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Site investigation SFR

Geophysical borehole logging in the boreholes KFR27 (0–500 m), KFR102A, KFR102B, KFR103, KFR104 and HFM07

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April 2009

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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.

Data in SKB's database can be changed for different reasons. Minor changes in SKB's database will not necessarily result in a revised report. Data revisions may also be presented as supplements, available at www.skb.se.

A pdf version of this document can be downloaded from www.skb.se.

Abstract

Geophysical borehole logging has been performed in boreholes KFR27, KFR102A, KFR102B, KFR103, and KFR104 all situated at SFR in Forsmark, Sweden. A reference logging was performed in the borehole HFM07.

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 KFR27 was recorded to app. 500 m, KFR102A was recorded to app. 600 m, KFR102B was recorded to app. 180 m, KFR103 was recorded to app. 200 m and KFR104 was recorded to app. 450 m.

The logging in HFM07 was performed as a control logging, to compare logging results previously performed in the borehole, during the period of 2003 to 2007.

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 1–8.

Sammanfattning

Geofysisk borrhålsloggning har genomförts i borrhålen KFR27, KFR102A, KFR102B, KFR103 och KFR104 vid SFR i Forsmark. En referensloggning utfördes i HFM07.

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 KFR27 från TOC till ca 500 m, KFR102A från TOC till ca 600 m, KFR102B från TOC till ca 180 m, i KFR103 från TOC till 200 m och i KFR104 från TOC till 450 m.

Den geofysiska borrhålsloggningen i HFM07 utfördes som en kontrollmätning, for at jämföra med loggningar utförda under perioden 2003 till 2007.

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

Processerade loggar presenteras i Appendix 1 till 8.

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Appendix 8 Borehole HFM07. Drawing no. 6.1. Borehole logs

1 Introduction

This document reports the results gained by the geophysical borehole logging in boreholes KFR27, KFR102A, KFR102B, KFR103 and KFR104, which is one of the activities performed within the site investigation at SFR. The work was carried out in accordance with activity plan AP SFR-08-018. In Table 1-1 controlling documents for performing this activity are listed. Both activity plan and method descriptions are SKB's internal controlling documents.

The measurements were conducted by RAMBØLL during three periods, October 6 to 8, 2008, January 13 to 14, 2009 and January 29, 2009. All boreholes were recorded from Top Of Casing (TOC) to the bottom of the borehole. The geometrical data from the boreholes are shown in Table 1-2. The location of the borehole is shown in Figure 1-1. The borehole HFM07 is used only for reference measurements, and is not shown in Figure 1-1.

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
AP SFR-08-018 Geofysisk borrhålsloggning i KFR27, KFR102A, KFR102B, KFR103 och KFR104	AP SFR-08-018	1.0
Method description	**Number**	**Version**
Metodbeskrivning för geofysisk borrhålsloggning	SKB MD 221.002	3.0

Table 1-2. Technical data for boreholes KFR27, KFR102A, KFR102B, KFR103, KFR104 and HFM07.

Borehole Parameter	KFR27	KFR102A	KFR102B	KFR103	KFR104	HFM07
Co-ordinates (RT90)	6701714.42 1633175.52	6701730.30 1633333.21	6701740.53 1633343.91	6701737.13 1633347.20	6701719.45 1632679.34	6697416.25 1634715.69
Elevation (RHB70)	2.87	2.66	2.51	2.43	2.83	5.78
Azimuth (TOC)	248.20°	302.26°	344.87°	179.87°	133.78°	342.32°
Inclination from horizontal (TOC)	–87.42°	–65.41°	–54.14°	–53.91°	–53.81°	–84.52°
Length [m]	501.64	600.83	180.06	200.50	454.57	122.50
Casing [m]	11.91	72.02	12.95	12.22	8.73	18.00
Borehole diameter [mm]	76 mm	76 mm	76 mm	76 mm	76 mm	140 mm
Cleaning level	Level 1	Level 2	Level 1	Level 1	Level 1	Level 1

