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Forsmark site investigation

Geophysical borehole logging in boreholes KFM01C, KFM09B, HFM07, HFM24, HFM26, HFM29 and HFM32

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April 2006

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Abstract

Geophysical borehole logging has been performed in boreholes KFM01C, KFM09B, HFM07, HFM24, HFM26, HFM29 and HFM32 all 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 KFM01C was recorded from 12 m to 450 m. KFM09B was recorded from 12 m to 615 m. HFM07 was recorded from 12 m to 122 m. HFM24 was recorded from 18 m to 151 m. HFM26 was recorded from 12 m to 202 m. HFM29 was recorded from 12 m to 200 m and HFM32 was recorded from 6 m to 202 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 Appendix 7.

Sammanfattning

Geofysisk borrhålsloggning har genomförts i borrhålen KFM01C, KFM09B, HFM07, HFM24, HFM26, HFM29 och HFM32 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 KFM01C från 12 m till 450 m. I KFM09B från 12 m till 615 m. I HFM07 från 12 m till 122 m. I HFM24 från 18 m till 151 m. I HFM26 från 12 m till 202 m. I HFM29 från 12 m till 200 m och i HFM32 från 6 m till 202 m.

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

Processerade loggar presenteras i Appendix 1 till 7.

Contents

1 Introduction

This document reports the results gained by the geophysical borehole logging in borehole KFM01C, KFM09B, HFM07, HFM24, HFM26, HFM29 and HFM32, 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 400-05-119 (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 January 23 to February 2, 2006. The boreholes were recorded from Top Of Casing (TOC) to the bottom of the boreholes. The technical data from the boreholes are shown in Table 1-2. The location of the boreholes is shown in Figure 1-1 and the technical data for the boreholes are shown in Figures 1-2 to Figure 1-8. The borehole HFM07 is a reference borehole.

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 kärnborrhålen KFM01C och KFM09B samt hammarborrhålen HFM24, HFM26 och HFM29	AP PF 400-05-119	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 the boreholes.

Borehole Parameter	KFM01C	KFM09B	HFM24	HFM26	HFM29	HFM32	HFM07
Co-ordinates (RT90)	6699526.071 1631403.838	6700119.89 1630638.78	6698662.373 1631719.641	6698008.929 1633516.386	6698018.647 1632502.813	6699015.036 1632137.068	6699015.036 1632137.068
Elevation (RHB70)	2.927	4.30	3.683	2.734	4.467	0.974	0.974
Azimuth	165.03	140.83	47.29	112.42	29.95	116.15	116.15
Inclination (from horizontal)	–50.00	–55.08	–59.56	–53.75	–58.57	–86.06	–86.06
Length (m)	450.02	616.45	151.35	202.50	199.70	202.65	202.65
Casing (m)	11.96	9.12	18.03	12.03	9.03	6.03	6.03
Borehole diametre (mm)	75.8	77.3	140	140	138	131.8	131.8

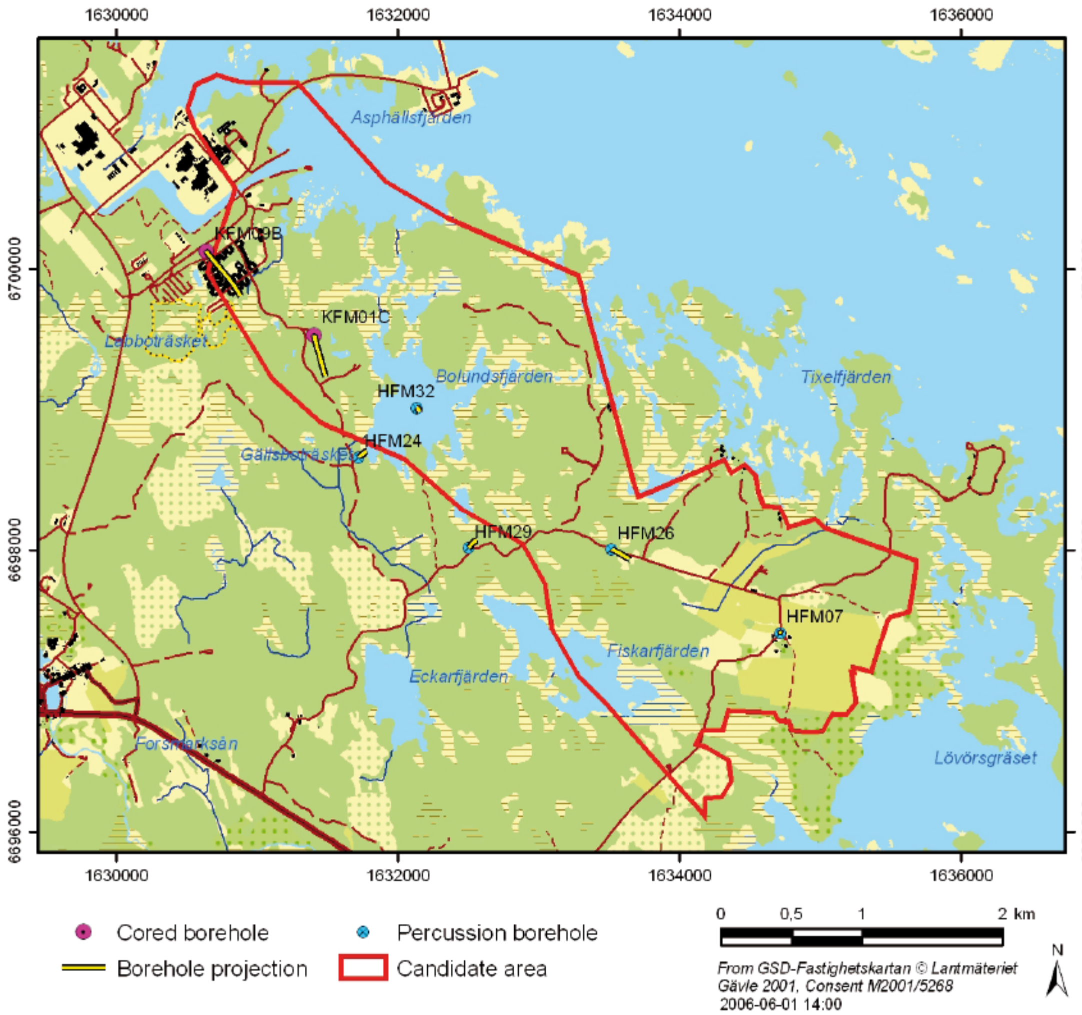


Figure 1-1. *General overview over the Forsmark area showing the location of the boreholes KFM01C, KFM09B, HFM07, HFM24, HFM26, HFM29 and HFM32.*

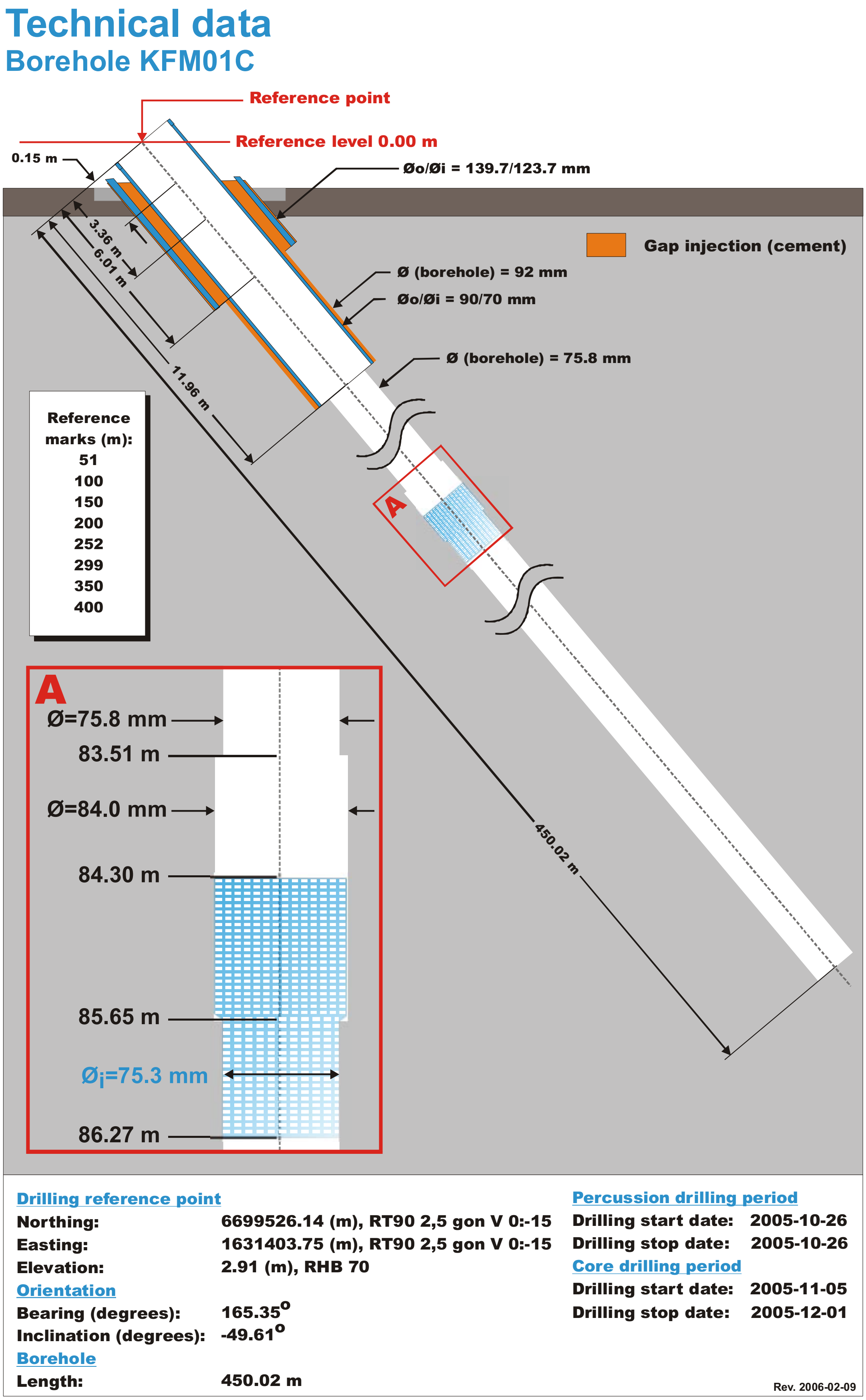
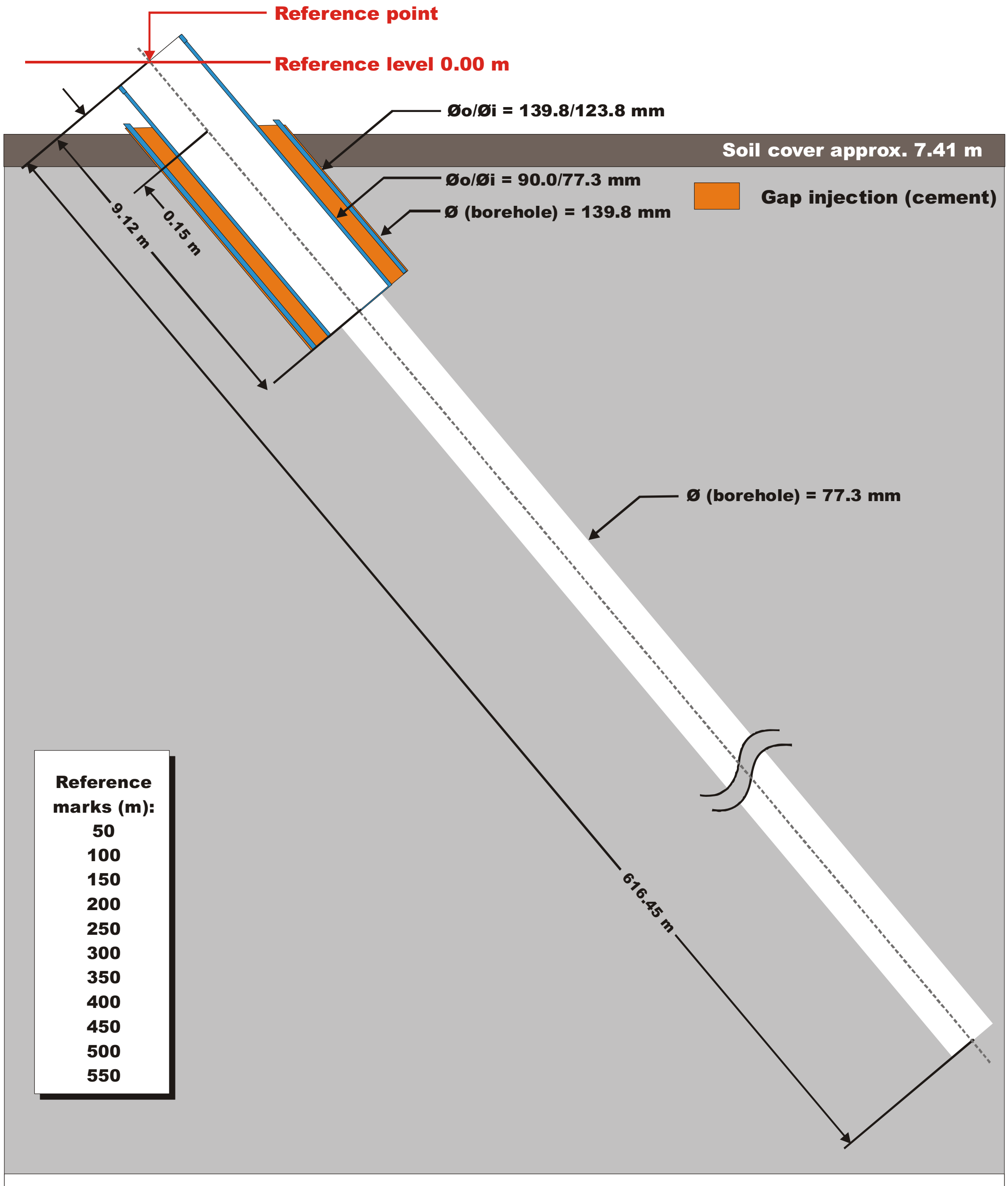


Figure 1-2. *Technical description of borehole KFM01C.*

Technical data
Borehole KFM09B



Drilling reference point

Northing:	6700119.89 (m), RT90 2,5 gon V 0:-15
Easting:	1630638.78 (m), RT90 2,5 gon V 0:-15
Elevation:	4.30 (m), RHB 70

Orientation

Bearing (degrees):	140.83°
Inclination (degrees):	-55.08°

Borehole

Length:	616.45 m

Core drilling period

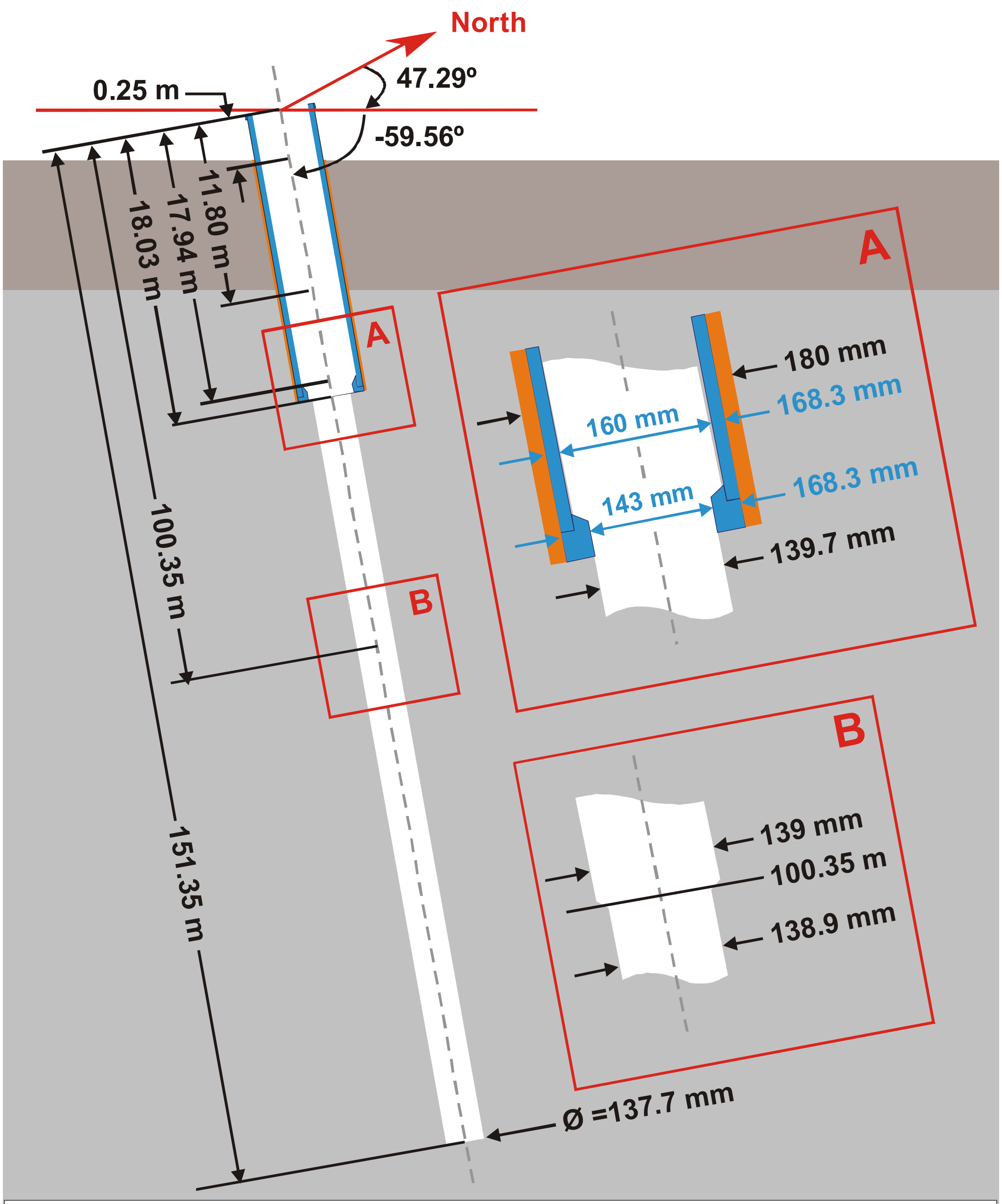
Drilling start date:	2005-11-15
Drilling stop date:	2005-12-21

Rev. 2006-01-20

Figure 1-3. *Technical description of borehole KFM09B.*

Technical data

Borehole HFM24



Drilling reference point

Northing: 6698662.373 (m), RT90 2,5 gon V 0:-15
Easting: 1631719.641 (m), RT90 2,5 gon V 0:-15
Elevation: 3.68 (m), RHB 70

