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Forsmark site investigation

Geophysical borehole logging in boreholes KFM11A and KFM90B

Uffe Torben Nielsen, Jørgen Ringgaard
RAMBØLL

May 2007

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Abstract

Geophysical borehole logging has been performed in borehole KFM11A and Acustic Televiewer logging in KFM90B. Both boreholes are situated in Forsmark, Sweden.

The objective of the survey is to determine the physical properties of the rock mass around the borehole, e.g. to determine rock types and quantify the fracture frequency and localise deformation zones in the rock. Geophysical borehole logging was used to measure changes in physical properties in the borehole fluid and the bedrock surrounding the boreholes.

Both boreholes were recorded from Top Of Casing (TOC). The logging in KFM11A was recorded to approximately 850 m and KFM90B was recorded to approximately 17.85 m.

The present report comprises a description of the applied equipment and the performed logging program, the fieldwork, data delivery and a presentation and discussion of the results.

Composite sheets of all the processed logs are included in Appendices 1–2.

Sammanfattning

Geofysisk borrhålsloggning har genomförts i borrhålet KFM11A och Acustic Televiewer loggning i KFM90B i Forsmark.

Syftet med geofysisk borrhålsloggning är att bestämma bergets fysikaliska egenskaper för att bestämma bergartsfördelningen i det genomborrade bergpartiet samt att kvantifiera sprickfrekvensen och att lokalisera deformationszoner. Med geofysisk borrhålsloggning mäts bergets och borrhålsvattnets fysikaliska egenskaper i borrhålet och omgivande berg.

Den geofysiska borrhålsloggningen genomfördes i KFM07C från TOC till ca. 850 m och Acustiv Televiewer loggning i KFM90B från TOC till 17,85 m.

Rapporten beskriver använd utrustning, genomfört loggningsprogram, fältarbete, leverans av data och en diskussion av resultatet.

Processerade loggar presenteras i Appendix 1–2.

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1 Introduction

This document reports the results gained by the geophysical borehole logging in boreholes KFM11A and KFM90B, which is one of the activities performed within the site investigation at Forsmark. The work was carried out in accordance with activity plan AP PF 400-06-103 (SKB internal controlling document). In Table 1-1 controlling documents for performing this activity are listed.

All measurements were conducted by RAMBØLL during the period November 21 to 23, 2006. The boreholes were recorded from Top Of Casing (TOC) to the bottom of the borehole. The technical data from the boreholes is shown in Table 1-2. Figure 1-1 shows the location of KFM11A and Figure 1-2 the location of KFM90B. A technical description ov borehole KFM11A is presented in Figure 1-3.

The delivered raw and processed data have been inserted in the database of SKB (SICADA) and data are traceable by the activity plan number.

Original data from the reported activity are stored in the primary database Sicada. Data are traceable in Sicada by the Activity Plan number (AP PF 400-06-103). Only data in databases are accepted for further interpretation and modelling. The data presented in this report are regarded as copies of the original data. Data in the databases may be revised, if needed. Such revisions will not necessarily result in a revision of the P-report, although the normal procedure is that major revisions entail a revision of the P-report. Minor revisions are normally presented as supplements, available at *www.skb.se*.

Table 1-1. Controlling documents for performing the activity (SKB internal controlling documents).

Activity plan	Number	Version
Geofysisk borrhålsloggning i KFM11A ver 1.0.doc	AP PF 400-06-103	1.0
Method descriptions	**Number**	**Version**
Metodbeskrivning för geofysisk borrhålsloggning	SKB MD 221.002	2.0
Metodbeskrivning för krökningsmätning av hammar- och kärnborrhål	SKB MD 224.001	1.0

Table 1-2. Technical data for borehole KFM11A and KFM90B.

Borehole parameter	KFM11A	KFM90B
Co-ordinates (RT90)	6701103.815 1632366.746	6700065.591 1631008.894
Elevation (RHB70)	2.954	–0.553
Inclination (from horizontal)	–40.25°	–81.85
Azimuth	–60.86°	261.66
Length [m]	851.15	18.20
Casing [m]	71.06	0
Borehole diameter [mm]	77.3	77.0
Cleaning level	Level 2	

Figure 1-1. *The location of borehole KFM11A and a general overview over the Forsmark area.*

Figure 1-2. *The location of borehole KFM90B and a general overview over the Forsmark area.*

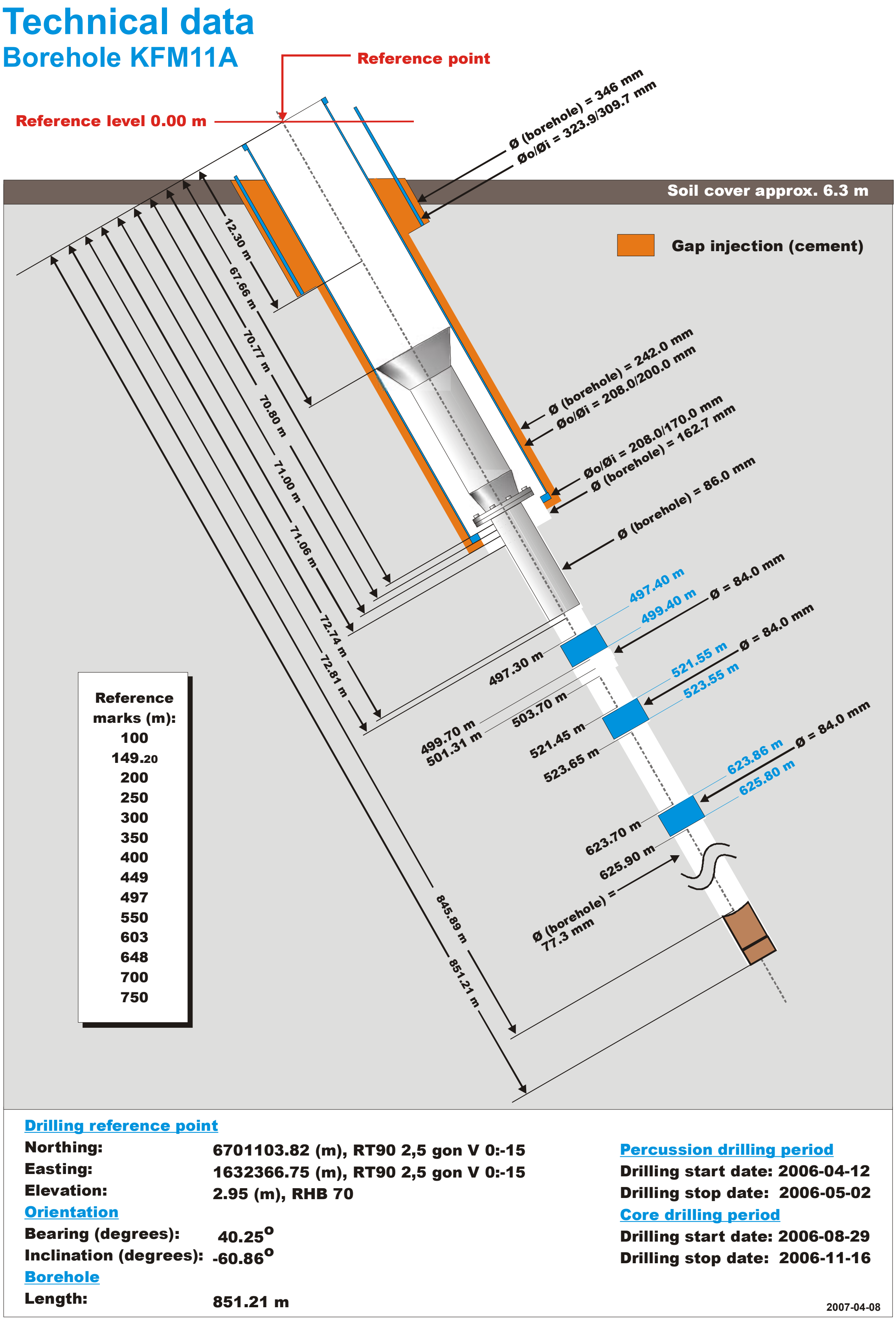

Figure 1-3. *Technical description of borehole KFM11A.*

2 Objective and scope

The objective of the survey is to both receive information of the borehole itself, and from the rock mass around the borehole. Geophysical borehole logging was used to measure changes in physical properties in the borehole fluid and the bedrock surrounding the boreholes. Acoustic televiewer was used for determination of the deviation of the borehole (azimuth and inclination) as well as to determine the length marks in the core-drilled boreholes, KFM11A.

This field report describes the equipment used as well as the measurement procedures. Geophysical borehole logging data is presented in graphs as a function of depth on drawings shown in Table 2-1.

Table 2-1. Appendix and drawing number.

Borehole	Drawing no.	Appendix
KFM11A	1.1	1
KFM90B	2.1	2

3 Equipment

The geophysical borehole logging program were performed with 7 multi tool probes and resulted in a suite of 16 log types, listed in Table 5-1. The tools and recorded logs are listed in Table 3-1.

Table 3-1. Logging tools and logs recorded.

Tool	Recorded logs	Dimension	Source detector spacing and type	Tool position in borehole	Tool used in borehole
Century 8144 Normal resistivity	Normal resistivity (16 and 64 inch), single point resistance and natural gamma.	237·5.3 cm			KFM11A
Century 8622 Magnetic susceptibility.	Magnetic susceptibility, natural gamma.	203·4.1 cm			KFM11A
Century 9042 Fluid temperatur and fluid resistivity.	Fluid temperatur, fluid resistivity and natural gamma.	137·4.1 cm			KFM11A
Century 9072 3 m focused guard.	3 m focused guard log resistivity and natural gamma.	310·6.4 cm			KFM11A
Century 9139 Compensated gamma density.	Compensated Gamma density, natural gamma, 140 cm focused guard log resistivity, 1-arm caliper.	380.3·5.6 cm	20.3 cm 125 m 200 mCi Cs137	Sidewall. Gamma source focused.	KFM11A
Century 9310 Sonic.	Full wave form travel-time providing P and S-wave velocity picking, compensated P-wave travel-time and natural gamma.	300·6.0 cm	Near 91.4 cm Far 121.9 cm	Centralized.	KFM11A
RG 25 112 000 HiRAT. Acoustic tel-eviewer.	Full waveform acoustic amplitude and travel-time, 360° orientated acoustic image, 360° very high resolution caliper, borehole azimuth and dip and natural gamma.	246·4 cm		Centralized.	KFM11A, KFM90B

4 Execution

4.1 General

In general the measurement procedures follow the SKB method description (MD 221.002, SKB internal controlling document). The logging program was executed in the period November 21 to 23, 2006. All relevant logging events are described in the daily report sheets delivered to SICADA and are traceable by the activity plan number.

The fluid resistivity and temperature logs are recorded in downward direction, as the first log run. All other log types are recorded running the tool in upward direction in the borehole.

The applied logging equipment was calibrated and cleaned before arriving at the site according to SKB cleaning level 2 (SKB internal controlling document SKB MD 600.004). Furthermore, all equipment was wiped with alcohol before it was lowered into the borehole.

For control, each log run is normally recorded both in down and in upward direction using the down run as a repeat section. For logging tool 9139 recording a repeat section in upward direction controls the data. The depth of the probe in the borehole is shown on both the recording computer and the winch. On the winch the tension of the cable is also shown. The winch will automatically stop, if the tension changes rapidly. The tension was recorded on all log runs using Century equipment, except tool 9310.

All data was recorded with max.10 cm sample interval. The speed of the logging for the 9139 tool was 5 m/min, for the 8622 tool 20 m/min and for all other tools 10 m/min, except for the HiRAT Acoustic tool in borehole where the speed was 2 m/min.

4.2 Nonconformities

The logging of KFM90B with Acustic Televiewer was not described in the activity plan AP PF 400-06-103. The logging of KFM11A has been performed in accordance with the activity plan.

5 Results

5.1 Presentation

All relevant logging events were described in the daily report sheets, which were delivered separately.

Logs presented in drawings no. 1.1–2.1 (Appendices 1 and 2) are presented in Table 5-1.

5.2 Orientation, alignment and stretch of logs

5.2.1 Orientation of images

The orientation of the results from the HiRAT Acoustic tool, are processed in the tool while recording, using the magnetometers and accelerometers in the tool.

5.2.2 Overlapping data

If the log data from one probe have been recorded in more than one file, the files are merged using events in both files. Overlapping in data is always used from the topmost-recorded file (overlapping data are never the mean value from two log runs).

Table 5-1. Logs presented in drawings no. 1.1 and 2.1 in Appendices 1 and 2.

