests in competent material the pocket can be many metres long and the tests be a sequence with the deepest test done first. The pressuremeter is then pulled up to the level for the next test in the sequence.

The location of the test is decided by mutual agreement between the operator and the Engineer after inspection of the recovered core. The ideal, from the pressuremeter perspective, is an unbroken section of material. However it is normal to target the worst rather than the best material. The more fractured region of the material should be located at the centre of the expanding membrane, so that the displacement followers are sure to see the least stiff response. The ends of the membrane see the greatest risk of puncturing so these should be located in the best material. An overlong pocket allows some adjustment of the pressuremeter position so that this arrangement can be achieved.

The HPD is lowered on rods to the test depth, with its umbilical taped to the rods at regular intervals. It is arranged that the HPD and its special adaptor rods are a similar length to a standard core barrel, and the rods used are those used to run the core barrel. This avoids any confusion over test depth.

For deep tests the HPD umbilical is made up of 100 metre lengths that are joined using a proprietary coupler arrangement as the probe is lowered to depth.

C.2 Running the pre-bored test

The pre-bored pressuremeter test can be of two kinds:

- After an initial pseudo-elastic phase the material will yield and show significant plastic development. The test will end when sufficient expansion has been seen (in rock, typically 3% cavity strain) or the maximum expansion capability of the probe is reached (soils only).
- There will only be the initial elastic phase – the test will end when the maximum working pressure of the probe is reached (20MPa) or at some earlier pressure if in the judgment of the operator there is a significant risk of the membrane rupturing and sufficient data have been recorded to allow a complete analysis.

Tests on this contract were of the first kind.

C.3 Pre-bored tests showing an elastic response only

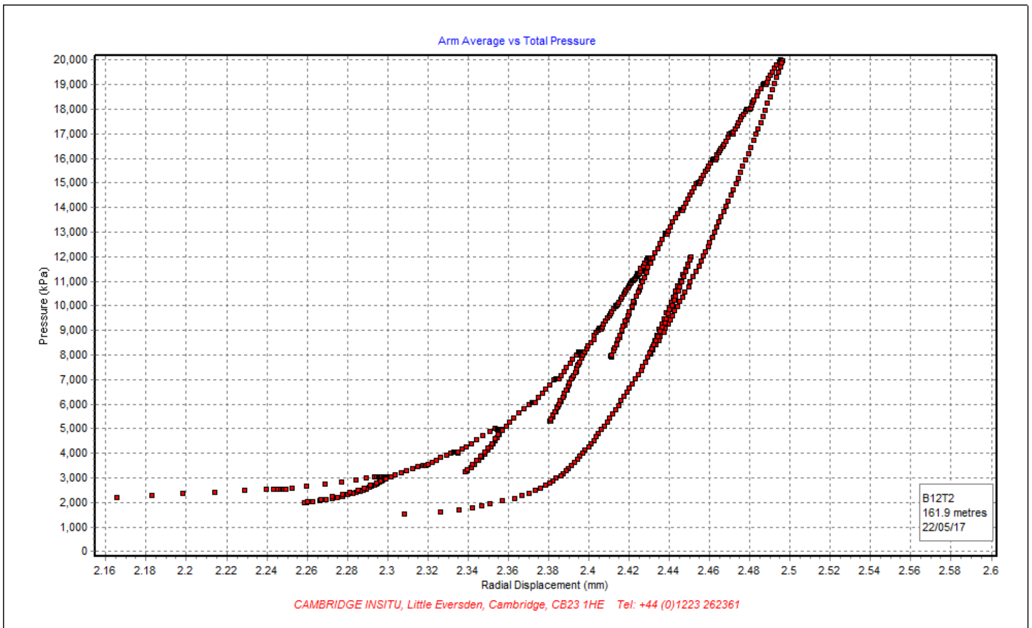
An example of the elastic only test is given in fig C.1. The procedure is as follows:

1. Before handing the probe over to the drilling crew the computer logging system is started, a unique reference given to the file and a few lines of readings logged. The

system is then put on hold as the probe is lowered down the hole, because logging these data would require an electrical connection to a rotating cable drum.

2. Once at depth the operator and driller compare notes to make sure both agree the probe location. The computer recommences logging and the test is started, using compressed air to raise the pressure in the probe in a controlled manner.
3. The tests are conducted as a series of pressure steps, each step being held for one minute. The steps tend to be at 0.5MPa intervals initially, then increased to 1MPa when the test is more advanced. Data are also recorded between steps at a slow enough rate to give a well defined loading curve where fine detail, such as indications of tensile failure, can be seen.
4. At intervals, unload/reload cycles are taken. The intervals vary depending on how much expansion has been seen or how much pressure has been applied. The size of the pressure drop for each cycle is about 1/3rd of pressure at the start of the loop. Loops continue to be taken until a consistent response is seen.
5. Ideally, each half of the loop needs to be defined by a minimum of 10 data points.
6. Prior to taking a loop the pressure is held constant for 3 minutes to allow the creep to reach an insignificant level.

Fig C.1 An HPD test in rock, no yield but slight fracture development



7. After the final loop the membrane is further pressurised up to near the maximum working load or until one of the other termination criteria are reached – *see later note, C.5*.
8. For some tests, once at maximum load, the pressure is held constant for several hours whilst displacements continue to be recorded. This gives data for a creep strain rate analysis.
9. The cavity is then unloaded at a smooth rate to give a well-defined contraction curve. This can include a reload/unload cycle, taken at a pressure that maps the pressure range used for the last cycle on the loading path.

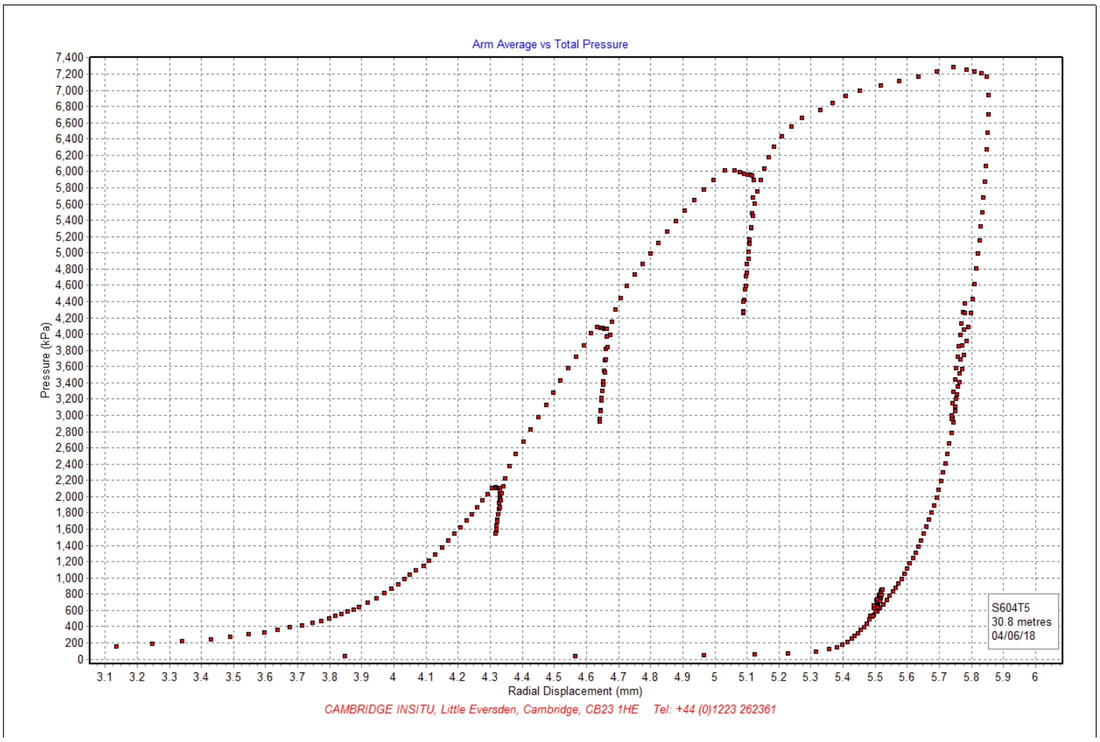
10. The membrane is allowed to deflate, and the probe removed from the hole or raised to the next level, as appropriate.

None of the steps in the procedure is rigid and can be amended in the light of what is seen during the test itself. In fractured material where there is a high chance of membrane rupture or at least a chance the test will be terminated before reaching maximum pressure then the boundaries of the second and third loops can move. It is at the discretion of the operator.

C.4 Pre-bored tests showing yield

An example of such a test is given in fig C.2. In the example the material yields at about 5MPa and a unload/reload cycle is taken either side of this point. Subsequent expansion confirms that the material has indeed failed, and a further loop is taken on the loading after a substantial stress change has taken place. If the material was weak then the point where additional loops are taken would depend on the deformation, say every 1mm – here it is set by the pressure. The pressure drop of the cycles is, roughly, about a quarter of the total radial stress at the cavity wall. Before each cycle the pressure is held for one minute, and is also held for a short period before commencing the final unloading. A substantial deformation has taken place, so the reason for terminating the test is that sufficient data have been gathered and there is no advantage in continuing the loading further.

Fig C.2 An HPD test in material that yields



The pressure at the start of the test when the membrane first moves, and again at the end when the membrane loses contact with the borehole, give some data for the ambient water pressure in the test cavity.

C.5 Terminating an HPD test

The decision about when to stop a test depends on a number of factors:

- Has enough information been gathered? For any test the operator is trying to record at least two unload/reload cycles and to record a full cavity *contraction*. This is because in recent times the advantages of analysing the unloading of a cavity have become apparent.
- If possible the operator wants to see the material yield, and record at least some of the plastic response of the material.
- If the maximum pressure capability of the instrument is reached then this is an obvious termination imperative. In general this is a limit that is appropriate for material showing elastic deformation only.
- This decision making process can be informed by indications that the material is cracking or showing unusual behaviour.
- If the maximum displacement capability of the instrument is reached then this is an obvious reason to terminate the test. Normally the decision to terminate based on displacement depends on the material and the size of the initial pocket. A tight pocket in material that yields at relatively low stress levels can be taken further than one in an oversize pocket that yields at stress levels greater than 100 bars.

C.6 Logging rate

Once power is applied to the instrument, the HPD95 outputs a line of data every 10 seconds.

APPENDIX D INTERPRETING PRESSUREMETER TESTS

This appendix gives details of the methods used to derive the results of pressuremeter tests on this contract. The text is illustrated with examples from the fieldwork.

1 PROPERTIES FROM PRESSUREMETER TESTS IN GRANULAR MATERIAL.

The approach which will be described briefly here is the usual way of interpreting the pressuremeter test in the UK. It relies on solving the boundary problem posed by a cavity expansion in an infinite medium.

The aim of the pressuremeter test is to expand a long cylindrical cavity within an undisturbed mass of soil. Fundamental strength properties of the material can be deduced from measurements made of cavity pressure and displacement. In practice no instrument can be placed into the ground without affecting the surrounding soil. In the case of a self-bored pressuremeter test the disturbance is generally within the elastic range of the soil and can be allowed for in the analysis procedure. For a pre-bored test where the cavity is completely unloaded the material will have experienced reverse failure.

1.1 The pressuremeter test in soil - initially elastic response/failure in shear.

Consider that the material is homogeneous, and shows simple elastic behaviour before failing in shear. The stress path followed by an element of soil adjacent to the cavity is given in fig 1.1 and the corresponding pressure /strain curve is shown alongside.

The radial stress, ideally at the insitu horizontal stress for a perfect installation, increases at the same rate as the circumferential stress decreases, regardless of whether the material is deforming under plane strain or plane stress conditions. The line 0 - 0 represents stress equality, so that in the ideal case considered here the point P_0 is the insitu lateral stress.

Once the radial stress increases above the insitu stress then the shear stress in the soil at the cavity wall will increase. If the insitu lateral stress is low, then it is possible that the circumferential stress would go into tension. However in this example the insitu stress is high enough to ensure that the shear stress limit is reached before tensile stresses can be generated.

The pressure necessary to initiate shear failure is denoted p_f in fig 1.1. After this pressure the strain rate shows a substantial increase, and the form of this part of the pressure/strain curve is a function of the shear strength of the material.

Radial stress and circumferential stress now increase together. If the shear stress limit is constant, and is not influenced by pressure, and if the material deforms at constant volume, then the failure shear strength can be determined by the analytical solution developed by Gibson & Anderson.

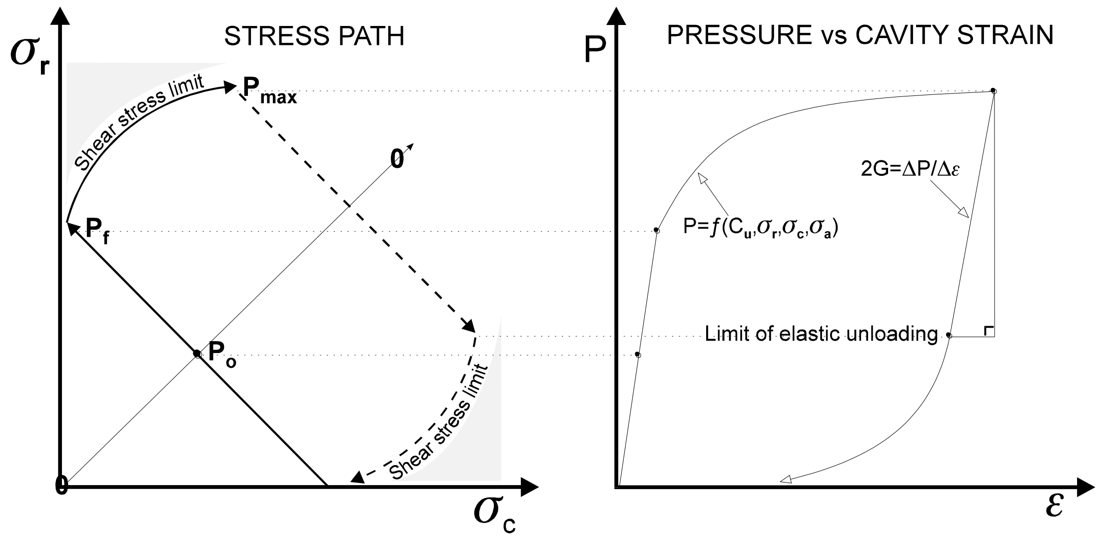


Fig 1.1 - Elastic Response followed by failure in shear

Before the shear stress limit is reached the pressuremeter response is elastic, both in loading and unloading. Assuming the material deforms at a constant modulus and the installation is perfect then the slope of the initial loading path gives the shear modulus of the material, using the classic procedure of Bishop, Hill & Mott (1945). The diagram also indicates that reversing the direction of loading causes an initial elastic response giving an alternative means of deriving the shear modulus. This implies that small cycles of unloading and reloading taken anywhere in a test after reaching the shear stress limit can be used as a source of stiffness information (Hughes 1982).

As fig 1.1 suggests, the complete unloading of the pressuremeter can also be used to give strength and stiffness parameters comparable with those obtained from the loading path.

From the right hand side of the stress diagram it is apparent that the pressuremeter provides only a limited set of the necessary information for resolving the stresses and strains around the probe. Specifically it gives the changes in radius of the borehole wall (a special case of hoop strain) and the corresponding changes in radial stress at the borehole wall. There are no data for hoop stress or radial strain or movements in the vertical direction. Test procedures are chosen to allow the missing data to be inferred – for example an undrained expansion means shearing occurs at constant volume and hence changes of radial strain must be equal and opposite to changes in hoop strain. The unseen vertical axis data are rendered redundant by making pressuremeters long with respect to their diameter, allowing plane strain expansion to be assumed.

1.2 Defining strain

For a pressuremeter measuring the radius of an expanding cavity the conversion from displacement to strain is $[R-R_0]/R_0$, where R is the current radius of the cavity and R_0 is the original radius of the cavity in the insitu state. This is simple strain and when displacements are measured at the borehole wall is termed cavity strain, ε_c.

R_0 can be approximated by the at rest radius of the instrument. The preferred approach is to identify when the applied pressure has reached the insitu lateral stress, and interpolate from this the corresponding radius, which then becomes R_0.

Note that although the pressuremeter measures the radius of the cavity wall, ε_c is actually a specific instance of circumferential or hoop strain. It is usually expressed as a percentage.

Figure 1.2 shows how pressures and strains in the expanding borehole are defined.

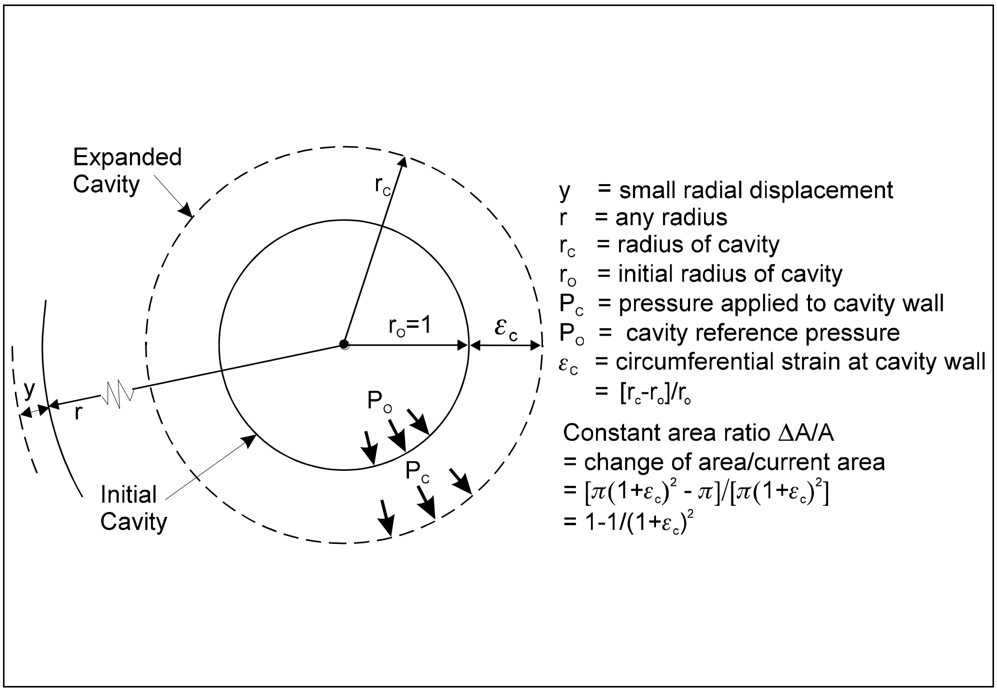


Fig 1.2 Pressures and strains around the expanding cavity

The other strain commonly used is the constant area ratio, which is shear strain. As fig 1.2 indicates it can be defined in terms of simple strain.

1.3 Average displacements versus the output of the separate axes

There are a number of displacement sensors in the expansion probe but recommended practice is to quote parameters from the average displacement curve. This is for two reasons:

- The reference for the measured displacements is the body of the instrument itself - trying to separate the individual axes means assuming that the body of the instrument remains fixed at all times, which is not realistic.
- All available analyses assume isotropic properties in the surrounding soil, and only the average pressure/strain curve represents this condition.

These remarks assume that the instrument is in full working order throughout the test - failure of a displacement follower means that alternative strategies must be adopted.

The significance of the first point above has been demonstrated by an examination of cycles of unloading taken from separate arms (Whittle 1993) and by work with a six arm version of the Self Boring Pressuremeter (Whittle et al 1995).

1.4 The Analysis program

We use (and supply to others) software for analysing a pressuremeter test. The program is called **WINSITU,** it has been in use for a number of years.

To use the program the user must first read in a text file of test data in engineering units. The program needs to know the type of instrument being used, and the user may choose to enter additional background information about the test.

The next task is to identify for the program the nature of the individual data points. Broadly, the options are these:

- a point can be part of the expansion curve
- or part of a reload loop
- or part of the contraction curve
- or none of the above. This might mean a 'rogue' data point, but it is more likely to be true of parts of the loading where the expansion was slowed prior to taking an unload/reload cycle. Data points recorded at this time are neither part of the expansion nor part of a cycle, and should be identified as such.

There is a quick on-screen routine for marking the points. Once marked, they appear in different colours. Most of the analyses use a limited set of the available data - for example the Gibson & Anderson analysis for undrained shear strength uses only points on the expansion curve.

The program implements all the standard analyses mainly in a graphical form. As fig 1.1 implies, there are significant changes of gradient in the pressure/strain curve denoting critical soil parameters. The user of the program is provided with on-screen tools to mark these breakpoints or to obtain the slope of the loading curve. The tools can be visualised as rulers, whose position is stored by the program in the file of test data. The evidence for any derived parameter is a screen dump of the appropriate analysis that shows the position of any rulers set by the user and quotes the parameter obtained. Even when the user declines to make a choice it is good practice to provide the screen dump as evidence of why a choice is difficult.

The results for a test appear as a summary sheet of derived parameters followed by a number of plots showing the application of the various procedures.

Sometimes analyses are required which are not included in the WINSITU program. In such instances commonly available spreadsheet software is used to implement the new analysis. Inevitably in such circumstances there is some risk of human error affecting the conversion of data in engineering units to the form required for analysis. WINSITU has export facilities and wherever possible is used as the data source for the spreadsheet.

2. ANALYSES FOR INSITU LATERAL STRESS

2.1 Overview

The expansion pressuremeter test is a sequence of measured co-ordinates of pressure and displacement of the cavity wall (once suitable corrections have been made to compensate for the response of the elastic membrane).

In order to solve the boundary problem, an origin for the expansion has to be determined. For insertion methods that imply stress *relief*, the origin is taken to be the point where insitu conditions are restored to the cavity. This means that an estimate of the insitu lateral stress has to be made, and the measured radius of the cavity at the point where the insitu lateral stress is restored is used to convert subsequent displacements to strain.

For a self boring pressuremeter and occasionally other pressuremeters it is possible to recognise the insitu lateral stress by inspection, the so-called lift-off method. It is also possible to recognise by inspection the shear stress limit (the point marked p_f in fig 1.1) as this is indicated by the onset of a markedly non-linear response. An iterative procedure first suggested by Marsland & Randolph (1977) allows the insitu lateral stress to be inferred. The method is not valid for tests in sands and tests in material with non-linear elastic properties. This rules out all soils. Nevertheless it is usual to run the analysis because it tends to set an upper limit to any estimate of insitu lateral stress.

Both methods are outlined by Mair & Wood (1987). Note that these methods amount to obtaining a value for the cavity reference pressure, p_o. It is impossible to measure the insitu lateral stress σ_{ho} because the act of placing instrumentation always results in some disturbance, even if small. The methods above are indirect indicators for determining σ_{ho}. It is open to question whether the reference stress is equivalent to the insitu lateral stress, and it is usual to bring a range of evidence to bear in order to decide if a particular value for p_o is also a plausible value for σ_{ho} . External evidence might take the form of using the derived reference stress within a k_O calculation, or checking that the derived vertical/horizontal anisotropy can be supported by the material shear strength i.e.

$$\sigma_{ho} - \sigma_{vo} < 2C_u \quad \text{...[2.1]}$$

A more complex approach uses the full set of parameters derived from a pressuremeter test within a model, and discovers whether the measured field curve can be recovered. The input data set is then adjusted in a strictly controlled manner until the best match for all parameters is obtained.

2.2 Marsland & Randolph (1977) Analysis

Marsland & Randolph analysis relies on being able to identify the onset of plastic behaviour, the yield stress p_f. The argument is as follows:

- In the vicinity of the insitu lateral stress the soil response is simple elastic manner and therefore the total pressure/ cavity strain plot will be linear
- Elastic behaviour will cease when the undrained shear strength of the soil is reached in the wall of the cavity, and hence the pressure /strain plot will begin to curve (see Fig 1.1).
- This can be expressed as: $p_f = p_o + c_u$ .....[2.2]
- From this it follows that p_o can be deduced by iteration. Initially a guess is made of a value for p_o; using this guess to define a temporary strain origin a total pressure:log volumetric strain plot is then generated in order to derive a value for c_u. The sum of

these two parameters is compared with the selected value of p_f. The choice of p_o is then suitably adjusted and the process repeated until a match is found. It is a straightforward matter to carry out this procedure on the computer.

The modified method in current use is a response to the difficulty that perfectly plastic deformation is not a realistic enough model for many materials and yield may occur at a different shear stress than the large strain shear strength. Hawkins et al (1990) suggested that the most appropriate choice was that value of shear stress pertaining at the apparent onset of plasticity, so [2.2] now becomes:

$$p_f = p_o + \tau_f \qquad .....[2.3]$$

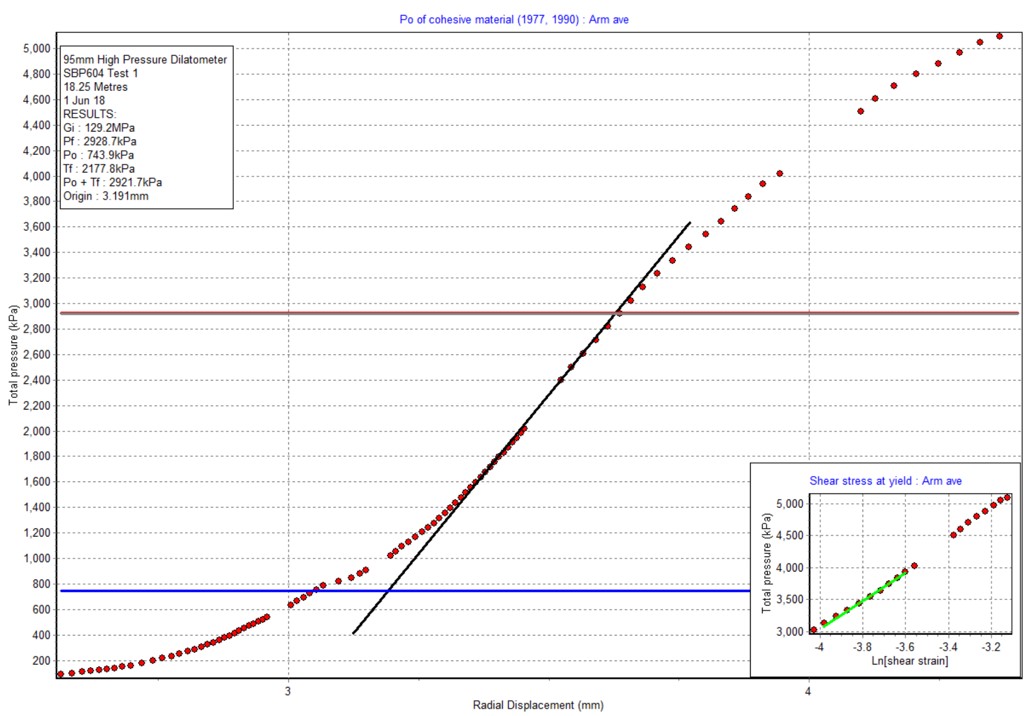


Fig 2.1 **An example of the Marsland & Randolph analysis**

τ_f can be obtained from a total pressure:log volumetric strain plot by selecting the slope at the pressure and strain corresponding to the choice of p_f (in practice, using the Palmer (1972) argument to identify the mobilised shear stress at failure).

The analysis is implemented graphically, using a number of rulers to identify significant points on the curve (Fig 2.1). There are a number of limitations:

- The assumption of simple elastic response - in practice most soils exhibit marked non-linear elastic characteristics, so that the pressure at which the material appears to go fully plastic is more than one increment of shear strength above P_0 - this point is developed later.
- The original analysis was developed as an aid to the interpretation of pre-bored pressuremeter tests where the process of forming the pocket results in the complete unloading of the cavity prior to the test commencing. It is certain therefore that the soil has seen stress relief. It is arguable whether in these circumstances that the yield point

remains unchanged, as more than elastic unloading has taken place. However the form of such tests does tend to give an unambiguous choice for the onset of plasticity.

- In a low disturbance test the situation is not so clear cut. The very factors that make the test desirable also results in more realistic behaviour being seen in the form of the early part of the test, with non-linear elasticity being a feature. Hence a choice of p_f is not obvious. The better the test, the harder such a choice becomes. However it is probable that in a good test the lift off pressure would be a credible choice so that in the wider context it is not a serious problem.
- A disturbed test does not necessarily imply stress relief. In some cases the pressuremeter is pushed or forced into the ground, and the material will have seen a stress greater than the yield stress before the loading of the cavity by the pressuremeter commences. In this event the analysis can contribute nothing – forcing such data to fit the assumptions of the analysis will over-estimate the insitu lateral stress.

Against these objections there is good empirical evidence that no matter the mode of failure, identifying the yield stress and working back to the insitu stress works for all soils, provided one takes the apparent mobilized shear stress at failure, not large strain. For this reason the procedure is often applied with apparent success to tests in frictional material.

2.3 Deriving insitu lateral stress by synthesis

The doubt concerning the appropriateness of using the measured values for cavity reference pressure p_o as best estimates for the insitu lateral stress σ_{ho} mean that other methods for inferring plausible values are required. We use two models, depending on the manner of the loading. For an undrained test the procedure introduced by Whittle (1999) is used. This assumes an undrained cavity expansion and contraction in a non-linear elastic/perfectly plastic medium. A single set of parameters matches both parts of the test curve. The procedure is rigorous with only one degree of freedom, the ability to adjust the insitu lateral stress.

For drained expansions in c'-phi material (where cohesion can be zero) a modified version of the Carter et al (1986) solution is used. The modified version assumes a non-linear elastic/perfectly plastic medium, and extends the solution to cover the elastic part of the final unloading. There are two degrees of freedom in the model, because cohesion cannot be independently determined and must also be adjusted in addition to the insitu lateral stress.

These procedures can be applied to pre-bored pressuremeter test data but a fit to the early part of the loading will not be possible.

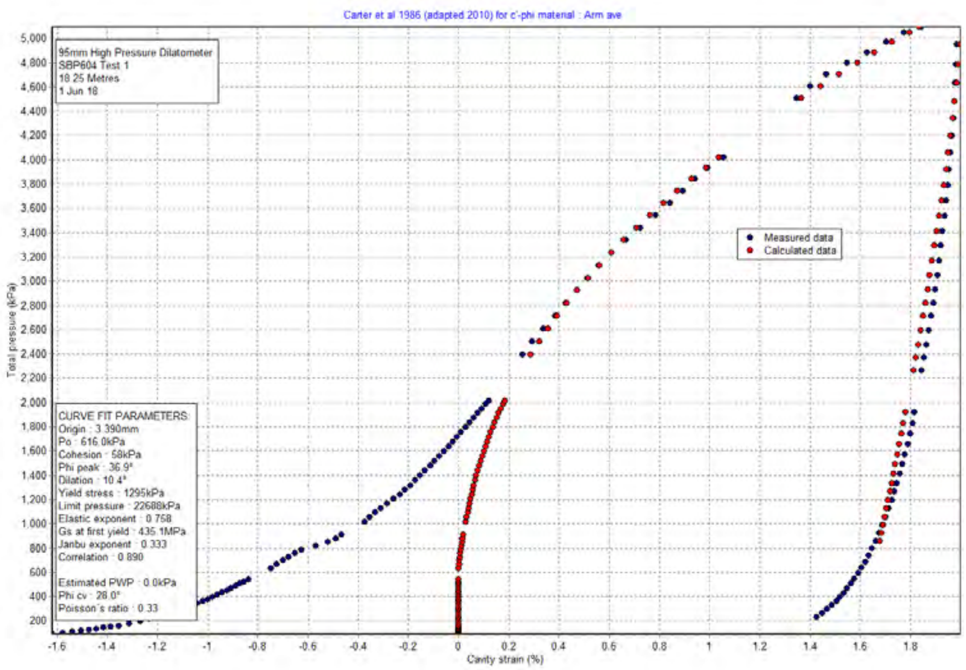


Fig 2.2 Using a drained non-linear elastic/perfectly plastic solution

It is only possible to derive one value for insitu lateral stress using these procedures, as isotropy of soil properties is a fundamental assumption. Because the procedure makes uses of all the evidence it is the preferred method for deriving the insitu lateral stress. However the model has to be appropriate. Material approaching a rock-like condition may have a component of tensile strength, which the model does not resolve. The effect will be to exaggerate the insitu lateral stress.

3. SHEAR MODULUS

Terms:

G_P	Pressuremeter shear modulus
G_S	Secant shear modulus
G_T	Tangential shear modulus
G_{100}	Secant shear modulus at the maximum elastic shear strain
G_{HH}, G_{VH}	Shear moduli for transversely isotropic material
E_H, E_V	Young's modulus in the horizontal and vertical direction
ν_{HH}, ν_{HV}	Poisson's ratios for transversely isotropic material
n	Ratio of horizontal to vertical Young's modulus E_H/E_V
K_O	Ratio of horizontal to vertical effective insitu stress
τ	Shear stress
p_C	Pressure measured at the cavity wall
ε_c	Circumferential strain measured at the borehole wall
γ	Shear strain
γ_c	Shear strain measured at the borehole wall
γ_s	Invariant shear strain
η	Radial stress intercept
β	Elastic exponent
α	Shear stress intercept

3.1 Background

Values of stiffness in real soils, however measured, are strain level and stress level dependent. Pressuremeter stiffness is affected by the additional factor of cross anisotropy. The pressuremeter used conventionally gives shear modulus parameters of type G_{HH}, where the first suffix shows the direction of loading and the second suffix the direction of particle movement. Most design calculations that require a value for shear modulus mean in practice the independent shear modulus $G_{VH.}$ Translating between pressuremeter values and alternative expressions for modulus is complex but worth pursuing because of the high quality of the pressuremeter measure. What follows is a brief outline of a possible approach.

There are three parts of the pressuremeter curve capable of providing information concerning shear modulus:

- From the slope of the initial elastic loading phase
- From the slope of the chord bisecting small rebound cycles
- From the slope of the first part of the contraction curve

3.2 The Initial Shear Modulus

Shear modulus can be derived from the slope of the initial part of the loading curve (see fig 2.1). In a pre-bored pressuremeter test, unless the probe is in good rock, this underestimates the true elastic properties of the material. The initial part of the test is affected by the process of making a pocket and the complete unloading of the cavity wall prior to starting the pressuremeter test.

As fig 1.1 shows, the calculation for shear modulus G is:

$$G = dP/2d\varepsilon_c \qquad [3.1]$$

The origin for deciding cavity strain ε_c is set by the point where the projected initial modulus line cuts the displacement axis. This origin does not apply to other parts of the loading curve and each cycle of unloading and reloading has its own local origin.

3.3 Cycles of elastic unloading and reloading

Data points from an unload/reload cycle are the preferred source of stiffness parameters, because these data are a function of the 'far field' material response . The plots provided show the position of a cursor which has been placed by eye to bisect the cycle. The slope of the cursor is the gradient of the reload loop and the program uses this slope to derive a value for shear modulus. This value is quoted in the top left hand corner of the plot together with an indication of the size of the loop expressed as the change of pressure and strain, and the co-ordinate of the centre of the loop. The theoretical equation used is:

$$G = [1+\varepsilon_c][dP/2d\varepsilon_c] \qquad [3.2]$$

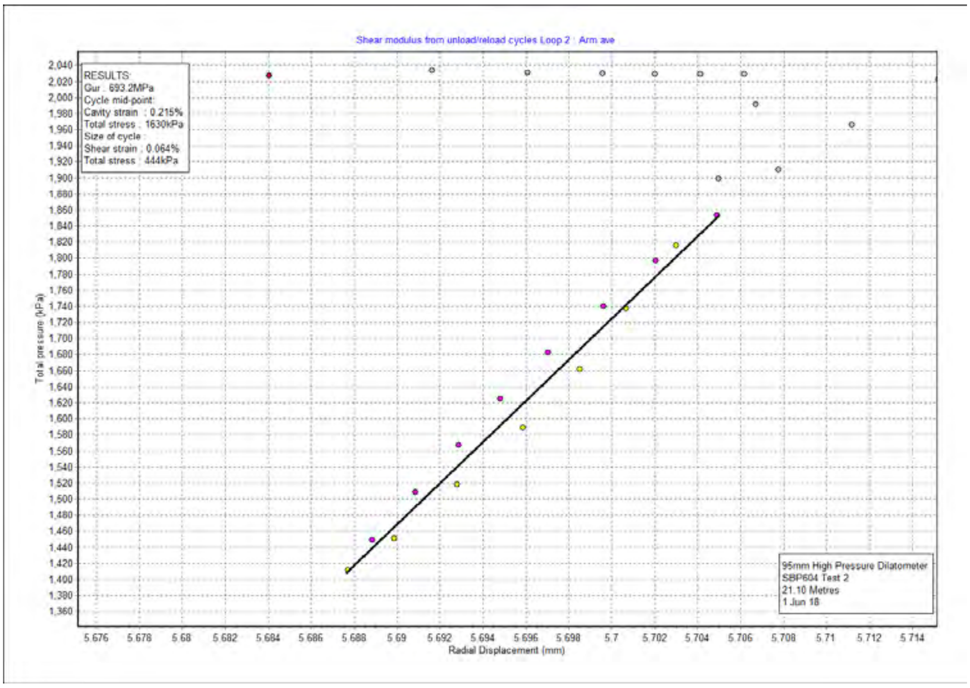


FIG 3.1 Expanded view of an unload/reload cycle

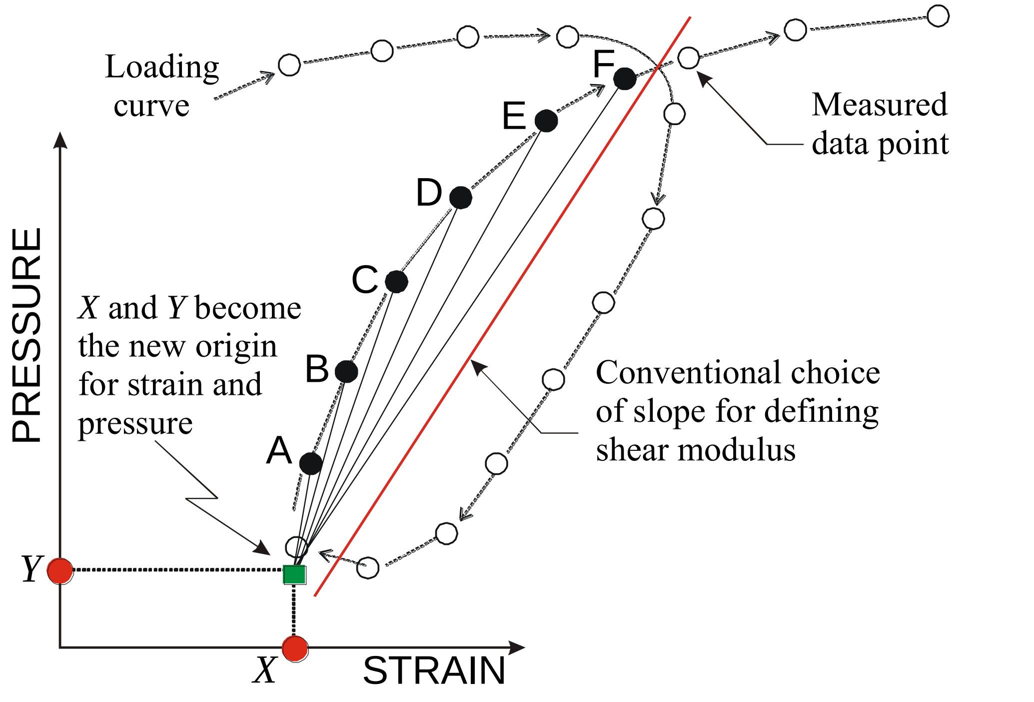
In practice, and using fig. 3.1 as an example, we calculate the gradient of the plotted line as change of pressure divided by change of displacement. This result is then multiplied by the displacement of the midpoint of the line added to the initial radius. This result is 2G and takes account of the alteration in the strain scale represented by loops taken at different stages of the cavity expansion.

It is important that the effects of creep (for whatever cause) be minimised before starting the cycle, and in fig 3.1 'deleted' points before the start of the unloading show where the pressure in the probe was held for a period of time.

3.4 Non-linear stiffness/strain response

In all soils and some rocks the stiffness/strain relationship is not linear. The unload/reload cycle can be made to describe the non-linear relationship by looking at smaller steps of pressure/strain other than the points at the extreme ends of the cycle.

FIG 3.2 Annotated unload/reload cycle



For reasons explained in Whittle et al (1992) it is preferable to examine one half of the rebound cycle only, that following the reversal of stress in a loop. The lowest recorded value of stress and strain then becomes the origin for subsequent data points until the original loading path is re-joined (fig 3.2).

The reloading data can be plotted on axes of log Δp_c versus log ΔV/V. Fig 3.3 is an example. The gradient of the best fit straight line to the data points gives the non-linear elastic exponent, where 1 is a linear elastic response.

The linear relationship between pressure and shear strain on log scales expands to a power law of the form

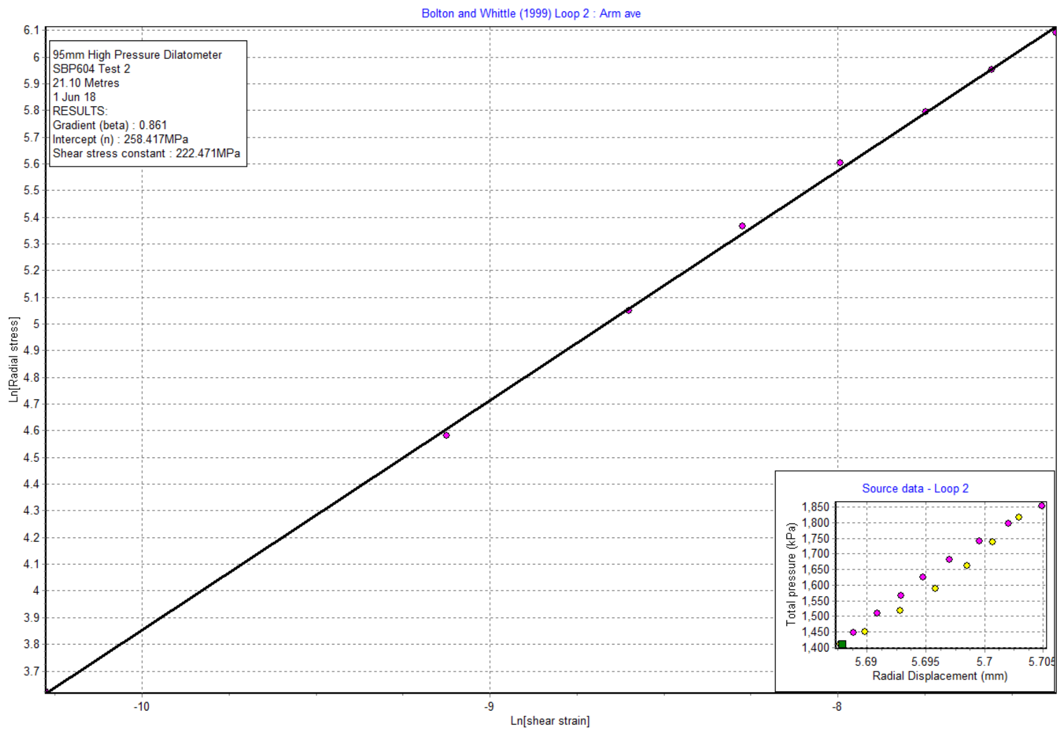
$$p_c = \eta\gamma^{\beta} \qquad [3.3]$$

where p_c is the change in radial stress at the cavity wall, γ is the corresponding shear strain and η and β are the intercept and gradient of the log log relationship.

Palmer (1972) shows for undrained plane strain loading the connection between cavity pressure and shear stress at any point on the pressure versus strain plot is given by

$$\tau = \gamma \frac{dP}{d\gamma} \qquad [3.4]$$

FIG 3.3 The non linear elastic response



Using the right hand side of [3.3] in [3.4] gives

$$\tau = \gamma \frac{d(\eta\gamma^{\beta})}{d\gamma} \qquad [3.5]$$

The differential equation can now be solved

$$\tau = \gamma\left(\eta\beta\gamma^{\beta-1}\right) = \eta\beta\gamma^{\beta} \qquad [3.6]$$

Hence the shear stress is related to the radial stress measured at the cavity wall by

$$\tau = \beta\, p_c \qquad [3.7]$$

This is precisely the result obtained by Bolton & Whittle (1999) using an alternative approach. It is convenient at this point to replace the combined coefficient $\eta\beta$ with a single term α, where

$$\alpha = .\eta\beta \qquad [3.8]$$

This can be turned into a general expression for secant shear modulus G_s by dividing both sides by the shear strain γ:

$$G_s = \eta\beta\gamma^{\beta-1} = \alpha\gamma^{\beta-1} \qquad [3.9]$$

and because the tangential modulus G_t is related to the secant modulus by the following relationship (Muir Wood 1990, Jardine 1992)

$$G_t = G_s + \gamma\left[\frac{dG_s}{d\gamma}\right] \qquad [3.10]$$

It follows from [3.9] that the solution to [3.10] is

$$G_t = \eta\beta^2\gamma^{\beta-1} = \alpha\beta\gamma^{\beta-1} \qquad [3.11]$$

Tests in good rock show a linear elastic response. Occasionally, where the material is friable or crushable a significant non-linear elastic response is apparent. Often loops carried out later in the loading when the applied stress is higher show the influence of grain crushing, revealed as a tendency for the exponent to become more non-linear.

If the test is drained, meaning the mean effective stress increases throughout the loading, then successive loops will have a higher intercept (fig.3.4). Loops taken too early in the expansion sometimes show an exponent greater than 1. This is a certain indication that the cycle has been taken too soon, and the response is a mixture of elastic and plastic strain changes.

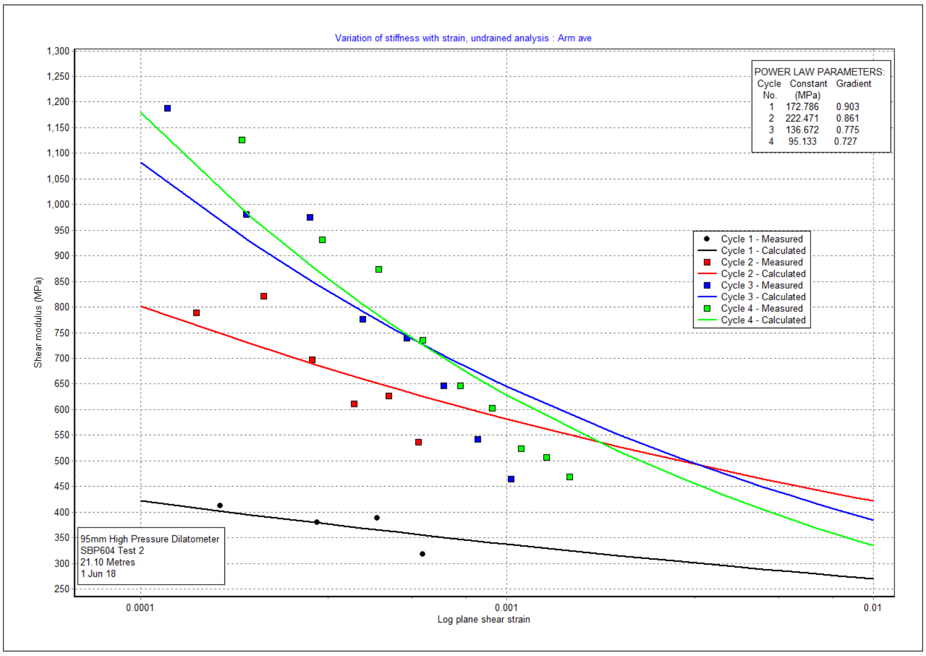


FIG 3.4 The effects of stress level on stiffness, drained test

Our practice is to give the exponent and intercept of the power law, and for comparative purposes to quote secant shear modulus parameters at three levels of plane shear strain, 10^{-2}, 10^{-3} and 10^{-4}. It is unwise to use the power law to predict modulus for strains smaller than 10^{-4}.

Fig 3.4 shows, in addition to the stiffness/strain curves, a scatter of points. These arise from applying the Palmer 1972 solution (3.4) directly to the measured field data– inevitably, this gives a noisy result but scattered in a regular way around the curve fitted trend.

3.5 Stress Level

Figure 3.4 is an example of a test in drained material where due to the ever changing mean effective stress the stiffness increases with successive loops. There are procedures for normalising the stiffness curve to a common stress level, usually the effective insitu lateral stress. It is complex because both strain and stress dependence have to be incorporated.

Whittle & Liu (2013) give a method for both stress and strain adjustment. It is based on Bellotti et al (1989) and can be applied to tests that contain at least four unload/reload cycles.

Their solution can be written as: $G = A\sigma^N$ [3.12]

A and N are both semi-log equations. For most purposes this level of complexity is not required and a simpler approach can be adopted.

1) Start by carrying out the non-linear analysis described above and discover α and β. Use these to find, for each cycle, G_s at an intermediate value of shear strain, such as 0.1%.
2) Calculate the mean effective stress σ'_{av} at the commencement of each loop. The effective radial stress p´ is measured by the pressuremeter and the calculation is

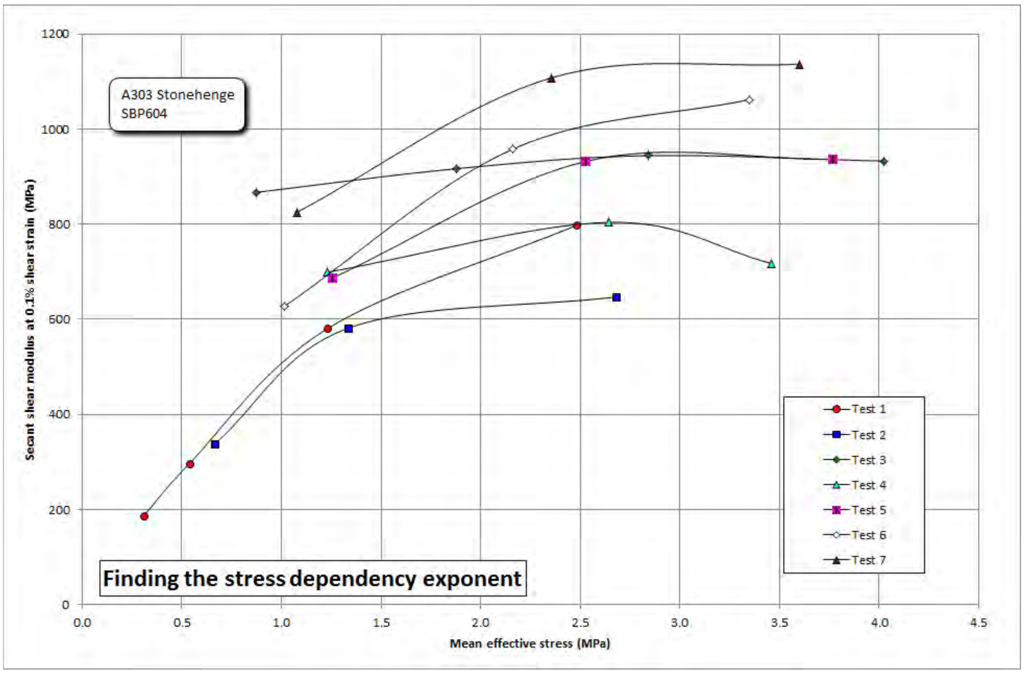
$$\sigma'_{av} = p'/(1+\sin\phi) - c'\cos\phi/(1+\sin\phi) \qquad [3.13]$$

where ϕ is the peak angle of internal friction and c´ is drained cohesion

3) Plot modulus against effective stress (fig 3.5).

The procedure relies on the material behaving like a soil. The example in fig 3.5 shows all tests from this contract treated in this way – cycles on the unloading have been omitted because[3.13] only applies to the loading. Each test gives a set of points that follow a power

Fig 3.5 Finding the stress dependency exponent



law trend. The exponent of the power law is describing the stress dependency at this level of shear strain. If the material is deforming under constant volume conditions then the exponent will be close to zero. Otherwise it seems to lie between 0.3 and 0.6.

Given the stress dependency exponent n, , for each cycle a stress adjusted version of α is found, α^*:

$$\alpha^* = \alpha(\sigma'_{ref}/\sigma'_{av})^n \qquad [3.14]$$

This is derived from the relationship suggested by Janbu ('63) and forms the basis of the approach to stress dependency used in Bellotti et al (1989). The reference stress is typically σ'_{vo} or σ'_{ho}. For applications where a vertical deformation modulus is required it seems sensible to use σ'_{vo}. α^* is used in place of α in [3.9] to derive the stress adjusted modulus.

Fig 3.6 – Raw secant shear modulus

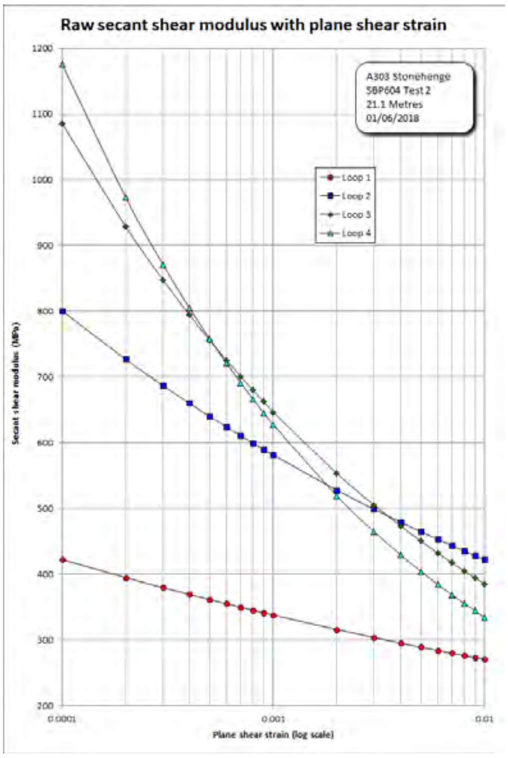
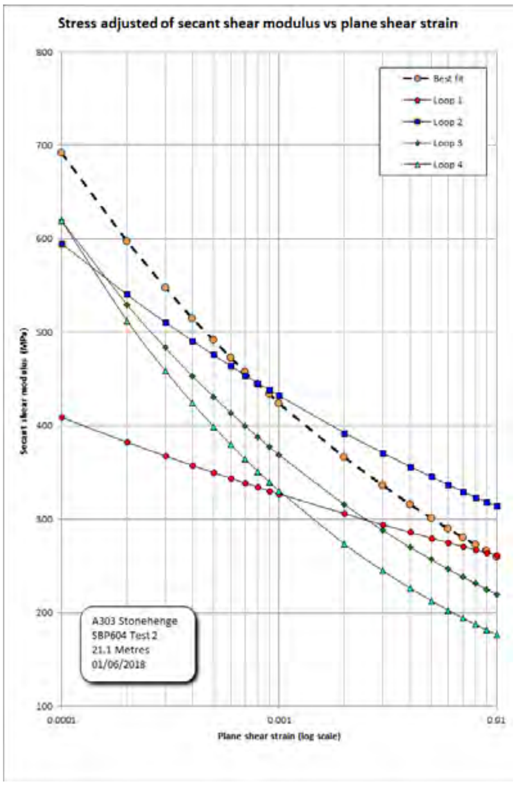


Fig 3.7 – Adjusted secant shear modulus



Figs 3.6 and 3.7 give a 'before' and 'after' example of the method being applied, with a 'best fit' trend added to the stress adjusted plot. Because the material in question is chalk rather than a true soil the adjustment is only approximate.

3.6 Cross hole anisotropy

The pressuremeter test gives values for G_{HH}, the shearing stiffness in the horizontal plane. This is directly applicable to the analysis of radial consolidation or cylindrical cavity expansion due to pile insertion. G_{VH} is applicable all shearing which has an element of deformation in the vertical plane, such as under a footing or round an axially loaded pile.

To convert from G_{HH} to G_{VH} some relationship between the two must be assumed. Wroth et al (1979) suggest that anisotropy arises from two causes:

- Structural anisotropy due to the deposition of soil on well defined planes
- Stress induced anisotropy, due to the differences in normal stress acting in different directions.

The second cause implies the stiffness in any direction will be a function of the effective insitu stress in that direction, ie a function of K_O.

It can be shown	$G_{HH} = E_H/[2(1+\nu_{HH})]$	... [3.15]
For undrained expansion	$\nu_{HH} = 1\text{-}n/2$	... [3.16]
and	$n = E_H/E_V = K_O$	... [3.17]
From this it follows	$E_H = (4\text{-}n)G_{HH}$	... [3.18]
and	$E_V = (4\text{-}n)G_{HH}/n$	... [3.19]

This is as far as argument from first principles can go, because of the additional contribution of the manner in which the material is deposited. K_O is likely to lie between 0.5 and 2, so from [3.18] E_H/G_{HH} lies between 2 and 3.5. From [3.19] E_V/G_{HH} lies between 1 and 1.75.

It is likely that G_{VH} will be linked to E_V by Poisson's ratio in a relationship of the form of equation [3.14]. Plausible values of E_V/G_{VH} would seem to be 2.4 to 3. Hence in a material with K_O of 2, G_{VH} could be as low as $G_{HH}/3$. Simpson et al (1996) come to the same conclusion, but find in practice heavily over-consolidated London clay gives relationships of the order of $G_{VH} \cong 0.65G_{HH}$. The influence of the strain range is not separately considered in these studies, and it is quite possible that the G_{100} values would be similar in all planes.

Lee & Rowe (1989) give details of the anisotropy characteristics of many clays varying from lightly over-consolidated to heavily over-consolidated. The general conclusion is E_V/G_{VH} lies between 4 and 5, rather more than the isotropic relationship of 3. However their paper was concerned with the impact of anisotropic stiffness properties on surface settlement. Deriving G_{VH} from E_V is therefore unsatisfactory, because although G_{VH} is insensitive to the direction of loading, E_V is not.

4. ANALYSES FOR STRENGTH, DRAINED LOADINGS

For drained expansion tests in purely frictional material the strength is described in terms of the peak angle of internal friction and dilation. The method used is that due to Hughes et al (1977). The form of the shear stress:shear strain curve is simple elastic/perfectly plastic and dilation and friction are related by Rowe's dilatency law. Although the soil response during elastic deformation is more realistically described as non-linear elastic, this has no effect on the plastic part of the curve from where strength is derived.

The technique is to plot effective pressure against cavity strain on log scales and to discover by inspection the maximum slope of the resulting curve. It is usual to only quote a single value for friction and dilation. The same assumptions have been applied by Withers et al (1989) to produce a solution for cavity contraction.

Manassero (1989) is a numerical solution that applies Rowe's dilatency law as a flow rule. Elastic strains in the plastic area are ignored for simplicity.

For tests in c′ – phi material a method based on the solution of Carter et al (1986) is used. In such material the value for friction angle can often be identified from the Hughes analysis.

4.1 Hughes et al (1977)

In addition to the usual conditions governing the expansion of a cylindrical cavity in plane strain this analysis assumes the following:

- A simple elastic/perfectly plastic model
- The expansion is fully drained, i.e. no excess pore water pressures are allowed to develop
- Following yield the sand deforms at a constant angle of internal friction
- Volumetric and shear strains are connected by Rowe's dilatancy law (1962)

Rowe's dilantancy law can be written:

$$[(1 + \sin \phi')/(1 - \sin \phi')] = [(1 + \sin \phi'_{cv})/(1 - \sin \phi'_{cv})][(1 + \sin \nu)/(1 - \sin \nu)] \quad [4.1]$$

where ϕ' is the peak angle of internal friction

ϕ'_{cv} is the critical state angle of friction

ν is the angle of dilation.

At failure the effective pressure at the cavity wall p′ is given by:

$$p' = \sigma'_{ho}(1 + \sin \phi') \quad [4.2]$$

Following failure:

$$\ln [p'] = S\, ln[(\varepsilon_c /(1+\varepsilon_c) + c/2)] + A \quad [4.3]$$

where A is a constant

S is $[(1 + \sin \Psi) \sin \phi']/(1 + \sin \phi')$

Equation 4.3 indicates that s is approximately the gradient of effective pressure plotted against cavity strain on log scales. Once obtained, both $\sin \phi'$ and $\sin \nu$ can be derived:

$$\sin \phi' = S/[1 + (S - 1) \sin \phi'_{cv}] \quad [4.4]$$

$$\sin \nu = S + (S - 1) \sin \phi'_{cv} \qquad [4.5]$$

The factor c/2, representing elastic strain in the plastic region, is usually ignored - it has been shown to introduce an error of about 0.03% in the strain scale for a typical dense sand.

An example of the Hughes analysis is shown in fig 4.1. Both the ambient pore water pressure u_o and ϕ'_{cv} are required to implement the analysis. Because the expansion is drained the membrane normally collapses at the head of water pressure, and an estimate of

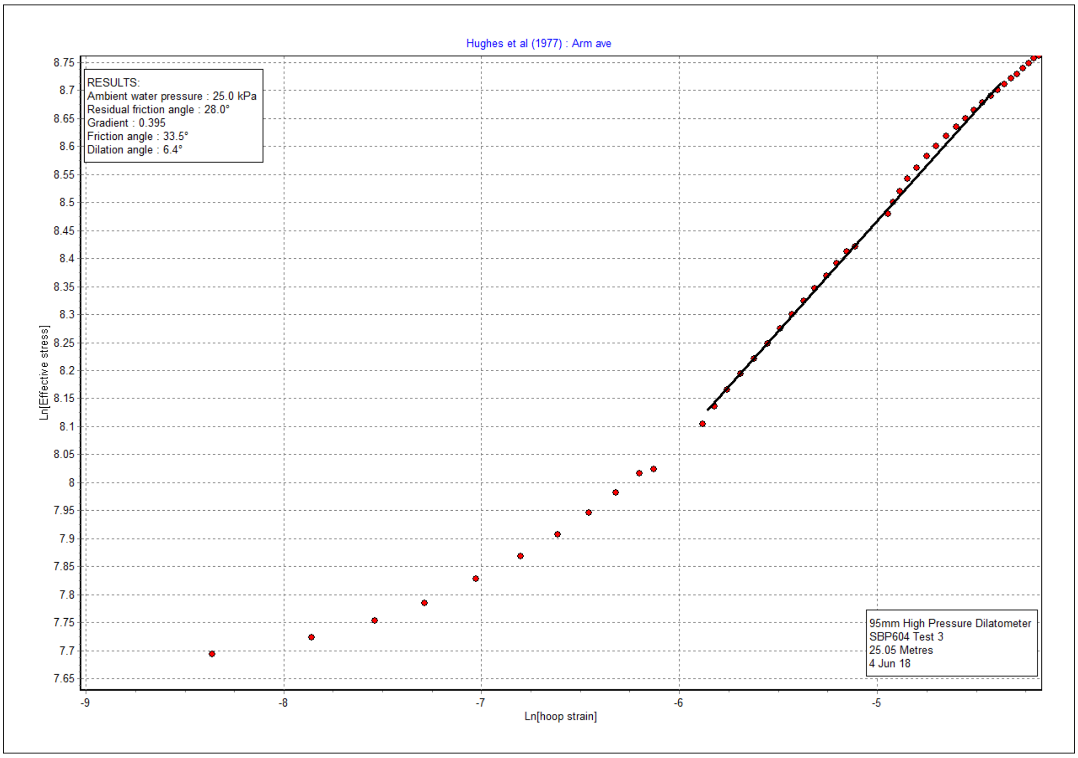


Fig 4.1 Example of Hughes et al (1977) applied to drained test in chalk

u_o can often be made from this behaviour. ϕ'_{cv} must either be given or estimated. The analysis is sensitive to the choice of strain origin.

If the test shown in fig 4.1 was taken to a high enough cavity strain then the final part of the loading would show strain softening indicating that the peak friction angle is passed and the current internal angle is reducing towards a residual value. Curvature at relatively low strain (as in the example) indicates the presence of some cohesion, in which case the ultimate slope of the trend gives the best estimate of the friction angle.

4.2 Manassero (1989)

This analysis is a numerical procedure that makes the same assumptions as Hughes et al (1977). The difference is that Rowes dilatancy relationship is employed as a flow rule, so that the requirement for deformation at a single value of friction angle is not necessary.

The advantage of this analysis is that it can produce a comprehensive stress/strain curve analogous to that of the Palmer (1972) analysis for an undrained expansion. The disadvantage is that the numerical method is very sensitive to even minor fluctuations in the measured data. Manassero suggests that the measured data be fitted with a polynomial function prior to implementing the numerical calculations.

The pressuremeter test provides data for the radial pressure and circumferential strain at the wall of the cavity. The radial strain ε_R at a point (i) corresponding to a measured data point of circumferential strain ε_C and effective pressure *P* is as follows:

$$\varepsilon_R(i) = \frac{p(i)[\varepsilon_C(i-1) + k_a^{cv}\varepsilon_R(i-1)] - p(i-1)\varepsilon_C(i)}{2[p(i)(1+k_a^{cv}) - p(i-1)} + \frac{p(i)[\varepsilon_C(i-1) - \varepsilon_R(i-1)] + p(i-1)[\varepsilon_R(i-1)(1+k_a^{cv}) - \varepsilon_C(i)}{2k_a^{cv}p(i-1)} \quad \text{.... [4.6]}$$

where k_a^{cv} is $1/k_p^{cv}$ and k_p^{cv} is $\frac{1+\sin\phi_{cv}}{1-\sin\phi_{cv}}$, the constant volume stress ratio coefficient.

Equation [4.6] is solved for each data point in turn, knowing that the expansion starts from zero strain.

Once the radial strain is known, volumetric strain ε_V and shear strain ε_γ can be obtained as follows:

$$\varepsilon_\gamma = \varepsilon_R - \varepsilon_C \quad \text{.... [4.7]}$$

$$\varepsilon_v = \varepsilon_R + \varepsilon_C \quad \text{.... [4.8]}$$

Further more the principal stresses are connected by:

$$\frac{\sigma_R}{\sigma_C} = -k_p^{cv}\frac{d\varepsilon_c}{d\varepsilon_R} \quad \text{.... [4.9]}$$

In principle the analysis can give a full description of the shear stress:shear strain response but as Manassero himself points out, real data are generally too noisy for use as direct input in a numerical analysis, and he suggests curve fitting the field test prior to implementing the solution.

4.3 Carter et al (1986, adapted 2010)

Carter et al (1986) is a closed form analytical solution for cavity expansion tests in ideal cohesive frictional material. There is an explicit small strain expression of the solution which makes a convenient basis for a curve comparison routine. What is presented here is a modified version of the solution incorporating non-linearity in the elastic phase of the test. A power law is used to describe the non-linear response and the parameters for the power law are obtained from rebound cycles carried out during the test. Unload/reload cycles offer the means of obtaining the elastic properties of the ground independently of disturbance caused by the process of placing the instrumentation - it is an important aspect of the methodology presented here that the analysis be constrained by the measured values of soil stiffness.

The process starts with the parameter set already obtained from the conventional analyses for cavity reference pressure, stiffness and internal angle of friction. Using the measured pressures but calculating the cavity strains according to the input parameter set, a theoretical curve is generated. This is overlaid on the measured field data. If the mis-match is significant, then certain parameters can be adjusted to improve the match. The fixed parameters are the stiffness data. The curve comparison procedure covers elastic loading, plastic loading and elastic contraction – the plastic contraction part of the test is ignored for the present. For simplicity, all stresses in the following description are effective. As does Carter *et al* the method is developed first in terms of a purely frictional material and is then modified for cohesion. The solution is presented in terms appropriate for cylindrical cavity expansion, the spherical case has been ignored.

There are two main reasons for using this procedure. With the analyses available at the present time it is difficult to separate out the contribution of cohesion and friction in a dilating material. This can be done reasonably easily with the curve comparison approach. The other reason is that the influence of cavity reference pressure on the overall curve is very obvious. Tests in material of this type are often pre-bored and there is very little that can be done to assess the cavity reference pressure when the initial part of the loading curve is dominated by disturbance effects. With this procedure implausible values are identified very easily.

Notation – as much of the Carter *et al* notation has been preserved here so some parameters used earlier are now rewritten

u	is an increment of radial displacement at a point in the continuum
r	is radius. r_0 is the initial radius of the cavity. r_a is current cavity radius.
R	is the radius of the elastic/plastic boundary
ε_R	is circumferential strain at the elastic/plastic boundary
ε_c	is cavity (circumferential) strain, measured by the pressuremeter and is $(r - r_0)/r$.
ε_s	is shear strain
p	p is effective pressure at the cavity wall and is measured by the pressuremeter
G	is shear modulus, G_s is secant shear modulus
ν	is Poisson's ratio
ϕ	is peak angle of internal friction. ϕ_{cv} is friction angle when the material is shearing at constant volume.
ψ	is dilation angle
c	is cohesion
σ	is stress, suffix r for radial stress, θ for circumferential stress
$\sigma_{A\varsigma}$	Mean effective stress
σ_R	Radial stress at the cavity wall at first yield
σ_{Ru}	Radial stress at the cavity wall at yield in cavity contraction
p_o	is effective cavity reference pressure.

p_{max}	is the maximum effective cavity pressure at the end of loading
p_{lim}	is the effective limit pressure for an infinite cavity expansion
ε_{max}	is the maximum cavity strain at the end of loading
M	is $(1+\sin\psi)/(1-\sin\psi)$
N	is $(1+\sin\phi)(1-\sin\phi)$
α	is 1/M
β	is 1/N
γ	is $(1+\alpha)/(1-\beta) = (NM+N)/(NM-M)$
ξ	is strain
χ	is given by $[(1-\nu)-\nu(M+N)+(1-\nu)MN] / MN$
Z	is $2\chi/(\alpha+\beta)$
T	is $2+Z$
A	is $T/(1+\alpha)$
B	is $-Z/(1-\beta)$
C	is 1−A−B
τ	is shear stress
q_{nn}	is the co-efficient of a non-linear elastic power law. The first suffix is r or denoting radial stress or shear stress intercept. The second suffix is c or s and defines the strain scale, circumferential or shear.
q_{ref}	is the radial stress elastic constant at insitu or reference stress
h	is the exponent of a non-linear elastic power law
d	is the stress exponent, describing the variation of stiffness with stress level
w	is the intercept of a plot of stiffness against stress level
J	is a scale factor to adjust for stiffness at differing stress levels

4.3.1 Carter, Booker and Yeung (1986)

Assuming small deformations (where 10% cavity strain is considered small), Carter *et al* offer the following general solution for a cylindrical cavity expansion:

$$\frac{u}{r} = \varepsilon_R\left[A\left(\frac{R}{r}\right)^{1+\alpha} + B\left(\frac{R}{r}\right)^{1-\beta} + C\right] \qquad ..[4.11]$$

In terms of parameters that the pressuremeter can measure directly, circumferential strain ε_c and radial stress *p* at the cavity wall, this solution can be written as

$$\varepsilon_C = \varepsilon_R\left[A\left(\frac{P}{\sigma_R}\right)^{\gamma} + B\left(\frac{P}{\sigma_R}\right) + C\right] \qquad ..[4.12]$$

Carter et al point out the similarity between this solution and that offered by Hughes et al (1977). Using the current notation the solution of Hughes et al can be written:

$$\varepsilon_C = \varepsilon_R \left(\frac{P}{\sigma_R} \right)^{\gamma} \qquad ..[4.13]$$

The omission of the linear and constant terms in 4.13 comes about because the earlier solution ignores elastic strain in the plastic region. The attraction of the earlier solution is that plotting cavity strain against radial stress on log scales gives the gradient γ which can used to discover the approximate values of friction angle ϕ and dilation angle ψ, so it is helpful to carry out the Hughes *et al* analysis as a means of providing input parameters for the Carter *et al* solution. The Hughes log-log plot also indicates the influence of cohesion, because the data will plot a strain-softening curve rather than a straight line.

4.3.2 Elastic Strain and non-linear stiffness

In the simple elastic model the cavity strains before yield are given by

Where $p_o < p < \sigma_R$

$$\varepsilon_C = \frac{p - p_o}{2G} \qquad ..[4.14]$$

At first yield, when $p = \sigma_R = p_o(1 + \sin\phi)$

$$\varepsilon_C = \frac{p_o \sin\phi}{2G} \qquad ..[4.15]$$

The non-linear elastic versions of.[4.14] and [4.15] are:

Where $p_o < p < \sigma_R$

$$\varepsilon_C = \left[\frac{p - p_o}{q_{ref}} \right]^{\frac{1}{h}} \qquad ..[4.16]$$

At first yield, when $p = \sigma_R$

$$\varepsilon_R = \left[\left(\frac{p_0}{q_{ref}} \right) \left(\frac{N - 1}{N(2h - 1) + 1} \right) \right]^{\frac{1}{h}} \qquad ..[4.17]$$

The derivation of the non-linear elastic equations are given later.

At the end of loading the cavity has a maximum pressure p_{max} and expansion ε_{max} and the first part of the final unloading is elastic with a non-linear characteristic prior to yield in extension. The elastic circumferential strain is given by:

Where $p_{max} > p > \sigma_{Ru}$

$$\varepsilon_C = \varepsilon_{max} - \left[\frac{p_{max} - p}{J q_{ref}} \right]^{\frac{1}{h}} \qquad ..[4.18]$$

At yield in extension $p_{max} > p$ and $p = \sigma_{Ru}$

$$\varepsilon_{RU} = \varepsilon_{max} - \left[\left(\frac{p_{max}}{J q_{ref}} \right) \left(\frac{N^2 - 1}{N(2h - 1) + N^2} \right) \right]^{\frac{1}{h}} \qquad ..[4.19]$$

The explanation of the terms q_{ref} and h and J is now presented, based on the methodology of Bolton and Whittle (1999). This solution uses a power law to describe the development of shear stress with strain for strains below the elastic/plastic threshold:

$$\tau = q_{ss}\varepsilon_s^h \qquad ..[4.20]$$

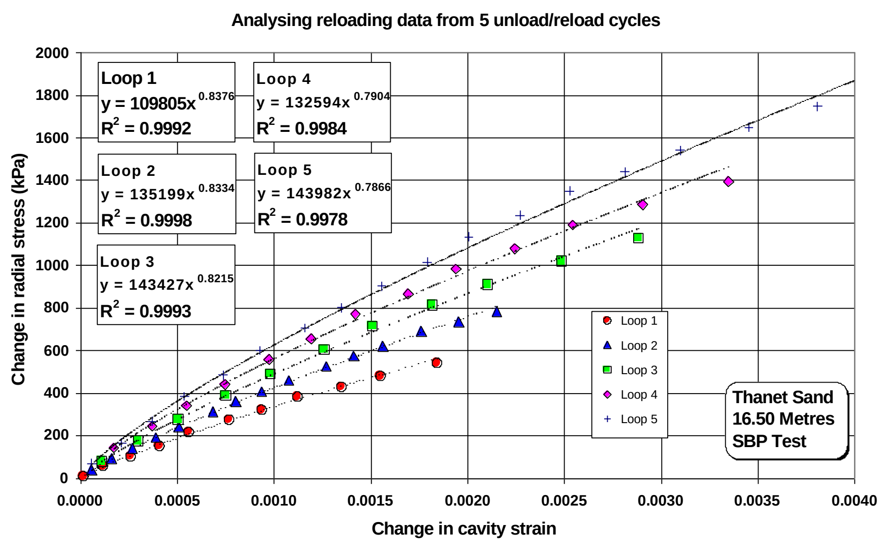
The co-efficient and exponent of the power law in [4.20] can be derived from plotting reloading data from unload/reload cycles. The origins for the data are the loop turnaround points. However for the purposes of curve fitting, the trend of radial stress versus cavity strain is required. This is not shear modulus, where the data would be shear stress plotted against shear strain. Fig 4.2 is an example (not from a test on this contract).

It is easy to manipulate the trends in fig 4.2 to give shear modulus. Assuming no volumetric strains are being developed whilst the material is deforming elastically, shear strain can be derived by multiplying the cavity strain values by two. Furthermore Bolton & Whittle show that the shear stress coefficient is related to the radial stress coefficient as follows:

$$q_{ss} = hq_{rs} \qquad ..[4.21]$$

and secant shear modulus G_s is $G_s = q_{ss}\varepsilon_s^{h-1}$ ..[4.22]

Figure 4.2 Plotting stiffness curves



4.3.3 Manipulating stiffness data for changes in mean effective stress

The stiffness data represented by q_{ref} and h give the stress/strain response of the elastic part of the curve. It is necessary to know the cavity strain at yield when this relationship will cease, given by [4.17]. Thereafter a single value of shear modulus, at yielding strain, is used implicitly by [4.12].

When the final unloading commences the shear modulus applicable to this part of the test will also depend on q_{ref} and h with q_{ref} multiplied by a scale factor decided by the increase in the mean effective stress. All that is then required is to know when the elastic unloading stops, and this is given by [3.24]. The yielding value of shear modulus for [3.17] is likely to be lower than that from simply taking the slope of the first loop in the test but probably higher than the initial slope of the virgin loading curve, which will be influenced by disturbance.

Bellotti et al (1989) give a procedure for converting modulus at intermediate stress levels to a reference level, the insitu mean effective stress p_o. It is based on the relationship proposed by Janbu (1963) and in terms of the nomenclature used here can be written:

$$q_{ref} = q_{rc}\left(\frac{p_0}{\sigma_{AV}}\right)^d \qquad ..[4.23]$$

Given a value of radial stress at the cavity wall p , the mean effective stress can be calculated as follows:

Unload/reload
$p > \sigma_R$

$$\sigma_{AV} = \left(\frac{p - c\cos\phi}{1+\sin\phi}\right) \qquad ..[4.24]$$

Reload/Unload
$p < \sigma_{RU}$

$$\sigma_{AV} = \left(\frac{p + c\cos\phi}{1-\sin\phi}\right) \qquad ..[4.25]$$

These two equations also incorporate the contribution of cohesion, *c*.

The modulus exponent *d* is obtained by plotting the mean effective stress against modulus and finding the best fit power law. The best correlation is obtained using *q* and *h* together as both are needed to fully describe the shape of the elastic response. Once a value for q_{ref} is obtained it is possible to predict the appropriate 'q' value for any other part of the curve, such as the final unloading, by calculating the mean effective stress for that point and multiplying by the ratio of that stress to the initial stress state. This is the scale factor J in [4.18] and [4.19].

4.3.4 Influence of Cohesion

It is surprisingly straightforward to introduce the influence of cohesion using Caquot's principle. All stresses are raised by *c* cotϕ, so that [4.12] now becomes:

$$\varepsilon_C = \varepsilon_R\left\lfloor A\left(\frac{P + c\cot\phi}{\sigma_R + c\cot\phi}\right)^{\gamma} + B\left(\frac{P + c\cot\phi}{\sigma_R + c\cot\phi}\right) + C\right\rfloor \qquad ..[4.26]$$

If there is no cohesion then the additional terms are zero and the equations revert to the frictional only form.

4.3.5 Deriving the limit pressure

Despite being a small strain solution it is possible to use the Carter et al solution in its adapted form to discover the limit pressure of an infinitely large expansion. At the limit state the ratio R/r_a of the elastic-plastic boundary to the current cavity size reaches a constant condition, which can be written:

$$\frac{1}{\varepsilon_R} = \left[T\left(\frac{R}{r_a}\right)^{1+\alpha} - Z\left(\frac{R}{r_a}\right)^{1-\beta}\right] \qquad ..[4.27]$$

or re-arranged to give

$$\frac{1}{\varepsilon_R} = \left\lfloor T\left(\frac{P_{\lim}}{\sigma_R}\right)^{\gamma} - Z\left(\frac{P_{\lim}}{\sigma_R}\right)\right\rfloor \qquad ..[4.28]$$

where P_{lim} is limit pressure. To apply these results, [3.22] is used to discover the elastic yield strain ε_R . Now guess the ratio P_{lim}/σ_R and use [3.33] within an iterative procedure to modify the guess until the known value of ε_R is obtained. Once the ratio has been identified, multiply it by the yield stress σ_R to obtain the limit pressure. This is effective limit pressure and we add to it the ambient pore water pressure to give the total limit pressure.

4.3.6 Deriving the elastic equations

Assuming the non-linear elastic response of the soil prior to yield can be described by a power law of the form $\tau = Q_s\varepsilon_s^h$ (after Bolton & Whittle 1999) and assuming that whilst the soil is deforming elastically there are no volumetric strains then it follows that the principal stresses at first yield can be written

$$\sigma_r = p_0 + \frac{\tau}{h} \quad \text{(A.1)}$$

$$\sigma_c = \sigma_r - 2\tau \quad \text{(A.2)}$$

where τ represents the mobilised shear stress at failure. For a perfectly plastic frictional material development of the plastic zone occurs at a constant stress ratio, with the radial stress the major principal stress so at yield we can write

$$\frac{\sigma_r}{\sigma_c} = N \quad \text{(A.3)}$$

Substituting [A.1] into [A.2] and the result into [A.3] leads to

$$Np_0 + \frac{N}{h}\tau - 2N\tau = p_0 + \frac{\tau}{h} \quad \text{(A.4)}$$

And this can be re-arranged to find τ/h:

$$\frac{\tau}{h} = p_0\left[\frac{N-1}{N(2h-1)+1}\right] \quad \text{(A.5)}$$

so substituting into [A.1]

$$\sigma_R = p_0\left[\frac{N2h}{N(2h-1)+1}\right] \quad \text{(A.6)}$$

Alternatively, in terms of sin ϕ

$$\sigma_R = p_0\left[1 + \frac{\sin\phi}{h + (h-1)\sin\phi}\right] \quad \text{(A.7)}$$

The final unloading starts with the radial stress at a maximum P_{mx} and the circumferential stress less than this at P_{mx}/N. Yield in extension first occurs at the borehole wall when the radial stress is

$$\sigma_r = p_{mx} - \frac{\tau}{h} \quad \text{(A.8)}$$

The circumferential stress will be

$$\sigma_c = \frac{p_{mx}}{N} + \tau\left(2 - \frac{1}{h}\right) \quad \text{(A.9)}$$

The mobilised shear stress τ is discovered in a similar way to the elastic loading equations noting that yield in contraction occurs with the circumferential stress being the major principal stress. τ/h for the elastic part of the final unloading is:

$$\frac{\tau}{h} = p_{mx}\left[\frac{N^2 - 1}{N(2h-1) + N^2}\right] \quad \text{(A.10)}$$

The equivalent to [A.6] for the final unloading is:

$$\sigma_{RU} = p_{mx}\left[\frac{N^2 - 1}{N(2h-1) + N^2}\right] \quad \text{(A.11)}$$

*N*2*h* introduces non-linearity into the elastic distribution of stress. If *h* = 1, the value for linear elasticity, [A.6] and [A.11] revert to the standard equations for yield in a frictional material. Typical values for *h* in sand like material would be 0.6 – 0.8.

For a c' – phi material the failure does not occur at a constant stress ratio but can be made to seem so if all stresses are raised by $c \cot \phi$.

[A.3] now becomes

$$\frac{\sigma_r + c\cot\phi}{\sigma_c + c\cot\phi} = N \quad \text{(A.12)}$$

and working this through, failure on first loading occurs when

$$\sigma_R = \left(p_0 + c\cot\phi\right)\left[\frac{N2h}{N(2h-1)+1}\right] - c\cot\phi \quad \text{(A.13)}$$

If there is no cohesion then [A.13] and [A.6] are the same. If the material is linear elastic, *h* = 1 and [A.13] reverts to the familiar Mohr-Coulomb expression for first yield.

Similarly, the expression for first yield in unloading in a c'-phi material is obtained by taking equation [A.8] and [A.9] and using the argument that the failure stress ratio is given by

$$\frac{\sigma_c + c\cot\phi}{\sigma_r + c\cot\phi} = N \quad \text{(A.14)}$$

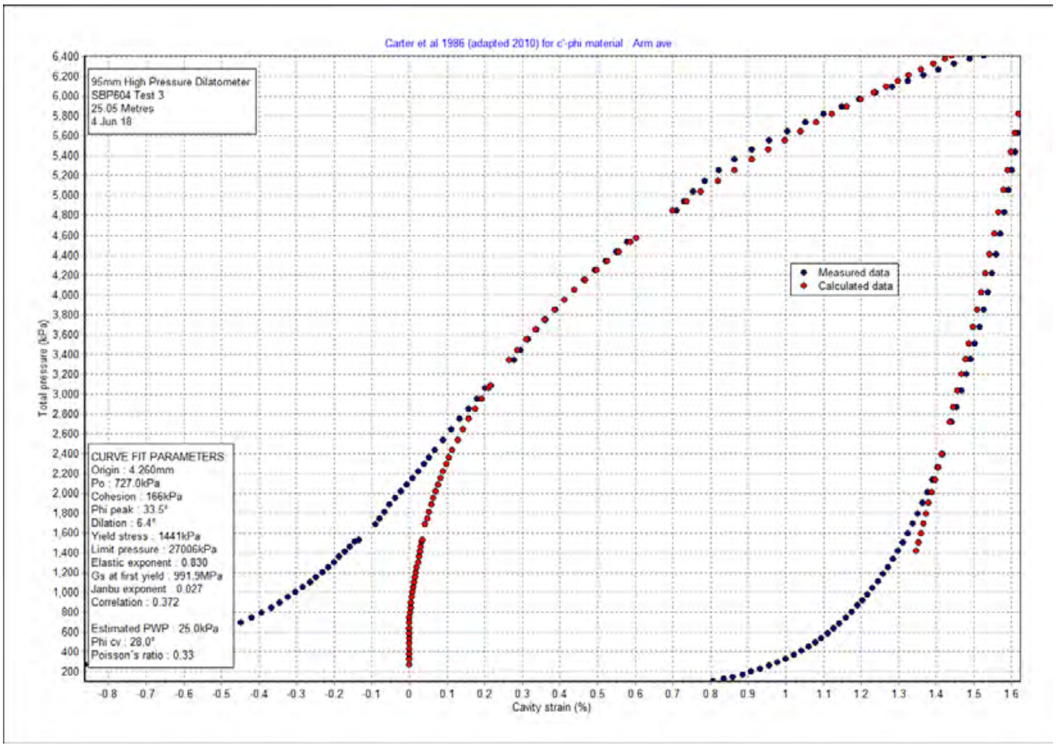
This leads to the following expression for the yielding stress in unloading:

$$\sigma_{RU} = \left[\frac{p_{mx}\left(N(2h-1)+1\right) - c\cot\phi(N^2 - N)}{N(2h-1) + N^2}\right] \quad \text{(A.15)}$$

4.3.7 Example

A typical result of the curve fitting method applied to a test is given in fig 4.3. This particular test shows some cohesion. There is almost no contraction data because the membrane ruptures, but the single point that is plotted matches the field curve reasonably well, and would make a plausible limit for the elastic contraction transition.

Fig 4.3 Drained test, curve fitting example, some cohesion



The list of parameters in the top left hand corner includes the Janbu exponent of how stiffness varies with stress level at yield strain.

5 ANALYSES FOR STRENGTH, DRAINED CONTRACTION

5.1 Withers et al (1989)

Withers, Howie, Hughes and Robertson (1989) is an analysis developed for the unloading of a cone pressuremeter in sand but is applicable to the unloading phase of any pressuremeter test in purely frictional material.

The solution is based on the Hughes et al (1977) analysis for the expansion of a self-boring pressuremeter in sand. During expansion, given a low disturbance insertion, effective radial stress is related to circumferential strain by the following:

$$P' = \sigma'_{ho}\left[\frac{2}{1+N}\right]\left[\left(\frac{G}{\sigma_{ho}}\right)(1+n)\left(\frac{1+N}{1-N}\right)\varepsilon + \left(\frac{1-n}{2}\right)\right]^{\left[\frac{1-N}{1+n}\right]} \quad [5.1]$$

where P' is the effective radial stress at the cavity wall

N is $(1 - \sin\varphi')/(1+\sin\varphi')$

φ' is the peak angle of internal friction

n is $(1 - \sin\upsilon)/(1+\sin\upsilon)$

υ is the angle of dilation of the soil

G is the shear modulus

σ'_{ho} is the effective insitu horizontal stress

By incorporating Rowe's stress dilatancy theorem (1962) and by knowing or estimating constant volume friction angle, the loading gradient can be turned into values for the peak angles of internal friction and dilation:

$$\sin\phi' = S/[1 + (S-1)\sin\phi'_{cv} \quad [5.2]$$

$$\sin\nu = S + (S-1)\sin\phi'_{cv} \quad [5.3]$$

The final unloading starts with an elastic phase which ends when the effective radial stress is

$$P' = NP \quad [5.4]$$

where P'_e is the maximum pressure reached during expansion.

The cavity strain at the onset of reverse plasticity will be

$$\varepsilon = \varepsilon_e - [(1-N)P'_e/2G] \quad [5.5]$$

where ε_e is the maximum strain reached. The solution for the plastic contraction is

$$P' = [NP'_e]\left\{\frac{[2G/P'_e][\varepsilon_e - \varepsilon][1+nN]}{[(1-N)(1+N)n] - [(1-N)/(1+N)n]}\right\}^{\left[\frac{n[N^2-1]}{nN^2+N}\right]} \quad [5.6]$$

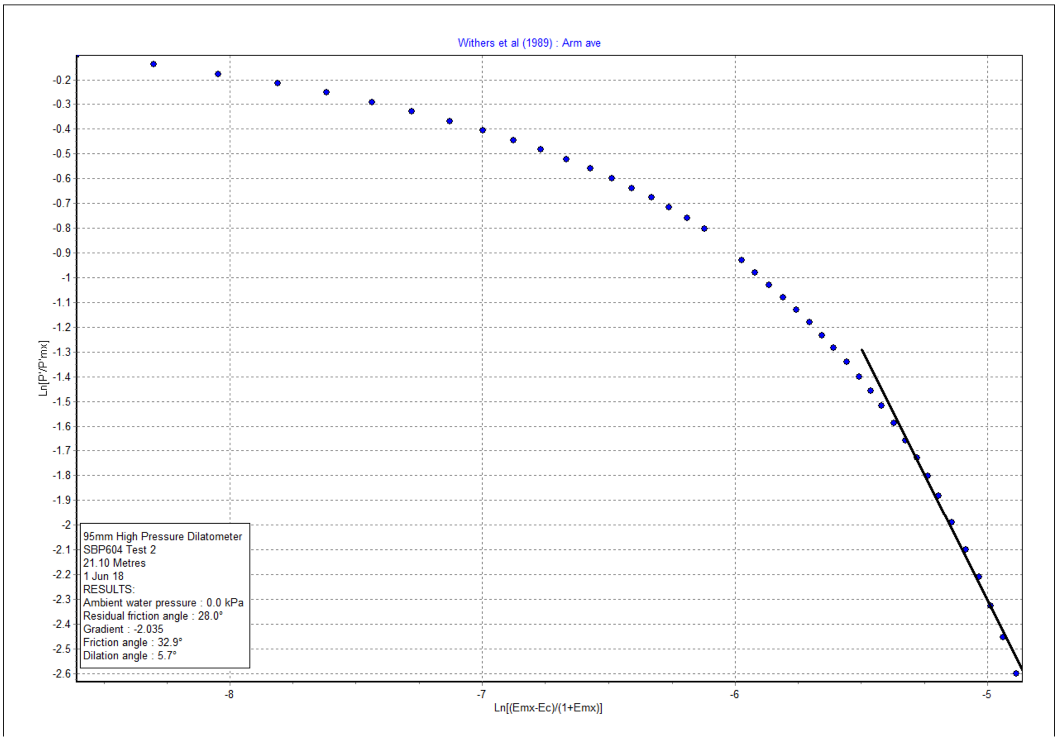
If $\log P'/P'_e$ is plotted against $\log[(\varepsilon_e - \varepsilon)/(1+\varepsilon_e)]$ the slope of the straight line portion will have a gradient S where

$$S = n(N^2-1)/(nN^2+N) \quad [5.7]$$

Hence $N = [(SN_{cv} + 1)/(1-\mathbf{S})]^{0.5}$ [5.8]

in an analogous way to the loading solution, the contraction gradient can be turned into values for the peak angles of internal friction and dilation using $N = nN_{cv}$.

Fig. 5.1 An example of the Withers et al solution applied to chalk



It is unlikely that the ultimate slope will include the last few points – in general, data for stress levels less than the effective insitu horizontal stress should be ignored. The exponent in [5.6] includes square terms which makes it less sensitive than the equivalent exponent for the loading [5.1].

APPENDIX E SAMPLE CALCULATION OF A LINE OF DATA

What is described in some detail in this appendix are the steps necessary to convert the raw data output from the pressuremeter into engineering units.

In order to convert pressuremeter signals into calibrated data the following steps are taken:

A. The raw data is in units of volts, and needs to be corrected for zero offsets and scaled using the sensitivities quoted in the calibration data. The calibrations for this sample test are presented as follows:-

INSTRUMENT CALIBRATIONS:F05T2 DEPTH: 32.1M DATE: 20 Jan 12

	ZERO		SLOPE		CORRECTION				COMPRESSION	
ARM 1	-2008.9	mV &	129.0	mV/mm	87.0	kPa &	21.4	kPa/mm	4.6	mm/GPa
ARM 2	-1005.8	mV &	125.4	mV/mm	87.0	kPa &	21.4	kPa/mm	4.6	mm/GPa
ARM 3	-1041.7	mV &	134.7	mV/mm	87.0	kPa &	21.4	kPa/mm	4.6	mm/GPa
ARM 4	-1364.4	mV &	126.0	mV/mm	87.0	kPa &	21.4	kPa/mm	4.6	mm/GPa
ARM 5	-2383.8	mV &	126.8	mV/mm	87.0	kPa &	21.4	kPa/mm	4.6	mm/GPa
ARM 6	-2555.3	mV &	123.2	mV/mm	87.0	kPa &	21.4	kPa/mm	4.6	mm/GPa
TPC A	-1290.7	mV &	85.6	mV/MPa						
TPC B	-434.3	mV &	83.1	mV/MPa						

The line of raw data reads from left to right. The units are volts:-

LINE	TPC A	ARM 1	ARM 2	ARM 3	ARM 4	ARM 5	ARM 6	TPC B	SIN	COS
258	-0.7461	-0.6467	0.4392	0.3014	-0.1929	-1.0354	-1.2876	0.0888	-0.2715	-0.2667

The first operation is to deduct the zero offsets. These are the figures found in the first column of the calibration information, but quoted here in volts. The columns for Sin and Cos disappear at this stage, as they are not transferred to the calibrated data file:

	TPC A	ARM 1	ARM 2	ARM 3	ARM 4	ARM 5	ARM 6	TPC B	
Output	-0.7461	-0.6467	0.4392	0.3014	-0.1929	-1.0354	-1.2876	0.0888	
Zero	-1.2907	-2.0089	-1.0058	-1.0417	-1.3644	-2.3838	-2.5553	-0.4343	
Result	0.5446	1.3622	1.4450	1.3431	1.1715	1.3484	1.2677	0.5231	......[1]

This result [1] can now be scaled. The information for this is found in the second column of calibration data, and is expressed as millivolts per millimetre to calculate displacement, and as millivolts per Mega Pascal to calculate pressure. As before, the results of the calculations are quoted in volts:

	TPC A	ARM 1	ARM 2	ARM 3	ARM 4	ARM 5	ARM 6	TPC B	
From [1]	0.5446	1.3622	1.4450	1.3431	1.1715	1.3484	1.2677	0.5231	
Slope	0.0856	0.1290	0.1254	0.1347	0.1260	0.1268	0.1232	0.0831	
Result	6.3621 (MPa)	10.5597 (mm)	11.5231 (mm)	9.9710 (mm)	9.2976 (mm)	10.6341 (mm)	10.2898 (mm)	6.2948 (MPa)	....[2]

At this point in the procedure, a choice has to be made about which total pressure cell or combination of cells to use in producing the calibrated data. The difference between the cells is because cell A is read at the beginning of a data scan and cell B at the end. The time taken to make the scan allows some pressure change to occur in the probe. In this example both cells are used so the value of pressure carried forward is (6.3621 + 6.2948 / 2 = 6.3285MPa.

B. The data is now in engineering units which reflect what is taking place inside the membrane. The remaining corrections are introduced to give a better representation of what is taking place at the point where the membrane bears on the borehole wall.

The displacement data is adjusted for the instrument displacements due to the pressure being applied to it. This is expressed as a linear movement in millimetres per Giga Pascal of pressure being applied, and is found in the 5th column of the calibration details:

	ARM 1	**ARM 2**	**ARM 3**	**ARM 4**	**ARM 5**	**ARM 6**	
Correction Factor (mm/GPa)	4.6	4.6	4.6	4.6	4.6	4.6	column 5
Internal Pressure (MPa)	6.3285	6.3285	6.3285	6.3285	6.3285	6.3285	
Adjustment ((5)*[2])/1000	0.0291	0.0291	0.0291	0.0291	0.0291	0.0291	.......[3]
Internal Displacement (mm)	10.5597	11.5231	9.9710	9.2976	10.6341	10.2898	...... [2]
Corrected Displacement (mm)	10.5306	11.4940	9.9419	9.2685	10.6050	10.2607	.......[4]

C. The displacement data calculated so far is the movement measured by the arms to the inside of the membrane. The figures quoted in the calibrated data listings are the movement of the outside of the protective sheath. This is derived from the internal movement by assuming that the cross-section area of the membrane is a constant. A full explanation of this and the derivation of the equation used is discussed in the appendix on calibration technique.

The equation is $E = \sqrt{[(R-t)^2 + D(2r+D)]} - (R-t)$ .... [a]

where E is the actual expansion of the pressuremeter
2R is the O.D of the pressuremeter at rest
2r is the I.D of the membrane at rest
D is the movement measured by the strain arm
t is the thickness of the Chinese lantern steel

For the pressuremeter used to produce this example:-

2R = 94.0 mm
2r = 82.0 mm
t = 0.5334 mm

Because the membrane can be assumed to have the same thickness at all points on the cross-section the technique employed is to calculate a scale factor from the average displacement:

	ARM 1	**ARM 2**	**ARM 3**	**ARM 4**	**ARM 5**	**ARM 6**	
Corrected Displacements	10.5306	11.4940	9.9419	9.2685	10.6050	10.2607	...[4]
Average Displacement	10.3501	10.3501	10.3501	10.3501	10.3501	10.3501	.....[5]
Result of equation [a] using D = [5]	9.3454	9.3454	9.3454	9.3454	9.3454	9.3454	.....[6]
Scale Factor [6]/[5]	0.9029	0.9029	0.9029	0.9029	0.9029	0.9029	.....[7]
Apply [7] to [4]	9.5083	10.3783	8.9768	8.3688	9.5755	9.2646	.....[8]

D. The result, using displacements from [8] and the average total pressure quoted in kPa:

LINE	ARM 1	ARM 2	ARM 3	ARM 4	ARM 5	ARM 6	TPC	
258	9.5083	10.3783	8.9768	8.3688	9.5755	9.2646	6328.5	.....[9]

In practice the errors introduced by rounding-off calculations may result in a small difference in the final figure. This is the line of data seen in the calibrated data file that is passed from the logging program to the analysis program.

E. However the conversion to data ready for analysis is not yet complete. The column for pressure is the pressure *inside* the membrane. What is required is the pressure on the *outside* of the membrane where it bears against the borehole wall. Before using the calibrated data file, therefore, the analysis program corrects the pressure data for the influence of the membrane, using the data in the calibrations for membrane correction. It is separately calculated for each arm position, although in practice an average correction value tends to be used. The correction figure is the sum of the zero figure (column 3 in the calibrations) plus the increased stiffness with strain (column 4):-

	ARM 1	ARM 2	ARM 3	ARM 4	ARM 5	ARM 6	
From Result [8]	9.5083	10.3783	8.9768	8.3688	9.5755	9.2646	
Average Displacement	9.3454	9.3454	9.3454	9.3454	9.3454	9.3454	.... [10]
kPa/mm (column 4)	21.4	21.4	21.4	21.4	21.4	21.4	.... [11]
Result [10]*[11] (kPa)	200.0	200.0	200.0	200.0	200.0	200.0	.... [12]
Correction zero (kPa)	87.0	87.0	87.0	87.0	87.0	87.0	(column 3)
Add zeroes to result [12]	287.0	287.0	287.0	287.0	287.0	287.0	.... [13]

This is the total membrane correction at each arm position and is now deducted from the total pressure cell readings. In this example because an average membrane correction has been used, the calculation is 6328.5kPa – 287.0kPa giving 6041.5kPa.

When the calibrated data is taken from the Analysis program the format differs from the PRN file produced by the logging program (see D, above). The analysis output gives the average radial displacement of opposing pairs of arms, together with a column of corrected pressure readings for each arm pair, and the uncorrected pressure:

LINE	Arms(1+4)/2	Arms (2+5)/2	Arms (3+6)/2	TPC 1	TPC 2	TPC 3	TPC
258	8.9386	9.9769	9.1207	6041.5	6041.5	6041.5	6328.5

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A303 STONEHENGE
GROUND INVESTIGATION

Results of pressuremeter testing carried out by Cambridge Insitu Ltd

AECOM project reference:	**60547200**
Structural Soils reference	**733442**
Cambridge Insitu reference:	**CIR1417/18**
Original report date:	**July 2018**
Version:	**1.0**

Volume 2 of 2

DATA FOR BOREHOLE SBP604 AND CALIBRATIONS

CAMBRIDGE INSITU LTD
Little Eversden
Cambridge
ENGLAND
CB23 1HE

Tel: +44 1223 262361
Fax: +44 1223 263947
Email: cam@cambridge-insitu.com
[redacted]

Table 2.1 Tests included

Test Name SBP604	Internal Ref.	Depth (mBGL)	Date	Max Press. (kPa)	HPD Probe	Oper.	Transducer calibration	Membrane calibration	Stiffness calibration
Test 1	S604T1	18.25	01-Jun-18	5094	Wally	RWW	23-May-18	Z2305T28	Z2305T18
Test 2	S604T2	21.10	01-Jun-18	5001	Wally	RWW	23-May-18	Z2305T28	Z2305T18
Test 3	S604T3	25.05	04-Jun-18	6411	Wally	RWW	23-May-18	Z2305T28	Z2305T18
Test 4	S604T4	27.25	04-Jun-18	6264	Wally	RWW	23-May-18	Z2305T28	Z2305T18
Test 5	S604T5	30.75	04-Jun-18	7286	Wally	RWW	23-May-18	Z2305T28	Z2305T18
Test 6	S604T6	34.05	05-Jun-18	7331	Wally	RWW	23-May-18	W0606T1	W0506T1
Test 7	S604T7	37.20	05-Jun-18	7890	Wally	RWW	23-May-18	W0606T1	W0506T1

Notes:

1. Depth is metres below ground level to the centre point of the expanding membrane. For the HPD the membrane is 0.6m long, so ±0.3m of the quoted depth is loaded during the test.
2. 'Max Press' is the maximum pressure reached during the test.
3. Probe – One probe was used for all tests, a 95mm diameter High Pressure Dilatometer (HPD) known as 'Wally'.
4. The probe has a calibration for its transducers, and additional calibrations for the membrane being used. The transducer calibrations are only carried out occasionally, the membrane calibrations are performed every time a membrane is changed.
5. 'Oper.' Is the operator. The tests were carried out by Robert Whittle of Cambridge Insitu Ltd.

The remainder of this volume is laid out as follows:

Immediately following this introduction is a section contained modulus data for all the tests plotted in various ways.
The analysed data are then given, separated by test.
After presenting the test data there is a short section with calibration data for the probe.
The test data are presented in approximately the following order:

Plots from the analysis program WINSITU:

1. A Results Summary Sheet
2. A plot of total pressure against cavity strain, using the output from the average of all displacement followers.
3. A plot of Total pressure/Radial displacement showing the slope identified as the initial shear modulus. Where plasticity is evident, the apparent yield stress and the cavity reference pressure inferred from this yield stress (Marsland & Randolph 1977, Hawkins 1990).
4. For drained expansion tests a log-log plot of current cavity strain against effective radial stress quoting the gradient (Hughes et al, 1977). This can be used to derive a peak friction angle and dilation angle if the constant volume friction angle is known (or estimated).
5. For drained tests a log-log plot using *contraction* data of current cavity strain against effective radial stress quoting the gradient (Withers et al, 1989). This can be used to derive a peak friction angle and dilation angle if the constant volume friction angle is known (or estimated).
6. Plots on axes of Radial displacement/Total Pressure showing enlarged views of unload/reload cycles and quoting shear modulus G.
7. Plots on axes of Ln[current cavity shear strain]/Ln[Total Pressure] showing loop reloading paths and quoting the gradient and intercept for each loop (Bolton & Whittle, 1999).
8. A plot on axes of secant shear modulus/Log[Shear strain] showing the decay of stiffness against strain curves derived from fitting a power law function to reloading data, all cycles. Individual data points obtained from applying Palmer (1972) directly to reloading data are also shown.
9. Where plasticity is evident, for drained tests, a plot on axes of Average Cavity Strain/Total pressure showing the results of curve fitting the field curve with the best set of parameters using a non-linear elastic/perfectly plastic solution (Carter et al 1986, *modified*).

Plots taken from the data collection software package WINLOG:

10. From WINLOG - On axes of Radial Displacement/Total Pressure showing average displacement.
11. From WINLOG - On axes of Radial Displacement/Total Pressure showing all displacement sensors (six curves)
12. From WINLOG - On axes of Radial Displacement/Total Pressure showing the average radial displacement for opposing pairs of arms (three curves)
13. From WINLOG - On axes of Radial Displacement/Total Pressure showing the average radial displacement for odd numbered arms and even numbered arms (two curves)

Because the information presented here comes from a variety of sources it is not possible to number the pages.

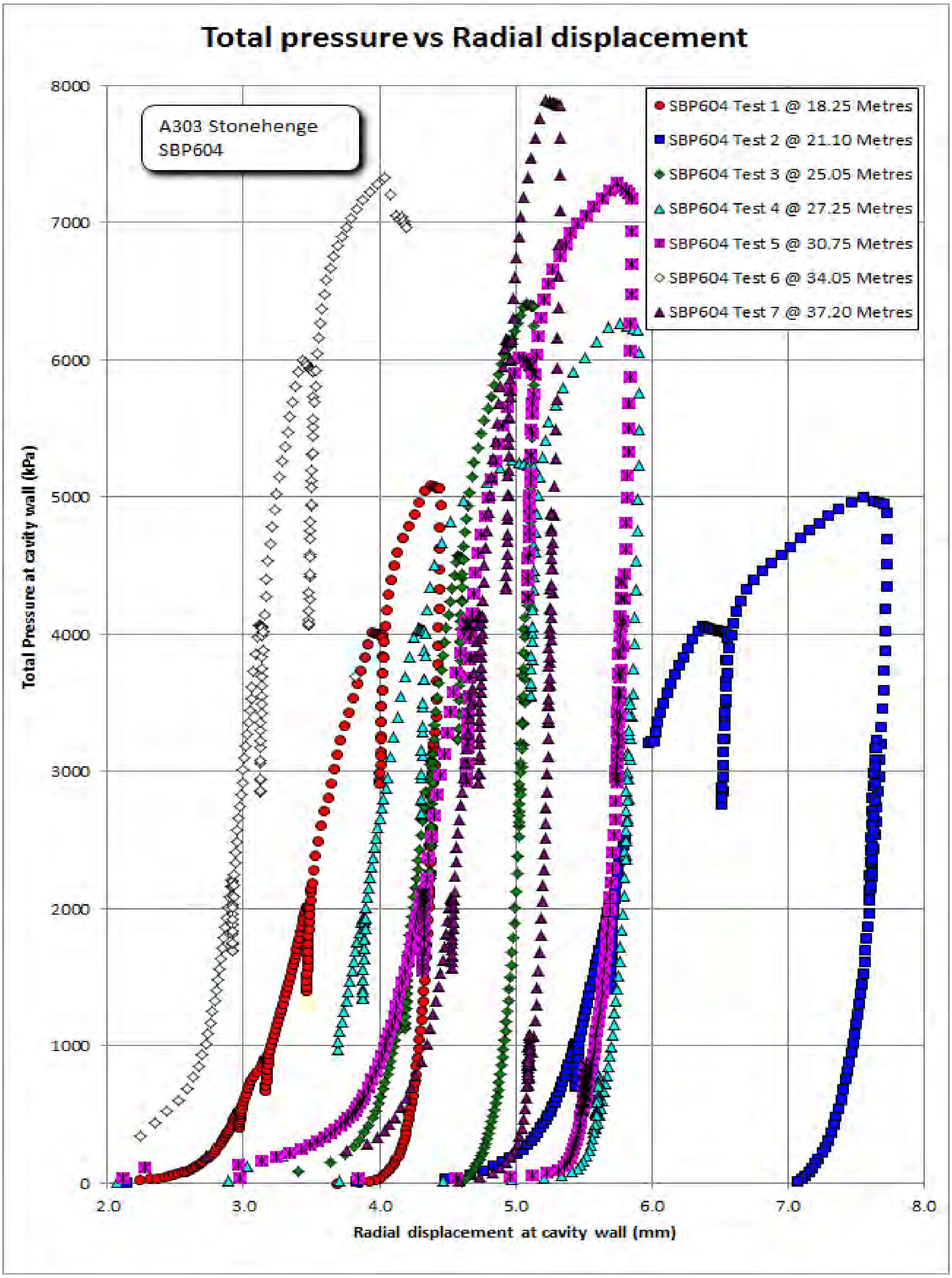
Winsitu colour coding

Plots from the analysis program WINSITU use a colour coding scheme to distinguish between different kinds of data. The options are these:

Data description	**Colour**
On the loading path	red
On the unloading path	blue
To be ignored	grey
Loop unloading	yellow
Loop reloading	magenta
Start of a creep hold	light green
End of a creep hold	dark green

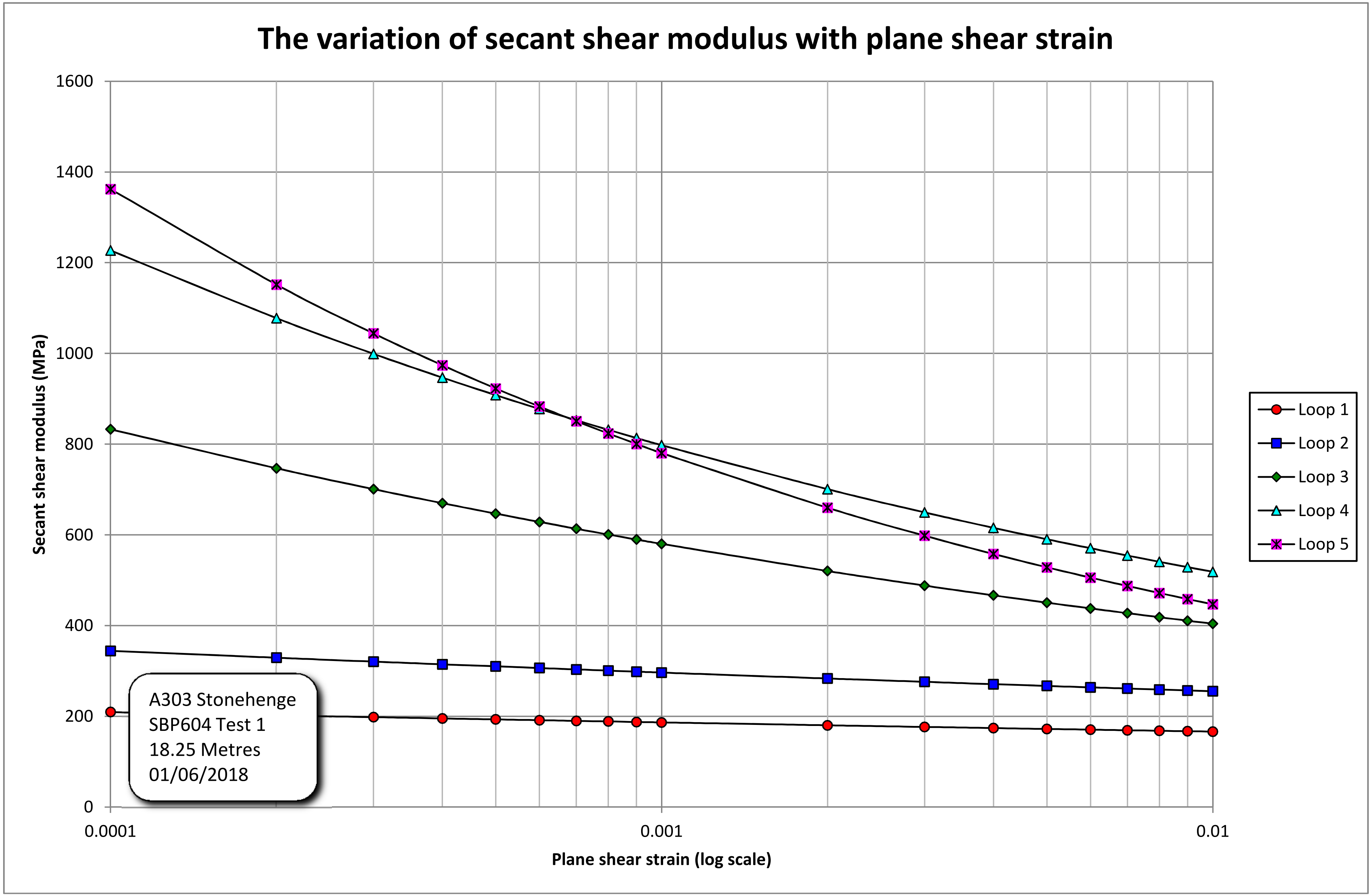
When a particular plot displays one colour only then this is arbitrary and the colour has no significance. When more than one colour is shown then the meaning is indicated above.

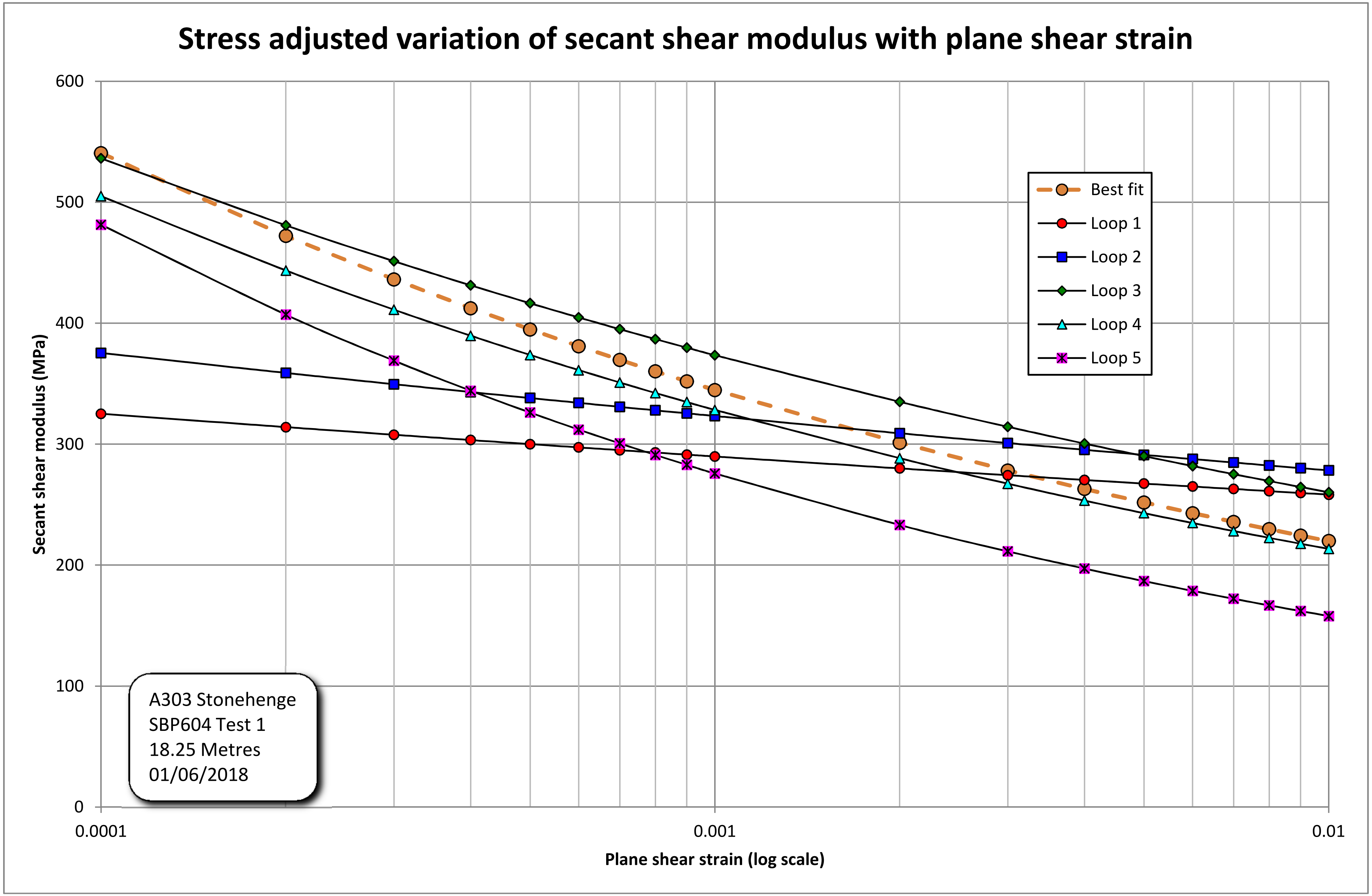
Fig 2.1 All the field curves

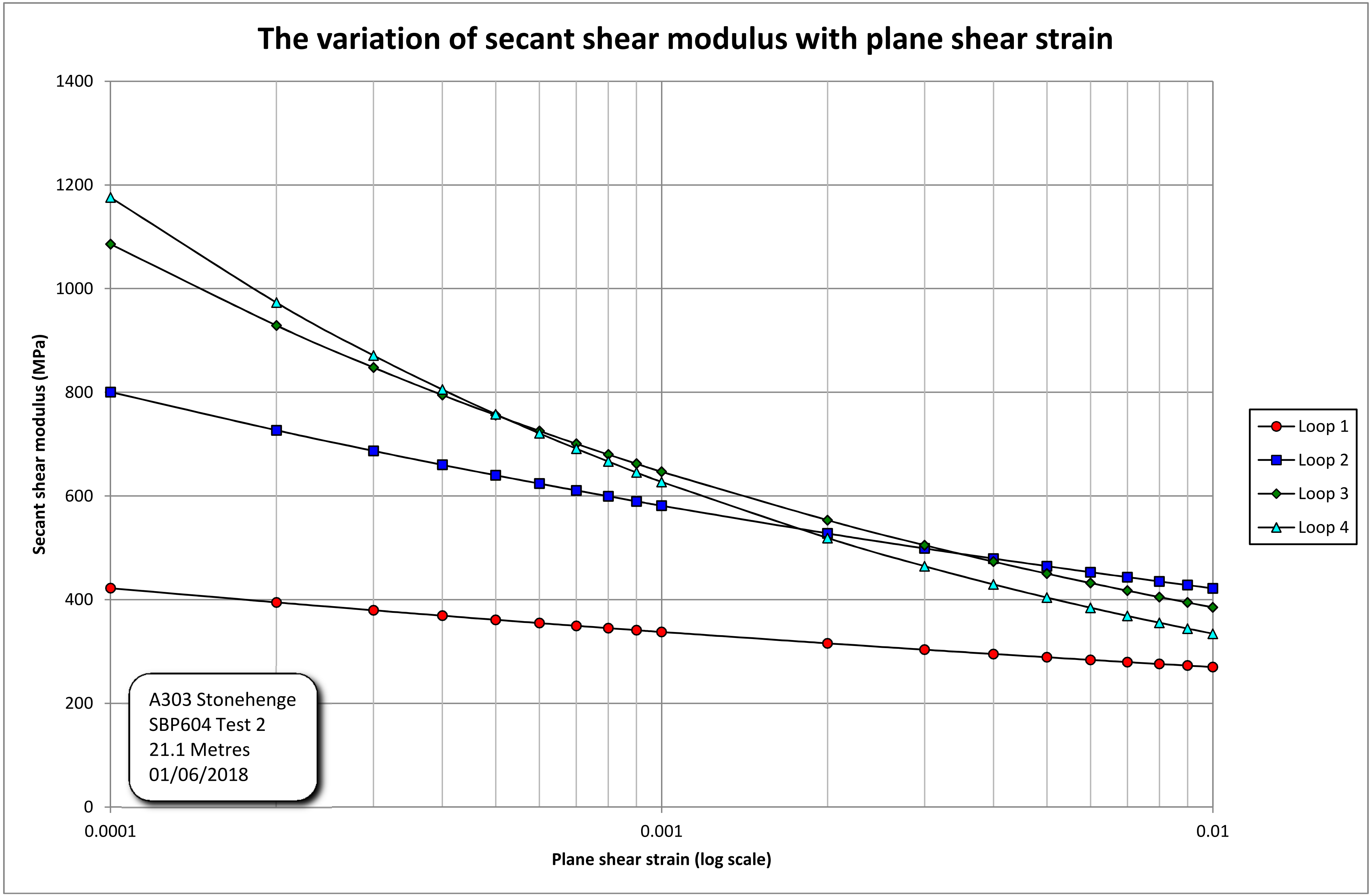


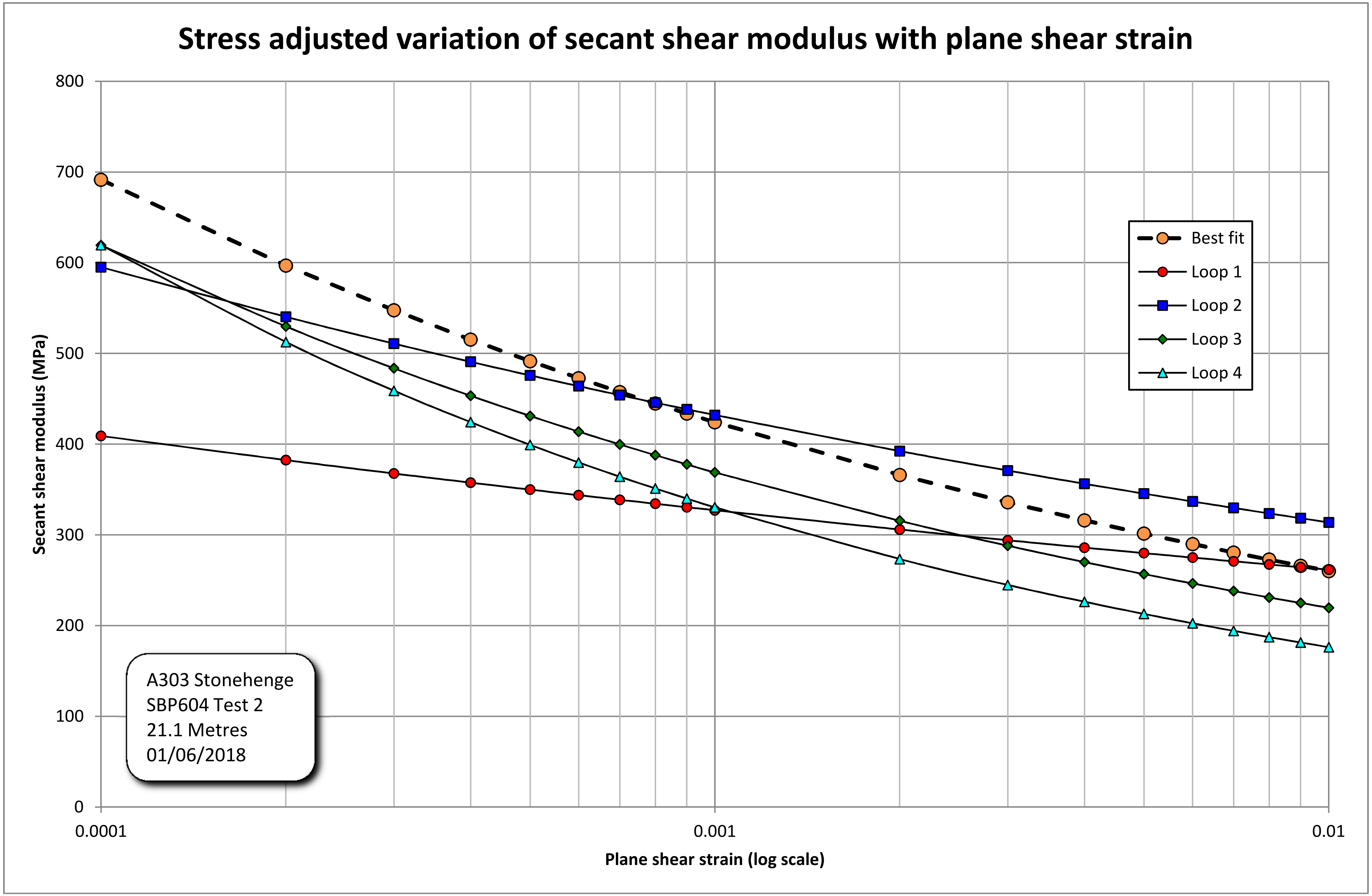
LOOP DATA

(TAKEN FROM WINSITU and WINLOG FILES)

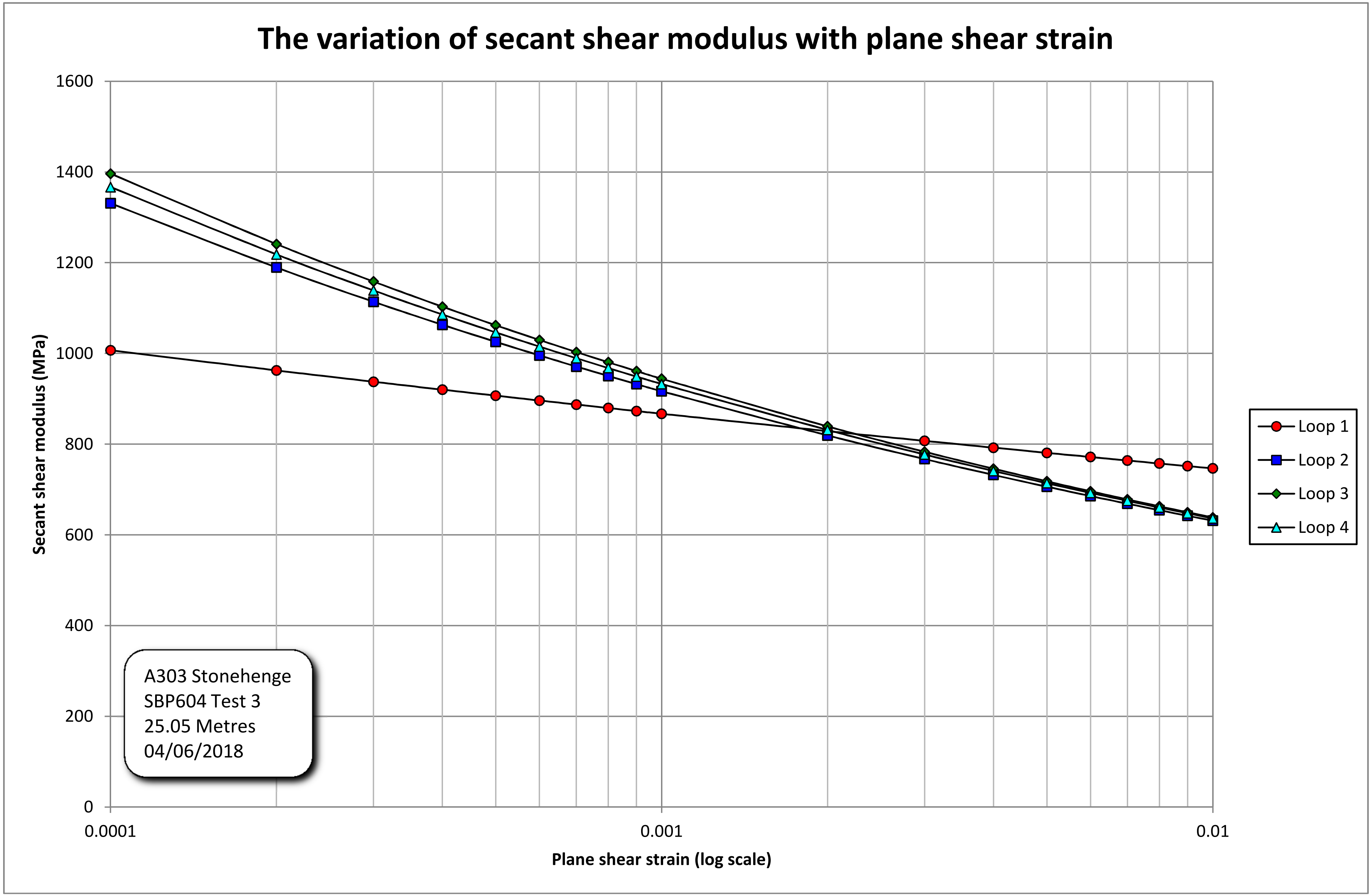

The variation of secant shear modulus with plane shear strain
Secant shear modulus (MPa)
1600
1400
1200
1000
800
600
400
200
0
0.0001
0.001
0.01
Plane shear strain (log scale)
Loop 1
Loop 2
Loop 3
Loop 4
Loop 5
A303 Stonehenge
SBP604 Test 1
18.25 Metres
01/06/2018

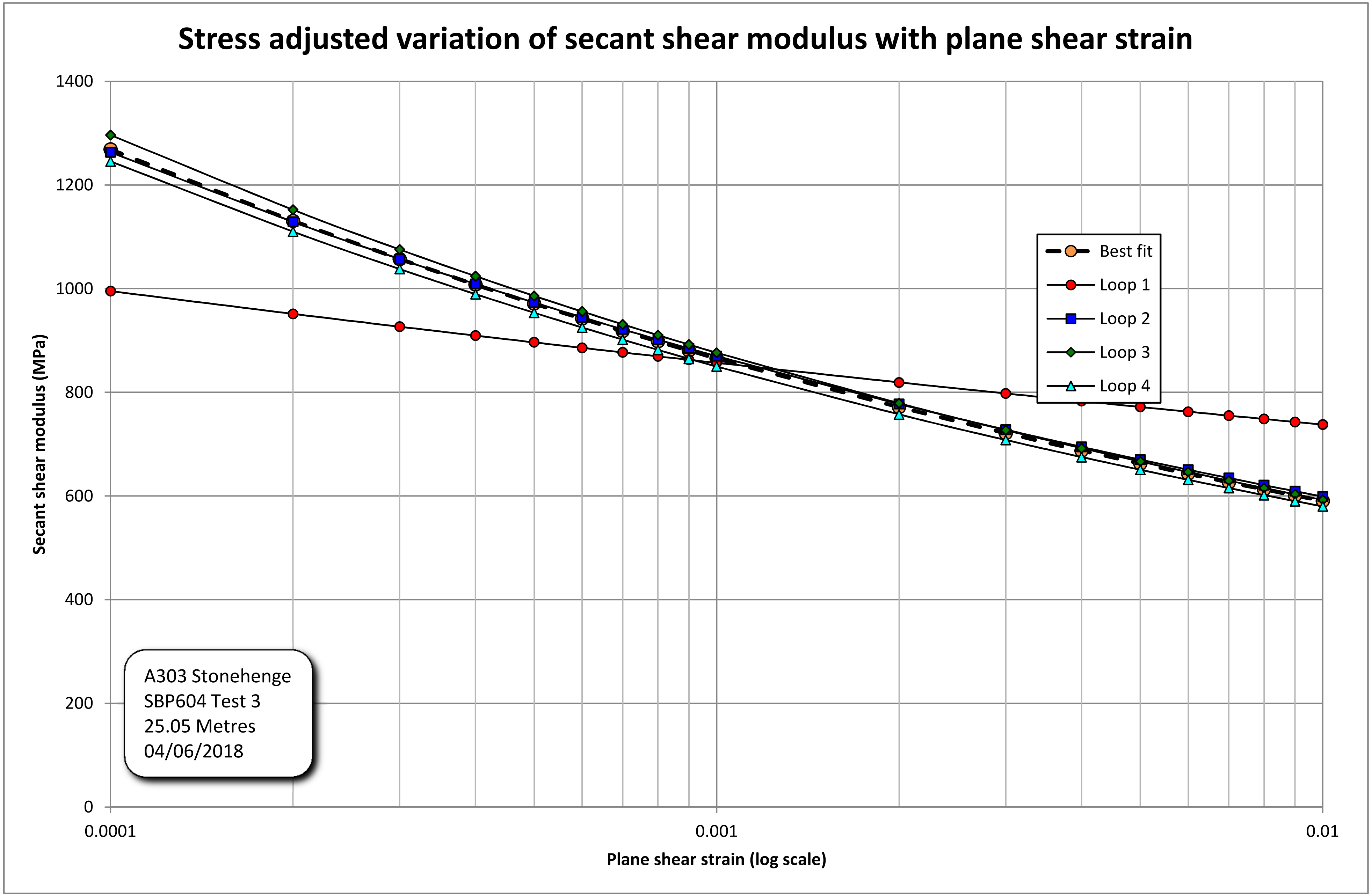

Stress adjusted variation of secant shear modulus with plane shear strain
Secant shear modulus (MPa)
600
500
400
300
200
100
0
0.0001
0.001
0.01
Plane shear strain (log scale)
Best fit
Loop 1
Loop 2
Loop 3
Loop 4
Loop 5
A303 Stonehenge
SBP604 Test 1
18.25 Metres
01/06/2018


The variation of secant shear modulus with plane shear strain
1400
1200
1000
800
600
400
200
0
Secant shear modulus (MPa)
0.0001
0.001
0.01
Plane shear strain (log scale)
Loop 1
Loop 2
Loop 3
Loop 4
A303 Stonehenge
SBP604 Test 2
21.1 Metres
01/06/2018



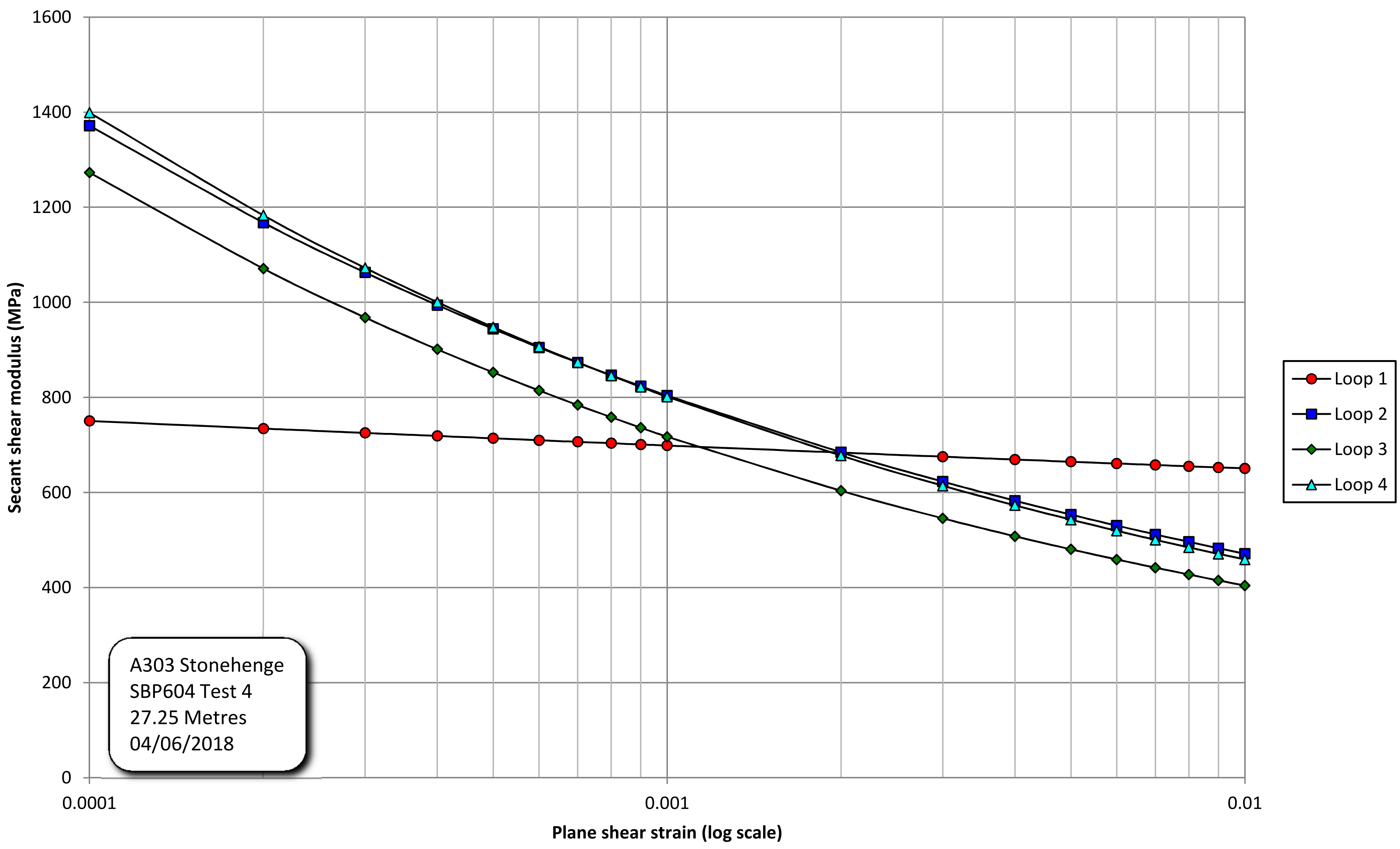
Stress adjusted variation of secant shear modulus with plane shear strain
Secant shear modulus (MPa)
800
700
600
500
400
300
200
100
0
0.0001
0.001
0.01
Plane shear strain (log scale)
Best fit
Loop 1
Loop 2
Loop 3
Loop 4
A303 Stonehenge
SBP604 Test 2
21.1 Metres
01/06/2018

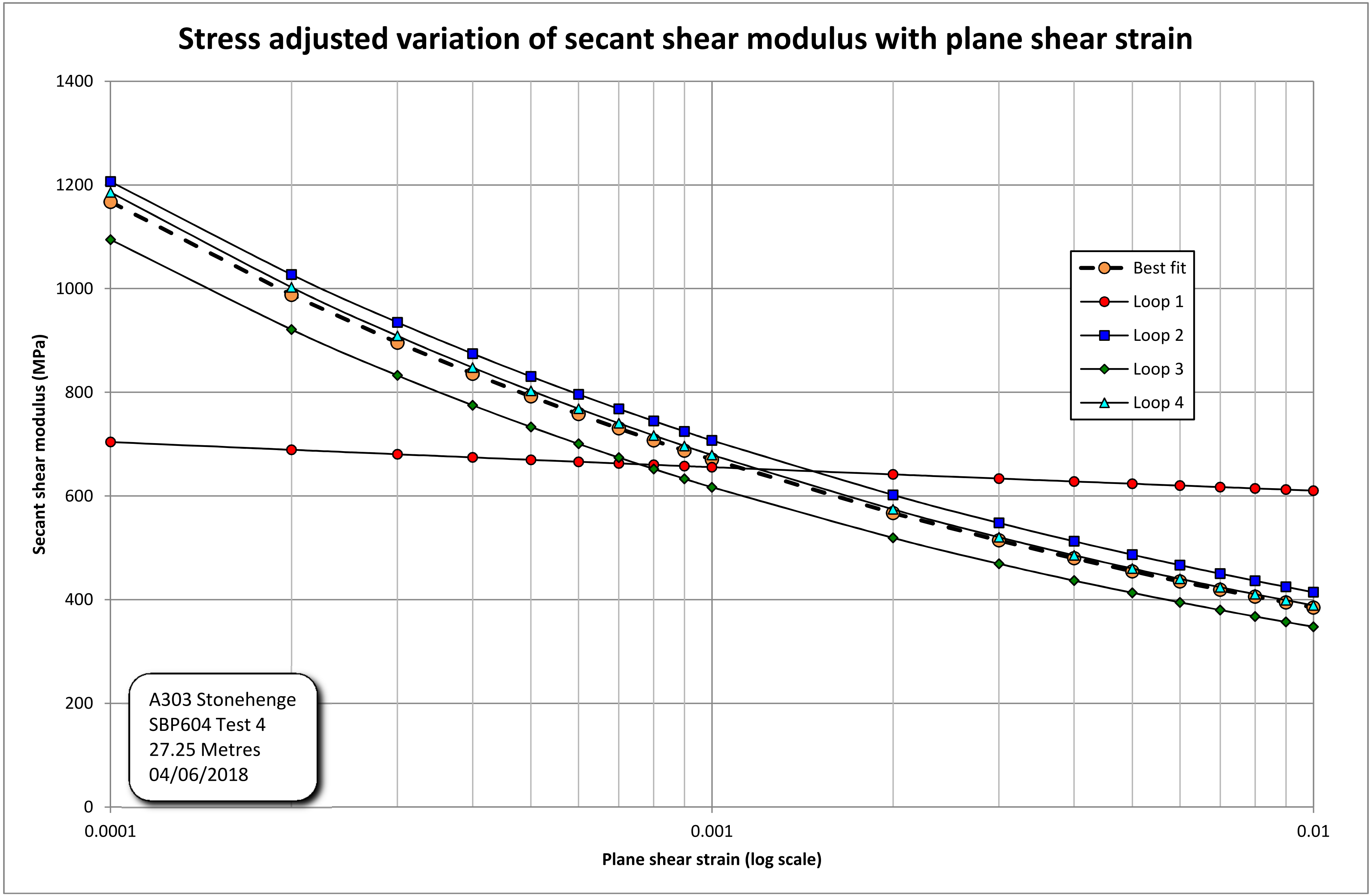

The variation of secant shear modulus with plane shear strain
1600
1400
1200
1000
800
600
400
200
0
Secant shear modulus (MPa)
0.0001
0.001
0.01
Plane shear strain (log scale)
Loop 1
Loop 2
Loop 3
Loop 4
A303 Stonehenge
SBP604 Test 3
25.05 Metres
04/06/2018

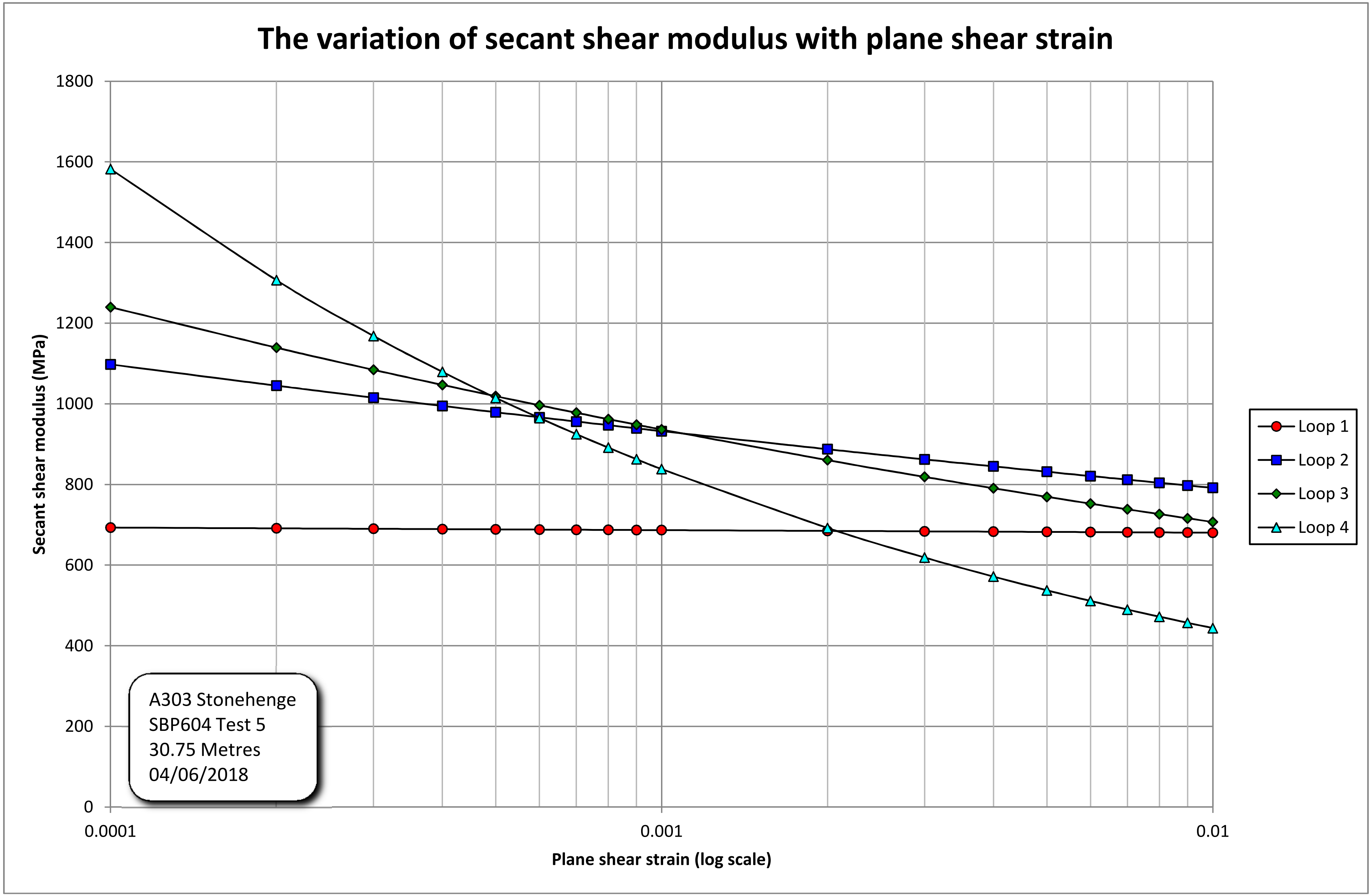


Stress adjusted variation of secant shear modulus with plane shear strain
Secant shear modulus (MPa)
0
200
400
600
800
1000
1200
1400
0.0001
0.001
0.01
Plane shear strain (log scale)
Best fit
Loop 1
Loop 2
Loop 3
Loop 4
A303 Stonehenge
SBP604 Test 3
25.05 Metres
04/06/2018

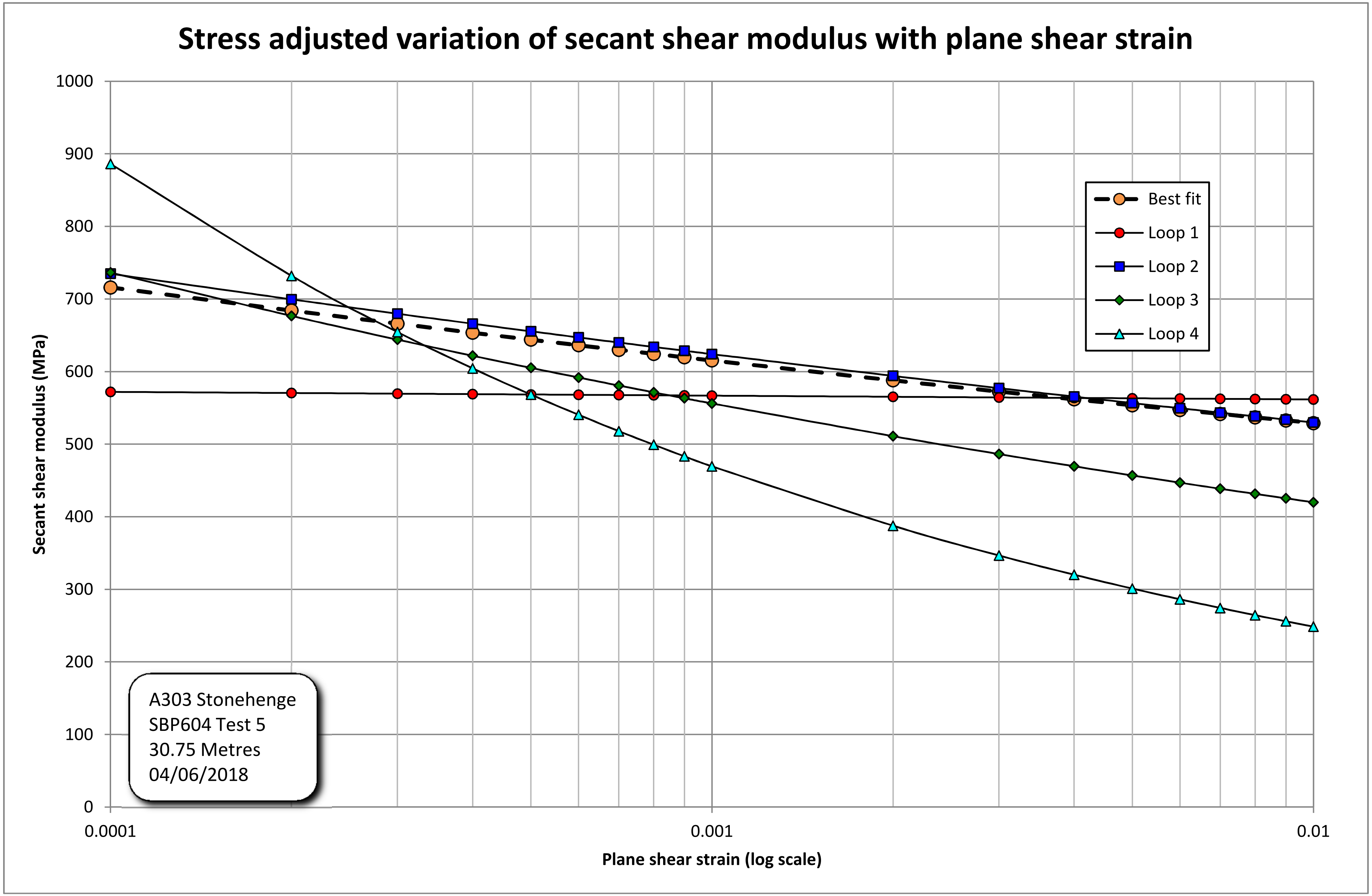
The variation of secant shear modulus with plane shear strain



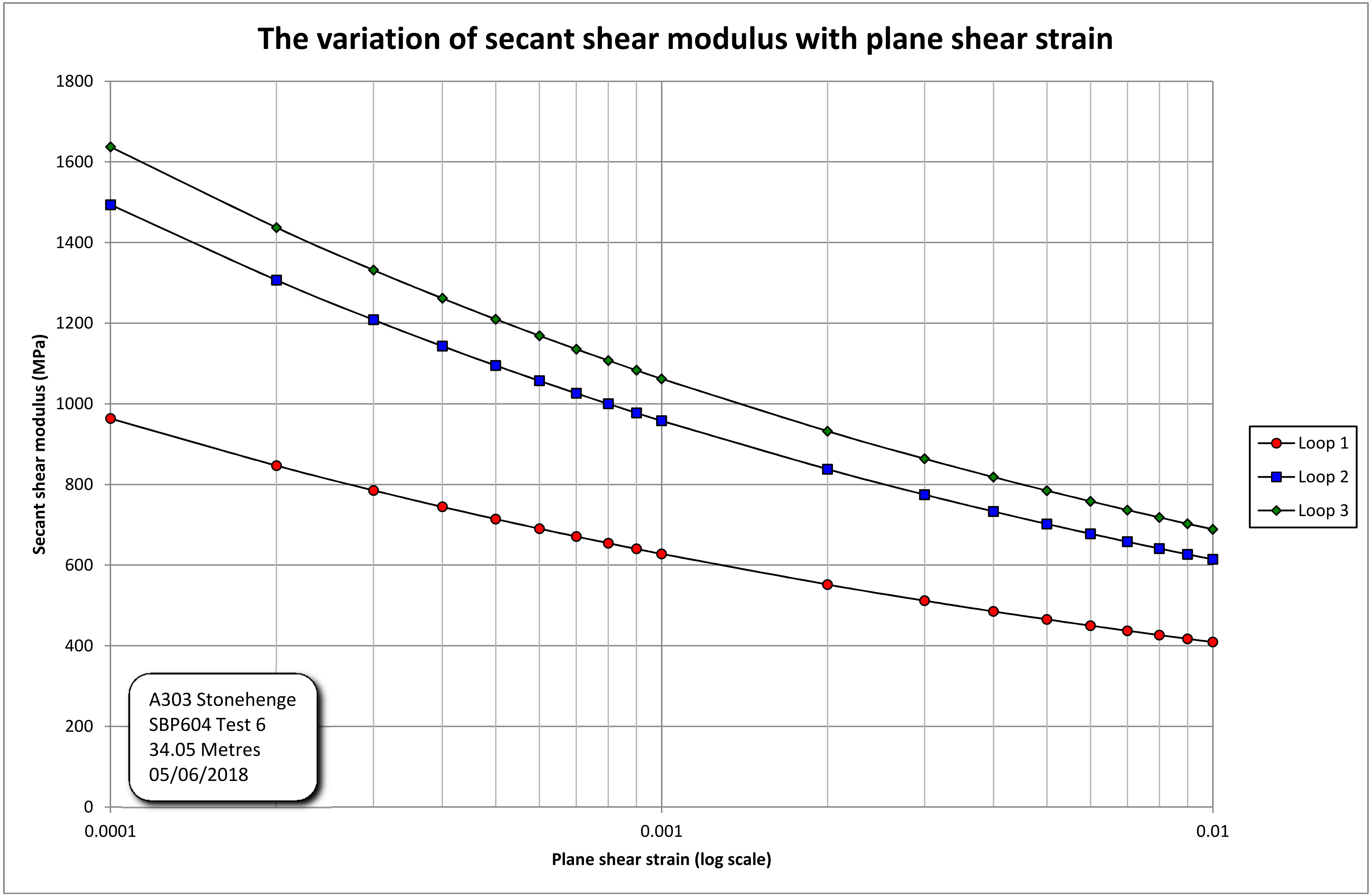

Stress adjusted variation of secant shear modulus with plane shear strain
Secant shear modulus (MPa)
1400
1200
1000
800
600
400
200
0
0.0001
0.001
0.01
Plane shear strain (log scale)
Best fit
Loop 1
Loop 2
Loop 3
Loop 4
A303 Stonehenge
SBP604 Test 4
27.25 Metres
04/06/2018



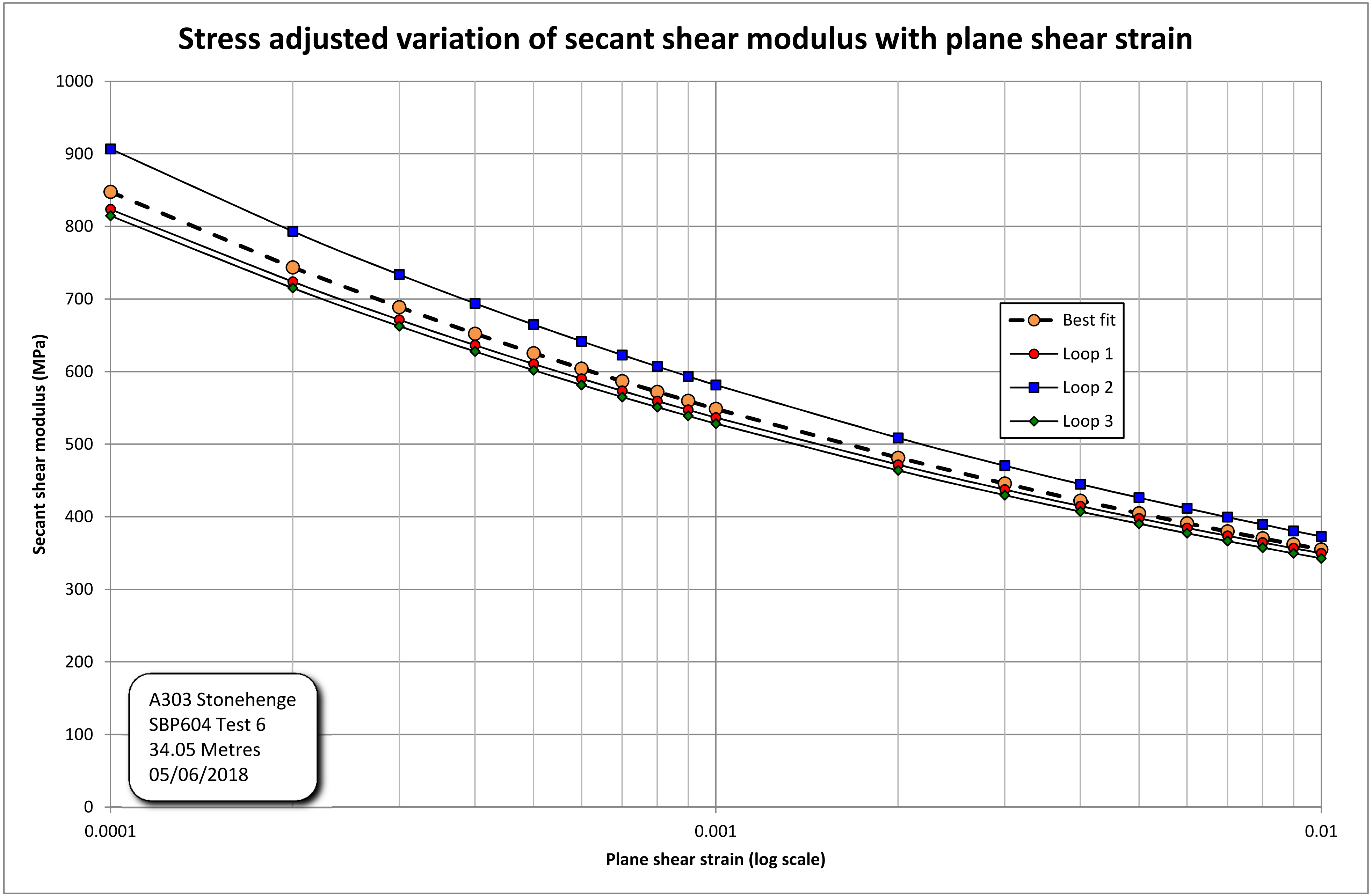
The variation of secant shear modulus with plane shear strain
Secant shear modulus (MPa)
1800
1600
1400
1200
1000
800
600
400
200
0
0.0001
0.001
0.01
Plane shear strain (log scale)
Loop 1
Loop 2
Loop 3
Loop 4
A303 Stonehenge
SBP604 Test 5
30.75 Metres
04/06/2018



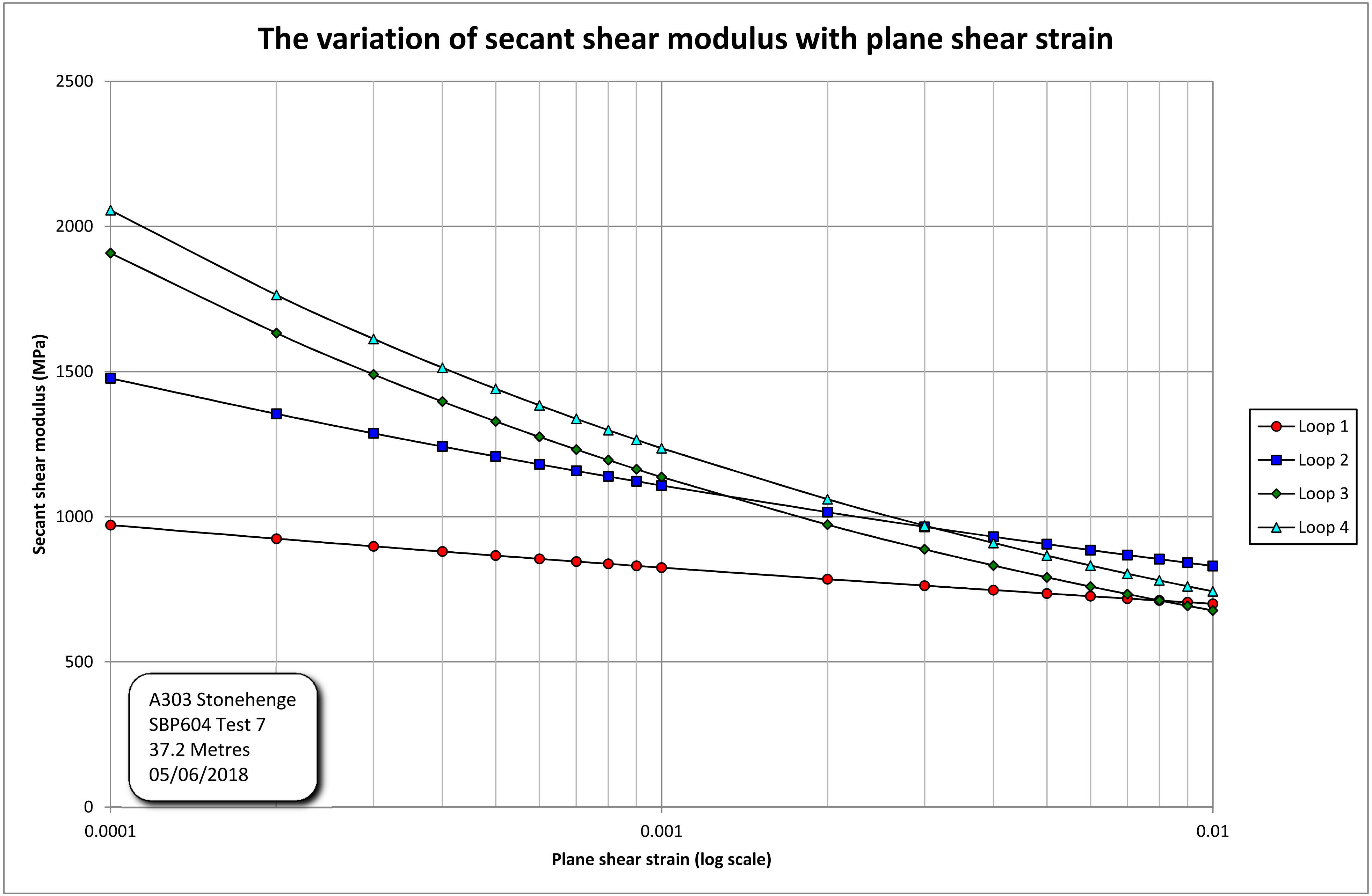
Stress adjusted variation of secant shear modulus with plane shear strain
Secant shear modulus (MPa)
1000
900
800
700
600
500
400
300
200
100
0
0.0001
0.001
0.01
Plane shear strain (log scale)
Best fit
Loop 1
Loop 2
Loop 3
Loop 4
A303 Stonehenge
SBP604 Test 5
30.75 Metres
04/06/2018

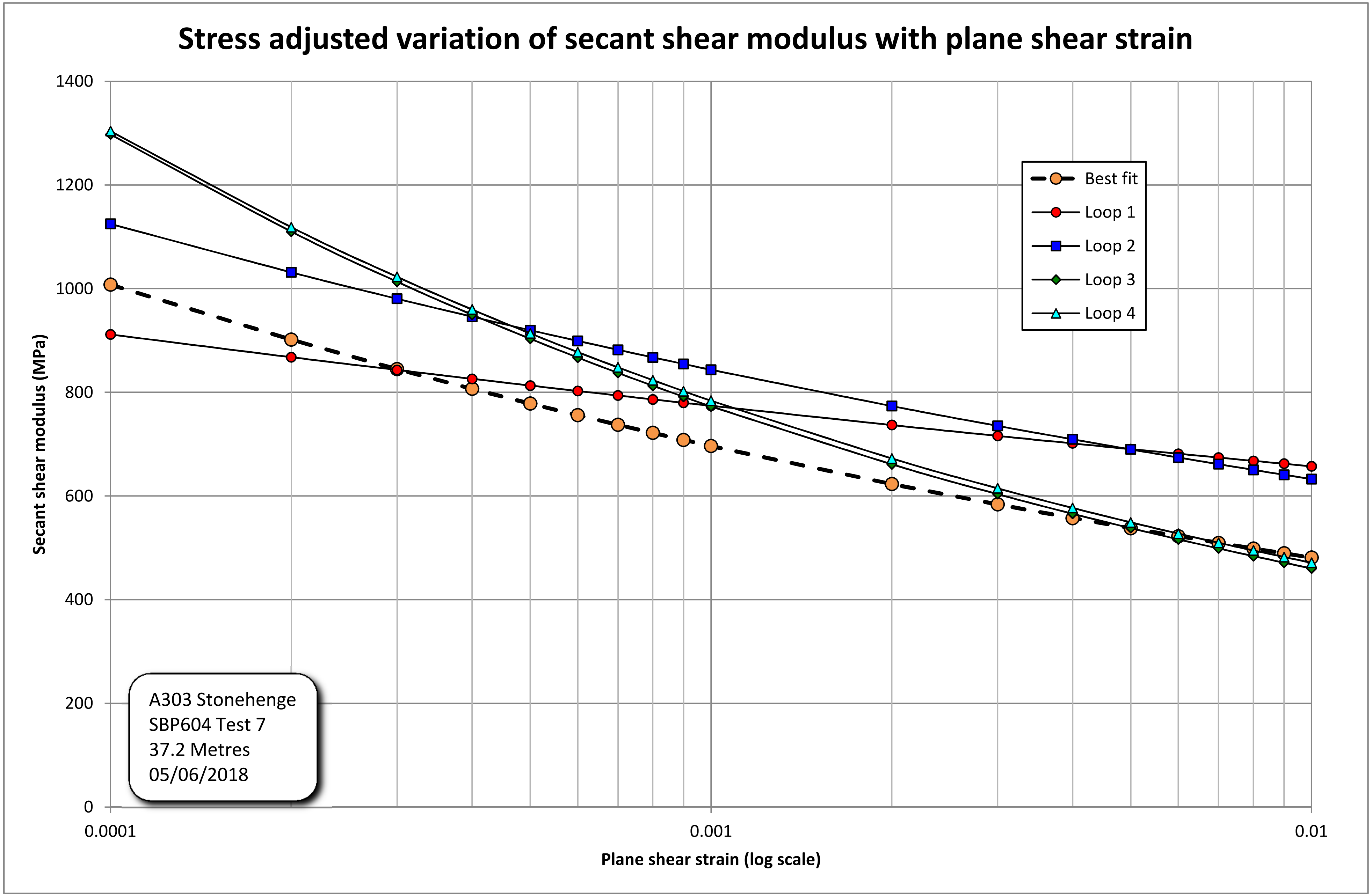


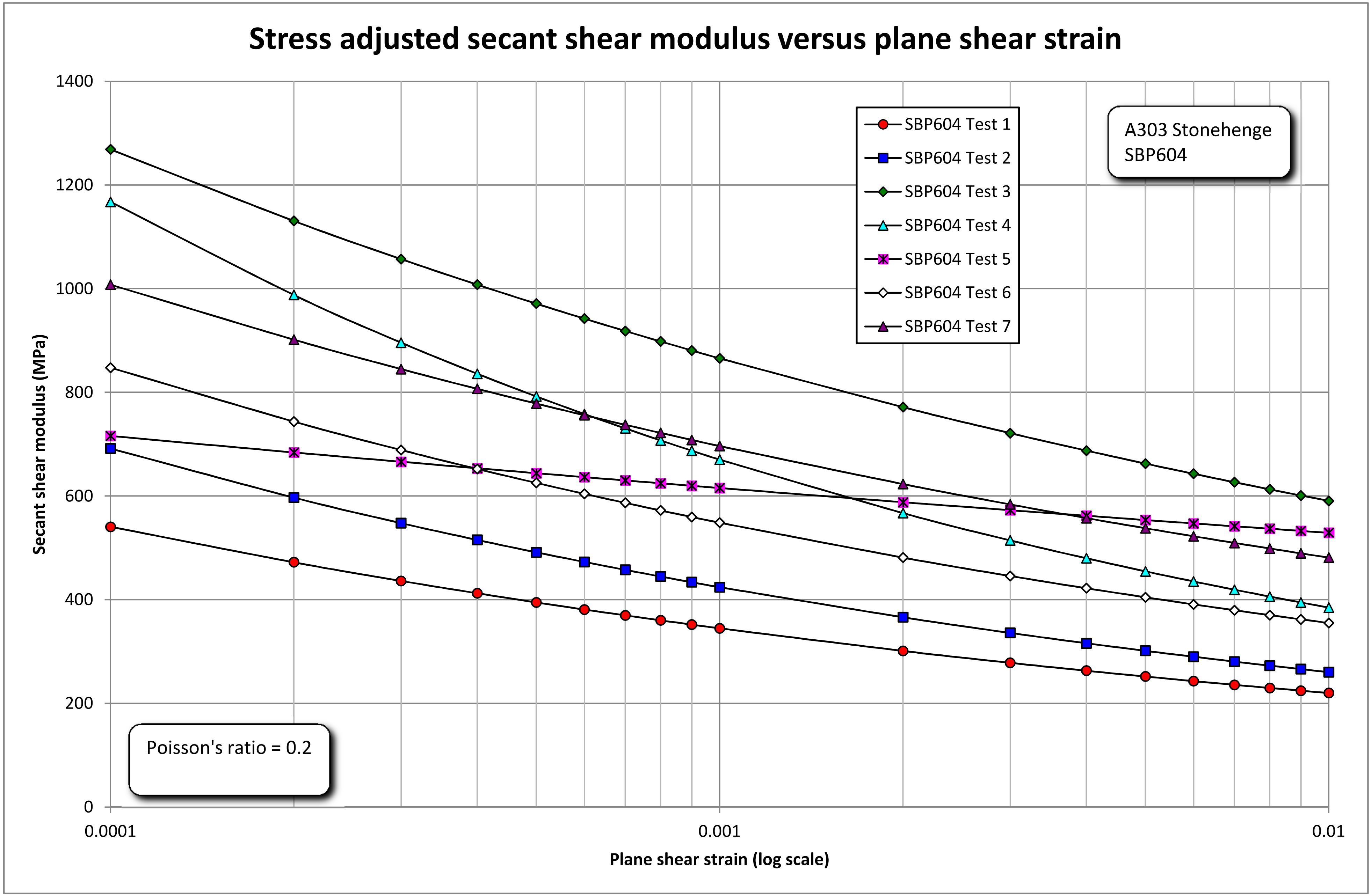
The variation of secant shear modulus with plane shear strain
Secant shear modulus (MPa)
1800
1600
1400
1200
1000
800
600
400
200
0
0.0001
0.001
0.01
Plane shear strain (log scale)
Loop 1
Loop 2
Loop 3
A303 Stonehenge
SBP604 Test 6
34.05 Metres
05/06/2018



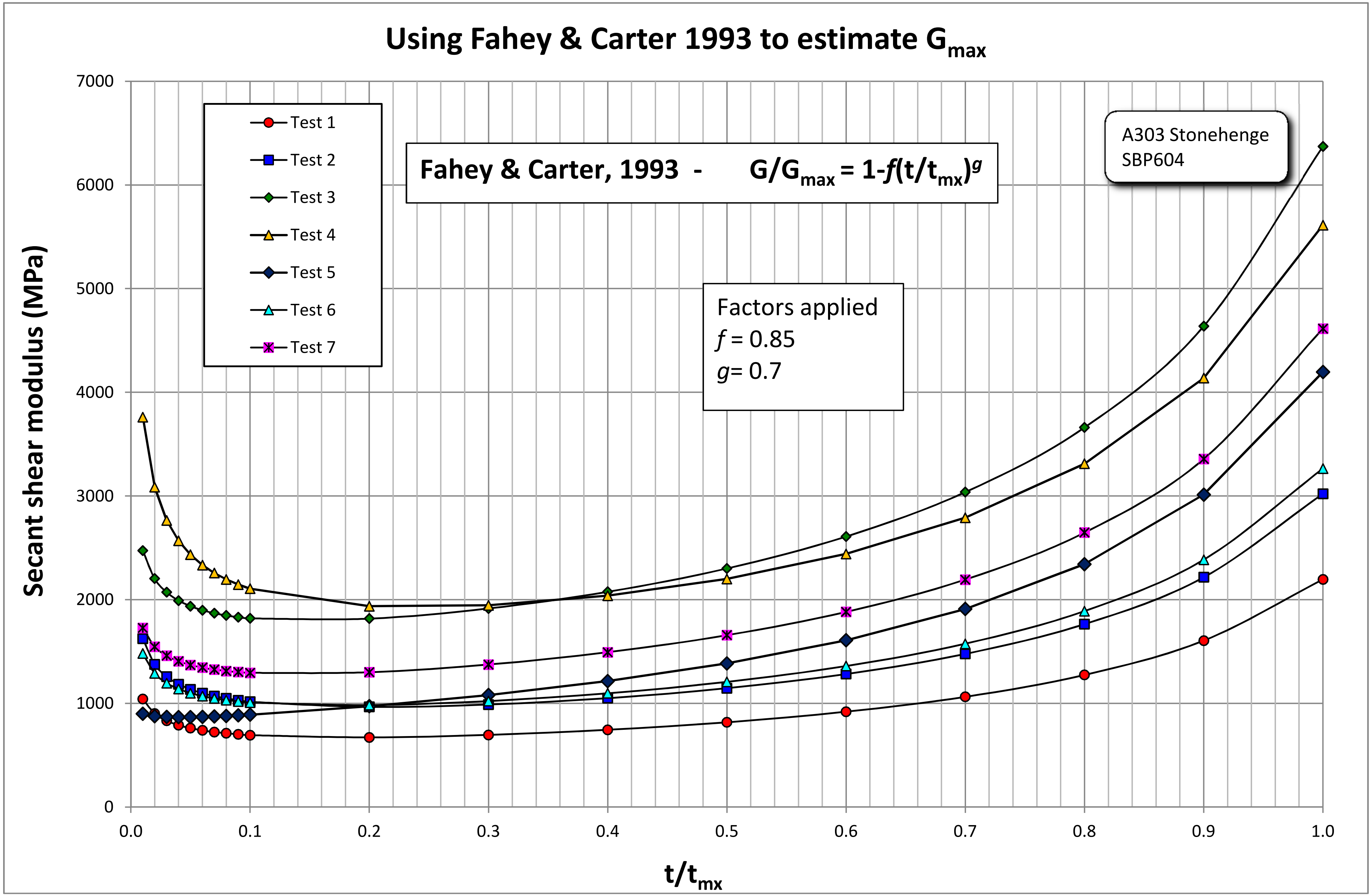
Stress adjusted variation of secant shear modulus with plane shear strain
1000
900
800
700
600
500
400
300
200
100
0
Secant shear modulus (MPa)
0.0001
0.001
0.01
Plane shear strain (log scale)
Best fit
Loop 1
Loop 2
Loop 3
A303 Stonehenge
SBP604 Test 6
34.05 Metres
05/06/2018


The variation of secant shear modulus with plane shear strain
Secant shear modulus (MPa)
2500
2000
1500
1000
500
0
0.0001
0.001
0.01
Plane shear strain (log scale)
Loop 1
Loop 2
Loop 3
Loop 4
A303 Stonehenge
SBP604 Test 7
37.2 Metres
05/06/2018


Stress adjusted variation of secant shear modulus with plane shear strain
Secant shear modulus (MPa)
Plane shear strain (log scale)
0
200
400
600
800
1000
1200
1400
0.0001
0.001
0.01
Best fit
Loop 1
Loop 2
Loop 3
Loop 4
A303 Stonehenge
SBP604 Test 7
37.2 Metres
05/06/2018



Stress adjusted secant shear modulus versus plane shear strain
Secant shear modulus (MPa)
0
200
400
600
800
1000
1200
1400
0.0001
0.001
0.01
Plane shear strain (log scale)
SBP604 Test 1
SBP604 Test 2
SBP604 Test 3
SBP604 Test 4
SBP604 Test 5
SBP604 Test 6
SBP604 Test 7
A303 Stonehenge
SBP604
Poisson's ratio = 0.2


Using Fahey & Carter 1993 to estimate G_{max}
Fahey & Carter, 1993 - $G/G_{max} = 1-f(t/t_{mx})^g$
Factors applied
f = 0.85
g= 0.7
A303 Stonehenge
SBP604
Test 1
Test 2
Test 3
Test 4
Test 5
Test 6
Test 7
Secant shear modulus (MPa)
t/t_{mx}
0
1000
2000
3000
4000
5000
6000
7000
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

TEST DATA

(TAKEN FROM WINSITU and WINLOG FILES)

Test reference	Internal reference	Depth (mBGL)
SBP604 Test 1	S604T1	18.25
SBP604 Test 2	S604T2	21.10
SBP604 Test 3	S604T3	25.05
SBP604 Test 4	S604T4	27.25
SBP604 Test 5	S604T5	30.75
SBP604 Test 6	S604T6	34.05
SBP604 Test 7	S604T7	37.20

SBP604 Test 1 - SUMMARY OF RESULTS
[File made with WinSitu Version 3.9.1.1]

[DETAILS OF TEST]

Project	:	60547200
Site	:	A303 Stonehenge
Borehole	:	SBP604
Test name	:	SBP604 Test 1
Test date	:	1 Jun 18
Test depth	:	18.25 Metres
Water table	:	22.5 Metres
Ambient PWP	:	0.0 kPa
Material	:	Chalk
Probe	:	95mm High Pressure Dilatometer
Diameter	:	97.0 mm

Data analysed using average arm displacement curve
A non-linear analysis of the rebound cycles has been carried out
The file includes results from a curve fitting analysis

Analysed by RWW on 6 Jun 18

Remarks: Pocket 17 to 19.35. Drilled with water only, many problems.

[RESULTS FOR CAVITY REFERENCE PRESSURE]

Strain Origin (mm)	:	"Arm ave=3.39"
Po from Marsland & Randolph (kPa)	:	"Arm ave=743.9"
Best estimate of Po (kPa)	:	"Arm ave=616.0"

[UNDRAINED STRENGTH PARAMETERS]

Undrained yield stress (kPa)	:	"Arm ave=2928.7"

[DRAINED ANALYSIS OF SANDS]
[Hughes et al 1977]

Constant volume friction angle (°)	:	28.0
Angle of internal friction (°)	:	"Arm ave=36.9"
Dilation angle (°)	:	"Arm ave=10.4"
Gradient of log-log plot	:	"Arm ave=0.443"

[Withers et al 1989]

Angle of internal friction (°)	:	"Arm ave=39.7"
Dilation angle (°)	:	"Arm ave=14.0"
Gradient of log-log plot	:	"Arm ave=-2.322"

[LINEAR INTERPRETATION OF SHEAR MODULUS G]
Initial slope shear modulus (MPa) :"Arm ave=129.2"

Axis	Loop No	Value (MPa)	Mean Strain (%)	Mean Pc (kPa)	dE (%)	dPc (kPa)
Arm ave	1	206.9	-0.818	447	0.035	73
Arm ave	2	360.7	-0.438	756	0.042	150
Arm ave	3	741.6	0.146	1637	0.061	449
Arm ave	4	1069.6	1.184	3249	0.061	650
Arm ave	5	900.8	1.890	2603	0.131	1179

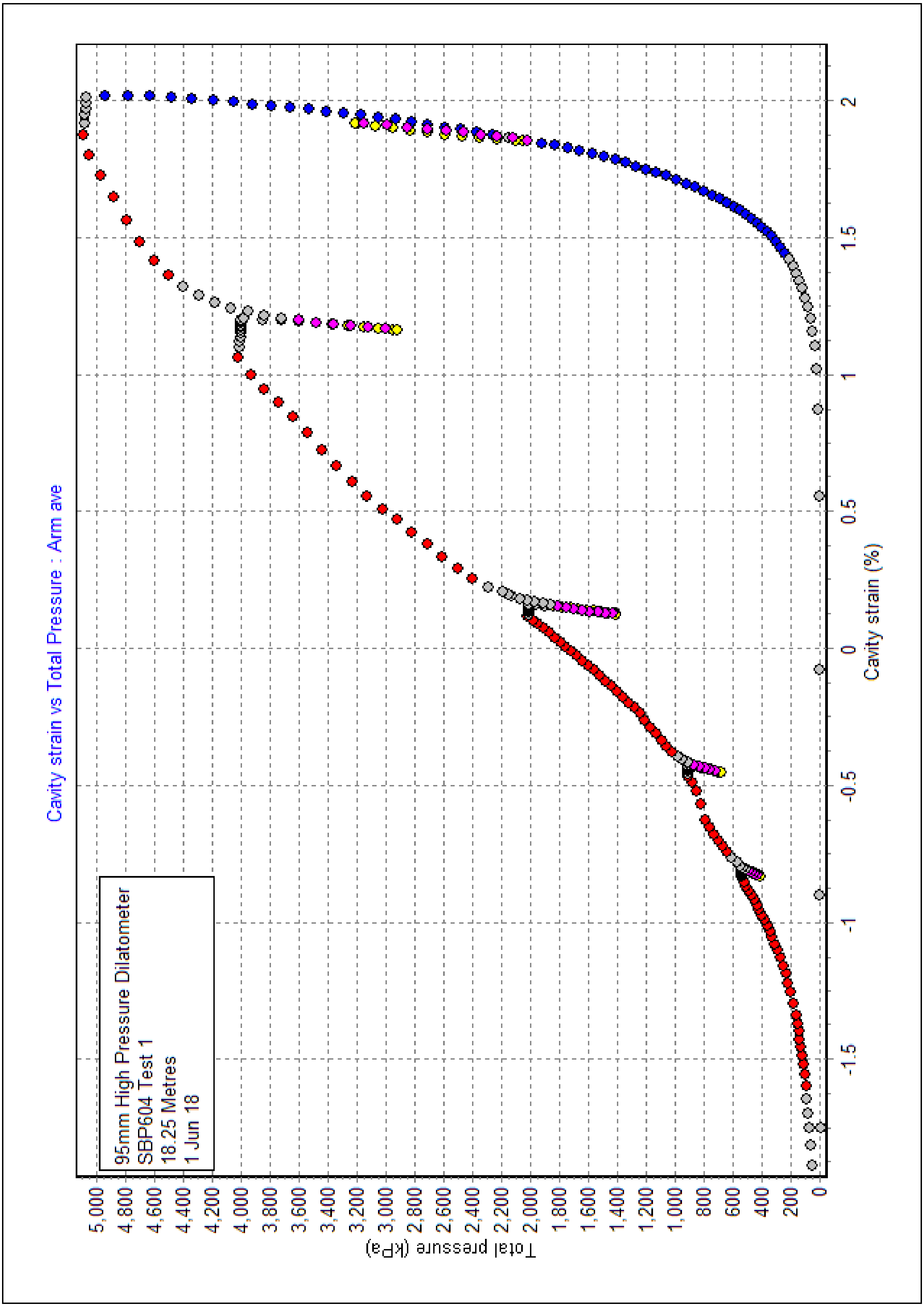
[UNDRAINED NON LINEAR INTERPRETATION OF SECANT SHEAR MODULUS]

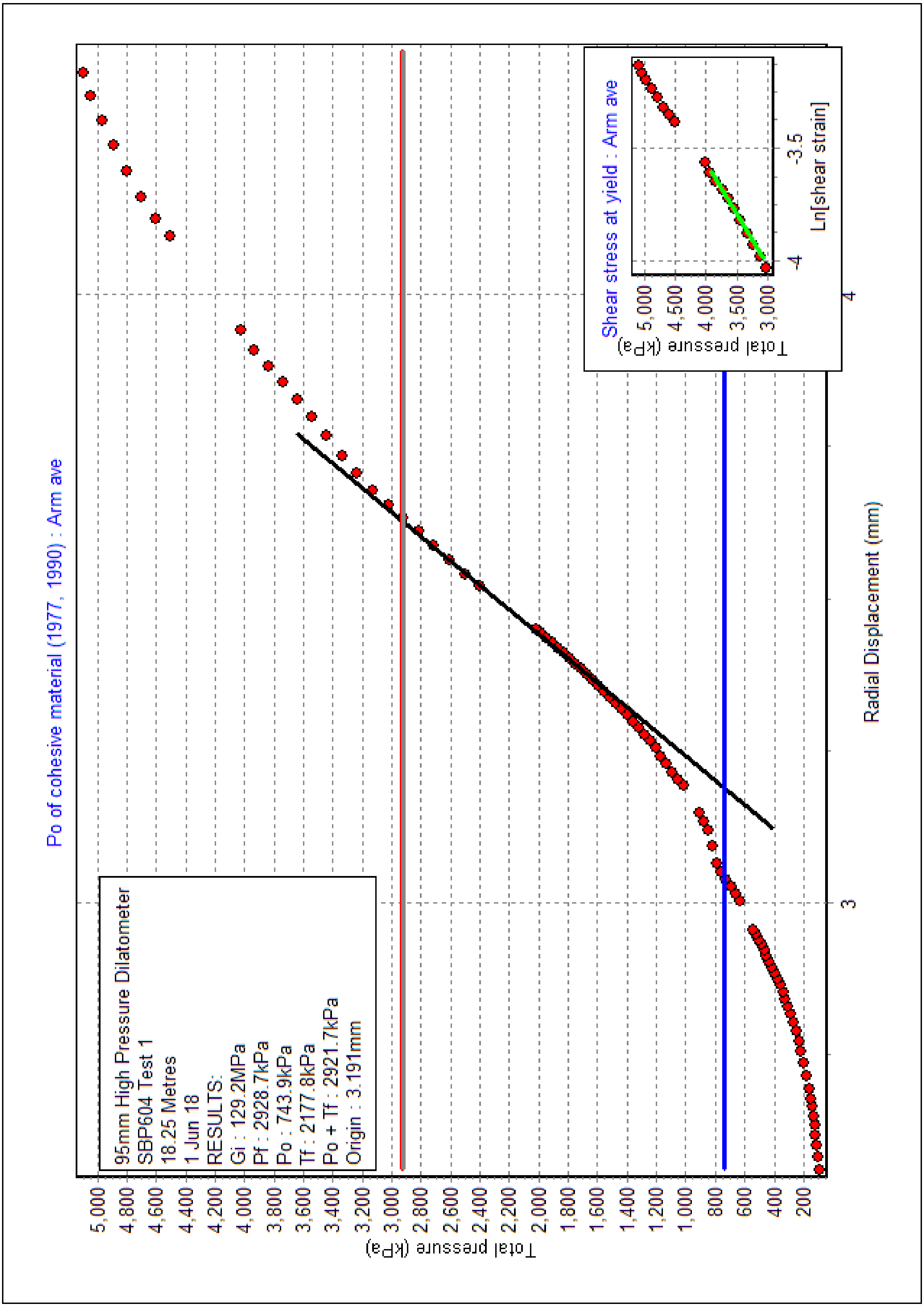
Axis	Loop No	Intercept (MPa)	Alpha (MPa)	Gradient
Arm ave	1	139.024	132.120	0.950
Arm ave	2	202.326	189.219	0.935
Arm ave	3	232.664	196.114	0.843
Arm ave	4	269.729	219.198	0.813
Arm ave	5	193.493	146.644	0.758

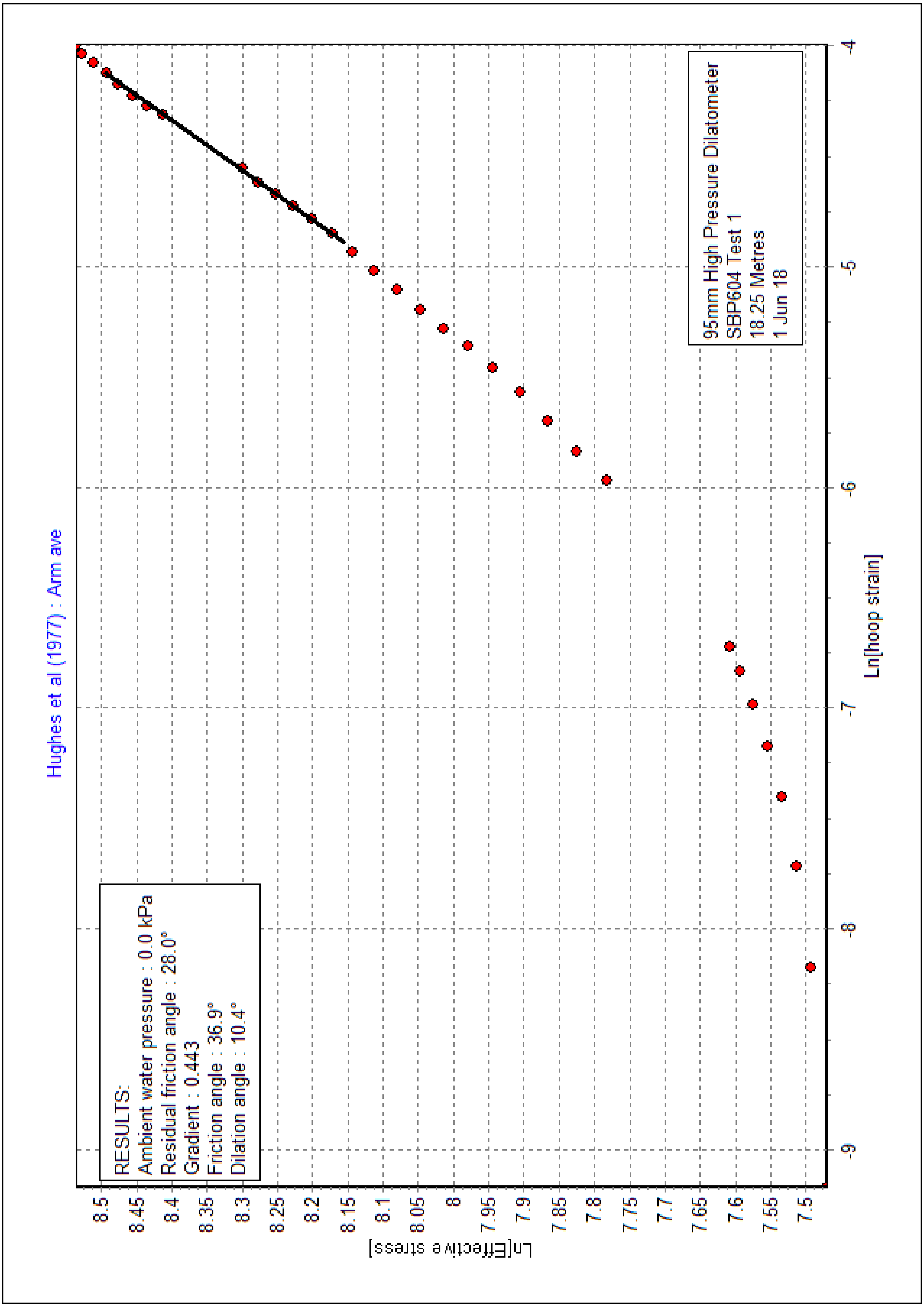
[PARAMETERS USED FOR DRAINED CURVE MODELLING]
{Axis is Arm ave}

Strain Origin (mm)	:	3.39
Po (kPa)	:	616
Cohesion (kPa)	:	58
Angle of peak friction (deg)	:	36.9
Angle of peak dilation (deg)	:	10.4
Total yield stress (kPa)	:	1295
Total limit stress (kPa)	:	22688
G at first yield (MPa)	:	435.1
Non-linear exponent	:	0.758
Janbu exponent	:	0.333
Correlation	:	0.890

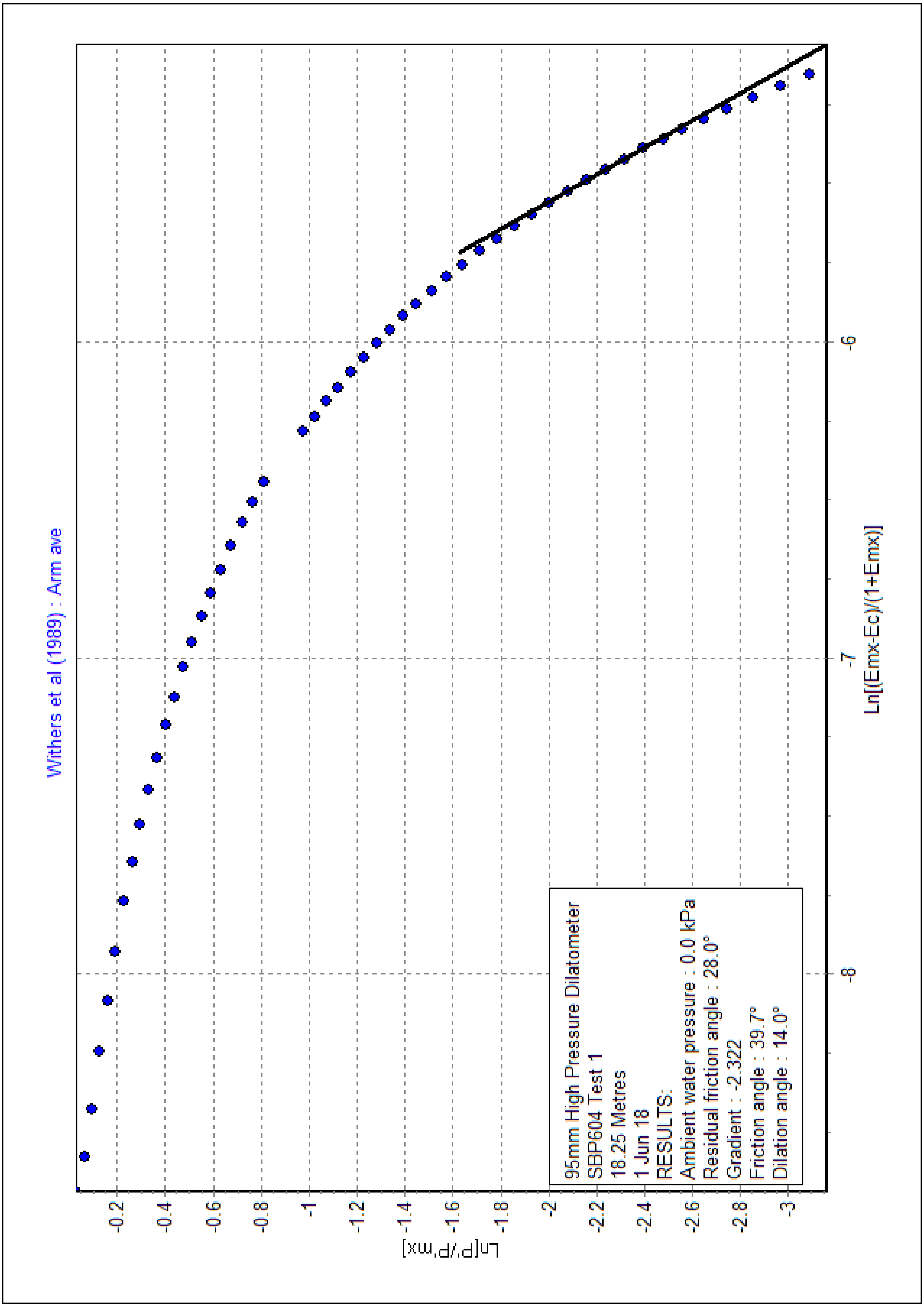
Ambient pore water pressure (kPa)	:	0
Residual friction angle (deg)	:	28.0
Poisson's ratio	:	0.33

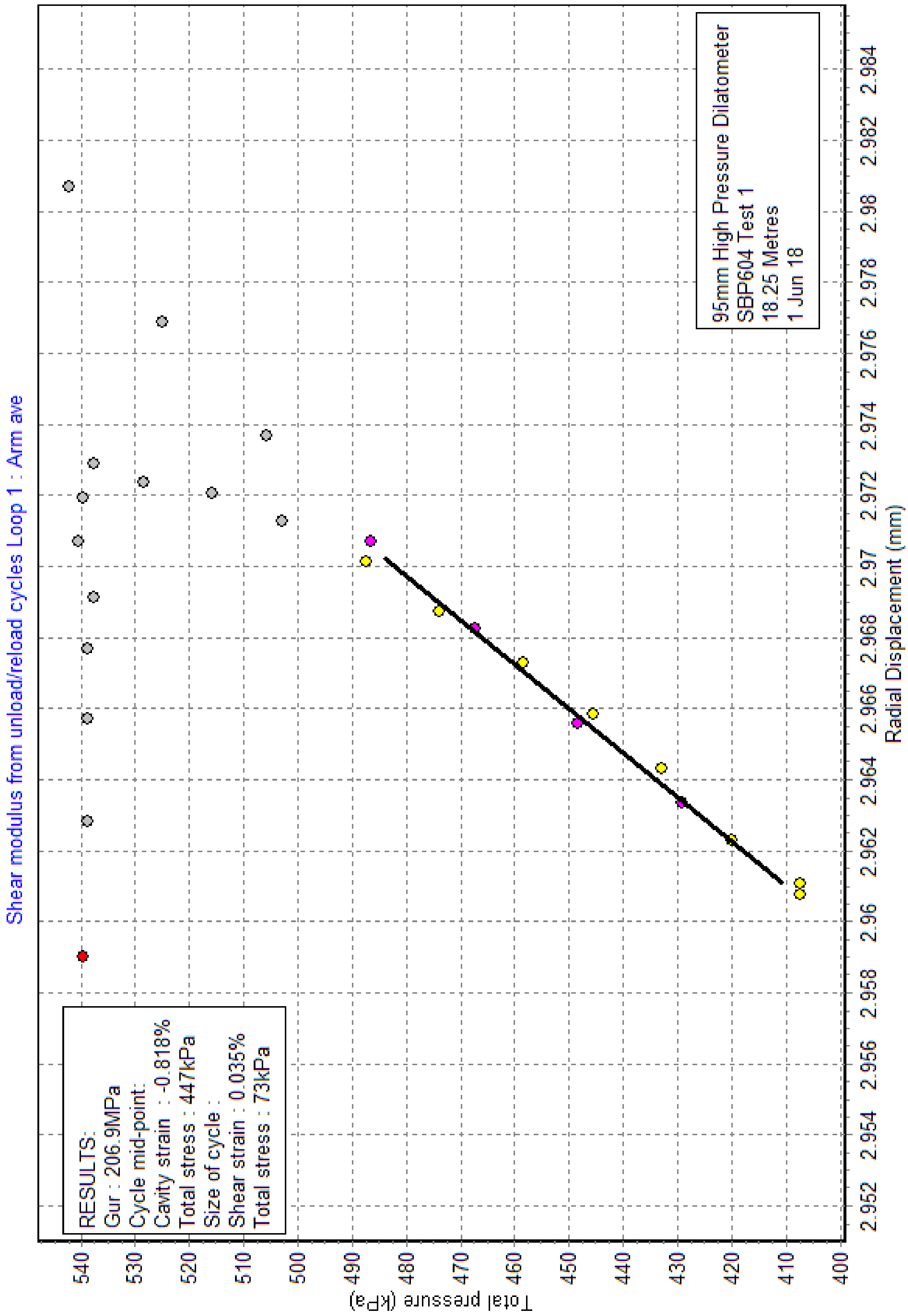

Cavity strain vs Total Pressure : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 1
18.25 Metres
1 Jun 18
Total pressure (kPa)
Cavity strain (%)
5,000
4,800
4,600
4,400
4,200
4,000
3,800
3,600
3,400
3,200
3,000
2,800
2,600
2,400
2,200
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
-1.5
-1
-0.5
0
0.5
1
1.5
2

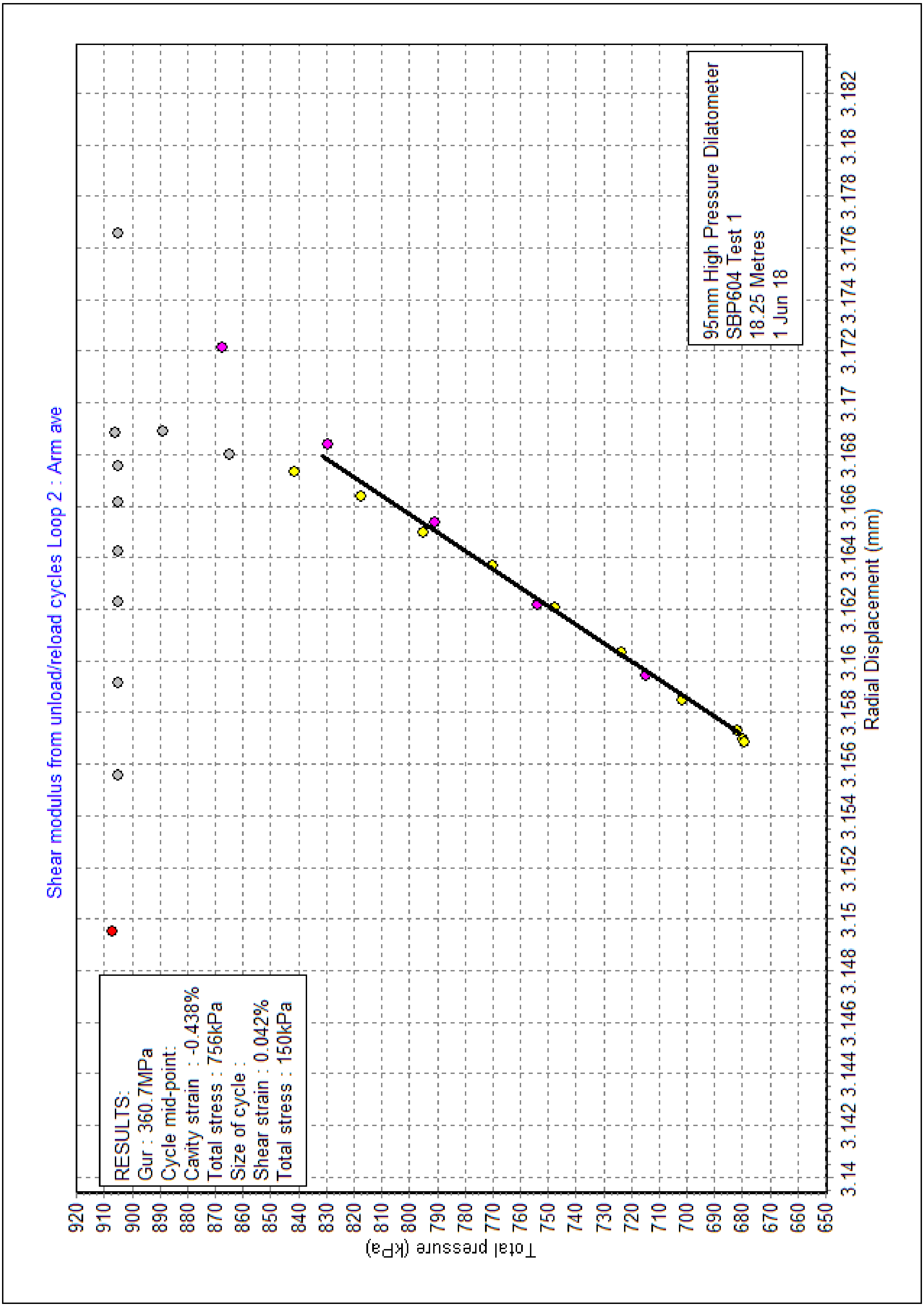

Po of cohesive material (1977, 1990) : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 1
18.25 Metres
1 Jun 18
RESULTS:
Gi : 129.2MPa
Pf : 2928.7kPa
Po : 743.9kPa
Tf : 2177.8kPa
Po + Tf : 2921.7kPa
Origin : 3.191mm
Total pressure (kPa)
5,000
4,800
4,600
4,400
4,200
4,000
3,800
3,600
3,400
3,200
3,000
2,800
2,600
2,400
2,200
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
Radial Displacement (mm)
3
4
Shear stress at yield : Arm ave
Total pressure (kPa)
5,000
4,500
4,000
3,500
3,000
Ln[shear strain]
-3.5
-4

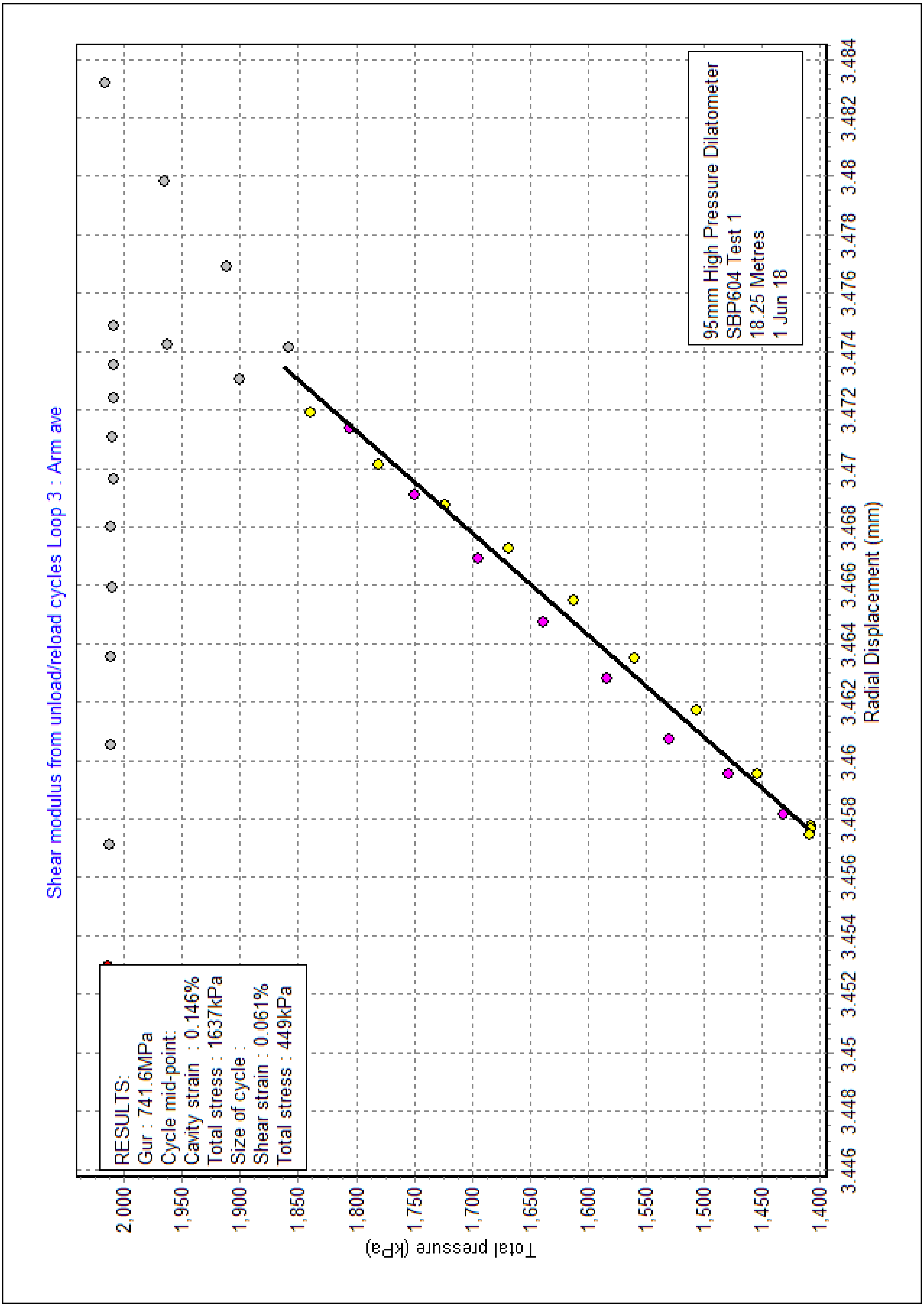


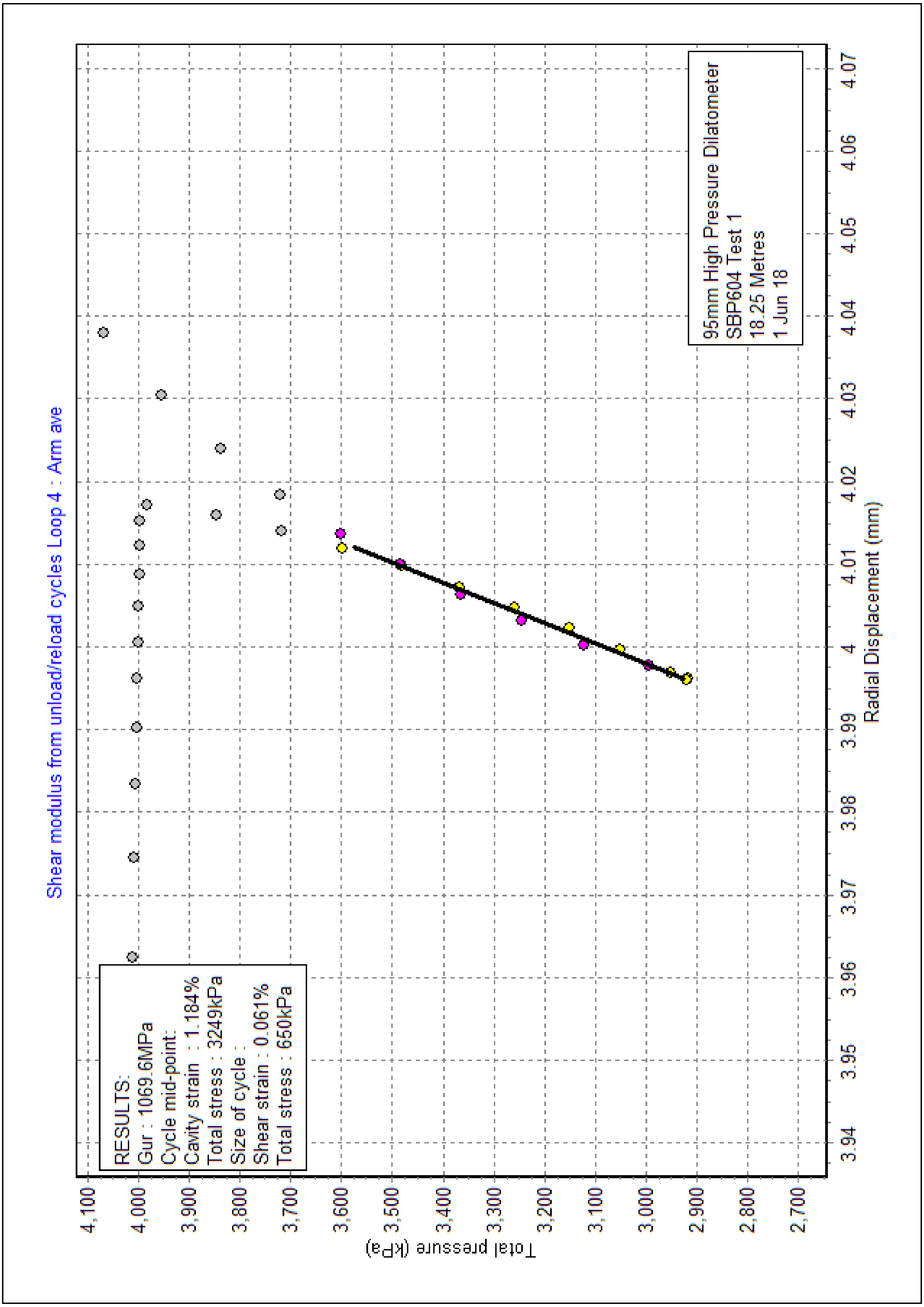
Hughes et al (1977) : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 1
18.25 Metres
1 Jun 18
RESULTS:
Ambient water pressure : 0.0 kPa
Residual friction angle : 28.0°
Gradient : 0.443
Friction angle : 36.9°
Dilation angle : 10.4°
Ln[hoop strain]
-4
-5
-6
-7
-8
-9
Ln[Effective stress]
8.5
8.45
8.4
8.35
8.3
8.25
8.2
8.15
8.1
8.05
8
7.95
7.9
7.85
7.8
7.75
7.7
7.65
7.6
7.55
7.5

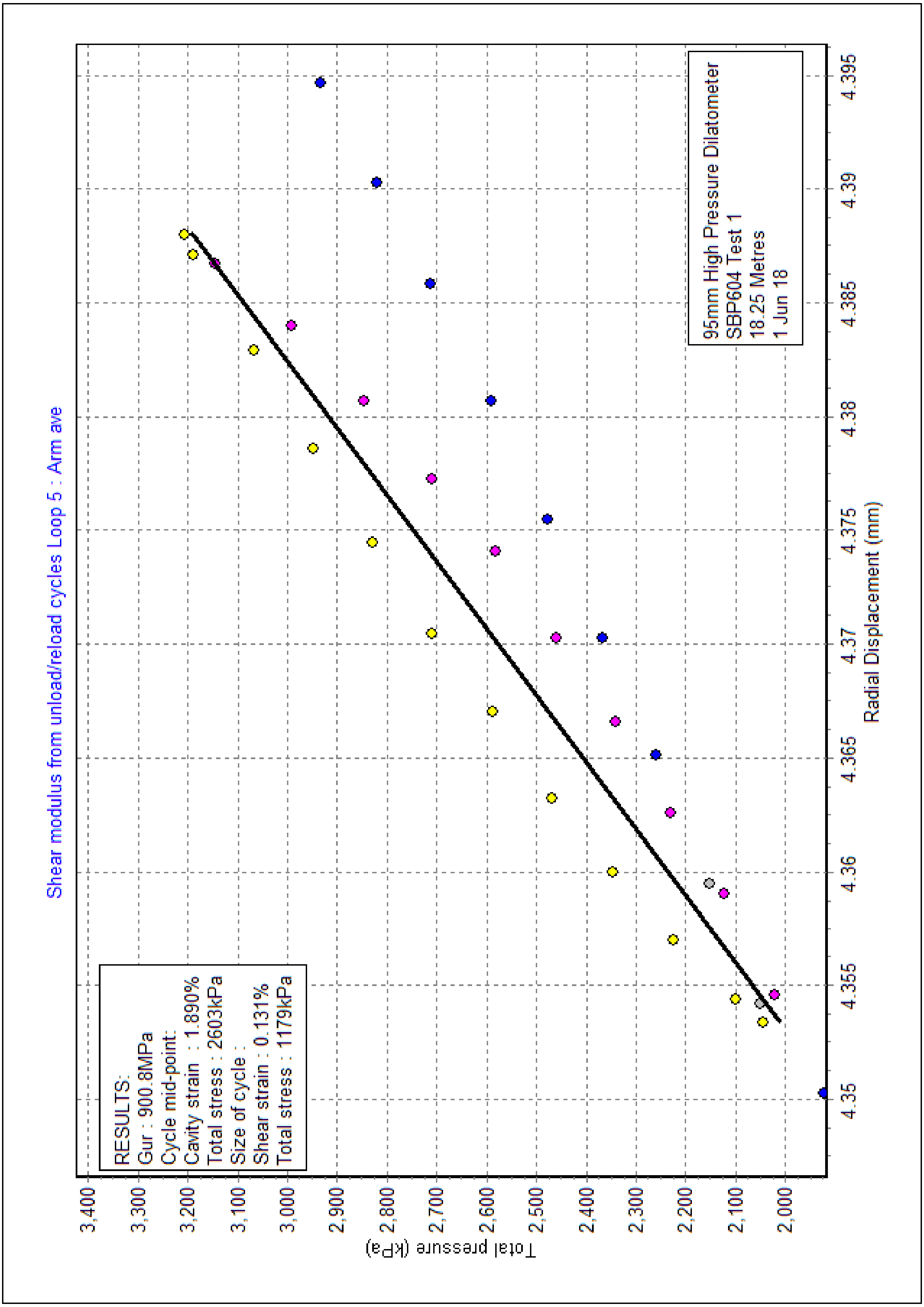

Withers et al (1989) : Arm ave
Ln[(Emx-Ec)/(1+Emx)]
Ln[P'/P'mx]
-6
-7
-8
-0.2
-0.4
-0.6
-0.8
-1
-1.2
-1.4
-1.6
-1.8
-2
-2.2
-2.4
-2.6
-2.8
-3
95mm High Pressure Dilatometer
SBP604 Test 1
18.25 Metres
1 Jun 18
RESULTS:
Ambient water pressure : 0.0 kPa
Residual friction angle : 28.0°
Gradient : -2.322
Friction angle : 39.7°
Dilation angle : 14.0°

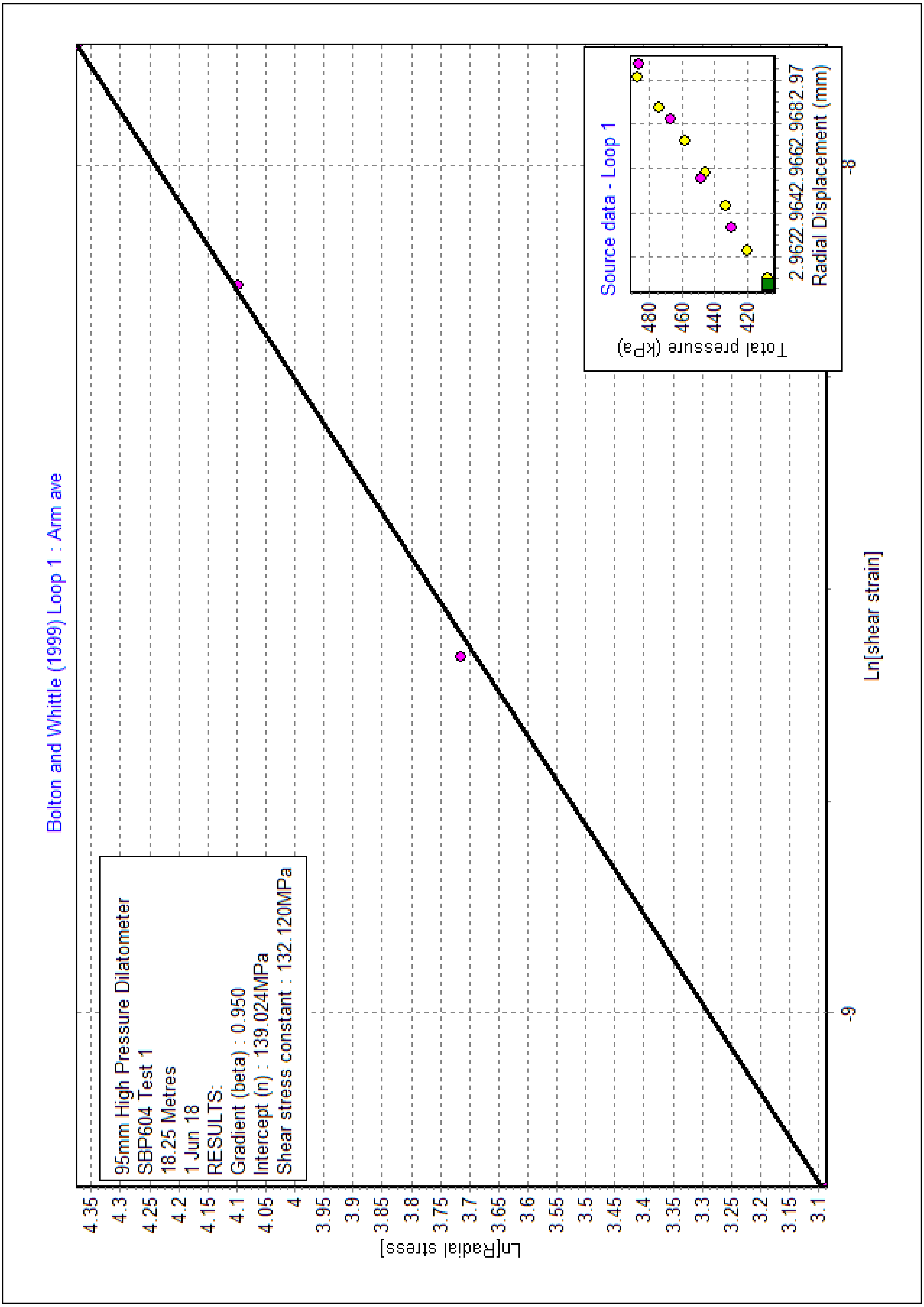

Shear modulus from unload/reload cycles Loop 1 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 1
18.25 Metres
1 Jun 18
RESULTS:
Gur : 206.9MPa
Cycle mid-point:
Cavity strain : -0.818%
Total stress : 447kPa
Size of cycle :
Shear strain : 0.035%
Total stress : 73kPa
Radial Displacement (mm)
Total pressure (kPa)

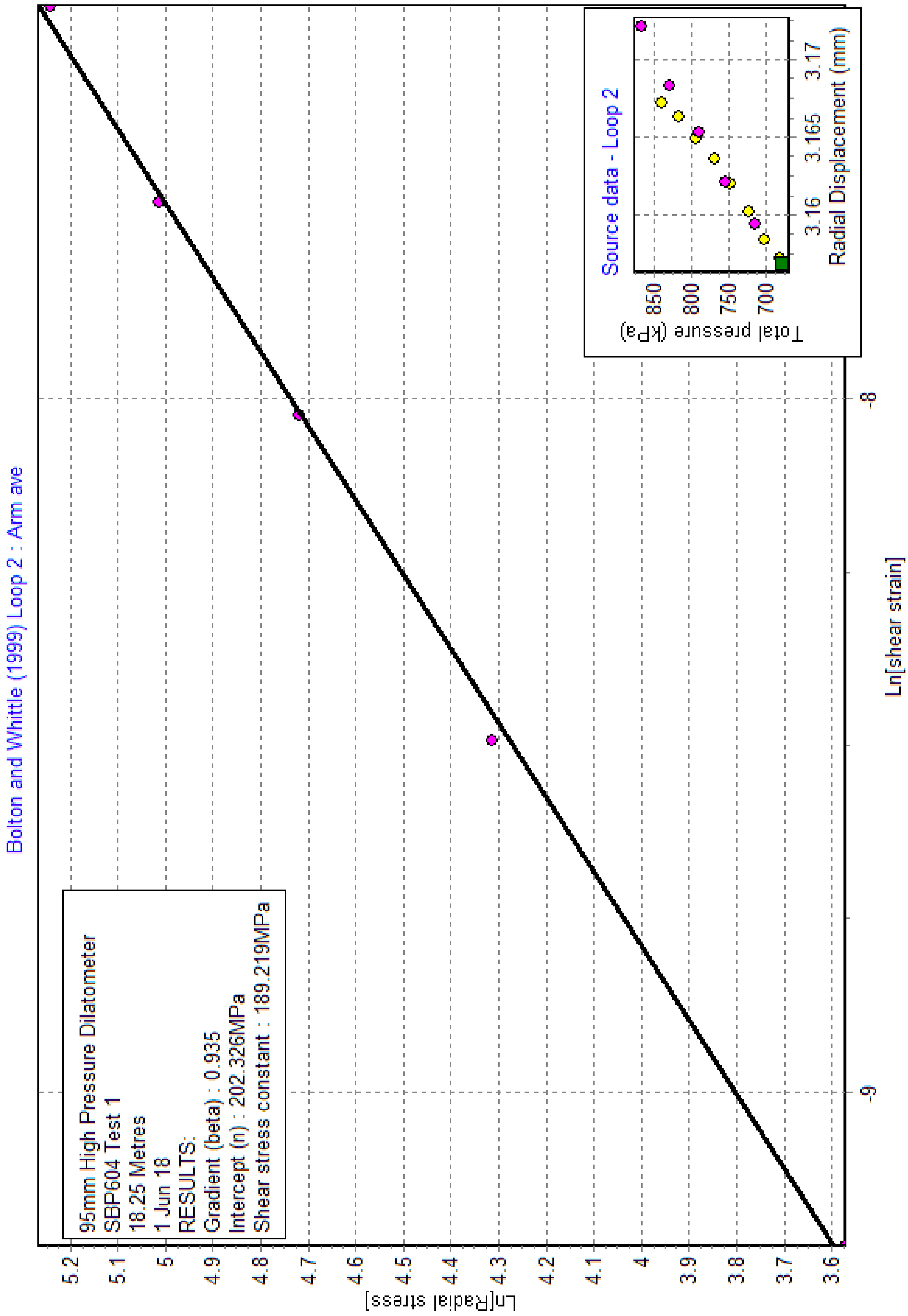

Shear modulus from unload/reload cycles Loop 2 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 1
18.25 Metres
1 Jun 18
RESULTS:
Gur : 360.7MPa
Cycle mid-point:
Cavity strain : -0.438%
Total stress : 756kPa
Size of cycle :
Shear strain : 0.042%
Total stress : 150kPa
Total pressure (kPa)
Radial Displacement (mm)

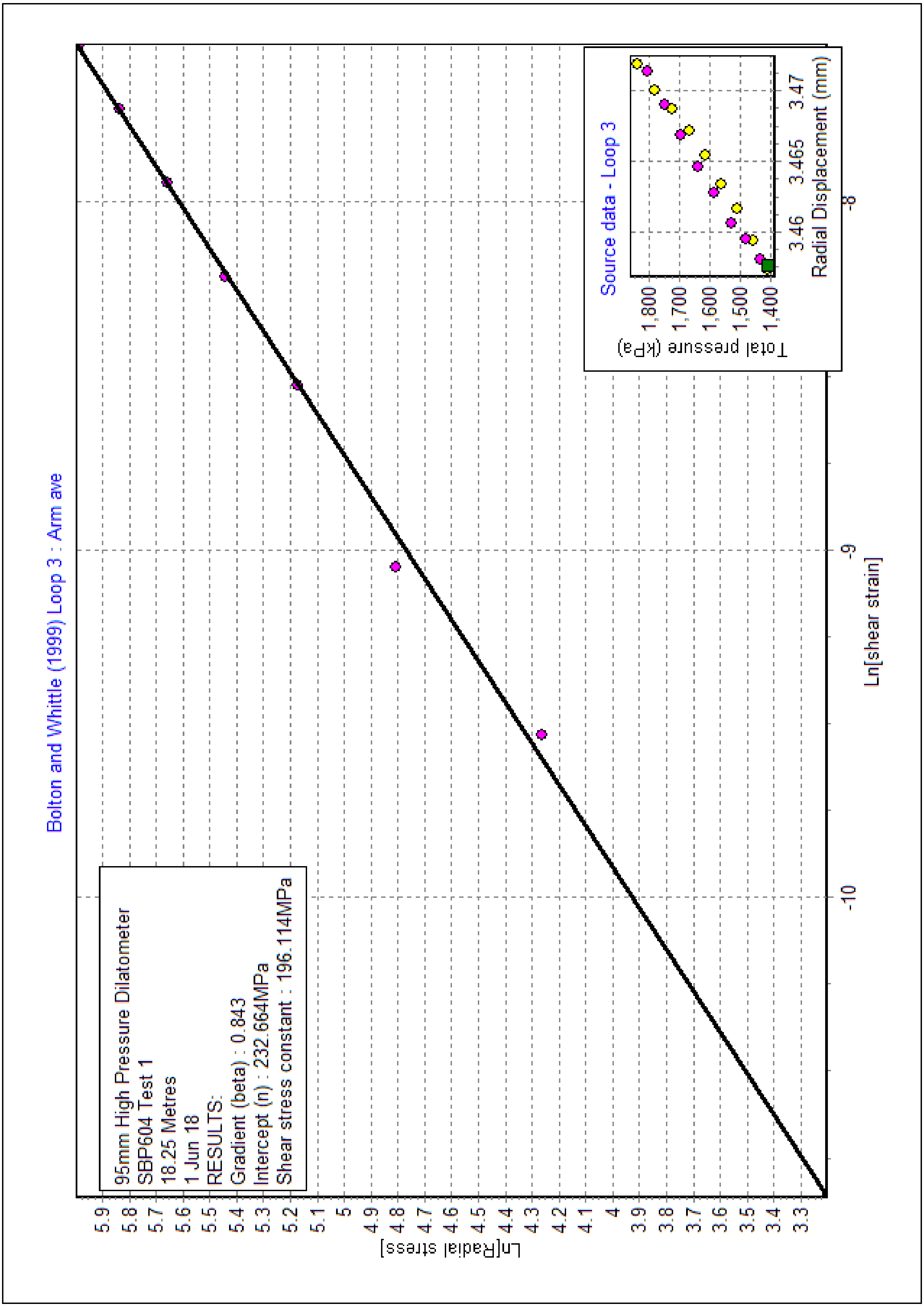

Shear modulus from unload/reload cycles Loop 3 : Arm ave
RESULTS:
Gur : 741.6MPa
Cycle mid-point:
Cavity strain : 0.146%
Total stress : 1637kPa
Size of cycle :
Shear strain : 0.061%
Total stress : 449kPa
95mm High Pressure Dilatometer
SBP604 Test 1
18.25 Metres
1 Jun 18
Total pressure (kPa)
2,000
1,950
1,900
1,850
1,800
1,750
1,700
1,650
1,600
1,550
1,500
1,450
1,400
Radial Displacement (mm)
3.446
3.448
3.45
3.452
3.454
3.456
3.458
3.46
3.462
3.464
3.466
3.468
3.47
3.472
3.474
3.476
3.478
3.48
3.482
3.484

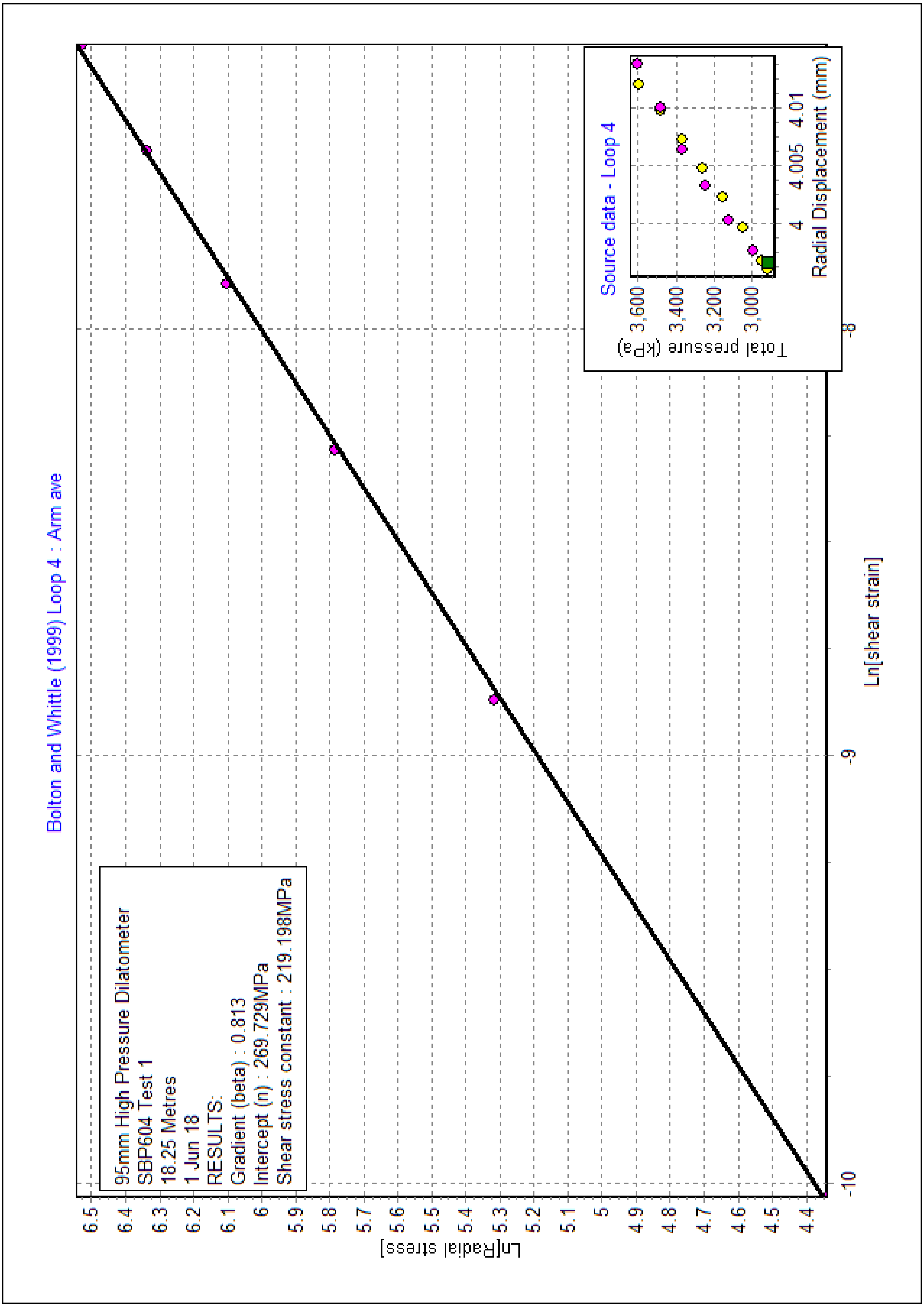

Shear modulus from unload/reload cycles Loop 4 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 1
18.25 Metres
1 Jun 18
RESULTS:
Gur : 1069.6MPa
Cycle mid-point:
Cavity strain : 1.184%
Total stress : 3249kPa
Size of cycle :
Shear strain : 0.061%
Total stress : 650kPa
Radial Displacement (mm)
Total pressure (kPa)
3.94
3.95
3.96
3.97
3.98
3.99
4
4.01
4.02
4.03
4.04
4.05
4.06
4.07
4,100
4,000
3,900
3,800
3,700
3,600
3,500
3,400
3,300
3,200
3,100
3,000
2,900
2,800
2,700

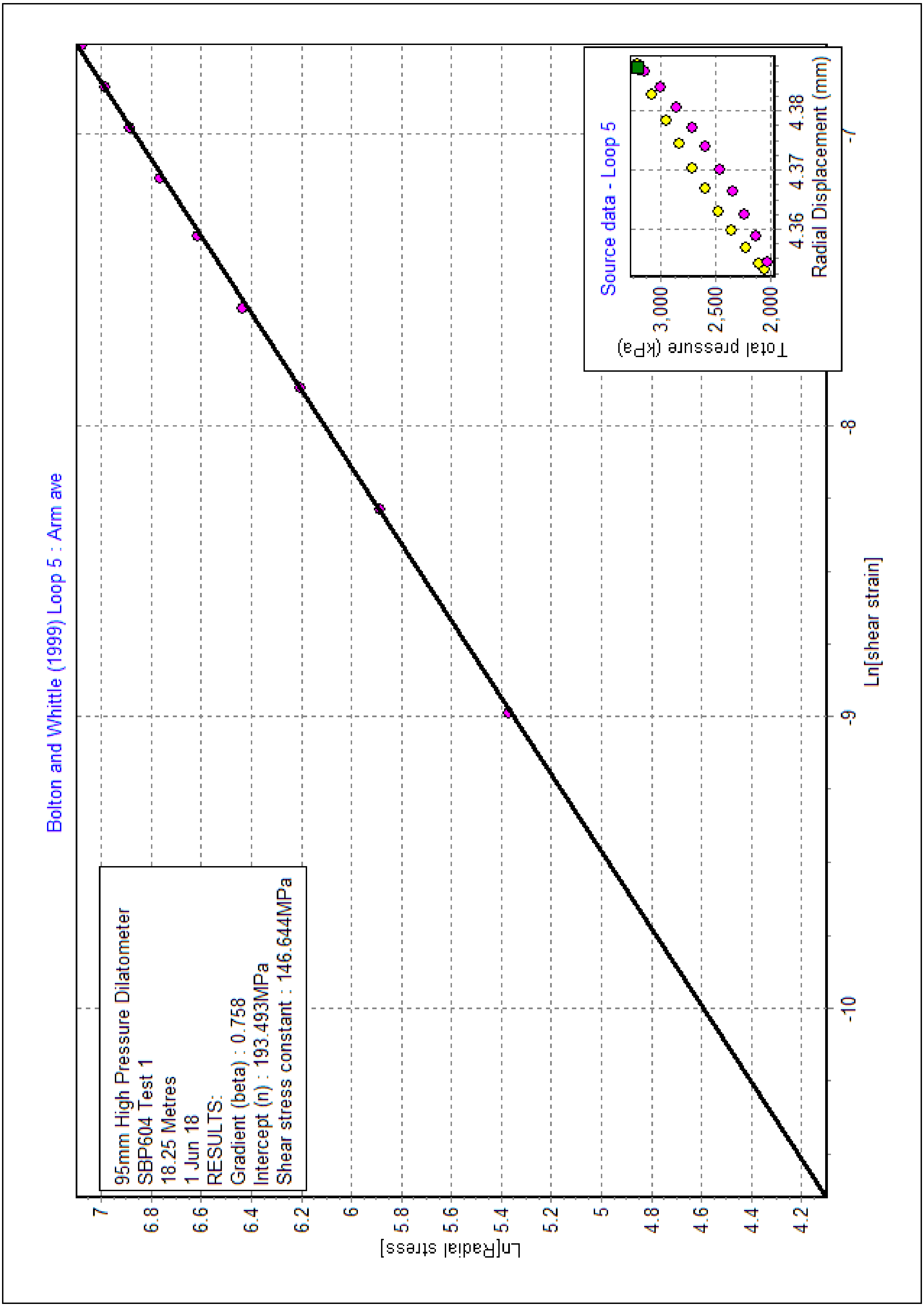

Shear modulus from unload/reload cycles Loop 5 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 1
18.25 Metres
1 Jun 18
RESULTS:
Gur : 900.8MPa
Cycle mid-point:
Cavity strain : 1.890%
Total stress : 2603kPa
Size of cycle :
Shear strain : 0.131%
Total stress : 1179kPa
Radial Displacement (mm)
Total pressure (kPa)
4.35
4.355
4.36
4.365
4.37
4.375
4.38
4.385
4.39
4.395
2,000
2,100
2,200
2,300
2,400
2,500
2,600
2,700
2,800
2,900
3,000
3,100
3,200
3,300
3,400

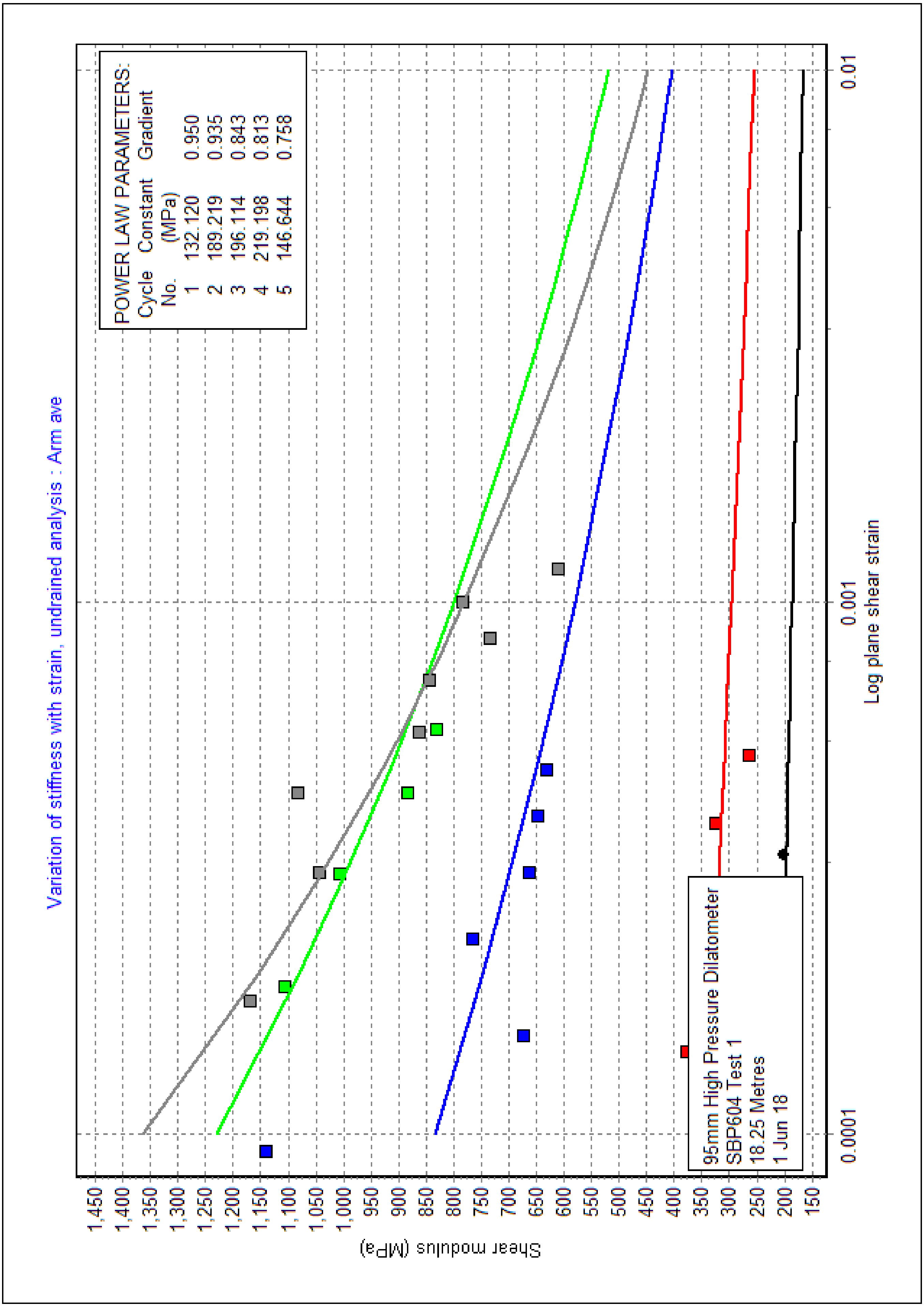

Bolton and Whittle (1999) Loop 1 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 1
18.25 Metres
1 Jun 18
RESULTS:
Gradient (beta) : 0.950
Intercept (n) : 139.024MPa
Shear stress constant : 132.120MPa
Ln[Radial stress]
Ln[shear strain]
-9
-8
Source data - Loop 1
Total pressure (kPa)
Radial Displacement (mm)
2.962 2.964 2.966 2.968 2.97
420
440
460
480

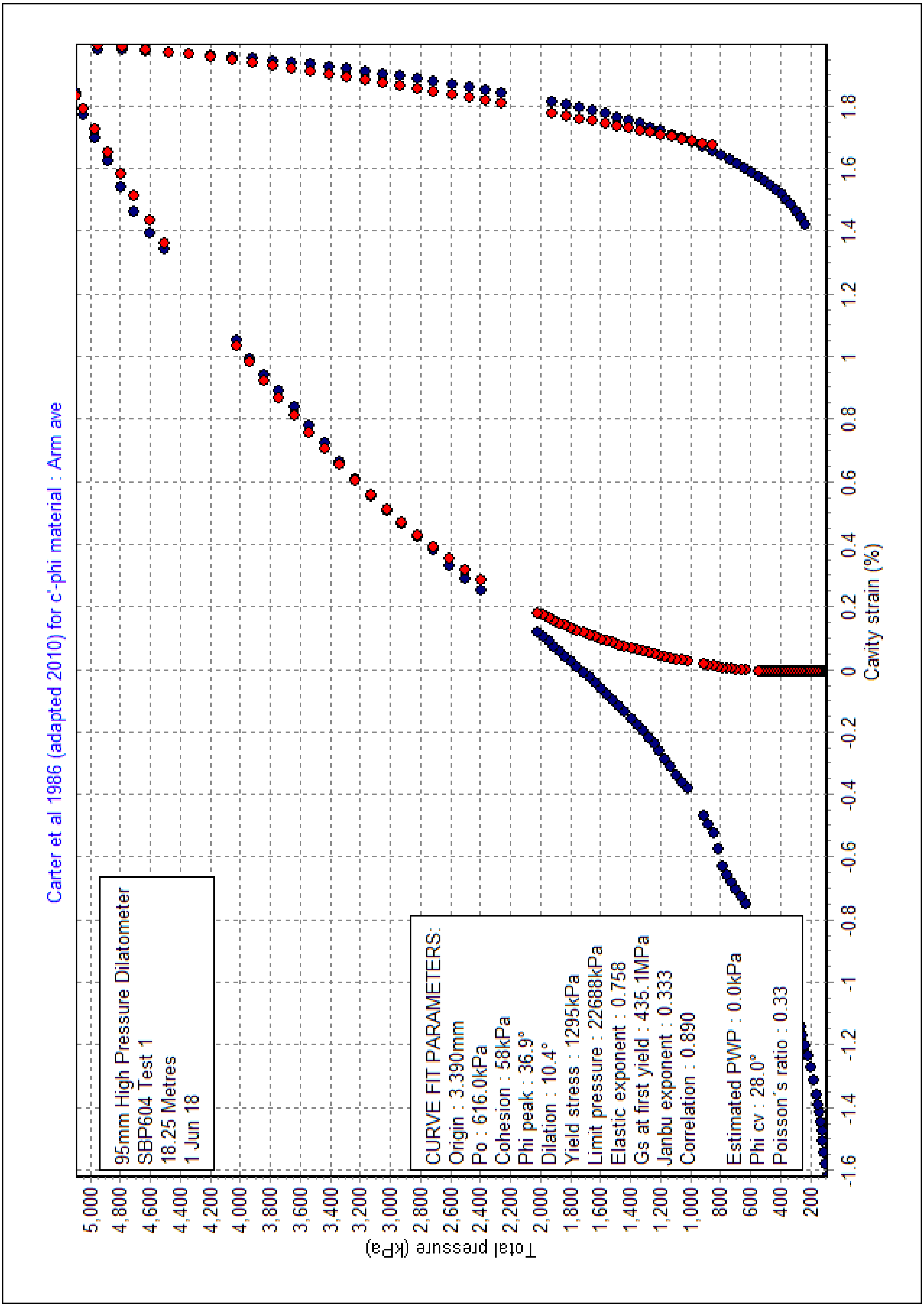

Bolton and Whittle (1999) Loop 2 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 1
18.25 Metres
1 Jun 18
RESULTS:
Gradient (beta) : 0.935
Intercept (n) : 202.326MPa
Shear stress constant : 189.219MPa
Ln[Radial stress]
5.2
5.1
5
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4
3.9
3.8
3.7
3.6
Ln[shear strain]
-9
-8
Source data - Loop 2
Total pressure (kPa)
850
800
750
700
Radial Displacement (mm)
3.16
3.165
3.17

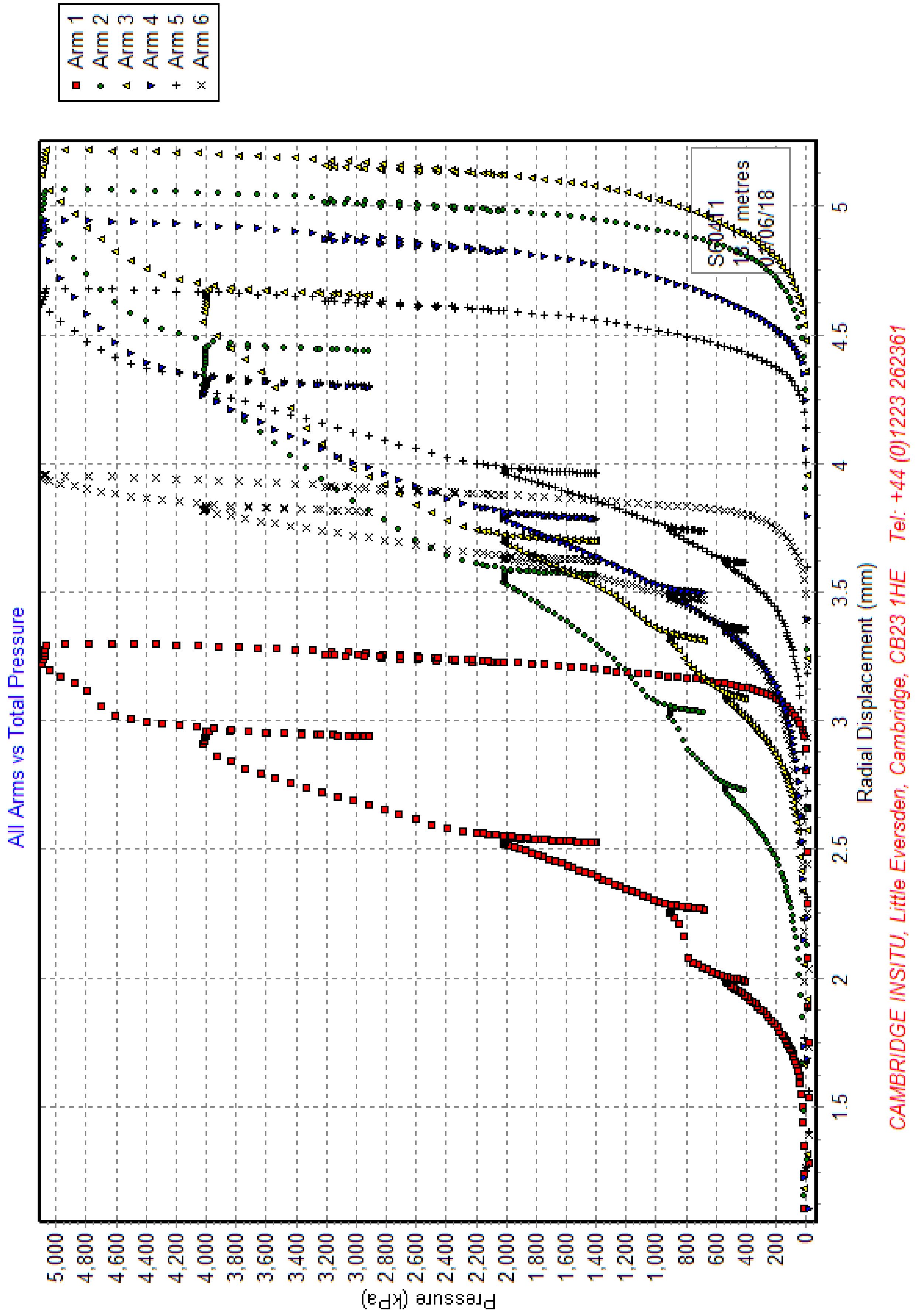

Bolton and Whittle (1999) Loop 3 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 1
18.25 Metres
1 Jun 18
RESULTS:
Gradient (beta) : 0.843
Intercept (n) : 232.664MPa
Shear stress constant : 196.114MPa
Source data - Loop 3
Total pressure (kPa)
1,800
1,700
1,600
1,500
1,400
Radial Displacement (mm)
3.46
3.465
3.47
Ln[Radial stress]
5.9
5.8
5.7
5.6
5.5
5.4
5.3
5.2
5.1
5
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4
3.9
3.8
3.7
3.6
3.5
3.4
3.3
Ln[shear strain]
-10
-9
-8

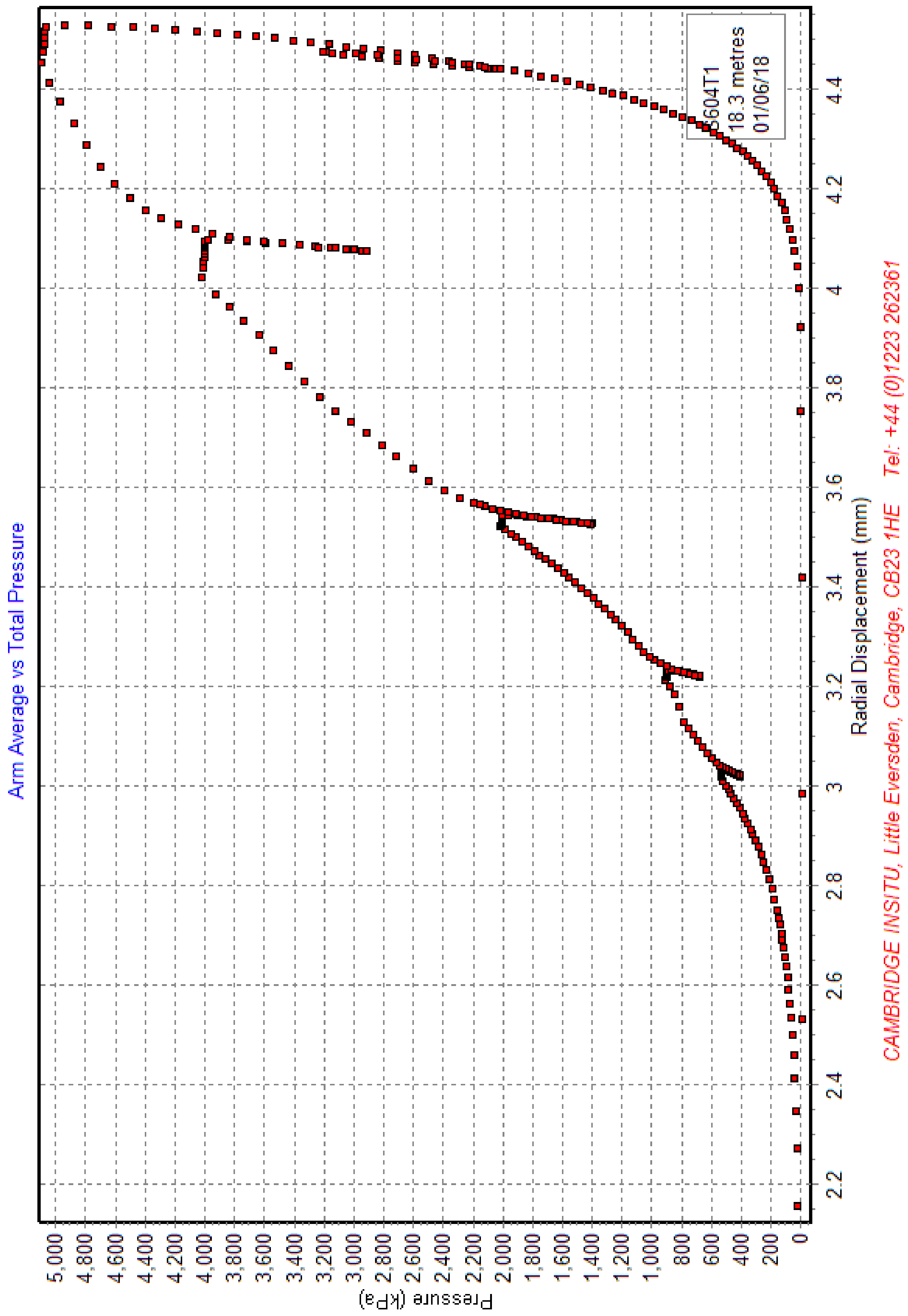

Bolton and Whittle (1999) Loop 4 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 1
18.25 Metres
1 Jun 18
RESULTS:
Gradient (beta) : 0.813
Intercept (n) : 269.729MPa
Shear stress constant : 219.198MPa
Ln[Radial stress]
Ln[shear strain]
Source data - Loop 4
Total pressure (kPa)
Radial Displacement (mm)

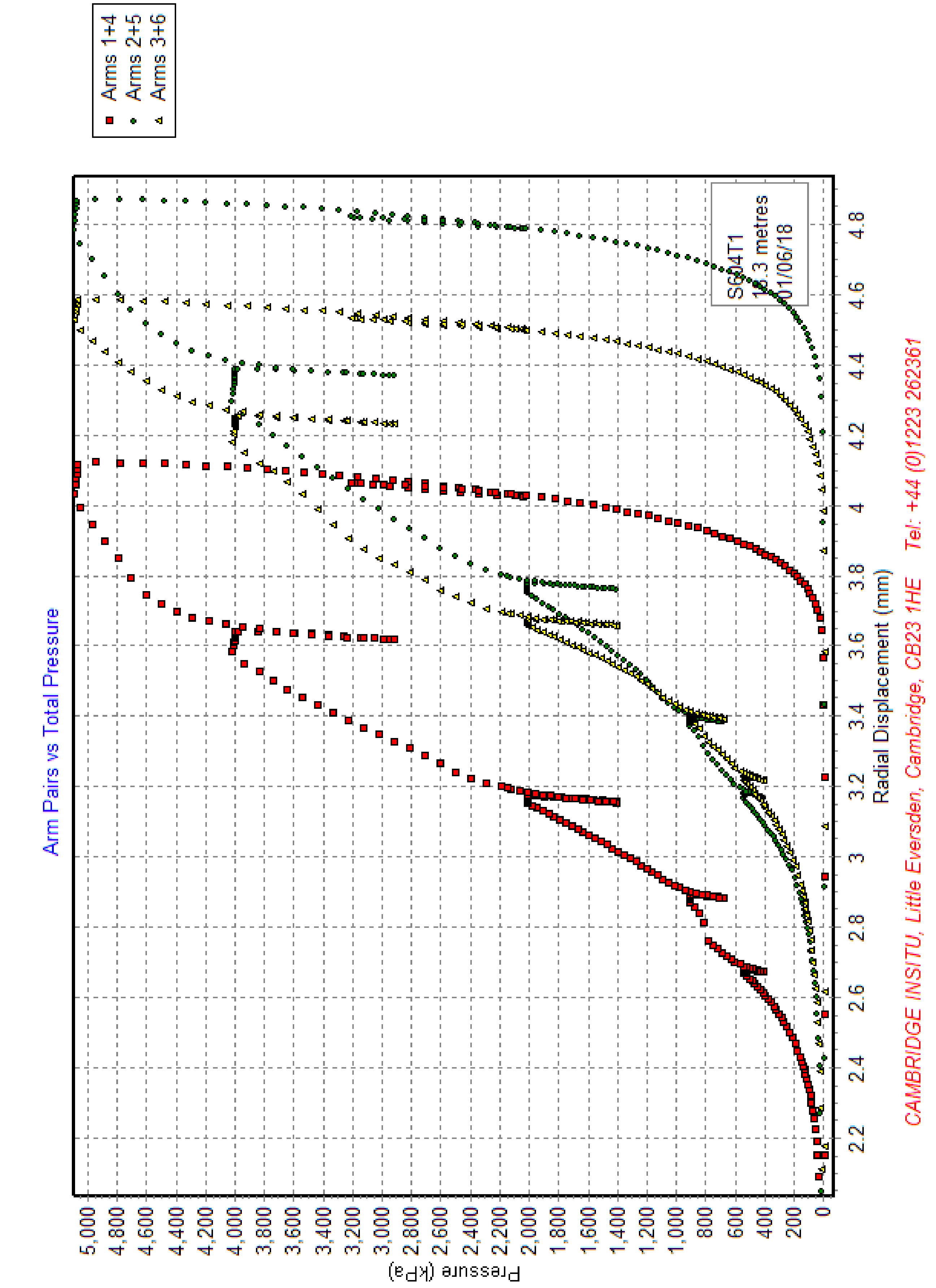

Bolton and Whittle (1999) Loop 5 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 1
18.25 Metres
1 Jun 18
RESULTS:
Gradient (beta) : 0.758
Intercept (n) : 193.493MPa
Shear stress constant : 146.644MPa
Ln[Radial stress]
7
6.8
6.6
6.4
6.2
6
5.8
5.6
5.4
5.2
5
4.8
4.6
4.4
4.2
Ln[shear strain]
-7
-8
-9
-10
Source data - Loop 5
Total pressure (kPa)
3,000
2,500
2,000
Radial Displacement (mm)
4.36
4.37
4.38

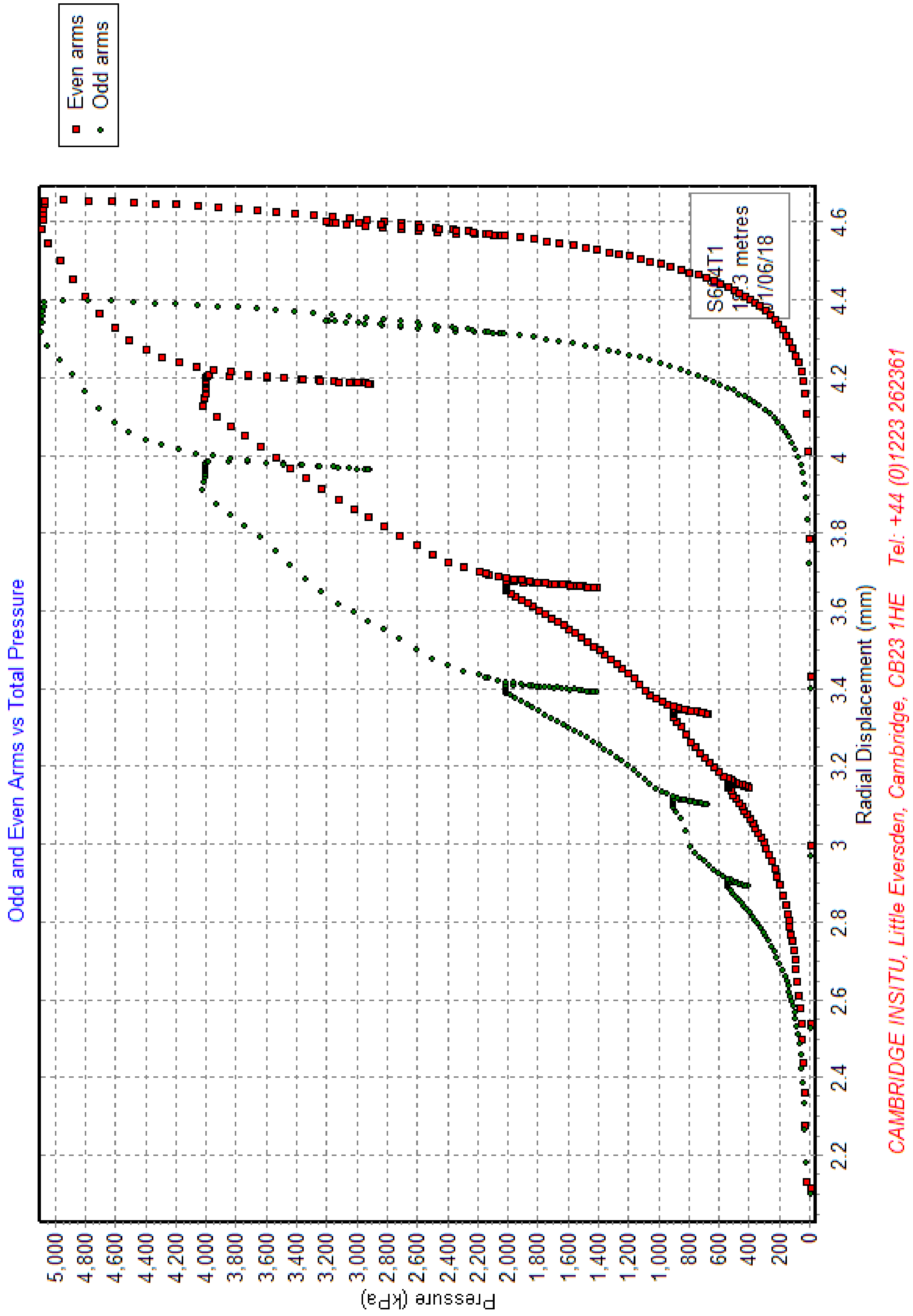

Variation of stiffness with strain, undrained analysis : Arm ave
POWER LAW PARAMETERS:
Cycle No.
Constant (MPa)
Gradient
1 132.120 0.950
2 189.219 0.935
3 196.114 0.843
4 219.198 0.813
5 146.644 0.758
95mm High Pressure Dilatometer
SBP604 Test 1
18.25 Metres
1 Jun 18
Shear modulus (MPa)
Log plane shear strain
0.0001
0.001
0.01
1,450
1,400
1,350
1,300
1,250
1,200
1,150
1,100
1,050
1,000
950
900
850
800
750
700
650
600
550
500
450
400
350
300
250
200
150


Carter et al 1986 (adapted 2010) for c'-phi material : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 1
18.25 Metres
1 Jun 18
CURVE FIT PARAMETERS:
Origin : 3.390mm
Po : 616.0kPa
Cohesion : 58kPa
Phi peak : 36.9°
Dilation : 10.4°
Yield stress : 1295kPa
Limit pressure : 22688kPa
Elastic exponent : 0.758
Gs at first yield : 435.1MPa
Janbu exponent : 0.333
Correlation : 0.890
Estimated PWP : 0.0kPa
Phi cv : 28.0°
Poisson's ratio : 0.33
Total pressure (kPa)
Cavity strain (%)
5,000
4,800
4,600
4,400
4,200
4,000
3,800
3,600
3,400
3,200
3,000
2,800
2,600
2,400
2,200
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
-1.6
-1.4
-1.2
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8


All Arms vs Total Pressure
Arm 1
Arm 2
Arm 3
Arm 4
Arm 5
Arm 6
Radial Displacement (mm)
Pressure (kPa)
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361


Arm Average vs Total Pressure
S604T1
18.3 metres
01/06/18
Radial Displacement (mm)
2.2 2.4 2.6 2.8 3 3.2 3.4 3.6 3.8 4 4.2 4.4
Pressure (kPa)
0 200 400 600 800 1,000 1,200 1,400 1,600 1,800 2,000 2,200 2,400 2,600 2,800 3,000 3,200 3,400 3,600 3,800 4,000 4,200 4,400 4,600 4,800 5,000
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361


Arm Pairs vs Total Pressure
Arms 1+4
Arms 2+5
Arms 3+6
01/06/18
Radial Displacement (mm)
Pressure (kPa)
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361


Odd and Even Arms vs Total Pressure
Even arms
Odd arms
Radial Displacement (mm)
Pressure (kPa)
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361

SBP604 Test 2 - SUMMARY OF RESULTS
[File made with WinSitu Version 3.9.1.1]

[DETAILS OF TEST]

Project	:	60547200
Site	:	A303 Stonehenge
Borehole	:	SBP604
Test name	:	SBP604 Test 2
Test date	:	1 Jun 18
Test depth	:	21.10 Metres
Water table	:	22.5 Metres
Ambient PWP	:	0.0 kPa
Material	:	Chalk
Probe	:	95mm High Pressure Dilatometer
Diameter	:	97.0 mm

Data analysed using average arm displacement curve
A non-linear analysis of the rebound cycles has been carried out
The file includes results from a curve fitting analysis

Analysed by RWW on 6 Jun 18

Remarks: Pocket drilled with air mist. Small data loss betw een 2.6 and 3.2MPa, unexplained.

[RESULTS FOR CAVITY REFERENCE PRESSURE]

Strain Origin (mm)	:	"Arm ave=5.58"
Po from Marsland & Randolph (kPa)	:	"Arm ave=728.2"
Best estimate of Po (kPa)	:	"Arm ave=612.0"

[UNDRAINED STRENGTH PARAMETERS]

Undrained yield stress (kPa)	:	"Arm ave=3022.9"

[DRAINED ANALYSIS OF SANDS]
[Hughes et al 1977]

Constant volume friction angle (°)	:	28.0
Angle of internal friction (°)	:	"Arm ave=30.7"
Dilation angle (°)	:	"Arm ave=3.1"
Gradient of log-log plot	:	"Arm ave=0.356"

[Withers et al 1989]

Angle of internal friction (°)	:	"Arm ave=32.9"
Dilation angle (°)	:	"Arm ave=5.7"
Gradient of log-log plot	:	"Arm ave=-2.035"

[LINEAR INTERPRETATION OF SHEAR MODULUS G]
Initial slope shear modulus (MPa) :"Arm ave=114.0"

Axis	Loop No	Value (MPa)	Mean Strain (%)	Mean Pc (kPa)	dE (%)	dPc (kPa)
Arm ave	1	406.7	-0.250	831	0.058	234
Arm ave	2	693.2	0.215	1630	0.064	444
Arm ave	3	769.8	1.749	3206	0.108	835
Arm ave	4	660.3	3.774	2657	0.180	1191

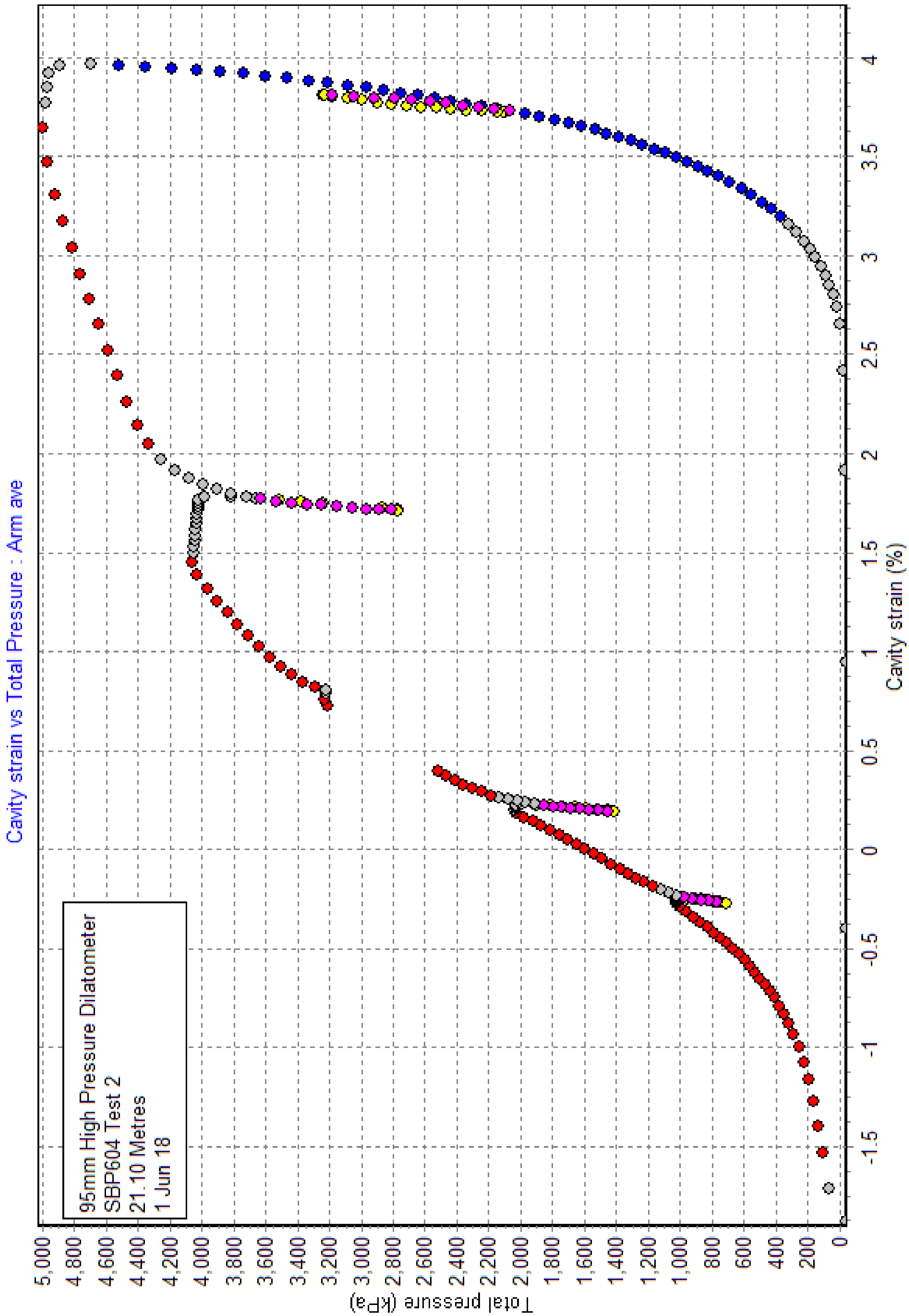
[UNDRAINED NON LINEAR INTERPRETATION OF SECANT SHEAR MODULUS]

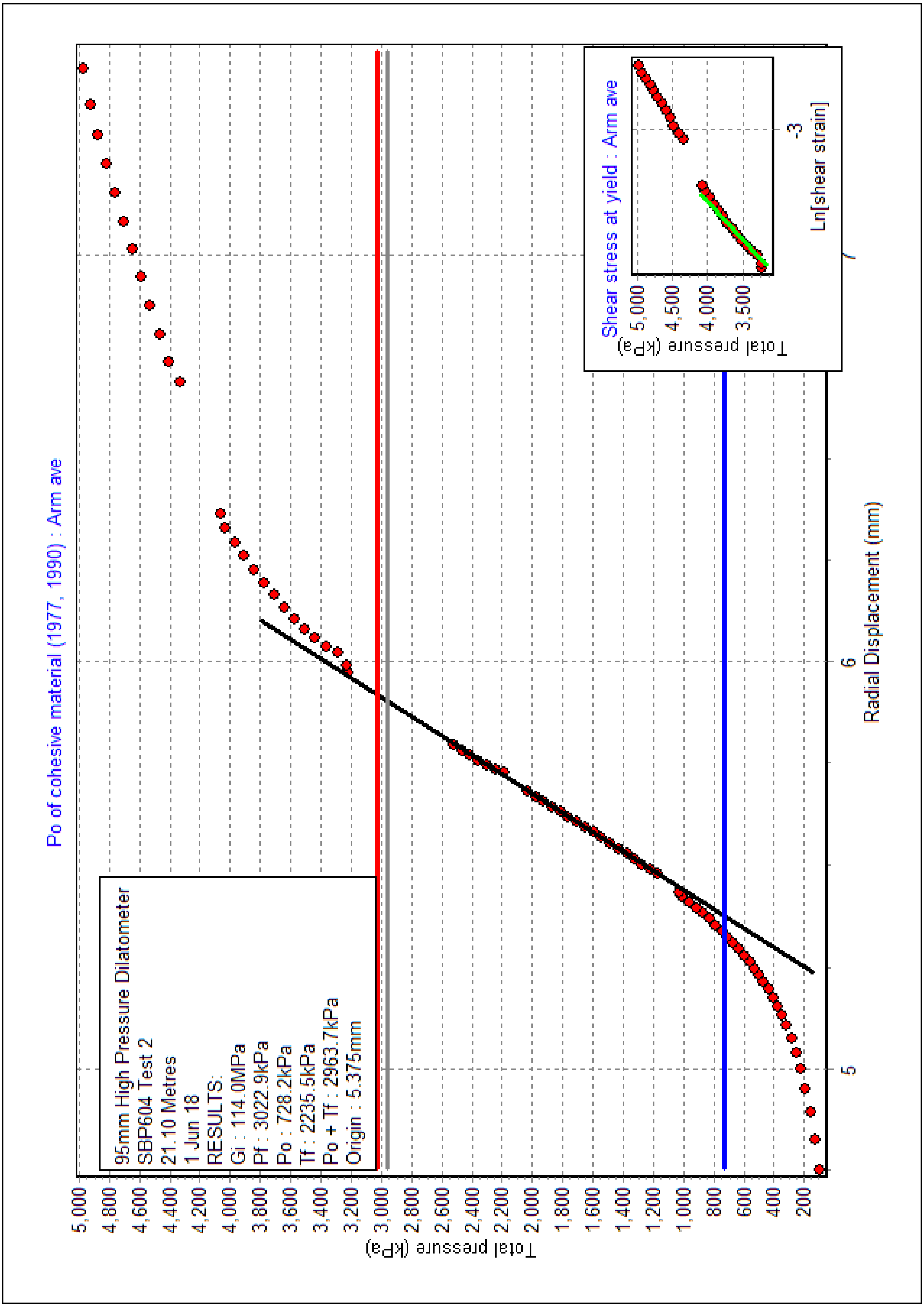
Axis	Loop No	Intercept (MPa)	Alpha (MPa)	Gradient
Arm ave	1	191.319	172.786	0.903
Arm ave	2	258.417	222.471	0.861
Arm ave	3	176.273	136.672	0.775
Arm ave	4	130.912	95.133	0.727

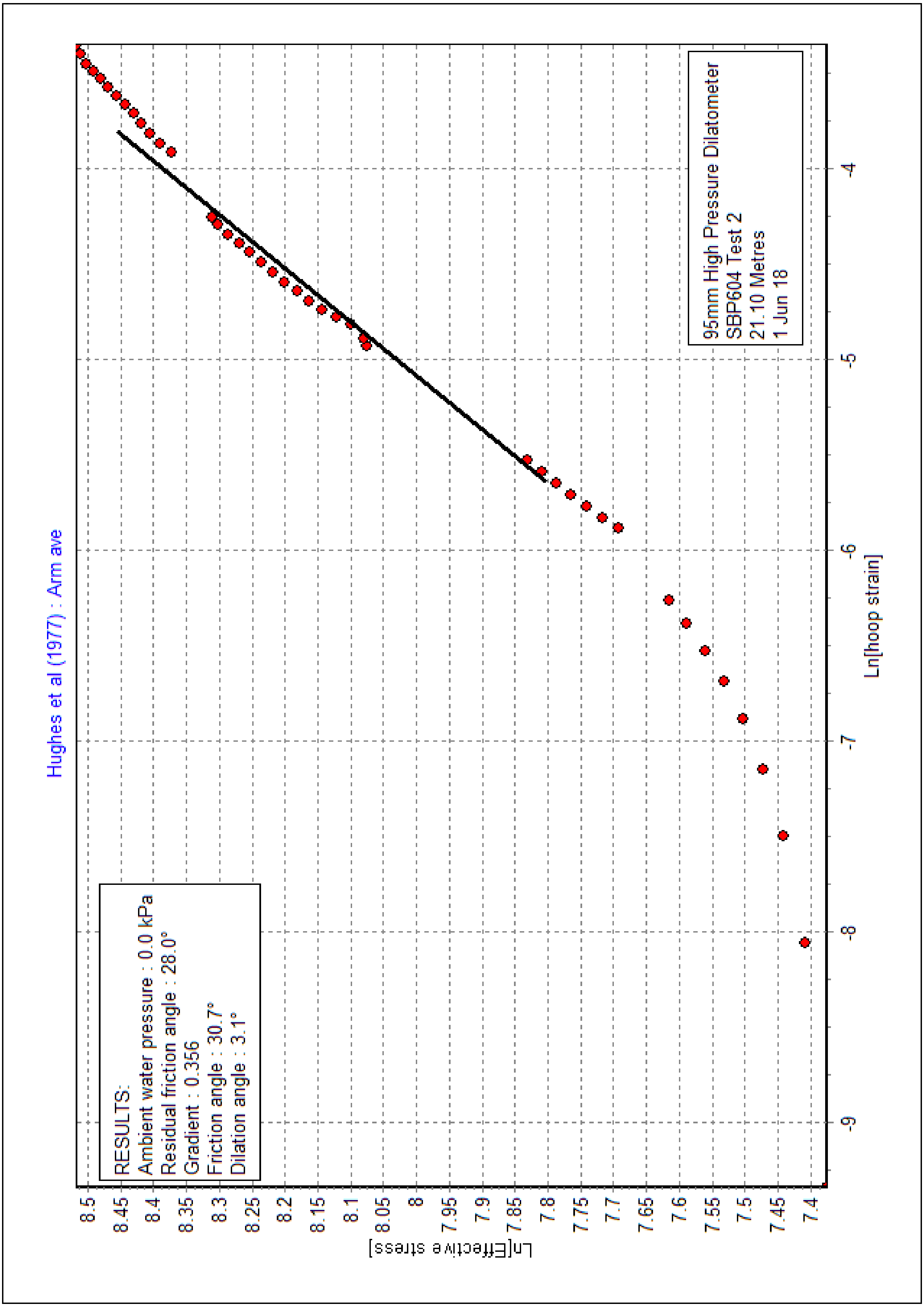
[PARAMETERS USED FOR DRAINED CURVE MODELLING]
{Axis is Arm ave}

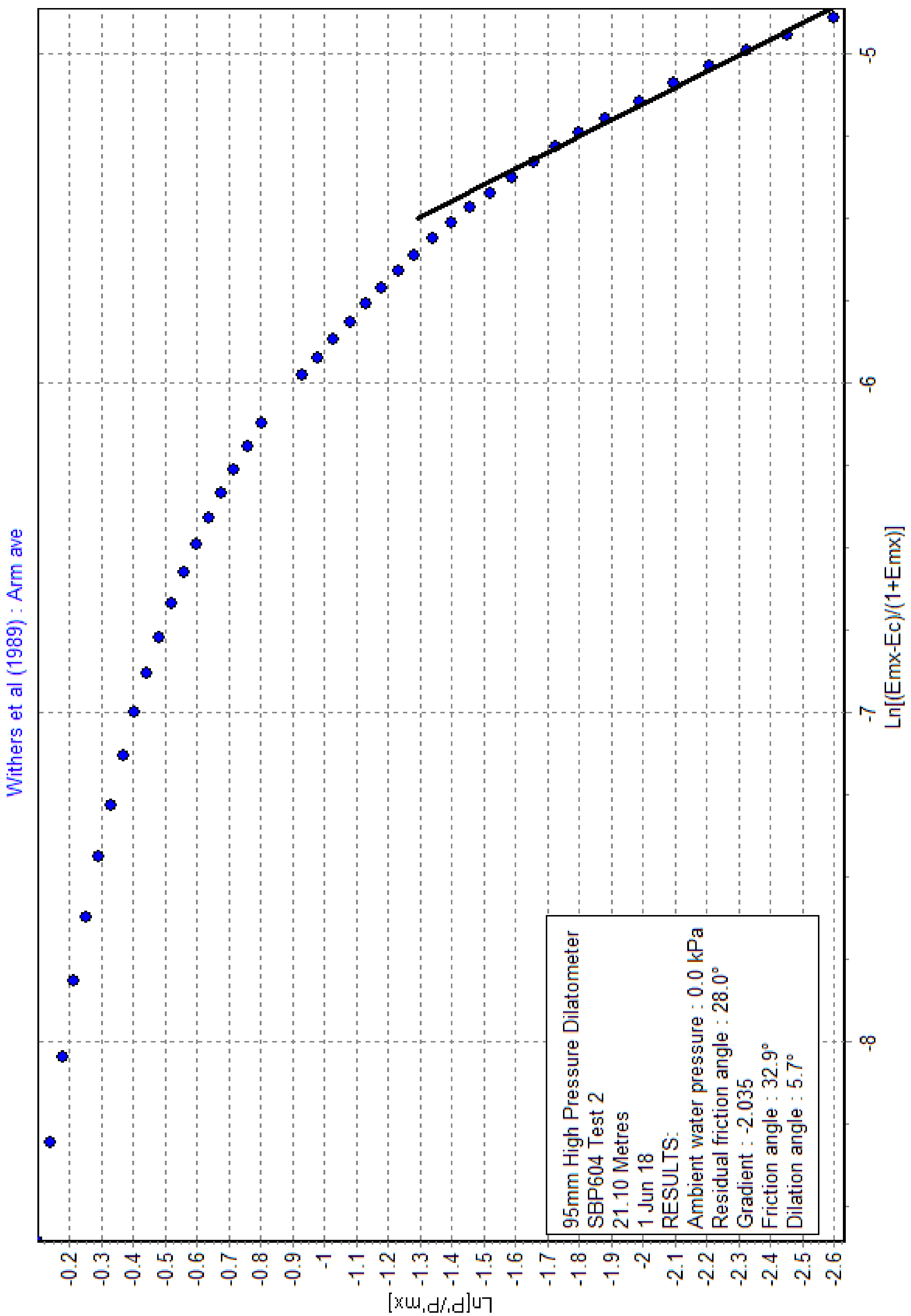
Strain Origin (mm)	:	5.58
Po (kPa)	:	612
Cohesion (kPa)	:	22
Angle of peak friction (deg)	:	30.7
Angle of peak dilation (deg)	:	3.1
Total yield stress (kPa)	:	1176
Total limit stress (kPa)	:	13881
G at first yield (MPa)	:	534.0
Non-linear exponent	:	0.727
Janbu exponent	:	0.138
Correlation	:	0.881

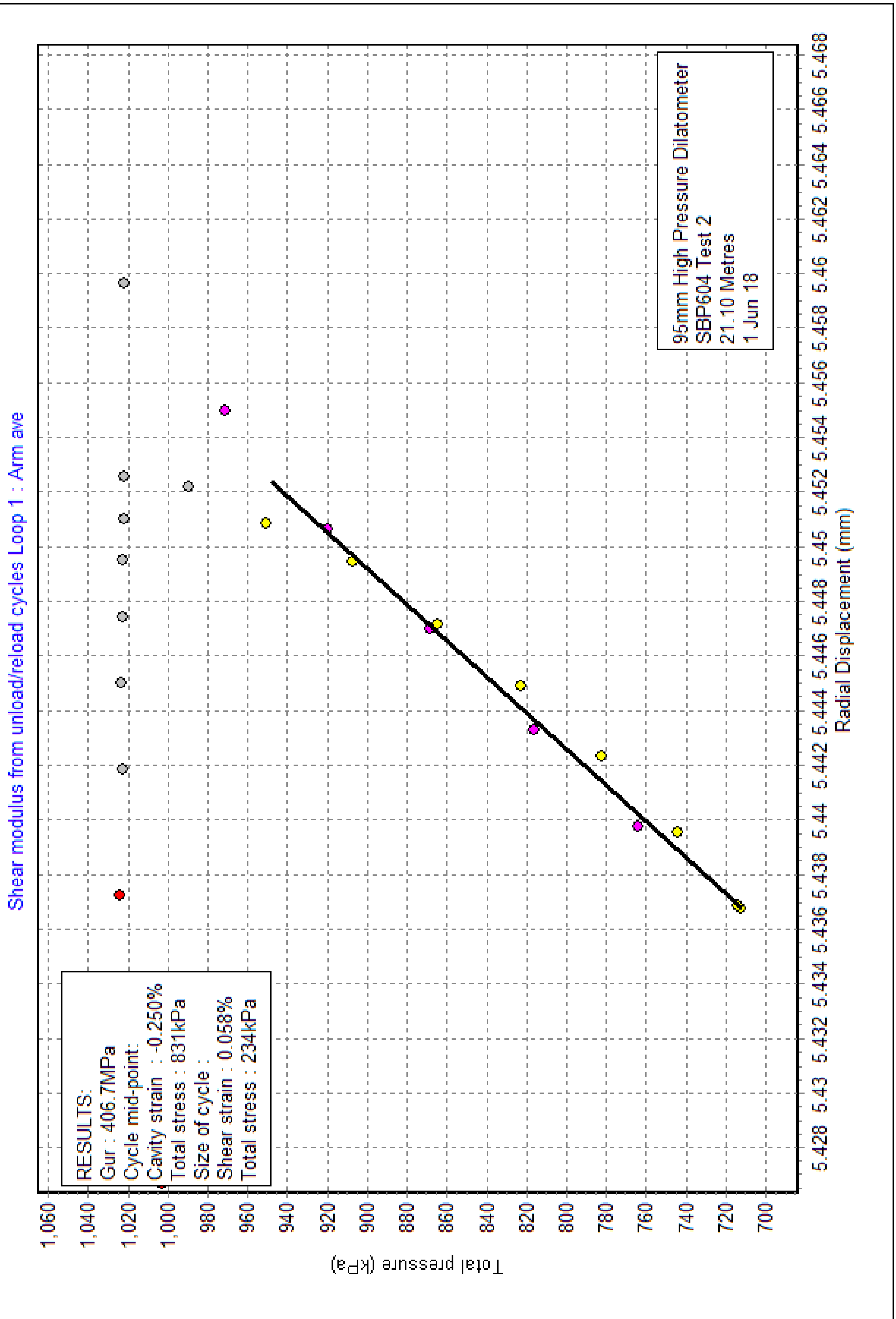
Ambient pore water pressure (kPa)	:	0
Residual friction angle (deg)	:	28.0
Poisson's ratio	:	0.33

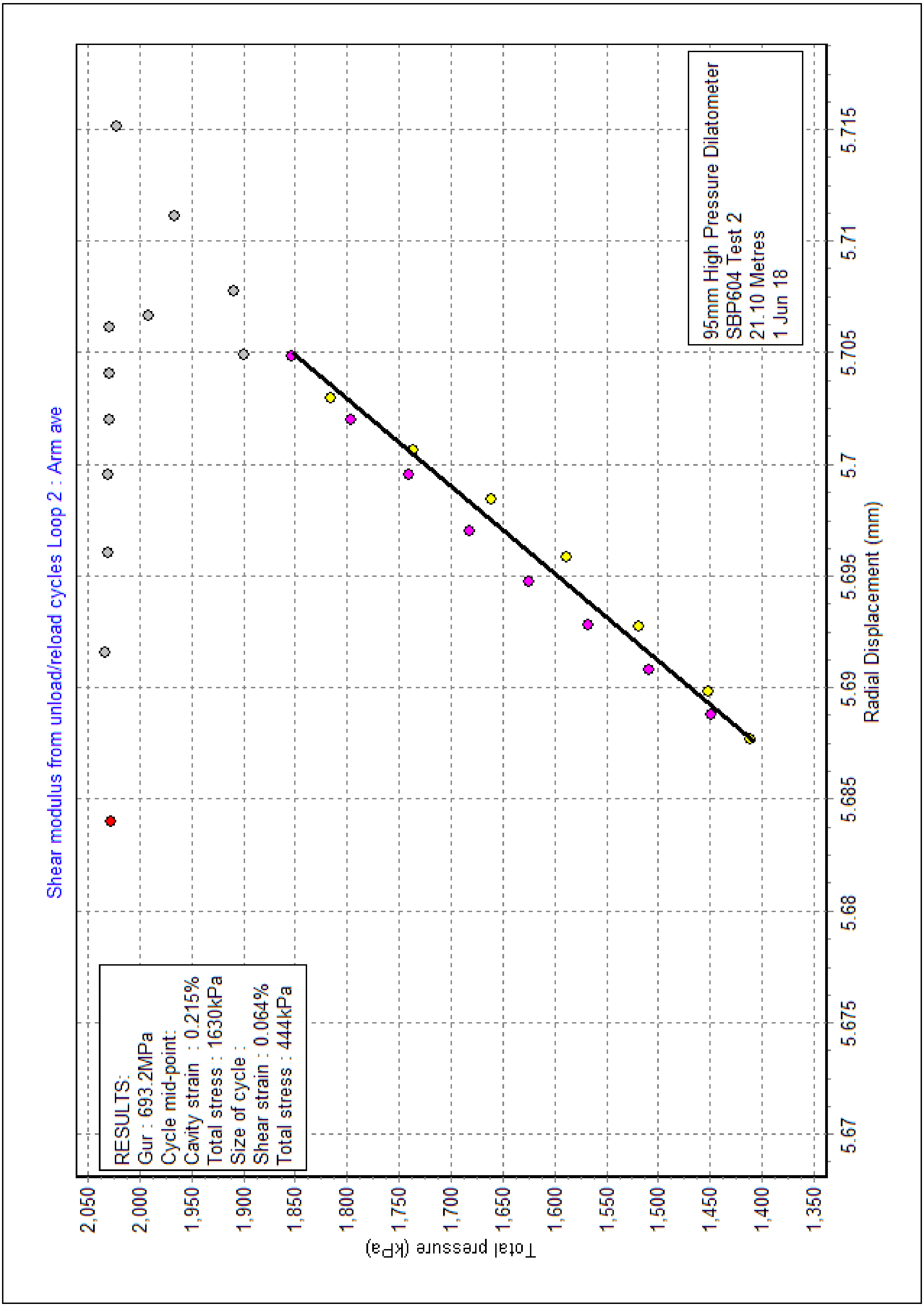

Cavity strain vs Total Pressure : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 2
21.10 Metres
1 Jun 18
Total pressure (kPa)
Cavity strain (%)

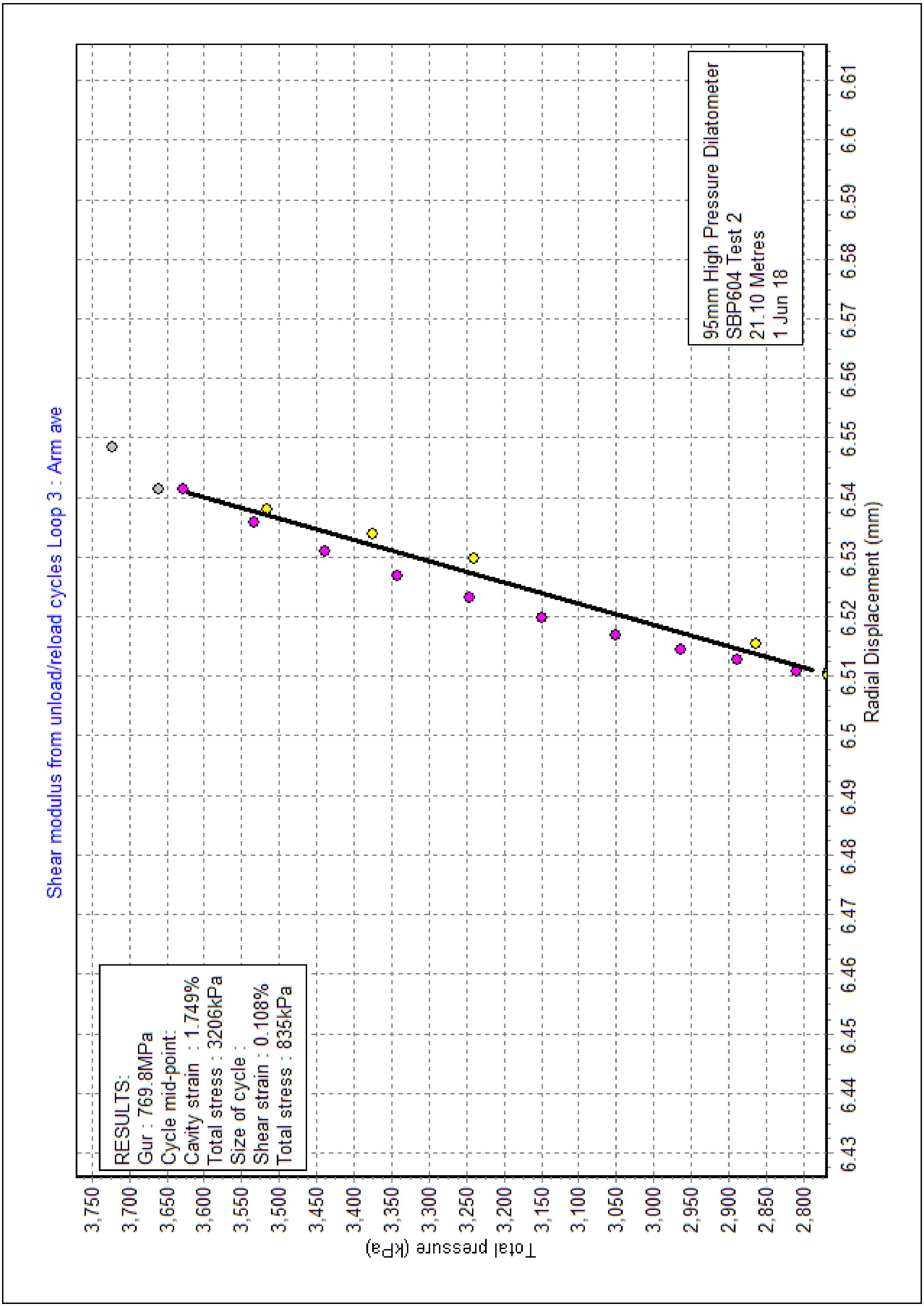

Po of cohesive material (1977, 1990) : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 2
21.10 Metres
1 Jun 18
RESULTS:
Gi : 114.0MPa
Pf : 3022.9kPa
Po : 728.2kPa
Tf : 2235.5kPa
Po + Tf : 2963.7kPa
Origin : 5.375mm
Total pressure (kPa)
Radial Displacement (mm)
Shear stress at yield : Arm ave
Ln[shear strain]

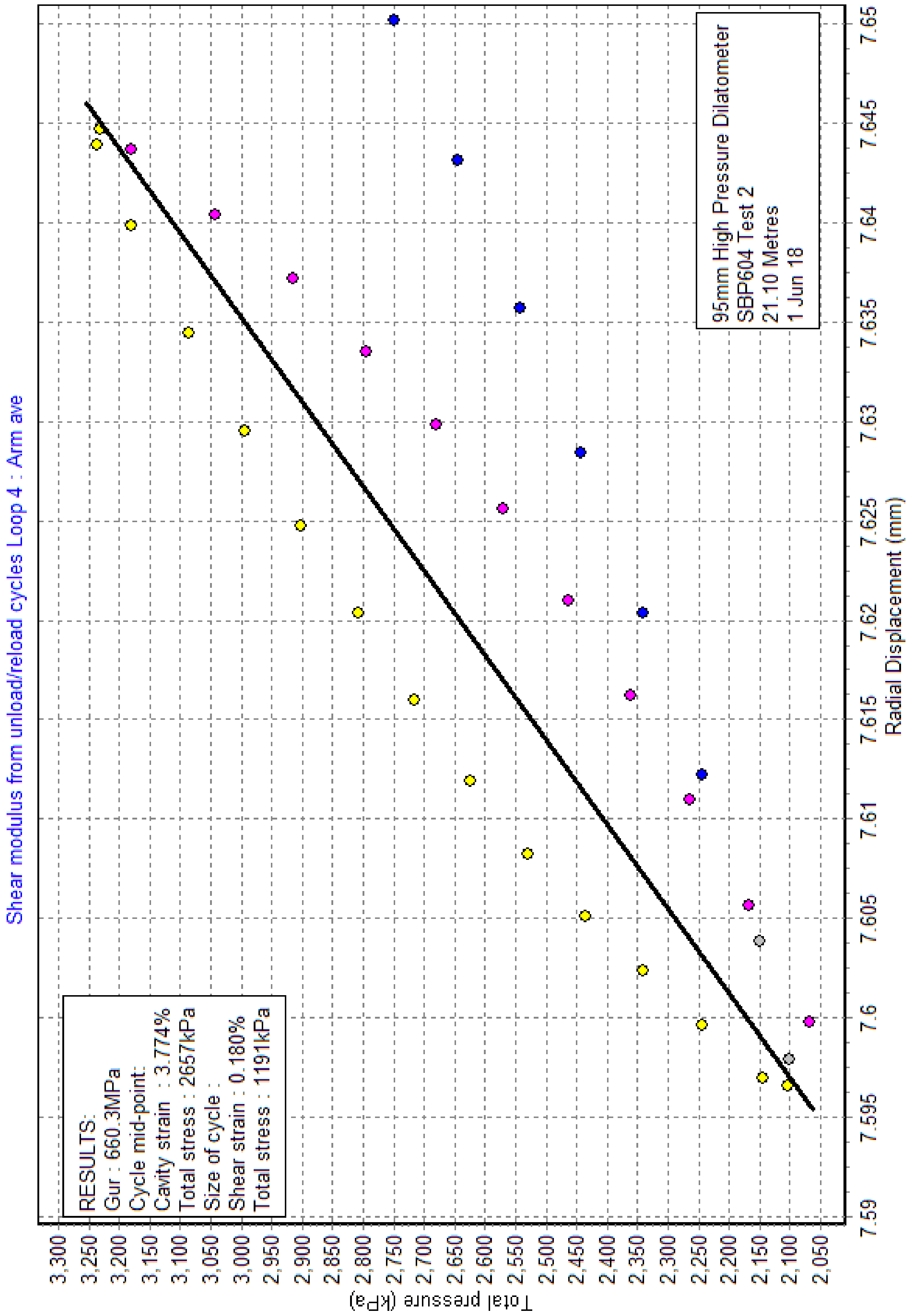

Hughes et al (1977) : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 2
21.10 Metres
1 Jun 18
RESULTS:
Ambient water pressure : 0.0 kPa
Residual friction angle : 28.0°
Gradient : 0.356
Friction angle : 30.7°
Dilation angle : 3.1°
Ln[hoop strain]
Ln[Effective stress]
-4
-5
-6
-7
-8
-9
8.5
8.45
8.4
8.35
8.3
8.25
8.2
8.15
8.1
8.05
8
7.95
7.9
7.85
7.8
7.75
7.7
7.65
7.6
7.55
7.5
7.45
7.4

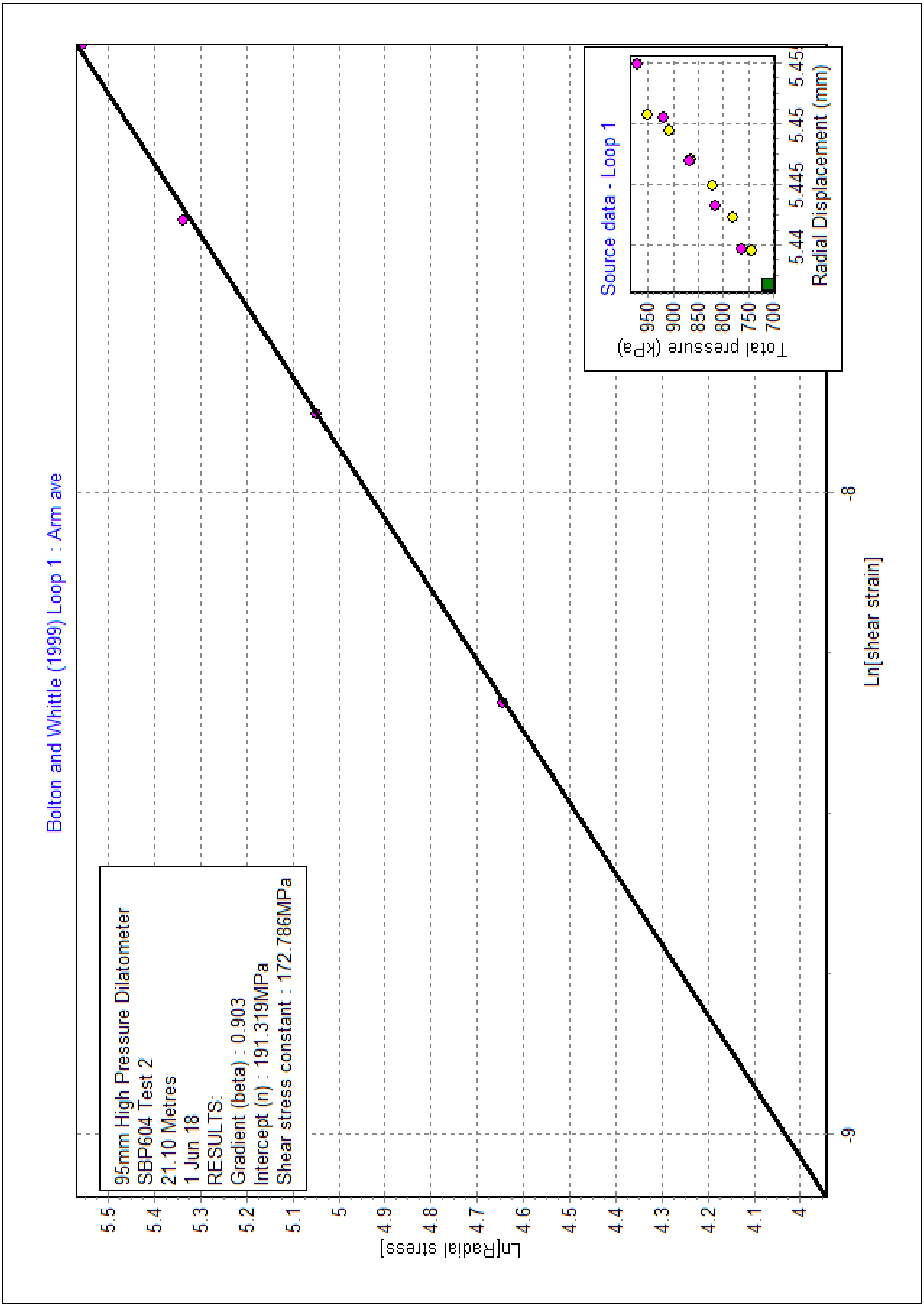

Withers et al (1989) : Arm ave
Ln[(Emx-Ec)/(1+Emx)]
Ln[P'/P'mx]
-5
-6
-7
-8
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
-0.9
-1
-1.1
-1.2
-1.3
-1.4
-1.5
-1.6
-1.7
-1.8
-1.9
-2
-2.1
-2.2
-2.3
-2.4
-2.5
-2.6
95mm High Pressure Dilatometer
SBP604 Test 2
21.10 Metres
1 Jun 18
RESULTS:
Ambient water pressure : 0.0 kPa
Residual friction angle : 28.0°
Gradient : -2.035
Friction angle : 32.9°
Dilation angle : 5.7°

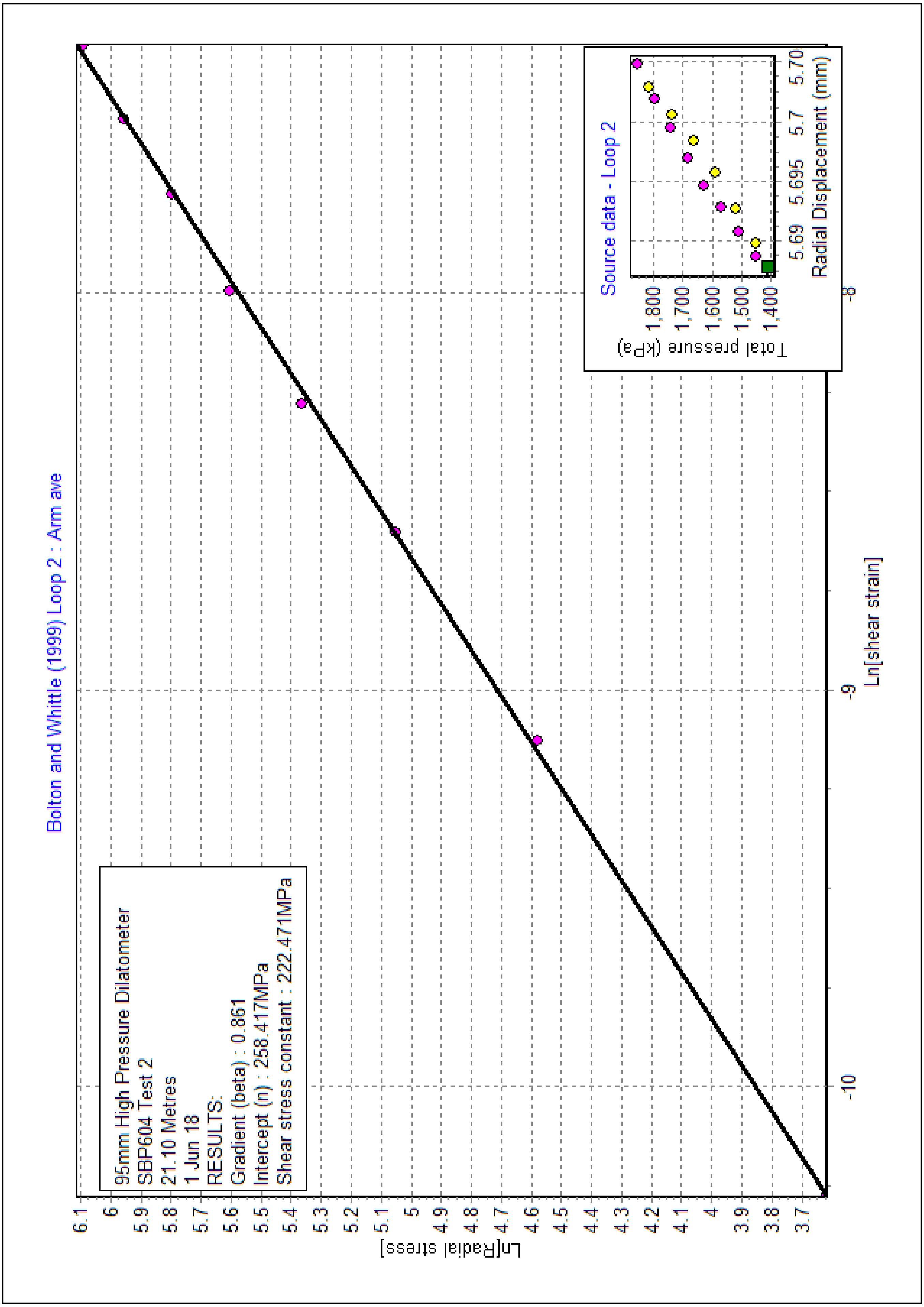

Shear modulus from unload/reload cycles Loop 1 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 2
21.10 Metres
1 Jun 18
RESULTS:
Gur : 406.7MPa
Cycle mid-point:
Cavity strain : -0.250%
Total stress : 831kPa
Size of cycle :
Shear strain : 0.058%
Total stress : 234kPa
Radial Displacement (mm)
5.428 5.43 5.432 5.434 5.436 5.438 5.44 5.442 5.444 5.446 5.448 5.45 5.452 5.454 5.456 5.458 5.46 5.462 5.464 5.466 5.468
Total pressure (kPa)
1,060 1,040 1,020 1,000 980 960 940 920 900 880 860 840 820 800 780 760 740 720 700


Shear modulus from unload/reload cycles Loop 2 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 2
21.10 Metres
1 Jun 18
RESULTS:
Gur : 693.2MPa
Cycle mid-point:
Cavity strain : 0.215%
Total stress : 1630kPa
Size of cycle :
Shear strain : 0.064%
Total stress : 444kPa
Radial Displacement (mm)
Total pressure (kPa)
5.67
5.675
5.68
5.685
5.69
5.695
5.7
5.705
5.71
5.715
2,050
2,000
1,950
1,900
1,850
1,800
1,750
1,700
1,650
1,600
1,550
1,500
1,450
1,400
1,350

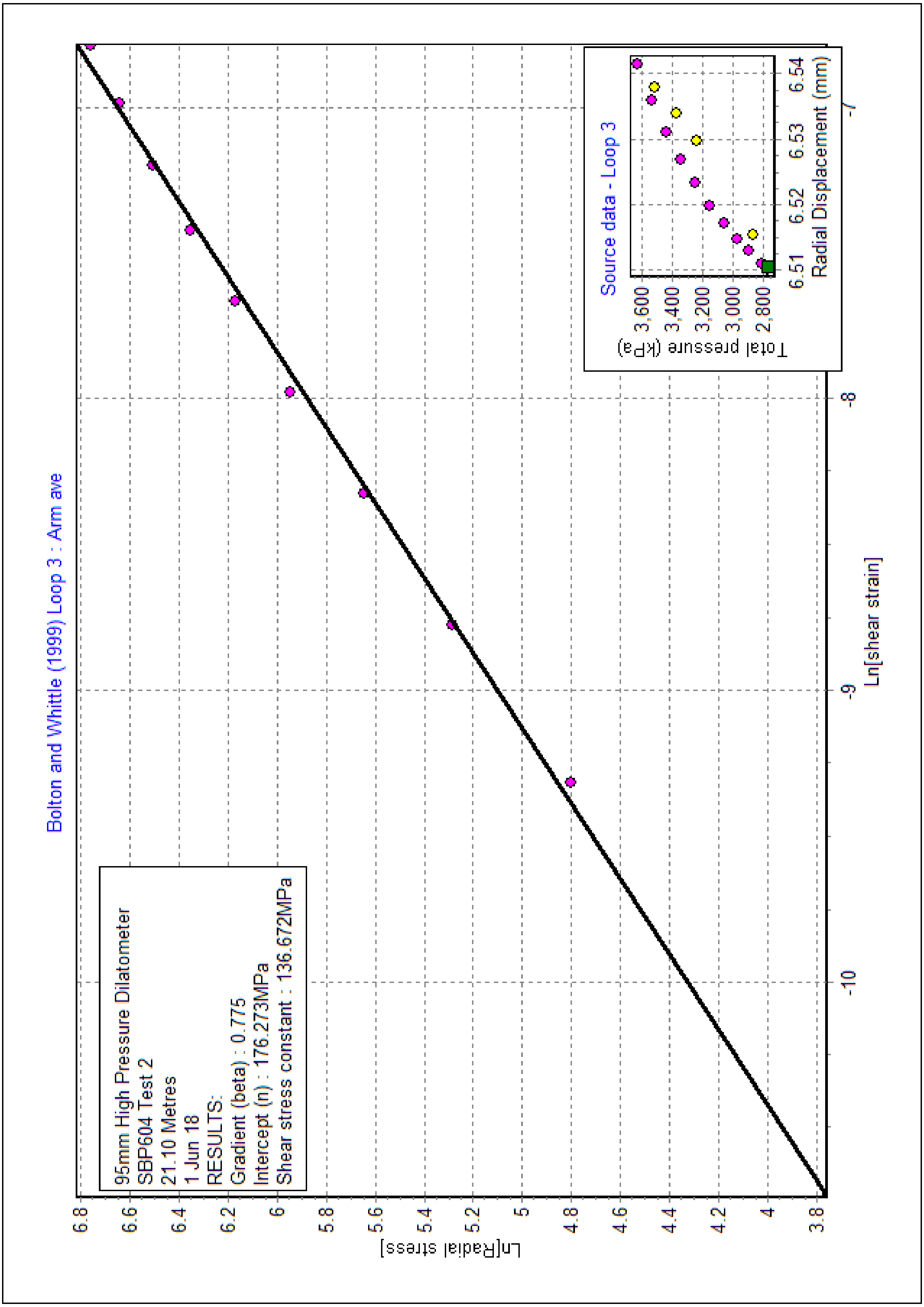

Shear modulus from unload/reload cycles Loop 3 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 2
21.10 Metres
1 Jun 18
RESULTS:
Gur : 769.8MPa
Cycle mid-point:
Cavity strain : 1.749%
Total stress : 3206kPa
Size of cycle :
Shear strain : 0.108%
Total stress : 835kPa
Radial Displacement (mm)
Total pressure (kPa)
6.43
6.44
6.45
6.46
6.47
6.48
6.49
6.5
6.51
6.52
6.53
6.54
6.55
6.56
6.57
6.58
6.59
6.6
6.61
3,750
3,700
3,650
3,600
3,550
3,500
3,450
3,400
3,350
3,300
3,250
3,200
3,150
3,100
3,050
3,000
2,950
2,900
2,850
2,800

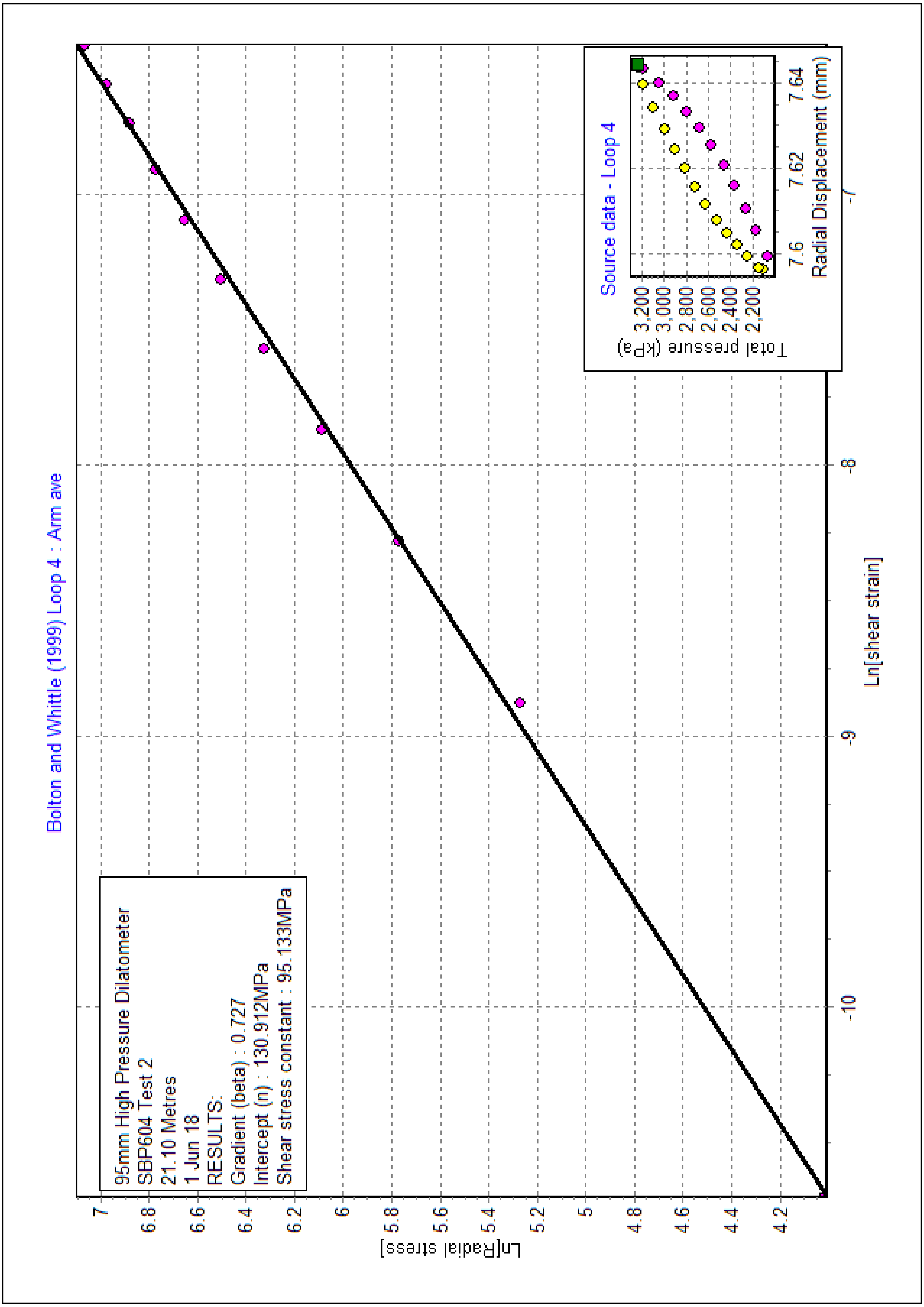

Shear modulus from unload/reload cycles Loop 4 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 2
21.10 Metres
1 Jun 18
RESULTS:
Gur : 660.3MPa
Cycle mid-point:
Cavity strain : 3.774%
Total stress : 2657kPa
Size of cycle :
Shear strain : 0.180%
Total stress : 1191kPa
Radial Displacement (mm)
Total pressure (kPa)

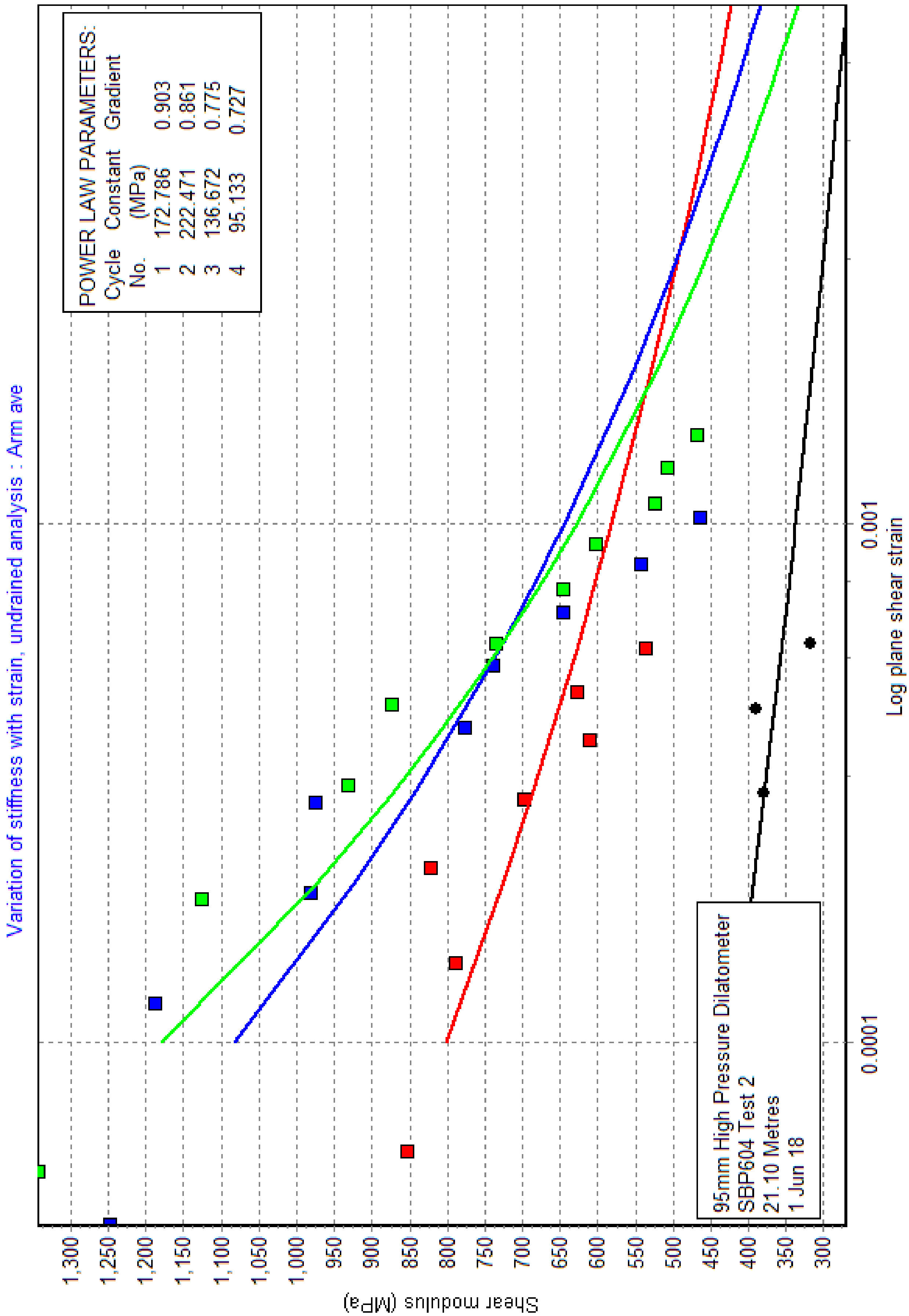

Bolton and Whittle (1999) Loop 1 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 2
21.10 Metres
1 Jun 18
RESULTS:
Gradient (beta) : 0.903
Intercept (n) : 191.319MPa
Shear stress constant : 172.786MPa
Source data - Loop 1
Total pressure (kPa)
Radial Displacement (mm)
Ln[Radial stress]
Ln[shear strain]
-8
-9

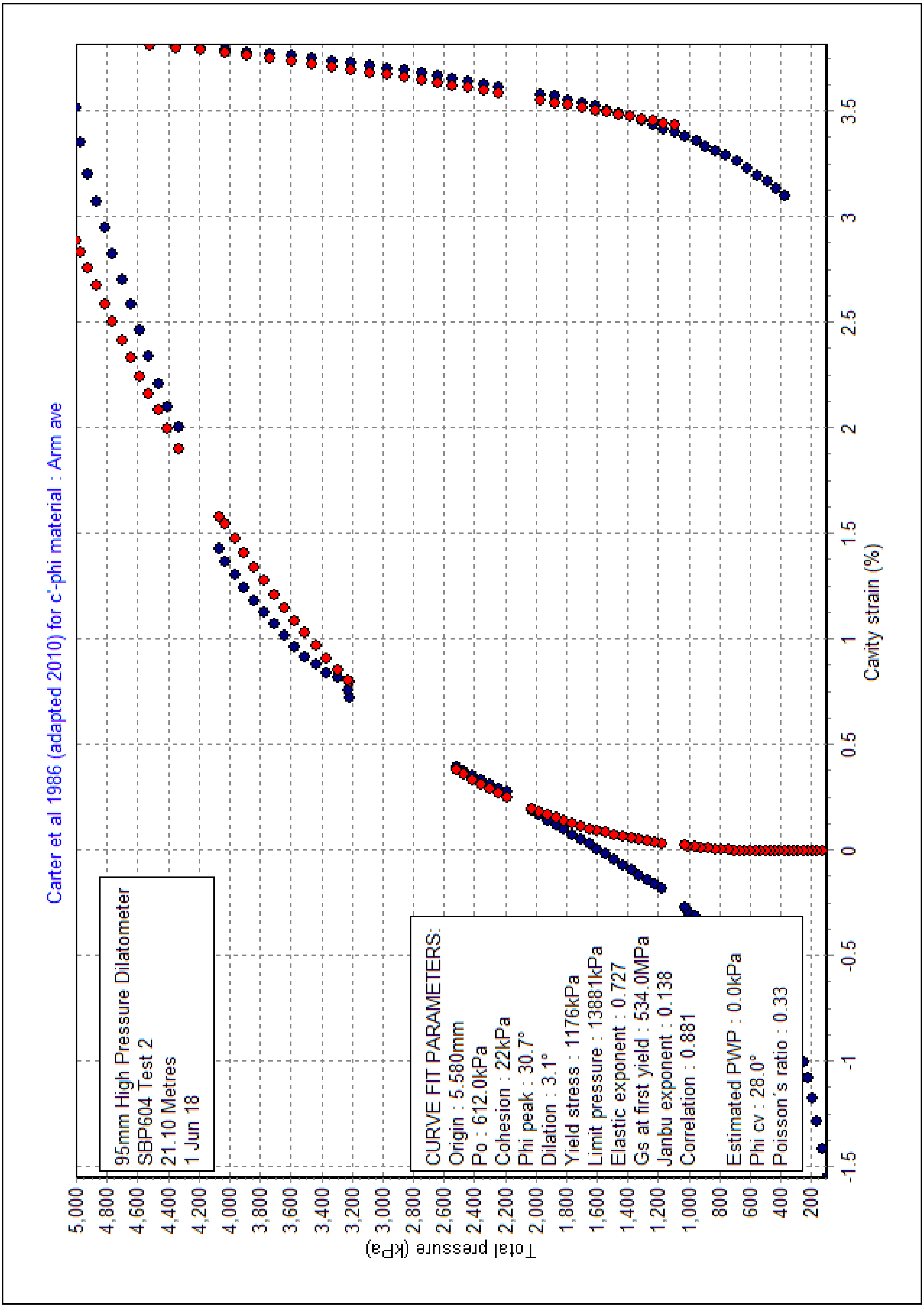


Bolton and Whittle (1999) Loop 2 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 2
21.10 Metres
1 Jun 18
RESULTS:
Gradient (beta) : 0.861
Intercept (n) : 258.417MPa
Shear stress constant : 222.471MPa
Ln[Radial stress]
6.1 6 5.9 5.8 5.7 5.6 5.5 5.4 5.3 5.2 5.1 5 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4 3.9 3.8 3.7
Ln[shear strain]
-8 -9 -10
Source data - Loop 2
Total pressure (kPa)
1,800 1,700 1,600 1,500 1,400
Radial Displacement (mm)
5.69 5.695 5.7 5.70

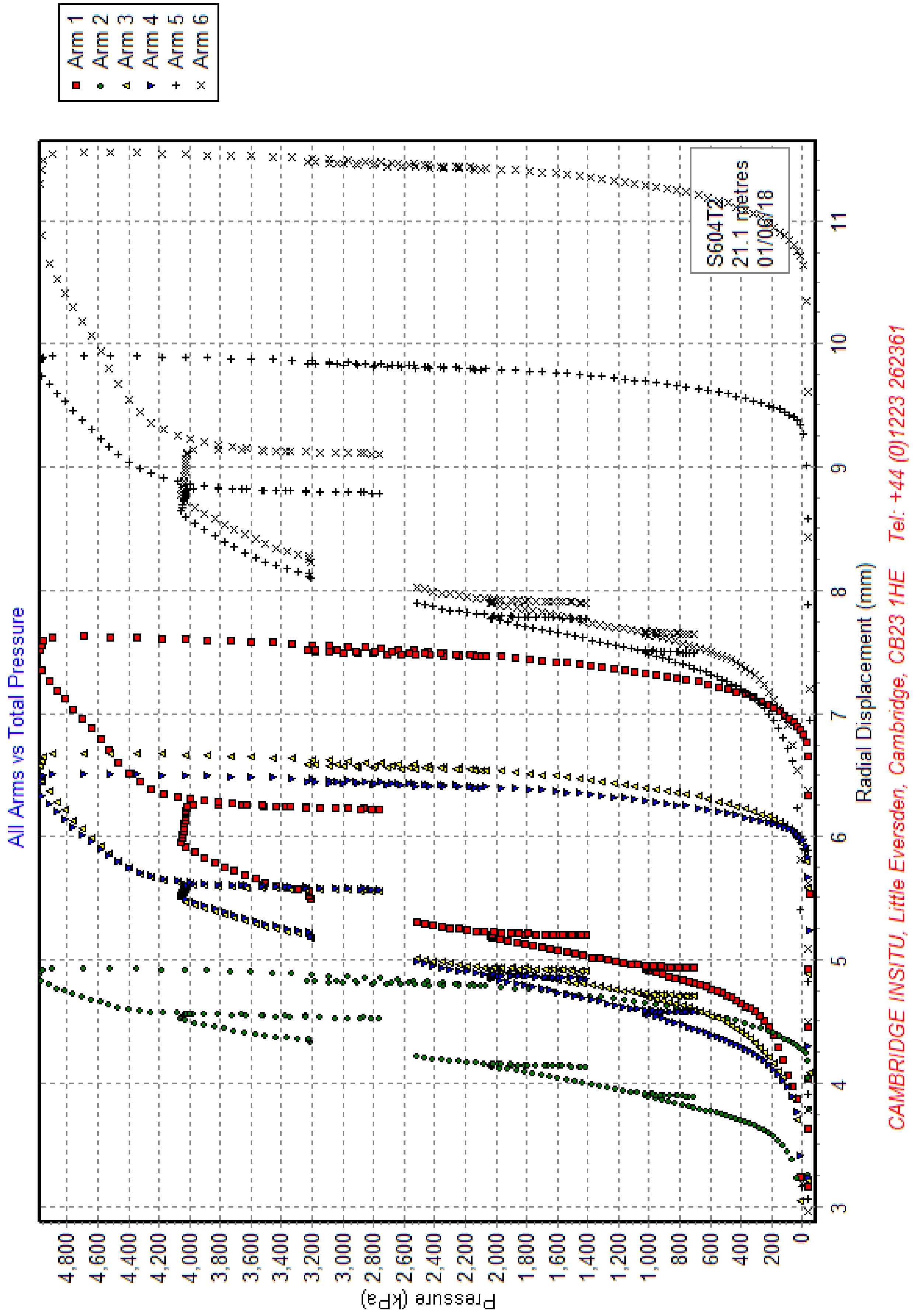

Bolton and Whittle (1999) Loop 3 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 2
21.10 Metres
1 Jun 18
RESULTS:
Gradient (beta) : 0.775
Intercept (n) : 176.273MPa
Shear stress constant : 136.672MPa
Source data - Loop 3
Total pressure (kPa)
Radial Displacement (mm)
Ln[Radial stress]
Ln[shear strain]

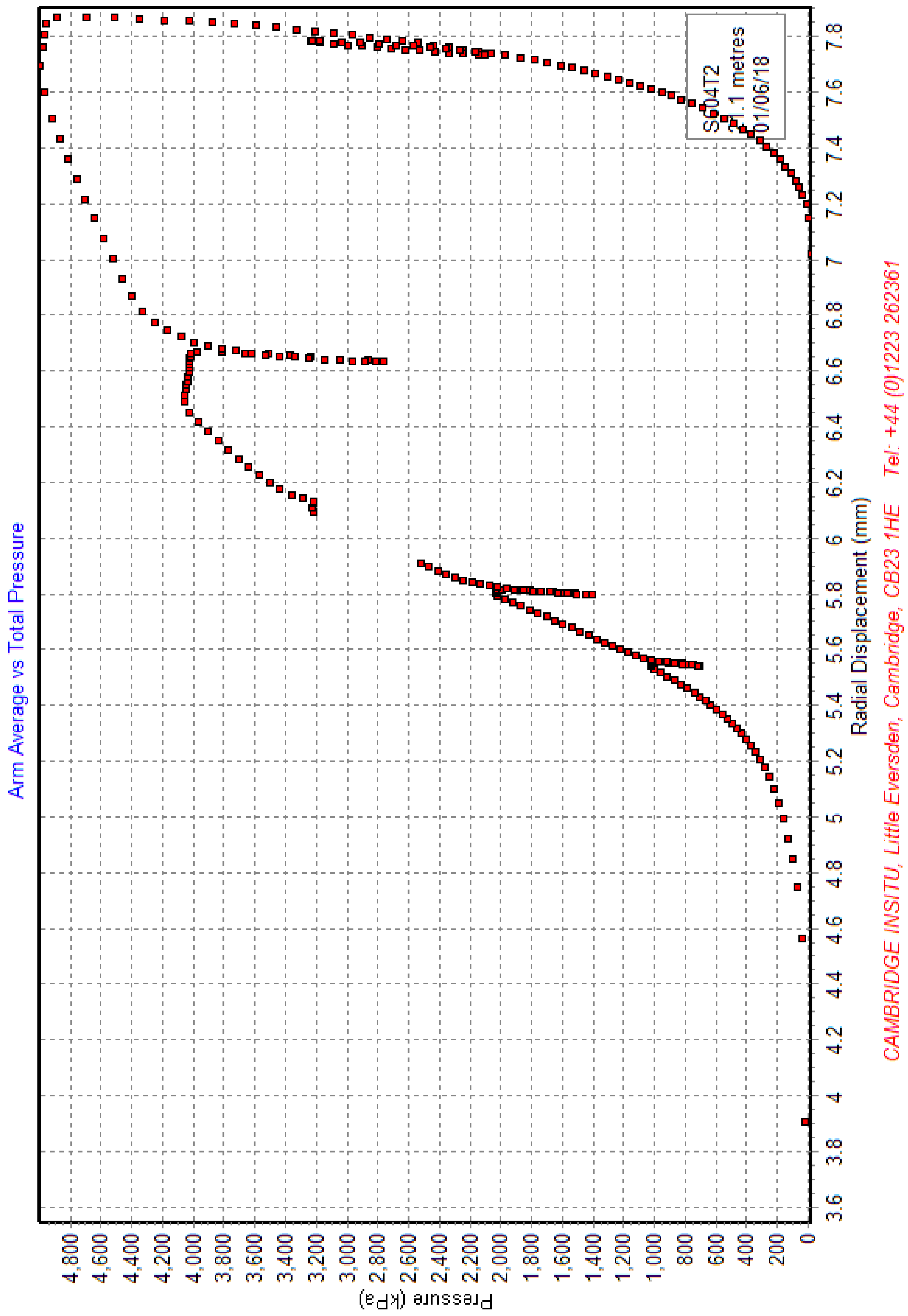

Bolton and Whittle (1999) Loop 4 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 2
21.10 Metres
1 Jun 18
RESULTS:
Gradient (beta) : 0.727
Intercept (n) : 130.912MPa
Shear stress constant : 95.133MPa
Source data - Loop 4
Total pressure (kPa)
3,200
3,000
2,800
2,600
2,400
2,200
Radial Displacement (mm)
7.6
7.62
7.64
Ln[Radial stress]
7
6.8
6.6
6.4
6.2
6
5.8
5.6
5.4
5.2
5
4.8
4.6
4.4
4.2
Ln[shear strain]
-7
-8
-9
-10

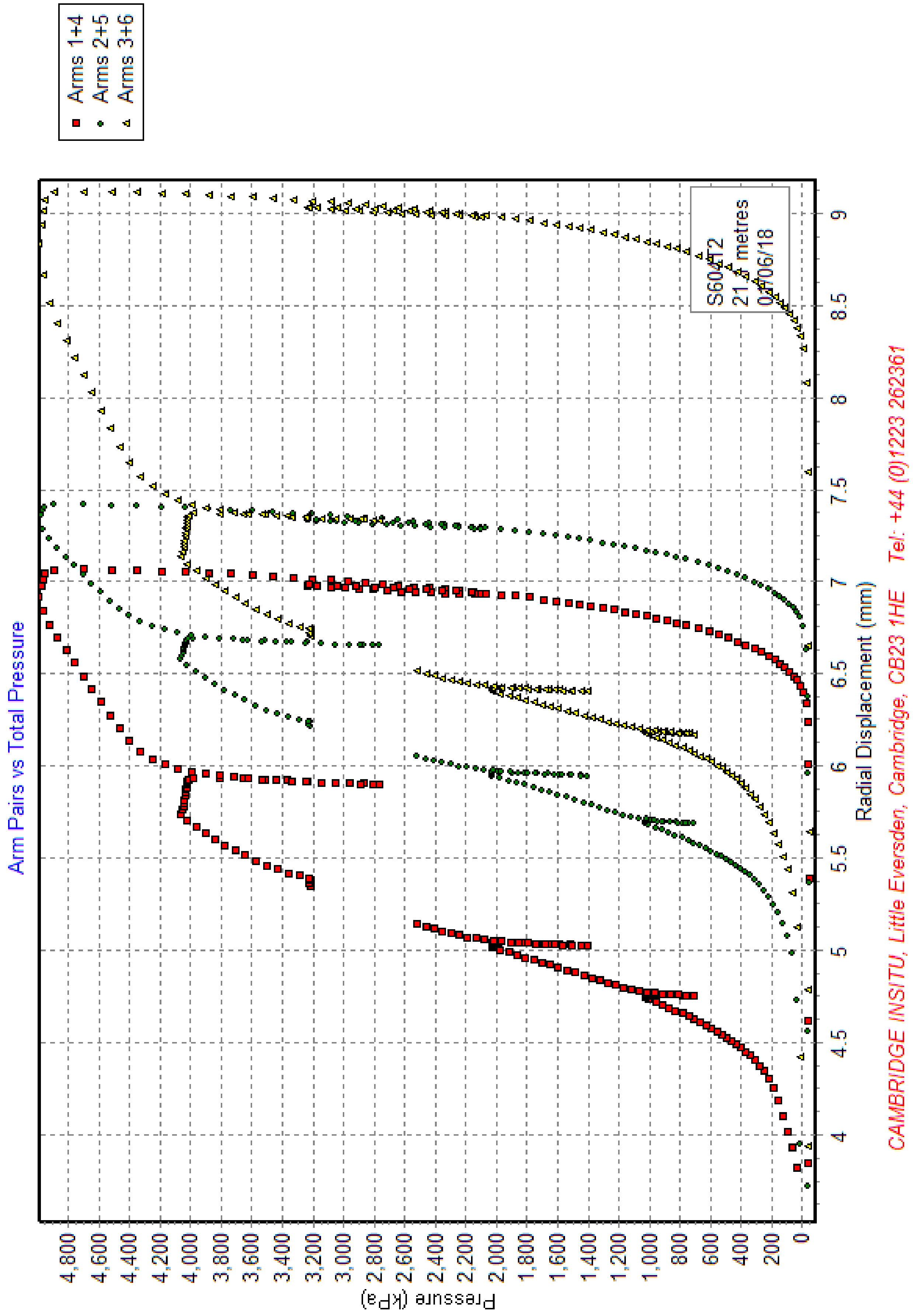

Variation of stiffness with strain, undrained analysis : Arm ave
POWER LAW PARAMETERS:
Cycle No. | Constant (MPa) | Gradient
1 | 172.786 | 0.903
2 | 222.471 | 0.861
3 | 136.672 | 0.775
4 | 95.133 | 0.727
95mm High Pressure Dilatometer
SBP604 Test 2
21.10 Metres
1 Jun 18
Shear modulus (MPa)
1,300
1,250
1,200
1,150
1,100
1,050
1,000
950
900
850
800
750
700
650
600
550
500
450
400
350
300
Log plane shear strain
0.0001
0.001

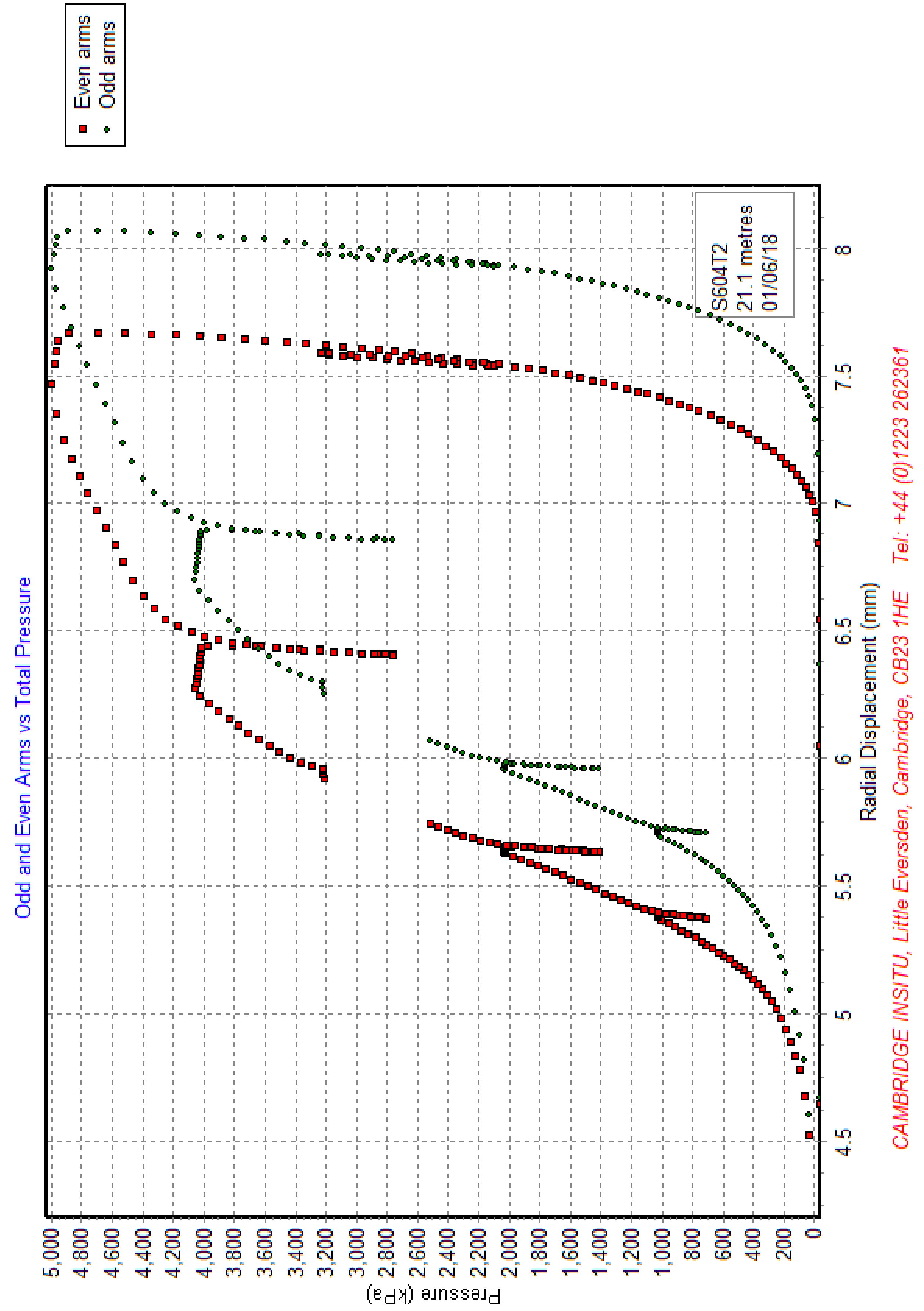


Carter et al 1986 (adapted 2010) for c'-phi material : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 2
21.10 Metres
1 Jun 18
CURVE FIT PARAMETERS:
Origin : 5.580mm
Po : 612.0kPa
Cohesion : 22kPa
Phi peak : 30.7°
Dilation : 3.1°
Yield stress : 1176kPa
Limit pressure : 13881kPa
Elastic exponent : 0.727
Gs at first yield : 534.0MPa
Janbu exponent : 0.138
Correlation : 0.881
Estimated PWP : 0.0kPa
Phi cv : 28.0°
Poisson's ratio : 0.33
Total pressure (kPa)
5,000
4,800
4,600
4,400
4,200
4,000
3,800
3,600
3,400
3,200
3,000
2,800
2,600
2,400
2,200
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
Cavity strain (%)
-1.5
-1
-0.5
0
0.5
1
1.5
2
2.5
3
3.5


All Arms vs Total Pressure
Arm 1
Arm 2
Arm 3
Arm 4
Arm 5
Arm 6
S604T2
21.1 metres
01/06/18
Radial Displacement (mm)
Pressure (kPa)
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361


Arm Average vs Total Pressure
S604T2
21.1 metres
01/06/18
Radial Displacement (mm)
Pressure (kPa)
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361


Arm Pairs vs Total Pressure
Arms 1+4
Arms 2+5
Arms 3+6
S604T2
metres
Radial Displacement (mm)
Pressure (kPa)
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361


Odd and Even Arms vs Total Pressure
Even arms
Odd arms
S604T2
21.1 metres
01/06/18
Radial Displacement (mm)
Pressure (kPa)
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361

SBP604 Test 3 - SUMMARY OF RESULTS
[File made with WinSitu Version 3.9.1.1]

[DETAILS OF TEST]

Project	:	60547200
Site	:	A303 Stonehenge
Borehole	:	SBP604
Test name	:	SBP604 Test 3
Test date	:	4 Jun 18
Test depth	:	25.05 Metres
Water table	:	22.5 Metres
Ambient PWP	:	25.0 kPa
Material	:	Chalk
Probe	:	95mm High Pressure Dilatometer
Diameter	:	97.0 mm

Data analysed using average arm displacement curve
A non-linear analysis of the rebound cycles has been carried out
The file includes results from a curve fitting analysis

Analysed by RWW on 6 Jun 18

Remarks: Pocket 23 to 26m

[RESULTS FOR CAVITY REFERENCE PRESSURE]

Strain Origin (mm)	:	"Arm ave=4.26"
Po from Marsland & Randolph (kPa)	:	"Arm ave=758.9"
Best estimate of Po (kPa)	:	"Arm ave=727.0"

[UNDRAINED STRENGTH PARAMETERS]

Undrained yield stress (kPa)	:	"Arm ave=3785.5"

[DRAINED ANALYSIS OF SANDS]
[Hughes et al 1977]

Constant volume friction angle (°)	:	28.0
Angle of internal friction (°)	:	"Arm ave=33.5"
Dilation angle (°)	:	"Arm ave=6.4"
Gradient of log-log plot	:	"Arm ave=0.395"

[Withers et al 1989]

Angle of internal friction (°)	:	"Arm ave=41.2"
Dilation angle (°)	:	"Arm ave=15.9"
Gradient of log-log plot	:	"Arm ave=-2.374"

[LINEAR INTERPRETATION OF SHEAR MODULUS G]
Initial slope shear modulus (MPa) :"Arm ave=230.6"

Axis	Loop No	Value (MPa)	Mean Strain (%)	Mean Pc (kPa)	dE (%)	dPc (kPa)
Arm ave	1	1011.8	-0.125	1310	0.036	360
Arm ave	2	1203.9	0.224	2545	0.057	686
Arm ave	3	1164.4	0.625	3709	0.084	979
Arm ave	4	974.0	1.489	3341	0.169	1649

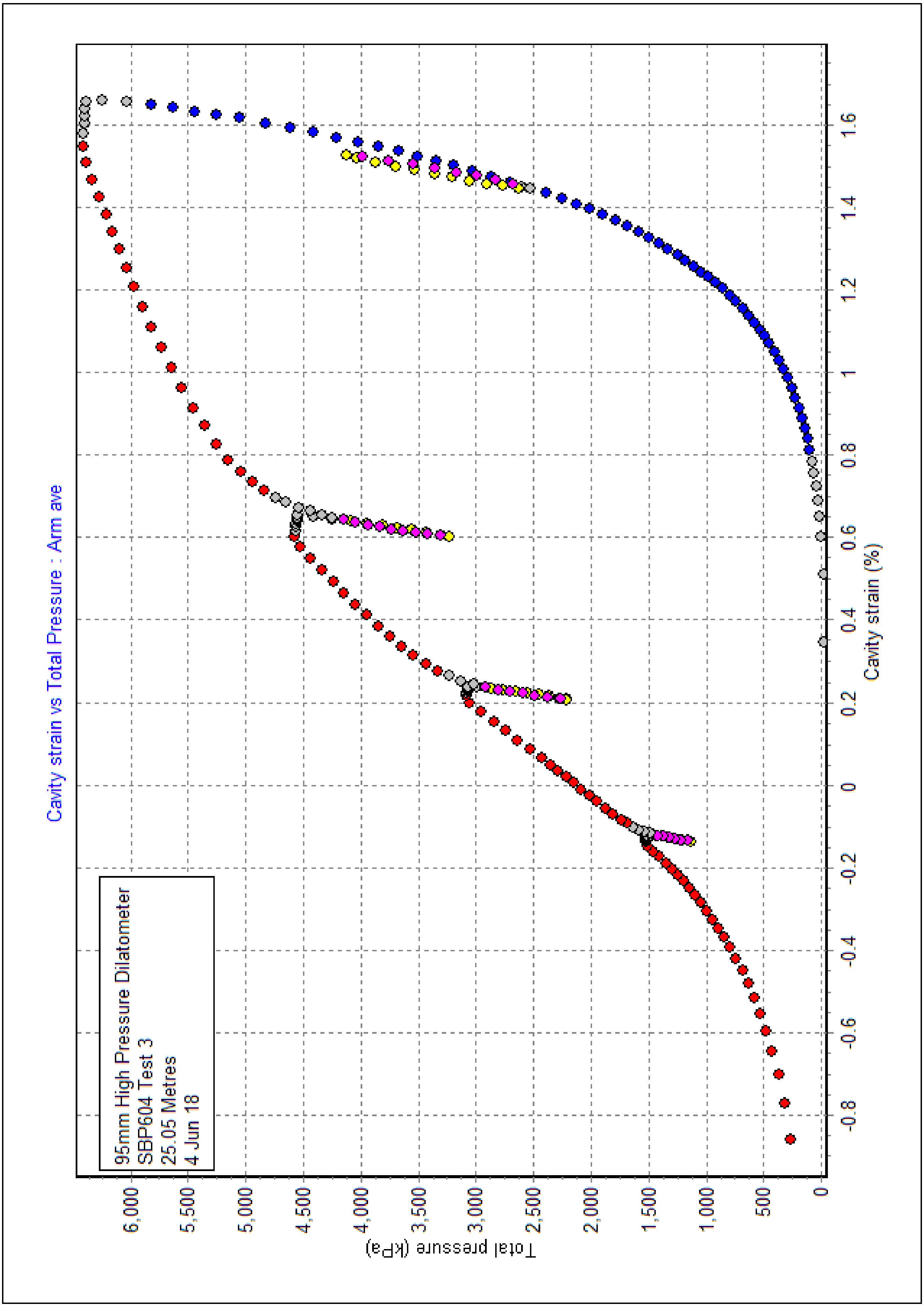
[UNDRAINED NON LINEAR INTERPRETATION OF SECANT SHEAR MODULUS]

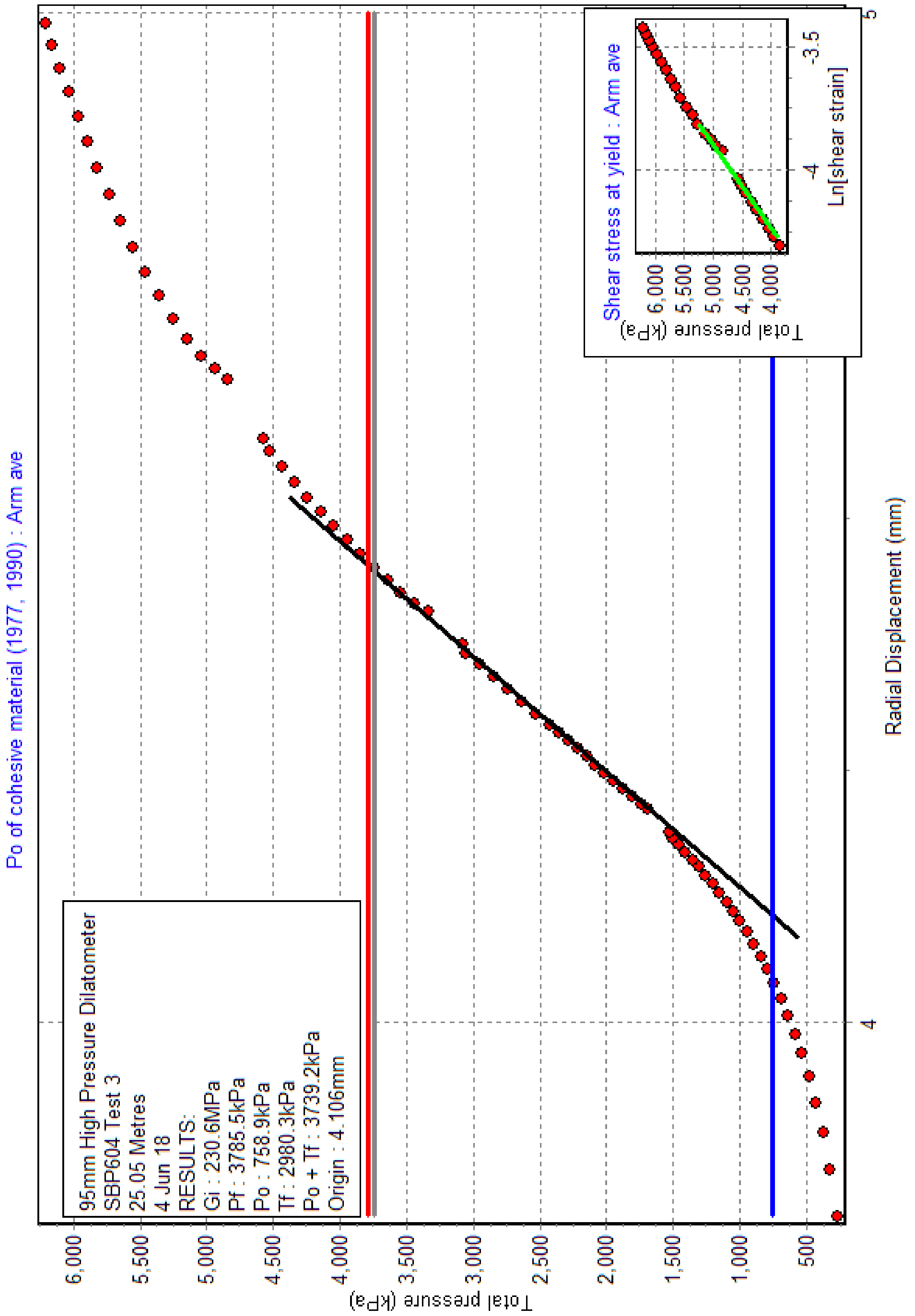
Axis	Loop No	Intercept (MPa)	Alpha (MPa)	Gradient
Arm ave	1	591.865	553.333	0.935
Arm ave	2	357.033	299.337	0.838
Arm ave	3	351.365	291.729	0.830
Arm ave	4	355.437	296.273	0.834

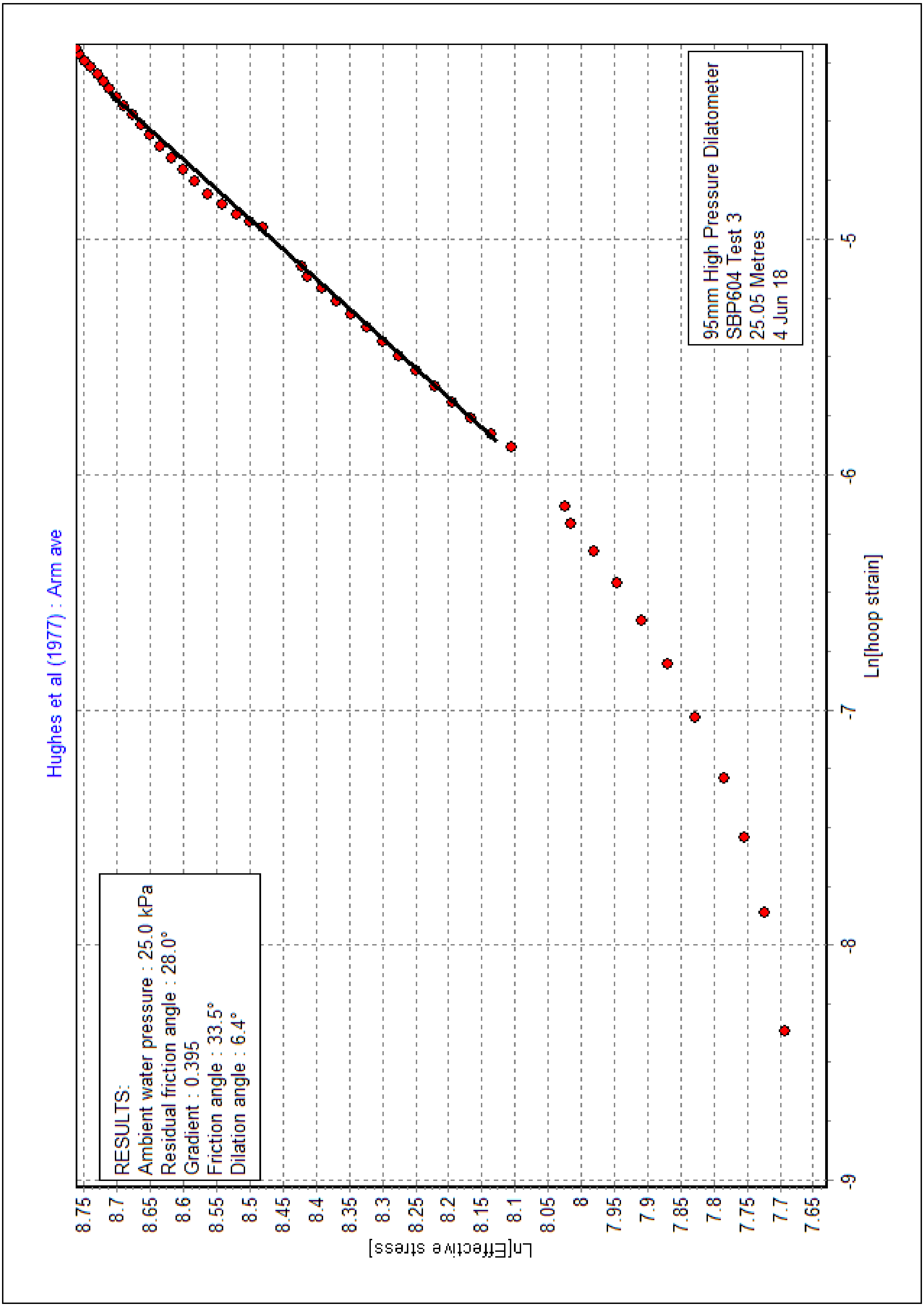
[PARAMETERS USED FOR DRAINED CURVE MODELLING]
{Axis is Arm ave}

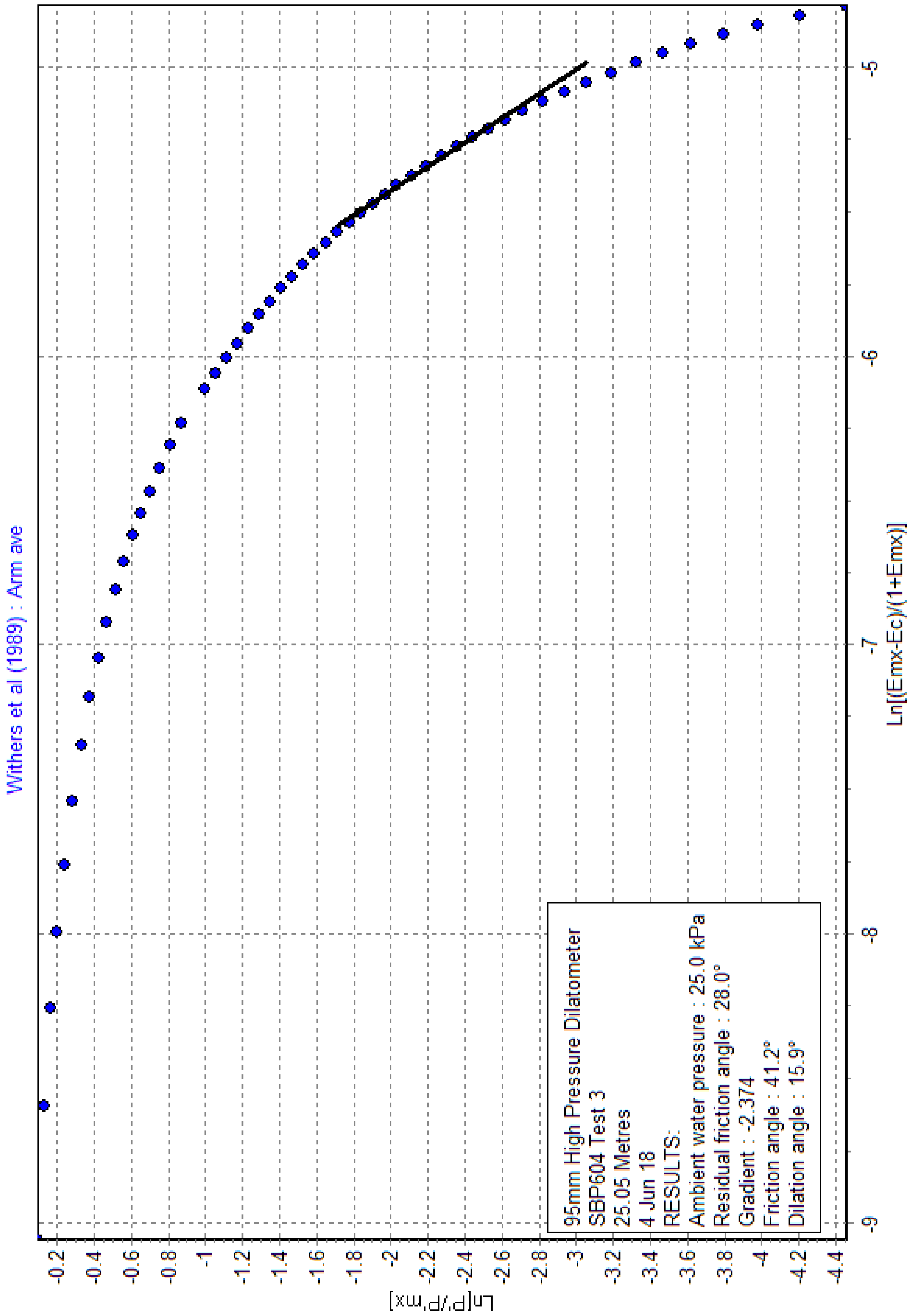
Strain Origin (mm)	:	4.26
Po (kPa)	:	727
Cohesion (kPa)	:	166
Angle of peak friction (deg)	:	33.5
Angle of peak dilation (deg)	:	6.4
Total yield stress (kPa)	:	1441
Total limit stress (kPa)	:	27006
G at first yield (MPa)	:	991.9
Non-linear exponent	:	0.830
Janbu exponent	:	0.027
Correlation	:	0.372

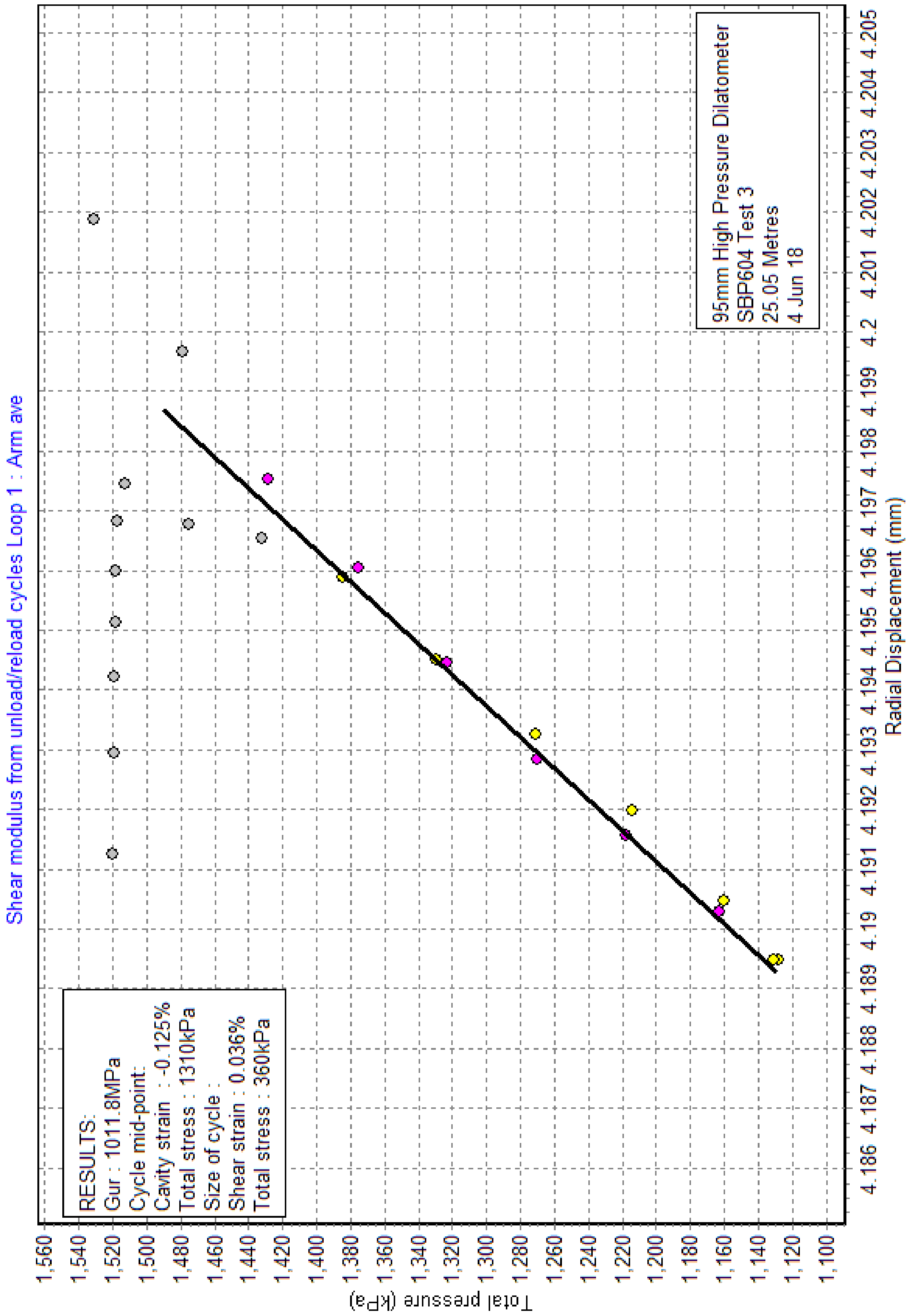
Ambient pore water pressure (kPa)	:	25
Residual friction angle (deg)	:	28.0
Poisson's ratio	:	0.33

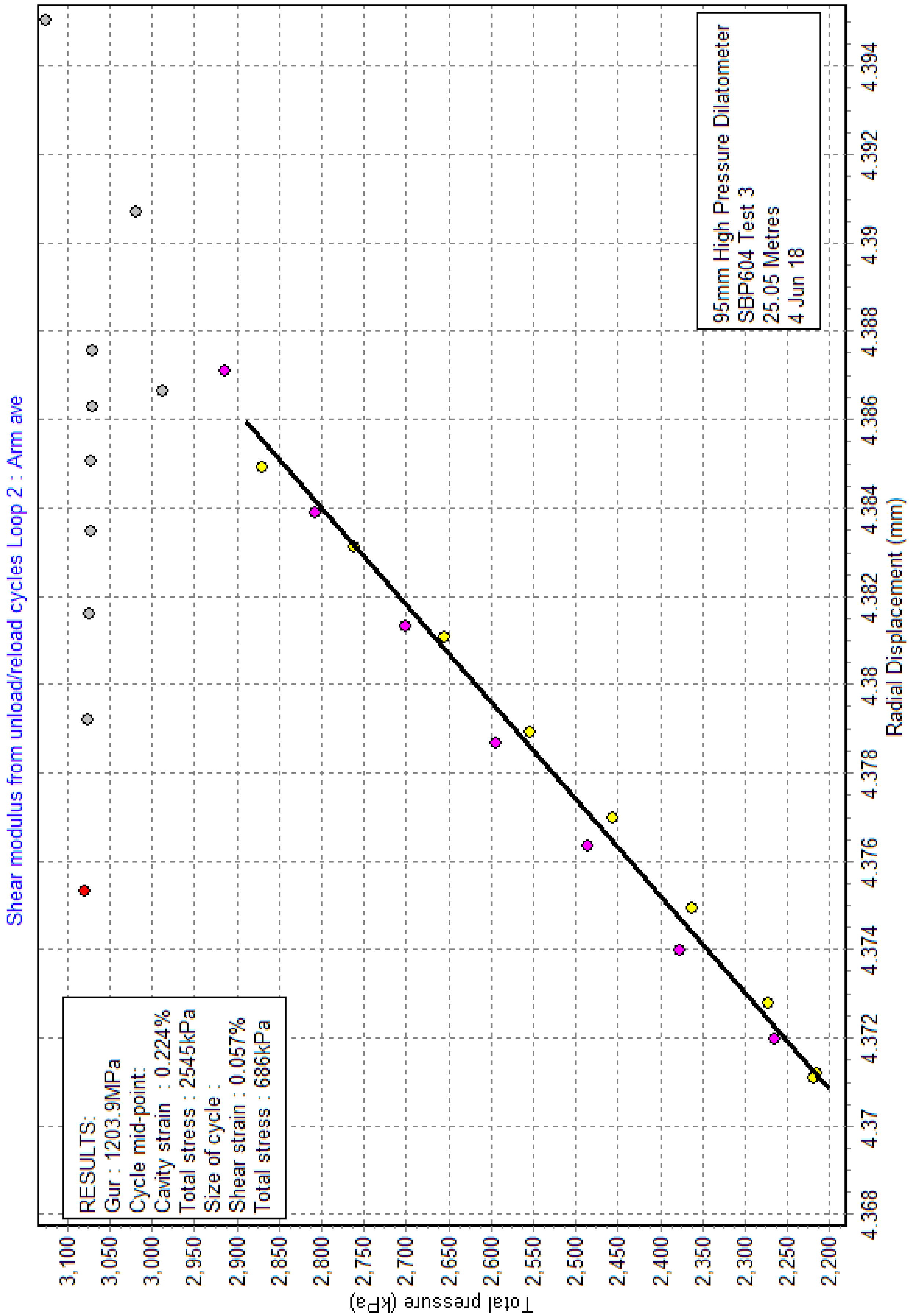

Cavity strain vs Total Pressure : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 3
25.05 Metres
4 Jun 18
Total pressure (kPa)
Cavity strain (%)
6,000
5,500
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6

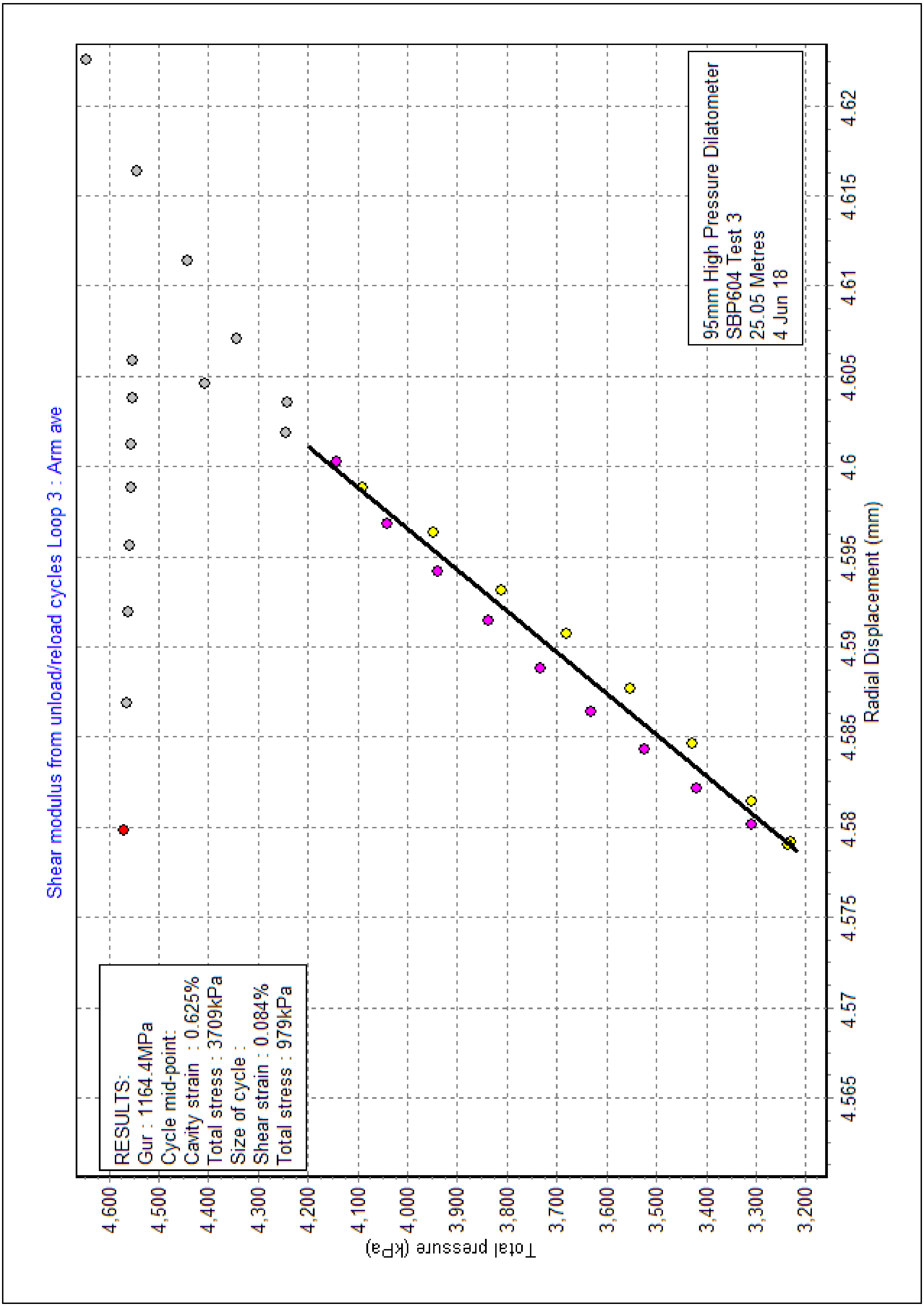

Po of cohesive material (1977, 1990) : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 3
25.05 Metres
4 Jun 18
RESULTS:
Gi : 230.6MPa
Pf : 3785.5kPa
Po : 758.9kPa
Tf : 2980.3kPa
Po + Tf : 3739.2kPa
Origin : 4.106mm
Total pressure (kPa)
6,000
5,500
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
Radial Displacement (mm)
4
5
Shear stress at yield : Arm ave
Ln[shear strain]
-3.5
-4

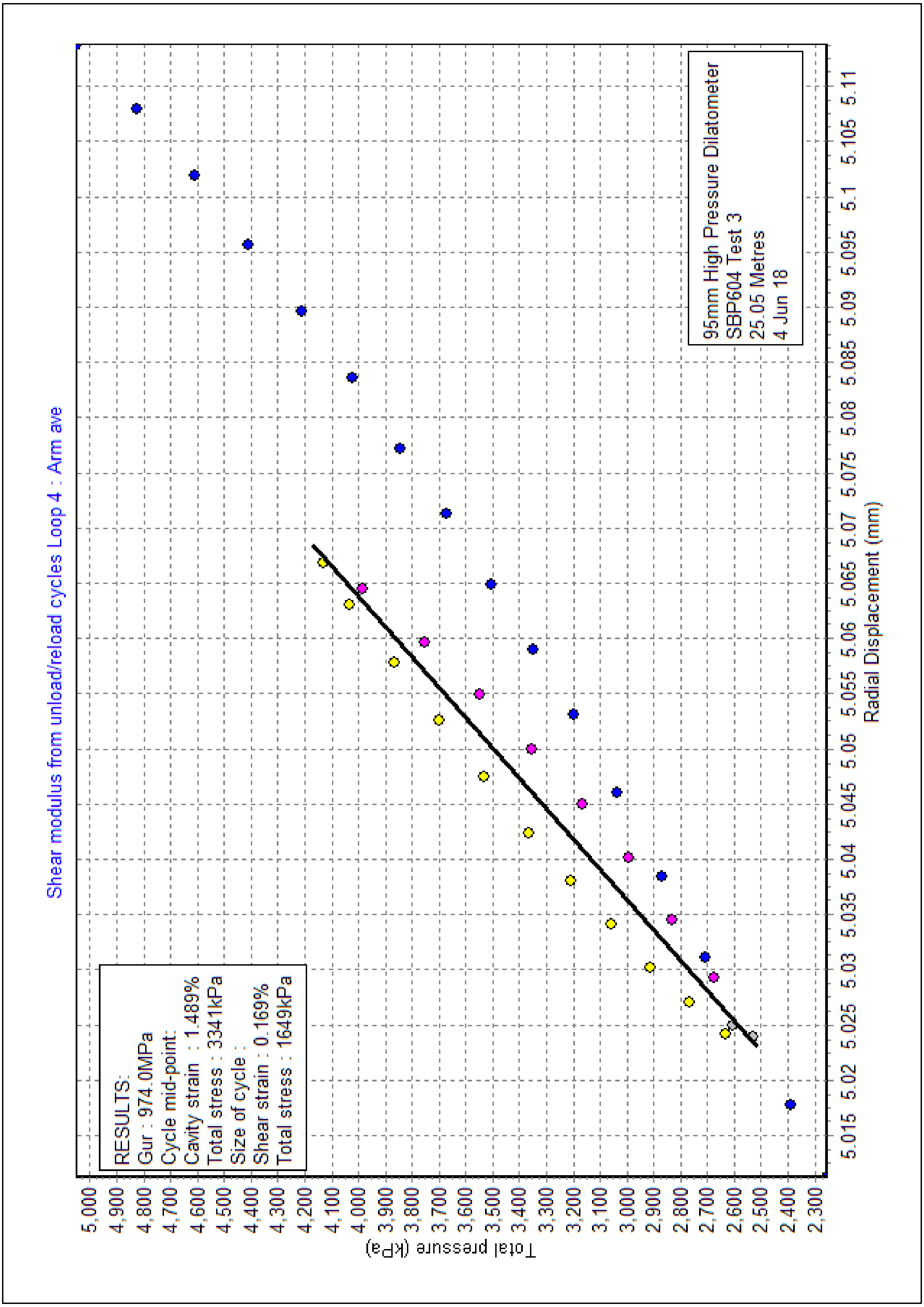

Hughes et al (1977) : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 3
25.05 Metres
4 Jun 18
RESULTS:
Ambient water pressure : 25.0 kPa
Residual friction angle : 28.0°
Gradient : 0.395
Friction angle : 33.5°
Dilation angle : 6.4°
Ln[Effective stress]
Ln[hoop strain]
8.75
8.7
8.65
8.6
8.55
8.5
8.45
8.4
8.35
8.3
8.25
8.2
8.15
8.1
8.05
8
7.95
7.9
7.85
7.8
7.75
7.7
7.65
-5
-6
-7
-8
-9

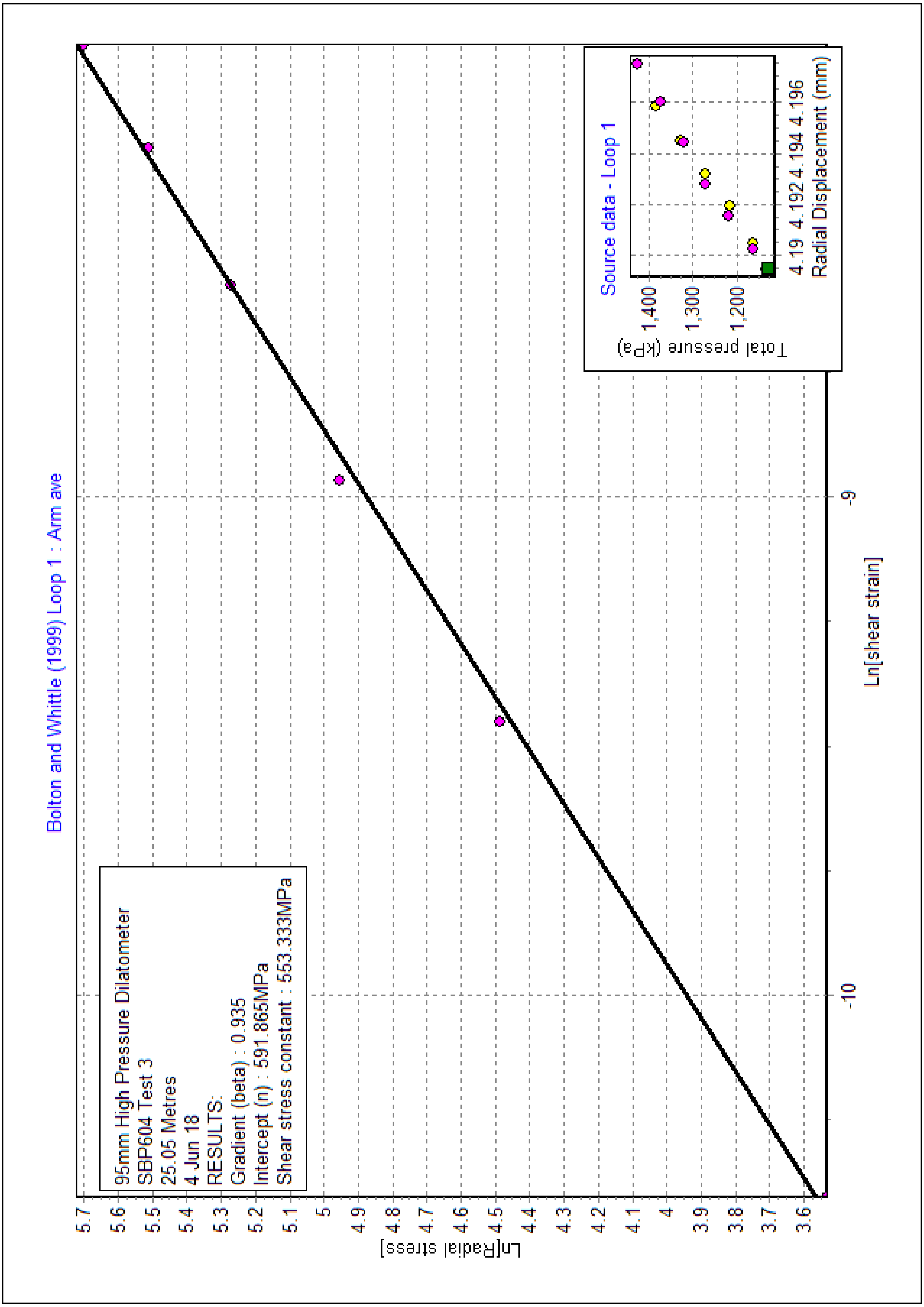

Withers et al (1989) : Arm ave
Ln[(Emx-Ec)/(1+Emx)]
Ln[P'/P'mx]
-5
-6
-7
-8
-9
-0.2
-0.4
-0.6
-0.8
-1
-1.2
-1.4
-1.6
-1.8
-2
-2.2
-2.4
-2.6
-2.8
-3
-3.2
-3.4
-3.6
-3.8
-4
-4.2
-4.4
95mm High Pressure Dilatometer
SBP604 Test 3
25.05 Metres
4 Jun 18
RESULTS:
Ambient water pressure : 25.0 kPa
Residual friction angle : 28.0°
Gradient : -2.374
Friction angle : 41.2°
Dilation angle : 15.9°

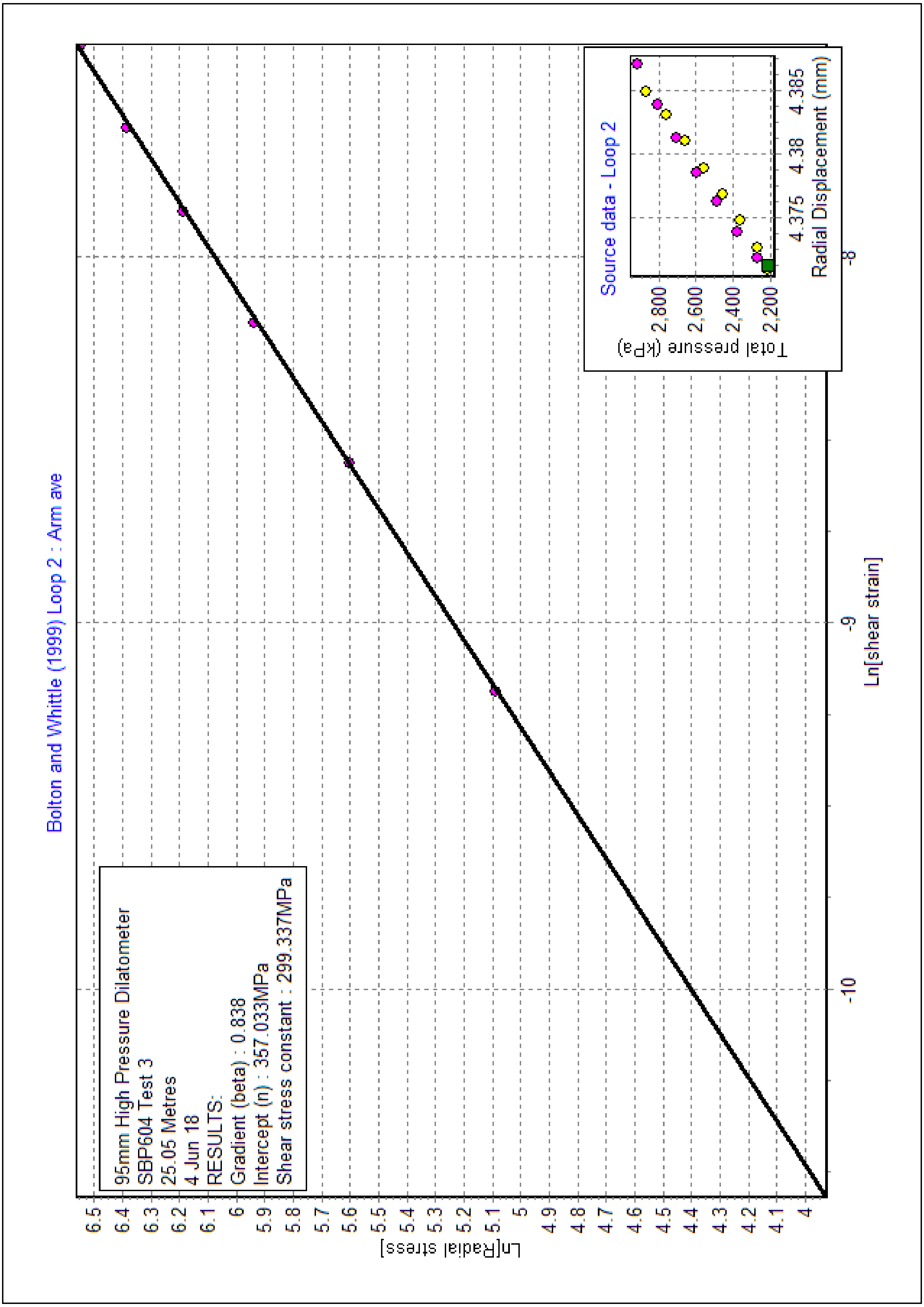

Shear modulus from unload/reload cycles Loop 1 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 3
25.05 Metres
4 Jun 18
RESULTS:
Gur : 1011.8MPa
Cycle mid-point:
Cavity strain : -0.125%
Total stress : 1310kPa
Size of cycle :
Shear strain : 0.036%
Total stress : 360kPa
Radial Displacement (mm)
Total pressure (kPa)
4.186 4.187 4.188 4.189 4.19 4.191 4.192 4.193 4.194 4.195 4.196 4.197 4.198 4.199 4.2 4.201 4.202 4.203 4.204 4.205
1,100 1,120 1,140 1,160 1,180 1,200 1,220 1,240 1,260 1,280 1,300 1,320 1,340 1,360 1,380 1,400 1,420 1,440 1,460 1,480 1,500 1,520 1,540 1,560

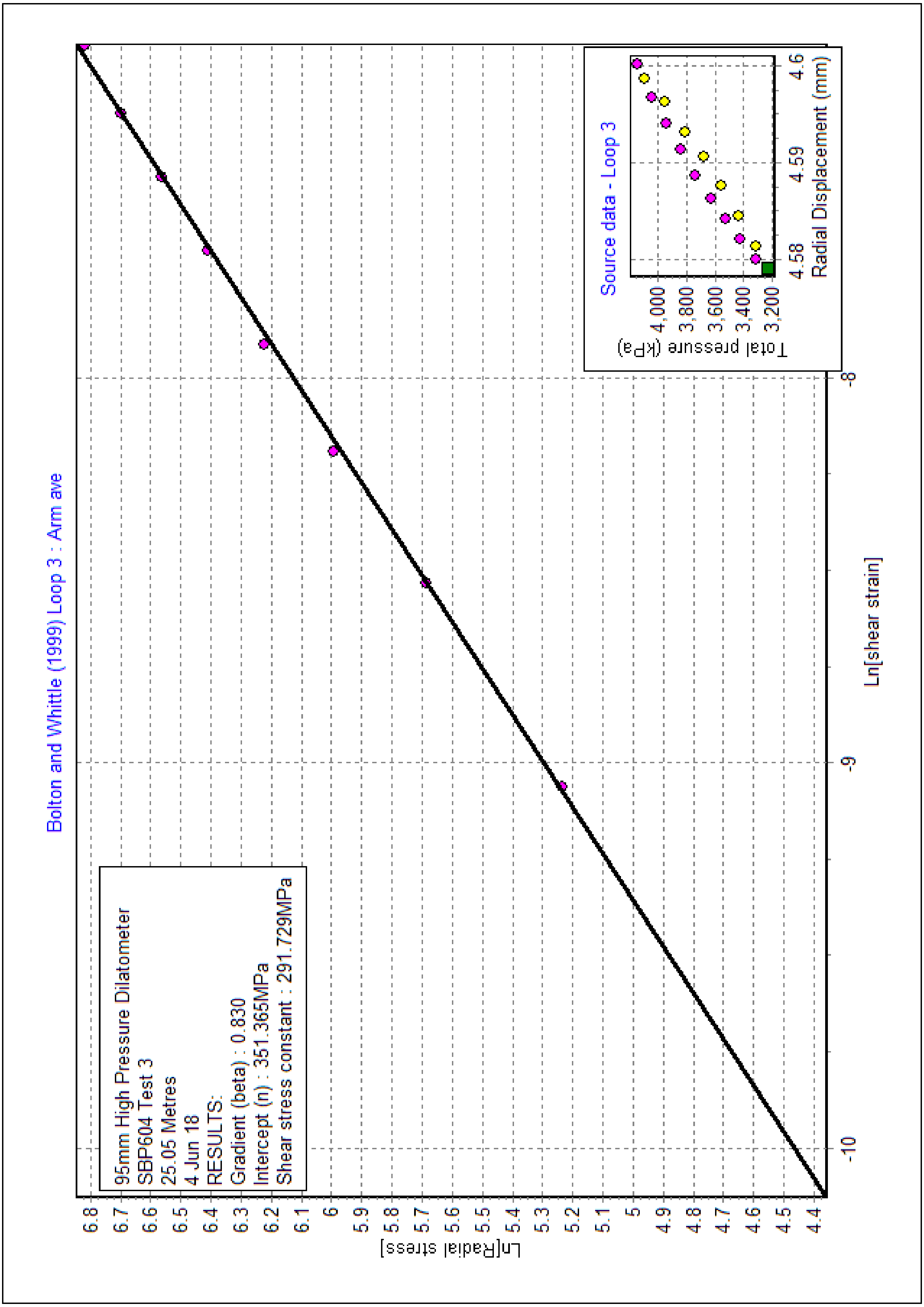

Shear modulus from unload/reload cycles Loop 2 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 3
25.05 Metres
4 Jun 18
RESULTS:
Gur : 1203.9MPa
Cycle mid-point:
Cavity strain : 0.224%
Total stress : 2545kPa
Size of cycle :
Shear strain : 0.057%
Total stress : 686kPa
Radial Displacement (mm)
Total pressure (kPa)

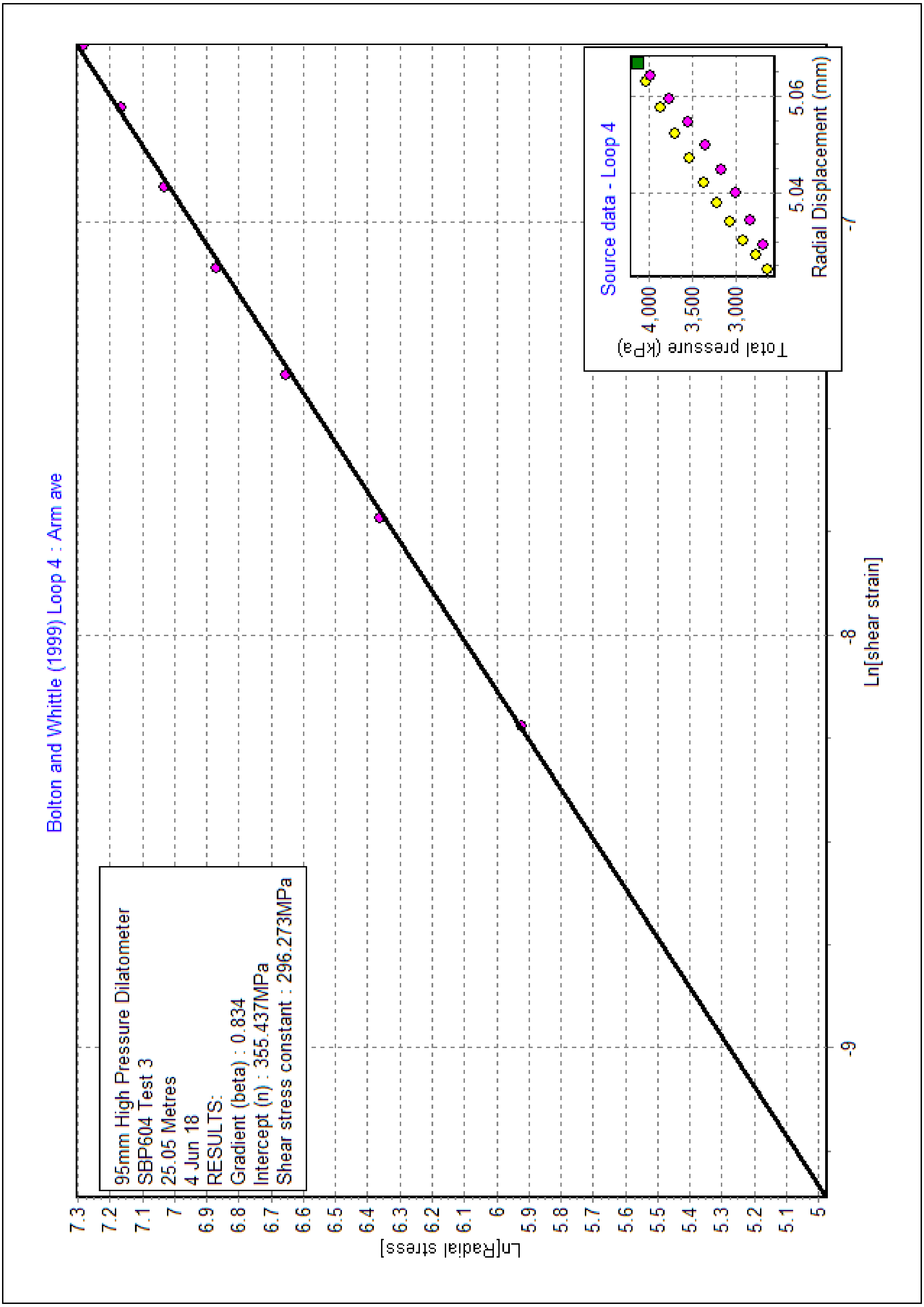

Shear modulus from unload/reload cycles Loop 3 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 3
25.05 Metres
4 Jun 18
RESULTS:
Gur : 1164.4MPa
Cycle mid-point:
Cavity strain : 0.625%
Total stress : 3709kPa
Size of cycle :
Shear strain : 0.084%
Total stress : 979kPa
Total pressure (kPa)
Radial Displacement (mm)
4,600
4,500
4,400
4,300
4,200
4,100
4,000
3,900
3,800
3,700
3,600
3,500
3,400
3,300
3,200
4.565
4.57
4.575
4.58
4.585
4.59
4.595
4.6
4.605
4.61
4.615
4.62

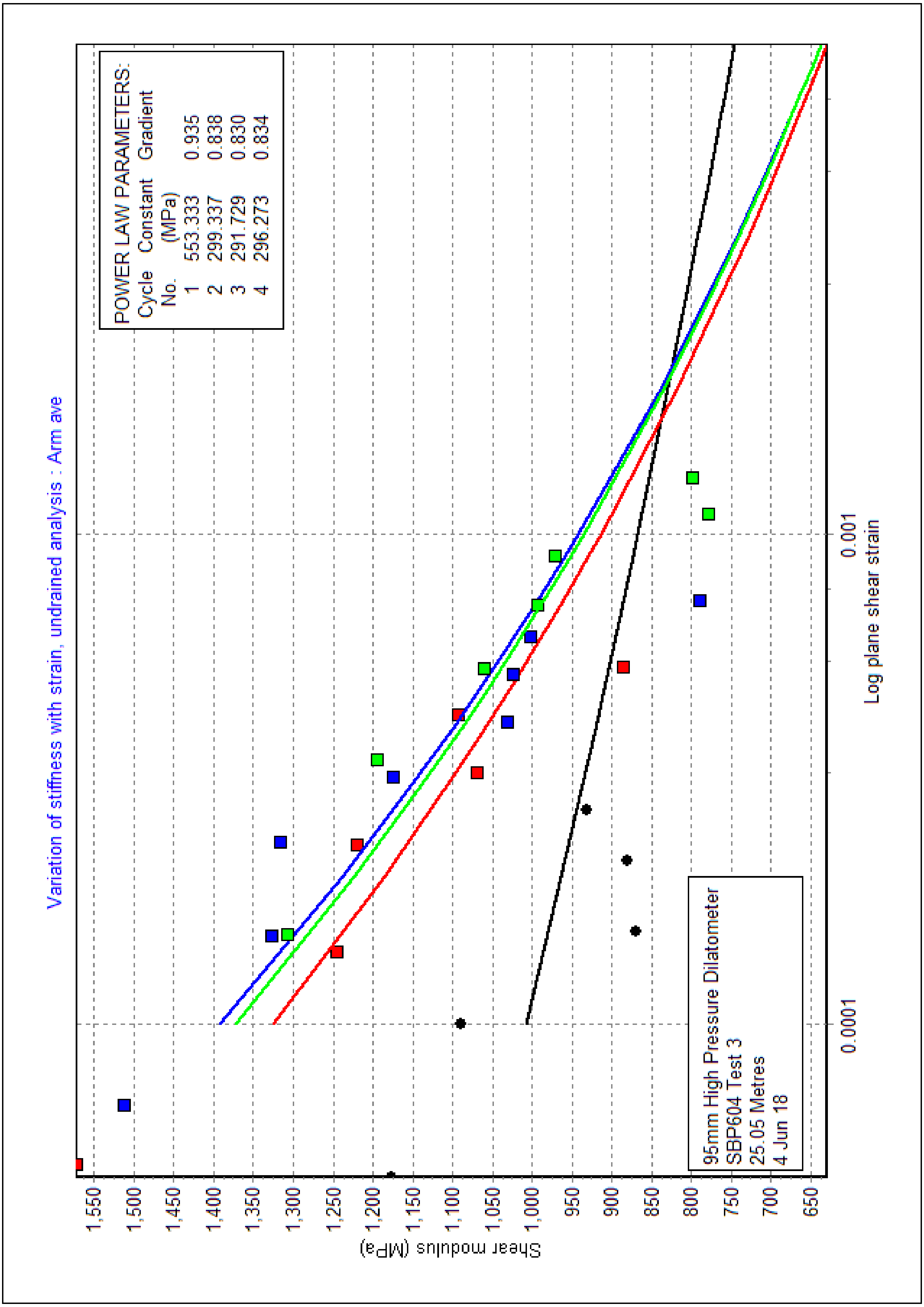

Shear modulus from unload/reload cycles Loop 4 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 3
25.05 Metres
4 Jun 18
RESULTS:
Gur : 974.0MPa
Cycle mid-point:
Cavity strain : 1.489%
Total stress : 3341kPa
Size of cycle :
Shear strain : 0.169%
Total stress : 1649kPa
Radial Displacement (mm)
5.015
5.02
5.025
5.03
5.035
5.04
5.045
5.05
5.055
5.06
5.065
5.07
5.075
5.08
5.085
5.09
5.095
5.1
5.105
5.11
Total pressure (kPa)
5,000
4,900
4,800
4,700
4,600
4,500
4,400
4,300
4,200
4,100
4,000
3,900
3,800
3,700
3,600
3,500
3,400
3,300
3,200
3,100
3,000
2,900
2,800
2,700
2,600
2,500
2,400
2,300

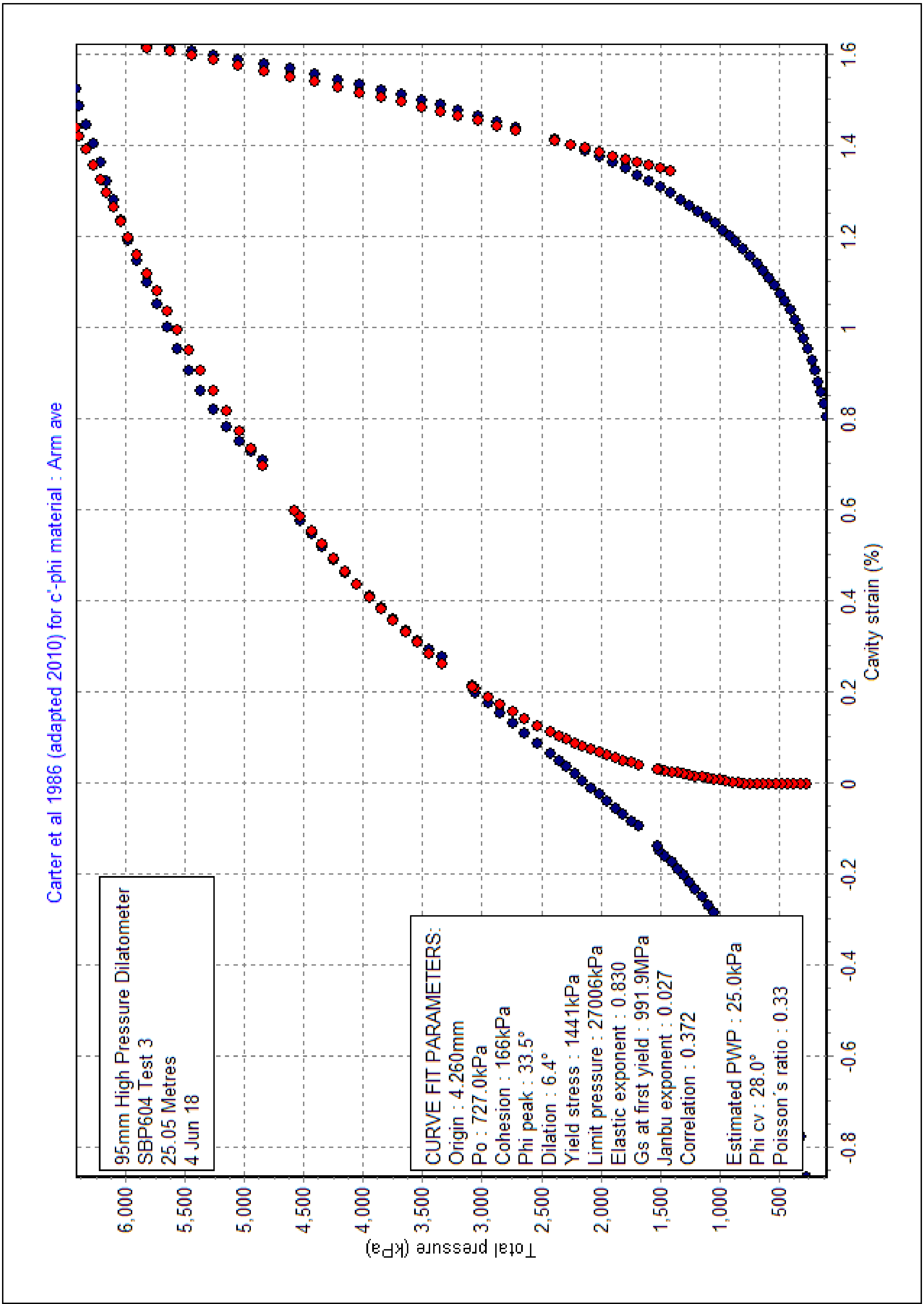

Bolton and Whittle (1999) Loop 1 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 3
25.05 Metres
4 Jun 18
RESULTS:
Gradient (beta) : 0.935
Intercept (n) : 591.865MPa
Shear stress constant : 553.333MPa
Ln[Radial stress]
5.7
5.6
5.5
5.4
5.3
5.2
5.1
5
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4
3.9
3.8
3.7
3.6
Ln[shear strain]
-10
-9
Source data - Loop 1
Total pressure (kPa)
1,400
1,300
1,200
4.19
4.192
4.194
4.196
Radial Displacement (mm)

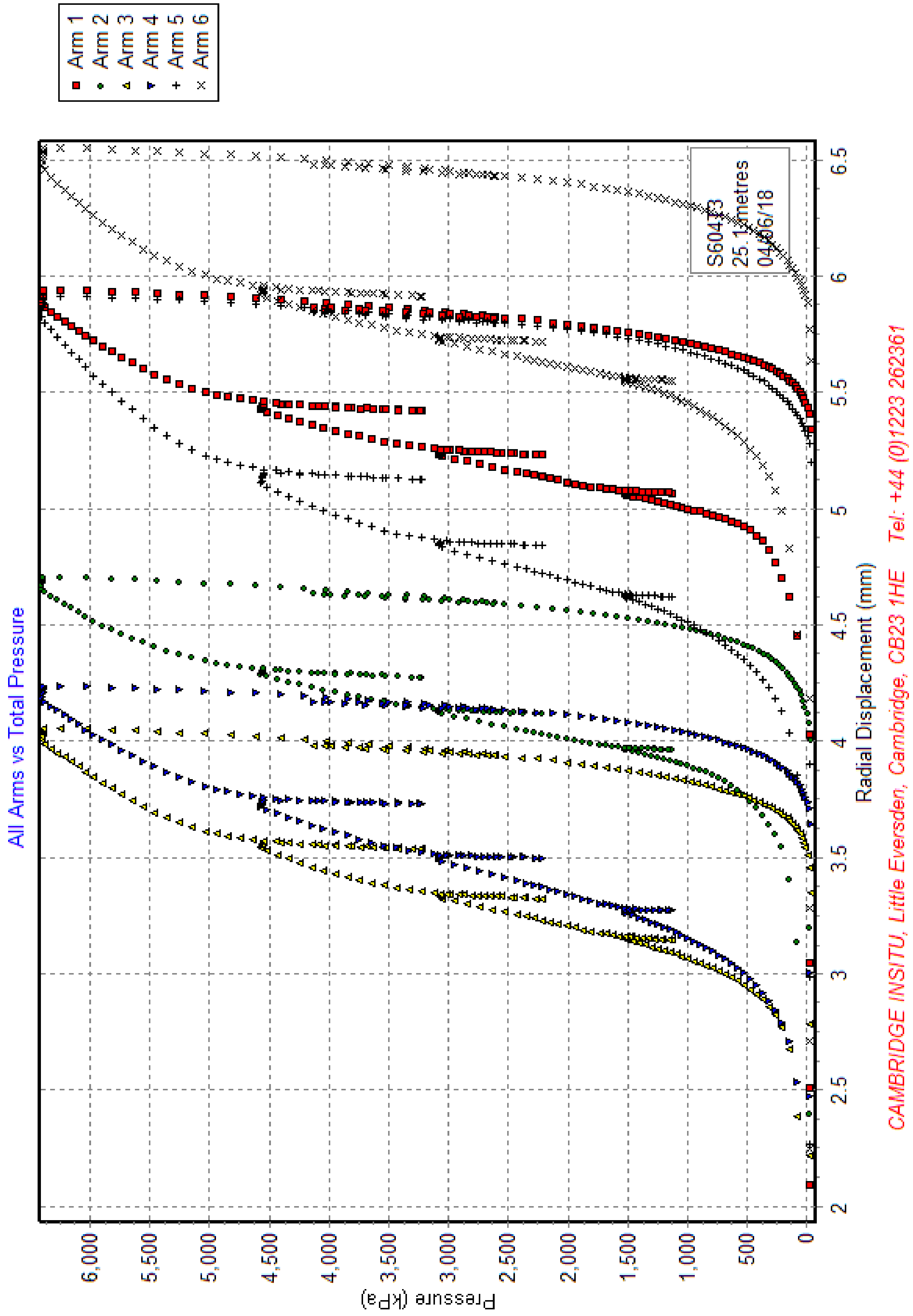

Bolton and Whittle (1999) Loop 2 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 3
25.05 Metres
4 Jun 18
RESULTS:
Gradient (beta) : 0.838
Intercept (n) : 357.033MPa
Shear stress constant : 299.337MPa
Ln[Radial stress]
Ln[shear strain]
-10
-9
-8
Source data - Loop 2
Total pressure (kPa)
Radial Displacement (mm)
4.375
4.38
4.385
2,200
2,400
2,600
2,800

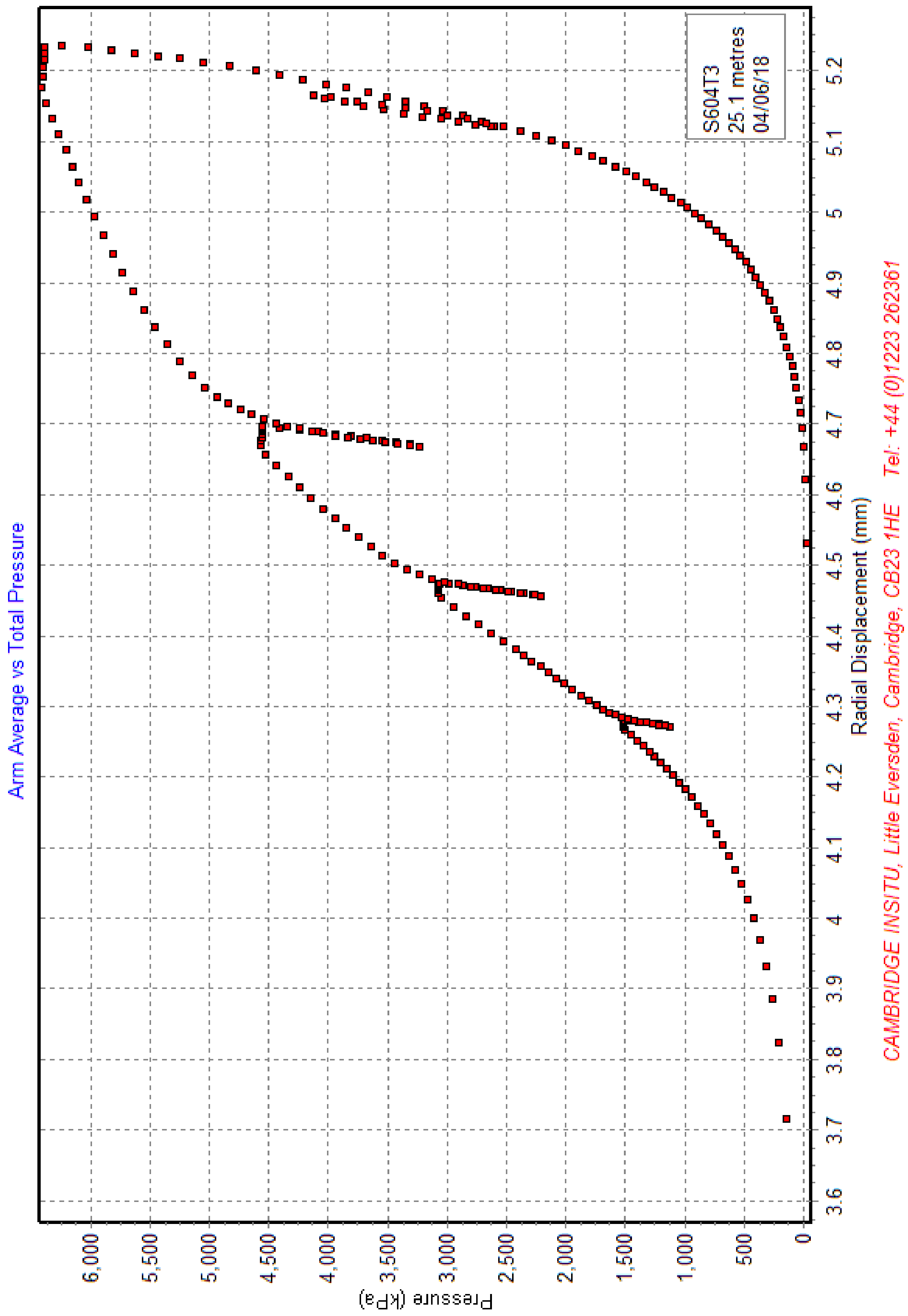

Bolton and Whittle (1999) Loop 3 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 3
25.05 Metres
4 Jun 18
RESULTS:
Gradient (beta) : 0.830
Intercept (n) : 351.365MPa
Shear stress constant : 291.729MPa
Ln[Radial stress]
Ln[shear strain]
-8
-9
-10
6.8
6.7
6.6
6.5
6.4
6.3
6.2
6.1
6
5.9
5.8
5.7
5.6
5.5
5.4
5.3
5.2
5.1
5
4.9
4.8
4.7
4.6
4.5
4.4
Source data - Loop 3
Total pressure (kPa)
Radial Displacement (mm)
4,000
3,800
3,600
3,400
3,200
4.58
4.59
4.6

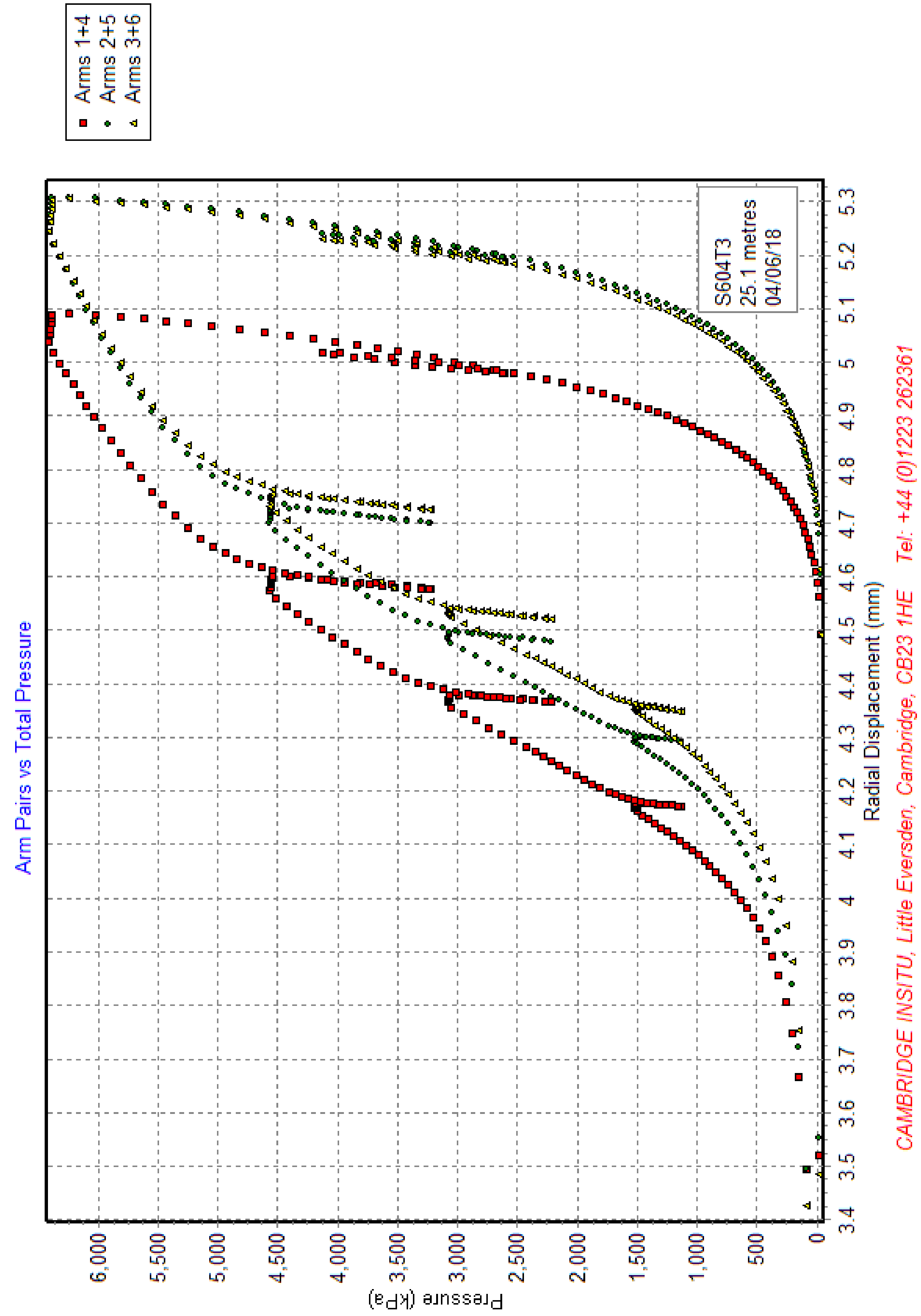

Bolton and Whittle (1999) Loop 4 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 3
25.05 Metres
4 Jun 18
RESULTS:
Gradient (beta) : 0.834
Intercept (n) : 355.437MPa
Shear stress constant : 296.273MPa
Ln[Radial stress]
7.3
7.2
7.1
7
6.9
6.8
6.7
6.6
6.5
6.4
6.3
6.2
6.1
6
5.9
5.8
5.7
5.6
5.5
5.4
5.3
5.2
5.1
5
Ln[shear strain]
-9
-8
-7
Source data - Loop 4
Total pressure (kPa)
4,000
3,500
3,000
Radial Displacement (mm)
5.04
5.06

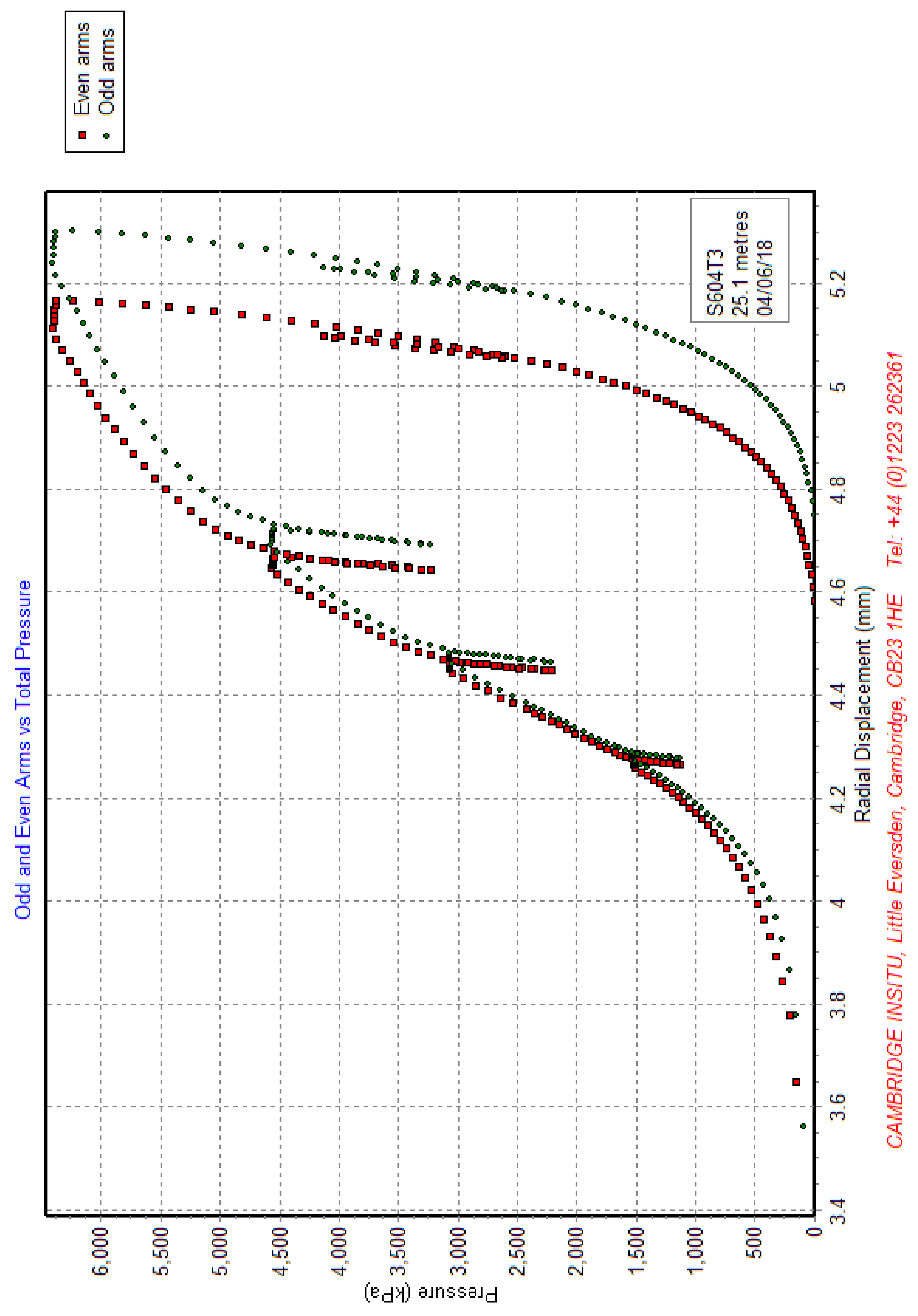

Variation of stiffness with strain, undrained analysis : Arm ave
POWER LAW PARAMETERS:
Cycle No. Constant (MPa) Gradient
1 553.333 0.935
2 299.337 0.838
3 291.729 0.830
4 296.273 0.834
95mm High Pressure Dilatometer
SBP604 Test 3
25.05 Metres
4 Jun 18
Shear modulus (MPa)
1,550
1,500
1,450
1,400
1,350
1,300
1,250
1,200
1,150
1,100
1,050
1,000
950
900
850
800
750
700
650
Log plane shear strain
0.0001
0.001


Carter et al 1986 (adapted 2010) for c'-phi material : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 3
25.05 Metres
4 Jun 18
CURVE FIT PARAMETERS:
Origin : 4.260mm
Po : 727.0kPa
Cohesion : 166kPa
Phi peak : 33.5°
Dilation : 6.4°
Yield stress : 1441kPa
Limit pressure : 27006kPa
Elastic exponent : 0.830
Gs at first yield : 991.9MPa
Janbu exponent : 0.027
Correlation : 0.372
Estimated PWP : 25.0kPa
Phi cv : 28.0°
Poisson's ratio : 0.33
Total pressure (kPa)
6,000
5,500
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
Cavity strain (%)
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6


All Arms vs Total Pressure
Arm 1
Arm 2
Arm 3
Arm 4
Arm 5
Arm 6
Radial Displacement (mm)
Pressure (kPa)
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361


Arm Average vs Total Pressure
S604T3
25.1 metres
04/06/18
Radial Displacement (mm)
Pressure (kPa)
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361


Arm Pairs vs Total Pressure
Arms 1+4
Arms 2+5
Arms 3+6
S604T3
25.1 metres
04/06/18
Pressure (kPa)
Radial Displacement (mm)
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361


Odd and Even Arms vs Total Pressure
Even arms
Odd arms
S604T3
25.1 metres
04/06/18
Radial Displacement (mm)
Pressure (kPa)
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361

SBP604 Test 4 - SUMMARY OF RESULTS
[File made with WinSitu Version 3.9.1.1]

[DETAILS OF TEST]

Project	:	60547200
Site	:	A303 Stonehenge
Borehole	:	SBP604
Test name	:	SBP604 Test 4
Test date	:	4 Jun 18
Test depth	:	27.25 Metres
Water table	:	22.5 Metres
Ambient PWP	:	46.6 kPa
Material	:	Chalk
Probe	:	95mm High Pressure Dilatometer
Diameter	:	97.0 mm

Data analysed using average arm displacement curve
A non-linear analysis of the rebound cycles has been carried out
The file includes results from a curve fitting analysis

Analysed by RWW on 6 Jun 18

Remarks: Pocket 26 to 28m. Full recovery. Chalk is slightly dirty grey and crumbly. Initial pressure setting too high, no data between 200 and 1000kPa. Includes a balance point check during final unload.