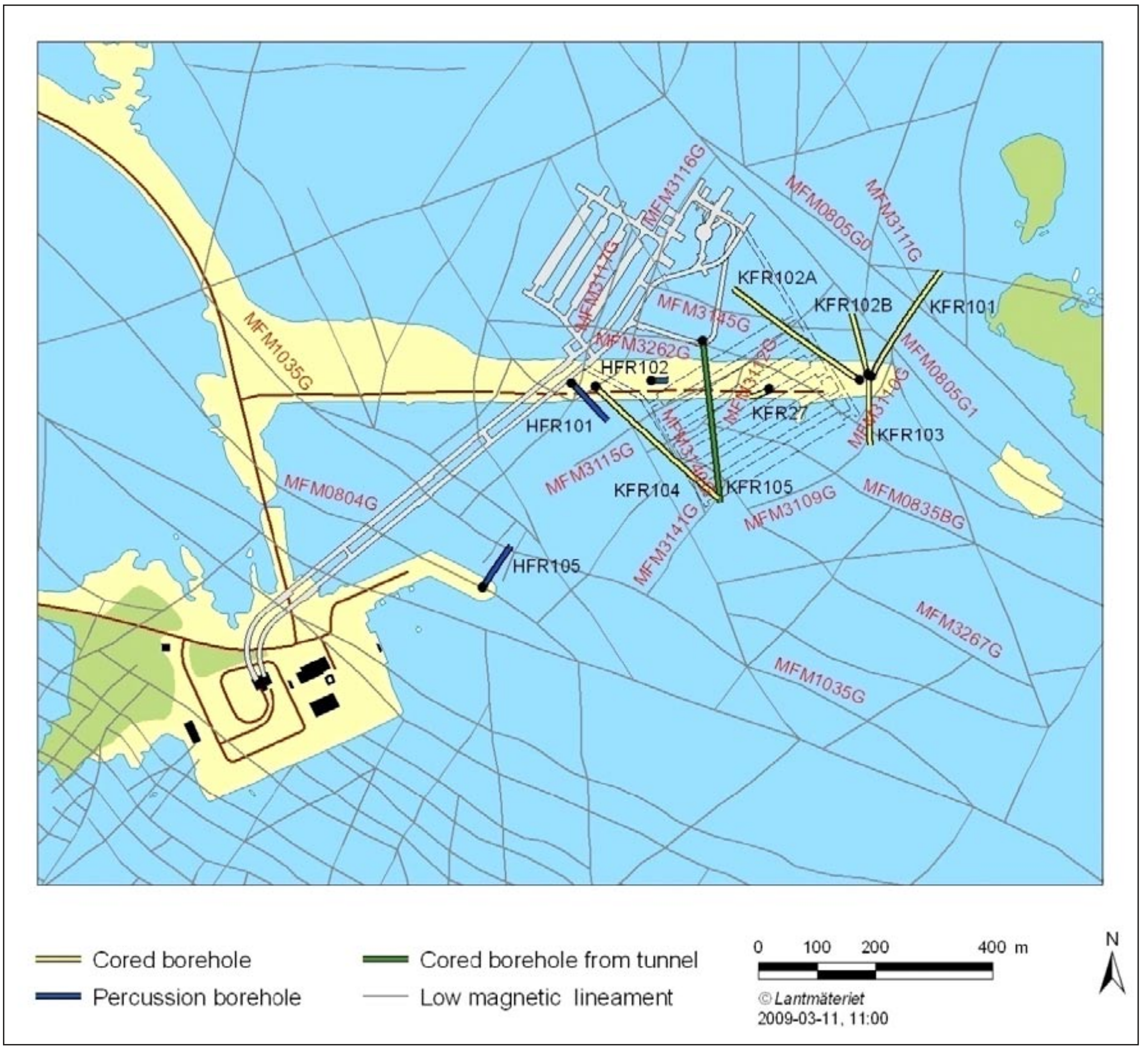


Figure 1-1. *General overview over the SFR area in Forsmark, showing the location of the core drilled boreholes KFR27, KFR102A, KFR102B, KFR103 and KFR104.*

