P-07-60

Forsmark site investigation

Geophysical borehole logging in boreholes KFM02B and KFM08D

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RAMBØLL

April 2007

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Abstract

Geophysical borehole logging has been performed in boreholes KFM02B and KFM08D both 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.

All boreholes were recorded from Top Of Casing (TOC). The logging in KFM02B was recorded to approximately 560 m and KFM08D was recorded to approximately 940 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 Appendix 1–2.

Sammanfattning

Geofysisk borrhålsloggning har genomförts i borrhålen KFM02B och KFM08D 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 KFM02B från TOC till ca 560 m och i KFM08D från TOC till ca 940 m.

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

Processerade loggar presenteras i Appendix 1–2.

Contents

1 Introduction

This document reports the results gained by the geophysical borehole logging in boreholes KFM02B and KFM08D, 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 400-07-003 (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 February 19 to 22, 2007. 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. The location of the boreholes is shown in Figure 1-1 and the technical data of the boreholes are displayed in Figure 1-2 and 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.

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

Activity plan	Number	Version
Geofysisk borrhålsloggning i KFM02B och KFM08D	AP PF 400-07-003	1.0
Method descriptions	**Number**	**Version**
Metodbeskrivning för geofysisk borrhålsloggning	SKB MD 221.002	3.0
Metodbeskrivning för krökningsmätning av hammar- och kärnborrhål	SKB MD 224.001	1.0

Table 1-2. Technical data for the boreholes.

Borehole parameter	KFM02B	KFM08D
Coordinates (RT90)	X: 6698719.192 Y: 1633186.286	X: 6700491.675 Y: 1631199.164
Elevation (RHB70)	Z: 7.615	Z: 2.606
Azimuth	313.1°	100.0°
Inclination	–80.3°	–55.0°
Length [m]	573.87	942.30
Casing [m]	88.55	59.48
Borehole diameter [mm]	75.8	77.3
Cleaning level	Level 2	Level 2

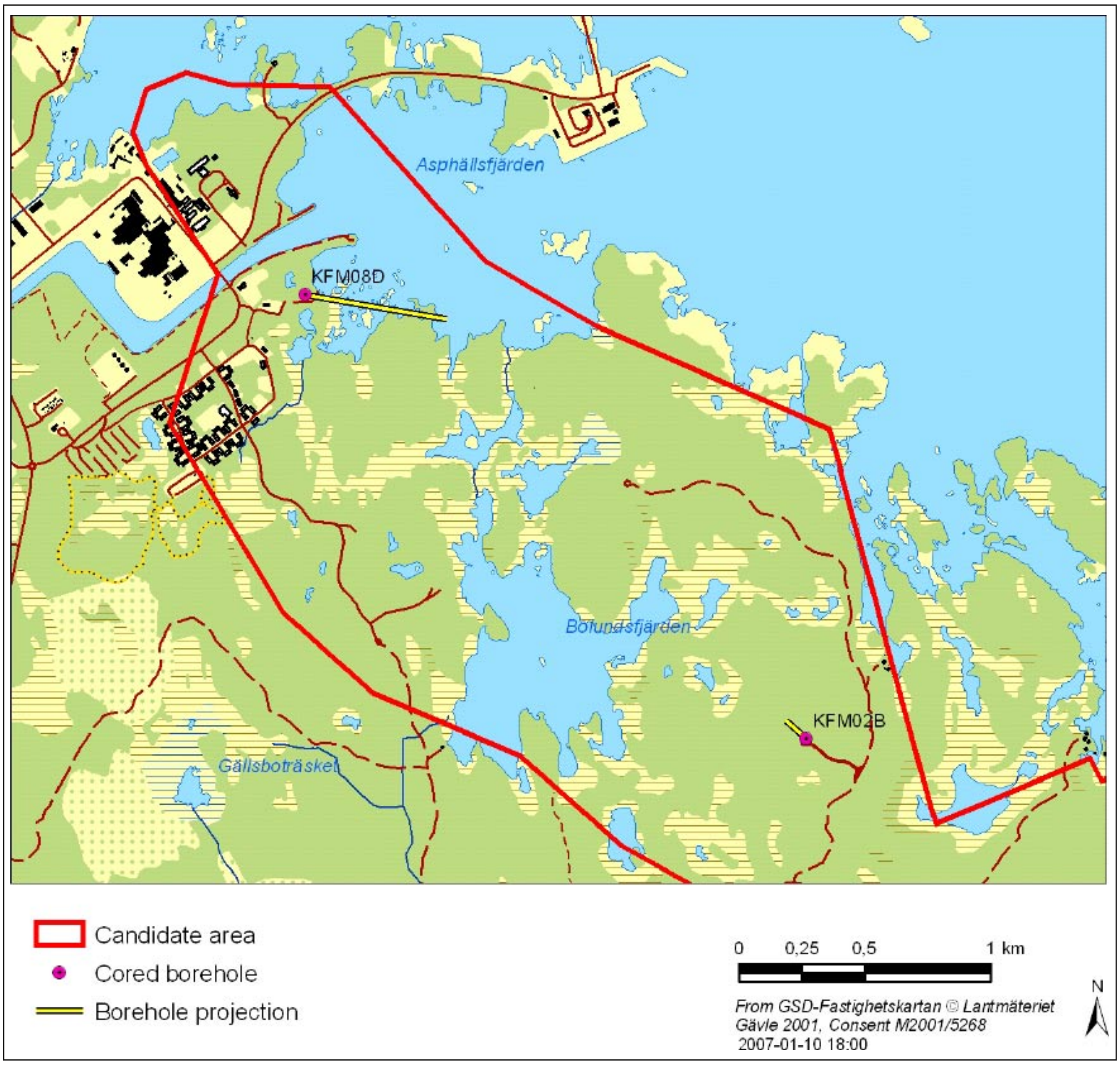
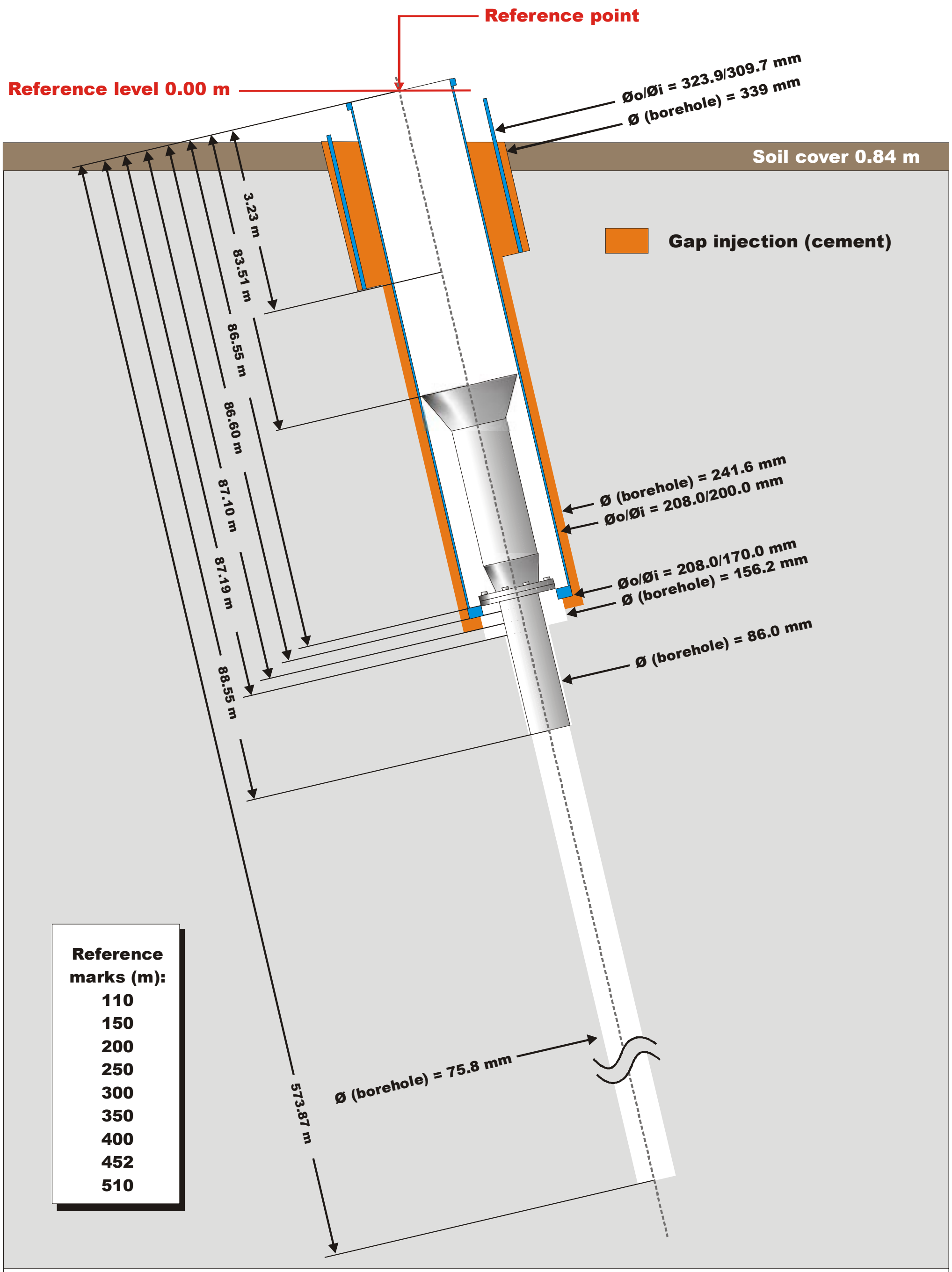


Figure 1-1. *General overview over the Forsmark areas showing the location of the boreholes KFM02B and KFM08D.*

Technical data
Borehole KFM02B



Drilling reference point

Northing:	6698719.19 (m), RT90 2,5 gon V 0:-15
Easting:	1633186.29 (m), RT90 2,5 gon V 0:-15
Elevation:	7.62 (m), RHB 70

