

Forsmark site investigation

Geophysical borehole logging in the boreholes KFM07A, KFM08A and KFM08B

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This report concerns a study which was conducted for SKB. The conclusions and viewpoints presented in the report are those of the authors and do not necessarily coincide with those of the client.

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Abstract

Geophysical borehole logging has been performed in boreholes KFM07A, KFM08A and KFM08B, all boreholes 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.

The logging in KFM07A was recorded from 100 m to 1000 m, KFM08A was recorded from 100 to 1000 m and KFM08B was recorded from 0 to 200 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 to 3.

Sammanfattning

Geofysisk borrhålsloggning har genomförts i borrhålen KFM07A, KFM08A och KFM08B 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 KFM07A från 100 m till 1000 m, KFM08A mättes från 100 till 1000 m och KFM08B mättes från 0 till 200 m.

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

Processerade loggar presenteras i Appendix 1 till 3.

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1 Introduction

This document reports the results gained by the geophysical borehole logging in boreholes KFM07A, KFM08A and KFM08B, which is one of the activities performed within the site investigation in Forsmark. The work was carried out in accordance with activity plan AP PF 400-05-008 (SKB internal controlling document) for boreholes KFM07A and KFM08B and in accordance with AP PF 400-05-042 for borehole KFM08A. In Table 1-1 controlling documents for performing this activity are listed.

All measurements were conducted by RAMBØLL during the period February 8 to 9 and April 27 to 29, 2005. All boreholes were recorded from Top Of Casing (TOC) to the bottom of the borehole. The technical data from the boreholes are shown in Table 1-2. The locations of the boreholes are shown in Figure 1-1.

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

Activity plan	Number	Version
Geofysisk borrhålsloggning i KFM07A och KFM08B	AP PF 400-05-008	1.0
Geofysisk borrhålsloggning i KFM08A	AP PF 400-05-042	1.0
Method descriptions	Number	Version
Metodbeskrivning för geofysisk borrhålsloggning	SKB MD 221.002	1.0
Metodbeskrivning för krökningsmätning av hammar- och kärnborrhål	SKB MD 224.001	1.0

Table 1-2. Technical data from core boreholes KFM07A, KFM08A and KFM08B.

Boreholes parameter	KFM07A	KFM08A	KFM08B
Co-ordinates (RT90)	X: 6700127.08	X: 6700494.68	X: 6700492.754
	Y: 1631031.57	Y: 1631197.03	Y: 1631173.266
Elevation (RHB70)	Z: 3.32	Z: 2.487	Z: 2.248
Azimuth	261.47°	319.42°	270.45°
Inclination (from horizontal)	-59.22°	-60.11°	-58.85°
Length	1001.55 m	1001.19 m	200.54 m
Casing	101.95 m	102.26 m	5.58
Borehole diameter	∅ 76 mm (101,95-1001.55 m)	∅ 76 mm (102,26-1001.19 m)	∅ 78.2 mm (5.58-200.54 m)
Cleaning level	Level 2	Level 2	Level 2

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

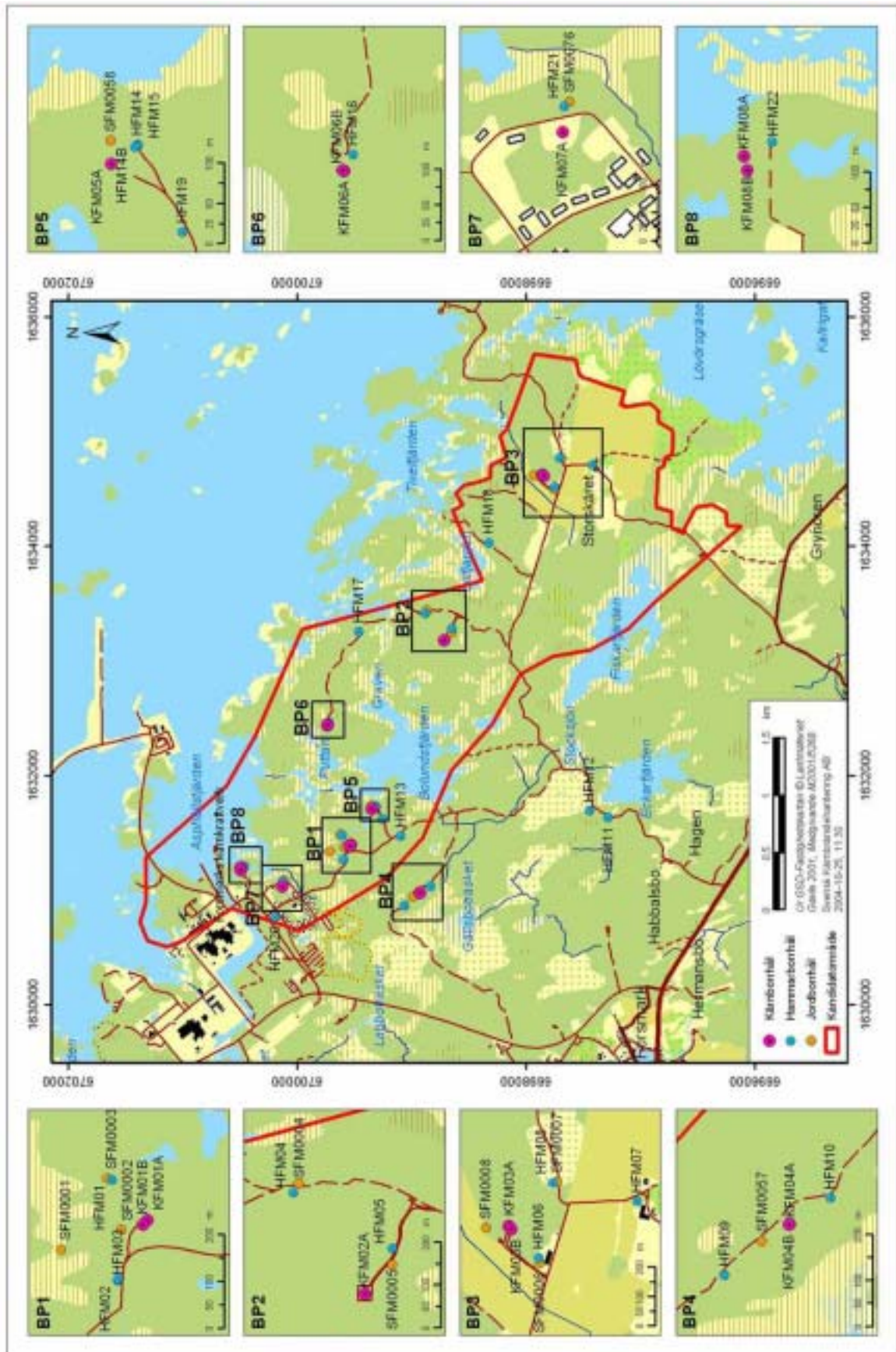


Figure 1-1. General overview over the Forsmark areas. Borehole KFM07A is located at drill site BP7. Borehole KFM08A and KFM08B are located at drill site BP8.

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 identifying the length marks in the core drilled boreholes, KFM07A and KFM08A .

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. The borehole KFM07A is presented in Appendix 1, drawing no 1.1, the borehole KFM08A is presented in Appendix 2, drawing no 2.1 and the borehole KFM08A is presented in Appendix 3, drawing no 3.1.

3 Equipment

The geophysical borehole logging program in all boreholes was performed with 7 multi tool probes and resulted in a suite of 19 log types, listed in Table 5-1.

Tool 9042 has not been used in borehole KFM07A.

The tools and recorded logs are listed in Table 3-1.

Table 3-1. Logging tools and logs recorded in KFM07A, KFM08A and KFM08B.

Tool	Recorded logs	Dimension	Source detector spacing and type	Tool position in borehole
Century 8044 Normal resistivity, fluid temperature and fluid resistivity.	Normal resistivity (16 & 64 inch), single point resistance, fluid resistivity, fluid temperature and natural gamma.	237·5.3 cm		
Century 8622 Magnetic susceptibility.	Magnetic susceptibility, natural gamma.	203·4.1 cm		
Century 9030 Gamma density.	Gamma density, natural gamma, 140 cm focused guard log resistivity, 10 cm 1-arm calliper.	307·5.6 cm	20.3 cm 125 mCi Cs137	Sidewall. Gamma source focused.
Century 9042 Fluid temperatur and fluid resistivity	Fluid temperatur, fluid resistivity and natural gamma.	137 x 4.1 cm		
Century 9072 3 m focused guard.	3 m focused guard log resistivity and natural gamma.	310·6.4 cm		
Century 9310 Sonic.	Full wave form travel-time providing P & S-wave velocity picking, compensated P-wave travel-time and natural gamma.	283.2·5.1 cm	Near 2 ft. Far 3 ft.	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.	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 8 to 9 and April 27 to 29, 2005. All relevant logging events were 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. The cleaning was done according to SKB cleaning level 2 (SKB internal controlling document SKB MD 600.004) before arriving at the site. Furthermore, all equipment was wiped with alcohol before it was lowered into the boreholes.

A function test of the deviation measurements in the HiRAT tool was performed before arriving at the site, following SKB internal controlling document SKB MD 224.001.

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 9030 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 tools was in general 10 m/min for the used log runs.

4.2 Nonconformities

Borehole KFM08A. The up run SP log from tool 8044 has been used in the processing.

5 Results

5.1 Presentation

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

Logs from KFM07A are presented in drawings no. 1.1 in Appendix 1. The TEMP(FL) and RES(FL) are recorded with the 8044 tool.

Logs from KFM08A are presented in drawings no. 2.1 in Appendix 2. The TEMP(FL) and RES(FL) are recorded with the 9042 tool.

Logs from KFM08B are presented in drawings no. 3.1 in Appendix 3. The TEMP(FL) and RES(FL) are recorded with the 9042 tool.

The different logs are presented in Table 5-1.

Table 5-1. Logs presented in drawings no. 1.1 – 3.1 in Appendices 1 - 3.

Log	Log name short	Unit	Tool
Fluid temperature	TEMP(FL)	deg C	8044/9042
Fluid resistivity	RES(FL)	ohm-m	8044/9042
Normal resistivity 16 inch	RES(16N)	ohm-m	8044
Normal resistivity 64 inch	RES(64N)	ohm-m	8044
Lateral resistivity	LATERAL	ohm-m	8044
Single point resistance	SPR	Ohm	8044
Self Potential	SP	mV	8044
Magnetic susceptibility	MAGSUSCEP	SI*10 ⁻⁵	8622
Caliper, 1-arm	CALIPER1	mm	9030
Gamma-gamma density	DENSITY	kg/m ³	9030
Focused guard log resistivity, 140 cm	RES(MG)	ohm-m	9030
Natural gamma	GAM(NAT)	µR/h	9030
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 Orientation, alignment and stretch of logs

5.2.1 Orientation of images

The orientation of the results from the HiRAT Acoustic tool, are done after recording. The orientation is done using the raw data from the magnetometers and accelerometers, where spikes and disturbed data are deleted or filtered away.

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. In case of overlaps, data is always used from the topmost-recorded file (overlapping data are never the mean value from two log runs).

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 constructed 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.

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 all 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.

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 $\mu\text{R/h}$ by multiplying the constant 0.077. This constant was computed from the logs previously performed in borehole KLX02 located in Oskarshamn.
Fluid temperature	-

Log	Description of log calculation
Fluid resistivity	-
Normal resistivity 16 inch	-
Normal resistivity 64 inch	-
Lateral resistivity	-
Single point resistance	-
Self-potential	-
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 the difference between the first arrival from the far and near signal. $(121.9 \text{ cm} - 91.4 \text{ cm}) / (\text{Time}(\text{far}) - \text{Time}(\text{near}))$.
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 acoustical televiewer, the fluid temperature, fluid velocity and the internal travel time in the acoustical 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 travel time	-

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 KFM07A

In order to obtain an exact depth calibration in borehole KFM07A, 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 from the HiRAT in borehole KFM07A.

Reference mark	HiRAT recorded
150.0	150.00
203.0	203.06
250.0	250.14
300.0	300.23
350.0	350.31
400.0	400.39
450.0	450.48
500.0	500.57
550.0	550.62
600.0	600.72
650.0	650.79
700.0	700.85
750.0	750.94
800.0	801.01
849.0	850.12
900.0	901.22
950.0	951.33
980.0	981.39

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 KFM07A, between all logruns, the obtained reference mark correlation is transferred to the other logs.

The complete log suite for borehole KFM07A 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 KFM08A

In order to obtain an exact depth calibration in borehole KFM08A, 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.