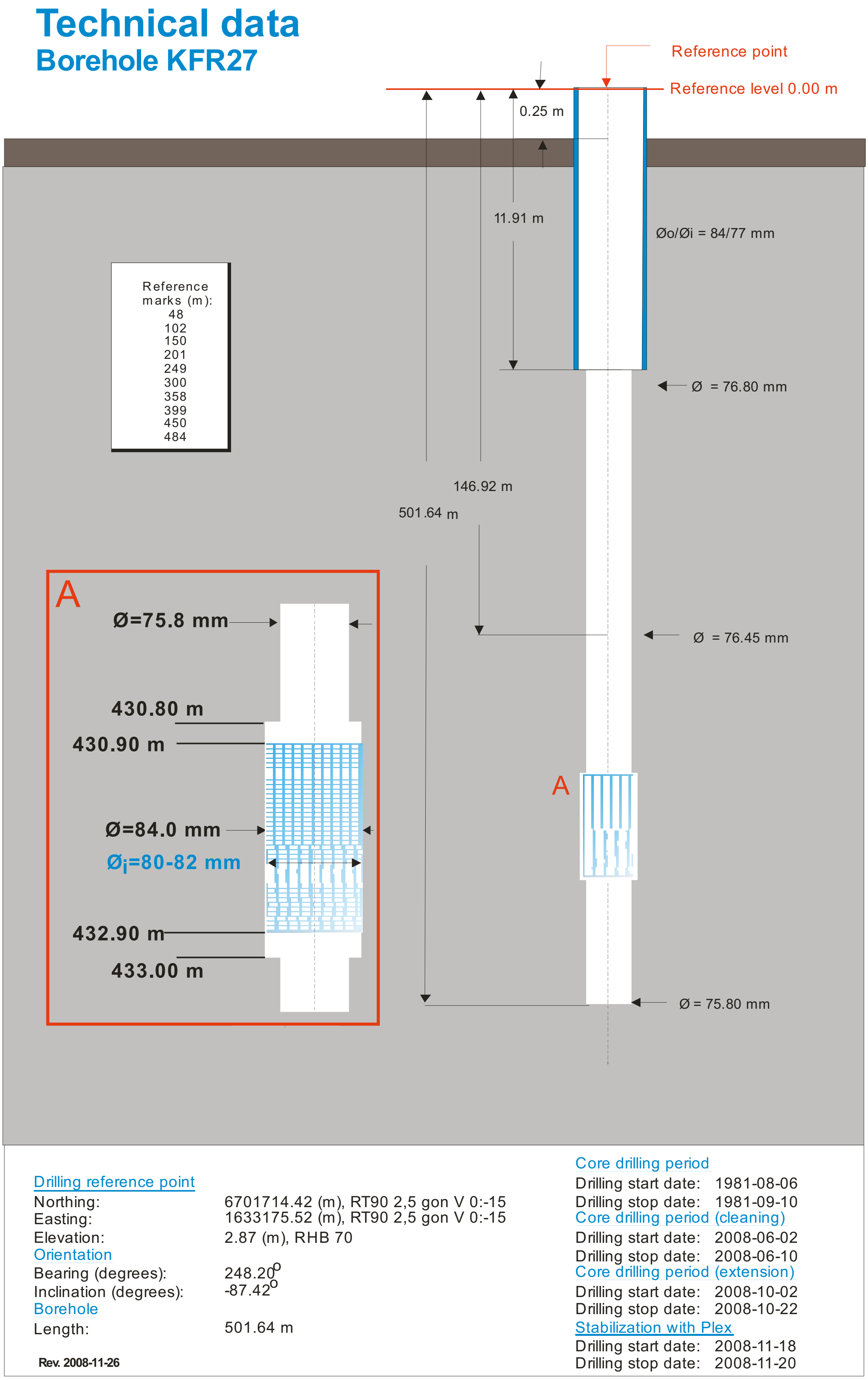