Orientation

Bearing (degrees):	313.06°
Inclination (degrees):	-80.27°

Borehole

Length:	573.87 m

Percussion drilling period

Drilling start date: 2006-01-18
Drilling stop date: 2006-01-30

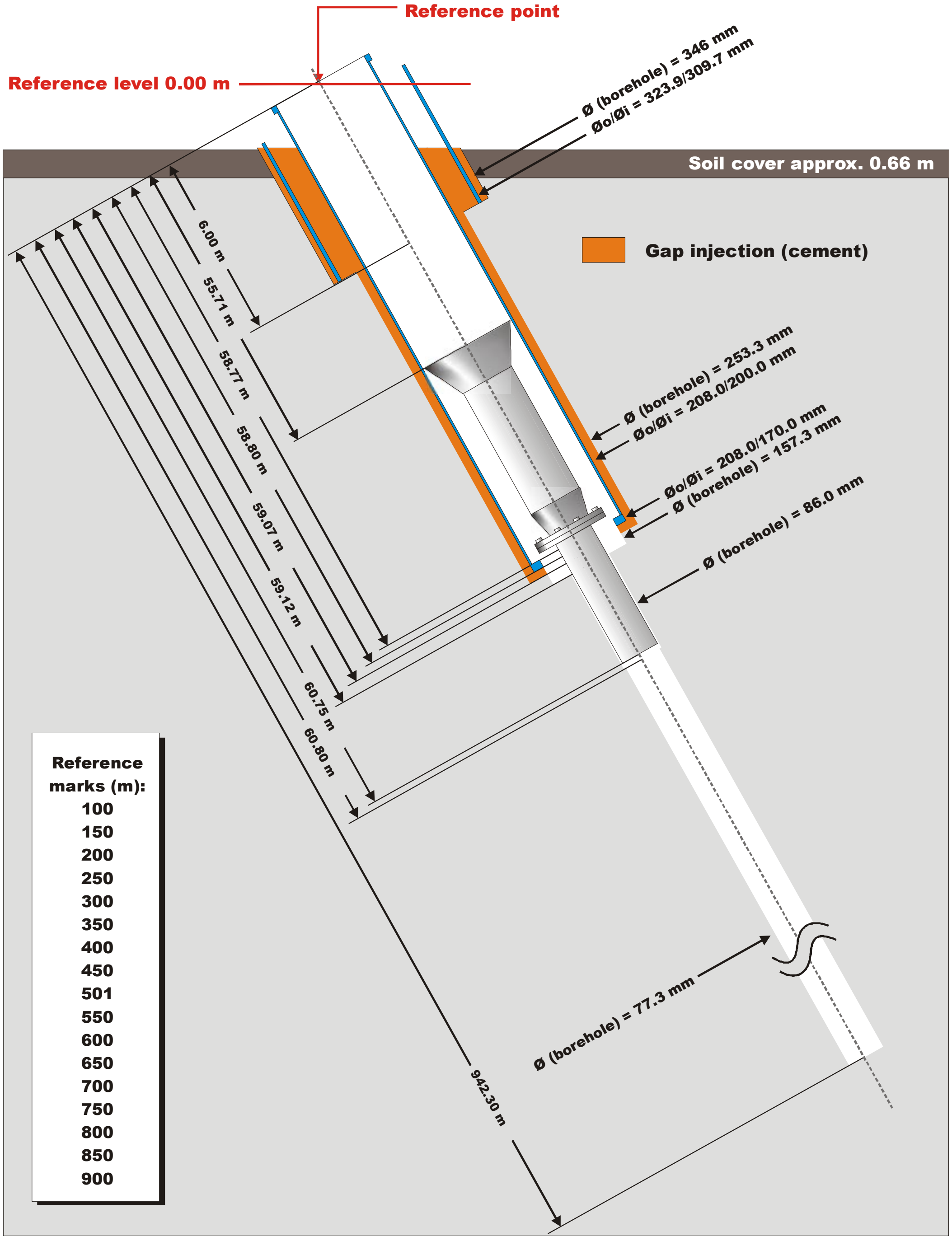
Core drilling period

Drilling start date: 2006-06-13
Drilling stop date: 2007-02-13

2007-02-16

Figure 1-2. Technical description of borehole KFM02B.

Technical data
Borehole KFM08D



Drilling reference point

Northing:	6700491.68 (m), RT90 2,5 gon V 0:-15
Easting:	1631199.16 (m), RT90 2,5 gon V 0:-15
Elevation:	2.61 (m), RHB 70

Orientation

Bearing (degrees):	99.98°
Inclination (degrees):	-55.00°

Borehole

Length:	942.30 m

Percussion drilling period

Drilling start date: 2006-11-23
Drilling stop date: 2006-12-04

Core drilling period

Drilling start date: 2006-12-13
Drilling stop date: 2007-02-10

2007-02-16

Figure 1-3. *Technical description of borehole KFM08D.*

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 boreholes.

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 no.

Borehole	Drawing no.	Appendix
KFM02B	1.1	1
KFM08D	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
Century 8144 Normal resistivity.	Normal resistivity (16 and 64 inch), single point resistance and natural gamma.	237 · 5.3 cm		
Century 8622 Magnetic susceptibility.	Magnetic susceptibility, natural gamma.	203 · 4.1 cm		
Century 9042 Fluid temperature and fluid resistivity.	Fluid temperature, fluid resistivity and natural gamma.	137 · 4.1 cm		
Century 9072 3 m focused guard.	3 m focused guard log resistivity and natural gamma.	310 · 6.4 cm		
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.
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.
RG 25 112 000 HiRAT. Acoustic televiewer.	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.

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 February 19 to 22, 2007. All relevant logging events are described in the daily report sheets delivered to SICADA and are traceable by the activity 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 boreholes.

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

No nonconformities are observed. The logging has been performed in accordance with the activity plan AP PF 400-07-003.

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 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 through 2.1 in Appendices 1 to 2.

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

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). The actual values can be found below. 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.

5.4 Borehole KFM02B

In order to obtain an exact depth calibration in borehole KFM02B, 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 5-2. 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 1,000.
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 for 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	–

Table 5-3. The reference track marks in the borehole and the recorded track marks form the HiRAT in borehole KFM02B.

Reference mark	HIRAT recorded
86.55	86.55
110.00	110.185
150.00	150.303
200.00	200.527
250.00	250.744
300.00	300.941
350.00	351.166
400.00	401.381
452.00	453.598
510.00	511.839

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 KFM02B, between all log runs, the obtained reference mark correlation is transferred to the other logs.

The complete log suite for borehole KFM02B 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 KFM08D

In order to obtain an exact depth calibration in borehole KFM08D, 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 5-4.

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 KFM08D, between all log runs, the obtained reference mark correlation is transferred to the other logs.

The complete log suite for borehole KFM08D is presented as 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.

Table 5-4. The reference track marks in the borehole and the recorded track marks form the HiRAT in borehole KFM08D.

Reference mark	HIRAT recorded
60.75	60.75
100.00	100.102
150.00	150.286
200.00	200.475
250.00	250.658
300.00	300.889
350.00	351.098
400.00	401.298
450.00	451.535
501.00	502.738
550.00	551.958
600.00	602.16
650.00	652.36
700.00	702.569
750.00	752.78
800.00	803.021
850.00	853.167
900.00	903.412

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.

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

Borehole	Probew	Log direction	WellCAD File	Description
KFM02B	8144	Up	KFM02B_02-19-07_14-41_8144C_.02_1.66_575.33_ORIG.log	Start Depth: 1.66 m. End Depth: 575.33 m.
KFM02B	8622	Up	KFM02B_02-19-07_18-41_8622C_.02_0.00_574.25_ORIG.log	Start Depth: 574.25 m. End Depth: 0 m.
KFM02B	9042	Down	KFM02B_02-19-07_08-39_9042C_.02_0.22_574.81_ORIG.log	Start Depth: 0.22 m. End Depth: 574.81 m.
KFM02B	9072	Up	KFM02B_02-20-07_10-07_9072C_.02_81.16_575.07_ORIG.log	Start Depth: 575.07 m. End Depth: 81.16 m.
KFM02B	9139	Up	KFM02B_02-19-07_16-38_9139A_.02_34.30_574.15_ORIG.log	Start Depth: 574.15 m. End Depth: 34.3 m.
KFM02B	9310	Up	KFM02B_02-20-07_08-47_9310C2_.02_1.28_574.10_ORIG.log	Start Depth: 574.1 m. End Depth: 1.28 m.
KFM02B	9310	Down	KFM02B_02-20-07_07-53_9310C2_.02_0.24_573.05_ORIG.log	Start Depth: 0.24 m. End Depth: 573.05 m.
KFM02B	HiRAT	Up	KFM02B_HiRAT_120pixels_up_unaligned_run3.HED	Start Depth: 405 m. End Depth: 75 m.
KFM02B	HiRAT	Up	KFM02B_HiRAT_120pixels_up_unaligned_run2.HED	Start Depth: 572 m. End Depth: 400 m.
KFM08D	8144	Up	KFM08D_02-20-07_15-24_8144C_.02_0.27_943.14_ORIG.log	Start Depth: 943.14 m. End Depth: 0.27 m.
KFM08D	8622	Up	KFM08D_02-22-07_07-56_8622C_.02_-1.43_935.00_ORIG.log	Start Depth: 935 m. End Depth: –1.43 m.
KFM08D	9042	Down	KFM08D_02-20-07_12-38_9042C_.02_0.22_955.32_ORIG.log	Start Depth: 0.22 m. End Depth: 955.32 m.
KFM08D	9072	Up	KFM08D_02-22-07_09-15_9072C_.02_42.94_932.37_ORIG.log	Start Depth: 932.37 m. End Depth: 42.94 m.
KFM08D	9139	Up	KFM08D_02-21-07_17-08_9139A_.02_50.65_937.41_ORIG.log	Start Depth: 937.41 m. End Depth: 50.65 m.
KFM08D	9310	Up	KFM08D_02-20-07_18-33_9310C2_.02_43.26_941.11_ORIG.log	Start Depth: 941.11 m. End Depth: 43.26 m.
KFM08D	HiRAT	Up	KFM08D_HiRAT_120pixels_up_unaligned_run2.HED	Start Depth: 941 m. End Depth: 0 m.

The delivered data have been inserted in the database (SICADA) by SKB and they 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 6-2. Drawing files in WellCad format.

Borehole	Drawing	WellCad file
KFM02B	1.1	KFM02B_Presentation.WCL
KFM08D	2.1	KFM08D_Presentation.WCL

Table 6-3. Data files in SICADA format.