Drilling period

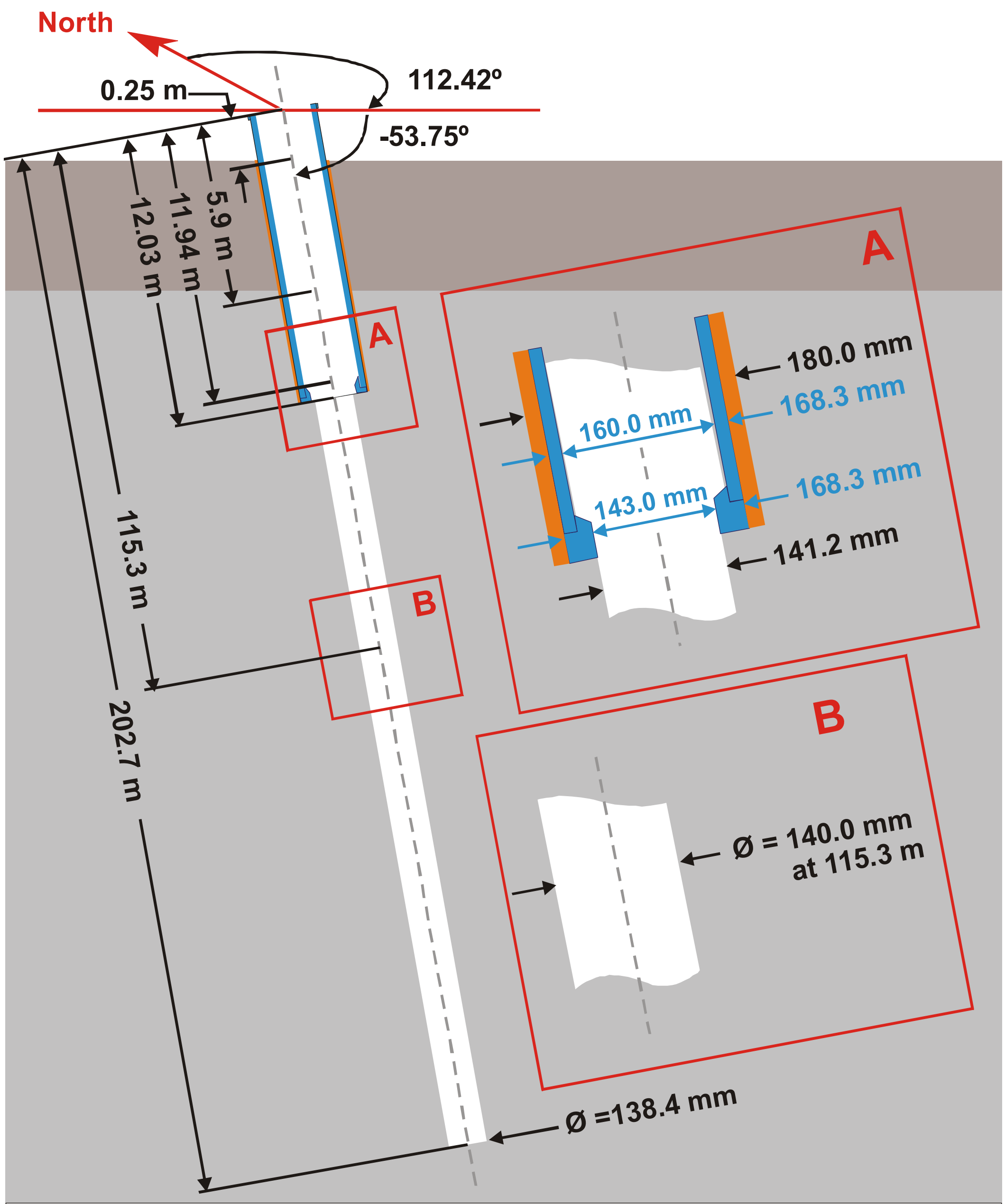
Drilling start date: 2005-11-21
Drilling stop date: 2005-11-29

rev 2005-12-10

Figure 1-4. *Technical description of borehole HFM24.*

Technical data

Borehole HFM26



Drilling reference point

Northing: 6698008.93 (m), RT90 2,5 gon V 0:-15
Easting: 1633516.39 (m), RT90 2,5 gon V 0:-15
Elevation: 2.73 (m), RHB 70

Drilling period

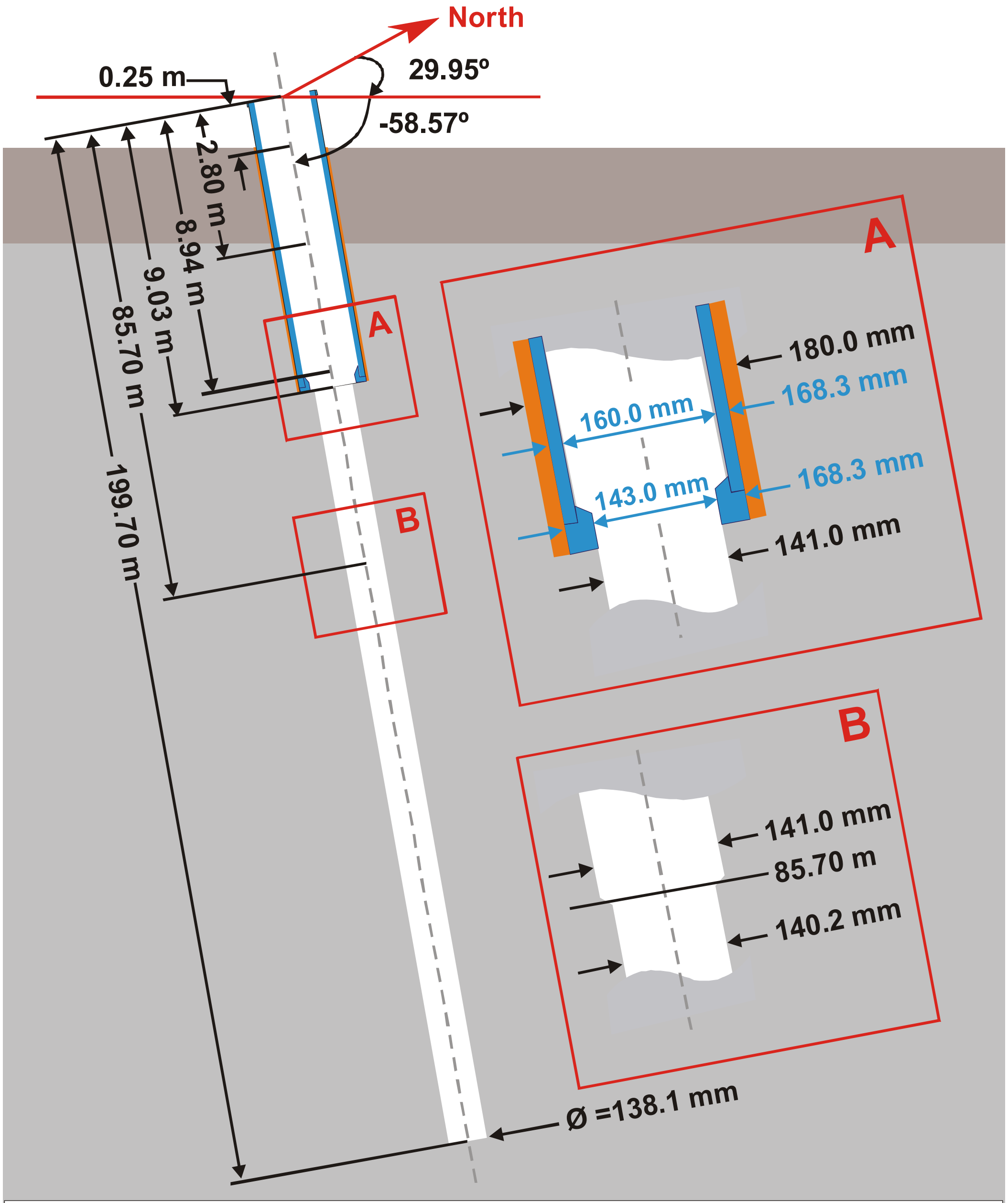
Drilling start date: 2005-11-10
Drilling stop date: 2005-11-18

rev 2005-12-10

Figure 1-5. *Technical description of borehole HFM26.*

Technical data

Borehole HFM29



Drilling reference point

Northing: 6698018.65 (m), RT90 2,5 gon V 0:-15
Easting: 1632502.81 (m), RT90 2,5 gon V 0:-15
Elevation: 4.47 (m), RHB 70

Drilling period

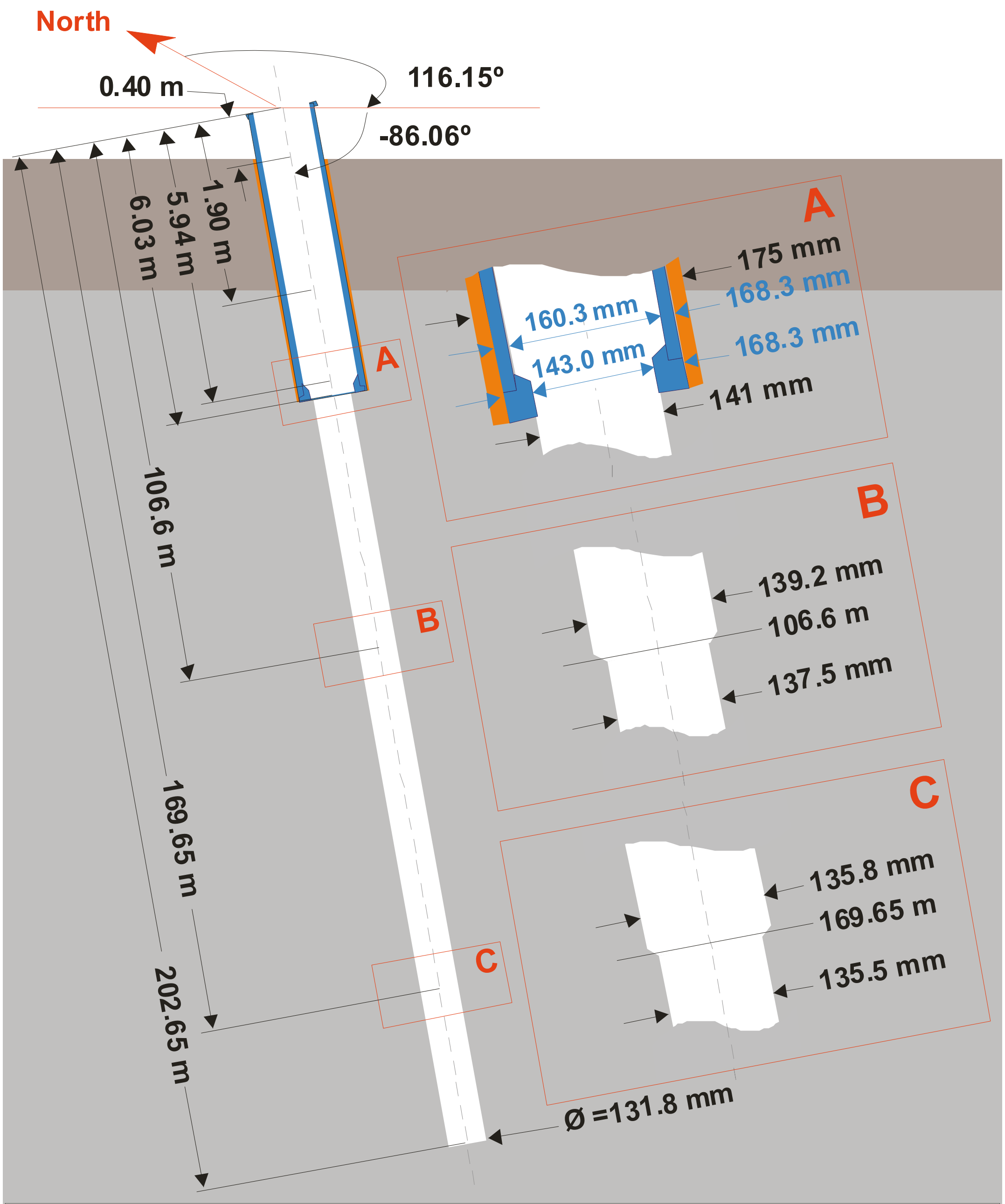
Drilling start date: 2005-12-12
Drilling stop date: 2005-12-19

rev 2006-02-20

Figure 1-6. *Technical description of borehole HFM29.*

Technical data

Borehole HFM32



Drilling reference point

Northing: 6699015.036 (m), RT90 2,5 gon V 0:-15
Easting: 1632137.068 (m), RT90 2,5 gon V 0:-15
Elevation: 0.974 (m), RHB 70

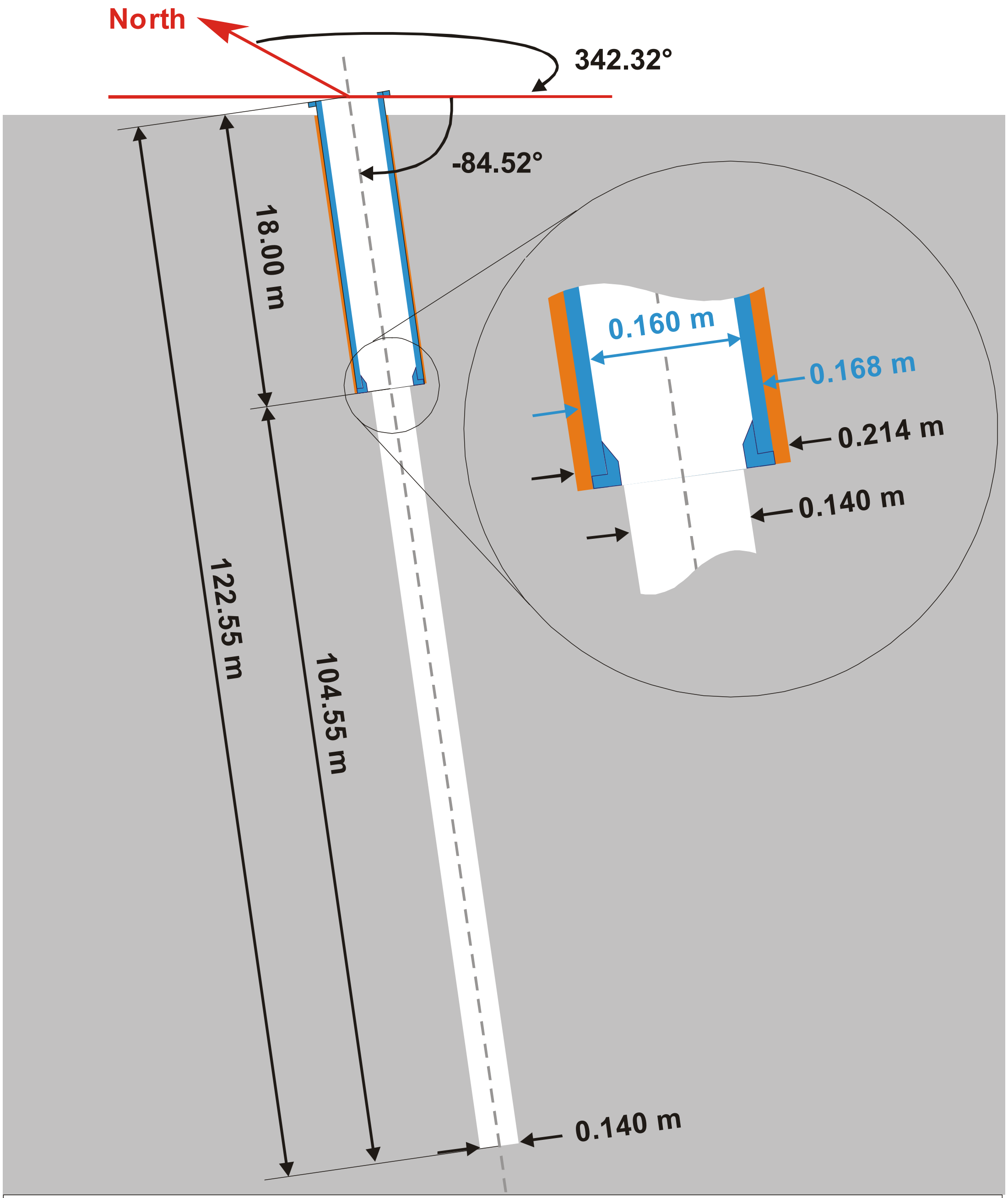
Drilling period

Drilling start date: 2006-01-11
Drilling stop date: 2006-01-14

Figure 1-7. *Technical description of borehole HFM32.*

Technical data

Borehole HFM07



Drilling reference point

Northing:	6697416.25 (m), RT90 2,5 gon V 0:-15
Easting:	1634715.69 (m), RT90 2,5 gon V 0:-15
Elevation:	5.78 (m.a.s.l.), RHB 70

Drilling period

Drilling start date:	2003-01-16
Drilling stop date:	2003-01-28

Figure 1-8. *Technical description of borehole HFM07.*

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 borehole, KFM01C and KFM09B.

This field report describes the equipment used as well as the measurement procedures. Geophysical borehole logging data is presented in Appendix 1(KFM01C), in Appendix 2 (KFM09B), in Appendix 3 (HFM24), in Appendix 4 (HFM26), in Appendix 5 (HFM29), in Appendix 6 (HFM32) and in Appendix 7 (HFM07).

3 Equipment

The geophysical borehole logging program were performed with 7 multi tool probes and resulted in a suite of 19 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 resis-tivity	Normal resistivity (16 and 64 inch), single point resistance and natural gamma.	237×5.3 cm			Not used in HFM32
Century 8622 Magnetic susceptibility.	Magnetic susceptibility, natural gamma.	203×4.1 cm			All boreholes
Century 9042 Fluid tempe-ratur and fluid resistivity	Fluid temperatur, fluid resistivity and natural gamma.	137×4.1 cm			All boreholes
Century 9072 3 m focused guard.	3 m focused guard log resistivity and natural gamma.	310×6.4 cm			All boreholes
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 sour-ce focused.	All boreholes
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.	All boreholes
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.	All boreholes

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 January 23 to February 2, 2006. 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 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.

4.2 Nonconformities

Borehole KFM01C has been stabilised with PLEX-plates between 84.31 m to 86.29 m. It was not possible to pass this interval with the Density probe 9139. The Density log has therefore only been recorded to a depth of 85 m.

The deviation measurements (with the HiRAT probe) of the borehole KFM01C (azimuth and inclination) was not repeatable between the down- and up-measurements. The calculation of the co-ordinates are therefore not optimal, and are not used in SICADA.

The 8144 Normal log probe was not recorded in borehole HFM32.

5 Results

5.1 Presentation

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

Logs presented in Appendix 1–7 (drawings no. 1.1–7.1) are presented in Table 5-1.

Table 5-1. Logs presented in drawings no. 1.1, Appendix 1.

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
Magnetic susceptibility	MAGSUSCEP	$SI \times 10^{-5}$	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 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).

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 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 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	–
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	–

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 KFM01C

In order to obtain an exact depth calibration in borehole KFM01C, 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.

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 KFM01C, between all log runs, the obtained reference mark correlation is transferred to the other logs.

The complete log suite for borehole KFM01C is presented as composite log sheets in drawing 1.1 in Appendix 1. The logs presented in drawing no. 1.1 are listed in Table 5-1.

Table 5-3. The reference track marks in the borehole and the recorded track marks from the HiRAT in borehole KFM01C.

Reference mark	HIRAT recorded
51.00	51.00
100.00	100.152
150.00	150.31
200.00	200.457
252.00	252.63
299.00	299.81
350.00	350.98
400.00	401.185

5.5 Borehole KFM09B

In order to obtain an exact depth calibration in borehole KFM09B, 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 KFM09B, between all log runs, the obtained reference mark correlation is transferred to the other logs.

The complete log suite for borehole KFM09B is presented as composite log sheets in drawing 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 from the HiRAT in borehole KFM09B.

Reference mark	HIRAT recorded
50.00	47.15
100.00	97.267
150.00	147.435
200.00	197.587
250.00	247.75
300.00	297.84
350.00	348.01
400.00	398.166
450.00	448.295
500.00	498.41
550.00	548.579

5.6 Borehole HFM24

Using 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.

The complete log suite for borehole HFM24 is presented as composite log sheet in drawing 3.1 in Appendix 3. The logs presented in drawing no. 3.1 are listed in Table 5-1.

Table 5-5. Gamma events in borehole HFM24.

Events	Depths
Top event	14.39
Bottom event	142.80

5.7 Borehole HFM26

Using 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 5-6.

The complete log suite for borehole HFM26 is presented as composite log sheet in drawing 4.1 in Appendix 4. The logs presented in drawing no. 4.1 are listed in Table 5-1.

Table 5-6. Gamma events in borehole HFM26.

Events	Depths
Top event	13.84
Bottom event	185.35

5.8 Borehole HFM29

Using 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 5-7.

The complete log suite for borehole HFM29 is presented as composite log sheet in drawing 5.1 in Appendix 5. The logs presented in drawing no. 5.1 are listed in Table 5-1.

Table 5-7. Gamma events in borehole HFM29.

Events	Depths
Top event	9.50
Bottom event	194.12

5.9 Borehole HFM32

Using 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 5-8.

The complete log suite for borehole HFM32 is presented as composite log sheet in drawing 6.1 in Appendix 6. The logs presented in drawing no. 6.1 are listed in Table 5-1.

Table 5-8. Gamma events in borehole HFM32.

Events	Depths
Top event	8.47
Bottom event	166.56

5.10 Borehole HFM07

Using 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 5-9.

The complete log suite for borehole HFM07 is presented as composite log sheet in drawing 7.1 in Appendix 7. The logs presented in drawing no. 7.1 are listed in Table 5-1.

Table 5-9. Gamma events in borehole HFM07.