Log	Log name short	Unit	Tool	Recorded/ calculated in borehole
Fluid temperature	TEMP(FL)	Deg C	9042	KFM11A
Fluid resistivity	RES(FL)	Ohm-m	9042	KFM11A
Normal resistivity 16 inch	RES(16N)	Ohm-m	8144	KFM11A
Normal resistivity 64 inch	RES(64N)	Ohm-m	8144	KFM11A
Lateral resistivity	LATERAL	Ohm-m	8144	KFM11A
Single point resistance	SPR	Ohm	8144	KFM11A
Self potential	SP	mV	8144	KFM11A
Magnetic susceptibility	MAGSUSCEP	$SI \cdot 10^{-5}$	8622	KFM11A
Caliper, 1-arm	CALIPER1	mm	9139	KFM11A
Gamma-gamma density	DENSITY	kg/m^3	9139	KFM11A
Focused guard log resistivity, 127 cm	RES(SG)	Ohm-m	9139	KFM11A
Natural gamma	GAM(NAT)	μR/h	9072	KFM11A
Natural gamma	GAM(NAT)	μR/h	HIRAT	KFM11A
Focused guard log resistivity, 300 cm	RES(DG)	Ohm-m	9072	KFM11A
P-wave velocity	P-VEL	m/s	9310	KFM11A
Full wave form, near receiver	AMP(N)	μs	9310	KFM11A
Full wave form, far receiver	AMP(F)	μs	9310	KFM11A
Caliper, high resolution. 360°	CALIPER 3D	mm	HiRAT	KFM11A, KFM90B
High resolution 1D Caliper	CALIPER MEAN	mm	HiRAT	KFM11A, KFM90B
Borehole azimuth magnetic north	AZIMUTH MN	Deg	HIRAT	KFM11A
Borehole inclination from horizontal	DIP	Deg	HIRAT	KFM11A
360° orientated acoustic travel time	TRAVEL TIME	100 ns	HiRAT	KFM11A, KFM90B
360° orientated acoustic travel time	AMPLITUDE	–	HiRAT	KFM11A, KFM90B

5.2.3 Alignment of data

In order to obtain an exact depth calibration, the track marks made while drilling are used. In boreholes without track marks, gamma events in the top and the bottom of the borehole are used. The connection between the track marks and the logs is obtained from the HiRAT Acoustic tool. The depths from the track marks and from the HiRAT tool are used to make a new depth scale in WellCAD. All log files are shifted using the new depth scale.

5.2.4 Stretch of logs

There is a minor difference in the depth registration between up- and down runs for the used winch. The size of the defect is about 1.5 m/km. To compensate for this the logs are stretched using another new depth scale for each tool. The depth scale is made by using gamma events from the tool compared with the same gamma events from the HiRAT tool. The events in both files are matched, and the new depth scale is made and added to the log. The bottom of the borehole is considered in stretching the logs in case that no data will occur below the bottom of the borehole.

5.2.5 Removing of data

The processing of the data includes removing of spikes, negative and unrealistic values and data in the casing.

5.2.6 Repicking of sonic log

The sonic velocity is normally calculated using an automatic picking routine in the sonic tool, 9310. In inclined boreholes the routine is often picking the wrong arrivals, due to so-called “road noise”. Therefore the sonic logs have been manually repicked in WellCAD using the full wave signal.

5.3 Calculated log curves

The different logs are calculated as described in Table 5-2.

5.3.1 Calculation of coordinates

To convert the measured azimuth and inclination to grid-coordinates, one needs to take into account the magnetic declination at the site at the time of data acquisition. The actual declination was found by means of the current International Geomagnetic Reference Field (IGRF). Disturbances from solar storms etc. were not taken into account. By means of the “Radius Of Curvature” method implemented in WellCad, the azimuth and inclination were converted to northing, easting and TVD coordinates relative to the top of the borehole. In the same calculation, the magnetic declination was added. Finally, the relative coordinates were added to the given coordinate in RT90 for the top of the borehole. The coordinates were calculated from 5 m below the casing bottom.

Table 5-2. Calculated log curves.

Log	Description of log calculation
Caliper, 1-arm	The Caliper was converted from [cm] to [mm] units by multiplying [cm] with 10.
Gamma-gamma density	The Gamma-gamma was converted from [g/cm^3] to [kg/m^3] units by multiplying with 1000.
Focused guard log resistivity, 140 cm	–
Natural gamma	The natural gamma log was converted from CPS to μR/h by multiplying the constant 0.077. This constant was computed from the logs previously performed in borehole KLX02 located in Oskarshamn.
Fluid temperature	–
Fluid resistivity	–
Normal resistivity 16 inch	–
Normal resistivity 64 inch	–
Lateral resistivity	–
Single point resistance	–
Self-potential	The SP value was converted from [mV] to [V] by dividing with 1,000.
Focused guard log resistivity, 300 cm	–
P-wave velocity	The P-VEL velocity is calculated using the difference in distance between the far and near receiver divided by time difference between the first arrival from the far and near signal. (121.9 cm– 91.4 cm)/(Time(far)–Time(near)).
Full wave form, near receiver	–
Full wave form, far receiver	–
Magnetic susceptibility	The magnetic susceptibility was converted from CGS units to SI units by multiplying the CGS value by 4π.
Caliper, high resolution. 360°. CALIPER 3D	The Caliper 3D is calculated using the acoustic travel time and the velocity in the borehole fluid. The velocity in the fluid is calculated using the fluid temperature and fluid conductivity.
High resolution 1D Caliper CALIPER MEAN	The Caliper mean is calculated using the mean travel time from the acoustic televiewer, the fluid temperature, fluid velocity and the internal travel time in the acoustic televiewer.
Borehole azimuth magnetic north	See 5.3.1
Borehole Inclination from lateral	See 5.3.1
360° orientated acoustic travel time	–
360° orientated acoustic amplitude	–

5.4 Borehole KFM11A

In order to obtain an exact depth calibration in borehole KFM11A, the reference track marks made while drilling are used. The correlation between the track marks and the logs is obtained from the HiRAT Acoustic tool.

The reference track marks in the borehole and the recorded track marks from the HiRAT are observed in the following depths, Table 5-3.

Table 5-3. The reference track marks in the borehole and the recorded track marks form the HiRAT in borehole KFM11A.

Reference mark	HiRAT recorded
72.77	72.770
100.00	100.177
149.20	149.512
200.00	200.473
250.00	250.610
300.00	300.832
350.00	350.900
400.00	401.026
449.00	450.261
497.00	498.449
550.00	551.569
603.00	604.765
648.00	650.011
700.00	702.109
750.00	752.394
801.00	n.a

To compensate for the difference between the reference track marks and the recorded track marks the logs are stretched. The result from the stretching is a new depth scale. The new depth scale is applied to the HiRAT file. In this way a perfect match between given depths of the reference marks and the recorded data is obtained. By means of alignment of the observed gamma events in KFM11A, between all log runs, the obtained reference mark correlation is transferred to the other logs.

The complete log suite for borehole KFM11A is presented as composite log sheets in drawing no. 1.1 in Appendix 1. The logs presented in drawing no. 1.1 are listed in Table 5-1.

5.5 Borehole KFM90B

Only the HiRAT probe has been recorded in the borehole KFM90B.

The complete log suite for borehole KFM90B is presented as a composite log sheet in drawing no. 2.1 in Appendix 2. The logs presented in drawing no. 2.1 are listed in Table 5-1.

6 Data delivery

Geophysical logging data from the measurements, recorded in Century and Robertson format, were delivered directly after the termination of the field activities. The recorded data files used in the processing have also been delivered in WellCAD format, Table 6-1.

The delivered data have been inserted in the database (SICADA) of SKB and are traceable by the activity plan number.

The processed files shown on the drawings have been delivered in WellCAD, Table 6-2, and as EXCEL files (one for each borehole) in SICADA format, Table 6-3.

Table 6-1. Recorded log files in Century or Robertson format used for processing.

Borehole	Probe	Log direction	WellCAD File	Description
KFM11A	8144	Up	kfm11a_11-23-06_07-44_8144C_.10_0.30_849.70_ORIG.log	Start: 849.7 m. End: 0.3 m.
KFM11A	8622	Up	kfm11a_11-22-06_15-35_8622C_.10_0.00_849.20_ORIG.log	Start: 849.2 m. End: 0 m.
KFM11A	9042	Down	kfm11a_11-22-06_07-28_9042C_.10_1.90_851.40_ORIG.log	Start: 1.9 m. End: 851.4 m.
KFM11A	9072	Up	kfm11a_11-22-06_17-01_9072C_.10_-2.40_845.20_ORIG.log	Start: 845.2 m. End: –2.4 m.
KFM11A	9139	Up	kfm11a_11-23-06_11-06_9139A_.10_0.30_847.70_ORIG.log	Start: 847.7 m. End: 0.3 m.
KFM11A	9310	Up	kfm11a_11-22-06_19-47_9310C2_.10_0.50_847.90_ORIG.log	Start: 847.9 m. End: 0.5 m.
KFM11A	9310	Down	kfm11a_11-22-06_18-26_9310C2_.10_1.50_848.30_ORIG.log	Start: 1.5 m. End: 848.3 m.
KFM11A	HiRAT	Up	KFM11A_HIRAT_180pixels_up_run2.HED	Start: 75 m. End: 0 m.
KFM11A	HiRAT	Up	KFM11A_HIRAT_180pixels_up_run3.HED	Start: 854 m. End: 600 m.
KFM11A	HiRAT	Up	KFM11A_HIRAT_180pixels_up_run1.HED	Start: 622 m. End: 60 m.
KFM90B	HiRAT	Up	KFM90B_HIRAT_180pixels_up_run1.HED	Start: 18.3 m. End : 0 m.

Table 6-2. Drawing files in WellCad format.

Borehole	Drawing	WellCad file
KFM11A	1.1	KFM11A_Presentation.WCL
KFM90B	2.1	KFM90B_Presentation.WCL

Table 6-3. Data files in SICADA format.

Sheet	Comment
KFM11A_CALIPER1_GP040 - Caliper logging.xls	KFM11A
KFM11A_CALIPER MEAN_GP041 - 3-D caliper.xls KFM90B_CALIPER MEAN_GP041 - 3-D caliper.xls	KFM11A, KFM90B
KFM11A_TEMP(FL)_RES(FL)_GP060 – Fluid temperature and resistivity logging.xls	KFM11A
KFM11A_DENSITY_GP090 – Density logging.xls	KFM11A
KFM11A_MAGSUSCEP_GP110 - Magnetic susceptibility logging.xls	KFM11A
KFM11A_GAM(NAT)_GP120 - Natural gamma logging.xls	KFM11A
KFM11A_SPR_GP150 - Single point resistance logging.xls	KFM11A
KFM11A_RES(64N)_GP160 - Resistivity, normal 1.6 m (64 in).xls	KFM11A
KFM11A_RES(MG)_GP161 - Resistivity, focused 140 cm.xls	KFM11A
KFM11A_RES(DG)_GP162 - Resistivity, focused 300 cm.xls	KFM11A
KFM11A_LATERAL_GP163 - Resistivity, lateral 1.6-0.1 m.xls	KFM11A
KFM11A_RES(16N)_GP164 - Resistivity, normal 0.4 m (16 in).xls	KFM11A
KFM11A_P-VEL_GP175 - Fullwave sonic.xls	KFM11A
KFM11A_GP830 - Acoustic televiewer.xls KFM90B_GP830 - Acoustic televiewer.xls	KFM11A, KFM90B
KFM11A_SP_GP180 - Self potential logging.xls	KFM11A

Appendix 1

Borehole KFM11A, drawing no. 1.1, borehole logs

Co-ordinates in RT90 2,5 gon V 0:-15

Northing: 6701103.82m Easting: 1632366.75m Elevation: 2.95m, RHB70

Diameter:	77.3mm
Reaming Diameter:	242mm
Outer Casing:	208mm
Inner Casing:	200mm
Casing Length:	72.77m
Borehole Length:	851.15m
Cone:	67.72 - 72.77m
Inclination at ground surface:	-60.86°
Azimuth:	40.25° GN
Comments:	