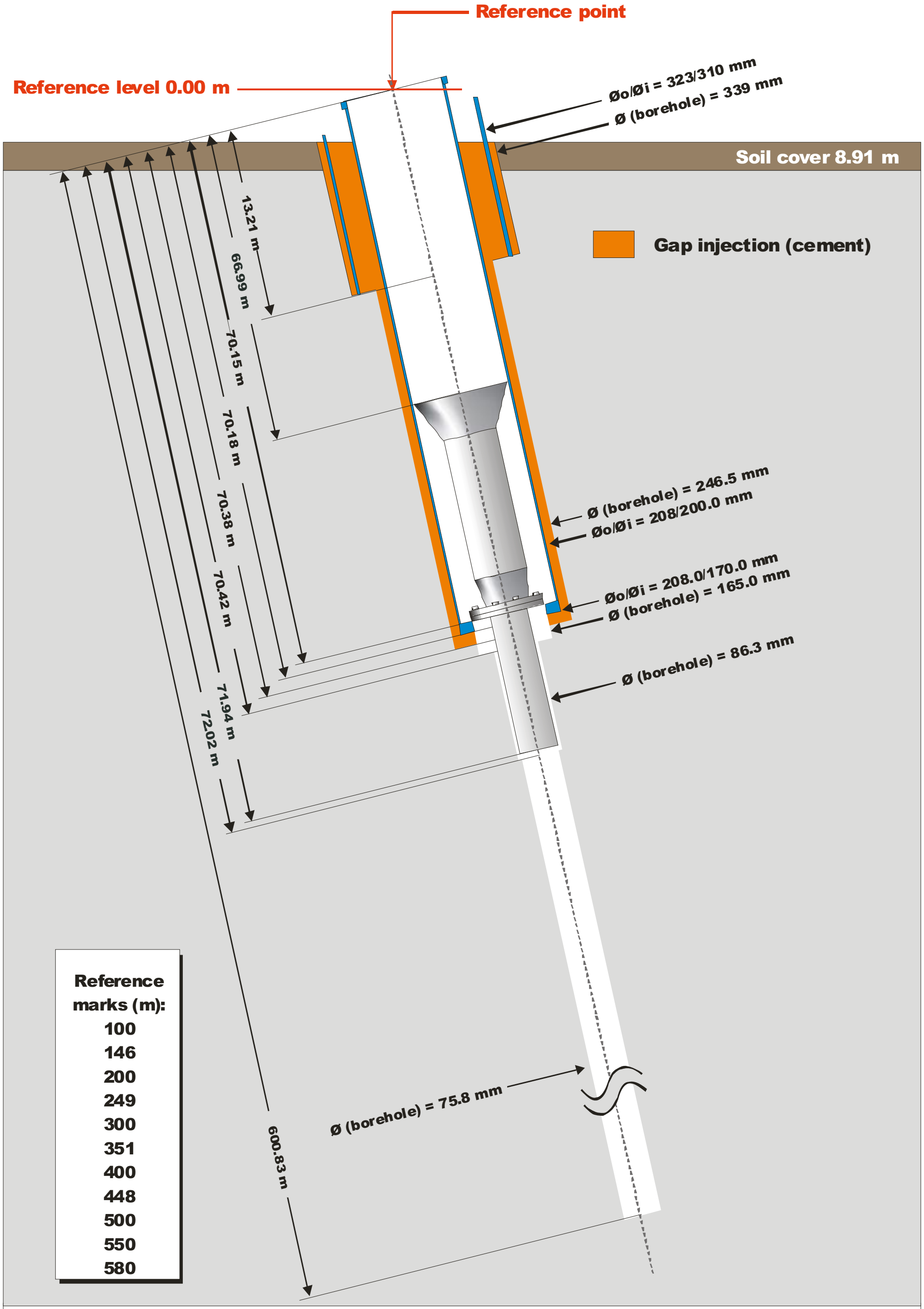