Events	Depths
Top event	18.8
Bottom event	115.2

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
KFM01C	8144	Down	KFM01C_02-02-06_07-12_8144C_.02_2.27_ 447.93_ORIG.log	Start Depth: 2.27 m. End Depth: 447.93 m
KFM01C	8622	Up	KFM01C_02-02-06_09-51_8622C_.1_0.90_ 448.10_ORIG.log	Start Depth: 448.1 m. End Depth: 0.9 m
KFM01C	9042	Down	kfm01c_02-01-06_18-00_9042C_.02_2.43_ 447.79_ORIG.log	Start Depth: 2.43 m. End Depth: 447.79 m
KFM01C	9072	Up	KFM01C_02-02-06_08-41_9072C_.02_1.30_ 447.31_ORIG.log	Start Depth: 447.31 m. End Depth: 1.3 m
KFM01C	9139	Up	KFM01C_02-02-06_13-43_9139A_.02_2.05_ 82.60_ORIG.log	Start Depth: 82.6 m. End Depth: 2.05 m
KFM01C	9310	Up	KFM01C_02-02-06_10-46_9310C2_.10_1.00_ 447.10_ORIG.log	Start Depth: 447.1 m. End Depth: 1 m
KFM01C	HiRAT	Up	KFM01C_90pixels_up_run1.HED	Start Depth: 447 m. End Depth: 0 m
KFM09B	8144	Down	KFM09B_01-31-06_07-32_8144C_.10_3.10_ 617.10_ORIG.log	Start Depth: 3.1 m. End Depth: 617.1 m
KFM09B	8622	Up	KFM09B_01-31-06_09-26_8622C_.10_-1.10_ 616.30_ORIG.log	Start Depth: 616.3 m. End Depth: –1.1 m
KFM09B	9042	Down	KFM09B_01-30-06_07-38_9042C_.02_0.22_ 615.69_ORIG.log	Start Depth: 0.22 m. End Depth: 615.69 m
KFM09B	9072	Up	KFM09B_01-30-06_09-41_9072C_.02_-1.54_ 615.37_ORIG.log	Start Depth: 615.37 m. End Depth: –1.54 m
KFM09B	9139	Up	KFM09B_01-30-06_14-52_9139A_.02_-2.14_ 614.51_ORIG.log	Start Depth: 614.51 m. End Depth: –2.14 m
KFM09B	9310	Up	KFM09B_01-30-06_18-43_9310C2_.10_ 559.50_615.50_ORIG.log	Start Depth: 615.5 m. End Depth: 559.5 m
KFM09B	9310	Up	KFM09B_01-30-06_18-57_9310C2_.10_ 478.40_562.30_PROC.log	Start Depth: 562.3 m. End Depth: 478.4 m
KFM09B	9310	Up	KFM09B_01-30-06_19-16_9310C2_.10_ 306.60_481.60_ORIG.log	Start Depth: 306.6 m. End Depth: 481.6 m
KFM09B	9310	Up	KFM09B_01-30-06_19-43_9310C2_.10_-1.60_ 337.30_ORIG.log	Start Depth: 337.3 m. End Depth: –1.6 m
KFM09B	HiRAT	Up	KFM09B_90pixels_up_run1.HED	Start Depth: 615 m. End Depth: 0 m
KFM09B	HiRAT	Up	KFM09B_90pixels_up_run1.HED	Start Depth: 615 m. End Depth: 0 m

Borehole	Probe	Log direction	WellCAD File	Description
HFM24	8144	Down	HFM24_01-31-06_13-51_8144C_.02_0.28_ 153.30_ORIG.log	Start Depth: 0.28 m. End Depth: 153.3 m
HFM24	8622	Up	HFM24_01-31-06_16-36_8622C_.02_-0.13_ 151.58_ORIG.log	Start Depth: 151.58 m. End Depth: –0.13 m
HFM24	9042	Down	HFM24_01-31-06_13-13_9042C_.02_0.22_ 152.16_ORIG.log	Start Depth: 0.22 m. End Depth: 152.16 m
HFM24	9072	Up	HFM24_01-31-06_14-27_9072C_.02_0.13_ 152.55_ORIG.log	Start Depth: 152.55 m. End Depth: 0.13 m
HFM24	9139	Up	HFM24_01-31-06_15-50_9139A_.02_-0.11_ 151.72_ORIG.log	Start Depth: 151.72 m. End Depth: –0.11 m
HFM24	9310	Up	HFM24_01-31-06_14-59_9310C2_.10_-0.10_ 151.20_ORIG.log	Start Depth: 151.2 m. End Depth: –0.1 m
HFM24	HiRAT	Up	HFM24_90pixels_up_run1.HED	Start Depth: 151 m. End Depth: 0 m
HFM26	8144	Down	HFM26_02-01-06_08-21_8144C_.02_0.28_ 202.98_ORIG.log	Start Depth: 0.28 m. End Depth: 202.98 m
HFM26	8622	Up	HFM26_02-01-06_12-39_8622C_.02_-0.34_ 202.58_ORIG.log	Start Depth: 202.58 m. End Depth: –0.34 m
HFM26	9042	Down	HFM26_02-01-06_07-39_9042C_.02_0.22_ 203.16_ORIG.log	Start Depth: 0.22 m. End Depth: 203.16 m
HFM26	9072	Up	HFM26_02-01-06_11-11_9072C_.02_-0.36_ 202.54_ORIG.log	Start Depth: 202.54 m. End Depth: –0.36 m
HFM26	9139	Up	HFM26_02-01-06_10-15_9139A_.02_-0.51_ 202.16_ORIG.log	Start Depth: 202.16 m. End Depth: –0.51 m
HFM26	9310	Up	HFM26_02-01-06_09-12_9310C2_.10_-0.90_ 201.10_ORIG.log	Start Depth: 201.1 m. End Depth: –0.9 m
HFM26	HiRAT	Up	HFM26_90pixels_up_run2.HED	Start Depth 210 m. End Depth: 0 m
HFM29	8144	Down	HFM29_01-31-06_19-27_8144C_.02_1.57_ 201.65_ORIG.log	Start Depth: 1.57 m. End Depth: 201.65 m
HFM29	8622	Up	HFM29_01-23-06_15-27_8622C_.10_-0.20_ 199.80_ORIG.log	Start Depth: 199.8 m. End Depth: –0.2 m
HFM29	9042	Down	HFM29_01-23-06_14-00_9042C_.10_0.20_ 201.10_ORIG.log	Start Depth: 0.2 m. End Depth: 201.1 m
HFM29	9072	Up	HFM29_01-23-06_14-52_9072C_.10_0.30_ 200.00_ORIG.log	Start Depth: 200 m. End Depth: 0.3 m
HFM29	9139	Up	HFM29_01-31-06_18-37_9139A_.02_1.17_ 199.94_ORIG.log	Start Depth: 199.94 m. End Depth: 1.17 m
HFM29	9310	Up	HFM29_01-23-06_17-12_9310C2_.10_0.60_ 199.00_ORIG.log	Start Depth: 199 m. End Depth: 0.6 m
HFM29	HiRAT	Up	HFM29_HiRAT_90pixels_Up_run2.HED	Start Depth: 199 m. End Depth: 0 m
HFM32	8622	Up	HFM32_01-23-06_10-17_8622C_.10_0.30_ 201.90_ORIG.log	Start Depth: 201.9 m. End Depth: 0.3 m
HFM32	9042	Down	HFM32_01-23-06_08-44_9042C_.10_0.20_ 203.50_ORIG.log	Start Depth: 0.2 m. End Depth: 203.5 m
HFM32	9072	Up	HFM32_01-23-06_09-37_9072C_.10_0.30_ 202.50_ORIG.log	Start Depth: 202.5 m. End Depth: 0.3 m
HFM32	9139	Up	HFM32_01-23-06_10-58_9139C_.10_0.20_ 202.60_ORIG.log	Start Depth: 202.6 m. End Depth: 0.2 m
HFM32	9310	Up	HFM32_01-23-06_12-48_9310C2_.10_3.30_ 201.60_ORIG.log	Start Depth: 201.6 m. End Depth: 3.3 m
HFM32	HiRAT	Up	HFM32_90pixels_Up_run2.HED	Start Depth: 201 m. End Depth: 0 m
HFM07	8144	Down	HFM07_02-01-06_13-48_8144C_.02_0.28_ 122.48_ORIG.log	Start Depth: 0.28 m. End Depth: 122.48 m

Borehole	Probe	Log direction	WellCAD File	Description
HFM07	8622	Up	HFM07_02-01-06_16-31_8622C_.02_-0.47_121.55_ORIG.log	Start Depth: 121.55 m. End Depth: –0.47 m
HFM07	9042	Down	HFM07_02-01-06_13-20_9042C_.02_0.20_122.14_ORIG.log	Start Depth: 0.2 m. End Depth: 122.14 m
HFM07	9072	Up	HFM07_02-01-06_15-42_9072C_.02_-0.17_121.67_ORIG.log	Start Depth: 121.67 m. End Depth: –0.17 m
HFM07	9139	Up	HFM07_02-01-06_15-07_9139A_.02_-0.27_121.33_ORIG.log	Start Depth: 121.33 m. End Depth: –0.27 m
HFM07	9310	Down	HFM07_02-01-06_14-25_9310C2_.10_-0.30_121.20_ORIG.log	Start Depth: –0.3 m. End Depth: 121.2 m
HFM07	HiRAT	Up	HFM07_90pixels_up_run1.HED	Start Depth: 121 m. End Depth: 0 m

Table 6-2. Drawing files in WellCad format.

Borehole	Drawing	WellCad file
KFM01C	1.1	KFM09A_Presentation.WCL
KFM09B	2.1	KFM07B_Presentation.WCL
HFM24	3.1	HFM24_Presentation.WCL
HFM26	4.1	HFM26_Presentation.WCL
HFM29	5.1	HFM29_Presentation.WCL
HFM32	6.1	HFM32_Presentation.WCL
HFM07	7.1	HFM07_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	Except HFM32
“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	Except HFM32
“Borehole”_RES(16N)_GP164 – Resistivity, normal 0.4 m (16 in).xls	Except HFM32
“Borehole”_P-VEL_GP175 – Fullwave sonic.xls	
“Borehole”_GP830 – Acoustic televiewer.xls	

Appendix 1

Borehole KFM01C, drawing no. 1.1, borehole logs

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

Northing: 6699526.071m Easting: 1631403.838m Elevation: 2.927m, RHB70

Diameter:	75.8mm
Reaming Diameter:	
Outer Casing:	147mm
Inner Casing:	70mm
Borehole Length:	450.00m
Cone:	
Inclination at ground surface:	-50°
Azimuth:	165.03° GN
Comments:	

Borehole logging programme

Name	Description	Tool	Unit
CALIPER1	Caliper, 1-arm	9030/9139	mm
DENSITY	Gamma-gamma density	9030/9139	kg/m³
RES(MG)	Focused guard log resistivity, 140cm	9030	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
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	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	mV
RES(SG)	Focused guard log resistivity, 128 cm	9139	ohm-m

Rev.	Date	Drawn by	Control	Approved
0	2006-02-21	JRI	UTN	UTN

Job: 547310A

Scale: 1:500

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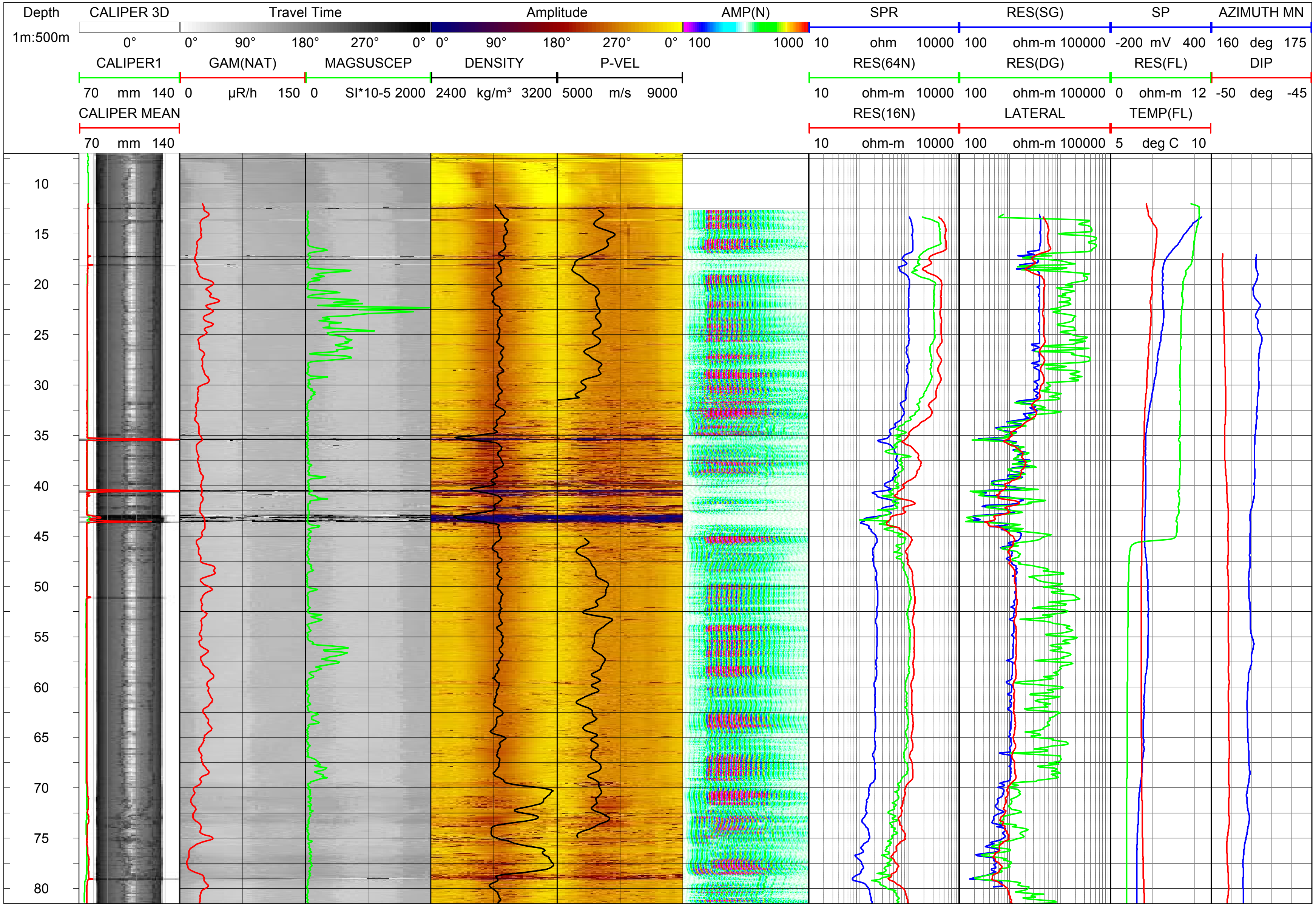
SKB geophysical borehole logging
Borehole KFM01C