Table 5-4. The reference track marks in the borehole and the recorded track marks from the HiRAT in borehole KFM08A.

Reference mark	HIRAT recorded
151.0	147.39
200.0	196.49
250.0	246.56
300.0	296.42
350.0	346.72
400.0	396.78
450.0	446.84
500.0	496.90
600.0	597.03
650.0	646.43
700.0	696.47
750.0	746.59
800.0	796.64
850.0	846.70
900.0	896.82
981.0	977.94

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 KFM08A, between all logruns, the obtained reference mark correlation is transferred to the other logs.

The complete log suite for borehole KFM08A 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.

5.6 Borehole KFM08B

Using the bottom of the casing and the natural gamma from the HiRAT as reference, the natural gamma logs from the other probes are aligned to the same depth. A new depth scale is added to each log and afterwards the logs are stretched using the events shown in Table 5-5.

Table 5-5. Gamma events in borehole KFM08B.

Events	Depths
Top event	16
Bottom event	77

The complete log suite for borehole KFM08B is presented as composite log sheet in drawing no. 3.1 in Appendix 3. The logs presented in drawing no. 3.1 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
KFM07A	8044	Down	KFM07_02-08-05_10-00_8044C_02_0.28_1003.16_ORIG.log	Start Depth: 0.28 m. End Depth: 1003.16 m
KFM07A	8622	Up	KFM07_02-08-05_17-34_8622C_02_-2.24_1003.90_ORIG.log	Start Depth: 1003.9 m. End Depth: -2.24 m
KFM07A	9030	Up	KFM07_02-09-05_10-50_9030CA_02_48.92_998.30_ORIG.log	Start Depth: 998.3 m. End Depth: 48.92 m
KFM07A	9072	Up	KFM07_02-08-05_13-08_9072C_02_-2.14_1003.08_ORIG.log	Start Depth: 1003.08 m. End Depth: -2.14 m
KFM07A	9310	Up	KFM07_02-08-05_15-23_9310C2_02_47.74_1001.95_ORIG.log	Start Depth: 1001.95 m. End Depth: 47.74 m
KFM07A	HiRAT	Up	KFM07A_Hirat_90_up2.HED	Start Depth: 1000 m. End Depth: 0 m
KFM08A	8044	Down	KFM08A_04-28-05_07-43_8044C_02_90.72_1001.07_ORIG.log	Start Depth: 90.72 m. End Depth: 1001.07 m
KFM08A	8044	Up	KFM08A_04-28-05_09-16_8044C_02_2.03_995.40_ORIG.log	Start Depth: 995.4 m. End Depth: 2.03 m
SP – log only				
KFM08A	8622	Up	KFM08A_04-27-05_17-05_8622C_02_-2.09_1001.53_ORIG.log	Start Depth: 1001.53 m. End Depth: -2.09 m
KFM08A	9030	Up	KFM08A_04-28-05_14-16_9030CA_02_-2.06_995.20_ORIG.log	Start Depth: 995.2 m. End Depth: -2.06 m
KFM08A	9042	Down	KFM08A_04-28-05_09-49_9042C_02_241.69_997.65_ORIG.log	Start Depth: 241.69 m. End Depth: 997.65 m
KFM08A	9042	Down	KFM08A_04-27-05_15-20_9042C_02_9.37_259.55_ORIG.log	Start Depth: 9.37 m. End Depth: 259.55 m
KFM08A	9042	Down	KFM08A_04-28-05_20-35_9042C_02_193.01_255.68_ORIG.log	Start Depth: 193.01 m. End Depth: 255.68 m

Borehole	Probe	Log direction	WellCAD File	Description
KFM08A	9072	Up	KFM08A_04-29-05_08-02_9072C_02_90.49_995.16_ORIG.log	Start Depth: 995.16 m. End Depth: 90.49 m
KFM08A	9310	Down	KFM08A_04-28-05_16-19_9310C2_10_-2.60_998.00_ORIG.log	Start Depth: 998 m. End Depth: -2.6 m
KFM08A	HIRAT	Up	KFM08a_hirat_uprun_01.HED	Start Depth: 1000 m. End Depth: 620 m
KFM08A	HIRAT	Up	KFM08a_hirat_uprun_02.HED	Start Depth: 630 m. End Depth: 0 m
KFM08B	8044	Down	KFM08B_04-29-05_10-00_8044C_02_0.28_202.32_ORIG.log	Start Depth: 0.28 m. End Depth: 202.32 m
KFM08B	8622	Up	KFM08B_02-09-05_15-33_8622C_02_-0.78_199.84_ORIG.log	Start Depth: 199.84 m. End Depth: -0.78 m
KFM08B	9030	Up	KFM08B_02-09-05_17-07_9030CA_02_-0.10_199.60_ORIG.log	Start Depth: 199.6 m. End Depth: -0.1 m
KFM08B	9042	Down	KFM08B_04-29-05_10-41_9042C_02_0.22_201.10_ORIG.log	Start Depth: 0.22 m. End Depth: 201.1 m
KFM08B	9072	Up	KFM08B_02-09-05_16-29_9072C_02_-0.49_200.31_ORIG.log	Start Depth: 200.31 m. End Depth: -0.49 m
KFM08B	9310	Up	KFM08B_02-09-05_15-03_9310C2_02_-0.64_198.68_ORIG.log	Start Depth: 198.68 m. End Depth: -0.64 m
KFM08B	HIRAT	Up	KFM08B_Hirat_90_UP2.HED	Start Depth: 196 m. End Depth: 0 m

Table 6-2. Drawing files in WellCad format

Borehole	Drawing	Drawing version	WellCad file
KFM07A	1.1	0	KFM07A_Presentation.WCL
KFM08A	2.1	0	KFM08A_Presentation.WCL
KFM08B	3.1	0	KFM08B_Presentation.WCL

Table 6-3. Data files in excel for each borehole. Files in SICADA format

Sheet	Comment
"Borehole"_GP040	- Caliper logging.xls
"Borehole"_GP041	- 3-D caliper.xls
"Borehole"_GP060	- Fluid temperature and resistivity logging.xls
"Borehole"_GP090	- Density logging.xls
"Borehole"_GP110	- Magnetic susceptibility logging.xls
"Borehole"_GP120	- Natural gamma logging.xls
"Borehole"_GP150	- Single point resistance logging.xls
"Borehole"_GP160	- Resistivity, normal 1.6 m (64 in).xls
"Borehole"_GP161	- Resistivity, focused 140 cm.xls
"Borehole"_GP162	- Resistivity, focused 300 cm.xls
"Borehole"_GP163	- Resistivity, lateral 1.6-0.1 m.xls
"Borehole"_GP164	- Resistivity, normal 0.4 m (16 in).xls
"Borehole"_GP175	- Fullwave sonic.xls
"Borehole"_GP180	- Self potential logging.xls
"Borehole"_GP830	- Acoustic televiewer.xls

7 Appendices

- 1 Borehole KFM07A. Drawing no. 1.1. Borehole logs.
- 2 Borehole KFM08A. Drawing no. 2.1. Borehole logs.
- 3 Borehole KFM08B. Drawing no. 3.1. Borehole logs.

Borehole No. KFM07A

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

Northing: 6700127.08m Easting: 1631031.57m Elevation: 3.32m, RHB70

Diameter: 77.3 mm
 Reaming Diameter:
 Outer Casing:
 Inner Casing:
 Borehole Length: 1001.55 m
 Cone:
 Inclination at ground surface: -59.22 deg
 Azimuth: 261.47 deg
 Comments:

Borehole logging programme

Name	Description	Tool	Unit
CALIPER1	Caliper, 1-arm	9030	mm
DENSITY	Gamma-gamma density	9030	kg/m ³
RES(MG)	Focused guard log resistivity, 140cm	9030	ohm-m
GAM(NAT)	Natural gamma	9030	µR/h
TEMP(FL)	Fluid temperature	8044	deg C
RES(FL)	Fluid resistivity	8044	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
TRAVEL TIME	360 degrees orientated acoustic travel time	HiRAT	100 ns
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	8044	ohm-m
RES(64N)	Normal resistivity 64 inch	8044	ohm-m
LATERAL	Lateral resistivity	8044	ohm-m
SPR	Single point resistivity	8044	ohm
SP	Self Potential	8044	mV