Borehole logging programme

Name	Description	Tool	Unit
CALIPER1	Caliper, 1-arm	9139	mm
DENSITY	Gamma-gamma density	9139	kg/m³
RES(SG)	Focused guard log resistivity, 128 cm	9139	ohm-m
GAM(NAT)	Natural gamma	9072	μR/h
TEMP(FL)	Fluid temperature	9042	deg C
RES(FL)	Fluid resistivity	9042	ohm-m
RES(DG)	Focused guard log resistivity, 300cm	9072	ohm-m
P-VEL	P-wave velocity	9310	m/s
AMP(N)	Full wave form, near receiver	9310	μs
AMP(F)	Full wave form, far receiver	9310	μs
MAGSUSCEP	Magnetic susceptibility	8622	SI*10-5
CALIPER 3D	Caliper, high resolution 360 degrees	HiRAT	mm
CALIPER MEAN	High resolution 1D caliper	HiRAT	mm
AZIMUTH MN	Borehole azimuth magnetic north	HiRAT	deg
DIP	Borehole inclination from horizontal	HiRAT	deg
RADIUS	360 degrees orientated acoustic radius	HiRAT	mm
AMPLITUDE	360 degrees orientated acoustic amplitude	HiRAT	-
THORIUM	Spectral gamma, Thorium component	9080	PPM
URANIUM	Spectral gamma, Uranium component	9080	PPM
POTASSIUM	Spectral gamma, Potassium component	9080	percent
RES(16N)	Normal resistivity 16 inch	8144	ohm-m
RES(64N)	Normal resistivity 64 inch	8144	ohm-m
LATERAL	Lateral resistivity	8144	ohm-m
SPR	Single point resistivity	8144	ohm
SP	Self Potential	8144	V

Rev.	Date	Drawn by	Control	Approved
0	2007-01-12	JRI	UTN	UTN

Job: 547310A

Scale: 1:500

RAMBØLL

Rambøll. Bredevej 2, DK-2830 Virum
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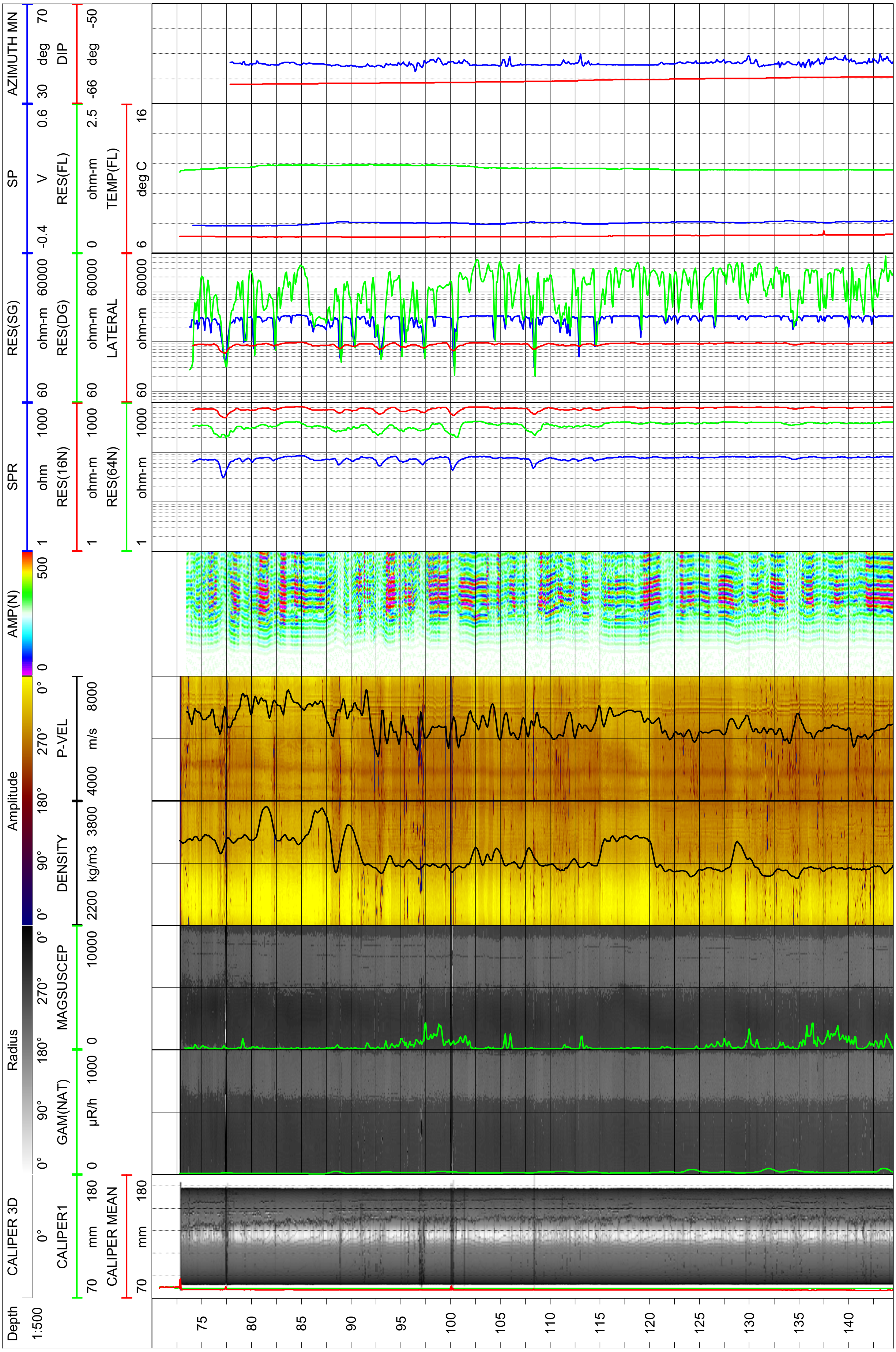
SKB geophysical borehole logging
Borehole KFM11A

Presentation

Filename:
KFM11A_Presentation.wcl

Drawing no.:
1.1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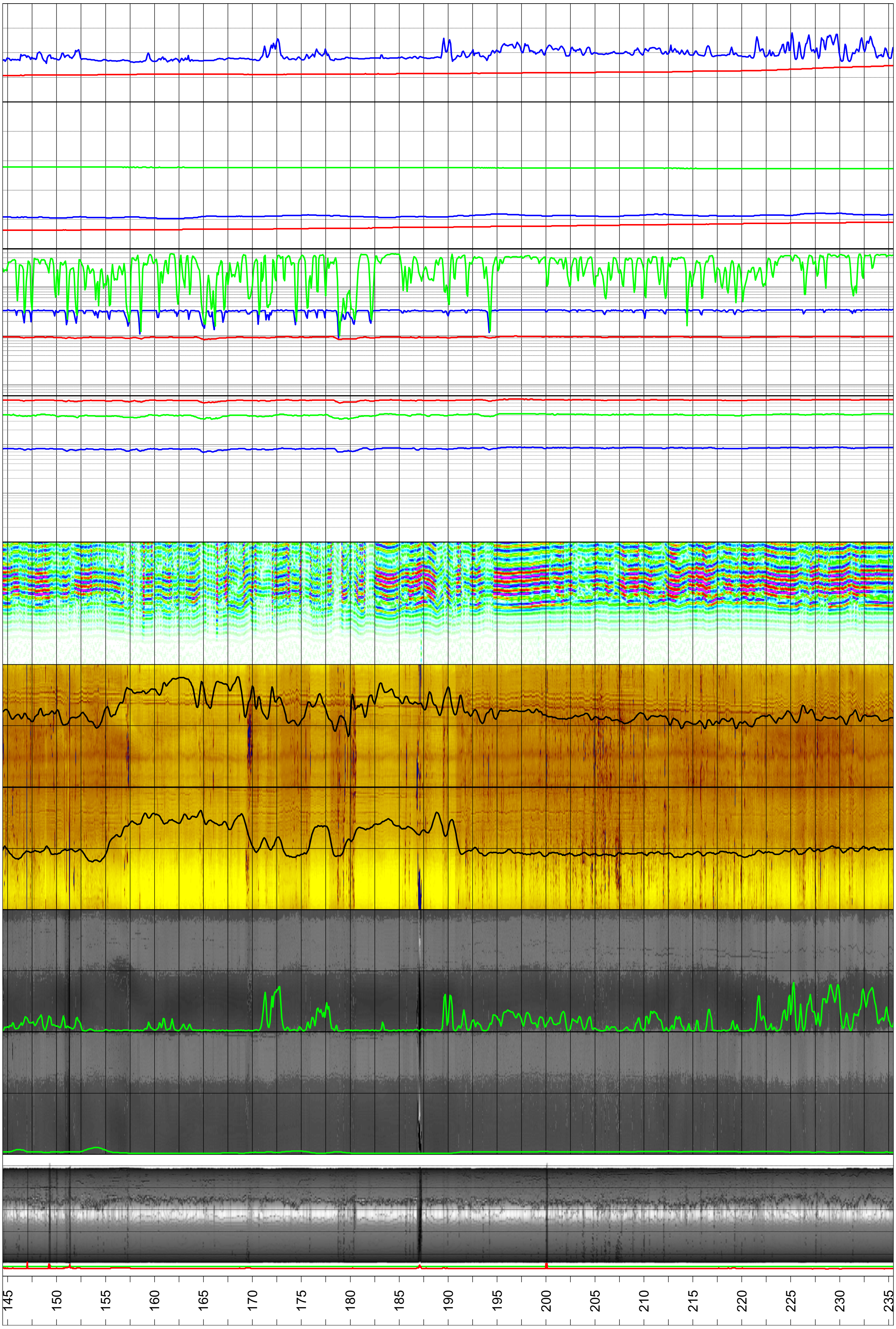