Presentation

Filename:
KFM01C_Presentation.wcl

Drawing no.:
1.1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CALIPER1
70 mm 140
CALIPER MEAN
70 mm 140
Travel Time
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GAM(NAT)
0 µR/h 150
MAGSUSCEP
0 SI*10-5 2000
Amplitude
0° 90° 180° 270° 0°
DENSITY
2400 kg/m³ 3200
P-VEL
5000 m/s 9000
AMP(N)
100 1000
SPR
10 ohm 10000
RES(64N)
10 ohm-m 10000
RES(16N)
10 ohm-m 10000
RES(SG)
100 ohm-m 100000
RES(DG)
100 ohm-m 100000
LATERAL
100 ohm-m 100000
SP
-200 mV 400
RES(FL)
0 ohm-m 12
TEMP(FL)
5 deg C 10
AZIMUTH MN
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DIP
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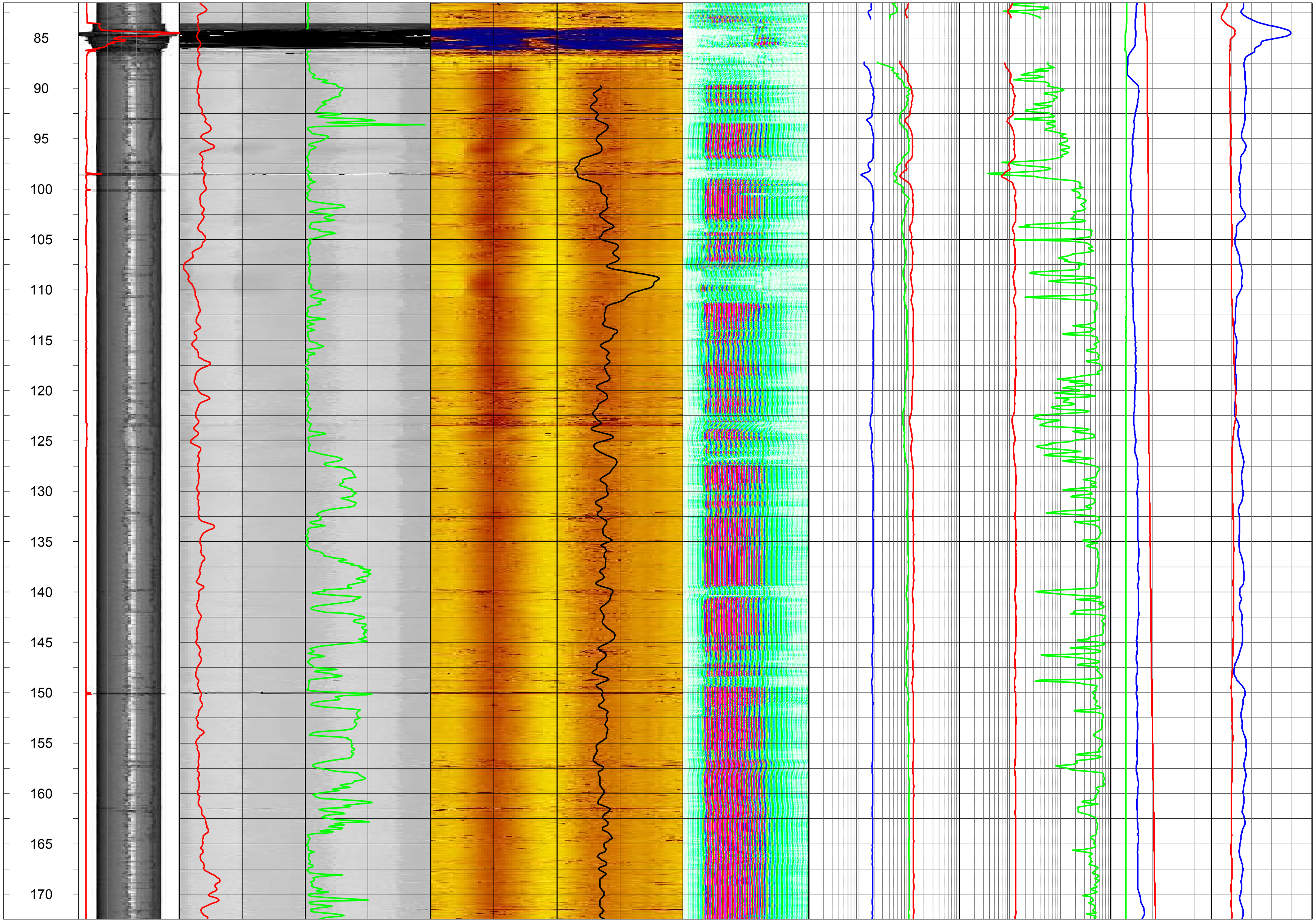
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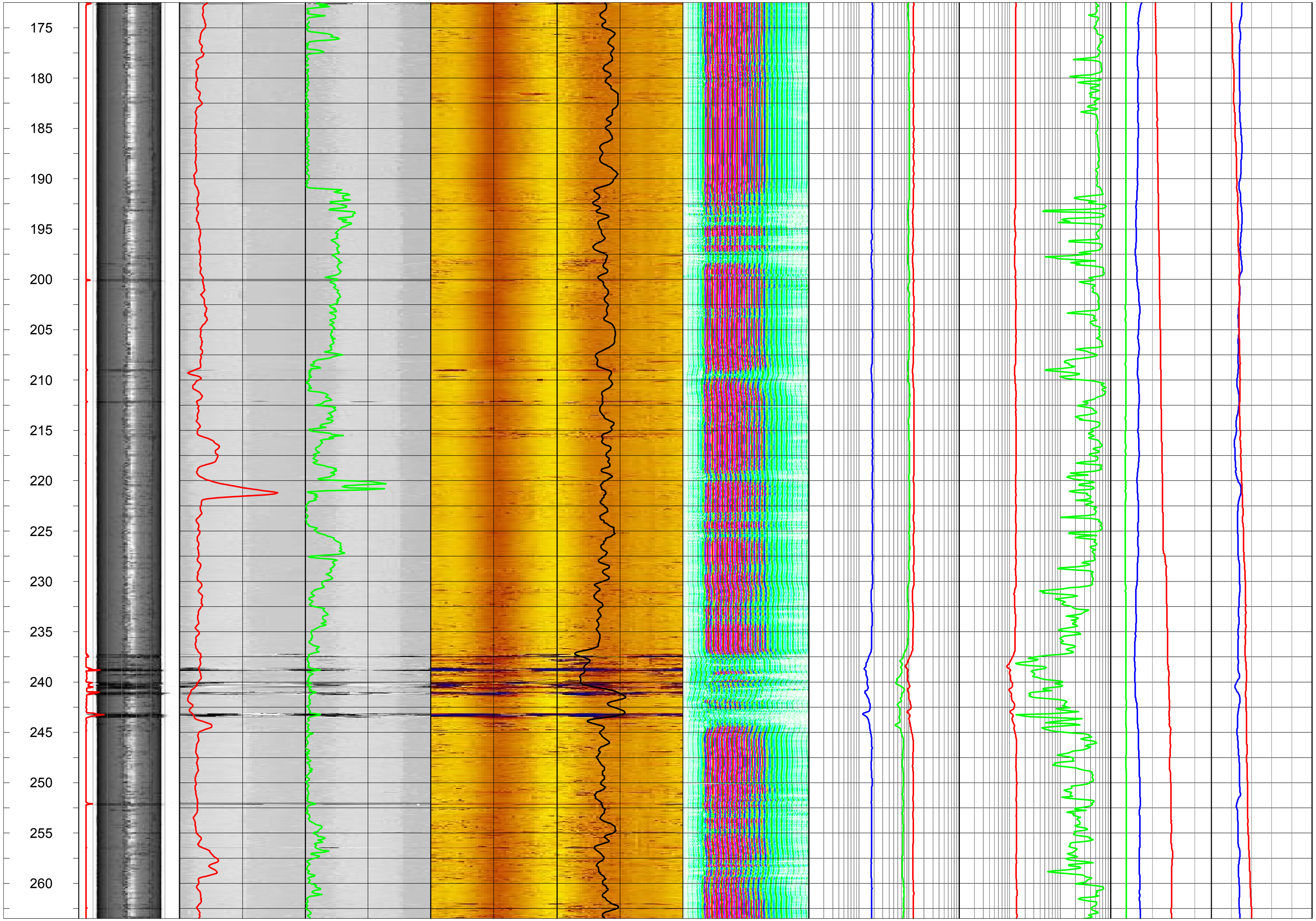
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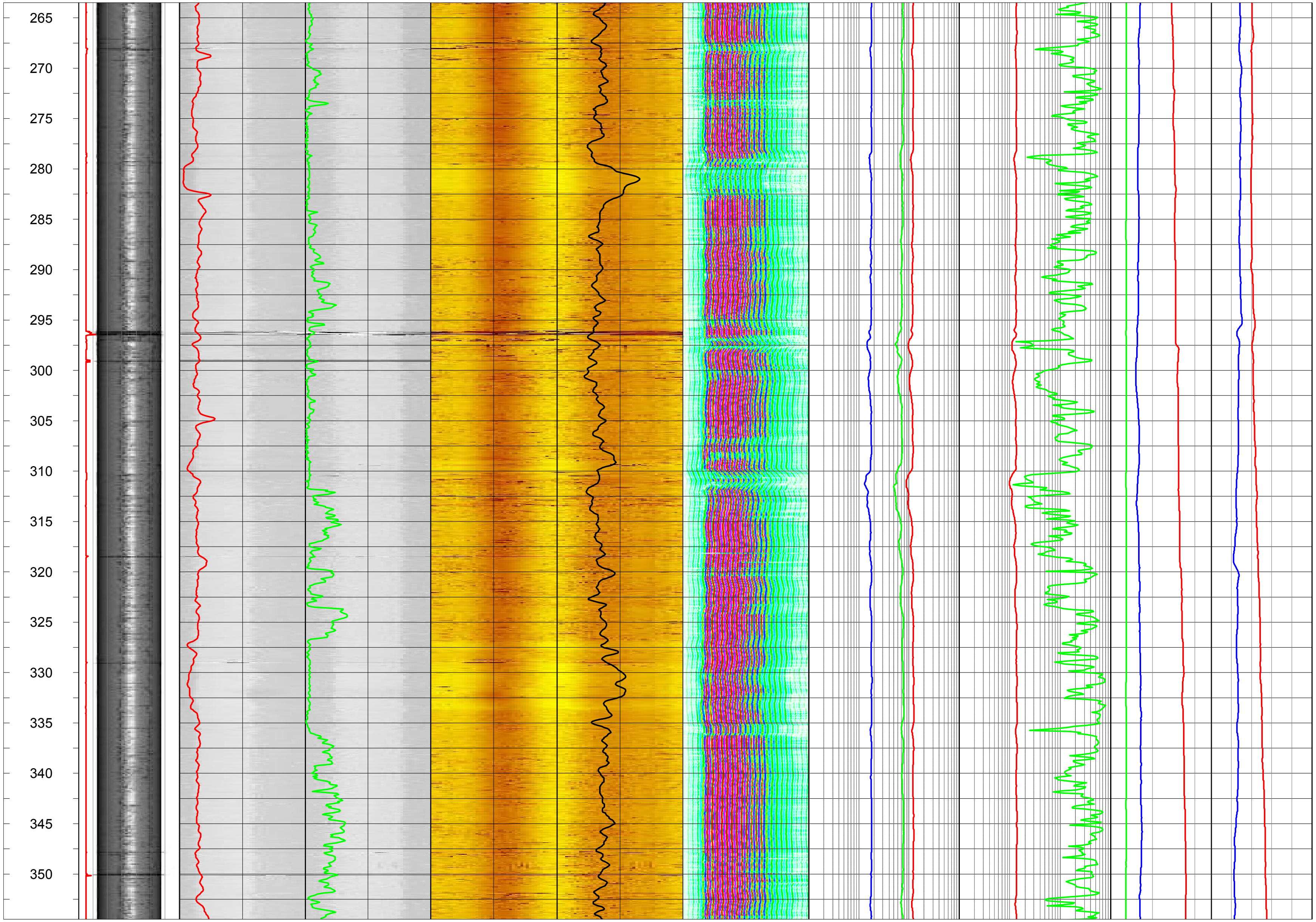
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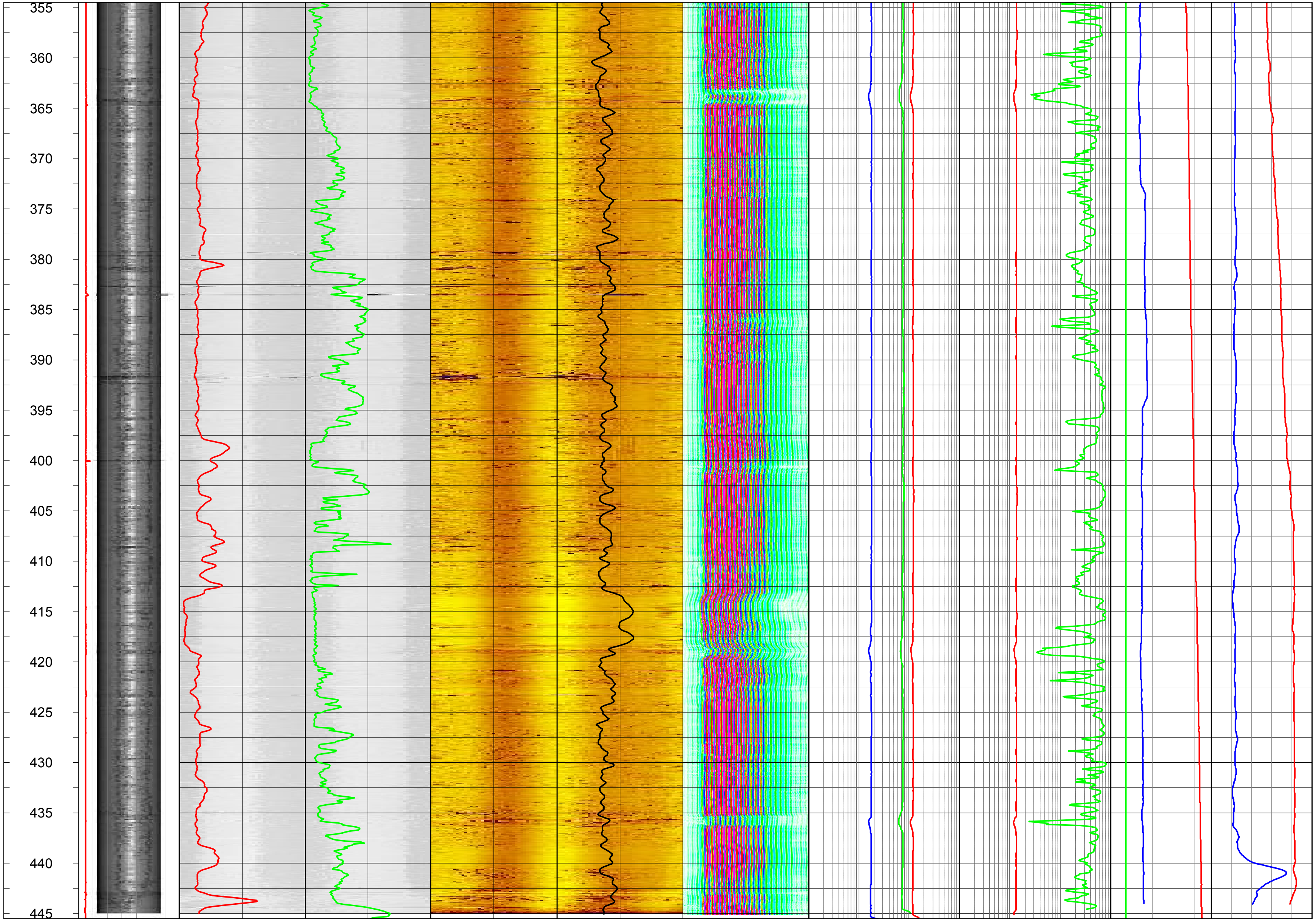
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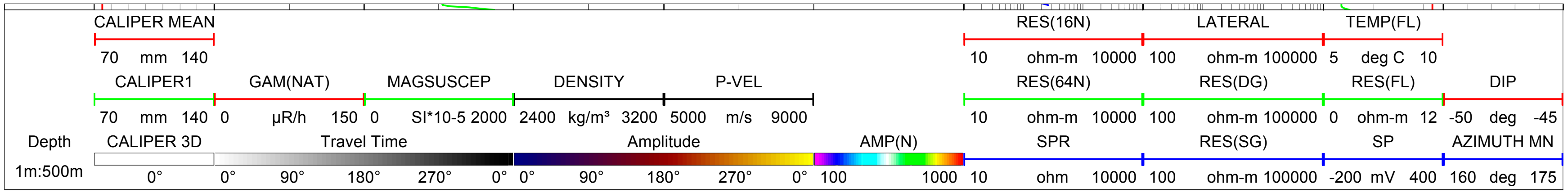
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70 mm 140
CALIPER1
70 mm 140
GAM(NAT)
0 µR/h 150
MAGSUSCEP
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DENSITY
2400 kg/m³ 3200
P-VEL
5000 m/s 9000
Depth
1m:500m
CALIPER 3D
0°
Travel Time
0° 90° 180° 270° 0°
Amplitude
0° 90° 180° 270° 0°
AMP(N)
100 1000
RES(16N)
10 ohm-m 10000
LATERAL
100 ohm-m 100000
TEMP(FL)
5 deg C 10
RES(64N)
10 ohm-m 10000
RES(DG)
100 ohm-m 100000
RES(FL)
0 ohm-m 12
DIP
-50 deg -45
SPR
10 ohm 10000
RES(SG)
100 ohm-m 100000
SP
-200 mV 400
AZIMUTH MN
160 deg 175

Appendix 2

Borehole KFM09B, drawing no. 2.1, borehole logs

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

Northing: 6700119.89m Easting: 1630638.78m Elevation: 4.30m, RHB70

Diameter:	77.3mm
Reaming Diameter:	139.8mm
Outer Casing:	90mm
Inner Casing:	77.3mm
Borehole Length:	616,45m
Cone:	
Inclination at ground surface:	-55.08°
Azimuth:	140.83° GN
Comments:	

Borehole logging programme

Name	Description	Tool	Unit
CALIPER1	Caliper, 1-arm	9030/9139	mm
DENSITY	Gamma-gamma density	9030/9139	kg/m³
RES(MG)	Focused guard log resistivity, 140cm	9030	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
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	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	mV
RES(SG)	Focused guard log resistivity, 128 cm	9139	ohm-m

Rev.	Date	Drawn by	Control	Approved
0	2006-02-14	JRI	UTN	UTN

Job: 547310A

Scale: 1:500

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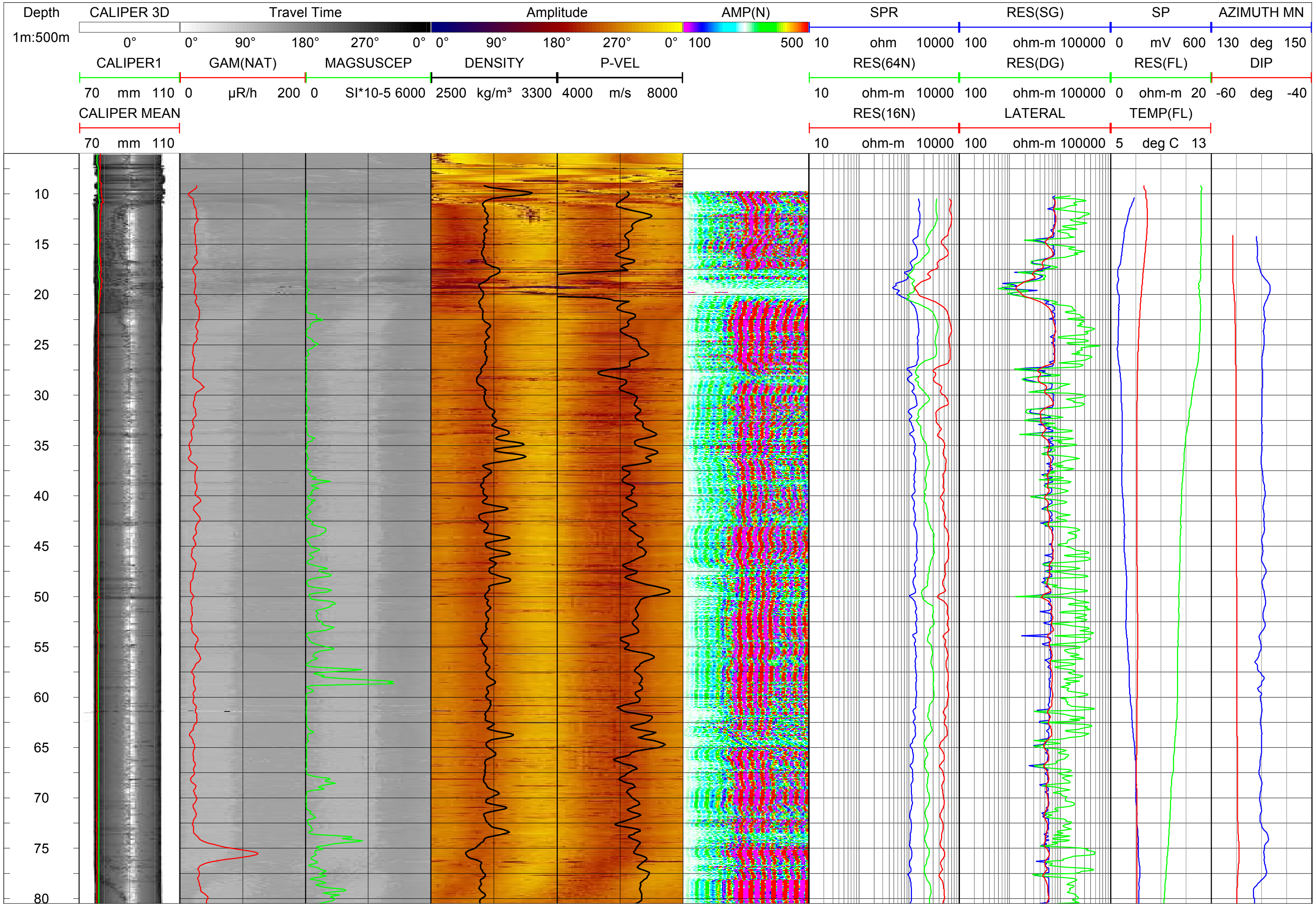
SKB geophysical borehole logging
Borehole KFM09B