[RESULTS FOR CAVITY REFERENCE PRESSURE]

Strain Origin (mm)	:	"Arm ave=3.85"
Po from Marsland & Randolph (kPa)	:	"Arm ave=642.0"
Best estimate of Po (kPa)	:	"Arm ave=622.0"

[UNDRAINED STRENGTH PARAMETERS]

Undrained yield stress (kPa)	:	"Arm ave=3340.7"

[DRAINED ANALYSIS OF SANDS]
[Hughes et al 1977]

Constant volume friction angle (°)	:	28.0
Angle of internal friction (°)	:	"Arm ave=29.9"
Dilation angle (°)	:	"Arm ave=2.1"
Gradient of log-log plot	:	"Arm ave=0.345"

[Withers et al 1989]

Angle of internal friction (°)	:	"Arm ave=38.0"
Dilation angle (°)	:	"Arm ave=11.8"
Gradient of log-log plot	:	"Arm ave=-2.257"

[LINEAR INTERPRETATION OF SHEAR MODULUS G]
Initial slope shear modulus (MPa) :"Arm ave=147.9"

Axis	Loop No	Value (MPa)	Mean Strain (%)	Mean Pc (kPa)	dE (%)	dPc (kPa)
Arm ave	1	818.1	0.058	1556	0.051	414
Arm ave	2	1024.7	0.884	3180	0.096	985
Arm ave	3	1031.7	2.427	3979	0.083	858
Arm ave	4	956.8	3.765	2930	0.118	1131

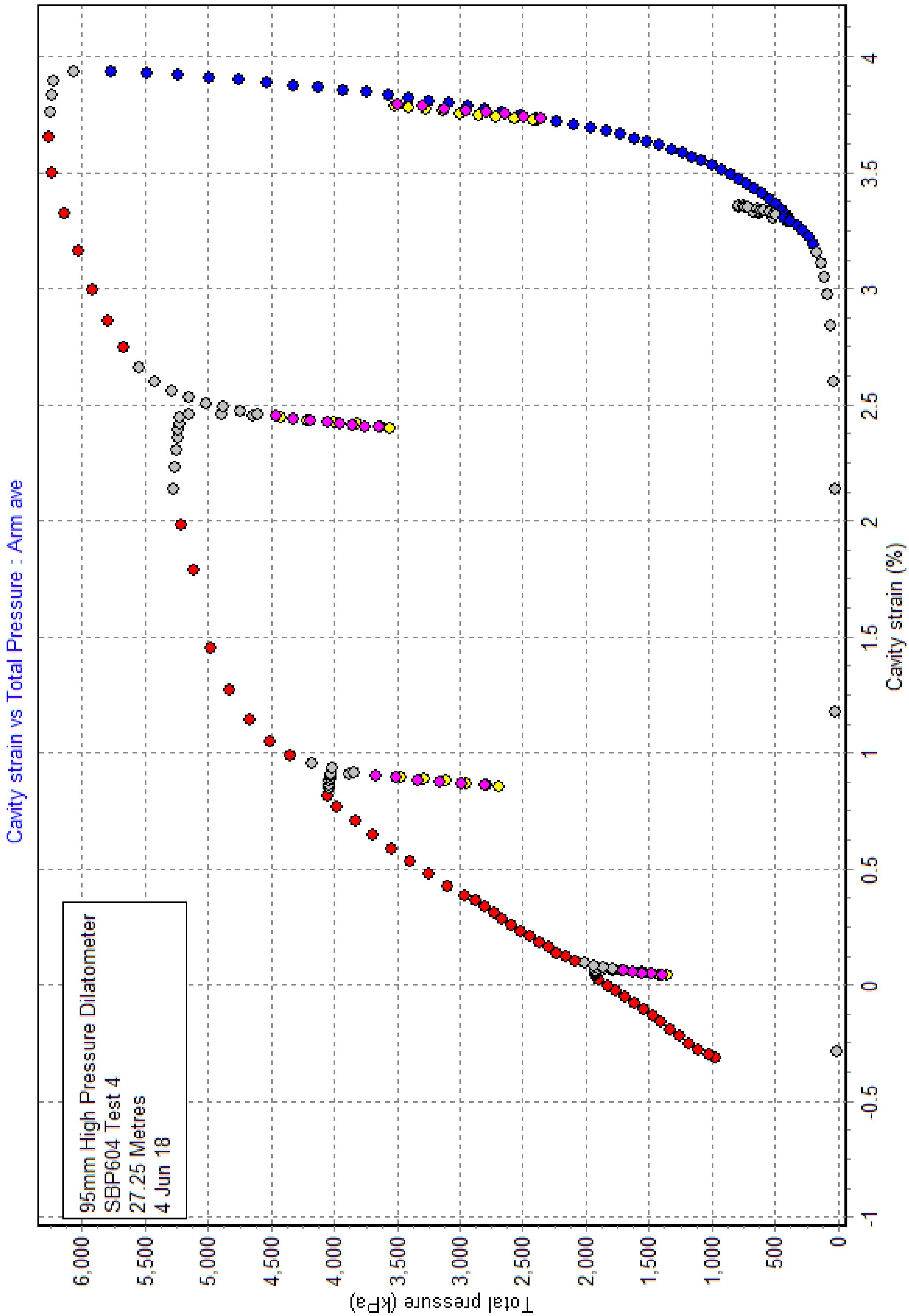
[UNDRAINED NON LINEAR INTERPRETATION OF SECANT SHEAR MODULUS]

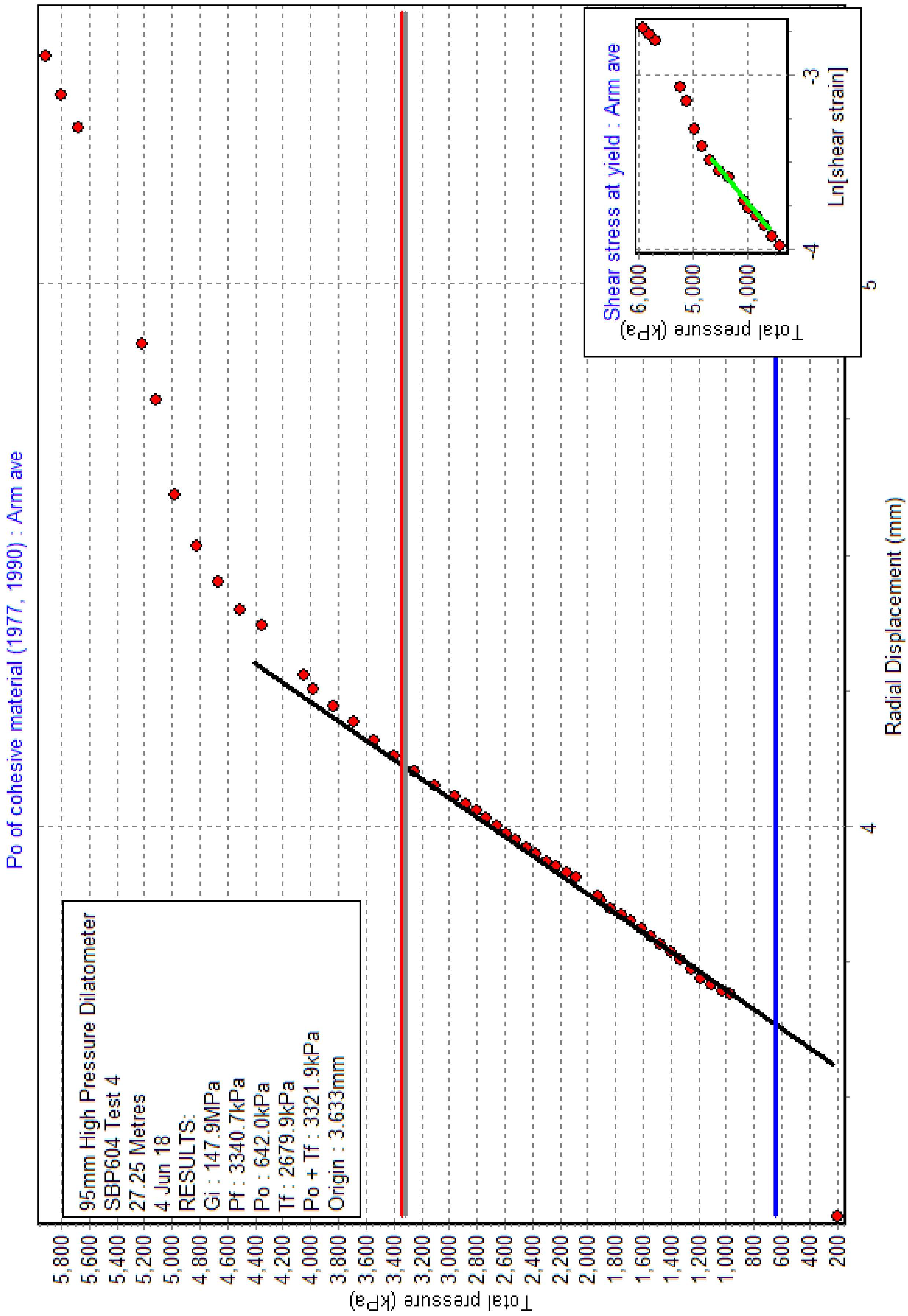
Axis	Loop No	Intercept (MPa)	Alpha (MPa)	Gradient
Arm ave	1	582.116	564.047	0.969
Arm ave	2	210.642	161.864	0.768
Arm ave	3	171.110	128.443	0.751
Arm ave	4	198.591	150.607	0.758

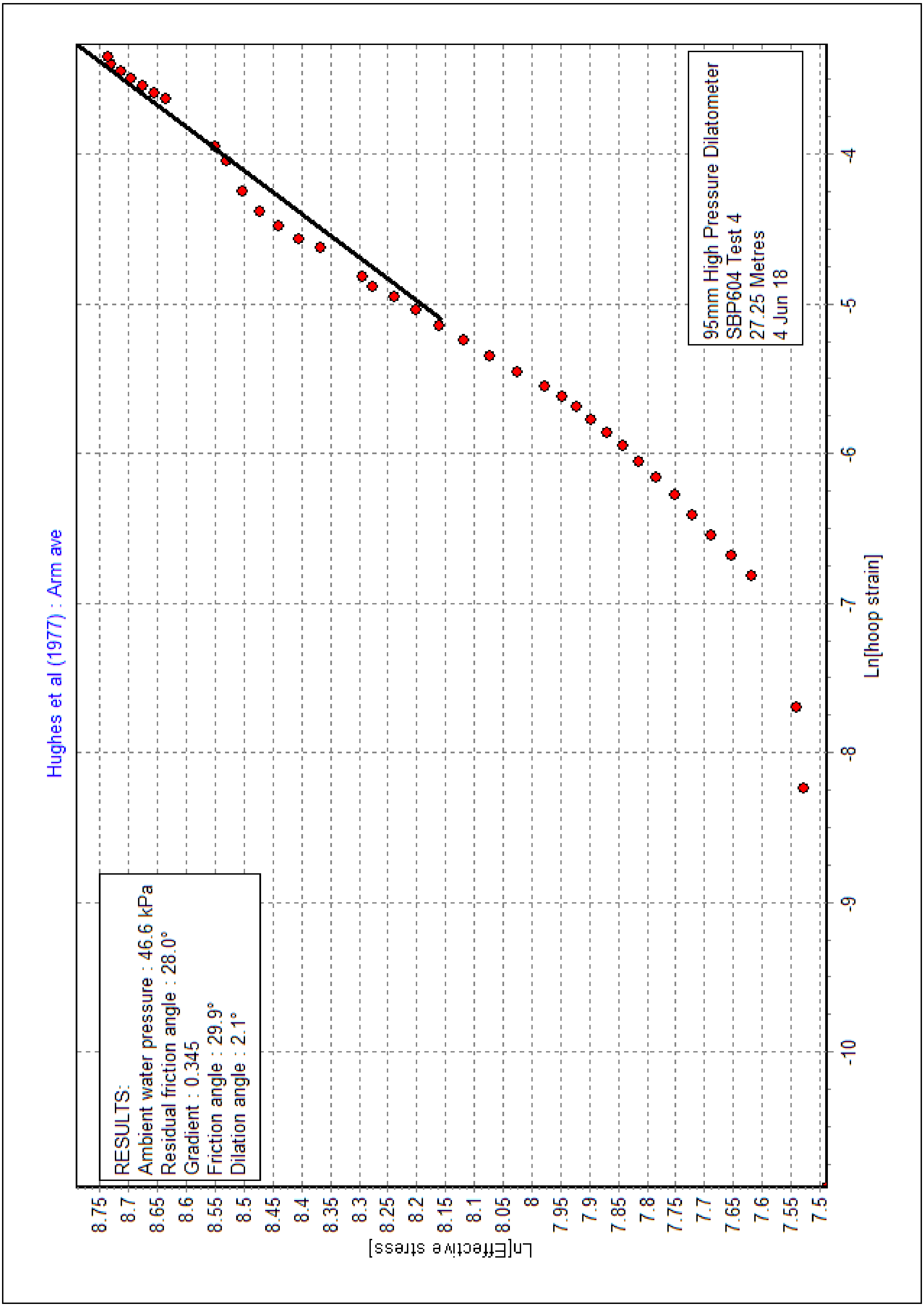
[PARAMETERS USED FOR DRAINED CURVE MODELLING]
{Axis is Arm ave}

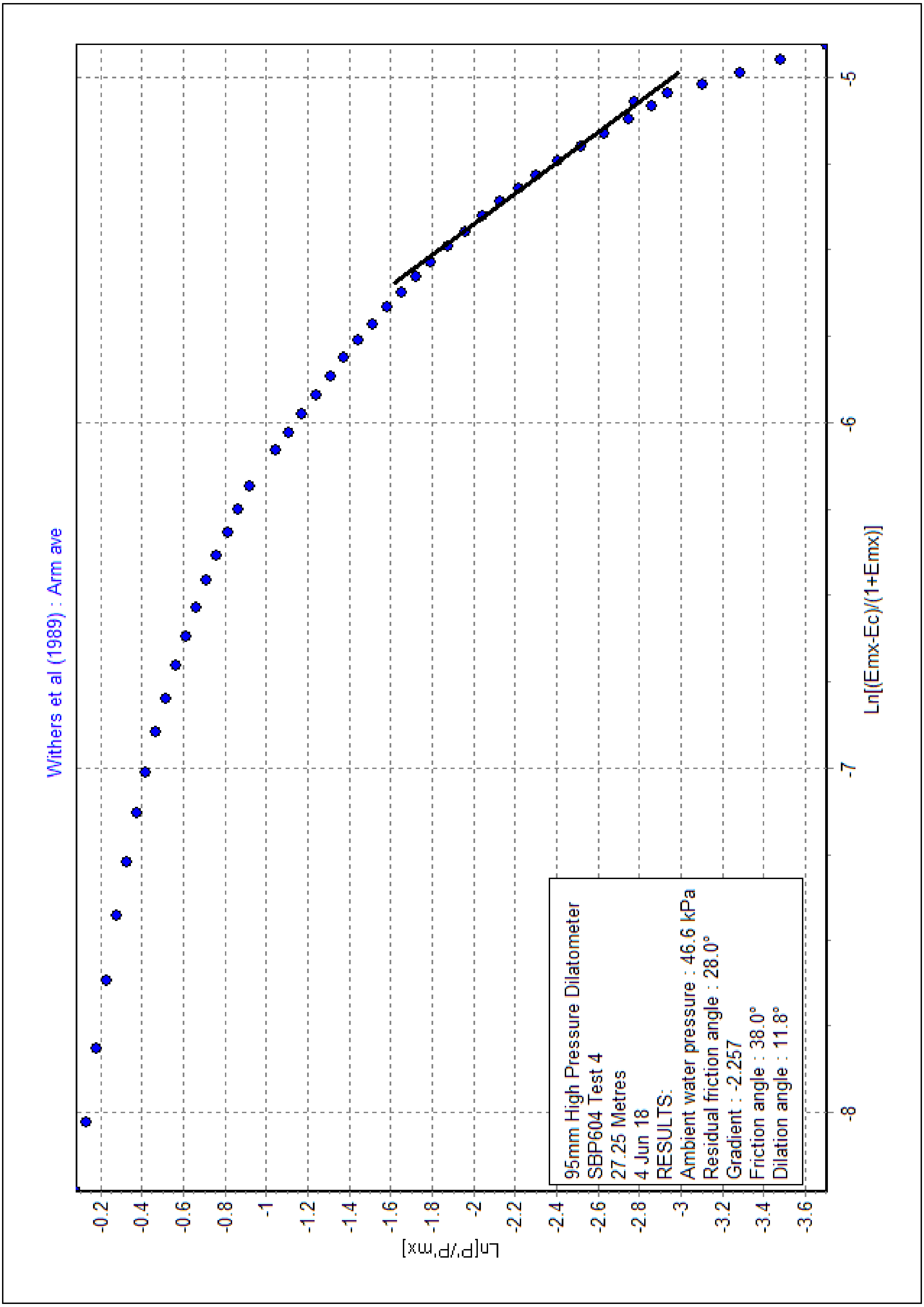
Strain Origin (mm)	:	3.85
Po (kPa)	:	622
Cohesion (kPa)	:	46
Angle of peak friction (deg)	:	29.9
Angle of peak dilation (deg)	:	2.1
Total yield stress (kPa)	:	1122
Total limit stress (kPa)	:	15805
G at first yield (MPa)	:	1036.3
Non-linear exponent	:	0.768
Janbu exponent	:	-0.016
Correlation	:	0.004

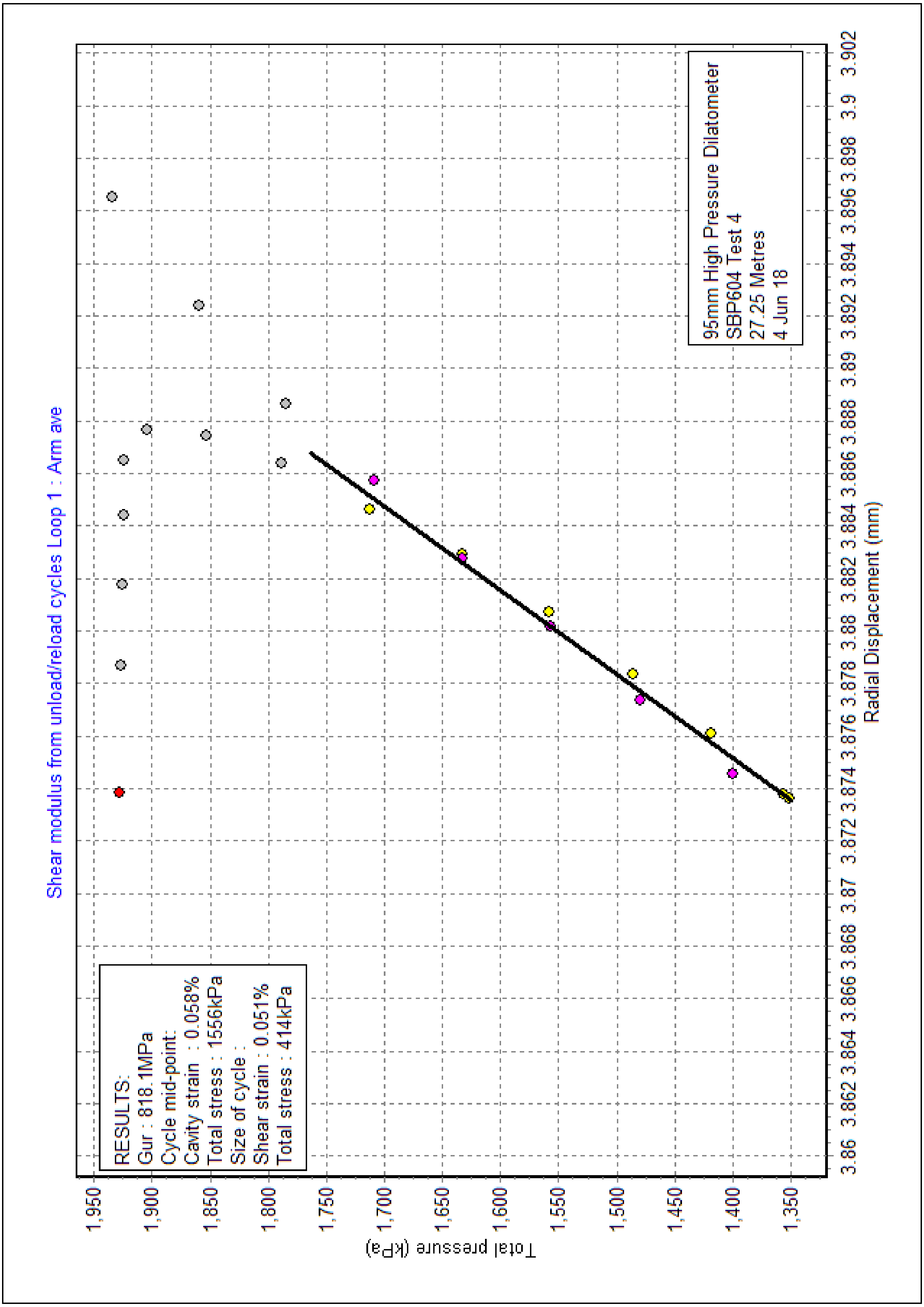
Ambient pore water pressure (kPa)	:	47
Residual friction angle (deg)	:	28.0
Poisson's ratio	:	0.33

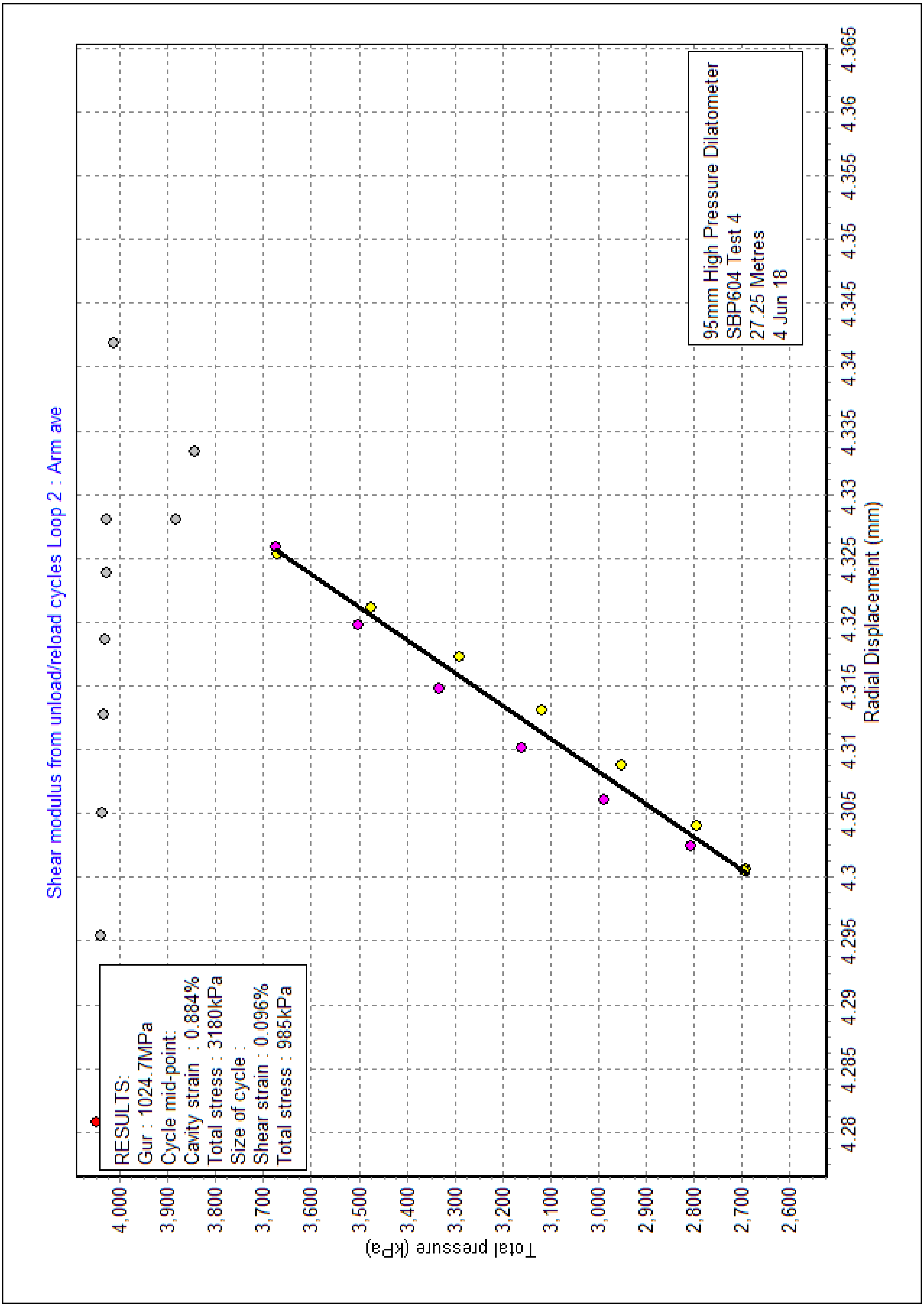

Cavity strain vs Total Pressure : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 4
27.25 Metres
4 Jun 18
Total pressure (kPa)
6,000
5,500
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Cavity strain (%)
-1
-0.5
0
0.5
1
1.5
2
2.5
3
3.5
4

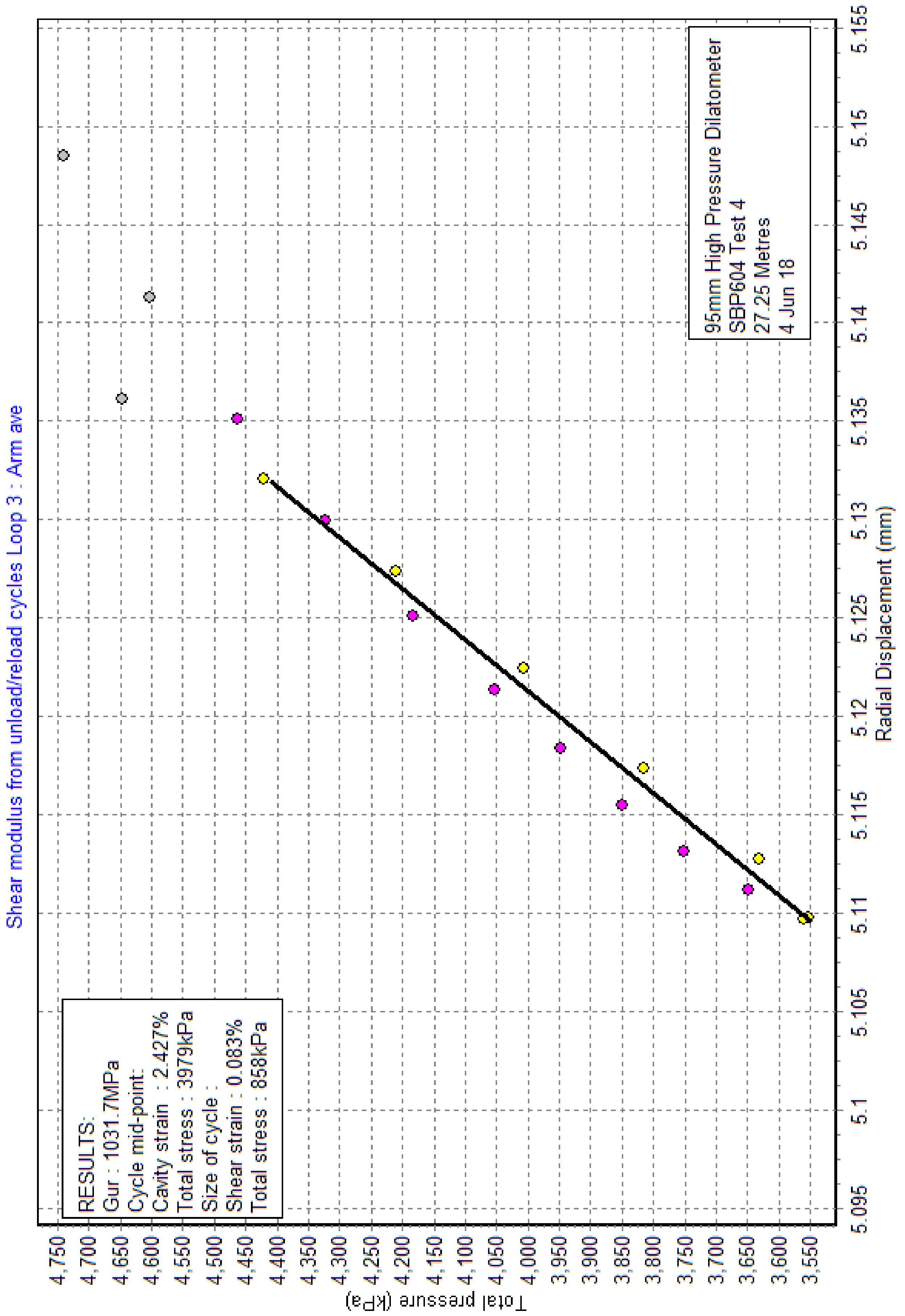

Po of cohesive material (1977, 1990) : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 4
27.25 Metres
4 Jun 18
RESULTS:
Gi : 147.9MPa
Pf : 3340.7kPa
Po : 642.0kPa
Tf : 2679.9kPa
Po + Tf : 3321.9kPa
Origin : 3.633mm
Total pressure (kPa)
5,800
5,600
5,400
5,200
5,000
4,800
4,600
4,400
4,200
4,000
3,800
3,600
3,400
3,200
3,000
2,800
2,600
2,400
2,200
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
Radial Displacement (mm)
4
5
Shear stress at yield : Arm ave
Total pressure (kPa)
6,000
5,000
4,000
Ln[shear strain]
-3
-4

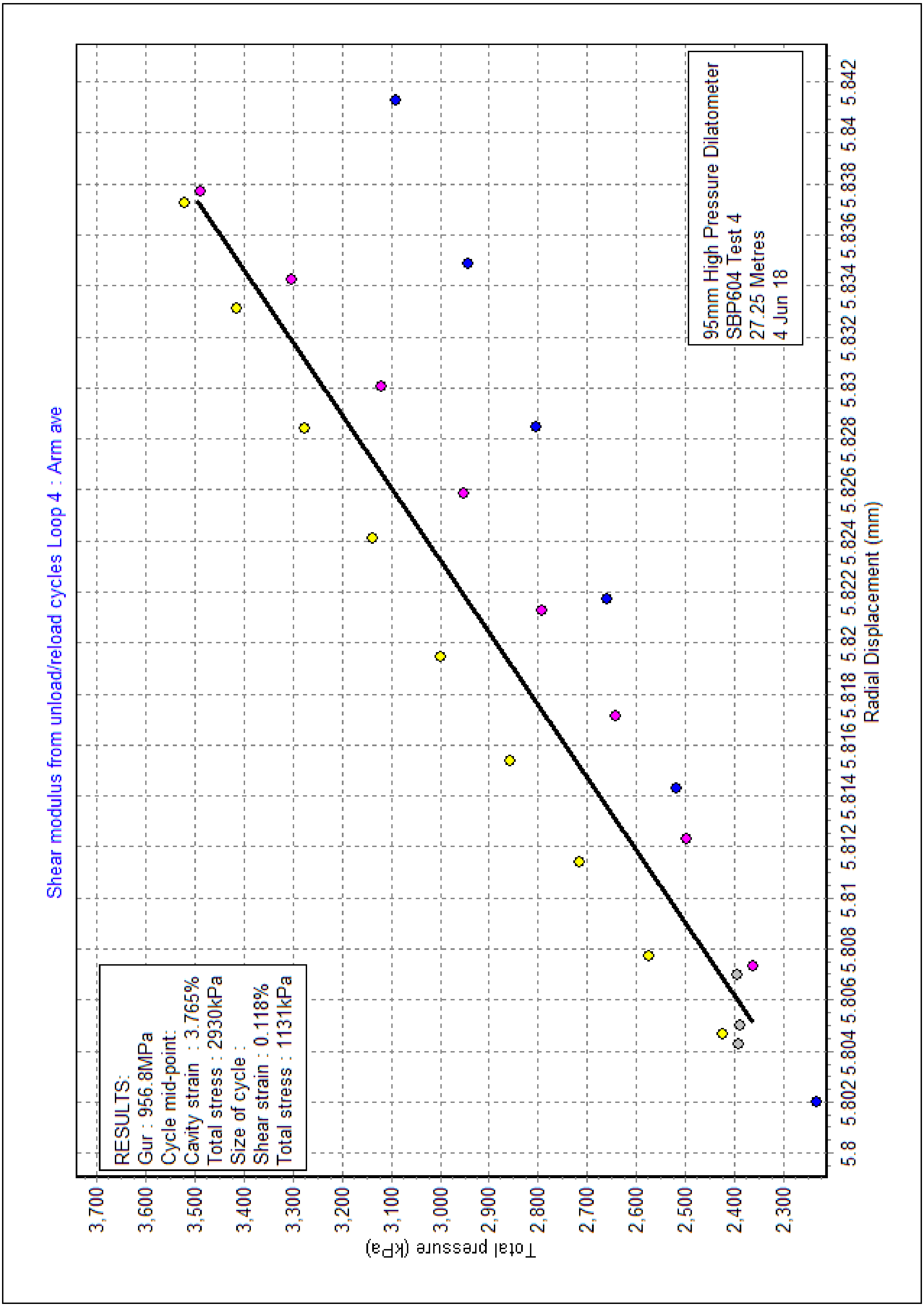

Hughes et al (1977) : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 4
27.25 Metres
4 Jun 18
RESULTS:
Ambient water pressure : 46.6 kPa
Residual friction angle : 28.0°
Gradient : 0.345
Friction angle : 29.9°
Dilation angle : 2.1°
Ln[hoop strain]
Ln[Effective stress]
-4
-5
-6
-7
-8
-9
-10
8.75
8.7
8.65
8.6
8.55
8.5
8.45
8.4
8.35
8.3
8.25
8.2
8.15
8.1
8.05
8
7.95
7.9
7.85
7.8
7.75
7.7
7.65
7.6
7.55
7.5

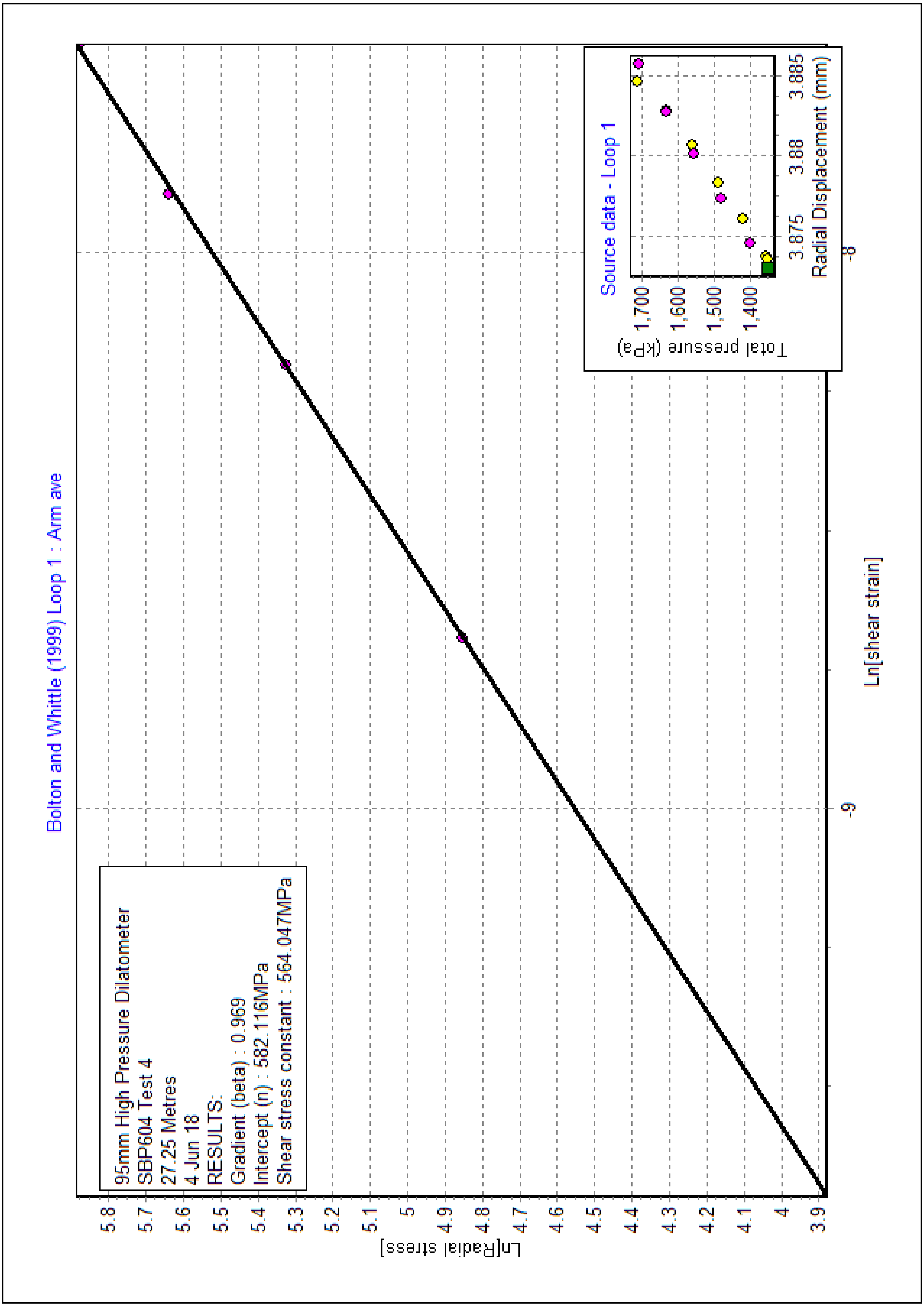

Withers et al (1989) : Arm ave
Ln[(Emx-Ec)/(1+Emx)]
Ln[P'/P'mx]
-5
-6
-7
-8
-0.2
-0.4
-0.6
-0.8
-1
-1.2
-1.4
-1.6
-1.8
-2
-2.2
-2.4
-2.6
-2.8
-3
-3.2
-3.4
-3.6
95mm High Pressure Dilatometer
SBP604 Test 4
27.25 Metres
4 Jun 18
RESULTS:
Ambient water pressure : 46.6 kPa
Residual friction angle : 28.0°
Gradient : -2.257
Friction angle : 38.0°
Dilation angle : 11.8°

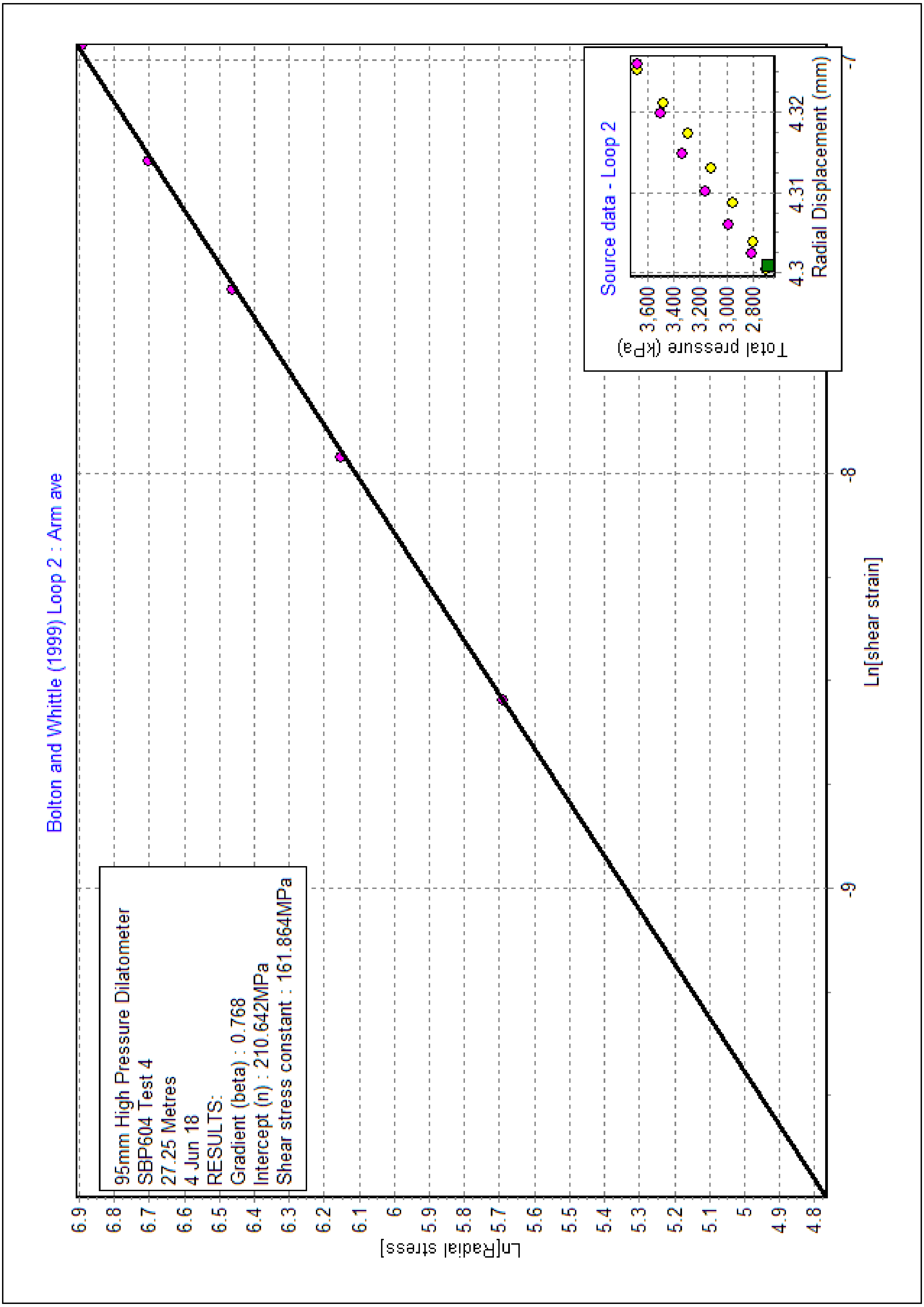

Shear modulus from unload/reload cycles Loop 1 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 4
27.25 Metres
4 Jun 18
RESULTS:
Gur : 818.1MPa
Cycle mid-point:
Cavity strain : 0.058%
Total stress : 1556kPa
Size of cycle :
Shear strain : 0.051%
Total stress : 414kPa
Radial Displacement (mm)
3.86 3.862 3.864 3.866 3.868 3.87 3.872 3.874 3.876 3.878 3.88 3.882 3.884 3.886 3.888 3.89 3.892 3.894 3.896 3.898 3.9 3.902
Total pressure (kPa)
1,350 1,400 1,450 1,500 1,550 1,600 1,650 1,700 1,750 1,800 1,850 1,900 1,950

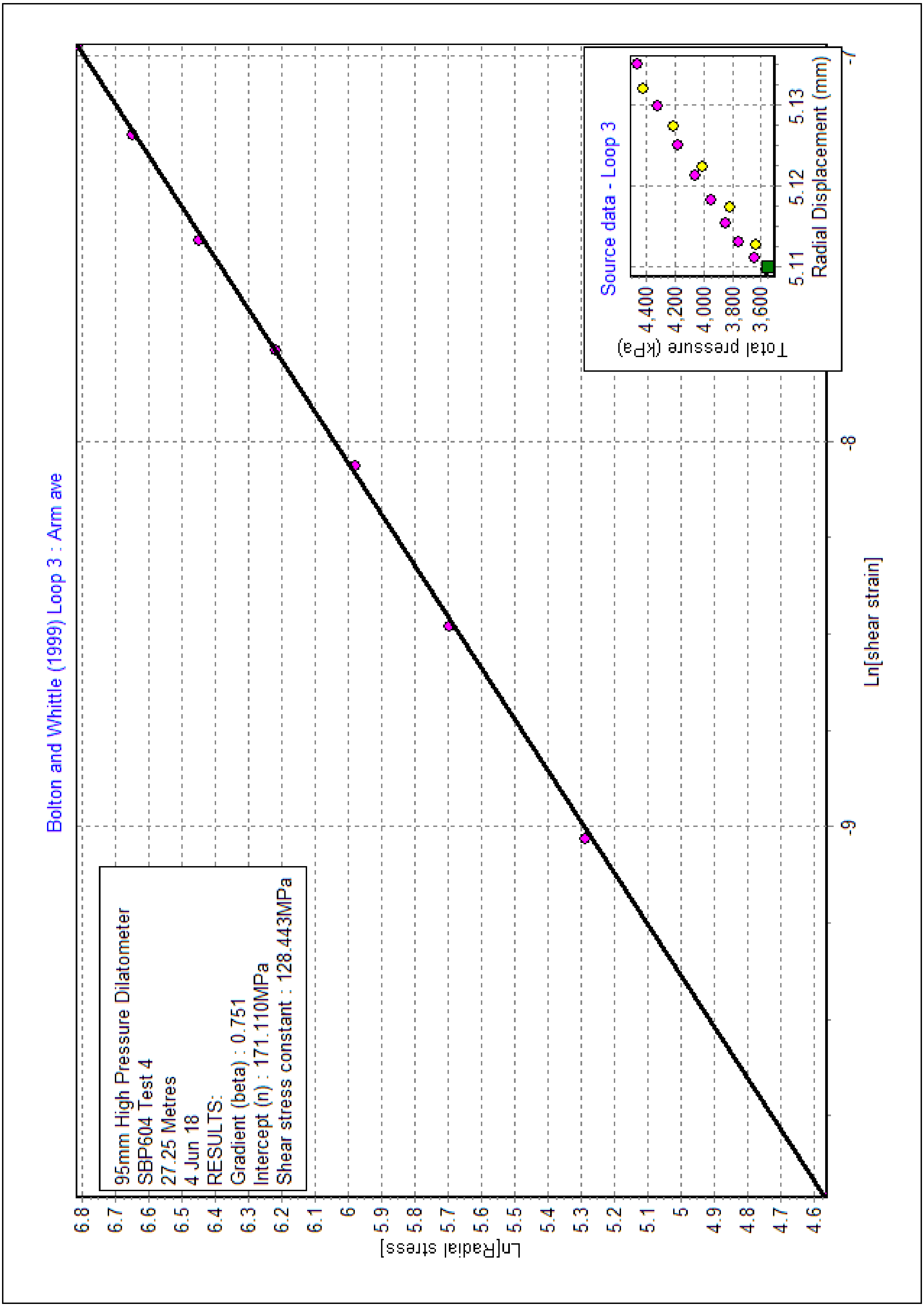

Shear modulus from unload/reload cycles Loop 2 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 4
27.25 Metres
4 Jun 18
RESULTS:
Gur : 1024.7MPa
Cycle mid-point:
Cavity strain : 0.884%
Total stress : 3180kPa
Size of cycle :
Shear strain : 0.096%
Total stress : 985kPa
Radial Displacement (mm)
Total pressure (kPa)
4.28
4.285
4.29
4.295
4.3
4.305
4.31
4.315
4.32
4.325
4.33
4.335
4.34
4.345
4.35
4.355
4.36
4.365
4,000
3,900
3,800
3,700
3,600
3,500
3,400
3,300
3,200
3,100
3,000
2,900
2,800
2,700
2,600

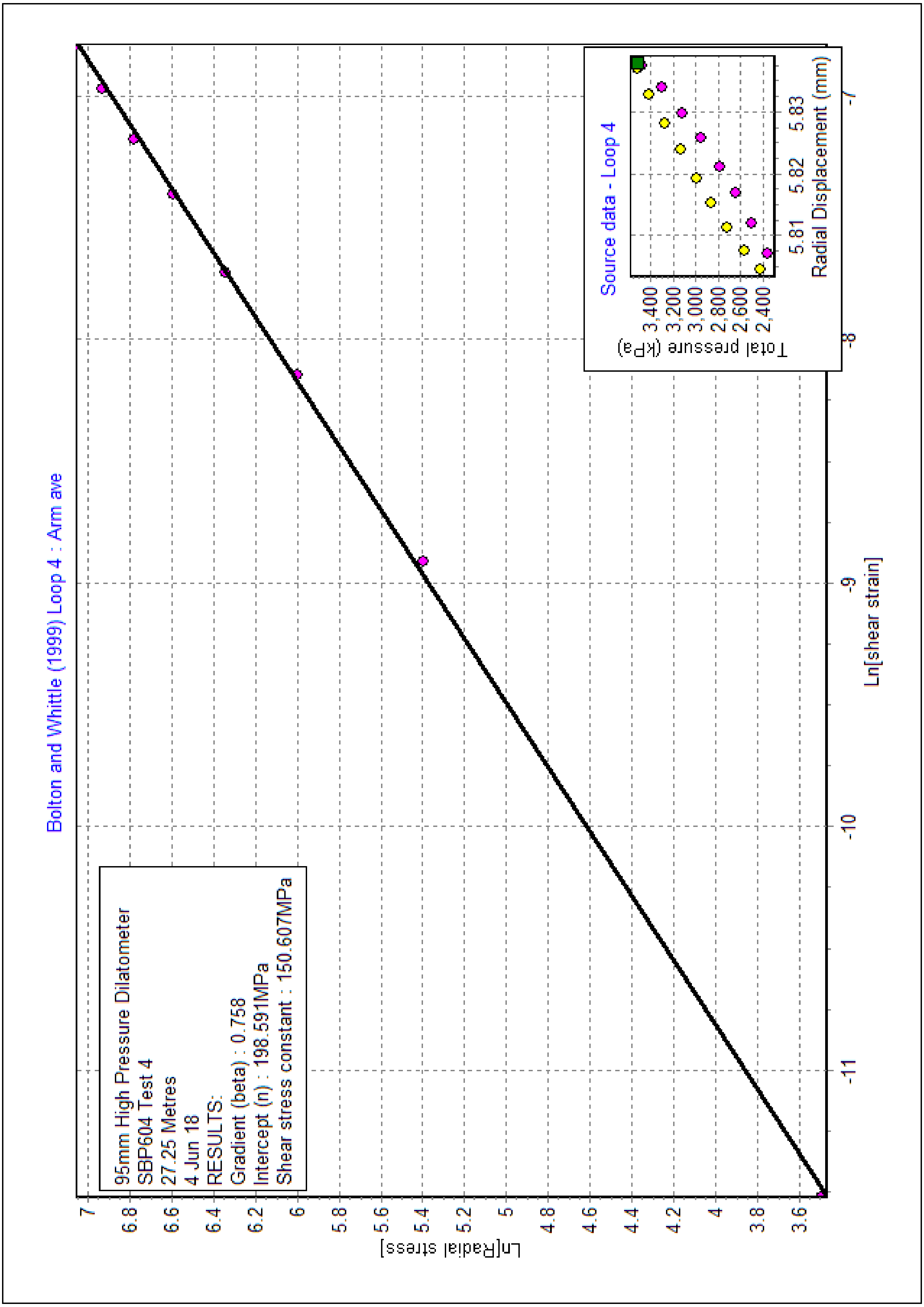

Shear modulus from unload/reload cycles Loop 3 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 4
27.25 Metres
4 Jun 18
RESULTS:
Gur : 1031.7MPa
Cycle mid-point:
Cavity strain : 2.427%
Total stress : 3979kPa
Size of cycle :
Shear strain : 0.083%
Total stress : 858kPa
Radial Displacement (mm)
Total pressure (kPa)
5.095
5.1
5.105
5.11
5.115
5.12
5.125
5.13
5.135
5.14
5.145
5.15
5.155
3,550
3,600
3,650
3,700
3,750
3,800
3,850
3,900
3,950
4,000
4,050
4,100
4,150
4,200
4,250
4,300
4,350
4,400
4,450
4,500
4,550
4,600
4,650
4,700
4,750


Shear modulus from unload/reload cycles Loop 4 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 4
27.25 Metres
4 Jun 18
RESULTS:
Gur : 956.8MPa
Cycle mid-point:
Cavity strain : 3.765%
Total stress : 2930kPa
Size of cycle :
Shear strain : 0.118%
Total stress : 1131kPa
Radial Displacement (mm)
Total pressure (kPa)
5.8
5.802
5.804
5.806
5.808
5.81
5.812
5.814
5.816
5.818
5.82
5.822
5.824
5.826
5.828
5.83
5.832
5.834
5.836
5.838
5.84
5.842
2,300
2,400
2,500
2,600
2,700
2,800
2,900
3,000
3,100
3,200
3,300
3,400
3,500
3,600
3,700

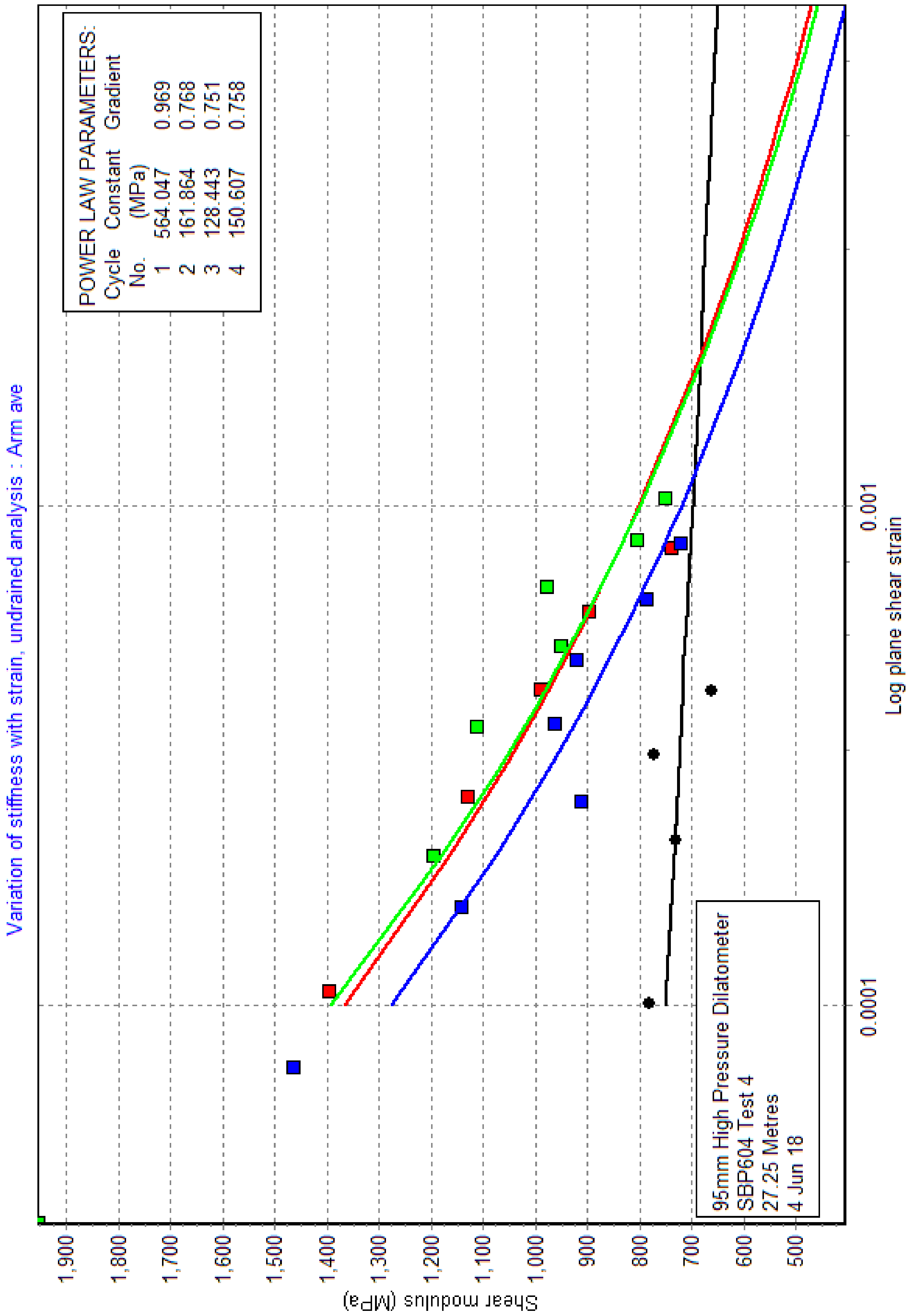

Bolton and Whittle (1999) Loop 1 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 4
27.25 Metres
4 Jun 18
RESULTS:
Gradient (beta) : 0.969
Intercept (n) : 582.116MPa
Shear stress constant : 564.047MPa
Ln[Radial stress]
Ln[shear strain]
5.8
5.7
5.6
5.5
5.4
5.3
5.2
5.1
5
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4
3.9
-9
-8
Source data - Loop 1
Total pressure (kPa)
Radial Displacement (mm)
1,700
1,600
1,500
1,400
3.875
3.88
3.885

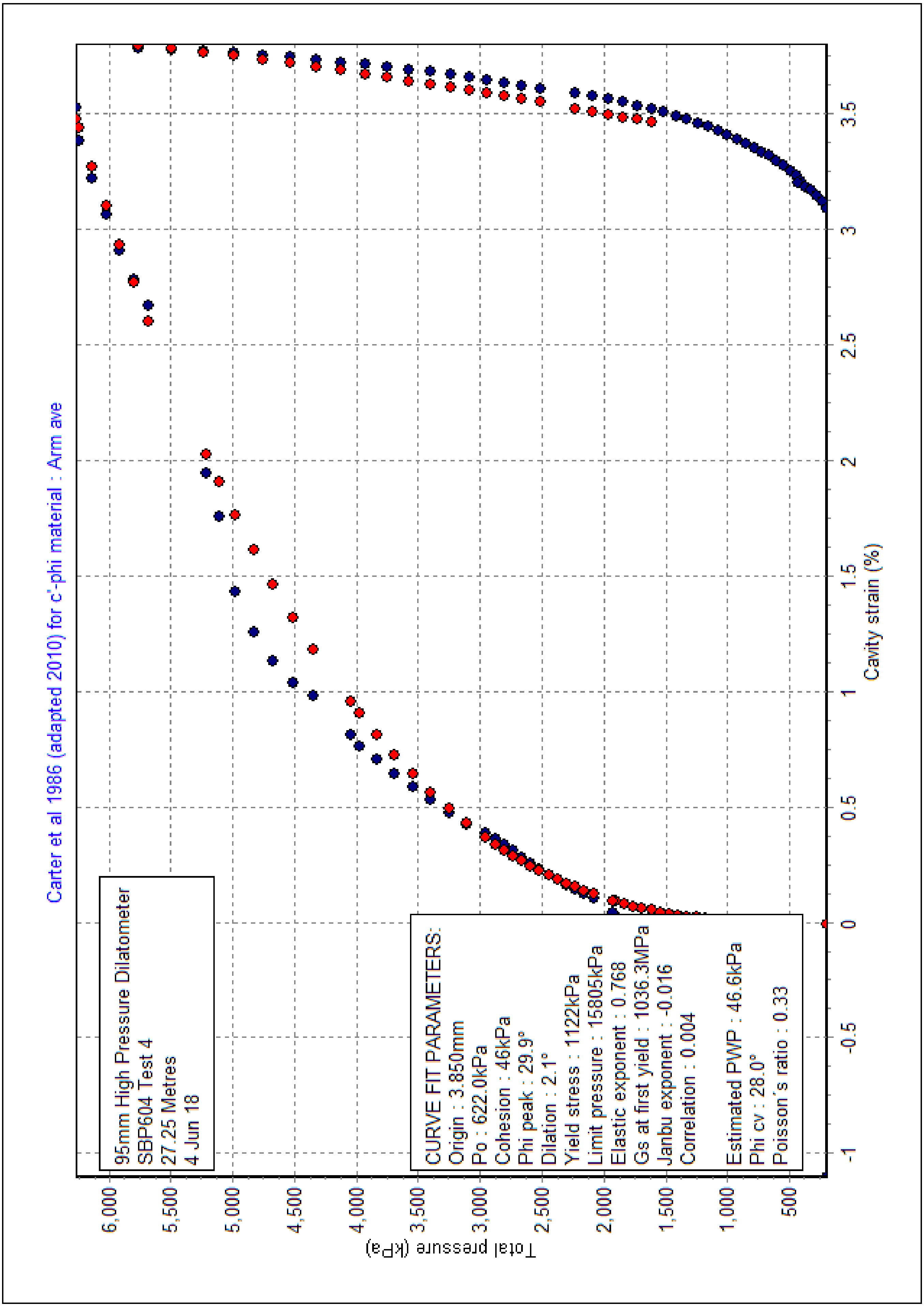

Bolton and Whittle (1999) Loop 2 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 4
27.25 Metres
4 Jun 18
RESULTS:
Gradient (beta) : 0.768
Intercept (n) : 210.642MPa
Shear stress constant : 161.864MPa
Ln[Radial stress]
6.9
6.8
6.7
6.6
6.5
6.4
6.3
6.2
6.1
6
5.9
5.8
5.7
5.6
5.5
5.4
5.3
5.2
5.1
5
4.9
4.8
Ln[shear strain]
-7
-8
-9
Source data - Loop 2
Total pressure (kPa)
3,600
3,400
3,200
3,000
2,800
Radial Displacement (mm)
4.3
4.31
4.32

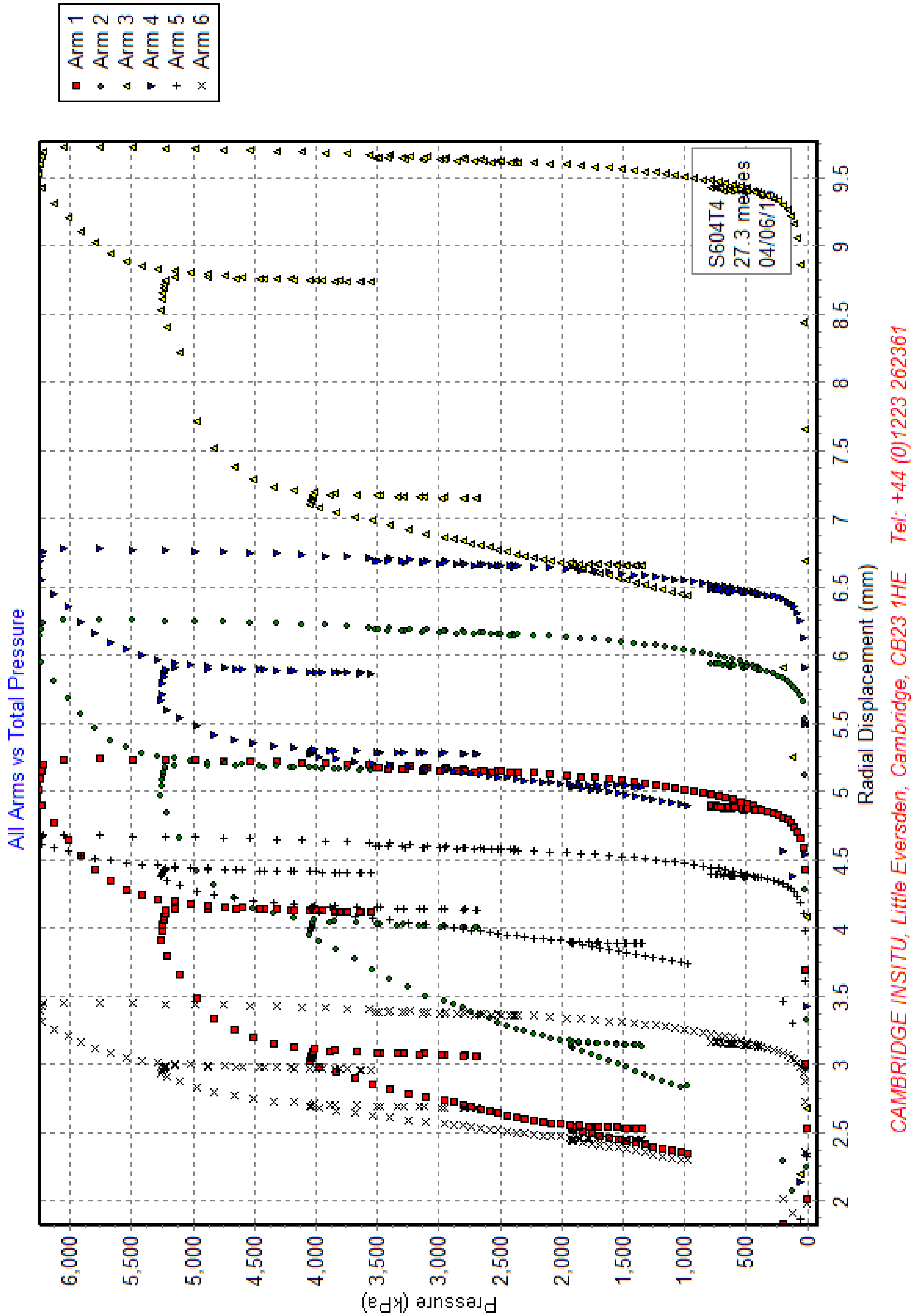

Bolton and Whittle (1999) Loop 3 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 4
27.25 Metres
4 Jun 18
RESULTS:
Gradient (beta) : 0.751
Intercept (n) : 171.110MPa
Shear stress constant : 128.443MPa
Ln[Radial stress]
6.8
6.7
6.6
6.5
6.4
6.3
6.2
6.1
6
5.9
5.8
5.7
5.6
5.5
5.4
5.3
5.2
5.1
5
4.9
4.8
4.7
4.6
Ln[shear strain]
-9
-8
-7
Source data - Loop 3
Total pressure (kPa)
4,400
4,200
4,000
3,800
3,600
Radial Displacement (mm)
5.11
5.12
5.13

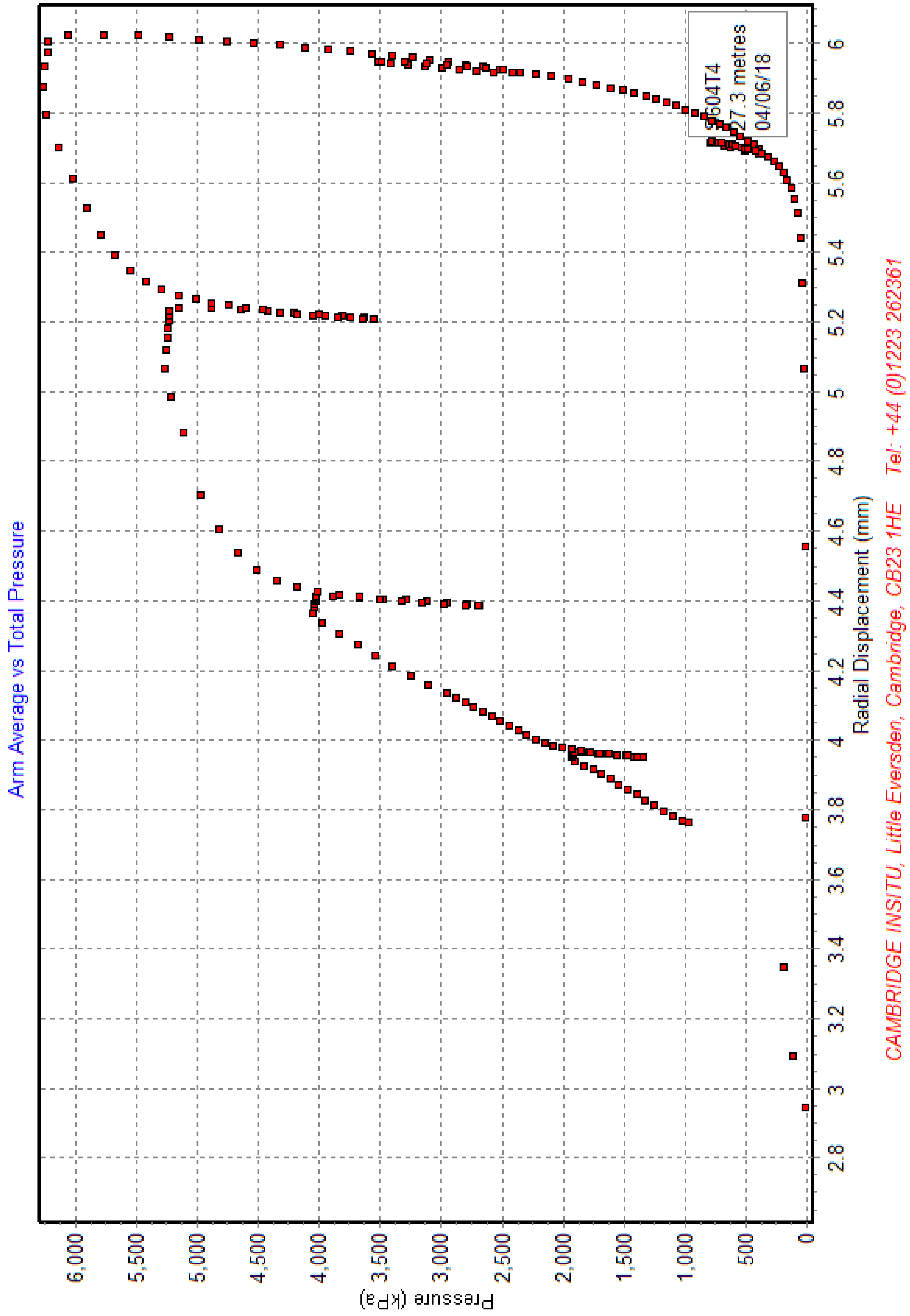


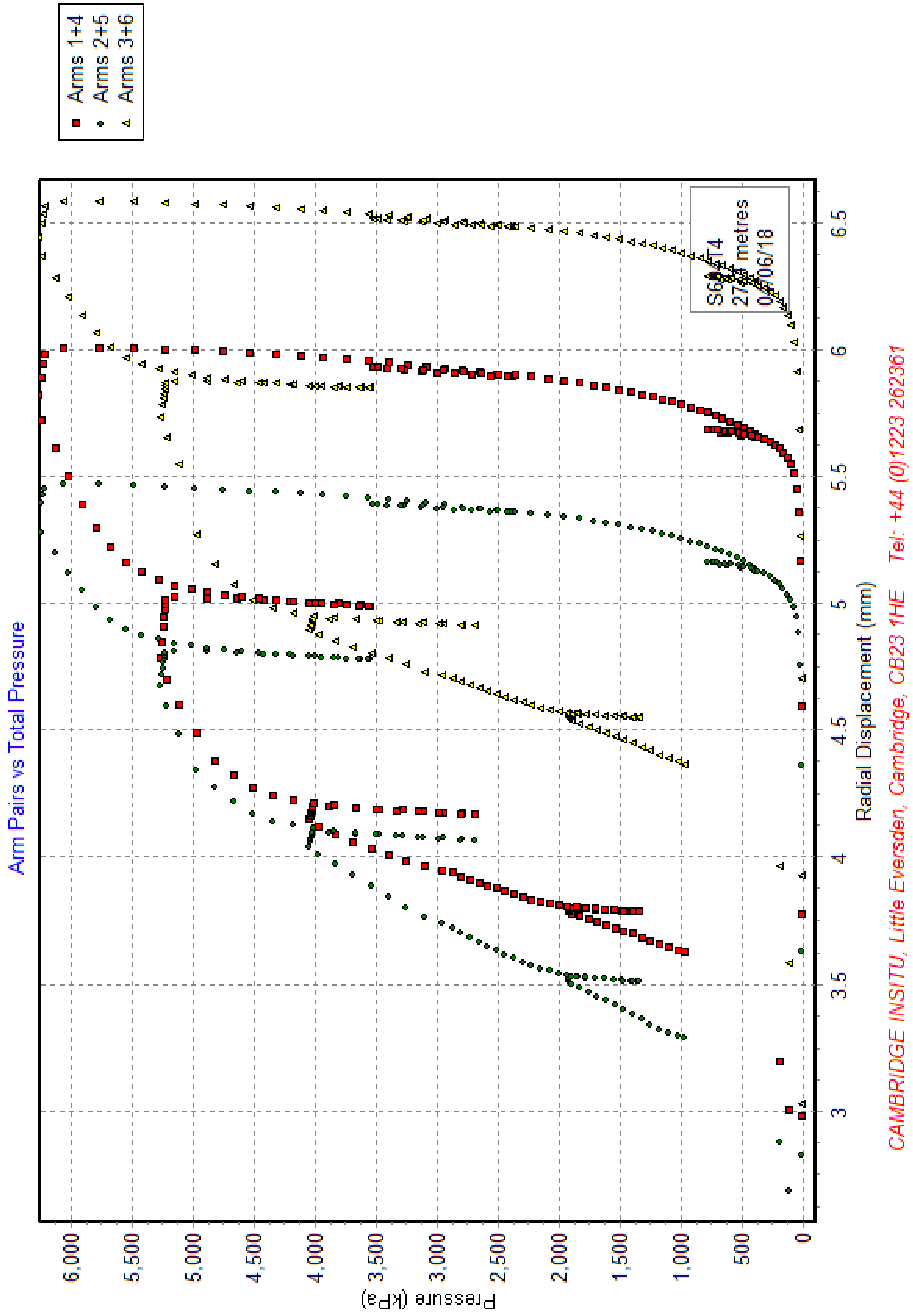
Bolton and Whittle (1999) Loop 4 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 4
27.25 Metres
4 Jun 18
RESULTS:
Gradient (beta) : 0.758
Intercept (n) : 198.591MPa
Shear stress constant : 150.607MPa
Ln[Radial stress]
7
6.8
6.6
6.4
6.2
6
5.8
5.6
5.4
5.2
5
4.8
4.6
4.4
4.2
4
3.8
3.6
Ln[shear strain]
-7
-8
-9
-10
-11
Source data - Loop 4
Total pressure (kPa)
3,400
3,200
3,000
2,800
2,600
2,400
Radial Displacement (mm)
5.81
5.82
5.83


Variation of stiffness with strain, undrained analysis : Arm ave
POWER LAW PARAMETERS:
Cycle No. | Constant (MPa) | Gradient
1 564.047 0.969
2 161.864 0.768
3 128.443 0.751
4 150.607 0.758
95mm High Pressure Dilatometer
SBP604 Test 4
27.25 Metres
4 Jun 18
Shear modulus (MPa)
1,900
1,800
1,700
1,600
1,500
1,400
1,300
1,200
1,100
1,000
900
800
700
600
500
Log plane shear strain
0.0001
0.001

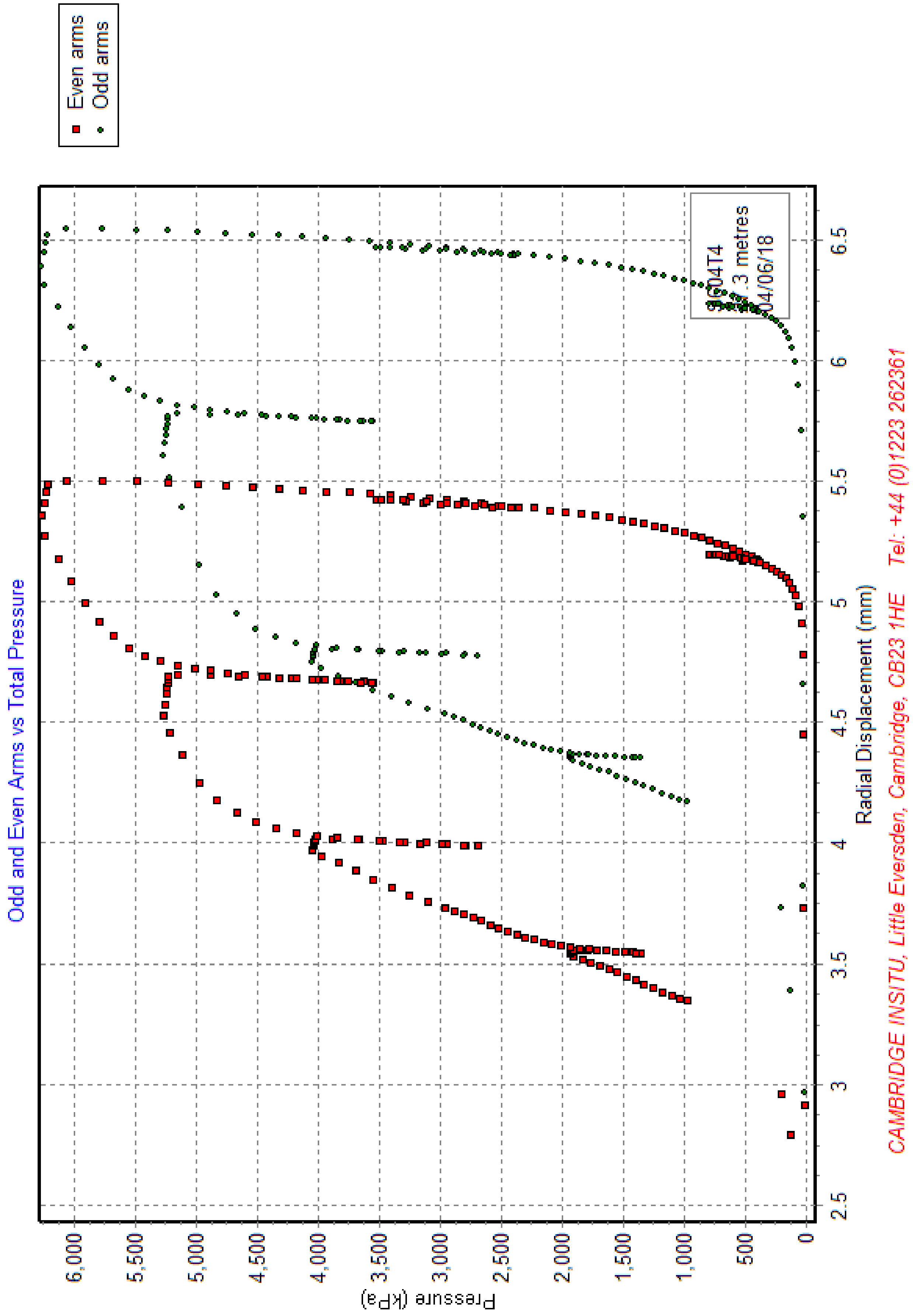

Carter et al 1986 (adapted 2010) for c'-phi material : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 4
27.25 Metres
4 Jun 18
CURVE FIT PARAMETERS:
Origin : 3.850mm
Po : 622.0kPa
Cohesion : 46kPa
Phi peak : 29.9°
Dilation : 2.1°
Yield stress : 1122kPa
Limit pressure : 15805kPa
Elastic exponent : 0.768
Gs at first yield : 1036.3MPa
Janbu exponent : -0.016
Correlation : 0.004
Estimated PWP : 46.6kPa
Phi cv : 28.0°
Poisson's ratio : 0.33
Total pressure (kPa)
6,000
5,500
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
Cavity strain (%)
-1
-0.5
0
0.5
1
1.5
2
2.5
3
3.5


Arm 1
Arm 2
Arm 3
Arm 4
Arm 5
Arm 6
All Arms vs Total Pressure
S604T4
27.3 metres
04/06/1
Radial Displacement (mm)
Pressure (kPa)
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361


Arm Average vs Total Pressure
S604T4
27.3 metres
04/06/18
Radial Displacement (mm)
Pressure (kPa)
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361



Arm Pairs vs Total Pressure
Arms 1+4
Arms 2+5
Arms 3+6
Radial Displacement (mm)
3
3.5
4
4.5
5
5.5
6
6.5
Pressure (kPa)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
4,500
5,000
5,500
6,000
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361


Odd and Even Arms vs Total Pressure
Even arms
Odd arms
3 metres
04/06/18
Radial Displacement (mm)
Pressure (kPa)
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361

SBP604 Test 5 - SUMMARY OF RESULTS
[File made with WinSitu Version 3.9.1.1]

[DETAILS OF TEST]

Project	:	60547200
Site	:	A303 Stonehenge
Borehole	:	SBP604
Test name	:	SBP604 Test 5
Test date	:	4 Jun 18
Test depth	:	30.75 Metres
Water table	:	22.5 Metres
Ambient PWP	:	80.9 kPa
Material	:	Chalk
Probe	:	95mm High Pressure Dilatometer
Diameter	:	97.0 mm

Data analysed using average arm displacement curve
A non-linear analysis of the rebound cycles has been carried out
The file includes results from a curve fitting analysis

Analysed by RWW on 7 Jun 18

Remarks: Core run nominally 29 to 32, but many problems with blocking off.

[RESULTS FOR CAVITY REFERENCE PRESSURE]

Strain Origin (mm)	:	"Arm ave=4.38"
Po from Marsland & Randolph (kPa)	:	"Arm ave=746.6"
Best estimate of Po (kPa)	:	"Arm ave=743.0"

[UNDRAINED STRENGTH PARAMETERS]

Undrained yield stress (kPa)	:	"Arm ave=3663.4"

[DRAINED ANALYSIS OF SANDS]
[Hughes et al 1977]

Constant volume friction angle (°)	:	28.0
Angle of internal friction (°)	:	"Arm ave=33.6"
Dilation angle (°)	:	"Arm ave=6.6"
Gradient of log-log plot	:	"Arm ave=0.397"

[Withers et al 1989]

Angle of internal friction (°)	:	"Arm ave=33.4"
Dilation angle (°)	:	"Arm ave=6.3"
Gradient of log-log plot	:	"Arm ave=-2.059"

[LINEAR INTERPRETATION OF SHEAR MODULUS G]
Initial slope shear modulus (MPa) :"Arm ave=171.9"

Axis	Loop No	Value (MPa)	Mean Strain (%)	Mean Pc (kPa)	dE (%)	dPc (kPa)
Arm ave	1	744.4	-0.109	1700	0.042	311
Arm ave	2	1073.8	0.511	3310	0.068	735
Arm ave	3	1100.8	1.366	4887	0.108	1193
Arm ave	4	968.9	2.607	3619	0.156	1514

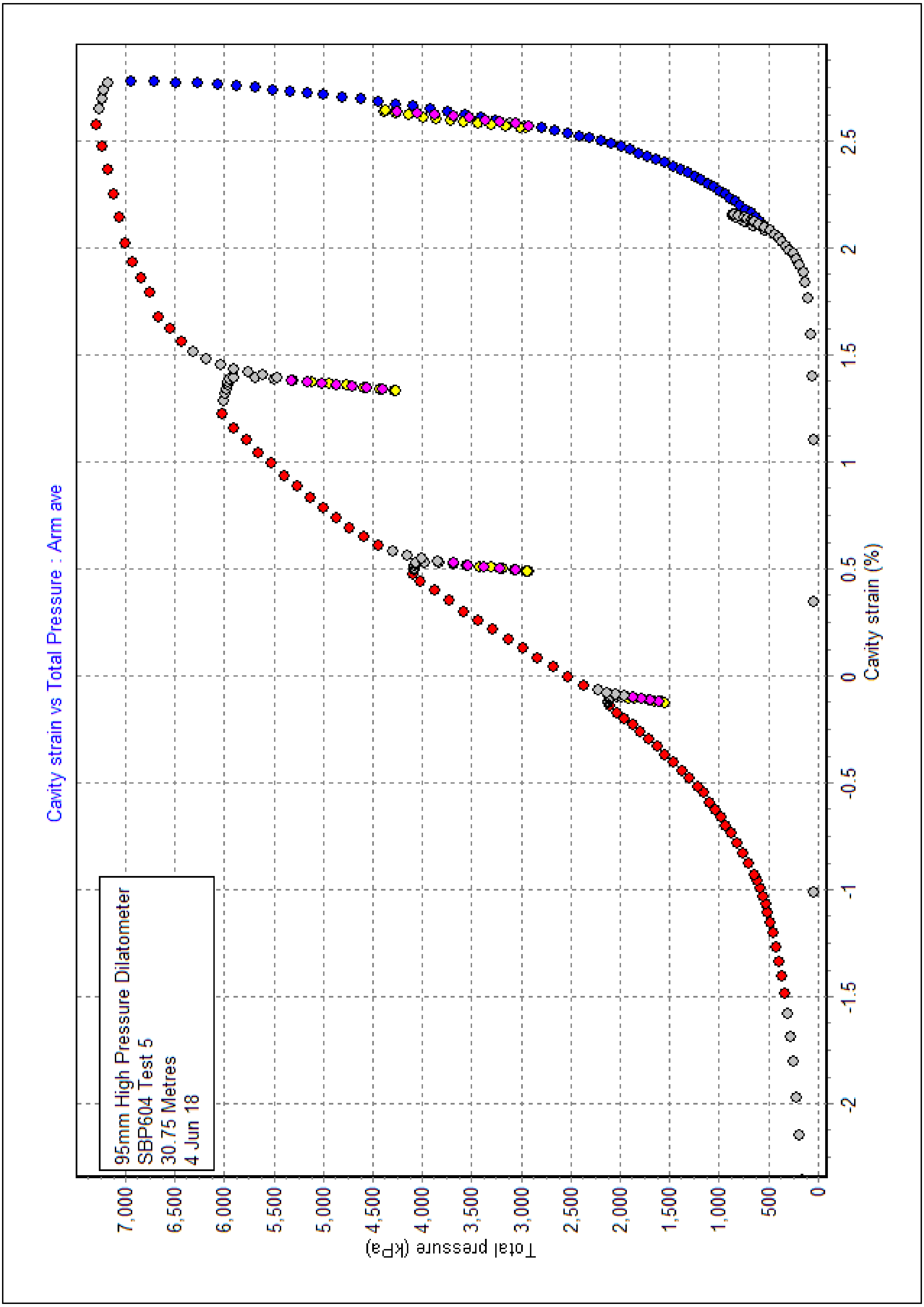
[UNDRAINED NON LINEAR INTERPRETATION OF SECANT SHEAR MODULUS]

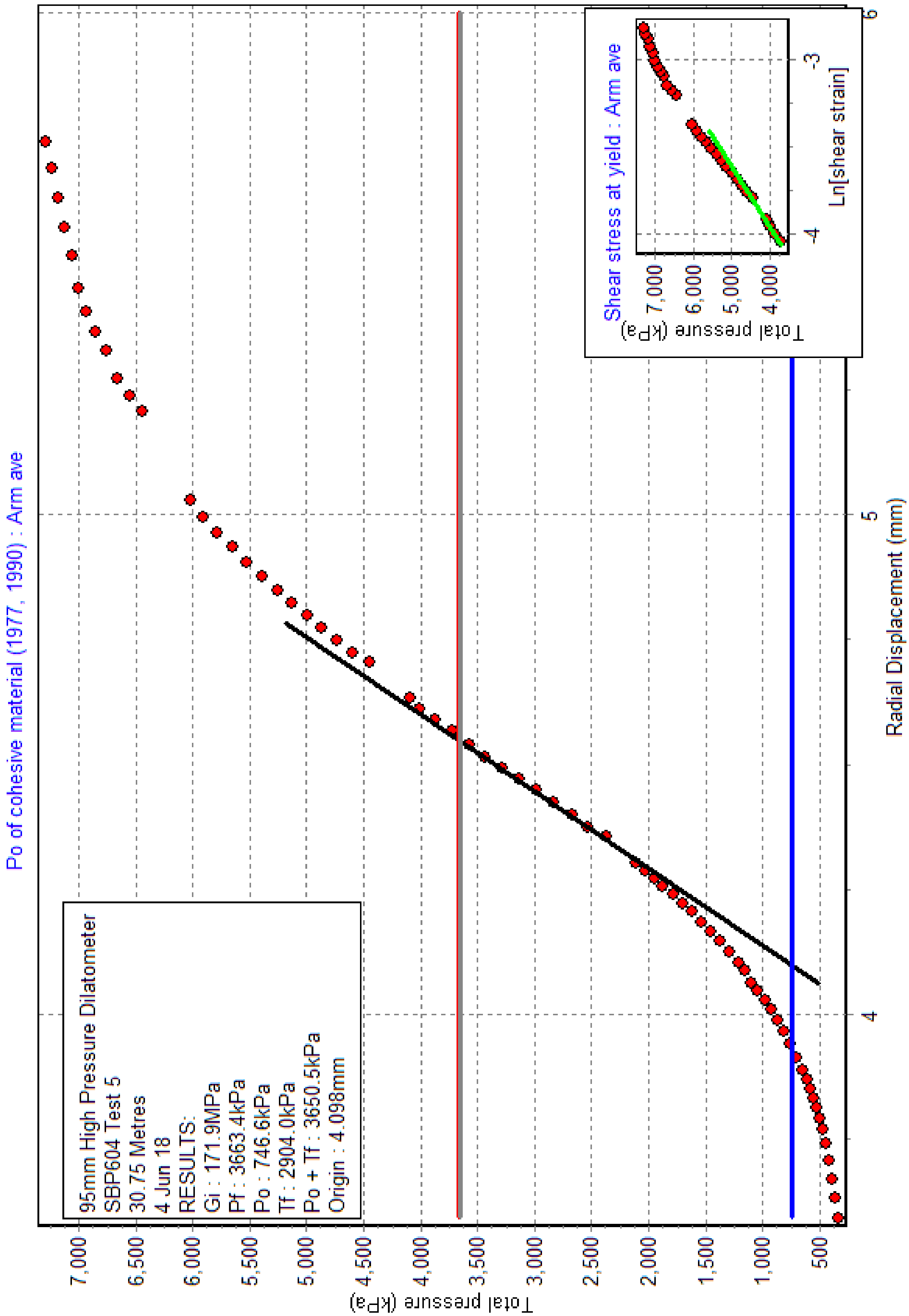
Axis	Loop No	Intercept (MPa)	Alpha (MPa)	Gradient
Arm ave	1	670.613	668.041	0.996
Arm ave	2	614.573	570.812	0.929
Arm ave	3	459.206	403.056	0.878
Arm ave	4	172.027	124.533	0.724

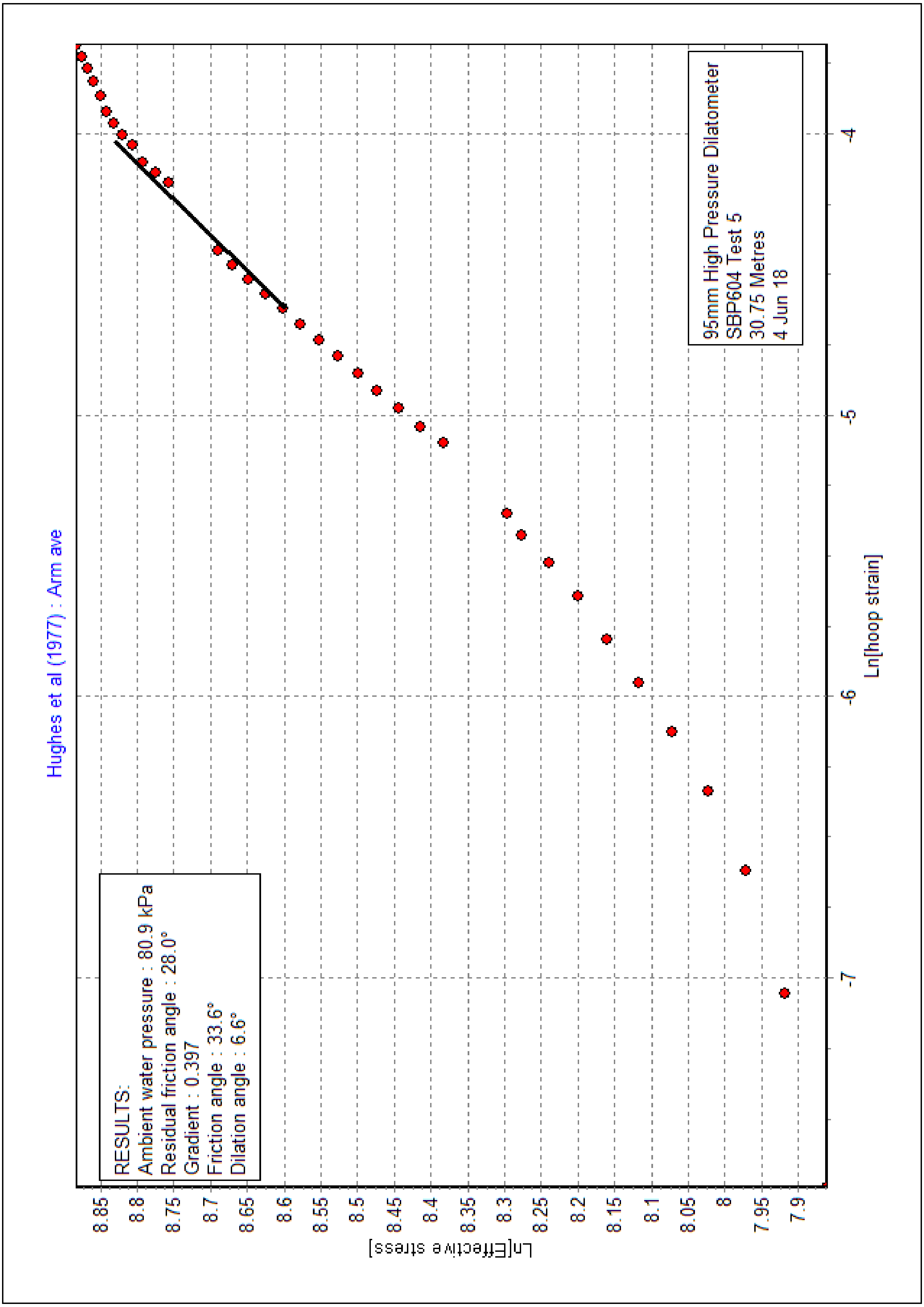
[PARAMETERS USED FOR DRAINED CURVE MODELLING]
{Axis is Arm ave}

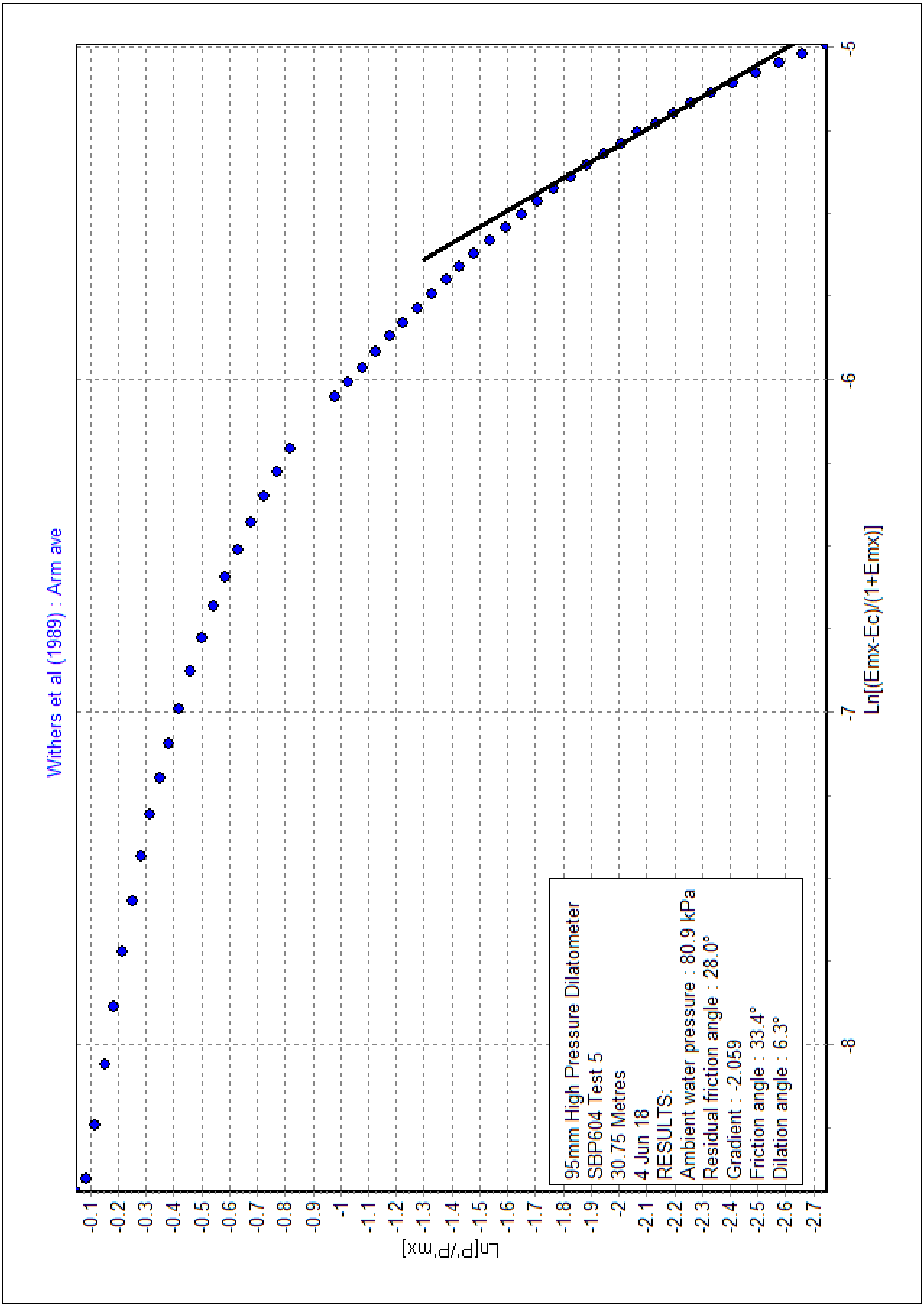
Strain Origin (mm)	:	4.38
Po (kPa)	:	743
Cohesion (kPa)	:	98
Angle of peak friction (deg)	:	33.6
Angle of peak dilation (deg)	:	6.6
Total yield stress (kPa)	:	1528
Total limit stress (kPa)	:	26328
G at first yield (MPa)	:	947.7
Non-linear exponent	:	0.724
Janbu exponent	:	0.009
Correlation	:	0.025

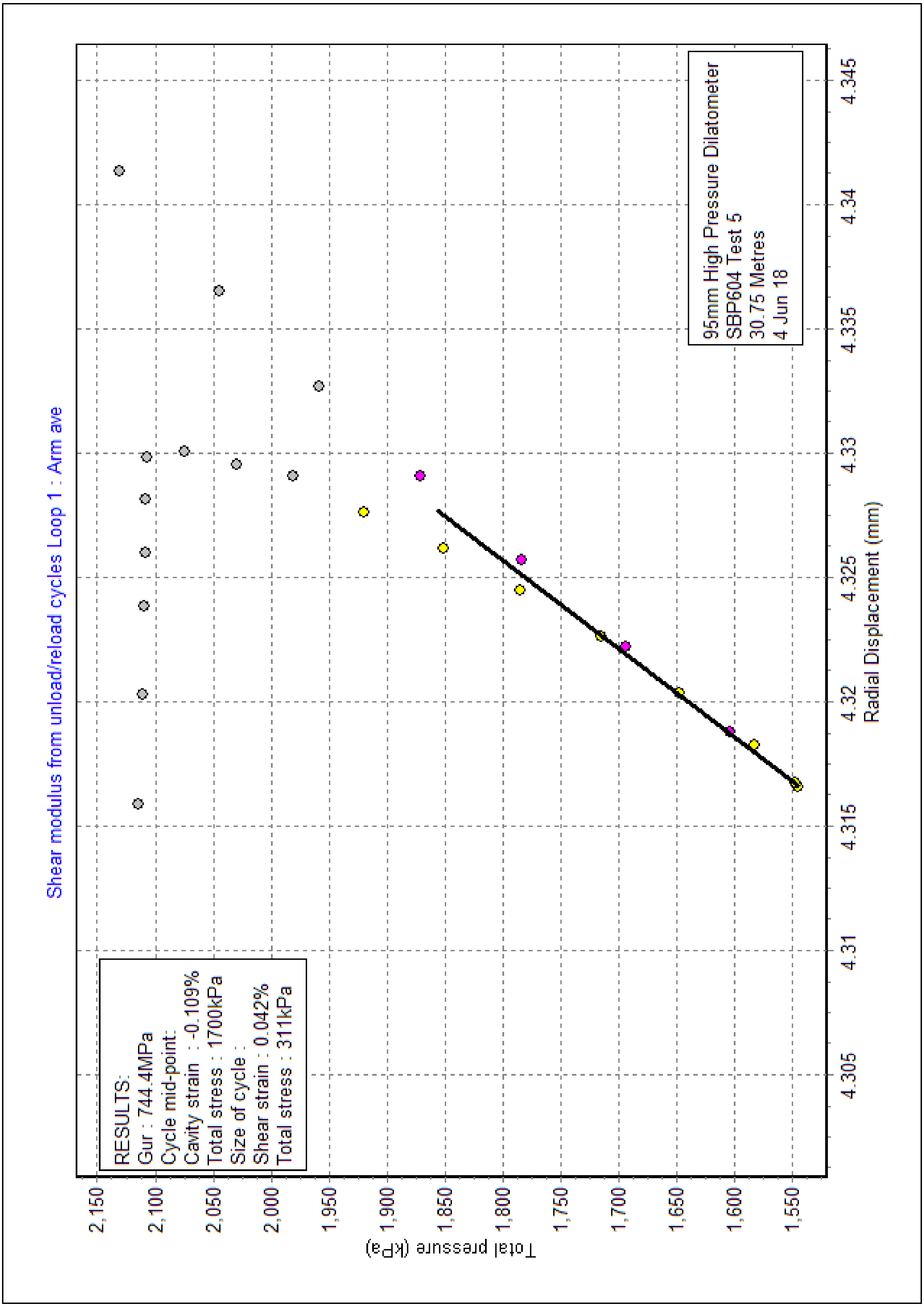
Ambient pore water pressure (kPa)	:	81
Residual friction angle (deg)	:	28.0
Poisson's ratio	:	0.33

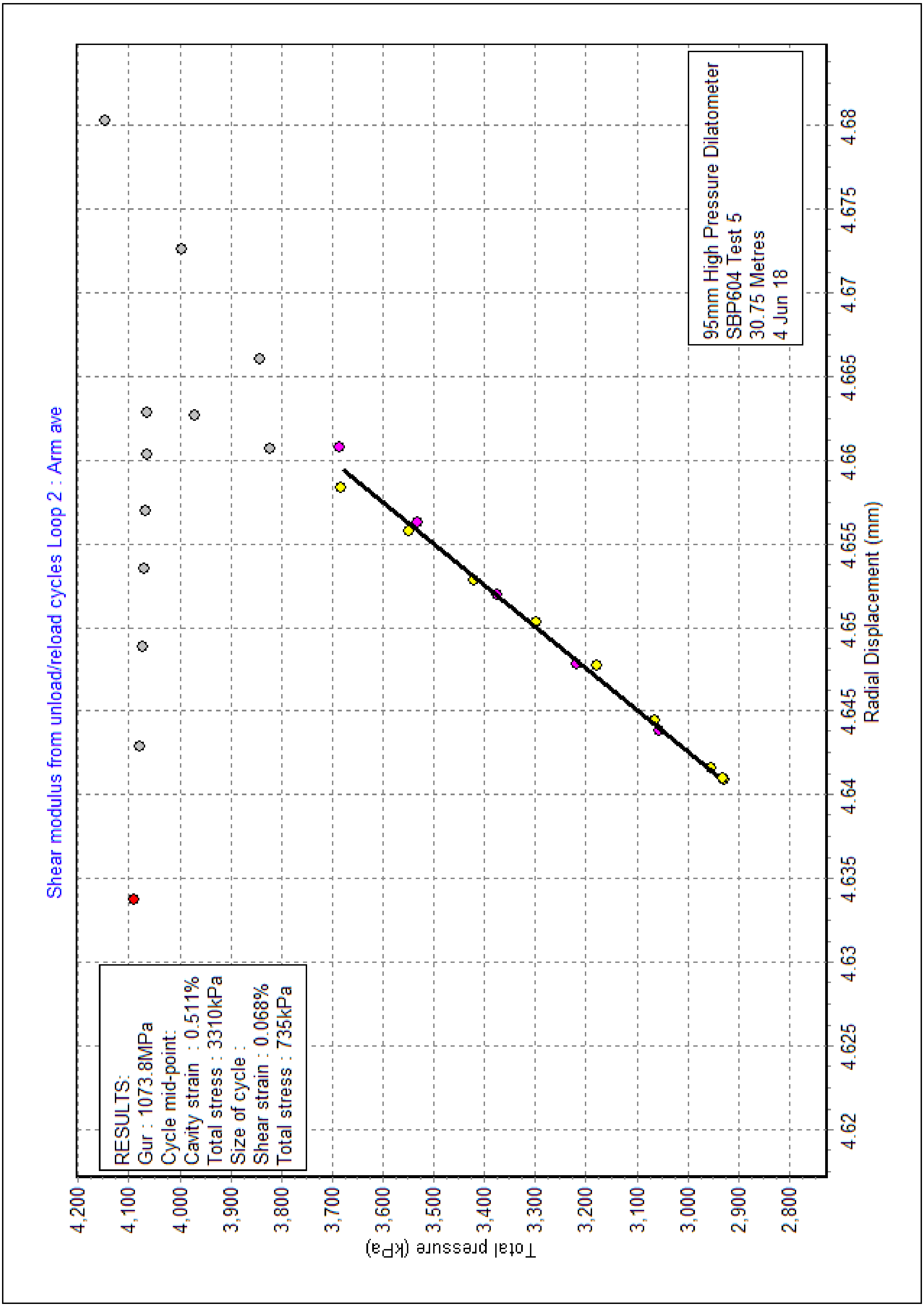

Cavity strain vs Total Pressure : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 5
30.75 Metres
4 Jun 18
Cavity strain (%)
Total pressure (kPa)
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
2.5
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
4,500
5,000
5,500
6,000
6,500
7,000

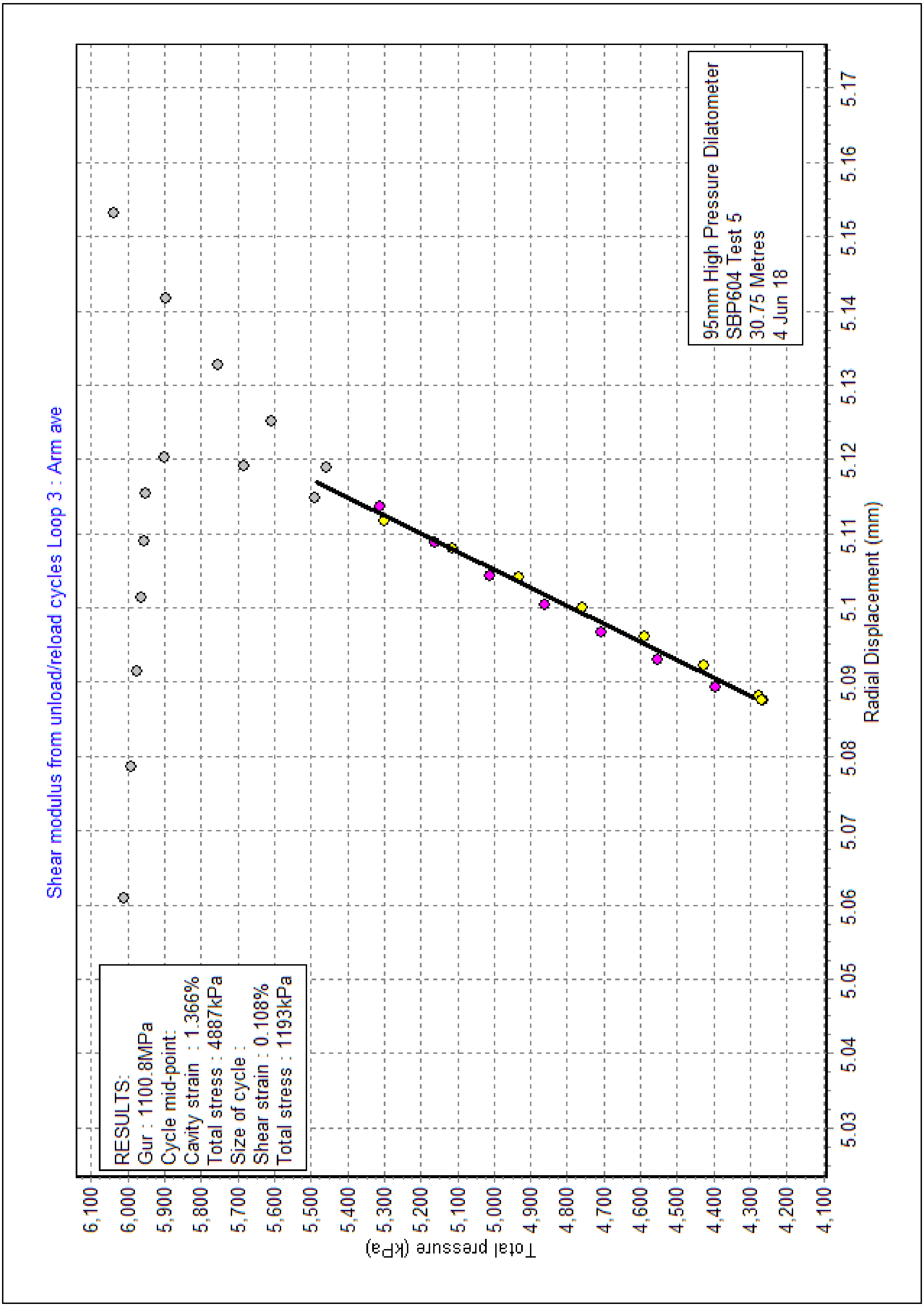

Po of cohesive material (1977, 1990) : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 5
30.75 Metres
4 Jun 18
RESULTS:
Gi : 171.9MPa
Pf : 3663.4kPa
Po : 746.6kPa
Tf : 2904.0kPa
Po + Tf : 3650.5kPa
Origin : 4.098mm
Total pressure (kPa)
7,000
6,500
6,000
5,500
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
Radial Displacement (mm)
4
5
6
Shear stress at yield : Arm ave
Total pressure (kPa)
7,000
6,000
5,000
4,000
Ln[shear strain]
-3
-4

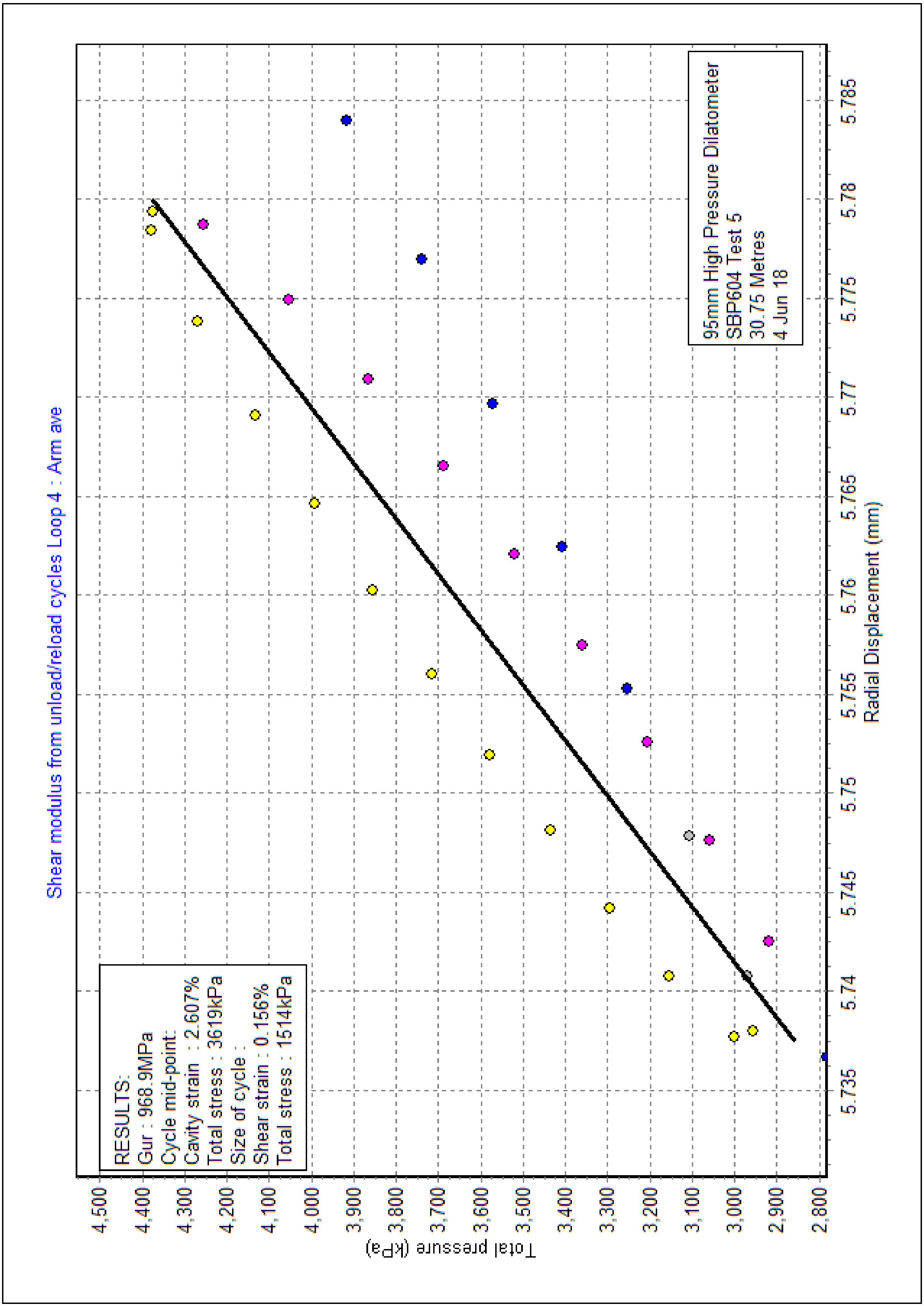

Hughes et al (1977) : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 5
30.75 Metres
4 Jun 18
RESULTS:
Ambient water pressure : 80.9 kPa
Residual friction angle : 28.0°
Gradient : 0.397
Friction angle : 33.6°
Dilation angle : 6.6°
Ln[Effective stress]
Ln[hoop strain]
8.85
8.8
8.75
8.7
8.65
8.6
8.55
8.5
8.45
8.4
8.35
8.3
8.25
8.2
8.15
8.1
8.05
8
7.95
7.9
-4
-5
-6
-7

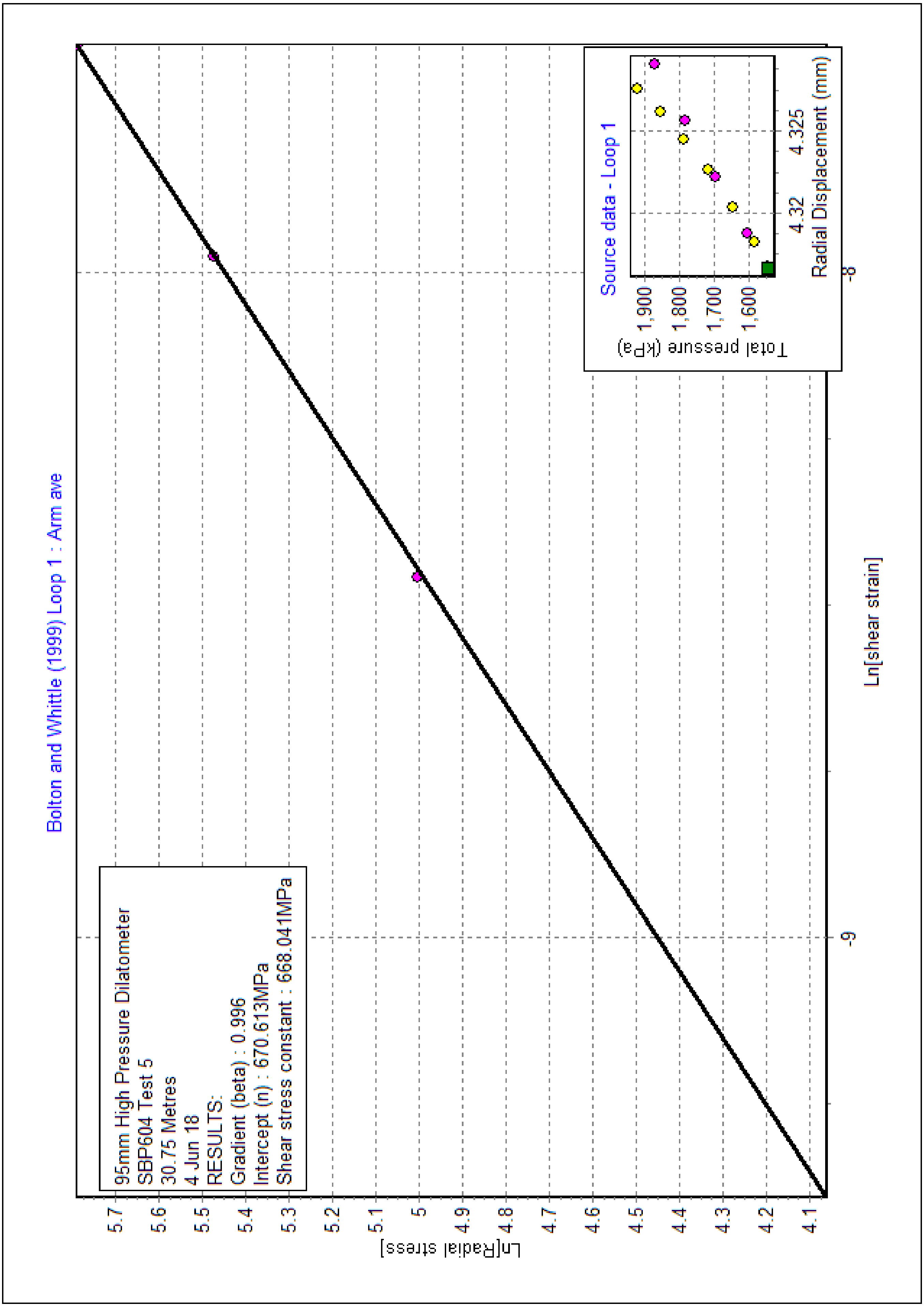

Withers et al (1989) : Arm ave
Ln[(Emx-Ec)/(1+Emx)]
Ln[P'/P'mx]
95mm High Pressure Dilatometer
SBP604 Test 5
30.75 Metres
4 Jun 18
RESULTS:
Ambient water pressure : 80.9 kPa
Residual friction angle : 28.0°
Gradient : -2.059
Friction angle : 33.4°
Dilation angle : 6.3°

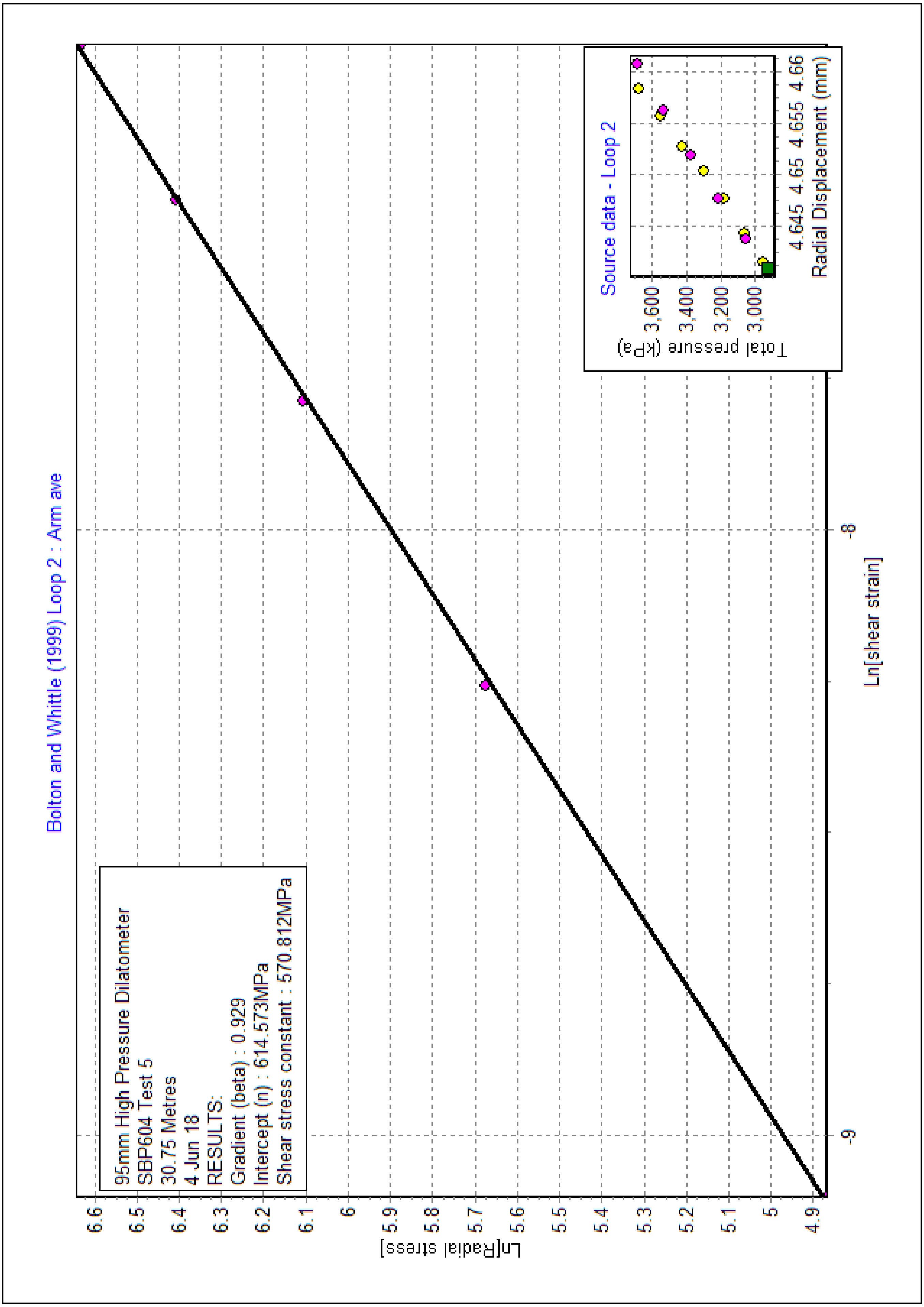

Shear modulus from unload/reload cycles Loop 1 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 5
30.75 Metres
4 Jun 18
RESULTS:
Gur : 744.4MPa
Cycle mid-point:
Cavity strain : -0.109%
Total stress : 1700kPa
Size of cycle :
Shear strain : 0.042%
Total stress : 311kPa
Radial Displacement (mm)
4.305
4.31
4.315
4.32
4.325
4.33
4.335
4.34
4.345
Total pressure (kPa)
2,150
2,100
2,050
2,000
1,950
1,900
1,850
1,800
1,750
1,700
1,650
1,600
1,550

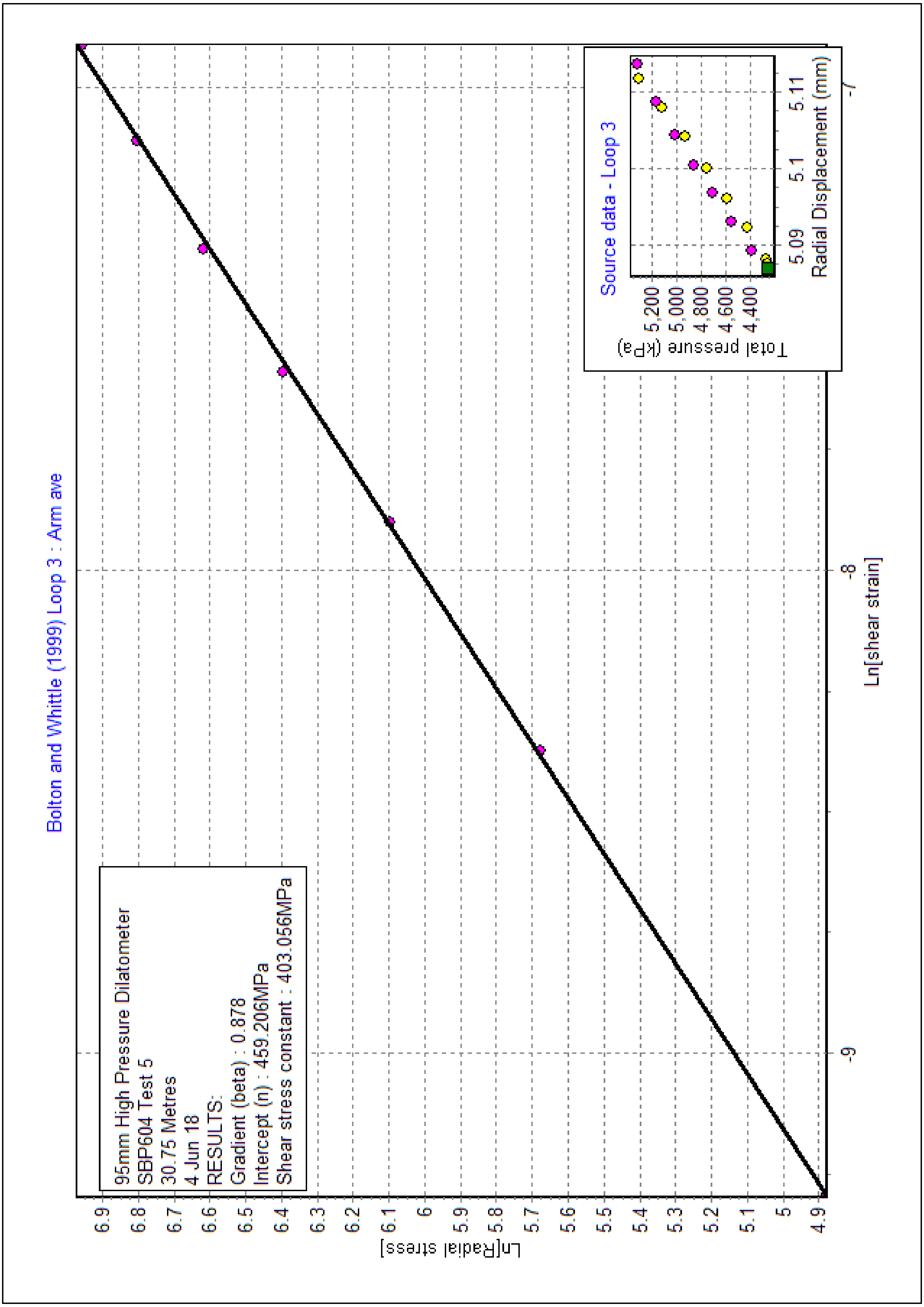

Shear modulus from unload/reload cycles Loop 2 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 5
30.75 Metres
4 Jun 18
RESULTS:
Gur : 1073.8MPa
Cycle mid-point:
Cavity strain : 0.511%
Total stress : 3310kPa
Size of cycle :
Shear strain : 0.068%
Total stress : 735kPa
Radial Displacement (mm)
4.62
4.625
4.63
4.635
4.64
4.645
4.65
4.655
4.66
4.665
4.67
4.675
4.68
Total pressure (kPa)
4,200
4,100
4,000
3,900
3,800
3,700
3,600
3,500
3,400
3,300
3,200
3,100
3,000
2,900
2,800

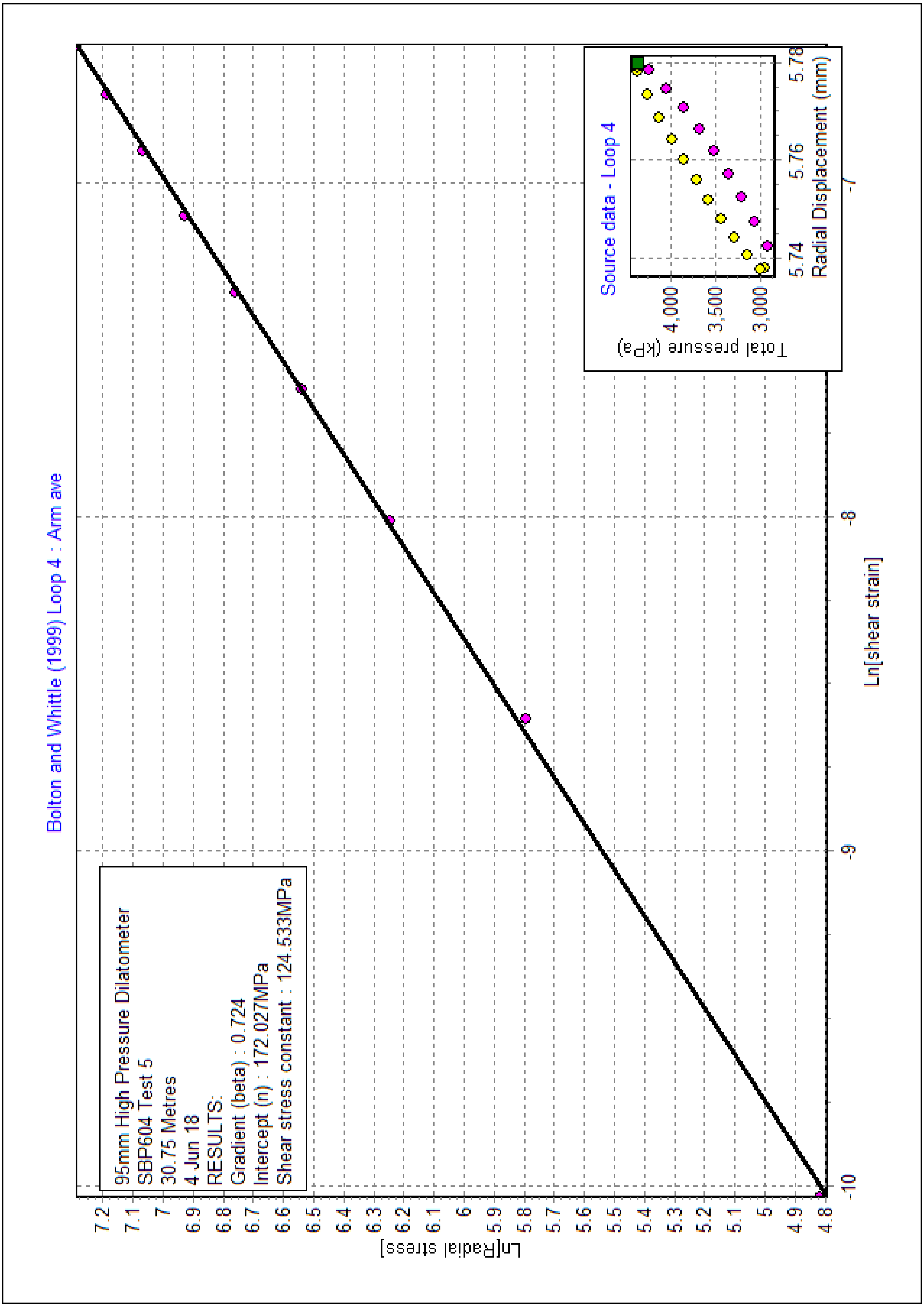

Shear modulus from unload/reload cycles Loop 3 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 5
30.75 Metres
4 Jun 18
RESULTS:
Gur : 1100.8MPa
Cycle mid-point:
Cavity strain : 1.366%
Total stress : 4887kPa
Size of cycle :
Shear strain : 0.108%
Total stress : 1193kPa
Radial Displacement (mm)
Total pressure (kPa)
5.03
5.04
5.05
5.06
5.07
5.08
5.09
5.1
5.11
5.12
5.13
5.14
5.15
5.16
5.17
4,100
4,200
4,300
4,400
4,500
4,600
4,700
4,800
4,900
5,000
5,100
5,200
5,300
5,400
5,500
5,600
5,700
5,800
5,900
6,000
6,100

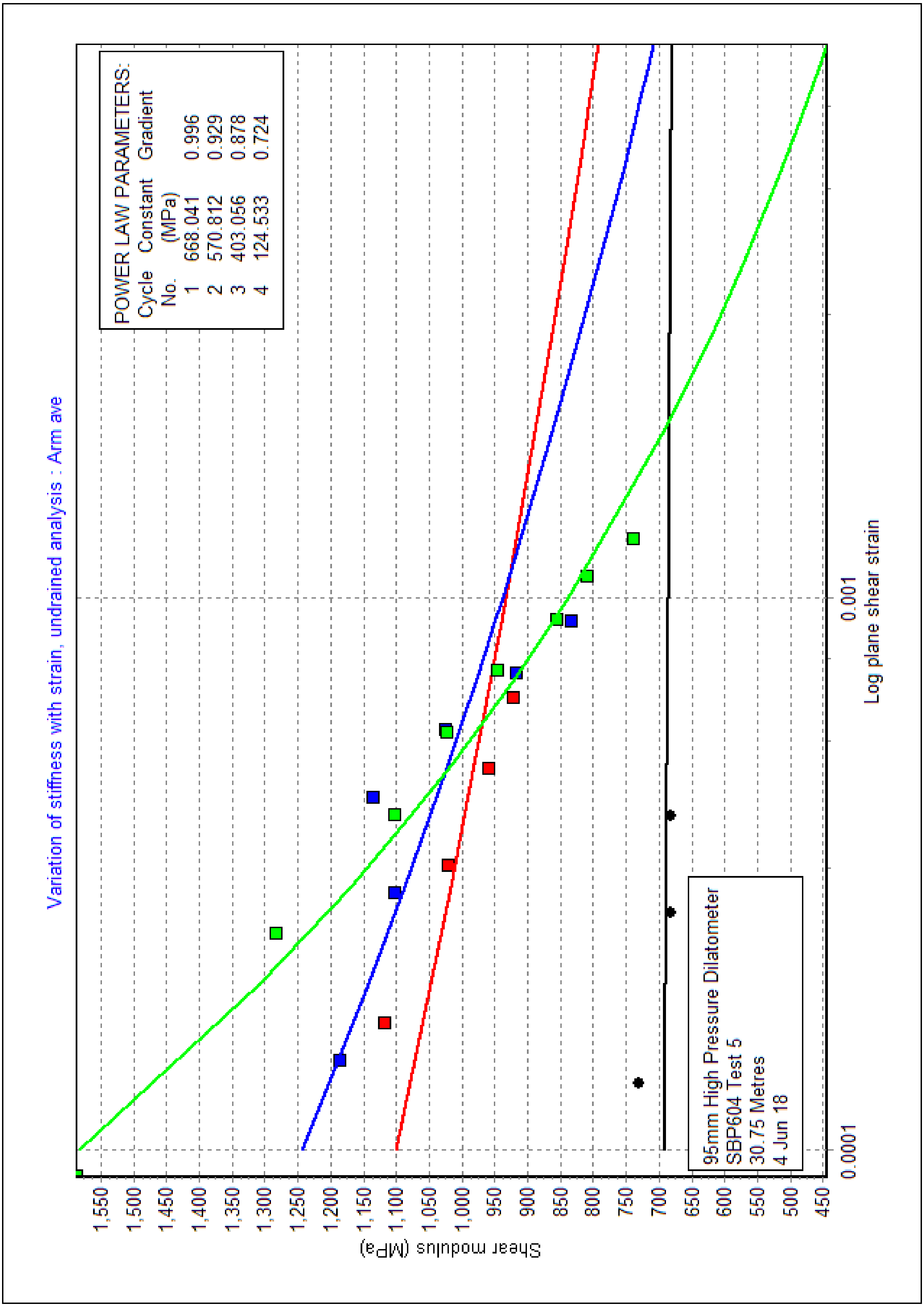

Shear modulus from unload/reload cycles Loop 4 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 5
30.75 Metres
4 Jun 18
RESULTS:
Gur : 968.9MPa
Cycle mid-point:
Cavity strain : 2.607%
Total stress : 3619kPa
Size of cycle :
Shear strain : 0.156%
Total stress : 1514kPa
Total pressure (kPa)
4,500
4,400
4,300
4,200
4,100
4,000
3,900
3,800
3,700
3,600
3,500
3,400
3,300
3,200
3,100
3,000
2,900
2,800
Radial Displacement (mm)
5.735
5.74
5.745
5.75
5.755
5.76
5.765
5.77
5.775
5.78
5.785

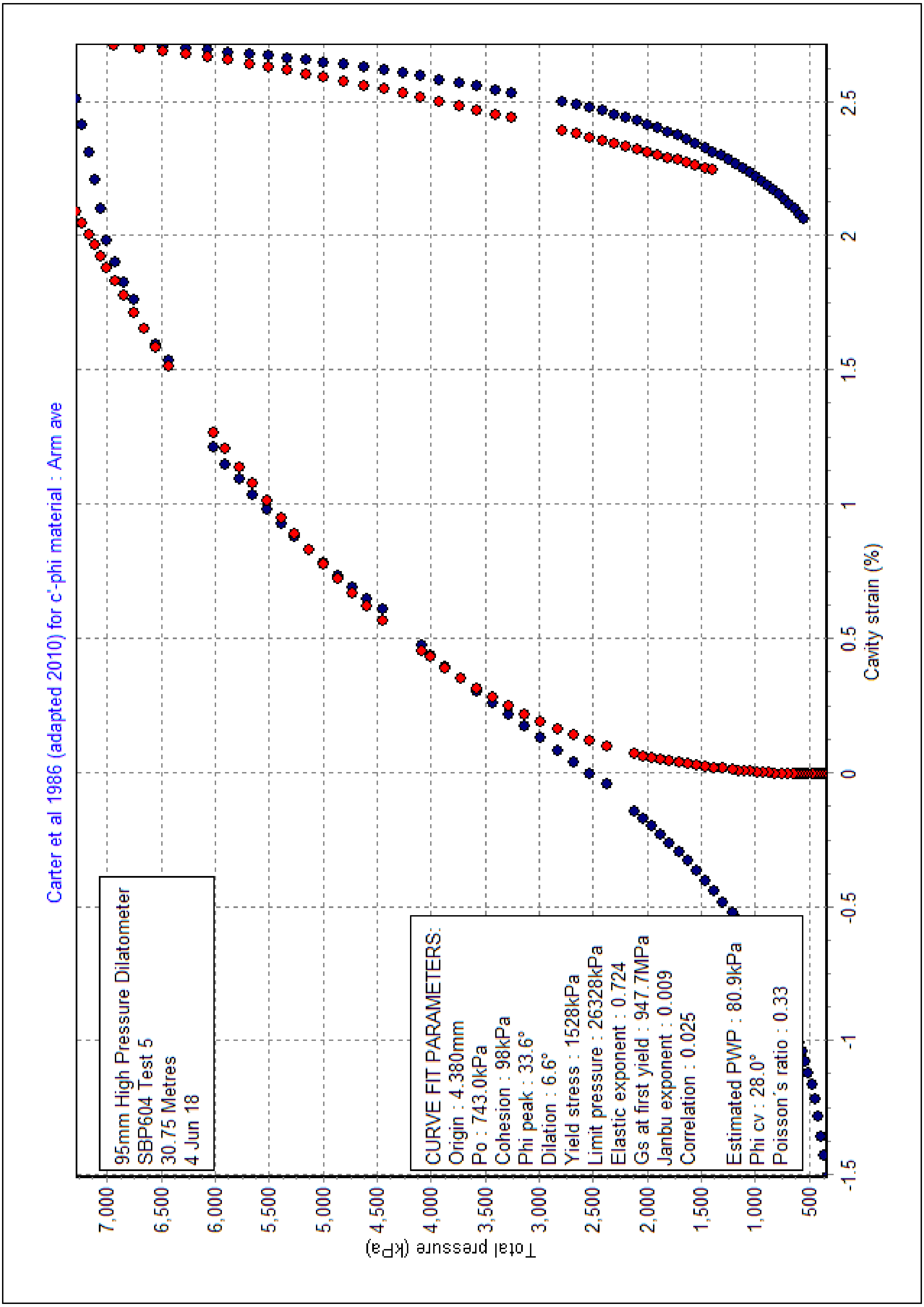

Bolton and Whittle (1999) Loop 1 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 5
30.75 Metres
4 Jun 18
RESULTS:
Gradient (beta) : 0.996
Intercept (n) : 670.613MPa
Shear stress constant : 668.041MPa
Source data - Loop 1
Total pressure (kPa)
1,900
1,800
1,700
1,600
4.32
4.325
Radial Displacement (mm)
Ln[Radial stress]
5.7
5.6
5.5
5.4
5.3
5.2
5.1
5
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
Ln[shear strain]
-9
-8

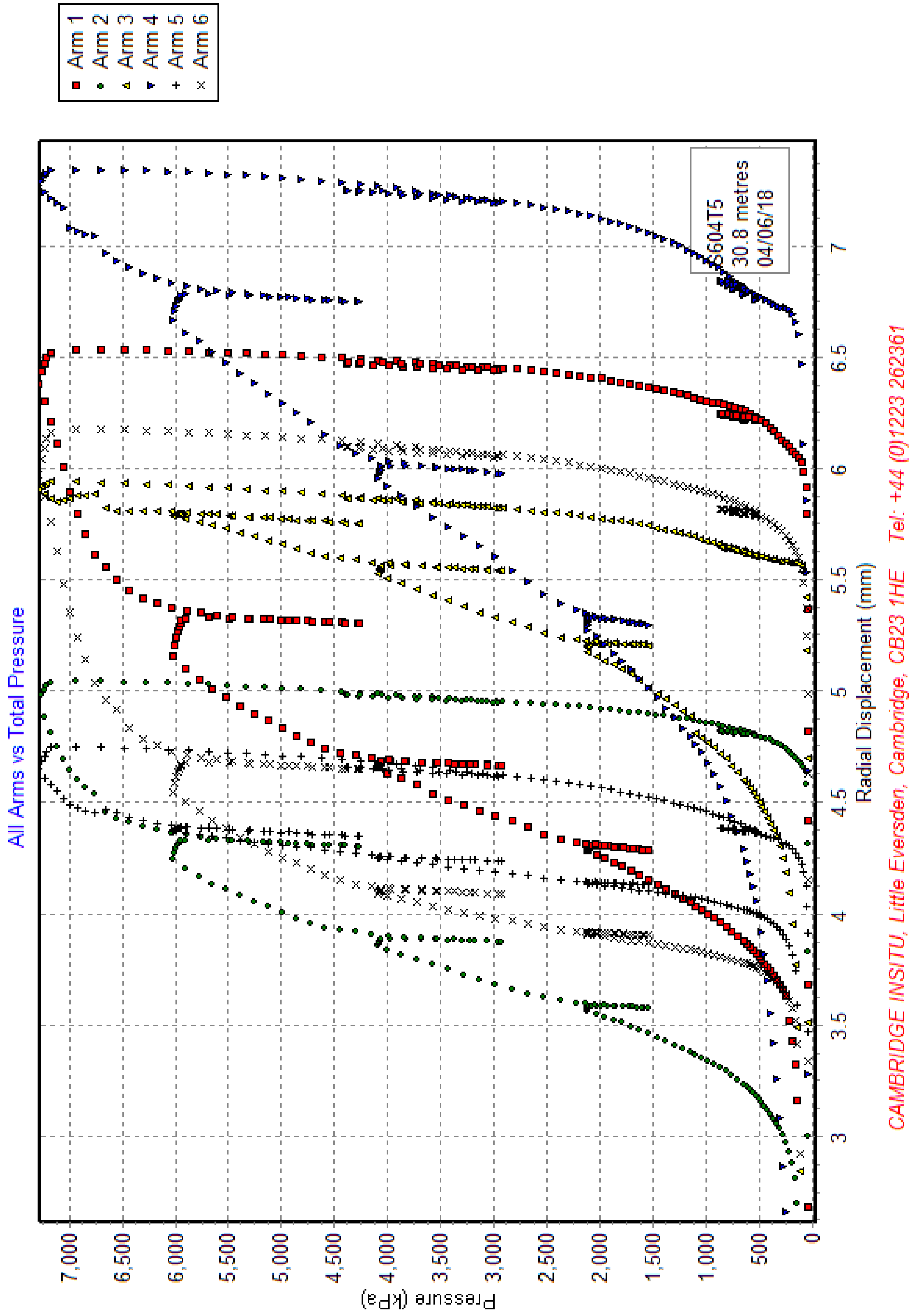

Bolton and Whittle (1999) Loop 2 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 5
30.75 Metres
4 Jun 18
RESULTS:
Gradient (beta) : 0.929
Intercept (n) : 614.573MPa
Shear stress constant : 570.812MPa
Source data - Loop 2
Total pressure (kPa)
3,600
3,400
3,200
3,000
4.645 4.65 4.655 4.66
Radial Displacement (mm)
Ln[Radial stress]
6.6
6.5
6.4
6.3
6.2
6.1
6
5.9
5.8
5.7
5.6
5.5
5.4
5.3
5.2
5.1
5
4.9
-9
-8
Ln[shear strain]

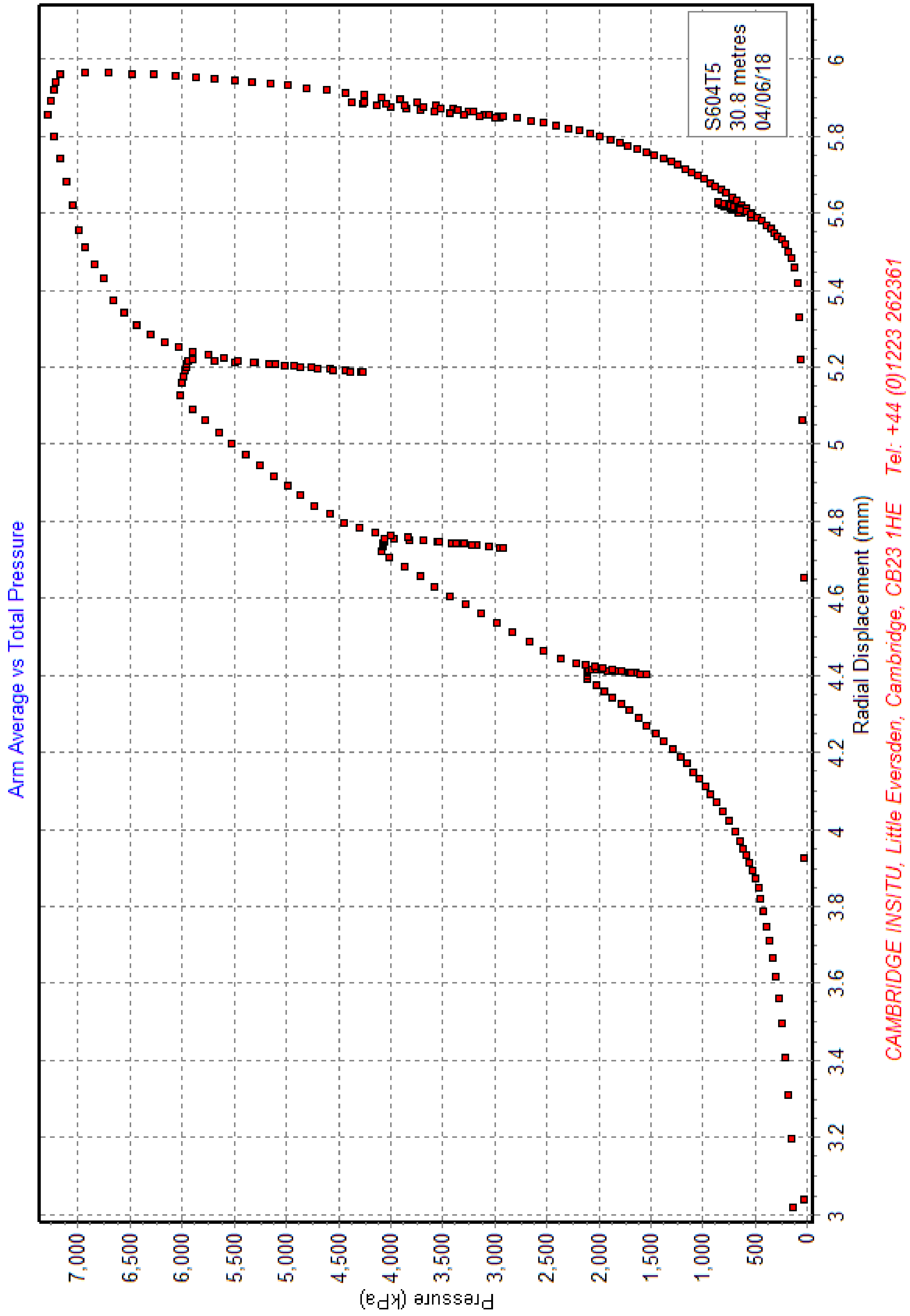

Bolton and Whittle (1999) Loop 3 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 5
30.75 Metres
4 Jun 18
RESULTS:
Gradient (beta) : 0.878
Intercept (n) : 459.206MPa
Shear stress constant : 403.056MPa
Ln[Radial stress]
6.9
6.8
6.7
6.6
6.5
6.4
6.3
6.2
6.1
6
5.9
5.8
5.7
5.6
5.5
5.4
5.3
5.2
5.1
5
4.9
Ln[shear strain]
-9
-8
-7
Source data - Loop 3
Total pressure (kPa)
5,200
5,000
4,800
4,600
4,400
Radial Displacement (mm)
5.09
5.1
5.11

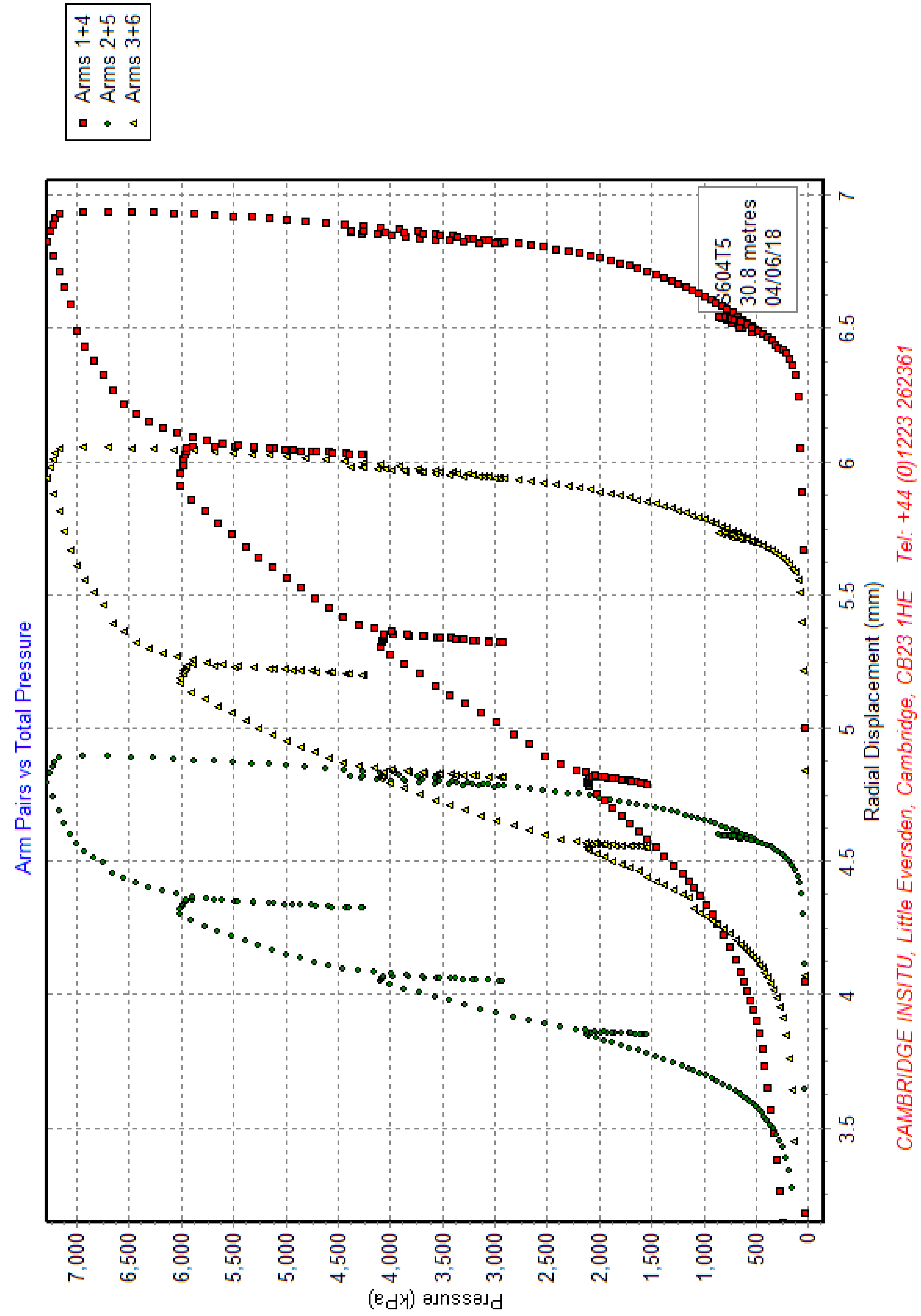

Bolton and Whittle (1999) Loop 4 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 5
30.75 Metres
4 Jun 18
RESULTS:
Gradient (beta) : 0.724
Intercept (n) : 172.027MPa
Shear stress constant : 124.533MPa
Ln[Radial stress]
Ln[shear strain]
Source data - Loop 4
Total pressure (kPa)
Radial Displacement (mm)

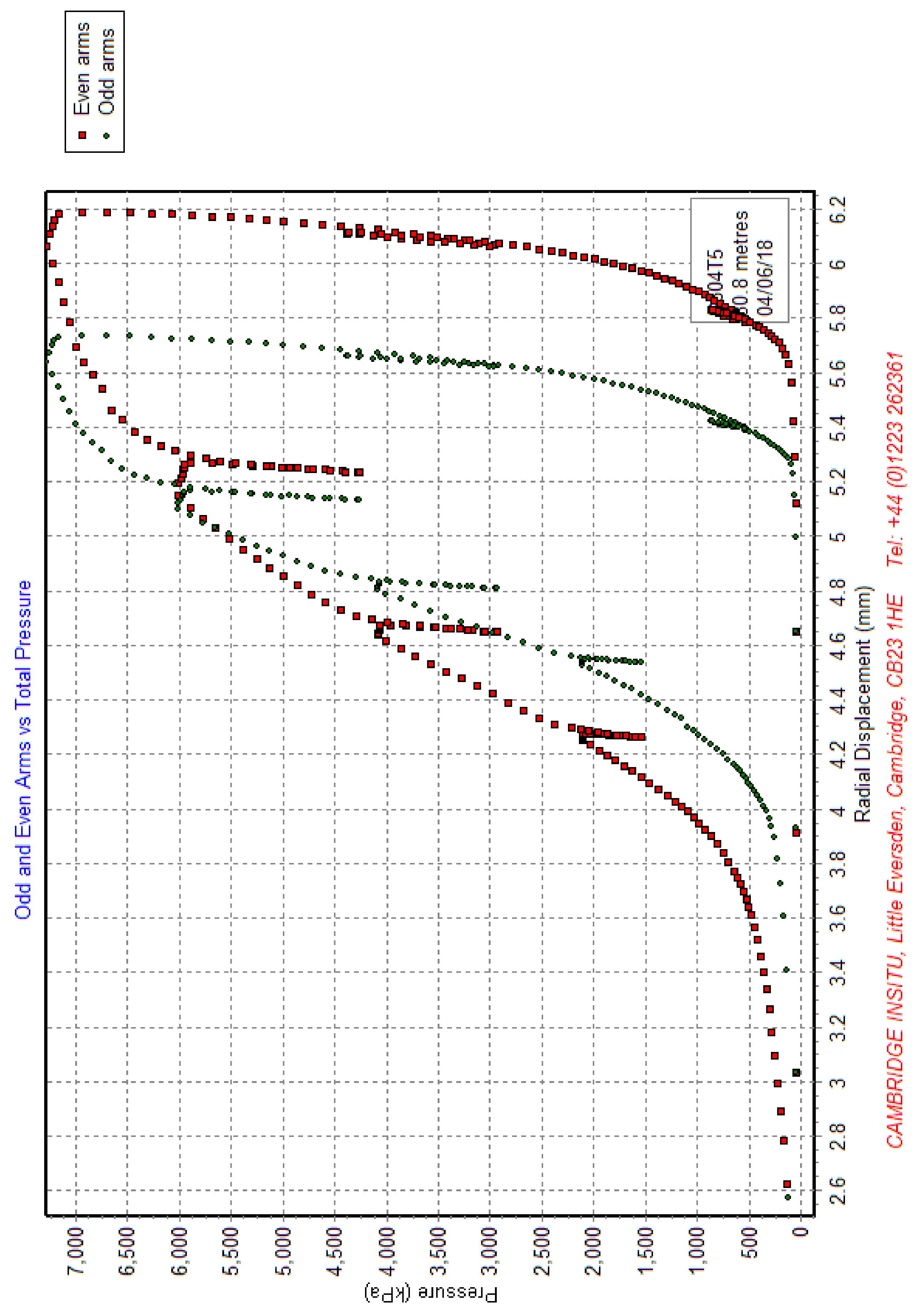

Variation of stiffness with strain, undrained analysis : Arm ave
POWER LAW PARAMETERS:
Cycle No.
Constant (MPa)
Gradient
1 668.041 0.996
2 570.812 0.929
3 403.056 0.878
4 124.533 0.724
Shear modulus (MPa)
1,550
1,500
1,450
1,400
1,350
1,300
1,250
1,200
1,150
1,100
1,050
1,000
950
900
850
800
750
700
650
600
550
500
450
Log plane shear strain
0.0001
0.001
95mm High Pressure Dilatometer
SBP604 Test 5
30.75 Metres
4 Jun 18


Carter et al 1986 (adapted 2010) for c'-phi material : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 5
30.75 Metres
4 Jun 18
CURVE FIT PARAMETERS:
Origin : 4.380mm
Po : 743.0kPa
Cohesion : 98kPa
Phi peak : 33.6°
Dilation : 6.6°
Yield stress : 1528kPa
Limit pressure : 26328kPa
Elastic exponent : 0.724
Gs at first yield : 947.7MPa
Janbu exponent : 0.009
Correlation : 0.025
Estimated PWP : 80.9kPa
Phi cv : 28.0°
Poisson's ratio : 0.33
Total pressure (kPa)
7,000
6,500
6,000
5,500
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
Cavity strain (%)
-1.5
-1
-0.5
0
0.5
1
1.5
2
2.5


All Arms vs Total Pressure
Arm 1
Arm 2
Arm 3
Arm 4
Arm 5
Arm 6
S604T5
30.8 metres
04/06/18
Radial Displacement (mm)
Pressure (kPa)
7,000
6,500
6,000
5,500
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
3
3.5
4
4.5
5
5.5
6
6.5
7
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361


Arm Average vs Total Pressure
S604T5
30.8 metres
04/06/18
Radial Displacement (mm)
Pressure (kPa)
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361


Arm Pairs vs Total Pressure
Arms 1+4
Arms 2+5
Arms 3+6
5604T5
30.8 metres
04/06/18
Radial Displacement (mm)
Pressure (kPa)
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361


Odd and Even Arms vs Total Pressure
Even arms
Odd arms
04T5
0.8 metres
04/06/18
Radial Displacement (mm)
Pressure (kPa)
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361

SBP604 Test 6 - SUMMARY OF RESULTS
[File made with WinSitu Version 3.9.1.1]

[DETAILS OF TEST]

Project	:	60547200
Site	:	A303 Stonehenge
Borehole	:	SBP604
Test name	:	SBP604 Test 6
Test date	:	5 Jun 18
Test depth	:	34.05 Metres
Water table	:	22.5 Metres
Ambient PWP	:	113.3 kPa
Material	:	Chalk
Probe	:	95mm High Pressure Dilatometer
Diameter	:	97.0 mm

Data analysed using average arm displacement curve
A non-linear analysis of the rebound cycles has been carried out
The file includes results from a curve fitting analysis

Analysed by RWW on 7 Jun 18

Remarks: Test ends with membrane rupturing lower end

[RESULTS FOR CAVITY REFERENCE PRESSURE]

Strain Origin (mm)	:	"Arm ave=2.87"
Po from Marsland & Randolph (kPa)	:	"Arm ave=861.0"
Best estimate of Po (kPa)	:	"Arm ave=833.0"

[UNDRAINED STRENGTH PARAMETERS]

Undrained yield stress (kPa)	:	"Arm ave=3671.1"

[DRAINED ANALYSIS OF SANDS]
[Hughes et al 1977]

Constant volume friction angle (°)	:	28.0
Angle of internal friction (°)	:	"Arm ave=38.8"
Dilation angle (°)	:	"Arm ave=12.9"
Gradient of log-log plot	:	"Arm ave=0.471"

[LINEAR INTERPRETATION OF SHEAR MODULUS G]
Initial slope shear modulus (MPa) :"Arm ave=266.2"

Axis	Loop No	Value (MPa)	Mean Strain (%)	Mean Pc (kPa)	dE (%)	dPc (kPa)
Arm ave	1	1031.7	0.098	1876	0.037	379
Arm ave	2	1350.4	0.502	3274	0.060	811
Arm ave	3	1341.3	1.209	4662	0.088	1182

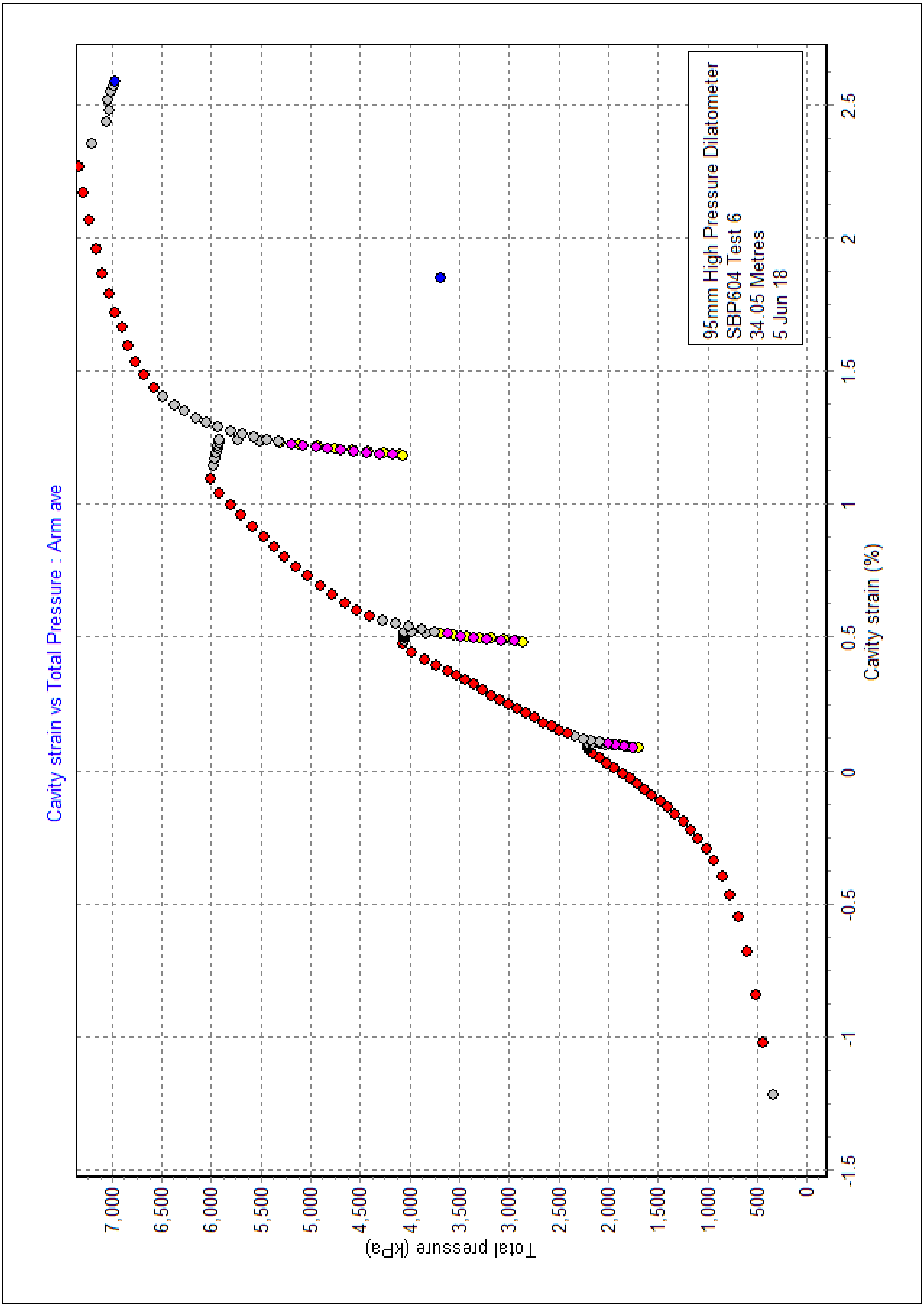
[UNDRAINED NON LINEAR INTERPRETATION OF SECANT SHEAR MODULUS]

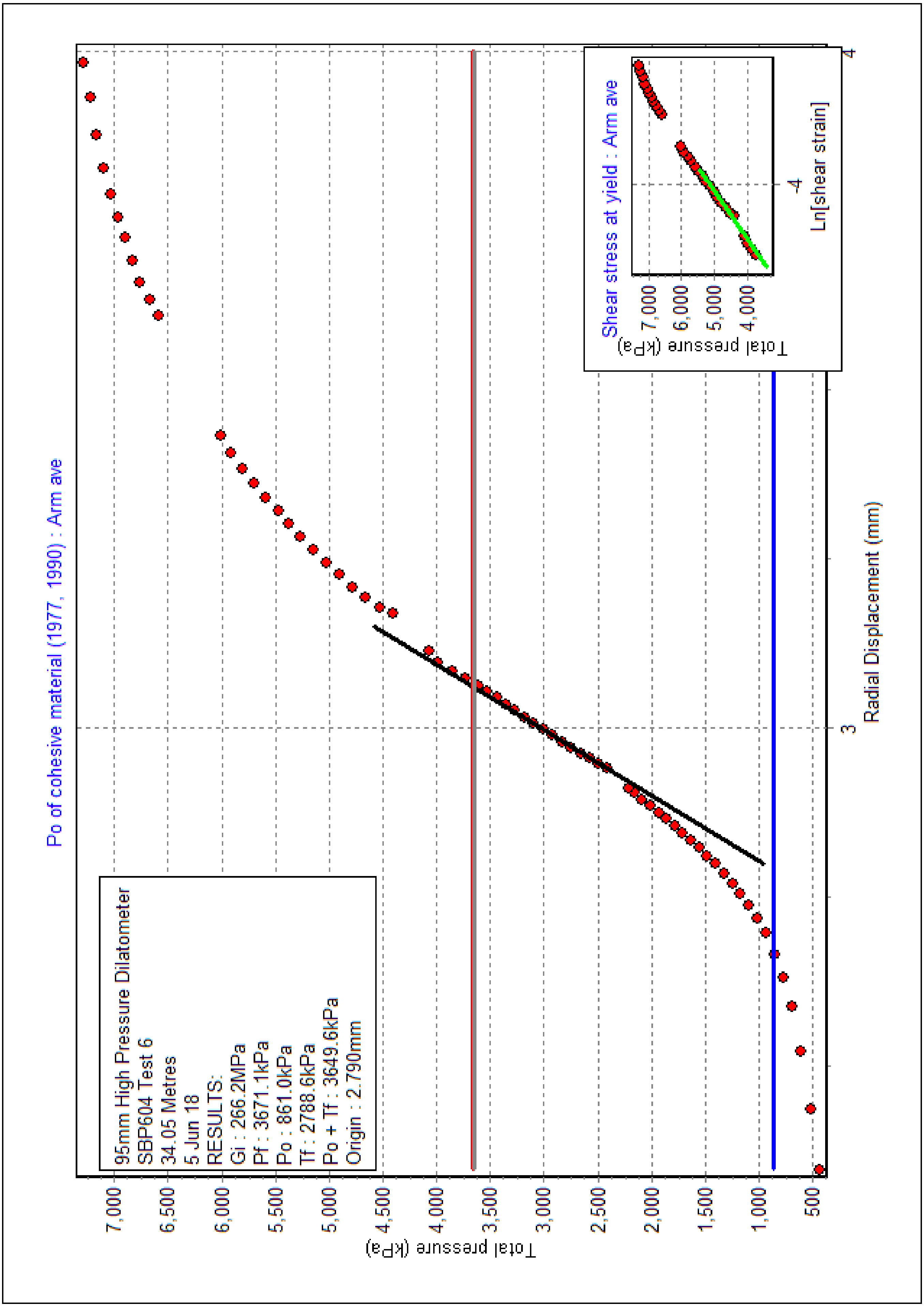
Axis	Loop No	Intercept (MPa)	Alpha (MPa)	Gradient
Arm ave	1	213.411	173.706	0.814
Arm ave	2	312.978	252.510	0.807
Arm ave	3	356.687	289.798	0.812

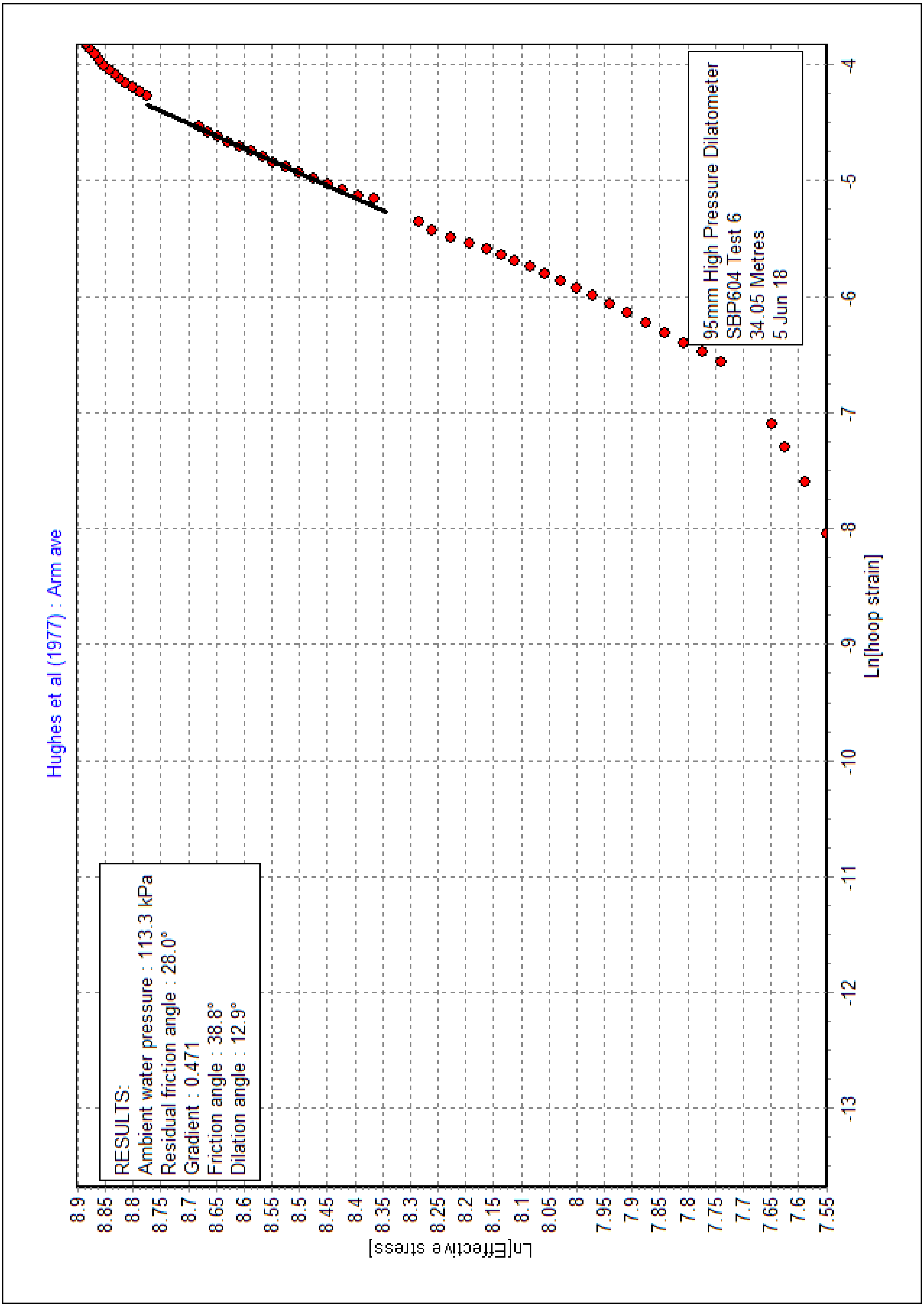
[PARAMETERS USED FOR DRAINED CURVE MODELLING]
{Axis is Arm ave}

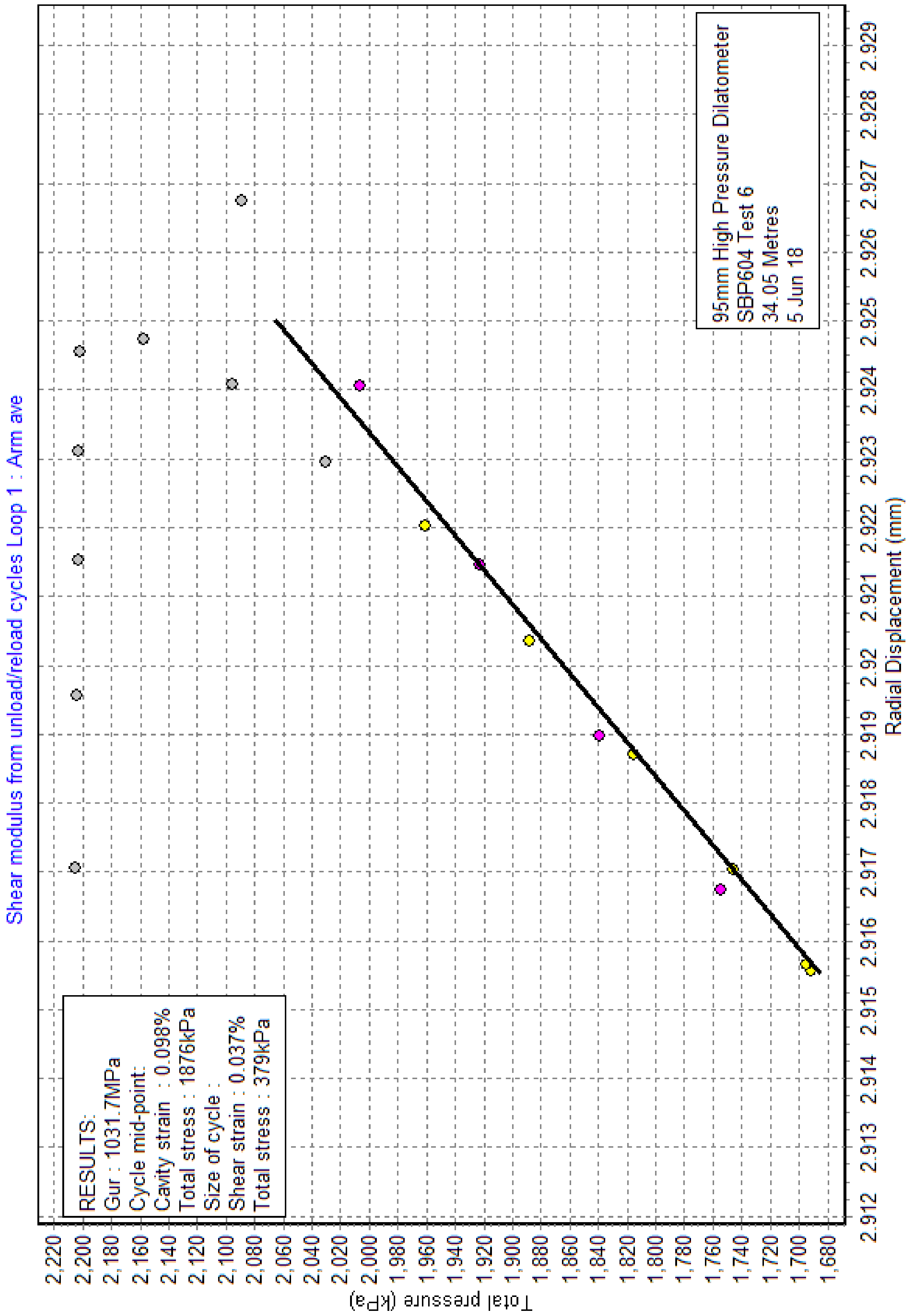
Strain Origin (mm)	:	2.87
Po (kPa)	:	833
Cohesion (kPa)	:	566
Angle of peak friction (deg)	:	38.8
Angle of peak dilation (deg)	:	12.9
Total yield stress (kPa)	:	2118
Total limit stress (kPa)	:	38144
G at first yield (MPa)	:	453.0
Non-linear exponent	:	0.812
Janbu exponent	:	0.452
Correlation	:	0.969

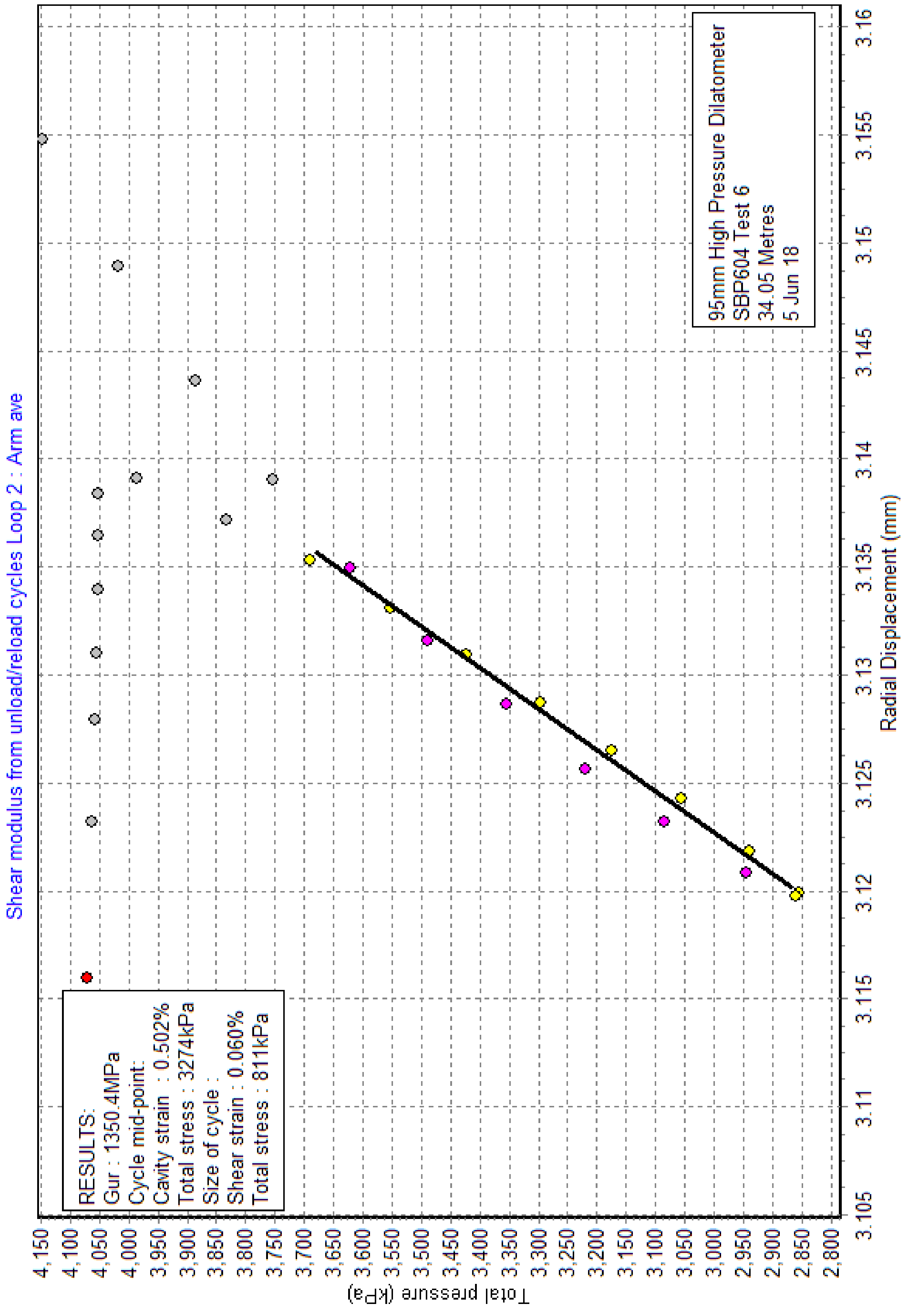
Ambient pore water pressure (kPa)	:	113
Residual friction angle (deg)	:	28.0
Poisson's ratio	:	0.33


Cavity strain vs Total Pressure : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 6
34.05 Metres
5 Jun 18
Total pressure (kPa)
Cavity strain (%)
7,000
6,500
6,000
5,500
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5

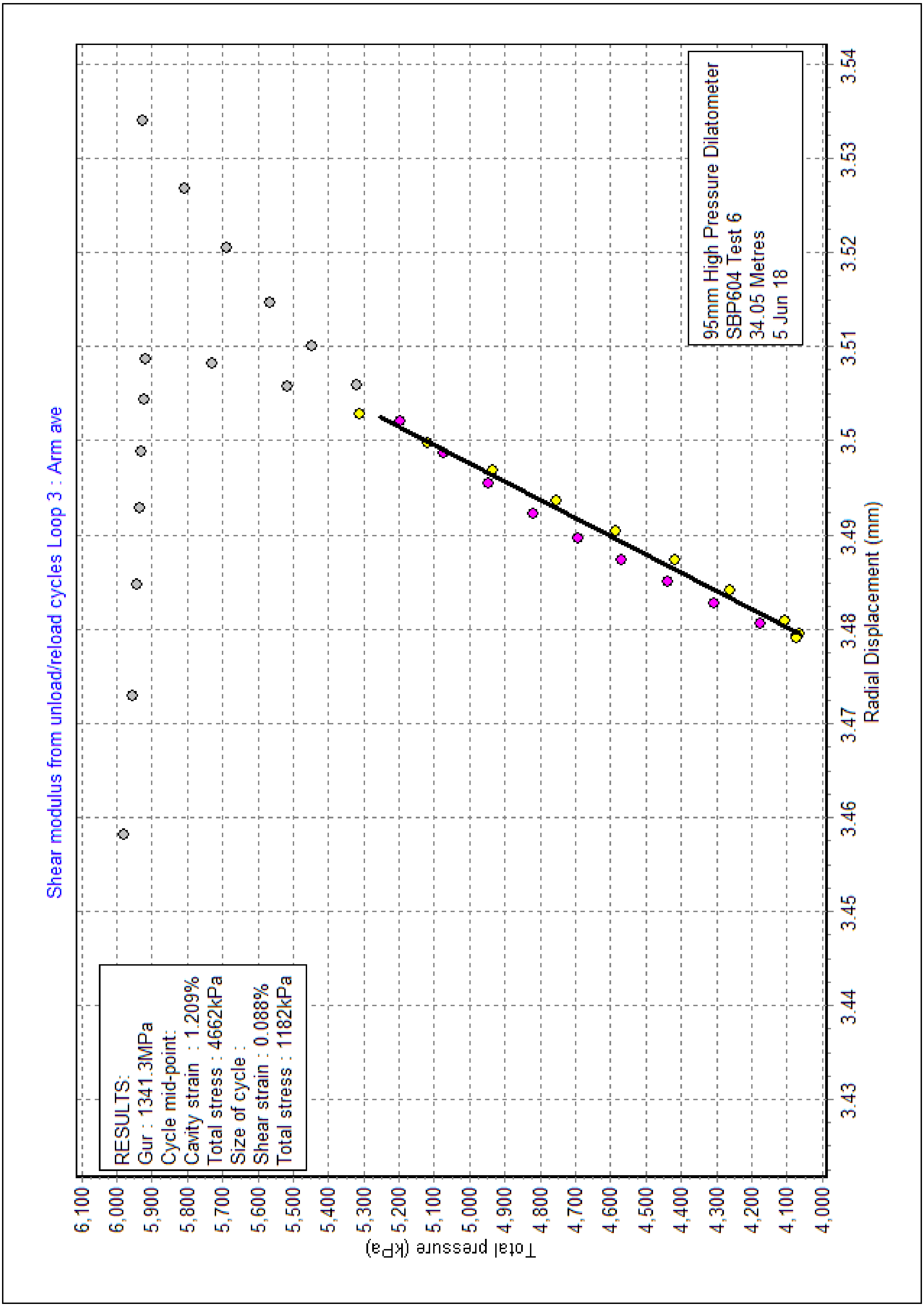

Po of cohesive material (1977, 1990) : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 6
34.05 Metres
5 Jun 18
RESULTS:
Gi : 266.2MPa
Pf : 3671.1kPa
Po : 861.0kPa
Tf : 2788.6kPa
Po + Tf : 3649.6kPa
Origin : 2.790mm
Total pressure (kPa)
Radial Displacement (mm)
Shear stress at yield : Arm ave
Ln[shear strain]

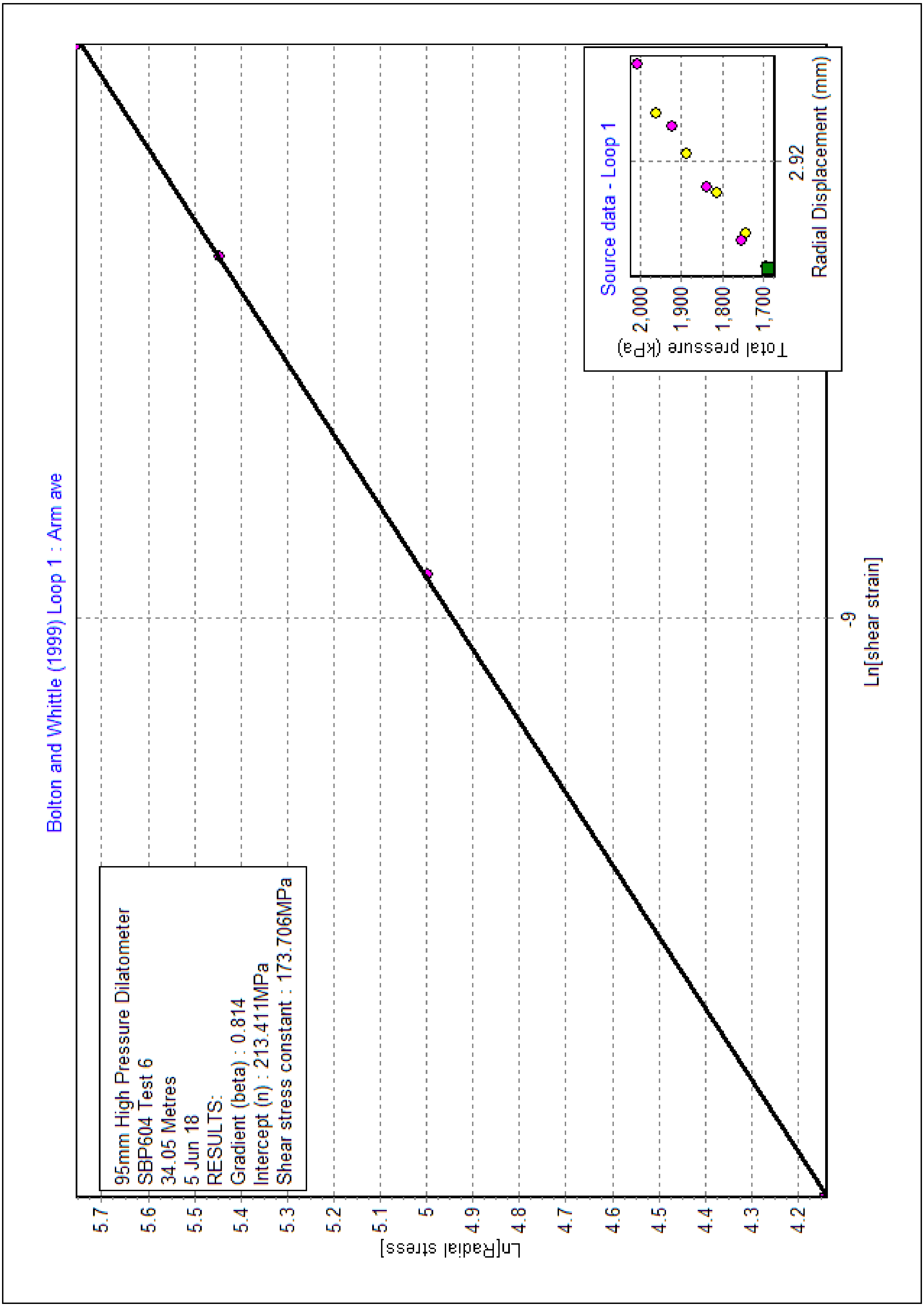

Hughes et al (1977) : Arm ave
RESULTS:
Ambient water pressure : 113.3 kPa
Residual friction angle : 28.0°
Gradient : 0.471
Friction angle : 38.8°
Dilation angle : 12.9°
95mm High Pressure Dilatometer
SBP604 Test 6
34.05 Metres
5 Jun 18
Ln[hoop strain]
Ln[Effective stress]

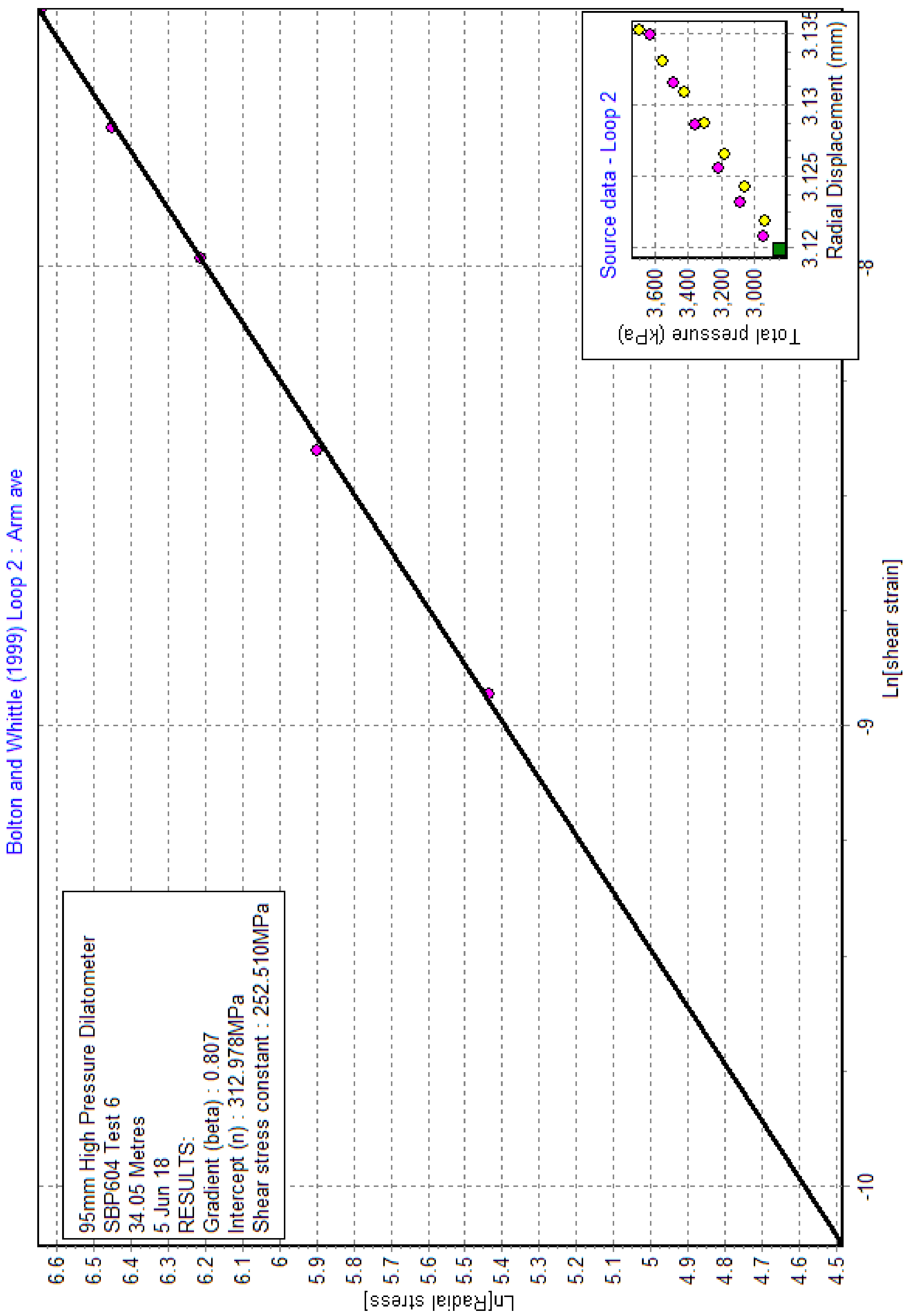

Shear modulus from unload/reload cycles Loop 1 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 6
34.05 Metres
5 Jun 18
RESULTS:
Gur : 1031.7MPa
Cycle mid-point:
Cavity strain : 0.098%
Total stress : 1876kPa
Size of cycle :
Shear strain : 0.037%
Total stress : 379kPa
Radial Displacement (mm)
Total pressure (kPa)
2.912
2.913
2.914
2.915
2.916
2.917
2.918
2.919
2.92
2.921
2.922
2.923
2.924
2.925
2.926
2.927
2.928
2.929
2,220
2,200
2,180
2,160
2,140
2,120
2,100
2,080
2,060
2,040
2,020
2,000
1,980
1,960
1,940
1,920
1,900
1,880
1,860
1,840
1,820
1,800
1,780
1,760
1,740
1,720
1,700
1,680

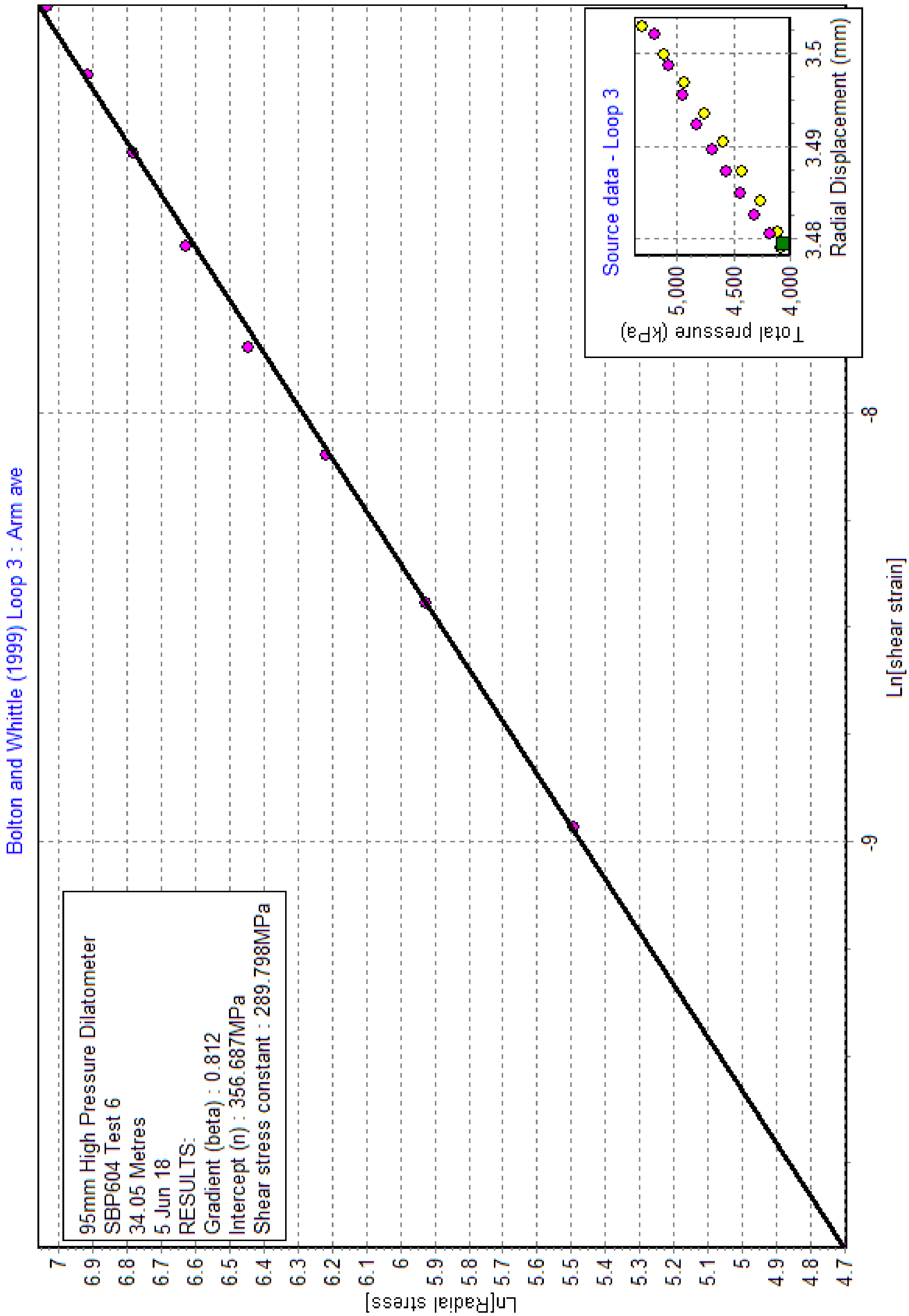


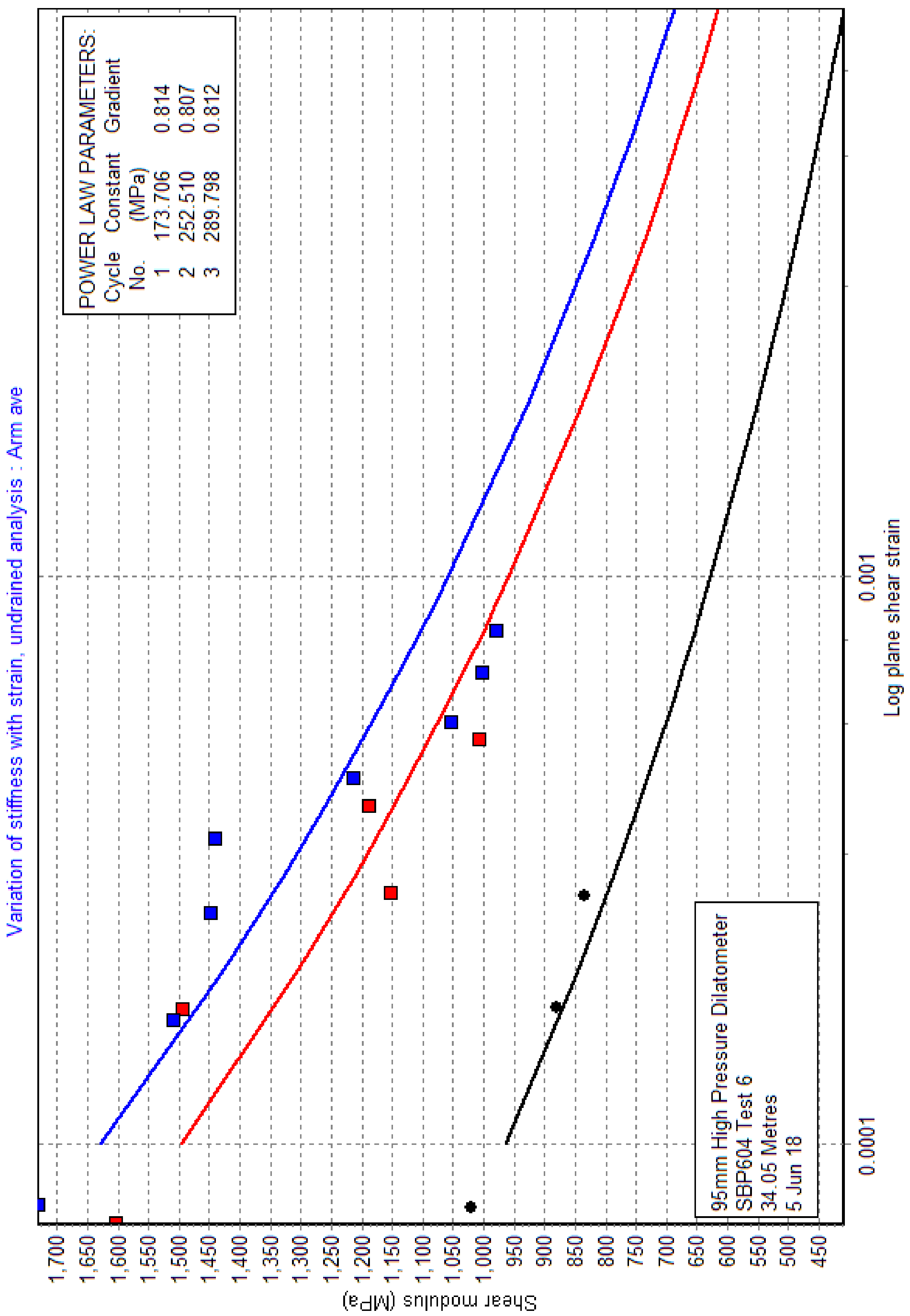
Shear modulus from unload/reload cycles Loop 2 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 6
34.05 Metres
5 Jun 18
RESULTS:
Gur : 1350.4MPa
Cycle mid-point:
Cavity strain : 0.502%
Total stress : 3274kPa
Size of cycle :
Shear strain : 0.060%
Total stress : 811kPa
Radial Displacement (mm)
Total pressure (kPa)
3.105
3.11
3.115
3.12
3.125
3.13
3.135
3.14
3.145
3.15
3.155
3.16
4,150
4,100
4,050
4,000
3,950
3,900
3,850
3,800
3,750
3,700
3,650
3,600
3,550
3,500
3,450
3,400
3,350
3,300
3,250
3,200
3,150
3,100
3,050
3,000
2,950
2,900
2,850
2,800

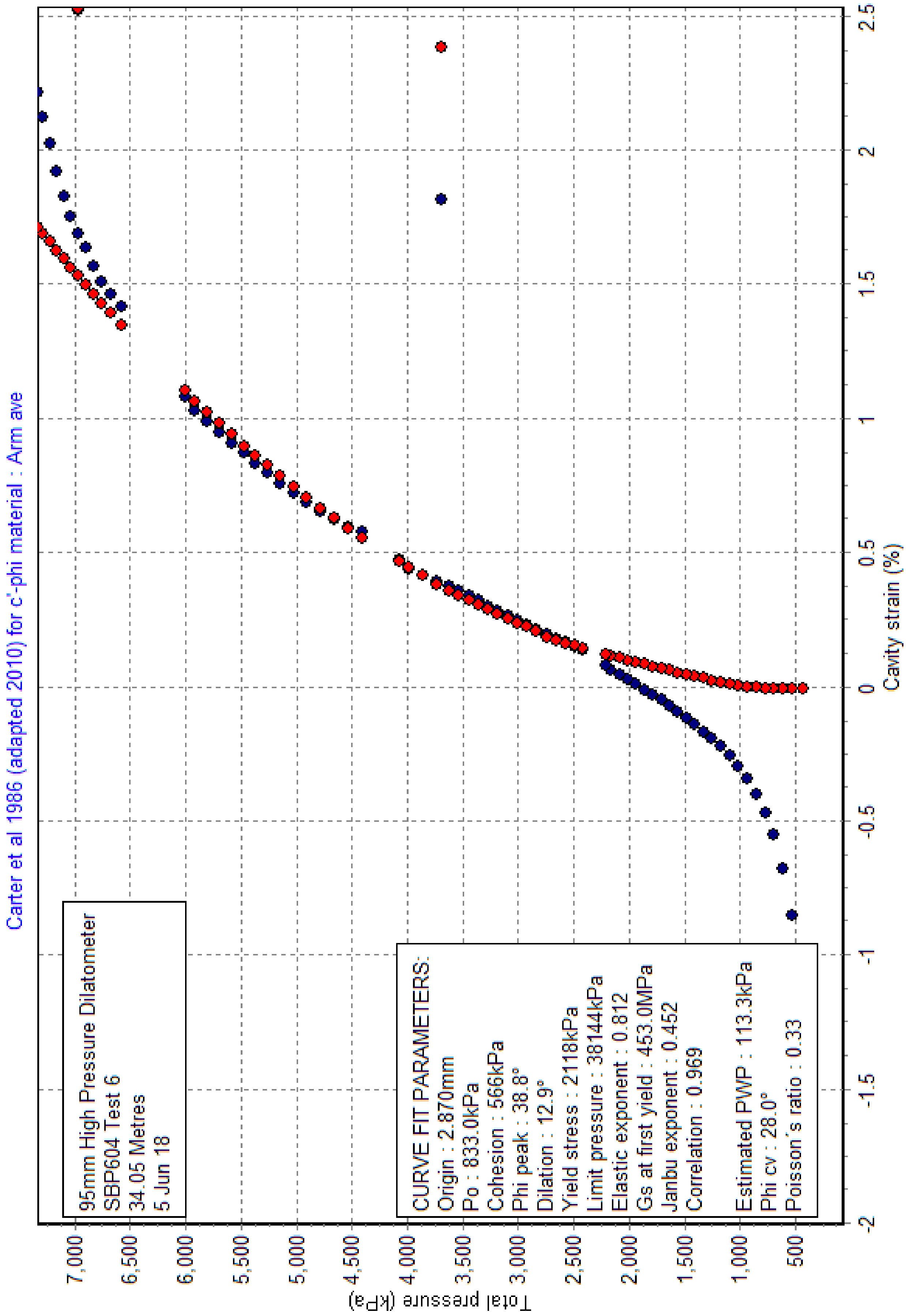

Shear modulus from unload/reload cycles Loop 3 : Arm ave
RESULTS:
Gur : 1341.3MPa
Cycle mid-point:
Cavity strain : 1.209%
Total stress : 4662kPa
Size of cycle :
Shear strain : 0.088%
Total stress : 1182kPa
95mm High Pressure Dilatometer
SBP604 Test 6
34.05 Metres
5 Jun 18
Total pressure (kPa)
6,100
6,000
5,900
5,800
5,700
5,600
5,500
5,400
5,300
5,200
5,100
5,000
4,900
4,800
4,700
4,600
4,500
4,400
4,300
4,200
4,100
4,000
Radial Displacement (mm)
3.43
3.44
3.45
3.46
3.47
3.48
3.49
3.5
3.51
3.52
3.53
3.54

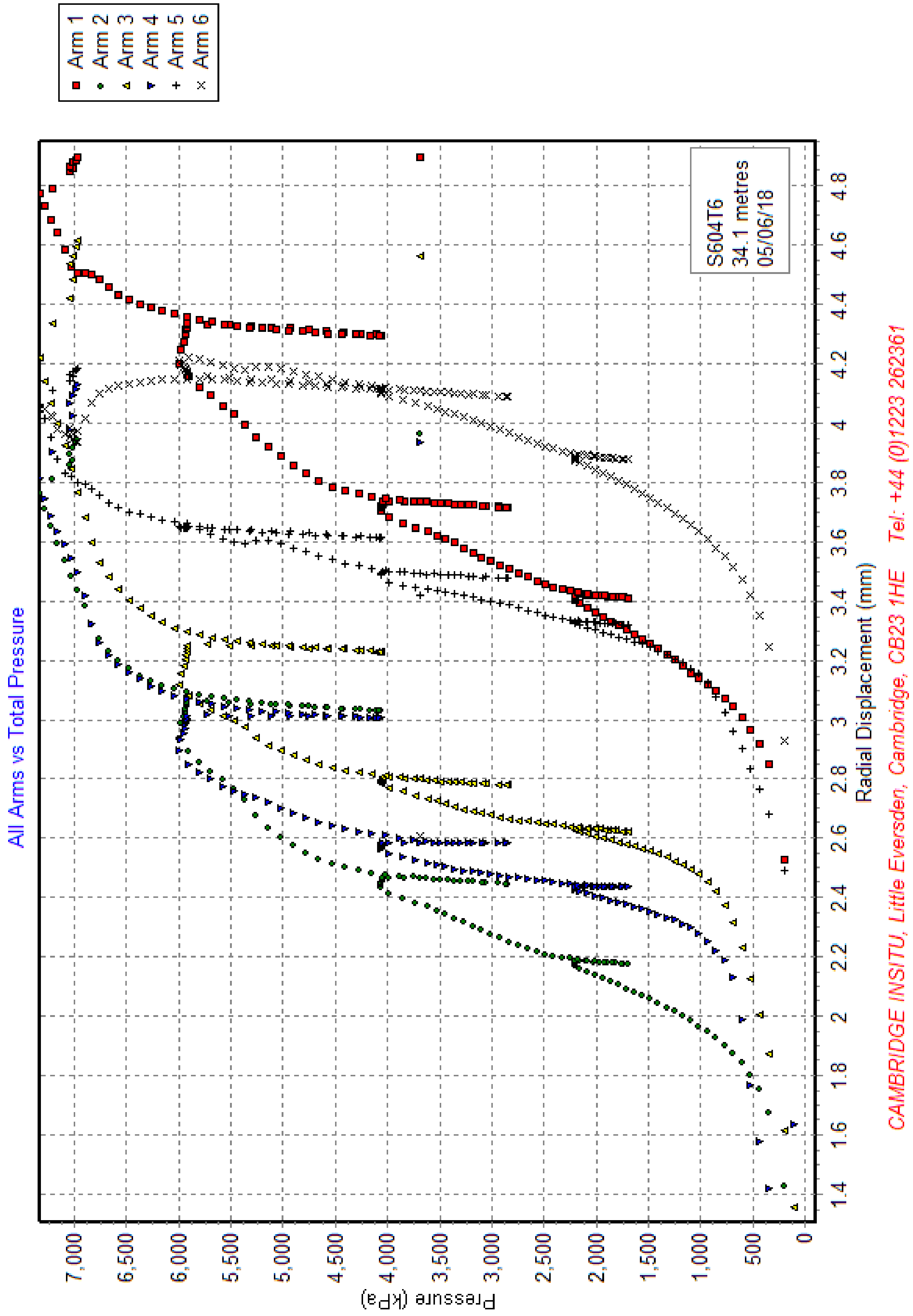

Bolton and Whittle (1999) Loop 1 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 6
34.05 Metres
5 Jun 18
RESULTS:
Gradient (beta) : 0.814
Intercept (n) : 213.411MPa
Shear stress constant : 173.706MPa
Ln[Radial stress]
5.7
5.6
5.5
5.4
5.3
5.2
5.1
5
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
Ln[shear strain]
-9
Source data - Loop 1
Total pressure (kPa)
2,000
1,900
1,800
1,700
Radial Displacement (mm)
2.92


Bolton and Whittle (1999) Loop 2 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 6
34.05 Metres
5 Jun 18
RESULTS:
Gradient (beta) : 0.807
Intercept (n) : 312.978MPa
Shear stress constant : 252.510MPa
Ln[Radial stress]
6.6
6.5
6.4
6.3
6.2
6.1
6
5.9
5.8
5.7
5.6
5.5
5.4
5.3
5.2
5.1
5
4.9
4.8
4.7
4.6
4.5
Ln[shear strain]
-10
-9
-8
Source data - Loop 2
Total pressure (kPa)
3,000
3,200
3,400
3,600
Radial Displacement (mm)
3.12
3.125
3.13
3.135

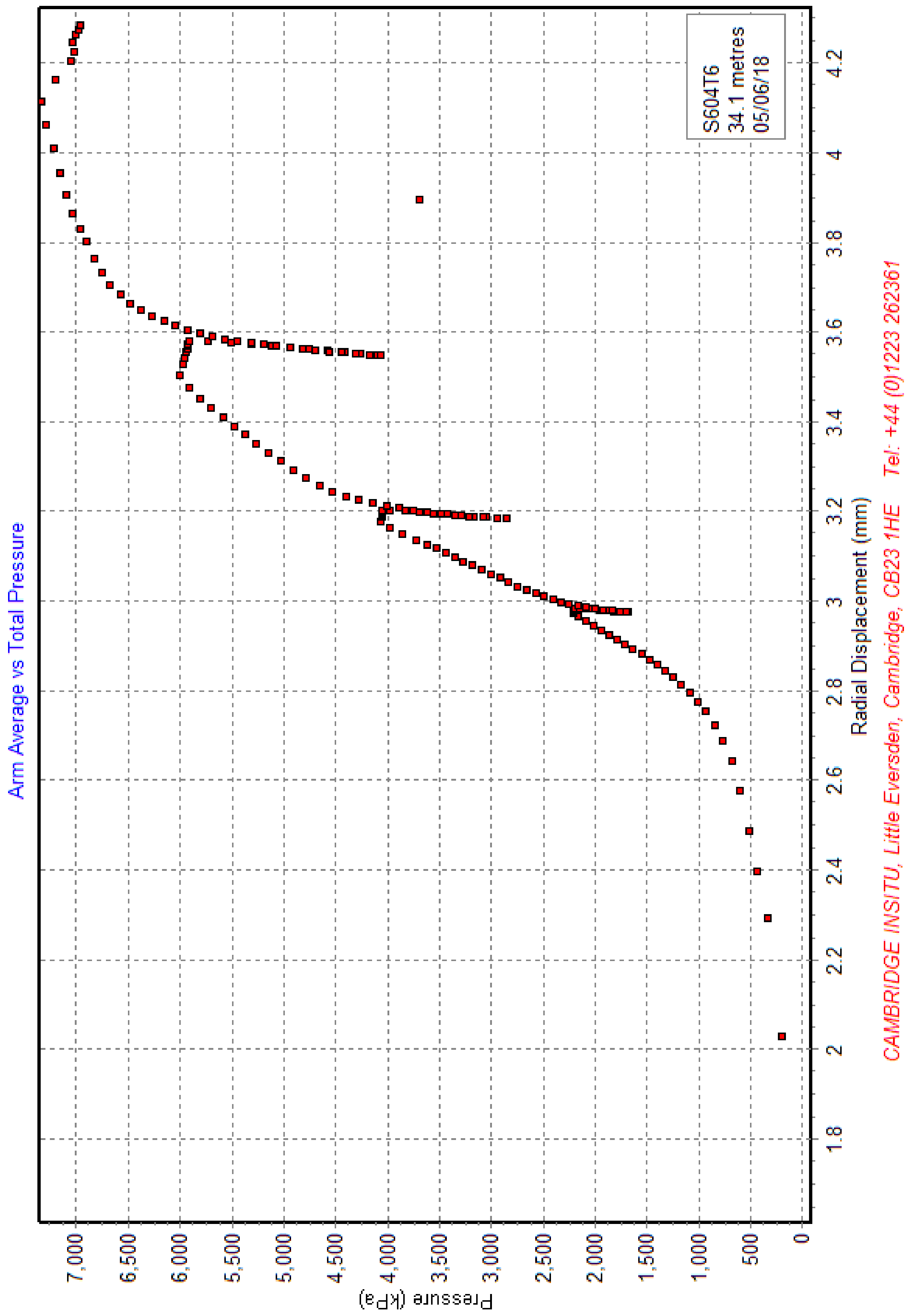

Bolton and Whittle (1999) Loop 3 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 6
34.05 Metres
5 Jun 18
RESULTS:
Gradient (beta) : 0.812
Intercept (n) : 356.687MPa
Shear stress constant : 289.798MPa
Ln[Radial stress]
Ln[shear strain]
-9
-8
7
6.9
6.8
6.7
6.6
6.5
6.4
6.3
6.2
6.1
6
5.9
5.8
5.7
5.6
5.5
5.4
5.3
5.2
5.1
5
4.9
4.8
4.7
Source data - Loop 3
Total pressure (kPa)
Radial Displacement (mm)
5,000
4,500
4,000
3.48
3.49
3.5

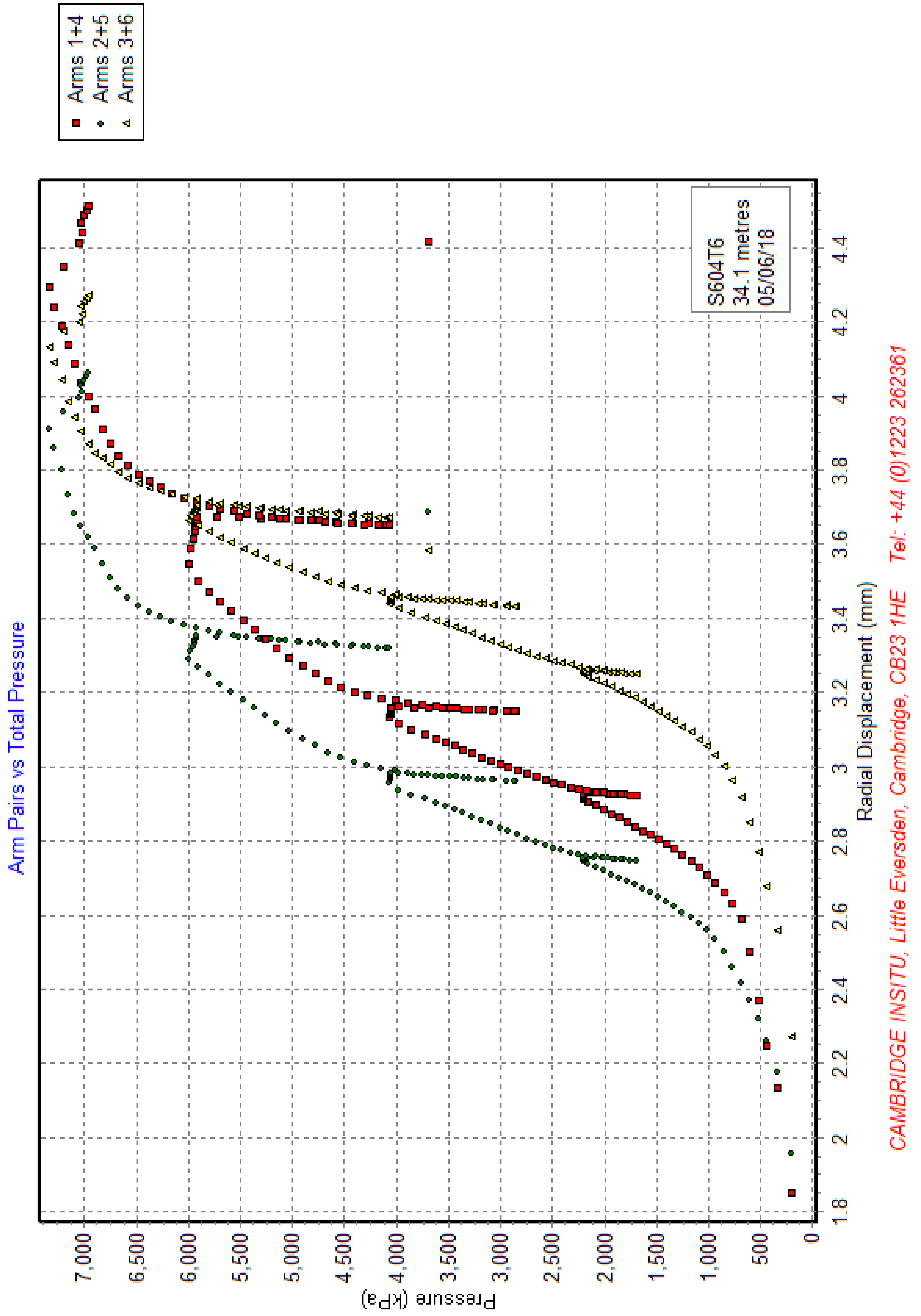

Variation of stiffness with strain, undrained analysis : Arm ave
POWER LAW PARAMETERS:
Cycle No. Constant (MPa) Gradient
1 173.706 0.814
2 252.510 0.807
3 289.798 0.812
95mm High Pressure Dilatometer
SBP604 Test 6
34.05 Metres
5 Jun 18
Shear modulus (MPa)
1,700 1,650 1,600 1,550 1,500 1,450 1,400 1,350 1,300 1,250 1,200 1,150 1,100 1,050 1,000 950 900 850 800 750 700 650 600 550 500 450
Log plane shear strain
0.0001
0.001

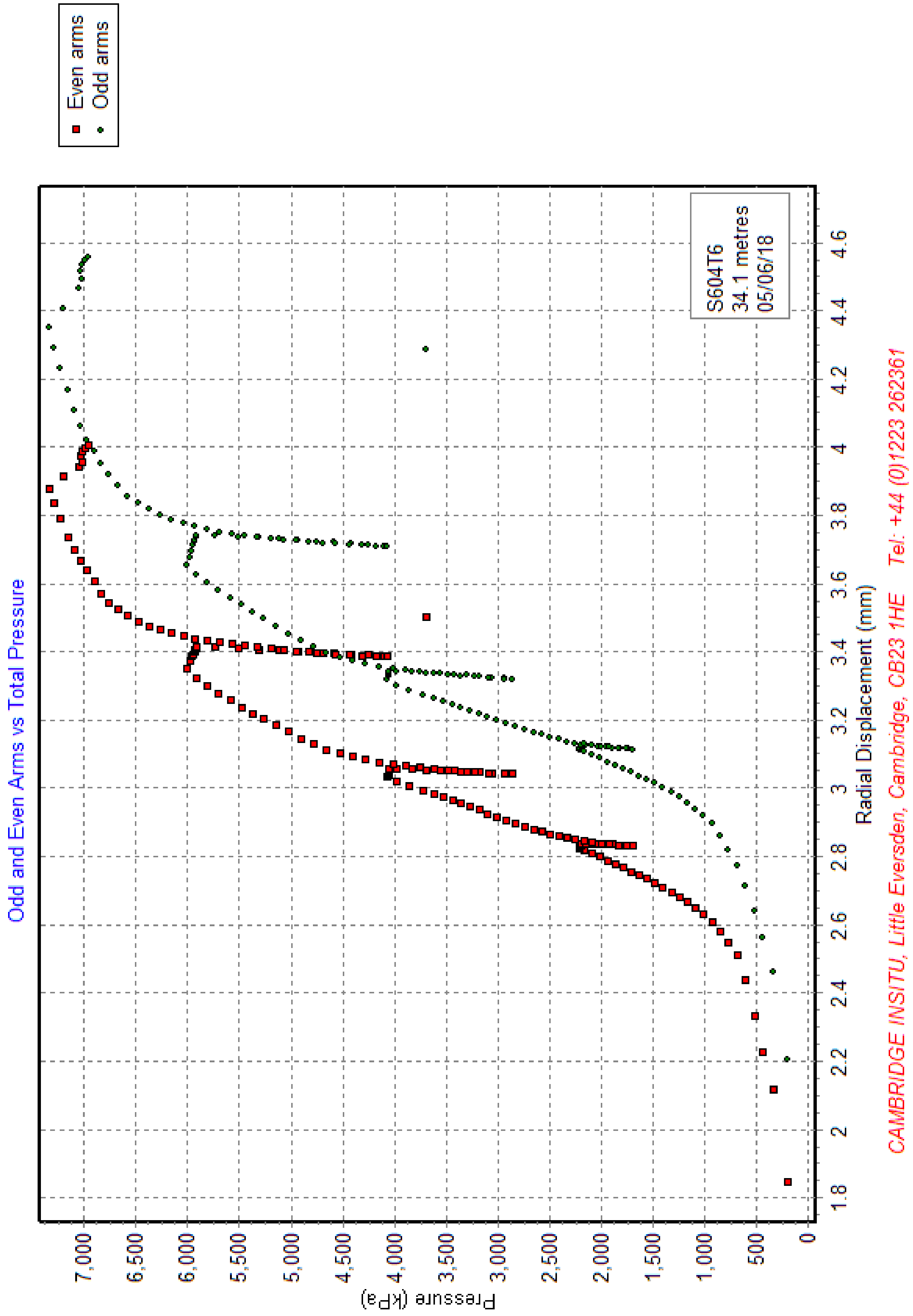

Carter et al 1986 (adapted 2010) for c'-phi material : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 6
34.05 Metres
5 Jun 18
CURVE FIT PARAMETERS:
Origin : 2.870mm
Po : 833.0kPa
Cohesion : 566kPa
Phi peak : 38.8°
Dilation : 12.9°
Yield stress : 2118kPa
Limit pressure : 38144kPa
Elastic exponent : 0.812
Gs at first yield : 453.0MPa
Janbu exponent : 0.452
Correlation : 0.969
Estimated PWP : 113.3kPa
Phi cv : 28.0°
Poisson's ratio : 0.33
Total pressure (kPa)
Cavity strain (%)
7,000
6,500
6,000
5,500
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
2.5



All Arms vs Total Pressure
Arm 1
Arm 2
Arm 3
Arm 4
Arm 5
Arm 6
S604T6
34.1 metres
05/06/18
Radial Displacement (mm)
Pressure (kPa)
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361


Arm Average vs Total Pressure
S604T6
34.1 metres
05/06/18
Radial Displacement (mm)
1.8
2
2.2
2.4
2.6
2.8
3
3.2
3.4
3.6
3.8
4
4.2
Pressure (kPa)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
4,500
5,000
5,500
6,000
6,500
7,000
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361


Arm Pairs vs Total Pressure
Arms 1+4
Arms 2+5
Arms 3+6
S604T6
34.1 metres
05/06/18
Radial Displacement (mm)
Pressure (kPa)
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361



Odd and Even Arms vs Total Pressure
Even arms
Odd arms
S604T6
34.1 metres
05/06/18
Radial Displacement (mm)
1.8 2 2.2 2.4 2.6 2.8 3 3.2 3.4 3.6 3.8 4 4.2 4.4 4.6
Pressure (kPa)
7,000 6,500 6,000 5,500 5,000 4,500 4,000 3,500 3,000 2,500 2,000 1,500 1,000 500 0
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361

SBP604 Test 7 - SUMMARY OF RESULTS
[File made with WinSitu Version 3.9.1.1]

[DETAILS OF TEST]
Project : 60547200
Site : A303 Stonehenge
Borehole : SBP604
Test name : SBP604 Test 7
Test date : 5 Jun 18
Test depth : 37.20 Metres
Water table : 22.5 Metres
Ambient PWP : 144.2 kPa
Material : Chalk
Probe : 95mm High Pressure Dilatometer
Diameter : 97.0 mm
Data analysed using average arm displacement curve
A non-linear analysis of the rebound cycles has been carried out
The file includes results from a curve fitting analysis

Analysed by RWW on 7 Jun 18

Remarks:

[RESULTS FOR CAVITY REFERENCE PRESSURE]
Strain Origin (mm) : "Arm ave=4.60"
Po from Marsland & Randolph (kPa) : "Arm ave=1112.8"
Best estimate of Po (kPa) : "Arm ave=993.0"

[UNDRAINED STRENGTH PARAMETERS]
Undrained yield stress (kPa) : "Arm ave=3311.2"

[DRAINED ANALYSIS OF SANDS]
[Hughes et al 1977]
Constant volume friction angle (°) : 28.0
Angle of internal friction (°) : "Arm ave=38.0"
Dilation angle (°) : "Arm ave=11.9"
Gradient of log-log plot : "Arm ave=0.459"

[Withers et al 1989]
Angle of internal friction (°) : "Arm ave=29.0"
Dilation angle (°) : "Arm ave=1.1"
Gradient of log-log plot : "Arm ave=-1.828"

[LINEAR INTERPRETATION OF SHEAR MODULUS G]
Initial slope shear modulus (MPa) :"Arm ave=306.4"

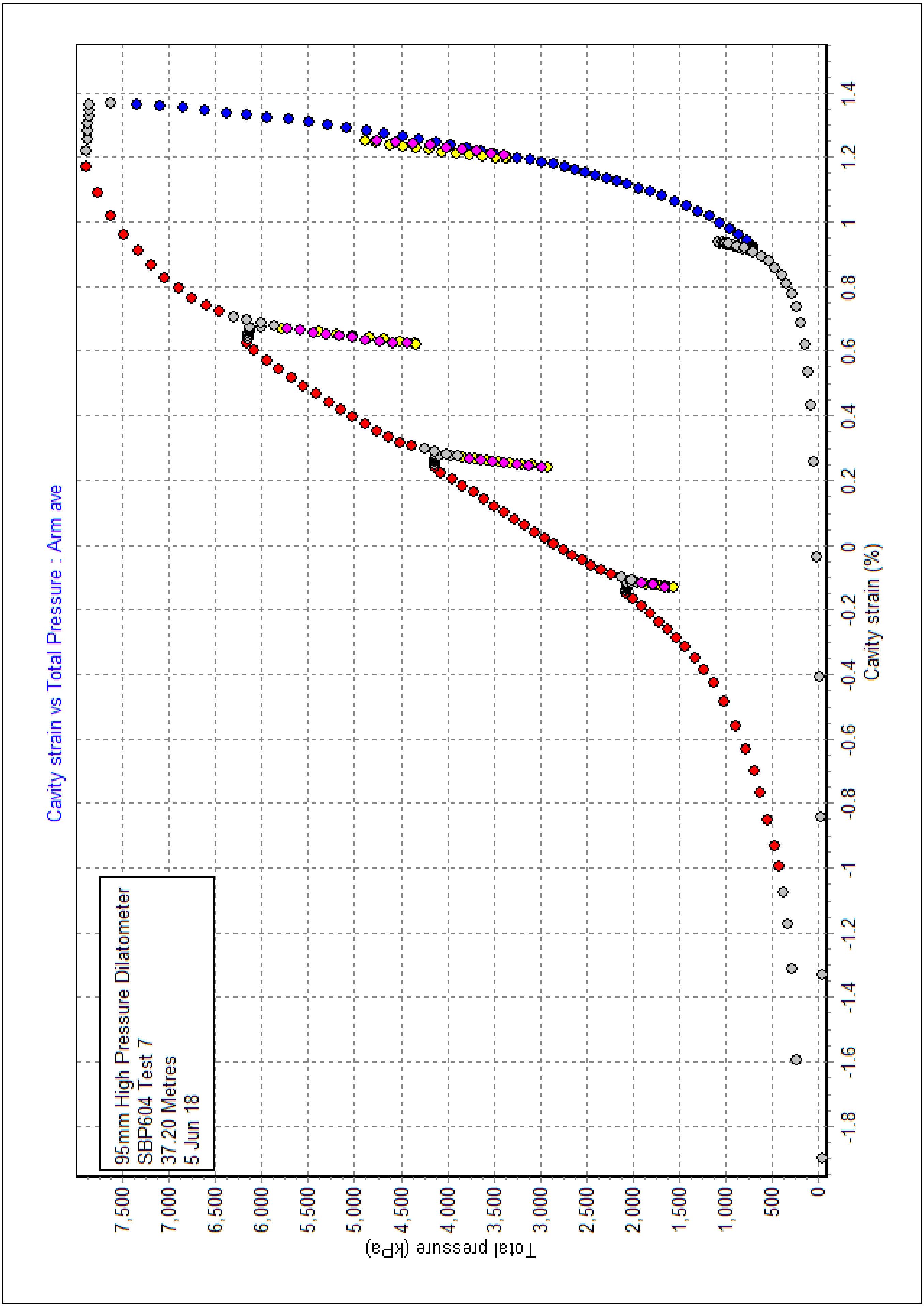
Axis	Loop No	Value (MPa)	Mean Strain (%)	Mean Pc (kPa)	dE (%)	dPc (kPa)
Arm ave	1	1158.0	-0.121	1740	0.029	338
Arm ave	2	1371.0	0.259	3377	0.066	906
Arm ave	3	1481.0	0.651	5073	0.102	1511
Arm ave	4	1471.2	1.230	4096	0.112	1646

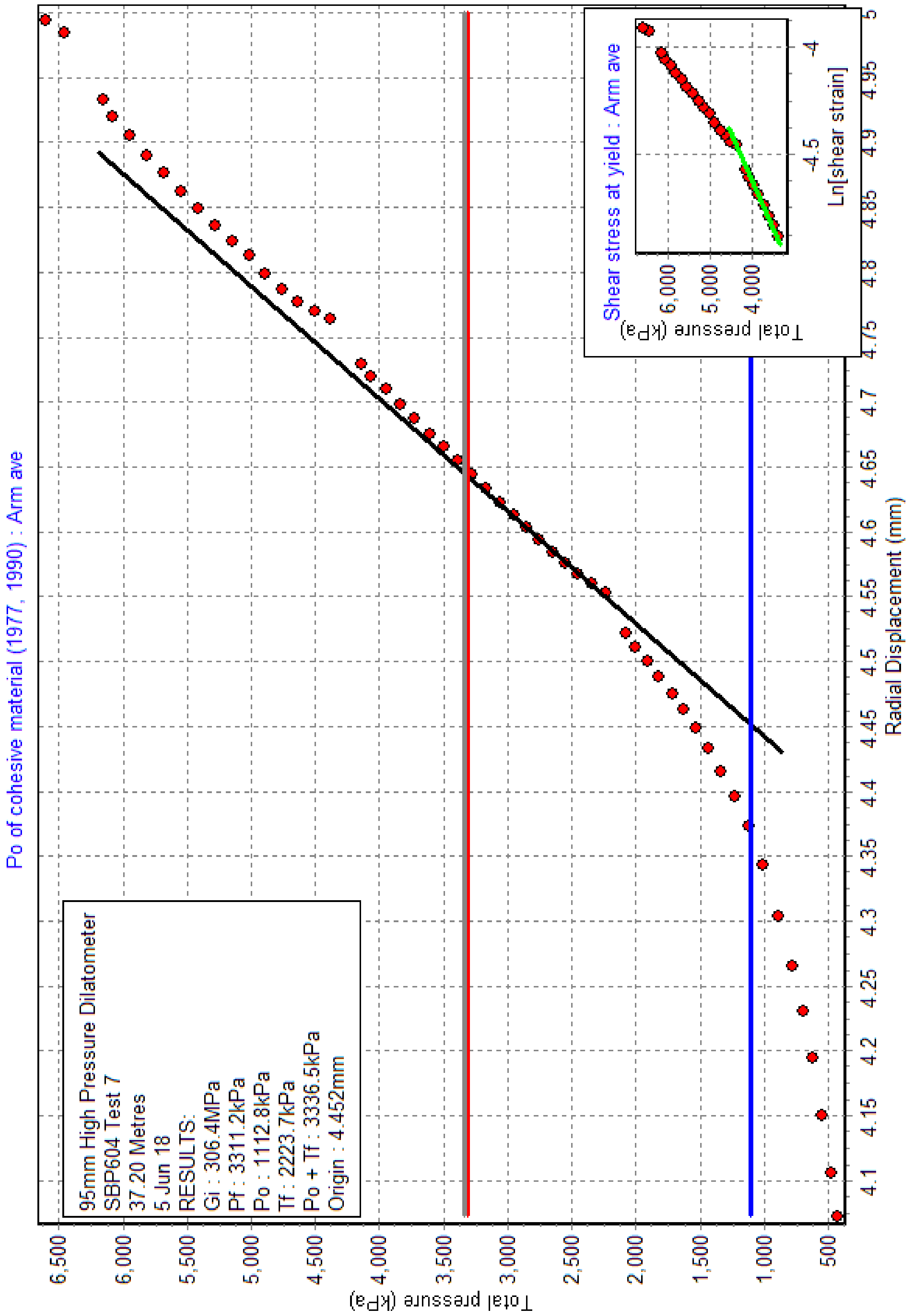
[UNDRAINED NON LINEAR INTERPRETATION OF SECANT SHEAR MODULUS]

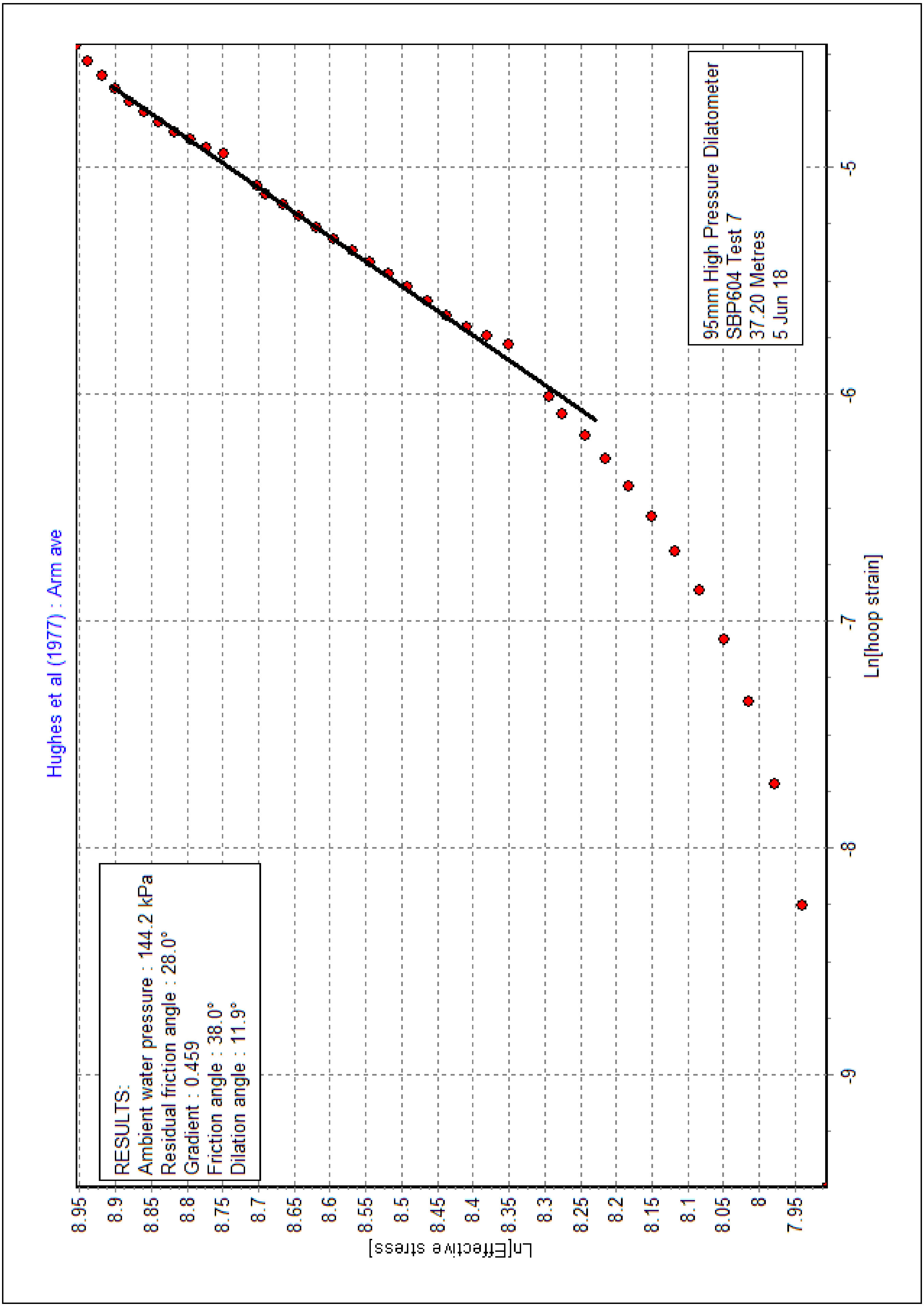
Axis	Loop No	Intercept (MPa)	Alpha (MPa)	Gradient
Arm ave	1	543.307	504.909	0.929
Arm ave	2	533.473	466.978	0.875
Arm ave	3	309.867	240.215	0.775
Arm ave	4	344.905	268.535	0.779

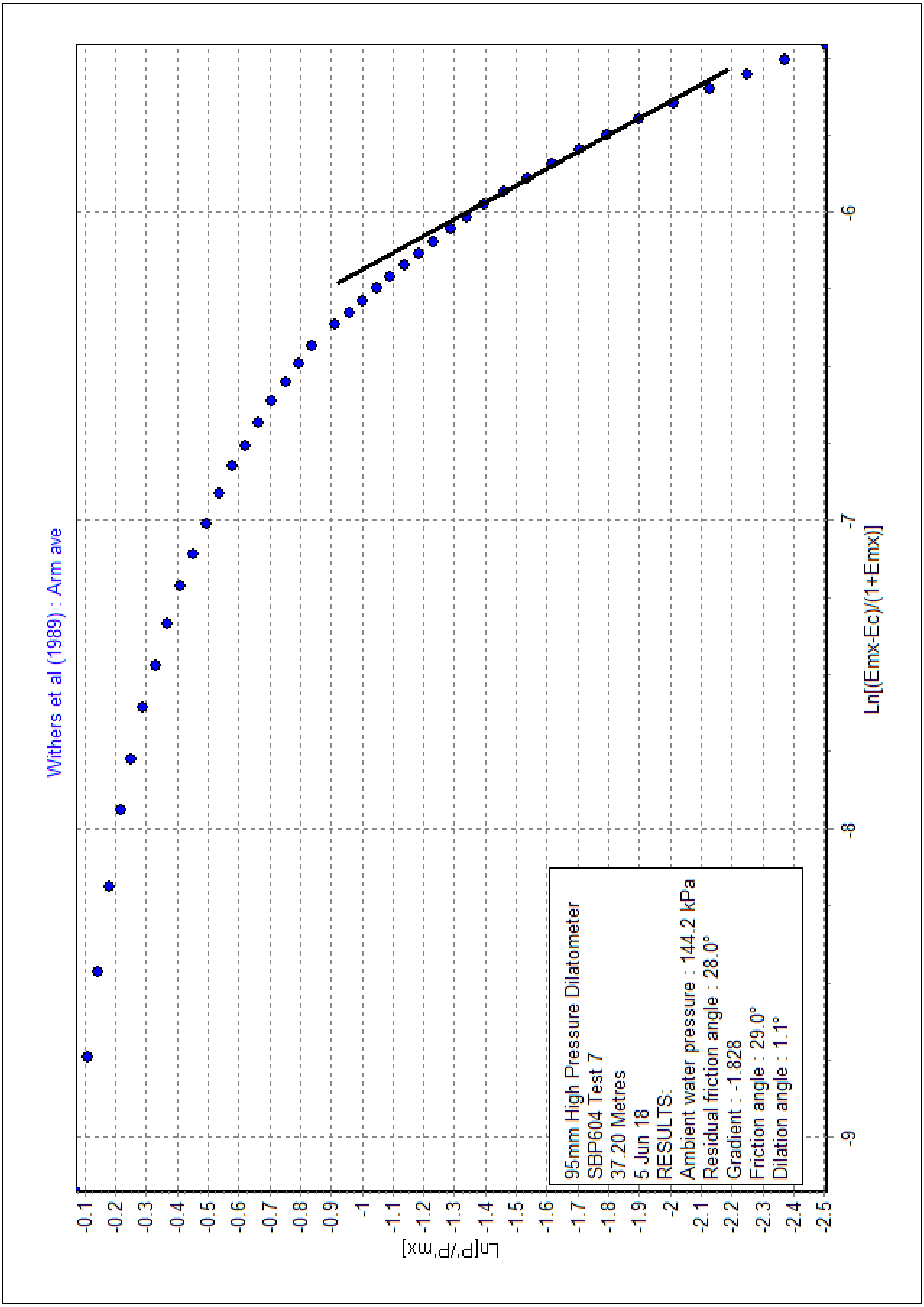
[PARAMETERS USED FOR DRAINED CURVE MODELLING]
{Axis is Arm ave}
Strain Origin (mm) : 4.60
Po (kPa) : 993
Cohesion (kPa) : 248
Angle of peak friction (deg) : 38.0
Angle of peak dilation (deg) : 11.9
Total yield stress (kPa) : 2110
Total limit stress (kPa) : 46760
G at first yield (MPa) : 952.6
Non-linear exponent : 0.779
Janbu exponent : 0.165
Correlation : 0.873

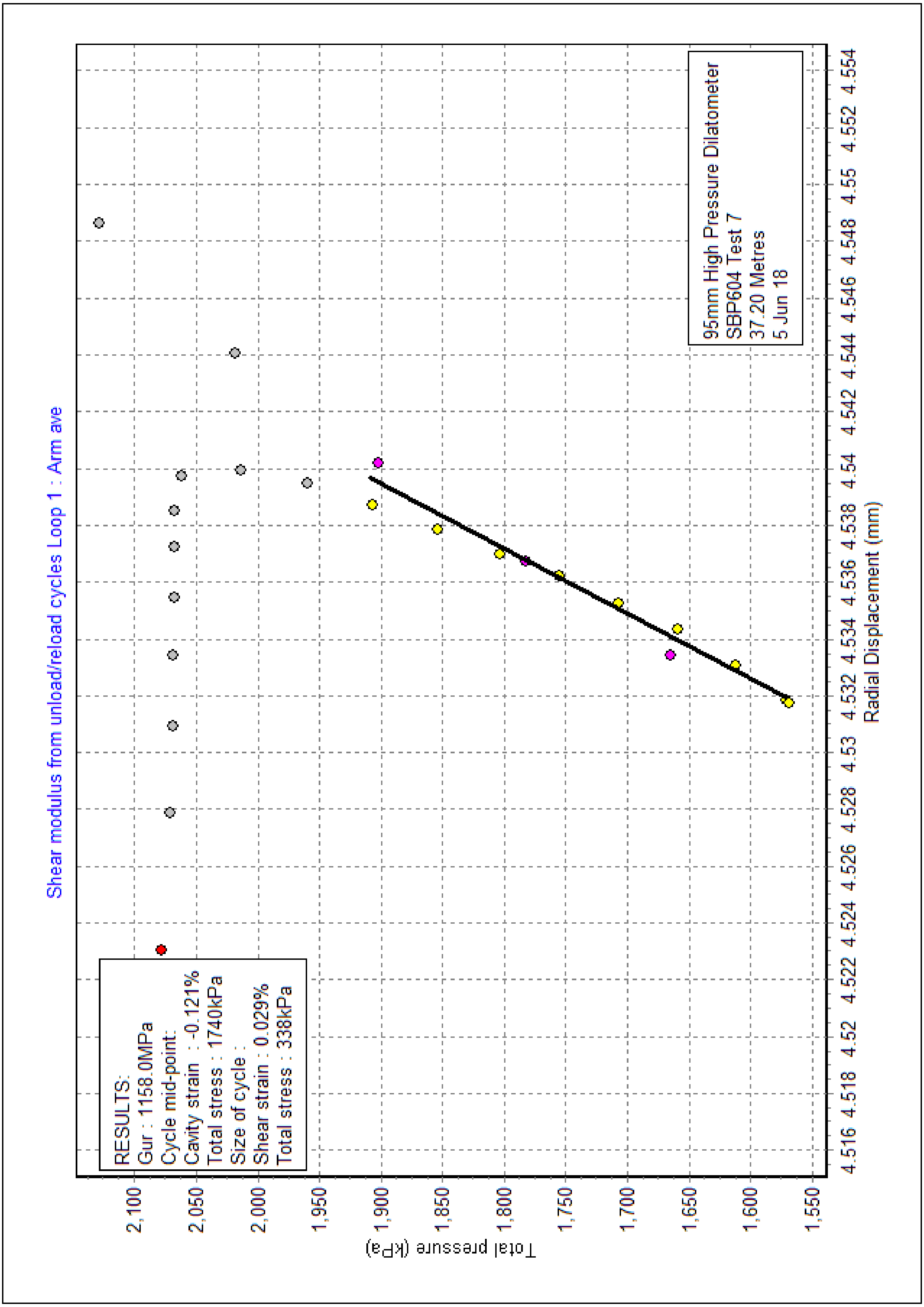
Ambient pore water pressure (kPa) : 144
Residual friction angle (deg) : 28.0
Poisson's ratio : 0.33

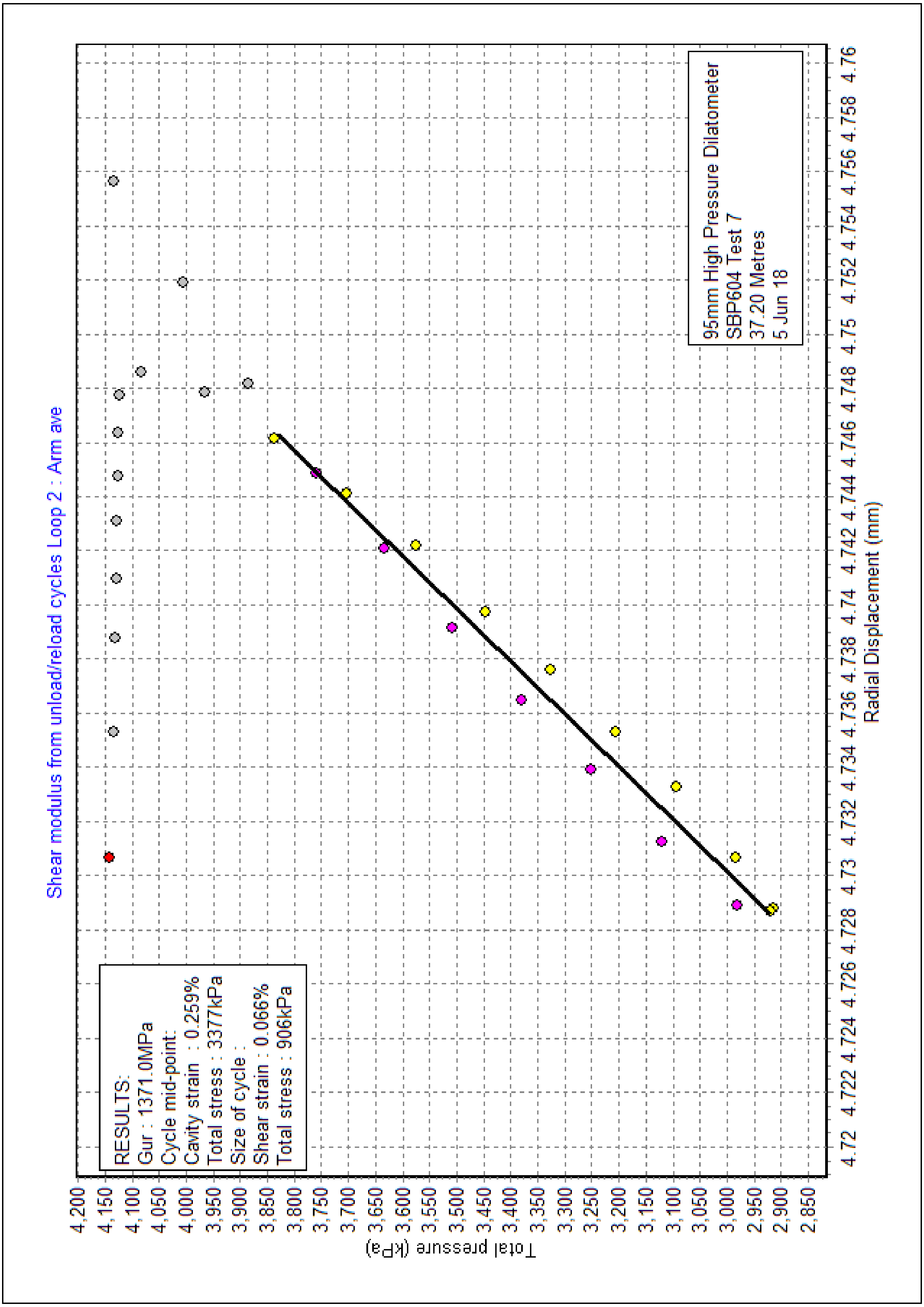

Cavity strain vs Total Pressure : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 7
37.20 Metres
5 Jun 18
Cavity strain (%)
Total pressure (kPa)
-1.8 -1.6 -1.4 -1.2 -1 -0.8 -0.6 -0.4 -0.2 0 0.2 0.4 0.6 0.8 1 1.2 1.4
0 500 1,000 1,500 2,000 2,500 3,000 3,500 4,000 4,500 5,000 5,500 6,000 6,500 7,000 7,500

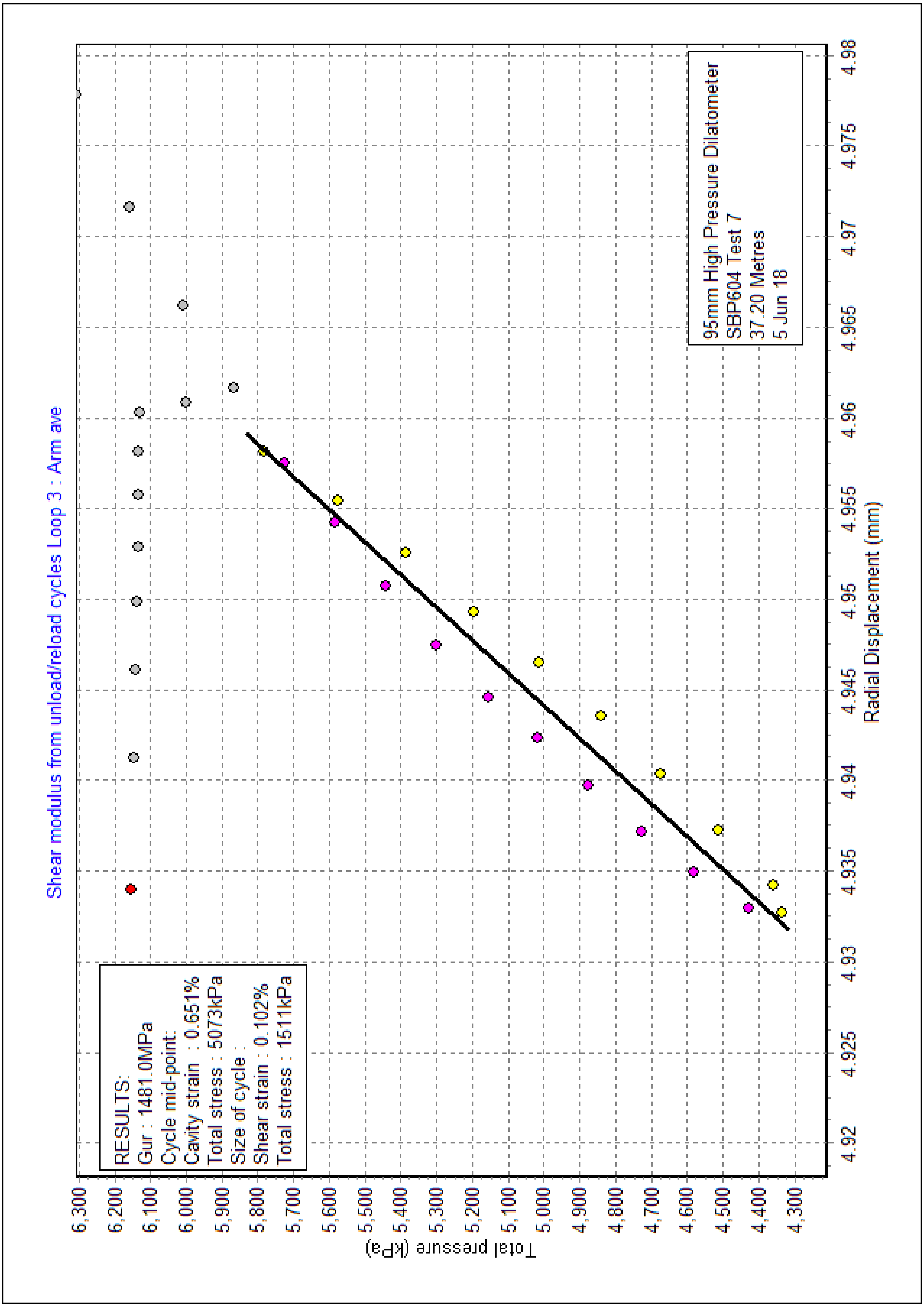

Po of cohesive material (1977, 1990) : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 7
37.20 Metres
5 Jun 18
RESULTS:
Gi : 306.4MPa
Pf : 3311.2kPa
Po : 1112.8kPa
Tf : 2223.7kPa
Po + Tf : 3336.5kPa
Origin : 4.452mm
Total pressure (kPa)
6,500
6,000
5,500
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
Radial Displacement (mm)
4.1
4.15
4.2
4.25
4.3
4.35
4.4
4.45
4.5
4.55
4.6
4.65
4.7
4.75
4.8
4.85
4.9
4.95
5
Shear stress at yield : Arm ave
Total pressure (kPa)
6,000
5,000
4,000
Ln[shear strain]
-4
-4.5

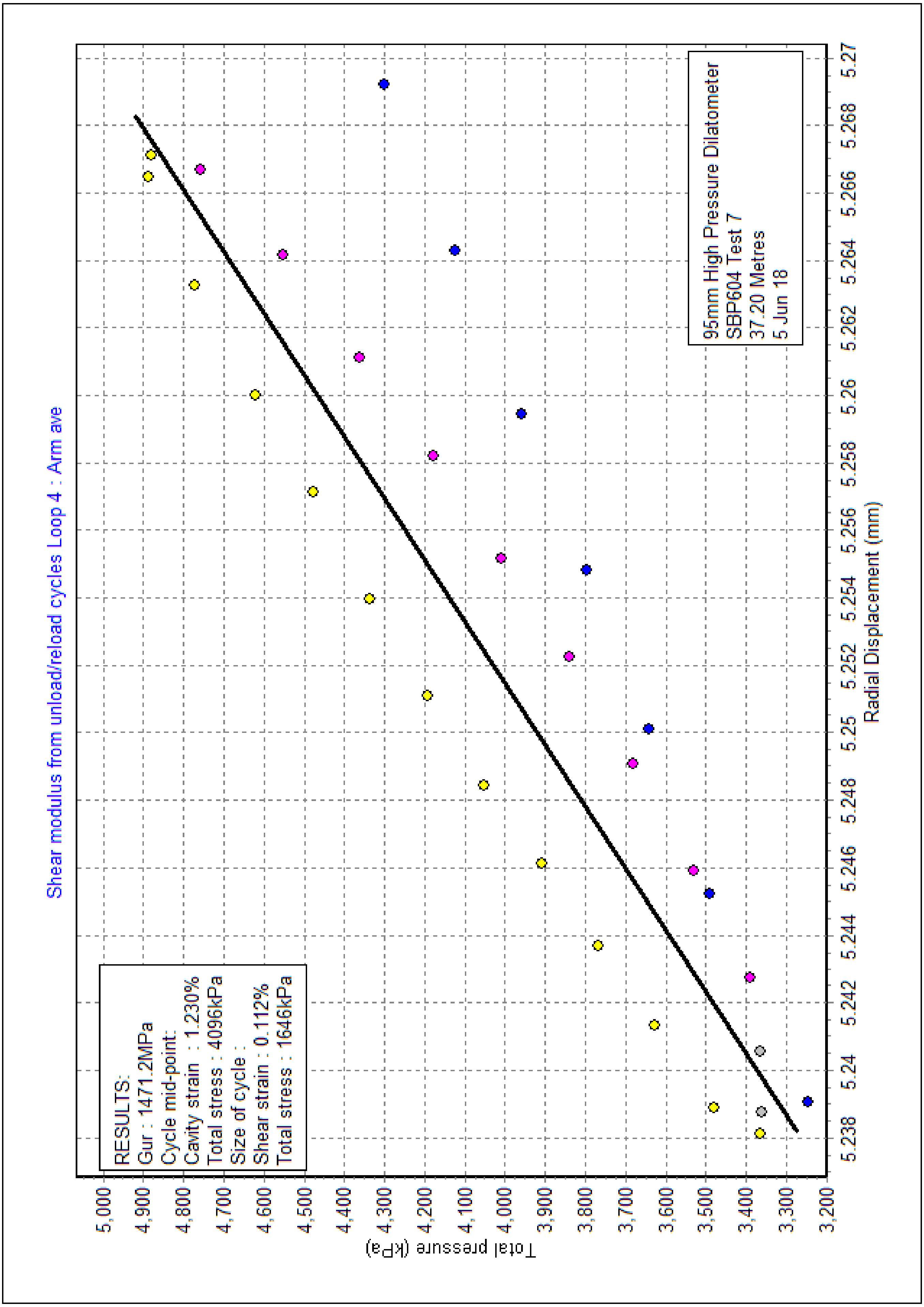

Hughes et al (1977) : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 7
37.20 Metres
5 Jun 18
RESULTS:
Ambient water pressure : 144.2 kPa
Residual friction angle : 28.0°
Gradient : 0.459
Friction angle : 38.0°
Dilation angle : 11.9°
Ln[Effective stress]
Ln[hoop strain]
8.95
8.9
8.85
8.8
8.75
8.7
8.65
8.6
8.55
8.5
8.45
8.4
8.35
8.3
8.25
8.2
8.15
8.1
8.05
8
7.95
-5
-6
-7
-8
-9

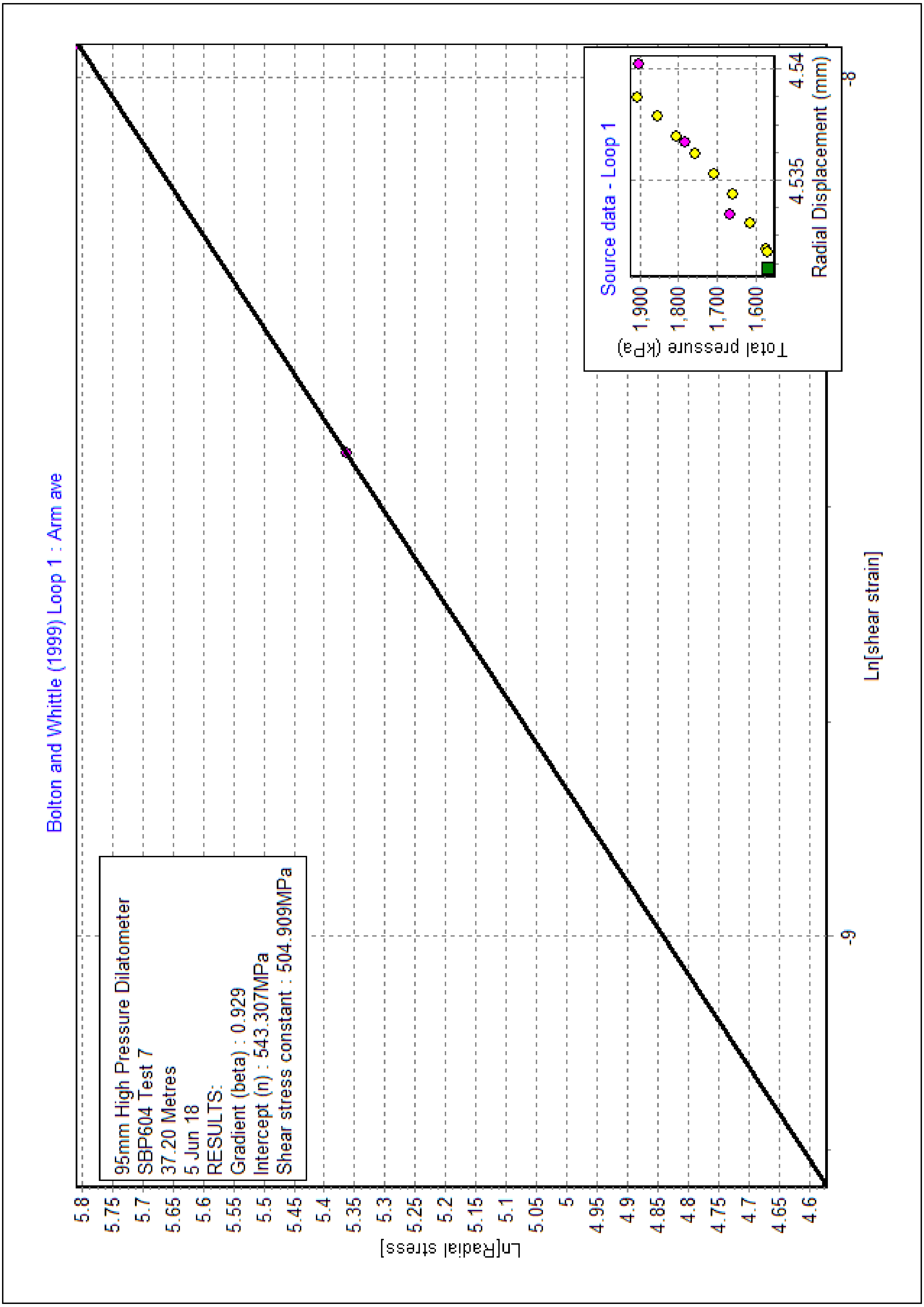

Withers et al (1989) : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 7
37.20 Metres
5 Jun 18
RESULTS:
Ambient water pressure : 144.2 kPa
Residual friction angle : 28.0°
Gradient : -1.828
Friction angle : 29.0°
Dilation angle : 1.1°
Ln[(Emx-Ec)/(1+Emx)]
Ln[P'/P'mx]
-6
-7
-8
-9
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
-0.9
-1
-1.1
-1.2
-1.3
-1.4
-1.5
-1.6
-1.7
-1.8
-1.9
-2
-2.1
-2.2
-2.3
-2.4
-2.5

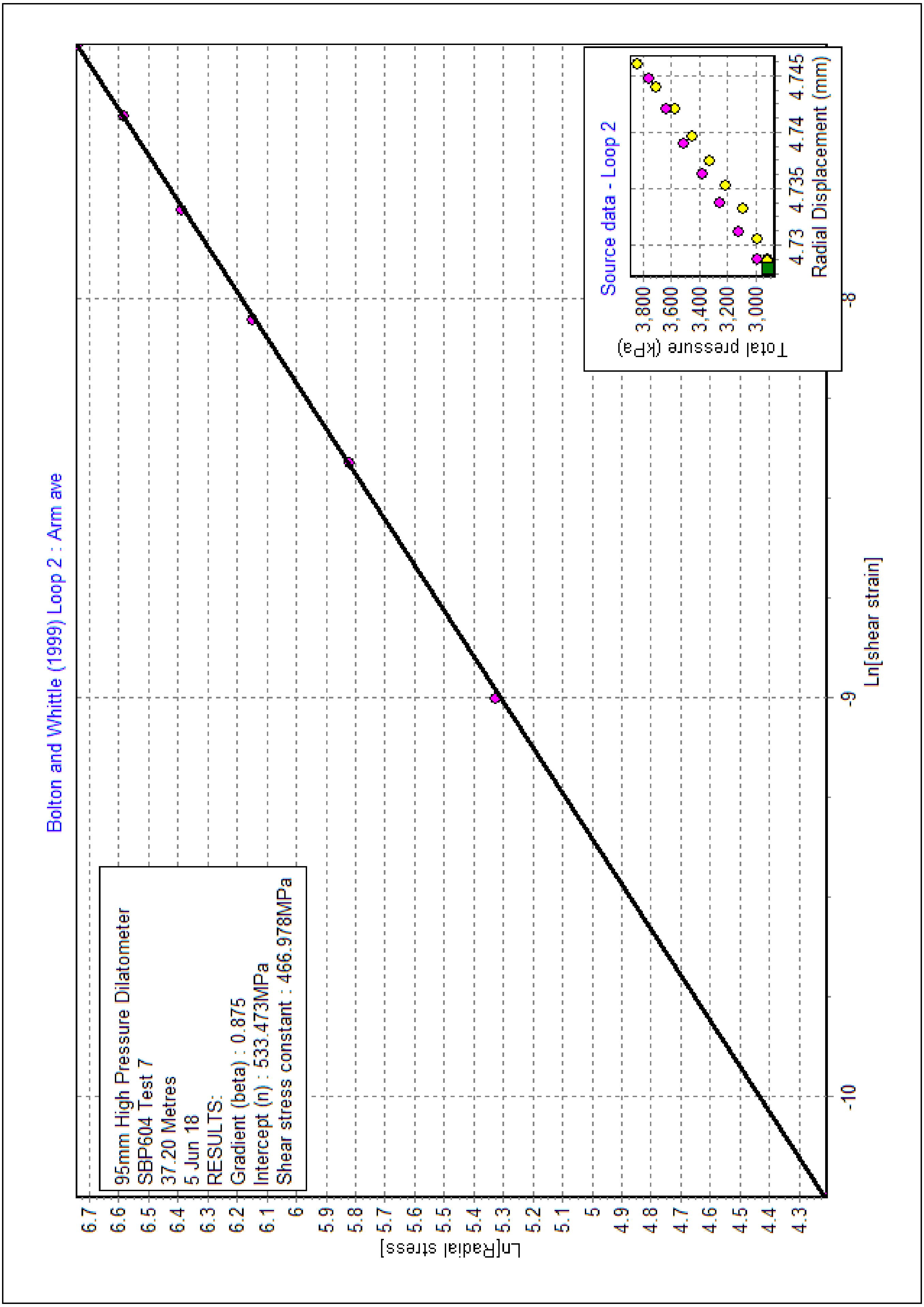

Shear modulus from unload/reload cycles Loop 1 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 7
37.20 Metres
5 Jun 18
RESULTS:
Gur : 1158.0MPa
Cycle mid-point:
Cavity strain : -0.121%
Total stress : 1740kPa
Size of cycle :
Shear strain : 0.029%
Total stress : 338kPa
Radial Displacement (mm)
Total pressure (kPa)
4.516
4.518
4.52
4.522
4.524
4.526
4.528
4.53
4.532
4.534
4.536
4.538
4.54
4.542
4.544
4.546
4.548
4.55
4.552
4.554
2,100
2,050
2,000
1,950
1,900
1,850
1,800
1,750
1,700
1,650
1,600
1,550

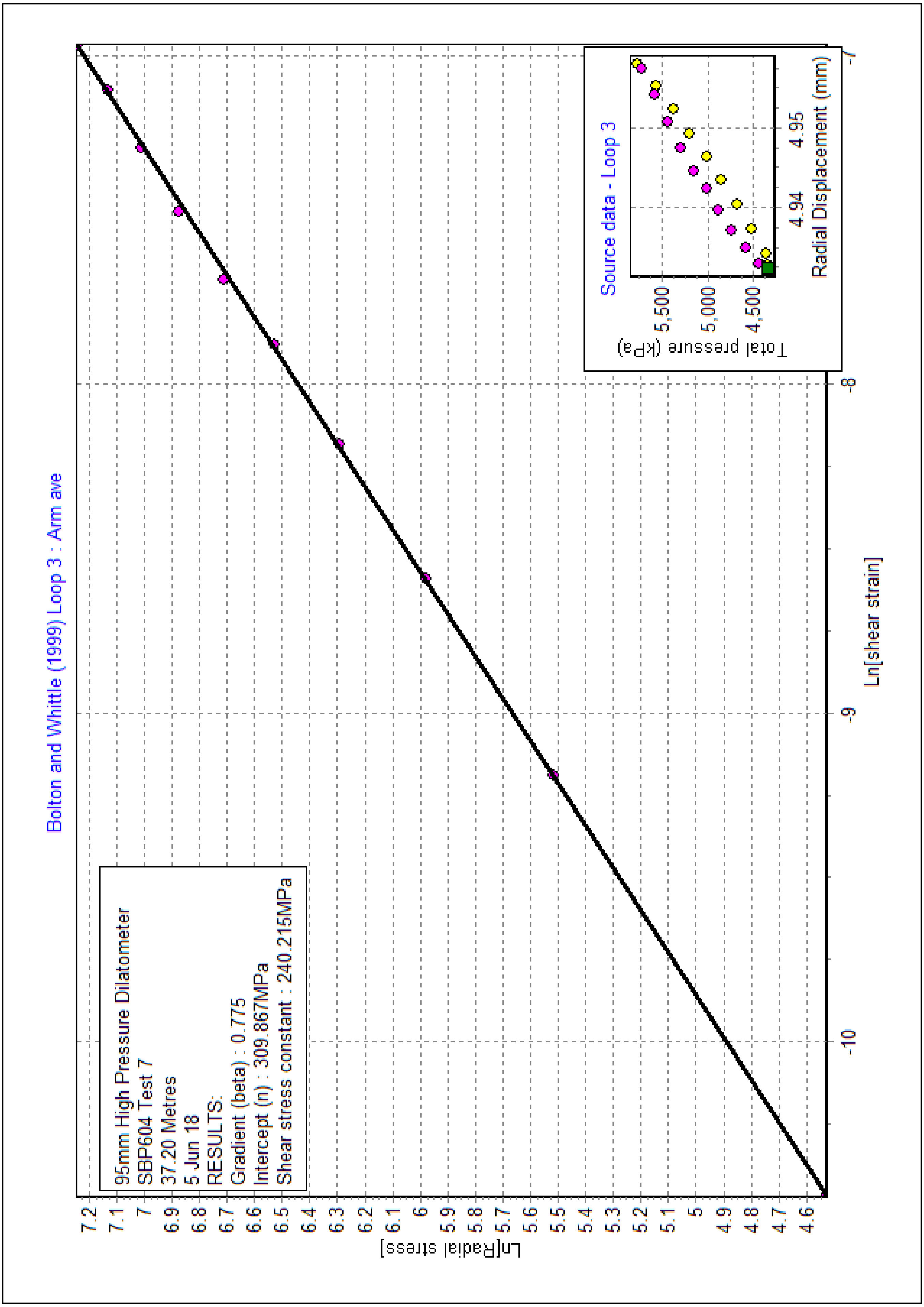

Shear modulus from unload/reload cycles Loop 2 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 7
37.20 Metres
5 Jun 18
RESULTS:
Gur : 1371.0MPa
Cycle mid-point:
Cavity strain : 0.259%
Total stress : 3377kPa
Size of cycle :
Shear strain : 0.066%
Total stress : 906kPa
Radial Displacement (mm)
Total pressure (kPa)
4.72 4.722 4.724 4.726 4.728 4.73 4.732 4.734 4.736 4.738 4.74 4.742 4.744 4.746 4.748 4.75 4.752 4.754 4.756 4.758 4.76
4,200 4,150 4,100 4,050 4,000 3,950 3,900 3,850 3,800 3,750 3,700 3,650 3,600 3,550 3,500 3,450 3,400 3,350 3,300 3,250 3,200 3,150 3,100 3,050 3,000 2,950 2,900 2,850

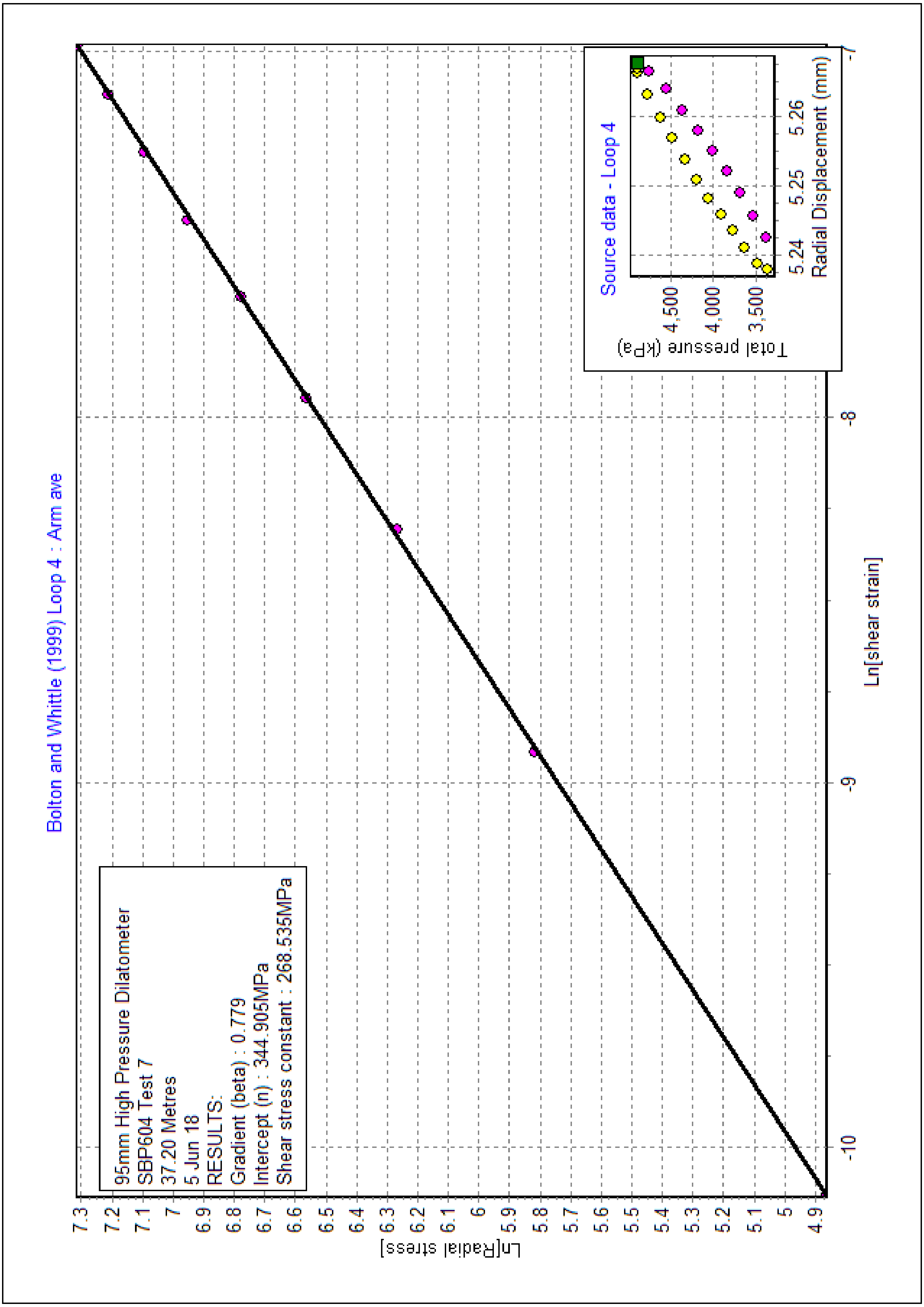

Shear modulus from unload/reload cycles Loop 3 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 7
37.20 Metres
5 Jun 18
RESULTS:
Gur : 1481.0MPa
Cycle mid-point:
Cavity strain : 0.651%
Total stress : 5073kPa
Size of cycle :
Shear strain : 0.102%
Total stress : 1511kPa
Radial Displacement (mm)
Total pressure (kPa)
4.92
4.925
4.93
4.935
4.94
4.945
4.95
4.955
4.96
4.965
4.97
4.975
4.98
6,300
6,200
6,100
6,000
5,900
5,800
5,700
5,600
5,500
5,400
5,300
5,200
5,100
5,000
4,900
4,800
4,700
4,600
4,500
4,400
4,300

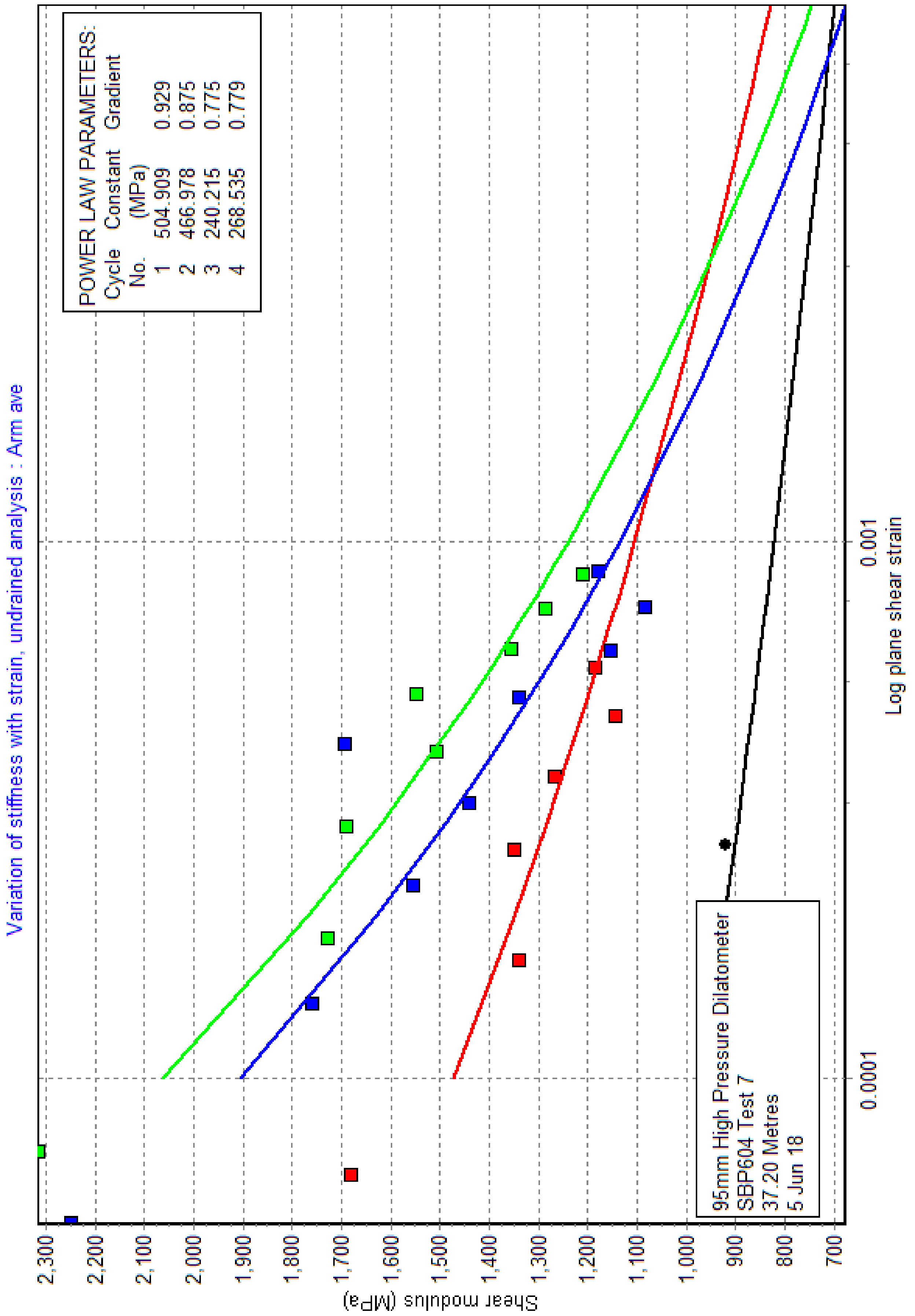

Shear modulus from unload/reload cycles Loop 4 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 7
37.20 Metres
5 Jun 18
RESULTS:
Gur : 1471.2MPa
Cycle mid-point:
Cavity strain : 1.230%
Total stress : 4096kPa
Size of cycle :
Shear strain : 0.112%
Total stress : 1646kPa
Radial Displacement (mm)
Total pressure (kPa)
5.238
5.24
5.242
5.244
5.246
5.248
5.25
5.252
5.254
5.256
5.258
5.26
5.262
5.264
5.266
5.268
5.27
5,000
4,900
4,800
4,700
4,600
4,500
4,400
4,300
4,200
4,100
4,000
3,900
3,800
3,700
3,600
3,500
3,400
3,300
3,200

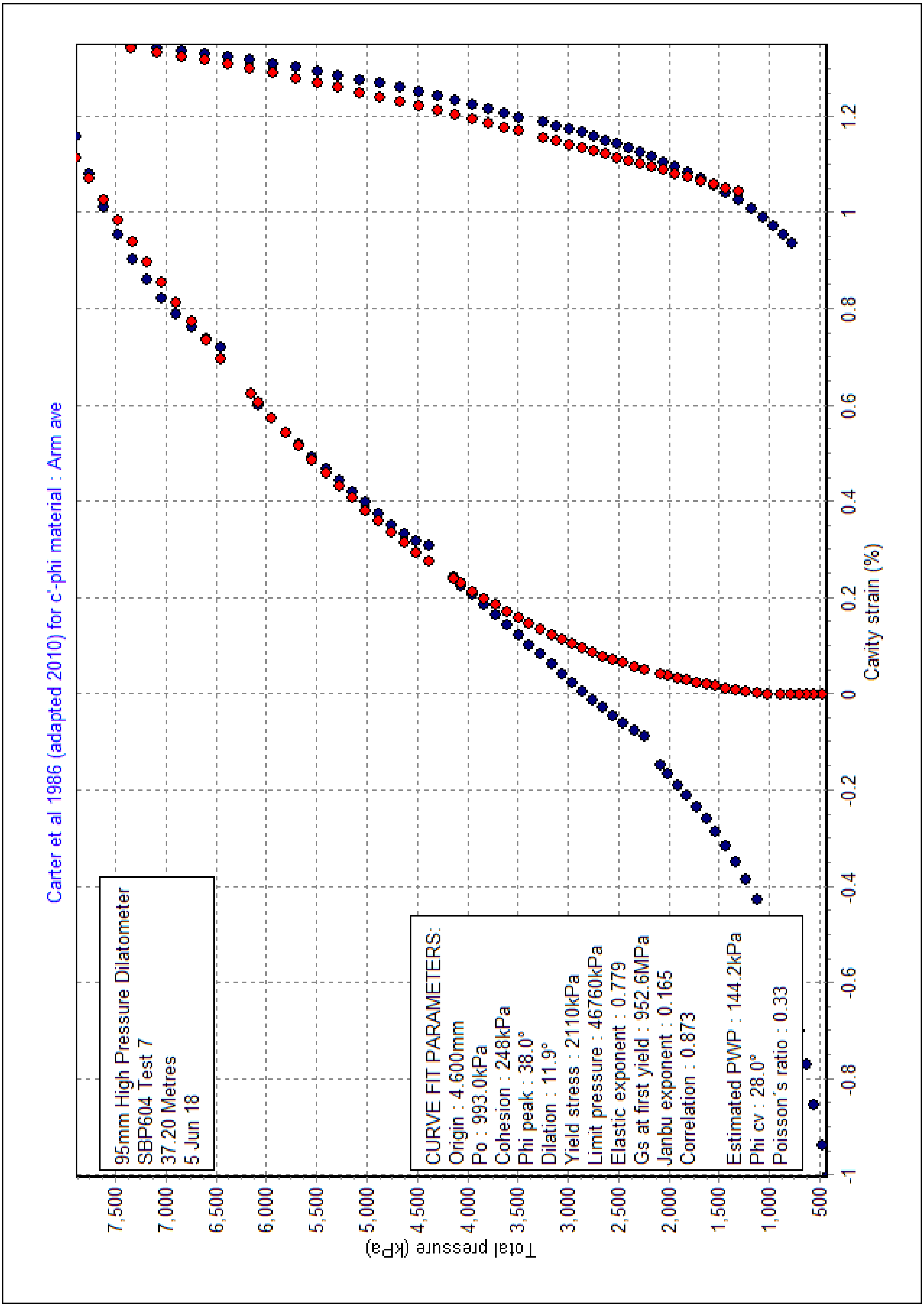

Bolton and Whittle (1999) Loop 1 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 7
37.20 Metres
5 Jun 18
RESULTS:
Gradient (beta) : 0.929
Intercept (n) : 543.307MPa
Shear stress constant : 504.909MPa
Ln[Radial stress]
Ln[shear strain]
-8
-9
5.8
5.75
5.7
5.65
5.6
5.55
5.5
5.45
5.4
5.35
5.3
5.25
5.2
5.15
5.1
5.05
5
4.95
4.9
4.85
4.8
4.75
4.7
4.65
4.6
Source data - Loop 1
Total pressure (kPa)
Radial Displacement (mm)
1,900
1,800
1,700
1,600
4.535
4.54


Bolton and Whittle (1999) Loop 2 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 7
37.20 Metres
5 Jun 18
RESULTS:
Gradient (beta) : 0.875
Intercept (n) : 533.473MPa
Shear stress constant : 466.978MPa
Ln[Radial stress]
6.7
6.6
6.5
6.4
6.3
6.2
6.1
6
5.9
5.8
5.7
5.6
5.5
5.4
5.3
5.2
5.1
5
4.9
4.8
4.7
4.6
4.5
4.4
4.3
Ln[shear strain]
-10
-9
-8
Source data - Loop 2
Total pressure (kPa)
3,800
3,600
3,400
3,200
3,000
Radial Displacement (mm)
4.73
4.735
4.74
4.745

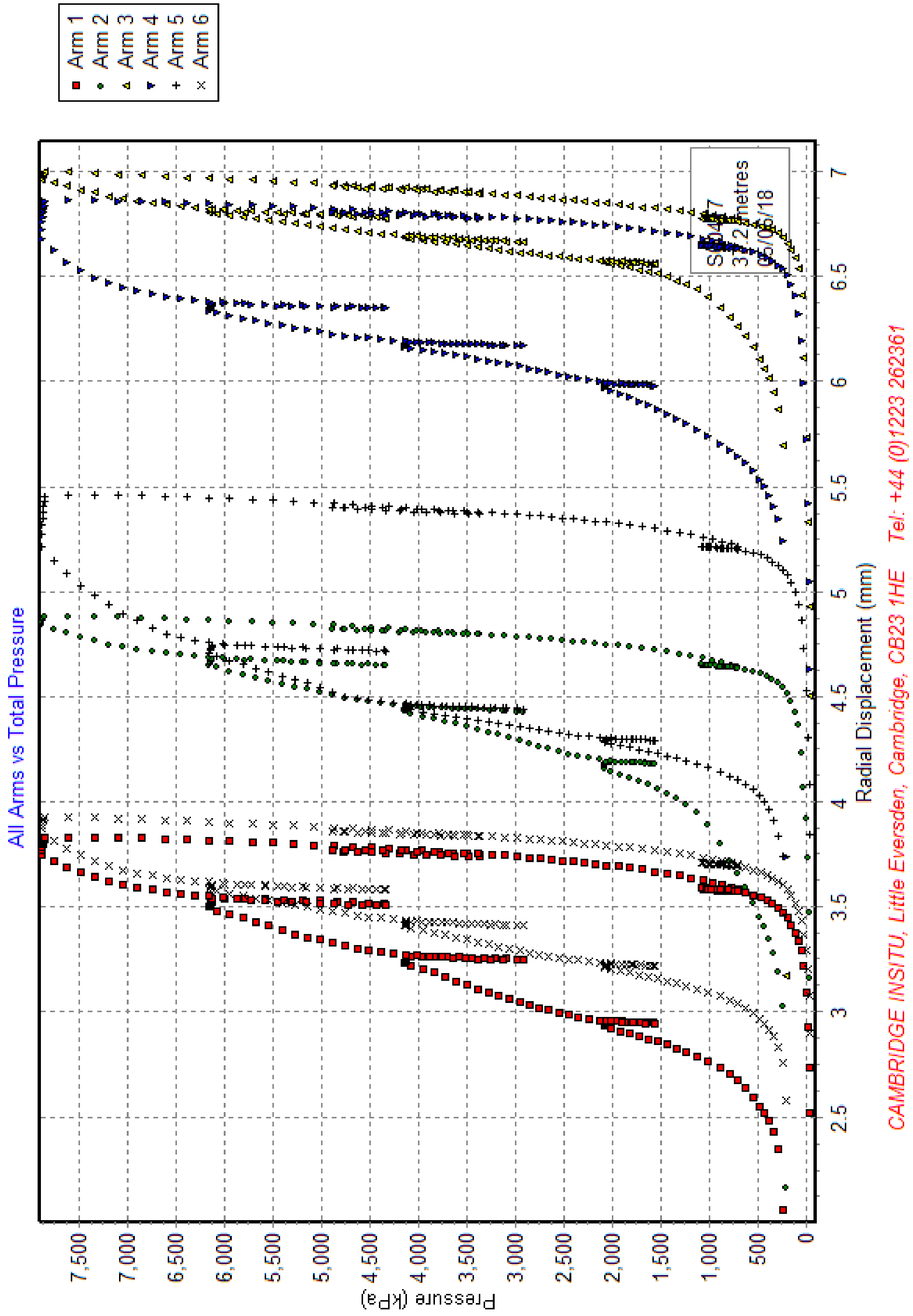

Bolton and Whittle (1999) Loop 3 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 7
37.20 Metres
5 Jun 18
RESULTS:
Gradient (beta) : 0.775
Intercept (n) : 309.867MPa
Shear stress constant : 240.215MPa
Ln[Radial stress]
Ln[shear strain]
7.2
7.1
7
6.9
6.8
6.7
6.6
6.5
6.4
6.3
6.2
6.1
6
5.9
5.8
5.7
5.6
5.5
5.4
5.3
5.2
5.1
5
4.9
4.8
4.7
4.6
-7
-8
-9
-10
Source data - Loop 3
Total pressure (kPa)
5,500
5,000
4,500
Radial Displacement (mm)
4.95
4.94

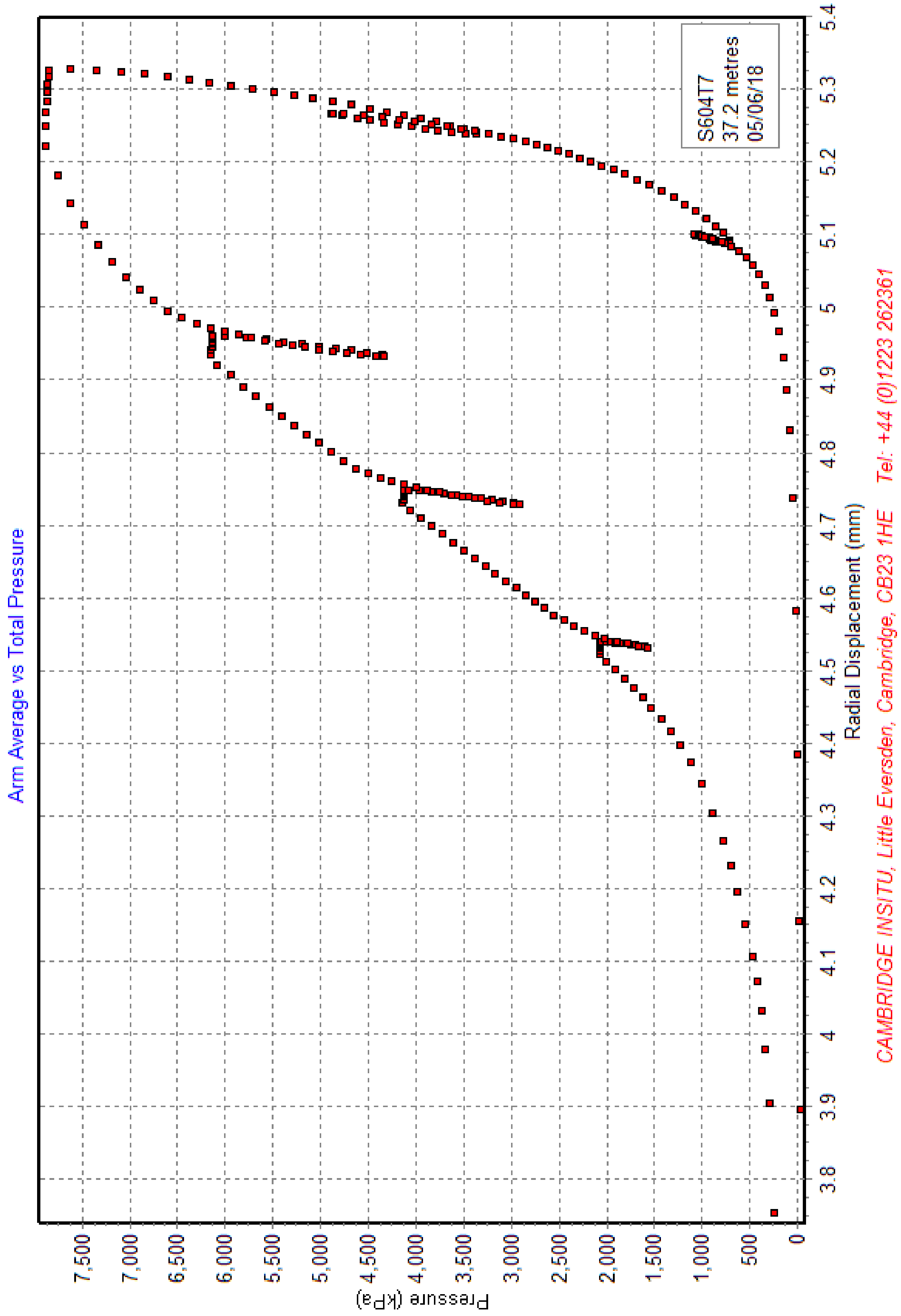

Bolton and Whittle (1999) Loop 4 : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 7
37.20 Metres
5 Jun 18
RESULTS:
Gradient (beta) : 0.779
Intercept (n) : 344.905MPa
Shear stress constant : 268.535MPa
Ln[Radial stress]
Ln[shear strain]
-7
-8
-9
-10
7.3
7.2
7.1
7
6.9
6.8
6.7
6.6
6.5
6.4
6.3
6.2
6.1
6
5.9
5.8
5.7
5.6
5.5
5.4
5.3
5.2
5.1
5
4.9
Source data - Loop 4
Total pressure (kPa)
4,500
4,000
3,500
Radial Displacement (mm)
5.24
5.25
5.26


Variation of stiffness with strain, undrained analysis : Arm ave
POWER LAW PARAMETERS:
Cycle No.
Constant (MPa)
Gradient
1 504.909 0.929
2 466.978 0.875
3 240.215 0.775
4 268.535 0.779
95mm High Pressure Dilatometer
SBP604 Test 7
37.20 Metres
5 Jun 18
Shear modulus (MPa)
2,300
2,200
2,100
2,000
1,900
1,800
1,700
1,600
1,500
1,400
1,300
1,200
1,100
1,000
900
800
700
Log plane shear strain
0.0001
0.001



Carter et al 1986 (adapted 2010) for c'-phi material : Arm ave
95mm High Pressure Dilatometer
SBP604 Test 7
37.20 Metres
5 Jun 18
CURVE FIT PARAMETERS:
Origin : 4.600mm
Po : 993.0kPa
Cohesion : 248kPa
Phi peak : 38.0°
Dilation : 11.9°
Yield stress : 2110kPa
Limit pressure : 46760kPa
Elastic exponent : 0.779
Gs at first yield : 952.6MPa
Janbu exponent : 0.165
Correlation : 0.873
Estimated PWP : 144.2kPa
Phi cv : 28.0°
Poisson's ratio : 0.33
Total pressure (kPa)
7,500
7,000
6,500
6,000
5,500
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
Cavity strain (%)
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1
1.2


All Arms vs Total Pressure
Arm 1
Arm 2
Arm 3
Arm 4
Arm 5
Arm 6
Radial Displacement (mm)
Pressure (kPa)
05/06/18
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361


Arm Average vs Total Pressure
S604T7
37.2 metres
05/06/18
Radial Displacement (mm)
3.8
3.9
4
4.1
4.2
4.3
4.4
4.5
4.6
4.7
4.8
4.9
5
5.1
5.2
5.3
5.4
Pressure (kPa)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
4,500
5,000
5,500
6,000
6,500
7,000
7,500
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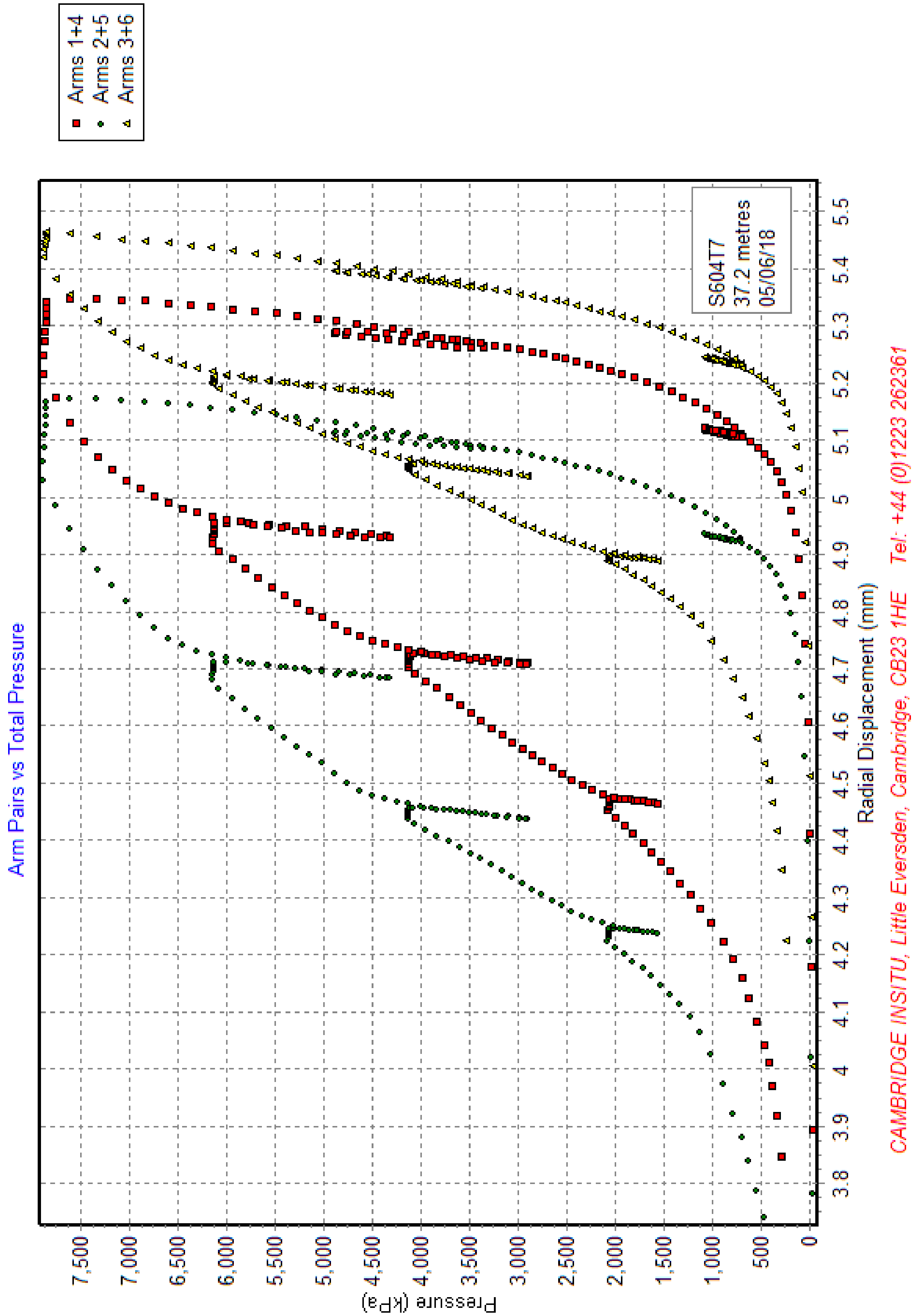
Arm Pairs vs Total Pressure
Arms 1+4
Arms 2+5
Arms 3+6
S604T7
37.2 metres
05/06/18
Radial Displacement (mm)
Pressure (kPa)
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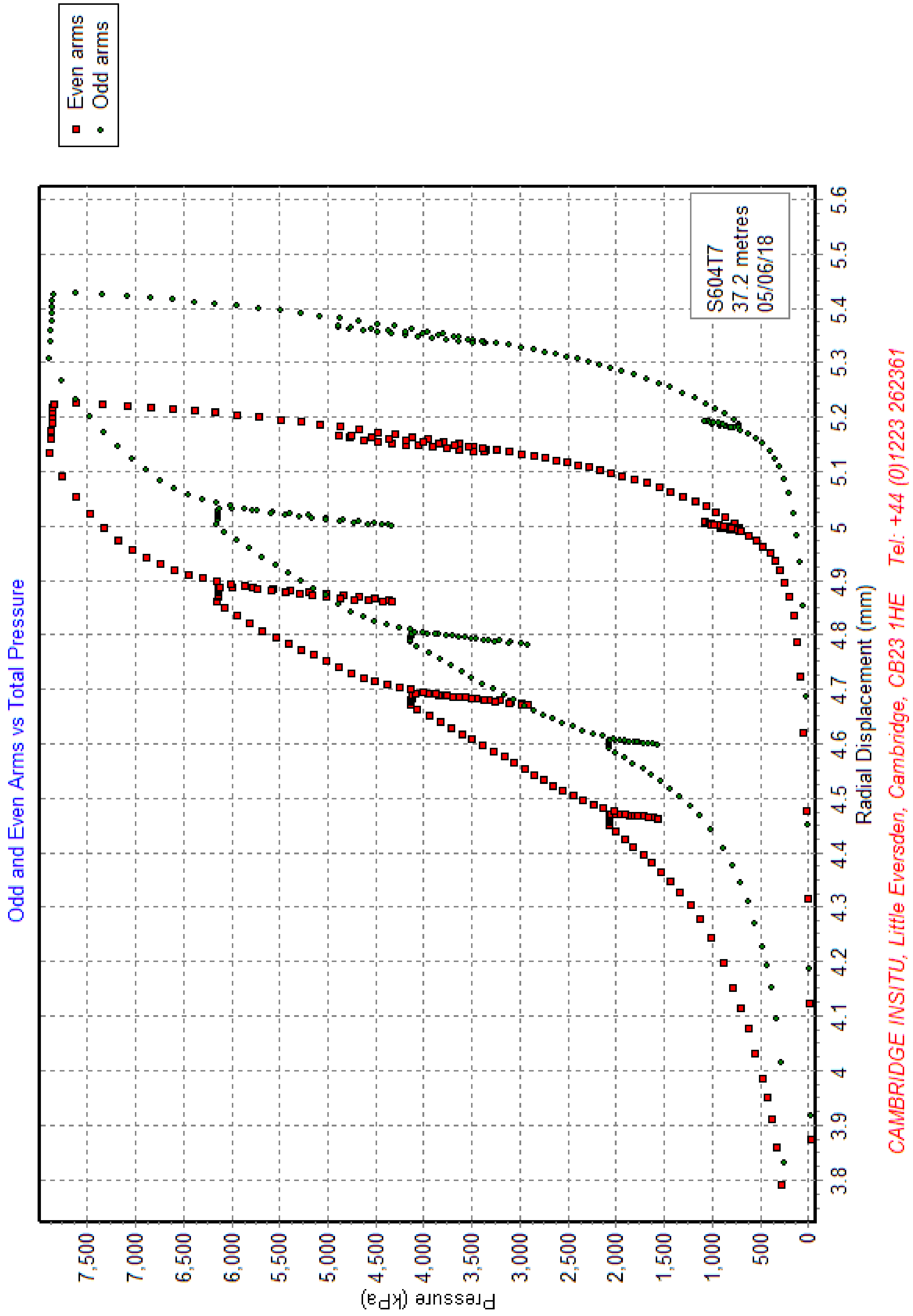
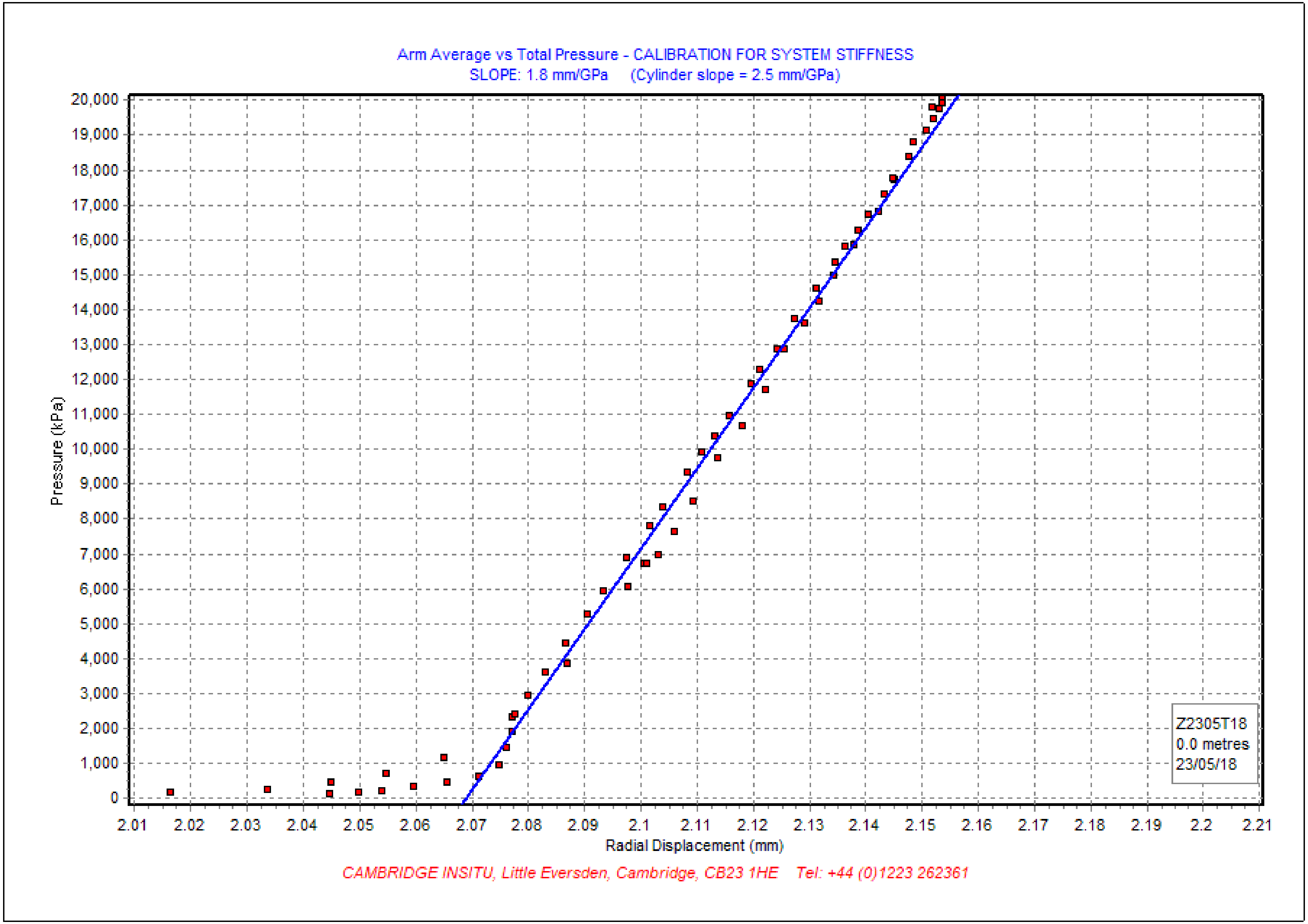
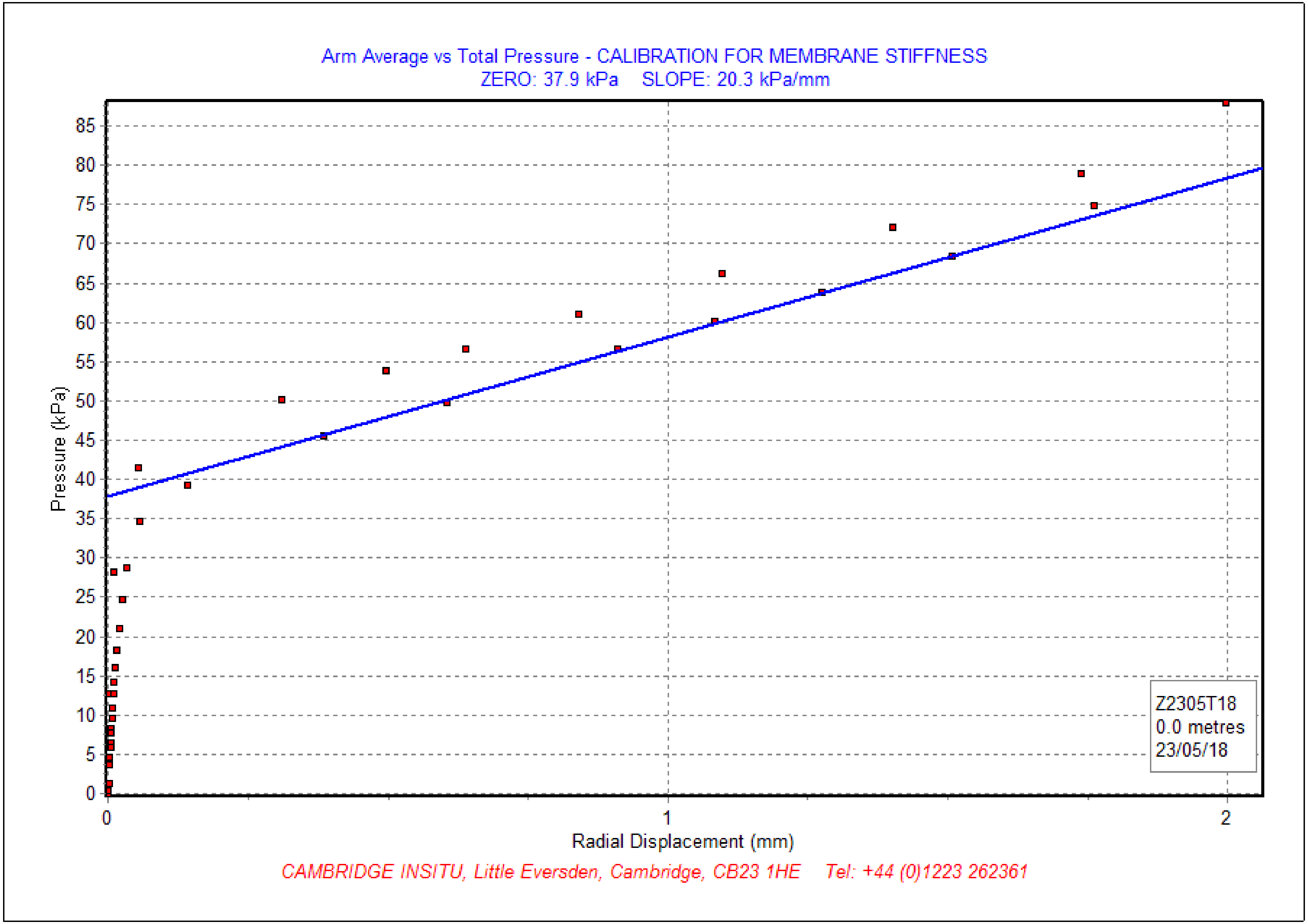

Odd and Even Arms vs Total Pressure
Even arms
Odd arms
S604T7
37.2 metres
05/06/18
Radial Displacement (mm)
Pressure (kPa)
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361

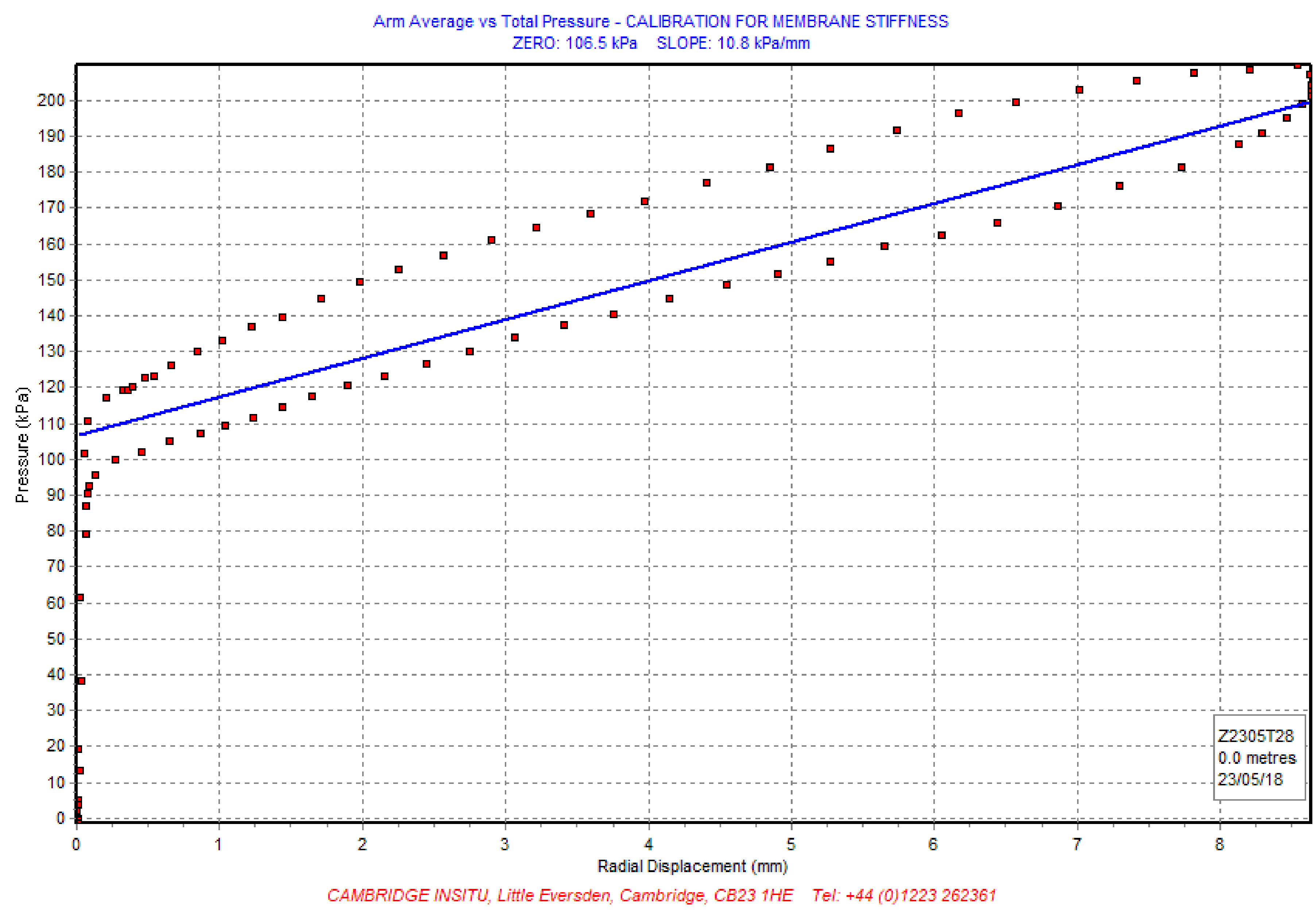
CALIBRATION DATA

REFERENCE	PROBE	DATE	NOTES
Z2305T18	Wally	23/5/18	Membrane and system stiffness
Z2305T28	Wally	23/5/18	Membrane in free air
W0506T1	Wally	5/6/18	System stiffness
W0606T1	Wally	6/6/18	Membrane stiffness
Transducers	Wally	4/4/18	Full calibration
Transducers	Wally	23/5/18	Full calibration

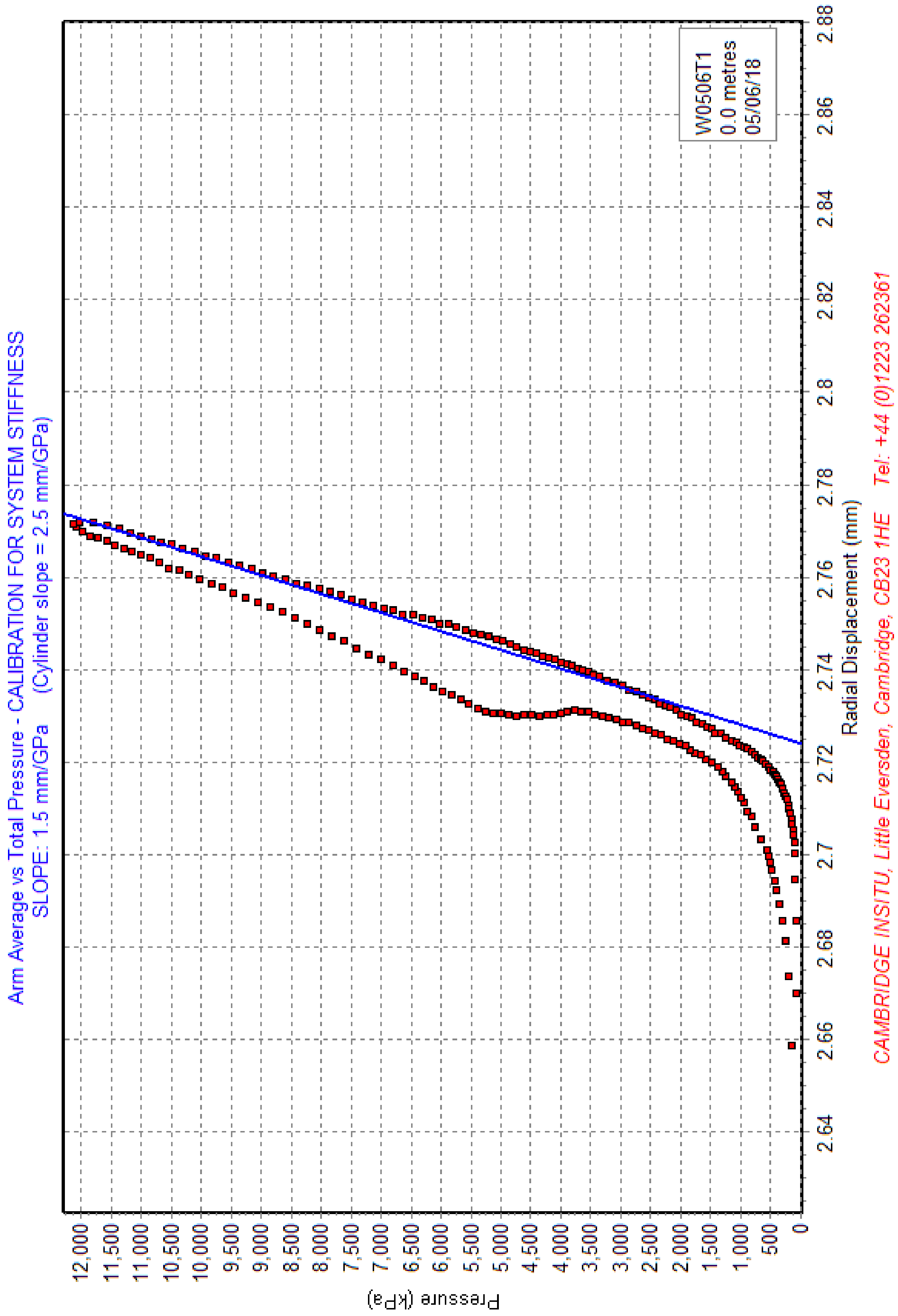

Arm Average vs Total Pressure - CALIBRATION FOR SYSTEM STIFFNESS
SLOPE: 1.8 mm/GPa (Cylinder slope = 2.5 mm/GPa)
Pressure (kPa)
20,000
19,000
18,000
17,000
16,000
15,000
14,000
13,000
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2.01
2.02
2.03
2.04
2.05
2.06
2.07
2.08
2.09
2.1
2.11
2.12
2.13
2.14
2.15
2.16
2.17
2.18
2.19
2.2
2.21
Radial Displacement (mm)
Z2305T18
0.0 metres
23/05/18
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361

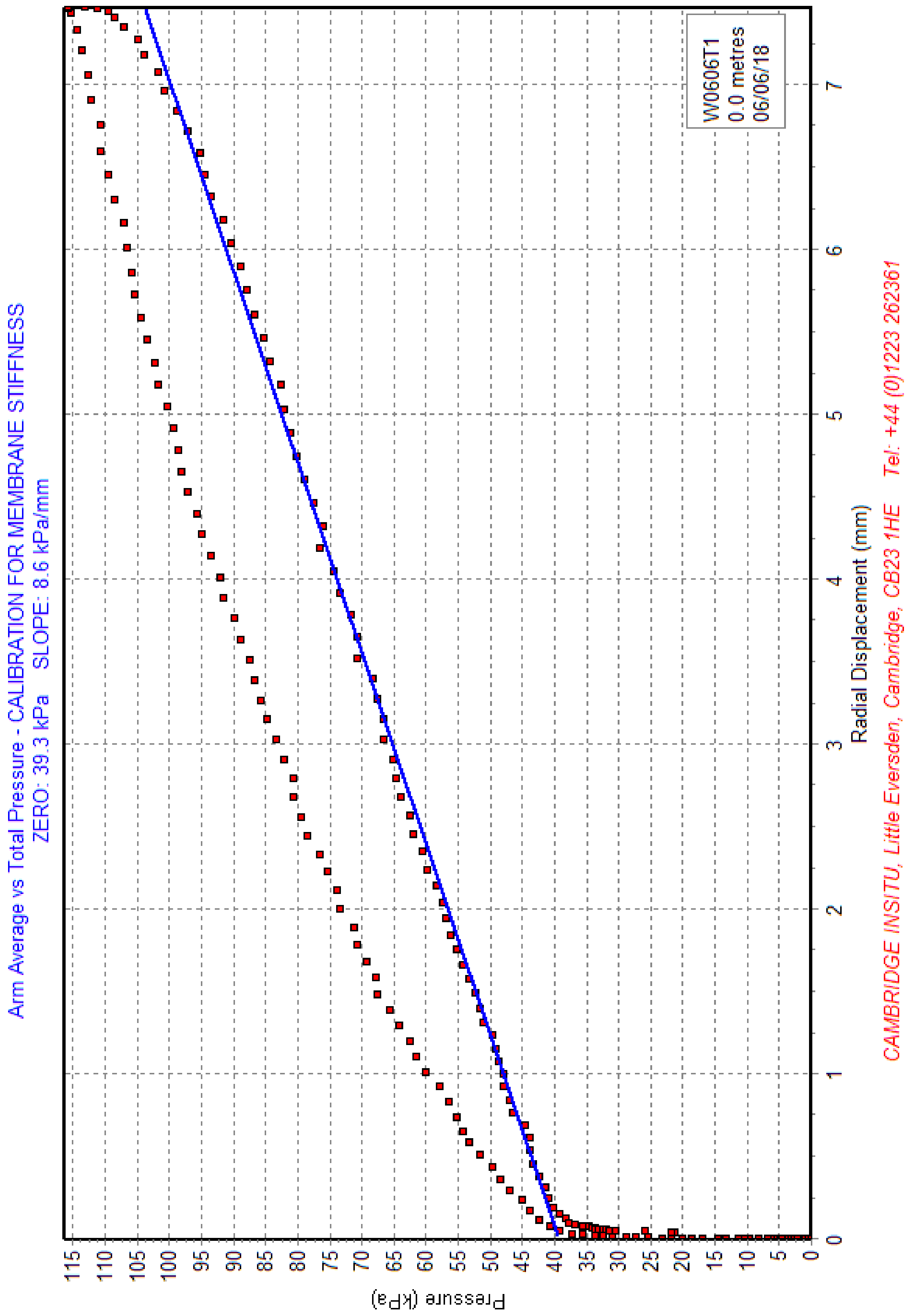


Arm Average vs Total Pressure - CALIBRATION FOR MEMBRANE STIFFNESS
ZERO: 37.9 kPa SLOPE: 20.3 kPa/mm
Pressure (kPa)
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0
1
2
Radial Displacement (mm)
Z2305T18
0.0 metres
23/05/18
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361



Arm Average vs Total Pressure - CALIBRATION FOR MEMBRANE STIFFNESS
ZERO: 106.5 kPa SLOPE: 10.8 kPa/mm
Pressure (kPa)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
Radial Displacement (mm)
0
1
2
3
4
5
6
7
8
Z2305T28
0.0 metres
23/05/18
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361


Arm Average vs Total Pressure - CALIBRATION FOR SYSTEM STIFFNESS
SLOPE: 1.5 mm/GPa (Cylinder slope = 2.5 mm/GPa)
W0506T1
0.0 metres
05/06/18
Radial Displacement (mm)
2.88
2.86
2.84
2.82
2.8
2.78
2.76
2.74
2.72
2.7
2.68
2.66
2.64
Pressure (kPa)
12,000
11,500
11,000
10,500
10,000
9,500
9,000
8,500
8,000
7,500
7,000
6,500
6,000
5,500
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361


Arm Average vs Total Pressure - CALIBRATION FOR MEMBRANE STIFFNESS
ZERO: 39.3 kPa SLOPE: 8.6 kPa/mm
W0606T1
0.0 metres
06/06/18
Pressure (kPa)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
105
110
115
Radial Displacement (mm)
0
1
2
3
4
5
6
7
CAMBRIDGE INSITU, Little Eversden, Cambridge, CB23 1HE Tel: +44 (0)1223 262361

Calibration Date	Operator	Instrument Type	Serial Number	Instrument Name
Thu 4 January 2018	KGC	HPD	160208	Wally

Arm Springs

mm	Arm 1 (mV)	Linearity (%)	Hysteresis (%)	Arm 2 (mV)	Linearity (%)	Hysteresis (%)	Arm 3 (mV)	Linearity (%)	Hysteresis (%)
0	-2051.9	101.8	0.13	-2599.8	92.8	0.04	-2281.8	103.4	0.06
2	-1752.2	102.0	0.21	-2341.1	102.6	-0.01	-1977.6	102.0	0.14
4	-1452.1	101.7	0.24	-2055.2	101.8	-0.05	-1677.5	101.5	0.15
6	-1152.8	100.6	0.28	-1771.3	101.0	-0.09	-1379.0	100.5	0.18
8	-856.7	100.3	0.26	-1489.9	100.5	-0.10	-1083.4	100.2	0.19
10	-561.4	99.6	0.28	-1209.7	99.9	-0.14	-788.6	99.3	0.20
12	-268.2	97.4	0.23	-931.2	98.5	-0.14	-496.5	98.9	0.18
14	18.6	98.7	0.09	-656.6	100.3	-0.24	-205.6	98.1	0.17
16	309.1	98.4	0.00	-377.0	98.0	-0.11	83.1	98.2	0.13
18	598.6	98.2	0.06	-103.7	98.6	-0.05	372.0	97.7	0.08
20	887.6	98.8		171.2	98.1		659.3	98.5	
18	596.9	97.8		-102.2	97.5		369.6	98.7	
16	309.0	99.5		-373.9	99.0		79.2	98.5	
14	16.0	98.9		-650.0	99.5		-210.5	99.0	
12	-275.0	100.1		-927.4	99.9		-501.8	99.5	
10	-569.5	100.2		-1205.9	100.8		-794.4	100.1	
8	-864.4	100.7		-1487.0	101.1		-1089.0	100.3	
6	-1160.9	101.3		-1768.8	102.2		-1384.2	101.2	
4	-1459.1	101.6		-2053.8	103.0		-1681.8	101.9	
2	-1758.3	101.0		-2340.8	93.3		-1981.7	102.6	
0	-2055.7			-2600.9			-2283.6		
Intercept	**-2044.6 mV**			**-2607.1 mV**			**-2270.1 mV**		
Slope	**147.2 mV/mm**			**139.4 mV/mm**			**147.1 mV/mm**		

mm	Arm 4 (mV)	Linearity (%)	Hysteresis (%)	Arm 5 (mV)	Linearity (%)	Hysteresis (%)	Arm 6 (mV)	Linearity (%)	Hysteresis (%)
0	-2098.9	102.5	0.06	-2366.2	102.4	0.14	-2114.5	102.8	0.22
2	-1808.1	101.8	0.10	-2077.5	101.7	0.04	-1852.3	103.3	0.01
4	-1519.2	101.4	0.07	-1790.7	101.0	0.02	-1588.7	102.0	-0.10
6	-1231.6	100.5	0.05	-1506.0	100.5	-0.04	-1328.5	100.5	-0.18
8	-946.5	100.0	0.05	-1222.7	100.1	-0.05	-1072.1	99.9	-0.23
10	-662.8	99.5	0.03	-940.5	99.5	-0.05	-817.2	98.7	-0.25
12	-380.6	99.2	0.02	-659.9	99.2	-0.04	-565.4	97.3	-0.25
14	-99.1	97.8	0.04	-380.3	98.3	-0.05	-317.3	98.1	-0.21
16	178.4	98.4	-0.06	-103.2	98.2	-0.07	-67.1	98.5	-0.18
18	457.5	98.3	0.00	173.6	98.1	-0.02	184.1	99.7	-0.10
20	736.4	98.3		450.1	97.9		438.5	98.8	
18	457.4	97.7		174.1	97.6		186.6	97.7	
16	180.1	98.8		-101.1	98.6		-62.6	97.8	
14	-100.2	99.0		-379.0	99.2		-312.0	96.8	
12	-381.2	99.6		-658.8	99.5		-558.9	98.8	
10	-663.7	100.2		-939.2	100.0		-810.9	100.1	
8	-948.0	100.5		-1221.2	100.7		-1066.2	101.0	
6	-1233.0	101.6		-1505.0	101.5		-1323.9	102.8	
4	-1521.3	102.0		-1791.2	102.0		-1586.2	104.4	
2	-1810.8	102.1		-2078.7	103.4		-1852.5	104.9	
0	-2100.5			-2370.2			-2120.0		
Intercept	**-2088.9 mV**			**-2356.5 mV**			**-2100.6 mV**		
Slope	**141.9 mV/mm**			**141.0 mV/mm**			**127.5 mV/mm**		

Pressure Cells

Bars	TPC A (mV)	Linearity (%)	Hysteresis (%)	TPC B (mV)	Linearity (%)	Hysteresis (%)
0	-2128.5	98.2	-0.14	-2375.5	98.7	-0.14
20	-1912.8	100.6	-0.16	-2158.7	99.7	-0.08
40	-1692.0	100.0	0.15	-1939.8	100.4	-0.11
60	-1472.4	99.6	-0.11	-1719.3	99.8	-0.07
80	-1253.7	100.5	-0.21	-1500.2	100.6	-0.15
100	-1033.1	99.2	-0.20	-1279.4	99.0	-0.14
120	-815.3	100.7	-0.07	-1062.0	101.3	-0.03
140	-594.2	99.9	-0.18	-839.5	98.7	-0.07
160	-374.8	101.6	-0.10	-622.7	100.7	-0.10
180	-151.6	98.4	-0.02	-401.6	102.2	-0.12
200	64.4	98.1		-177.1	101.0	
180	-151.1	100.9		-398.9	100.9	
160	-372.7	99.1		-620.4	99.1	
140	-590.3	101.8		-838.0	101.7	
120	-813.8	97.9		-1061.4	97.9	
100	-1028.7	100.3		-1276.4	100.4	
80	-1249.0	100.6		-1496.8	100.6	
60	-1470.0	102.6		-1717.7	100.1	
40	-1695.3	97.5		-1937.4	100.0	
20	-1909.3	98.5		-2157.0	98.1	
0	-2125.5			-2372.5		
Intercept	**-2129.9 mV**			**-2376.6 mV**		
Slope	**10.979 mV/Bars**			**10.979 mV/Bars**		
Slope	**109.8 mV/MPa**			**109.8 mV/MPa**		

Calibration Date	Operator	Instrument Type	Serial Number	Instrument Name
Wed 23 May 2018	JJB	HPD	160208	Wally

Arm Springs

mm	Arm 1 (mV)	Linearity (%)	Hysteresis (%)	Arm 2 (mV)	Linearity (%)	Hysteresis (%)	Arm 3 (mV)	Linearity (%)	Hysteresis (%)
0	-2019.2	103.2	0.07	-2596.0	100.8	0.03	-2274.6	105.5	-0.02
2	-1717.1	102.3	0.17	-2316.3	102.4	0.00	-1966.7	102.3	0.09
4	-1417.9	101.8	0.30	-2032.2	101.3	-0.04	-1668.2	101.5	0.12
6	-1120.1	100.2	0.35	-1751.2	100.7	-0.08	-1372.1	100.7	0.16
8	-827.0	100.0	0.29	-1471.9	99.9	-0.10	-1078.4	99.9	0.18
10	-534.4	99.5	0.30	-1194.6	99.5	-0.12	-786.8	99.0	0.18
12	-243.3	98.9	0.27	-918.5	98.3	-0.13	-497.9	98.7	0.15
14	46.0	98.5	0.24	-645.9	99.0	-0.21	-209.9	98.1	0.14
16	334.3	97.2	0.19	-371.3	98.5	-0.17	76.4	97.9	0.12
18	618.8	97.6	0.05	-97.9	98.3	-0.06	361.9	97.6	0.07
20	904.3	98.1		174.7	97.6		646.8	98.4	
18	617.2	98.6		-96.2	97.4		359.8	98.4	
16	328.6	99.0		-366.5	98.6		72.8	98.3	
14	39.0	99.2		-640.1	99.0		-214.1	98.8	
12	-251.2	99.8		-914.8	99.7		-502.3	99.4	
10	-543.3	99.9		-1191.3	100.2		-792.2	99.9	
8	-835.6	100.8		-1469.2	100.9		-1083.6	100.5	
6	-1130.4	101.3		-1749.1	101.6		-1376.8	101.1	
4	-1426.7	100.9		-2031.0	102.8		-1671.8	101.9	
2	-1722.0	102.3		-2316.3	101.1		-1969.2	104.5	
0	-2021.3			-2596.8			-2274.0		
Intercept	**-2008.7 mV**			**-2587.5 mV**			**-2257.1 mV**		
Slope	**146.3 mV/mm**			**138.7 mV/mm**			**145.9 mV/mm**		

mm	Arm 4 (mV)	Linearity (%)	Hysteresis (%)	Arm 5 (mV)	Linearity (%)	Hysteresis (%)	Arm 6 (mV)	Linearity (%)	Hysteresis (%)
0	-2067.1	102.7	-0.09	-2341.6	102.6	-0.01	-2078.7	104.6	0.09
2	-1778.1	102.3	0.03	-2055.1	101.8	0.03	-1814.4	103.4	-0.01
4	-1490.3	101.0	0.04	-1770.9	101.1	0.01	-1553.1	101.7	-0.11
6	-1206.1	100.8	0.01	-1488.6	100.8	0.01	-1295.9	100.6	-0.17
8	-922.4	100.0	0.05	-1207.2	99.9	-0.02	-1041.6	99.7	-0.23
10	-641.0	99.5	0.05	-928.2	99.3	-0.02	-789.5	98.8	-0.24
12	-361.1	99.1	0.05	-651.0	99.3	-0.03	-539.8	97.5	-0.25
14	-82.3	98.5	0.06	-373.8	98.3	-0.03	-293.3	97.9	-0.28
16	194.9	97.5	0.03	-99.3	98.3	-0.05	-45.7	98.2	-0.22
18	469.3	98.3	-0.02	175.2	98.6	-0.03	202.6	99.2	-0.08
20	745.7	98.1		450.5	98.3		453.4	98.4	
18	469.8	98.0		176.0	98.1		204.7	96.8	
16	194.0	98.8		-98.0	98.5		-40.1	97.4	
14	-83.9	99.0		-373.1	99.3		-286.2	97.8	
12	-362.5	99.5		-650.3	99.3		-533.5	98.9	
10	-642.5	100.0		-927.7	99.9		-783.4	99.9	
8	-923.7	100.5		-1206.7	101.1		-1035.9	101.1	
6	-1206.3	101.4		-1488.9	101.1		-1291.5	102.4	
4	-1491.5	102.2		-1771.2	102.0		-1550.4	104.3	
2	-1779.0	101.5		-2056.0	102.2		-1814.1	105.5	
0	-2064.6			-2341.3			-2080.9		
Intercept	**-2055.2 mV**			**-2331.0 mV**			**-2061.3 mV**		
Slope	**140.7 mV/mm**			**139.6 mV/mm**			**126.4 mV/mm**		

Pressure Cells

Bars	TPC A (mV)	Linearity (%)	Hysteresis (%)	TPC B (mV)	Linearity (%)	Hysteresis (%)
0	-2092.4	102.1	-0.03	-2322.3	101.8	0.00
20	-1868.6	98.9	-0.05	-2099.2	99.0	-0.09
40	-1652.0	107.0	-0.16	-1882.2	106.9	-0.24
60	-1417.5	98.8	0.35	-1647.9	100.3	0.27
80	-1201.1	100.1	0.22	-1428.1	98.6	0.27
100	-981.8	98.9	0.39	-1211.9	98.8	0.33
120	-765.0	97.9	0.30	-995.4	98.5	0.21
140	-550.5	100.1	0.38	-779.5	94.7	0.38
160	-331.1	97.6	0.28	-571.9	106.4	-0.24
180	-117.3	101.2	0.06	-338.7	96.6	0.24
200	104.4	101.8		-127.0	99.0	
180	-118.7	99.8		-343.9	101.6	
160	-337.3	101.1		-566.6	100.9	
140	-558.8	97.2		-787.8	96.8	
120	-771.7	99.8		-1000.0	100.0	
100	-990.3	98.4		-1219.1	98.1	
80	-1206.0	100.0		-1434.1	100.2	
60	-1425.1	101.9		-1653.8	101.8	
40	-1648.4	100.0		-1877.0	100.5	
20	-1867.4	102.4		-2097.2	102.7	
0	-2091.8			-2322.4		
Intercept	**-2085.7 mV**			**-2315.5 mV**		
Slope	**10.955 mV/Bars**			**10.960 mV/Bars**		
Slope	**109.6 mV/MPa**			**109.6 mV/MPa**		

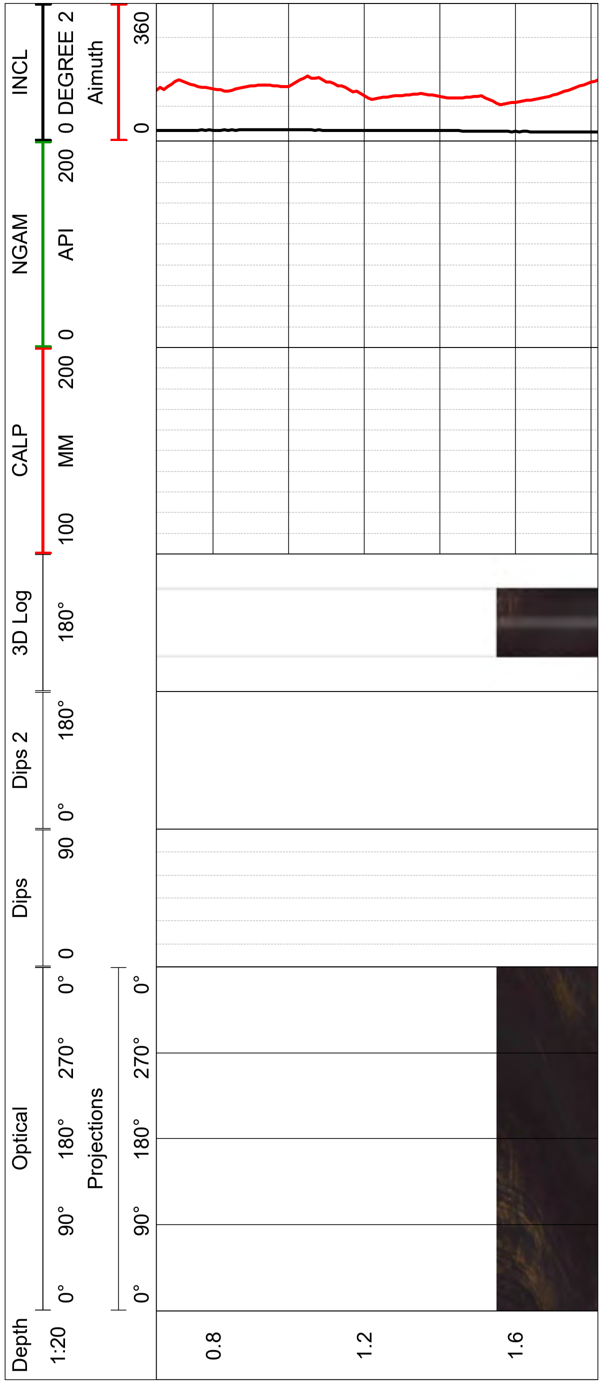
ROBERTSON GEO SERVICES — Unlocking Your GeoData

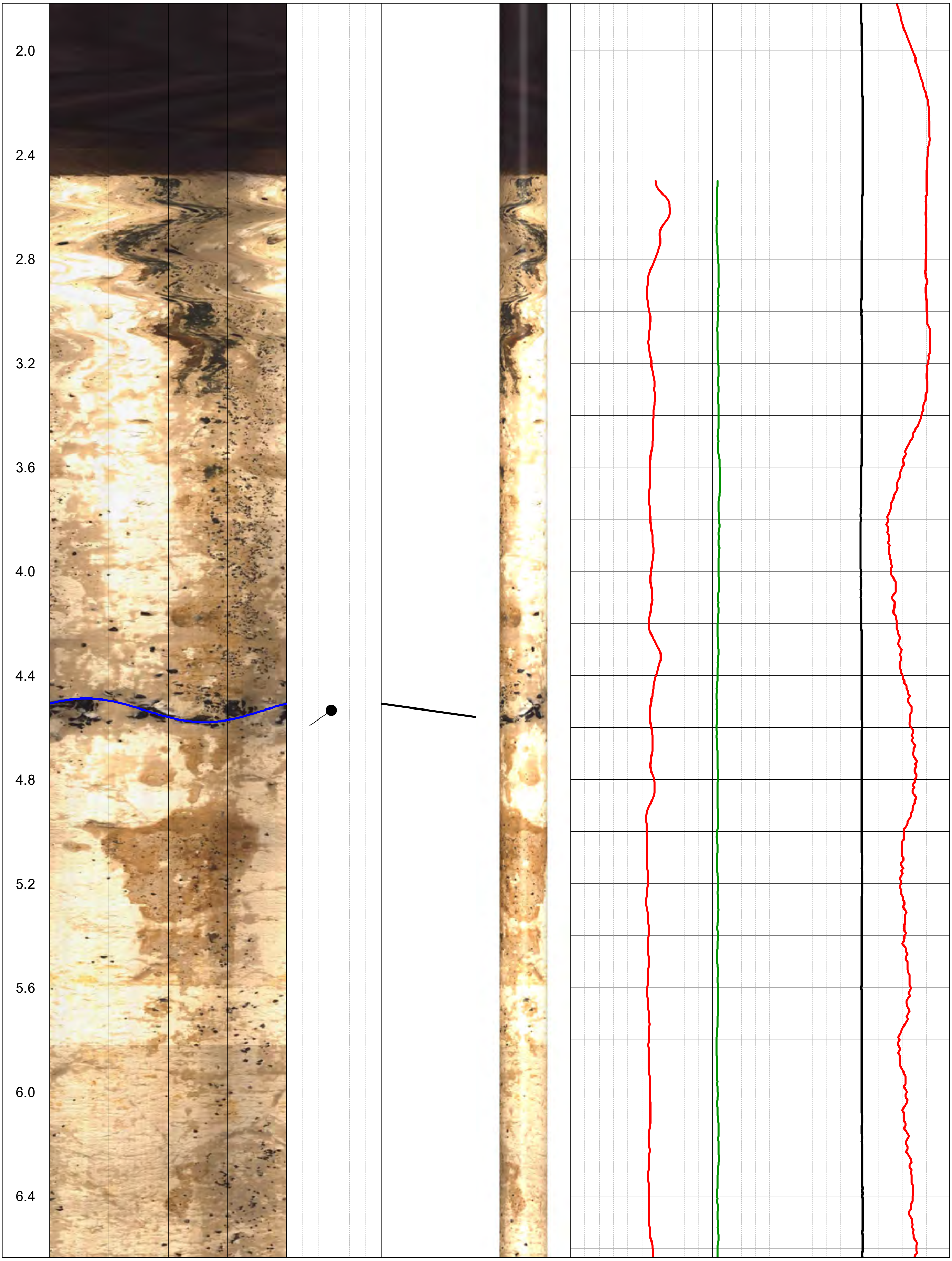
CO Structural Soils
WELL R602
FLD A303 Stonehenge
CTY England
STE
FILING No

COMPANY	Structural Soils		
WELL ID	R602		
FIELD	A303 Stonehenge		
COUNTRY	England	STATE	
LOCATION	Easting: 412295.44 Northing: 141857.61		OTHER SERVICES
SEC	TWP	RGE	
PERMANENT DATUM	GL	ELEVATION 92.693	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.