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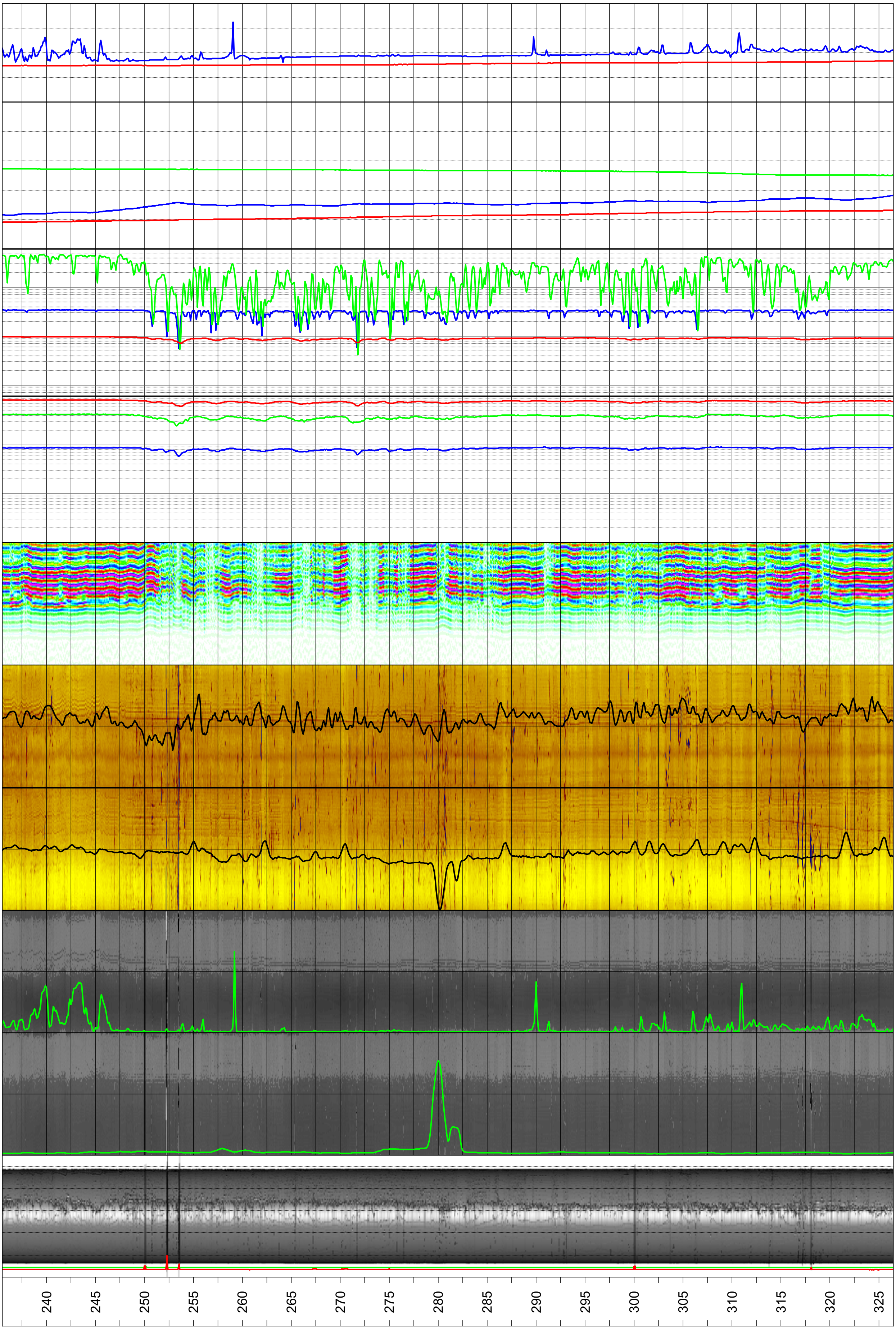
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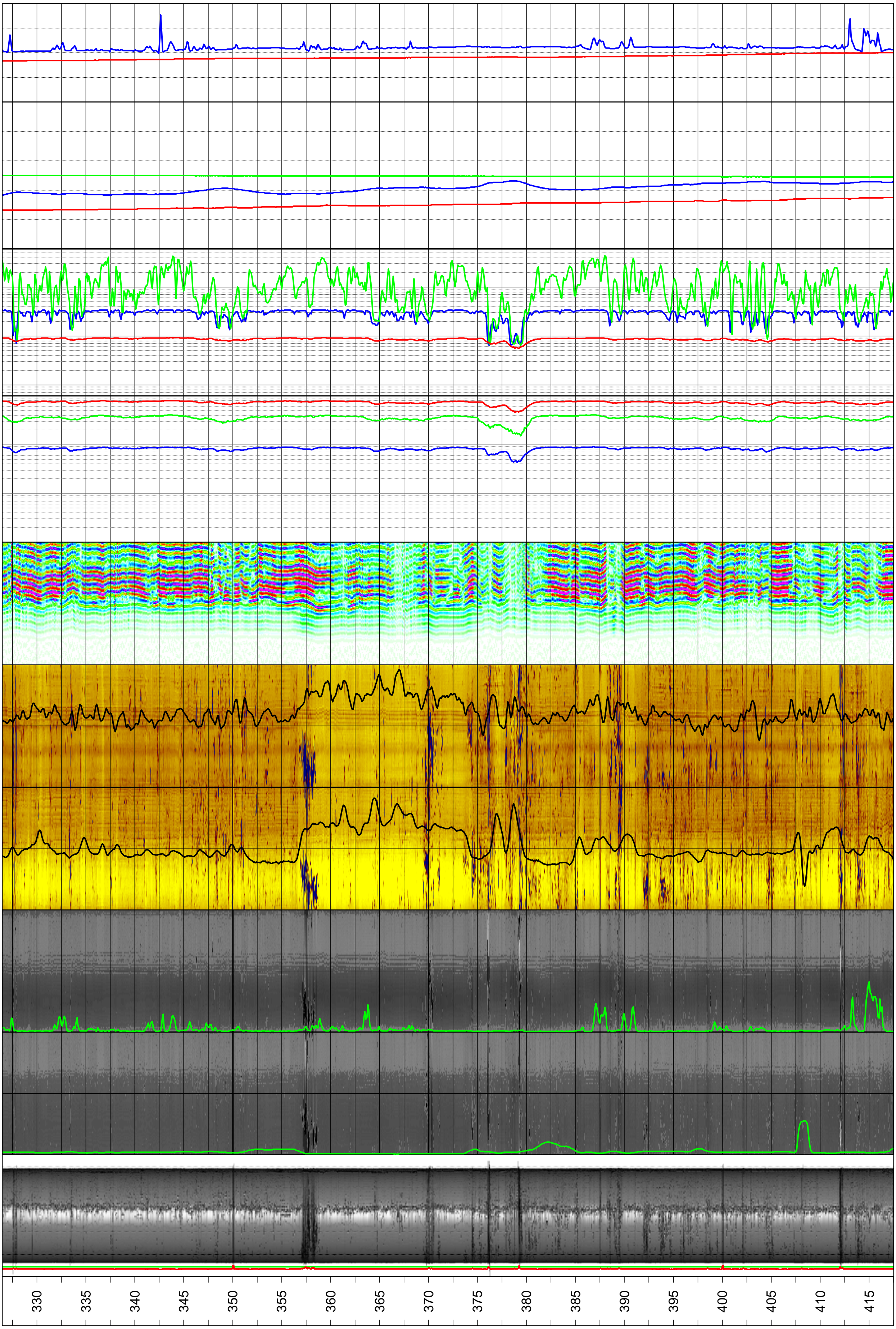
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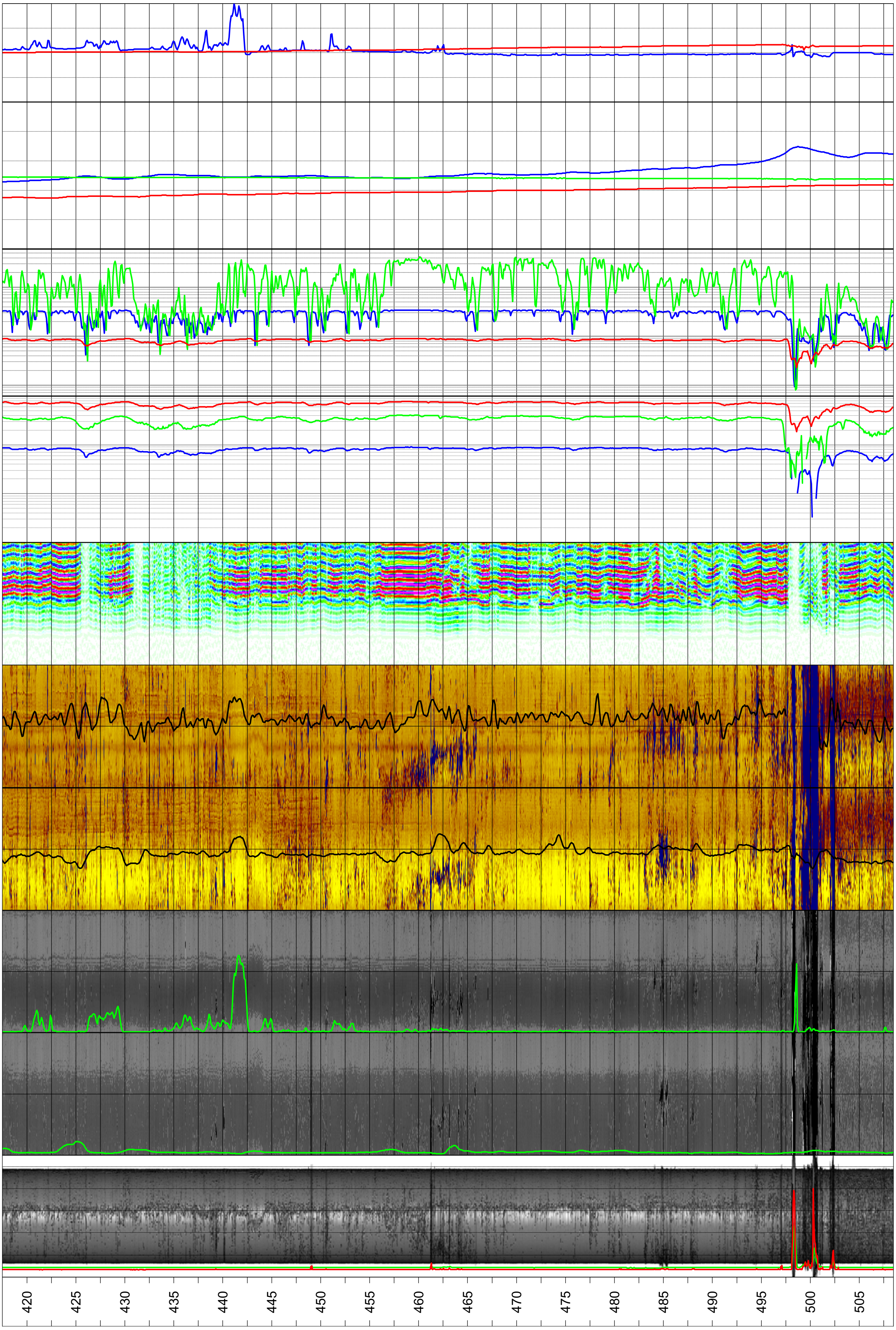
400
405
410
415


420
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430
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470
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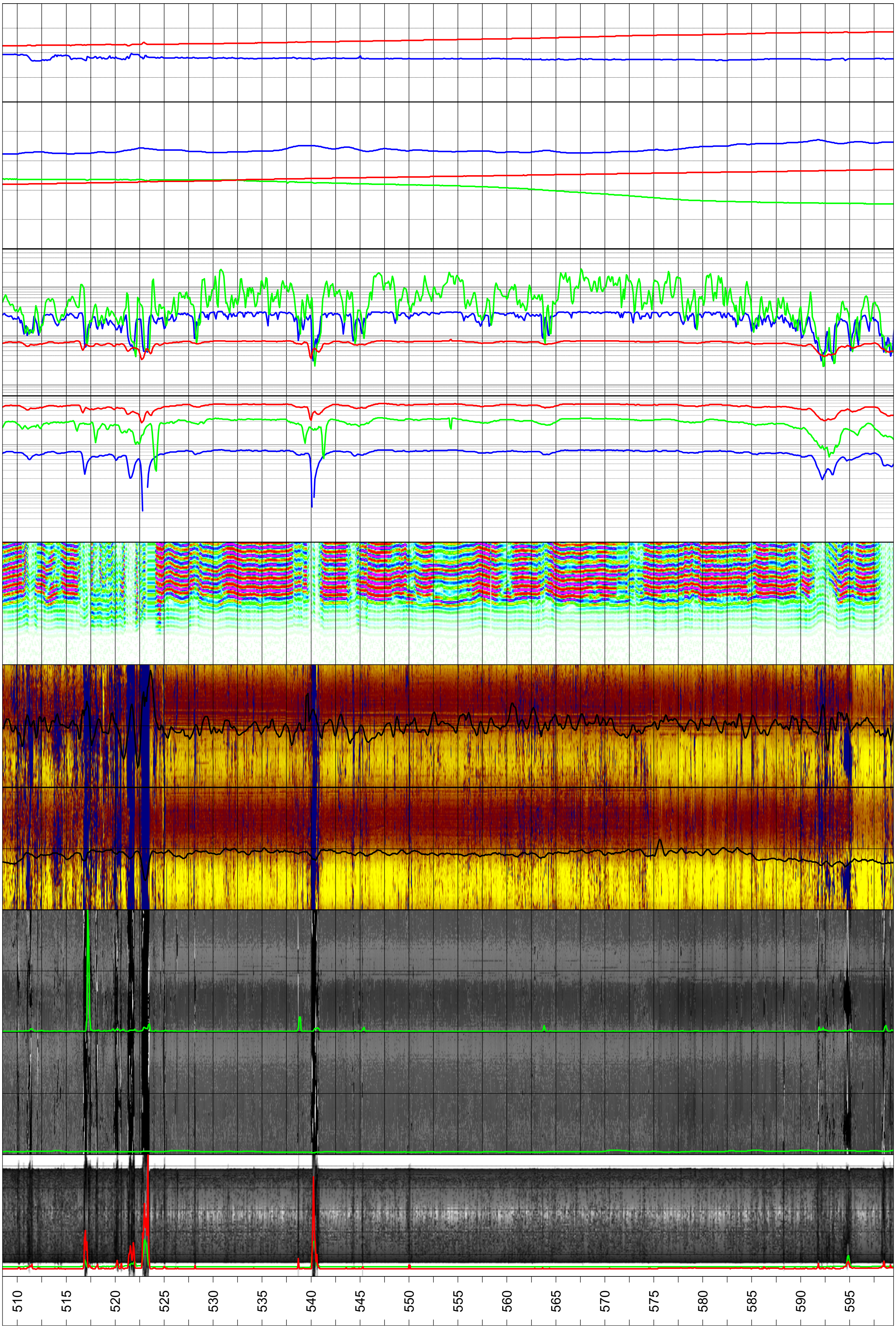
490
495
500
505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550
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560
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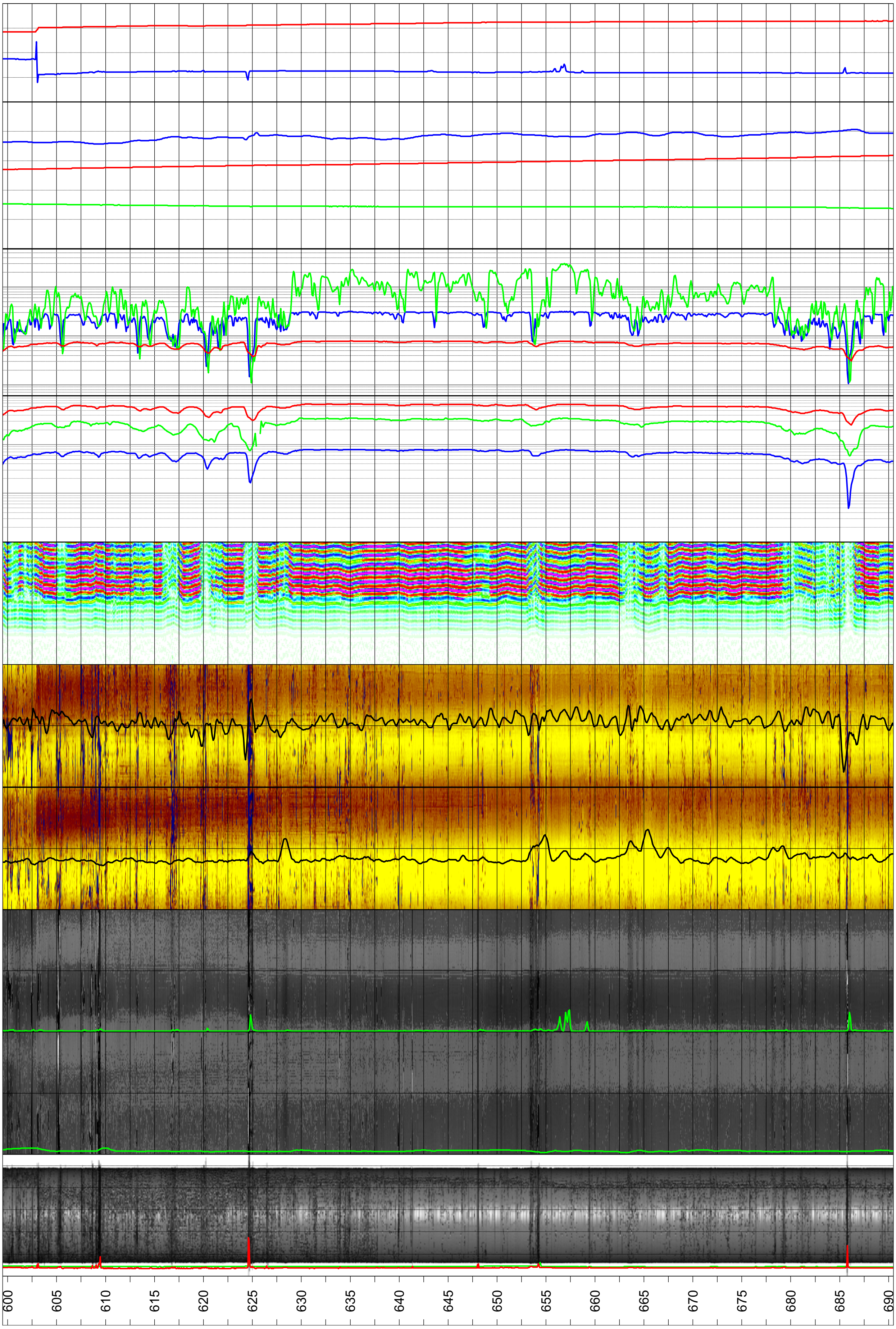
585
590
595