Presentation

Filename: KFM09B_Presentation.wcl

Drawing no.: **2.1**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0°
CALIPER1
70 mm 110
CALIPER MEAN
70 mm 110
Travel Time
0° 90° 180° 270° 0°
GAM(NAT)
0 μR/h 200
MAGSUSCEP
0 SI*10-5 6000
Amplitude
0° 90° 180° 270° 0°
DENSITY
2500 kg/m³ 3300
P-VEL
4000 m/s 8000
AMP(N)
100 500
SPR
10 ohm 10000
RES(64N)
10 ohm-m 10000
RES(16N)
10 ohm-m 10000
RES(SG)
100 ohm-m 100000
RES(DG)
100 ohm-m 100000
LATERAL
100 ohm-m 100000
SP
0 mV 600
RES(FL)
0 ohm-m 20
TEMP(FL)
5 deg C 13
AZIMUTH MN
130 deg 150
DIP
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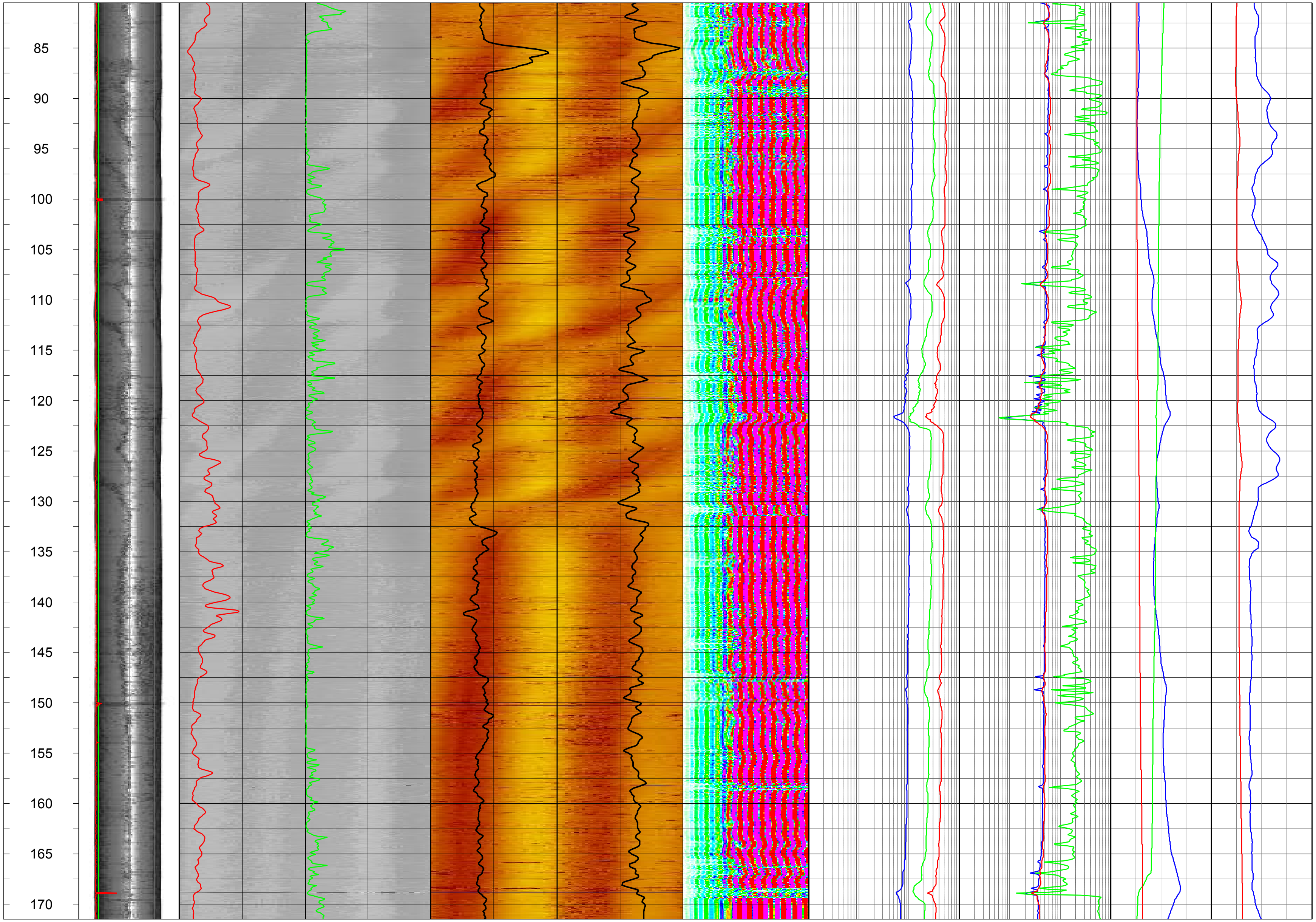
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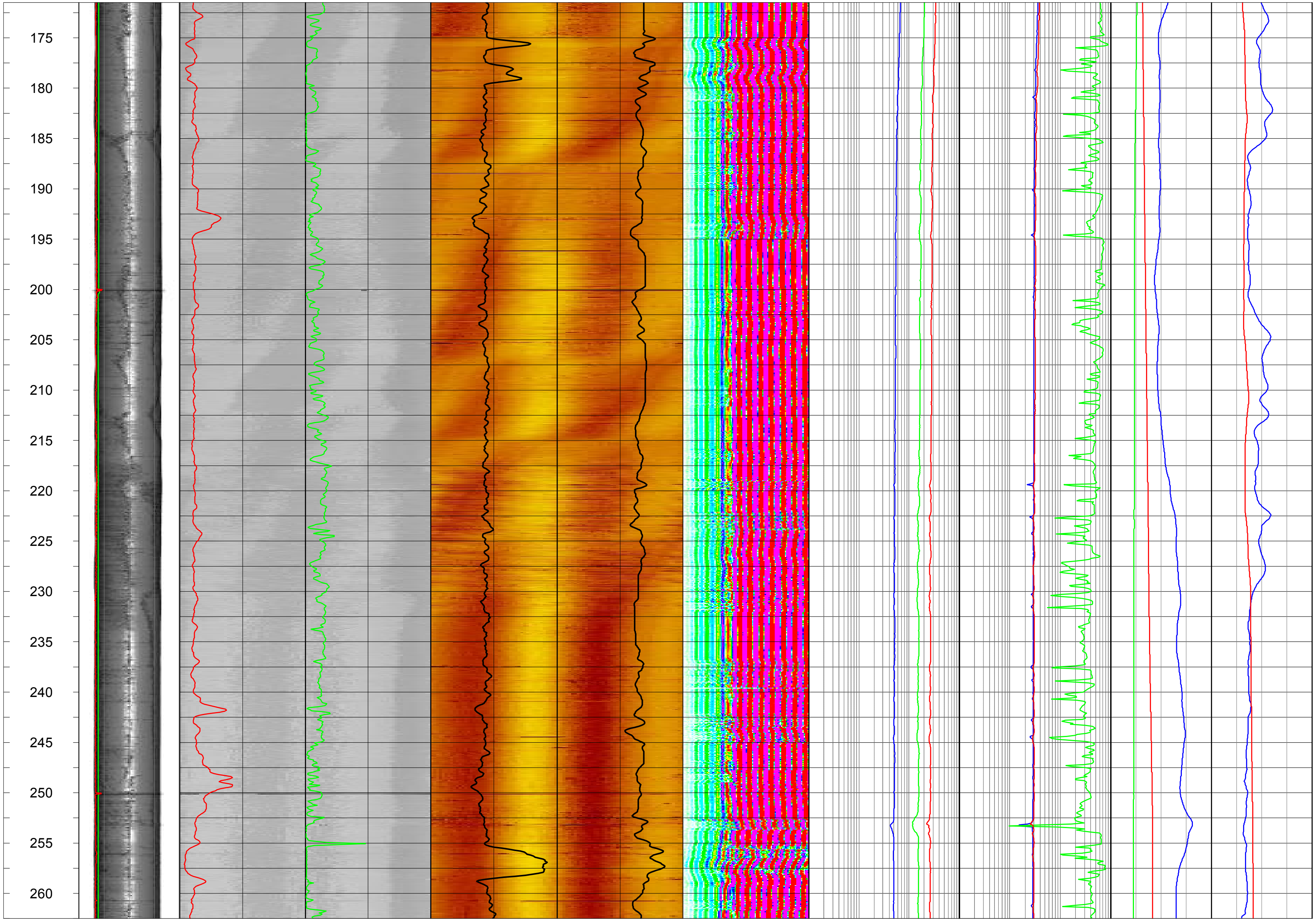
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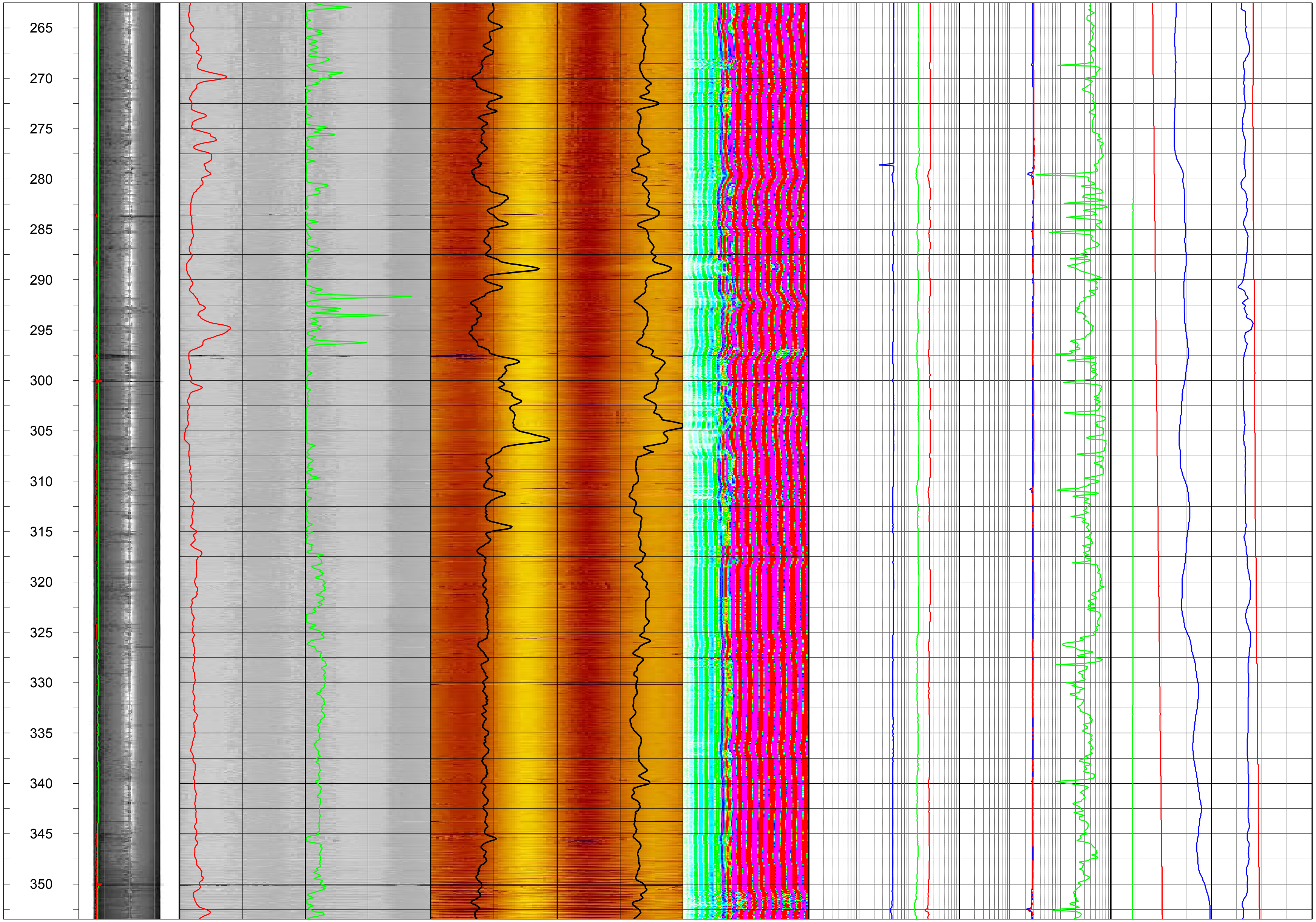
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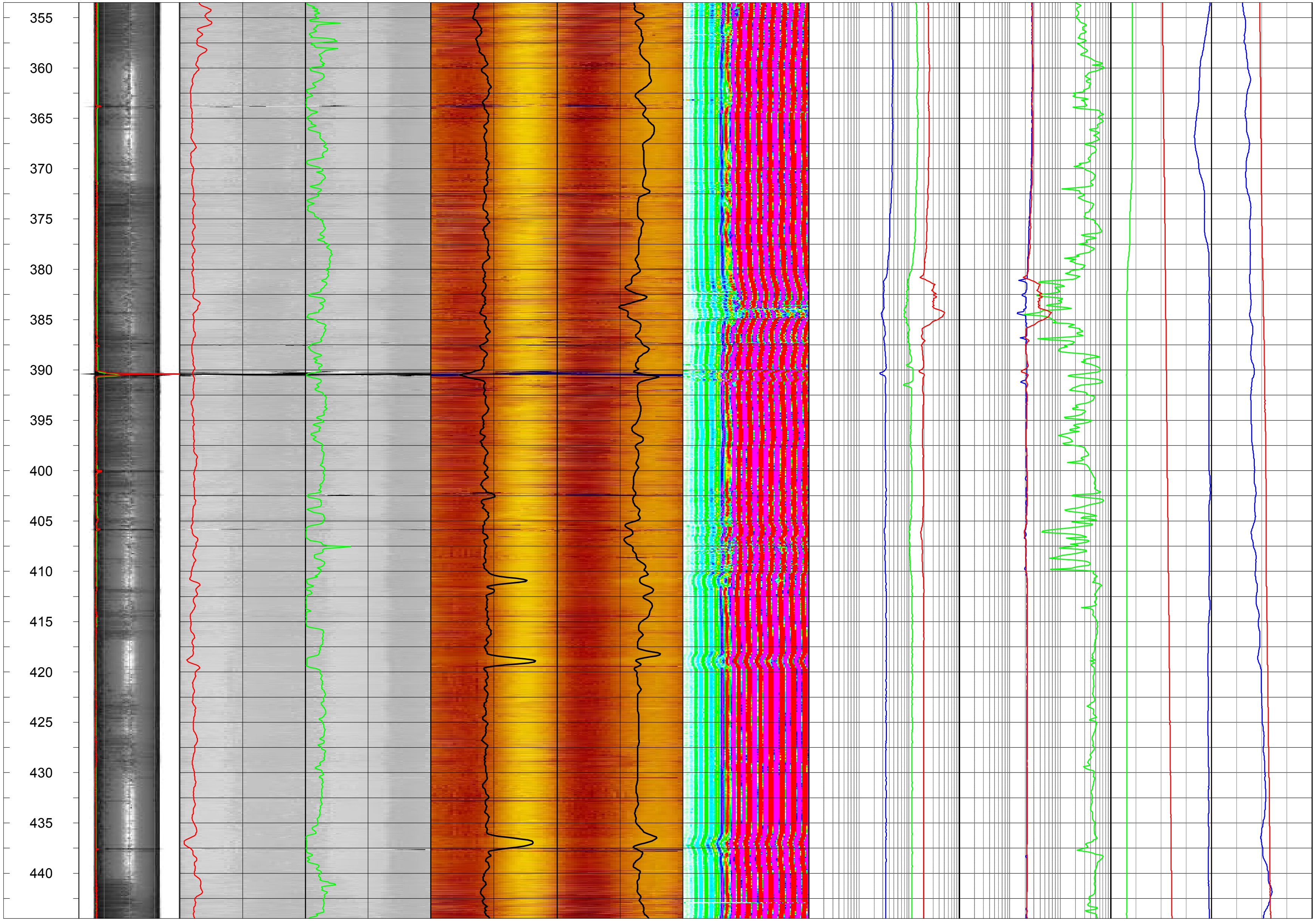
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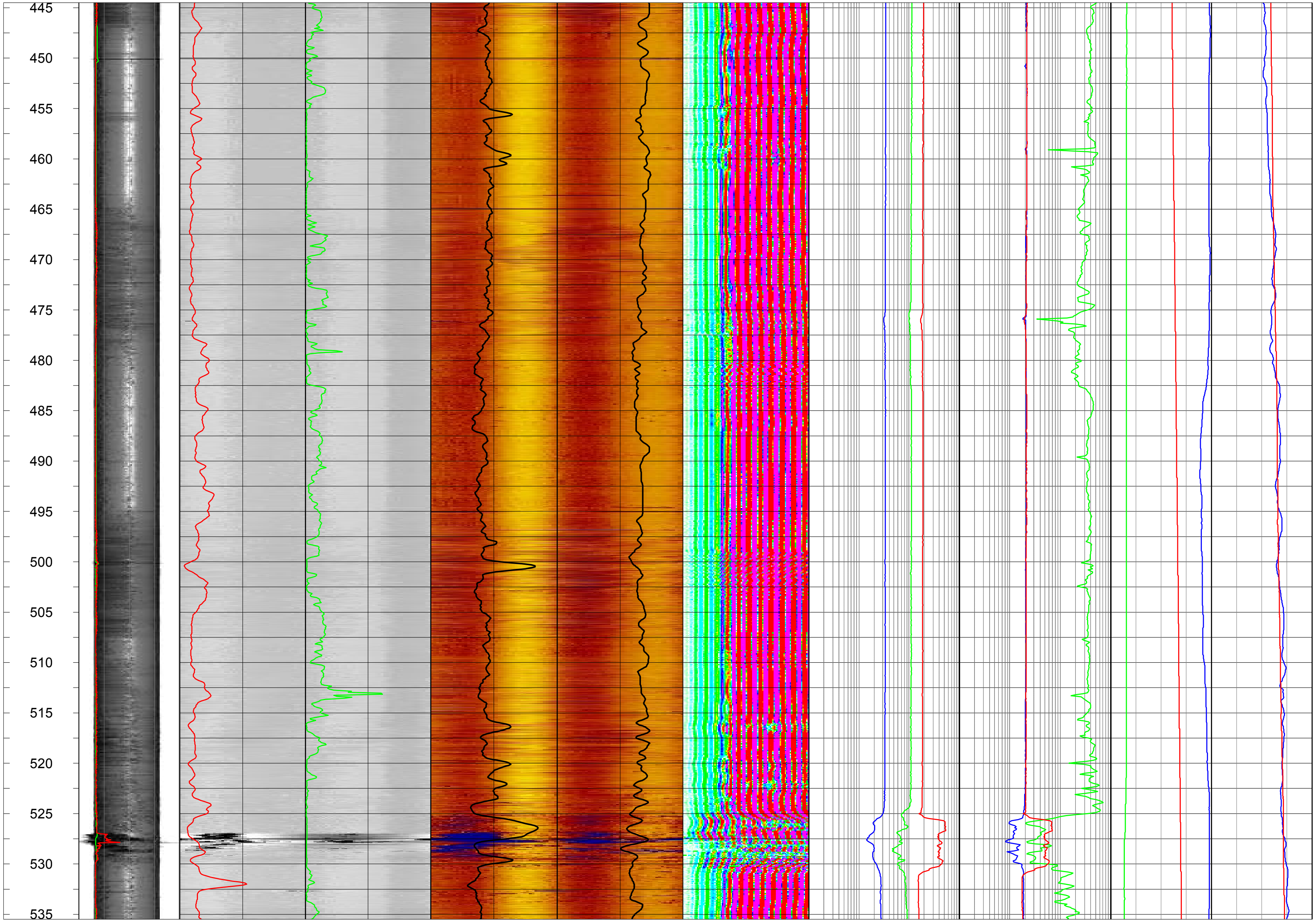
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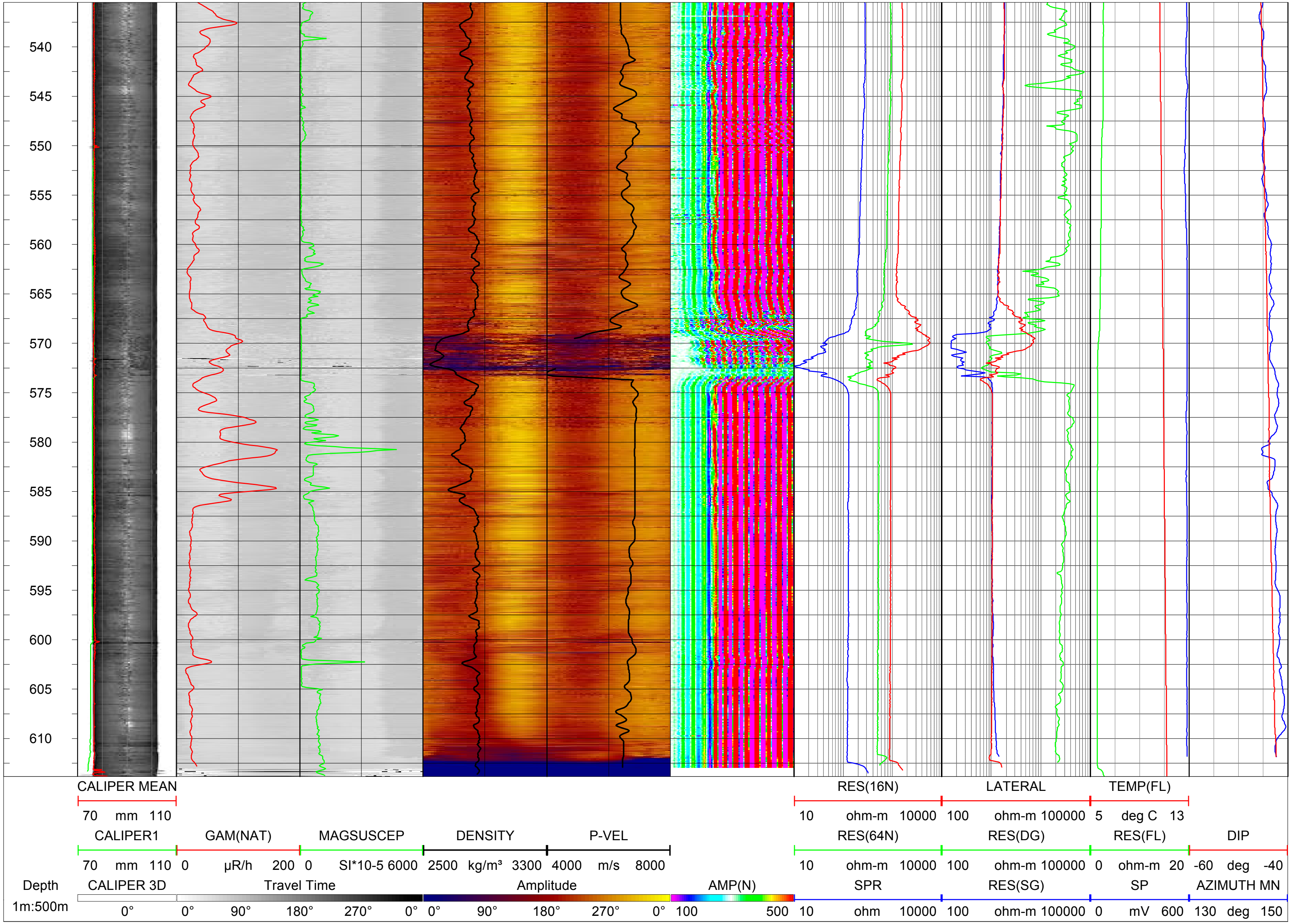
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CALIPER MEAN
70 mm 110
RES(16N)
10 ohm-m 10000
LATERAL
100 ohm-m 100000
TEMP(FL)
5 deg C 13
CALIPER1
70 mm 110
GAM(NAT)
0 μR/h 200
MAGSUSCEP
0 SI*10-5 6000
DENSITY
2500 kg/m³ 3300
P-VEL
4000 m/s 8000
RES(64N)
10 ohm-m 10000
RES(DG)
100 ohm-m 100000
RES(FL)
0 ohm-m 20
DIP
-60 deg -40
Depth
1m:500m
CALIPER 3D
0°
Travel Time
0° 90° 180° 270° 0°
Amplitude
0° 90° 180° 270° 0°
AMP(N)
100 500
SPR
10 ohm 10000
RES(SG)
100 ohm-m 100000
SP
0 mV 600
AZIMUTH MN
130 deg 150