Rev.	Date	Drawn by	Control	Approved
0	2005-02-23	UTN	JRI	UTN

Job
0547310A

Scale
1:500



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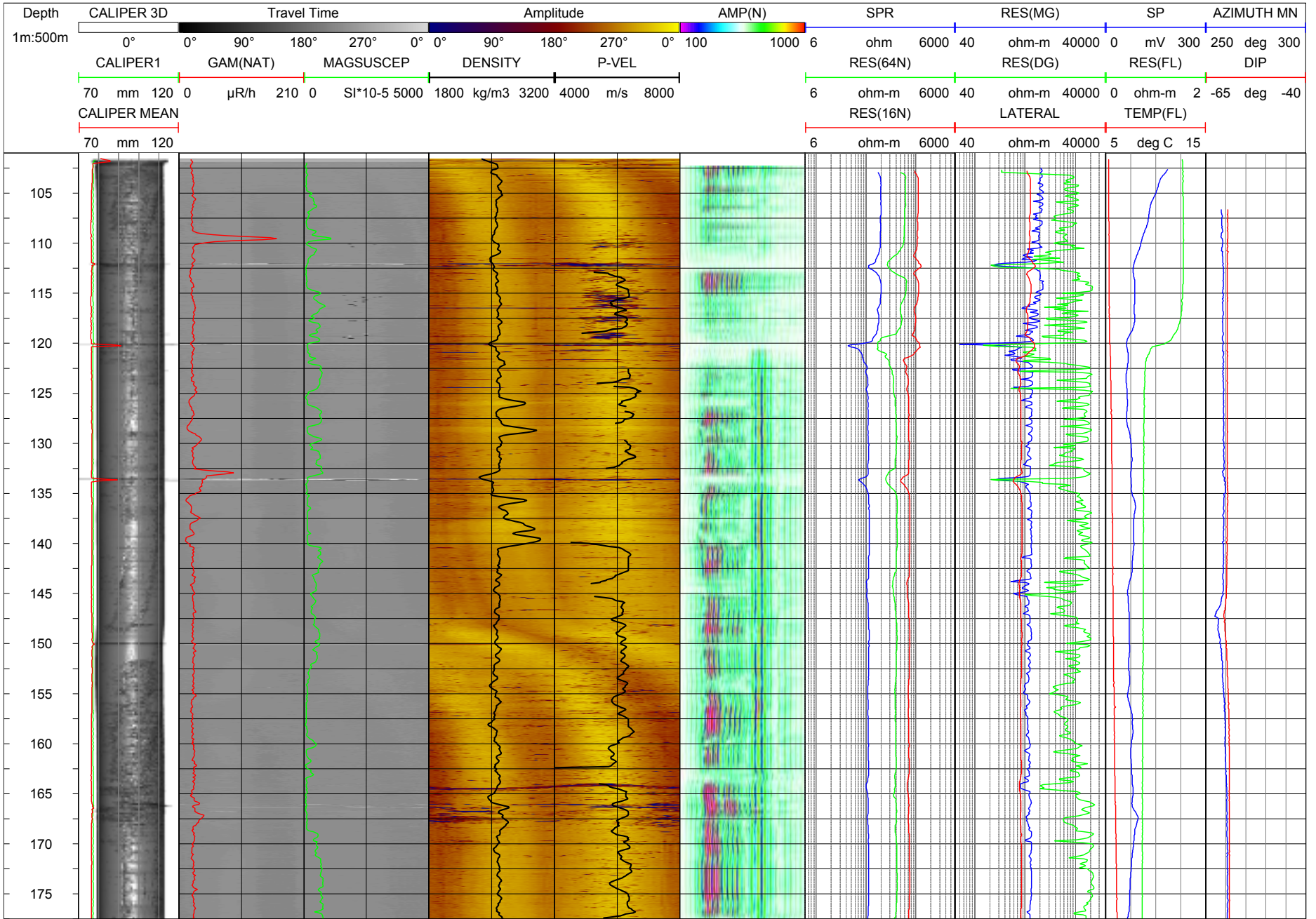
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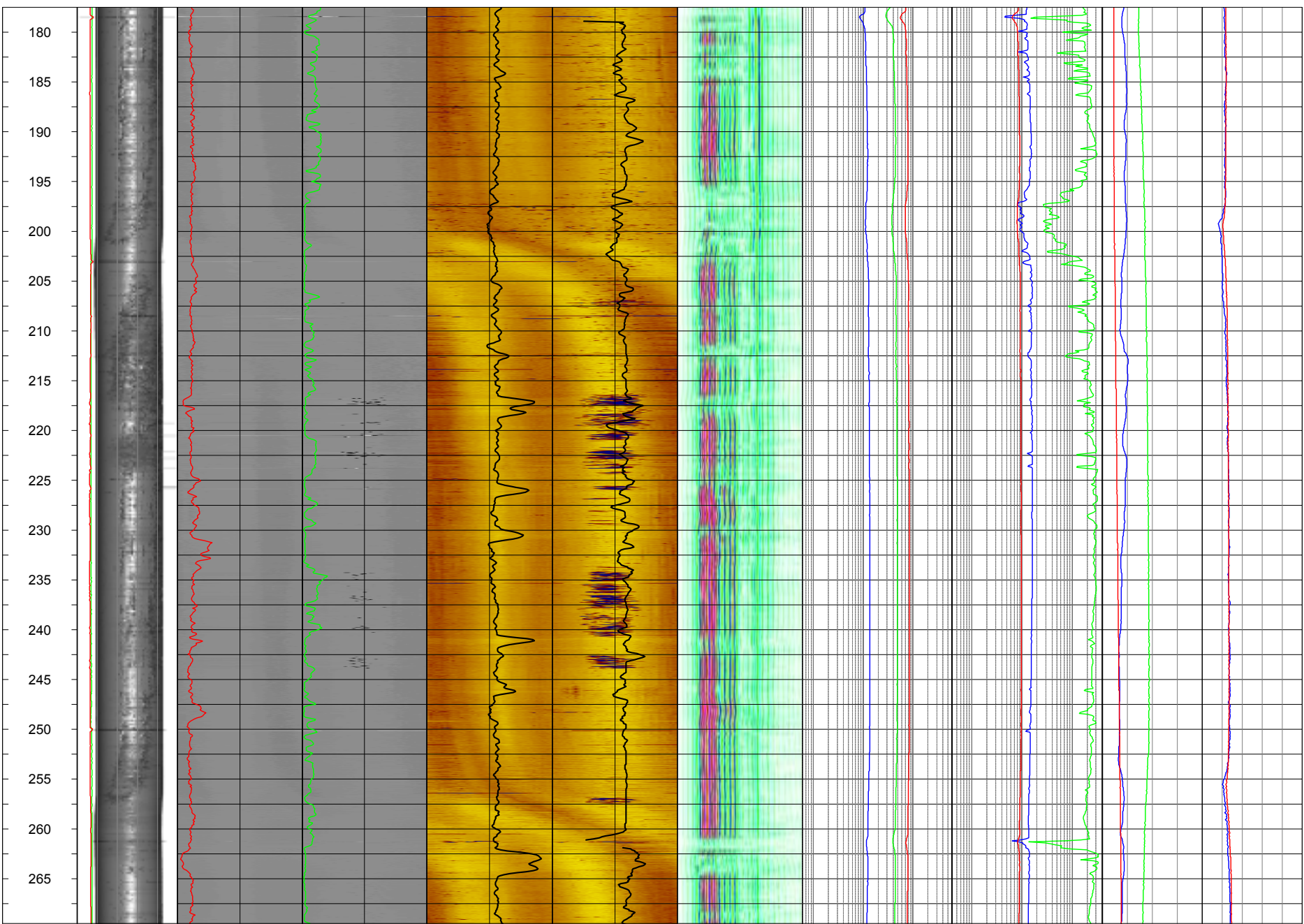
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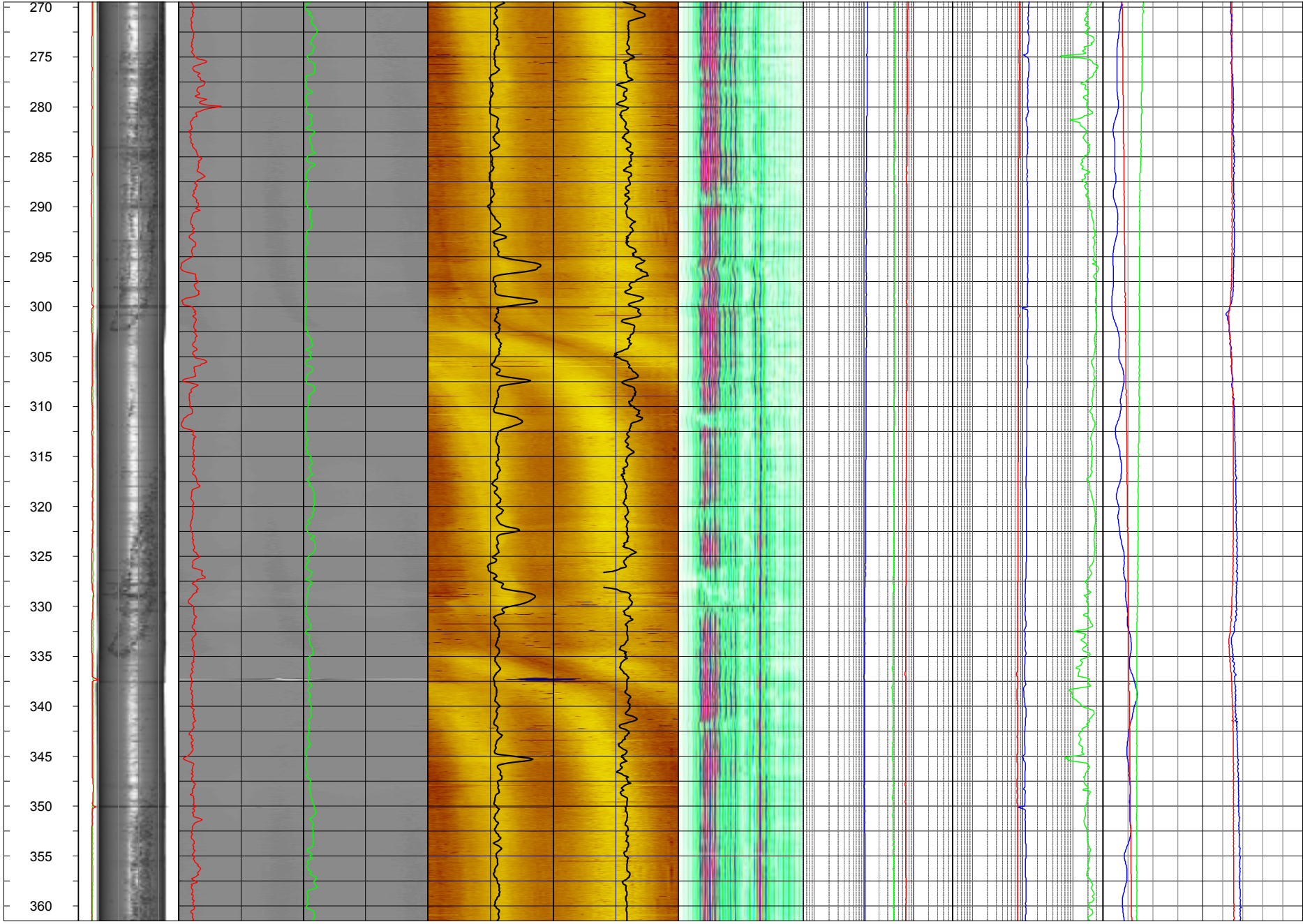