DATE	16/05/18	TYPE FLUID IN HOLE	Water
RUN No		SALINITY	
TYPE LOG	Optical, Caliper & Gamma	DENSITY	
DEPTH-DRILLER	35	LEVEL	19.8
DEPTH-LOGGER	34.9	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	34.9		
TOP LOGGED INTERVAL	0.65		
OPERATING RIG TIME			
RECORDED BY	James Boyett		
WITNESSED BY	Kyle Owen		

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

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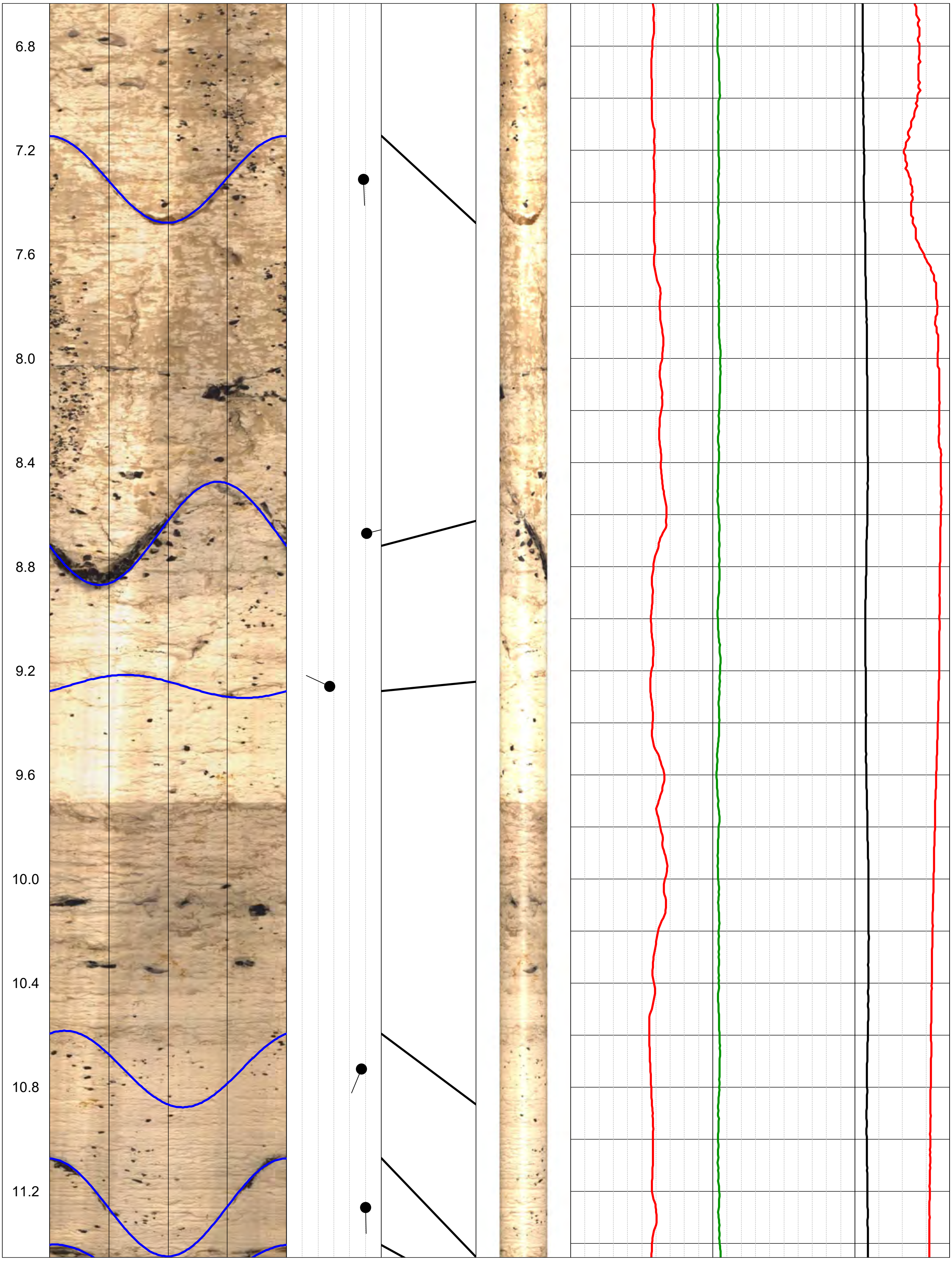
6.0
6.4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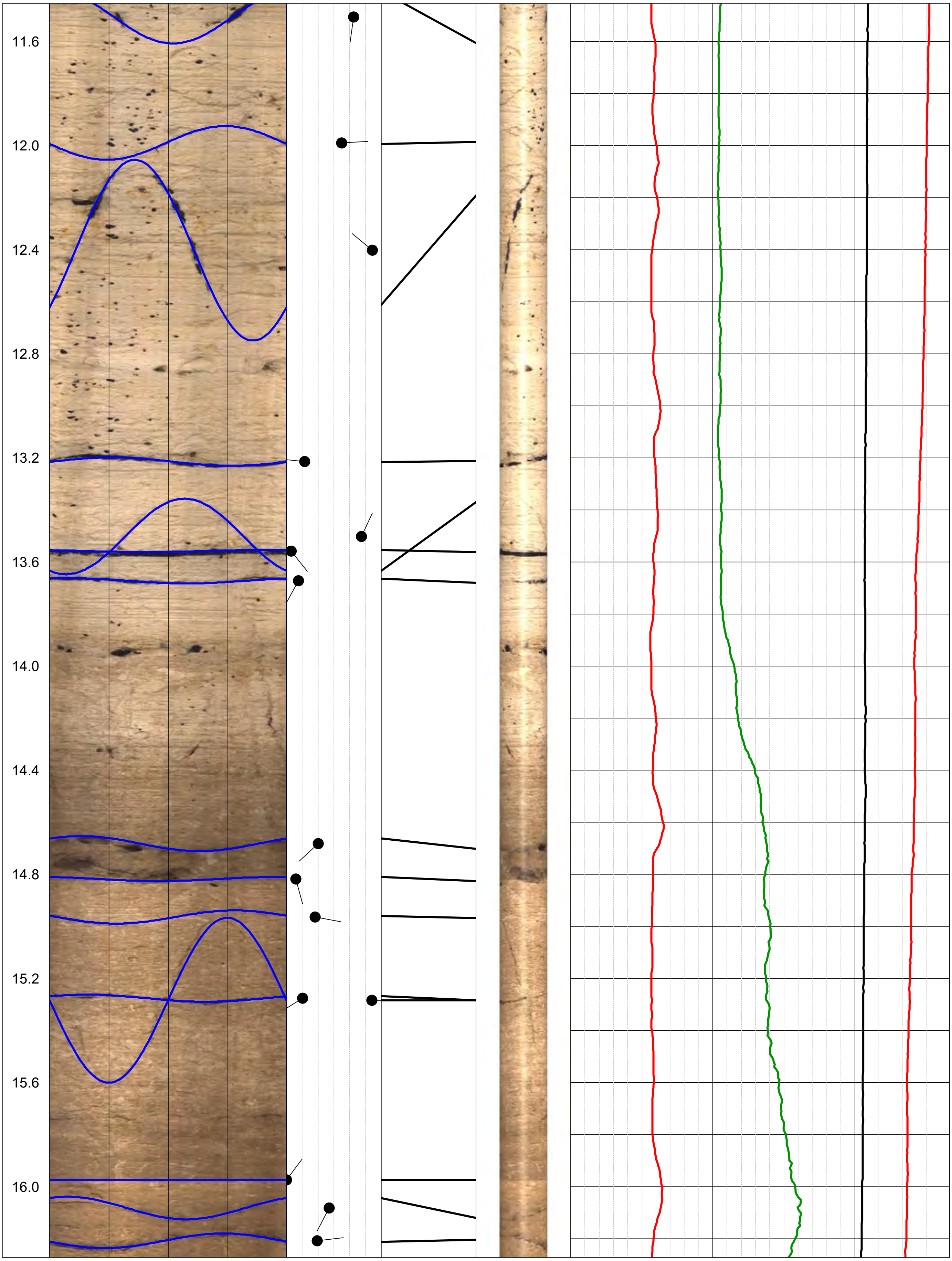
10.8
11.2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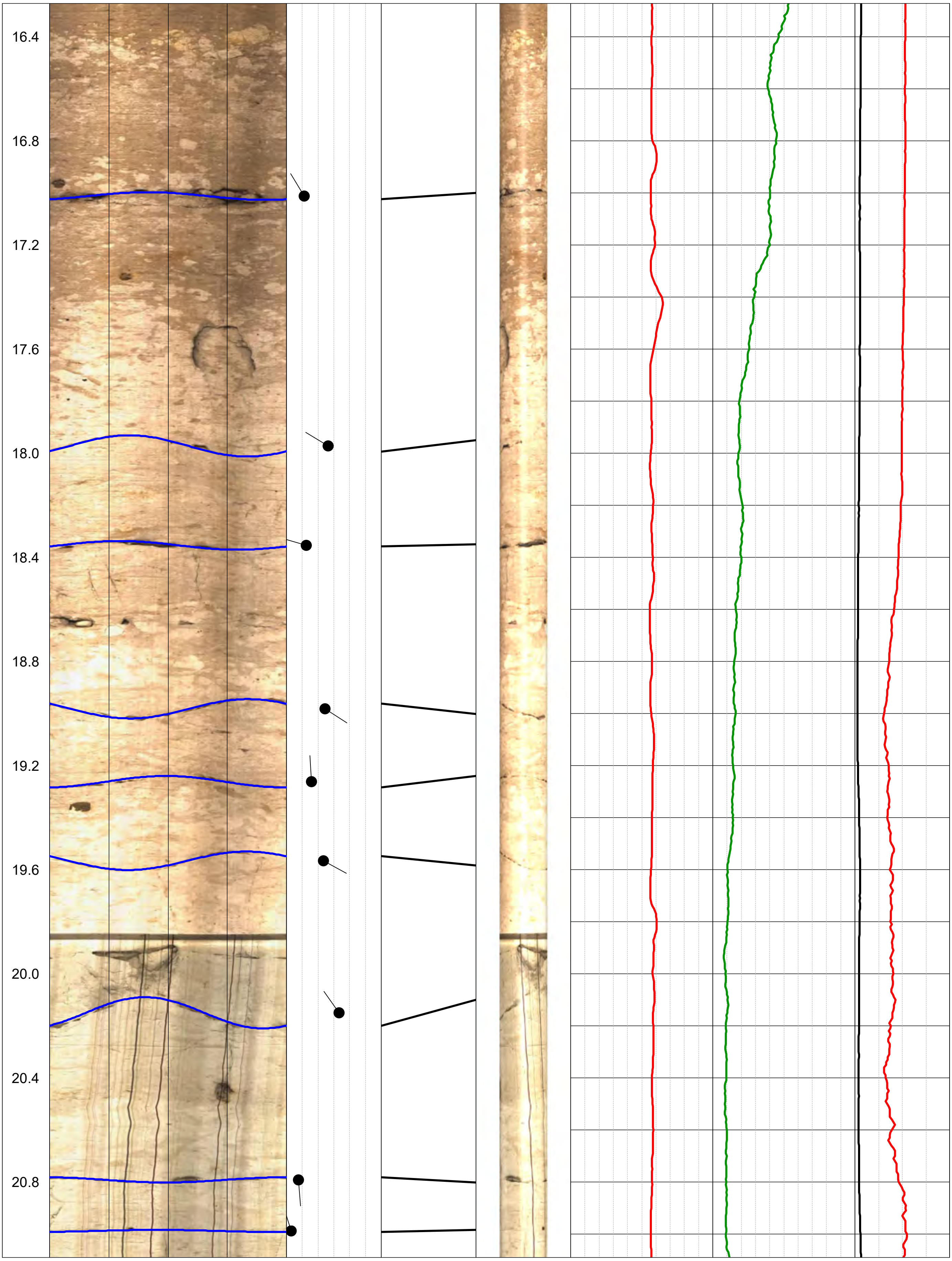
14.0
14.4
14.8
15.2
15.6
16.0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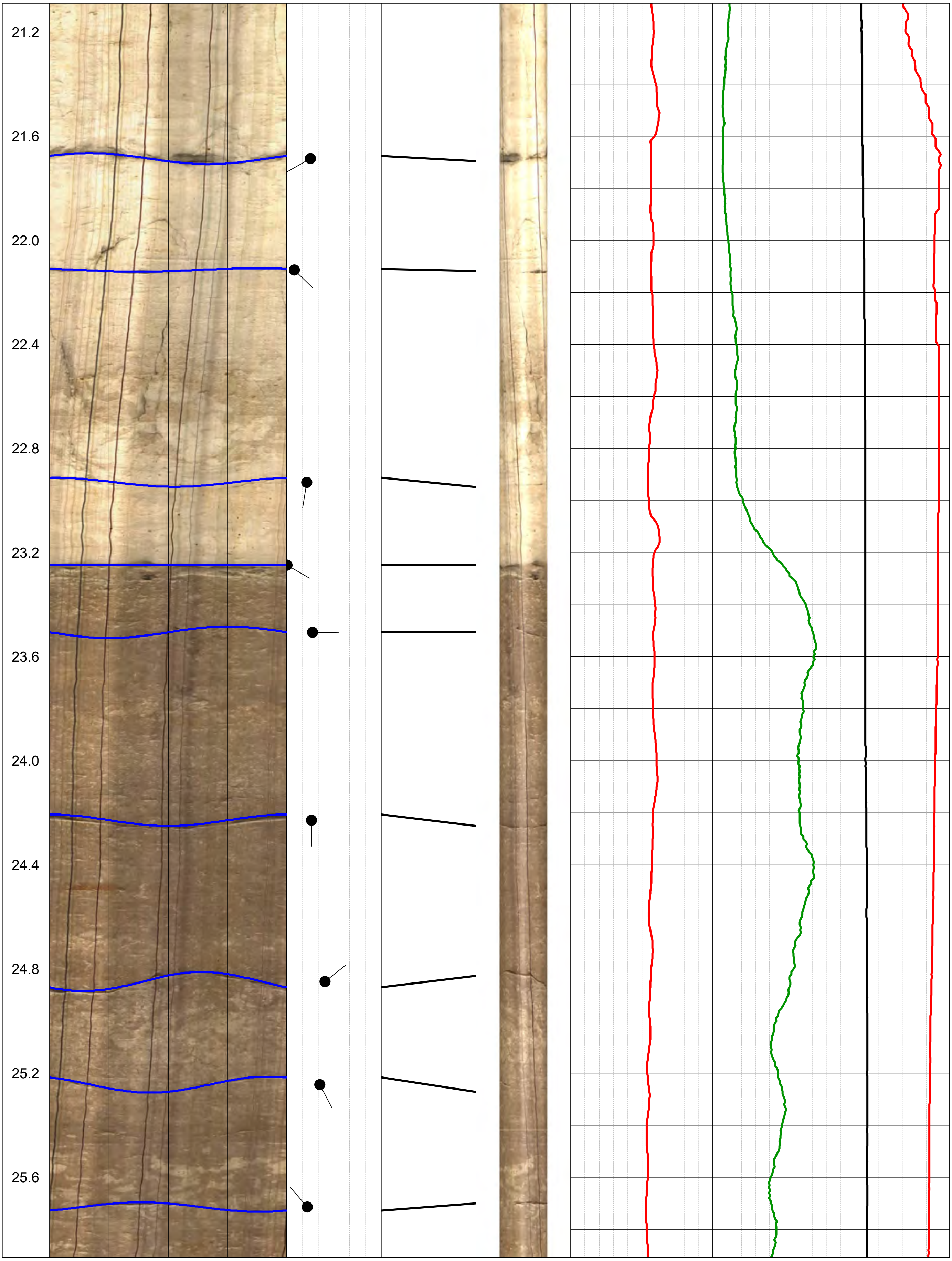
20.4
20.8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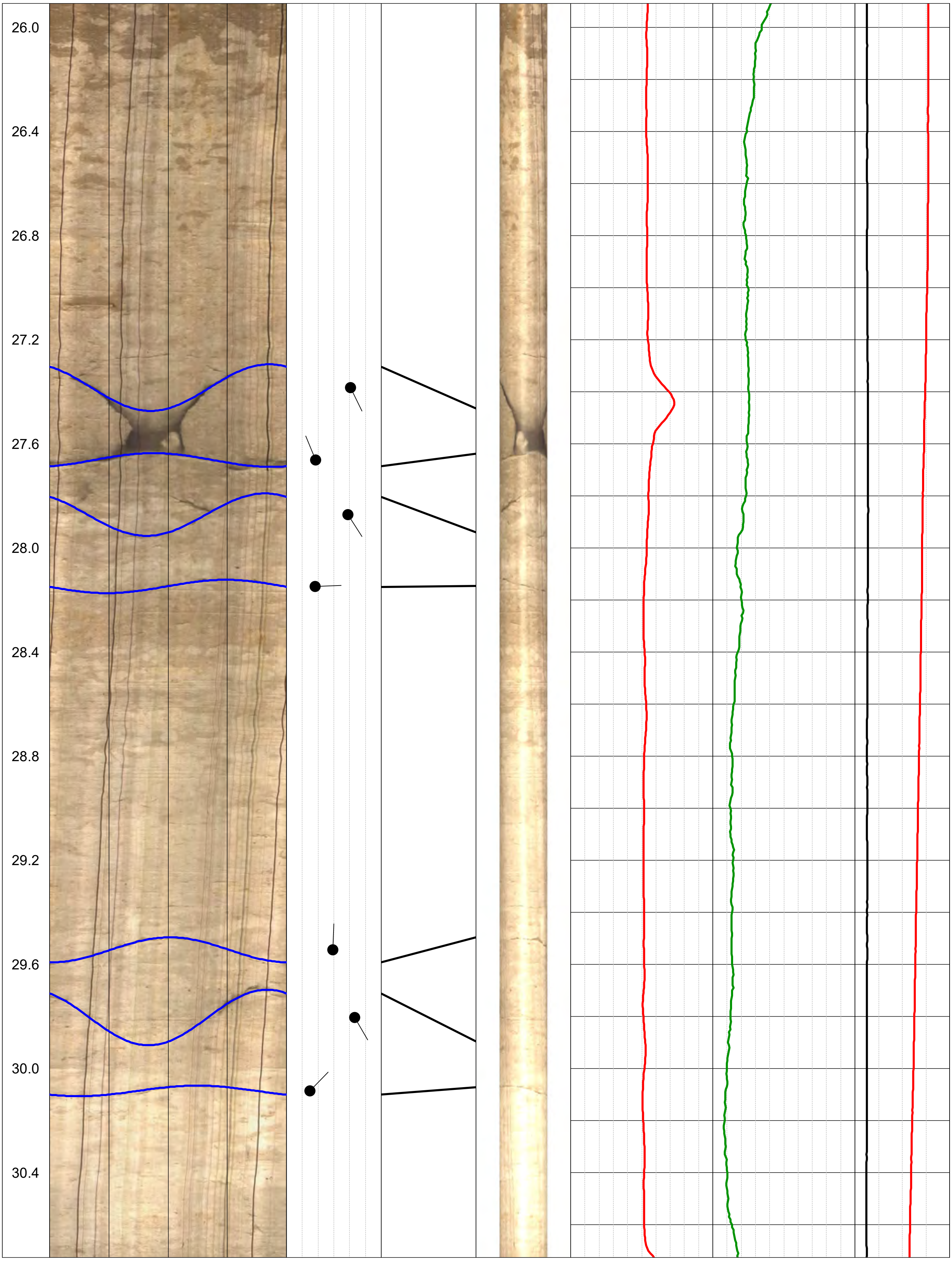
24.4
24.8
25.2
25.6



26.0
26.4
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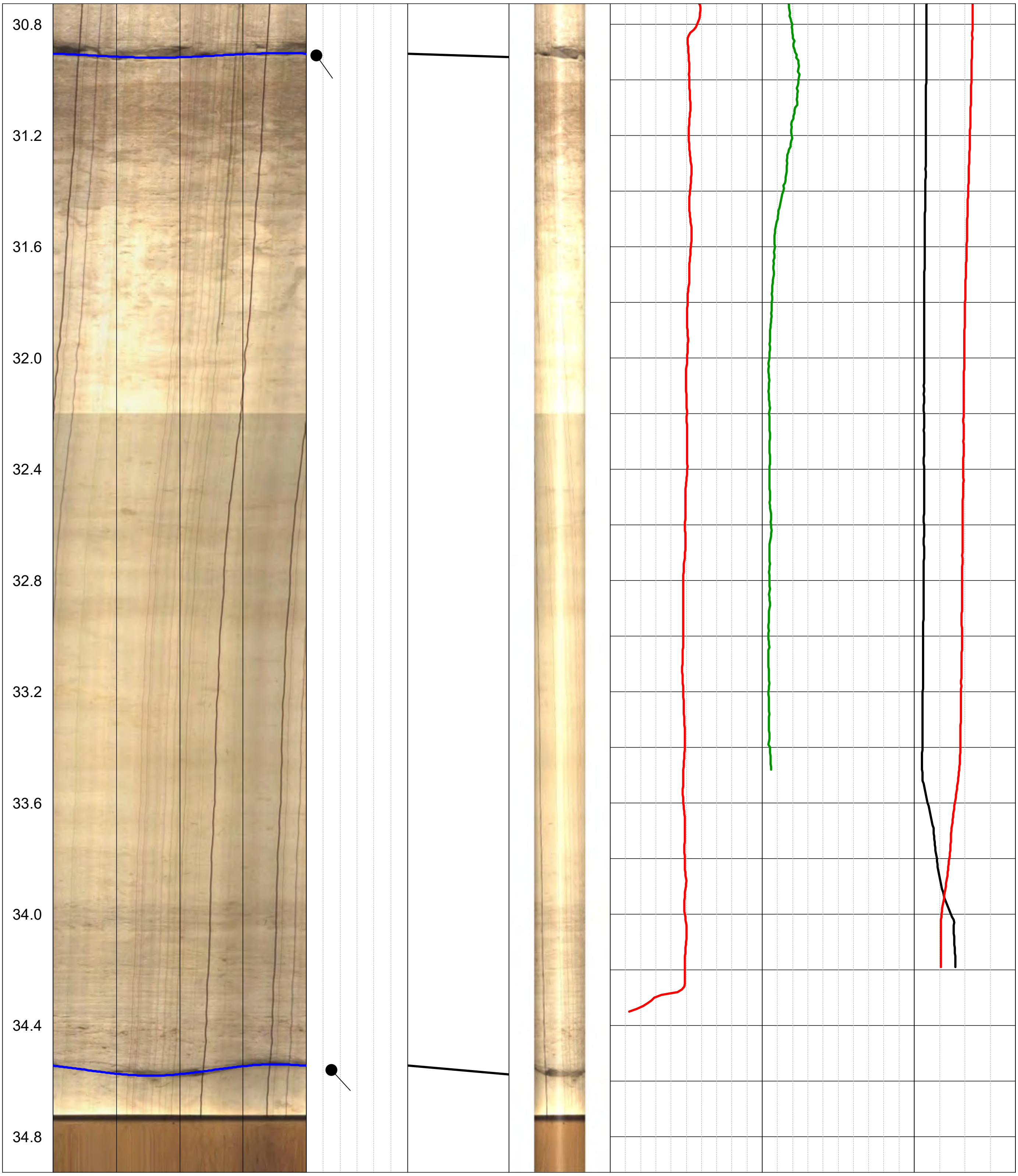
27.6
28.0
28.4
28.8
29.2
29.6
30.0
30.4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32.8
33.2
33.6
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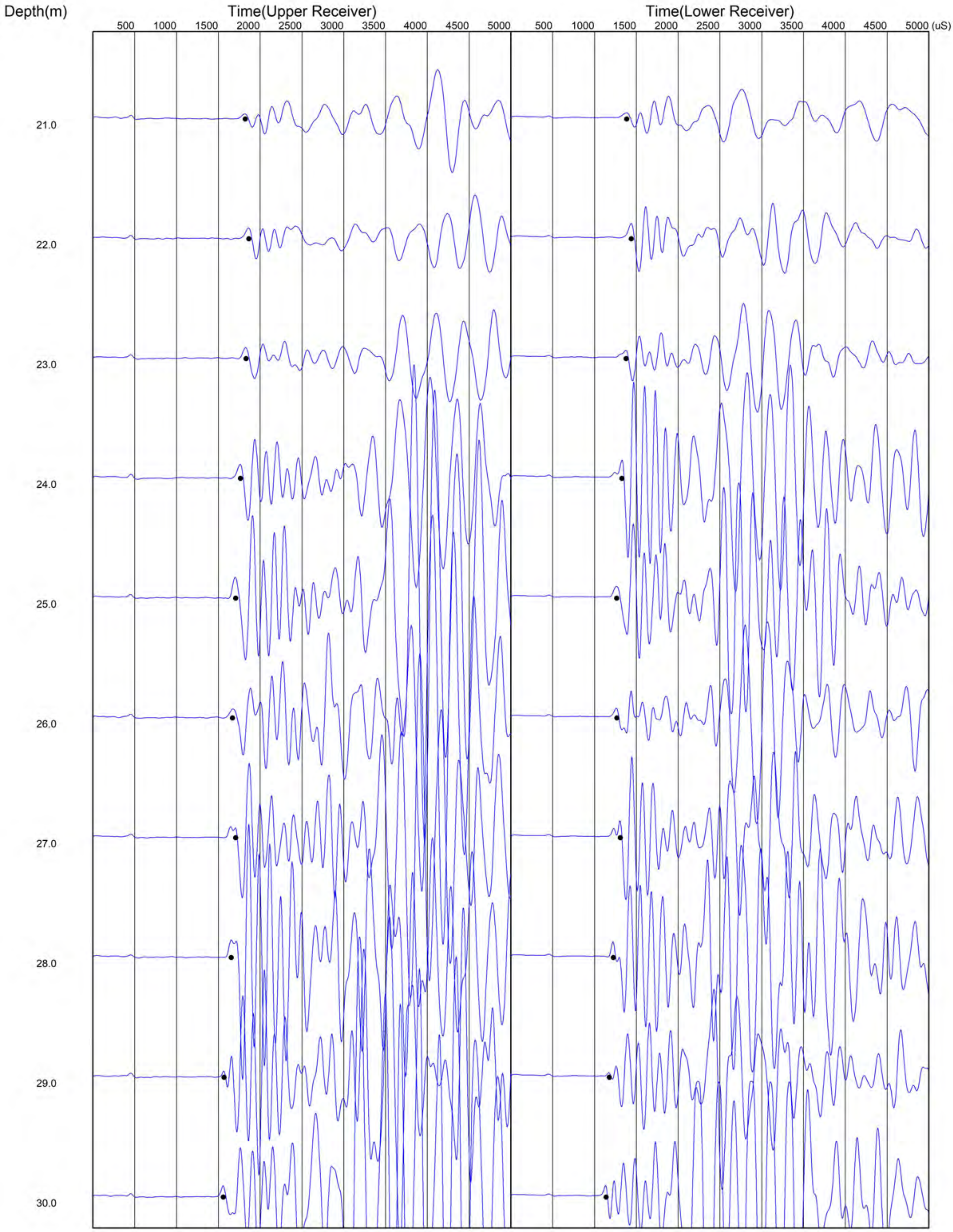
34.4
34.8

P Wave

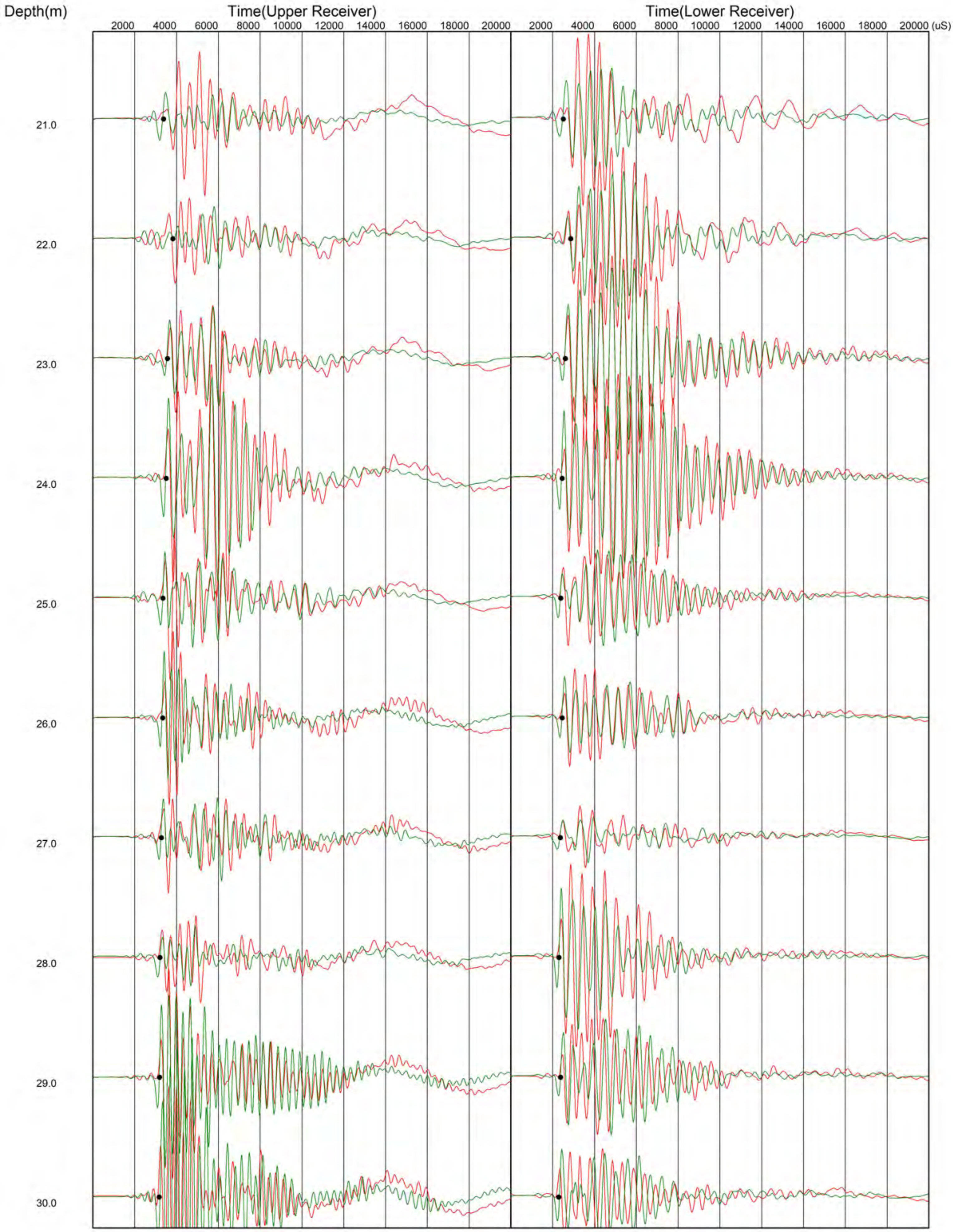


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
21.0
22.0
23.0
24.0
25.0
26.0
27.0
28.0
29.0
30.0

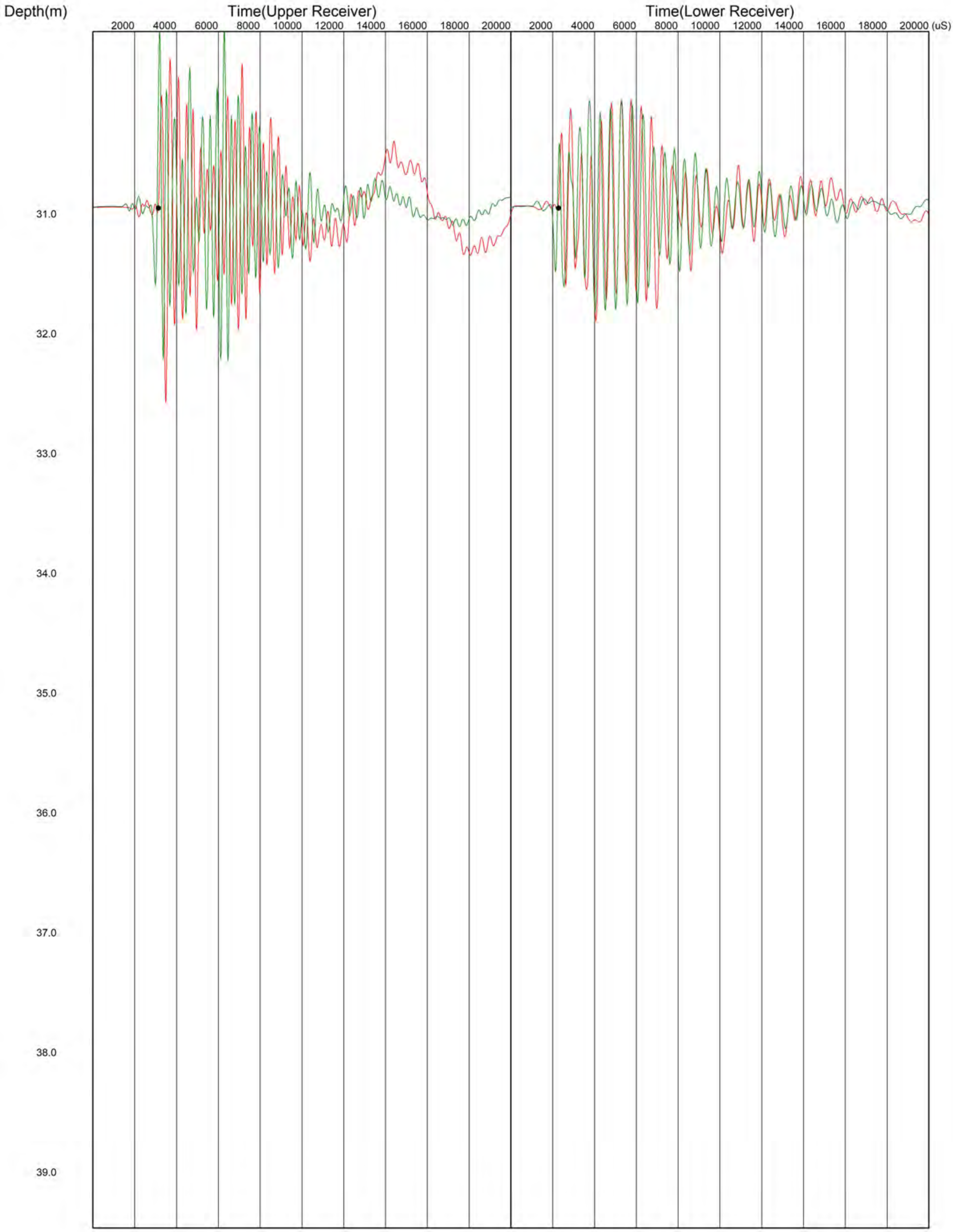
P Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
31.0
32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0

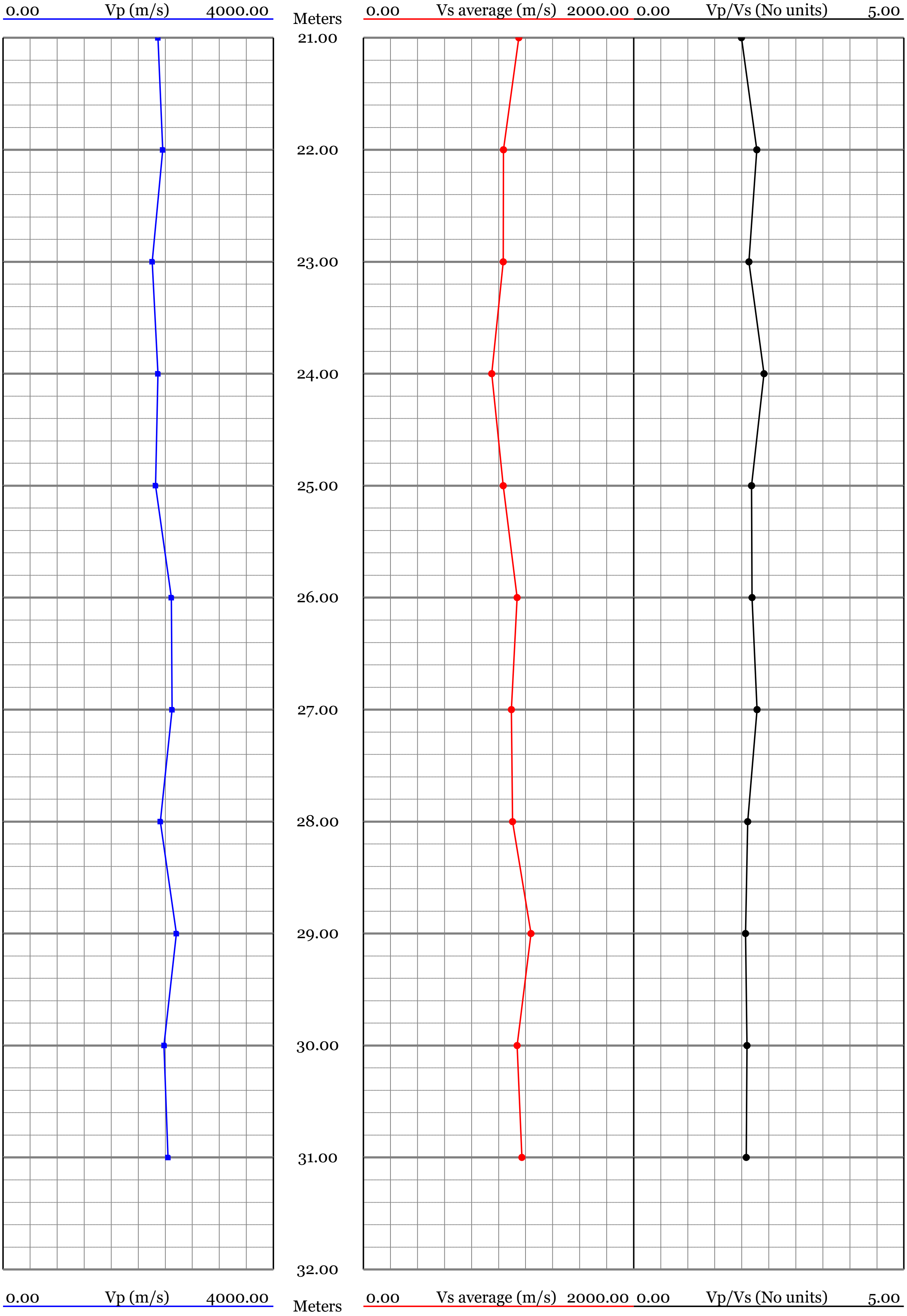
S Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
21.0
22.0
23.0
24.0
25.0
26.0
27.0
28.0
29.0
30.0

S Wave



Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
31.0
32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0


0.00
Vp (m/s)
4000.00
Meters
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00
21.00
22.00
23.00
24.00
25.00
26.00
27.00
28.00
29.00
30.00
31.00
32.00
0.00
Vp (m/s)
4000.00
Meters
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00

Depth	Azimuth	Dip	Aperture
m	deg	deg	mm
7.31	177.87	73.33	0.00
8.67	75.86	75.83	0.00
11.26	179.03	75.08	0.00
13.21	275.32	17.74	0.00
13.56	143.81	4.57	0.00
13.67	208.62	11.31	0.00
14.82	165.57	9.09	0.00
15.28	90.00	81.03	0.00
15.97	0.00	0.00	0.00
16.08	207.50	40.92	0.00
16.21	83.73	29.25	0.00
17.01	329.05	16.48	0.00
17.97	300.91	39.20	0.00
18.35	285.69	18.51	0.00
18.98	122.07	36.60	0.00
19.26	356.22	23.75	0.00
19.57	119.44	35.32	0.00
20.15	324.93	50.16	0.00
20.79	175.98	11.31	0.00
20.99	342.02	4.57	0.00
21.69	240.98	22.87	0.00
23.25	0.00	0.00	0.00
24.23	180.71	23.75	0.00
24.85	51.44	36.28	0.00
27.66	337.61	27.76	0.00
30.91	145.70	9.09	0.00

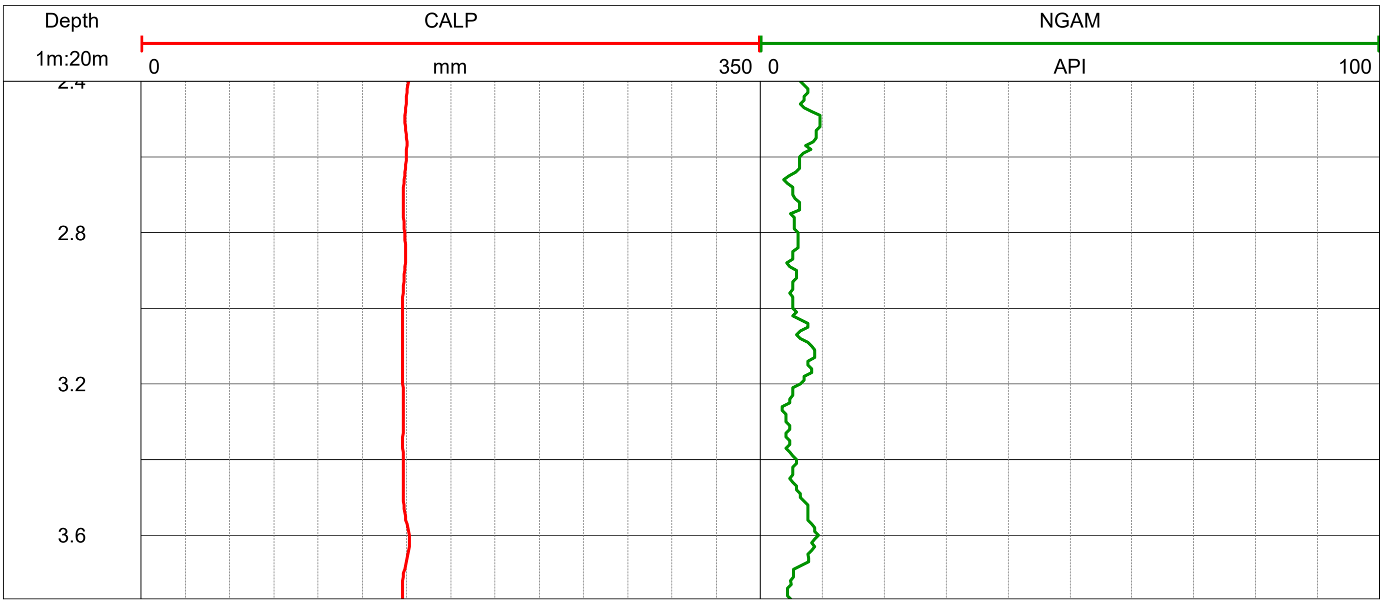
ROBERTSON GEO SERVICES
Unlocking Your GeoData

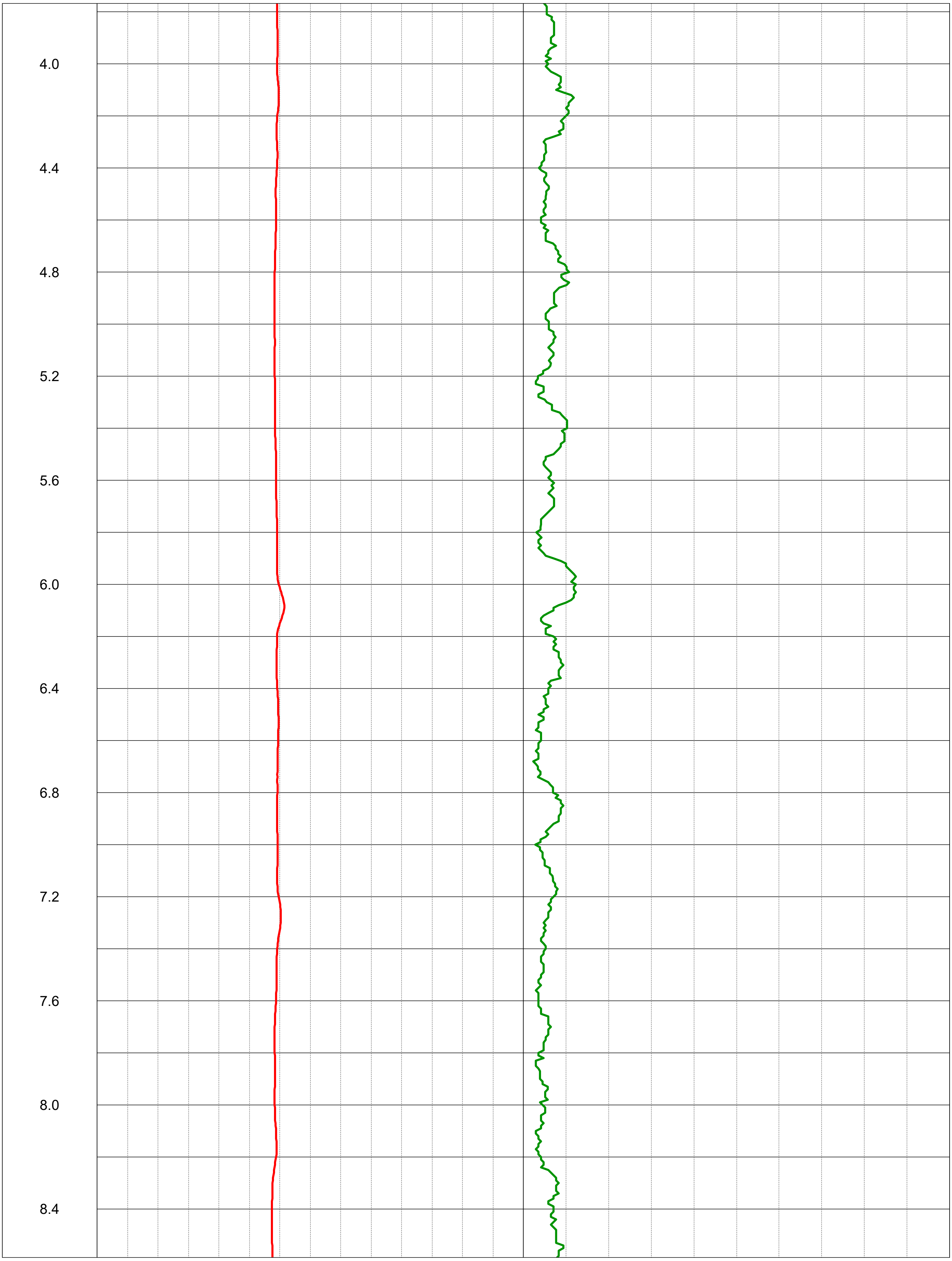
COMPANY	Structural Soils
WELL ID	R606
FIELD	A303 Stonehenge
COUNTRY	England
STATE	
LOCATION	
Easting:	412220.01
Northing:	141912
SEC	
TWP	
RGE	
OTHER SERVICES	

CO Structural Soils
WELL R606
FLD A303 Stonehenge
CTY England
STE
FILING No

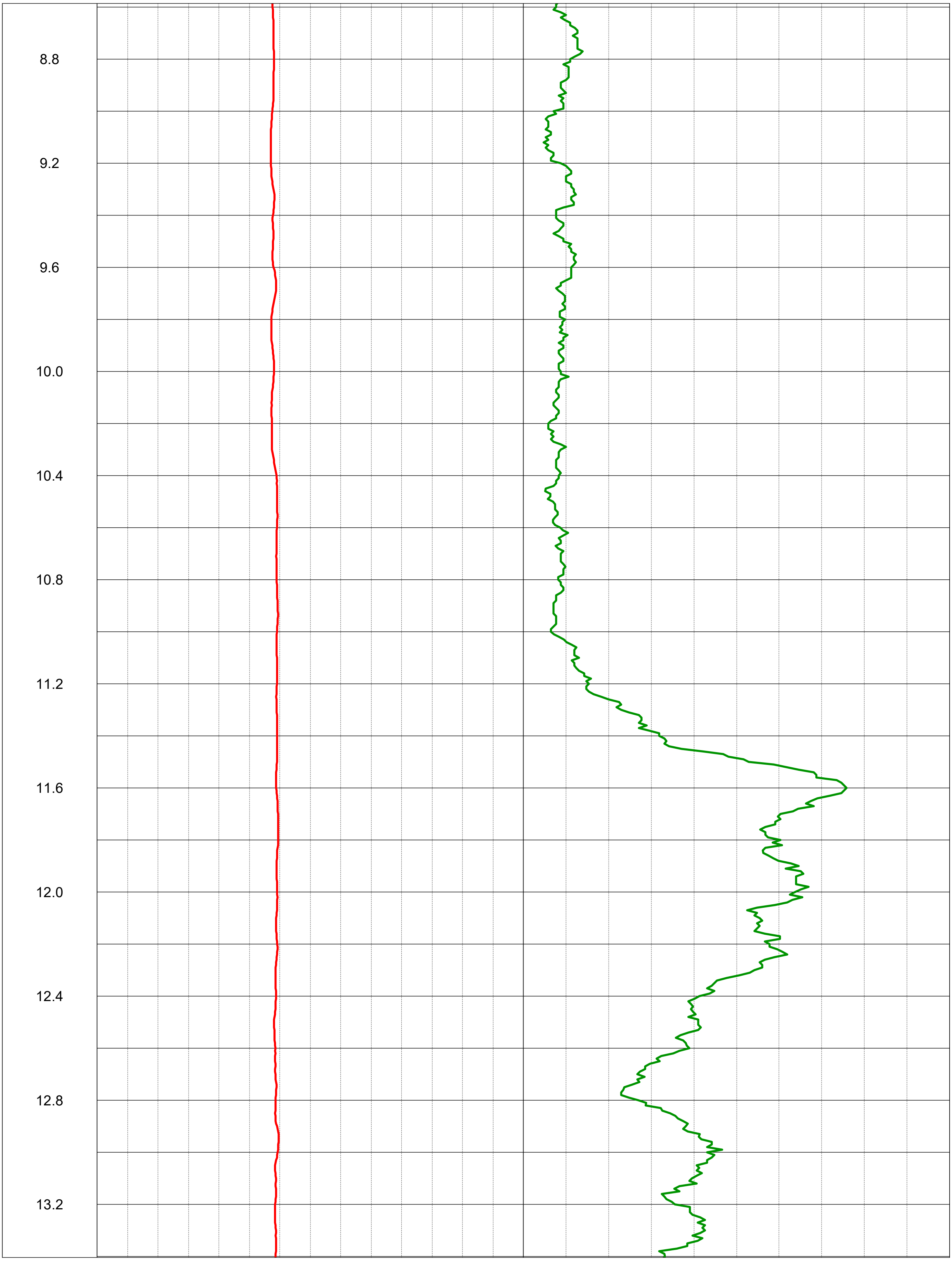
PERMANENT DATUM	GL	ELEVATION	94.973	K.B.	
LOG MEAS. FROM		ABOVE PERM. DATUM		D.F.	
DRILLING MEAS. FROM				G.L.	
DATE	23/05/18	TYPE FLUID IN HOLE		Water	
RUN No		SALINITY			
TYPE LOG	Caliper Gamma	DENSITY			
DEPTH-DRILLER	60	LEVEL		24	
DEPTH-LOGGER	56.7	MAX. REC. TEMP.			
BTM LOGGED INTERVAL	56.7				
TOP LOGGED INTERVAL	2.4				
OPERATING RIG TIME					
RECORDED BY	James Boyett				
WITNESSED BY	Kyle Owen				

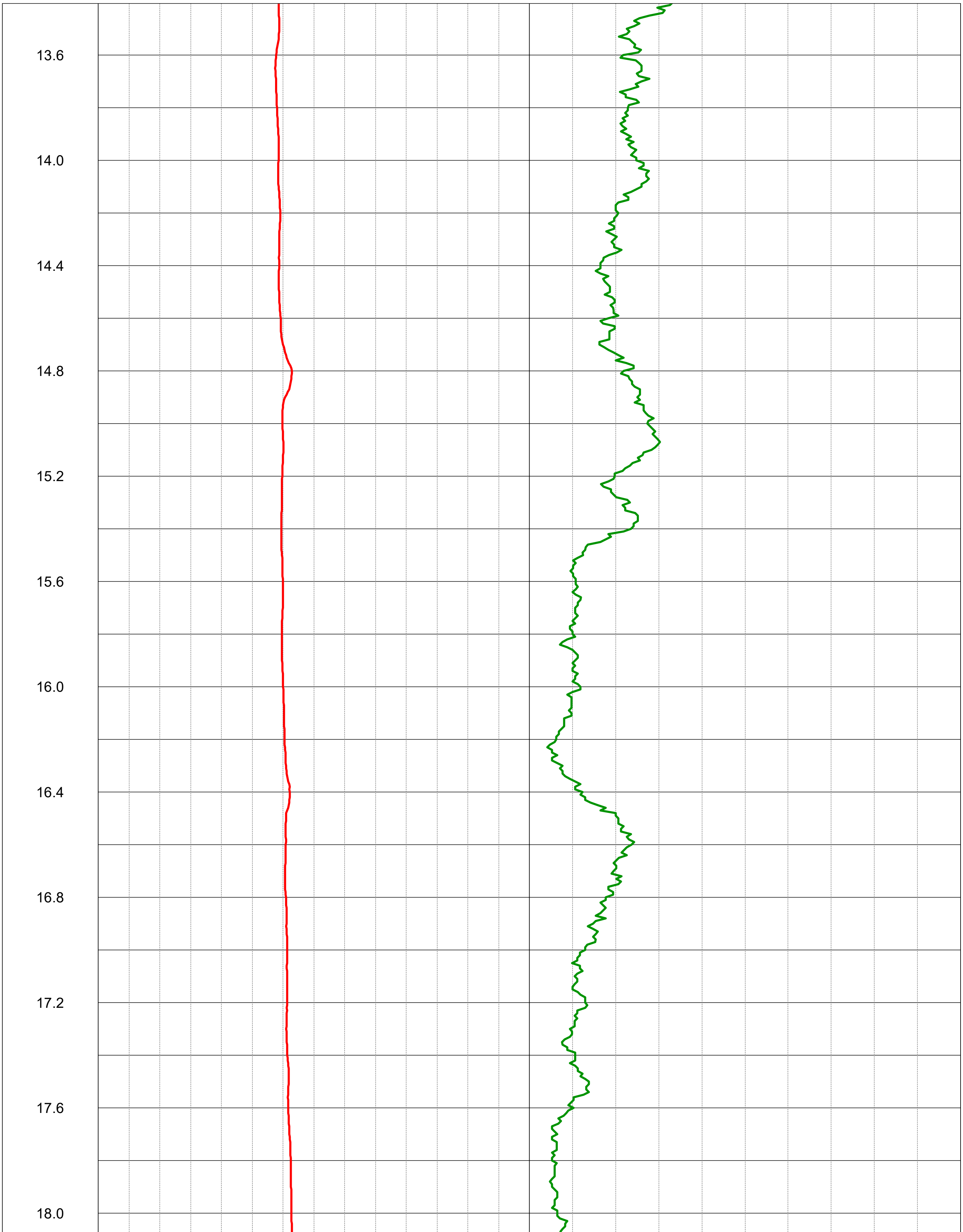
RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO





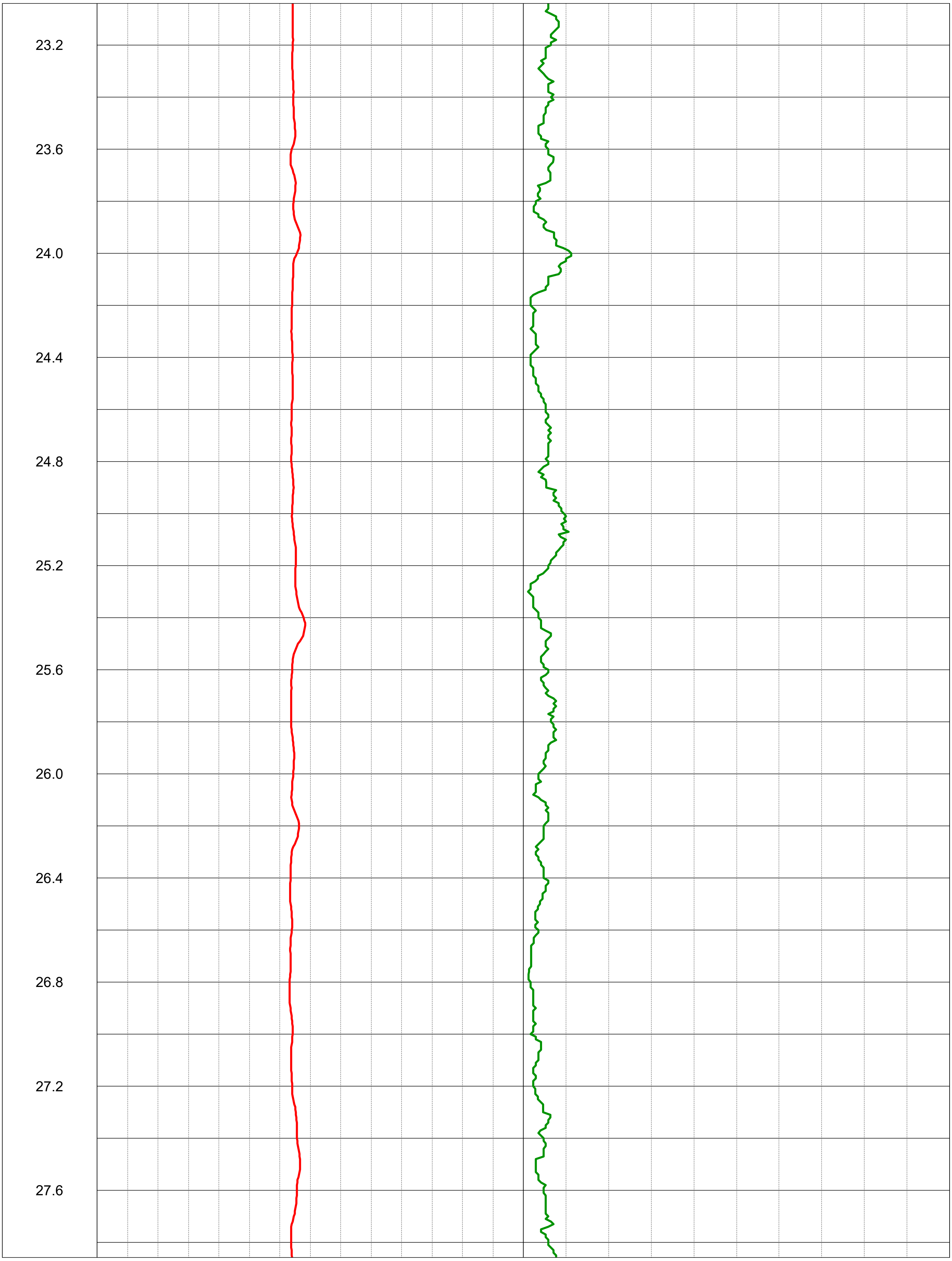
4.0
4.4
4.8
5.2
5.6
6.0
6.4
6.8
7.2
7.6
8.0
8.4


8.8
9.2
9.6
10.0
10.4
10.8
11.2
11.6
12.0
12.4
12.8
13.2

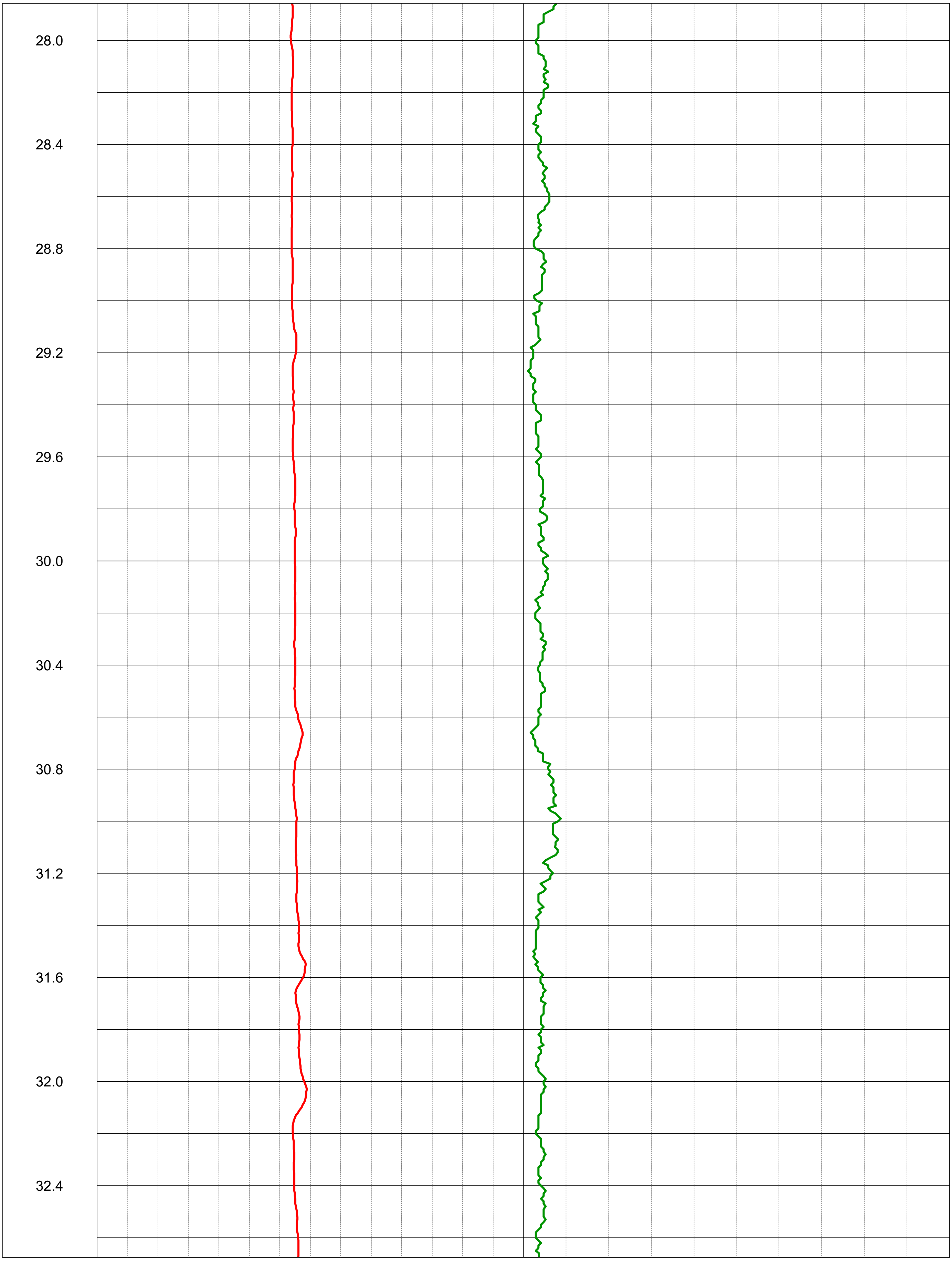


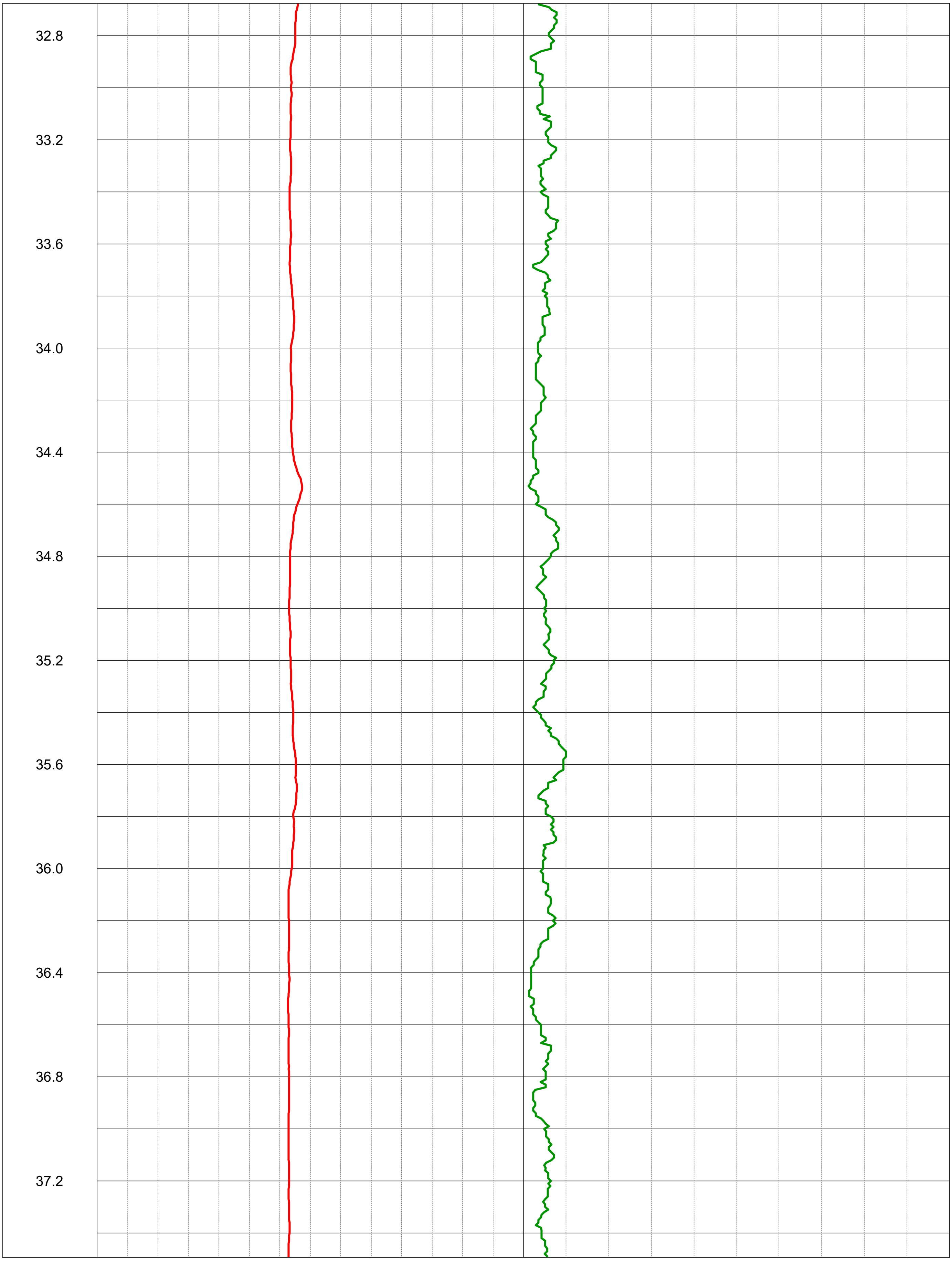
13.6
14.0
14.4
14.8
15.2
15.6
16.0
16.4
16.8
17.2
17.6
18.0

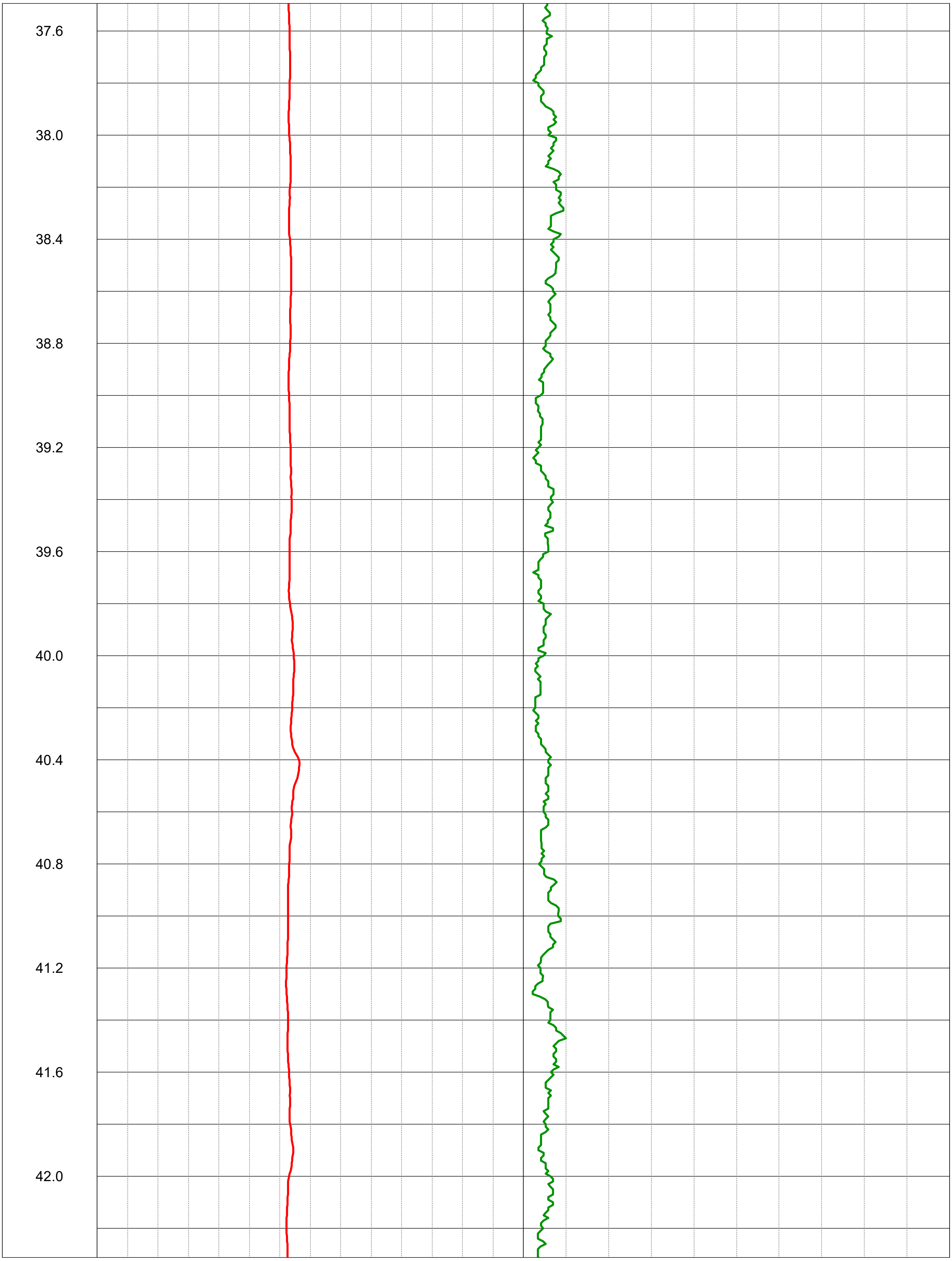

18.4
18.8
19.2
19.6
20.0
20.4
20.8
21.2
21.6
22.0
22.4
22.8

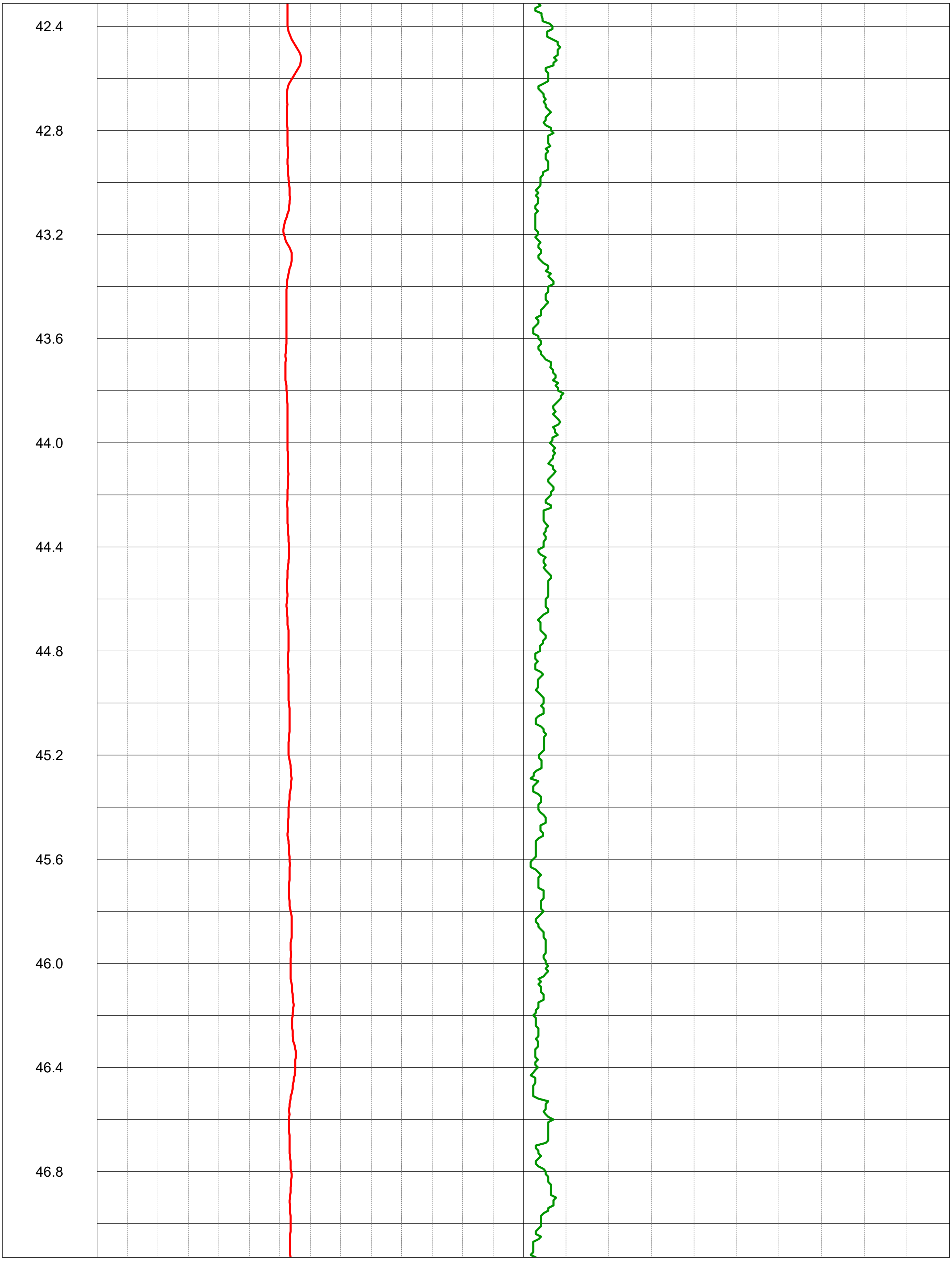


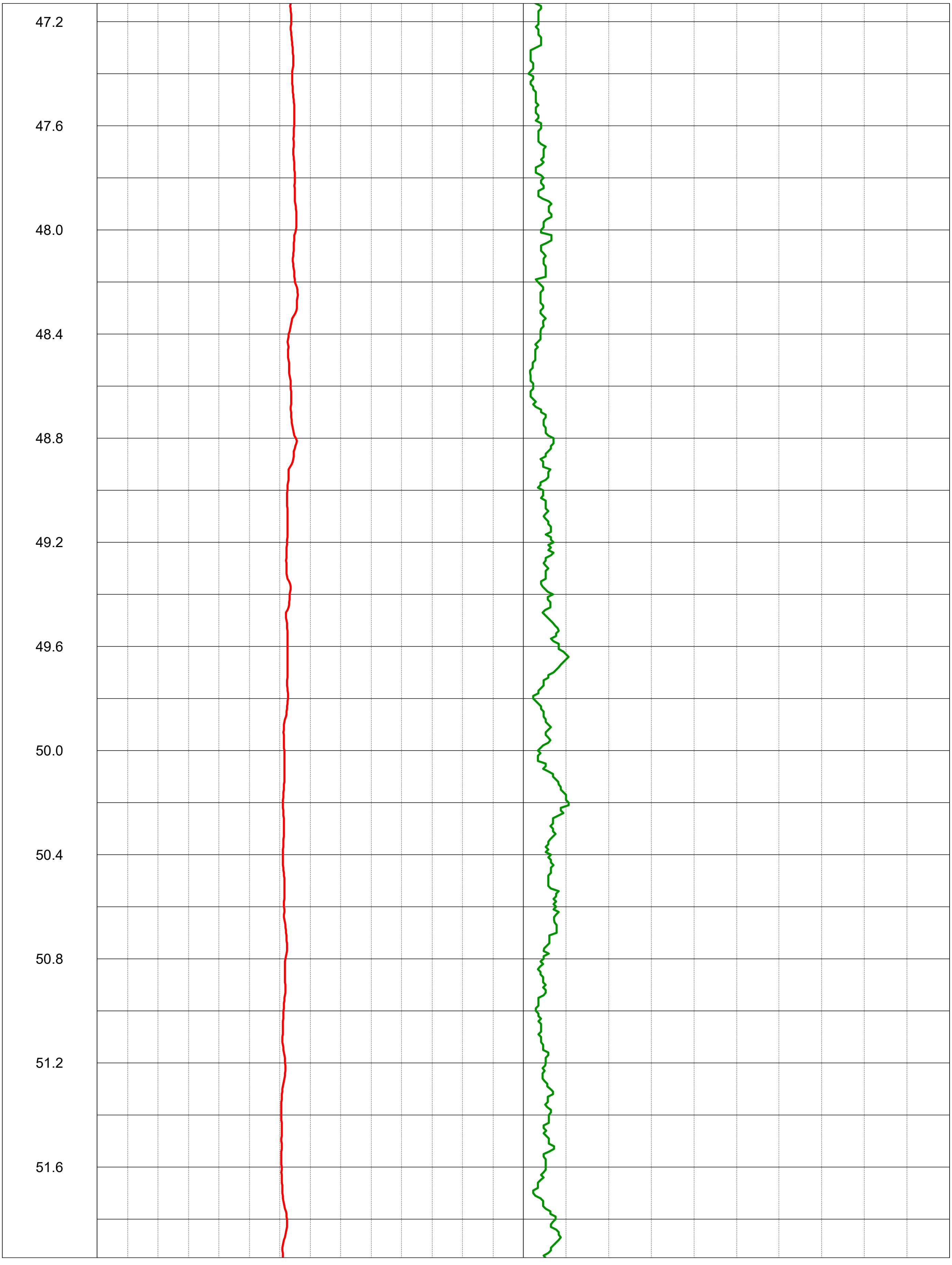
23.2
23.6
24.0
24.4
24.8
25.2
25.6
26.0
26.4
26.8
27.2
27.6

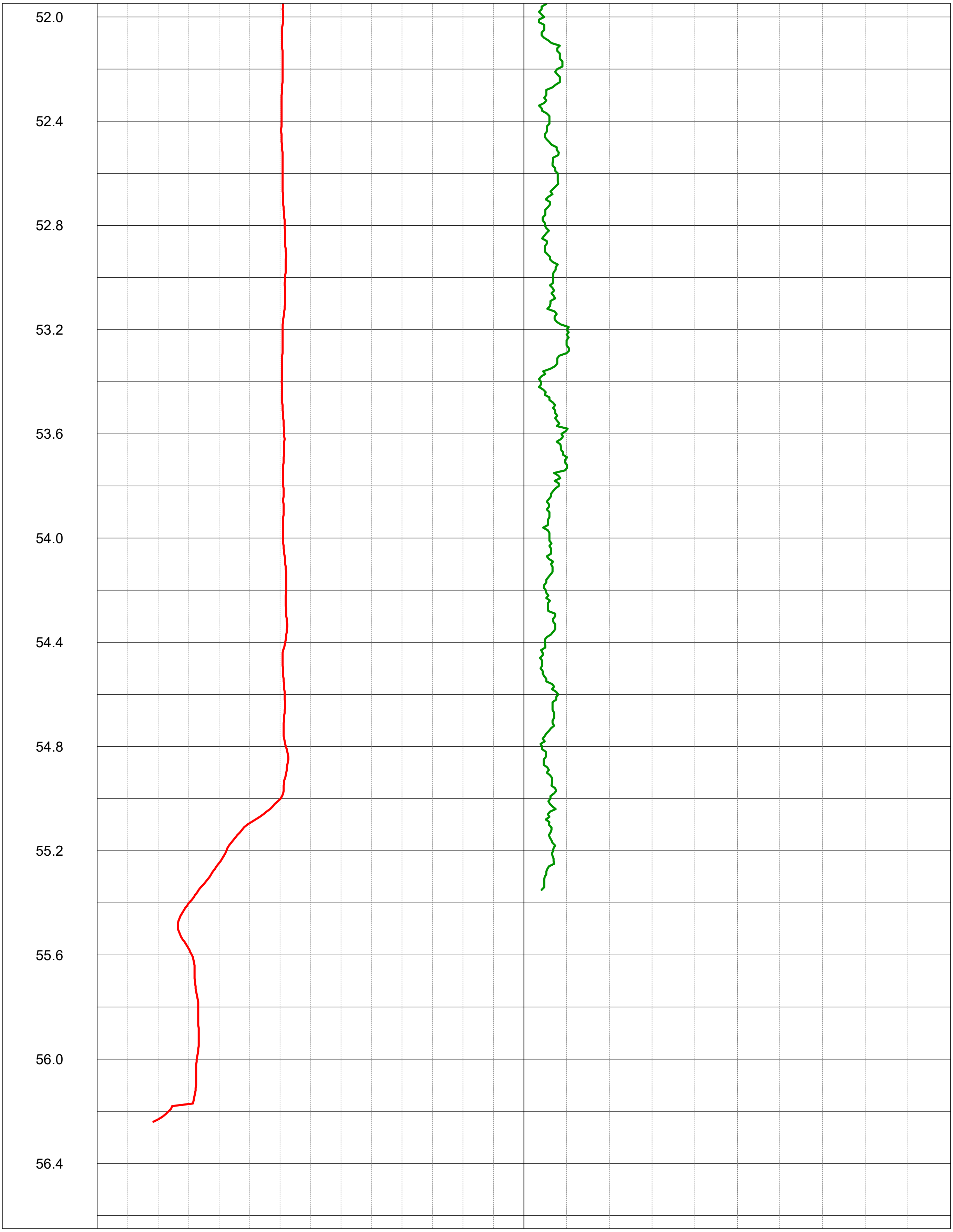

28.0
28.4
28.8
29.2
29.6
30.0
30.4
30.8
31.2
31.6
32.0
32.4


32.8
33.2
33.6
34.0
34.4
34.8
35.2
35.6
36.0
36.4
36.8
37.2

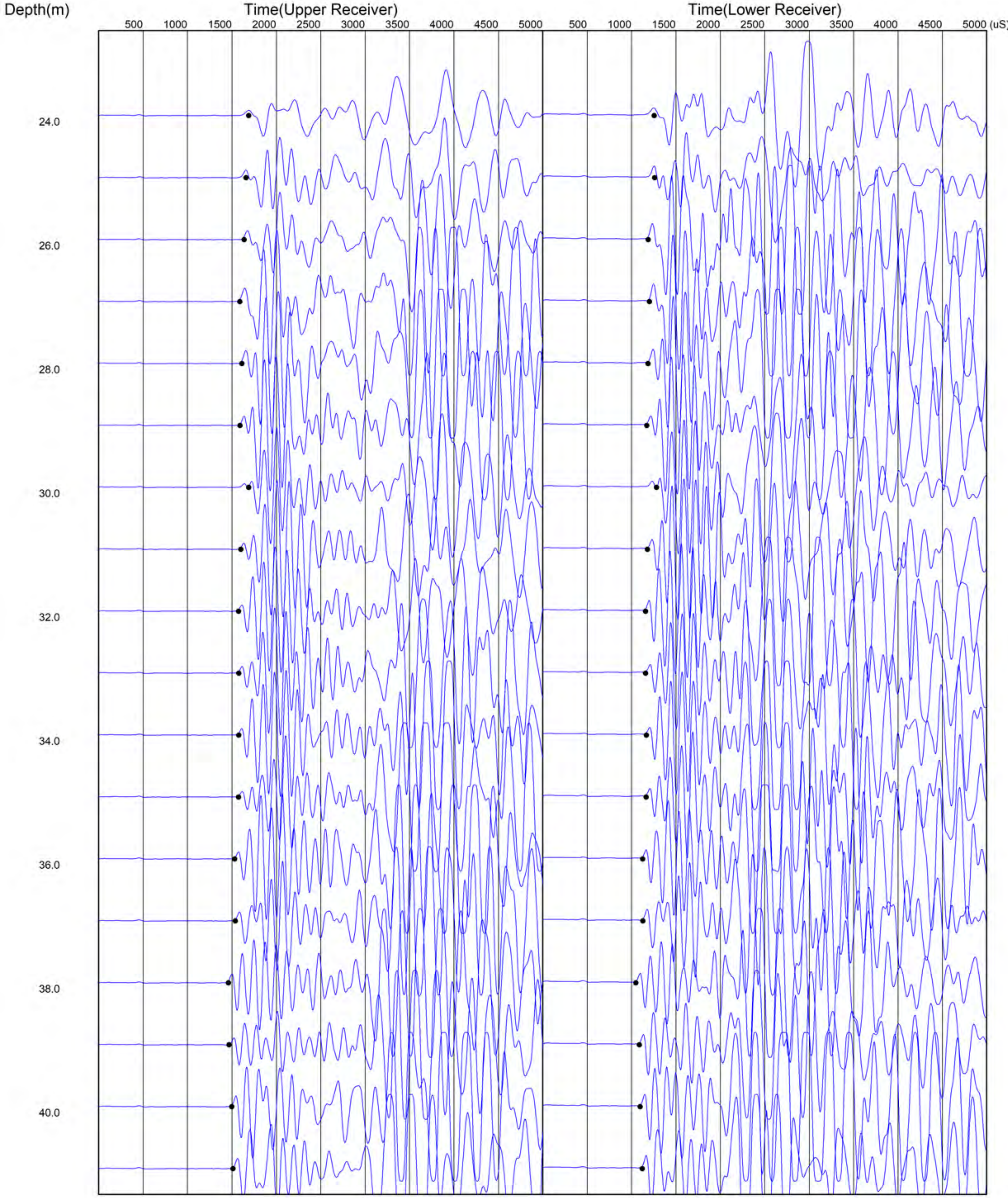

37.6
38.0
38.4
38.8
39.2
39.6
40.0
40.4
40.8
41.2
41.6
42.0


42.4
42.8
43.2
43.6
44.0
44.4
44.8
45.2
45.6
46.0
46.4
46.8

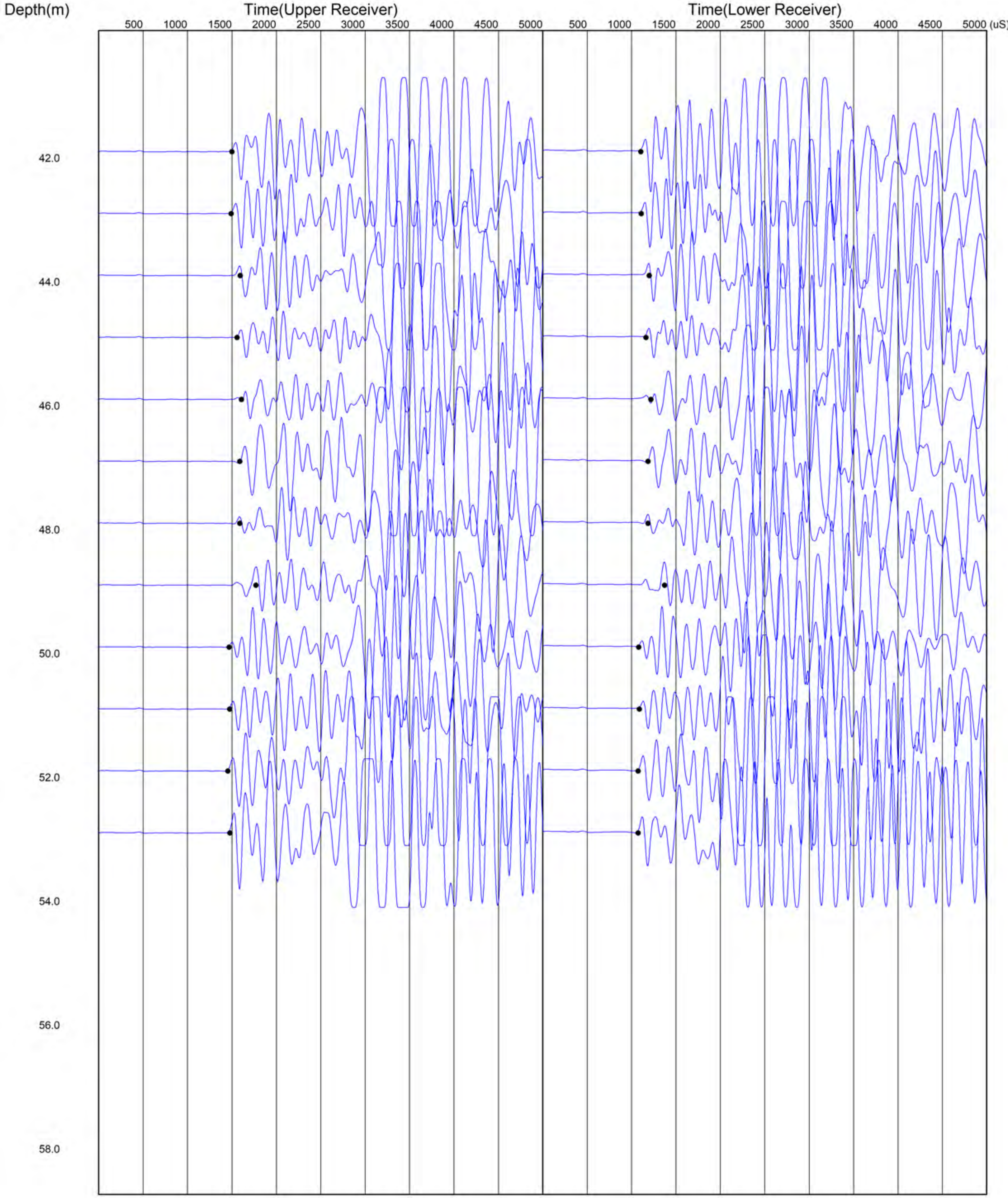

47.2
47.6
48.0
48.4
48.8
49.2
49.6
50.0
50.4
50.8
51.2
51.6


52.0
52.4
52.8
53.2
53.6
54.0
54.4
54.8
55.2
55.6
56.0
56.4

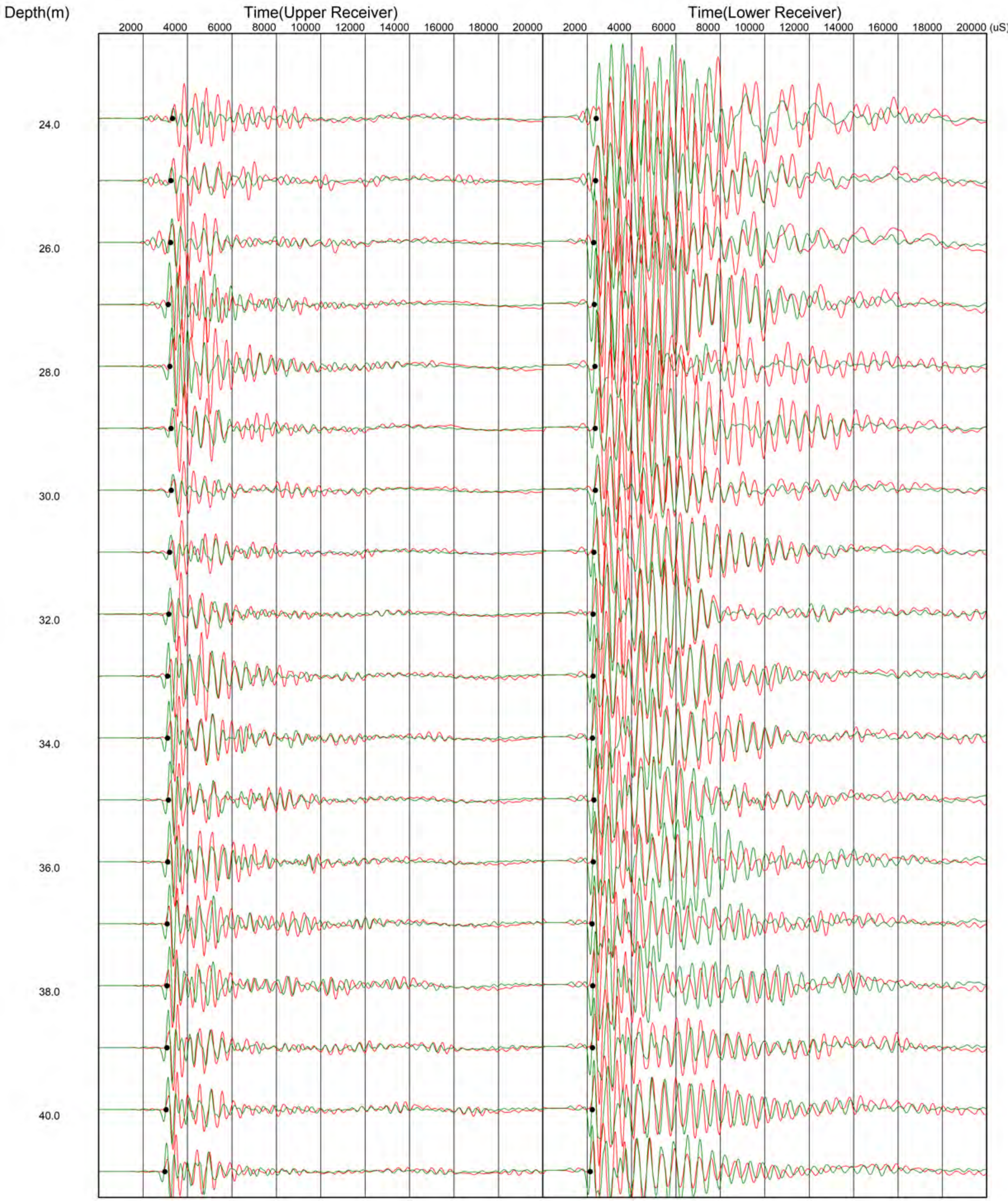
P Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
24.0
26.0
28.0
30.0
32.0
34.0
36.0
38.0
40.0

P Wave

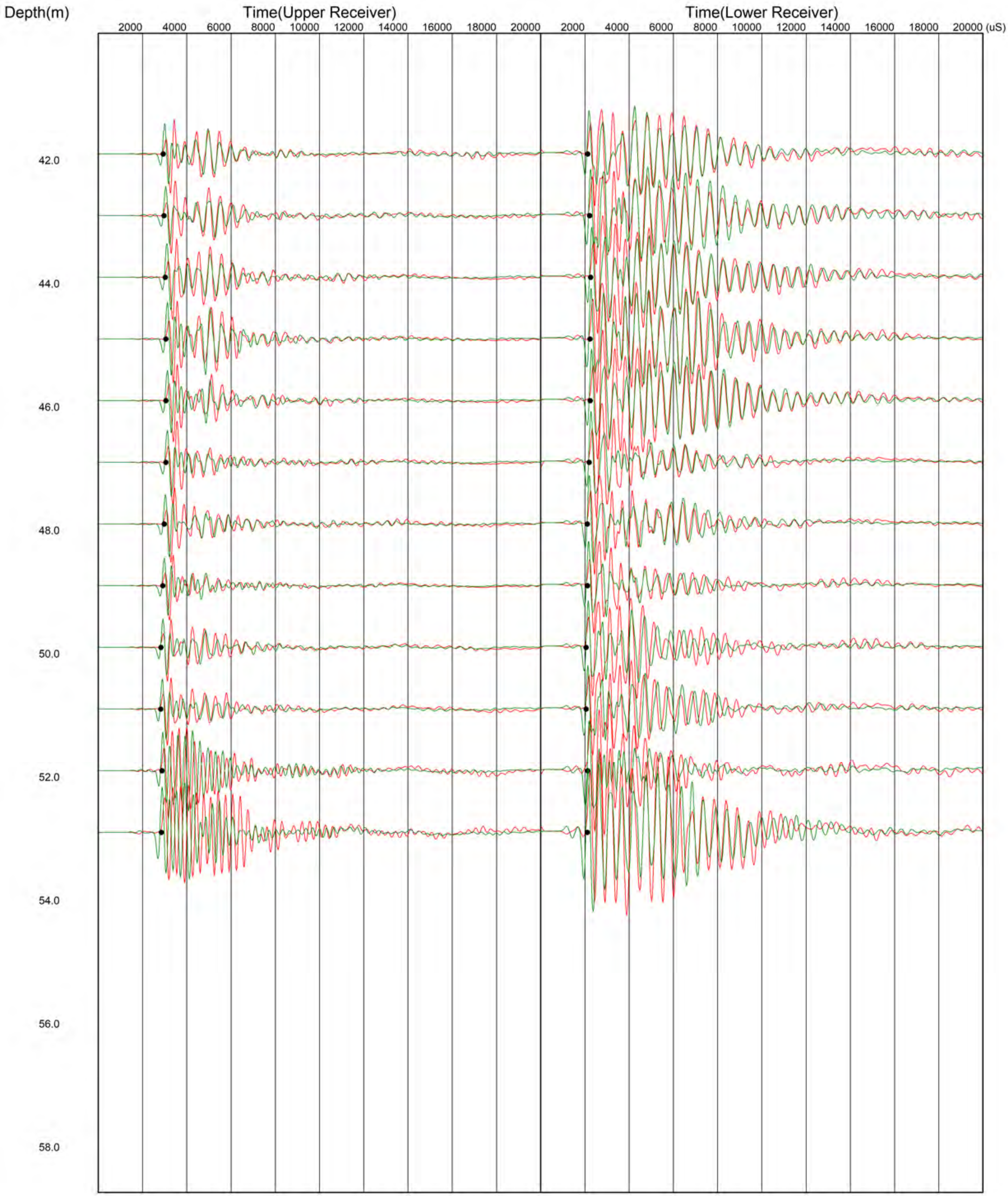

Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
42.0
44.0
46.0
48.0
50.0
52.0
54.0
56.0
58.0

S Wave

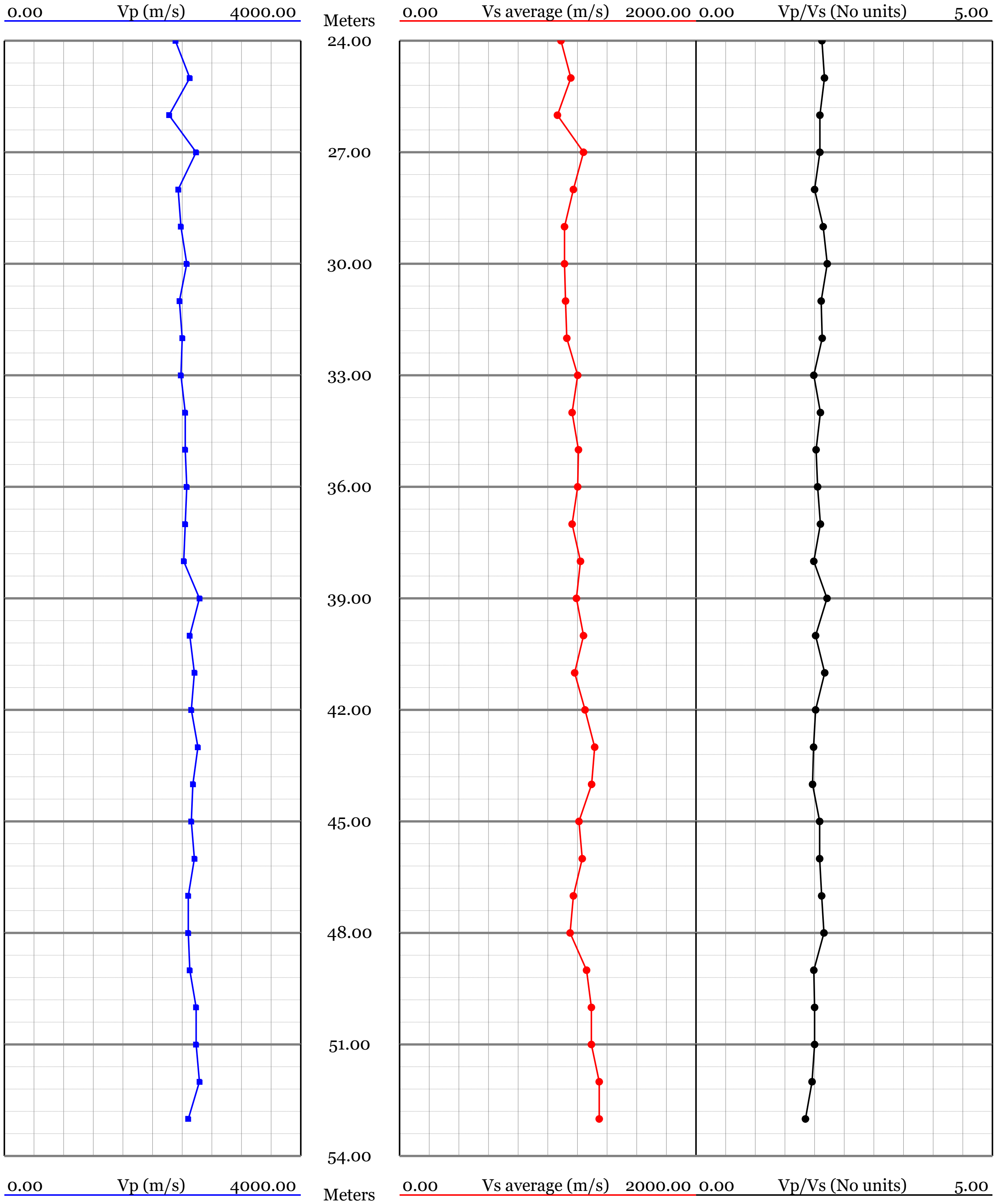


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
24.0
26.0
28.0
30.0
32.0
34.0
36.0
38.0
40.0

S Wave



Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
42.0
44.0
46.0
48.0
50.0
52.0
54.0
56.0
58.0


0.00
Vp (m/s)
4000.00
Meters
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00
24.00
27.00
30.00
33.00
36.00
39.00
42.00
45.00
48.00
51.00
54.00
0.00
Vp (m/s)
4000.00
Meters
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00

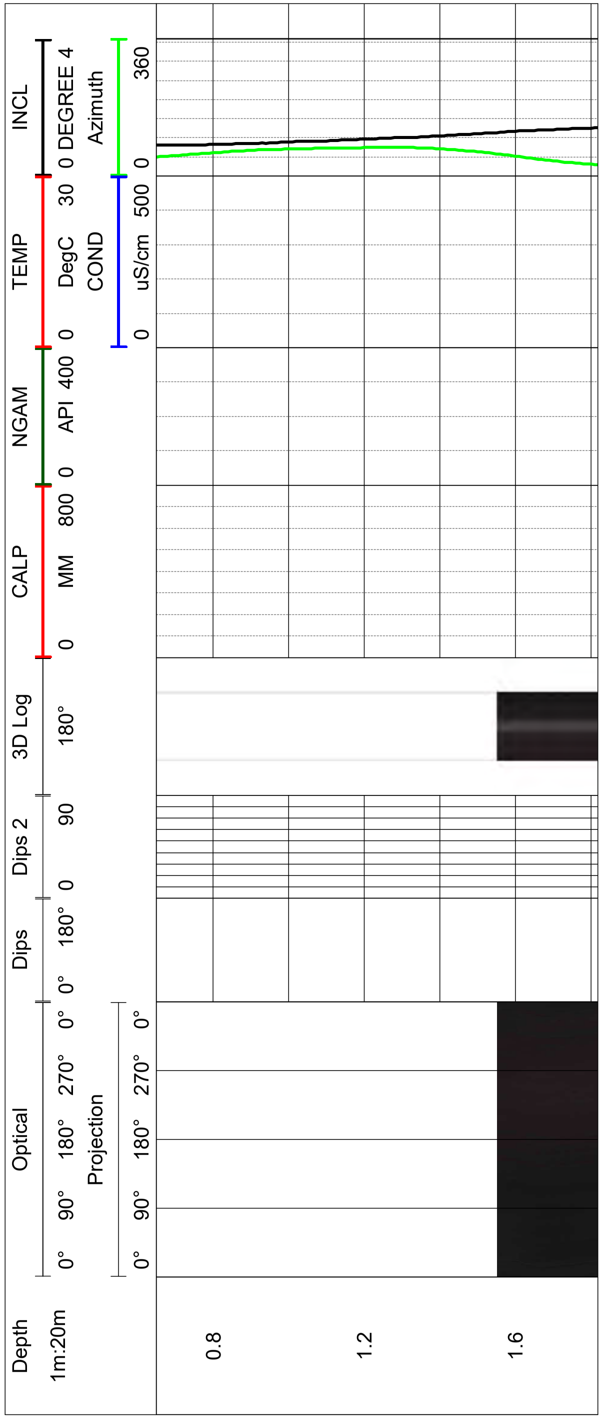
ROBERTSON GEO SERVICES
Unlocking Your GeoData

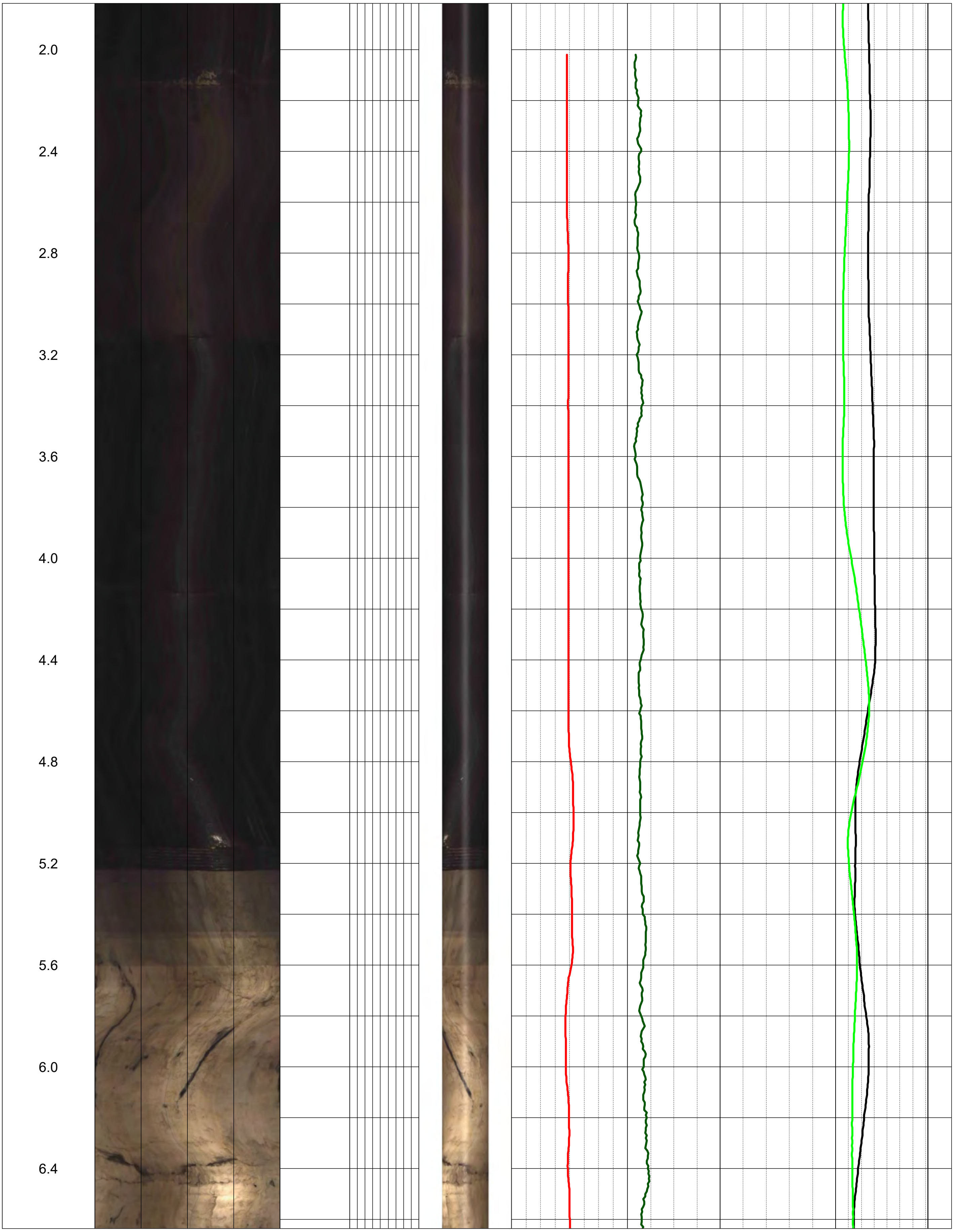
CO Structural Soils	COMPANY	Structural Soils
WELL W601	WELL ID	W601
FLD A303 Stonehenge	FIELD	A303 Stonehenge
CTY England	COUNTRY	England STATE
STE	LOCATION Easting: 412303.91 Northing: 141872 SEC TWP RGE	OTHER SERVICES
FILING No		

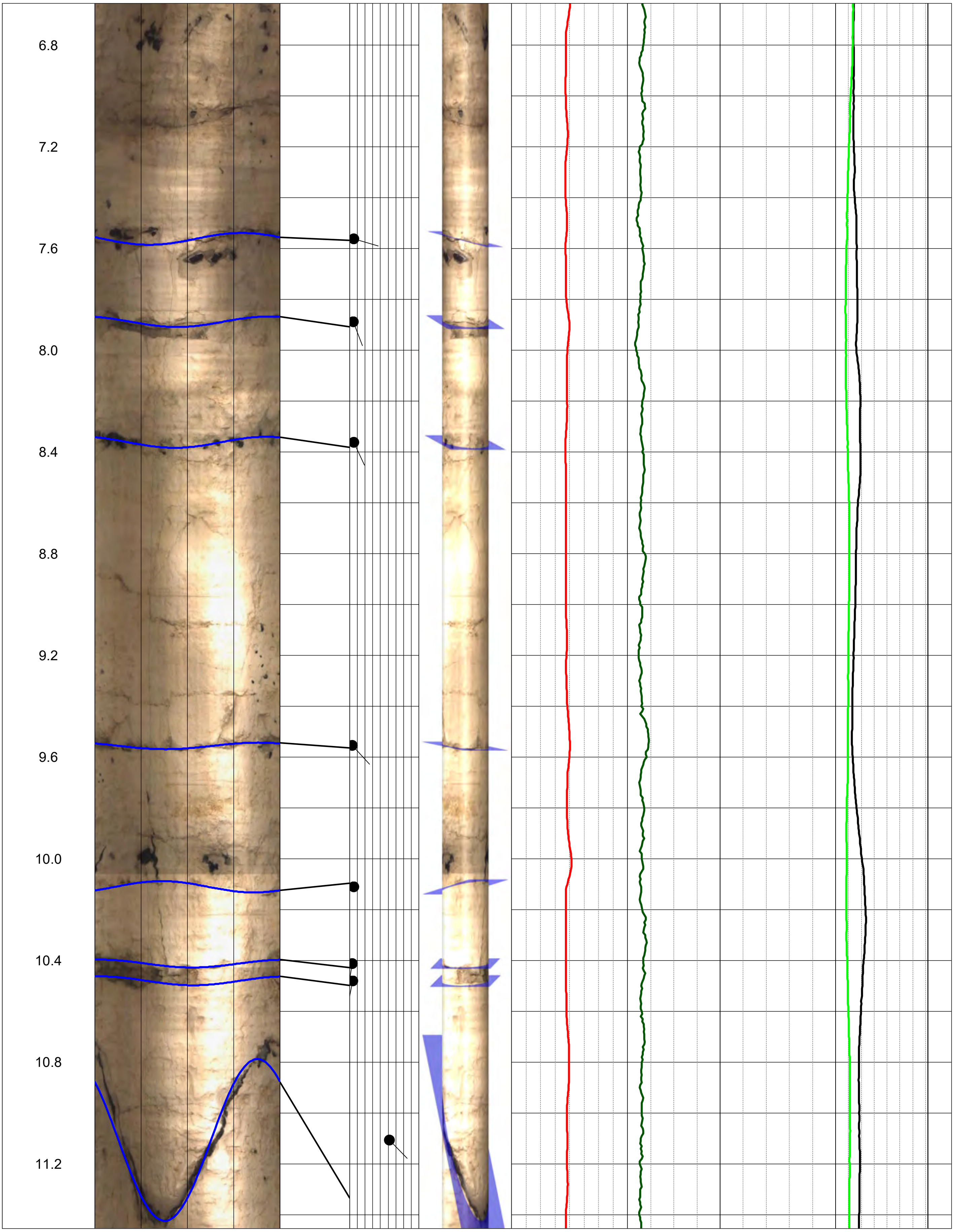
PERMANENT DATUM	GL	ELEVATION	93.101	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM		D.F.
DRILLING MEAS. FROM				G.L.

DATE	01/06/18	TYPE FLUID IN HOLE	Water
RUN No		SALINITY	
TYPE LOG	Composite	DENSITY	
DEPTH-DRILLER	60	LEVEL	22.5
DEPTH-LOGGER	60.1	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	60.1		
TOP LOGGED INTERVAL	1.6		
OPERATING RIG TIME			
RECORDED BY	Kyle Owen		
WITNESSED BY	James Boyett		

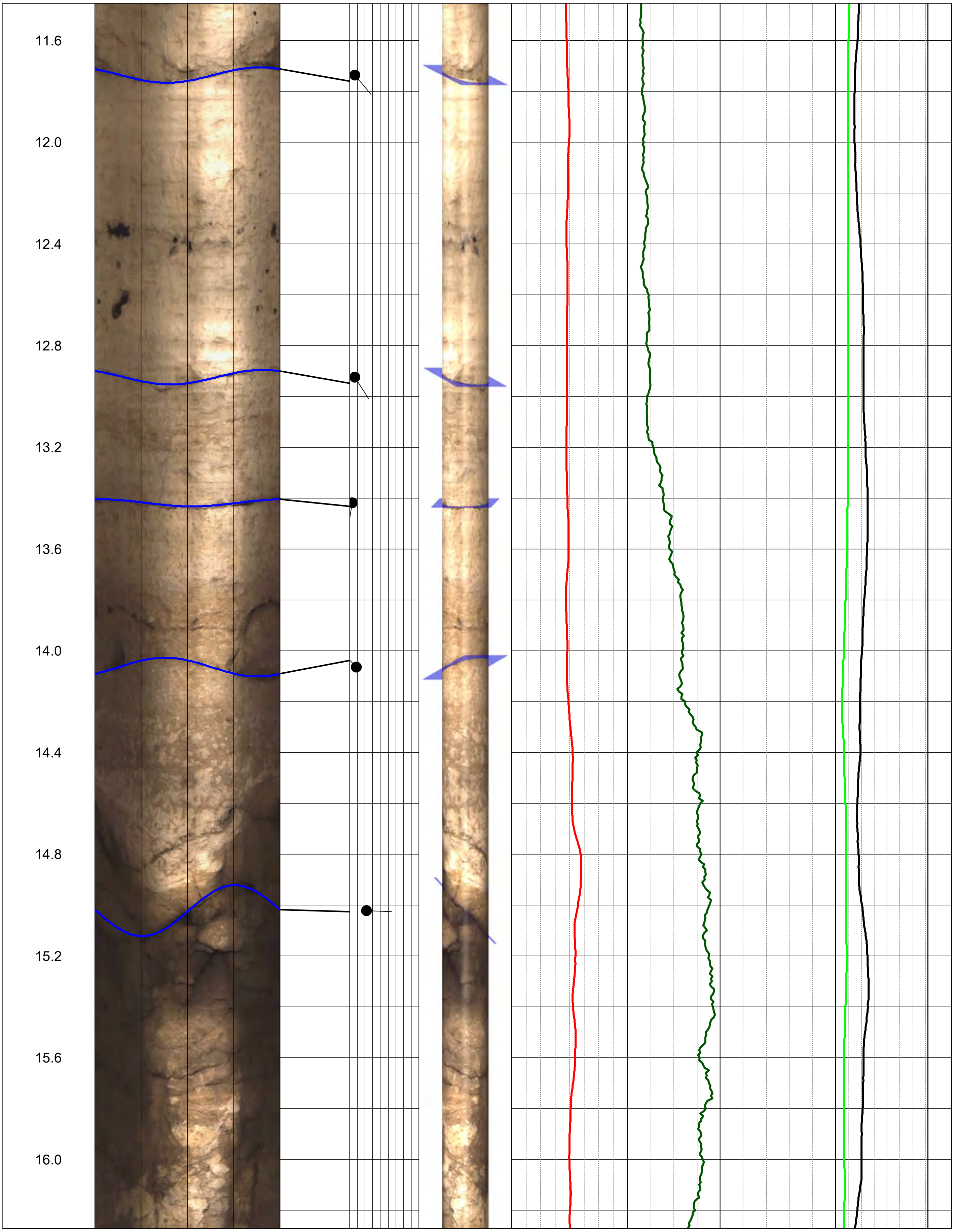
RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

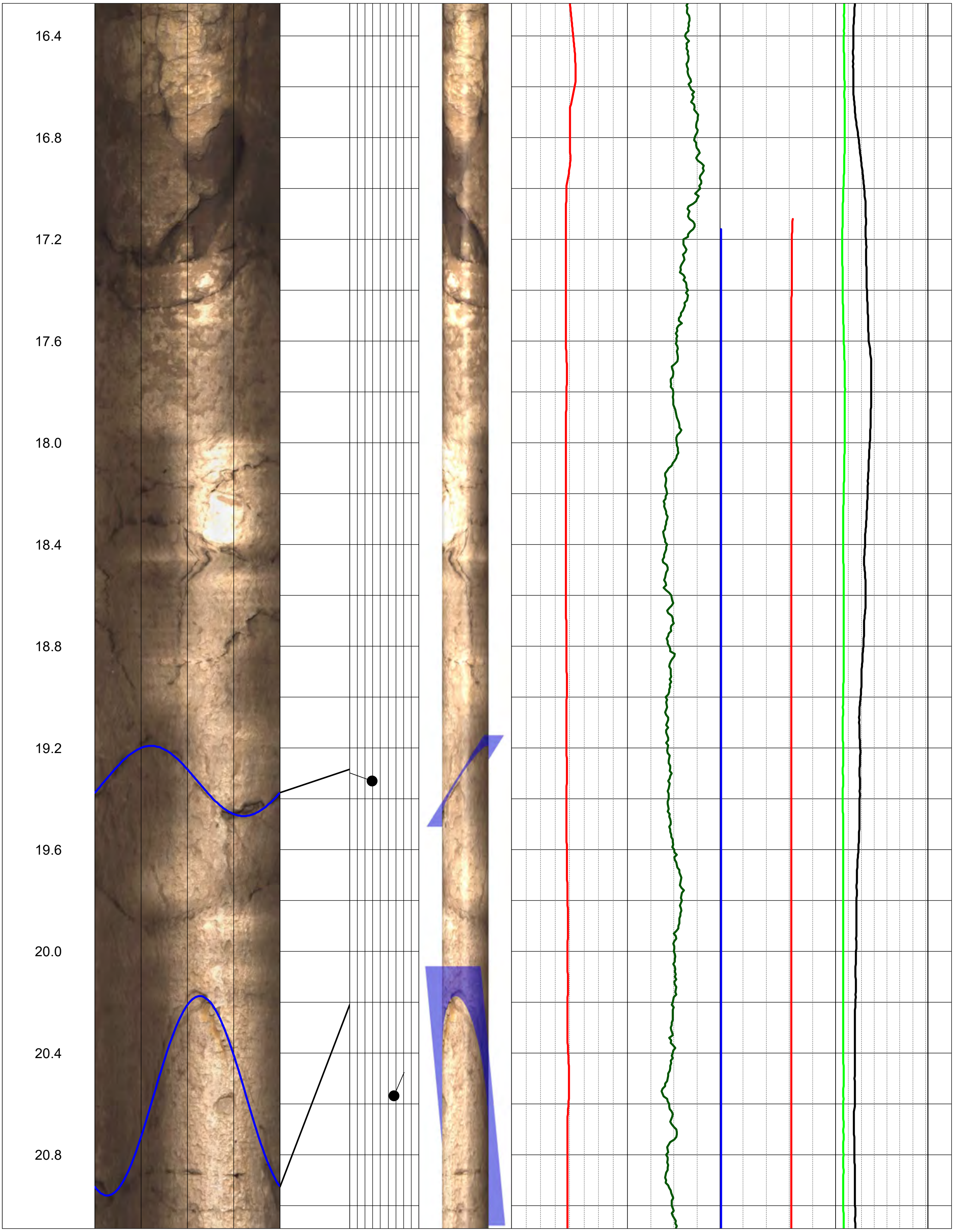


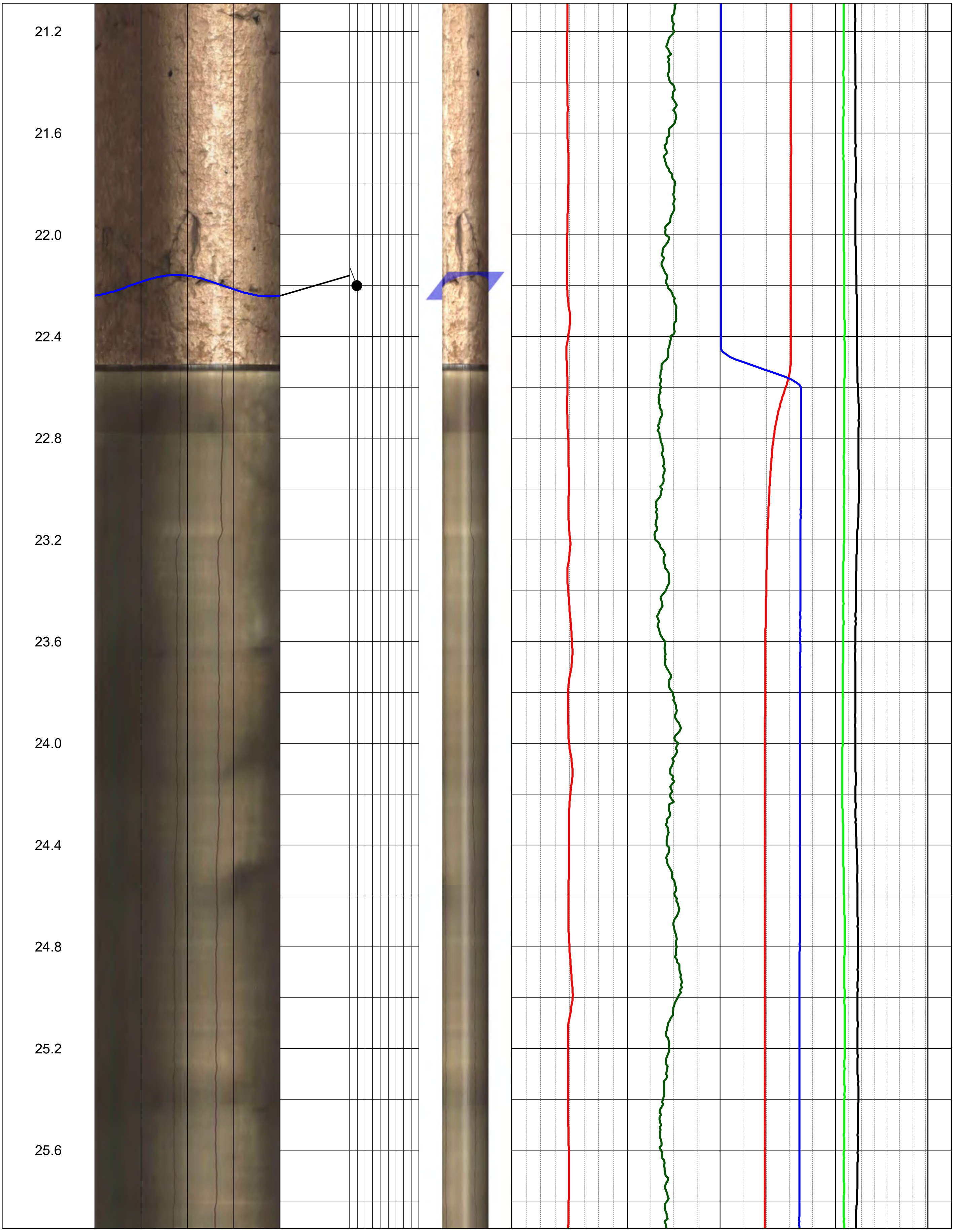

2.0
2.4
2.8
3.2
3.6
4.0
4.4
4.8
5.2
5.6
6.0
6.4



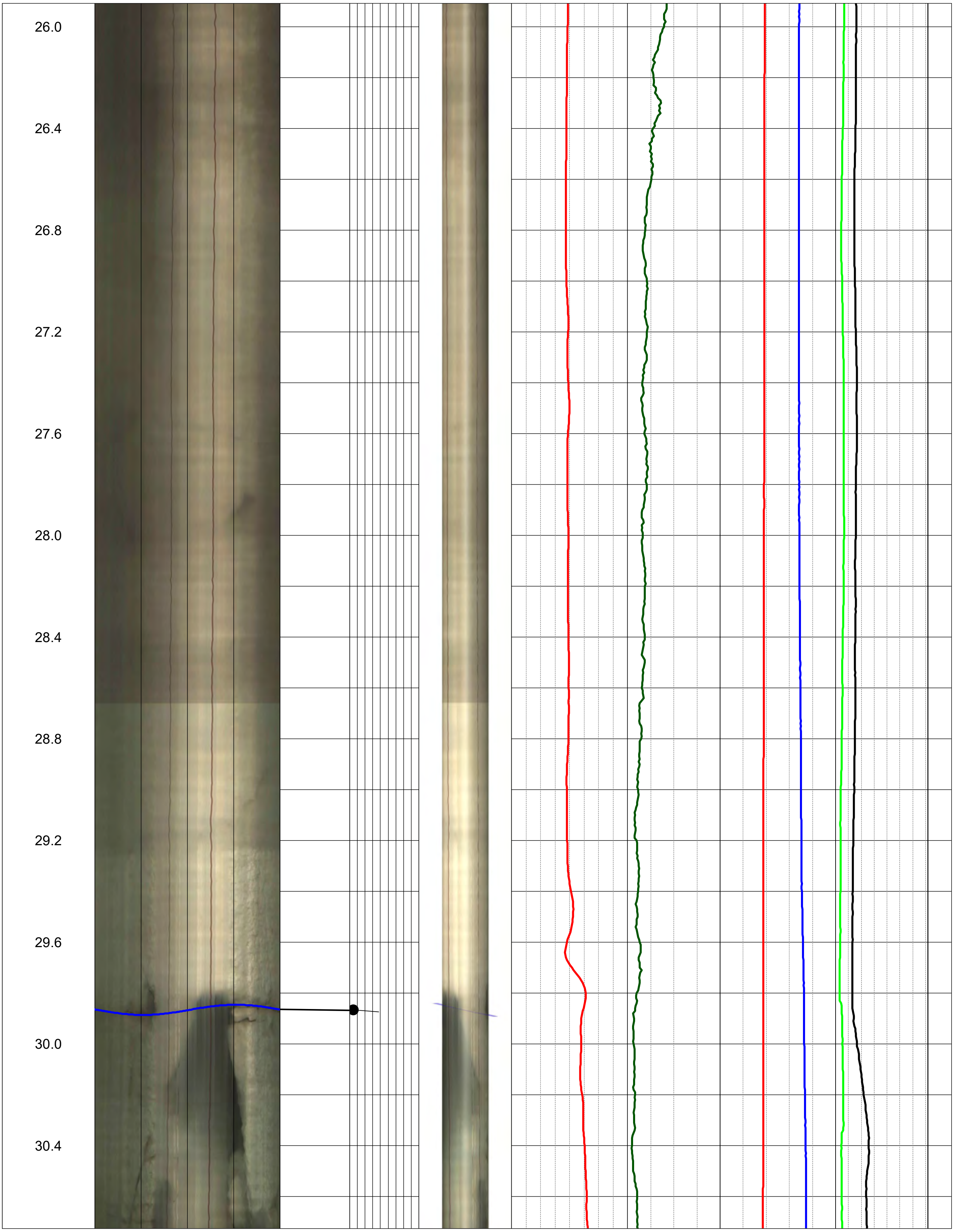
6.8
7.2
7.6
8.0
8.4
8.8
9.2
9.6
10.0
10.4
10.8
11.2

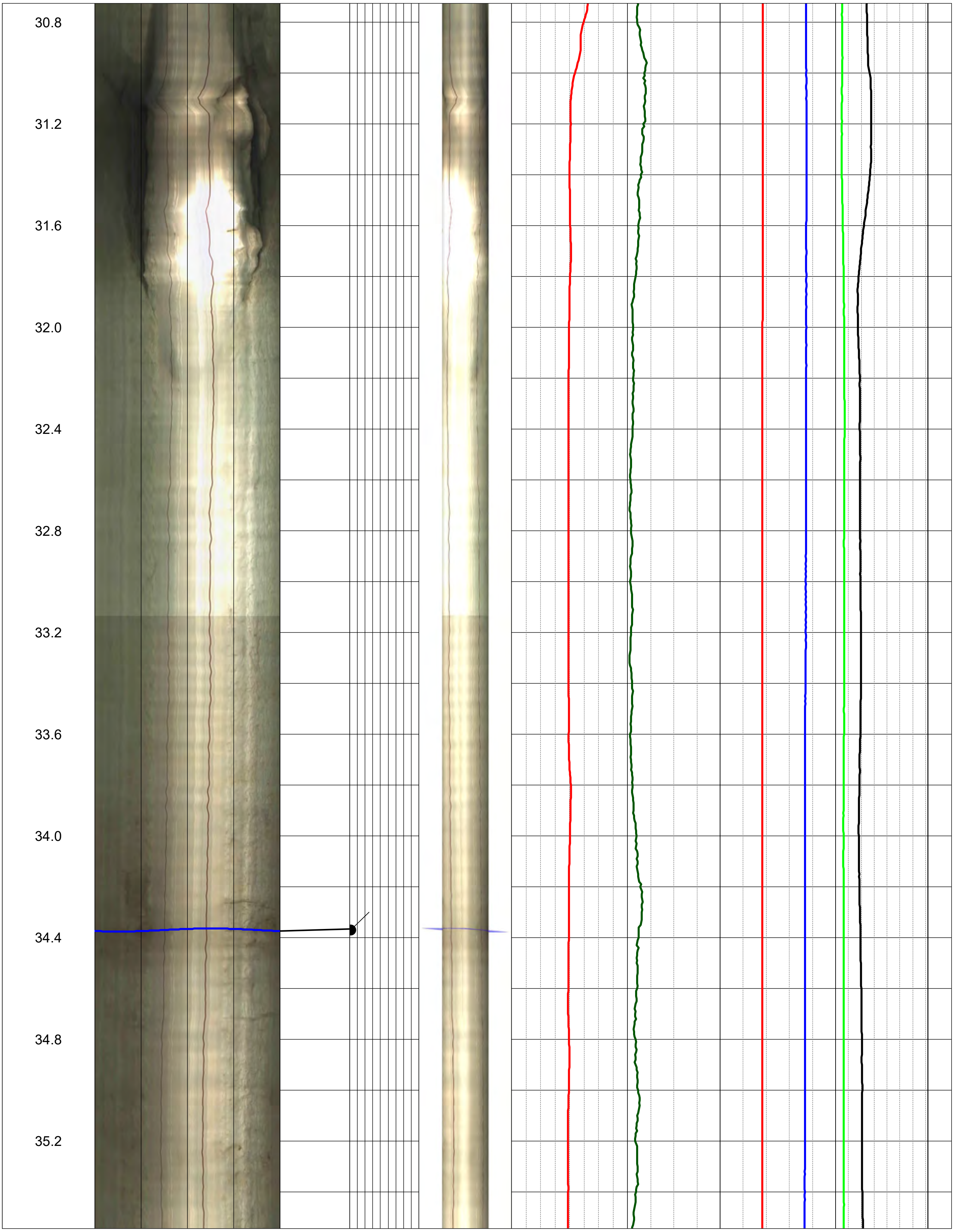

11.6
12.0
12.4
12.8
13.2
13.6
14.0
14.4
14.8
15.2
15.6
16.0

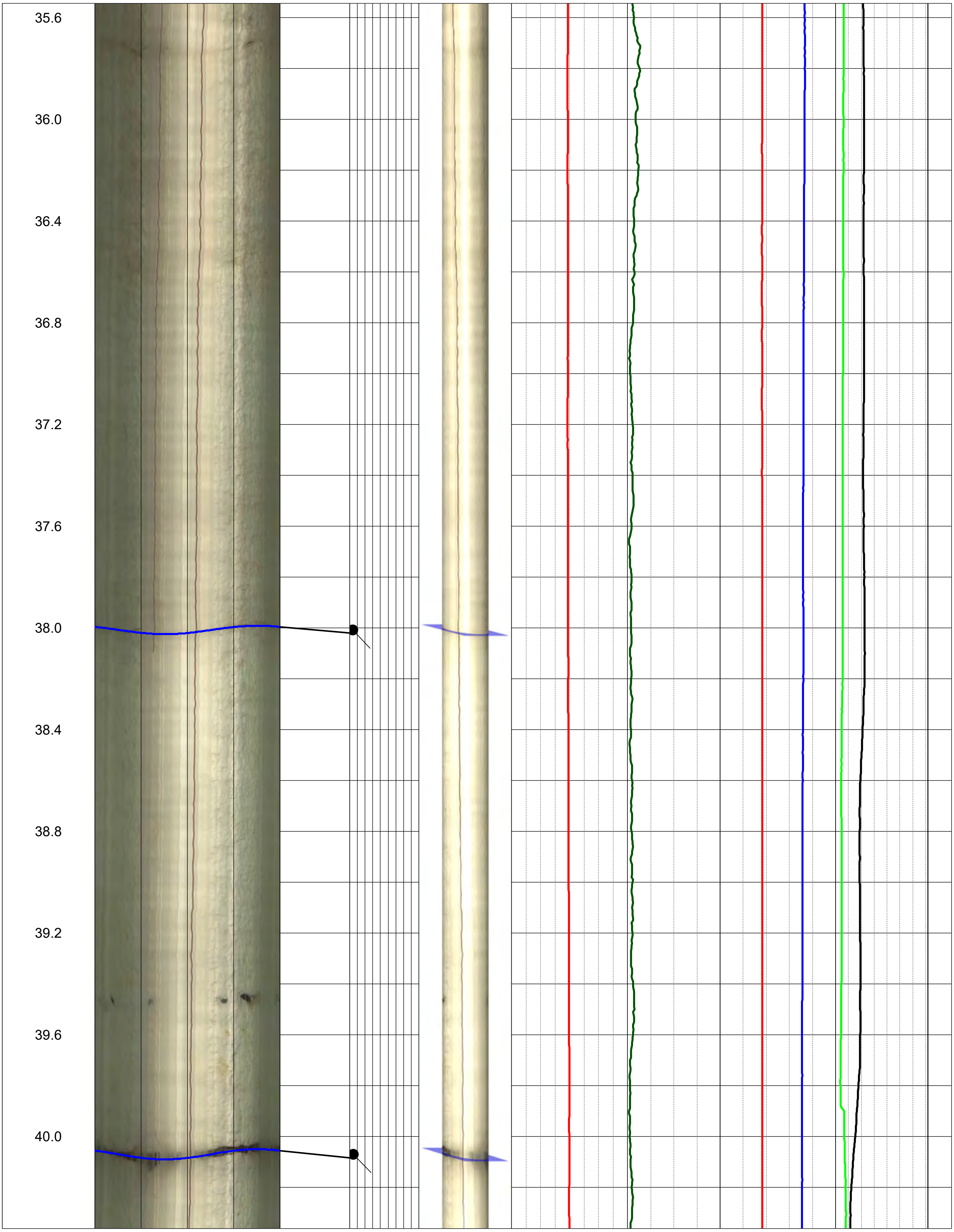

16.4
16.8
17.2
17.6
18.0
18.4
18.8
19.2
19.6
20.0
20.4
20.8



21.2
21.6
22.0
22.4
22.8
23.2
23.6
24.0
24.4
24.8
25.2
25.6


26.0
26.4
26.8
27.2
27.6
28.0
28.4
28.8
29.2
29.6
30.0
30.4


30.8
31.2
31.6
32.0
32.4
32.8
33.2
33.6
34.0
34.4
34.8
35.2


35.6
36.0
36.4
36.8
37.2
37.6
38.0
38.4
38.8
39.2
39.6
40.0

40.4

40.8

41.2

41.6

42.0

42.4

42.8

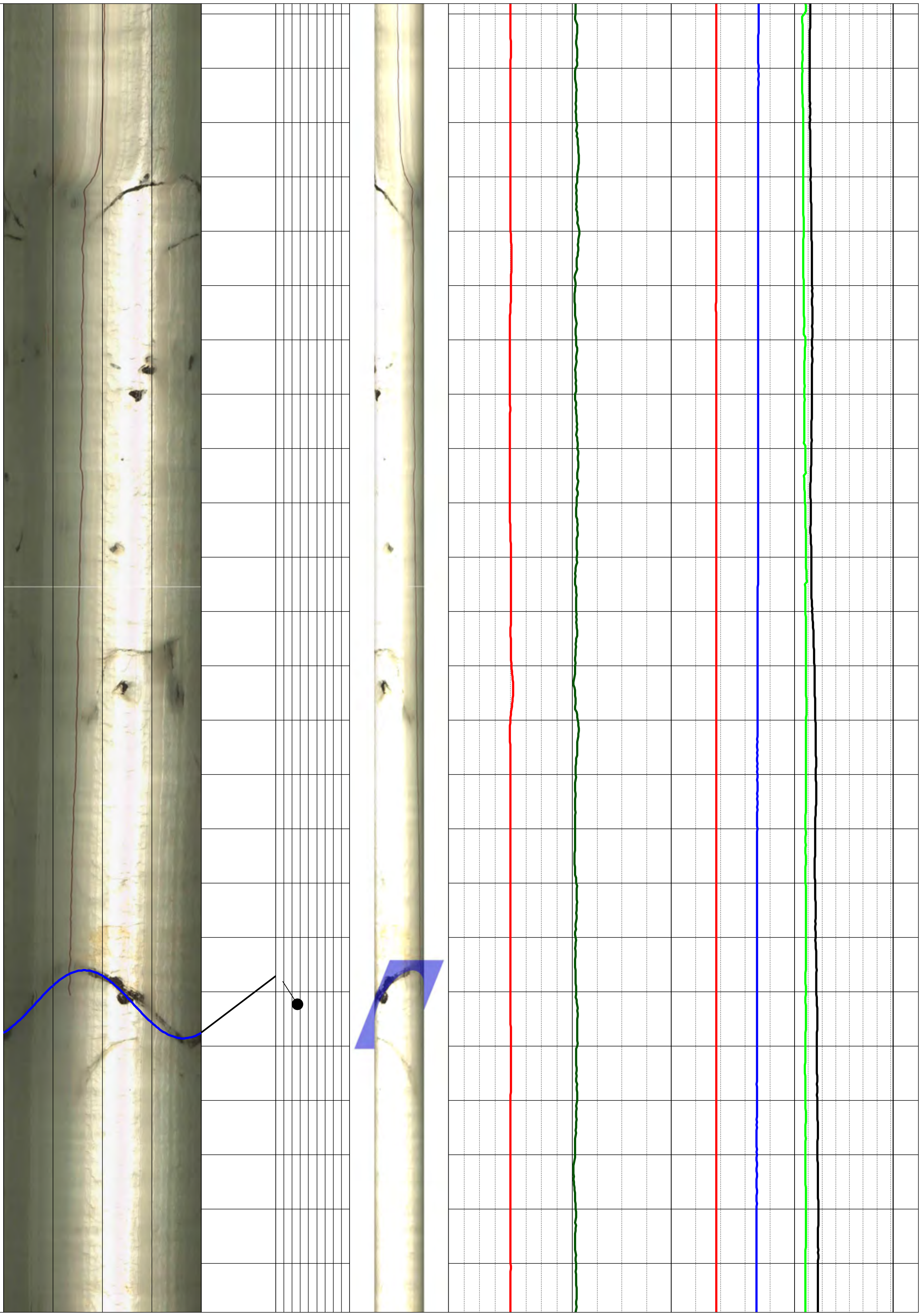
43.2

43.6

44.0

44.4

44.8



45.2

45.6

46.0

46.4

46.8

47.2

47.6

48.0

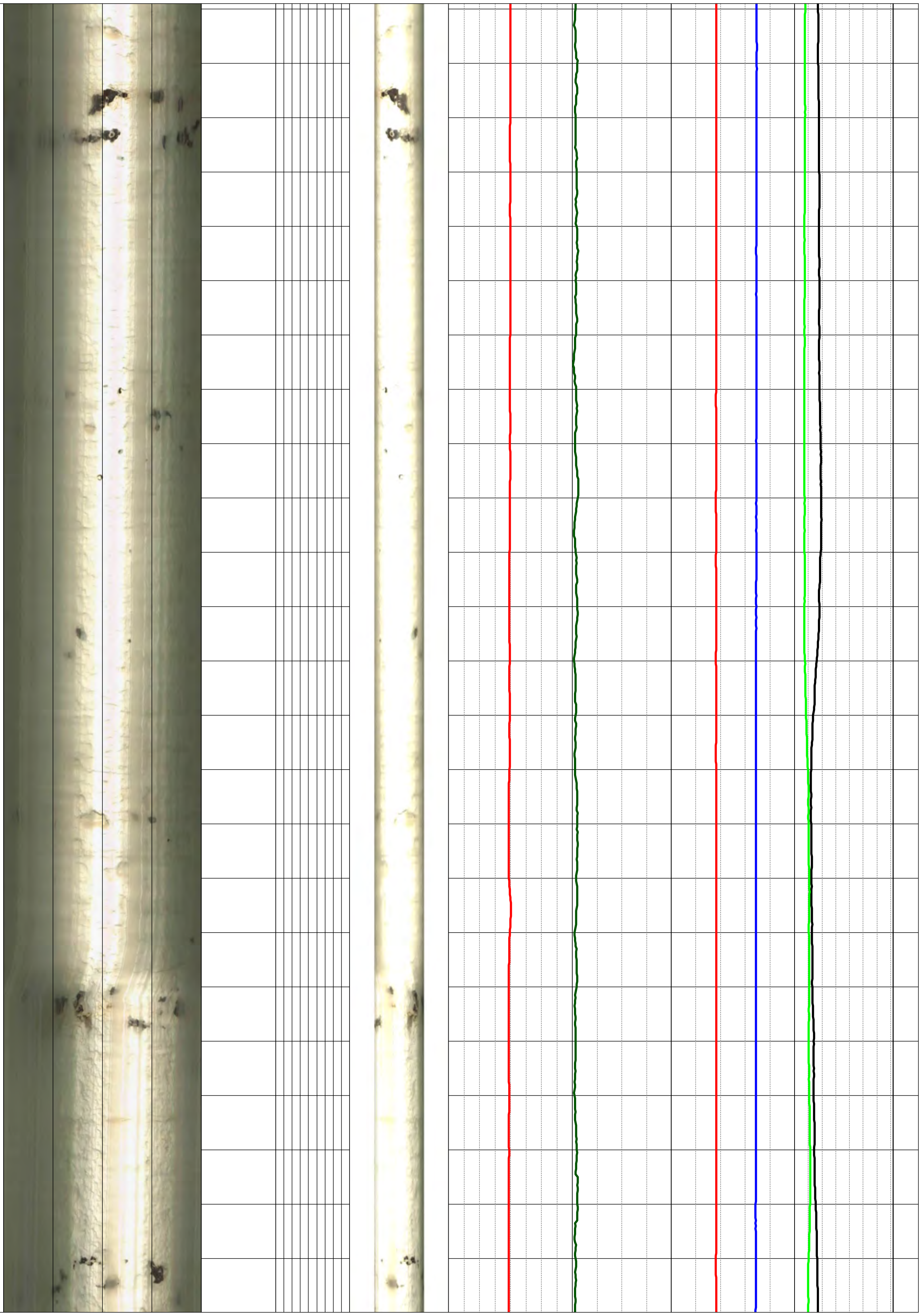
48.4

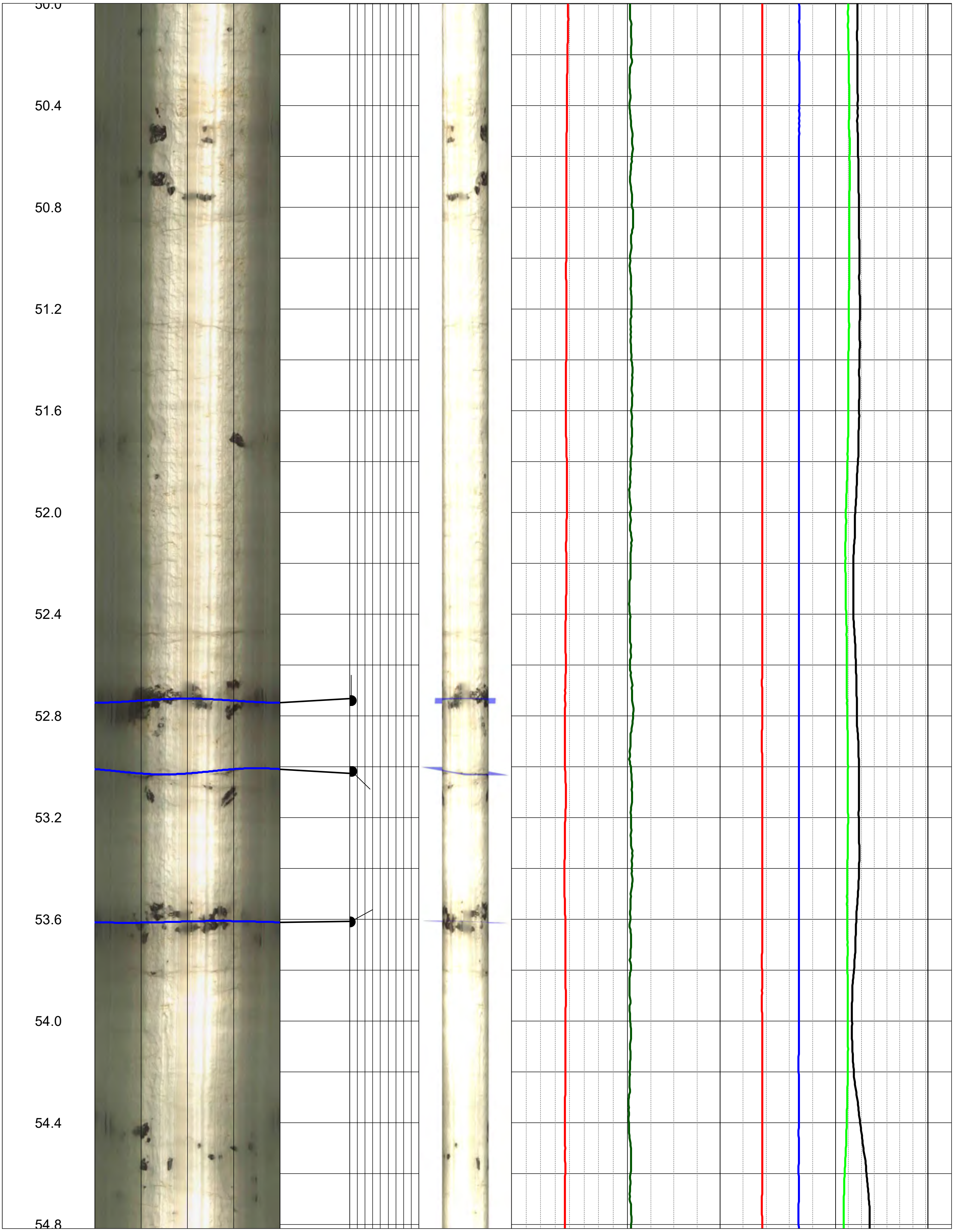
48.8

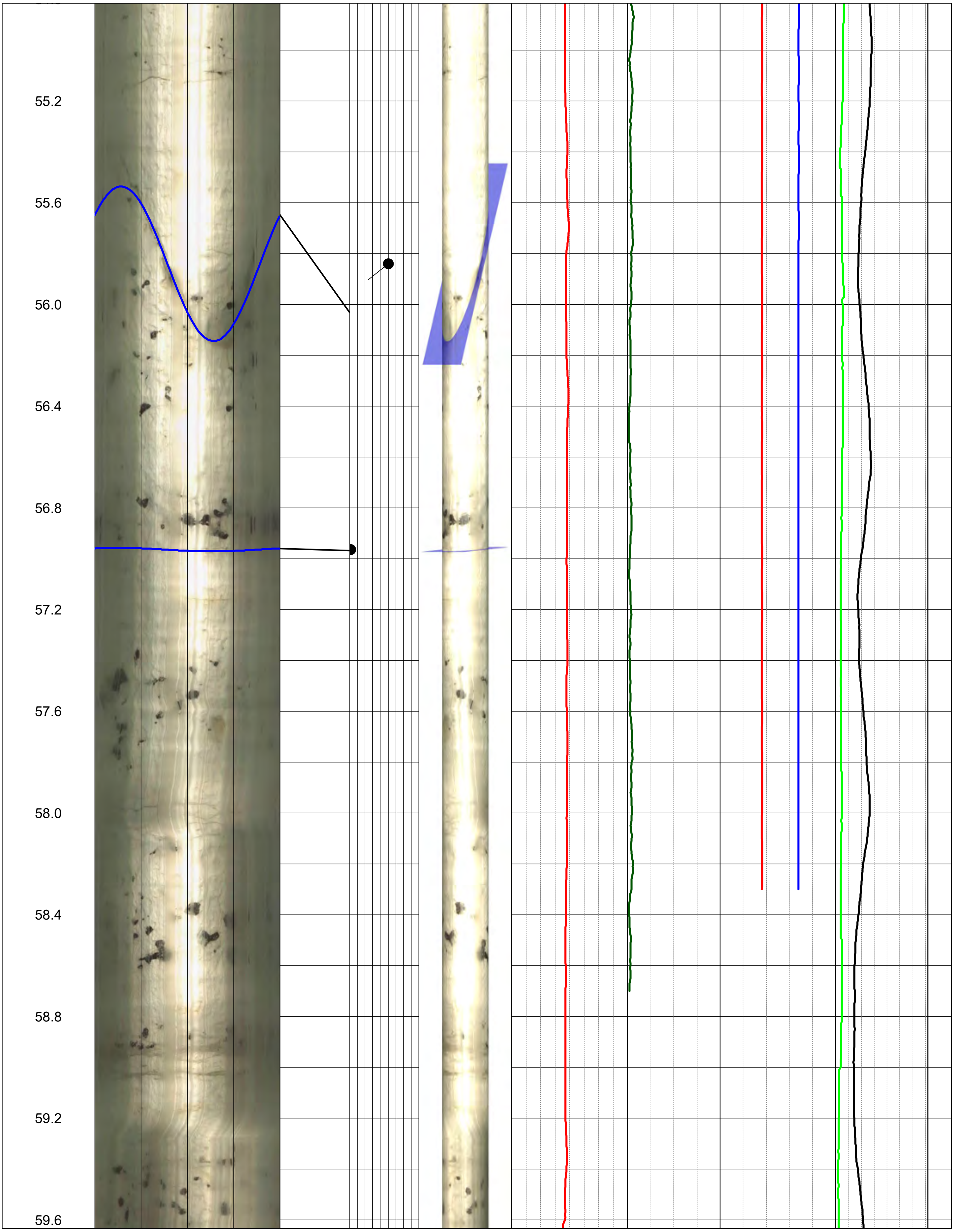
49.2

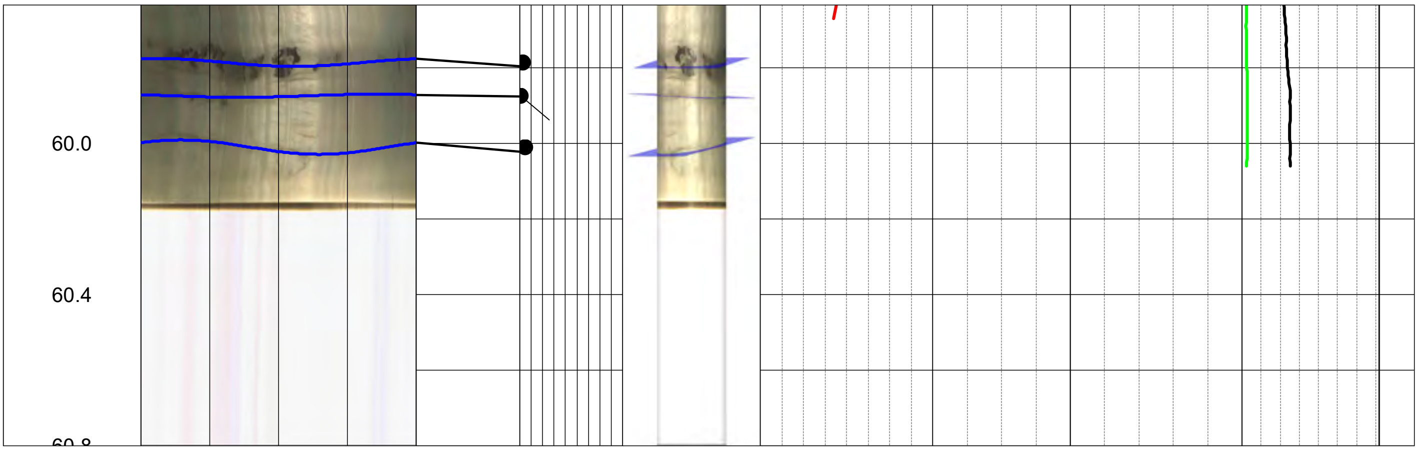
49.6

50.0




50.0
50.4
50.8
51.2
51.6
52.0
52.4
52.8
53.2
53.6
54.0
54.4
54.8


55.2
55.6
56.0
56.4
56.8
57.2
57.6
58.0
58.4
58.8
59.2
59.6



60.0
60.4

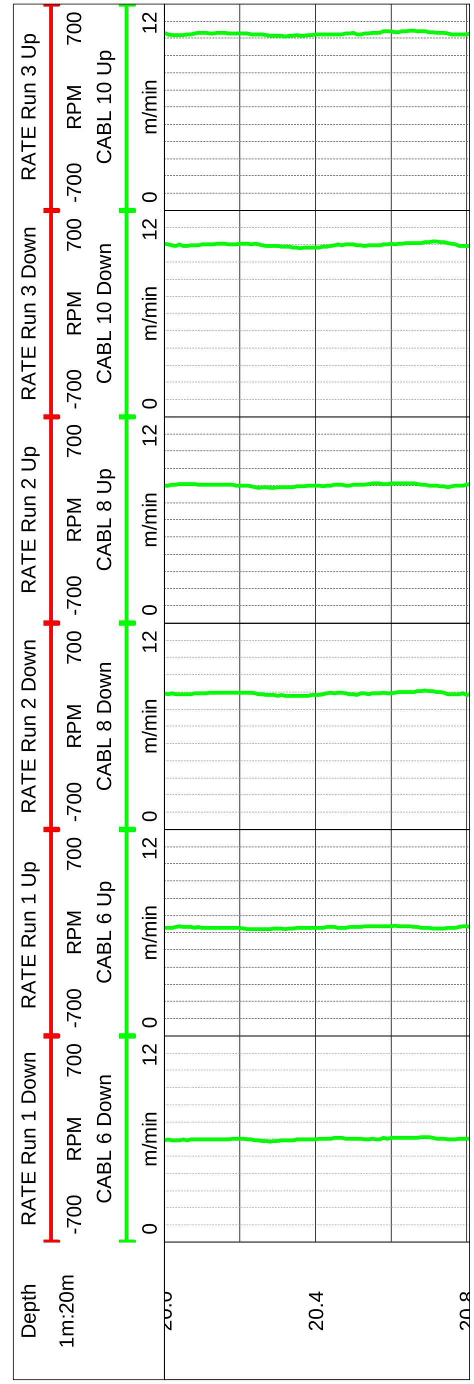
ROBERTSON GEO SERVICES
Unlocking Your GeoData

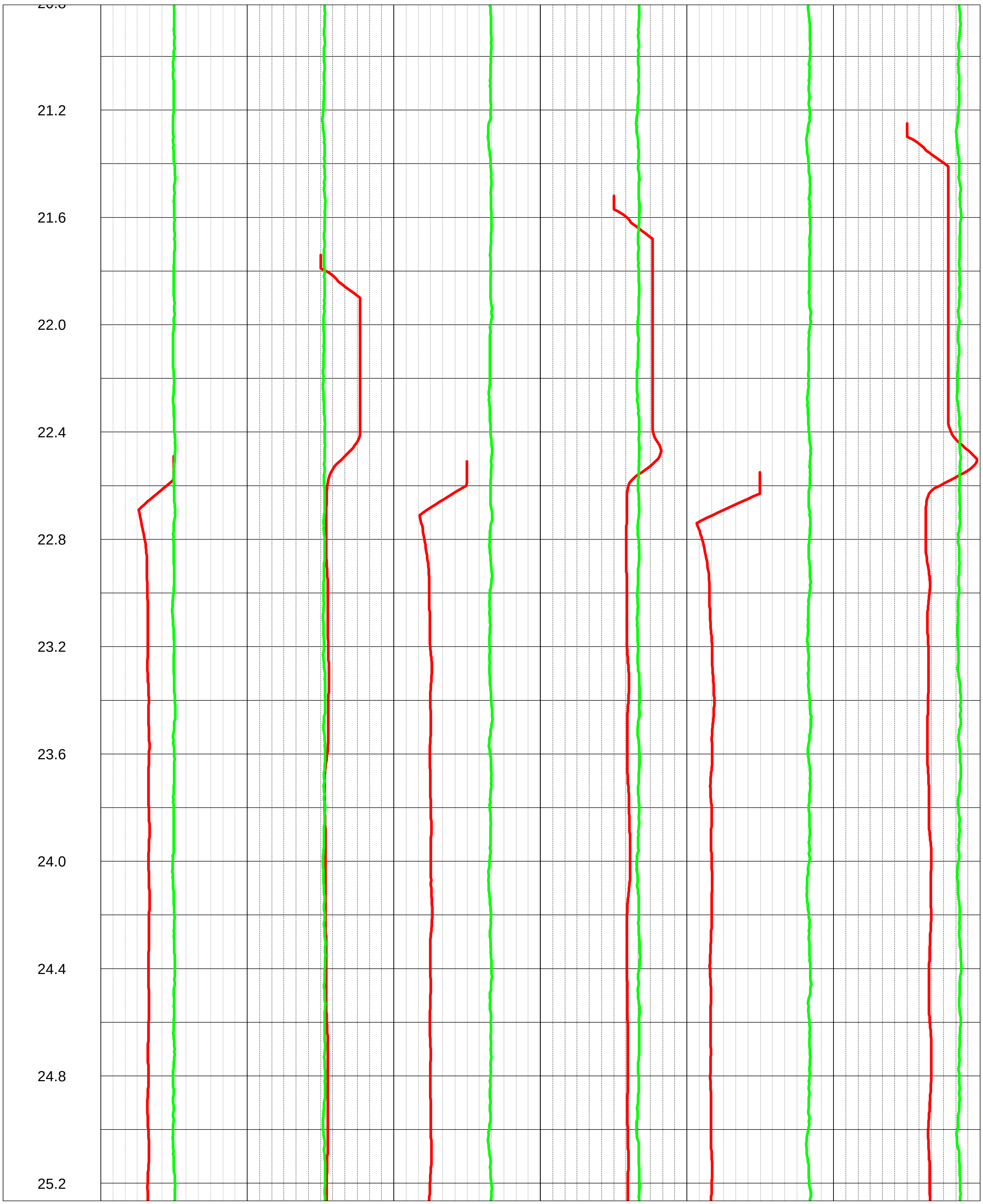
CO WELL FLD CTY STE FILING No	COMPANY	Structural Soils	
	WELL ID	W601	
	FIELD	A303 Stonehenge	
	COUNTRY	England	STATE
	LOCATION A303 Stonehenge		OTHER SERVICES
	SEC	TWP	RGE

PERMANENT DATUM	GL	ELEVATION	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.

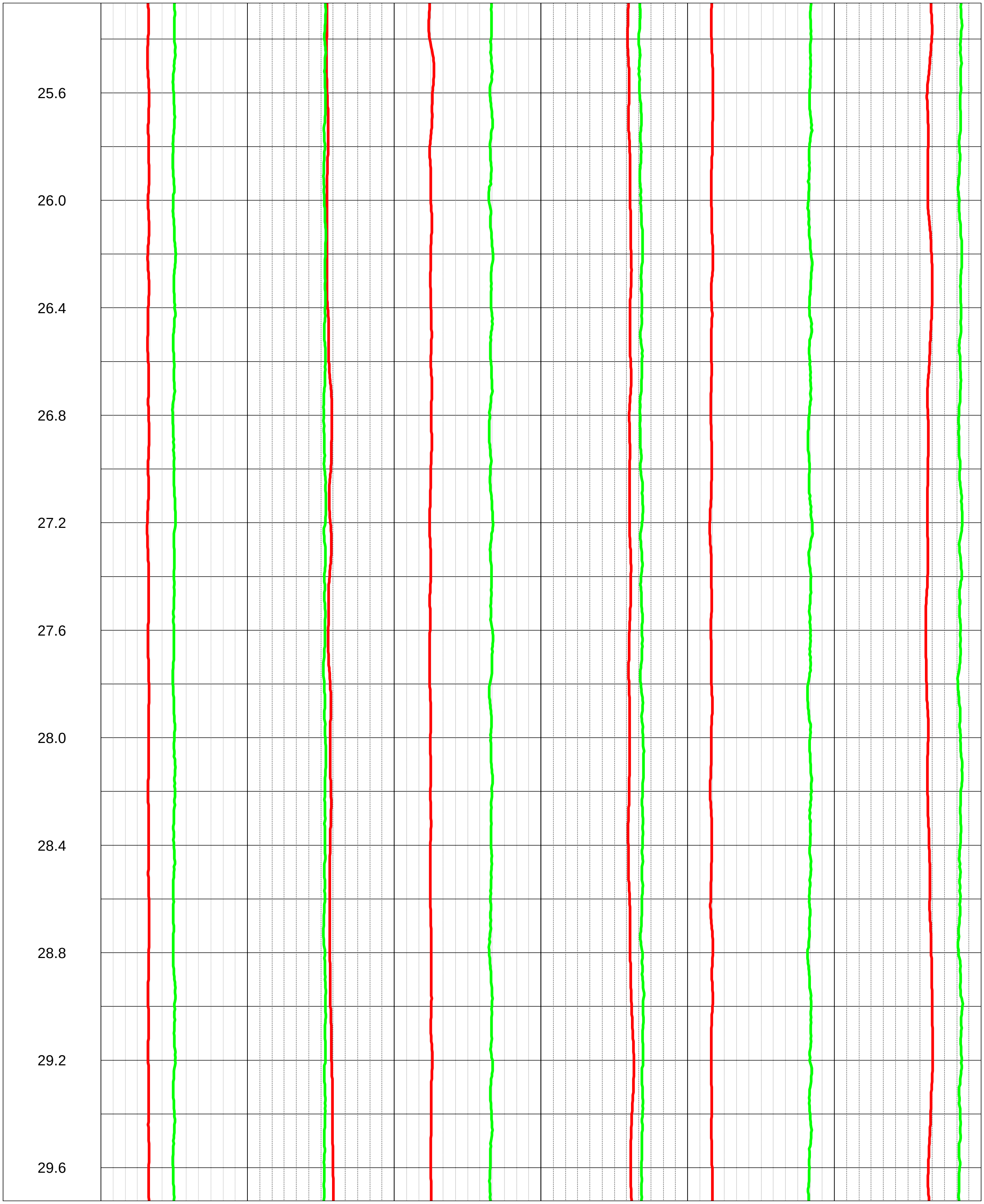
DATE	01/06/18	TYPE FLUID IN HOLE	Water
RUN No	1	SALINITY	
TYPE LOG	Flowmeter	DENSITY	
DEPTH-DRILLER	60	LEVEL	22.5
DEPTH-LOGGER	58.5	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	58.5		
TOP LOGGED INTERVAL	20		
OPERATING RIG TIME			
RECORDED BY	KO		
WITNESSED BY	JB		

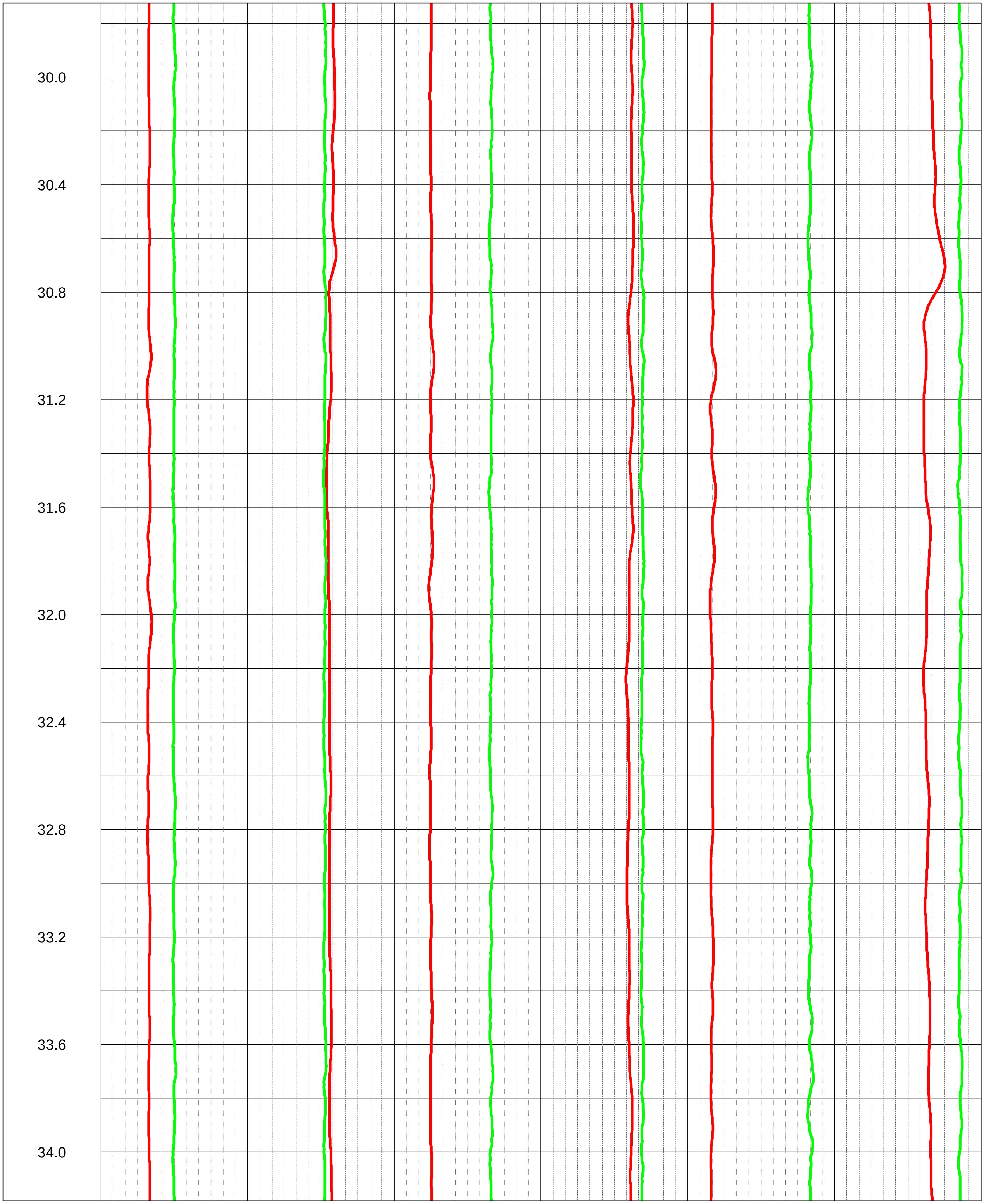
RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

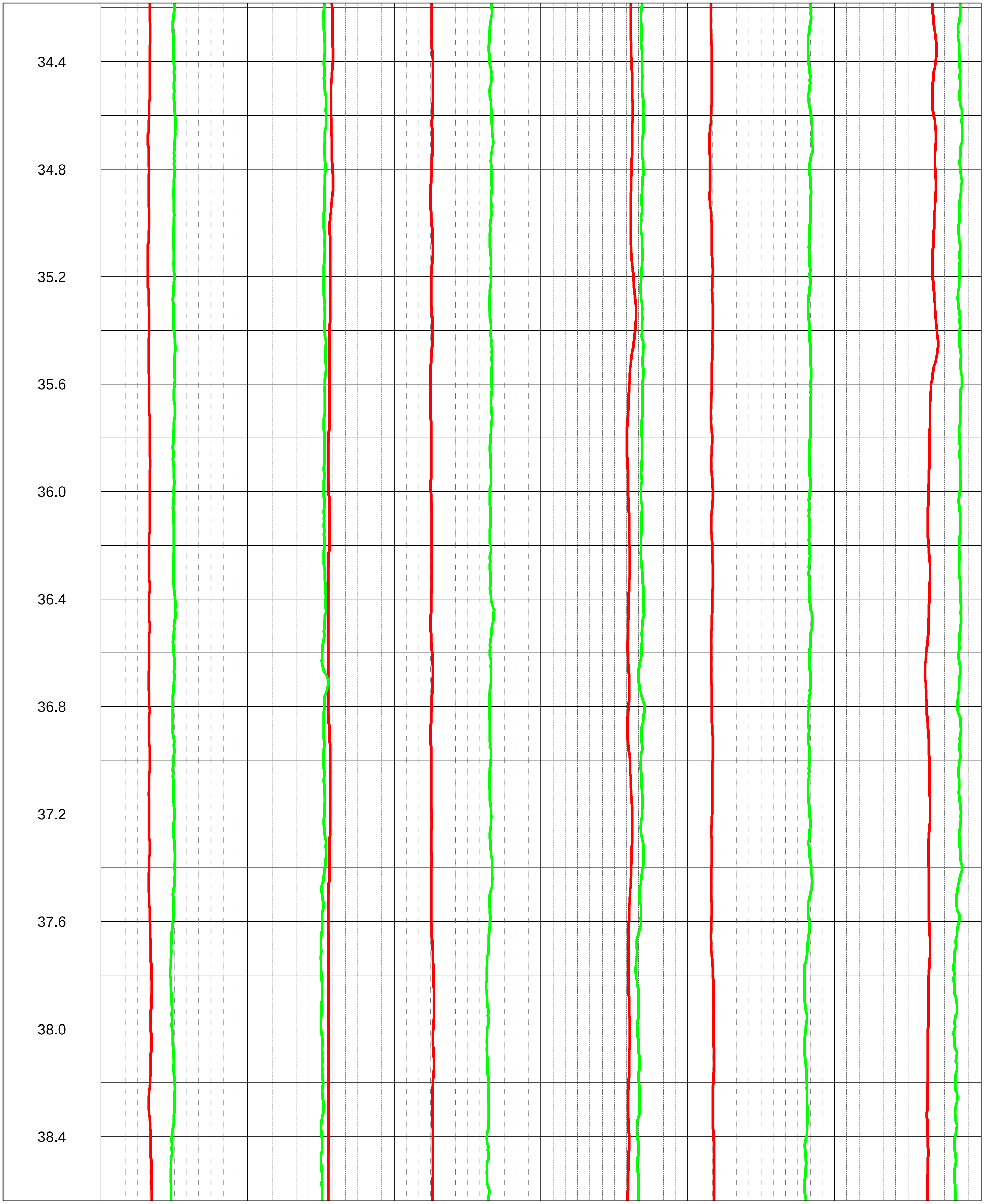


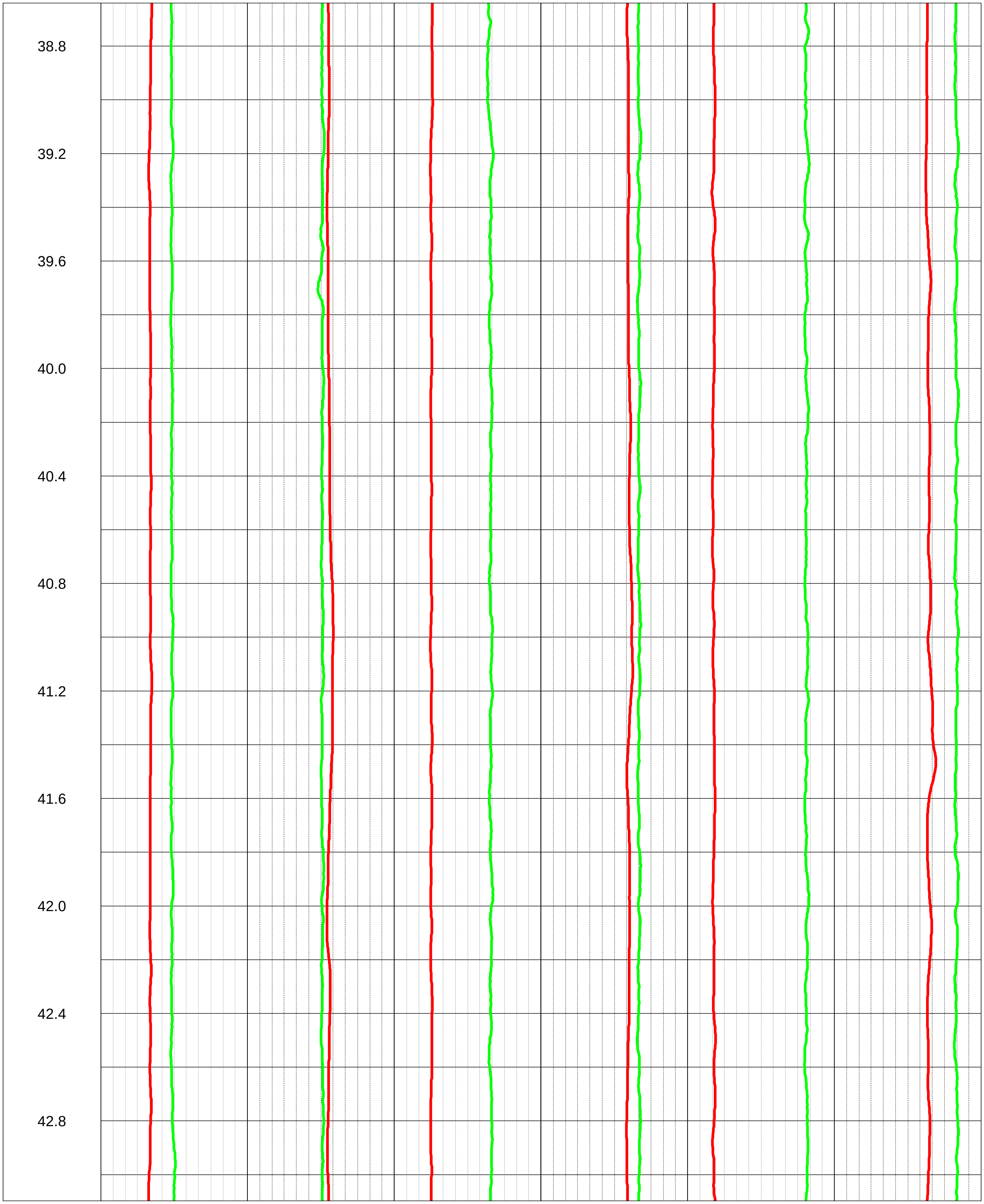


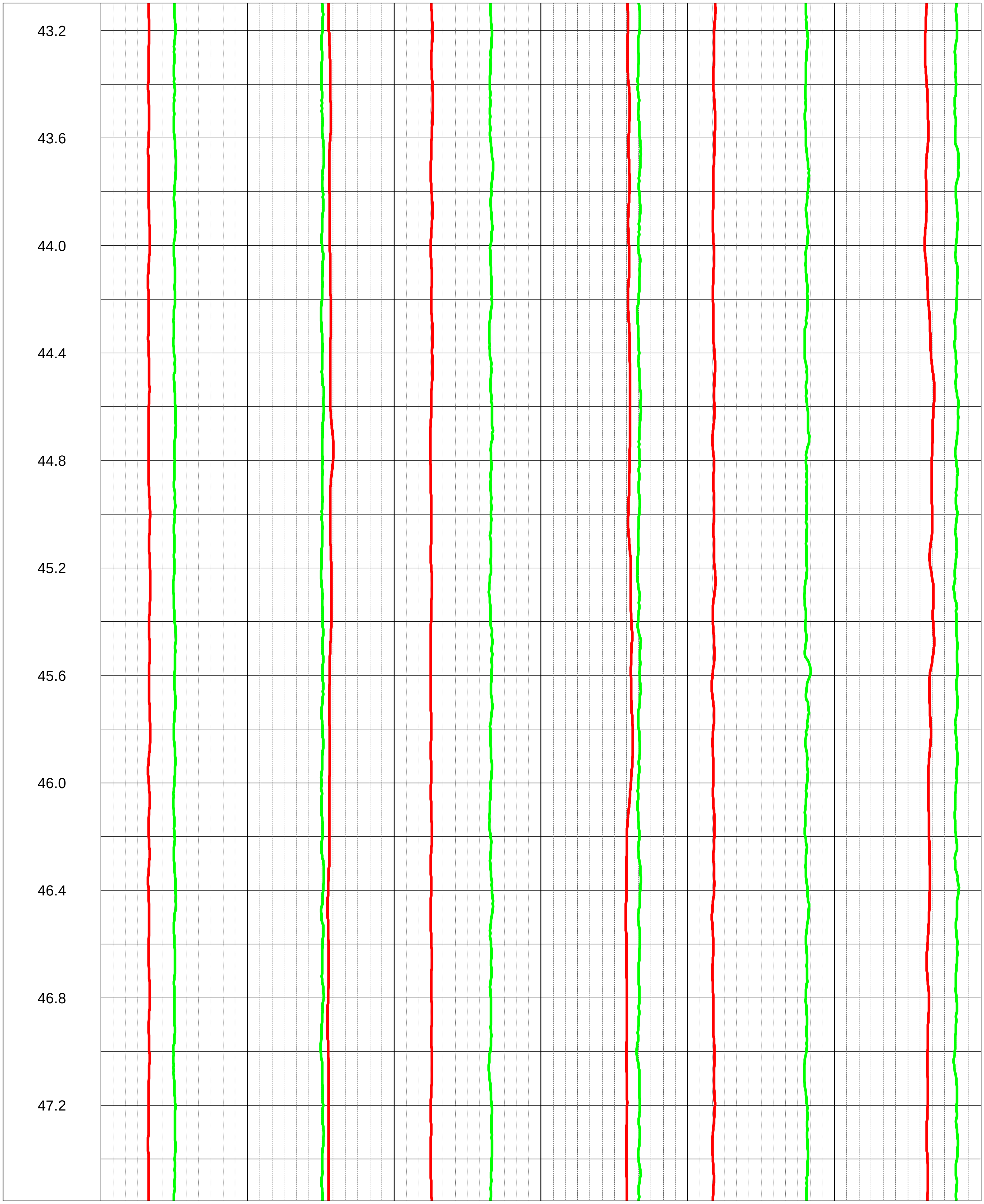
21.2
21.6
22.0
22.4
22.8
23.2
23.6
24.0
24.4
24.8
25.2


25.6
26.0
26.4
26.8
27.2
27.6
28.0
28.4
28.8
29.2
29.6


30.0
30.4
30.8
31.2
31.6
32.0
32.4
32.8
33.2
33.6
34.0


34.4
34.8
35.2
35.6
36.0
36.4
36.8
37.2
37.6
38.0
38.4


38.8
39.2
39.6
40.0
40.4
40.8
41.2
41.6
42.0
42.4
42.8


43.2
43.6
44.0
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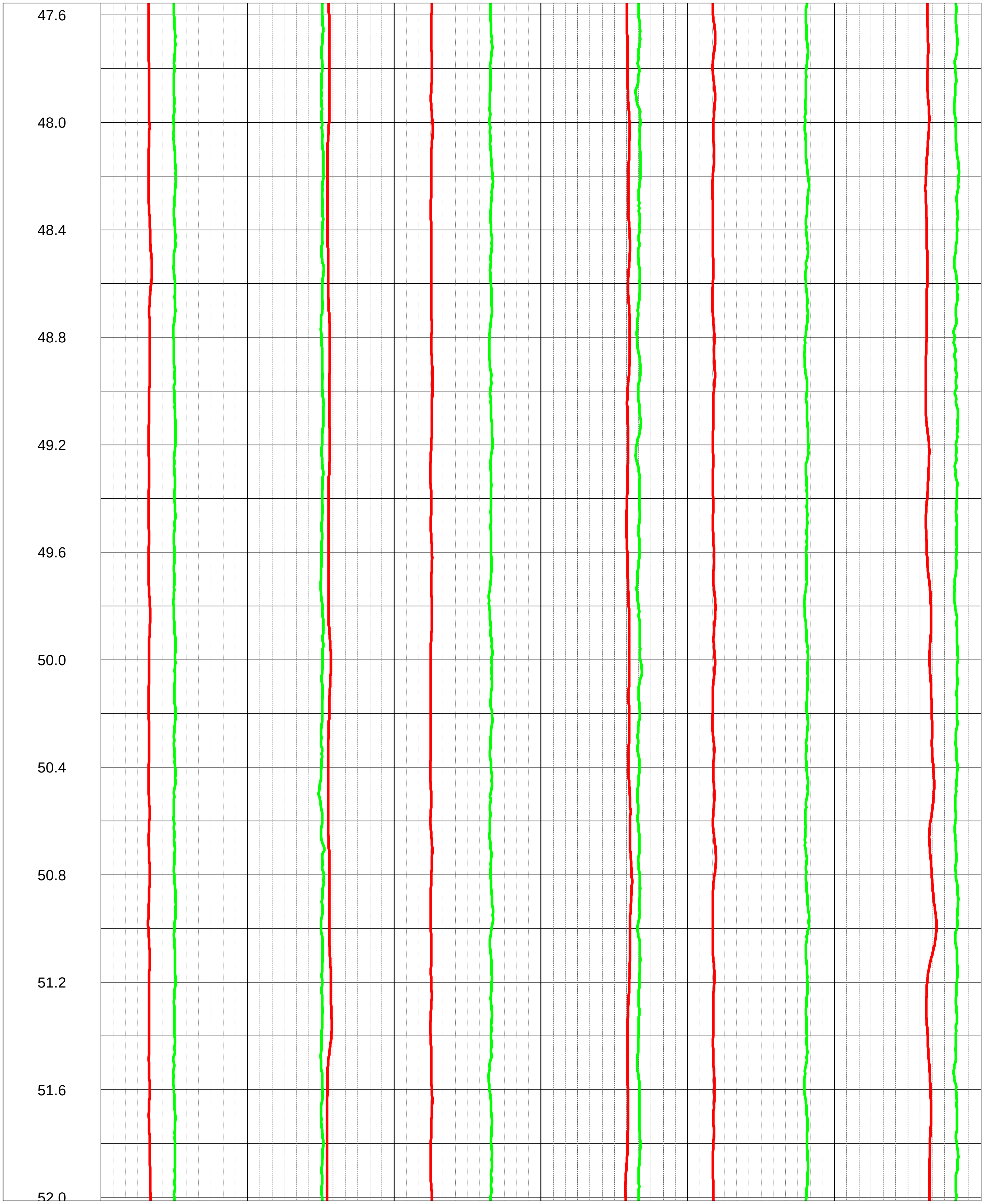
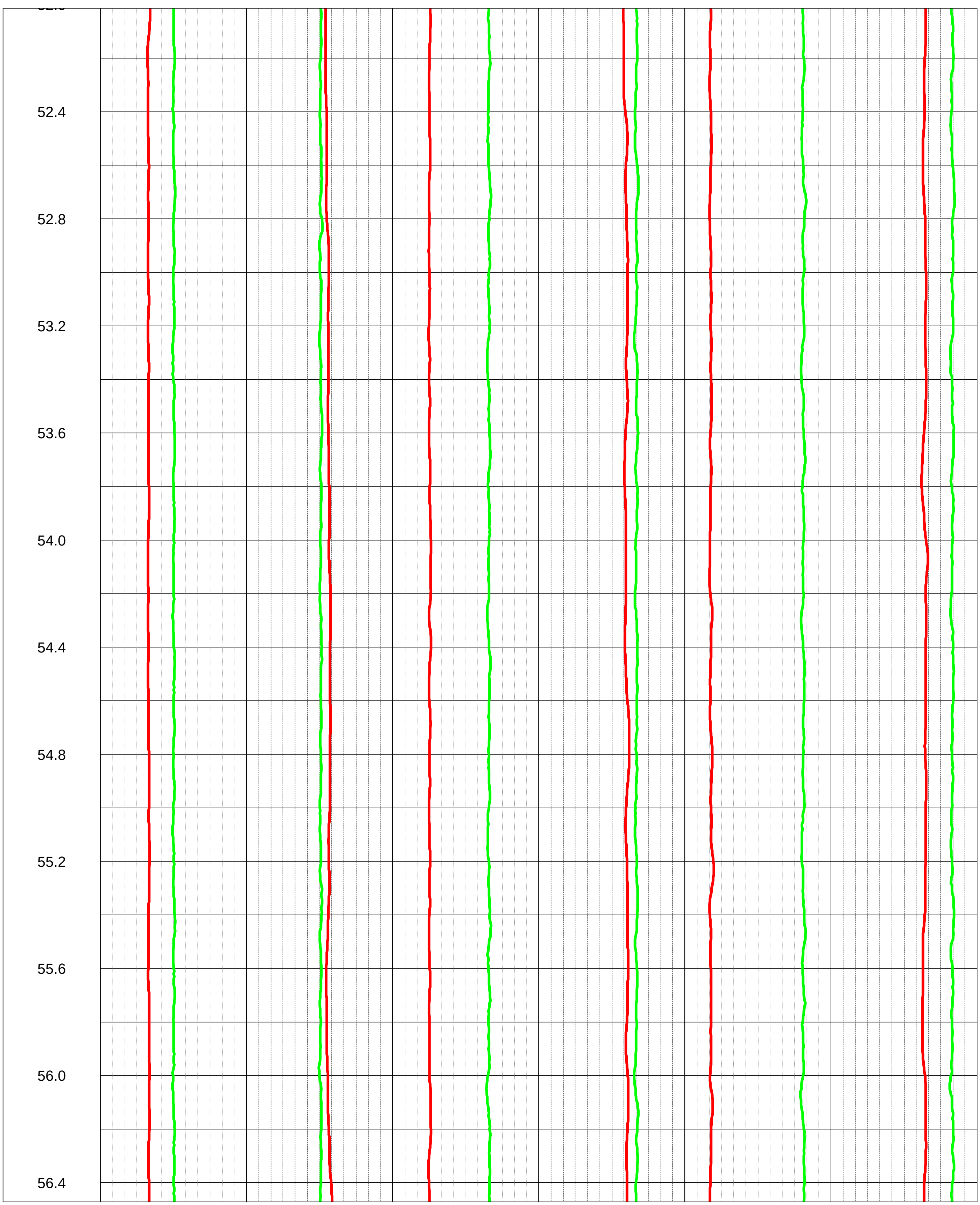
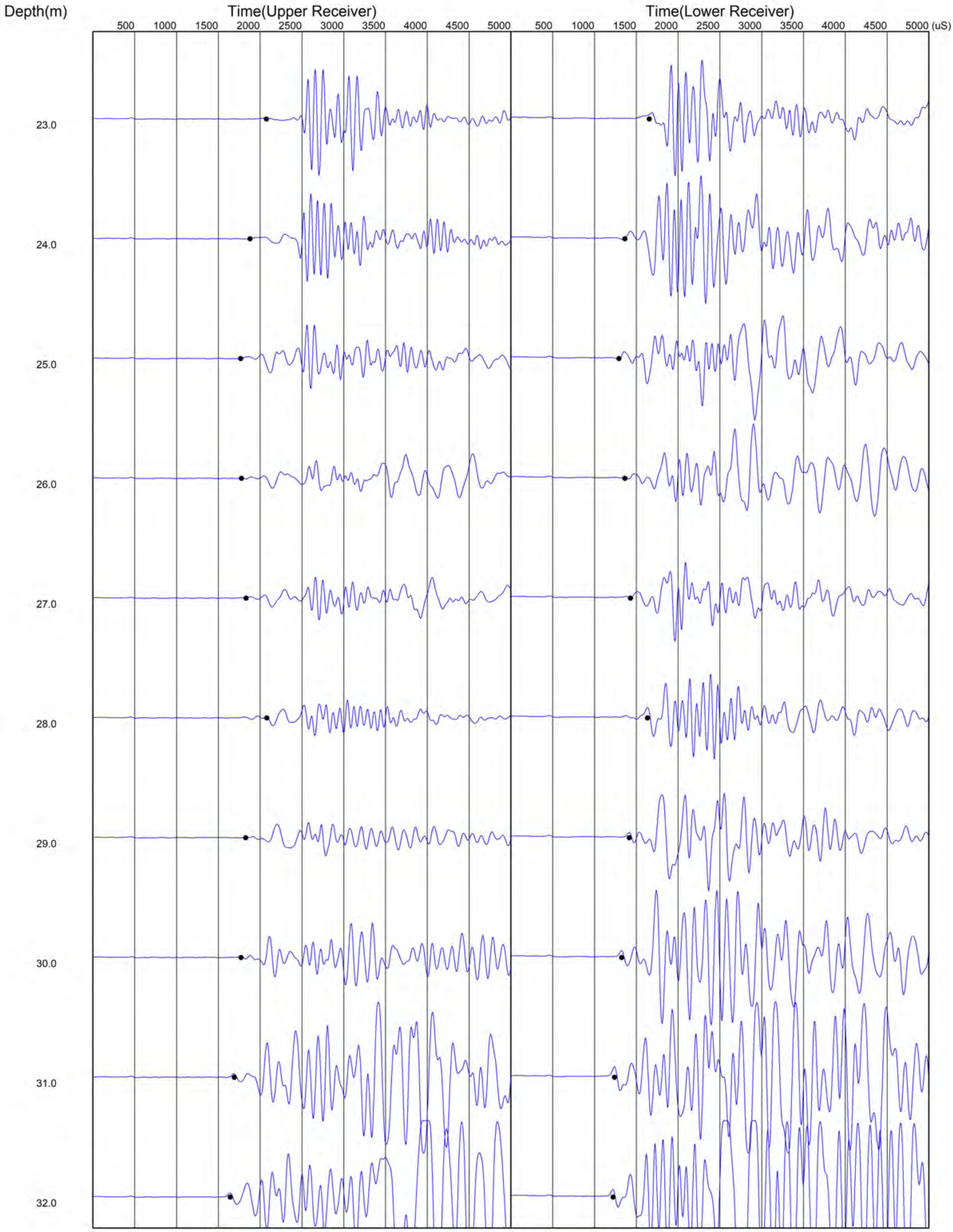
44.8
45.2
45.6
46.0
46.4
46.8
47.2


47.6
48.0
48.4
48.8
49.2
49.6
50.0
50.4
50.8
51.2
51.6
52.0


52.4
52.8
53.2
53.6
54.0
54.4
54.8
55.2
55.6
56.0
56.4

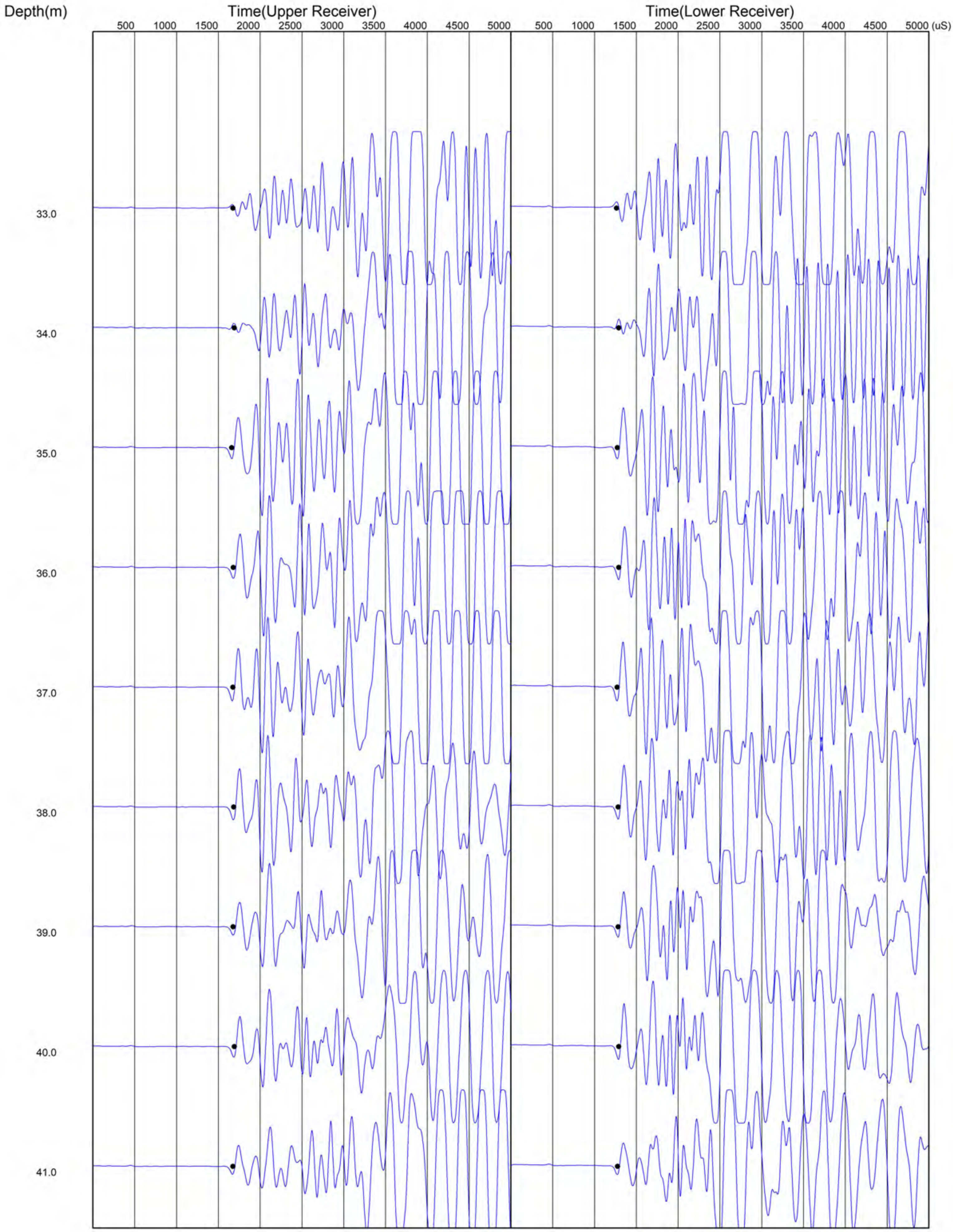

56.8
57.2
57.6
58.0
58.4

P Wave



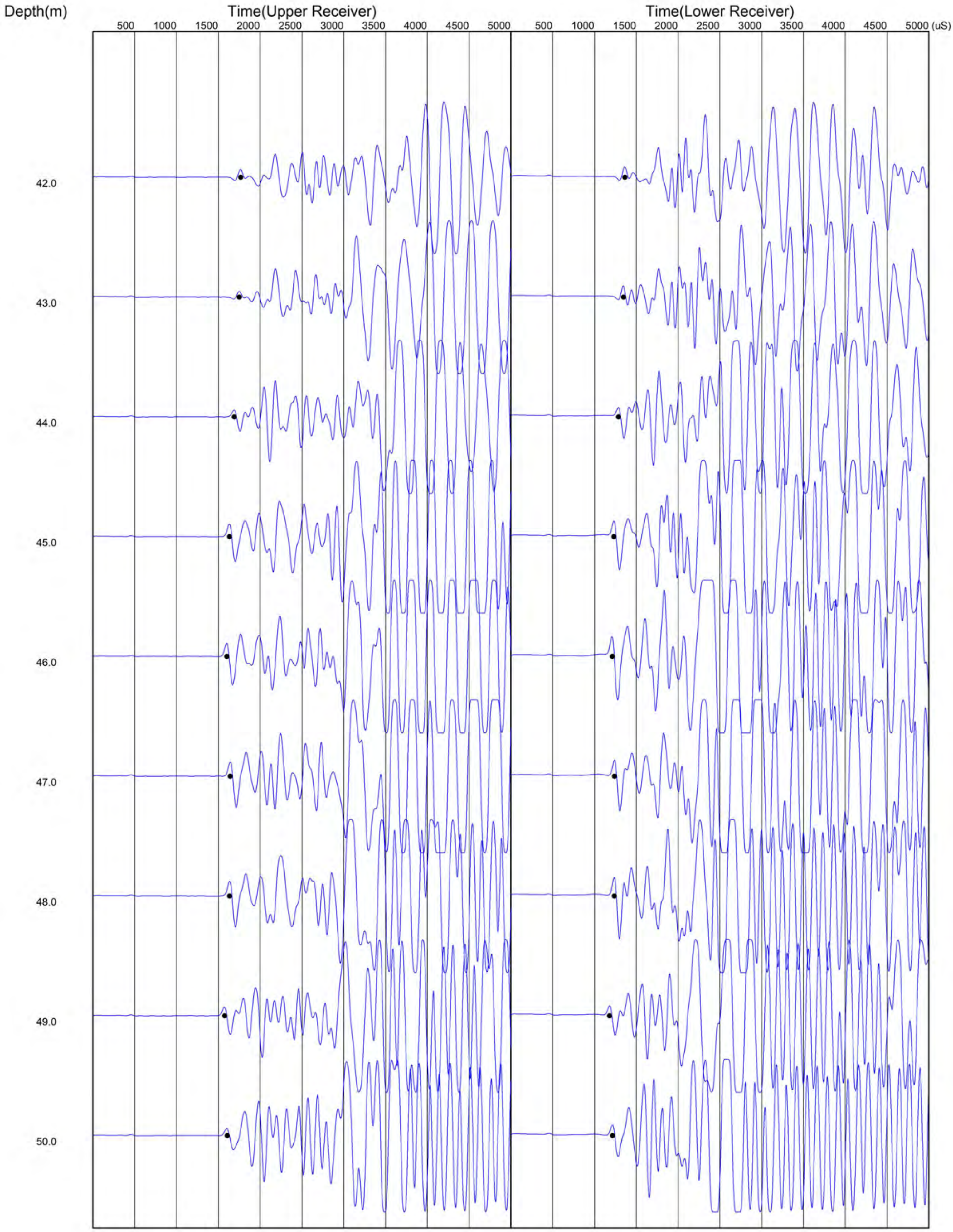
Depth(m)
Time(Upper Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
23.0
24.0
25.0
26.0
27.0
28.0
29.0
30.0
31.0
32.0

P Wave



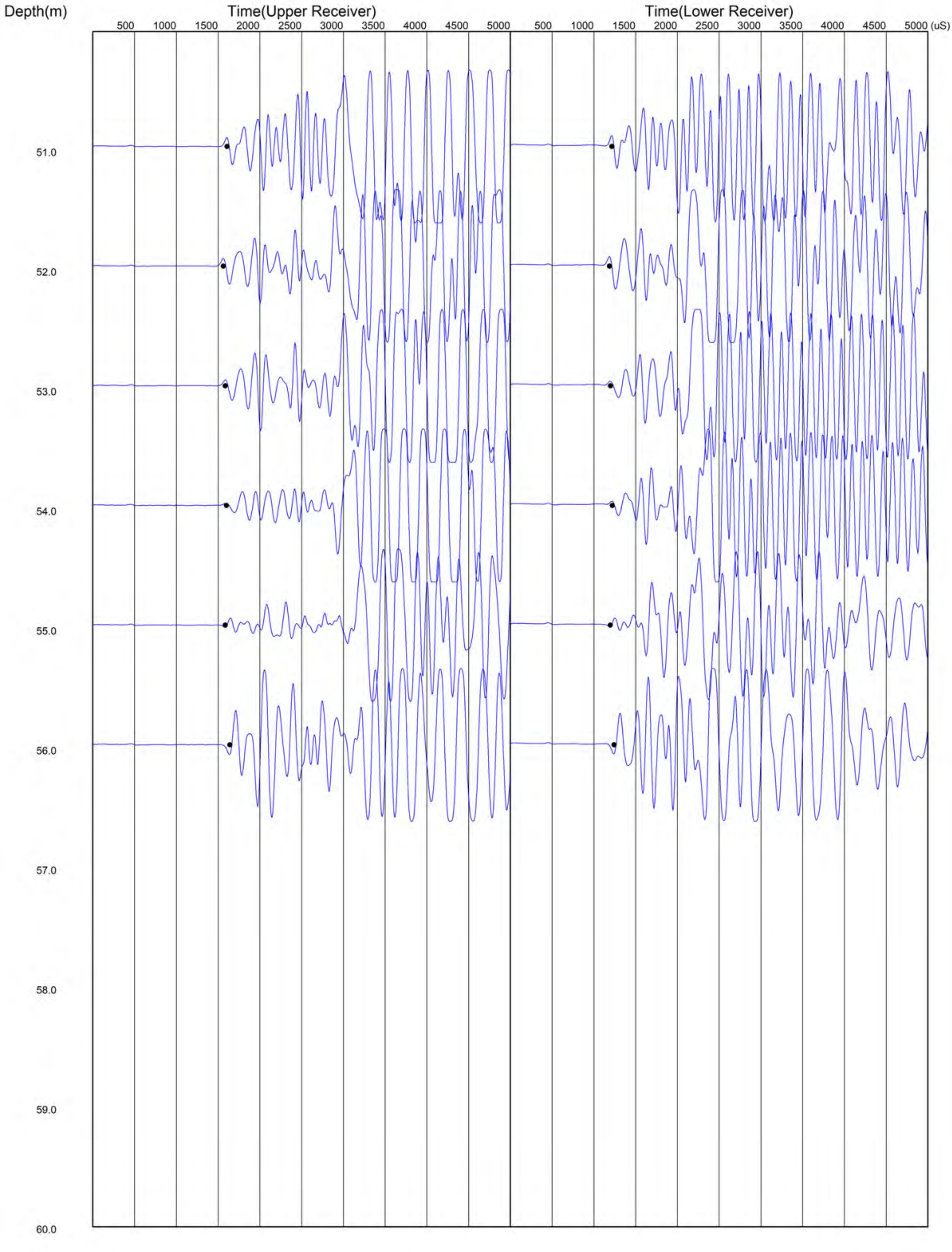
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0
41.0

P Wave



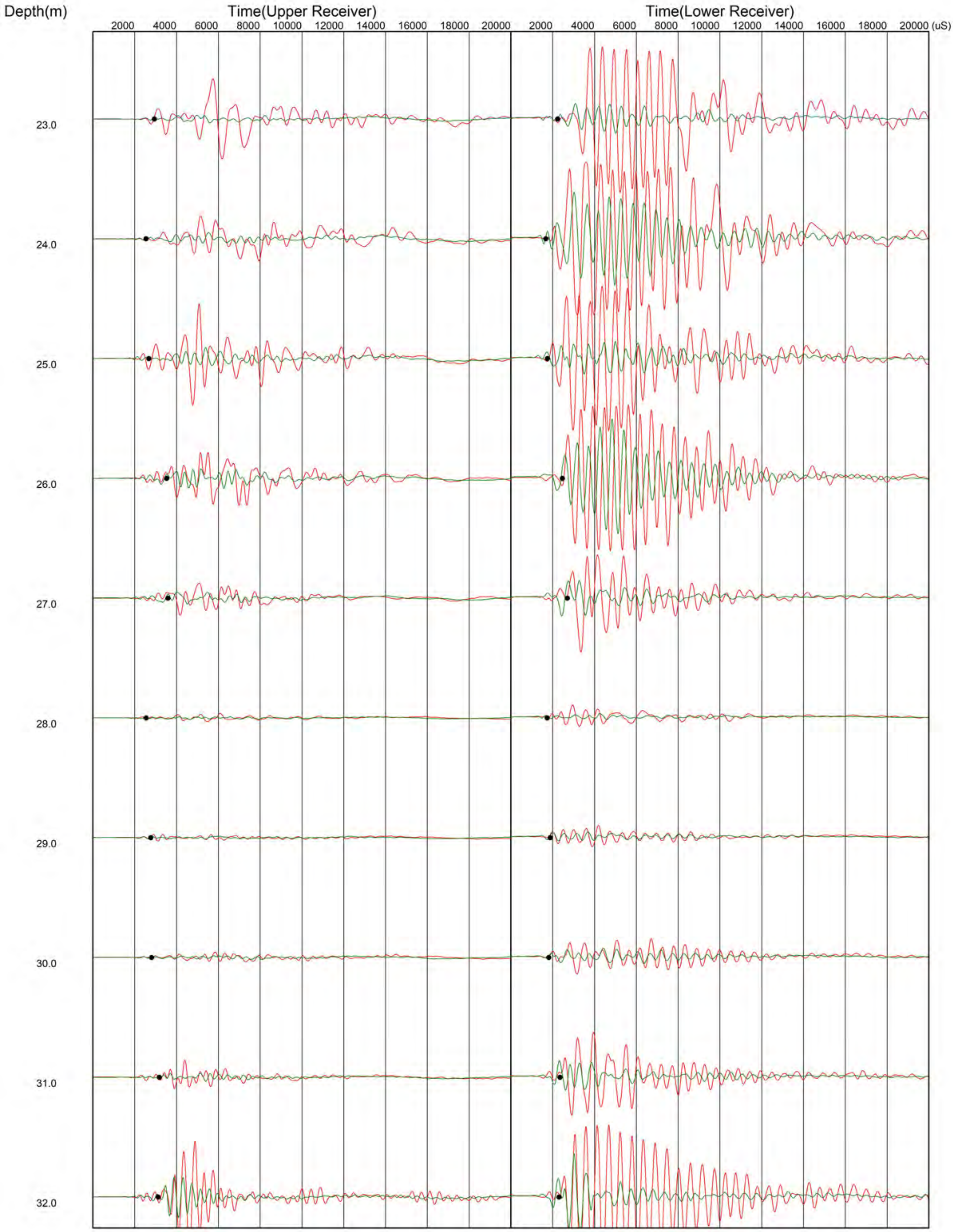
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
42.0
43.0
44.0
45.0
46.0
47.0
48.0
49.0
50.0

P Wave

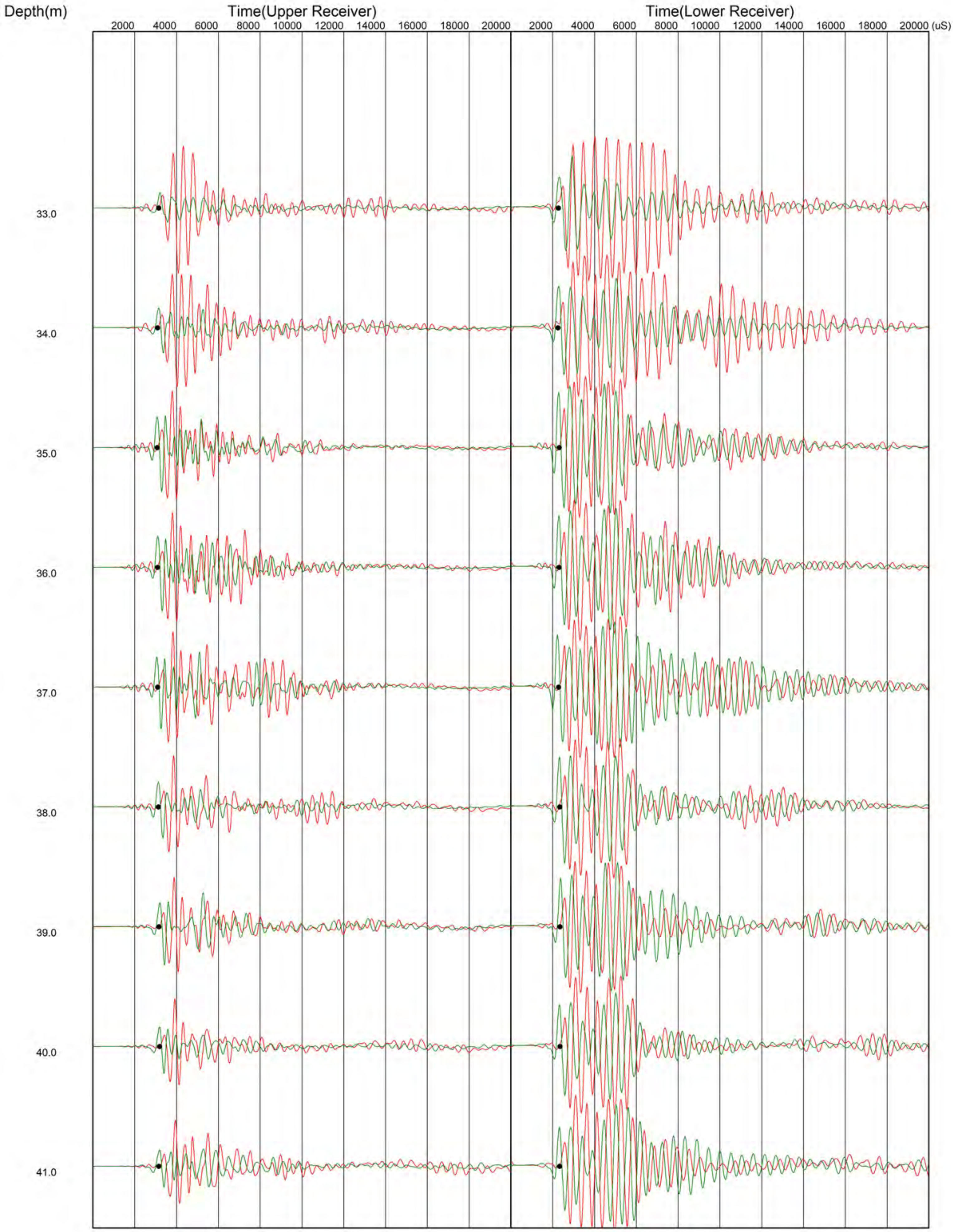


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
51.0
52.0
53.0
54.0
55.0
56.0
57.0
58.0
59.0
60.0

S Wave

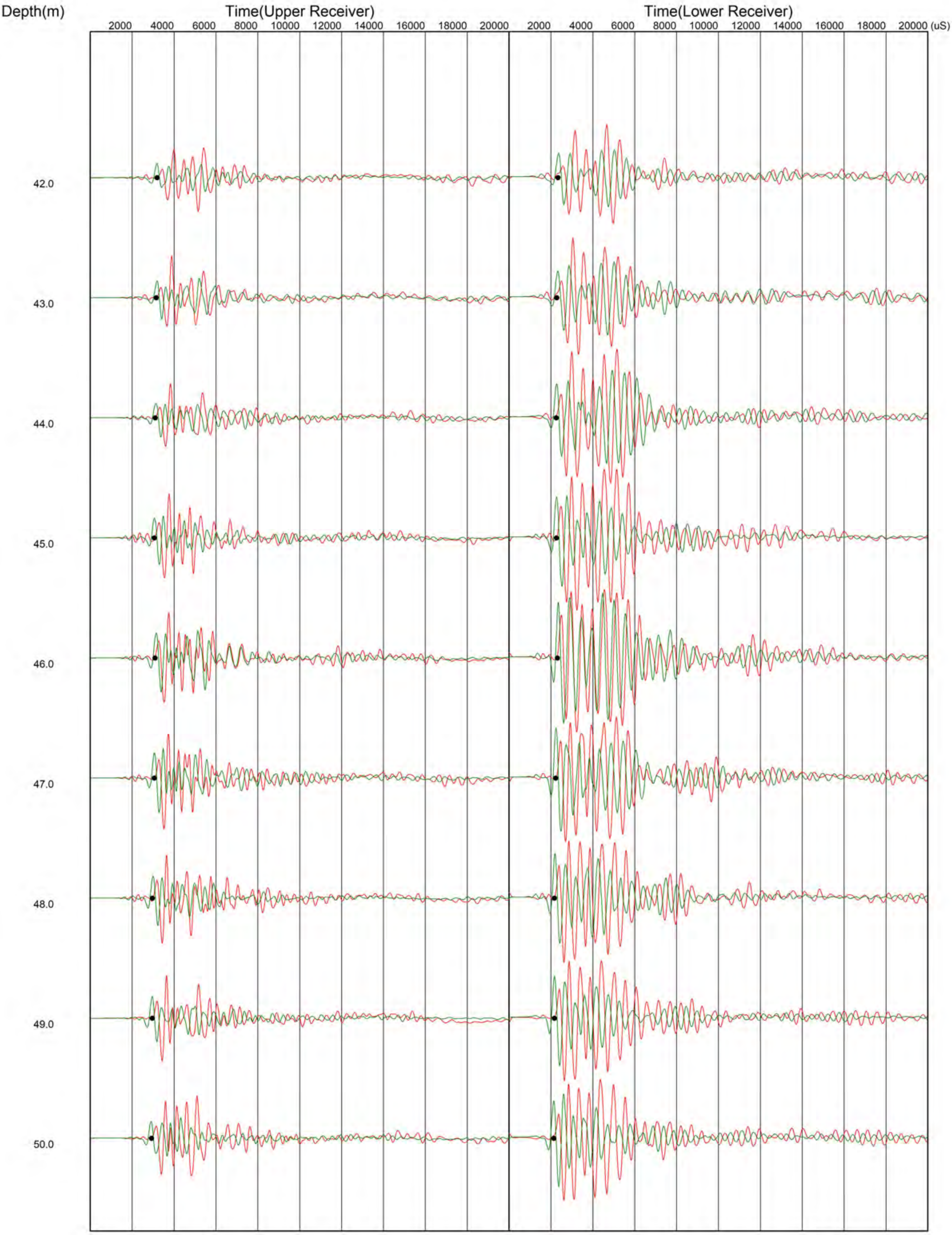

Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
23.0
24.0
25.0
26.0
27.0
28.0
29.0
30.0
31.0
32.0

S Wave

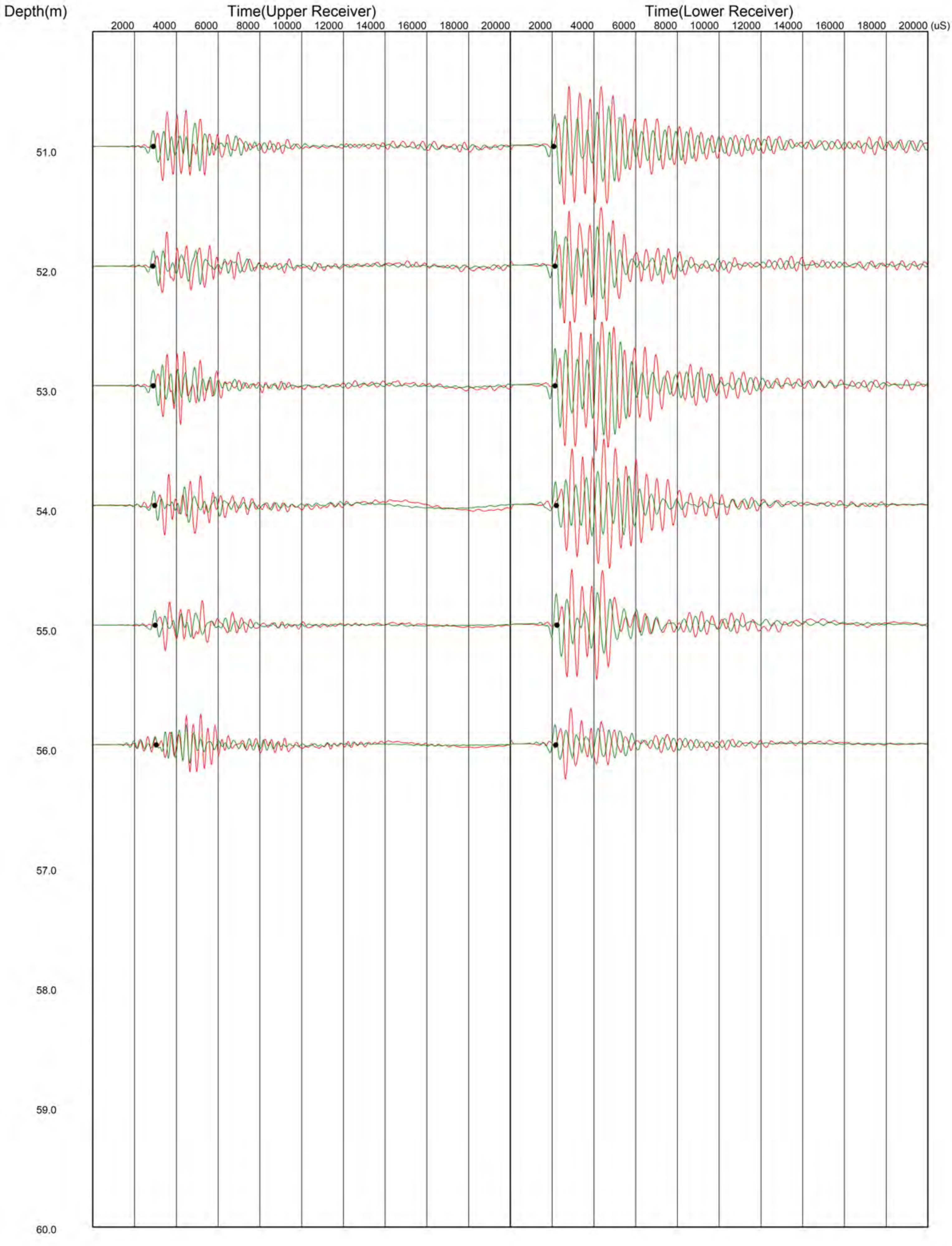


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0
41.0

S Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
42.0
43.0
44.0
45.0
46.0
47.0
48.0
49.0
50.0

S Wave



Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
51.0
52.0
53.0
54.0
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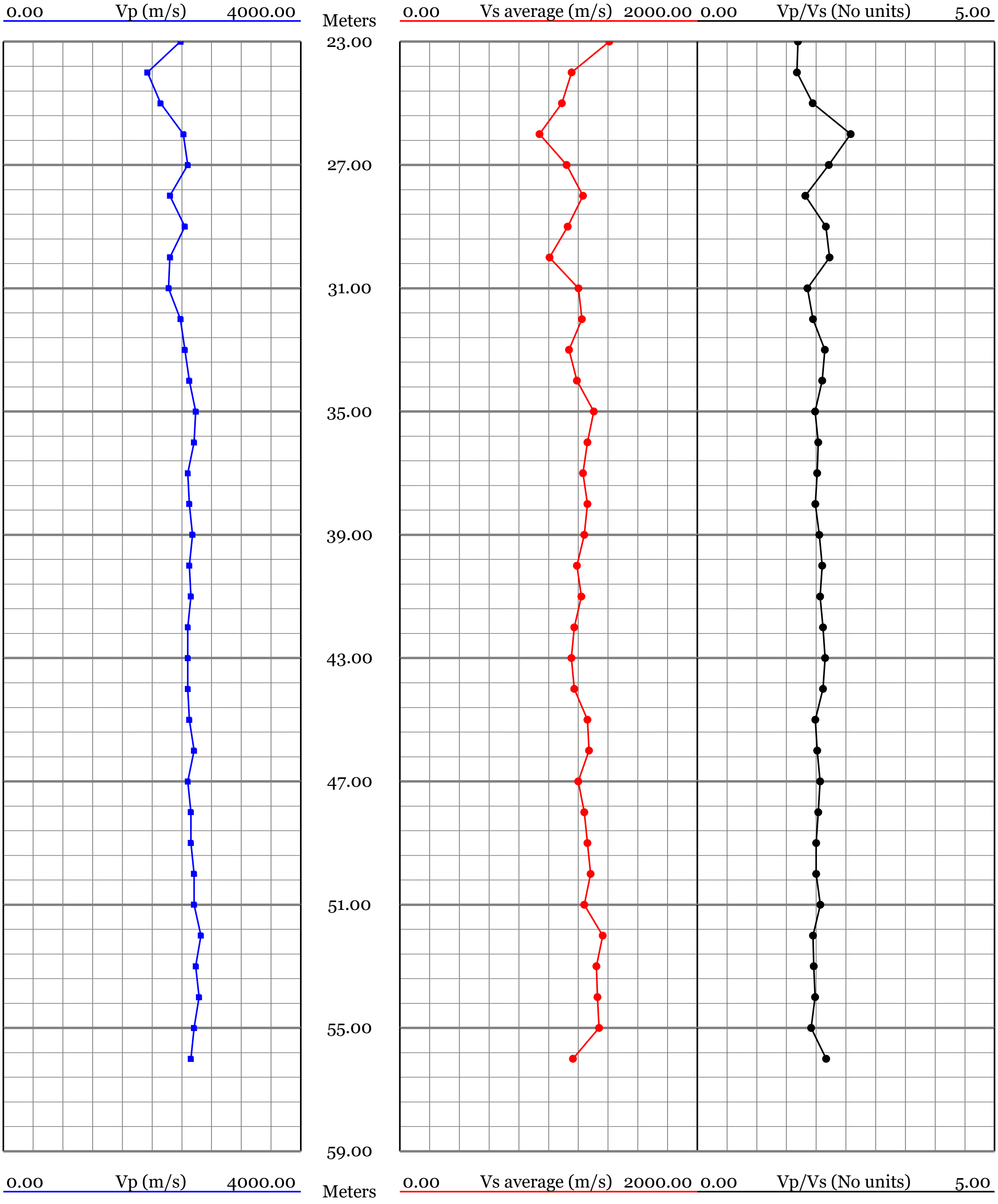
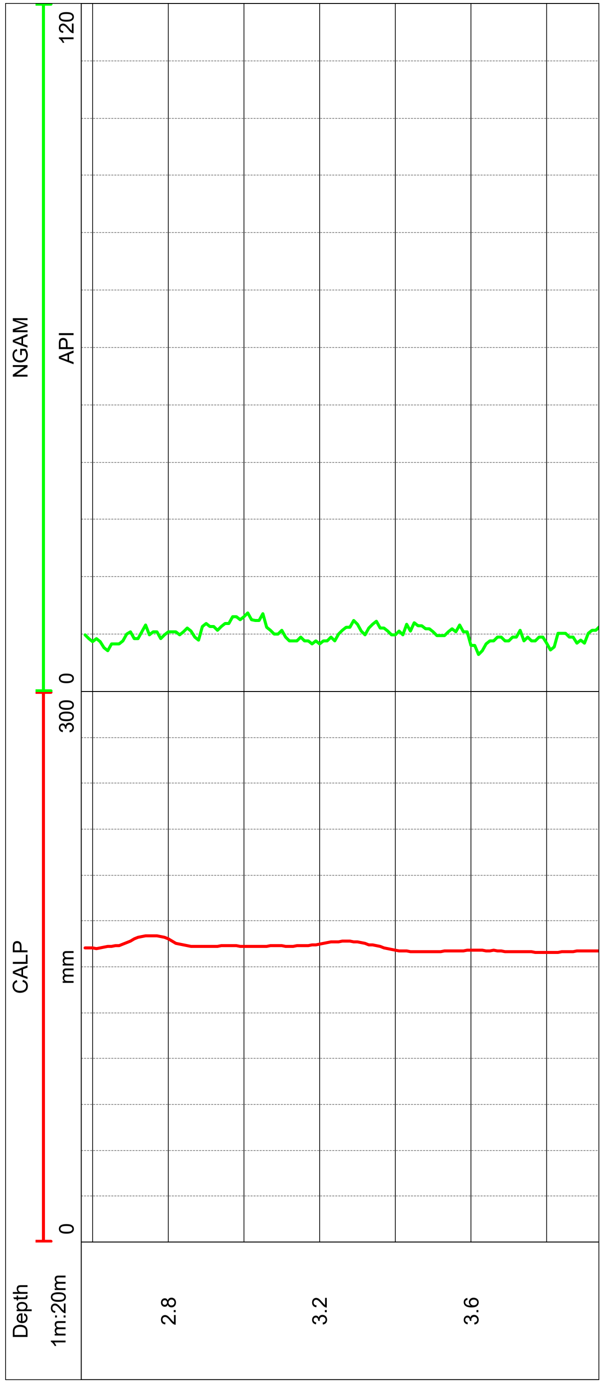
58.0
59.0
60.0


0.00
Vp (m/s)
4000.00
Meters
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00
23.00
27.00
31.00
35.00
39.00
43.00
47.00
51.00
55.00
59.00
0.00
Vp (m/s)
4000.00
Meters
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00

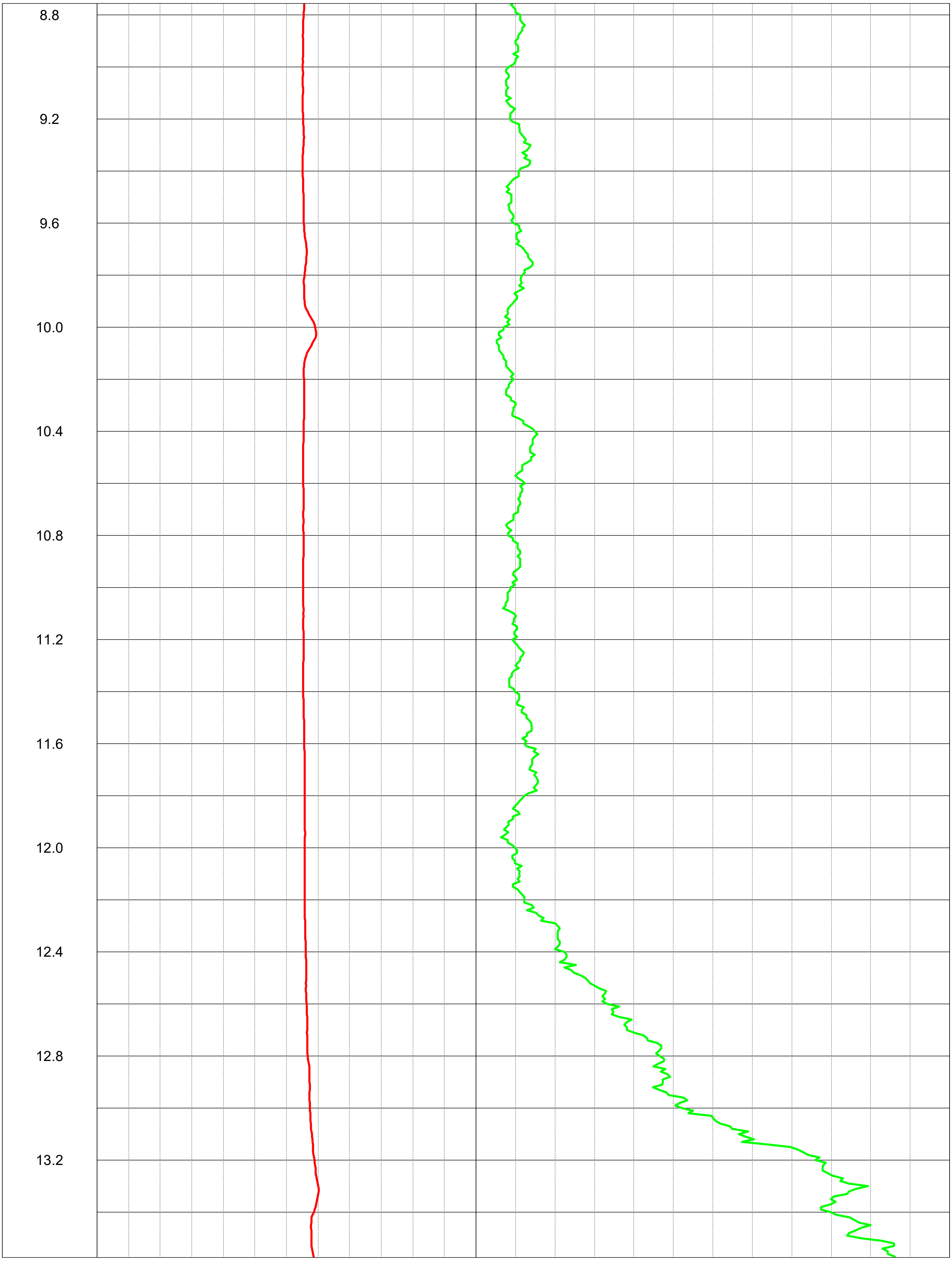
CO Structural Soils
WELL R607
FLD A303 Stonehenge
CTY England
STE
FILING No

COMPANY	Structural Soils		
WELL ID	R607		
FIELD	A303 Stonehenge		
COUNTRY	England	STATE	
LOCATION Easting: 412275.96 Northing: 141892.98 SEC TWP RGE			OTHER SERVICES
PERMANENT DATUM	GL	ELEVATION 93.942	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.
DATE	23/05/18	TYPE FLUID IN HOLE	Water
RUN No		SALINITY	
TYPE LOG	Galiper Gamma	DENSITY	
DEPTH-DRILLER	60	LEVEL	23
DEPTH-LOGGER	60.39	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	60.39		
TOP LOGGED INTERVAL	2.57		
OPERATING RIG TIME			
RECORDED BY	James Boyett		
WITNESSED BY	Kyle Owen		

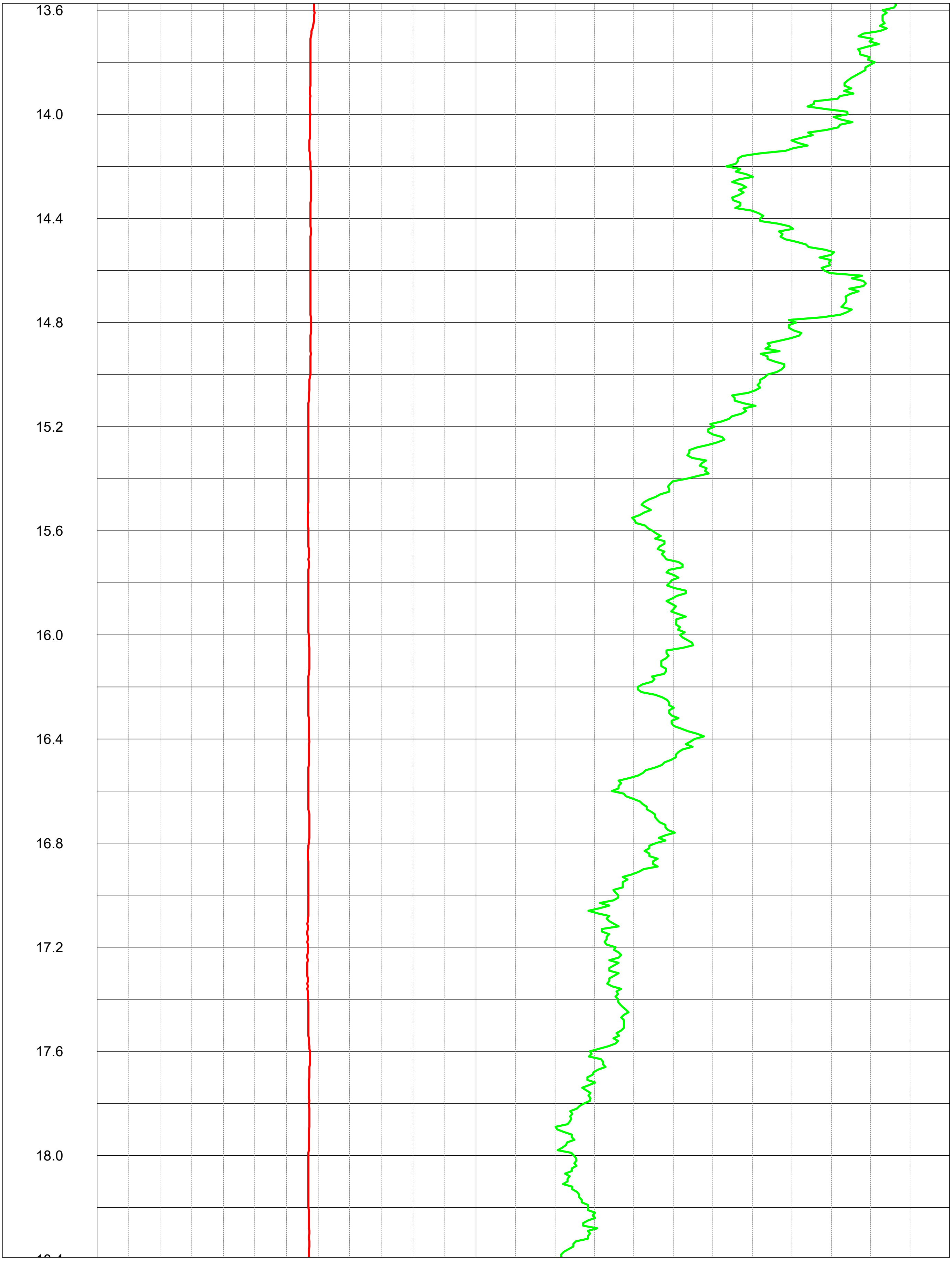
RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

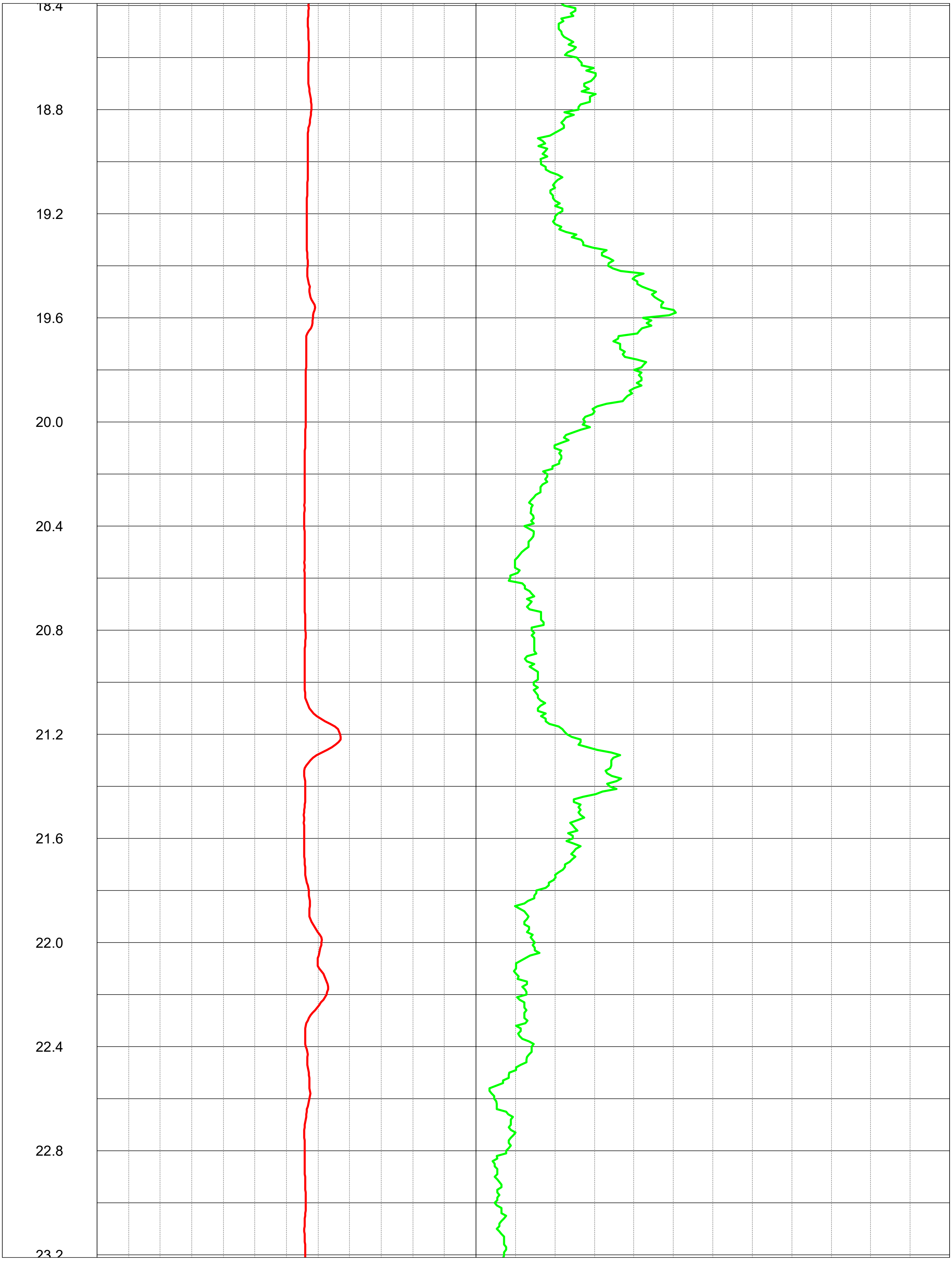


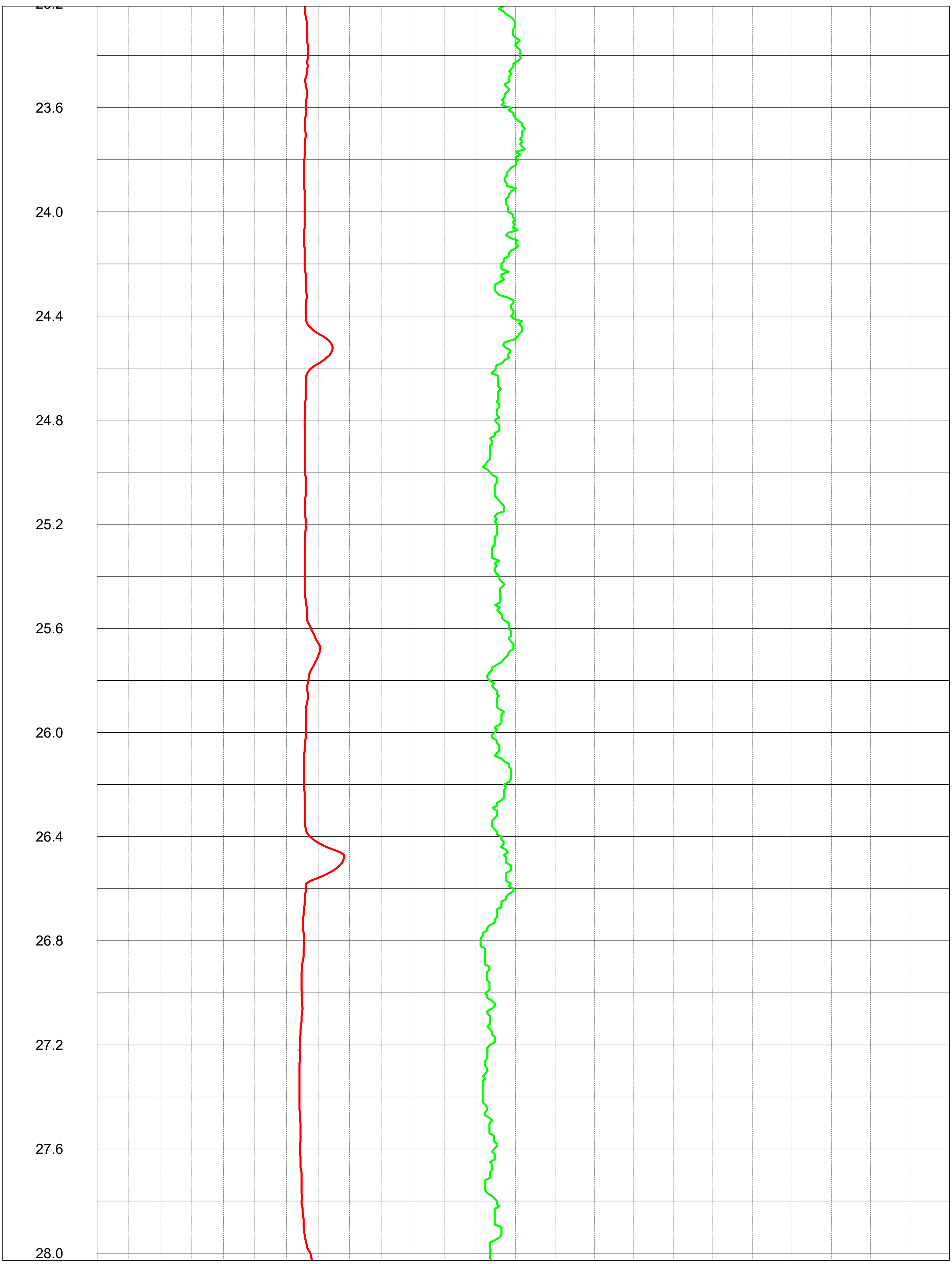

4.0
4.4
4.8
5.2
5.6
6.0
6.4
6.8
7.2
7.6
8.0
8.4



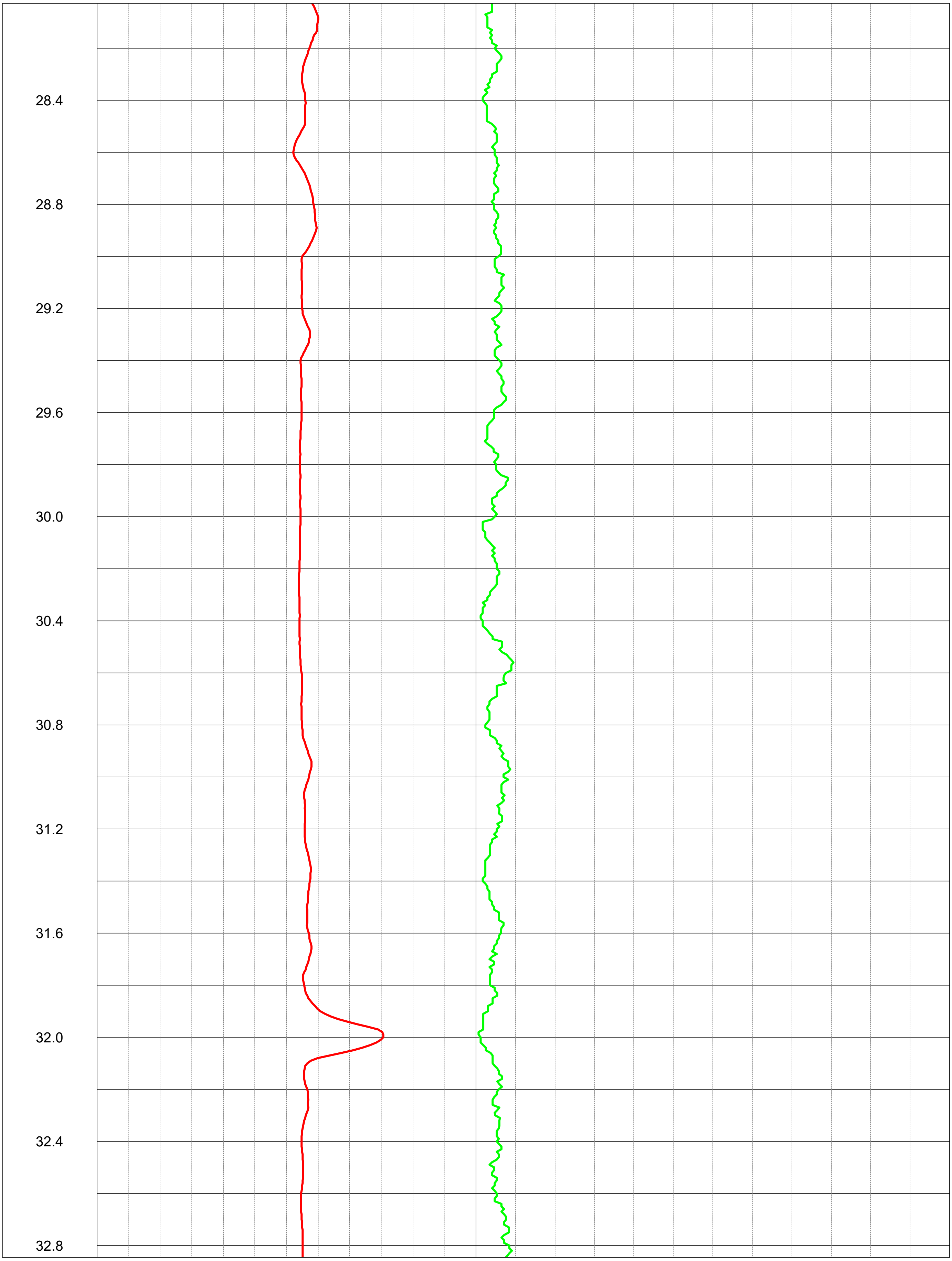
8.8
9.2
9.6
10.0
10.4
10.8
11.2
11.6
12.0
12.4
12.8
13.2

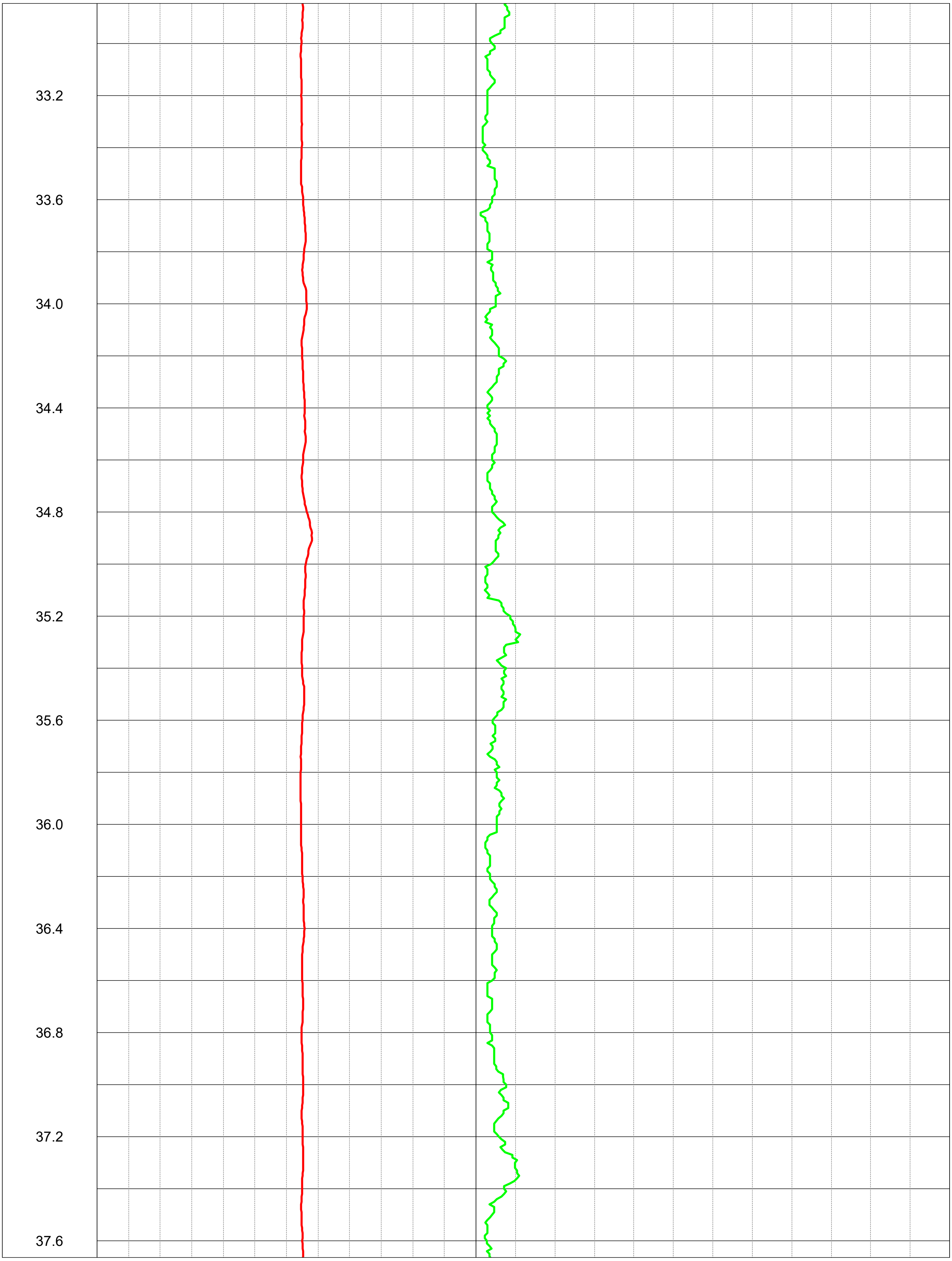

13.6
14.0
14.4
14.8
15.2
15.6
16.0
16.4
16.8
17.2
17.6
18.0

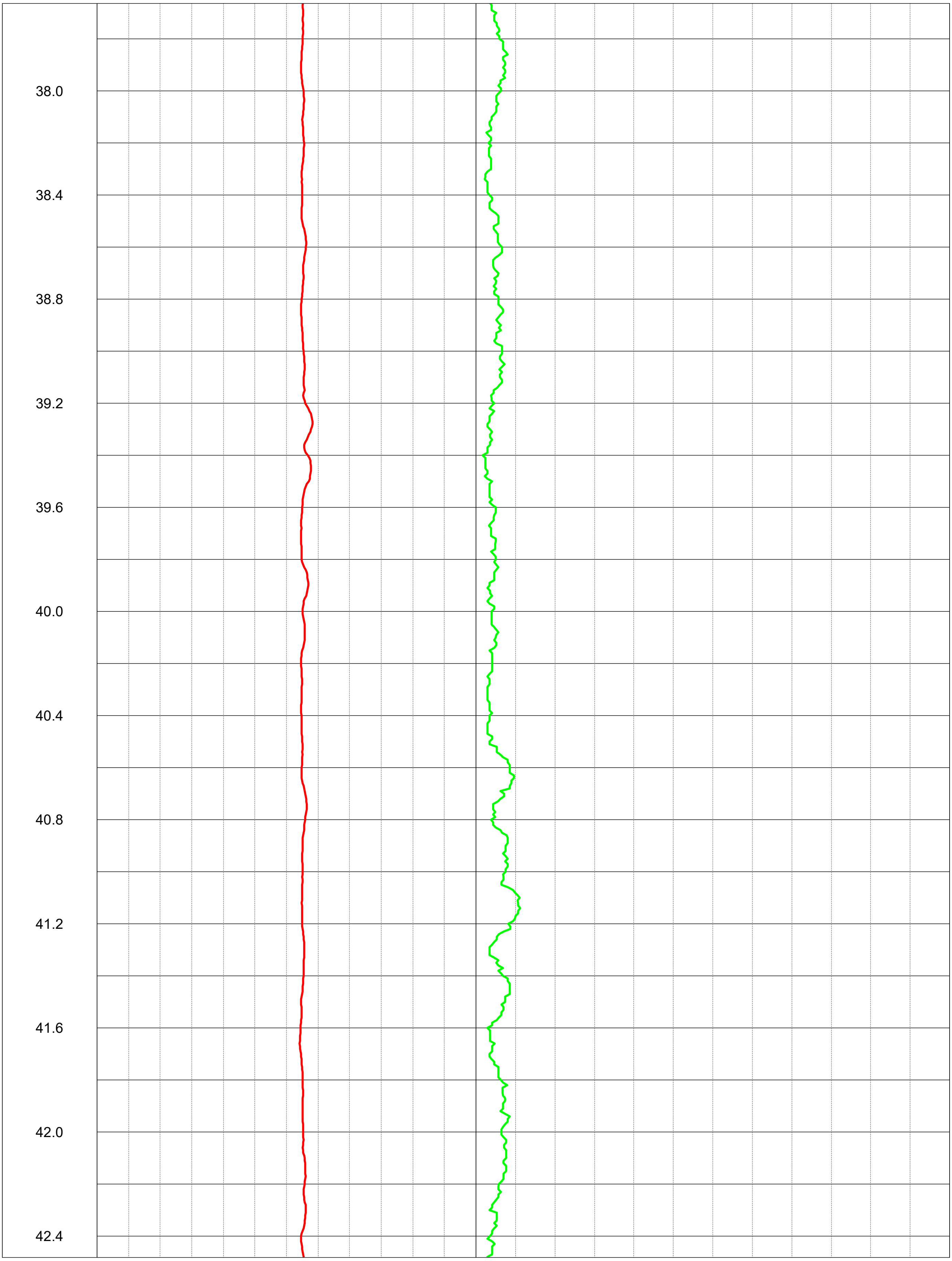

18.4
18.8
19.2
19.6
20.0
20.4
20.8
21.2
21.6
22.0
22.4
22.8
23.2



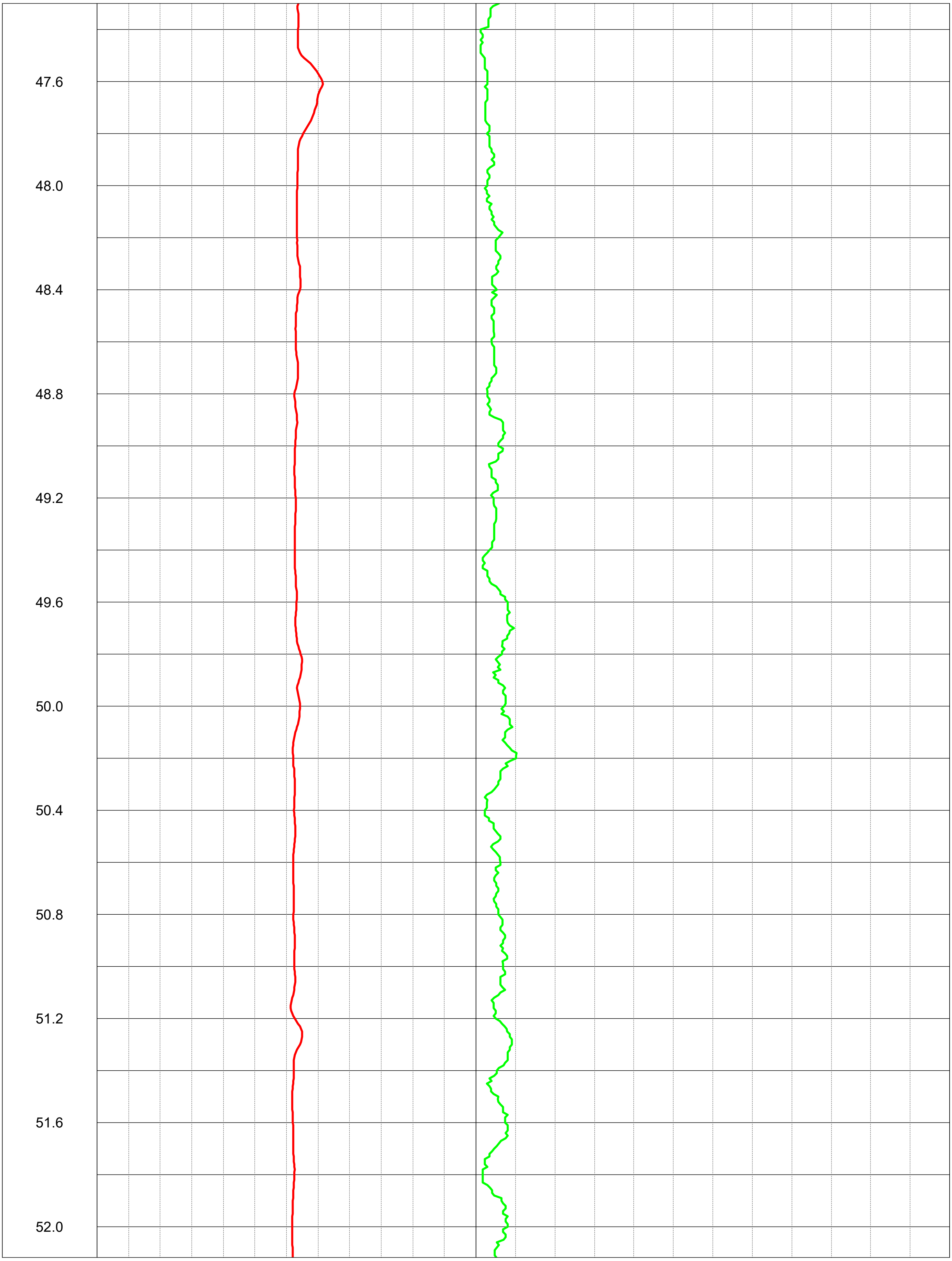
23.6
24.0
24.4
24.8
25.2
25.6
26.0
26.4
26.8
27.2
27.6
28.0

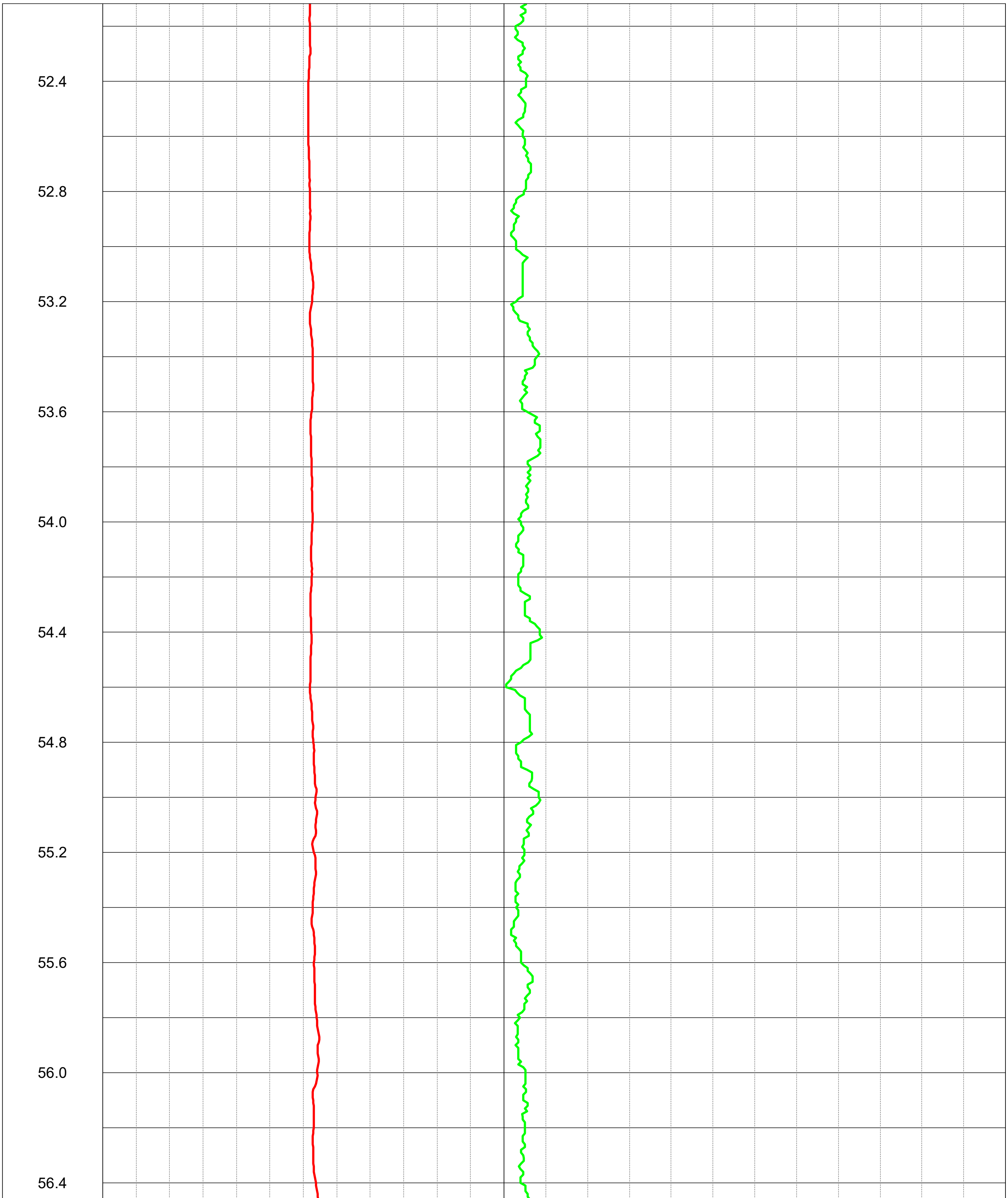

28.4
28.8
29.2
29.6
30.0
30.4
30.8
31.2
31.6
32.0
32.4
32.8

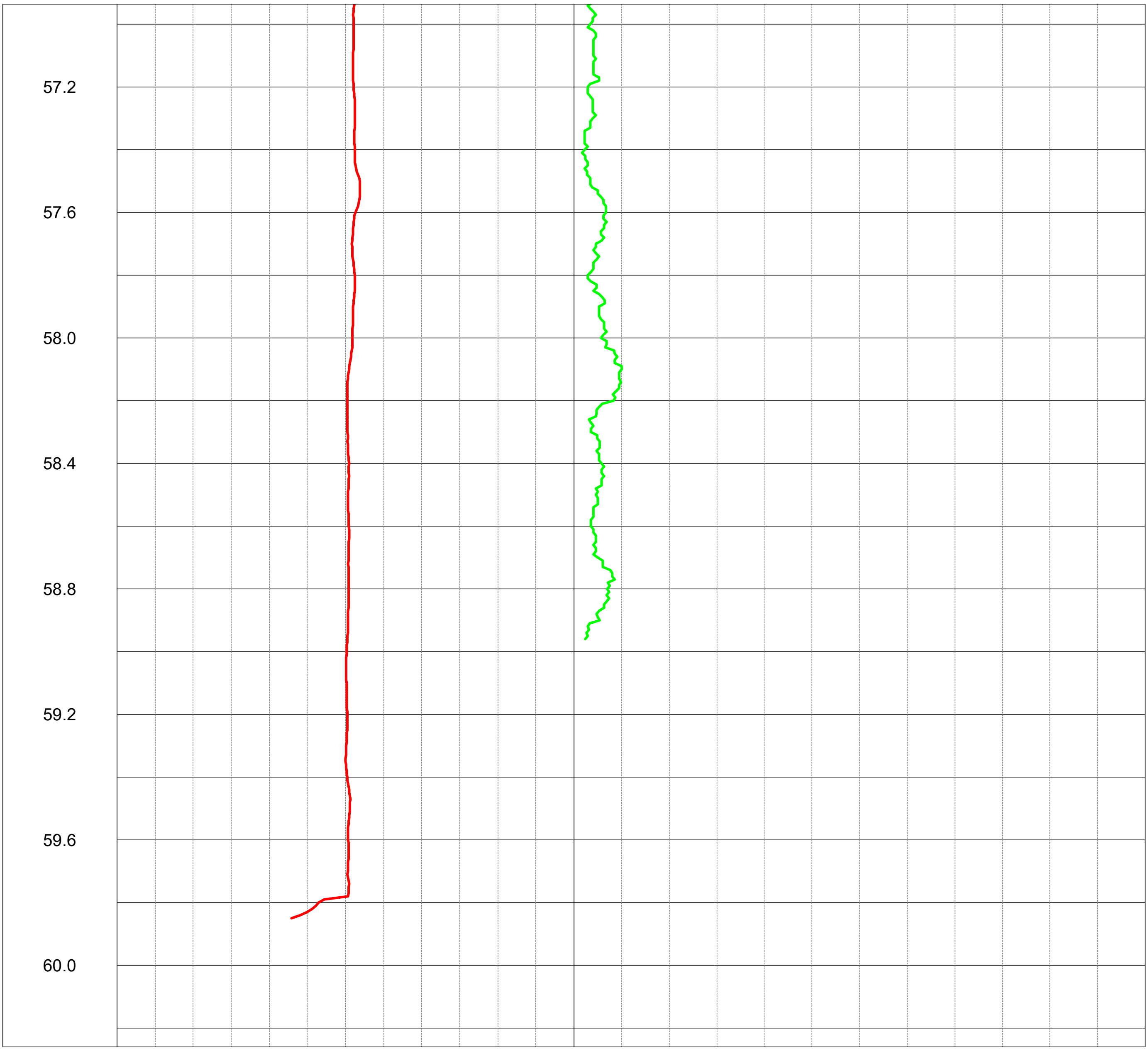

33.2
33.6
34.0
34.4
34.8
35.2
35.6
36.0
36.4
36.8
37.2
37.6


38.0
38.4
38.8
39.2
39.6
40.0
40.4
40.8
41.2
41.6
42.0
42.4

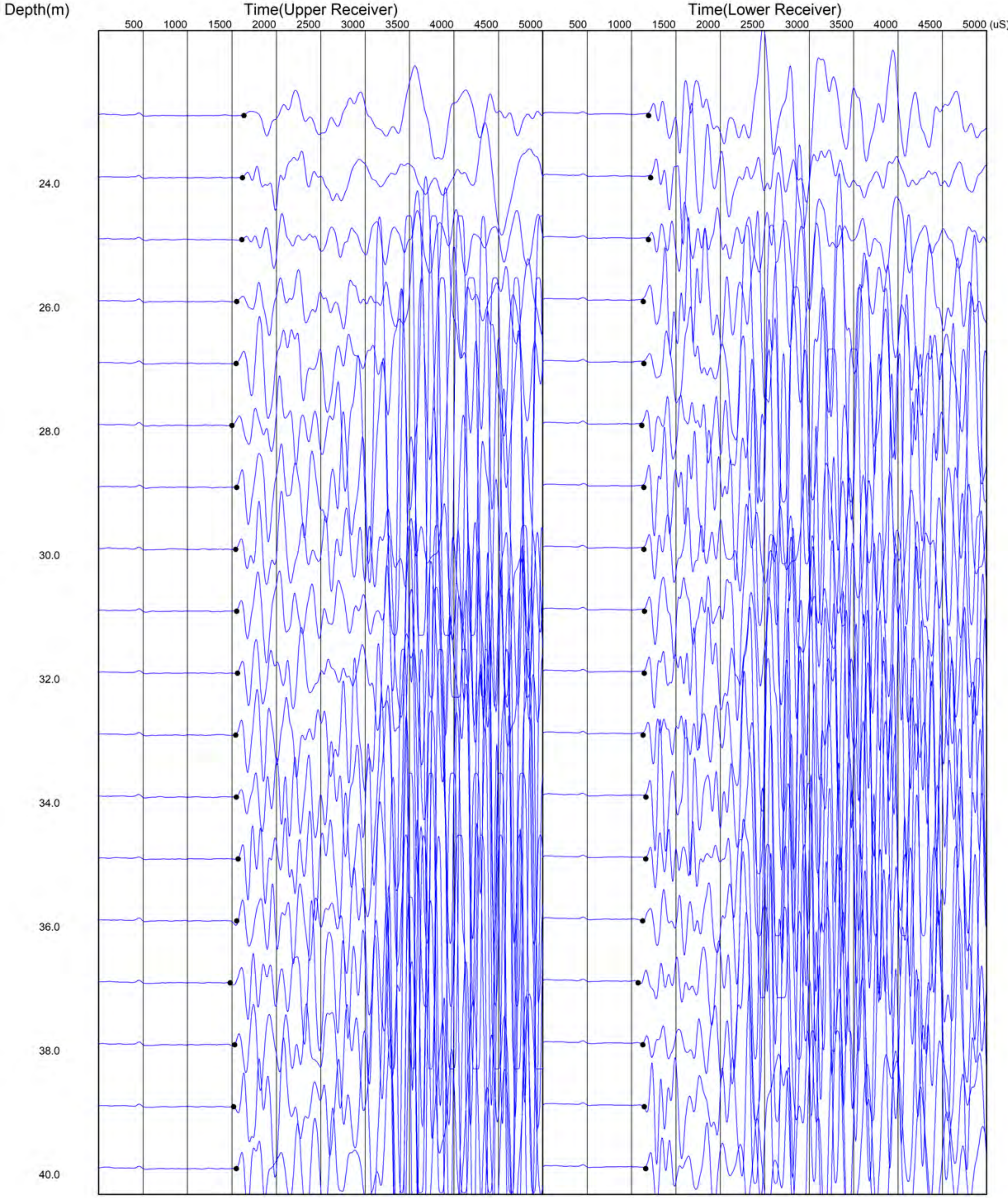

42.8
43.2
43.6
44.0
44.4
44.8
45.2
45.6
46.0
46.4
46.8
47.2


47.6
48.0
48.4
48.8
49.2
49.6
50.0
50.4
50.8
51.2
51.6
52.0

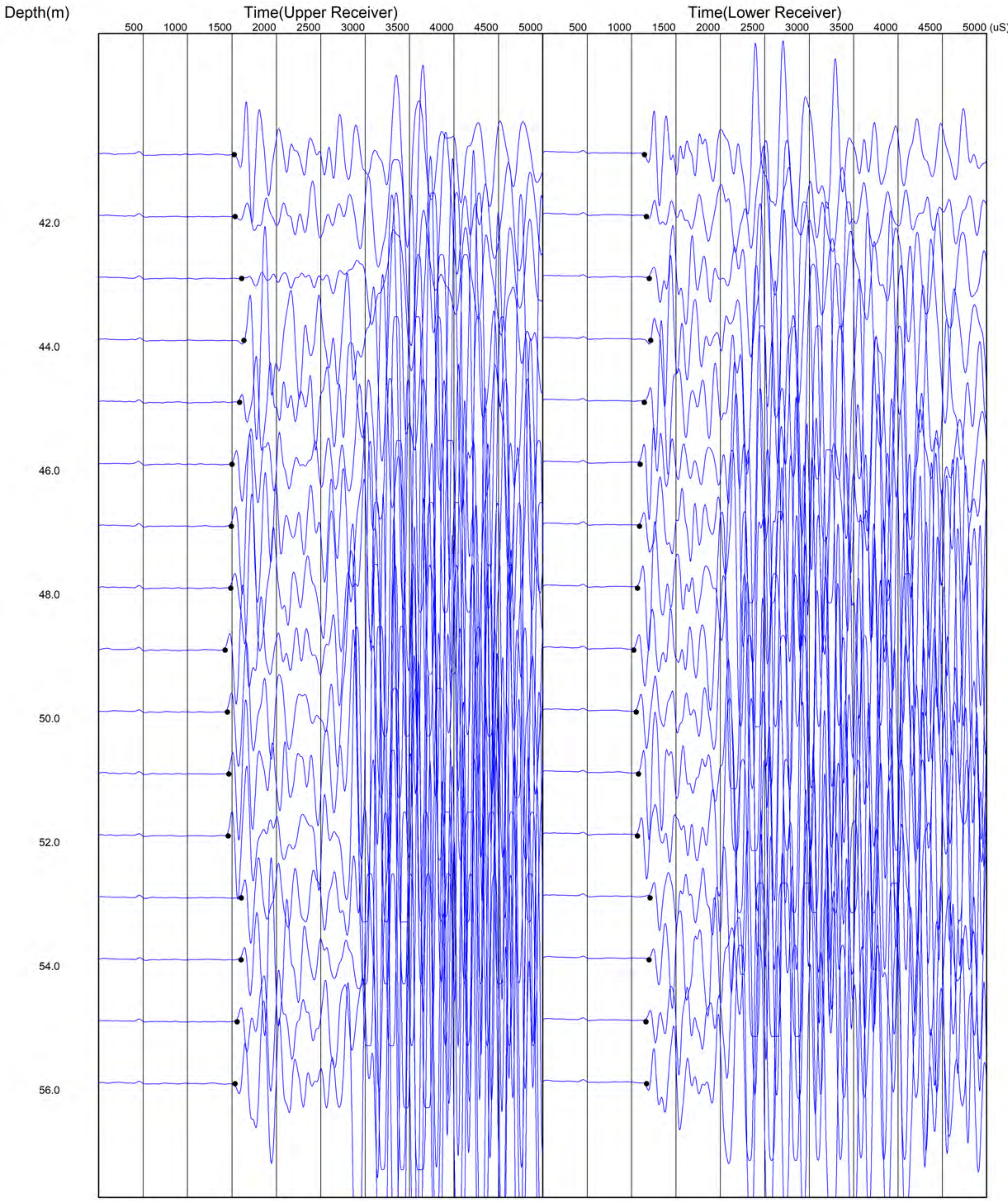

52.4
52.8
53.2
53.6
54.0
54.4
54.8
55.2
55.6
56.0
56.4
56.8


57.2
57.6
58.0
58.4
58.8
59.2
59.6
60.0

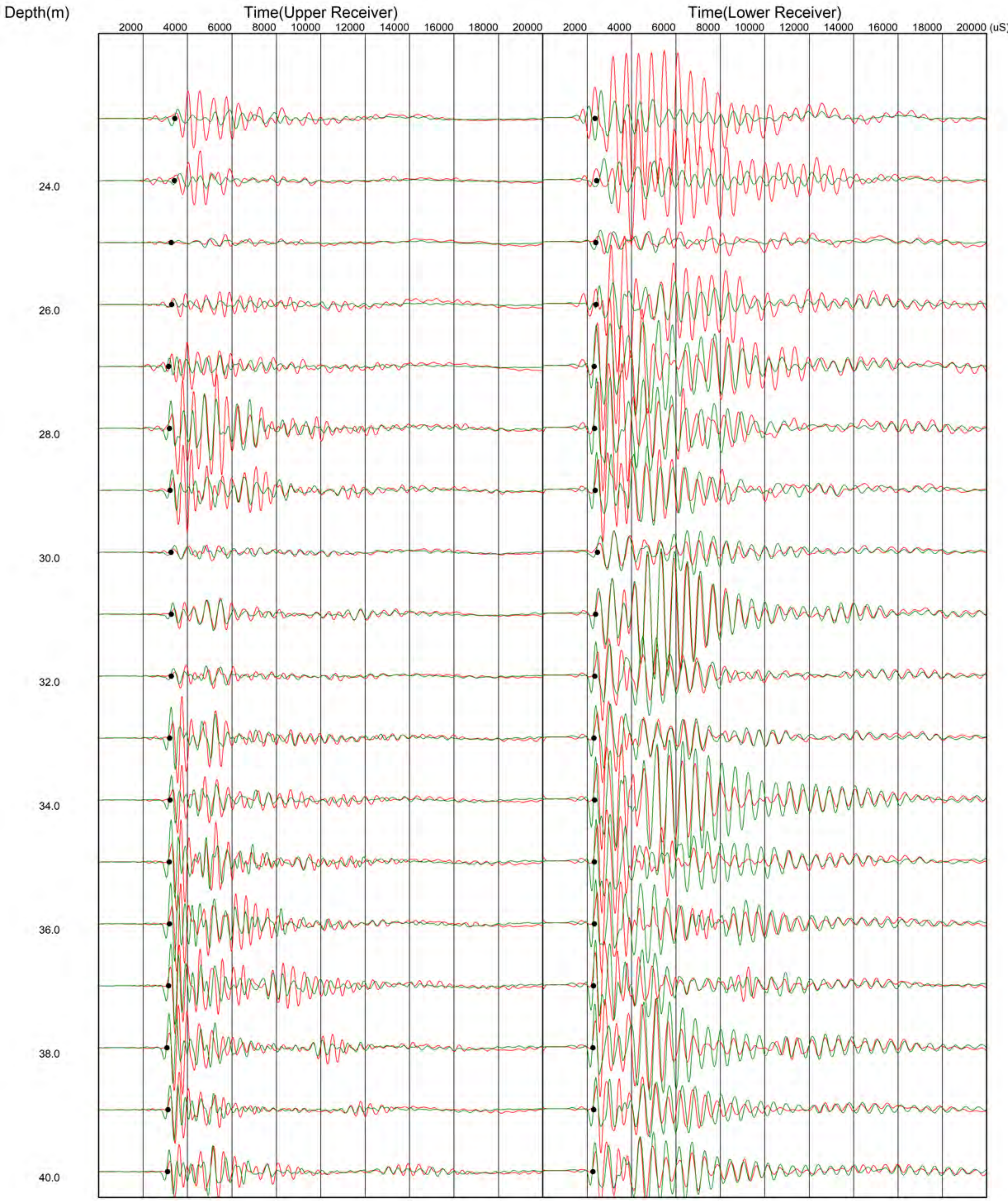
P Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
24.0
26.0
28.0
30.0
32.0
34.0
36.0
38.0
40.0

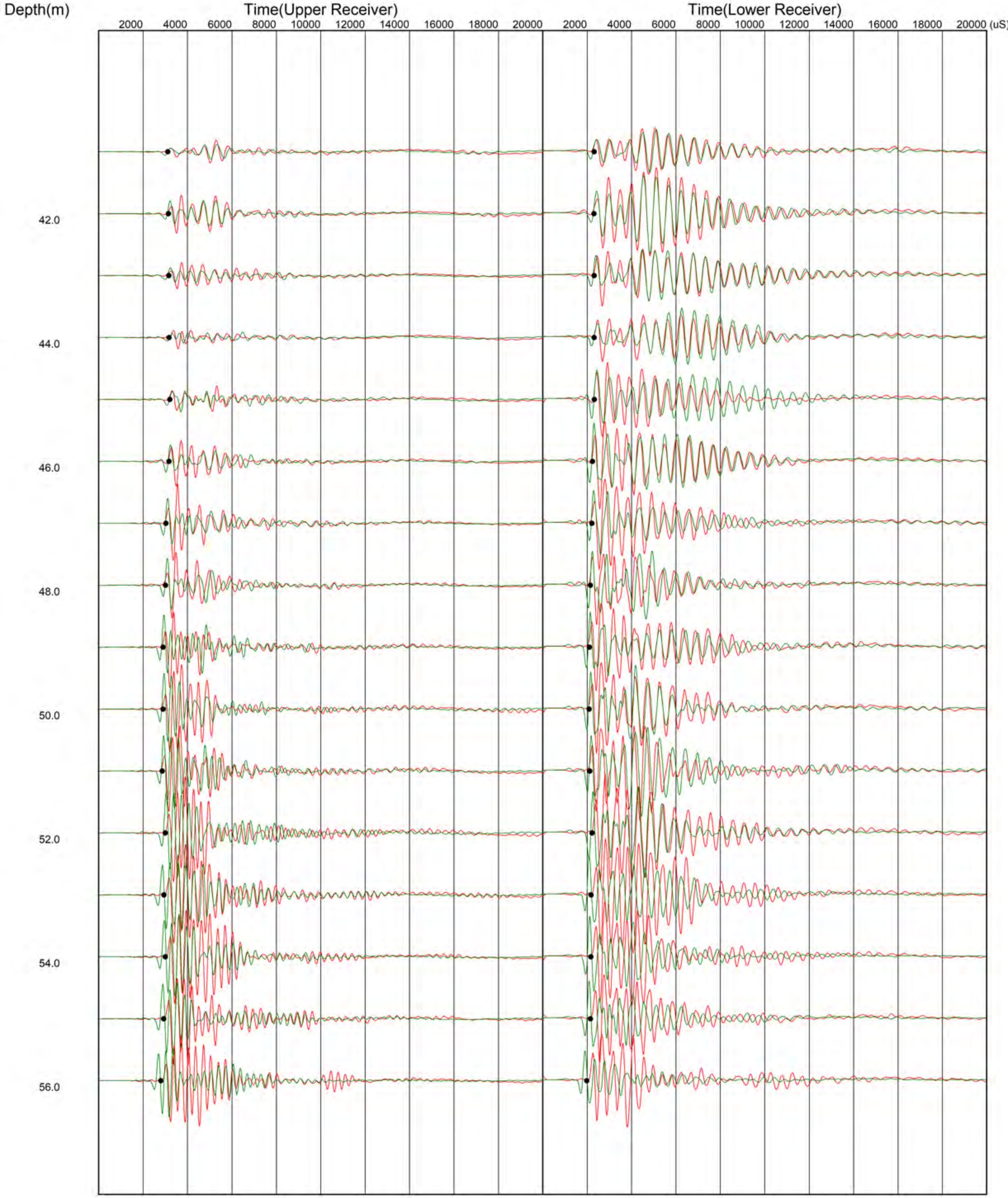
P Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
42.0
44.0
46.0
48.0
50.0
52.0
54.0
56.0

S Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
24.0
26.0
28.0
30.0
32.0
34.0
36.0
38.0
40.0

S Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
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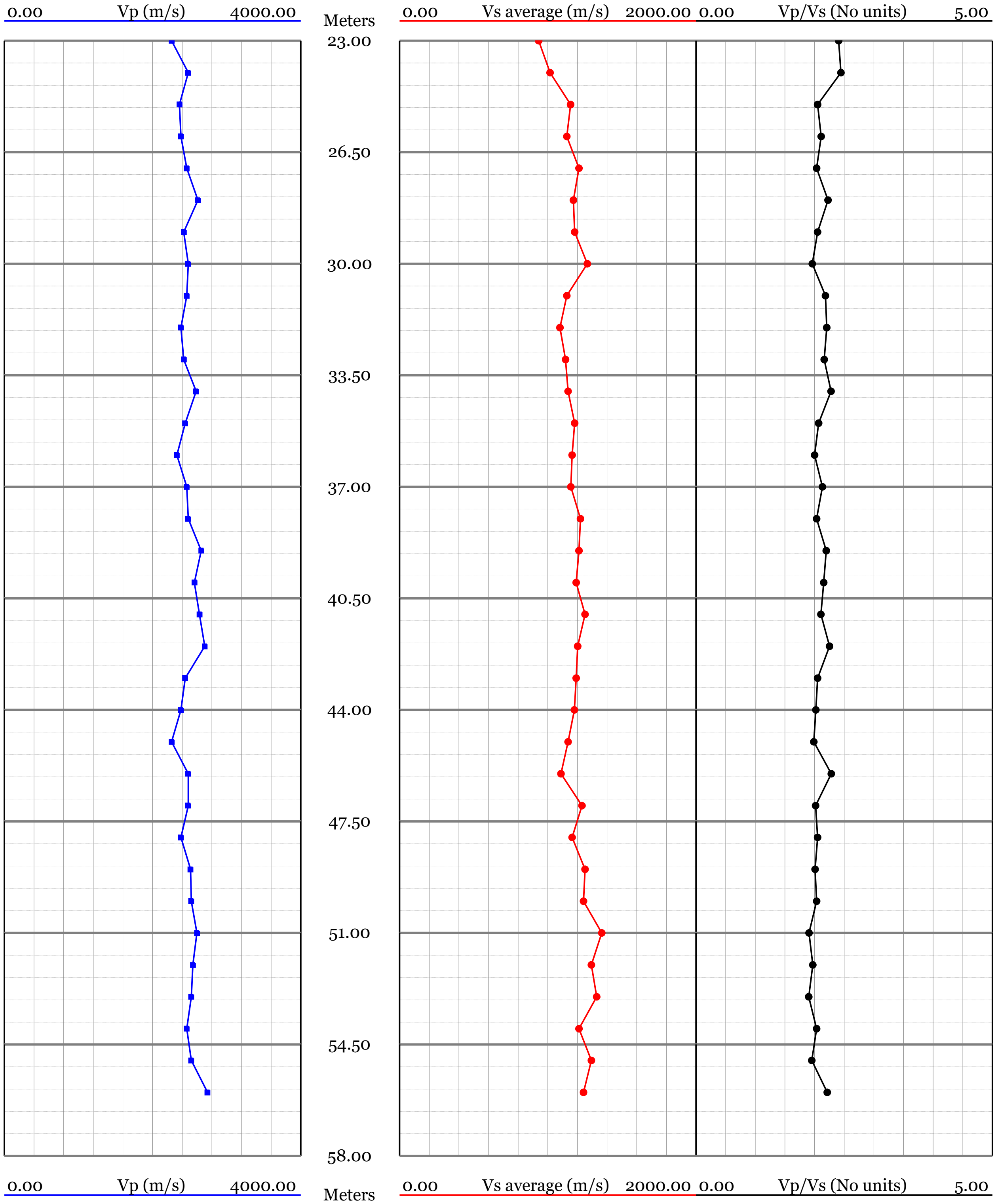
52.0
54.0
56.0


0.00
Vp (m/s)
4000.00
Meters
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00
23.00
26.50
30.00
33.50
37.00
40.50
44.00
47.50
51.00
54.50
58.00
0.00
Vp (m/s)
4000.00
Meters
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00

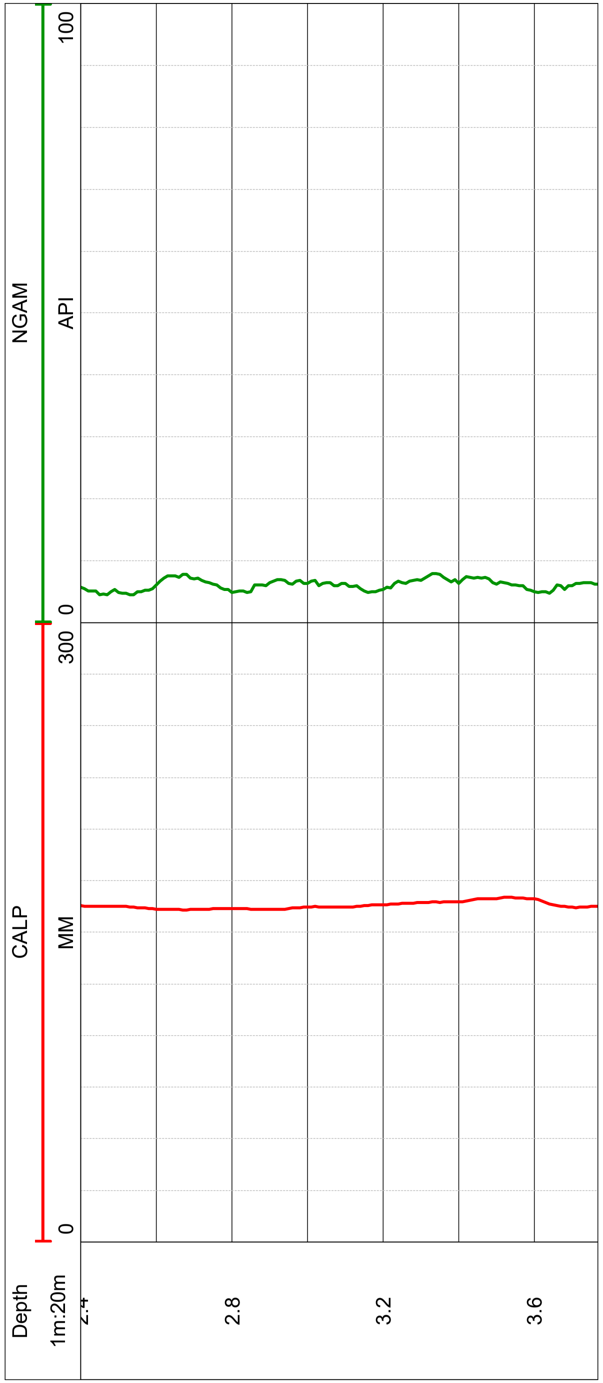
CO Structural Soils
WELL R608
FLD A303 Stonehenge
CTY England
STE
FILING No

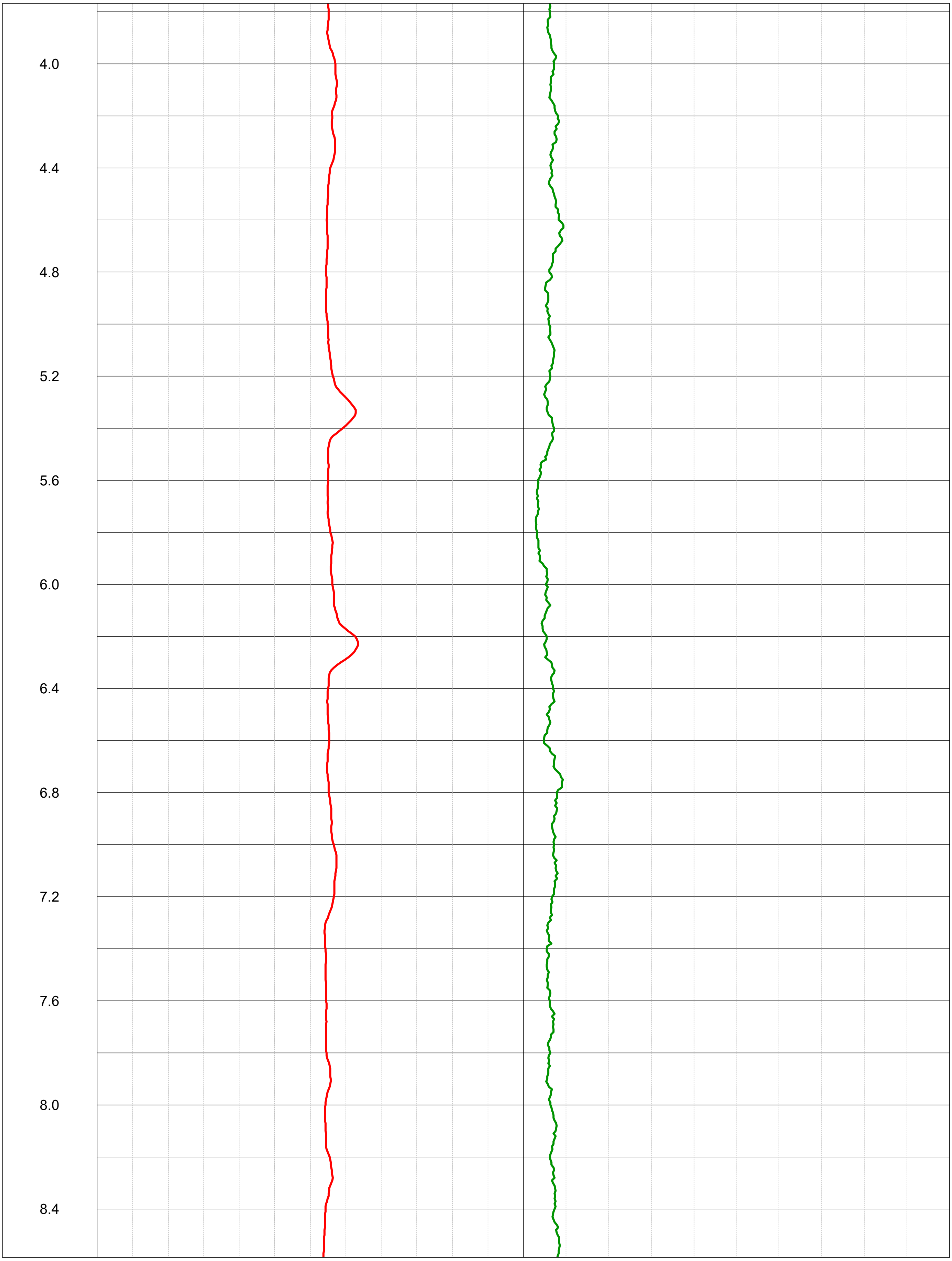
COMPANY	Structural Soils		
WELL ID	R608		
FIELD	A303 Stonehenge		
COUNTRY	England	STATE	
LOCATION Easting: 412277.03 Northing: 141926.06 SEC TWP RGE			OTHER SERVICES

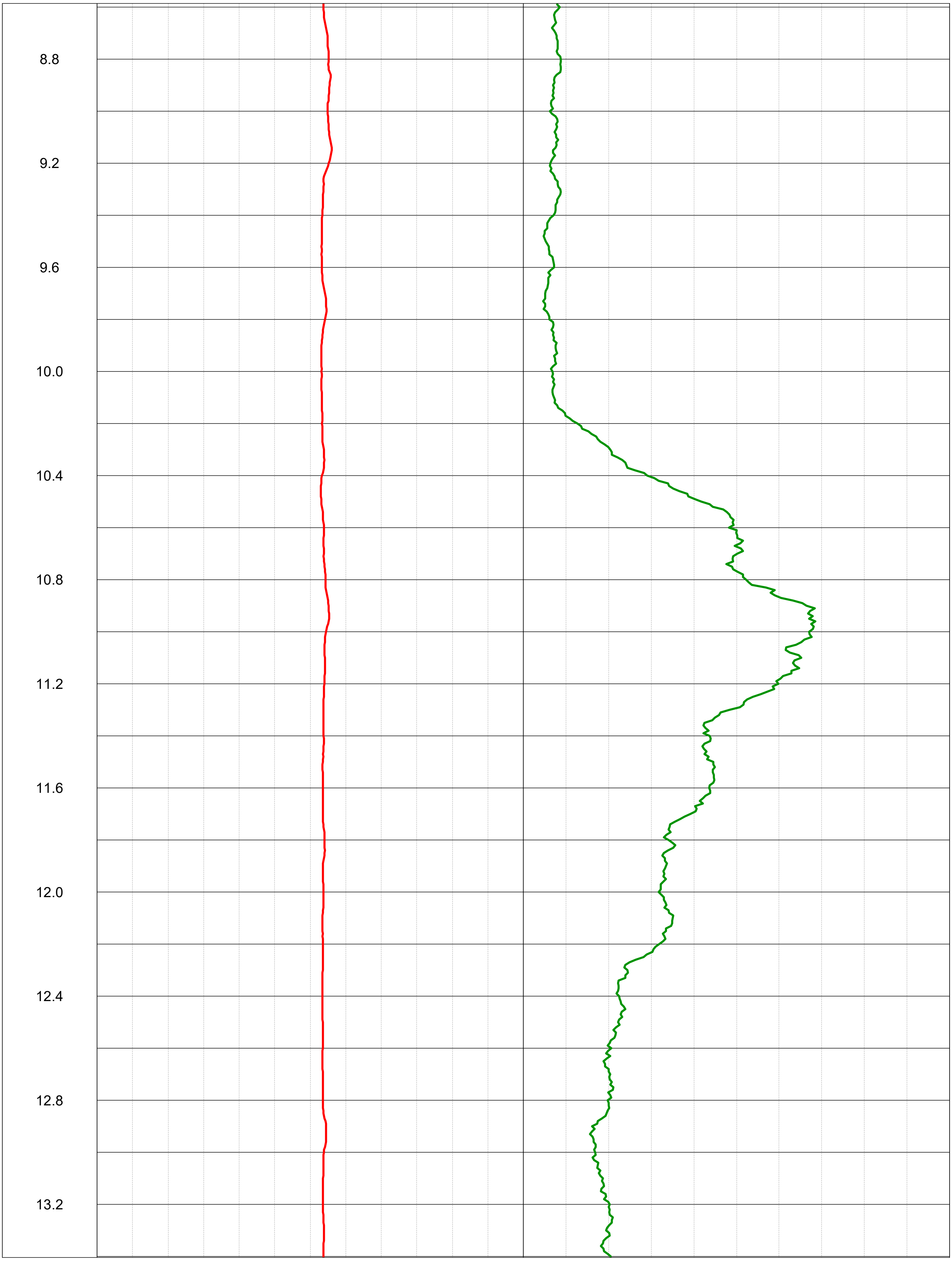
PERMANENT DATUM	GL	ELEVATION	94.642	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM		D.F.
DRILLING MEAS. FROM				G.L.

DATE	16/05/18	TYPE FLUID IN HOLE	Water
RUN No		SALINITY	
TYPE LOG	Caliper Gamma	DENSITY	
DEPTH-DRILLER	60	LEVEL	22
DEPTH-LOGGER	59.4	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	59.4		
TOP LOGGED INTERVAL	2.4		
OPERATING RIG TIME			
RECORDED BY	James Boyett		
WITNESSED BY	Kyle Owen		

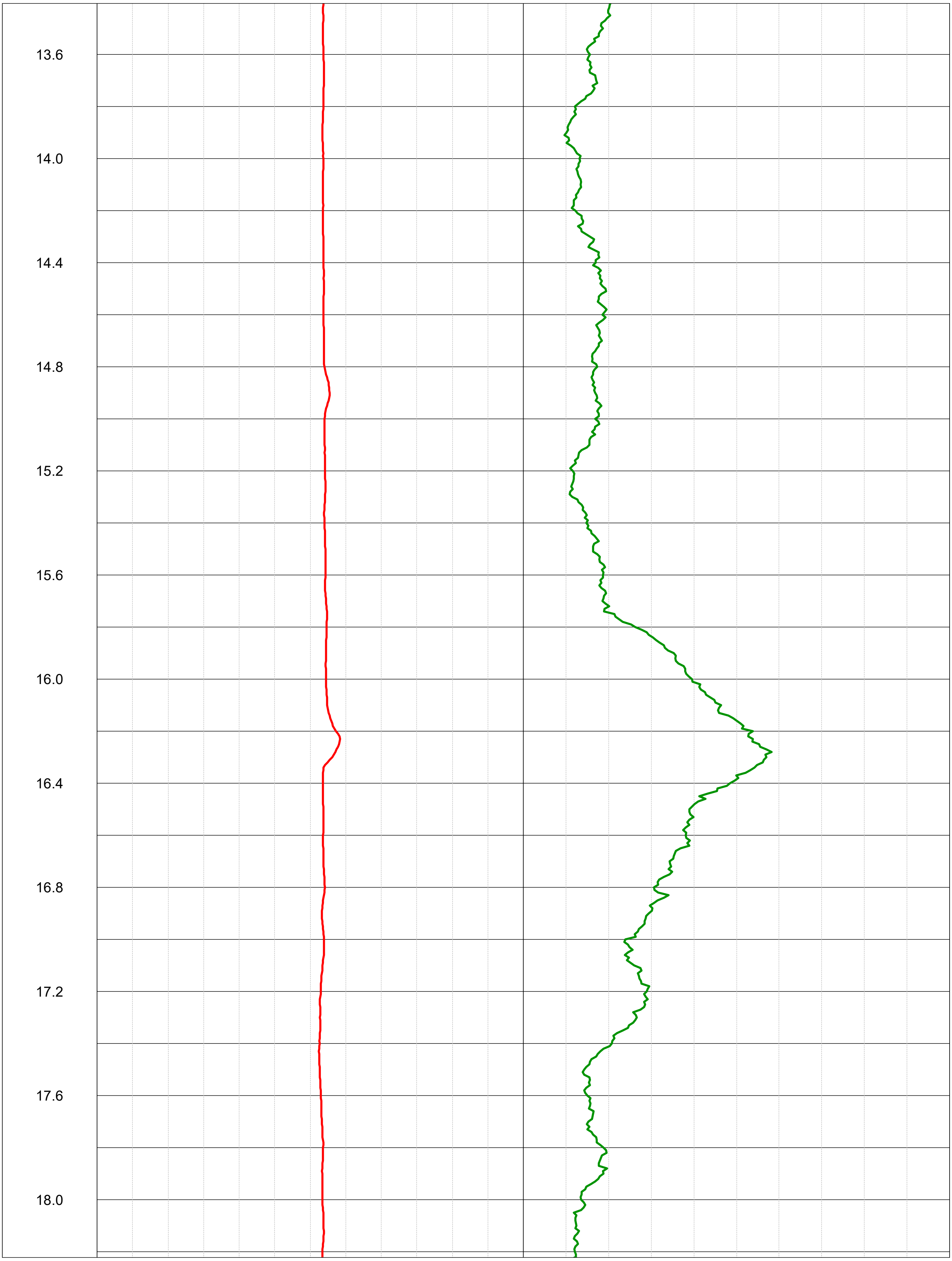
RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

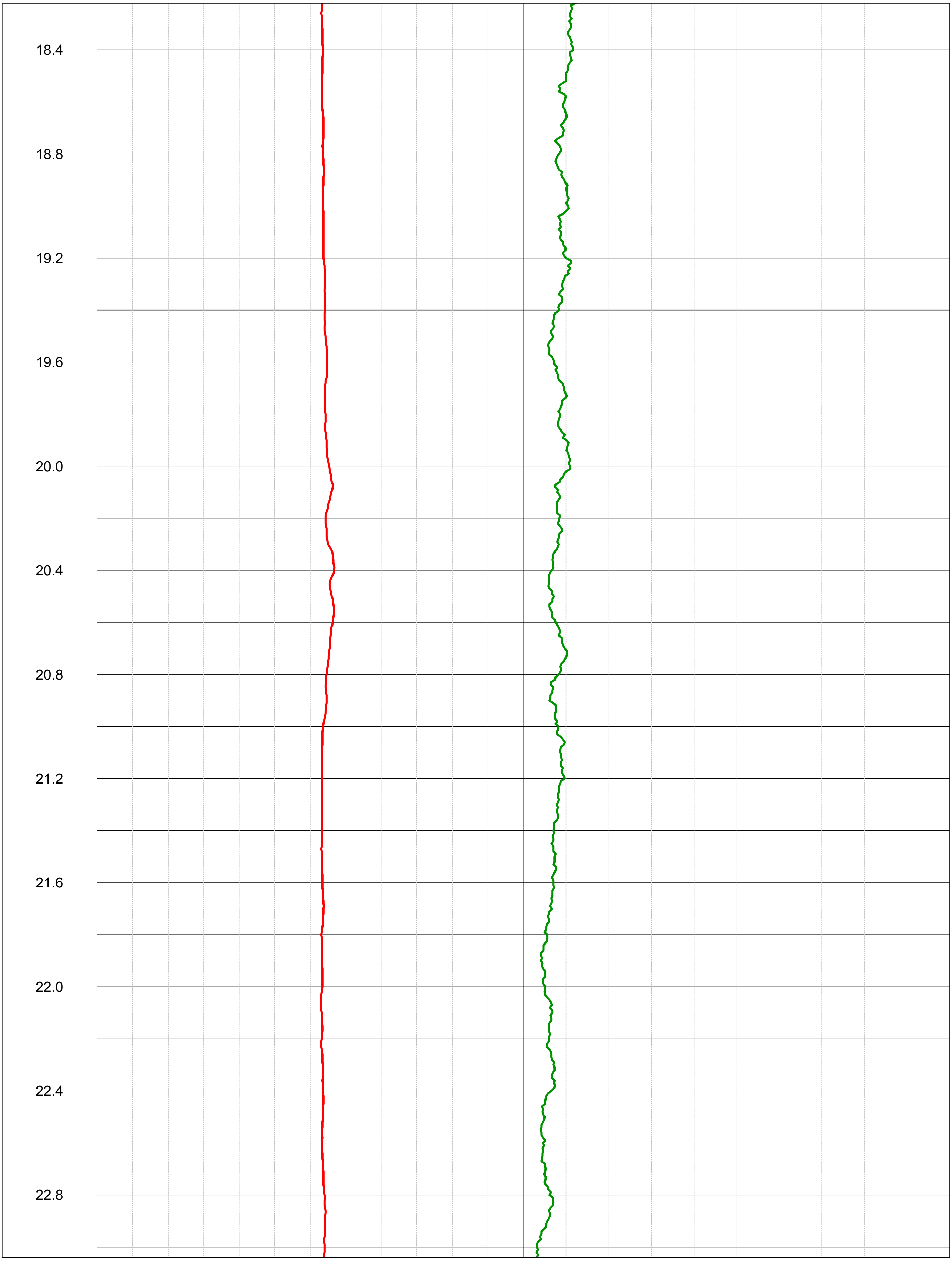


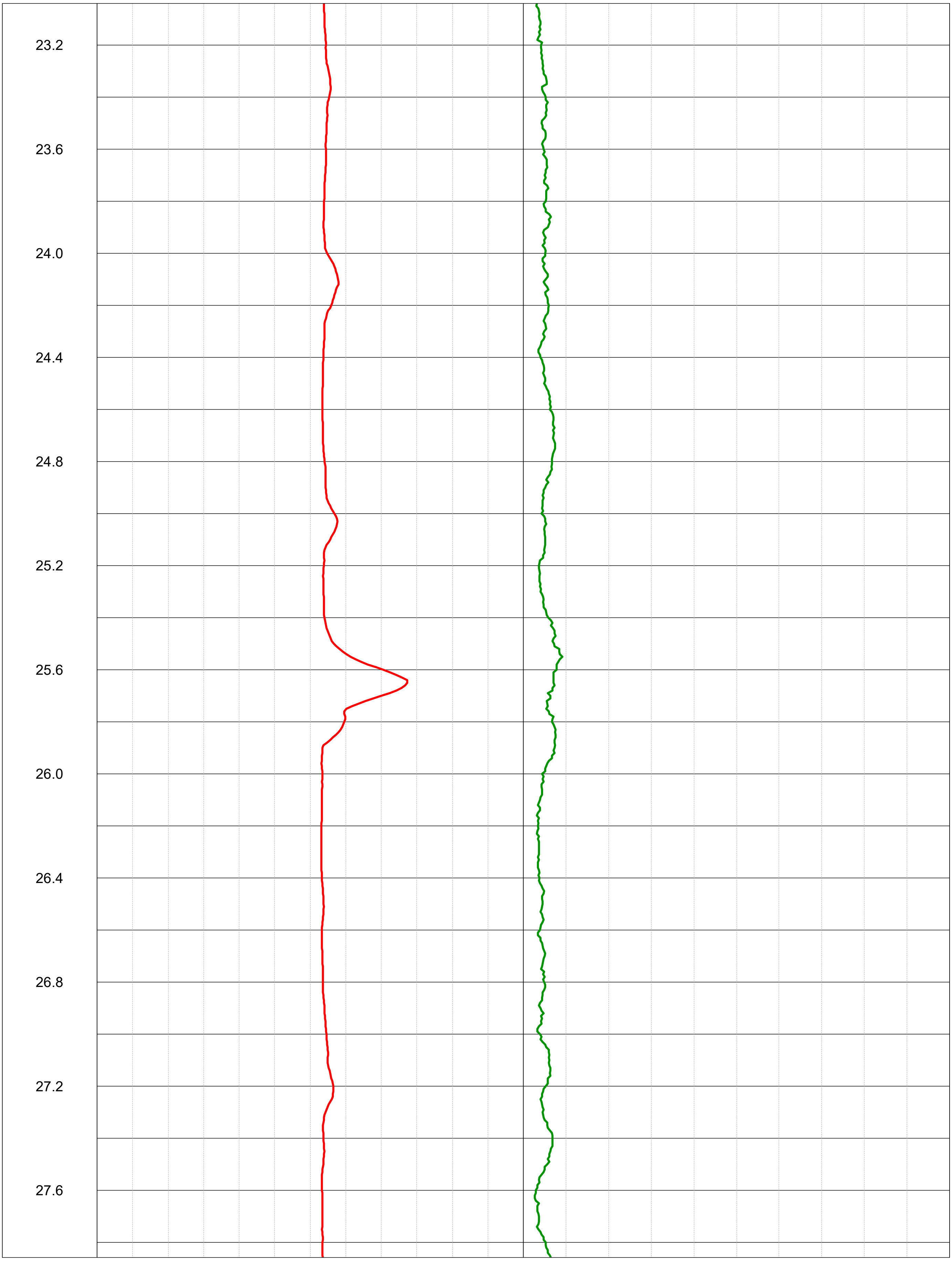

4.0
4.4
4.8
5.2
5.6
6.0
6.4
6.8
7.2
7.6
8.0
8.4

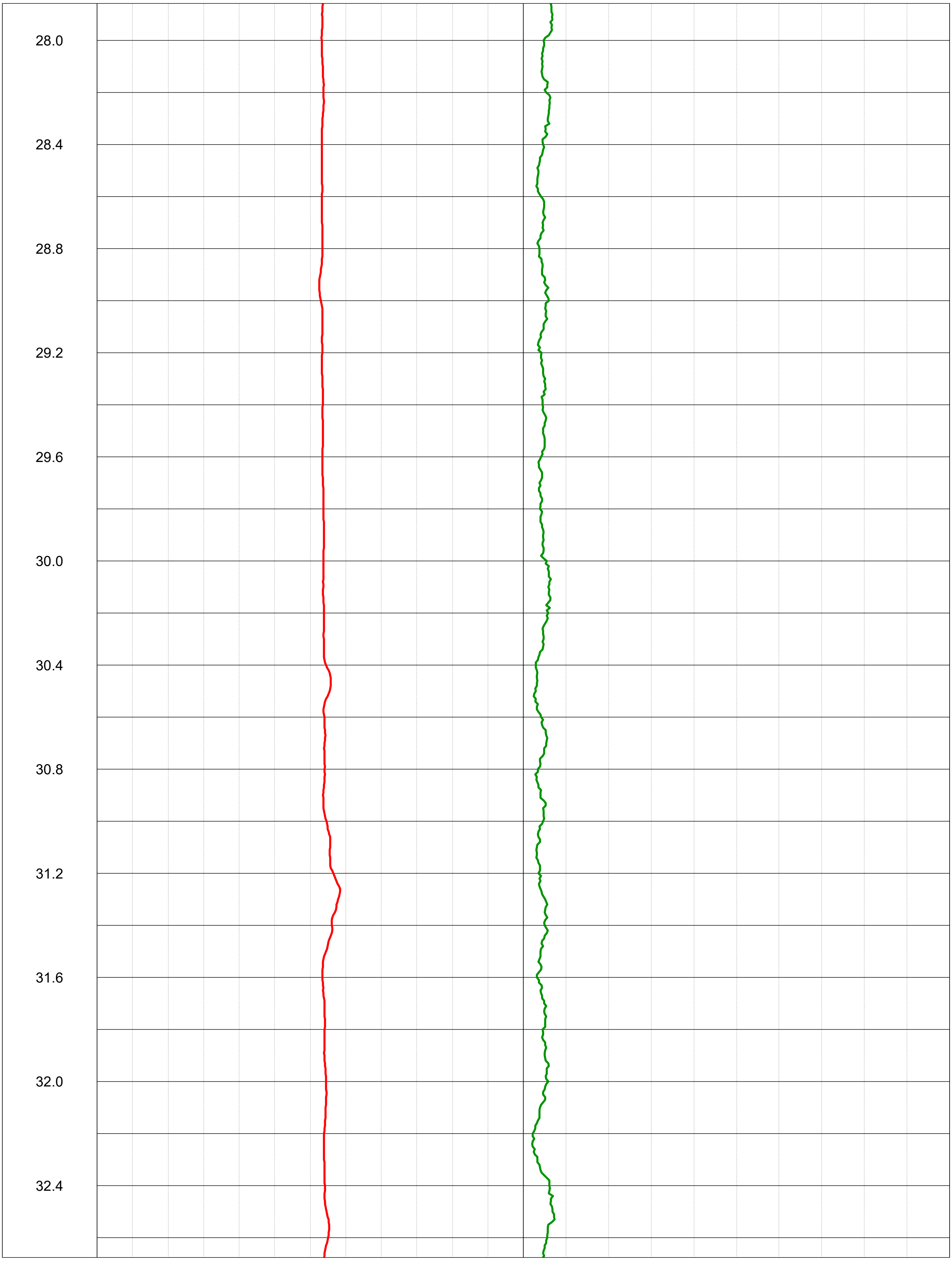


8.8
9.2
9.6
10.0
10.4
10.8
11.2
11.6
12.0
12.4
12.8
13.2

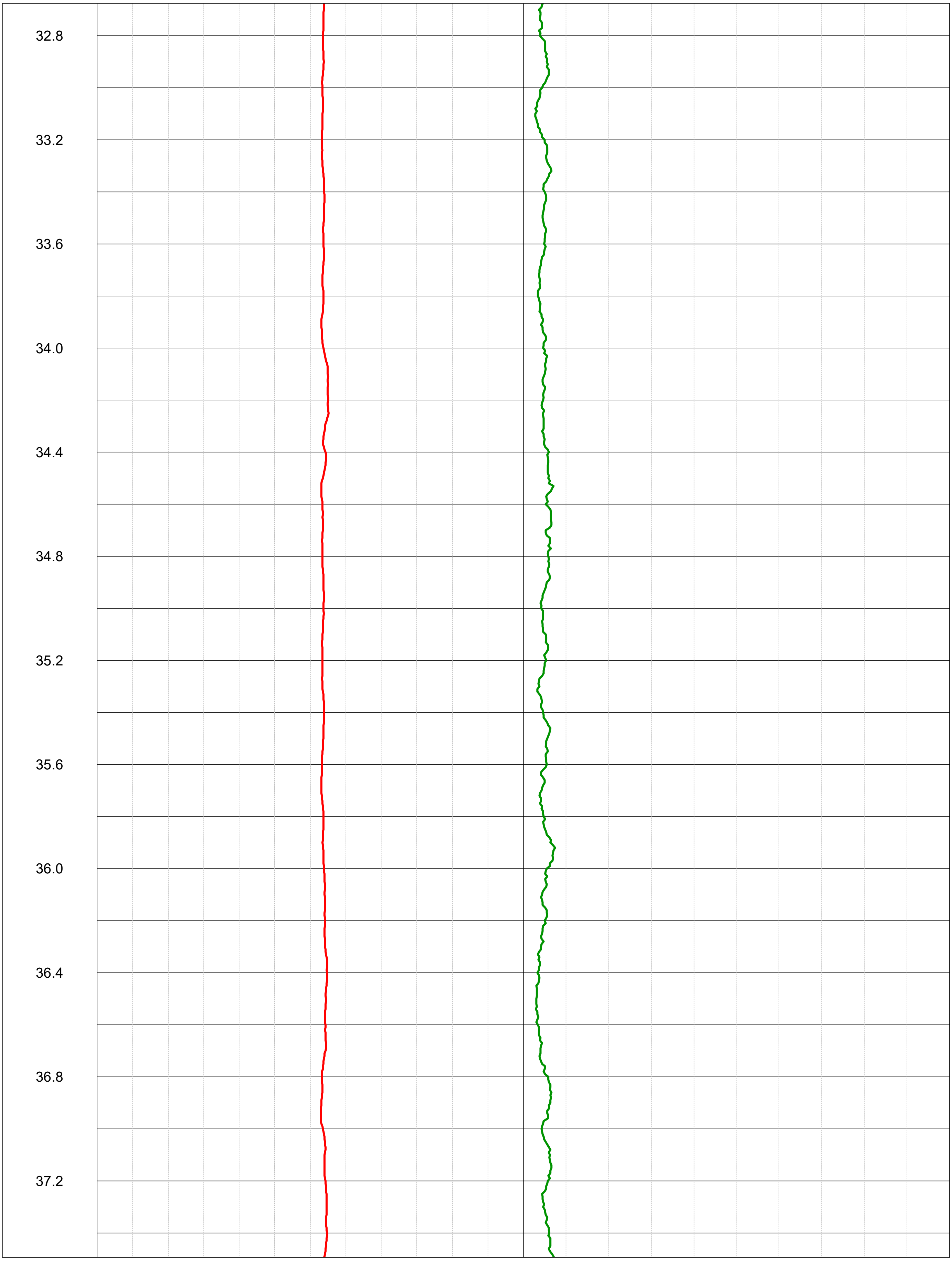

13.6
14.0
14.4
14.8
15.2
15.6
16.0
16.4
16.8
17.2
17.6
18.0


18.4
18.8
19.2
19.6
20.0
20.4
20.8
21.2
21.6
22.0
22.4
22.8

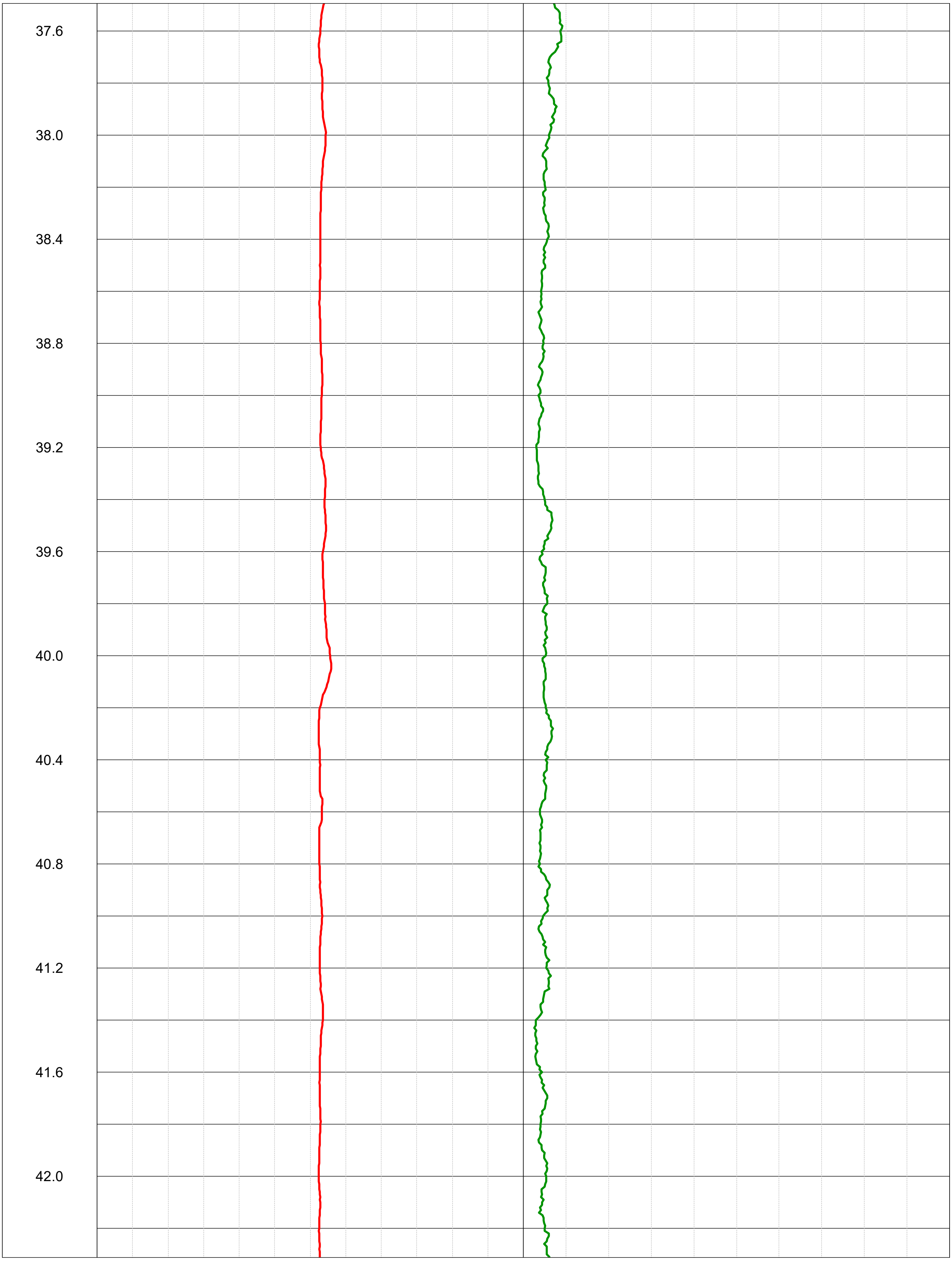

23.2
23.6
24.0
24.4
24.8
25.2
25.6
26.0
26.4
26.8
27.2
27.6

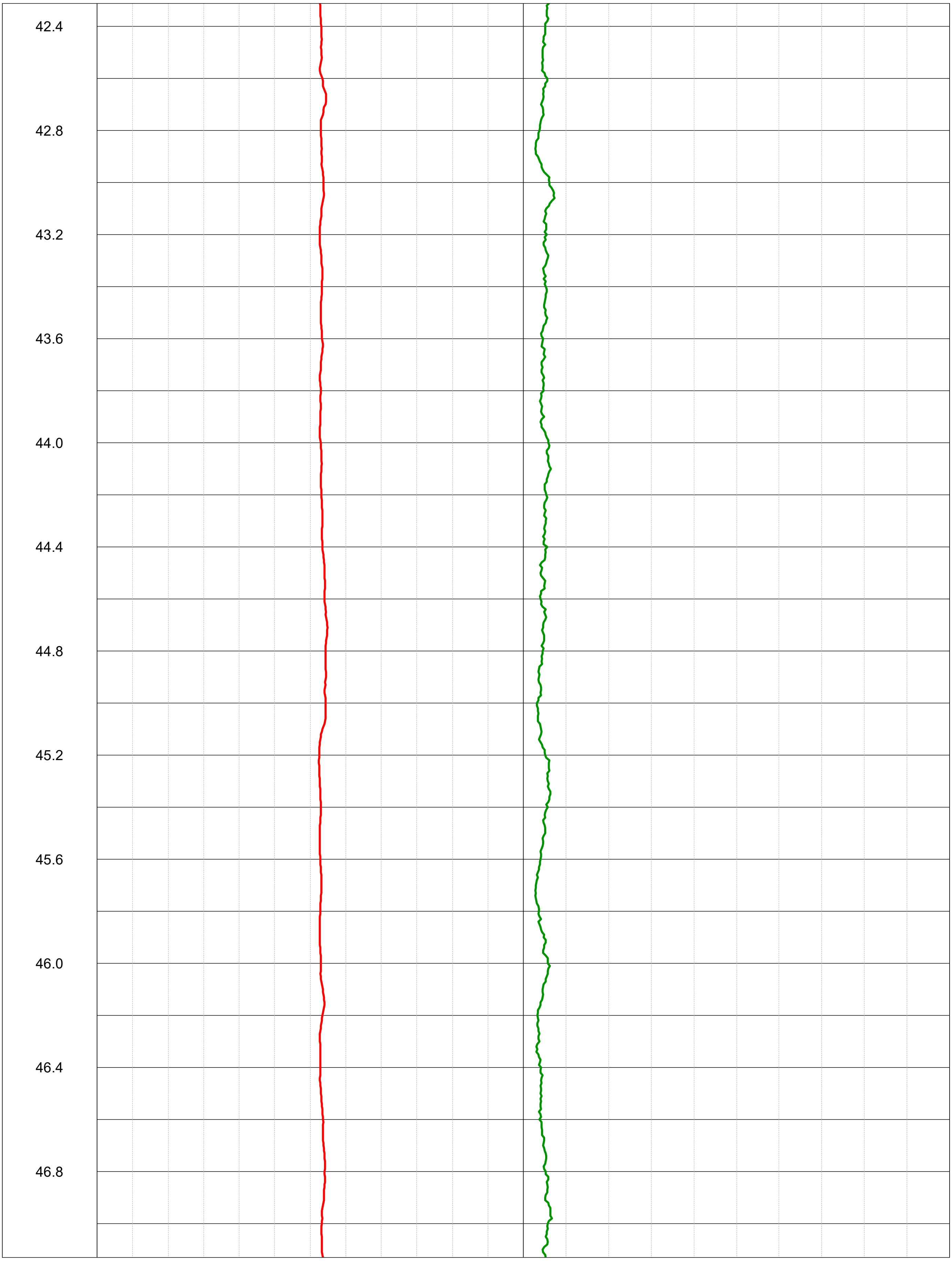


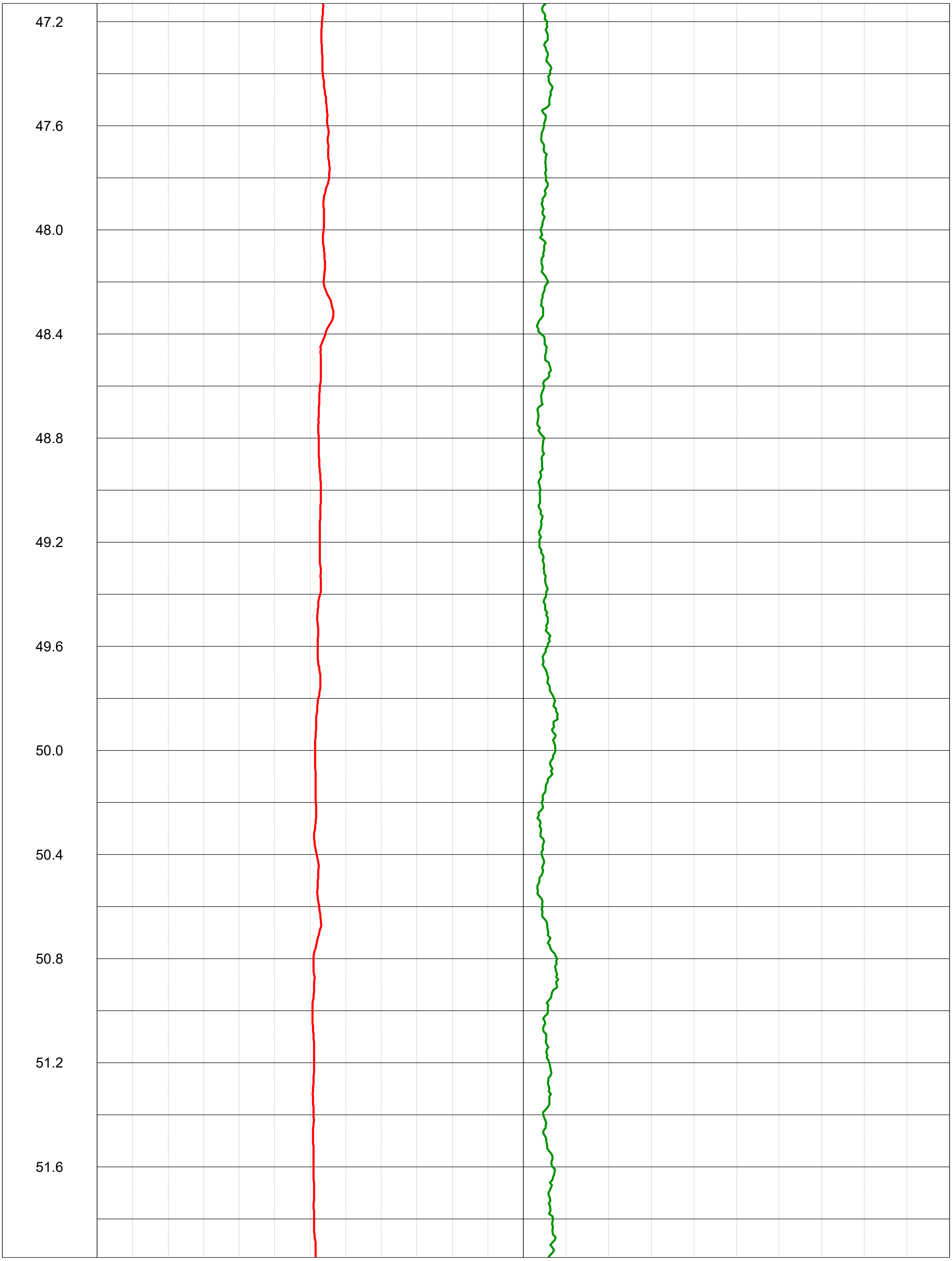
28.0
28.4
28.8
29.2
29.6
30.0
30.4
30.8
31.2
31.6
32.0
32.4

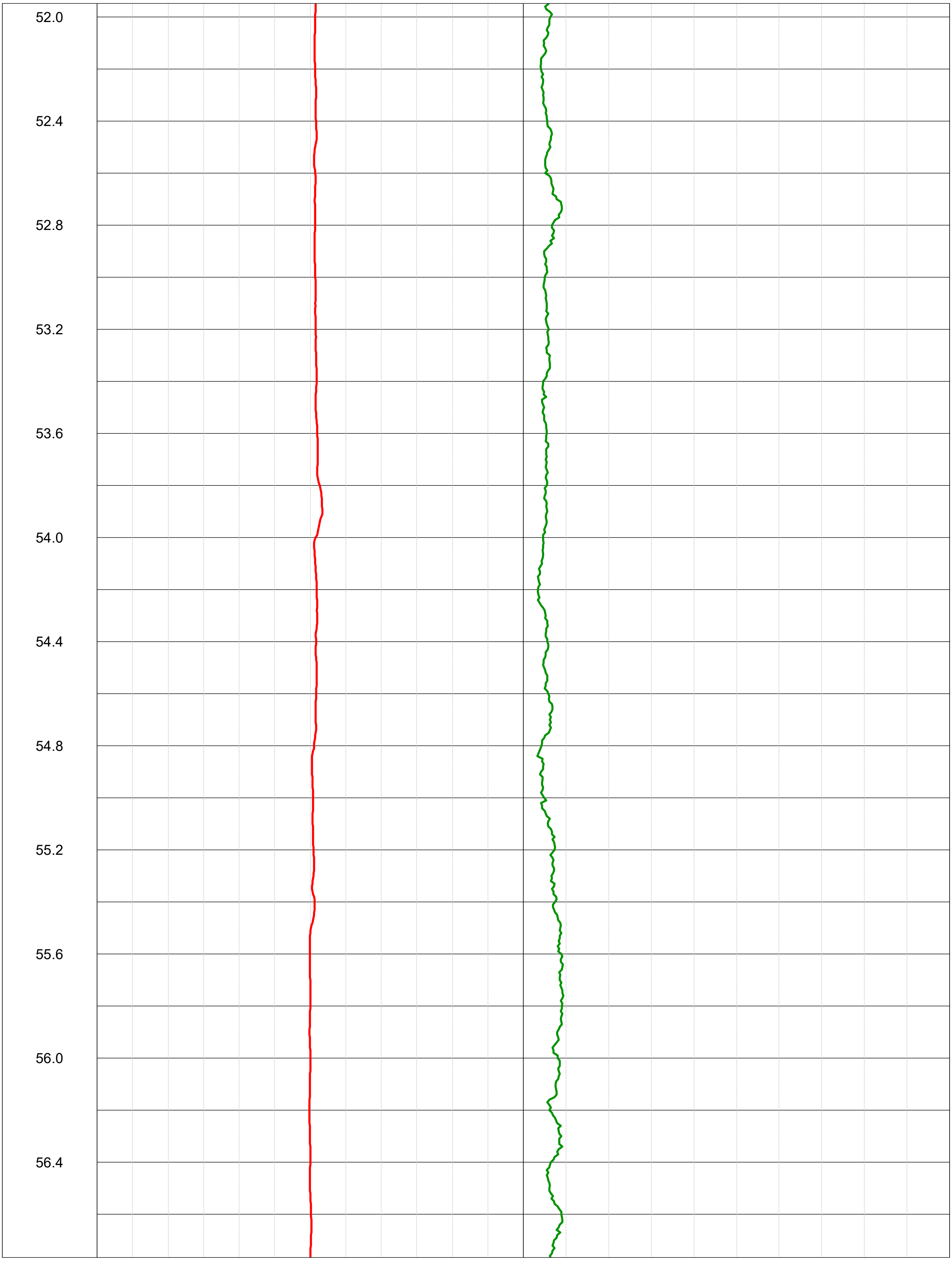


32.8
33.2
33.6
34.0
34.4
34.8
35.2
35.6
36.0
36.4
36.8
37.2


37.6
38.0
38.4
38.8
39.2
39.6
40.0
40.4
40.8
41.2
41.6
42.0

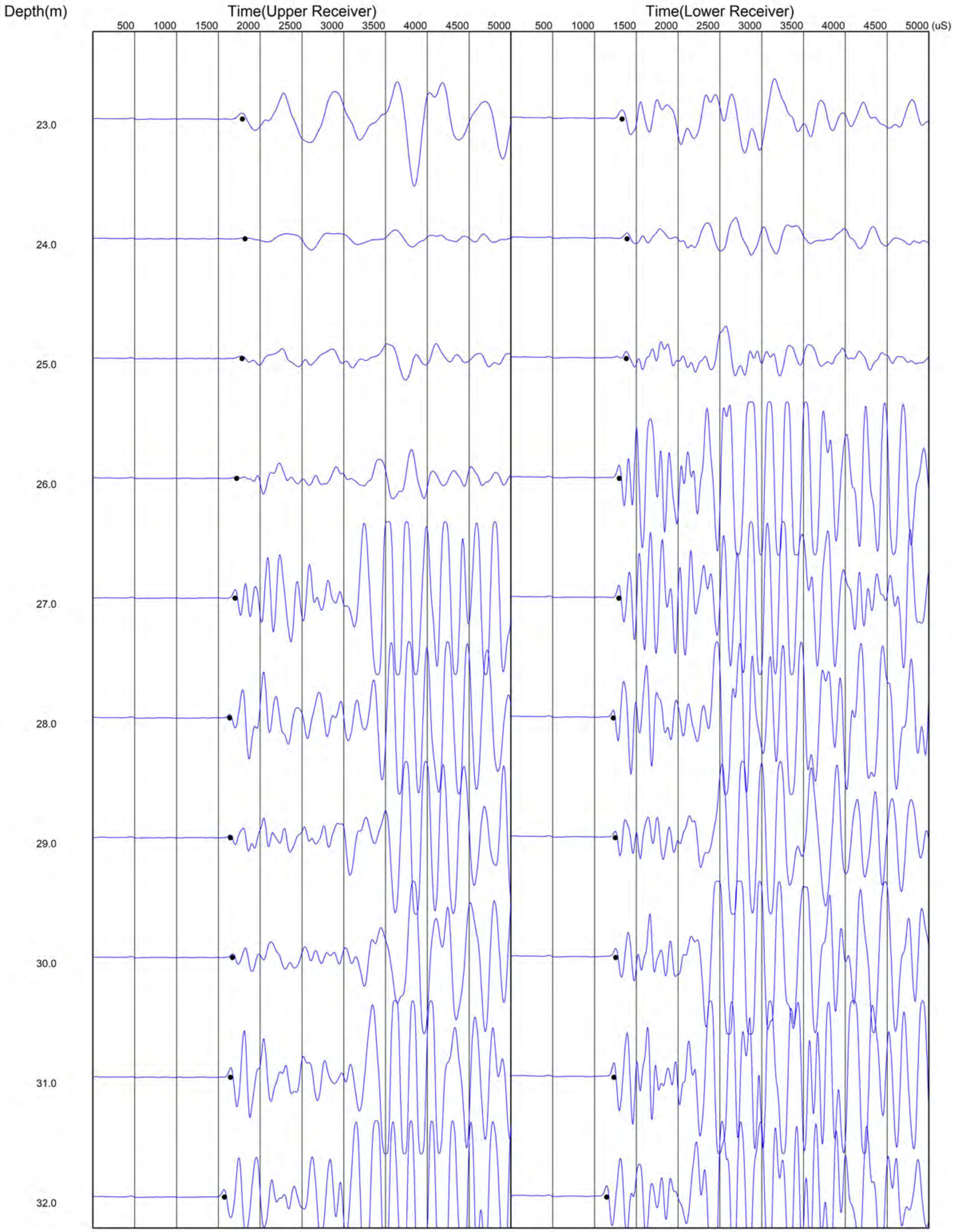

42.4
42.8
43.2
43.6
44.0
44.4
44.8
45.2
45.6
46.0
46.4
46.8


47.2
47.6
48.0
48.4
48.8
49.2
49.6
50.0
50.4
50.8
51.2
51.6


52.0
52.4
52.8
53.2
53.6
54.0
54.4
54.8
55.2
55.6
56.0
56.4

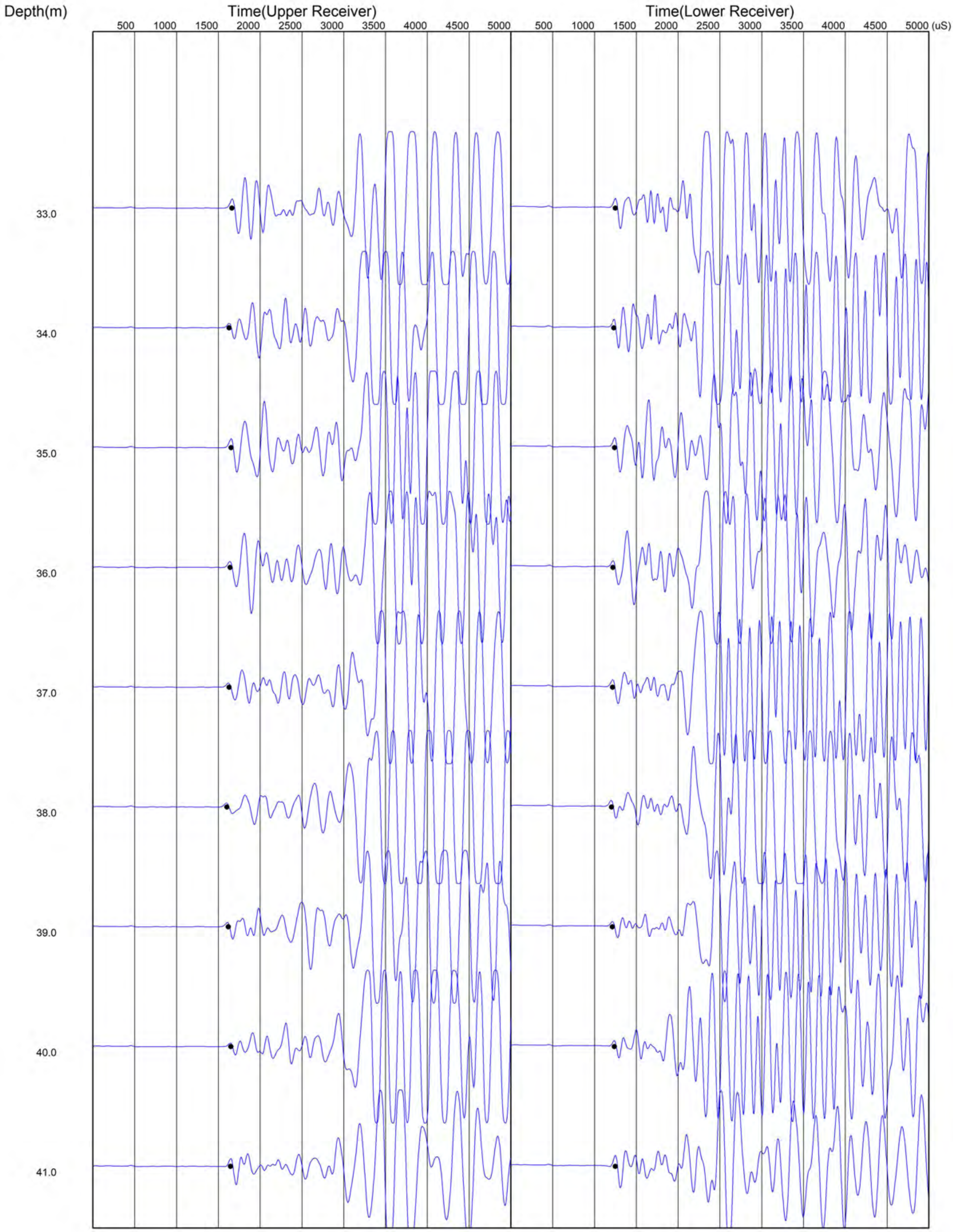

56.8
57.2
57.6
58.0
58.4
58.8
59.2
59.6

P Wave



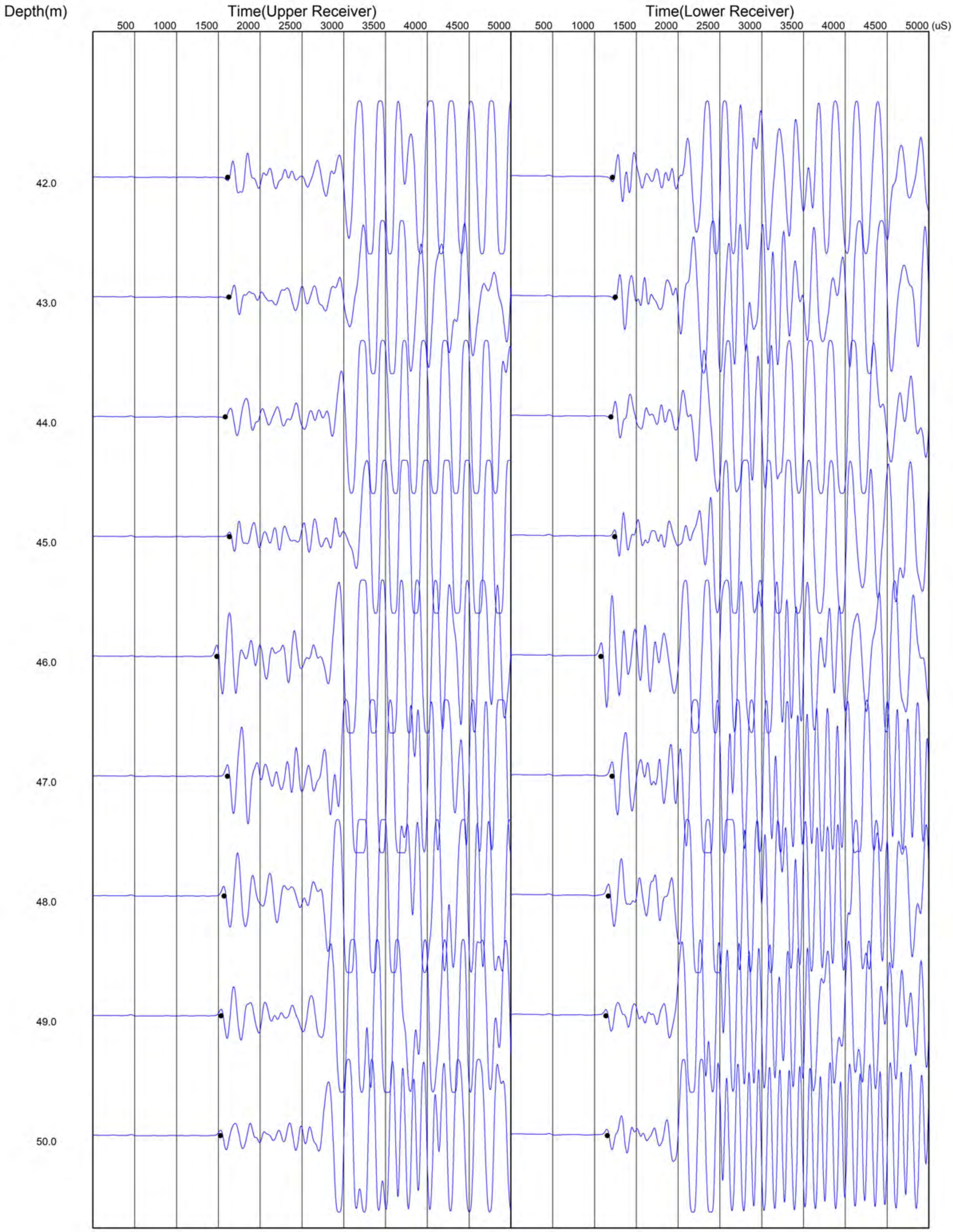
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
23.0
24.0
25.0
26.0
27.0
28.0
29.0
30.0
31.0
32.0

P Wave



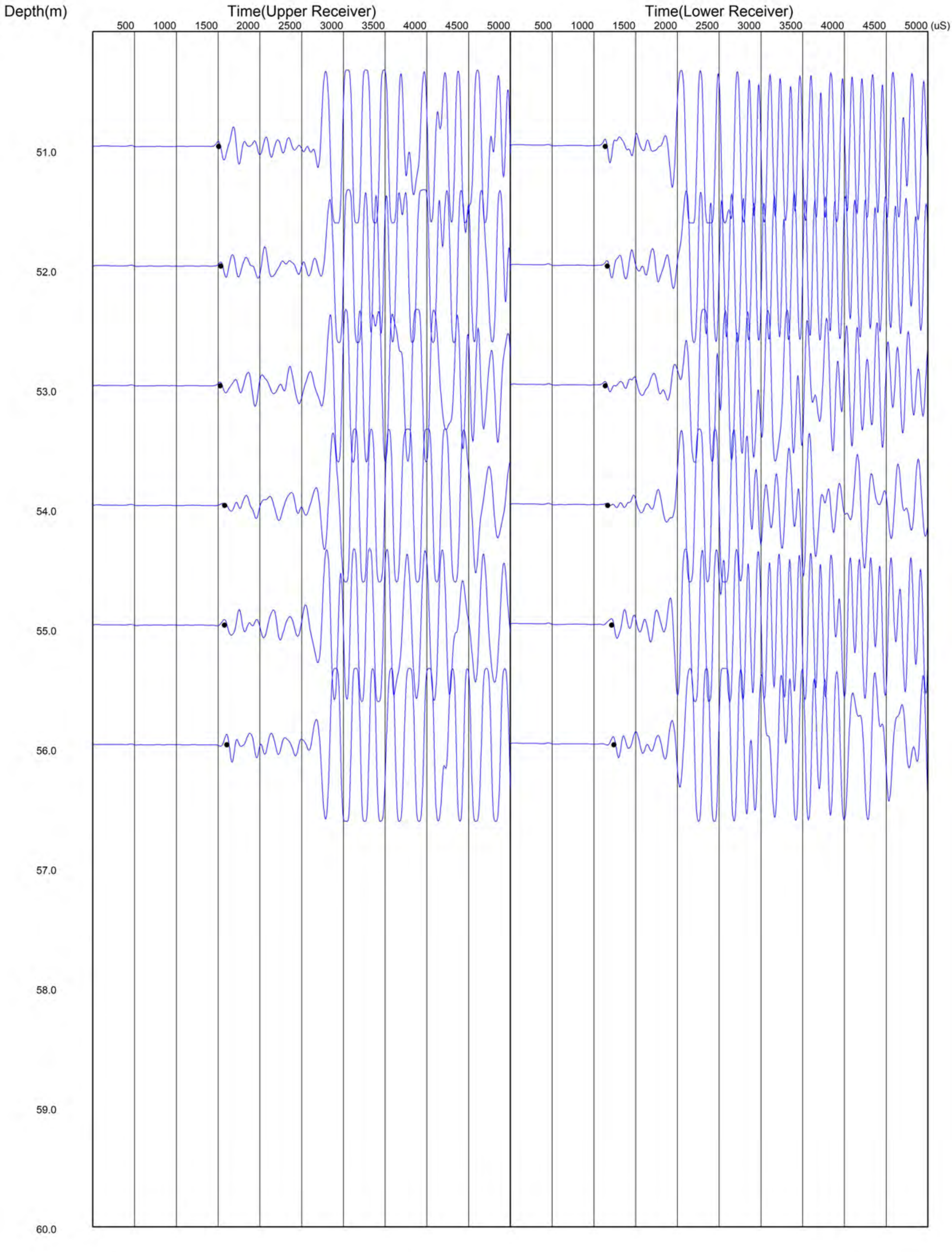
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0
41.0

P Wave



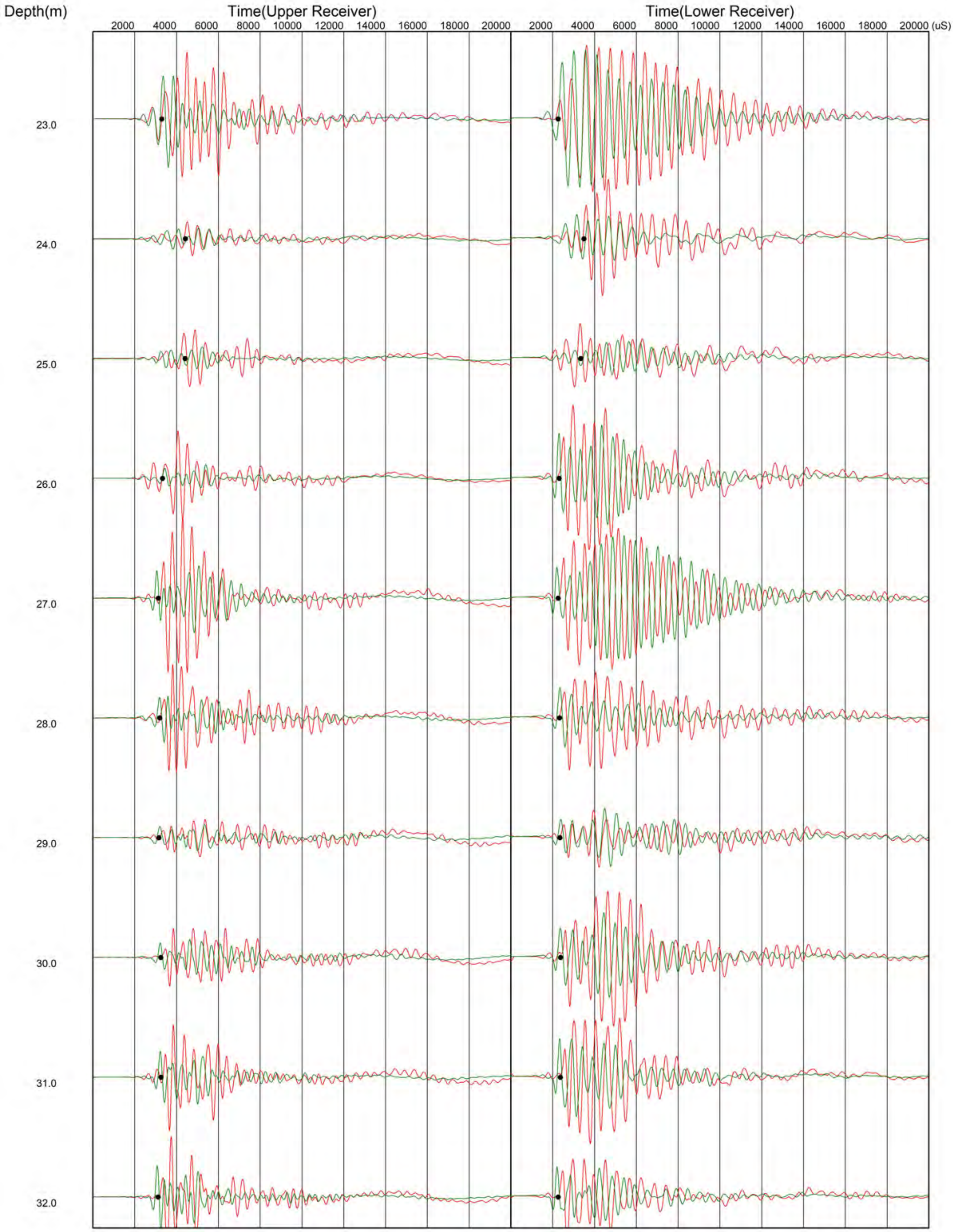
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
42.0
43.0
44.0
45.0
46.0
47.0
48.0
49.0
50.0

P Wave



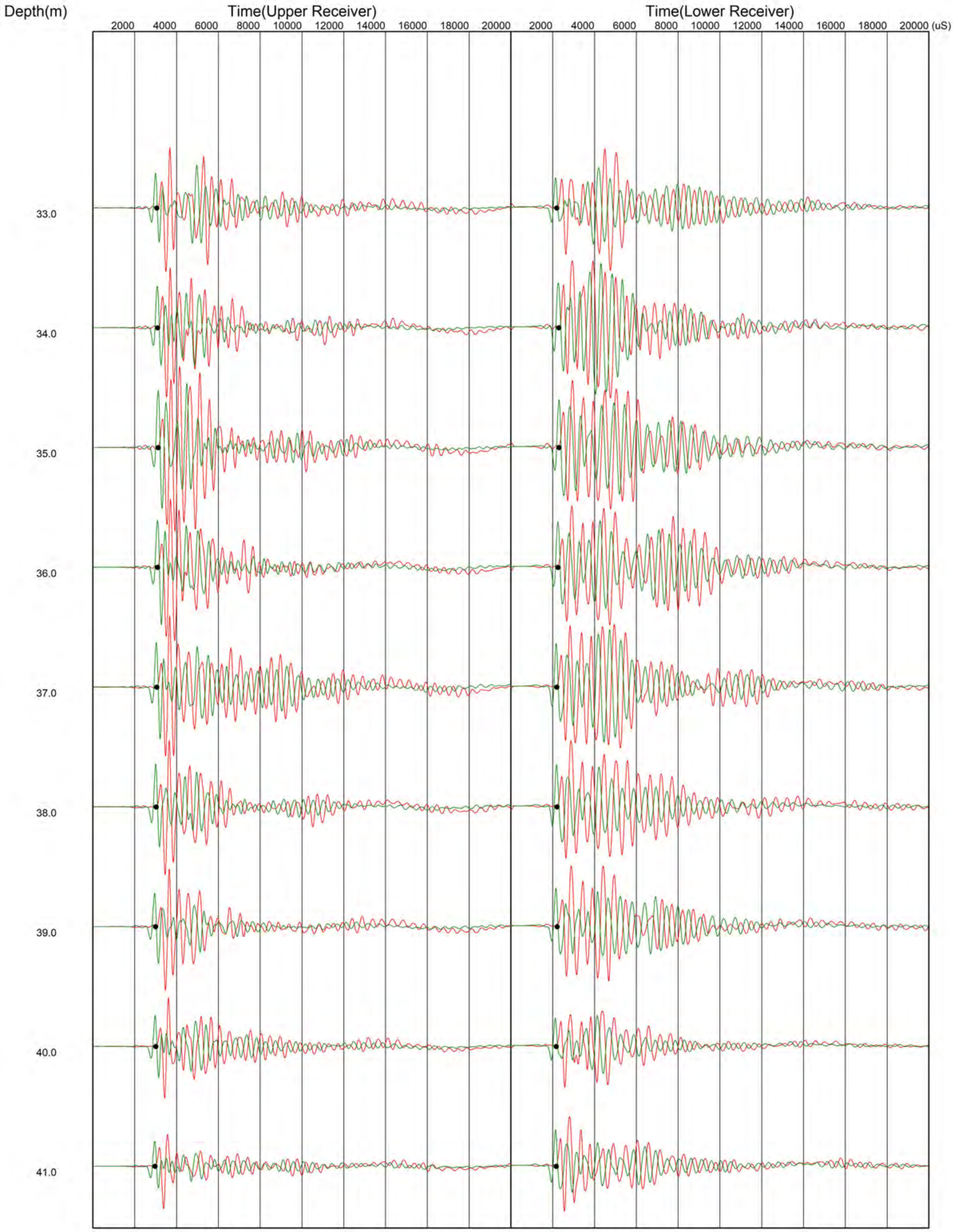
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
51.0
52.0
53.0
54.0
55.0
56.0
57.0
58.0
59.0
60.0

S Wave



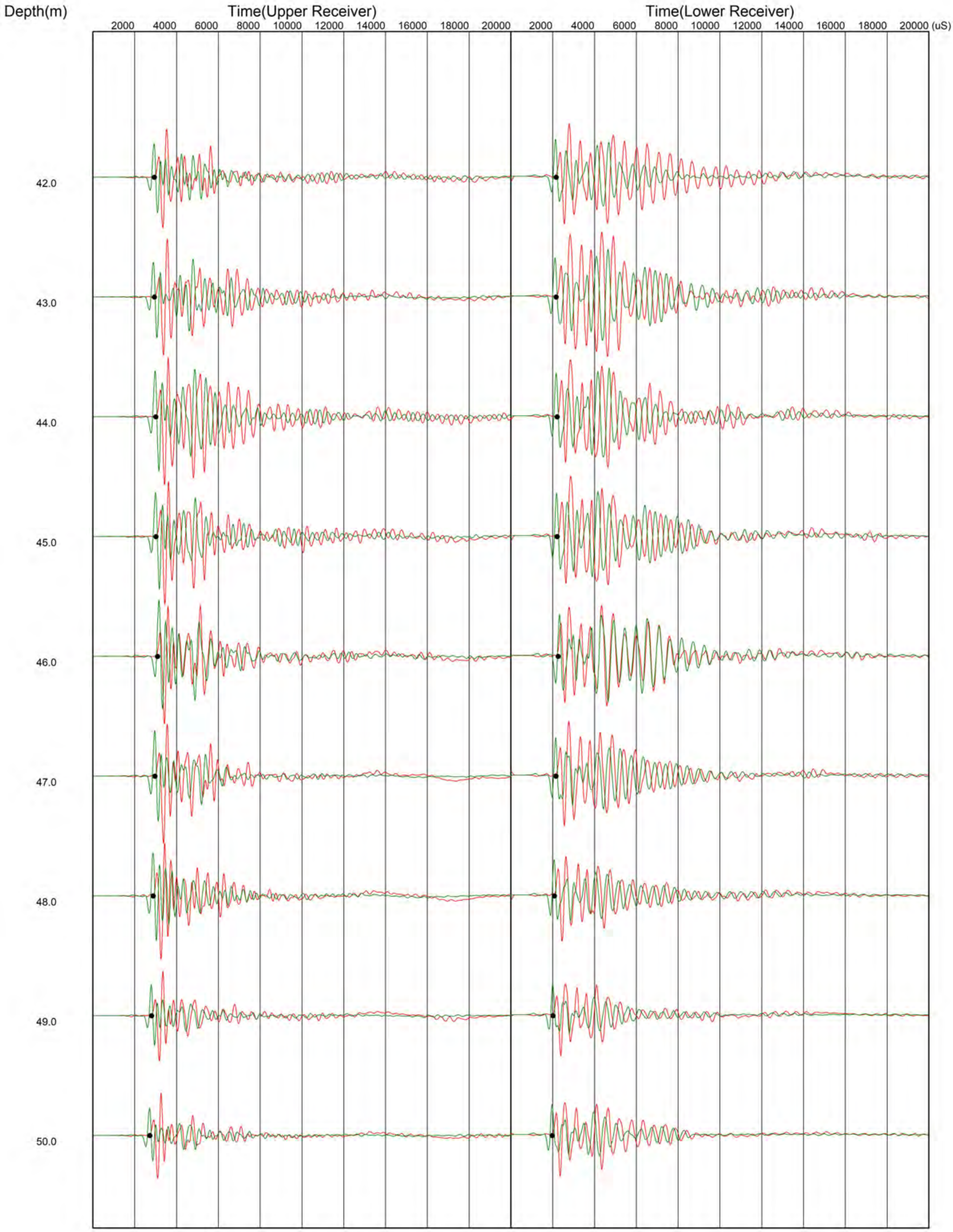
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
23.0
24.0
25.0
26.0
27.0
28.0
29.0
30.0
31.0
32.0

S Wave

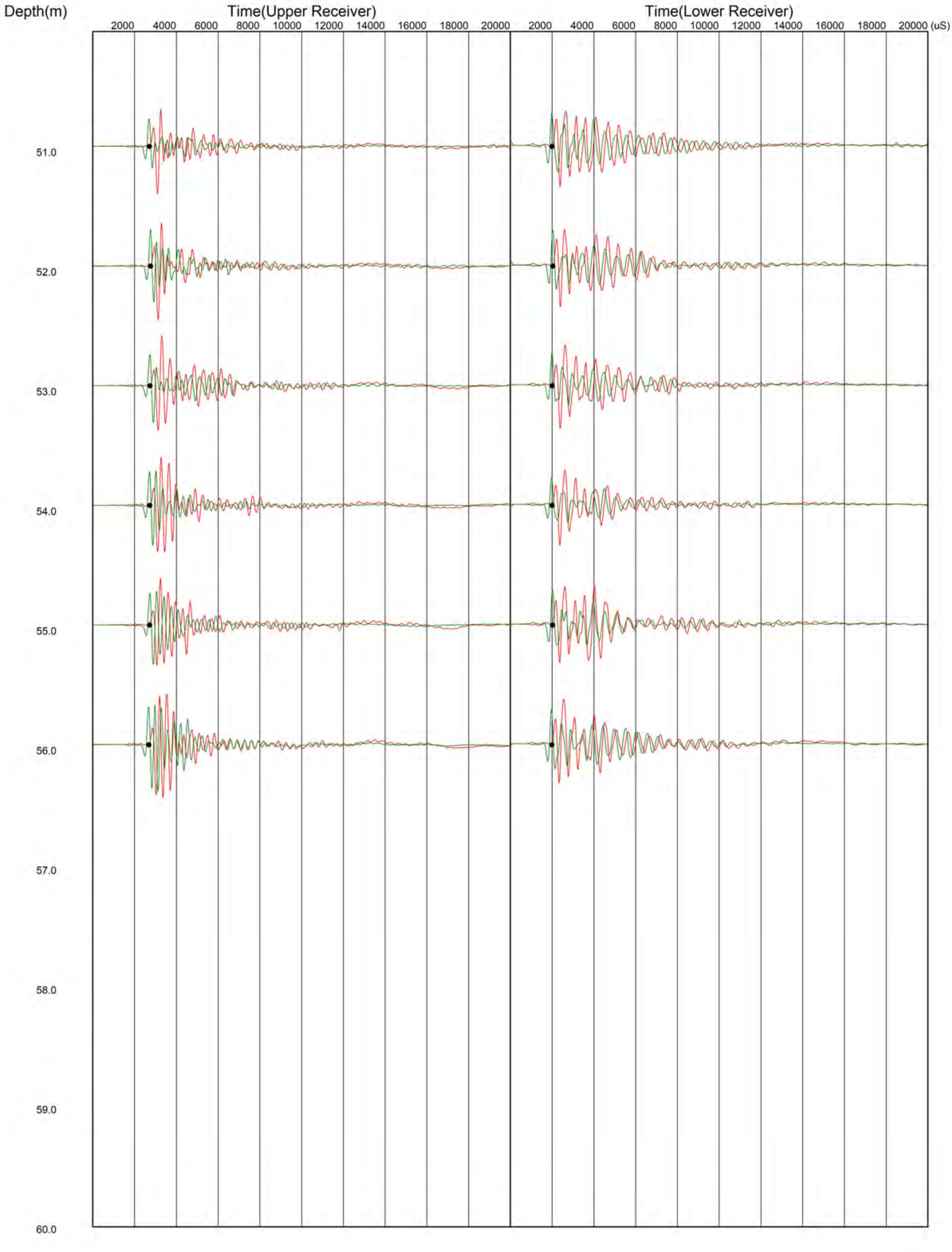


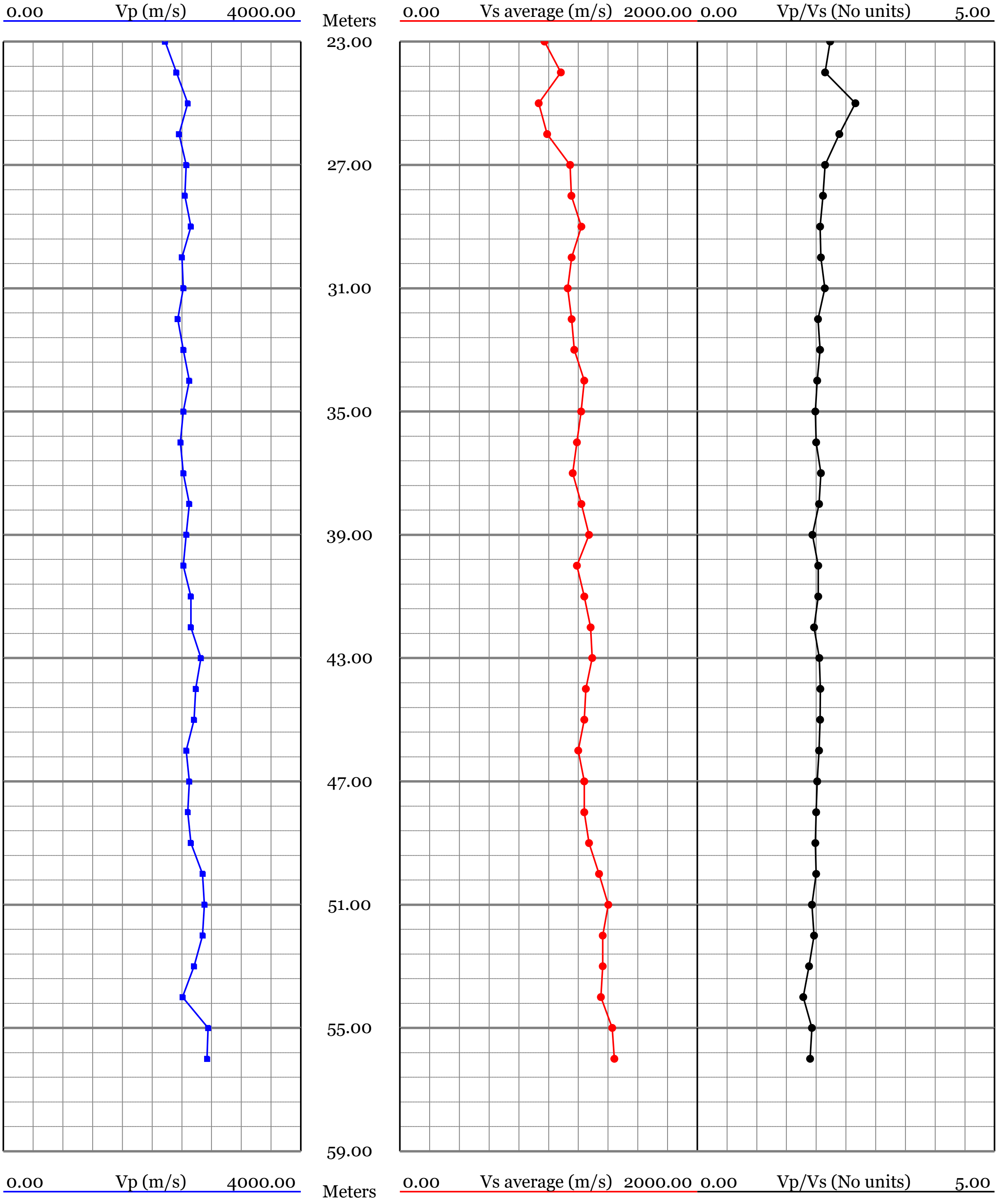
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
(uS)
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0
41.0

S Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
42.0
43.0
44.0
45.0
46.0
47.0
48.0
49.0
50.0

S Wave

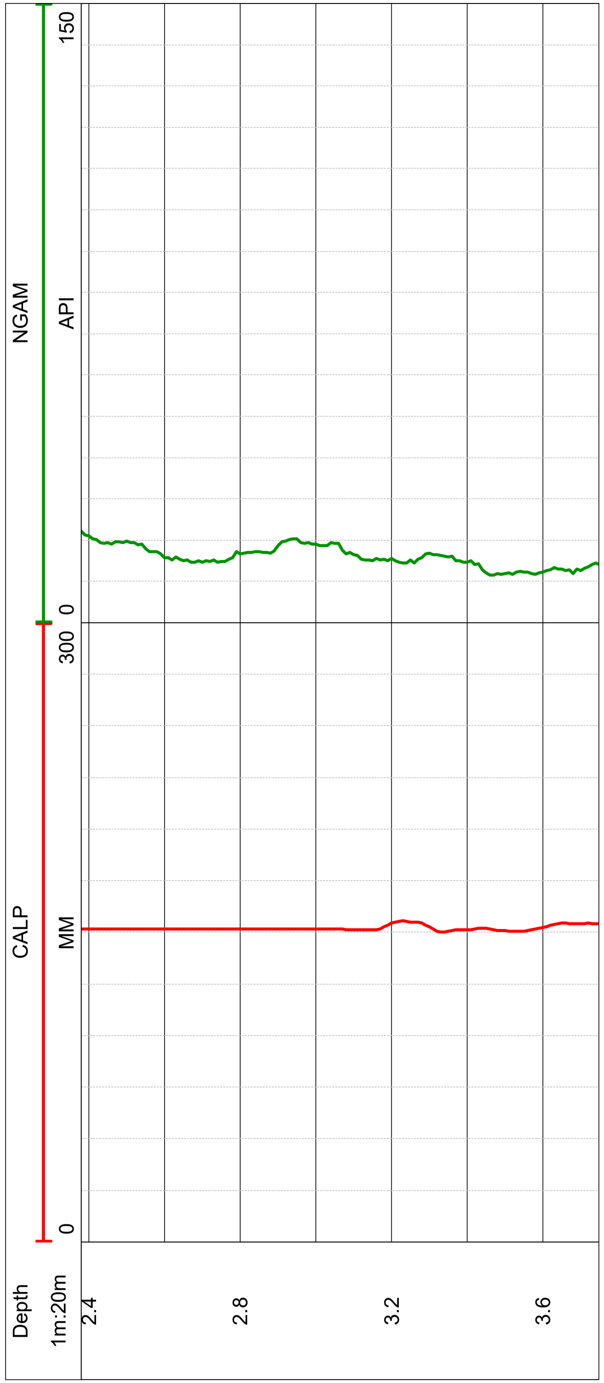

Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
51.0
52.0
53.0
54.0
55.0
56.0
57.0
58.0
59.0
60.0

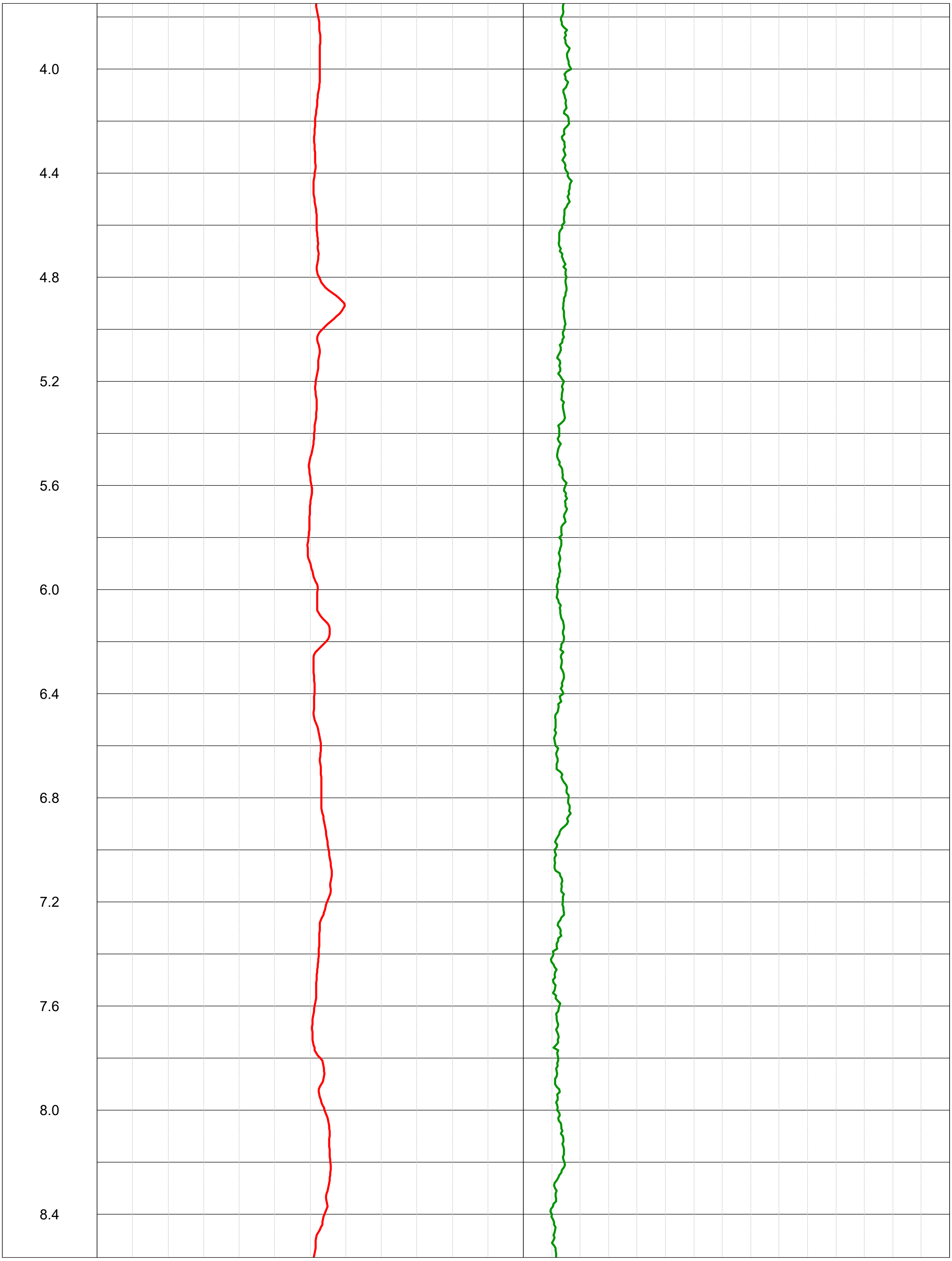

0.00
Vp (m/s)
4000.00
Meters
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00
23.00
27.00
31.00
35.00
39.00
43.00
47.00
51.00
55.00
59.00