Figure 1-2. Technical description of borehole KFR27.

Technical data-prel
Borehole KFR102A



Drilling reference point

Northing: 6701730.30 (m), RT90 2,5 gon V 0:-15

Easting: 1633330.21 (m), RT90 2,5 gon V 0:-15

Elevation: 2.66 (m), RHB 70

Orientation

Bearing (degrees): 302.26°

Inclination (degrees): -65.41°

Borehole

Length: 600.83 m

Percussion drilling period

Drilling start date: 2008-11-10

Drilling stop date: 2008-11-17

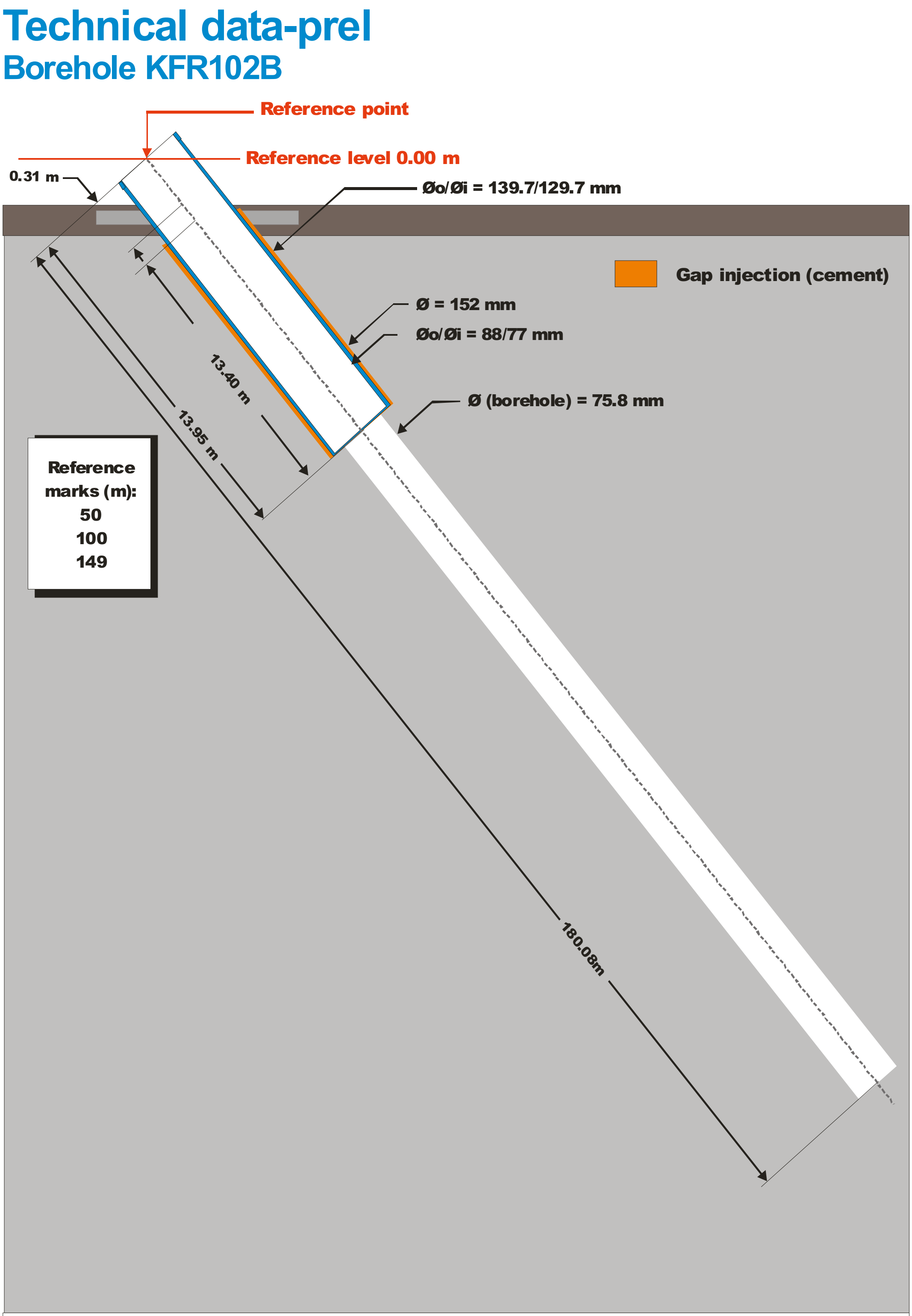
Core drilling period

Drilling start date: 2008-11-23

Drilling stop date: 2007-12-12

2008-12-15

Figure 1-3. Technical description of borehole KFR102A.



Drilling reference point

Northing:	6701740.53 (m), RT90 2,5 gon V 0:-15
Easting:	1633343.91 (m), RT90 2,5 gon V 0:-15
Elevation:	2.51 (m), RHB 70