600
605
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660
665
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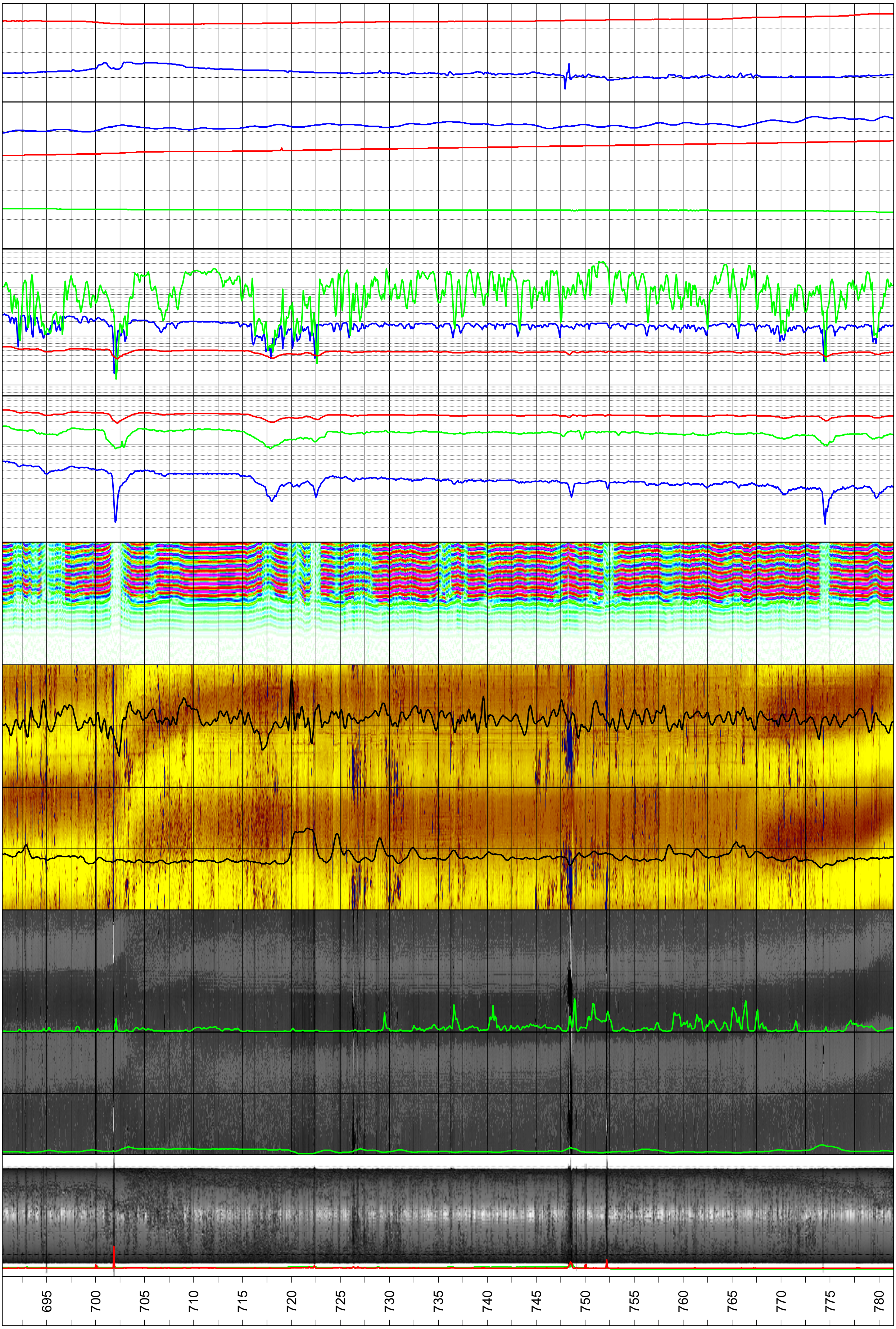
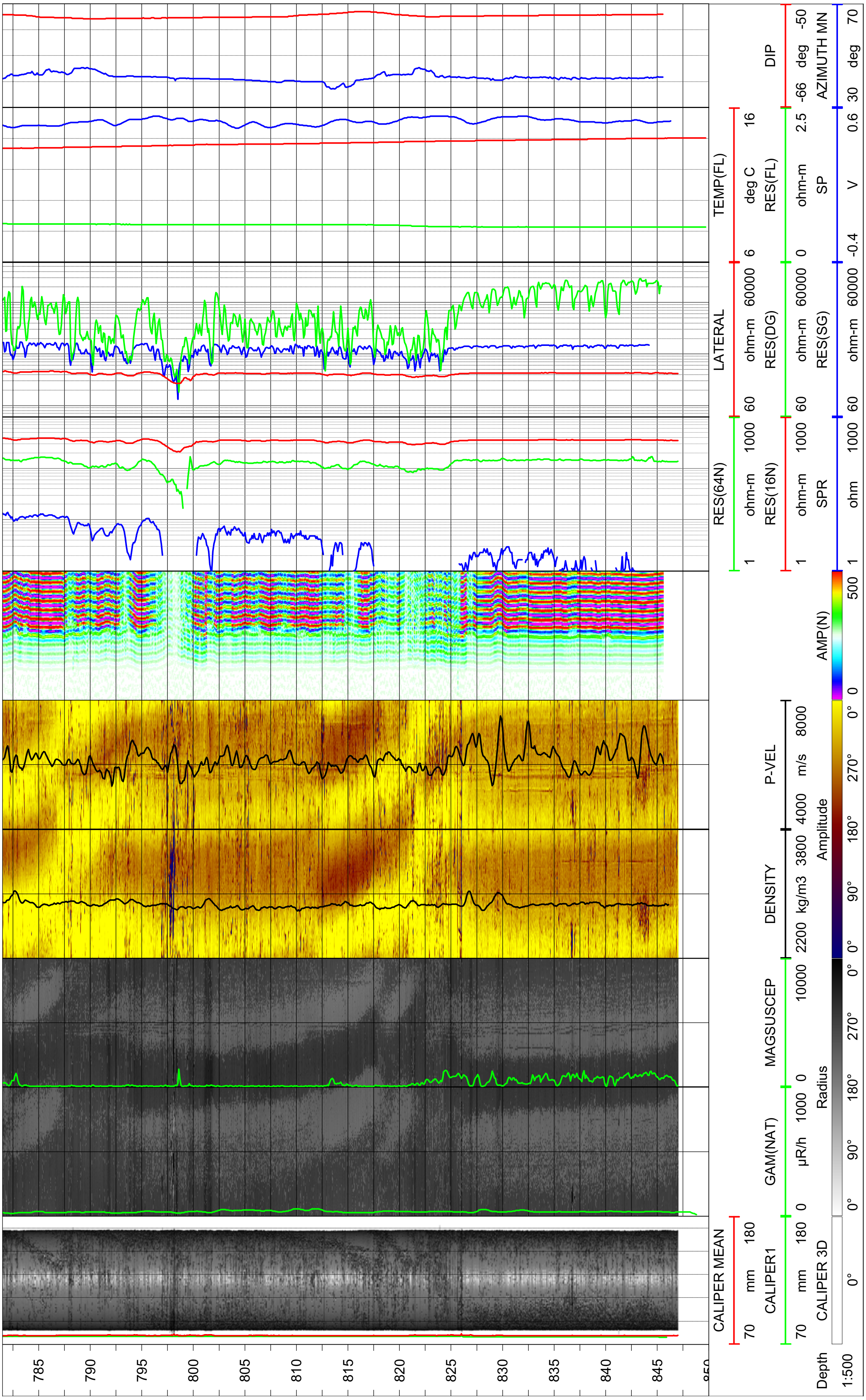
675
680
685
690


695
700
705
710
715
720
725
730
735
740
745
750
755
760
765
770
775
780


DIP
-66 deg -50
AZIMUTH MN
30 deg 70
TEMP(FL)
6 deg C 16
RES(FL)
0 ohm-m 2.5
SP
-0.4 V 0.6
LATERAL
60 ohm-m 60000
RES(DG)
60 ohm-m 60000
RES(SG)
60 ohm-m 60000
RES(64N)
1 ohm-m 1000
RES(16N)
1 ohm-m 1000
SPR
1 ohm 1000
AMP(N)
0 500
P-VEL
4000 m/s 8000
DENSITY
2200 kg/m3 3800
Amplitude
0° 90° 180° 270° 0°
MAGSUSCEP
0 10000
GAM(NAT)
0 µR/h 1000
Radius
0° 90° 180° 270° 0°
CALIPER MEAN
70 mm 180
CALIPER1
70 mm 180
CALIPER 3D
0°
Depth
1:500
785
790
795
800
805
810
815
820
825
830
835
840
845
850

Borehole KFM90B, drawing no. 2.1, borehole logs

Co-ordinates in RT90 2,5 gon V 0:-15

Northing: Easting: Elevation:

Diameter:
Reaming Diameter:
Outer Casing:
Inner Casing:
Casing Length:
Borehole Length:
Cone:
Inclination at ground surface:
Azimuth:
Comments: Acoustic Televiewer