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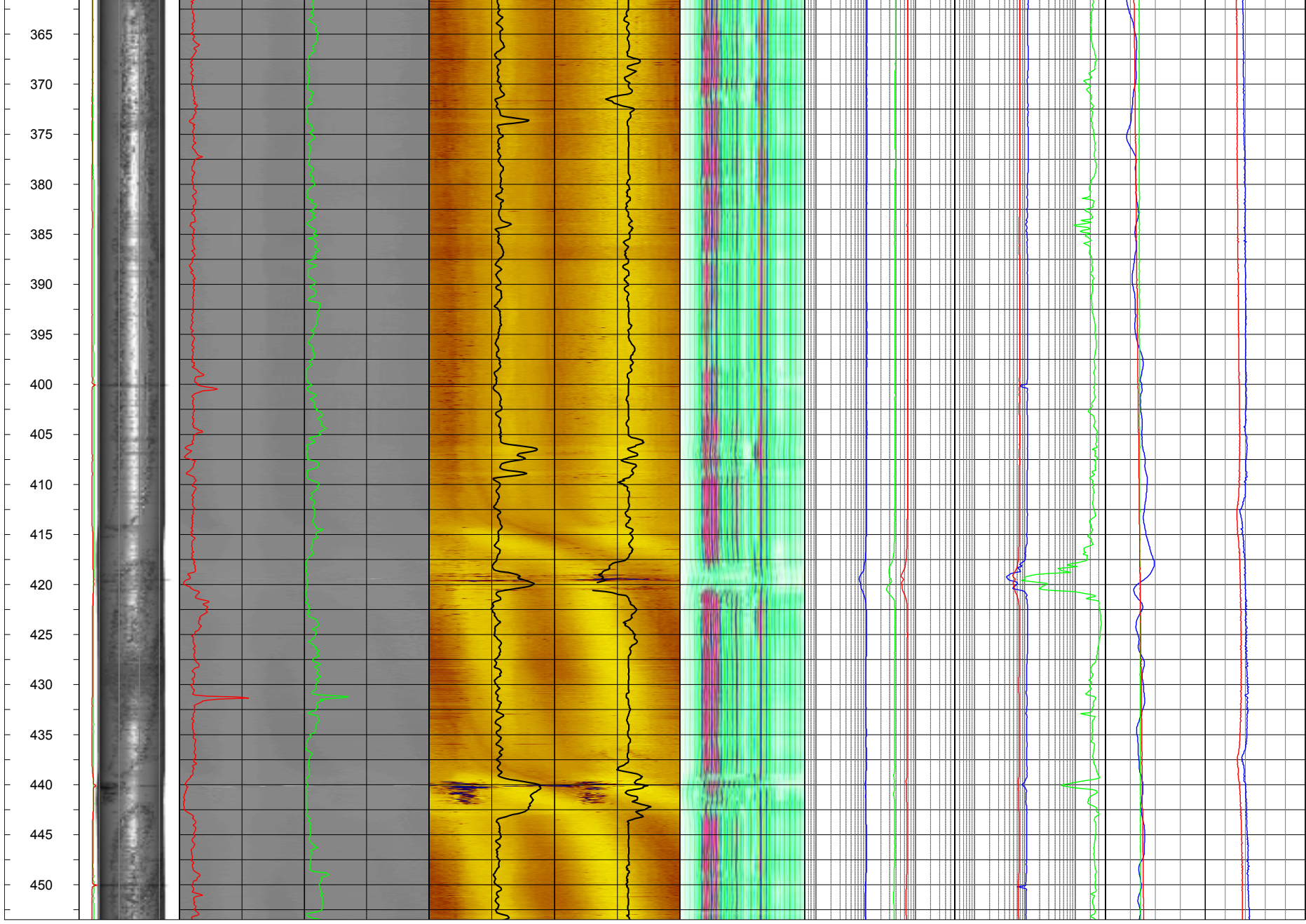
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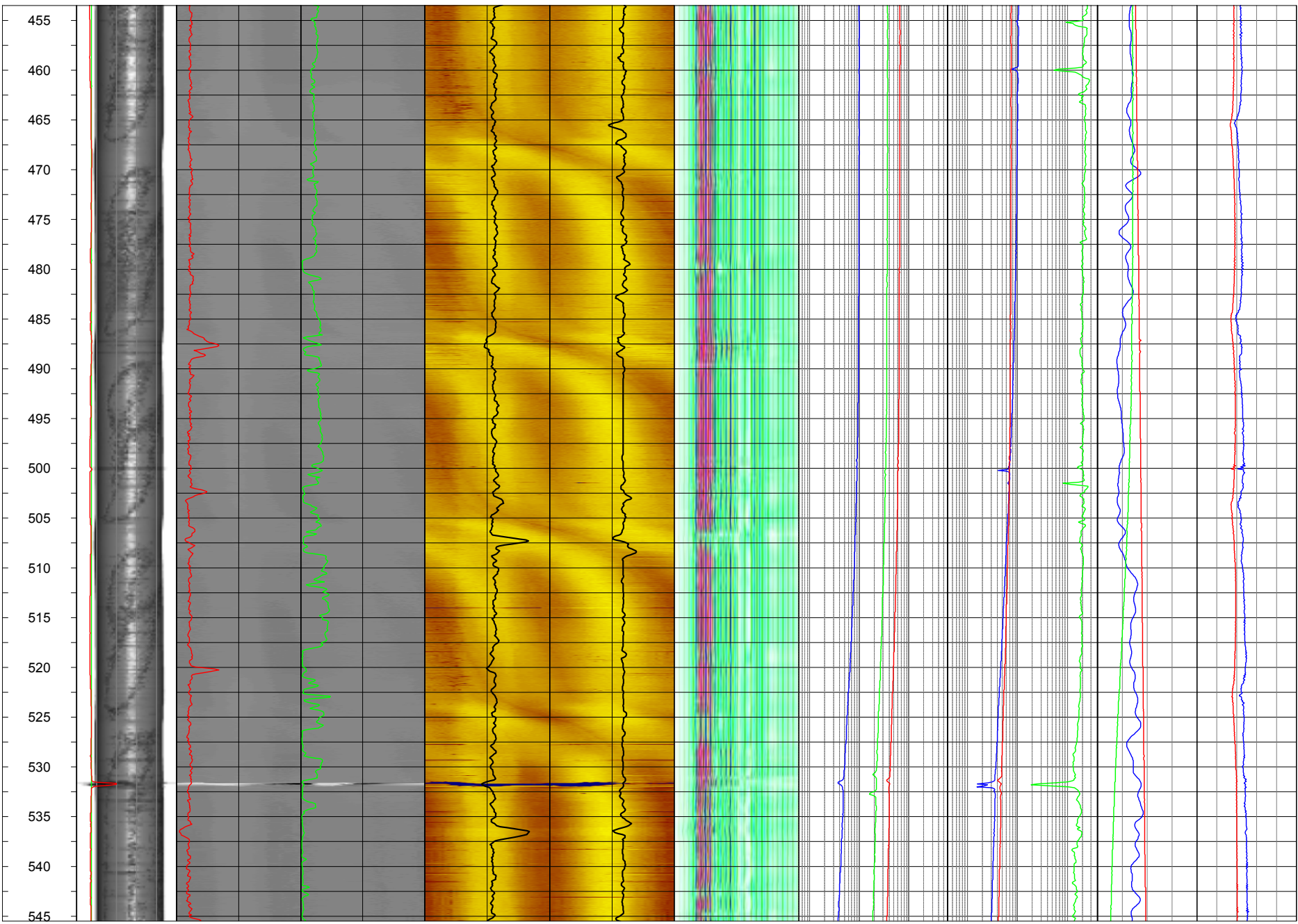
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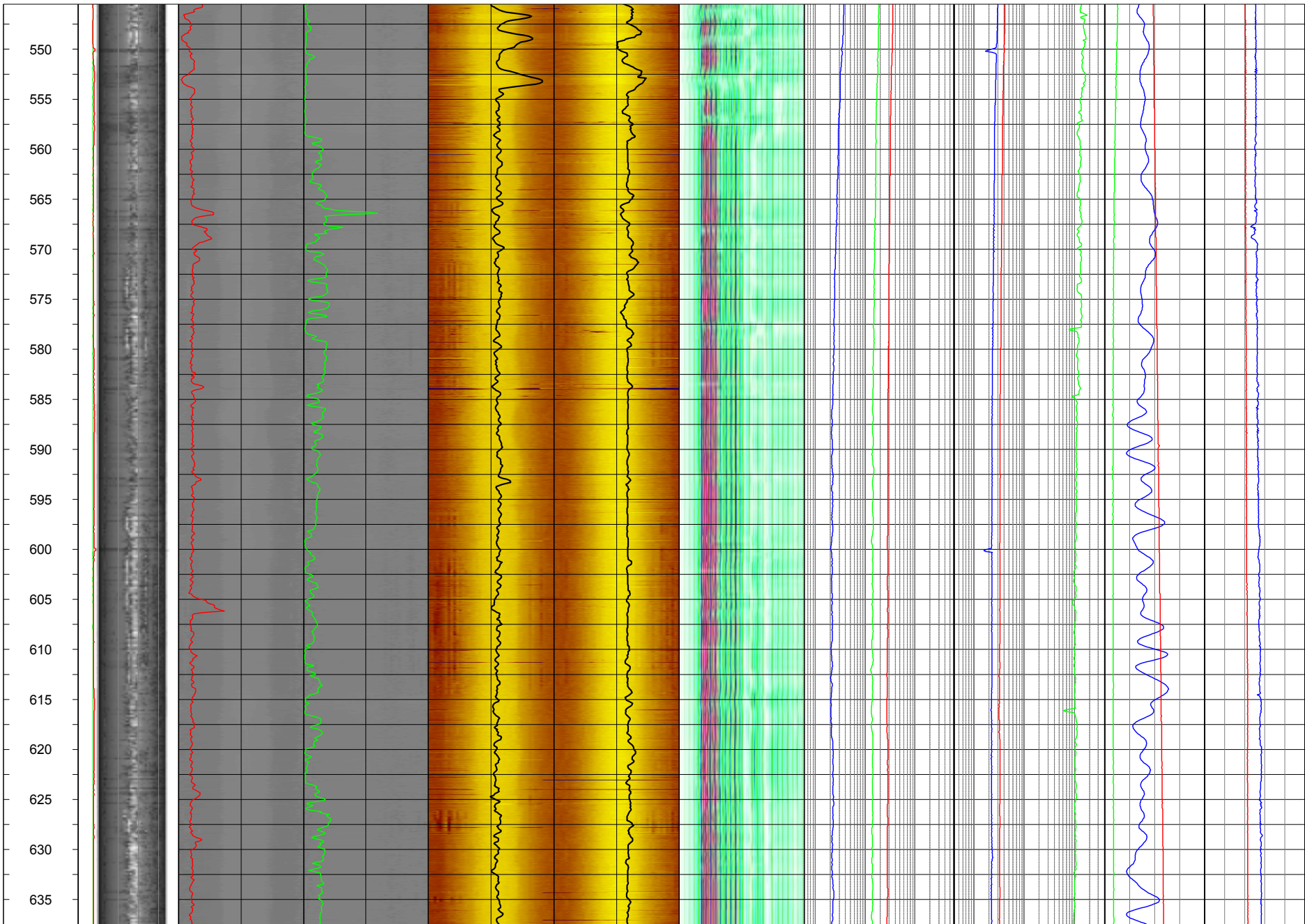