Appendix 3

Borehole HFM24, drawing no. 3.1, borehole logs

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

Northing: 6698662.373m Easting: 1631719.641m Elevation: 3.683m, RHB70

Diameter:	138-140mm
Reaming Diameter:	
Outer Casing:	168.3mm
Inner Casing:	160mm
Borehole Length:	151.35m
Cone:	
Inclination at ground surface:	-59.56°
Azimuth:	47.29° GN
Comments:	

Borehole logging programme

Name	Description	Tool	Unit
CALIPER1	Caliper, 1-arm	9030/9139	mm
DENSITY	Gamma-gamma density	9030/9139	kg/m³
RES(MG)	Focused guard log resistivity, 140cm	9030	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
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	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	mV
RES(SG)	Focused guard log resistivity, 128 cm	9139	ohm-m

Rev.	Date	Drawn by	Control	Approved
0	2006-02-15	JRI	UTN	UTN

Job 547310A

Scale 1:500

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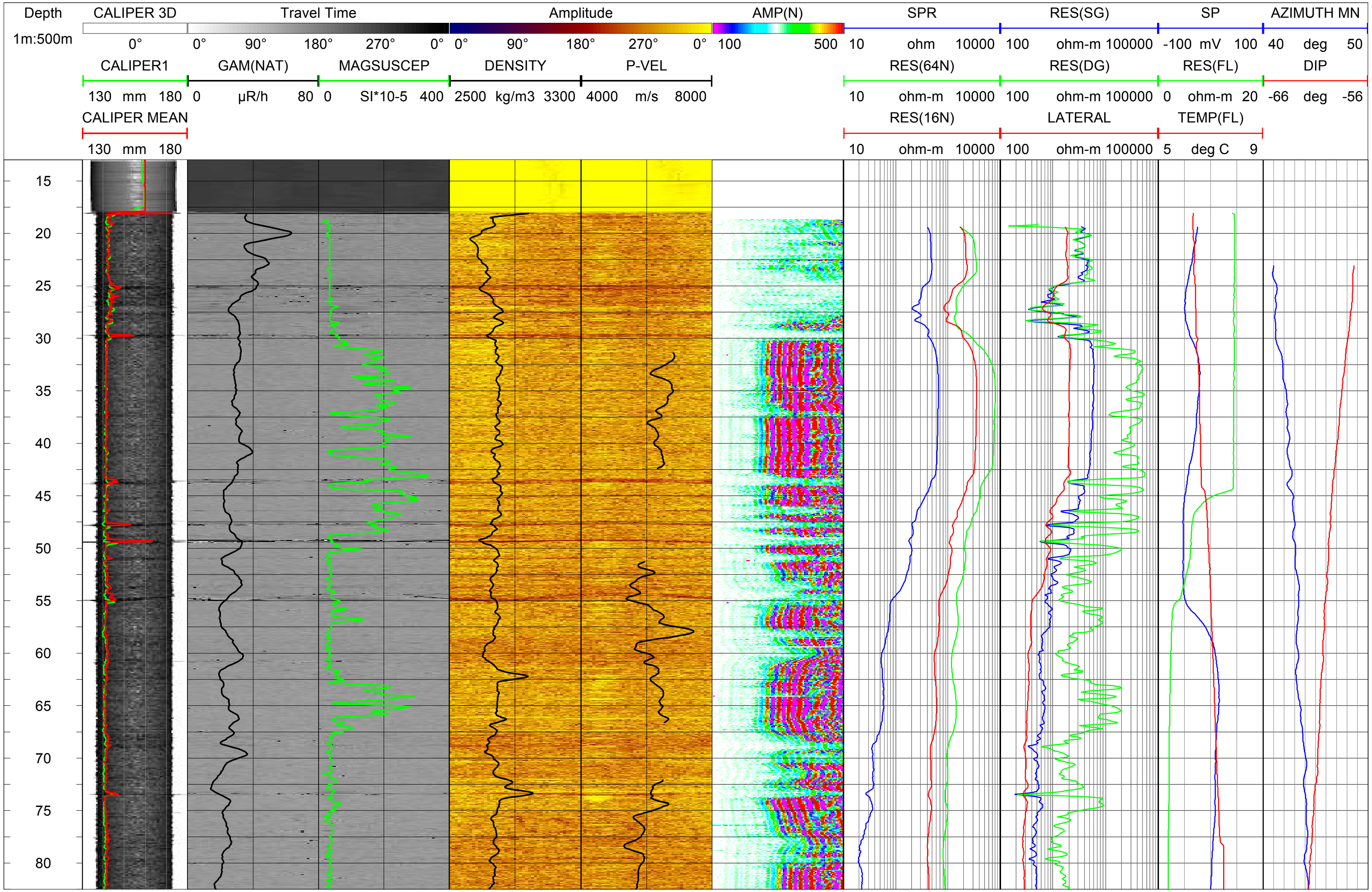
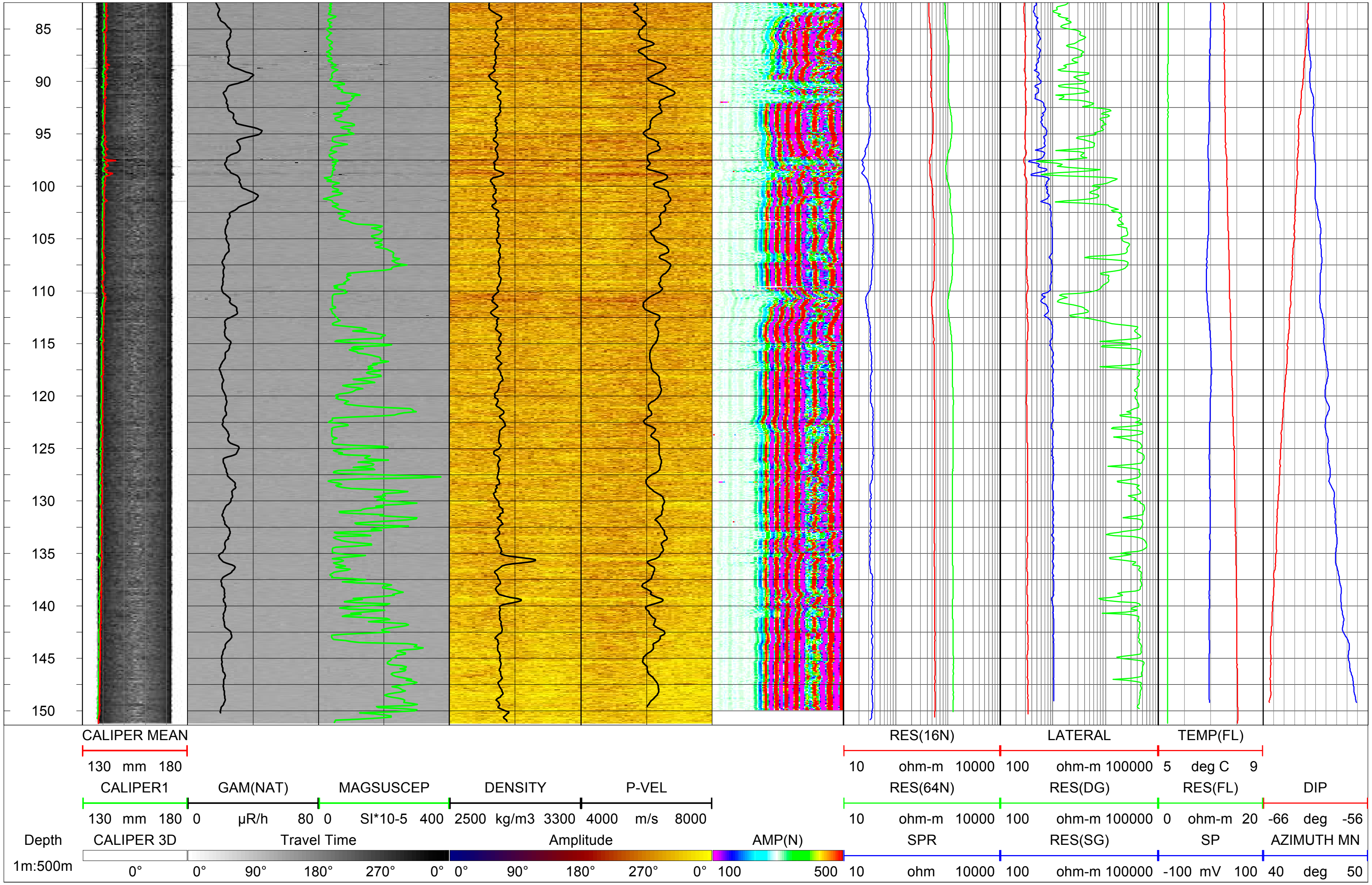
SKB geophysical borehole logging
Borehole HFM24

Presentation

Filename:
HFM24_Presentation.wcl

Drawing no.:
3.1


Depth
1m:500m
CALIPER 3D
0°
CALIPER1
130 mm 180
CALIPER MEAN
130 mm 180
Travel Time
0° 90° 180° 270° 0°
GAM(NAT)
0 µR/h 80
MAGSUSCEP
0 SI*10-5 400
Amplitude
0° 90° 180° 270° 0°
DENSITY
2500 kg/m3 3300
P-VEL
4000 m/s 8000
AMP(N)
100 500
SPR
10 ohm 10000
RES(64N)
10 ohm-m 10000
RES(16N)
10 ohm-m 10000
RES(SG)
100 ohm-m 100000
RES(DG)
100 ohm-m 100000
LATERAL
100 ohm-m 100000
SP
-100 mV 100
RES(FL)
0 ohm-m 20
TEMP(FL)
5 deg C 9
AZIMUTH MN
40 deg 50
DIP
-66 deg -56
15
20
25
30
35
40
45
50
55
60
65
70
75
80



85
90
95
100
105
110
115
120
125
130
135
140
145
150
CALIPER MEAN
130 mm 180
CALIPER1
130 mm 180
CALIPER 3D
0°
GAM(NAT)
0 μR/h 80
MAGSUSCEP
0 SI*10-5 400
Travel Time
0° 90° 180° 270° 0°
DENSITY
2500 kg/m3 3300
P-VEL
4000 m/s 8000
Amplitude
0° 90° 180° 270° 0°
AMP(N)
100 500
RES(16N)
10 ohm-m 10000
RES(64N)
10 ohm-m 10000
SPR
10 ohm 10000
LATERAL
100 ohm-m 100000
RES(DG)
100 ohm-m 100000
RES(SG)
100 ohm-m 100000
TEMP(FL)
5 deg C 9
RES(FL)
0 ohm-m 20
SP
-100 mV 100
DIP
-66 deg -56
AZIMUTH MN
40 deg 50
Depth
1m:500m

Borehole HFM26, drawing no. 4.1, borehole logs

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

Northing: 6698008.929m Easting: 1633516.386m Elevation: 2.734m, RHB70

Diameter:	140mm
Reaming Diameter:	180mm
Outer Casing:	168.3mm
Inner Casing:	160mm
Borehole Length:	202.7m
Cone:	
Inclination at ground surface:	-53.75°
Azimuth:	112.42° GN
Comments:	

Borehole logging programme

Name	Description	Tool	Unit
CALIPER1	Caliper, 1-arm	9030/9139	mm
DENSITY	Gamma-gamma density	9030/9139	kg/m³
RES(MG)	Focused guard log resistivity, 140cm	9030	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
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	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	mV
RES(SG)	Focused guard log resistivity, 128 cm	9139	ohm-m

Rev.	Date	Drawn by	Control	Approved
0	2006-02-15	JRI	UTN	UTN

Job	Scale
547310A	1:500

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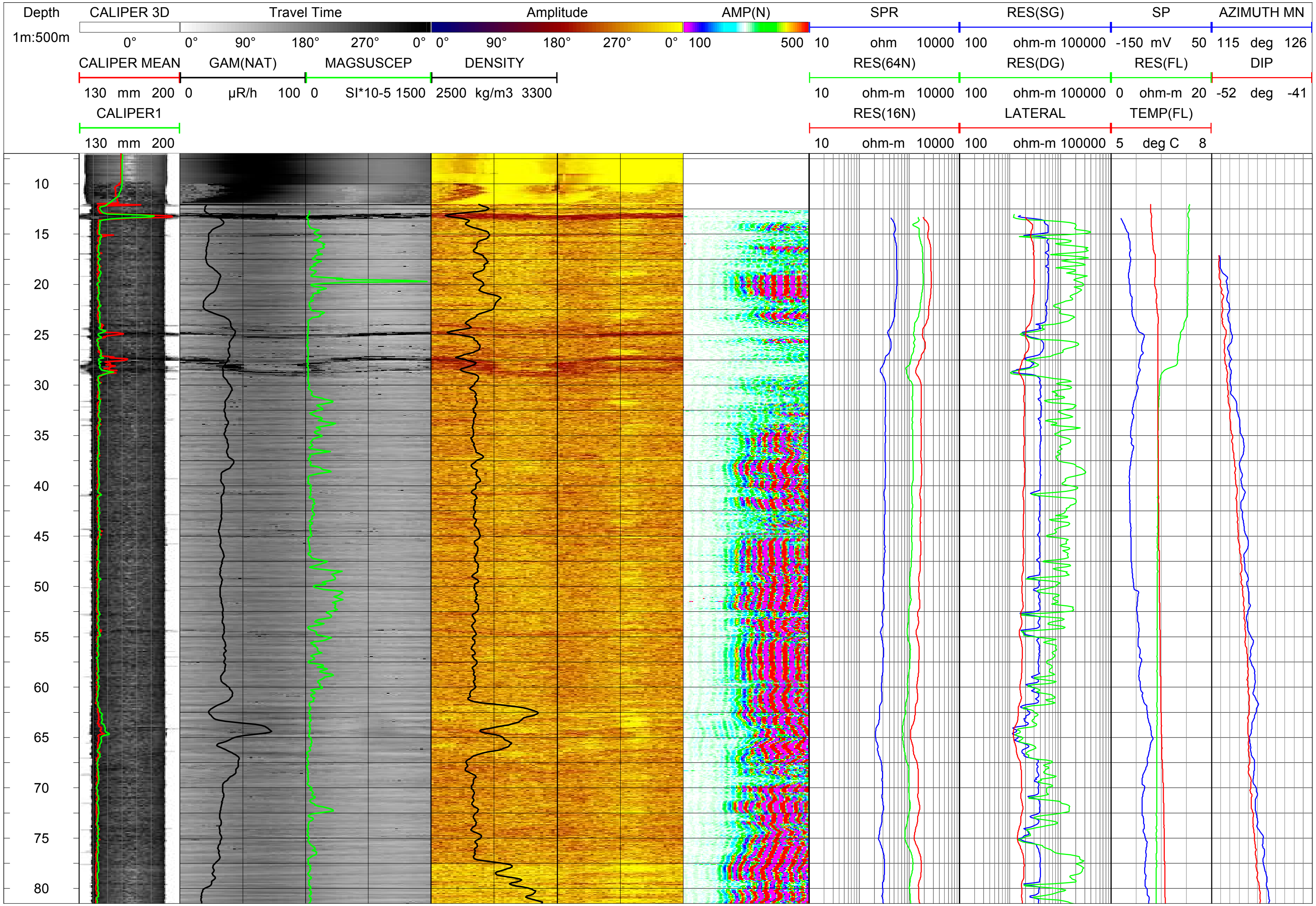
SKB geophysical borehole logging
Borehole HFM26