Borehole logging programme

Name	Description	Tool	Unit
CALIPER1	Caliper, 1-arm	9139	mm
DENSITY	Gamma-gamma density	9139	kg/m³
RES(SG)	Focused guard log resistivity, 128 cm	9139	ohm-m
GAM(NAT)	Natural gamma	9072	µR/h
TEMP(FL)	Fluid temperature	9042	deg C
RES(FL)	Fluid resistivity	9042	ohm-m
RES(DG)	Focused guard log resistivity, 300cm	9072	ohm-m
P-VEL	P-wave velocity	9310	m/s
AMP(N)	Full wave form, near receiver	9310	µs
AMP(F)	Full wave form, far receiver	9310	µs
MAGSUSCEP	Magnetic susceptibility	8622	SI*10-5
CALIPER 3D	Caliper, high resolution 360 degrees	HiRAT	mm
CALIPER MEAN	High resolution 1D caliper	HiRAT	mm
AZIMUTH MN	Borehole azimuth magnetic north	HiRAT	deg
DIP	Borehole inclination from horizontal	HiRAT	deg
RADIUS	360 degrees orientated acoustic radius	HiRAT	mm
AMPLITUDE	360 degrees orientated acoustic amplitude	HiRAT	-
THORIUM	Spectral gamma, Thorium component	9080	PPM
URANIUM	Spectral gamma, Uranium component	9080	PPM
POTASSIUM	Spectral gamma, Potassium component	9080	percent
RES(16N)	Normal resistivity 16 inch	8144	ohm-m
RES(64N)	Normal resistivity 64 inch	8144	ohm-m
LATERAL	Lateral resistivity	8144	ohm-m
SPR	Single point resistivity	8144	ohm
SP	Self Potential	8144	V

Rev.	Date	Drawn by	Control	Approved
0	2006-12-12	JRI	UTN	UTN

Job	Scale
547310A	1:10

RAMBØLL

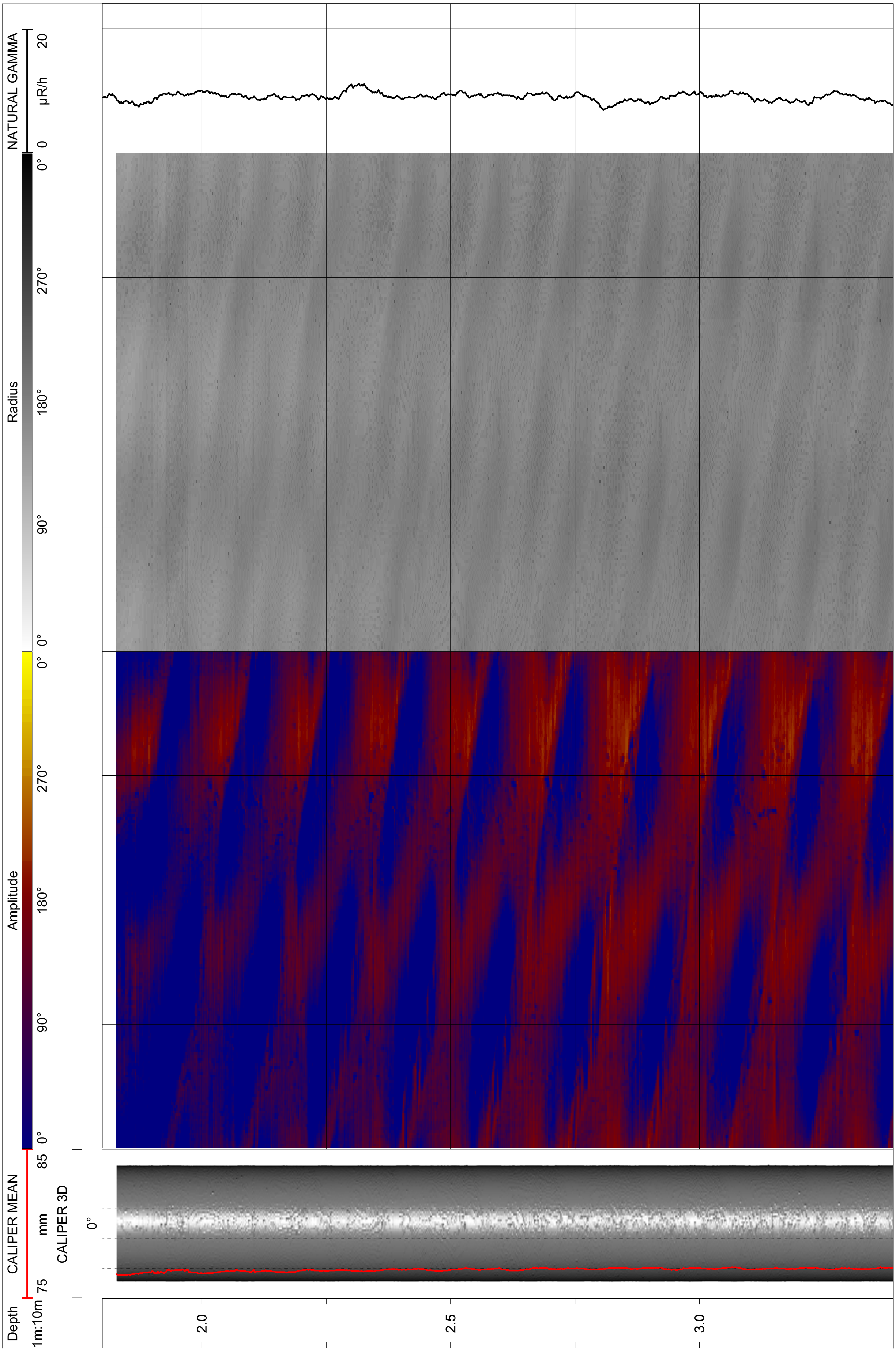
Rambøll, Bredevej 2, DK-2830 Virum
Phone + 45 45 98 60 00, Fax + 45 45 98 67 00