Sheet	Comment
“Borehole”_CALIPER1_GP040 - Caliper logging.xls	
“Borehole”_CALIPER MEAN_GP041 - 3-D caliper.xls	
“Borehole”_TEMP(FL)_RES(FL)_GP060 – Fluid temperature and resistivity logging.xls	
“Borehole”_DENSITY_GP090 – Density logging.xls	
“Borehole”_MAGSUSCEP_GP110 - Magnetic susceptibility logging.xls	
“Borehole”_GAM(NAT)_GP120 - Natural gamma logging.xls	
“Borehole”_SPR_GP150 - Single point resistance logging.xls	
“Borehole”_RES(64N)_GP160 - Resistivity, normal 1.6 m (64 in).xls	
“Borehole”_RES(MG)_GP161 - Resistivity, focused 140 cm.xls	
“Borehole”_RES(DG)_GP162 - Resistivity, focused 300 cm.xls	
“Borehole”_LATERAL_GP163 - Resistivity, lateral 1.6-0.1 m.xls	
“Borehole”_RES(16N)_GP164 - Resistivity, normal 0.4 m (16 in).xls	
“Borehole”_P-VEL_GP175 - Fullwave sonic.xls	
“Borehole”_GP830 - Acoustic televiewer.xls	
“Borehole”_SP_GP180 - Self potential logging.xls	

Borehole KFM02B. Drawing no. 1.1. Borehole logs

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

Northing: 6698719.19m Easting: 1633186.29m Elevation: 7.62m, RHB70

Diameter:	75.8mm
Reaming Diameter:	241.6mm
Outer Casing:	
Inner Casing:	80mm
Casing Length:	88.55m
Borehole Length:	573.87m
Cone:	
Inclination at ground surface:	-80.27°
Azimuth:	313.06°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	2007-02-20	JRI	UTN	UTN

Job: 547310A

Scale: 1:500

RAMBØLL

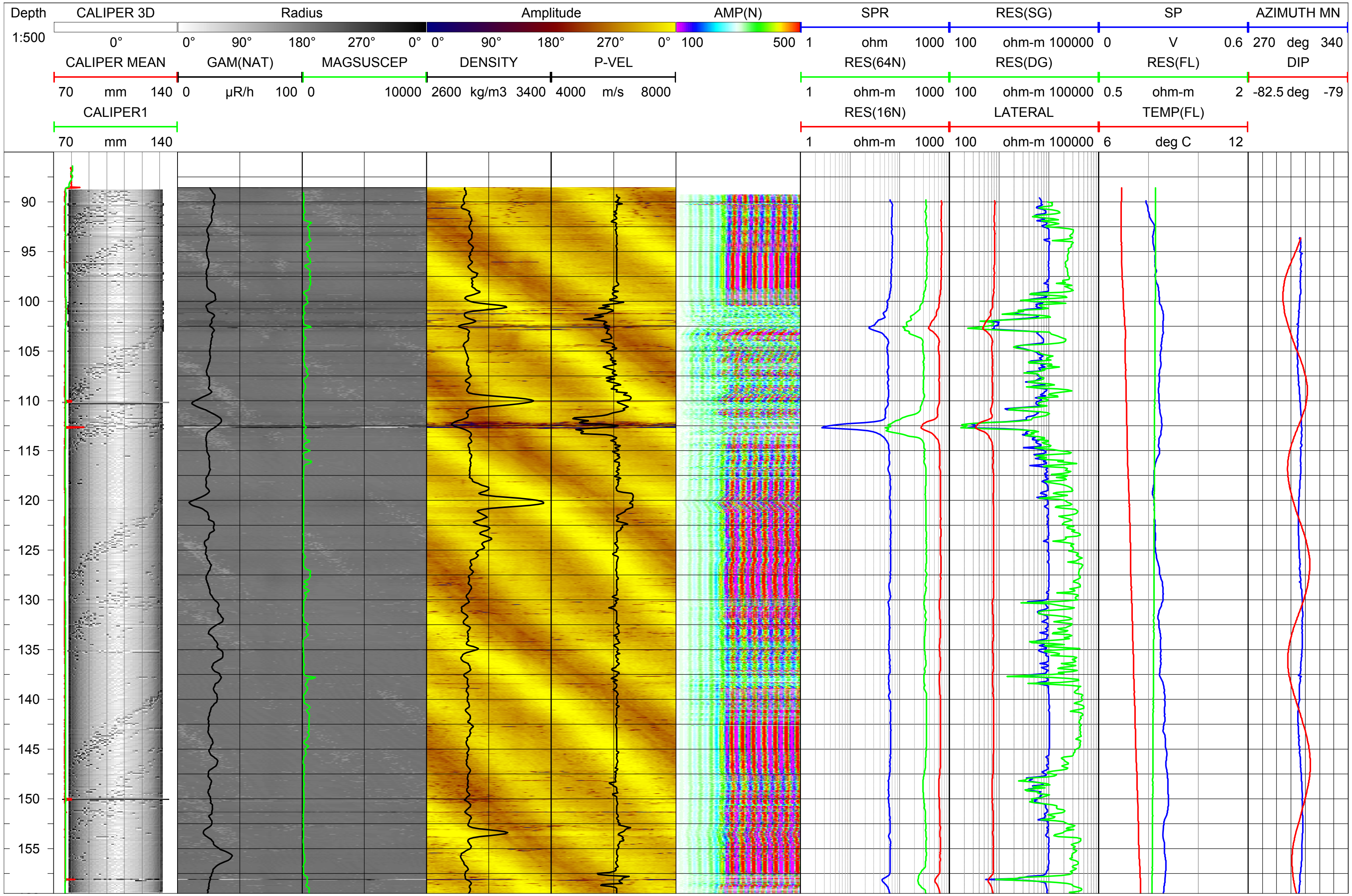
Rambøll. Bredevej 2, DK-2830 Virum
Phone + 45 45 98 60 00, Fax + 45 45 98 67 00