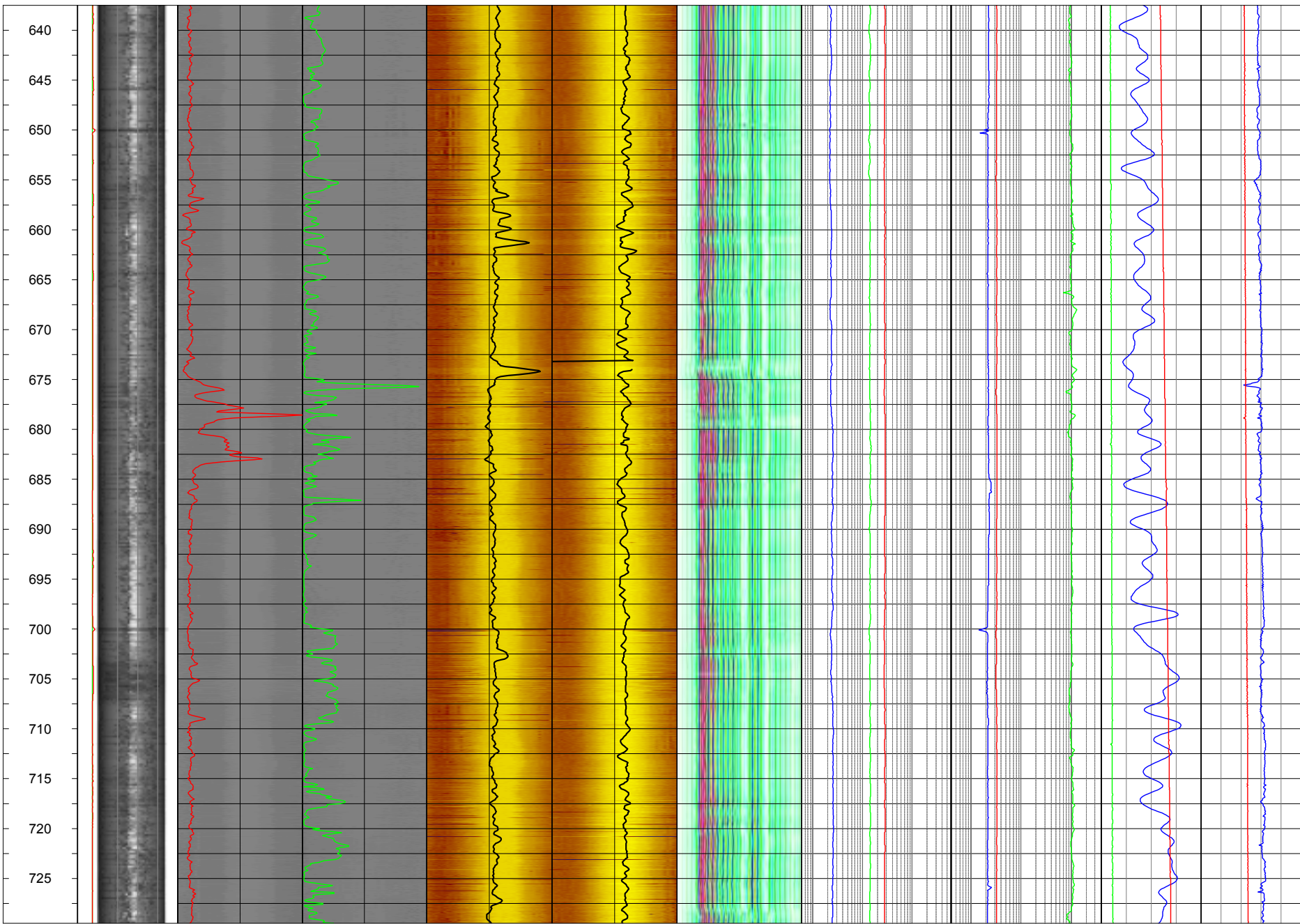


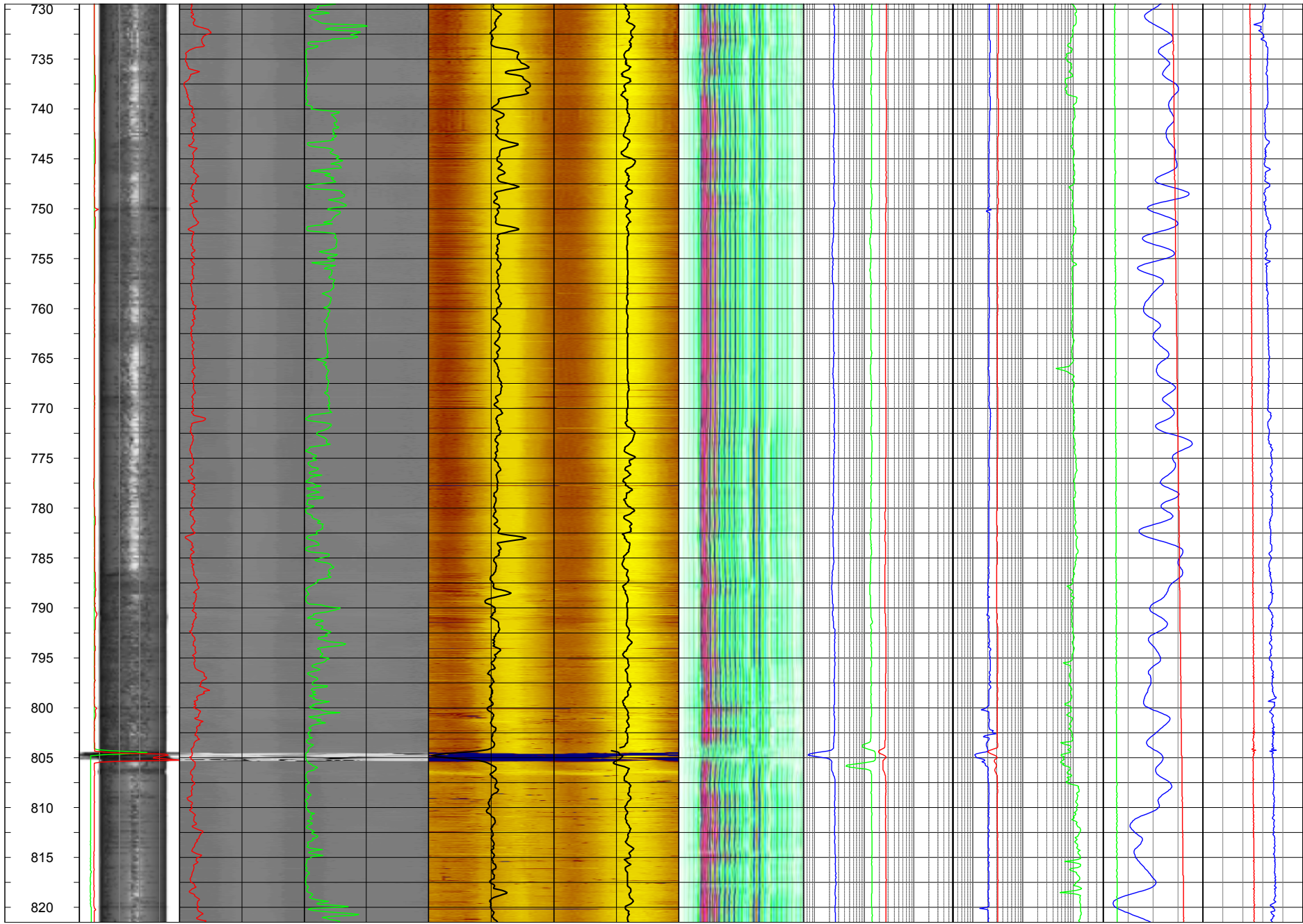


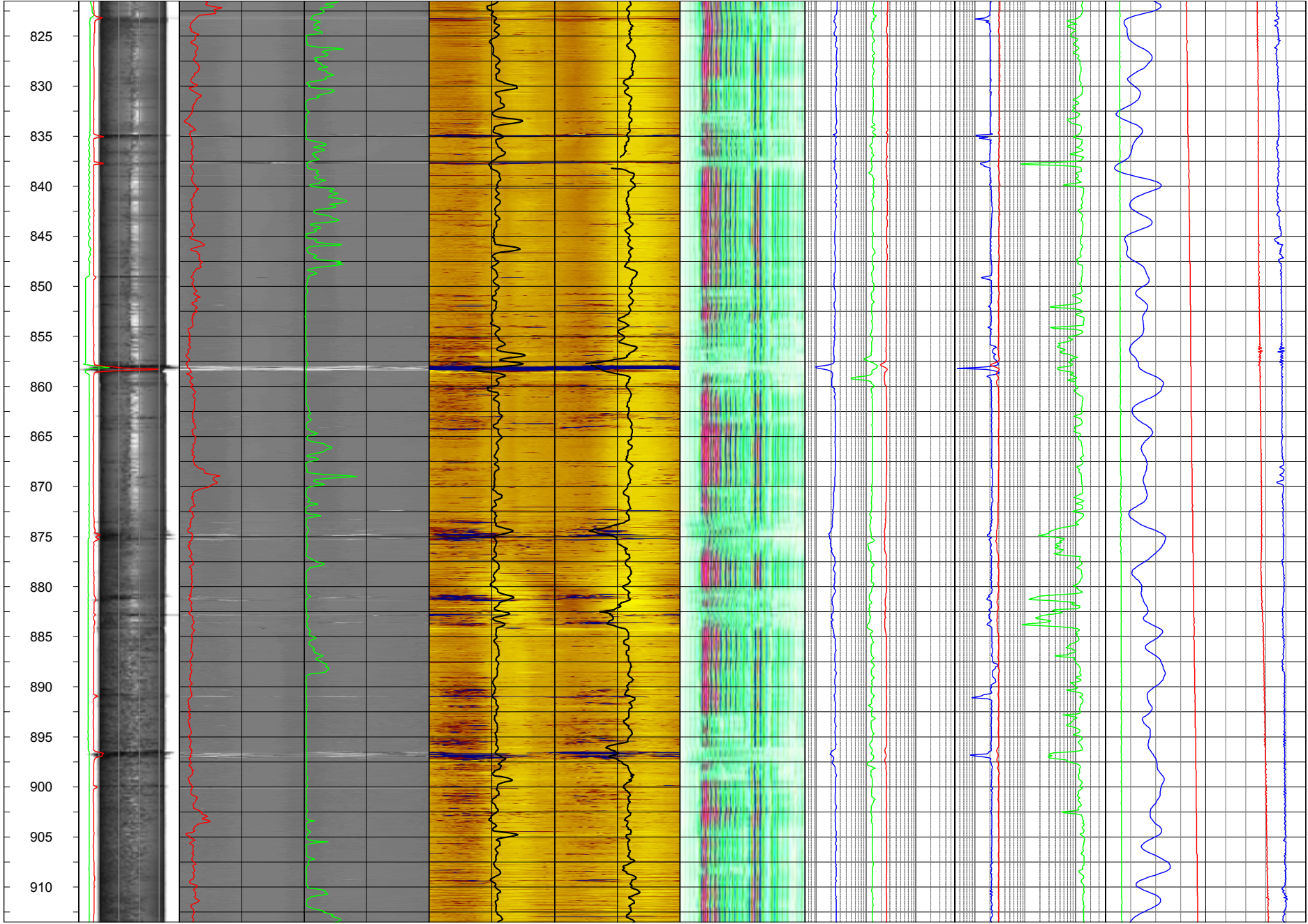


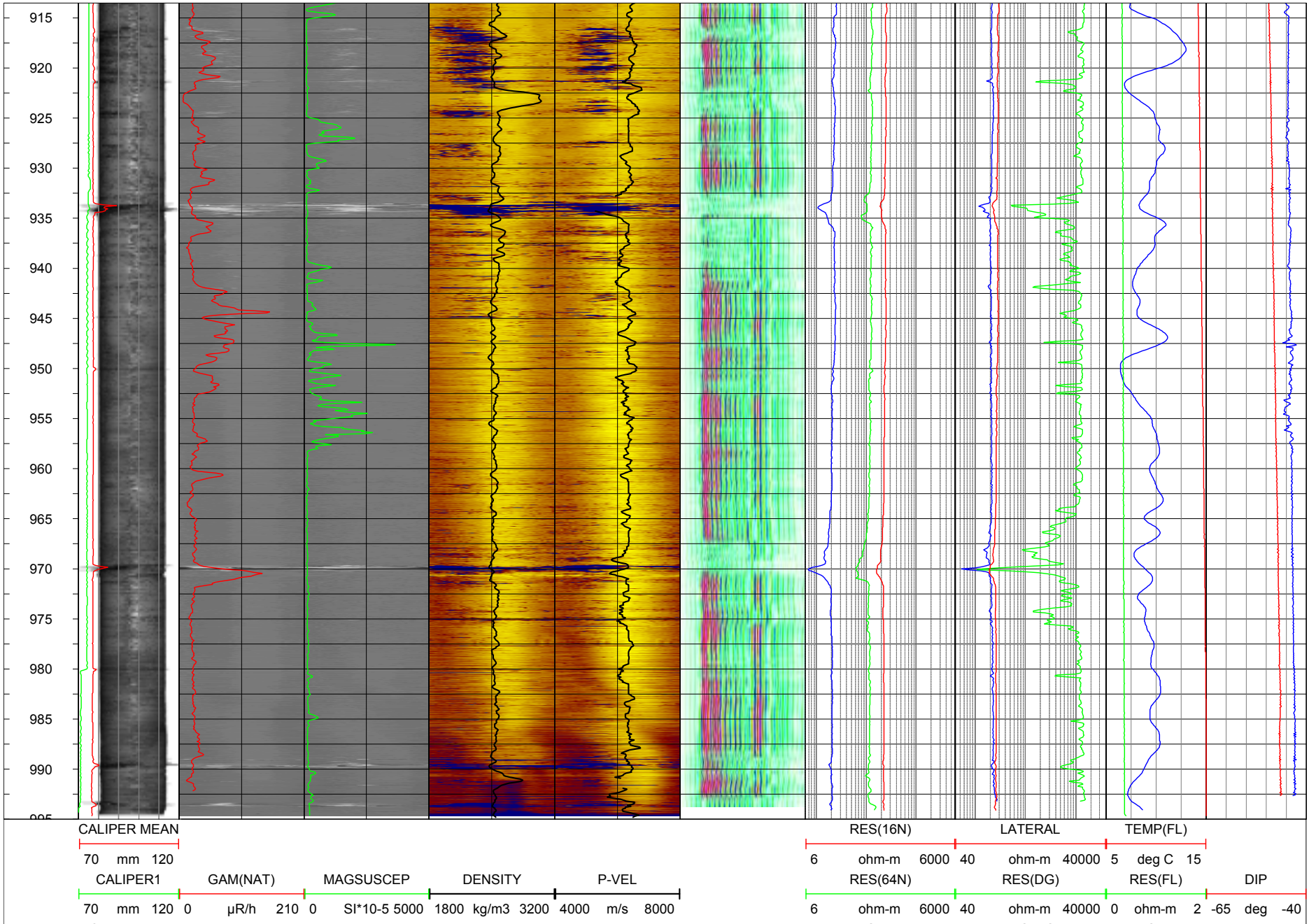


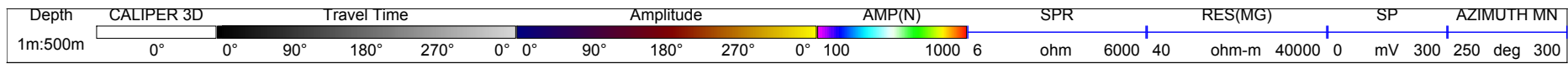












Borehole No. KFM08A

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

Northing: 6700494.68 Easting: 1631197.03 Elevation: 2.50

Diameter: 77.3 mm
 Reaming Diameter:
 Outer Casing:
 Inner Casing:
 Borehole Length: 1001.19 m
 Cone:
 Inclination at ground surface: -60.11 deg
 Azimuth: 319.42 deg
 Comments:

Borehole logging programme

Name	Description	Tool	Unit
CALIPER1	Caliper, 1-arm	9030	mm
DENSITY	Gamma-gamma density	9030	kg/m ³
RES(MG)	Focused guard log resistivity, 140cm	9030	ohm-m
GAM(NAT)	Natural gamma	9030	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
TRAVEL TIME	360 degrees orientated acoustic travel time	HiRAT	100 ns
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	8044	ohm-m
RES(64N)	Normal resistivity 64 inch	8044	ohm-m
LATERAL	Lateral resistivity	8044	ohm-m
SPR	Single point resistivity	8044	ohm
SP	Self Potential	8044	mV