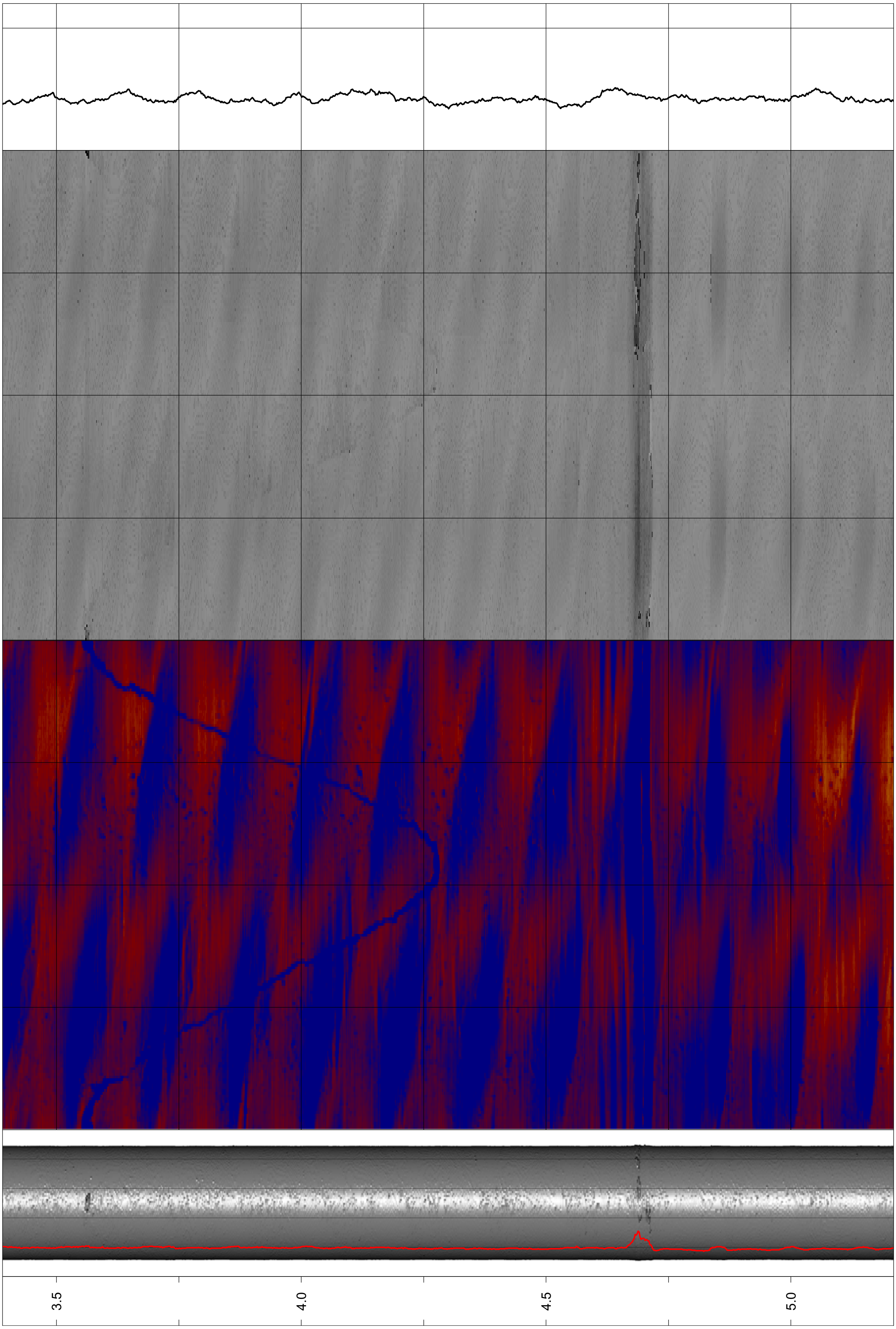
SKB geophysical borehole logging
KFM90B

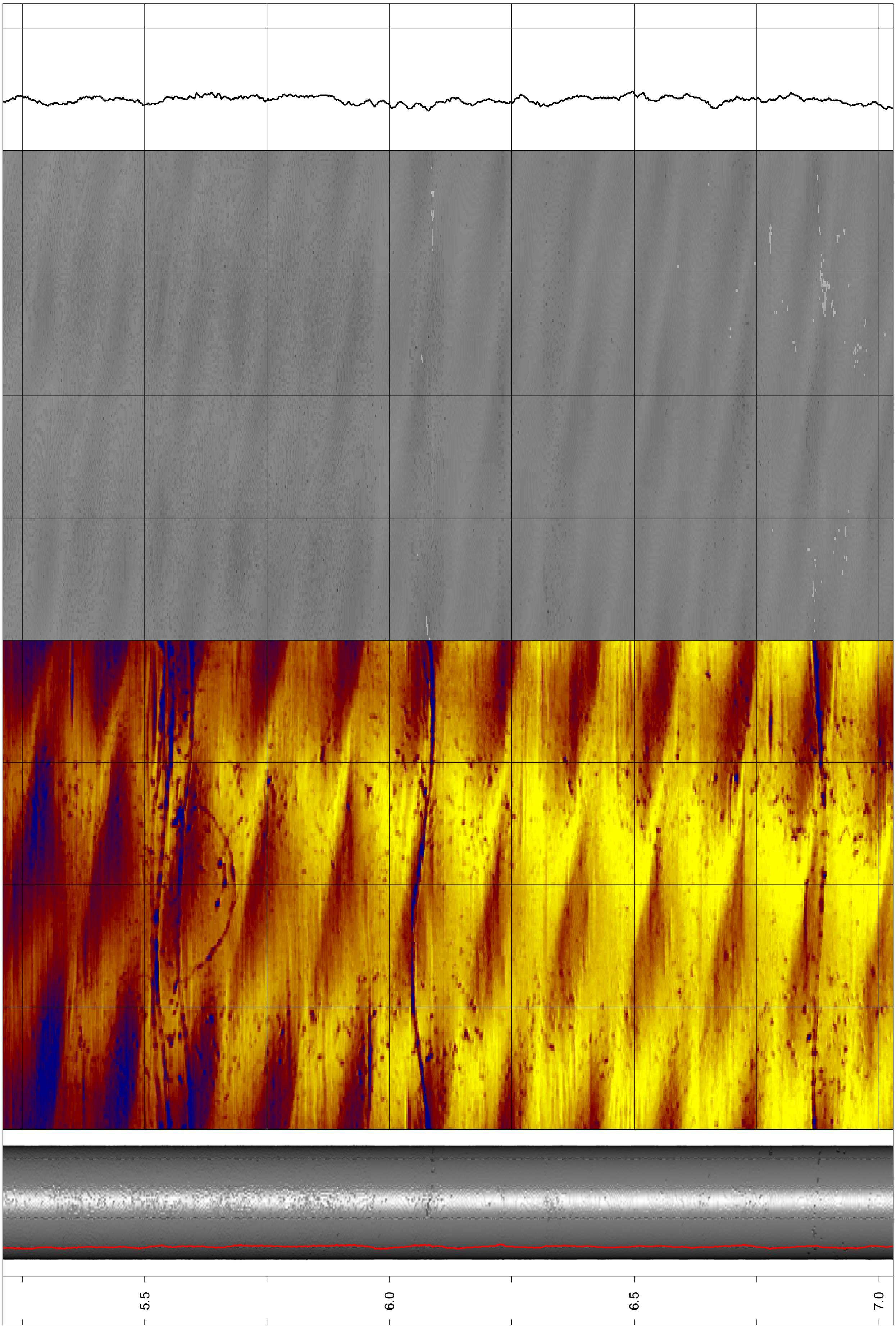
Presentation

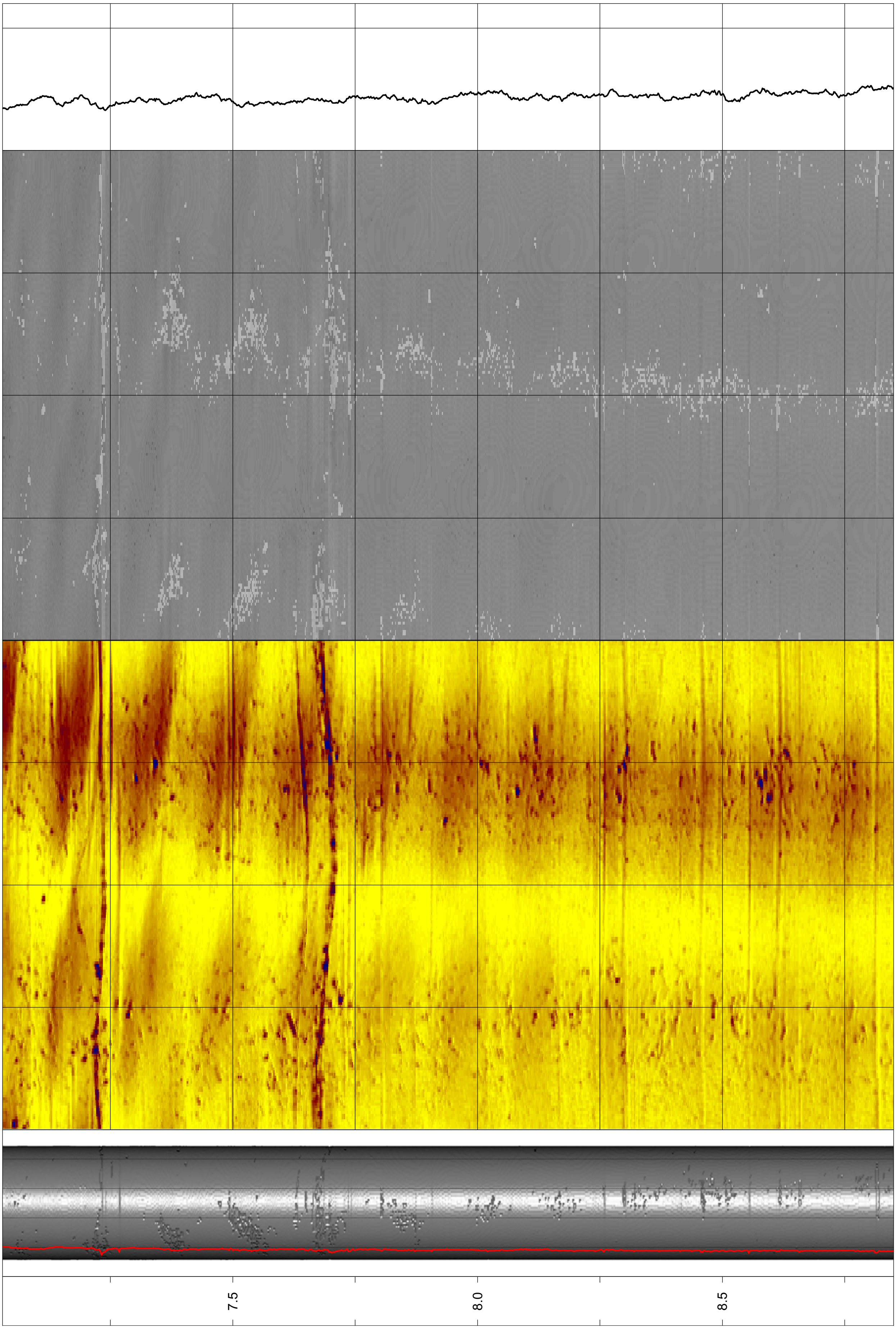
Filename:
KFM90B_Presentation.wcl

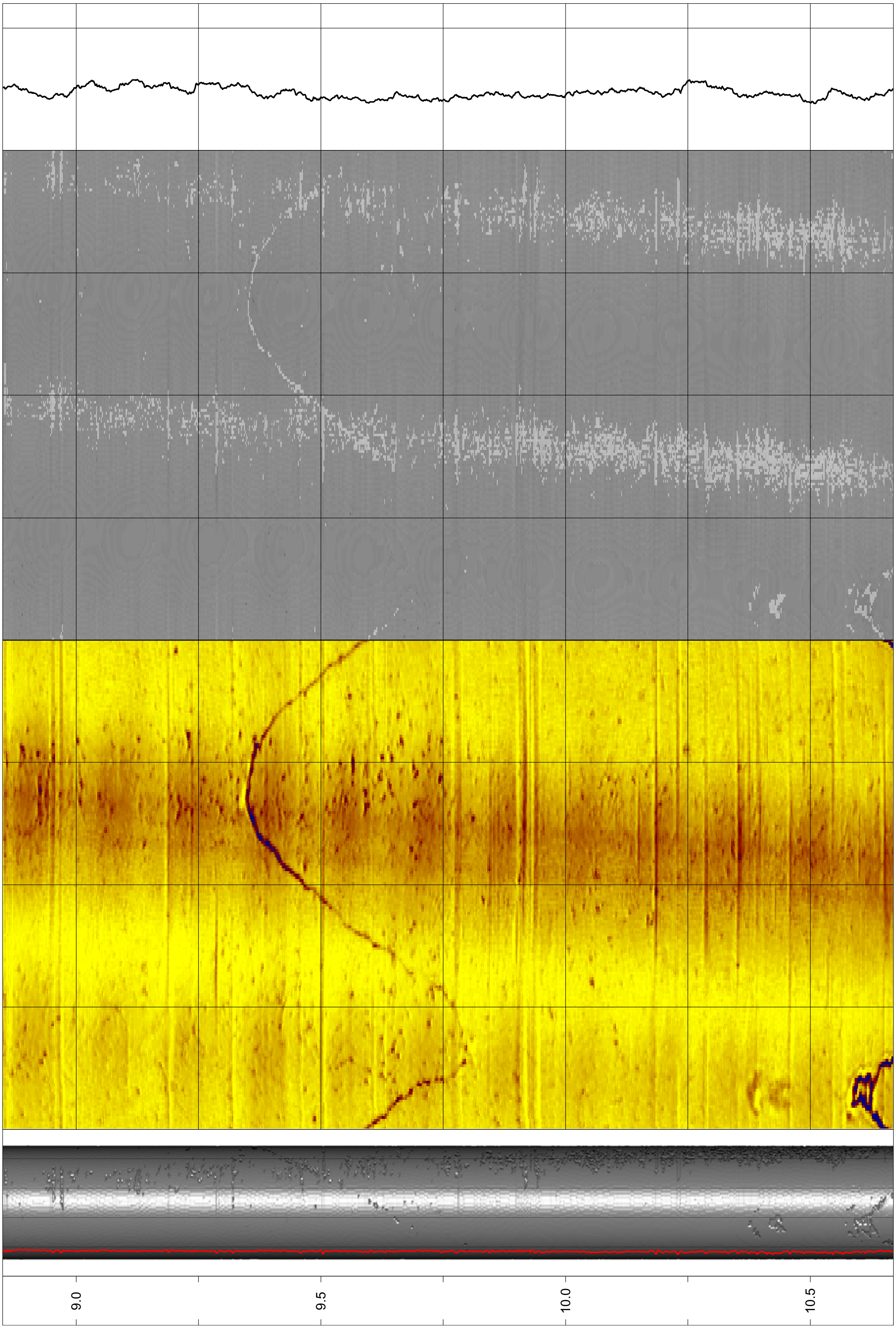
Drawing no.:
2.1

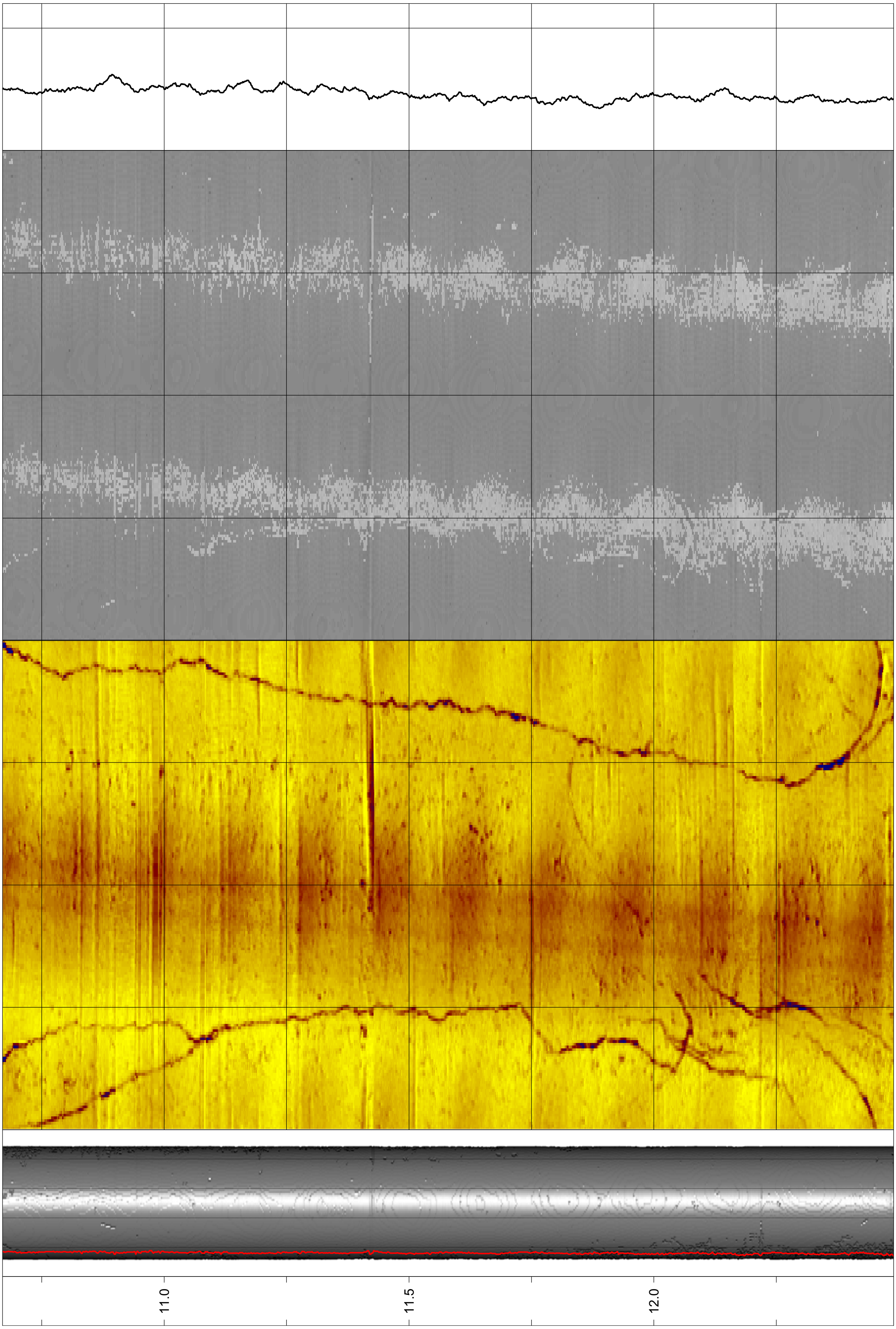

NATURAL GAMMA
0
µR/h
20
Radius
0°
90°
180°
270°
0°
Amplitude
0°
90°
180°
270°
0°
CALIPER MEAN
75
mm
85
CALIPER 3D
0°
Depth
1m:10m
2.0
2.5
3.0