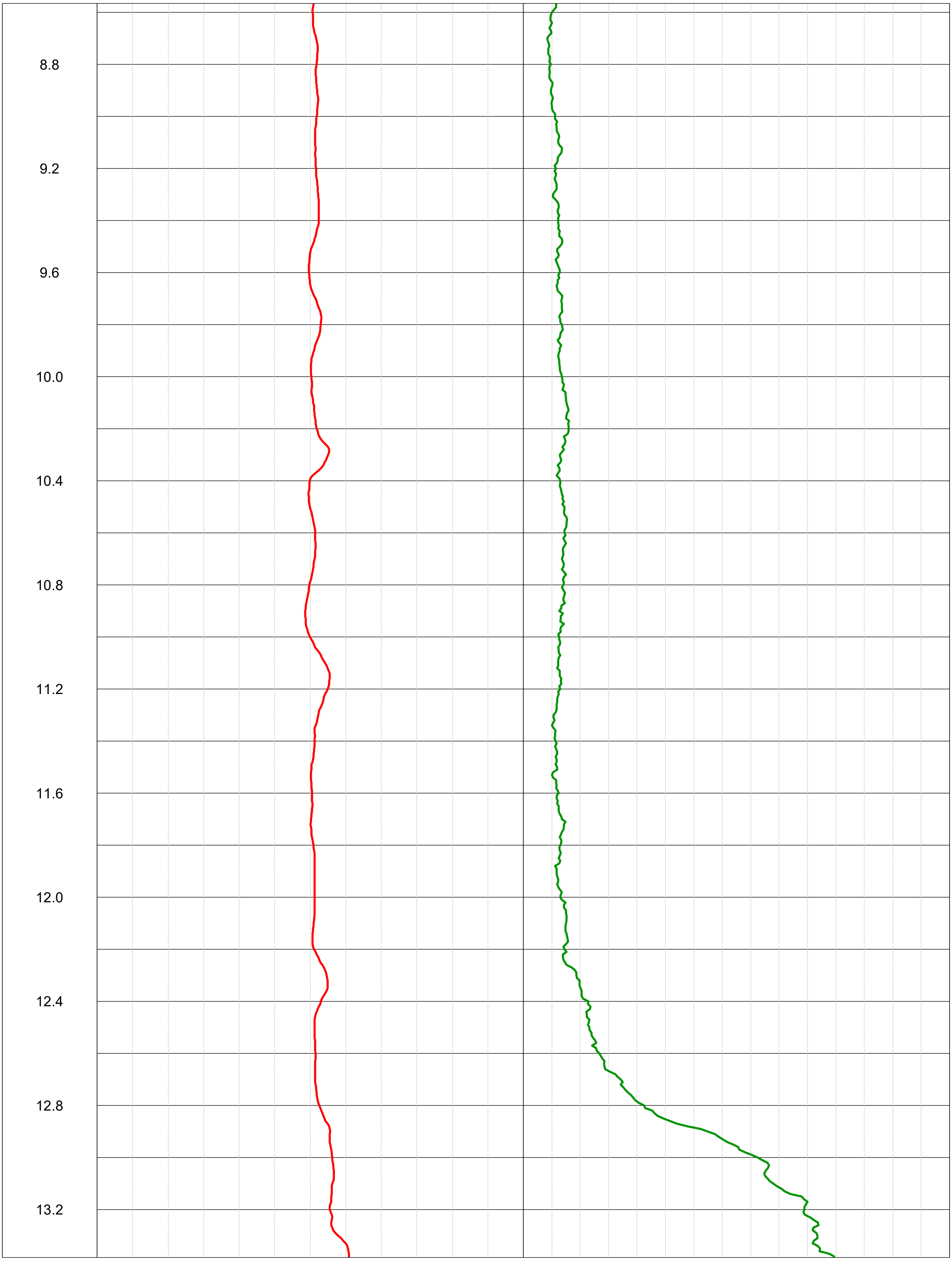
ROBERTSON GEO SERVICES
Unlocking Your GeoData

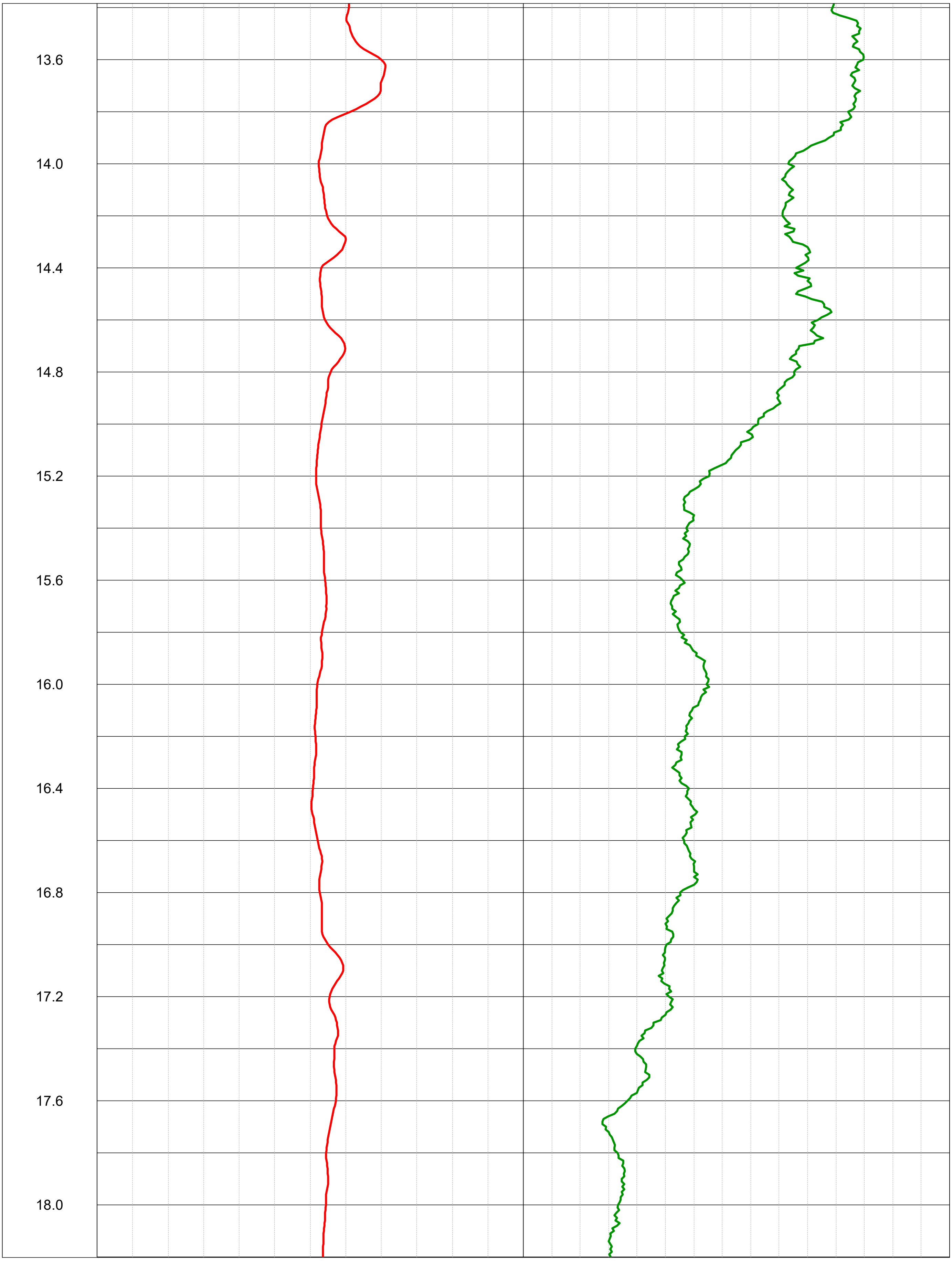
CO Structural Soils WELL RX609 FLD A303 Stonehenge CTY England STE FILING No	COMPANY Structural Soils WELL ID RX609 FIELD A303 Stonehenge COUNTRY England STATE		
	LOCATION Easting: 412287.98 Northing: 141883.91 SEC TWP RGE		OTHER SERVICES
PERMANENT DATUM	GL	ELEVATION 93.614	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.
DATE	15/05/18	TYPE FLUID IN HOLE	Water
RUN No		SALINITY	
TYPE LOG	Caliper Gamma	DENSITY	
DEPTH-DRILLER	60	LEVEL	22
DEPTH-LOGGER	59.4	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	59.4		
TOP LOGGED INTERVAL	2.38		
OPERATING RIG TIME			
RECORDED BY	James Boyett		
WITNESSED BY	Kyle Owen		

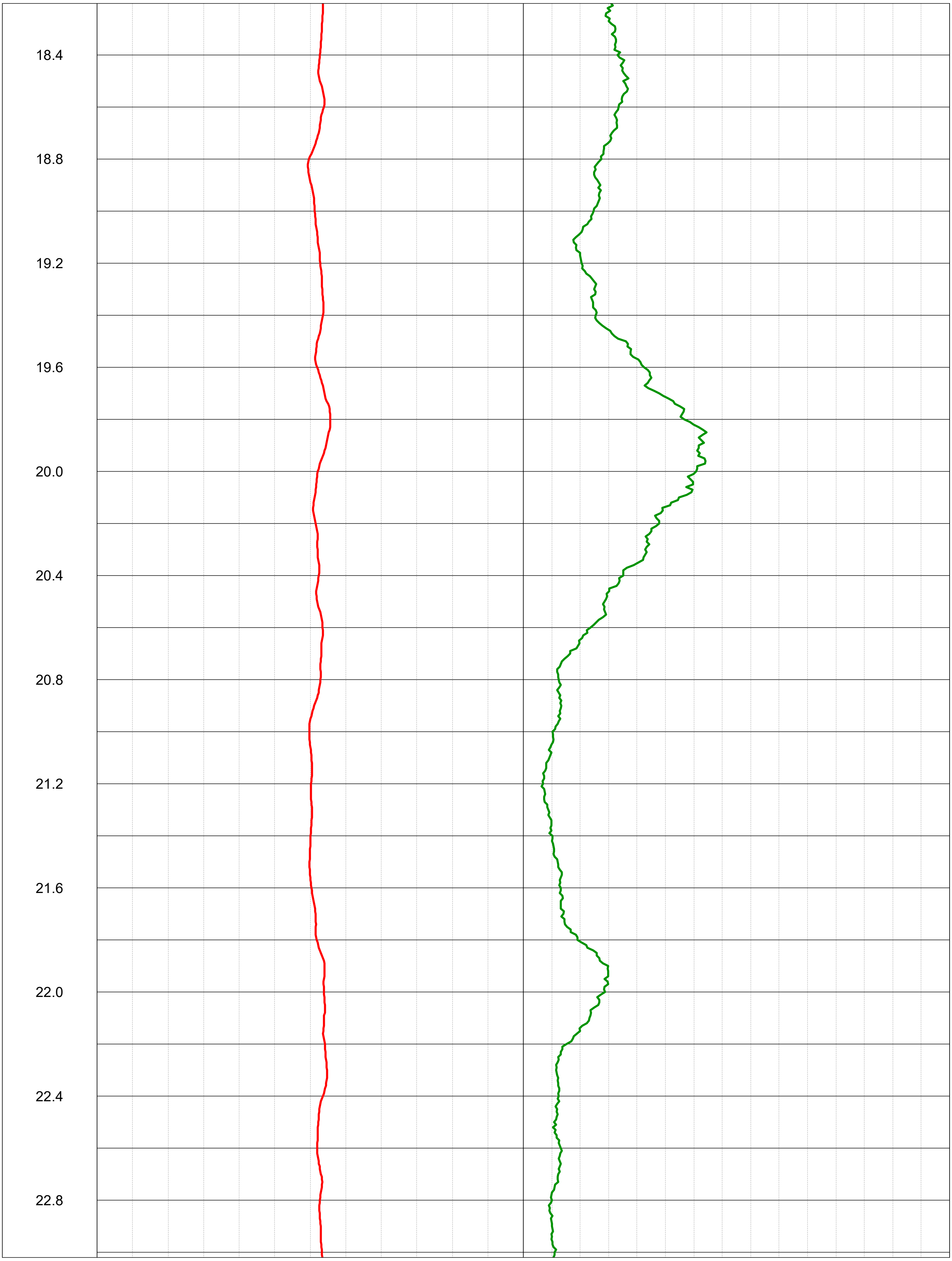
RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

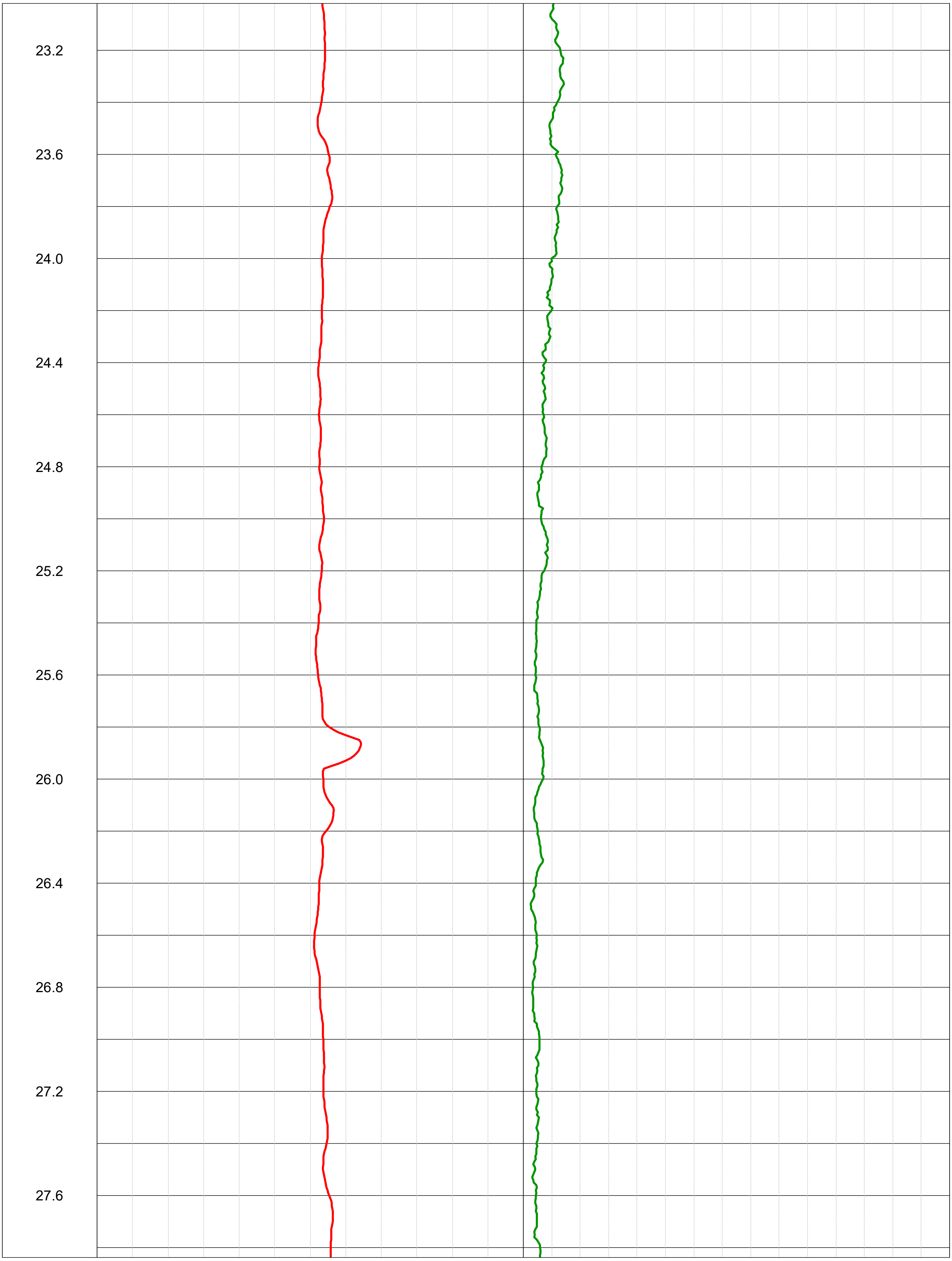


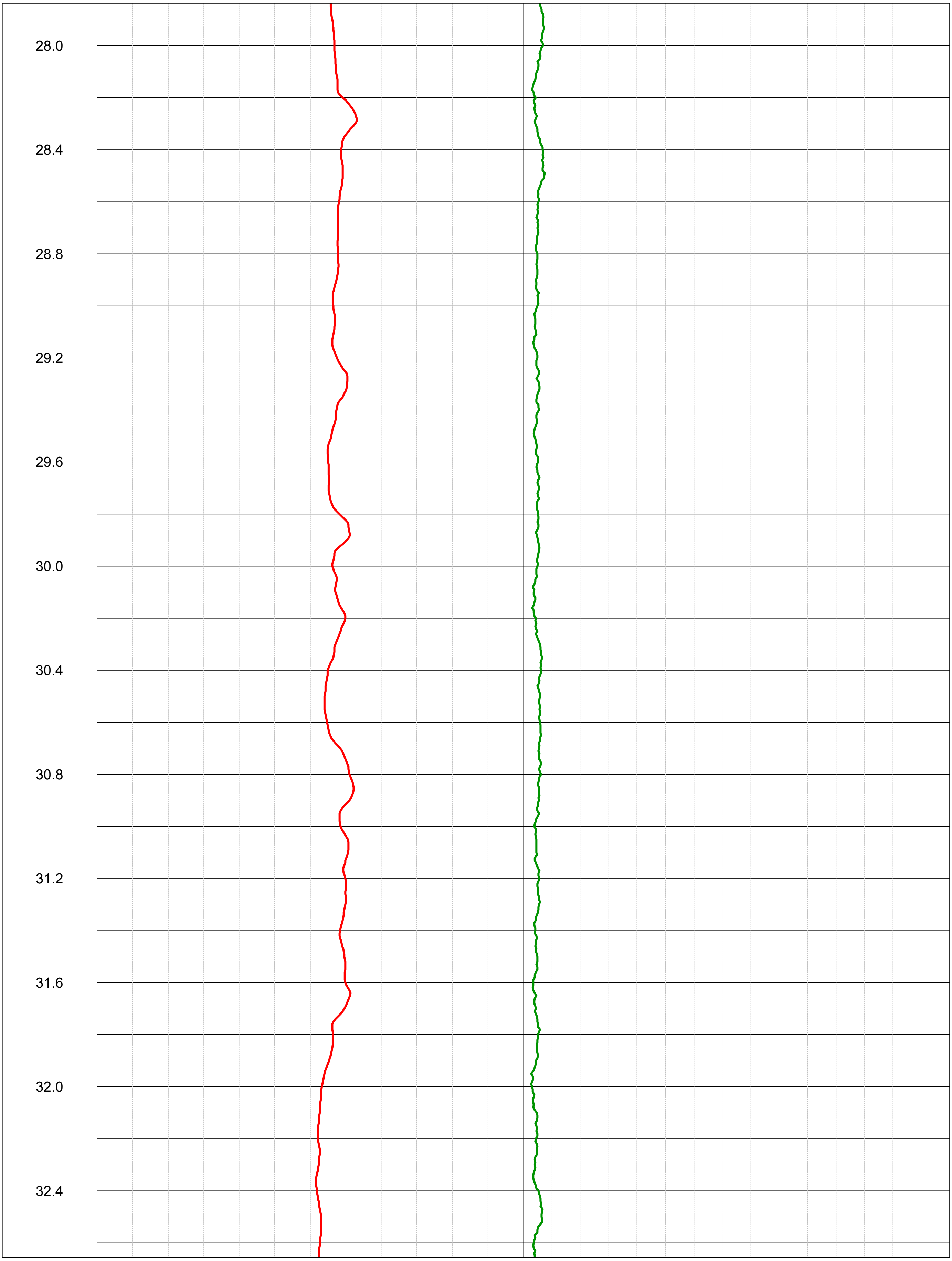

4.0
4.4
4.8
5.2
5.6
6.0
6.4
6.8
7.2
7.6
8.0
8.4

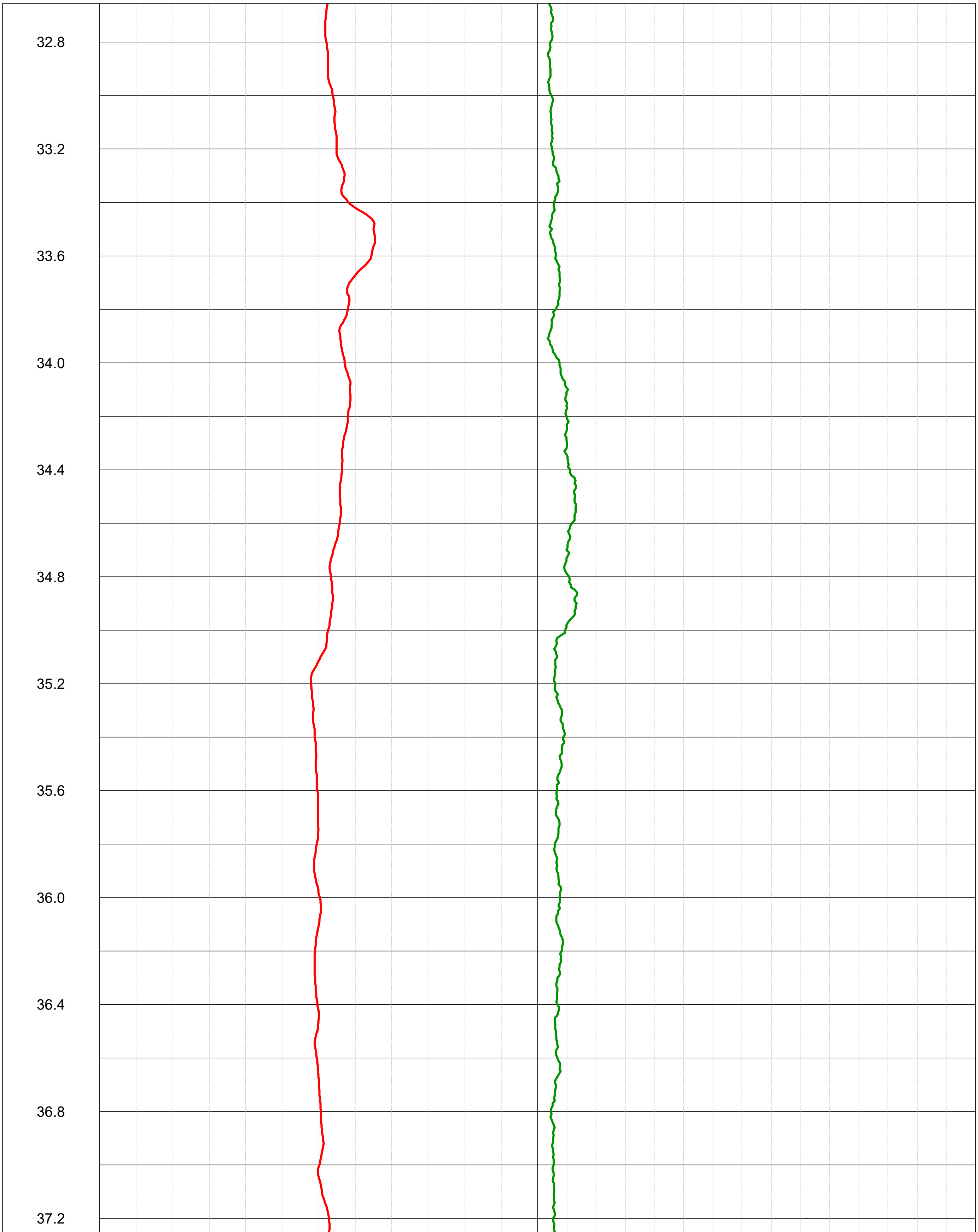

8.8
9.2
9.6
10.0
10.4
10.8
11.2
11.6
12.0
12.4
12.8
13.2

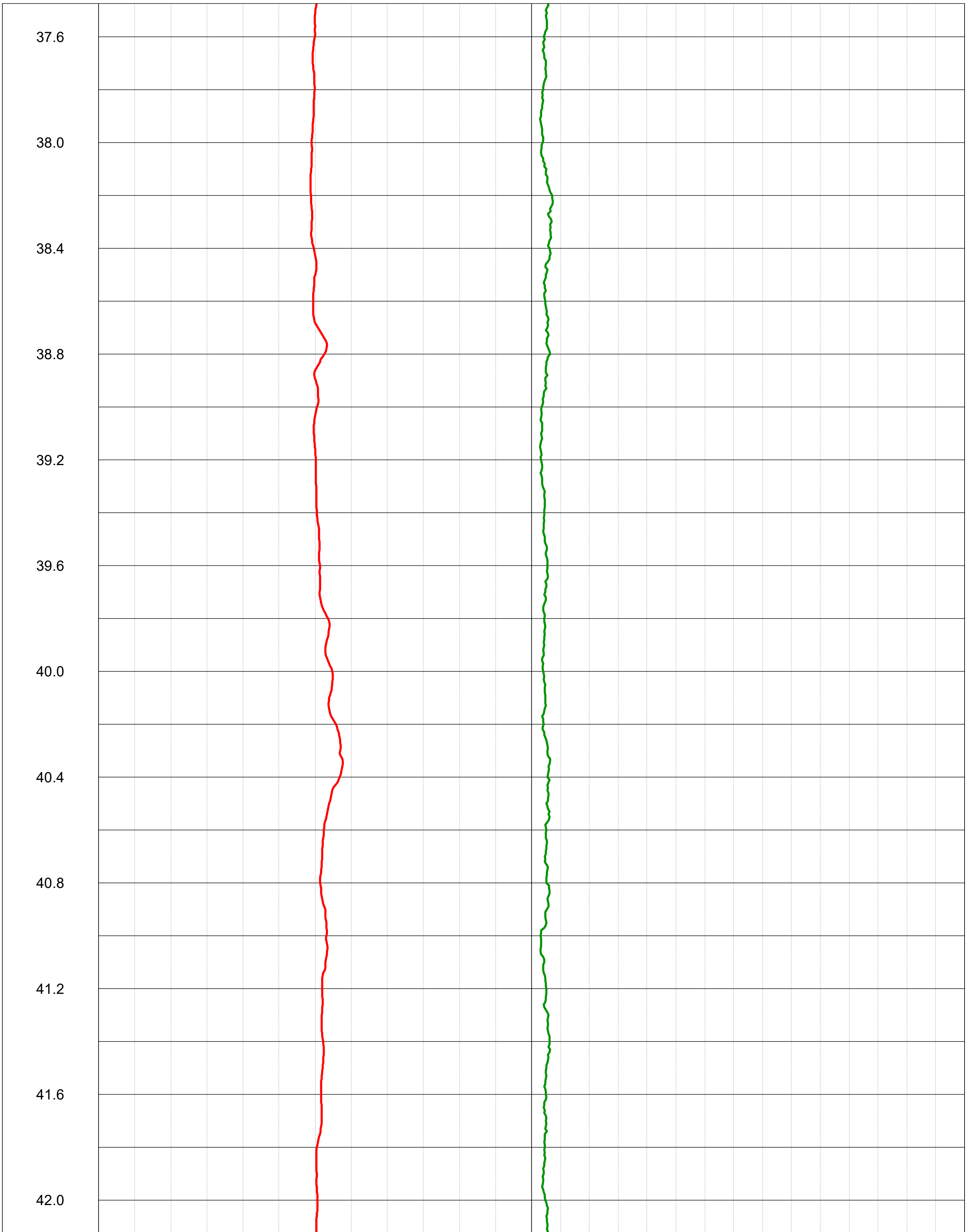

13.6
14.0
14.4
14.8
15.2
15.6
16.0
16.4
16.8
17.2
17.6
18.0

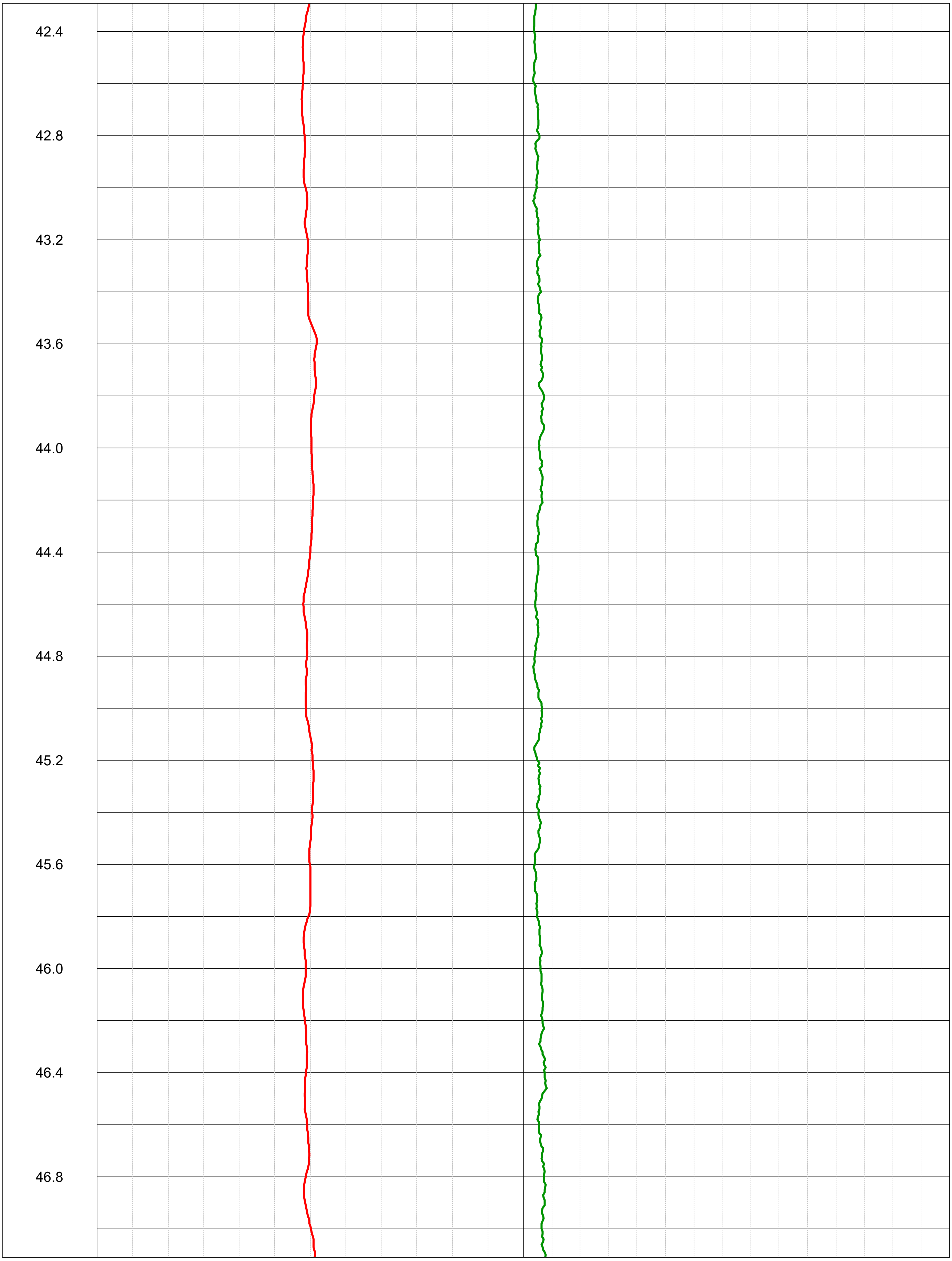

18.4
18.8
19.2
19.6
20.0
20.4
20.8
21.2
21.6
22.0
22.4
22.8

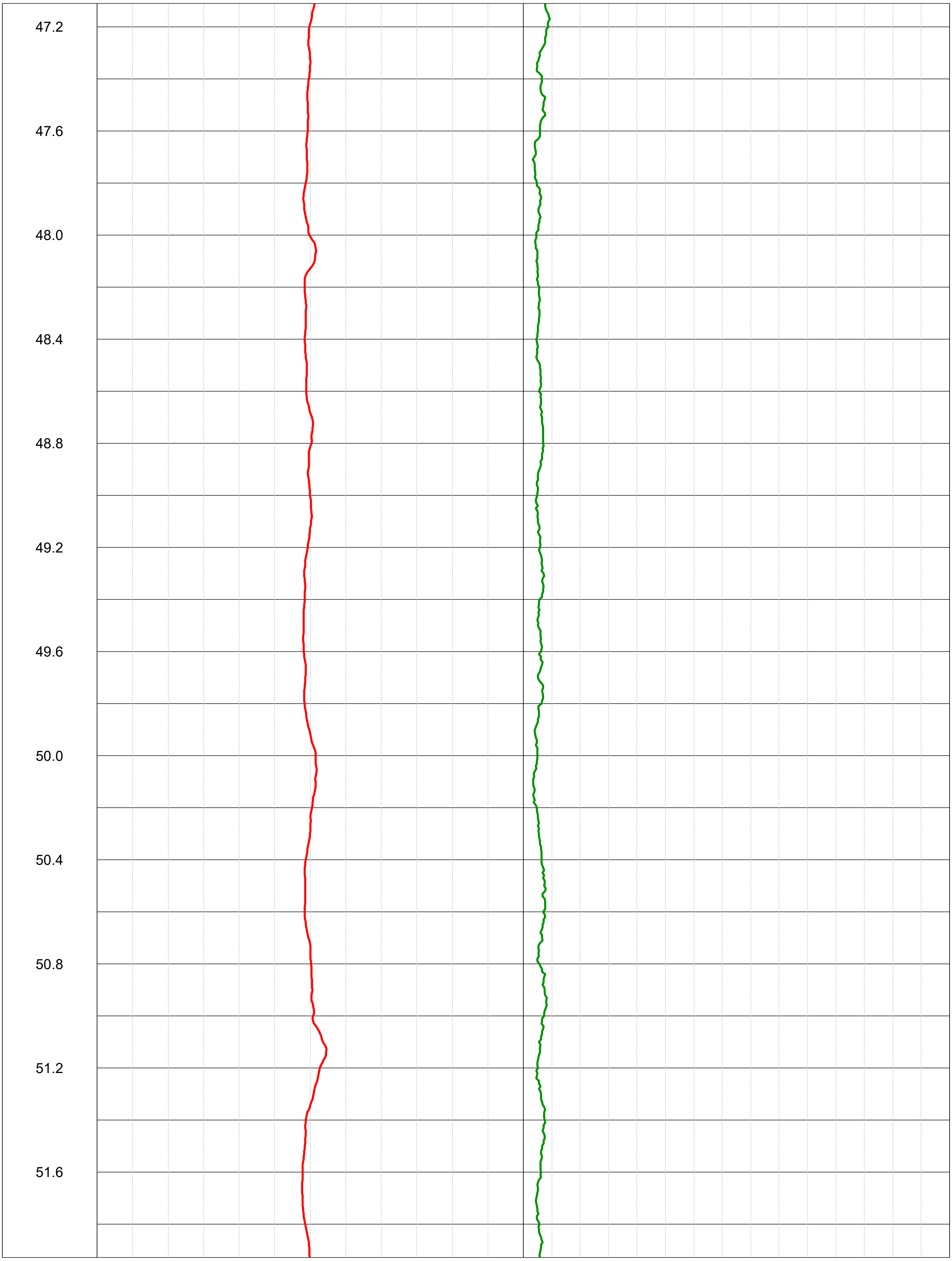

23.2
23.6
24.0
24.4
24.8
25.2
25.6
26.0
26.4
26.8
27.2
27.6


28.0
28.4
28.8
29.2
29.6
30.0
30.4
30.8
31.2
31.6
32.0
32.4

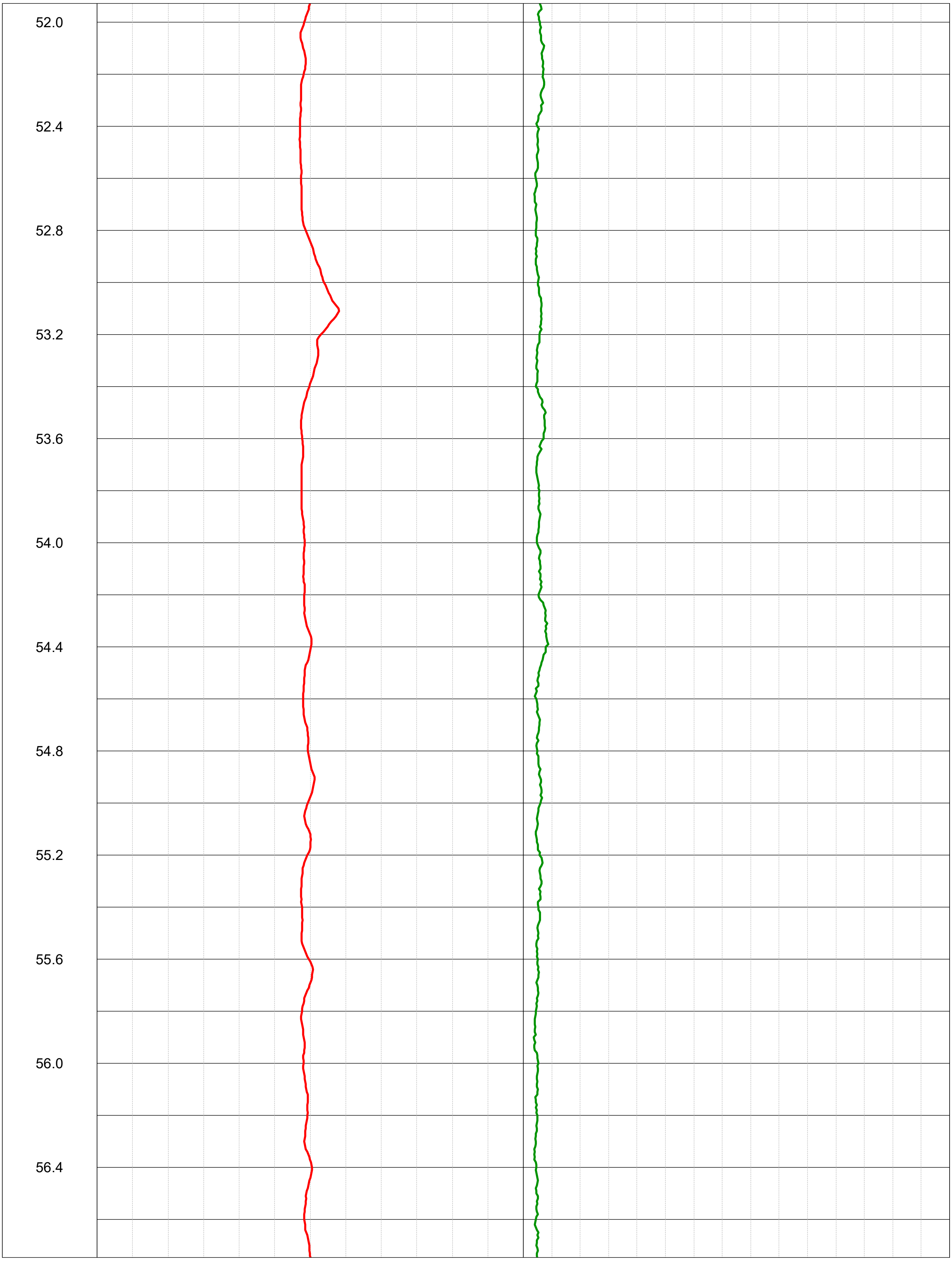

32.8
33.2
33.6
34.0
34.4
34.8
35.2
35.6
36.0
36.4
36.8
37.2


37.6
38.0
38.4
38.8
39.2
39.6
40.0
40.4
40.8
41.2
41.6
42.0


42.4
42.8
43.2
43.6
44.0
44.4
44.8
45.2
45.6
46.0
46.4
46.8

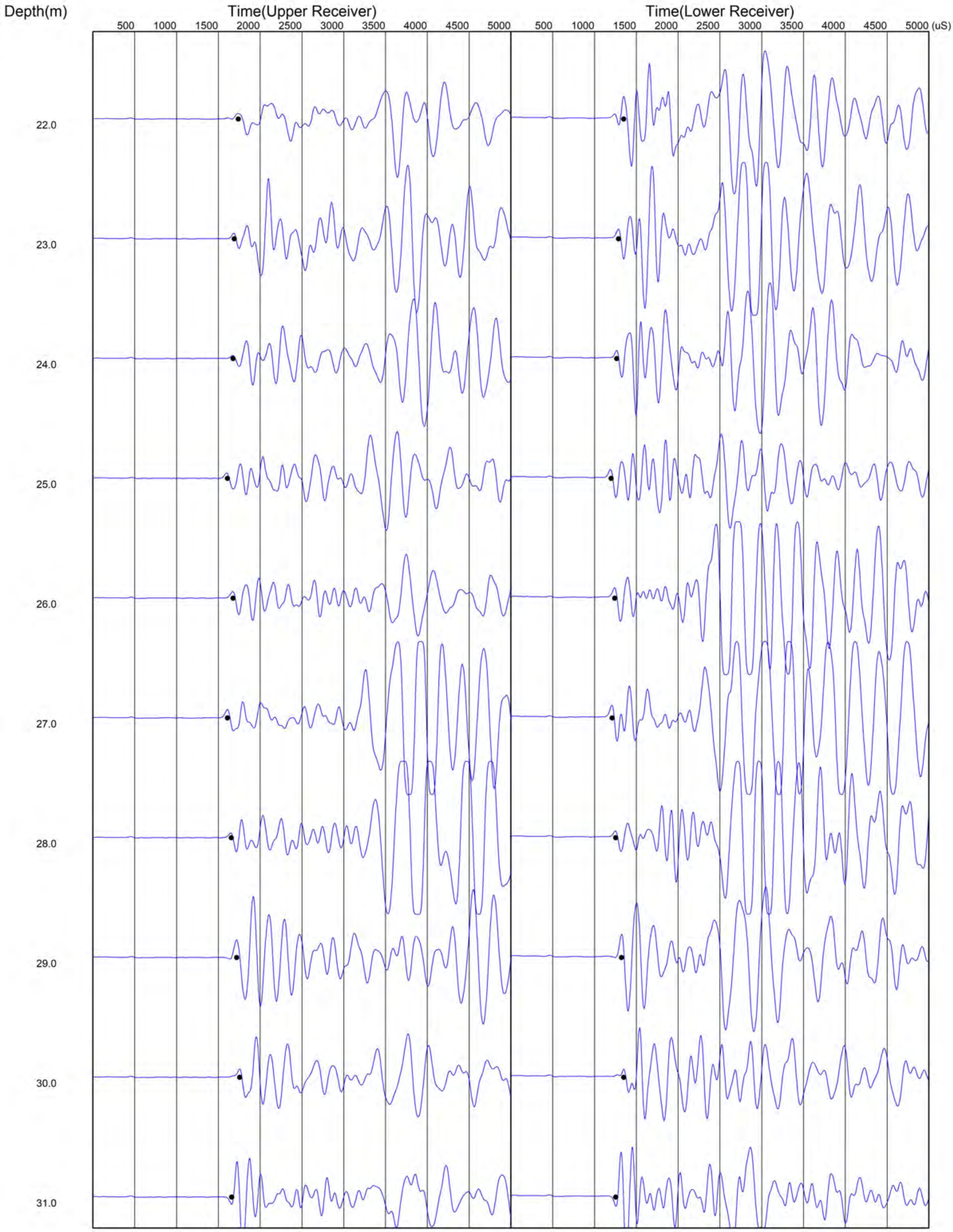


47.2
47.6
48.0
48.4
48.8
49.2
49.6
50.0
50.4
50.8
51.2
51.6

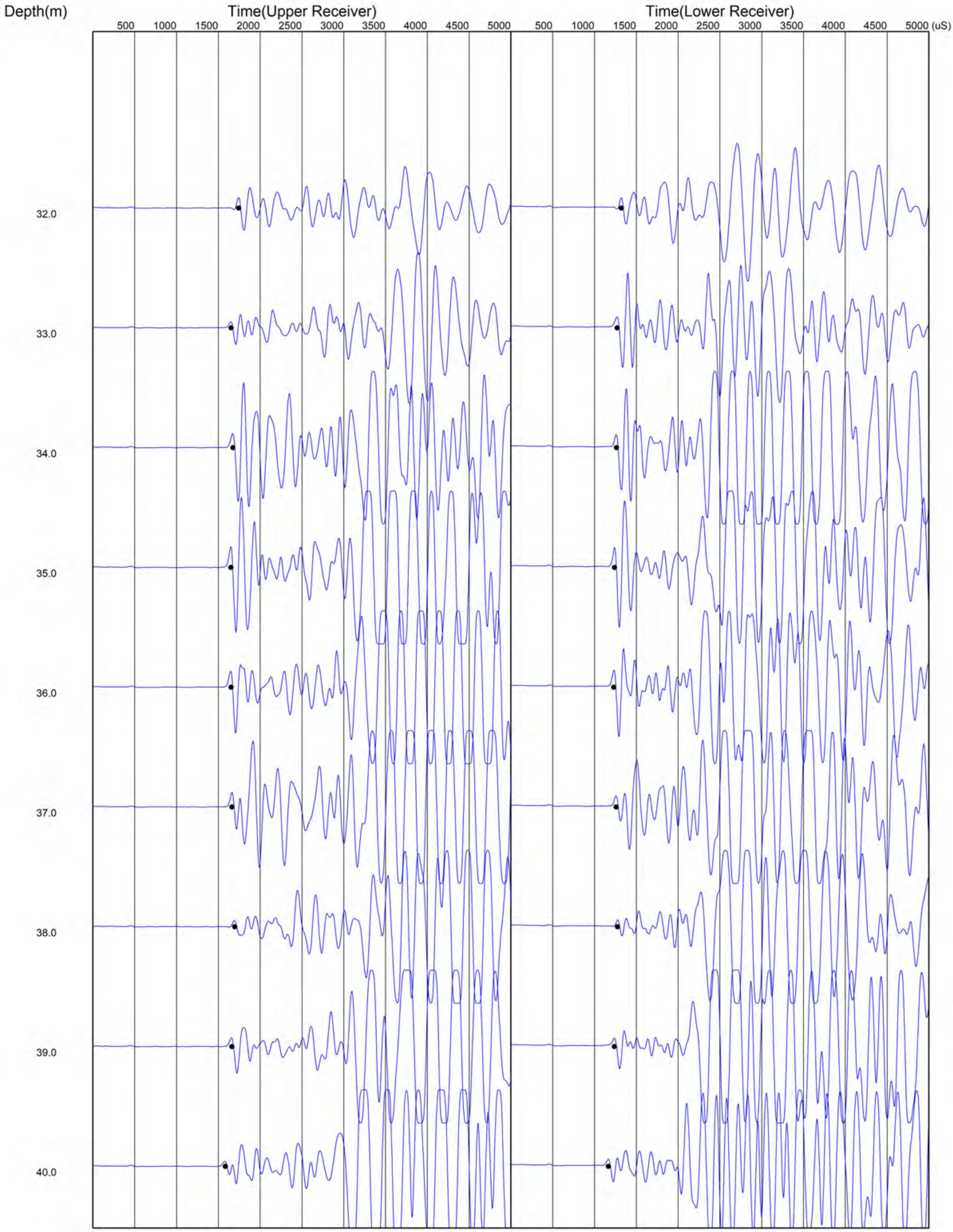

52.0
52.4
52.8
53.2
53.6
54.0
54.4
54.8
55.2
55.6
56.0
56.4


56.8
57.2
57.6
58.0
58.4
58.8
59.2
59.6

P Wave

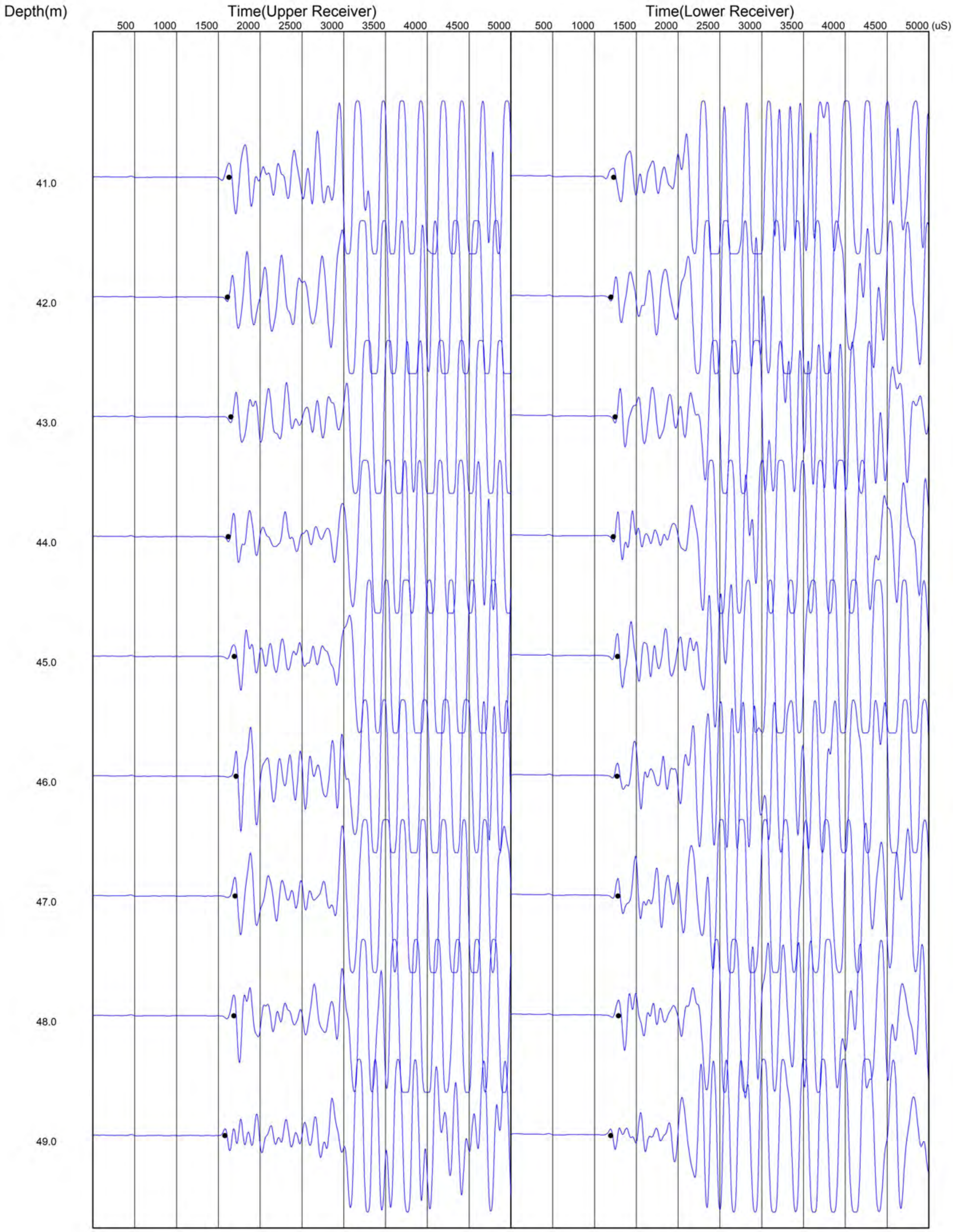

Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
22.0
23.0
24.0
25.0
26.0
27.0
28.0
29.0
30.0
31.0

P Wave



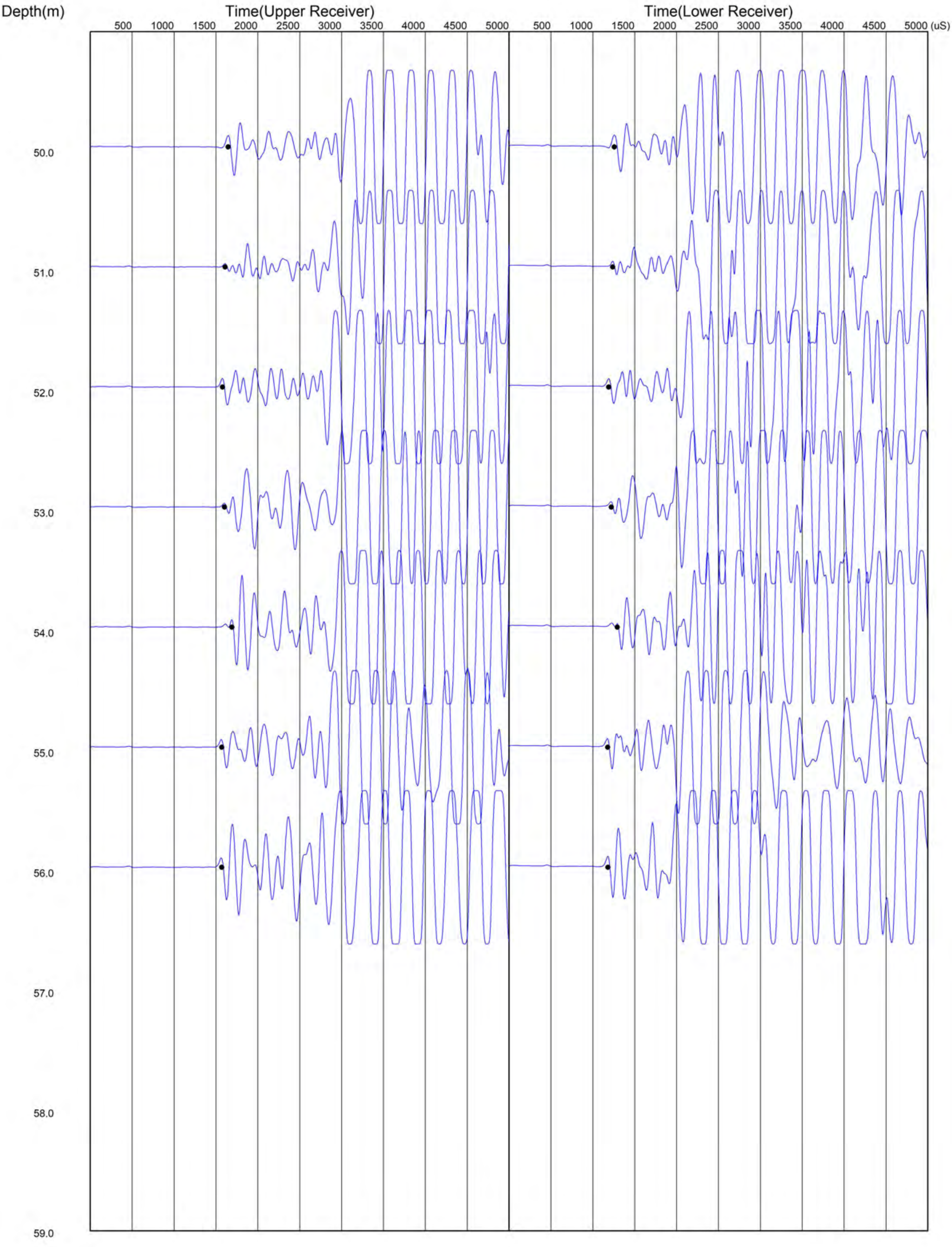
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
500
1000
1500
2000
2500
3000
3500
4000
4500
5000 (uS)
32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0

P Wave



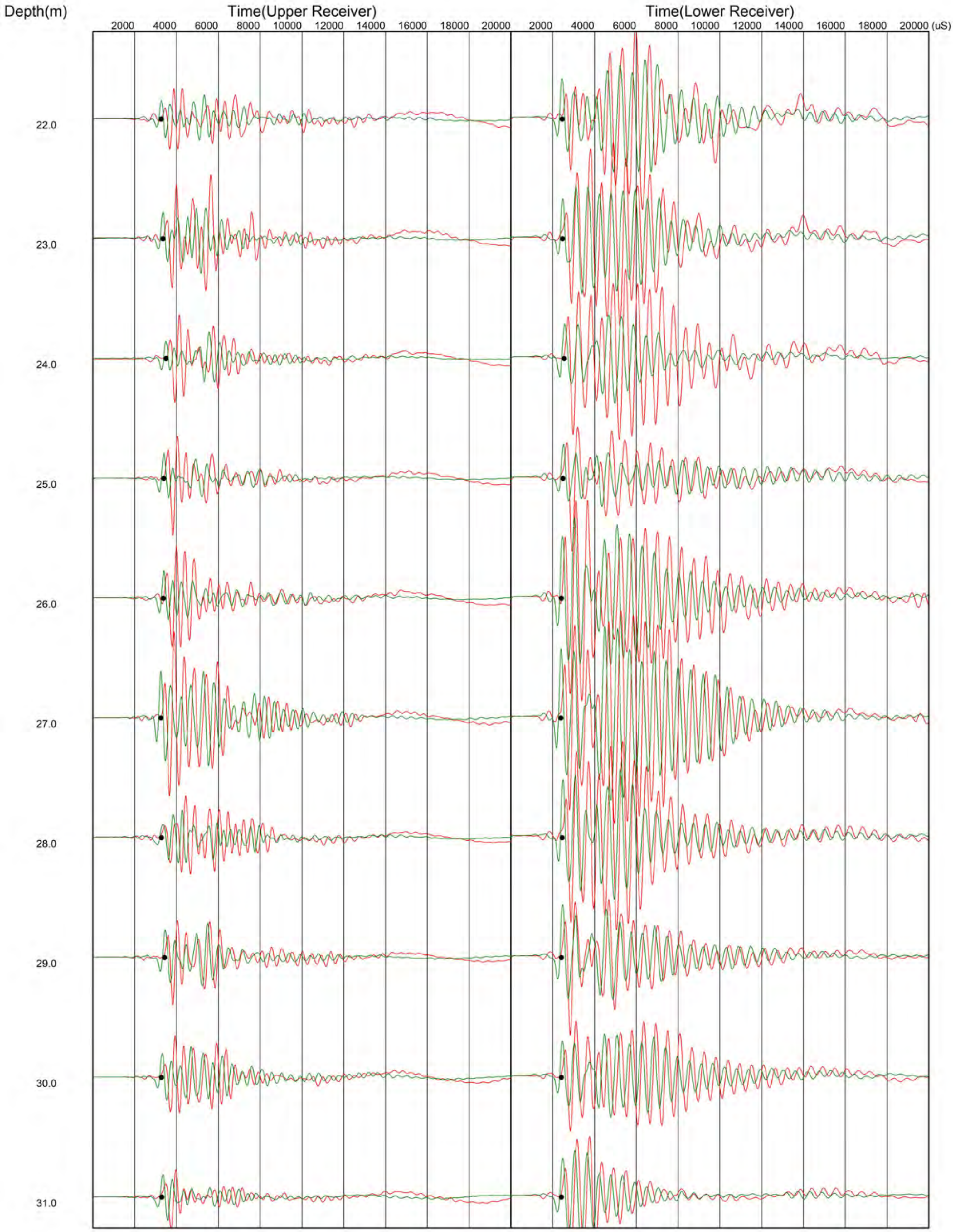
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
(uS)
41.0
42.0
43.0
44.0
45.0
46.0
47.0
48.0
49.0

P Wave



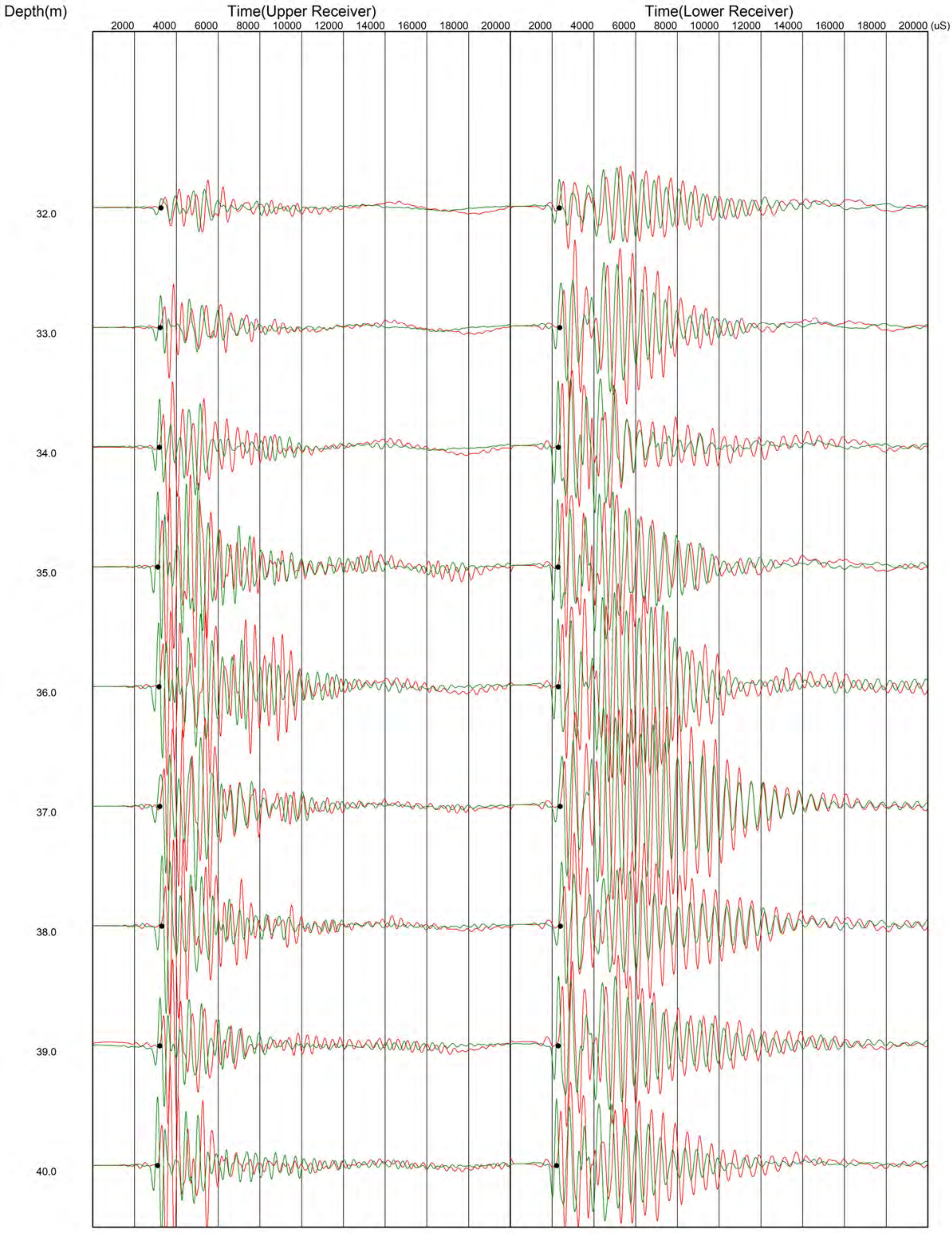
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5000 (uS)
50.0
51.0
52.0
53.0
54.0
55.0
56.0
57.0
58.0
59.0

S Wave

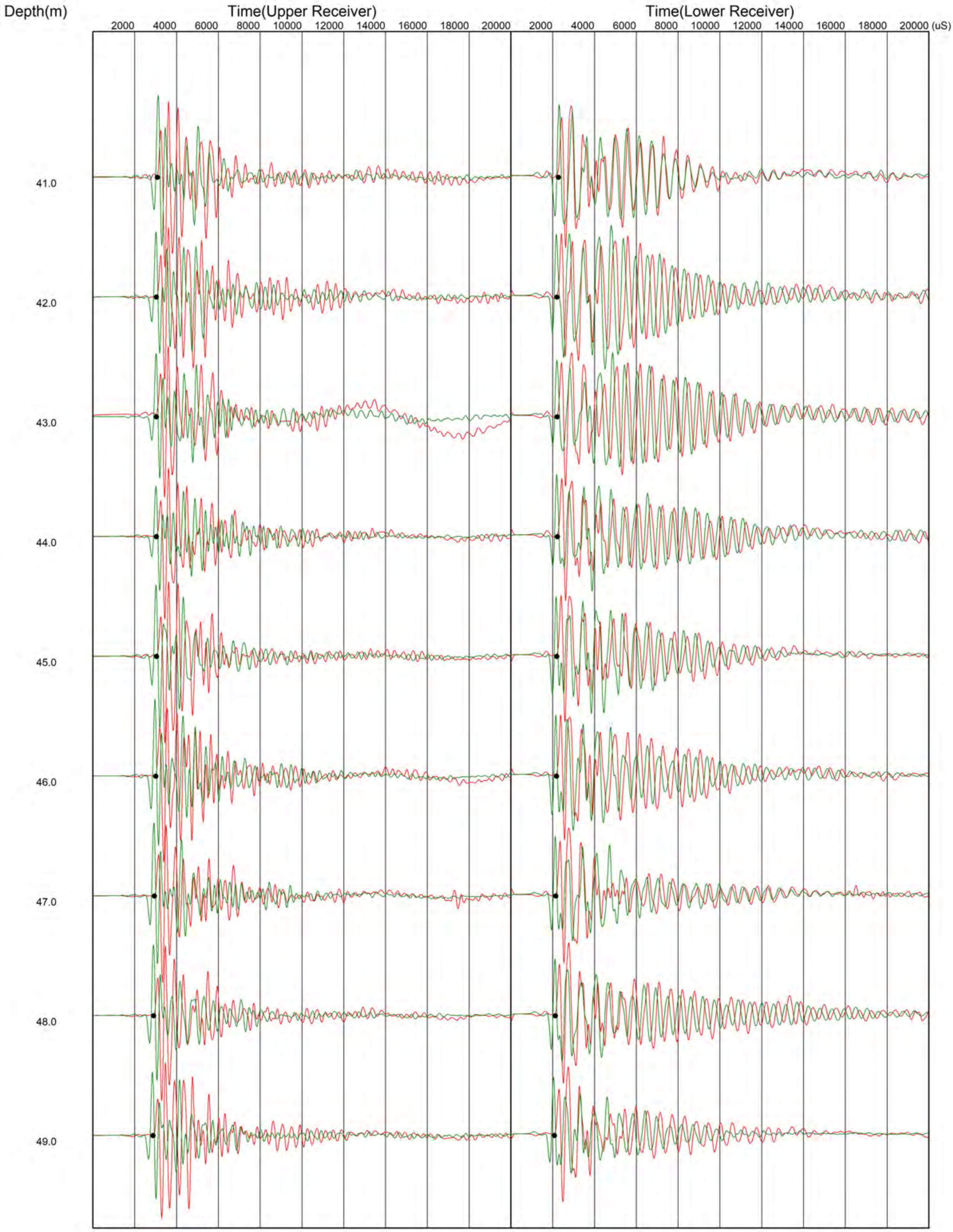


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
22.0
23.0
24.0
25.0
26.0
27.0
28.0
29.0
30.0
31.0

S Wave

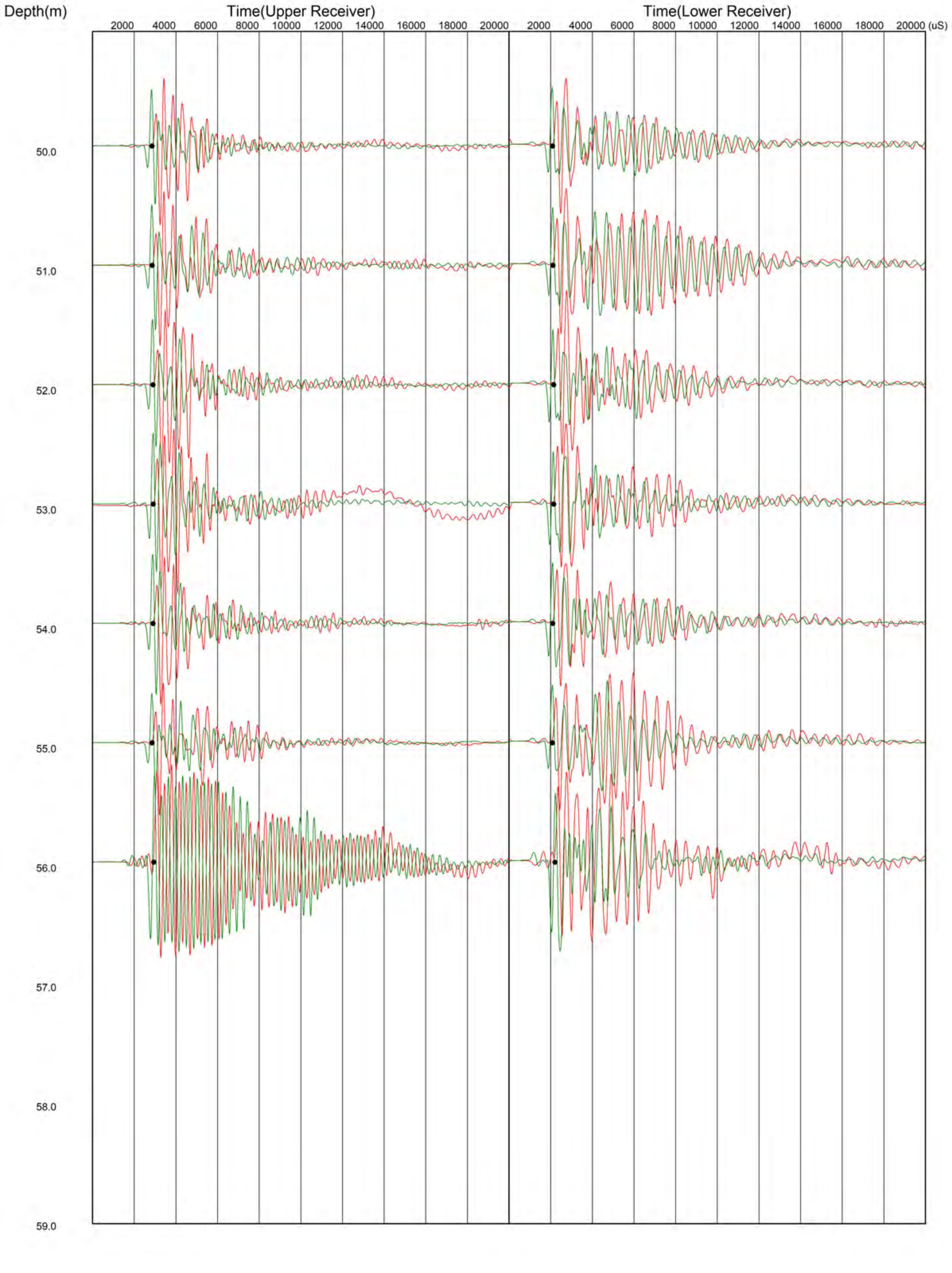

Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0

S Wave

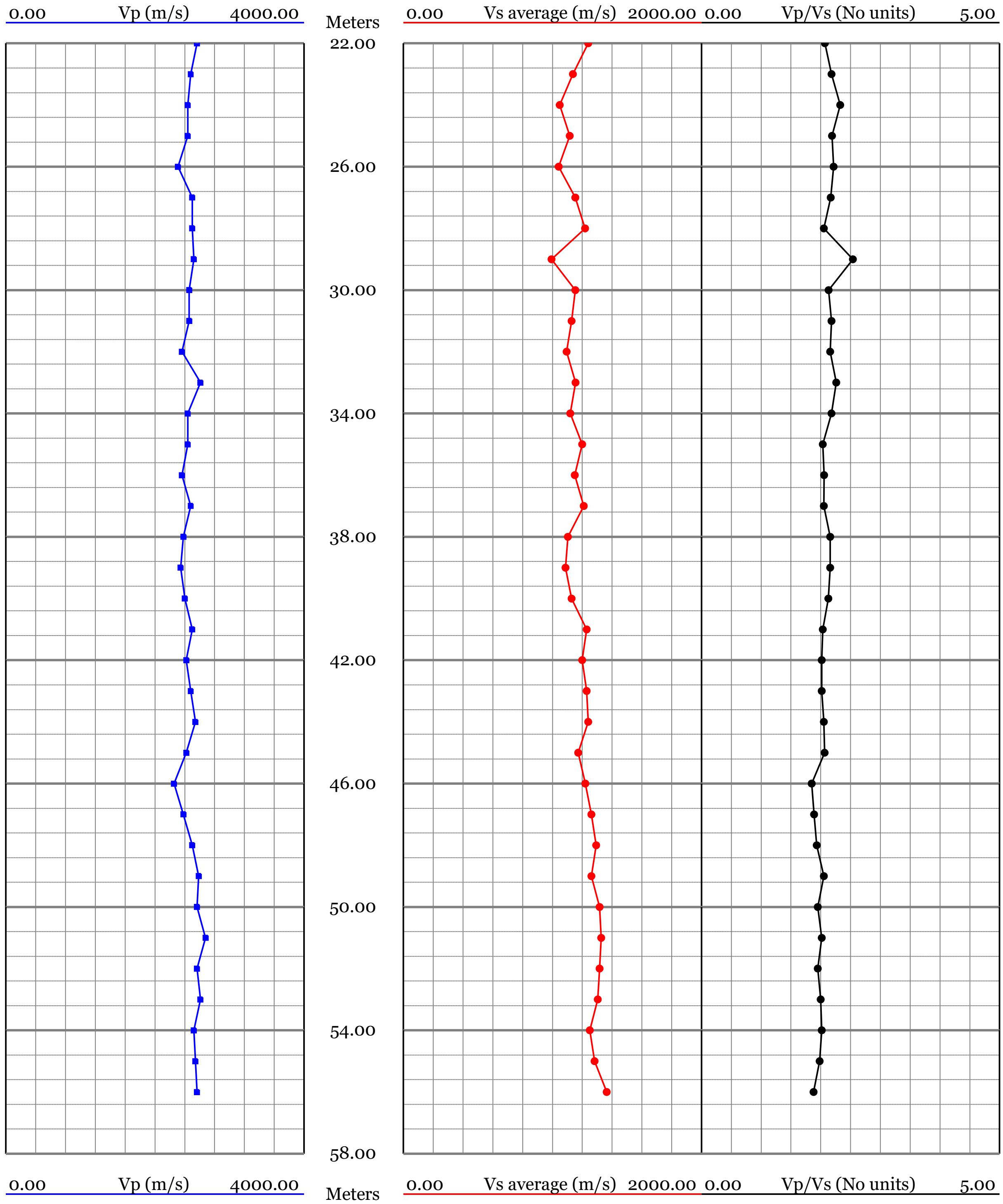


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
41.0
42.0
43.0
44.0
45.0
46.0
47.0
48.0
49.0

S Wave



Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
50.0
51.0
52.0
53.0
54.0
55.0
56.0
57.0
58.0
59.0


0.00
Vp (m/s)
4000.00
Meters
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00
22.00
26.00
30.00
34.00
38.00
42.00
46.00
50.00
54.00
58.00

CO	Structural Soils
WELL	R610
FLD	A303 Stonehenge
CTY	England
STE	
FILING No	

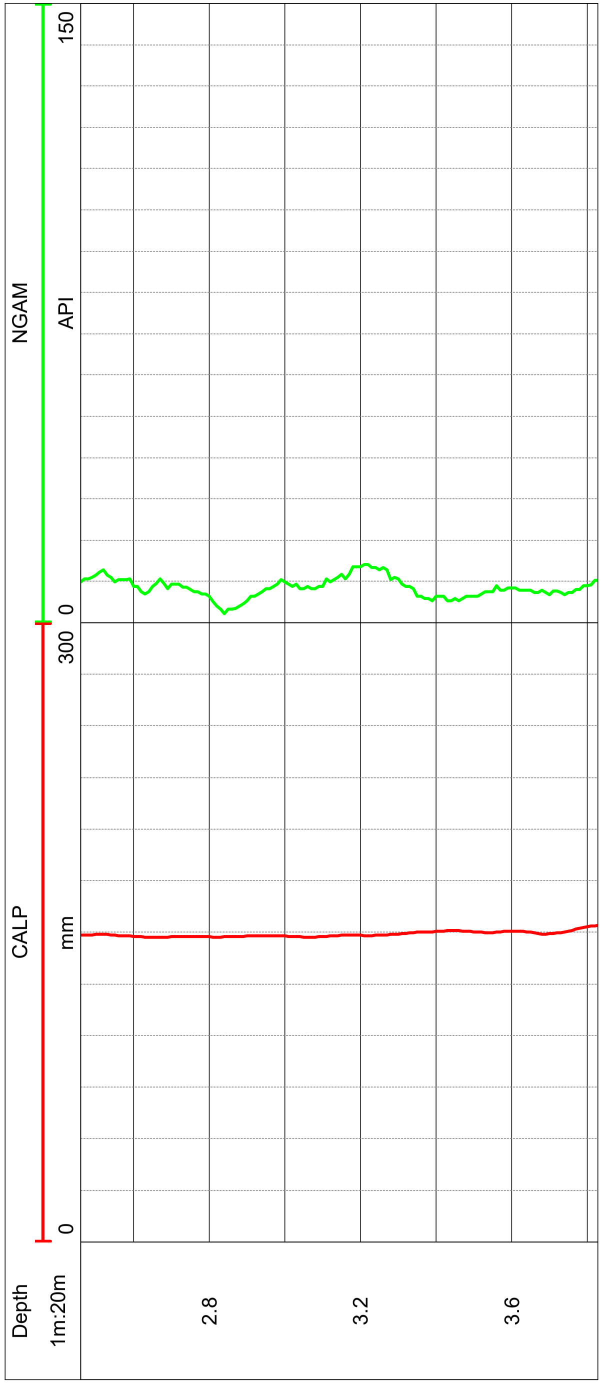
COMPANY	Structural Soils		
WELL ID	R610		
FIELD	A303 Stonehenge		
COUNTRY	England	STATE	

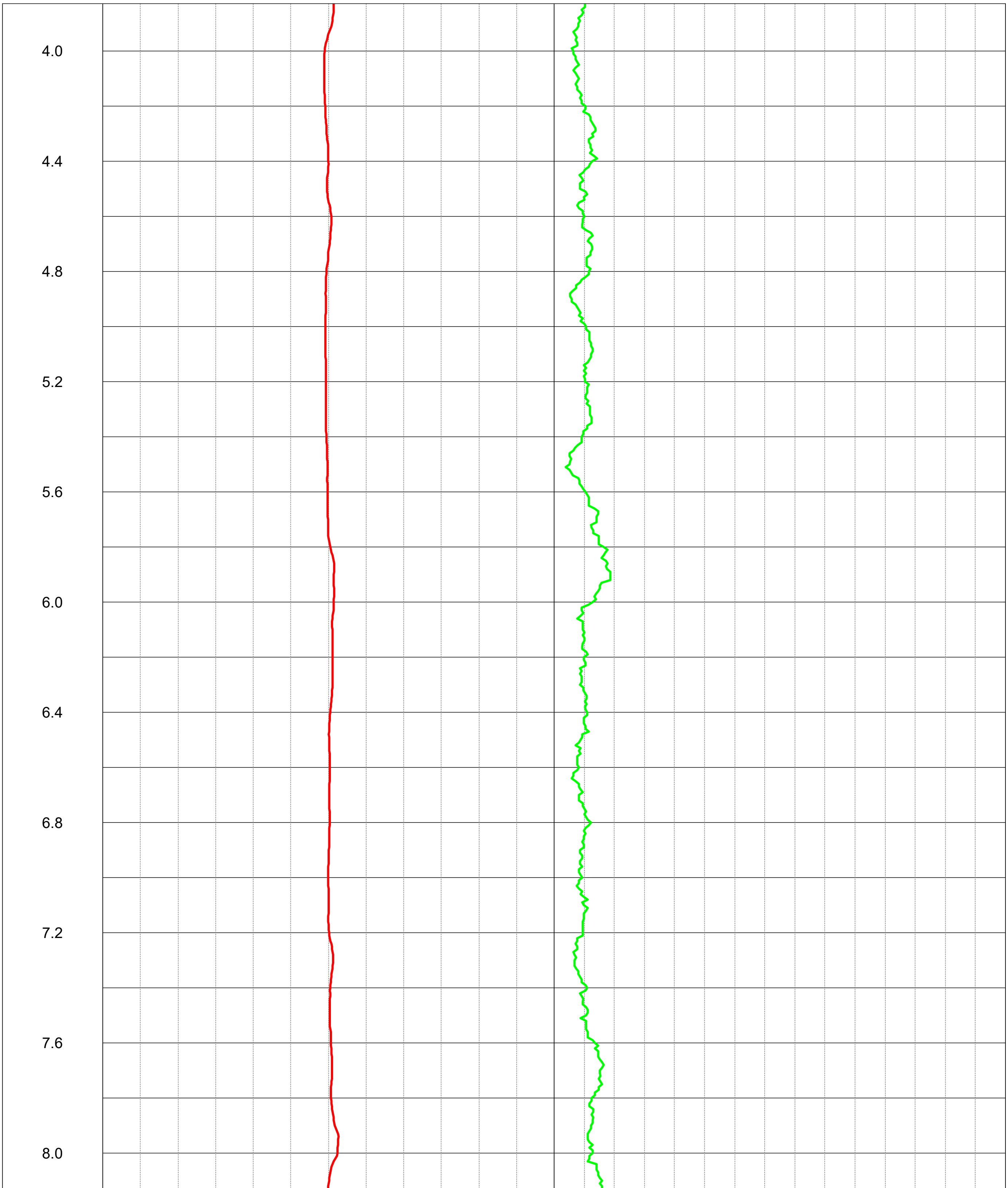
LOCATION			OTHER SERVICES
Easting: 412333.99			
Northing: 141912.2			
SEC	TWP	RGE	

PERMANENT DATUM	GL	ELEVATION	93.751	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM		D.F.
DRILLING MEAS. FROM				G.L.

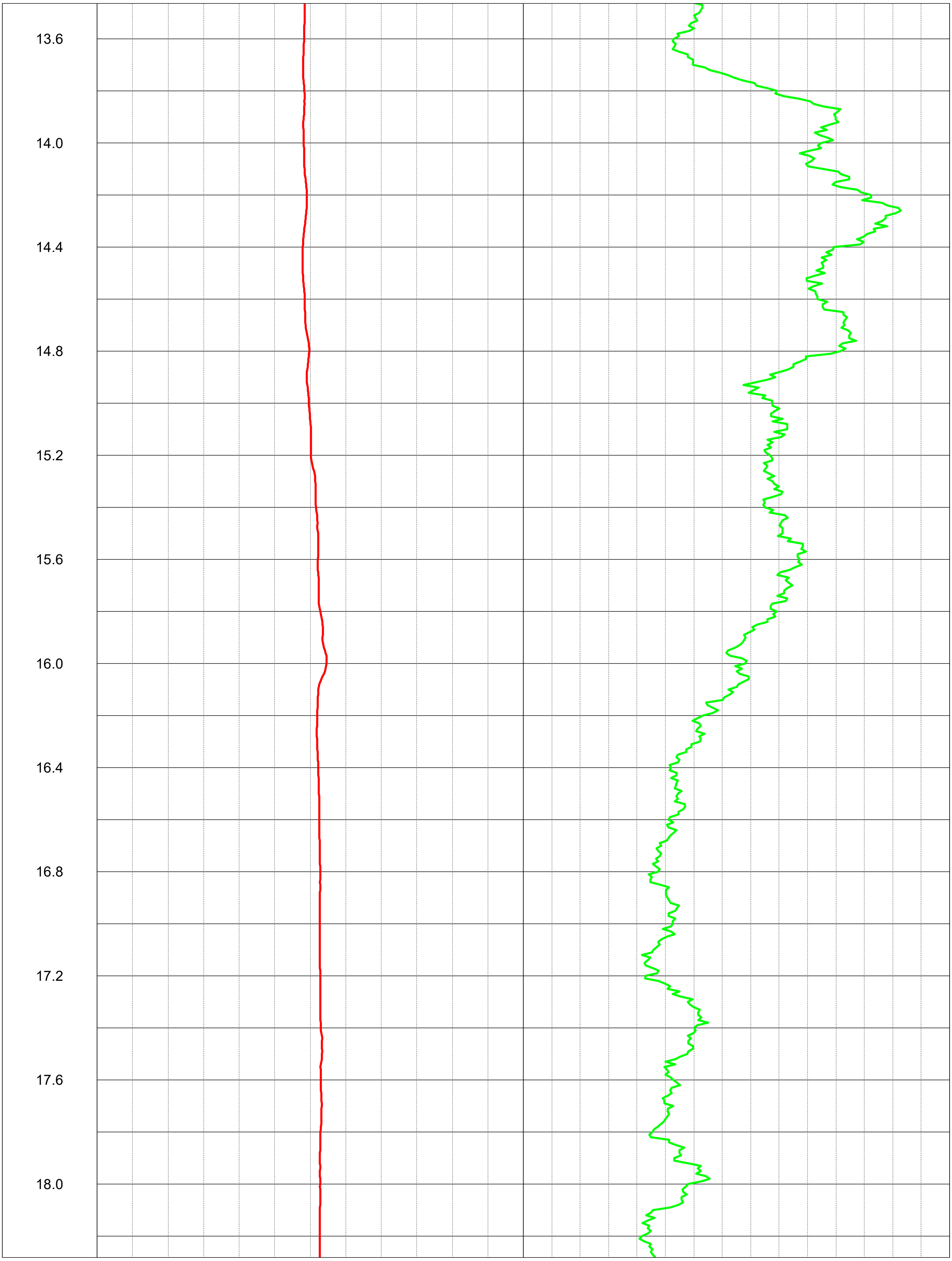
DATE	23/05/18	TYPE FLUID IN HOLE	Water
RUN No		SALINITY	
TYPE LOG	Caliper Gamma	DENSITY	
DEPTH-DRILLER	53	LEVEL	
DEPTH-LOGGER	49	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	49		
TOP LOGGED INTERVAL	2.46		
OPERATING RIG TIME			
RECORDED BY	James Boyett		
WITNESSED BY	Kyle Owen		

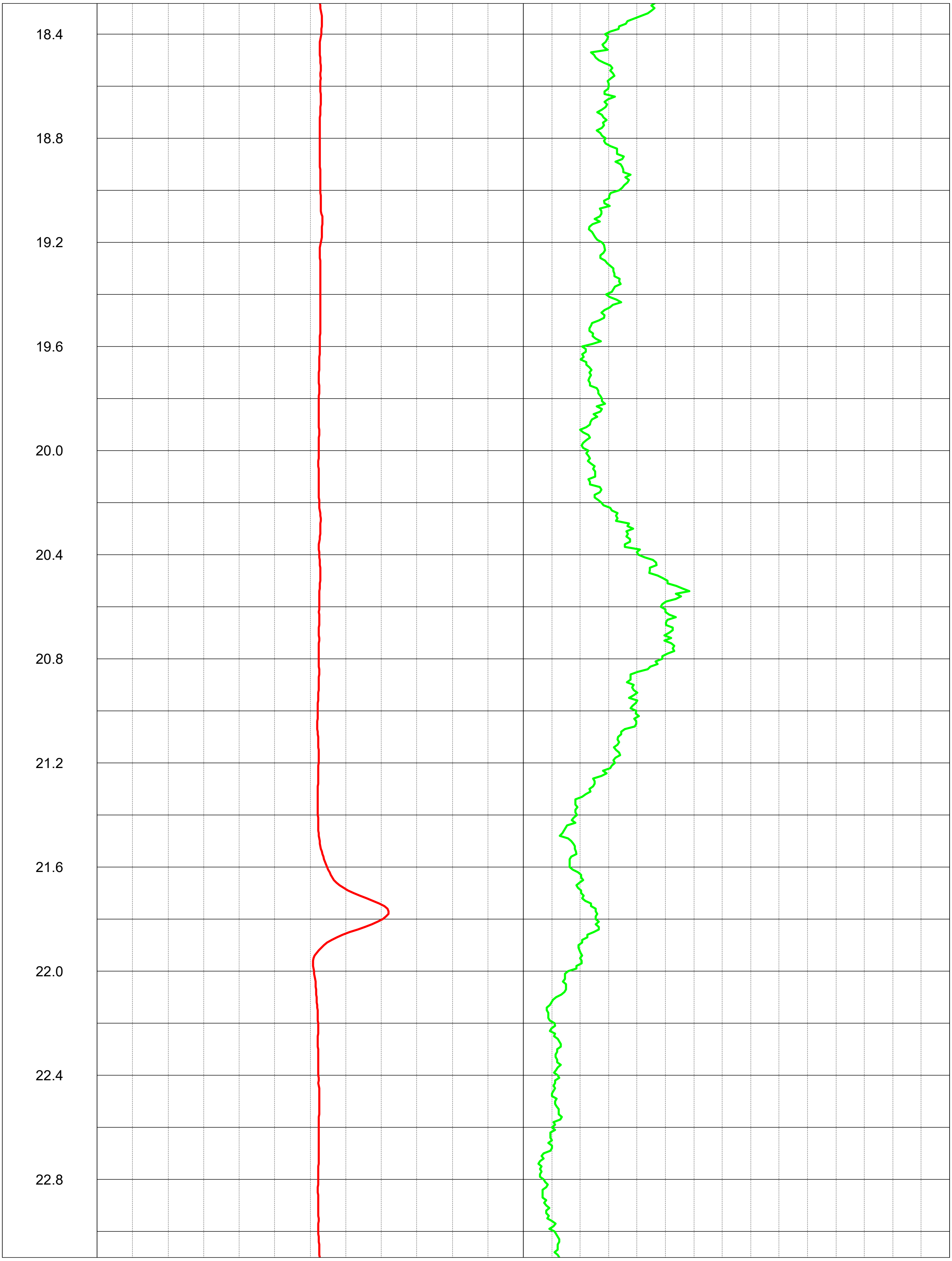
RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

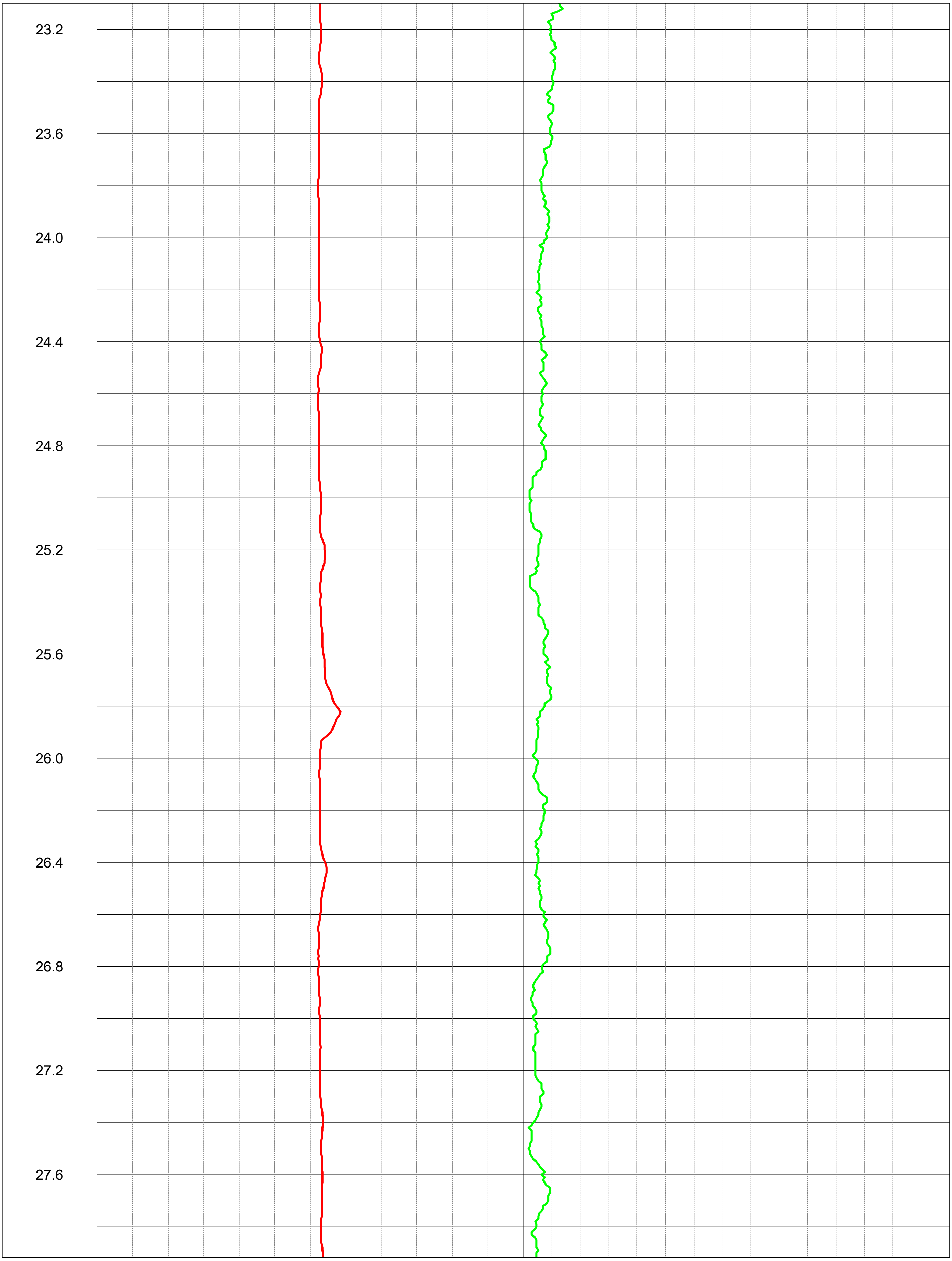


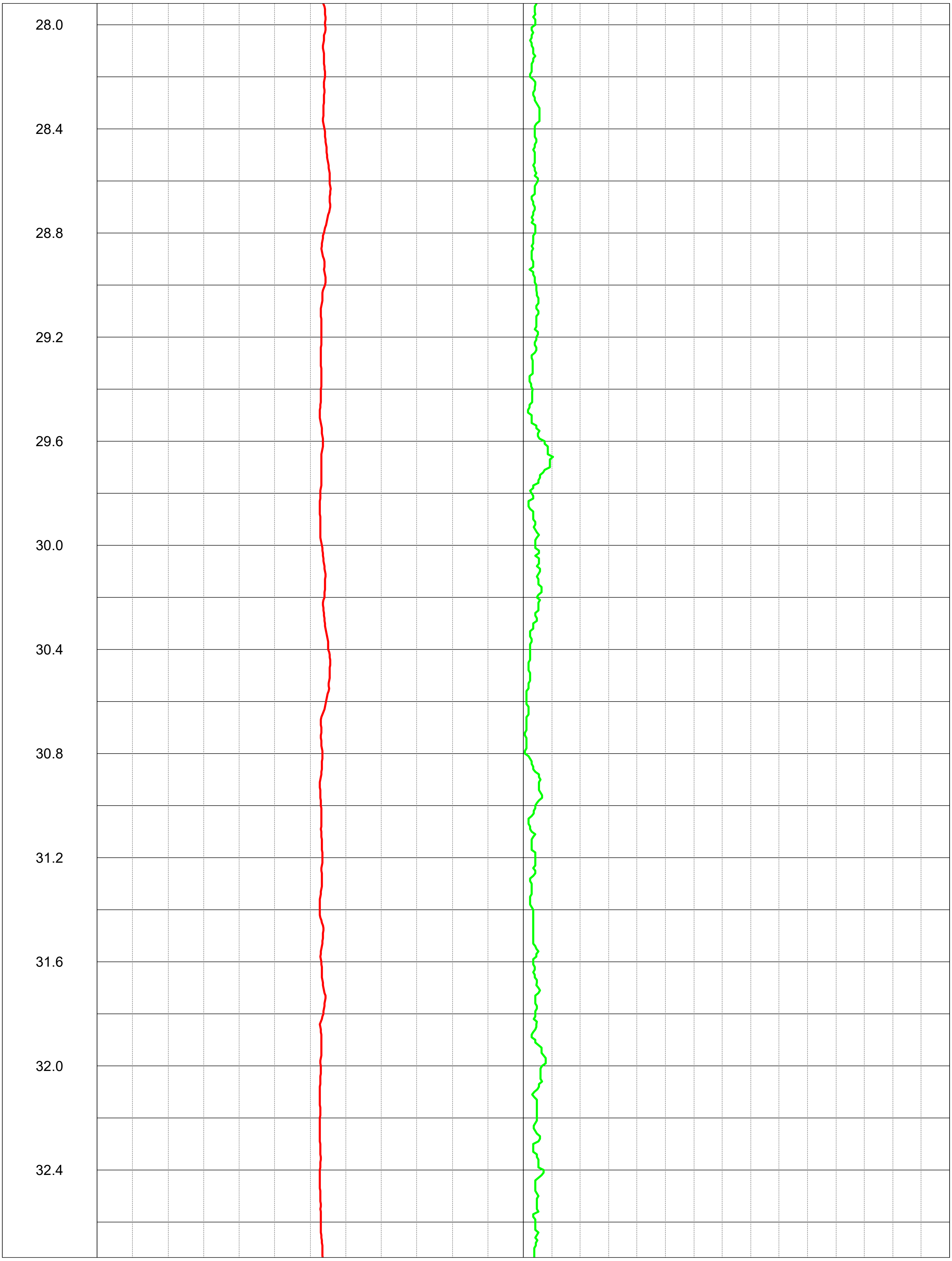

4.0
4.4
4.8
5.2
5.6
6.0
6.4
6.8
7.2
7.6
8.0
8.4

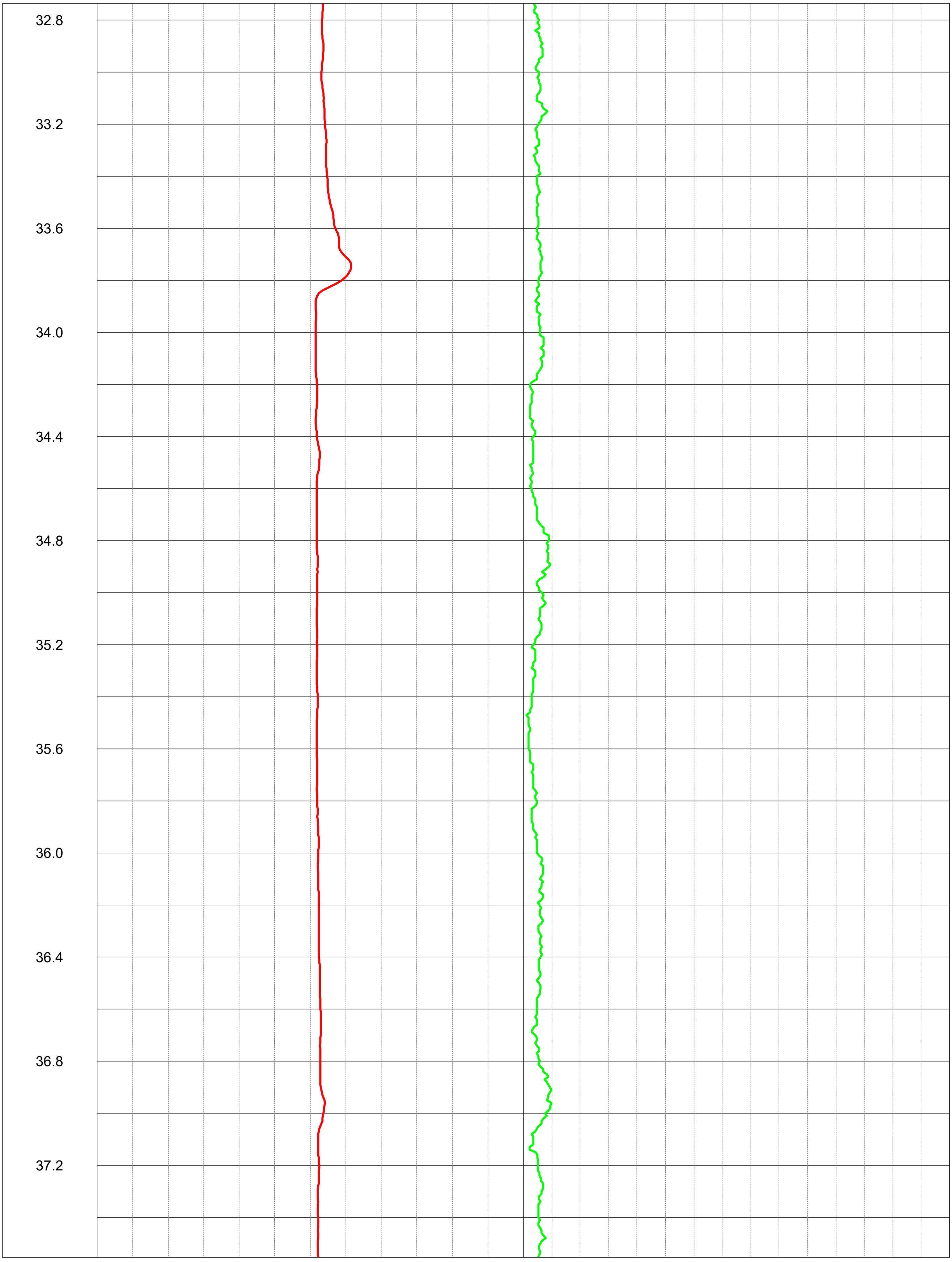

8.8
9.2
9.6
10.0
10.4
10.8
11.2
11.6
12.0
12.4
12.8
13.2

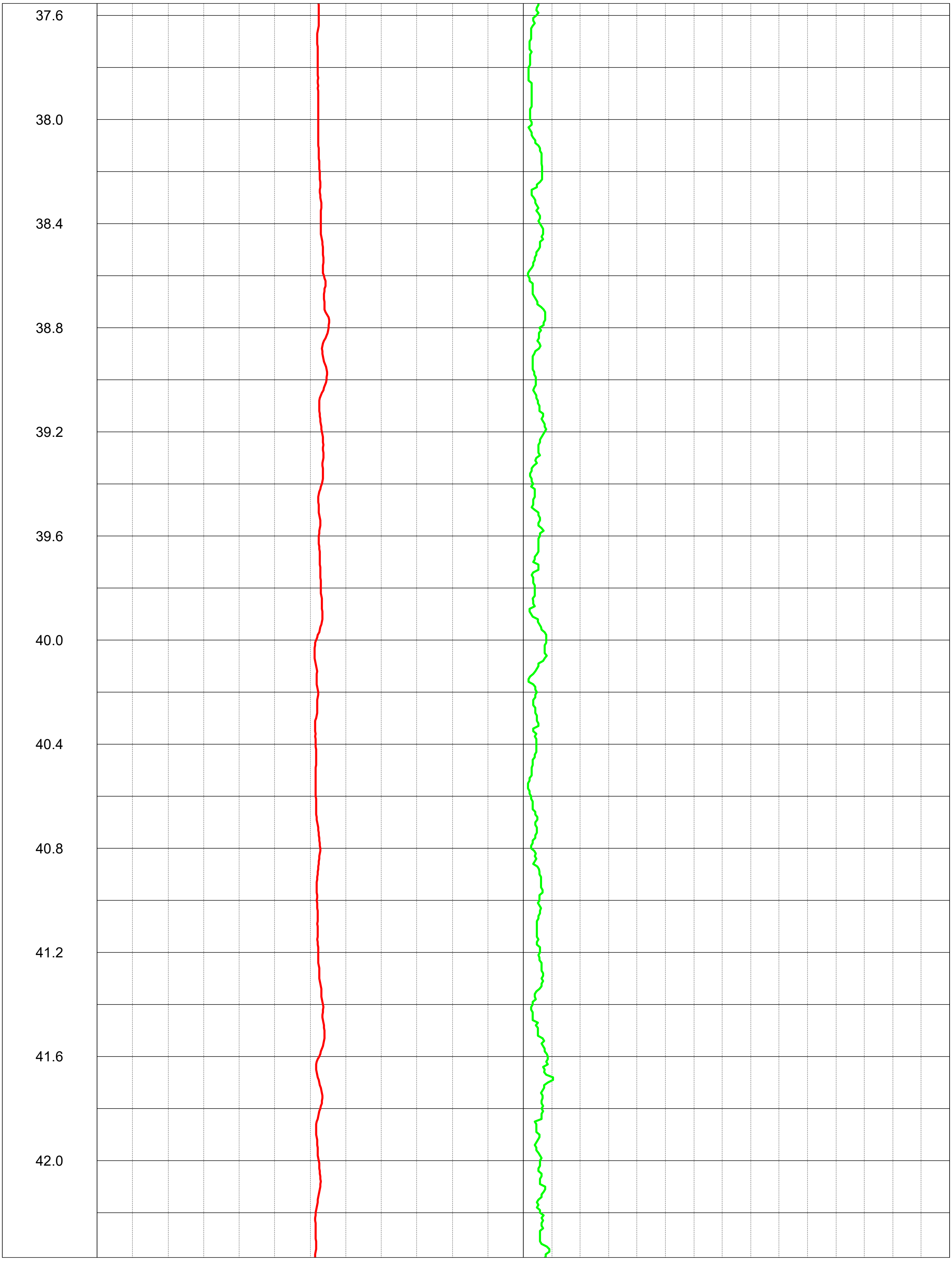

13.6
14.0
14.4
14.8
15.2
15.6
16.0
16.4
16.8
17.2
17.6
18.0

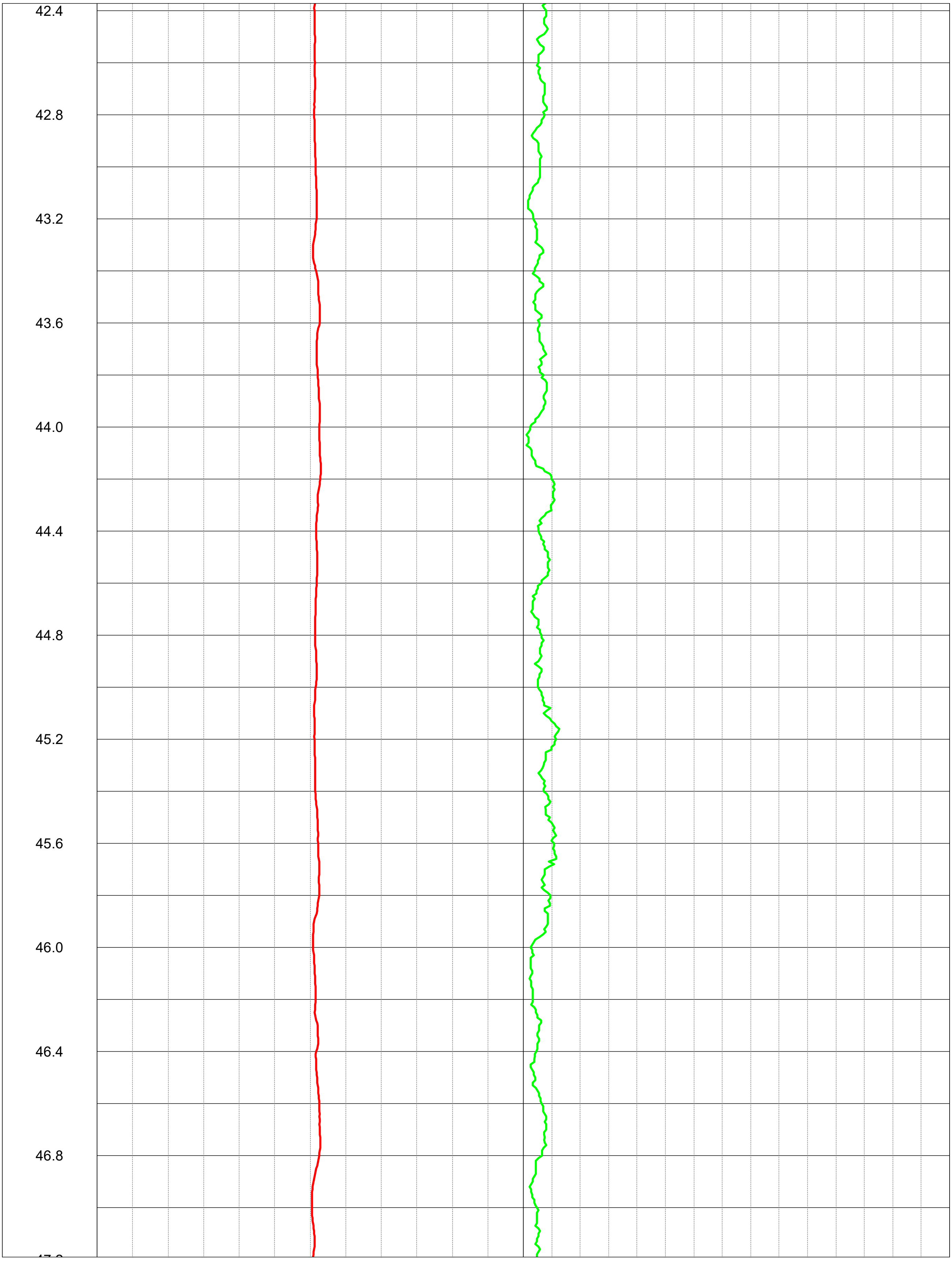

18.4
18.8
19.2
19.6
20.0
20.4
20.8
21.2
21.6
22.0
22.4
22.8

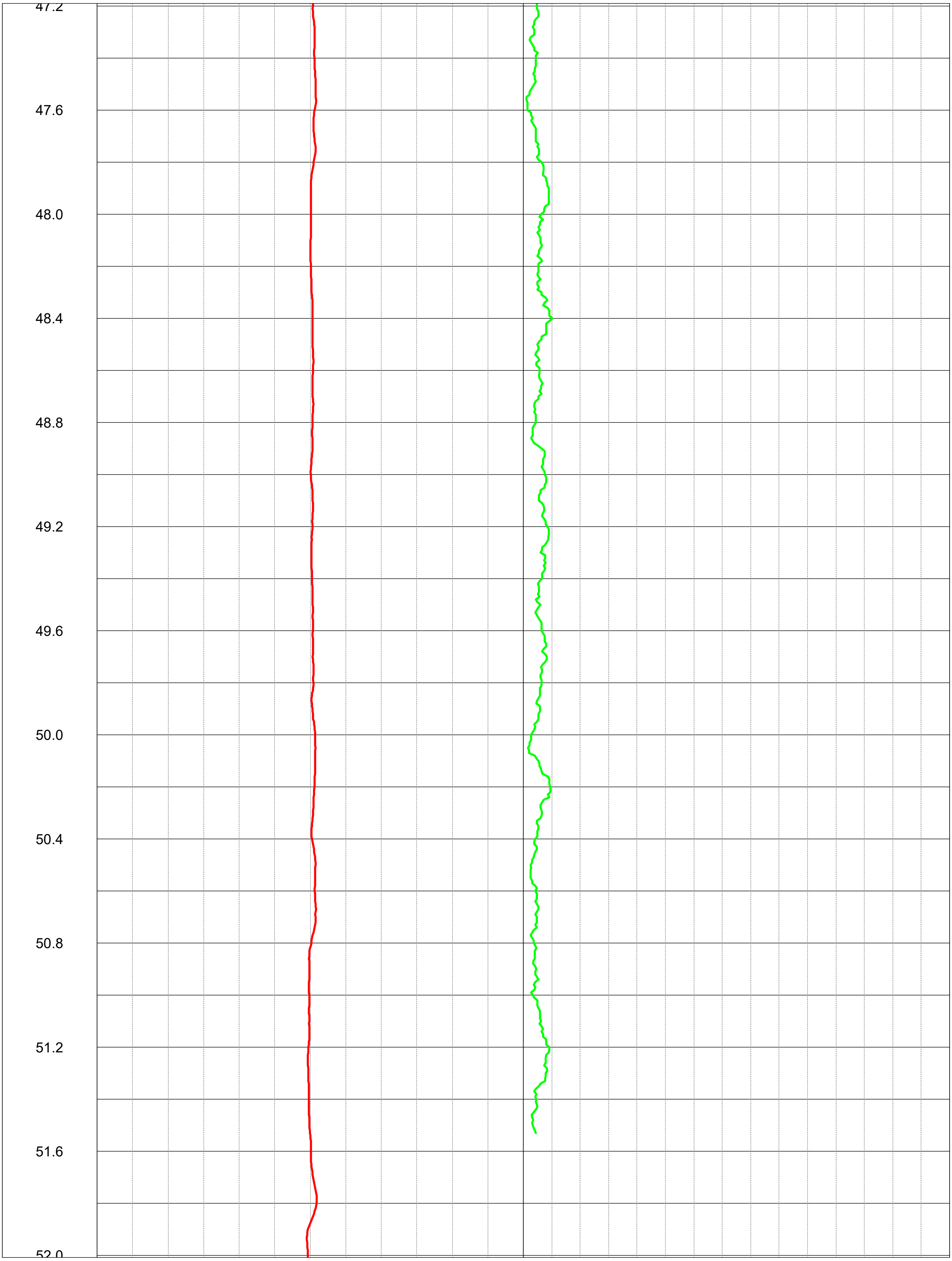

23.2
23.6
24.0
24.4
24.8
25.2
25.6
26.0
26.4
26.8
27.2
27.6


28.0
28.4
28.8
29.2
29.6
30.0
30.4
30.8
31.2
31.6
32.0
32.4

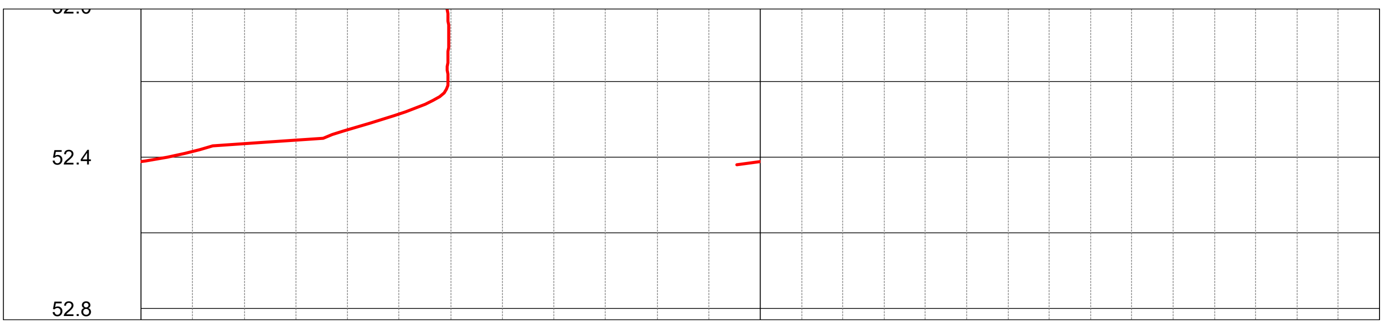

32.8
33.2
33.6
34.0
34.4
34.8
35.2
35.6
36.0
36.4
36.8
37.2


37.6
38.0
38.4
38.8
39.2
39.6
40.0
40.4
40.8
41.2
41.6
42.0

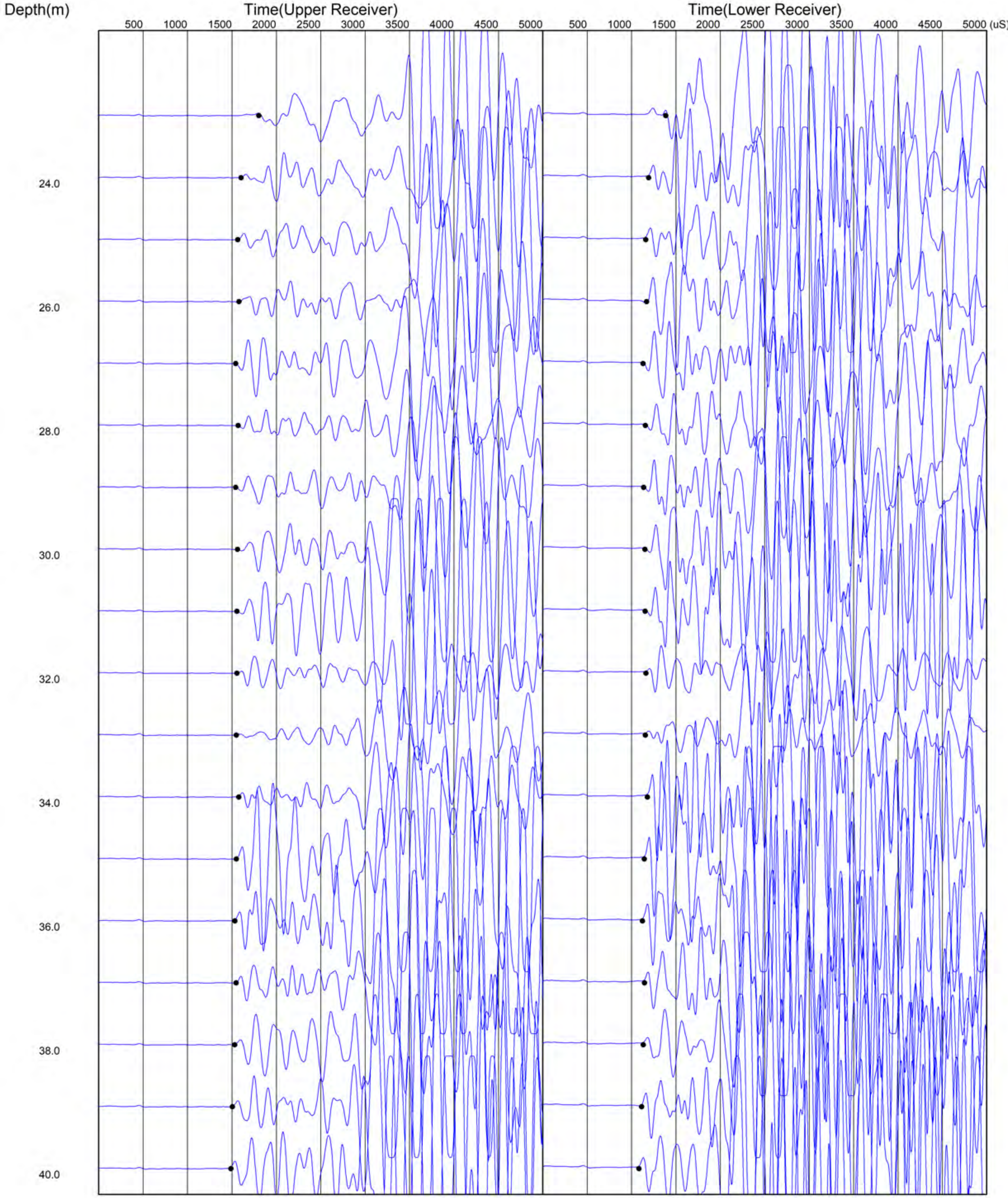

42.4
42.8
43.2
43.6
44.0
44.4
44.8
45.2
45.6
46.0
46.4
46.8



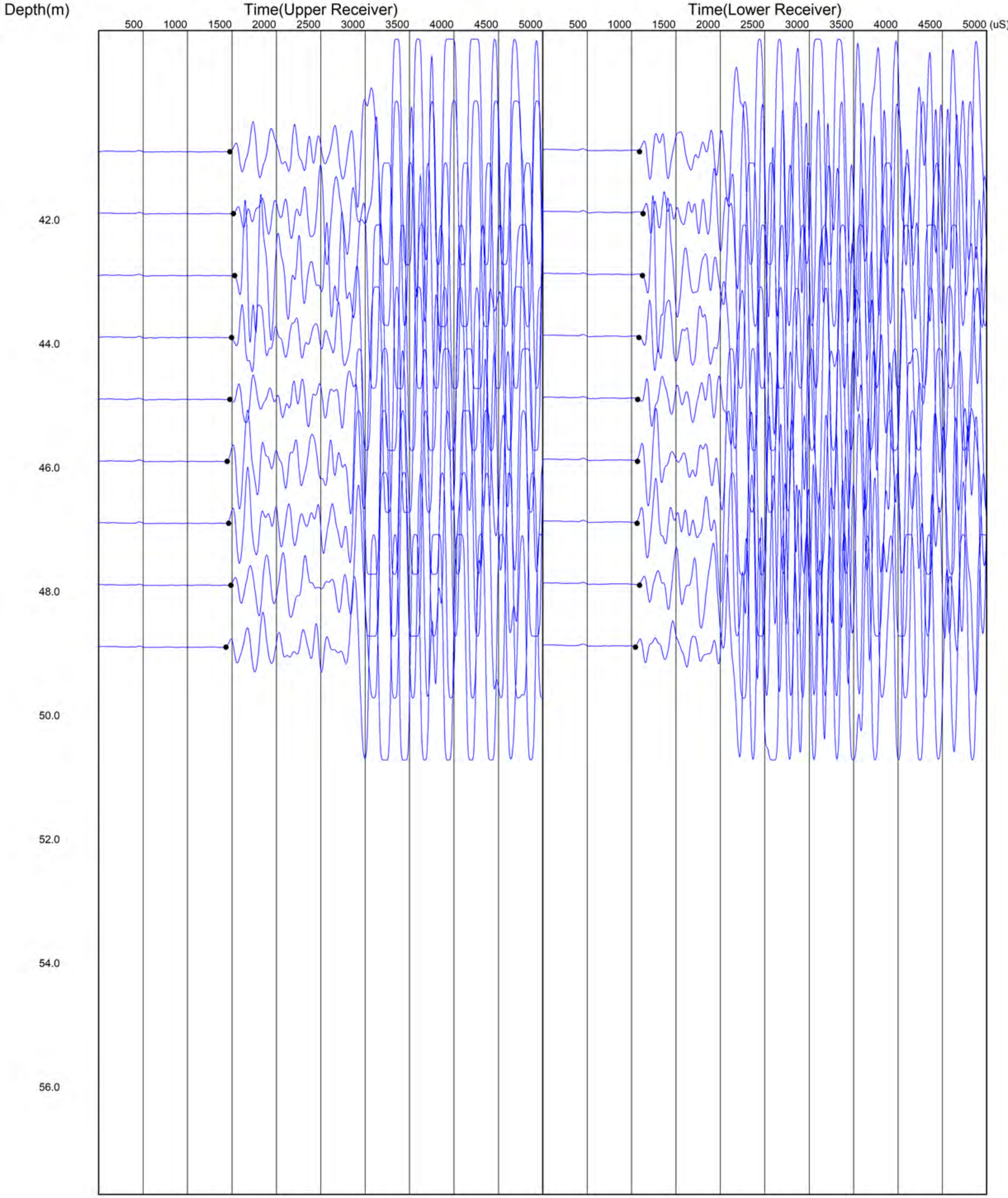
47.2
47.6
48.0
48.4
48.8
49.2
49.6
50.0
50.4
50.8
51.2
51.6
52.0


52.4
52.8

P Wave

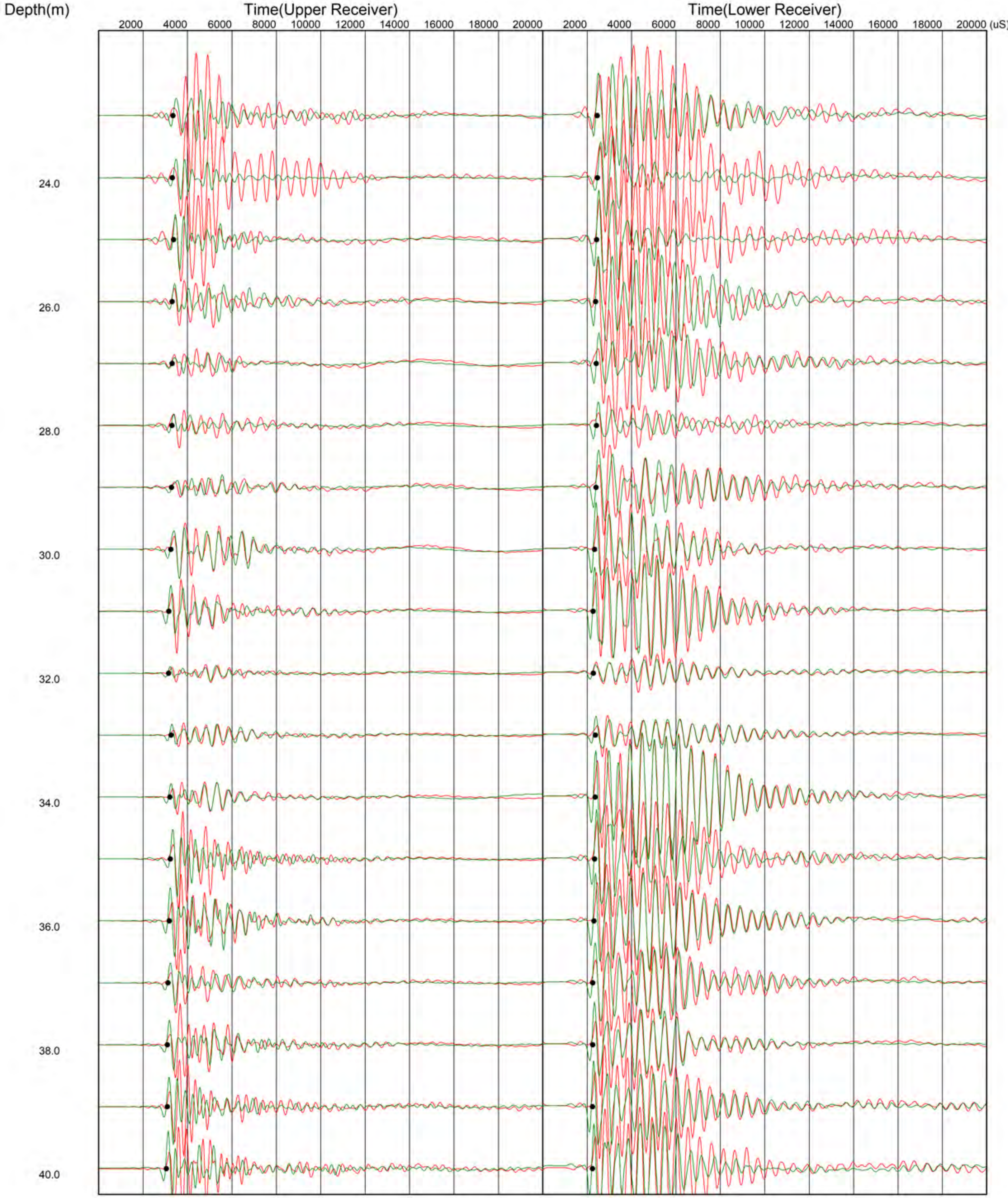

Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
24.0
26.0
28.0
30.0
32.0
34.0
36.0
38.0
40.0

P Wave

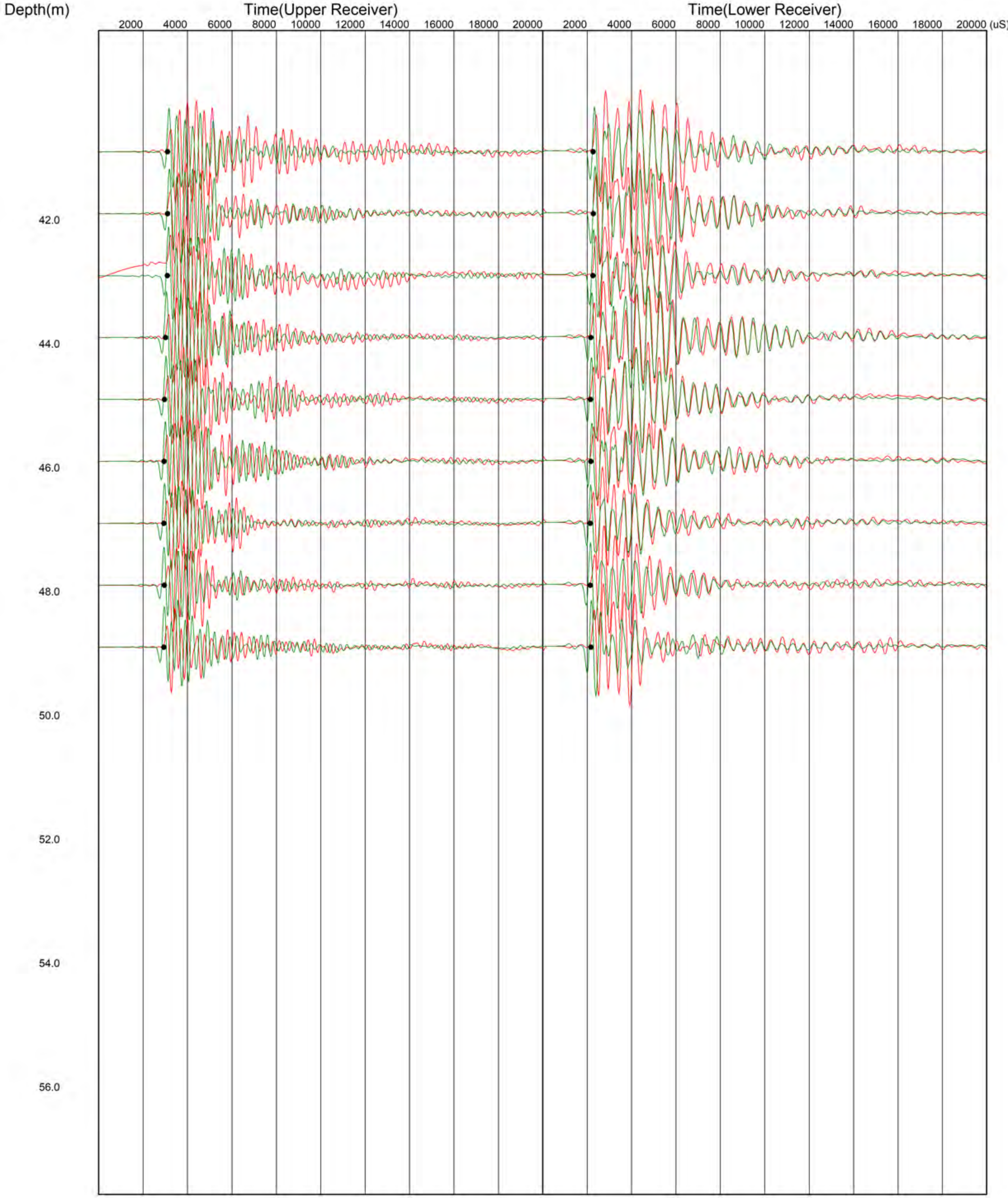


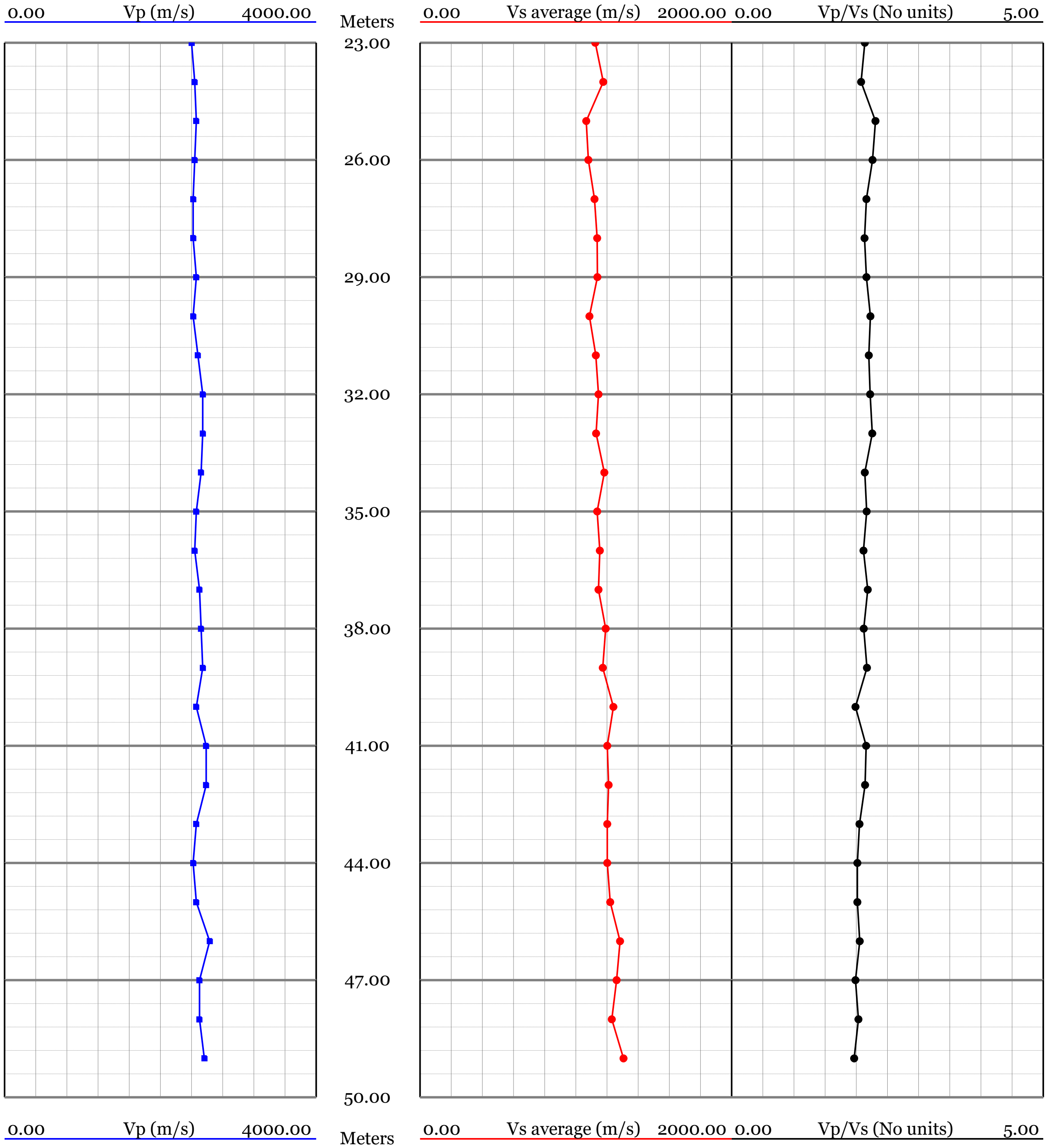
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
500
1000
1500
2000
2500
3000
3500
4000
4500
5000 (uS)
42.0
44.0
46.0
48.0
50.0
52.0
54.0
56.0

S Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
24.0
26.0
28.0
30.0
32.0
34.0
36.0
38.0
40.0

S Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
42.0
44.0
46.0
48.0
50.0
52.0
54.0
56.0


0.00
Vp (m/s)
4000.00
Meters
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00
23.00
26.00
29.00
32.00
35.00
38.00
41.00
44.00
47.00
50.00
0.00
Vp (m/s)
4000.00
Meters
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00

ROBERTSON GEO SERVICES
Unlocking Your GeoData

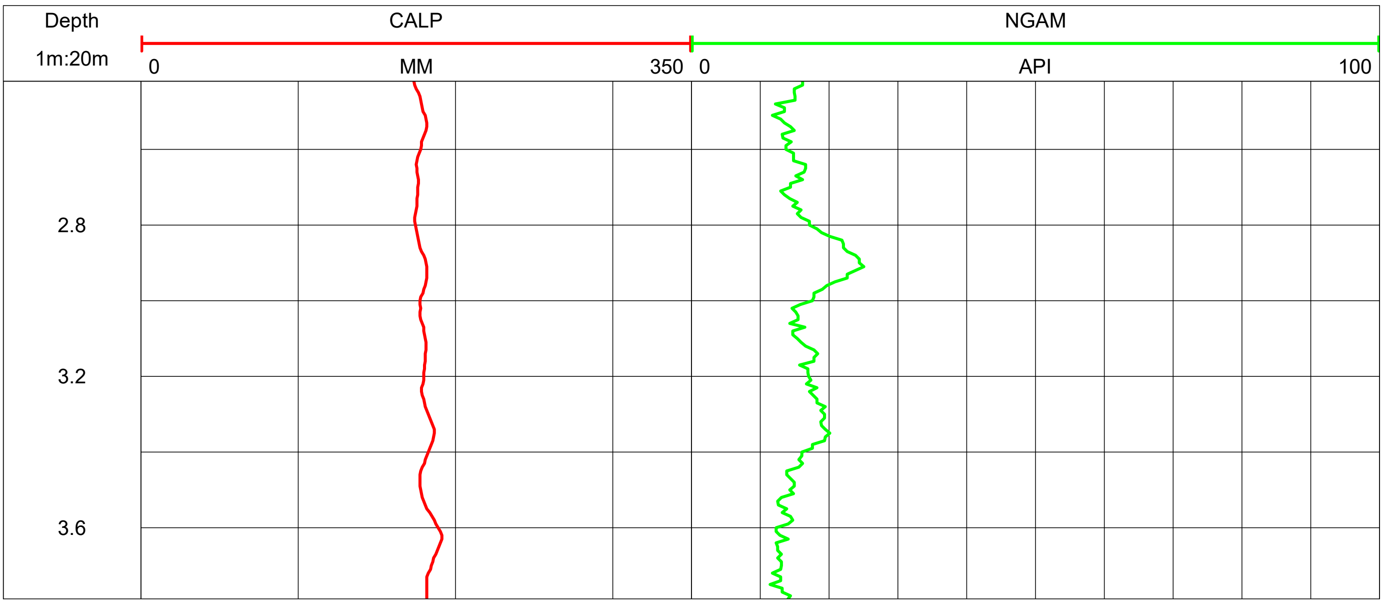
COMPANY	Structural Soils
WELL ID	R611
FIELD	A303 Stonehenge
COUNTRY	England
STATE	
LOCATION	
Easting:	412363.98
Northing:	141959.94
SEC	
TWP	
RGE	
OTHER SERVICES	

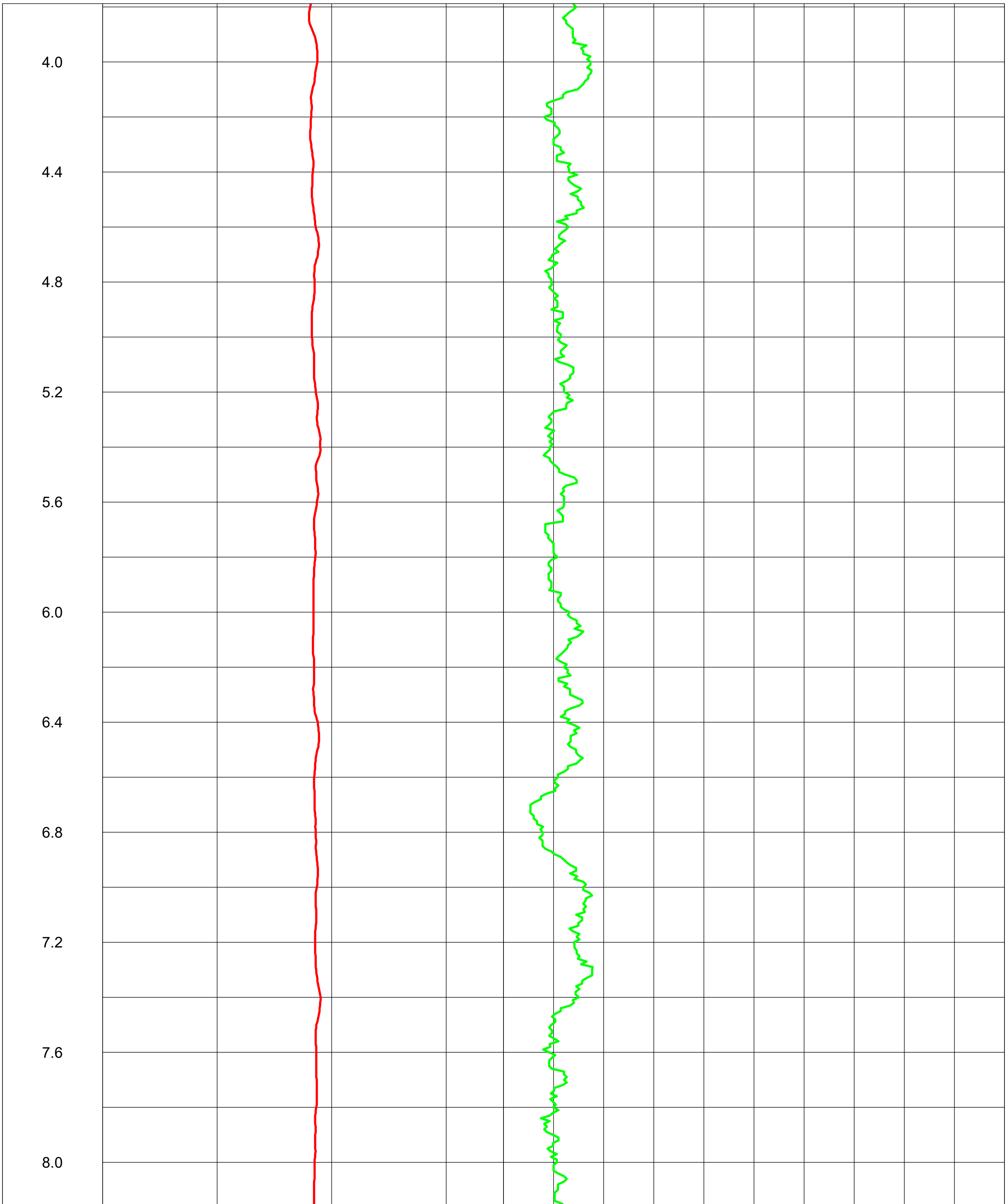
CO	Structural Soils
WELL	R611
FLD	A303 Stonehenge
CTY	England
STE	
FILING No	

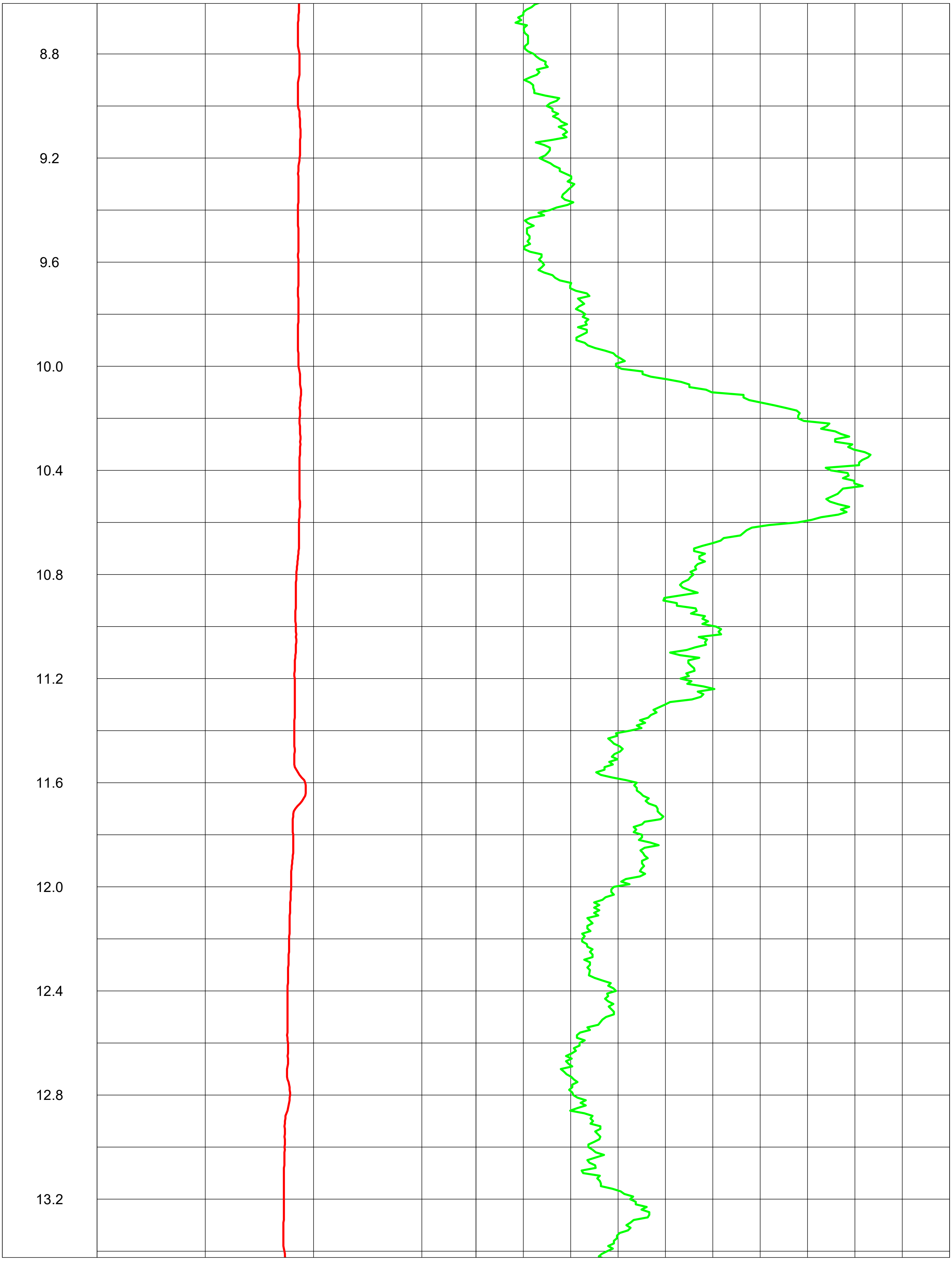
PERMANENT DATUM	GL	ELEVATION	94.059
LOG MEAS. FROM		ABOVE PERM. DATUM	
DRILLING MEAS. FROM			
K.B.			
D.F.			
G.L.			

DATE	31/05/18	TYPE FLUID IN HOLE	Water
RUN No		SALINITY	
TYPE LOG	Caliper Gamma	DENSITY	
DEPTH-DRILLER	53	LEVEL	23
DEPTH-LOGGER	52.74	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	52.74		
TOP LOGGED INTERVAL	2.42		
OPERATING RIG TIME			
RECORDED BY	Kyle Owen		
WITNESSED BY	James Boyett		

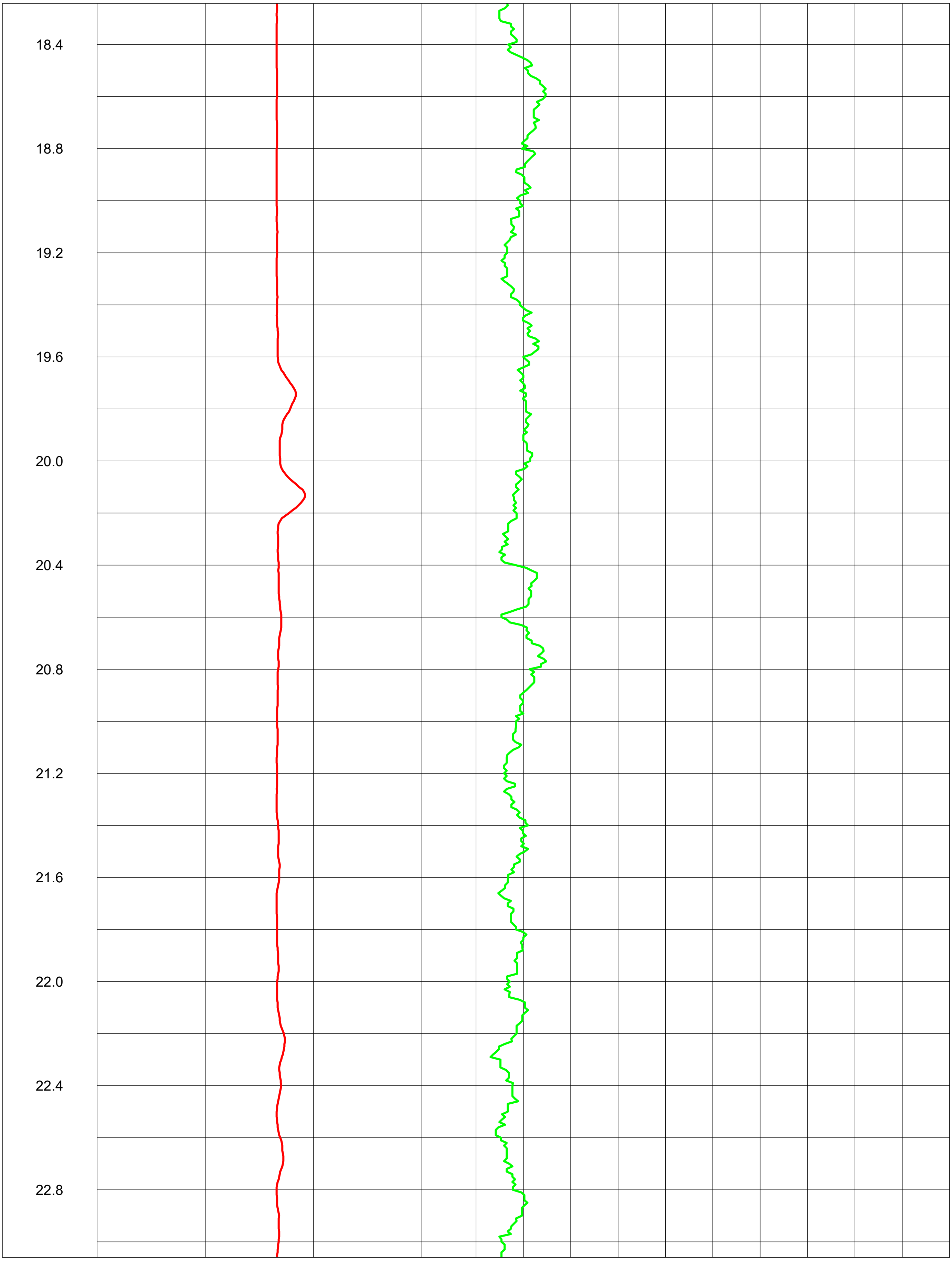
RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

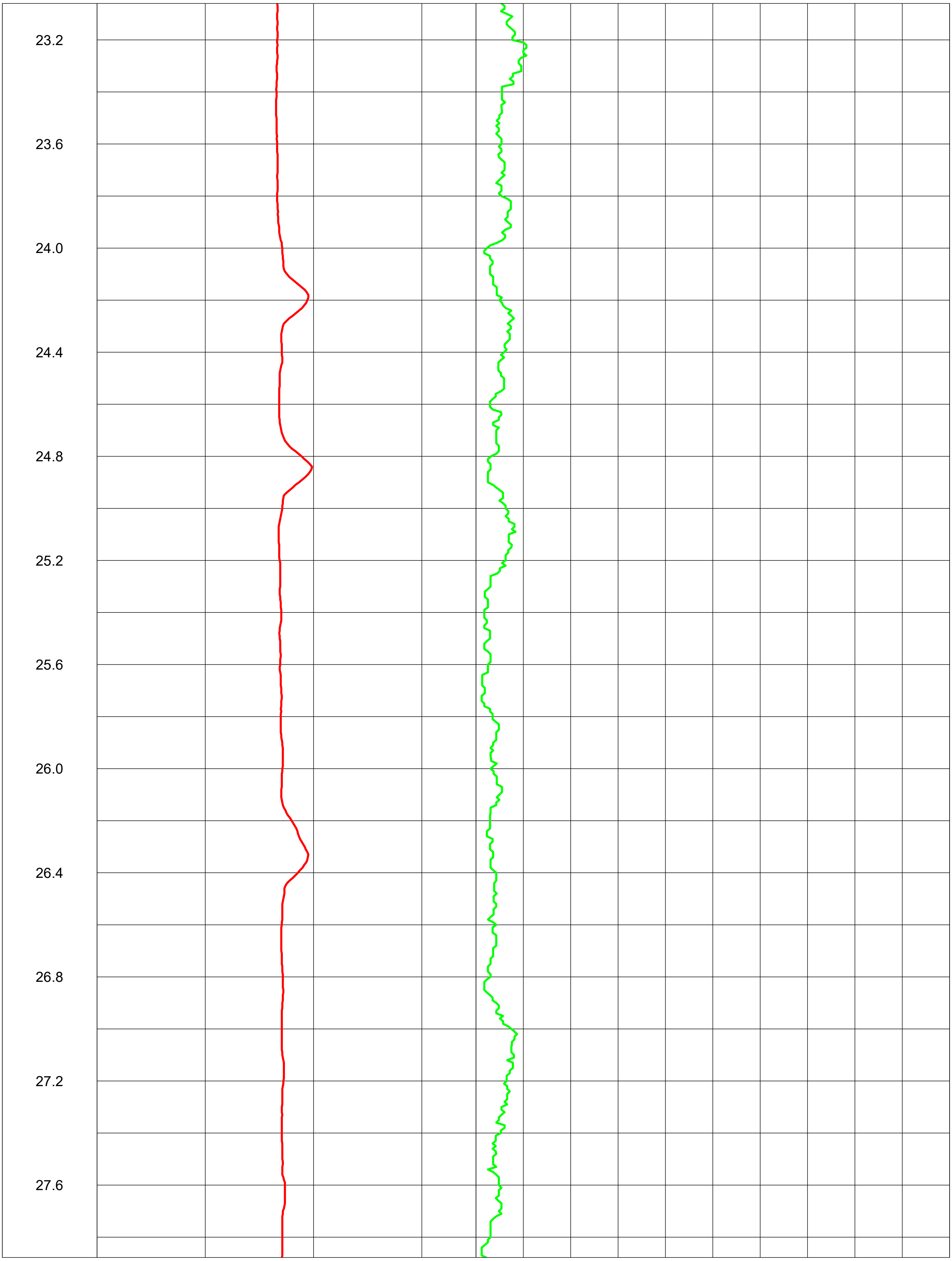


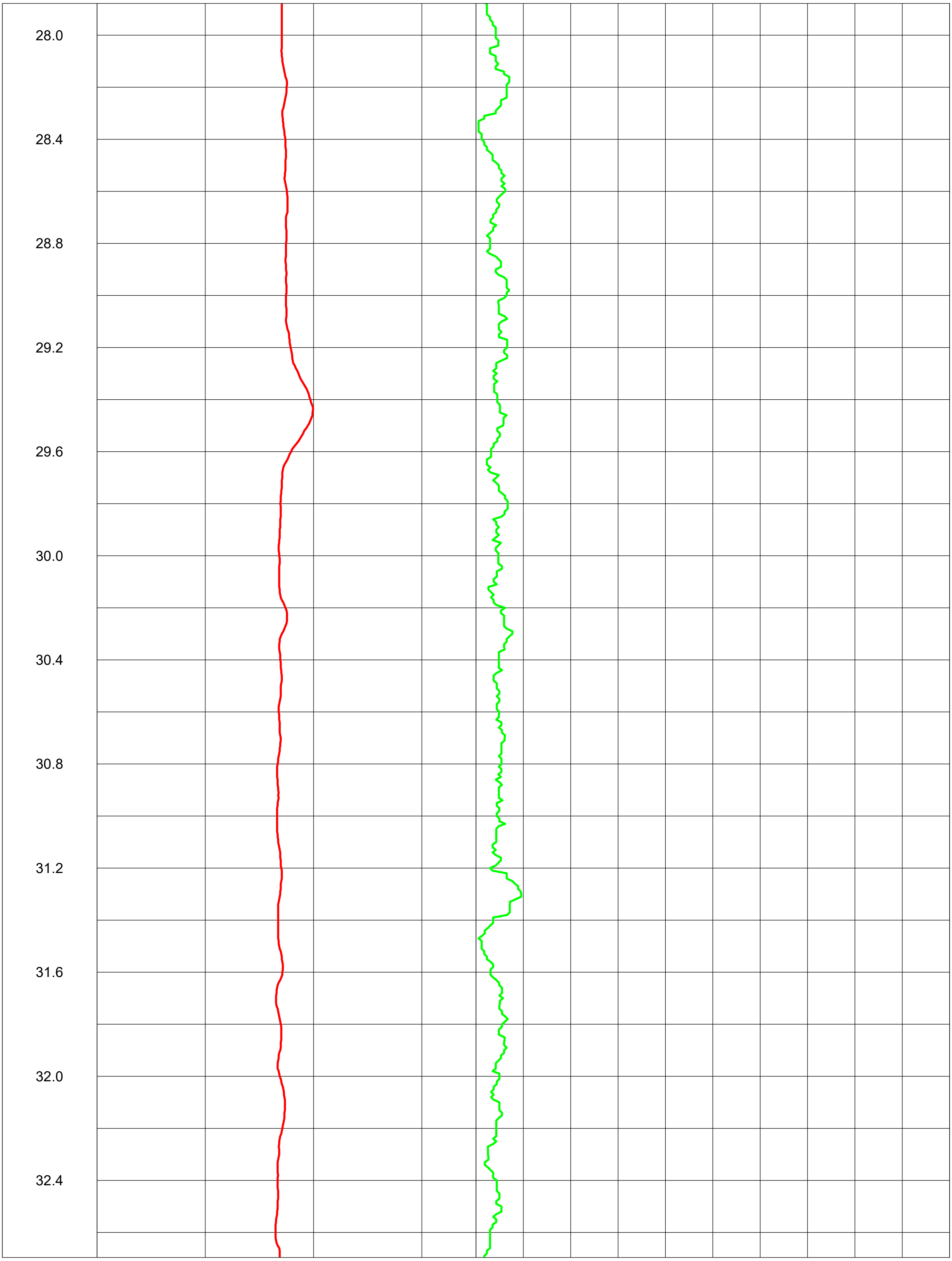

4.0
4.4
4.8
5.2
5.6
6.0
6.4
6.8
7.2
7.6
8.0
8.4

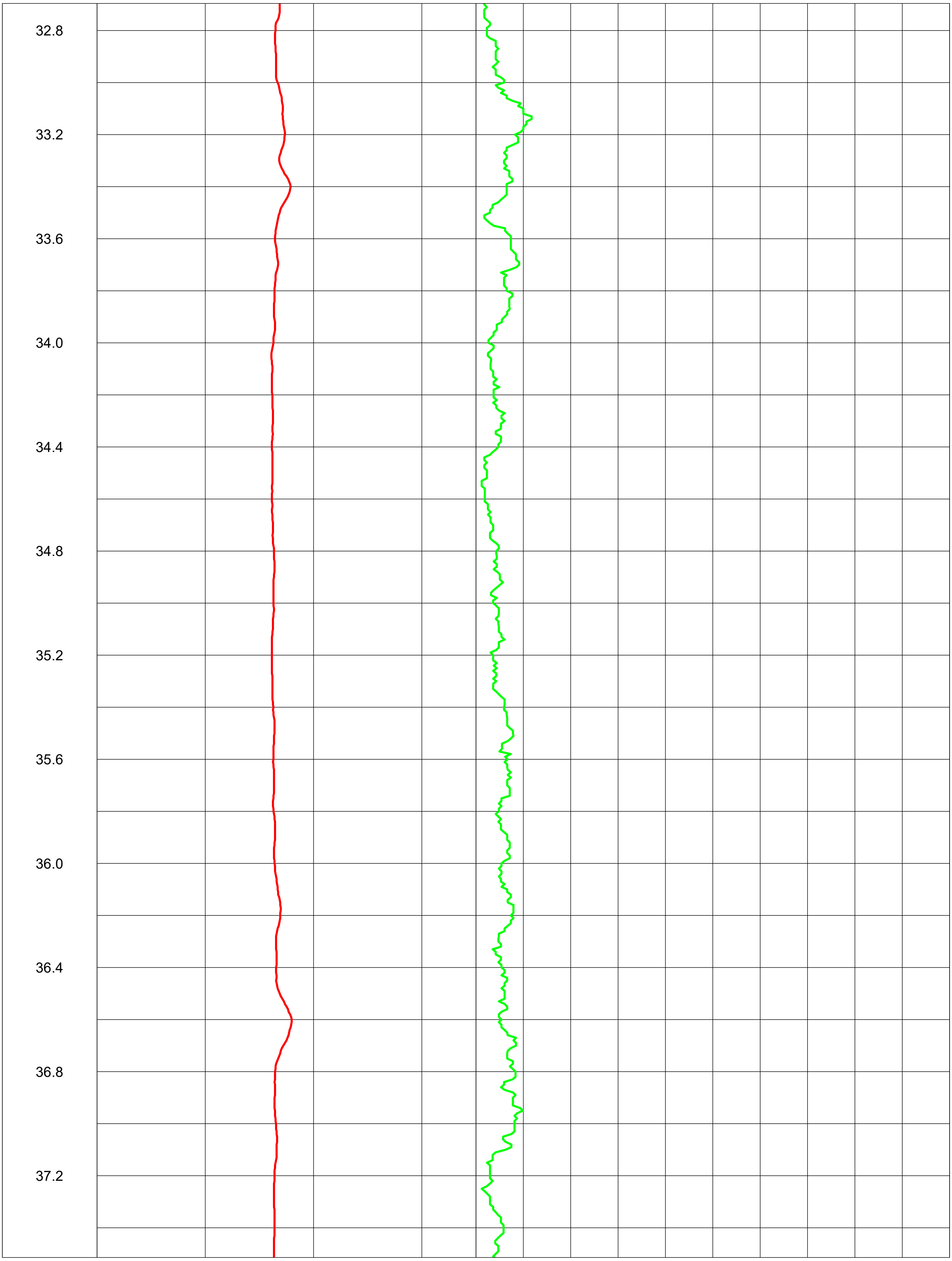

8.8
9.2
9.6
10.0
10.4
10.8
11.2
11.6
12.0
12.4
12.8
13.2


13.6
14.0
14.4
14.8
15.2
15.6
16.0
16.4
16.8
17.2
17.6
18.0

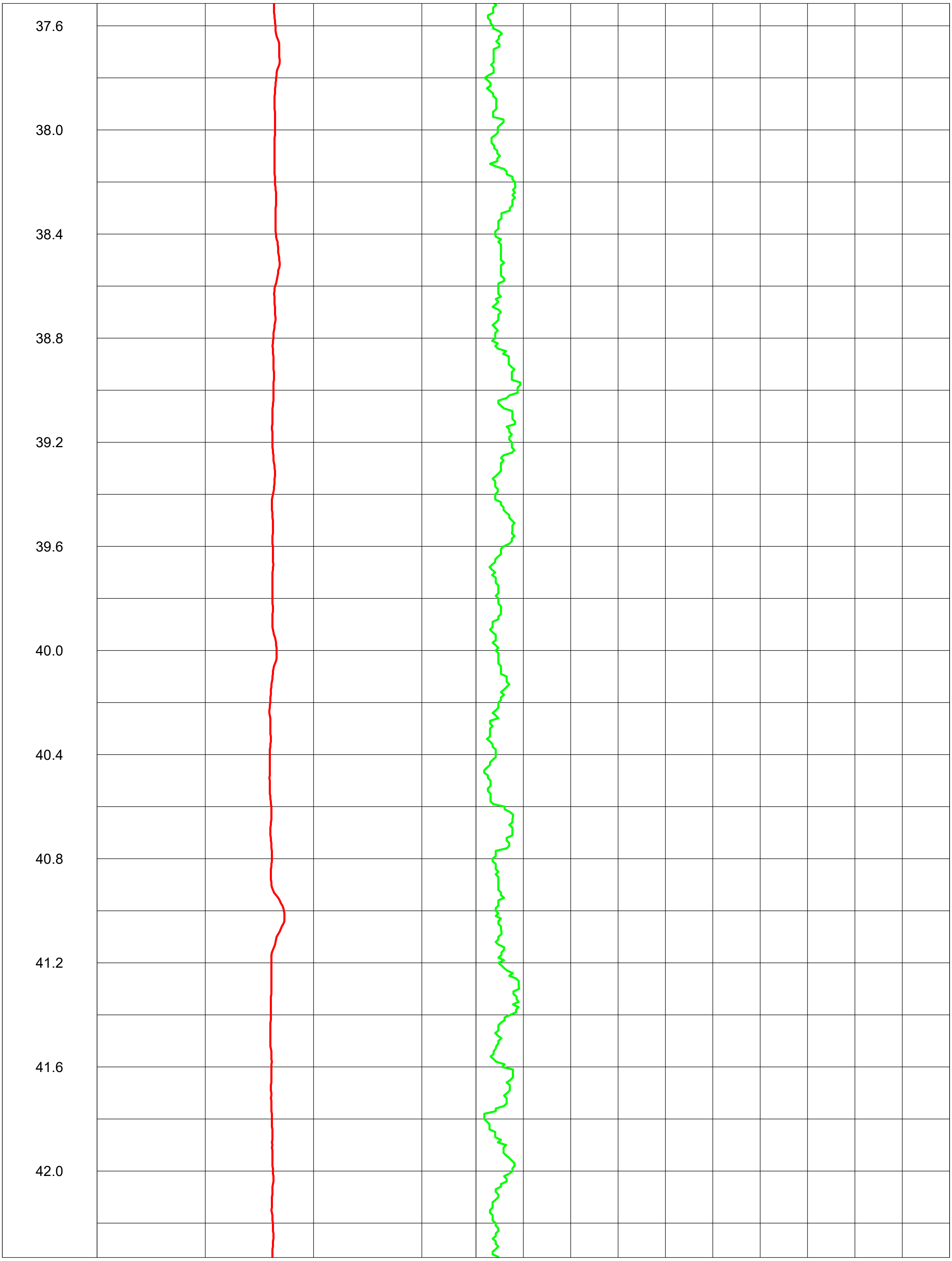

18.4
18.8
19.2
19.6
20.0
20.4
20.8
21.2
21.6
22.0
22.4
22.8

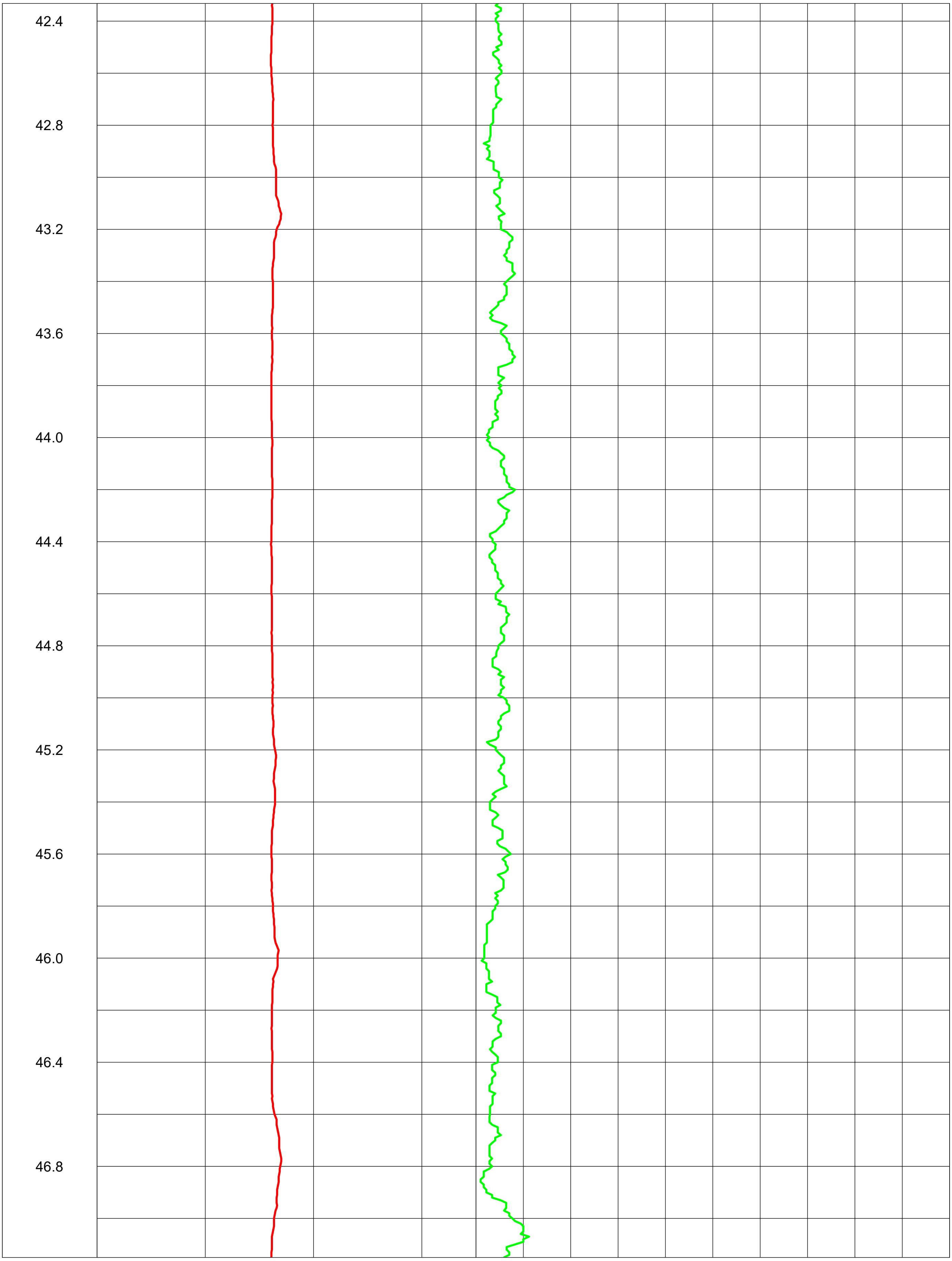

23.2
23.6
24.0
24.4
24.8
25.2
25.6
26.0
26.4
26.8
27.2
27.6

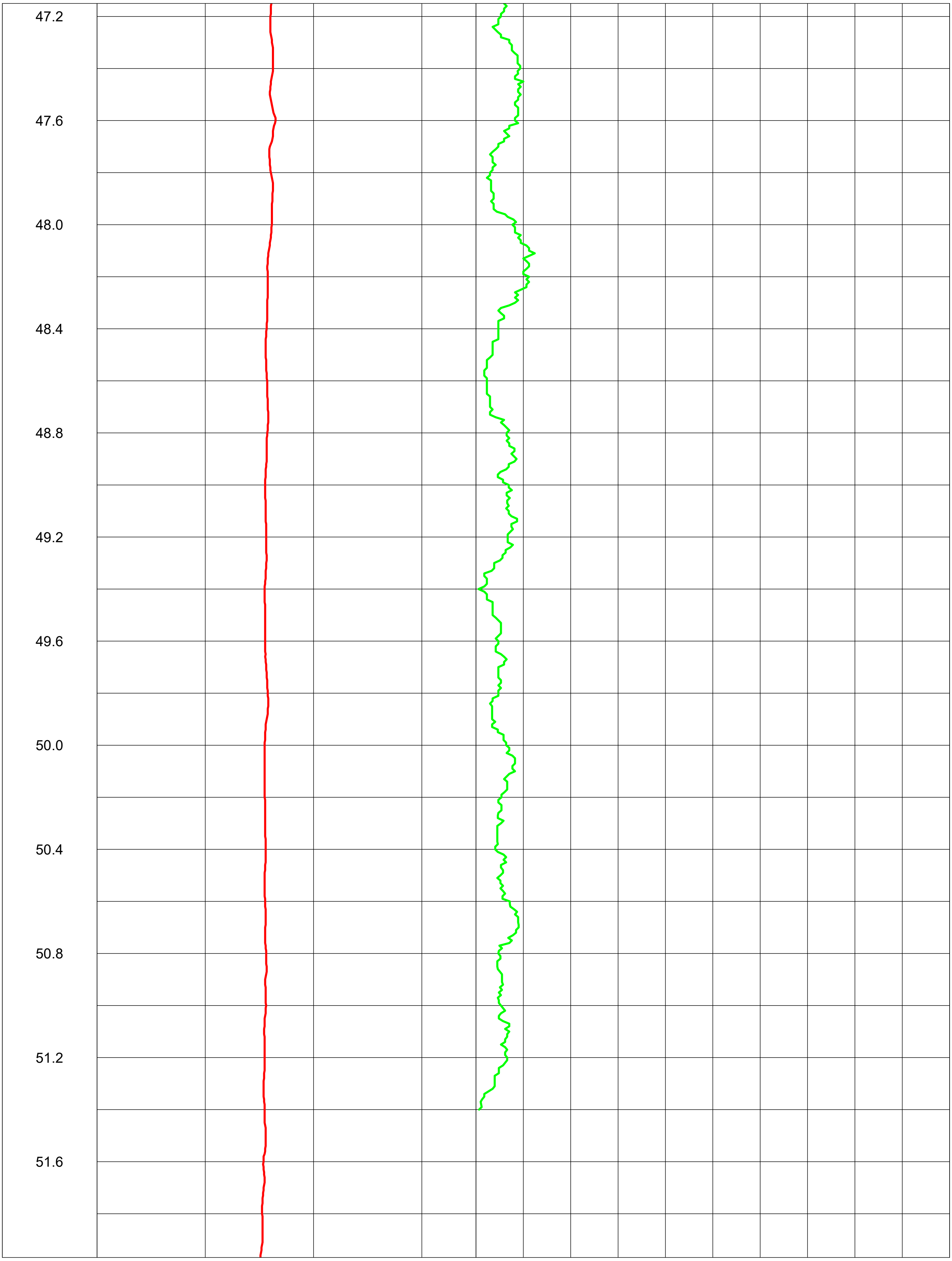

28.0
28.4
28.8
29.2
29.6
30.0
30.4
30.8
31.2
31.6
32.0
32.4

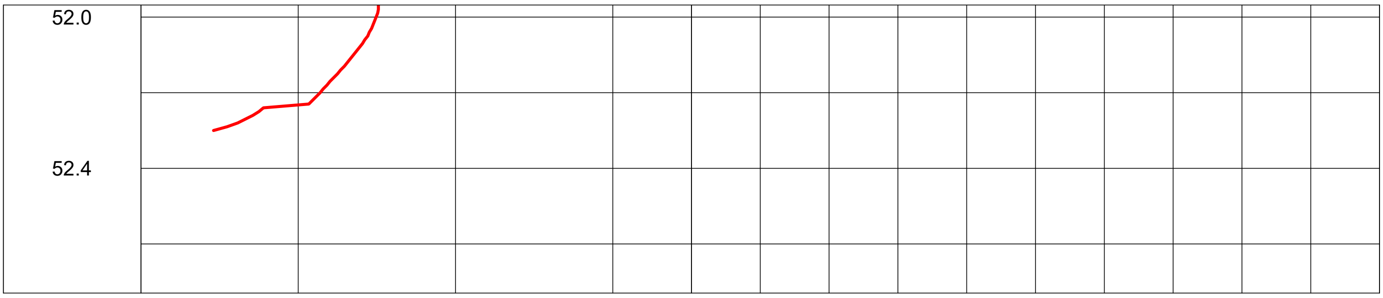


32.8
33.2
33.6
34.0
34.4
34.8
35.2
35.6
36.0
36.4
36.8
37.2

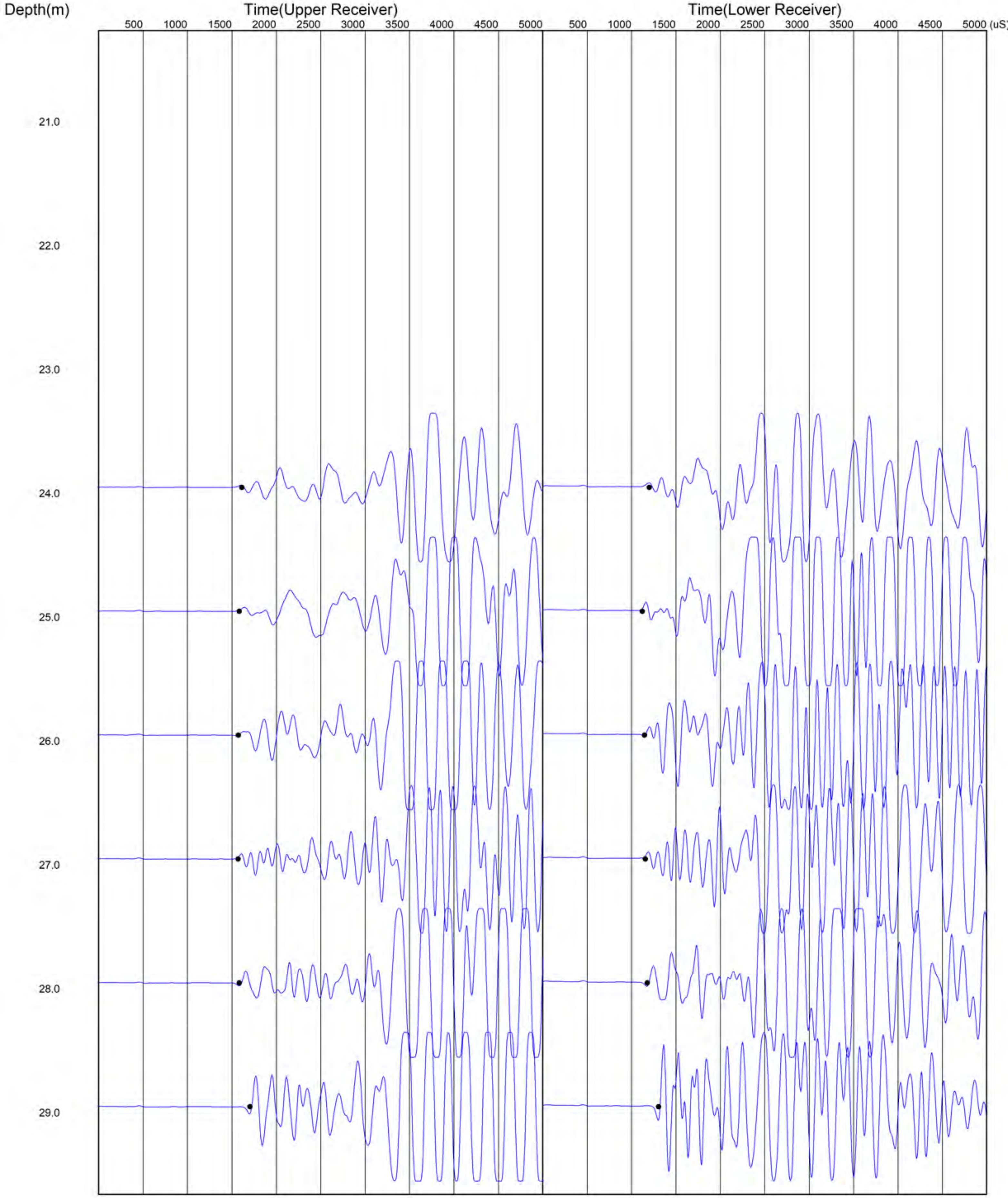

37.6
38.0
38.4
38.8
39.2
39.6
40.0
40.4
40.8
41.2
41.6
42.0


42.4
42.8
43.2
43.6
44.0
44.4
44.8
45.2
45.6
46.0
46.4
46.8

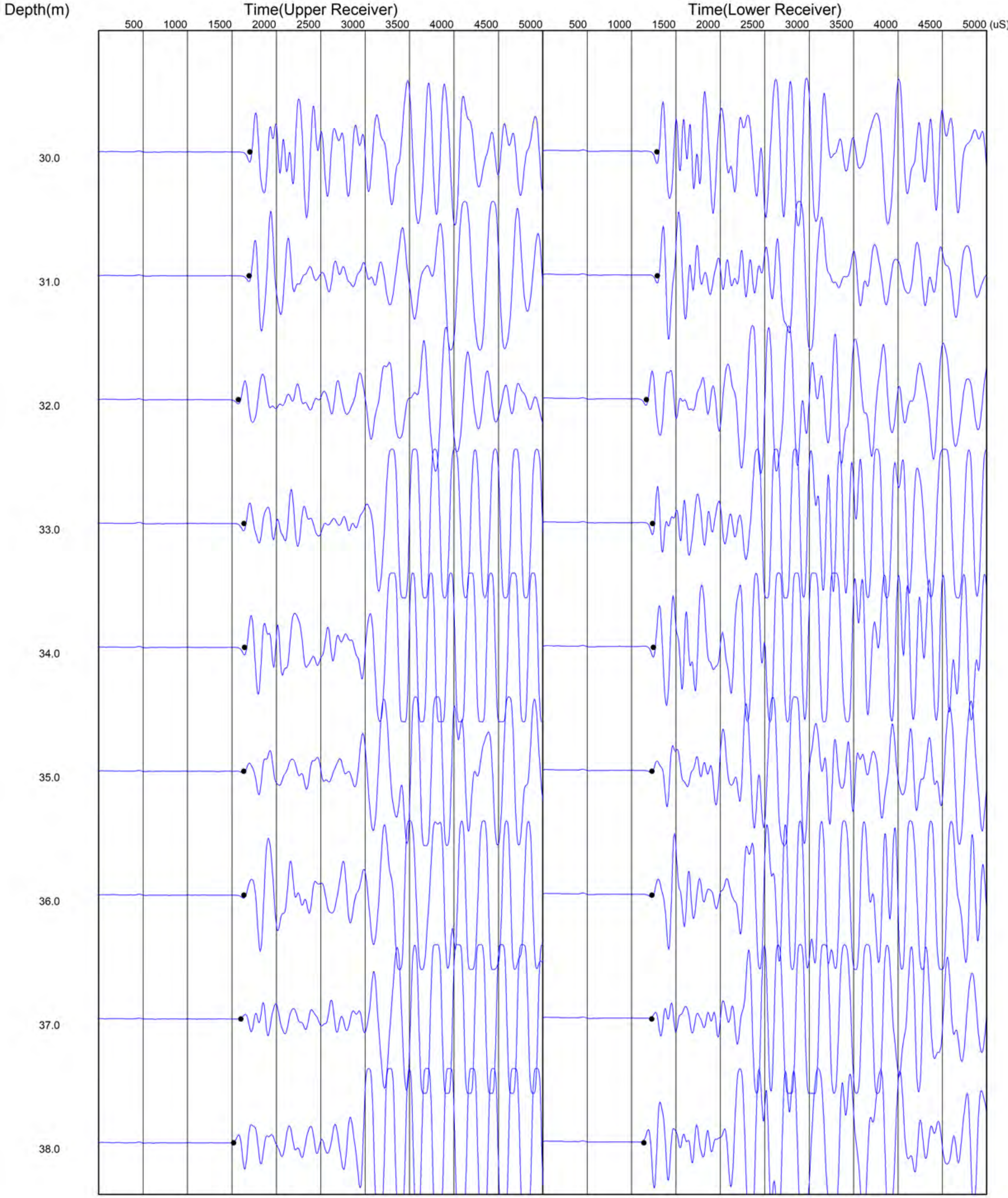

47.2
47.6
48.0
48.4
48.8
49.2
49.6
50.0
50.4
50.8
51.2
51.6

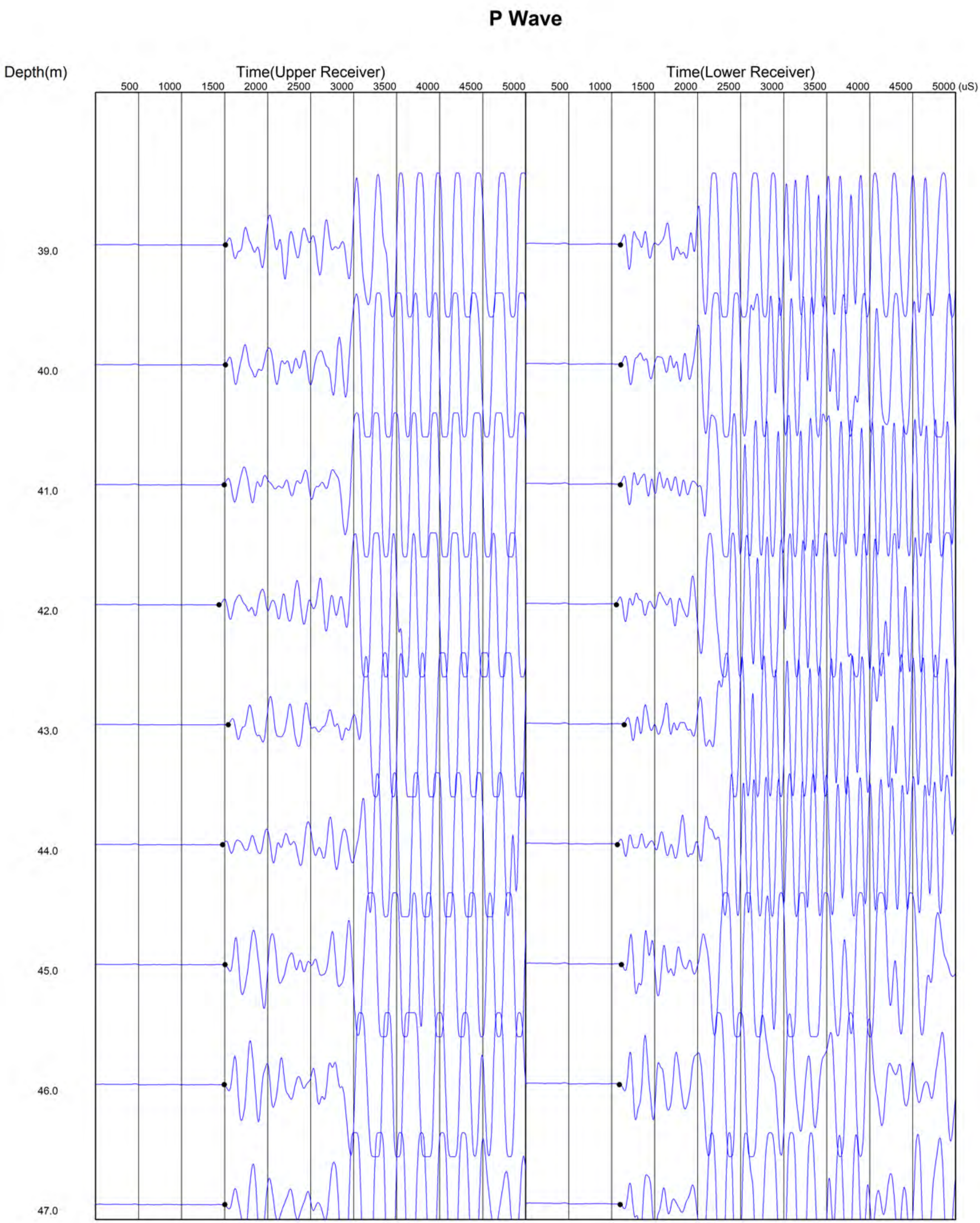

52.0
52.4

P Wave

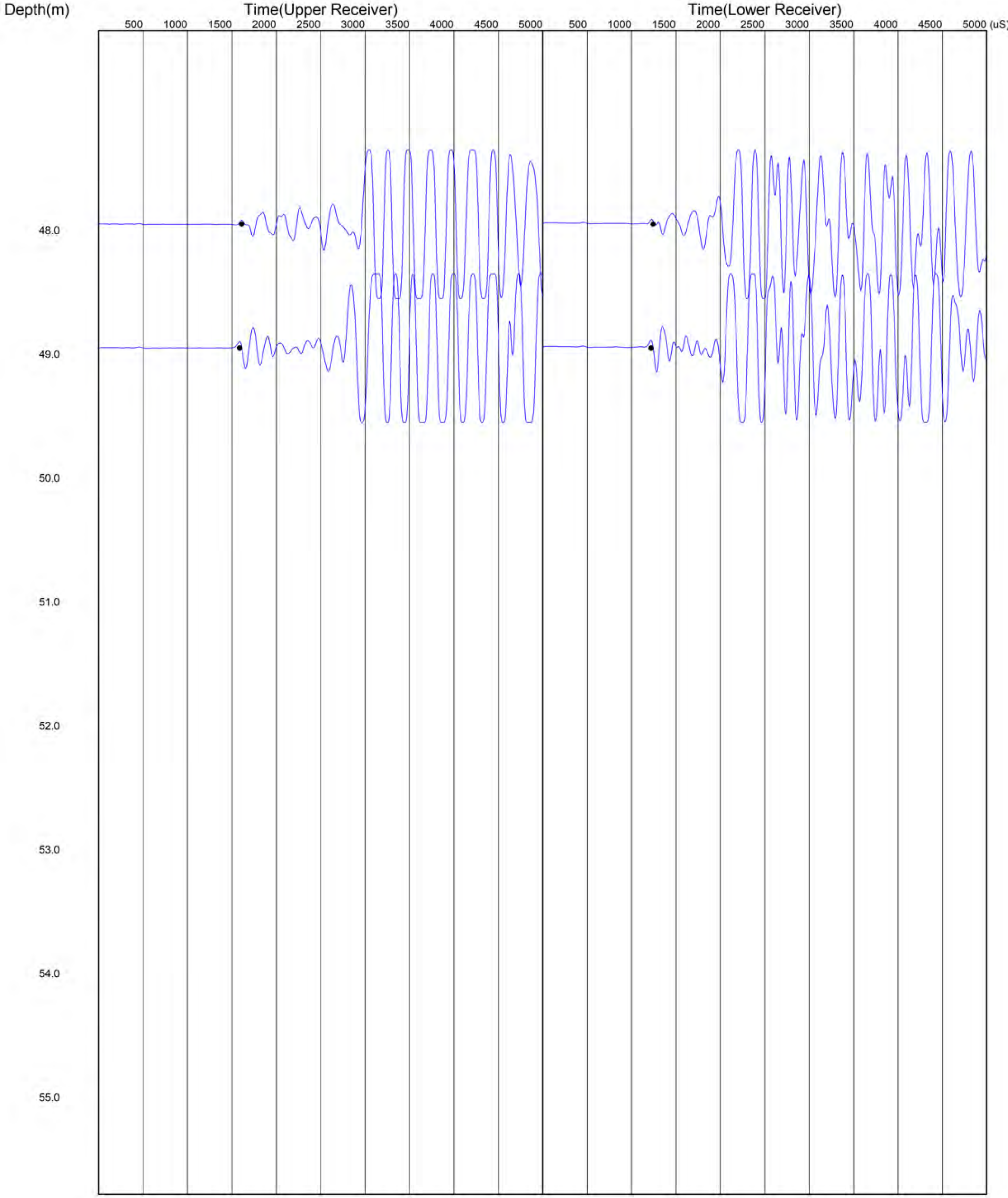

Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
21.0
22.0
23.0
24.0
25.0
26.0
27.0
28.0
29.0

P Wave

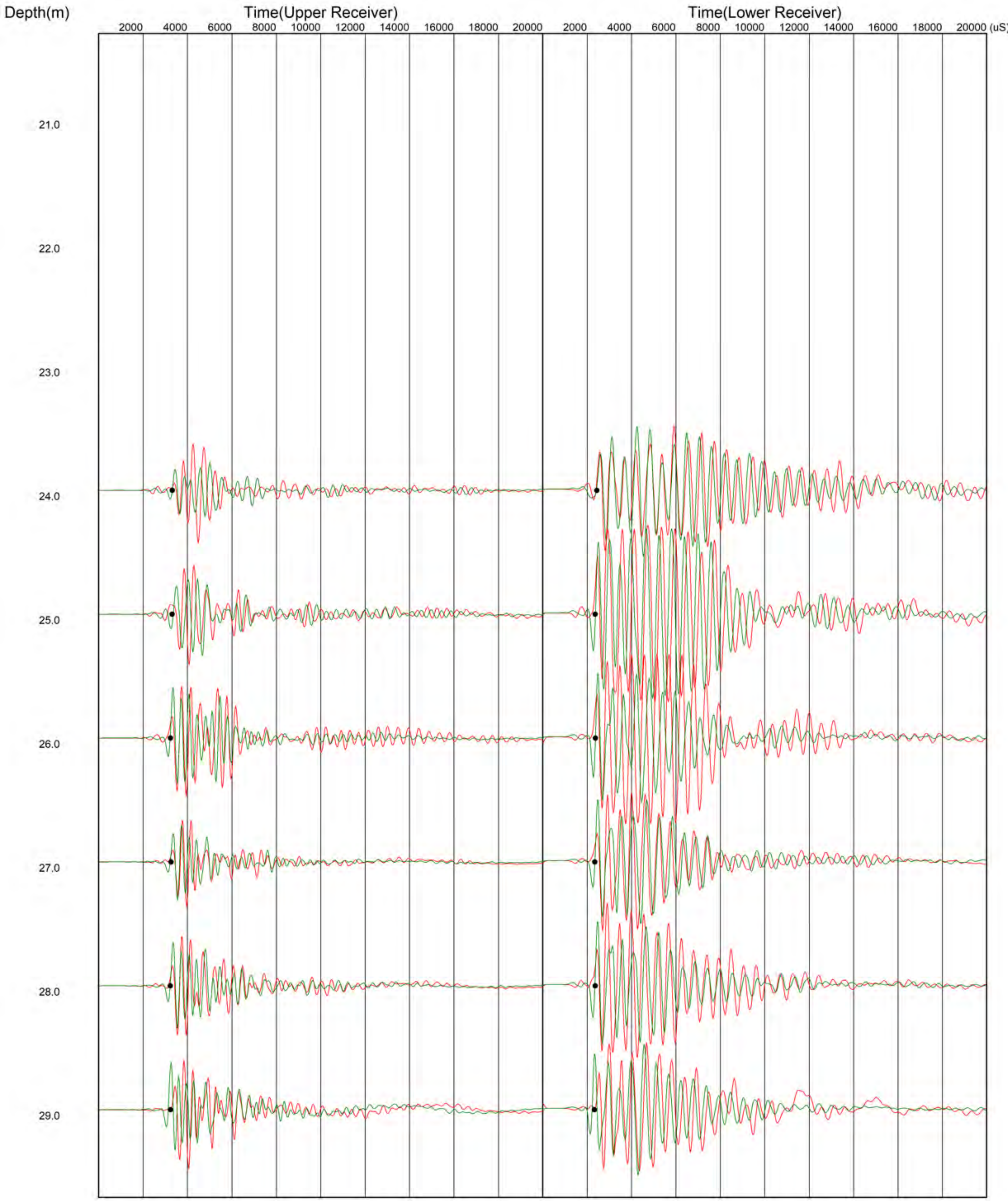

Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
30.0
31.0
32.0
33.0
34.0
35.0
36.0
37.0
38.0


P Wave
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
39.0
40.0
41.0
42.0
43.0
44.0
45.0
46.0
47.0

P Wave

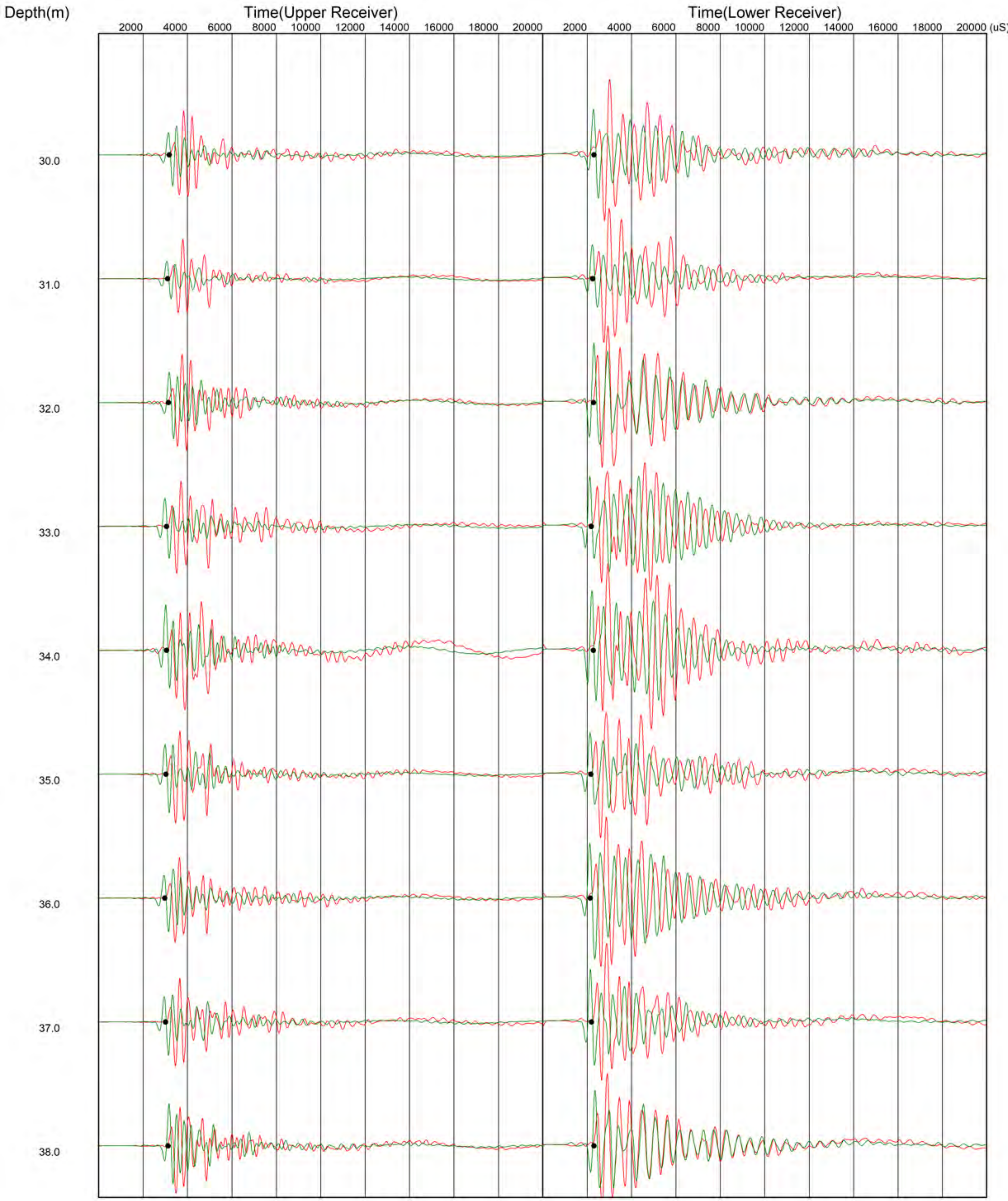

Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
48.0
49.0
50.0
51.0
52.0
53.0
54.0
55.0

S Wave



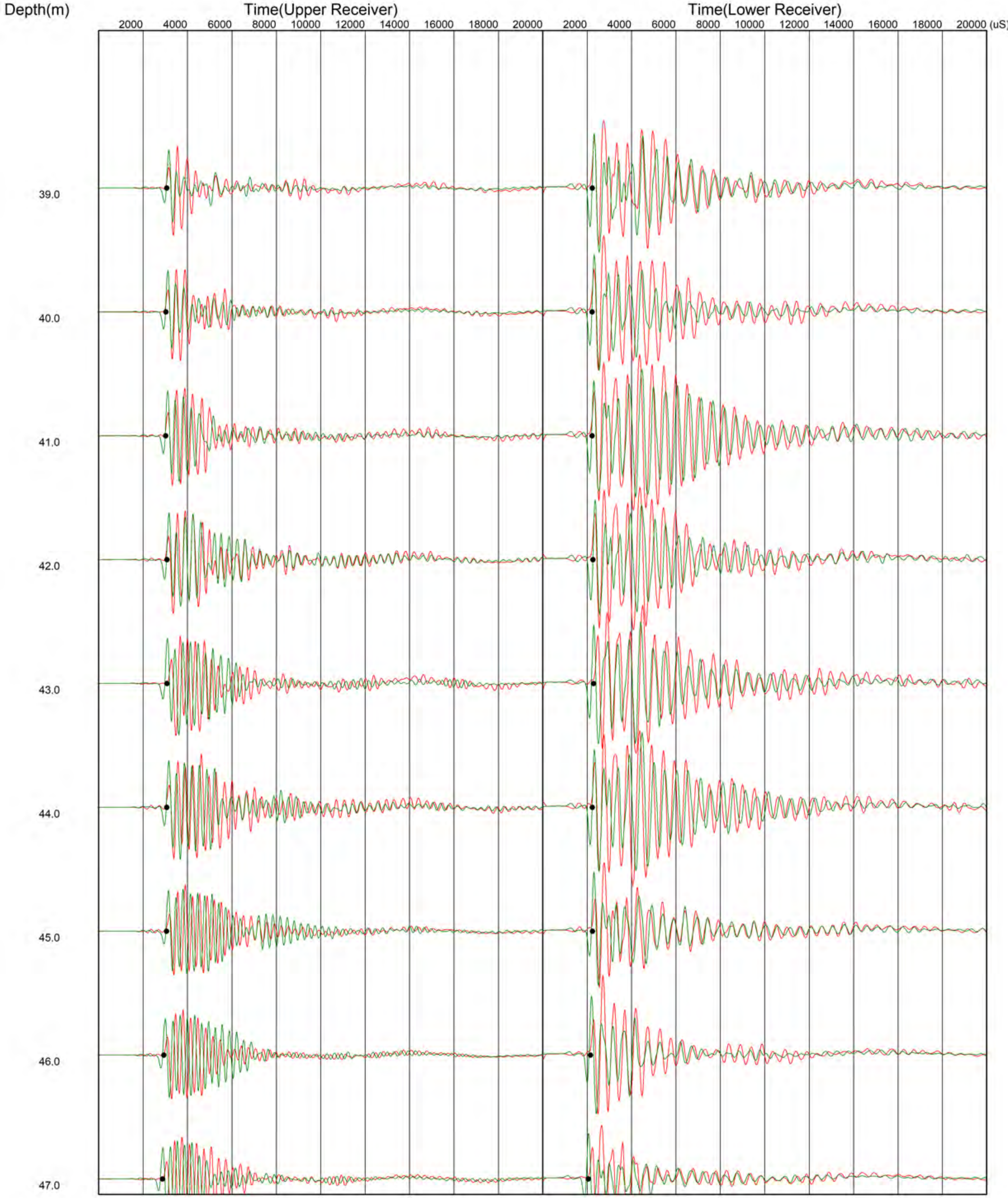
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
21.0
22.0
23.0
24.0
25.0
26.0
27.0
28.0
29.0

S Wave



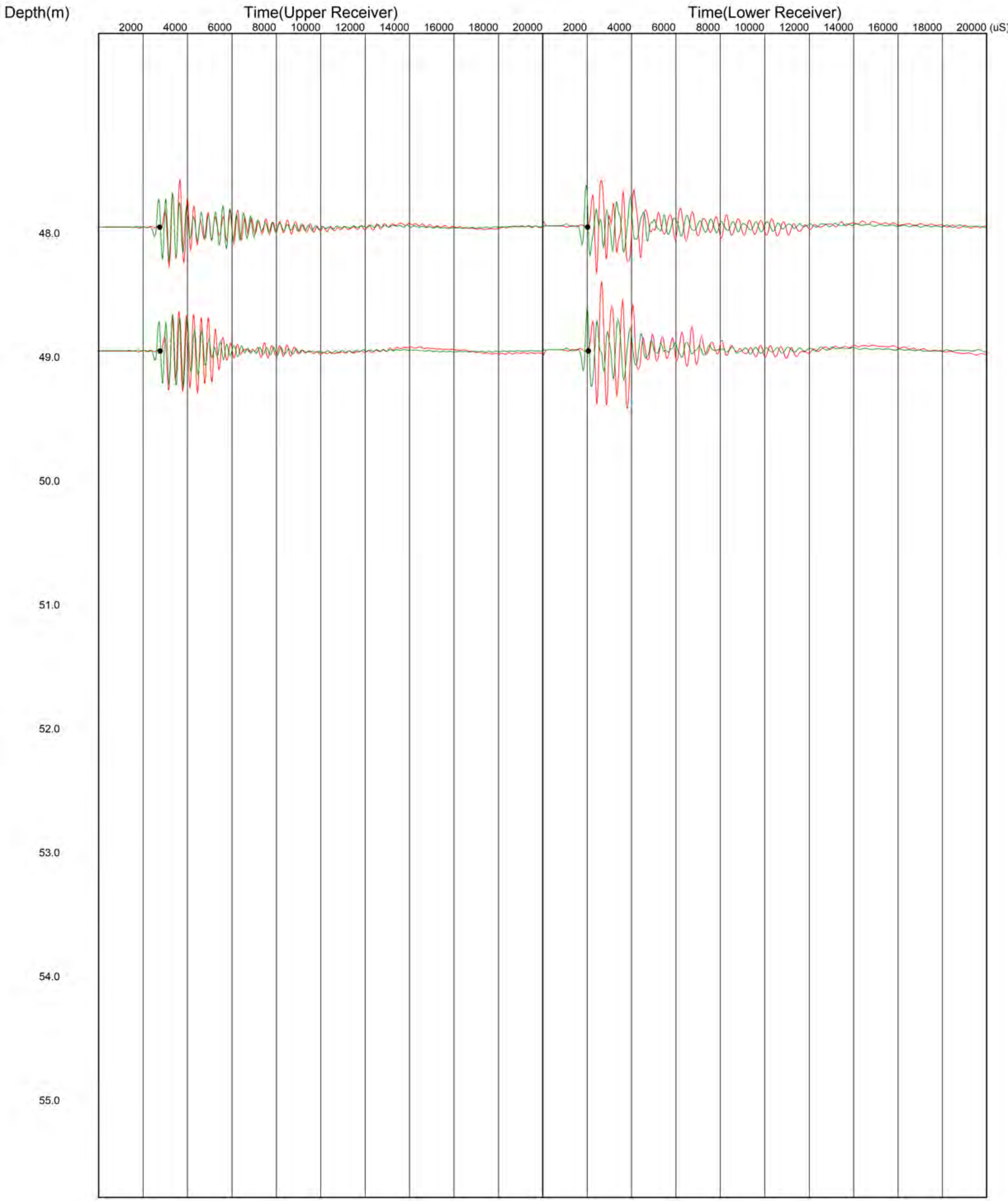
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
30.0
31.0
32.0
33.0
34.0
35.0
36.0
37.0
38.0

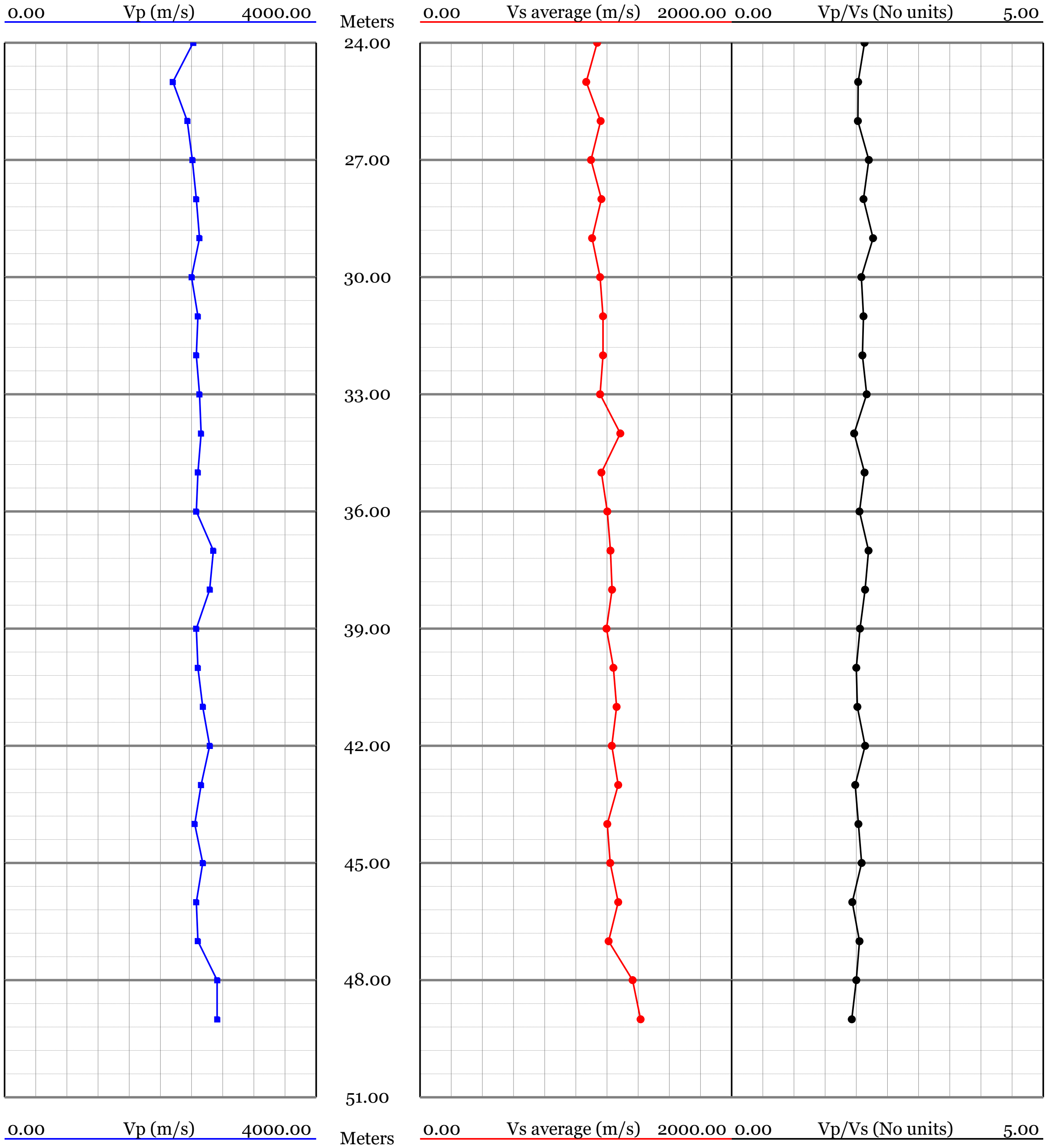
S Wave



Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
39.0
40.0
41.0
42.0
43.0
44.0
45.0
46.0
47.0

S Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
48.0
49.0
50.0
51.0
52.0
53.0
54.0
55.0


0.00
Vp (m/s)
4000.00
Meters
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00
24.00
27.00
30.00
33.00
36.00
39.00
42.00
45.00
48.00
51.00
0.00
Vp (m/s)
4000.00
Meters
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00

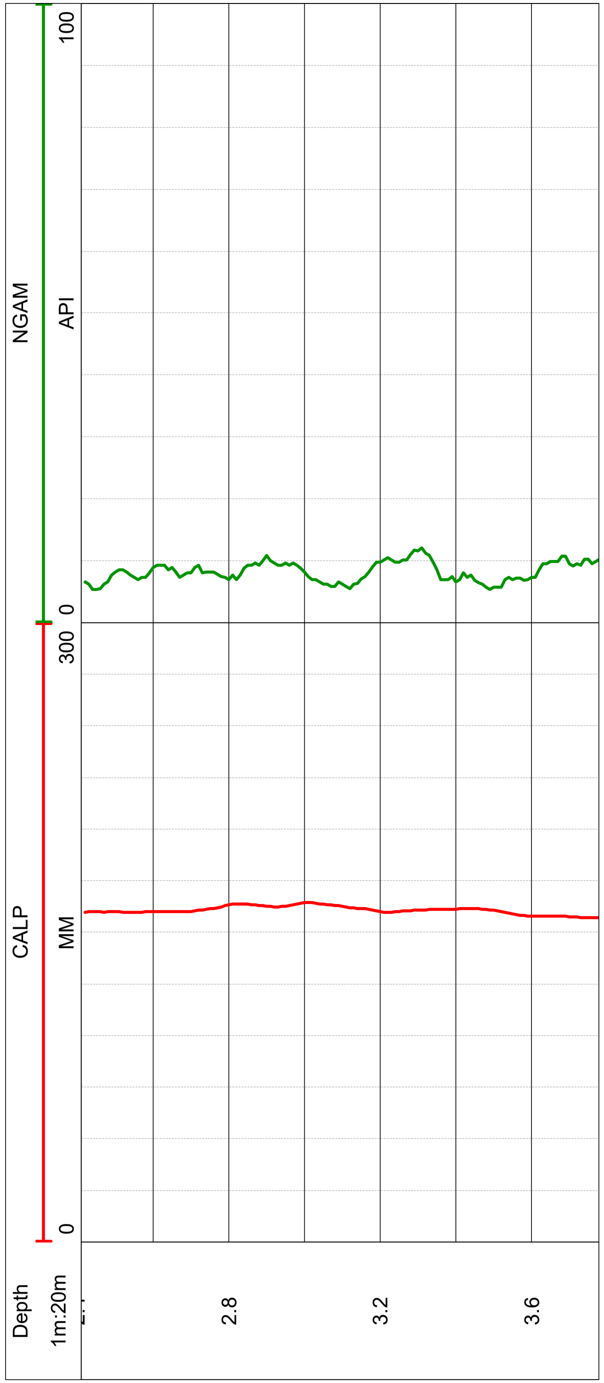
ROBERTSON GEO SERVICES
Unlocking Your GeoData

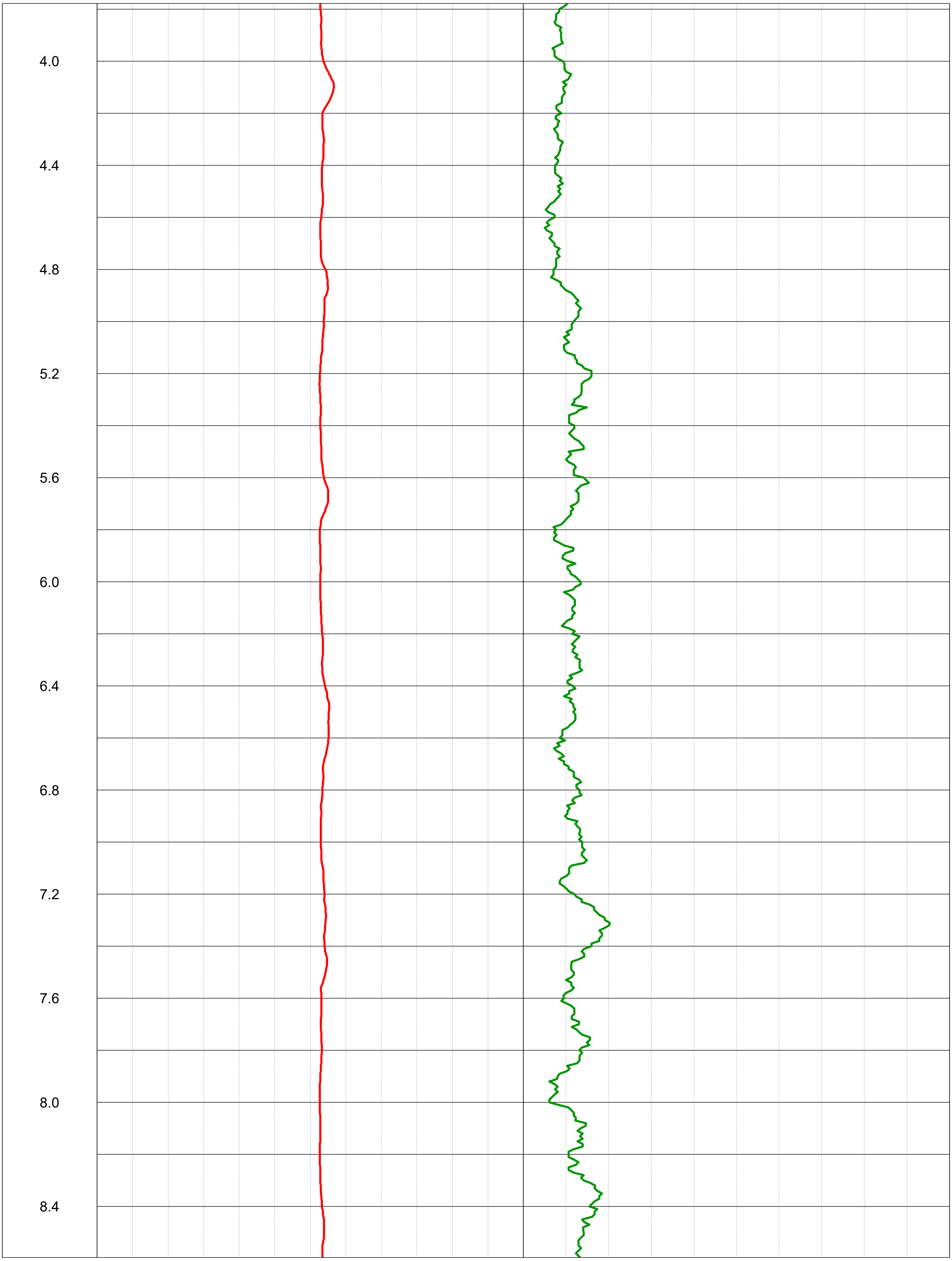
CO Structural Soils	COMPANY	Structural Soils	
WELL R612	WELL ID	R612	
FLD A303 Stonehenge	FIELD	A303 Stonehenge	
CTY England	COUNTRY	England	STATE
STE	LOCATION Easting: 412396.03 Northing: 141886		OTHER SERVICES
FILING No	SEC	TWP	RGE

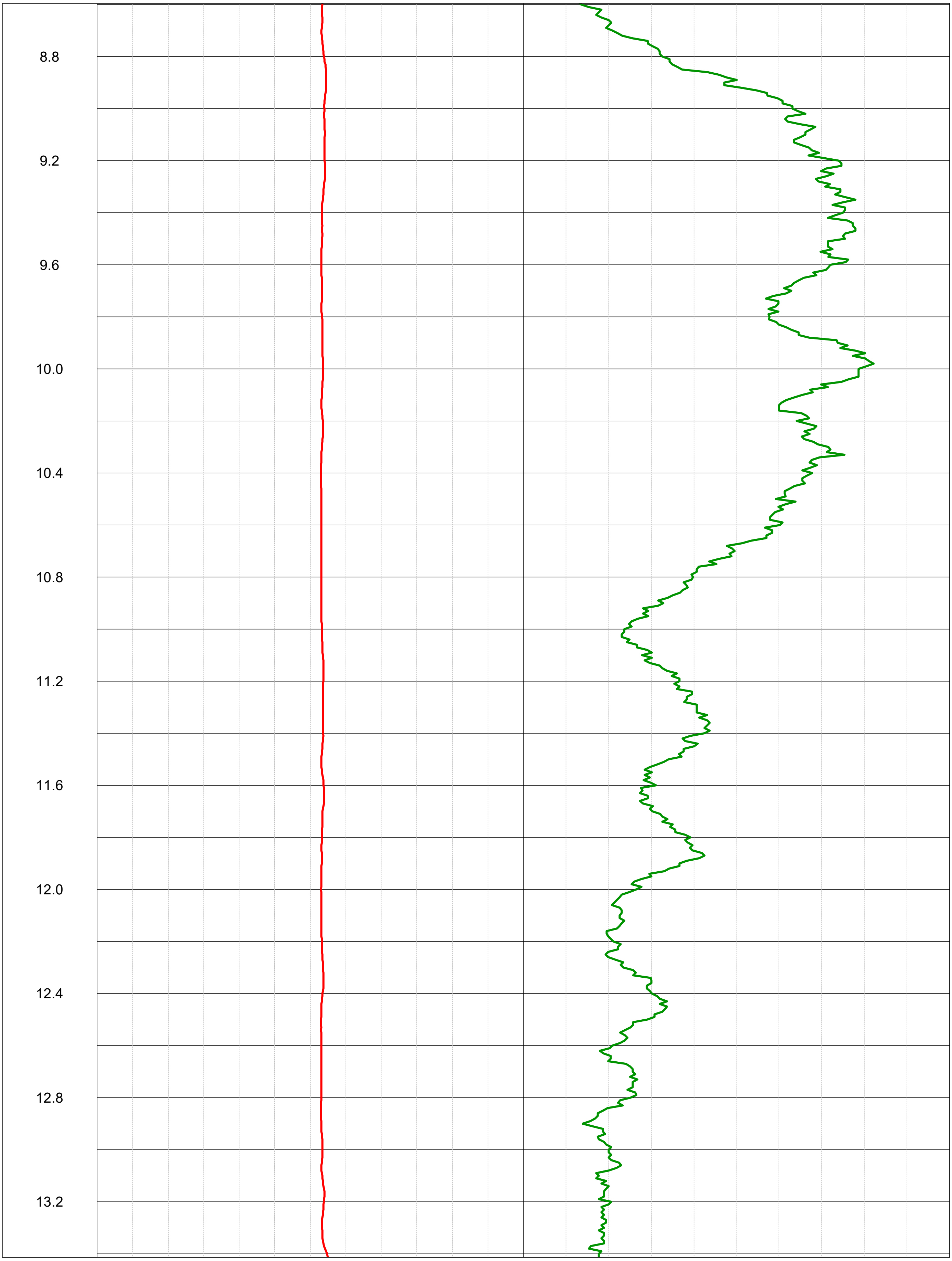
PERMANENT DATUM	GL	ELEVATION	93.083	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM		D.F.
DRILLING MEAS. FROM				G.L.

DATE	31/05/18	TYPE FLUID IN HOLE	Water
RUN No		SALINITY	
TYPE LOG	Caliper Gamma	DENSITY	
DEPTH-DRILLER	53	LEVEL	19
DEPTH-LOGGER	54.4	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	54.4		
TOP LOGGED INTERVAL	2.42		
OPERATING RIG TIME			
RECORDED BY	James Boyett		
WITNESSED BY	Kyle Owen		

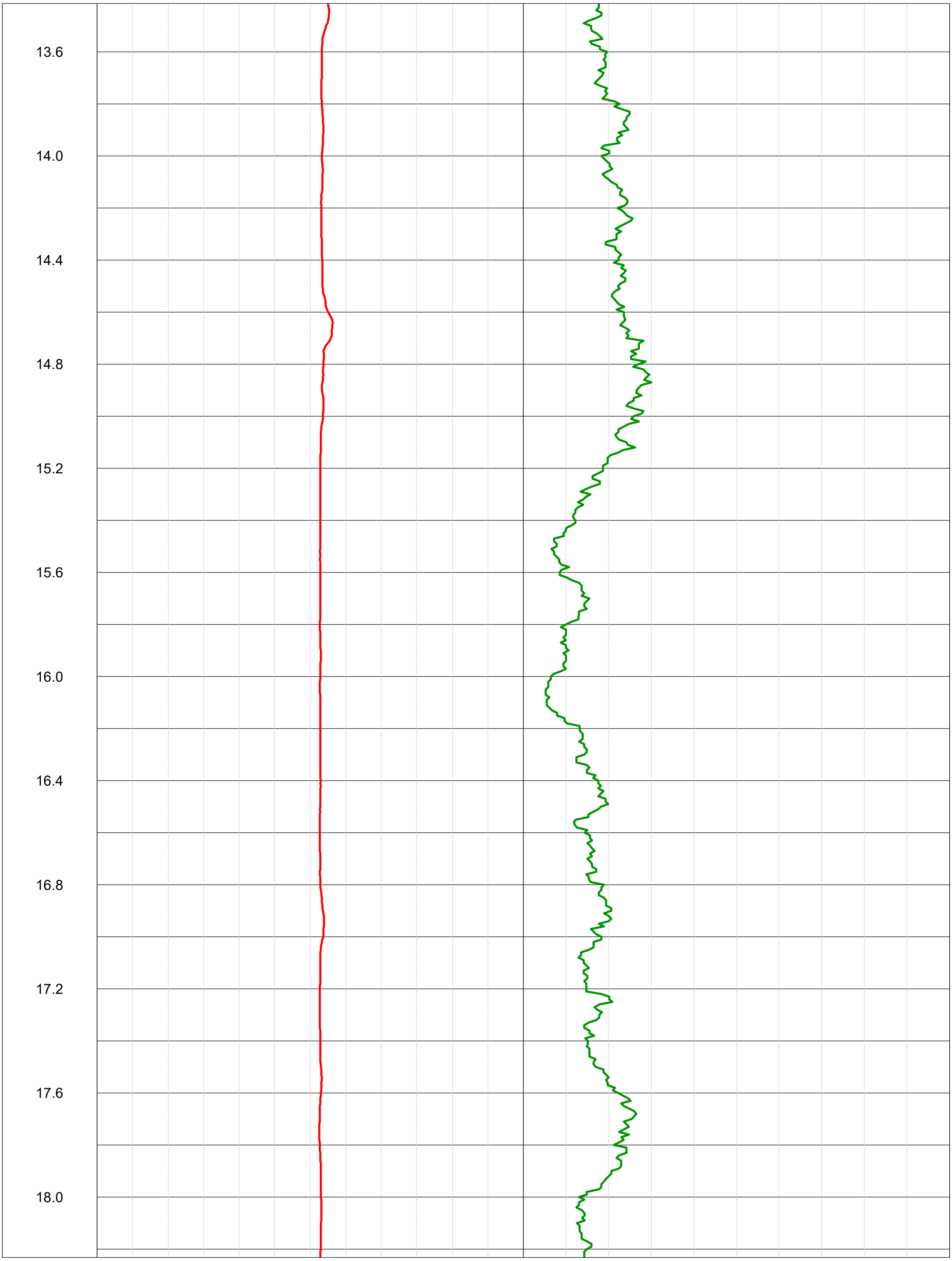
RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

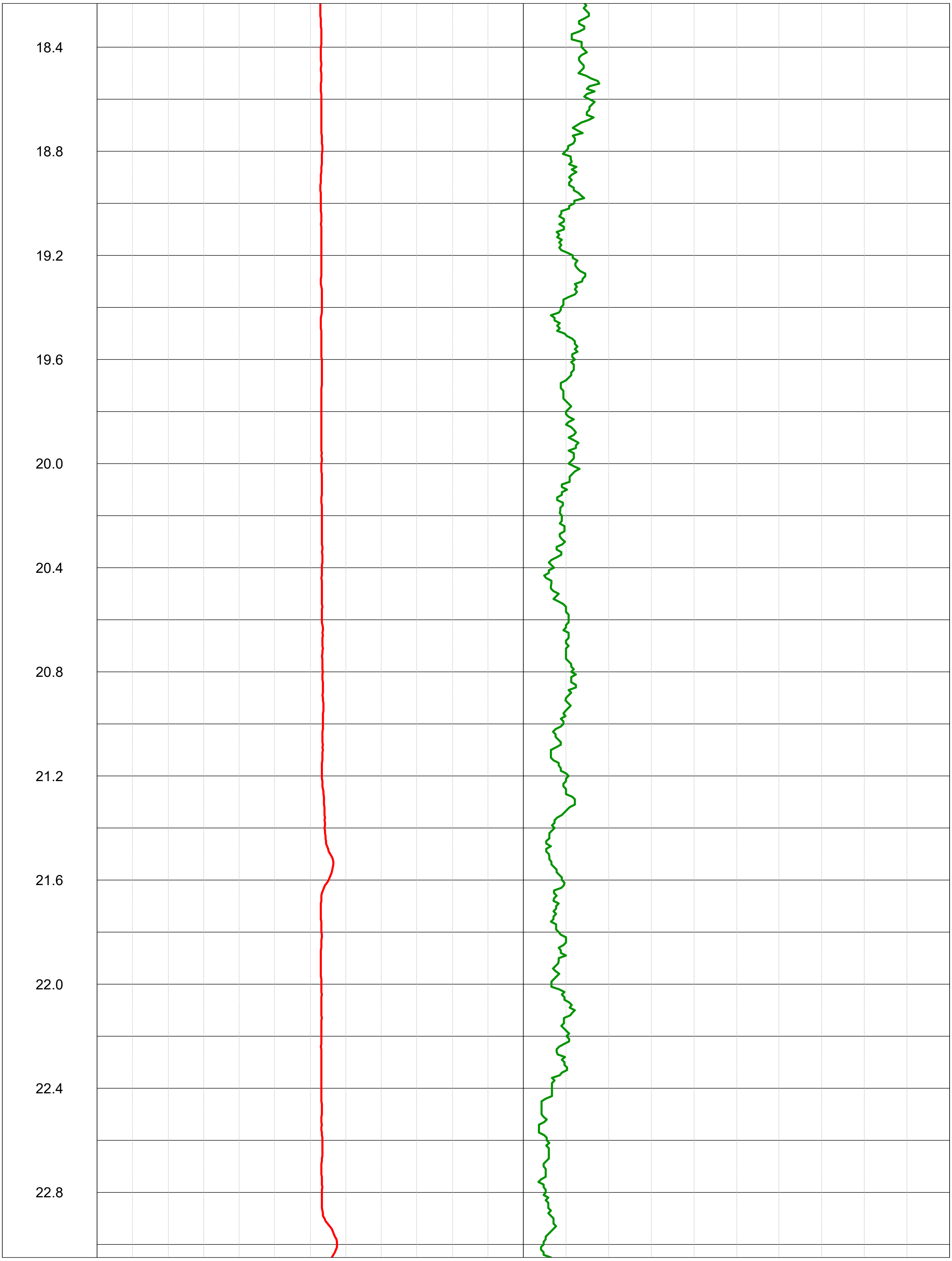


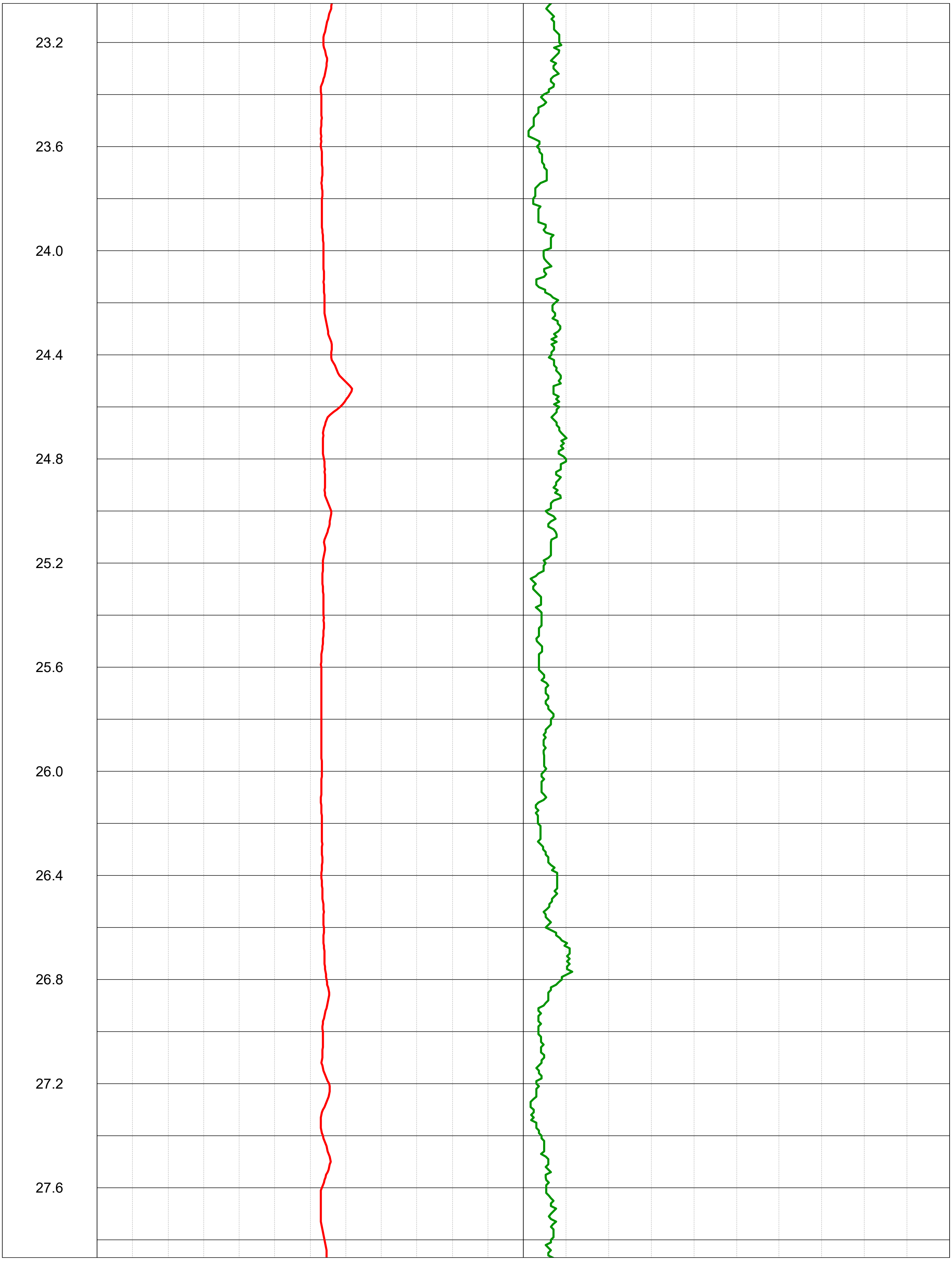

4.0
4.4
4.8
5.2
5.6
6.0
6.4
6.8
7.2
7.6
8.0
8.4

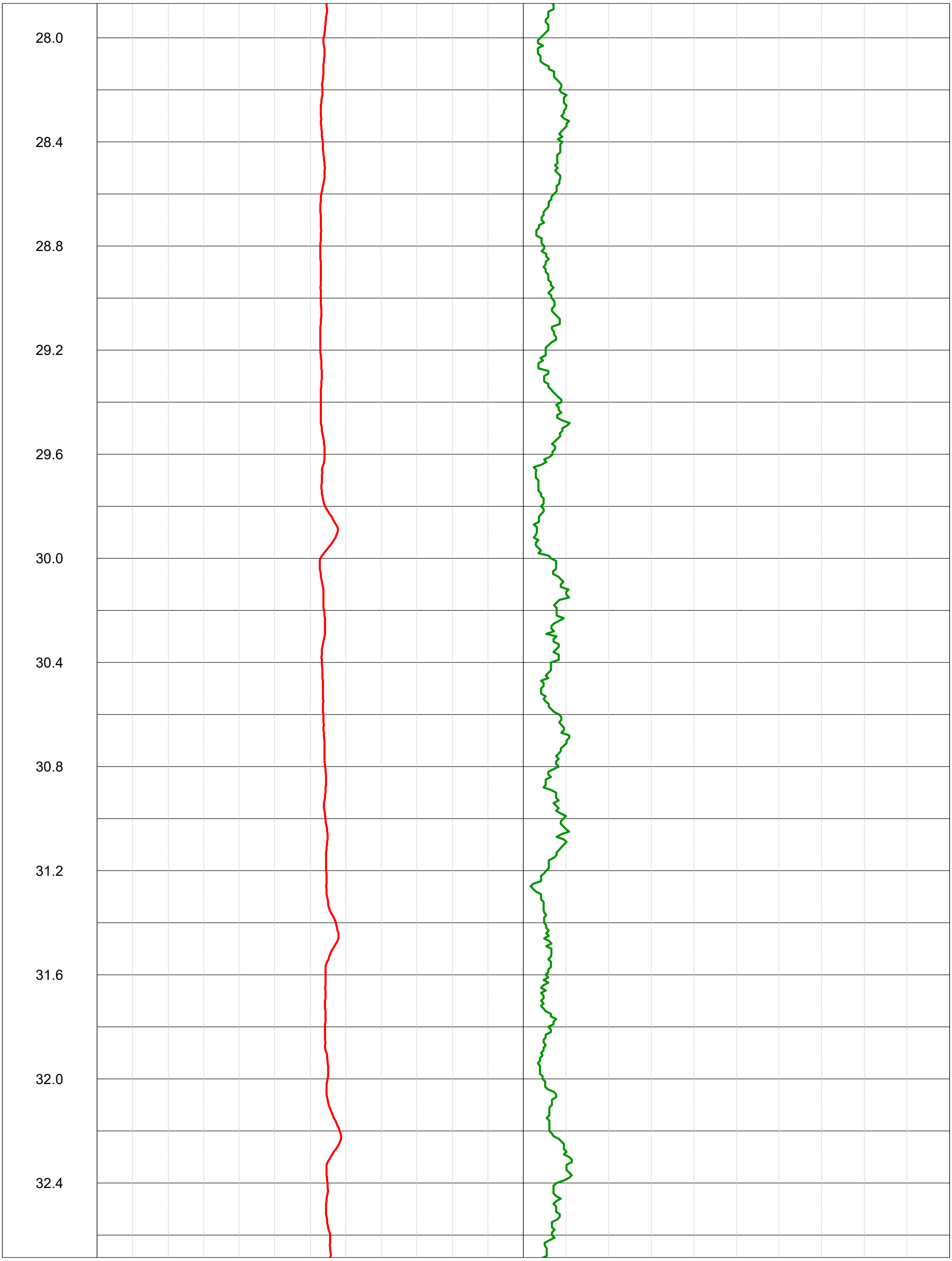


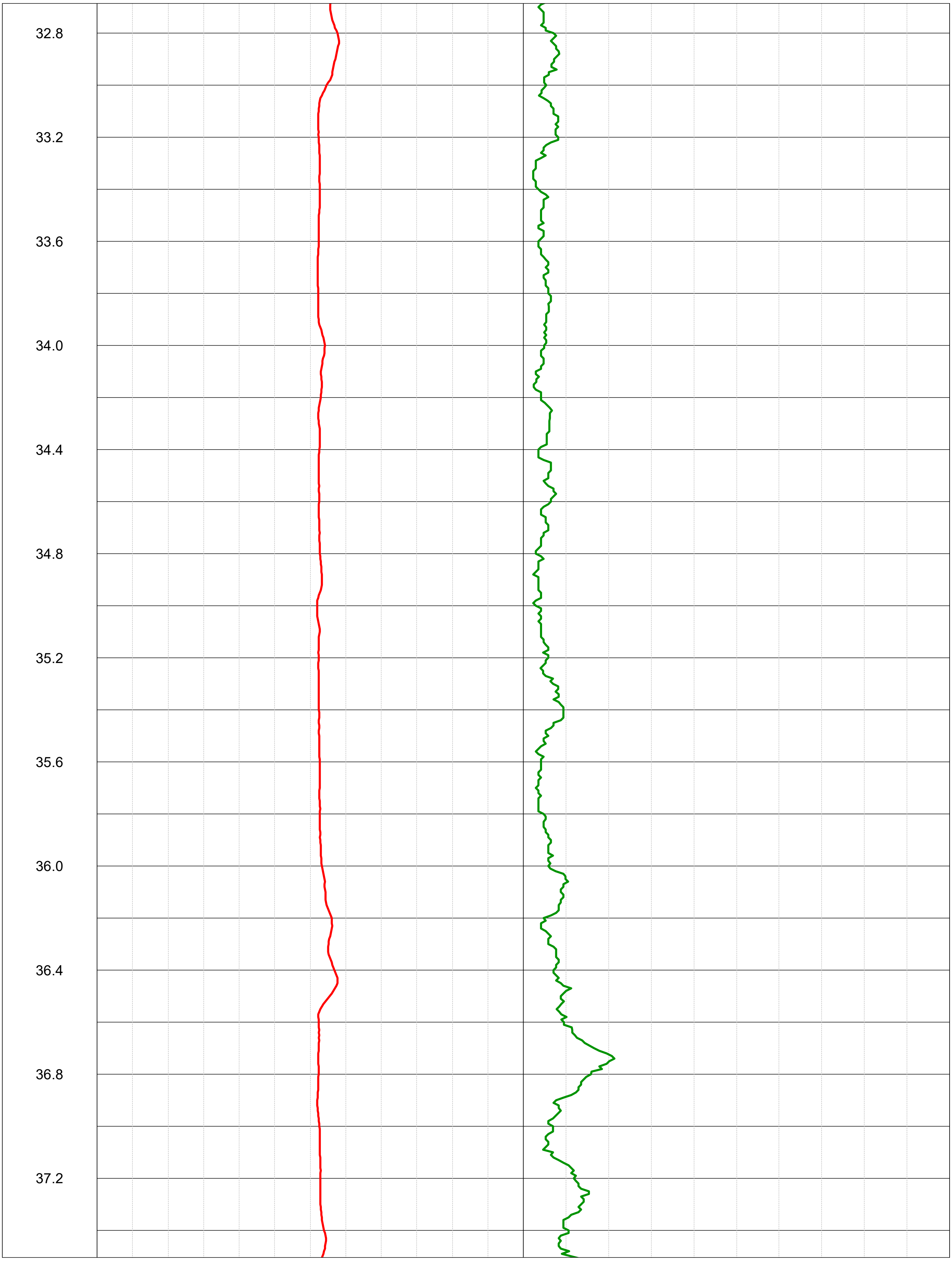
8.8
9.2
9.6
10.0
10.4
10.8
11.2
11.6
12.0
12.4
12.8
13.2

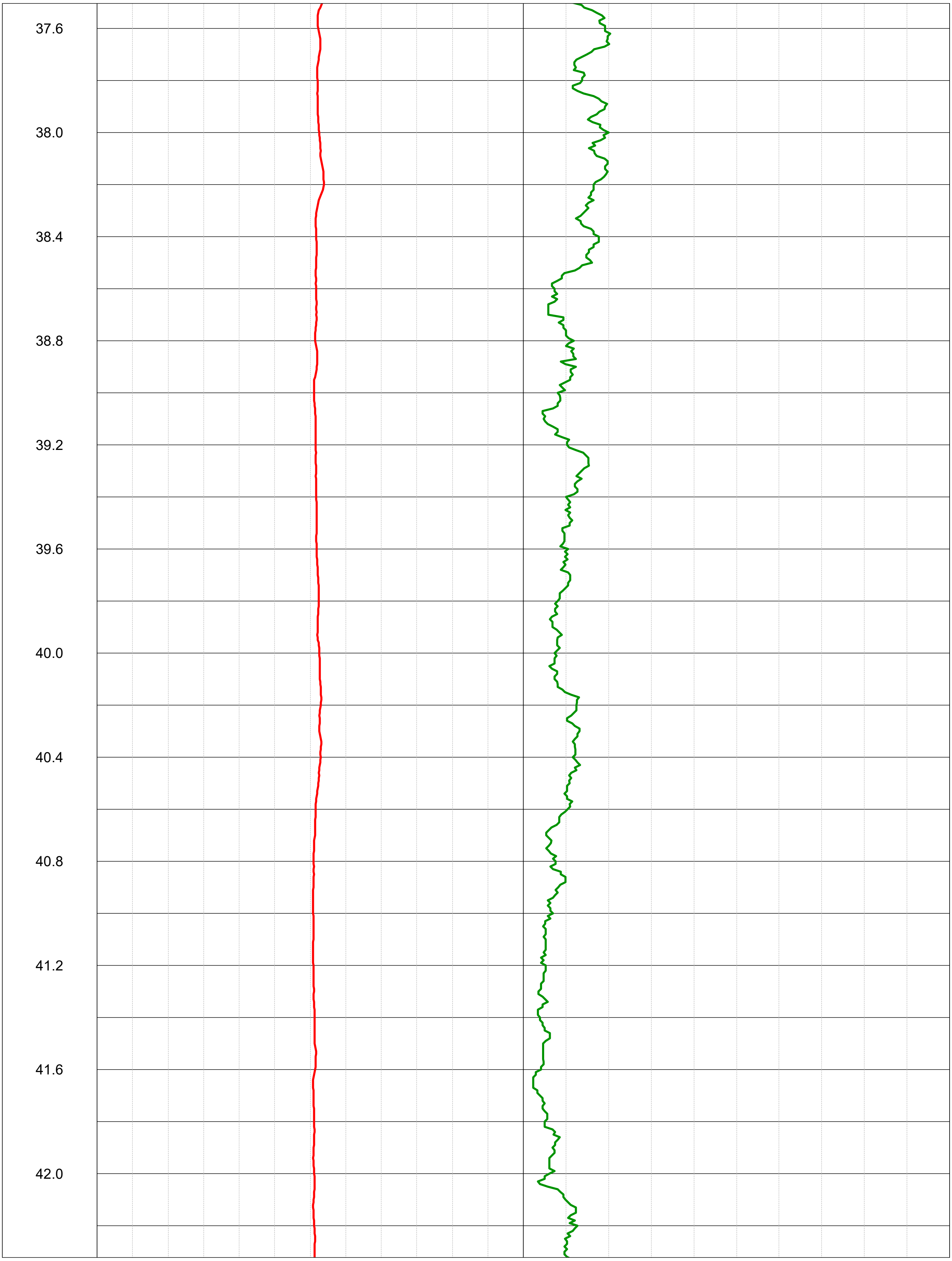

13.6
14.0
14.4
14.8
15.2
15.6
16.0
16.4
16.8
17.2
17.6
18.0

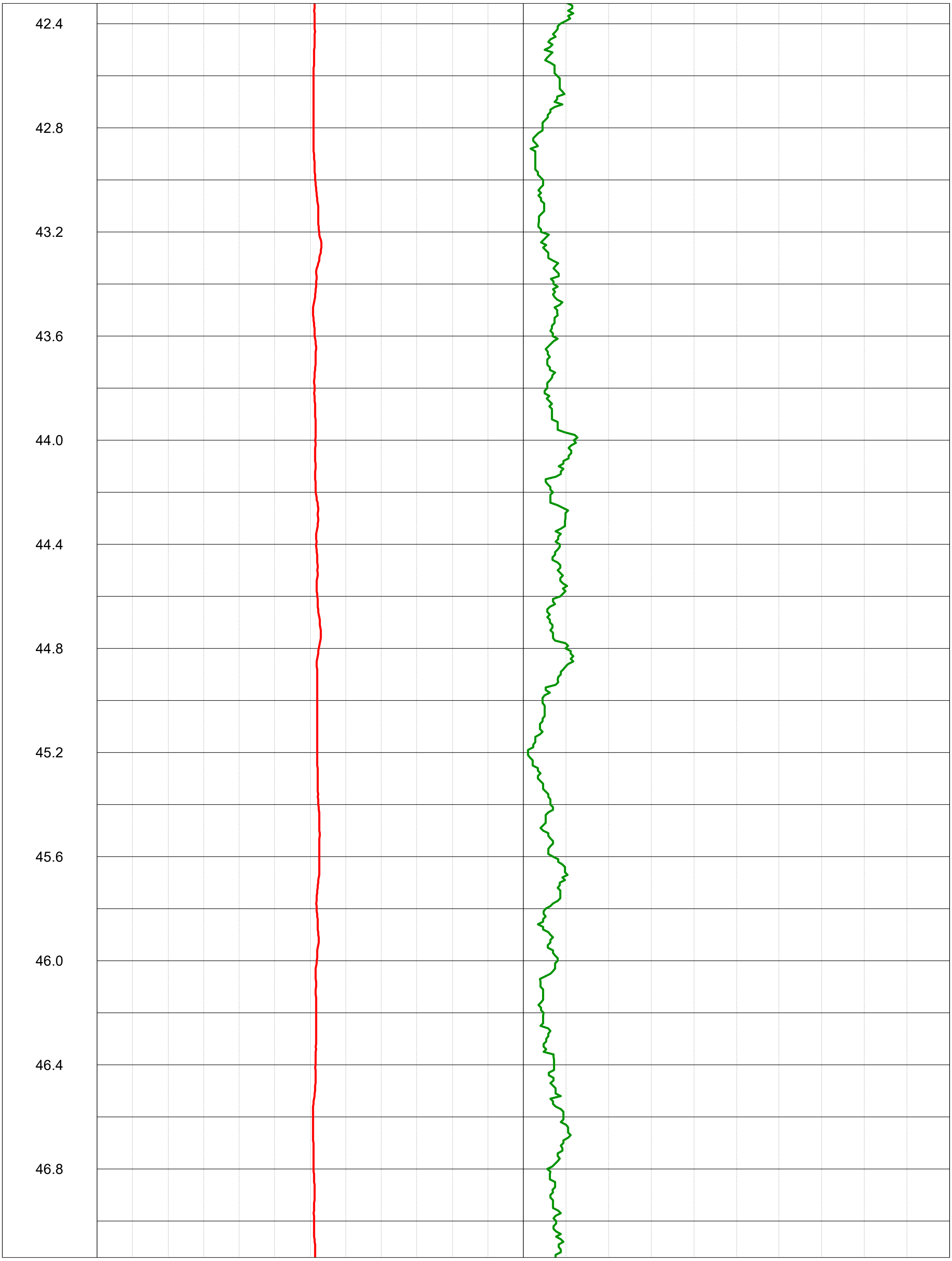

18.4
18.8
19.2
19.6
20.0
20.4
20.8
21.2
21.6
22.0
22.4
22.8

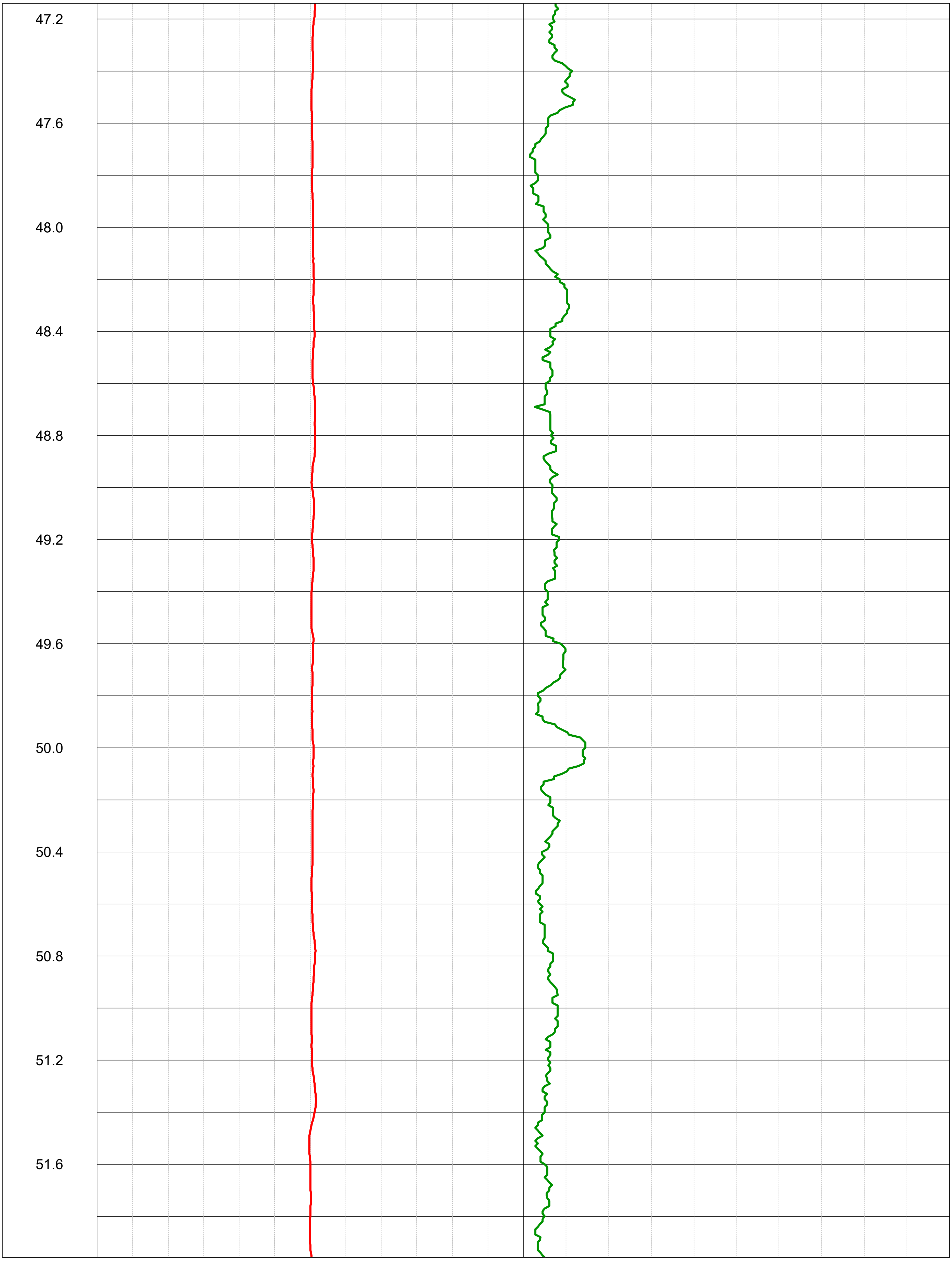

23.2
23.6
24.0
24.4
24.8
25.2
25.6
26.0
26.4
26.8
27.2
27.6


28.0
28.4
28.8
29.2
29.6
30.0
30.4
30.8
31.2
31.6
32.0
32.4


32.8
33.2
33.6
34.0
34.4
34.8
35.2
35.6
36.0
36.4
36.8
37.2

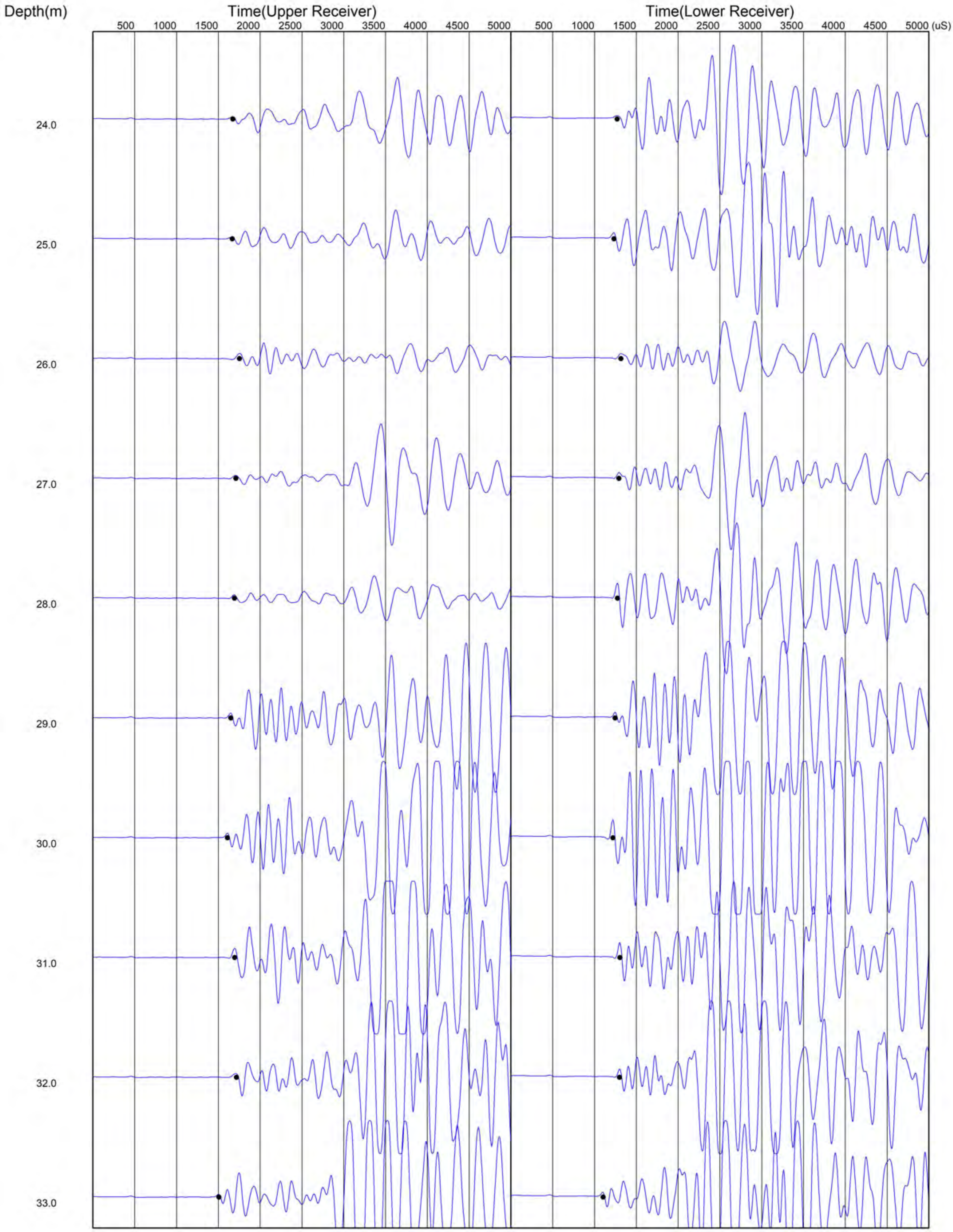

37.6
38.0
38.4
38.8
39.2
39.6
40.0
40.4
40.8
41.2
41.6
42.0


42.4
42.8
43.2
43.6
44.0
44.4
44.8
45.2
45.6
46.0
46.4
46.8

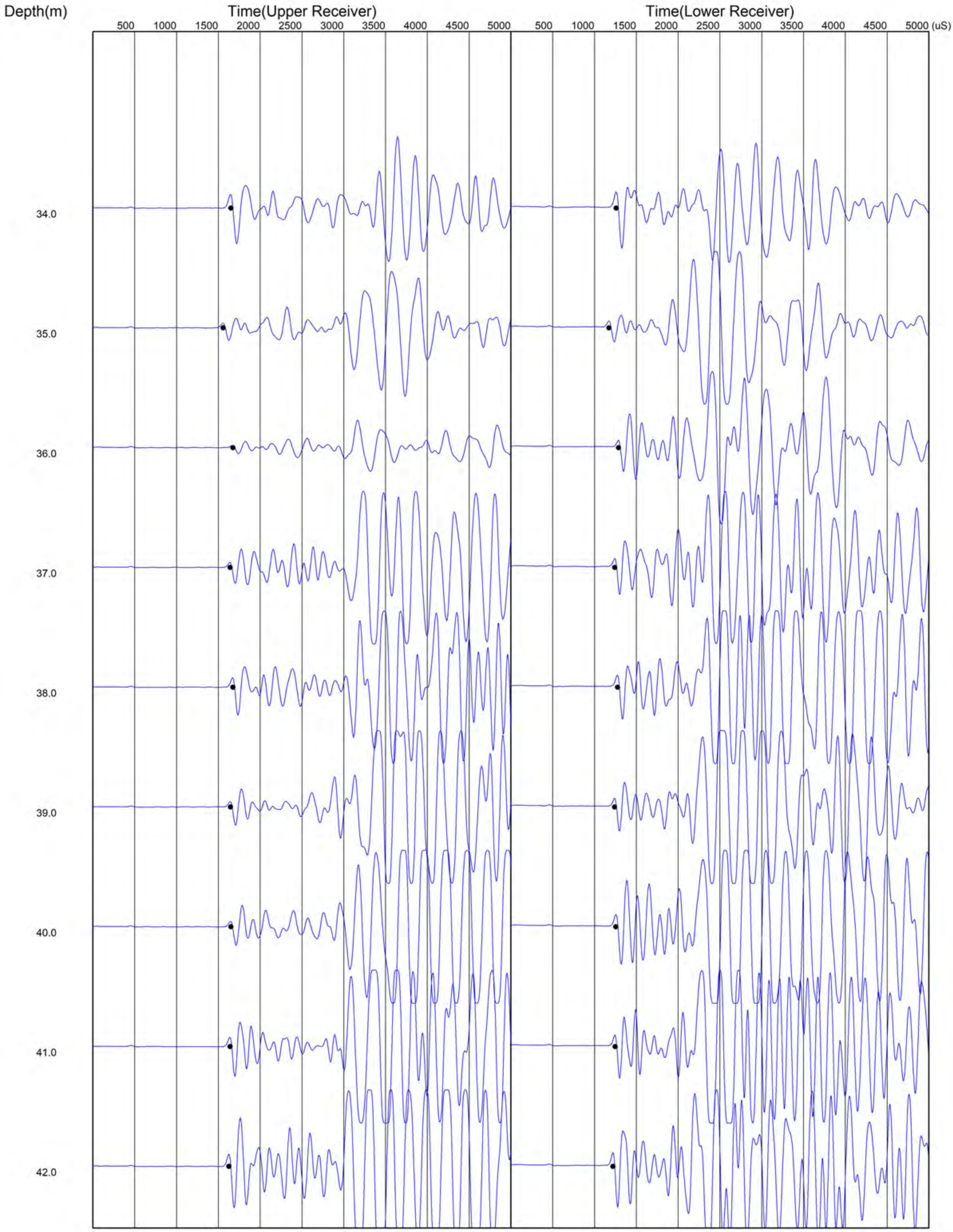

47.2
47.6
48.0
48.4
48.8
49.2
49.6
50.0
50.4
50.8
51.2
51.6


52.0
52.4
52.8
53.2
53.6
54.0
54.4
54.8

P Wave

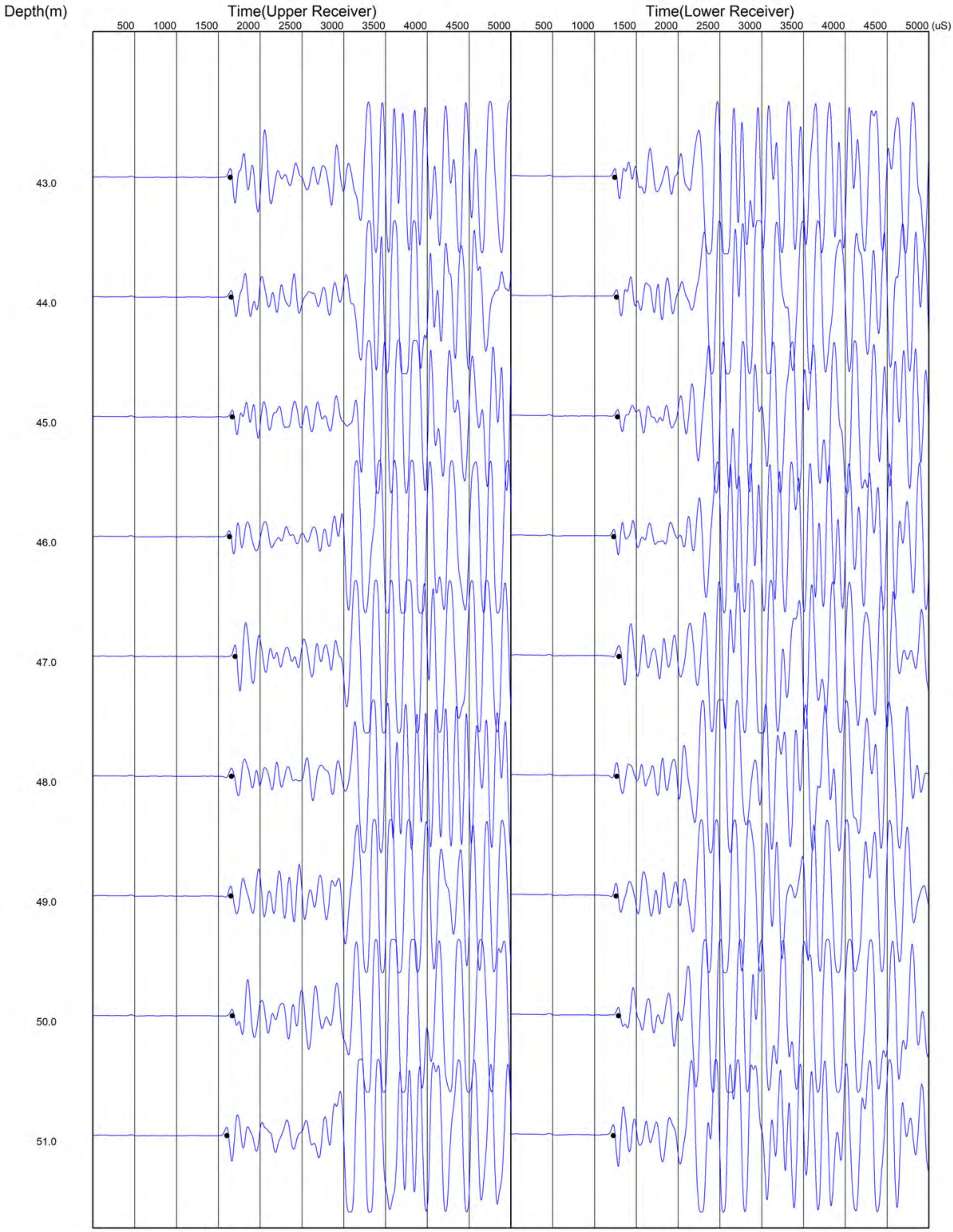

Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
24.0
25.0
26.0
27.0
28.0
29.0
30.0
31.0
32.0
33.0

P Wave



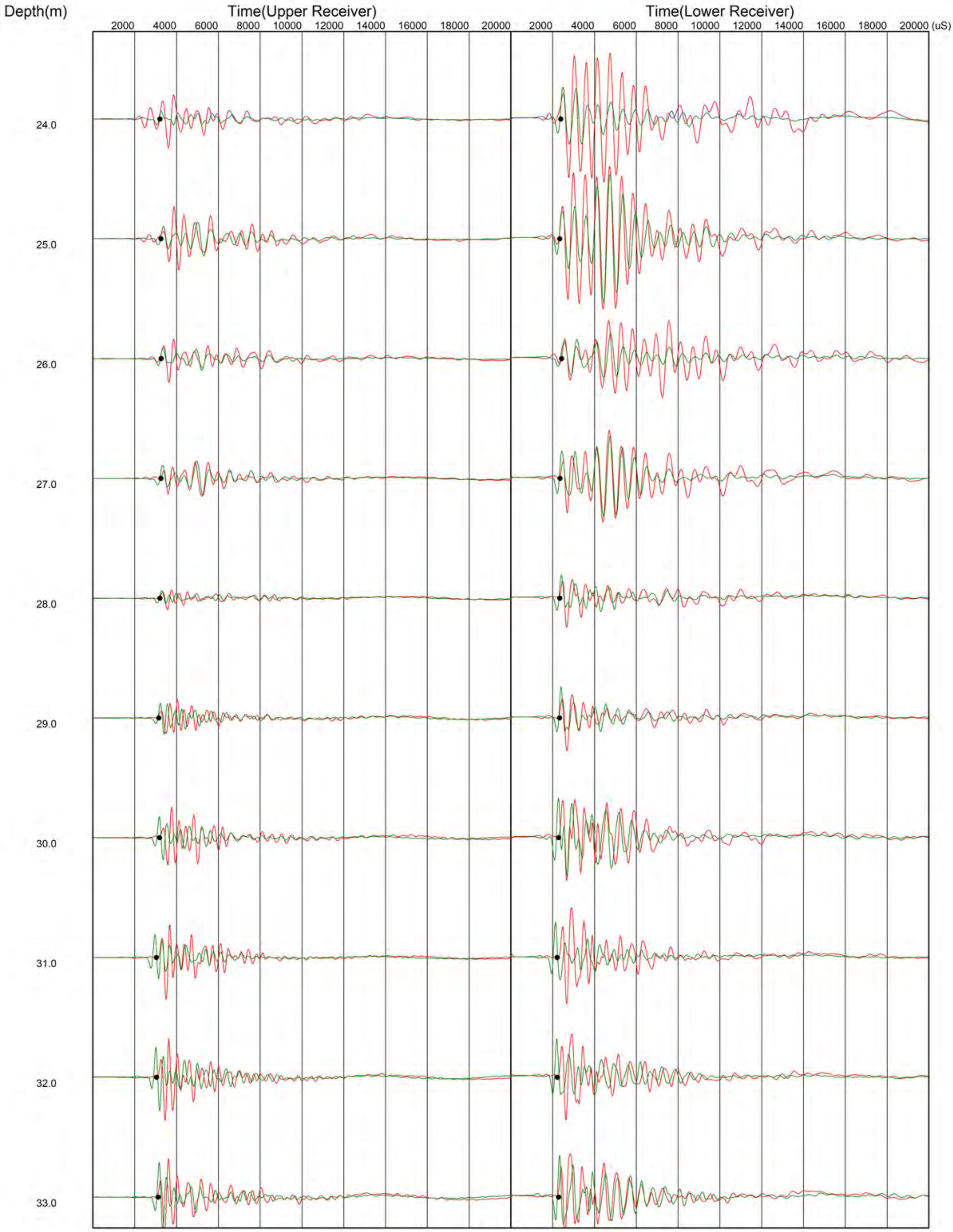
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
34.0
35.0
36.0
37.0
38.0
39.0
40.0
41.0
42.0

P Wave



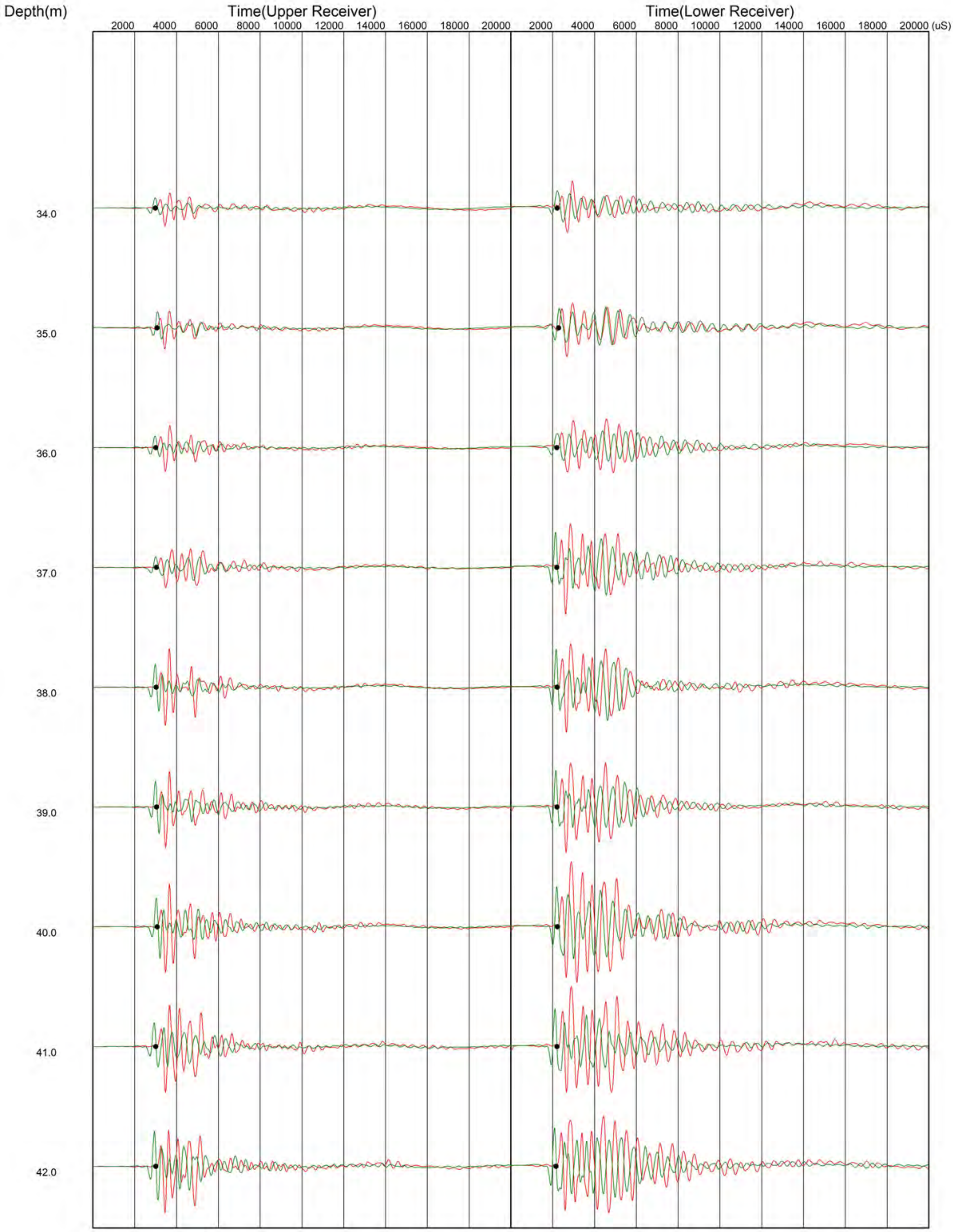
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
43.0
44.0
45.0
46.0
47.0
48.0
49.0
50.0
51.0

S Wave



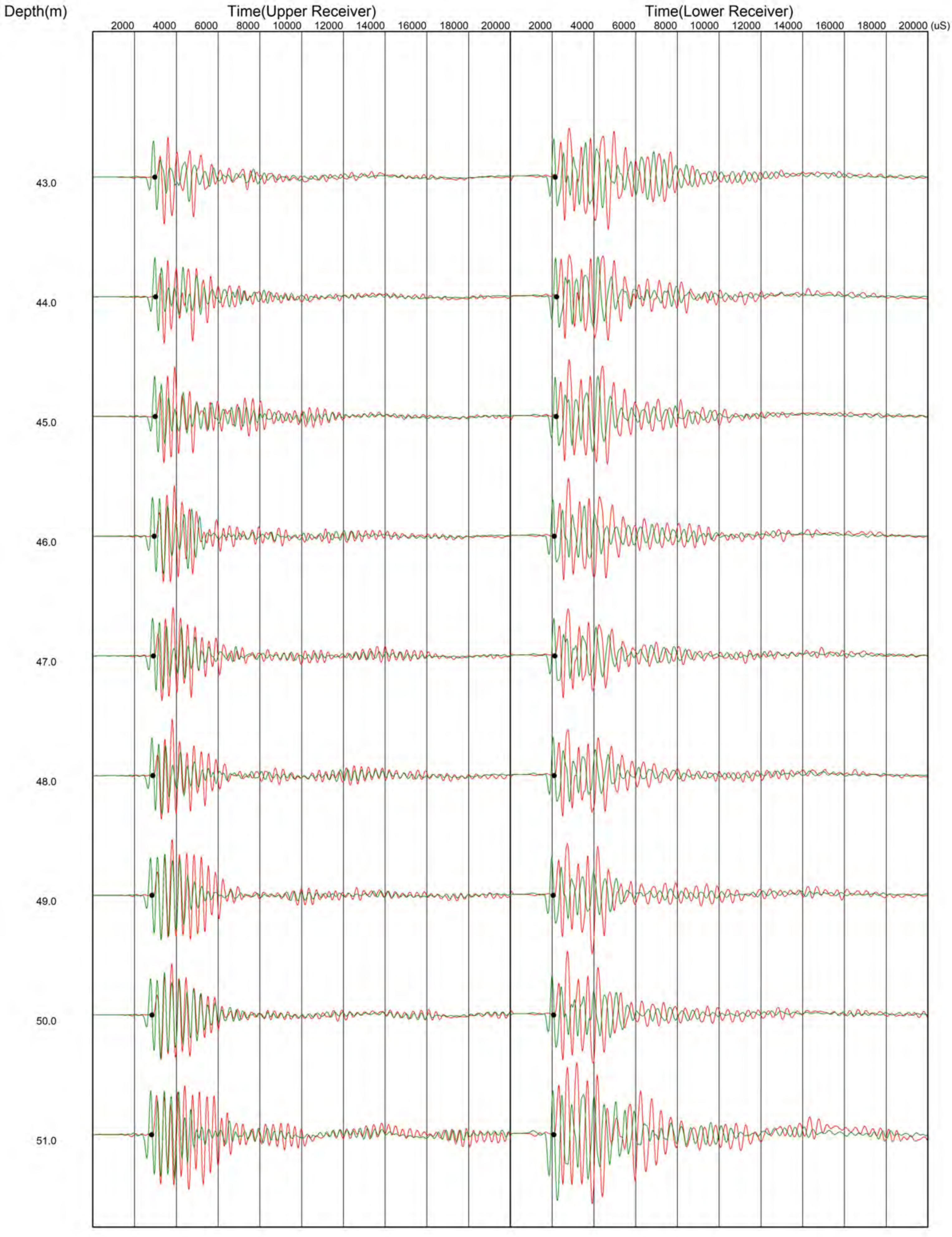
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
24.0
25.0
26.0
27.0
28.0
29.0
30.0
31.0
32.0
33.0

S Wave

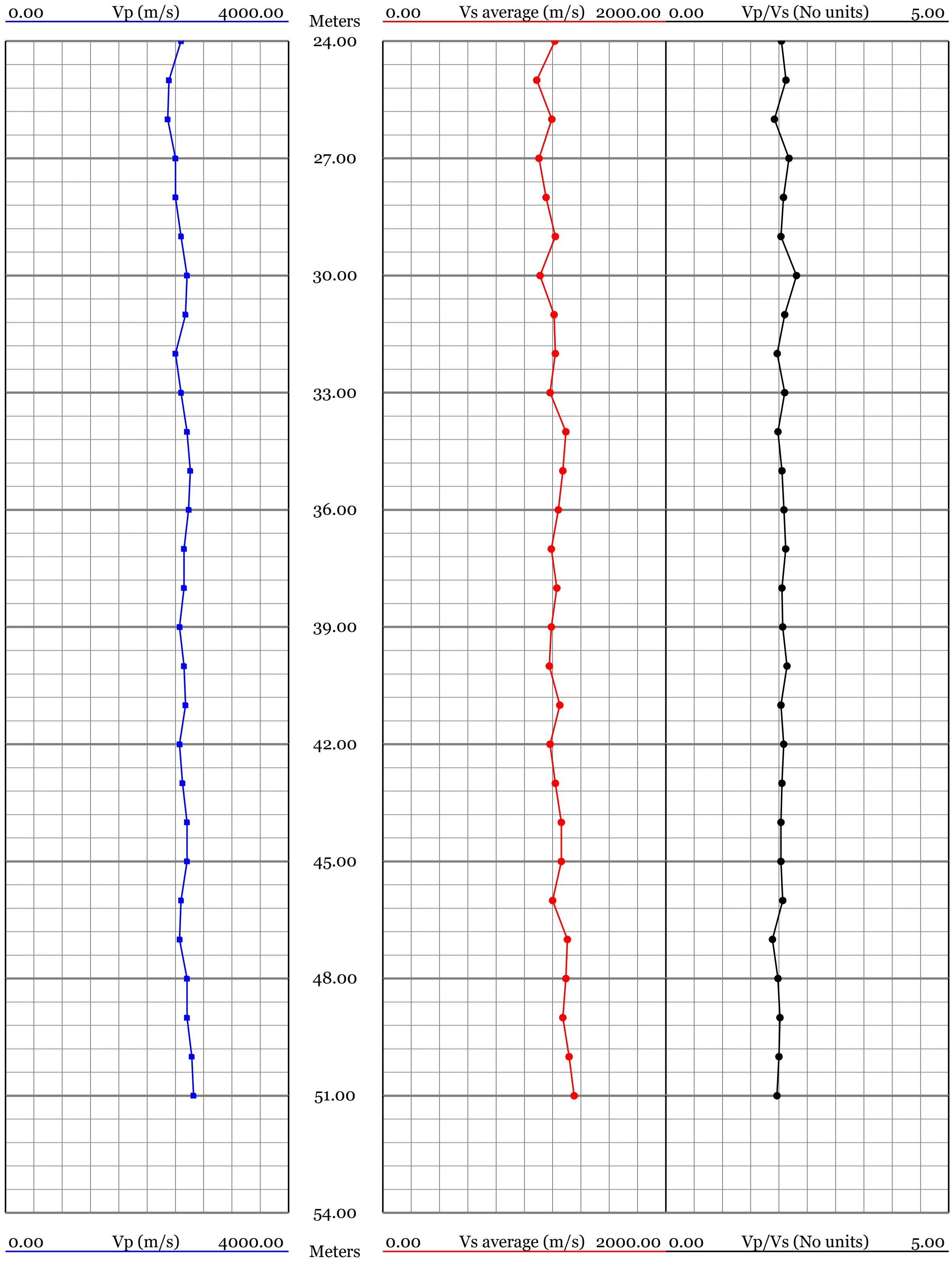


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
34.0
35.0
36.0
37.0
38.0
39.0
40.0
41.0
42.0

S Wave



Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
43.0
44.0
45.0
46.0
47.0
48.0
49.0
50.0
51.0


0.00
Vp (m/s)
4000.00
Meters
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00
24.00
27.00
30.00
33.00
36.00
39.00
42.00
45.00
48.00
51.00
54.00
0.00
Vp (m/s)
4000.00
Meters
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00

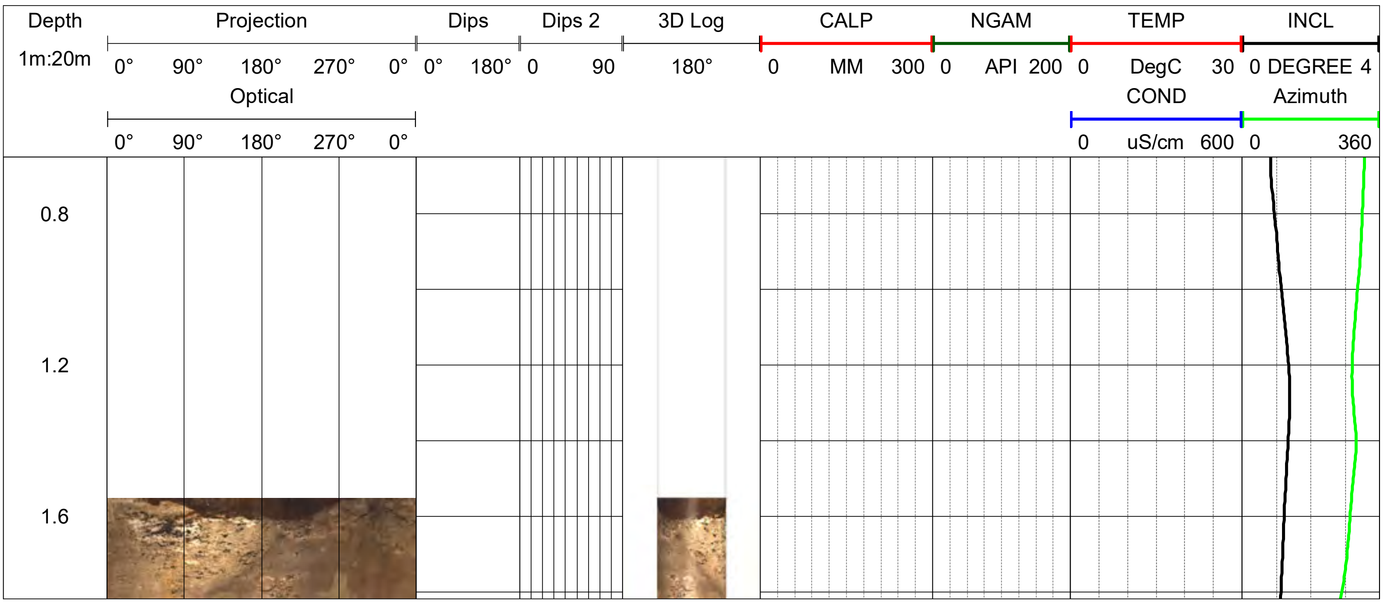
ROBERTSON GEO SERVICES
Unlocking Your GeoData

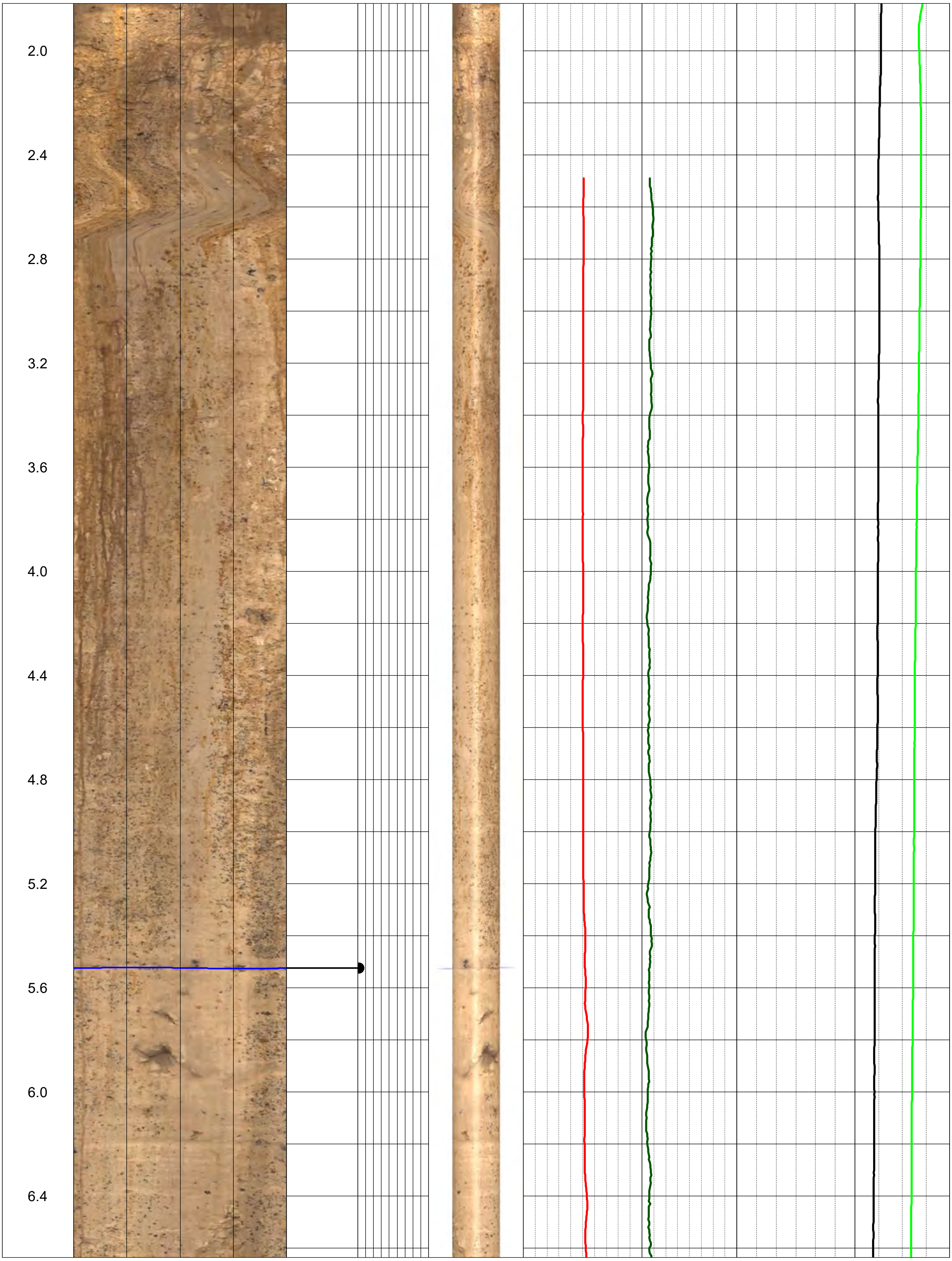
COMPANY	Structural Soils		
WELL ID	R613		
FIELD	A303 Stonehenge		
COUNTRY	England	STATE	
LOCATION			OTHER SERVICES
Easting: 412441			
Northing: 141974.98			
SEC	TWP	RGE	

CO Structural Soils
WELL R613
FLD A303 Stonehenge
CTY England
STE
FILING No

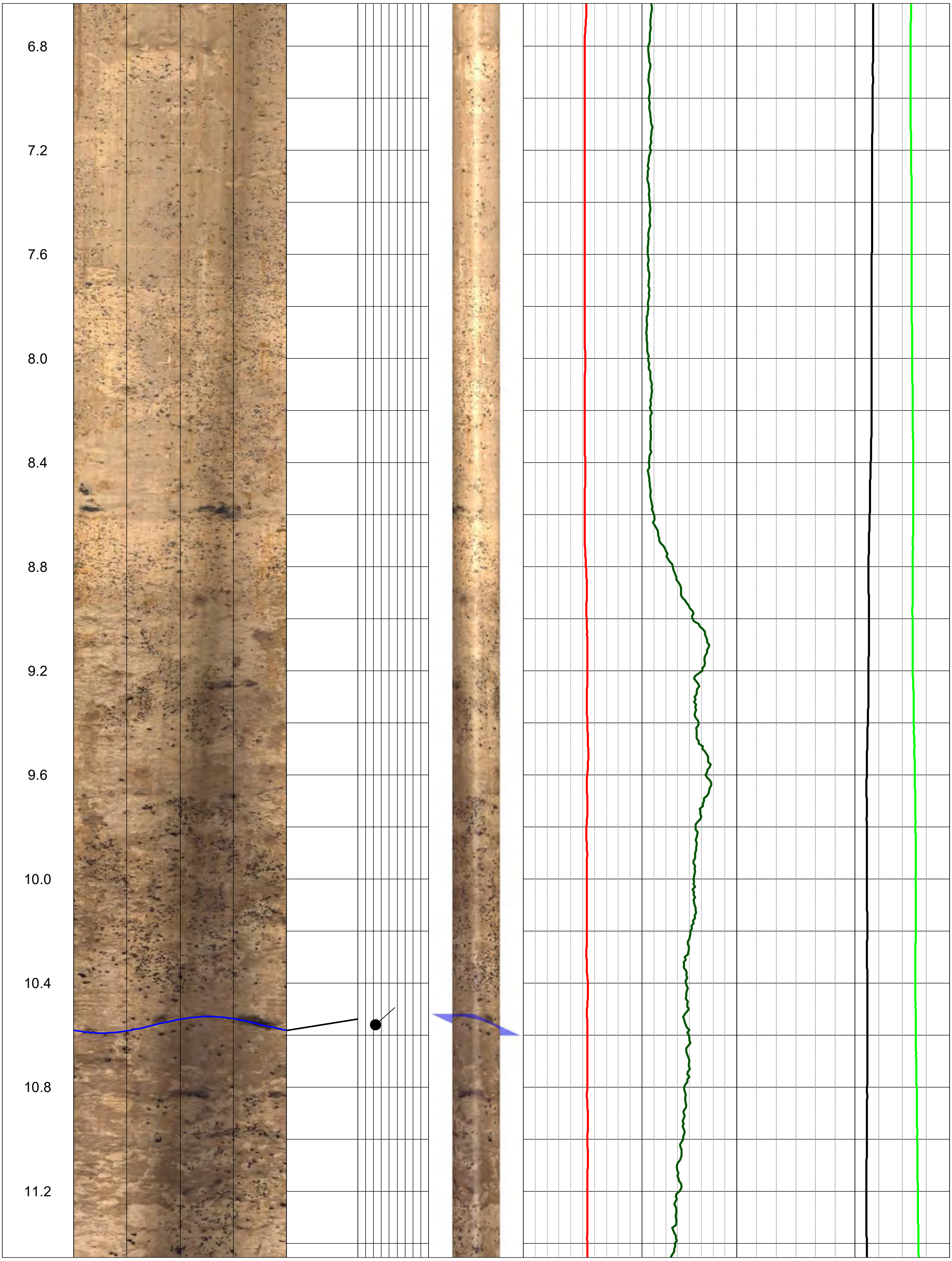
PERMANENT DATUM	GL	ELEVATION	93.521	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM		D.F.
DRILLING MEAS. FROM				G.L.
DATE	31/05/18	TYPE FLUID IN HOLE	Water	
RUN No		SALINITY		
TYPE LOG	OPTV, 3ACS, NGAM, TCDS	DENSITY		
DEPTH-DRILLER	56	LEVEL	23.1	
DEPTH-LOGGER	55.64	MAX. REC. TEMP.		
BTM LOGGED INTERVAL	55.64			
TOP LOGGED INTERVAL	1.6			
OPERATING RIG TIME				
RECORDED BY	James Boyett			
WITNESSED BY	Kyle Owen			

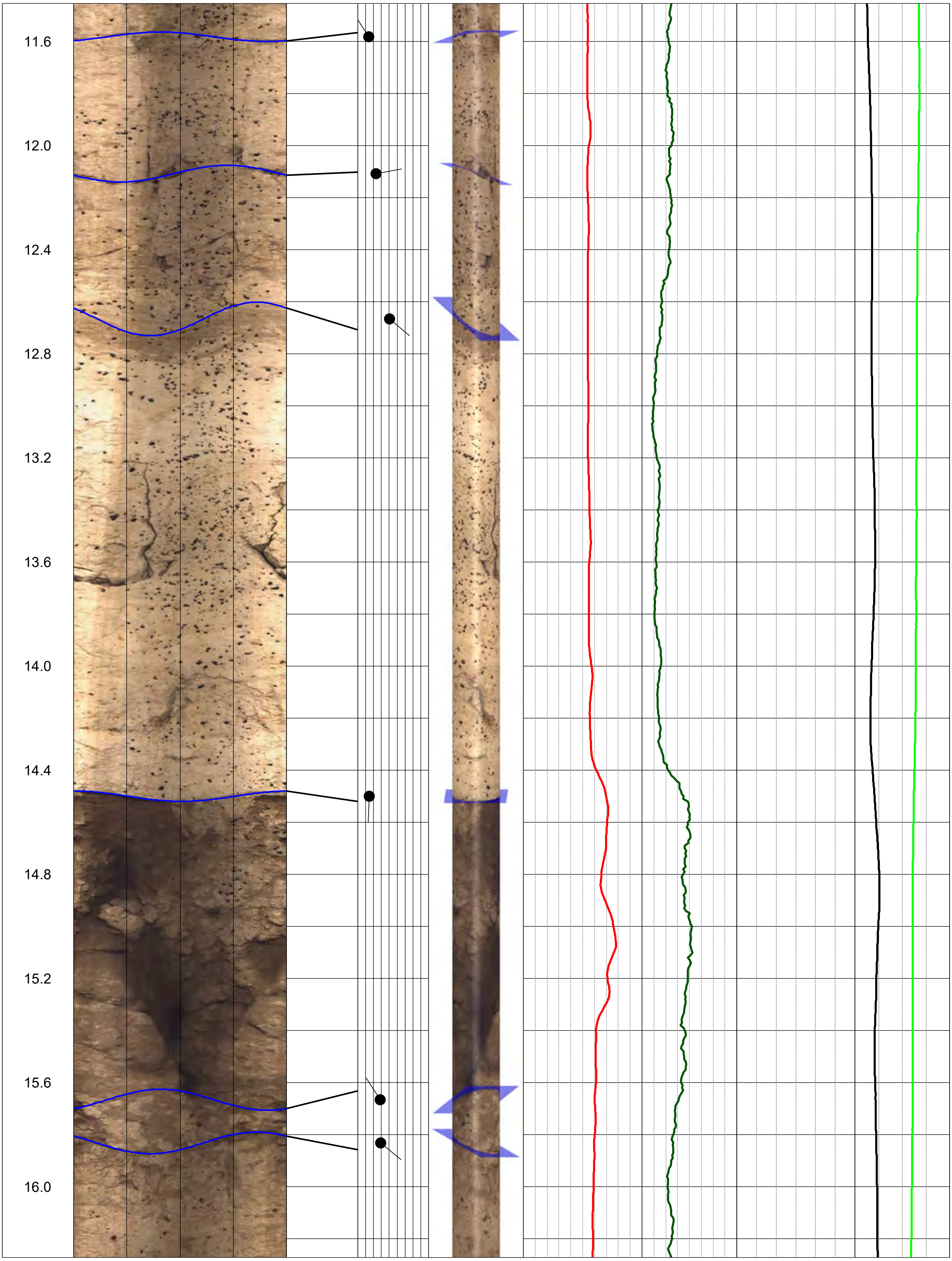
RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

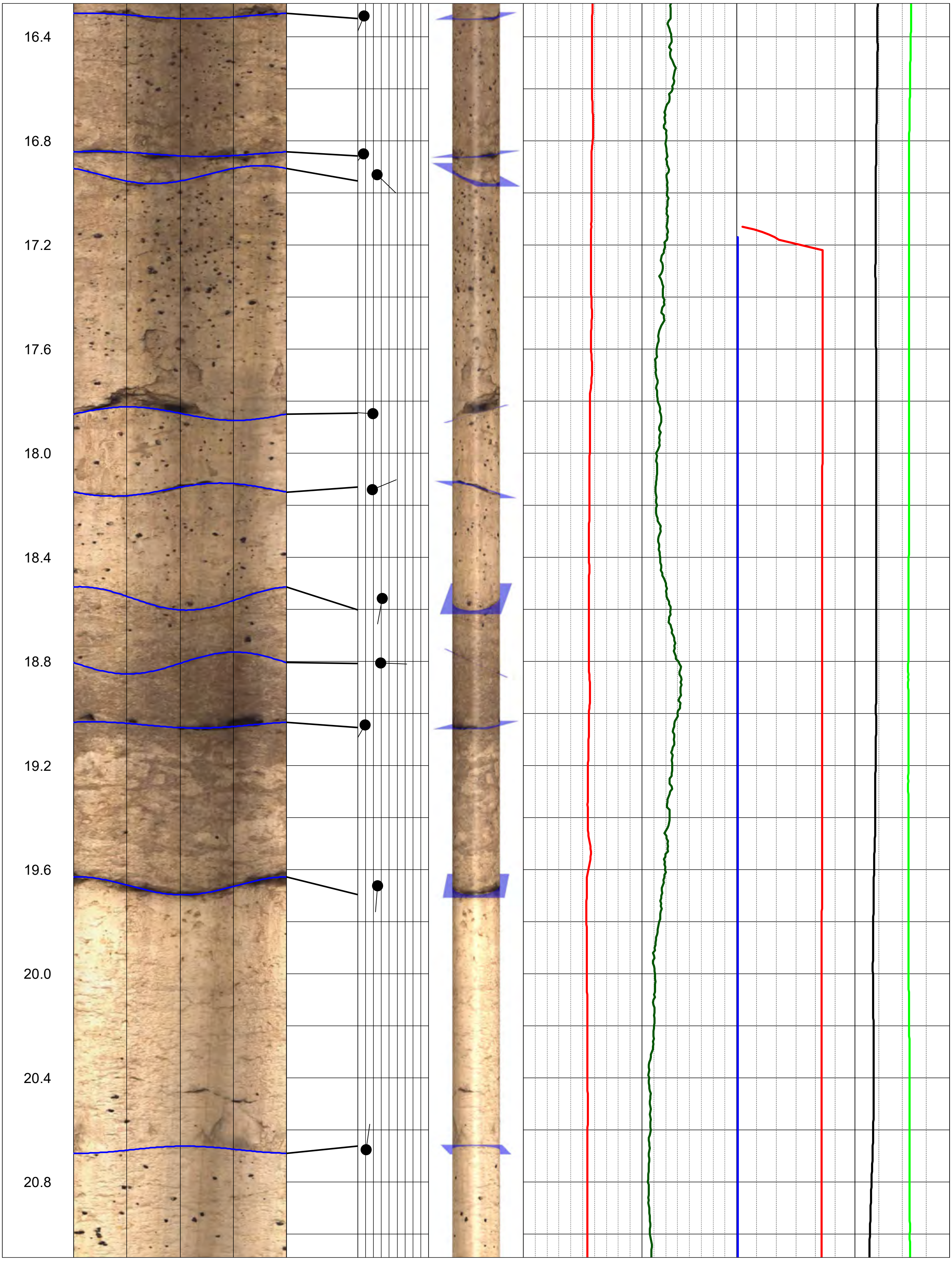


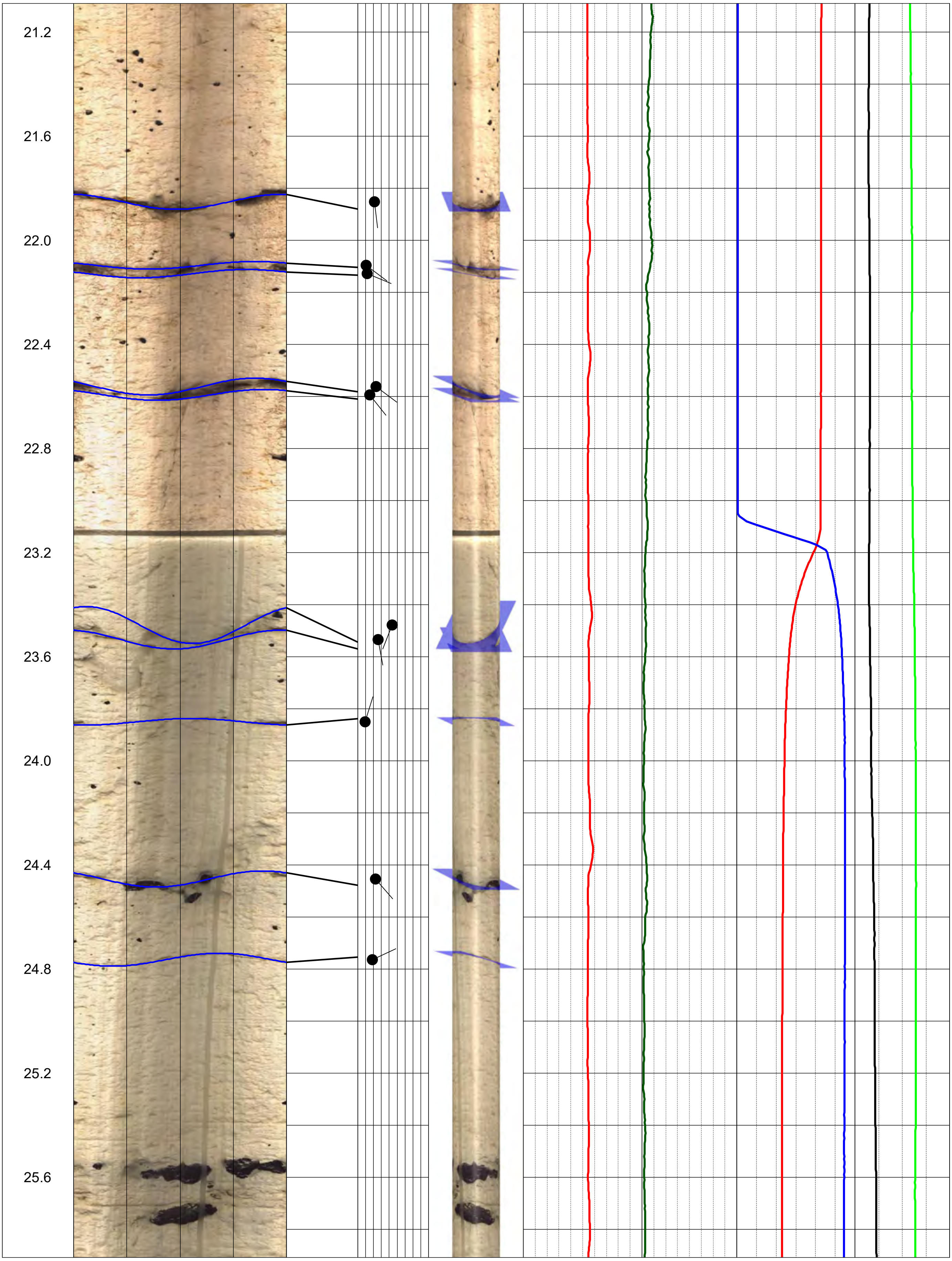


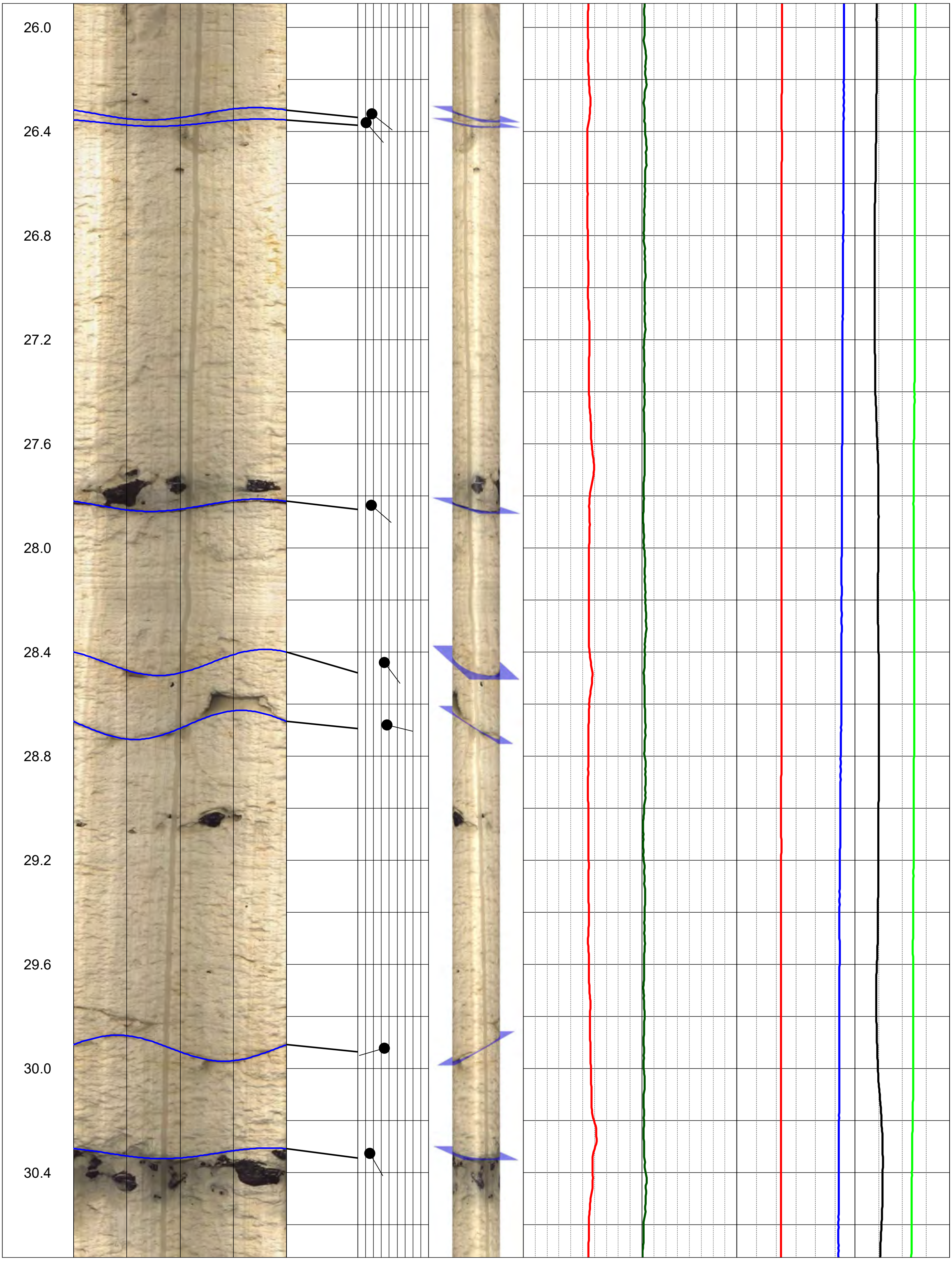
2.0
2.4
2.8
3.2
3.6
4.0
4.4
4.8
5.2
5.6
6.0
6.4

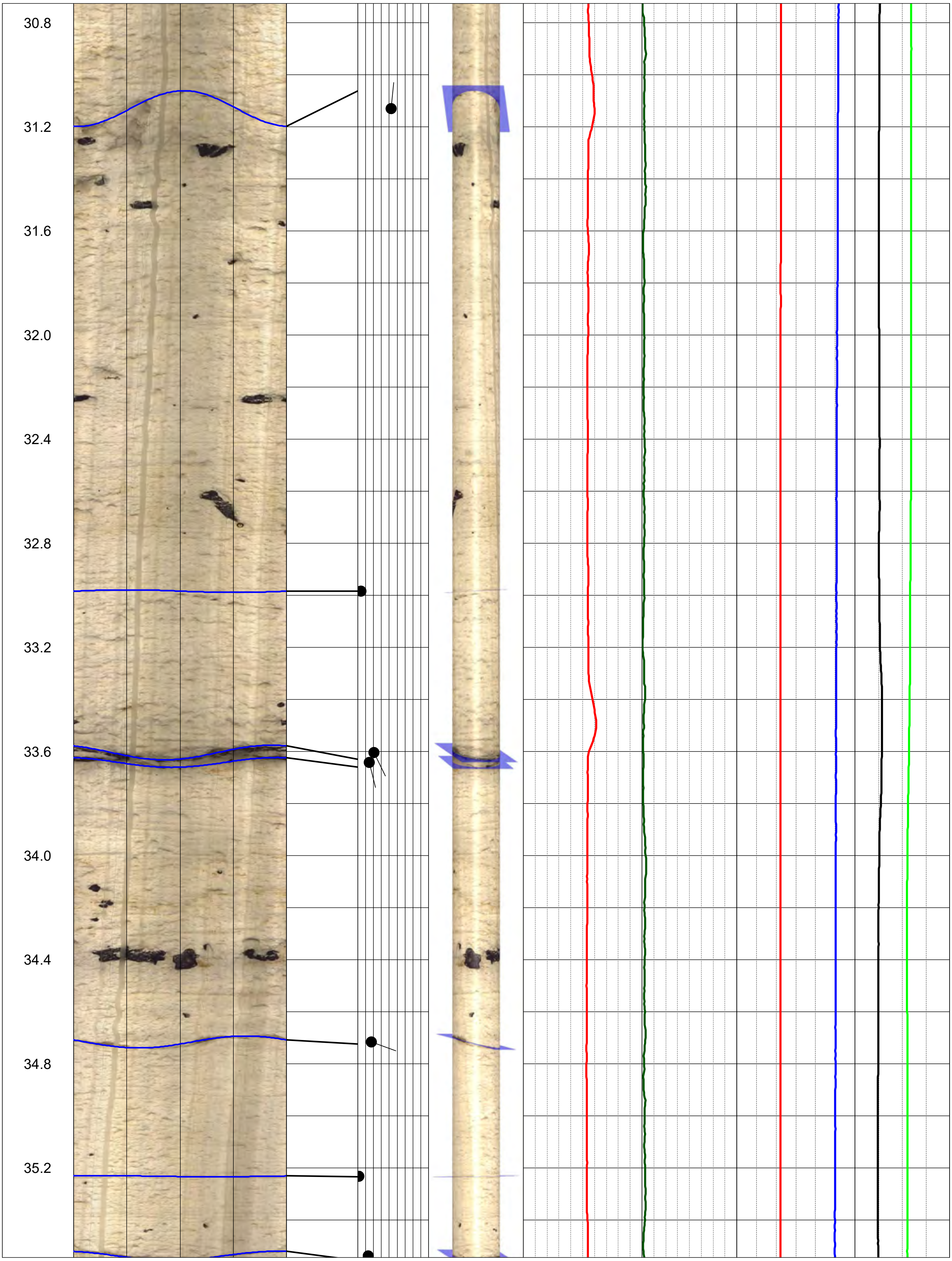

6.8
7.2
7.6
8.0
8.4
8.8
9.2
9.6
10.0
10.4
10.8
11.2

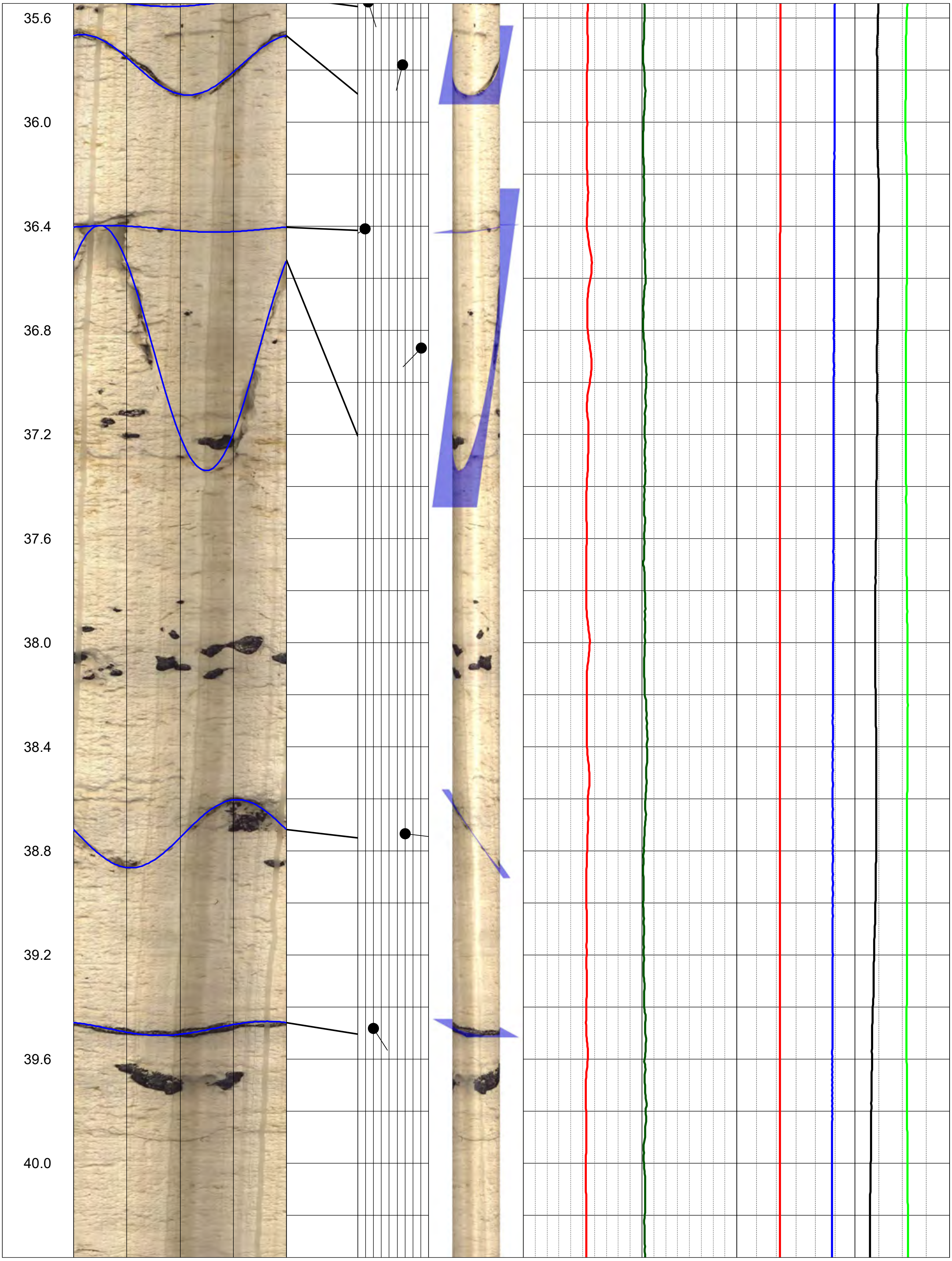

11.6
12.0
12.4
12.8
13.2
13.6
14.0
14.4
14.8
15.2
15.6
16.0

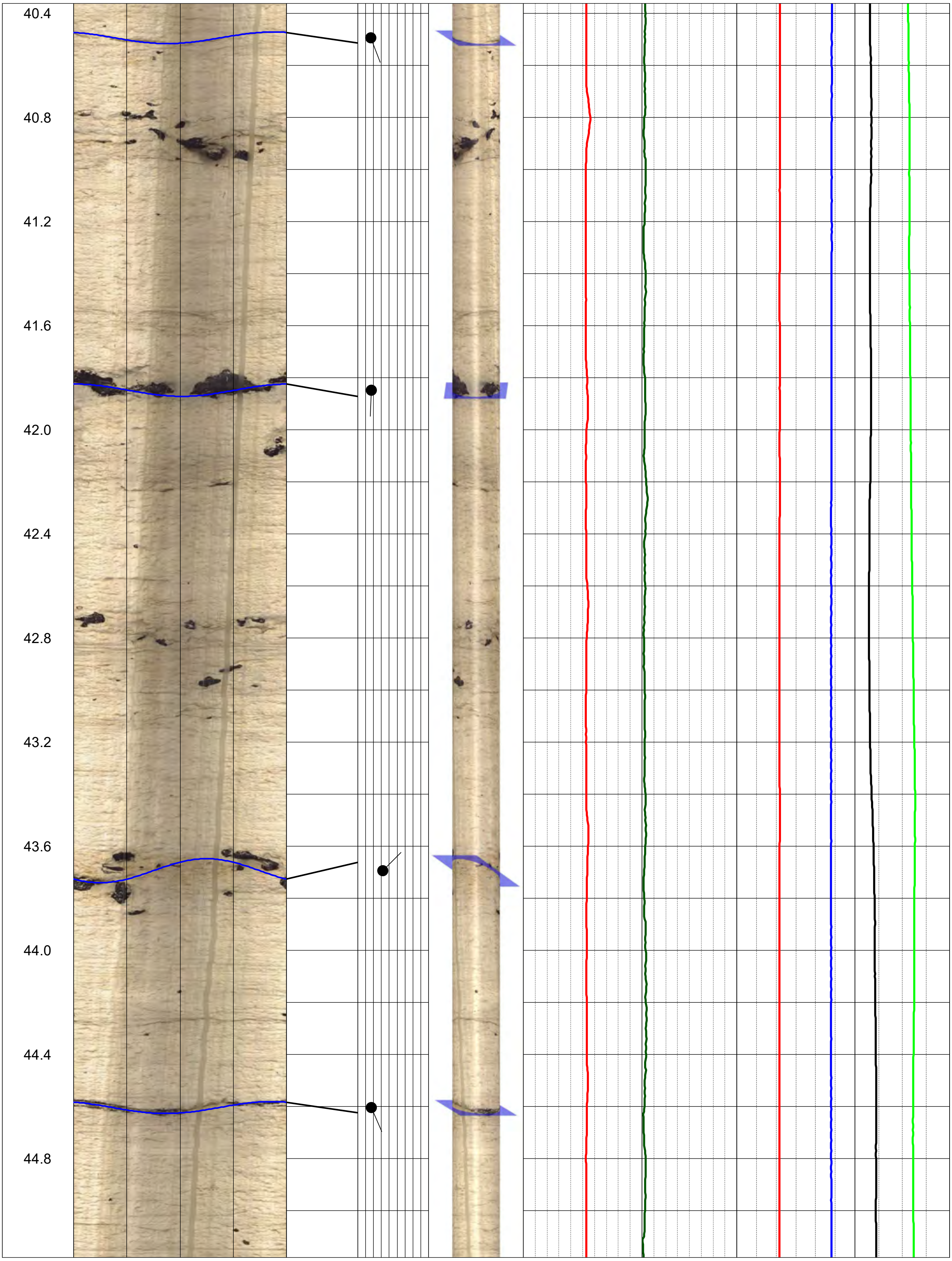

16.4
16.8
17.2
17.6
18.0
18.4
18.8
19.2
19.6
20.0
20.4
20.8

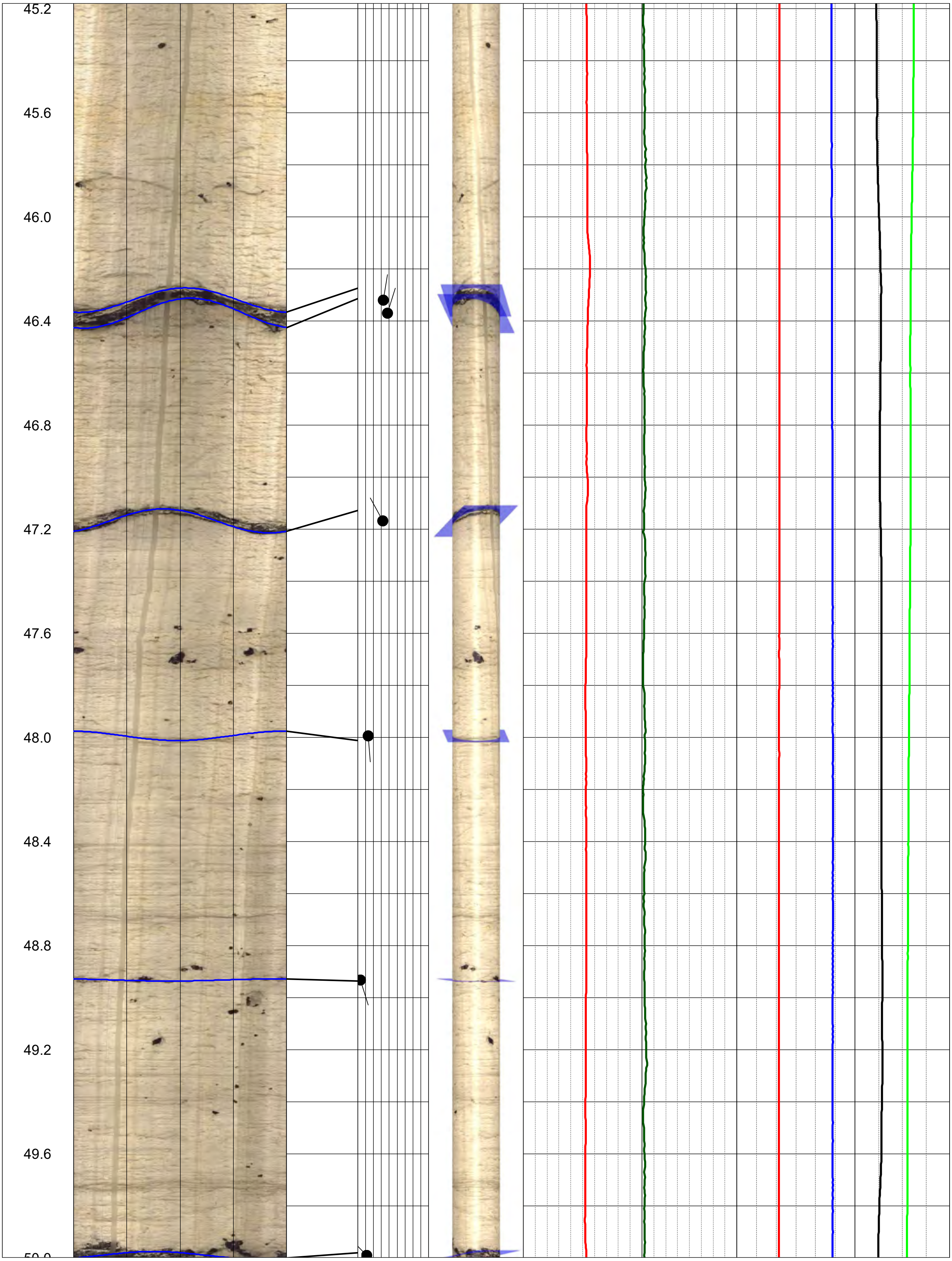

21.2
21.6
22.0
22.4
22.8
23.2
23.6
24.0
24.4
24.8
25.2
25.6

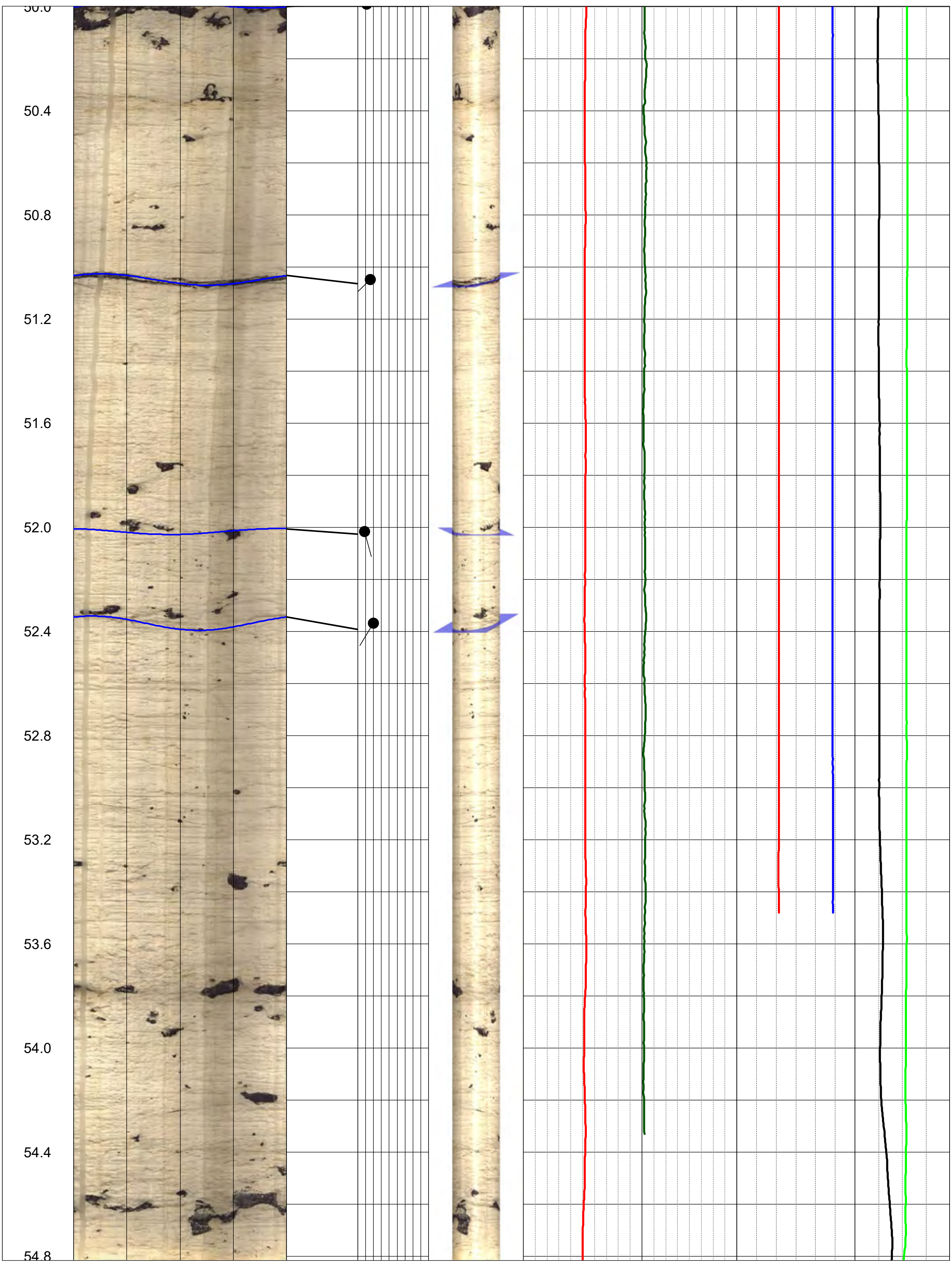

26.0
26.4
26.8
27.2
27.6
28.0
28.4
28.8
29.2
29.6
30.0
30.4


30.8
31.2
31.6
32.0
32.4
32.8
33.2
33.6
34.0
34.4
34.8
35.2

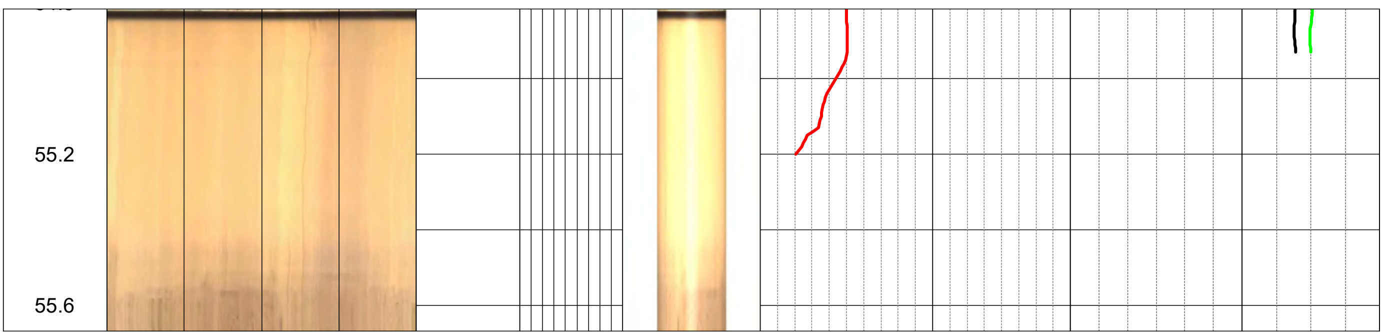

35.6
36.0
36.4
36.8
37.2
37.6
38.0
38.4
38.8
39.2
39.6
40.0


40.4
40.8
41.2
41.6
42.0
42.4
42.8
43.2
43.6
44.0
44.4
44.8


45.2
45.6
46.0
46.4
46.8
47.2
47.6
48.0
48.4
48.8
49.2
49.6



50.4
50.8
51.2
51.6
52.0
52.4
52.8
53.2
53.6
54.0
54.4
54.8

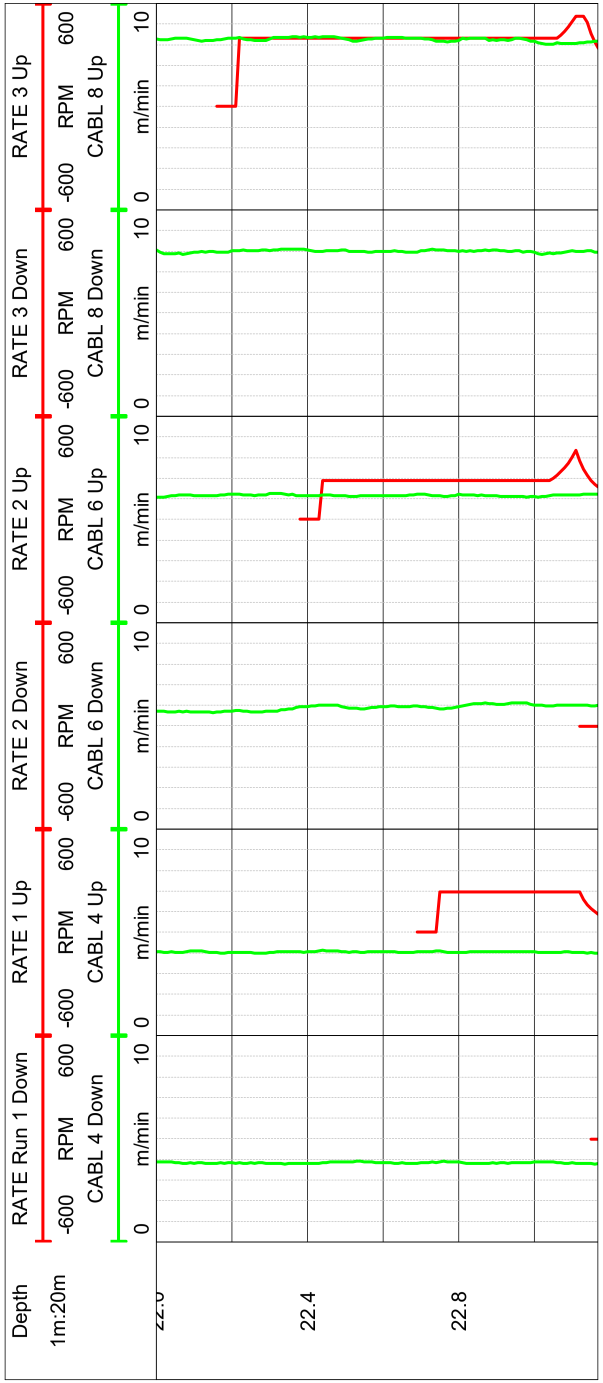

55.2
55.6

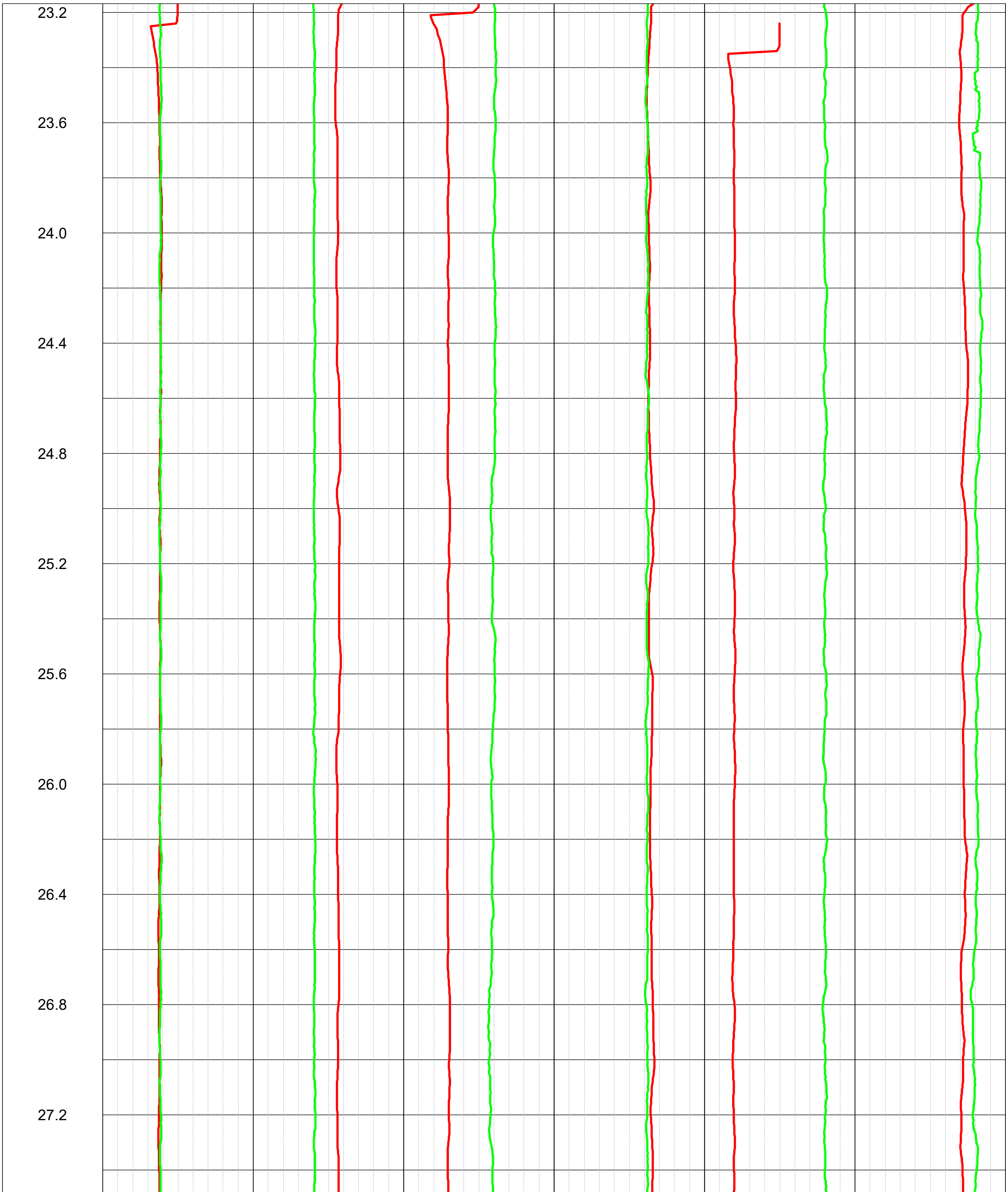
ROBERTSON GEO SERVICES
Unlocking Your GeoData

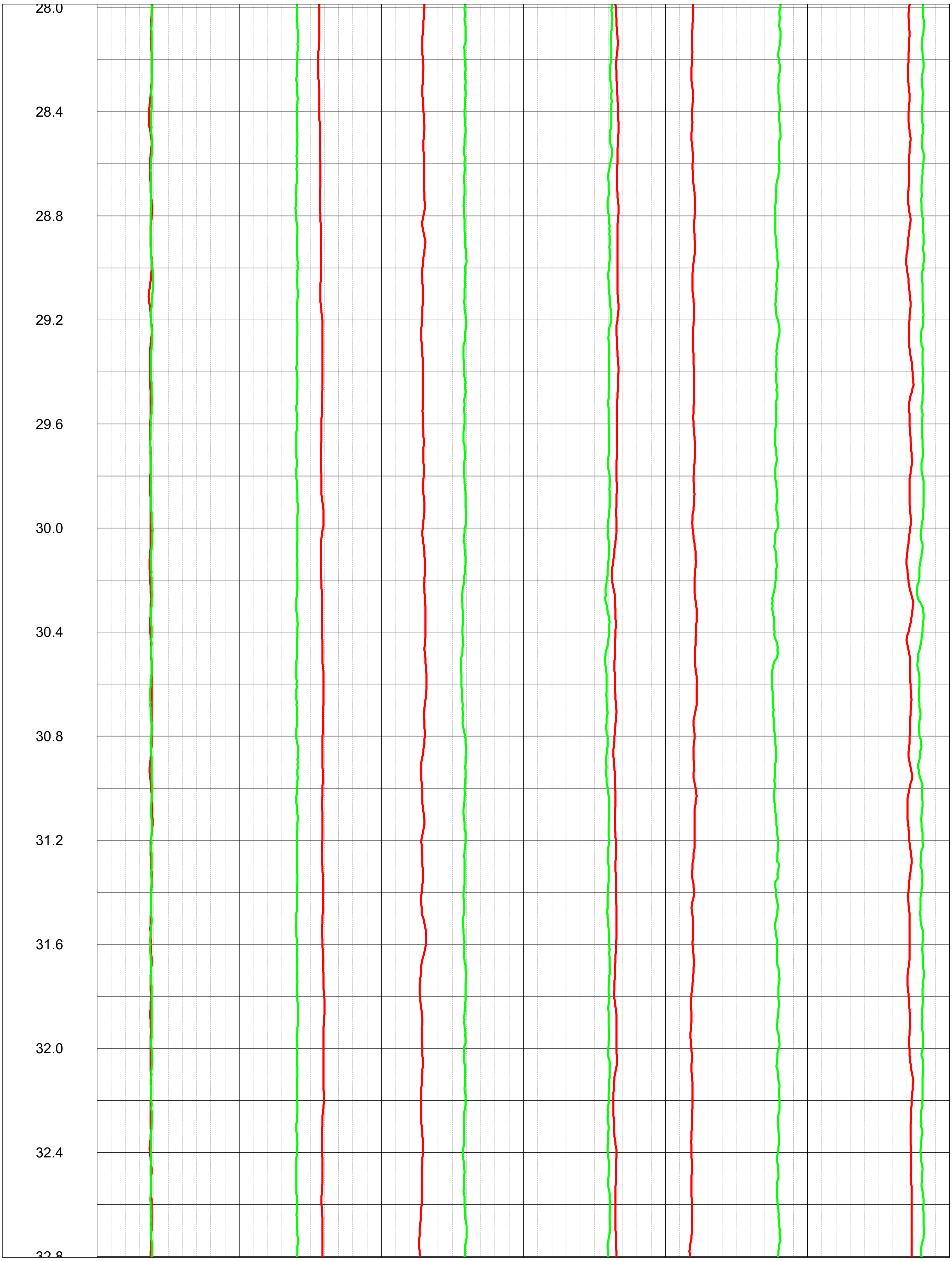
CO Structural Soils
WELL R613
FLD A303 Stonehenge
CTY
STE
FILING No

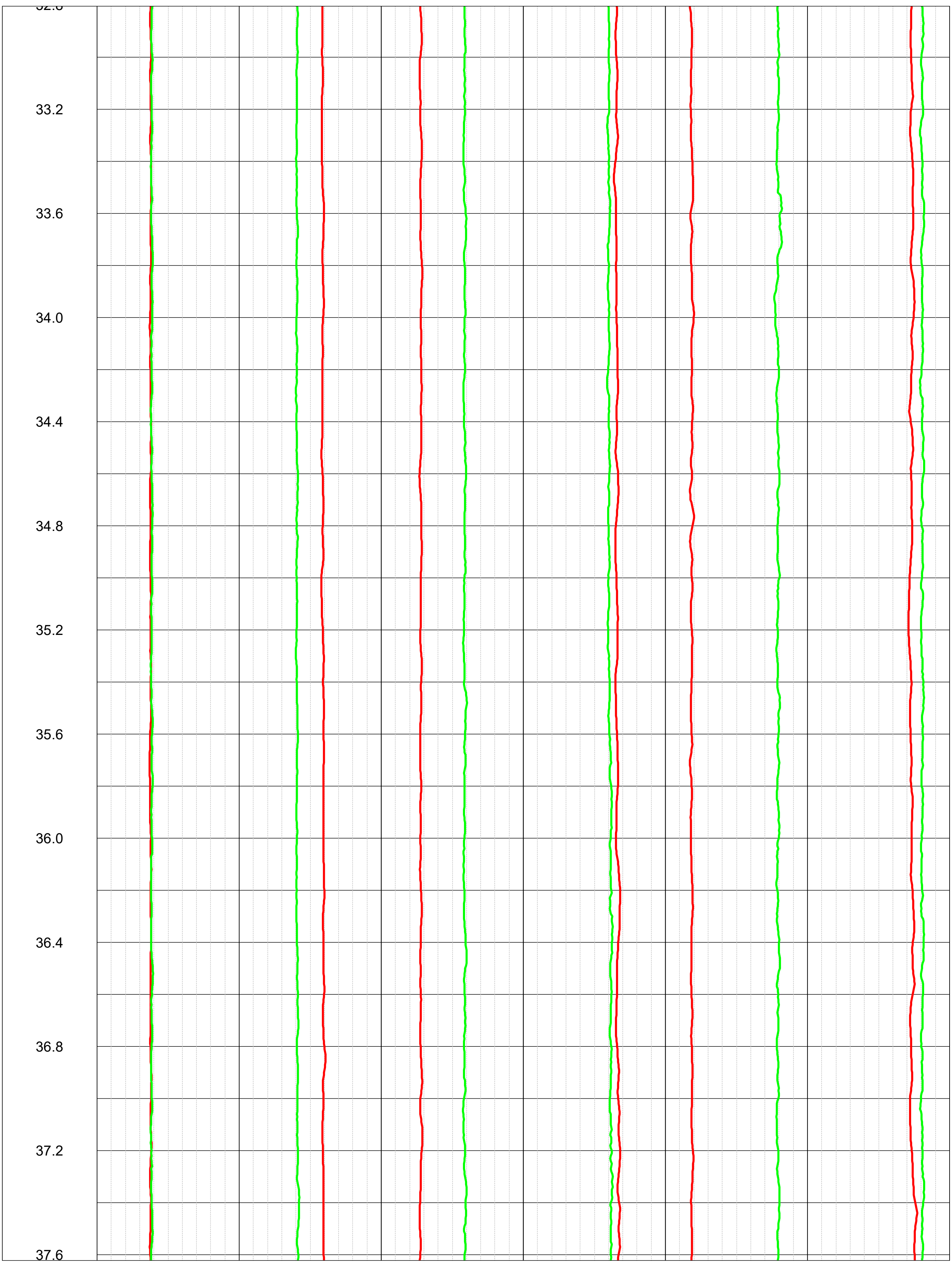
COMPANY	Structural Soils		
WELL ID	R613		
FIELD	A303 Stonehenge		
COUNTRY	England	STATE	
LOCATION	A303 Stonehenge		OTHER SERVICES
SEC	TWP	RGE	
PERMANENT DATUM	GL	ELEVATION	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.
DATE	31/05/18	TYPE FLUID IN HOLE	Water
RUN No		SALINITY	
TYPE LOG	Flowmeter	DENSITY	
DEPTH-DRILLER	56	LEVEL	23.1
DEPTH-LOGGER	54.5	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	54.5		
TOP LOGGED INTERVAL	22		
OPERATING RIG TIME			
RECORDED BY	James Boyett		
WITNESSED BY	Kyle Owen		

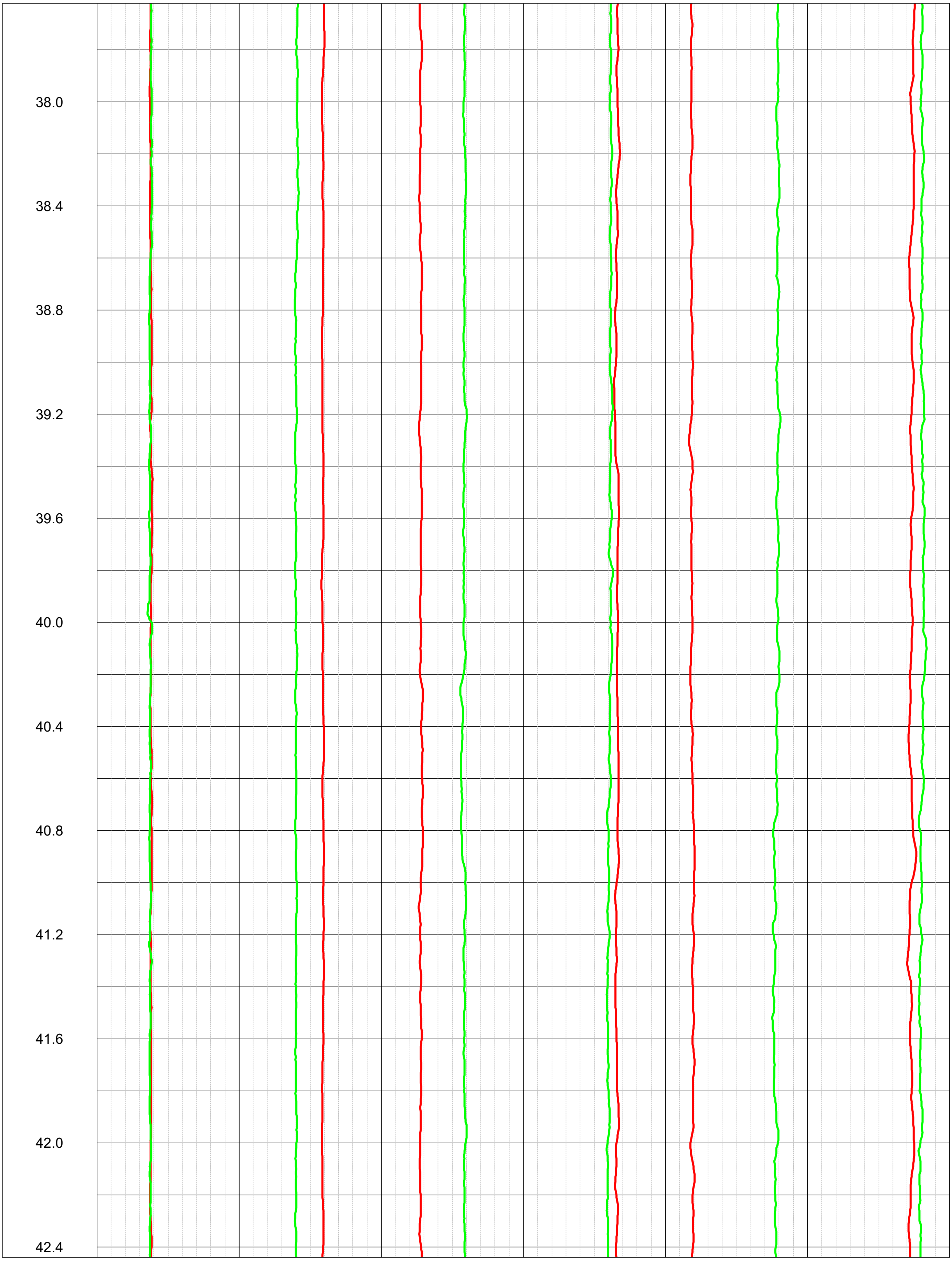
RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

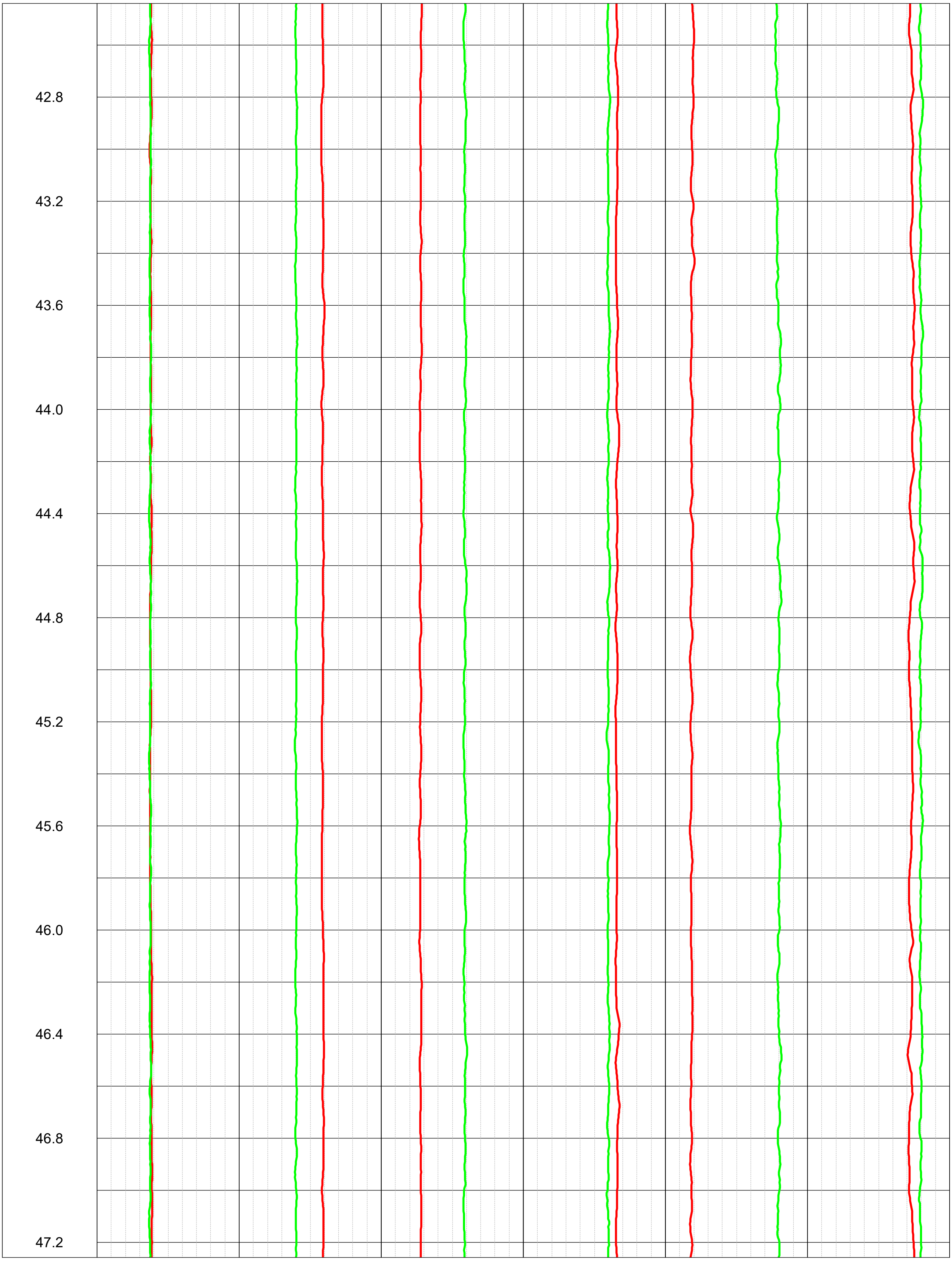


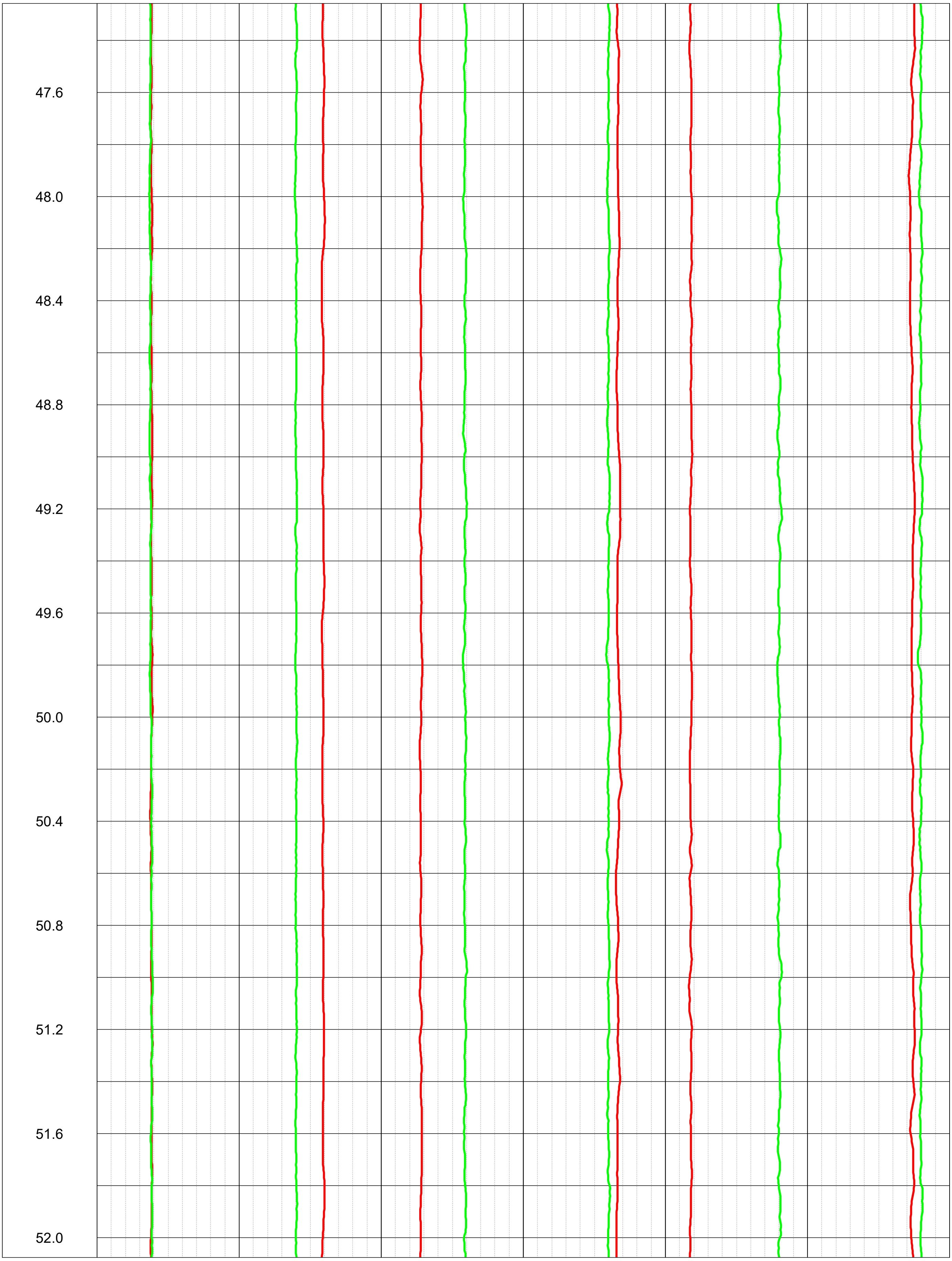

23.2
23.6
24.0
24.4
24.8
25.2
25.6
26.0
26.4
26.8
27.2
27.6


28.0
28.4
28.8
29.2
29.6
30.0
30.4
30.8
31.2
31.6
32.0
32.4
32.8


33.2
33.6
34.0
34.4
34.8
35.2
35.6
36.0
36.4
36.8
37.2
37.6

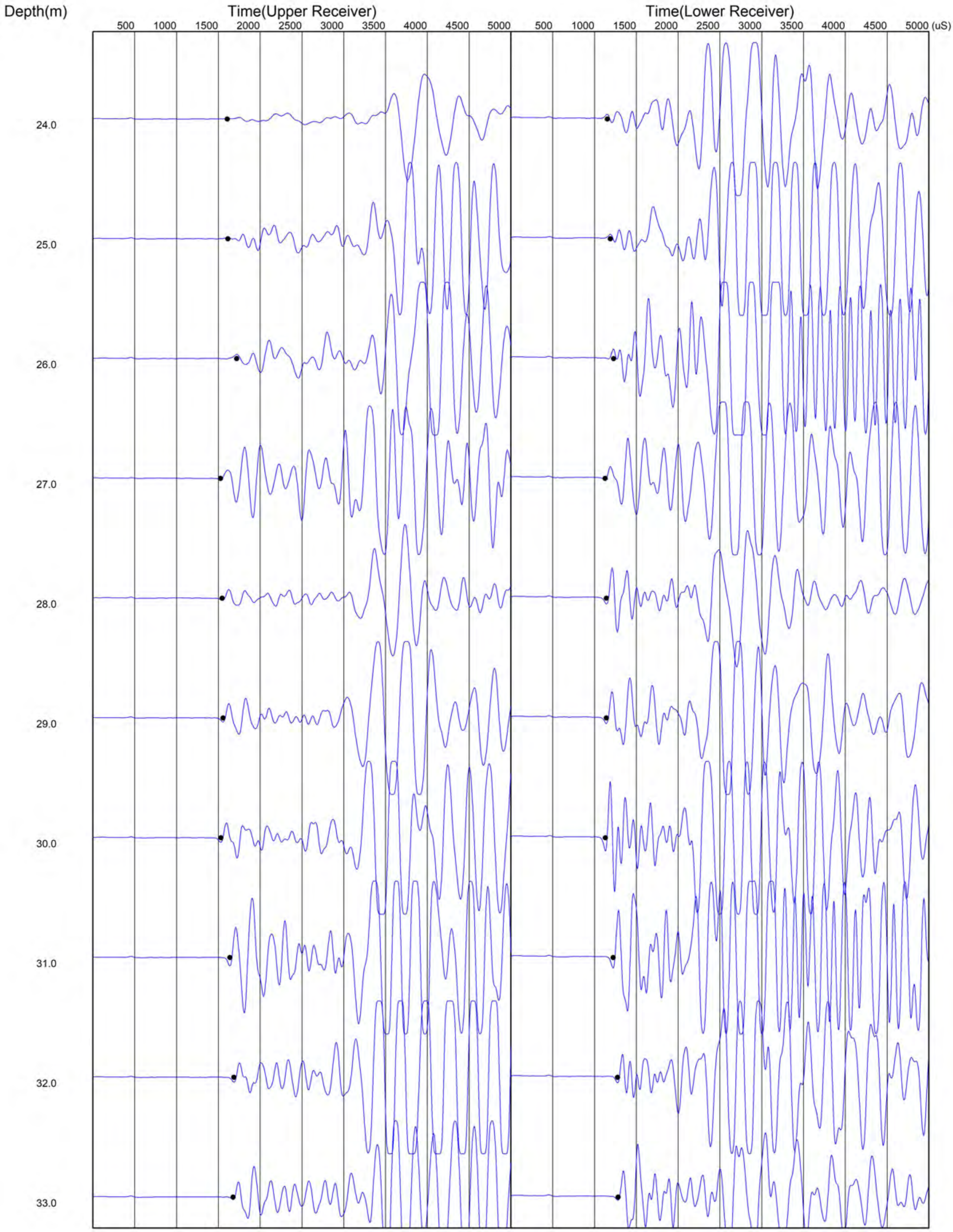

38.0
38.4
38.8
39.2
39.6
40.0
40.4
40.8
41.2
41.6
42.0
42.4


42.8
43.2
43.6
44.0
44.4
44.8
45.2
45.6
46.0
46.4
46.8
47.2

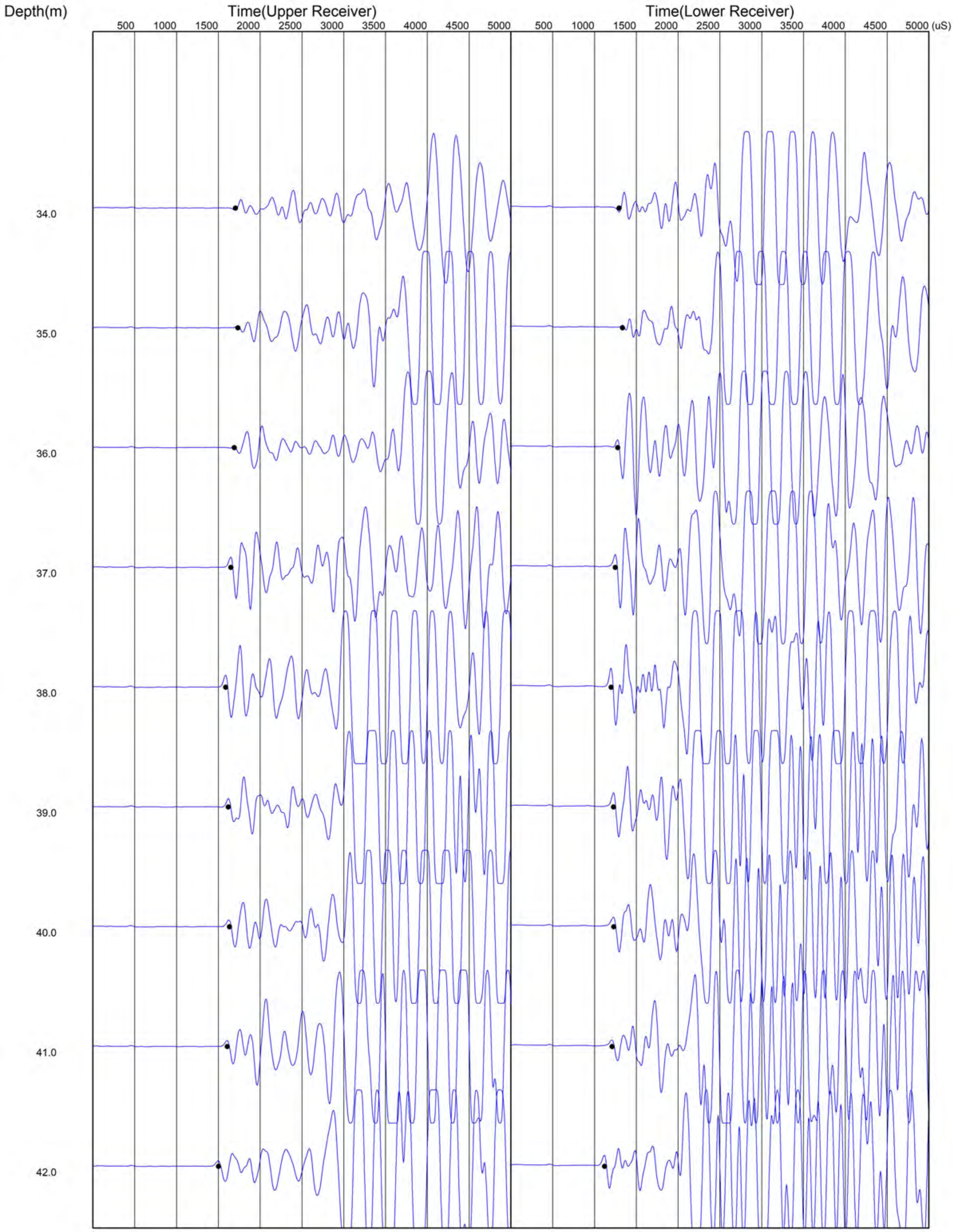

47.6
48.0
48.4
48.8
49.2
49.6
50.0
50.4
50.8
51.2
51.6
52.0

52.4
52.8
53.2
53.6
54.0
54.4

P Wave

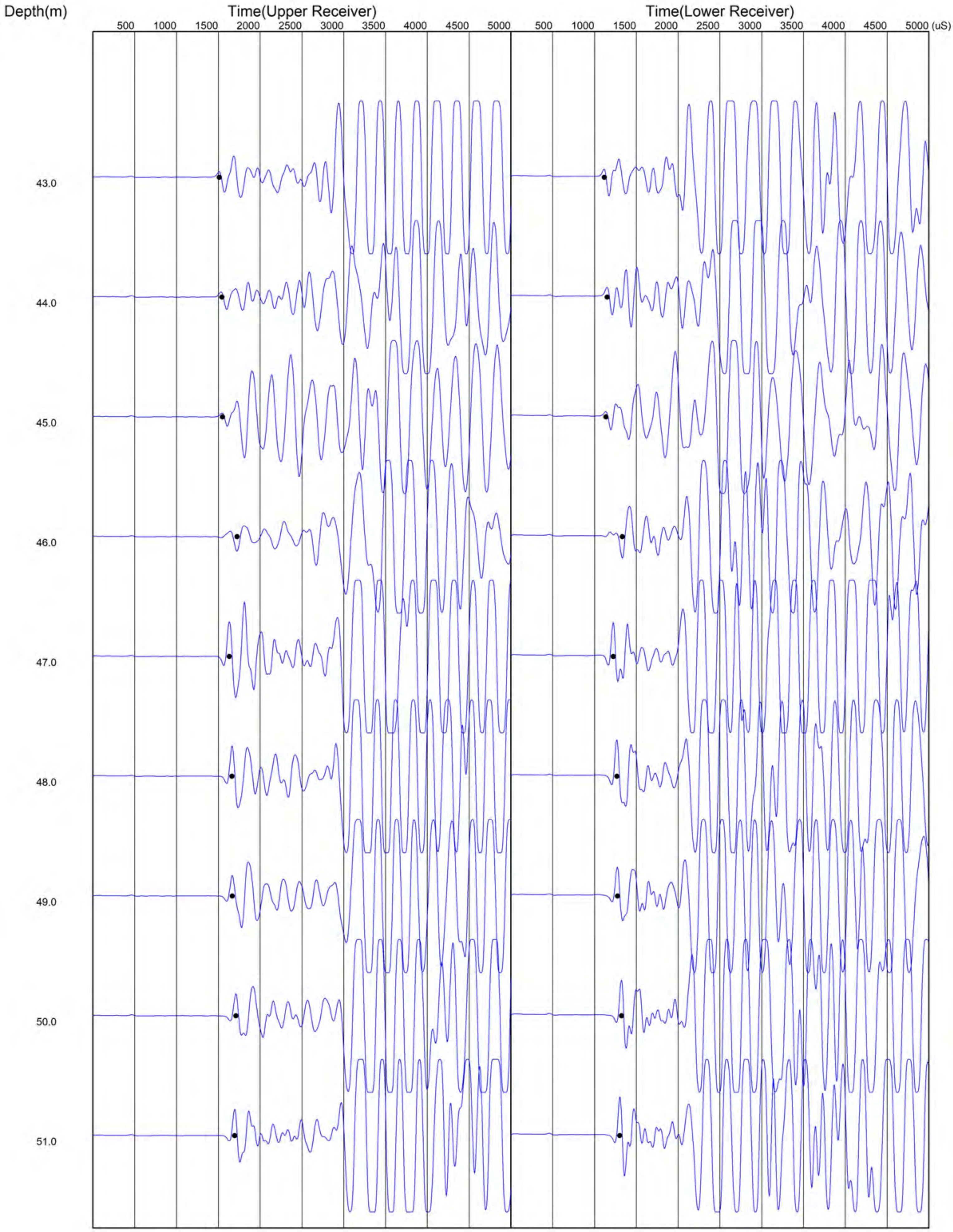

Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
24.0
25.0
26.0
27.0
28.0
29.0
30.0
31.0
32.0
33.0

P Wave

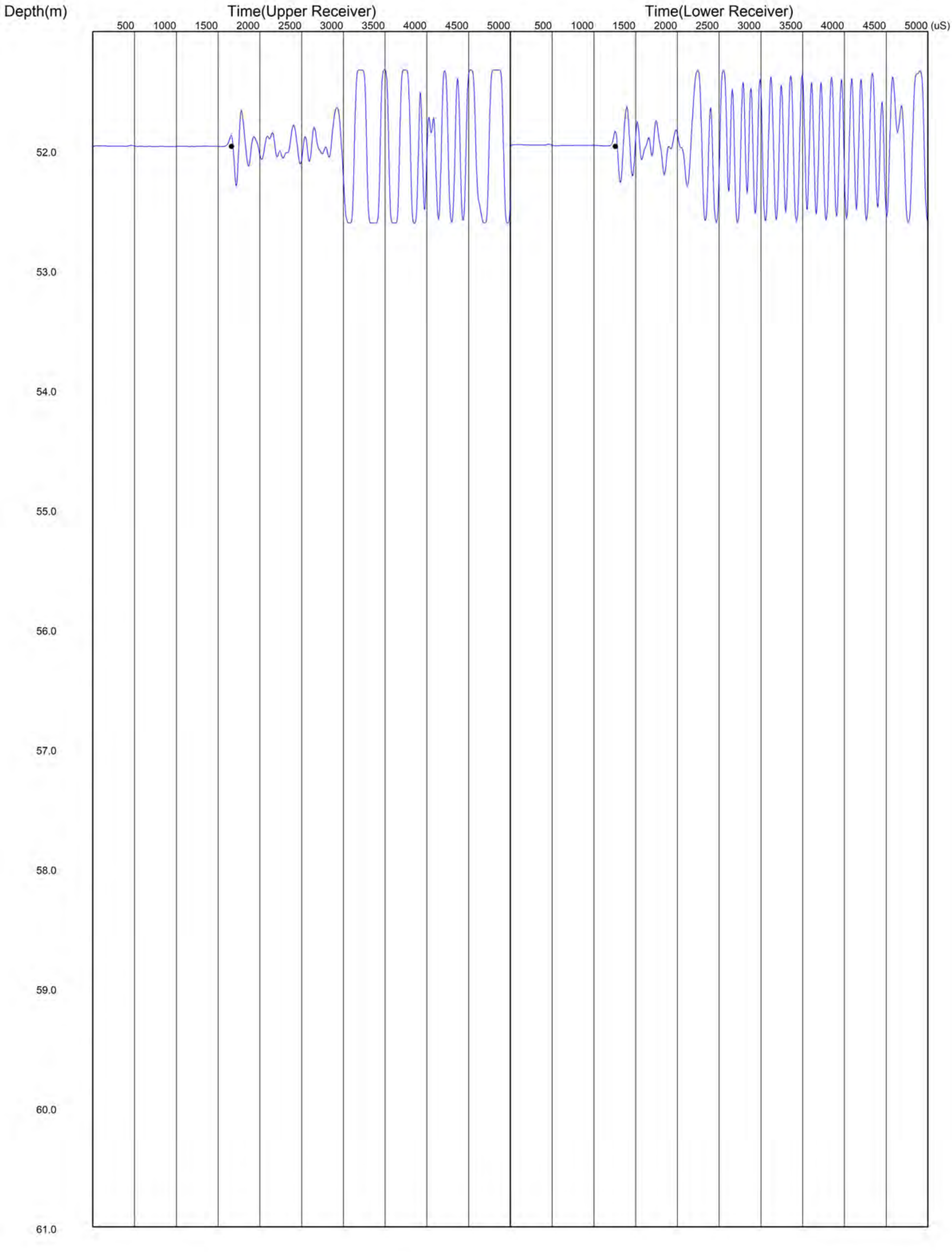


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
500
1000
1500
2000
2500
3000
3500
4000
4500
5000 (uS)
34.0
35.0
36.0
37.0
38.0
39.0
40.0
41.0
42.0

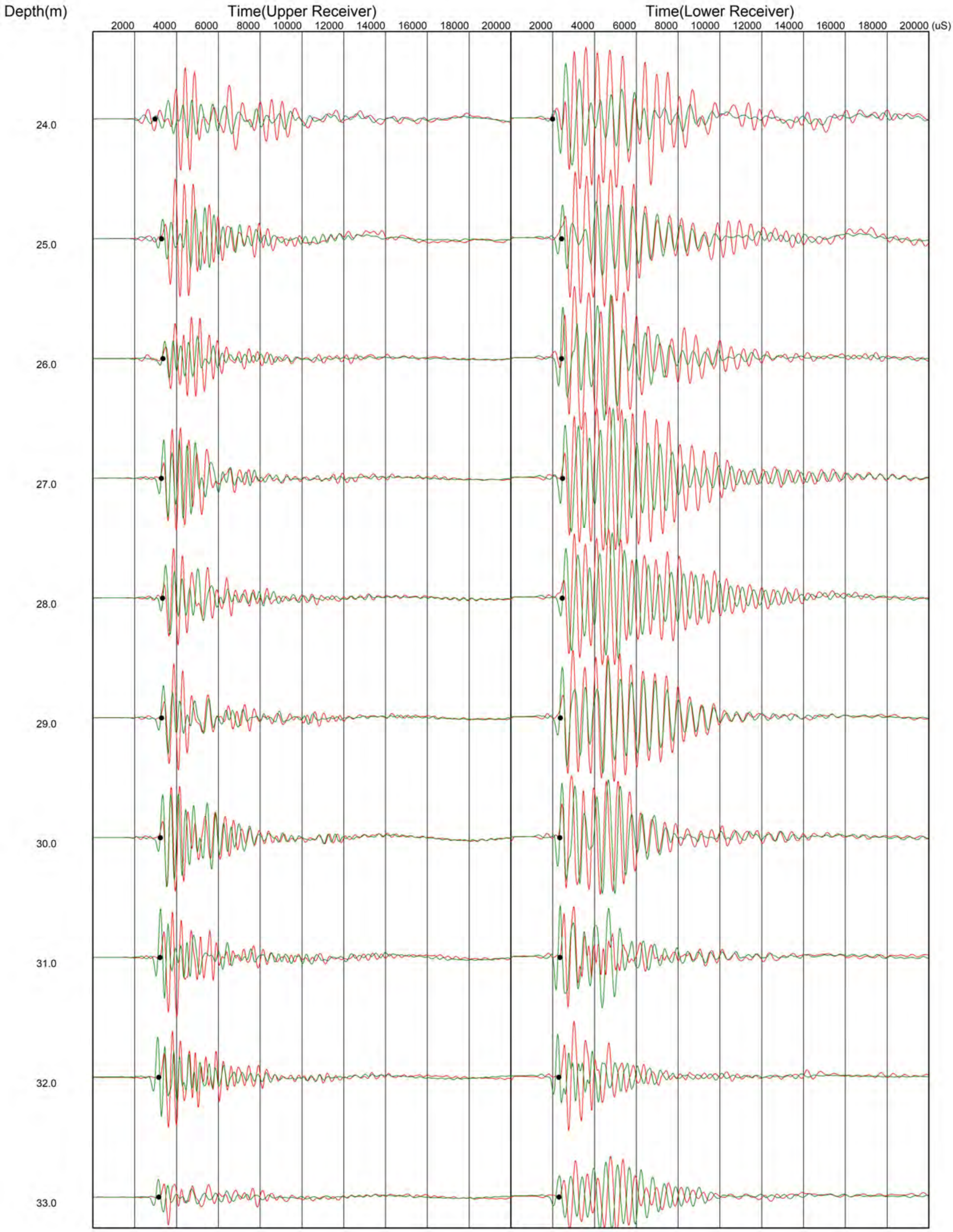
P Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
(uS)
43.0
44.0
45.0
46.0
47.0
48.0
49.0
50.0
51.0

P Wave

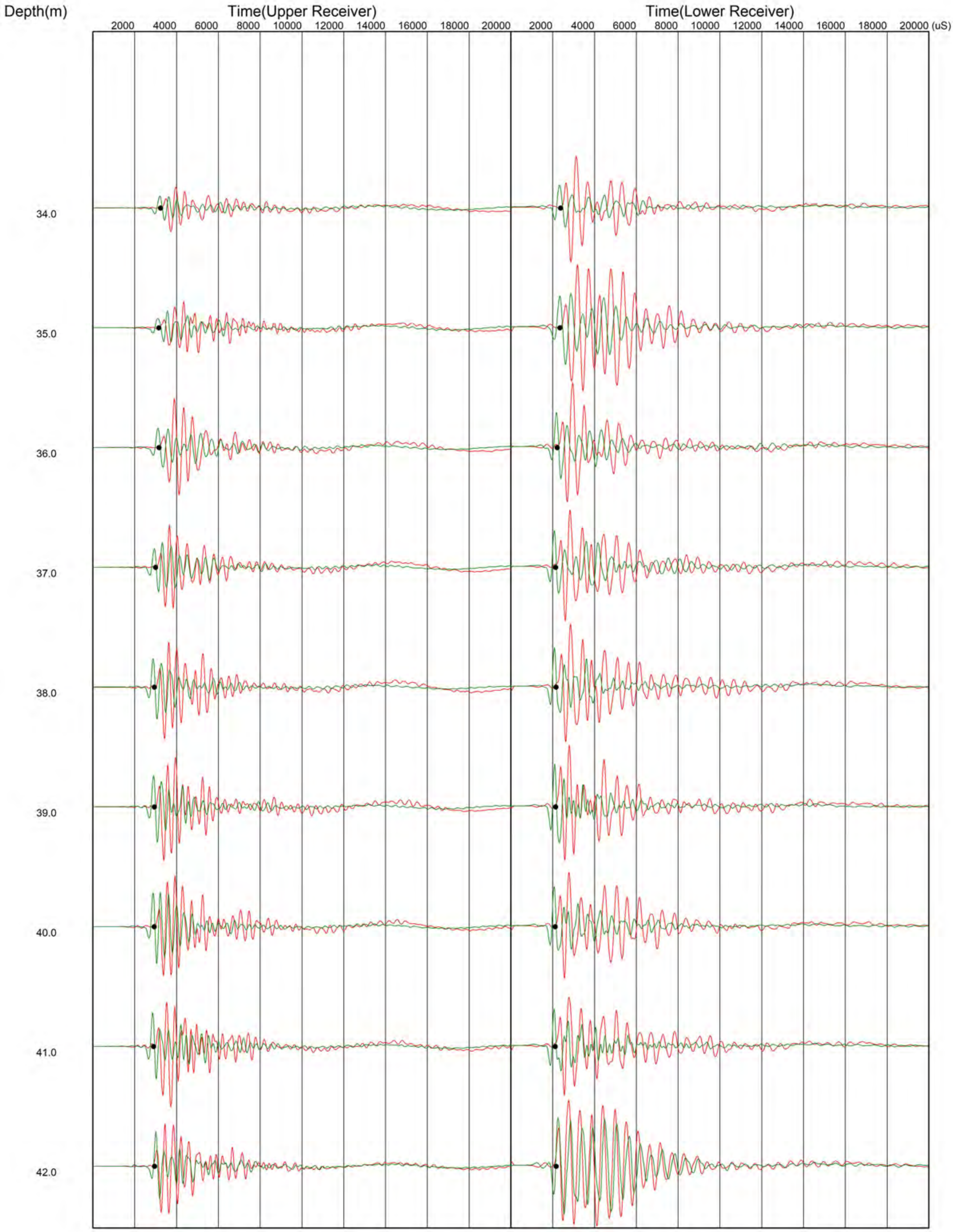

Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
52.0
53.0
54.0
55.0
56.0
57.0
58.0
59.0
60.0
61.0

S Wave



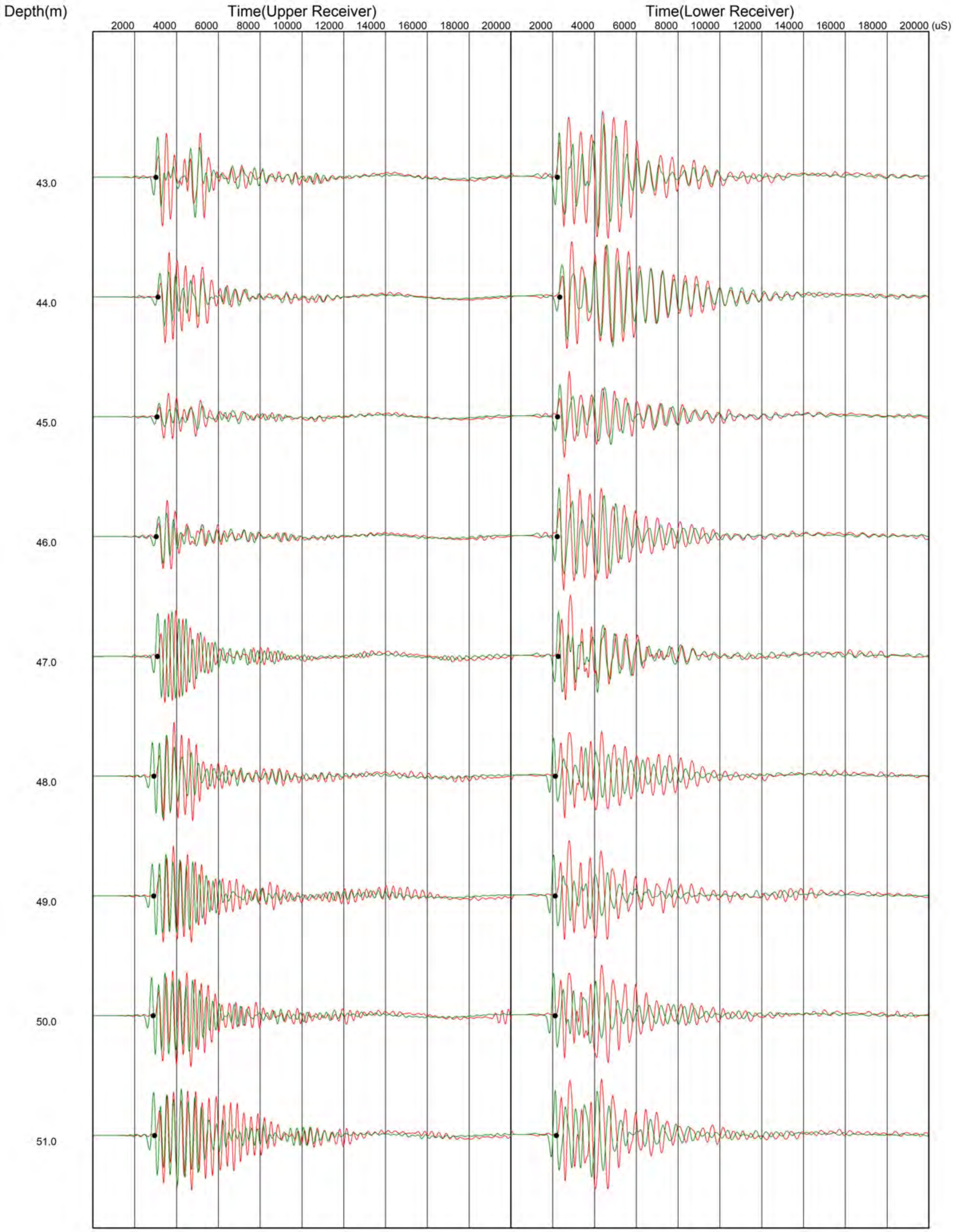
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
24.0
25.0
26.0
27.0
28.0
29.0
30.0
31.0
32.0
33.0

S Wave

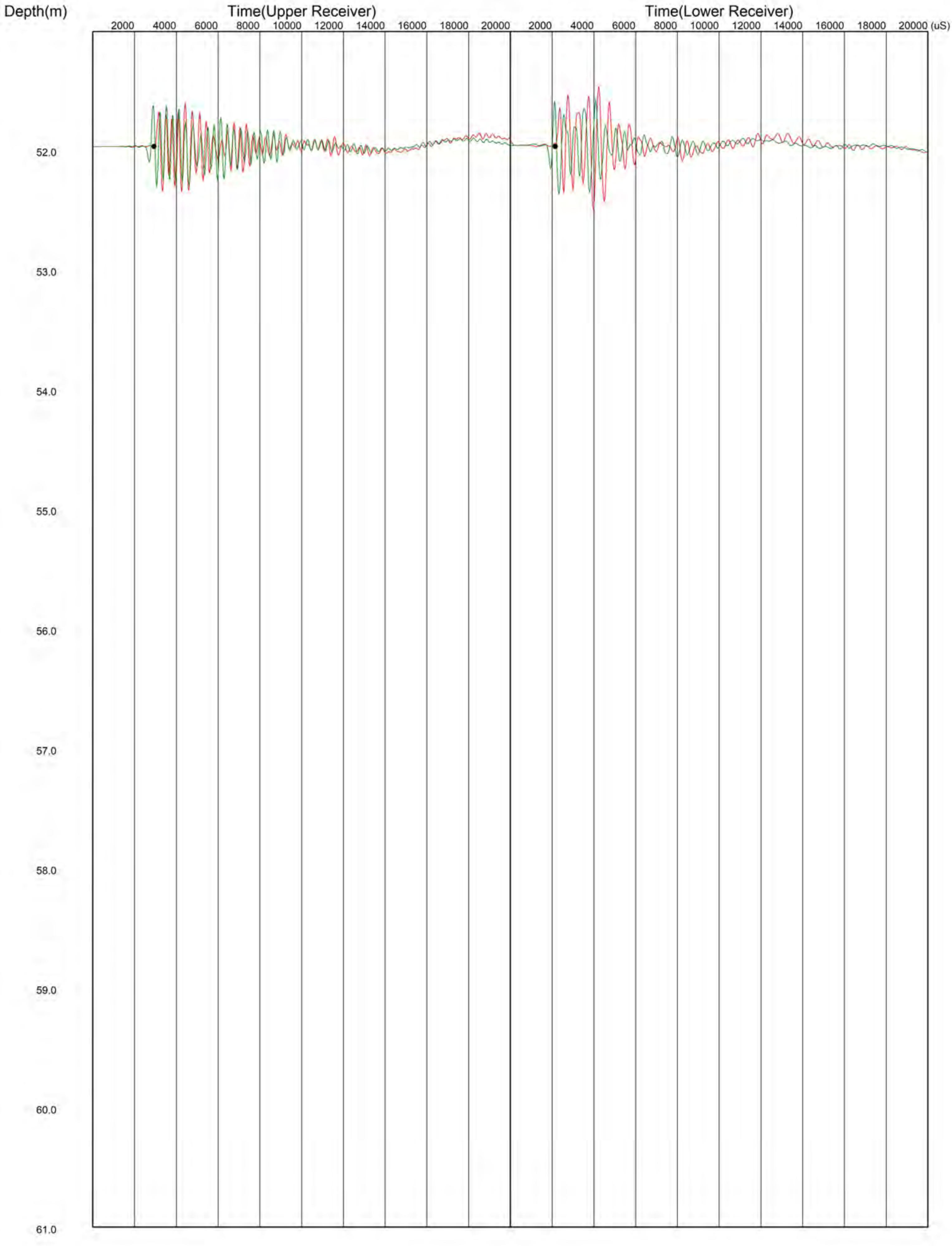


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
34.0
35.0
36.0
37.0
38.0
39.0
40.0
41.0
42.0

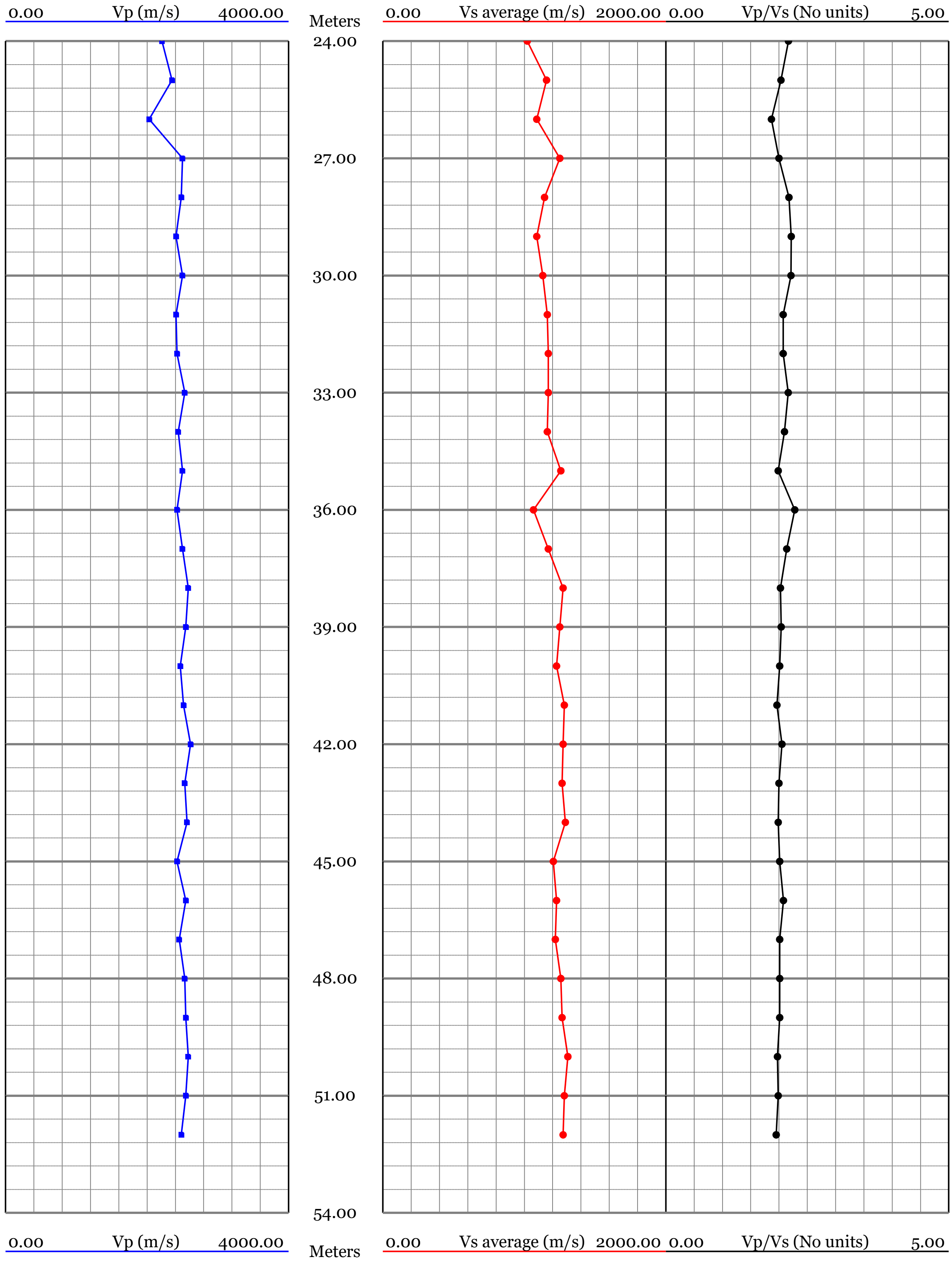
S Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
43.0
44.0
45.0
46.0
47.0
48.0
49.0
50.0
51.0

S Wave



Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
(uS)
52.0
53.0
54.0
55.0
56.0
57.0
58.0
59.0
60.0
61.0


0.00
Vp (m/s)
4000.00
Meters
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00
24.00
27.00
30.00
33.00
36.00
39.00
42.00
45.00
48.00
51.00
54.00

ROBERTSON GEO SERVICES
Unlocking Your GeoData

CO	Structural Soils	COMPANY	Structural Soils
WELL	R614	WELL ID	R614
FLD	A303 Stonehenge	FIELD	A303 Stonehenge
CTY	England	COUNTRY	England
STE		STATE	
FILING No		LOCATION	

LOCATION
Easting: 412496.94
Northing: 141900.96

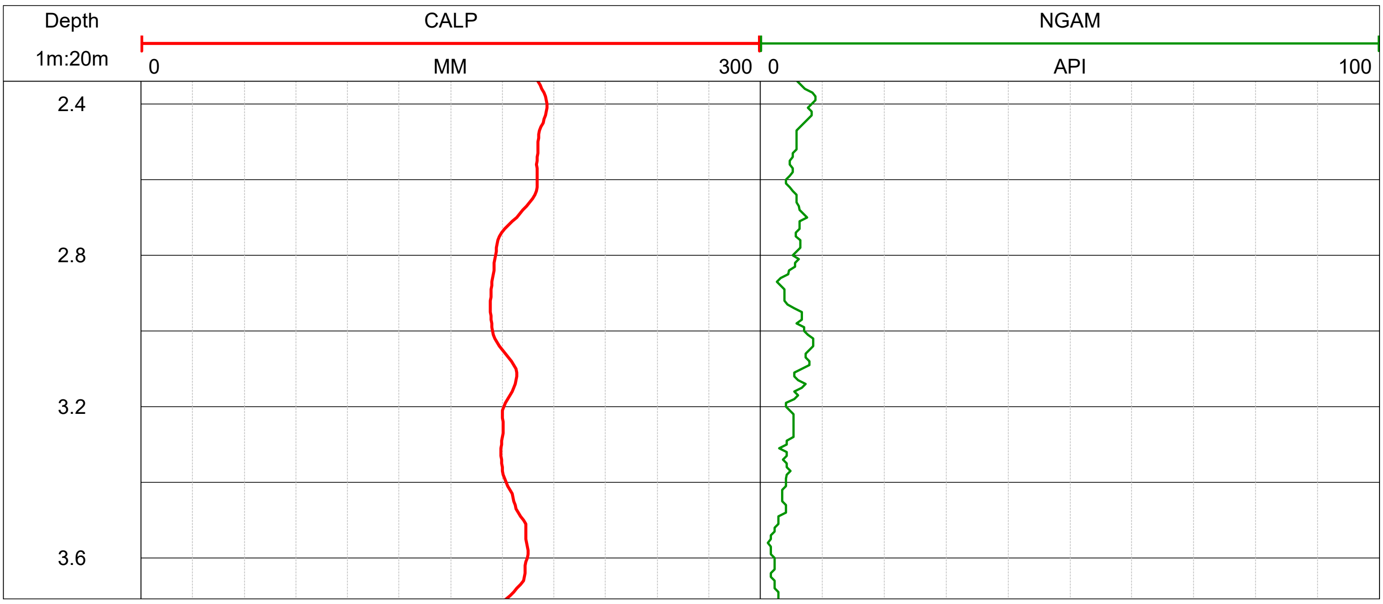
OTHER SERVICES

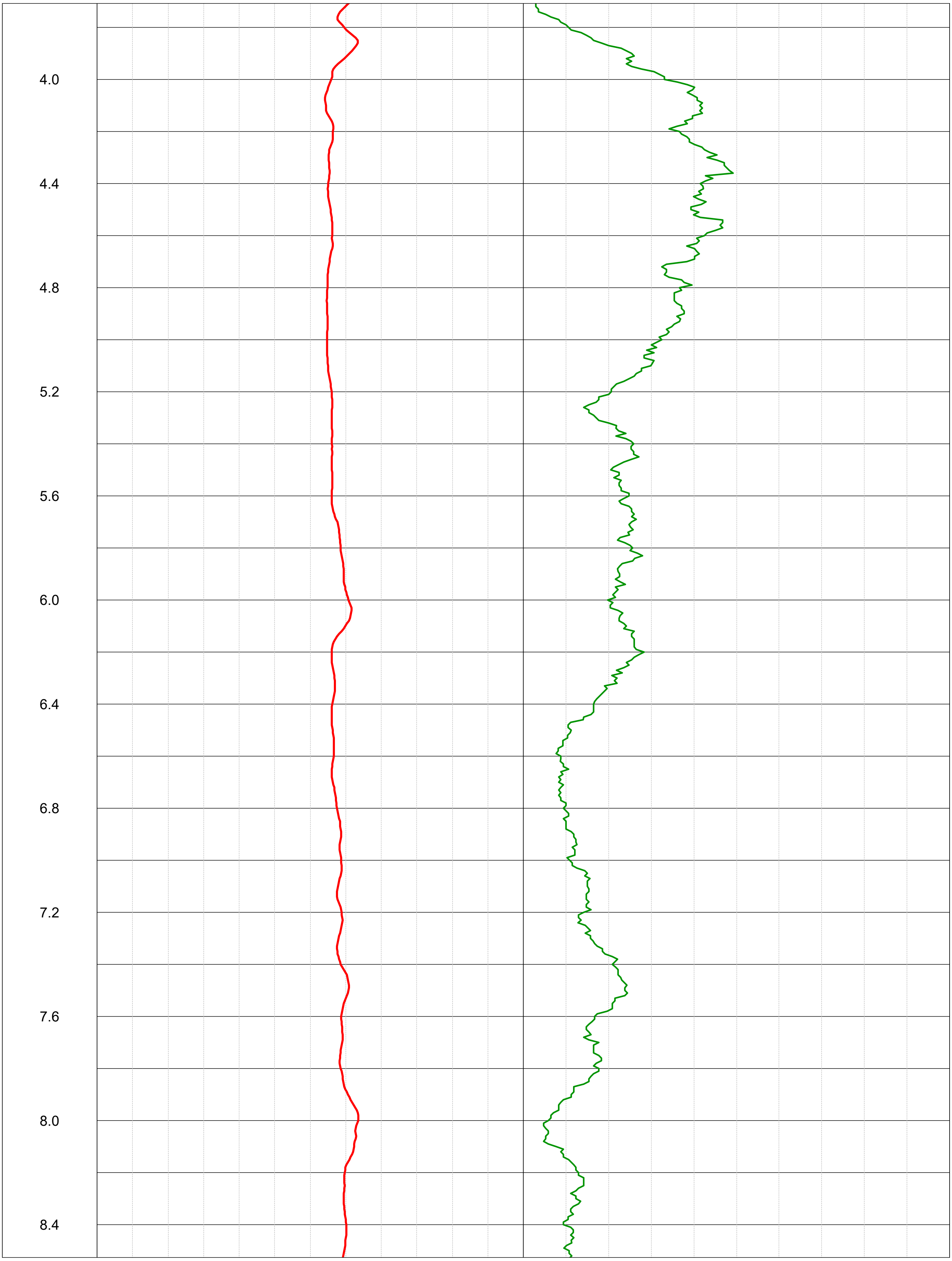
SEC	TWP	RGE

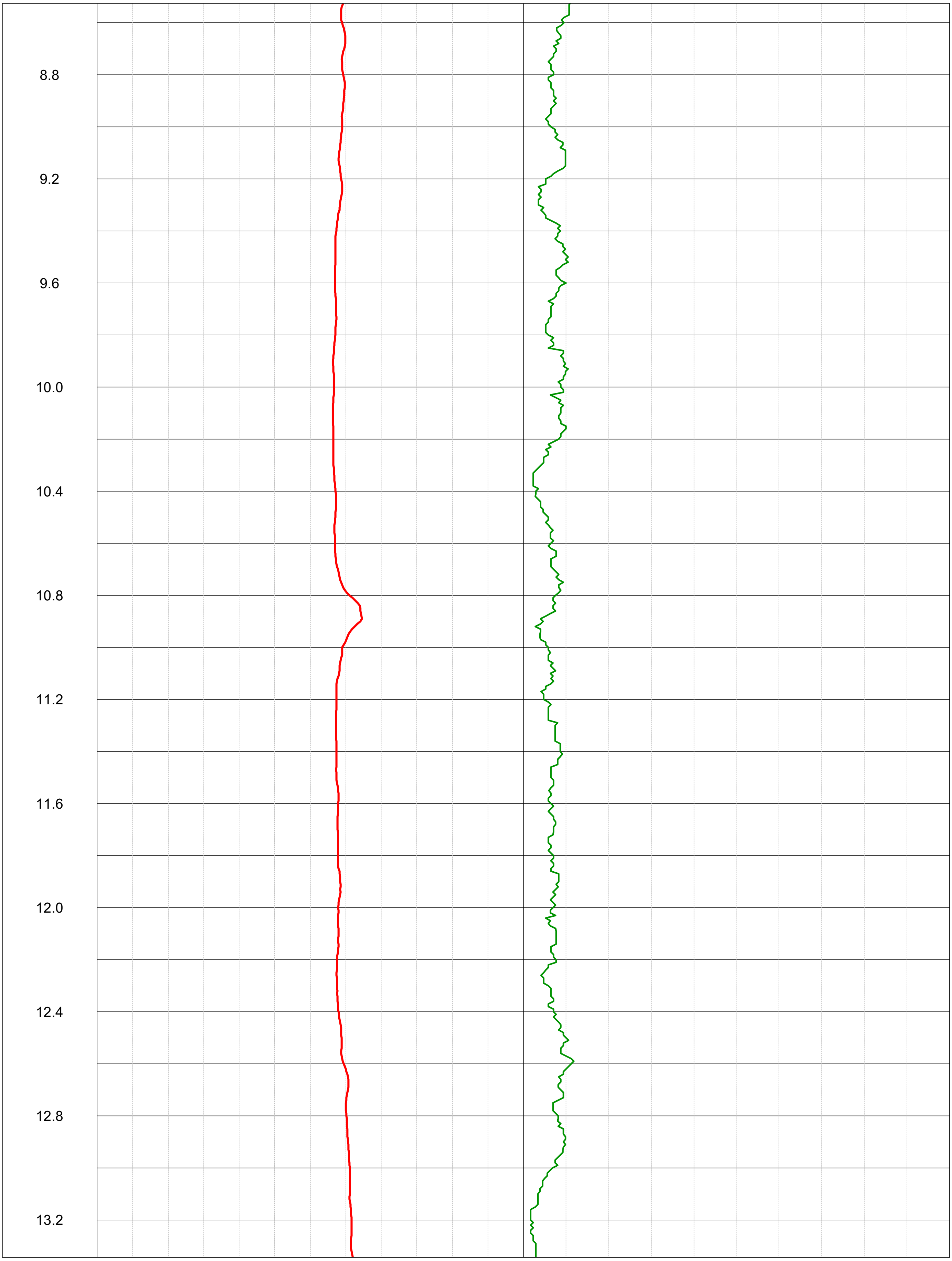
PERMANENT DATUM	GL	ELEVATION	93.068	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM		D.F.
DRILLING MEAS. FROM				G.L.