SKB geophysical borehole logging
Borehole KFM02B

Presentation

Filename: KFM02B_Presentation.wcl

Drawing no.: 1.1


Depth
1:500
CALIPER 3D
0°
CALIPER MEAN
70 mm 140
CALIPER1
70 mm 140
Radius
0° 90° 180° 270° 0°
GAM(NAT)
0 μR/h 100
MAGSUSCEP
0 10000
Amplitude
0° 90° 180° 270° 0°
DENSITY
2600 kg/m3 3400
P-VEL
4000 m/s 8000
AMP(N)
100 500
SPR
1 ohm 1000
RES(64N)
1 ohm-m 1000
RES(16N)
1 ohm-m 1000
RES(SG)
100 ohm-m 100000
RES(DG)
100 ohm-m 100000
LATERAL
100 ohm-m 100000
SP
0 V 0.6
RES(FL)
0.5 ohm-m 2
TEMP(FL)
6 deg C 12
AZIMUTH MN
270 deg 340
DIP
-82.5 deg -79
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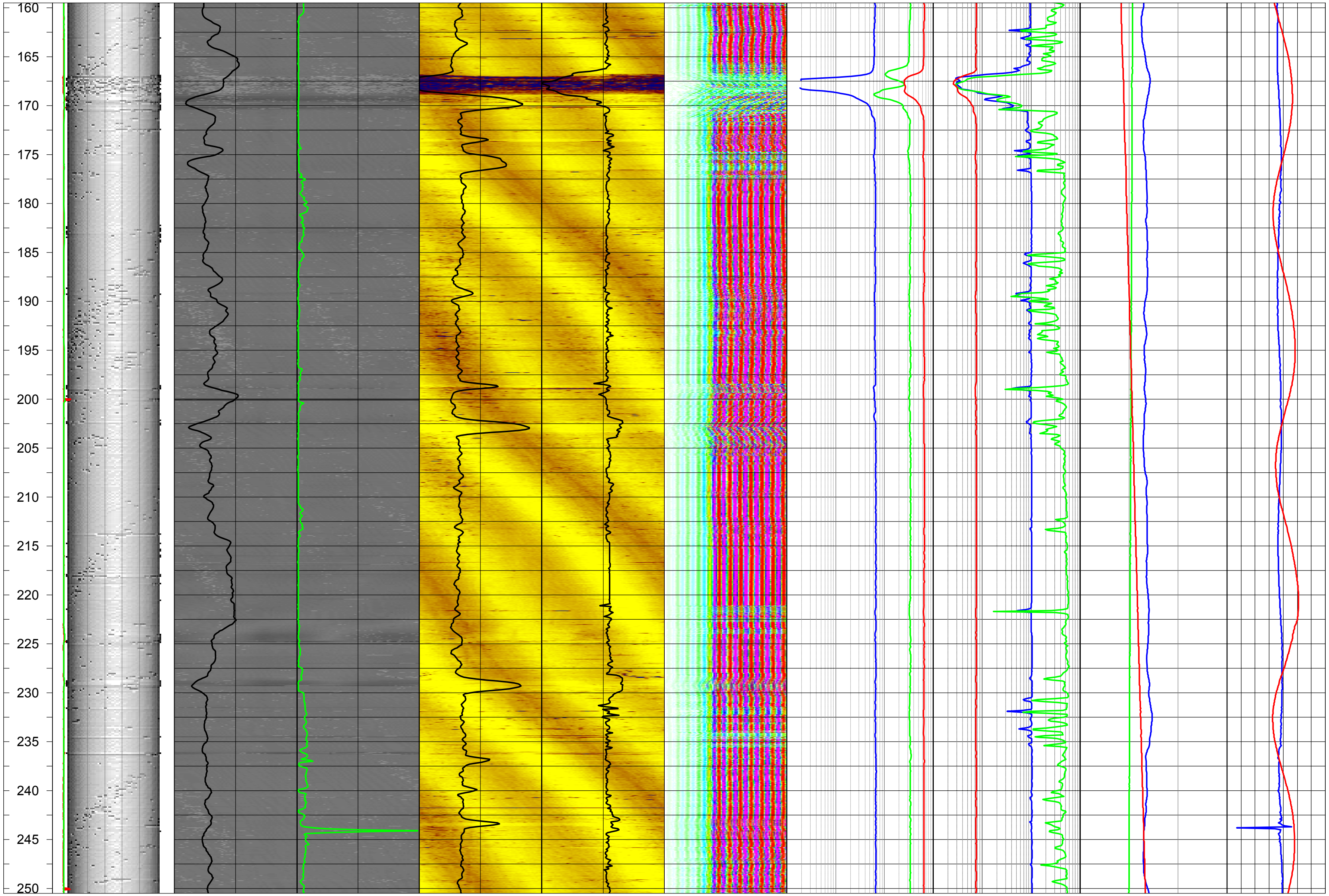
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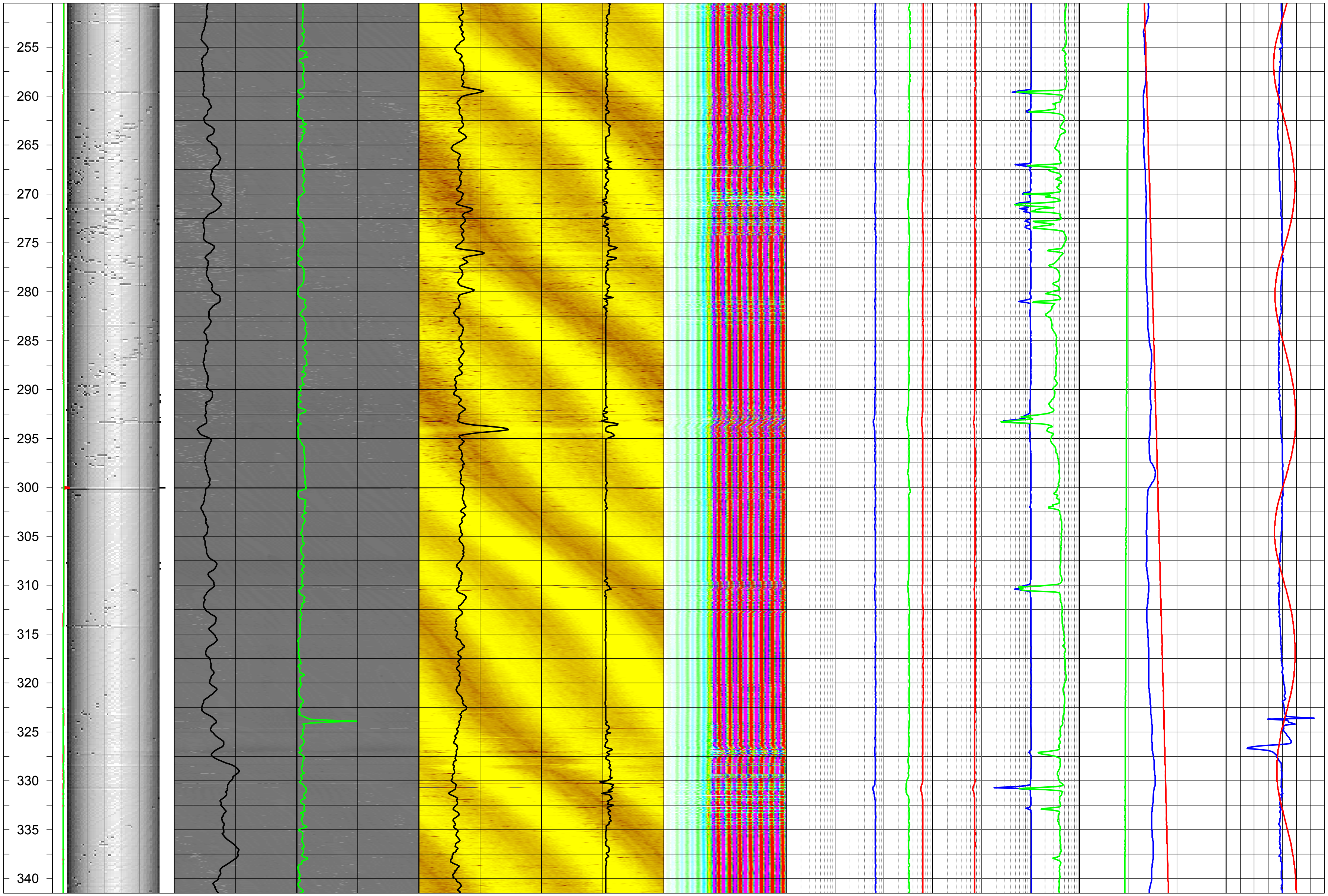
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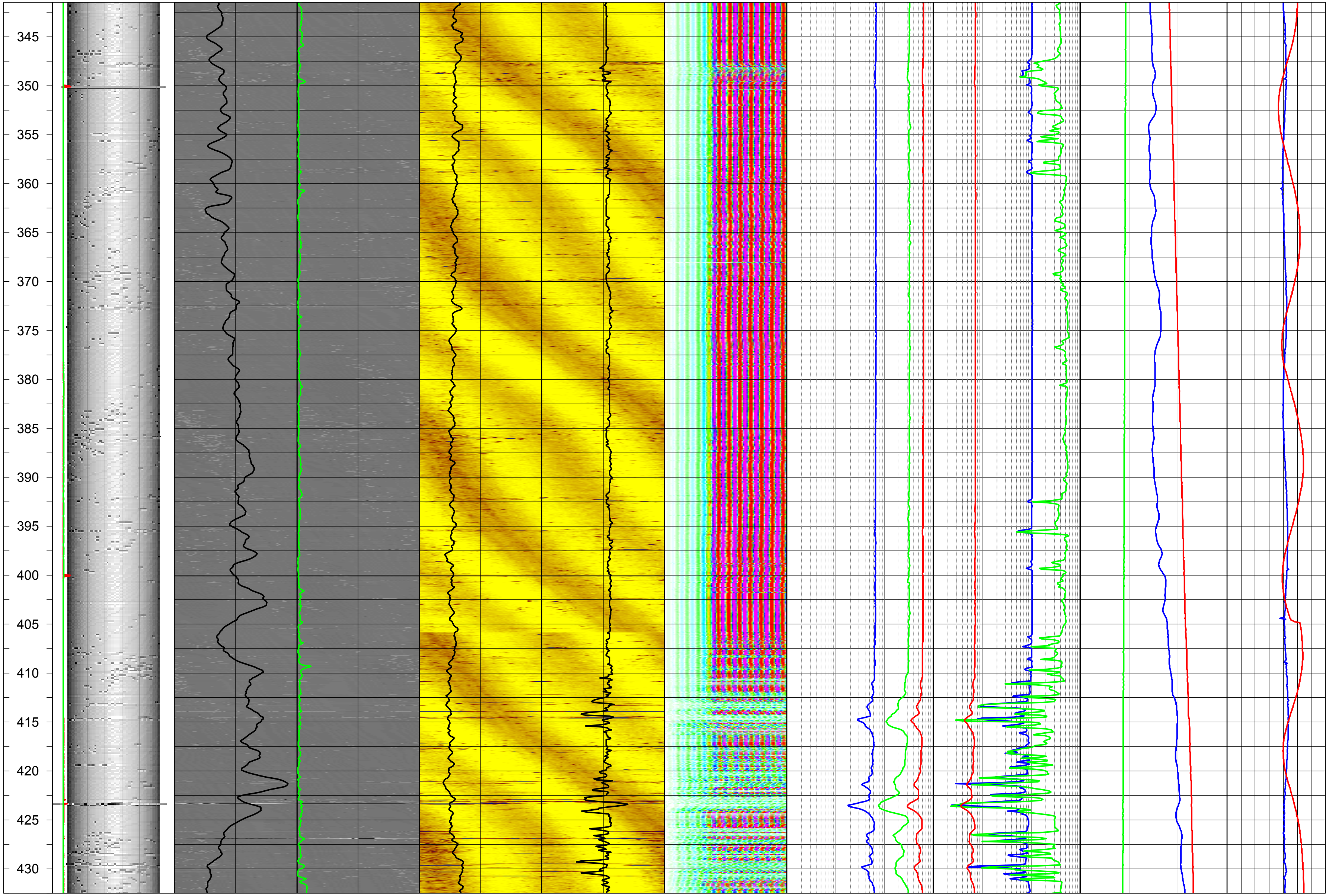
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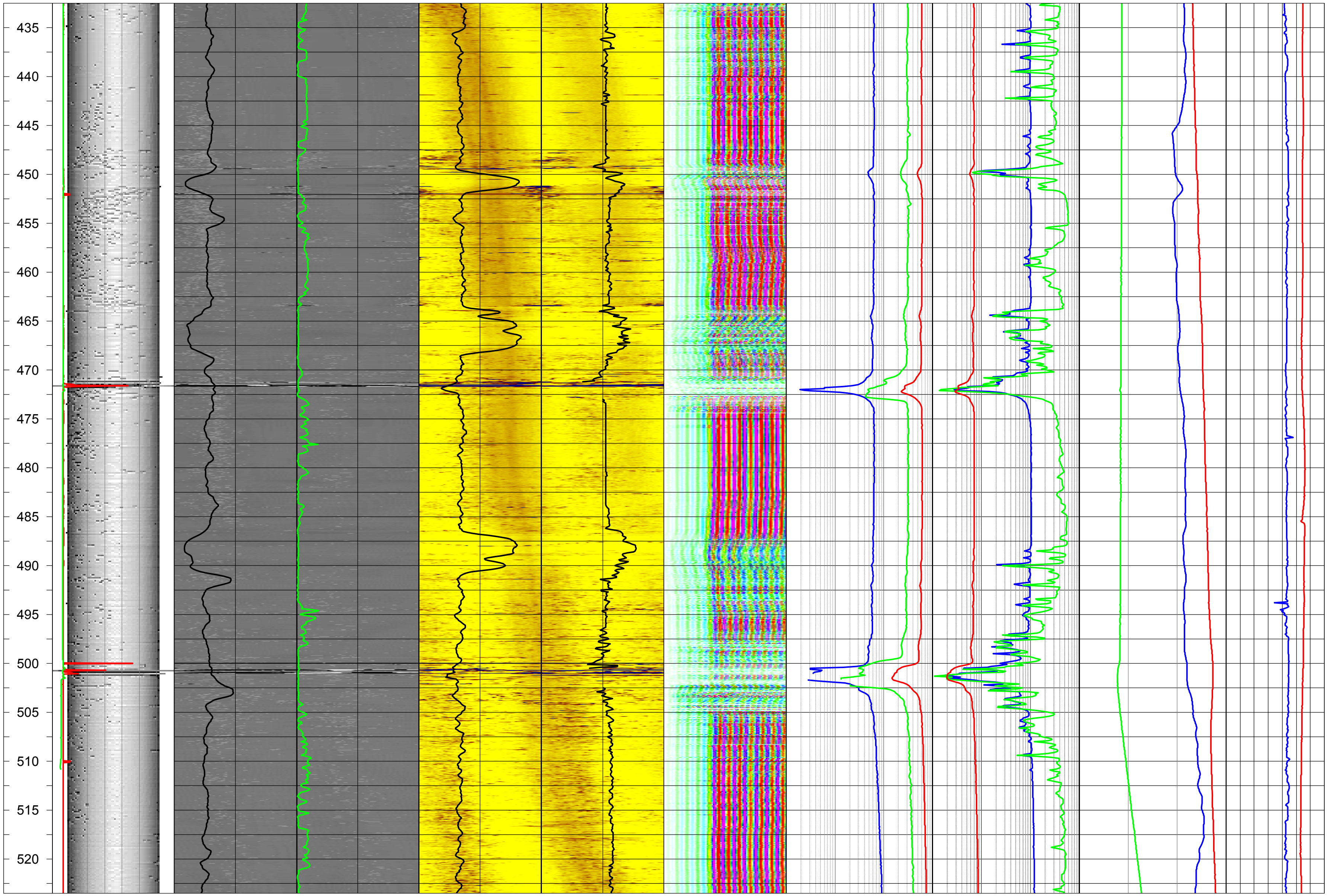