Rev.	Date	Drawn by	Control	Approved
0	2005-05-19	JIJ	JRI	UTN

Job
0547310A

Scale
1:500

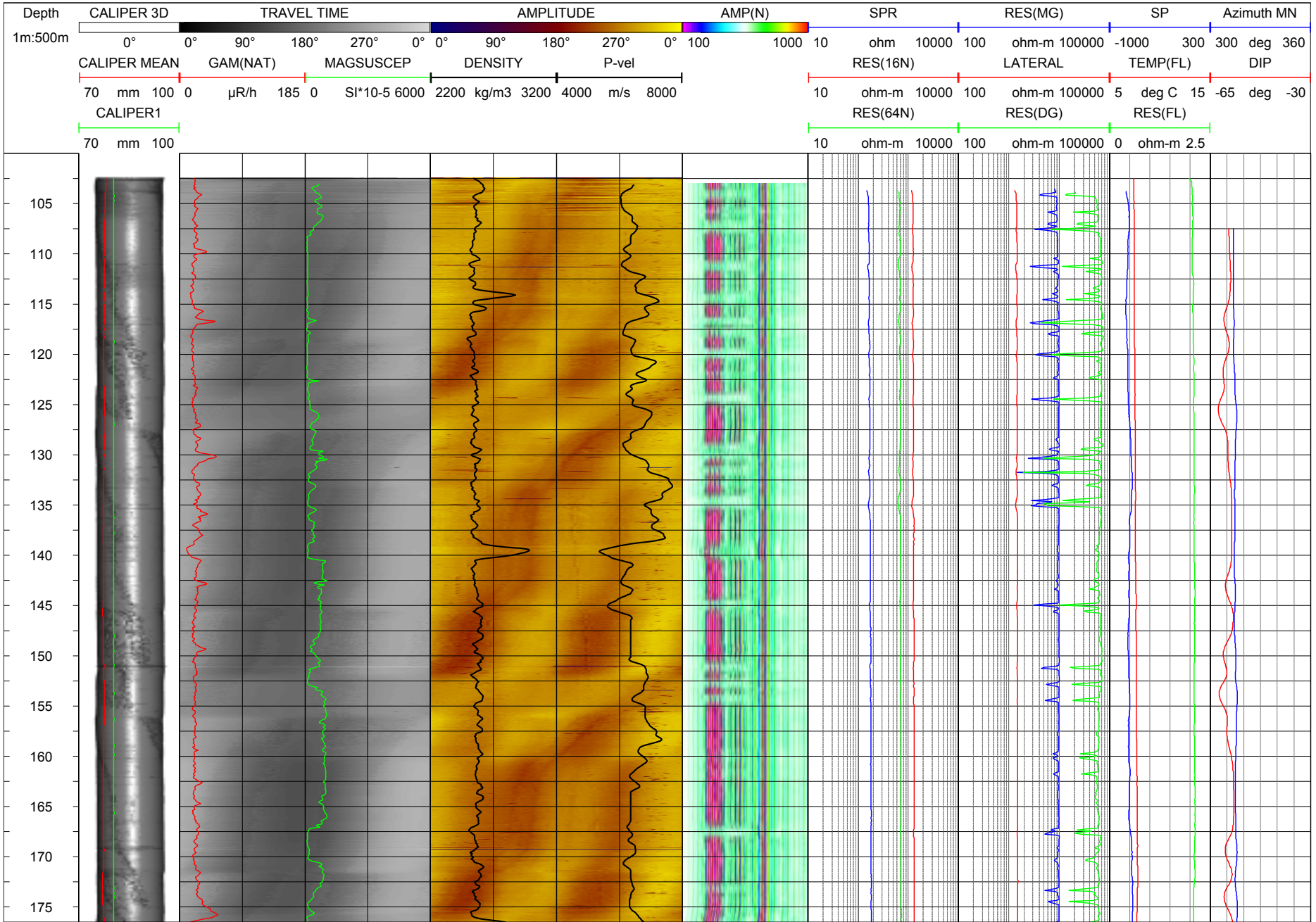


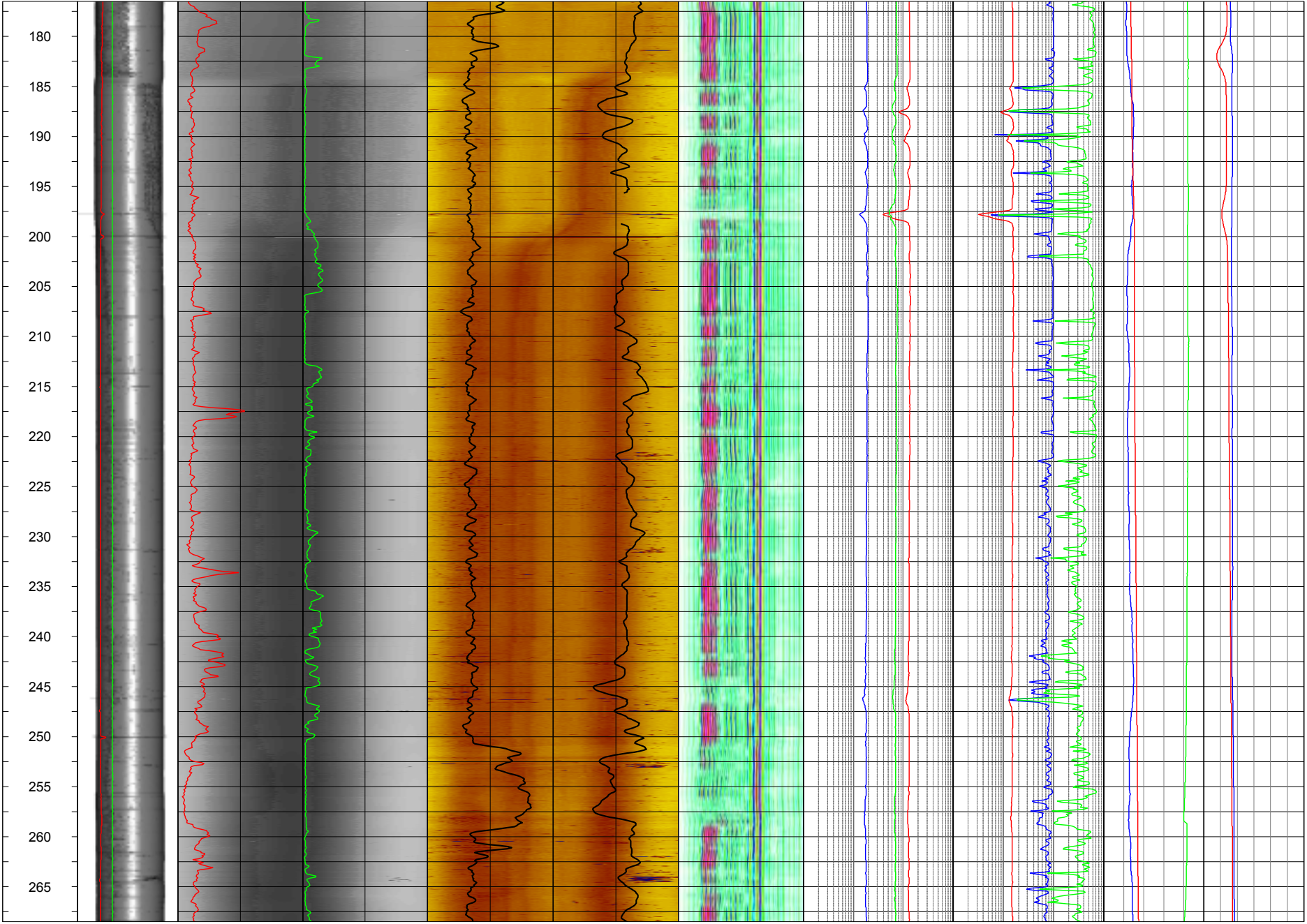
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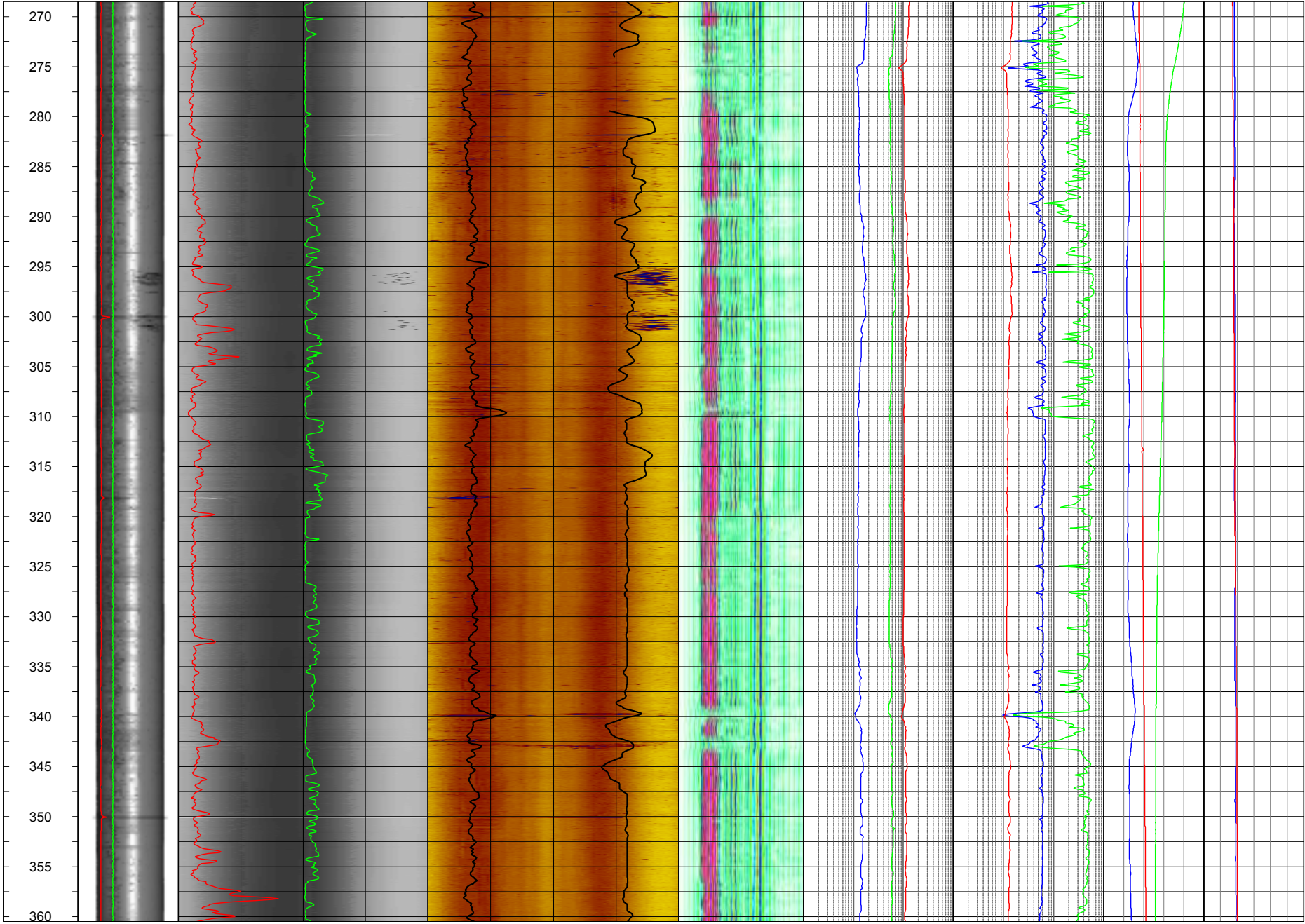
SKB geophysical borehole logging Borehole KFM08A