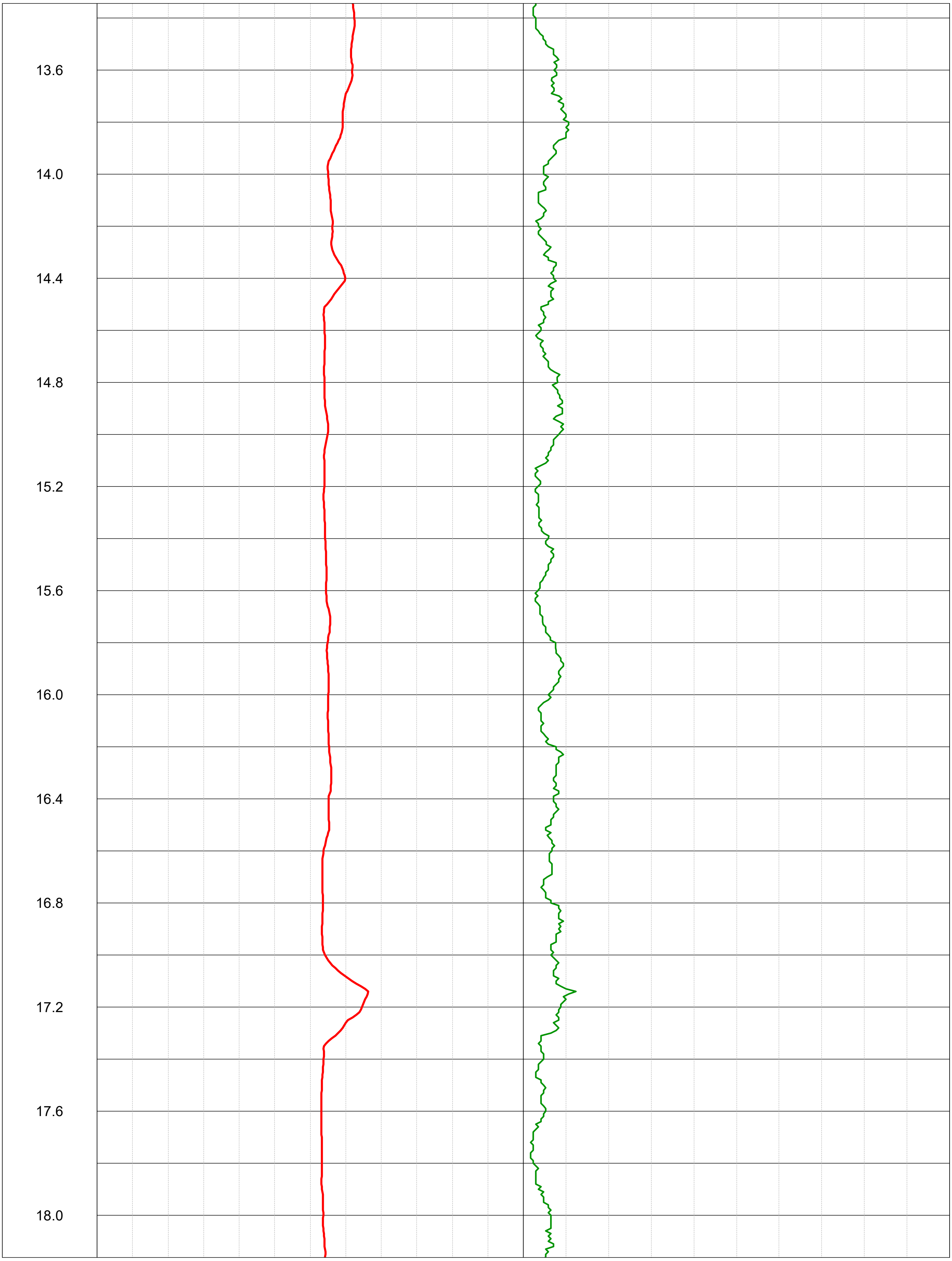
DATE	07/06/18	TYPE FLUID IN HOLE	Water
RUN No		SALINITY	
TYPE LOG	Caliper Gamma	DENSITY	
DEPTH-DRILLER	56	LEVEL	21
DEPTH-LOGGER	53	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	53		
TOP LOGGED INTERVAL	2.3		
OPERATING RIG TIME			
RECORDED BY	Kyle Owen		
WITNESSED BY	James Boyett		

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

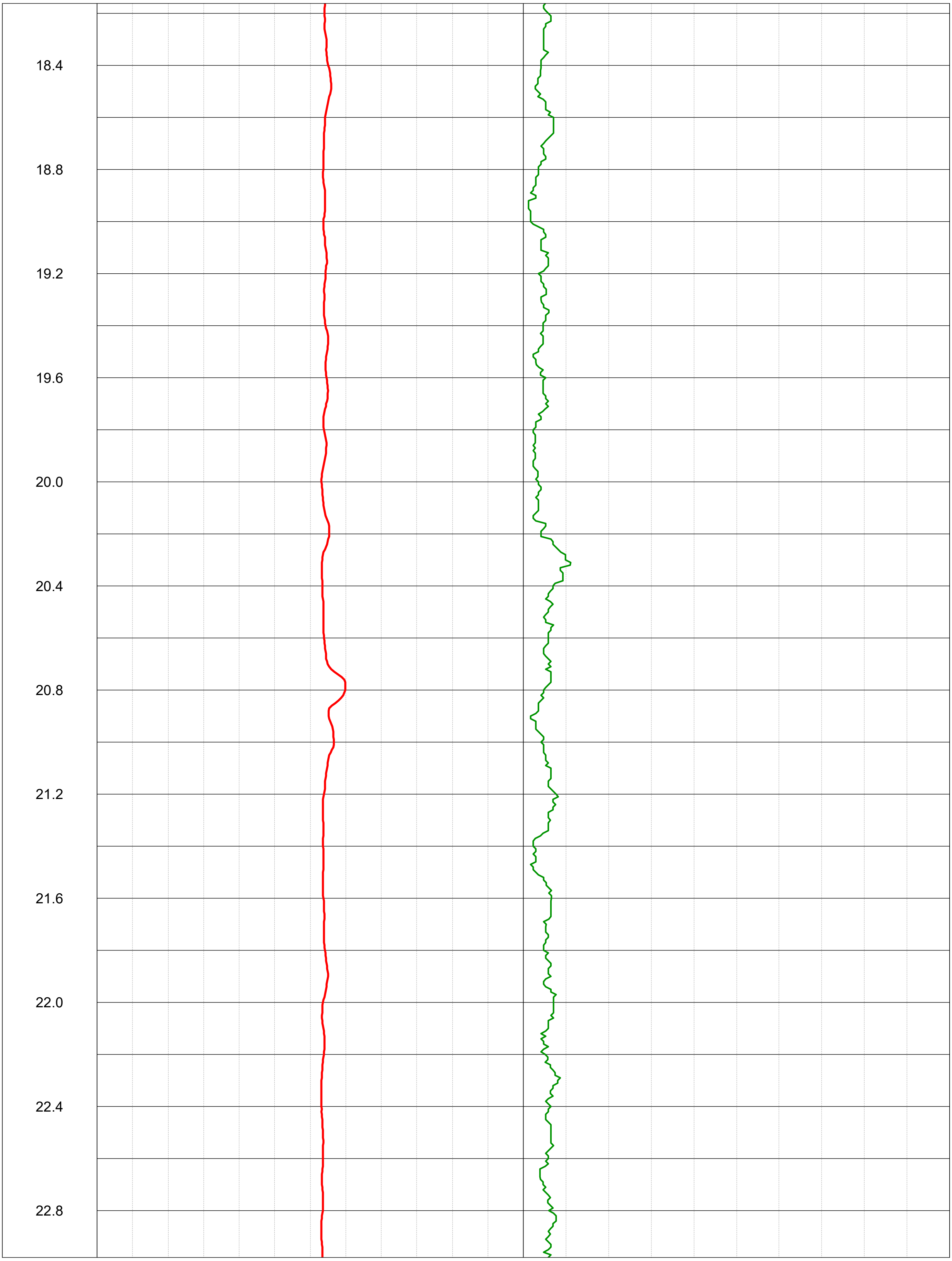


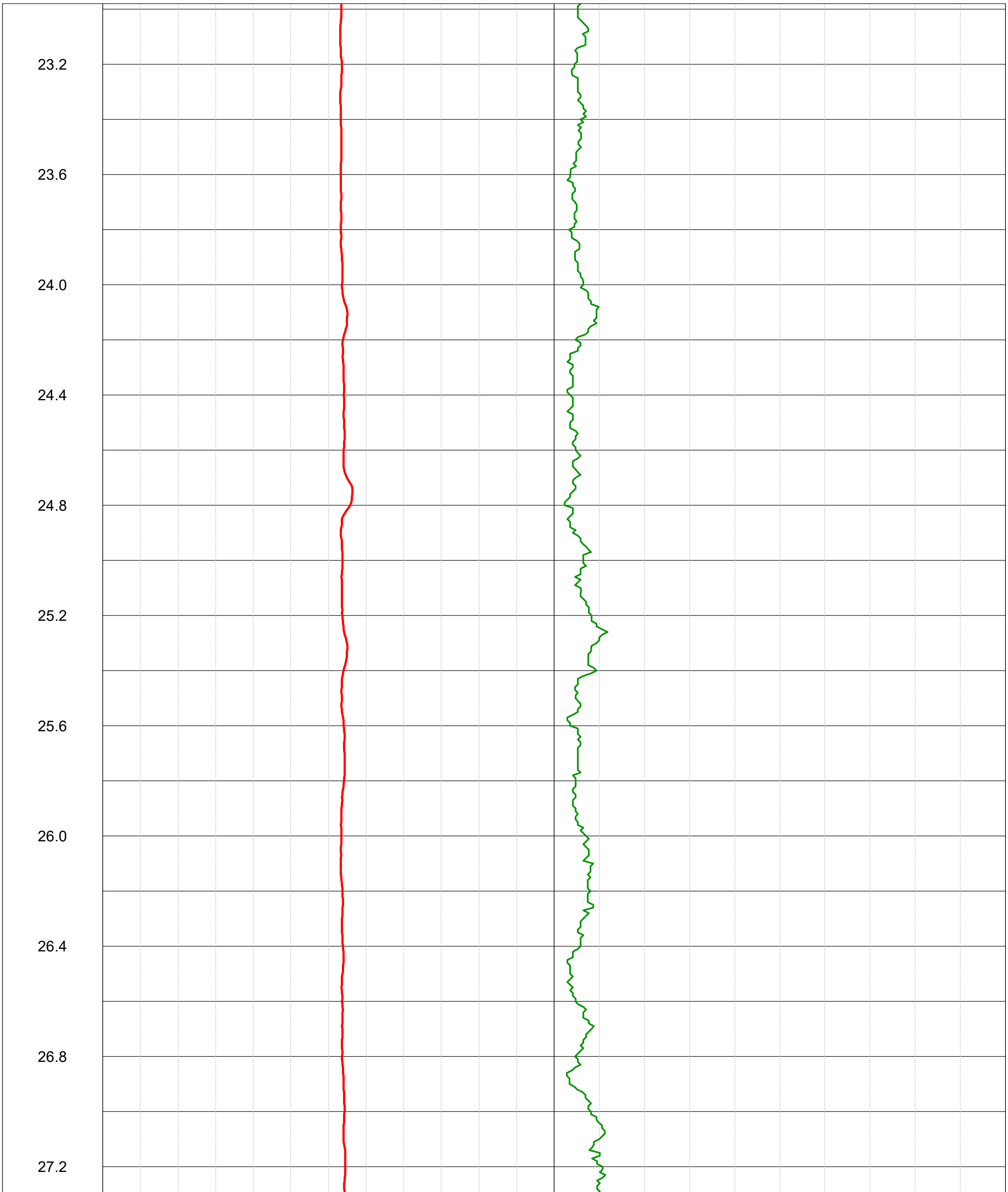

4.0
4.4
4.8
5.2
5.6
6.0
6.4
6.8
7.2
7.6
8.0
8.4


8.8
9.2
9.6
10.0
10.4
10.8
11.2
11.6
12.0
12.4
12.8
13.2

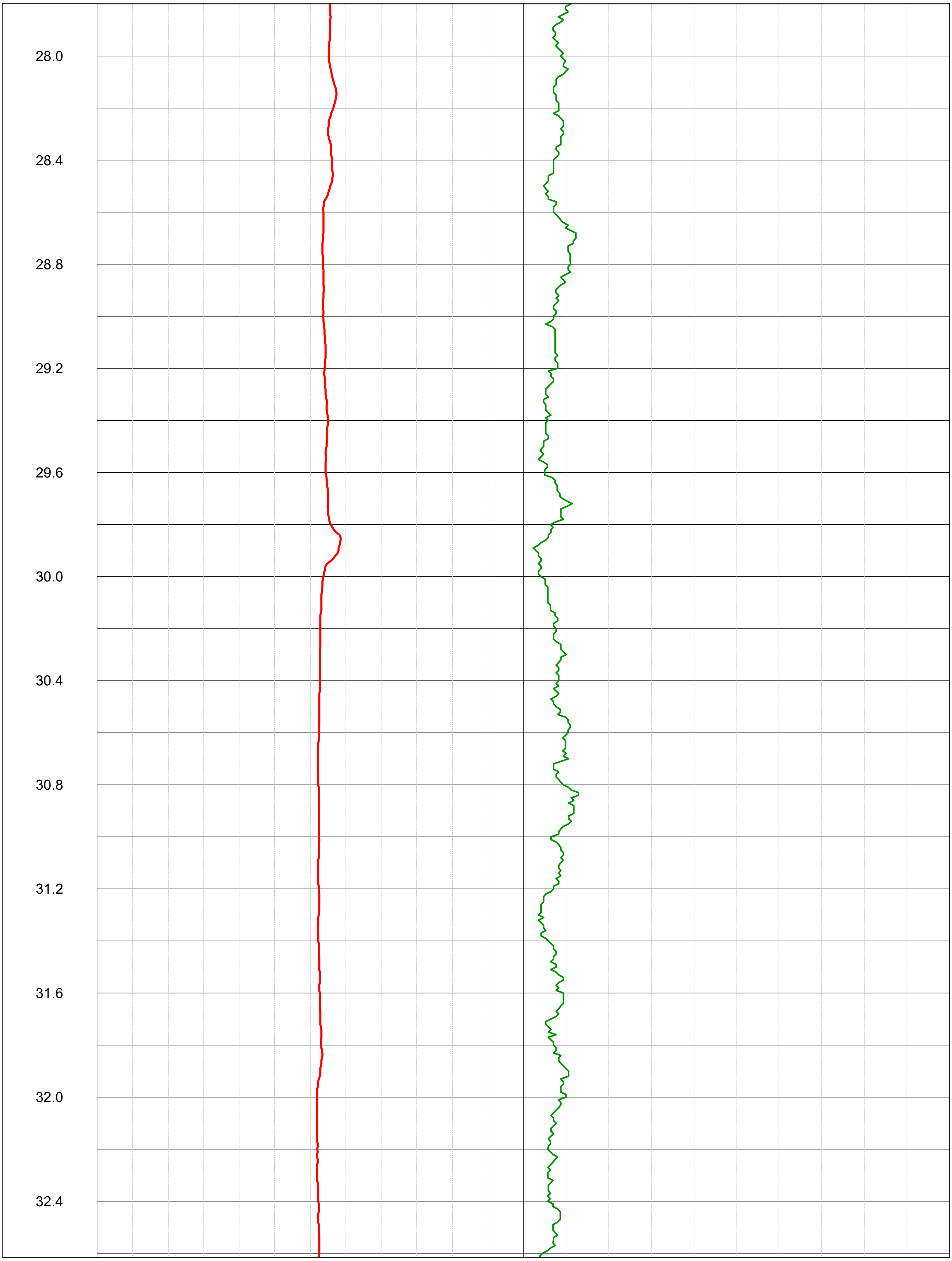


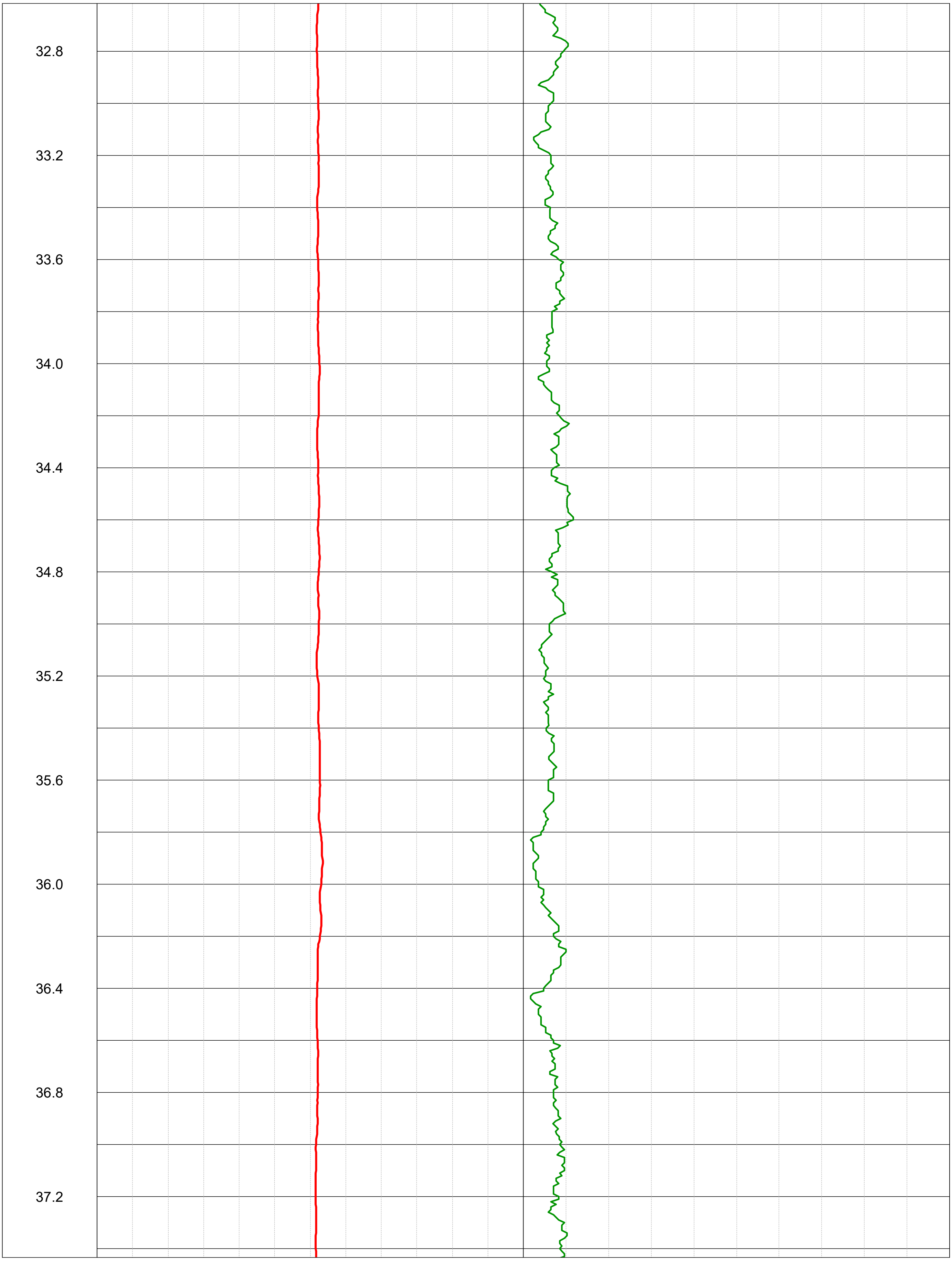
13.6
14.0
14.4
14.8
15.2
15.6
16.0
16.4
16.8
17.2
17.6
18.0

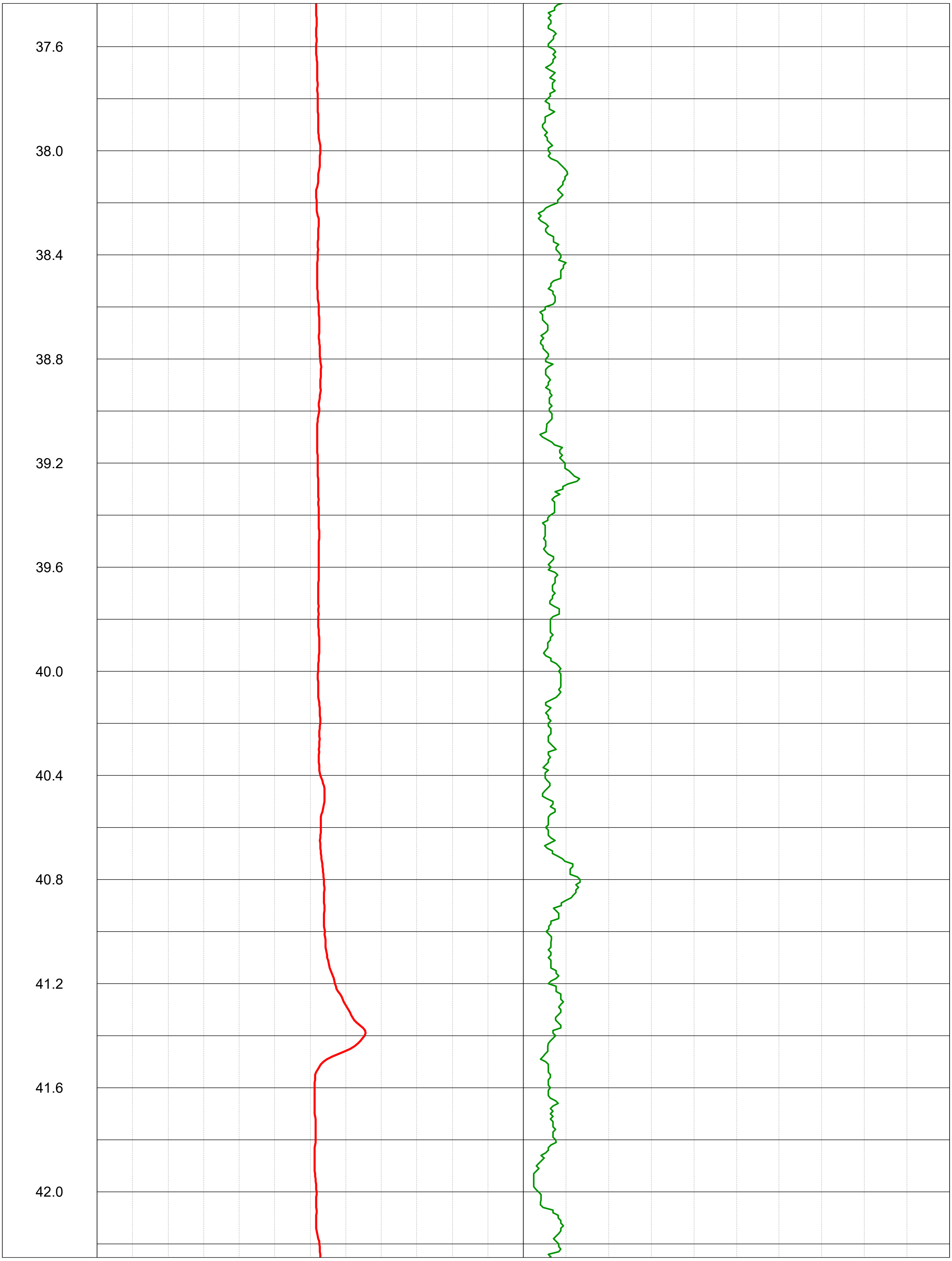

18.4
18.8
19.2
19.6
20.0
20.4
20.8
21.2
21.6
22.0
22.4
22.8

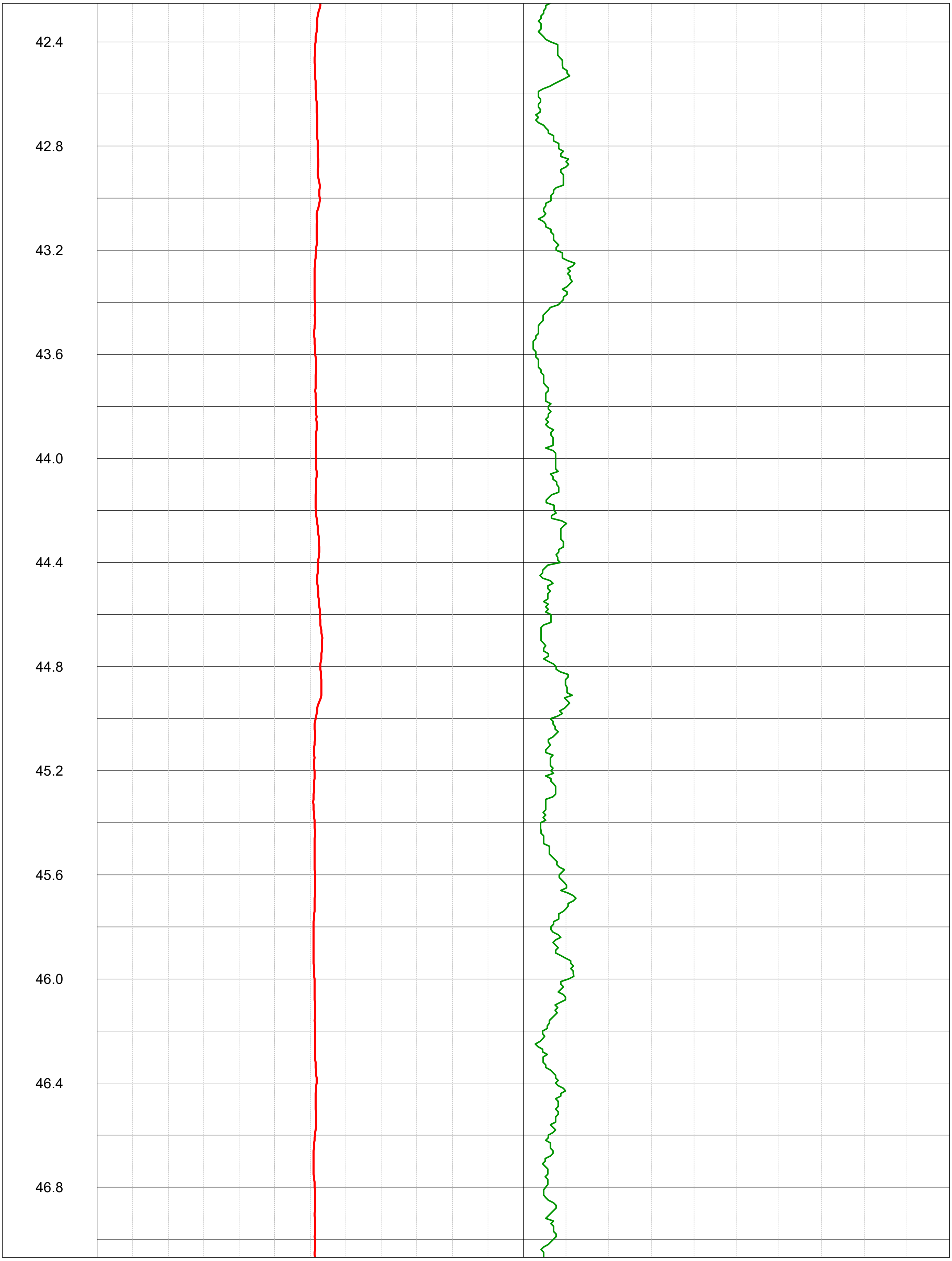


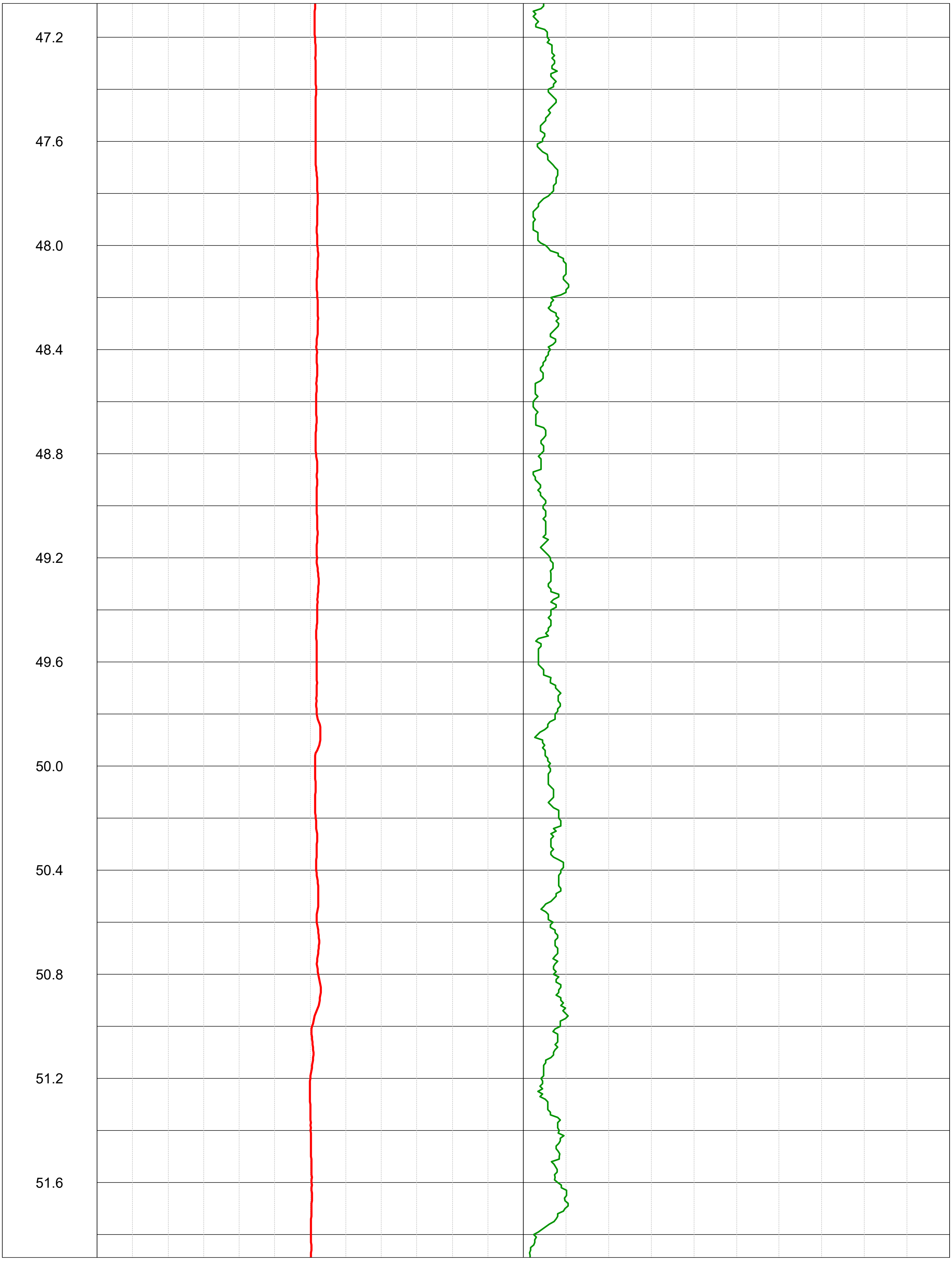
23.2
23.6
24.0
24.4
24.8
25.2
25.6
26.0
26.4
26.8
27.2
27.6

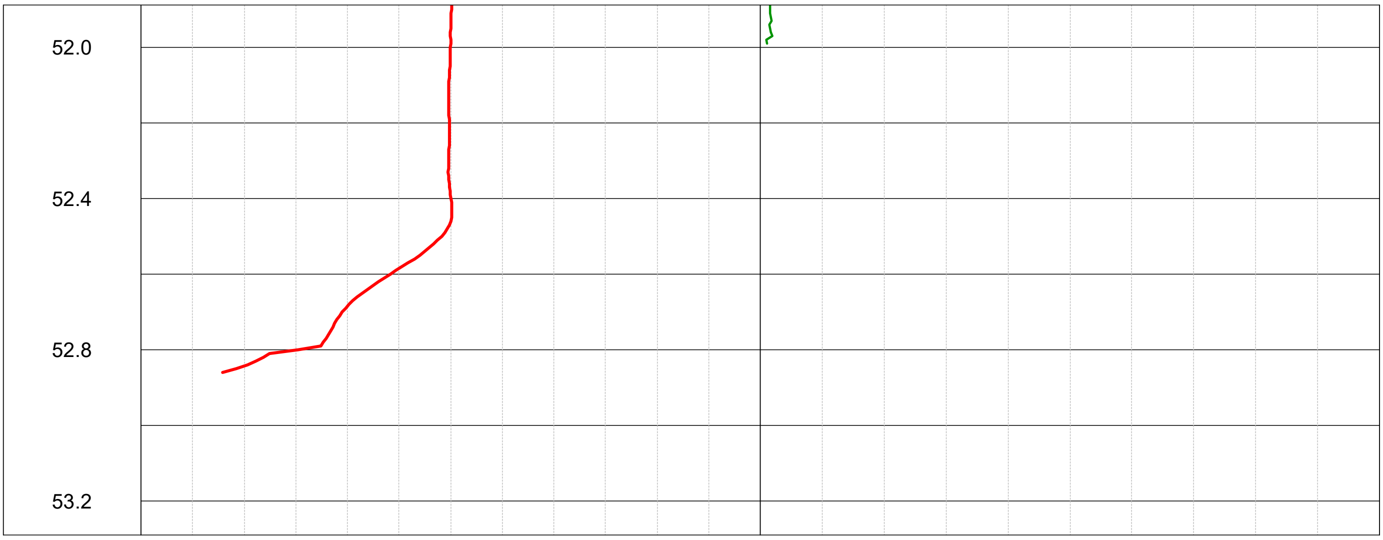

28.0
28.4
28.8
29.2
29.6
30.0
30.4
30.8
31.2
31.6
32.0
32.4


32.8
33.2
33.6
34.0
34.4
34.8
35.2
35.6
36.0
36.4
36.8
37.2

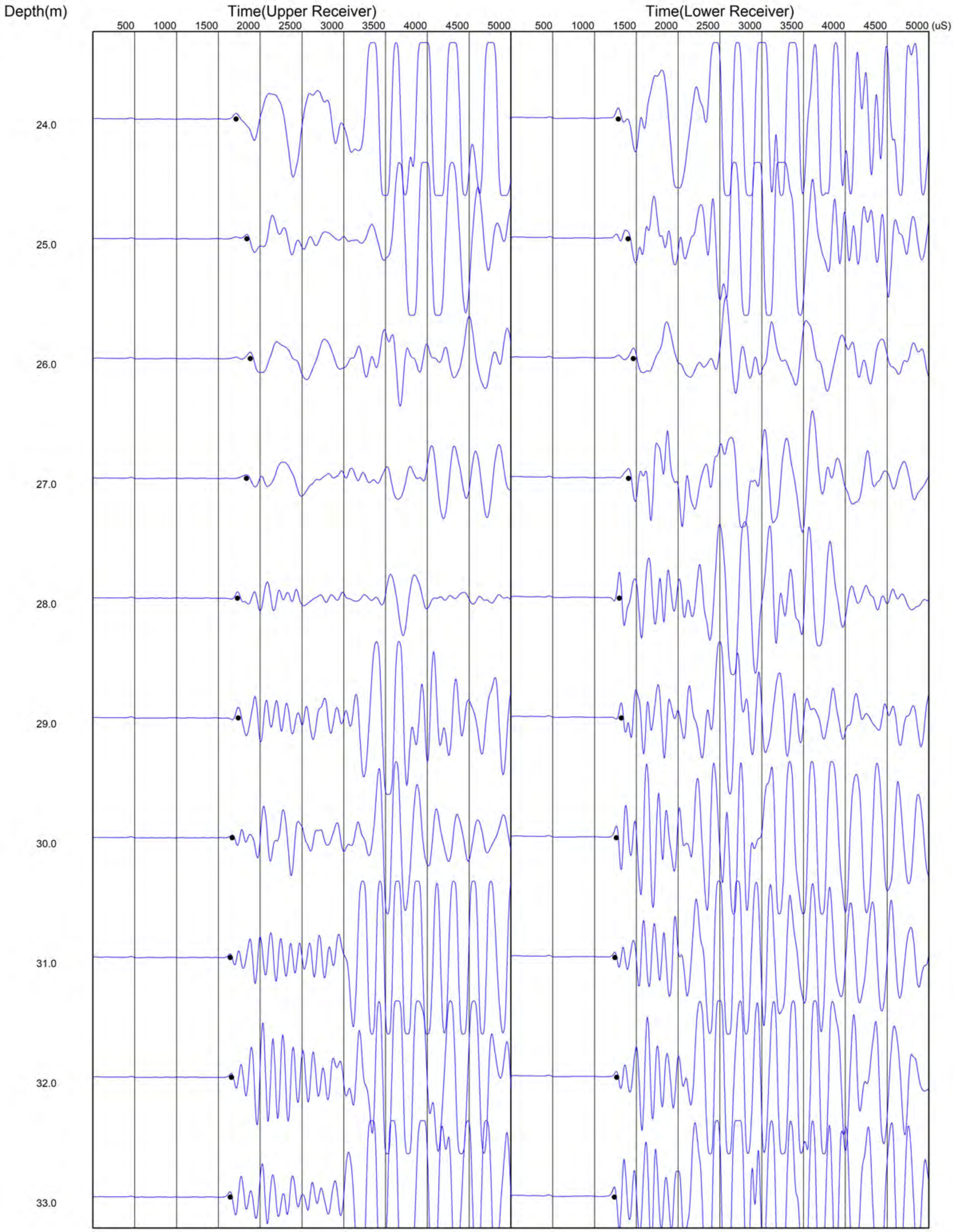

37.6
38.0
38.4
38.8
39.2
39.6
40.0
40.4
40.8
41.2
41.6
42.0


42.4
42.8
43.2
43.6
44.0
44.4
44.8
45.2
45.6
46.0
46.4
46.8


47.2
47.6
48.0
48.4
48.8
49.2
49.6
50.0
50.4
50.8
51.2
51.6

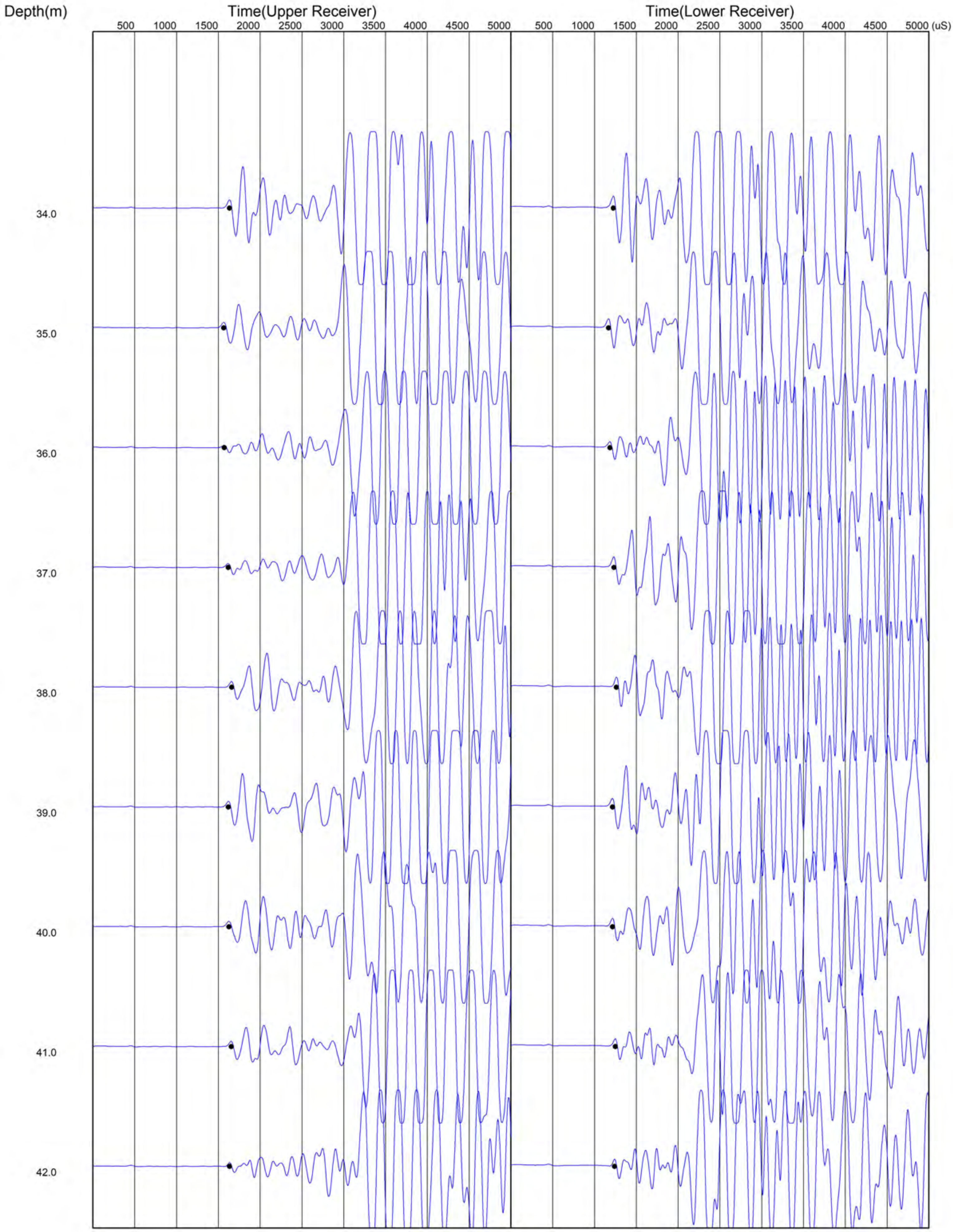

52.0
52.4
52.8
53.2

P Wave



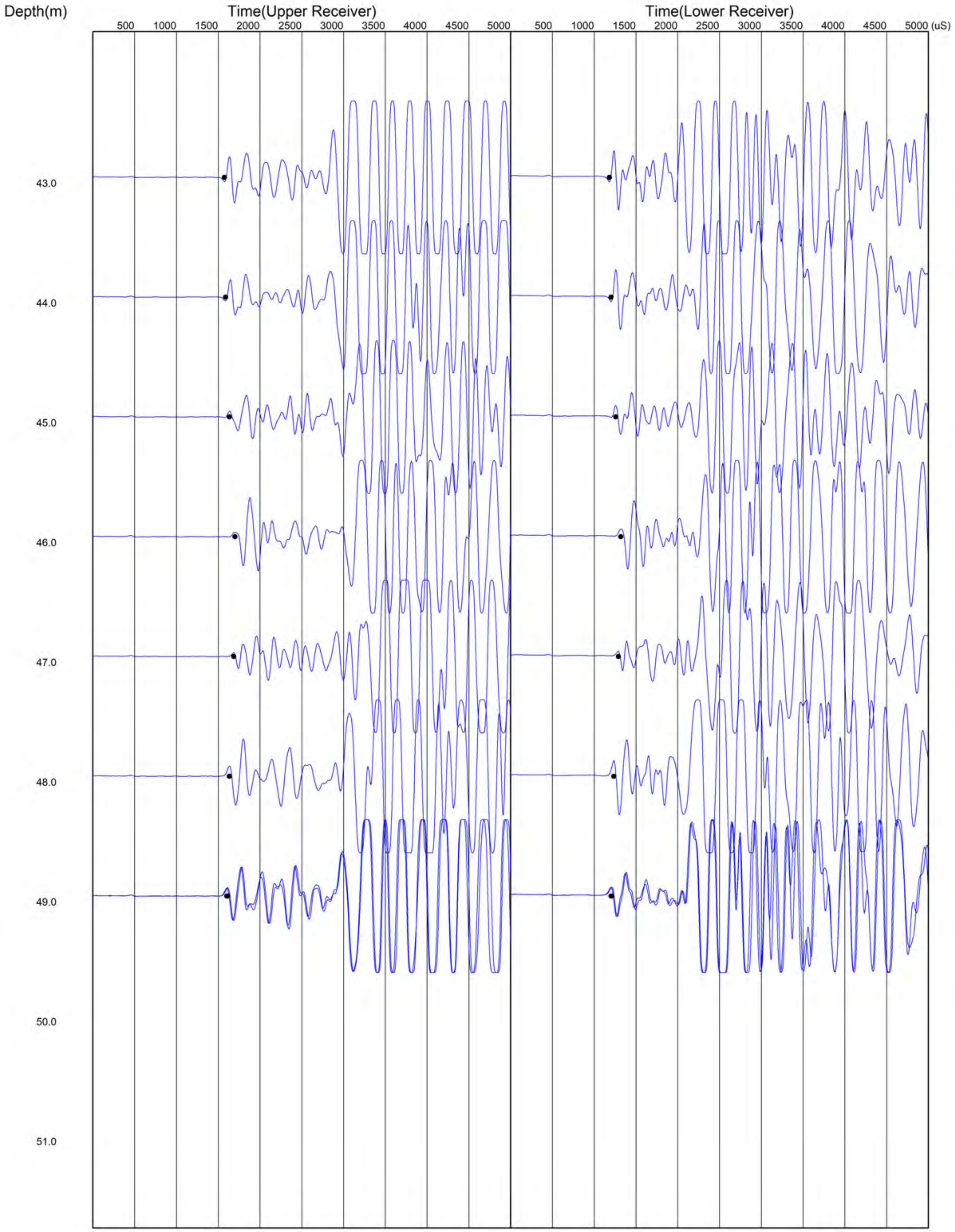
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
24.0
25.0
26.0
27.0
28.0
29.0
30.0
31.0
32.0
33.0

P Wave

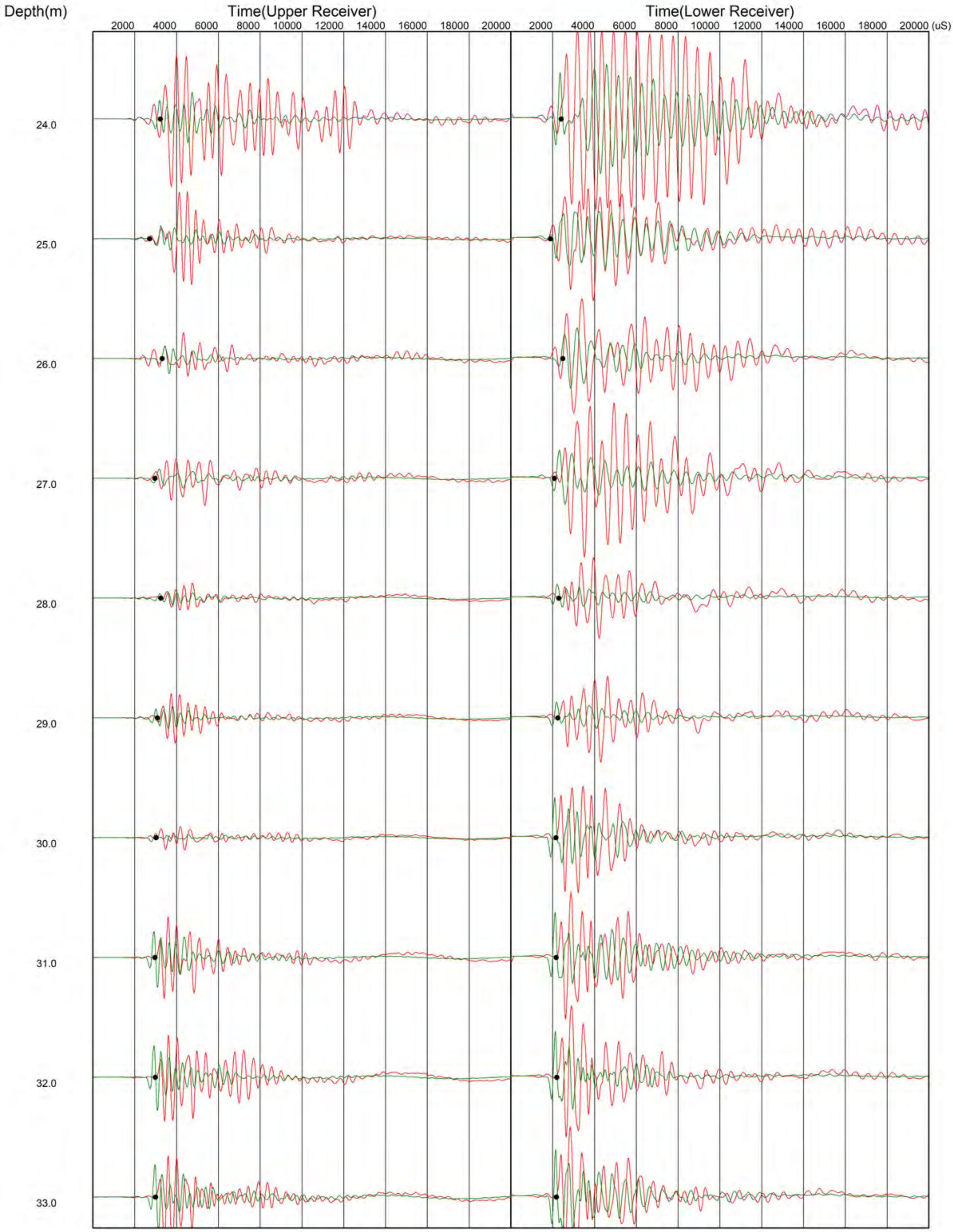


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
34.0
35.0
36.0
37.0
38.0
39.0
40.0
41.0
42.0

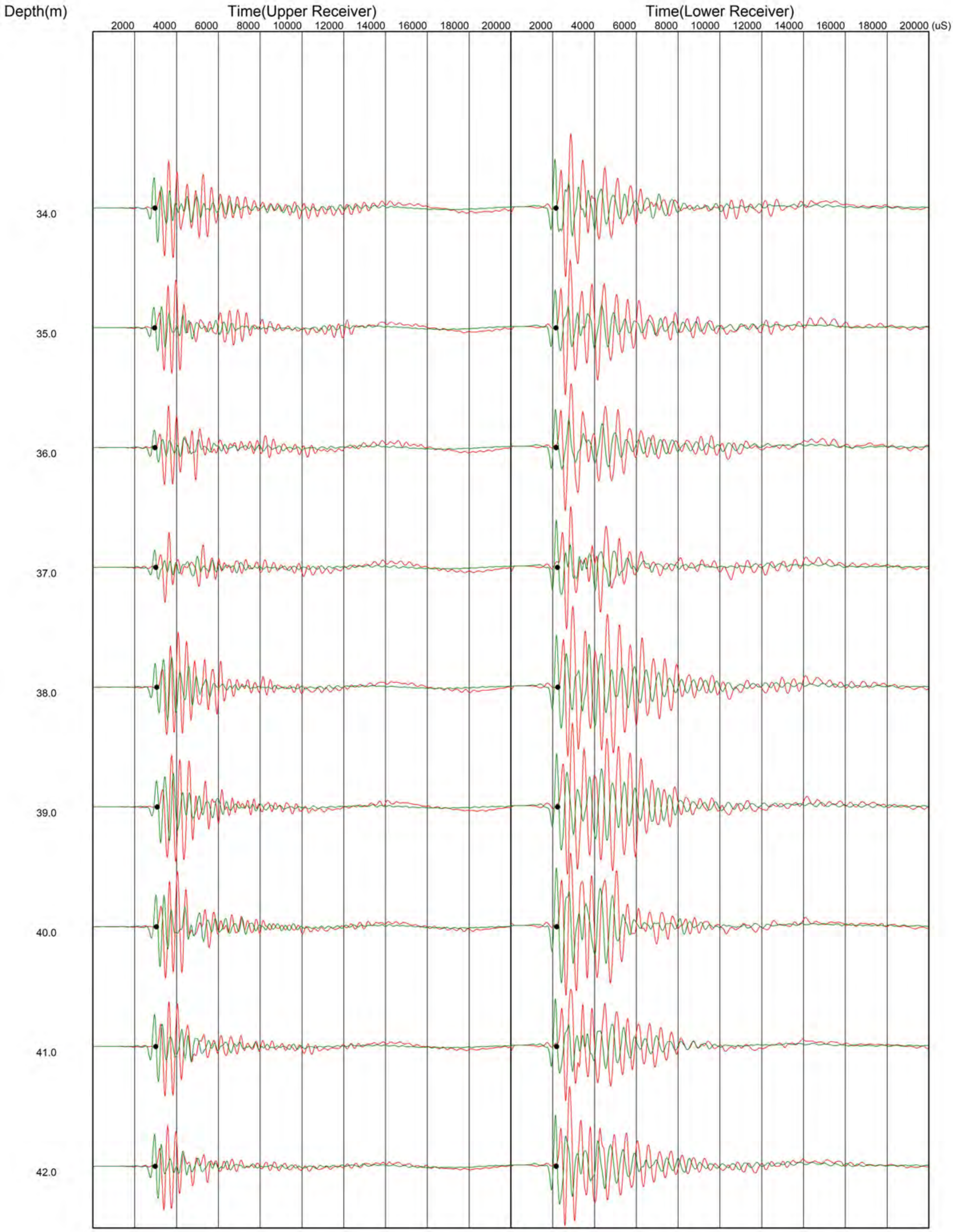
P Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
43.0
44.0
45.0
46.0
47.0
48.0
49.0
50.0
51.0

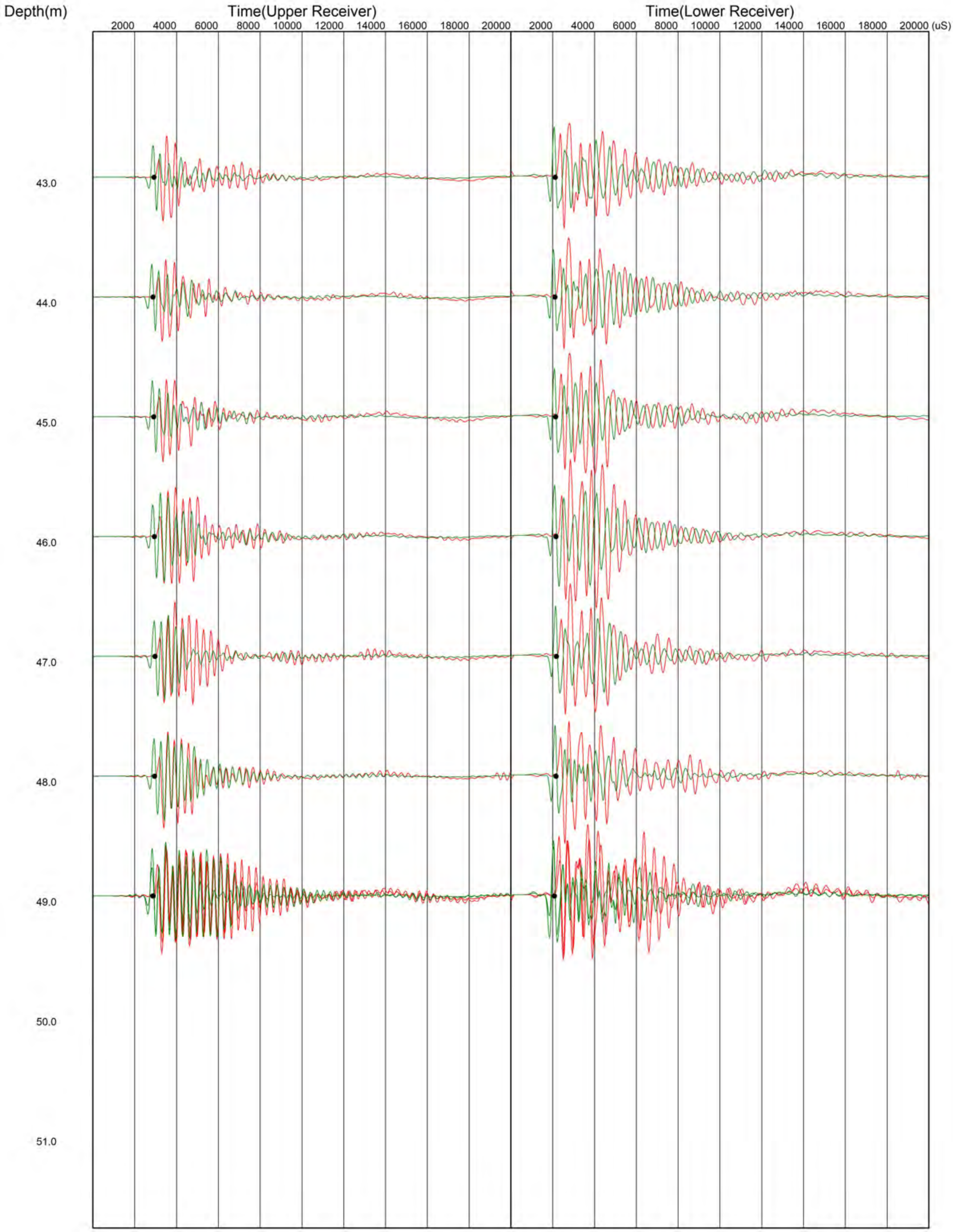
S Wave

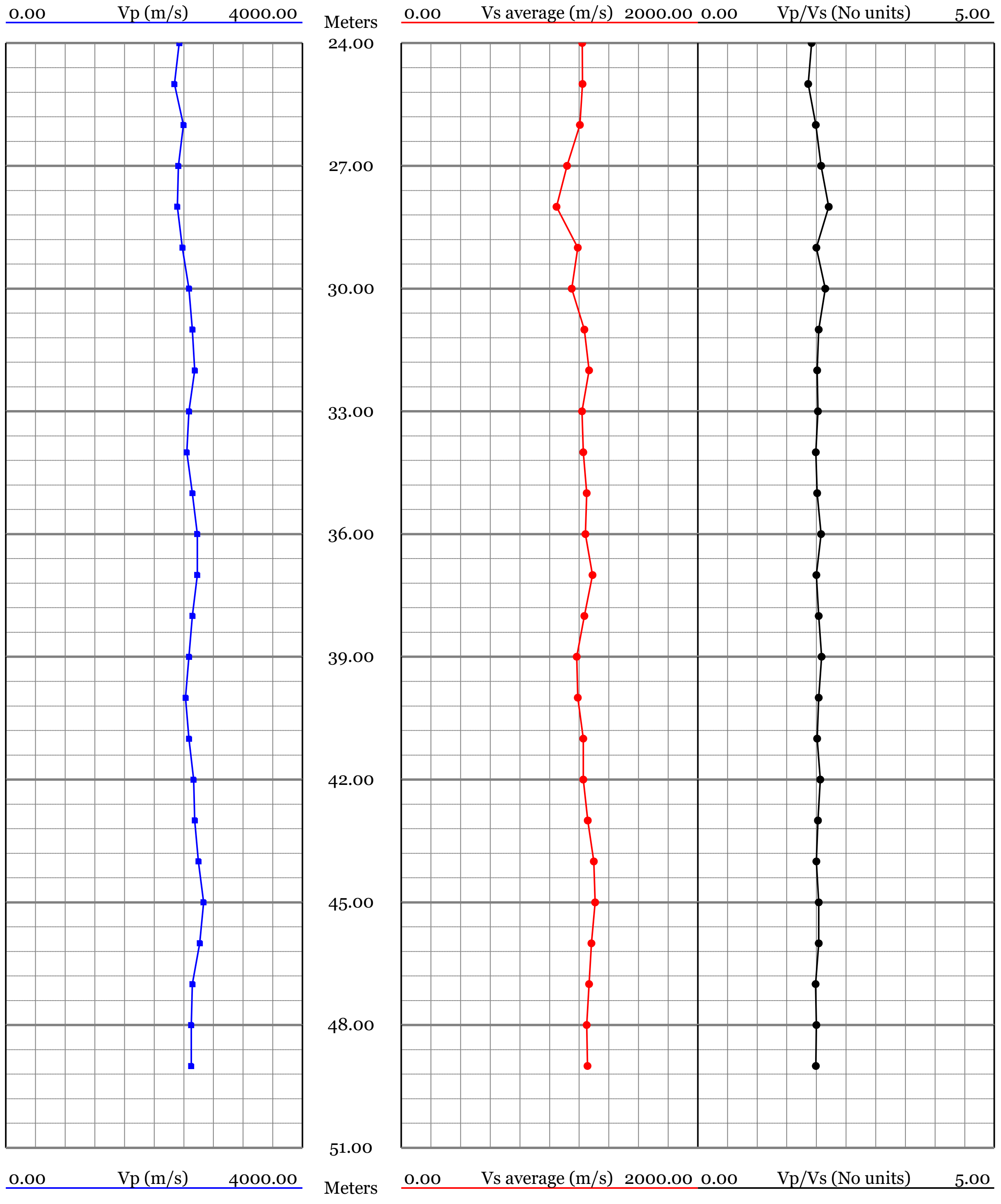

Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
24.0
25.0
26.0
27.0
28.0
29.0
30.0
31.0
32.0
33.0

S Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
34.0
35.0
36.0
37.0
38.0
39.0
40.0
41.0
42.0

S Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
43.0
44.0
45.0
46.0
47.0
48.0
49.0
50.0
51.0


0.00
Vp (m/s)
4000.00
Meters
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00
24.00
27.00
30.00
33.00
36.00
39.00
42.00
45.00
48.00
51.00
0.00
Vp (m/s)
4000.00
Meters
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00

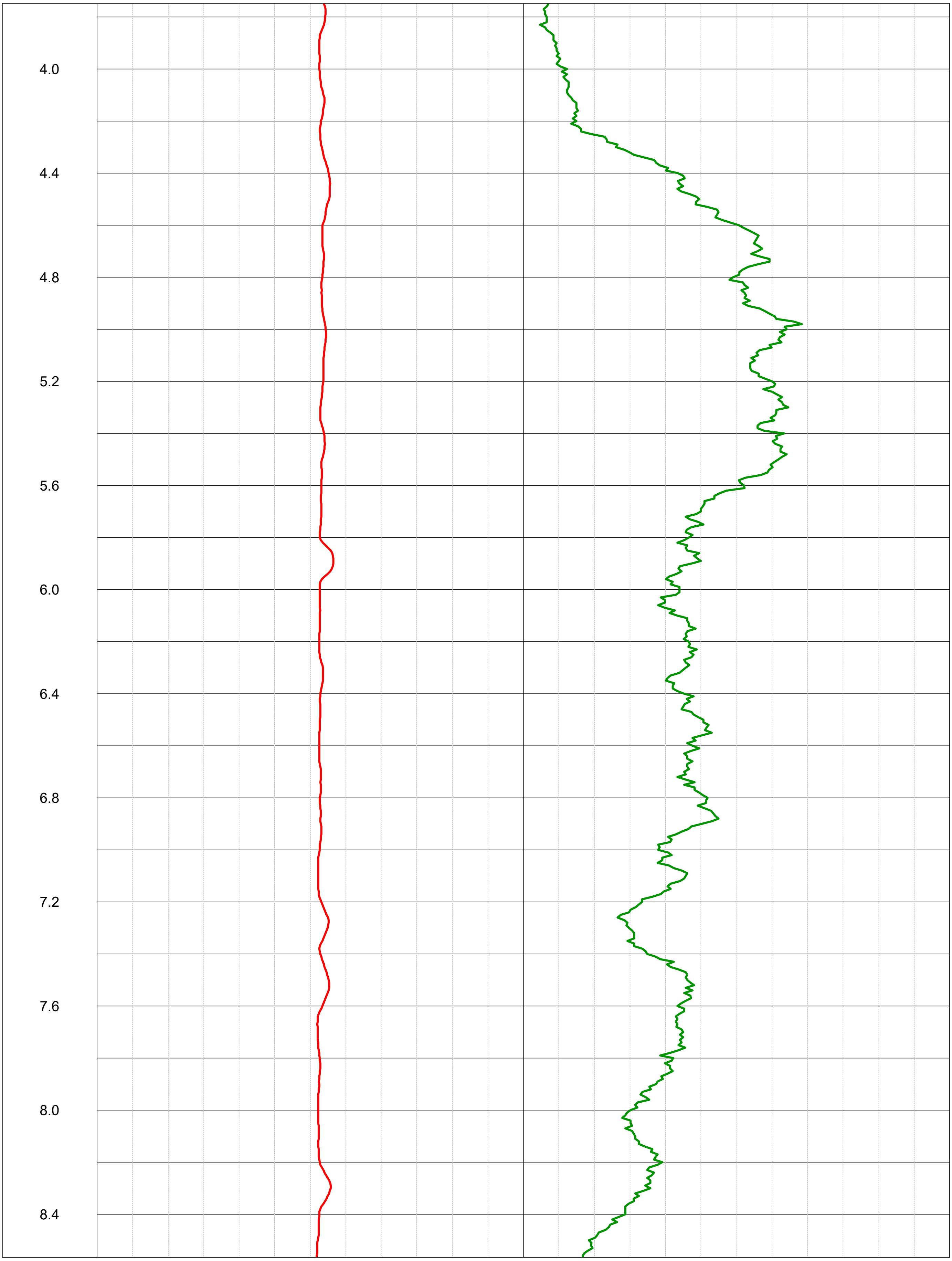
ROBERTSON GEO SERVICES
Unlocking Your GeoData

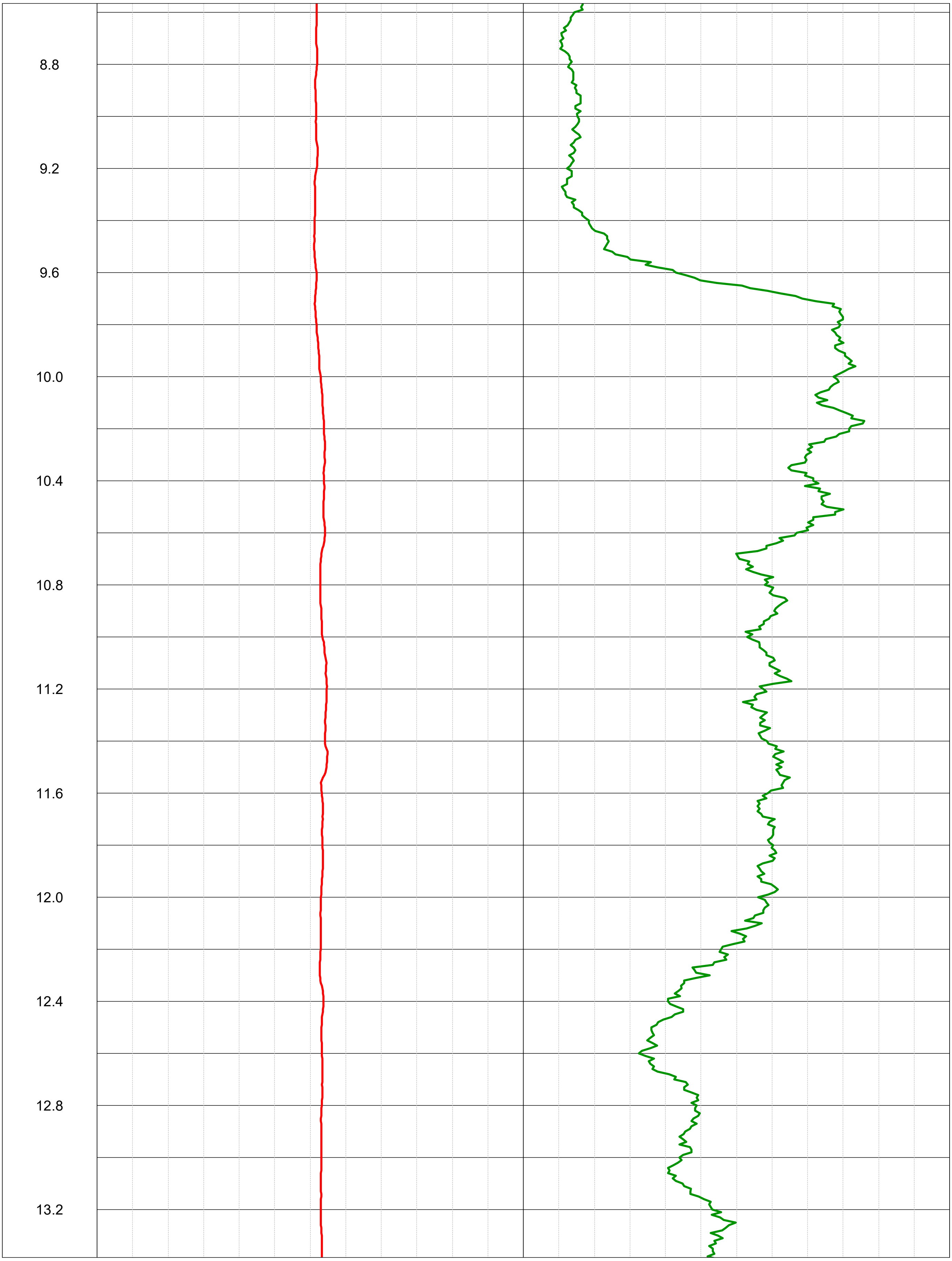
CO Structural Soils
WELL R615
FLD A303 Stonehenge
CTY England
STE
FILING No

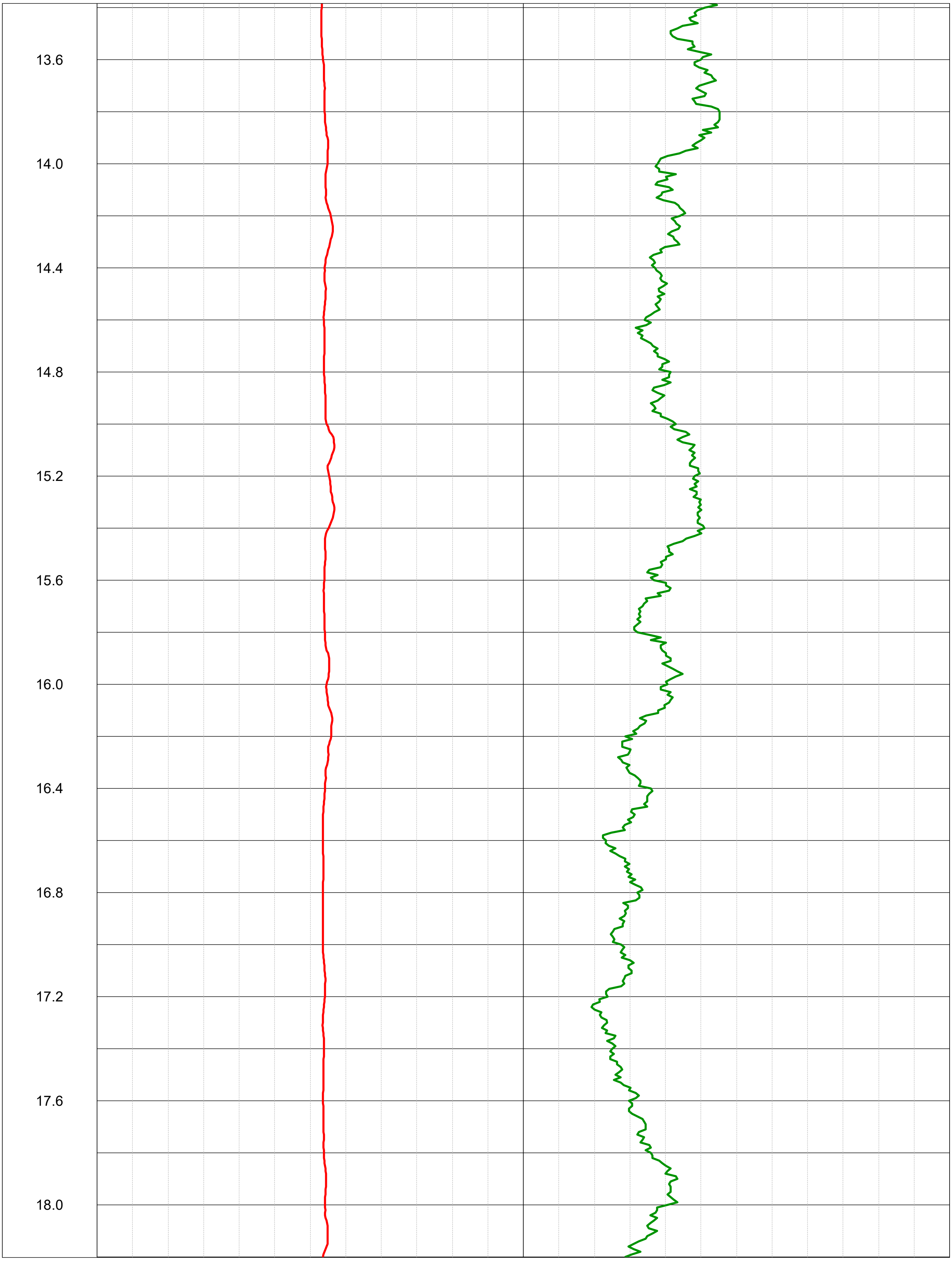
COMPANY	Structural Soils		
WELL ID	R615		
FIELD	A303 Stonehenge		
COUNTRY	England	STATE	
LOCATION Easting: 412542.01 Northing: 141990.98			OTHER SERVICES
SEC	TWP	RGE	
PERMANENT DATUM	GL	ELEVATION 91.469	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.

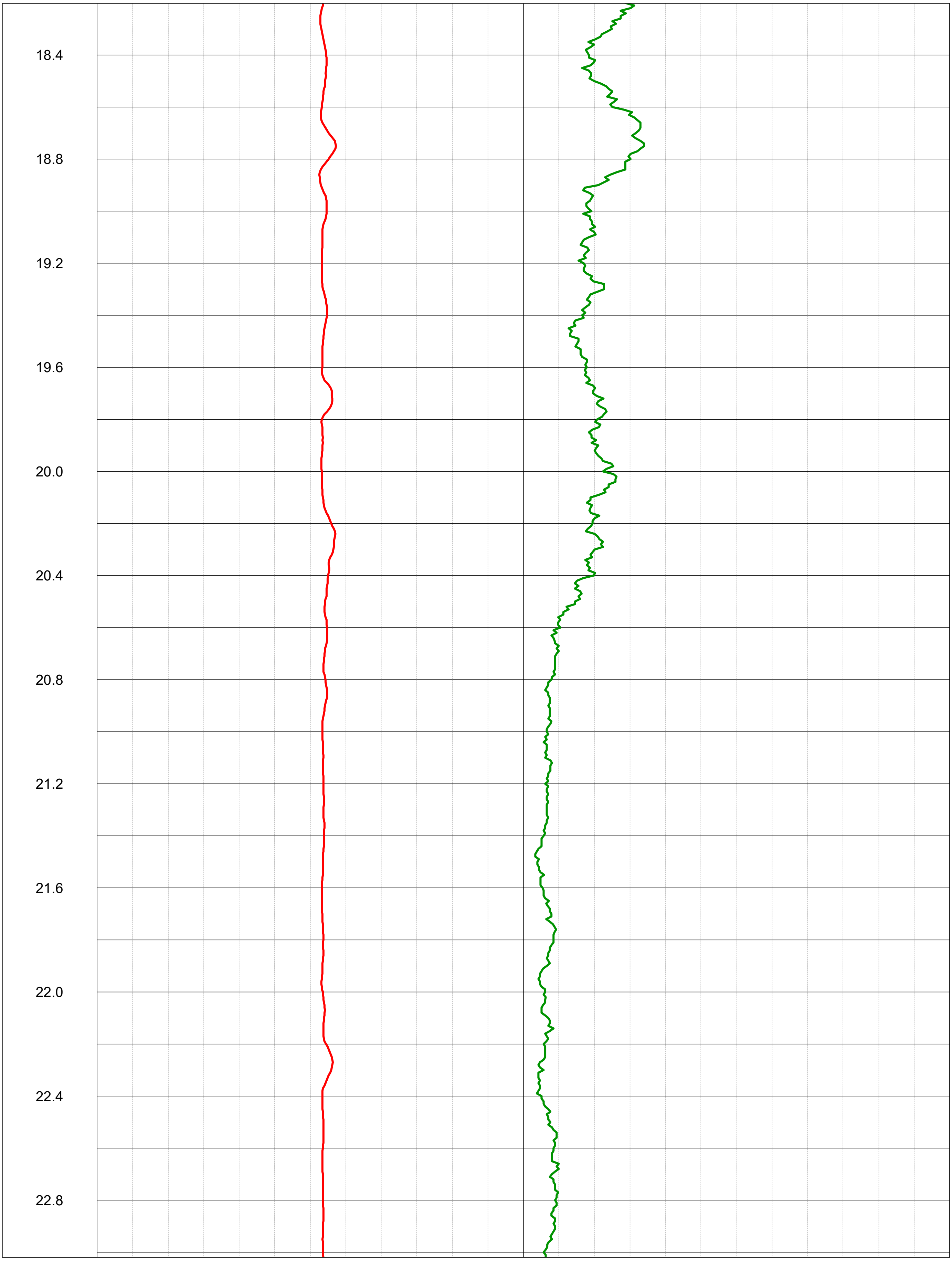
DATE	07/06/18	TYPE FLUID IN HOLE	Water
RUN No		SALINITY	
TYPE LOG	Caliper Gamma	DENSITY	
DEPTH-DRILLER	56	LEVEL	21
DEPTH-LOGGER	55.6	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	55.6		
TOP LOGGED INTERVAL	2.4		
OPERATING RIG TIME			
RECORDED BY	Kyle Owen		
WITNESSED BY	James Boyett		

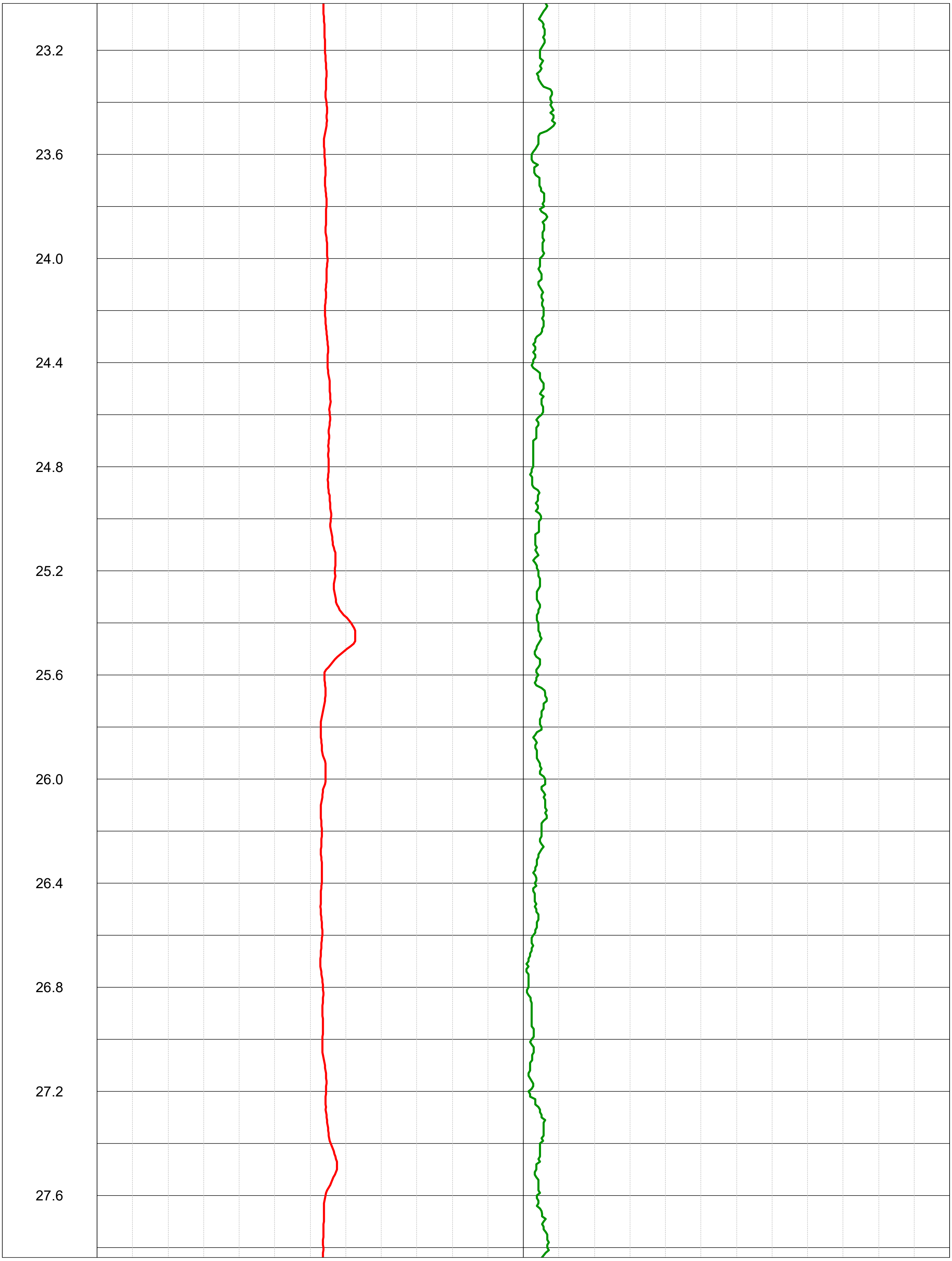
RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

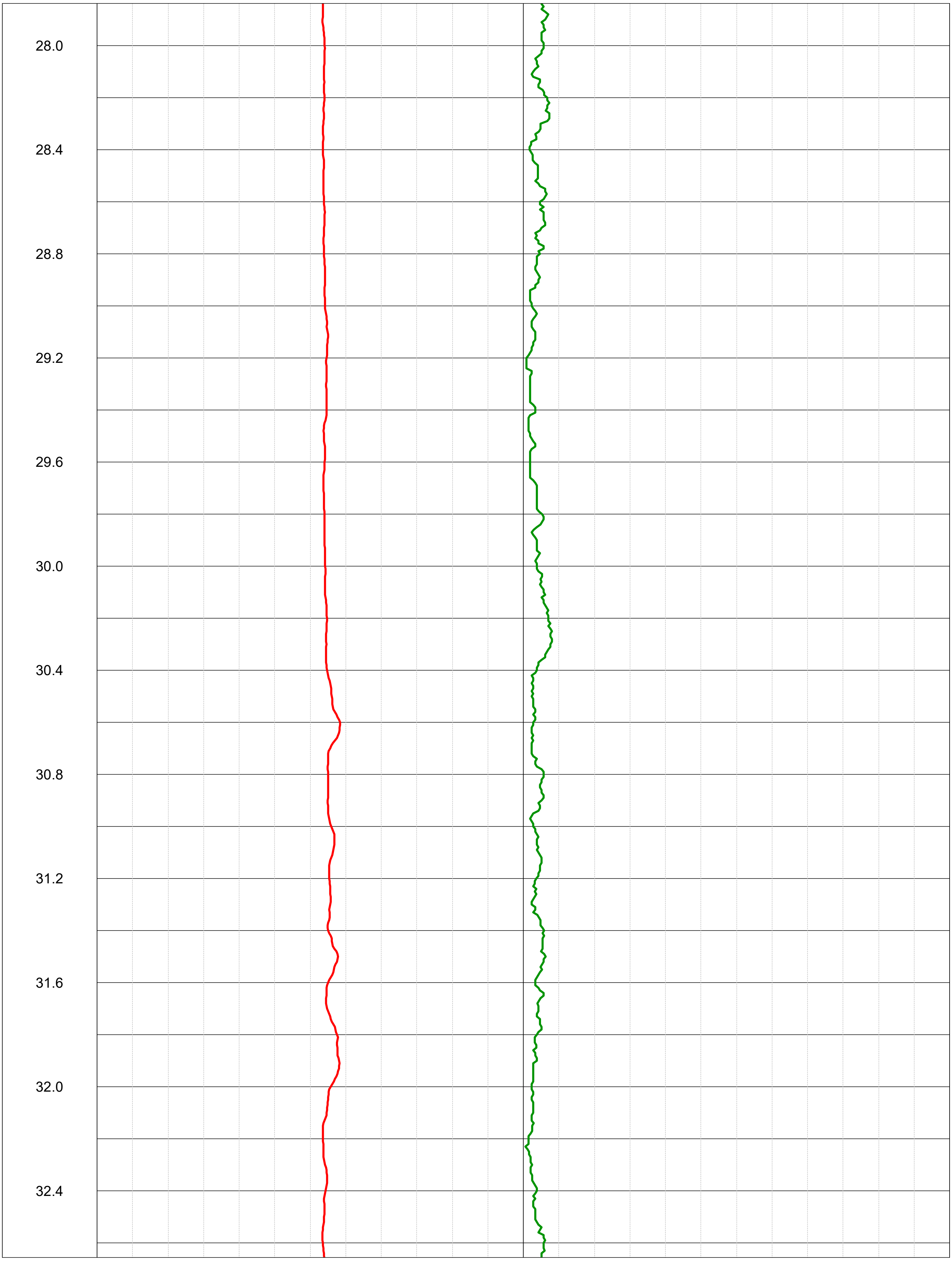

4.0
4.4
4.8
5.2
5.6
6.0
6.4
6.8
7.2
7.6
8.0
8.4


8.8
9.2
9.6
10.0
10.4
10.8
11.2
11.6
12.0
12.4
12.8
13.2

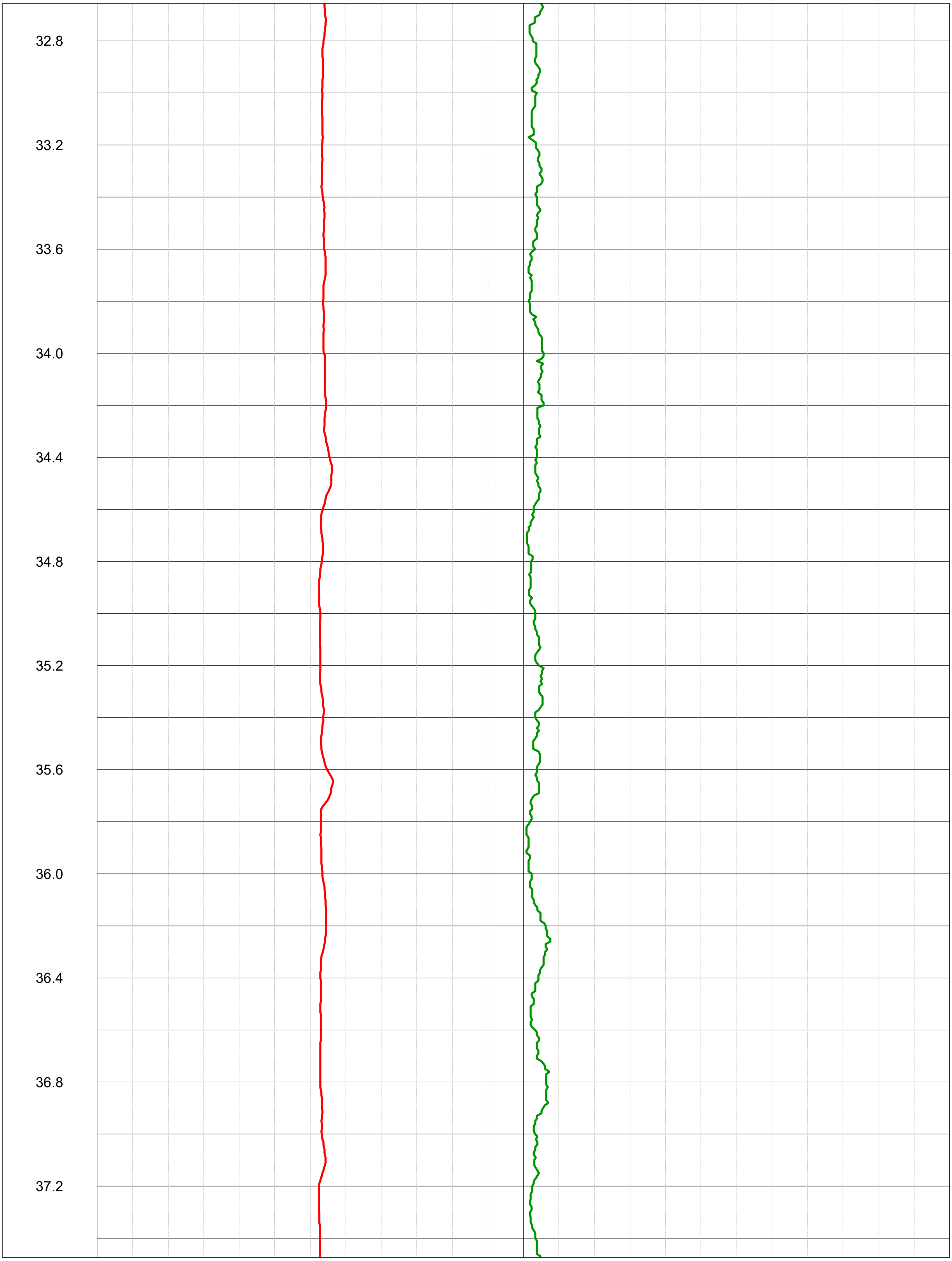

13.6
14.0
14.4
14.8
15.2
15.6
16.0
16.4
16.8
17.2
17.6
18.0


18.4
18.8
19.2
19.6
20.0
20.4
20.8
21.2
21.6
22.0
22.4
22.8

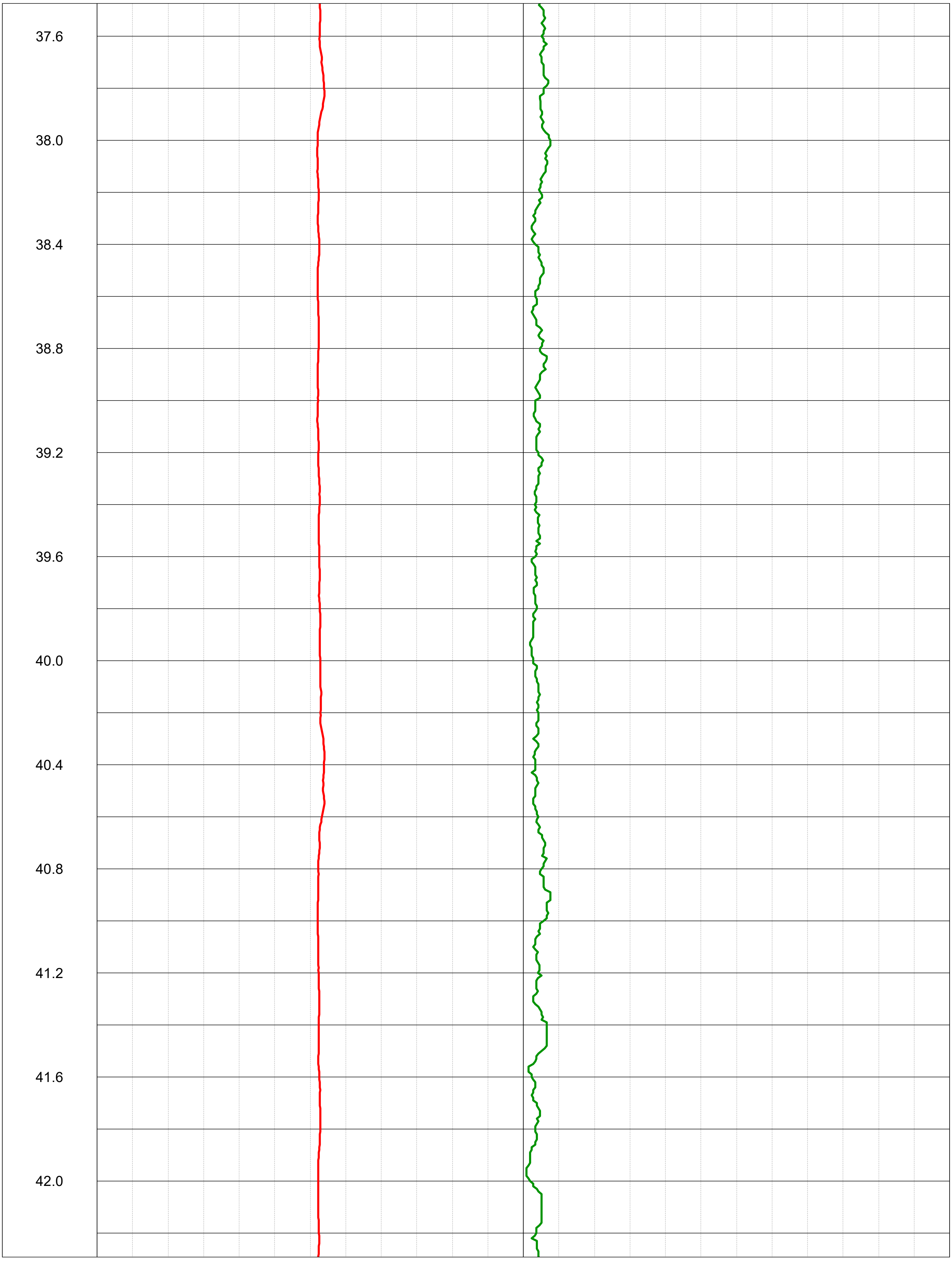

23.2
23.6
24.0
24.4
24.8
25.2
25.6
26.0
26.4
26.8
27.2
27.6

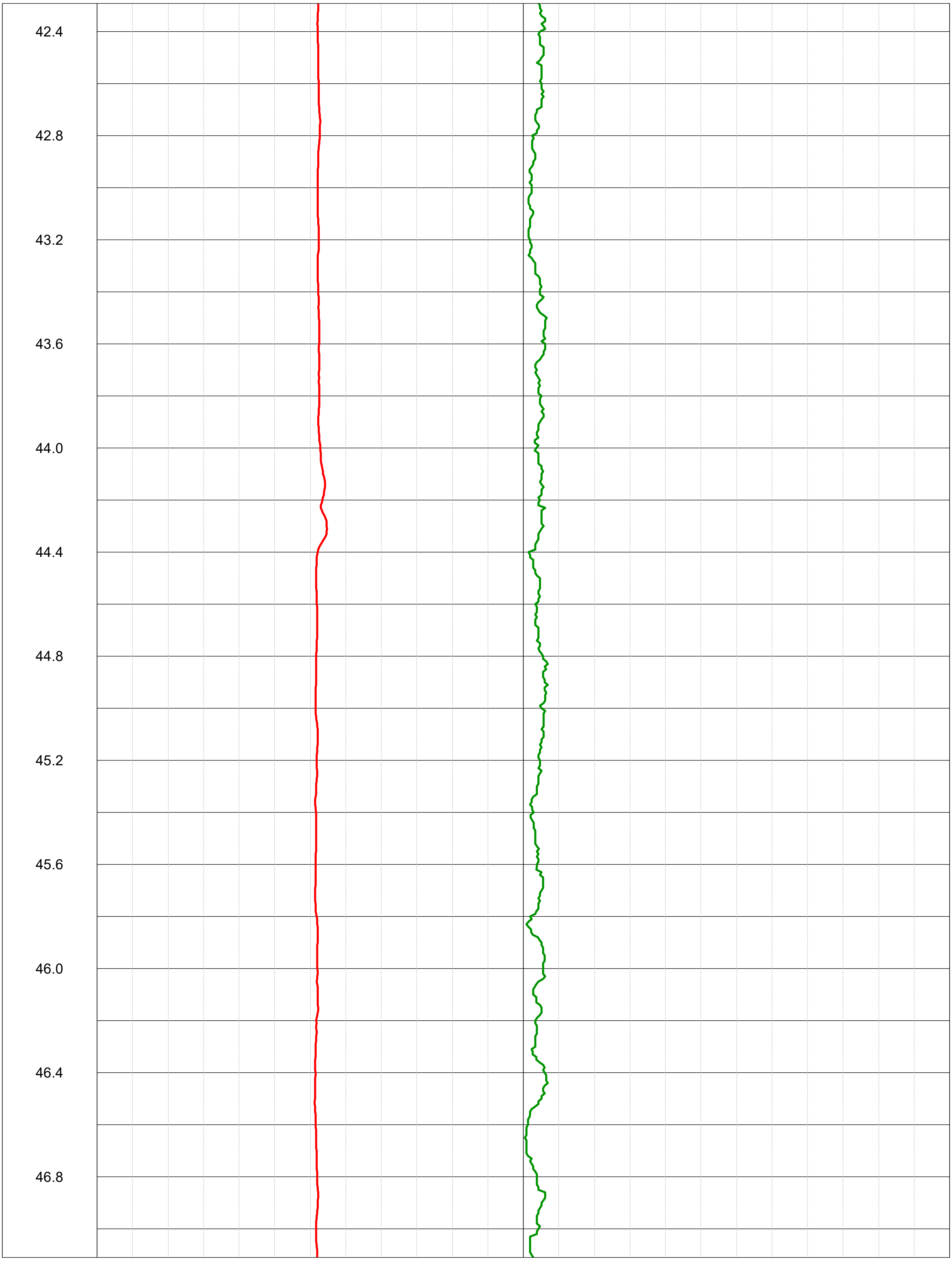


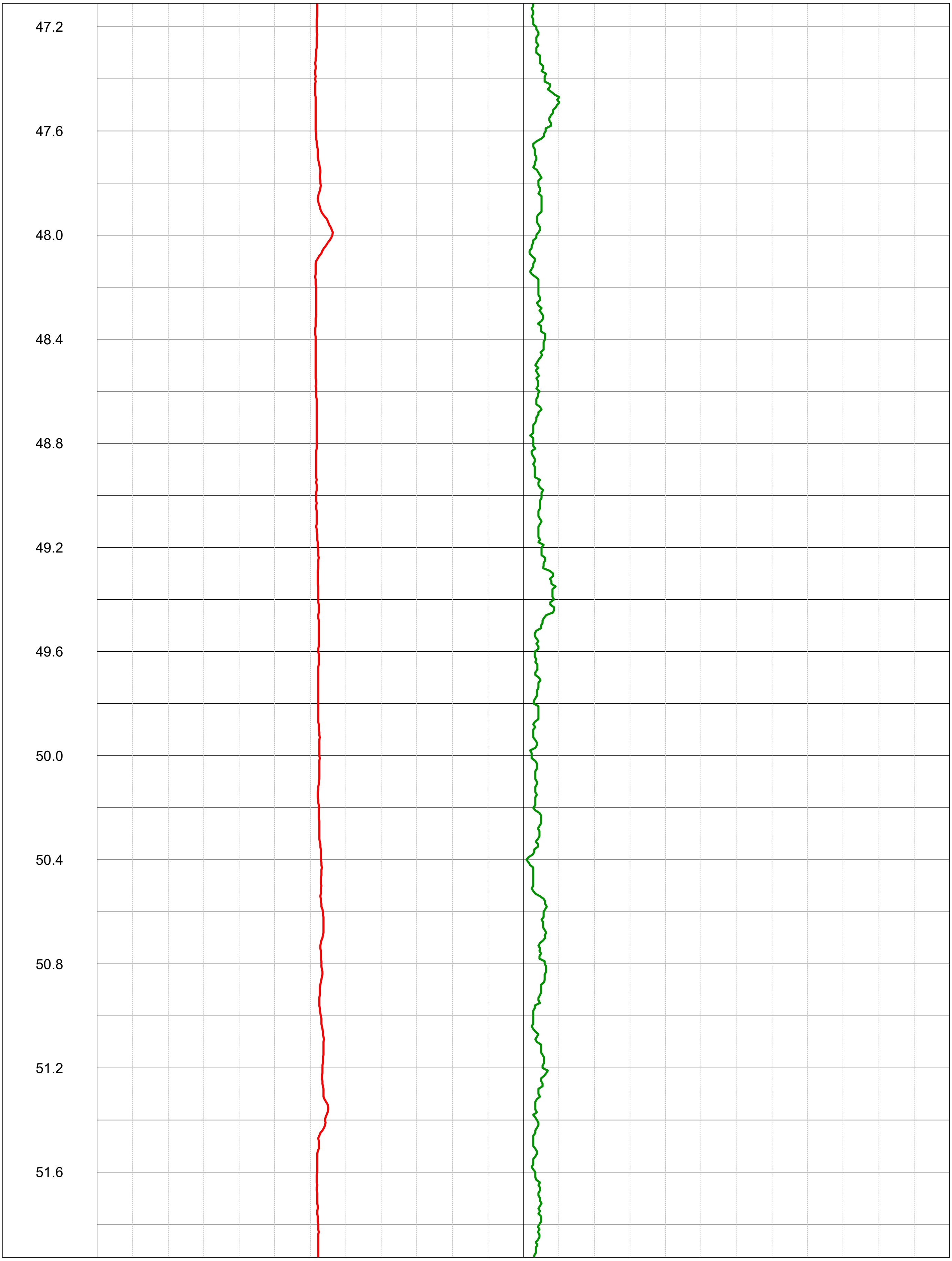
28.0
28.4
28.8
29.2
29.6
30.0
30.4
30.8
31.2
31.6
32.0
32.4

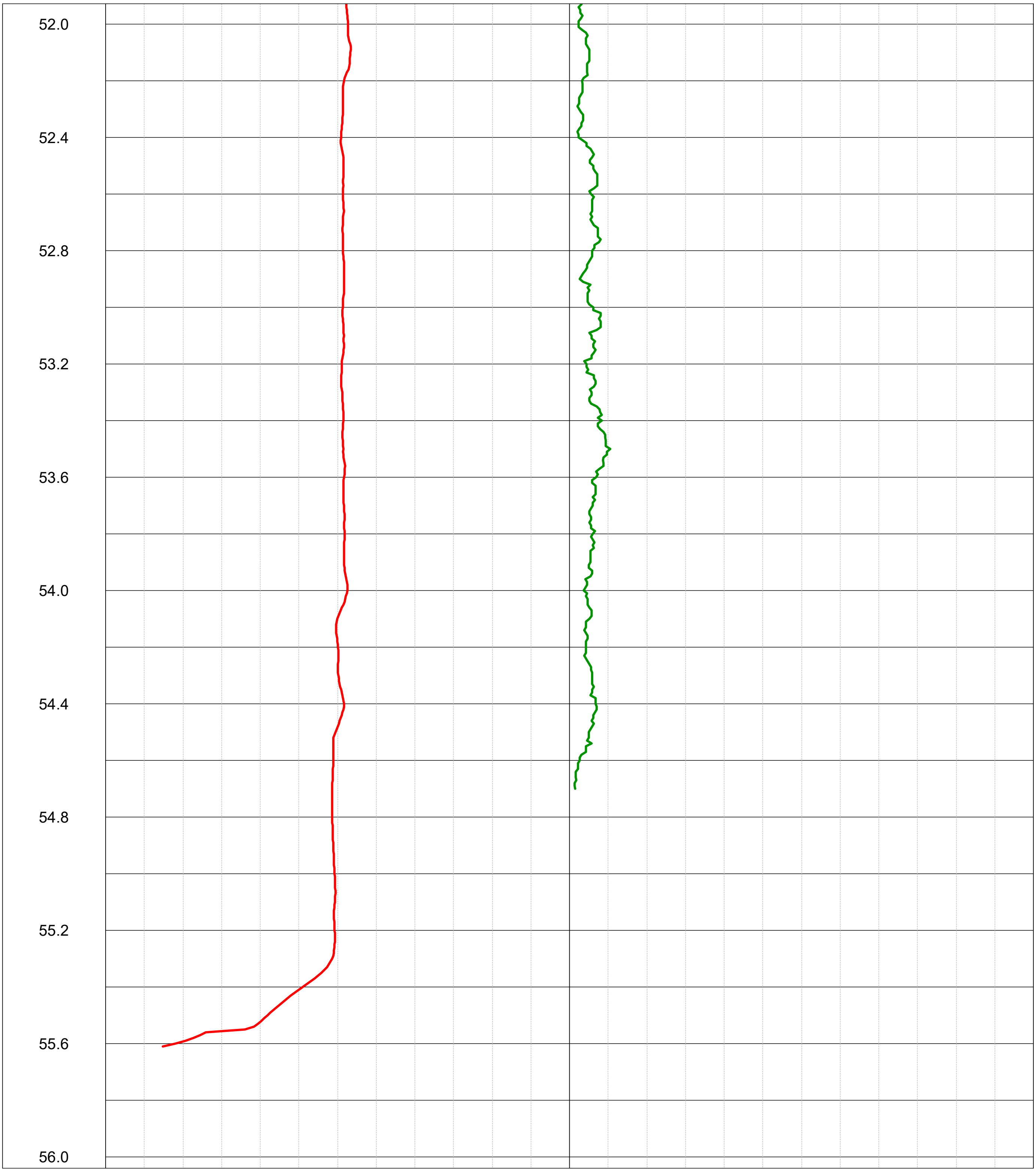


32.8
33.2
33.6
34.0
34.4
34.8
35.2
35.6
36.0
36.4
36.8
37.2

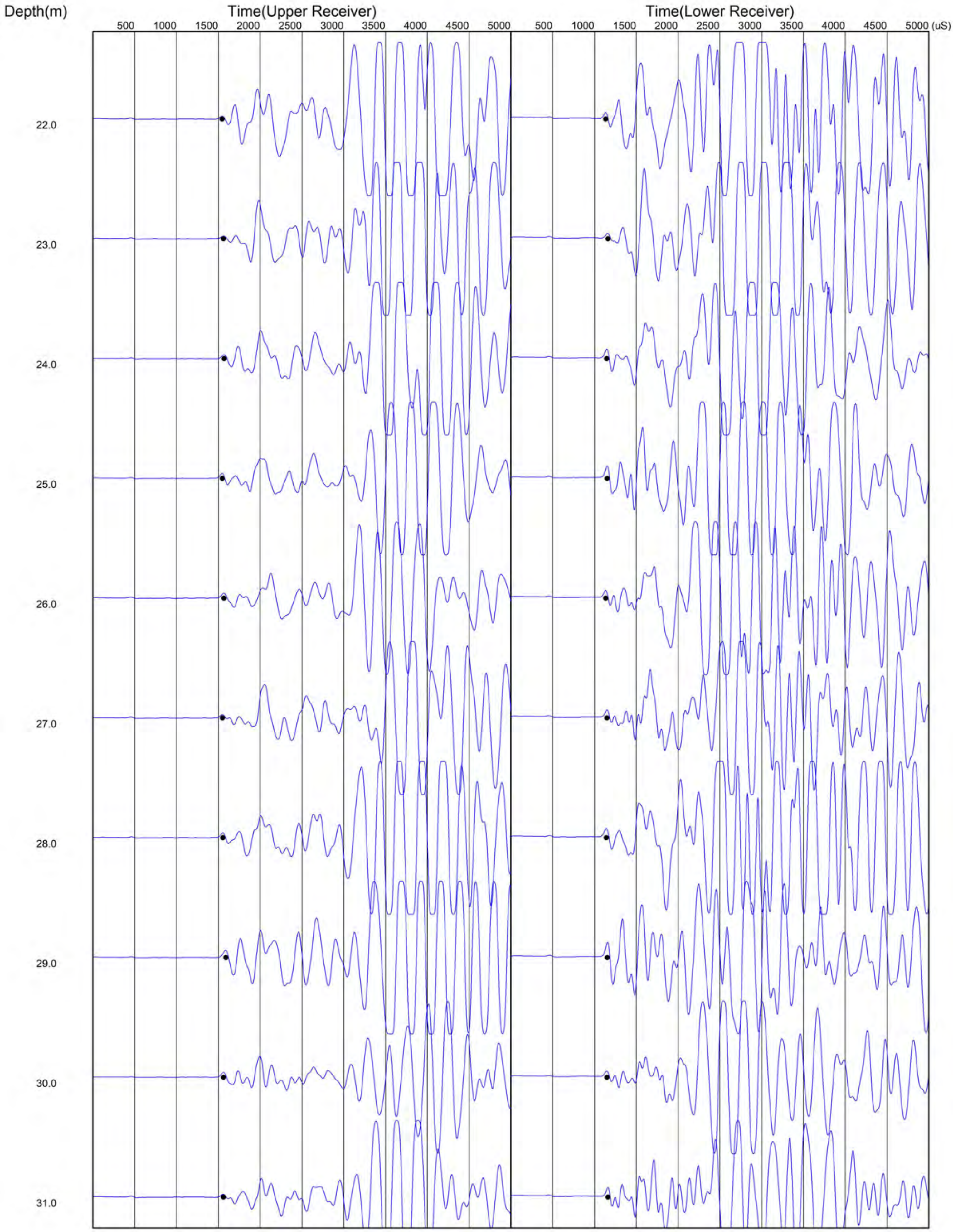

37.6
38.0
38.4
38.8
39.2
39.6
40.0
40.4
40.8
41.2
41.6
42.0


42.4
42.8
43.2
43.6
44.0
44.4
44.8
45.2
45.6
46.0
46.4
46.8


47.2
47.6
48.0
48.4
48.8
49.2
49.6
50.0
50.4
50.8
51.2
51.6

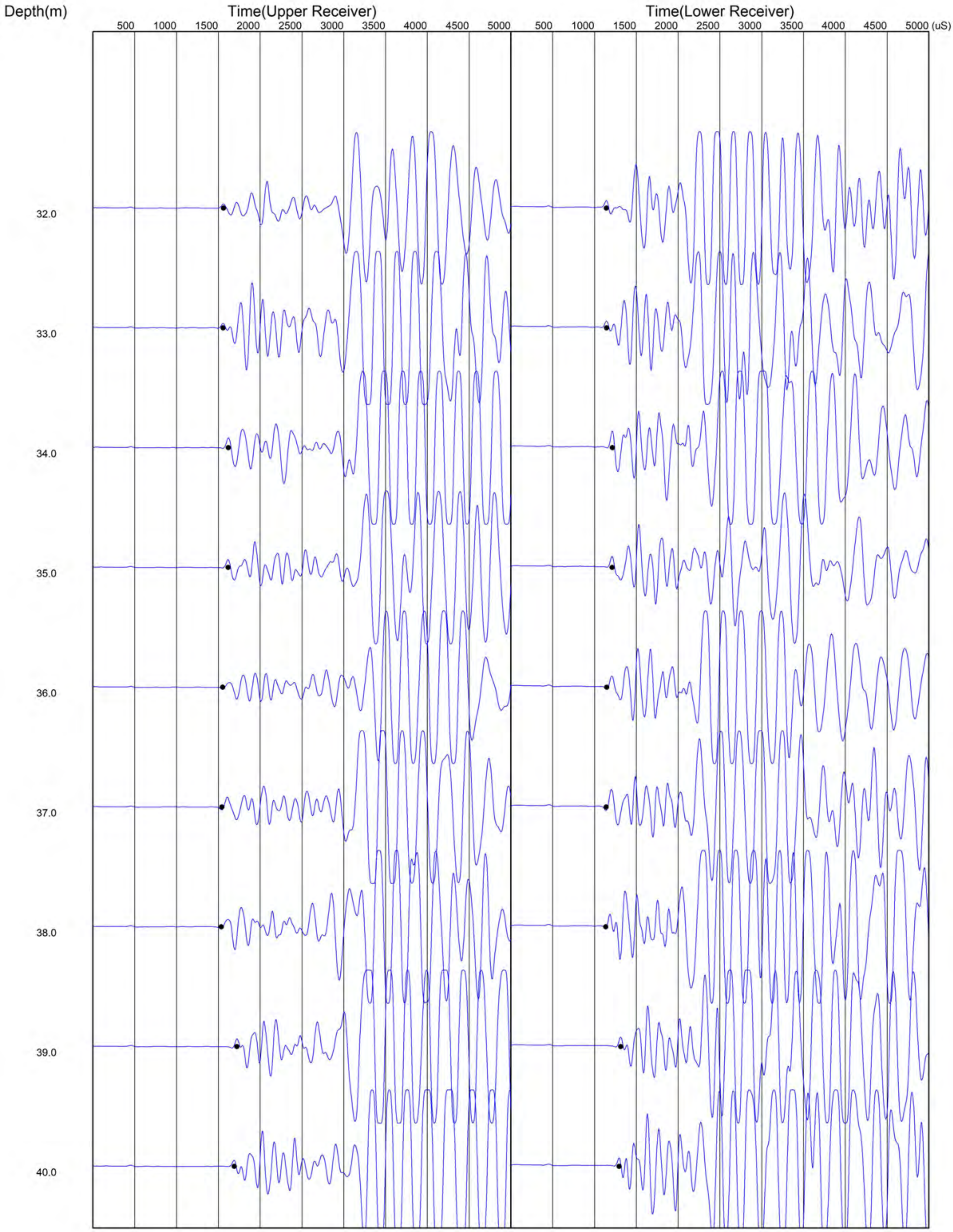

52.0
52.4
52.8
53.2
53.6
54.0
54.4
54.8
55.2
55.6
56.0

P Wave

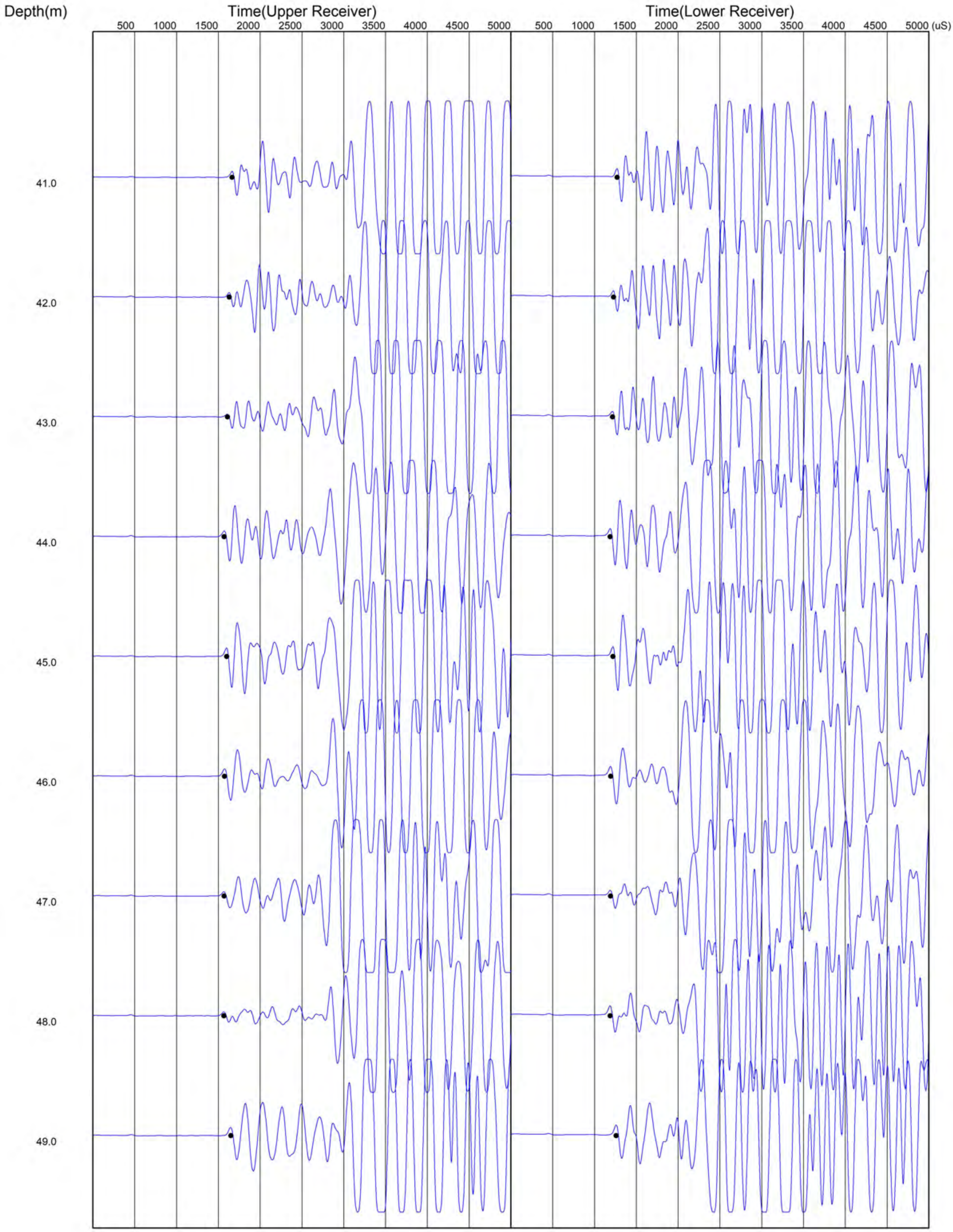


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
22.0
23.0
24.0
25.0
26.0
27.0
28.0
29.0
30.0
31.0

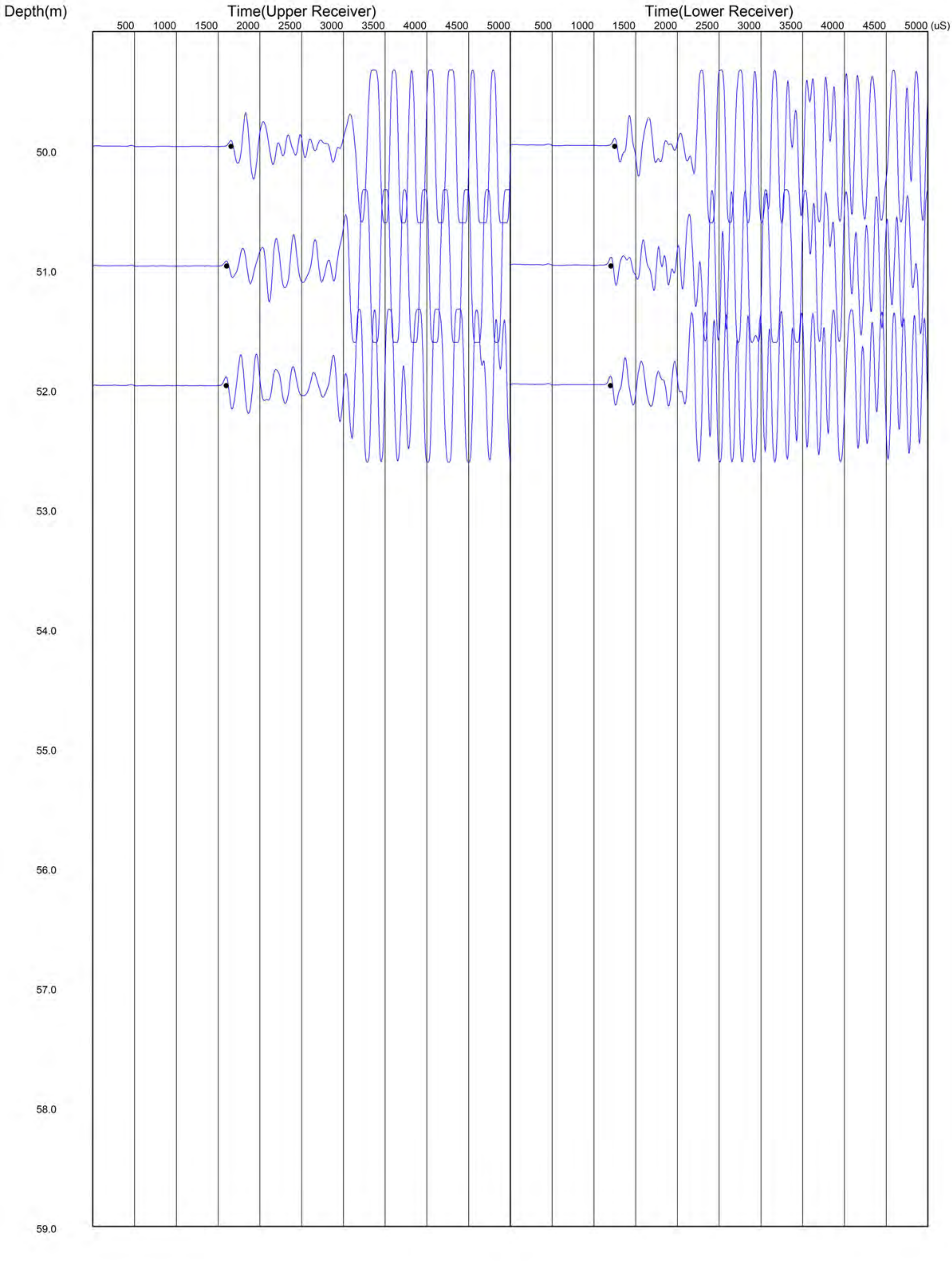
P Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
(uS)
32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0

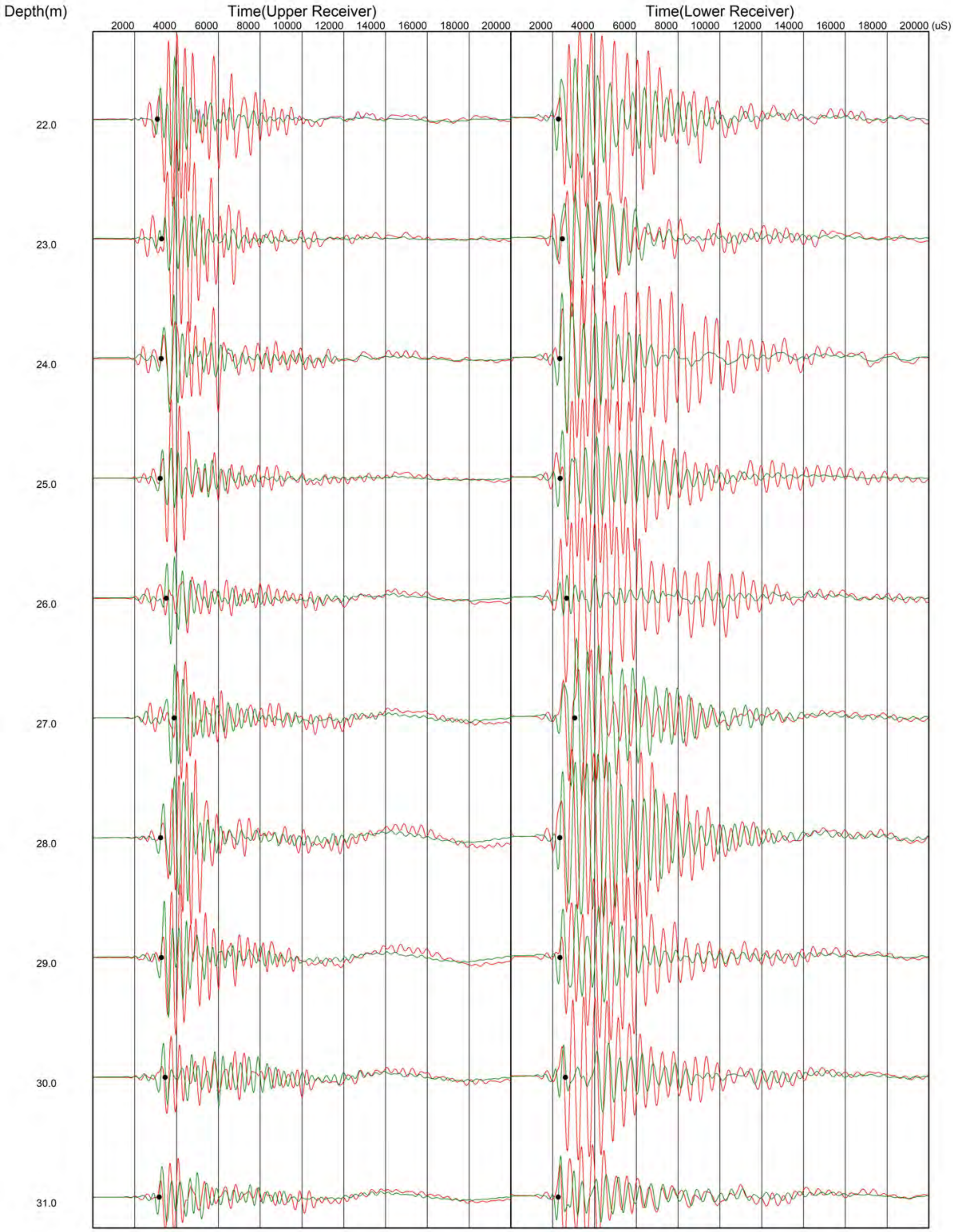
P Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
41.0
42.0
43.0
44.0
45.0
46.0
47.0
48.0
49.0

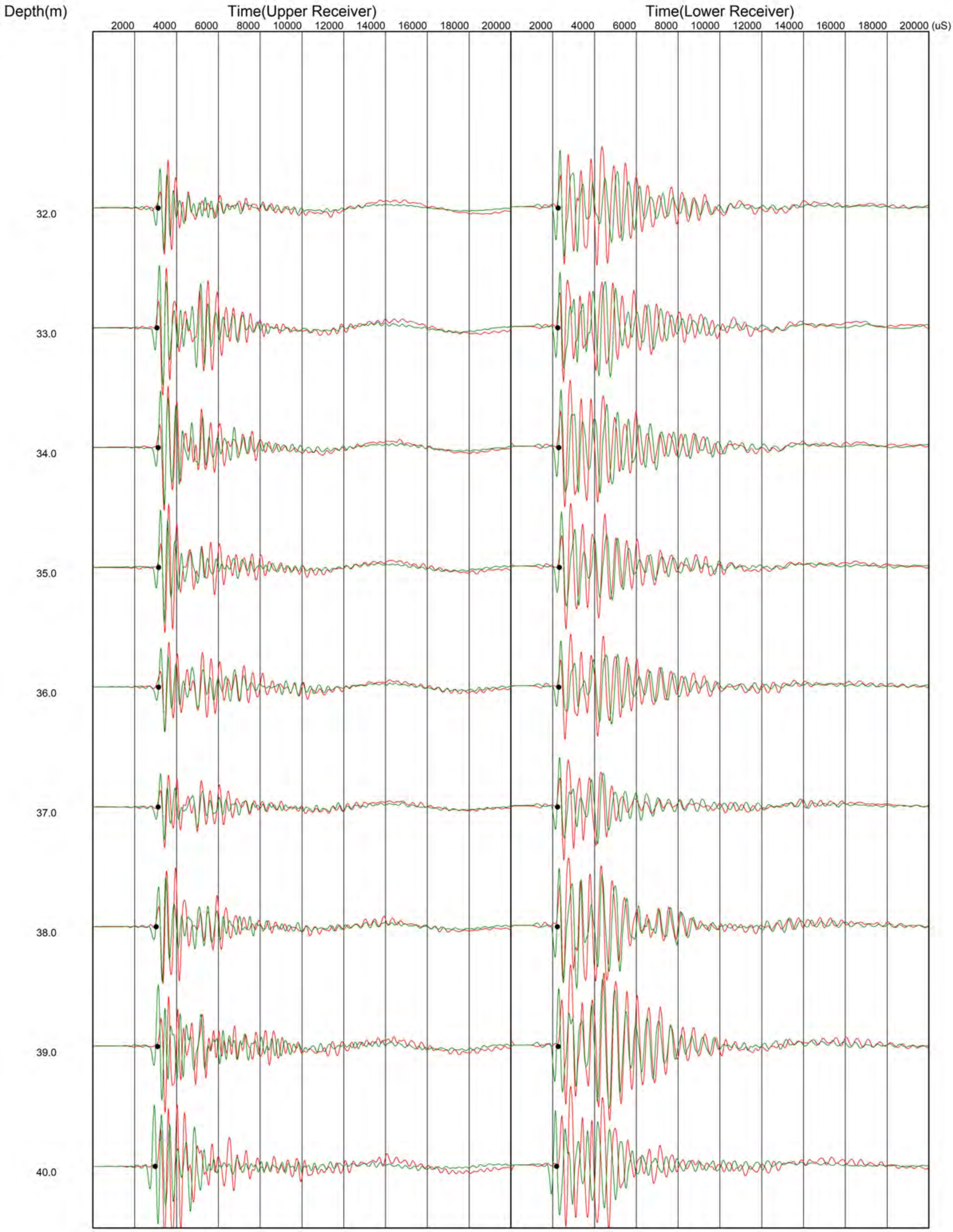
P Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
50.0
51.0
52.0
53.0
54.0
55.0
56.0
57.0
58.0
59.0

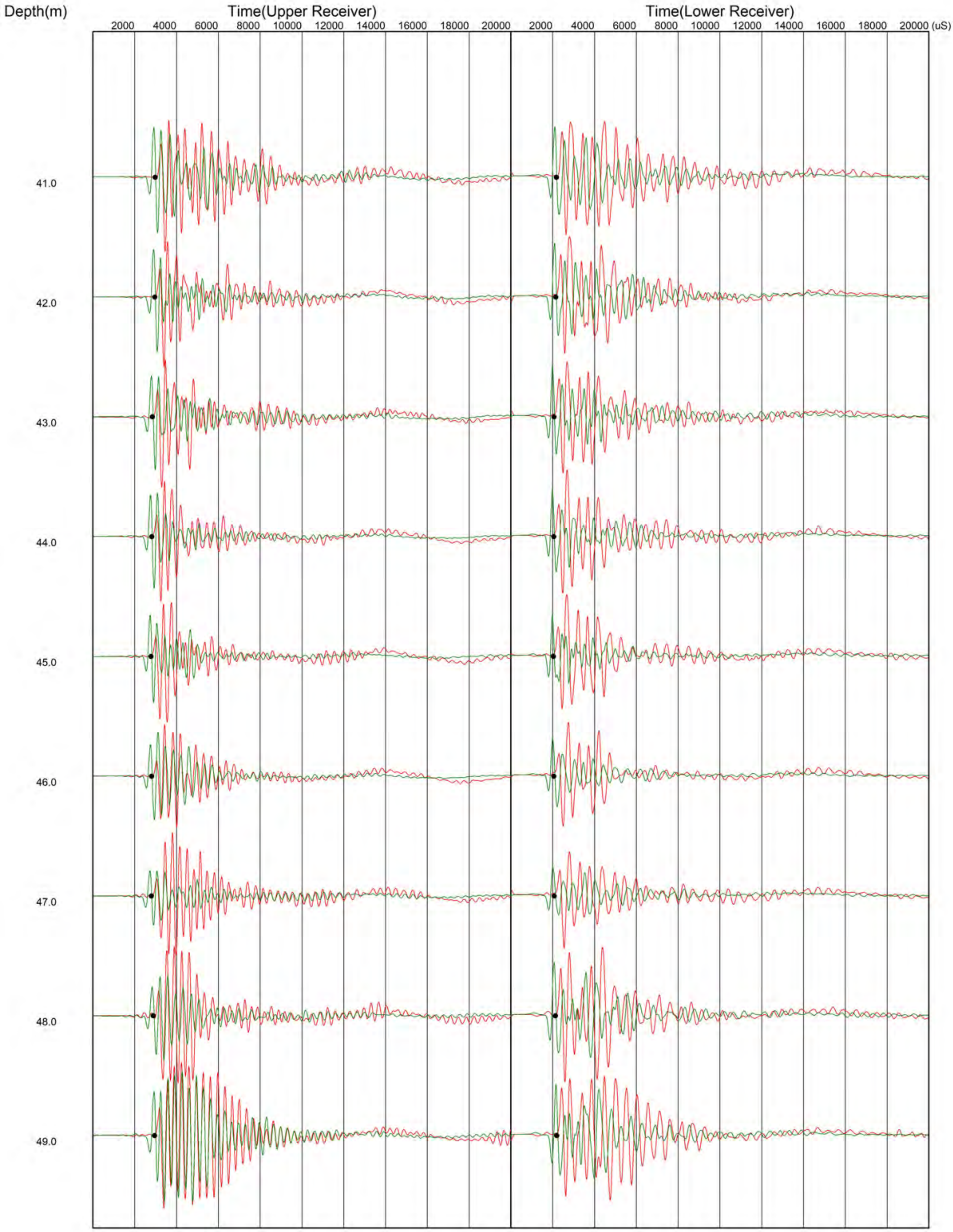
S Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
22.0
23.0
24.0
25.0
26.0
27.0
28.0
29.0
30.0
31.0

S Wave

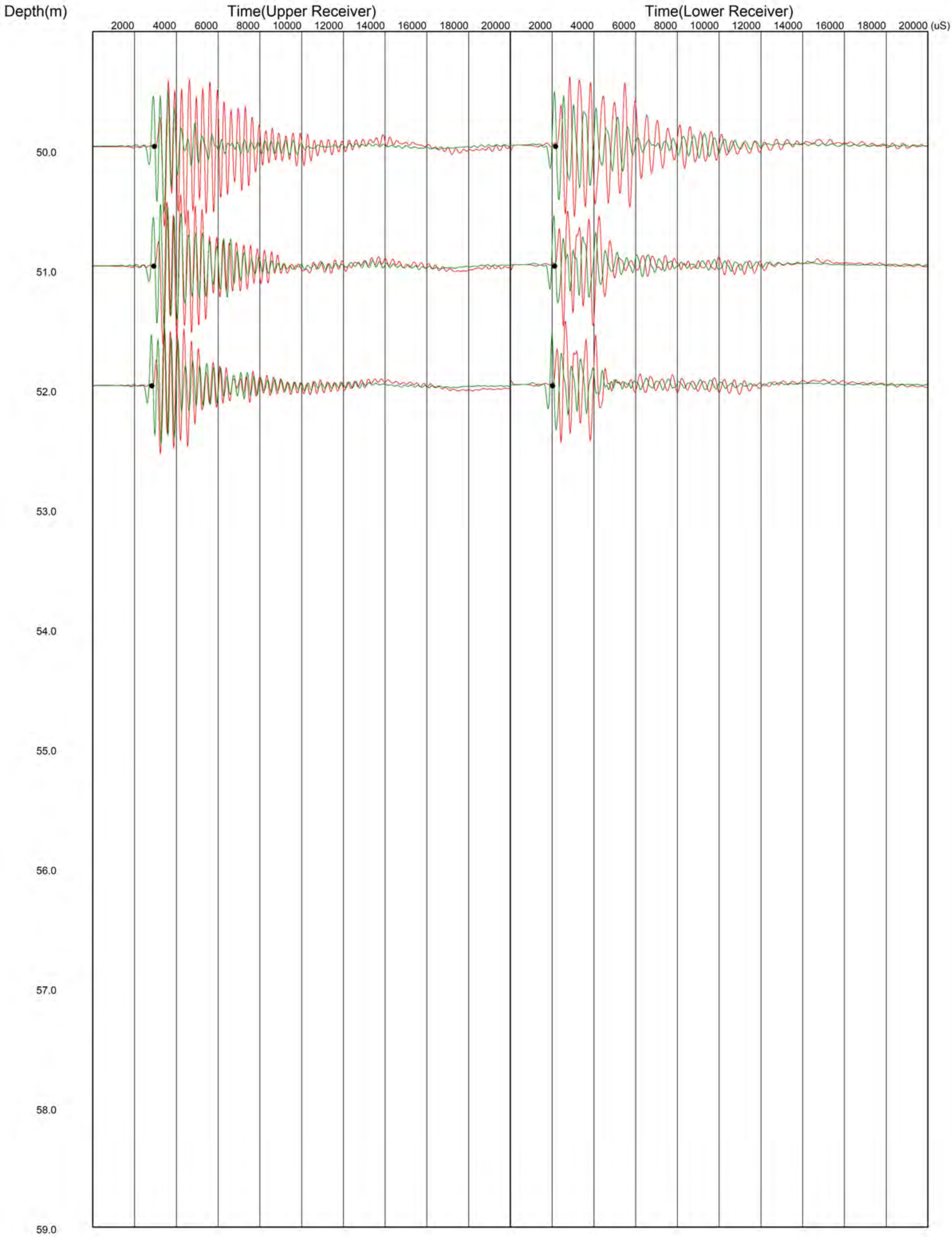

Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0

S Wave

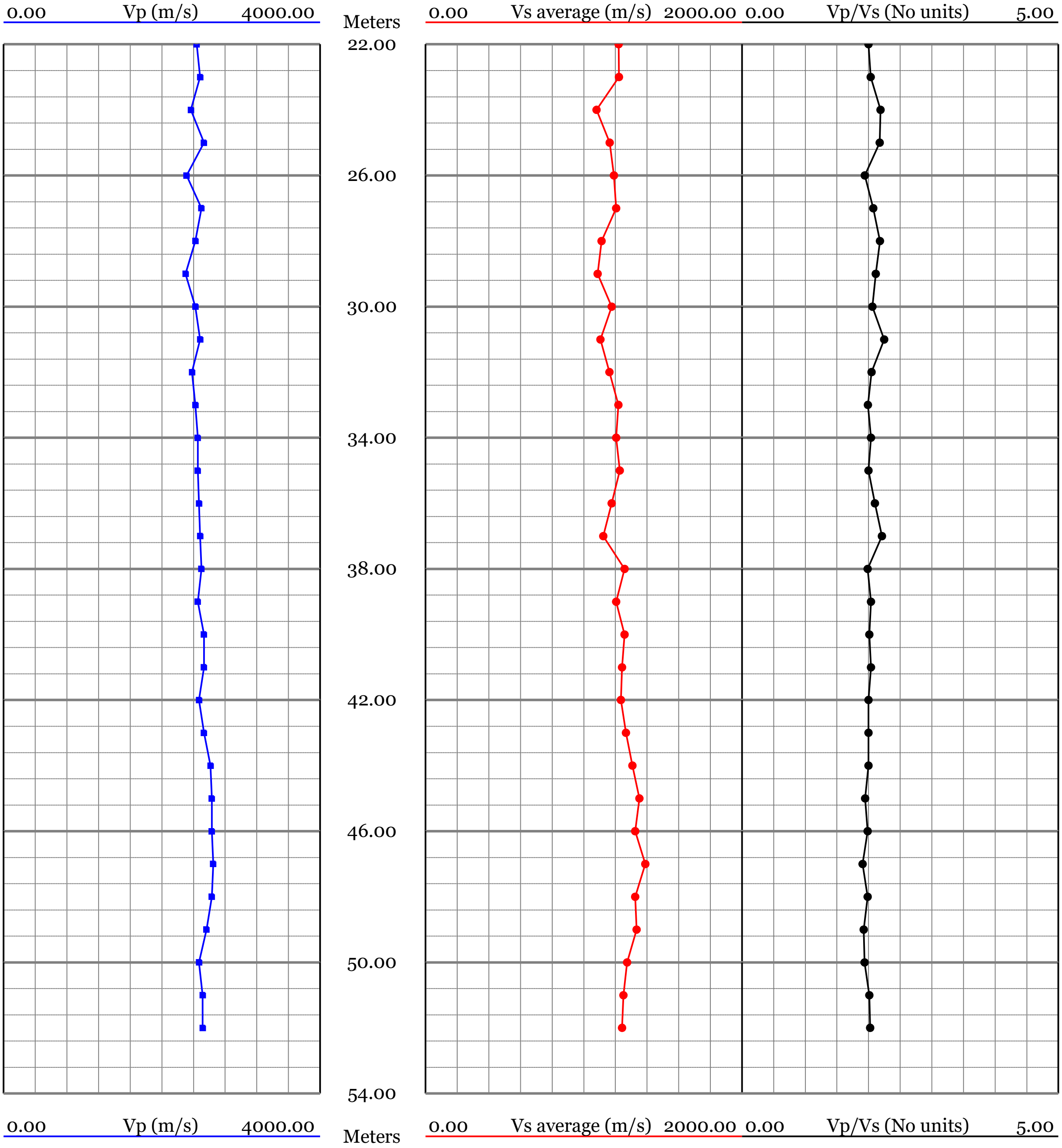


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
(uS)
41.0
42.0
43.0
44.0
45.0
46.0
47.0
48.0
49.0

S Wave



Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
(uS)
50.0
51.0
52.0
53.0
54.0
55.0
56.0
57.0
58.0
59.0



0.00
Vp (m/s)
4000.00
Meters
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00
22.00
26.00
30.00
34.00
38.00
42.00
46.00
50.00
54.00

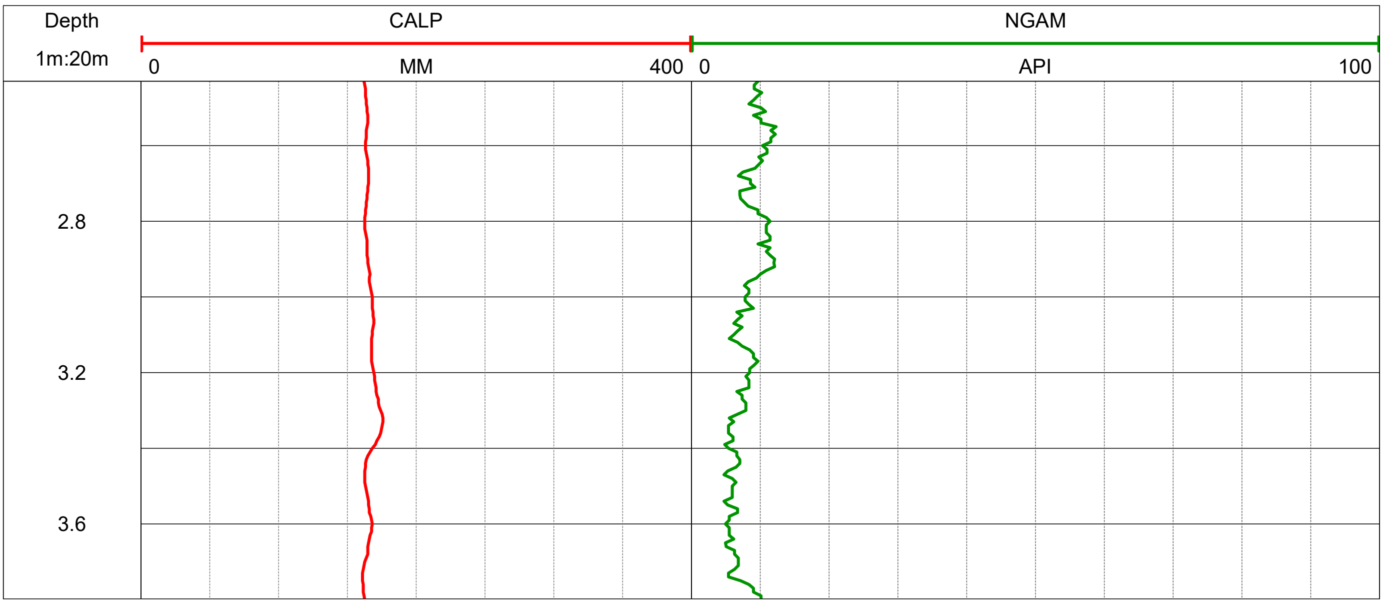
ROBERTSON GEO SERVICES
Unlocking Your GeoData

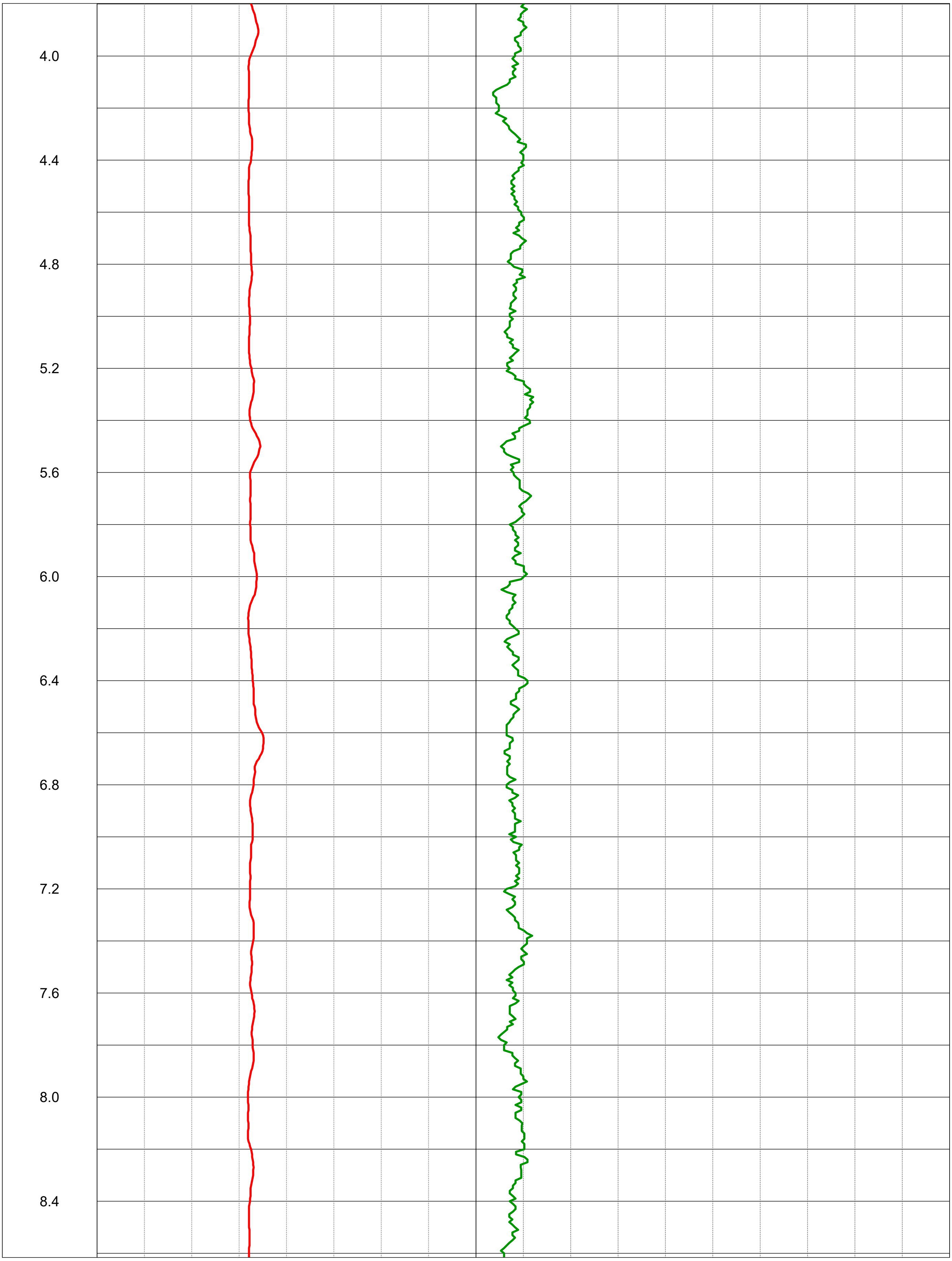
CO	Structural Soils
WELL	R616
FLD	A303 Stonehenge
CTY	England
STE	
FILING No	

COMPANY	Structural Soils		
WELL ID	R616		
FIELD	A303 Stonhenge		
COUNTRY	England	STATE	
LOCATION			OTHER SERVICES
Easting:	412596.89		
Northing:	141916.03		
SEC	TWP	RGE	
PERMANENT DATUM	GL	ELEVATION 91.523	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.

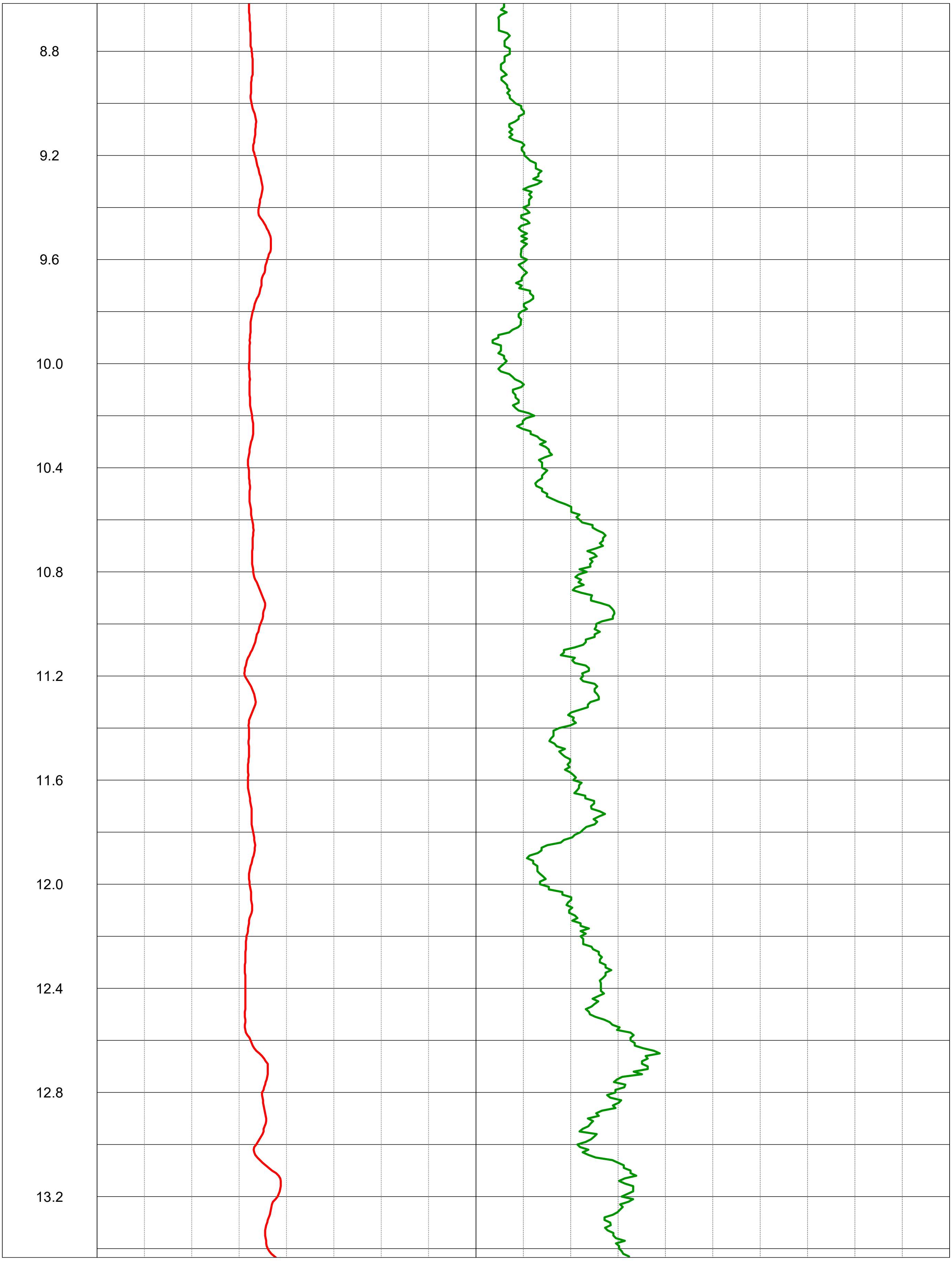
DATE	19/06/18	TYPE FLUID IN HOLE	Water
RUN No	1	SALINITY	
TYPE LOG	Caliper Gamma	DENSITY	
DEPTH-DRILLER	56	LEVEL	23
DEPTH-LOGGER	55.29	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	55.29		
TOP LOGGED INTERVAL	2.44		
OPERATING RIG TIME			
RECORDED BY	Kyle Owen		
WITNESSED BY	James Boyett		

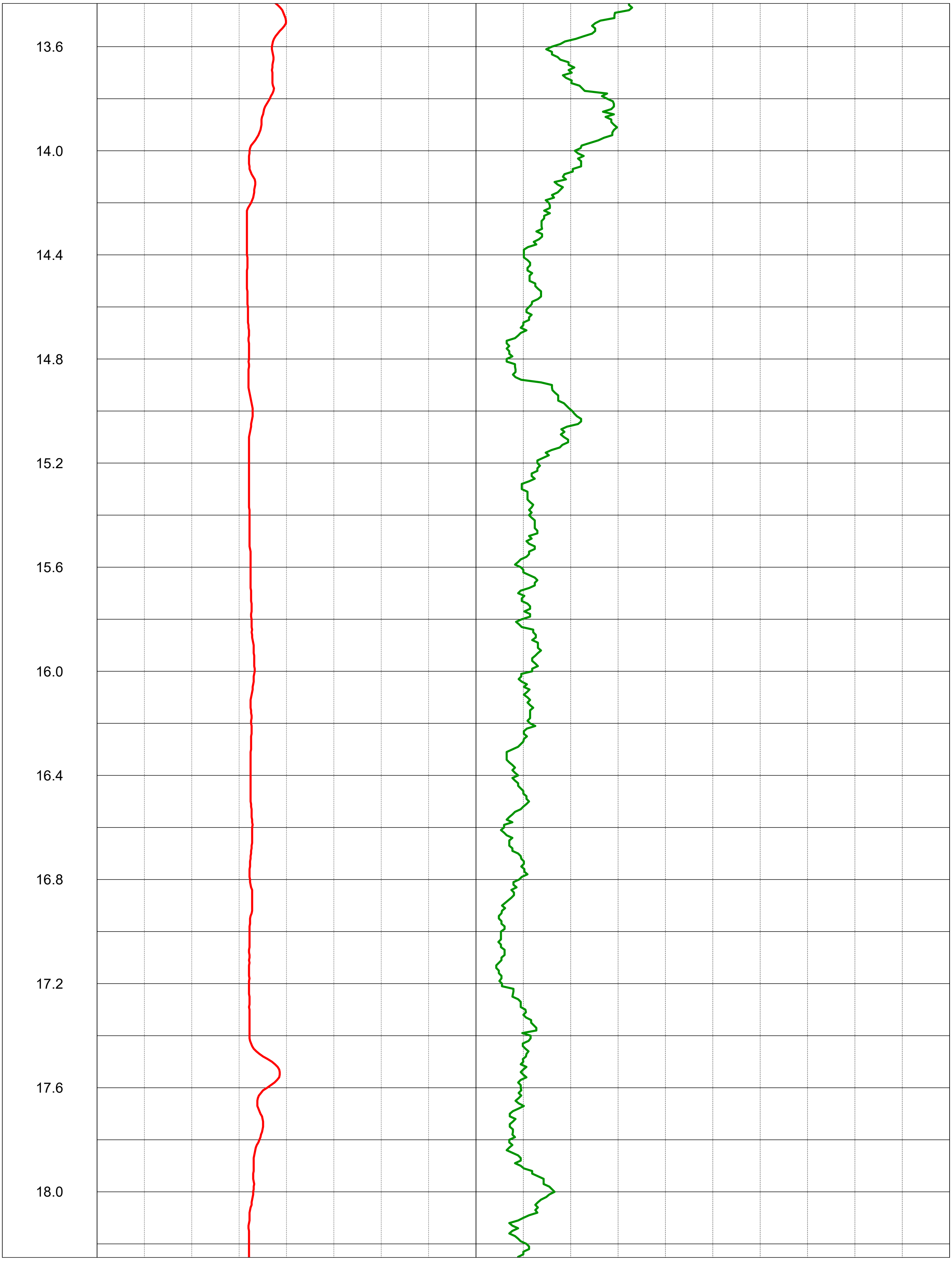
RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

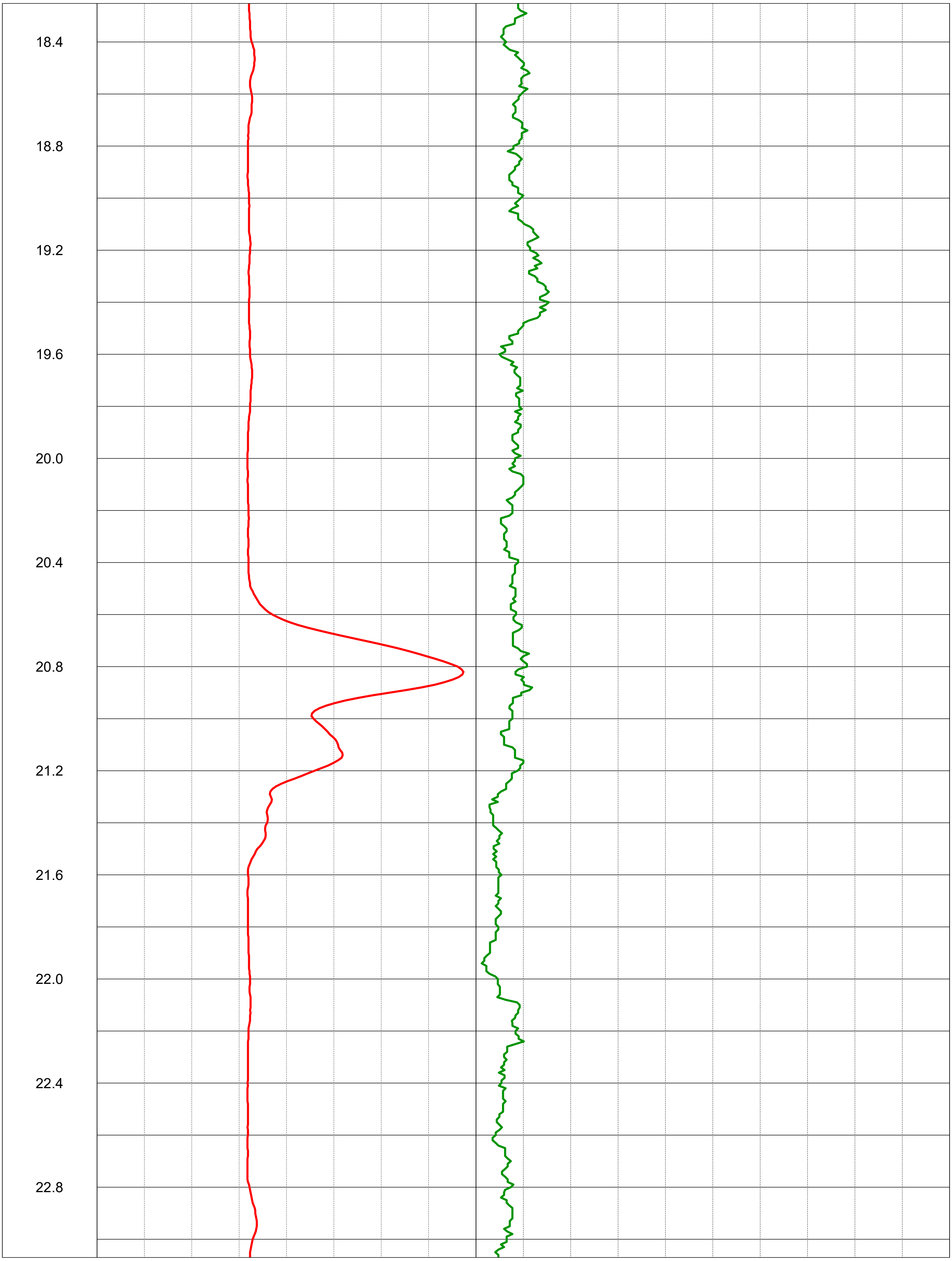


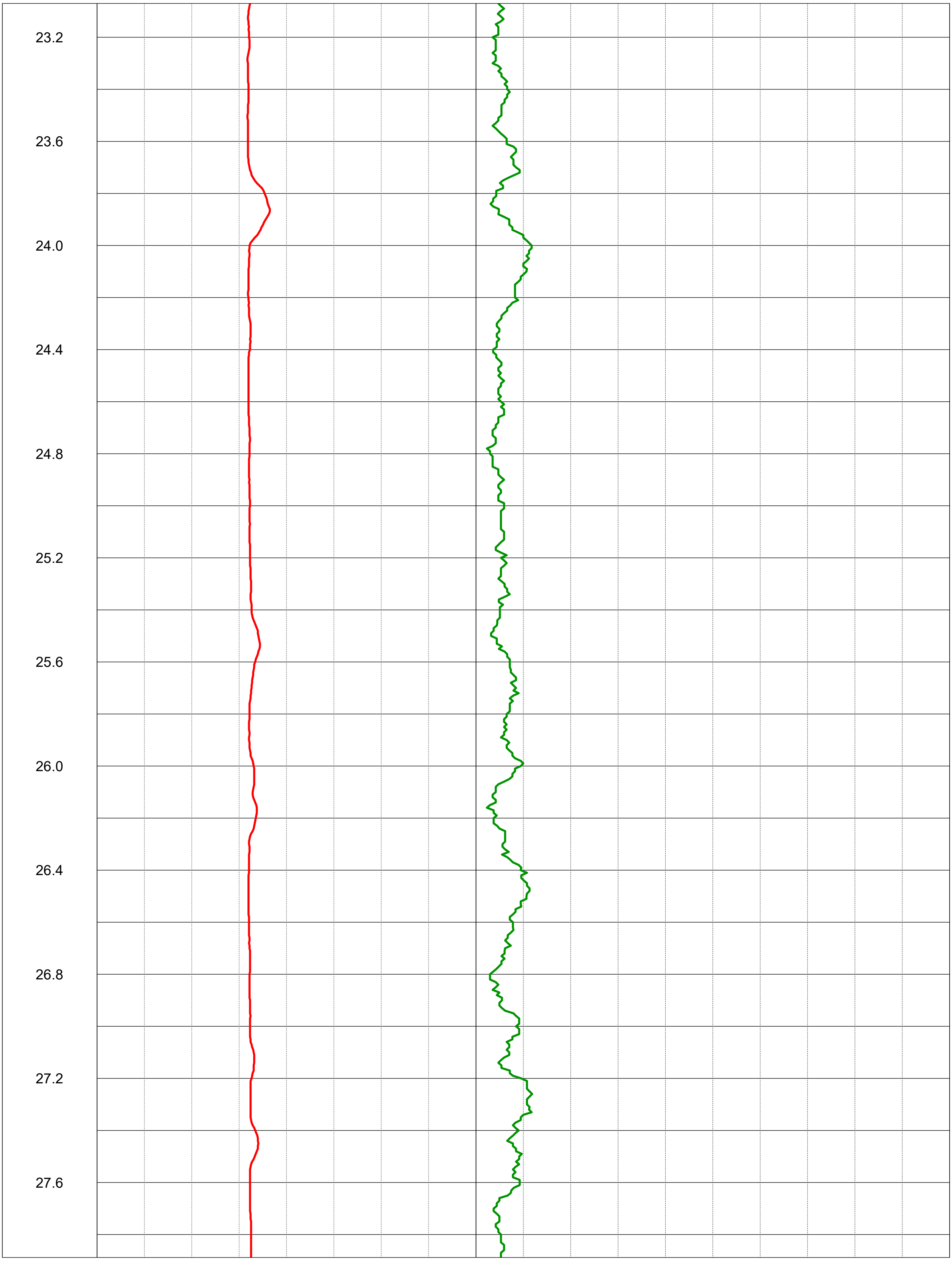


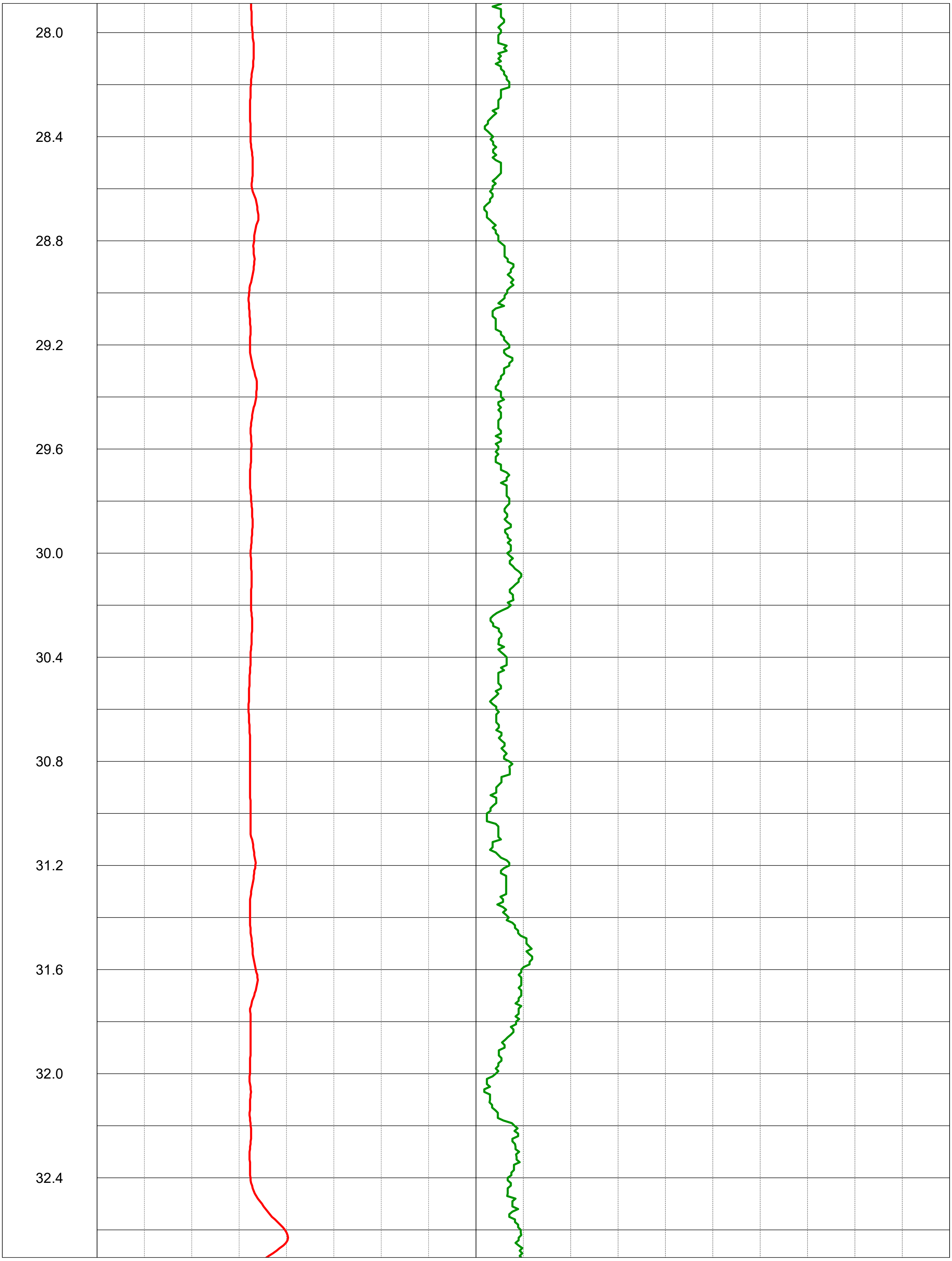
4.0
4.4
4.8
5.2
5.6
6.0
6.4
6.8
7.2
7.6
8.0
8.4


8.8
9.2
9.6
10.0
10.4
10.8
11.2
11.6
12.0
12.4
12.8
13.2

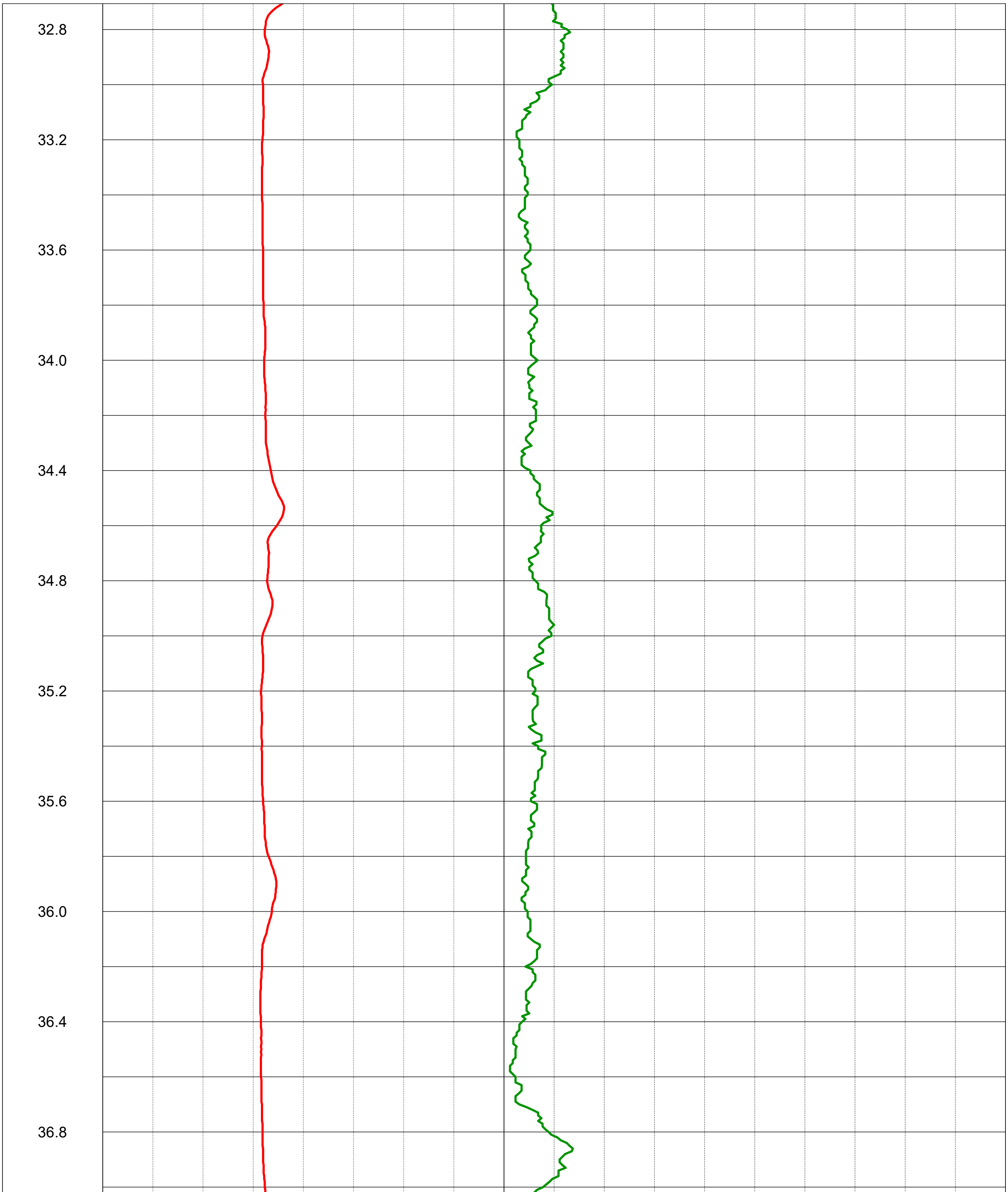

13.6
14.0
14.4
14.8
15.2
15.6
16.0
16.4
16.8
17.2
17.6
18.0

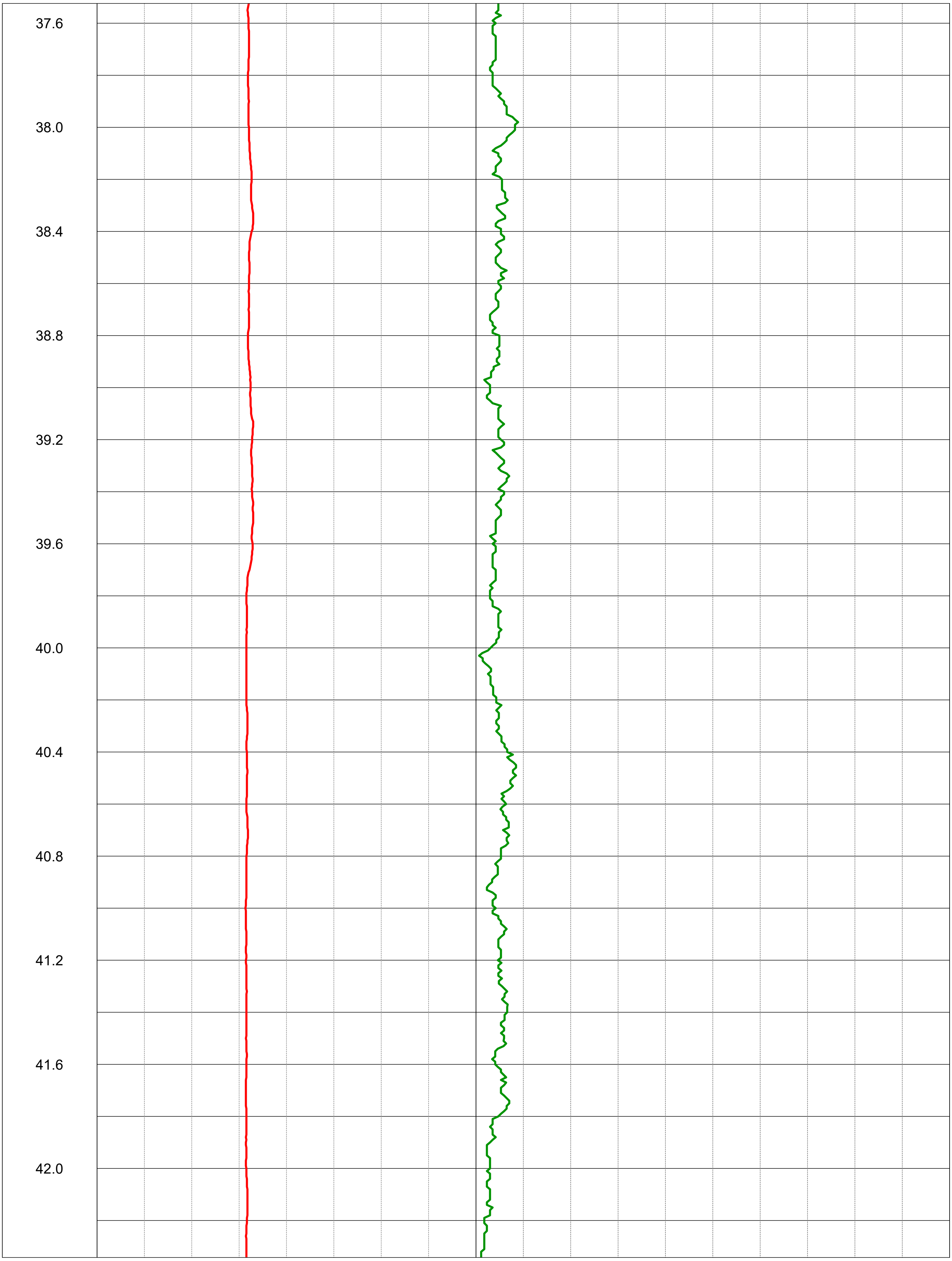

18.4
18.8
19.2
19.6
20.0
20.4
20.8
21.2
21.6
22.0
22.4
22.8

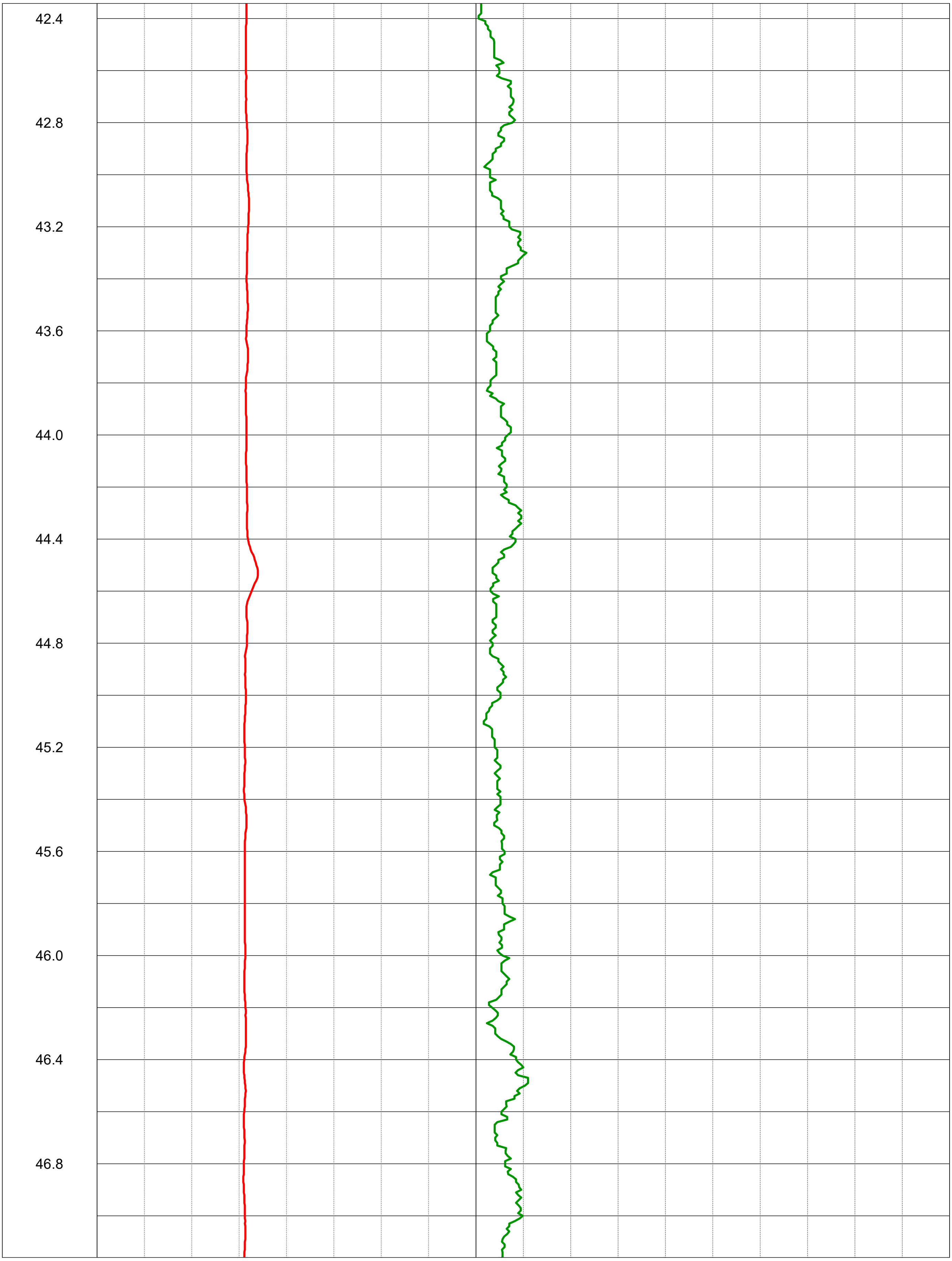

23.2
23.6
24.0
24.4
24.8
25.2
25.6
26.0
26.4
26.8
27.2
27.6

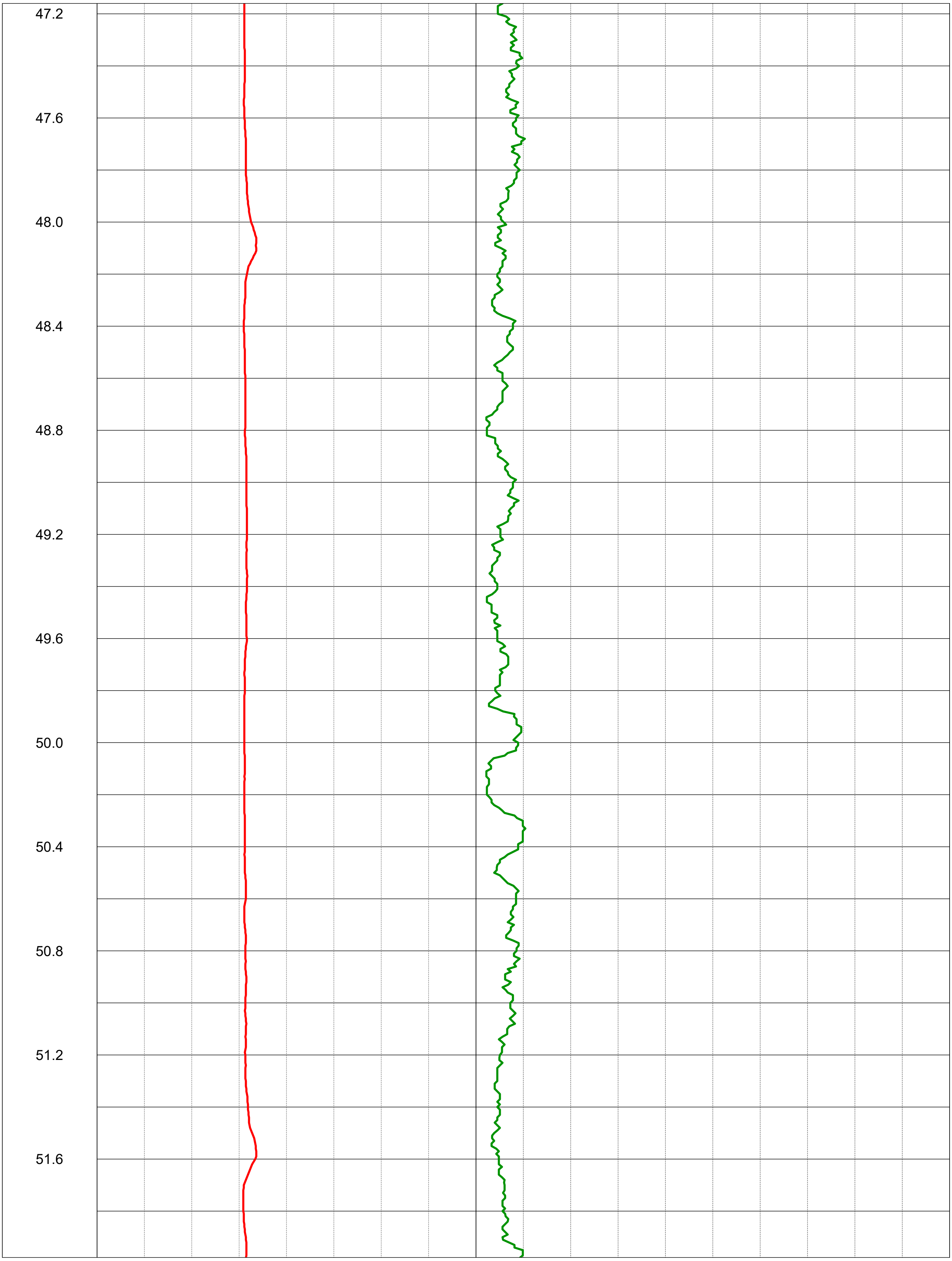


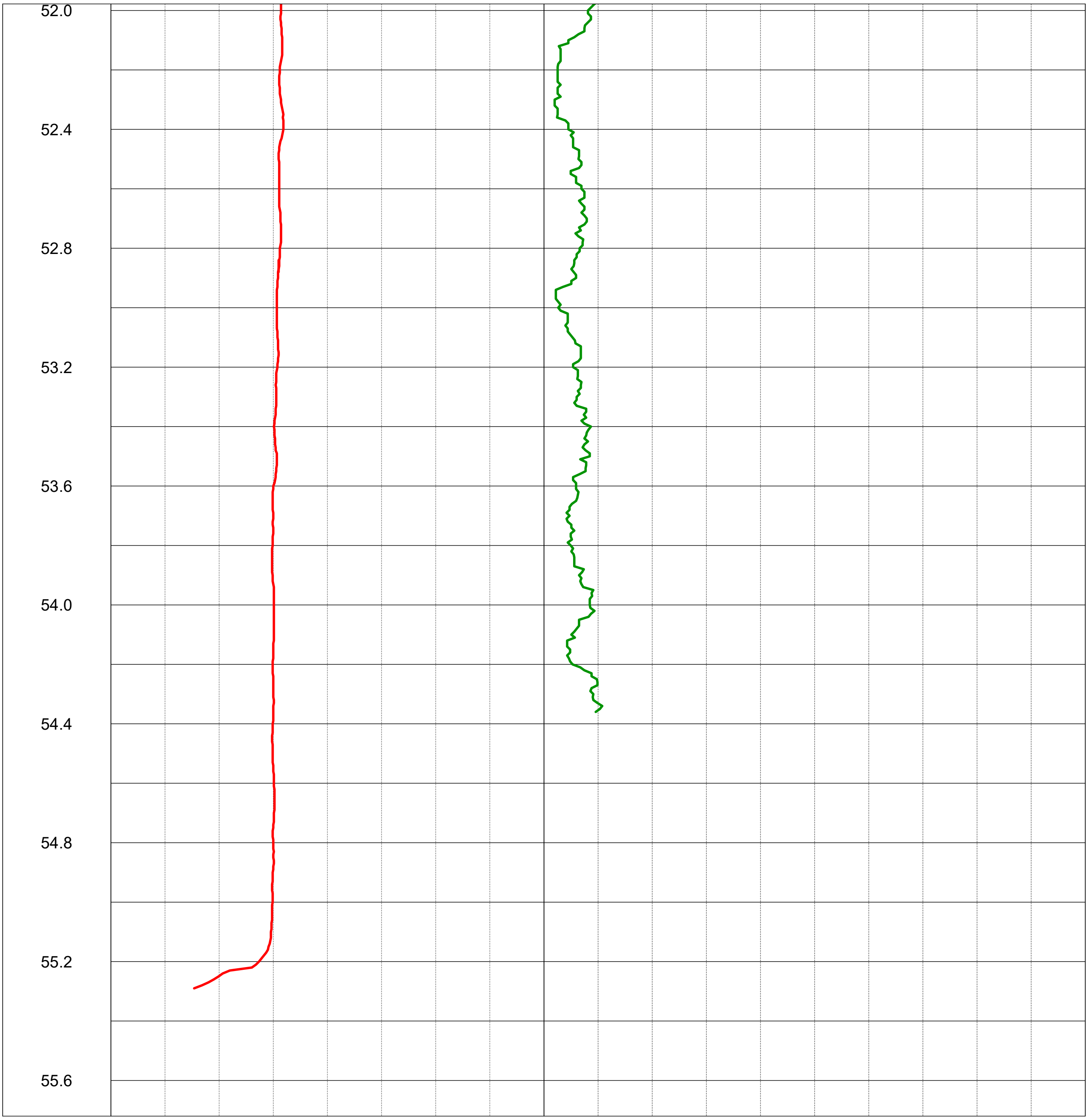
28.0
28.4
28.8
29.2
29.6
30.0
30.4
30.8
31.2
31.6
32.0
32.4

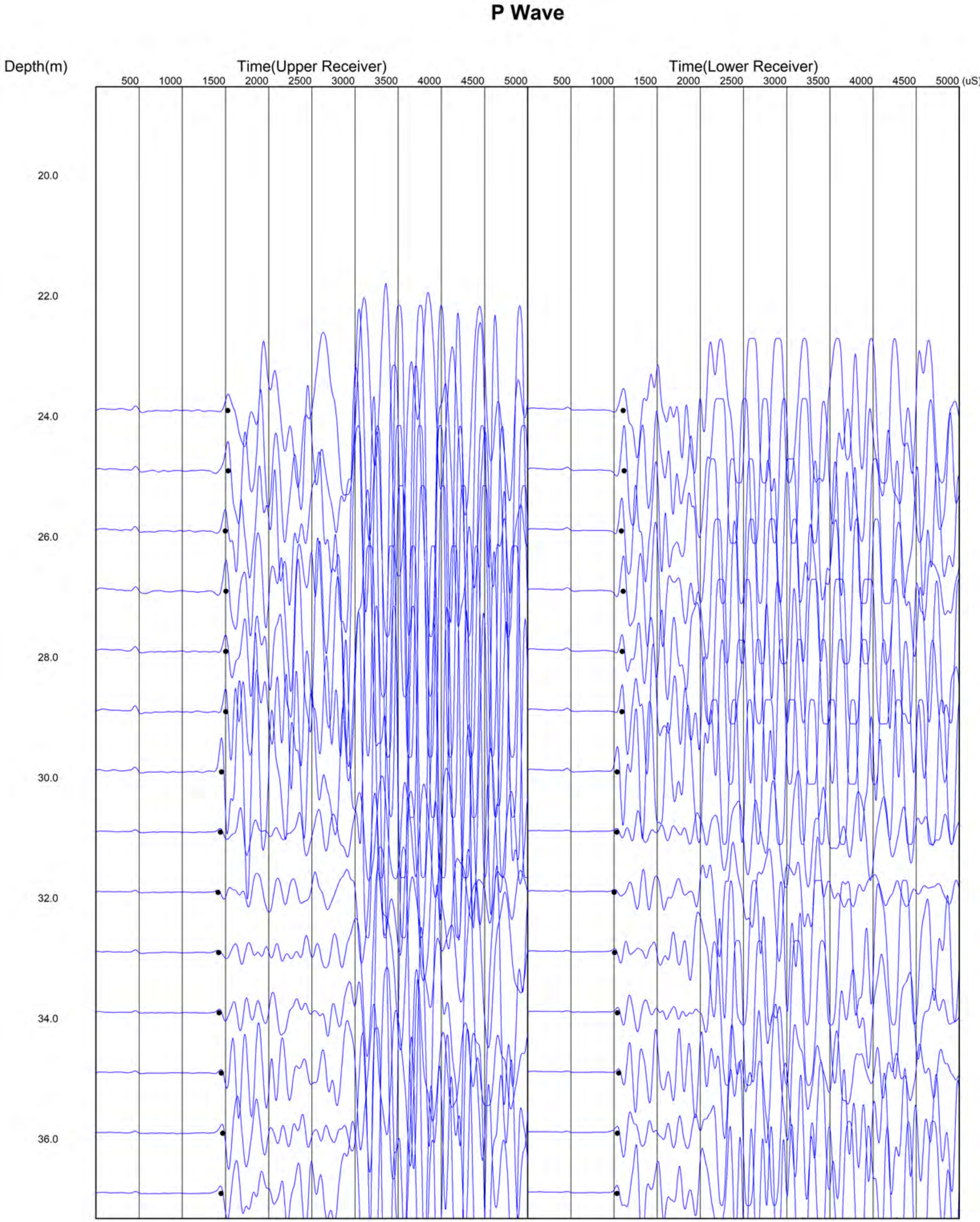

32.8
33.2
33.6
34.0
34.4
34.8
35.2
35.6
36.0
36.4
36.8
37.2


37.6
38.0
38.4
38.8
39.2
39.6
40.0
40.4
40.8
41.2
41.6
42.0

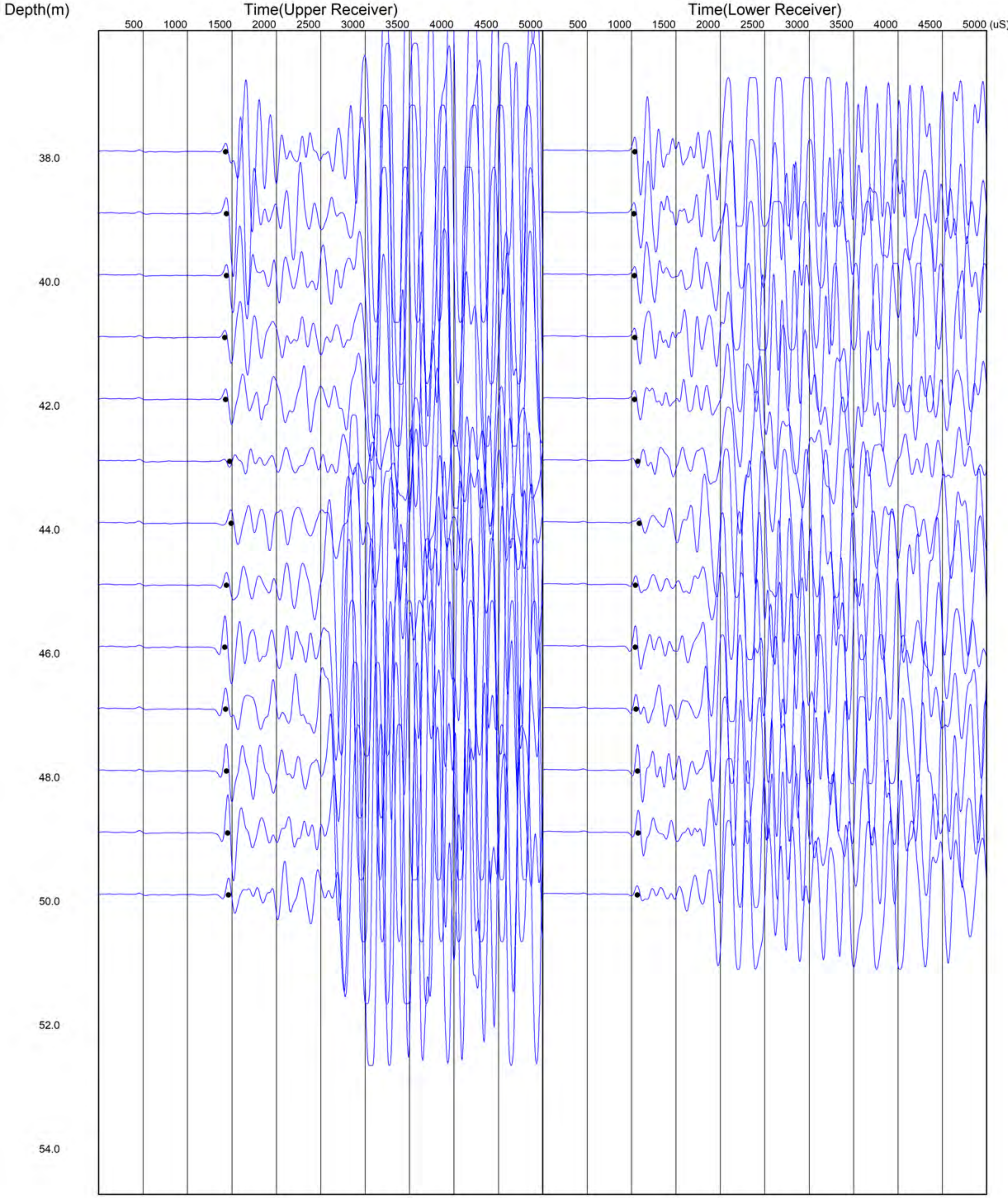

42.4
42.8
43.2
43.6
44.0
44.4
44.8
45.2
45.6
46.0
46.4
46.8


47.2
47.6
48.0
48.4
48.8
49.2
49.6
50.0
50.4
50.8
51.2
51.6


52.0
52.4
52.8
53.2
53.6
54.0
54.4
54.8
55.2
55.6

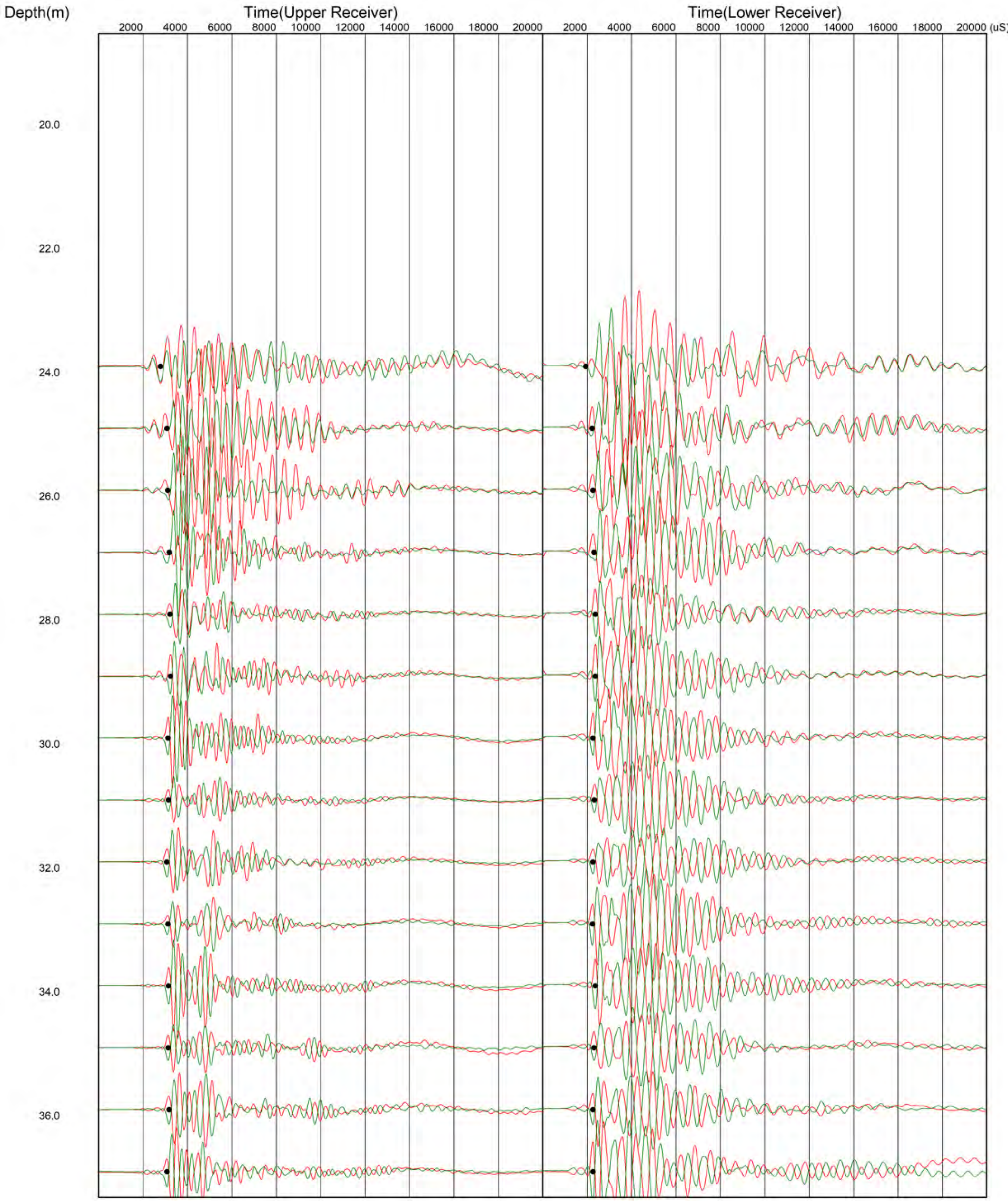

P Wave
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
20.0
22.0
24.0
26.0
28.0
30.0
32.0
34.0
36.0

P Wave

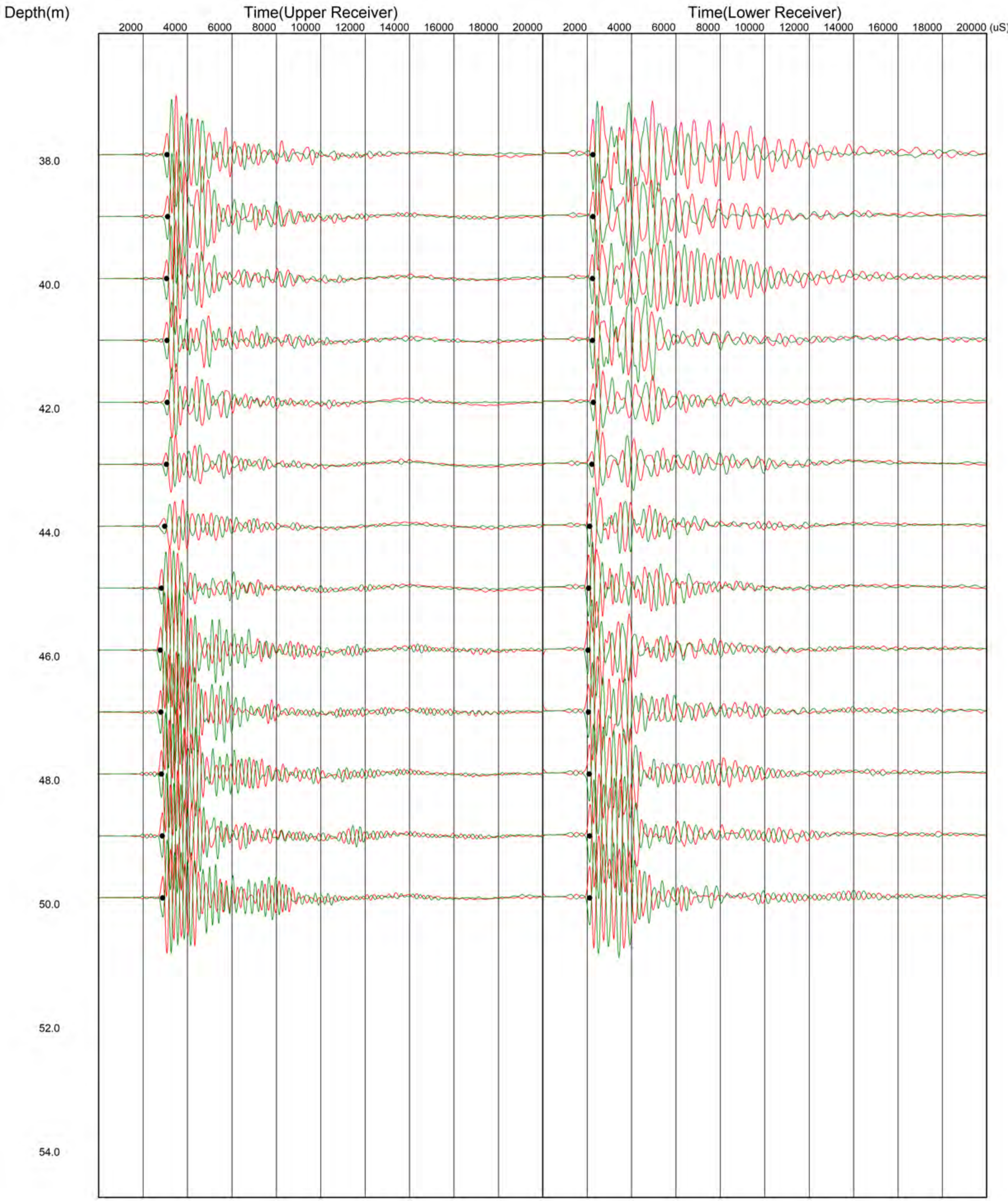


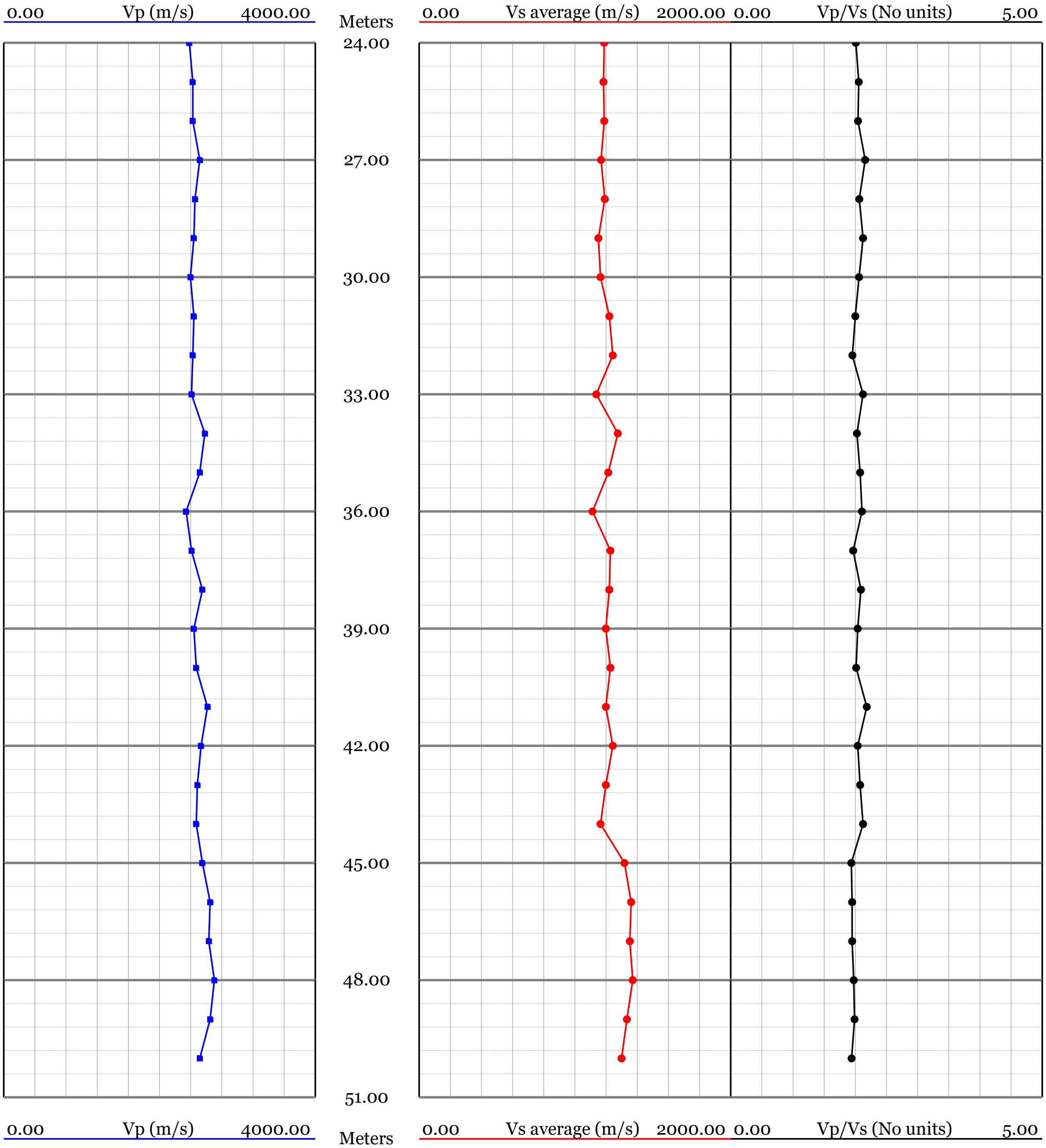
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
500
1000
1500
2000
2500
3000
3500
4000
4500
5000 (uS)
38.0
40.0
42.0
44.0
46.0
48.0
50.0
52.0
54.0

S Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
20.0
22.0
24.0
26.0
28.0
30.0
32.0
34.0
36.0

S Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
38.0
40.0
42.0
44.0
46.0
48.0
50.0
52.0
54.0


0.00
Vp (m/s)
4000.00
Meters
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00
24.00
27.00
30.00
33.00
36.00
39.00
42.00
45.00
48.00
51.00
0.00
Vp (m/s)
4000.00
Meters
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00

ROBERTSON GEO SERVICES
Unlocking Your GeoData

CO Structural Soils			
WELL W617			
FLD A303 Stonehenge			
CTY England			
STE			
FILING No			
COMPANY	Structural Soils		
WELL ID	W617		
FIELD	A303 Stonehenge		
COUNTRY	England	STATE	
LOCATION			OTHER SERVICES
Easting: 412751.02			
Northing: 141968.7			
SEC	TWP	RGE	
PERMANENT DATUM	GL	ELEVATION 79.601	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.

DATE	09/07/18	TYPE FLUID IN HOLE	Water
RUN No		SALINITY	
TYPE LOG		DENSITY	
DEPTH-DRILLER	46	LEVEL	12
DEPTH-LOGGER	45	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	45		
TOP LOGGED INTERVAL	1.7		
OPERATING RIG TIME			
RECORDED BY	Ian Jones		
WITNESSED BY	Joanne Van-Aardt		

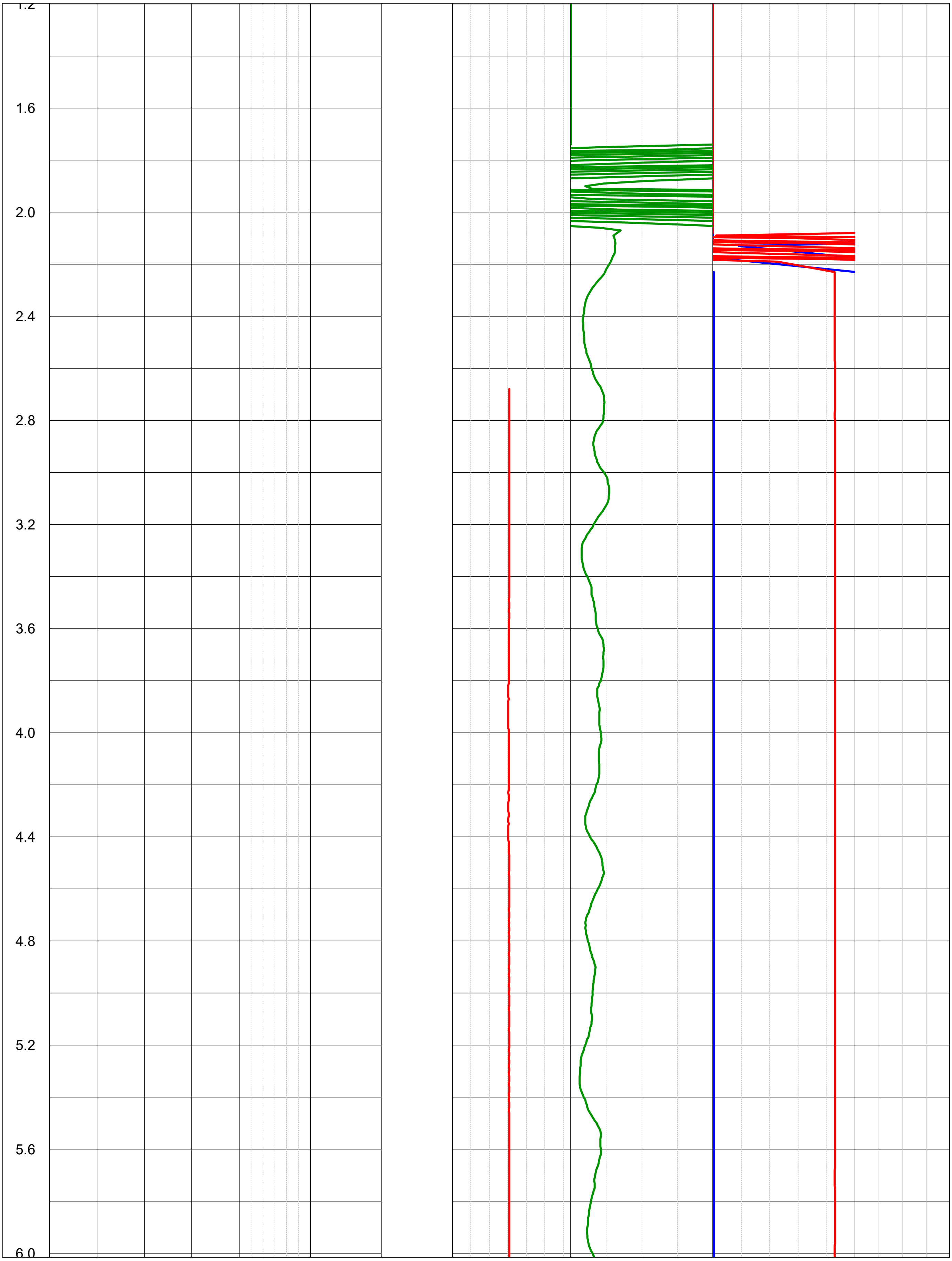
RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

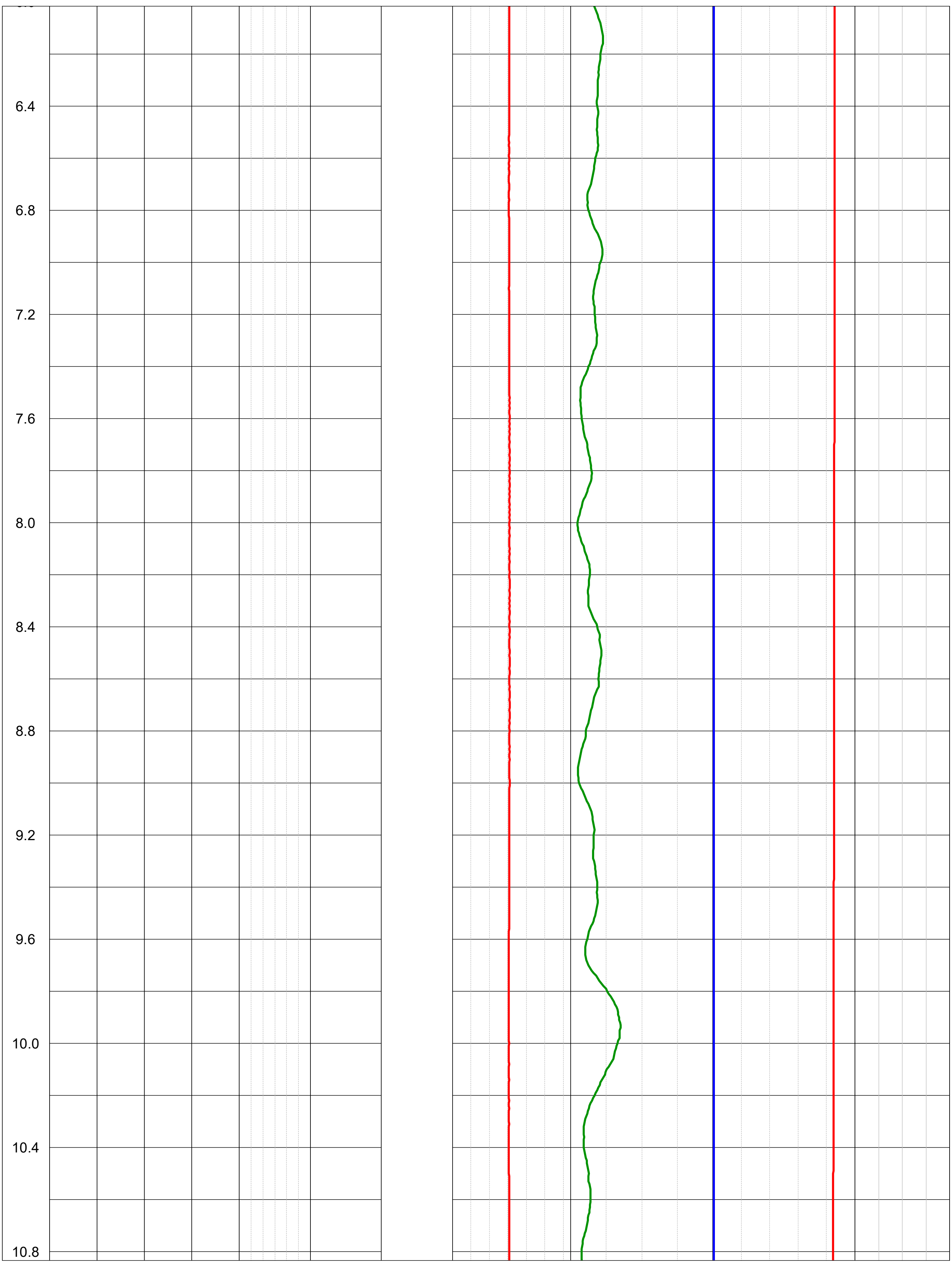
Depth	Optical	Dips	Dips 2	3D Log	CALP	NGAM	COND	Azimuth
1:20	0° 90° 180° 270° 0°	0 90	0° 180°	180°	0 MM 800	0 API 20	0 uS/cm 500	0 360
	Projections						TEMP	INCL
	0° 90° 180° 270° 0°						0 DegC 35	0 4

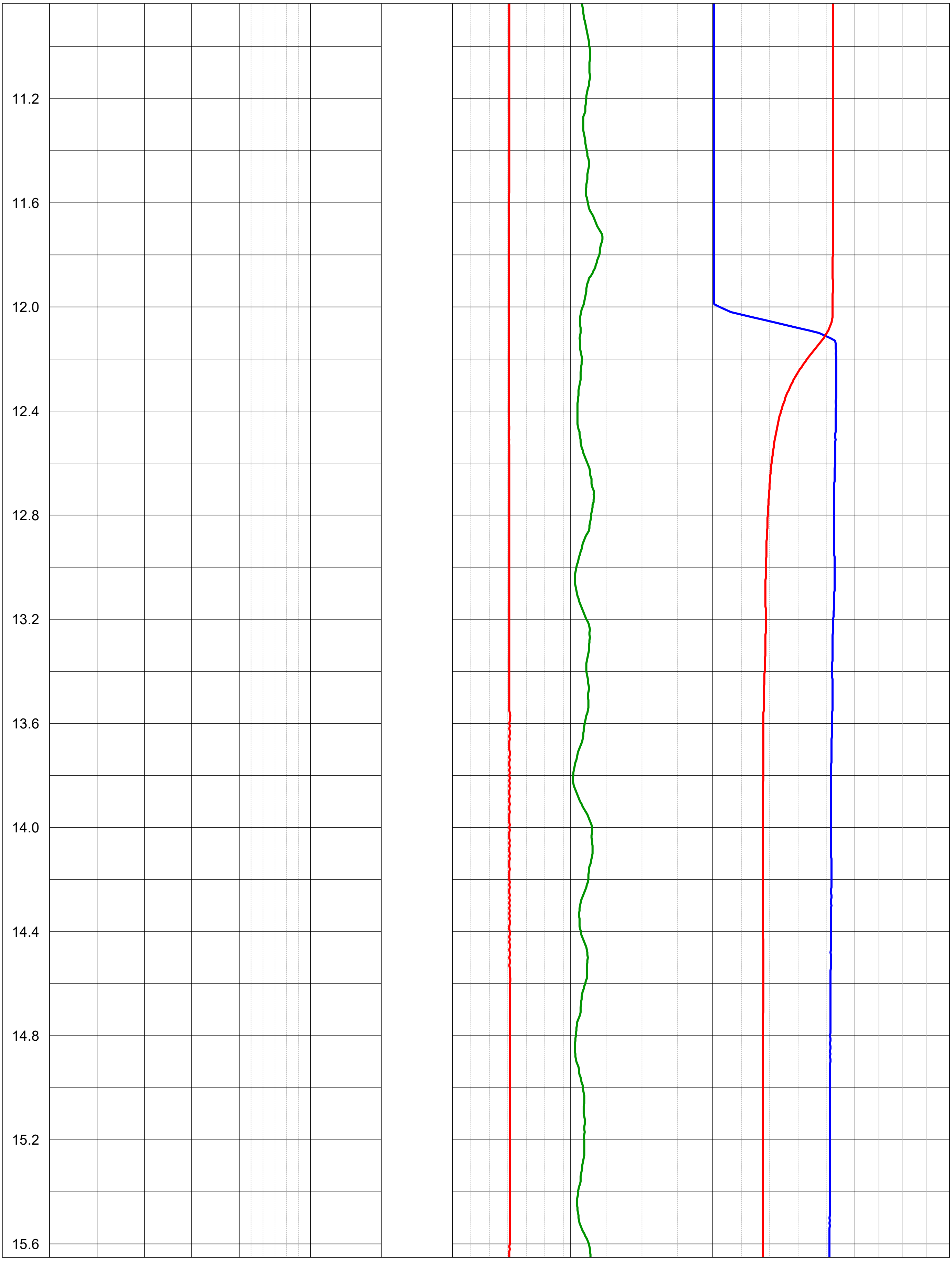
0.4

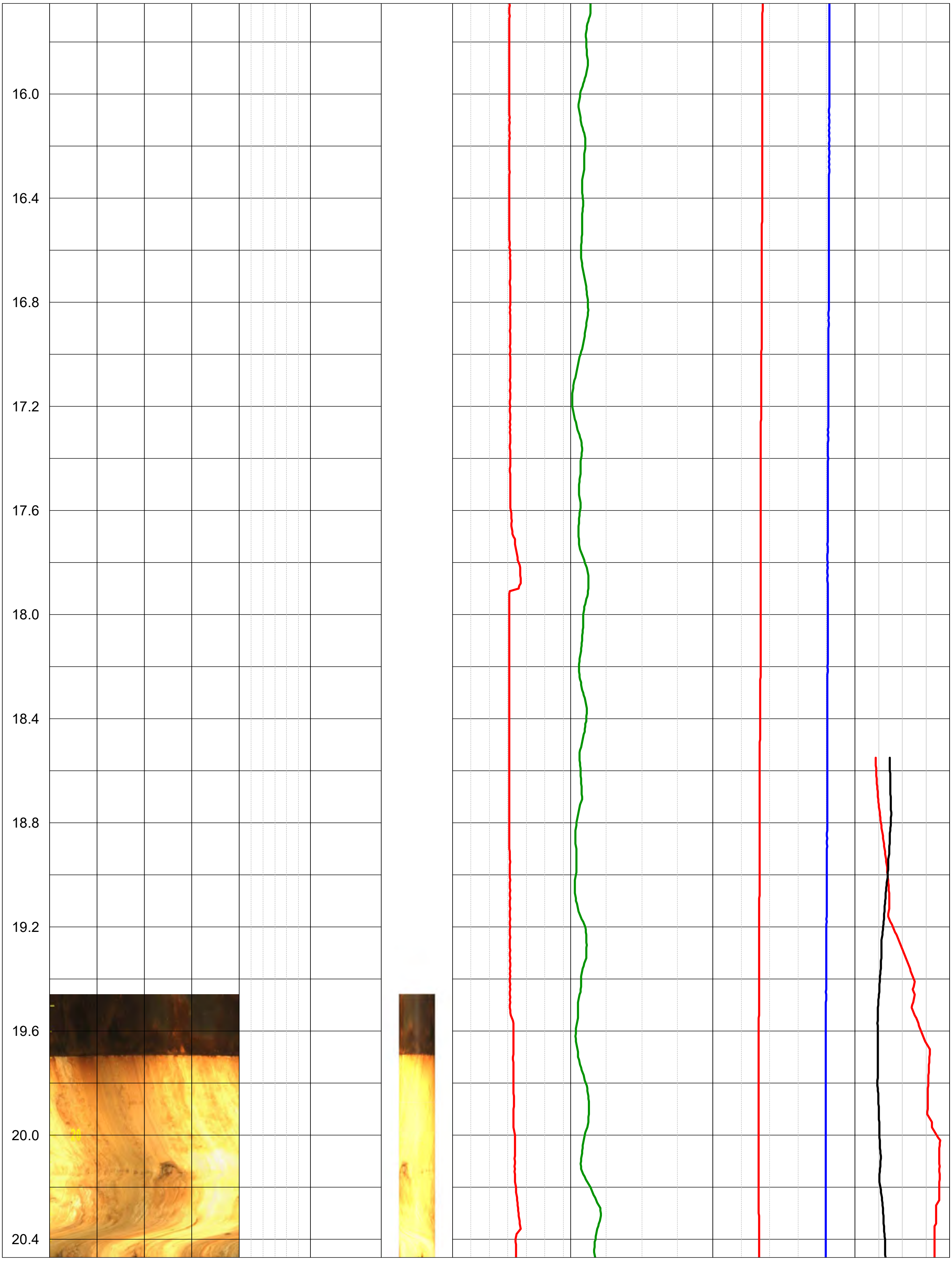
0.8

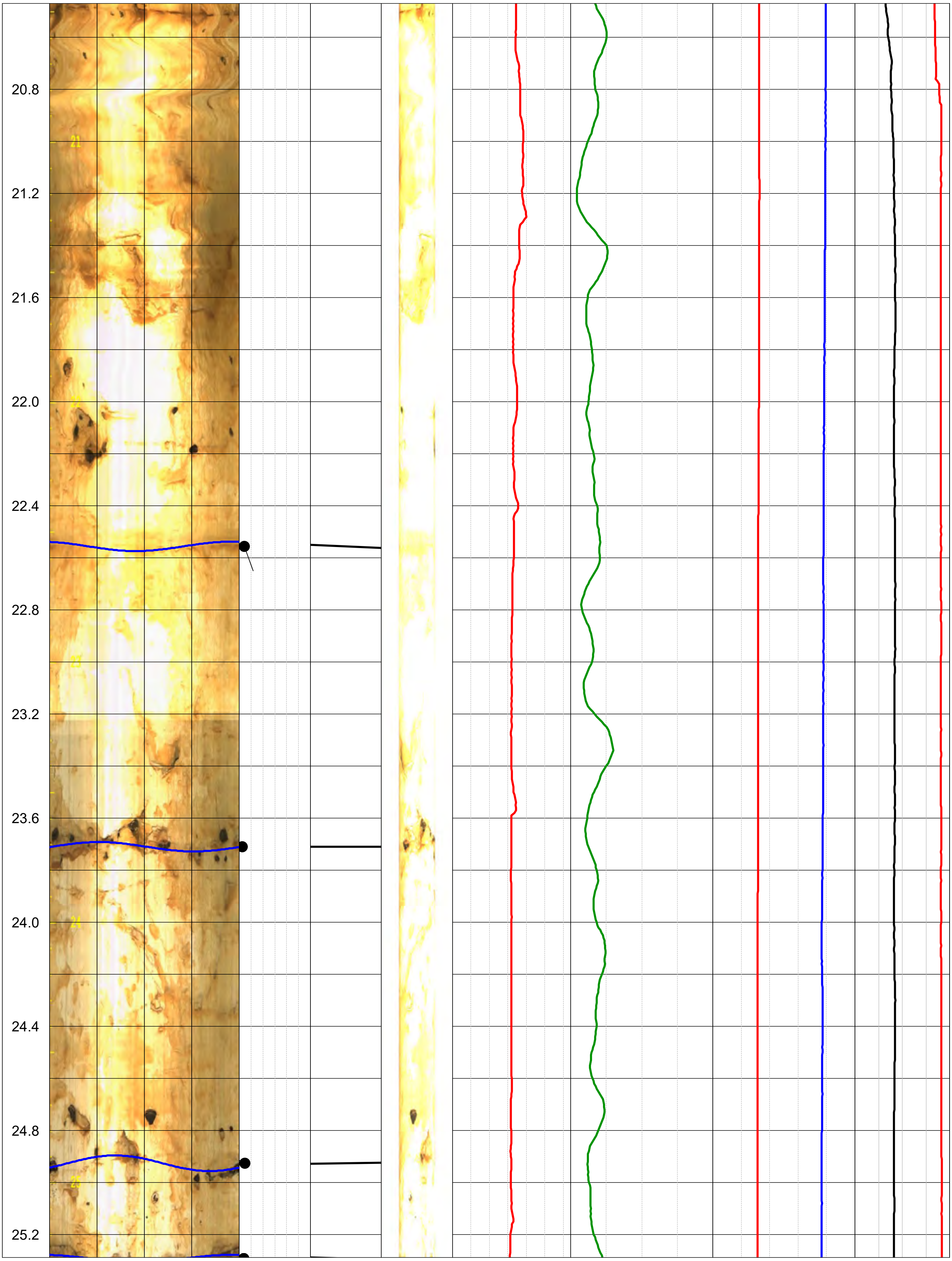
1.2

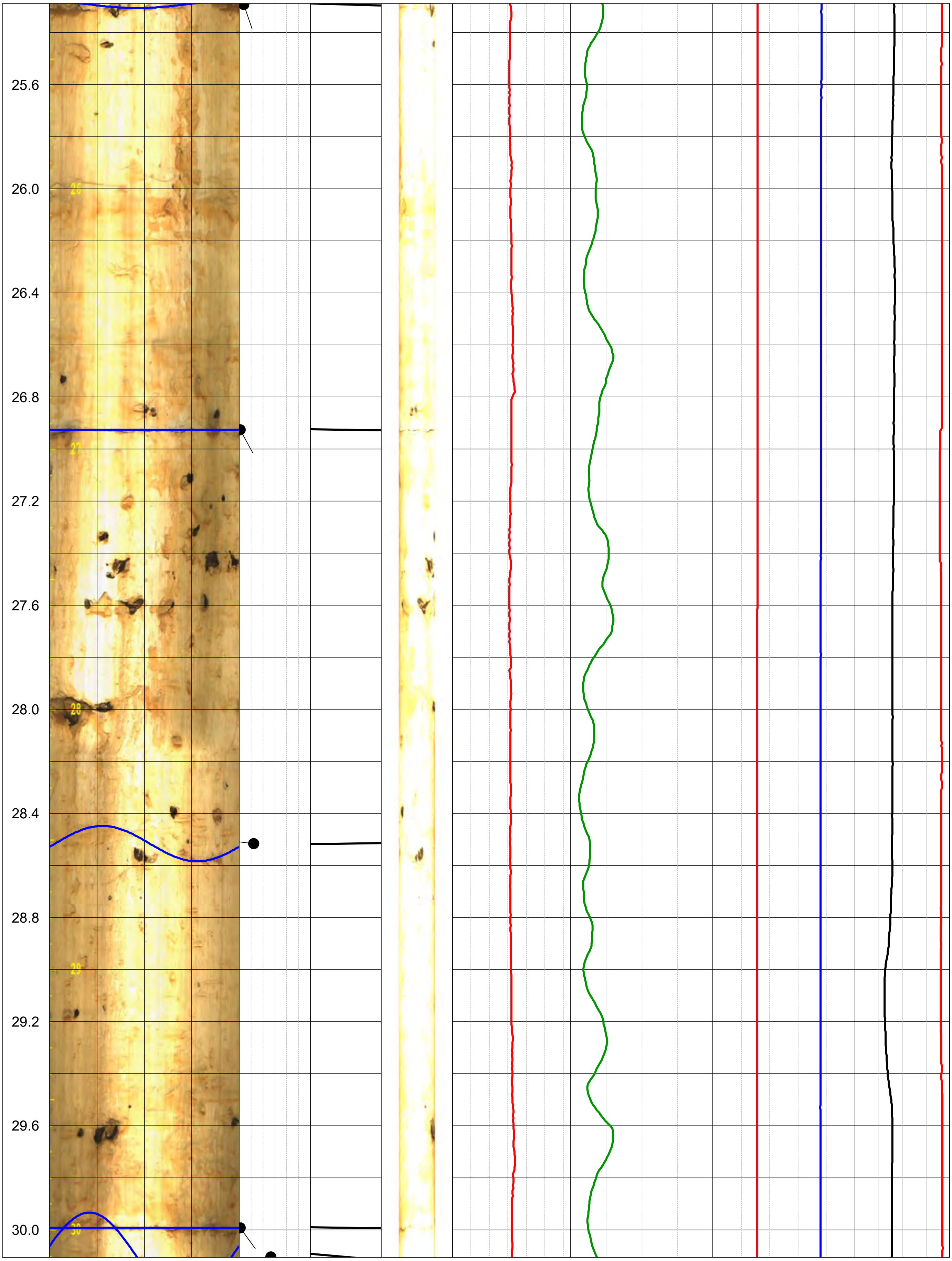

1.2
1.6
2.0
2.4
2.8
3.2
3.6
4.0
4.4
4.8
5.2
5.6
6.0

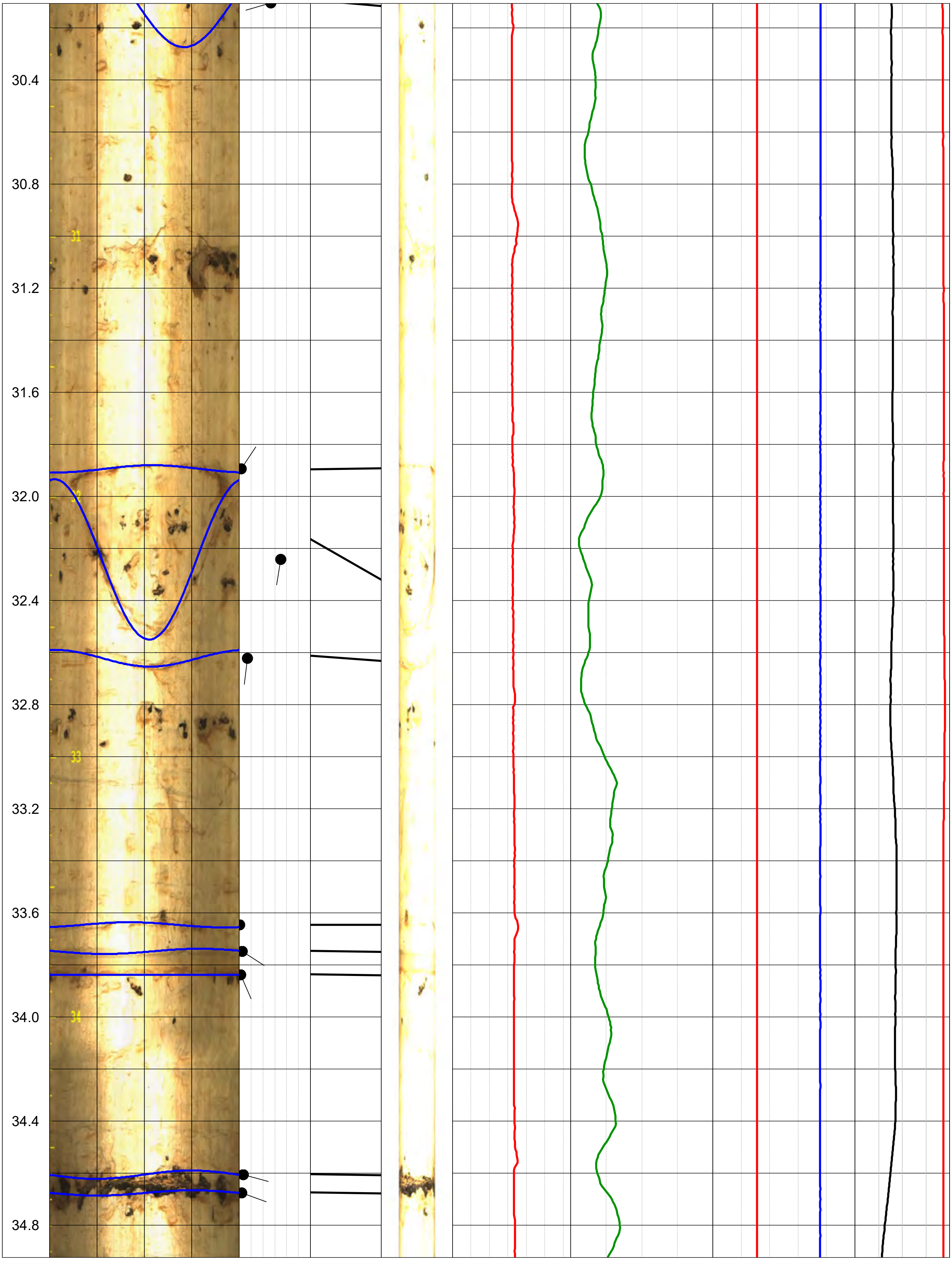

6.4
6.8
7.2
7.6
8.0
8.4
8.8
9.2
9.6
10.0
10.4
10.8

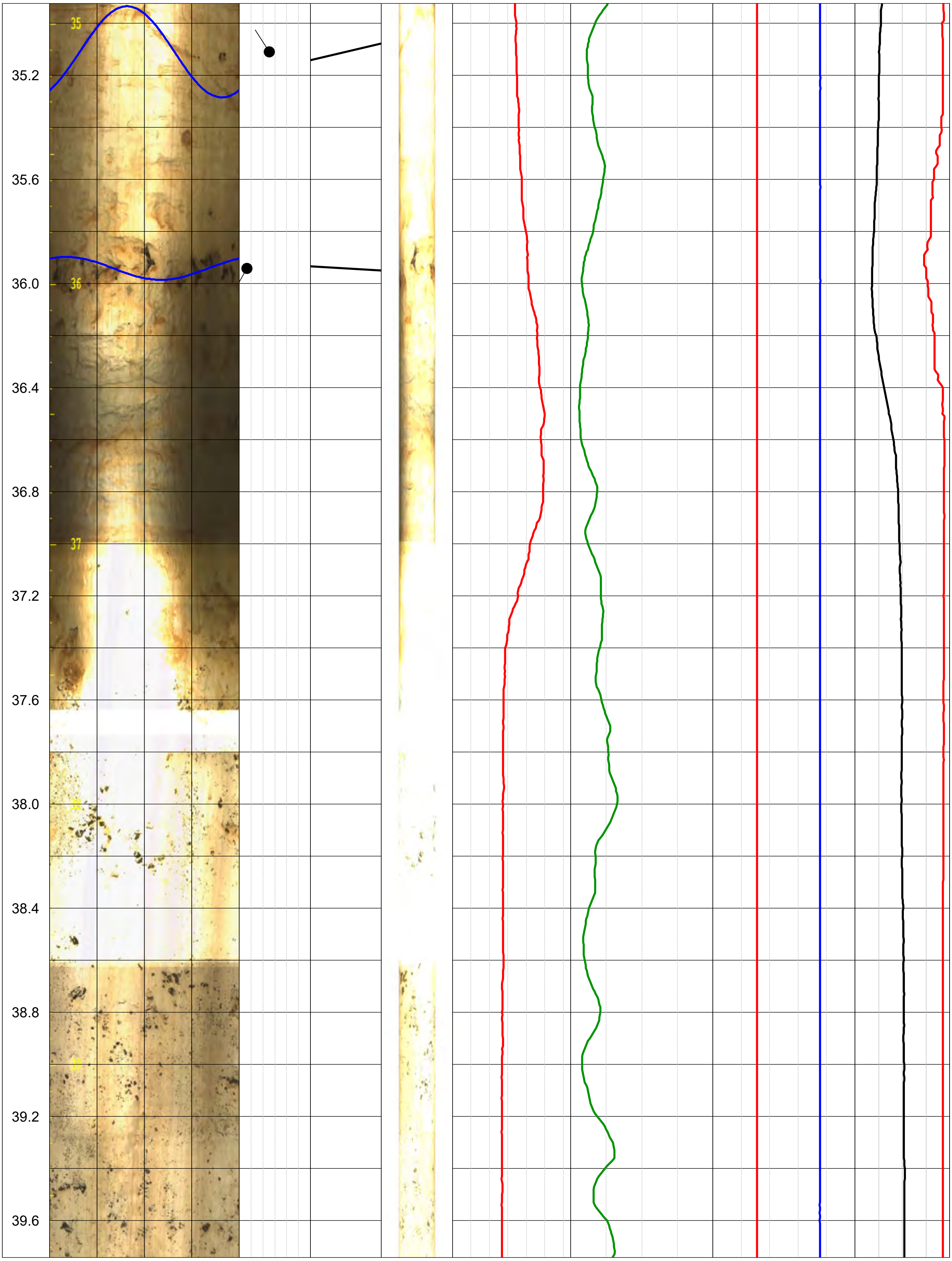

11.2
11.6
12.0
12.4
12.8
13.2
13.6
14.0
14.4
14.8
15.2
15.6

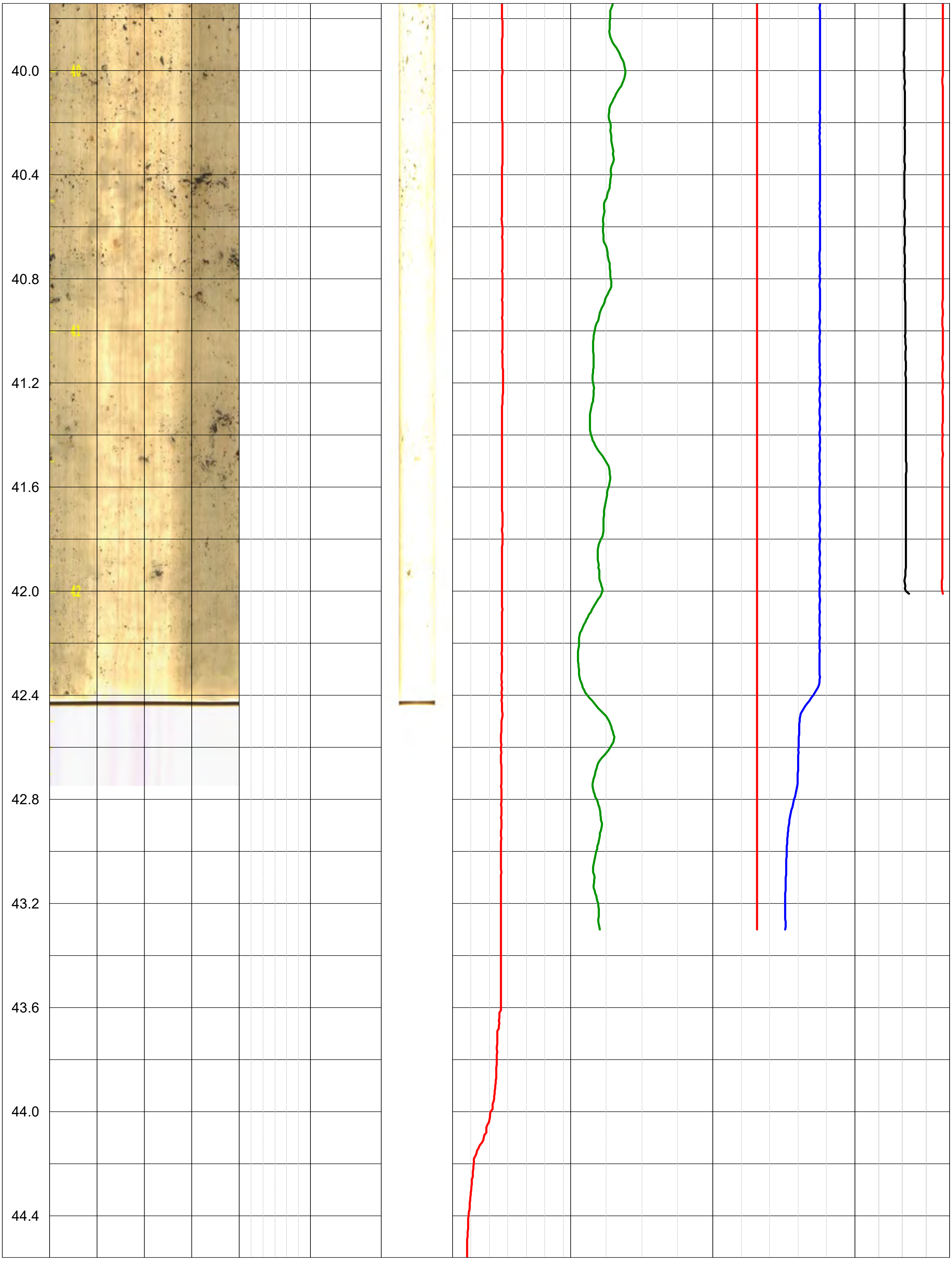

16.0
16.4
16.8
17.2
17.6
18.0
18.4
18.8
19.2
19.6
20.0
20.4

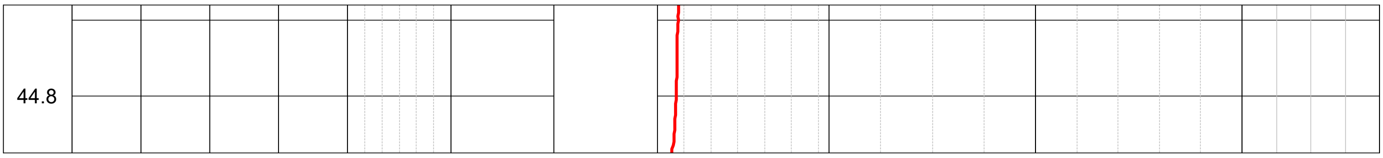

20.8
21.2
21.6
22.0
22.4
22.8
23.2
23.6
24.0
24.4
24.8
25.2


25.6
26.0
26.4
26.8
27.2
27.6
28.0
28.4
28.8
29.2
29.6
30.0


30.4
30.8
31.2
31.6
32.0
32.4
32.8
33.2
33.6
34.0
34.4
34.8


35.2
35.6
36.0
36.4
36.8
37.2
37.6
38.0
38.4
38.8
39.2
39.6


40.0
40.4
40.8
41.2
41.6
42.0
42.4
42.8
43.2
43.6
44.0
44.4


44.8

CO Structural Soils
WELL W617
FLD Stonehenge
CTY England
STE
FILING No

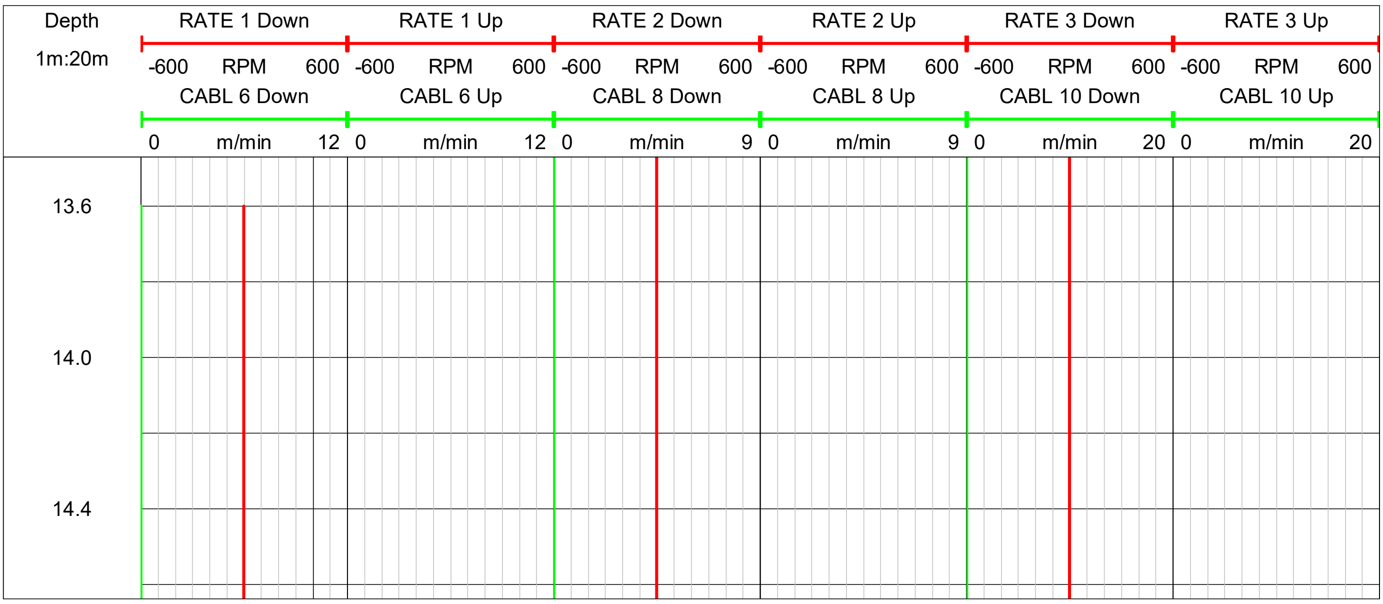
ROBERTSON GEO SERVICES
Unlocking Your GeoData

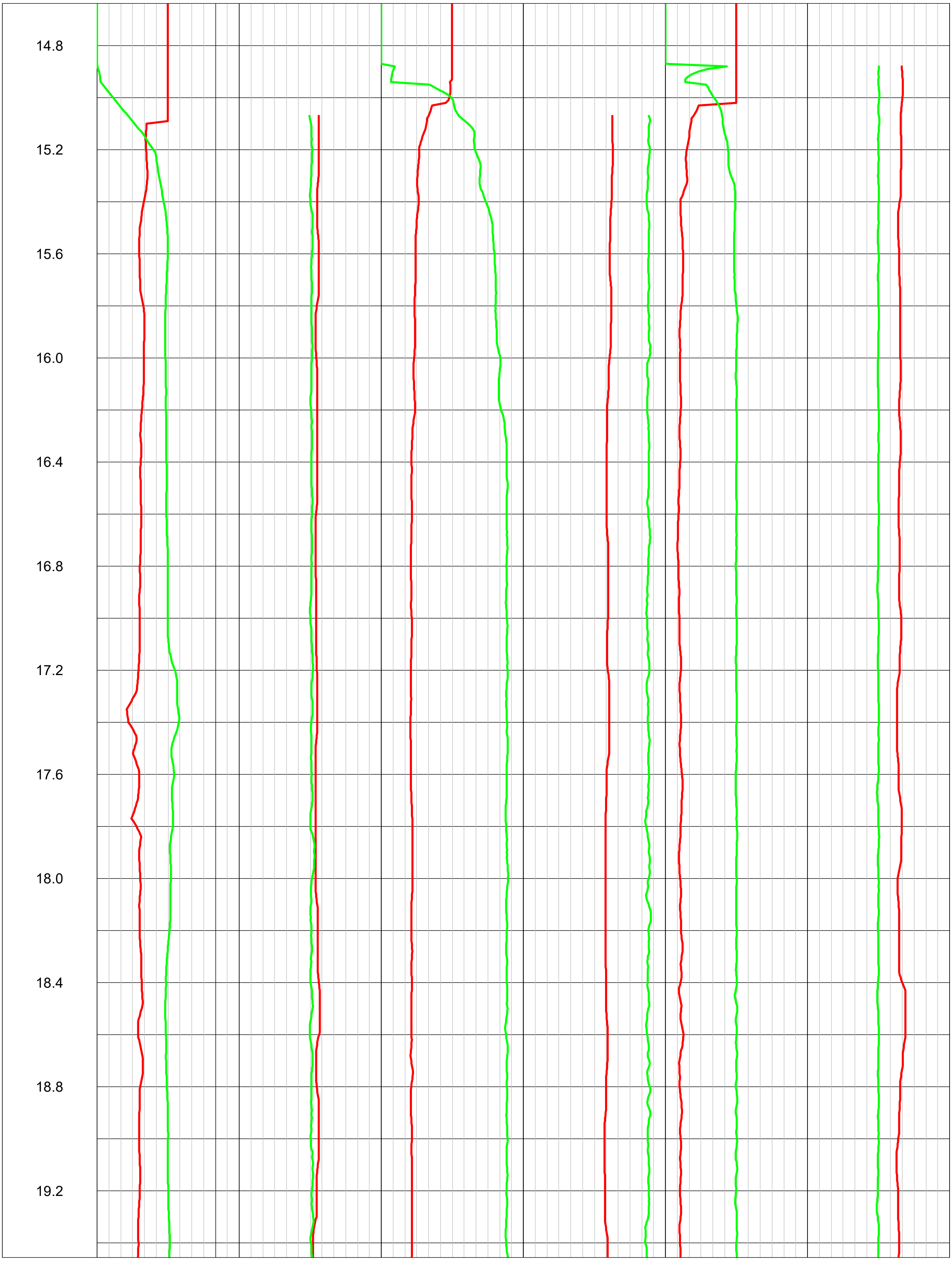
COMPANY	Structural Soils
WELL ID	W617
FIELD	A303 Stonehenge
COUNTRY	England
STATE	
LOCATION	Easting: 412751.02 Northing: 141968.7
SEC	TWP RGE
OTHER SERVICES	

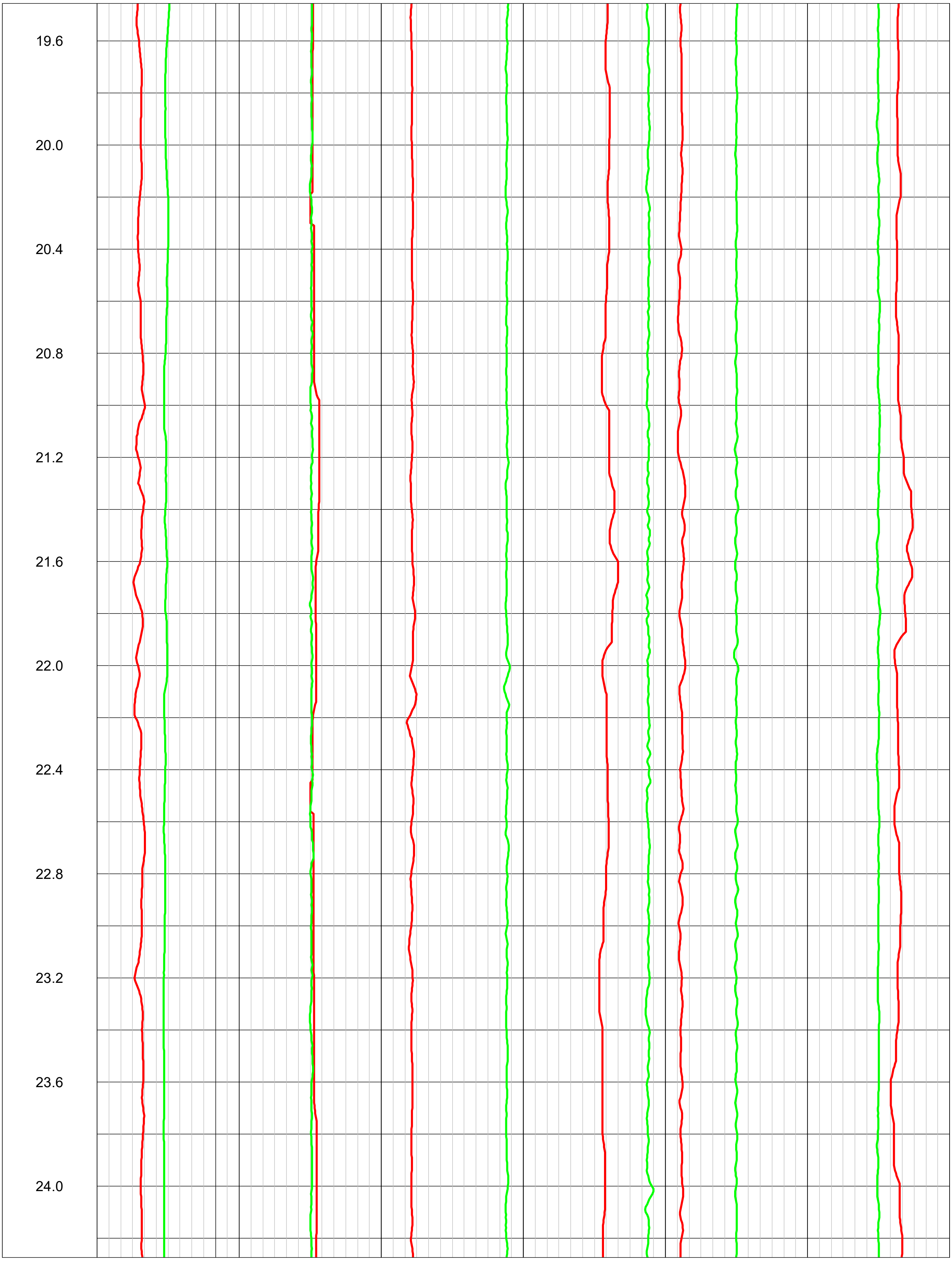
PERMANENT DATUM	GL	ELEVATION	79.601
LOG MEAS. FROM		ABOVE PERM. DATUM	
DRILLING MEAS. FROM			
K.B.		D.F.	G.L.

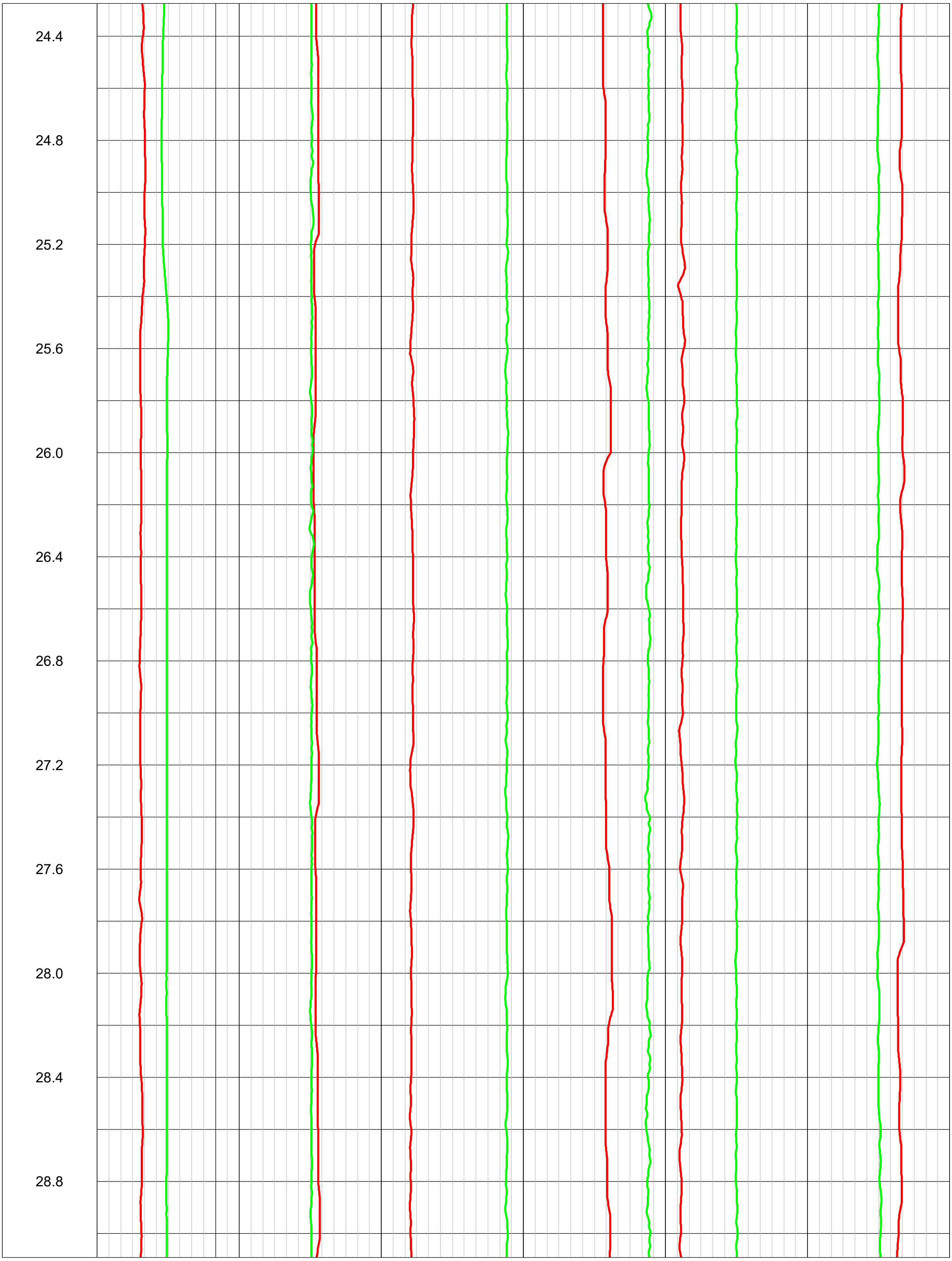
DATE	09/07/18	TYPE FLUID IN HOLE	Water
RUN No		SALINITY	
TYPE LOG	Flowmeter	DENSITY	
DEPTH-DRILLER	46	LEVEL	12
DEPTH-LOGGER	45	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	42.5		
TOP LOGGED INTERVAL	15		
OPERATING RIG TIME			
RECORDED BY	Ian Jones		
WITNESSED BY	Joanne Van-Aardt		

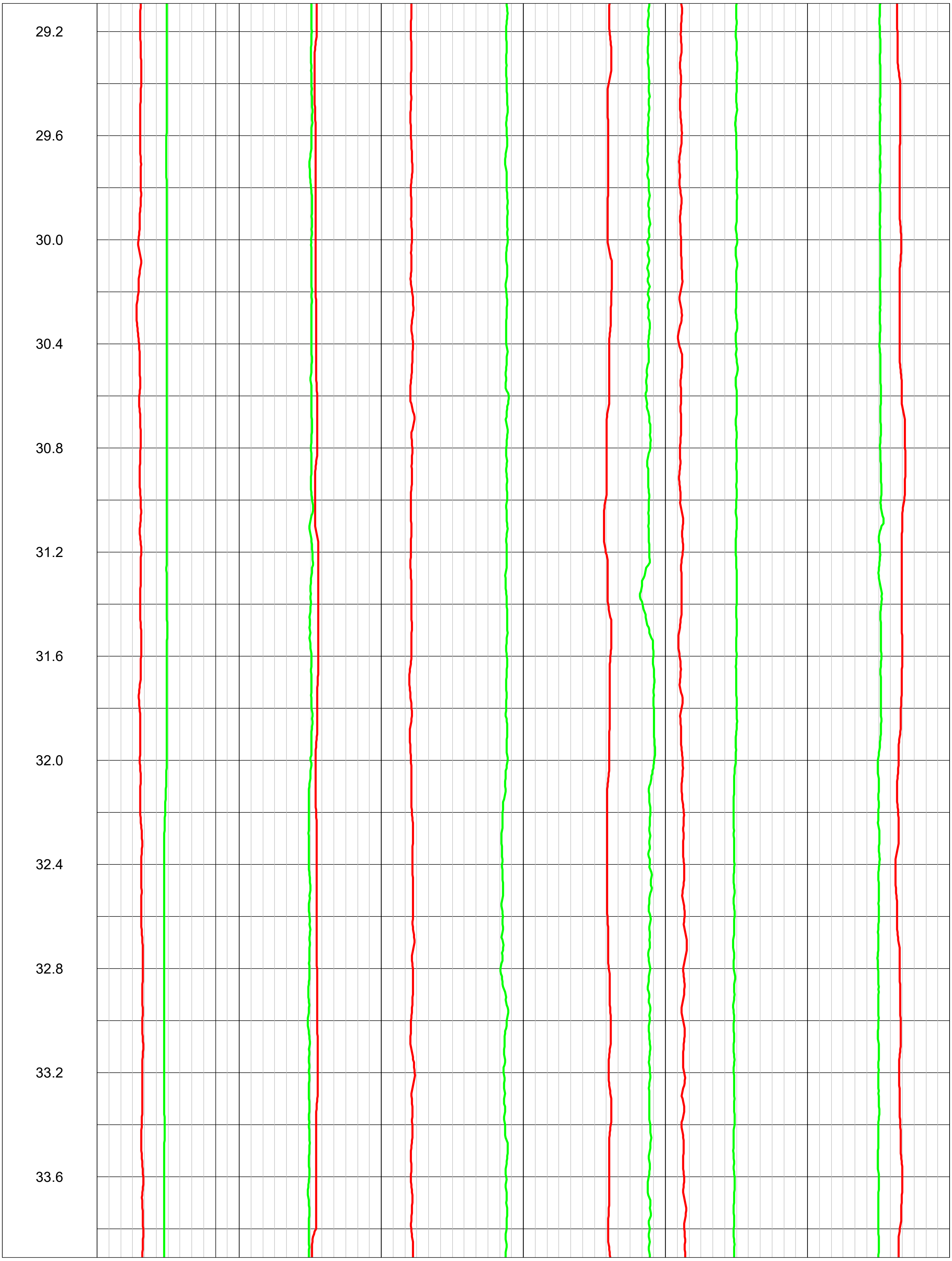
BOREHOLE RECORD				CASING RECORD			
RUN NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO



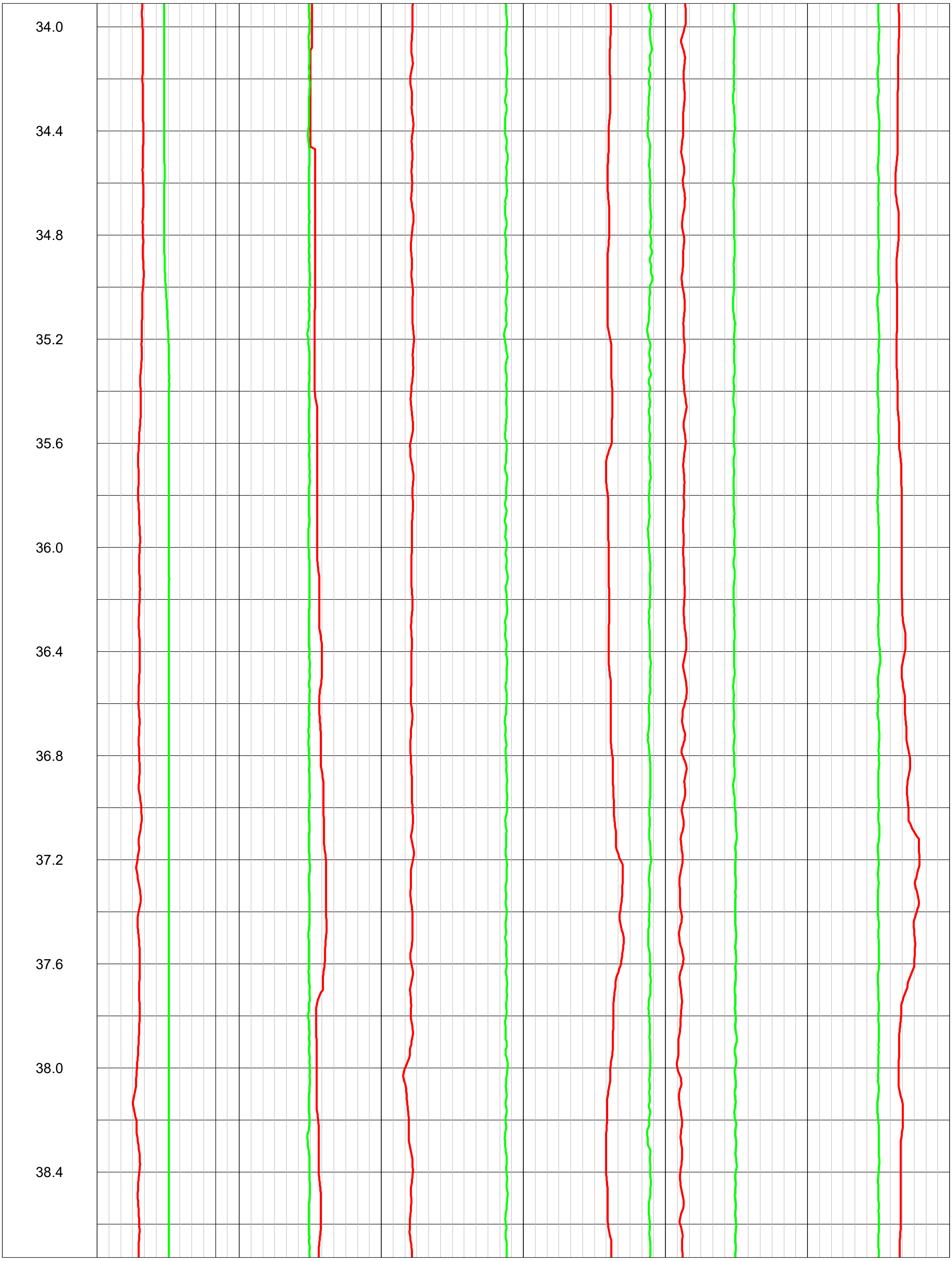

14.8
15.2
15.6
16.0
16.4
16.8
17.2
17.6
18.0
18.4
18.8
19.2

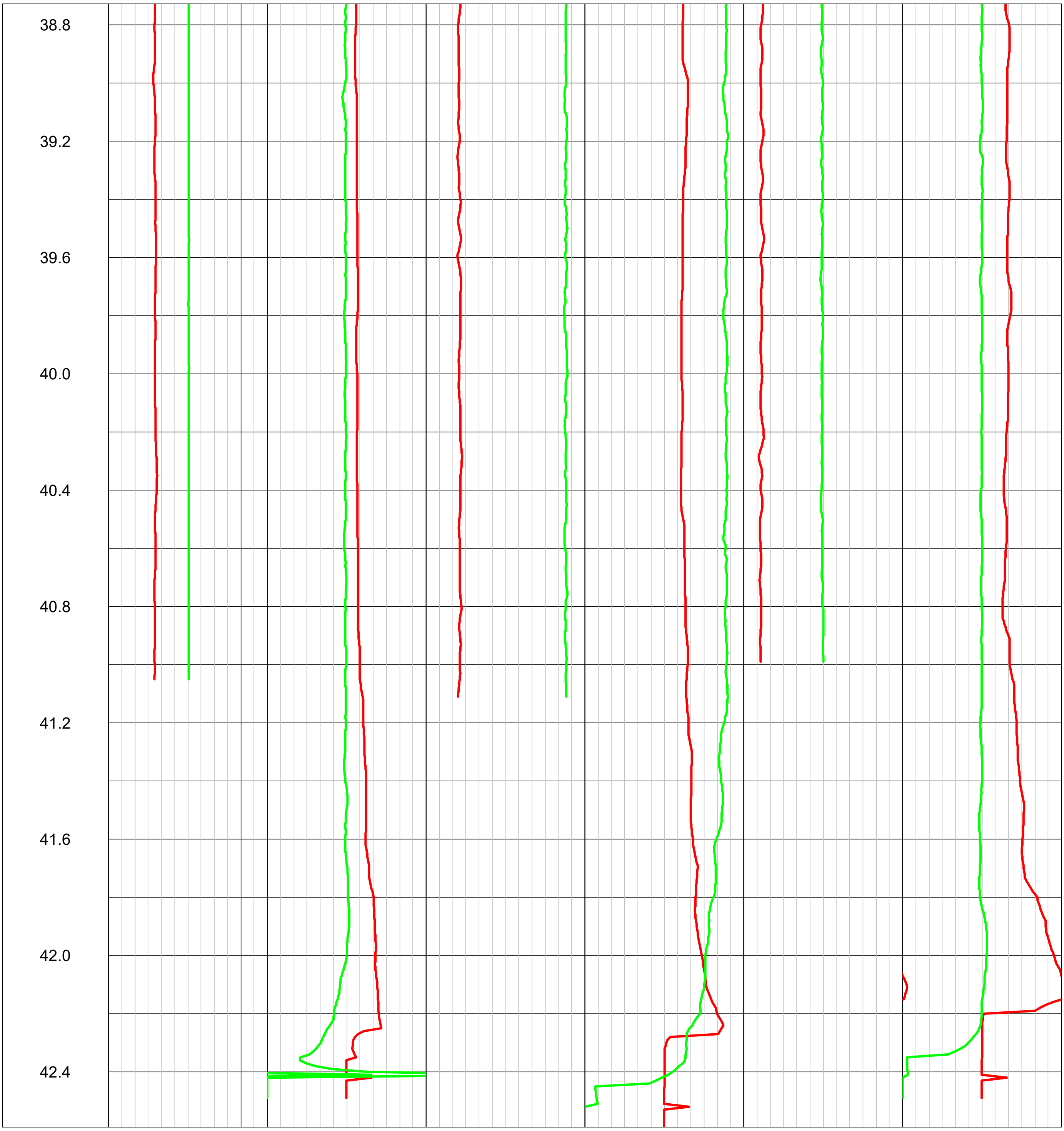

19.6
20.0
20.4
20.8
21.2
21.6
22.0
22.4
22.8
23.2
23.6
24.0


24.4
24.8
25.2
25.6
26.0
26.4
26.8
27.2
27.6
28.0
28.4
28.8



29.2
29.6
30.0
30.4
30.8
31.2
31.6
32.0
32.4
32.8
33.2
33.6


34.0
34.4
34.8
35.2
35.6
36.0
36.4
36.8
37.2
37.6
38.0
38.4


38.8
39.2
39.6
40.0
40.4
40.8
41.2
41.6
42.0
42.4

Depth	Azimuth	Dip	Aperture
m	deg	deg	mm
22.56	160.17	6.65	0.00
23.71	256.37	4.22	0.00
24.93	298.79	6.94	0.00
25.29	161.50	5.61	0.00
26.93	151.73	1.45	0.00
28.52	277.06	18.28	0.00
29.99	144.02	1.42	0.00
30.10	253.91	39.77	0.00
31.89	33.72	2.72	0.00
32.24	188.70	52.42	0.00
32.62	186.46	10.29	0.00
33.65	334.23	0.79	0.00
33.75	123.13	3.93	0.00
33.84	156.43	1.79	0.00
34.61	104.66	5.15	0.00
34.68	109.73	3.60	0.00
35.11	326.82	38.04	0.00
35.94	209.47	10.01	0.00

ROBERTSON GEO SERVICES
Unlocking Your GeoData

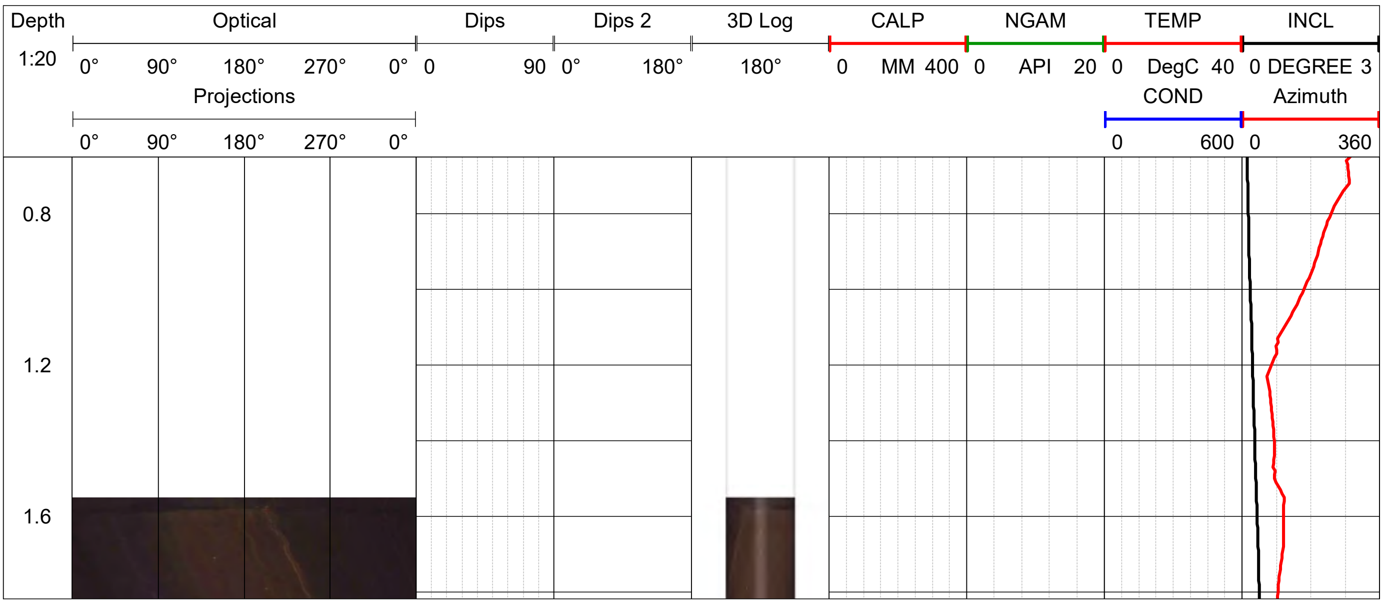
CO Structural Soils
WELL R618
FLD A303 Stonehenge
CTY England
STE
FILING No

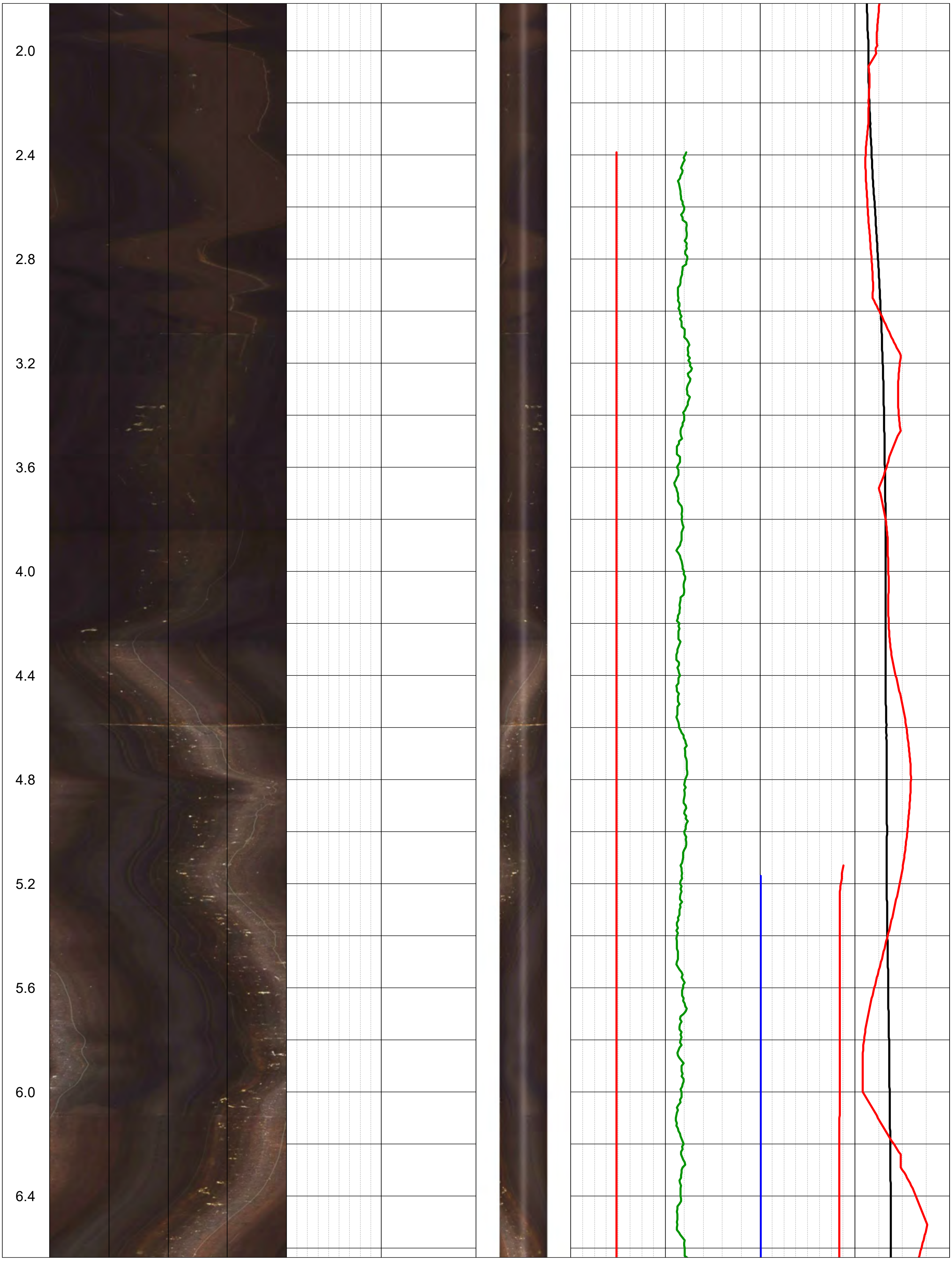
COMPANY	Structural Soils
WELL ID	R618
FIELD	A303 Stonehenge
COUNTRY	England
STATE	
LOCATION	Easting: 412770.92 Northing: 141968.88
OTHER SERVICES	
SEC	
TWP	
RGE	

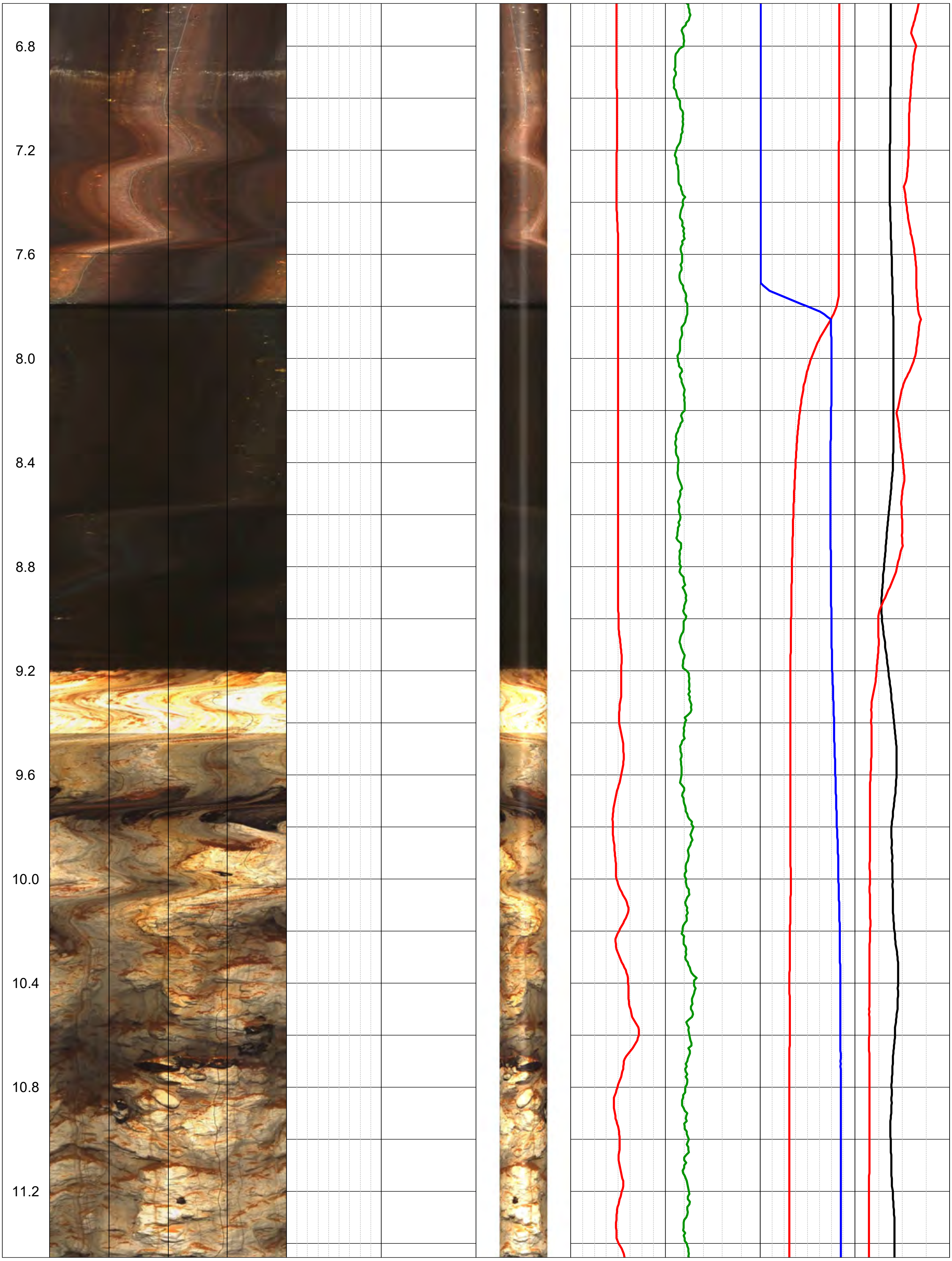
PERMANENT DATUM	GL	ELEVATION	79.507	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM		D.F.
DRILLING MEAS. FROM				G.L.

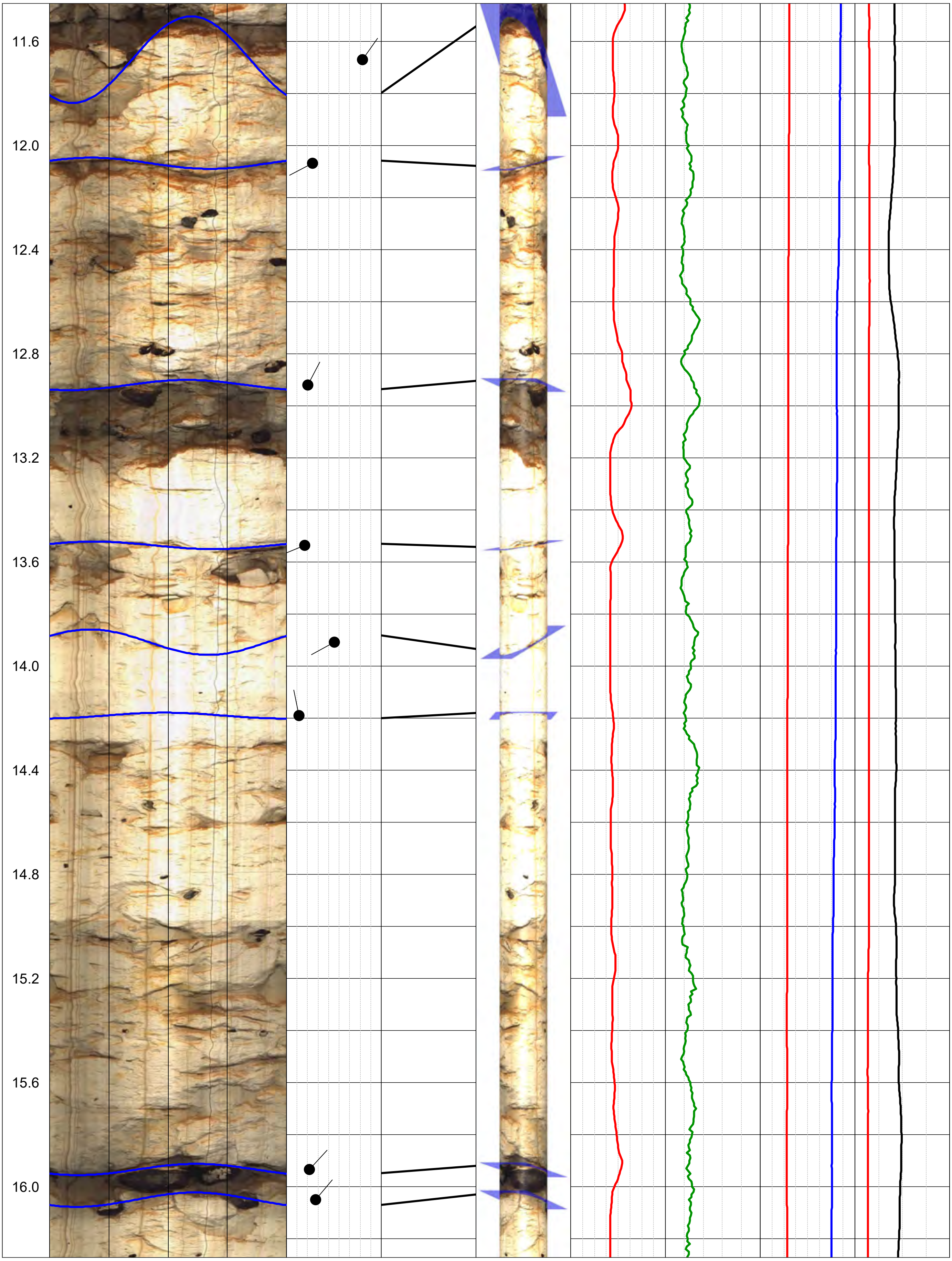
DATE	15/05/18	TYPE FLUID IN HOLE	Water
RUN No		SALINITY	
TYPE LOG	Composite	DENSITY	
DEPTH-DRILLER	48	LEVEL	7.8
DEPTH-LOGGER	48.3	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	48.3		
TOP LOGGED INTERVAL	0.65		
OPERATING RIG TIME			
RECORDED BY	James Boyett		
WITNESSED BY	Kyle Owen		

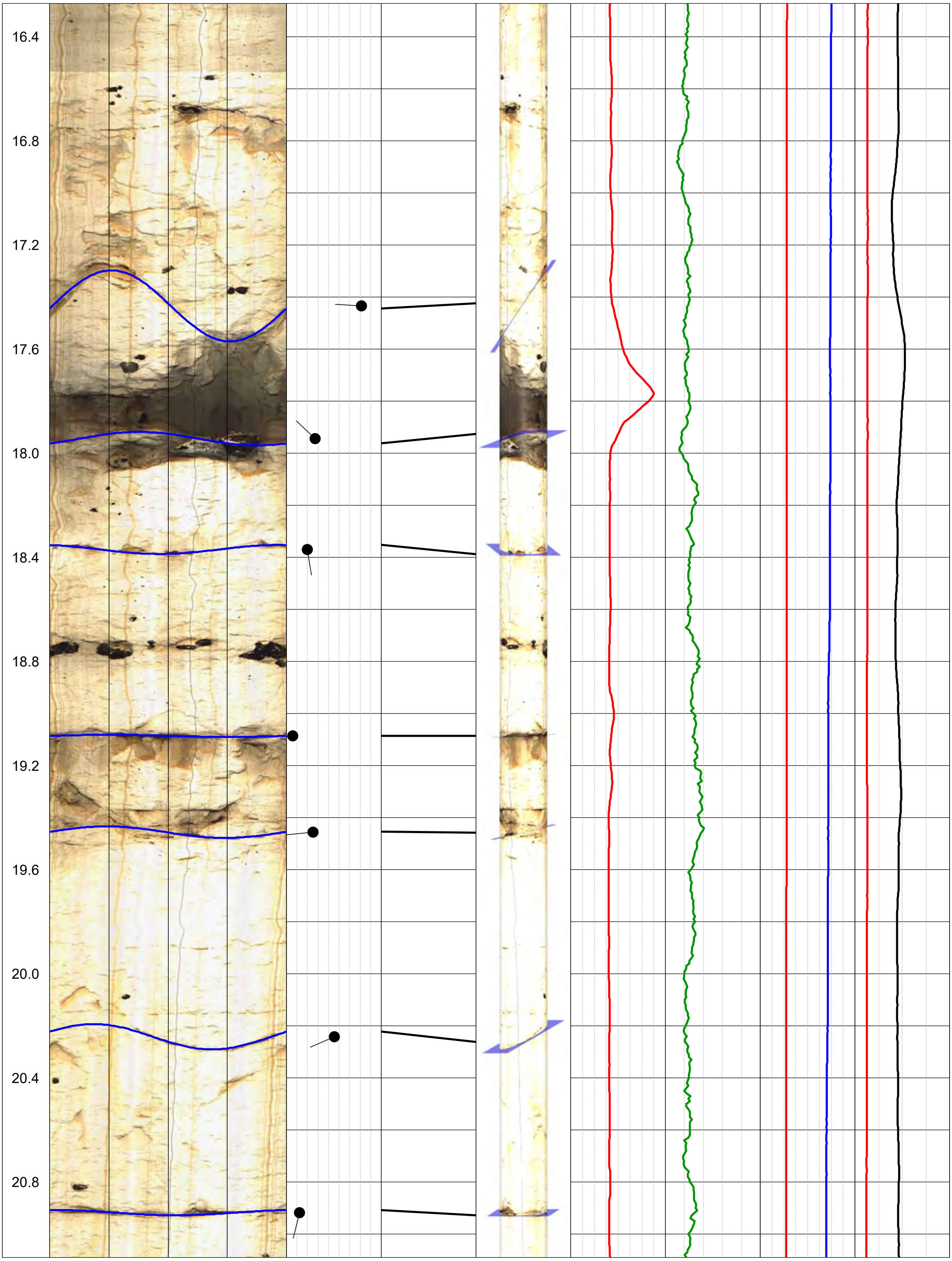
BOREHOLE RECORD				CASING RECORD			
RUN NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

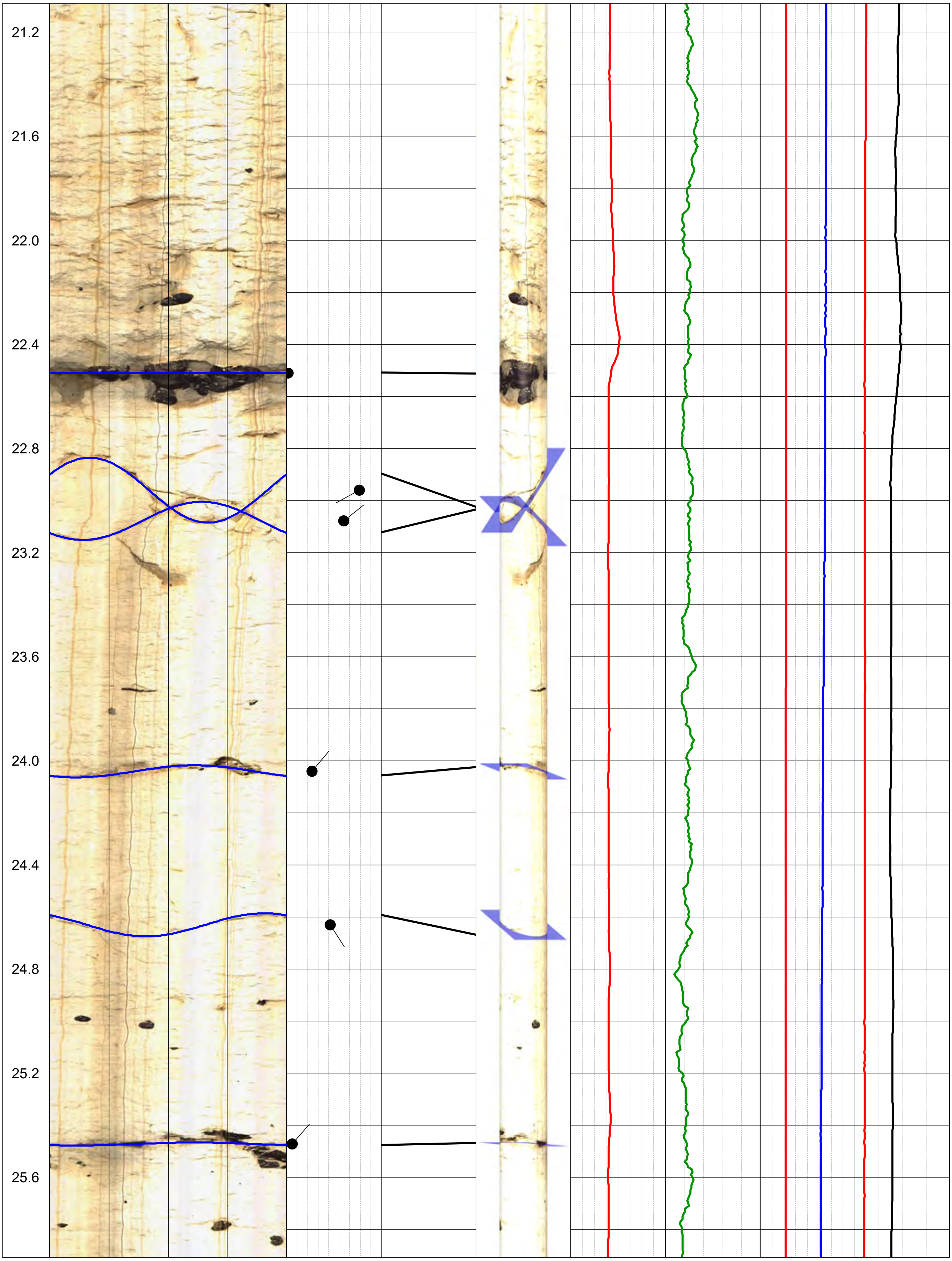


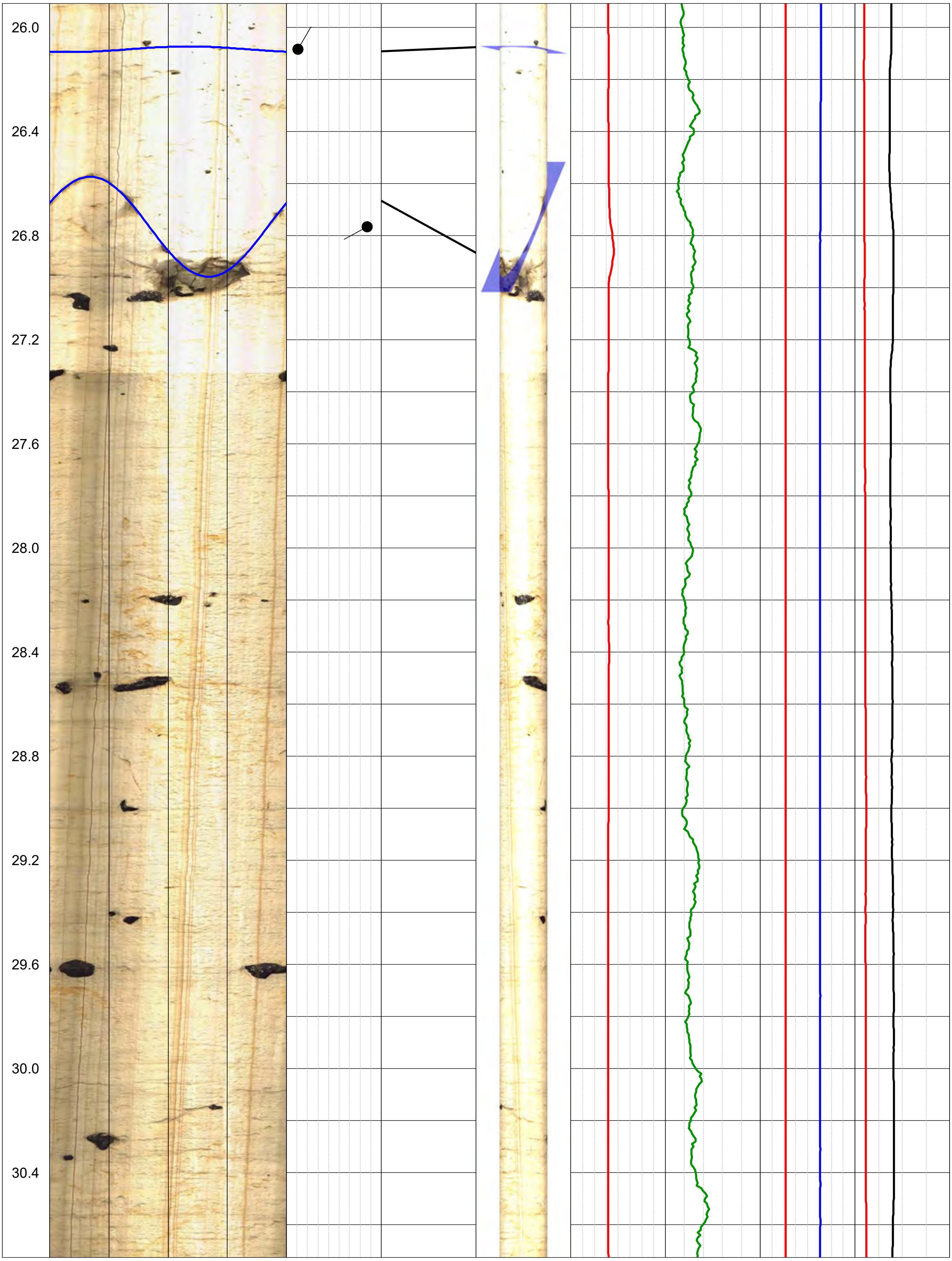

2.0
2.4
2.8
3.2
3.6
4.0
4.4
4.8
5.2
5.6
6.0
6.4

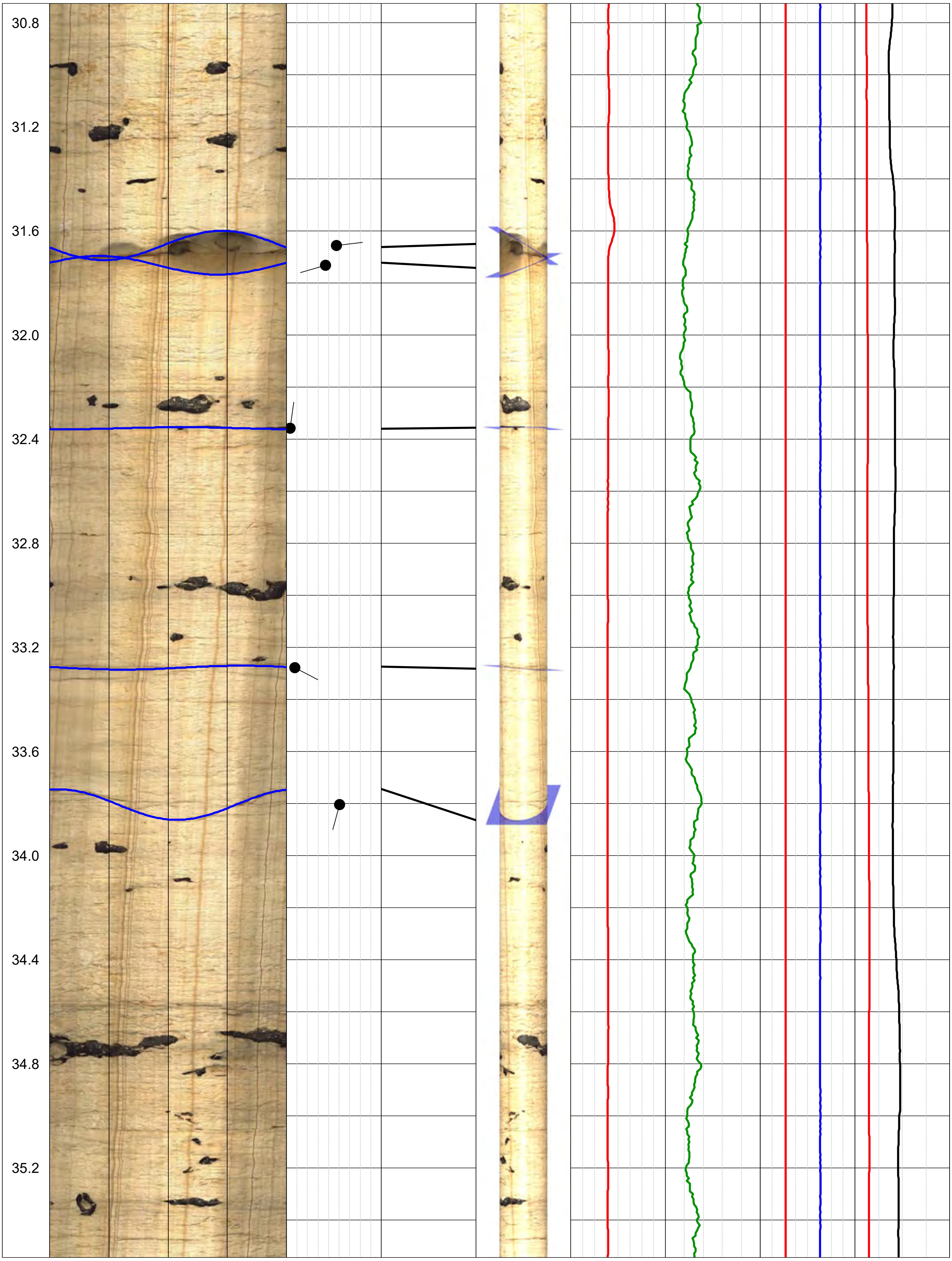

6.8
7.2
7.6
8.0
8.4
8.8
9.2
9.6
10.0
10.4
10.8
11.2


11.6
12.0
12.4
12.8
13.2
13.6
14.0
14.4
14.8
15.2
15.6
16.0

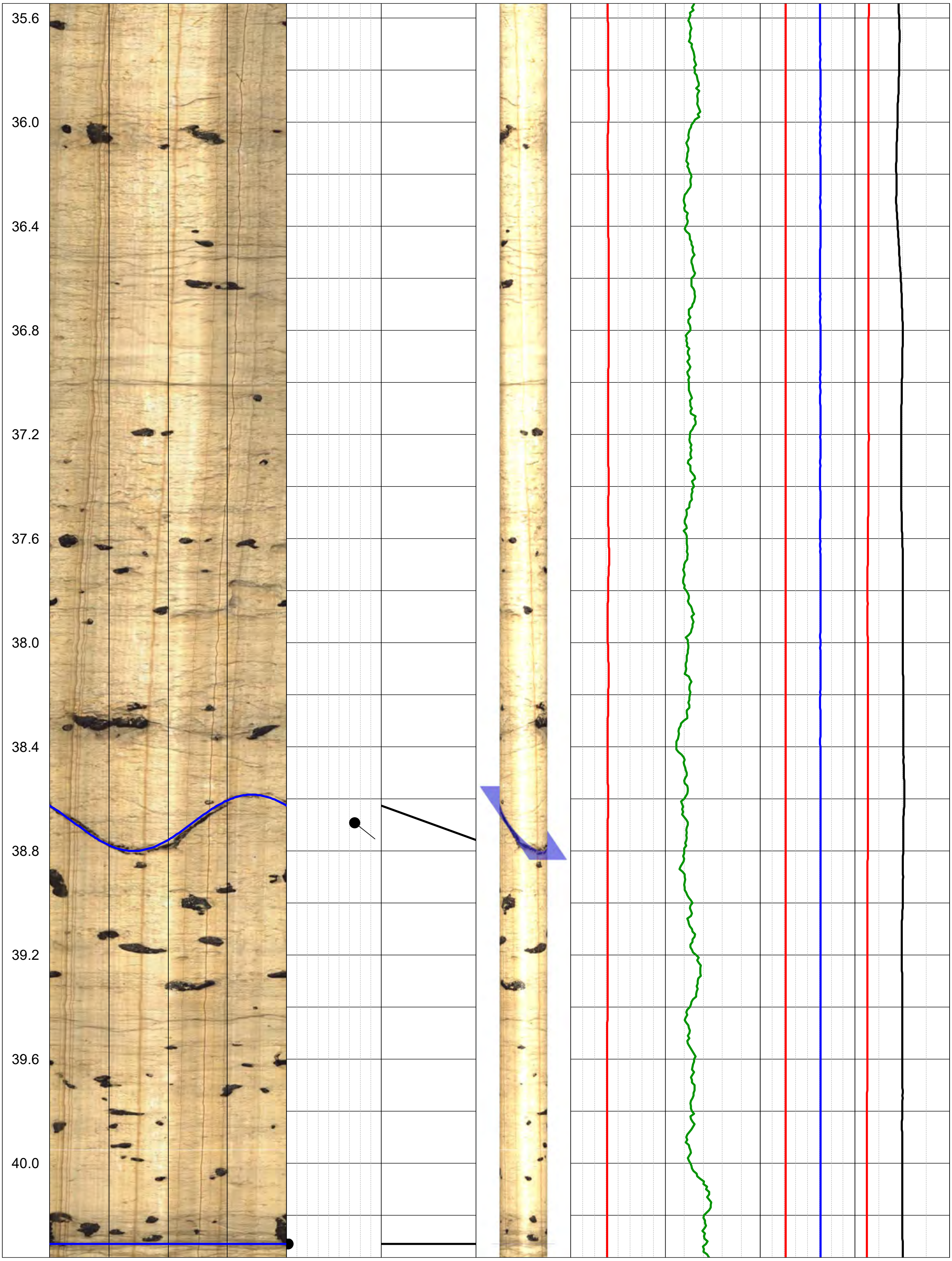

16.4
16.8
17.2
17.6
18.0
18.4
18.8
19.2
19.6
20.0
20.4
20.8

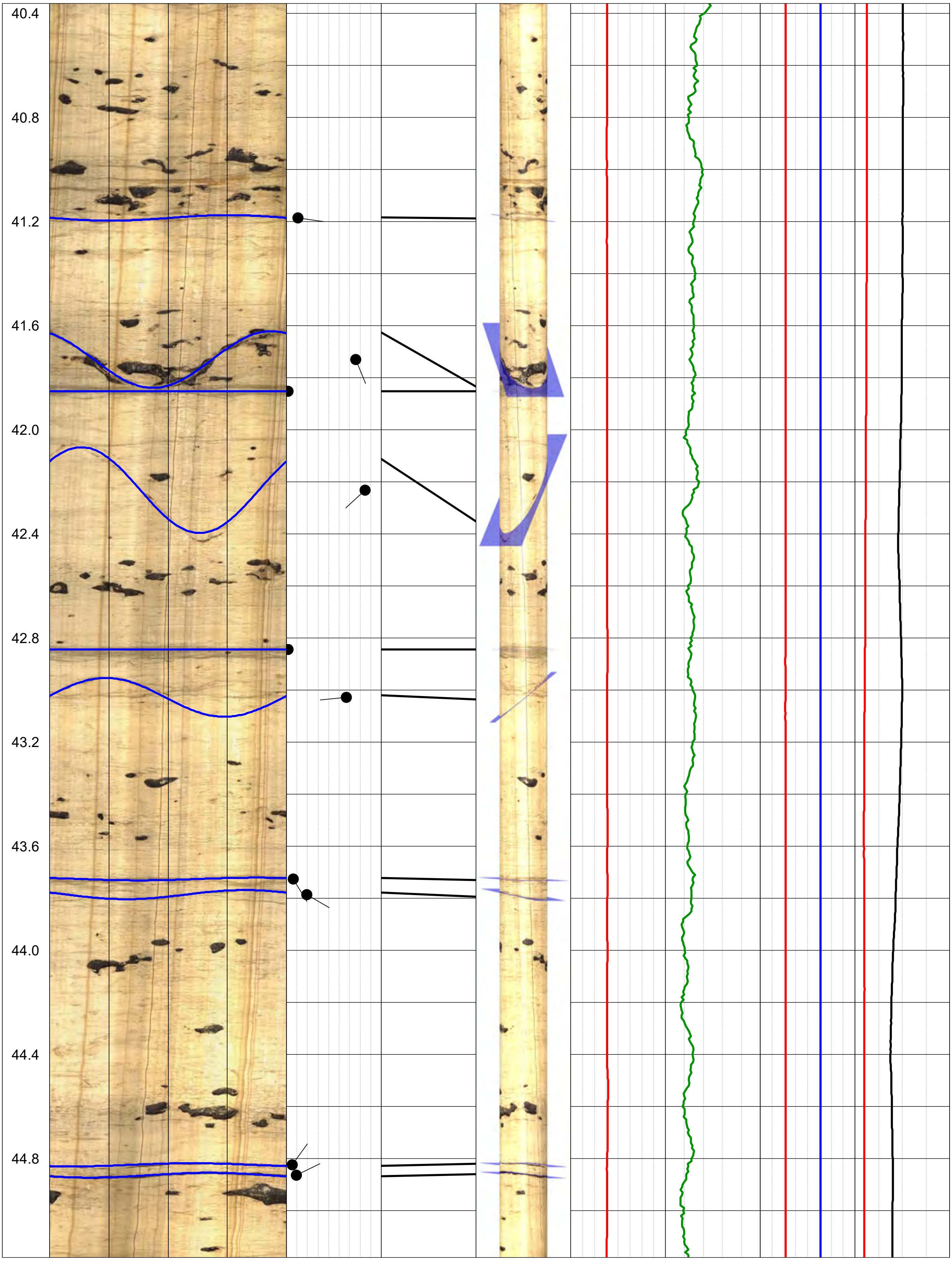

21.2
21.6
22.0
22.4
22.8
23.2
23.6
24.0
24.4
24.8
25.2
25.6

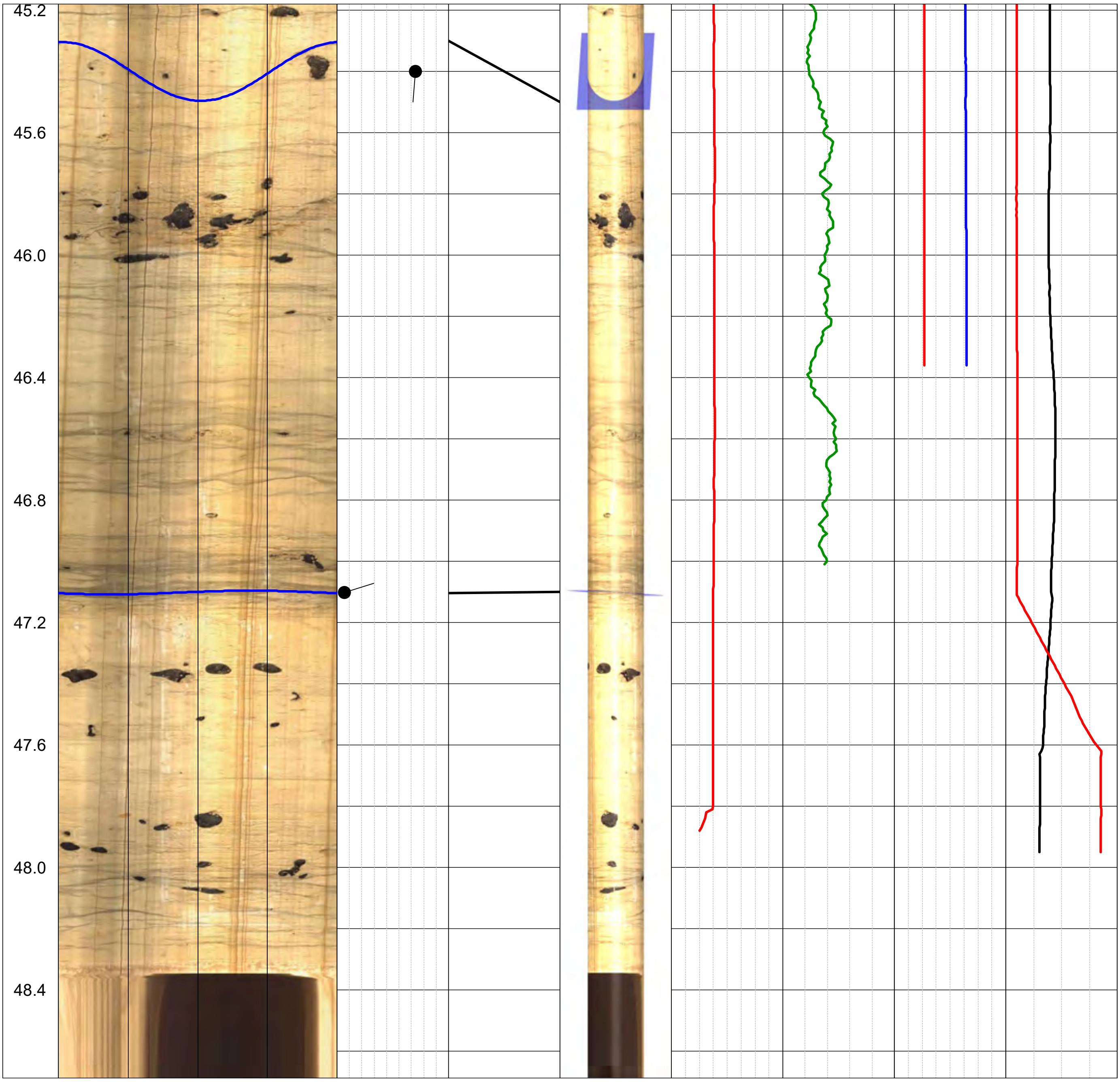

26.0
26.4
26.8
27.2
27.6
28.0
28.4
28.8
29.2
29.6
30.0
30.4



30.8
31.2
31.6
32.0
32.4
32.8
33.2
33.6
34.0
34.4
34.8
35.2


35.6
36.0
36.4
36.8
37.2
37.6
38.0
38.4
38.8
39.2
39.6
40.0


40.4
40.8
41.2
41.6
42.0
42.4
42.8
43.2
43.6
44.0
44.4
44.8


45.2
45.6
46.0
46.4
46.8
47.2
47.6
48.0
48.4

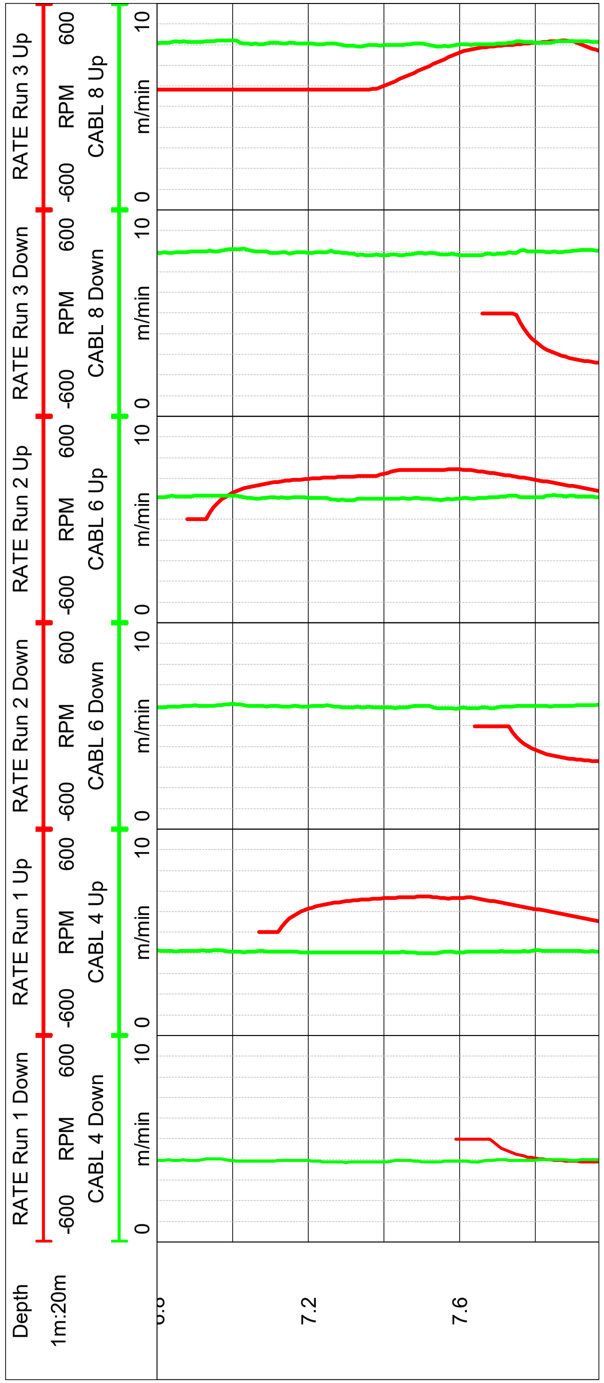
ROBERTSON GEO SERVICES
Unlocking Your GeoData

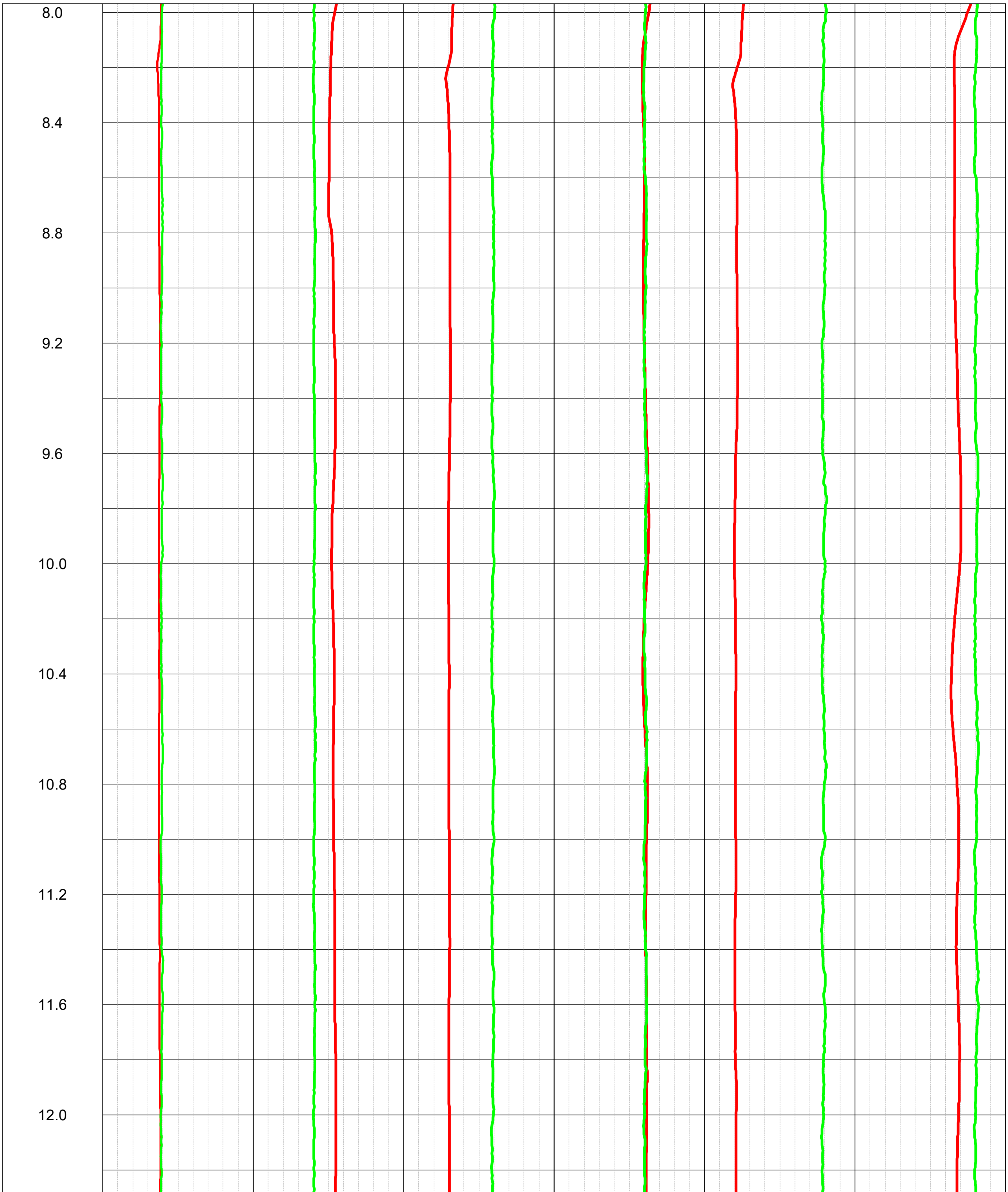
CO Structural Soils	COMPANY	Structural Soils	
WELL R618	WELL ID	R618	
FLD A303 Stonehenge	FIELD	A303 Stonehenge	
CTY England	COUNTRY	England	STATE
STE	LOCATION		OTHER SERVICES
	Easting: 412770.92		
	Northing: 141968.88		
FILING No	SEC	TWP	RGE

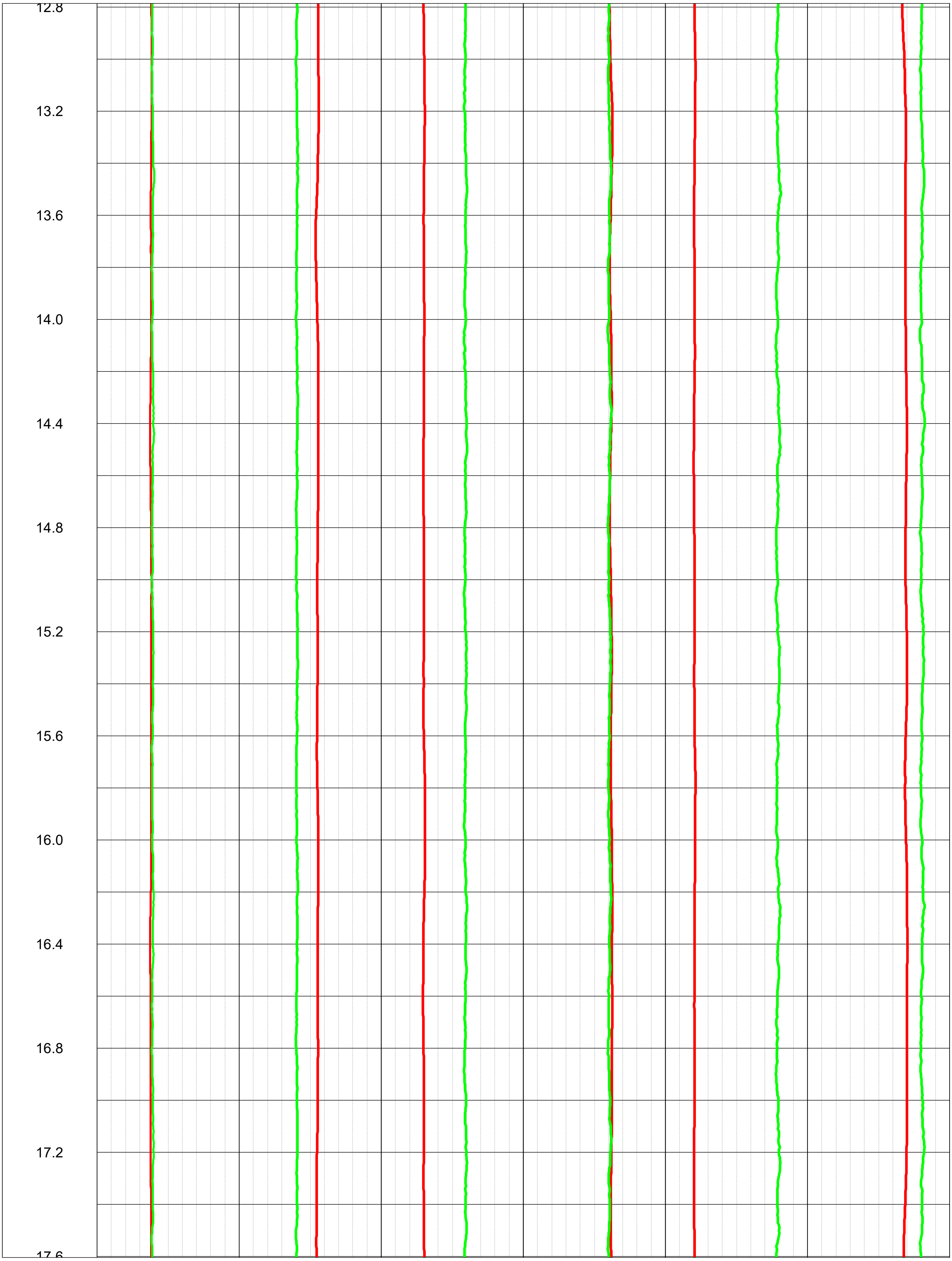
PERMANENT DATUM	GL	ELEVATION	79.507	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM		D.F.
DRILLING MEAS. FROM				G.L.

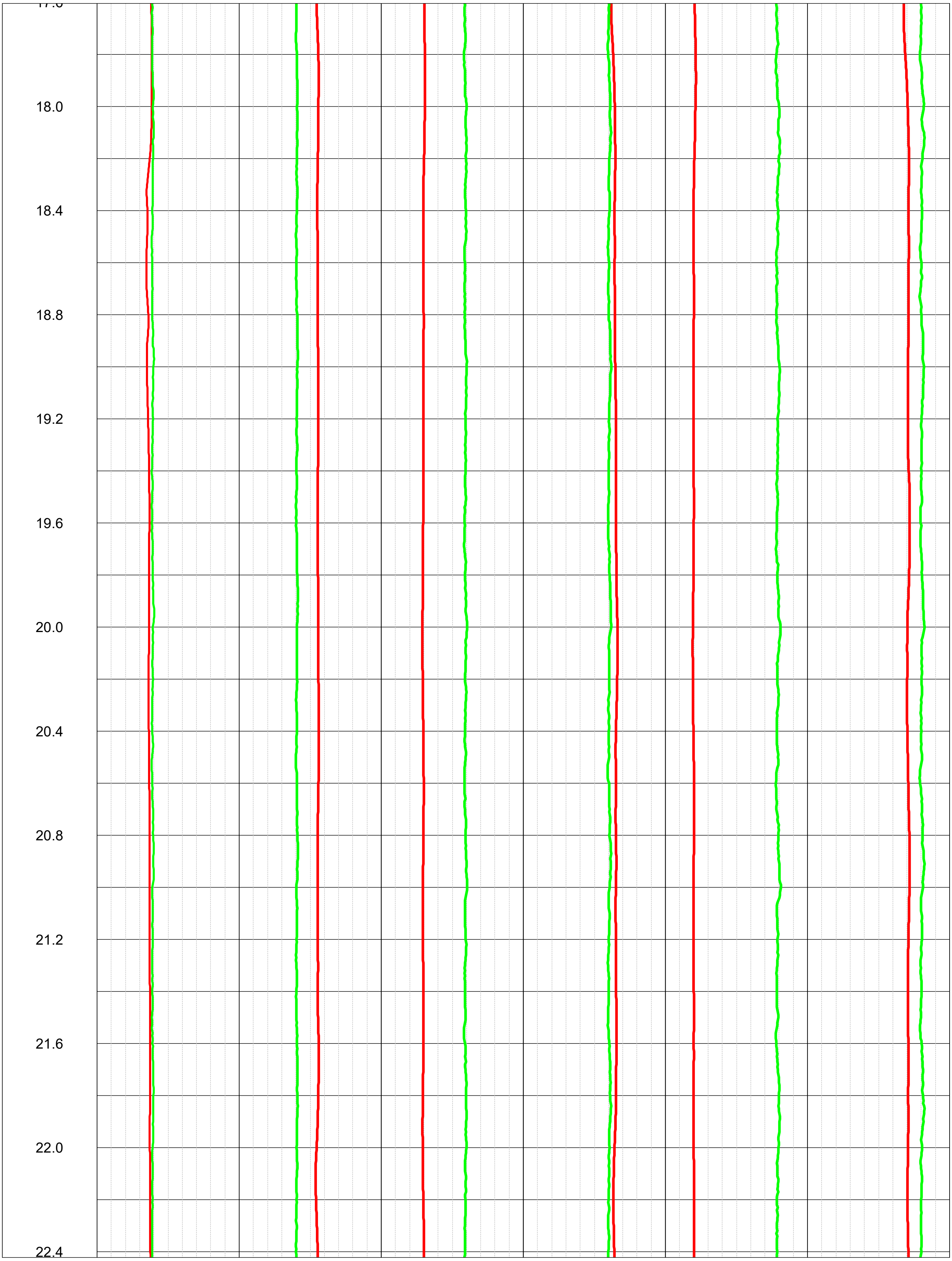
DATE	15/05/18	TYPE FLUID IN HOLE	Water
RUN No		SALINITY	
TYPE LOG	Flowmeter	DENSITY	
DEPTH-DRILLER	48	LEVEL	7.8
DEPTH-LOGGER	48	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	48		
TOP LOGGED INTERVAL	6.8		
OPERATING RIG TIME			
RECORDED BY	James Boyett		
WITNESSED BY	Kyle Owen		

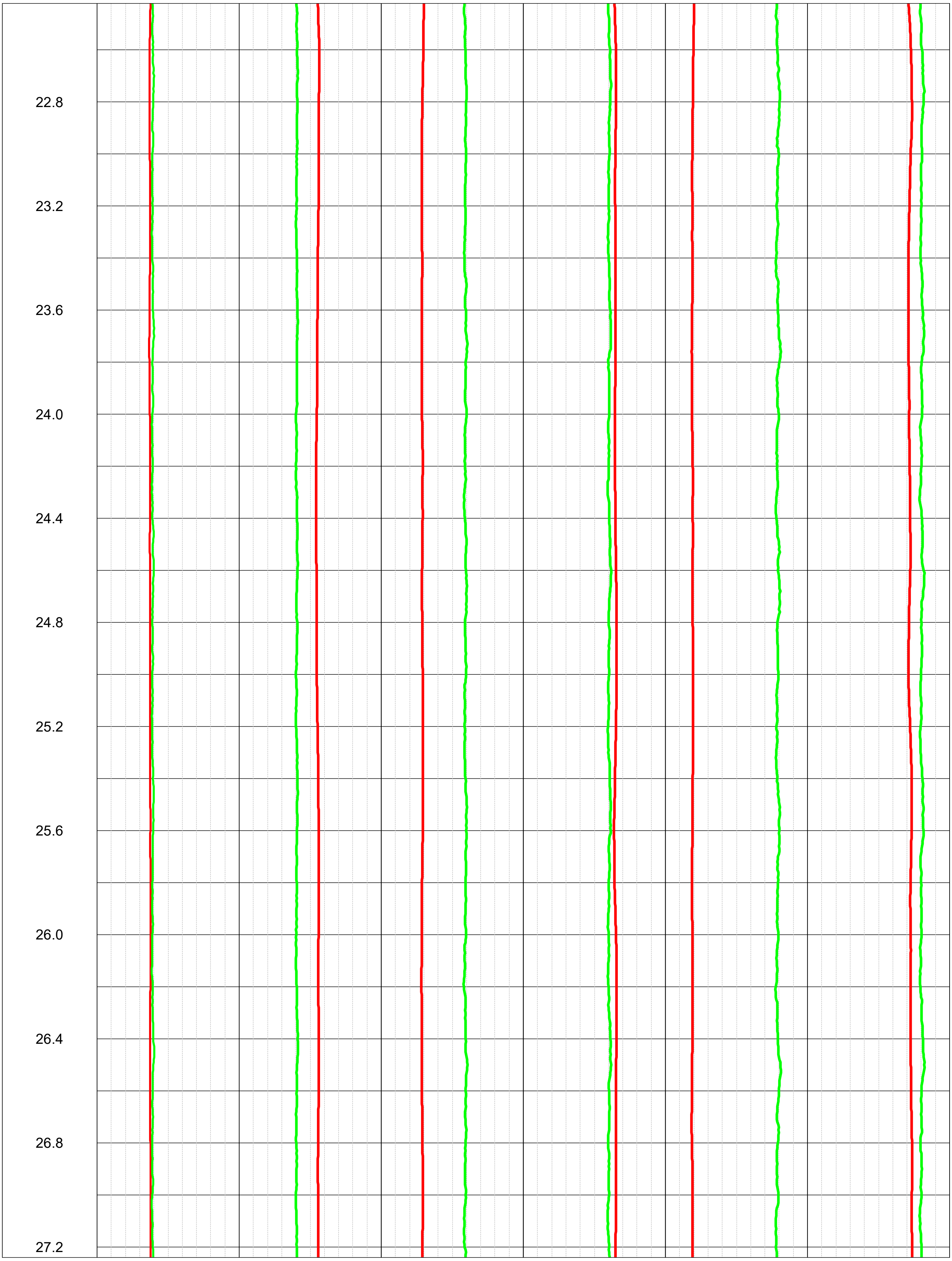
RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO




8.0
8.4
8.8
9.2
9.6
10.0
10.4
10.8
11.2
11.6
12.0
12.4


12.8
13.2
13.6
14.0
14.4
14.8
15.2
15.6
16.0
16.4
16.8
17.2
17.6


17.6
18.0
18.4
18.8
19.2
19.6
20.0
20.4
20.8
21.2
21.6
22.0
22.4


22.8
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25.6
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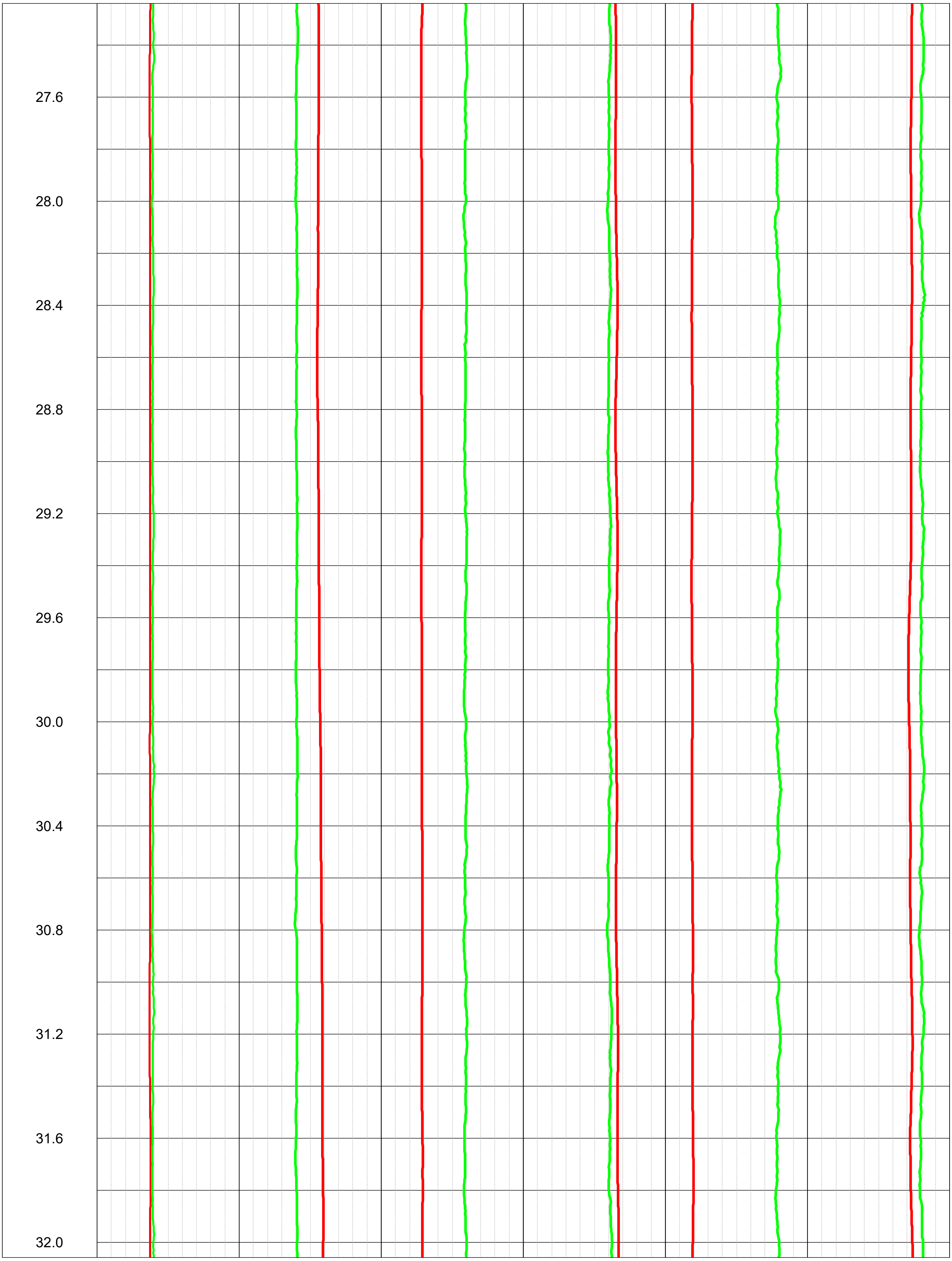
26.8
27.2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30.4
30.8
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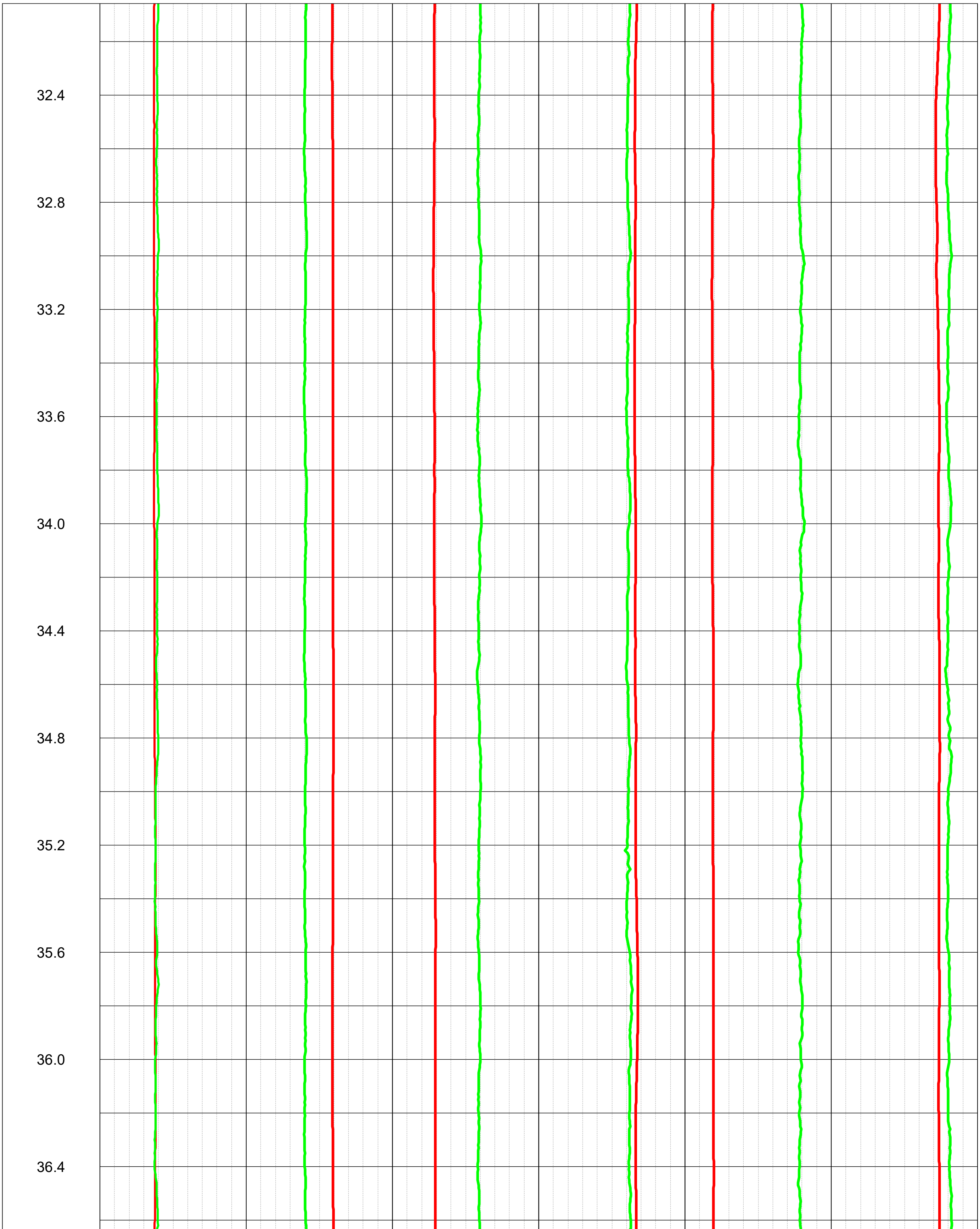
31.6
32.0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34.8
35.2
35.6
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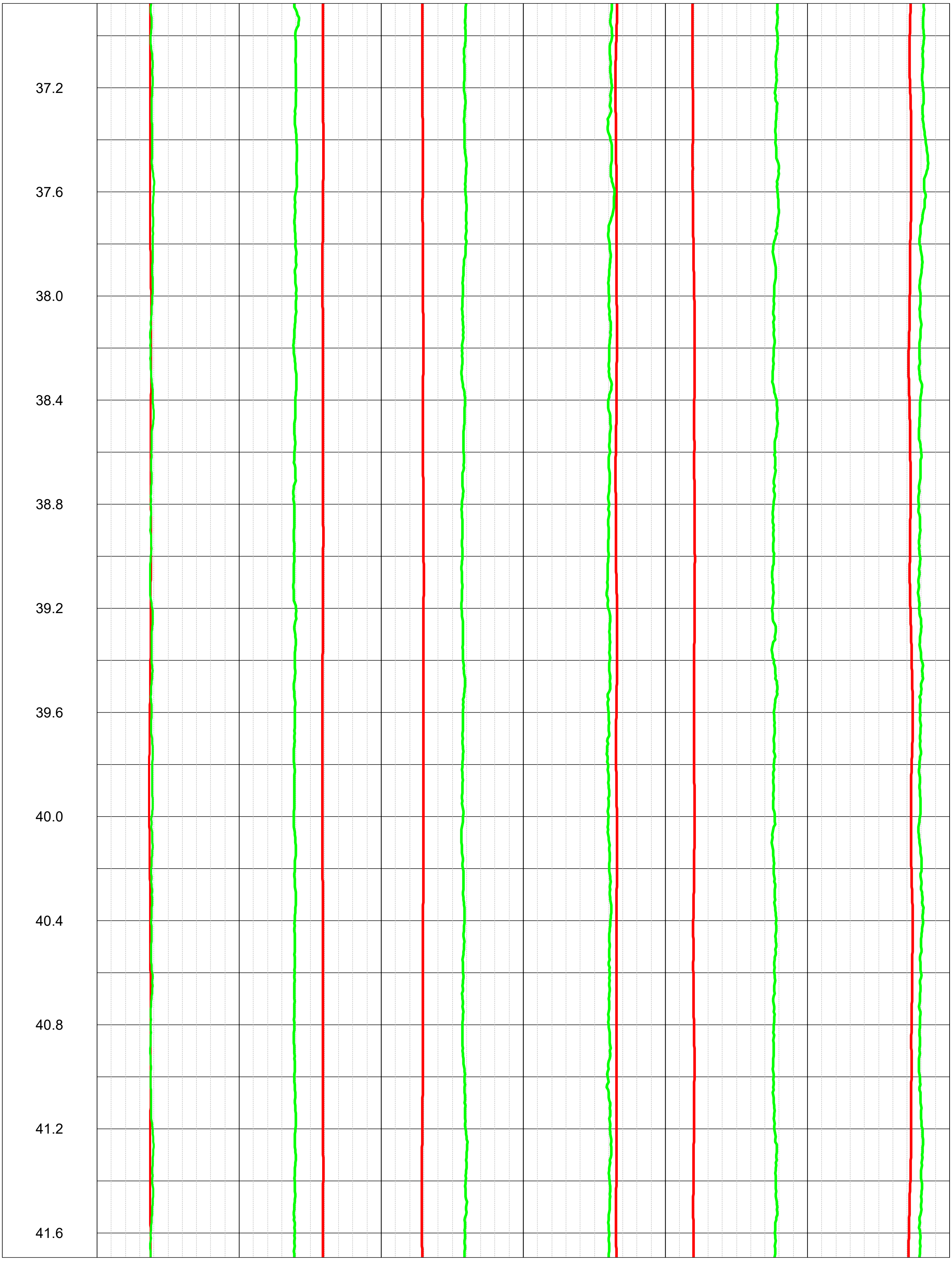
36.4
36.8


37.2
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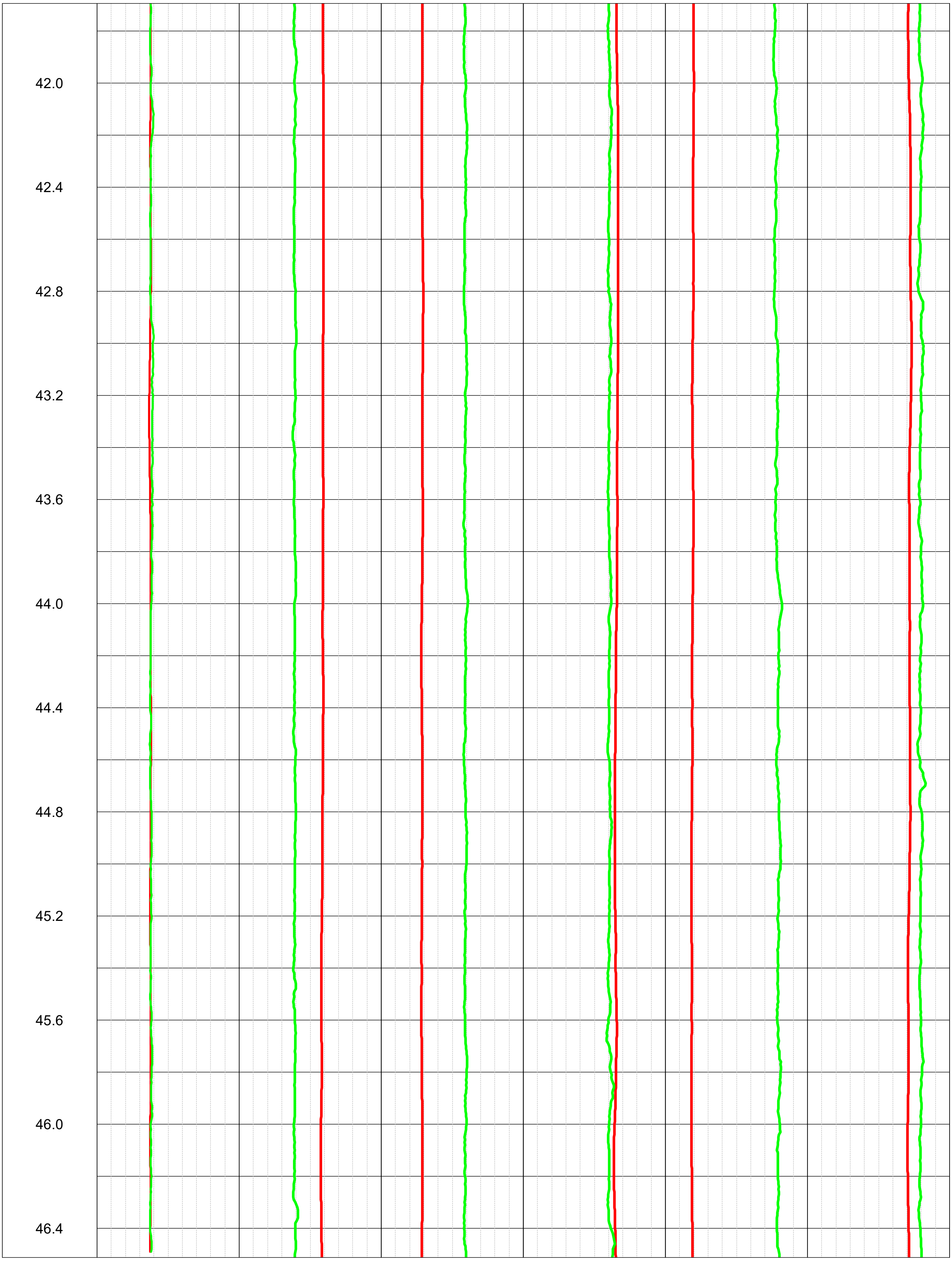
39.2
39.6
40.0
40.4
40.8
41.2
41.6


42.0
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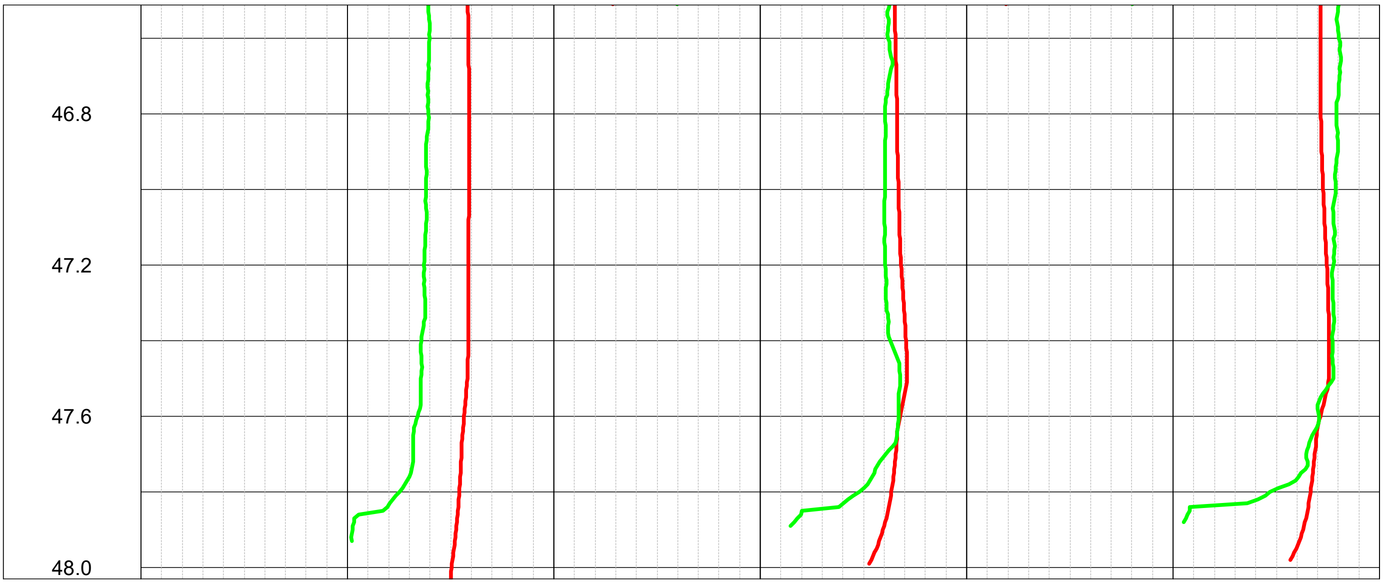
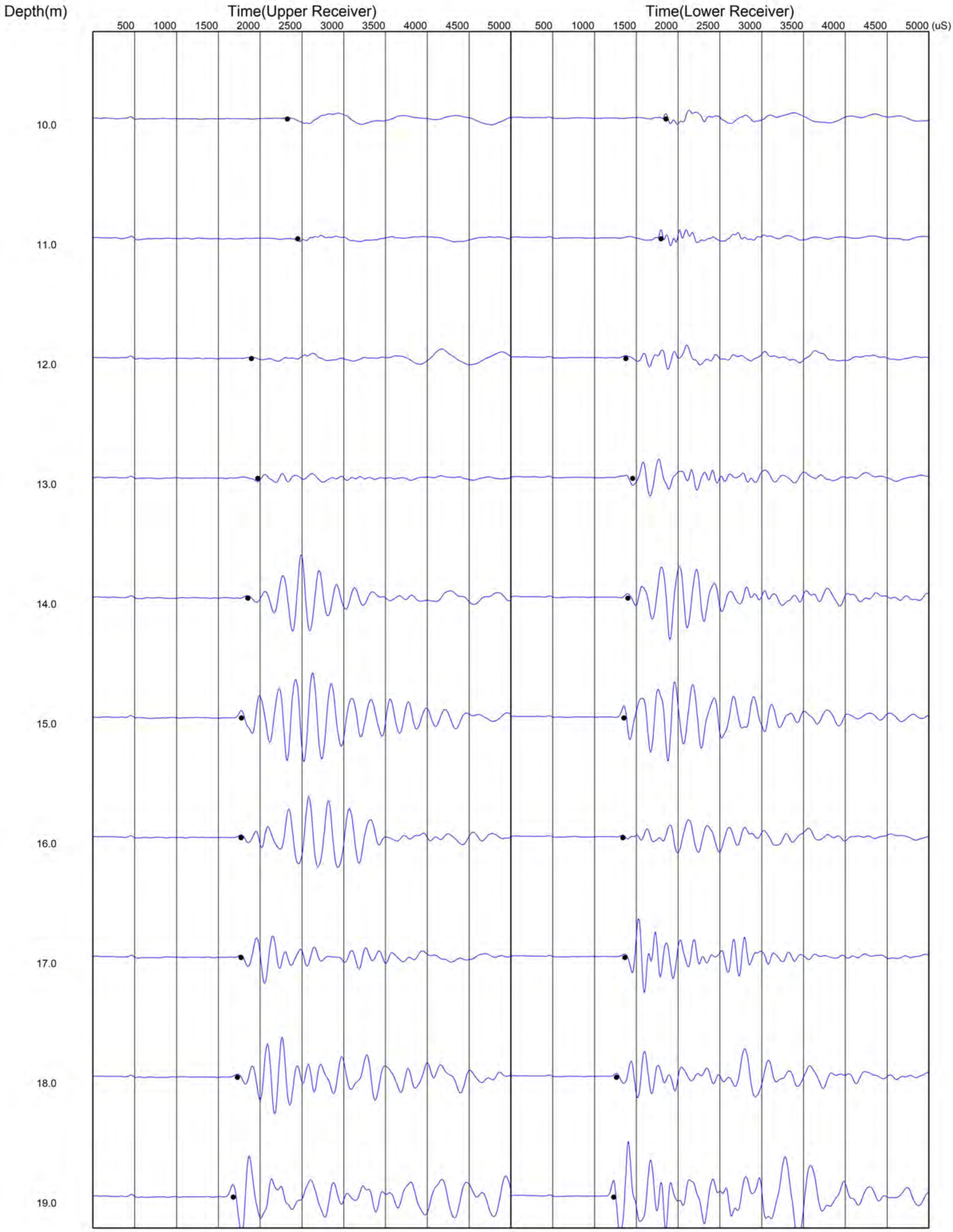
42.8
43.2
43.6
44.0
44.4
44.8
45.2
45.6
46.0
46.4

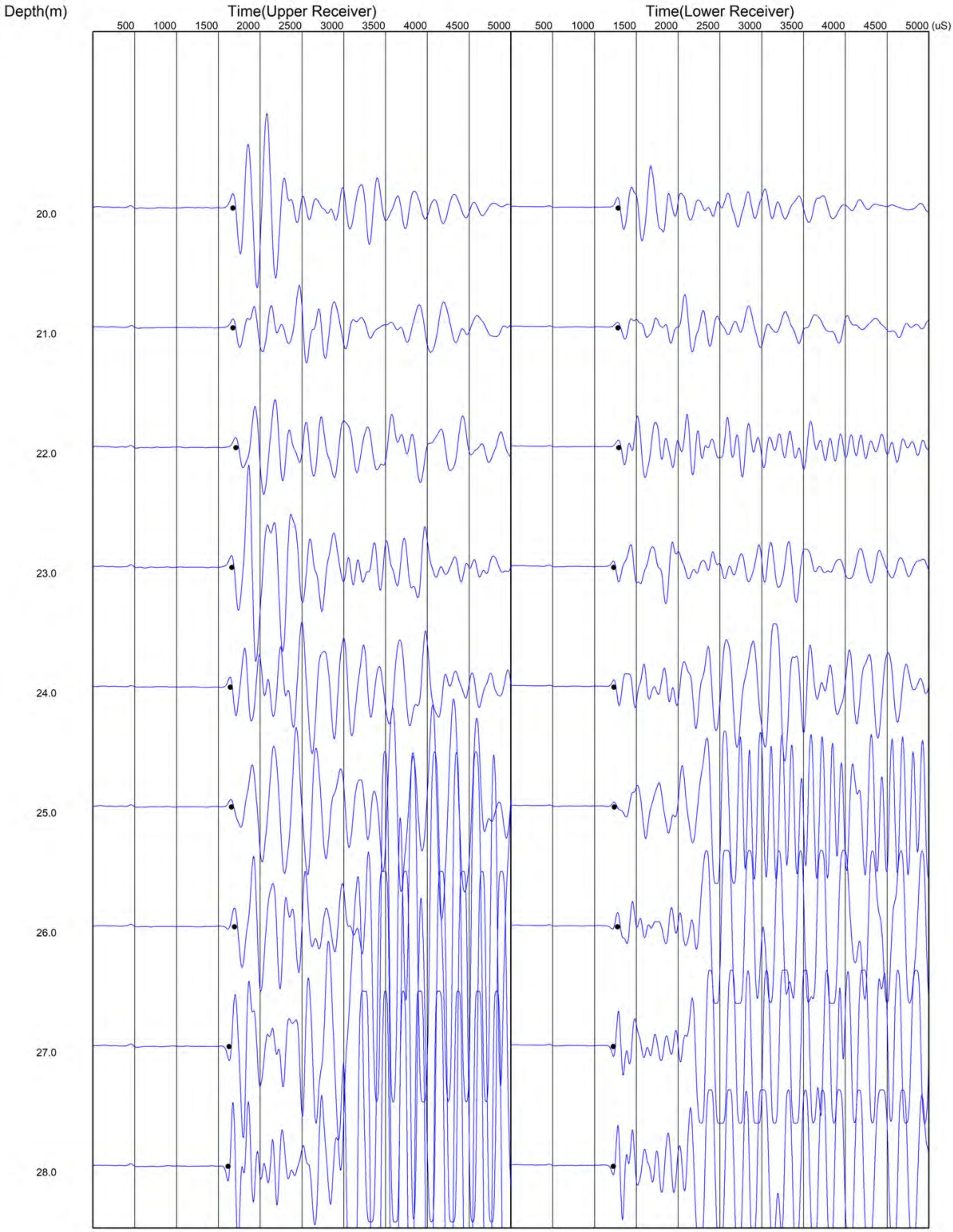

46.8
47.2
47.6
48.0

P Wave



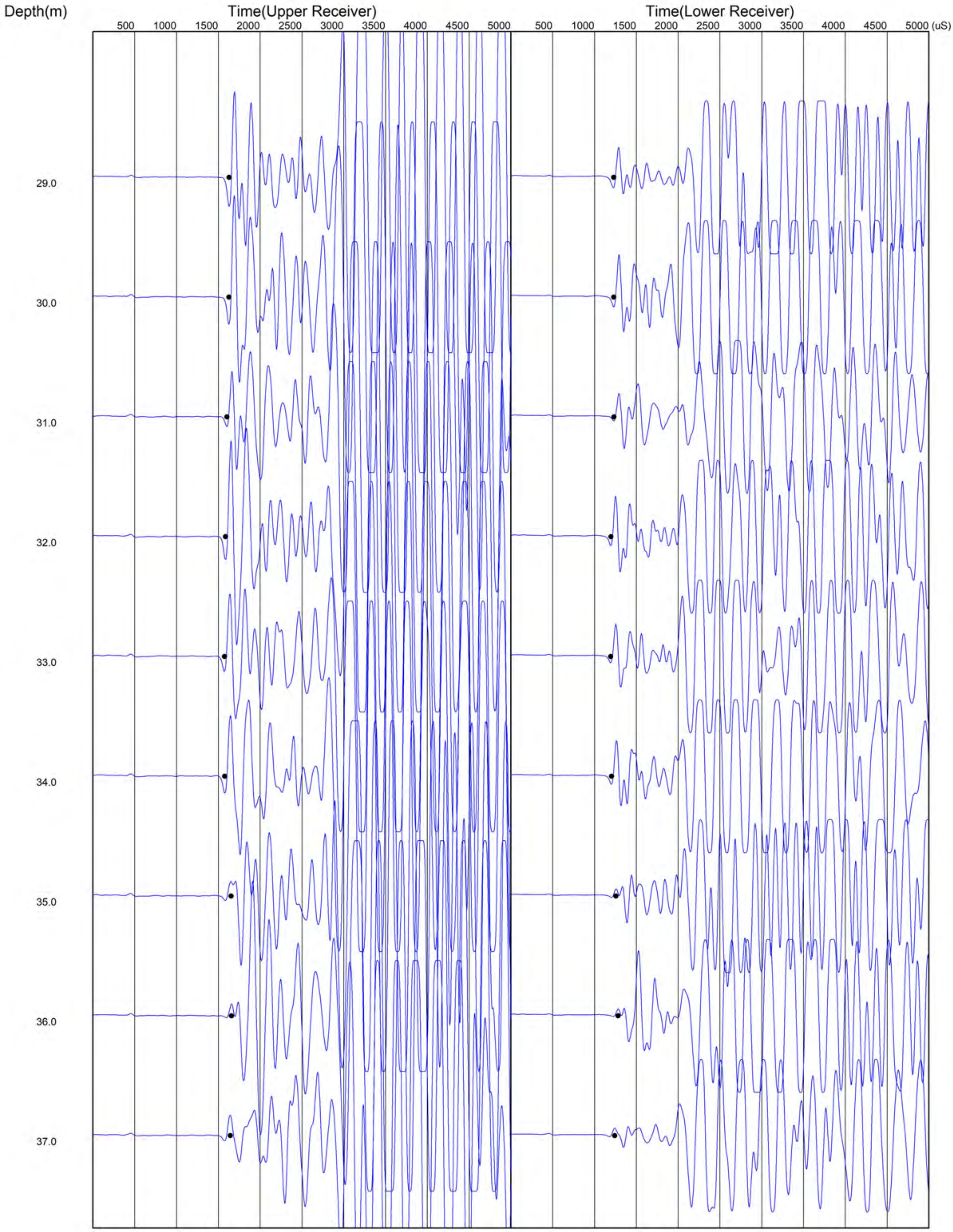
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
10.0
11.0
12.0
13.0
14.0
15.0
16.0
17.0
18.0
19.0

P Wave



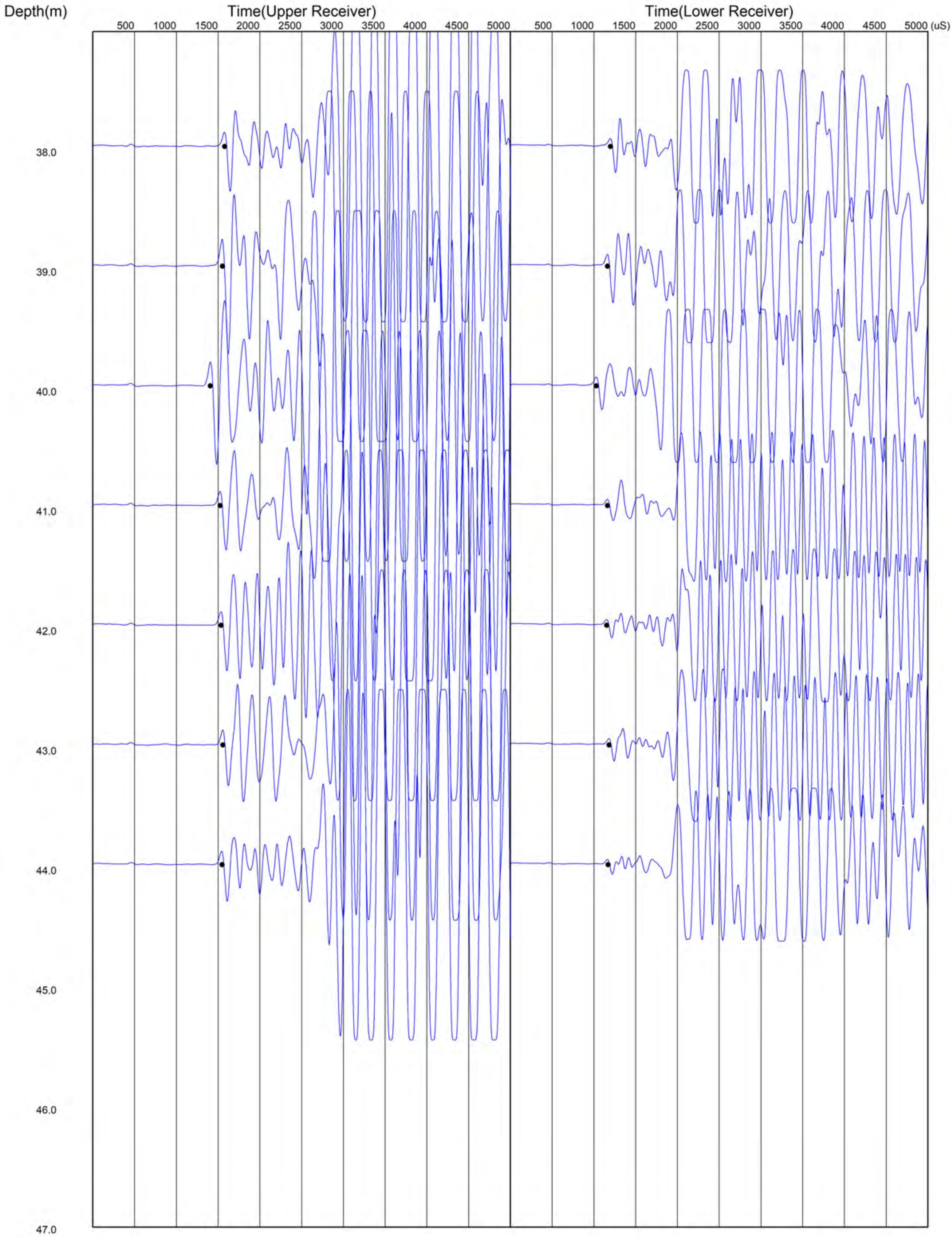
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
20.0
21.0
22.0
23.0
24.0
25.0
26.0
27.0
28.0

P Wave

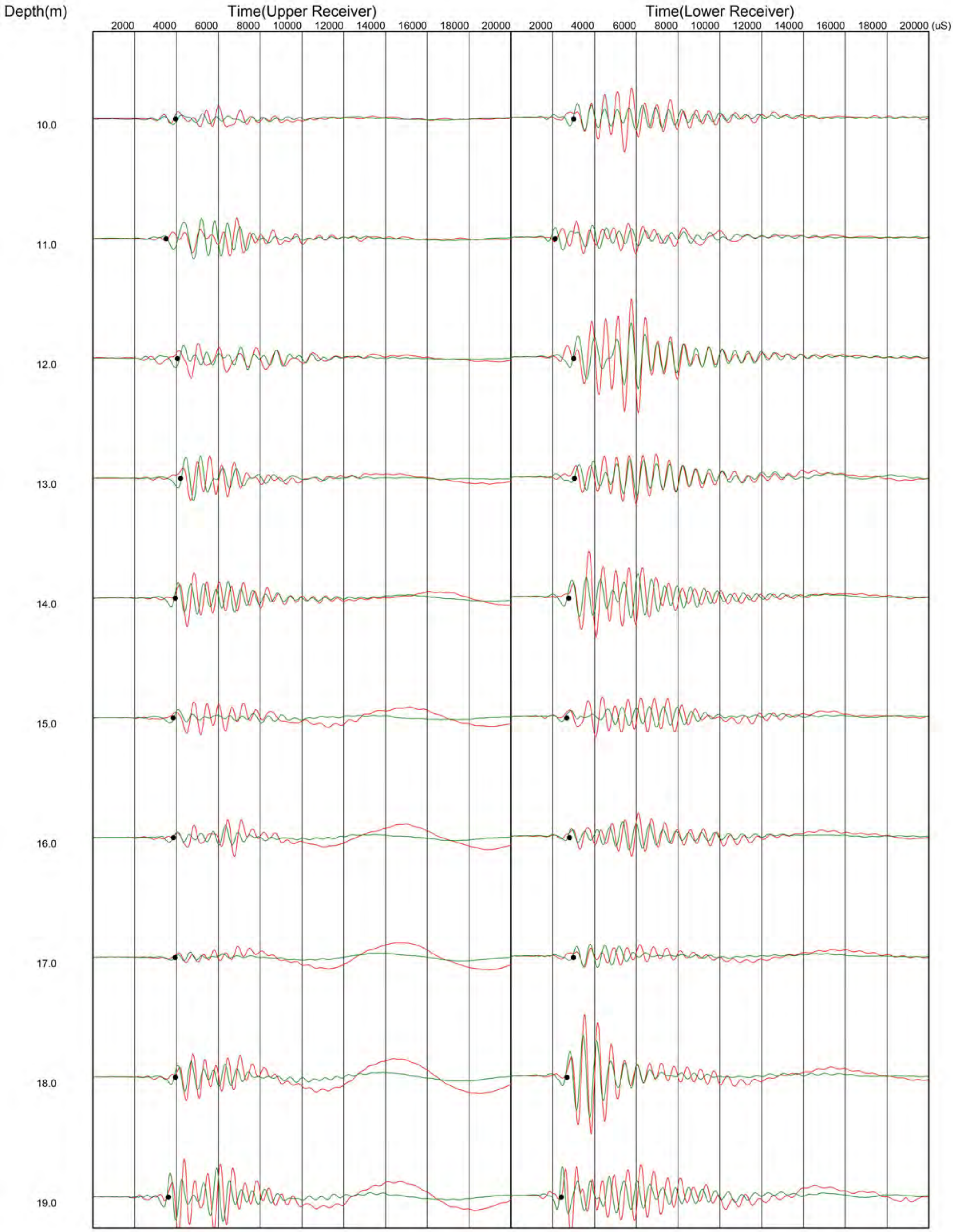


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
29.0
30.0
31.0
32.0
33.0
34.0
35.0
36.0
37.0

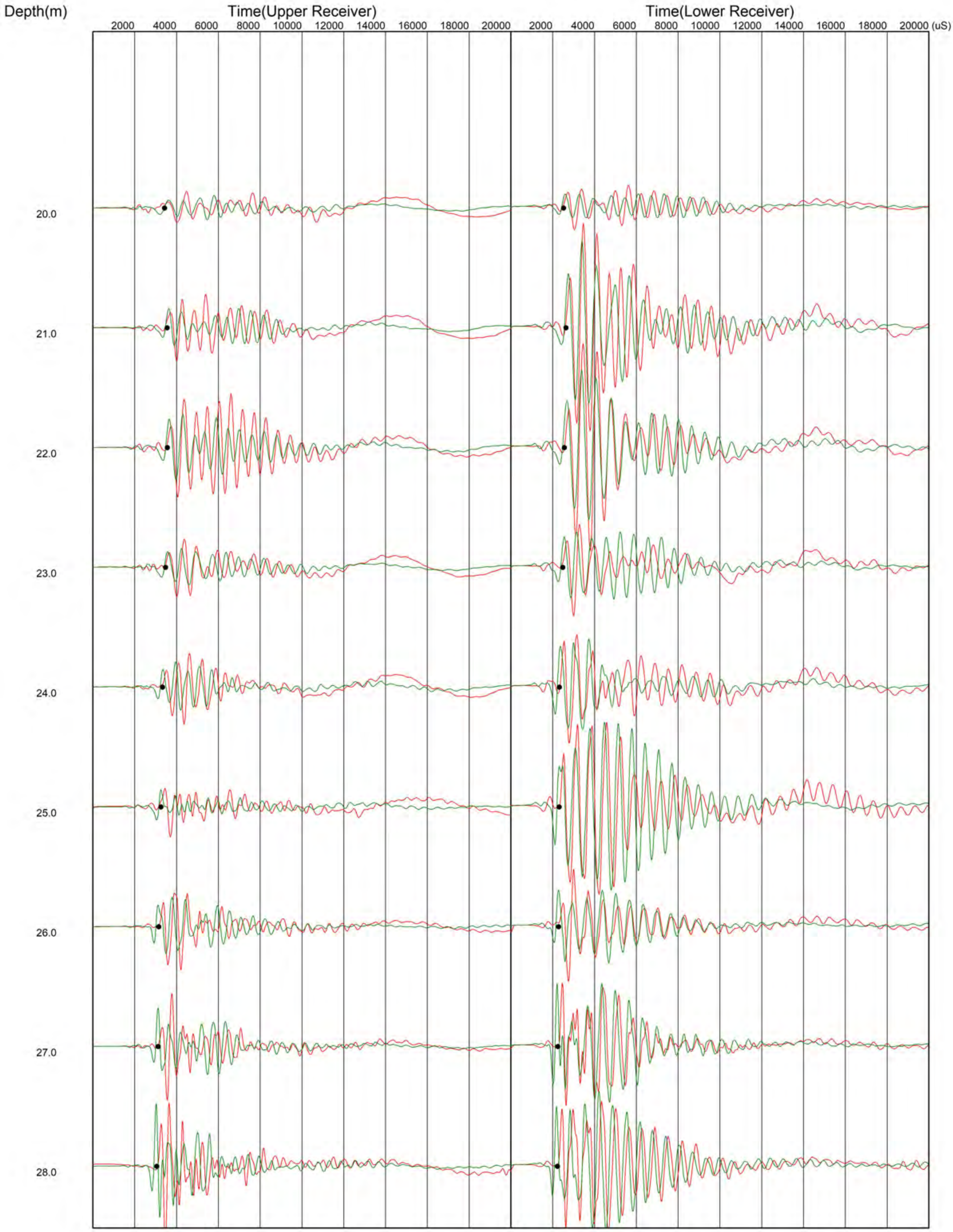
P Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
38.0
39.0
40.0
41.0
42.0
43.0
44.0
45.0
46.0
47.0

S Wave

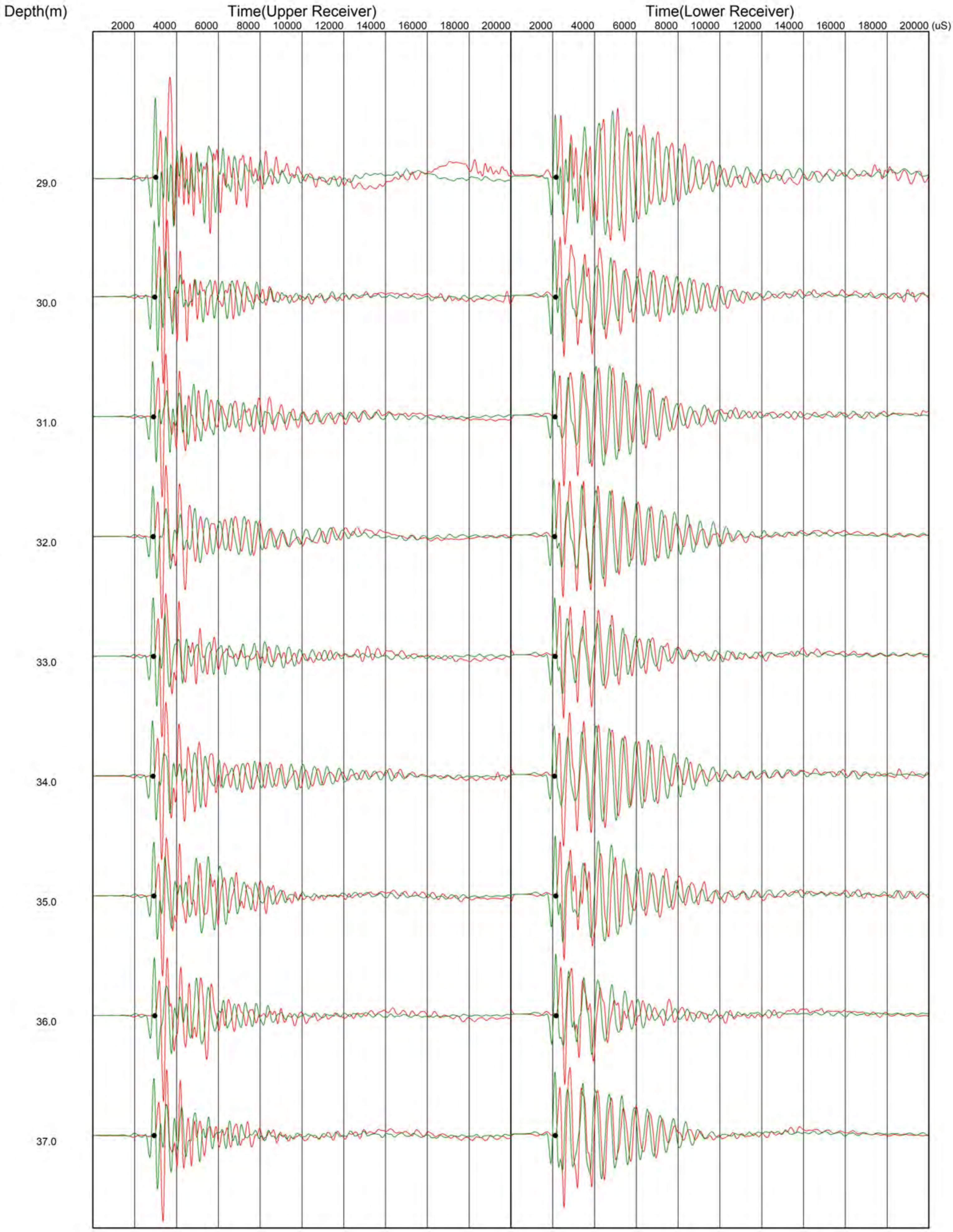

Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
10.0
11.0
12.0
13.0
14.0
15.0
16.0
17.0
18.0
19.0

S Wave



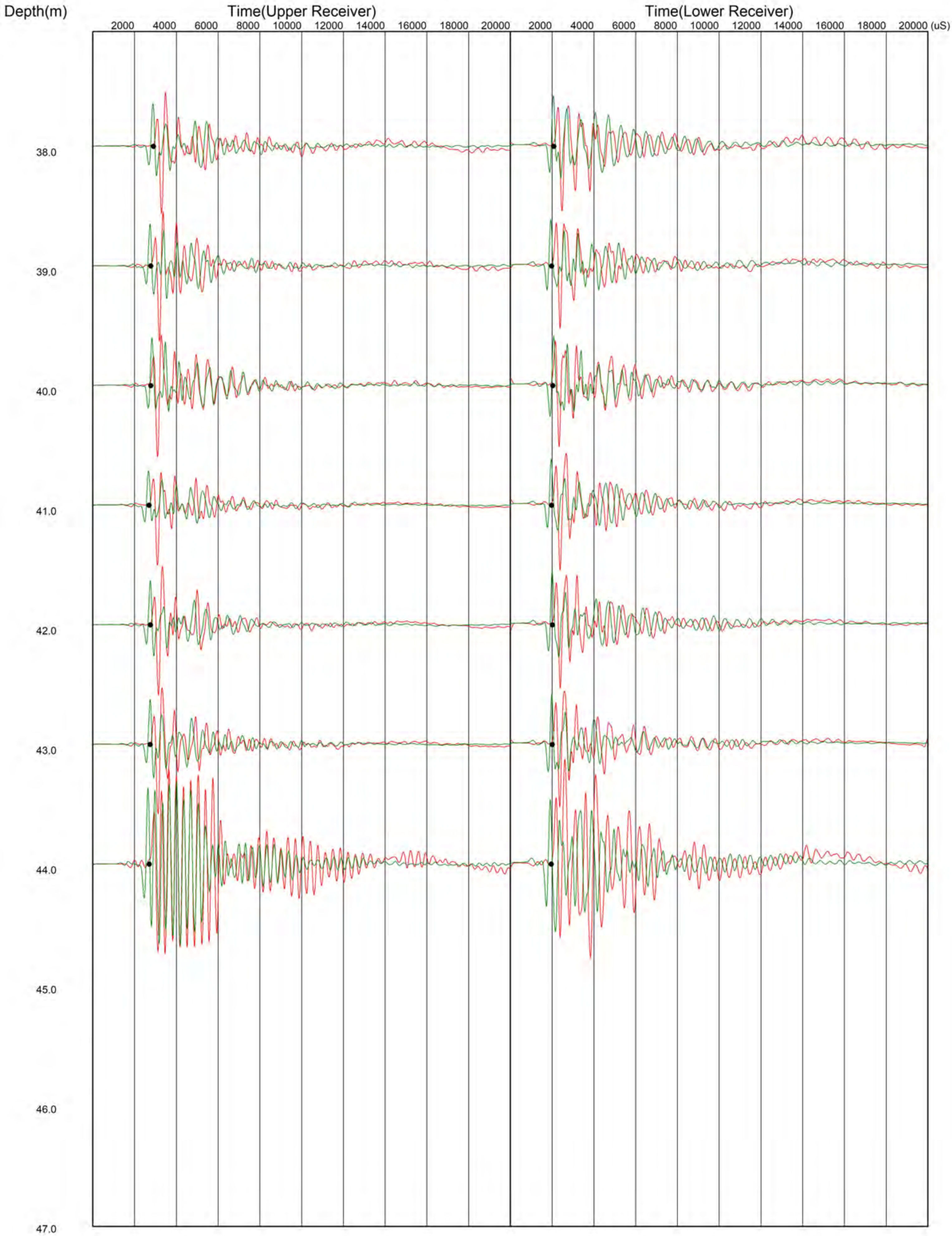
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
(uS)
20.0
21.0
22.0
23.0
24.0
25.0
26.0
27.0
28.0

S Wave



Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
29.0
30.0
31.0
32.0
33.0
34.0
35.0
36.0
37.0

S Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
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39.0
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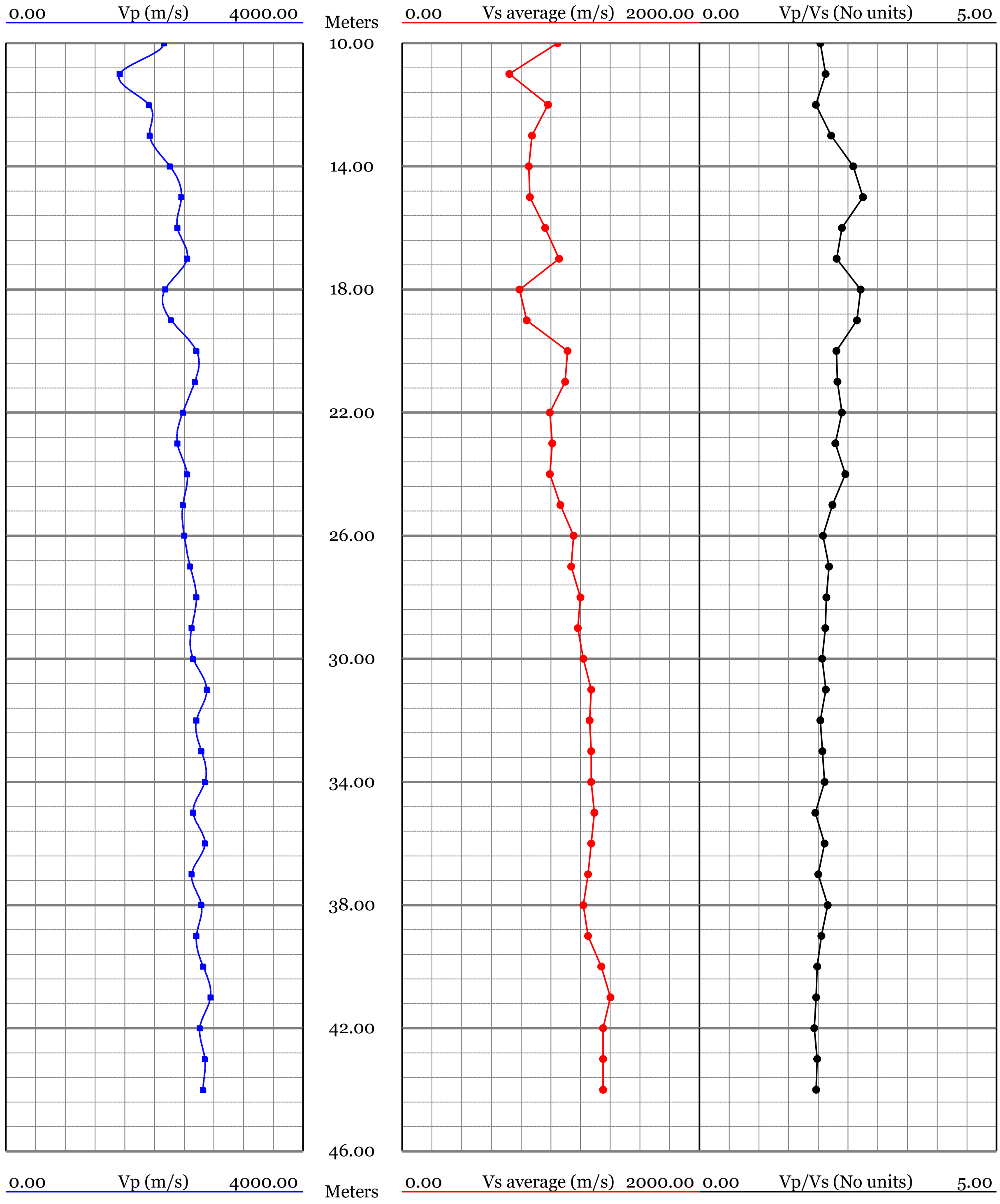
45.0
46.0
47.0


0.00
Vp (m/s)
4000.00
Meters
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00
10.00
14.00
18.00
22.00
26.00
30.00
34.00
38.00
42.00
46.00
0.00
Vp (m/s)
4000.00
Meters
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00

Depth	Azimuth	Dip	Aperture
m	deg	deg	mm
11.67	35.02	73.30	0.00
12.07	242.94	23.19	0.00
12.92	29.14	21.52	0.00
13.54	248.42	16.12	0.00
13.91	240.86	44.30	0.00
14.19	354.28	12.61	0.00
15.93	43.15	23.38	0.00
16.05	40.93	28.93	0.00
17.43	274.10	69.89	0.00
17.94	316.08	27.14	0.00
18.37	167.07	18.97	0.00
19.09	271.92	4.75	0.00
19.46	266.74	23.81	0.00
20.24	246.88	44.22	0.00
20.92	190.17	11.31	0.00
22.51	0.00	0.00	0.00
22.96	240.93	68.14	0.00
23.08	50.91	55.75	0.00
24.04	40.24	25.03	0.00
24.63	146.65	41.35	0.00
25.47	40.85	6.46	0.00
26.08	30.65	12.14	0.00
26.77	241.59	75.41	0.00
31.66	82.09	48.39	0.00
31.73	254.97	35.64	0.00
32.36	19.87	4.57	0.00
33.28	110.58	8.56	0.00
33.80	193.86	49.59	0.00
38.69	127.43	65.23	0.00
40.31	0.00	0.00	0.00
41.19	92.79	12.03	0.00
41.73	157.06	65.36	0.00
41.85	0.00	0.00	0.00
42.23	227.93	73.13	0.00
42.84	0.00	0.00	0.00
43.03	265.50	56.07	0.00
43.73	136.08	5.85	0.00
43.79	116.37	19.35	0.00
44.82	35.95	6.84	0.00
44.86	61.57	10.43	0.00

45.40	184.18	62.50	0.00
47.10	67.42	6.98	0.00

ROBERTSON GEO SERVICES®
Unlocking Your GeoData

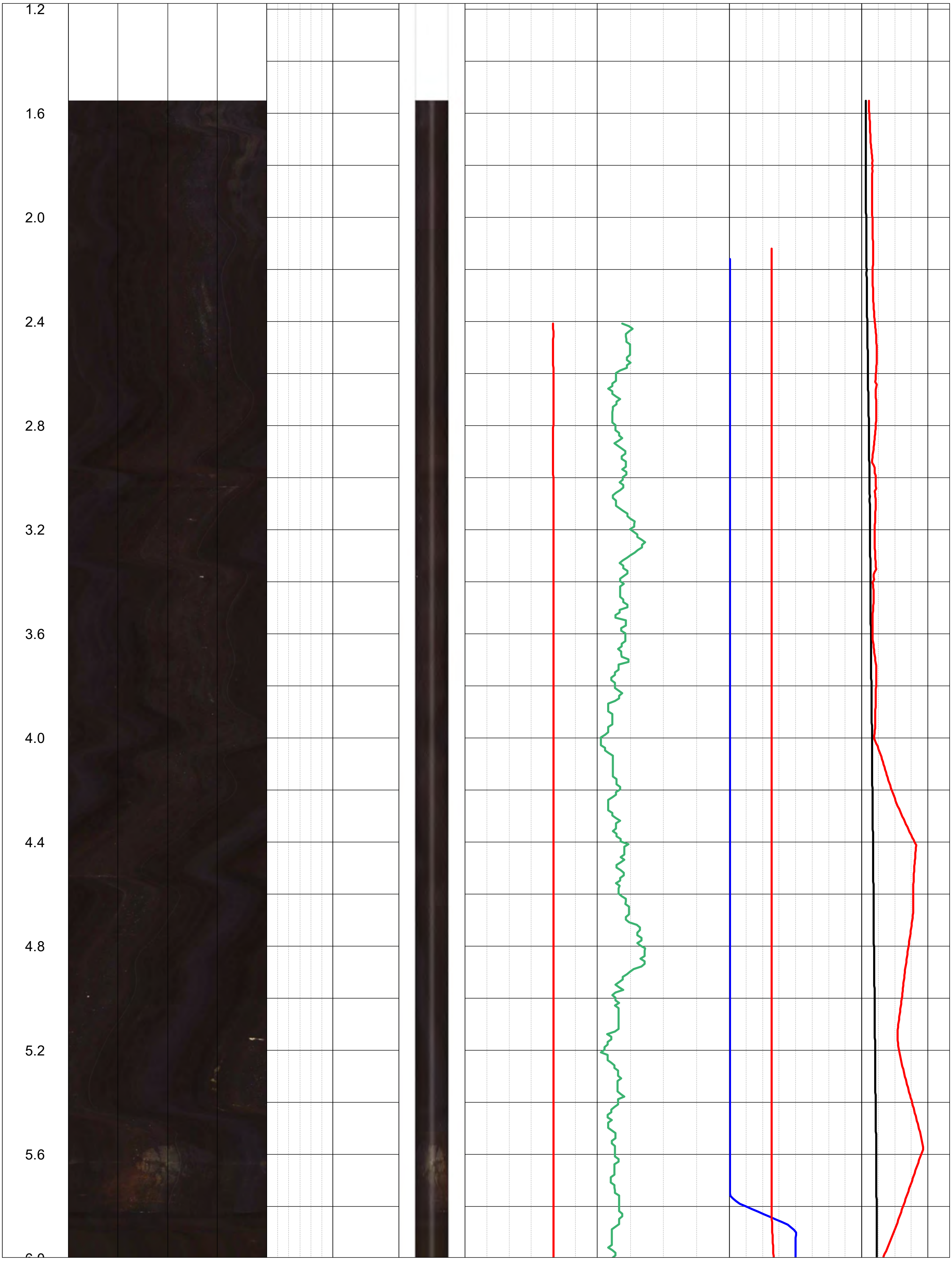
CO Structural Soils
WELL R620
FLD A303 Stonehenge
CTY England
STE
FILING No

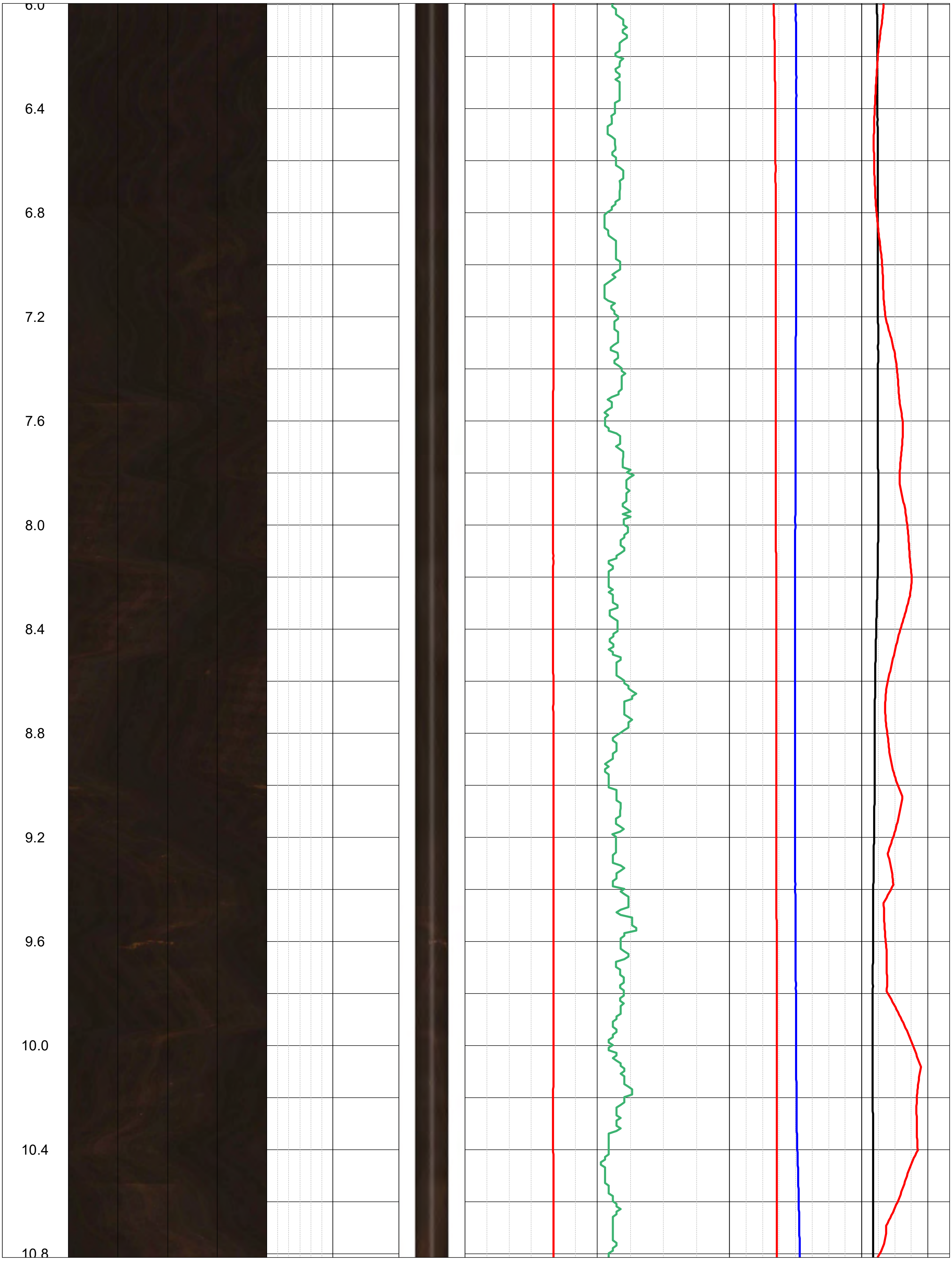
COMPANY	Structural Soils		
WELL ID	R620		
FIELD	A303 Stonehenge		
COUNTRY	England	STATE	
LOCATION			OTHER SERVICES
Easting: 412752.1			
Northing: 141959.2			
SEC	TWP	RGE	
PERMANENT DATUM	GL	ELEVATION 79.479	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.