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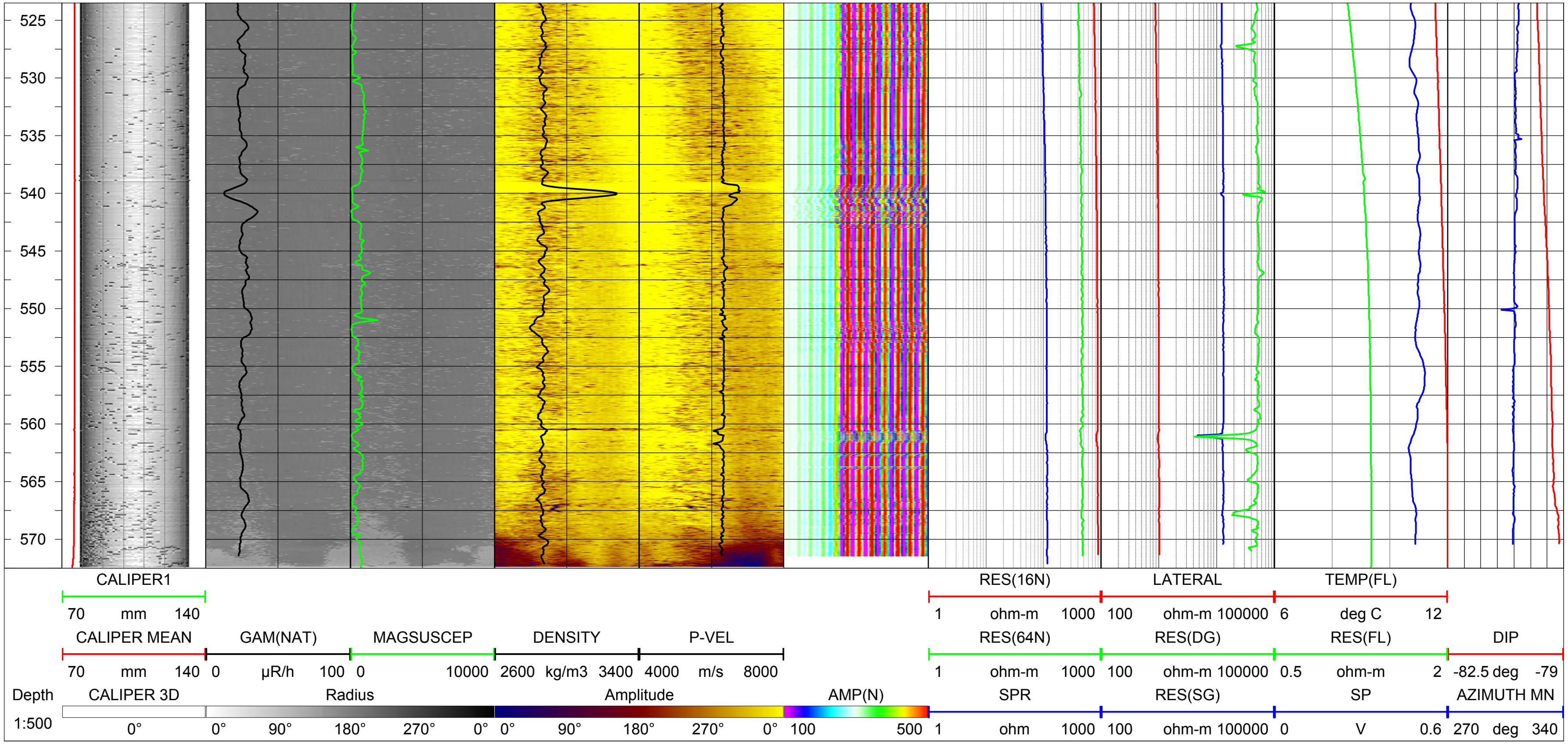
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CALIPER1
70 mm 140
RES(16N)
1 ohm-m 1000
LATERAL
100 ohm-m 100000
TEMP(FL)
6 deg C 12
CALIPER MEAN
70 mm 140
GAM(NAT)
0 μR/h 100
MAGSUSCEP
0 10000
DENSITY
2600 kg/m3 3400
P-VEL
4000 m/s 8000
RES(64N)
1 ohm-m 1000
RES(DG)
100 ohm-m 100000
RES(FL)
0.5 ohm-m 2
DIP
-82.5 deg -79
Depth
1:500
CALIPER 3D
0°
Radius
0° 90° 180° 270° 0°
Amplitude
0° 90° 180° 270° 0°
AMP(N)
100 500
SPR
1 ohm 1000
RES(SG)
100 ohm-m 100000
SP
0 V 0.6
AZIMUTH MN
270 deg 340

Borehole KFM08D. Drawing no. 2.1. Borehole logs

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

Northing: 6700491.68m Easting: 1631199.16m Elevation: 2.61m, RHB70

Diameter:	77.3mm
Reaming Diameter:	253.3mm
Outer Casing:	86mm
Inner Casing:	80mm
Casing Length:	60.75m
Borehole Length:	942.30m
Cone:	55.71-58.77m
Inclination at ground surface:	-55.00°
Azimuth:	99.98° 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	2007-03-07	JRI	UTN	UTN

Job	Scale
547310A	1:500

RAMBØLL

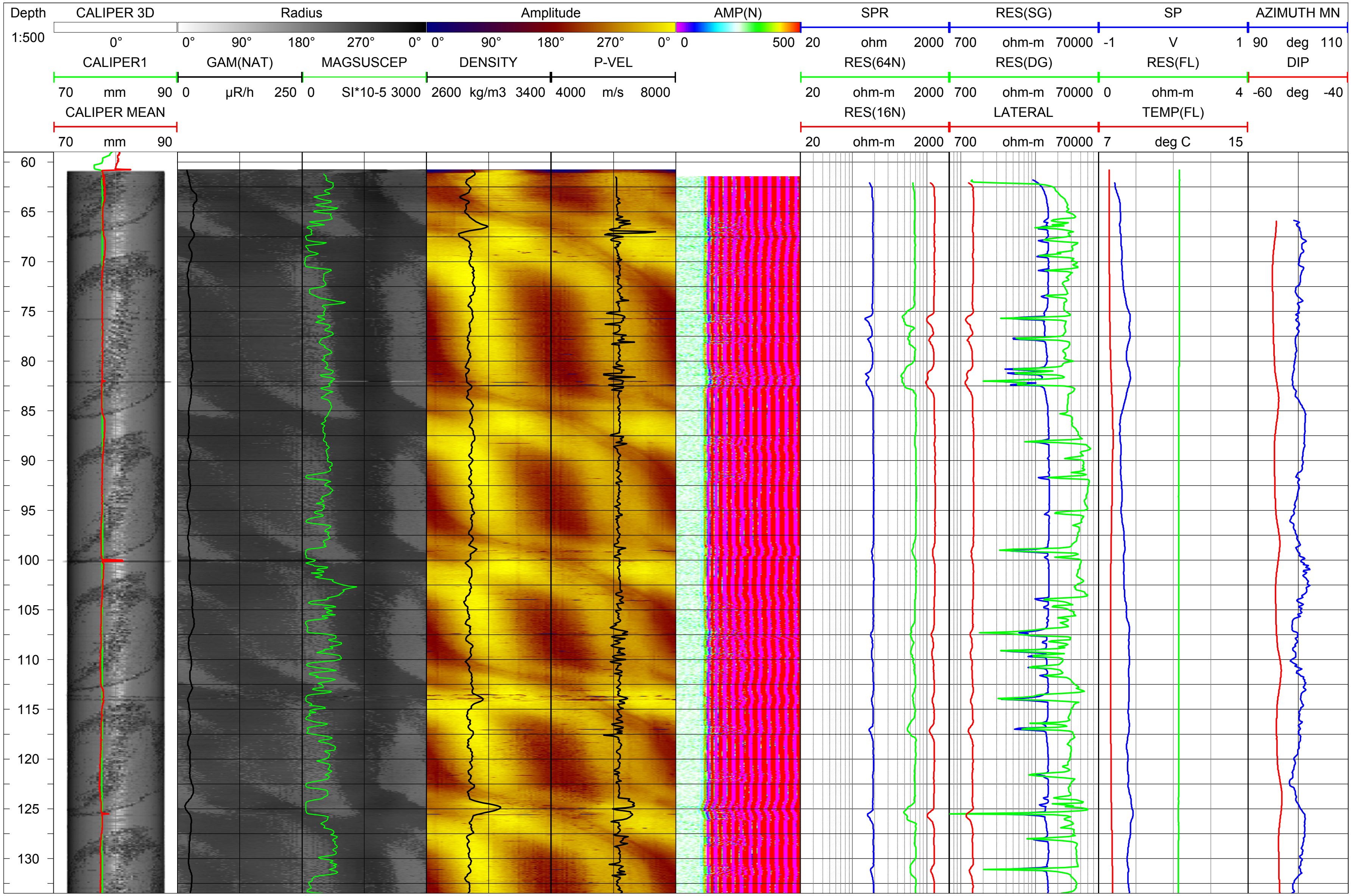
Rambøll. Bredevej 2, DK-2830 Virum
Phone + 45 45 98 60 00, Fax + 45 45 98 67 00