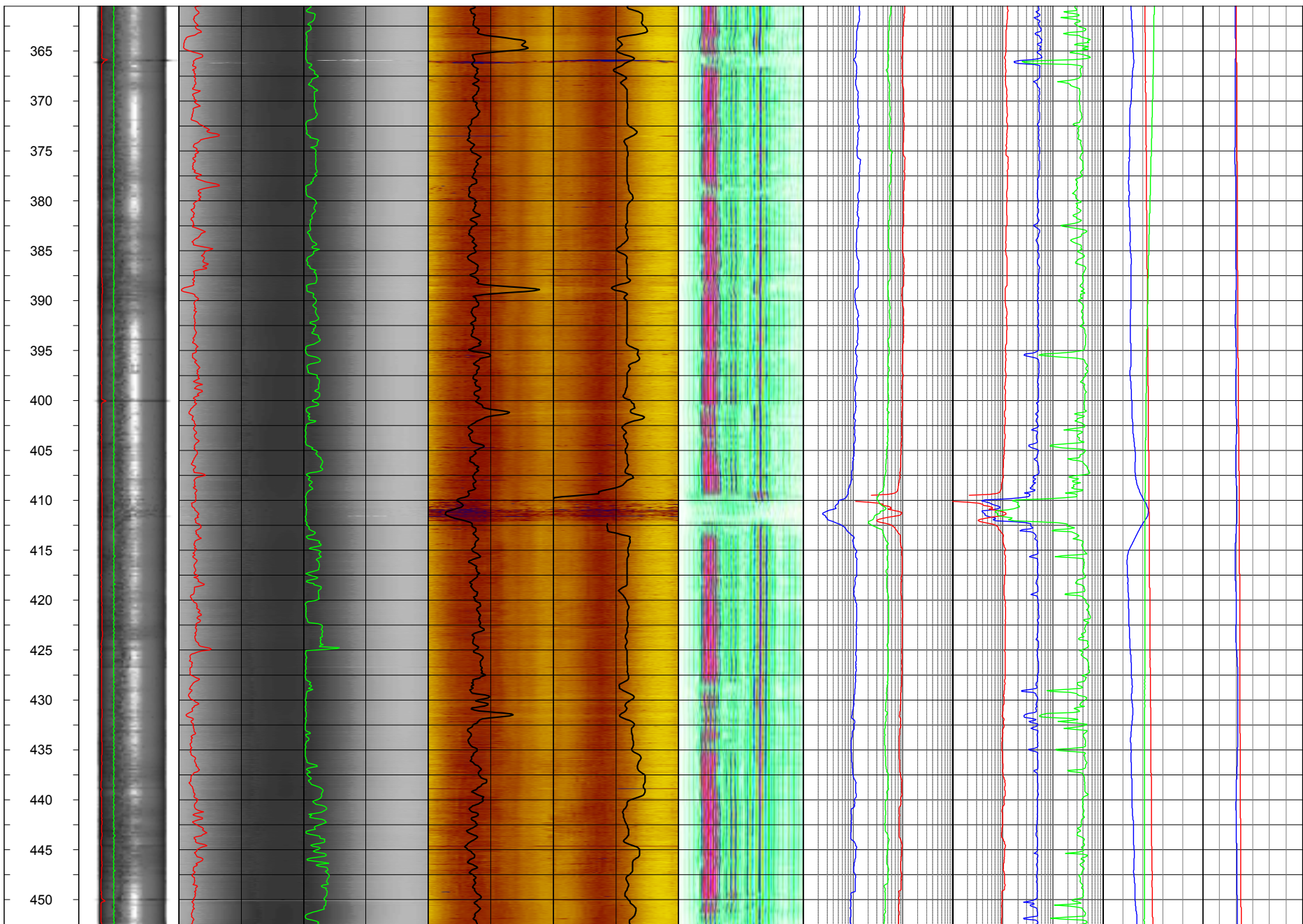
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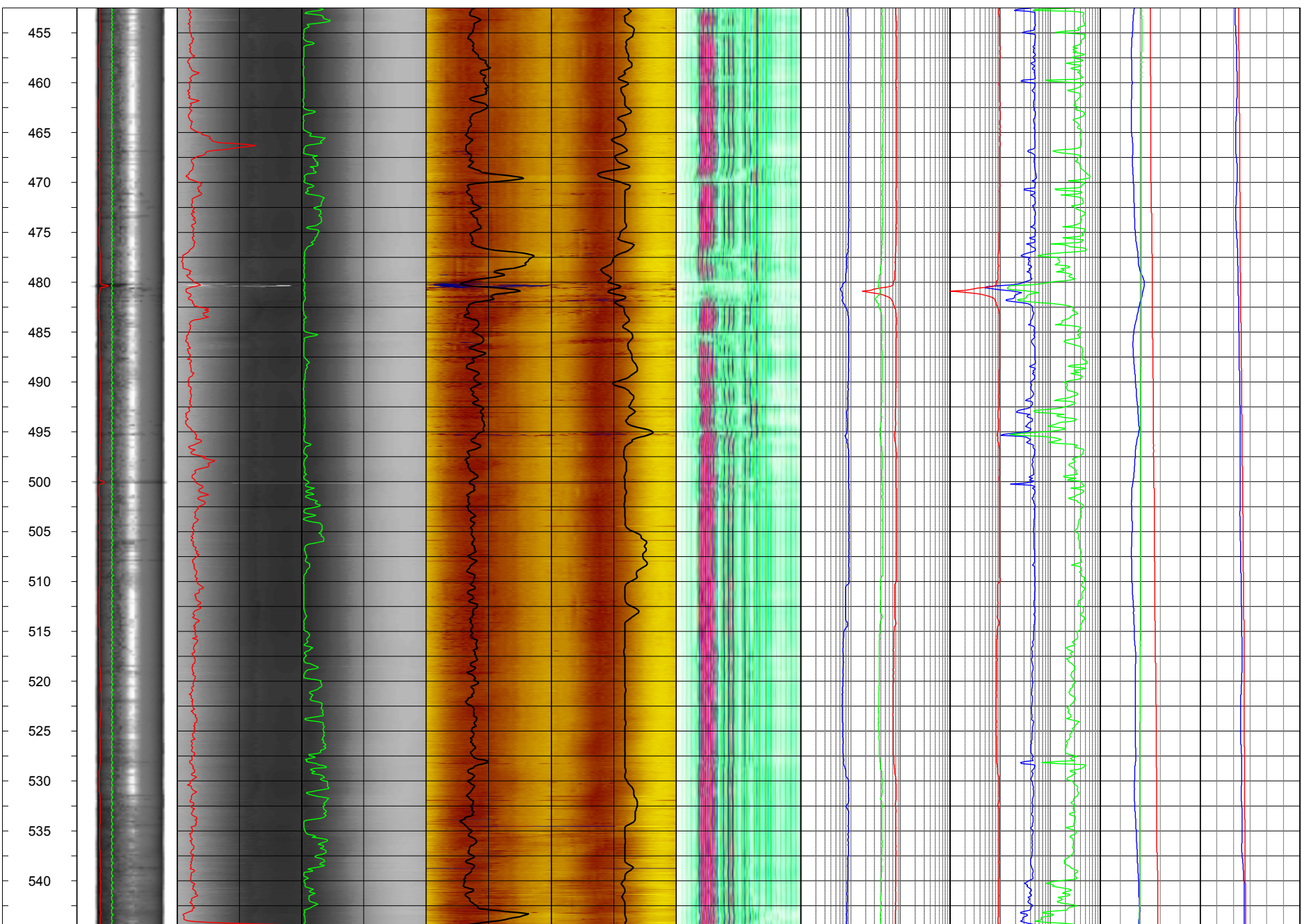
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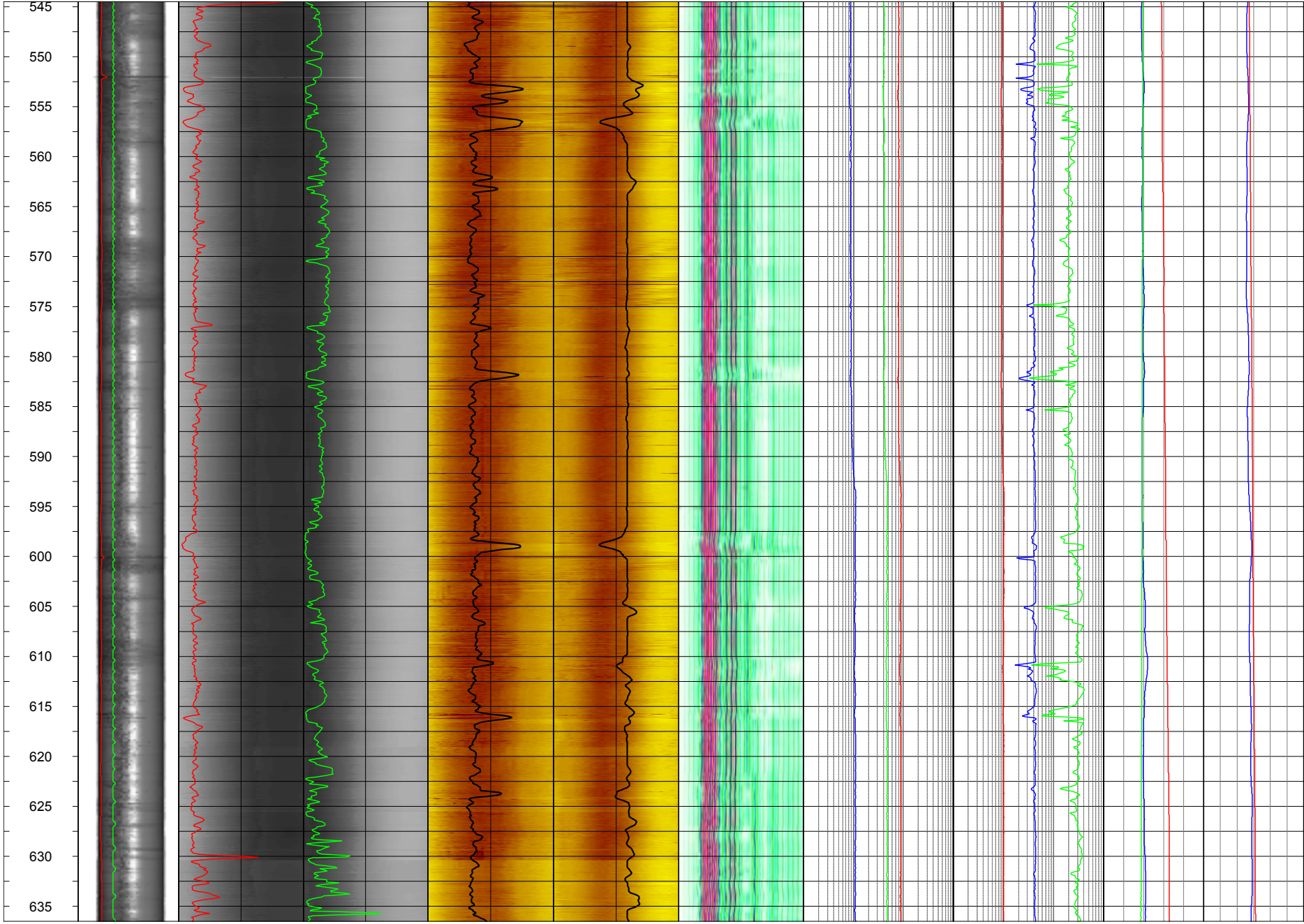