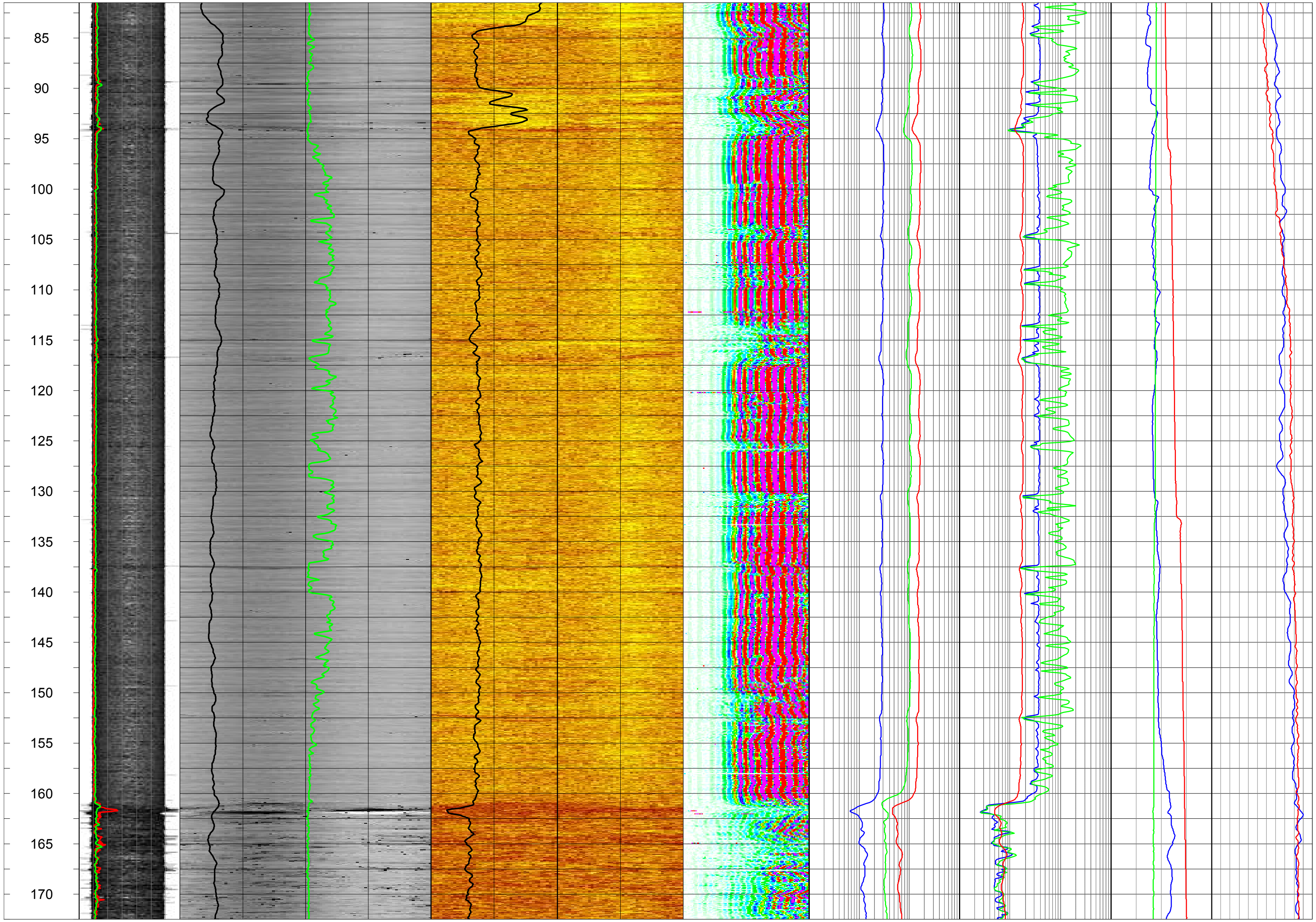
Presentation

Filename:
HFM26_Presentation.wcl

Drawing no.:
4.1



Depth
1m:500m
CALIPER 3D
0°
CALIPER MEAN
130 mm 200
CALIPER1
130 mm 200
Travel Time
0° 90° 180° 270° 0°
GAM(NAT)
0 μR/h 100
MAGSUSCEP
0 SI*10-5 1500
Amplitude
0° 90° 180° 270° 0°
DENSITY
2500 kg/m3 3300
AMP(N)
100 500
SPR
10 ohm 10000
RES(64N)
10 ohm-m 10000
RES(16N)
10 ohm-m 10000
RES(SG)
100 ohm-m 100000
RES(DG)
100 ohm-m 100000
LATERAL
100 ohm-m 100000
SP
-150 mV 50
RES(FL)
0 ohm-m 20
TEMP(FL)
5 deg C 8
AZIMUTH MN
115 deg 126
DIP
-52 deg -41
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80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115
120
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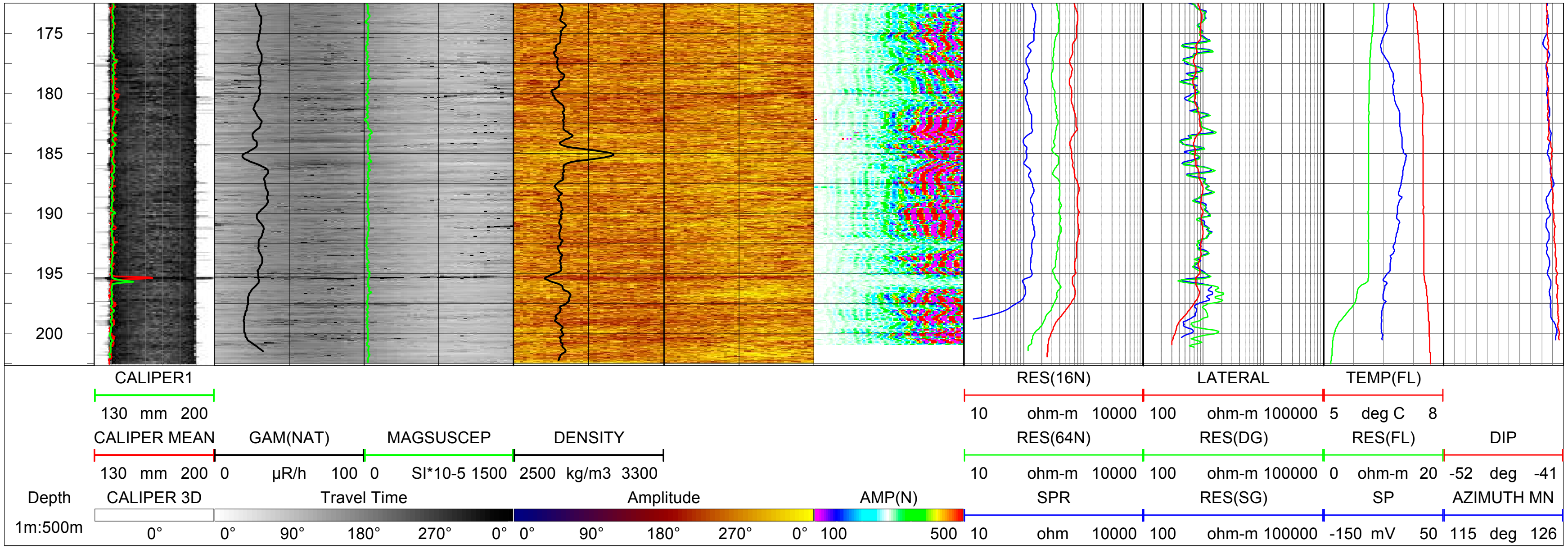
170


175
180
185
190
195
200
CALIPER1
130 mm 200
CALIPER MEAN
130 mm 200
CALIPER 3D
0°
GAM(NAT)
0 μR/h 100
MAGSUSCEP
0 SI*10-5 1500
DENSITY
2500 kg/m3 3300
Travel Time
0° 90° 180° 270° 0°
Amplitude
0° 90° 180° 270° 0°
AMP(N)
100 500
RES(16N)
10 ohm-m 10000
RES(64N)
10 ohm-m 10000
SPR
10 ohm 10000
LATERAL
100 ohm-m 100000
RES(DG)
100 ohm-m 100000
RES(SG)
100 ohm-m 100000
TEMP(FL)
5 deg C 8
RES(FL)
0 ohm-m 20
SP
-150 mV 50
DIP
-52 deg -41
AZIMUTH MN
115 deg 126
Depth
1m:500m

Borehole HFM29, drawing no. 5.1, borehole logs

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

Northing: 6698018.647m Easting: 1632502.813m Elevation: 4.467m, RHB70

Diameter:	138.1mm
Reaming Diameter:	
Outer Casing:	168.3mm
Inner Casing:	160mm
Borehole Length:	199.7m
Cone:	
Inclination at ground surface:	-58.57°
Azimuth:	29.95° GN
Comments:	

Borehole logging programme

Name	Description	Tool	Unit
CALIPER1	Caliper, 1-arm	9030/9139	mm
DENSITY	Gamma-gamma density	9030/9139	kg/m³
RES(MG)	Focused guard log resistivity, 140cm	9030	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
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	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	mV
RES(SG)	Focused guard log resistivity, 128 cm	9139	ohm-m

Rev.	Date	Drawn by	Control	Approved
0	2006-02-02	JRI	UTN	UTN

Job	Scale
547310A	1:500

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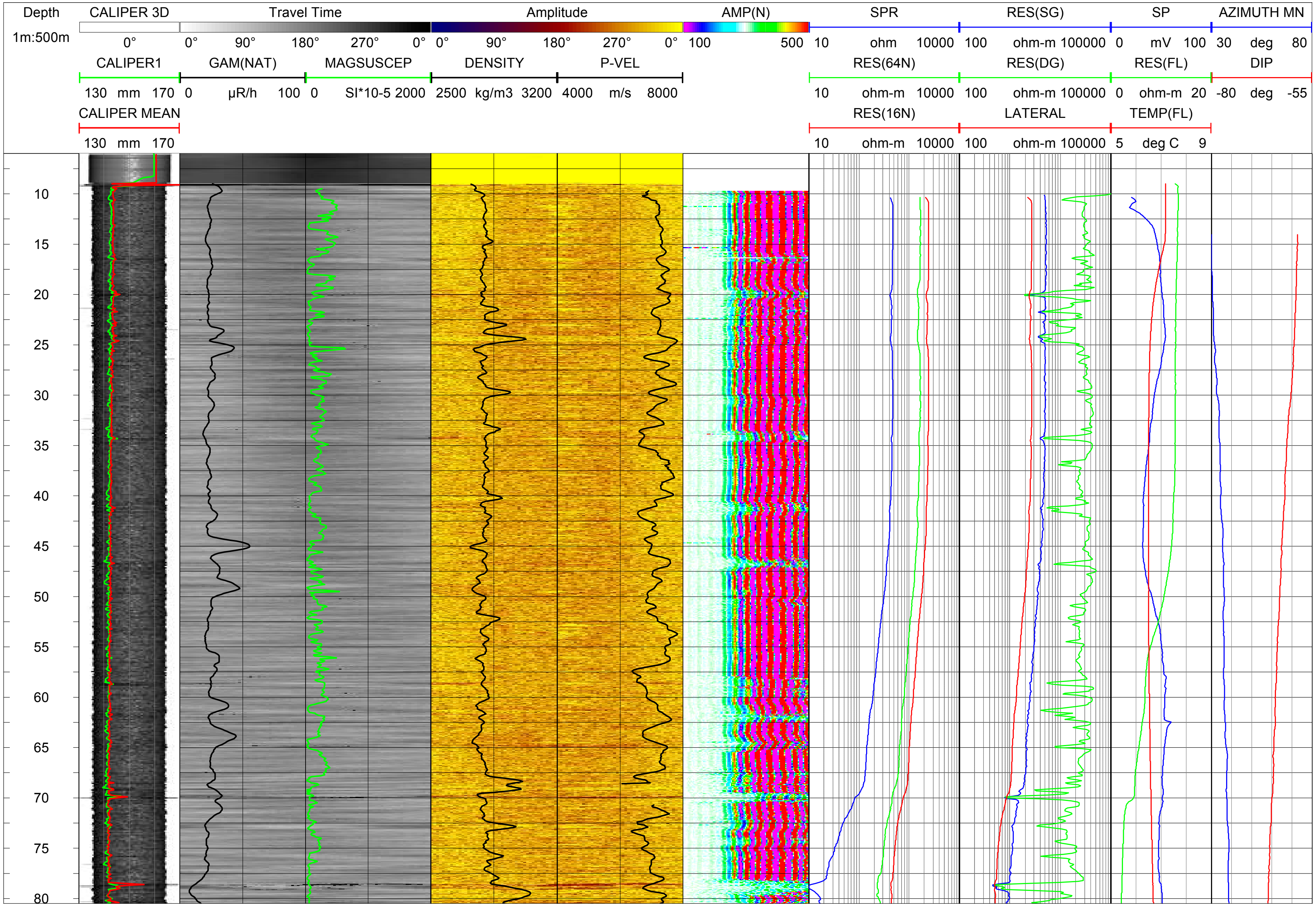
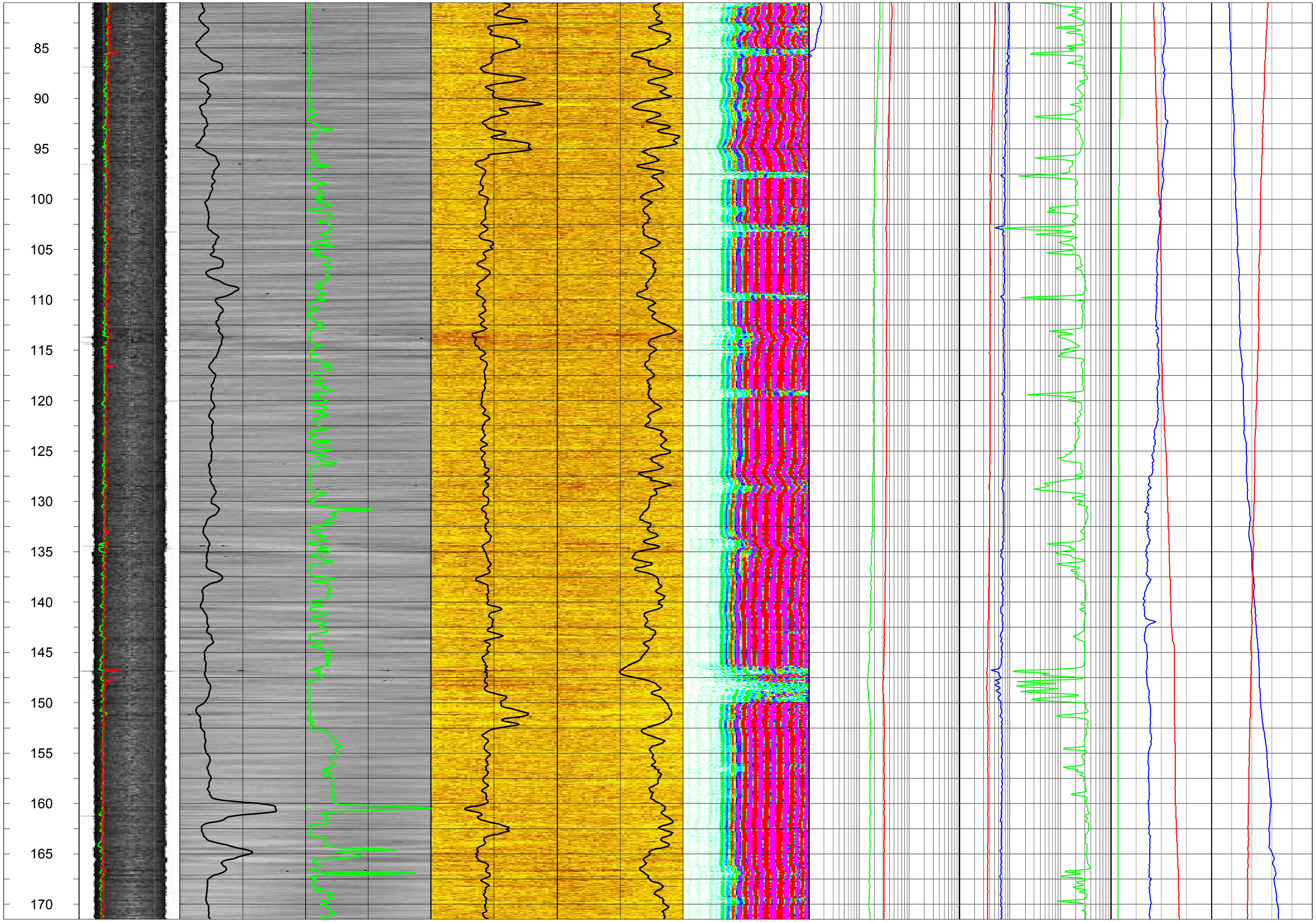
SKB geophysical borehole logging
Borehole HFM29

Filename:
HFM29_Presentation.wcl

Drawing no.:
5.1


Depth
1m:500m
CALIPER 3D
0°
CALIPER1
130 mm 170
CALIPER MEAN
130 mm 170
Travel Time
0° 90° 180° 270° 0°
GAM(NAT)
0 μR/h 100
MAGSUSCEP
0 SI*10-5 2000
Amplitude
0° 90° 180° 270° 0°
DENSITY
2500 kg/m3 3200
P-VEL
4000 m/s 8000
AMP(N)
100 500
SPR
10 ohm 10000
RES(64N)
10 ohm-m 10000
RES(16N)
10 ohm-m 10000
RES(SG)
100 ohm-m 100000
RES(DG)
100 ohm-m 100000
LATERAL
100 ohm-m 100000
SP
0 mV 100
RES(FL)
0 ohm-m 20
TEMP(FL)
5 deg C 9
AZIMUTH MN
30 deg 80
DIP
-80 deg -55
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80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100
105
110
115
120
125
130
135
140
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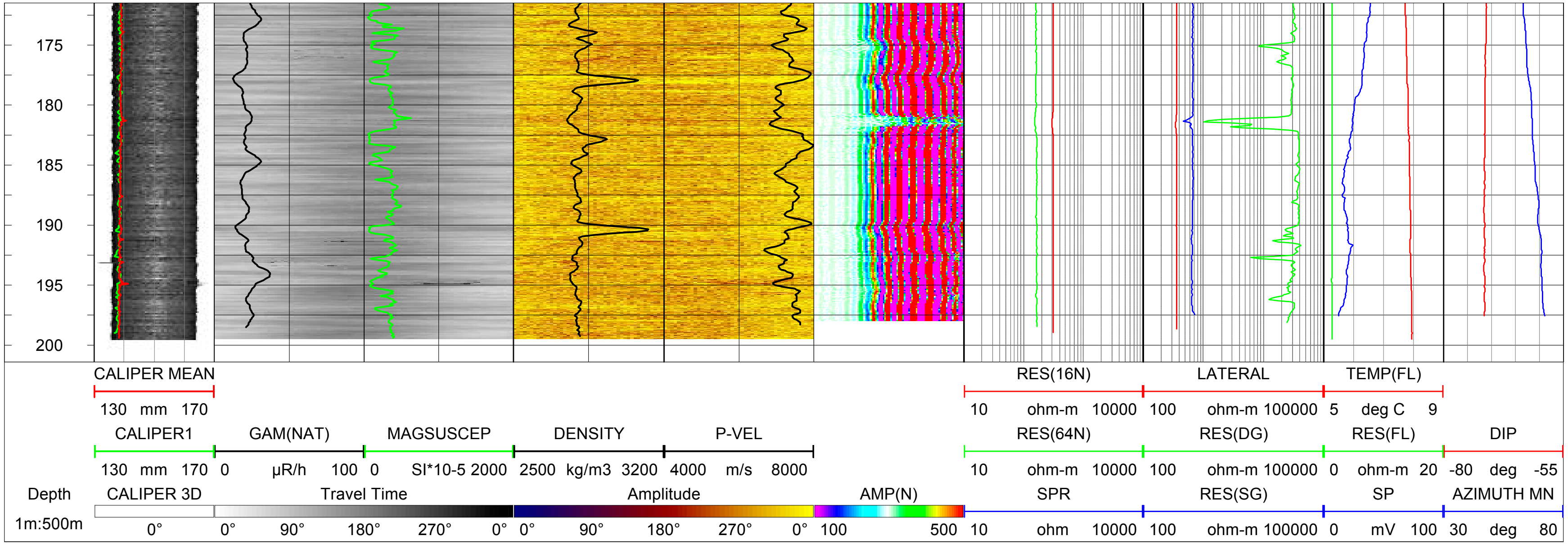
150
155
160
165
170


175
180
185
190
195
200
CALIPER MEAN
130 mm 170
CALIPER1
130 mm 170
GAM(NAT)
0 μR/h 100
MAGSUSCEP
0 SI*10-5 2000
DENSITY
2500 kg/m3 3200
P-VEL
4000 m/s 8000
RES(16N)
10 ohm-m 10000
RES(64N)
10 ohm-m 10000
SPR
10 ohm 10000
LATERAL
100 ohm-m 100000
RES(DG)
100 ohm-m 100000
RES(SG)
100 ohm-m 100000
TEMP(FL)
5 deg C 9
RES(FL)
0 ohm-m 20
SP
0 mV 100
DIP
-80 deg -55
AZIMUTH MN
30 deg 80
Depth
1m:500m
CALIPER 3D
0°
Travel Time
0° 90° 180° 270° 0°
Amplitude
0° 90° 180° 270° 0°
AMP(N)
100 500

Borehole HFM32, drawing no. 6.1, borehole logs

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

Northing: 6699015.036m Easting: 1632137.068m Elevation: 0.974m, RHB70

Diameter:	135-141mm
Reaming Diameter:	175mm
Outer Casing:	168.3mm
Inner Casing:	160.3mm
Borehole Length:	202.65m
Cone:	
Inclination at ground surface:	-86.06°
Azimuth:	116.15° GN
Comments:	

Borehole logging programme

Name	Description	Tool	Unit
CALIPER1	Caliper, 1-arm	9030/9139	mm
DENSITY	Gamma-gamma density	9030/9139	kg/m³
RES(MG)	Focused guard log resistivity, 140cm	9030	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
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	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	mV
RES(SG)	Focused guard log resistivity, 128 cm	9139	ohm-m