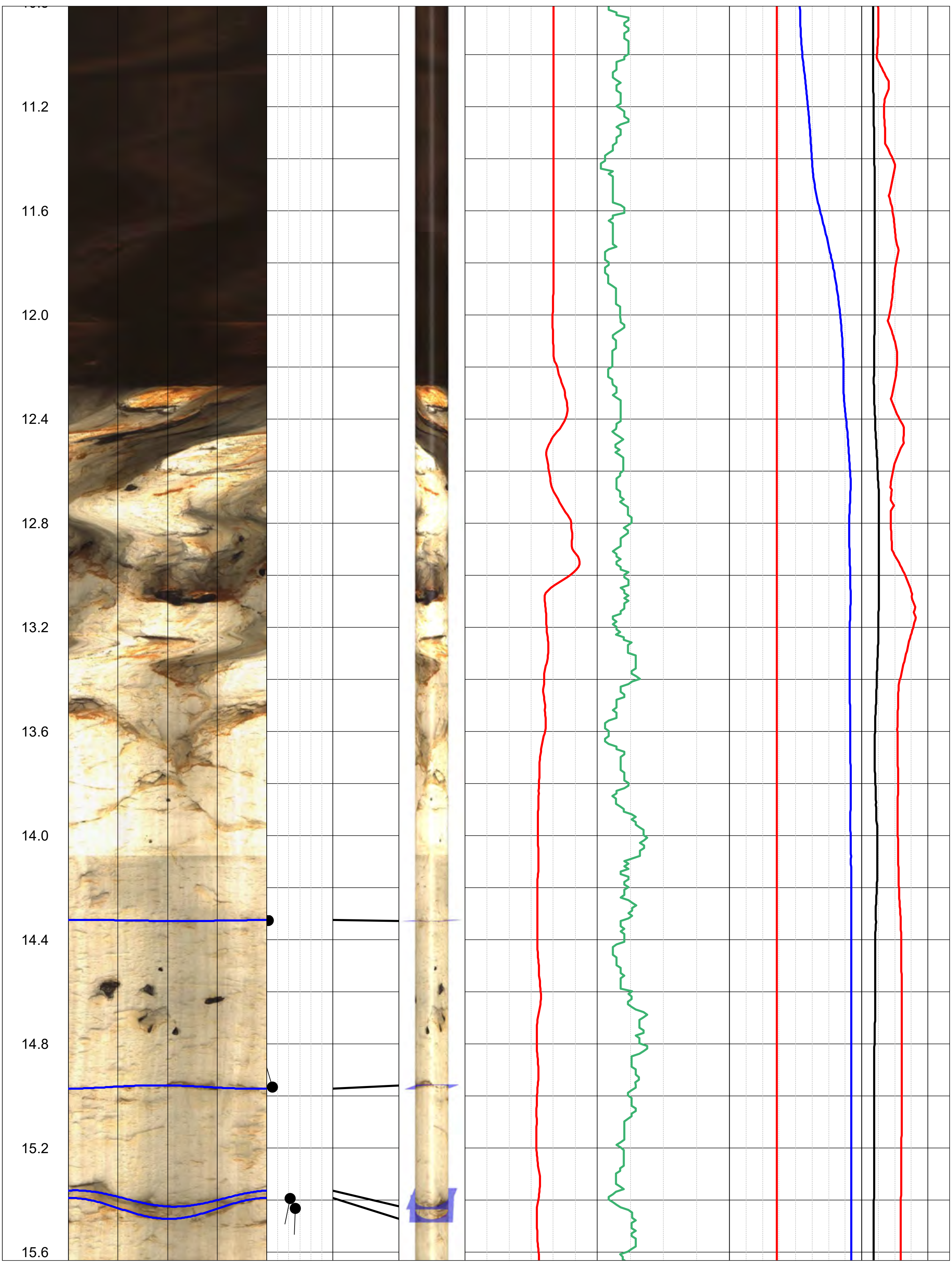
DATE	02/05/18	TYPE FLUID IN HOLE	Water
RUN No		SALINITY	
TYPE LOG	Composite	DENSITY	
DEPTH-DRILLER	48	LEVEL	5.8
DEPTH-LOGGER	48	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	48		
TOP LOGGED INTERVAL	1.6		
OPERATING RIG TIME			
RECORDED BY	James Boyett		
WITNESSED BY	Kyle Owen		

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

Depth	Projections	Dips	Dips 2	3D Log	CALP	NGAM	COND	INCL
1m:20m	0° 90° 180° 270° 0°	0 90		180°	0 MM 300	0 API 20	0 uS/cm 800	0 4
	Optical						TEMP	Azimuth
	0° 90° 180° 270° 0°						0 DegC 30	0 360
0.4								
0.8								


1.2
1.6
2.0
2.4
2.8
3.2
3.6
4.0
4.4
4.8
5.2
5.6
6.0


6.0
6.4
6.8
7.2
7.6
8.0
8.4
8.8
9.2
9.6
10.0
10.4
10.8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12.0
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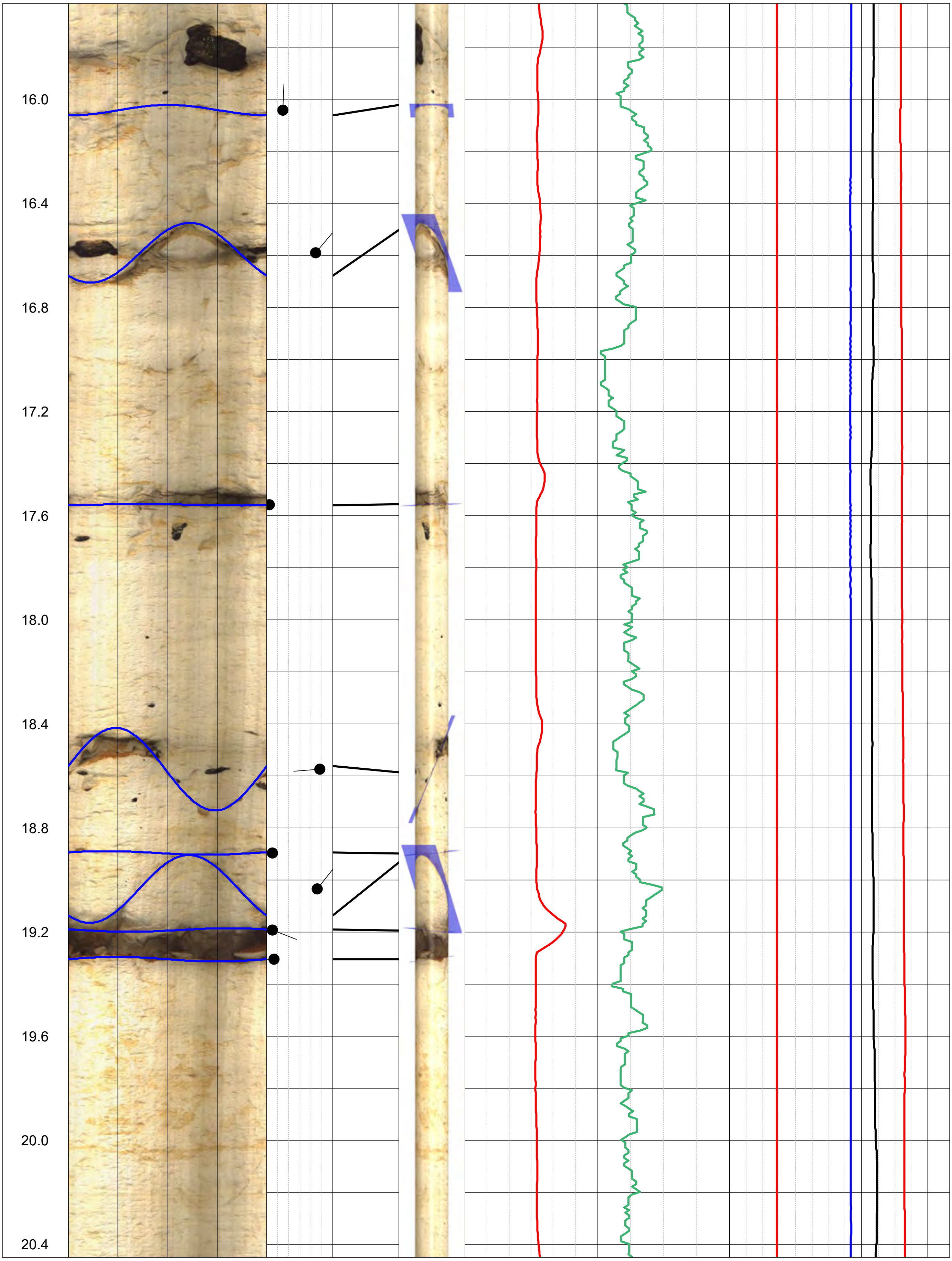
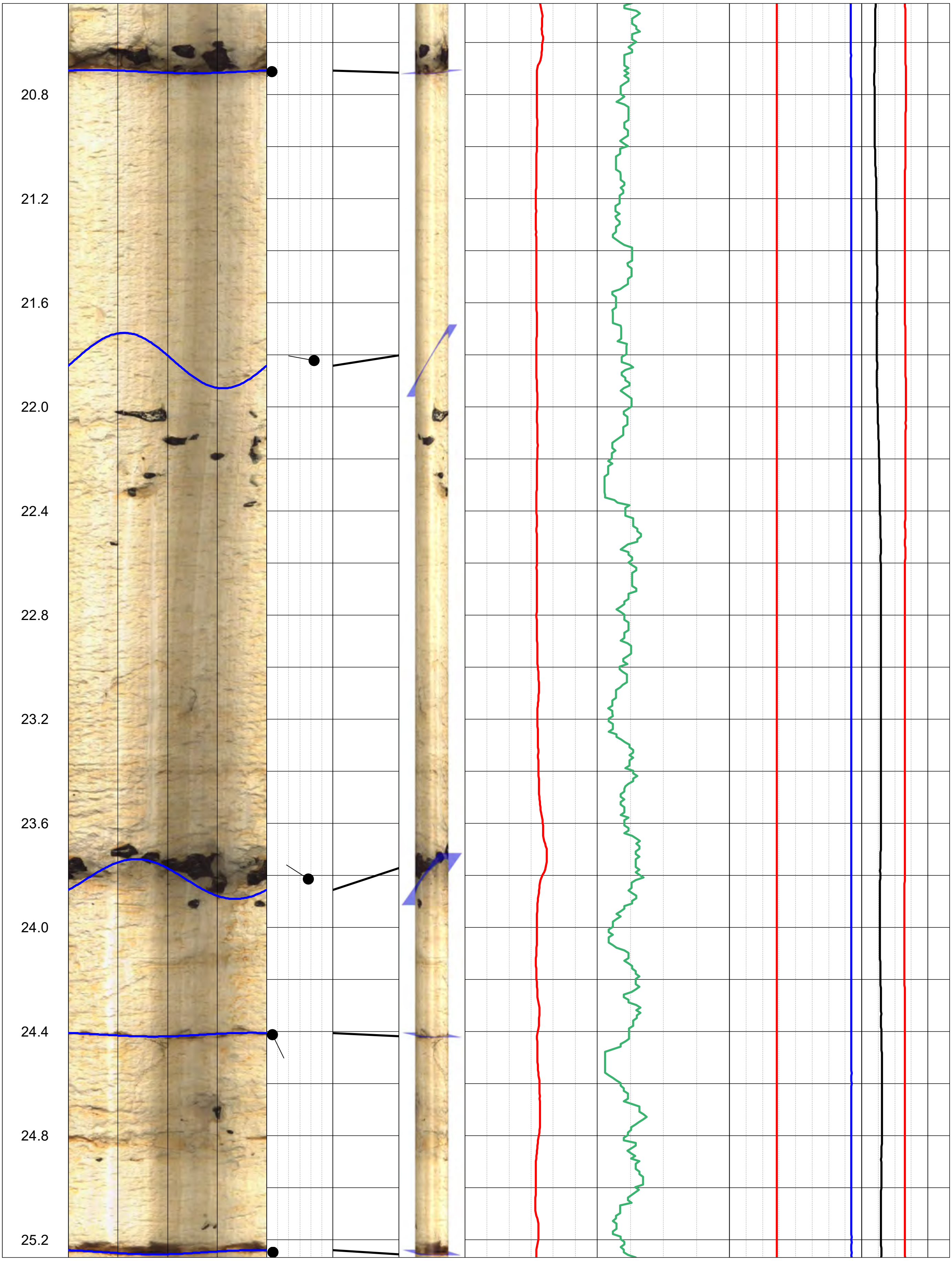
12.8
13.2
13.6
14.0
14.4
14.8
15.2
15.6


16.0
16.4
16.8
17.2
17.6
18.0
18.4
18.8
19.2
19.6
20.0
20.4


20.8
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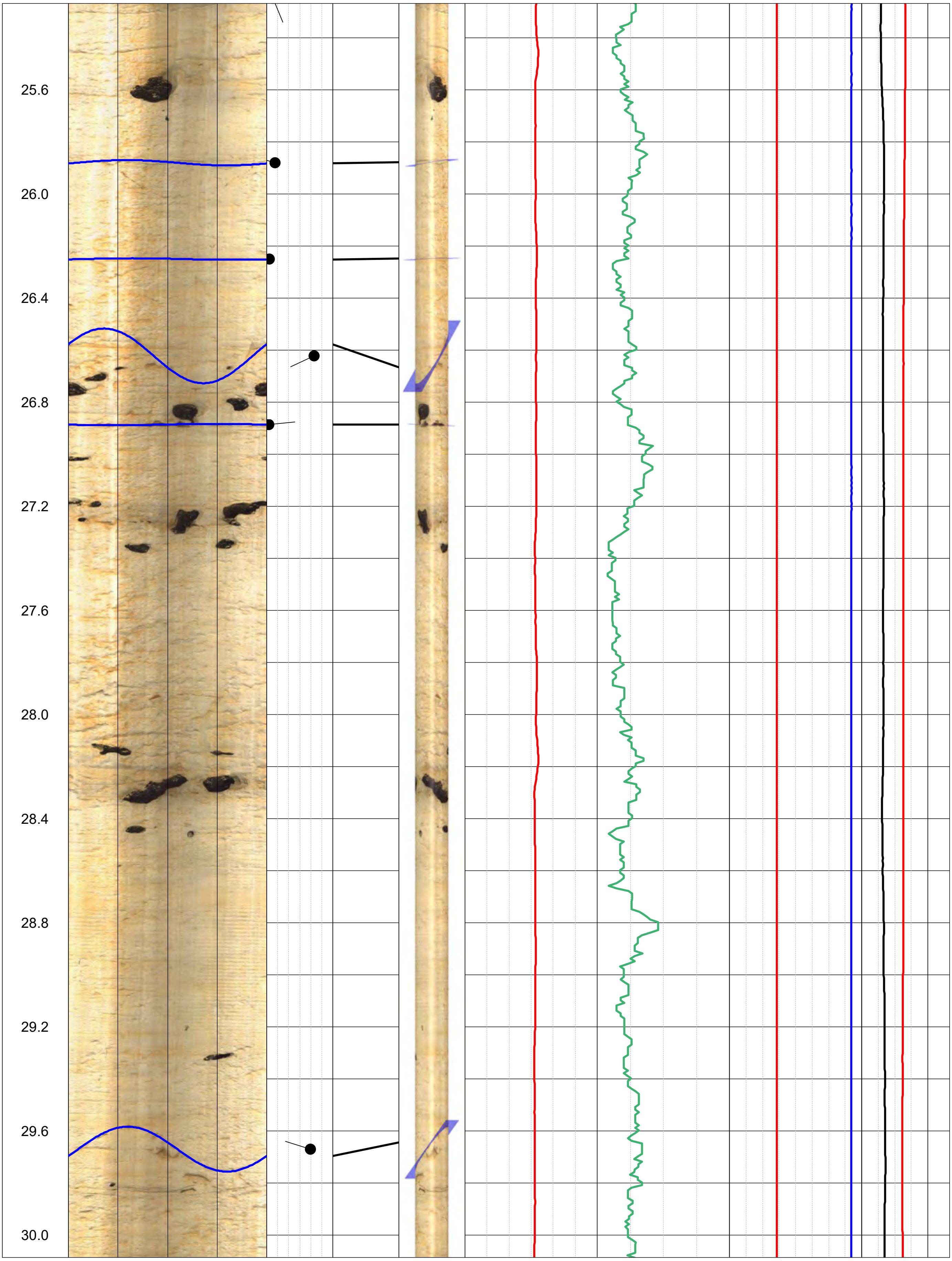
22.0
22.4
22.8
23.2
23.6
24.0
24.4
24.8
25.2


25.6
26.0
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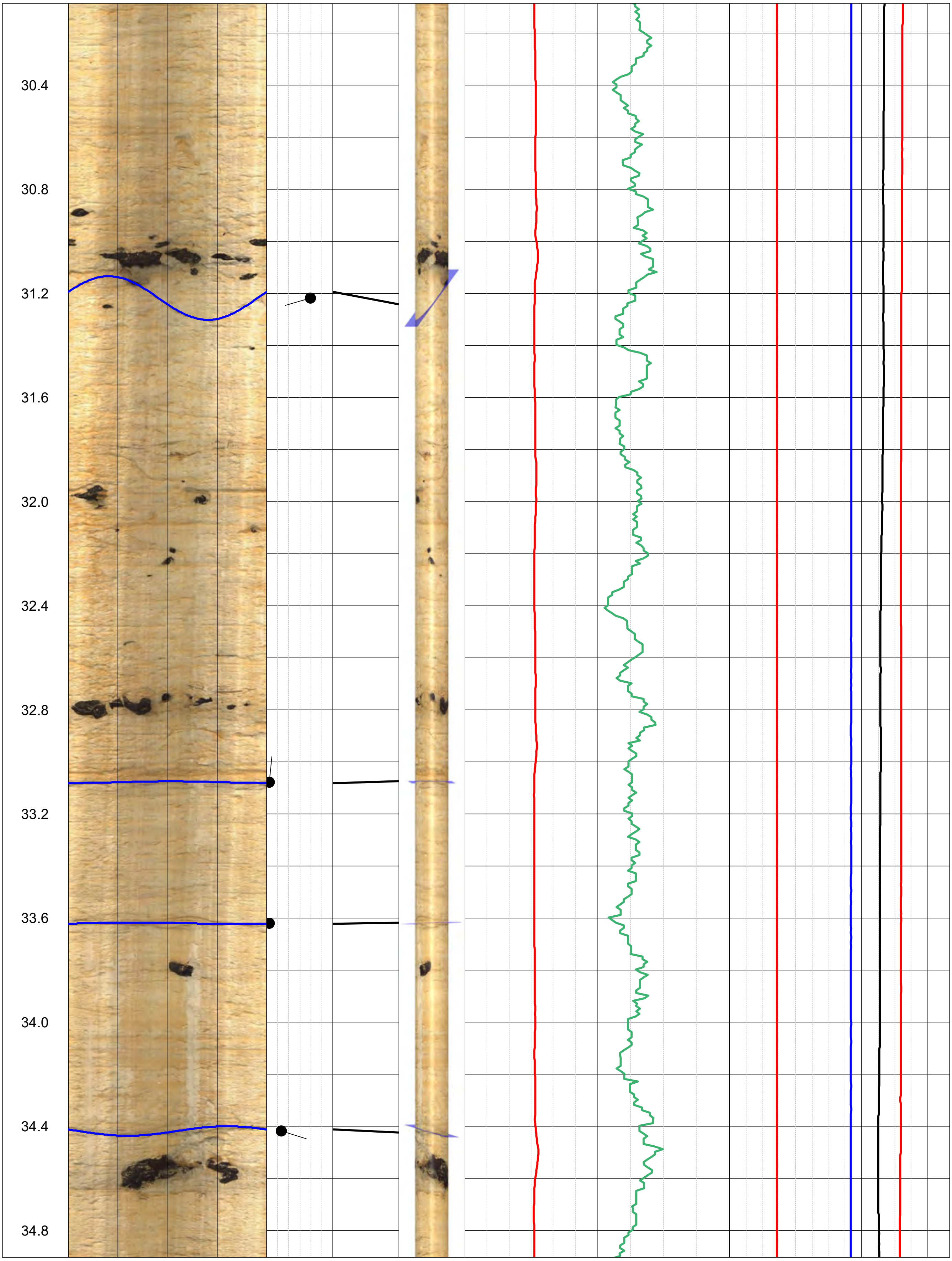
26.8
27.2
27.6
28.0
28.4
28.8
29.2
29.6
30.0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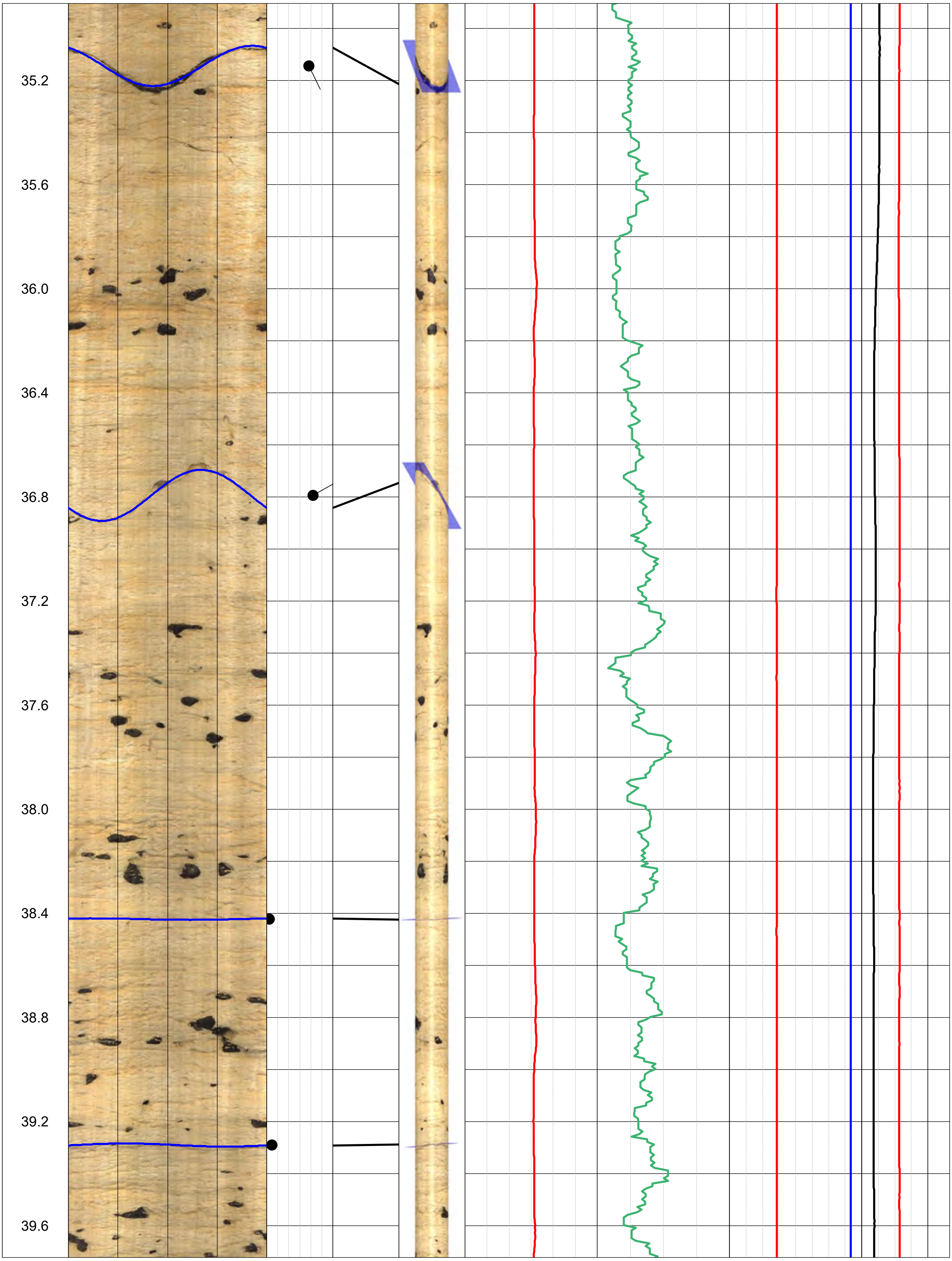
30.8
31.2
31.6
32.0
32.4
32.8
33.2
33.6
34.0
34.4
34.8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35.6
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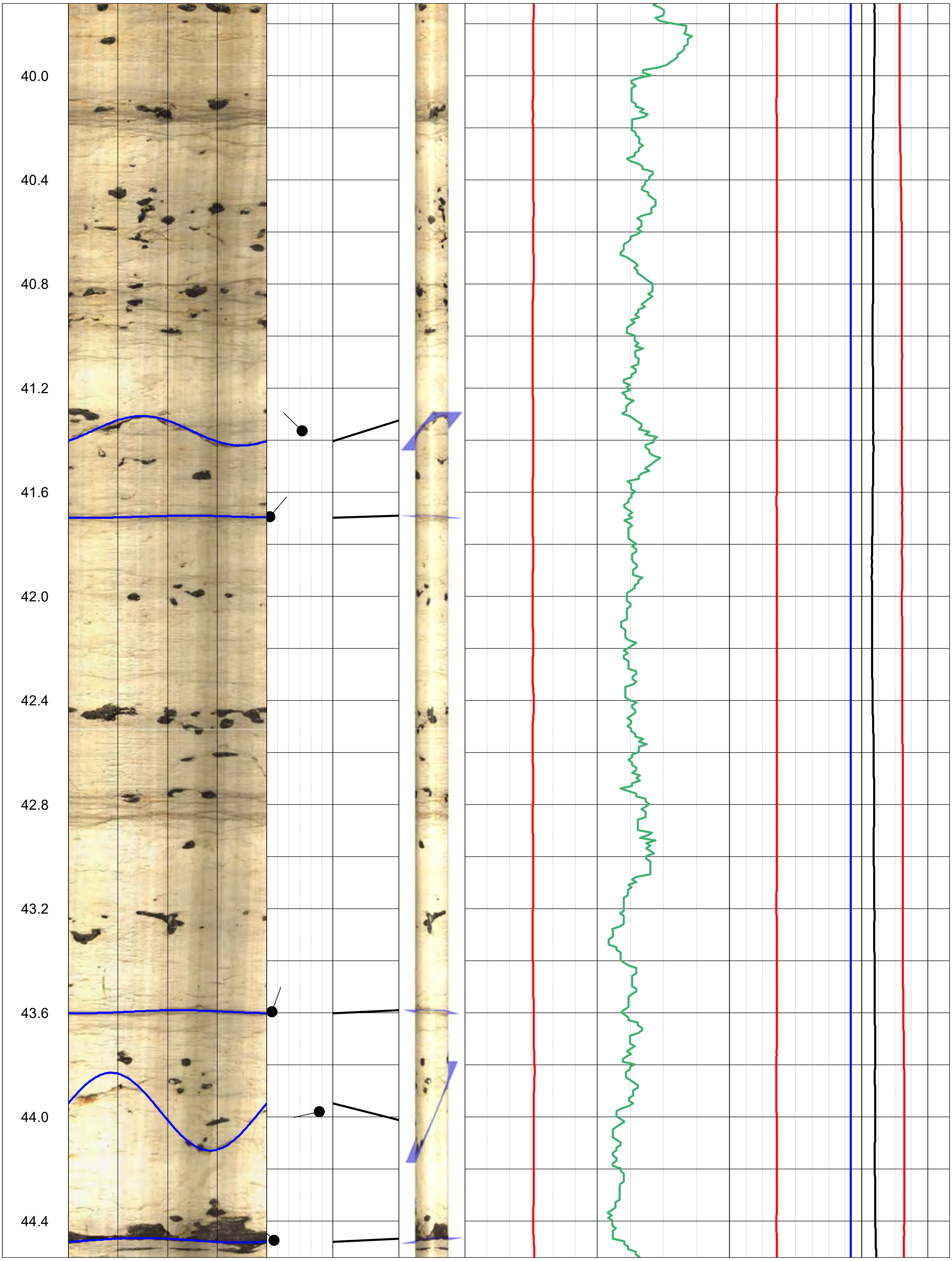
36.8
37.2
37.6
38.0
38.4
38.8
39.2
39.6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40.8
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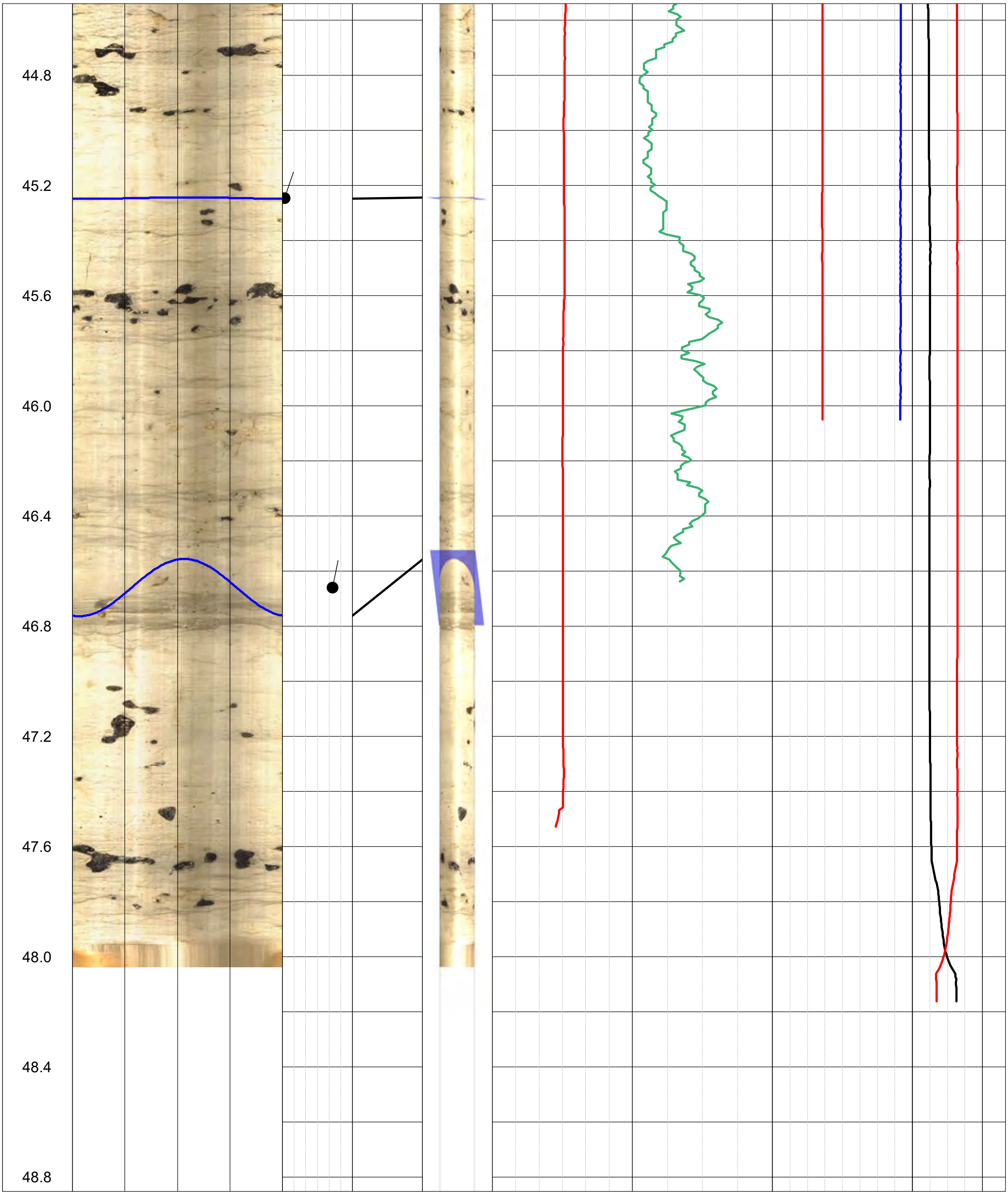
41.6
42.0
42.4
42.8
43.2
43.6
44.0
44.4


44.8
45.2
45.6
46.0
46.4
46.8
47.2
47.6
48.0
48.4
48.8

ROBERTSON GEOLOGGING

COMPANY	Structural Soils
WELL ID	R620
FIELD	Stonehenge A303
COUNTRY	England
STATE	
LOCATION	A303 Stonehenge
OTHER SERVICES	
SEC	
TWP	
RGE	

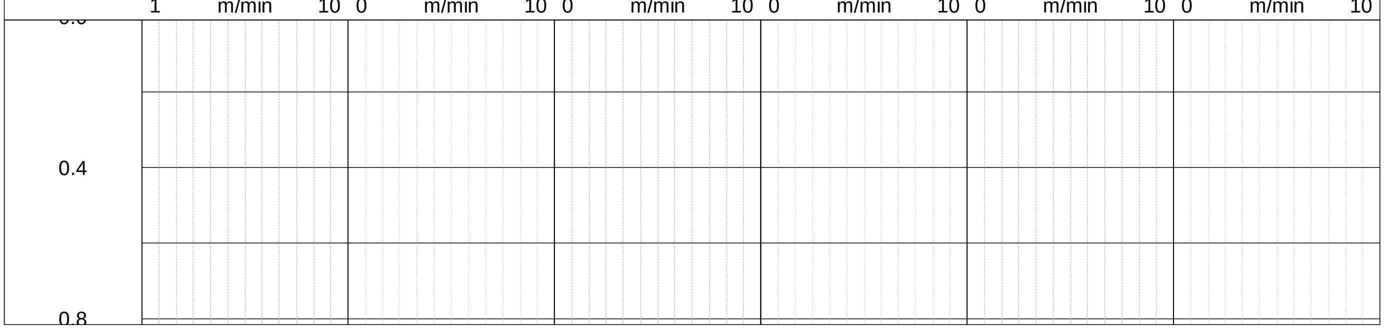
CO
WELL R620
FLD Stonehenge
CTY
STE
FILING No

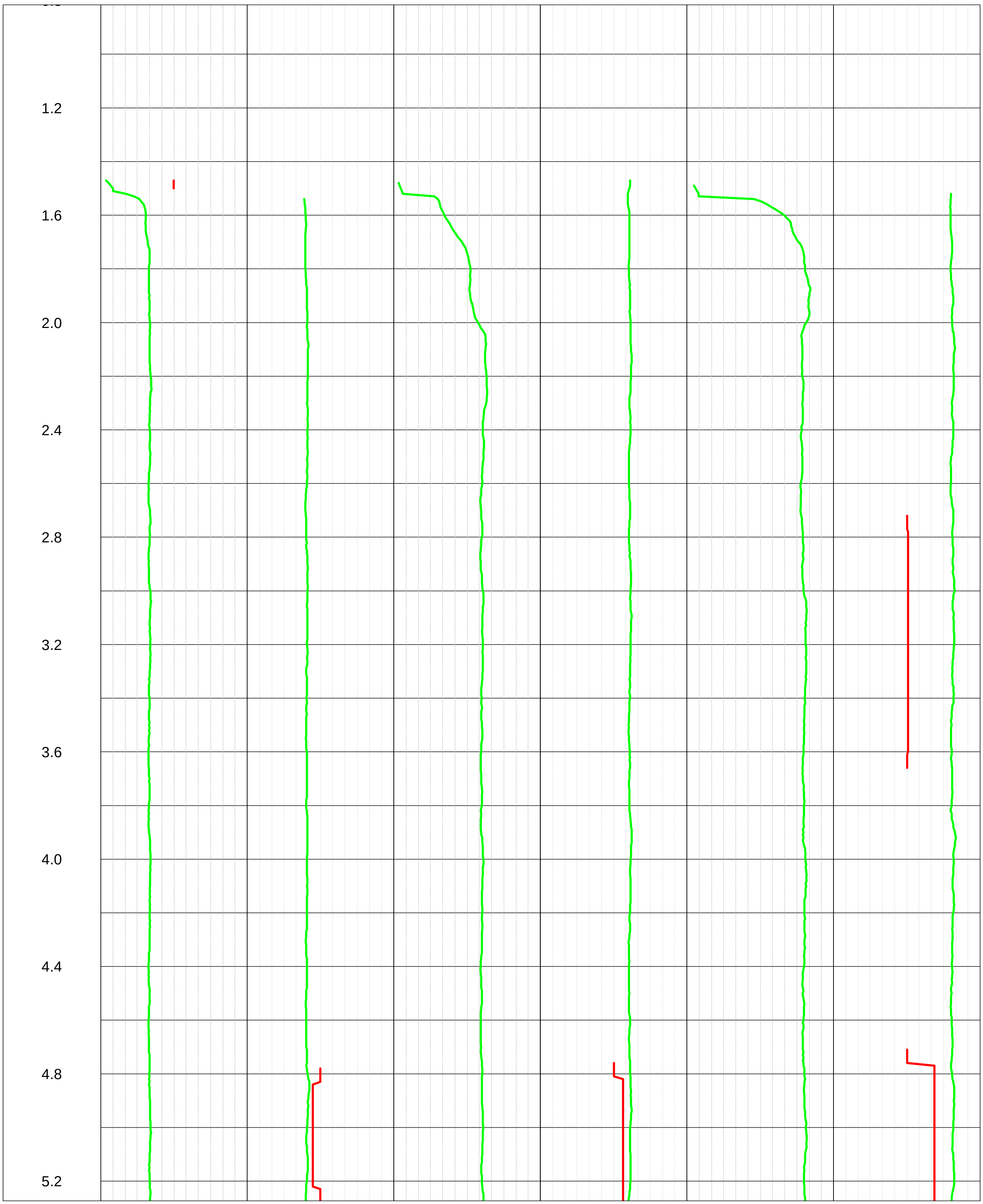
PERMANENT DATUM	GL	ELEVATION	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.

DATE	02 May 18	TYPE FLUID IN HOLE	Water
RUN No	1	SALINITY	
TYPE LOG	Flowmeter	DENSITY	
DEPTH-DRILLER	48.3	LEVEL	5.8
DEPTH-LOGGER	48	MAX. REC. TEMP.	
BTM LOGGED INTERVAL			
TOP LOGGED INTERVAL			
OPERATING RIG TIME			
RECORDED BY	JB		
WITNESSED BY	KO		

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

Depth 1m:20m	RATE Run 1 Down	RATE Run 1 Up	RATE Run 2 Down	RATE Run 2 Up	RATE Run 3 Down	RATE Run 3 Up
	-600 RPM 600	-600 RPM 600	-600 RPM 600	-600 RPM 600	-600 RPM 600	-600 RPM 600
	CABL 4 Down	CABL 4 Up	CABL 6 Down	CABL 6 Up	CABL 8 Down	CABL 8 Up
	1 m/min 10	0 m/min 10	0 m/min 10	0 m/min 10	0 m/min 10	0 m/min 10




1.2
1.6
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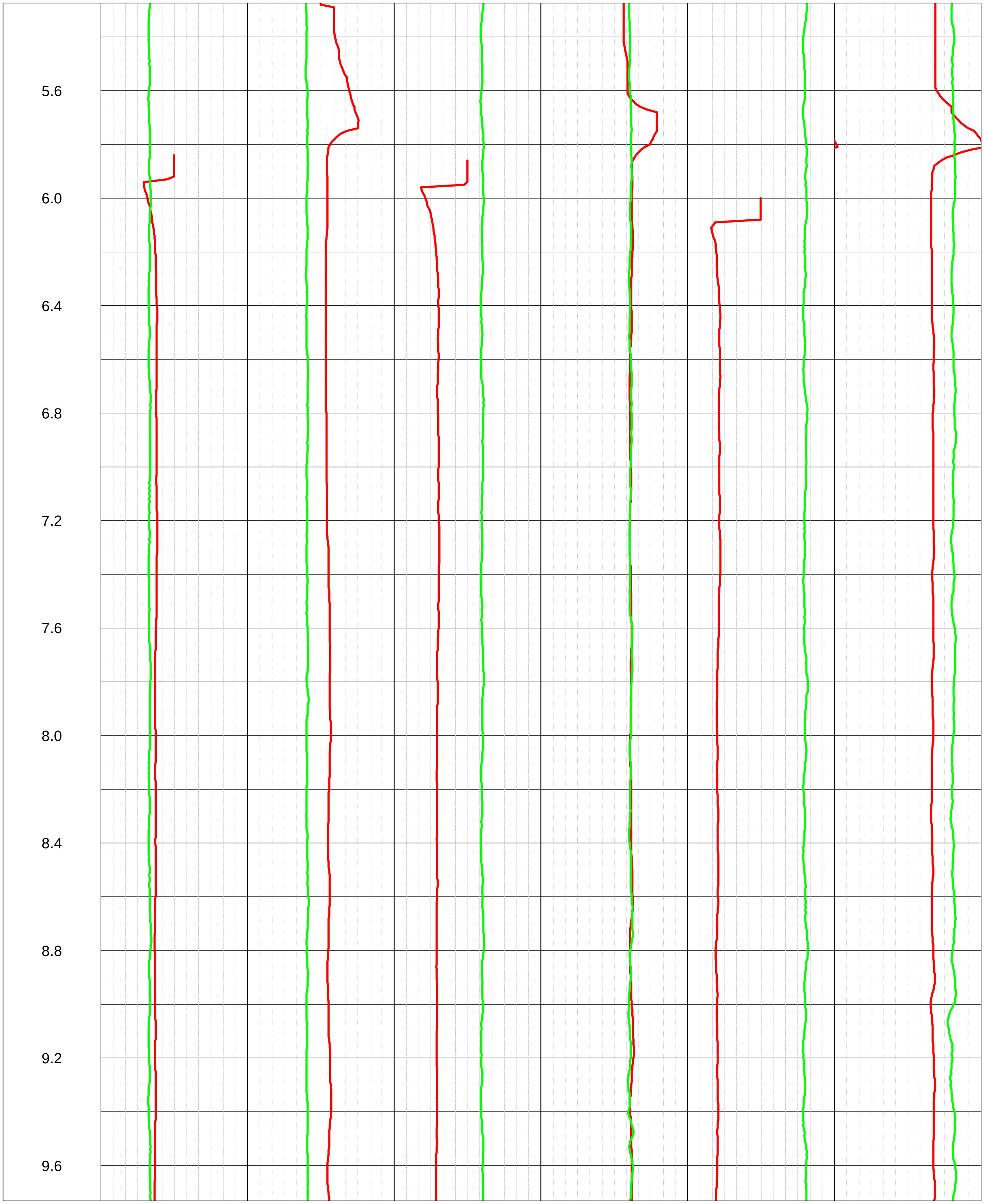
2.4
2.8
3.2
3.6
4.0
4.4
4.8
5.2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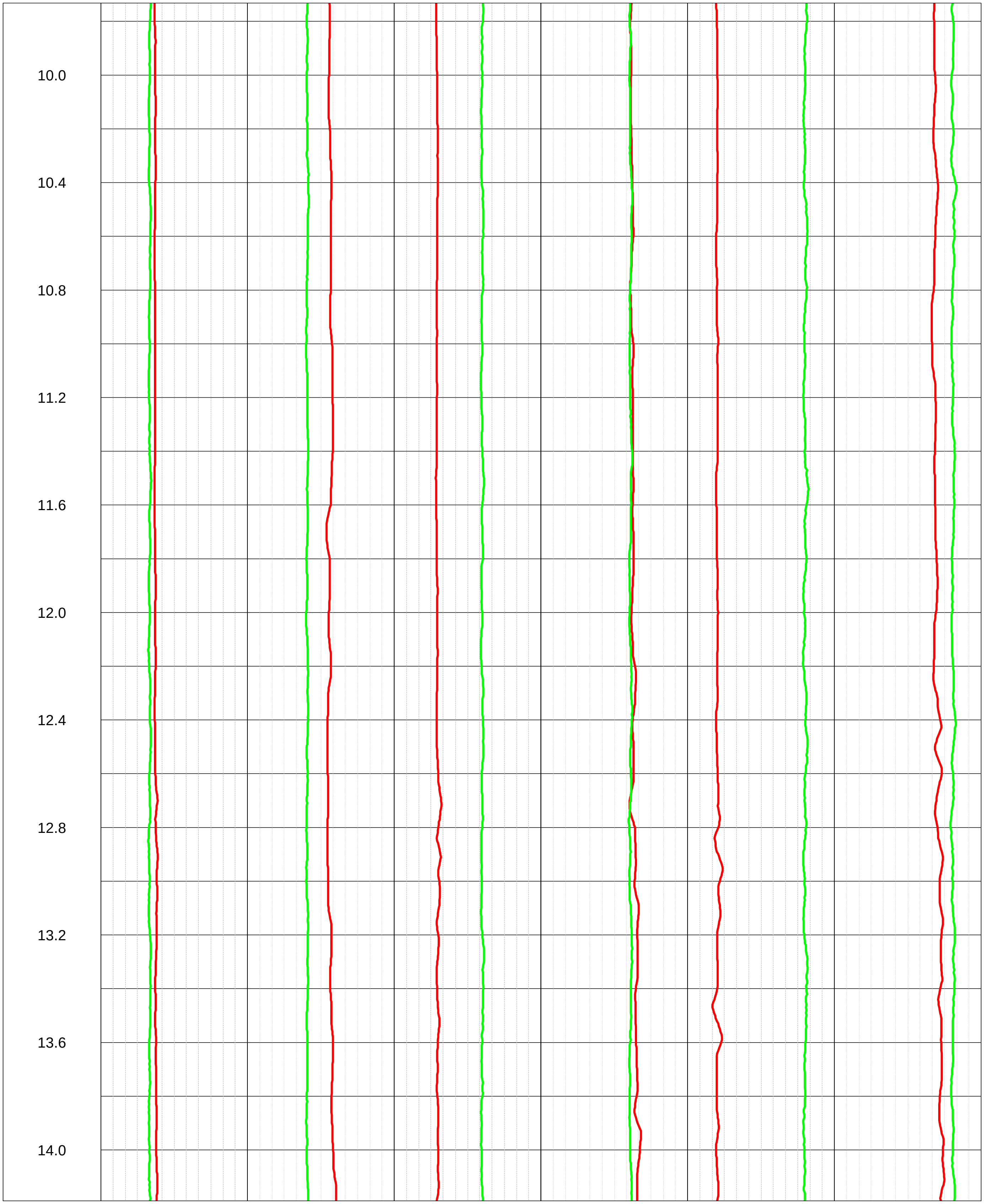
6.8
7.2
7.6
8.0
8.4
8.8
9.2
9.6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12.4
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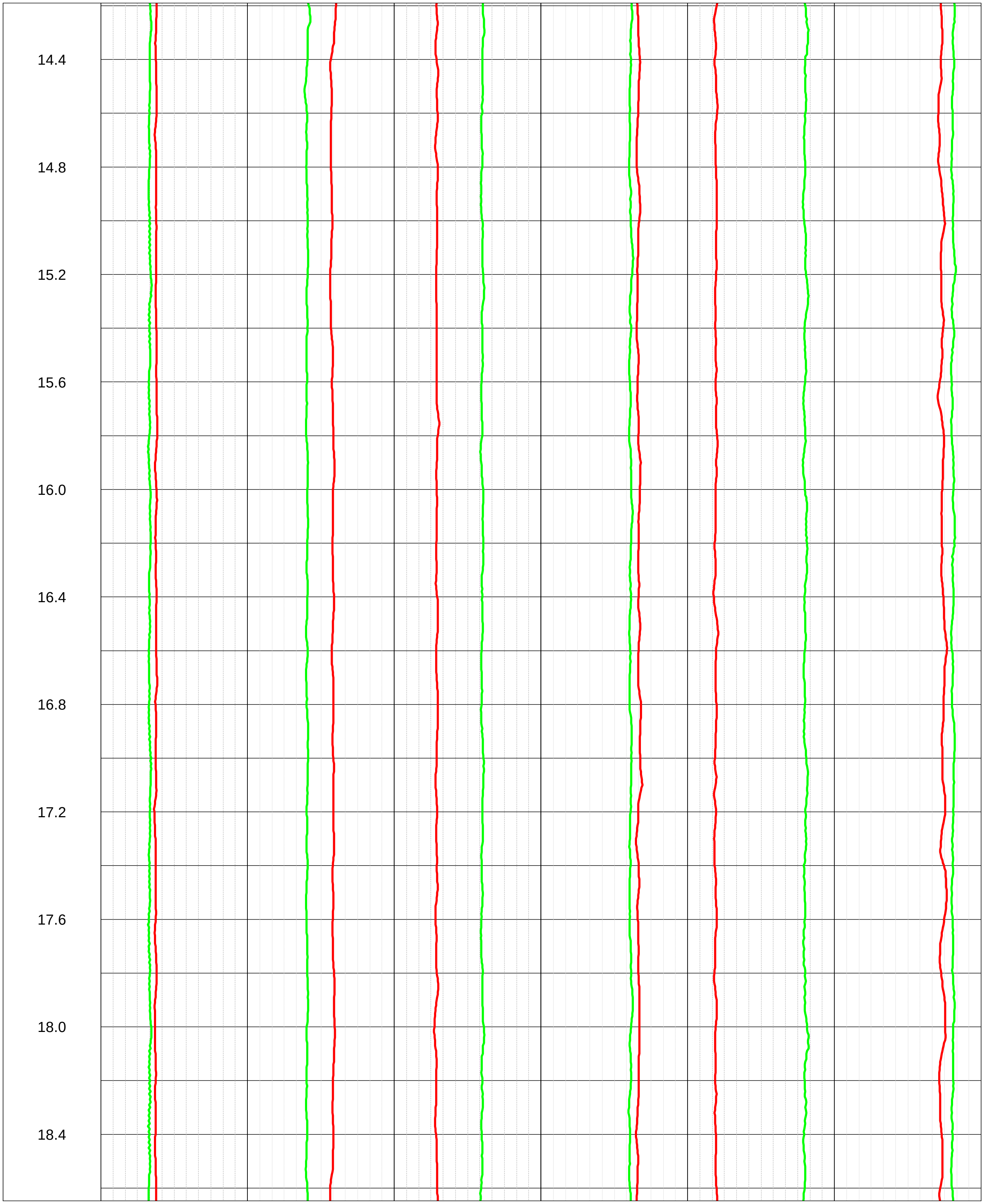
13.2
13.6
14.0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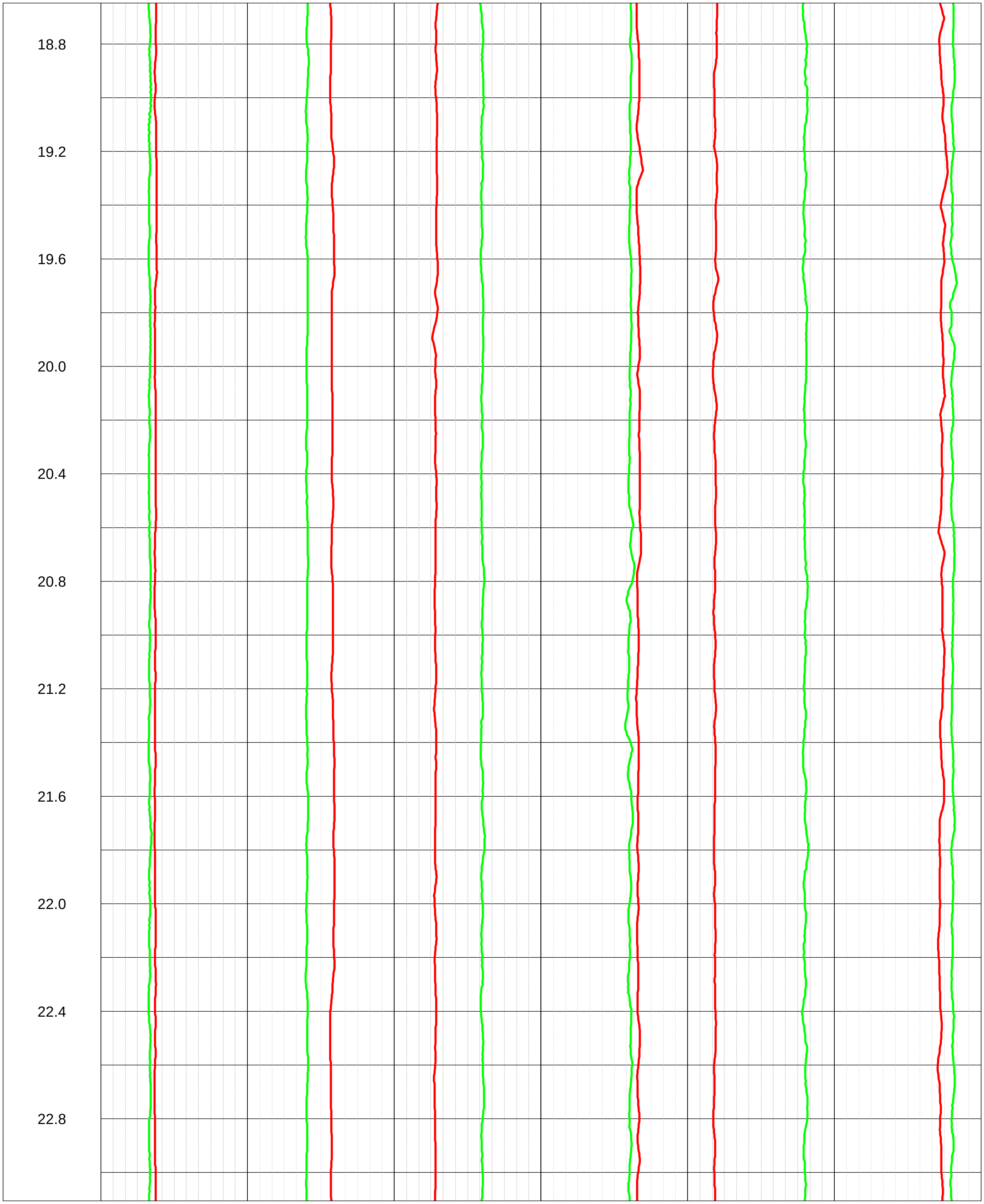
14.8
15.2
15.6
16.0
16.4
16.8
17.2
17.6
18.0
18.4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19.2
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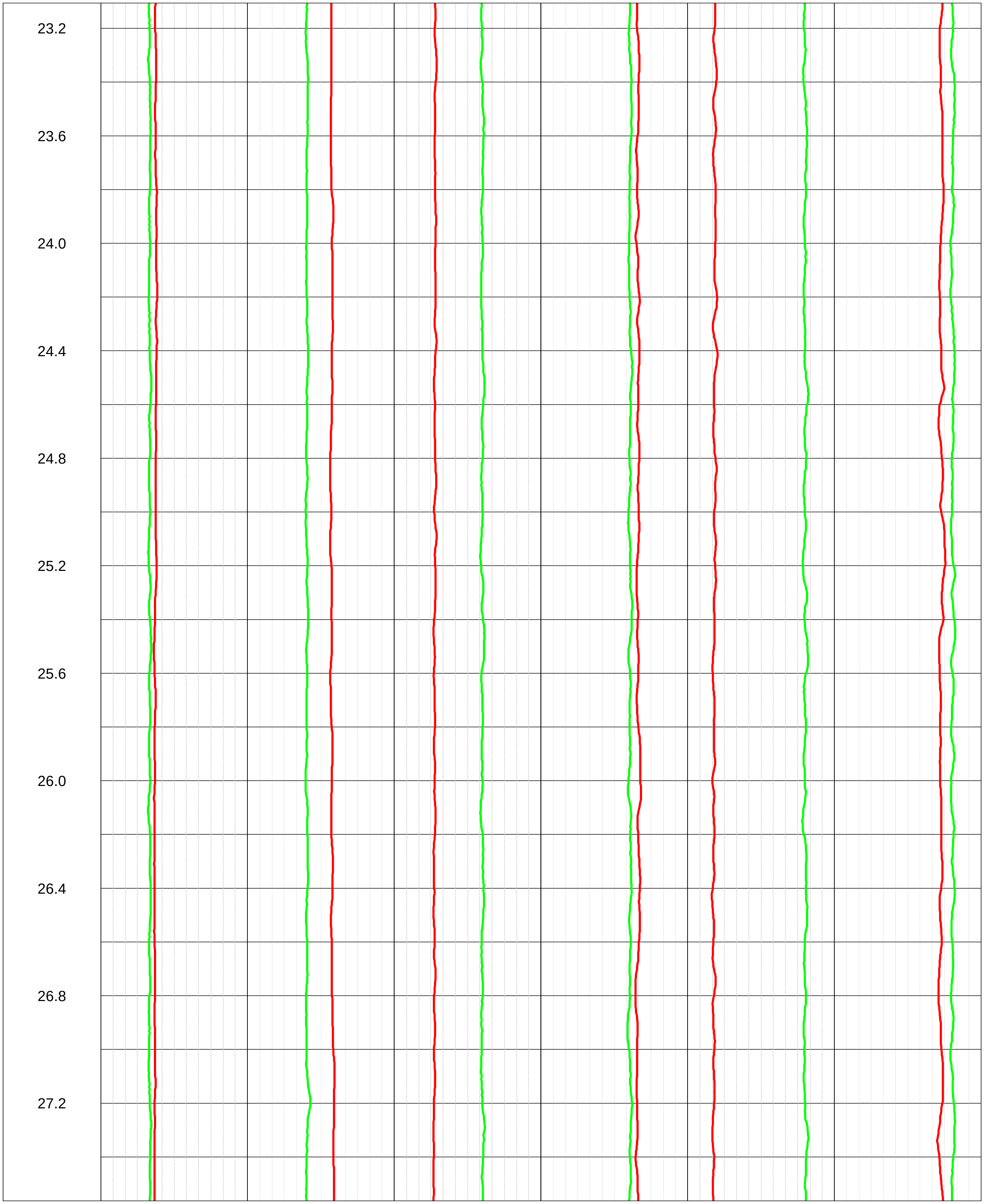
20.8
21.2
21.6
22.0
22.4
22.8


23.2
23.6
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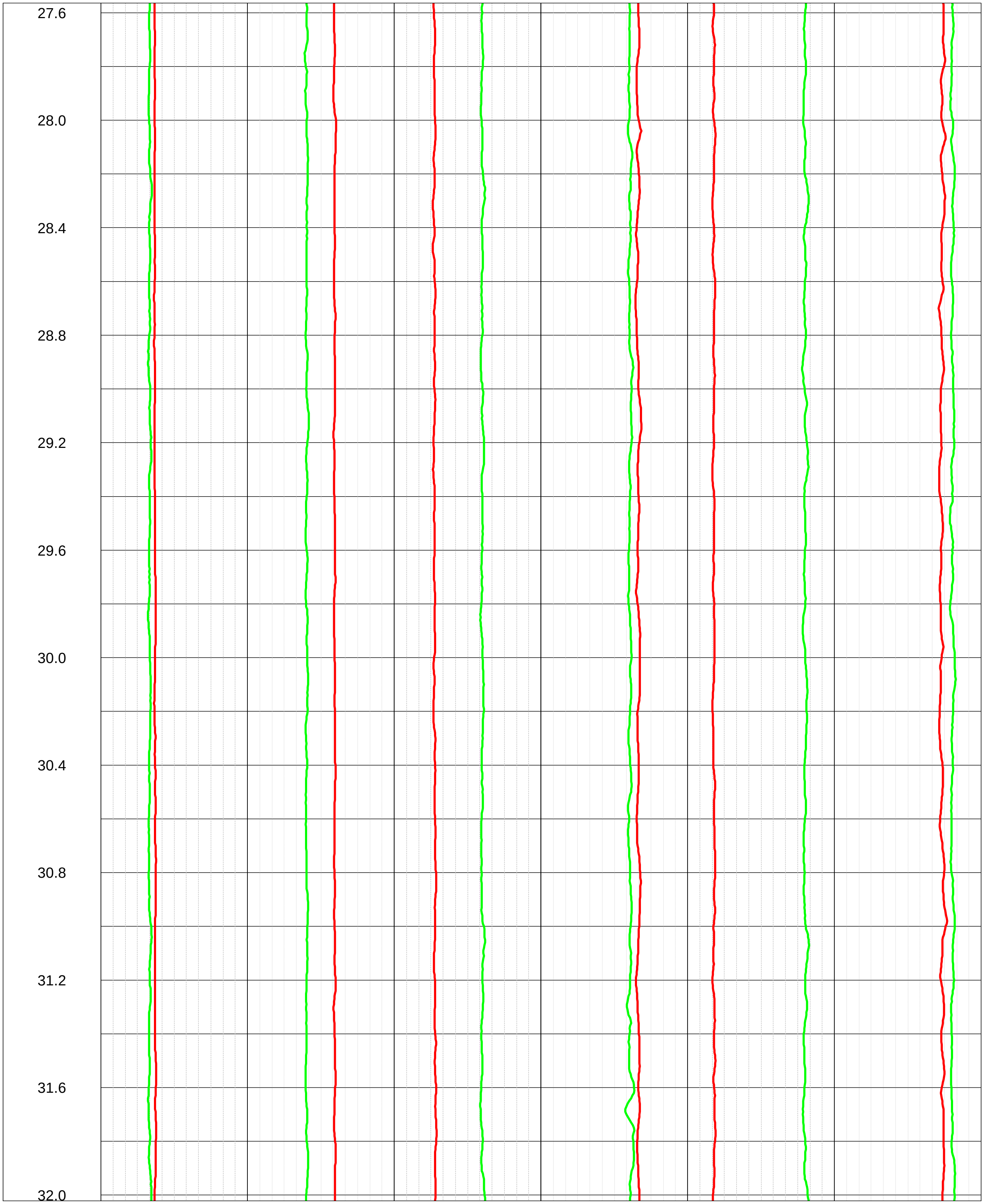
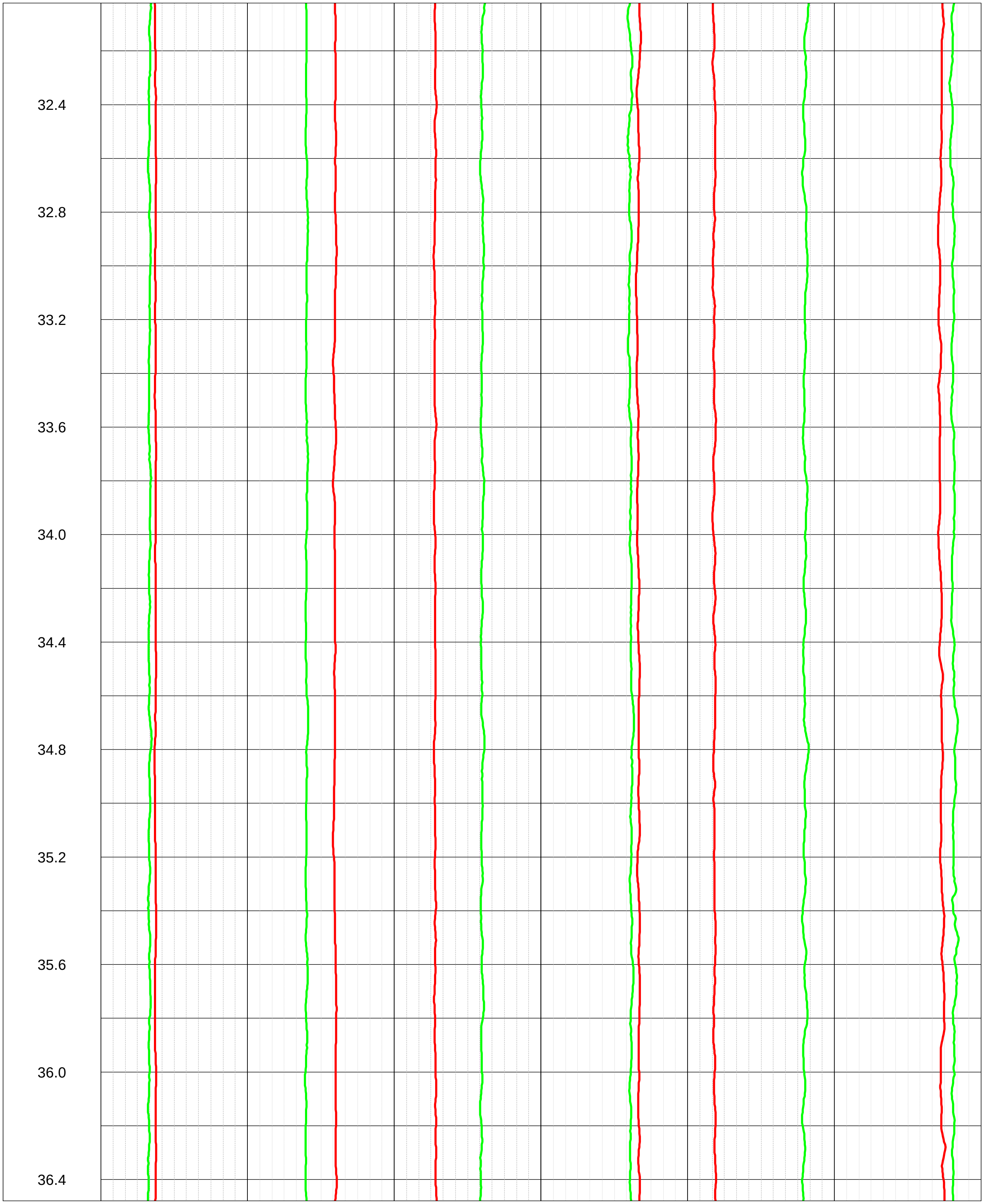
24.4
24.8
25.2
25.6
26.0
26.4
26.8
27.2


27.6
28.0
28.4
28.8
29.2
29.6
30.0
30.4
30.8
31.2
31.6
32.0


32.4
32.8
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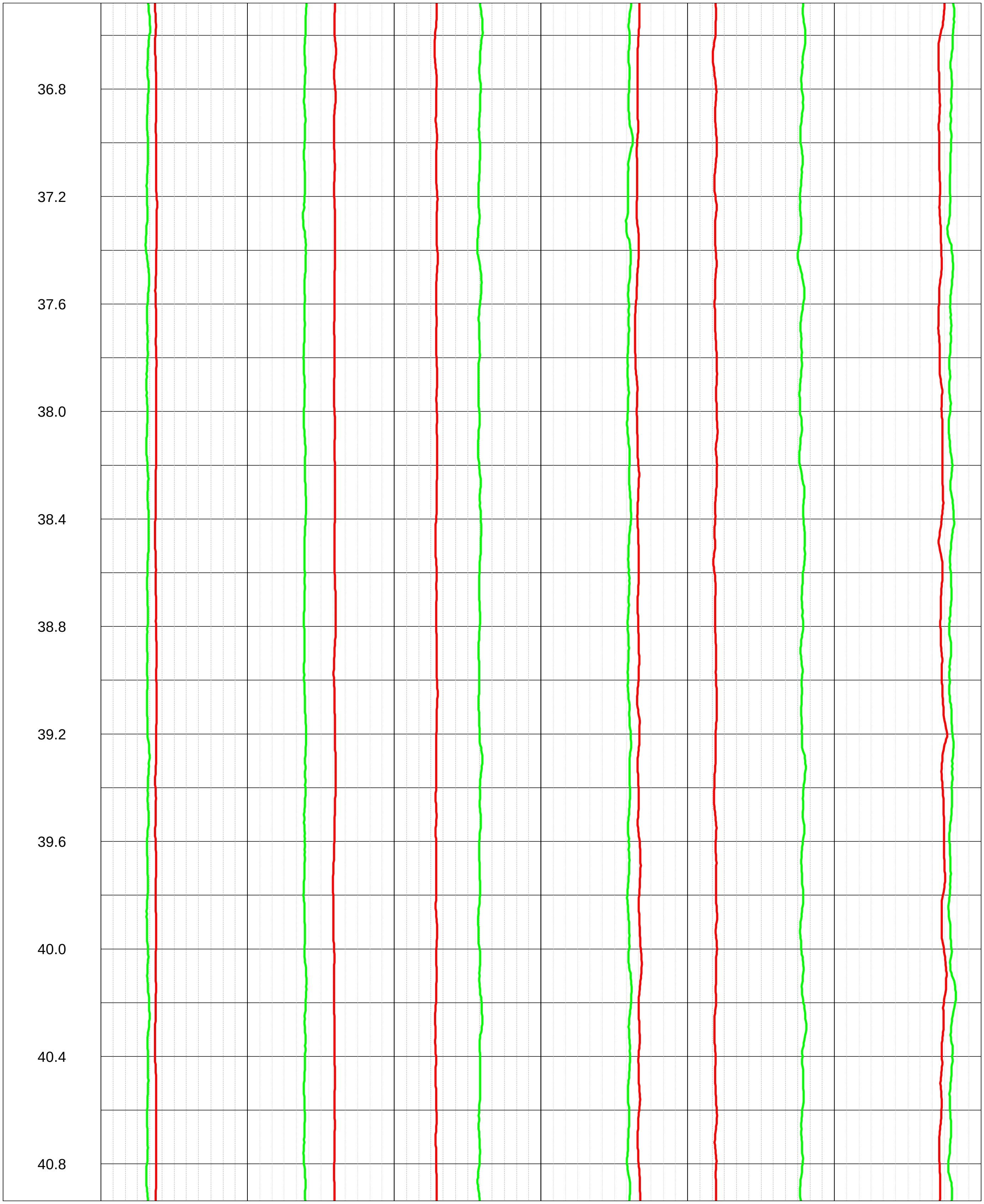
34.8
35.2
35.6
36.0
36.4


36.8
37.2
37.6
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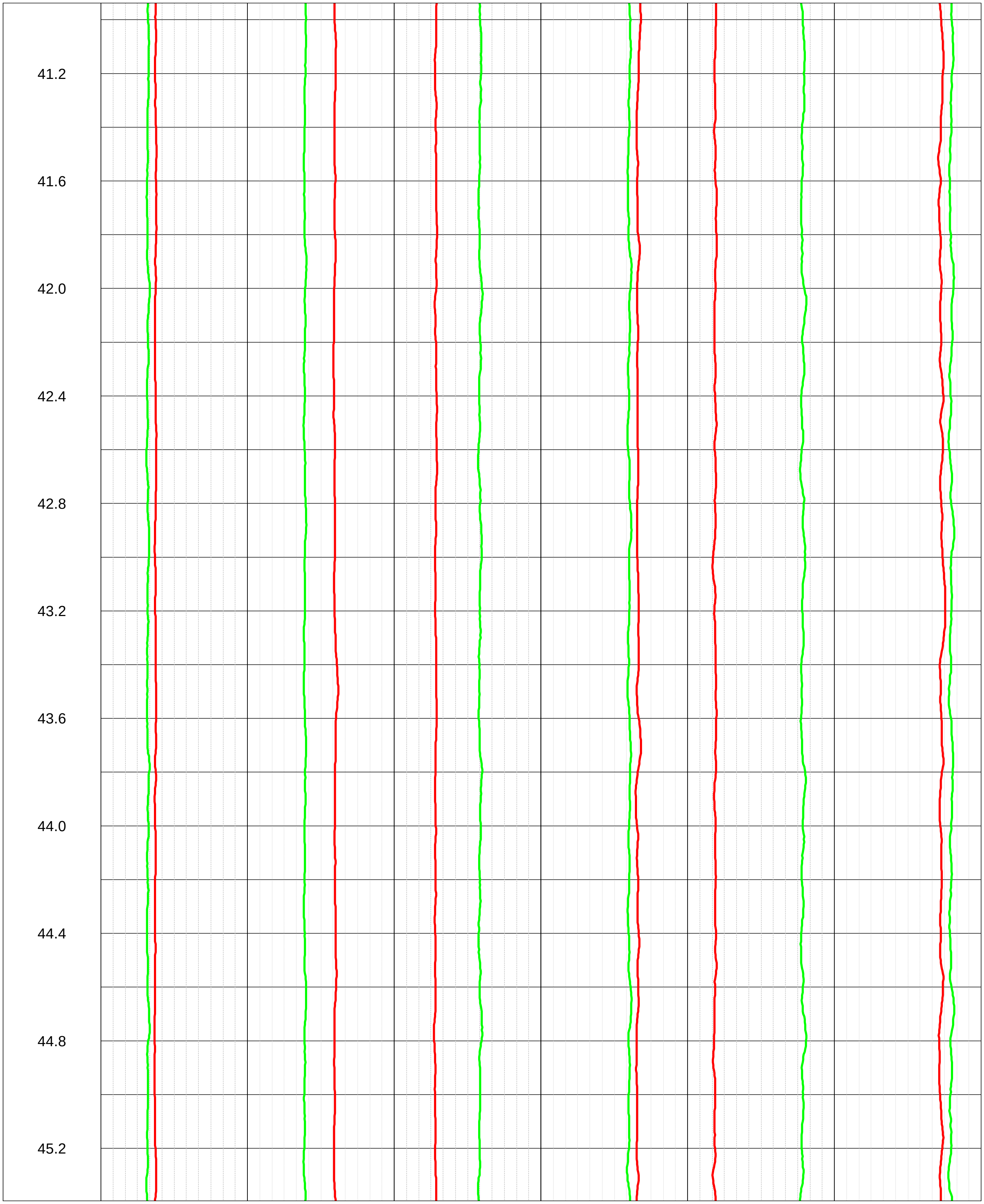
38.4
38.8
39.2
39.6
40.0
40.4
40.8


41.2
41.6
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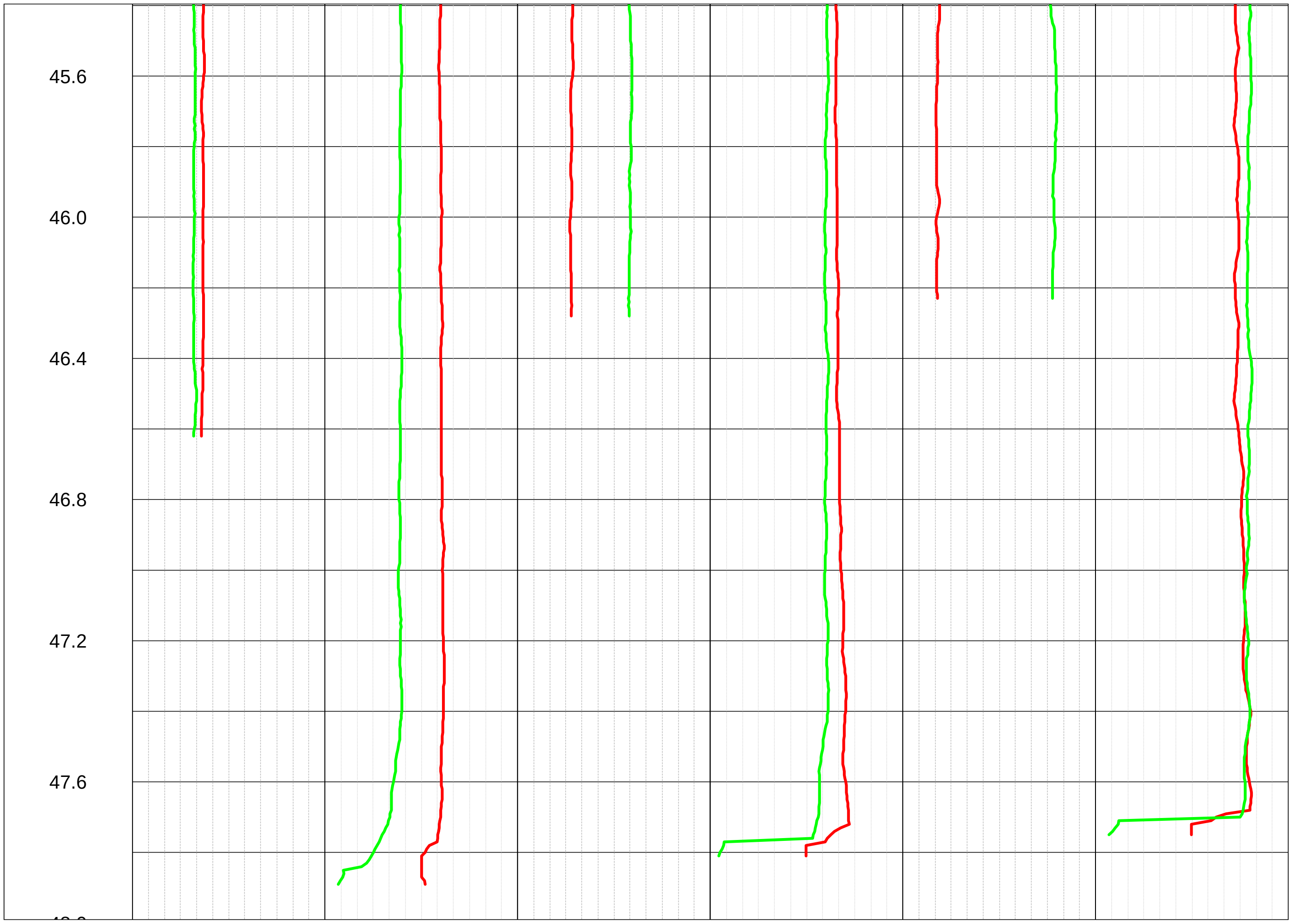
42.8
43.2
43.6
44.0
44.4
44.8
45.2


45.6
46.0
46.4
46.8
47.2
47.6

ROBERTSON GEOLOGGING LIMITED

A303 Stonehenge

Caliper, Gamma

COMPANY	Structural Soils
WELL	R620
FIELD	Stonehenge
COUNTRY	England
STATE	
COUNTY	
LAT.:	
LONG.:	

OTHER SERVICES

Perm. Da..	GL	Elev	KB	0.00
Log. Datum	GL		DF	0.00
Drill Datum			GL	0.00

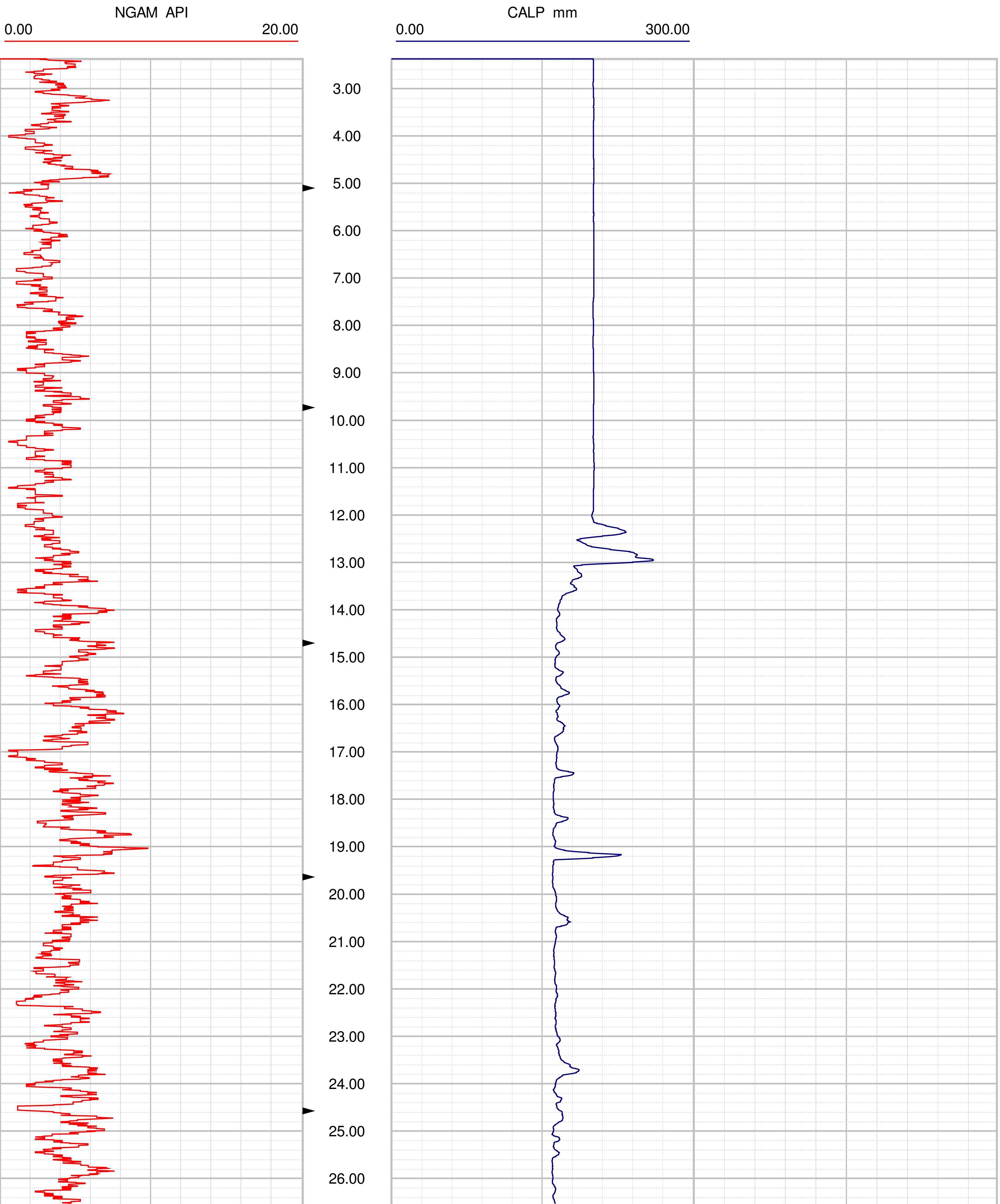
DATE	02 May 1	11 Apr 1	11 Apr 1
RUN#	1	0	0
TYPE OF LOG	3ACS		
DEPTH DRILLER	48.30	0.00	0.00
DEPTH LOGGER	0.00	0.00	0.00
LOG DEEPEST	48.00	0.00	0.00
LOG SHALLOW	0.00	0.00	0.00
FLUID IN HOLE	Water		
SALINITY			
DENSITY			
LEVEL			
MAX TEMP ℃	0.00	0.00	0.00
RIG TIME			
RECORDED BY	JB		
WITNESSED BY	KO		

RUN#	BIT RECORD			CASING RECORD			
	SIZE	FROM	TO	SIZE	WEIGHT	FROM	TO
1	0.00	0.00	0.00	0.00	0.00	0.00	43.00
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00

ROBERTSON GEOLOGGING TECHNOLOGY

REMARKS (C:\Users\Sonar\Desktop\Structural Soils - Stoneheng..

511



NGAM API
0.00
20.00
CALP mm
0.00
300.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
10.00
11.00
12.00
13.00
14.00
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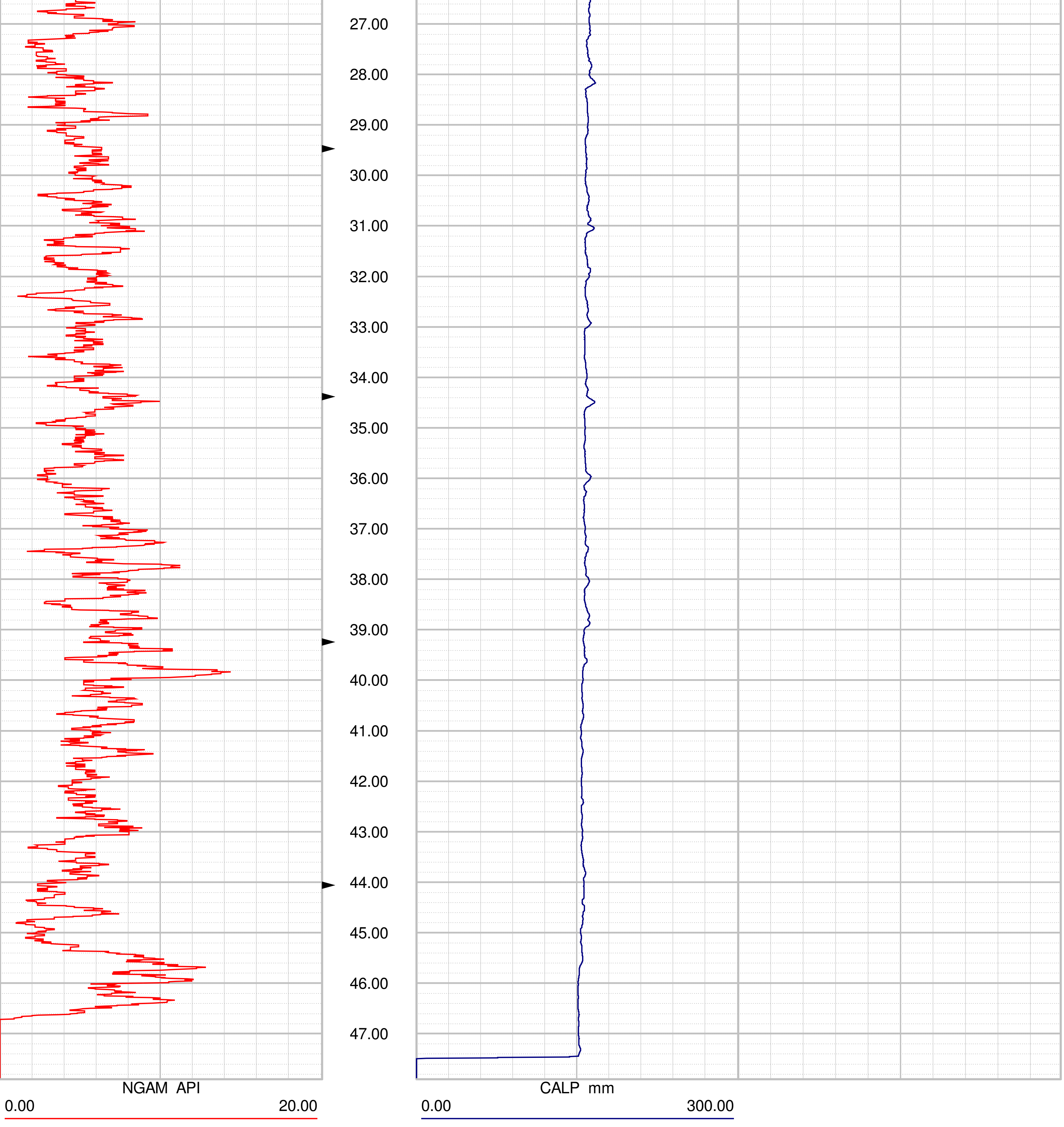
24.00
25.00
26.00

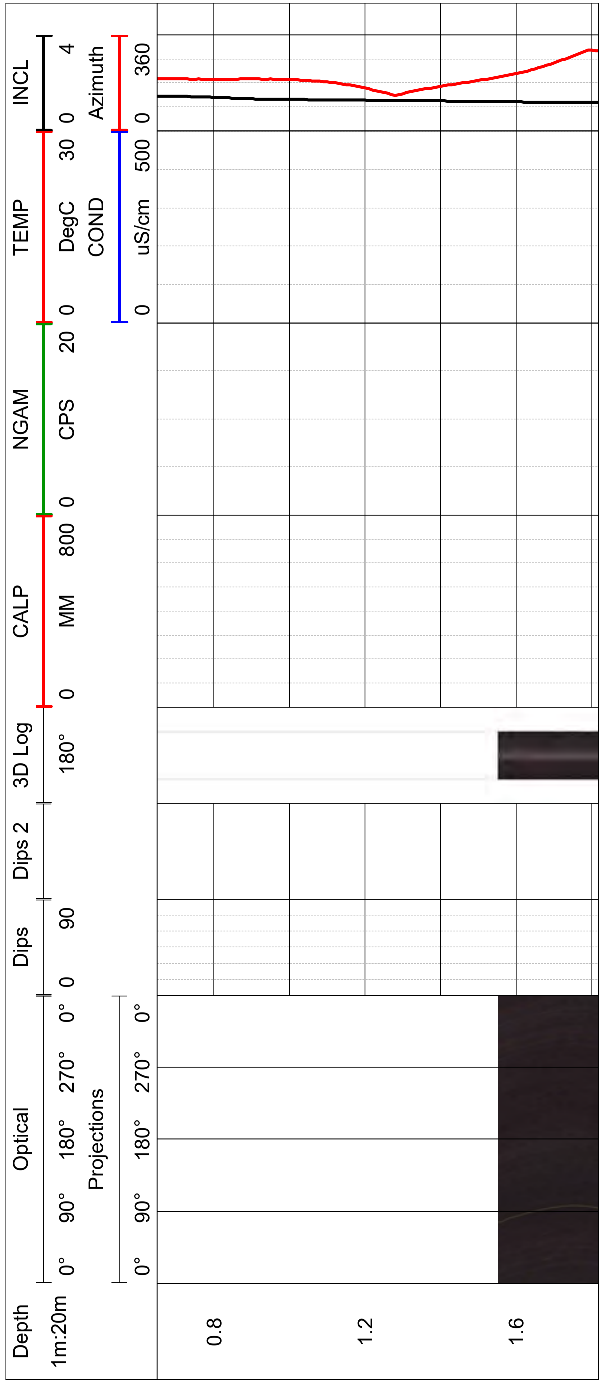


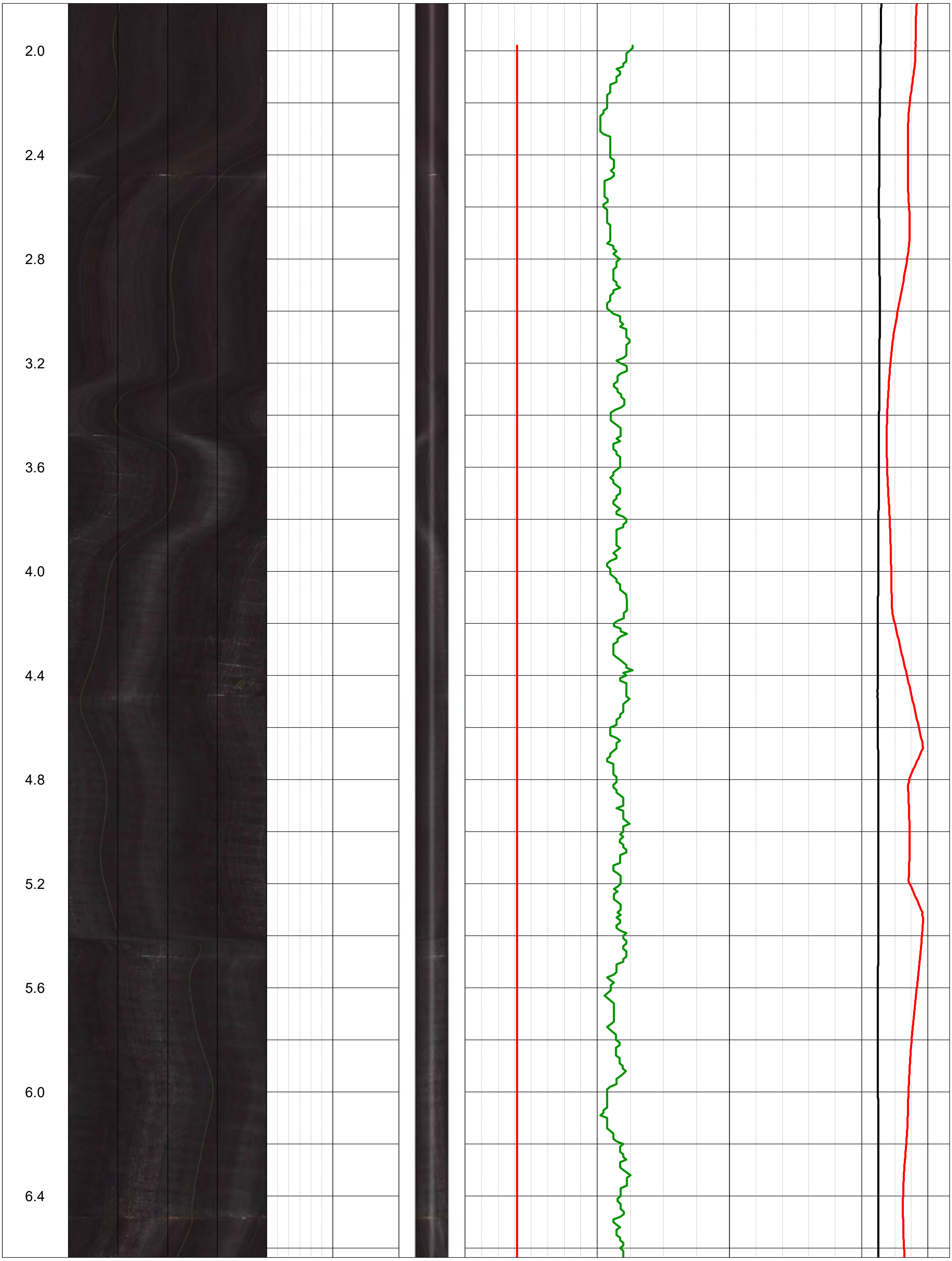
Depth: 2.00 m Date: 02 May 2018 Time: 10:31:41 File: "C:\Client Data\Structural Soils - Stonehenge (Visit 2)\3ACS\R620_3ACS_020518.LOG"

CO Structural Soils
WELL W623
FLD A303 Stonehenge
CTY England
STE
FILING No

COMPANY	Structural Soils		
WELL ID	W623		
FIELD	A303 Stonehenge		
COUNTRY	England	STATE	
LOCATION			OTHER SERVICES
Easting: 413433.33			
Northing: 141267.53			
SEC	TWP	RGE	
PERMANENT DATUM	GL	ELEVATION 111.678	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.
DATE	08/05/18	TYPE FLUID IN HOLE	Water
RUN No		SALINITY	
TYPE LOG	Composite	DENSITY	
DEPTH-DRILLER	70	LEVEL	44.6
DEPTH-LOGGER	66.2	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	66.2		
TOP LOGGED INTERVAL	0.7		
OPERATING RIG TIME			
RECORDED BY	James Boyett		
WITNESSED BY	Joanne Van-Aardt		

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

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4.8
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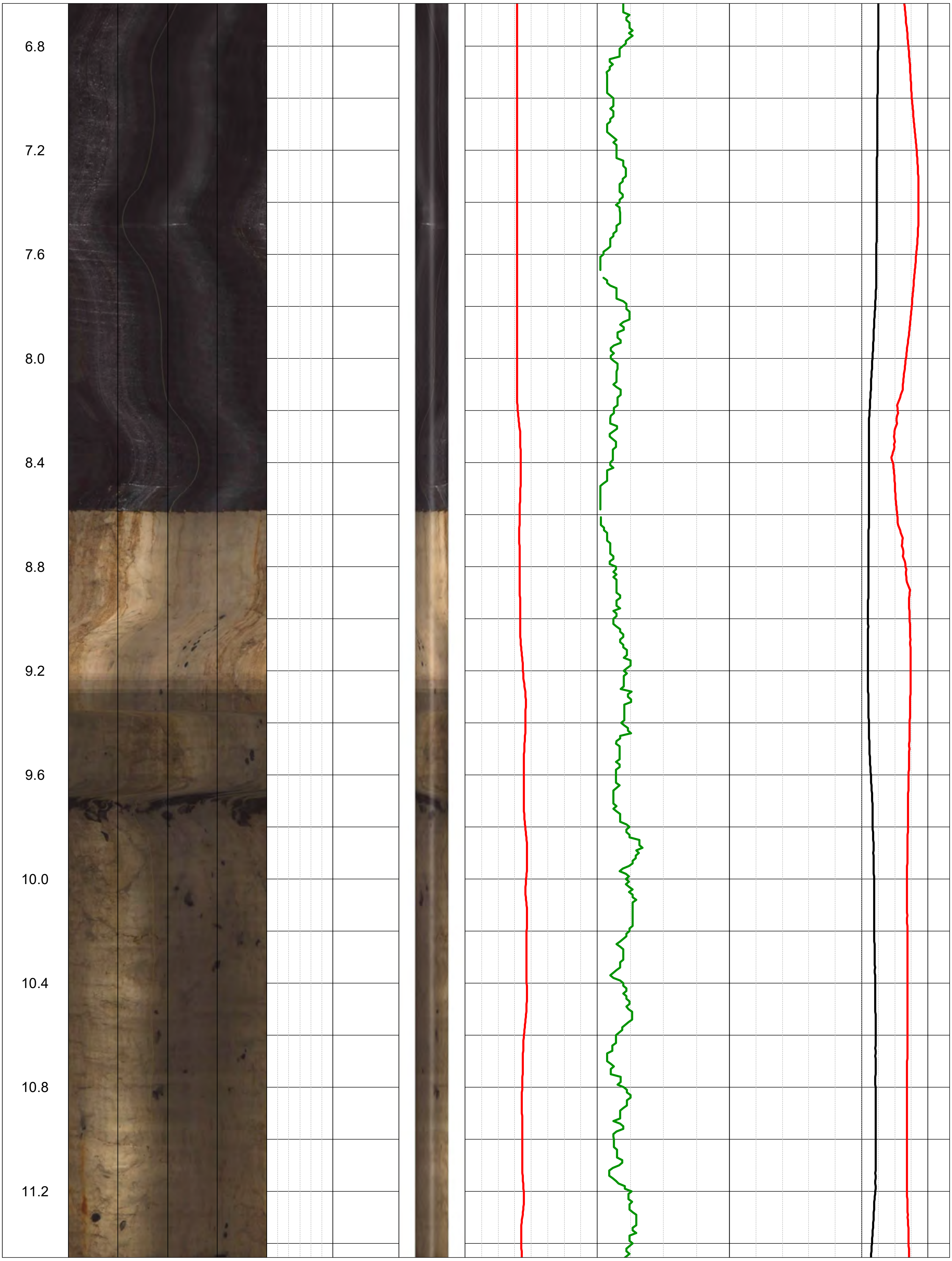
6.0
6.4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9.6
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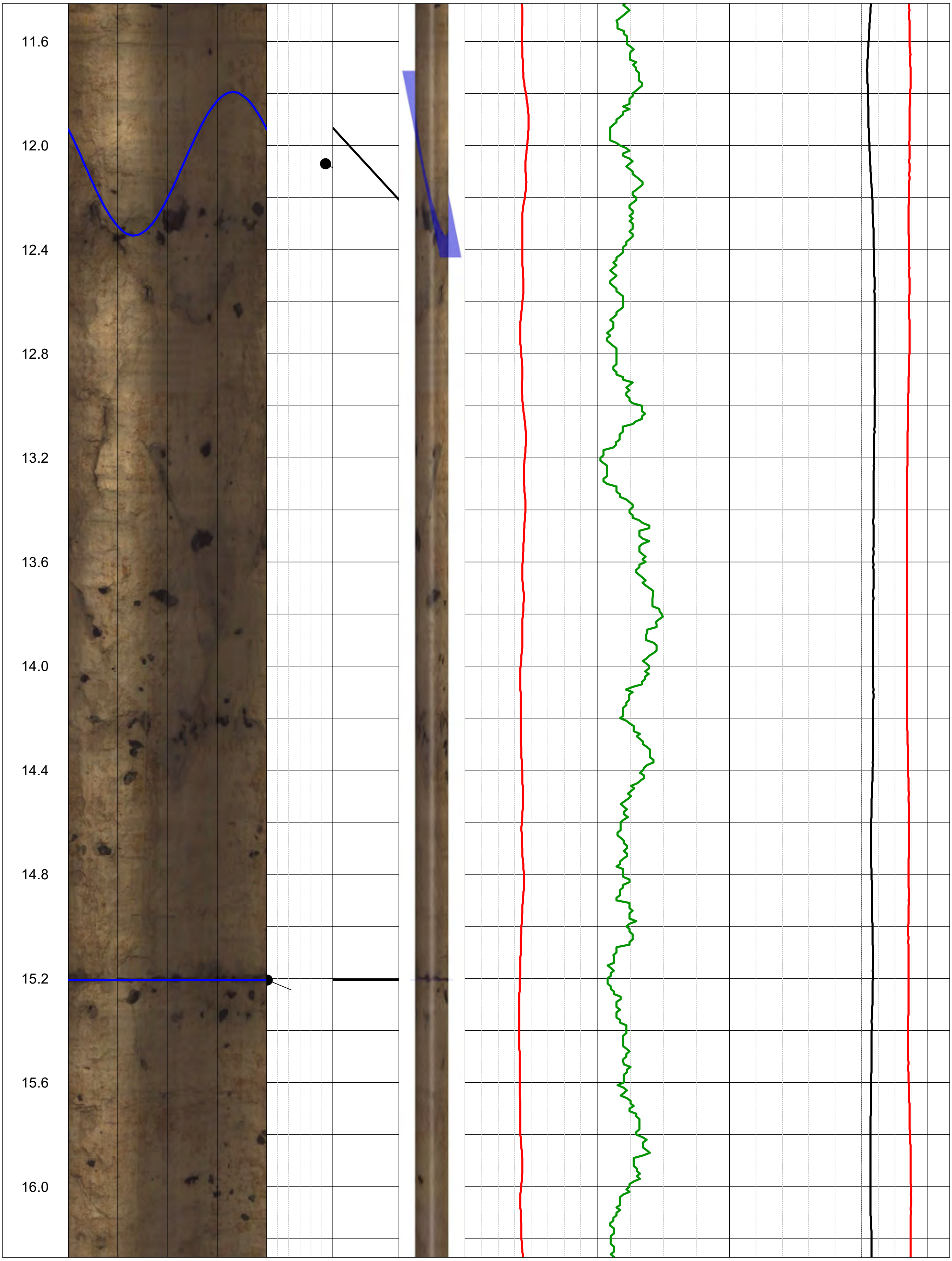
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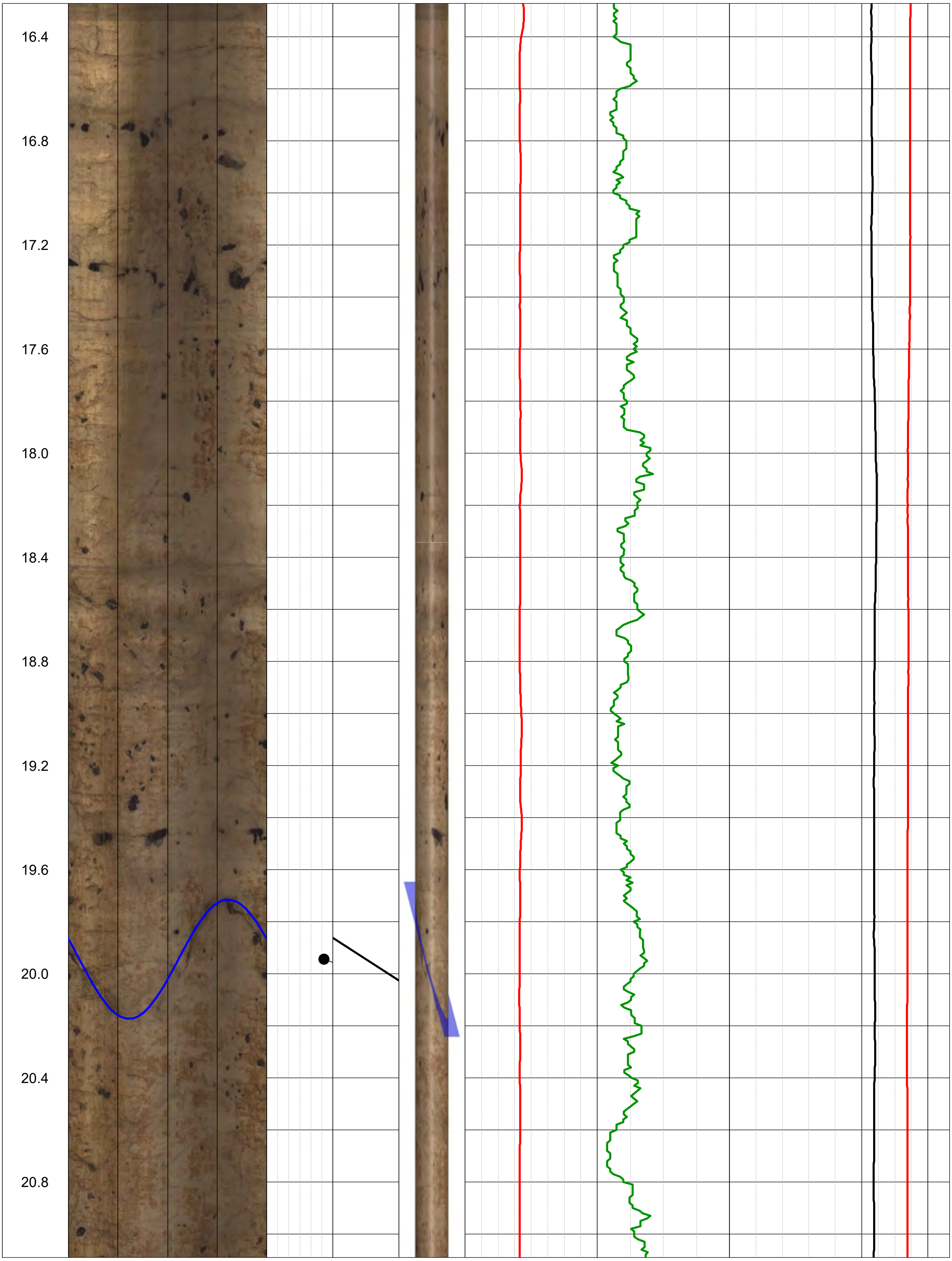
16.0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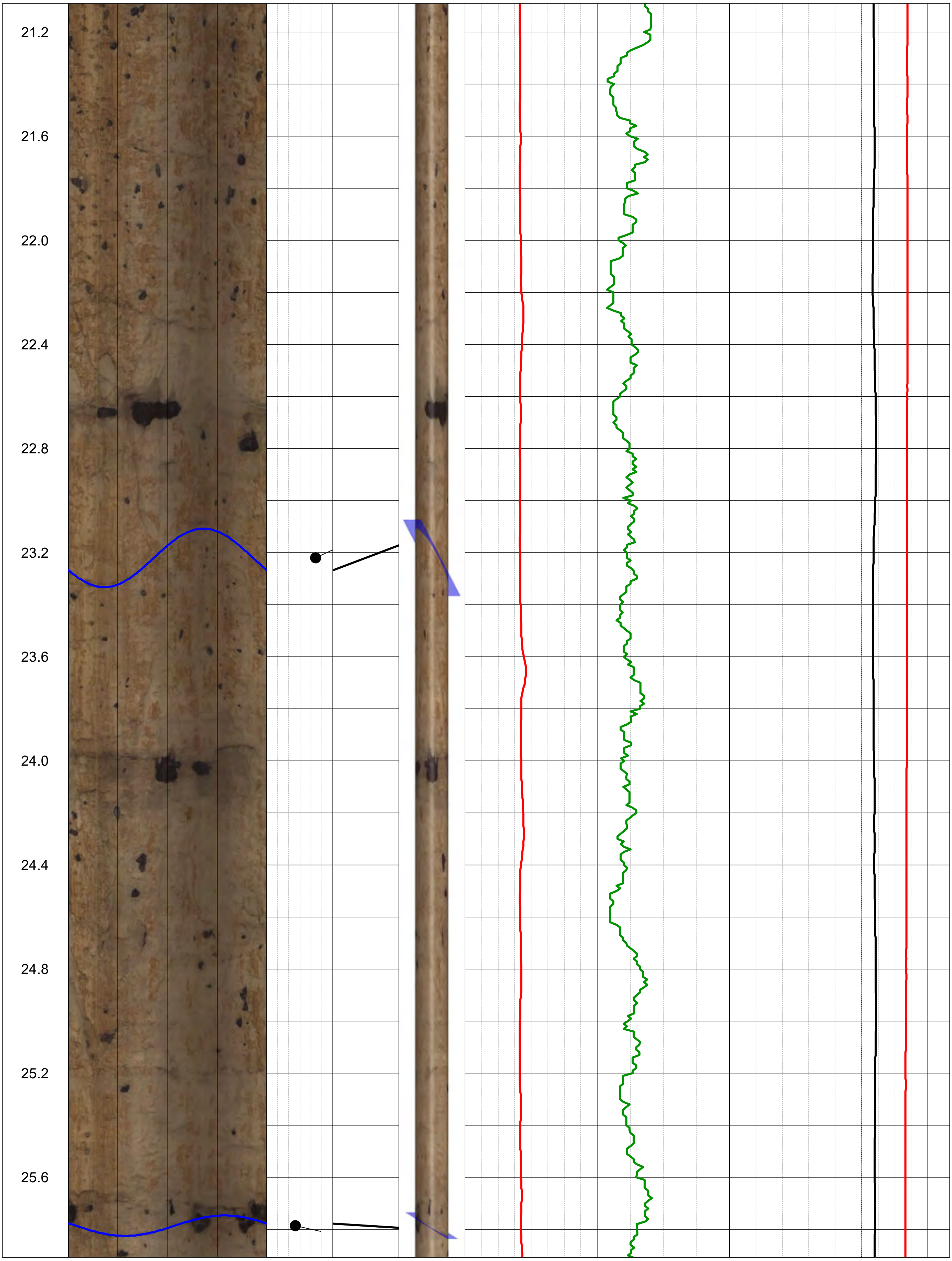
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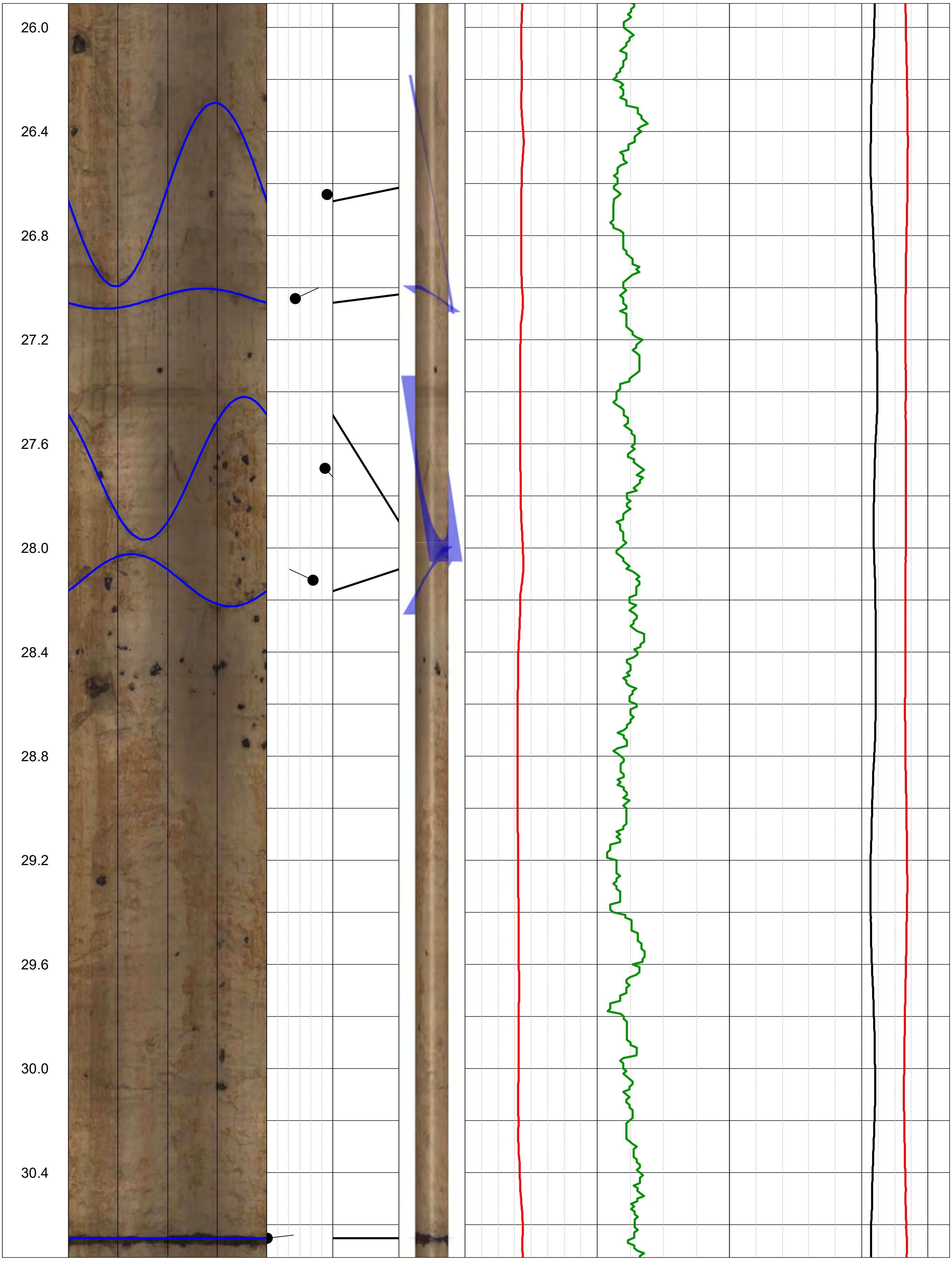
25.2
25.6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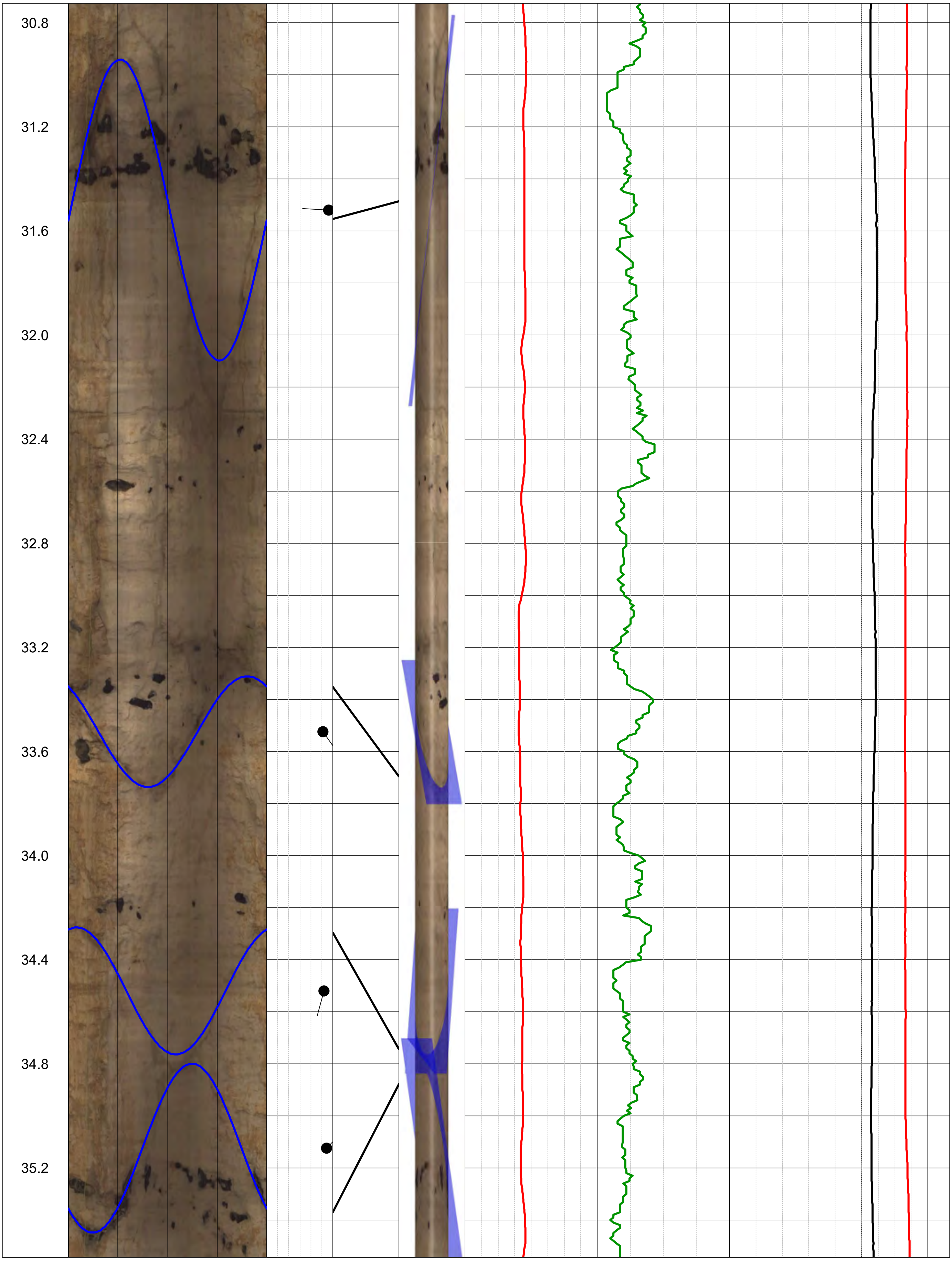
28.8
29.2
29.6
30.0
30.4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33.6
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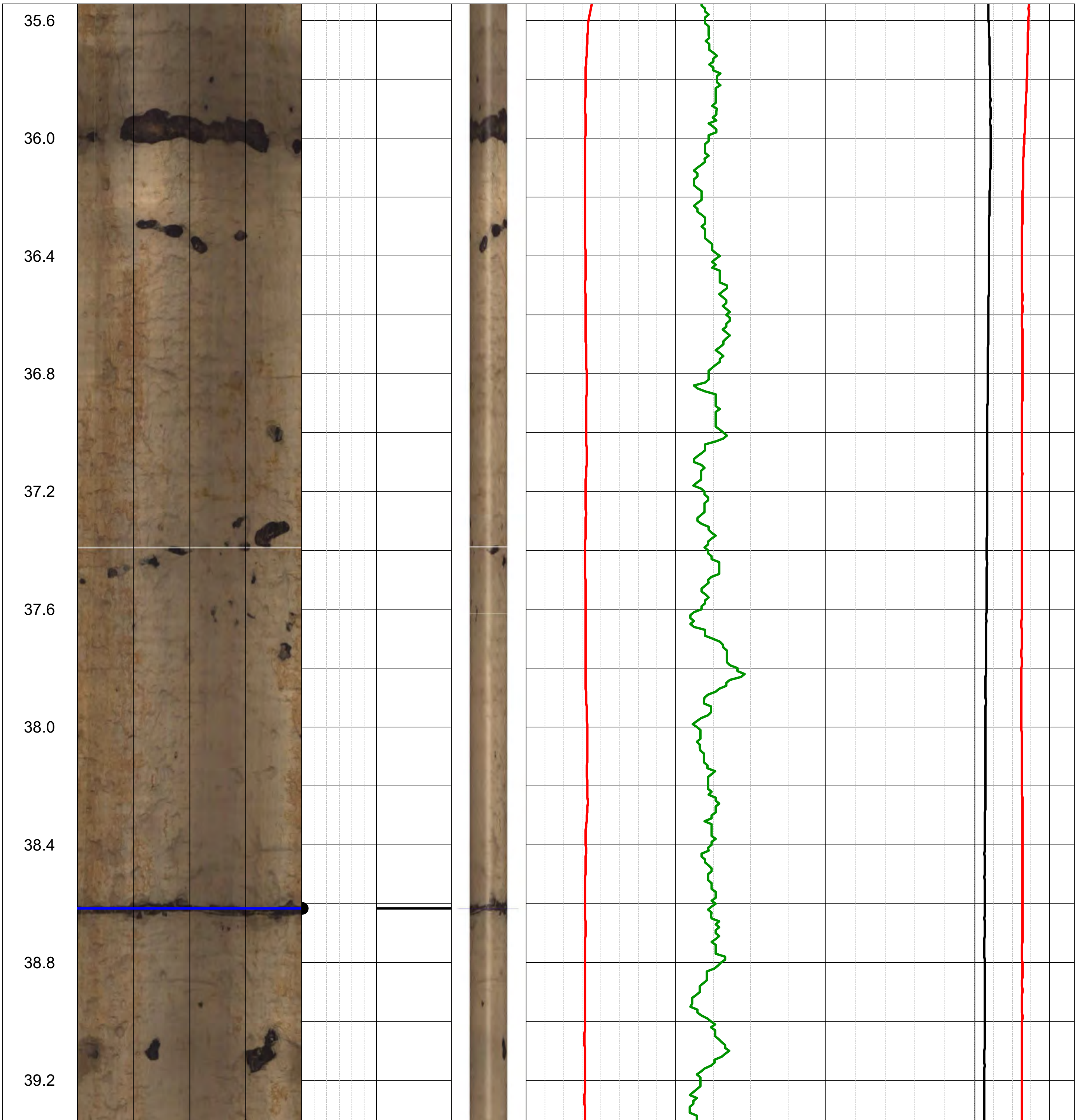
34.4
34.8
35.2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37.6
38.0
38.4
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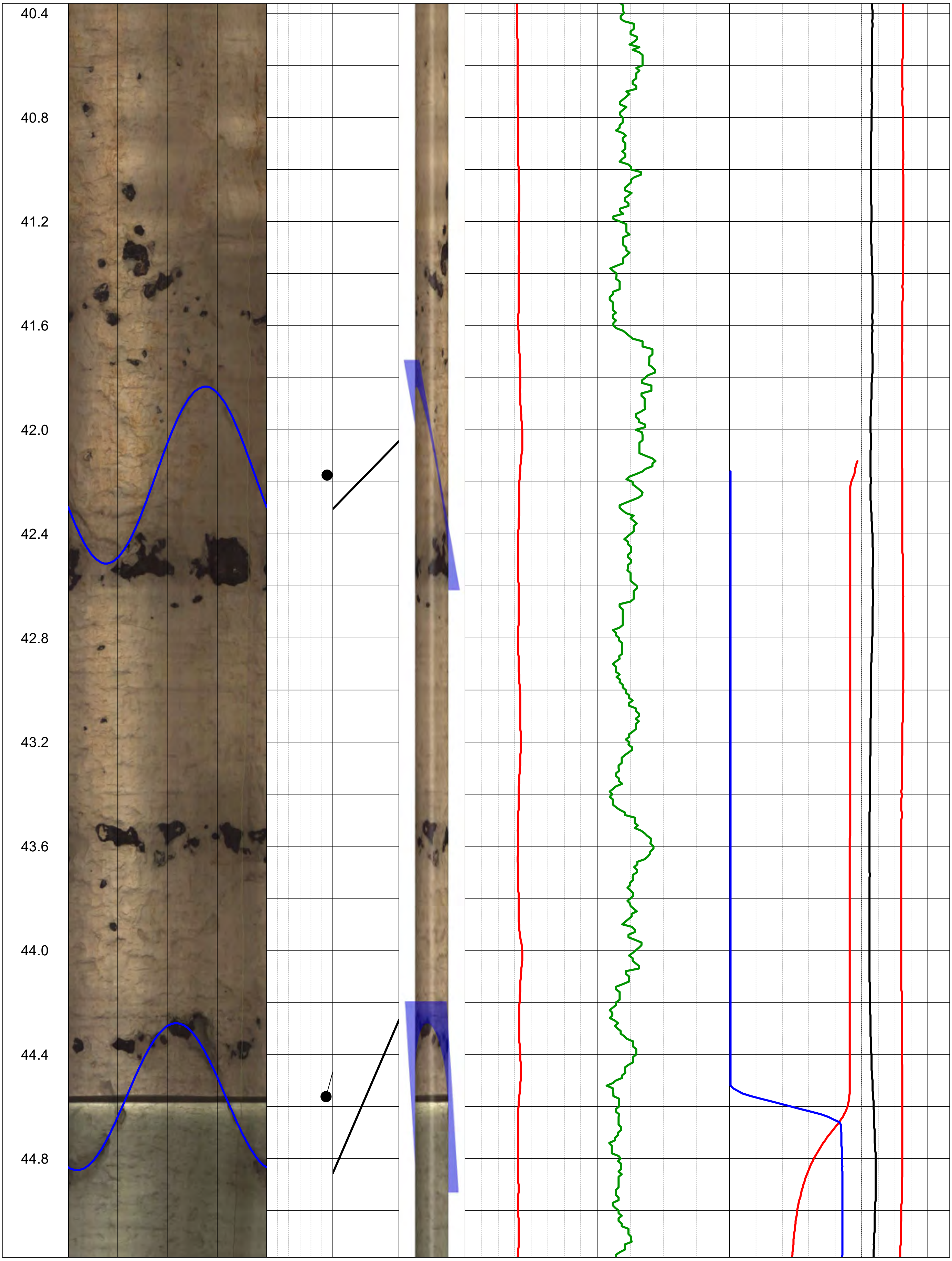
39.2
39.6
40.0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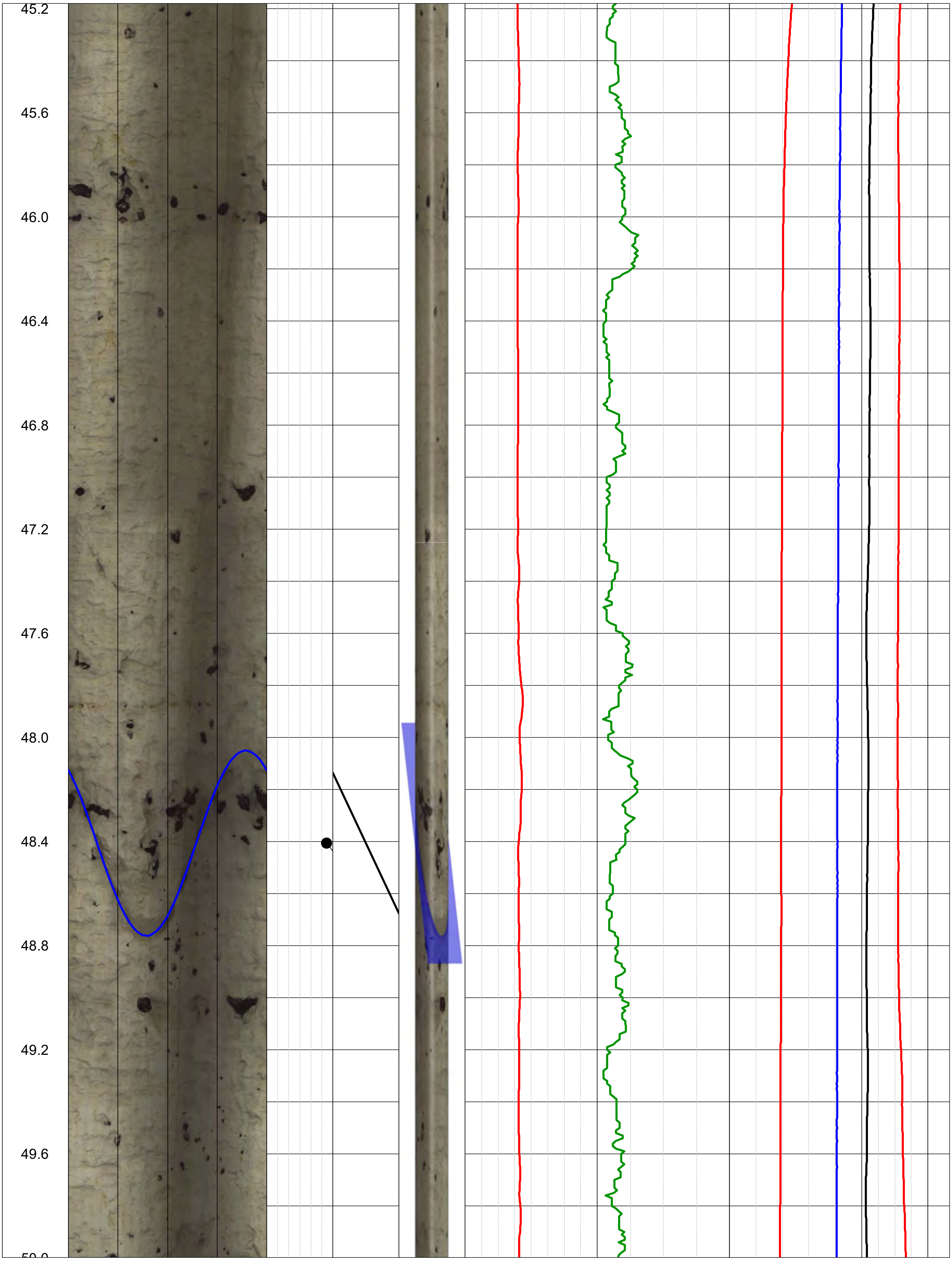
43.2
43.6
44.0
44.4
44.8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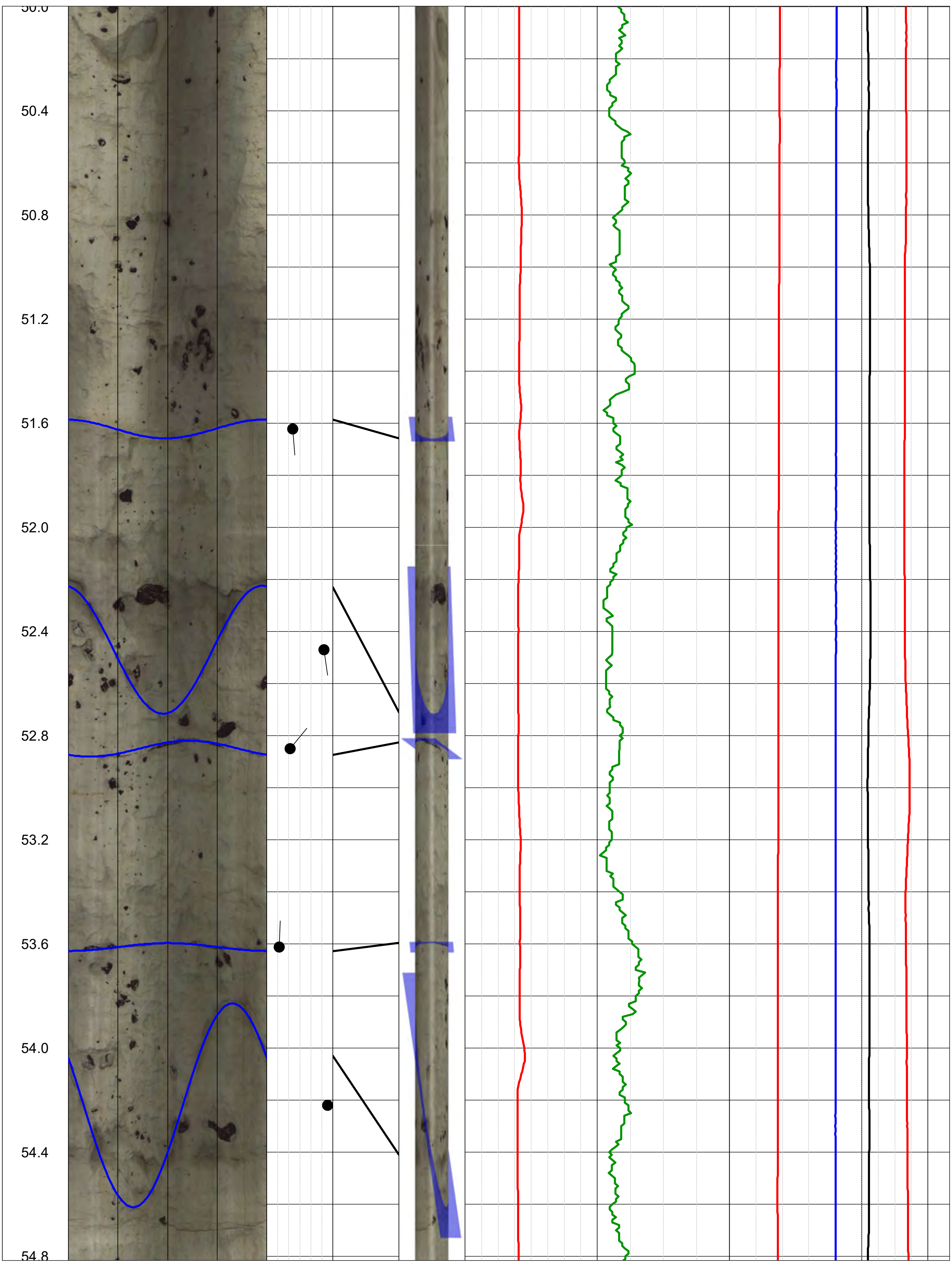
48.0
48.4
48.8
49.2
49.6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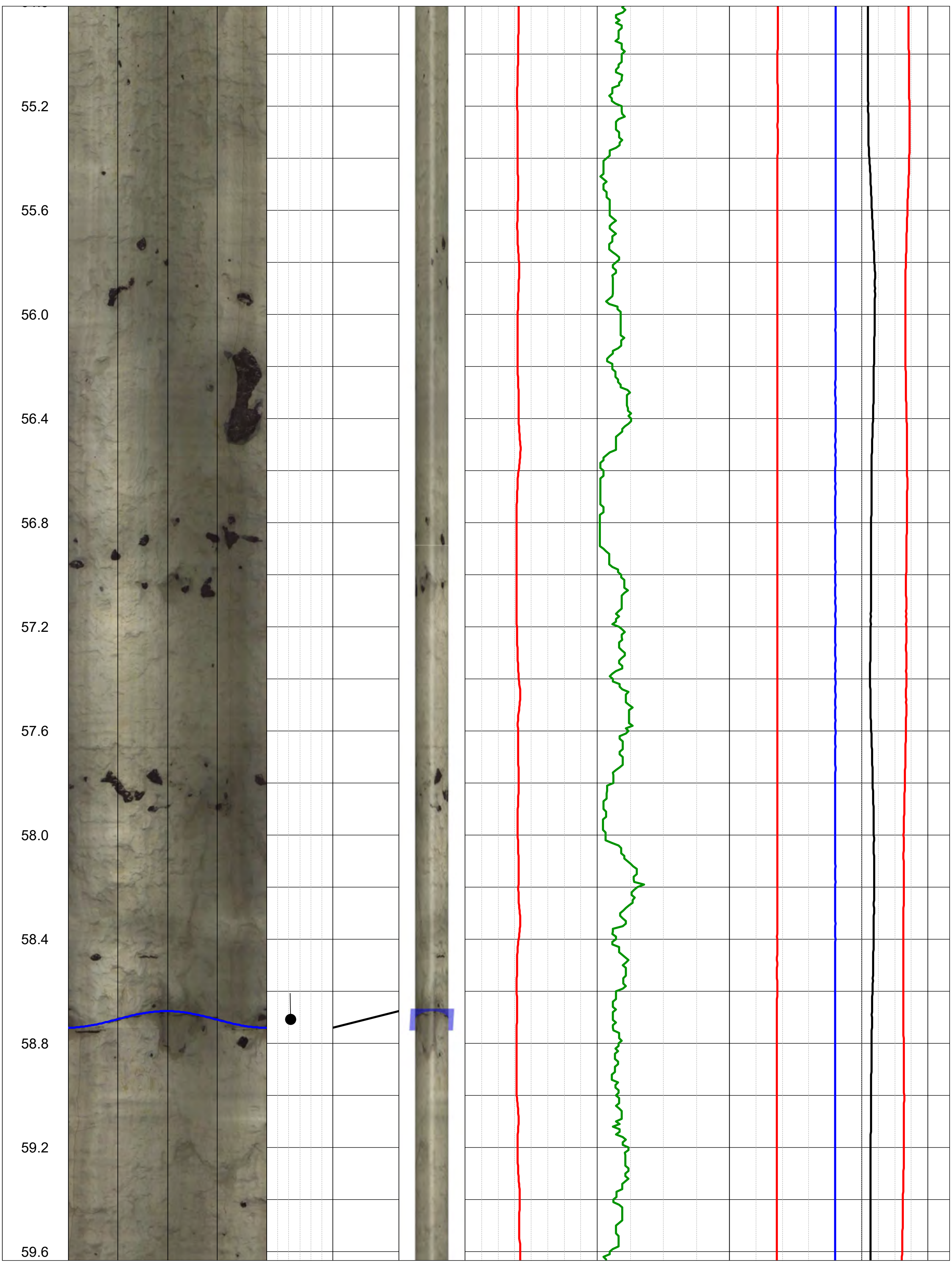
53.6
54.0
54.4
54.8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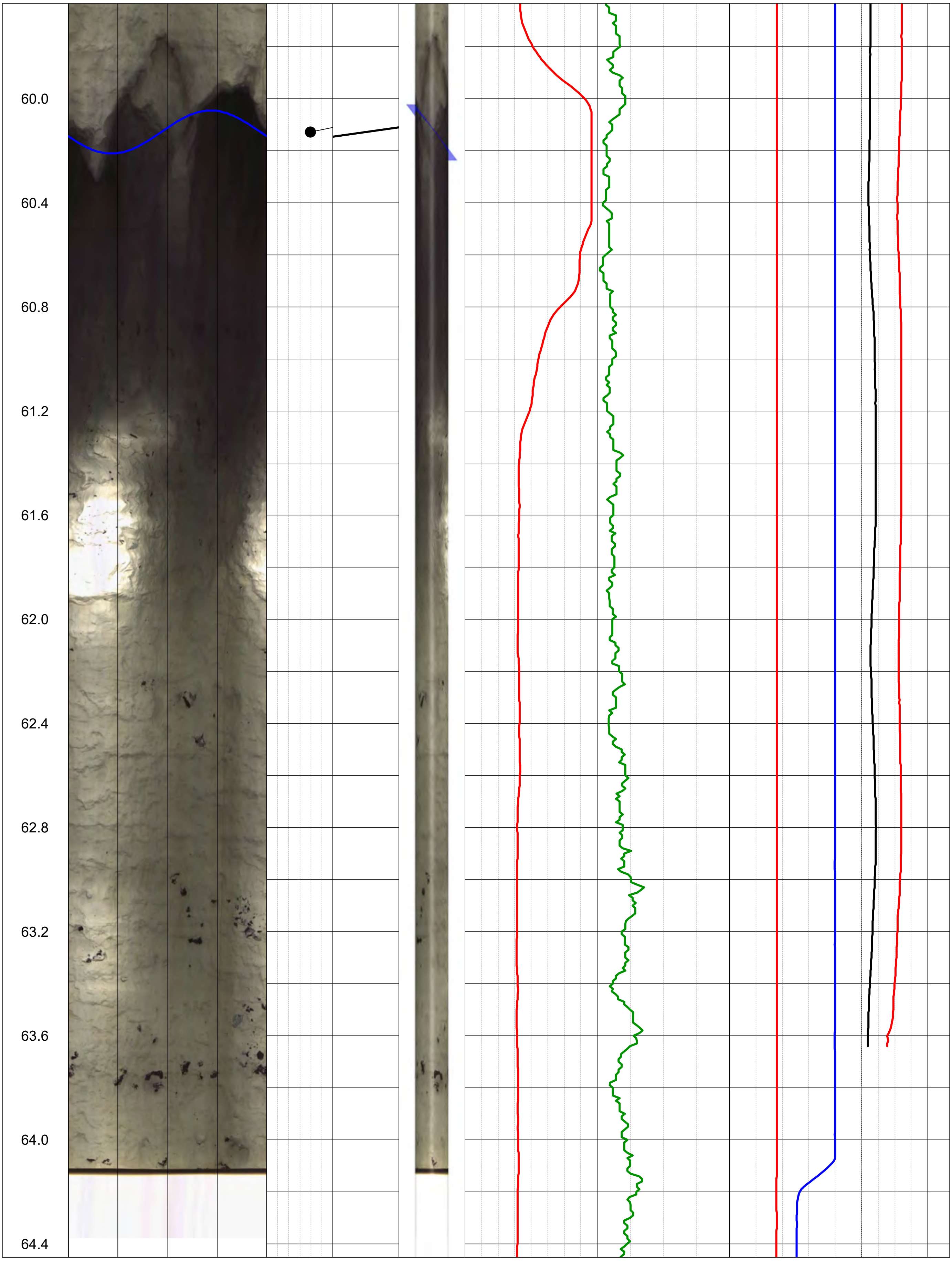
59.2
59.6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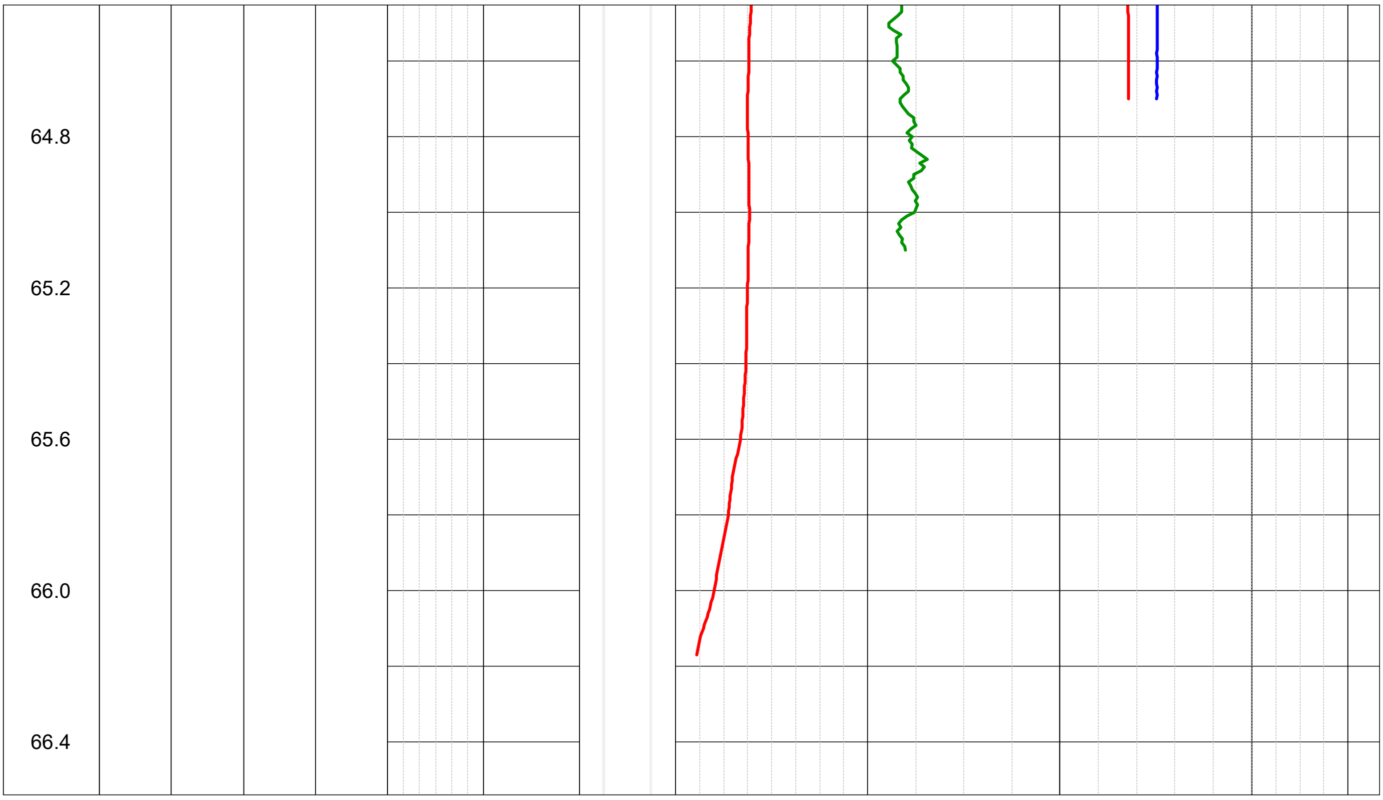
64.0
64.4


64.8
65.2
65.6
66.0
66.4

ROBERTSON GEO SERVICES®
Unlocking Your GeoData

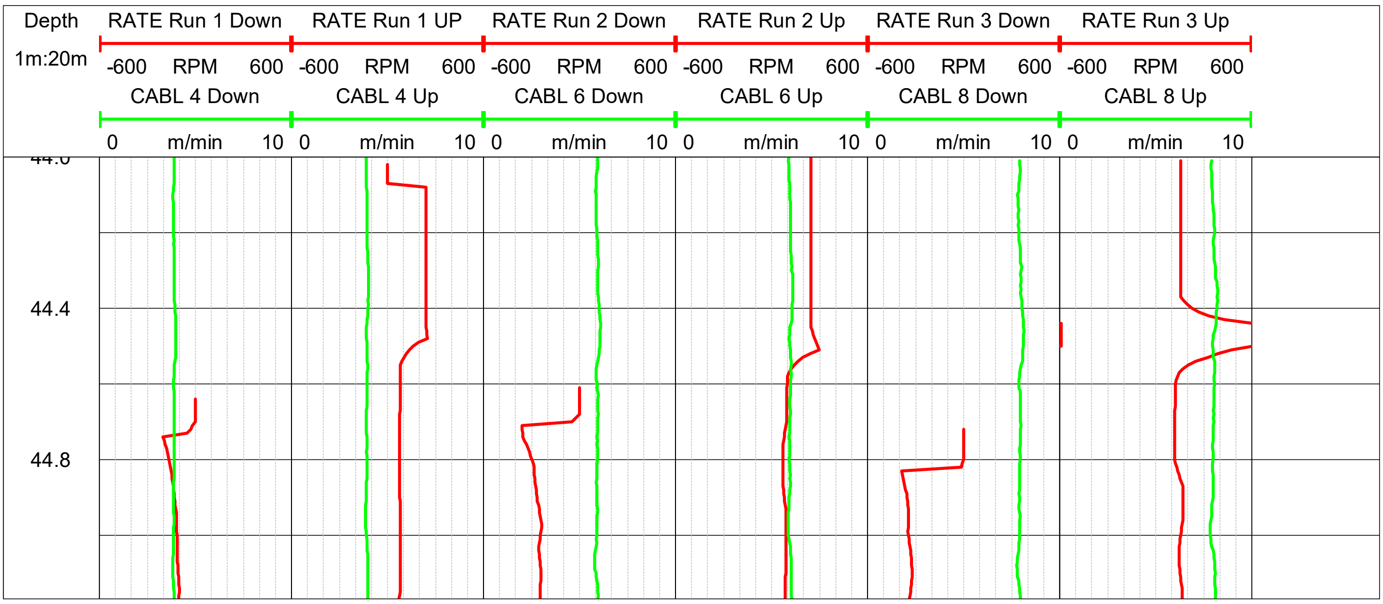
CO	Structural Soils
WELL	W623
FLD	A303 Stonehenge
CTY	England
STE	
FILING No	

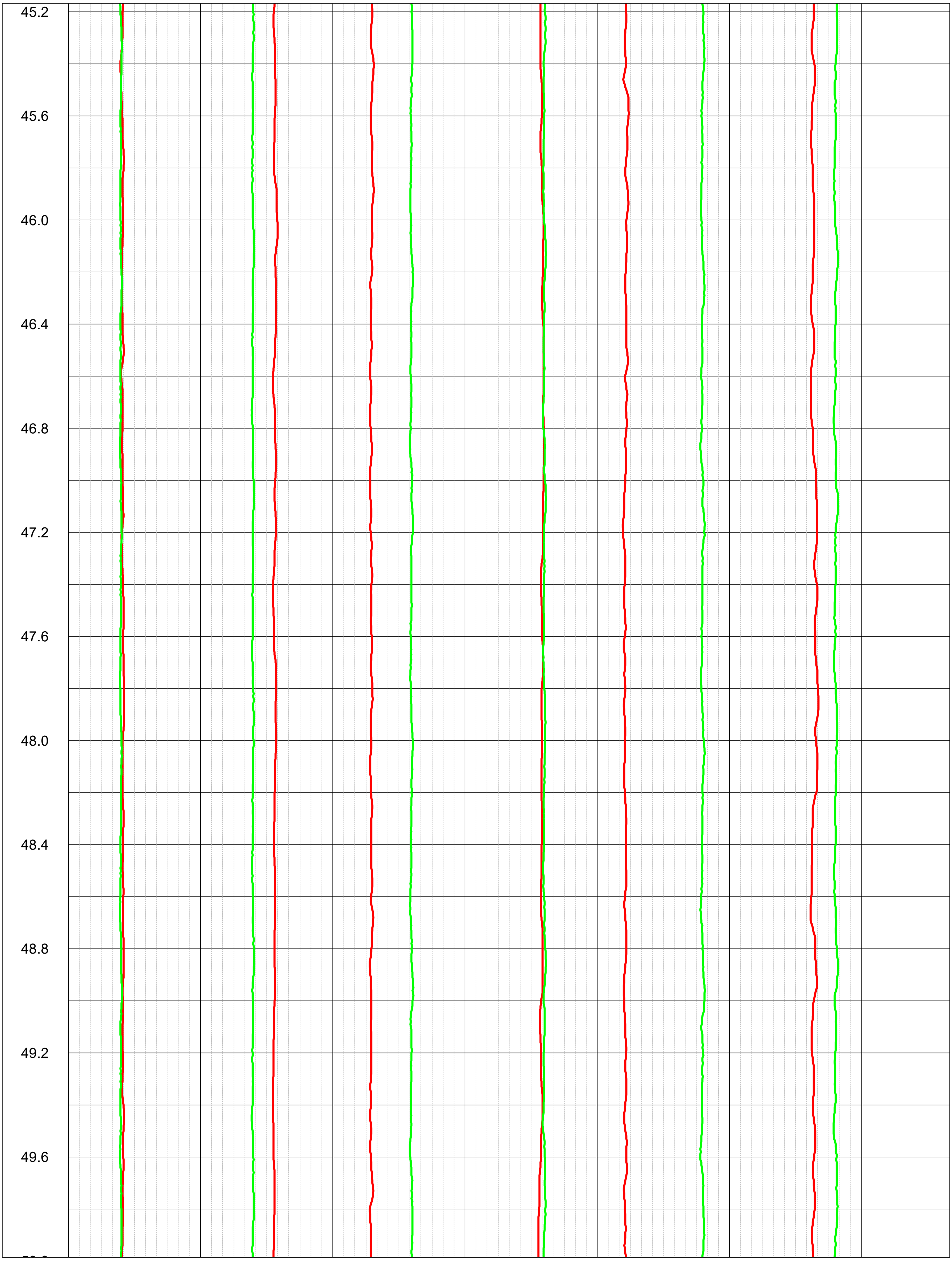
COMPANY	Structural Soils	
WELL ID	W623	
FIELD	A303 Stonehenge	
COUNTRY	England	STATE
LOCATION		OTHER SERVICES
Easting: 413433.33		
Northing: 141267.53		
SEC	TWP	RGE

PERMANENT DATUM	GL	ELEVATION 111.678	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.

DATE	08/08/18	TYPE FLUID IN HOLE	Water
RUN No		SALINITY	
TYPE LOG	Flowmeter	DENSITY	
DEPTH-DRILLER	70	LEVEL	44.6
DEPTH-LOGGER	63.4	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	63.4		
TOP LOGGED INTERVAL	44		
OPERATING RIG TIME			
RECORDED BY	James Boyett		
WITNESSED BY	Joanne Van-Aardt		

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

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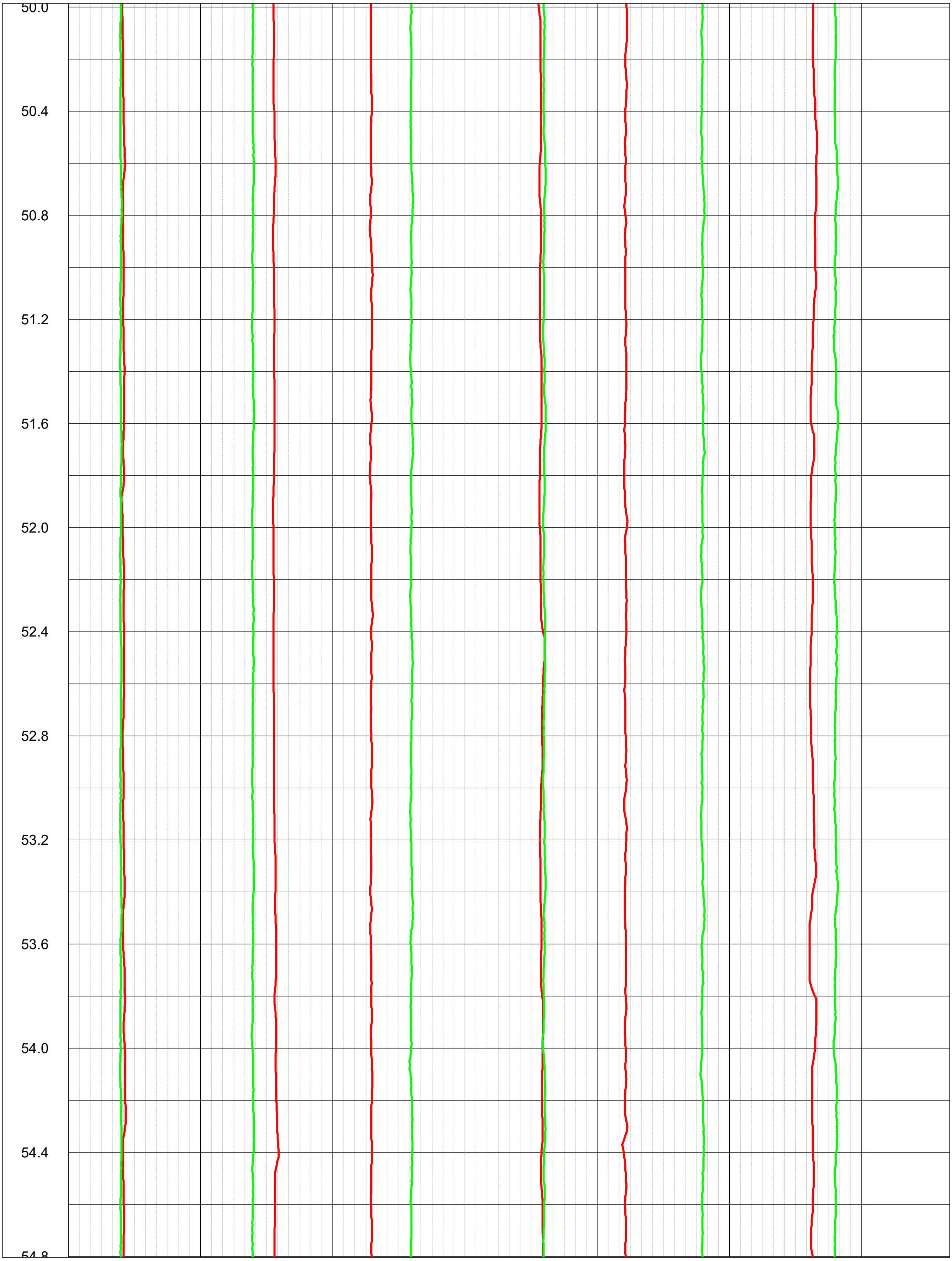
48.4
48.8
49.2
49.6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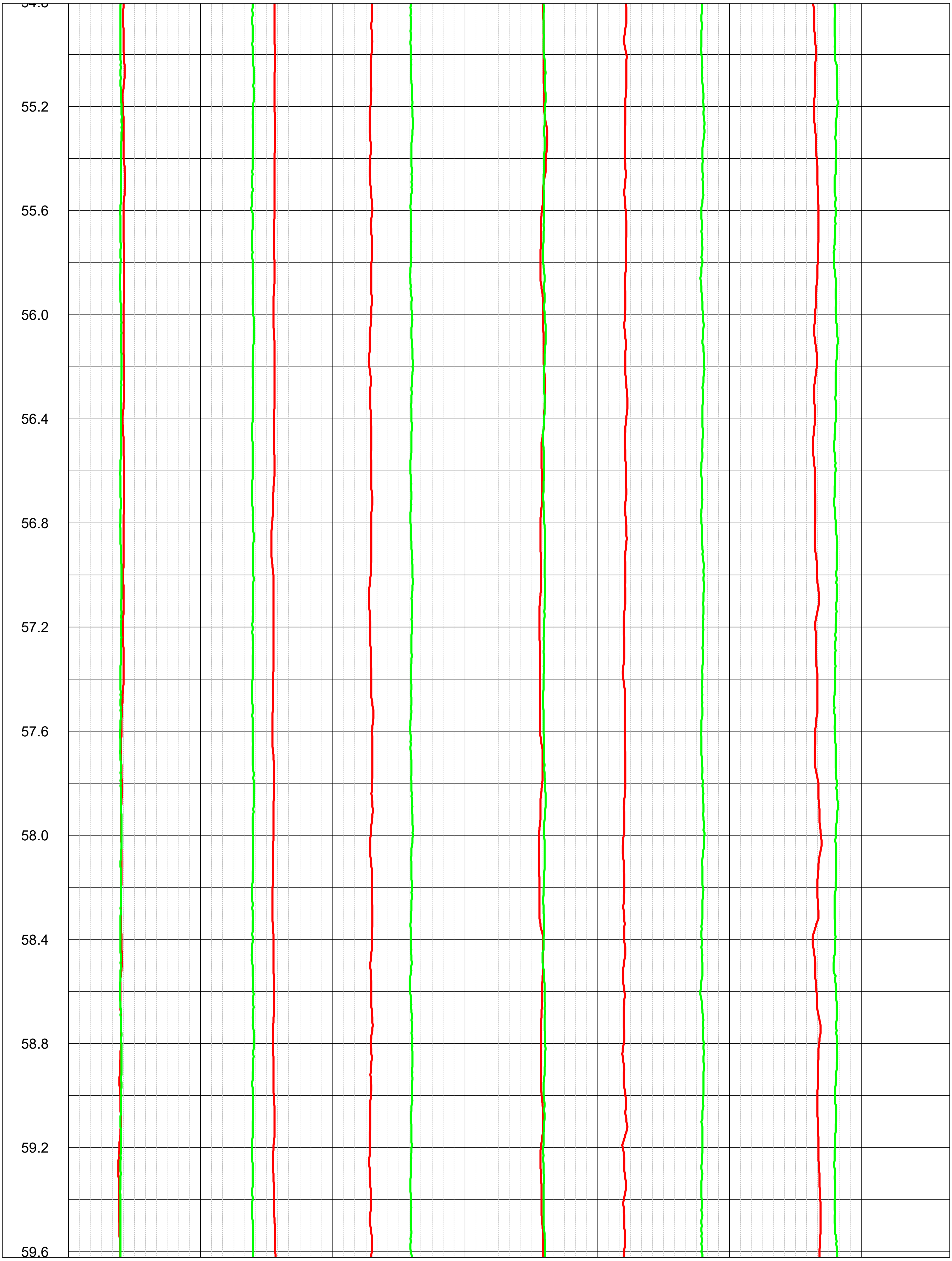
53.2
53.6
54.0
54.4
54.8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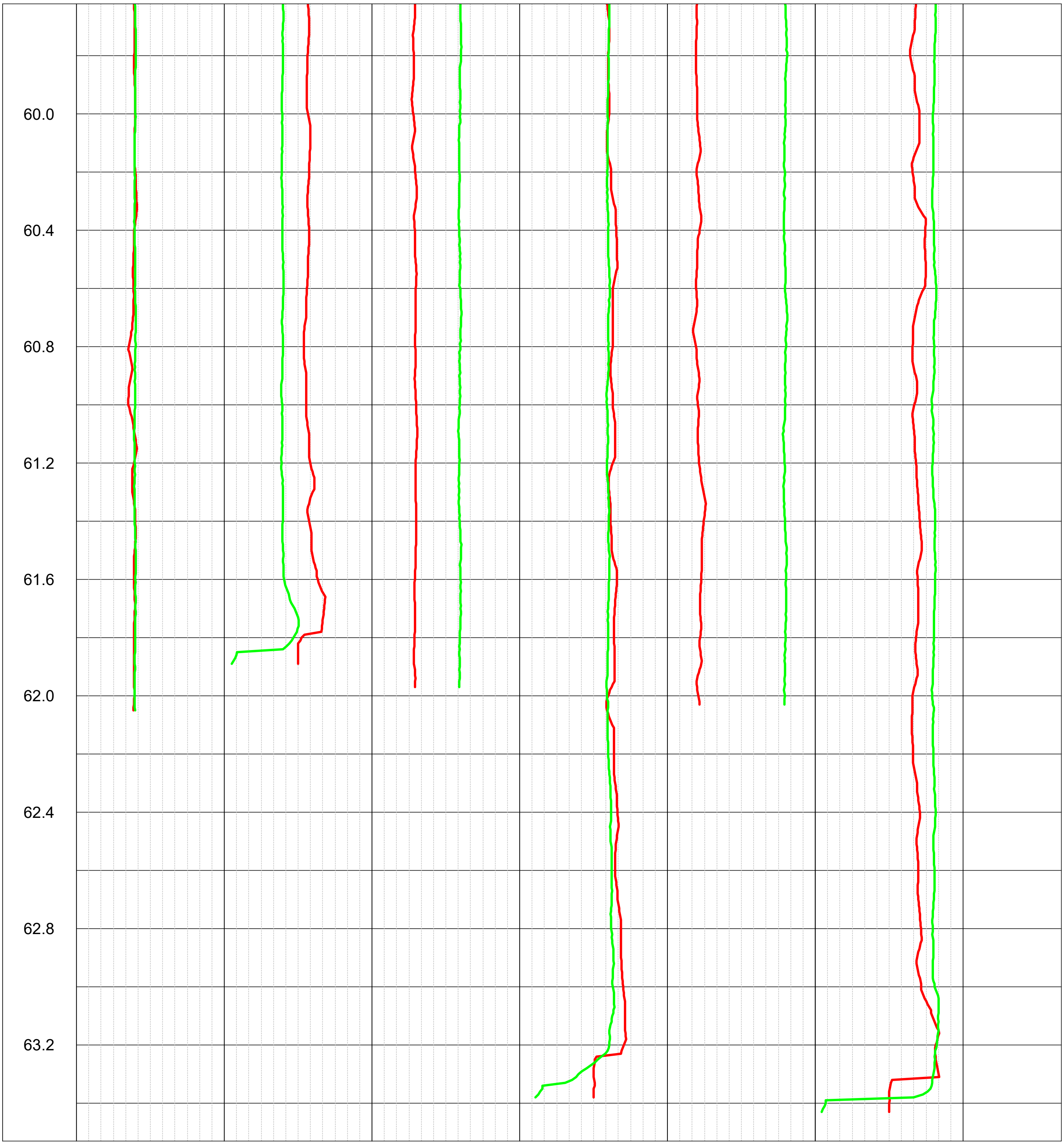
58.8
59.2
59.6


60.0
60.4
60.8
61.2
61.6
62.0
62.4
62.8
63.2

Depth	Azimuth	Dip	Aperture
m	deg	deg	mm
12.07	118.85	79.71	0.00
15.21	0.00	0.00	0.00
19.94	109.91	77.67	0.00
23.22	65.19	66.04	0.00
25.79	103.17	38.12	0.00
26.64	86.04	81.92	0.00
27.04	65.14	37.86	0.00
27.69	138.60	79.67	0.00
28.12	294.32	63.51	0.00
30.65	0.00	0.00	0.00
31.52	273.91	85.05	0.00
33.52	144.54	76.76	0.00
34.52	195.22	78.40	0.00
35.12	44.37	81.25	0.00
38.62	252.29	0.48	0.00
42.17	68.67	81.63	0.00
44.56	15.58	79.96	0.00
48.41	141.99	81.99	0.00
51.62	175.94	35.75	0.00
52.47	171.94	78.50	0.00
52.85	38.82	31.34	0.00
53.61	0.78	16.79	0.00
54.22	117.74	82.72	0.00
58.71	357.96	32.52	0.00
60.13	78.34	58.84	0.00

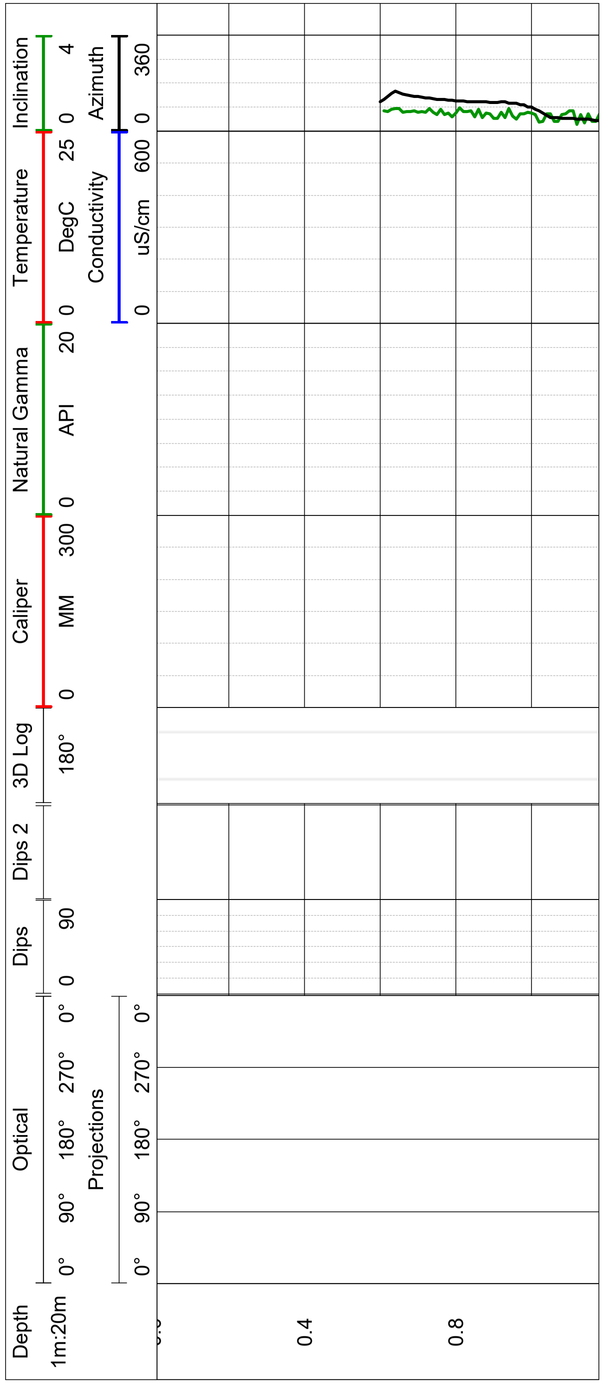
ROBERTSON GEO SERVICES
Unlocking Your GeoData

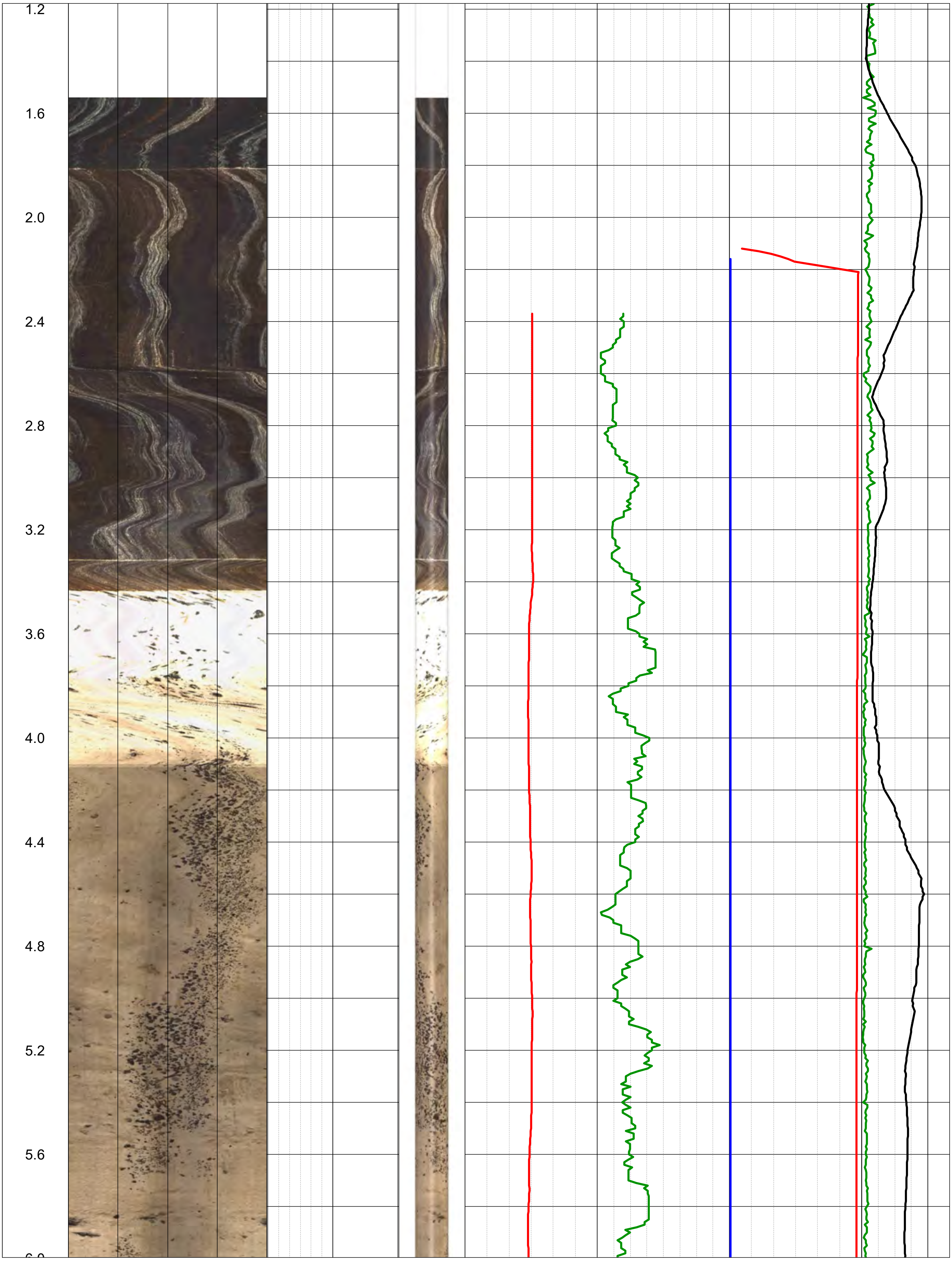
CO Structural Soils	COMPANY	Structural Soils	
WELL RX624	WELL ID	RX624	
FLD A393 Stonehenge	FIELD	A303 Stonehenge	
CTY England	COUNTRY	England	STATE
STE	LOCATION Easting: 413355.91 Northing: 141334		OTHER SERVICES
FILING No	SEC	TWP	RGE

PERMANENT DATUM	GL	ELEVATION	108.154	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM		D.F.
DRILLING MEAS. FROM				G.L.

DATE	18/04/18	TYPE FLUID IN HOLE	Water
RUN No		SALINITY	
TYPE LOG	Composite	DENSITY	
DEPTH-DRILLER	70	LEVEL	39.4
DEPTH-LOGGER	68	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	68		
TOP LOGGED INTERVAL	0.6		
OPERATING RIG TIME			
RECORDED BY	Kyle Owen		
WITNESSED BY	James Boyett		

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

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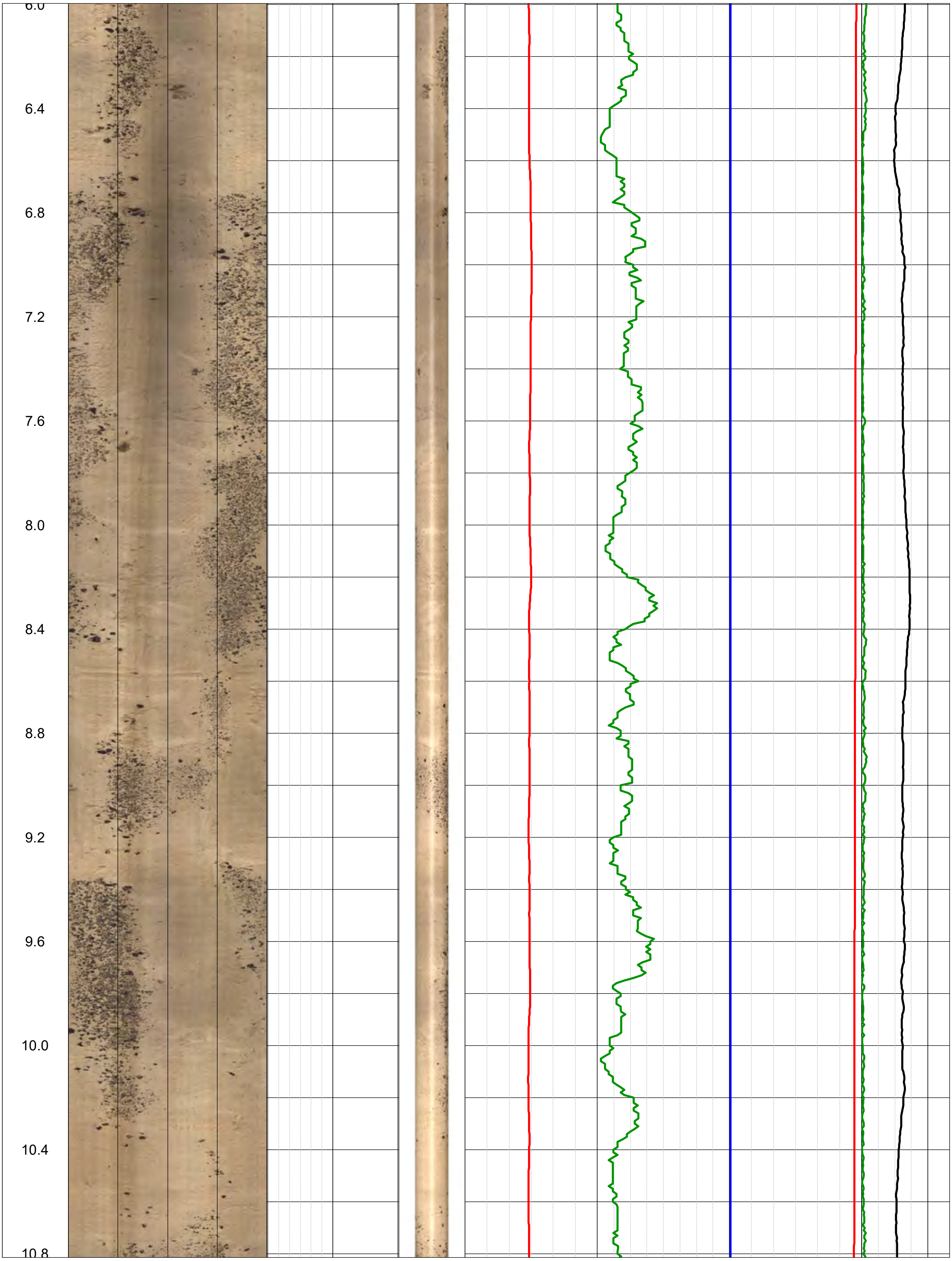
4.0
4.4
4.8
5.2
5.6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9.2
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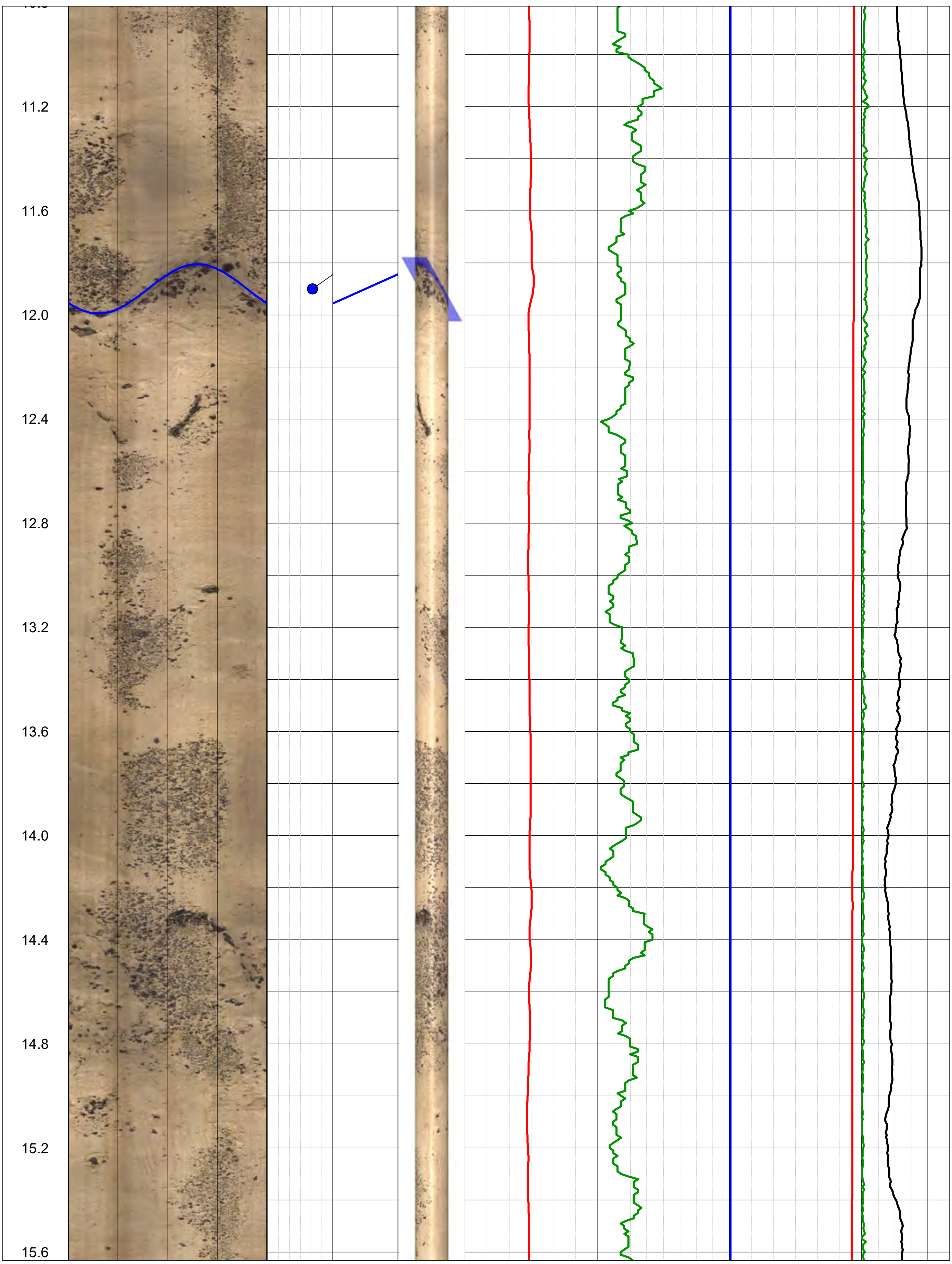
10.4
10.8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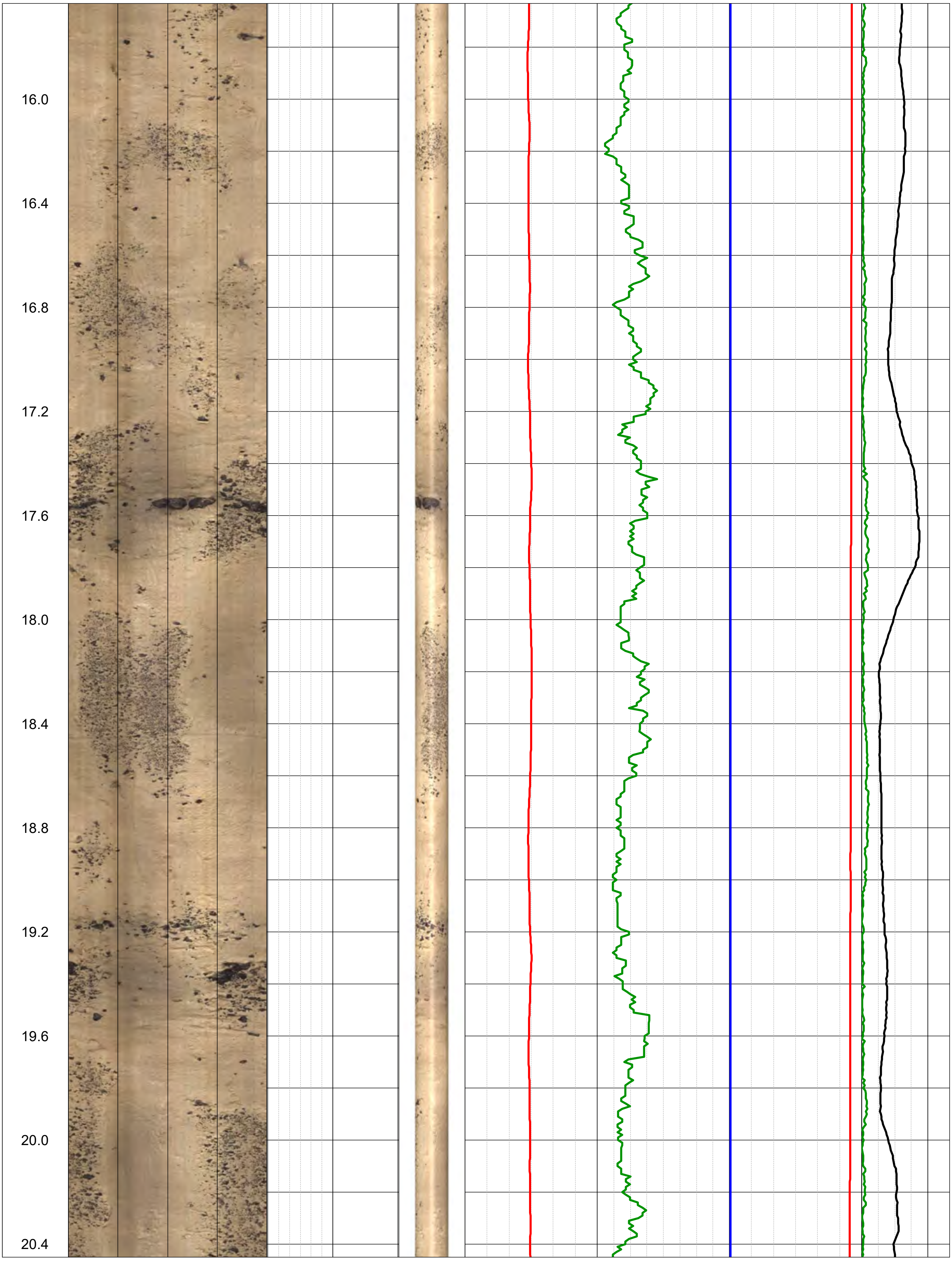
15.6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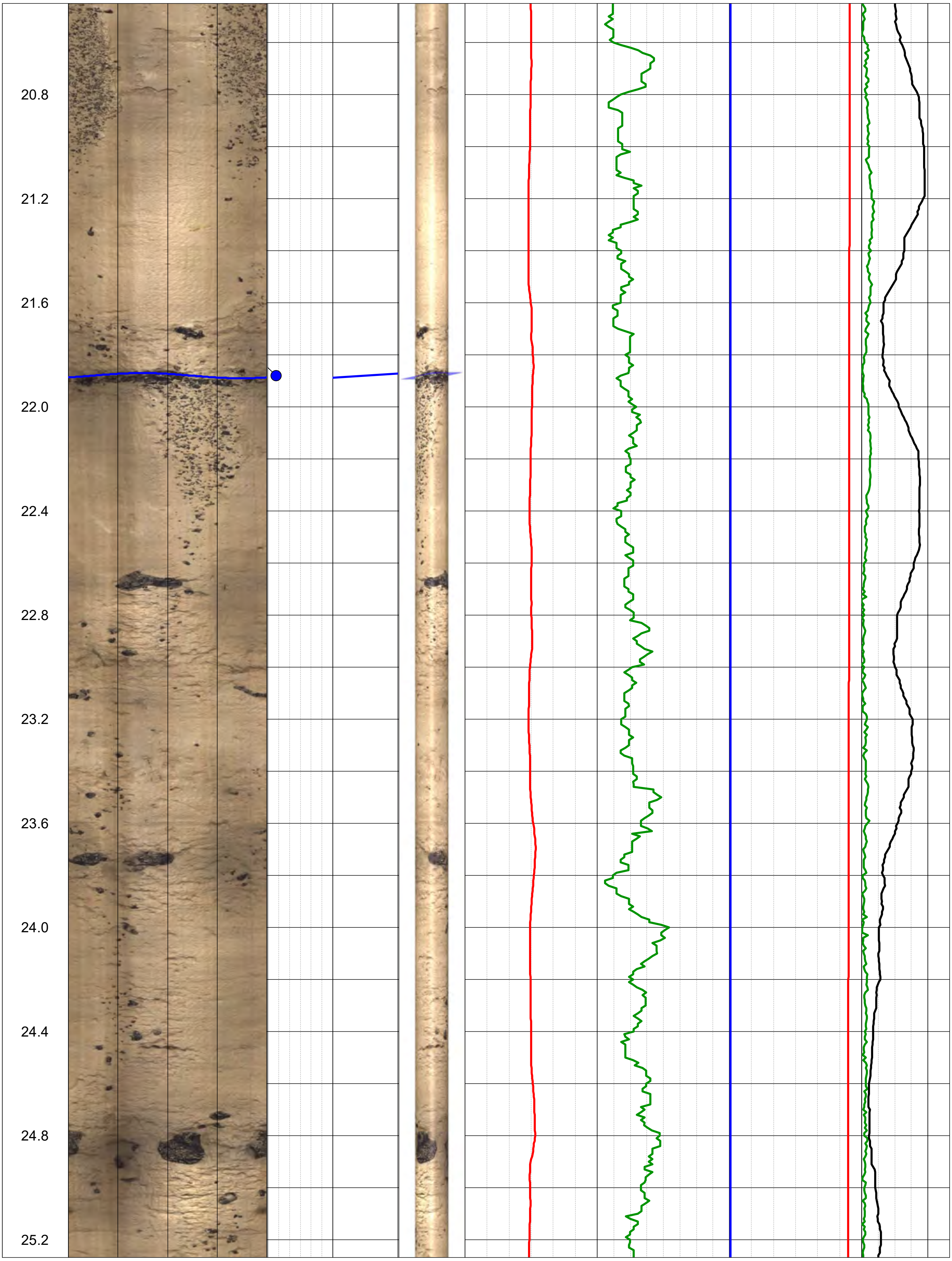
20.4



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23.6
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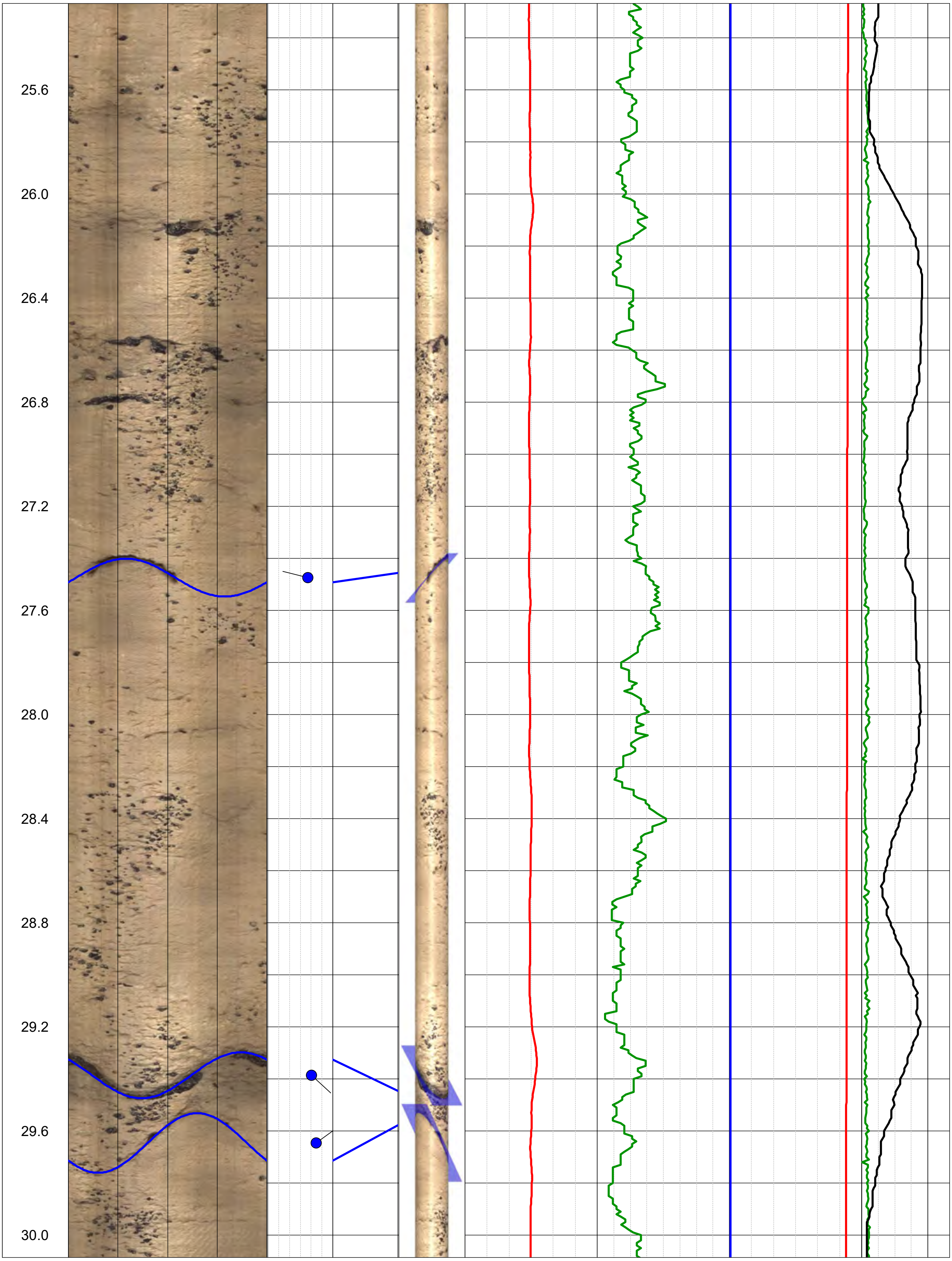
24.8
25.2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28.4
28.8
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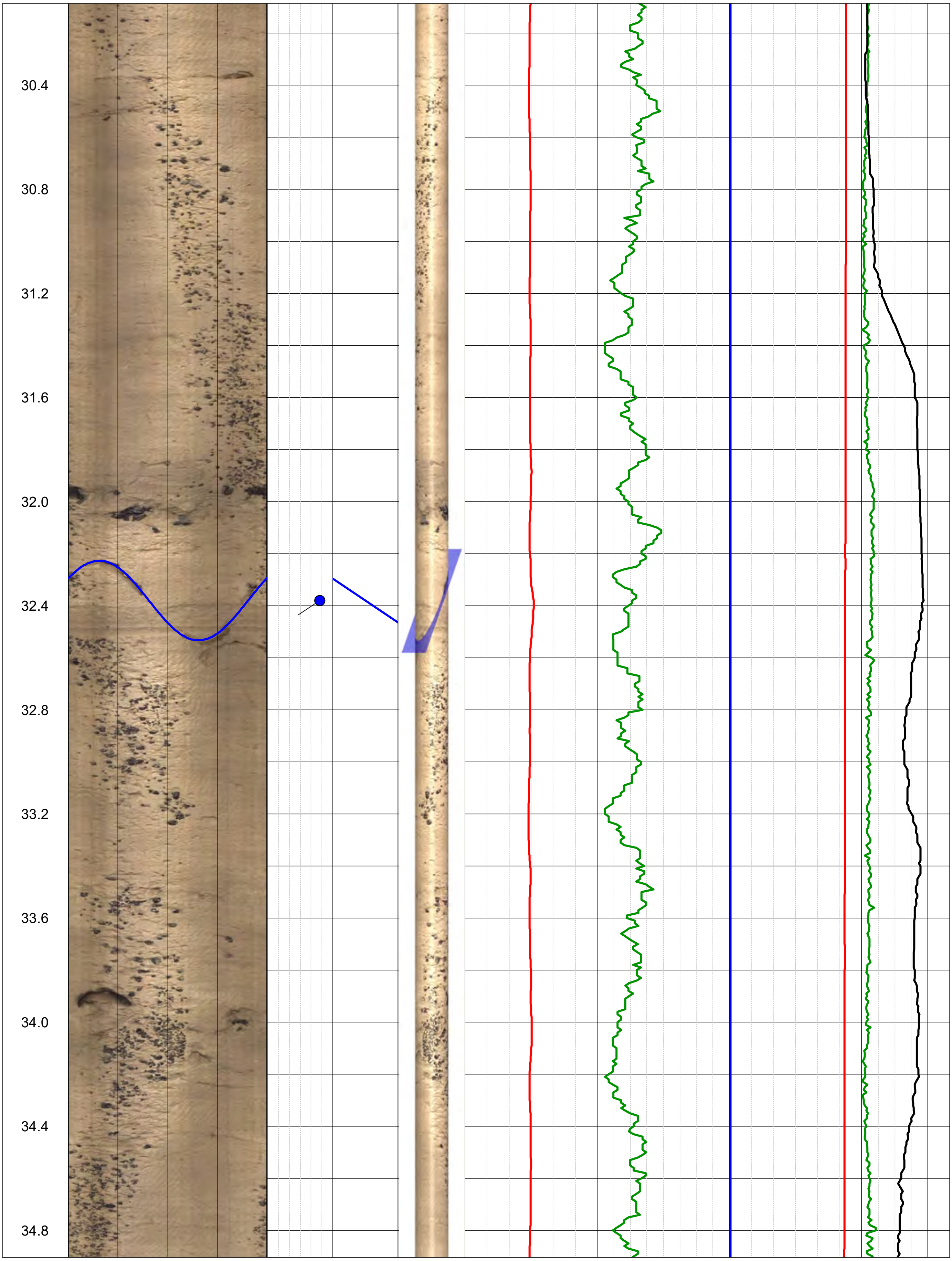
29.6
30.0



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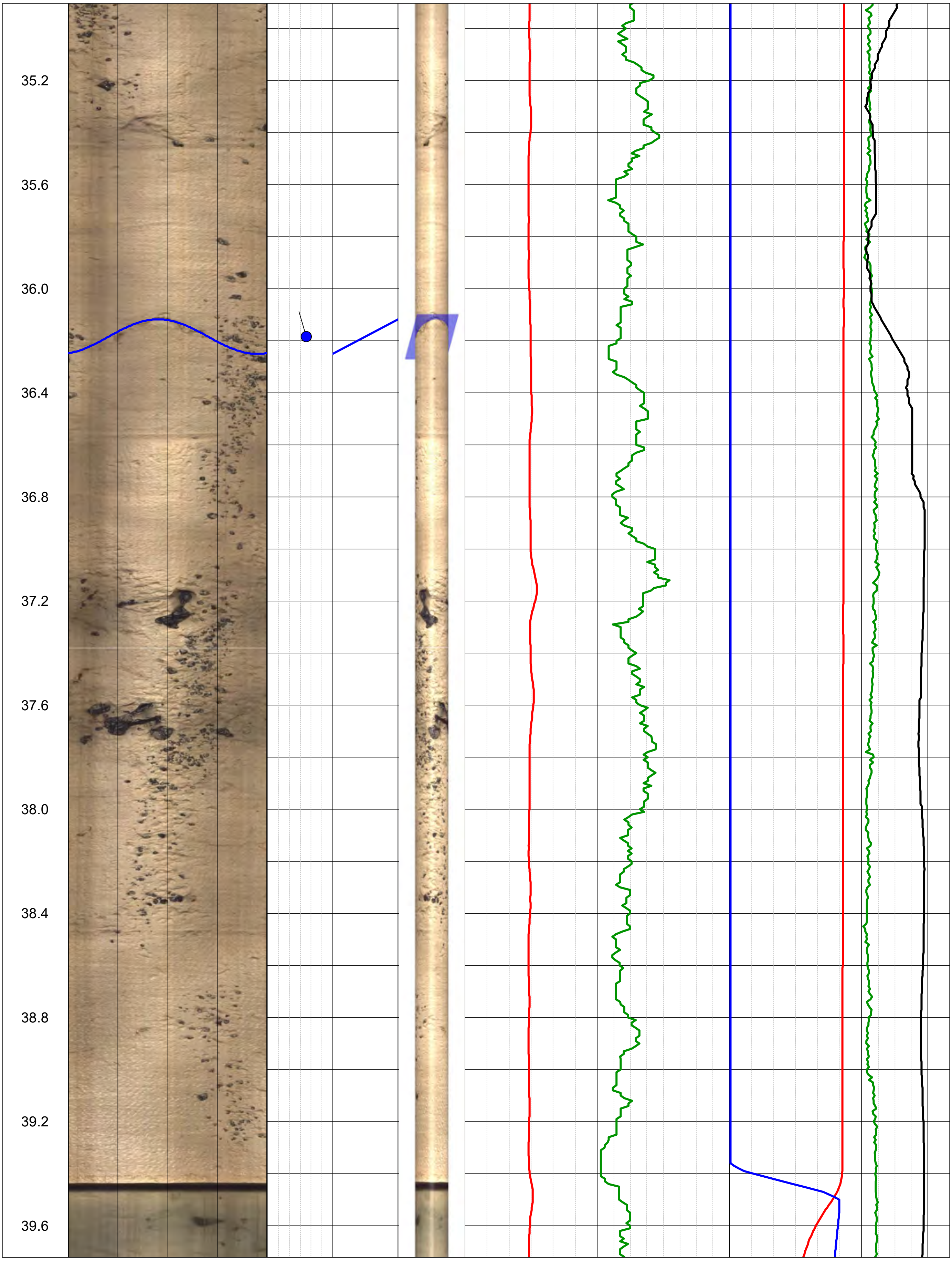
34.8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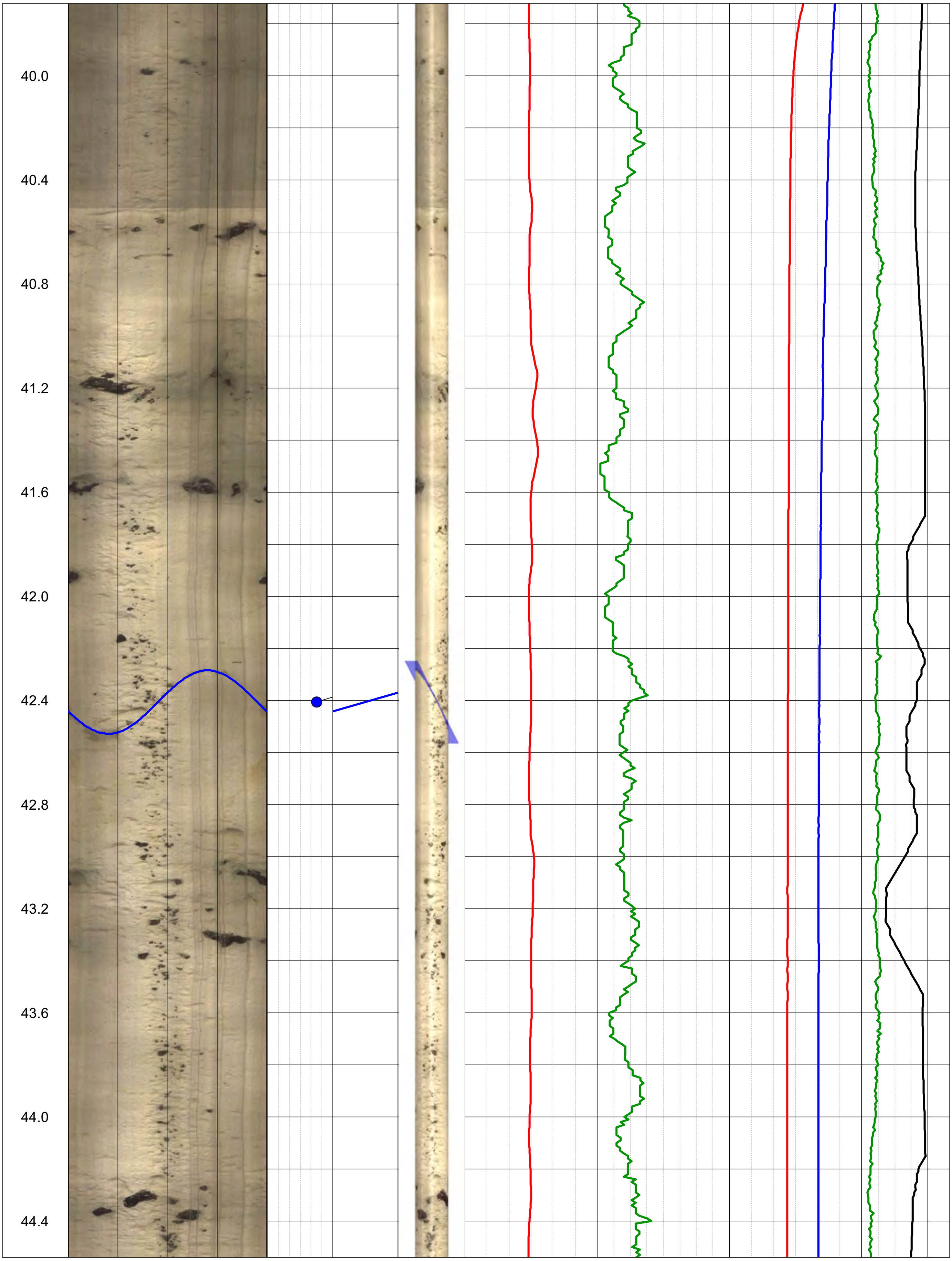
39.6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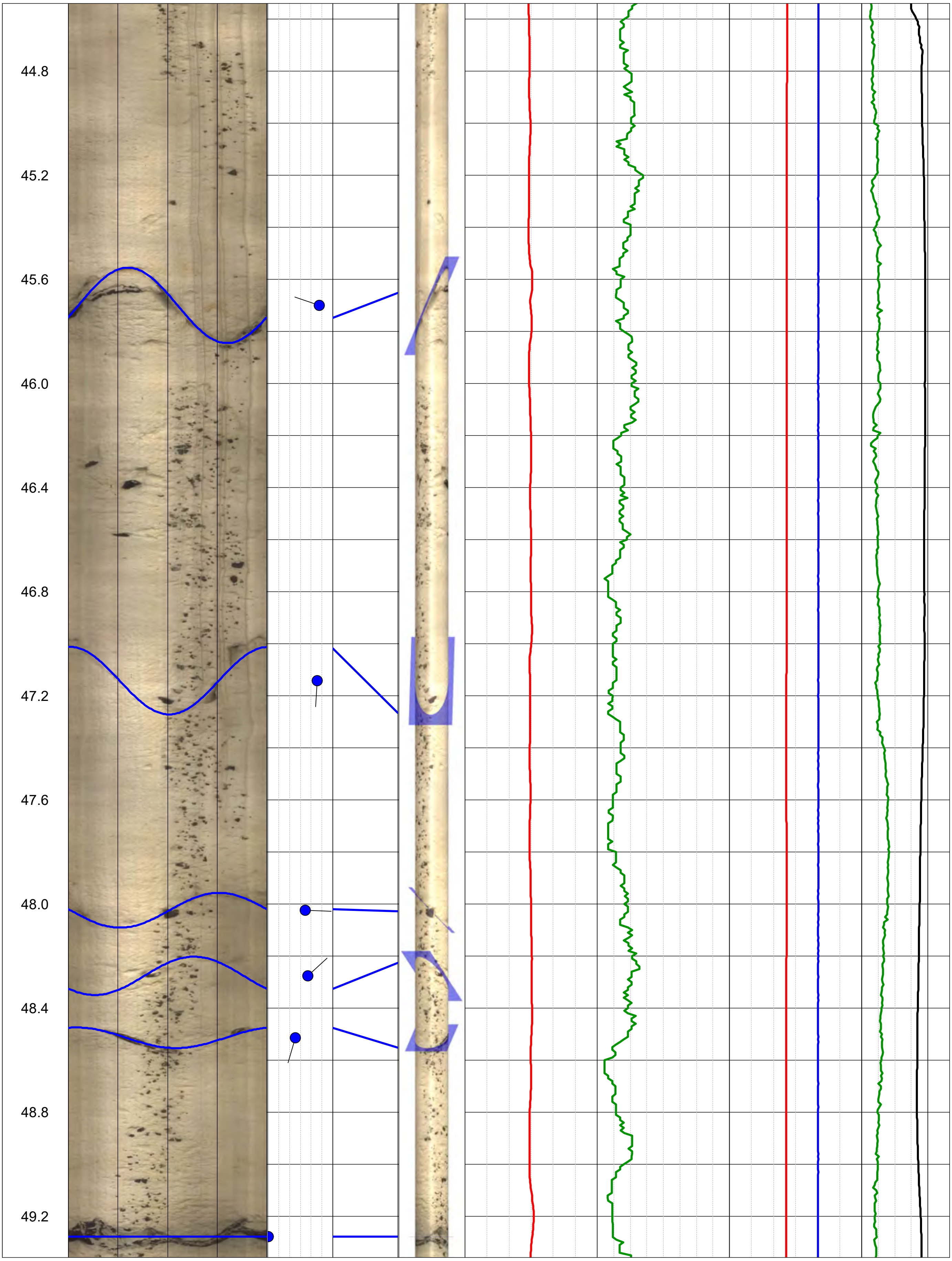
43.6
44.0
44.4


44.8
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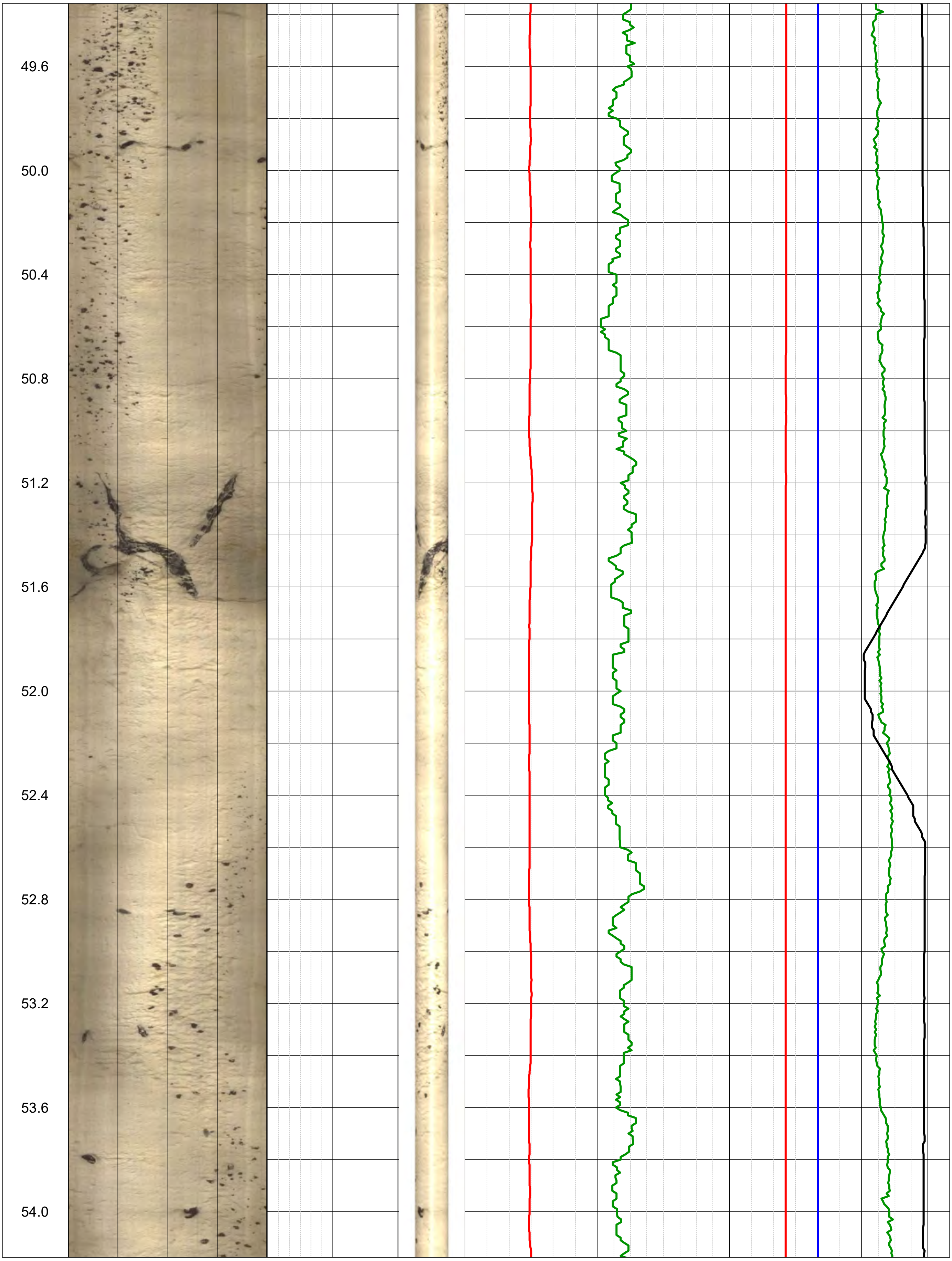
48.8
49.2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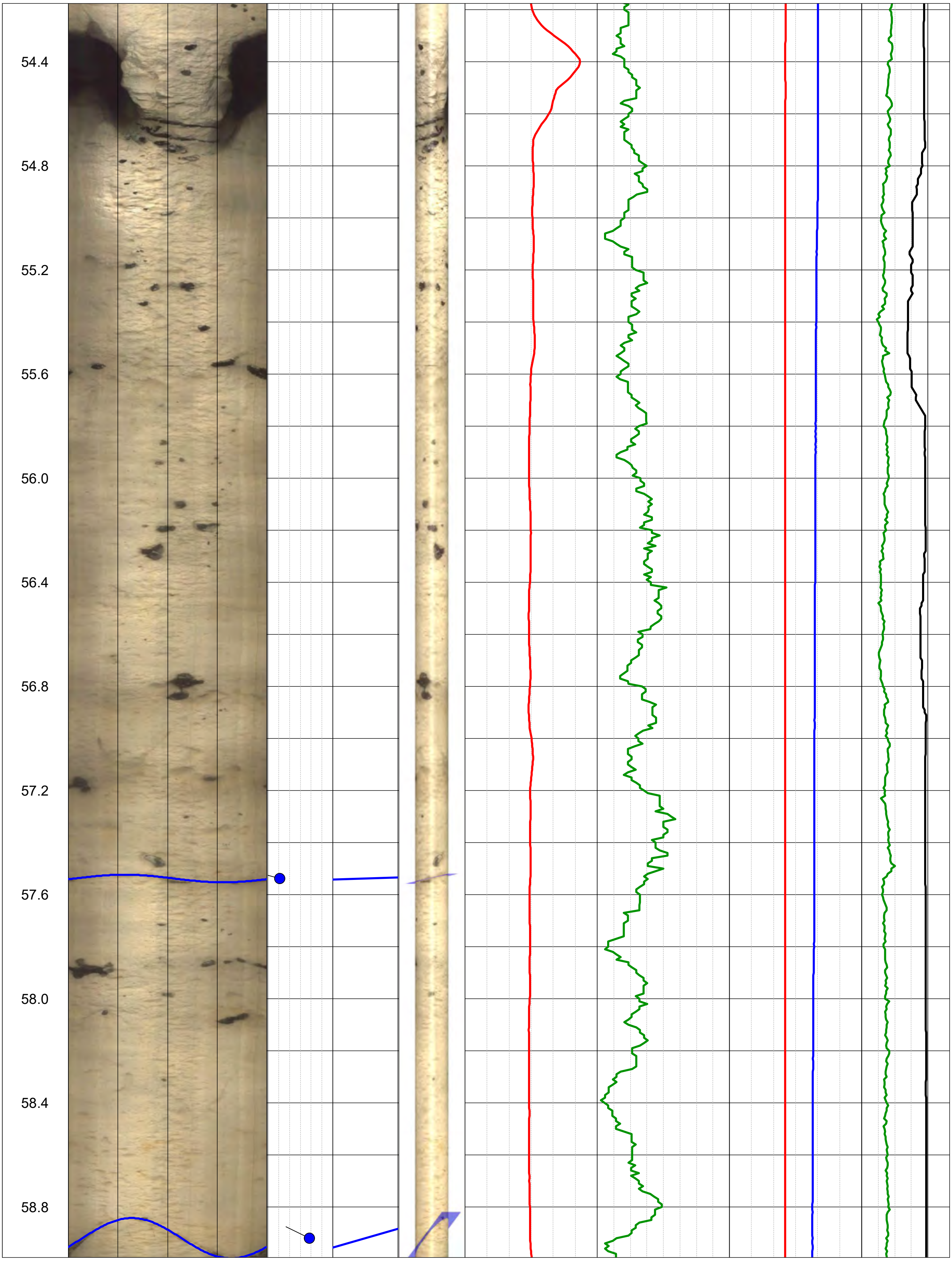
54.4
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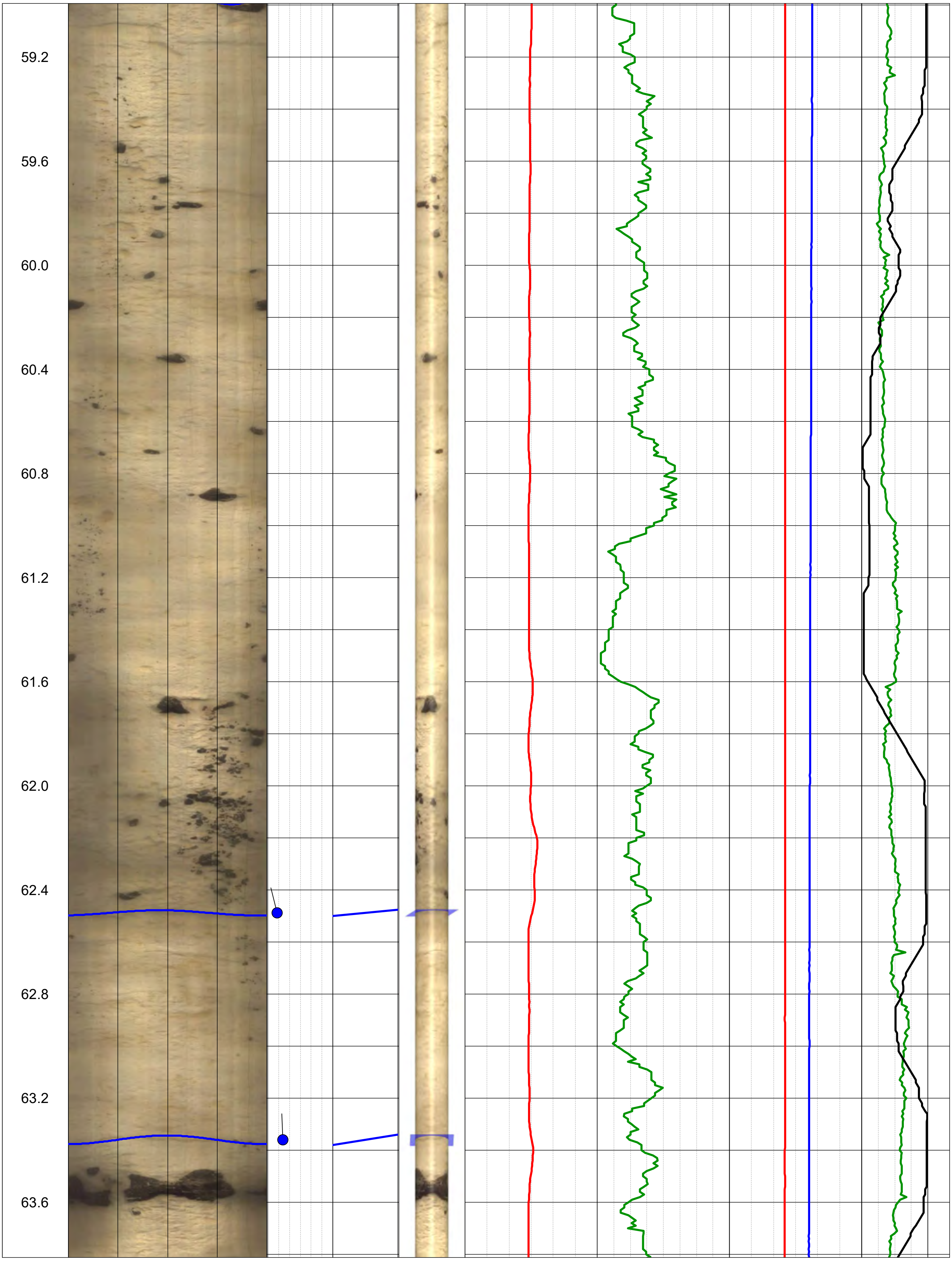
57.2
57.6
58.0
58.4
58.8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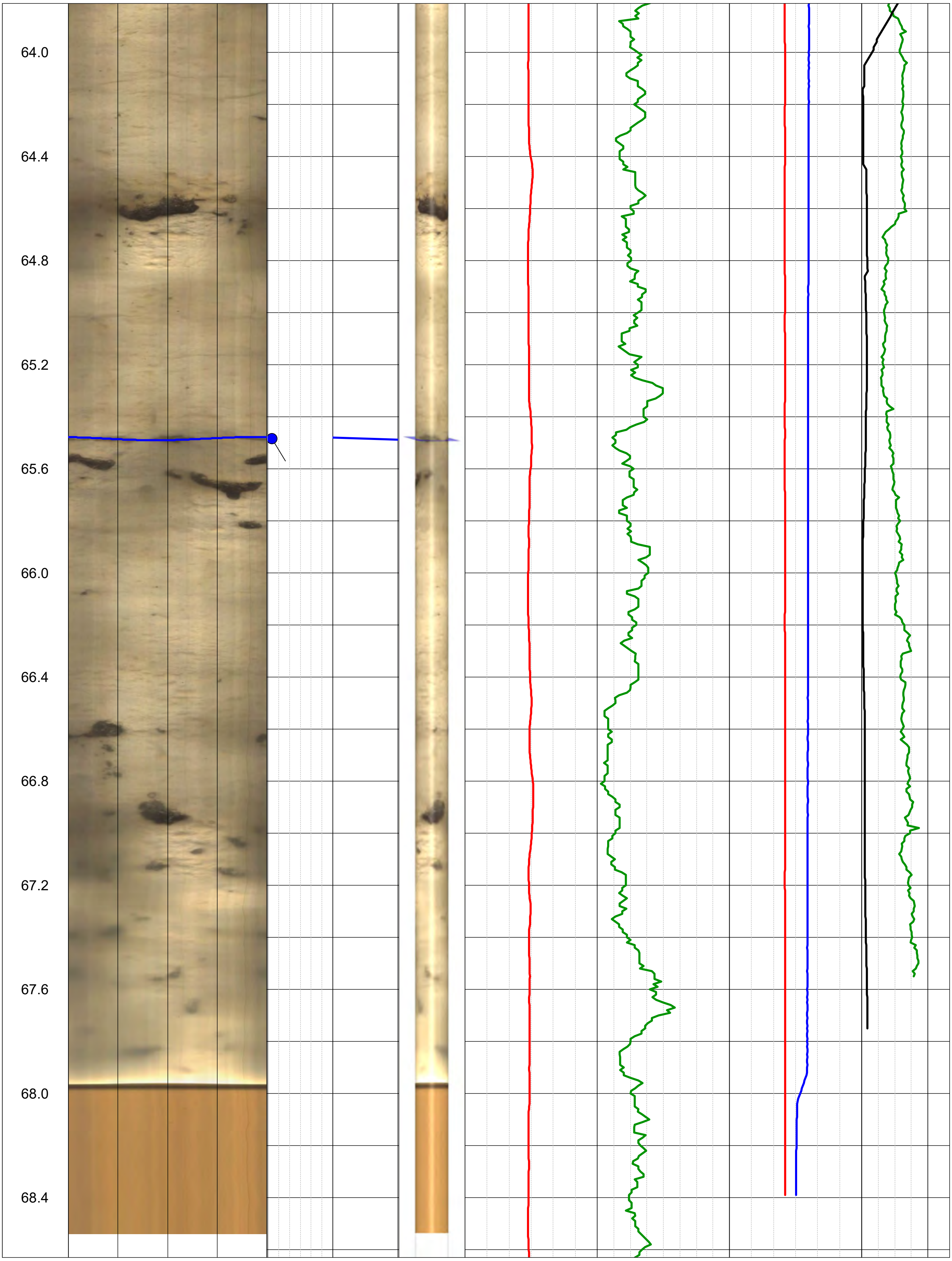
62.0
62.4
62.8
63.2
63.6



64.0
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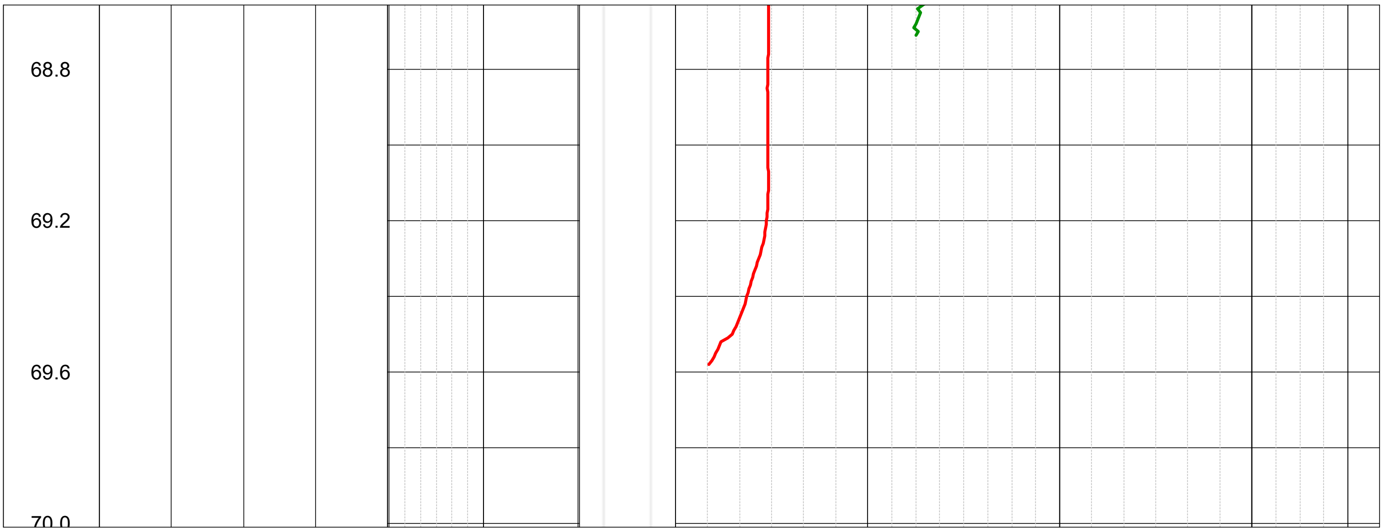
66.0
66.4
66.8
67.2
67.6
68.0
68.4


68.8
69.2
69.6
70.0

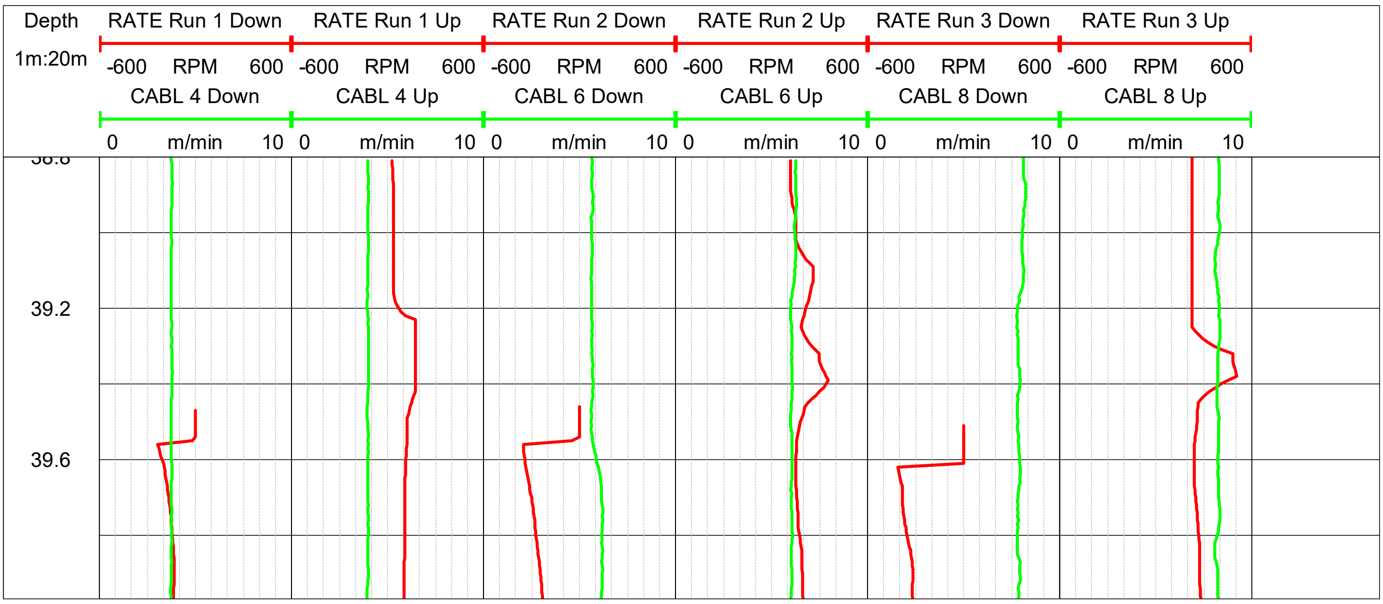
ROBERTSON GEO SERVICES
Unlocking Your GeoData

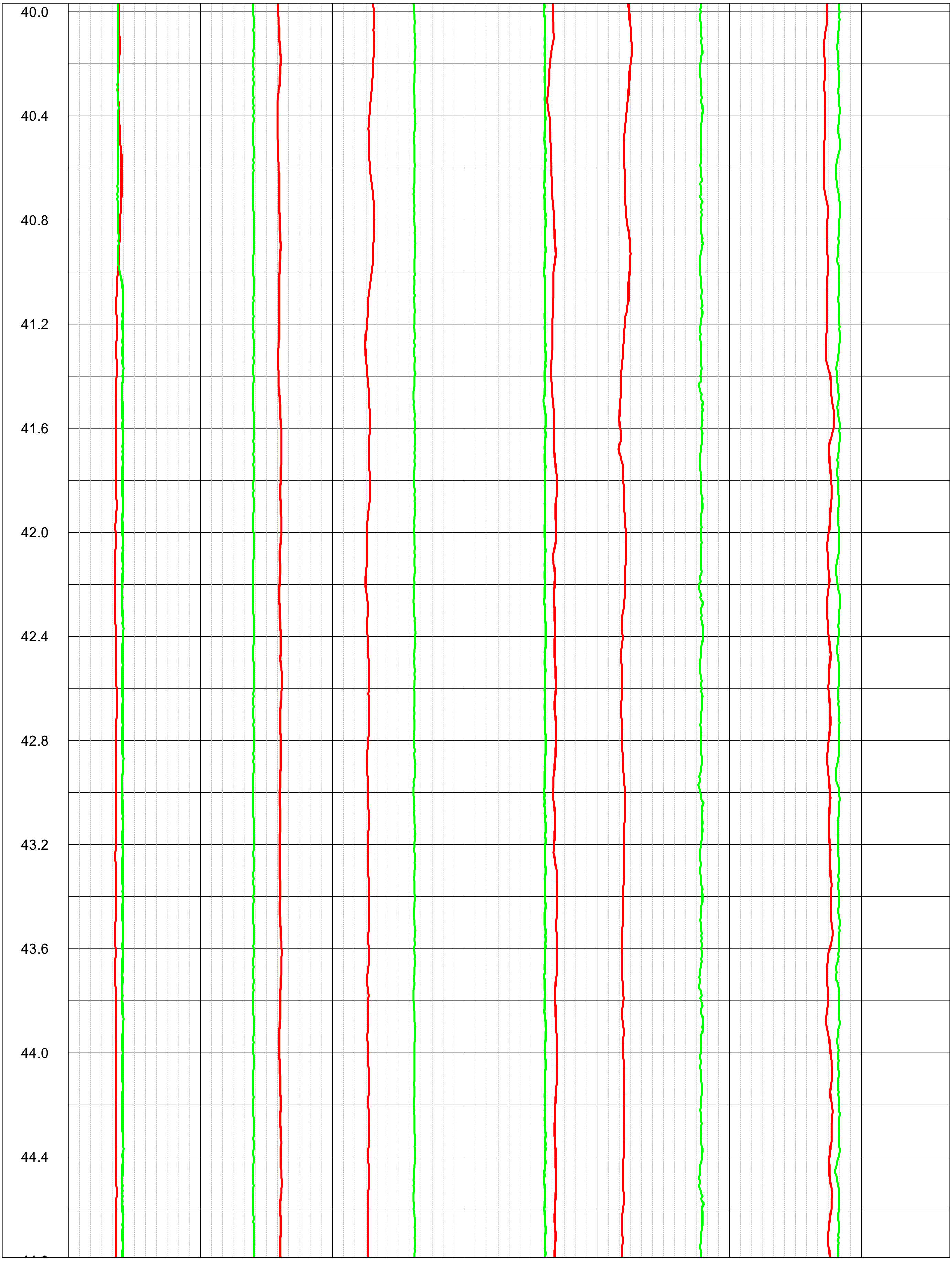
CO Structural Soils
WELL RX624
FLD A303 Stonehenge
CTY England
STE
FILING No

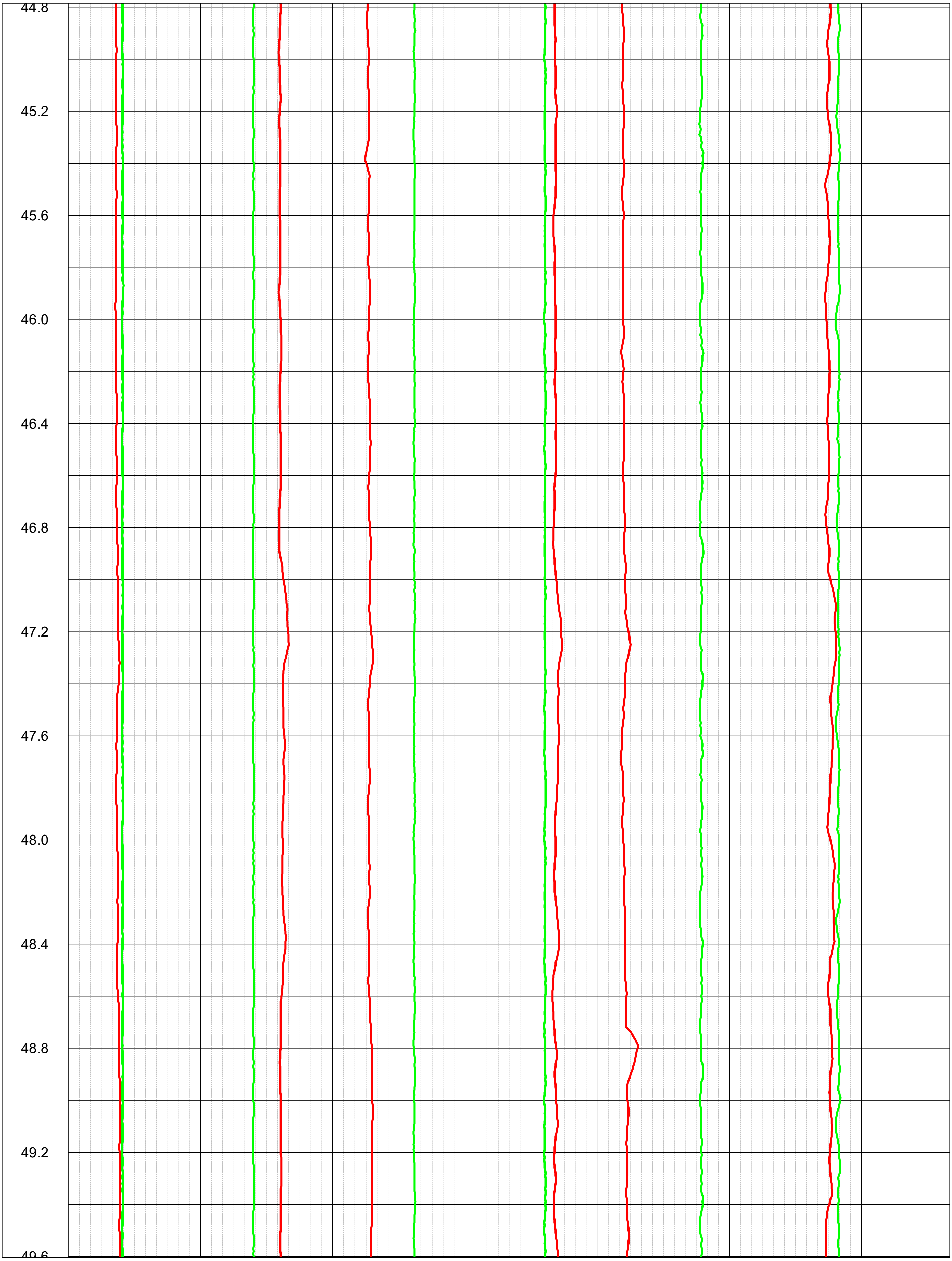
COMPANY	Structural Soils		
WELL ID	RX624		
FIELD	A303 Stonehenge		
COUNTRY	England	STATE	
LOCATION			OTHER SERVICES
Easting:	413355.91		
Northing:	141334		
SEC	TWP	RGE	
PERMANENT DATUM	GL	ELEVATION 108.154	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.

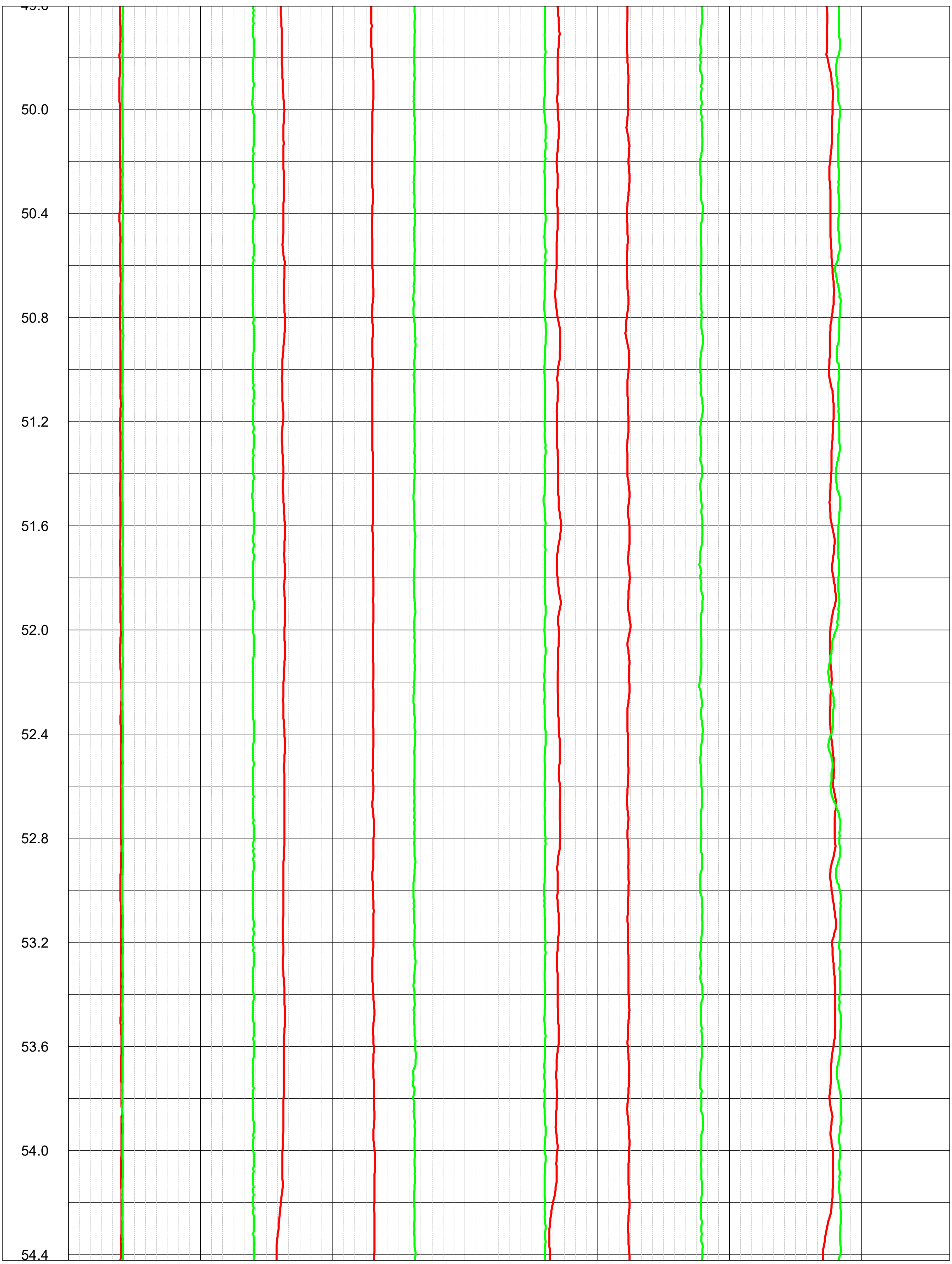
DATE	18/04/18	TYPE FLUID IN HOLE	Water
RUN No		SALINITY	
TYPE LOG	Flowmeter	DENSITY	
DEPTH-DRILLER	70	LEVEL	39.4
DEPTH-LOGGER	68.5	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	68.5		
TOP LOGGED INTERVAL	38.8		
OPERATING RIG TIME			
RECORDED BY	Kyle Owen		
WITNESSED BY	James Boyett		

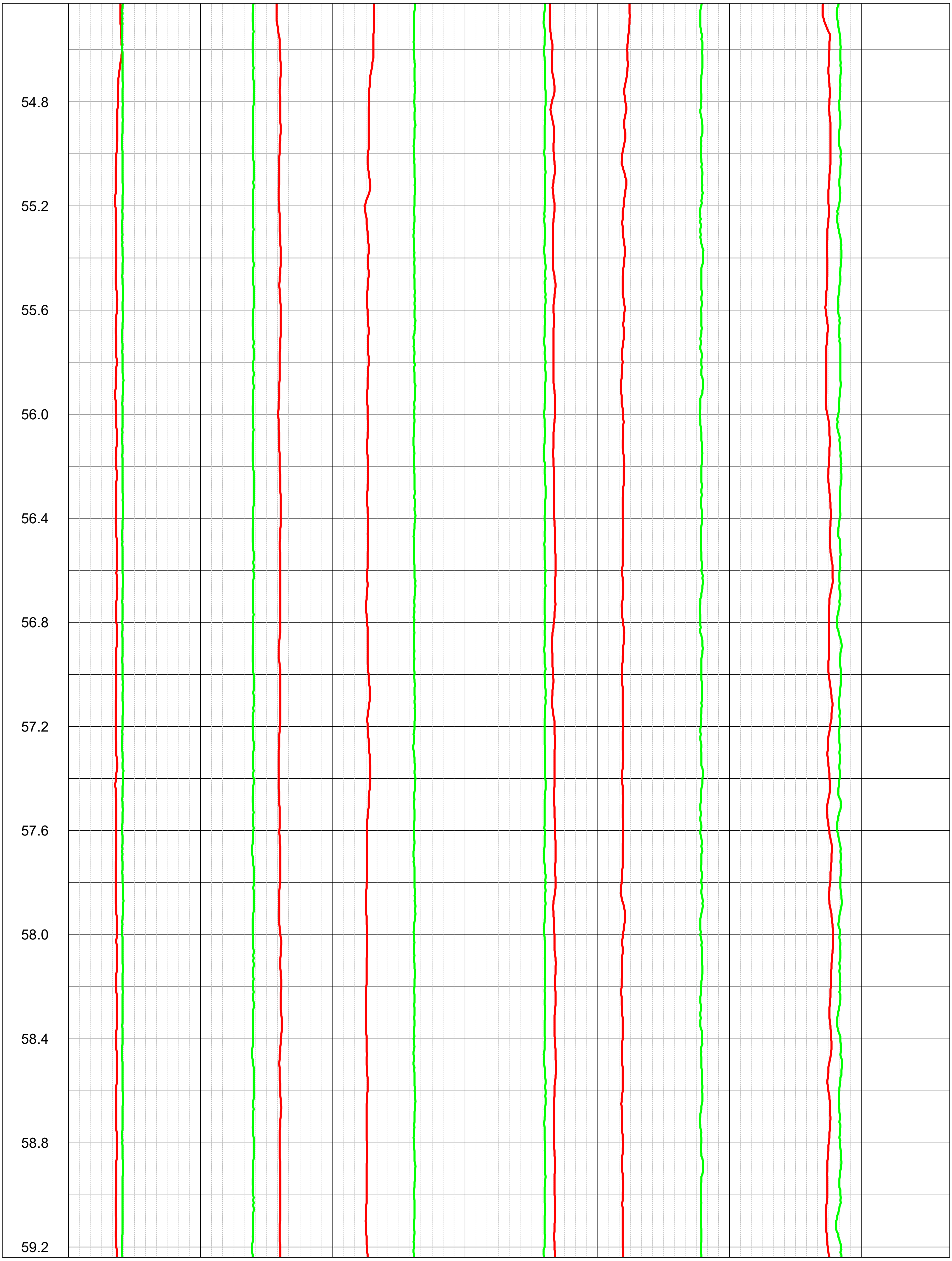
RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

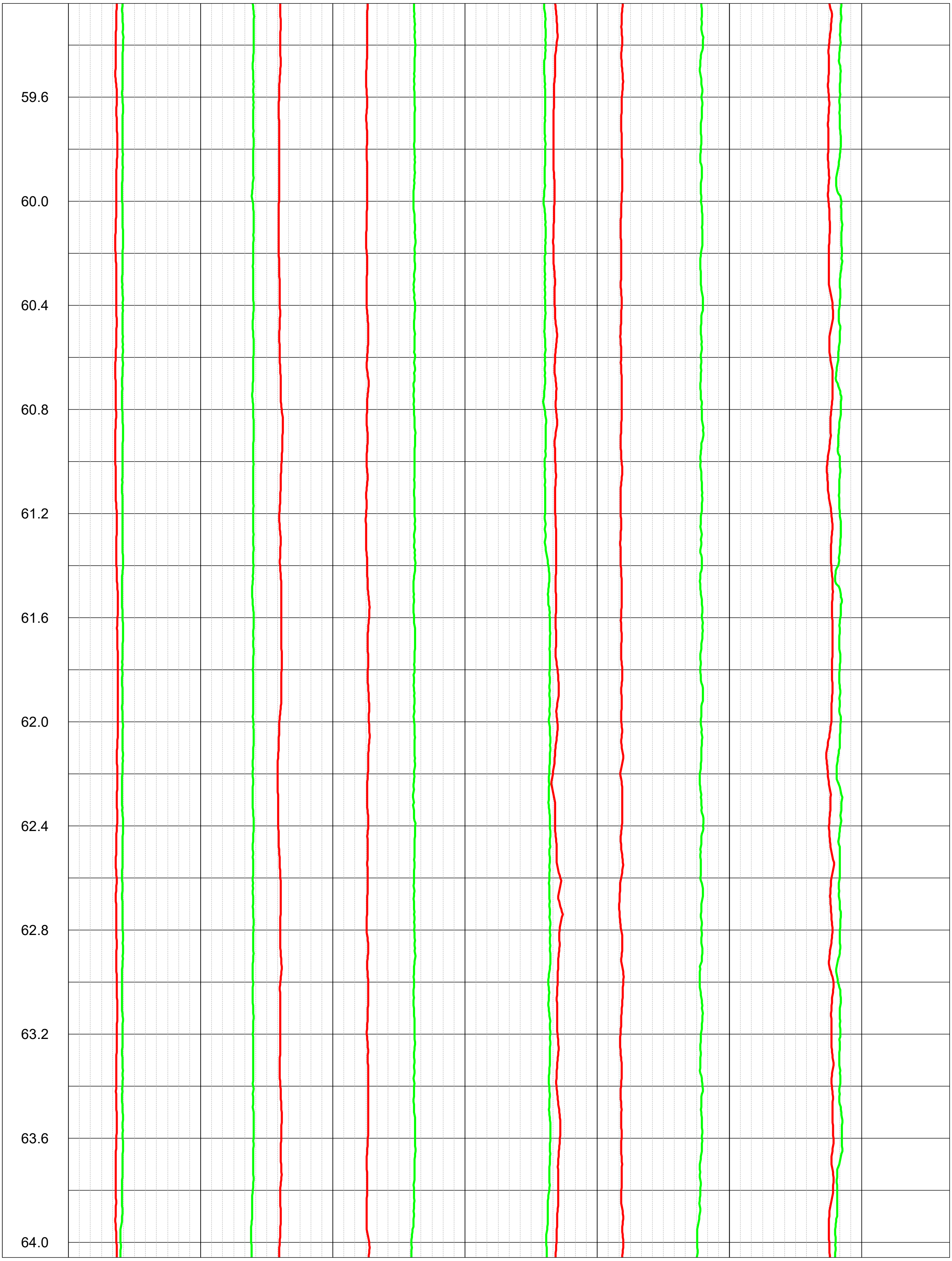


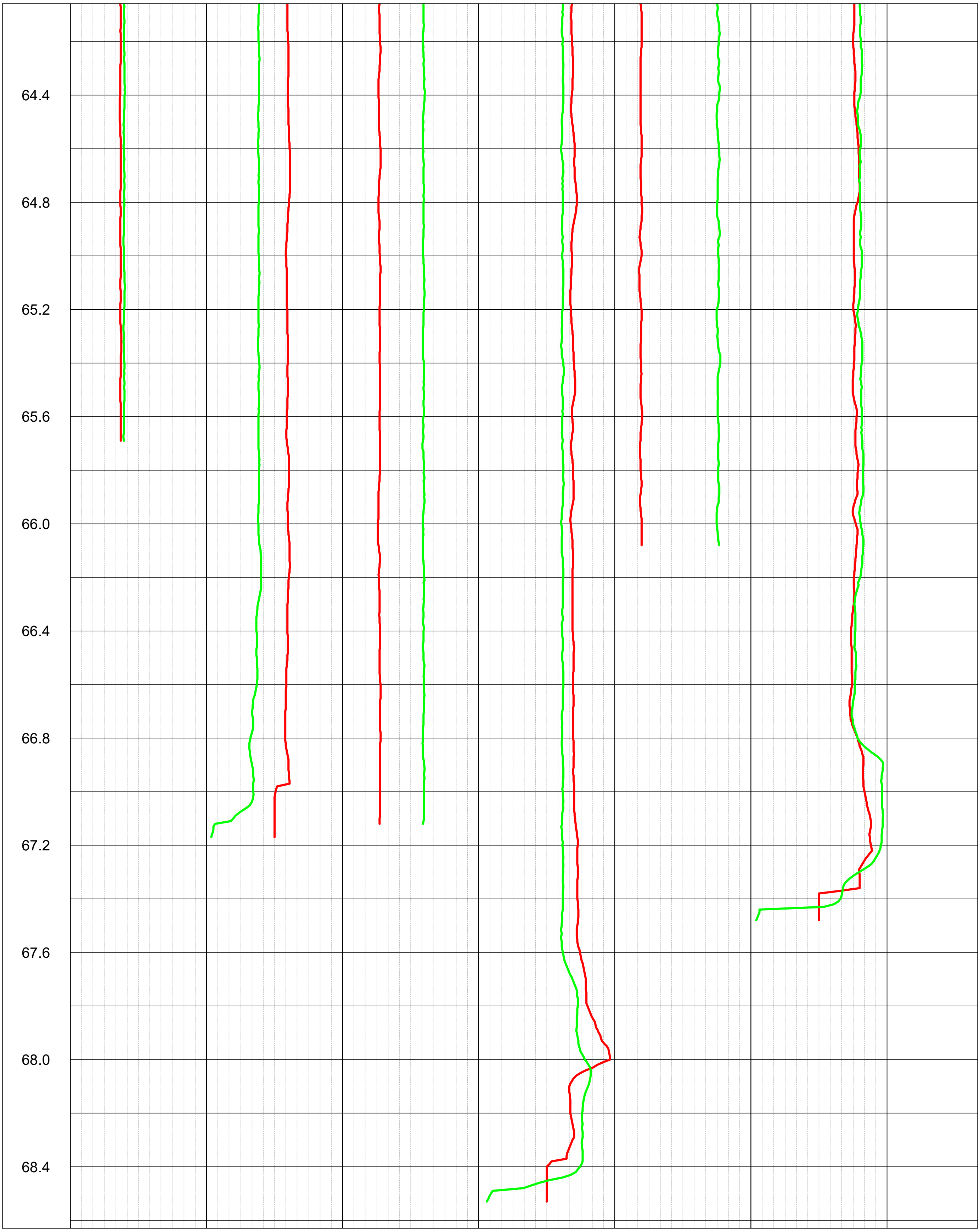

40.0
40.4
40.8
41.2
41.6
42.0
42.4
42.8
43.2
43.6
44.0
44.4


44.8
45.2
45.6
46.0
46.4
46.8
47.2
47.6
48.0
48.4
48.8
49.2
49.6


49.6
50.0
50.4
50.8
51.2
51.6
52.0
52.4
52.8
53.2
53.6
54.0
54.4


54.8
55.2
55.6
56.0
56.4
56.8
57.2
57.6
58.0
58.4
58.8
59.2


59.6
60.0
60.4
60.8
61.2
61.6
62.0
62.4
62.8
63.2
63.6
64.0


64.4
64.8
65.2
65.6
66.0
66.4
66.8
67.2
67.6
68.0
68.4

Depth	Azimuth	Dip	Aperture
m	deg	deg	mm
11.90	54.43	62.09	0.00
21.88	313.95	11.31	0.00
27.47	284.06	55.56	0.00
29.39	133.10	60.46	0.00
29.65	53.95	66.42	0.00
32.38	236.22	71.90	0.00
36.18	343.30	53.08	0.00
42.41	72.72	67.69	0.00
45.70	288.24	70.97	0.00
47.14	183.03	68.91	0.00
48.02	93.66	53.26	0.00
48.28	48.05	55.79	0.00
48.51	195.08	38.39	0.00
49.28	0.00	0.00	0.00
57.54	281.43	16.20	0.00
58.92	295.31	57.11	0.00
62.49	345.05	11.31	0.00
63.36	358.71	18.57	0.00
65.48	158.96	7.05	0.00

ROBERTSON GEO SERVICES
Unlocking Your GeoData

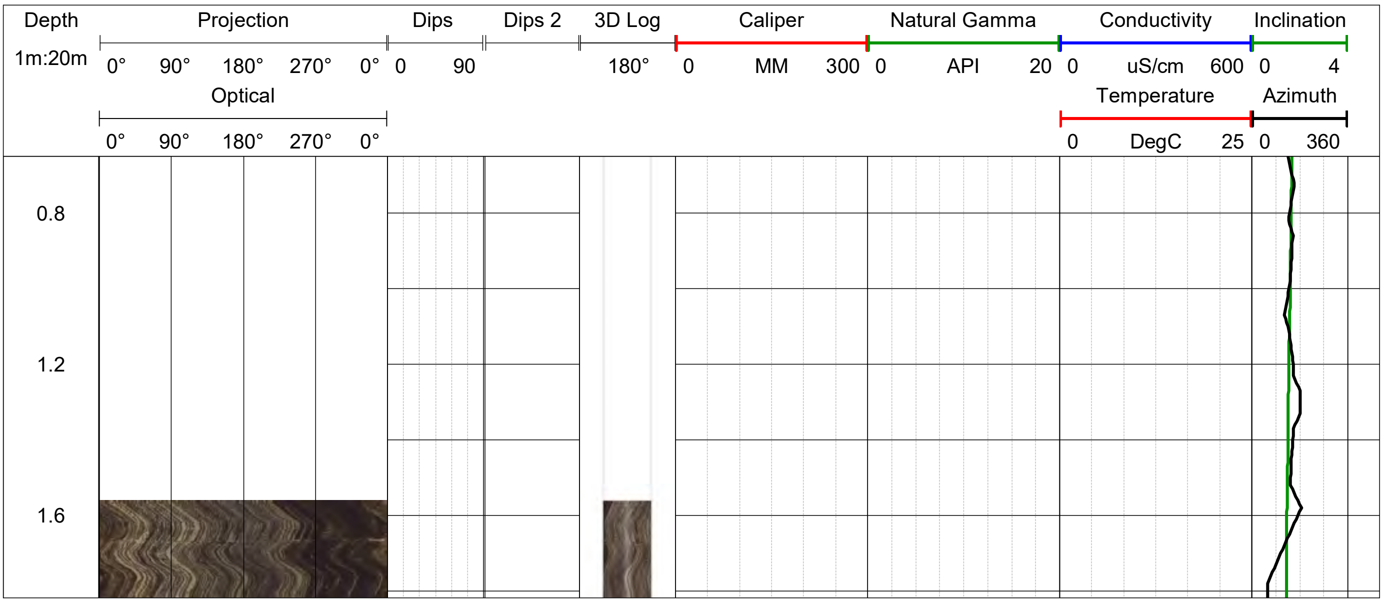
COMPANY	Structural Soils
WELL ID	RX627
FIELD	A303 Stonehenge
COUNTRY	England
STATE	
LOCATION	Easting: 413448.75 Northing: 141281.77
SEC	TWP	RGE
OTHER SERVICES	

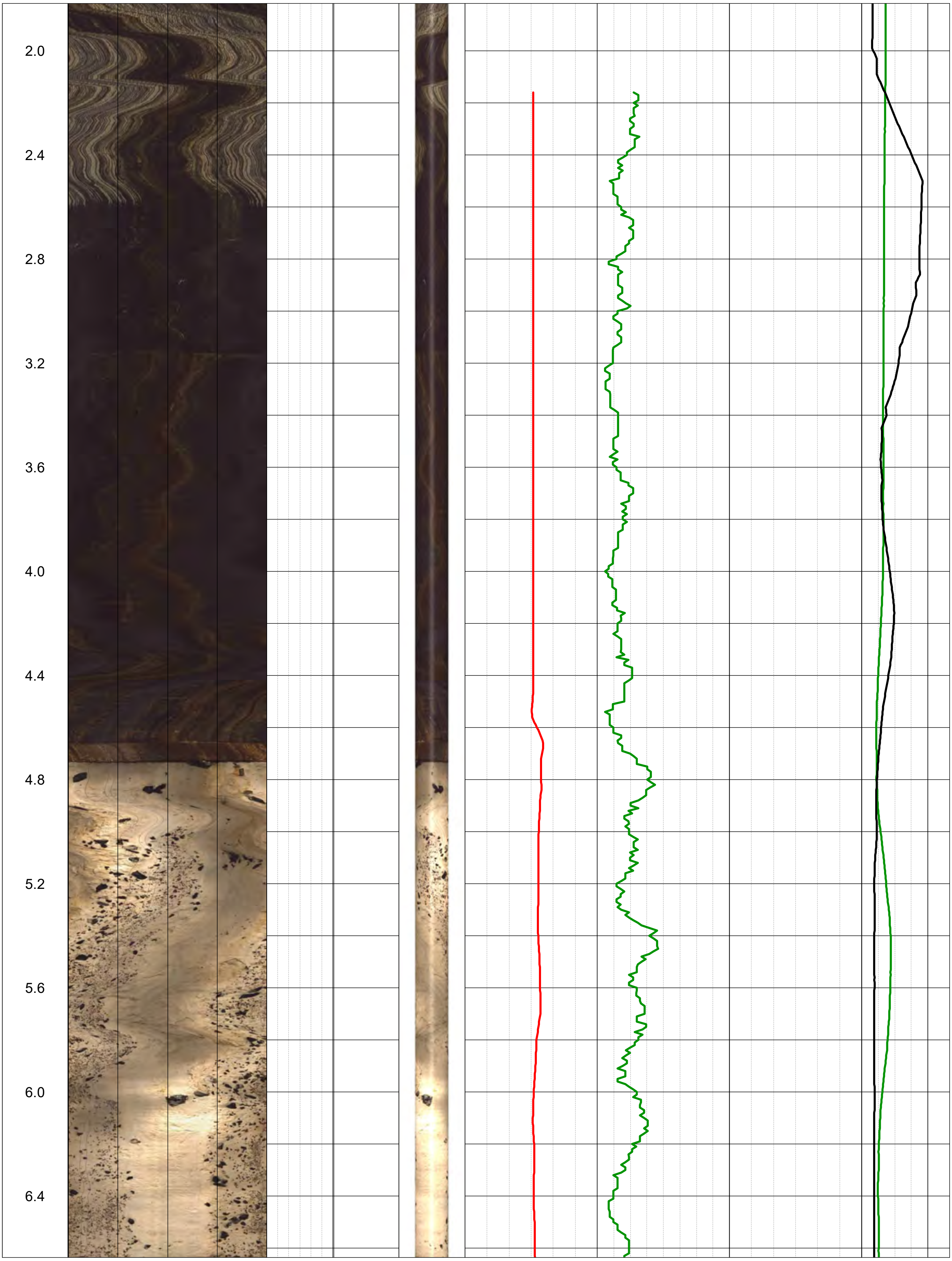
CO Structural Soils
WELL RX627
FLD A303 Stonehenge
CTY England
STE
FILING No

PERMANENT DATUM	GL	ELEVATION	111.998	K.B.	
LOG MEAS. FROM		ABOVE PERM. DATUM		D.F.	
DRILLING MEAS. FROM				G.L.	

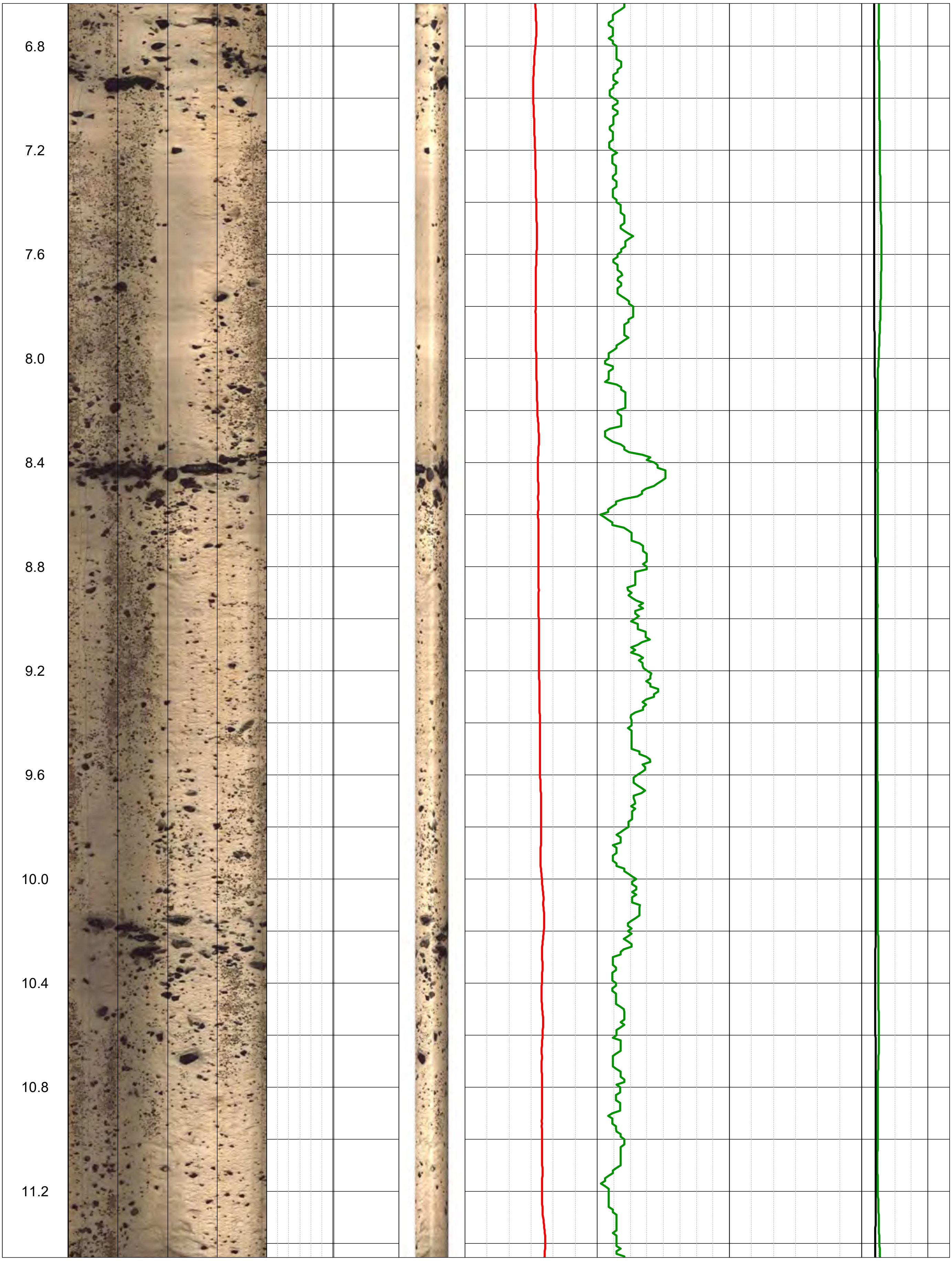
DATE	19/04/18	TYPE FLUID IN HOLE	Water
RUN No		SALINITY	
TYPE LOG	Composite	DENSITY	
DEPTH-DRILLER	70	LEVEL	43.6
DEPTH-LOGGER	69.3	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	69.3		
TOP LOGGED INTERVAL	0.7		
OPERATING RIG TIME			
RECORDED BY	Kyle Owen		
WITNESSED BY	James Boyett		

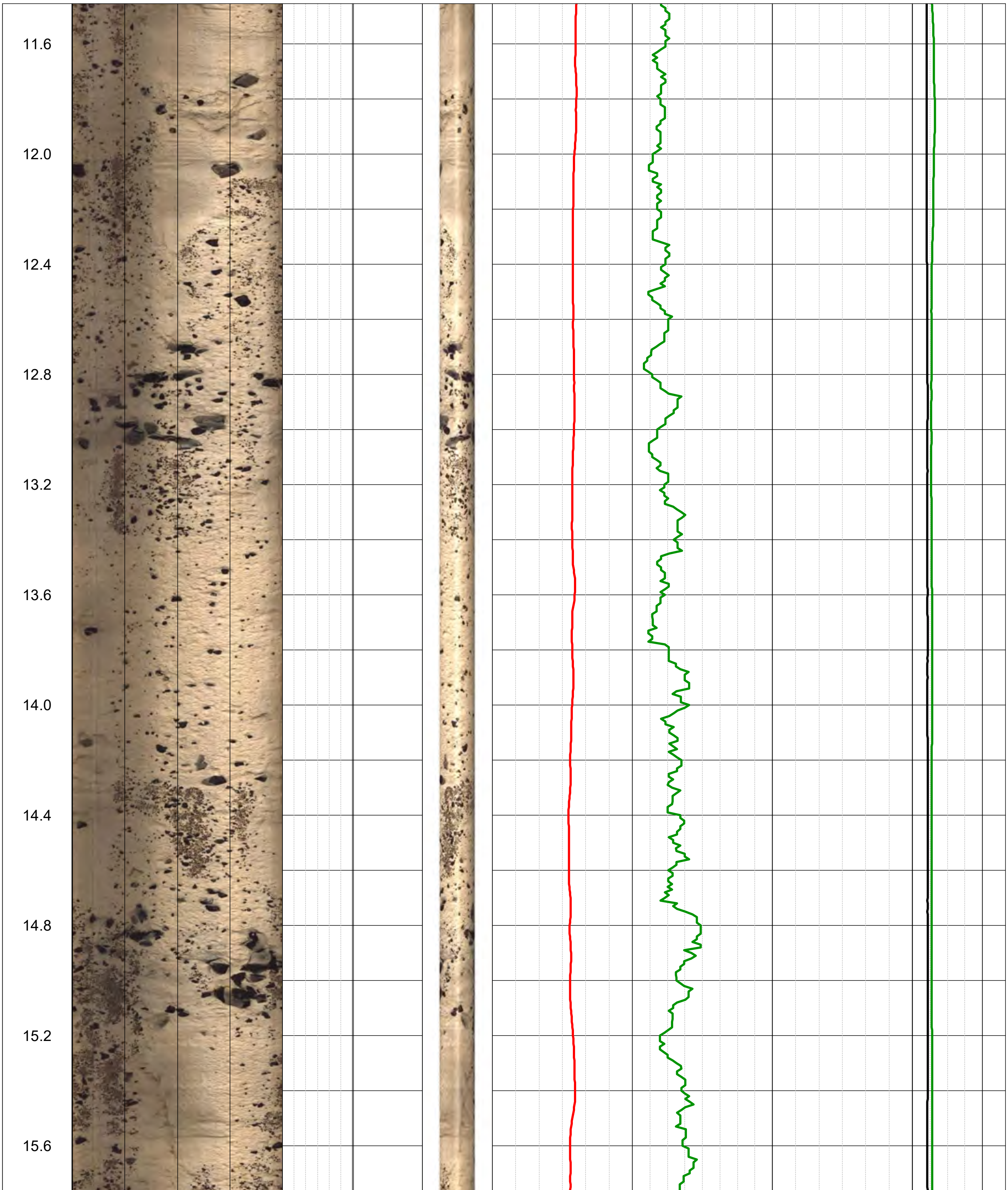
RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

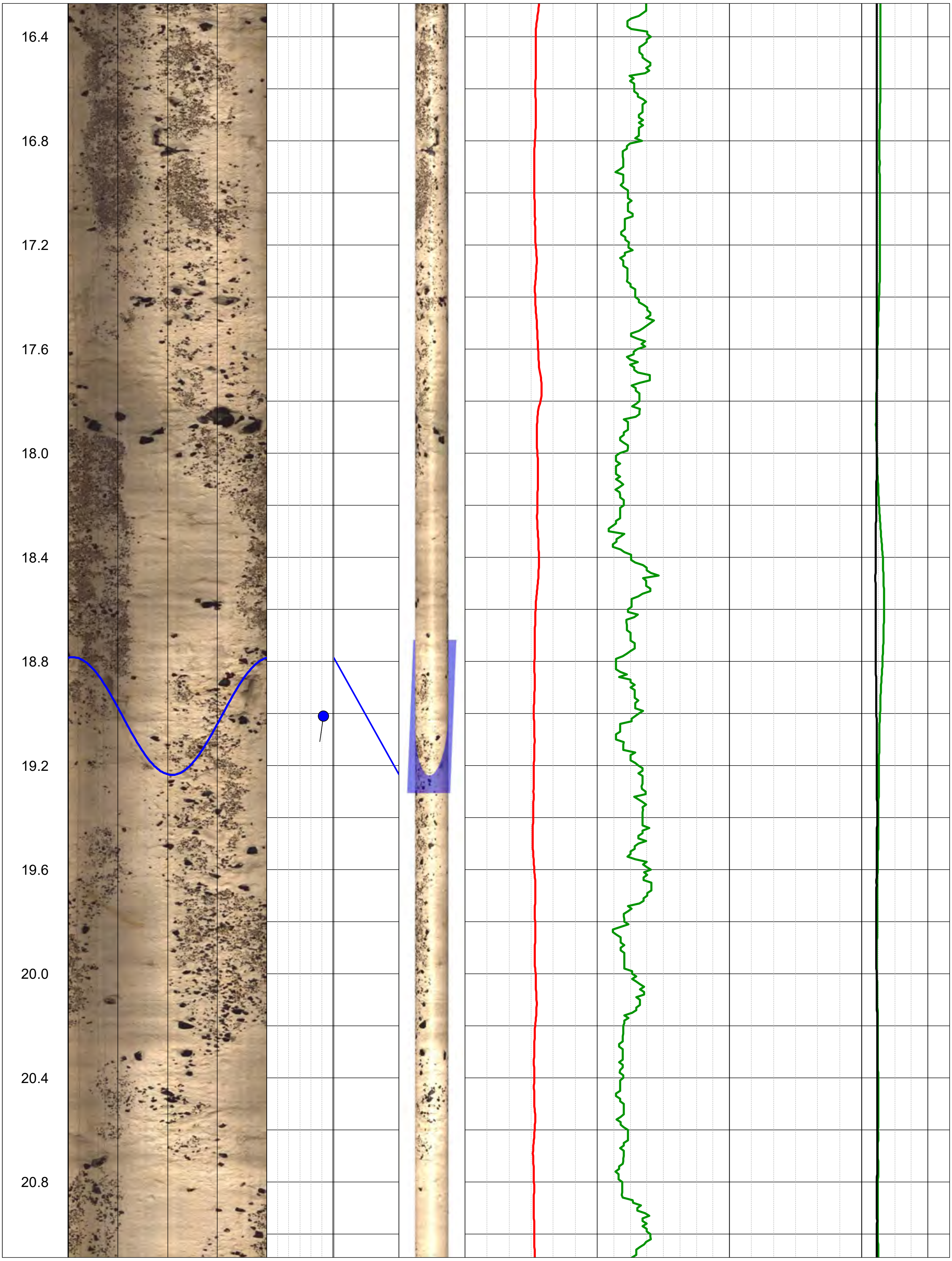


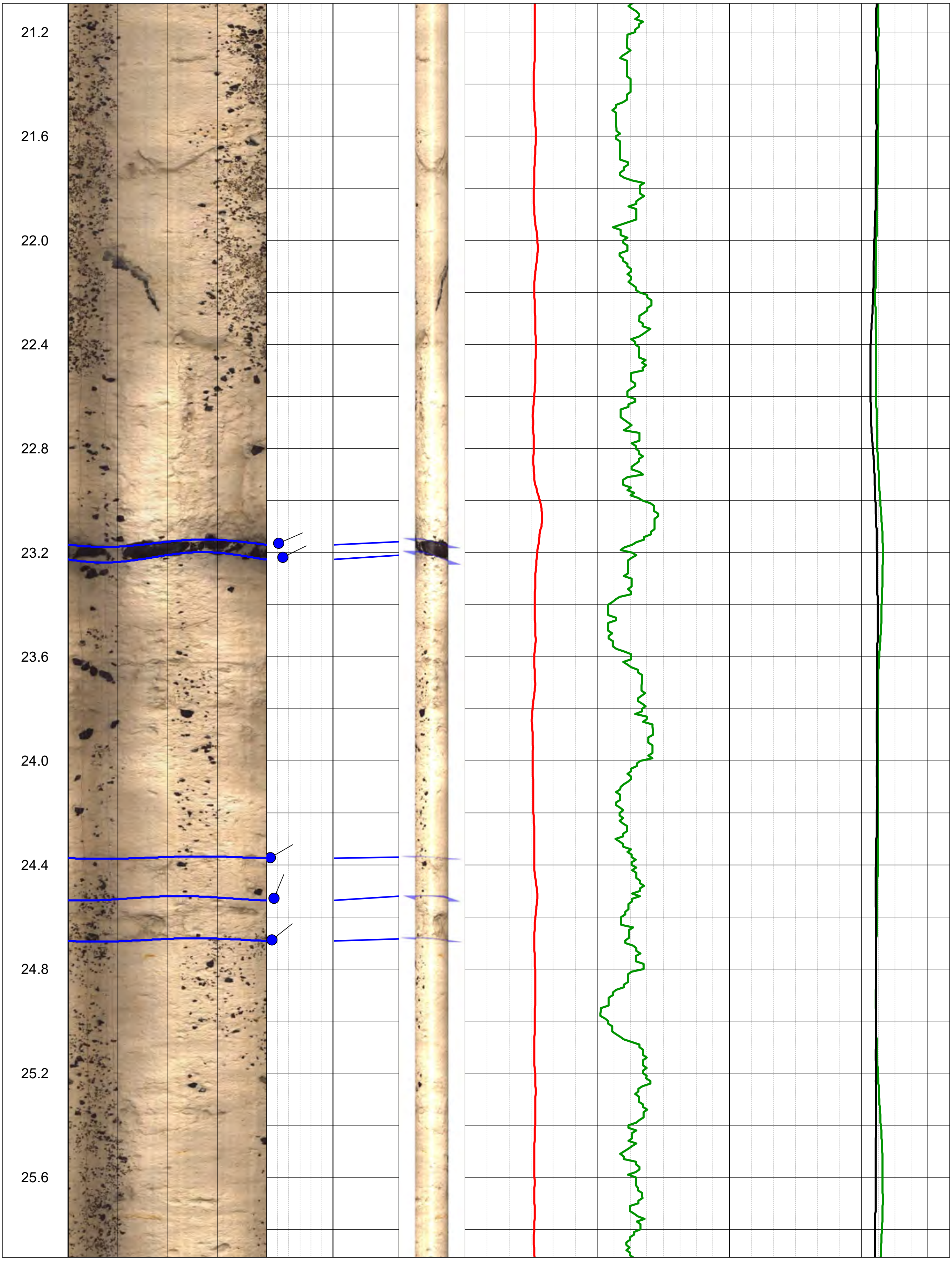


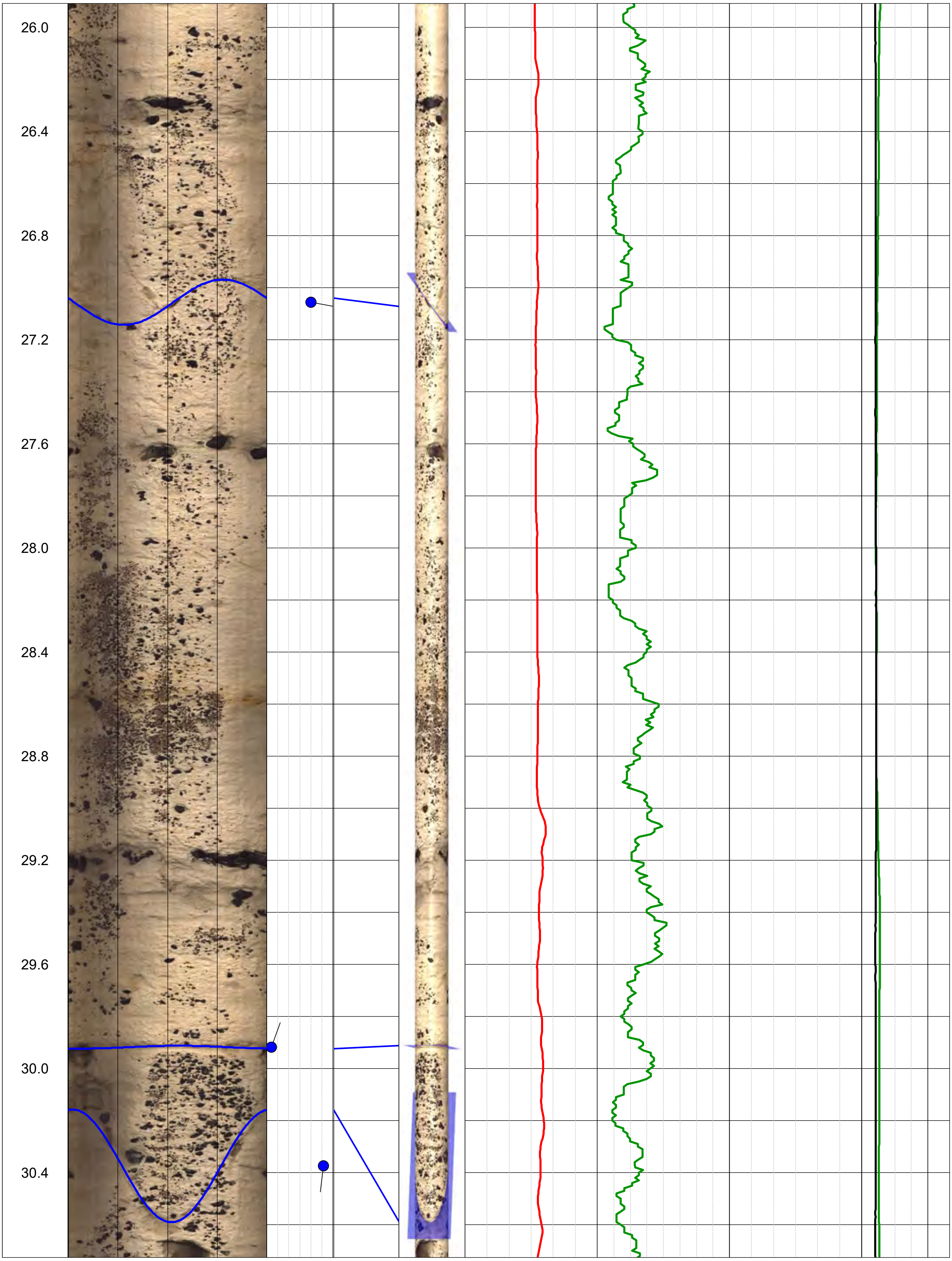
2.0
2.4
2.8
3.2
3.6
4.0
4.4
4.8
5.2
5.6
6.0
6.4


6.8
7.2
7.6
8.0
8.4
8.8
9.2
9.6
10.0
10.4
10.8
11.2

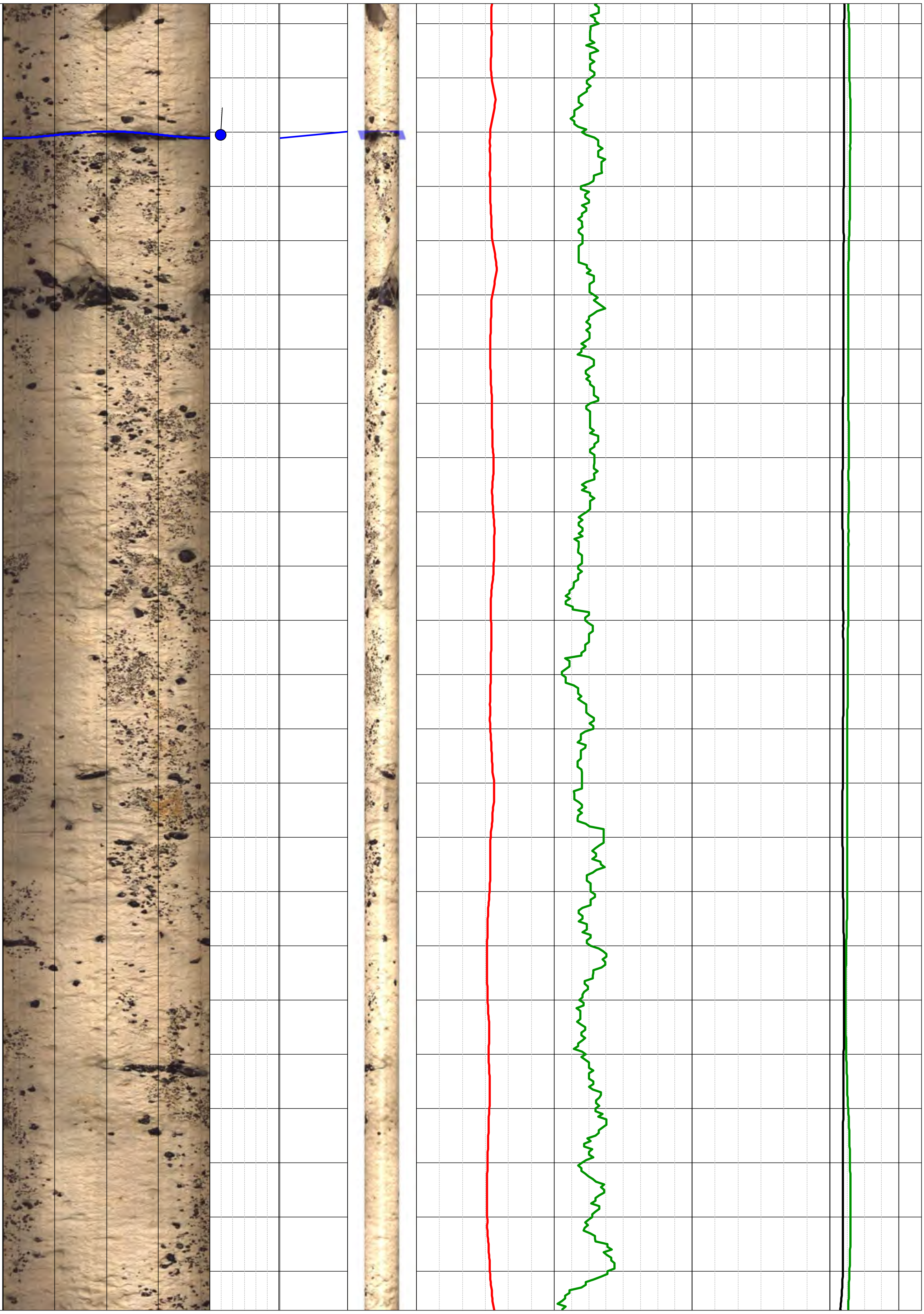

11.6
12.0
12.4
12.8
13.2
13.6
14.0
14.4
14.8
15.2
15.6
16.0

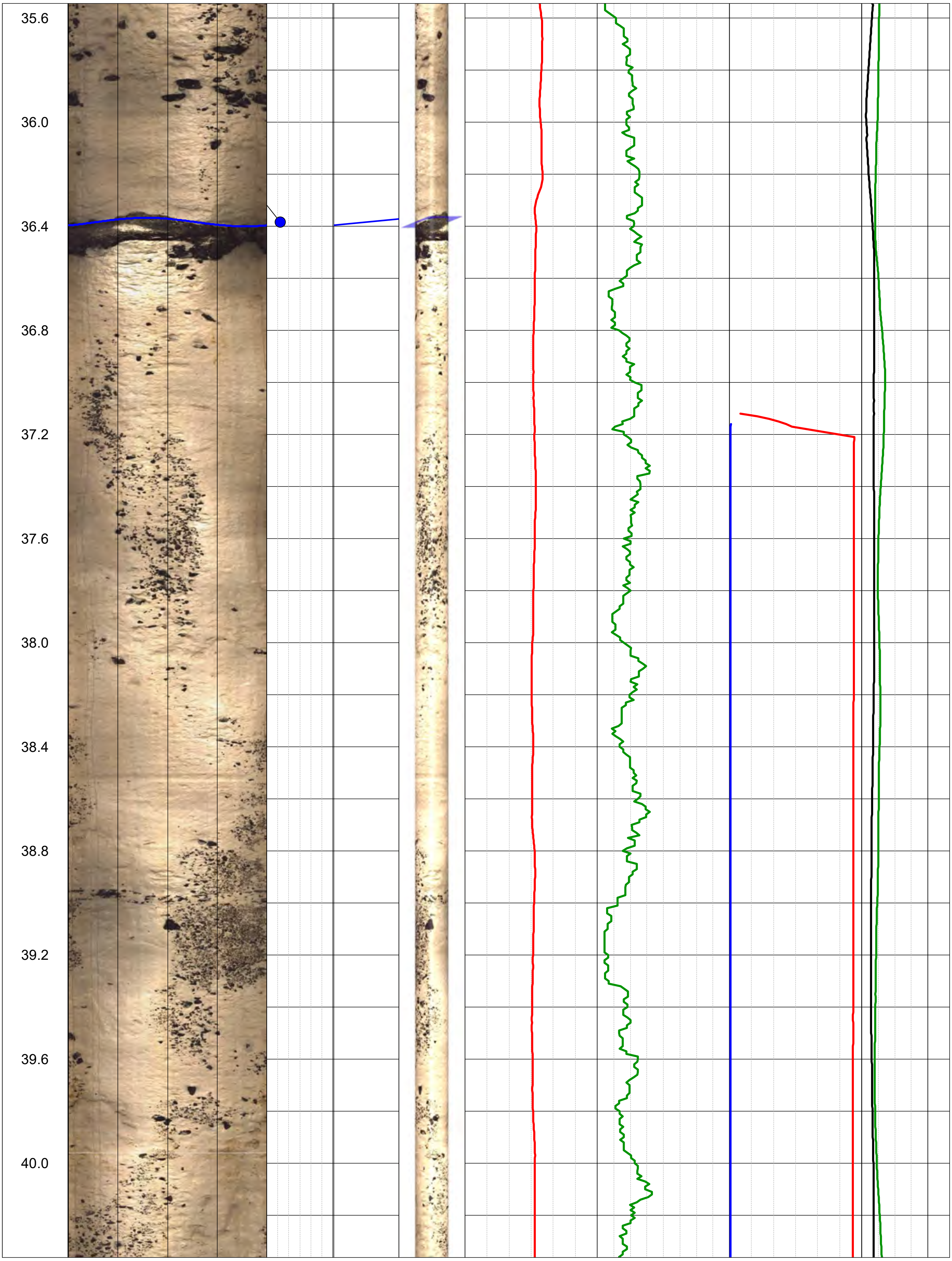

16.4
16.8
17.2
17.6
18.0
18.4
18.8
19.2
19.6
20.0
20.4
20.8

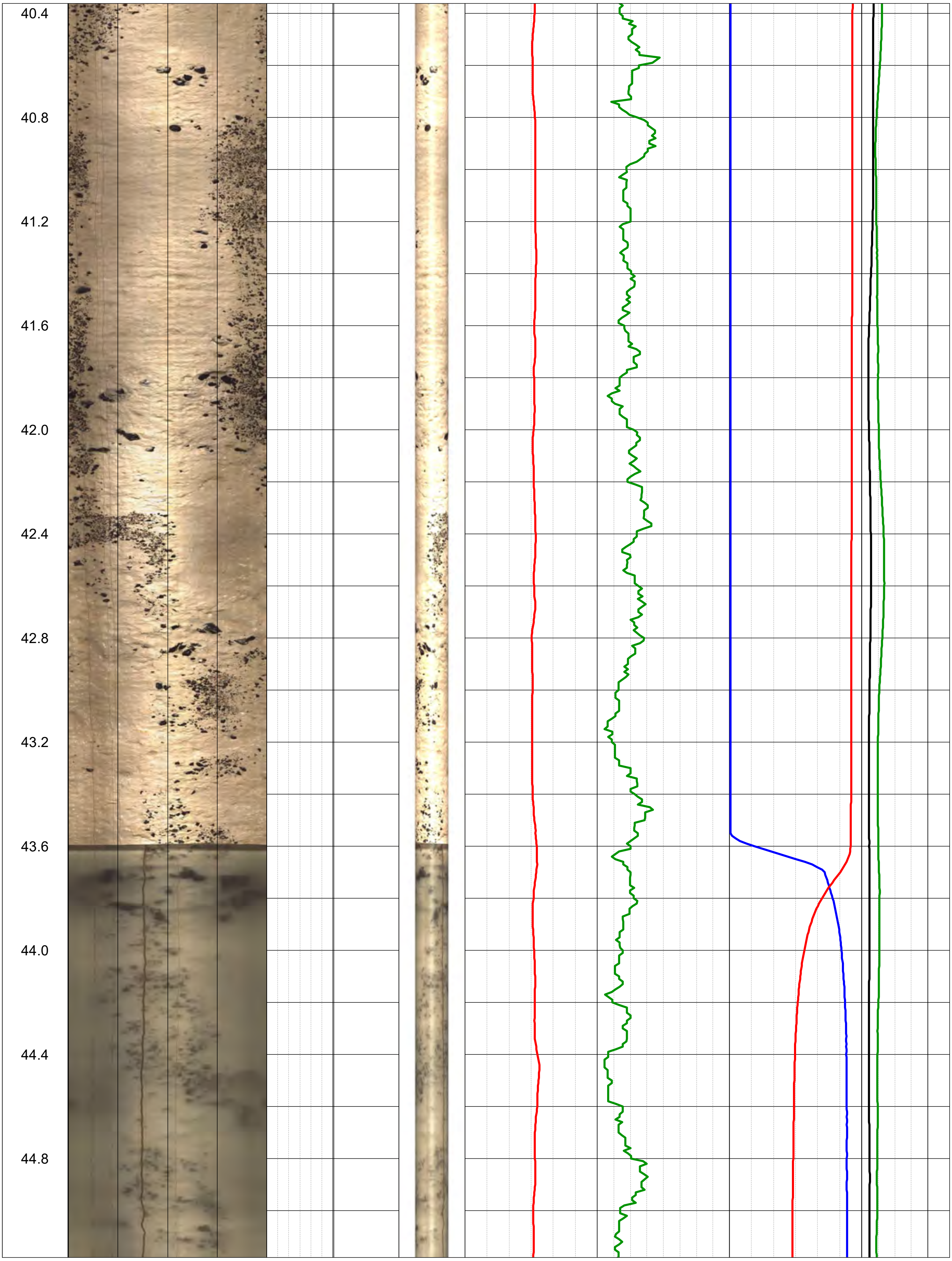

21.2
21.6
22.0
22.4
22.8
23.2
23.6
24.0
24.4
24.8
25.2
25.6


26.0
26.4
26.8
27.2
27.6
28.0
28.4
28.8
29.2
29.6
30.0
30.4

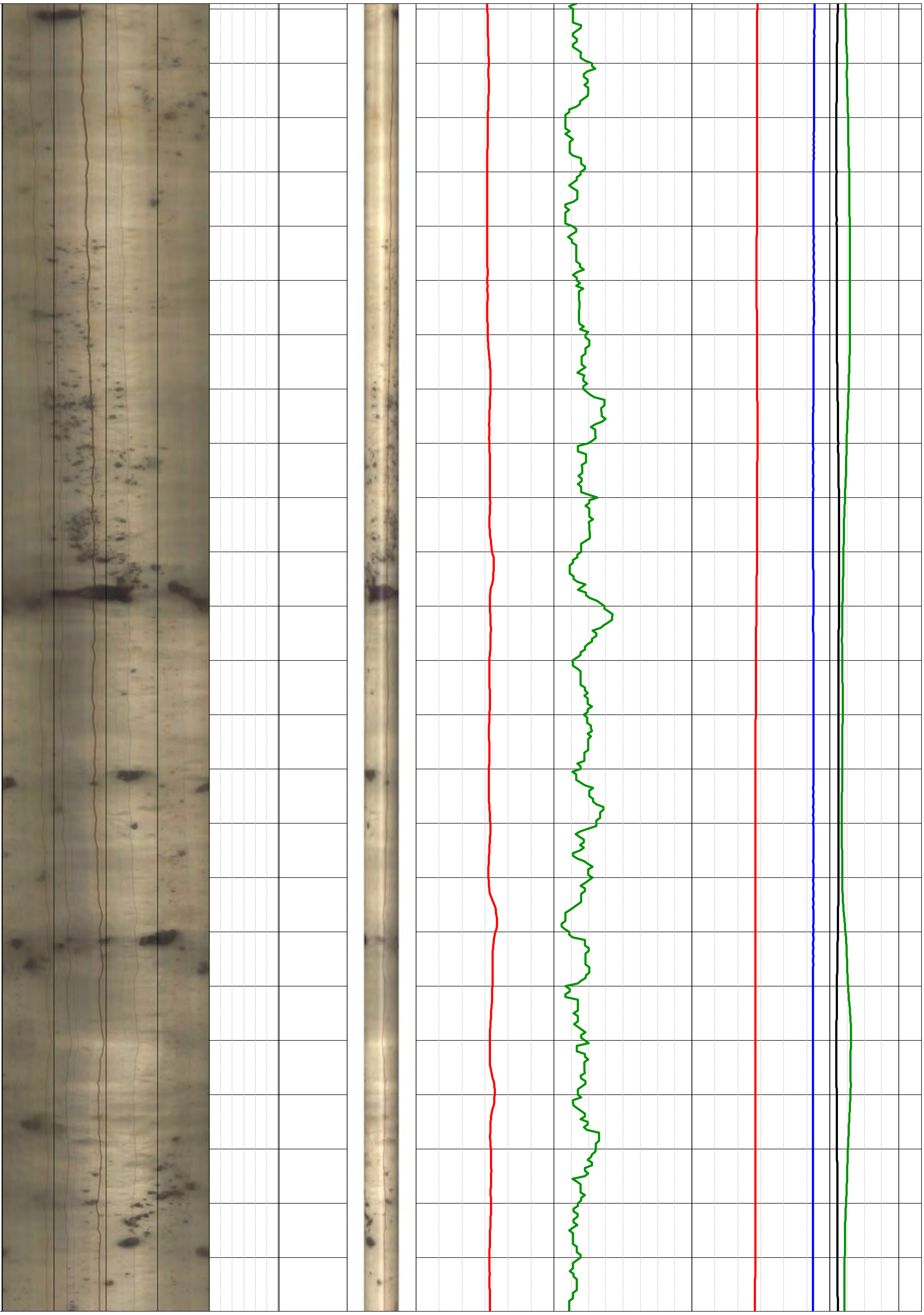
30.8
31.2
31.6
32.0
32.4
32.8
33.2
33.6
34.0
34.4
34.8
35.2

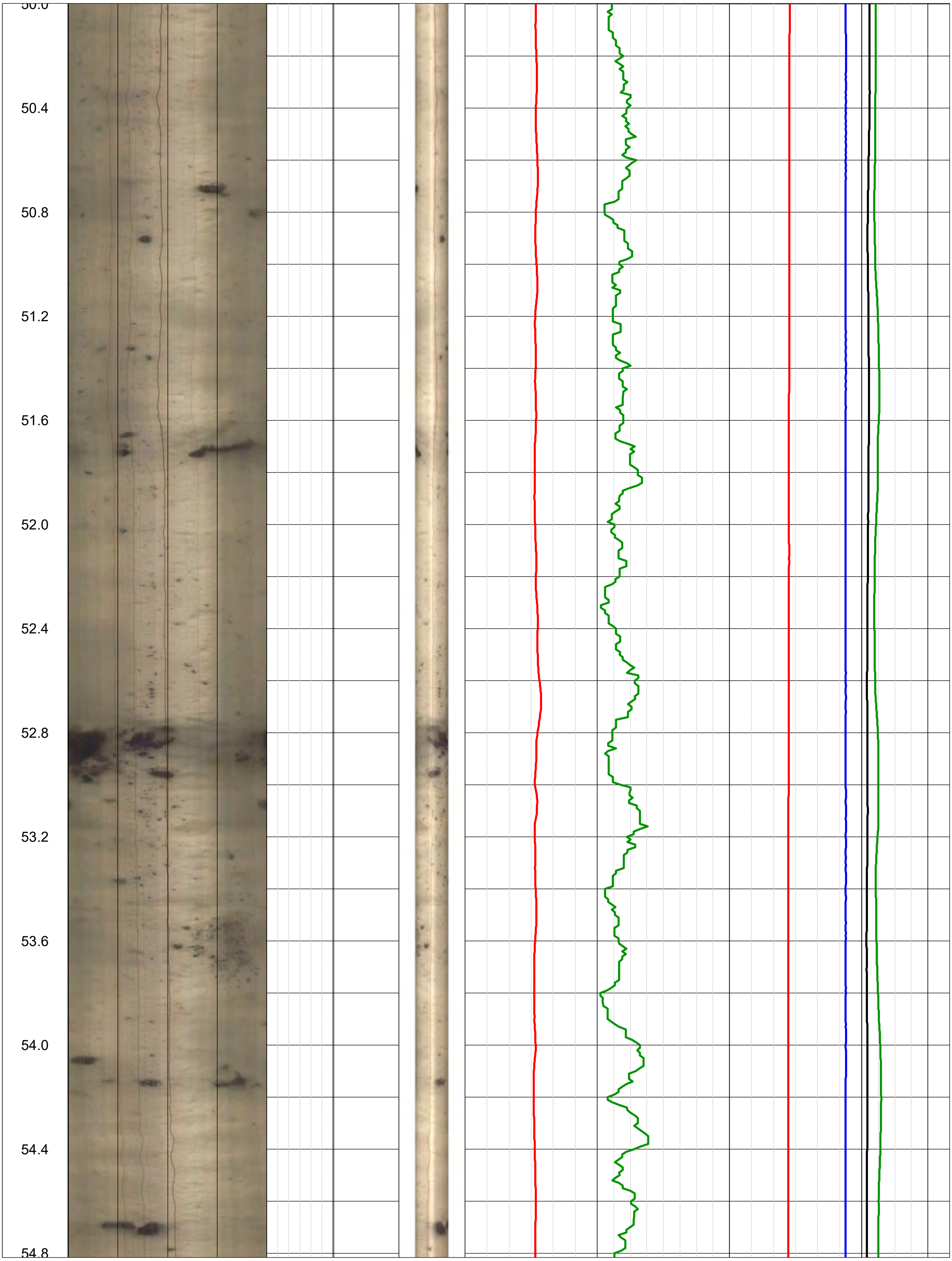


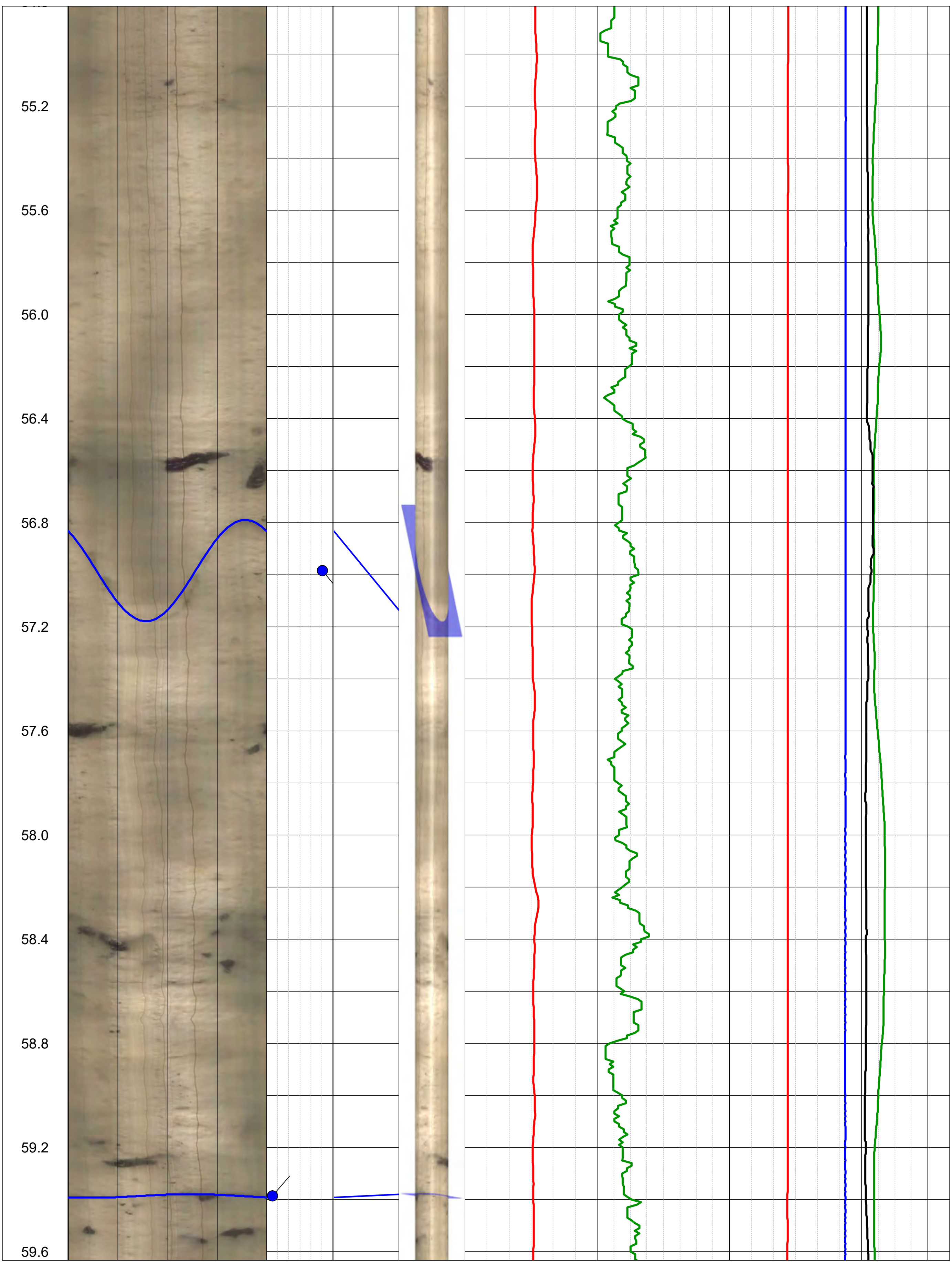

35.6
36.0
36.4
36.8
37.2
37.6
38.0
38.4
38.8
39.2
39.6
40.0

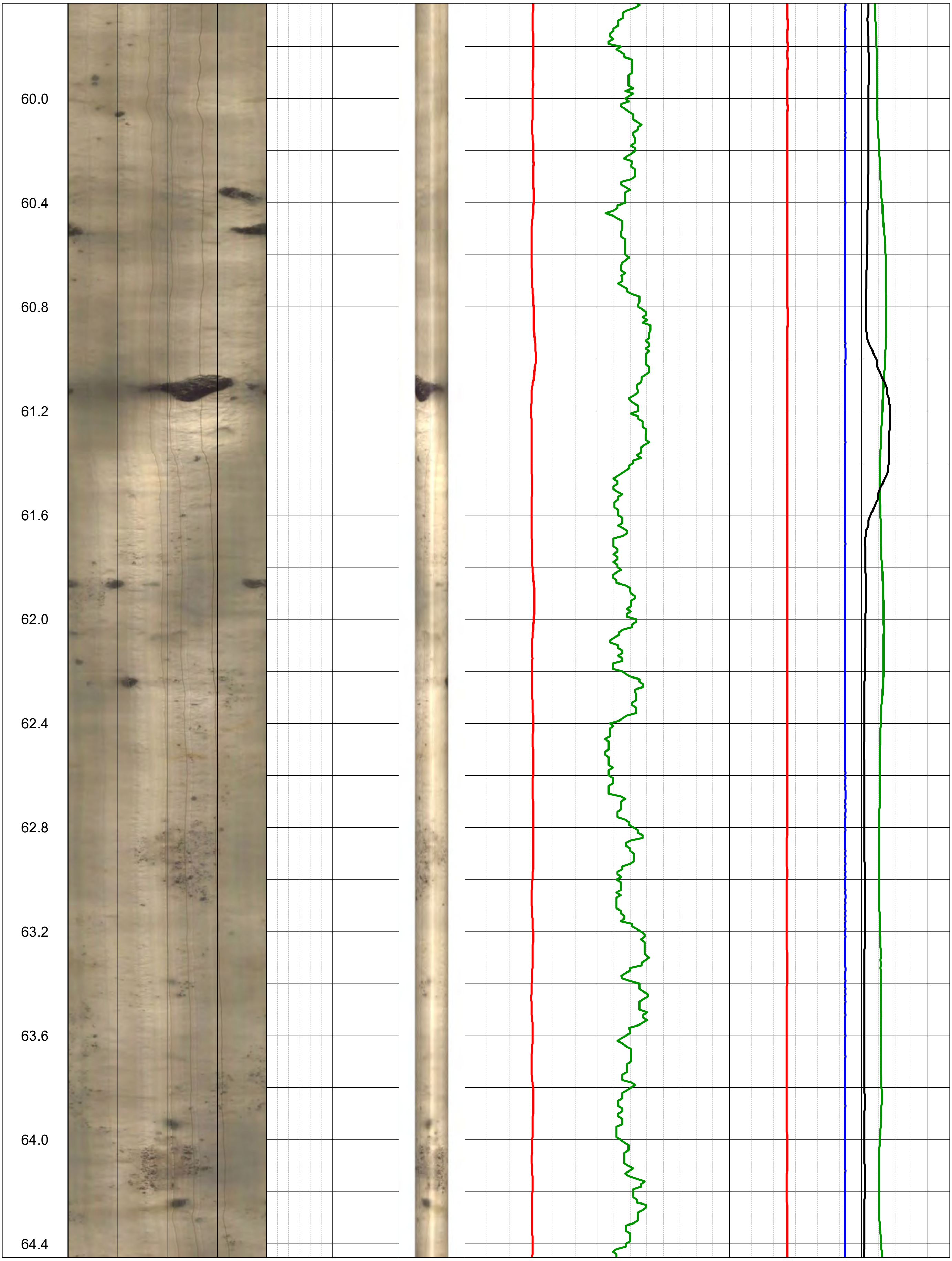

40.4
40.8
41.2
41.6
42.0
42.4
42.8
43.2
43.6
44.0
44.4
44.8

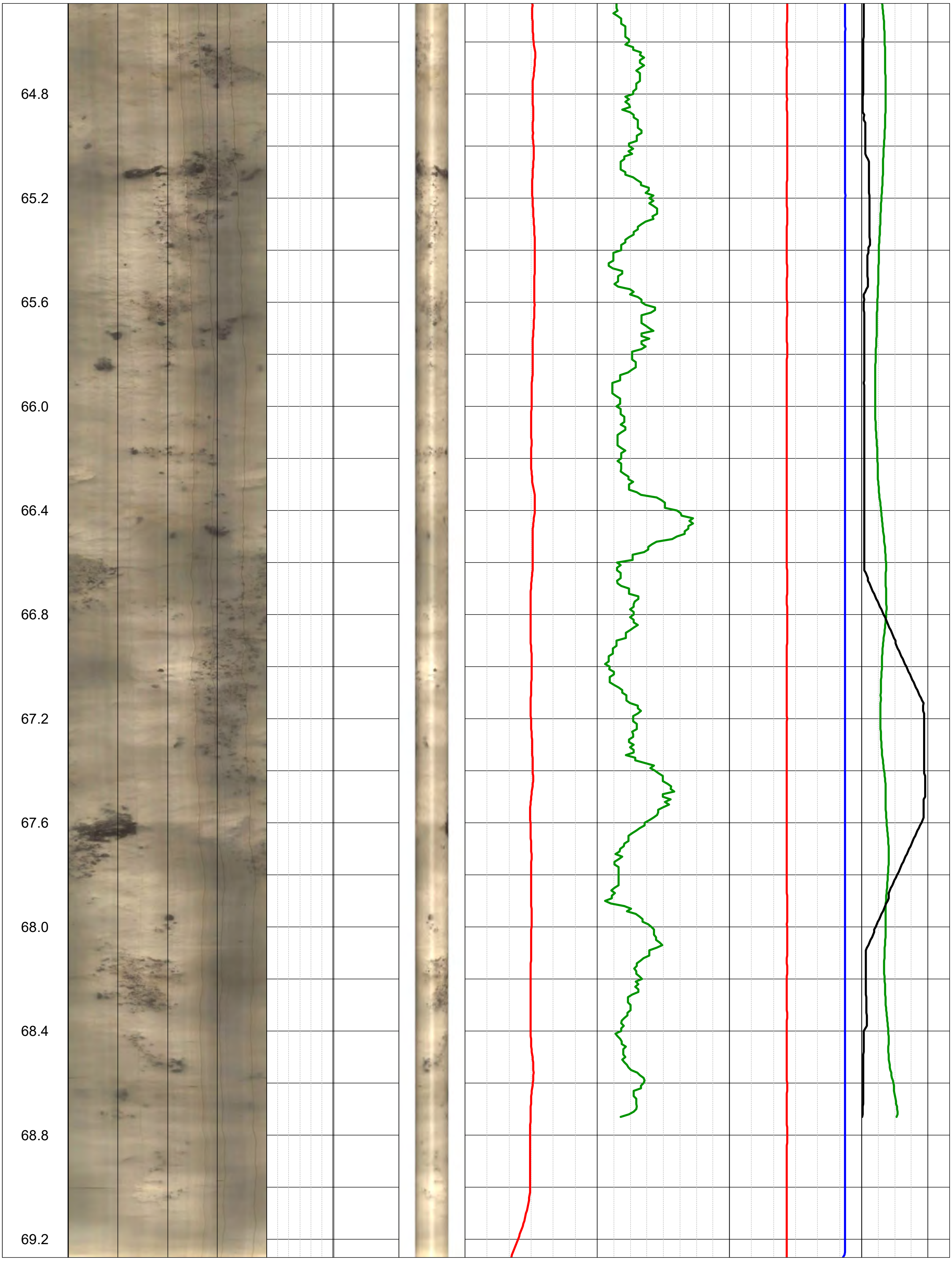
45.2
45.6
46.0
46.4
46.8
47.2
47.6
48.0
48.4
48.8
49.2
49.6
50.0

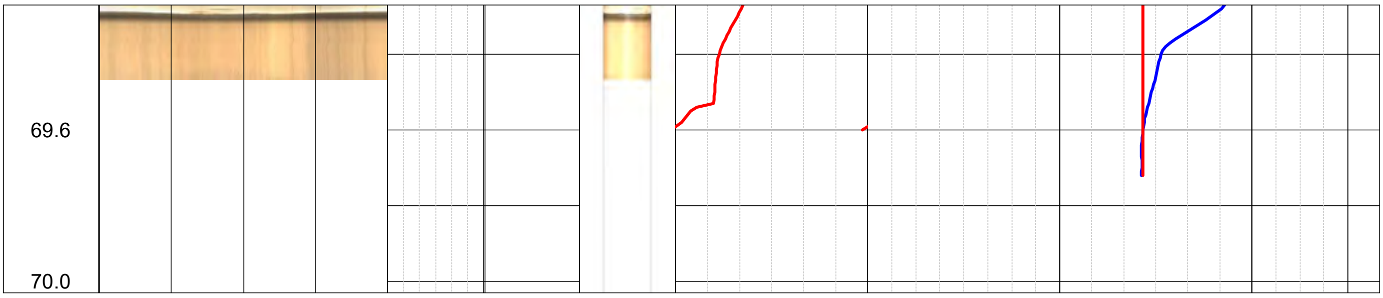



50.0
50.4
50.8
51.2
51.6
52.0
52.4
52.8
53.2
53.6
54.0
54.4
54.8


55.2
55.6
56.0
56.4
56.8
57.2
57.6
58.0
58.4
58.8
59.2
59.6


60.0
60.4
60.8
61.2
61.6
62.0
62.4
62.8
63.2
63.6
64.0
64.4


64.8
65.2
65.6
66.0
66.4
66.8
67.2
67.6
68.0
68.4
68.8
69.2


69.6
70.0

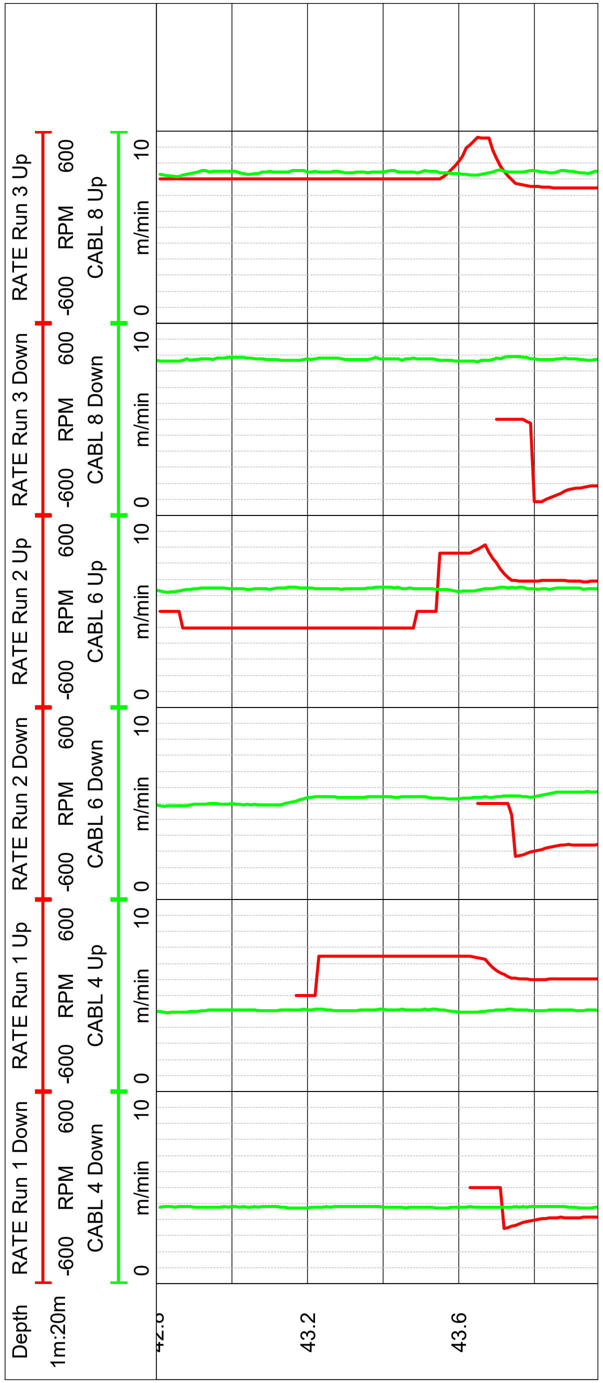
ROBERTSON GEO SERVICES
Unlocking Your GeoData

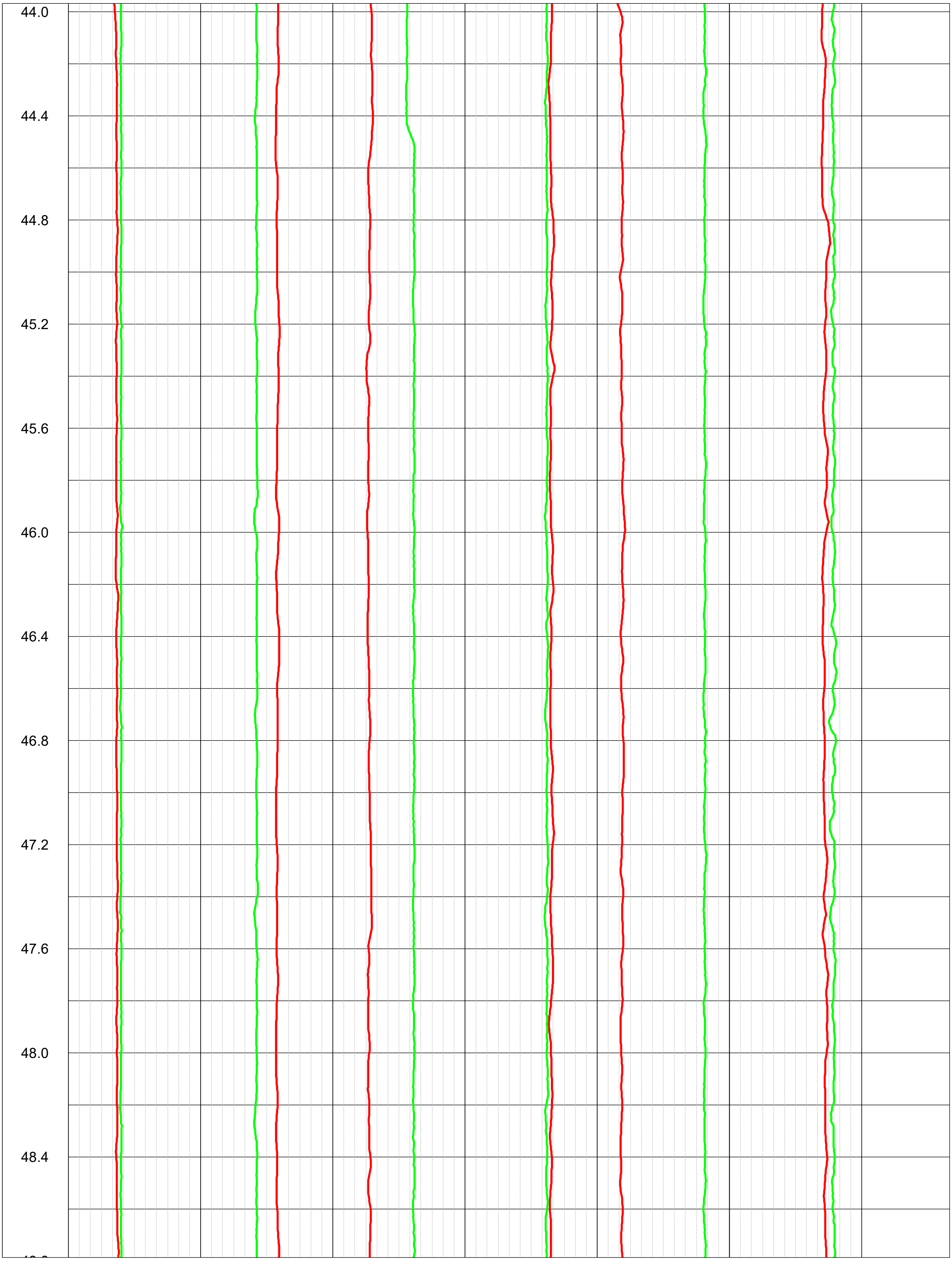
CO Structural Soils
WELL RX627
FLD A303 Stonehenge
CTY England
STE
FILING No

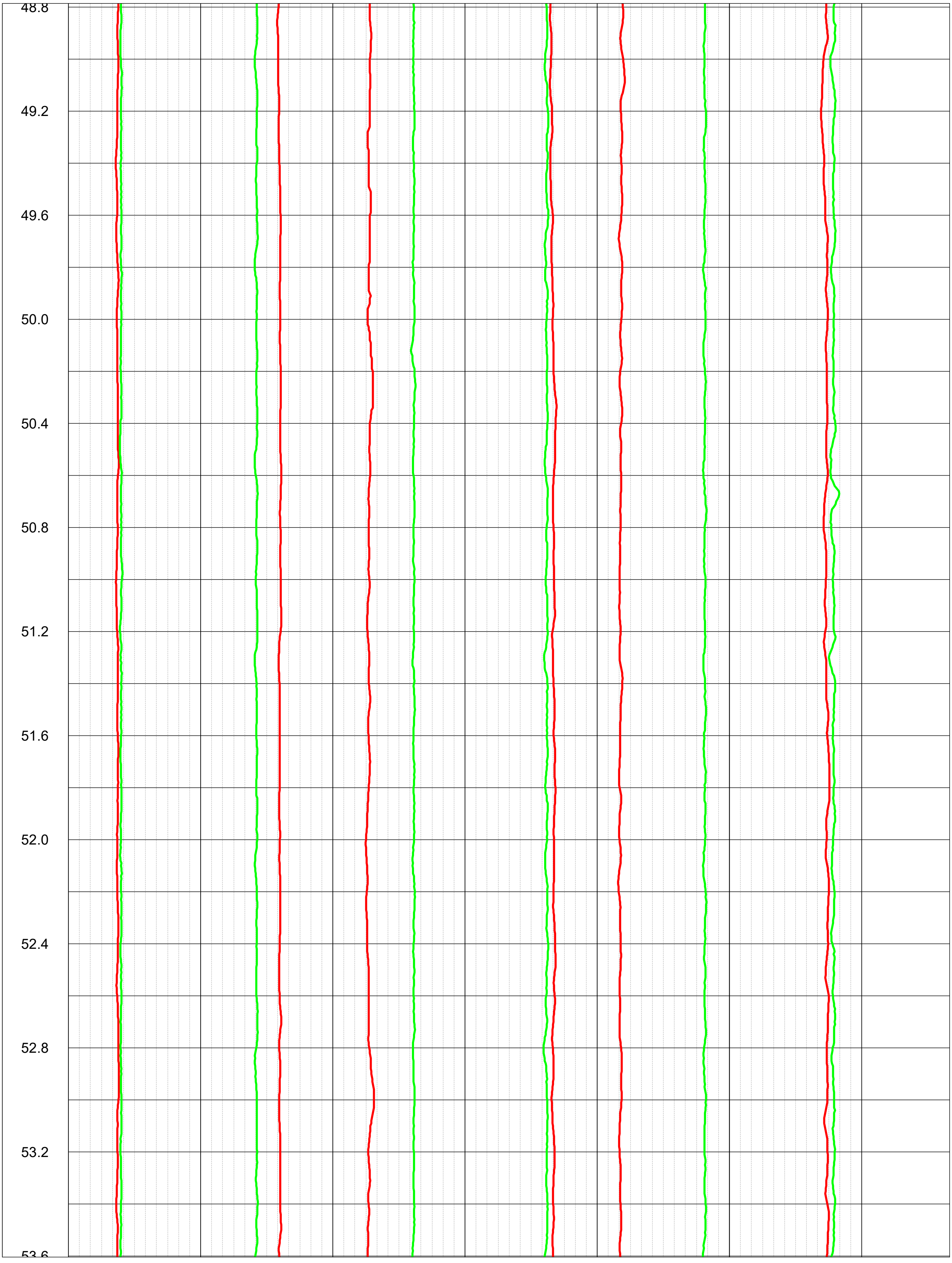
COMPANY	Structural Soils		
WELL ID	RX627		
FIELD	A303 Stonehenge		
COUNTRY	England	STATE	
LOCATION Easting: 413448.75 Northing: 141281.77 SEC TWP RGE			OTHER SERVICES
PERMANENT DATUM	GL	ELEVATION 111.998	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.

DATE	19/04/18	TYPE FLUID IN HOLE	Water
RUN No		SALINITY	
TYPE LOG	Flowmeter	DENSITY	
DEPTH-DRILLER	71	LEVEL	39.5
DEPTH-LOGGER	69	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	69		
TOP LOGGED INTERVAL	41		
OPERATING RIG TIME			
RECORDED BY	Kyle Owen		
WITNESSED BY	James Boyett		

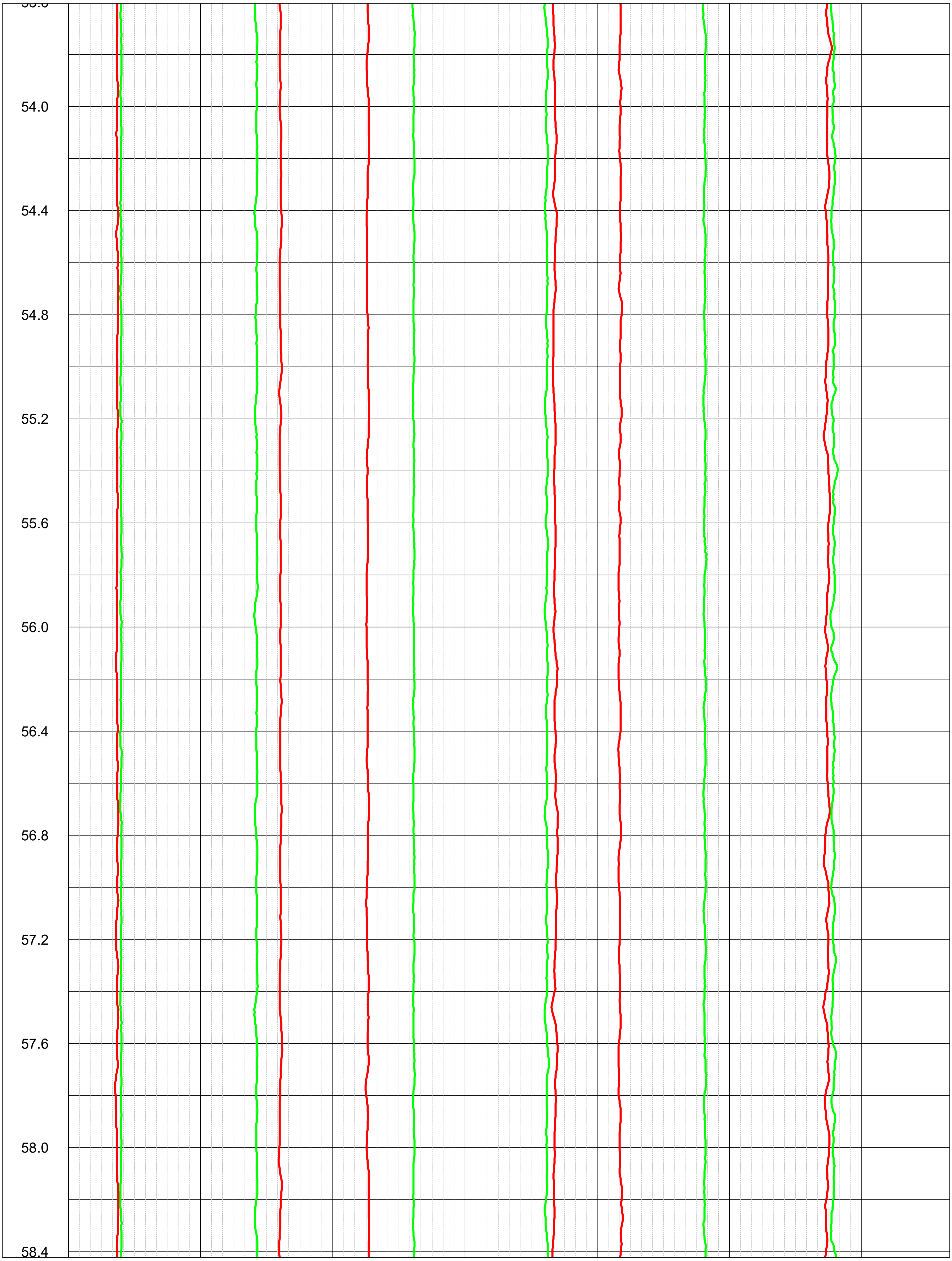
RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

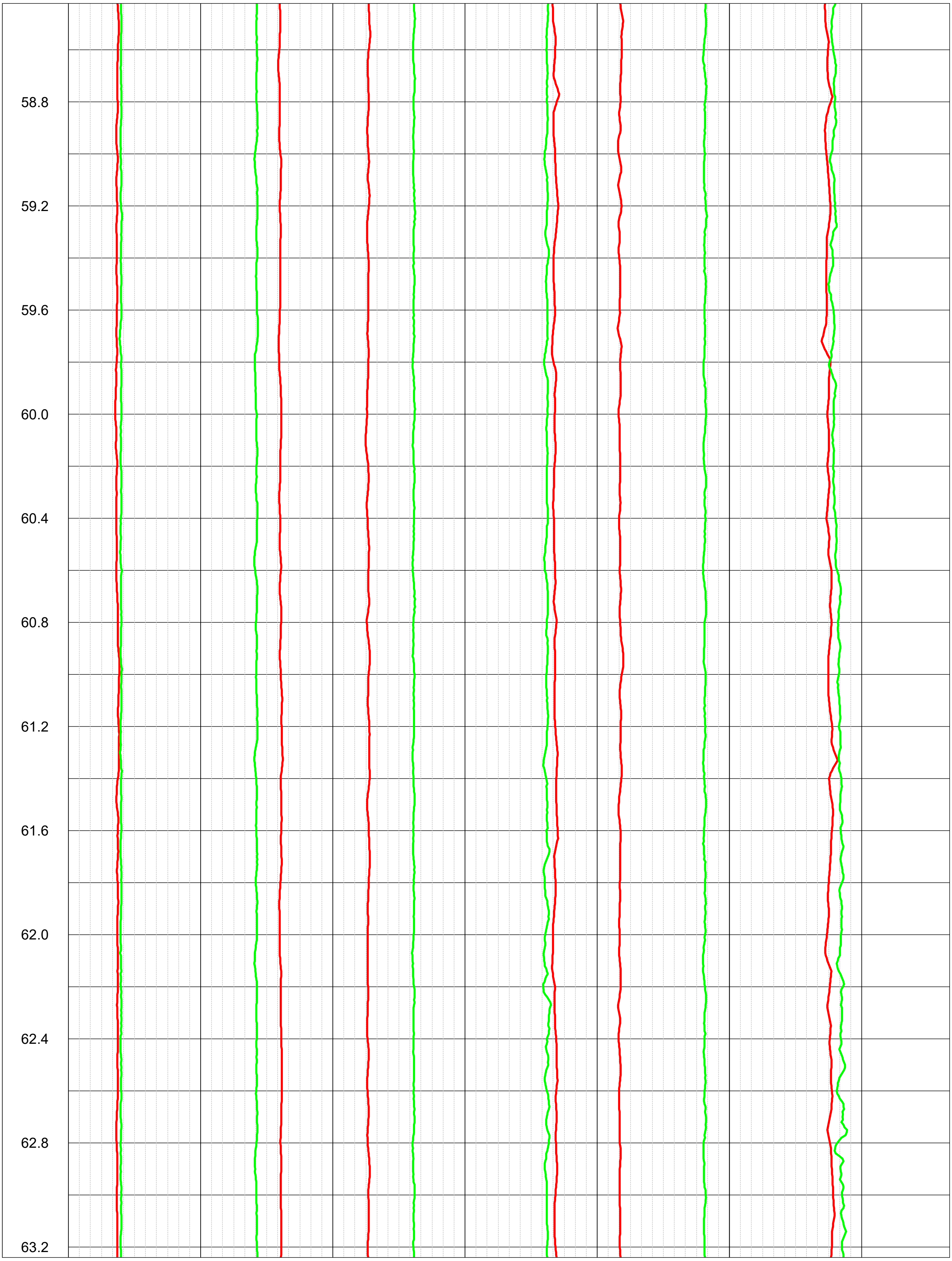


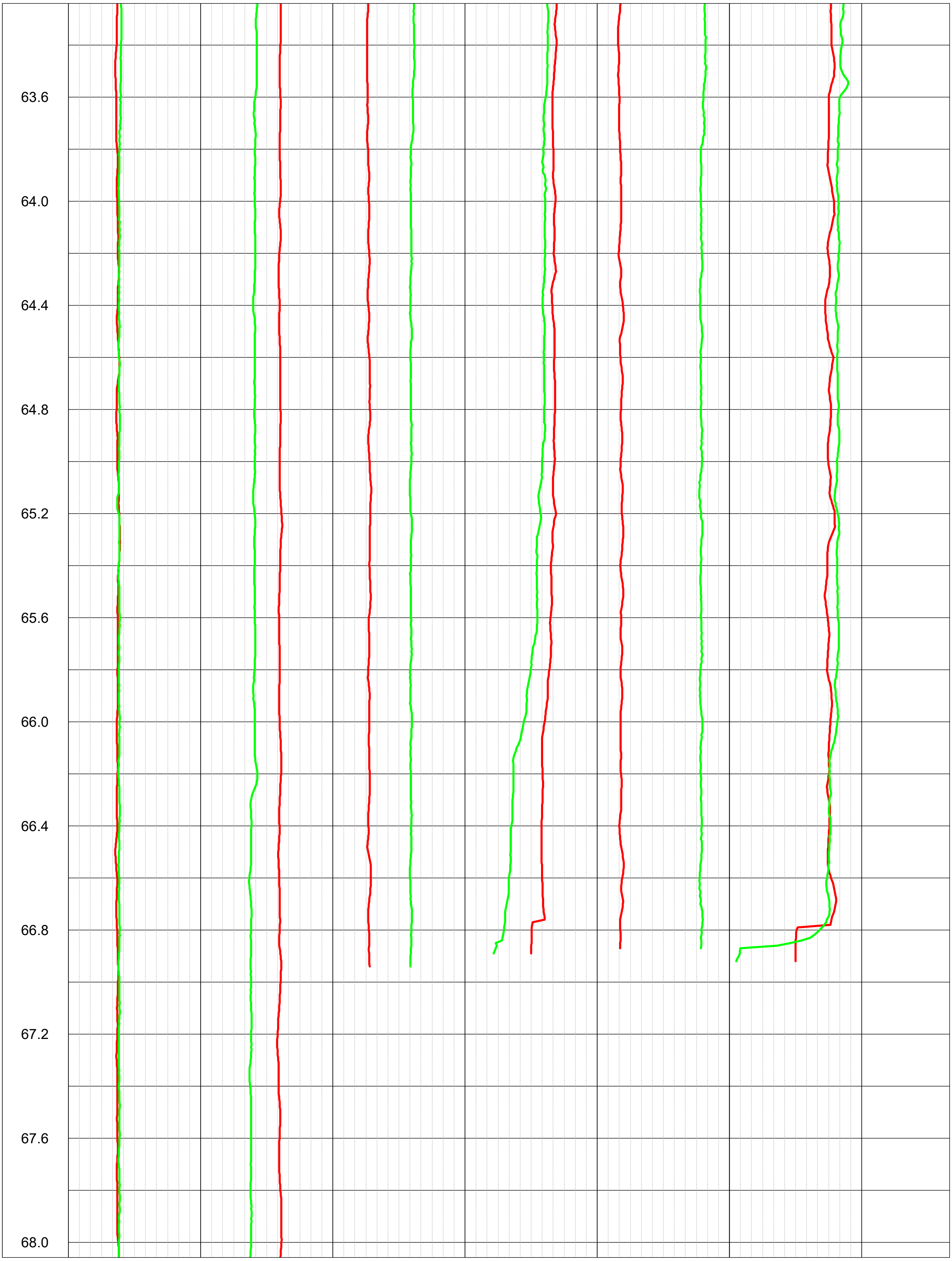

44.0
44.4
44.8
45.2
45.6
46.0
46.4
46.8
47.2
47.6
48.0
48.4



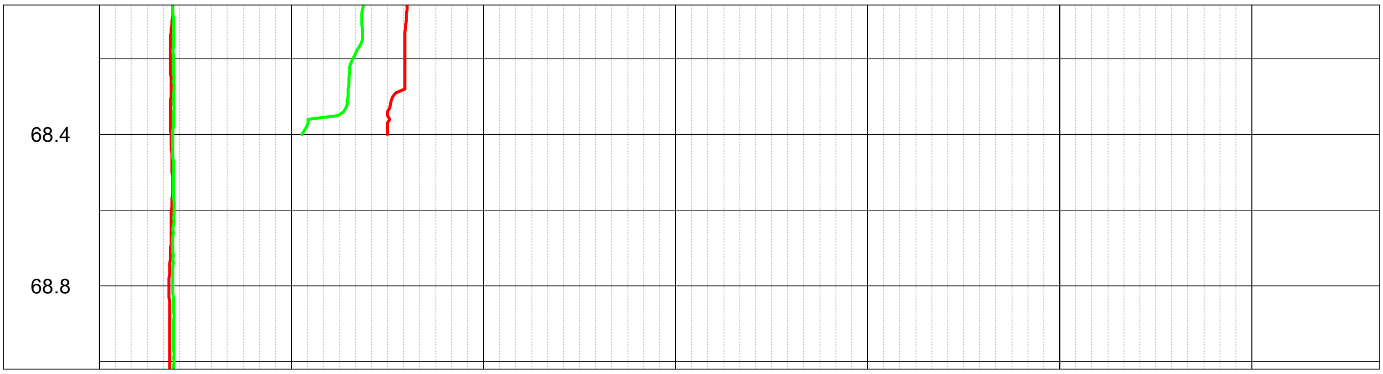
48.8
49.2
49.6
50.0
50.4
50.8
51.2
51.6
52.0
52.4
52.8
53.2
53.6


53.6
54.0
54.4
54.8
55.2
55.6
56.0
56.4
56.8
57.2
57.6
58.0
58.4


58.8
59.2
59.6
60.0
60.4
60.8
61.2
61.6
62.0
62.4
62.8
63.2



63.6
64.0
64.4
64.8
65.2
65.6
66.0
66.4
66.8
67.2
67.6
68.0


68.4
68.8

Depth	Azimuth	Dip	Aperture
m	deg	deg	mm
19.01	188.15	77.52	0.00
23.16	66.61	16.05	0.00
23.22	63.76	21.78	0.00
24.37	60.13	5.14	0.00
24.53	22.21	9.78	0.00
24.69	51.75	7.41	0.00
27.06	100.47	60.11	0.00
29.92	19.79	6.28	0.00
30.37	187.23	77.00	0.00
31.21	3.85	14.13	0.00
36.38	321.33	18.22	0.00
56.98	140.91	75.59	0.00
59.39	41.10	7.97	0.00

ROBERTSON GEO SERVICES
Unlocking Your GeoData

CO	Structural Soils
WELL	R71801
FLD	A303 Stone Henge
CTY	
STE	
FILING No	

COMPANY	Structural Soils		
WELL ID	R71801		
FIELD	A303 Stone Henge		
COUNTRY	England	STATE	
LOCATION			OTHER SERVICES
SEC	TWP	RGE	

PERMANENT DATUM	GL	ELEVATION	K.B.
LOG MEAS. FROM	GL	ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM	GL		G.L.

DATE	27/09/18	TYPE FLUID IN HOLE	
RUN No		SALINITY	
TYPE LOG	Composite	DENSITY	
DEPTH-DRILLER	51.5	LEVEL	
DEPTH-LOGGER	51.5	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	51.5		
TOP LOGGED INTERVAL	2	CASING SHOE	
OPERATING RIG TIME			
RECORDED BY	IJ		
WITNESSED BY	AJ		

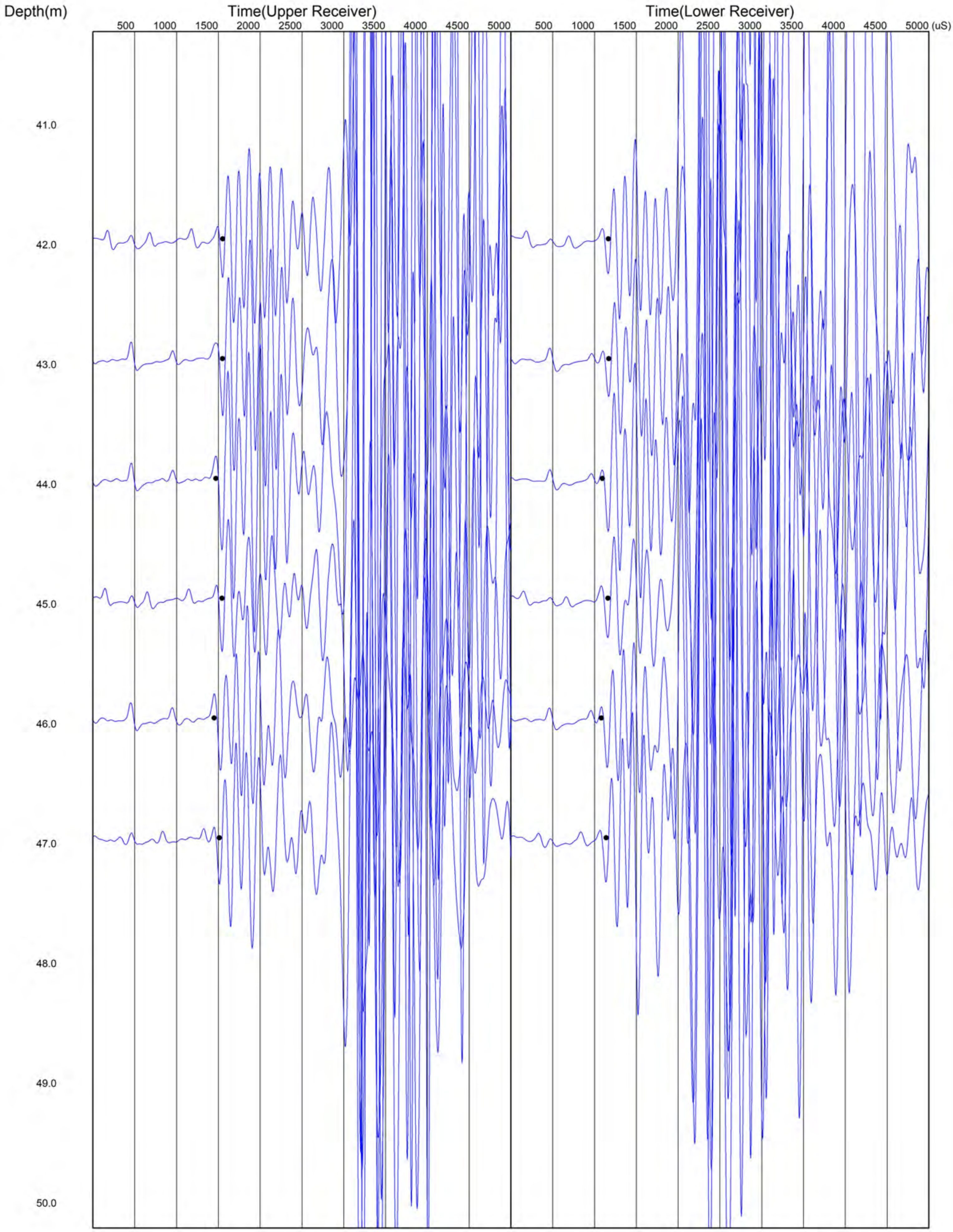
RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

Depth 1:20	Optical 0° 90° 180° 270° 0° / Projections 0° 90° 180° 270° 0°	Dips 1 0 90	Dips 2 0° 180°	3D Log -0°	CALP 0 300	NGAM 0 API 25	TEMP 0 DegC 40 / COND 0 500	Inclination 0 DEGREE 4 / Azimuth 0 360

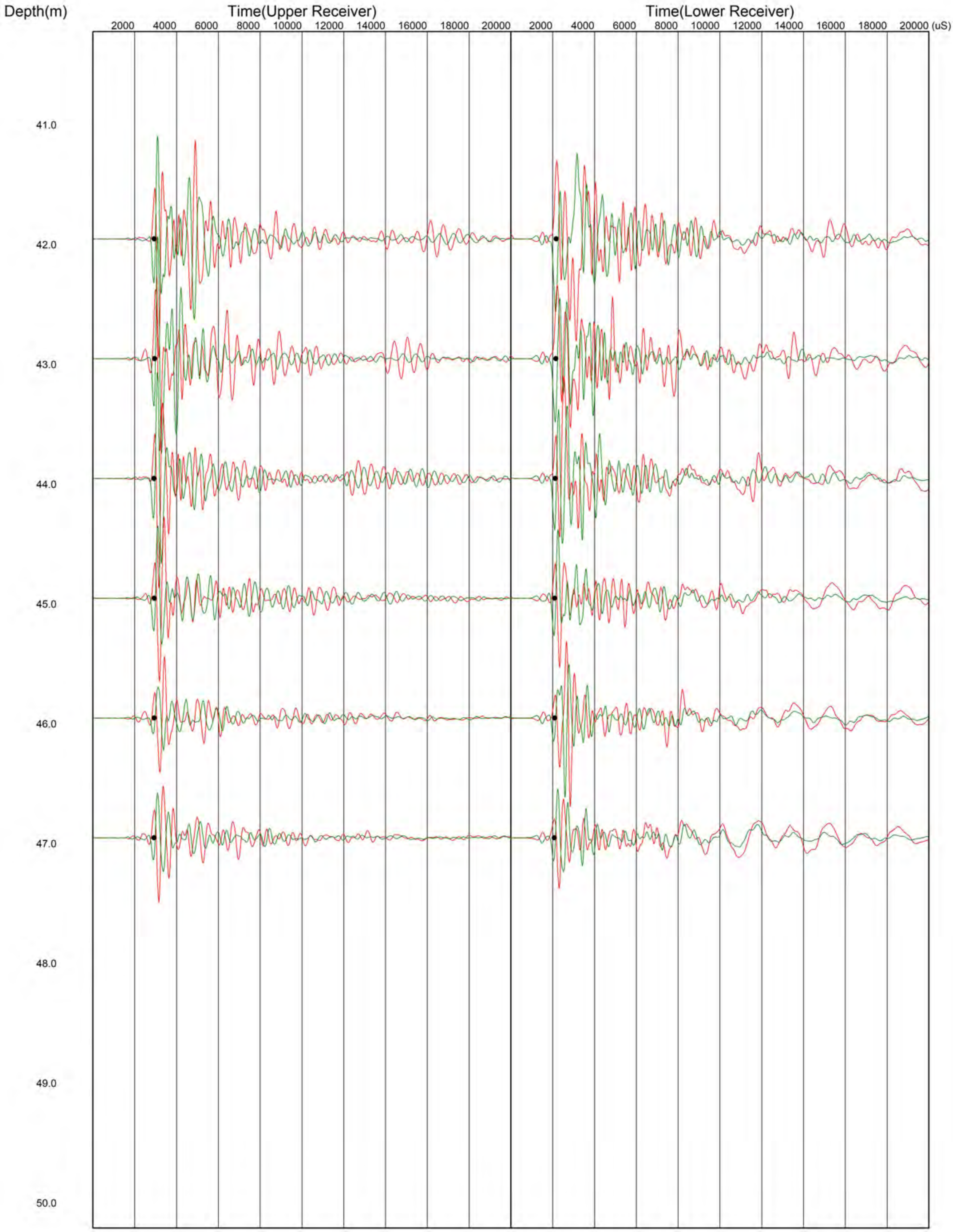
CO	COMPANY	Structural Soils	
WELL	WELL ID	RT1801	
FLD	FIELD	A303 Stonehenge	
CTY	COUNTRY	England	
STE	LOCATION		STATE
FILING No			OTHER SERVICES
	SEC	TWP	RGE
PERMANENT DATUM	GL	ELEVATION	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.
DATE	27/09/18	TYPE FLUID IN HOLE	Water
RUN No		SALINITY	
TYPE LOG	HRPM	DENSITY	
DEPTH-DRILLER	51.5	LEVEL	
DEPTH-LOGGER	51.5	MAX. REC. TEMP	
BTM LOGGED INTERVAL	51		
TOP LOGGED INTERVAL	35	CASING SHOE	
OPERATING RIG TIME			
RECORDED BY	AJ		
WITNESSED BY	IJ		

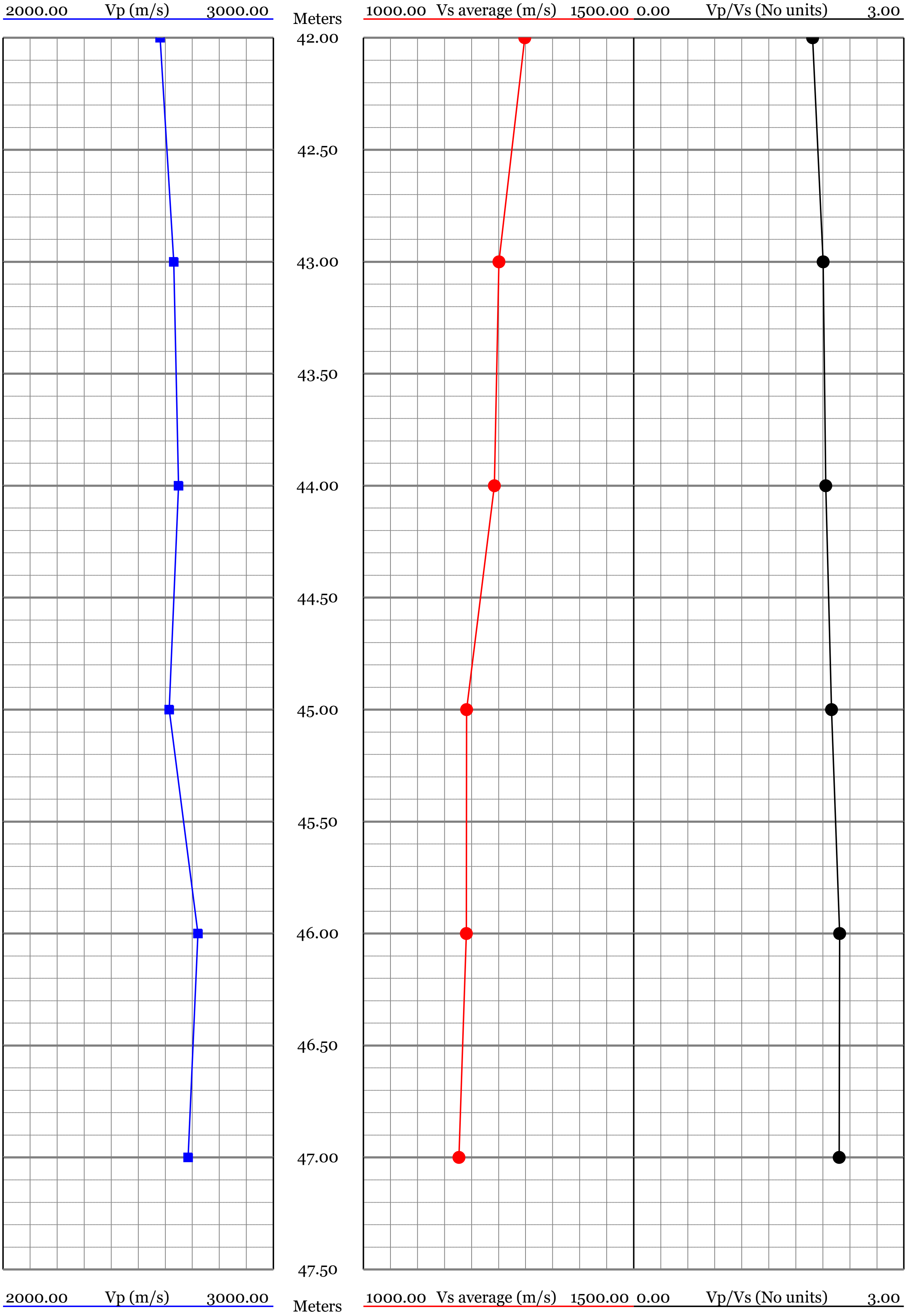
BOREHOLE RECORD				CASING RECORD			
RUN No	BIT	FROM	TO	SIZE	WGT	FROM	TO

P Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
41.0
42.0
43.0
44.0
45.0
46.0
47.0
48.0
49.0
50.0

S Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
41.0
42.0
43.0
44.0
45.0
46.0
47.0
48.0
49.0
50.0



2000.00 Vp (m/s) 3000.00
Meters
1000.00 Vs average (m/s) 1500.00
0.00 Vp/Vs (No units) 3.00
42.00
42.50
43.00
43.50
44.00
44.50
45.00
45.50
46.00
46.50
47.00
47.50
2000.00 Vp (m/s) 3000.00
Meters
1000.00 Vs average (m/s) 1500.00
0.00 Vp/Vs (No units) 3.00

ROBERTSON GEO SERVICES — Unlocking Your GeoData

CO	Structural Soils	COMPANY	Structural Soils
WELL	R71805	WELL ID	R71805
FLD	A303 Stonehenge	FIELD	A303 Stonehenge
CTY	England	COUNTRY	England
STE		STATE	
FILING No		LOCATION	
		OTHER SERVICES	

SEC		TWP		RGE		
PERMANENT DATUM	GL	ELEVATION			K.B.	
LOG MEAS. FROM	GL	ABOVE PERM. DATUM			D.F.	
DRILLING MEAS. FROM					G.L.	
DATE	19/10/18	TYPE FLUID IN HOLE			Water	
RUN No		SALINITY				
TYPE LOG	Composite	DENSITY				
DEPTH-DRILLER	46	LEVEL			35.3	
DEPTH-LOGGER	46	MAX. REC. TEMP.				
BTM LOGGED INTERVAL	46					
TOP LOGGED INTERVAL	0.7	CASING SHOE				
OPERATING RIG TIME						
RECORDED BY	Aaron Jones					
WITNESSED BY	Kyle Owen					

BOREHOLE RECORD				CASING RECORD			
RUN NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

ROBERTSON GEO SERVICES
Unlocking Your GeoData

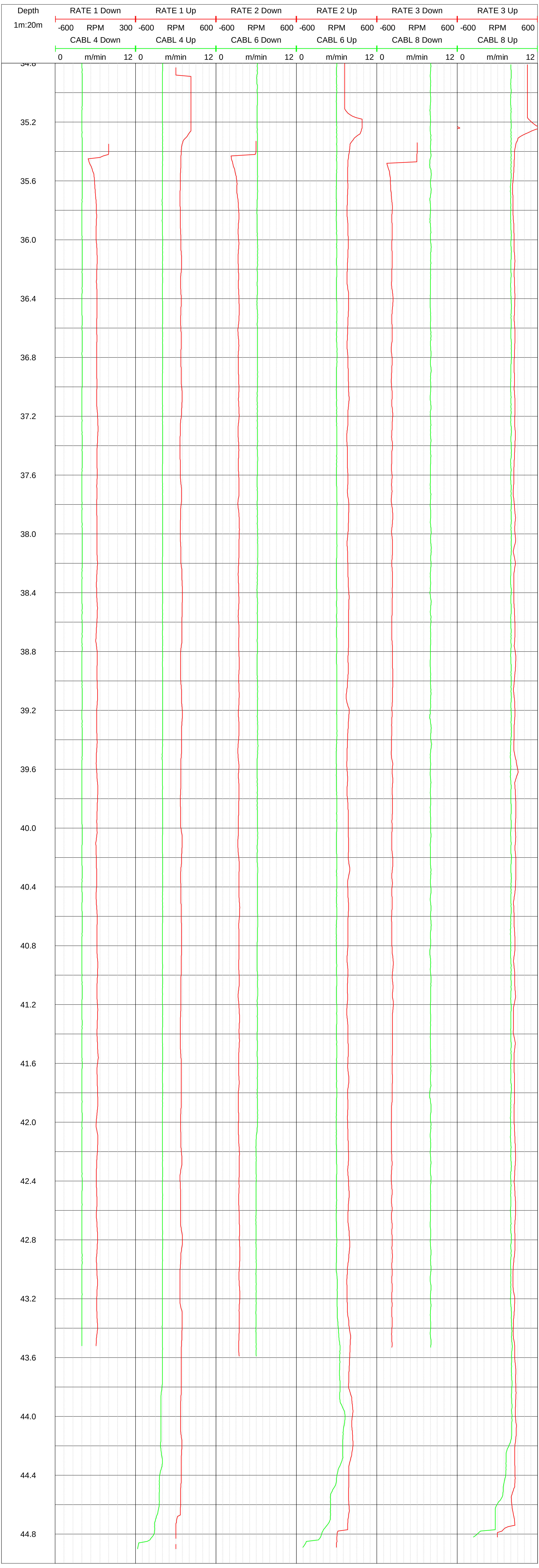
COMPANY	Structural Soils
WELL ID	R71805
FIELD	A303 Stonehenge
COUNTRY	England
STATE	
LOCATION	
OTHER SERVICES	

CO Structural Soils
WELL R71805
FLD A303 Stonehenge
CTY England
STE
FILING No

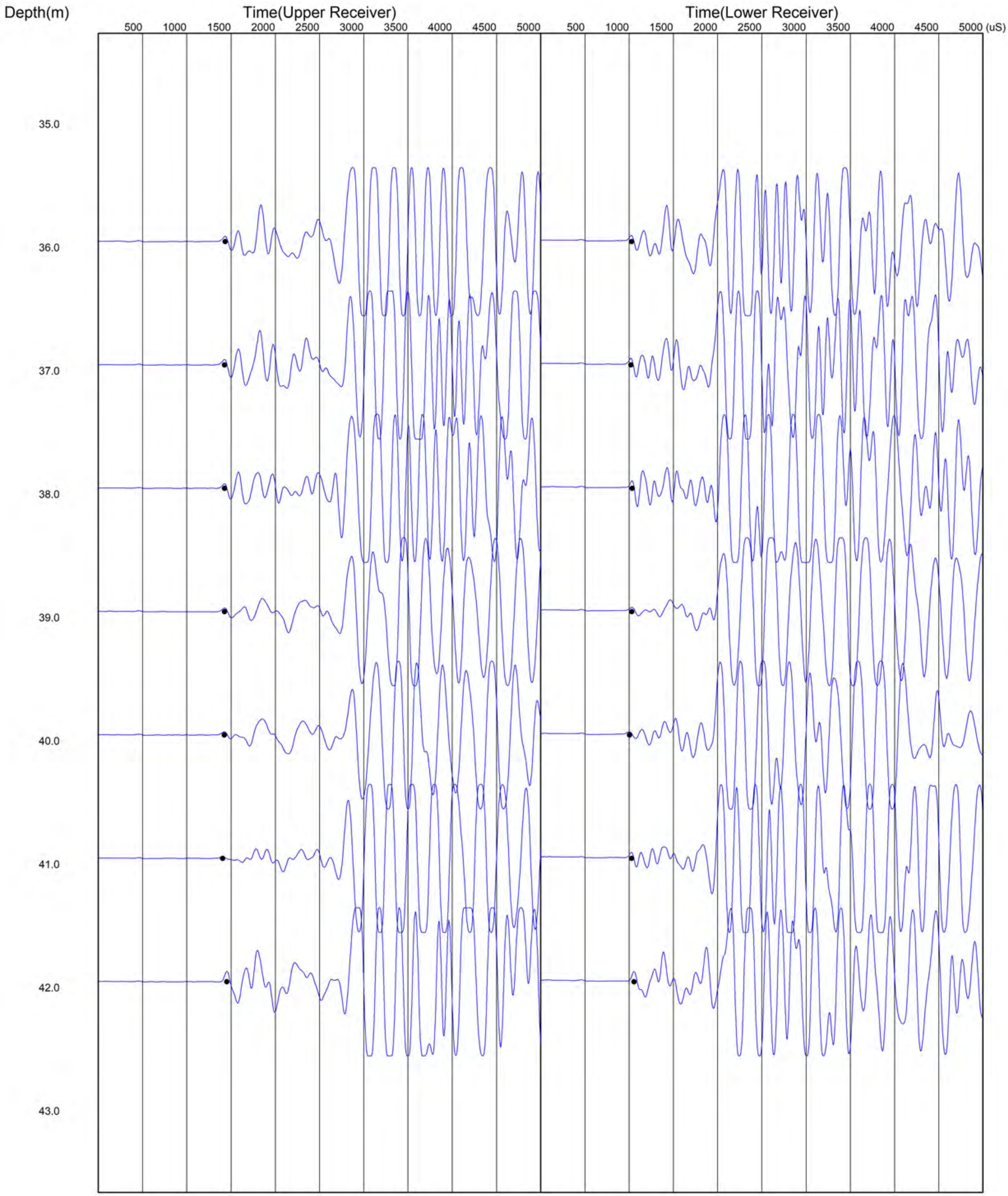
SEC	TWP	RGE	
PERMANENT DATUM	GL	ELEVATION	K.B.
LOG MEAS. FROM	GL	ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.