SKB geophysical borehole logging
Borehole KFM08D

Presentation

Filename:
KFM08D_Presentation.wcl

Drawing no.:
2.1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1:500
CALIPER 3D
0°
CALIPER1
70 mm 90
CALIPER MEAN
70 mm 90
Radius
0° 90° 180° 270° 0°
GAM(NAT)
0 µR/h 250
MAGSUSCEP
0 SI*10-5 3000
Amplitude
0° 90° 180° 270° 0°
DENSITY
2600 kg/m3 3400
P-VEL
4000 m/s 8000
AMP(N)
0 500
SPR
20 ohm 2000
RES(64N)
20 ohm-m 2000
RES(16N)
20 ohm-m 2000
RES(SG)
700 ohm-m 70000
RES(DG)
700 ohm-m 70000
LATERAL
700 ohm-m 70000
SP
-1 V 1
RES(FL)
0 ohm-m 4
TEMP(FL)
7 deg C 15
AZIMUTH MN
90 deg 110
DIP
-60 deg -40
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75
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95
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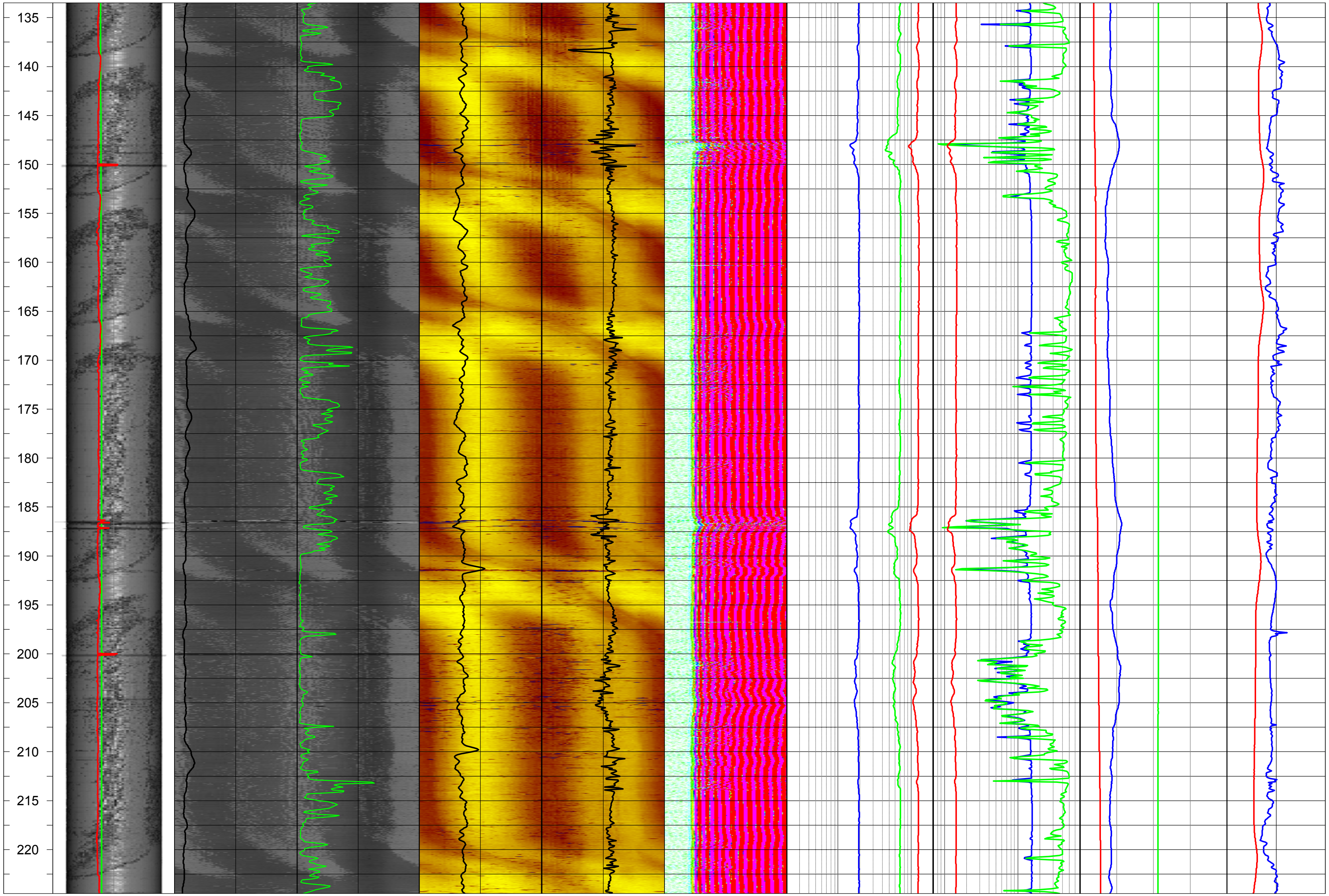
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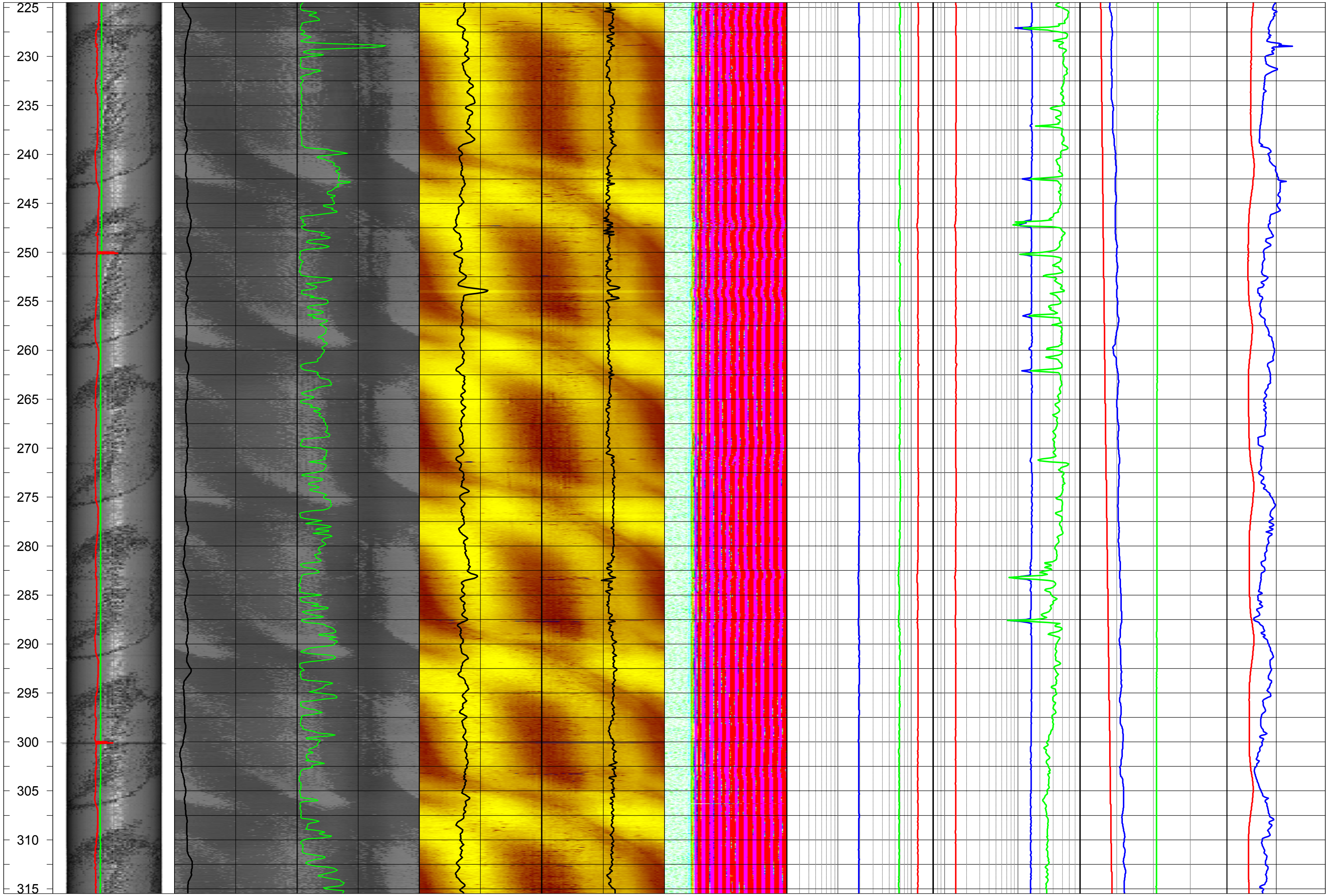
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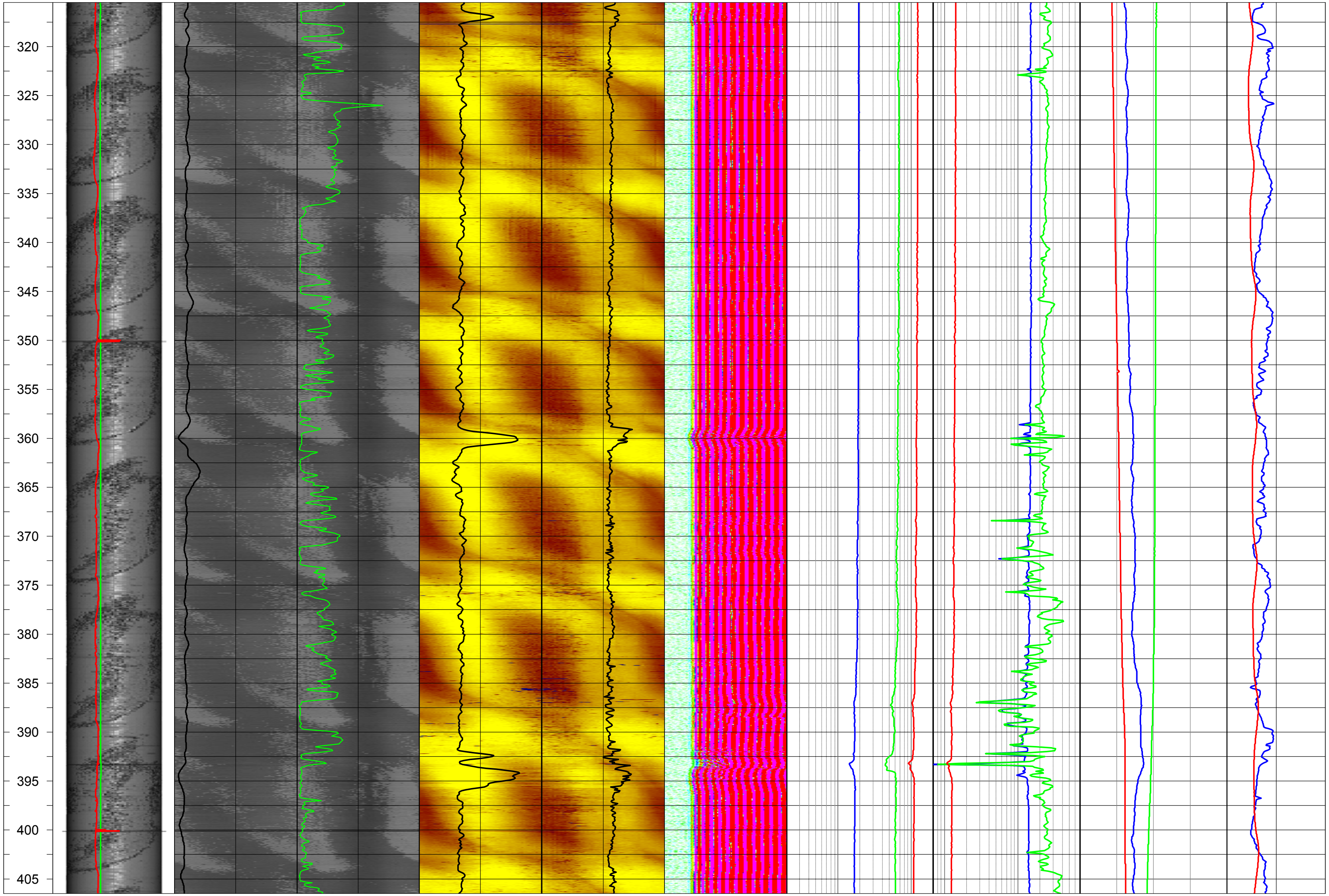
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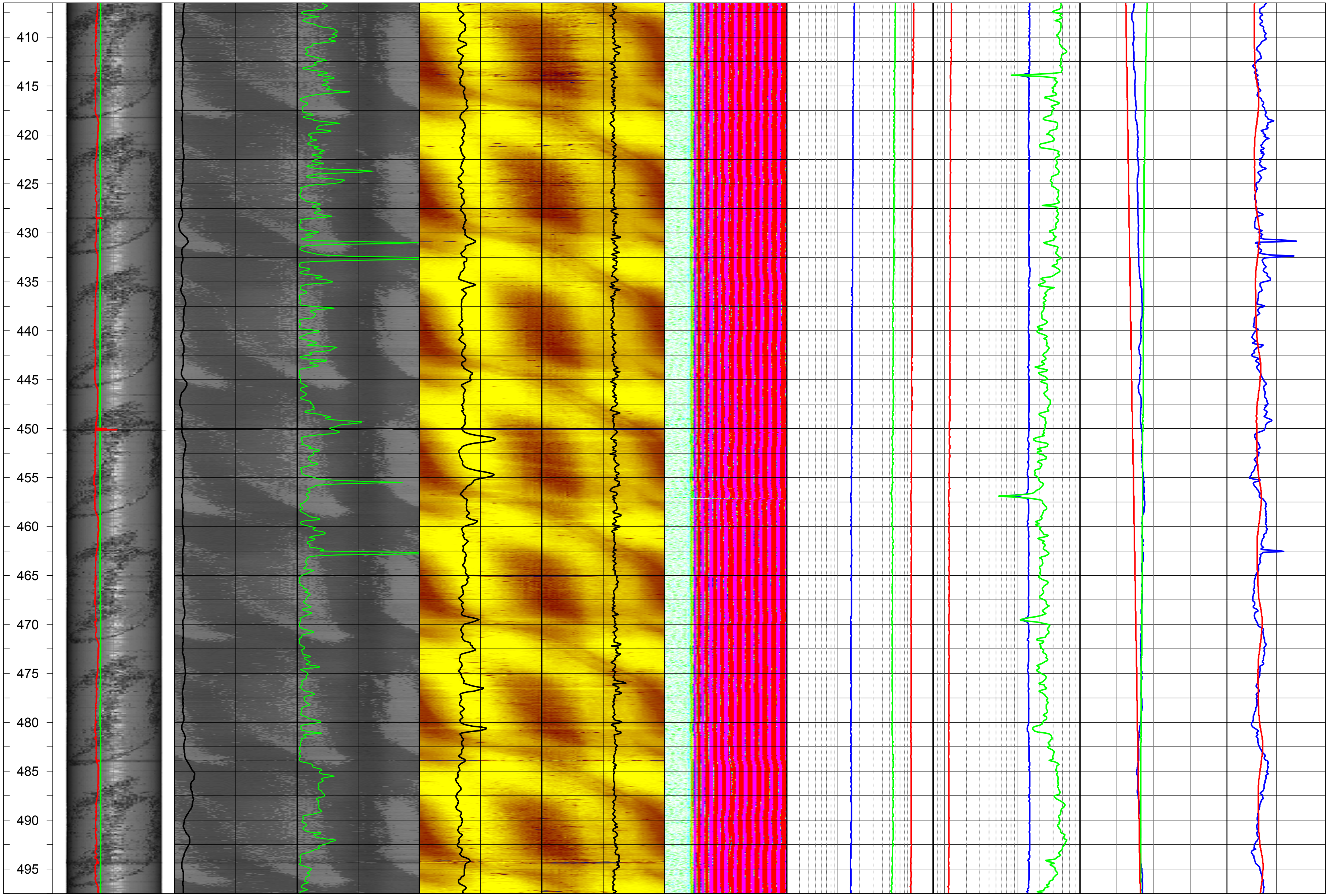