Rev.	Date	Drawn by	Control	Approved
0	2006-02-17	JRI	UTN	UTN

Job	Scale
547310A	1:500

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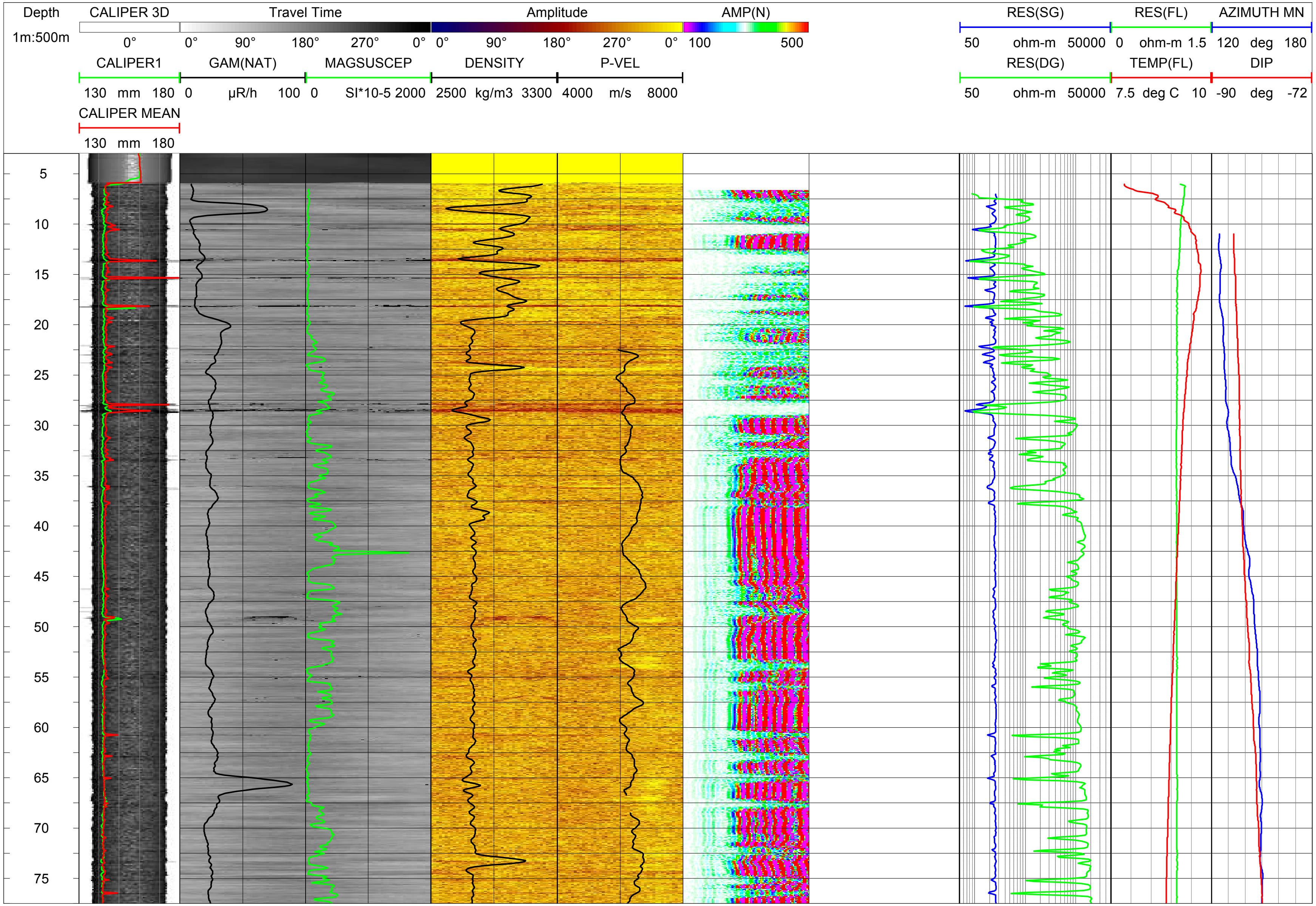
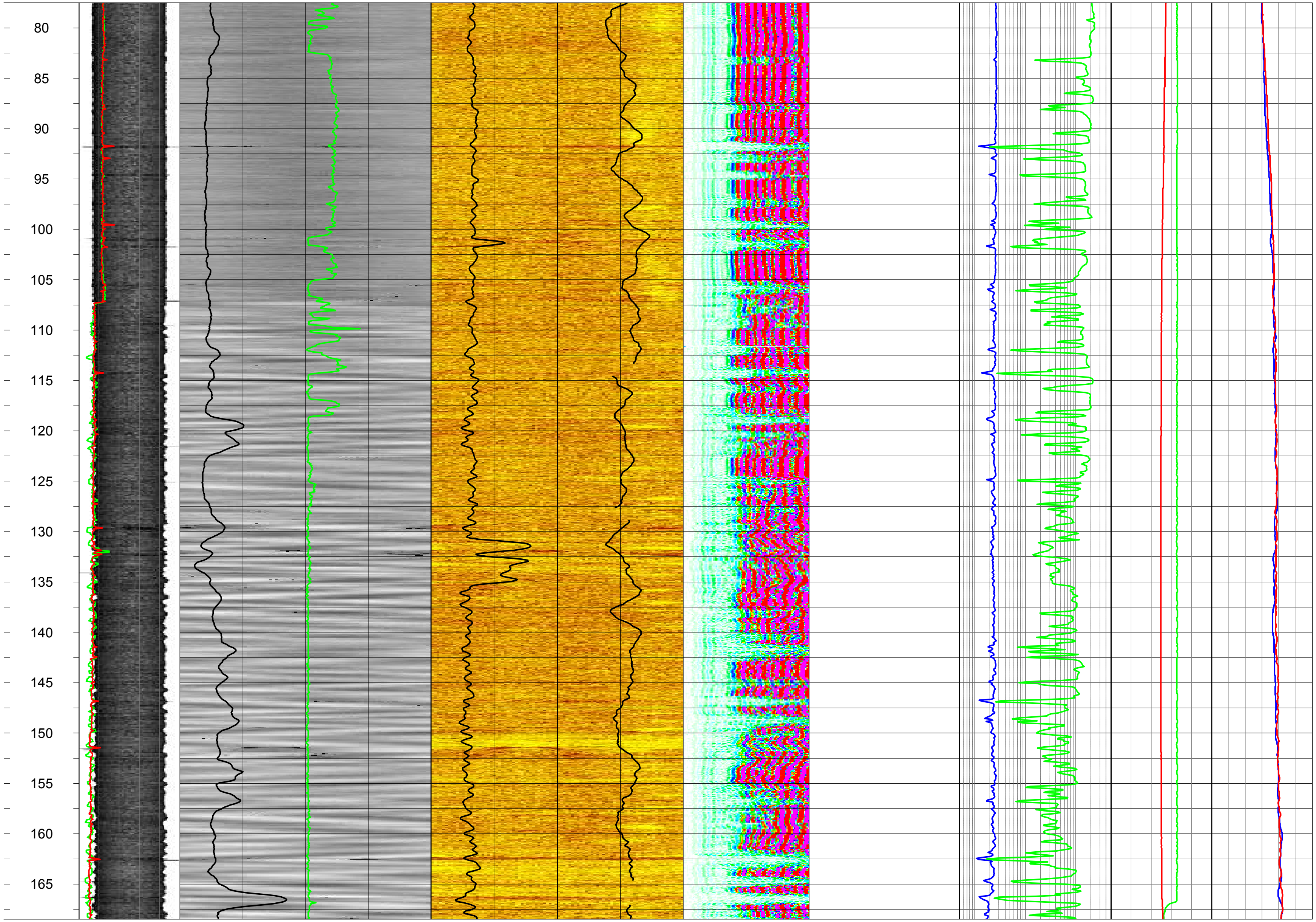
SKB geophysical borehole logging
Borehole HFM32

Presentation

Filename:
HFM32_Presentation.wcl

Drawing no.:
6.1


Depth
1m:500m
CALIPER 3D
0°
CALIPER1
130 mm 180
CALIPER MEAN
130 mm 180
Travel Time
0° 90° 180° 270° 0°
GAM(NAT)
0 μR/h 100
MAGSUSCEP
0 SI*10-5 2000
Amplitude
0° 90° 180° 270° 0°
DENSITY
2500 kg/m3 3300
P-VEL
4000 m/s 8000
AMP(N)
100 500
RES(SG)
50 ohm-m 50000
RES(DG)
50 ohm-m 50000
RES(FL)
0 ohm-m 1.5
TEMP(FL)
7.5 deg C 10
AZIMUTH MN
120 deg 180
DIP
-90 deg -72
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75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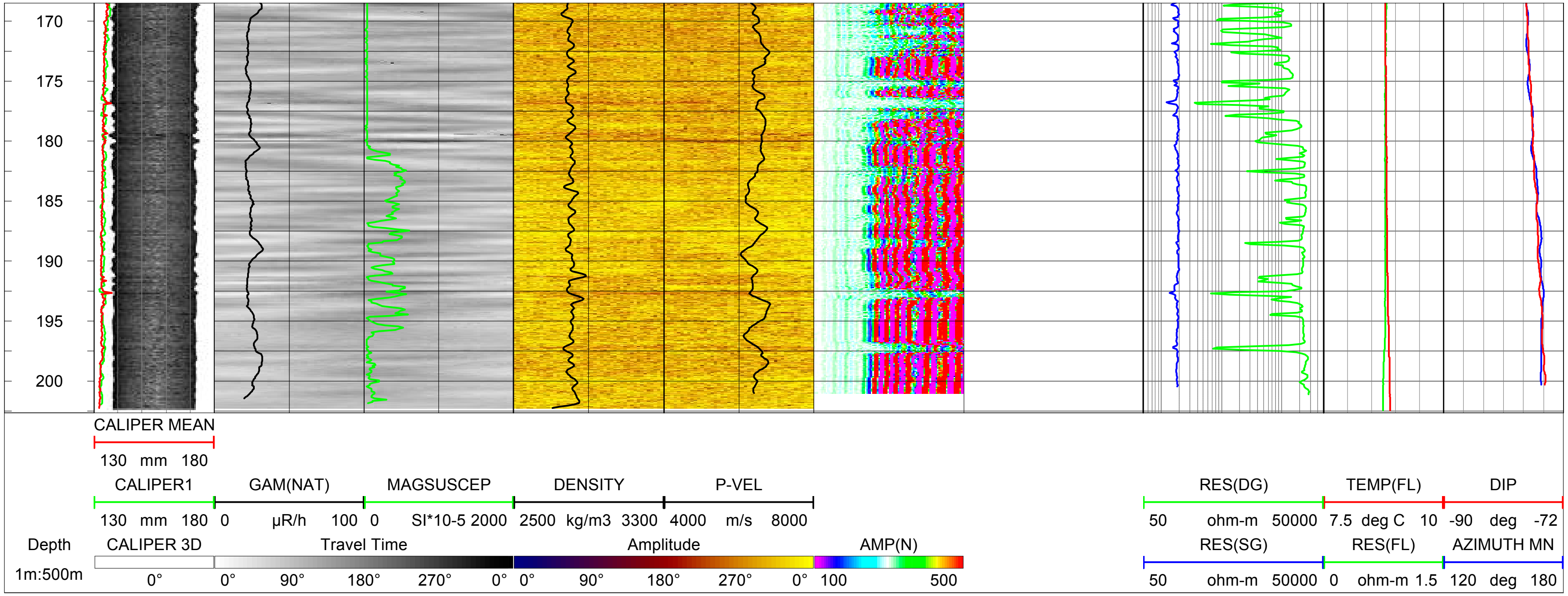
165


170
175
180
185
190
195
200
CALIPER MEAN
130 mm 180
CALIPER1
130 mm 180
GAM(NAT)
0 μR/h 100
MAGSUSCEP
0 SI*10-5 2000
DENSITY
2500 kg/m3 3300
P-VEL
4000 m/s 8000
Depth
1m:500m
CALIPER 3D
0°
Travel Time
0° 90° 180° 270° 0°
Amplitude
0° 90° 180° 270° 0°
AMP(N)
100 500
RES(DG)
50 ohm-m 50000
TEMP(FL)
7.5 deg C 10
DIP
-90 deg -72
RES(SG)
50 ohm-m 50000
RES(FL)
0 ohm-m 1.5
AZIMUTH MN
120 deg 180

Borehole HFM07, drawing no. 7.1, borehole logs

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

Northing: 6697416.25m Easting: 1634715.69m Elevation: 5.78m, RHB70

Diameter:	140mm
Reaming Diameter:	
Outer Casing:	168mm
Inner Casing:	160mm
Borehole Length:	122.55m
Cone:	
Inclination at ground surface:	-84.52°
Azimuth:	342.32° GN
Comments:	

Borehole logging programme

Name	Description	Tool	Unit
CALIPER1	Caliper, 1-arm	9030/9139	mm
DENSITY	Gamma-gamma density	9030/9139	kg/m³
RES(MG)	Focused guard log resistivity, 140cm	9030	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
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	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	mV
RES(SG)	Focused guard log resistivity, 128 cm	9139	ohm-m

Rev.	Date	Drawn by	Control	Approved
0	2006-02-15	JRI	UTN	UTN

Job: 547310A

Scale: 1:500

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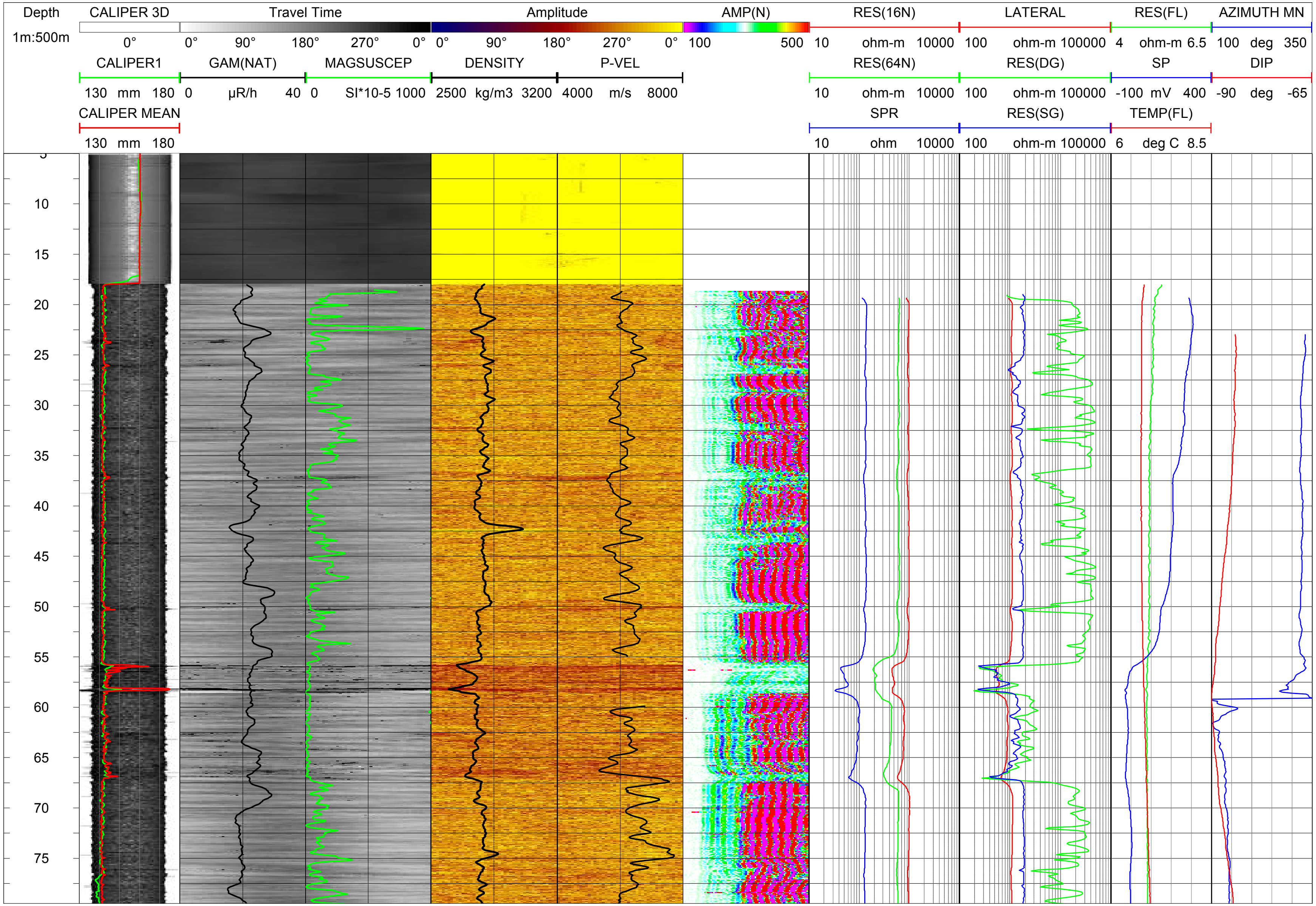
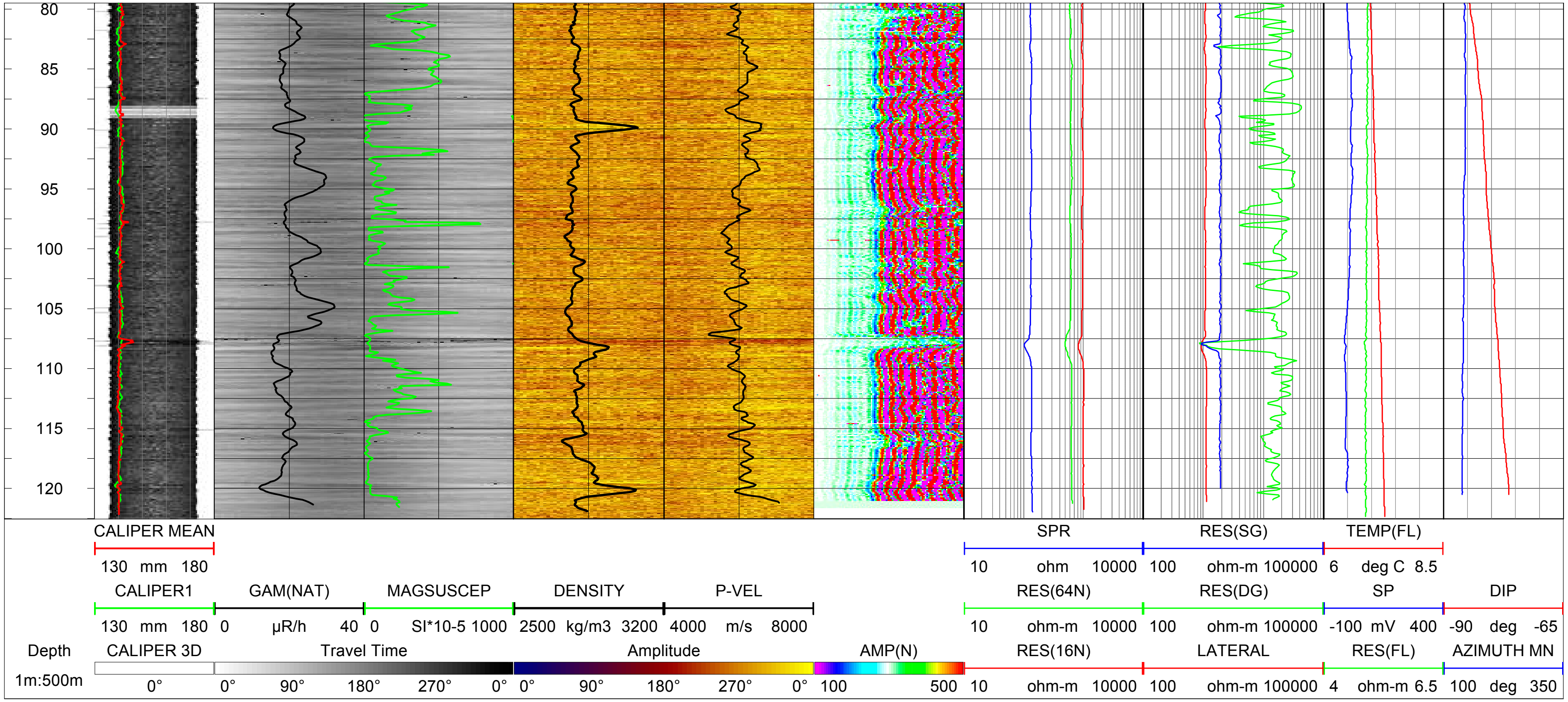
SKB geophysical borehole logging
Borehole HFM07

Presentation

Filename: HFM07_Presentation.wcl

Drawing no.: 7.1


Depth
1m:500m
CALIPER 3D
0°
CALIPER1
130 mm 180
CALIPER MEAN
130 mm 180
Travel Time
0° 90° 180° 270° 0°
GAM(NAT)
0 µR/h 40
MAGSUSCEP
0 SI*10-5 1000
Amplitude
0° 90° 180° 270° 0°
DENSITY
2500 kg/m3 3200
P-VEL
4000 m/s 8000
AMP(N)
100 500
RES(16N)
10 ohm-m 10000
RES(64N)
10 ohm-m 10000
SPR
10 ohm 10000
LATERAL
100 ohm-m 100000
RES(DG)
100 ohm-m 100000
RES(SG)
100 ohm-m 100000
RES(FL)
4 ohm-m 6.5
SP
-100 mV 400
TEMP(FL)
6 deg C 8.5
AZIMUTH MN
100 deg 350
DIP
-90 deg -65
10
15
20
25
30
35
40
45
50
55
60
65
70
75


80
85
90
95
100
105
110
115
120
CALIPER MEAN
130 mm 180
CALIPER1
130 mm 180
CALIPER 3D
0°
Depth
1m:500m
GAM(NAT)
0 µR/h 40
MAGSUSCEP
0 SI*10-5 1000
Travel Time
0° 90° 180° 270° 0°
DENSITY
2500 kg/m3 3200
P-VEL
4000 m/s 8000
Amplitude
0° 90° 180° 270° 0°
AMP(N)
100 500
SPR
10 ohm 10000
RES(64N)
10 ohm-m 10000
RES(16N)
10 ohm-m 10000
RES(SG)
100 ohm-m 100000
RES(DG)
100 ohm-m 100000
LATERAL
100 ohm-m 100000
TEMP(FL)
6 deg C 8.5
SP
-100 mV 400
RES(FL)
4 ohm-m 6.5
DIP
-90 deg -65
AZIMUTH MN
100 deg 350