DATE	19/10/18	TYPE FLUID IN HOLE	Water
RUN No		SALINITY	
TYPE LOG	Flowmeter	DENSITY	
DEPTH-DRILLER	46	LEVEL	35.3
DEPTH-LOGGER	46	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	46		
TOP LOGGED INTERVAL	34.8	CASING SHOE	
OPERATING RIG TIME			
RECORDED BY	Aaron Jones		
WITNESSED BY	Kyle Owen		

BOREHOLE RECORD				CASING RECORD			
RUN NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

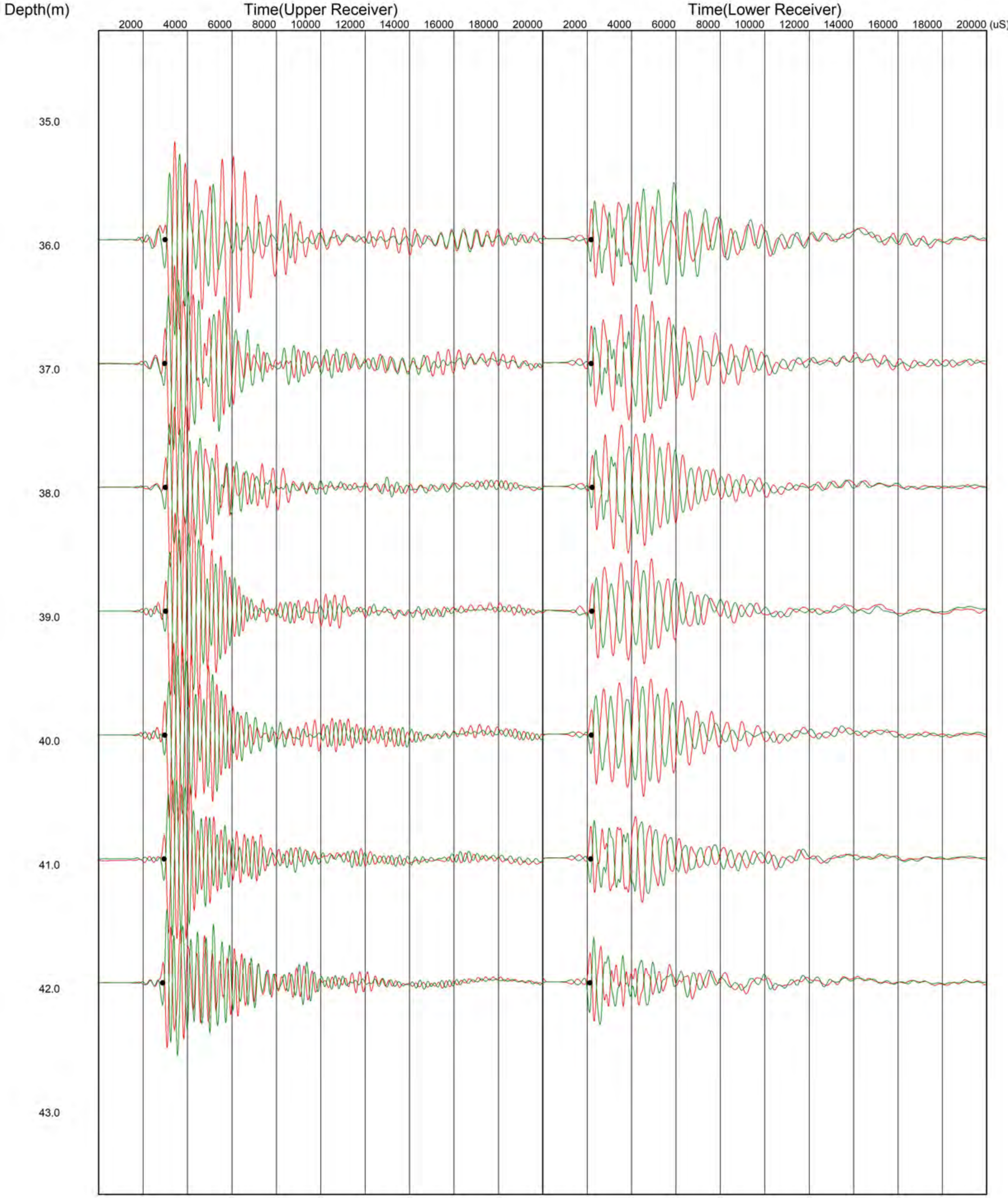


P Wave



Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
500
1000
1500
2000
2500
3000
3500
4000
4500
5000 (uS)
35.0
36.0
37.0
38.0
39.0
40.0
41.0
42.0
43.0

S Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
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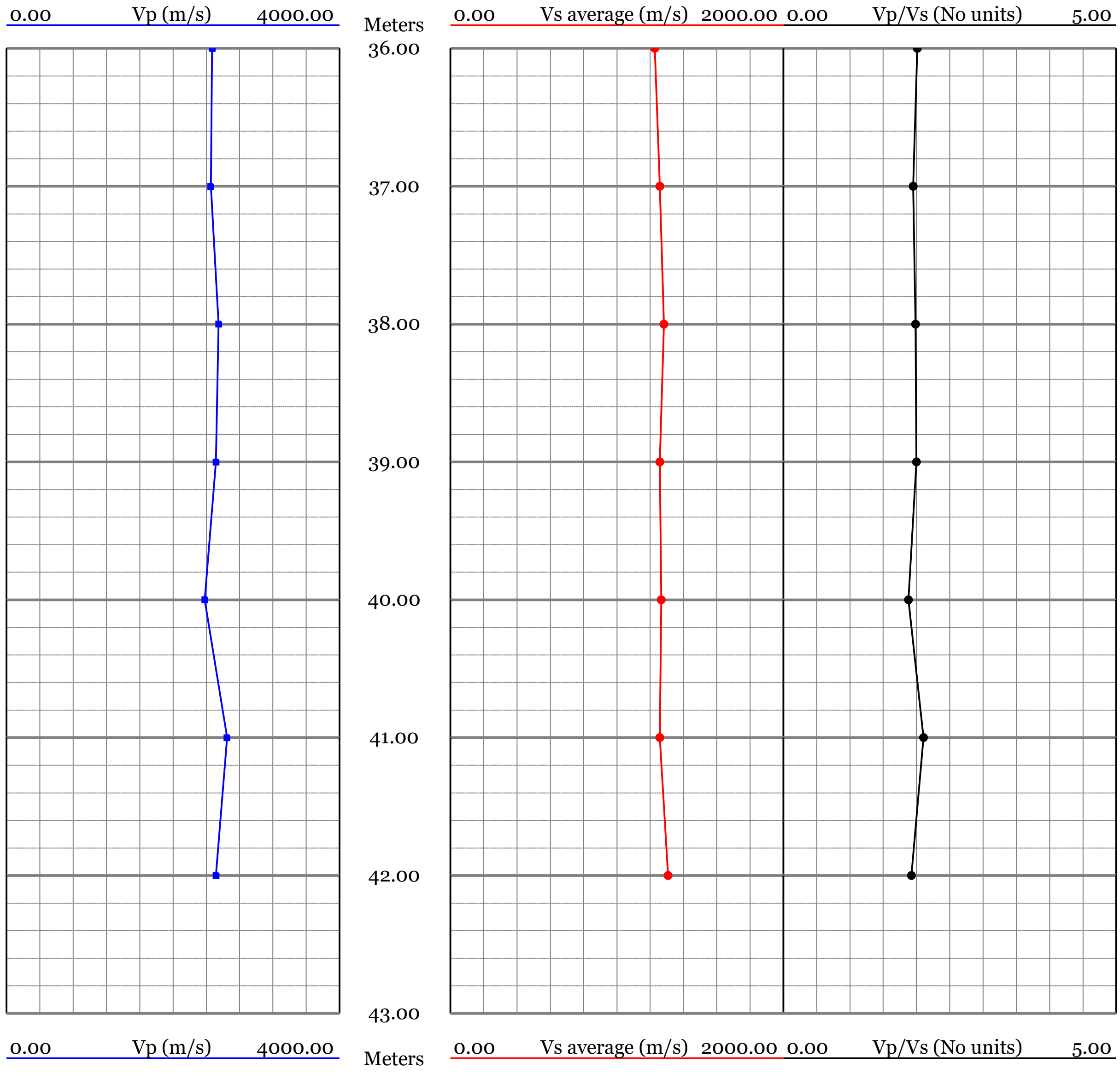
36.0
37.0
38.0
39.0
40.0
41.0
42.0
43.0


0.00
Vp (m/s)
4000.00
Meters
36.00
37.00
38.00
39.00
40.00
41.00
42.00
43.00
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00

ROBERTSON GEO SERVICES — Unlocking Your GeoData

COMPANY	Structural Soils		
WELL ID	R71809		
FIELD	A303 Stonehenge		
COUNTRY	England	STATE	
LOCATION			OTHER SERVICES
SEC	TWP	RGE	
PERMANENT DATUM	GL	ELEVATION	K.B.
LOG MEAS. FROM	GL	ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.
DATE	19/10/18	TYPE FLUID IN HOLE	Water
RUN No		SALINITY	
TYPE LOG	Composite	DENSITY	
DEPTH-DRILLER	45.8	LEVEL	31.8
DEPTH-LOGGER	45.8	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	45.8		
TOP LOGGED INTERVAL	0.7	CASING SHOE	
OPERATING RIG TIME			
RECORDED BY	Aaron Jones		
WITNESSED BY	Kyle Owen		

CO Structural Soils
WELL R71809
FLD A303 Stonehenge
CTY England
STE
FILING No

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

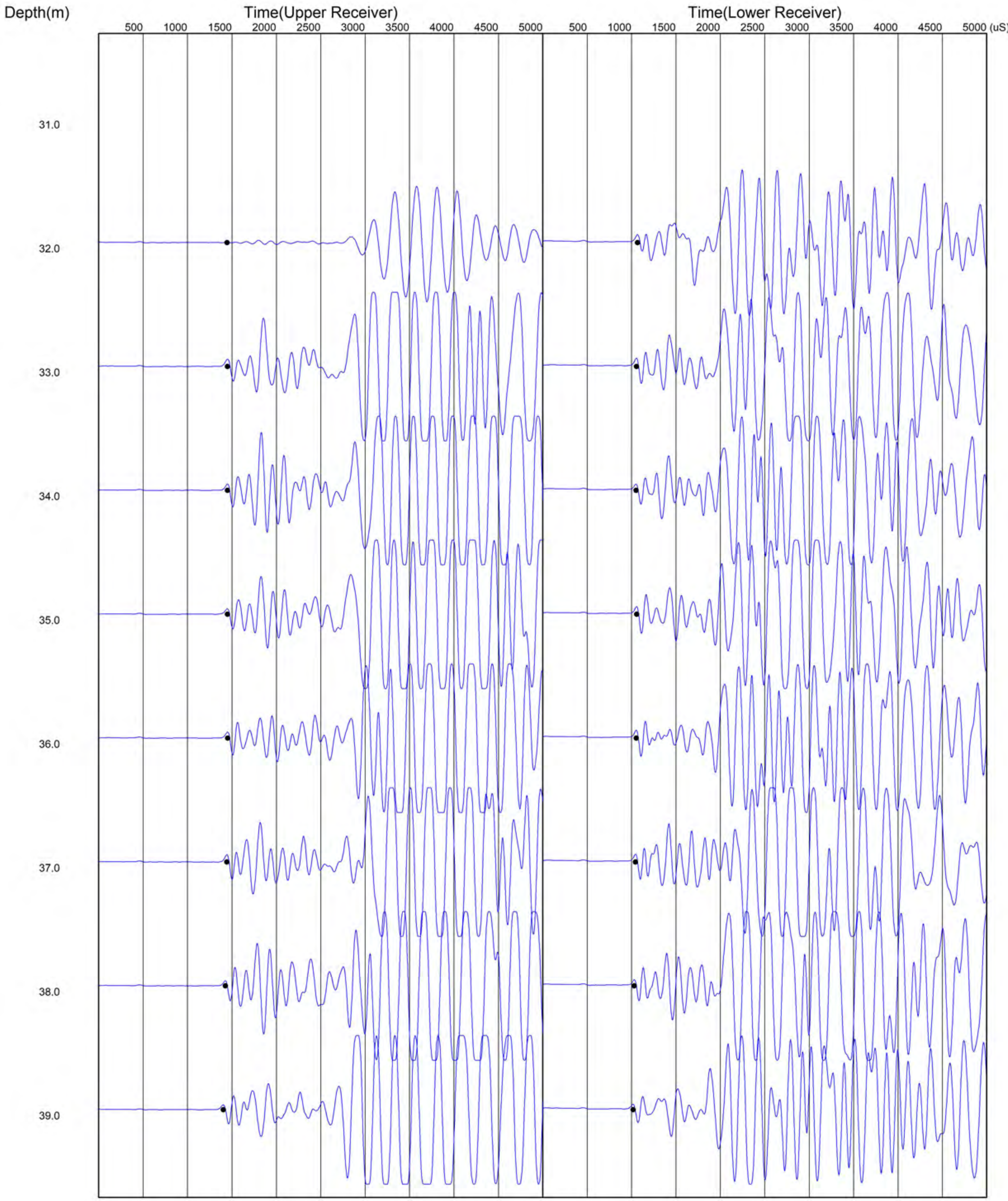
CO Structural Soils
WELL R71809
FLD A303 Stonehenge
CTY England
STE
FILING No

COMPANY	Structural Soils
WELL ID	R71809
FIELD	A303 Stonehenge
COUNTRY	England
LOCATION	
STATE	
OTHER SERVICES	
SEC	
TWP	
RGE	

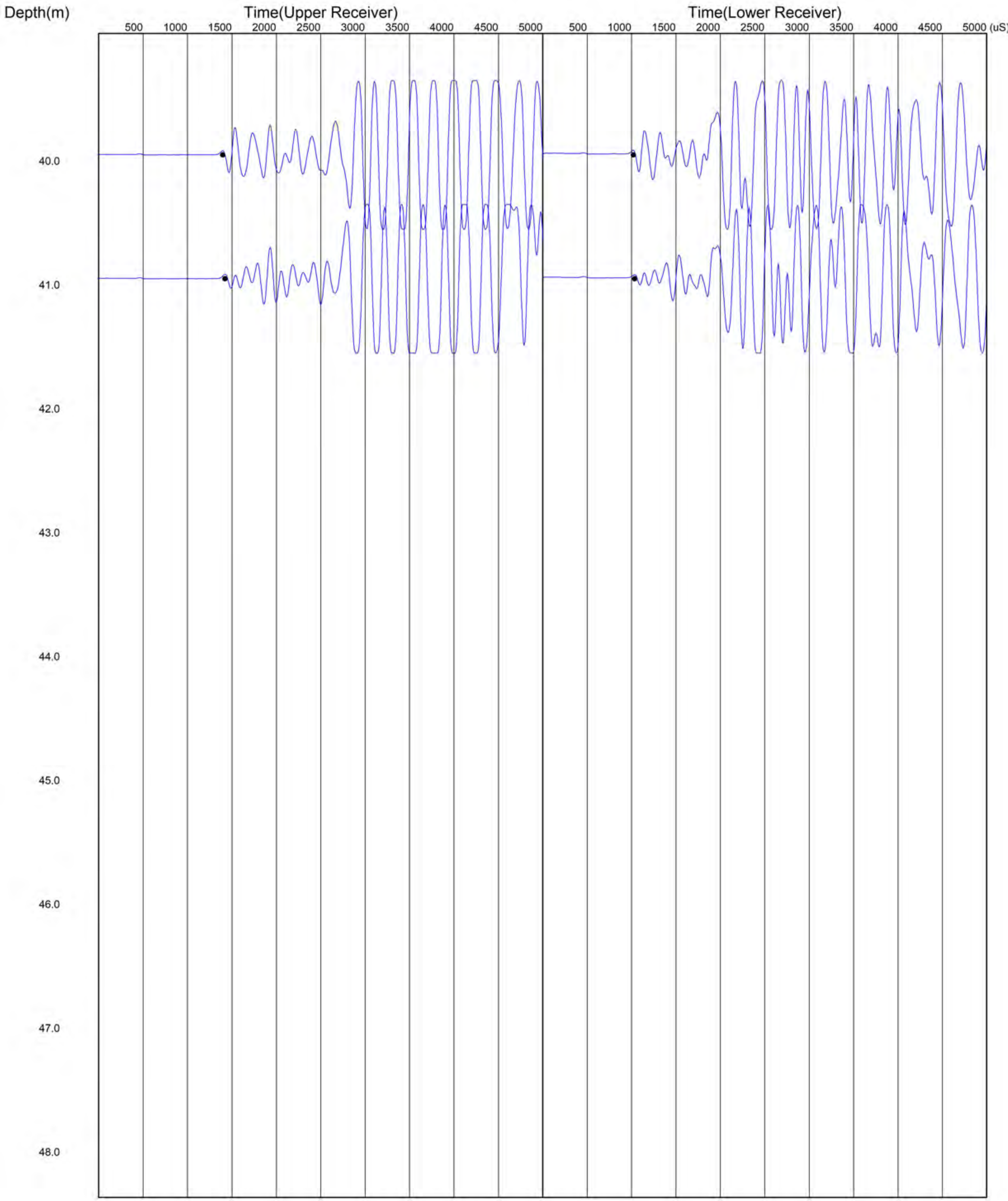
PERMANENT DATUM	GL	ELEVATION		K.B.	
LOG MEAS. FROM	GL	ABOVE PERM. DATUM		D.F.	
DRILLING MEAS. FROM				G.L.	
DATE	19/10/18	TYPE FLUID IN HOLE	Water		
RUN No		SALINITY			
TYPE LOG	Flowmeter	DENSITY			
DEPTH-DRILLER	45.8	LEVEL	31.8		
DEPTH-LOGGER	45.8	MAX. REC. TEMP.			
BTM LOGGED INTERVAL	44.9				
TOP LOGGED INTERVAL	31.4	CASING SHOE			
OPERATING RIG TIME					
RECORDED BY	Aaron Jones				
WITNESSED BY	Kyle Owen				

BOREHOLE RECORD				CASING RECORD			
RUN NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

P Wave

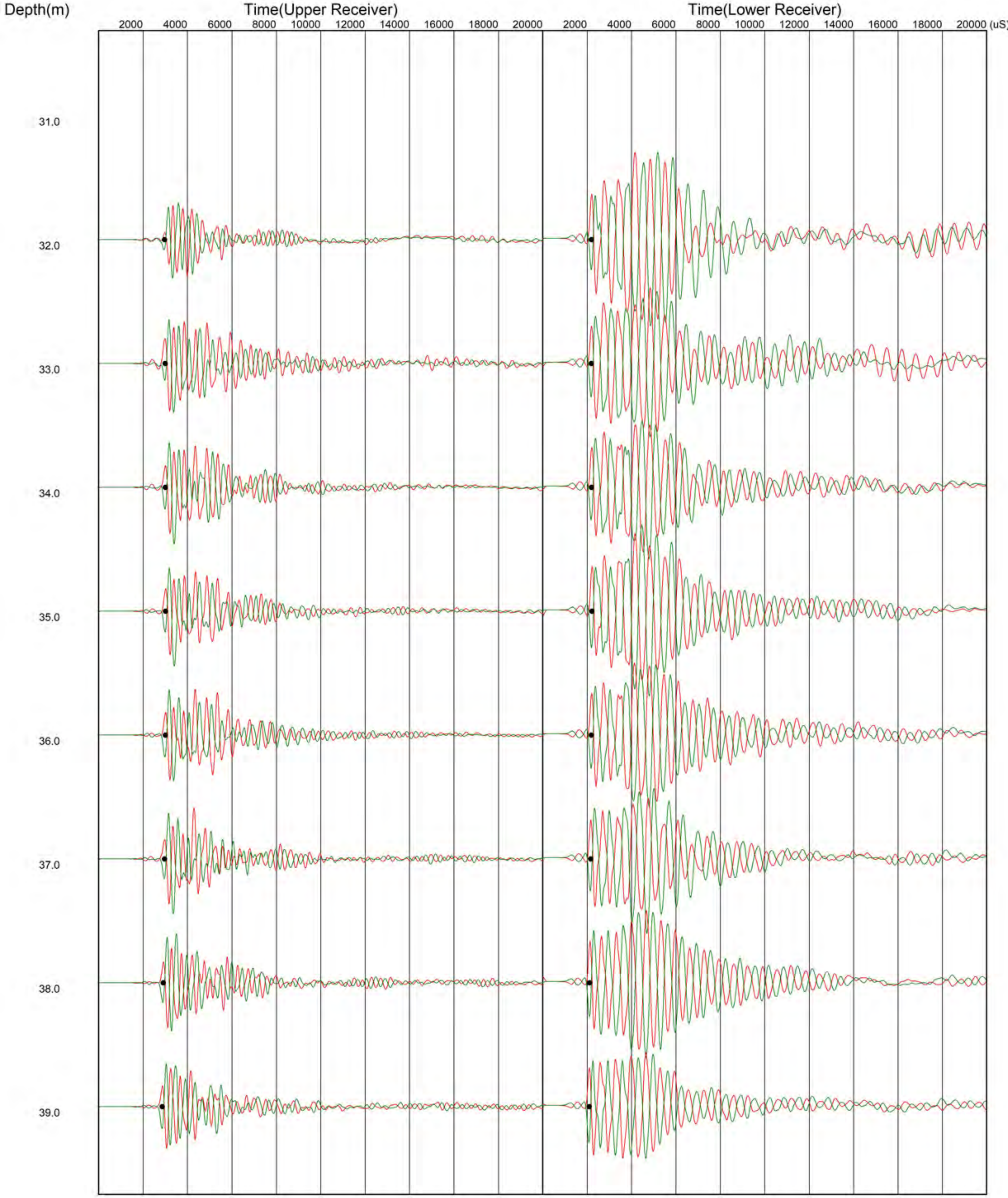

Depth(m)
Time(Upper Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
31.0
32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0

P Wave

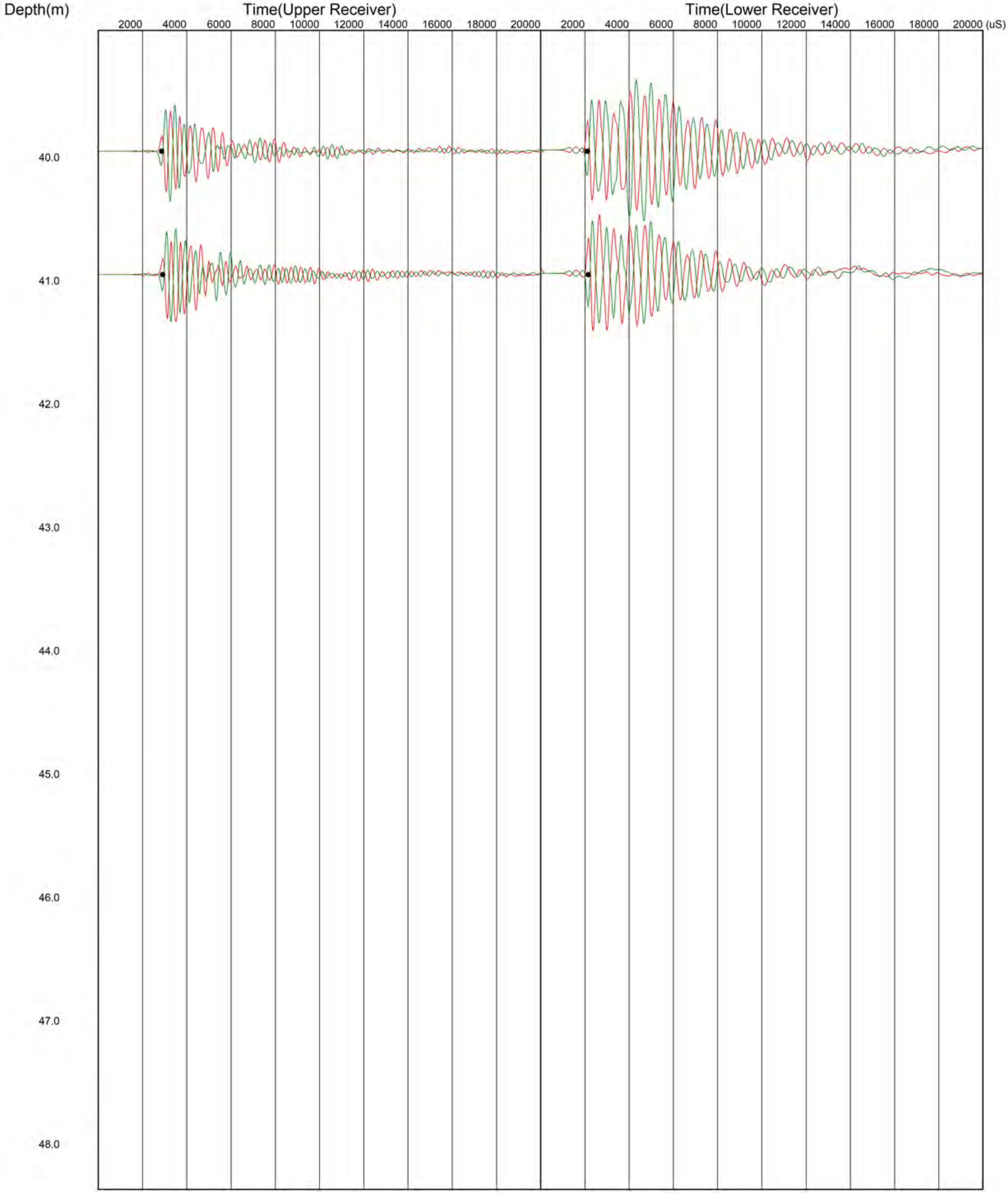


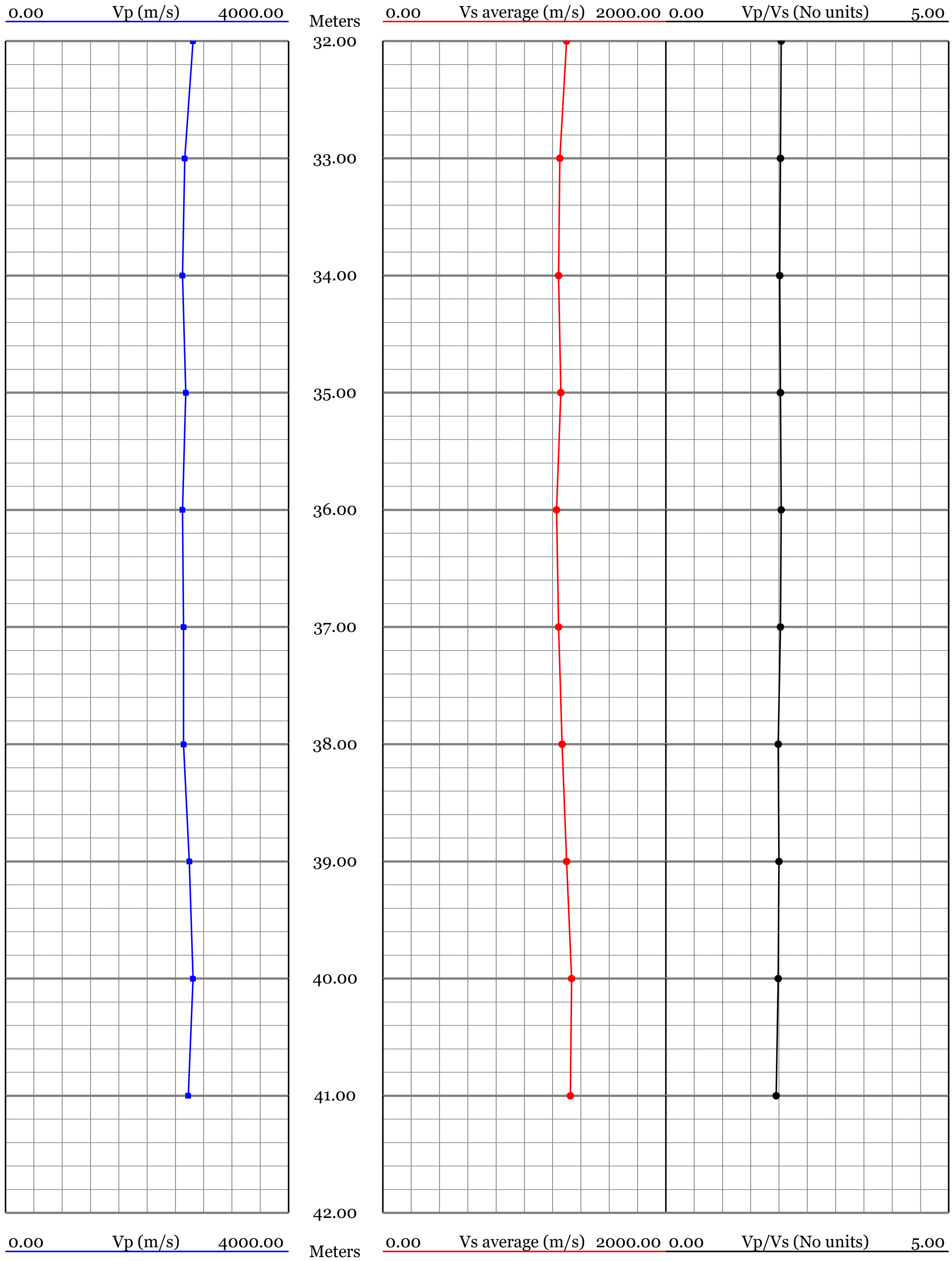
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
500
1000
1500
2000
2500
3000
3500
4000
4500
5000 (uS)
40.0
41.0
42.0
43.0
44.0
45.0
46.0
47.0
48.0

S Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
(uS)
31.0
32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0

S Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
40.0
41.0
42.0
43.0
44.0
45.0
46.0
47.0
48.0


0.00 Vp (m/s) 4000.00
Meters
0.00 Vs average (m/s) 2000.00
0.00 Vp/Vs (No units) 5.00
32.00
33.00
34.00
35.00
36.00
37.00
38.00
39.00
40.00
41.00
42.00
0.00 Vp (m/s) 4000.00
Meters
0.00 Vs average (m/s) 2000.00
0.00 Vp/Vs (No units) 5.00

ROBERTSON GEO SERVICES
Unlocking Your GeoData

COMPANY	Structural Soils		
WELL ID	R71813		
FIELD	A303 Stonehenge		
COUNTRY	England	STATE	
LOCATION			OTHER SERVICES
CO Structural Soils	SEC	TWP	RGE
WELL R71813			
FLD A303 Stonehenge			
CTY England			
STE			
FILING No			
PERMANENT DATUM	GL	ELEVATION	K.B.
LOG MEAS. FROM	GL	ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.
DATE	16/10/2018	TYPE FLUID IN HOLE	Water
RUN No		SALINITY	
TYPE LOG	Composite	DENSITY	
DEPTH-DRILLER	46.5m	LEVEL	28.6m
DEPTH-LOGGER	46.2m	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	46.2m		
TOP LOGGED INTERVAL	1.62m	CASING SHOE	
OPERATING RIG TIME			
RECORDED BY	Joanne Van-Aardt		
WITNESSED BY	James Boyett		

BOREHOLE RECORD				CASING RECORD			
RUN NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

ROBERTSON GEO SERVICES
Unlocking Your GeoData

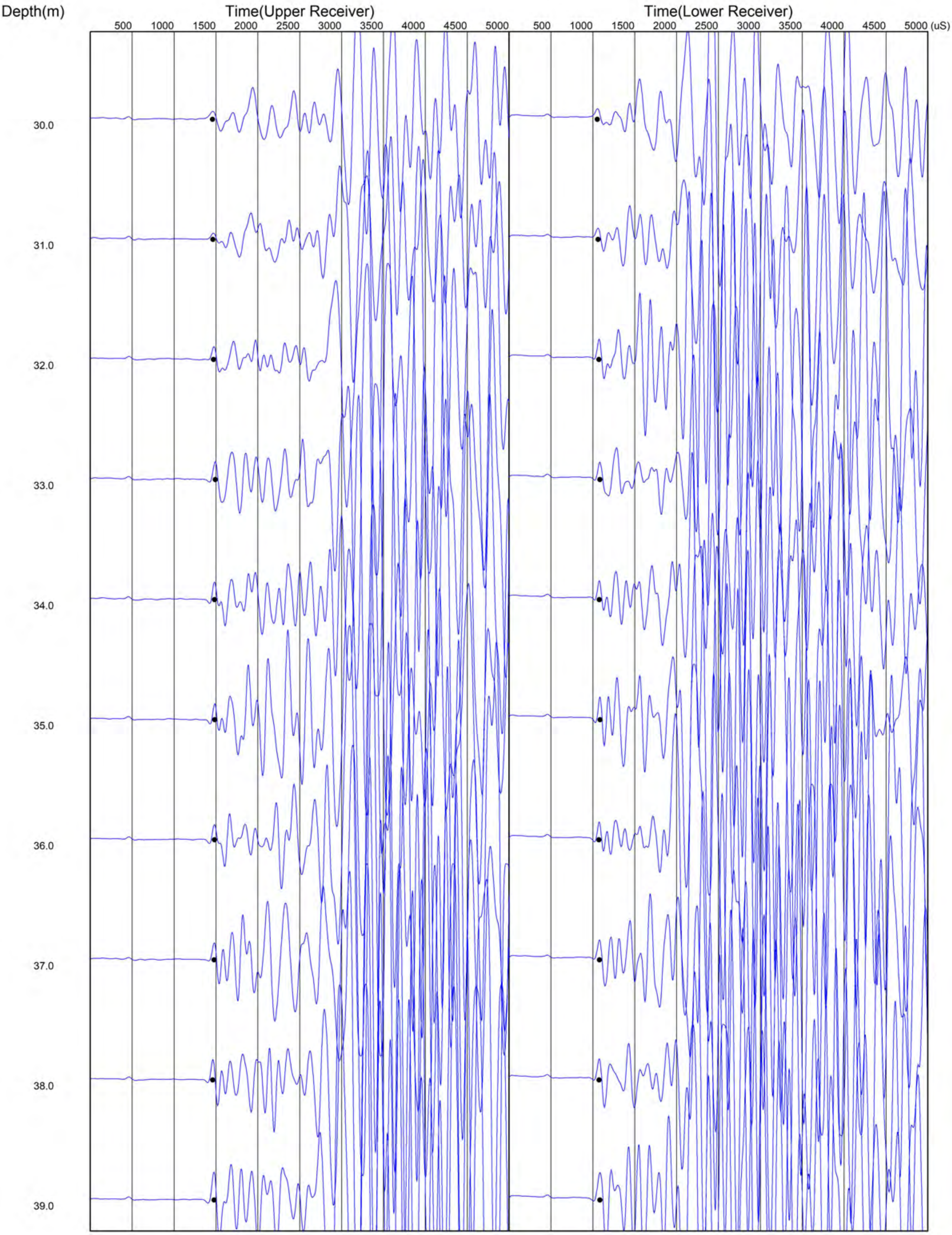
CO Structural Soils	COMPANY	Structural Soils	
WELL R71813	WELL ID	R71813	
FLD A303 Stonehenge	FIELD	A303 Stonehenge	
CTY England	COUNTRY	England	STATE
STE	LOCATION		OTHER SERVICES
FILING No	SEC	TWP	RGE

PERMANENT DATUM	GL	ELEVATION	K.B.
LOG MEAS. FROM	GL	ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.

DATE	16/10/18	TYPE FLUID IN HOLE	Water
RUN No		SALINITY	
TYPE LOG	Flowmeter	DENSITY	
DEPTH-DRILLER	46.5m	LEVEL	28.6m
DEPTH-LOGGER	44.4m	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	44.4m		
TOP LOGGED INTERVAL	28m	CASING SHOE	
OPERATING RIG TIME			
RECORDED BY	James Boyett		
WITNESSED BY	Joanne Van-Aardt		

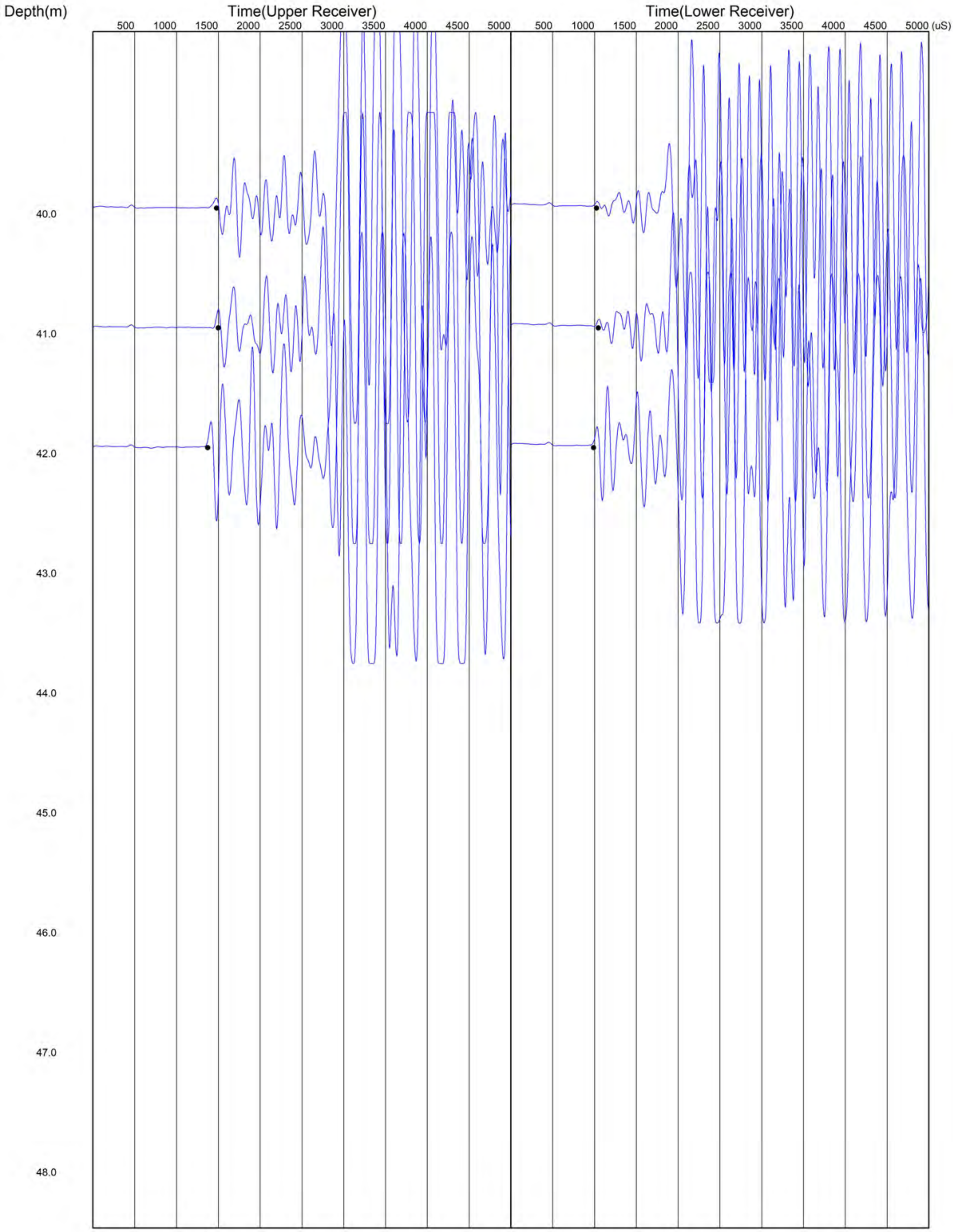
RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

P Wave



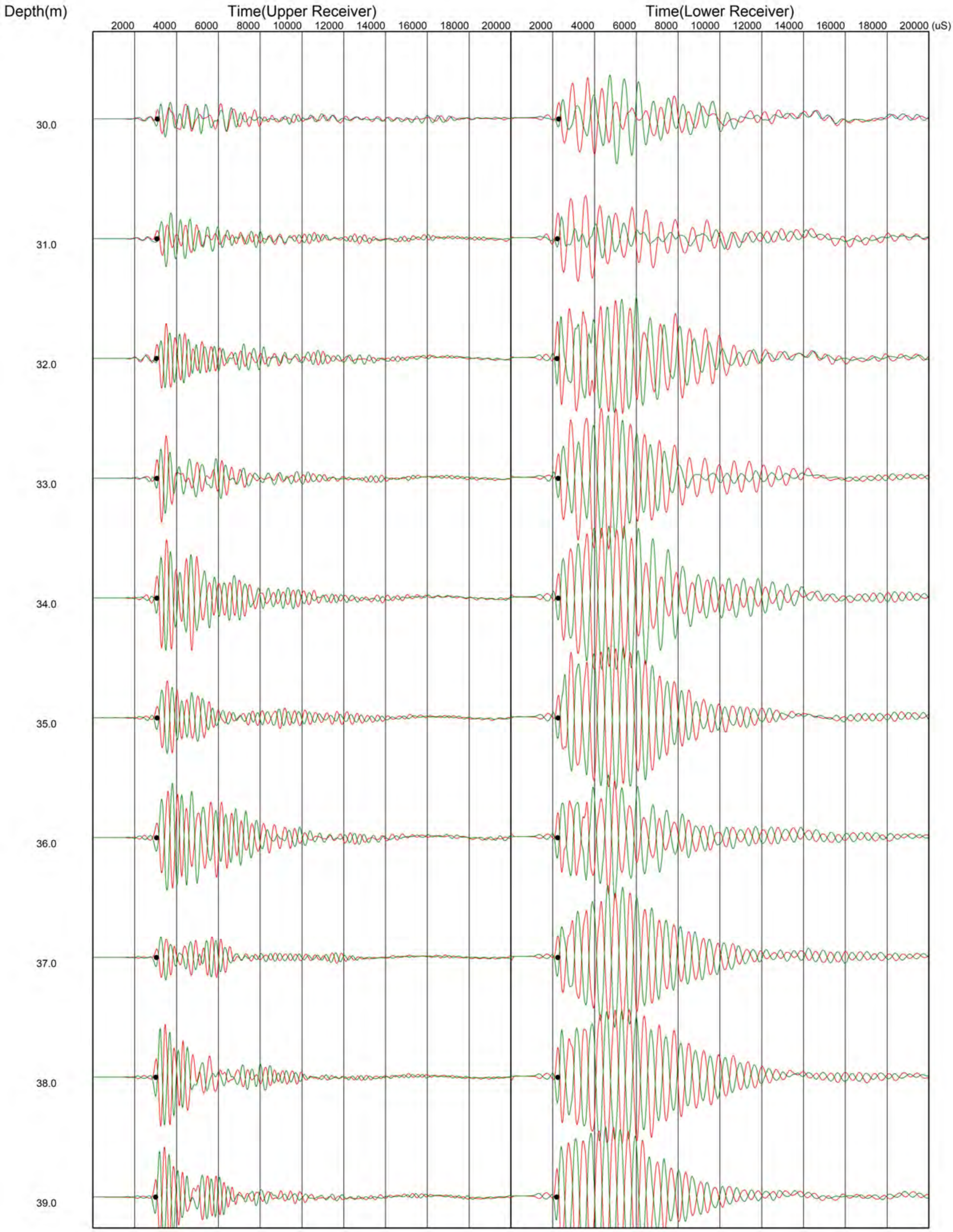
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
500
1000
1500
2000
2500
3000
3500
4000
4500
5000 (uS)
30.0
31.0
32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0

P Wave

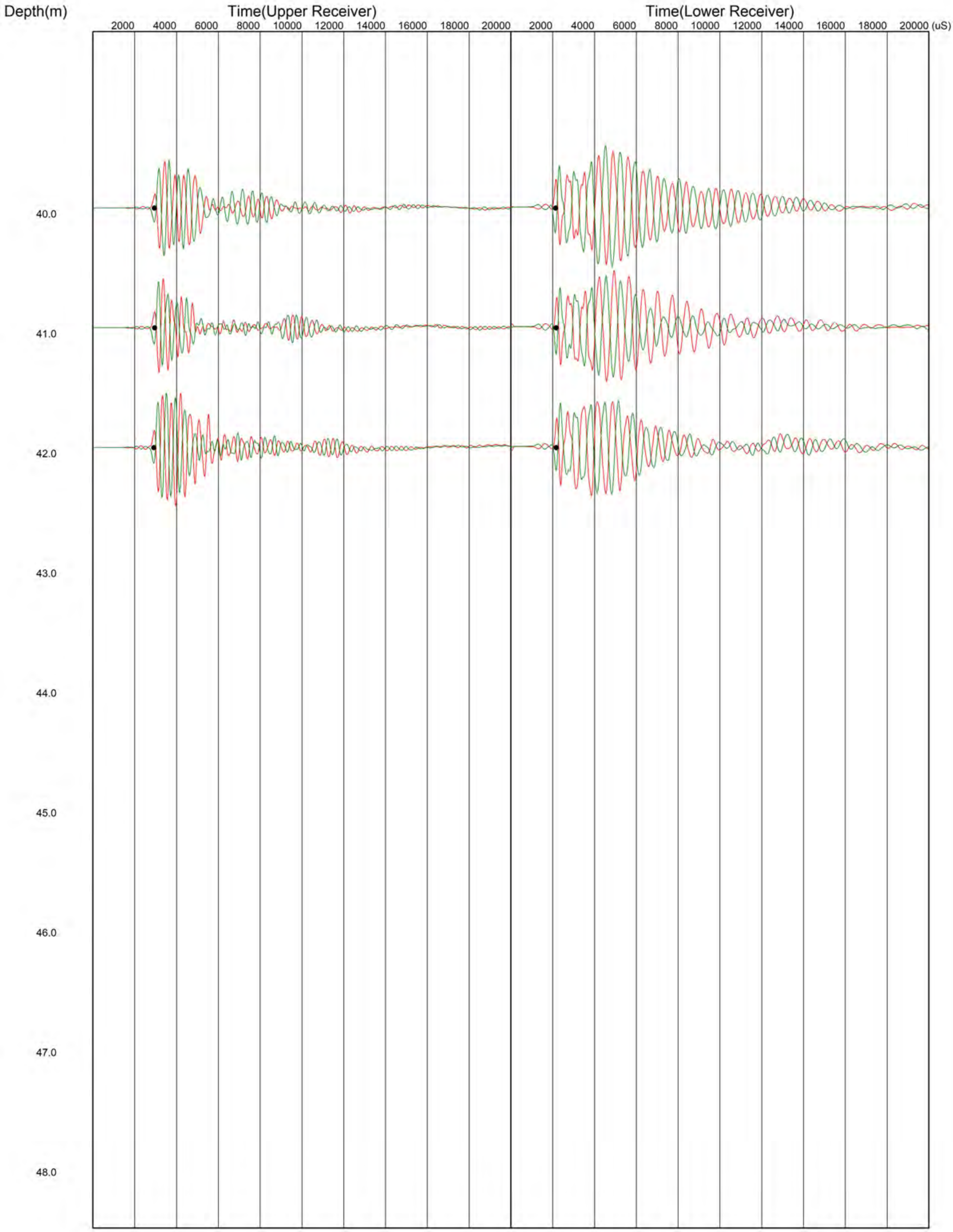


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
(uS)
40.0
41.0
42.0
43.0
44.0
45.0
46.0
47.0
48.0

S Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
30.0
31.0
32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0

S Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
(uS)
40.0
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42.0
43.0
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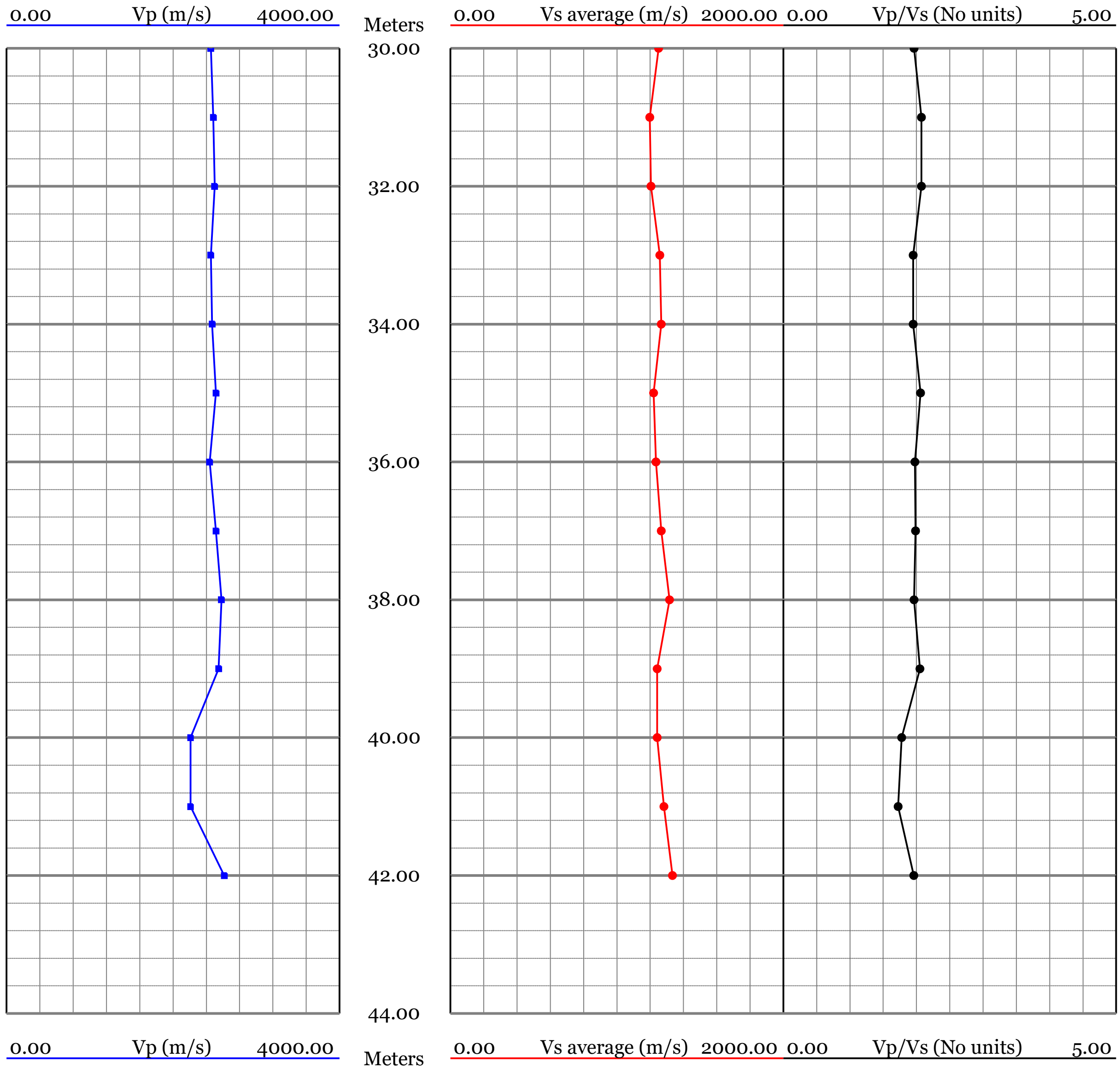
46.0
47.0
48.0


0.00
Vp (m/s)
4000.00
Meters
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00
30.00
32.00
34.00
36.00
38.00
40.00
42.00
44.00

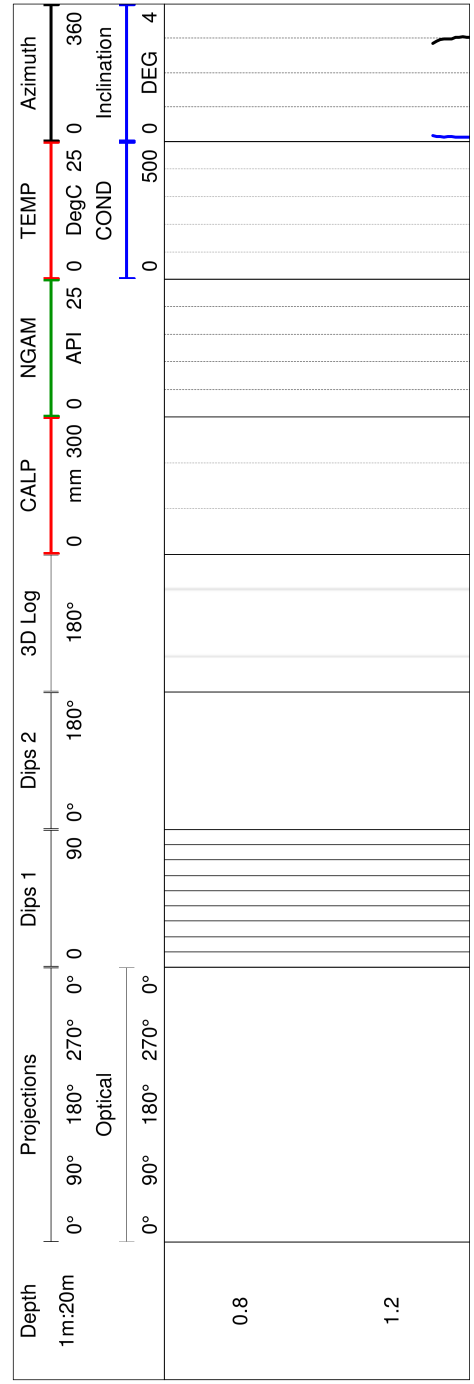
CO
WELL
FLD
CTY
STE
FILING No

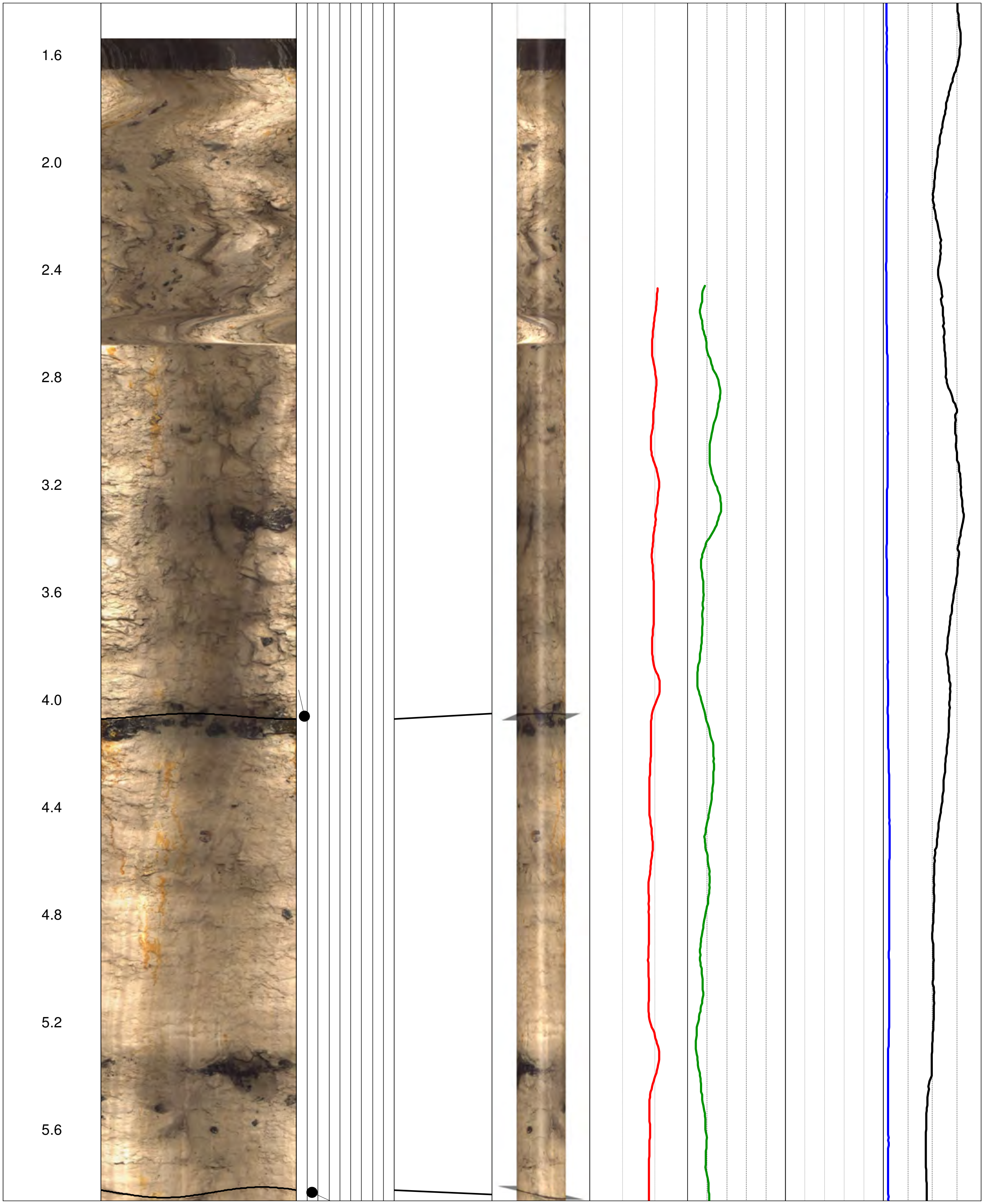
COMPANY	Structural Soils		
WELL ID	R71817		
FIELD	A303 Stonehenge		
COUNTRY	England	STATE	
LOCATION			OTHER SERVICES
SEC	TWP	RGE	

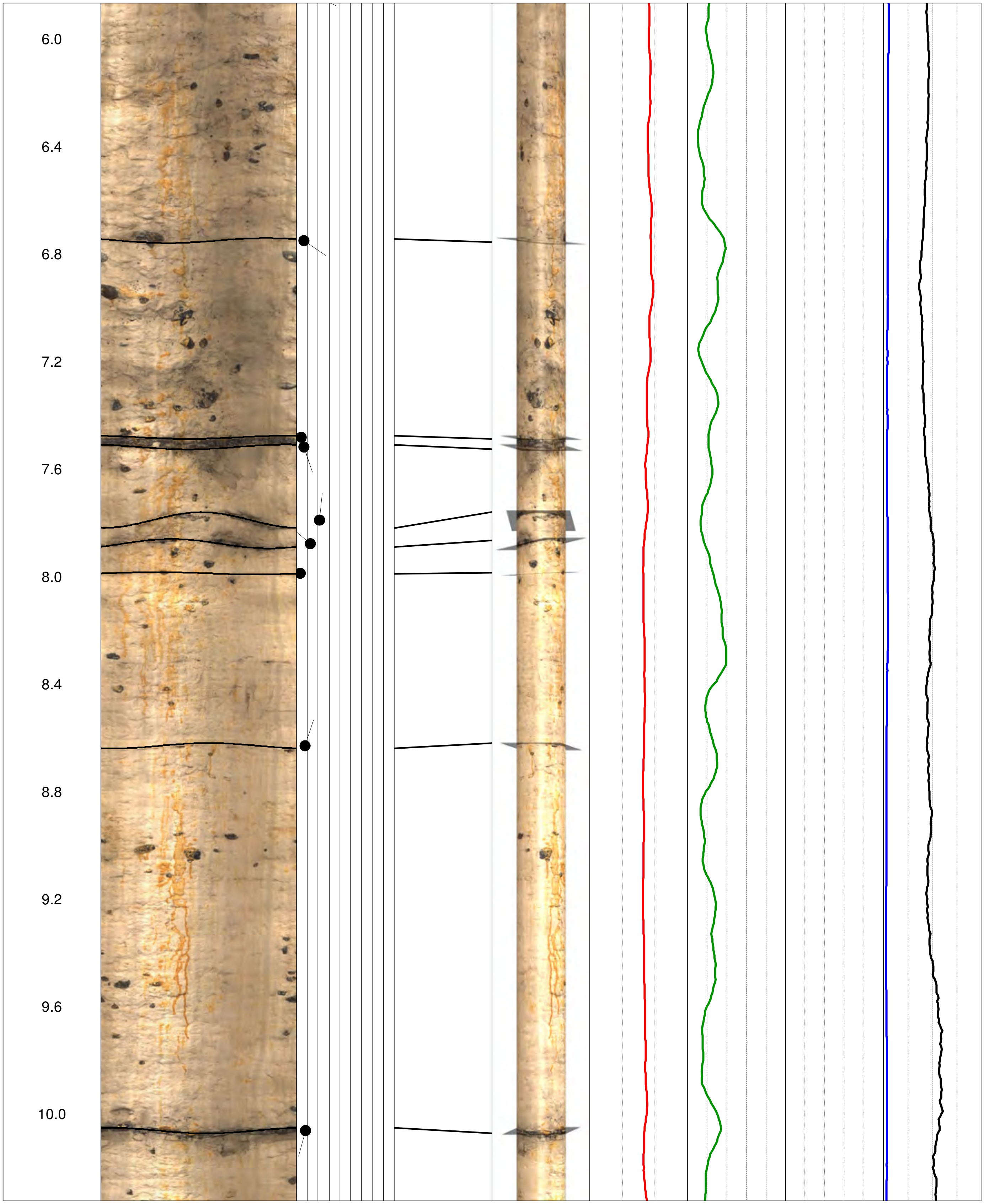
PERMANENT DATUM	GL	ELEVATION	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.

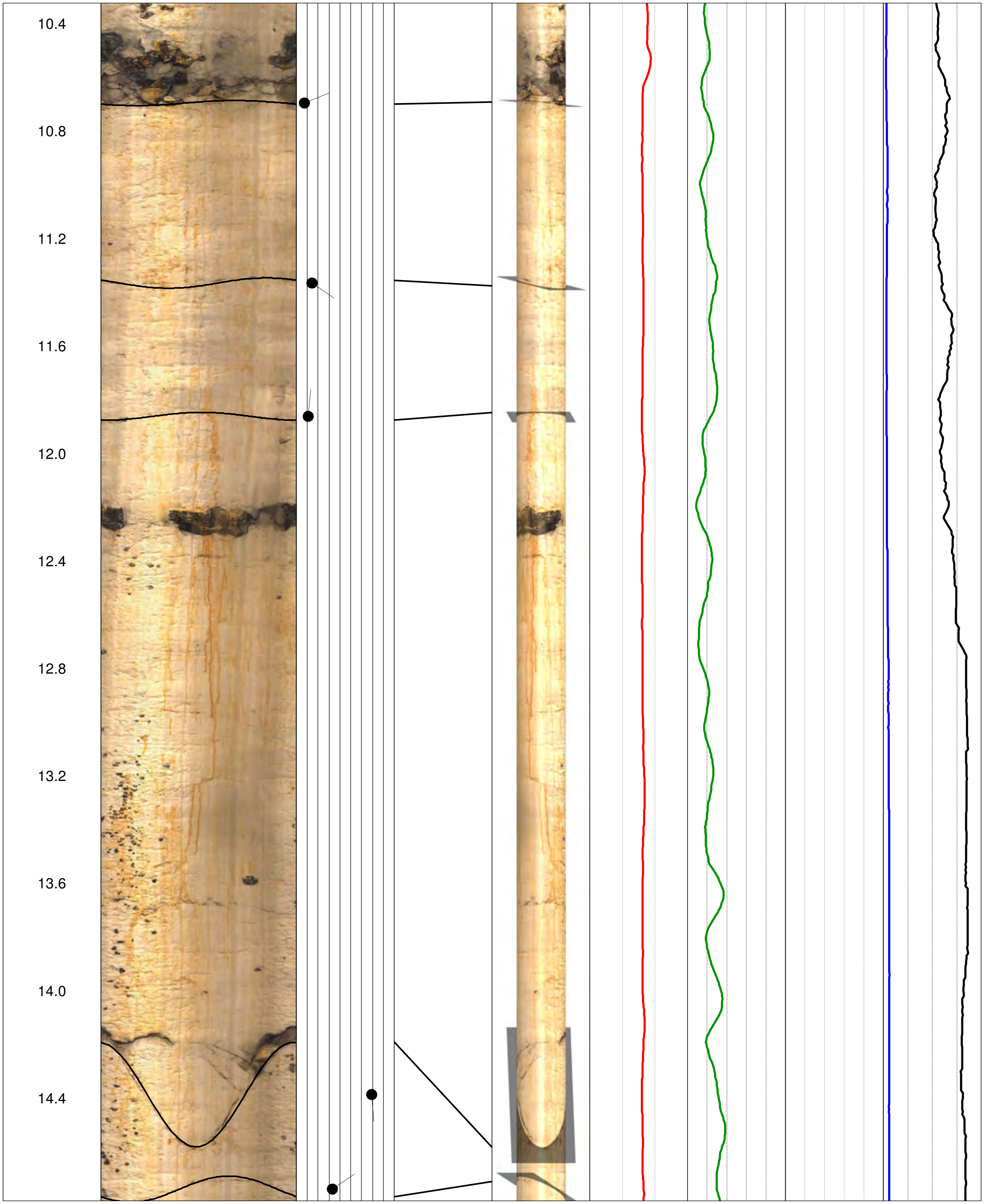
DATE	12/10/18	TYPE FLUID IN HOLE	Water
RUN No		SALINITY	
TYPE LOG	Composite	DENSITY	
DEPTH-DRILLER	45 m	LEVEL	26.25 m
DEPTH-LOGGER	45.5 m	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	45.5 m		
TOP LOGGED INTERVAL	1.62 m	CASING SHOE	
OPERATING RIG TIME			
RECORDED BY	KO		
WITNESSED BY	JB		

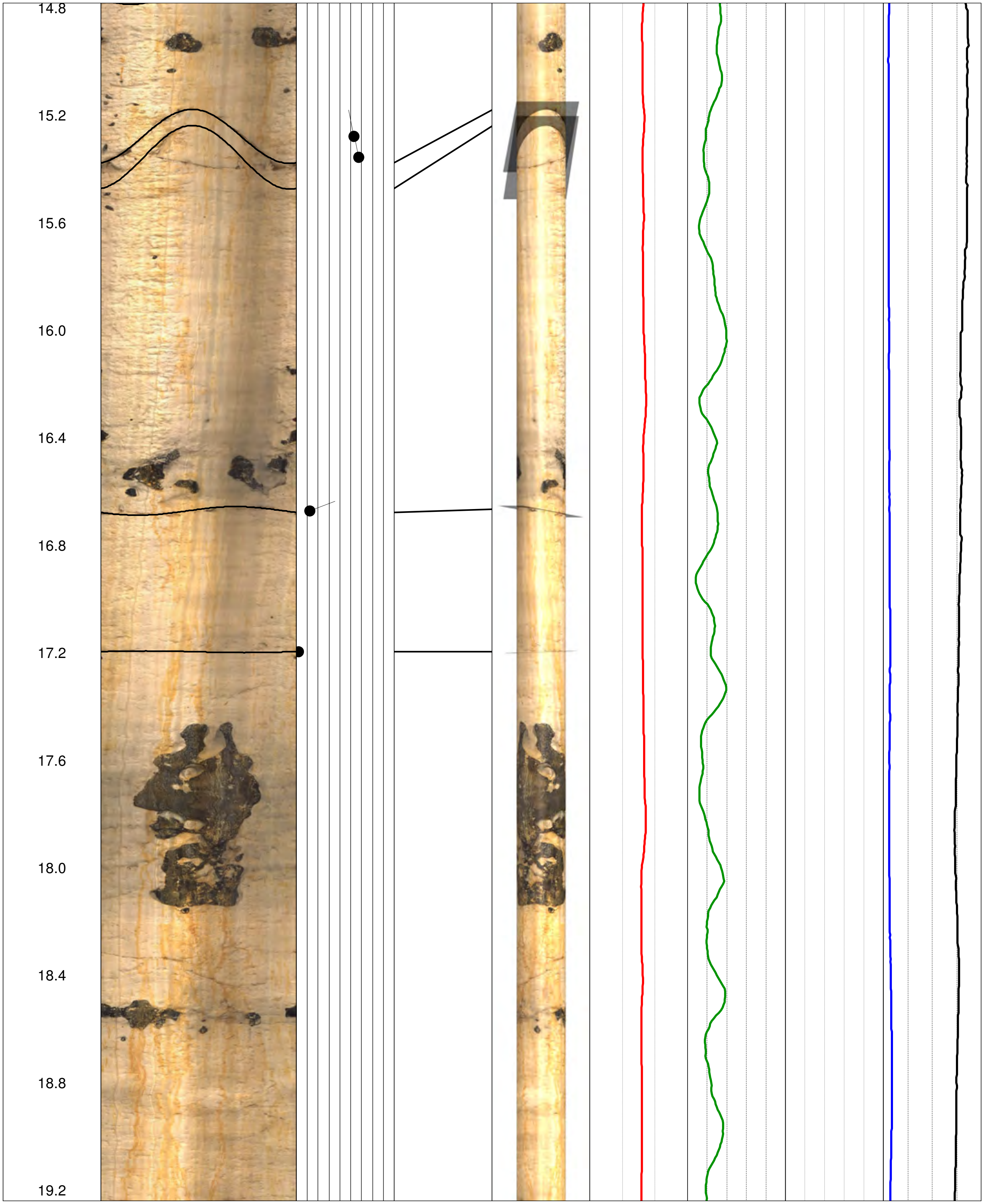
RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

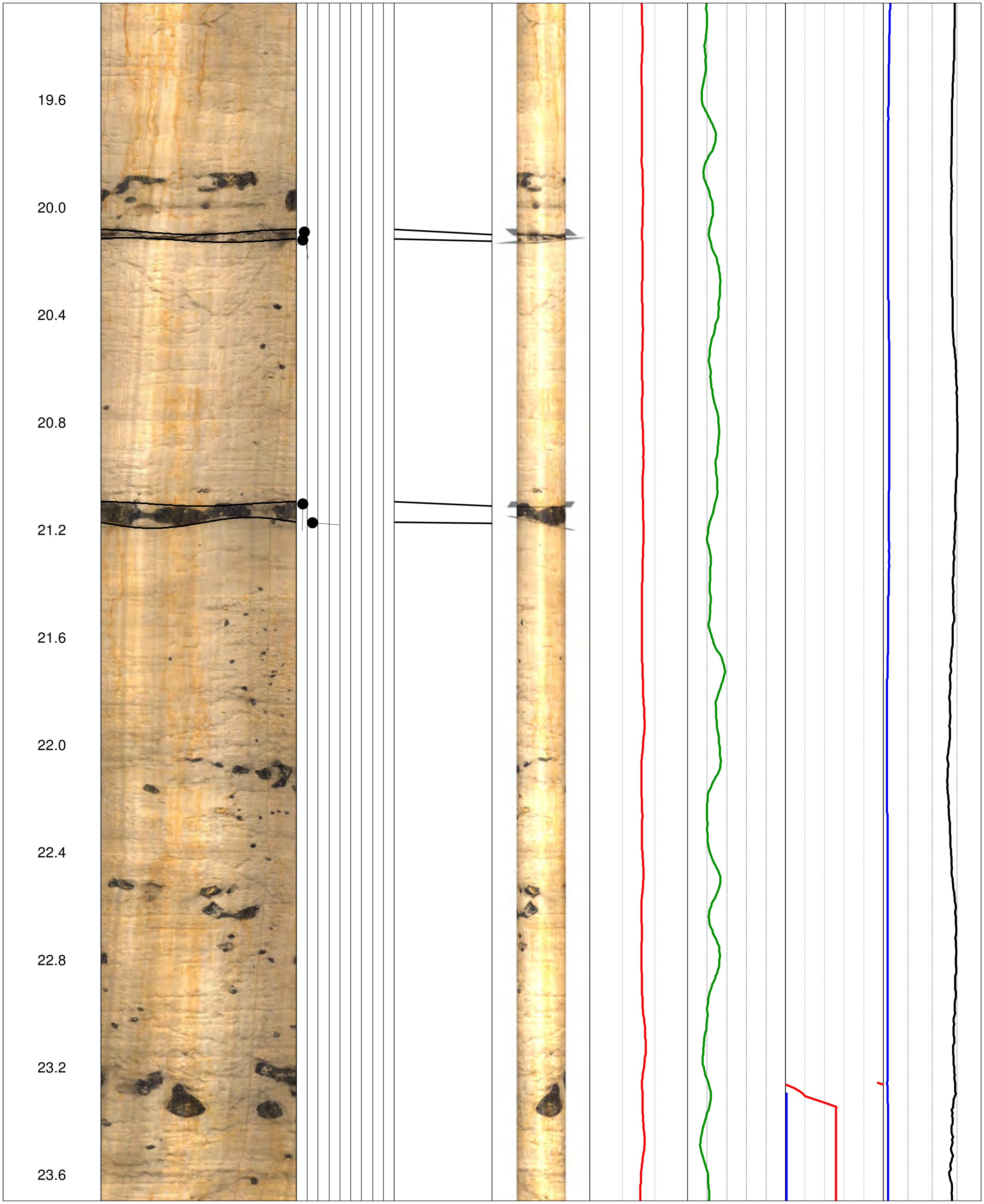


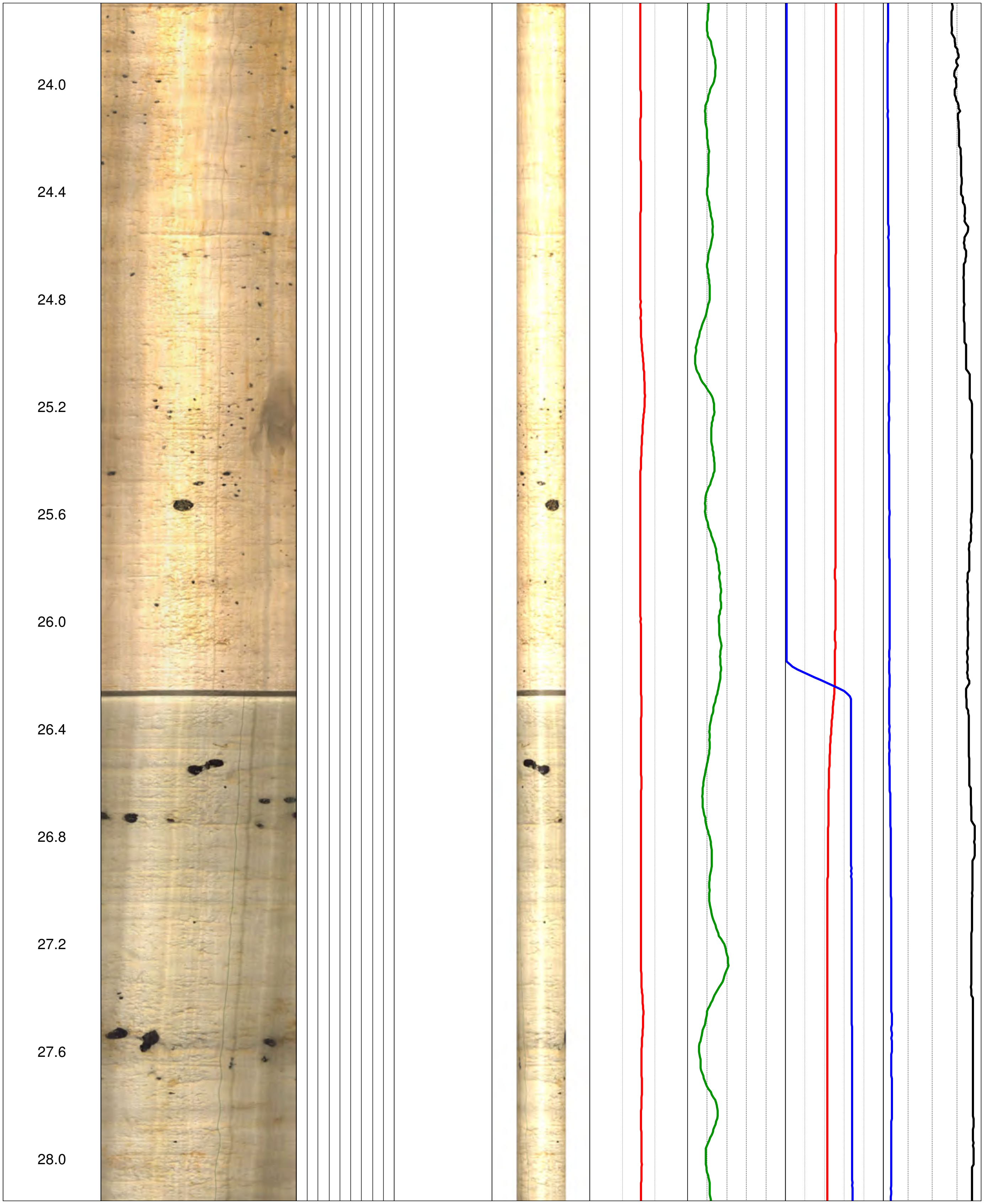

1.6
2.0
2.4
2.8
3.2
3.6
4.0
4.4
4.8
5.2
5.6

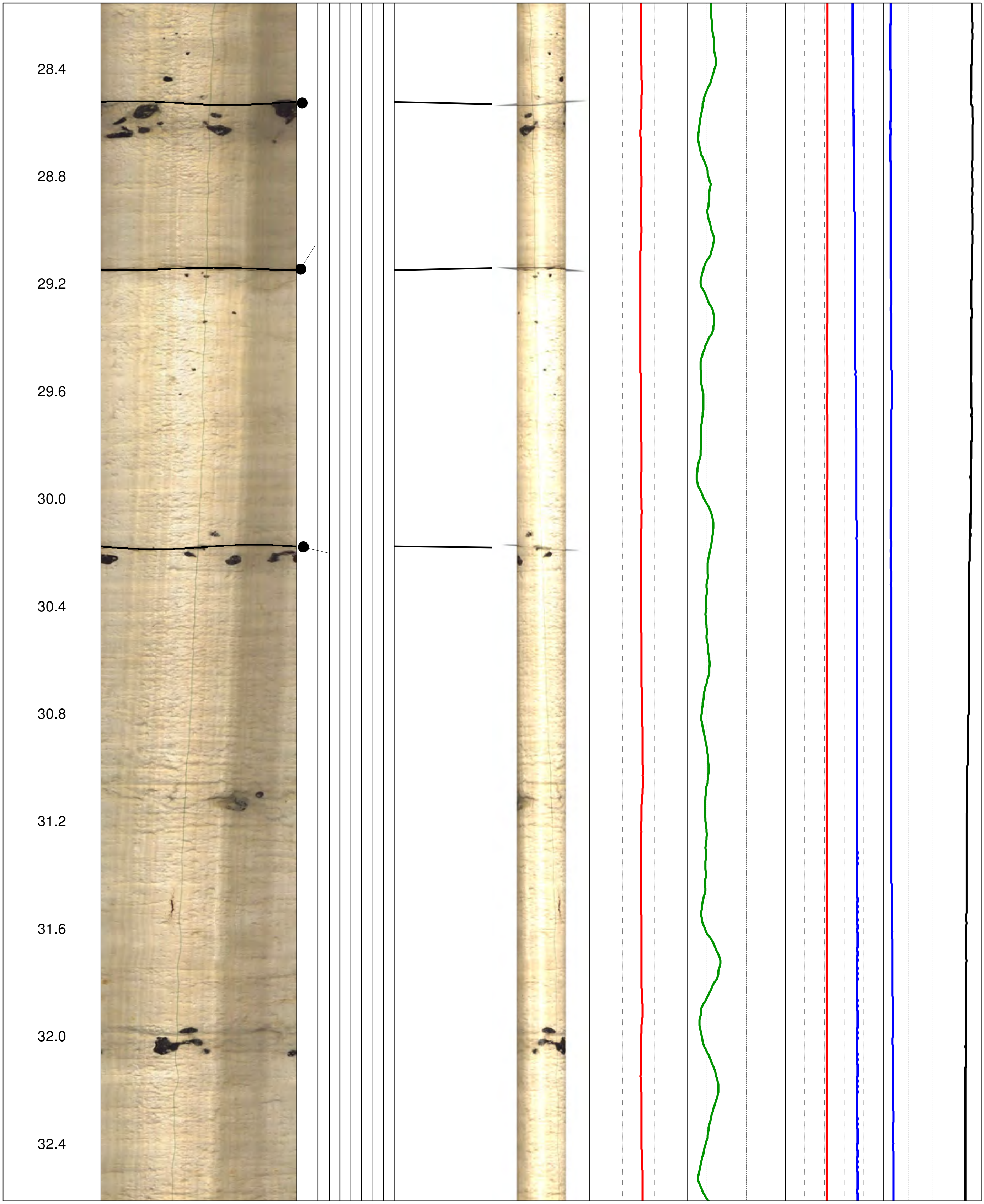

6.0
6.4
6.8
7.2
7.6
8.0
8.4
8.8
9.2
9.6
10.0

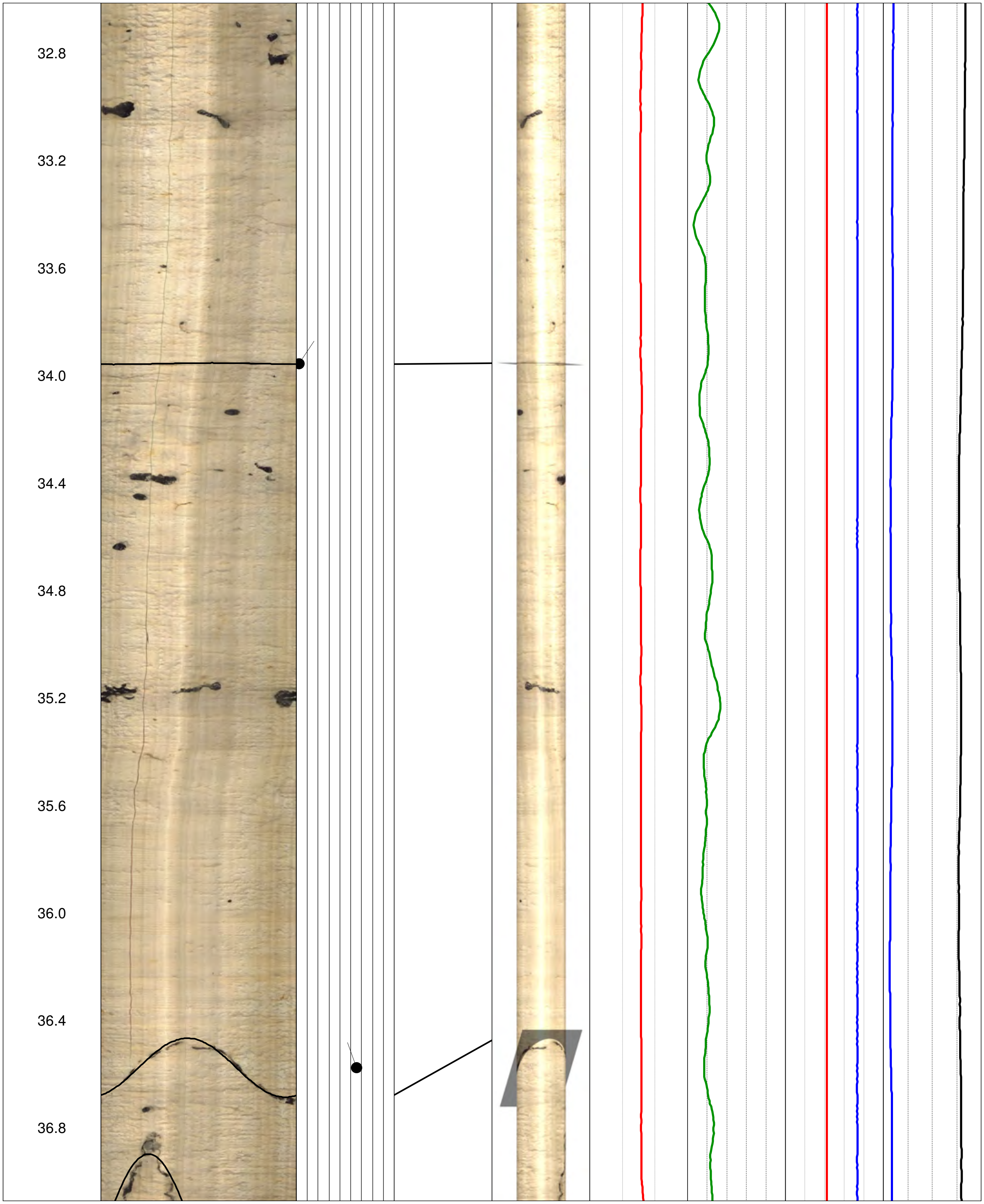

10.4
10.8
11.2
11.6
12.0
12.4
12.8
13.2
13.6
14.0
14.4

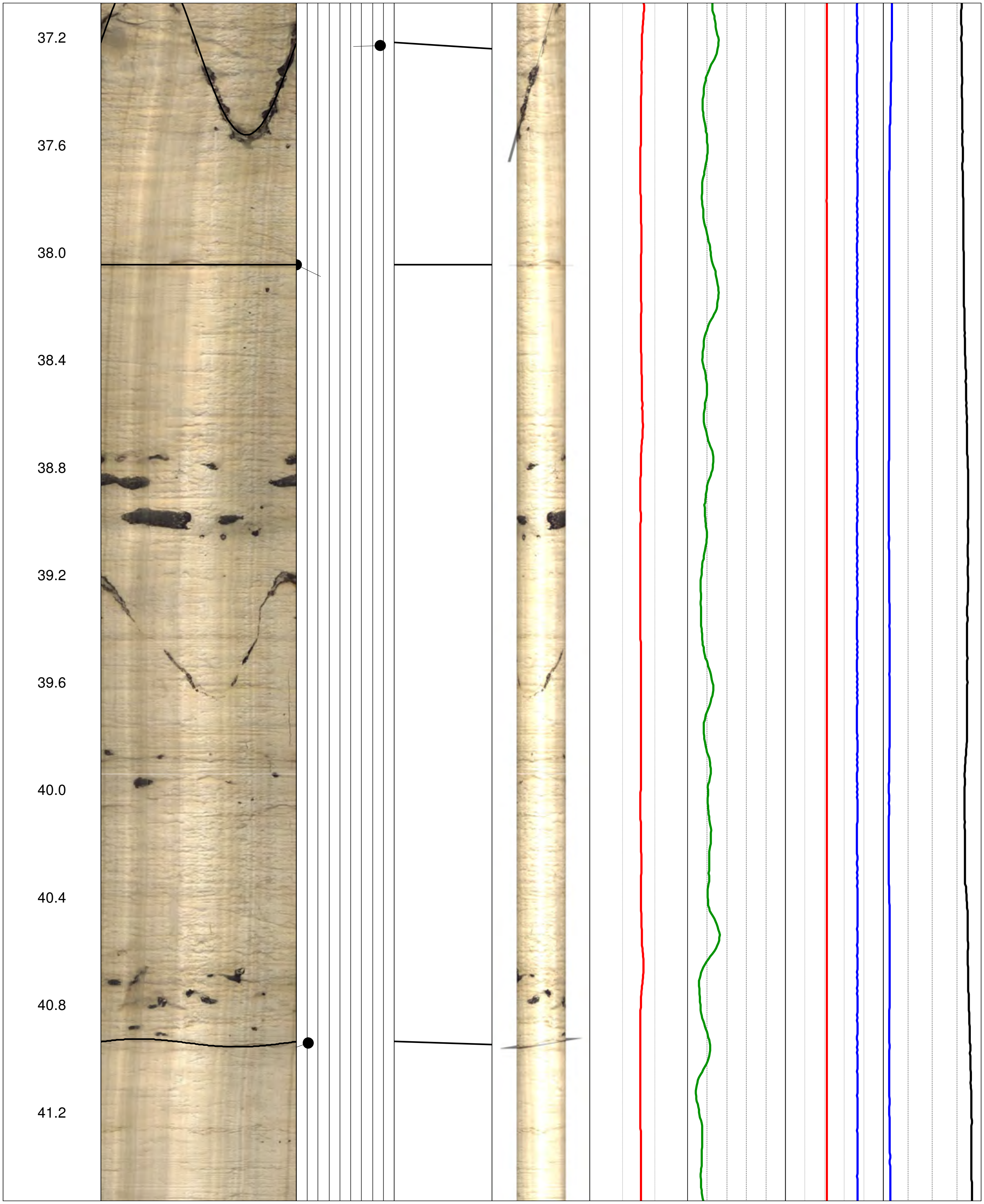

14.8
15.2
15.6
16.0
16.4
16.8
17.2
17.6
18.0
18.4
18.8
19.2

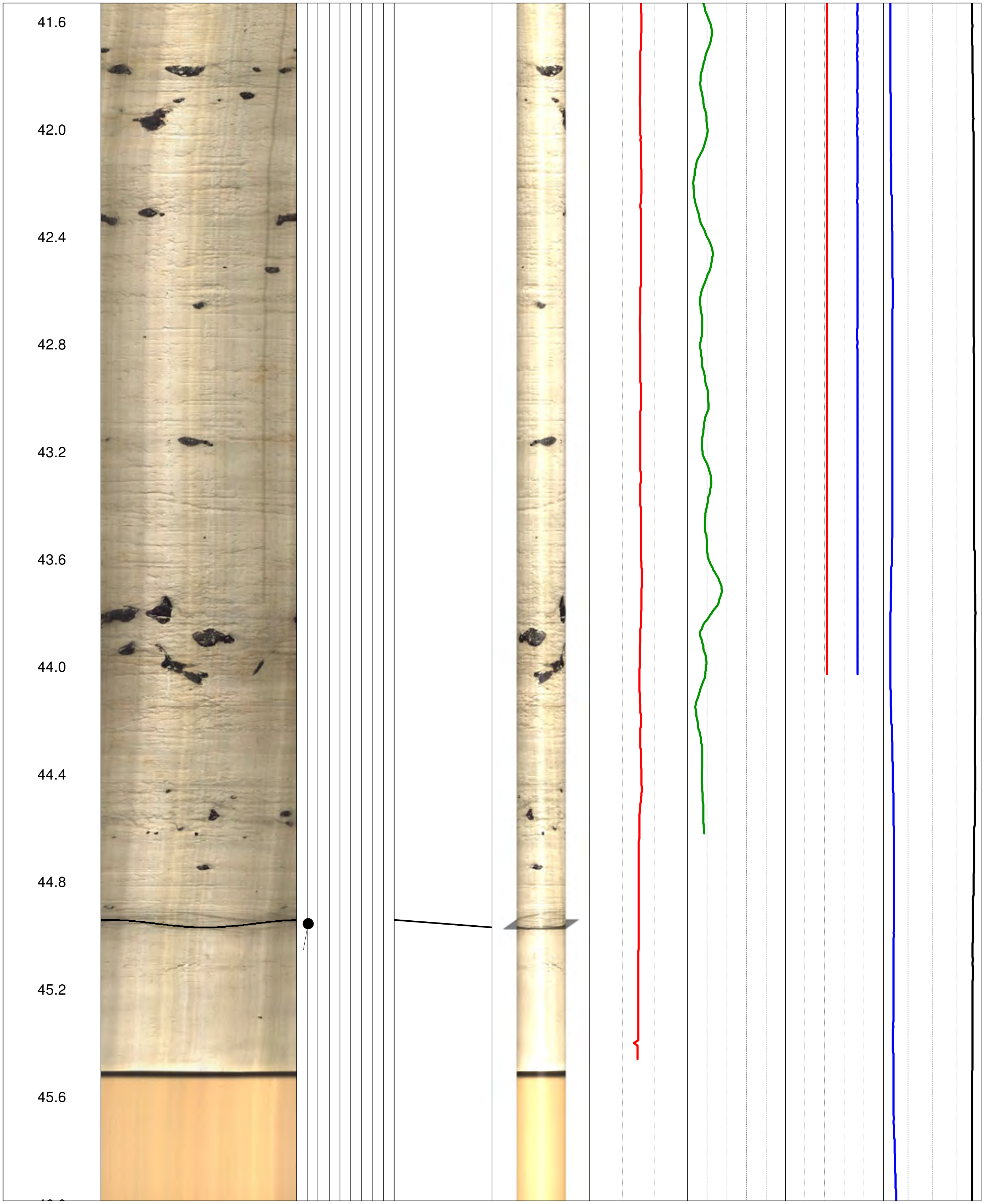

19.6
20.0
20.4
20.8
21.2
21.6
22.0
22.4
22.8
23.2
23.6


24.0
24.4
24.8
25.2
25.6
26.0
26.4
26.8
27.2
27.6
28.0


28.4
28.8
29.2
29.6
30.0
30.4
30.8
31.2
31.6
32.0
32.4


32.8
33.2
33.6
34.0
34.4
34.8
35.2
35.6
36.0
36.4
36.8


37.2
37.6
38.0
38.4
38.8
39.2
39.6
40.0
40.4
40.8
41.2

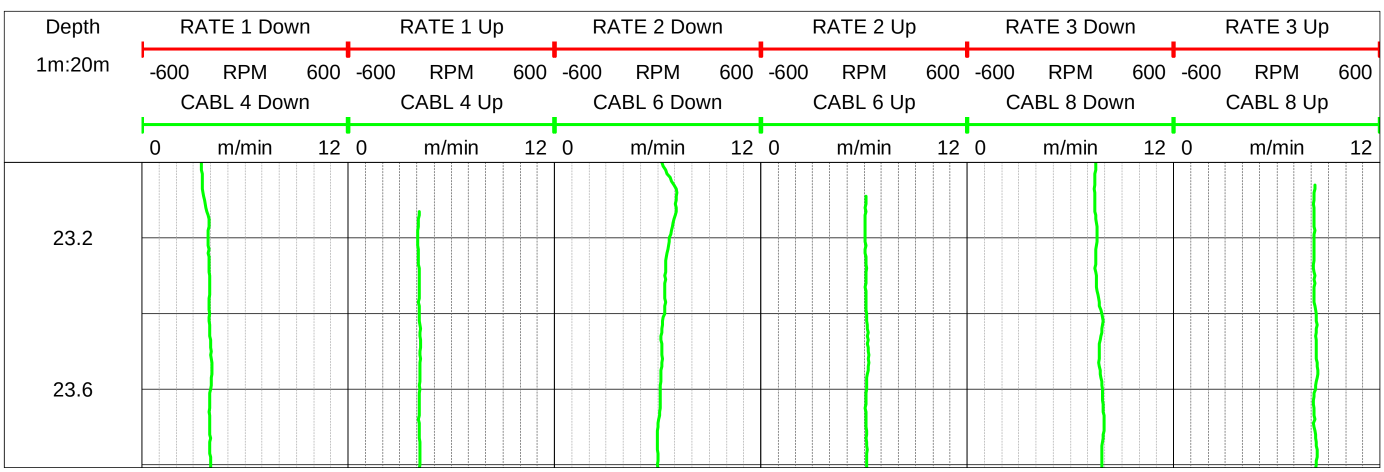

41.6
42.0
42.4
42.8
43.2
43.6
44.0
44.4
44.8
45.2
45.6

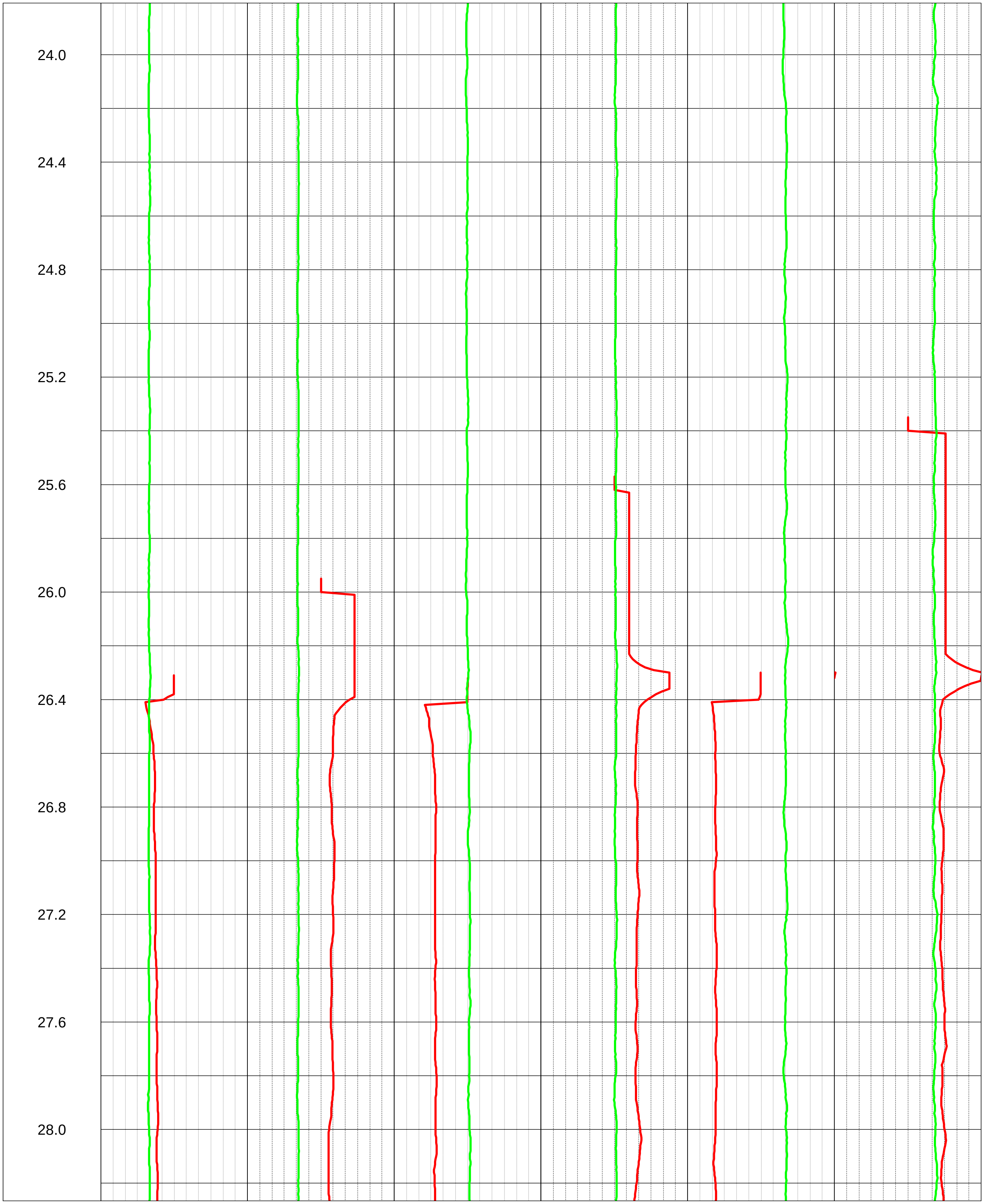
46.0									

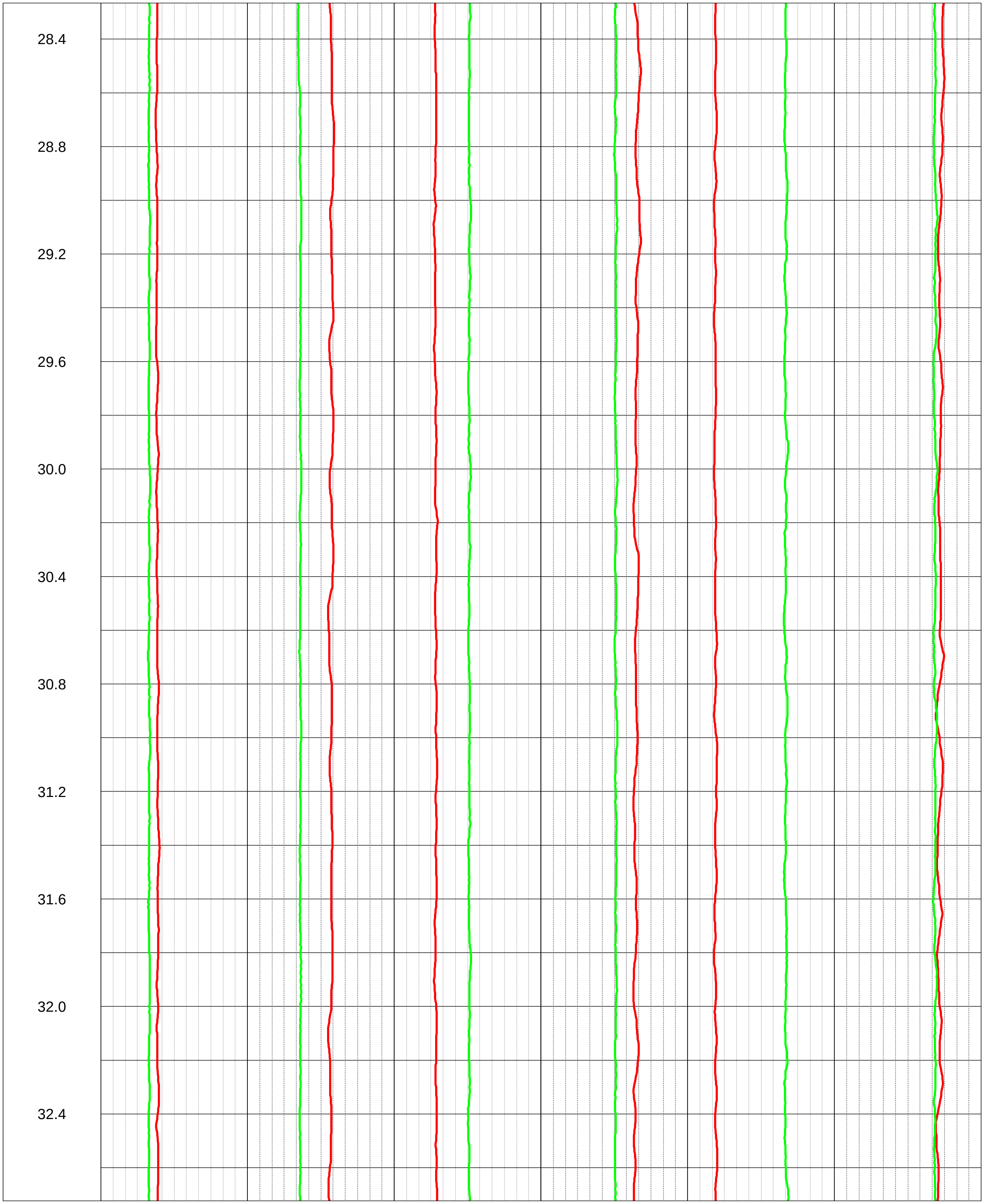
ROBERTSON GEO SERVICES
Unlocking Your GeoData

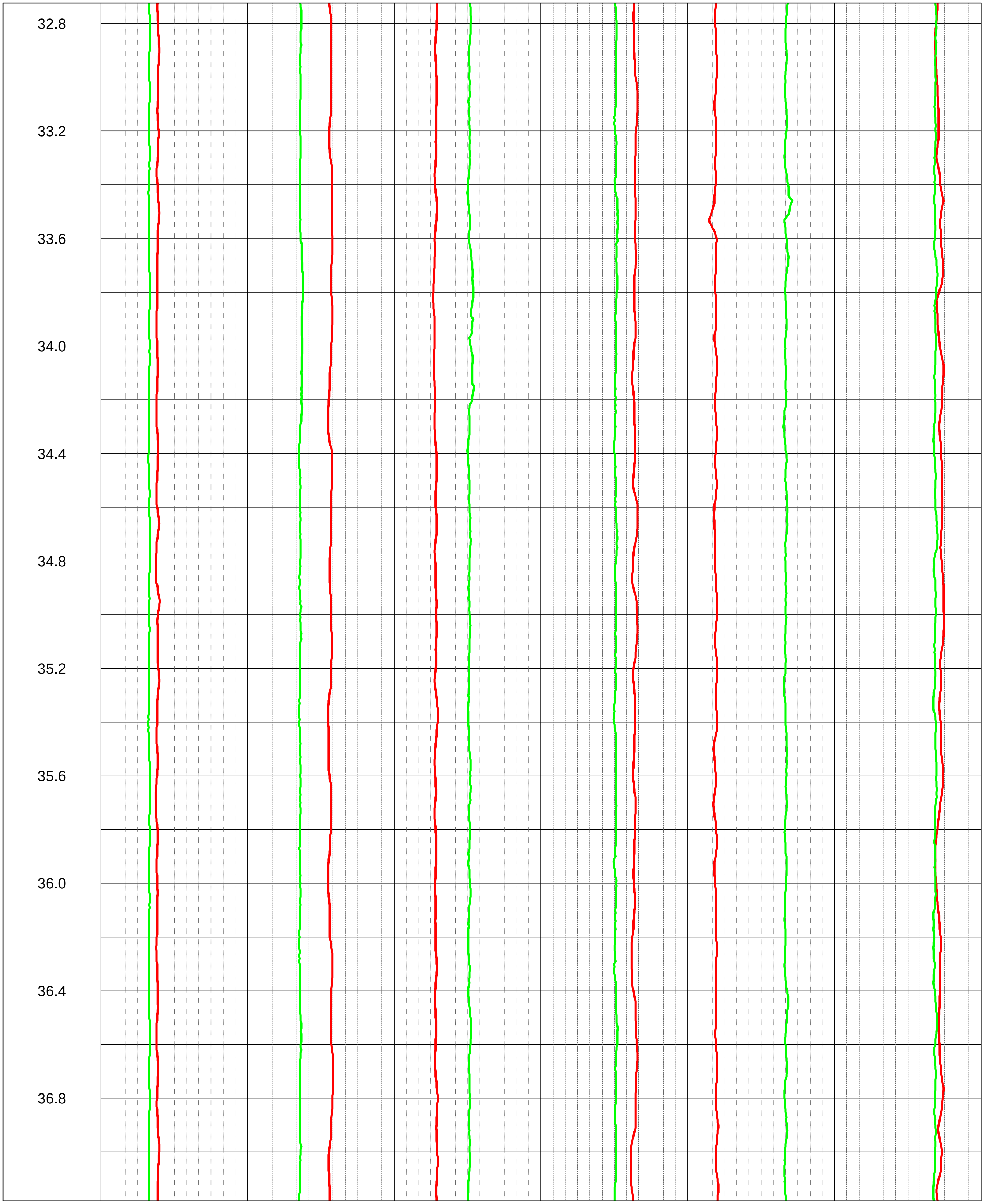
COMPANY	Structural Soils		
WELL ID	R71817		
FIELD	A303 Stonehenge		
COUNTRY	England	STATE	
LOCATION			OTHER SERVICES
CO			
WELL			
FLD			
CTY			
STE			
FILING No			
SEC	TWP	RGE	
PERMANENT DATUM	GL	ELEVATION	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.
DATE	12/10/18	TYPE FLUID IN HOLE	Water
RUN No		SALINITY	
TYPE LOG	Flowmeter	DENSITY	
DEPTH-DRILLER	45 m	LEVEL	26.25 m
DEPTH-LOGGER	44.46 m	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	44.46 m		
TOP LOGGED INTERVAL	23 m	CASING SHOE	
OPERATING RIG TIME			
RECORDED BY	KO		
WITNESSED BY	JB		

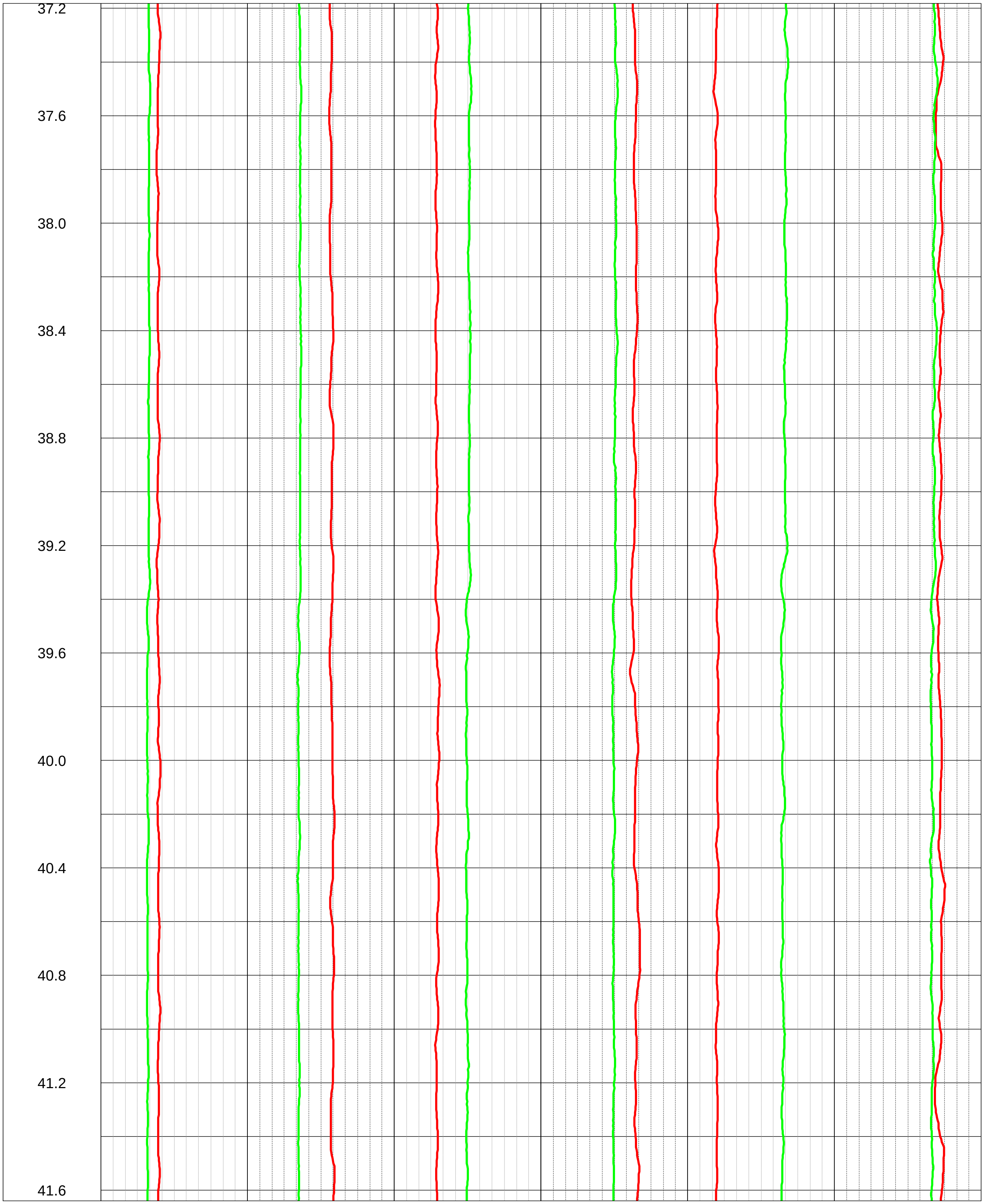
BOREHOLE RECORD				CASING RECORD			
RUN NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

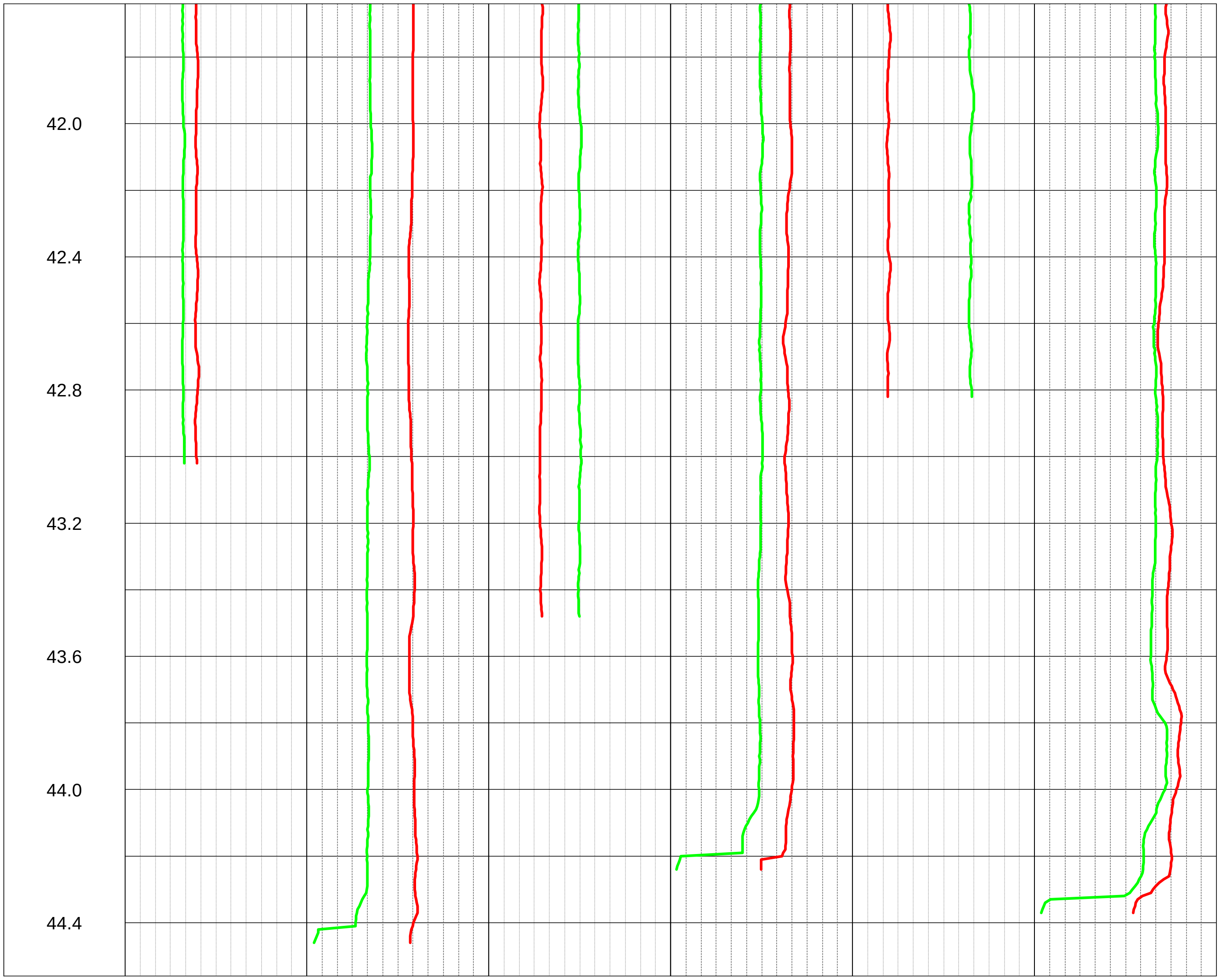



24.0
24.4
24.8
25.2
25.6
26.0
26.4
26.8
27.2
27.6
28.0

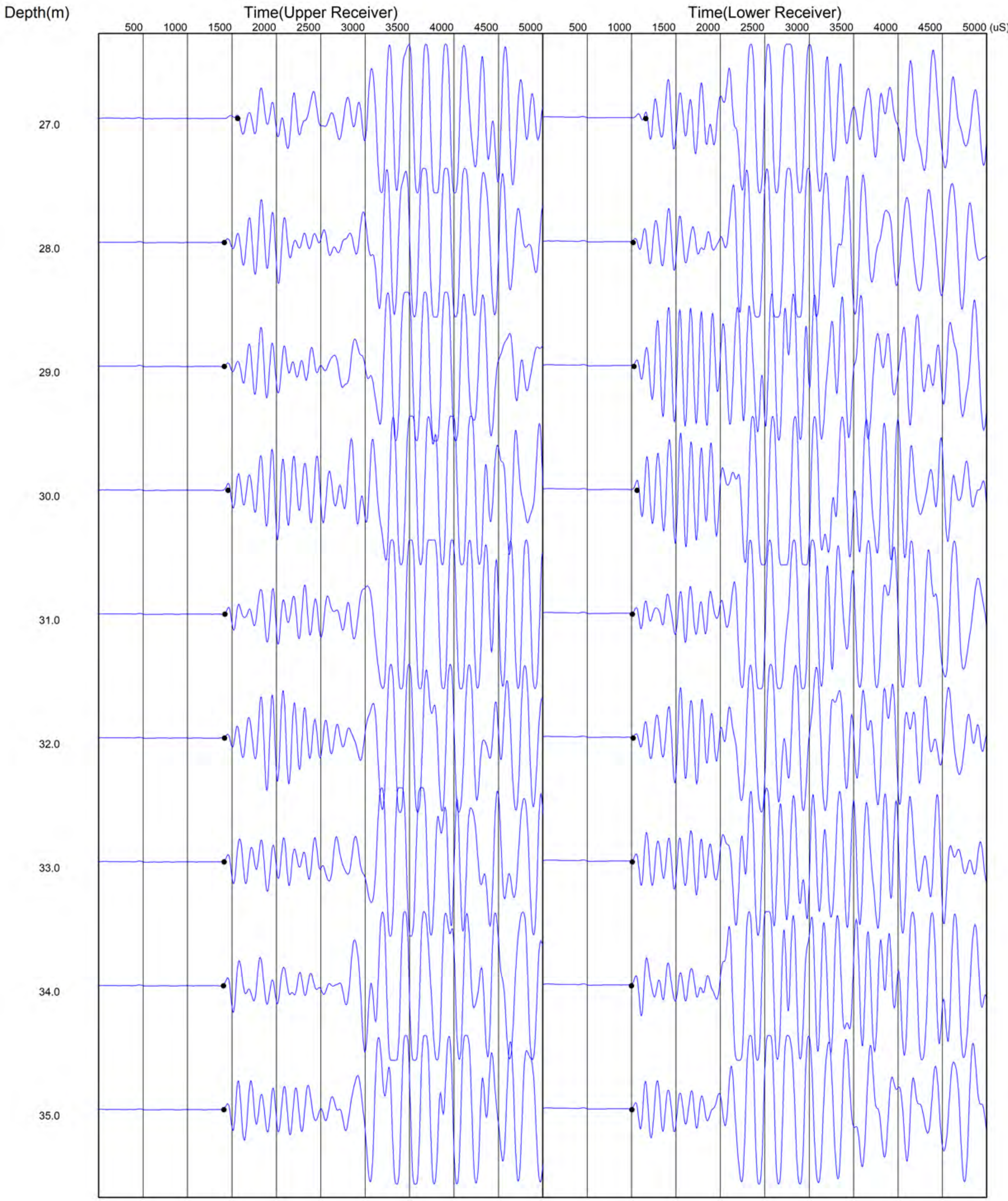

28.4
28.8
29.2
29.6
30.0
30.4
30.8
31.2
31.6
32.0
32.4


32.8
33.2
33.6
34.0
34.4
34.8
35.2
35.6
36.0
36.4
36.8


37.2
37.6
38.0
38.4
38.8
39.2
39.6
40.0
40.4
40.8
41.2
41.6

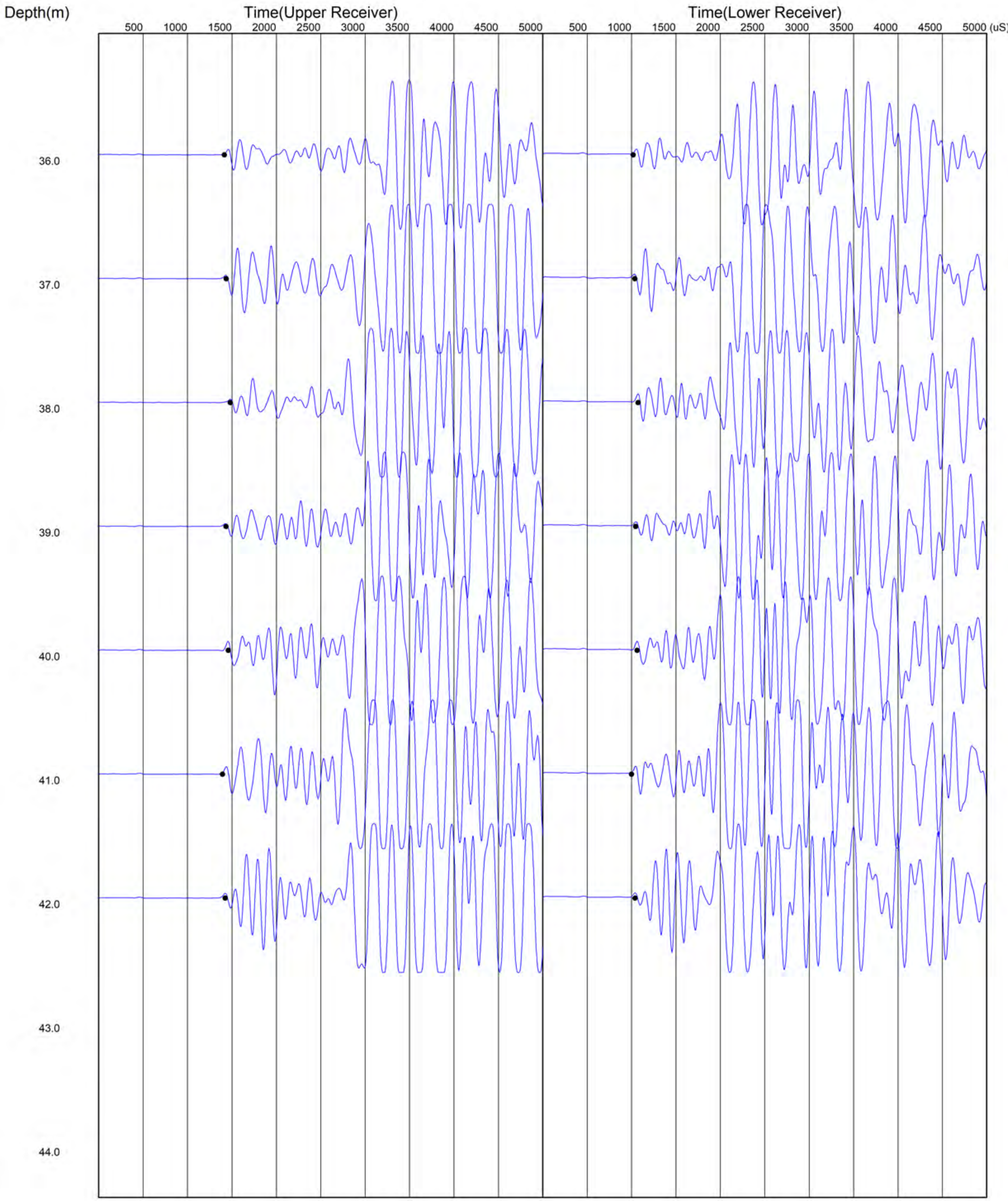

42.0
42.4
42.8
43.2
43.6
44.0
44.4

P Wave

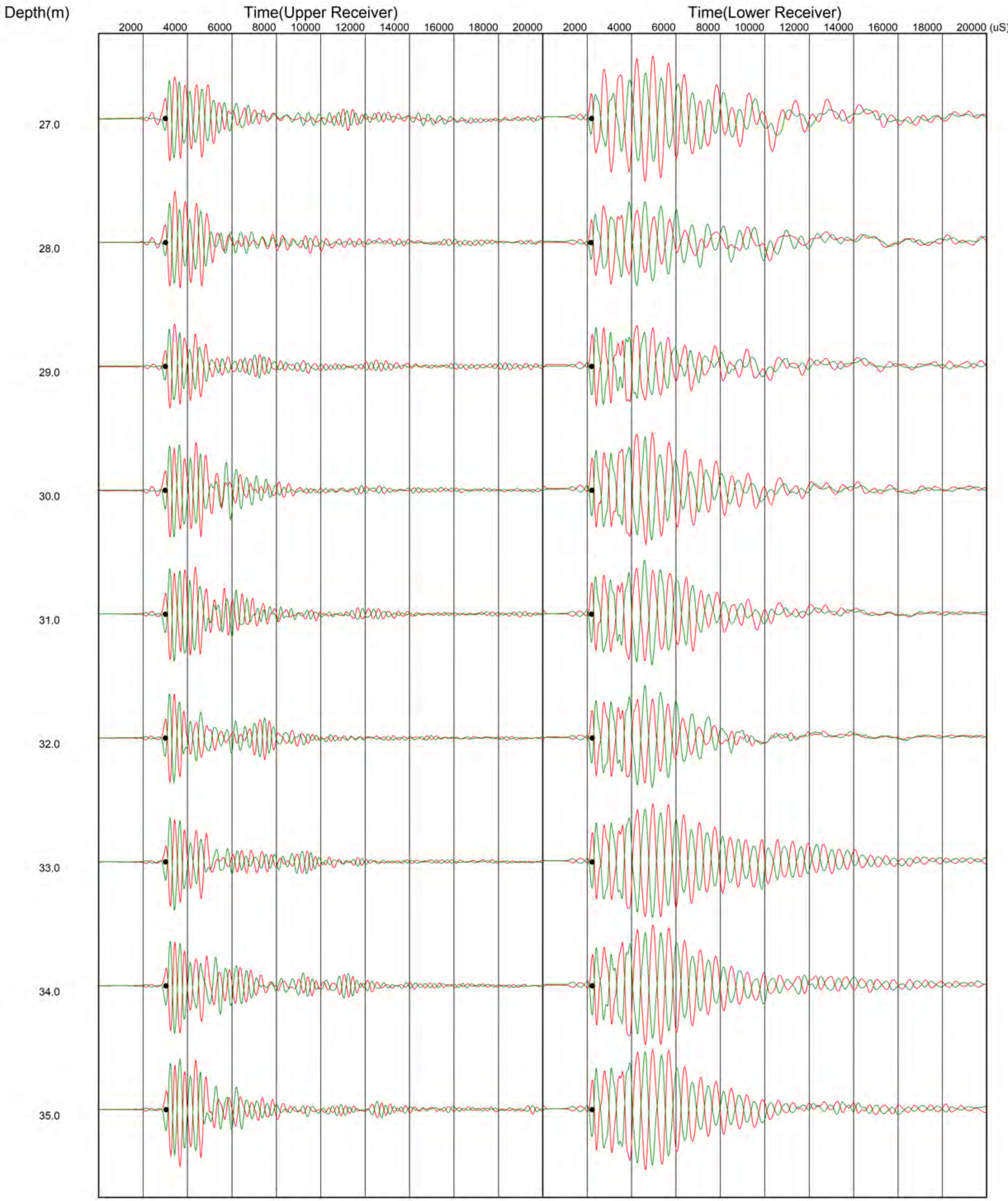


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
500
1000
1500
2000
2500
3000
3500
4000
4500
5000 (uS)
27.0
28.0
29.0
30.0
31.0
32.0
33.0
34.0
35.0

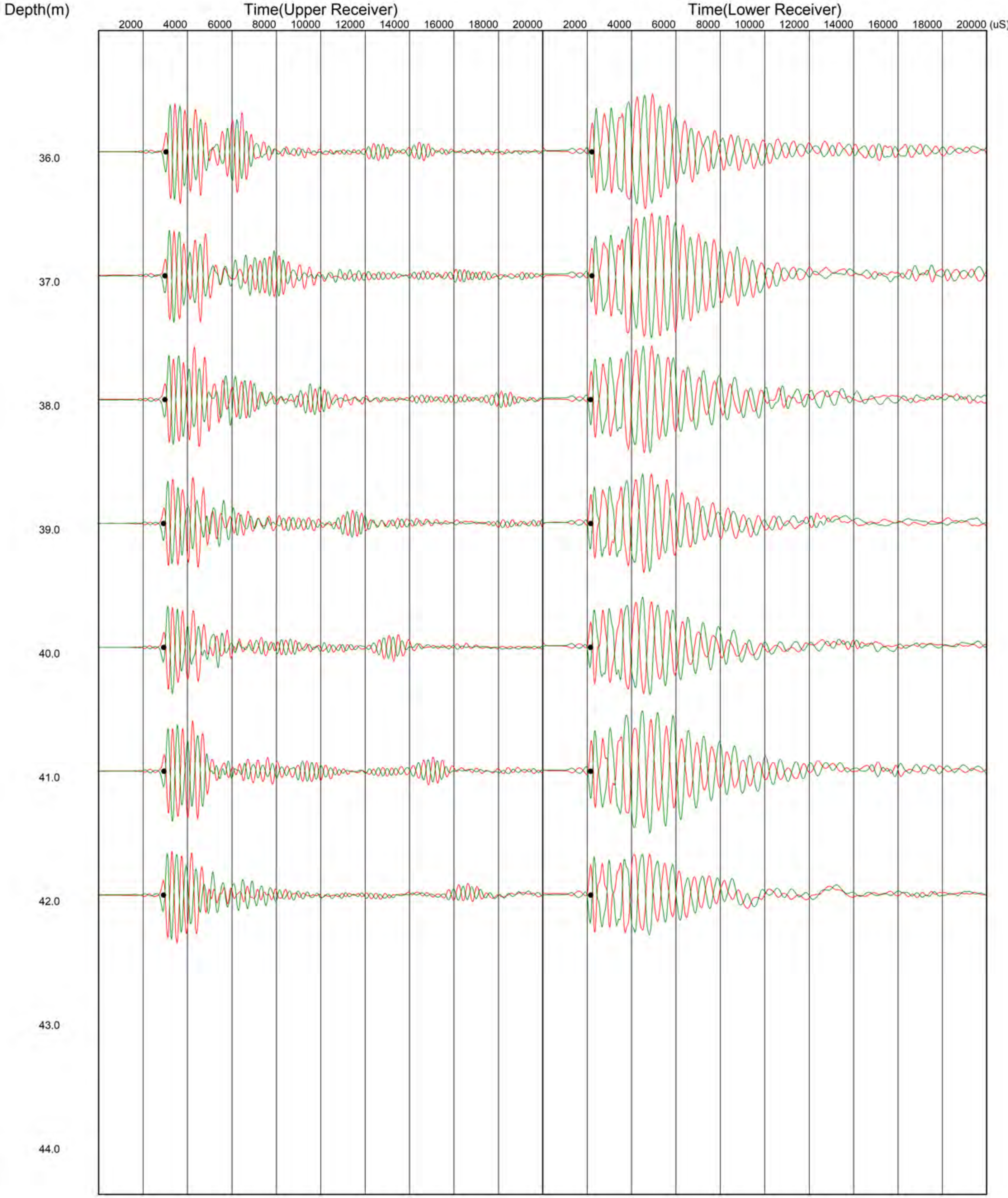
P Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
500
1000
1500
2000
2500
3000
3500
4000
4500
5000 (uS)
36.0
37.0
38.0
39.0
40.0
41.0
42.0
43.0
44.0

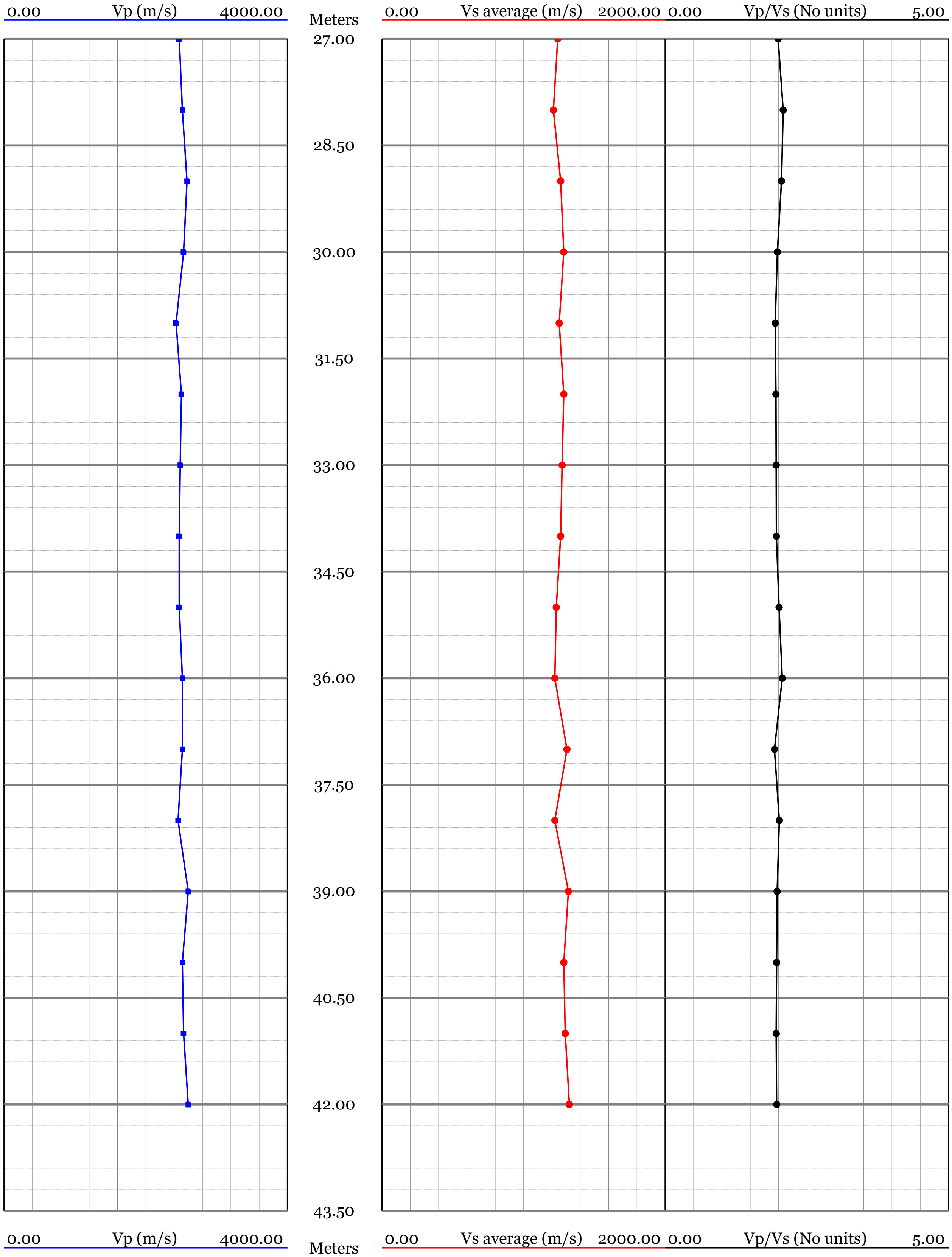
S Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
27.0
28.0
29.0
30.0
31.0
32.0
33.0
34.0
35.0

S Wave



Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
(uS)
36.0
37.0
38.0
39.0
40.0
41.0
42.0
43.0
44.0


0.00
Vp (m/s)
4000.00
Meters
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00
27.00
28.50
30.00
31.50
33.00
34.50
36.00
37.50
39.00
40.50
42.00
43.50
0.00
Vp (m/s)
4000.00
Meters
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00

ROBERTSON GEO SERVICES
Unlocking Your GeoData

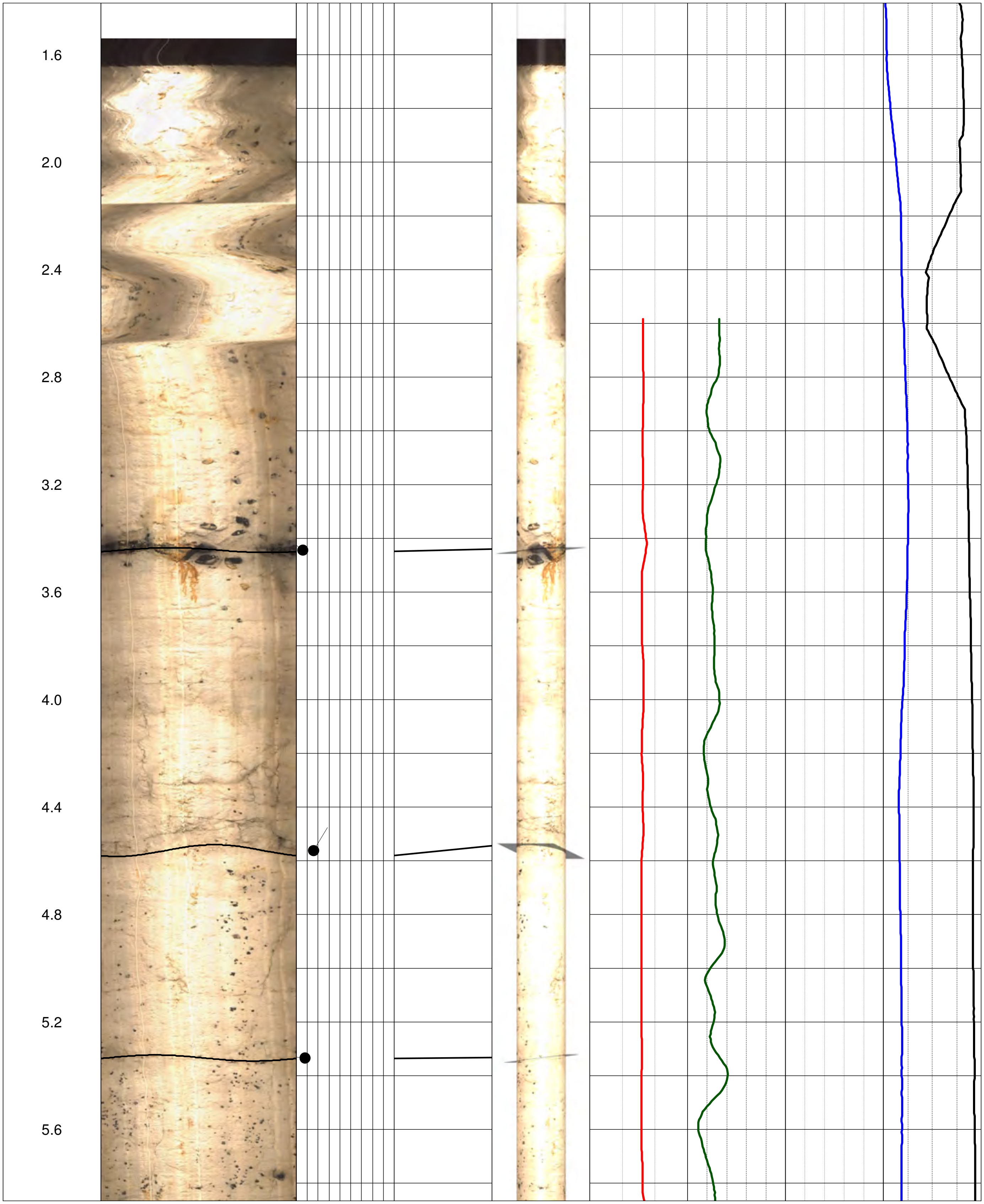
COMPANY	Structural Soils		
WELL ID	R71822		
FIELD	A303 Stonehenge		
COUNTRY	England	STATE	
LOCATION			OTHER SERVICES

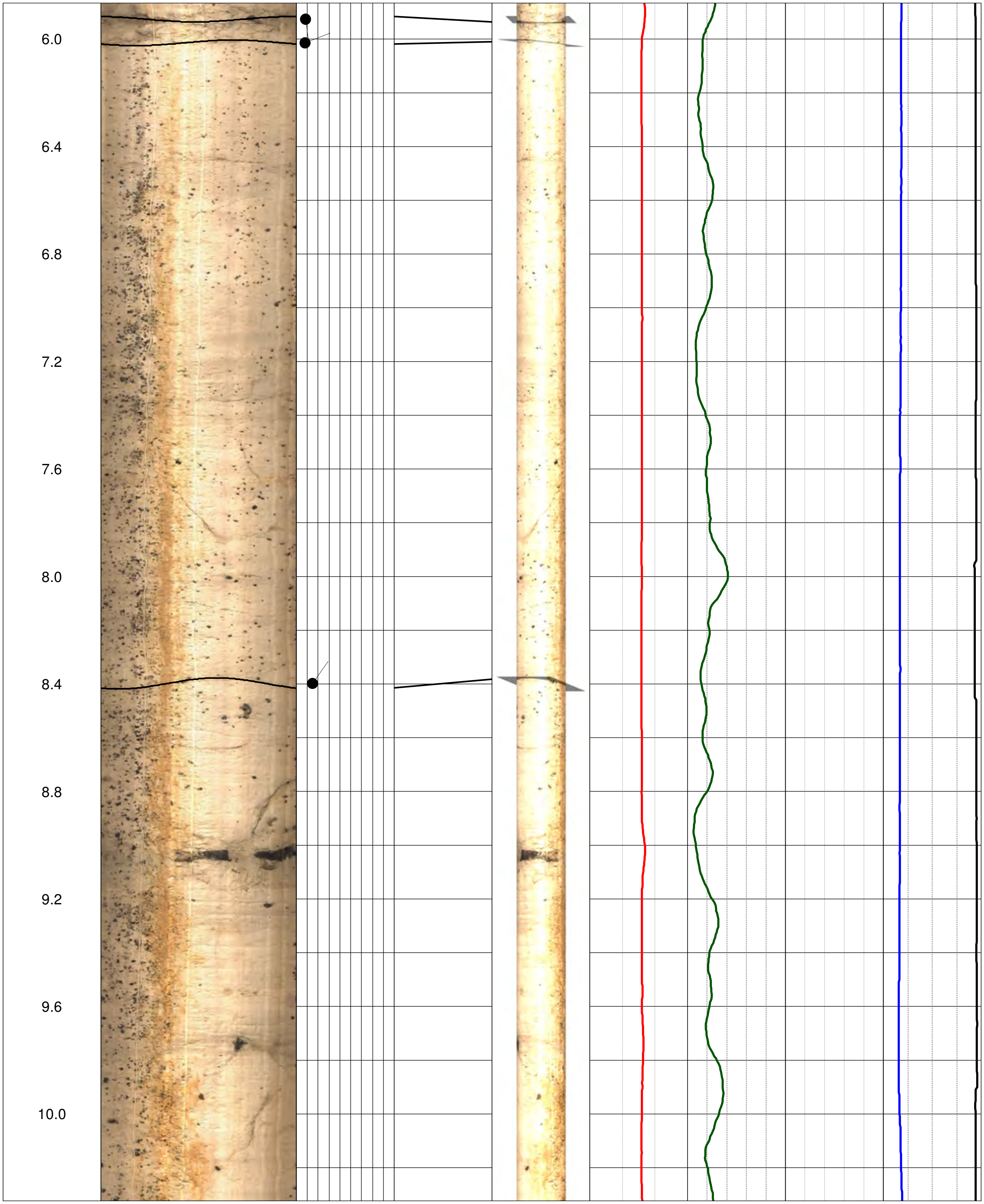
CO					
WELL					
FLD					
CTY					
STE					
FILING No					
SEC		TWP		RGE	
PERMANENT DATUM	GL		ELEVATION		K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM			D.F.
DRILLING MEAS. FROM					G.L.

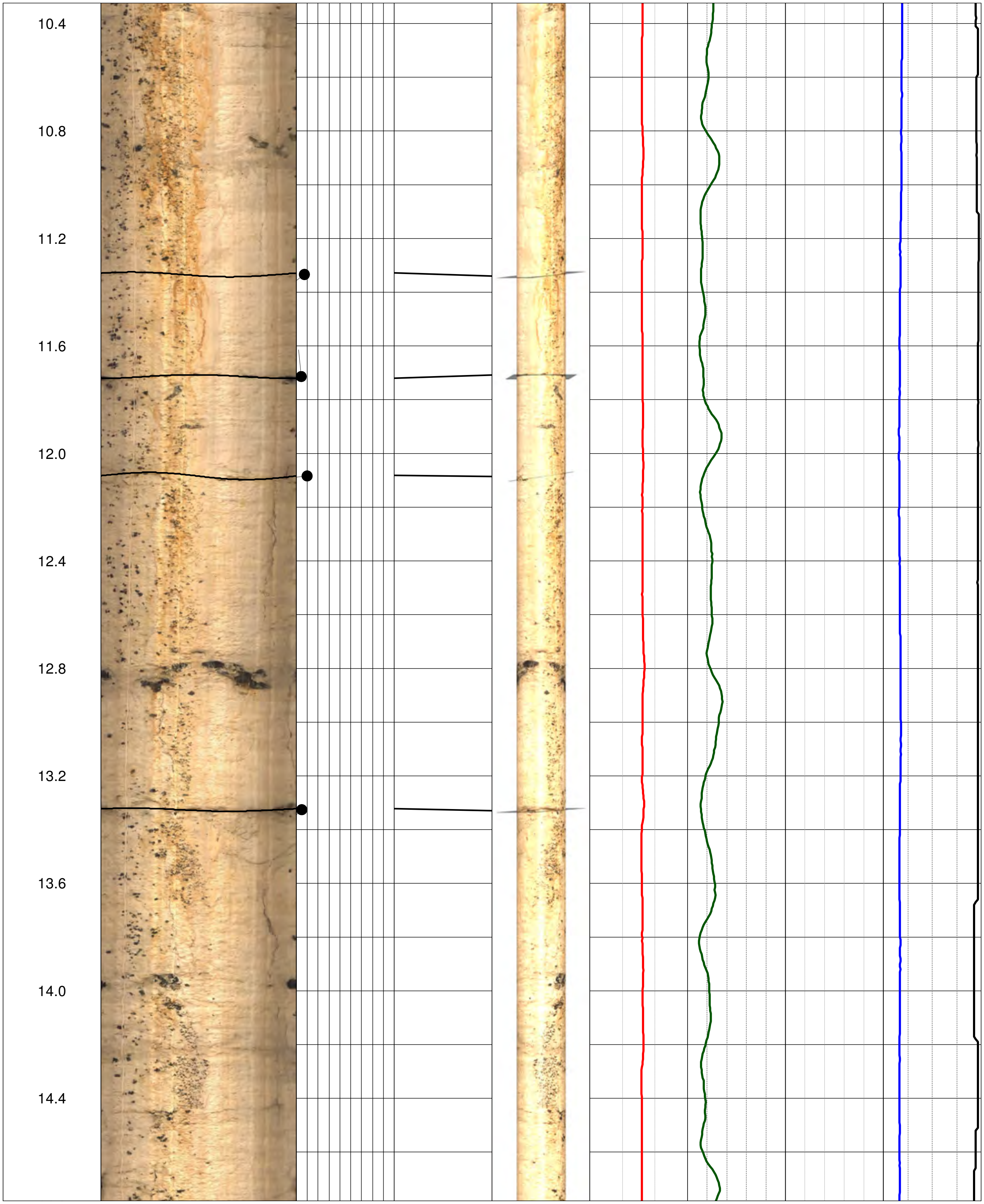
DATE	12/10/18	TYPE FLUID IN HOLE	Water
RUN No		SALINITY	
TYPE LOG	Composite	DENSITY	
DEPTH-DRILLER	50 m	LEVEL	34.65 m
DEPTH-LOGGER	50.47 m	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	50.47 m		
TOP LOGGED INTERVAL	1.62 m	CASING SHOE	
OPERATING RIG TIME			
RECORDED BY	KO		
WITNESSED BY	JB		

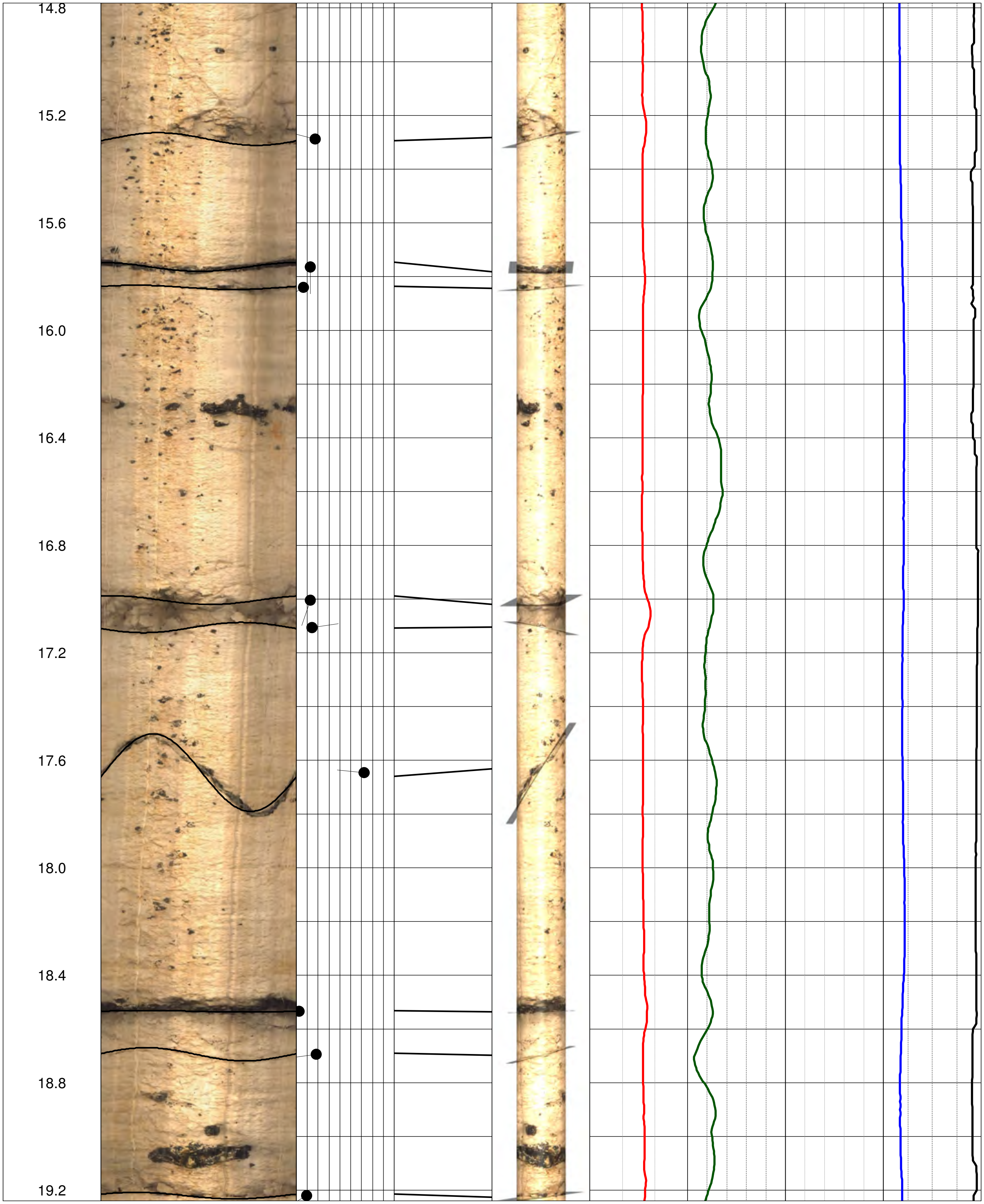
RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

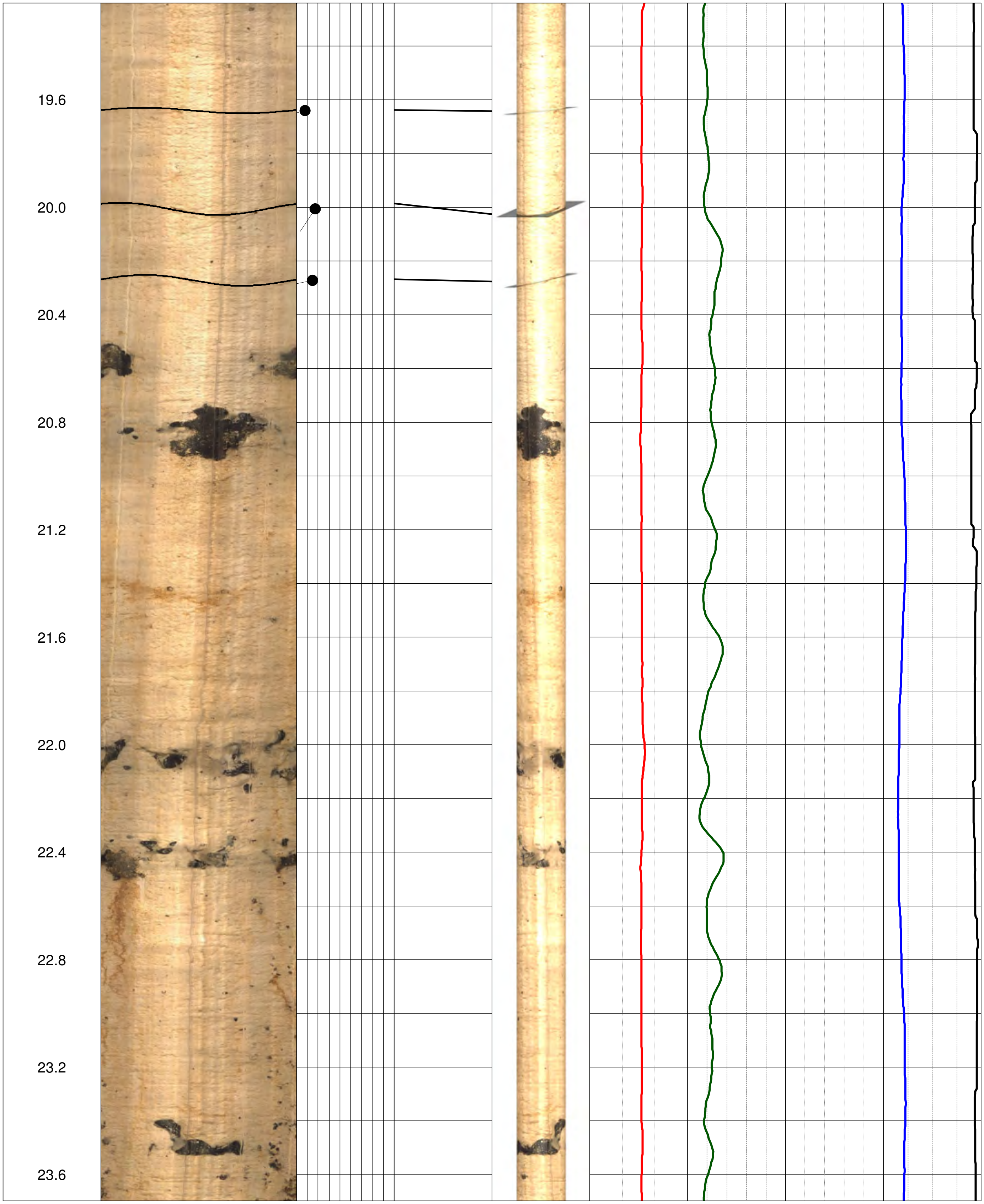
Depth	Projections	Dips 1	Dips 2	3D Log	CALP	NGAM	TEMP	Azimuth
1m:20m	0° 90° 180° 270° 0°	0 90	0° 180°	180°	0 mm 300	0 API 25	0 DegC 25	0 360
	Optical						COND	Inclination
	0° 90° 180° 270° 0°						0 500	0 DEG 4
0.8								
1.2								

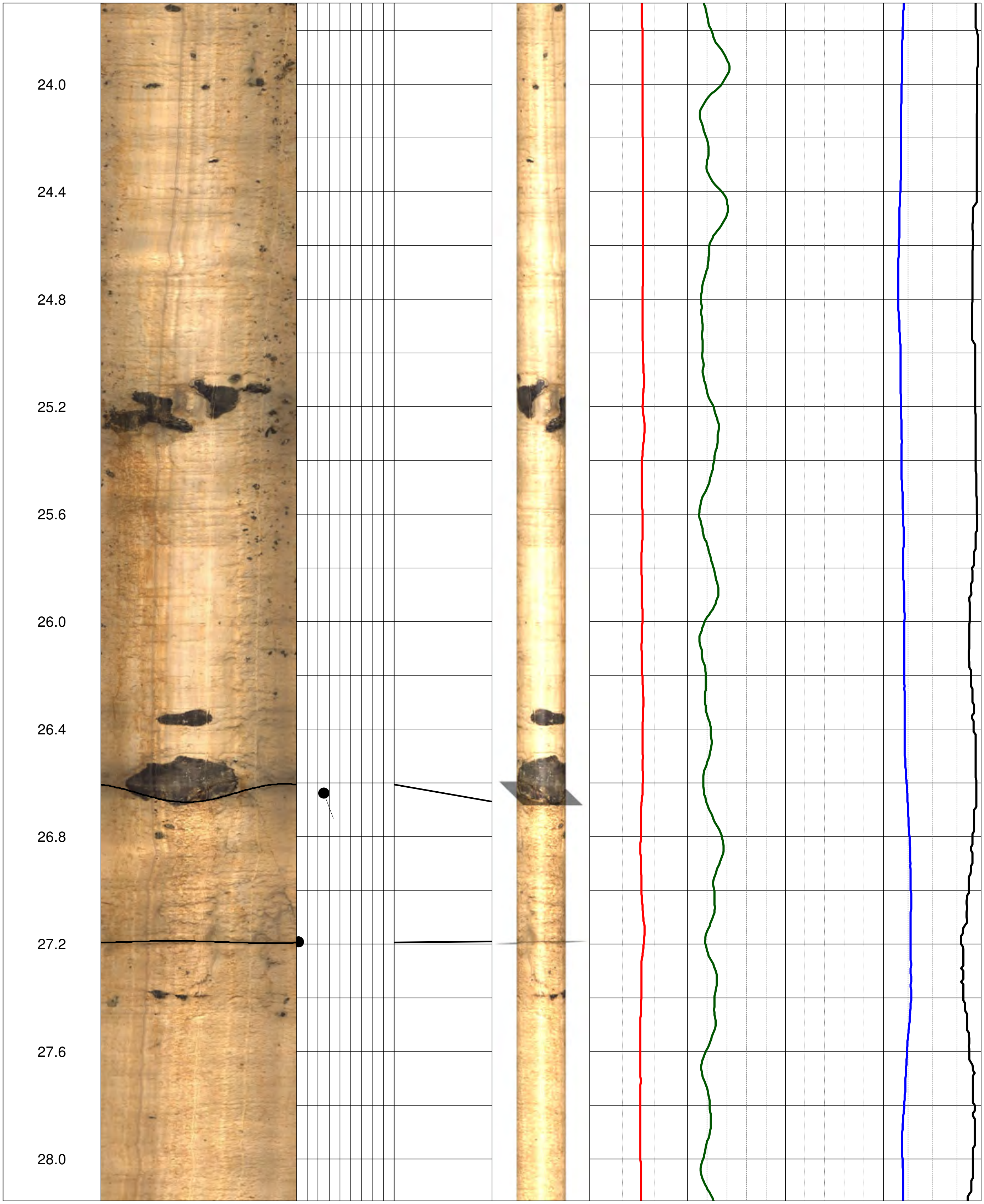

1.6
2.0
2.4
2.8
3.2
3.6
4.0
4.4
4.8
5.2
5.6

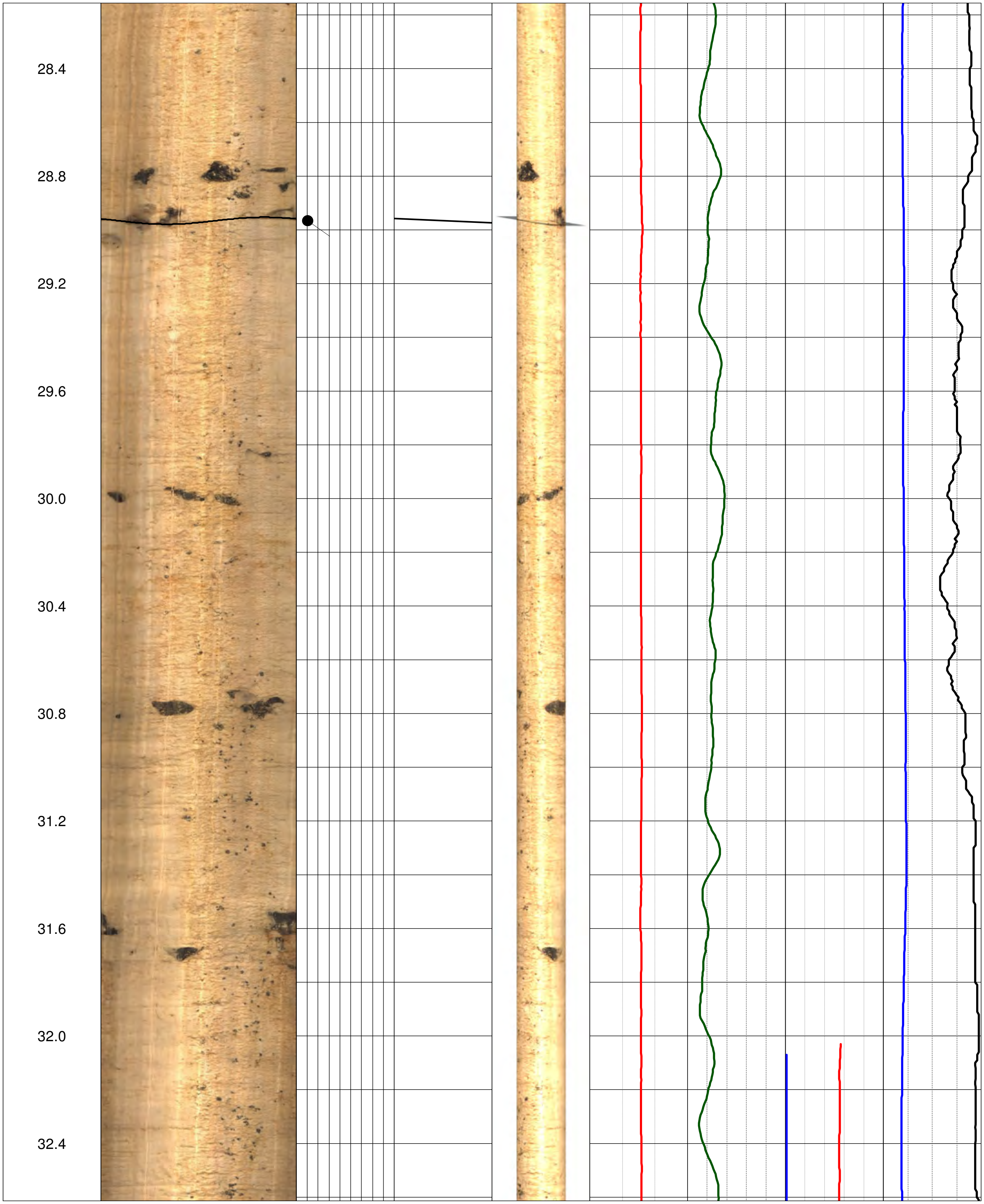

6.0
6.4
6.8
7.2
7.6
8.0
8.4
8.8
9.2
9.6
10.0

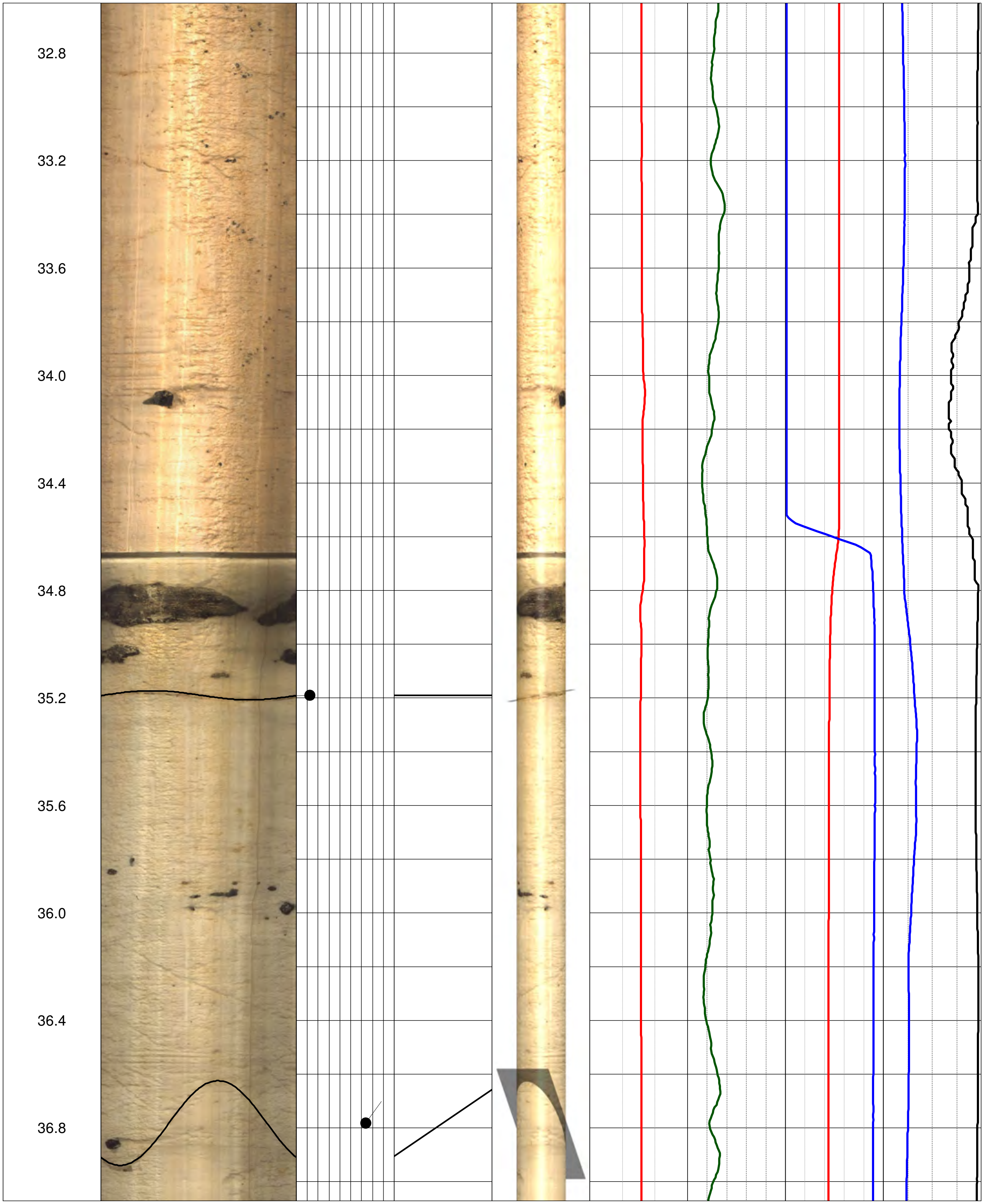

10.4
10.8
11.2
11.6
12.0
12.4
12.8
13.2
13.6
14.0
14.4

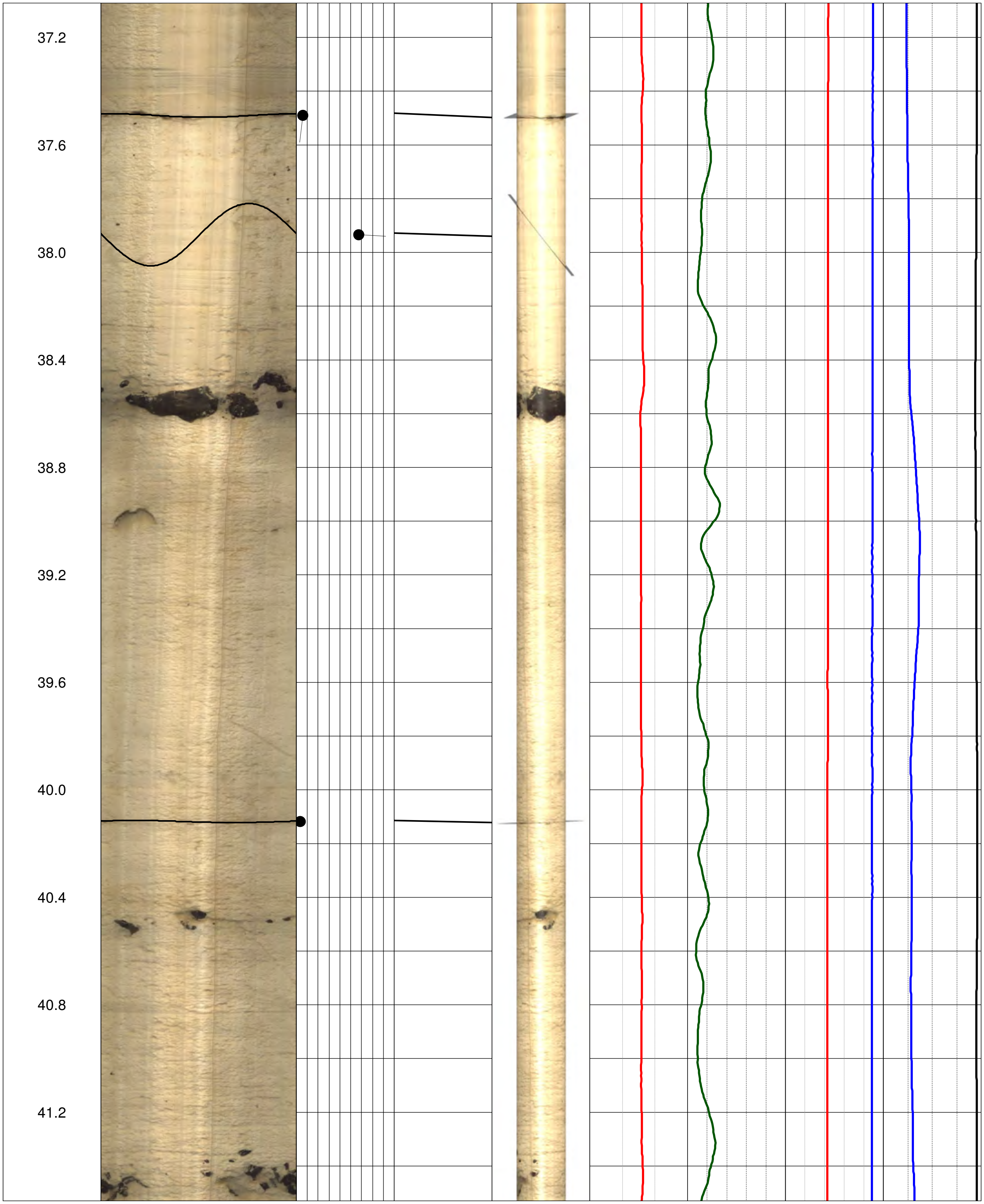

14.8
15.2
15.6
16.0
16.4
16.8
17.2
17.6
18.0
18.4
18.8
19.2

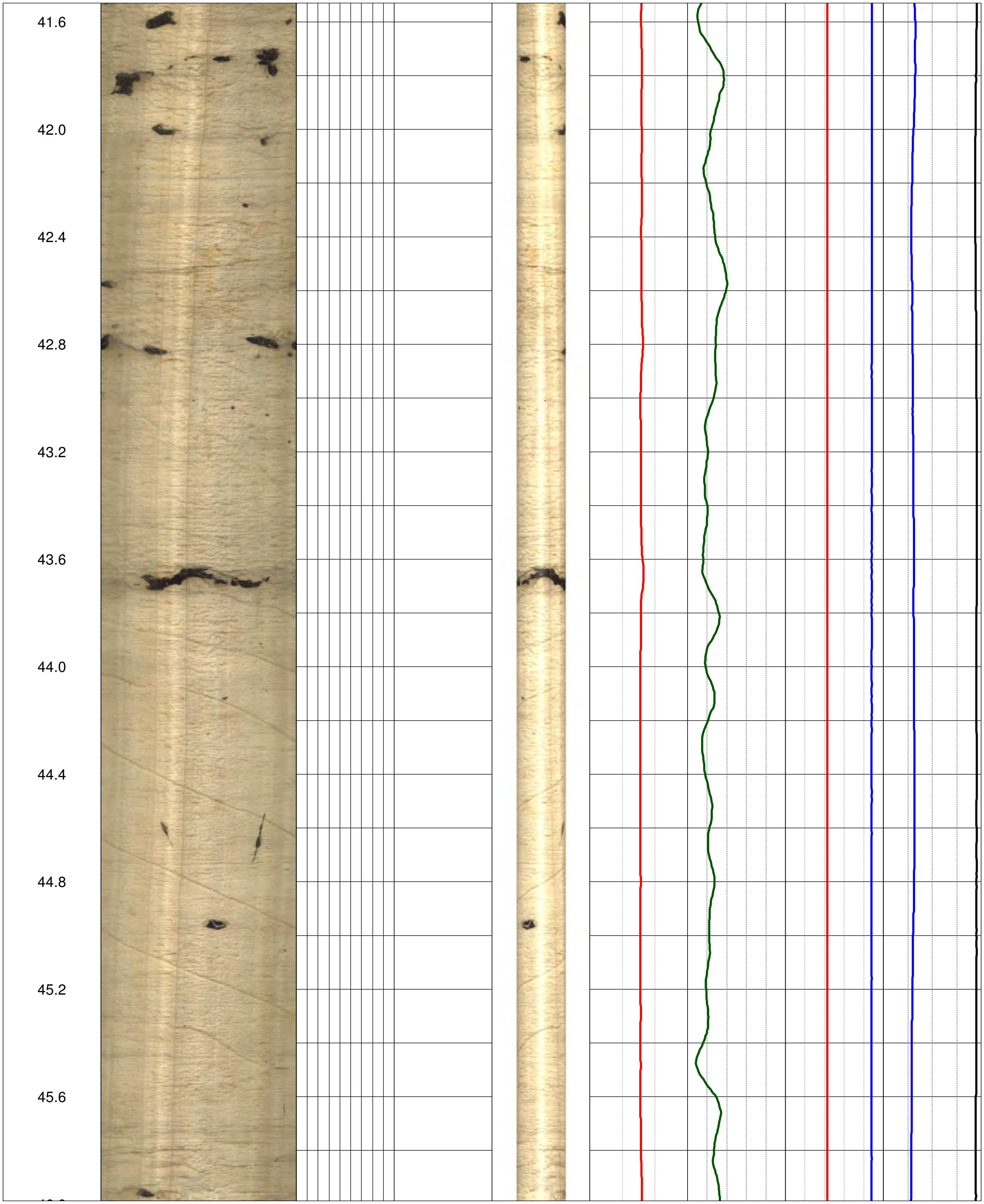

19.6
20.0
20.4
20.8
21.2
21.6
22.0
22.4
22.8
23.2
23.6

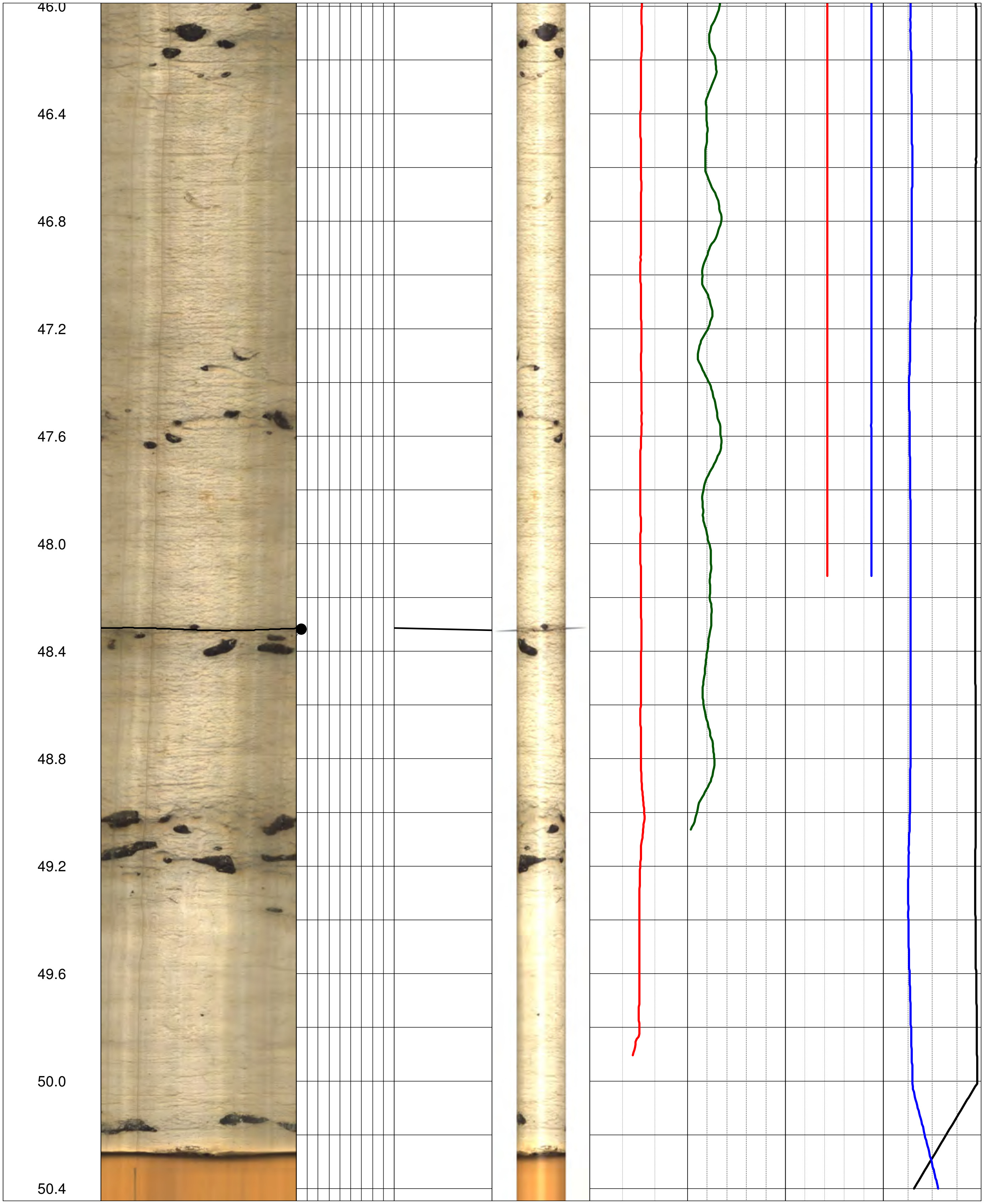

24.0
24.4
24.8
25.2
25.6
26.0
26.4
26.8
27.2
27.6
28.0


28.4
28.8
29.2
29.6
30.0
30.4
30.8
31.2
31.6
32.0
32.4


32.8
33.2
33.6
34.0
34.4
34.8
35.2
35.6
36.0
36.4
36.8


37.2
37.6
38.0
38.4
38.8
39.2
39.6
40.0
40.4
40.8
41.2


41.6
42.0
42.4
42.8
43.2
43.6
44.0
44.4
44.8
45.2
45.6

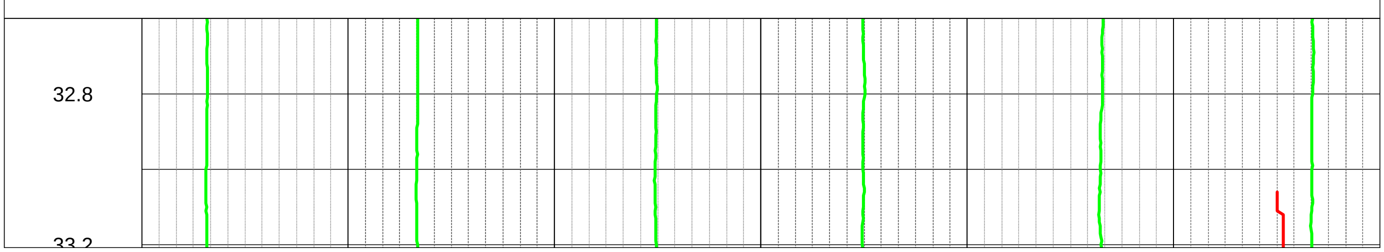

46.0
46.4
46.8
47.2
47.6
48.0
48.4
48.8
49.2
49.6
50.0
50.4

ROBERTSON GEO SERVICES — Unlocking Your GeoData

COMPANY	Structural Soils		
WELL ID	R71822		
FIELD	A303 Stonehenge		
COUNTRY	England	STATE	
LOCATION			OTHER SERVICES
CO			
WELL			
FLD			
CTY			
STE			
FILING No			
SEC	TWP	RGE	
PERMANENT DATUM	GL	ELEVATION	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.
DATE	12/10/18	TYPE FLUID IN HOLE	Water
RUN No		SALINITY	
TYPE LOG	Flowmeter	DENSITY	
DEPTH-DRILLER	50 m	LEVEL	34.65 m
DEPTH-LOGGER	49.81 m	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	49.81 m		
TOP LOGGED INTERVAL	32.6 m	CASING SHOE	
OPERATING RIG TIME			
RECORDED BY	KO		
WITNESSED BY	JB		

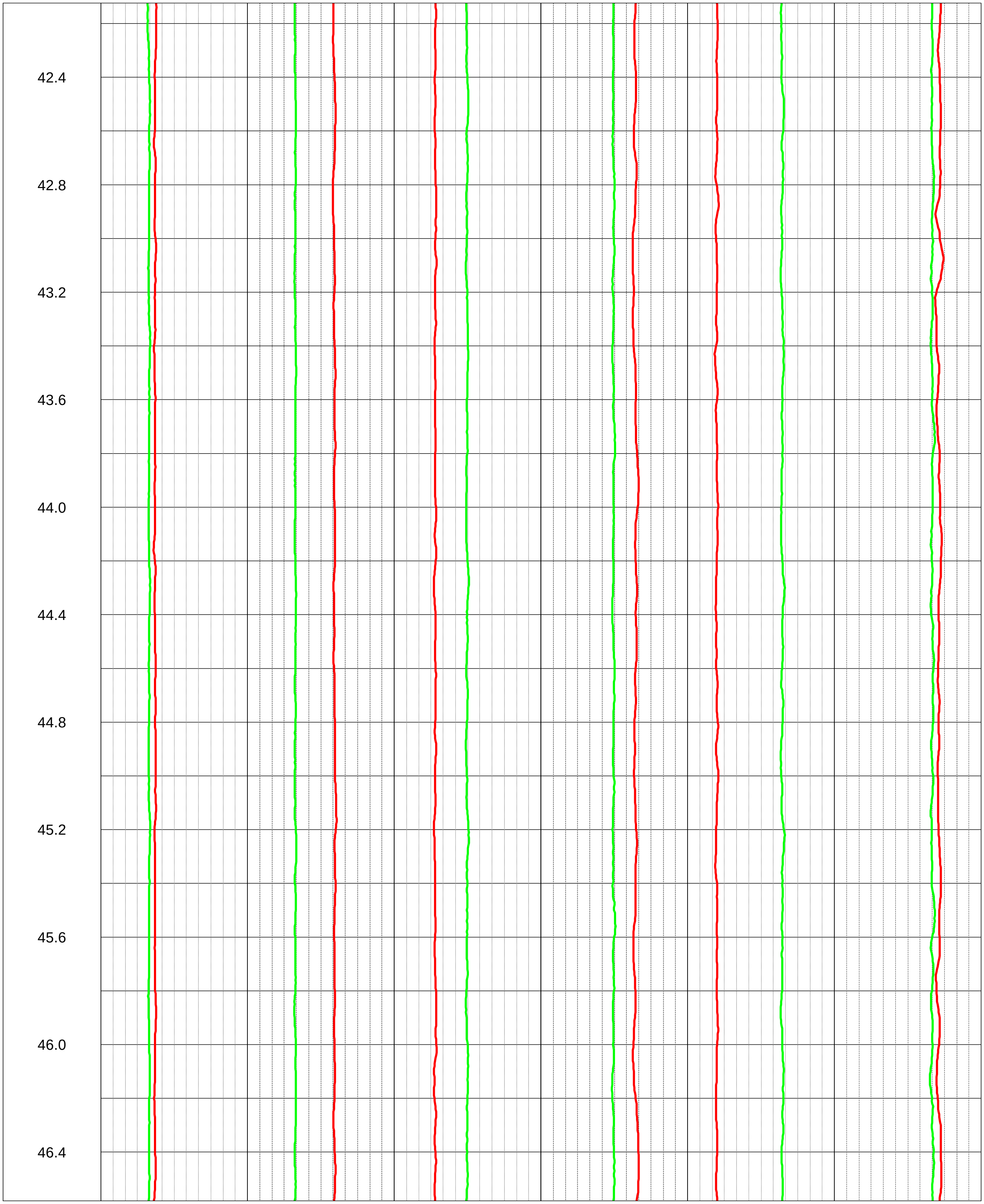
RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

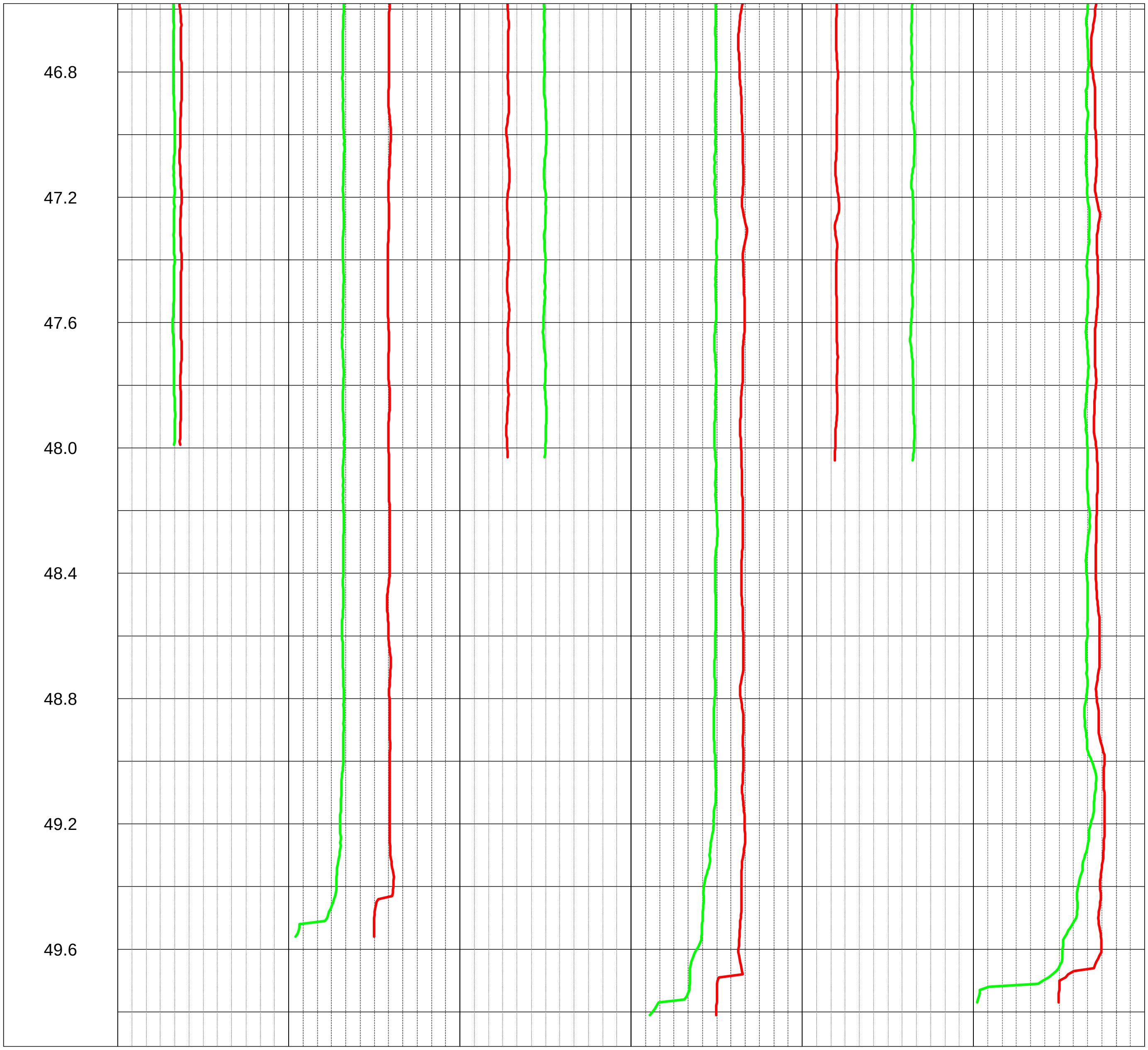
Depth	RATE 1 Down	RATE 1 Up	RATE 2 Down	RATE 2 Up	RATE 3 Down	RATE 3 Up
1m:20m	-600 RPM 600	-600 RPM 600	-600 RPM 600	-600 RPM 600	-600 RPM 600	-600 RPM 600
	CABL 4 Down	CABL 4 Up	CABL 6 Down	CABL 6 Up	CABL 8 Down	CABL 8 Up
	0 m/min 12	0 m/min 12	0 m/min 12	0 m/min 12	0 m/min 12	0 m/min 12



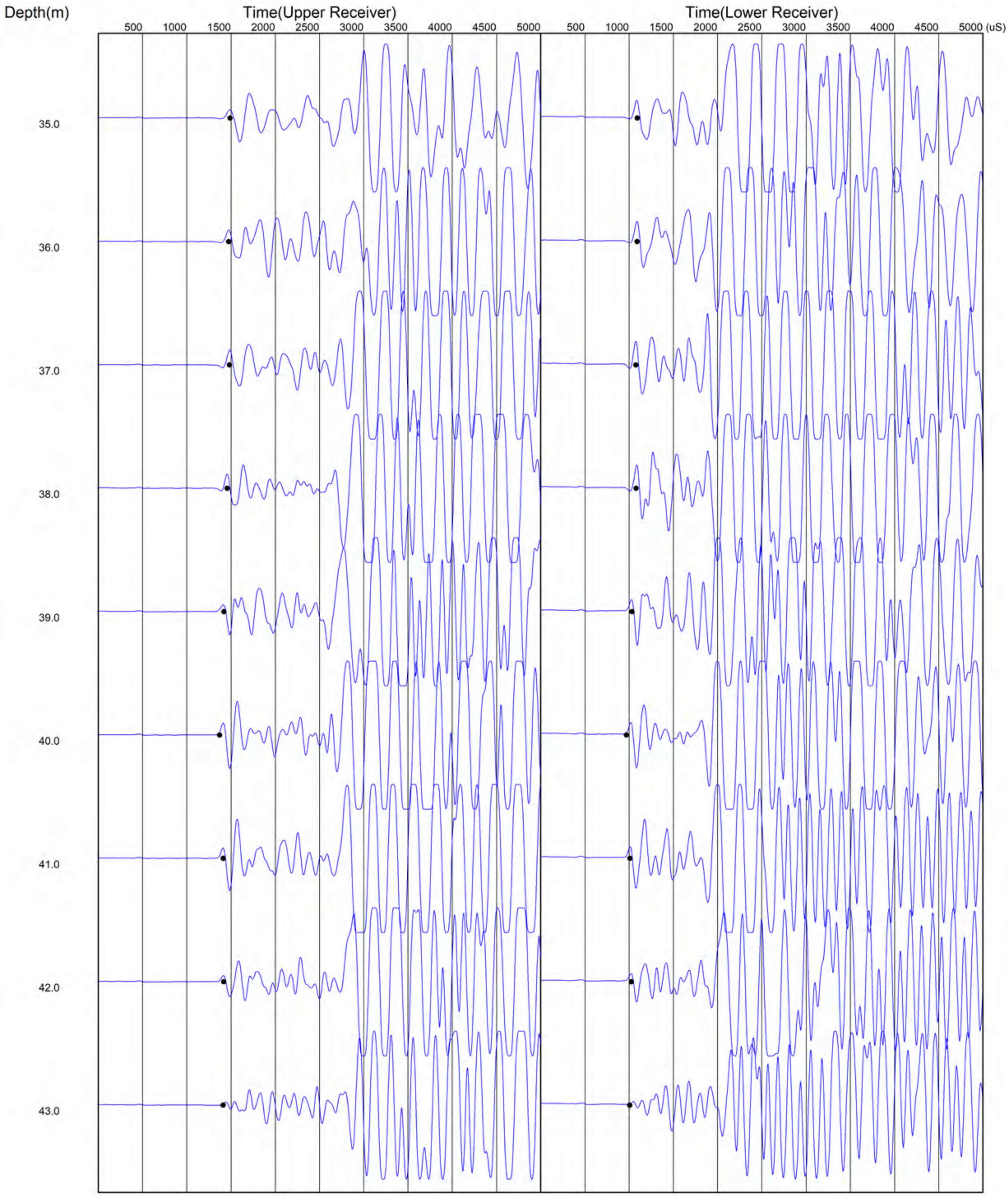

33.2
33.6
34.0
34.4
34.8
35.2
35.6
36.0
36.4
36.8
37.2
37.6


38.0
38.4
38.8
39.2
39.6
40.0
40.4
40.8
41.2
41.6
42.0


42.4
42.8
43.2
43.6
44.0
44.4
44.8
45.2
45.6
46.0
46.4

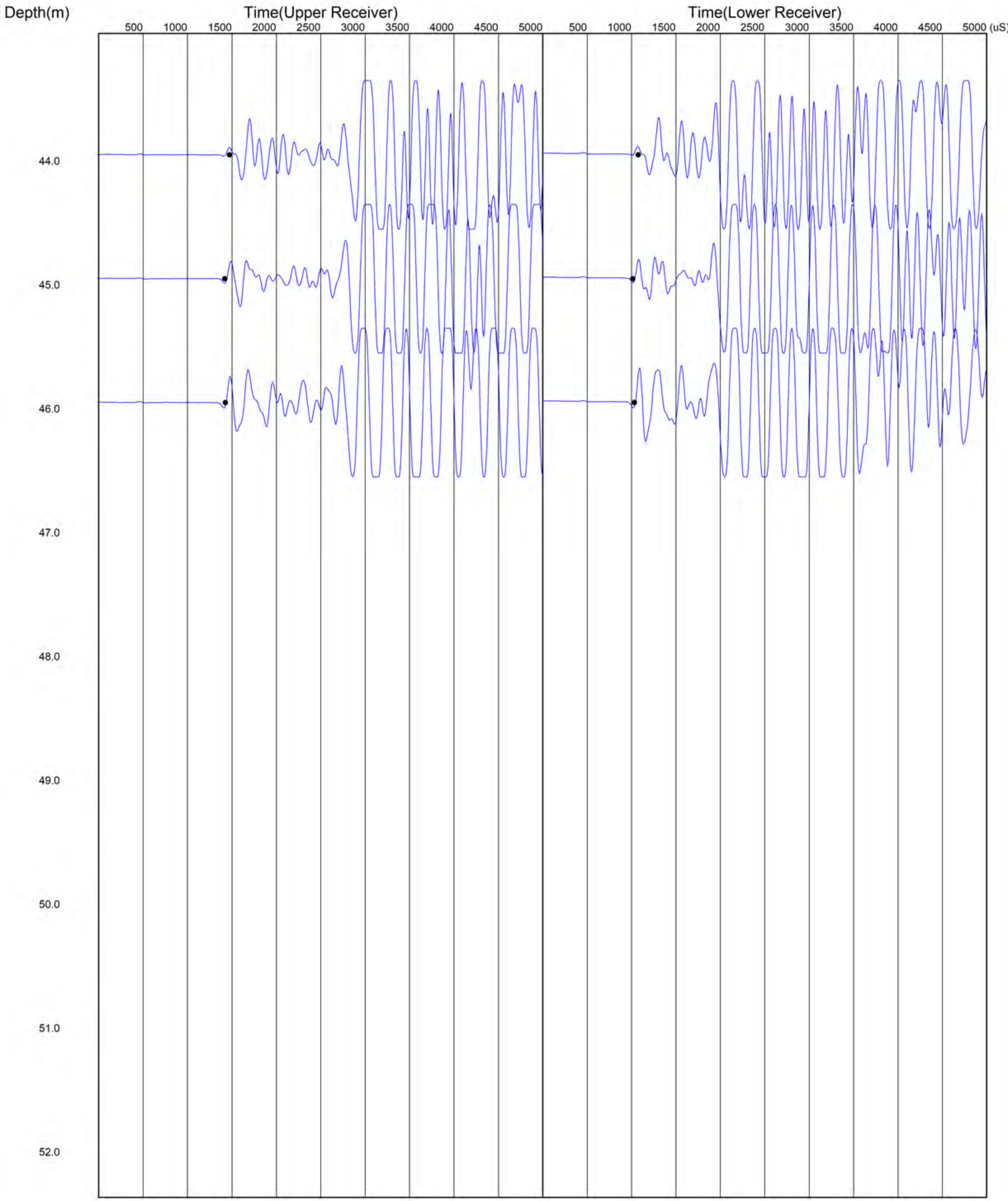

46.8
47.2
47.6
48.0
48.4
48.8
49.2
49.6

P Wave



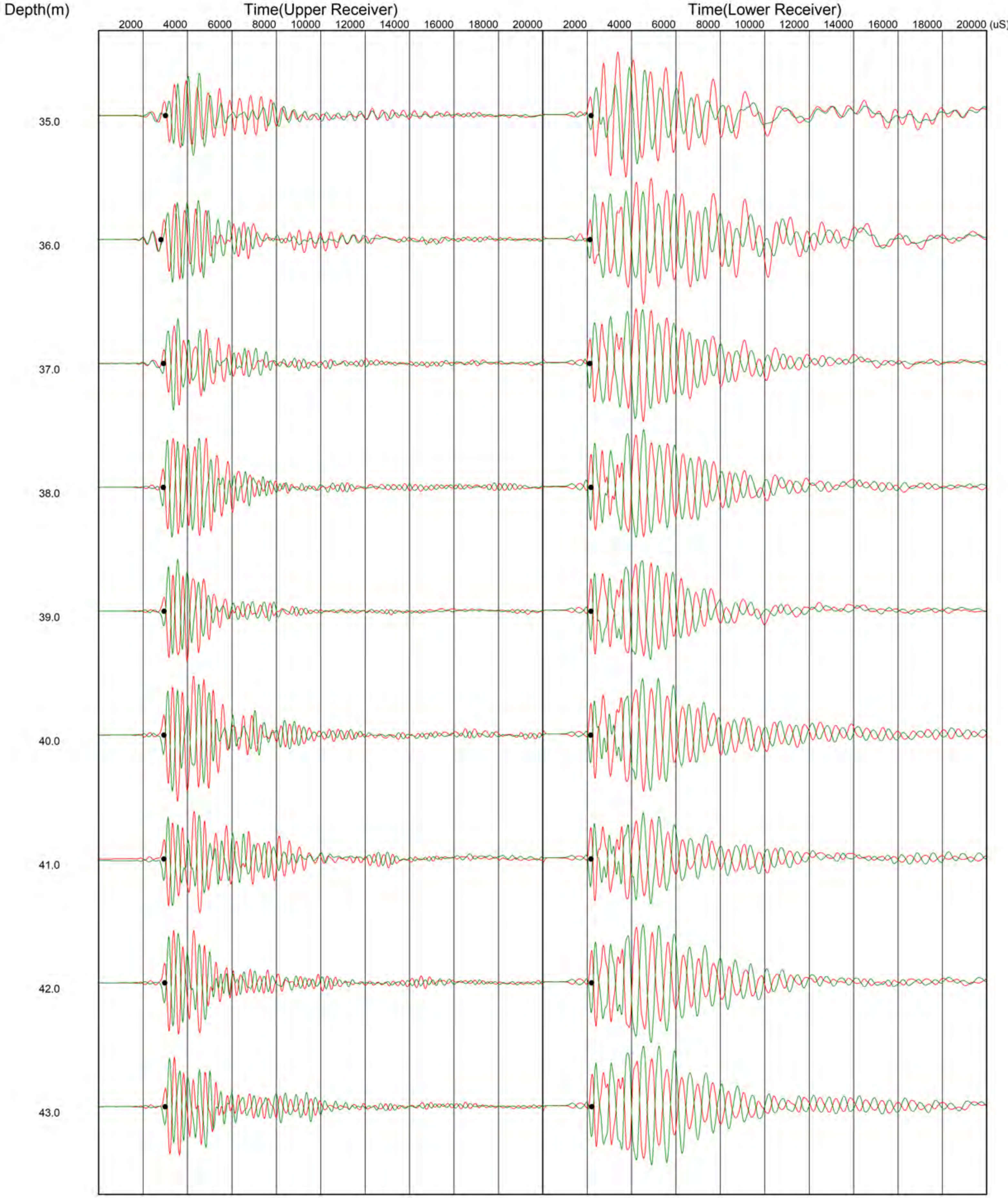
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
35.0
36.0
37.0
38.0
39.0
40.0
41.0
42.0
43.0

P Wave

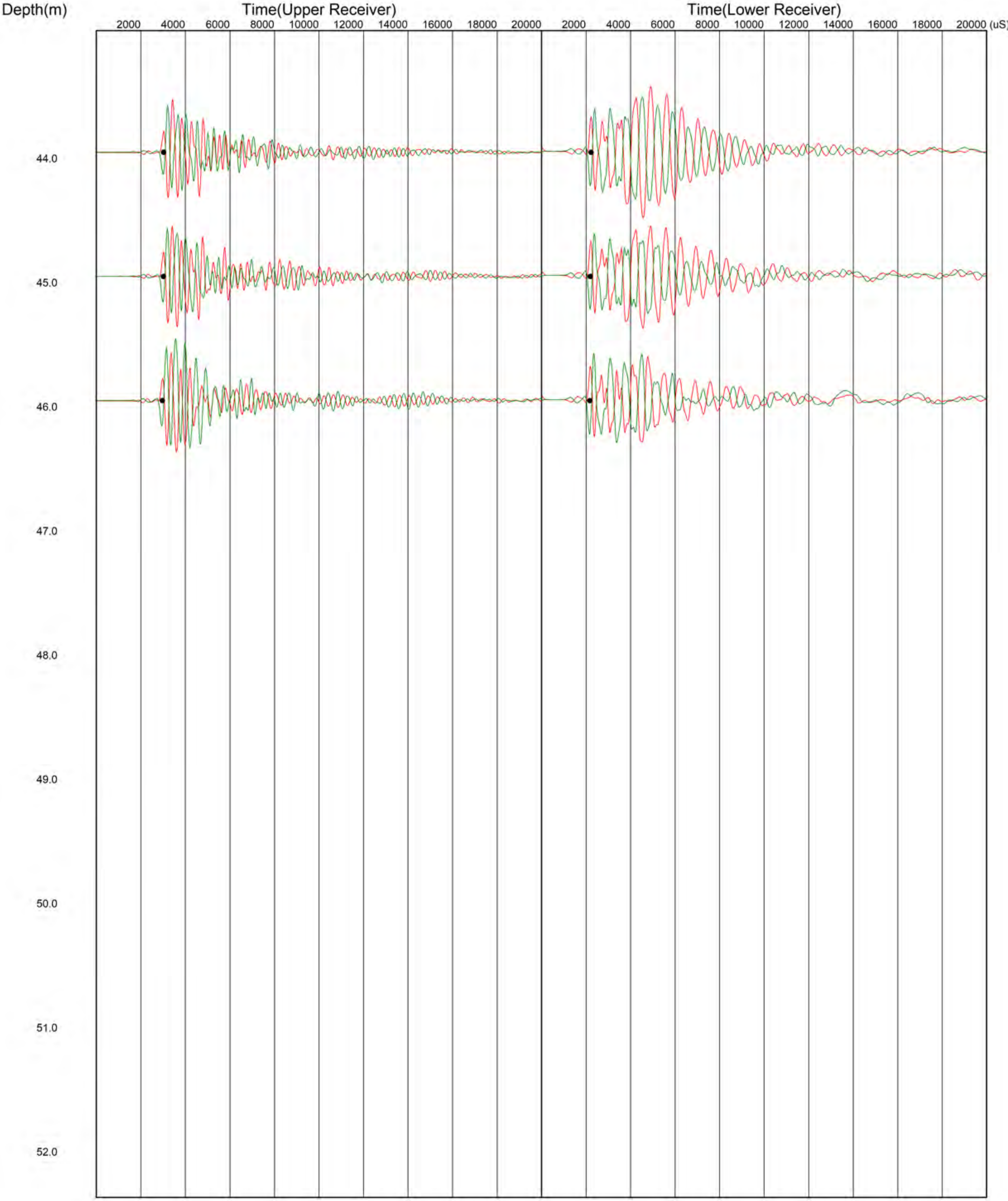


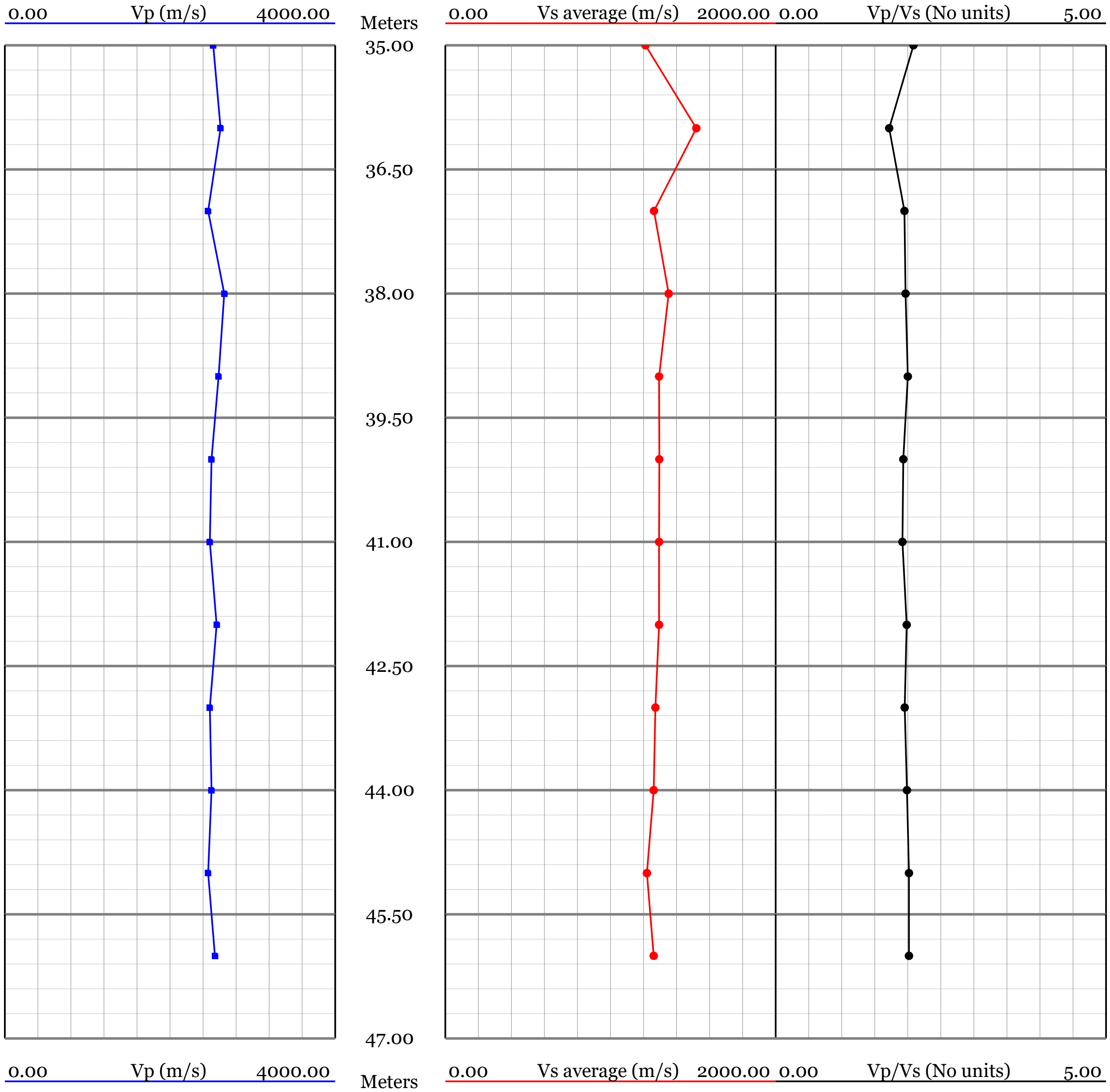
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
44.0
45.0
46.0
47.0
48.0
49.0
50.0
51.0
52.0

S Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
35.0
36.0
37.0
38.0
39.0
40.0
41.0
42.0
43.0

S Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
44.0
45.0
46.0
47.0
48.0
49.0
50.0
51.0
52.0


0.00
Vp (m/s)
4000.00
Meters
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00
35.00
36.50
38.00
39.50
41.00
42.50
44.00
45.50
47.00
0.00
Vp (m/s)
4000.00
Meters
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00

ROBERTSON GEO SERVICES
Unlocking Your GeoData

COMPANY	Structual Soils
WELL ID	R71906
FIELD	A303 Stonehenge
COUNTRY	England
STATE	
LOCATION	A303 Stonehenge
OTHER SERVICES	

CO Structural Soils
WELL R71806
FLD A303 Stonehenge
CTY England
STE
FILING No

SEC TWP RGE

PERMANENT DATUM	GL	ELEVATION	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.
DATE	07 Sep 2018	TYPE FLUID IN HOLE	Water
RUN No	1	SALINITY	
TYPE LOG	Composite	DENSITY	
DEPTH-DRILLER	53.75	LEVEL	17.2
DEPTH-LOGGER	53.26	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	53.26		
TOP LOGGED INTERVAL		CASING SHOE	
OPERATING RIG TIME			
RECORDED BY	JVA		
WITNESSED BY	RW		

BOREHOLE RECORD				CASING RECORD			
RUN NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

ROBERTSON GEO SERVICES
Unlocking Your GeoData

COMPANY	Structual Soils		
WELL ID	R71906		
FIELD	A303 Stonehenge		
COUNTRY	England	STATE	
LOCATION	A303 Stonehenge	OTHER SERVICES	
SEC	TWP	RGE	

CO / WELL / FLD / CTY / STE / FILING No

PERMANENT DATUM	GL	ELEVATION	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.

DATE	07 Sep 2018	TYPE FLUID IN HOLE	Water
RUN No	1	SALINITY	
TYPE LOG	Composite	DENSITY	
DEPTH-DRILLER	53.75	LEVEL	17.2
DEPTH-LOGGER	53.26	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	53.26		
TOP LOGGED INTERVAL		CASING SHOE	
OPERATING RIG TIME			
RECORDED BY	JVA		
WITNESSED BY	RW		

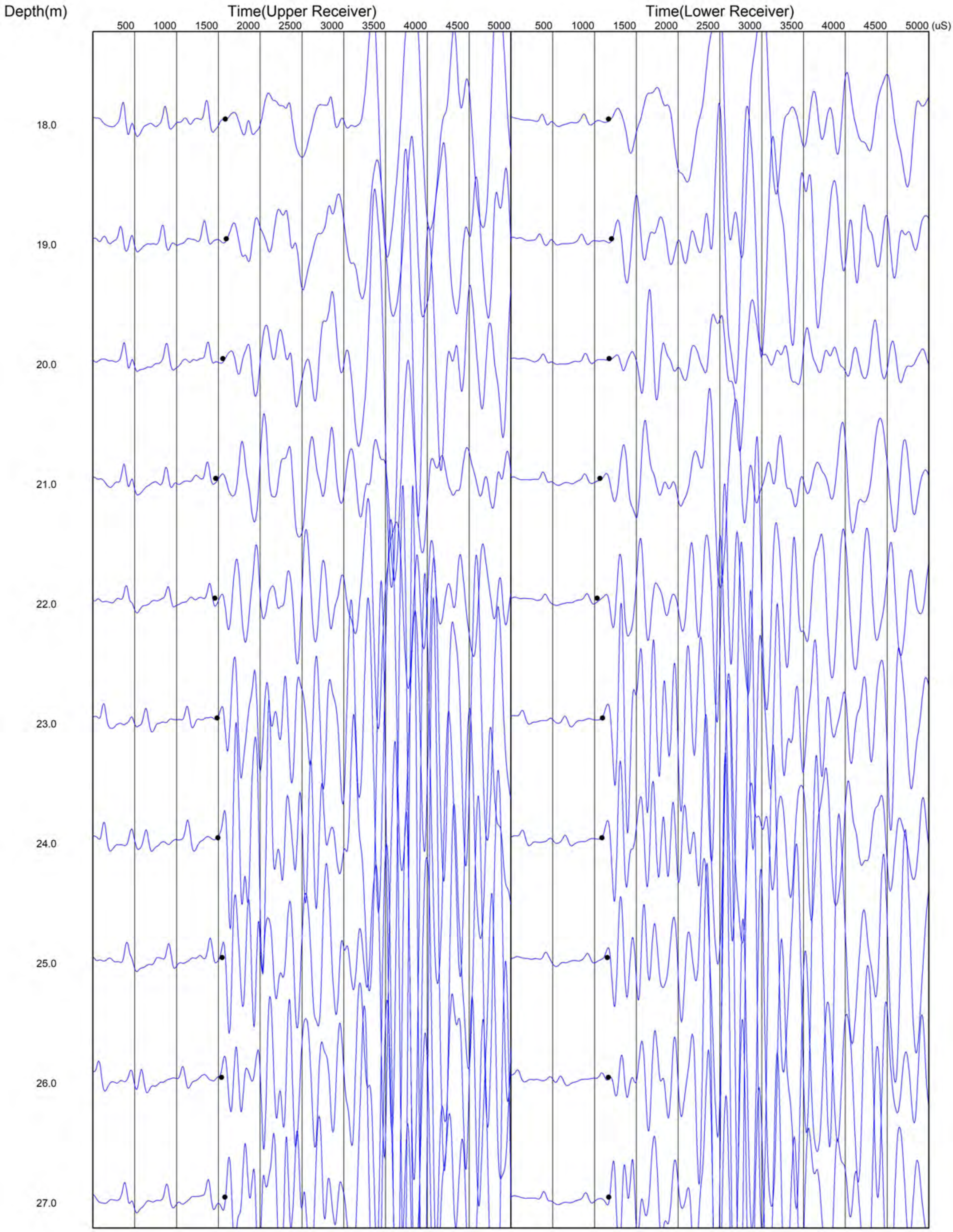
RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

ROBERTSON GEO SERVICES — Unlocking Your GeoData

COMPANY	Stuctual Soils
WELL ID	R7196
FIELD	A303 Stonehenge
COUNTRY	England
STATE	
LOCATION	A303 Stonehenge
OTHER SERVICES	
SEC	
TWP	
RGE	
CO	
WELL	
FLD	
CTY	
STE	
FILING No	
PERMANENT DATUM	GL
ELEVATION	
K.B.	
LOG MEAS. FROM	
ABOVE PERM. DATUM	
D.F.	
DRILLING MEAS. FROM	
G.L.	
DATE	07 Sep 18
RUN No	
TYPE LOG	Flowmeter
DEPTH-DRILLER	53.75
DEPTH-LOGGER	53.26
BTM LOGGED INTERVAL	52.5
TOP LOGGED INTERVAL	17.2
OPERATING RIG TIME	
RECORDED BY	JVA
WITNESSED BY	RW
TYPE FLUID IN HOLE	Water
SALINITY	
DENSITY	
LEVEL	17.2
MAX. REC. TEMP.	
CASING SHOE	

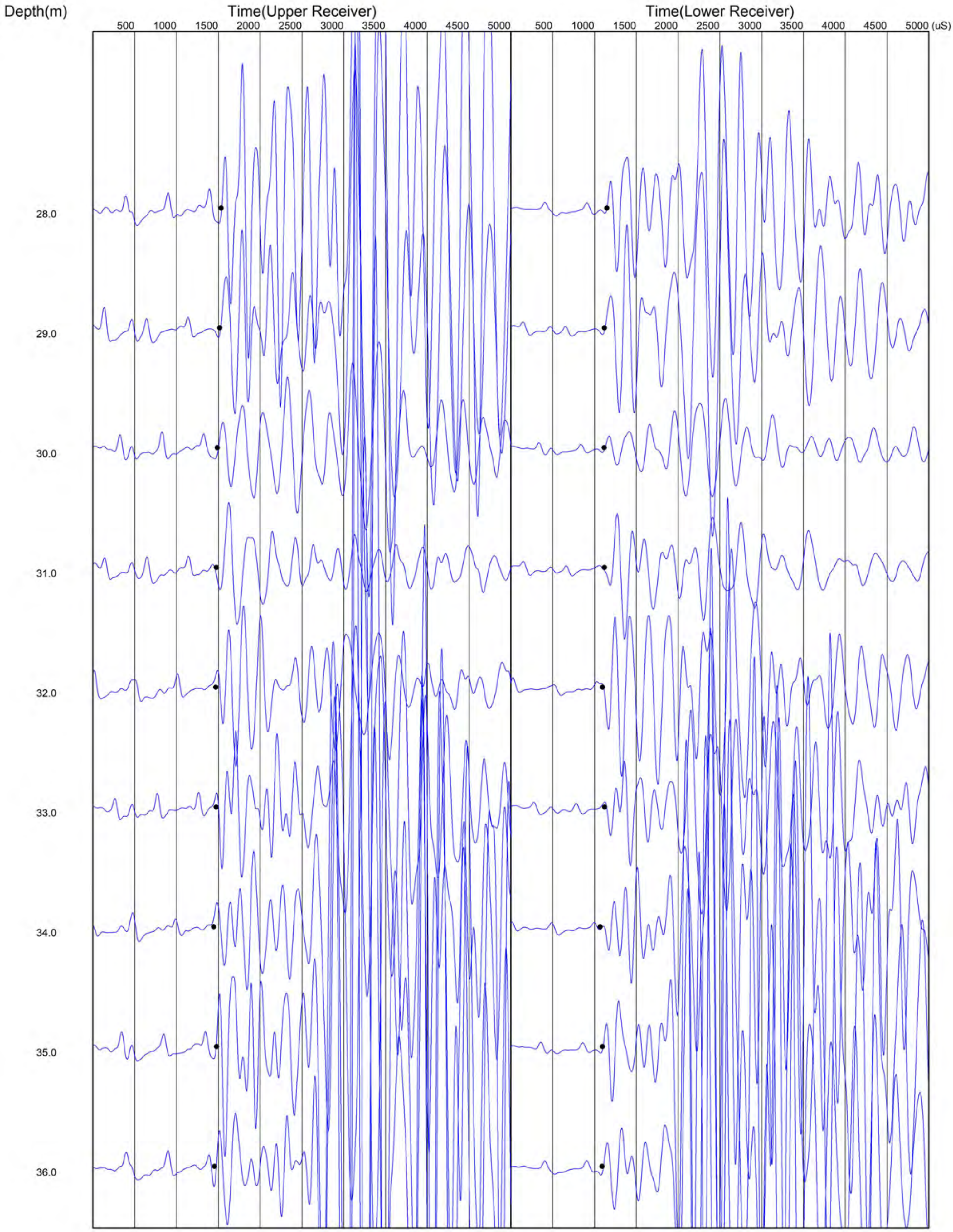
BOREHOLE RECORD				CASING RECORD			
RUN NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

P Wave



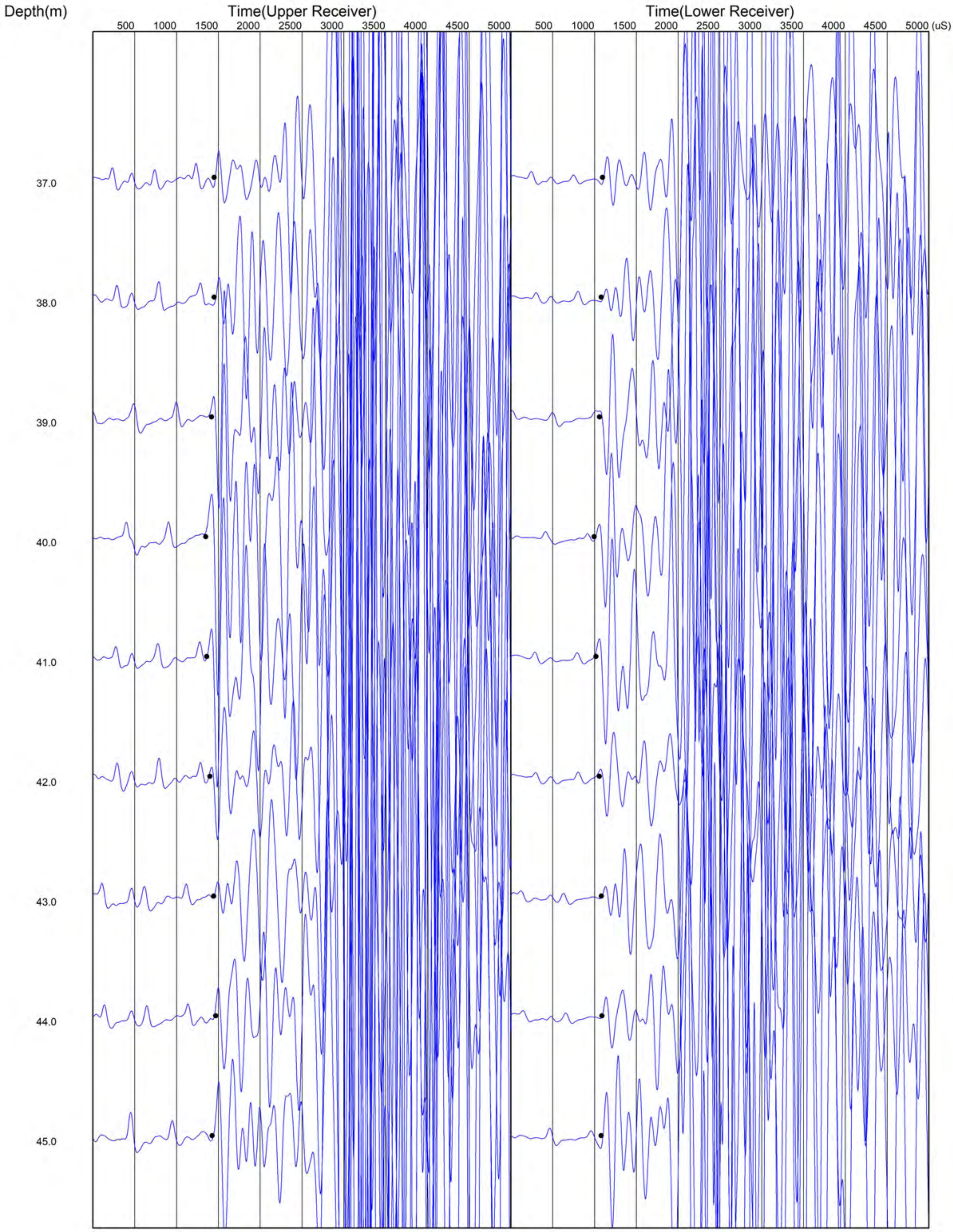
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
(uS)
18.0
19.0
20.0
21.0
22.0
23.0
24.0
25.0
26.0
27.0

P Wave



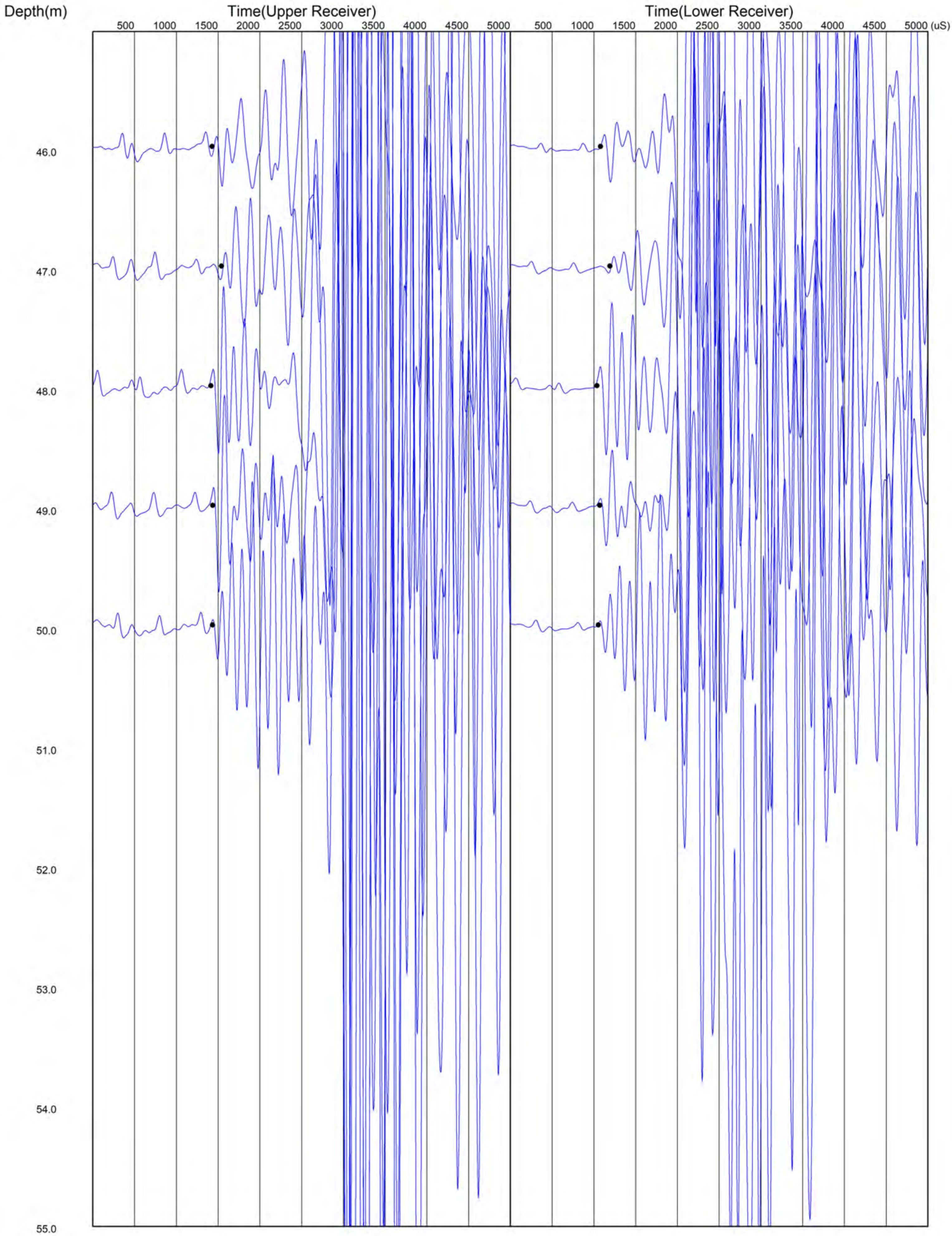
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
500
1000
1500
2000
2500
3000
3500
4000
4500
5000 (uS)
28.0
29.0
30.0
31.0
32.0
33.0
34.0
35.0
36.0

P Wave



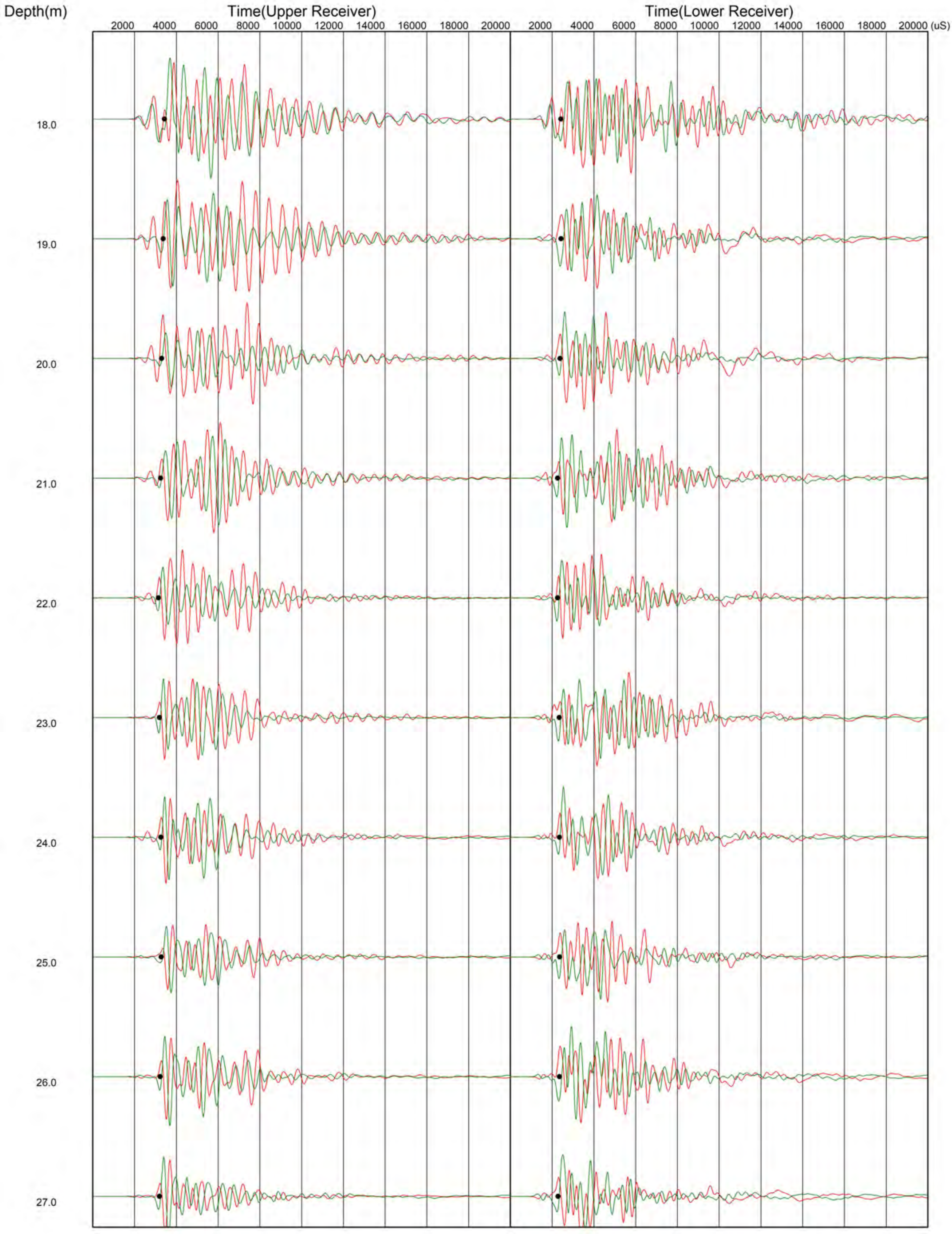
Depth(m)
Time(Upper Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
37.0
38.0
39.0
40.0
41.0
42.0
43.0
44.0
45.0

P Wave

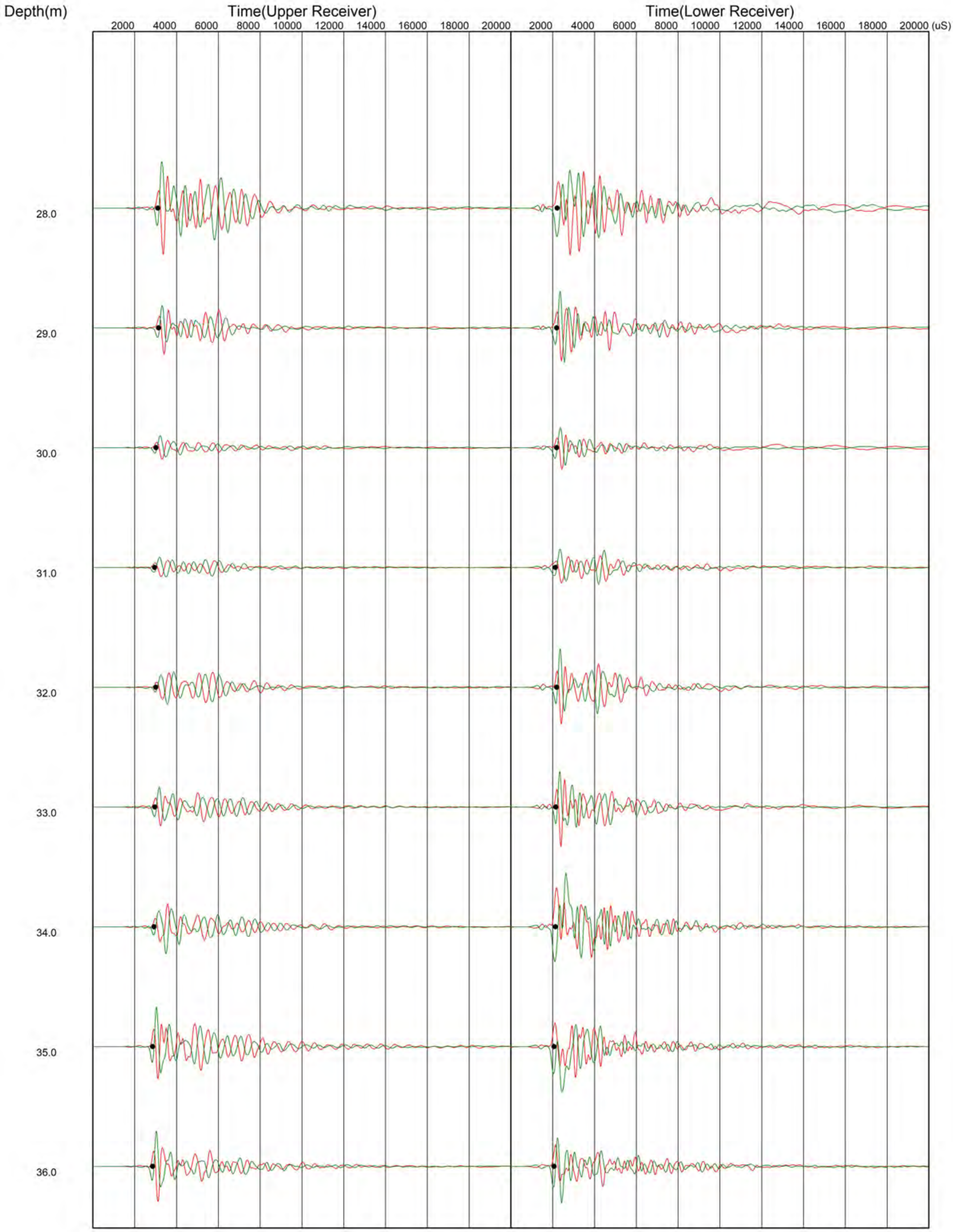


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
46.0
47.0
48.0
49.0
50.0
51.0
52.0
53.0
54.0
55.0

S Wave

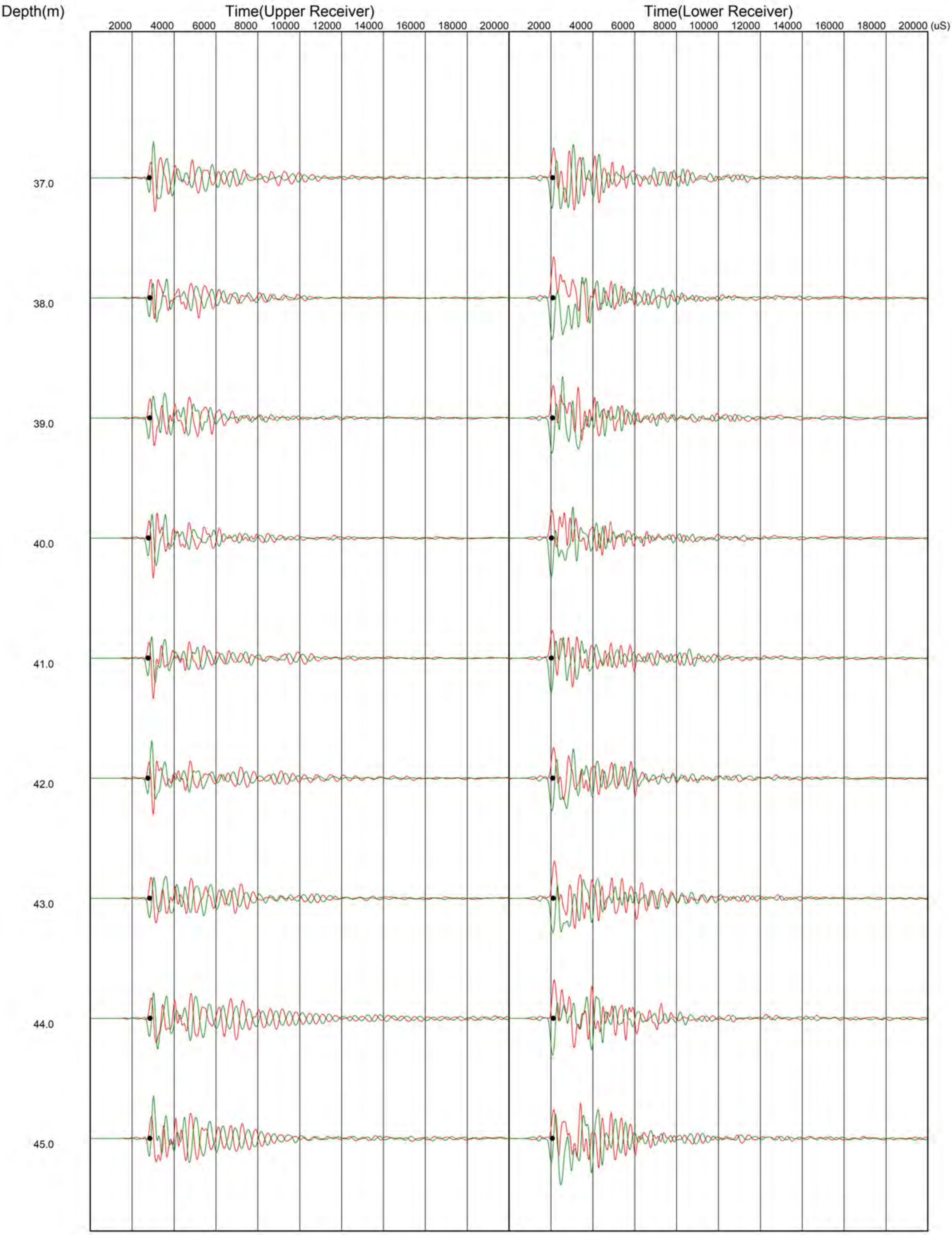

Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
18.0
19.0
20.0
21.0
22.0
23.0
24.0
25.0
26.0
27.0

S Wave

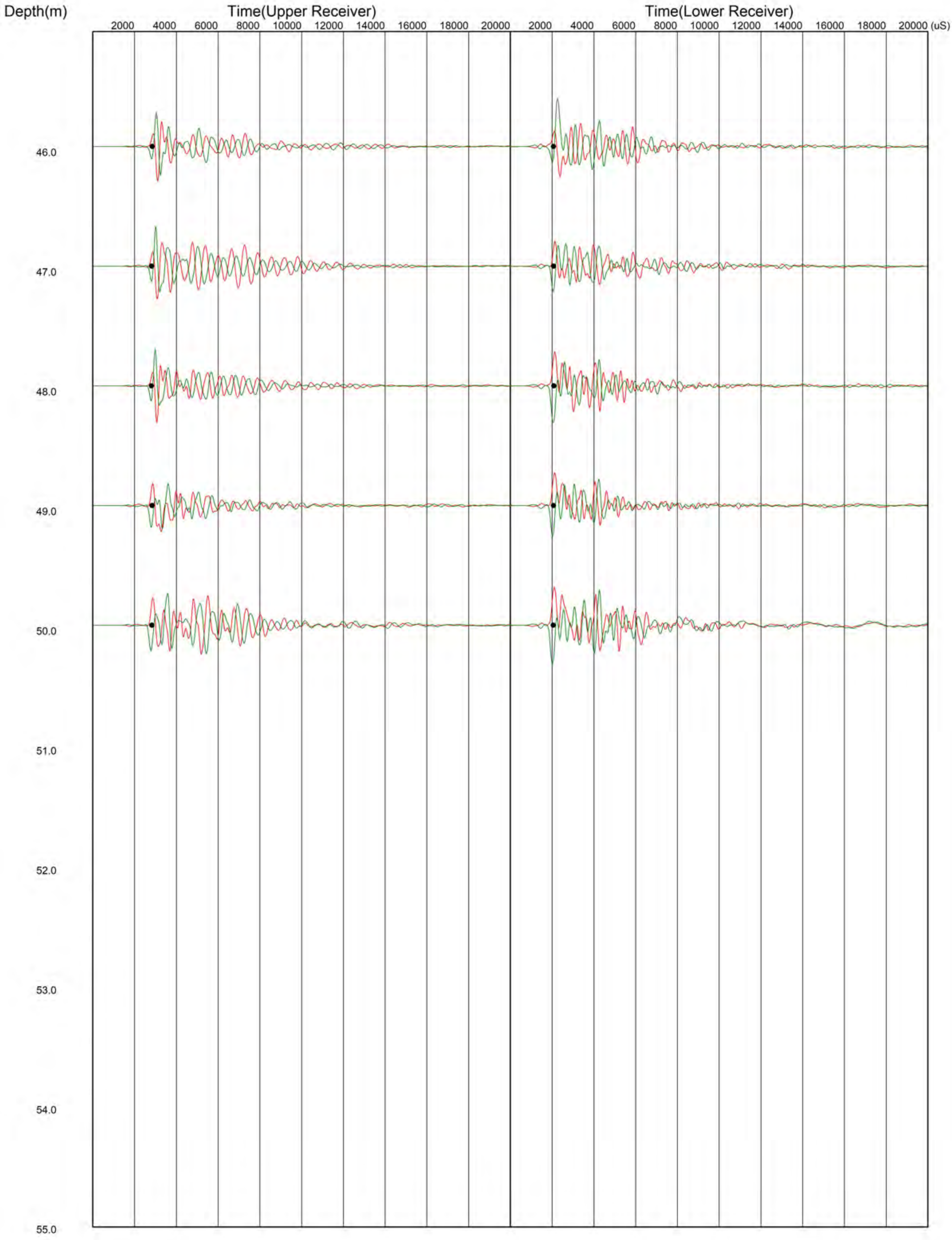


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
28.0
29.0
30.0
31.0
32.0
33.0
34.0
35.0
36.0

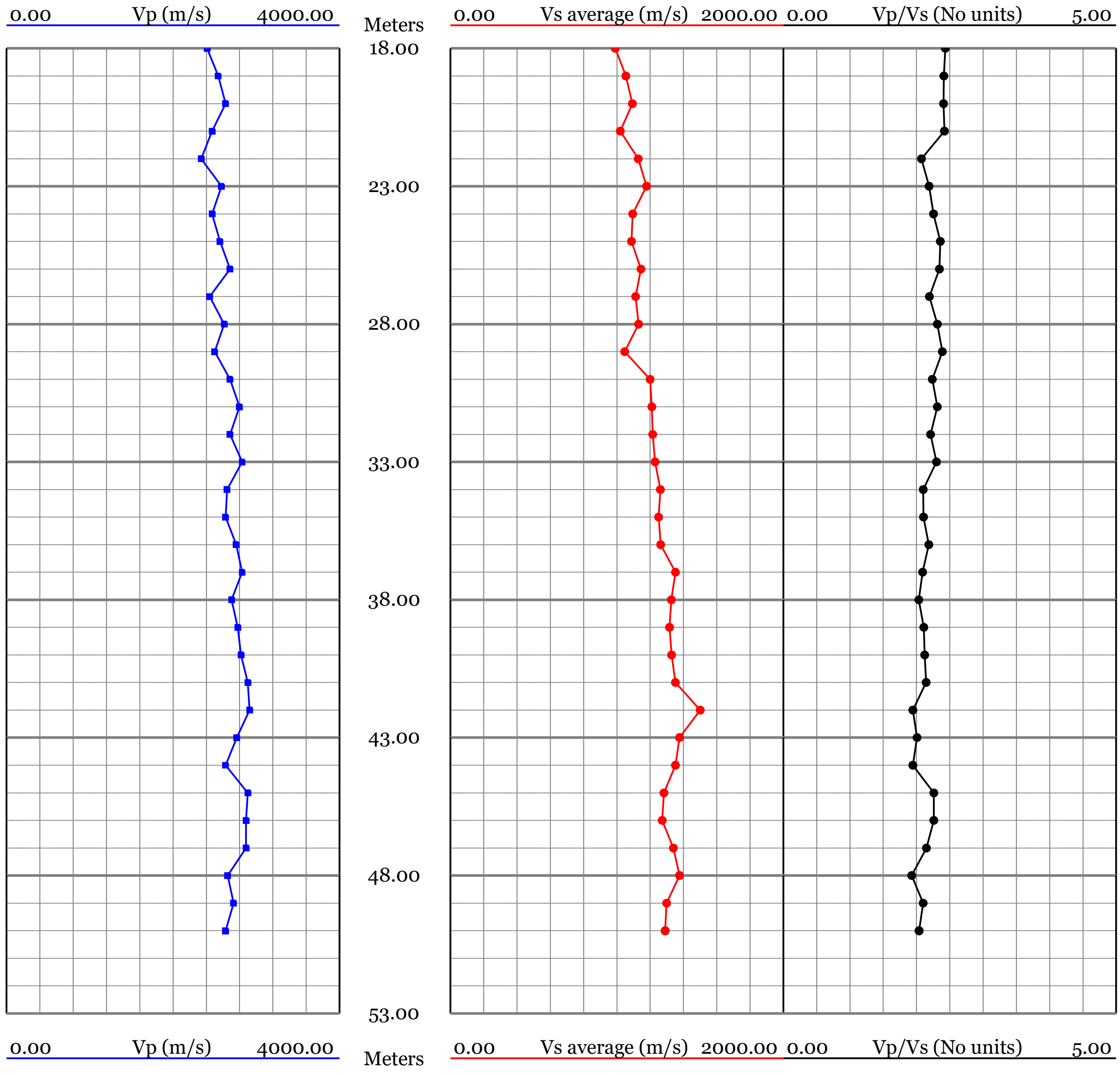
S Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
37.0
38.0
39.0
40.0
41.0
42.0
43.0
44.0
45.0

S Wave



Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
46.0
47.0
48.0
49.0
50.0
51.0
52.0
53.0
54.0
55.0


0.00
Vp (m/s)
4000.00
Meters
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00
18.00
23.00
28.00
33.00
38.00
43.00
48.00
53.00
0.00
Vp (m/s)
4000.00
Meters
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00

ROBERTSON GEO SERVICES — Unlocking Your GeoData

CO / COMPANY	Structural Soils
WELL / WELL ID	R71907
FLD / FIELD	A303 Stonehenge
CTY / COUNTRY	England
STE / STATE	
FILING No / LOCATION	A303 Stonehenge
SEC	TWP

SEC — TWP — RGE

OTHER SERVICES

PERMANENT DATUM	GL	ELEVATION	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.
DATE	23 Aug 18	TYPE FLUID IN HOLE	Water
RUN No	1	SALINITY	
TYPE LOG	Composite	DENSITY	
DEPTH-DRILLER	66.2	LEVEL	31.9
DEPTH-LOGGER	65.77	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	65.77		
TOP LOGGED INTERVAL	1.62		
OPERATING RIG TIME			
RECORDED BY	KO		
WITNESSED BY	RW		

RUN NO.	BOREHOLE RECORD BIT	FROM	TO	CASING RECORD SIZE	WGT.	FROM	TO

ROBERTSON GEO SERVICES
Unlocking Your GeoData

COMPANY	Structural Soils		
WELL ID	R71907		
FIELD	A303 Stonehenge		
COUNTRY	England	STATE	
LOCATION	A303 Stonehenge		OTHER SERVICES
SEC	TWP	RGE	

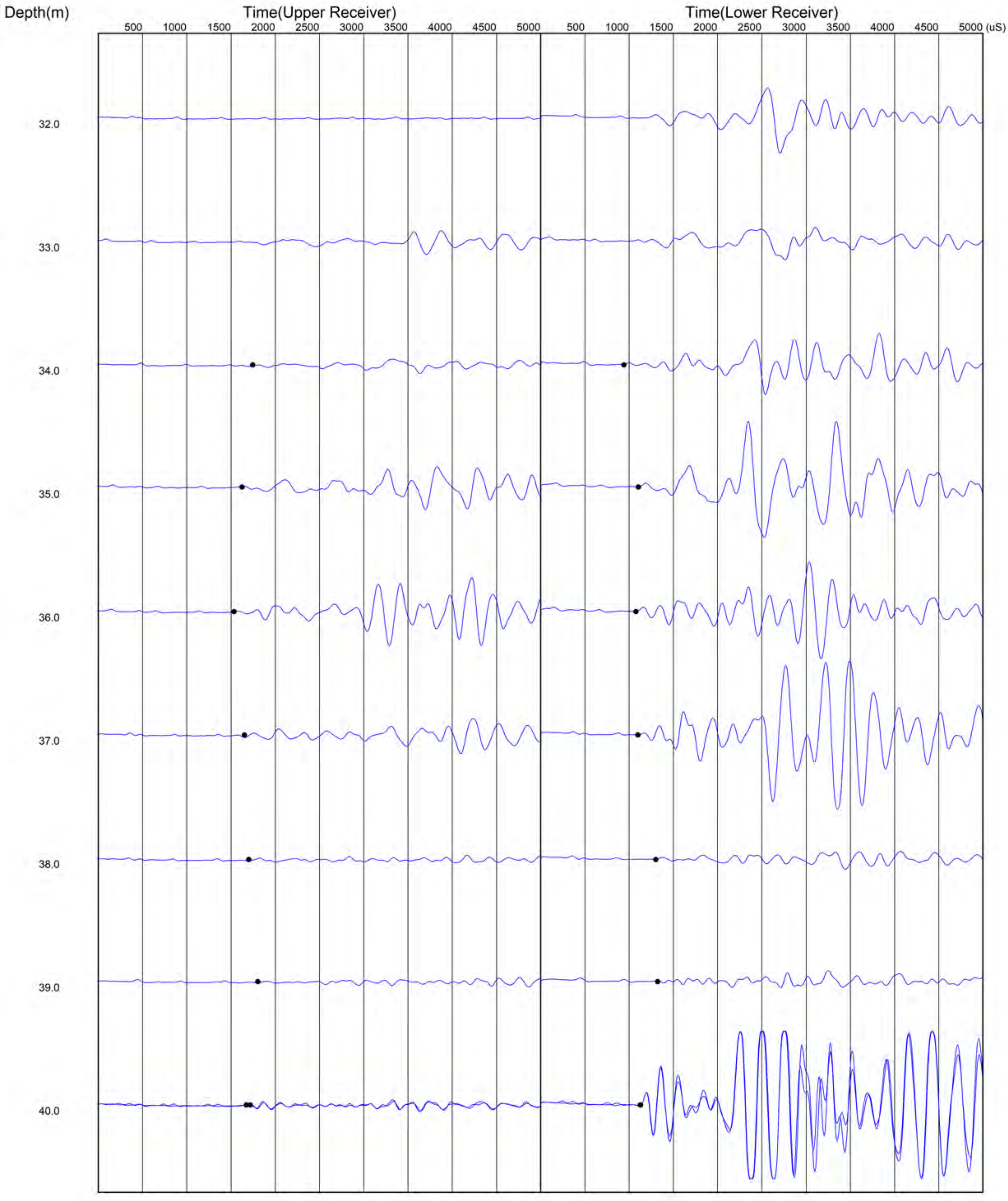
CO
WELL
FLD
CTY
STE
FILING No

PERMANENT DATUM	GL	ELEVATION	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.

DATE	23 Aug 18	TYPE FLUID IN HOLE	Water
RUN No	1-6	SALINITY	
TYPE LOG	Flowmeter	DENSITY	
DEPTH-DRILLER	66.2	LEVEL	31.9
DEPTH-LOGGER	64.85	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	64.85		
TOP LOGGED INTERVAL	27.2		
OPERATING RIG TIME			
RECORDED BY	RW		
WITNESSED BY	KO		

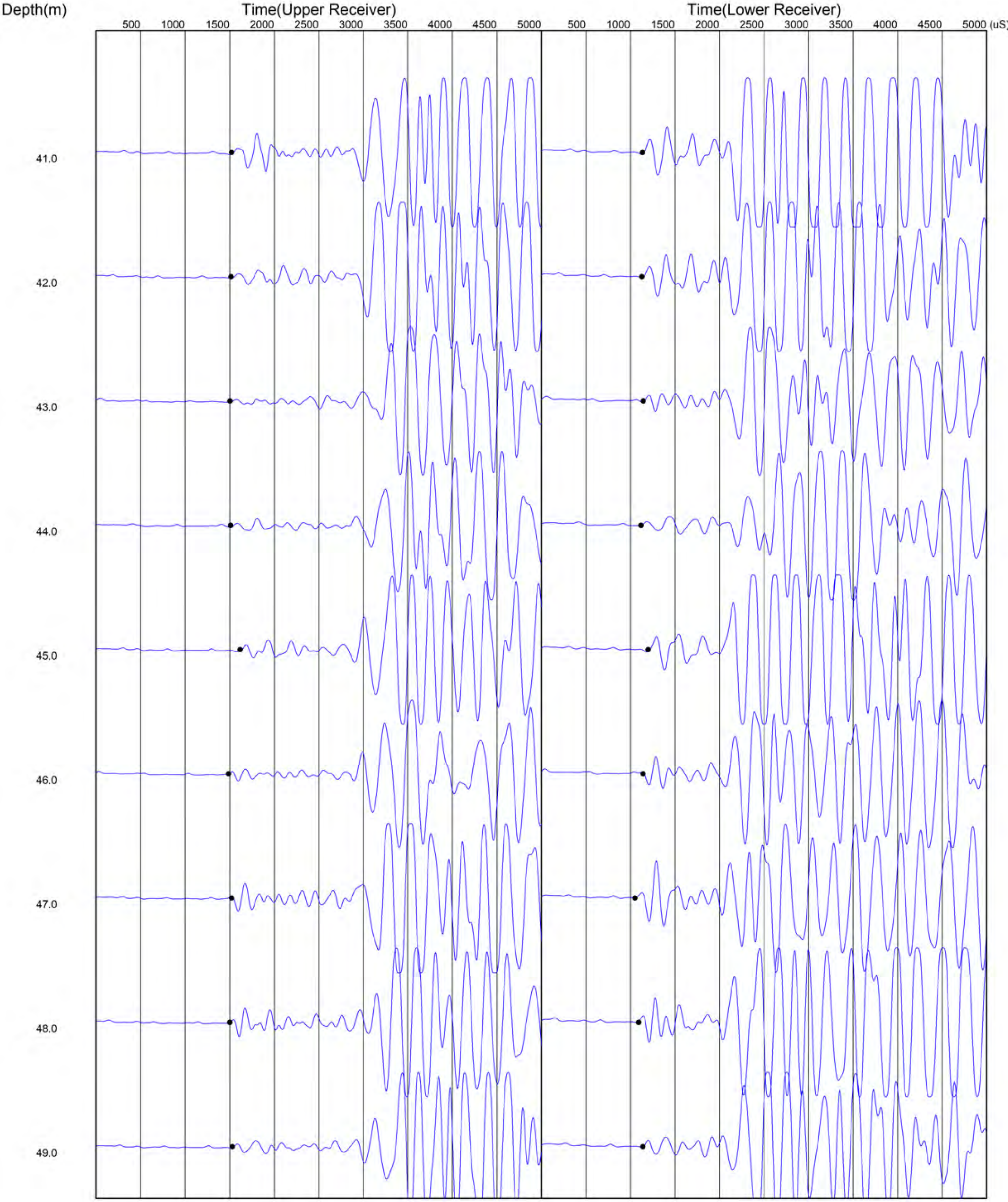
BOREHOLE RECORD				CASING RECORD			
RUN NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

P Wave



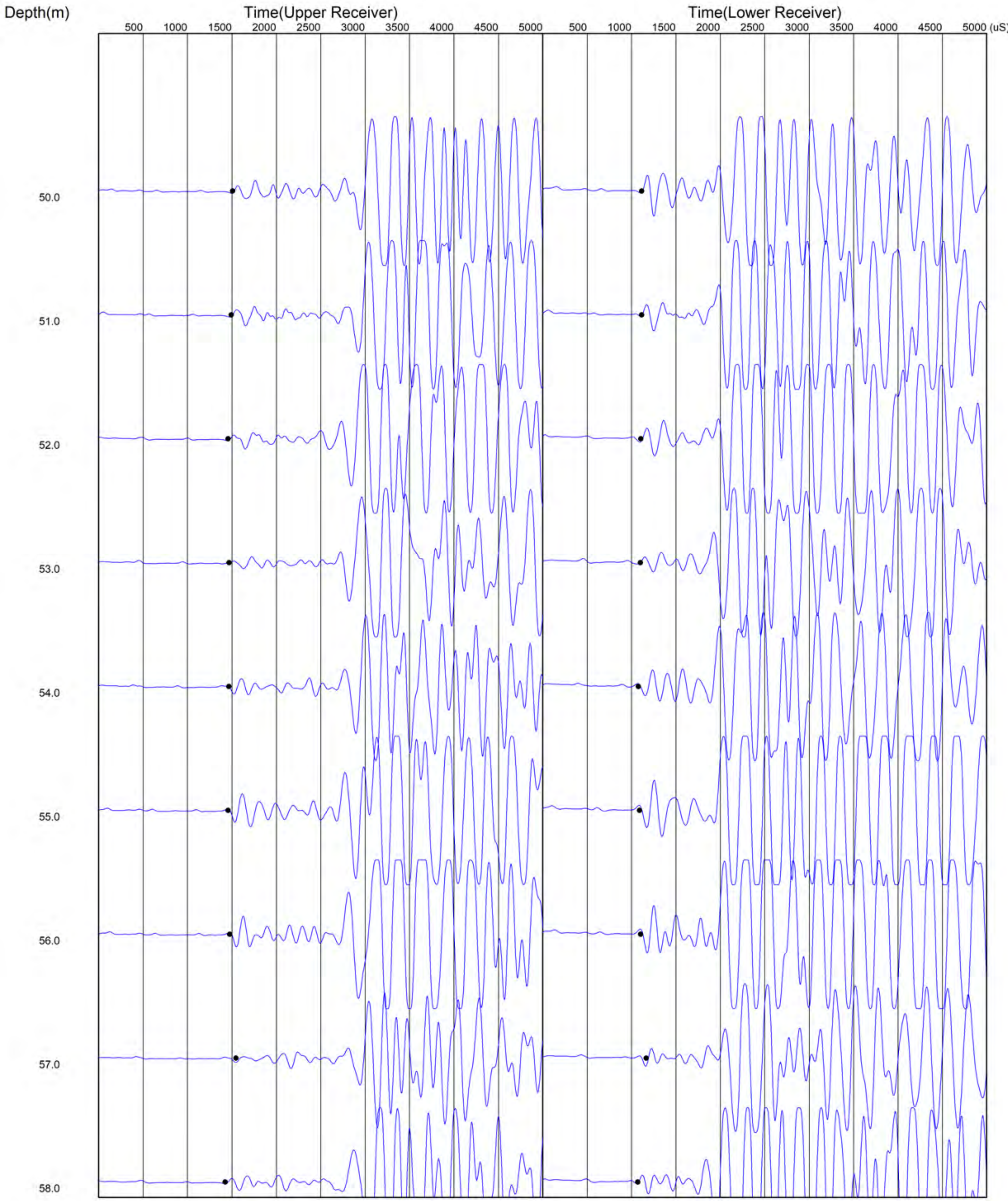
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0

P Wave



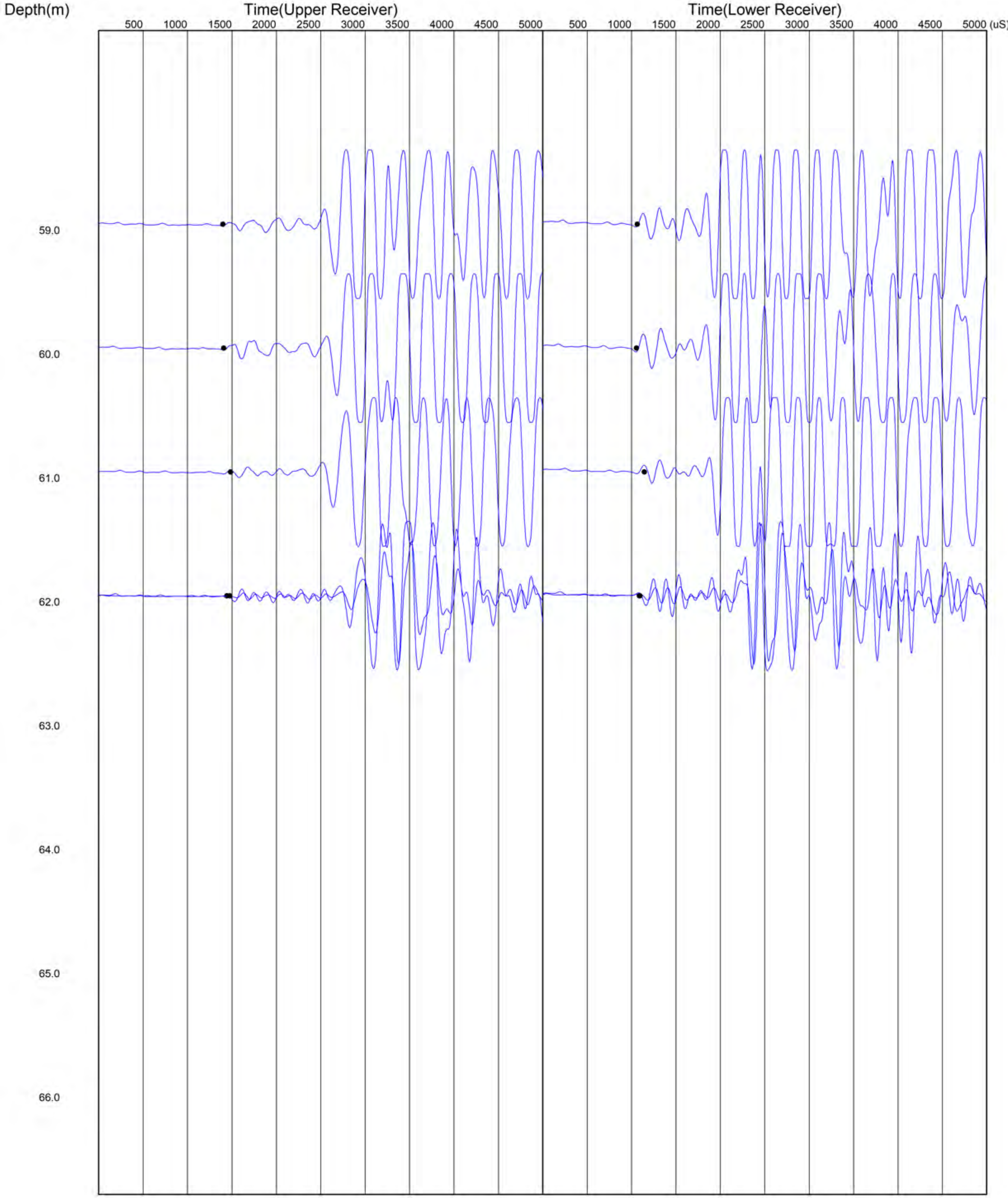
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
41.0
42.0
43.0
44.0
45.0
46.0
47.0
48.0
49.0

P Wave

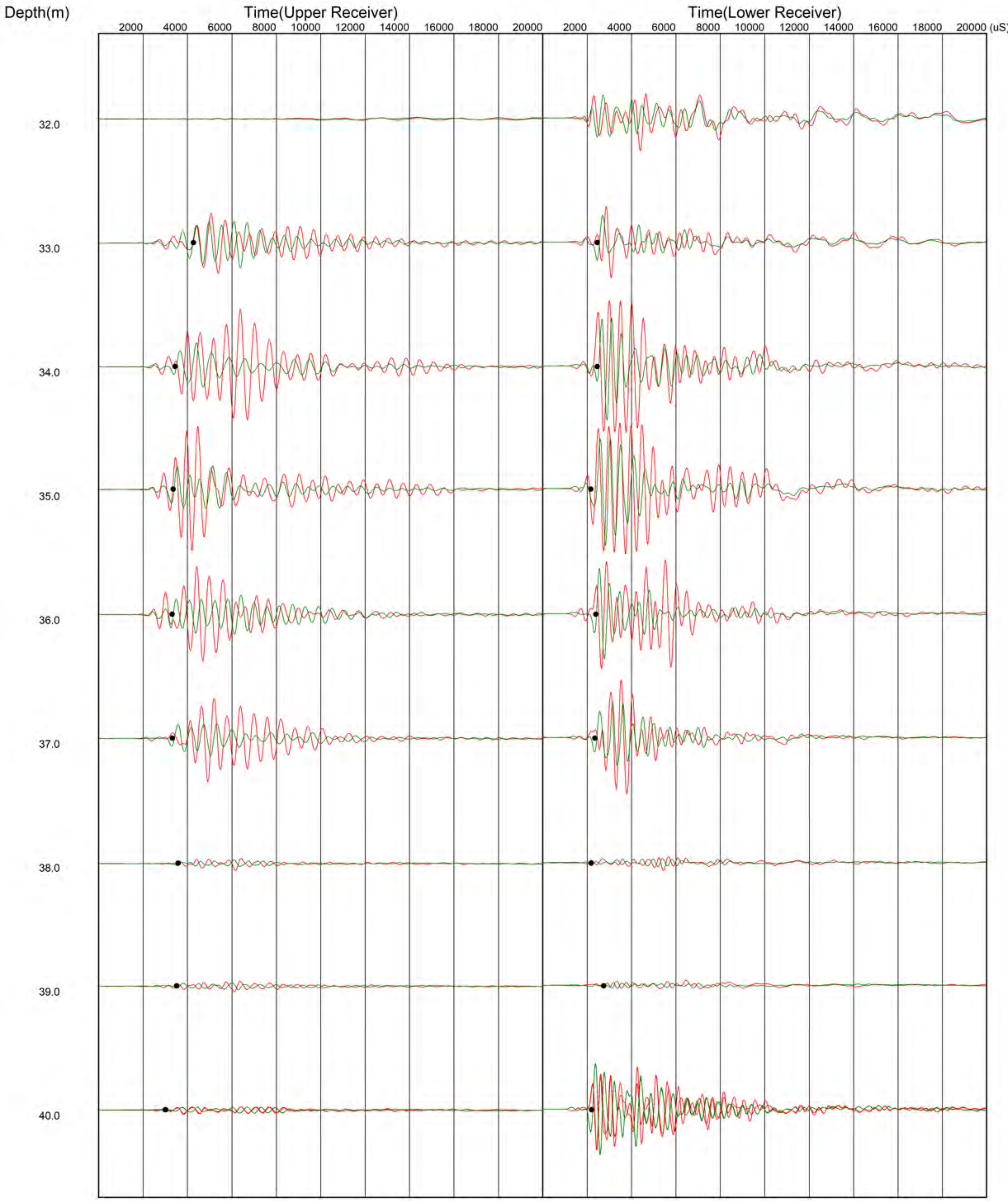


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
50.0
51.0
52.0
53.0
54.0
55.0
56.0
57.0
58.0

P Wave

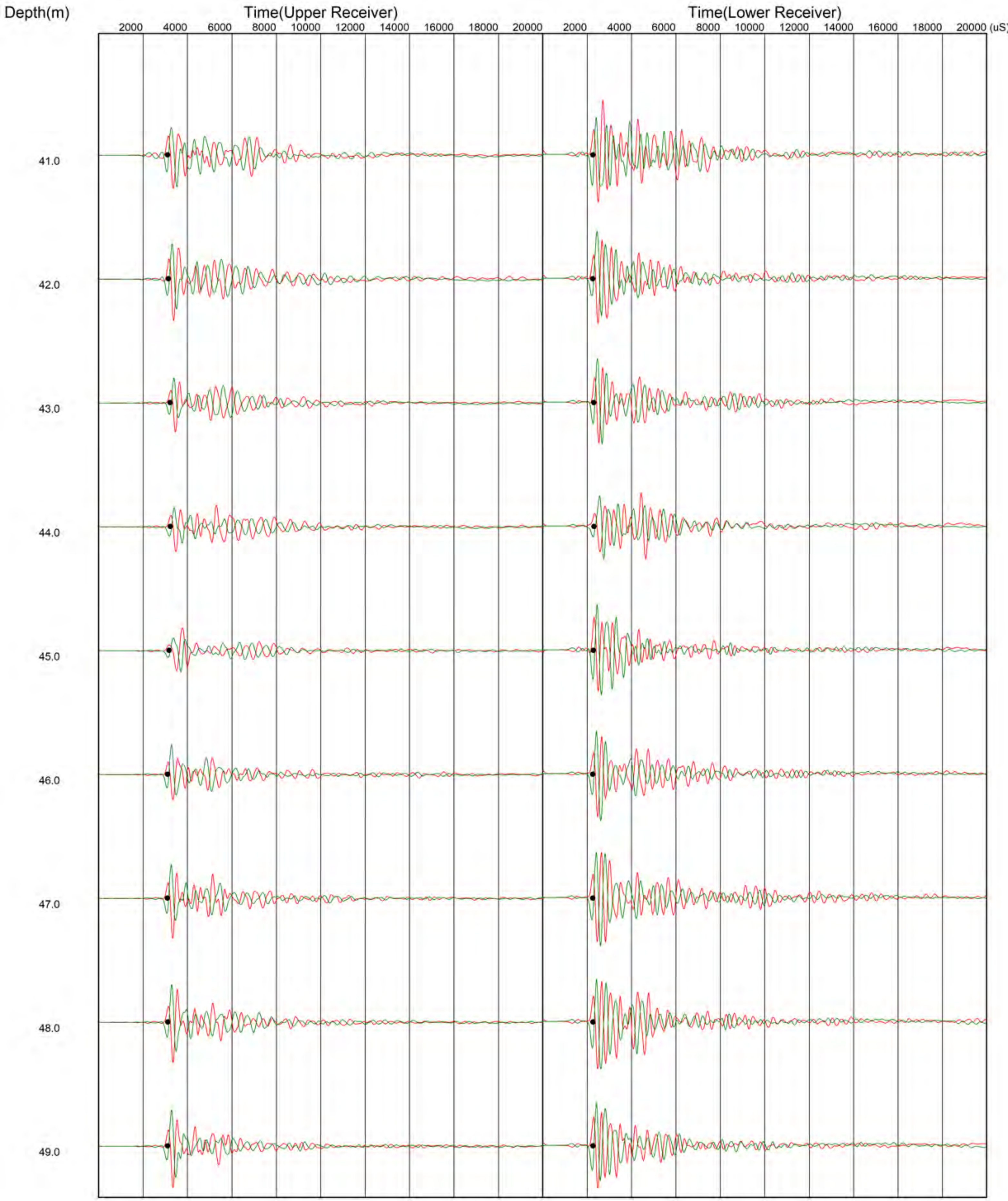

Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
59.0
60.0
61.0
62.0
63.0
64.0
65.0
66.0

S Wave



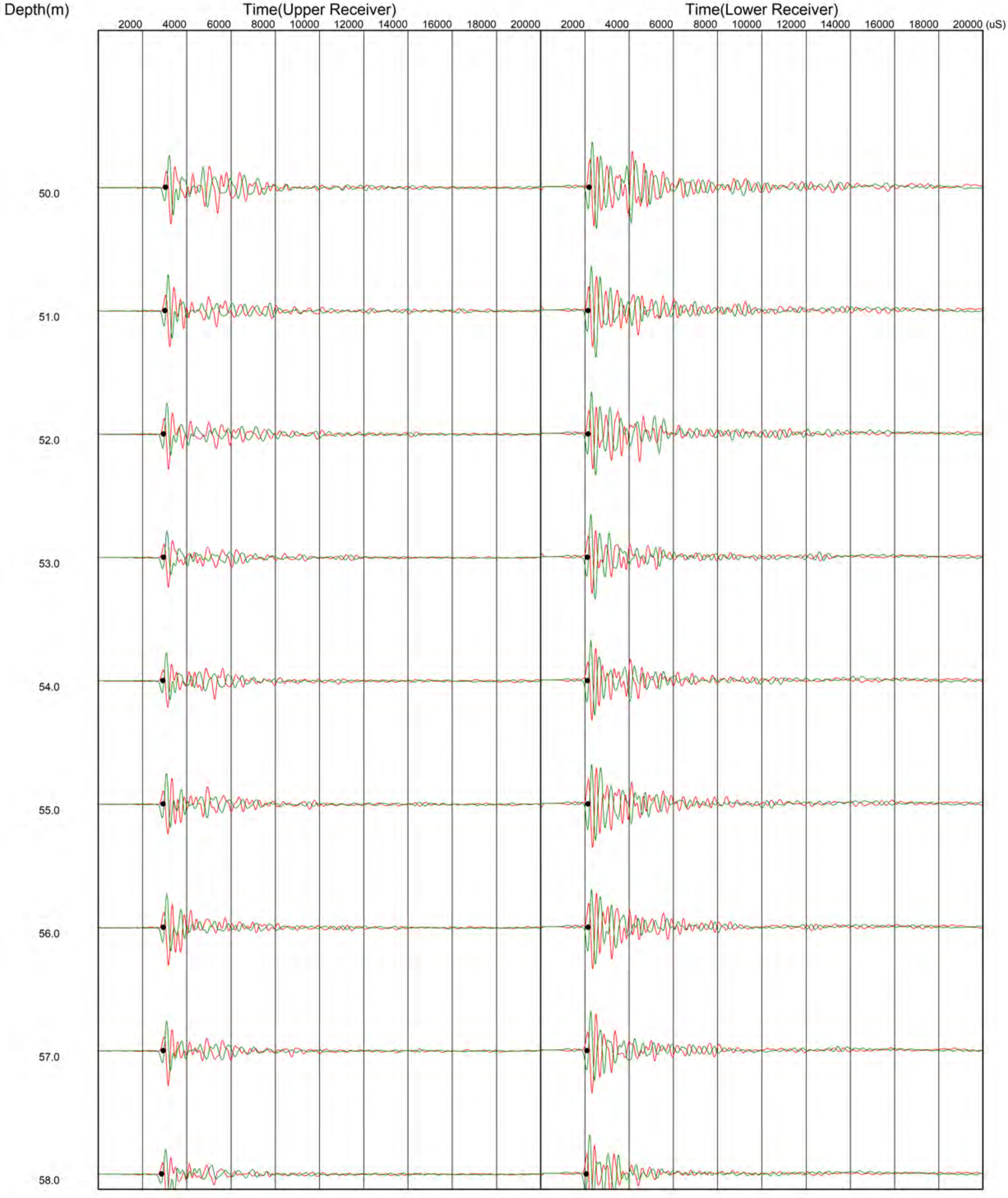
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
(uS)
32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0

S Wave

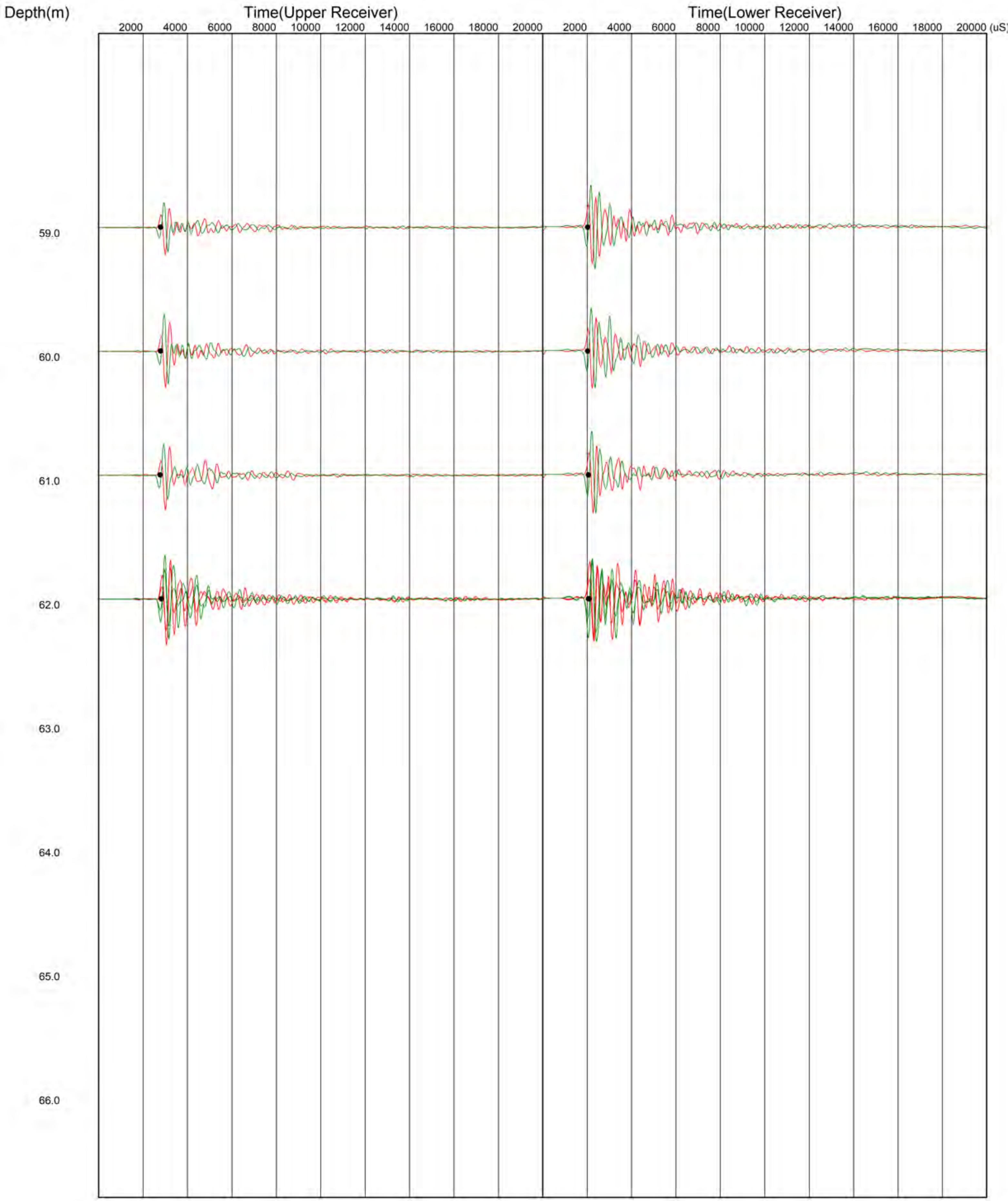


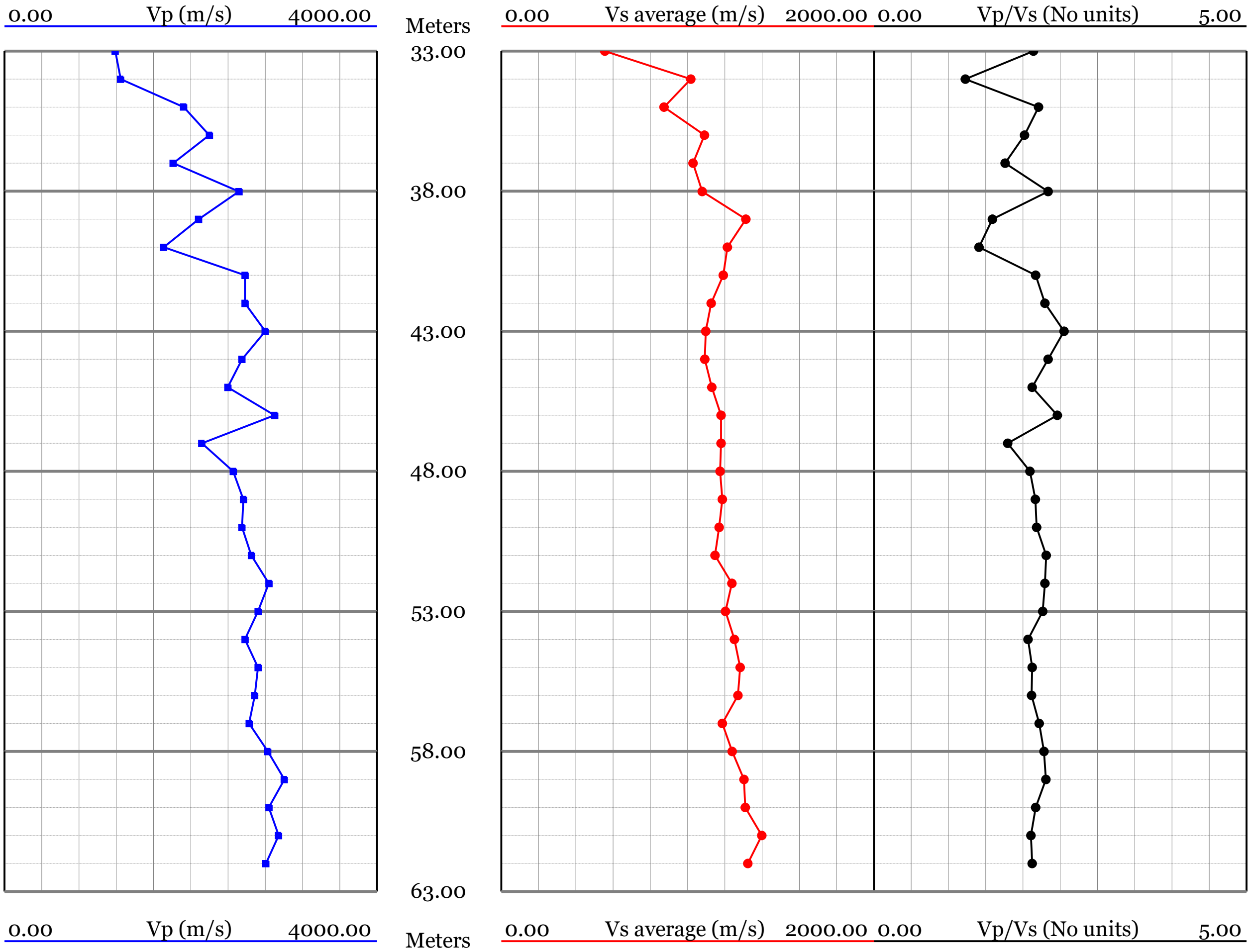
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
(uS)
41.0
42.0
43.0
44.0
45.0
46.0
47.0
48.0
49.0

S Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
(uS)
50.0
51.0
52.0
53.0
54.0
55.0
56.0
57.0
58.0

S Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
59.0
60.0
61.0
62.0
63.0
64.0
65.0
66.0


0.00
Vp (m/s)
4000.00
Meters
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00
33.00
38.00
43.00
48.00
53.00
58.00
63.00
0.00
Vp (m/s)
4000.00
Meters
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00

ROBERTSON GEO SERVICES
Unlocking Your GeoData

COMPANY	Structural Soils		
WELL ID	R71909		
FIELD	A303 Stonehenge		
COUNTRY	England	STATE	
LOCATION		OTHER SERVICES	
SEC	TWP	RGE	
PERMANENT DATUM	GL	ELEVATION	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.
DATE	14/09/18	TYPE FLUID IN HOLE	Water
RUN No	1	SALINITY	
TYPE LOG	Composite	DENSITY	
DEPTH-DRILLER	70	LEVEL	39.4
DEPTH-LOGGER	70.4	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	70.4		
TOP LOGGED INTERVAL	1.62	CASING SHOE	
OPERATING RIG TIME			
RECORDED BY	KO		
WITNESSED BY	AJ		

CO
WELL
FLD
CTY
STE
FILING No

BOREHOLE RECORD				CASING RECORD			
RUN NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

ROBERTSON GEO SERVICES
Unlocking Your GeoData

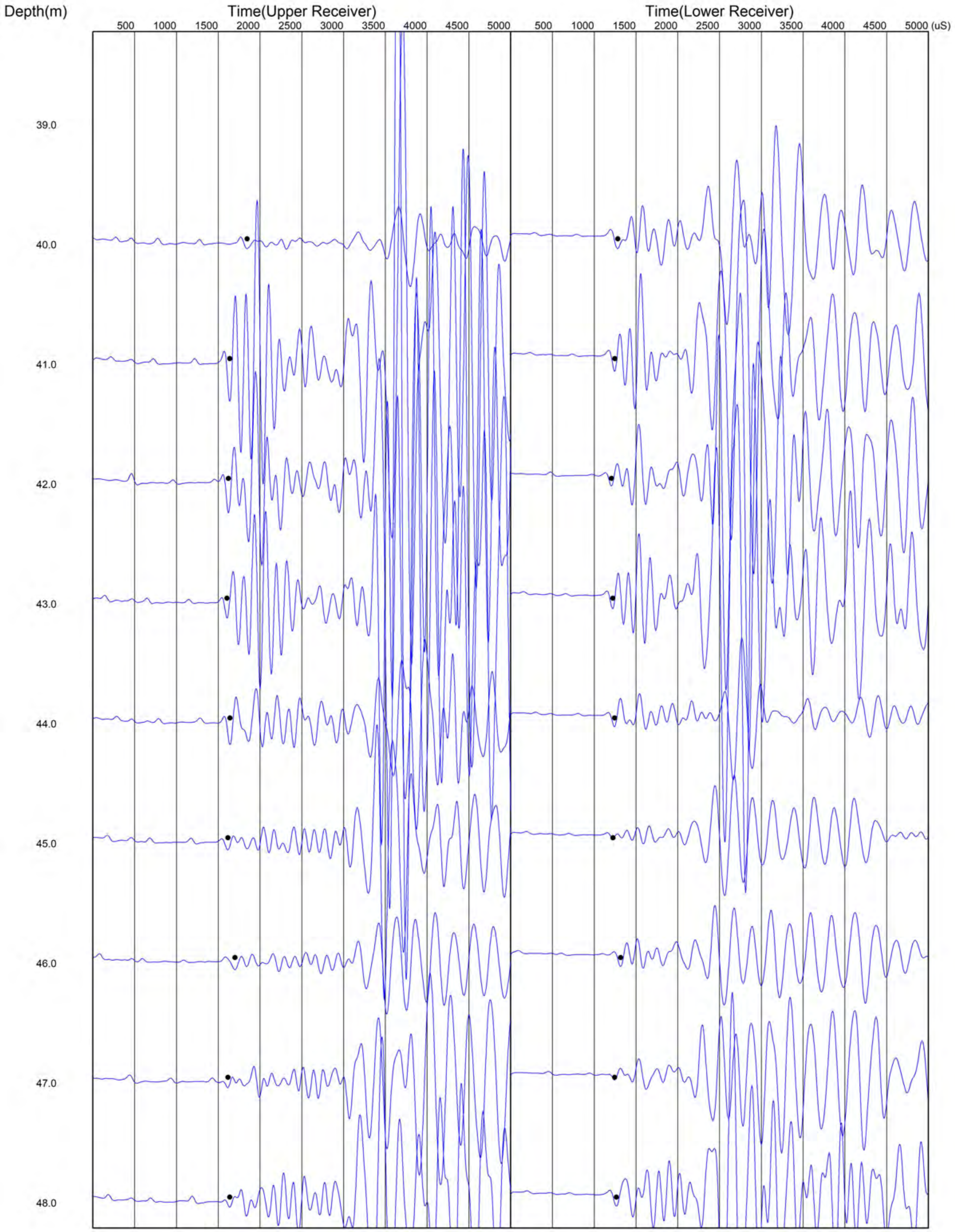
CO	COMPANY	Structural Soils	
WELL	WELL ID	R71909	
FLD	FIELD	A303 Stonehenge	
CTY	COUNTRY	England	STATE
STE	LOCATION		OTHER SERVICES
FILING No	SEC	TWP	RGE

PERMANENT DATUM	GL	ELEVATION	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.

DATE	14/09/18	TYPE FLUID IN HOLE	Water
RUN No		SALINITY	
TYPE LOG	HRFM	DENSITY	
DEPTH-DRILLER	70	LEVEL	39.4
DEPTH-LOGGER	68	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	68		
TOP LOGGED INTERVAL	35	CASING SHOE	
OPERATING RIG TIME			
RECORDED BY	AJ		
WITNESSED BY	KO		

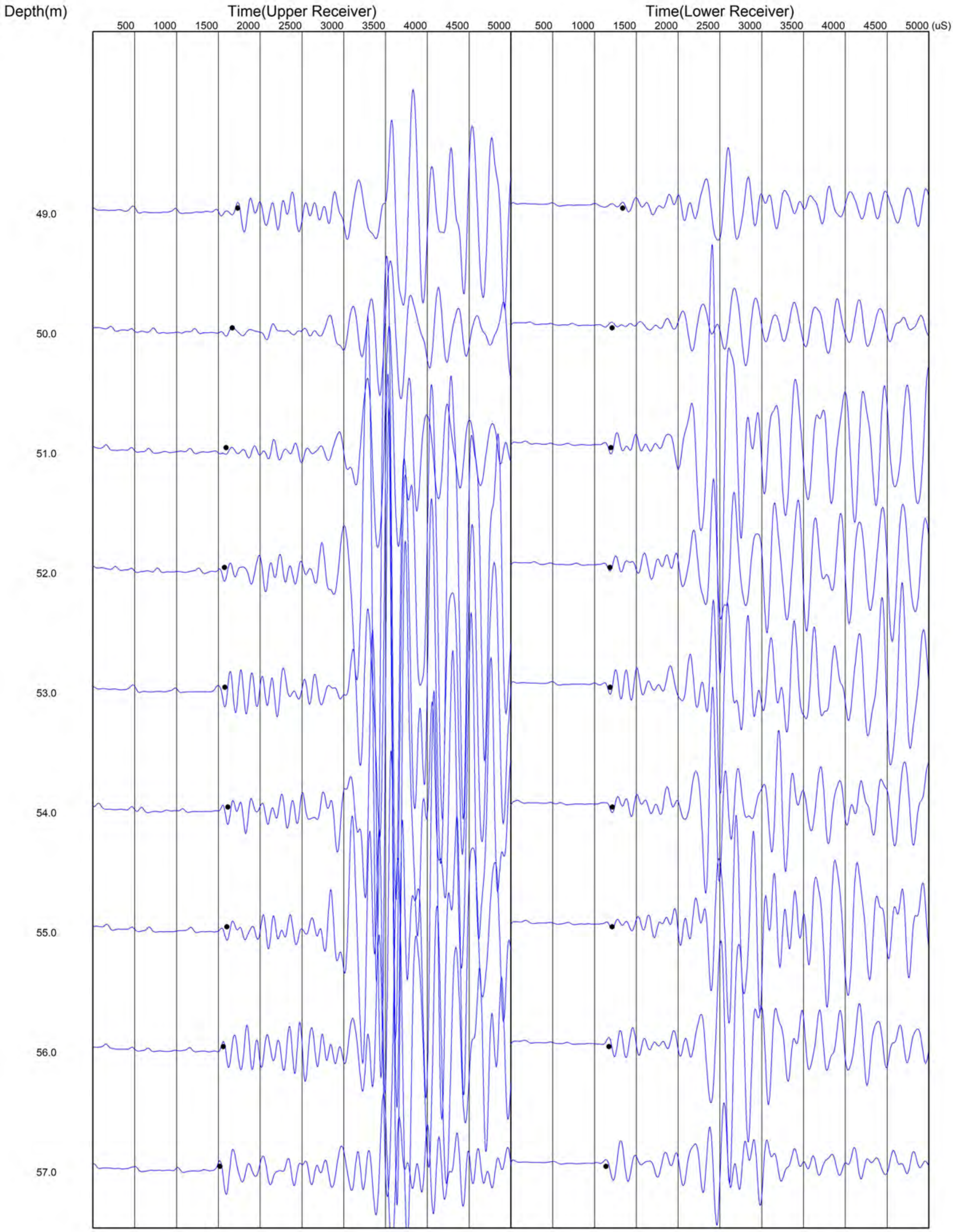
RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

P Wave



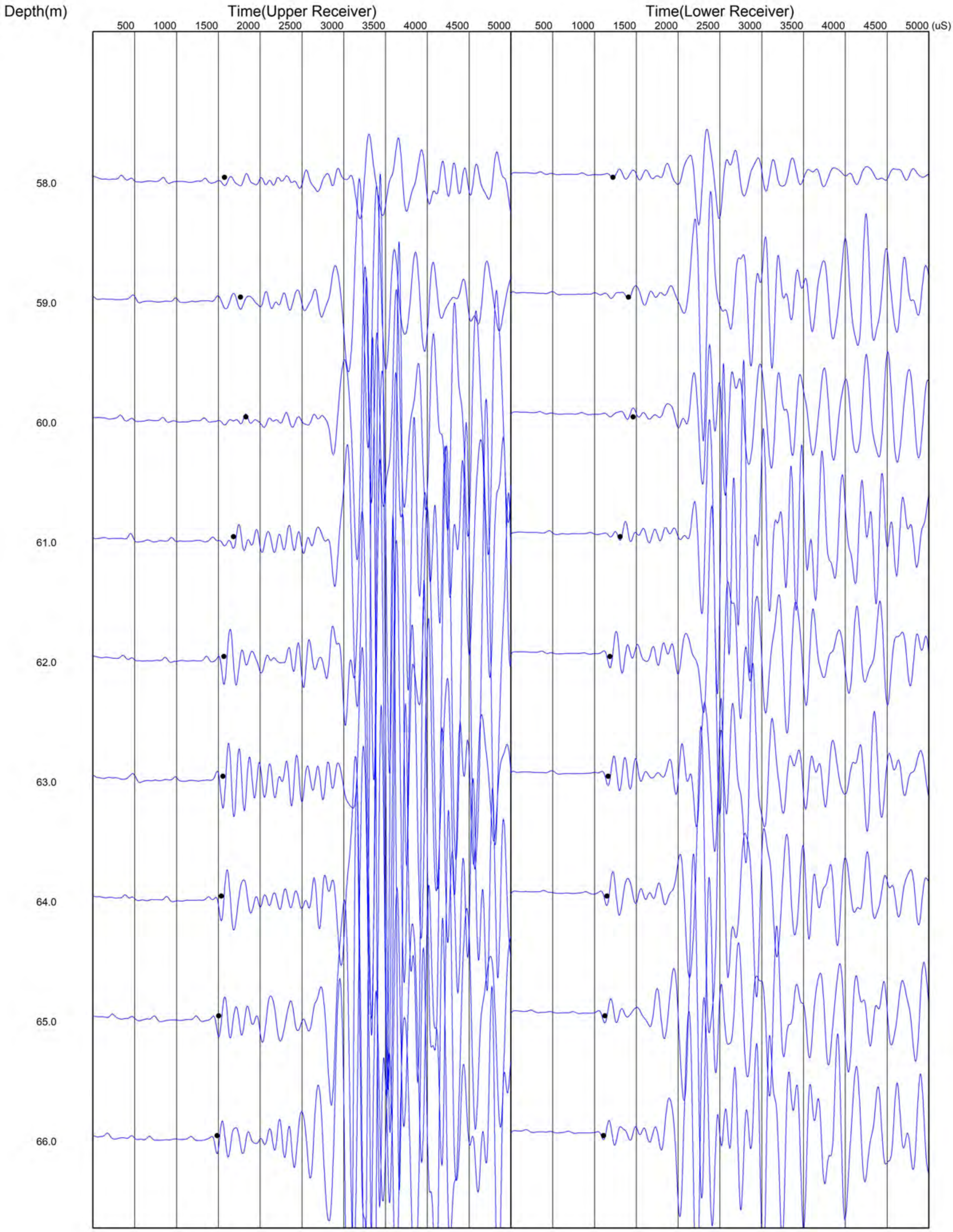
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
(uS)
39.0
40.0
41.0
42.0
43.0
44.0
45.0
46.0
47.0
48.0

P Wave

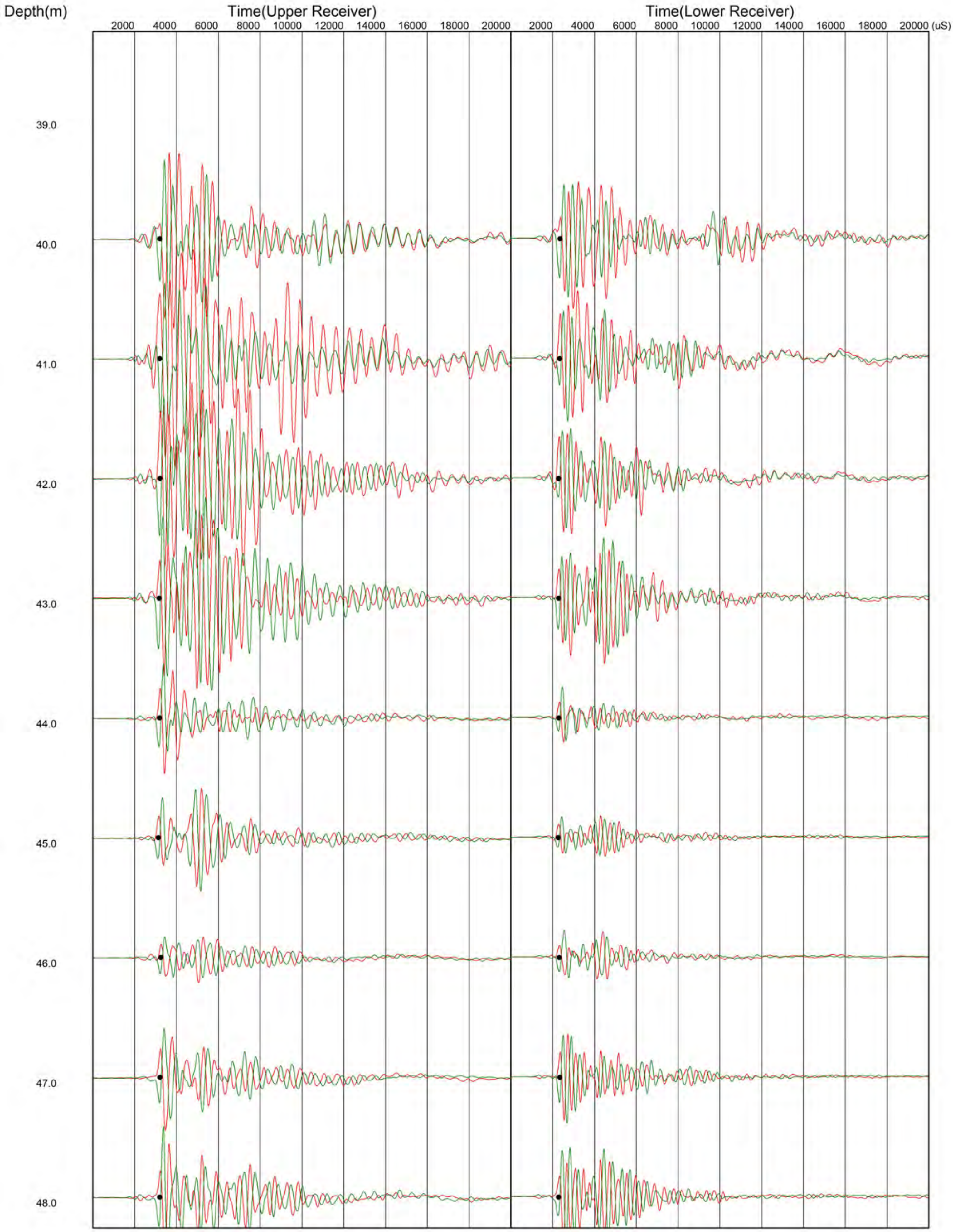


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
500
1000
1500
2000
2500
3000
3500
4000
4500
5000 (uS)
49.0
50.0
51.0
52.0
53.0
54.0
55.0
56.0
57.0

P Wave

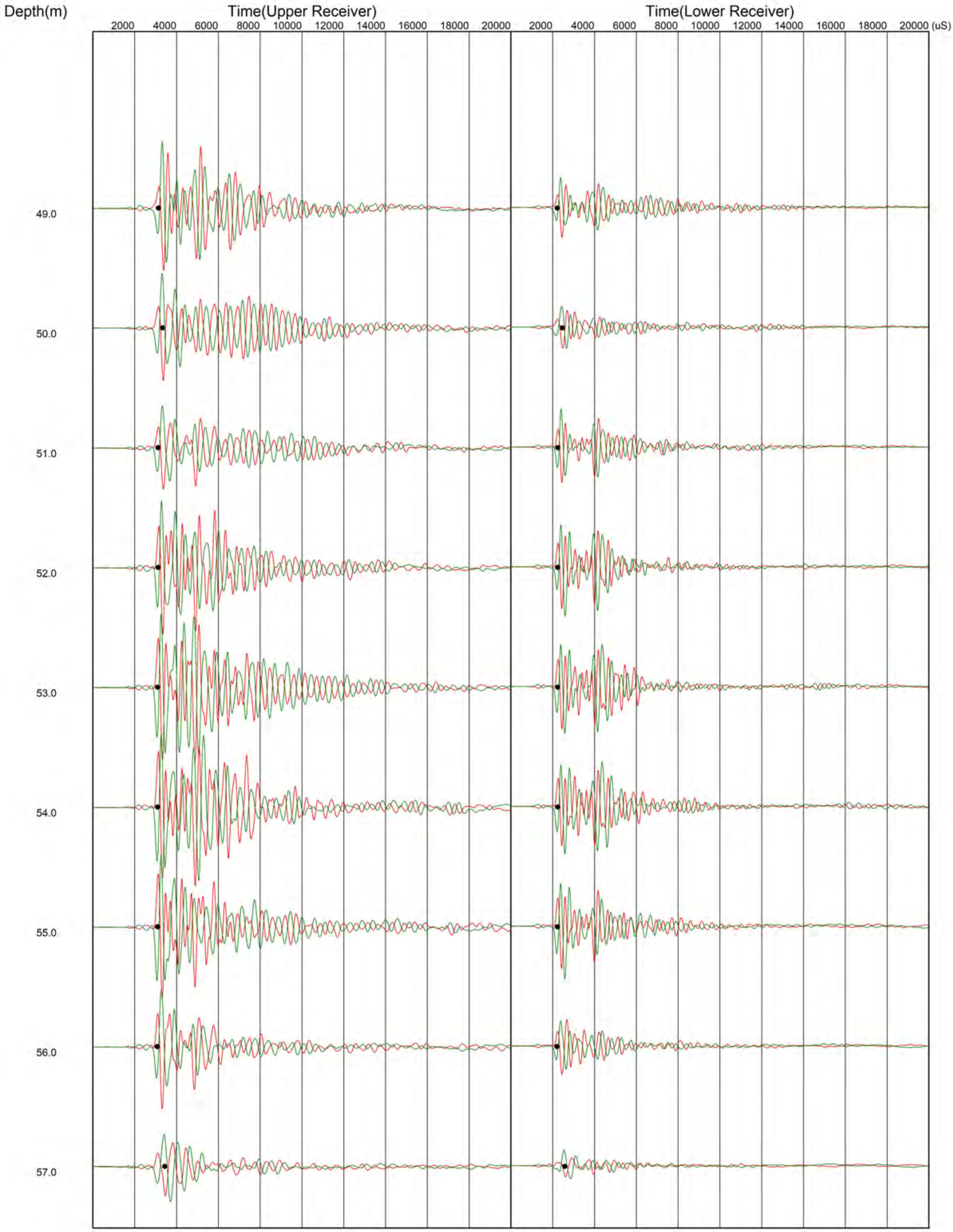

Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
58.0
59.0
60.0
61.0
62.0
63.0
64.0
65.0
66.0

S Wave

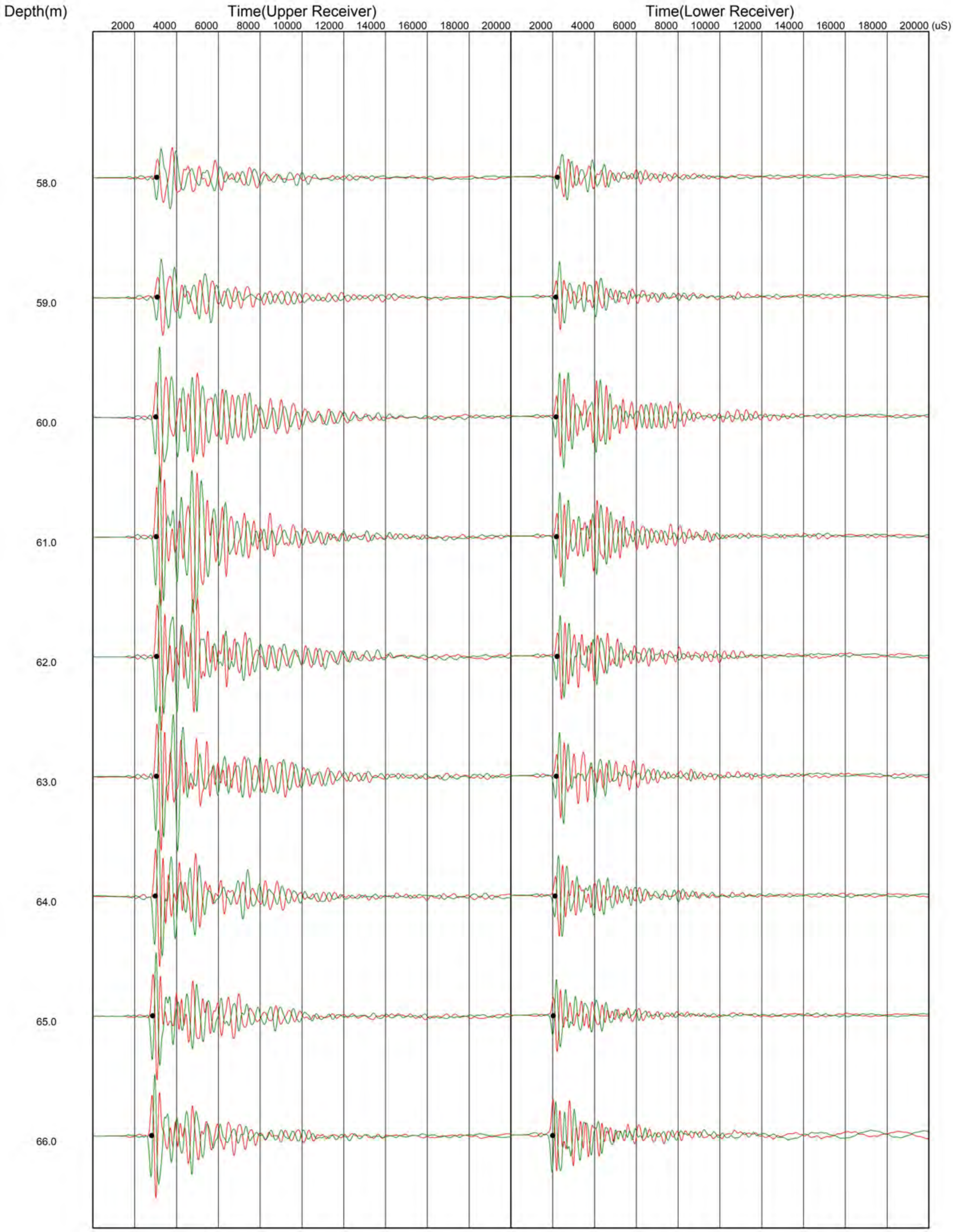


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
39.0
40.0
41.0
42.0
43.0
44.0
45.0
46.0
47.0
48.0

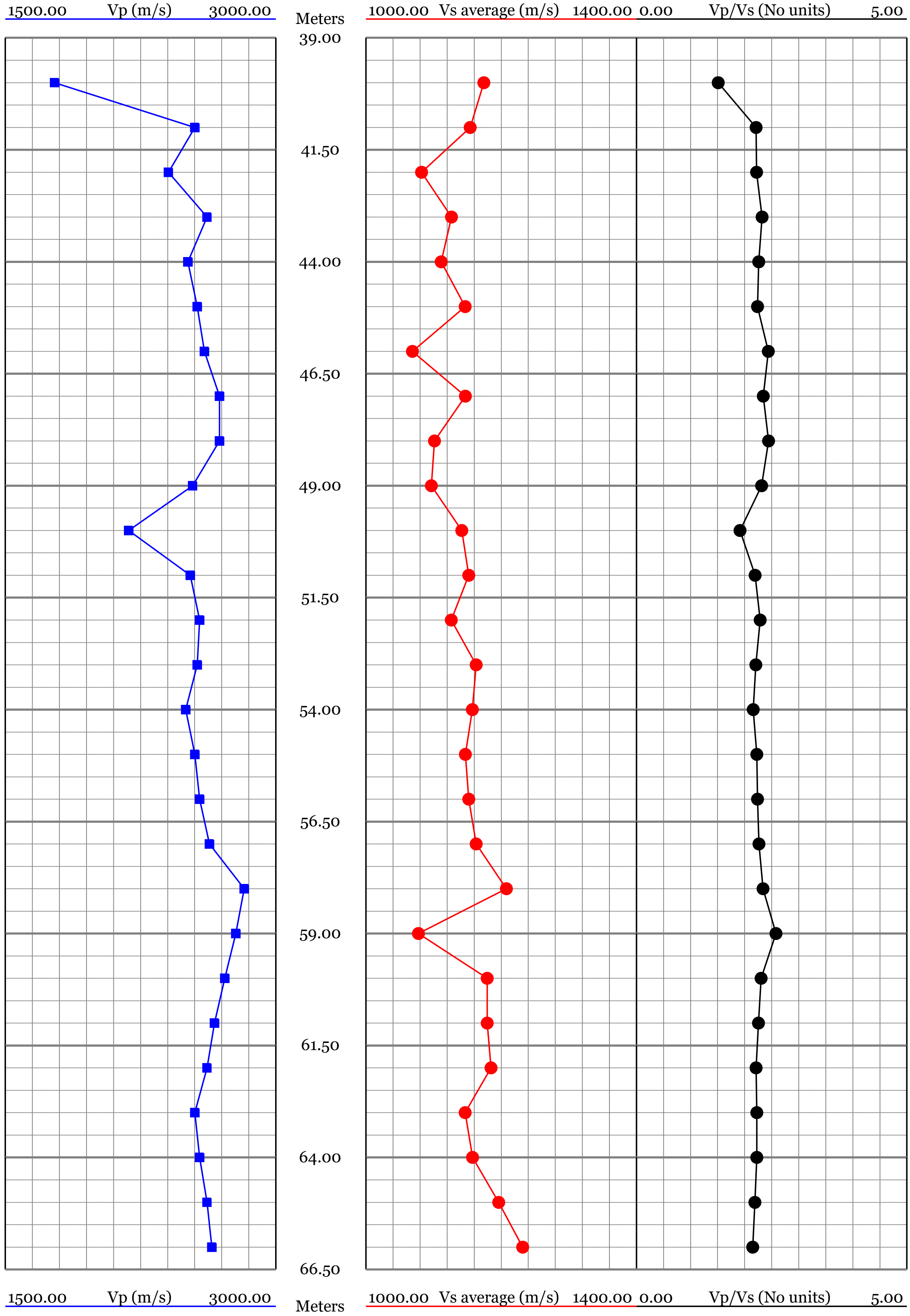
S Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
49.0
50.0
51.0
52.0
53.0
54.0
55.0
56.0
57.0

S Wave



Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
58.0
59.0
60.0
61.0
62.0
63.0
64.0
65.0
66.0

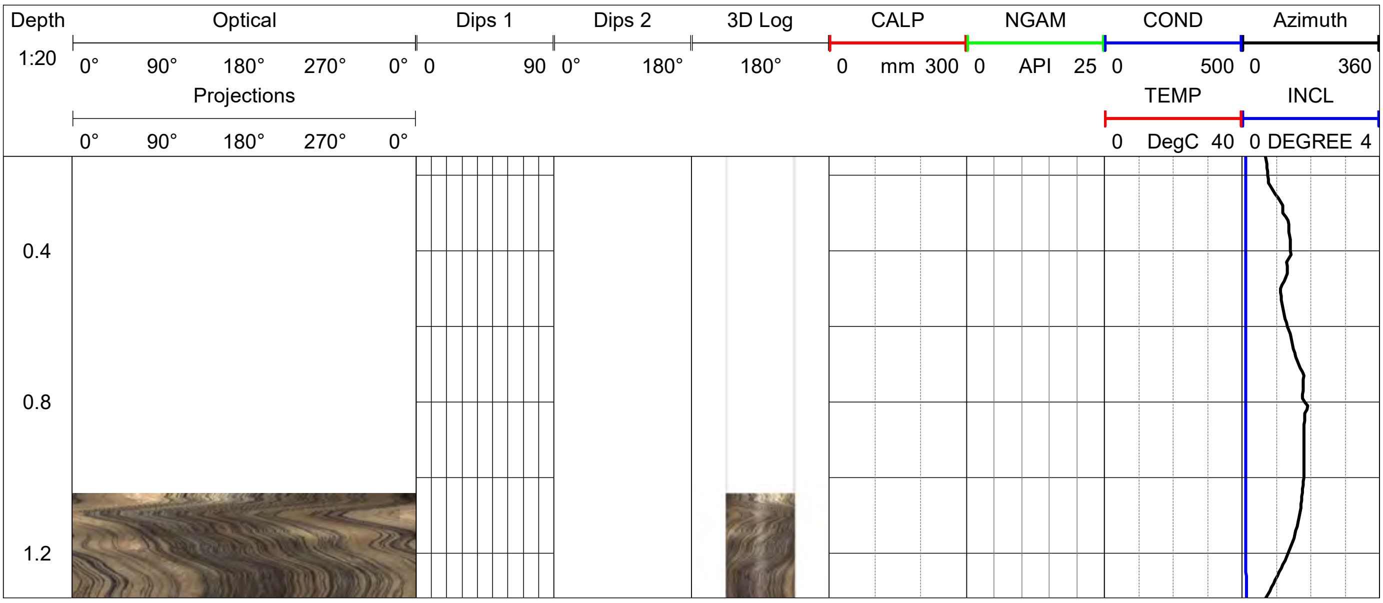


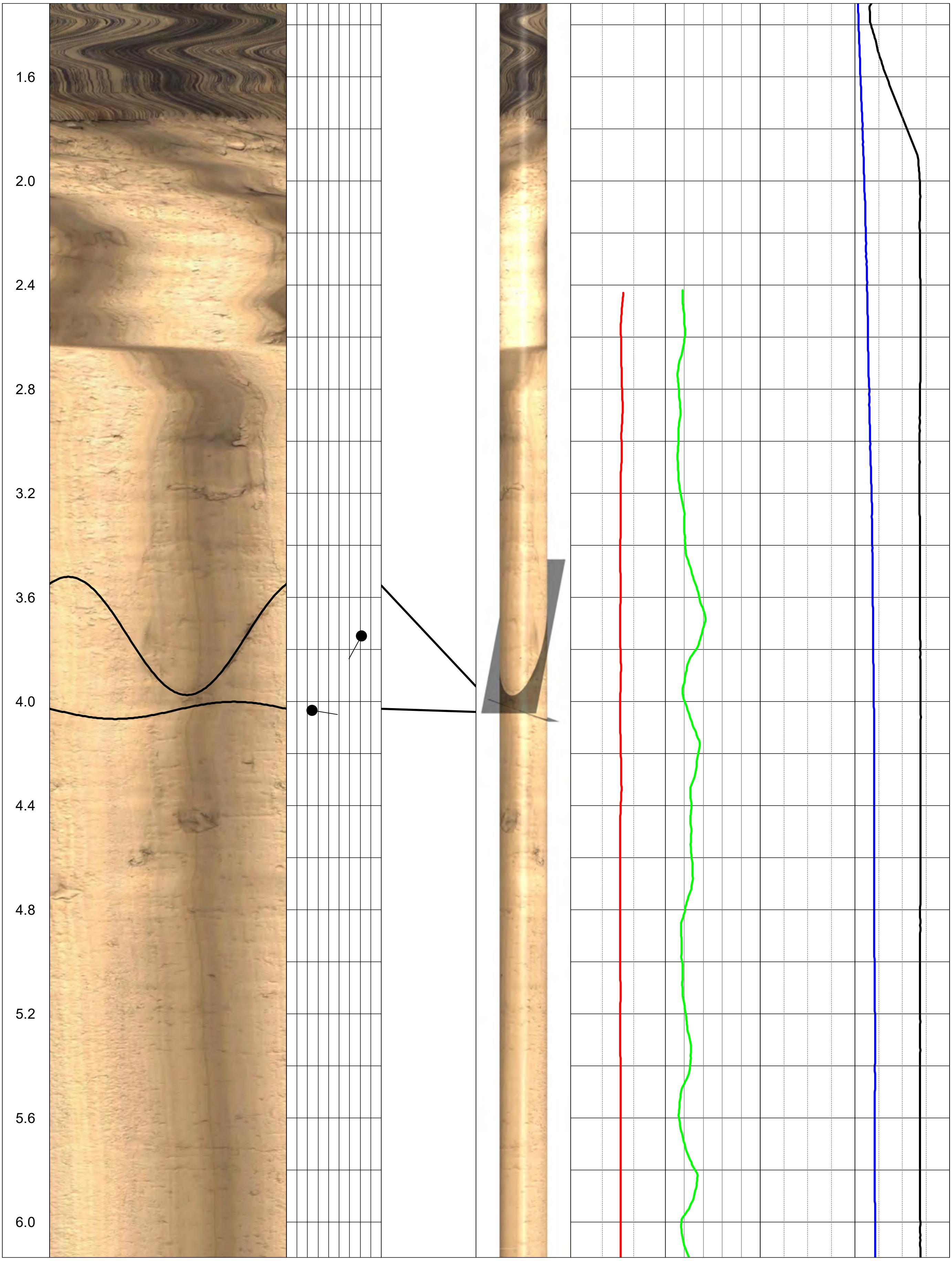
1500.00 Vp (m/s) 3000.00
Meters
1000.00 Vs average (m/s) 1400.00
0.00 Vp/Vs (No units) 5.00
39.00
41.50
44.00
46.50
49.00
51.50
54.00
56.50
59.00
61.50
64.00
66.50

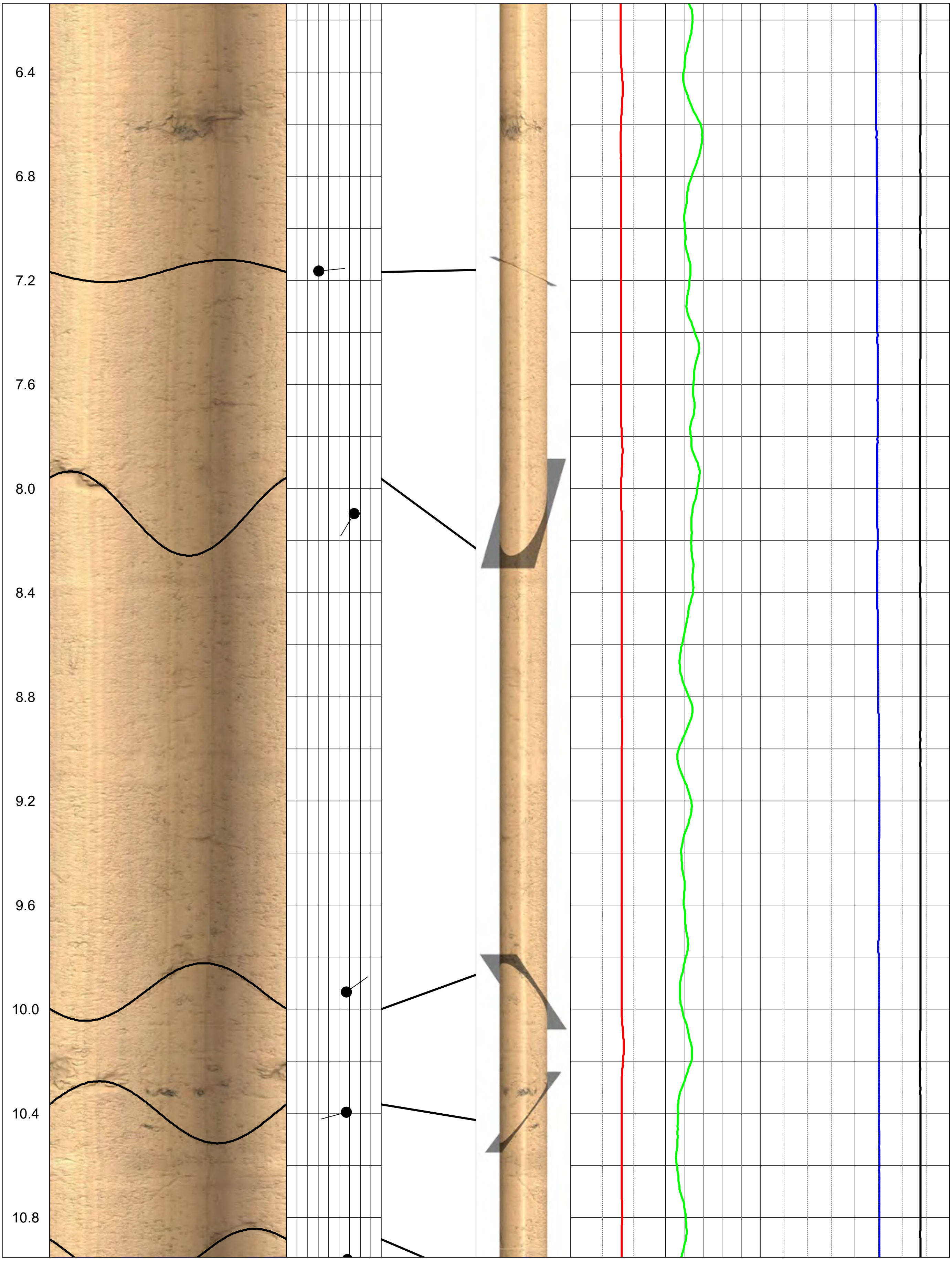
ROBERTSON® GEO SERVICES
Unlocking Your GeoData

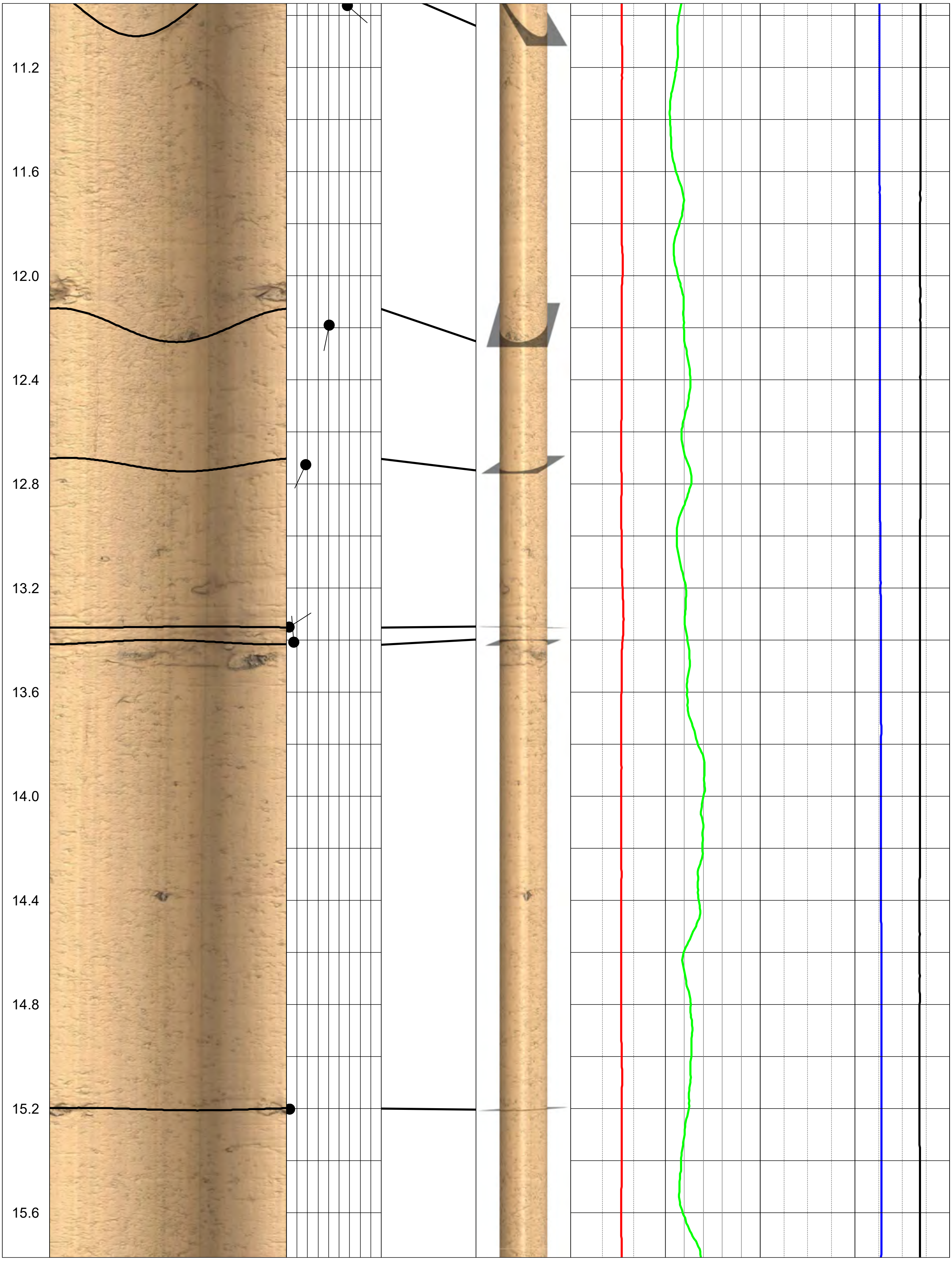
CO			
WELL			
FLD			
CTY			
STE			
FILING No			
COMPANY	Structural Soils		
WELL ID	R71911		
FIELD	A303 Stonehenge		
COUNTRY	England	STATE	
LOCATION			OTHER SERVICES
SEC	TWP	RGE	
PERMANENT DATUM	GL	ELEVATION	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.
DATE	14/09/18	TYPE FLUID IN HOLE	Water
RUN No	1	SALINITY	
TYPE LOG	Composite	DENSITY	
DEPTH-DRILLER	67	LEVEL	42.8
DEPTH-LOGGER	66.86	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	66.86		
TOP LOGGED INTERVAL	1.62	CASING SHOE	
OPERATING RIG TIME			
RECORDED BY	KO		
WITNESSED BY	AJ		

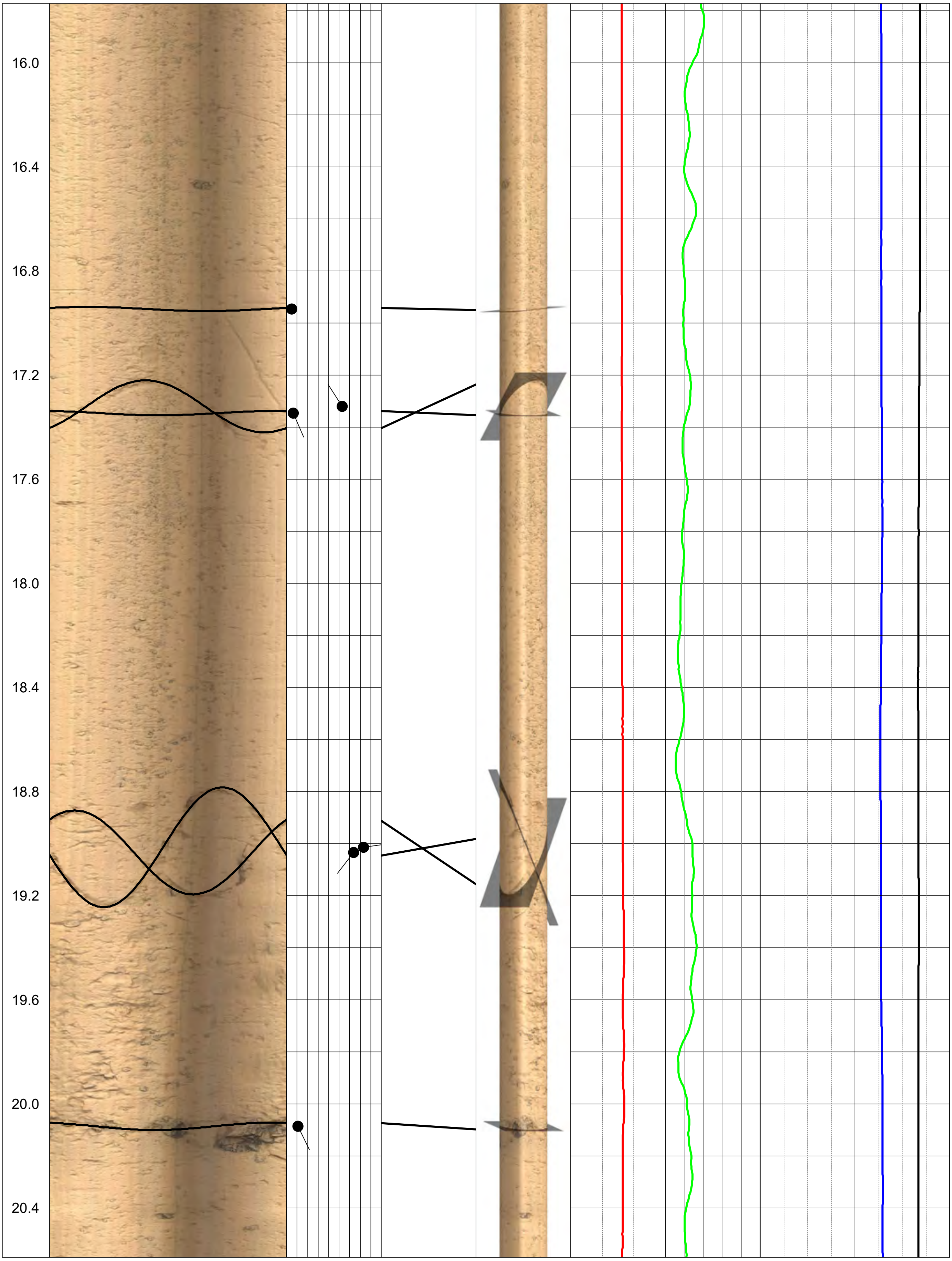
RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

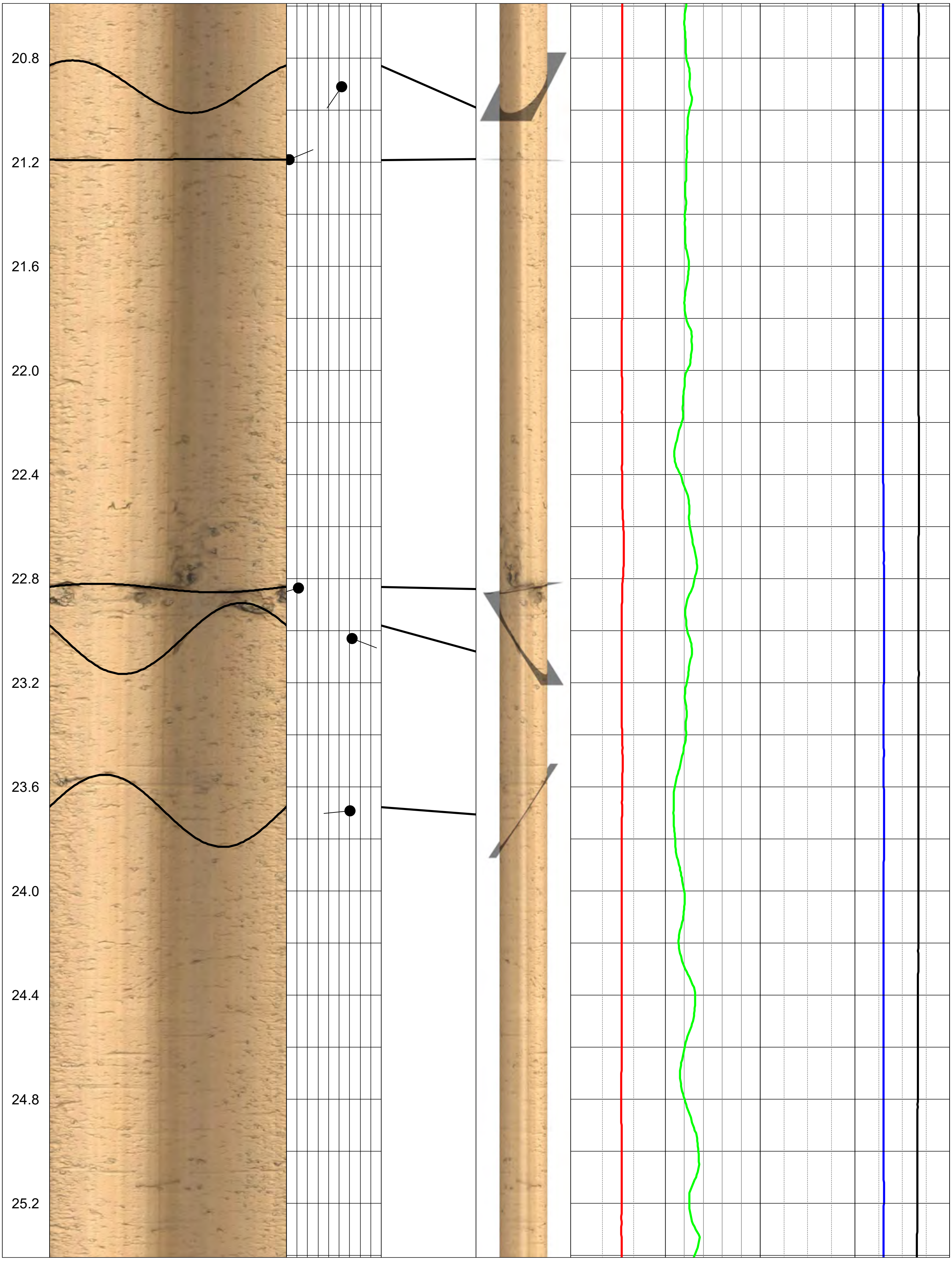


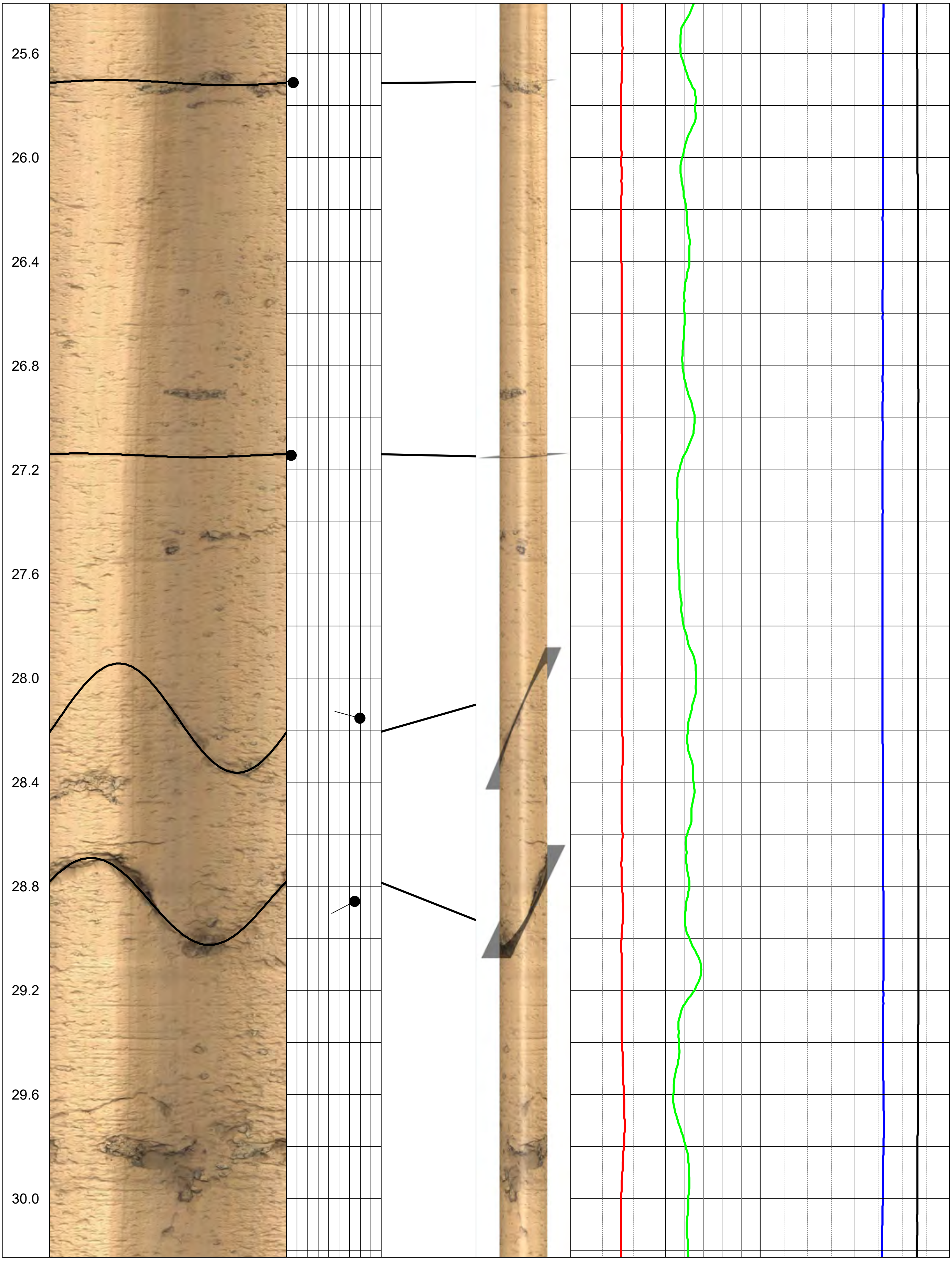

1.6
2.0
2.4
2.8
3.2
3.6
4.0
4.4
4.8
5.2
5.6
6.0

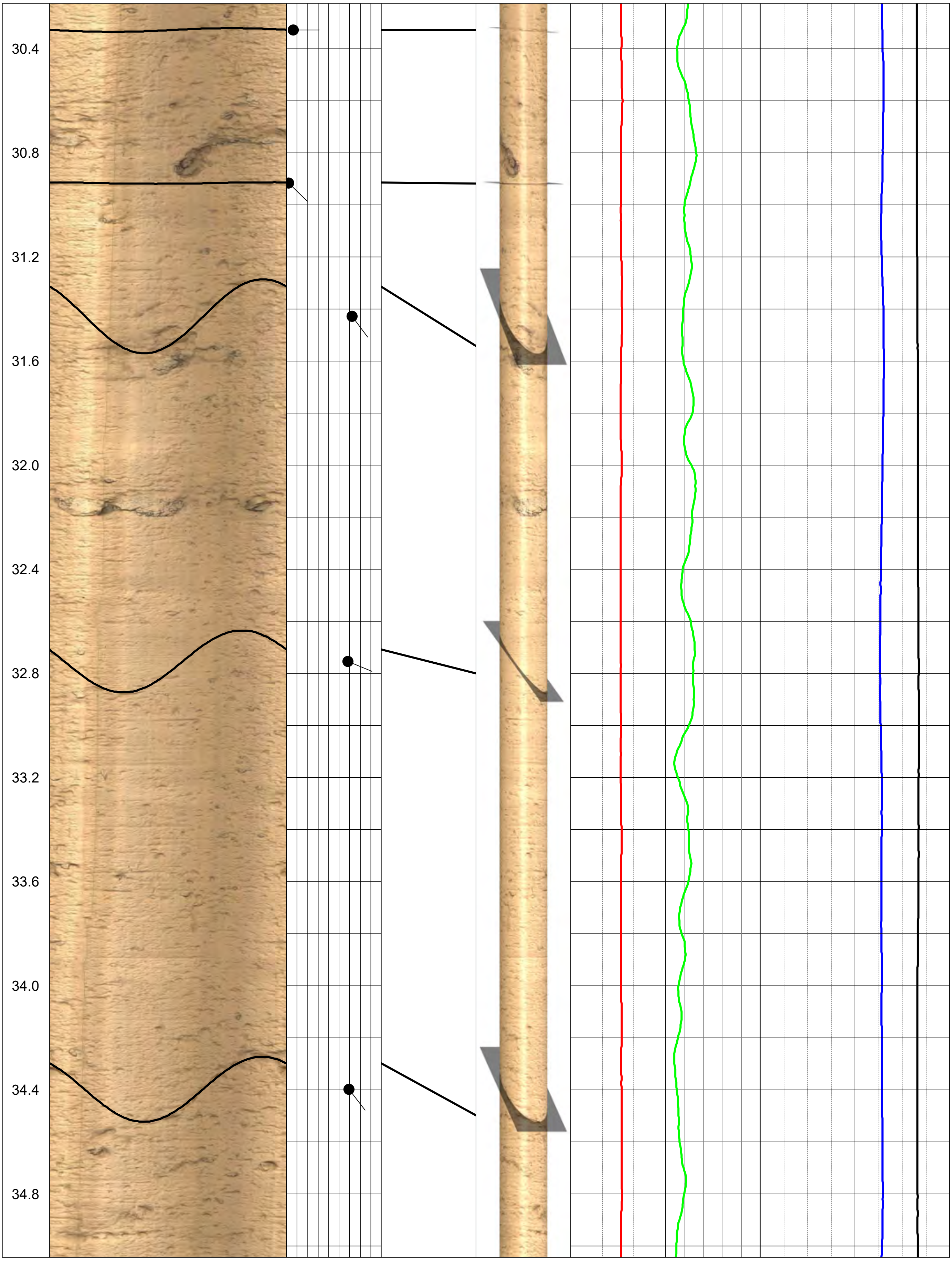

6.4
6.8
7.2
7.6
8.0
8.4
8.8
9.2
9.6
10.0
10.4
10.8

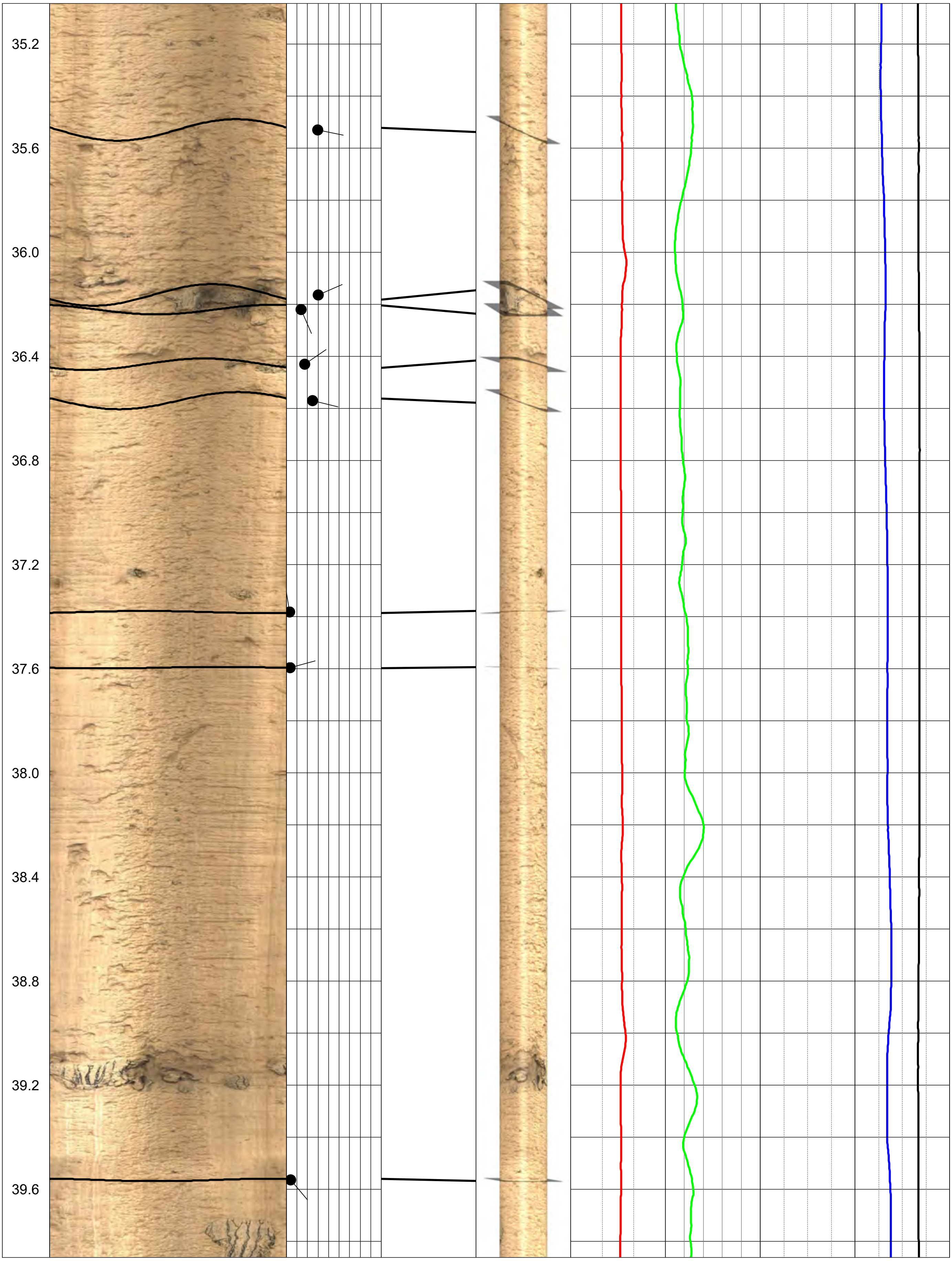

11.2
11.6
12.0
12.4
12.8
13.2
13.6
14.0
14.4
14.8
15.2
15.6


16.0
16.4
16.8
17.2
17.6
18.0
18.4
18.8
19.2
19.6
20.0
20.4

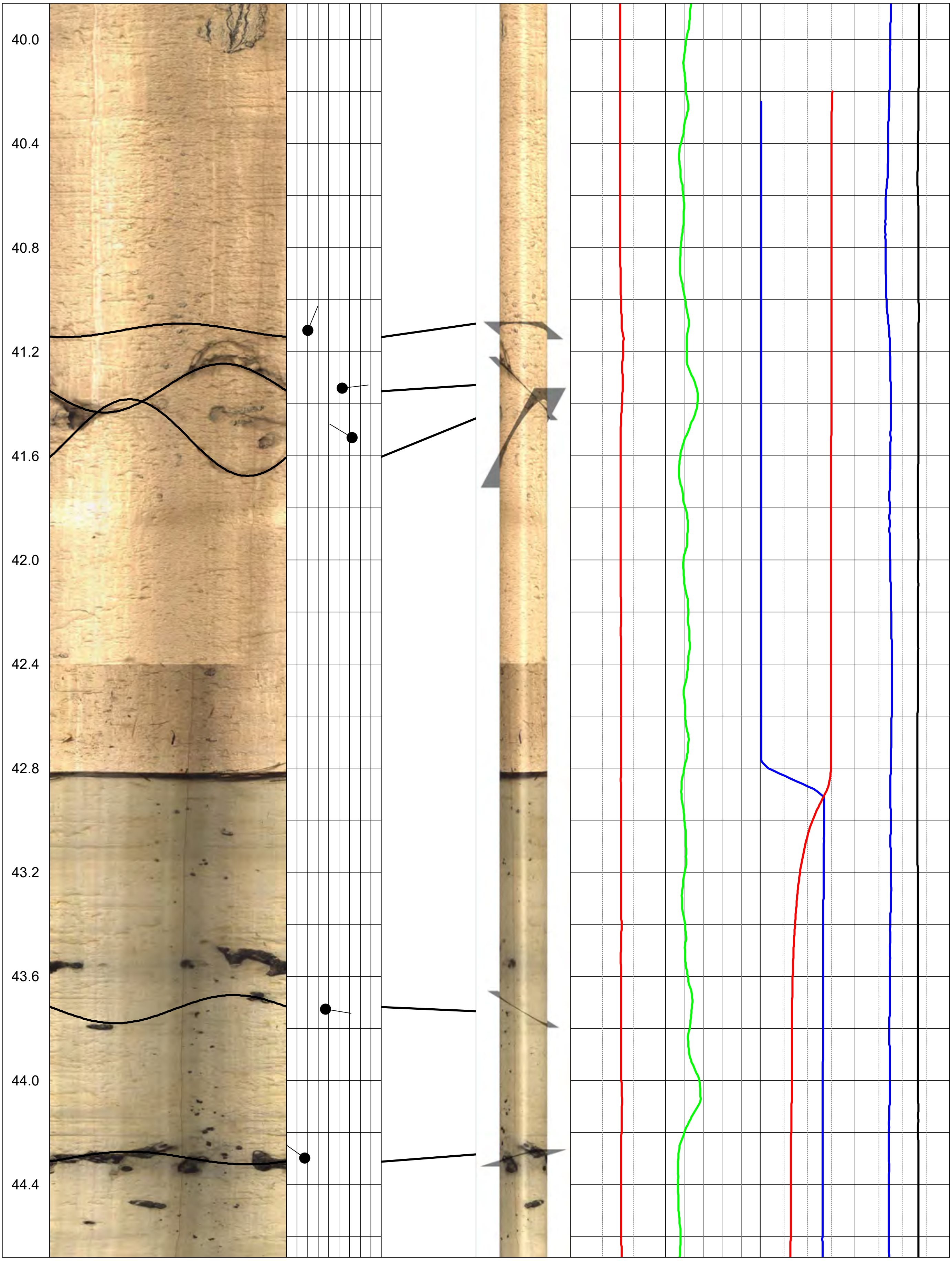

20.8
21.2
21.6
22.0
22.4
22.8
23.2
23.6
24.0
24.4
24.8
25.2

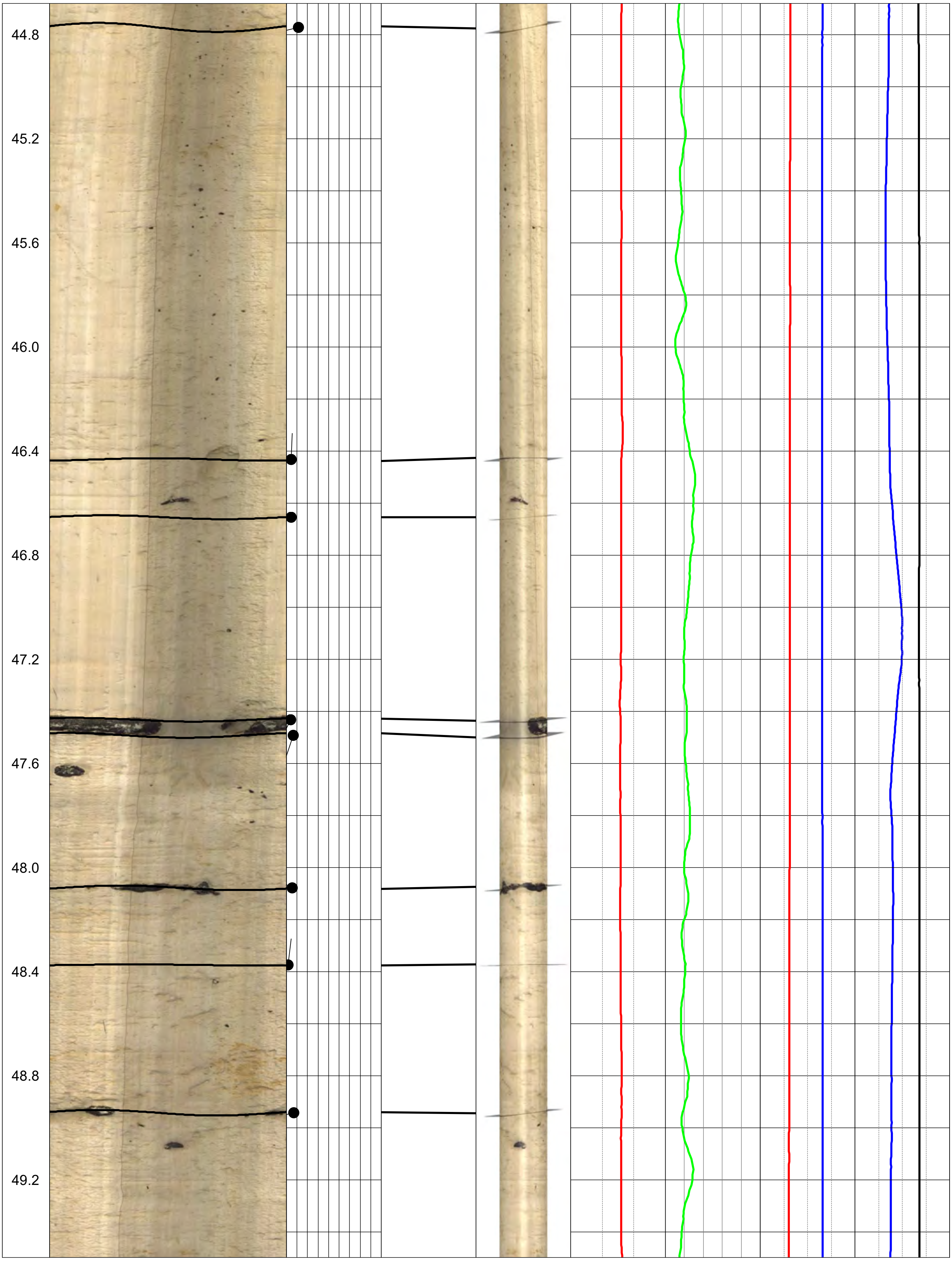

25.6
26.0
26.4
26.8
27.2
27.6
28.0
28.4
28.8
29.2
29.6
30.0

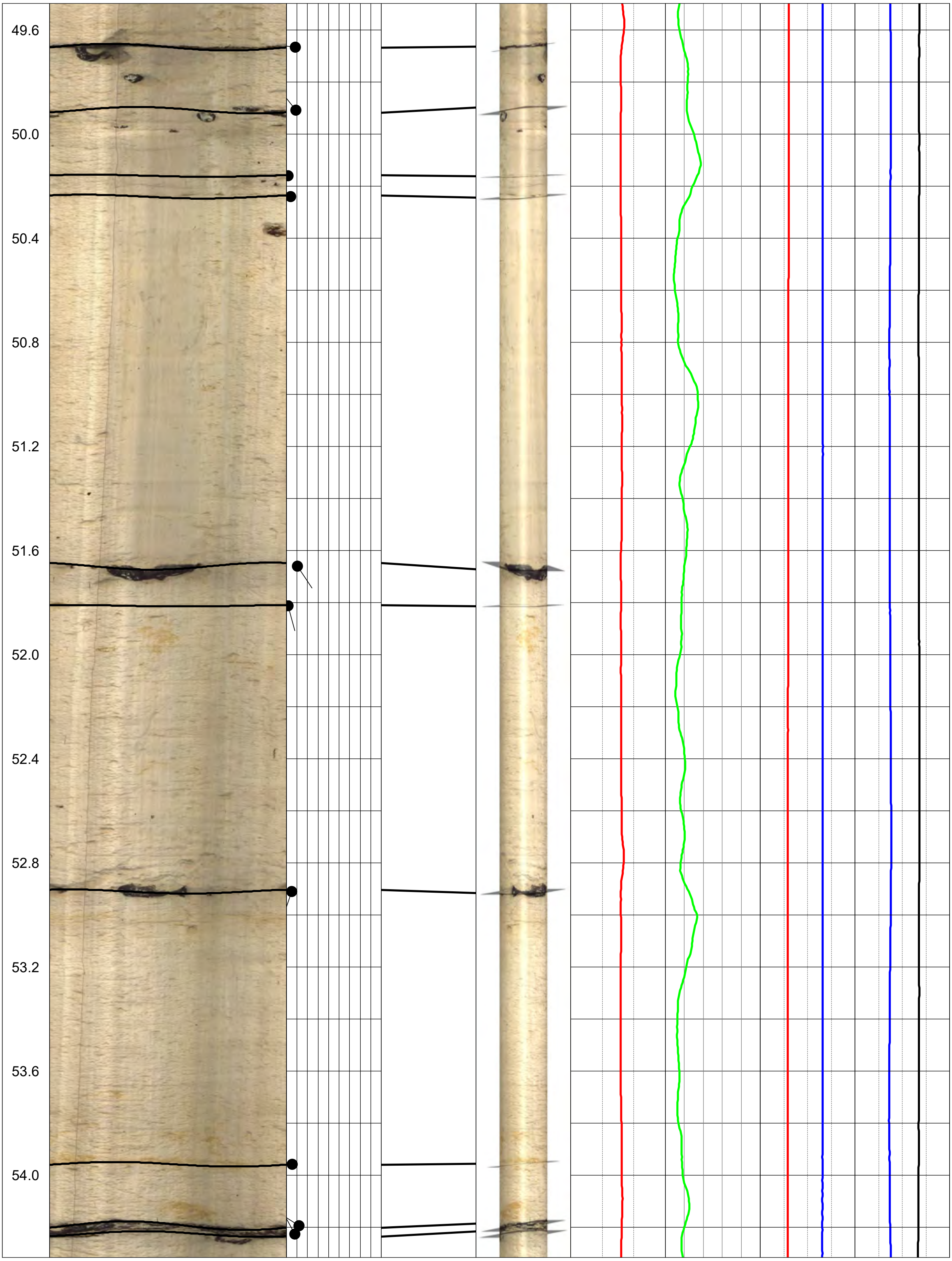

30.4
30.8
31.2
31.6
32.0
32.4
32.8
33.2
33.6
34.0
34.4
34.8

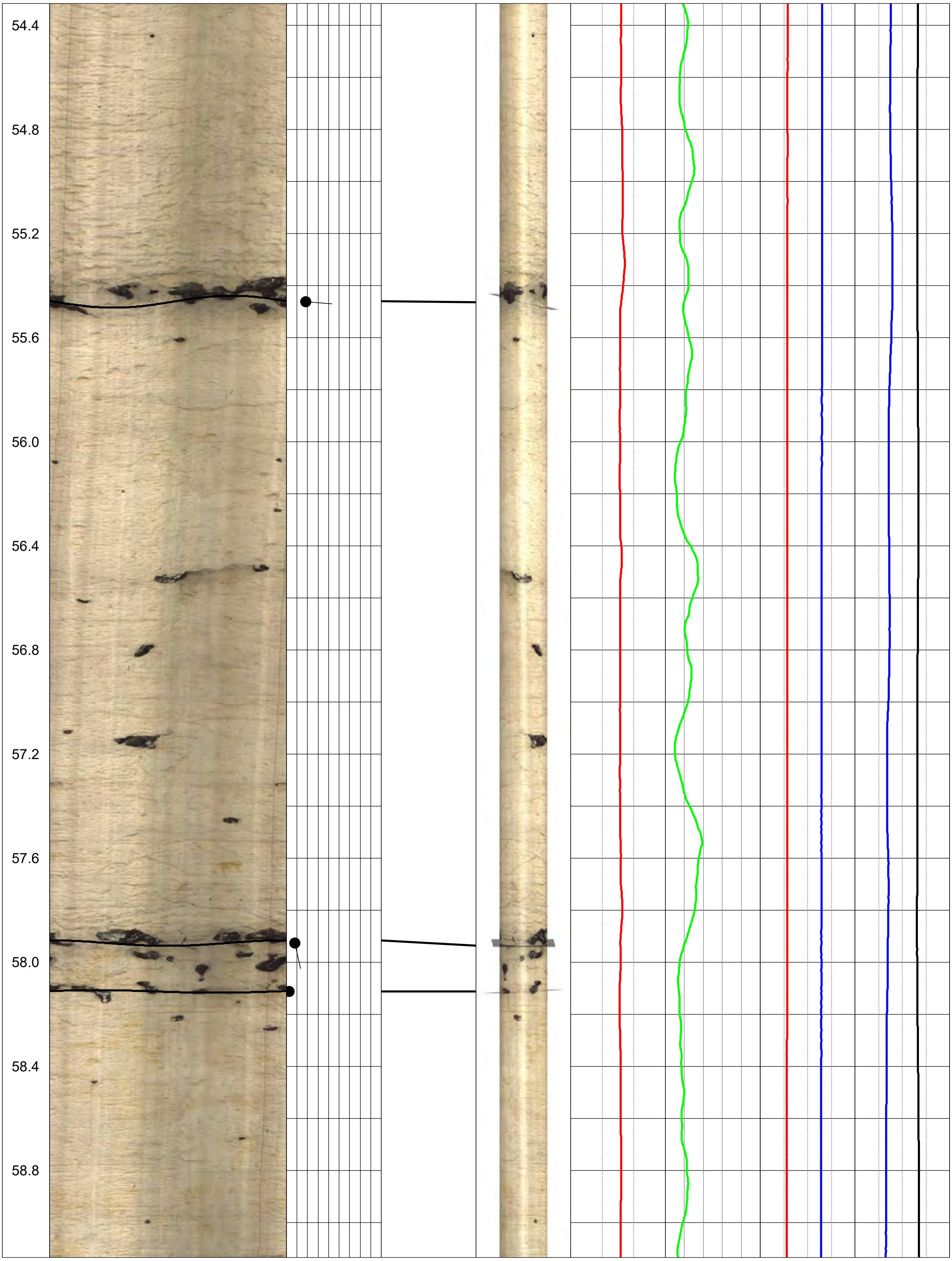


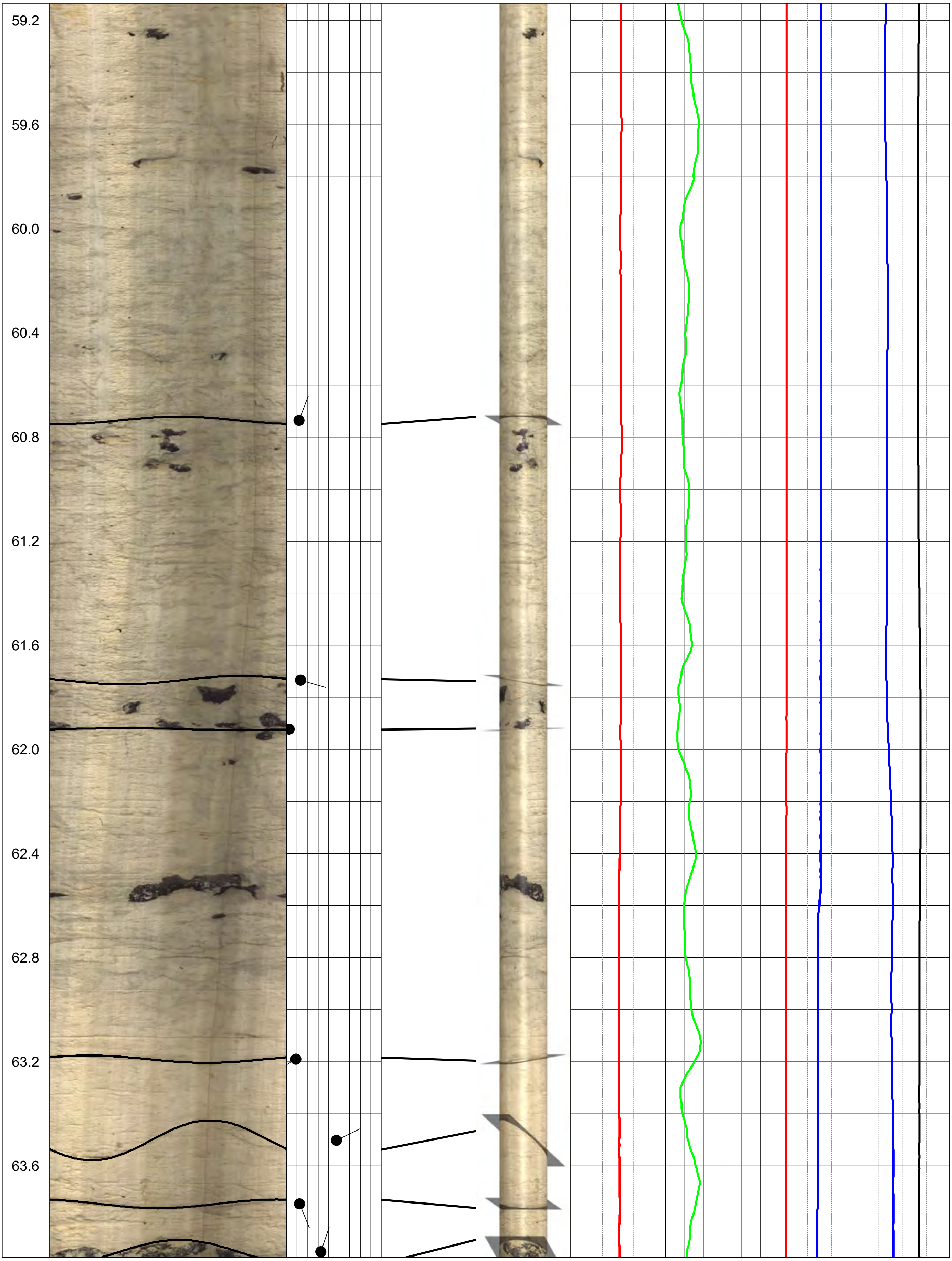
35.2
35.6
36.0
36.4
36.8
37.2
37.6
38.0
38.4
38.8
39.2
39.6

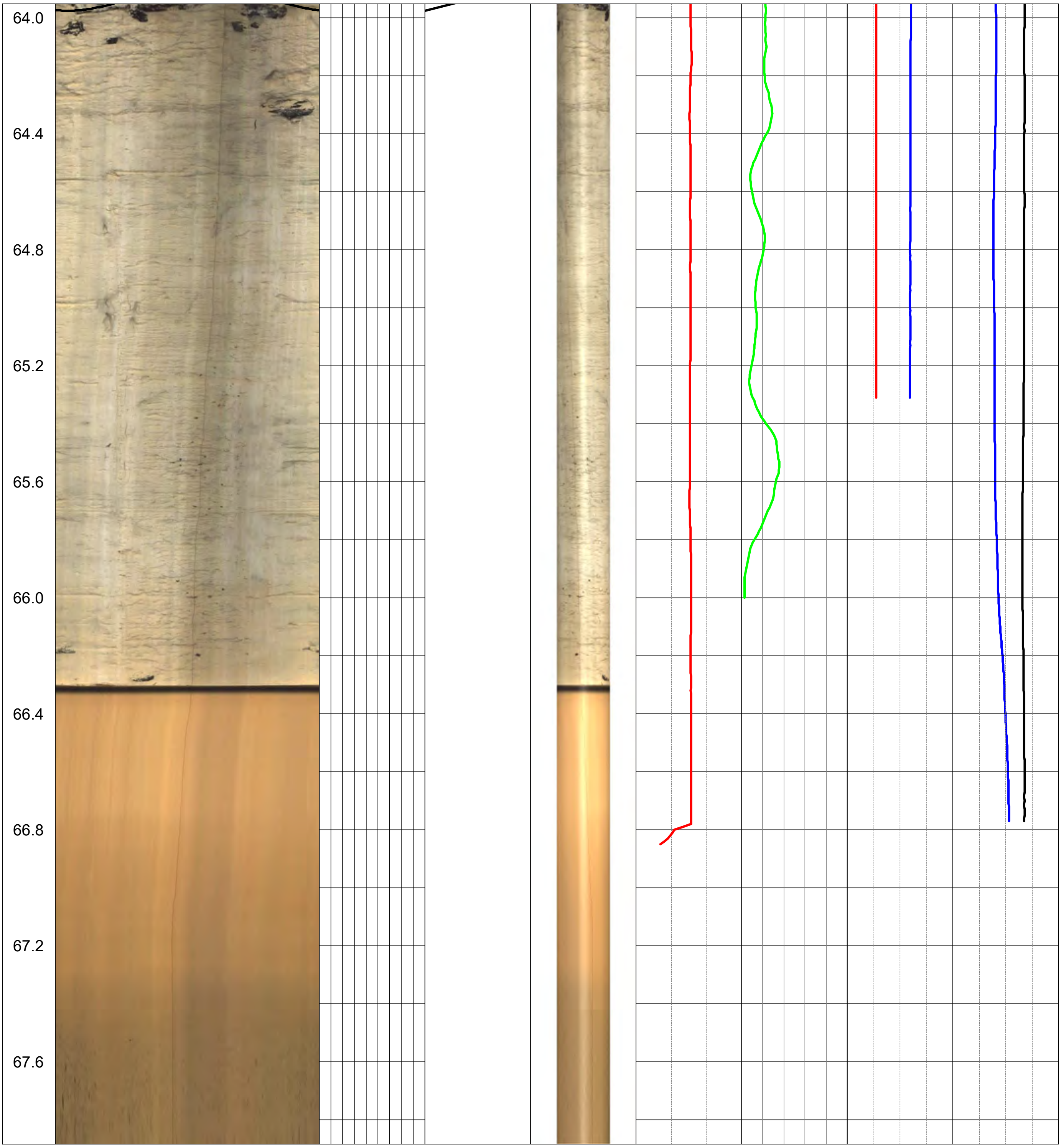

40.0
40.4
40.8
41.2
41.6
42.0
42.4
42.8
43.2
43.6
44.0
44.4


44.8
45.2
45.6
46.0
46.4
46.8
47.2
47.6
48.0
48.4
48.8
49.2


49.6
50.0
50.4
50.8
51.2
51.6
52.0
52.4
52.8
53.2
53.6
54.0


54.4
54.8
55.2
55.6
56.0
56.4
56.8
57.2
57.6
58.0
58.4
58.8


59.2
59.6
60.0
60.4
60.8
61.2
61.6
62.0
62.4
62.8
63.2
63.6


64.0
64.4
64.8
65.2
65.6
66.0
66.4
66.8
67.2
67.6

ROBERTSON GEO SERVICES
Unlocking Your GeoData

COMPANY	Structural Soils		
WELL ID	R71911		
FIELD	A303 Stonehenge		
COUNTRY	England	STATE	
LOCATION			OTHER SERVICES
SEC	TWP	RGE	

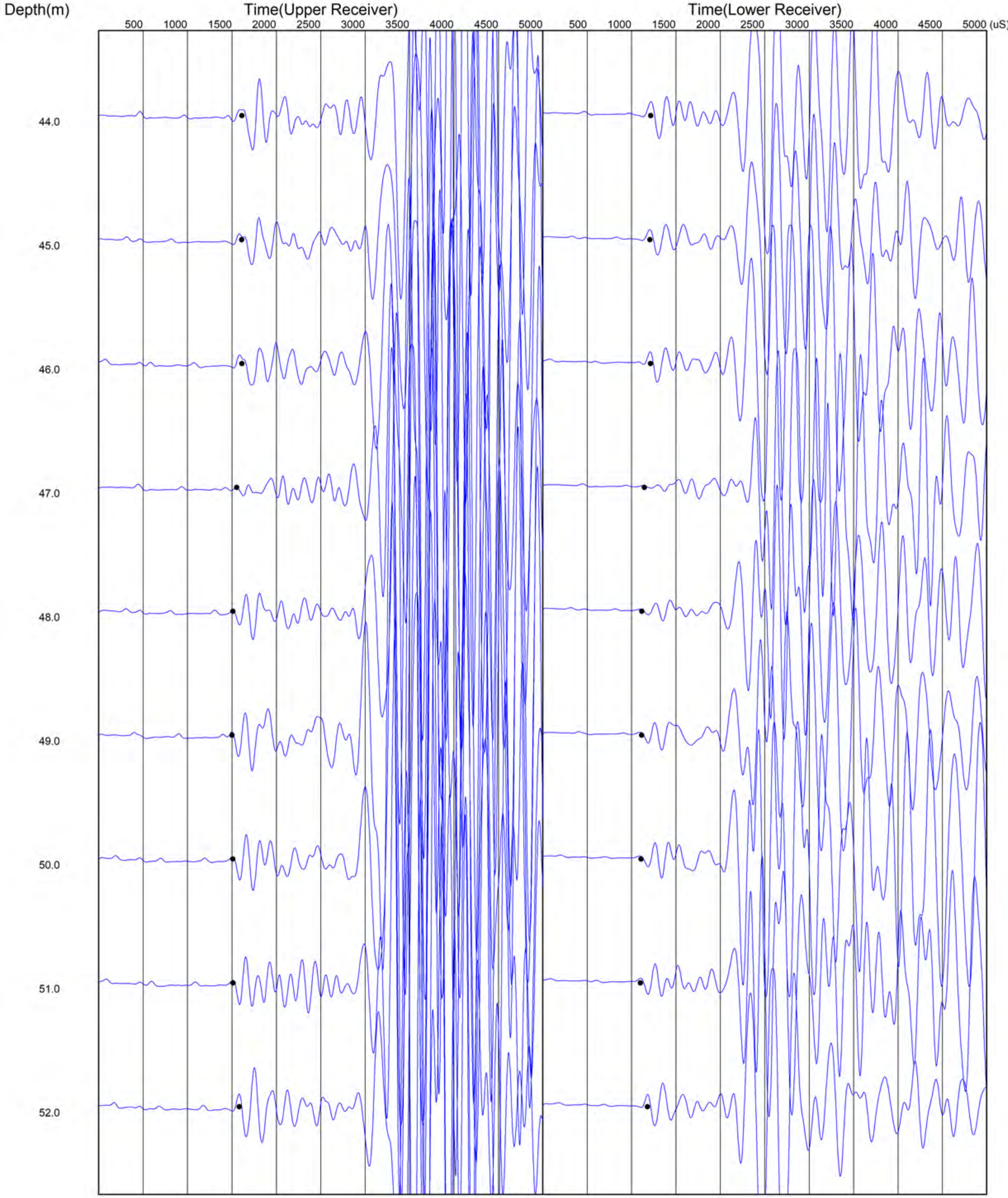
CO / WELL / FLD / CTY / STE / FILING No

PERMANENT DATUM	GL	ELEVATION	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.