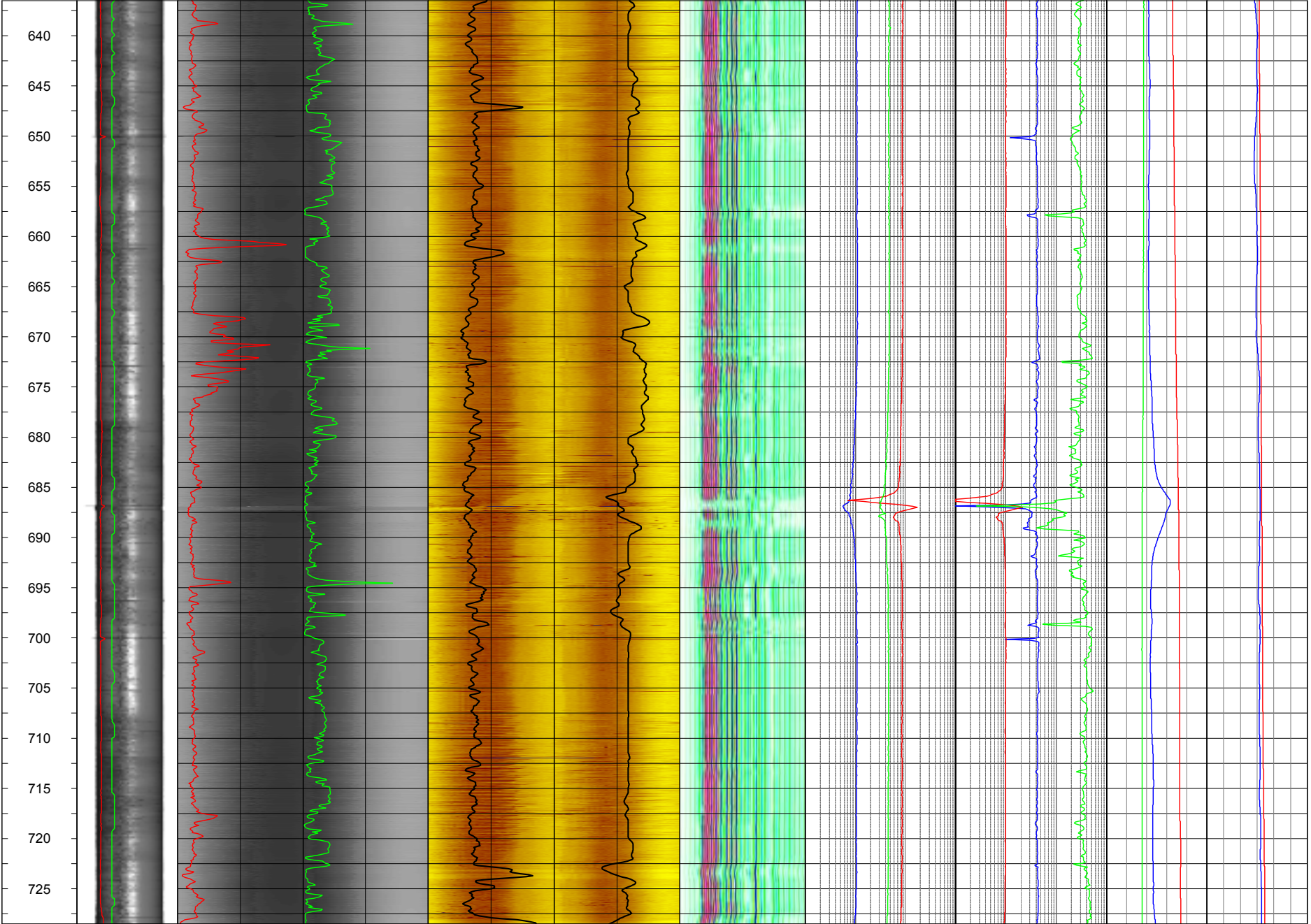


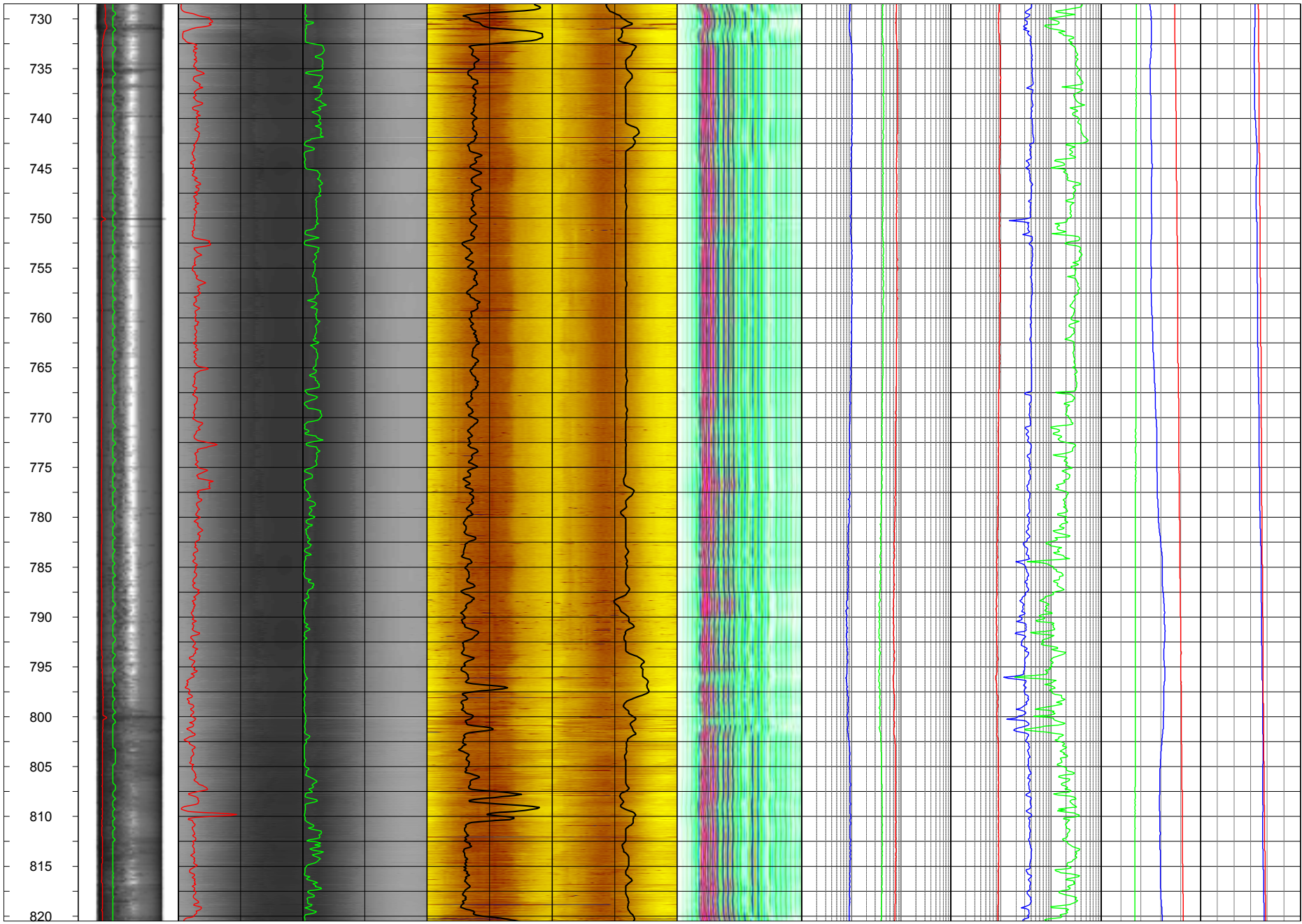


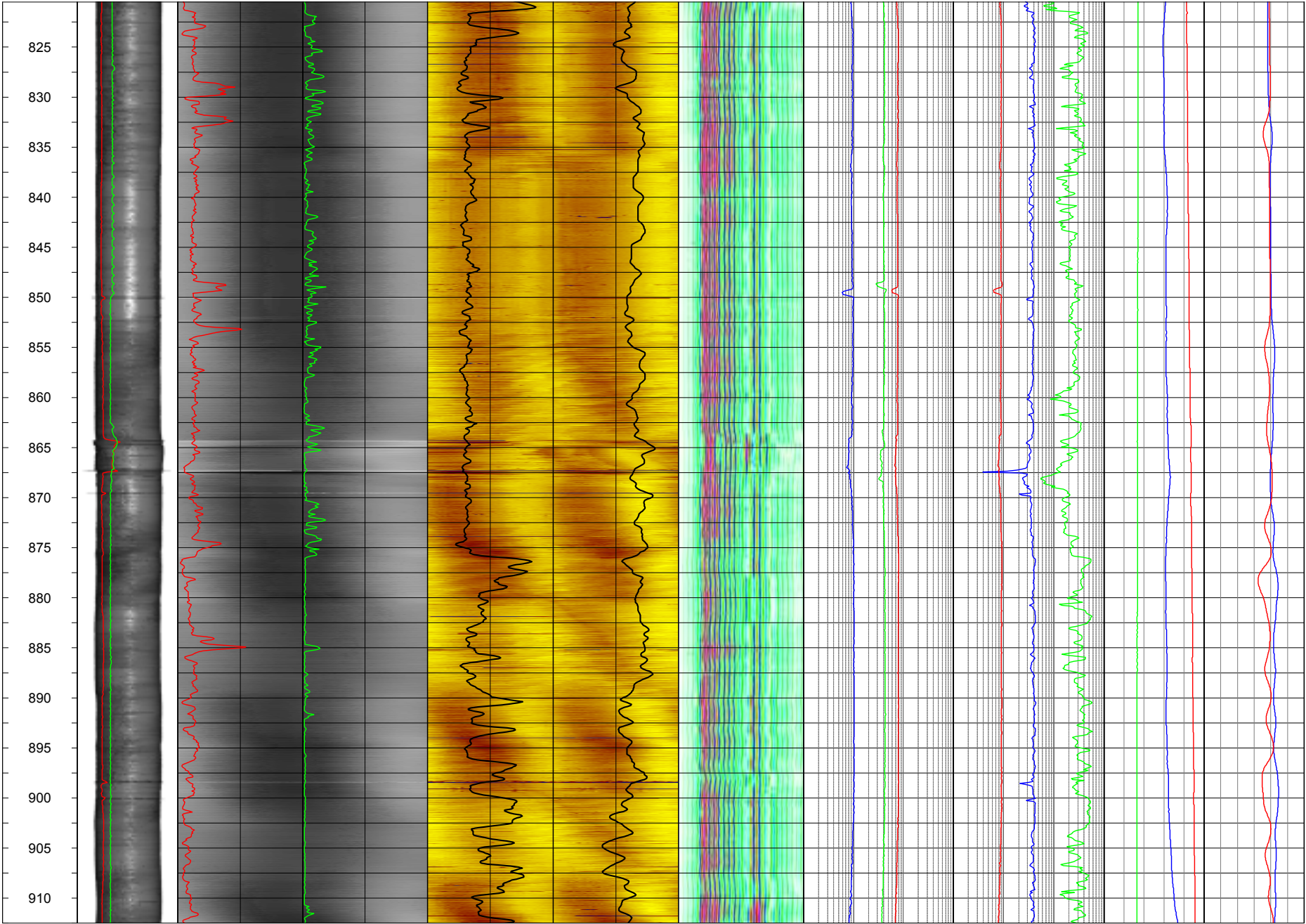


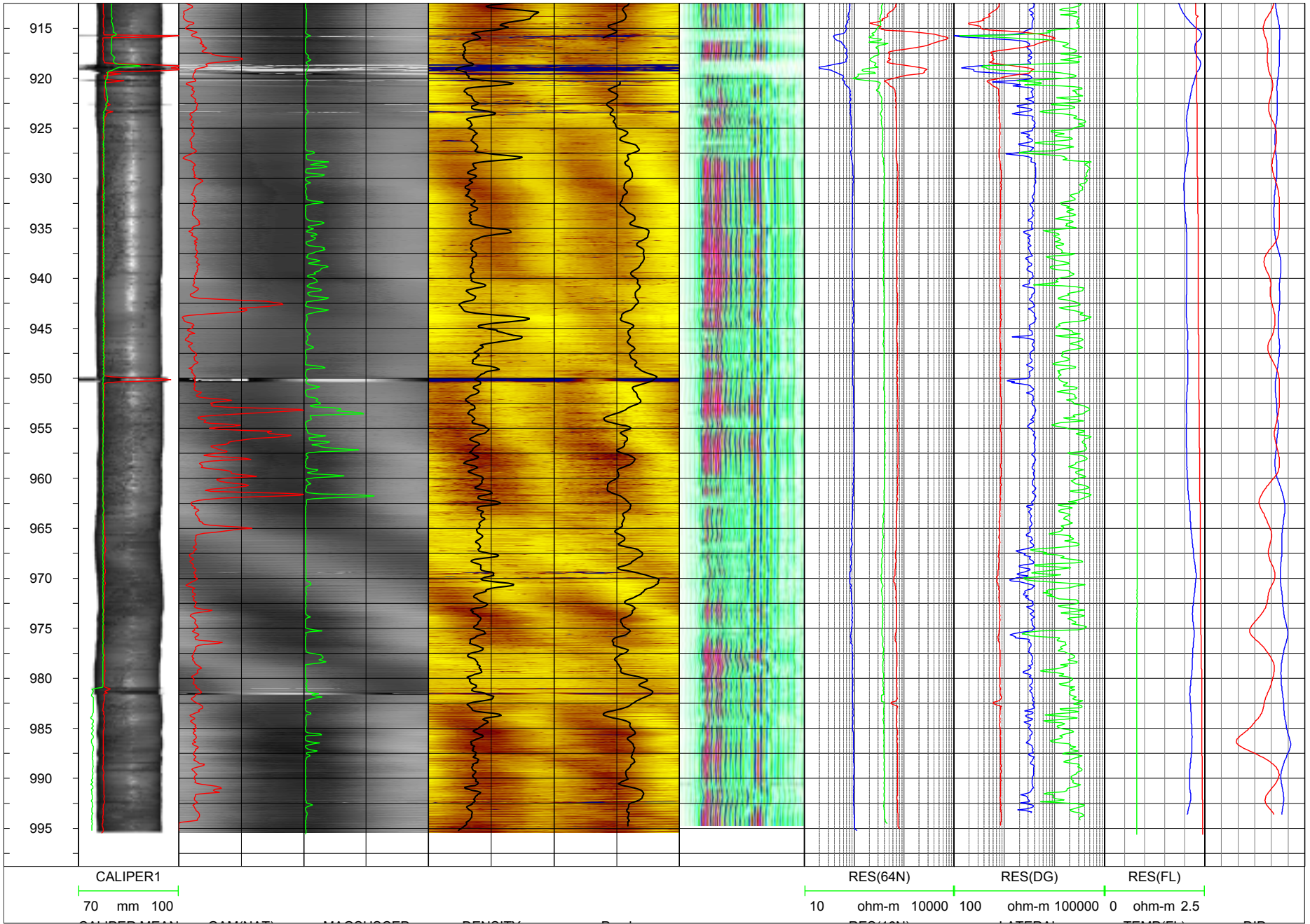


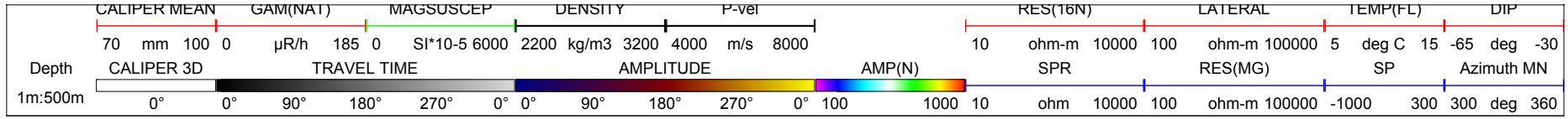












Borehole No. KFM08B

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

Northing: 6700492.754m Easting: 1631173.266m Elevation: 2.248m, RHB70

Diameter: 76.2mm
 Reaming Diameter:
 Outer Casing: 90mm
 Inner Casing: 78.0mm
 Borehole Length: 200.54m
 Cone:
 Inclination at ground surface: -58.85°
 Azimuth: 270.45°
 Comments:

Borehole logging programme

Name	Description	Tool	Unit
CALIPER1	Caliper, 1-arm	9030	mm
DENSITY	Gamma-gamma density	9030	kg/m ³
RES(MG)	Focused guard log resistivity, 140cm	9030	ohm-m
GAM(NAT)	Natural gamma	9030	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
TRAVEL TIME	360 degrees orientated acoustic travel time	HiRAT	100 ns
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	8044	ohm-m
RES(64N)	Normal resistivity 64 inch	8044	ohm-m
LATERAL	Lateral resistivity	8044	ohm-m
SPR	Single point resistivity	8044	ohm
SP	Self Potential	8044	mV

Rev.	Date	Drawn by	Control	Approved
1	2005-06-02	JRI	UTN	UTN

Job
0547310A

Scale
1:500



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SKB geophysical borehole logging Borehole KFM08B

Presentation

Filename:
KFM08B_Presentation.wcl

Drawing no.:

3.1