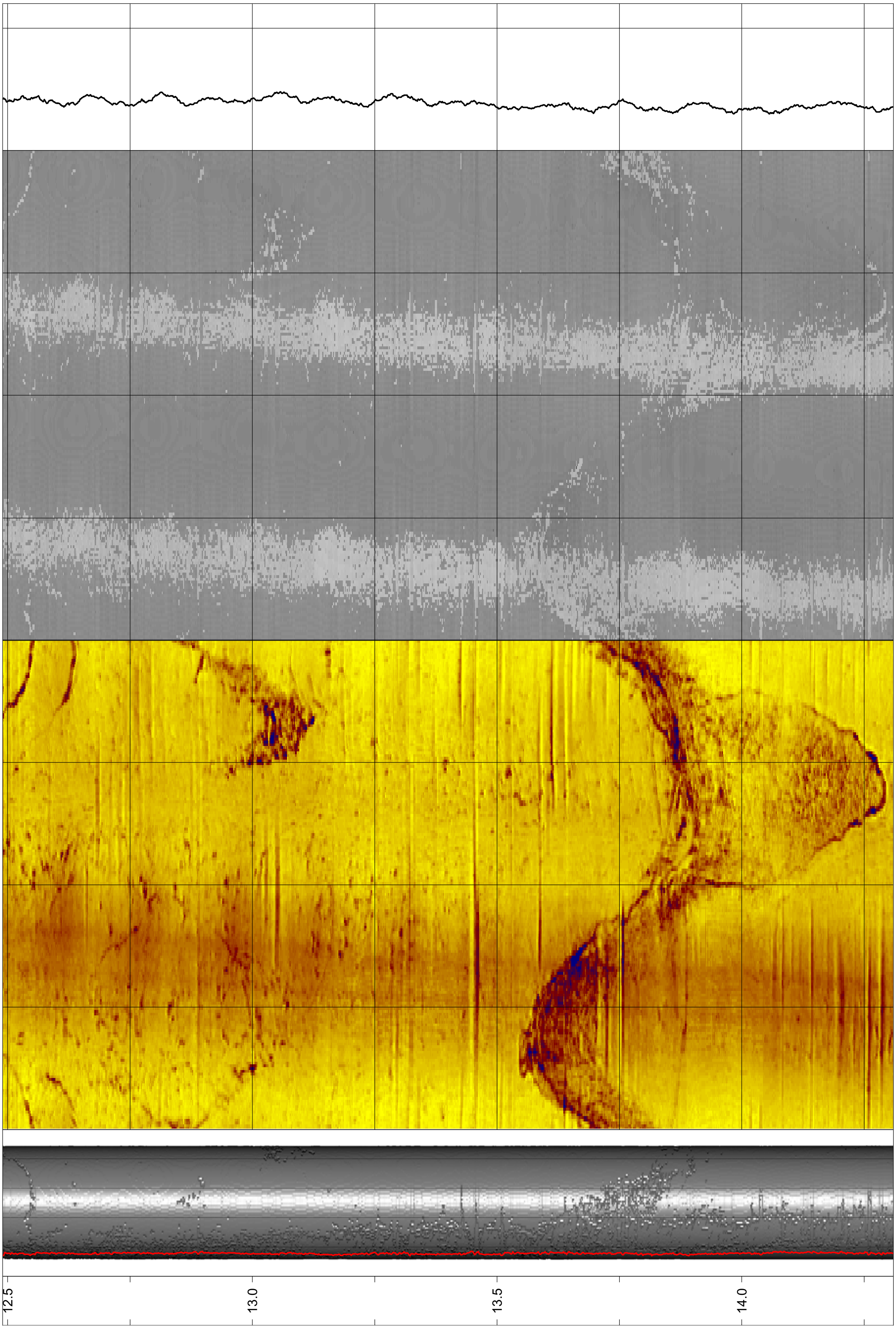

3.5
4.0
4.5
5.0


5.5
6.0
6.5
7.0

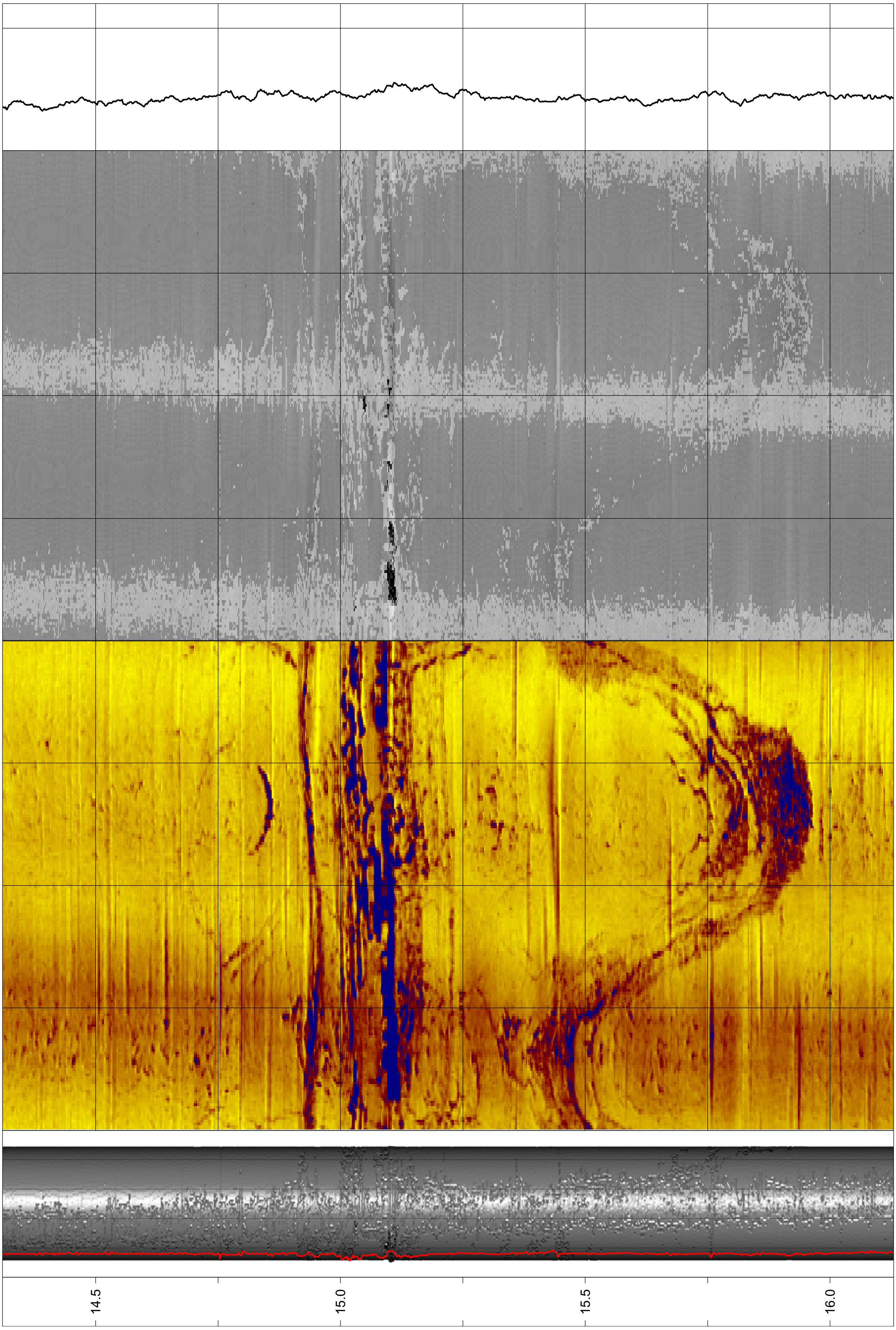

7.5
8.0
8.5

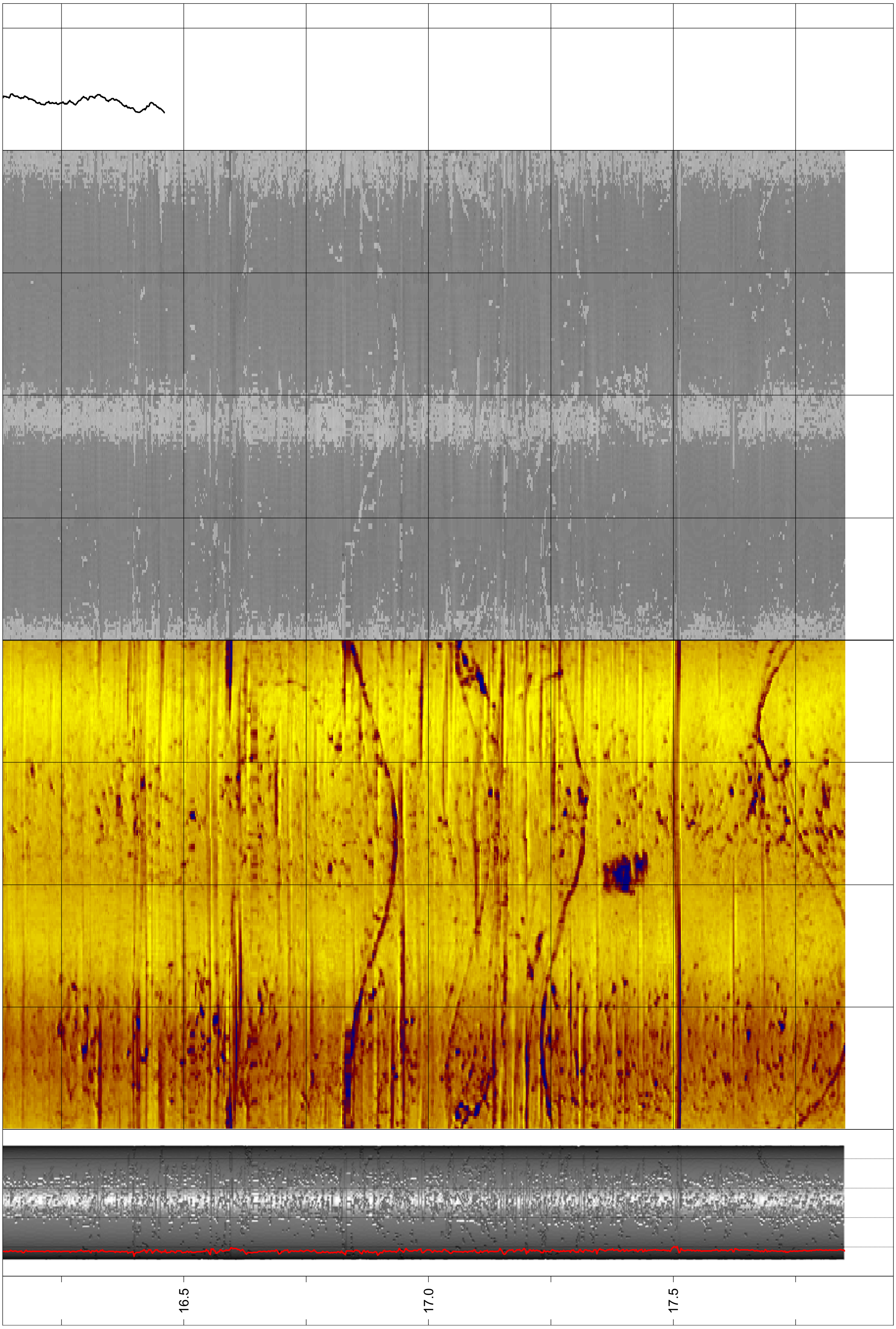

9.0
9.5
10.0
10.5

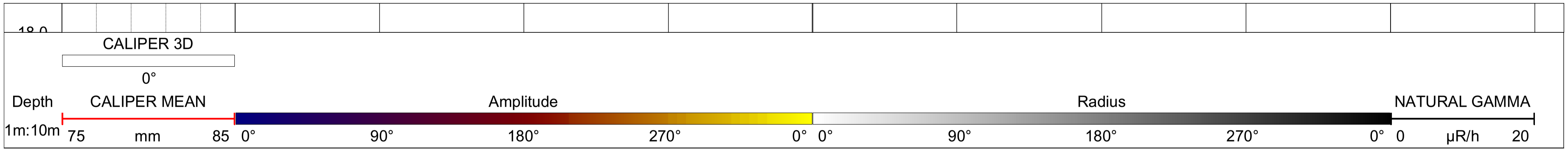

11.0
11.5
12.0



12.5
13.0
13.5
14.0


14.5
15.0
15.5
16.0


16.5
17.0
17.5


18.0
CALIPER 3D
0°
Depth
CALIPER MEAN
Amplitude
Radius
NATURAL GAMMA
1m:10m
75
mm
85
0°
90°
180°
270°
0°
0°
90°
180°
270°
0°
0
µR/h
20