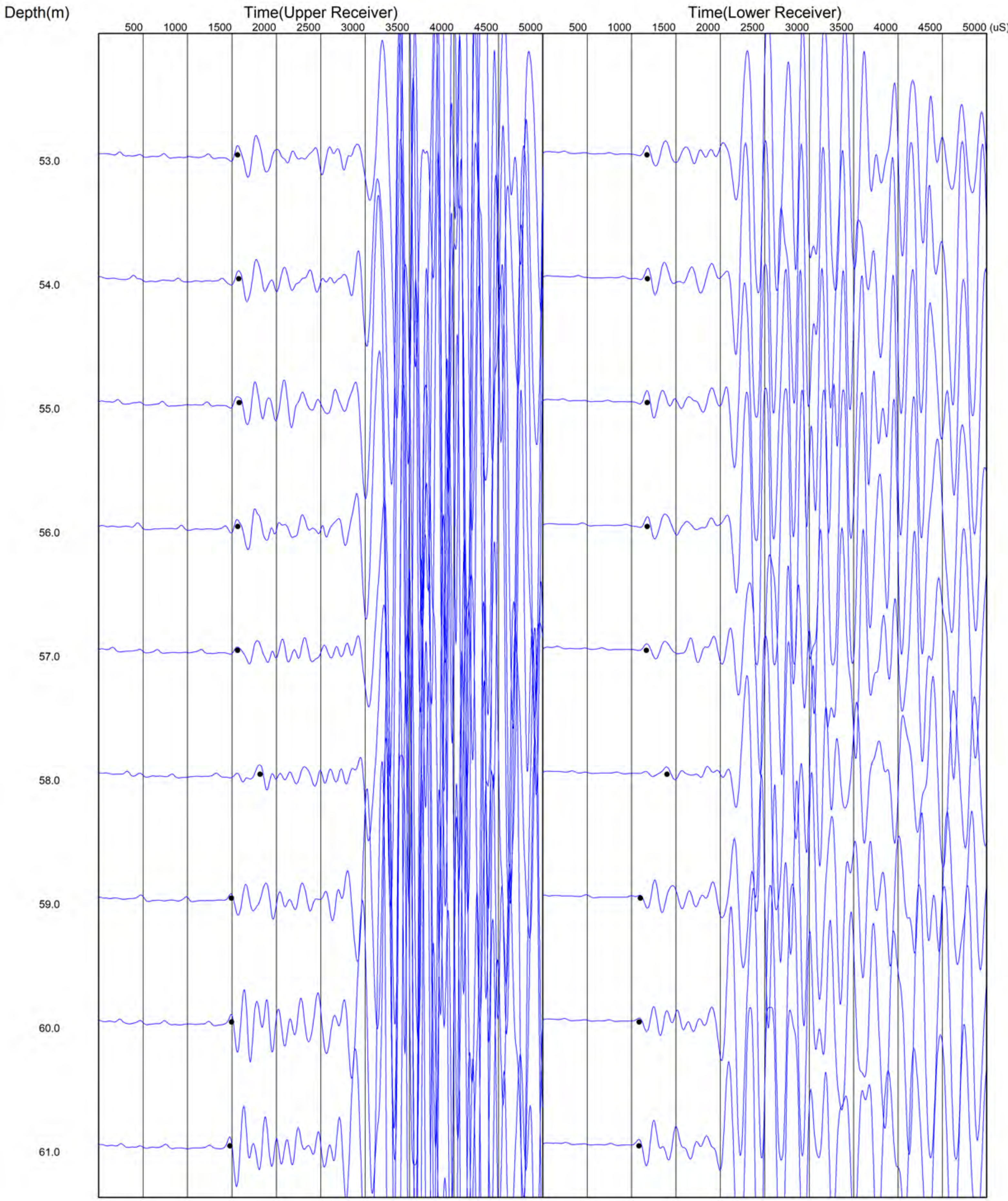
DATE	14/09/18	TYPE FLUID IN HOLE	Water
RUN No		SALINITY	
TYPE LOG	HRFM	DENSITY	
DEPTH-DRILLER	67	LEVEL	42.8
DEPTH-LOGGER	66.19	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	66.19		
TOP LOGGED INTERVAL	40.00	CASING SHOE	
OPERATING RIG TIME			
RECORDED BY	KO		
WITNESSED BY	AJ		

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

P Wave

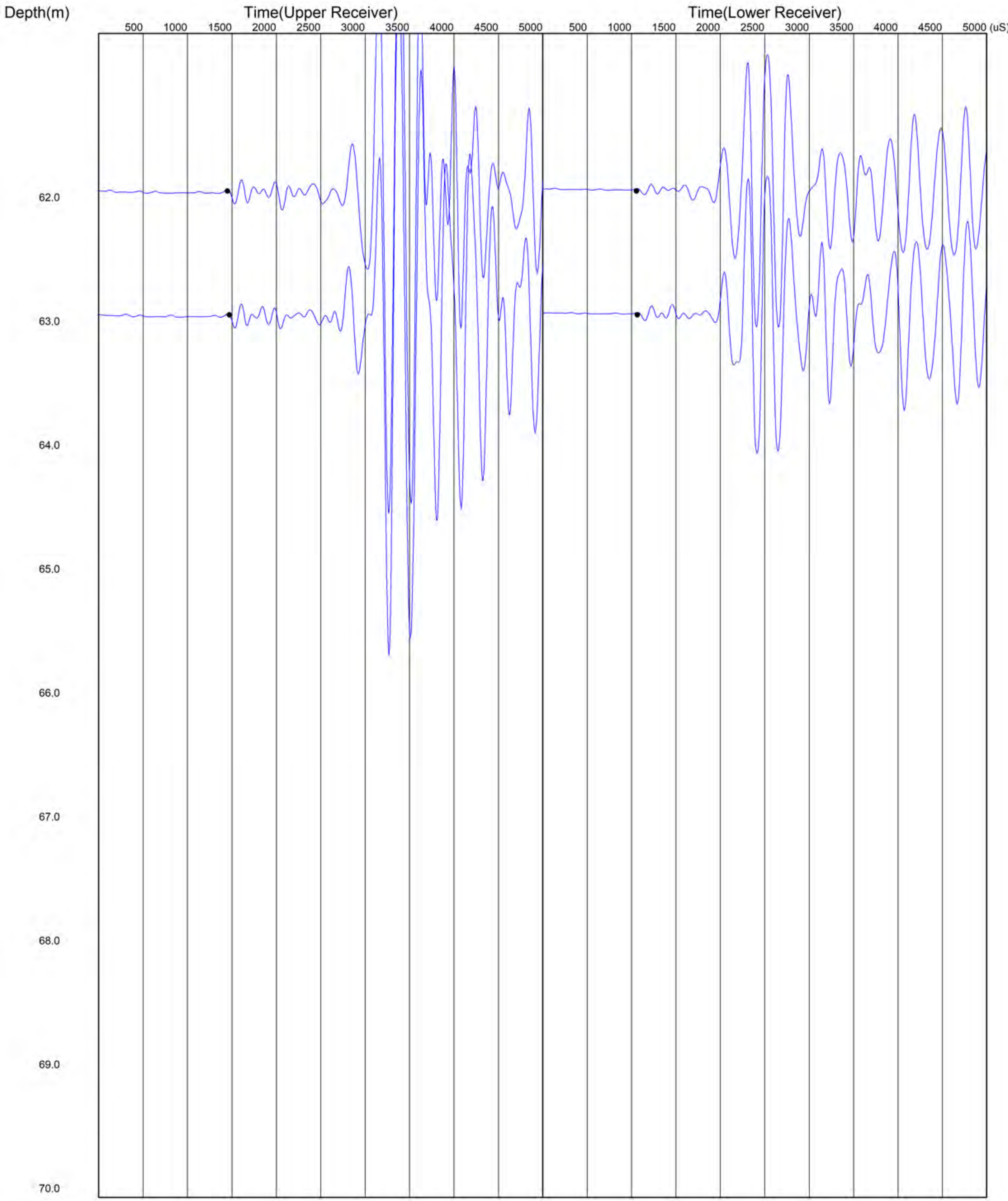

Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
44.0
45.0
46.0
47.0
48.0
49.0
50.0
51.0
52.0

P Wave



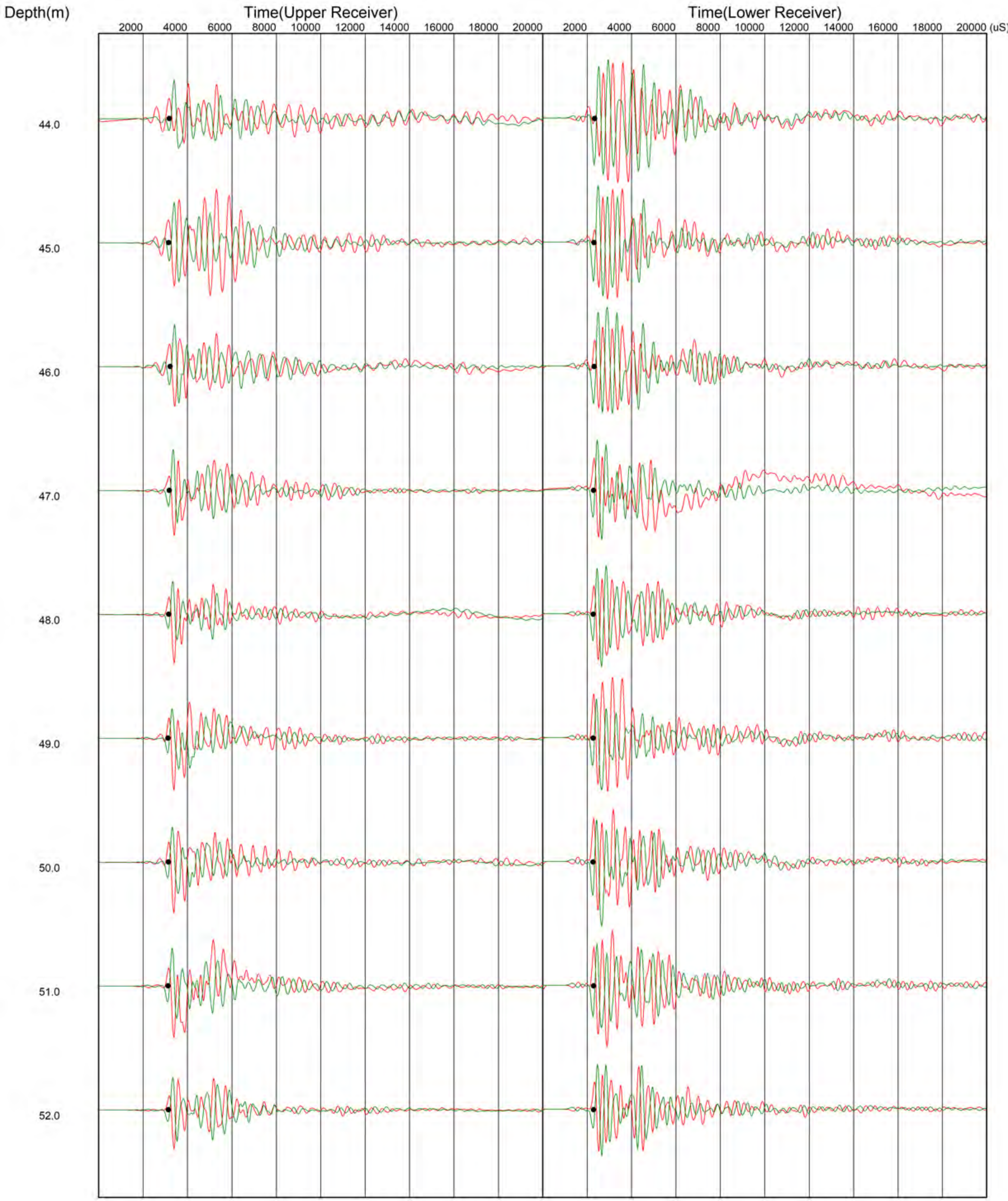
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
500
1000
1500
2000
2500
3000
3500
4000
4500
5000 (uS)
53.0
54.0
55.0
56.0
57.0
58.0
59.0
60.0
61.0

P Wave



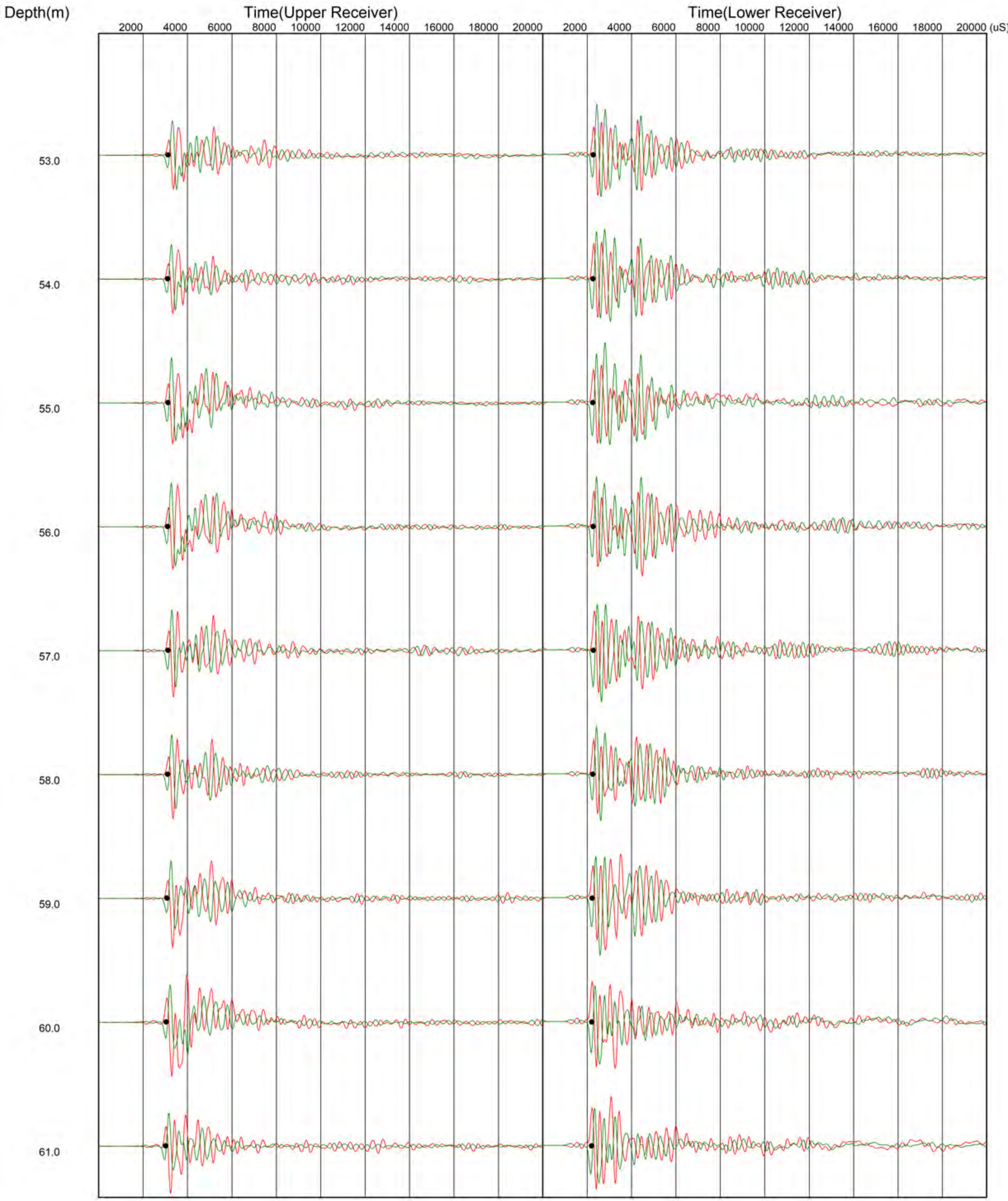
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
62.0
63.0
64.0
65.0
66.0
67.0
68.0
69.0
70.0

S Wave

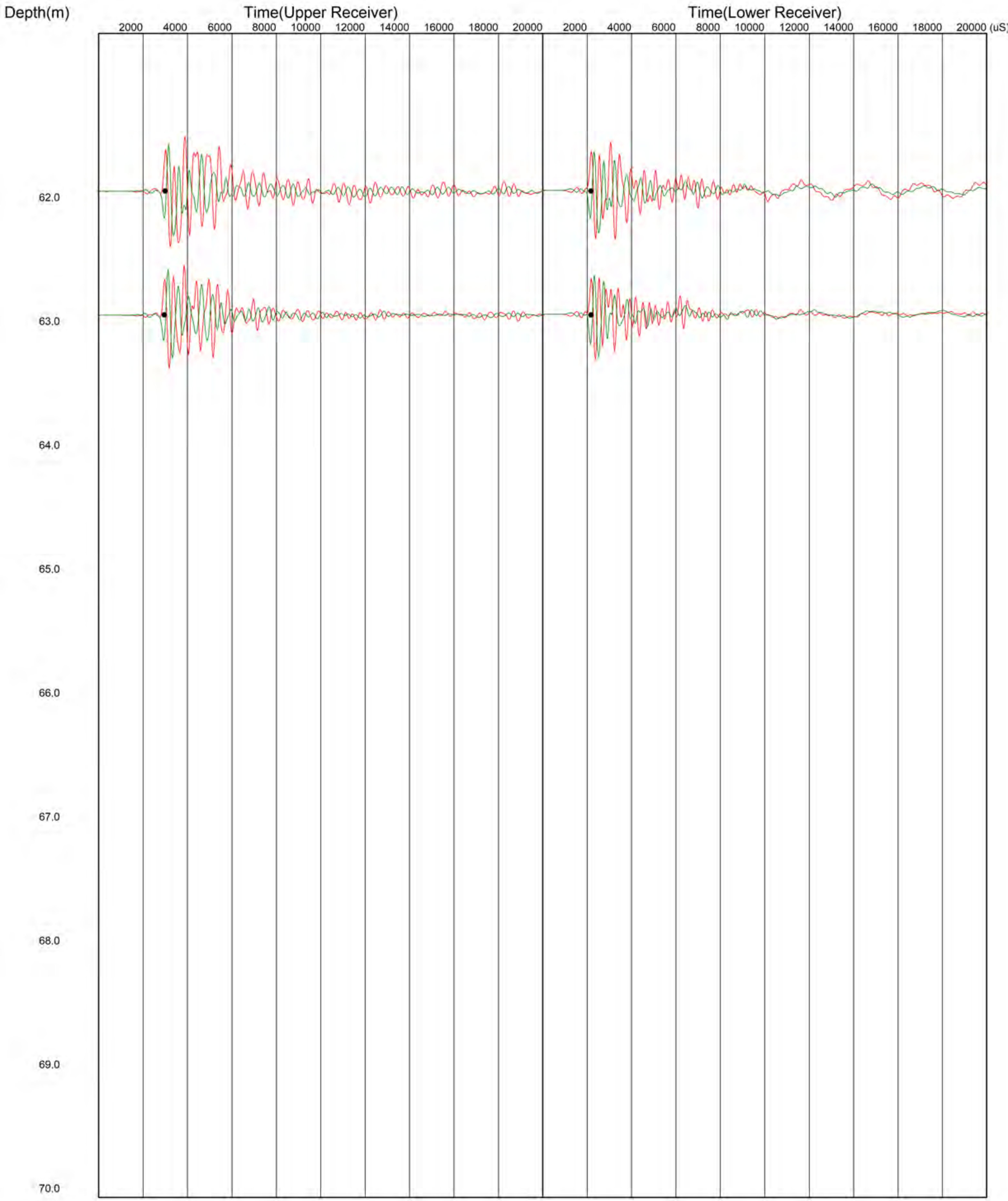


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
(uS)
44.0
45.0
46.0
47.0
48.0
49.0
50.0
51.0
52.0

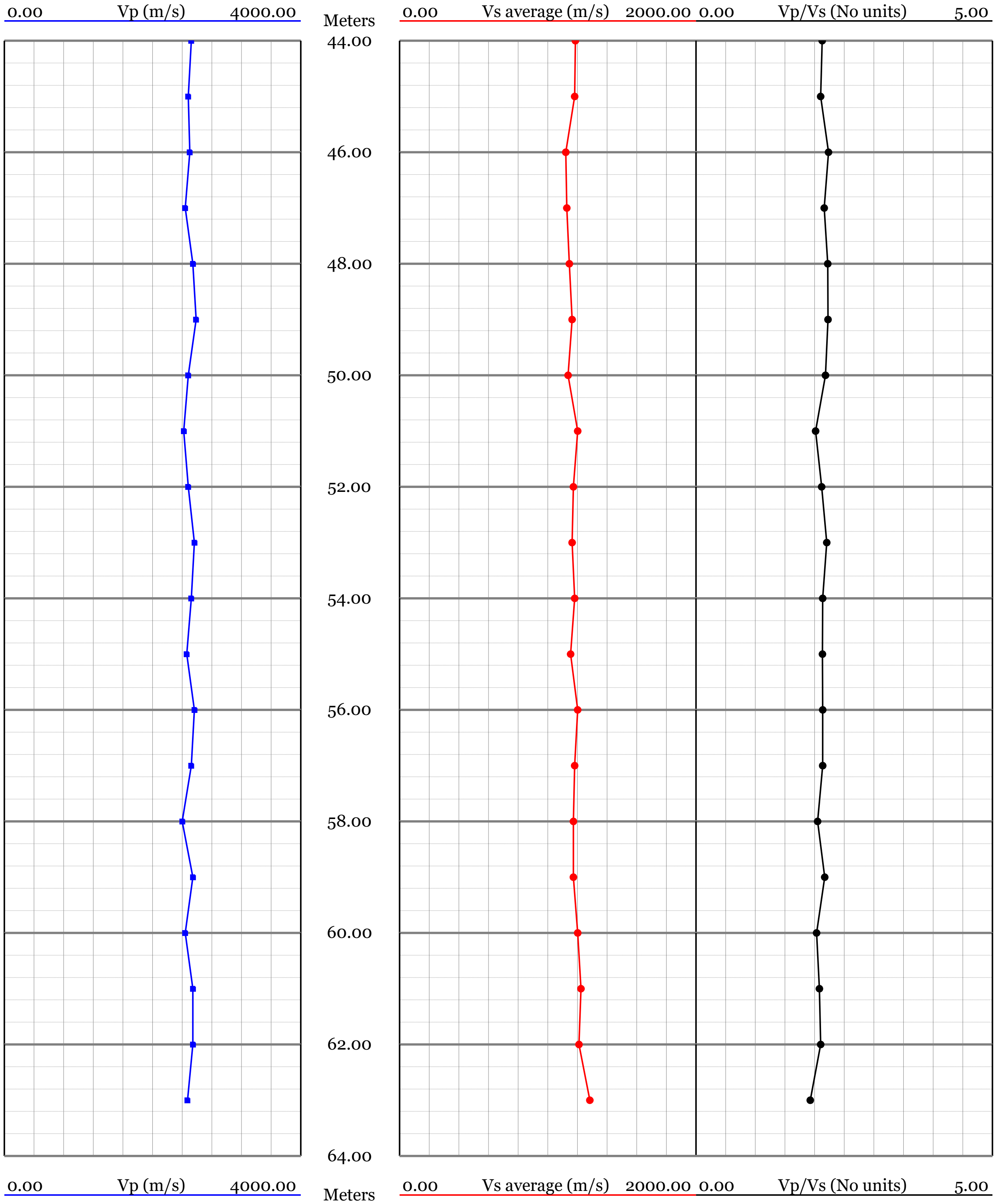
S Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
53.0
54.0
55.0
56.0
57.0
58.0
59.0
60.0
61.0

S Wave



Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
62.0
63.0
64.0
65.0
66.0
67.0
68.0
69.0
70.0

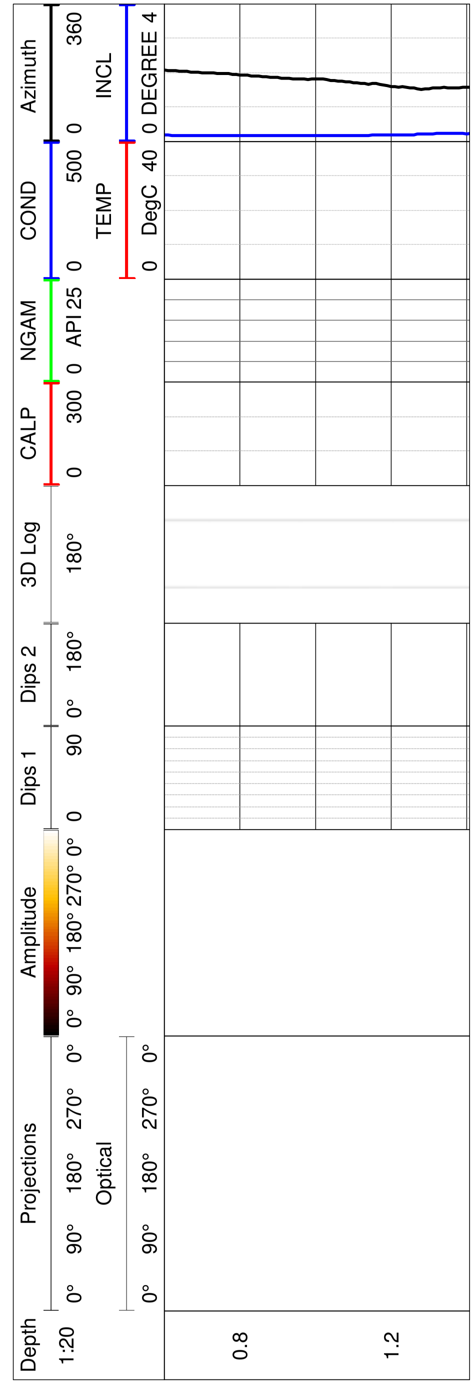

0.00
Vp (m/s)
4000.00
Meters
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00
44.00
46.00
48.00
50.00
52.00
54.00
56.00
58.00
60.00
62.00
64.00

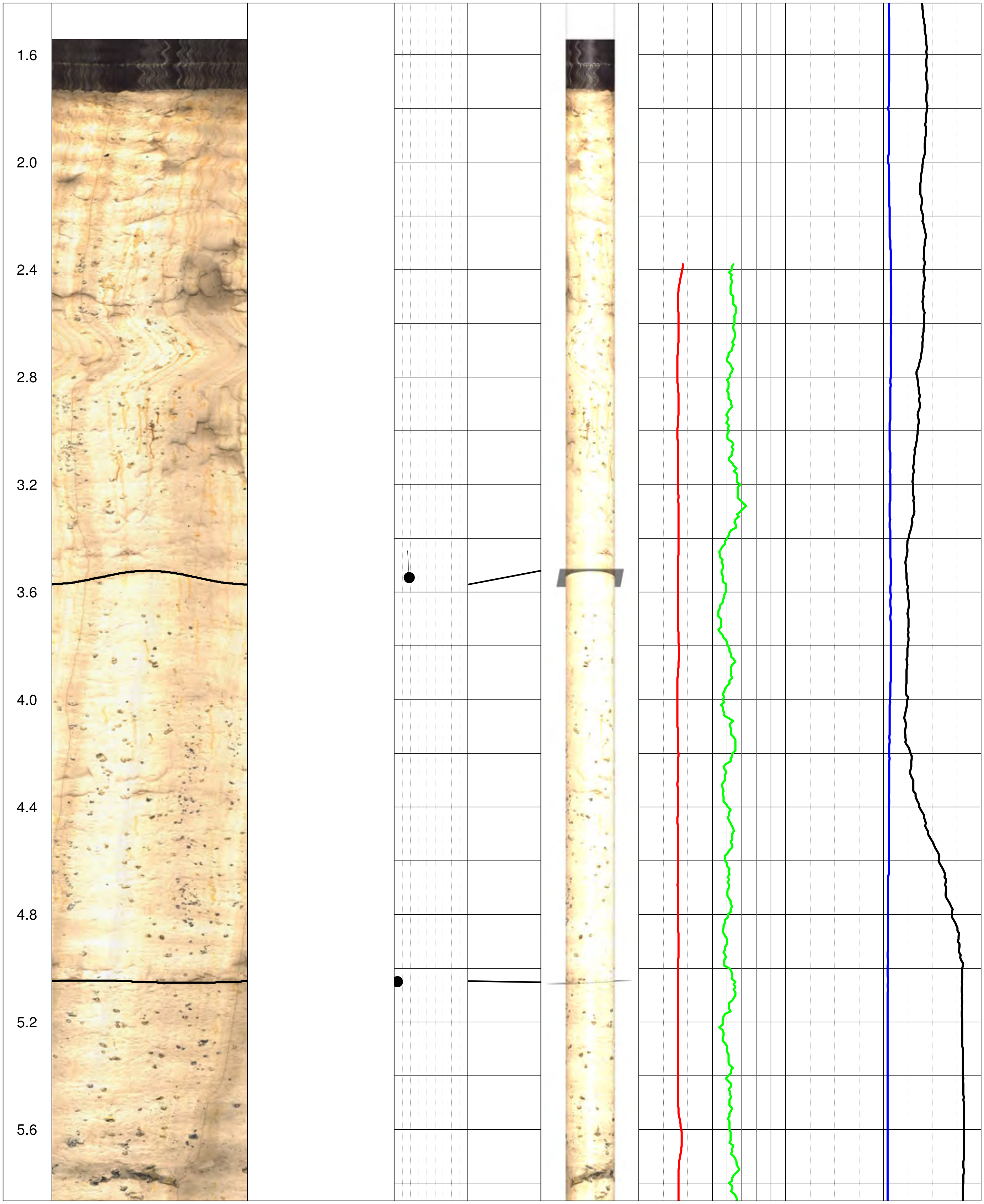
ROBERTSON GEO SERVICES
Unlocking Your GeoData

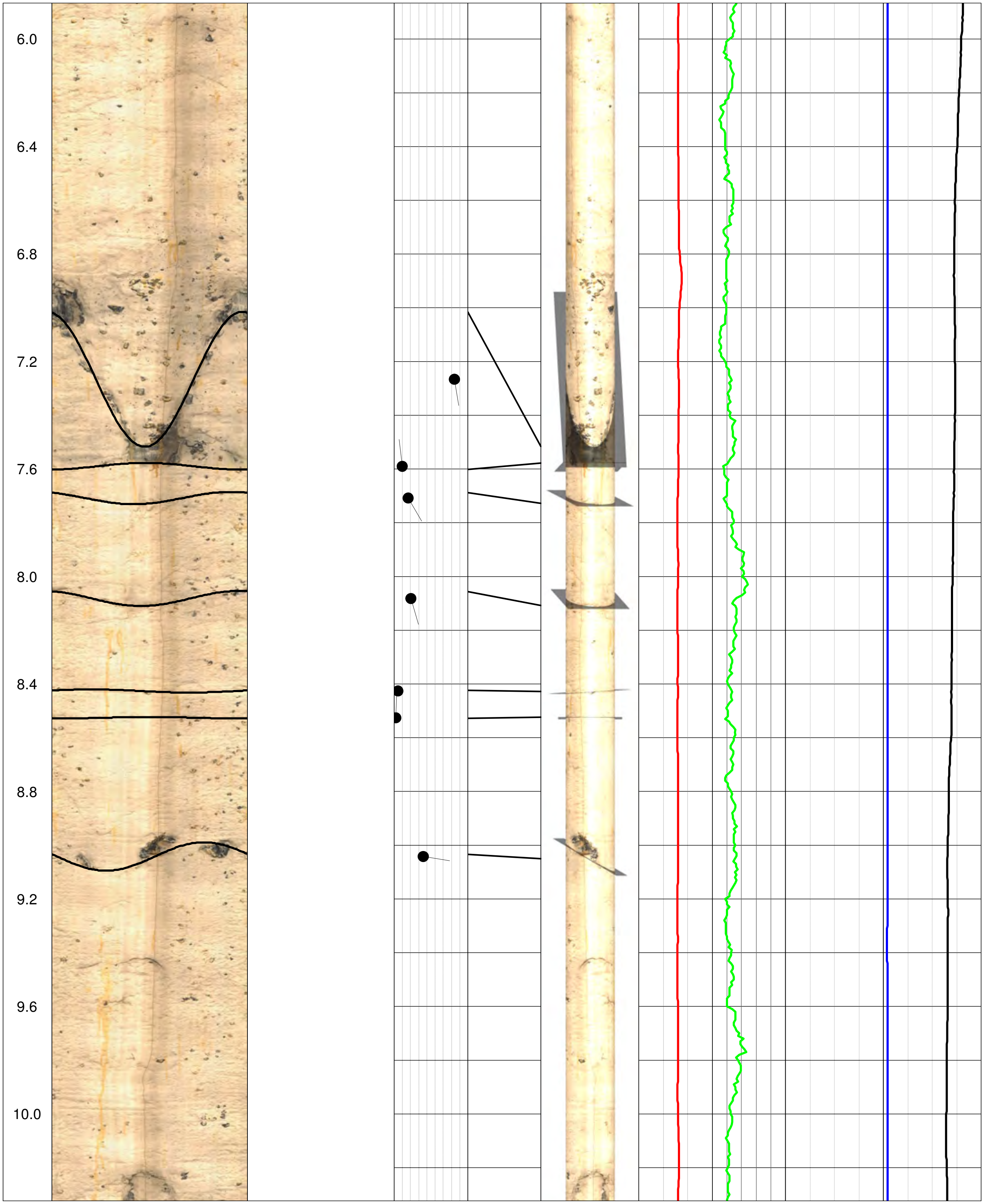
CO	COMPANY	Structural Soils	
WELL	WELL ID	R71913	
FLD	FIELD	A303 Structural Soils	
CTY	COUNTRY	England	STATE
STE	LOCATION		OTHER SERVICES
FILING No	SEC	TWP RGE	

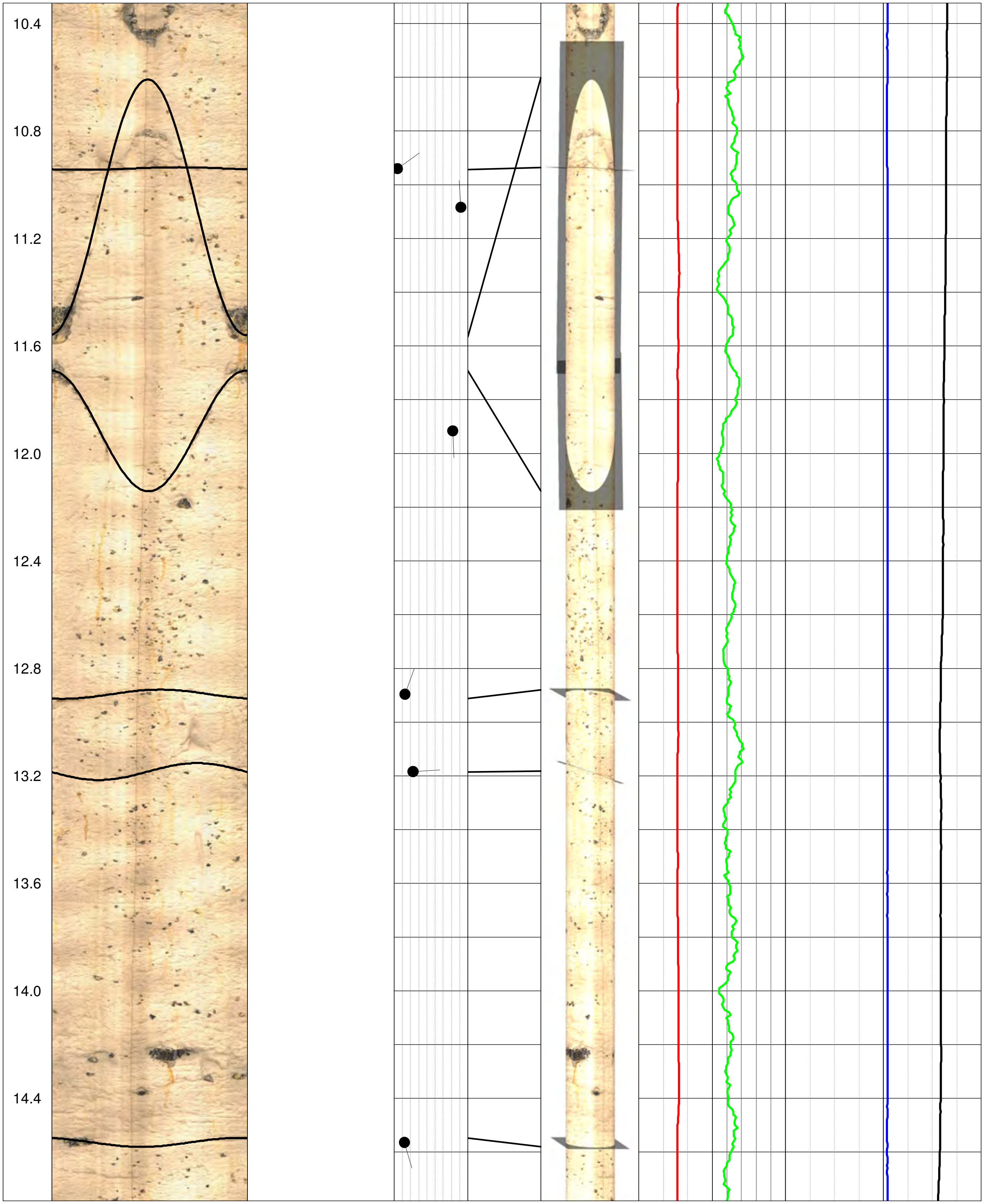
PERMANENT DATUM	GL	ELEVATION	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.
DATE	19/09/18	TYPE FLUID IN HOLE	Water
RUN No	1	SALINITY	
TYPE LOG	Composite	DENSITY	
DEPTH-DRILLER	50.5	LEVEL	35.75
DEPTH-LOGGER	50.3	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	50.3		
TOP LOGGED INTERVAL	1.54	CASING SHOE	
OPERATING RIG TIME			
RECORDED BY	KO		
WITNESSED BY	AJ		

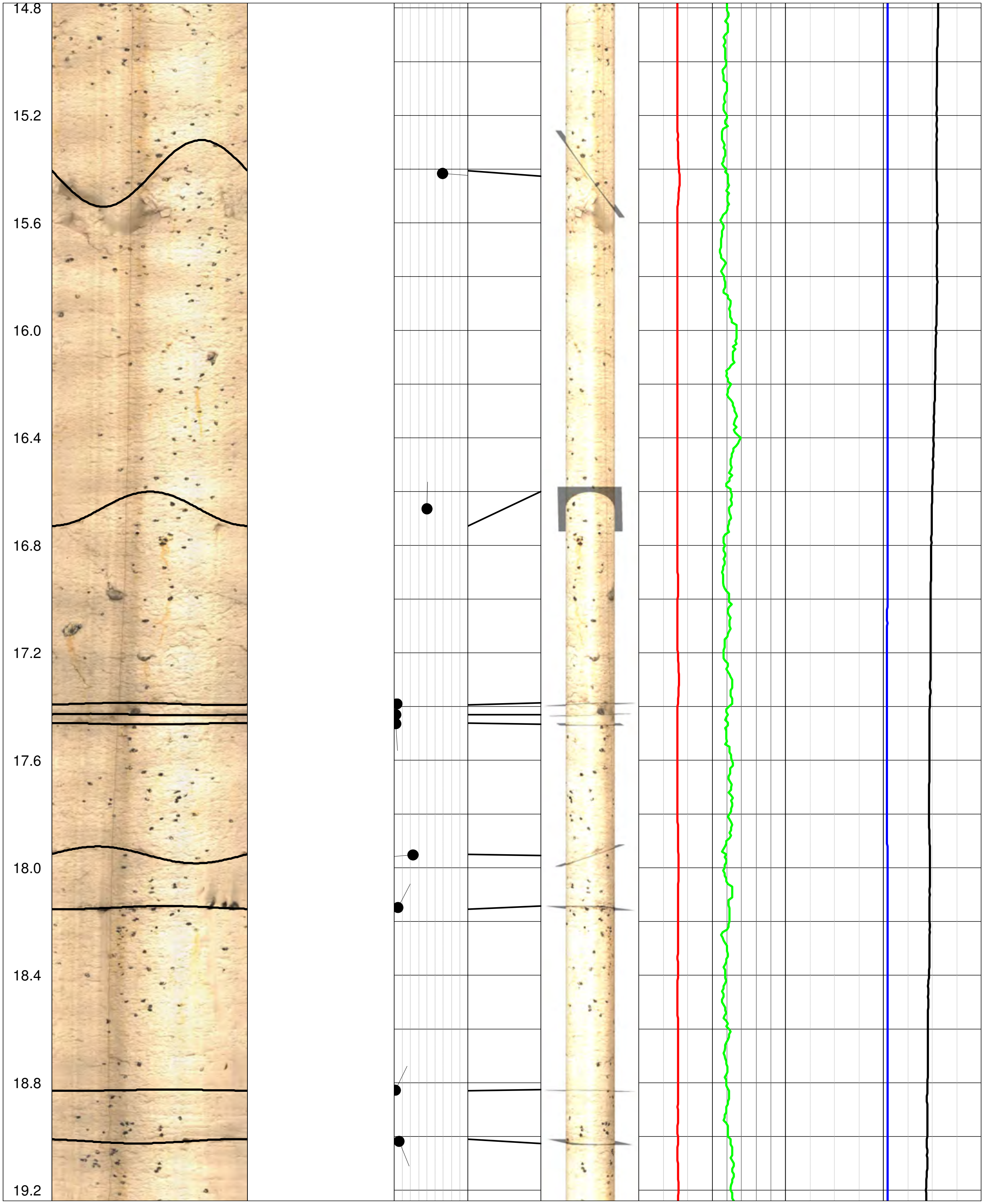
RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

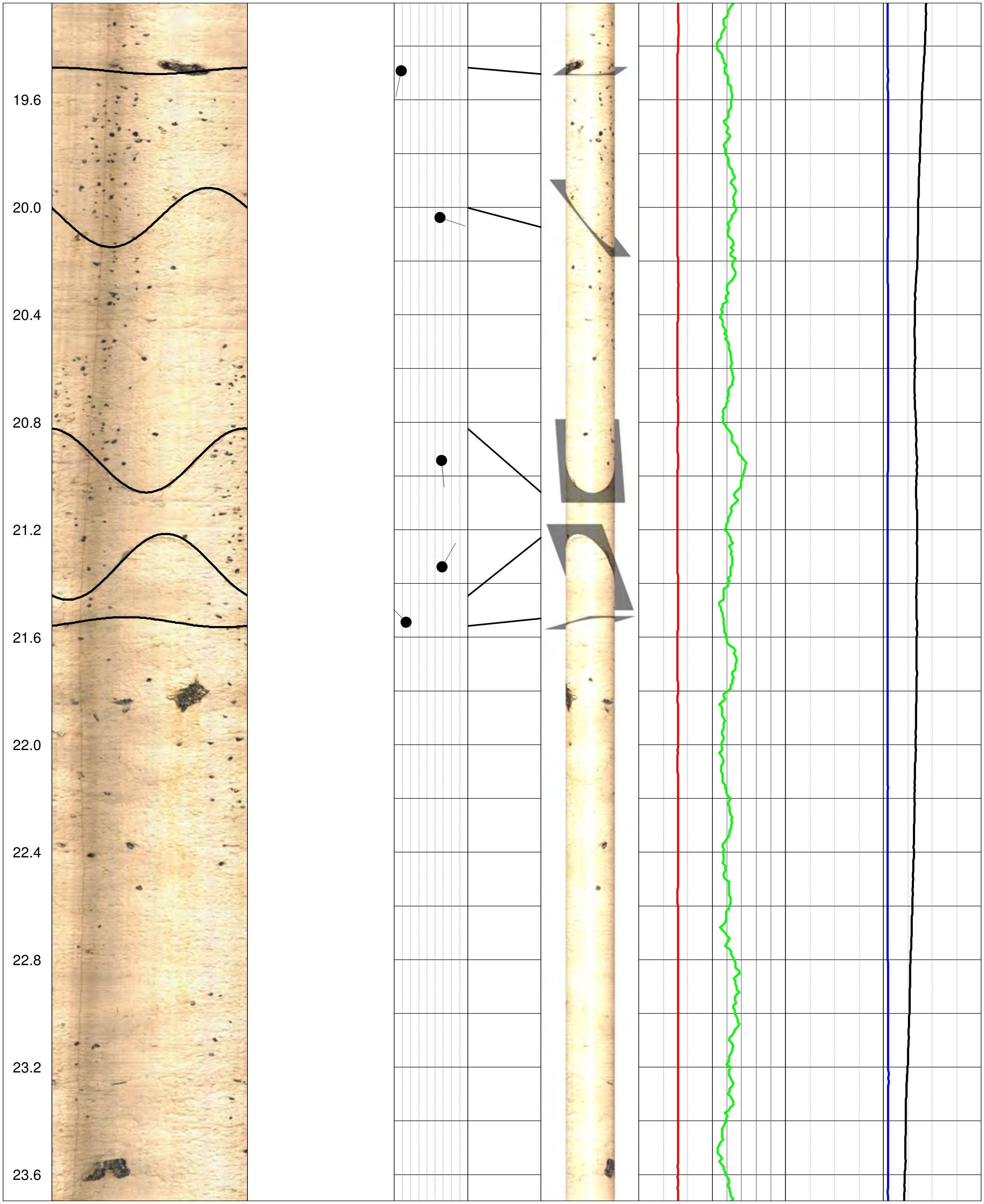


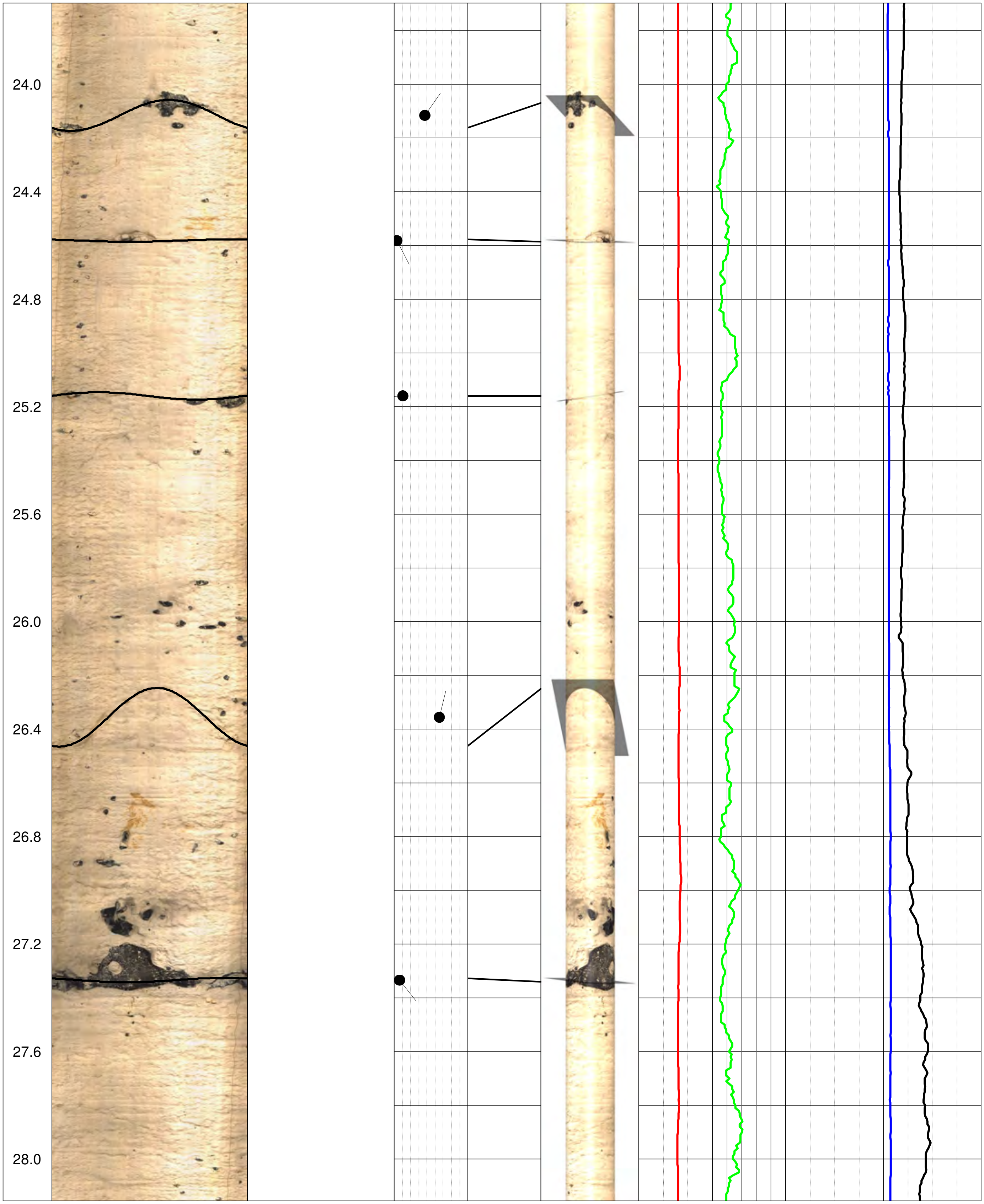

1.6
2.0
2.4
2.8
3.2
3.6
4.0
4.4
4.8
5.2
5.6

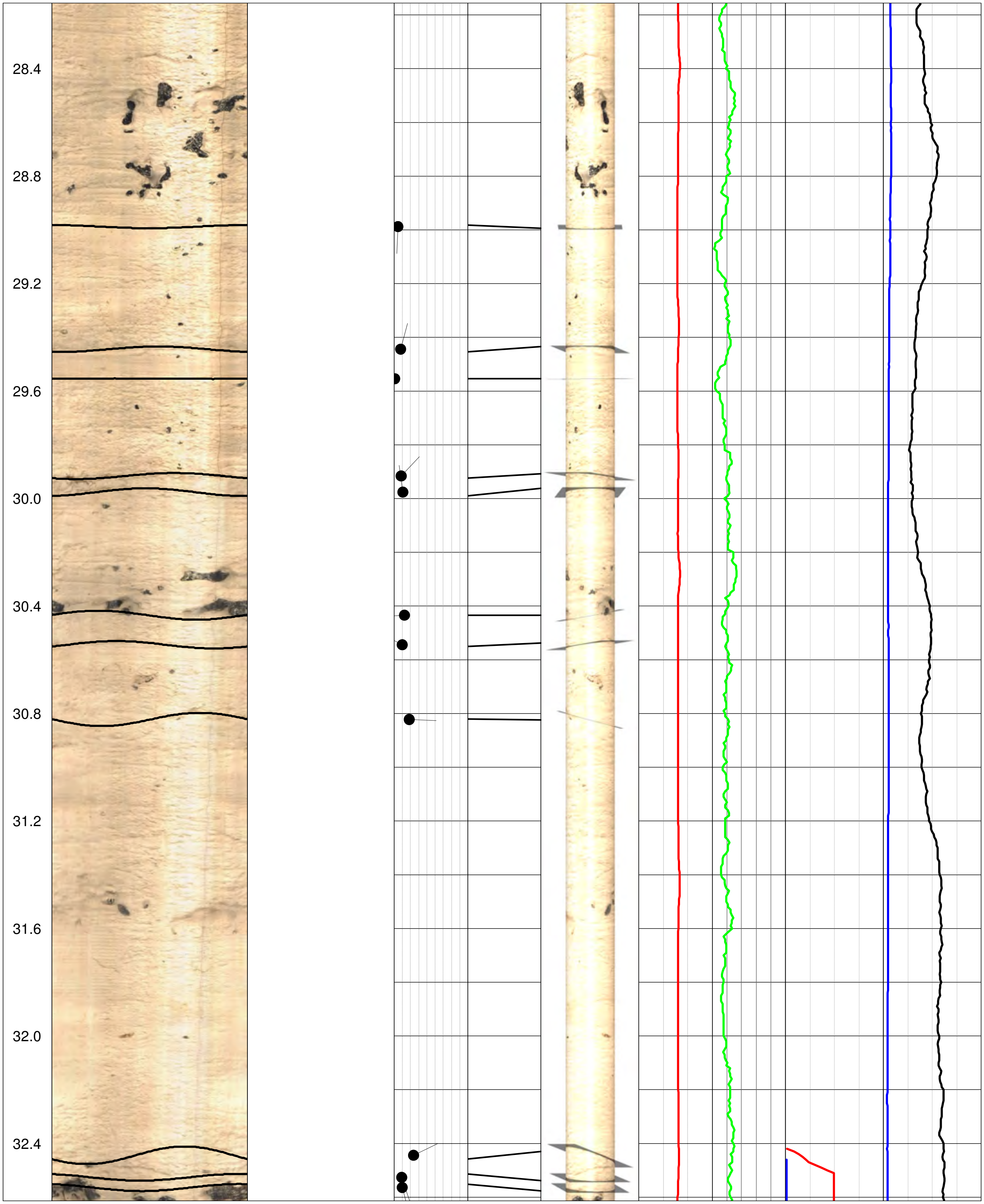

6.0
6.4
6.8
7.2
7.6
8.0
8.4
8.8
9.2
9.6
10.0

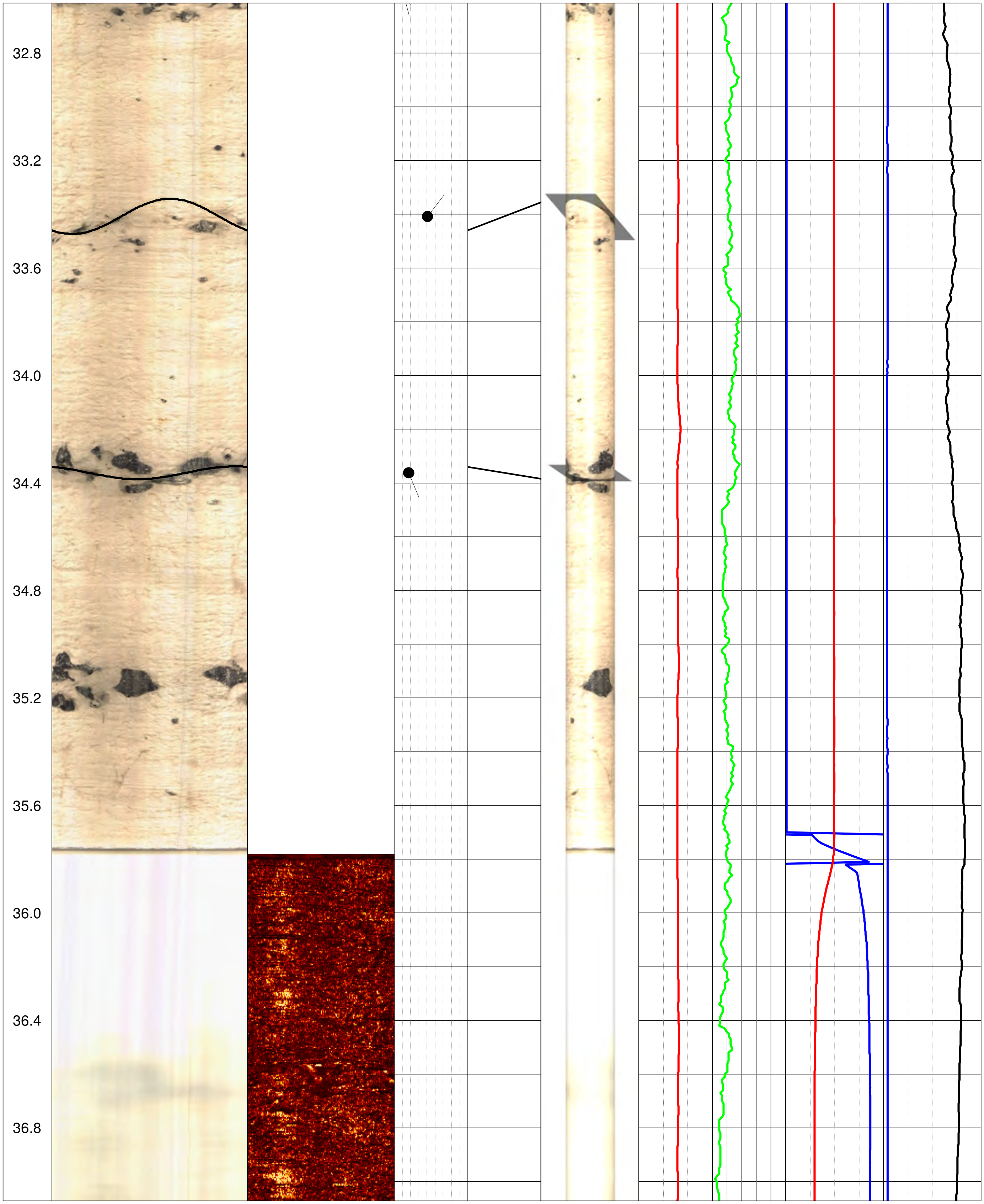

10.4
10.8
11.2
11.6
12.0
12.4
12.8
13.2
13.6
14.0
14.4

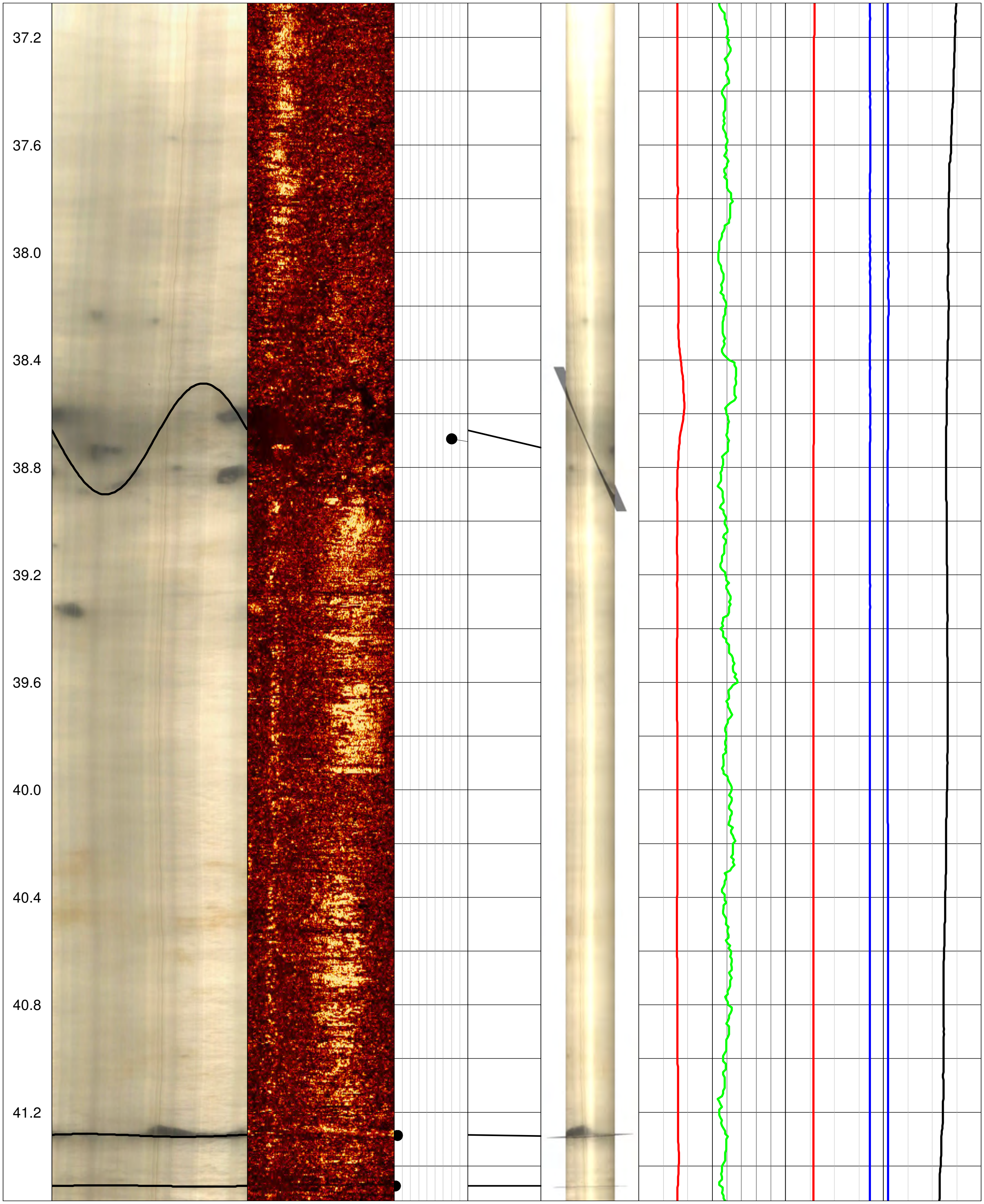

14.8
15.2
15.6
16.0
16.4
16.8
17.2
17.6
18.0
18.4
18.8
19.2

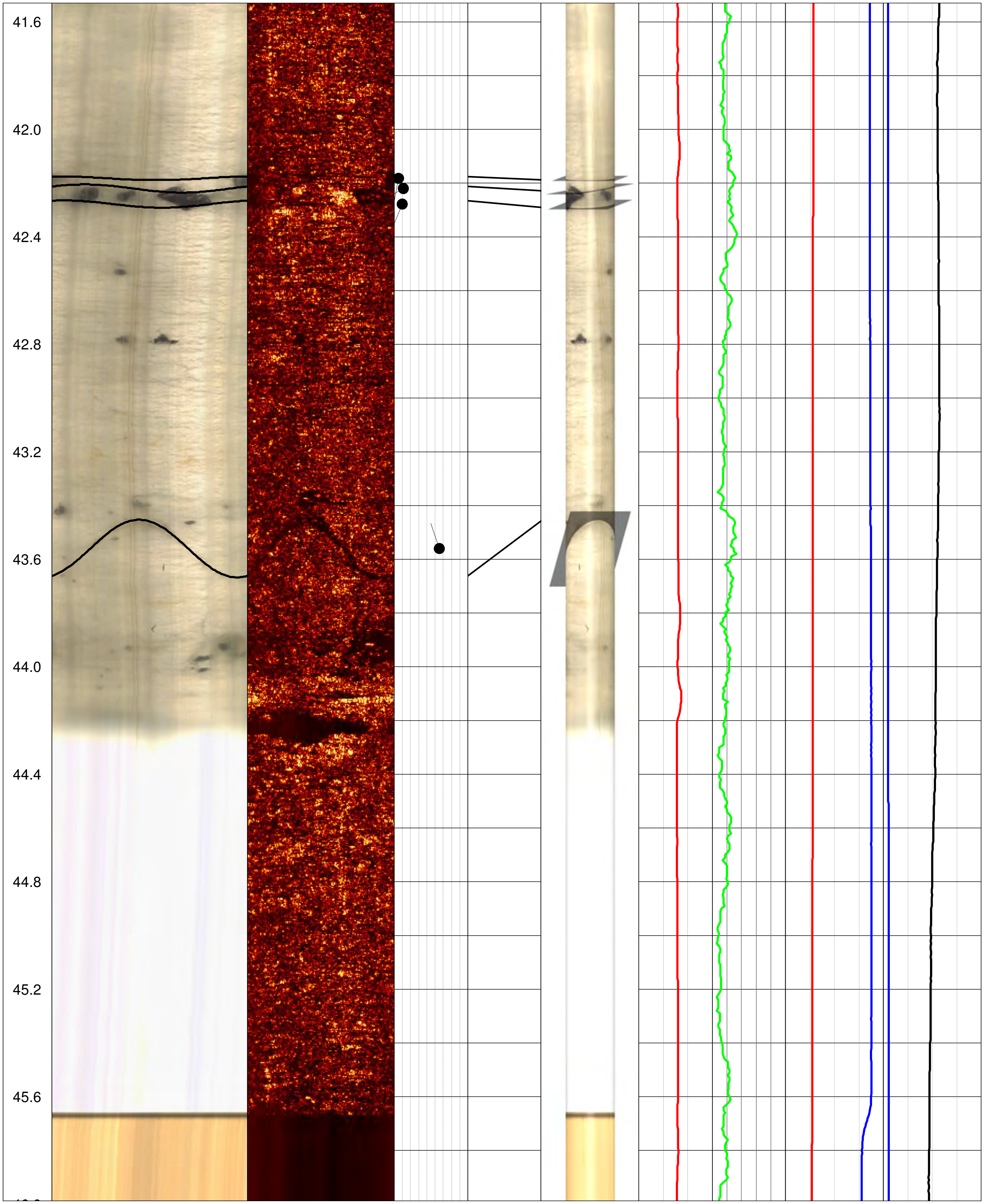

19.6
20.0
20.4
20.8
21.2
21.6
22.0
22.4
22.8
23.2
23.6

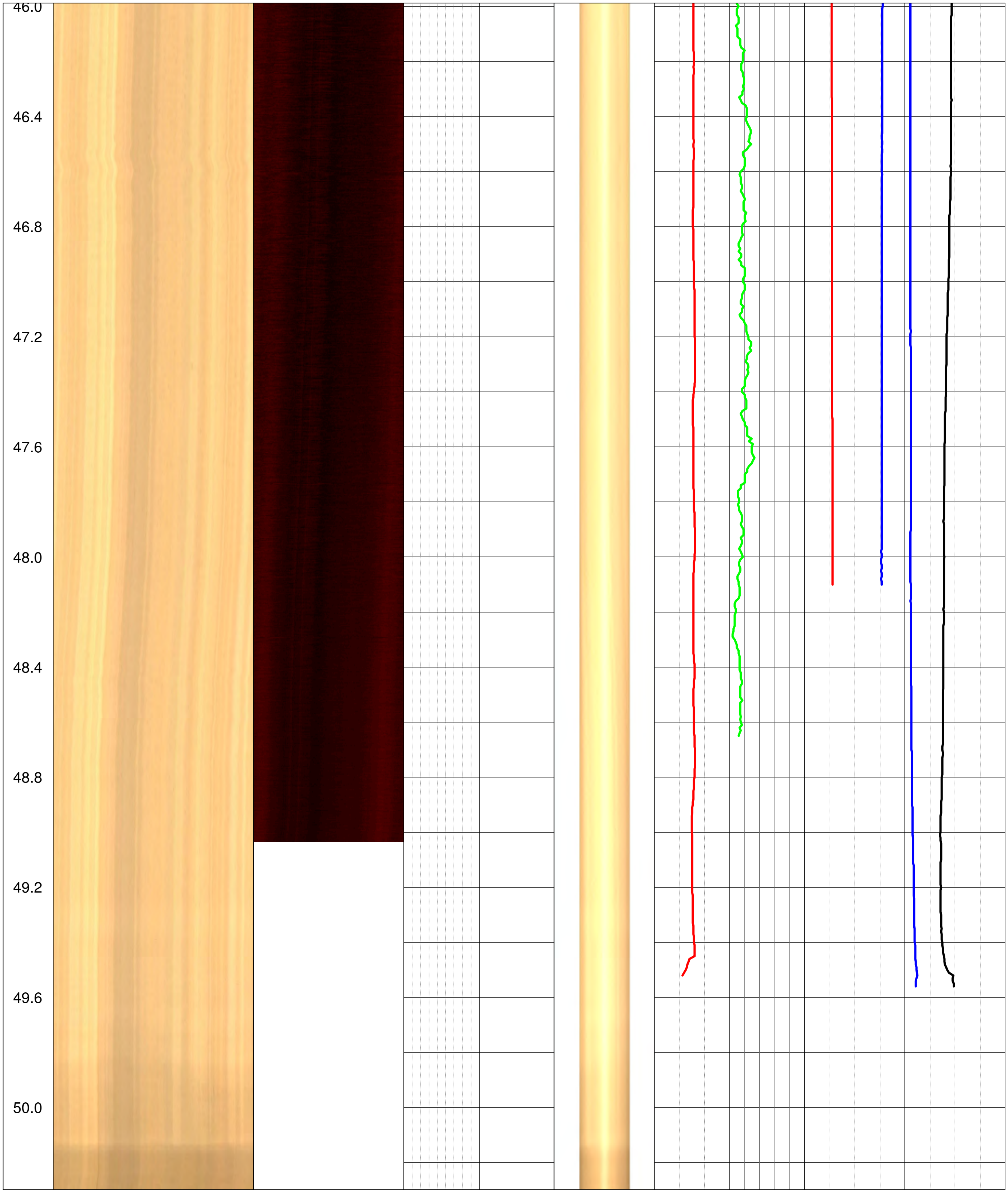

24.0
24.4
24.8
25.2
25.6
26.0
26.4
26.8
27.2
27.6
28.0


28.4
28.8
29.2
29.6
30.0
30.4
30.8
31.2
31.6
32.0
32.4


32.8
33.2
33.6
34.0
34.4
34.8
35.2
35.6
36.0
36.4
36.8


37.2
37.6
38.0
38.4
38.8
39.2
39.6
40.0
40.4
40.8
41.2


41.6
42.0
42.4
42.8
43.2
43.6
44.0
44.4
44.8
45.2
45.6


46.0
46.4
46.8
47.2
47.6
48.0
48.4
48.8
49.2
49.6
50.0

ROBERTSON GEO SERVICES
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COMPANY	Structural Soils		
WELL ID	R71913		
FIELD	A303 Stonehenge		
COUNTRY	England	STATE	
LOCATION			OTHER SERVICES
SEC	TWP	RGE	

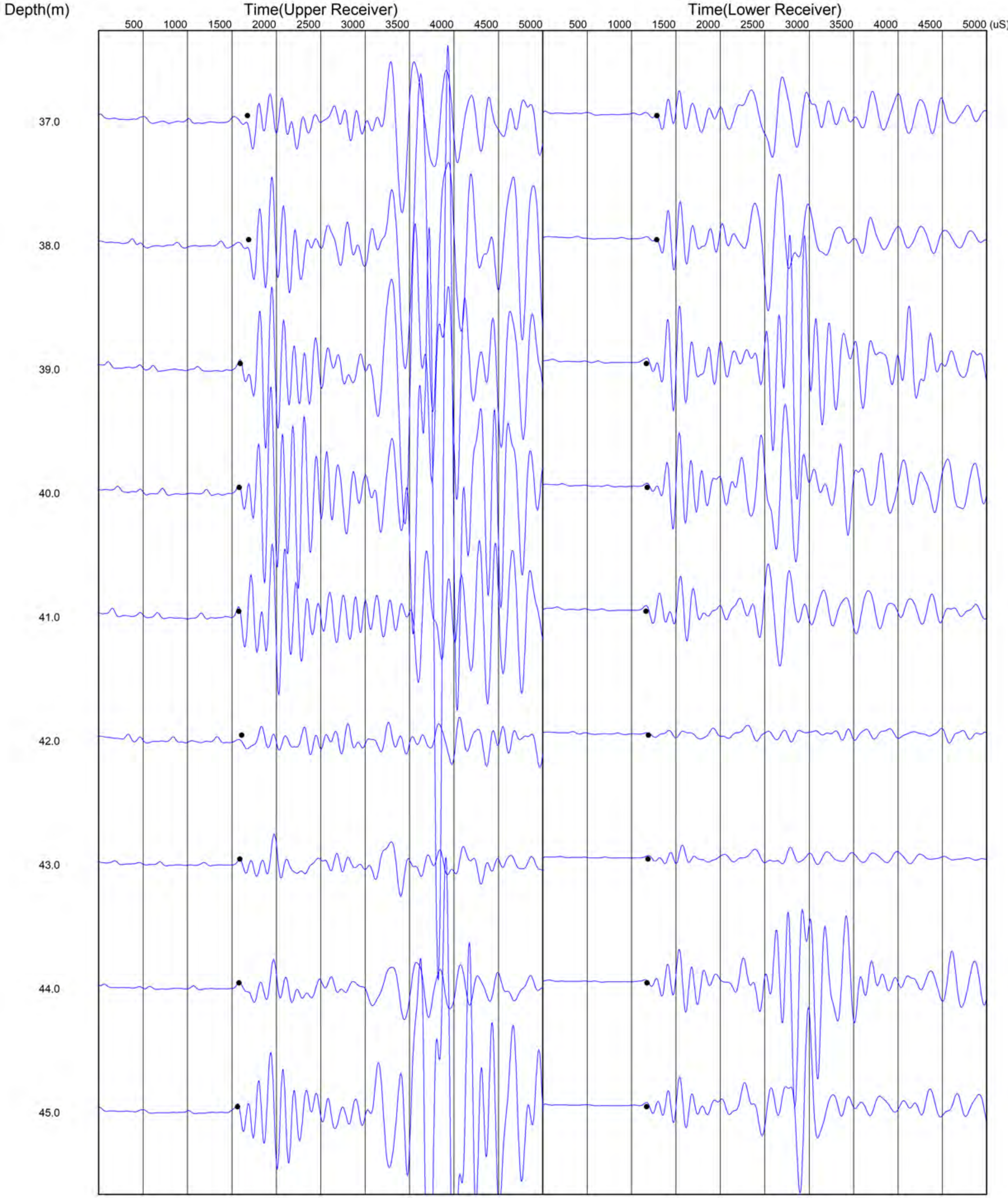
CO / WELL / FLD / CTY / STE / FILING No

PERMANENT DATUM	GL	ELEVATION	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.

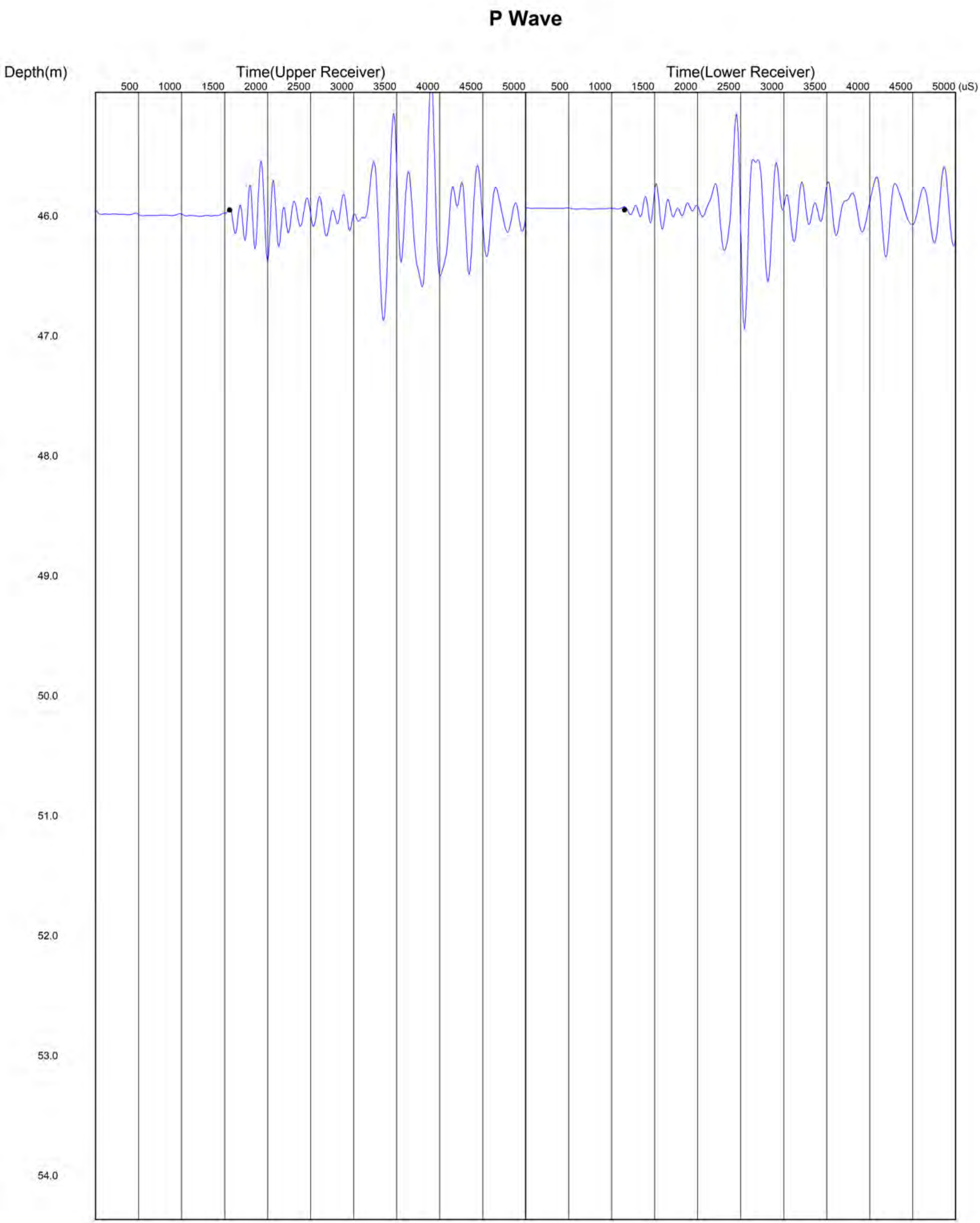
DATE	19/09/18	TYPE FLUID IN HOLE	Water
RUN No		SALINITY	
TYPE LOG	HRFM	DENSITY	
DEPTH-DRILLER	50.5	LEVEL	35.75
DEPTH-LOGGER	49.51	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	49.51		
TOP LOGGED INTERVAL	32	CASING SHOE	
OPERATING RIG TIME			
RECORDED BY	KO		
WITNESSED BY	AJ		

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

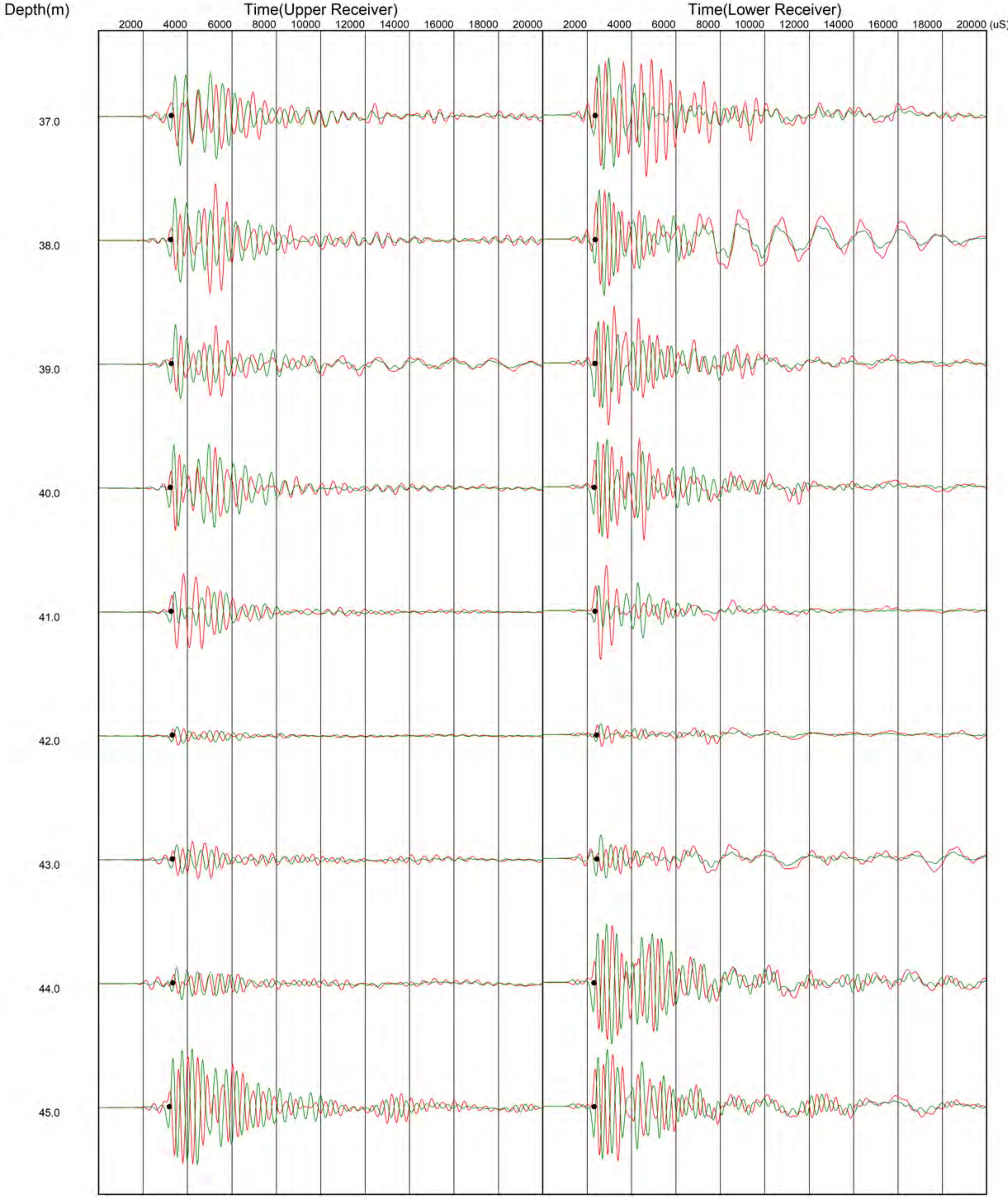
P Wave



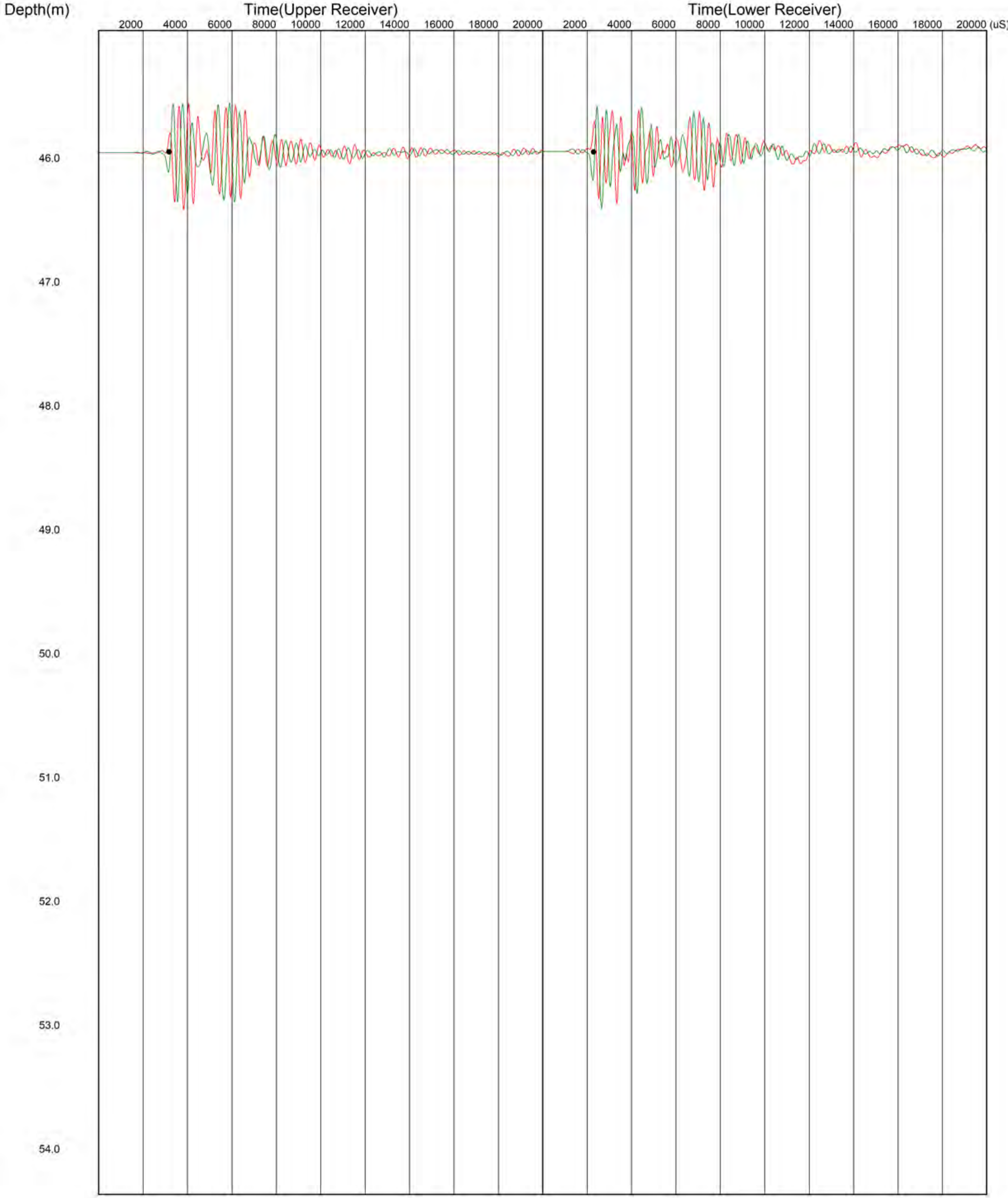
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
37.0
38.0
39.0
40.0
41.0
42.0
43.0
44.0
45.0


P Wave
Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
500
1000
1500
2000
2500
3000
3500
4000
4500
5000 (uS)
46.0
47.0
48.0
49.0
50.0
51.0
52.0
53.0
54.0

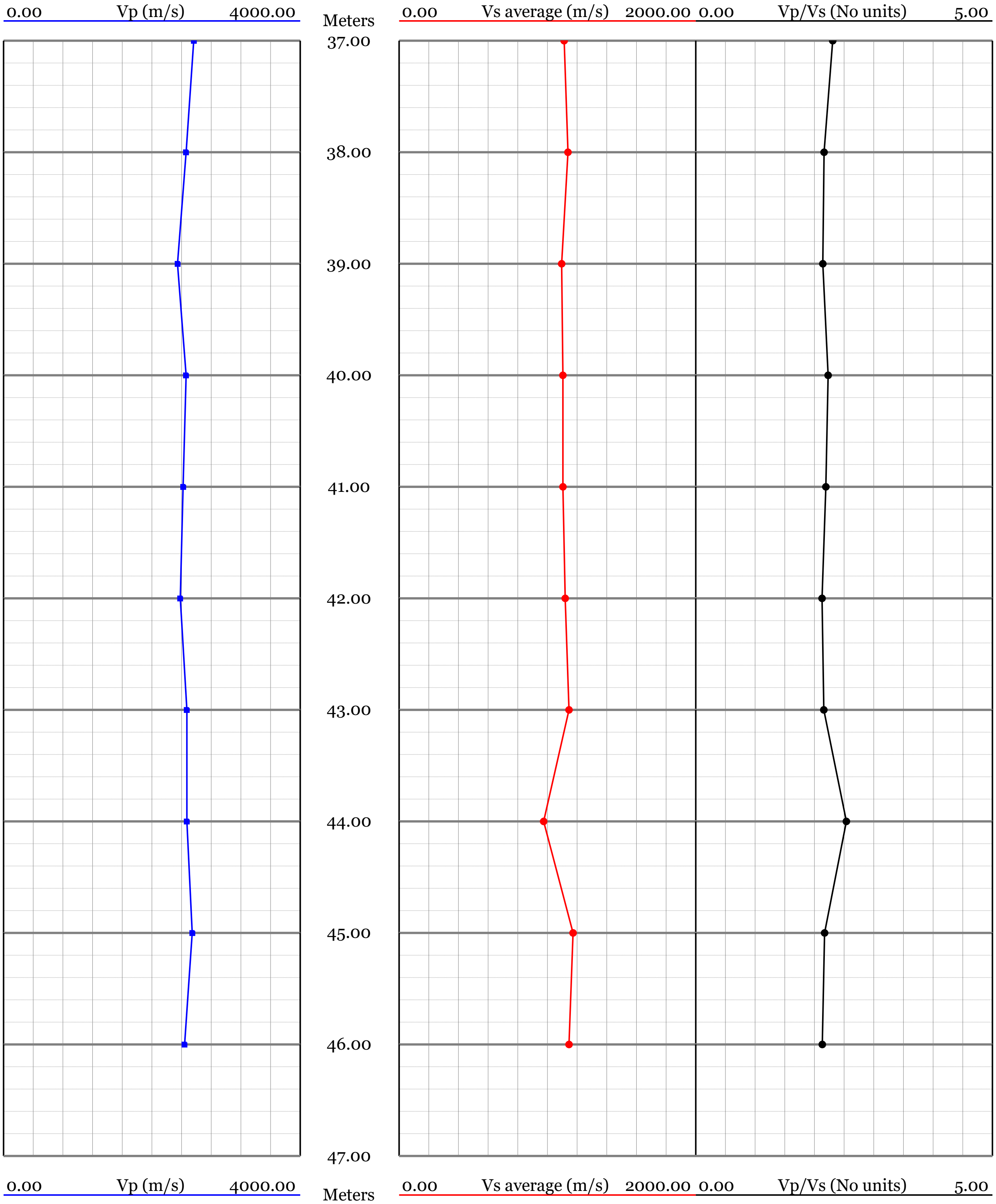
S Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
37.0
38.0
39.0
40.0
41.0
42.0
43.0
44.0
45.0

S Wave



Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000 (uS)
46.0
47.0
48.0
49.0
50.0
51.0
52.0
53.0
54.0


0.00
Vp (m/s)
4000.00
Meters
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00
37.00
38.00
39.00
40.00
41.00
42.00
43.00
44.00
45.00
46.00
47.00
0.00
Vp (m/s)
4000.00
Meters
0.00
Vs average (m/s)
2000.00
0.00
Vp/Vs (No units)
5.00

ROBERTSON GEO SERVICES®
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CO	COMPANY	Structural Soils
WELL	WELL ID	R72003
FLD	FIELD	A303 Stonehenge
CTY	COUNTRY	England
STE	STATE	
FILING No	LOCATION	OTHER SERVICES

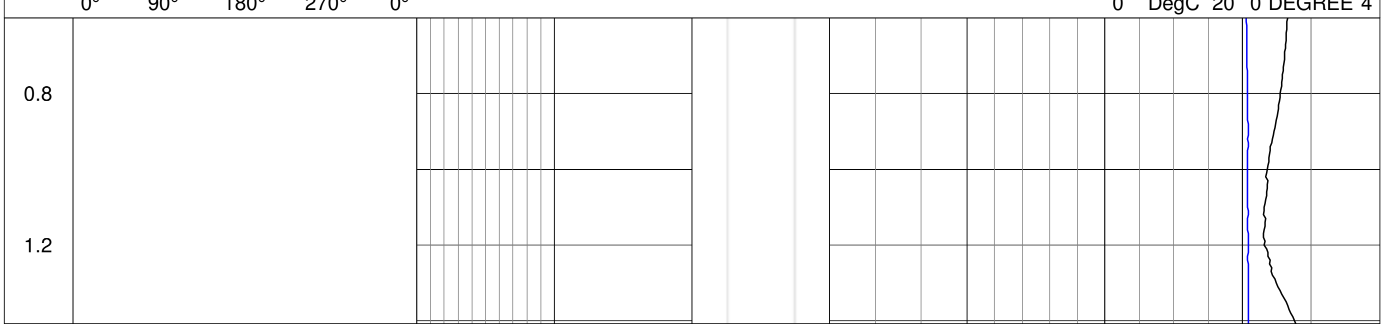
SEC	TWP	RGE

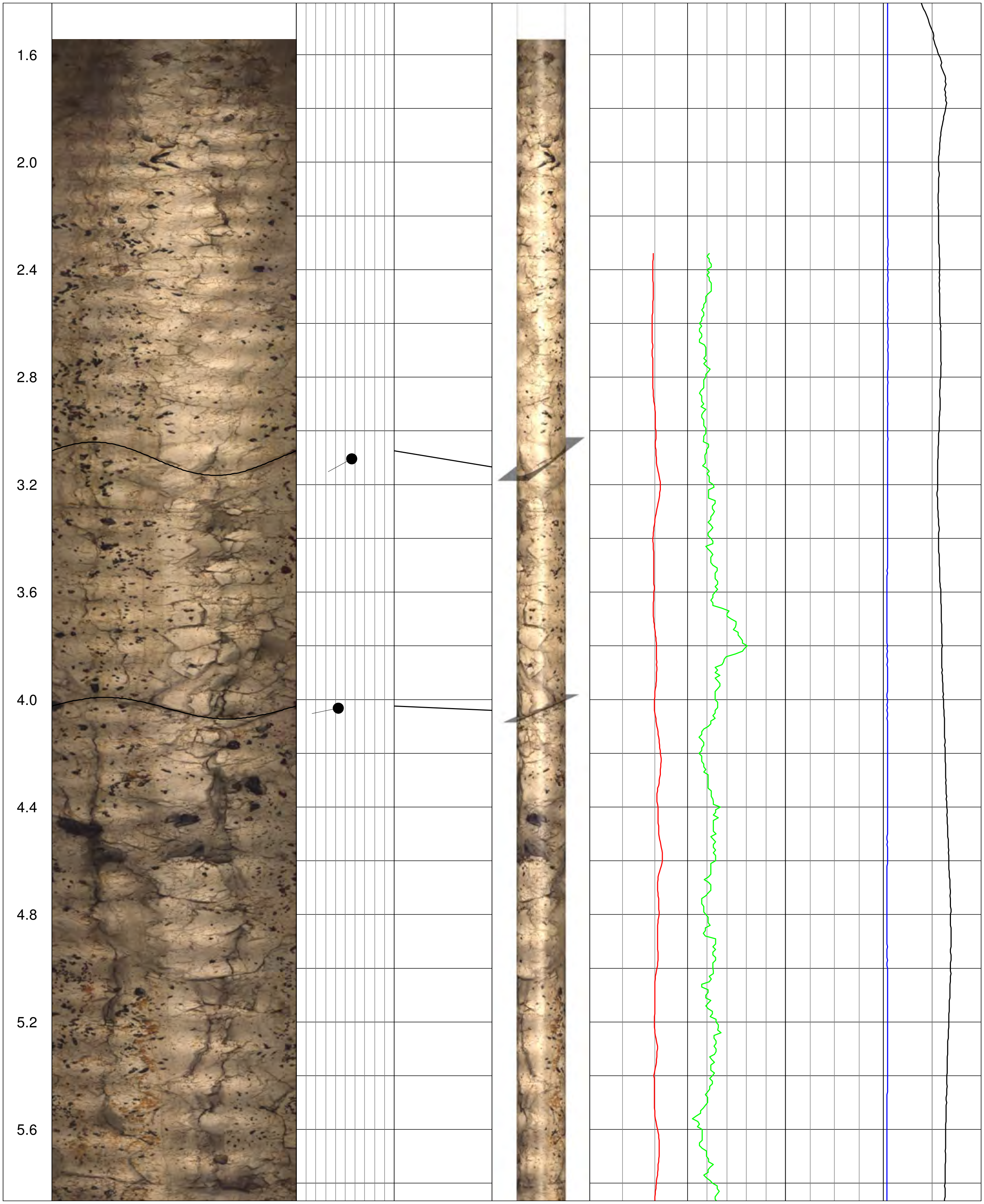
PERMANENT DATUM	GL	ELEVATION	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.

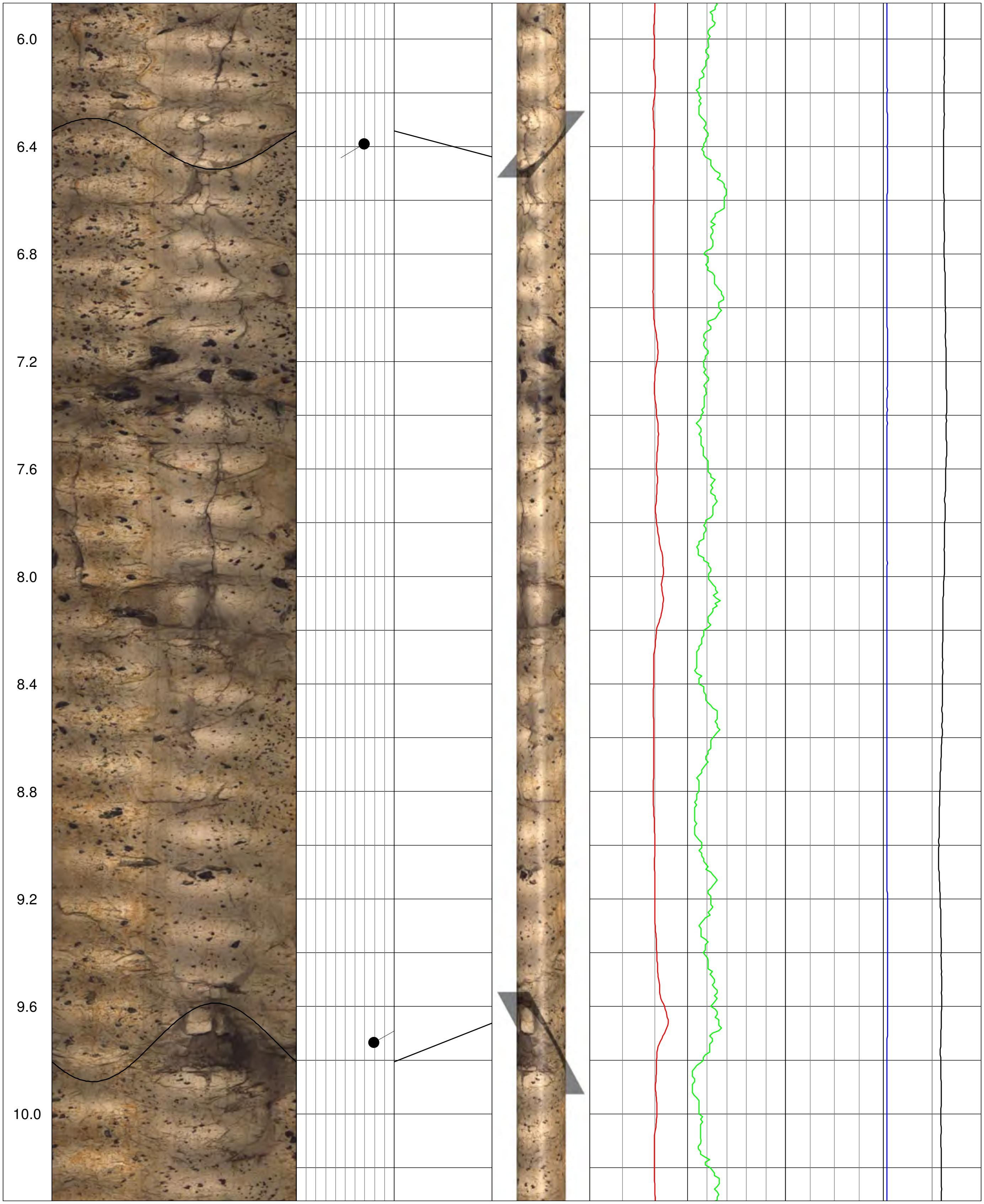
DATE	20/09/18	TYPE FLUID IN HOLE	Water
RUN No	1	SALINITY	
TYPE LOG	Composite	DENSITY	
DEPTH-DRILLER	45	LEVEL	
DEPTH-LOGGER	44.87	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	44.87		
TOP LOGGED INTERVAL	1.62	CASING SHOE	
OPERATING RIG TIME			
RECORDED BY	AJ		
WITNESSED BY	KO		

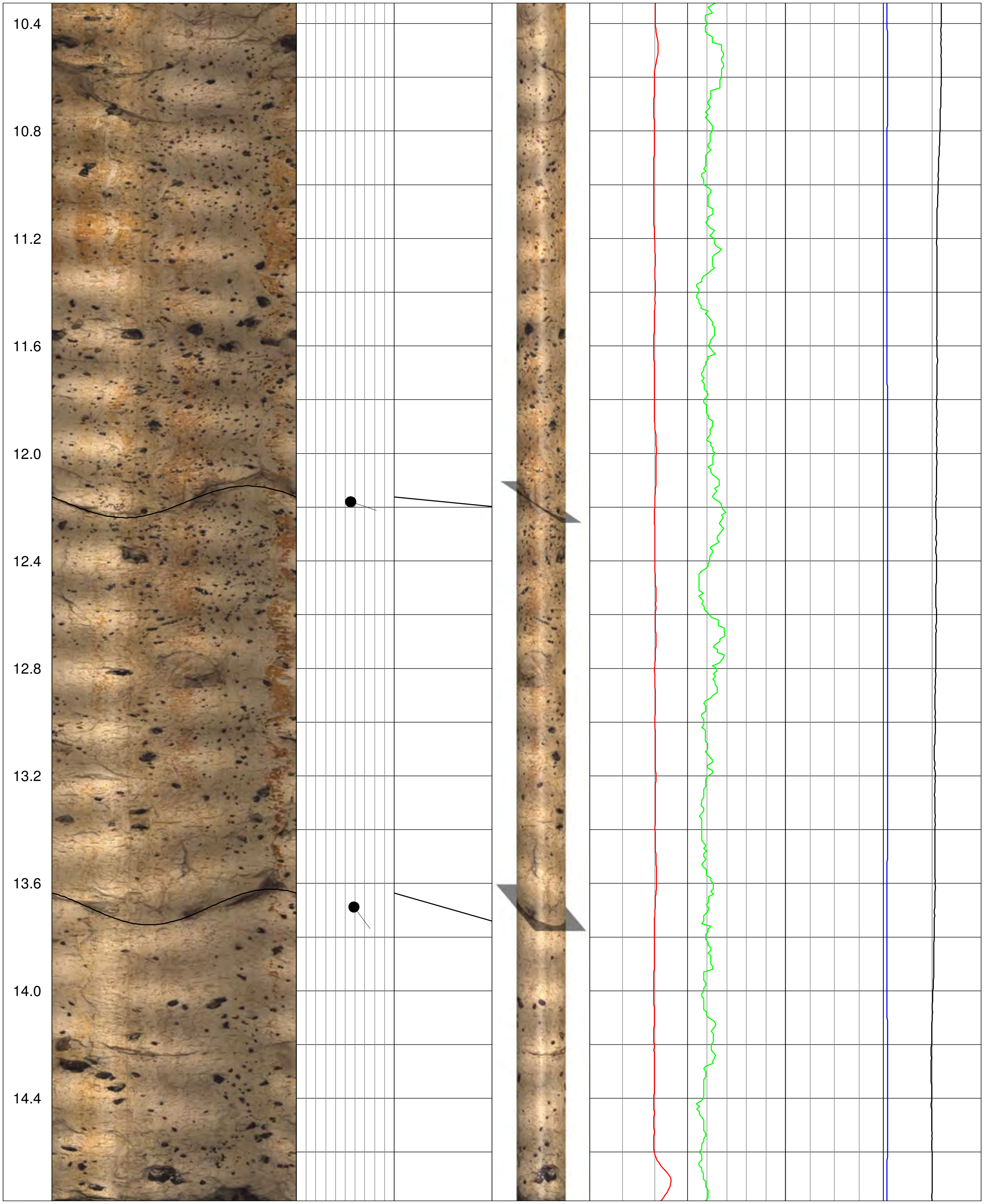
RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

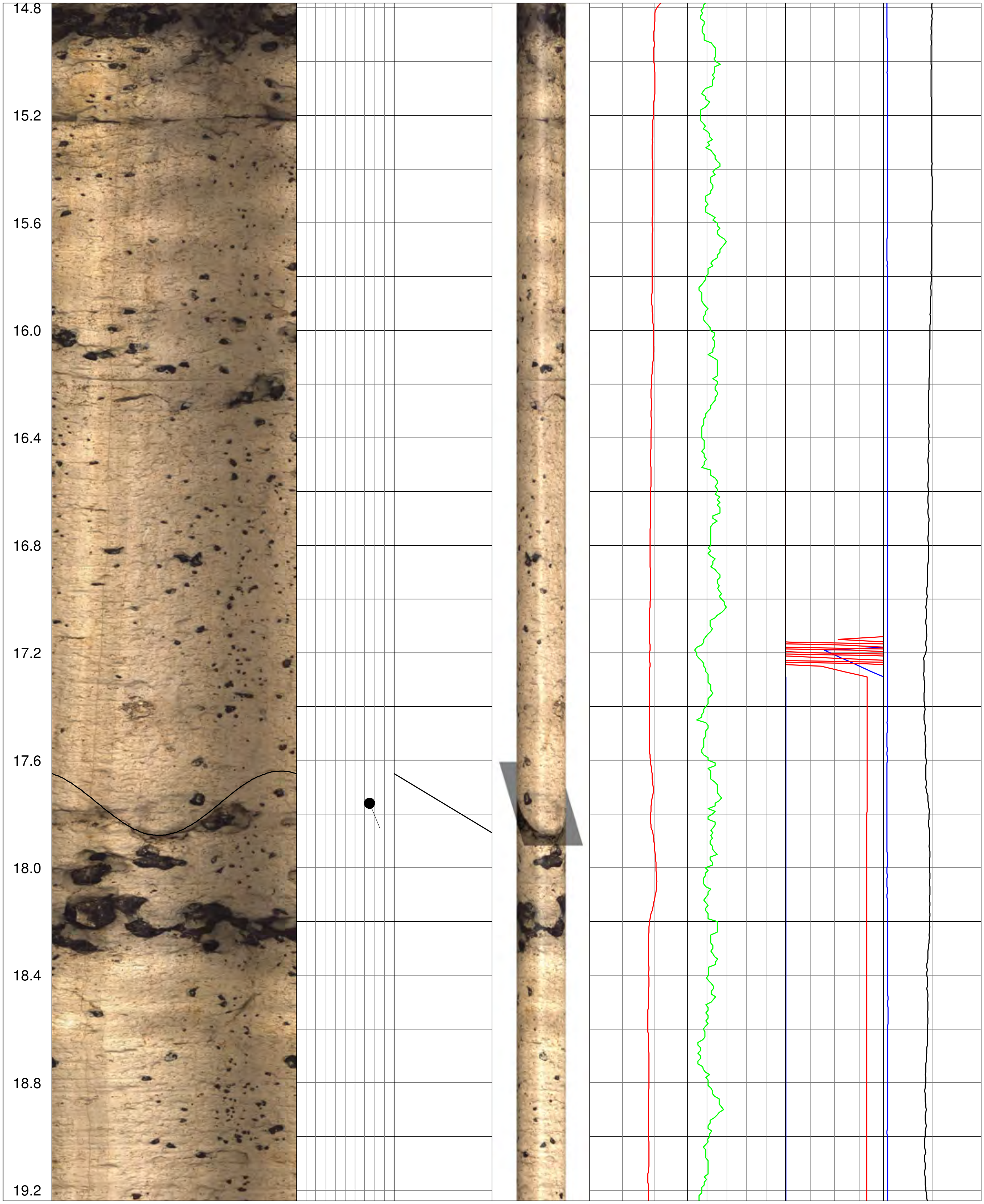
Depth	Optical	Dips 1	Dips 2	3D Log	CALP	NGAM	COND	Azimuth
1:20	0° 90° 180° 270° 0°	0 90	0° 180°	180°	0 mm 300	0 API 25	0 1500	0 360
	Projections						TEMP	INCL
	0° 90° 180° 270° 0°						0 DegC 20	0 DEGREE 4

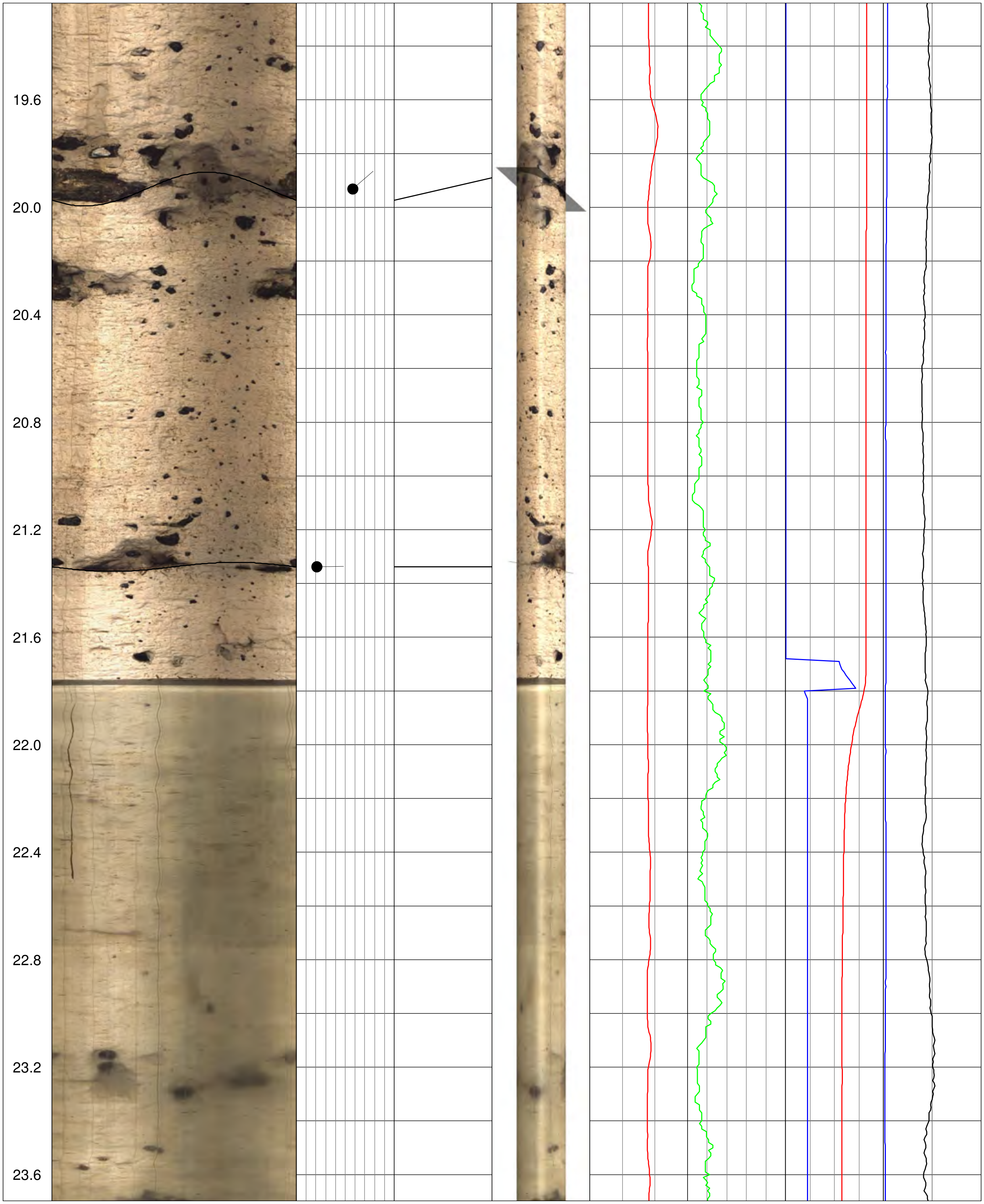


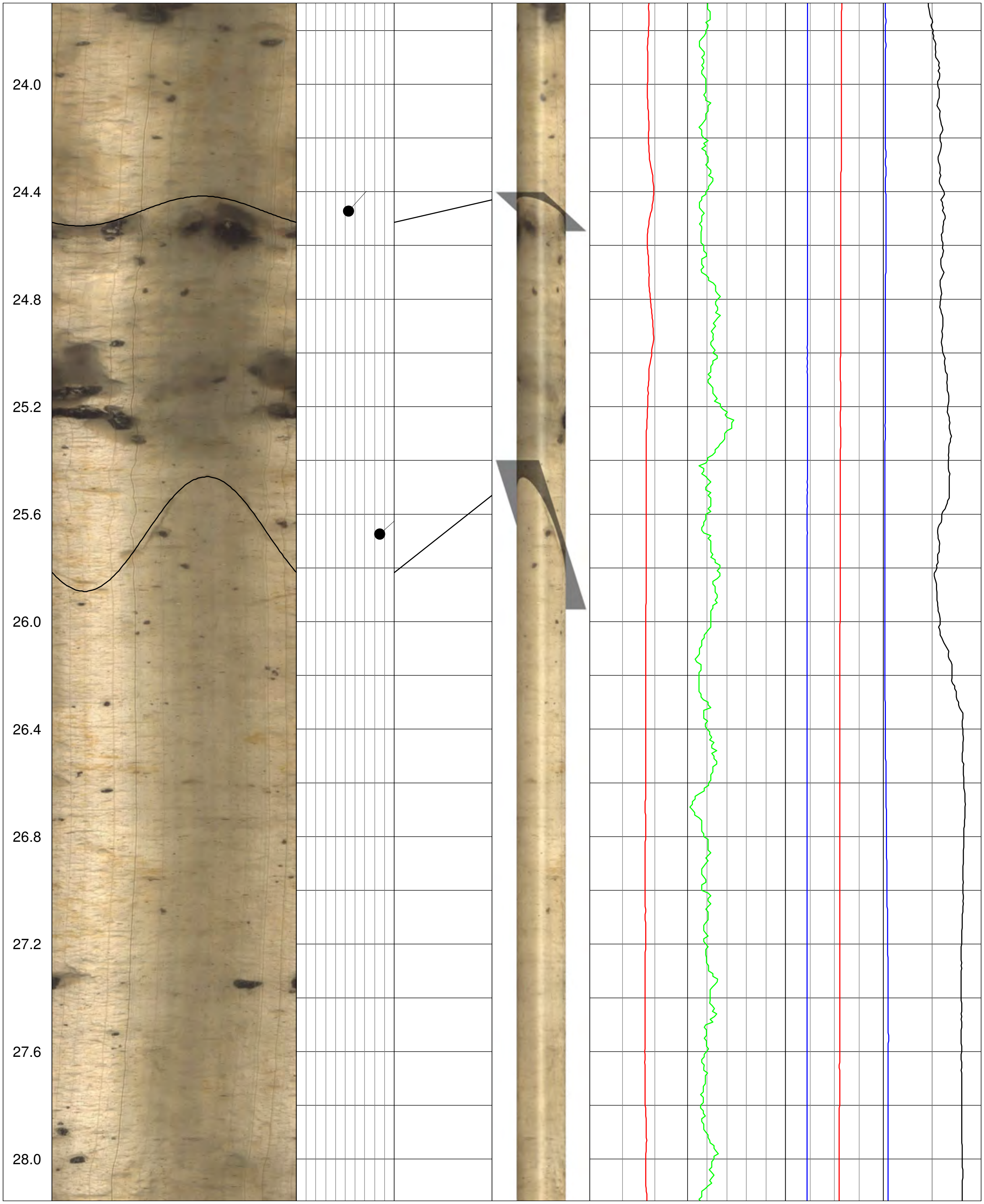

1.6
2.0
2.4
2.8
3.2
3.6
4.0
4.4
4.8
5.2
5.6

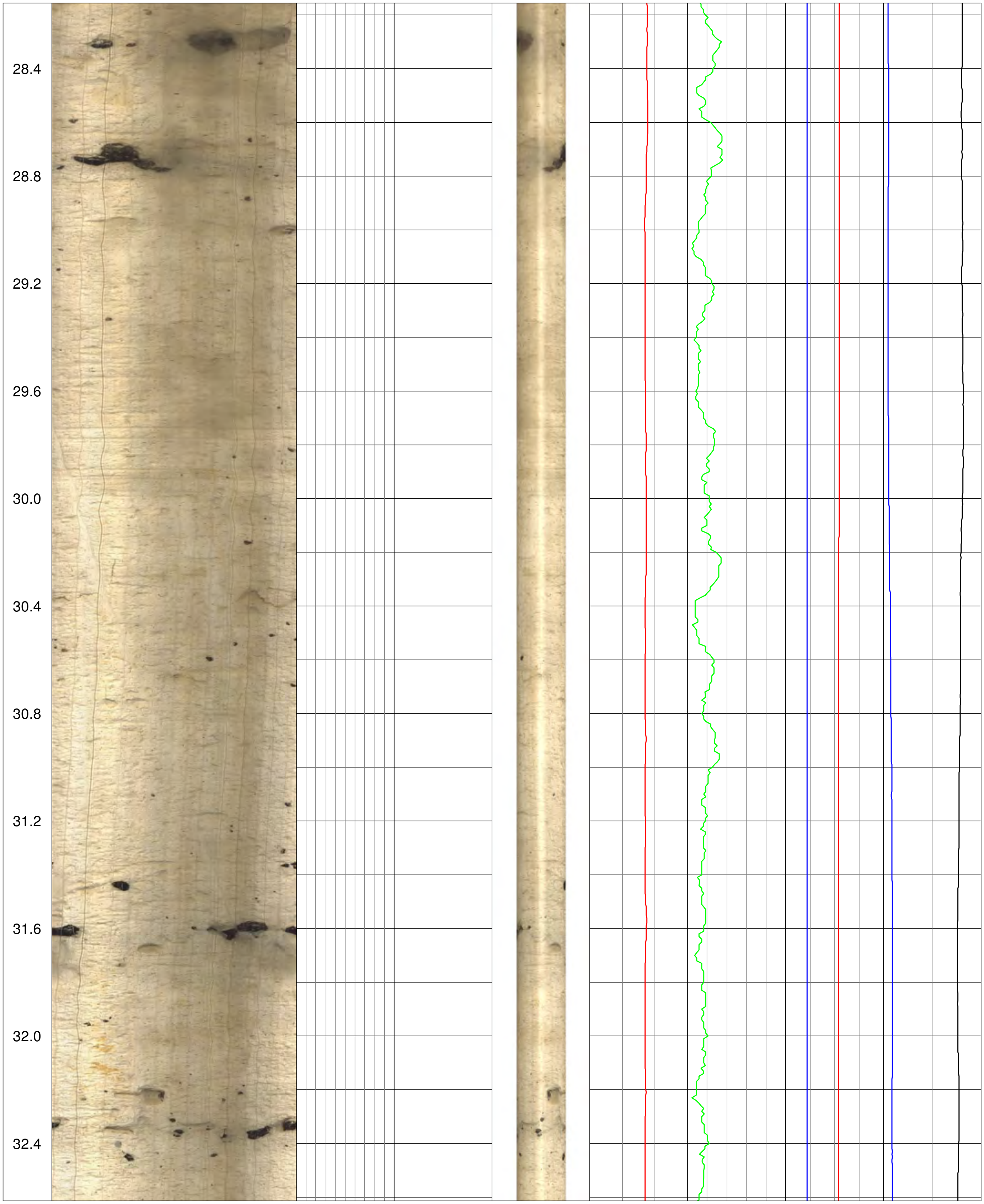

6.0
6.4
6.8
7.2
7.6
8.0
8.4
8.8
9.2
9.6
10.0

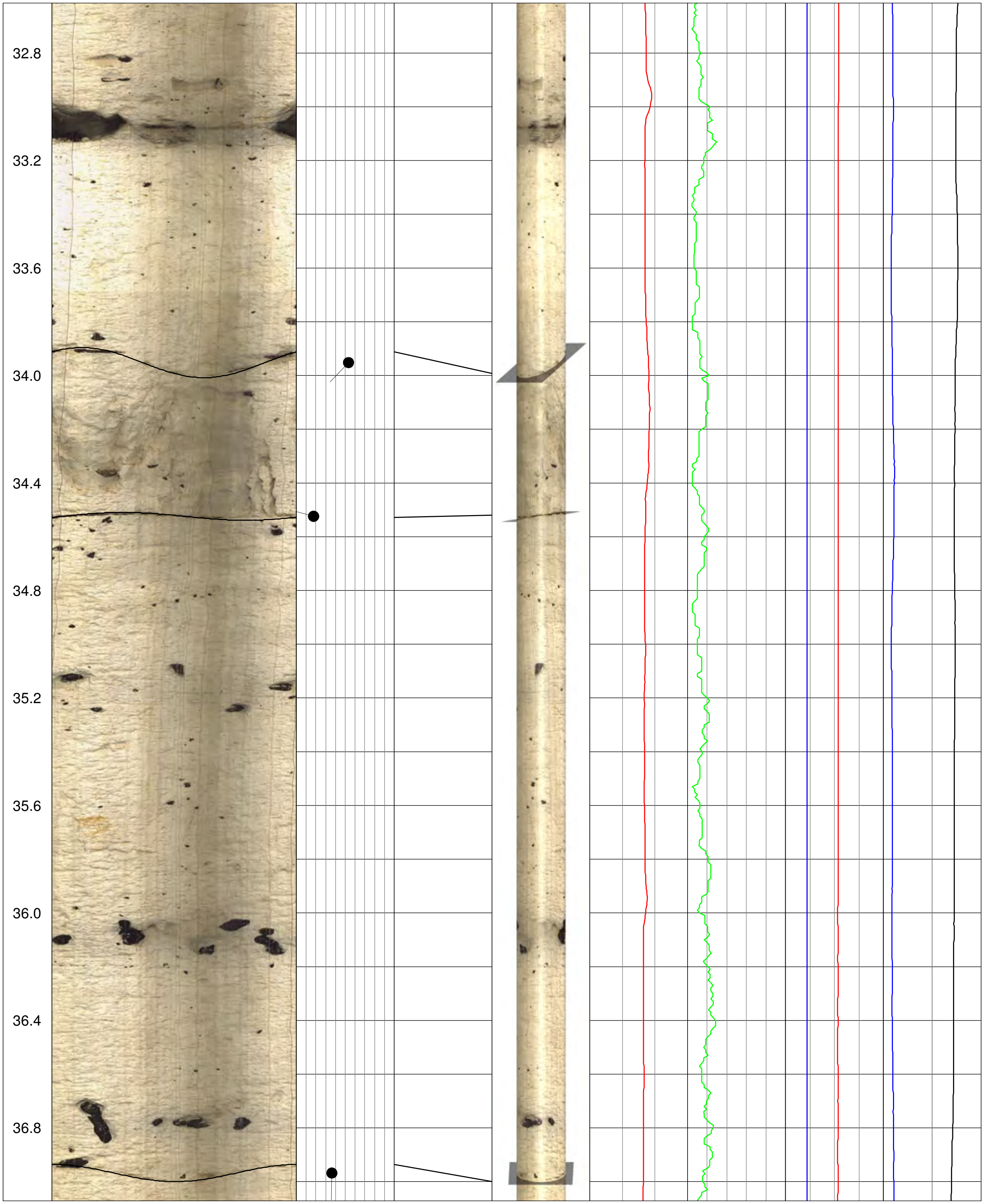

10.4
10.8
11.2
11.6
12.0
12.4
12.8
13.2
13.6
14.0
14.4

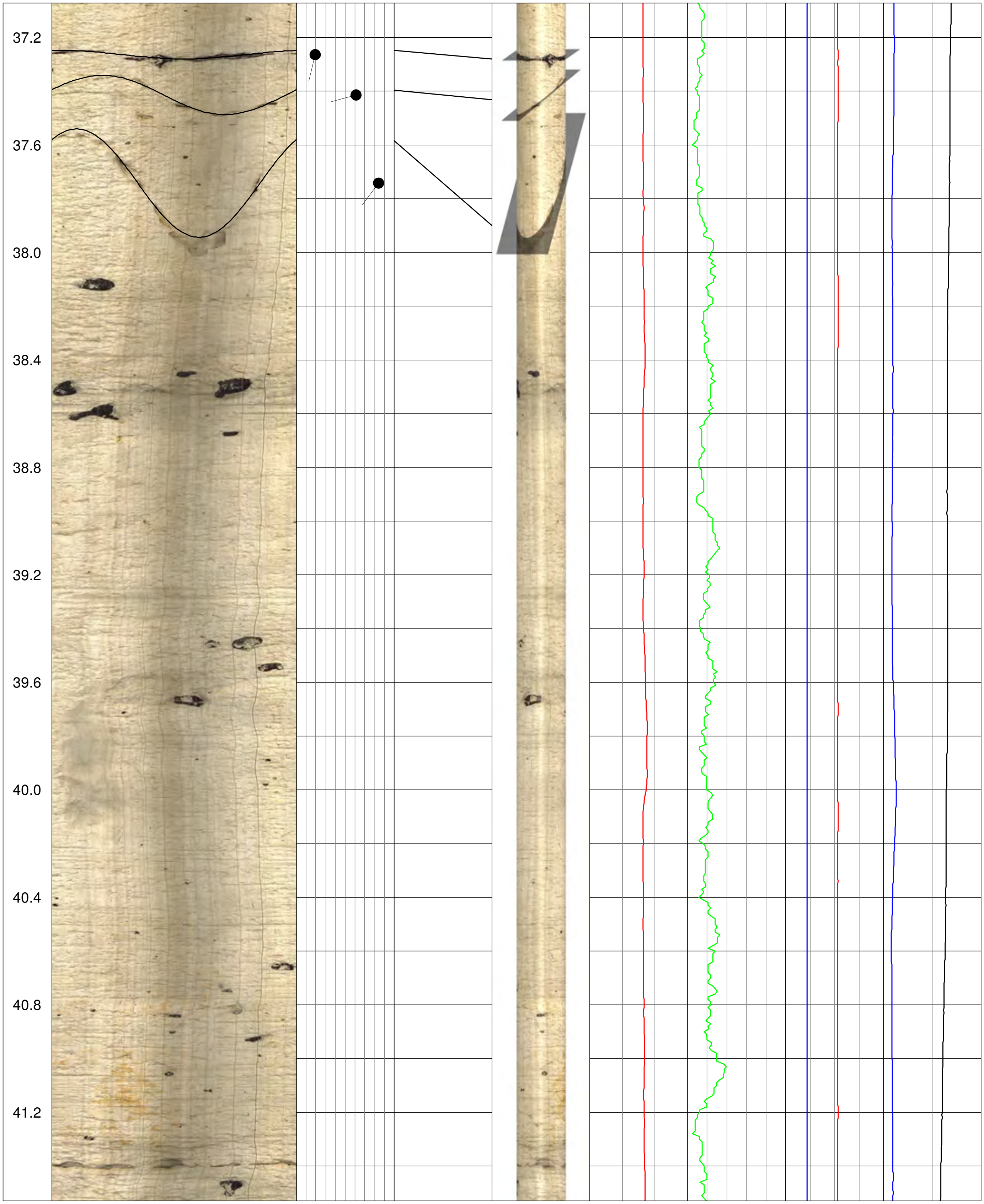

14.8
15.2
15.6
16.0
16.4
16.8
17.2
17.6
18.0
18.4
18.8
19.2

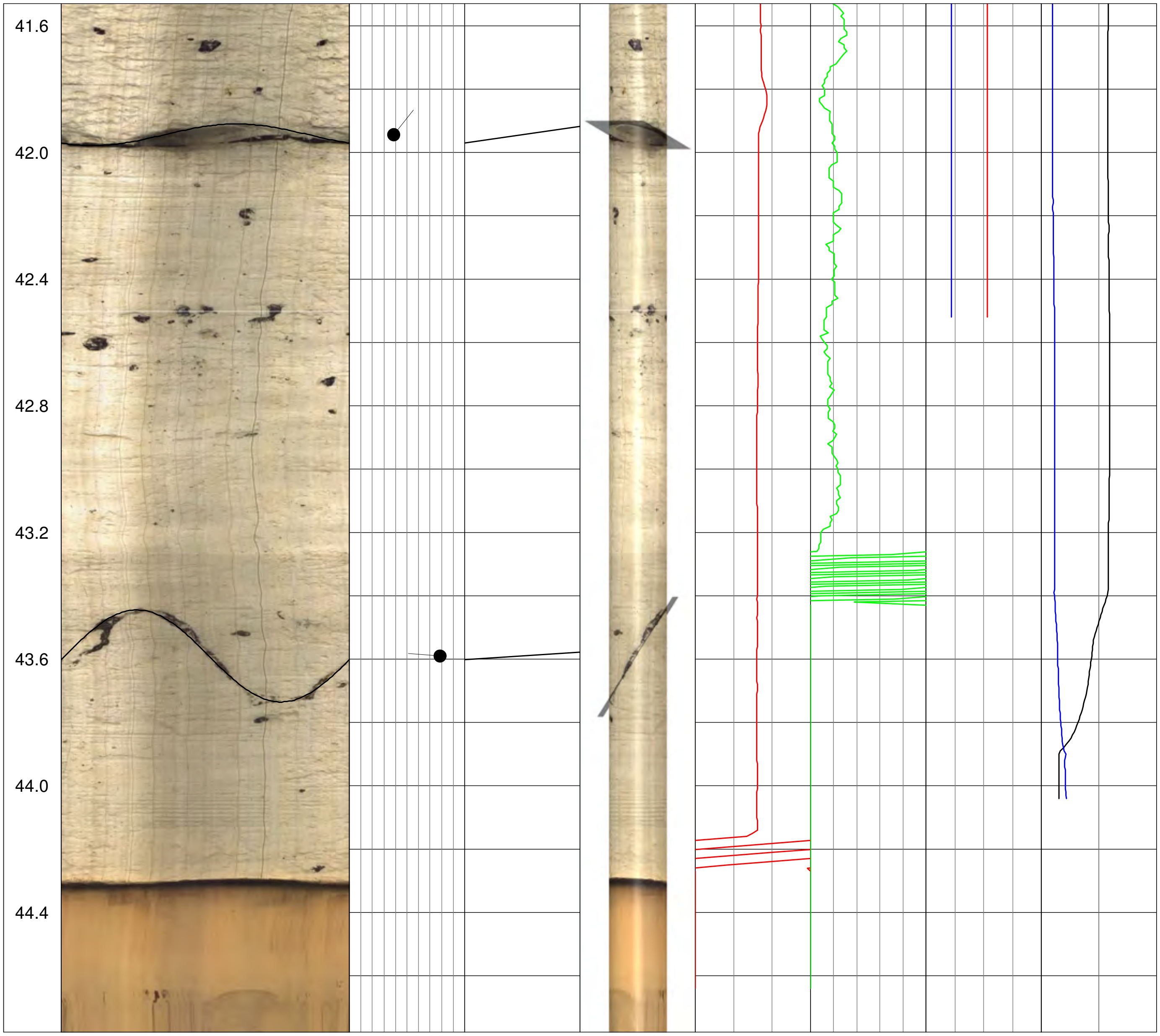

19.6
20.0
20.4
20.8
21.2
21.6
22.0
22.4
22.8
23.2
23.6


24.0
24.4
24.8
25.2
25.6
26.0
26.4
26.8
27.2
27.6
28.0


28.4
28.8
29.2
29.6
30.0
30.4
30.8
31.2
31.6
32.0
32.4


32.8
33.2
33.6
34.0
34.4
34.8
35.2
35.6
36.0
36.4
36.8


37.2
37.6
38.0
38.4
38.8
39.2
39.6
40.0
40.4
40.8
41.2


41.6
42.0
42.4
42.8
43.2
43.6
44.0
44.4

ROBERTSON GEO SERVICES
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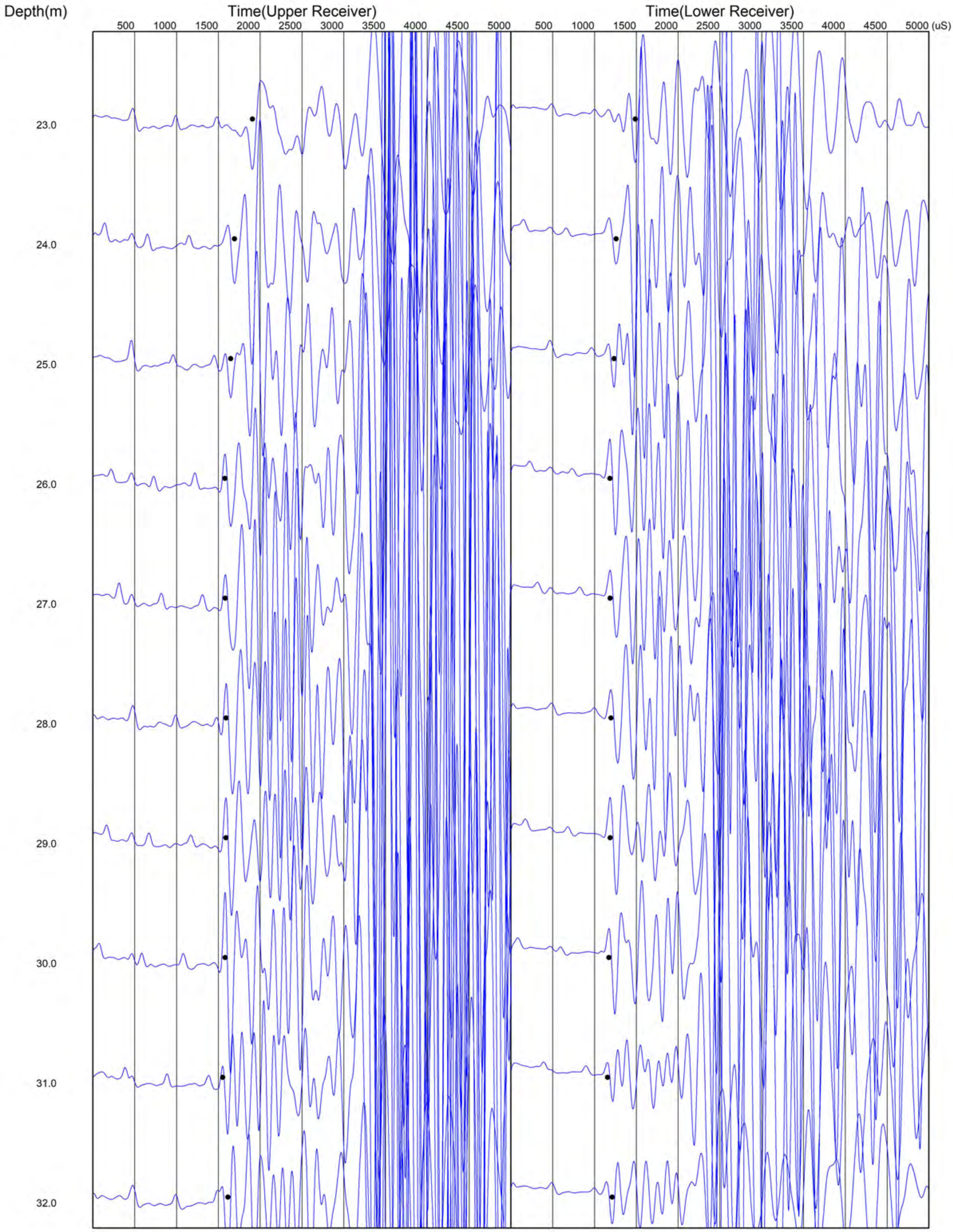
COMPANY	Structural Soils	
WELL ID	R72003	
FIELD	A303 Stonehenge	
COUNTRY	England	STATE
LOCATION		OTHER SERVICES
CO / WELL / FLD / CTY / STE / FILING No	SEC TWP RGE	

PERMANENT DATUM	GL	ELEVATION	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.

DATE	21/09/18	TYPE FLUID IN HOLE	Water
RUN No		SALINITY	
TYPE LOG	HRFM	DENSITY	
DEPTH-DRILLER	45	LEVEL	
DEPTH-LOGGER	44.87	MAX. REC. TEMP.	
BTM LOGGED INTERVAL	44		
TOP LOGGED INTERVAL	15	CASING SHOE	
OPERATING RIG TIME			
RECORDED BY	AJ		
WITNESSED BY	KO		

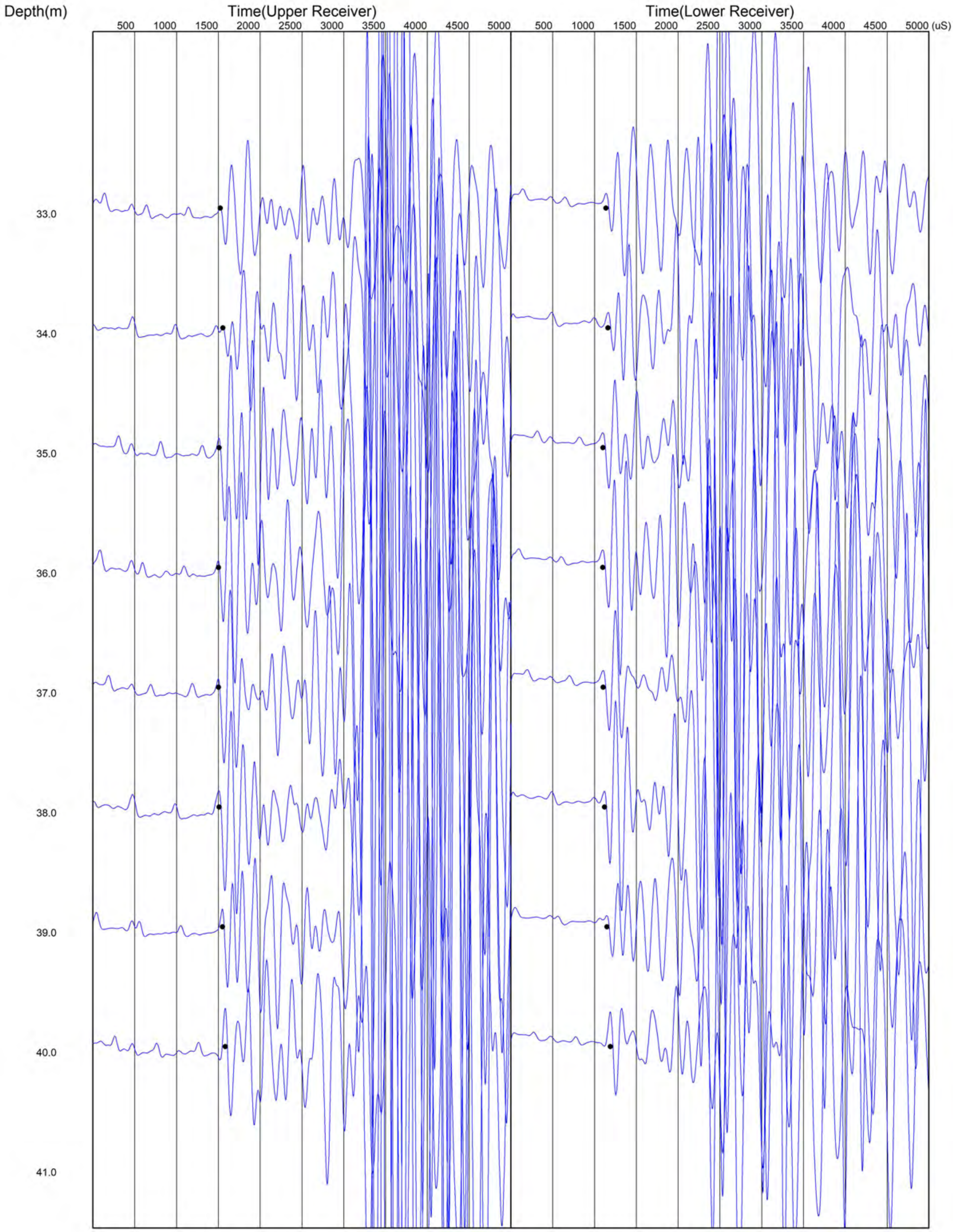
RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

P Wave

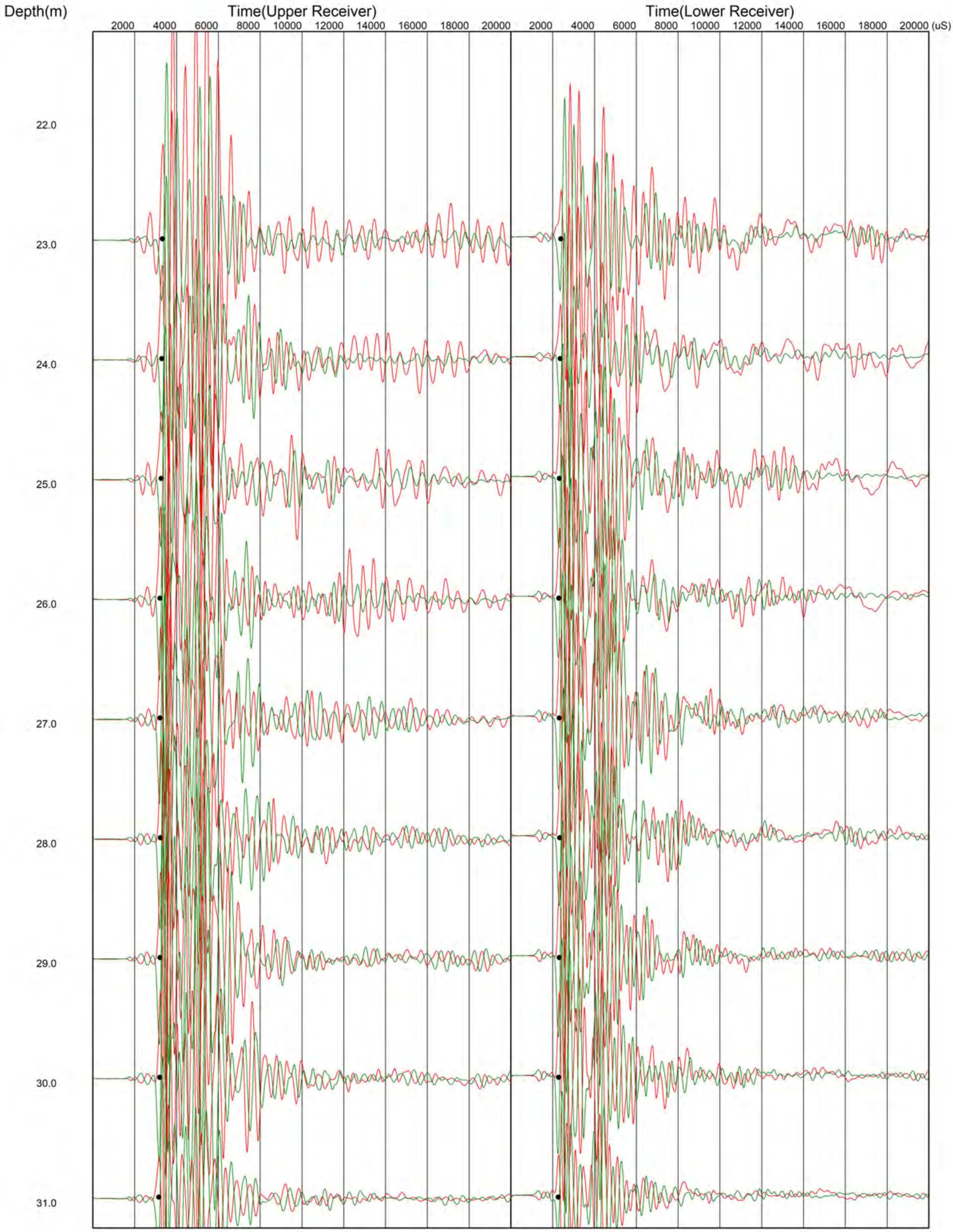


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
23.0
24.0
25.0
26.0
27.0
28.0
29.0
30.0
31.0
32.0

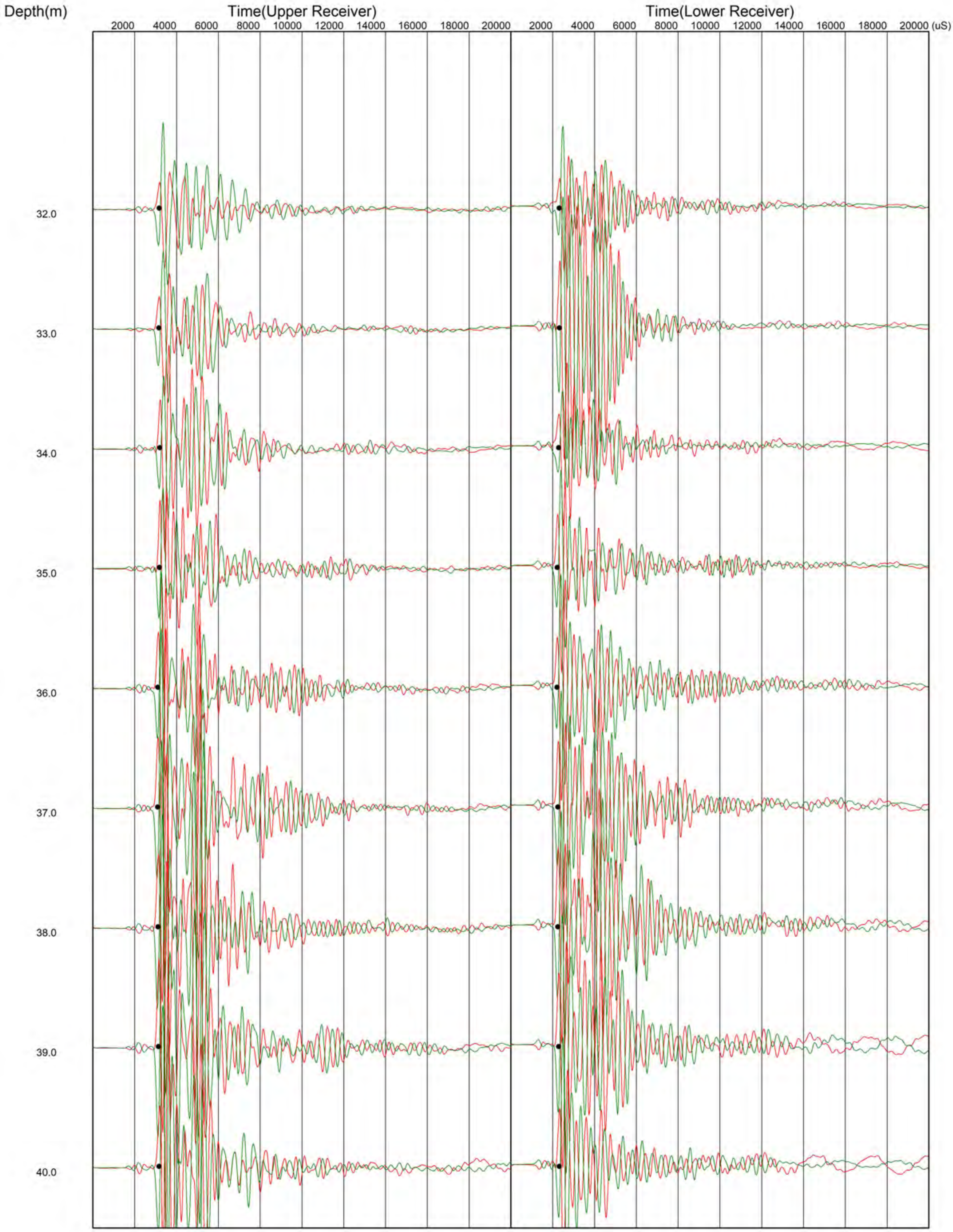
P Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
500 1000 1500 2000 2500 3000 3500 4000 4500 5000
500 1000 1500 2000 2500 3000 3500 4000 4500 5000 (uS)
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0
41.0

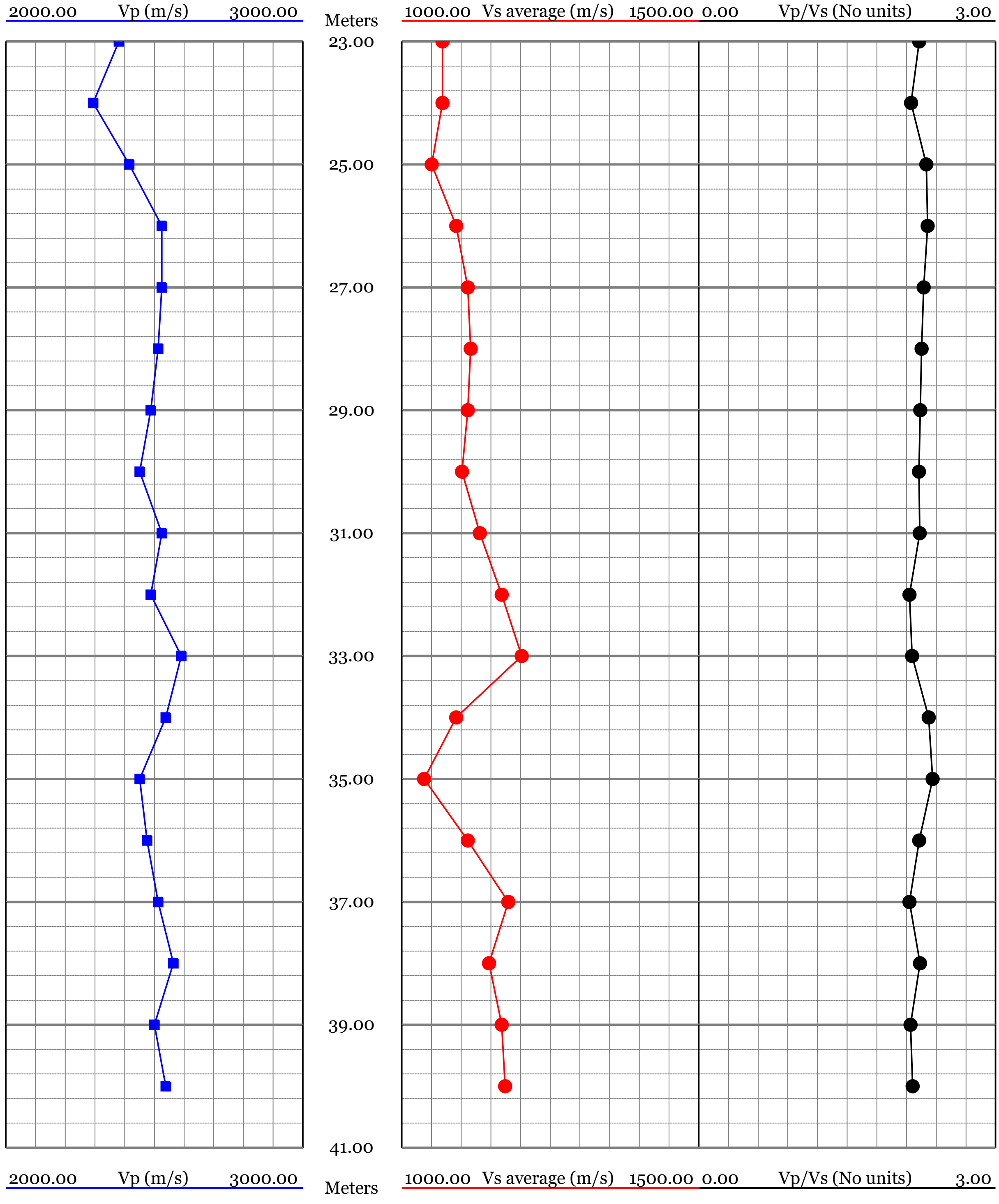
S Wave


Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 (uS)
22.0
23.0
24.0
25.0
26.0
27.0
28.0
29.0
30.0
31.0

S Wave



Depth(m)
Time(Upper Receiver)
Time(Lower Receiver)
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
(uS)
32.0
33.0
34.0
35.0
36.0
37.0
38.0
39.0
40.0


2000.00 Vp (m/s) 3000.00
Meters
1000.00 Vs average (m/s) 1500.00
0.00 Vp/Vs (No units) 3.00
23.00
25.00
27.00
29.00
31.00
33.00
35.00
37.00
39.00
41.00
2000.00 Vp (m/s) 3000.00
Meters
1000.00 Vs average (m/s) 1500.00
0.00 Vp/Vs (No units) 3.00

PUMPING TEST FACTUAL REPORT
Test 1 of 3 – Cluster W623

Contract Name:	A303 Amesbury to Berwick Down Ground Investigation – Pumping Tests
Client Name:	Highways England (HE)
Consultant:	AECOM (A)
Geotechnical specialist:	Structural Soils Ltd (SS)
Groundwater Pumping Test & Dewatering Specialist:	Stuart Well Ltd (SWL)
Report No	SWC6161-PT-W623

Revision	Date	Description	Prepared By (SWL)	Checked By (SWL)	Approved By (SS)	Approved By (A)
1	20/08/2018	Submitted for approval	DB	DW		

For:

Structural Soils Ltd
The Old School
Silthouse Lane
Bedminster
BS3 4EB

Contact:

Michael Addinall
Senior Geotechnical Engineer
[redacted]

By:

Stuart Well Ltd
Hargham Road
Shropham
Norfolk
NR17 1DT

Contact:

Daniel Brooks
Contract Manager
[redacted]

Contents

1. Introduction

In April 2018 Stuart Wells Ltd was appointed by Structural Soils Ltd to undertake a pumping test for the A303 Amesbury to Berwick Down Ground Investigation project.

To aid design of the A303 Amesbury to Berwick Down tunnelling and shaft sinking civil works, a series of 3 pumping tests were undertaken along an approximate 1.5km section of the future tunnel alignment. Each test is sited in a specific ground investigation (GI) zone of the ground investigation package to better understand the chalk. The testing can be summarised as follows.

GI Zone: South of alignment – test 1

- A single pumping well (W623) and 5no monitoring wells
- Primary purpose of the pumping test in this GI Zone is to better understand the hydrogeology of the chalk ridge.

GI Zone: Tunnel alignment west of Stonehenge Bottom – test 2

- A single pumping well (W601) and 7no monitoring wells
- Primary purpose of the pumping test in this GI Zone is to better understand the hydrogeology of the phosphatic chalk at this location

GI Zone: Tunnel alignment west of Stonehenge Bottom – test 3

- A single pumping well (W617) and 6no monitoring wells
- Primary purpose of the pumping test in this GI Zone is to better understand the hydrogeology of the dry valley. The thickness of superficial and de-structured chalk and faulting.

This factual report details the activities and the results of the testing carried out at W623.

Figure 1: Site Location Map

2. Summary of Ground Conditions

The ground conditions at W623 is summarised as follows as indicated by the borehole log undertaken by Structural Soils Ltd.

Stratum	Top level of stratum (mAOD)
Brown slightly gravelly sandy SILT with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of chalk flint. Cobbles are angular to subangular flint.	93.10
Cream and pale brown structureless CHALK comprising slightly sandy gravelly SILT with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of chalk and rare flint. Cobbles are angular flint (Grade Dm).	92.85
White and cream structureless CHALK comprising slightly sandy silty subangular to subrounded fine to coarse GRAVEL of chalk and rare flintwith low cobble content. Sand is fine to coarse. Cobbles are angular to subrounded chalk flint (Grade Dc).	92.60
Firm white CHALK occasionally abundant with flint (driller description) Rotary drilling techniques used below 87.60mAOD. Drillers description to base of hole is described as CHALK and FLINT.	92.20
Base of borehole	32.10

Table 1: Summary of geology

3. Field Work

The programme of works undertaken at site can be summarised as follows:

Date	Activity
29th May to 6th June 2018	Background monitoring
6th June 2018	Equipment Test
7th June 2018	Step Test
12th June to 19th June 2018	Constant Rate Test
19th June to 22nd June 2018	Recovery Test

Table 2: Programme of works

Equipment used during testing is summarised as follows:

- A 45kW electrical submersible borehole pump was utilised for the testing after proving suitable during the equipment test on 6th June 2018.
- A series of 5.5 to 11kW electrical submersible drainage pumps were utilised as a boost system pump capable of pushing the discharge water to the discharge point located 1km distance from the pumping well
- A duty and standby 150kVA generator with automatic changeover panel were used to power the borehole pump and a series of duty and standby with automatic changeover panel were used to power the boost pumps
- Electronic Dataloggers were used at each well record continuous water level readings for the duration of the testing period. Data cable on each datalogger permitted the use of a Bluetooth datalogger/transmitter to send data throughout testing by email.
- Manual water level readings were recorded using a Manual Dip Tape

- Flow rate was monitored using a series of 2no electronic flow meters each with telemetry permitting remote monitoring of flow rate and a v-notch tank was used before the boost pumps as a back up to the flow meters if the flow meters should fail at any time.

The layout of the wells is shown in figure 2, and the well installation details provided in table 7.

4. Results

4.1. Background monitoring

Before undertaking the pumping test, the water level was monitored for a period of 7 days from 29th May to 6th June 2018 to observe any natural fluctuations in the water table. The pre-test monitoring shows that the groundwater at this location is dropping with a drop in water level observed at all wells on between 0.27 to 0.33m over a period of 7 days and 15 hours. This gives an estimated drop in water level of between 0.043m to 0.035m per day. We speculate that this is due to seasonal variation however interpretation is out of the scope of this report.

See as follows a summary of the data.

Well Name	Water Level (mAOD)
W623	Start level at 65.79mAOD End level at 65.50mAOD (0.29m drop)
RX624	Start level at 66.40mAOD End level at 66.07mAOD (0.33m drop)
RX625	Start level at 66.12mAOD End level at 65.85mAOD (0.27m drop)
RX626	Start level at 65.92mAOD End level at 65.67mAOD (0.25 drop)
RX627	Start level at 66.32mAOD End level at 66.03mAOD (0.29m drop)
RX628	Start level at 66.63mAOD End level at 66.35mAOD (0.28m drop)

Table 3: Background monitoring data

4.2. Step Test

A series of 5no steps pumping at 10l/s, 15l/s, 20l/s, 25l/s and 30l/s were undertaken at W623 on 07/06/2018. Each step was for a period of 100 minutes each.

Following completion of the step tests, the flow rate of 25l/s was selected as the most suitable flow rate for the constant drawdown test flow rate.

	Date	Time	Time into test (Minutes)	Water Level (mAOD)	Cumulative Drawdown (m)
Step 1 – 10l/s	07/06/2018	09:30	0	65.72	
	07/06/2018	11:10	100	64.78	0.94
Step 2 – 15l/s	07/06/2018	11:10	0	64.78	
	07/06/2018	12:50	100	63.97	1.75
Step 3 – 20l/s	07/06/2018	12:50	0	63.97	
	07/06/2018	14:30	100	62.95	2.76
Step 4 – 25l/s	07/06/2018	14:30	0	62.95	
	07/06/2018	16:10	100	61.80	3.91
Step 5 – 30l/s	07/06/2018	16:10	0	61.80	
	07/06/2018	17:50	100	60.44	5.28

Table 4: Summary of step test results

4.3. Constant Rate Test

The result of the constant rate test can be summarised as follows pumping at a flow rate of 25l/s for a period of 7 days from 13:00 on 12th June to 13:00 on 19th June 2018.

	13:00 on 12/06/18	13:00 on 19/06/18		
Well Name	**Water Level (mAOD)**	**Water Level (mAOD)**	**Drawdown (m)**	**Distance to W623 (m)**
W623	65.55	61.73	3.82	-
RX624	65.84	64.64	1.20	94.49
RX625	65.60	62.57	3.04	7.81
RX626	65.33	63.85	1.48	19.11
RX627	65.79	64.01	1.78	20.52
RX628	66.13	65.56	0.57	48.80

Table 5: Summary of constant rate test results

The results showing the response of the water table relative to the pumping rate, time of pumping and the radial distance away from the pumping well are presented in figures 3, 4 and 5. The full data set (table8) is presented in excel format along with the report.

Yours faithfully,

[redacted]

[redacted]

Daniel Brooks
Contracts Manager
For & behalf of **Stuart Well Services Limited**

David Wright CGeol
Director & Principal Groundwater Engineer
For & behalf of **Stuart Well Services Limited**

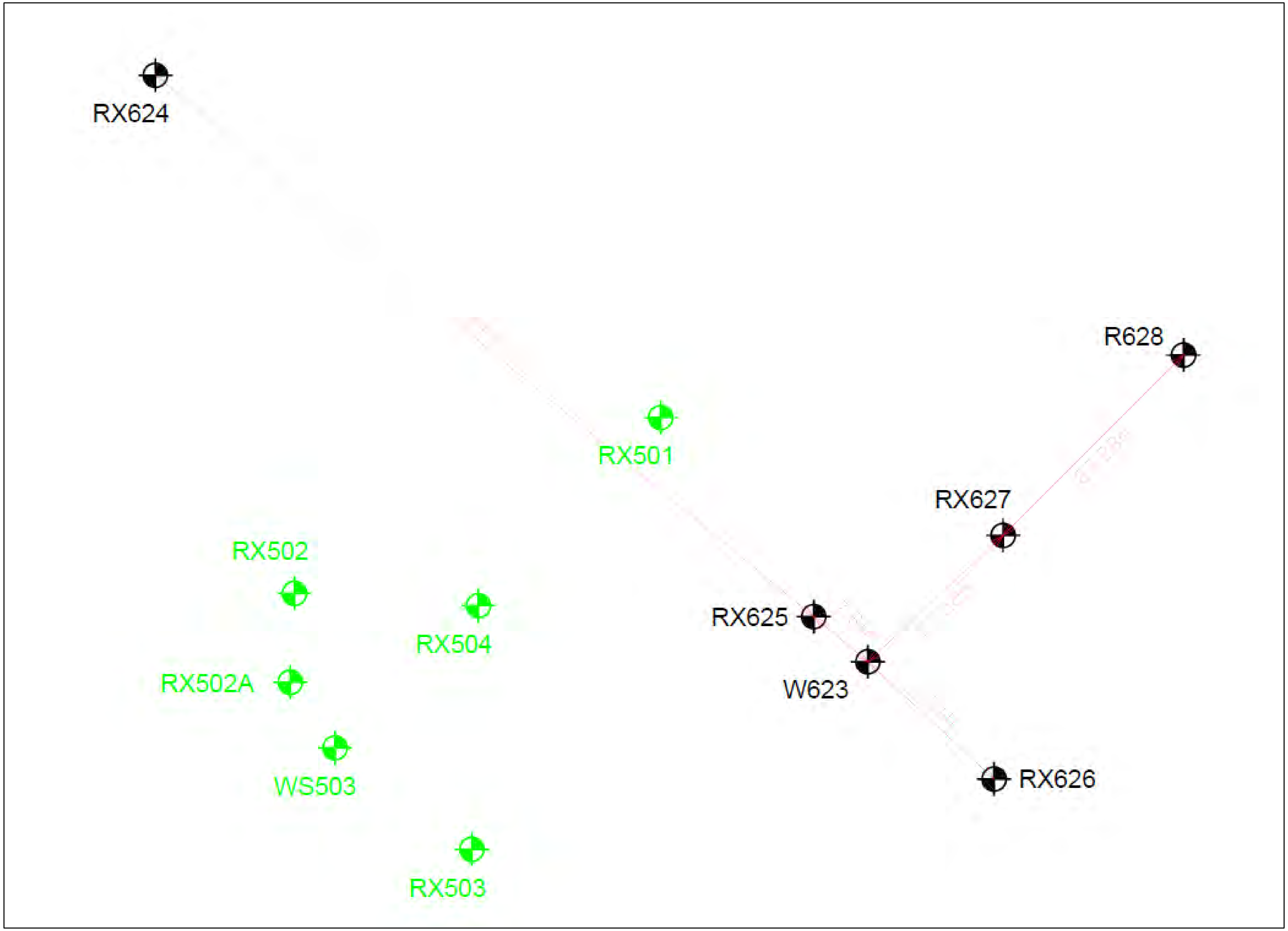


Figure 2: Well location plan

				Screened Sections				
	Easting	Northing	Ground Level	Top	Bottom	Borehole Size	Liner Size	Distance from Pumping Well W623
Well Name	m	m	mAOD	mAOD	mAOD	mm	mm	m
W623 (Pumping Well)	413433.300	141267.500	111.678	106.678	41.678	350.00	255.00	n/a
RX624	413355.906	141334.000	108.154	103.154	38.154	150.00	50.00	94.49
RX625	413428.958	141274.058	111.648	106.648	41.648	150.00	50.00	7.81
RX626	413447.586	141255.149	111.606	106.606	41.606	150.00	50.00	19.11
RX627	413448.754	141281.772	111.998	106.998	41.998	150.00	50.00	20.52
RX628	413469.195	141302.103	112.583	107.583	42.583	150.00	50.00	48.80

Table 6: Well specification

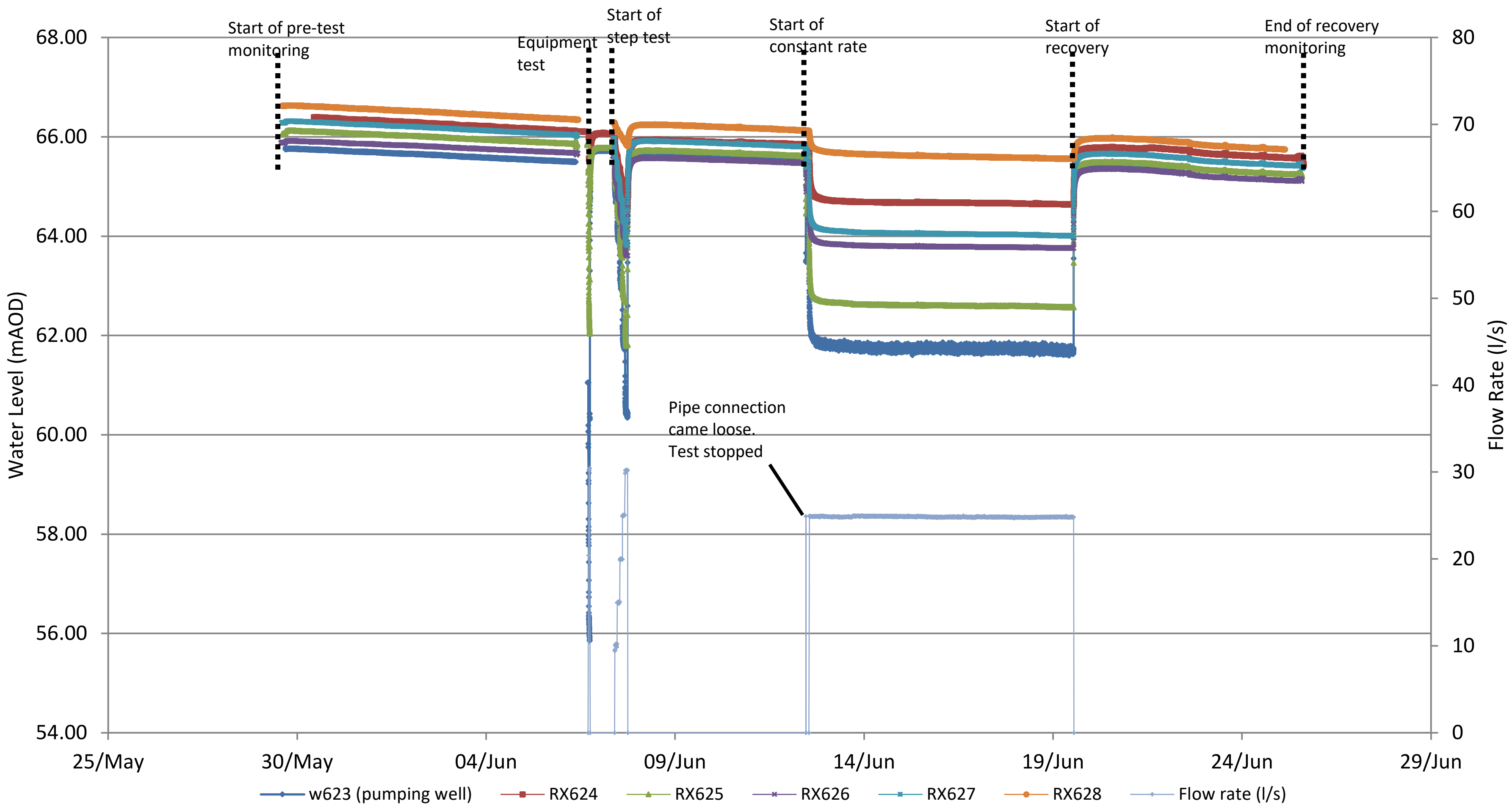


Figure 3: Time-water level graph

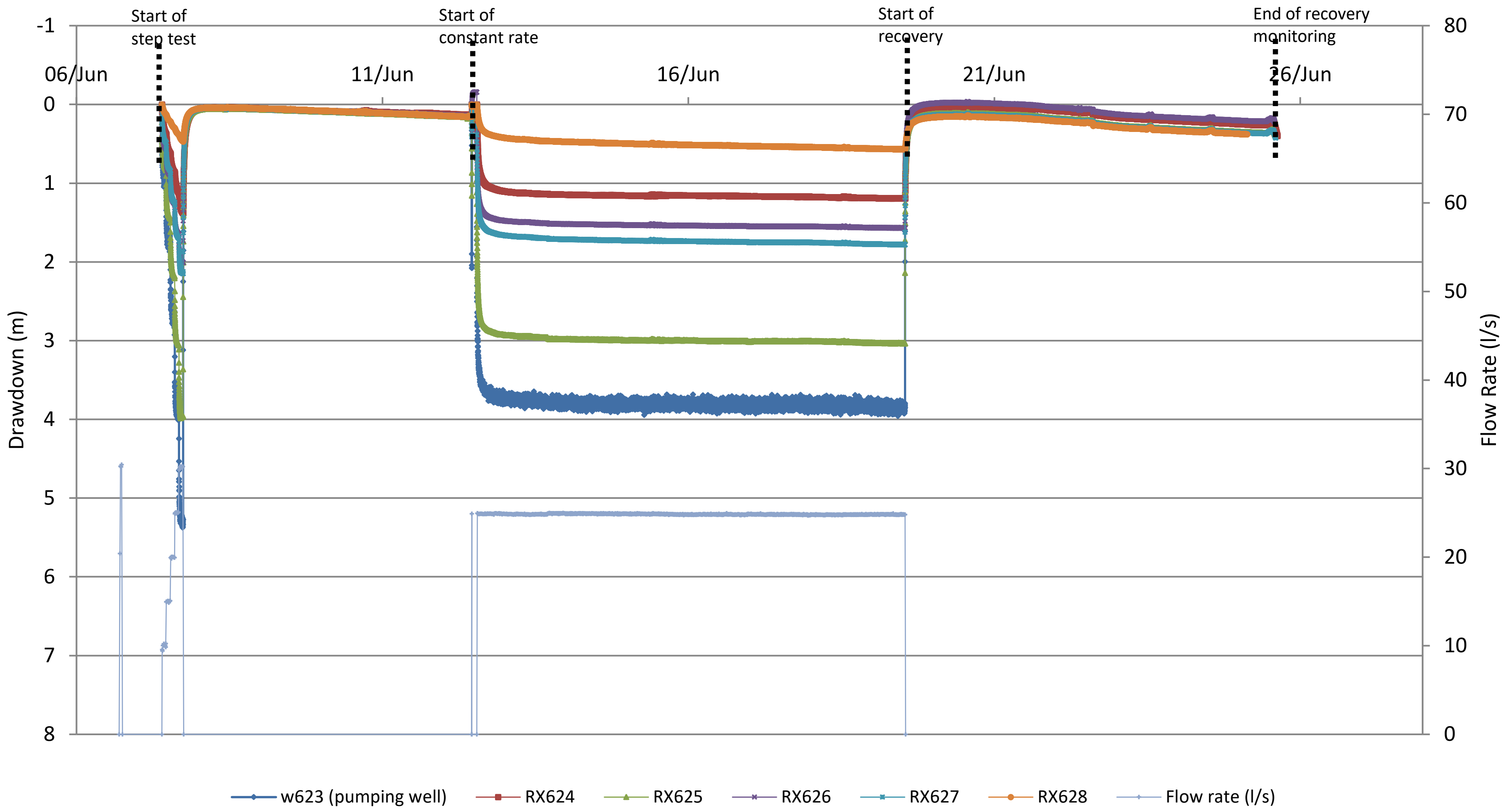


Figure 4: Time-drawdown graph

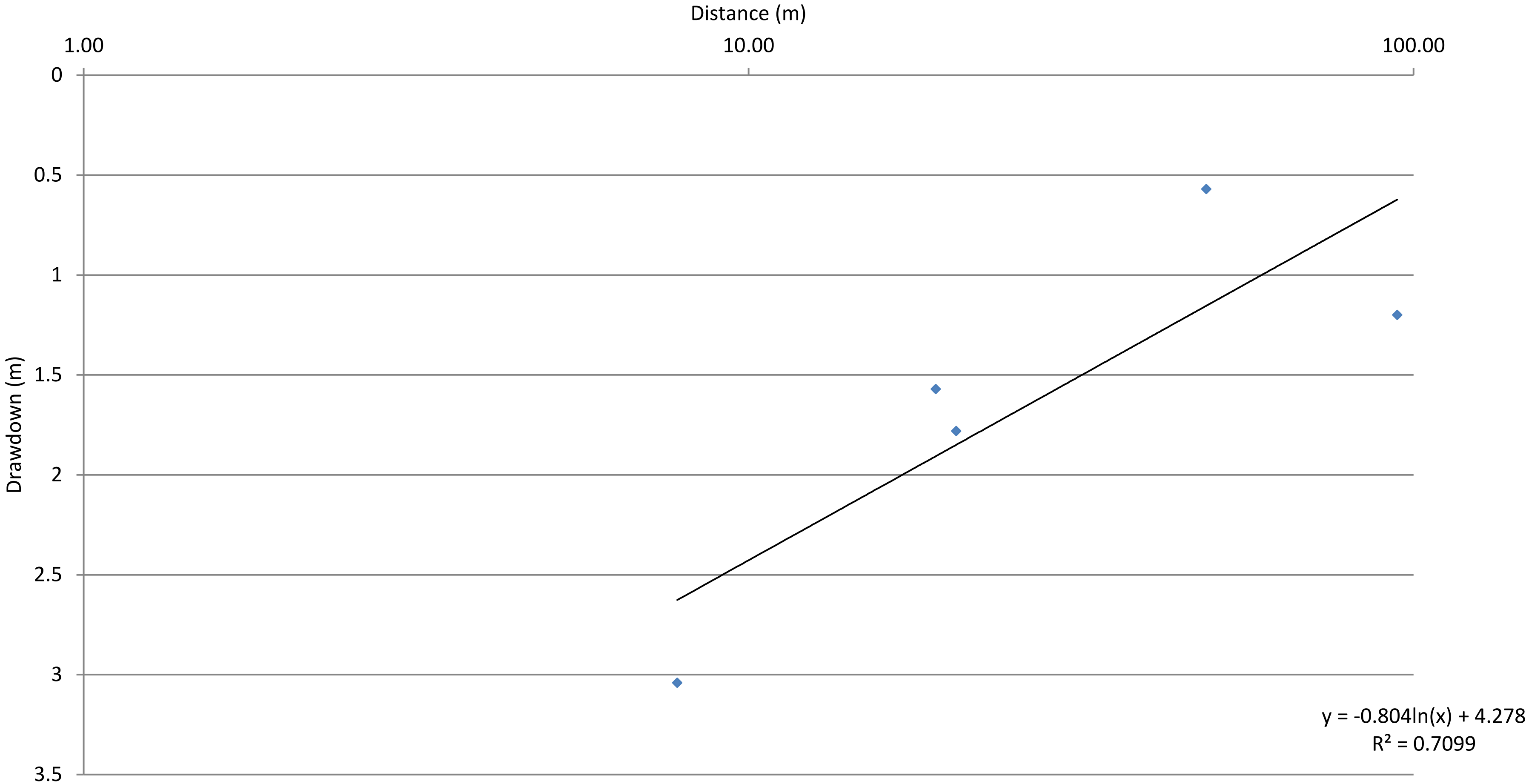


Figure 5: Semi-log distance drawdown graph

Table 7: Table of Pump Test Data

See electronic data.

Stuart Wells Limited

SWC6161 Stonehenge - Structural Soils - pre test water levels

Date	Time	PW 623		625	626	627	628	624
30/5/18	08:55	46.167						
AM	08:50			45.960				
	08:48				46.160			
	09:00					46.020		
	09:05						46.375	
	09:11							42.140
PM	15:35	46.150						
	15:37			45.965				
	15:51				46.150			
	15:41					46.025		
	15:46						46.380	
	15:30							42.145
31/5/18	08:45	46.180						
AM	08:47			45.995.				
	08:37				46.180			
	09:01					46.060		
	09:07						46.410	
	08:40							
	08:52							42.180
PM	15:35	46.195						
	15:40			46.050				
	15:55				46.185			
	15:45					46.065		
	15:50						46.420	
	15:30							42.195
1/6/18	09:13	46.220						
AM	09:15			46.030				
	09:26				46.205.			
	09:19					46.095		
	09:22						46.445	
	09:08							42.220

Weather / Comments:

Stuart Wells Limited

SWC6161 Stonehenge - Structural Soils - pre test water levels

Date	Time	PW623		625	626	627	628	624
1/6/18	14:10	46·230						
PM	14:15			46·035				
	14:18					46·095		
	14:20						46·450	
	14:06							42·230
2/6/18	08:30	46·250						
AM	08:53			46·060				
	09:04				46·235			
	08:56					46·120		
	09:00						46·480	
	08:45							42·260
PM	14:10	46·255						
	14:12			46·065				
	14:24				46·240			
	14:16					46·130		
	14:20						46·485	
	14:05							42·265
3/6/18	08:34	46·290						
AM	08:36			46·100				
	08:49				46·270			
	08:42					46·165		
	08:45						46·520	
	08:29							42·300
PM	14:50	46·300						
	14:52			46·105				
	15:02				46·280			
	14:55					46·170		
	14:57						46·530	
	14:46							42·310

Weather / Comments:

Stuart Wells Limited

SWC6161 Stonehenge - Structural Soils - pre test water levels

Date	Time	PW623		625	626	627	628	624
4/6/18	08:51	46·325						
AM	08:54			46·140				
	09:05				46·310			
	09:00					46·205		
	09:02						46·560	
	08:47							42·350
PM	14:56	46·330						
	15:01			46·150				
	15:00				46·320			
	15:02					46·215		
	15:04						46·570	
	14:56							42·355
5/6/18	08:45	46·360						
AM	08:47			46·175				
	08:58				46·345			
	08:50					46·245		
	08:56						46·600	
	08:40							42·390
PM	15:25	46·370						
	15:28			46·185				
	15:38				46·355			
	15:32					46·255		
	15:35						46·610	
	15:20							42·400

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge - step tests

Well location ref:	W623	Step Test		Weather
Date:	7/6/18	Step No	5	OVERCAST
TOC to GL (m)	380mm A.G.L.	Flow Rate (l/s)	30	

Time (hh:mm)	Elapsed Time	W623	625	626	628	627
16:10	0	50.295	49.349	48.071	47.075	48.050
	1	50.790	49.525	48.145	47.075	48.070
	2	50.960	49.655	48.190	47.075	48.110
	3	51.050	49.743	48.210	47.075	48.150
	4	51.115	49.802	48.230	47.080	48.195
	5	51.190	49.846	48.250	47.080	48.220
	6	51.225	49.896	48.265	47.080	48.245
	7	51.270	49.933	48.275	47.085	48.270
	8	51.300	49.963	48.285	47.085	48.285
	9	51.330	49.990	48.295	47.085	48.300
	10	51.355	50.013	48.305	47.090	48.315
	12	51.390	50.050	48.320	47.095	48.325
	14	51.420	50.080	48.335	47.095	48.355
	16	51.440	50.109	48.347	47.100	48.370
	18	51.470	50.137	48.355	47.100	48.385
	20	51.495	50.160	48.365	47.105	48.400
	22	51.520	50.177	48.370	47.105	48.410
	24	51.525	50.193	48.375	47.110	48.425
	26	51.555	50.209	48.382	47.110	48.430
	28	51.570	50.224	48.390	47.115	48.440
16:40	30	51.575	50.237	48.395	47.115	48.450
	35	51.600	50.257	48.402	47.120	48.465
	40	51.605	50.269	48.410	47.125	48.475
	45	51.610	50.275	48.415	47.130	48.480
	50	51.590	50.261	48.420	47.135	48.485
	55	51.580	50.255	48.420	47.140	48.485
17:10	60	51.570	50.251	—	47.140	48.485
17:20	70	51.540	50.242	48.417	47.150	48.485
17:30	80	51.560	50.257	48.425	47.155	48.490
17:40	90	51.565	50.254	48.425	47.160	48.495
17:50	100	51.570	50.253	48.430	47.160	48.495

Weather / Comments:

Stuart We||Services Ltd

SWC6161 Stonehenge - step tests

Well location ref:	W623.	Step Test		Weather
Date:	7/6/18	Step No	1	OVERCAST
TOC to GL (m)	380MM.	Flow Rate (l/s)	10	

Time (hh:mm)	Elapsed Time	W623	625	626	628	627
09:30	0	46·330	46·300	46·420	46·690	46·345
	1	46·775	46·635	46·610	46·690	46·415
	2	46·875	46·687	46·650	46·695	46·460
	3	46·920	46·709	46·675	46·700	46·495
	4	46·930	46·731	46·690	46·700	46·520
	5	46·955	46·745	46·705	46·705	46·540
	6	46·965	46·766	46·720	46·705	46·555
	7	46·985	46·784	46·732	46·710	46·570
	8	47·015	46·806	46·745	46·710	46·585
	9	47·035	46·824	46·760	46·715	46·600
	10	47·050	46·840	46·770	46·715	46·610
	12	47·055	46·855	46·785	46·720	46·635
	14	47·060	46·866	46·795	46·725	46·640
	16	47·070	46·880	46·805	46·730	46·655
	18	47·100	46·902	46·820	46·735	46·660
	20	47·125	46·925	46·835	46·740	46·675
	~~25~~ 22	47·165	46·955	46·850	46·745	46·695
	~~30~~ 24	47·170	46·966	46·860	46·745	46·705
	~~35~~ 26	47·185	46·978	46·870	46·750	46·715
	~~40~~ 28	47·190	46·990	46·880	46·755	46·720
10:00	~~45~~ 30	47·200	46·997	46·885	46·755	46·725
	~~50~~ 35	47·210	47·012	46·895	46·765	46·740
	~~55~~ 40	47·215	47·020	46·905	46·770	46·750
	~~60~~ 45	47·260	47·056	46·925	46·775	46·770
	~~70~~ 50	47·280	47·074	46·940	46·780	46·780
	~~80~~ 55	47·290	47·087	46·948	46·785	46·790
10:30	~~90~~ 60	47·285	47·089	46·954	46·790	46·795
10:40	~~100~~ 70	47·300	47·097	46·965	46·795	46·810
10:50	80	47·310	47·113	46·975	46·805	46·815
11:00	90	47·300	47·107	46·978	46·810	46·820
11:10	100	47·330	47·180	46·990	46·815	46·835

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge - step tests

Well location ref:	W623	Step Test		Weather
Date:	7/6/18	Step No	1	OVERCAST
TOC to GL (m)	380mm	Flow Rate (l/s)	10	

Time (hh:mm)	Elapsed Time	FM 1	FM 2	V NOTCH.	624	
09:30	0	228824	206047		42·485	
	1				42·500	
	2				42·517	
	3				42·525	
	4				42·535	
	5				42·550	
	6				42·560	
	7				42·575	
	8				42·580	
	9				42·590	
	10	234828	212055		42·605	
	12				42·620	
	14				42·640	
	16			140mm	42·655	
	18				42·667	
	20	240595	217817		42·680	
	~~15~~ 22				42·691	
	~~30~~ 24				42·702	
	~~35~~ 26				42·715	
	~~40~~ 28				42·725	
10:00	~~45~~ 30	246659	223889	140mm	42·735	
	~~50~~ 35				42·755	
	~~55~~ 40	252585	229810	135mm	42·770	
	~~60~~ 45				42·780	
	~~70~~ 50	258711	235937	145mm	42·801	
	~~80~~ 55				42·811	
10:30	~~90~~ 60	264799	242063	135mm	42·820	
10:40	~~100~~ 70	270851	248097	140mm	42·835	
10:50	80	276879	254134	135mm	42·850	
11:00	90	282868	260124	135mm	42·860	
11:10	100	288927	266190	135mm	42·870	

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge - step tests

Well location ref:	w623	Step Test		Weather
Date:	7/6/18	Step No	2	OVERCAST
TOC to GL (m)	380 mm A.G.L.	Flow Rate (l/s)	15	

Time (hh:mm)	Elapsed Time	w623	625	626	628	627
11:10	0	47·330	47·180	46·990	46·815	46·835
	1	47·670	47·300	47·065	46·825	46·855
	2	47·720	47·355	47·087	46·820	46·890
	3	47·760	47·380	47·102	46·820	46·920
	4	47·795	47·416	47·115	46·820	46·940
	5	47·800	47·443	47·125	46·825	46·955
	6	47·830	47·460	47·137	46·825	46·970
	7	47·845	47·477	47·145	46·825	46·985
	8	47·865	47·495	47·153	46·830	46·995
	9	47·885	47·517	47·165	46·830	47·005
	10	47·900	47·530	47·172	46·830	47·020
	12	47·920	47·553	47·185	46·835	47·035
	14	47·940	47·570	47·196	46·840	47·045
	16	47·950	47·587	47·205	46·840	47·060
	18	47·960	47·595	47·215	46·845	47·070
	20	47·975	47·607	47·222	46·850	47·080
	~~25~~ 22	47·975	47·615	47·227	46·850	47·085
	~~30~~ 24	48·000	47·627	47·235	46·855	47·090
	~~35~~ 26	48·050	47·635	47·241	46·855	47·095
	~~40~~ 28	48·010	47·641	47·245	46·860	47·100
11:40	~~45~~ 30	48·020	47·650	47·251	46·860	47·110
	~~50~~ 35	—	—	—	46·865	47·115
	~~55~~ 40	48·050	47·675	47·272	46·870	47·130
	~~60~~ 45	48·065	47·690	47·282	46·875	47·140
	~~70~~ 50	48·070	47·698	47·287	46·880	47·145
	~~80~~ 55	48·070	47·695	47·290	46·885	47·150
12:10	~~90~~ 60	48·070	47·700	47·295	46·885	47·155
12:20	~~100~~ 70	48·085	47·715	47·303	46·890	47·160
12:30	80	48·100	47·725	47·312	46·895	47·175
12:40	90	48·100	47·735	47·318	46·900	47·180
12:50	100	48·115	47·740	47·345	46·905	47·185

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge - step tests

Well location ref:	W623	Step Test		Weather
Date:	7/6/18	Step No	2	OVERCAST
TOC to GL (m)	380mm	Flow Rate (l/s)	15	

Time (hh:mm)	Elapsed Time	FM1	FM2	"V" NOTCH	624	
11:10	0	288927	266190		42.870	
	1				42.875	
	2				42.885	
	3				42.890	
	4				42.900	
	5				42.910	
	6				42.920	
	7				42.925	
	8				42.930	
	9				42.940	
11:20	10	298046	275152	155mm	42.945	
	12				42.960	
	14				42.965	
	16				42.975	
	18				42.985	
	20	307007	284314	160mm	42.995	
	~~25~~ 22				43.005	
	~~30~~ 24				43.010	
	~~35~~ 26				43.015	
	~~40~~ 28				43.020	
11:40	~~45~~ 30	315940	293267	160mm	43.030	
	~~50~~ 35				43.040	
	* ~~55~~ 42	326910	304253	160mm	43.050	
	~~60~~ 45				43.060	
	~~70~~ 50	334062	311407	160mm	43.070	
	~~80~~ 55				43.080	
12:10	~~90~~ 60	343187	320497	155mm	43.085	
12:20	~~100~~ 70	352222	329526	150mm	43.095	
12:30	80	361248	338578	155mm	43.100	
12:40	90	370292	347630	155mm	43.110	
12:50	100	379283	356604	155mm	43.120	

Weather / Comments:

* F/M READING FOR 40MINS TAKEN AT 42MINS.

Stuart Well Services Ltd

SWC6161 Stonehenge - step tests

Well location ref:	W623	Step Test		Weather
Date:	7/6/18	Step No	3	OVERCAST
TOC to GL (m)	380mm A.G.L	Flow Rate (l/s)	20	RAIN 14:00HRS

Time (hh:mm)	Elapsed Time	W623	625	626	628	627
12:50	0	48.115	47.740	47.345	46.905	47.185
	1	48.460	—	47.386	46.905	47.205
	2	48.580	47.960	47.421	46.905	47.235
	3	48.630	48.030	47.440	46.910	47.270
	4	48.675	48.070	47.456	46.910	47.295
	5	48.710	48.100	47.470	46.910	47.320
	6	48.755	48.135	47.482	46.915	47.340
	7	48.765	48.160	47.493	46.915	47.355
	8	48.790	48.180	47.503	46.915	47.375
	9	48.800	48.200	47.510	46.920	47.390
13:00	10	48.820	—	47.517	46.920	47.400
	12	48.850	48.245	47.531	46.925	47.420
	14	48.865	48.265	47.543	46.925	47.430
	16	48.880	48.285	47.555	46.930	47.445
	18	48.900	48.300	47.562	46.930	47.455
13:10	20	48.910	—	47.572	46.935	47.465
	~~25~~ 22	—	—	—	46.935	47.475
	~~30~~ 24	48.940	48.335	47.582	46.940	47.485
	~~35~~ 26	48.935	48.340	47.590	46.940	47.490
	~~40~~ 28	48.960	48.350	47.597	46.945	47.495
13:20	~~45~~ 30	48.970	48.370	47.605	46.945	47.500
	~~50~~ 35	48.995	48.385	47.617	46.950	47.520
	~~55~~ 40	49.016	48.405	47.627	46.955	47.535
	~~60~~ 45	49.025	48.415	47.638	46.960	47.540
	~~70~~ 50	49.025	—	47.642	46.965	47.545
	~~80~~ 55	49.039	48.430	47.651	46.965	47.555
13:50	~~90~~ 60	49.050	48.445	47.655	46.970	47.560
14:00	~~100~~ 70	49.060	48.455	47.665	46.975	47.570
14:10	80	49.060	48.455	47.670	46.980	47.580
14:20	90	49.075	48.473	47.678	46.985	47.585
14:30	100	49.095	48.476	47.682	46.990	47.590

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge - step tests

Well location ref:	W623	Step Test		Weather
Date:	7/6/18	Step No	3	OVERCAST
TOC to GL (m)	380mm A.G.L.	Flow Rate (l/s)	20	RAIN 14:00HRS.

Time (hh:mm)	Elapsed Time	FM1	FM2	"V" NOTCH	624	
12:50	0	379283	356604		43.120	
	1				43.122	
	2				43.130	
	3				43.135	
	4				43.145	
	5				43.150	
	6				43.160	
	7				43.170	
	8				43.175	
	9				43.180	
13:00	10	391288	368636	170mm	43.190	
	12				43.200	
	14				43.210	
	16				43.220	
	18				43.230	
13:10	20			170mm	43.240	
	~~25~~ 22				43.250	
	~~30~~ 24	408106	385363		43.255	
	~~35~~ 26				43.260	
	~~40~~ 28				43.265	
13:20	~~45~~ 30	415330	392558	170mm	43.270	
	~~50~~ 35				43.280	
13:30	~~55~~ 40	427363	404598	180mm	43.295	
	~~60~~ 45				43.305	
	~~70~~ 50	439381	416612	170mm	43.310	
	~~80~~ 55				43.320	
13:50	~~90~~ 60	451500	428704	170mm	43.330	
14:00	~~100~~ 70	463500	440785	180mm	43.335	
14:10	80	475506	452772	170mm	43.340	
14:20	90	487457	464663	170mm	43.350	
14:30	100	499579	476770	170mm	43.355	

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge - step tests

Well location ref: W623	Step Test		Weather
Date: 7/6/18	Step No	4	OVERCAST. RAIN.
TOC to GL (m) 380mm A.G.L.	Flow Rate (l/s)	25.	

Time (hh:mm)	Elapsed Time	W623	625	626	628	627
14:30	0	49.095	48.476	47.682	46.990	47.590
	1	49.519	48.623	47.752	46.990	47.605
	2	49.680	48.745	47.793	46.990	47.645
	3	49.760	48.844	47.818	46.995	47.690
	4	49.830	48.887	47.835	46.995	47.725
	5	49.870	48.939	47.854	46.995	47.760
	6	49.910	48.980	47.870	46.995	47.785
	7	49.930	49.006	47.878	47.000	47.795
	8	49.950	49.033	47.890	47.000	47.815
	9	49.980	—	—	47.000	—
14:40	10	50.000	49.072	—	47.005	47.850
	12	50.025	49.099	47.920	47.005	47.870
	14	50.050	49.125	47.935	47.010	47.880
	16	50.070	49.146	47.944	47.010	47.895
	18	50.095	49.168	47.955	47.015	47.905
14:50	20	50.100	49.184	47.965	47.020	47.915
	25 22	50.120	49.200	47.973	47.020	47.930
	30 24	50.135	49.209	47.980	47.025	47.935
	35 26	50.150	49.224	47.985	47.025	47.945
	40 28	50.160	49.232	47.993	47.030	47.950
15:00	45 30	50.180	49.242	48.000	47.030	47.960
	50 35	50.205	49.266	48.010	47.035	47.970
	55 40	50.220	49.280	48.020	47.040	47.985
	60 45	50.230	49.294	48.030	47.045	47.995
	70 50	50.225	49.300	48.035	47.050	48.005
	80 55	50.225	49.303	48.038	47.050	48.005
15:30	90 60	50.235	49.312	48.043	47.055	48.010
15:40	100 70	50.260	49.328	48.050	47.060	48.025
15:50	80	50.270	49.336	48.060	47.065	48.035
16:00	90	50.280	49.346	48.068	47.070	48.045
16:10	100	50.295	49.349	48.071	47.075	48.050

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge - step tests

Well location ref:	W623	Step Test		Weather
Date:	7/6/18	Step No	4	OVERCAST
TOC to GL (m)	380mm A.G.L.	Flow Rate (l/s)	25	RAIN.

Time (hh:mm)	Elapsed Time	FM1	FM2	"V" NOTCH	624	
14:30	0	499579	476770		43·355	
	1				43·360	
	2				43·365	
	3				43·380	
	4				43·390	
	5				43·395	
	6				43·405	
	7				43·415	
	8				43·420	
	9				43·430	
14:40	10			170mm	43·435	
	12	517483	494629		43·450	
	14				43·465	
	16				43·480	
	18				43·490	
14:50	20			190mm	43·495	
	~~25~~ 22	532602	509715		43·500	
	~~30~~ 24				43·510	
	~~35~~ 26				43·515	
	~~40~~ 28				43·520	
15:00	~~45~~ 30	544667	521724	195mm	43·525	
	~~50~~ 35				43·535	
	~~55~~ 40	559788	536784	190mm	43·545.	
	~~60~~ 45				43·555	
	~~70~~ 50	574871	551828	190mm	43·565	
	~~80~~ 55				43·570	
15:30	~~90~~ 60	589·922.	566820	190mm	43·575	
15:40	~~100~~ 70	605063	581931	185mm	*43·590	
15:50	80	620145	597021	185mm	43·600	
16:00	90	635217	611918	185mm	43·605	
16:10	100	650303	627090	190mm	43·615	

Weather / Comments:

* 624 70MIN READING TAKEN AT 73MINS

Stuart Well Services Ltd

SWC6161 Stonehenge - step tests

Well location ref:	W623	Step Test		Weather	
Date:	7/6/18	Step No	5	OVERCAST	
TOC to GL (m)	380mm A.C.L.	Flow Rate (l/s)	30		

Time (hh:mm)	Elapsed Time	FM1	FM2	"V" NOTCH	624	
16:10	0	650303	627090		43.615	
	1				43.620	
	2				43.625	
	3				43.635	
	4				43.640	
	5				43.650	
	6				43.660	
	7				43.670	
	8				43.675	
	9				43.685	
16:20	10	668284	644923	200MM	43.690	
	12				43.705	
	14				43.715	
	16				43.725	
	18				43.735	
16:30	20	686475	663059	200MM	43.745	
	22				43.750	
	24				43.760	
	26				43.770	
	28				43.775	
16:40	30	704682	681150	200MM	43.780	
	35				43.795	
	40	722883	699280	200mm	43.805	
	45				43.815	
	50	741111	717459	190mm	43.825	
	55				43.830	
17:10	60	—	—	205mm	43.840	
17:20	70	777590	753840	200mm	43.850	
17:30	80	795800	771949	200mm	43.855	
17:40	90	814026	790092	200mm	43.865	
17:50	100	832160	808221	190mm	43.875	

Weather / Comments:

Stuart Wells Limited

SWC6161 Stonehenge - Structural Soils - pre test water levels

Date	Time	623	624	625	626	627	628	
12/06/18	08:37	46.495						
"	08:45		42.665					
"	08:50			46.450				
"	09:00				46.565			
"	08:55					46.505		
"	08:58						46.850.	

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge 7 day constant rate testing

Date:	12/6/18	SHEET	1	Weather
Constant Rate	Flow Rate (l/s) 25			FINE.

Time (hh:mm)	Elapsed Time	PW 623	FM 1	FM 2	"V" NOTCH.	
13:00	0	46.500	842991	813598		
	1	48.100				
	2	48.300				
	3	48.445				
	4	48.600				
	5	48.715				
	6	48.795				
	7	48.865				
	8	48.965				
	9	49.020				
13:10	10	49.075	858022	828684		
	12	49.185				
	14	49.255				
	16	49.335				
	18	49.385				
13:20	20	49.450	873058	843678		
	25	49.570				
13:30	30	49.645	888104	858683		
	35	49.720				
13:40	40	49.775	903164	873674		
	45	49.810				
13:50	50	49.840	918208	888661		
	55	49.870				
14:00	60	49.950	933245	903633		
14:10	70	49.950	948299	918603		
14:20	80	49.980	963365	933617		
14:30	90	50.000	978393	948602		
14:40	100	50.010	993439	963585		
15:00	120	50.050	1023464	993509		
15:20	140	50.075	1053526	1023460		
15:40	160	50.100	1083572	1053382		

Weather / Comments:

Stuart We||Services Ltd

SWC6161 Stonehenge recovery test

Date:	START 12/6/18	SHEET	2	Weather
Constant Rate	Flow Rate (l/s) 25.			

Time (hh:mm)	Elapsed Time	PW623	FM1	FM2	"V" NOTCH	
16:00	180	50·115	1113640	1083327		
16:20	200	50·130	1143705	1113279		
16:40	220	50·140	1173760	1143207		
17:00	240	50·155	1203823	1173198		
17:20	260	50·165	1233900	1203147		
17:40	280	50·180	1263953	1233126		
18:00	300					
18:50	350					
19:40	400					
20:30	450					
21:20	500					
22:10	550					
23:00	600					
23:50	650					
13/6 00:40	700					
01:30	750					
02:20	800					
03:10	850					
04:00	900					
04:50	950					
05:40	1000					
07:20	1100					
09:00	1200	50·250	2645174	2609622		
10:40	1300	50·255	2795108	2759006		
12:20	1400	50·260	2945147	2908368		
14:00	1500	50·265	3095228	3058003		
15:40	1600	50·270	3245288	3207469		
17:20	1700	50·300	3395548	3357196		
19:00	18:00					
20:40	1900					
22:20	2000					

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge 7 day constant rate testing

Date:	START 12/6/18	SHEET	3	Weather
Constant Rate	Flow Rate (l/s) 25			

Time (hh:mm)	Elapsed Time	PW623	FM1	FM2		
14/6 00:00	2100					
01:40	2200					
03:20	2300					
05:00	2400					
06:40	2500					
08:20	2600	50·300	4750621	4707107		
10:00	2700	50·300	4901058	4857026		
11:40	2800	50·300	5051506	5006875		
13:20	2900	50·285	5201902	5156699		
15:00	3000	50·300	5352368	5306489		
16:40	3100	50·300	5502781	5456397		
18:20	3200					
20:00	3300					
21:40	3400					
23:20	3500					
15/6 01:00	3600					
02:40	3700					
04:20	3800					
06:00	3900					
07:40	4000					
09:20	4100	50·305	7005779	6953690		
11:00	4200	50·305	7155638	7103337		
12:40	4300	50·305	7306271	7252991		
14:20	4400	50·305	7456544	7402671		
16:00	4500	50·305	7606712	7552271		
17:40	4600	50·310	7756759	7701870		
19:20	4700					
21:00	4800					
22:40	4900					
16/6 00:20	5000					
02:00	5100					

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge 7 day constant rate testing

Date:	START 12/6/18	SHEET	4	Weather
Constant Rate	Flow Rate (l/s) 25			

Time (hh:mm)	Elapsed Time	PW 623	FM1	FM2		
03:40	5200					
05:20	5300					
07:00	5400					
08:40	5500	50·315	9106310	9046109		
10:20	5600					
12:00	5700	50·320	9406394	9344977		
13:40	5800					
15:20	5900	50·315	9706351	9643755		
17:00	6000					
18:40	6100					
20:20	6200					
22:00	6300					
23:40	6400					
01:20	6500					
03:00	6600					
04:40	6700					
06:20	6800					
08:00	6900	50·310	11205897	11137788		
09:40	7000					
11:20	7100	50·315	11505705	11436423		
13:00	7200					
14:40	7300	50·315	11805626	11735169		
16:20	7400					
18:00	7500	50·315	12105394	12033776		
19:40	7600					
21:20	7700					
23:00	7800					
00:40	7900					
02:00	7980					
03:40	8080					
05:20	8180					

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge 7 day constant rate testing

Date:	START 12/6/18	SHEET	5	Weather
Constant Rate	Flow Rate (l/s) 25.			

Time (hh:mm)	Elapsed Time	ELAPSED MINS	PW623	FM1	FM2	
07:00	0	8280				
08:40	* 1	8380	50·320	13422919	13346333	
10:20	2	8480	50·315	13572597	13495547	
12:00	3	8580	50·320	13722339	13644684	
13:40	4	8680	50·330	13872107	13793795	
15:20	* 5	8780	50·330	14021973	13943086	
17:20	6	8900	50·330	14201823	14122219	
19:00	7	9000				
20:40	8	9100				
22:20	9	9200				
19/6 00:00	10	9300				
01:40	12	9400				
03:20	14	9500				
05:00	16	9600				
06:40	18	9700				
08:20	20	9800	50·345	15551350	15466640	
10:00	25	9900	50·340	15701320	15616042	
11:40	30	10000	50·340	15851210	15765297	
13:00	35	10,080	50·340	15971252	15884768	
	40					
	45					
	50					
	55					
	60					
	70					
	80					
	90					
	100					
	120					
	140					
	160					

Weather / Comments:

* FROM 02:00HRS 18/6/18 TO 15:20HRS
TAKE 20 MINS EARLY FROM BRITISH STANDARDS

Stuart Well Services Ltd

SWC6161 Stonehenge 7 day constant rate testing

Date:	12-6-18	Pump Hole	W623	Weather
Constant Rate	Flow Rate (l/s) 25	Monitor Hole	624	o/cast, dry sunny spells - warm
		Dipmeter	180509	

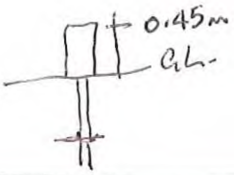
Time (hh:mm)	Elapsed Time	624		624		
11:00	0	42.665	13:00	42.670		
	1	42.720		42.685		
	2	42.765		42.720		
	3	42.790		42.770		
	4	42.790		42.805		
	5	42.790		42.840		
	6	42.785		42.880		
	7	42.780		42.920		
	8	42.775		42.945		
	9	42.770		42.975		
	10	42.760		43.005		
	12	42.750		43.055		
	14	42.740		43.100		
	16	42.730		43.140		
12:52	~~18~~	42.670		43.175		
	20	Aborted test		43.210		
	25			43.275		
	30			43.335		
	35			43.380		
	40			43.420		
	45			43.450		
	50			43.480		
	55			43.500		
	60		14:00	43.525		
	70			43.560		
	80		(81)	43.590		
	90			43.615		
	100			43.635		
	120		15.00	43.665		
	140		15.20	43.690		
	160		15.40	43.710		

Weather / Comments: [redacted]

Monitoring Well 624 (cont)

Stuart Well Services Ltd

SWC6161 Stonehenge 7 day constant rate testing



Date:	12-6-18 (cont)	PW1 TOC to GL(m)		Weather
Constant Rate	Flow Rate (l/s) 25	MW1 TOC to GL(m)		
		MW2 TOC to GL(m)		All dips to top of Upstand.

Time (hh:mm)	Elapsed Time	PW1 (pumping well) (624)	Monitoring Well 1	~~Monitoring Well 2~~	~~V-Notch~~	~~Flowmeter~~
16:00	180	43.725		SAT	TIME	WL.
	200	43.740		16/6/18	08:48	43.910
	220	43.750			12:07	43.910
17:00	240	43.760			15:28	43.915
	260	43.770		SUN		
17:40	280	43.775		17/6/18	08:09	43.920
	300				11:28	43.920
WED 13/6/18	350				14:47	43.925
09:05	400	43.865			18:07	43.925
10:43	450	43.870		MON		
12:23	500	43.875		18/6/18	08:48	43.930
14:03	550	43.875			10:27	43.935
15:43	600	43.875			12:08	43.935
17:23	650	43.880			13:47	43.935
	700				15:27	43.935
THURS 14/6/18	750				17:27	43.940
08:27	800	43.890		TUES		
10:02	850	43.890		19/6/18	08:27	43.950
11:42	900	43.890			10:01	43.950
13:20	950	43.890			11:41	43.950
15:01	1000	43.895			13:00	43.950
16:41	1100	43.890				
	1200					
FRI 15/6/18	1300					
09:22	1400	43.905				
11:02	1500	43.905				
12:41	1600	43.905				
14:22	1700	43.905				
16:01	1800	43.905				
17:47	1900	43.910				
	2000					

Weather / Comments: [redacted]

R625

Stuart Well Services Ltd

SWC6161 Stonehenge 7 day constant rate testing

Date:	12/6/18			Weather
Constant Rate	Flow Rate (l/s) 25			Cloudy/with sun

Time (hh:mm)	Elapsed Time		R625			
	0	~~46.455~~	46.461			
	1	~~46.372~~	47.205			
	2	~~47.478~~	47.418			
	3		47.601			
	4		47.748			
	5		47.870			
	6		47.953			
	7		48.030			
	8		48.103			
	9		48.167			
	10		48.232			
	12		48.350			
	14		48.429			
	16		48.502			
	18		48.564			
	20		48.625			
	25		48.760			
	30		48.825			
	35		48.893			
	40		48.947			
	45		48.988			
	50		49.021			
	55		49.047			
	60		49.075			
	70		49.119			
	80		49.153			
	90		49.176			
	100		49.196			
	120		49.229			
	140		49.249			
	160		49.268			

Weather / Comments:

R625

Stuart Well Services Ltd

SWC6161 Stonehenge 7 day constant rate testing

Date:		PW1 TOC to GL(m)		Weather
Constant Rate	Flow Rate (l/s) 25	MW1 TOC to GL(m)		
		MW2 TOC to GL(m)		

Time (hh:mm)	Elapsed Time	PW1 (pumping well)	Monitoring Well 1	Monitoring Well 2	V-Notch	Flowmeter
	180	49.284		DATE	TIME	W L.
	200	49.298		SAT 16/6/16	08:41	49.470
	220	49.309			12:01	49.475
	240	49.318			15:01	49.475
	260	49.327		SUN		
	280	49.333		17/6/18	08:01	49.475
	300				11:21	49.475
WED 13/6/18	350				14:41	49.475
09:07	400	49.415			18:01	49.475
10:46	450	49.415		MON		
12:24	500	49.420		18/6/18	08:41	49.480
14:04	550	49.425			10:21	49.480
15:44	600	49.430			12:01	49.480
17:25	650	49.445			13:41	49.485
	700				15:21	49.485
THURS 14/6/18	750				17:21	49.490
08:21	800	49.450		TUES		
10:01	850	49.450		19/6/18	08:21	49.505
11:41	900	49.450			10:01	49.500
13:21	950	49.455			11:41	49.500
15:01	1000	49.455			13:00	49.502
16:41	1100	49.455				
	1200					
FRI 15/6/18	1300					
09:20	1400	49.465				
11:01	1500	49.465				
12:41	1600	49.465				
14:21	1700	49.465				
16:01	1800	49.465				
17:41	1900	49.465				
	2000					

Weather / Comments:

Stuart Well Services Ltd

Glenn Hughes.

SWC6161 Stonehenge 7 day constant rate testing

Date:	12/6/18		W623 Pump well	Weather
Constant Rate	Flow Rate (l/s) 25		R626	Overcast Dry Breezy

Time (hh:mm)	Elapsed Time	R626				
13:00	0	46.575				
	1	46.985				
	2	47.065				
	3	47.130				
	4	47.195				
	5	47.245				
	6	47.295				
	7	47.335				
	8	47.365				
	9	47.405				
	10	47.435				
	12	47.490				
	14	47.535				
	16	47.580				
	18	47.610				
	20	47.645				
	25	47.715				
	30	47.770				
	35	47.815				
	40	47.850				
	45	47.880				
	50	47.900				
	55	47.925				
	60	47.945				
	70	47.970				
	80	47.995				
	90	48.015				
	100	48.030				
	120	48.055				
	140	48.070				
	160	48.090				

Weather / Comments:

BR. 626

Stuart Well Services Ltd

Glenn Hughes

SWC6161 Stonehenge 7 day constant rate testing

Date:	Start 12/6/18 @ 1300.	PW1 TOC to GL(m)		Weather
Constant Rate	Flow Rate (l/s) 25	MW1 TOC to GL(m)		
		MW2 TOC to GL(m)		

Time (hh:mm)	Elapsed Time	~~PW1 (pumping well)~~ BH626	~~Monitoring Well 1~~	~~Monitoring Well 2~~	~~V-Notch~~	~~Flowmeter~~
	180	48.100		DATE	TIME	WL.
	200	48.110	SAT	16/6/18	08:42	48·255
	220	48.120			12:02	48·255
	240	48.130			15:02	48·255
	260	48.135		SUN		
5:40pm	280	48.140.		17/6/18	08:02	48·260
	~~300~~				11:22	48·260
WED 13/6/18	~~350~~				14:42	48·260
09:05	~~400~~	48·210			18:02	48·260
10:45	~~450~~	48·210		MON		
12:24	~~500~~	48·215		18/6/18	08:42	48·265
14:03	~~550~~	48·215			10:22	48·265
15:40	~~600~~	48·220			12:02	48·265
17:24	~~650~~	48·225			13:42	48·270
	~~700~~				15:22	48·270
THURS 14/6/18	~~750~~				17:22	48·270
08:22	~~800~~	48·235		TUES		
10:02	~~850~~	48·235		19/6/18	08:22	48·280
11:42	~~900~~	48·235			10:02	48·280
13:22	~~950~~	48·235			11:42	48·280
15:02	~~1000~~	48·235			13:00	48·280
16:42	~~1100~~	48·240				
	~~1200~~					
FRI 15/6/18	~~1300~~					
09:21	~~1400~~	48·245				
11:02	~~1500~~	48·245				
12:42	~~1600~~	48·245				
14:22	~~1700~~	48·250				
16:02	~~1800~~	48·250				
17:42	~~1900~~	48·250				
	~~2000~~					

Weather / Comments:

Stuart Well Services Ltd

R627

SWC6161 Stonehenge 7 day constant rate testing

Date:	12.6.2018			Weather
Constant Rate	Flow Rate (l/s) 25 l/s			R627

Time (hh:mm)	Elapsed Time					
13:00	0	46.525				
	1	.660				
	2	.810				
	3	.915				
	4	47.005				
	5	.090				
	6	.153				
	7	.205				
	8	.255				
	9	.300				
	10	.340				
	12	.410				
	14	.470				
	16	.520				
	18	.565				
	20	.605				
	25	.690				
	30	.750				
	35	.795				
	40	.835				
	45	.870				
	50	.895				
	55	.925				
	60	.935				
	70	.970				
	80	.995				
	90	48.005				
	100	.025				
	120	.050				
	140	.070				
	160	.080				

Weather / Comments:

R627

Stuart Well Services Ltd

SWC6161 Stonehenge 7 day constant rate testing

Date:	12.6.2018	PW1 TOC to GL(m)		Weather	
Constant Rate	Flow Rate (l/s) 25 l/s	MW1 TOC to GL(m)		overcast - Dry R627	
		MW2 TOC to GL(m)			

Time (hh:mm)	Elapsed Time	PW1 (pumping well) R627	Monitoring Well 1	Monitoring Well 2	V-Notch	Flowmeter
	180	48.100		DATE	TIME	WL.
16:20	200	48.105	SAT	16/6/18	08:43	48.270
	220	48.115			12:03	48.275
17:00	240	48.125			15:03	48.275
	260	48.132		SUN		
	280	48.140		17/6/18	08:03	48.285
	300				11:23	48.285
WED 13/6/18	350				14:43	48.285
09:02	400	48.215			18:03	48.285
10:42	450	48.220		MON		
12:21	500	48.220		18/6/18	08:43	48.295
14:01	550	48.225			10:23	48.295
15:41	600	48.225			12:03	48.295
17:22	650	48.235			13:43	48.300
	700				15:23	48.300
THURS 14/6/18	750				17:23	48.300
08:23	800	48.250		TUES		
10:03	850	48.250		19/6/18	08:23	48.315
11:43	900	48.250			10:03	48.310
13:26	950	48.250			11:40	48.310
15:03	1000	48.250			13:00	48.310
16:43	1100	48.255				
	1200					
FRI 15/6/18	1300					
09:22	1400	48.260				
11:03	1500	48.265				
12:43	1600	48.265				
14:23	1700	48.265				
16:03	1800	48.270				
17:43	1900	48.270				
	2000					

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge 7 day constant rate testing

Date:	12.06.2018			Weather OVERCAST.
Constant Rate	Flow Rate (l/s)			R628

Time (hh:mm)	Elapsed Time					
13:00	0	~~46.860~~	46.855			
13:01	1	~~46.870~~	46.860			
13:02	2		46.865			
13:03	3		46.875			
13:04	4		46.880			
13:05	5		46.890			
13:06	6		46.900			
13:07	7		46.905			
13:08	8		46.910			
13:09	9		46.915			
13:10	10		46.925			
13:12	12		46.935			
13:14	14		46.950			
13:16	16		46.960			
13:18	18		46.970			
13:20	20		46.980			
13:25	25		47.000			
13:30	30		47.~~[illegible]~~	020		
13:35	35		47.~~[illegible]~~	040		
13:40	40		47.~~[illegible]~~	055		
13:45	45		47.~~[illegible]~~	070		
13:50	50		47.080			
13:55	55		47.090			
14:00	60		47.105			
14:10	70		47.115			
14:20	80		47.130			
14:30	90		47.145			
14:40	100		47.155			
15:00	120		47.170			
15:20	140		47.185			
15:40	160		47.195			

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge 7 day constant rate testing

Date:		PW1 TOC to GL(m)		Weather	
Constant Rate	Flow Rate (l/s)	MW1 TOC to GL(m)		R628	
		MW2 TOC to GL(m)			

Time (hh:mm)	Elapsed Time	PW1 (pumping well)	Monitoring Well 1	~~Monitoring Well 2~~	~~[illegible]~~	~~Flowmeter~~
16:00	180	~~457~~	47.200	DATE	TIME	WL
16:20	200		47.220	SAT 16/6/18	08:44	47.380
16:40	220		47.225		12:04	47.385
17:00	240		47.230		15:24	47.385
17:20	260		47.235	SUN		
17:40	280		47.240	17/6/18	08:04	47.395
	300				11:24	47.395
WED 13/6/18	350				14:44	47.400
09:04	400		47.315		18:04	47.400
10:43	450		47.315	MON		
12:22	500		47.315	18/6/18	08:44	47.410
14:02	550		47.320		10:24	47.410
15:42	600		47.325		12:04	47.410
17:23	650		47.325		13:44	47.415
	700				15:23	47.415
THURS 14/6/18	750				17:23	47.420
08:24	800		47.340	TUES		
10:04	850		47.340	19/6/18	08:24	47.430
11:44	900		47.345		10:03	47.425
13:20	950		47.345		11:40	47.430
15:03	1000		47.350		13:00	47.430
16:44	1100		47.350			
	1200					
FRI 15/6/18	1300					
09:22	1400		47.365			
11:02	1500		47.365			
12:43	1600		47.365			
14:24	1700		47.370			
16:04	1800		47.370			
17:44	1900		47.370			
	2000					

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge recovery test

Date:	START DATE 19/6/18	PW	623	Weather
Constant Rate	Flow Rate (l/s) —			

TUES 19/6

Time (hh:mm)	Elapsed Time	WL		TIME	ELAPSED TIME	WL
13:00	0	59.340		16:00	180	46.720
	1	48.450		16:20	200	46.710
	2	48.100		16:40	220	46.700
	3	47.910		17:00	240	46.690
	4	47.780		17:20	260	46.685
	5	47.685		17:40	280	
	6	47.625		18:00	300	
	7	47.570		18:50	350	
	8	47.520		19:40	400	
	9	47.485		20:30	450	
13:10	10	47.445		21:20	500	
	12	47.380		22:10	550	
	14	47.325		23:00	600	
	16	47.280		23:50	650	
	18	47.240	WED 20/6/18	00:40	700	
13:20	20	47.205		01:30	750	
	25	47.135		02:20	800	
13:30	30	47.080		03:10	850	
	35	47.035		04:00	900	
13:40	40	47.000		04:50	950	
	45	46.970		05:40	1000	
13:50	50	46.945		07:20	1100	
	55	46.920		09:00	1200	46.625
14:00	60	46.905		10:40	1300	46.620
14:10	70	46.870		12:20	1400	46.625
14:20	80	46.845		14:00	1500	46.625
14:30	90	46.820		15:40	1600	46.625
14:40	100	46.805		17:20	1700	
15:00	120	46.775		19:00	1800	
15:20	140	46.750		20:40	1900	
15:40	160	46.740		22:20	2000	

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge recovery test

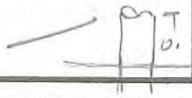
Date:	START DATE 19/6/18	PW	623	Weather
Constant Rate	Flow Rate (l/s) —			

Time (hh:mm)	Elapsed Time	WL				
21/6 00:00	2100					
01:40	2200					
03:20	2300					
05:00	2400					
06:40	2500					
08:20	2600	46·650				
10:00	2700	46·650				
11:40	2800	46·650				
13:20	2900	46·655				
15:00	3000	46·660				
16:40	3100	46·650				
22/6 08:23		46·700				

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge recovery test

Date:	START DATE 19/6/18		624	Weather
Constant Rate	Flow Rate (l/s)  T 0.	0.445m	[redacted]	Dry o/cast, sli wind.

Tues 19/6

Time (hh:mm)	Elapsed Time	WL	Taken at top of Top Hat	TIME	ELAPSED TIME	WL
13:00	0	43.950		16:00	180	42.910
	1	43.985		16:20	200	42.895
	2	43.885		16:40	220	42.885
	3	43.840		17:00	240	42.875
	4	43.795		17:20	260	42.870
	5	43.755		17:40	280	
	6	43.715		18:00	300	
	7	43.680	WED			
	8	43.650	20/6/18	09:08	1208	42.805
	9	43.625		10:47	1307	42.805
13:10	10	43.600		12:28	1408	42.805
	12	43.550		14:08	1508	42.810
	14	43.510		15:47	1607	42.810
	16	43.470	THURS			
	18	43.440	21/6/18	08:36	2615	42.835
13:20	20	43.405		10:07	2707	42.840
	25	43.340		11:46	2806	42.840
13:30	30	43.295		13:27	2907	42.845
	35	43.250		15:07	3007	42.845
13:40	40	43.215		16:53		47.850
	45	43.185	FRI			
13:50	50	43.155	22/6/18	10:03		47.900
	55	43.130				
14:00	60	43.110				
14:10	70	43.080				
14:20	80	43.050				
14:30	90	43.025				
14:40	100	43.050				
15:00	120	42.970				
15:20	140	42.945				
15:40 (41)	160	42.925				

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge recovery test

Date:	START DATE 19/6/18		625	Weather
Constant Rate	Flow Rate (l/s)			

TUES 19/6

Time (hh:mm)	Elapsed Time	WL		TIME	ELAPSED TIME	WL
13:00	0	49.502		16:00	180	46.675
	1	48.542		16:20	200	46.665
	2	48.175		16:40	220	46.654
	3	47.963		17:00	240	46.654
	4	47.813		17:20	260	46.643
	5	47.705		17:40	280	
	6	47: 627		18:00	300	
	7	47.567	WED			
	8	47.513	20/6/18	09:00	1200	46.580
	9	47.470		10:40	1300	46.580
13:10	10	47.428		12:21	1401	46.580
	12	47.358		14:01	1501	46.585
	14	47.292	THURS			
	16	47.245	21/6/18	08:22	2602	46.605
	18	47.203		10:01	2701	46.605
13:20	20	47.688		11:41	2801	46.610
	25	47.005		13:21	2901	46.610
13:30	30	47.045		15:01	3001	46.615
	35	46.995		16:47		46.625
13:40	40	46.960	FRI			
	45	46 924	22/6/18	09:59		46.670
13:50	50	46.898				
	55	46.875				
14:00	60	46.855				
14:10	70	46.824				
14:20	80	46.190				
14:30	90	46.776				
14:40	100	46.759				
15:00	120	46.730				
15:20	140	46.705				
15:40	160	46.686				

Weather / Comments:

1300:15

Stuart Well Services Ltd

Glenn Hughes

SWC6161 Stonehenge recovery test

Date:	START DATE 19/6/18		626	Weather
Constant Rate	Flow Rate (l/s) —			Overcast Dry

Time (hh:mm)	Elapsed Time	WL		TIME	ELAPSED TIME	WL
TUES 19/6 13:00.15	0	48.280		16:00	180	46.780
	1	47.925		16:20	200	46.770
	2	47.800		16:40	220	46.760
	3	47.715		17:00	240	46.755
	4	47.650		17:20	260	46.745
	5	47.595		17:40	280	
	6	47.550		18:00	300	
	7	47.515	WED			
	8	47.485	20/6/18	09:02	1202	46.690
	9	47.455		10:41	1301	46.690
13:10	10	47.425		12:22	1402	46.690
	12	47.375		14:02	1502	46.690
	14	47.330	THURS			
	16	47.290	21/6/18	08:23	2603	46.710
	18	47.255		10:02	2702	46.720
13:20	20	47.225		11:41	2801	46.720
	25	47.160		13:22	2902	46.720
13:30	30	47.110		15:02	3002	46.720
	35	47.070		16:48		46.730
13:40	40	47.035	FRI			
	45	47.010	22/6/18	09:57		46.770
13:50	50	46.985				
	55	46.965				
14:00	60	46.950				
14:10	70	46.915				
14:20	80	46.900				
14:30	90	46.870				
14:40	100	46.855				
15:00	120	46.830				
15:20	140	46.810				
15:40	160	46.795				

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge recovery test

Date:	START DATE 19/6/18		627	Weather
Constant Rate	Flow Rate (l/s) —			

Time (hh:mm)	Elapsed Time	WL		TIME	ELAPSED TIME	WL
13:00	0	48.310		16:00	180	46.745
	1	48.175		16:20	200	46.735
	2	47.980		16:40	220	46.725
	3	47.820		17:00	240	46.720
	4	47.725		17:20	260	46.715
	5	47.630		17:40	280	
	6	47.555		18:00	300	
	7	47.495	WED			
	8	47.450	20/6/18	09:04	1204	46.660
	9	47.410		10:42	1302	46.660
13:10	10	47.375		12:23	1403	46.660
	12	47.315		14:03	1503	46.660
	14	47.270	THURS			
	16	47.225	21/6/18	08:24	2604	46.675
	18	47.200		10:03	2703	46.680
13:20	20	47.165		11:42	2802	46.680
	25	47.110		13:23	2903	46.680
13:30	30	47.060		15:03	3003	46.680
	35	47.025		16:51		46.690
13:40	40	46.995	FRI			
	45	46.965	22/6/18	10:00		46.735
13:50	50	46.945				
	55	46.920				
14:00	60	46.905				
14:10	70	46.880				
14:20	80	46.855				
14:30	90	46.835				
14:40	100	46.820				
15:00	120	46.795				
15:20	140	46.775				
15:40	160	46.760				

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge recovery test

Date:	START DATE 19/6/18		628	**Weather**
Constant Rate	**Flow Rate (l/s)** —			

Time (hh:mm)	Elapsed Time	WL		TIME	ELAPSED TIME	WL
13:00	0	47.430		16:00	180	47.090
	1	47.440		16:20	200	47.085
	2	47.425		16:40	220	47.080
	3	47.410		17:00	240	47.070
	4	47.410		17:20	260	47.065
	5	47.400		17:40	280	
	6	47.405		18:00	300	
	7	47.395	WED			
	8	47.395	20/6/18	09:06	1206	47.010
	9	47.380		10:43	1303	47.010
13:10	10	47.385		12:24	1404	47.015
	12	47.370		14:04	1504	47.015
	14	47.360	THURS			
	16	47.355	21/6/18	08:26	2606	47.040
	18	47.340		10:04	2704	47.040
13:20	20	47.330		11:43	2803	47.045.
	25	47.305		13:24	2904	47.045
13:30	30	47.290		15:04	3004	47.050
	35	47.270		16:49		47.055
13:40	40	47.250	FRI			
	45	47.245	22/6/18	10:01		47.095
13:50	50	47.225				
	55	47.210				
14:00	60	47.200				
14:10	70	47.185				
14:20	80	47.170				
14:30	90	47.155				
14:40	100	47.145				
15:00	120	47.125				
15:20	140	47.110				
15:40	160	47.100				

Weather / Comments:

PUMPING TEST FACTUAL REPORT
Test 2 of 3 – Cluster W601

Contract Name:	A303 Amesbury to Berwick Down Ground Investigation – Pumping Tests
Client Name:	Highways England (HE)
Consultant:	AECOM (A)
Geotechnical specialist:	Structural Soils Ltd (SS)
Groundwater Pumping Test & Dewatering Specialist:	Stuart Well Ltd (SWL)
Report No	SWC6161-PT-W601

Revision	Date	Description	Prepared By (SWL)	Checked By (SWL)	Approved By (SS)	Approved By (A)
1	10/09/2018	Submitted for approval	DB	DW		

For:

Structural Soils Ltd
The Old School
Silthouse Lane
Bedminster
BS3 4EB

Contact:

Michael Addinall
Senior Geotechnical Engineer
[redacted]

By:

Stuart Well Ltd
Hargham Road
Shropham
Norfolk
NR17 1DT

Contact:

Daniel Brooks
Contract Manager
[redacted]

Contents

1. Introduction

In April 2018 Stuart Wells Ltd was appointed by Structural Soils Ltd to undertake a pumping test for the A303 Amesbury to Berwick Down Ground Investigation project.

To aid design of the A303 Amesbury to Berwick Down tunnelling and shaft sinking civil works, a series of 3 pumping tests were undertaken along an approximate 1.5km section of the future tunnel alignment. Each test is sited in a specific ground investigation (GI) zone of the ground investigation package to better understand the chalk. The testing can be summarised as follows.

GI Zone: South of alignment – test 1

- A single pumping well (W623) and 5no monitoring wells
- Primary purpose of the pumping test in this GI Zone is to better understand the hydrogeology of the chalk ridge.

GI Zone: Tunnel alignment west of Stonehenge Bottom – test 2

- A single pumping well (W601) and 7no monitoring wells
- Primary purpose of the pumping test in this GI Zone is to better understand the hydrogeology of the phosphatic chalk at this location

GI Zone: Tunnel alignment west of Stonehenge Bottom – test 3

- A single pumping well (W617) and 6no monitoring wells
- Primary purpose of the pumping test in this GI Zone is to better understand the hydrogeology of the dry valley. The thickness of superficial and de-structured chalk and faulting.

This factual report details the activities and the results of the testing carried out at W601.

Figure 1: Site Location Map

2. Summary of Ground Conditions

The ground conditions at W601 is summarised as follows as indicated by the borehole log undertaken by Structural Soils Ltd.

Stratum	Top level of stratum (mAOD)
Brown slightly gravelly sandy SILT with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of chalk and flint. Cobbles are angular to subangular flint.	93.10
Cream and pale brown structureless CHALK comprising slightly sandy gravelly SILT with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of chalk and rare flint. Cobbles are angular flint. (Grade Dm)	92.85
White and cream structureless CHALK comprising slightly sandy silty subangular to subrounded fine to coarse GRAVEL of chalk and rare flint with low cobble content. Sand is fine to coarse. Cobbles are angular to subrounded chalk and flint. (Grade Dc)	92.60
Firm white CHALK occasionally abundant with flint (driller's description). . . . Rotary drilling techniques used below 5.50m depth.	92.20
CHALK and FLINT (Driller's Description)	87.60
Base of borehole	32.10

Table 1: Summary of geology

3. Field Work

The programme of works undertaken at site can be summarised as follows:

Date	Activity
14th June to 25th June 2018	Background monitoring
27th June 2018	Equipment Test
3rd July 2018	Step Test
10th July to 17th July 2018	Constant Rate Test
17th July to 23rd July 2018	Recovery Test

Table 2: Programme of works

Equipment used during testing is summarised as follows:

- A 45kW electrical submersible borehole pump was utilised for the testing after proving suitable during the equipment test on 27th June 2018.
- A series of 5.5 to 11kW electrical submersible drainage pumps were utilised as a boost system pump capable of pushing the discharge water to the discharge point located 1km distance from the pumping well
- A duty and standby 150kVA generator with automatic changeover panel were used to power the borehole pump and a series of duty and standby with automatic changeover panel were used to power the boost pumps
- Electronic Dataloggers were used at each well record continuous water level readings for the duration of the testing period. Data cable on each datalogger permitted the use of a Bluetooth datalogger/transmitter to send data throughout testing by email.
- Manual water level readings were recorded using a Manual Dip Tape

- Flow rate was monitored using a series of 2no electronic flow meters each with telemetry permitting remote monitoring of flow rate and a v-notch tank was used before the boost pumps as a back up to the flow meters if the flow meters should fail at any time.

The layout of the wells is shown in figure 2, and the well installation details provided in table 7.

4. Results

4.1. Background monitoring

Before undertaking the pumping test, the water level was monitored from 14th to 25th June 2018 to observe any natural fluctuations in the water table. The pre-test monitoring shows that the groundwater at this location is dropping at an estimated drop of between 0.057m to 0.08m per day. We speculate that this is due to seasonal variation however interpretation is out of the scope of this report.

See as follows a summary of the data.

Well Name	Date	Time	Water Level (mAOD)	Change of water level (m)
W601	14/06/18	16:16	69.36	
W601	25/06/18	10:48	68.74	-0.62
W602	14/06/18	16:27	69.46	
W602	25/06/18	10:54	68.84	-0.62
W606	20/06/18	17:31	69.27	
W606	25/06/18	17:17	68.88	-0.39
W607	20/06/18	17:28	69.29	
W607	25/06/18	10:34	68.89	-0.40
W608	20/06/18	17:35	69.33	
W608	25/06/18	11:12	68.95	-0.38
W609	15/06/18	10:12	69.65	
W609	25/06/18	10:24	68.97	-0.68
W610	15/06/18	13:08	69.52	
W610	25/06/18	10:40	68.84	-0.68
W612	15/06/18	13:28	69.27	
W612	25/06/18	11:29	68.70	-0.57

Table 3: Background monitoring data

4.2. Step Test

A series of 5no steps pumping at 15l/s, 19.5l/s, 23l/s, 26.5l/s and 30l/s were undertaken at W601 on 03/07/2018. Each step was for a period of 100 minutes each.

Following completion of the step tests, the flow rate of 25l/s was selected as the most suitable flow rate for the constant drawdown test flow rate.

	Date	Time	Time into test (Minutes)	Water Level (mAOD)	Cumulative Drawdown (m)
Step 1 – 10l/s5	03/07/2018	09:00	0	68.29	-
	03/07/2018	10:40	100	66.94	1.35
Step 2 – 19.5l/s	03/07/2018	10:40	0	66.94	-
	03/07/2018	12:20	100	66.17	2.12
Step 3 – 23l/s	03/07/2018	12:20	0	66.17	-
	03/07/2018	14:00	100	65.19	3.10
Step 4 – 26.5l/s	03/07/2018	14:00	0	65.19	-

	03/07/2018	15:40	100	63.86	4.43
Step 5 – 30l/s	03/07/2018	15:40	0	63.86	-
	03/07/2018	17:20	100	61.37	6.92

Table 4: Summary of step test results

4.3. Constant Rate Test

The result of the constant rate test can be summarised as follows pumping at a flow rate of 23.3l/s for a period of 7 days from 10:00 on 10th June to 11:00 on 17th June 2018.

	10:00 on 10/07/18	**11:00 on 17/07/18**		
Well Name	**Water Level (mAOD)**	**Water Level (mAOD)**	**Drawdown (m)**	**Distance to W601 (m)**
W601	67.90	62.45	5.44	-
R602	67.99	65.08	2.91	16.64
R606	67.97	65.92	2.04	93.00
R607	67.99	65.48	2.51	35.00
R608	68.01	65.60	2.41	60.00
R609	68.10	65.22	2.88	20.00
R610	67.97	65.30	2.66	50.00
R612	67.83	65.99	1.84	106.70

Table 5: Summary of constant rate test results

The results showing the response of the water table relative to the pumping rate, time of pumping and the radial distance away from the pumping well are presented in figures 3, 4 and 5. The full data set (table8) is presented in excel format along with the report.

Yours faithfully,

[redacted]

[redacted]

Daniel Brooks
Contracts Manager
For & behalf of **Stuart Well Services Limited**

David Wright CGeol
Director & Principal Groundwater Engineer
For & behalf of **Stuart Well Services Limited**

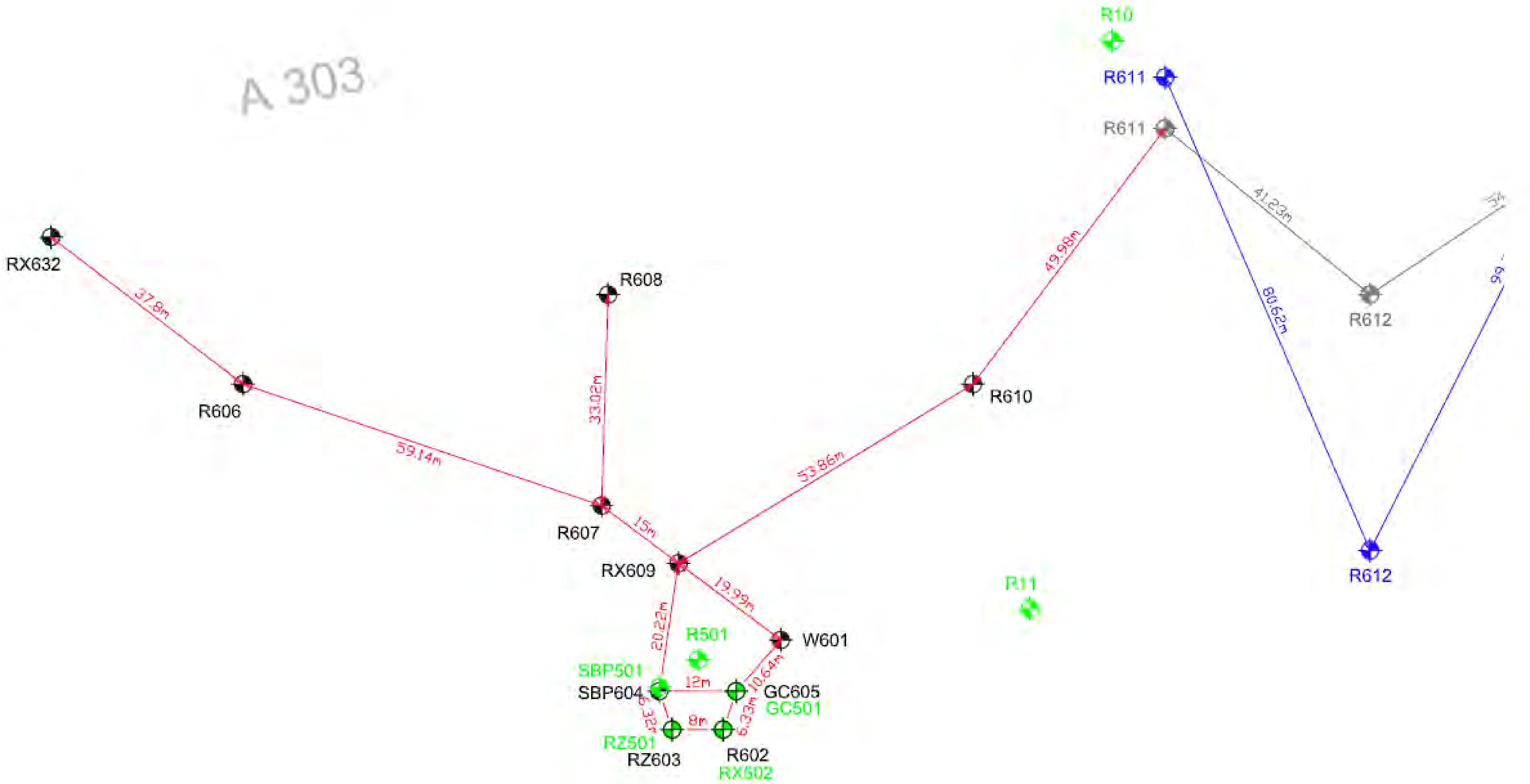


Figure 2: Well location plan

				Screened Sections					
	Easting	Northing	Ground Level	Top	Bottom	Borehole Size	Liner Size	Distance from Pumping Well W601	Drawdown
Well Name	m	m	mAOD	mAOD	mAOD	mm	mm	m	m
W601 (Pumping Well)	412303.91	141872.00	93.10	88.10	33.10	350	255		16.87
R602	412295.40	141857.60	92.69	87.69	57.69	150	50	16.64	2.93
R606	412219.90	141911.80	94.91	89.91	34.91	150	50	93.00	2.04
R607	412276.30	141892.60	93.99	88.99	33.99	150	50	35.00	2.51
R608	412277.20	141925.90	94.65	89.65	34.65	150	50	60.00	2.41
R609	412288.20	141884.20	93.64	88.64	33.64	150	50	20.00	2.88
R610	412334.10	141912.50	93.84	88.84	48.84	150	50	50.00	2.66
R612	412396.03	141886.00	93.08	88.08	50.08	150	50	106.70	1.84

Table 6: Well specification

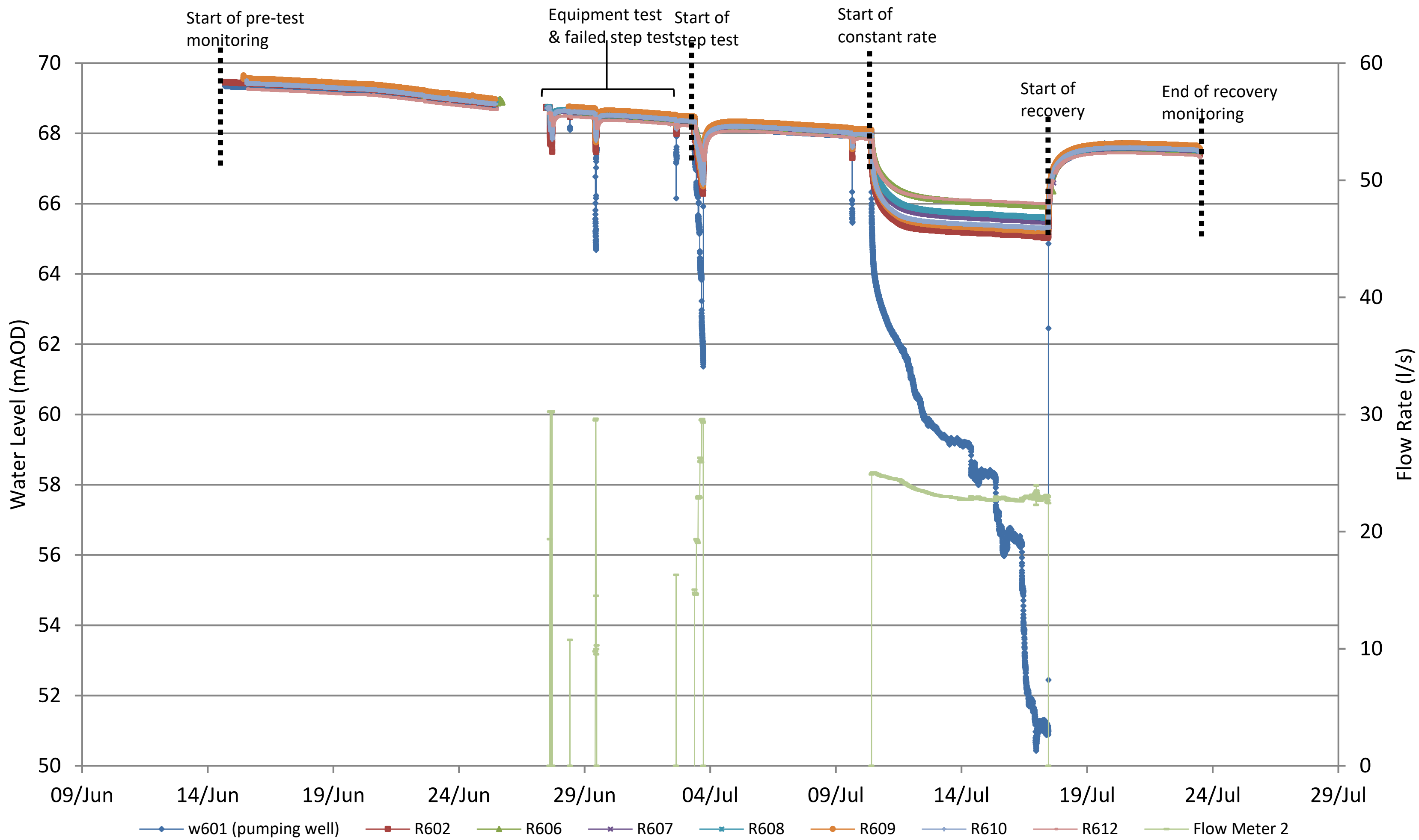


Figure 3: Time-water level graph

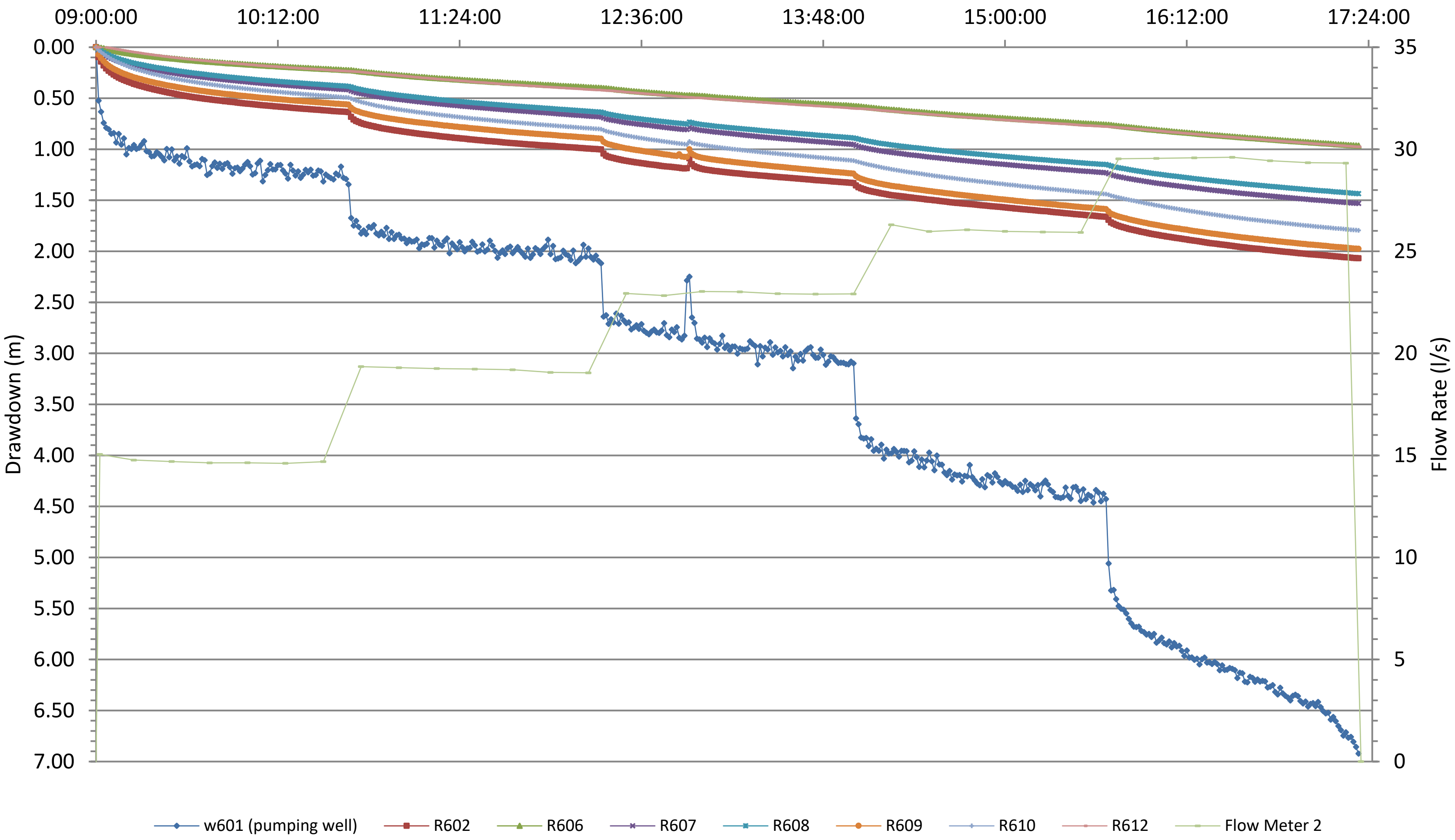


Figure 4: Time-drawdown graph (step test)

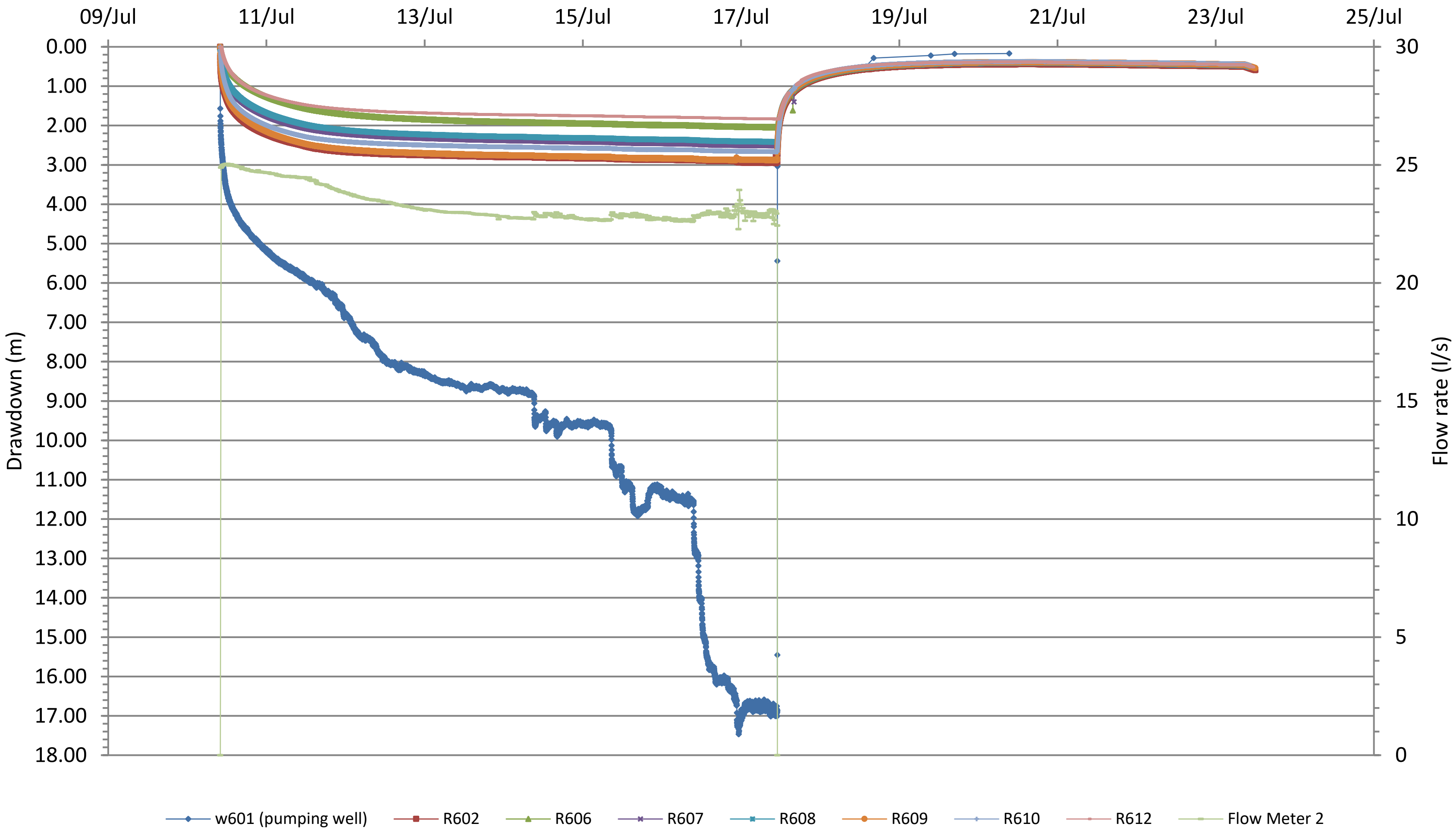


Figure 5: Time-drawdown graph (constant rate test)

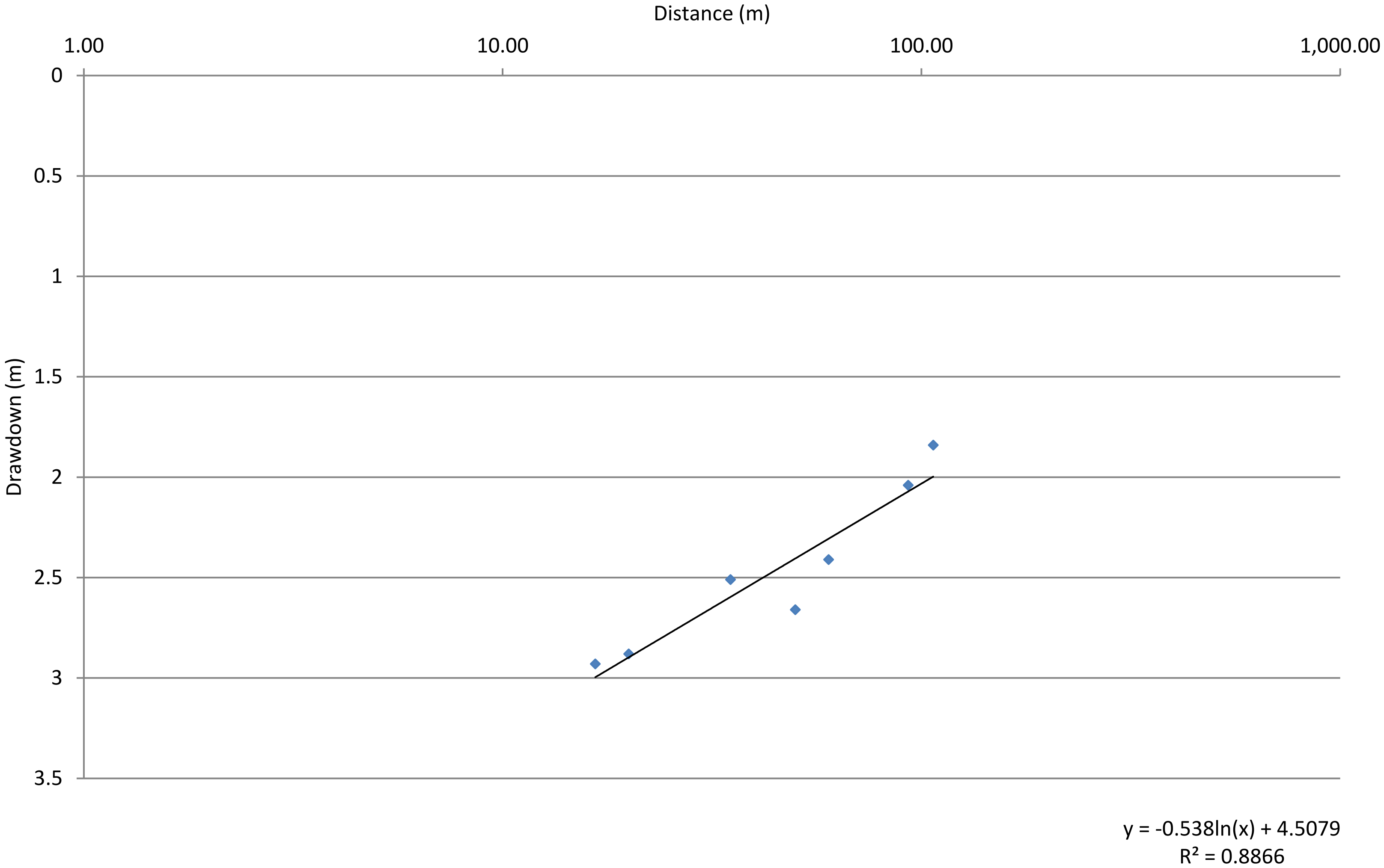


Figure 6: Semi-log distance drawdown graph

Table 7: Table of Pump Test Data

See electronic data.

Stuart Wells Limited

SWC6161 Stonehenge Pre-test water levels

Date	Time	PW601	602	606	607	608	609	610
TUES 19/6	10:54	23915						
	10:56		23·685					
	10:27			25·930				
	10:53				25·045			
	10:47					25·635		
	10:51						24·580	
	10:49							24·840
[illegible]D 20/6	11:28	23·950						
	11:30		23·720					
	11:42			25·965				
	11:25				25·080			
	11:44					25·670		
	11:24						24·615	
	11:21							24·865
THURS 21/6	10:12	24·010						
	10:16		23·785					
	10:30			26·035				
	10:21				25·145			
	10:26					25·740		
	10:19						24·685	
	10:23							24·940
FRI 601	9:57	24·204						
22/6.	10:16		23·867					
	10:02			26·111				
	10:21				25·231			
	09:57					25·822		
	10:18						24·770	
	10:07							25·022

Weather / Comments:

Stuart Wells Limited

SWC6161 Stonehenge Pre-test water levels

Date	Time	PW601	602	606	607	608	609	610
MON 25/6	10:17	24.355						
	10:20		24.100					
	11:10			26.350				
	10:34				25.465			
	11:16					26.060		
	10:25						25.005	
	10:57							25.260
TUES 26/6	09:25	24.410						
	09:23		24.180					
	09:35			26.425				
	09:28				25.535			
	09:32					26.130		
	09:27						25.080	
	09:30							25.330
WED 27/6	09:02	24.685						
	09:06		24.250					
	09:25			26.490				
	09:10				25.610			
	09:29					26.205		
	09:13						25.150	
	09:17							25.400
THURS 28/6	08:50	24.955						
	08:48		24.350					
	08:34			26.600				
	08:42				25.710			
	08:38					26.305		
	08:46						25.245	
	08:47							25.500
FRI 29/6	08:50	25.000						
	08:49		24.390					
	09:10			26.640				

Weather / Comments:

Stuart Wells Limited

SWC6161 Stonehenge Pre-test water levels

Date	Time	PW601	602	606	607	608	609	610
FRI 29/6	08:52				25·760			
	09:15					26·350		
	08:53						25·295	
	08:55							25·545

Weather / Comments:

Stuart Wells Limited

SWC6161 Stonehenge Pre-test water levels

Date	Time	612						
TUES 19/6	11:00	24.240						
WED 20/6	11:48	24.280						
THURS 21/6	10:37	24.350						
FRI 22/6	10:27	24.430						
MON 25/6	11:22	24.670						
TUES 26/6	09:29	24.735						
WED 27/6	09:35	24.805						
THURS 28/6	08:42	24.905						
FRI 29/6	09:21	24.940						

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge - Step Tests

Well location ref:	601	Step Test		Weather
Date:	3/7/18.	Step No	1	FINE
TOC to GL (m)		Flow Rate (l/s)	15LPS	

Time (hh:mm)	Elapsed Time	Water Level	FM. 1	FM. 2	V-Notch	pH EC
09:00	0	25.230	16156226	16243045		
	1	25.770				
	2	25.870				
	3	25.970				
	4	26.010				
	5	26.060				
	6	26.080				
	7	26.100				
	8	26.120				
	9	26.140				
09:10	10	26.150	16165045	16251947		
	12	26.170				
	14	26.200				
	16	26.220				
	18	26.230				
09:20	20	26.240	16173915	16260844		
	25	26.270				
09:30	30	26.300	16182772	16269715		
	35	26.330				
09:40	40	26.350	16191612	16278533		
	45	26.370				
09:50	50	26.380	16200399	16287364		
	55	26.390				
10:00	60	26.400	16209174	16296167		
10:10	70	26.430	16217966	16305020		
10:20	80	26.460	16226717	16313819		
10:30	90	26.480	16235510	16322617		
10:40	100	26.500	16244308	16331416		

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge - step tests

Well location ref: PW 601	Step Test		Weather
Date: 3/7/18	Step No	2	FINE.
TOC to GL (m)	Flow Rate (l/s)	19.5 LPS.	

Time (hh:mm)	Elapsed Time	Water Level	FM.1	FM.2	V-Notch	pH EC
10:40	0	26.500	16244308	16331416		
	1	26.880				
	2	26.950				
	3	26.970				
	4	26.990				
	5	27.010				
	6	27.030				
	7	27.030				
	8	27.030				
	9	27.040				
10:50	10	27.040	16255928	16343110		
	12	27.060				
	14	27.070				
	16	27.080				
	18	27.090				
11:00	20	27.100	16267532	16354754		
	25	27.120				
11:10	30	27.140	16279120	16366332		
	35	27.150				
11:20	40	27.170	16290661	16377913		
	45	27.190				
11:30	50	27.200	16302207	16389495		
	55	27.220				
11:40	60	27.230	16313750	16401091		
11:50	70	27.250	16325277	16412673		
12:00	80	27.260	16336778	16424213		
12:10	90	27.280	16348204	16435672		
12:20	100	27.290	16359651	—		

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge - Step Tests

Well location ref:	601	Step Test		Weather
Date:	3/7/18	Step No	3	FINE
TOC to GL (m)		Flow Rate (l/s)	23 LPS	

Time (hh:mm)	Elapsed Time	Water level	FM.1	FM.2	V-Notch	pH EC
12:20	0	27.290	16359651	—		
	1	27.830				
	2	27.900				
	3	27.910				
	4	27.890				
	5	27.900				
	6	27.910				
	7	27.920				
	8	27.930				
	9	27.940				
12:30	10	27.950	16373556	16461139		
	12	27.960				
	14	27.970				
	16	27.980				
	18	27.990				
12:40	20	28.000	16387268	16474891		
	25	28.030				
* 12:50	30	28.050	16400966	16488661		
	35	27.520				
13:00	40	28.090	16413871	16501625		
	45	28.130				
13:10	50	28.160	16427666	16515439		
	55	28.180				
13:20	60	28.190	16441513	16529362		
13:30	70	28.220	16455252	16543139		
13:40	80	28.250	16468969	16556916		
13:50	90	28.290	16482730	16570670		
14:00	100	28.330	16496450	16584351		

Weather / Comments:
12:50 * PUMP STOPPED + RE STARTED ON STANDBY

Stuart Well Services Ltd

SWC6161 Stonehenge - Step Tests

Well location ref:	PW601	Step Test		Weather
Date:	3/7/18	Step No	4	FINE
TOC to GL (m)		Flow Rate (l/s)	26.5LPS	

Time (hh:mm)	Elapsed Time	PW601	FM1	FM2	"V" NOTCH.	
14:00	0	28.330	16496450	16584351		
	1	28.870				
	2	29.000				
	3	29.050				
	4	29.090				
	5	29.110				
	6	29.130				
	7	29.150				
	8	29.160				
	9	29.180				
14:10	10	29.200	16512347	16600393		
	12	29.230				
	14	29.250				
	16	29.220				
	18	29.230				
14:20	* 20	29.230	16529662	16617774		
	25	29.270				
14:30	30	29.300	16543743	16631920		
	35	29.350				
14:40	* 40	29.410	16560927	16649150		
	45	29.430				
14:50	50	29.460	16574975	16663291		
	55	29.490				
15:00	60	29.520	—	—		
15:10	70	29.570	16606205	16694578		
15:20	80	29.600	16621773	16710326		
15:30	90	29.640	16637430	16725921		
15:40	100	29.680	16653092	16741268		

Weather / Comments:

* 20MIN FM TAKEN AT 21MINS.
* 40MIN FM TAKEN AT 41MINS.

Stuart Well Services Ltd

SWC6161 Stonehenge - Step Tests

Well location ref:	PW601	Step Test		Weather
Date:	3/7/18	Step No	5	FINE
TOC to GL (m)		Flow Rate (l/s)	30LPS	

Time (hh:mm)	Elapsed Time	PW601	FM1	FM2	"V" NOTCH	
15:40	0	29.680	16653092	16741268		
	1	30.450				
	2	30.530				
	3	30.590				
	4	30.660				
	5	30.690				
	6	30.720				
	7	30.760				
	8	30.810				
	9	30.840				
15:50	10	30.860	16670702	16759222		
	12	30.890				
	14	30.950				
	16	31.000				
	18	31.030				
16:00	20	31.050	16688451	16777124		
	25	31.090				
16:10	30	31.150	16706187	16794840		
	35	31.220				
16:20	40	31.280	16723970	16812628		
	45	31.330				
16:30	50	31.370	16741742	16830473		
	55	31.420				
16:40	60	31.450	16759493	16848275		
16:50	70	31.570	16777257	16866076		
17:00	80	31.660	16794924	16883714		
17:10	90	31.830	16812608	16901425		
17:20	100	32.150	16830286	16918975		

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge 7 day constant rate testing

Date: START	TUES 10/7/18	PW601		Weather
Constant Rate	Flow Rate (l/s) 25 LPS	PAGE	1	FINE

Time (hh:mm)	Elapsed Time	PW601	FM1	FM2	"V" NOTCH	
10:00	0	25·430	16854432	16943157		
	1	26·990				
	2	27·180				
	3	27·310				
	4	27·400				
	5	27·450				
	6	27·510				
	7	27·560				
	8	27·600				
	9	27·640				
10:10	10	27·680	16869792	16958517		
	12	27·730				
	14	27·790				
	16	27·850				
	18	27·900				
10:20	20	27·940	16884796	16973580		
	25	28·050				
10:30	30	28·140	16899802	16988645		
	35	28·220				
10:40	40	28·290	16914868	17003628		
	45	28·360				
10:50	50	28·440	16929942	17018677		
	55	28·490				
11:00	60	28·550	16945008	17033767		
11:10	70	28·680	16960095	17048828		
11:20	80	28·790	16975171	17063778		
11:30	90	28·900	16990286	17078829		
11:40	100	28·980	17005380	17093975		
12:00	120	29·100	17035593	17124156		
12:20	140	29·210	17065826	17154309		
12:40	160	29·310	17096019	17184472		

Weather / Comments:

Stuart Wells Services Ltd

SWC6161 Stonehenge 7 day constant rate testing

Date: START	10/7/18	PW601		Weather
Constant Rate	Flow Rate (l/s) 25LPS			
		PAGE	2	

Time (hh:mm)	Elapsed Time	PW601	FM1	FM2	"V" NOTCH	
13:00	180	29·390	17126222	17214637		
13:20	200	29·460	17156409	17244743		
13:40	220	29·520	17186559	17274869		
14:00	240	29·580	17216683	17304940		
14:20	260	29·630	17246811	17335048		
14:40	280	29·680	17276941	17365063		
15:00	300	29·730	17307035	17395093		
15:50	350	29·830	17382222	17470156		
16:40	400	29·940	17457268	17545134		
17:30	450	30·050	17532187	17619866		
18:20	500					
19:10	550					
20:00	600					
20:50	650					
21:40	700					
22:30	750					
23:20	800					
WED 11/7 00:10	850					
01:00	900					
01:50	950					
02:40	1000					
04:20	1100					
06:00	1200					
07:40	1300					
09:20	1400	31·180	18943217	19028202		
11:00	1500	31·275	19090810	19175582		
12:40	1600	31·360	19238337	19322830		
* 14:21	1701	31·450	19386712	19470891		
16:00	1800	31·490	19531721	19615602		
17:40	1900	31·660	19677535	19761248		
19:20	2000					

Weather / Comments:

14:20 READINGS TAKEN @ 14:21 HRS.

Stuart Well Services Ltd

SWC6161 Stonehenge 7 day constant rate testing

Date: START	10/7/18	PW601		Weather
Constant Rate	Flow Rate (l/s) 25 LPS			
		PAGE	3.	

Time (hh:mm)	Elapsed Time	PW601	FM 1	FM 2	"V" NOTCH	
21:00	2100					
22:40	2200					
THUR 12/7 00:20	2300					
02:00	2400					
03:40	2500					
05:20	2600					
07:00	2700					
08:40	2800	33·020	20968419	21049835		
10:20	2900	33·240	21110205	21191301		
12:00	3000	33·365	21251707	21332594		
13:40	3100	33·495	21392937	21473621		
15:20	3200	33·515	21533877	21614332		
17:00	3300	33·510	21674357	21754591		
18:40	3400					
20:20	3500					
22:00	3600					
23:40	3700					
FRI 13/7 01:20	3800					
03:00	3900					
04:40	4000					
06:20	4100					
08:00	4200	33·970	22929031	23007159		
09:40	4300	34·035	23067649	23145557		
11:20	4400	34·060	23206250	23284022		
13:00	4500	34·165	23344881	23422488		
14:40	4600	34·090	23483300	23560675		
16:20	4700	34·100	23621513	23698720		
18:00	4800					
19:40	4900					
21:20	5000					
23:00	5100					

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge 7 day constant rate testing

Date: START	10/7/18	PW601		Weather
Constant Rate	Flow Rate (l/s) 25LPS			
		PAGE	4	

Time (hh:mm)	Elapsed Time	PW601	FM1	FM2	"V" Notch	
SAT 14/7 00:40	5200					
02:20	5300					
04:00	5400					
05:40	5500					
07:20	5600					
09:00	5700	34.260	24997331	25072119		
10:40	5800					
12:20	5900	33.420	25272904	25347379		
14:00	6000					
* 15:45	6105	33.580	25556683	25630907		
17:20	6200					
19:00	6300					
20:40	6400					
22:20	6500					
SUN 15/7 00:00	6600					
01:40	6700					
03:20	6800					
05:00	6900					
06:40	7000					
08:20	7100	33.430	2699650	26991922		
10:00	7200					
11:40	7300	34.640	27195216	27267169		
13:20	7400					
15:00	7500	35.200	27471025	27542750		
16:40	7600					
18:20	7700					
20:00	7800					
21:40	7900					
23:20	8000					
MON 16/7 01:00	8100					
02:40	8200					

Weather / Comments:

* SAT 14/7 = 15:40 READING TAKEN 15:45HRS

Stuart Well Services Ltd

SWC6161 Stonehenge 7 day constant rate testing

Date: START	10/7/18	PW601		Weather
Constant Rate	Flow Rate (l/s) 25LPS.			
		SHEET	5	

Time (hh:mm)	Elapsed Time	PW601	FM1	FM2	"V" NOTCH.	
04:20	8300					
06:00	8400					
07:40	8500					
09:20	8600	35.020	28978764	29048630		
11:00	8700	36.040	29116064	29185779		
12:40	8800	39.120	29254150	29323691		
14:20	8900	39.800	29392514	29461918		
16:00	9000	40.170	29530866	29600159		
17:40	9100					
19:20	9200					
21:00	9300					
TUES 22:40	9400					
17/7 00:20	9500					
02:00	9600					
03:40	9700					
05:20	9800					
07:00	9900					
08:40	10000	41.070	30917576	3098102		
10:20	10100	41.210	31050154	31118398		
11:00	10180	41.120	31105127	31173112		

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge recovery test

Date:	TUES 17/7/18	PW601		Weather
Constant Rate	Flow Rate (l/s)			FINE.

Time (hh:mm)	Elapsed Time	WL	TIME	ELAPSED TIME	WL	DATE
11:00	0	41.120	14:00	180	26.730	
	1	31.650	14:20	200	26.685	
	2	28.520	14:40	220	26.650	
	3	28.300	15:00	240	26.610	
	4	28.200	15:20	260	26.580	
	5	28.140	15:40	280	26.550	
	6	28.090	16:00	300	26.520	
	7	28.040	16:50	350	26.460	
	8	27.995	17:40	400		
	9	27.955				
11:10	10	27.915	08:40	1300	26.010	WED 18/7
	12	27.850	10:20	1400	25.985	
	14	27.795	12:00	1500	25.965	
	16	27.745	13:40	1600	25.945	
	18	27.700	16:15		25.715	
11:20	20	27.660				
	25	27.570	09:34		25.650	THURS 19/7
11:30	30	27.500	16:45		25.610	
	35	27.435				
11:40	40	27.375	09:22		25.600	FRI 20/7
	45	27.330				
11:50	50	27.280				
	55	27.240				
12:00	60	27.200				
12:10	70	27.135				
12:20	80	27.080				
12:30	90	27.025				
12:40	100	26.980				
13:00	120	26.900				
13:20	140	26.840				
13:40	160	26.780				

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge - Step Tests

Well location ref:	R602	Step Test		Weather
Date:	03-7-18	Step No		SUNNY
TOC to GL (m)	300	Flow Rate (l/s)		

Time (hh:mm)	Elapsed Time					
	0	24.630	25.270	25.640	25.965	26.295
	1	24.735	25.325	25.670	25.995	26.330
	2	24.770	25.345	25.695	26.005	26.350
	3	24.815	25.360	25.705	26.020	26.365
	4	24.840	25.370	25.710	26.030	26.375
	5	24.860	25.380	25.720	26.035	26.385
	6	24.880	25.385	25.725	26.040	26.395
	7	24.900	25.395	25.735	26.045	26.405
	8	24.915	25.400	25.740	26.050	26.410
	9	24.930	25.405	25.745	26.060	26.415
	10	24.945	25.415	25.750	26.065	26.425
	12	24.965	25.420	25.755	26.070	26.435
	14	24.985	25.430	25.765	26.085	26.450
	16	25.005	25.440	25.770	26.090	26.460
	18	25.015	25.450	25.780	26.095	26.465
	20	25.035	25.455	25.785	26.100	26.470
	25	25.060	25.475	25.800	26.115	26.495
	30	25.090	25.490	25.815	26.130	26.515
	35	25.110	25.505	25.735 *	26.140	26.535
	40	25.130	25.520	25.825	26.155	26.550
	45	25.145	25.535	25.850	26.170	26.565
	50	25.165	25.540	25.860	26.180	26.585
	55	25.175	25.555	25.875	26.190	26.600
	60	25.190	25.565	25.885	26.205	26.615
	70	25.210	25.585	25.900	26.230	26.640
	80	25.235	25.600	25.925	26.255	26.660
	90	25.255	25.620	25.945	26.280	26.685
	100	25.270	25.640	25.965	26.295	26.705

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge 7 day constant rate testing

Date:	10/07/18	R 602		Weather
Constant Rate	Flow Rate (l/s) 25 LPS.	PAGE	1	SUNNY

Time (hh:mm)	Elapsed Time	24.985				
	1	25.265	200	26.540		
	2	25.345	220	26.580		
	3	25.400	240	26.615		
	4	25.440	260	26.650		
	5	25.480	280	26.685		
	6	25.510	300	26.715		
	7	25.535	350	26.790		
	8	25.560	400	26.850		
	9	25.580	450	26.910		
	10	25.600				
	12	25.645	WED 11/7	TIME	ELAPSED TIME	WL
	14	25.670		09:21	1401	27.455
	16	25.705		11:01	1501	27.490
	18	25.730		12:41	1601	27.530
	20	25.755		14:22	1702	27.560
	25	25.810		16:01	1801	27.585
	30	25.855		17:41	1901	27.605
	35	25.900	THURS 12/7	08:41	2801	27.700
	40	25.935		10:22	2902	27.725
	45	25.970		12:01	3001	27.730
	50	26.000		13:41	3101	27.735
	55	26.030		15:21	3201	27.740
	60	26.055		17:01	3301	27.745
	70	26.105	FRI 13/7	08:01	4201	27.775
	80	26.150		09:41	4301	27.780
	90	26.195		11:21	4401	27.785
	100	26.235		13:01	4501	27.785
	120	26.315		14:41	4601	27.790
	140	26.385		16:21	4701	27.800
	160	26.440	SAT 14/7	09:01	5701	27.820
	180	26.495		12:25	5905	27.830

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge 7 day constant rate testing

Date: START	10/7/18	BH	602	Weather
Constant Rate	Flow Rate (l/s) 25 LPS.			
		PAGE	2	

Time (hh:mm)	Elapsed Time	WL	DATE			
15:53	6113	27·830				
08:24	7104	27·850	SUN 15/7/18			
11:43	7303	27·860				
15:01	7503	27·870				
09:21	8601	27·890	MON 16/7/18			
11:01	8701	27·895				
12:41	8801	27·900				
14:27	8907	27·910				
16:01	9001	27·910				
17:41	1001	27·910				
08:45		27·920	TUES 17/7/18			
10:20		27·930				
11:00						

Weather / Comments:

26·095
1623 BAROMETRIC LOGGER moved 1613 26·100
DATA LOGGER MOVED FOR SAFETY OVERNIGHT

Stuart Well Services Ltd

SWC6161 Stonehenge recovery test

Date:	17/7/18		R602	Weather
Constant Rate	Flow Rate (l/s)			Sunny Spells

Time (hh:mm)	Elapsed Time	27·930				
1100	1	27·930		1420	200	26·280
	2	27·820		1440	220	26·240
	3	27·750		1500	240	26·205
	4	27·705		1520	260	26·170
	5	27·665		1540	280	26·145
	6	27·630		1600	300	26·105
	7	27·590		1650	350	26·050
	8	27·550		1740	400	
	9	27·515				
1110	10	27·480		WED 18/7	08:43	25·590
	12	27·410			10:21	25·570
	14	27·355			12:02	25·550
	16	27·310			16:22	25·515
	18	27·265				
1120	20	27·225		THURS 19/7	09:21	25·430
	25	27·140			16:46	25·420
	30	27·065				
	35	27·000		FRI 20/7	09:32	25·410
	40	26·950				
	45	26·900				
	50	26·860				
	55	26·820				
1200	60	26·785				
	70	26·720				
	80	26·665				
	90	26·615				
	100	26·570				
	120	26·495				
	140	26·430				
	160	26·375				
1400	180	26·325				

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge - Step Tests

Well location ref:	R606	Step Test		Weather
Date:	03/07/2018	Step No		
TOC to GL (m)		Flow Rate (l/s)		

Time (hh:mm)	Elapsed Time	Step 1		Step 2		Step 3
9.00	0	26.885	10.40	27.105	12.20	27.285
9.01	1	26.885	10.41	27.110	12.21	27.290
9.02	2	26.890	10.42	27.115	12.22	27.290
9.03	3	26.900	10.43	27.120	12.23	27.290
9.04	4	26.900	10.44	27.120	12.24	27.290
9.05	5	26.905	10.45	27.125	12.25	27.295
9.06	6	26.915	10.46	27.125	12.26	27.300
9.07	7	26.920	10.47	27.130	12.27	27.300
9.08	8	26.925	10.48	27.130	12.28	27.305
9.09	9	26.925	10.49	27.135	12.29	27.305
9.10	10	26.930	10.50	27.135	12.30	27.310
9.12	12	26.940	10.52	27.140	12.32	27.310
9.14	14	26.945	10.54	27.145	12.34	27.315
9.16	16	26.955	10.56	27.150	12.36	27.320
9.18	18	26.960	10.58	27.155	12.38	27.325
9.20	20	26.970	11.00	27.160	12.40	27.330
9.25	25	26.980	11.05	27.170	12.45	27.340
9.30	30	26.990	11.10	27.175	12.50	27.350
9.35	35	27.005	11.15	27.185	12.55	27.355
9.40	40	27.015	11.20	27.195	13.00	27.365
9.45	45	27.025	11.25	27.200	13.05	27.375
9.50	50	27.035	11.30	27.215	13.10	27.380
9.55	55	27.045	11.35	27.220	13.18	27.395
10.00	60	27.055	11.40	27.225	13.20	27.400
10.10	70	27.065	11.50	27.240	13.30	27.410
10.20	80	27.080	12.00	27.255	13.40	27.430
10.30	90	27.095	12.10	27.270	13.50	27.440
10.40	100	27.105	12.20	27.285	14.00	27.455

Weather / Comments:

13.28 - willie notes 'chalky water' @ V notch

Step 4		Step 5	
14.00	27.460	15.40	27.645
14.01	27.460	15.41	27.645
14.02	27.465	15.42	27.650
14.03	27.465	15.43	27.655
14.04	27.470	15.44	27.655
14.05	27.470	15.45	27.660
14.06	27.475	15.46	27.660
14.07	27.475	15.47	27.665
14.08	27.480	15.48	27.670
14.09	27.480	15.49	27.670
14.10	27.485	15.50	27.670
14.12	27.490	15.52	27.675
14.14	27.495	15.54	27.685
14.16	27.~~450~~500	15.56	27.690
14.18	27.500	15.58	27.690
14.20	27.505	16.00	27.695
14.25	27.515	16.05	27.710
14.30	27.525	16.10	27.720
14.35	27.535	16.15	27.730
14.40	27.545	16.20	27.740
14.45	27.555	16.25	27.750
14.50	27.565	16.30	27.760
14.55	27.575	16.35	27.770
15.00	27.580	16.40	27.780
15.10	27.595	16.50	27.800
15.20	27.610	17.00	27.815
15.30	27.625	17.10	27.830
15.40	27.645	17.20	27.850

Stuart Well Services Ltd

SWC6161 Stonehenge 7 day constant rate testing

Date:	10/7/18		R 606	**Weather**
Constant Rate	**Flow Rate (l/s)**	OACE	Troy Edwards 1	

Time (hh:mm)	**Elapsed Time**	1	12.00 2	14.00 3	4	5.
10.00AM	0	27.245	27.765	27.990		
	1	27.275	121 27.770	27.990		
	2	27.280	27.770	27.995		
	3	27.290	27.775	27.995		
	4	27.295	27.775	27.995		
	5	27.300	27.780	28.000		
	6	27.310	27.780	28.000		
	7	27.320	27.785	28.000		
	8	27.330	27.785	28.005		
	9	27.340	27.790	28.005		
	10	27.350	130 27.790	28.005		
	12	27.365	27.795	28.010		
	14	27.375	27.800	28.010		
	16	27.390	27.805	28.010		
	18	27.400	27.810	28.015		
	20	27.415	140 27.815	28.015		
	25	27.440	27.825	28.025		
	30	27.460	150 27.830	28.030		
	35	27.490	27.845	28.035		
	40	27.515	160 27.855	28.040		
	45	27.535	27.865	28.050		
	50	27.550	170 27.875	28.055		
	55	27.575	27.880	28.065		
1 Hour	60	27.590	180 27.890	28.065		
	70	27.625	27.910	28.080	300mins	
	80	27.660	27.925	28.130	350mins	
	90	27.685	27.940	28.185	400mins	
	100	27.715	27.960	28.230	450mins	
2 Hour	120	27.765	27.990			

Weather / Comments:

Stuart We||Services Ltd

SWC6161 Stonehenge 7 day constant rate testing

Date: START	10/7/18	WELL NO	606	Weather
Constant Rate	Flow Rate (l/s) 25LPS			
		PAGE	2	

Time (hh:mm)	Elapsed Time	WL	DATE	TIME	WL	DATE.
09:29	1409	28.765	11/7/18	10:29	29.295.	TUES 17/7/18
11:08	1508	28.800		11:00		
12:47	1607	28.830				
14:28	1708	28.855				
16:08	1808	28.880				
17:47	1907	28.900				
08:47	2807	29.030	THURS 12/7			
10:31	2911	29.040				
12:07	3007	29.050				
13:46	3106	29.060				
15:26	3206	29.065				
17:07	3307	29.070				
08:10	4210	29.120	FRI 13/7			
09:49	4309	29.125				
11:27	4407	29.130				
13:06	4506	29.135				
14:47	4607	29.140				
16:26	4706	29.145				
09:08	5708	29.175	SAT 14/7/18			
12:33	5913	29.180				
16:06	6126	29.190				
08:31	7111	29.210	SUN 15/7/18			
11:51	7311	29.220				
15:08	7508	29.230				
09:29	8609	29.255	MON 16/7/18			
11:07	8707	29.260				
12:46	8806	29.265	"			
14:24	8904	29.270				
16:06	9006	29.270				
17:49	1009	29.275				
08:53		29.295.	TUES 17/7/18			

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge - step tests RECOVERY.

Well location ref:	606	Step Test	Weather
Date:	17/7/18	Step No	R606
TOC to GL (m)		Flow Rate (l/s)	

Time (hh:mm)	Elapsed Time	WL		TIME	ELAPSED TIME	WL
11:00	0	29·300		14:00	180	28·545
	1	29·300		14:20	200	28·505
	2	29·300		14:40	220	28·470
	3	29·295		15:00	240	28·430
	4	29·285		15:20	260	28·405
	5	29·275		15:40	280	28·380
	6	29·270		16:00	300	28·355
	7	29·260		16:50	350	28·295
	8	29·250				
	9	29·240	WED 18/7	09:02		27·840
11:10	10	29·230		10:36		27·820
	12	29·215		12:17		27·800
	14	—		16:39		27·765
	16	29·180				
	18	29·165	THURS 19/7	09:15.		27·690
11:20	20	29·145		16:37		27·670
	25	29·115	FRI 20/7	09:55		27·670
11:30	30	29·080				
	35	29·045				
11:40	40	29·015				
	45	28·985				
11:50	50	28·960				
	55	28·930				
12:00	60	28·910				
12:10	70	28·860				
12:20	80	28·820				
12:30	90	28·750				
12:40	100	28·720				
13:00	120	28·690				
13:20	140	—				
13:40	160	28·585				

Weather / Comments:

LOGGER REINSTALL = 15:43 HRS WL = 28·375

Stuart Well Services Ltd

SWC6161 Stonehenge - Step Tests

Well location ref:	R607.	Step Test		Weather
Date:	3·7·18	Step No		HOT / DRY.
TOC to GL (m)	350mm	Flow Rate (l/s)		

Time (hh:mm)	Elapsed Time	STEP 1	STEP 2	STEP 3	STEP 4	STEP 5
09·00	0	26·000	26430	26685	26955	27240 15·40
0901	1	26030	26440	26690	26975	27255
	2	260.50	26445	26700	26985	27260
	3	260·70	26450	26700	26990	27270
	4	260·80	26455	26710	26995	27275
	5	260·95	26460	26720	27000	27280
	6	26·110	26465	26725	27005	27285
	7	26 120	26470	26730	27010	27290
	8	26130	26475	26735	27015	27295
	9	26135	26475	26740	27020	27300
	10	26·145	26480	26745	27020	27305
	12	26165	26480	26750	27030	27 ~~305~~ 310
	14	26175	26490	26755	27035	27315
	16	26185	26495	26760	27040	27325
	18	26195	26500	26765	27050	27335
	20	26205	26510	26775	27055	27340
	25	26230	26525	26790	27075 2.25	27360 4.05
	30	26250	26545	26805	27085 2.30	27375
	35	26270	26555	26805	27095 2.35	27390 4.15
	40	26285	26565	26815	27110	27405
	45	26300	26580	26835	27120	27410 4.25
	50	26320	26590	26850	27135	27430
	55	26325	26600	26860	27145	27445 4.35
	60	26340	26610	26875	27155 15.00	27450
10·10	70	26360	26630	26895	27175 15.10	27480 4.50
	80	26380	26650	26920	27200 15.20	27500
	90	26400	26665	26940	27220 15.30	27520
10·40	100	26415	26-685	26·955	27·240	27535

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge 7 day constant rate testing

Date:	10/07/18			Weather Sunny overcast 5%
Constant Rate	Flow Rate (l/s) 25/LPS.	PAGE	1	607

Time (hh:mm)	Elapsed Time					
1000	0	26.375m		1300	180	27.450m
1001	1	26.440m		1320	200	27.490m
1002	2	26.475m		1340	220	27.530m
1003	3	26.500m		1400	240	27.565m
1004	4	26.530m		1420	260	27.595m
1005	5	26.550m		1440	280	27.625m
1006	6	26.565m		1500	300	27.660m
1007	7	26.585m		1550	350	27.720m
1008	8	26.600m		1640	400	27.785
1009	9	26.615m		1730	450	27.840
1010	10	26.630m				
1012	12	26.655m	WED 11/7	TIME	ELAPSED TIME	WL
1014	14	26.680m		09:23	1403	28.395
1016	16	26.695m		11:03	1503	28.430
1018	18	26.720m		12:43	1603	28.460
1020	20	26.740m		14:24	1704	28.490
1025	25	26.790m		16:04	1804	28.510
1030	30	26.825m		17:43	1903	28.530
1035	35	26.870m	THURS 12/7	08:43	2803	28.645
1040	40	26.915m		10:23	2903	28.650
1045	45	26.950m		12:03	3003	28.660
1050	50	26.985m		13:42	3102	28.665
1055	55	27.010m		15:22	3202	28.675
1100	60	27.040m		17:03	3303	28.675
1110	70	27.095m	FRI 13/7	08:03	4203	28.720
1121	80	27.140m		09:43	4303	28.725
1131	90	27.181m		11:23	4403	28.730
1140	100	27.221m		13:02	4502	28.735
1200	120	27.285m		14:43	4603	28.740
1220	140	27.345m		16:23	4703	28.740
1240	160	27.400m	SAT 14/7	09:03	5703	28.770

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge 7 day constant rate testing

Date: START	10/7/18	BH	607	Weather
Constant Rate	Flow Rate (l/s) 25 LPS			
		PAGE	2	

Time (hh:mm)	Elapsed Time	WL	DATE			
12:27	5907	28.780				
15:58	6118	28.780				
08:26	7106	28.800	SUN 15/7/18			
11:47	7307	28.810				
15:04	7504	28.820				
09:23	8603	28.845	MON 16/7/18			
11:04	8704	28.850				
12:43	8803	28.860				
14:22	8902	28.860				
16:03	9003	28.870				
17:44	1004	28.870				
08:39		28.885	TUES 17/7/18			
10:23		28.875				
11:00		28.880				

Weather / Comments:

Stuart We|| Services Ltd

SWC6161 Stonehenge recovery test

Date:	17/07/18		~~609~~ 607	Weather
Constant Rate	Flow Rate (l/s)			overcast

Time (hh:mm)	Elapsed Time	Øread= 28.880m				
1100	1	28.870m			200	27.605m
	2	28.820m			220	27.570m
	3	28.775m		1500	240	27.530m
	4	28.740m			260	27.495m
	5	28.715m		16	280	27.475m
	6	28.695m		1600	300	27.445m
	7	28.670m			350	27.385m
	8	28.650m				
	9	28.630m				
	10	28.610m		Data log reinstalled	1604	27.445
	12	28.575m				
	14	28.540m		WED 18/7	08:52	26.940
	16	28.510m			10:24	26.920
	18	28.475m			12:16	26.900
	20	28.450m			16:27	26.865
	25	28.385m				
	30	28.330m		THURS 19/7	09:14	26.795
	35	28.275m			16:41	26.780
	40	28.230m		FRI 20/7	09:38	26.770
	45	28.190m				
	50	28.150m				
	55	28.120m				
1200	60	28.085m				
	70	28.025m				
	80	27.970m				
	90	27.925m				
	100	27.885m				
1300	120	27.810m				
	140	27.750m				
	160	27.695m				
1400	180	27.650m				

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge - Step Tests

Well location ref:	R608	Step Test		Weather
Date:	3/7/18	Step No		
TOC to GL (m)		Flow Rate (l/s)		

Time (hh:mm)	Elapsed Time	Step 1 (0:00)	Step 2 (1:40)	Step 3 (3:20)		
9:00	0	26.596	26.971	27.225	27.478	27.738
	1	26.612	26.979	27.232	27.485	27.746
	2	26.632	26.986	27.234	27.491	27.752
	3	26.644	26.993	27.247	27.497	27.758
	4	26.656	26.998	27.252	27.503	27.764
	5	26.668	27.004	27.255	27.507	27.769
	6	26.679	27.010	27.259	27.511	27.776
	7	26.687	27.013	27.263	27.515	27.779
	8	26.698	27.018	27.266	27.520	27.783
	9	26.705	27.022	27.271	27.524	27.790
	10	26.712	27.025	27.277	27.529	27.794
	12	26.725	27.034	27.281	27.537	27.802
	14	26.750	27.039	27.288	27.544	27.811
	16	26.749	27.046	27.293	27.550	27.818
	18	26.760	27.052	27.300	27.557	27.823
	20	26.771	27.059	27.306	27.562	27.830
	25	26.789	27.078	27.319	27.577	27.845
	30	26.810	27.086	27.332	27.589	27.865
	35	26.830	27.099	27.324	27.599	27.875
	40	26.843	27.112	27.346	27.616	27.890
	45	26.857	27.123	27.361	27.627	27.906
	50	26.871	27.132	27.375	27.640	27.915
	55	26.884	27.144	27.386	27.651	27.928
	60	26.896	27.155	27.398	27.664	27.940
	70	26.917	27.175	27.422	27.682	27.964
	80	26.935	27.197	27.440	27.703	27.984
	90	26.954	27.209	27.457	27.723	28.005
	100	26.971	27.225	27.478	27.738	28.025

Weather / Comments:

![Stuart Well Services Ltd logo]

SWC6161 Stonehenge 7 day constant rate testing

Date:	10/07/2018			Weather
Constant Rate	Flow Rate (l/s) 25/LPS	PAGE	1	R608

Time (hh:mm)	Elapsed Time				
10:00	0	26.957	13:00 180	27.960m +1min	
	1	27.008	200	~~27.960~~ +1min	28.000m +1min
	2	27.036	220	28.035m +1min	
	3	27.066	230	28.070m +1min	
	4	27.088	14:00 240	28.105m +1min	
	5	27.106	[illegible] 260	~~[illegible]~~	~~[illegible]~~ ?
	6	27.125	280	28.132	+1min
	7	27.143	18:00 300	28.157	
	8	27.158	350	28.226	
	9	27.172	400	28.285	
	10	27.186	450	28.337	
	12	27.210	500		
	14	27.235			
	16	27.256		WED 11/7	
	18	27.280		TIME	ELAPSED TIME	WL
	20	27.300		09:28	1408	28.880
	25	27.340		11:07	1507	28.915
	30	27.382		12:48	1608	28.945
	35	27.414		14:26	1706	28.970
	40	27.456		16:10	1810	28.990
	45	27.482		17:48	1908	29.010
	50	27.515	THURS 12/7	08:48	2808	29.120
	55	27.542		10:30	2910	29.135
11:00	60	27.568		12:05	3005	29.140
	70	27.615		13:44	3104	29.150
	80	27.662		15:24	3204	29.155
11:30	90	27.696	"	17:06	3306	29.160
	100	27.736	FRI 13/7	08:09	4209	29.200
	120	27.802		09:48	4308	29.205
	140	27.868		11:25	4405	29.210
	160	27.911		13:04	4504	29.215

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge 7 day constant rate testing

Date: START	10/7/18	BH	608	Weather
Constant Rate	Flow Rate (l/s) 25LPS			
		PAGE	2	

Time (hh:mm)	Elapsed Time	WL	DATE.			
14:46	4606	29·220	13/7/18			
16:26	4706	29·225				
09:06	5706	29·250	14/7/18			
12:31	5911	29·255				
16:05	6125	29·260				
08:29	7109	29·280	SUN 15/7/18			
11:50	7310	29·295				
15:07	7507	29·300				
09:27	8607	29·320	MON 16/7/18			
11:05	8705	29·330				
12:44	8804	29·340				
14:22	8902	29·345				
16:04	9004	29·345				
17:47	1007	29·350				
08:50		29·365	TUES 17/7/18			
10:29		29·370				
11:00		29·360				

Weather / Comments:

A303 STONEHENGE - GROUND INVESTIGATION

Stuart Well Services Ltd

Well location ref:	R608		Weather
Date:	17/07/18		Sunny spells Dry
TOC to GL (m)	31 cm aGL		

	Mins	R608		Mins	Mbdat.				
11:00	0	29.36	062	240+2	28.115				
	1	29.36	260	260	R				
	2	29.341	281	280	28.08				
	3	29.305		300	28.05				
	4	29.280		322	28.00				
	5	29.257	16:50	350	27.970				
	6	29.235		450					
	7	29.215							
	8	29.202		WED 18/7	08:59	27.525			
	9	29.180			10:29	27.505			
	10	29.184			12:15	27.470			
	12	29.130			16:34	27.450			
	14	29.090							
	16	29.072		THURS 19/7	09:16	27.380			
	18	29.050			16:39	27.365			
	20	29.012							
	25	28.962		FRI 20/7	09:44	27.360			
	30	28.900							
	35	28.865							
	40	28.801							
	45	28.760							
	50	28.725							
12:00	60	28.663							
	70	28.600							
	80	28.547							
	90	28.503							
	100	28.460							
3:00	120	28.390							
	140	28.328							
	160	28.275							
4:00	180	28.232							
	200	28.187							
	220	28.150							

Weather / Comments:

Pump turned off at 11:00 BST - Recovery
Logger was moved at 15:26 BST + WL = 28.075 mbdat

Stuart Well Services Ltd

SWC6161 Stonehenge - Step Tests

Well location ref:	R609	Step Test		Weather
Date:	03/07/18	Step No		
TOC to GL (m)	255mm	Flow Rate (l/s)		

Time (hh:mm)	Elapsed Time	(1) 10l/s	(2) 15l/s	(3) 20l/s	(4) 25l/s	(5) 30l/s
Start	0	25.530m	26.100m	26.430m	26.775m	27.125m
0901	1	25.580m	26.135m 1041	26.465m 1221	26.805m 1401	27.160m 1541
0902	2	25.645m	26.145m 1042	26.480m 1222	26.820m 1402	27.175m 1542
0903	3	25.675m	26.160m 1043	26.490 1223	26.825m 1403	27.185m 1543
0904	4	25.695m	26.170m 1044	26.500m 1224	26.835m 1404	27.195m 1544
0905	5	25.715m	26.180m 1045	26.505m 1225	26.845m 1405	27.200m 1545
0906	6	25.735m	26.185m 1046	26.510m 1226	26.855m 1406	27.205m 1546
0907	7	25.745m	26.190m 1047	26.515m 1227	26.860m 1407	27.210m 1547
0908	8	25.760m	26.195m 1048	26.520m 1228	26.865m 1408	27.215m 1548
0909	9	25.775m	26.205m 1049	26.525m 1229	26.870m 1409	27.220m 1549
0910	10	25.785m	26.210m 1050	26.530m 1230	26.875m 1410	27.230m 1550
0912	12	25.805m	26.215m 1052	26.535m 1232	26.880m 1412	27.245m 1552
0914	14	25.820m	26.225m 1054	26.545m 1234	26.890m 1414	27.255m 1554
0916	16	25.835m	26.235m 1056	26.555m 1236	26.900m 1416	27.265m 1556
0918	18	25.850m	26.240m 1058	26.560m 1238	26.905m 1418	27.275m 1558
0920	20	25.865m	26.250m 1100	26.570m 1240	26.910m 1420	27.285m 1600
0925	25	25.895m	26.265m 1105	26.590m 1245	26.930m 1425	27.300m 1605
0930	30	25.915m	26.280m 1110	26.605m 1250	26.945m 1430	27.320m 1610
0935	35	25.940m	26.300m 1115	26.545m 1255	26.965m 1435	27.340m 1615
0940	40	25.955m	26.310m 1120	26.620m 1300	26.980m 1440	27.355m 1620
0945	45	25.975m	26.325m 1125	26.640m 1305	26.995m 1445	27.370m 1625
0950	50	25.995m	26.335m 1130	26.655m 1310	27.005m 1450	27.390m 1630
0955	55	26.005m	26.345m 1135	26.670m 1315	27.015m 1455	27.405m 1635
1000	60	26.020m	26.360m 1140	26.685m 1320	27.030m 1500	27.415m 1640
1010	70	26.040m	26.380m 1150	26.705m 1330	27.060m 1510	27.445m 1650
1020	80	26.060m	26.400m 1200	26.730m 1340	27.085m 1520	27.470m 1700
1030	90	26.080m	26.415m 1210	26.755m 1350	27.105m 1530	27.495m 1710
1040	100	26.100m	26.430m 1220	26.775 1400	27.125m 1540	27.505m 1720

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge 7 day constant rate testing

Date:	10/7/18	R609		Weather	
Constant Rate	Flow Rate (l/s) 25/LPS	PAGE	1	Hot / Sunny	

Time (hh:mm)	Elapsed Time					
10:00	0	26.080		13:00	180	27.334
10 01	1	26.175		13:20	200	27.379
10 02	2	26.205		13 40	220	27.420
1003	3	26.245		14:00	240	27.465
1004	4	26.271		14 20	260	27.491
1005	5	26.295		14.40	280	27.520
1006	6	26.325		15.00	300	27.553
1007	7	26.350			350	27.625
1008	8	26.372			400	27 685
1009	9	26.390			456	27.740
10.10	10	26.400				
1012	12	26.424		WED 11/7		
1014	14	26.457		TIME	ELAPSED TIME	WL
1016	16	26.485		09:22	1402	28.320
1018	18	26.513		11:02	1502	28.355
1020	20	26.536		12:42	1602	28.385
1025	25	26.595		14:23	1703	28.410
10.30	30	26.640		16:03	1803	28.435
10.35	35	26.688		17:42	1902	28.445
10.40	40	26.727	THURS 12/7	08:42	2802	28.560
10 45	45	26.767		10:23	2903	28.570
1050	50	26.800		12:02	3002	28.575
10 55	55	26.833		13:42	3162	28.580
11.00	60	26.861		15:22	3202	28.590
11 10	70	26.919		17:02	3302	28.590
11 20	80	26.971	FRI 13/7	08:02	4202	28.630
11.30	90	27.018		09:42	4302	28.635
11 40	100	27.065		11:22	4402	28.640
12:00	120	27.141		13:01	4501	28.640
12 20	140	27.213		14:42	4602	28.645
12:40	160	27.277		16:22	4702	28.650

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge 7 day constant rate testing

Date: START	10/7/18	BH	609	Weather
Constant Rate	Flow Rate (l/s) 25 LPS			
		PAGE	2	

Time (hh:mm)	Elapsed Time	WL	DATE			
09:02	5702	28·670	SAT 14/7/18			
12:26	5906	28·680				
15:57	6117	28·690				
08:25	7105	28·705	SUN 15/7/18			
11:46	7306	28·720				
15:03	7503	28·730				
09:22	8602	28·745	MON 16/7/18			
11:03	8703	28·755				
12:42	8802	28·770				
14:21	8901	28·770				
16:02	9002	28·775				
17:43	1003	28·775				
08:41		28·780	TUES 17/7/18			
10:21		28·790				
11:00		28·800				

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge recovery test

Date:	17/7/18		609.	Weather
Constant Rate	Flow Rate (l/s) Recovery	Borehole	R6098	

Time (hh:mm)	Elapsed Time	Reading	Elapsed Time	Reading		
	0	28.800	180	27.208	14:00	
11:00	1	~~842~~	200	27.165		
	2	28.675	220	27.122		
	3	28.589	240	27.089	15:00	
	4	28.538	260	27.057		
	5	28.509	280	27.030		
	6	28.495	300	27.000	16:00	
	7	28.428	350	26.941		
	8	28.391				
	9:40	28 410?		WED 18/7	08:47	26.480
11:10	10	28 399			10:23	26.460
	12	28 372			12:03	26.440
	14	28 337			16:25	26.410
	16	28 291				
	18	28 215		THURS 19/7	09:13	26.330
11:20	20	28 185			16:43	26.315
	25	28.118		FRI 20/7	09:35	26.310
	30	27.950				
	35	27.893				
	40	27.836				
	45	27.790				
	50	27.746				
	55	27.709				
12:00	60	27.671				
	70	27.606				
	80	27.548				
	90	27.501				
	100	27.454				
13:00	120	27.380				
	140	27.313				
	160	27.256				

Weather / Comments: up to 11:20 - dips may be out due to dip meter.
14:11 - 26.990 - reinstalled logger in casing

Stuart Well Services Ltd

SWC6161 Stonehenge - Step Tests

Well location ref:	R610	Step Test		Weather
Date:	3.07.2018	Step No		
TOC to GL (m)	28.0 cm	Flow Rate (l/s)		

Time (hh:mm)	Elapsed Time					
	0	25.78.0				
	1	25.82.0	26.29.5	26.60.0	26.91.0	27.23.5
	2	25.83.5	26.30.5	26.61.0	26.91.5	27.24.5
	3	25.85.0	26.31.0	26.62.0	26.92.0	27.25.5
	4	25.87.0	26.32.0	26.62.5	26.93.0	27.26.0
	5	25.89.0	26.32.5	26.63.0	26.93.5	27.26.5
	6	25.90.0	26.33.5	26.63.5	26.94.0	27.27.0
	7	25.91.5	26.34.0	26.64.0	26.94.5	27.27.5
	8	25.92.5	26.34.5	26.64.5	26.95.0	27.28.0
	9	25.93.5	26.35.0	26.65.0	26.96.0	27.28.5
	10	25.95.0	26.35.5	26.65.5	26.96.0	27.29.0
	12	25.96.5	26.36.5	26.66.5	26.97.0	27.30.0
	14	25.98.5	26.37.5	26.67.0	26.98.5	27.31.0
	16	26.00.5	26.38.0	26.68.0	26.99.0	27.32.0
	18	26.01.5	26.39.0	26.69.0	27.00.0	27.33.0
	20	26.03.5	26.40.0	26.69.5	27.01.0	27.34.0
	25	26.06.0	26.41.5	26.71.5	27.02.5	27.36.0
	30	26.08.5	26.43.0	26.73.0	27.04.0	27.38.0
	35	26.11.0	26.44.5	26.74.0	27.06.0	27.40.5
	40	26.13.0	26.46.0	26.75.0	27.07.5	27.42.0
	45	26.15.5	26.47.5	26.76.5	27.09.0	27.44.0
	50	26.16.5	26.49.0	26.78.0	27.10.5	27.45.5
	55	26.18.0	26.50.0	26.79.5	27.12.0	27.47.0
	60	26.19.5	26.51.0	26.81.0	27.13.5	27.48.5
	70	26.22.0	26.53.5	26.83.0	27.16.0	27.51.0
	80	26.24.0	26.55.0	26.85.5	27.18.5	27.54.0
	90	26.26.0	26.57.5	26.88.0	27.20.5	27.56.5
	100	26.28.0	26.59.0	26.90.0	27.23.0	27.58.5

Weather / Comments:

Stuart Wells Services Ltd

SWC6161 Stonehenge 7 day constant rate testing

Date:	10/07/2018			Weather Sunny, Hot.
Constant Rate	Flow Rate (l/s) 25 l/s.	PAGE	1	RG10

Time (hh:mm)	Elapsed Time	level mbdat	time	Elapsed time	level mbdat	
10.00	0	26.155	13:00	180	27.430	
	1	26.220	13.20	200	27.480	
	2	26.260	13.40	220	27.525	
	3	26.295	14.00	240	27.565	
	4	26.320	14:20	260	27.600	
	5	26.345	14:40	280	27.630	
	6	26.370	15:00	300	27.660	
	7	26.395	15:50	350	27.730	
	8	26.415	16:40	400	27.795	
	9	26.440	17:30	450	27.850	
	10	26.460	18:20	500		
	12	26.495	19:10	550		
	14	26.530	20:00	600		
	16	26.560	20:50	650		
	18	26.590				
	20	26.610		WED 11/7		
	26	26.690		TIME	ELAPSED TIME	WL
	30	26.735		09:24	1404	28.390
	35	26.770		11:04	1504	28.425
	40	26.825		12:44	1604	28.455
	45	26.840		14:23	1703	28.480
	50	26.880		16:05	1805	28.500
	55	26.910		17:44	1904	28.515
11:00	60	26.945	THURS 12/7	08:44	2804	28.605
	70	27.010		10:24	2904	28.610
	80	27.060		12:03	3003	28.620
11.30	90	27.110		13:42	3102	28.625
11.40	100	27.160.		15:23	3203	28.630
12:00	120	27.230		17:04	3304	28.640
12:20	140	27.310	FRI 13/7	08:04	4204	28.675
12:40	160	27.375		09:44	4304	28.675

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge 7 day constant rate testing

Date: START	10/7/18	WELL	610	Weather
Constant Rate	Flow Rate (l/s) 25LPS			
		PAGE	2	

Time (hh:mm)	Elapsed Time	WL	DATE			
11:23	4403	28.675	FRI 13/7			
13:03	4503	28.685				
14:44	4604	28.690				
16:24	4704	28.690				
09:04	5704	28.710	SAT 14/7/18			
12:28	5908	28.720				
15:59	6119	28.725				
08:27	7107	28.740	SUN 15/7/18			
11:48	7308	28.755				
15:05	7505	28.765				
09:24	8604	28.780	MON 16/7/18			
11:04	8704	28.785				
12:44	8804	28.790				
14:24	8904	28.795				
16:02	9002	28.800				
17:45	1005	28.805				
08:47		28.815	TUES 17/7/18			
10:24		28.820				
11:00		28.820				

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge recovery test

Date:	17.07.2018	BH-R610		Weather
Constant Rate	Flow Rate (l/s)	62 - 30cm		NICE

Time (hh:mm)	Elapsed Time					
11:00	0	28.82.0		180	27.42.5	
	1	28.81.5		200	27.37.5	
	2	28.79.0		220	27.33.5	
	3	28.75.0		240	27.30.0	
	4	28.72.0		260	27.27.0	
	5	28.69.5		280	27.24.0	
	6	28.67.0		300	27.21.0	
	7	28.64.5		~~320~~		
	8	28.62.5		320	27.19.0	
	9	28.60.5		350	27.15.0	
	10	28.58.5				
	12	28.54.5	WED 18/7	08:55	26.710	
	14	28.50.5		10:26	26.690	
	16	28.47.0		12:12	26.670	
	18	28.43.0		16:29	26.640	
	20	28.39.5				
	25	28.31.0	THURS 19/7	09:23	26.565	
	30	28.24.0		16:48	26.555	
	35	28.17.5				
	40	28.11.5	FRI 20/7	09:44	26.545	
	45	28.05.5				
	50	28.00.5				
	55	27.96.0				
	60	27.92.0				
	70	27.84.0				
	80	27.78.0				
	90	27.72.5				
	100	27.68.0				
	120	27.59.5				
	140	27.53.0				
	160	27.47.0				

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge - Step Tests

Well location ref:	RX 612	Step Test		Weather
Date:	3rd July 2018	Step No		Dry sunny, warm sl. wind → Hot / windy occ cloud.
TOC to GL (m)		Flow Rate (l/s)		John Andrews.

Time (hh:mm)	Elapsed Time	STEP 1 15 l/s	STEP 2 19.5 l/s	STEP 3 23 l/s	STEP 4 26.5 l/s	STEP 5 30 l/s	
09:00	0	25.160	10:40 25.405	12:20 25.595	14:00 25.765	15:40 25.945	
	1	25.165	25.410	25.595	25.765	25.945	
	2	25.170	25.410	25.600	25.770	25.950	
	3	25.175	25.410	25.600	25.770	25.950	
	4	25.180	25.410	25.605	25.770	25.955	
	5	25.185	25.420	25.605	25.775	25.955	
	6	25.190	25.420	25.610	25.780	25.960	
	7	25.195	25.420	25.610	25.780	25.960	
	8	25.200	25.420	25.610	25.780	25.960	
	9	25.205	25.425	25.615	25.785	25.965	
	10	25.205	25.430	25.615	25.785	25.965	10
	12	25.215	25.430	25.620	—	25.970	12
	14	25.220	25.440	25.625	25.795	25.975	14
	16	25.230	25.440	25.625	25.800	25.980	16
	18	25.235	25.445	25.630	25.800	25.985	18
	20	25.240	25.450	25.635	25.805	25.990	20
	25	25.260	25.460	25.645	25.810	26.000	25
	30	25.270	25.475	25.655	25.825	26.010	30
	35	25.285	25.485	25.665	25.835	26.020	35
	40	25.300	25.490	25.670	25.845	26.030	40
	45	25.310	25.500	25.680	25.855	26.045	45
	50	25.320	25.515	25.690	25.865	26.055	50
	55	25.330	25.525	25.700	25.875	26.065	55
1hr	60	25.340	25.535	25.710	25.880 (61)	26.070	60
	70 72	25.360	25.550	25.720	25.890 (65)	26.095 (72)	
	80	25.375	25.565	25.735	25.890 (70)	26.110	
	90	25.385	25.580	25.750	25.895 (75)	26.125	
	100	25.405	25.595	25.765	25.915 (80)	26.145	
					25.930 (90)		

Weather / Comments:

25.945 (100)

Stuart Well Services Ltd

SWC6161 Stonehenge 7 day constant rate testing

Date:	10-7-2018	BH 612	[redacted]	**Weather** Dry Sun Mild - warm → Hot. sl. wind. to mod.
Constant Rate	**Flow Rate (l/s)**			

Time (hh:mm)	Elapsed Time					
10:00	0	25.550	13:00	180	26.190	
	1	25.555		~~190~~	~~26.225~~	
	2	25.560		200	26.225	
	3	25.565		220	26.255	
	4	25.570	14:00	240	26.285	
	5	25.580		260	26.315	
	6	25.590		280	26.340	
	7	25.595	15:00	300	26.365	
	8	25.605	15:50	350	26.425	
	9	25.610	16:40	400	26.475	
10:10	10	25.620	17:30	450	26.520	
	12	25.635	18:20	500		
	14	25.650				
	16	25.665		WED 11/7		
	18	25.675		TIME	ELAPSED TIME	WL
	20	25.685		09:31	1411	26.985
	25	25.715		11:10	1510	27.010
10:30	30	25.745		12:51	1611	27.035
	35	25.770		14:28	1708	27.055
	40	25.790		16:12	1812	27.075
	45	25.815		17:50	1910	27.085
	50	25.835	THURS 12/7	08:50	2810	27.180
	55	25.855		10:27	2907	27.185
11:00	60	25.875		12:07	3007	27.190
11:10	70	25.910		13:46	3106	27.200
11:20	80	25.945		15:27	3207	27.205
11:30	90	25.975		17:07	3307	27.210
11:40	100	26.005	FRI 13/7	08:12	4212	27.245
12:00	120	26.055		09:51	4311	27.250
12:20	140	26.105		11:27	4407	27.250
12:40	~~160~~ 161	26.155		13:07	4507	27.255

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge 7 day constant rate testing

Date: START	10/7/18	BH	612	Weather
Constant Rate	Flow Rate (l/s) 25LPS			
		PAGE	2	

Time (hh:mm)	Elapsed Time	WL	DATE
14:51	4611	27.260	13/7/18
16:50	4710	27.265	
09:10	5710	27.280	SAT 14/7/18
12:35	5915	27290	
16:02	6122	27.290	
08:34	7114	27.305	SUN 15/7/18
11:53	7313	27.305	
15:10	7510	27.320	
09:31	8611	27.345	MON 16/7/18
11:08	8708	27.345	
12:50	8810	27.350	
14:32	8912	27.355	
16:06	9006	27.360	
17:51	1011	27.360	
09:14		27.380	TUES 17/7/18
10:32		27.370	
11:00		27.375	

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge recovery test

Date:	17-7-2018		BH 612	Weather
Constant Rate	Flow Rate (l/s) Recovery		[redacted]	dry mild o/cast occ sun

Time (hh:mm)	Elapsed Time					
11:00	0	27.375	14:00	180	26.705	
	1	27.375	~~14:00~~	~~180~~ 200	26.670	
	2	27.370		~~190~~ 220	26.630	
	3	27.370	15:00	~~200~~ 240	26.595	
	4	27.370	~~[illegible]~~	260	26.565	
	5	27.365		280	26.535	
	6	27.365	16:00	300	26.510	
	7	27.360	16:50 →	[illegible]	26.480	@ 16.30 ☆
	8	27.355	~~17:40~~	~~400~~ 350	26.450	
	9	27.355		~~450~~		
11:10	10	27.350				
	12	27.345		WED 18/7	26.050	09:05
	14	27.335			26.035	10:39
	16	27.325			—	12:00
	18	27.320			25.990	16:42
11:20	20	27.310				
	25	27.280		THURS 19/7	25.930	09:27
	30	27.255			25.925	16:51
	35	27.230				
	40	27.205		FRI 20/7	25.930	10:40
	45	27.175				
	50	27.150				
	55	27.125				
12:00	60	27.100				
	70	27.055				
	80	27.015				
	90	26.975				
	100	26.~~[illegible]~~930				
13:00	120	26.860				
	140	26.810				
	160	26.750				

Weather / Comments: ☆ diver reset within hole.

Stuart Wells Limited

SWC6161 Stonehenge ~~Pre-test water levels~~

Date	Time	PH	µS	PPM	TEMP.			
11/7/18	16:00	7.26	536	267	15.4			
	17:40	7.20	535	266	16.0			
12/7/18	08:40	7.41	518	259	14.9			
	10:20	7.36	525	260	15.9			
	12:00	7.35	527	264	16.0			
	13:40	7.44	530	265	13.9			
	15:20	NO	METER	AVALIBLE				
	17:00	7.44	512	256	14.8			
13/7/18	08:00	7.51	524	261	13.7			
	09:40	7.35	517	260	14.9			
	11:20	7.46	528	263	13.8			
	13:00	7.62	536	285	13.0			
	14:40	7.27	543	271	14.3			
	16:20	7.21	539	278	14.0			
14/7/18	09:00	7.23	568	283	13.2			
	12:20	7.24	551	276	14.5			
	15:40	7.21	567	284	15.9			
15/7/18	08:20	7.24	556	278	15.9			
	11:40	7.10	560	280	14.5			
	15:00	7.25	569	285	15.0			
16/7/18	09:20	7.29	561	281	13.9			
	11:00	7.12	573	286	14.3			
	12:40	7.09	571	286	13.8			
	14:20	7.18	570	286	14.9			
	16:00	7.08	558	279	13.6			
	17:40	7.07	562	282	14.1			
17/7/18	08:40	7.16	556	277	14.1			
	10:20	7.20	550	278	14.4			
	11:00	7.18	552	281	13.6			

Weather / Comments:

Stuart Wells Limited

PUMPING TEST FACTUAL REPORT
Test 3 of 3 – Cluster W601

Contract Name:	A303 Amesbury to Berwick Down Ground Investigation – Pumping Tests
Client Name:	Highways England (HE)
Consultant:	AECOM (A)
Geotechnical specialist:	Structural Soils Ltd (SS)
Groundwater Pumping Test & Dewatering Specialist:	Stuart Well Ltd (SWL)
Report No	SWC6161-PT-W617

Revision	Date	Description	Prepared By (SWL)	Checked By (SWL)	Approved By (SS)	Approved By (A)
1	24/09/2018	Submitted for approval	DB	DW		

For:

Structural Soils Ltd
The Old School
Silthouse Lane
Bedminster
BS3 4EB

Contact:

Michael Addinall
Senior Geotechnical Engineer
[redacted]

By:

Stuart Well Ltd
Hargham Road
Shropham
Norfolk
NR17 1DT

Contact:

Daniel Brooks
Contract Manager
[redacted]

Contents

1. Introduction

In April 2018 Stuart Wells Ltd was appointed by Structural Soils Ltd to undertake a pumping test for the A303 Amesbury to Berwick Down Ground Investigation project.

To aid design of the A303 Amesbury to Berwick Down tunnelling and shaft sinking civil works, a series of 3 pumping tests were undertaken along an approximate 1.5km section of the future tunnel alignment. Each test is sited in a specific ground investigation (GI) zone of the ground investigation package to better understand the chalk. The testing can be summarised as follows.

GI Zone: South of alignment – test 1

- A single pumping well (W623) and 5no monitoring wells
- Primary purpose of the pumping test in this GI Zone is to better understand the hydrogeology of the chalk ridge.

GI Zone: Tunnel alignment west of Stonehenge Bottom – test 2

- A single pumping well (W601) and 7no monitoring wells
- Primary purpose of the pumping test in this GI Zone is to better understand the hydrogeology of the phosphatic chalk at this location

GI Zone: Tunnel alignment west of Stonehenge Bottom – test 3

- A single pumping well (W617) and 6no monitoring wells
- Primary purpose of the pumping test in this GI Zone is to better understand the hydrogeology of the dry valley. The thickness of superficial and de-structured chalk and faulting.

This factual report details the activities and the results of the testing carried out at W617.

Figure 1: Site Location Map

2. Summary of Ground Conditions

The ground conditions at W617 is summarised as follows as indicated by the borehole log undertaken by Structural Soils Ltd.

Stratum	Top level of stratum (mAOD)
Brown slightly gravelly sandy CLAY. Sand is fine to coarse. GRAVEL is subangular to subrounded fine to coarse of chalk and flint.	79.60
Cream to pale brown slightly gravelly silty fine to coarse SAND with low cobble content. Gravel is angular to subrounded fine to coarse flint and chalk. Cobbles are subangular to subrounded flint.	79.30
Firm brown chalky CLAY abundant with flints (drillers description)	78.40
Firm white CHALK with numerous flint (drillers description)	77.80
Chalk and flint (drillers description)	61.60
Base of borehole	31.60

Table 1: Summary of geology

3. Field Work

The programme of works undertaken at site can be summarised as follows:

Date	Activity
13th July to 23rd July 2018	Background monitoring
24th & 25th July 2018	Equipment Test
26th July 2018	Step Test
27th July to 3rd August 2018	Constant Rate Test
3rd August to 6th August 2018	Recovery Test

Table 2: Programme of works

Equipment used during testing is summarised as follows:

- A 7.5kW electrical submersible borehole pump was utilised for the testing after proving suitable during the equipment test on 25th July 2018.
- A series of 5.5 to 11kW electrical submersible drainage pumps were utilised as a boost system pump capable of pushing the discharge water to the discharge point located 1km distance from the pumping well
- A duty and standby 150kVA generator with automatic changeover panel were used to power the borehole pump and a series of duty and standby with automatic changeover panel were used to power the boost pumps
- Electronic Dataloggers were used at each well record continuous water level readings for the duration of the testing period. Data cable on each datalogger permitted the use of a Bluetooth datalogger/transmitter to send data throughout testing by email.
- Manual water level readings were recorded using a Manual Dip Tape
- Flow rate was monitored using a series of 2no electronic flow meters each with telemetry permitting remote monitoring of flow rate and a v-notch tank was used before the boost pumps as a back up to the flow meters if the flow meters should fail at any time.

The layout of the wells is shown in figure 2, and the well installation details provided in table 7.

4. Results

4.1. Background monitoring

Before undertaking the pumping test, the water level was monitored from 13th to 23rd July 2018 to observe any natural fluctuations in the water table. The pre-test monitoring shows that the groundwater at this location is dropping at an estimated drop of between 0.012m to 0.024m per day. We speculate that this is due to seasonal variation however interpretation is out of the scope of this report.

See as follows a summary of the data.

Well Name	Date	Time	Water Level (mAOD)	Change of water level (m)
W617	13/07/18		67.23	
W617	23/07/18		67.10	0.13
R618	13/07/18		67.27	
R618	23/07/18		67.13	0.14
R619	13/07/18		67.16	
R619	23/07/18		66.96	0.20
R620	13/07/18		67.11	
R620	23/07/18		66.99	0.12
RX621	13/07/18		67.06	
RX621	23/07/18		66.84	0.22
RX622	13/07/18		67.03	
RX622	23/07/18		66.79	0.24

Table 3: Background monitoring data

4.2. Step Test

A series of 5no steps pumping at 2.0l/s, 3.0l/s, 5.0l/s, 6.0l/s and 7.0l/s were undertaken at W617 on 26/07/2018. Each step was for a period of 100 minutes each.

Following completion of the step tests, the flow rate of 5.8l/s was selected as the most suitable flow rate for the constant drawdown test flow rate.

	Date	Time	Time into test (Minutes)	Water Level (mAOD)	Cumulative Drawdown (m)
Step 1 – 2.0l/s5	26/07/2018	09:20	0	66.83	-
	26/07/2018	11:00	100	65.88	0.95
Step 2 – 3.0l/s	26/07/2018	11:00	0	65.88	-
	26/07/2018	12:40	100	64.97	1.87
Step 3 – 5.0l/s	26/07/2018	12:40	0	64.97	-
	26/07/2018	14:20	100	62.29	4.54
Step 4 – 6.0l/s	26/07/2018	14:20	0	62.29	-
	26/07/2018	16:00	100	59.14	7.70
Step 5 – 7.0l/s	26/07/2018	16:00	0	59.14	-
	26/07/2018	17:40	100	49.76	17.07

Table 4: Summary of step test results

4.3. Constant Rate Test

The result of the constant rate test can be summarised as follows pumping at a flow rate of 5.8l/s for a period of 7 days from 10:00 on 27th July to 10:00 on 3rd August 2018.

	10:00 on 27/07/18	10:00 on 03/08/18		
Well Name	**Water Level (mAOD)**	**Water Level (mAOD)**	**Drawdown (m)**	**Distance to W601 (m)**
W617	66.69	47.49	19.20	-
R618	67.02	66.34	0.68	20.00
R619	66.87	66.59	0.27	35.00
R620	66.94	65.54	1.40	10.00
RX621	66.80	66.27	0.53	50.00
RX622	66.72	66.40	0.32	99.00

Table 5: Summary of constant rate test results

The results showing the response of the water table relative to the pumping rate, time of pumping and the radial distance away from the pumping well are presented in figures 3, 4 and 5. The full data set (table8) is presented in excel format along with the report.

Yours faithfully,

[redacted]

Daniel Brooks
Contracts Manager
For & behalf of **Stuart Well Services Limited**

[redacted]

David Wright CGeol
Director & Principal Groundwater Engineer
For & behalf of **Stuart Well Services Limited**

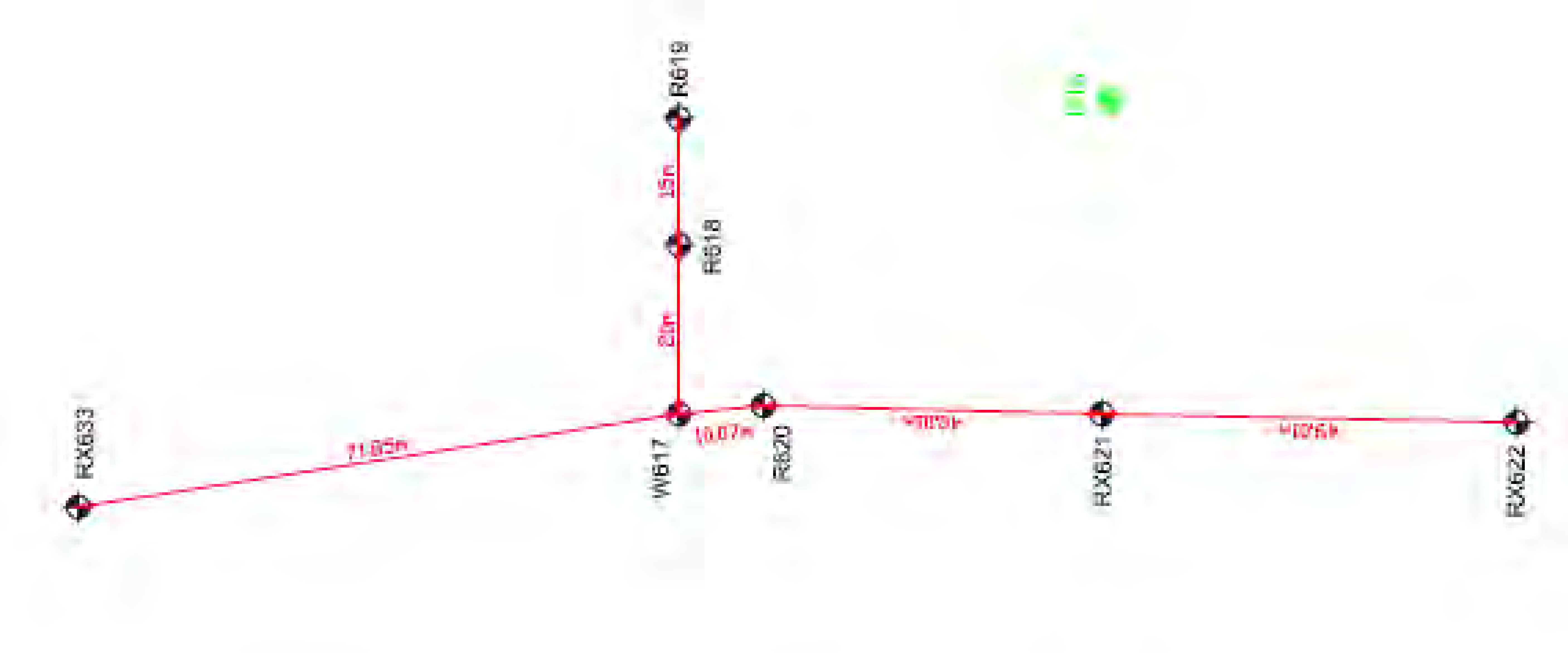


Figure 2: Well location plan

				Screened Sections					
	Easting	Northing	Ground Level	Top	Bottom	Borehole Size	Liner Size	Distance from Pumping Well W601	Drawdown
Well Name	m	m	mAOD	mAOD	mAOD	mm	mm	m	m
W617 (Pumping Well)	412751.02	141968.70	79.60	74.60	39.60	350	255	-	19.81
R618	412770.92	141968.88	79.51	74.51	39.51	150	50	20.00	0.68
R619	412785.92	141968.95	79.58	74.58	39.58	150	50	35.00	0.27
R620	412751.95	141959.18	79.56	74.56	39.56	150	50	10.00	0.93
RX621	412751.05	141919.04	79.87	74.87	39.87	150	50	50.00	0.53
RX622	412749.96	141869.94	80.58	75.58	40.58	150	50	99.00	0.32

Table 6: Well specification

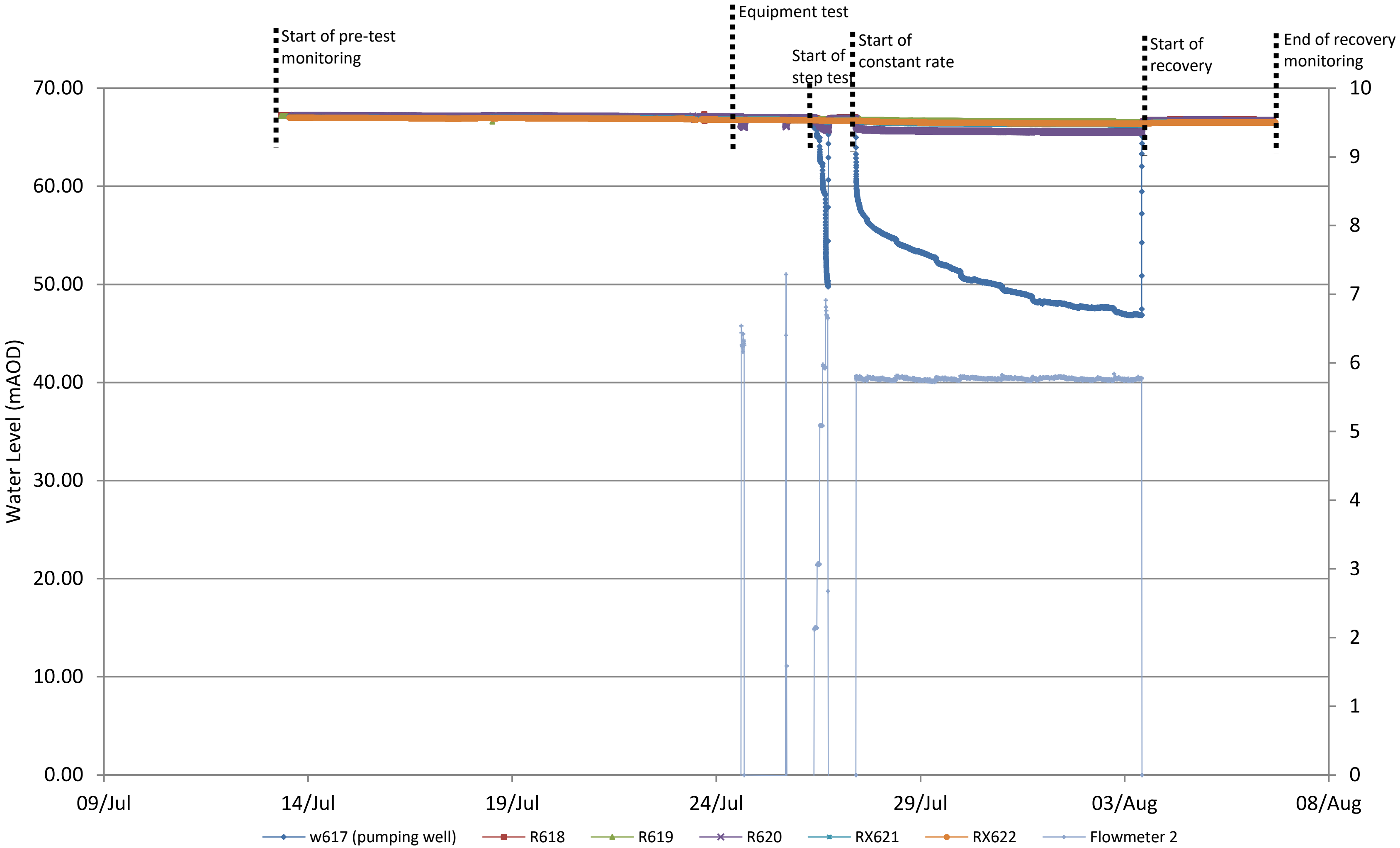


Figure 3: Time-water level graph

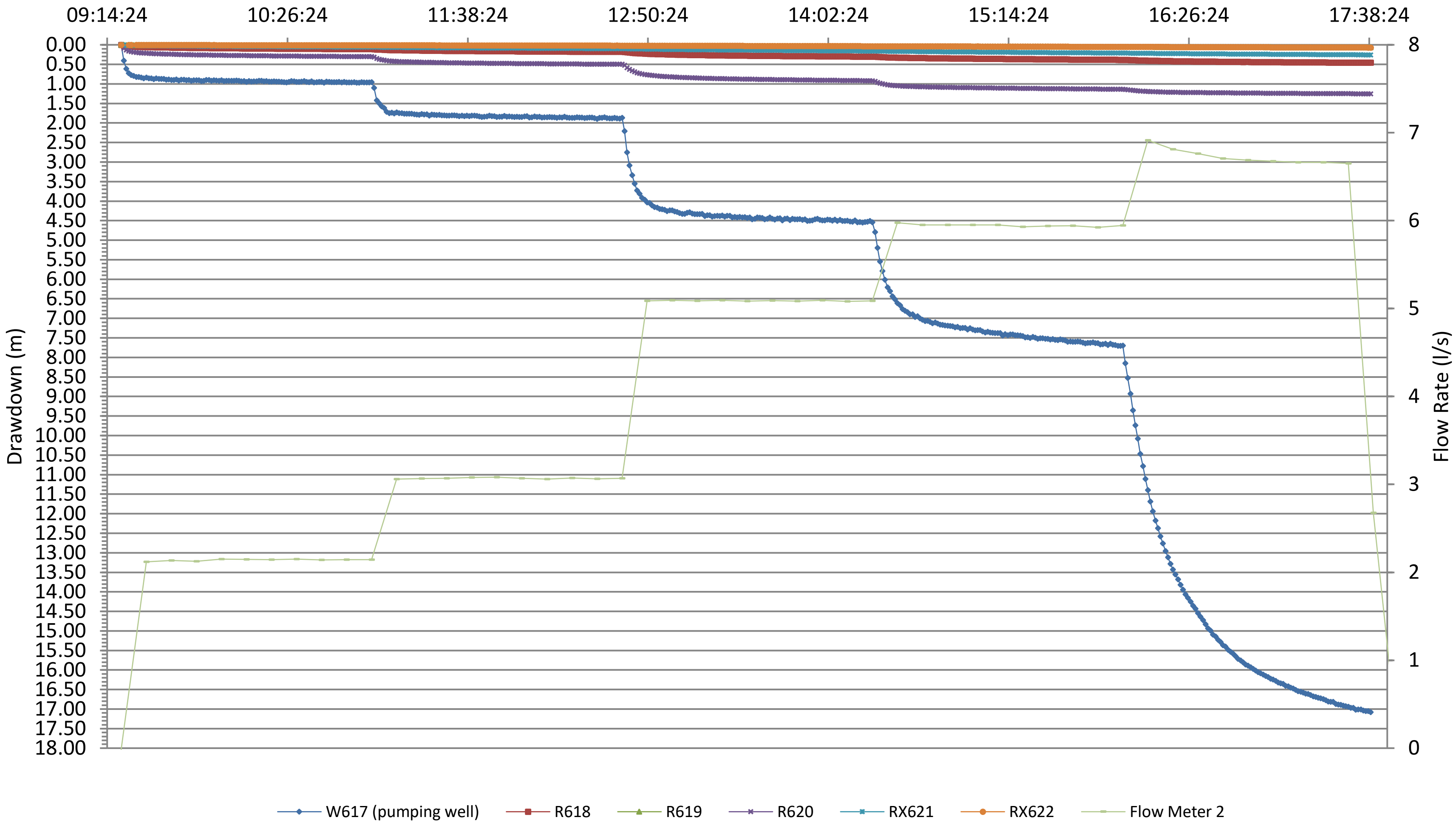


Figure 4: Time-drawdown graph (step test)

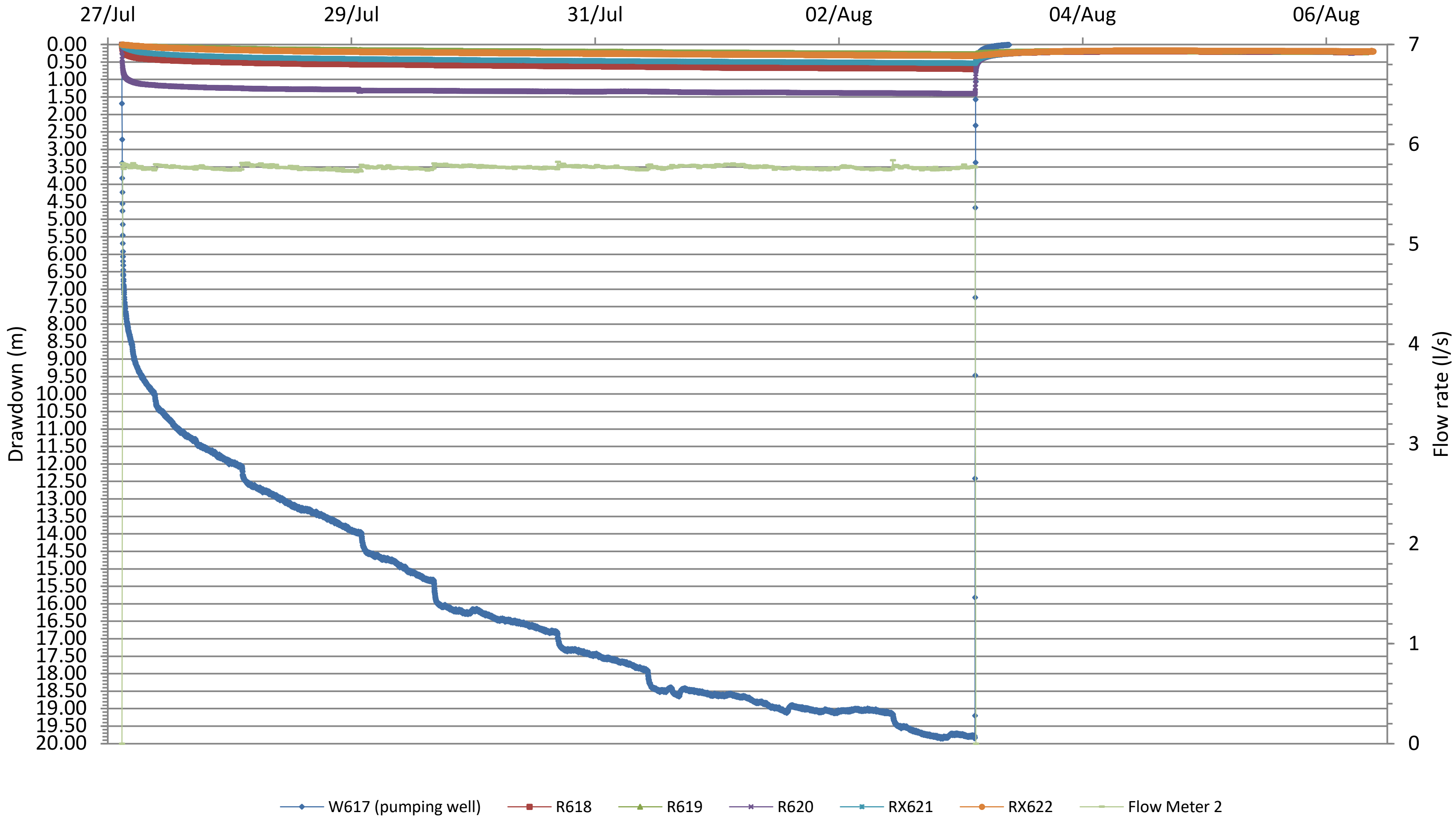


Figure 5: Time-drawdown graph (constant rate test)

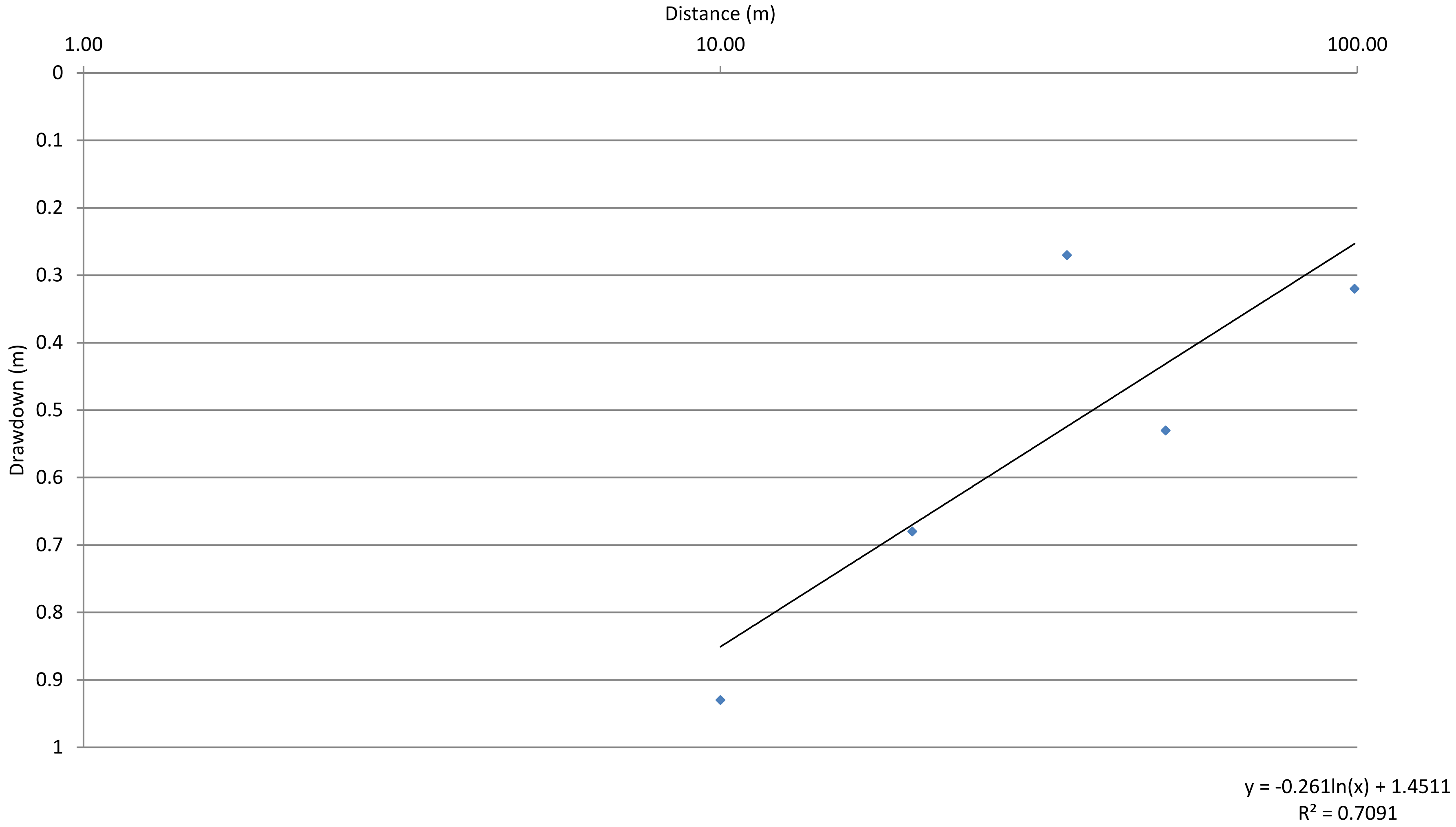


Figure 6: Semi-log distance drawdown graph

Table 7: Table of Pump Test Data

See electronic data.

Stuart Wells Limited

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3RD CLUSTER -

SWC6161 Stonehenge Pre-test water levels

Date	Time	617	618	619	620	621	622	
FRI 13/7/18	16:57	12.840						
	14:03		12.615					
	14:02			12.900				
	13:52				12.890			
	13:54					13.235		
	13:56						14.030	
SAT 14/7/18	08:31	12.820						
	08:43		12.600					
	08:42			12.910				
	08:33				12.790			
	08:35					13.245		
	08:37						14.050	
SUN 15/7/18	09:06	12.860						
	09:24		12.640					
	09:22			12.950				
	09:08				12.825			
	09:11					13.280		
	09:17						14.085	
MON 16/7/18	13:49	12.895						
	13:42		12.670					
	13:45			12.985				
	13:52				12.860			
	13:57					13.310		
	14:00						14.115	
TUES 17/7/18	09:55	12.915						
	09:58		12.700					
	09:57			13.010				
	10:05				12.885			
	10:07					13.350		
	10:08						14.145	

Weather / Comments:

A303 STONEHENGE - GROUND INVESTIGATION

Stuart Well Services Ltd

PRE TEST WATER LEVELS.

Well location ref:				Weather
Date:				
TOC to GL (m)				

DATE	TIME	617	618	619	620	621	622	
WED 18/7	13:17	12.890						
	13:32		12.670					
	13:23			12.975				
	13:20				12.855			
	13:36					13.310		
	13:41						14.100	
THURS 19/7	12:07	12.875						
	12:27		12.665					
	12:31			12.970				
	12:11				12.845			
	12:35					13.295		
	12:38						14.090	
FRI /20/7	08:53	12.910						
	08:59		12.680					
	09:03			12.990				
	08:55				12.865			
	09:07					13.310		
	09:09						4.110	

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge - step tests

Well location ref:	PW 617	Step Test		Weather
Date:	26/7/18	Step No	1	FINE
TOC to GL (m)	650mm A.G.L	Flow Rate (l/s)	2 LPS	

Time (hh:mm)	Elapsed Time	WL	FM1	FM2		
09:20	0	13.250	4860.389	1934.293		
	1	13.800				
	2	13.990				
	3	14.110				
	4	14.150				
	5	14.190				
	6	14.200				
	7	14.210				
	8	14.220				
	9	14.230				
09:30	10	14.240	4861.609	1935.529		
	12	14.240				
	14	14.250				
	16	14.260				
	18	14.265				
09:40	20	14.270	4862.827	1936.760		
	25	14.280				
09:50	30	14.290	4864.057	1937.991		
	35	14.295				
10:00	40	14.300	4865.258	1939.221		
	45	14.310				
10:10	50	14.315	4866.471	1940.449		
	55	14.320				
10:20	60	14.320	4867.684	1941.676		
10:30	70	14.330	4868.890	1942.905		
10:40	80	14.340	4870.105	1944.134		
10:50	90	14.350	4871.319	1945.367		
11:00	100	14.350	4872.530	1946.595		

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge - step tests

Well location ref:	PW617	Step Test		Weather
Date:	26/7/18	Step No	2	FINE.
TOC to GL (m)	650mm A.G.L.	Flow Rate (l/s)	3LPS.	

Time (hh:mm)	Elapsed Time	WL.	FM1	FM2		
11:00	0	14.350	4872.530	1946.595		
	1	14.530				
	2	14.810				
	3	14.890				
	4	14.950				
	5	15.000				
	6	15.100				
	7	15.120				
	8	15.130				
	9	15.135				
11:10	10	15.140	4874.325	1948.420		
	12	15.150				
	14	15.155				
	16	15.160				
	18	15.170				
11:20	20	15.170	4876.131	1950.260		
	25	15.185				
11:30	30	15.190	4877.974	1952.095		
	35	15.200				
11:40	40	15.205	4879.804	1953.941		
	45	15.210				
11:50	50	15.220	4881.630	1955.777		
	55	15.225				
12:00	60	15.230	4883.450	1957.607		
12:10	70	15.240	4885.285	1959.457		
12:20	80	15.245	4887.112	1961.393		
12:30	90	15.250	4888.940	1963.137		
12:40	100	15.260	4890.767	1964.974		

Weather / Comments:

Stuart We||Services Ltd

STEP TEST

SWC6161 Stonehenge - ~~7 Day Constant Rate Testing~~

Date:	26/7/18	STEP	3	Weather
~~Constant Rate~~	Flow rate (l/s) 5LPS	PW617		FINE

Time (hh:mm)	Elapsed Time	PW	FM1	FM2		
12:40	0	15·260	4890·767	1964·974		
	1	15·570				
	2	16·110				
	3	16·470				
	4	16·700				
	5	16·950				
	6					
	7	17·210				
	8	17·290				
	9	17·370				
12:50	10	17·430	4893·715	1967·934		
	12	17·500				
	14	17·560				
	16	17·600				
	18	17·640				
13:00	20	17·660	4896·758	1970·980		
	25	17·700				
13:10	30	17·730	4899·811	1974·013		
	35	17·760				
13:20	40	17·775	4902·842	1977·058		
	45	17·790				
13:30	50	17·820	4905·890	1980·101		
	55	17·830				
13:40	60	17·840	4908·920	1983·131		
13:50	70	17·865	4911·961	1986·168		
14:00	80	17·880	4915·000	1989·218		
14:10	90	17·900	4918·044	1992·241		
14:20	100	17·920	4921·073	1995·265		

Weather / Comments:

Stuart Well Services Ltd

STEP TEST.

SWC6161 Stonehenge - ~~7 Day Constant Rate Testing~~

Date:	26/7/18	STEP	4	Weather
~~Constant Rate~~	Flow rate (l/s) 6 LPS	PW617		FINE.

Time (hh:mm)	Elapsed Time	WL	FM1	FM2		
14:20	0	17.920	133061	31293968		
	1	18.160				
	2	18.550				
	3	18.920				
	4	19.180				
	5	19.400				
	6	19.580				
	7	19.710				
	8	19.860				
	9	19.930				
14:30	10	20.005	136621	31297586		
	12	20.140				
	14	20.240				
	16	20.320				
	18	20.360				
14:40	20	20.420	140193	31301190		
	25	20.500				
14:50	30	20.580	143769	31304770		
	35	20.650				
15:00	40	20.680	147327	31308357		
	45	20.730				
15:10	50	20.775	150893	31311930		
	55	20.820				
15:20	60	20.850	154456	31315515		
15:30	70	20.920	158012	31319094		
15:40	80	20.980	161580	31322677		
15:50	90	21.040	165137	31326256		
16:00	100	21.090	168690	31329838		

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge - ~~7 Day Constant Rate Testing~~

Date:	26/7/18	STEP	5	Weather
~~Constant Rate~~	Flow rate (l/s) 7LPS			FINE.

Time (hh:mm)	Elapsed Time	WL	FM1	FM2		
16:00	0	21.090	168690	31329838		
	1	21.490				
	2	21.890				
	3	22.260				
	4	22.710				
	5	23.100				
	6	23.450				
	7	23.820				
	8	24.160				
	9	24.470				
16:10	10	24.760	172853	31334022		
	12	25.300				
	14	25.750				
	16	26.140				
	18	26.510				
16:20	20	26.800	176972	31338159		
	25	27.450				
16:30	30	27.910	181032	31342237		
	35	28.390				
16:40	40	28.730	185057	31346294		
	45	29.110				
16:50	50	29.280	189075	31350339		
	55	29.490				
17:00	60	29.650	193071	31354366		
17:10	70	29.930	197057	31358387		
17:20	80	30.150	201038	31362395		
17:30	90	30.350	205018	31366409		
17:40	100	30.500	208995	31370403		

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge - 7 Day Constant Rate Testing

Date: START	27/7/18			Weather
Constant Rate	Flow rate (l/s) 5.8 LPS	PUMP WELL	617	FINE
		SHEET	1	

Time (hh:mm)	Elapsed Time	WL	FM1	FM2	"V" NOTCH.	
10:00	0	13.290	209174	31371770		
	1	15.170				
	2	16.190				
	3	16.860				
	4	17.340				
	5	17.730				
	6	18.050				
	7	18.290				
	8	18.660				
	9	18.970				
10:10	10	19.220	212690	31375289		
	12	19.620				
	14	19.890				
	16	20.090				
	18	20.250				
10:20	20	20.370	216173	31378773		
	25	20.610				
10:30	30	20.870	219673	31382277		
	35	21.020				
10:40	40	21.140	223160	31385773		
	45	21.220				
10:50	50	21.320	226649	31389273		
	55	21.410				
11:00	60	21.500	230138	31392766		
11:10	70	21.640	233617	31396258		
11:20	80	21.770	237092	31399741		
11:30	90	21.870	240571	31403222		
11:40	100	21.960	244047	31406702		
12:00	120	22.130	250998	31413670		
12:20	140	22.480	257969	31420662		
12:40	160	22.650	264936	31427650		

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge - 7 Day Constant Rate Testing

Date: START	27/7/18			Weather
Constant Rate	Flow rate (l/s) 5.8 LPS	PUMP WELL	617	
		SHEET	2	

Time (hh:mm)	Elapsed Time	WL.	FM1	FM2	"V" NOTCH	
13:00	180	22.770	271902	31434614		
13:20	200	22.880	278860	31441583		
13:40	220	22.980	285814	31448543		
14:00	240	23.060	292770	31455499		
14:20	260	23.140	299723	31462445		
14:40	280	23.200	306676	31469396		
15:00	300	23.280	313619	31476349		
15:50	350	23.440	330972	31493714		
16:40	400	23.780	348340	31511090		
17:30	450					
18:20	500					
19:10	550					
20:00	600					
20:50	650					
21:40	700					
22:30	750					
SAT 23:20	800					
28/7 00:10	850					
01:00	900					
01:50	950					
02:40	1000					
04:20	1100					
06:00	1200					
07:40	1300					
09:20	1400	25.600	695787	31858759		
11:00	1500					
12:40	1600	26.230	765468	31928592		
14:20	1700					
16:00	1800	26.440	835088	31998383		
17:40	1900					
19:20	2000					

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge - 7 Day Constant Rate Testing

Date: START	27/7/18			Weather
Constant Rate	Flow rate (l/s) 5·8LPS	PUMP WELL	617	
		SHEET	3	

Time (hh:mm)	Elapsed Time	WL	FM1	FM2	V" NOTCH	
21:00	2100					
22:40	2200					
SUN 29/7 00:20	2300					
02:00	2400					
03:40	2500					
05:20	2600					
07:00	2700					
08:40	2800	27·510	1181318	32345315		
10:20	2900					
12:00	3000	28·160	1250641	32414867		
13:40	3100					
15:20	3200	28·320	1319912	32484497		
17:00	3300					
18:40	3400					
20:20	3500					
22:00	3600					
23:40	3700					
MON 30/7 01:20	3800					
03:00	3900					
04:40	4000					
06:20	4100					
08:00	4200	29·720	1666104	32832572		
09:40	4300	29·855	1700761	32867418		
11:21	4400	29·955	1735742	32902634		
13:00	4500	30·000	1770011	32937079		
14:40	4600	30·050	1804605	32971875		
16:20	4700	30·090	1839198	33006670		
18:00	4800					
19:40	4900					
21:20	5000					
23:00	5100					

Weather / Comments:

MON 30/7/18 11:20 AM READING TAKEN 11:21 HRS.

Stuart We||Services Ltd

SWC6161 Stonehenge - 7 Day Constant Rate Testing

Date: START	27/7/18			Weather
Constant Rate	Flow rate (l/s) 5·8LPS	Pump well	617	
		SHEET	4	

Time (hh:mm)	Elapsed Time	WL	FM1	FM2	"V" NOTCH.	
TUES 31/7 00:40	5200					
02:20	5300					
04:00	5400					
05:40	5500					
07:20	5600					
09:00	5700	31·115	2185318	33354826		
10:40	5800	31·145.	2219953	33389648		
12:20	5900	31·210	2254604	33424457		
14:10	6010	31·275	2292675	33462701		
15:40	6100	31·375	2323820	33493940		
17:20	6200	31·450	2358432	33528620		
19:00	6300					
20:40	6400					
22:20	6500					
WED 1/8 00:00	6600					
01:40	6700					
03:20	6800					
05:00	6900					
06:40	7000					
08:20	7100	32·170	2671026	33842176		
10:00	7200	32·140	2705785	33877140		
11:40	7300	32·215	2740571	33912099		
13:20	7400	32·250	2775321	33946973		
15:00	7500	32·370	2810053	33981820		
16:40	7600	32·400	2844780	34016660		
18:20	7700					
20:00	7800					
21:40	7900					
23:20	8000					
THURS 2/8 01:00	8100					
02:40	8200					

Weather / Comments:
14:00 HRS READING TAKEN AT 14:10 HRS ON TUES 31/7/18
DUE TO SAFETY ORDIT

Stuart Well Services Ltd

SWC6161 Stonehenge - 7 Day Constant Rate Testing

Date: START	27/7/18			Weather
Constant Rate	Flow rate (l/s) 5.8LPS	Pump well	617	
		SHEET	5.	

Time (hh:mm)	Elapsed Time	WL	FM1	FM2	"V" NOTCH.	
04:20	8300					
06:00	8400					
07:40	8500					
09:20	8600	32.600	3191264	34364109		
11:00	8700	32.580	3225906	34398923		
12:40	8800	32.590	3260546	34433630		
14:20	8900	32.600	3295192	34468328		
16:00	9000	32.640	3329846	34503024		
17:40	9100	32.700	3364428	34537703		
19:20	9200					
21:00	9300					
22:40	9400					
Fri 3/8 00:20	9500					
02:00	9600					
03:40	9700					
05:20	9800					
07:00	9900					
08:40	10000	33.350	3676001	34850501		
10:00	10080	33.370	3703679	34878349		

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge recovery test

Date:	03-8-2018	PW617		Weather
Constant Rate	Flow Rate (l/s)			Hot + Sunny

Time (hh:mm)	Elapsed Time	WL	TIME	ELAPSED TIME	WL.	
10:00	0	33.37	13.00	180	13.60	
10.01	1	29.88	13.20	200	13.59	
10.02	2	26.51	13.40	220	13.58	
10.03	3	23.50	14.00	240	13.575	
10.04	4	21.15	14.20	260	13.57	
10.05	5	18.61	14:40	280	13.565	
10.06	6	17.12	*15.00*	300	13.56	
10.07	7	16.02	15.50	350		
10.08	8	15.22	16.40	400		
10.09	9	14.67	17.30	450		
10:10	10	14.32	18.20	500		
10.12	12	14.05				
10.14	14	13.97				
10.16	16	13.93				
10.18	18	13.91				
10:20	20	13.89				
10.25	25	13.84				
10:30	30	13.82				
10.35	35	13.79				
10:40	40	13.77				
10.45	45	13.75				
10:50	50	13.74				
10.55	55	13.73				
11.00	60	13.72				
11.10	70	13.70				
11.20	80	13.68				
11.30	90	13.67				
11.40	100	13.66				
12.00	120	13.64				
12.20	140	13.62				
12.40	160	13.61				

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge - step tests

Well location ref:	R618	Step Test		Weather
Date:	25/8/18	Step No		
TOC to GL (m)		Flow Rate (l/s)		

Time (hh:mm)	Elapsed Time	Step 1	Step 2	Step 3	Step 4	Step 5
	0	12.835	12.939	13.009	13.132	13.213
	1	12.856	12.941	13.011	13.134	13.215
	2	12.862	12.947	13.019	13.137	13.217
	3	12.868	12.951	13.027	13.142	13.219
	4	12.870	12.954	13.033	13.147	13.222
	5	12.874	12.956	13.037	13.150	13.225
	6	12.880	12.958	~~13~~	13.151	13.227
	7	12.886	12.962	13.049	13.152	13.228
	8	12.888	12.964	13.052	13.154	13.231
	9	12.888	12.966	13.056	13.156	13.232
	10	12.889	12.968	13.058	13.158	13.234
	12	12.890	12.969	13.063	13.161	13.236
	14	12.892	12.971	13.068	13.163	13.240
	16	12.895	12.973	13.070	13.166	13.242
	18	12.897	12.973	13.075	13.167	13.245
	20	12.899	12.975	13.077	13.170	13.246
	25	12.904	12.977	13.086	13.173	13.251
	30	12.908	12.982	13.091	13.177	13.255
	35	12.913	12.985	13.097	13.181	13.260
	40	12.915	12.989	13.102	13.184	13.262
	45	12.917	12.991	13.104	13.188	13.266
	50	12.920	12.993	13.106	13.191	13.269
	55	12.923	12.995	13.111	13.194	13.271
	60	12.927	12.997	~~[illegible]~~	13.196	13.273
	70	12.932	13.000	13.119	13.200	13.277
	80	12.934	13.003	13.123	13.202	13.281
	90	12.935	13.007	13.130	13.207	13.286
	100	12.939	13.009	13.132	13.213	13.289

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge - 7 Day Constant Rate Testing

Date:	27/7/18	R618		Weather
Constant Rate	Flow rate (l/s) 5.8			

Time (hh:mm)	Elapsed Time					
10:00	0	12.876	13:00	180	13.250	
	1	12.915		200	13.255	
	2	12.938		220	13.260	
	3	12.958	14:00	240	13.265	
	4	12.972		260	13.270	
	5	12.985		280	13.275	
	6	12.994	15:00	300	13.275	
	7	13.003		350	13.285	
	8	13.010		400	13.295	
	9	13.018		450		
10:10	10	13.025		500		
	12	13.038	DATE	TIME	ELAPSED TIME	WL.
	14	13.047	SAT 28/7/18	09:23	1403	13.380
	16	13.057		12:43	1603	13.395
	18	13.065		16:03	1803	13.400
10:20	20	13.073	SUN 29/7/18	08:44	2804	13.430
	25	13.090		12:02	3002	13.440
	30	13.105		15:23	3203	13.445
	35	13.115	MON 30/7/18	08:03	4203	13.465
	40	13.127		09:43	4303	13.470
	45	13.135		11:25	4405	13.470
	50	13.143		13:03	4503	13.475
	55	13.152		14:43	4603	13.475
11:00	60	13.158		16:24	4704	13.475
	70	13.171	TUES 31/7/18	09:03	5703	13.495
	80	13.182		10:42	5802	13.495
	90	13.193		12:23	5903	13.495
	100	13.200		14:12	6012	13.495
12:00	120	13.212		15:40	6110	13.495
	140	13.228		17:23	6203	13.500
	160	13.240	WED 1/8/18	08:23	7103	13.520

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge - 7 Day Constant Rate Testing

Date: START	27/7/18	BH	618	Weather
Constant Rate	Flow rate (l/s) 5-8LPS			

Time (hh:mm)	Elapsed Time	WL	DATE			
10:02	7202	13.520	WED 1/8/18			
11:43	7303	13.520				
13:23	7403	13.520				
15:02	7502	13.525				
16:43	7603	13.525				
09:23	8603	13.540	THURS 2/8/18			
11:03	8703	13.540				
12:43	8803	13.540				
14:23	8903	13.540				
16:00	9000	13.535				
17:43	9103	13.545				
08:42	100002	13.560	FRI 3/8/18			
10:00	10080	13.550				

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge recovery test

Date:	3-8-18		RG18	Weather
Constant Rate	Flow Rate (l/s) — T 0.330			Dry, sun, warm → hot. sli wind.

Time (hh:mm)	Elapsed Time	WL	TIME	ELAPSED TIME	WL.	
10:00	0	13.550	13:00	180	13.150	
	1	13.550		200	13.145	
	2	13.545		220	13.140	
	3	13.530	14:00	240	13.135	
	4	13.520		260	13.130	
	5	13.505		280	13.125	
	6	13.490	15:00	300	13.120	
	7	13.470	15:50	350		
	8	13.455	16:40	400		
	9	13.440		450		
10:10	10	13.425		500		
	12	13.400				
	14	13.385				
	16	13.370				
	18	13.355				
	20	13.345				
	25	13.325				
	30	13.305				
	35	13.290				
	40	13.275				
	45	13.265				
	50	13.250				
	55	13.245				
	60	13.240				
	70	13.225				
	80	13.210				
11:30	90	13.205				
11:40	100	13.195				
~~11:40~~ 12:00	120	13.180				
12:20	140	13.170				
12:40	160	13.160				

Weather / Comments:

Stuart Well Services Ltd

RE

SWC6161 Stonehenge - step tests

Well location ref:	619	Step Test		Weather
Date:	26/07/2018	Step No		Hot e Sunny
TOC to GL (m)		Flow Rate (l/s)		

Time (hh:mm)	Elapsed Time	Step 1	2	3	4	5
9.20hr	0	13.145	11.00 13.155	12.40 13.165	14.20 13.175	16.00 13.195
	1	13.145	13.155	13.165	21 13.180	1 13.195
	2	13.145	13.155	13.165	22 13.180	2 13.195
	3	13.145	13.155	13.165	23 13.180	3 13.195
	4	13.145	13.155	13.165	24 13.180	4 13.195
	5	13.145	13.155	13.165	25 13.180	5 13.195
	6	13.145	13.160	13.165	26 13.180	6 13.195
	7	13.145	13.160	13.165	27 13.180	7 13.195
	8	13.145	13.160	13.165	28 13.180	8 13.195
	9	13.145	13.160	13.165	29 13.180	9 13.195
	10	13.145	11.10 13.160	12.50 13.165	14.30 13.180	16.10 13.195
	12	13.145	13.160	13.165	32 13.180	12 13.195
	14	13.145	13.160	13.165	34 13.180	14 13.200
	16	13.145	13.160	13.165	36 13.180	16 13.200
	18	13.150	13.160	13.165	38 13.180	18 13.200
	20	13.150	13.160	13.165	40 13.180	20 13.200
	25	13.150	13.160	13.170	45 13.180	25 13.200
	30	13.150	13.160	13.10 13.170	50 13.180	30 13.200
	35	13.150	13.160	13.15 13.170	55 13.180	35 13.200
	10.00 40	13.150	11.40 13.160	13.20 13.170	15.00 13.180	16.40 13.200
	45	13.150	13.160	13.25 13.170	5 13.180	45 13.200
	50	13.150	13.160	30 13.170	10 13.185	50 13.200
	55	13.155	13.160	55 13.170	15 13.185	55 13.200
	10.20 60	13.155	13.160	4. 13.175	20 13.185	17.00 13.200
	70	13.155	13.160	50 13.175	30 13.190	10 13.200
	80	13.155	13.165	14.00 13.175	40 13.190	20 13.205
	90	13.155	13.165	14.10 13.175	50 13.195	30 13.205
	00	13.155	12.40 13.165	14.20 13.175	16.00 13.195	17.40 13.205

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge - 7 Day Constant Rate Testing

Date:	27-7-18		R619	**Weather**
Constant Rate	**Flow rate (l/s)** 0.460		[redacted]	Dry, warm high cloud → hot

Time (hh:mm)	**Elapsed Time**					
10:00	0	13.170	12:00	120	13.209	
	1	13.175		140	13.210	
	2	13.175		160	13.215	
	3	13.180	13:00	180	13.215	
	4	13.180		200	13.220	
	5	13.180		220	13.220	
	6	13.180	14:00	240	13.220	
	7	13.180		260	13.225	
	8	13.180		280	13.225	
	9	13.185	15:00	300.	13.230	
	10	13.185	15:50	350	13.230	
	12	13.185	16.40	400	13.235	
	14	13.185	17:30			
	16	13.190	DATE	TIME	ELAPSED TIME	WL
	18	13.190	SAT 28/7/18	09:24	1404	13.295
	20	13.190		12:44	1604	13.300
	25	13.190		16:05	1805	13.310
10:30	30	13.190	SUN 29/7/18	08:45	2805	13.335
	35	13.190		12:03	3003	13.340
	40	13.190		15:25	3205	13.340
	45	13.195	MON 30/7/18	08:05	4205	13.360
	50	13.195		09:44	4304	13.365
	55	13.195		11:26	4406	13.365
11:00	60	13.195		13:04	4504	13.365
	70	13.200		14:44	4604	13.370
	80	13.200		16:21	4701	13.370
	90	13.200	TUES 31/7/18	09:04	5704	13.385
	100	13.205		10:43	5803	13.385
				12:25	5905	13.390
				14:14	6014	13.390
				15:43	6103	13.390

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge - 7 Day Constant Rate Testing

Date: START	27/7/18	WELL	619	Weather
Constant Rate	Flow rate (l/s) 5.8 LPS			

Time (hh:mm)	Elapsed Time	DATE	WL			
17:25	6205	TUES 31/7/18	13.395			
08:22	7102	WED 1/8/18	13.410			
10:03	7203		13.410			
11:44	7304		13.410			
13:24	7404		13.410			
15:03	7503		13.410			
16:44	7604		13.415			
09:24	8604	THURS 2/8/18	13.430			
11:04	8704		13.430			
12:44	8804		13.430			
14:24	8904		13.435			
16:02	9002		13.430			
17:44	9104		13.435.			
08:43	100003	FRI 3/8/18	13.450			
10:00	10080		13.458			

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge recovery test

Date:	03/08/18	GW 614		Weather
Constant Rate	Flow Rate (l/s)			Clear, Sunny, Hot

Time (hh:mm)	Elapsed Time	WL	TIME	ELAPSED TIME	WL.	
10:00	0	13.458	13:00	180	13.412	
10:01	1	13.458		200	13.408	
10:02	2	13.458		220	13.405	
	3	13.458	14:00	240	13.405	
	4	13.456		260	13.404	
	5	13.454		280	13.402	
	6	13.454	15:00	300	13.402	
	7	13.453	15:50	350		
	8	13.452	16:40	400		
	9	13.449	17:30	450		
10:10	10	13.449	18:20	500		
	12	13.446				
	14	13.444				
	16	13.443				
	18	13.442				
10:20	20	13.440				
	25	13.436				
	30	13.43[illegible]				
	35	13.432				
10:40	40	13.431				
	45	13.430				
	50	13.429				
	55	13.428				
11:00	60	13.427				
11:11	70	13.424				
	80	13.422				
11:30	90	13.419				
	100	13.418				
12:00	120	13.417				
	140	13.416				
	160	13.414				

Weather / Comments:

Stuart Well Services Ltd

STEP TEST

SWC6161 Stonehenge - ~~7 Day Constant Rate Testing~~

Date:	26 July 2018	Obs. Well		**Weather**
~~Constant Rate~~	Flow rate (l/s) Pumping well W617.	R620		Sunny, Dry, Hot

Time (hh:mm)	Elapsed Time	Step 1 2 l/s	Step 2 3 l/s	Step 3 5 l/s	Step 4 6 l/s	Step 5 ~7 l/s
09:20	0	13.04	13.320	13.52.	13.94	14.160
	1	~~[illegible]~~	13.332	13.545	13.96.	14.162
	2	13.155	13.37	13.605	13.985	14.170
	3	13.18	13.387	13.650	14.005	14.180
	4	13.195	13.402	13.685	14.025	14.190
	5	13.205	13.412	13.715	14.040	14.195
	6	13.215	13.425	.74	.045	14.20
	7	13.220	13.432	.755	.055	14.202
	8	13.225	13.438	.770	.060	14.210
	9	13.230	13.44	.78	.065	14.210
	10	13.235	13.445	X	.07	14.215
	12	13.240	13.45	.805	.08	14.220
	14	13.245	13.46	.820	.085	14.225
	16	13.250	13.46	.83	.09	14.230
	18	13.255	13.463	.84	.095	14.232
	20	13.260	13.465	.845	.100	.235
	25	13.265	13.470	.86	.105	.240
	30	13.272	13.48.	.87	.110	.245
	35	13.280	36min 13.48.	.88	.115	.25
	40	13.285	13.485	.89	.120	.25
	45	13.290	13.49.	.895	.125	.255
	50	13.295	13.495	.903	.130	.257
	55	13.300	13.497	58min .910	.135	.260
	60	13.300	13.50	.910	.137	.263
	70	13.305	13.505	.922	.145	.265
	80	13.312	13.510	.930	.150	.27
	90	13.315	13.515	.935	.155	.273
	100	13.320	13.52.	13.94	14.160	14.277

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge - 7 Day Constant Rate Testing

Date:	27/07/2018	Pump Well	Obs Well	Weather
Constant Rate	Flow rate (l/s) ~ 5.8 l/s.	W617	R620	Dry, Sunny, Overcast.

Time (hh:mm)	Elapsed Time	WL mbgp.	Elapsed Time			
10:00	0	13.060	(14:00) 240	14.190.		
	1	13.280	260	14.195		
	2	13.40	280	14.20		
	3	13.480	(15:00) 300	14.203.		
	4	13.555	350	14.210		
	5	13.615	400	14.230		
	6	13.660	450			
	7	13.690				
	8	13.715	DATE	TIME	ELAPSED TIME	WL.
	9	13.745	SAT 28/7/18	09:21	1401	14.310
	10	13.765		12:41	1601	14.325
	~~15~~	* See notes. 10→20		16:01	1801	14.330
	20	13.890	SUN 29/7/18	08:42	2802	14.350
	25	13.925		12:01	3001	14.355
	30	13.960		15:22	3202	14.360
	35	13.98	MON 30/7/18	08:01	4201	14.375
	40	14.00		09:41	4301	14.375
	45	14.015		11:23	4403	14.375
	50	14.025		13:01	4501	14.375
	55	14.035		14:42	4602	14.375
11:00	60	14.045		16:21	4701	14.380
	70	14.065.	TUES 31/7/18	09:01	5701	14.390
	80	14.075		10:41	5801	14.390
	90	14.090		12:22	5901	14.390
11:40	100	14.100		14:11	6011	14.395
12:00	120	14.120		15:41	6101	14.395
	140	14.138		17:21	6201	14.395
	160	14.153.	WED 1/8/18	08:22	7102	14.425
13:00	180	14.175		10:01	7201	14.425
	200	14.182.		11:41	7301	14.425
	220			13:21	7401	14.420

Weather / Comments:
12 min: 13.800
14 min: 13.830
16 min: 13.855
18 mins: 13.875

Stuart Well Services Ltd

SWC6161 Stonehenge - 7 Day Constant Rate Testing

Date: START	27/7/18	BH	620	Weather
Constant Rate	Flow rate (l/s) 5-8LPS			

Time (hh:mm)	Elapsed Time	WL	DATE			
15:01	7501	14.425	WED 1/8/18			
16:41	7601	14.425				
09:21	8601	14.440	THURS 2/8/18			
11:01	8701	14.440				
12:41	8801	14.445				
14:21	8901	14.445				
16:01	9001	14.445				
17:41	9101	14.445				
08:40	10000	14.460	FRI 3/8/18			
10:00	10080	14.465				

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge recovery test

Date:	3. Aug 2018	R620	obs.	Weather
Constant Rate	Flow Rate (l/s)			Dry, Sunny

Time (hh:mm)	Elapsed Time	WL	TIME	ELAPSED TIME	WL.	
10.00	0	14.465	13:00	180	~~[illegible]~~	
	1	14.460		200	13.38	
	2	14.445		220	13.37	
	3	14.415	14:00.	240	13.36	
	4	14.380		260	13.355	
	5	14.305		280	13.350	
	6	14.195	15:00	300	13.35	
	7	14.090		350		
	8	13.990		400		
	9	13.905		450		
	10	13.840		500		
	12	13.765				
	14	13.725				
	16	13.700				
	18	13.675				
	20	13.660.				
	25	13.620				
	30	13.590				
	35	13.570				
	40	13.552				
	45	13.535				
	50	13.525				
	55	13.512				
11:00	60	13.500				
	70	13.485				
	80	13.465				
11.30	90	13.455				
	100	13.445				
12:00	120	13.425				
	140	13.410				
	160	13.395				

Weather / Comments:

1- 1m to 10min
2m to 20m
5m to 1hr
10m to 100min

Stuart Well Services Ltd

SWC6161 Stonehenge - step tests

Well location ref:	RX621	Step Test		Weather
Date:	26/7/18-9.20	Step No		SUNNY-DRY (25°-30°)
TOC to GL (m)		Flow Rate (l/s)		

Time (hh:mm)	Elapsed Time	9.20 STEP 1	11.00 STEP 2	12.40 STEP 3	14.20 STEP 4	16.00 STEP 5
0		13478	13527	13569	13632	13684
1		13479	13528	13569	13633	13684
2		13479	13529	13571	13634	13685
3		13481	13530	13572	13635	13685
4		13482	13531	13575	13636	13686
5		13485	13532	13577	13637	13686
6		13485	13533	13577	13638	13688
7		13487	13534	13578	13638	13688
8		13487	13535	13579	13639	13689
9		13488	13535	13580	13639	13690
10		13489	13535	13581	13640	13691
12		13489	13537	13582	13643	13692
14		13490	13538	13584	13644	13693
16		13492	13540	13586	13645	13694
18		13494	13541	13588	13647	13695
20		13498	13541	13590	13648	13697
25		13499	13543	13594	13649	13700
30		13502	13546	13597	13652	13702
35		13504	13548	13599	13655	13704
40		13507	13550	13602	13657	13705
45		13508	13552	13604	13660	13707
50		13510	13553	13607	13661	13709
55		13512	13555	13611	13664	13712
60		13514	13557	13612	13666	13715
70		13518	13560	13617	13671	13719
80		13521	13563	13621	13675	13723
90		13524	13566	13625	13679	13727
100		13527	13569	13632	13684	13728

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge - 7 Day Constant Rate Testing

Date:	27/7/18	BH		**Weather**
Constant Rate	**Flow rate (l/s)** 5.8LPS	RX621		SUNNY/CLOUDY

Time (hh:mm)	**Elapsed Time**	WL		ELAPSED TIME	WL.	
10.00	0	13500		180	13 712	
	1	13523		200	13 727	
	2	13 527		220	13736	
	3	13530		240	13 739	
	4	13 537		260	13746	
	5	13 544		280	13751	
	6	13 544		300	13 758	
	7	13 547		350	13·790	15:51HRS
	8	13 549		400	13·820	16:41HRS
	9	13 552	DATE	TIME	ELAPSED TIME	WL
	10	13 5 54	SAT 28/7/18	09:29	1409	13·870
	12	13 563		12:47	1607	13·880
	14	13567		16:09	1809	13·880
	16	13 570	SUN 29/7/18	08:47	2807	13·925
	18	13 573		12:06	3006	13·930
	20	13577		15:29	3209	13·950
	25	13585	MON 30/7/18	08:07	4207	13·950
	30	13592		09:46	4306	13·950
	35	13598		11:29	4409	13·955
	40	13604		13:07	4507	13·955
	45	13610		14:47	4607	13·960
	50	13618		16:24	4704	13·960
	55	13621	TUES 31/7/18	09:07	5707	13·975
	60	13627		10:45	5805	13·980
	70	13639		12:26	5906	13·980
	80	13647		14:15	6015	13·980
	90	13656		15:46	6106	13·980
	100	13664		17:27	6207	13·980
	120	13678	WED 1/8/18	08:26	7106	14·000
	140	13693		10:05	7205	14·000
	160	13704		11:46	7306	14·000

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge - 7 Day Constant Rate Testing

Date: START	27/7/18	BH	621	Weather
Constant Rate	Flow rate (l/s) 5-8LPS			

Time (hh:mm)	Elapsed Time	WL	DATE			
13:26	7406	14.000	WED 1/8/18			
15:05	7505	14.005				
16:46	7606	14.005				
09:27	8607	14.020	THURS 2/8/18			
11:06	8706	14.020				
12:46	8806	14.020				
14:26	8906	14.020				
16:03	9003	14.025				
17:46	9106	14.025				
08:45	10005	14.040	FRI 3/8/18			
10:00	10080	14.040				

Weather / Comments:

Stuart Well Services Ltd

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SWC6161 Stonehenge recovery test

Date:	3/8/18			Weather
Constant Rate	Flow Rate (l/s)	RX621 I FOSTER		SUNNY/HOT

Time (hh:mm)	Elapsed Time	WL	TIME	ELAPSED TIME	WL.	
10:00	0	14.040	12:00	180	13.822	
	1	14.040	12:20	200	13.812	
	2	14.039	12:40	220	13.805	
	3	14.038	14:00	240	13.800	
	4	14.036	14:20	260	13.794	
	5	14.034	14:40	280	13.789	
	6	14.031	15:00	300	13.785	
	7	14.026	15:50	350		
	8	14.021	16:40	400		
	9	14.017	17:30	450		
	10	14.013	18:20	500		
	12	14.003				
	14	13.997				
	16	13.991				
	18	13.984				
	20	13.978				
	25	13.966				
	30	13.955				
	35	13.944				
	40	13.935				
	45	13.927				
	50	13.918				
	55	13.913				
11:00	60	13.906				
	70	13.894				
	80	13.885				
	90	13.875				
	100	13.865				
12:00	120	13.853				
12:20	140	13.841				
12:40	160	13.830				

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge - step tests

Troy EDWARDS.

Well location ref:	RX 622.	Step Test		Weather
Date:	26 July 18	Step No		Sunny. 09:20
TOC to GL (m)		Flow Rate (l/s)		

14.290 | 14.270

Time (hh:mm)	Elapsed Time	1	2	3	2.20 pm. 4	5 4:00pm
1	14.290	14.270	14.280	14.290	14.300	14.320
2	14.290	14.270	14280	14.290	14.305	14.320
3		14.275	14.280	14.290	14.305	14.320
4		14.280	14.280	14.290	14.305	14.320
5		14.280	14 285	14.290	14.305	14.320
6		14.280	14.285	14.290	14.305	14.320
7		14.280	14 285	14.290	14.305	14.320
8		14.280	14285	14.290	14.305	14.320
9		14.280	14.285	14.290	14.305	14.320
10		14.280	14.285	14.290	14.305	14.320
12		14.280	14.285	14.290	14.310	14.320
14		14.280	14 285	14.290	14.310	14.320
16		14.280	14 285	14.290	14.310	14.320
18		14.280	14 285	14.290	14.310	14.325
20		14.280	14.285.	14.290	14.310	14.325
25		14.280	14.285	14.290	14 310	14.325.
30		14.280	14.285	14.290	14.310	14.325
35		14.280	14.285	14.290	14 310	14.325.
40		14.280	14.285	14.295	14.310	14 325.
45		14.280	14.285	14.295	14 315	14.325
50		14.280	14.285	14.295	14 315.	14.325
55		14.280	14.285	14.295	14.315	14.325
60	10.20	14.280	14.285	14.295	14.320	14.325 5.00
70		14.280	14.285	14.295	14.320	14.325
80		14.280	14.285	14.300	14.320	14.325
90		14.280	14.285	14.300	14.320	14.330
100	11.00	14.280	14 290	14.300	14.320	14.330
				[illegible]	4.00pm.	Finish
				2.20pm		5.40pm.

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge - 7 Day Constant Rate Testing

Date:	27/7/18			Weather
Constant Rate	Flow rate (l/s)	WELL NO	RX 622	
		Troy Edwards		

Time (hh:mm)	Elapsed Time	WL	TIME	ELAPSED TIME	WL.	
10.00	0	14.305	13.00	180	14.345	
10.01	1	14.305	13.20	200	14.350	
10.02	2	14.305	13.40	220	14.350	
10.03	3	14.305	14.00	240	14.355	
10.04	4	14.305	14.20	260	14.355	
10.05	5	14.305	14.40	280	14.360	
10.06	6	14.305	15.00	300	14.365	
10.07	7	14.305	15.50	350	14.370	
10.08	8	14.310	16.40	400	14.375	
10.09	9	14.310				
10.10	10	14.310	DATE	TIME	ELAPSED TIME	WL.
10.12	12	14.310	SAT 28/7/18	09:36	1416	14.455
10.14	14	14.310		12:50	1610	14.465
10.16	16	14.310		16:11	1811	14.470
10.18	18	14.310	SUN 29/7/18	08:50	2810	14.505
10.20	20	14.310		12:08	3008	14.510
10.25	25	14.310		15:31	3211	14.510
10.30	30	14.310	MON 30/7/18	08:10	4210	14.535
10.35	35	14.315		09:48	4308	14.535
10.40	40	14.315		11:31	4411	14.535
10.45	45	14.315		13:08	4508	14.535.
10.50	50	14.315		14:49	4609	14.535
10.55	55	14.320		16:28	4708	14.540
11.00	60	14.320	TUES 31/7/18	09:09	5709	14.555
11.10	70	14.320		10:46	5806	14.555
11.20	80	14.325		12:28	5908	14.555
11.30	90	14.325		14:17	6007	14.560
11.40	100	14.330		15:47	6107	14.560
12.00	120	14.335		17:30	6210	14.560
12.20	140	14.340	WED 1/8/18	08:27	7107	14.575
12.40	160	14.340		10:07	7207	14.575

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge - 7 Day Constant Rate Testing

Date: START	27/7/18	BH	622	Weather
Constant Rate	Flow rate (l/s) 5.8 LPS			

Time (hh:mm)	Elapsed Time	WL	DATE			
11:47	7307	14.580	WED 1/8/18			
13:28	7408	14.580				
15:07	7507	14.580				
16:48	7608	14.580				
09:28	8608	14.600	THURS 2/8/18			
11:08	8708	14.600				
12:47	8807	14.600				
14:27	8907	14.600				
16:04	9004	14.600				
17:47	9107	14.600				
08:46	100006	14.620	FRI 3/8/18			
10:00	10080	14.620				

Weather / Comments:

Stuart Well Services Ltd

SWC6161 Stonehenge recovery test

Ph1.

Date:	03/07/2018			Weather
Constant Rate	Flow Rate (l/s)			R622

Time (hh:mm)	Elapsed Time	WL	TIME	ELAPSED TIME	WL.	
1000	0	14.620.		180	14.580	
	1	14.620		200	14.575	
	2	14.620.		220	14.570	
	3	14.620		240	14.565	
	4	14.620.		260	14.560	
	5	14.620.		280	14.560	
	6	14.620		300	14.555	
	7	14.620		350		
	8	14.620.		400		
	9	14.620		450		
1010	10	14.620.		500		
	12	14.620.				
	14	14.620				
	16	14.620.				
	18	14.615				
	20	14.615.				
	25	14.615.				
	30	14.615				
	35	14.615.				
	40	14.610.				
	45	14.610.				
11	50	14.610.				
	55	14.610.				
	60	14.605				
	70	14.605.				
	80	14.605				
	90	14.605				
1140	100	14.600				
1200	120	14.590				
1220	140	14.585				
	160	14.580				

Weather / Comments:

Carl: [illegible] ~~0117~~

Tom: 0117 [illegible]

Stuart Wells Limited

WATER QUALITY.

SWC6161 Stonehenge ~~Pre-test water levels~~

Date	Time	PH	PS	PPM	TEMP.			
27/7/18	16:40	7·13	596	300	13·6			
28/7/18	09:20	7·37	586	293	12·4			
	12:40	7·25	587	294	13·3			
	16:00	7·4	595	298	14·1			
29/7/18	08:40	7·44	576	288	12·6			
	12:00	7·35	580	290	12·6			
	15:20	7·31	588	294	13·0			
30/7/18	08:00	7·42	581	291	12·5			
	09:40	7·26	585	292	13·1			
	11:20	7·26	584	295	13·5.			
	13:00	7·21	583	292	13·3			
	14:40	7·27	592	295	13·2			
	16:20	7·21	591	296	14·0			
31/7/18	09:00	7·40	578	289	13·6			
	10:40	7·23	591	295	14·0			
	12:20	7·25	582	290	14·9			
	14:10	7·02	592	292	15·1			
	15:40	7·22	586	290	13·8			
	17:20	7·28	587	292	13·8			
1/9/18	08:20	9·44	575	288	13·0			
	10:00	7·21	584	292	13·5			
	11:40	7·18	584	291	13·7			
	13:20	7·18	582	293	14·7			
	15:00	7·21	586	294	14·1			
	16:40	7·17	583	291	14·6			
2/8/18	09:20	7·30	582	293	14·0			
	11:00	7·15	587	295	14·4			
	12:40	7·10	586	294	15·3			
	14:20	7·10	587	293	16·0			
	16:00	7·17	583	294	14·9			
	17:40	7·22	588	294	14·2			

Weather / Comments:

3/8/18 08:40 7·39 590 295 14·1