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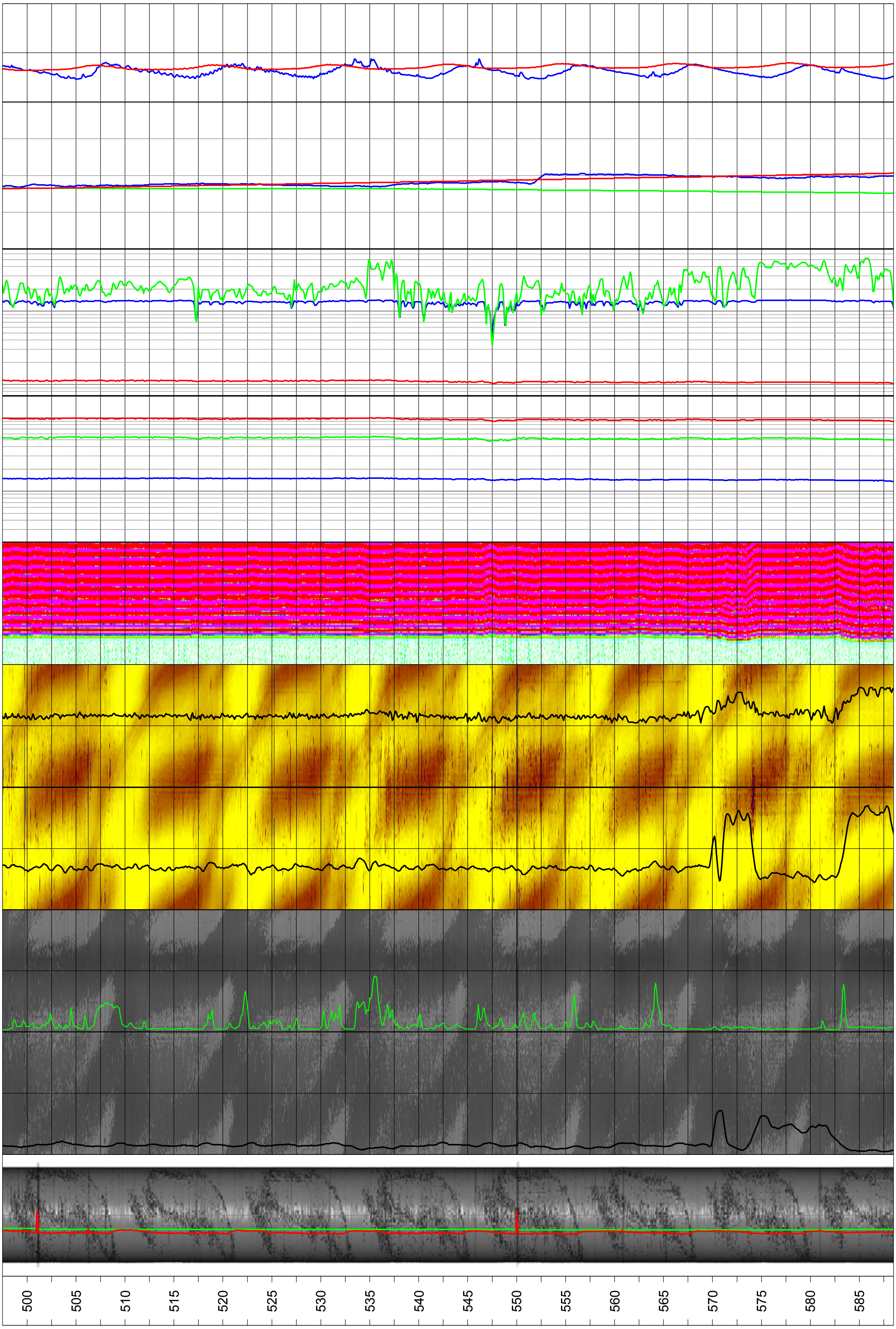
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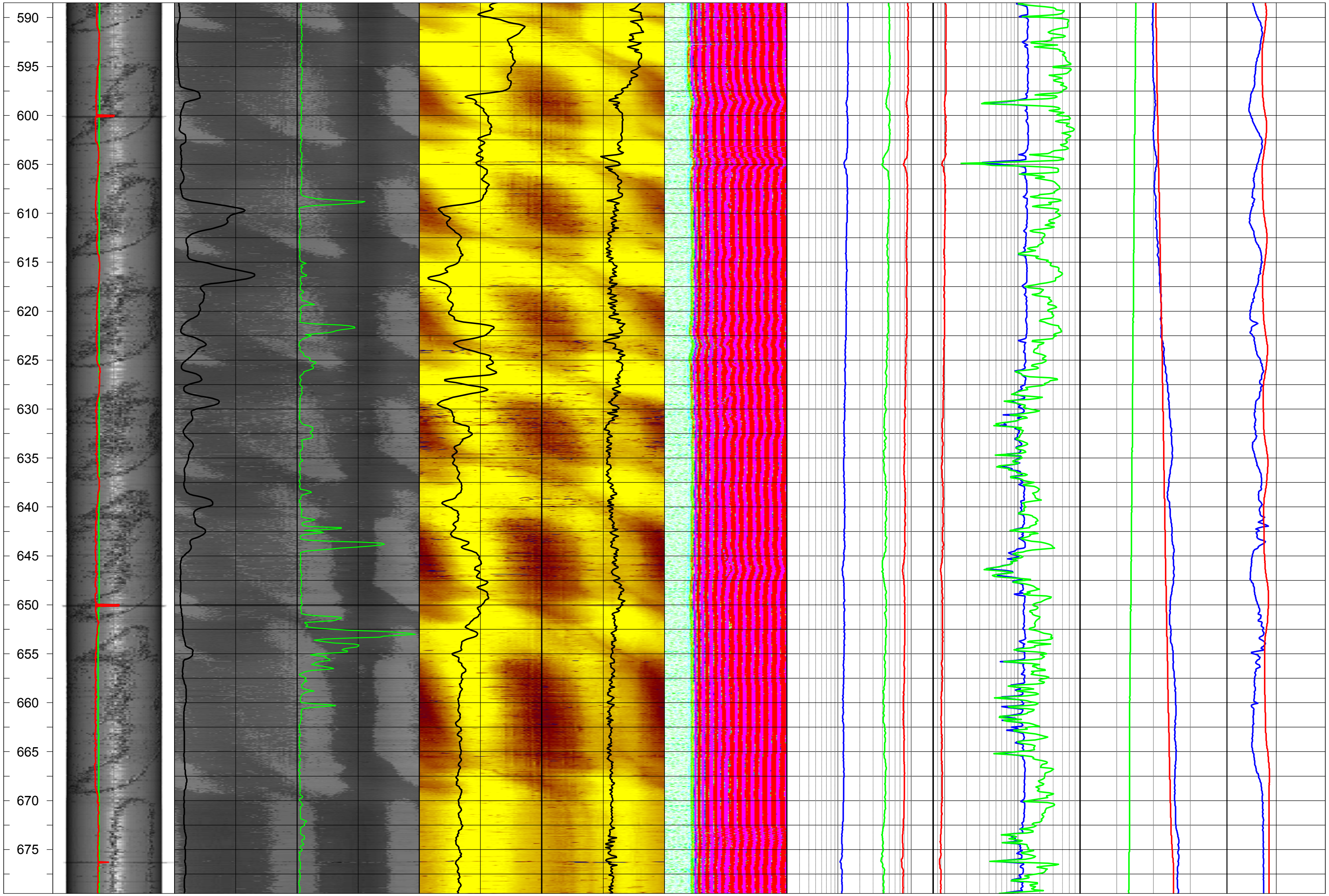
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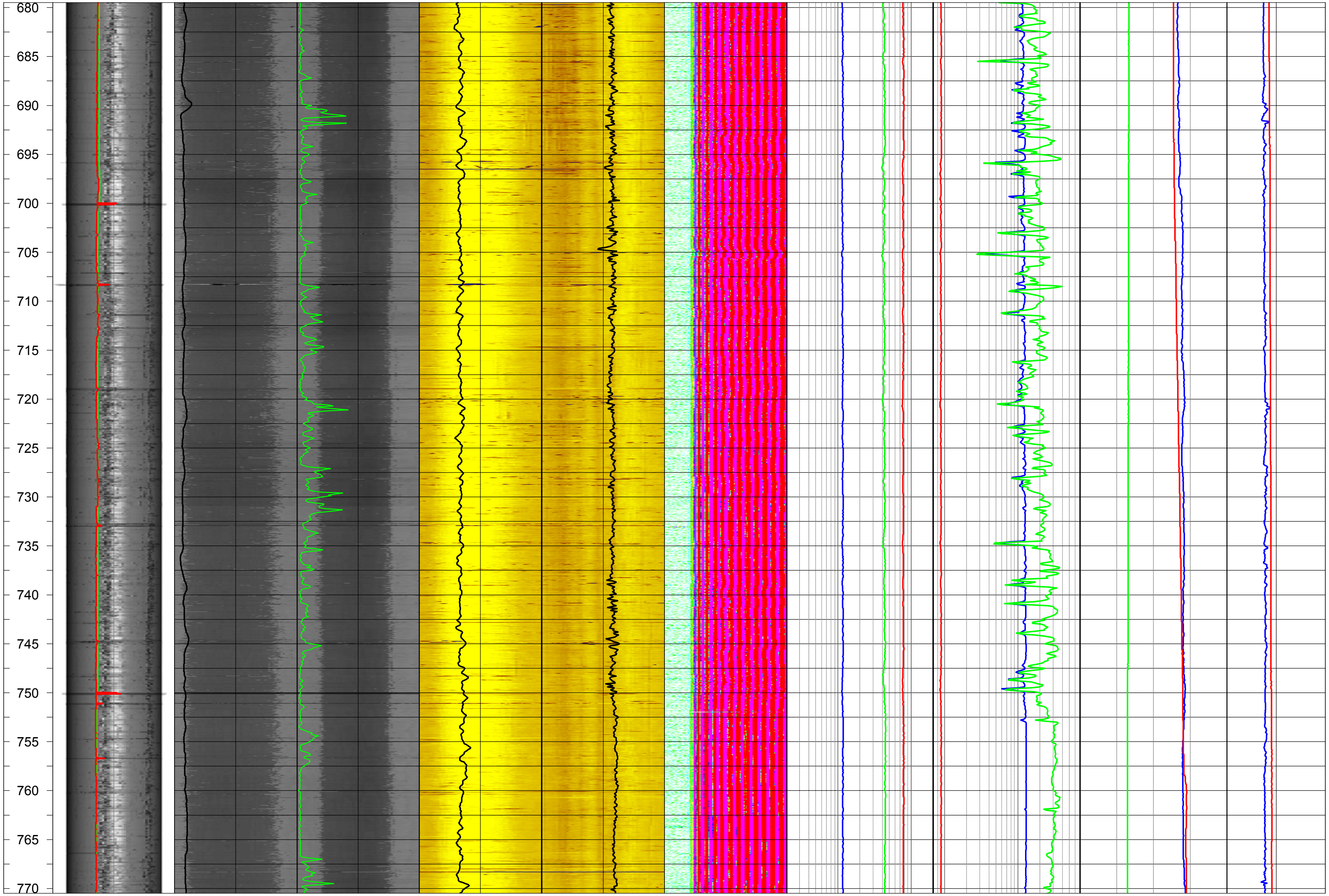
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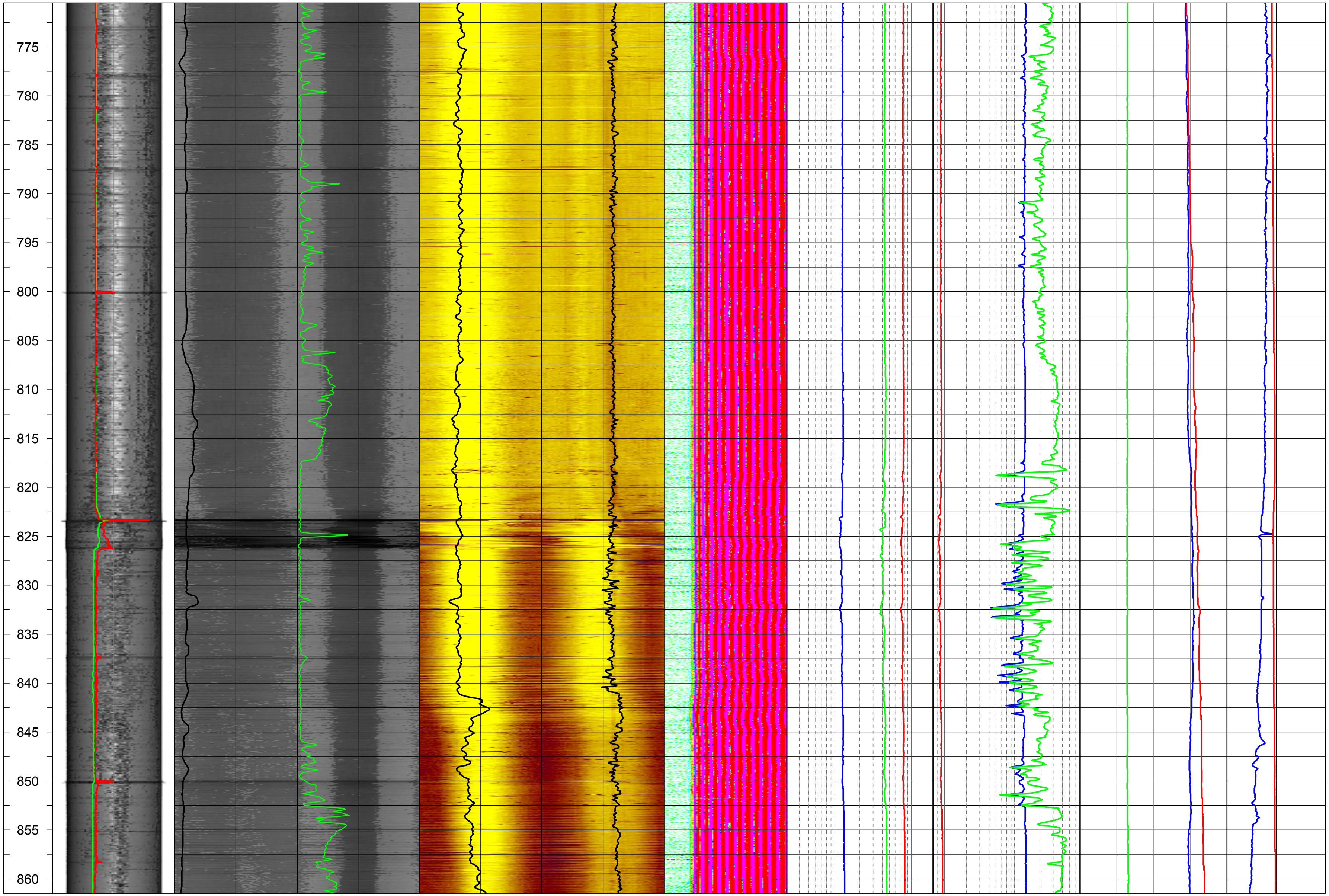
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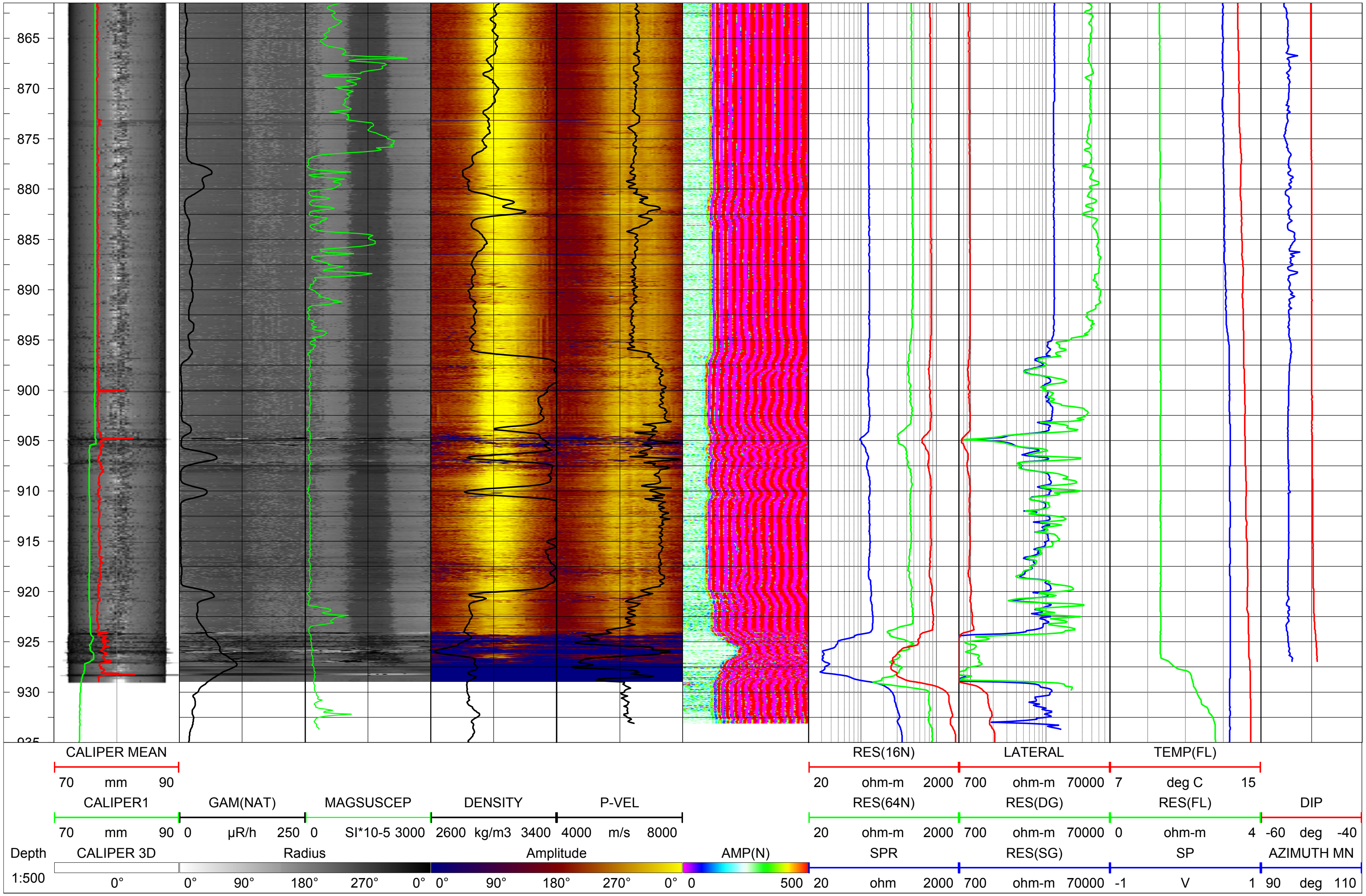
865
870
875
880
885
890
895
900
905
910
915
920
925
930
CALIPER MEAN
70 mm 90
CALIPER1
70 mm 90
GAM(NAT)
0 μR/h 250
MAGSUSCEP
0 SI*10-5 3000
DENSITY
2600 kg/m3 3400
P-VEL
4000 m/s 8000
Depth
1:500
CALIPER 3D
0°
Radius
0° 90° 180° 270° 0°
Amplitude
0° 90° 180° 270° 0°
AMP(N)
0 500
RES(16N)
20 ohm-m 2000
RES(64N)
20 ohm-m 2000
SPR
20 ohm 2000
LATERAL
700 ohm-m 70000
RES(DG)
700 ohm-m 70000
RES(SG)
700 ohm-m 70000
TEMP(FL)
7 deg C 15
RES(FL)
0 ohm-m 4
SP
-1 V 1
DIP
-60 deg -40
AZIMUTH MN
90 deg 110