Orientation

Bearing (degrees):	344.87°
Inclination (degrees):	-54.14°

Borehole

Length:	180.08 m

Percussion drilling period

Drilling start date:	2008-05-05
Drilling stop date:	2008-05-05

Core drilling period

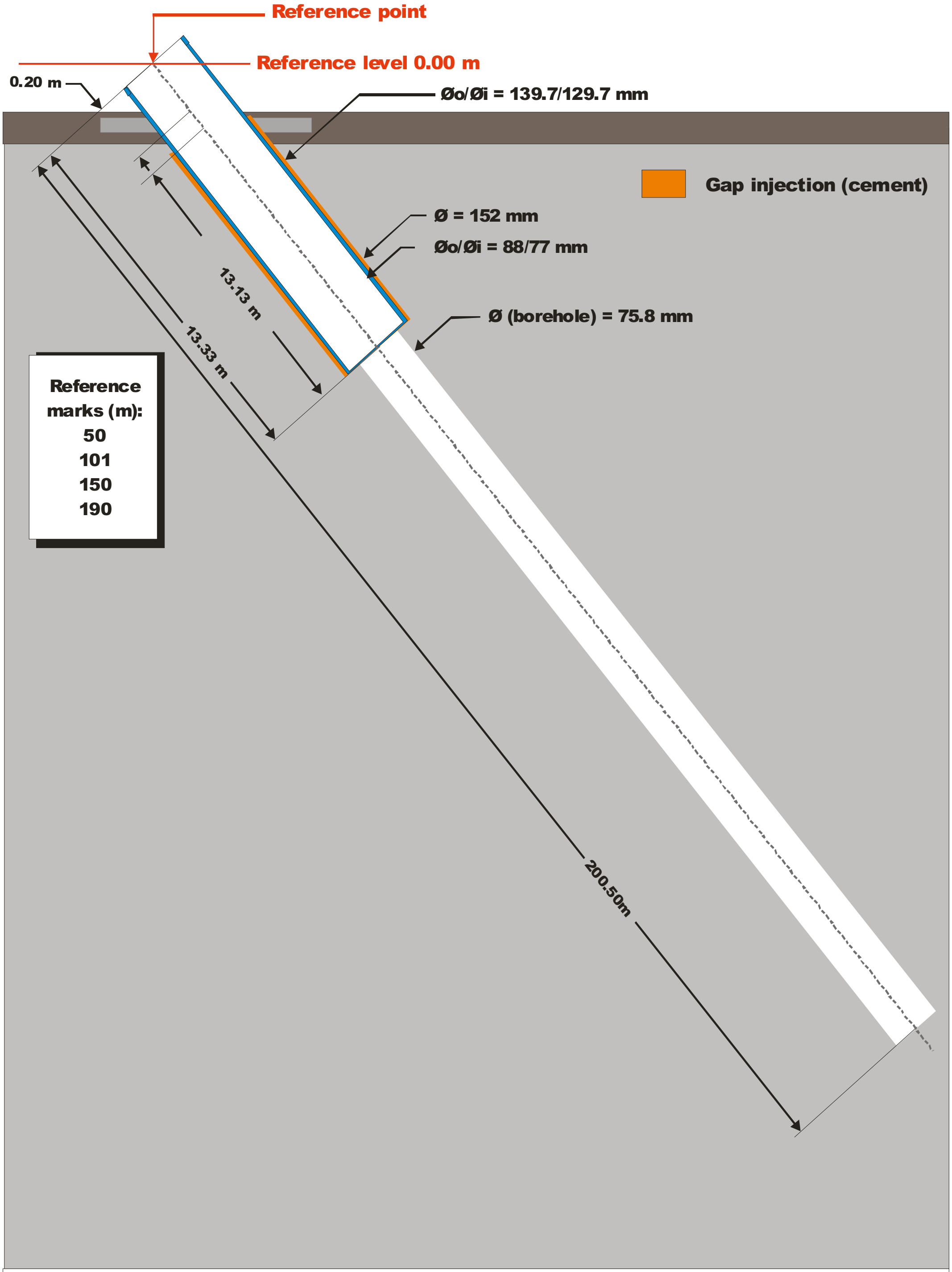
Drilling start date:	2008-08-06
Drilling stop date:	2008-08-14

Rev. 2008-08-14

Figure 1-4. Technical description of borehole KFR102B.

Technical data-prel

Borehole KFR103



Drilling reference point

Northing: 6701737.13 (m), RT90 2,5 gon V 0:-15

Easting: 1633347.20 (m), RT90 2,5 gon V 0:-15

Elevation: 2.43 (m), RHB 70

Orientation

Bearing (degrees): 179.87°

Inclination (degrees): -53.91°

Borehole

Length: 200.50 m

Percussion drilling period

Drilling start date: 2008-05-08

Drilling stop date: 2008-05-08

Core drilling period

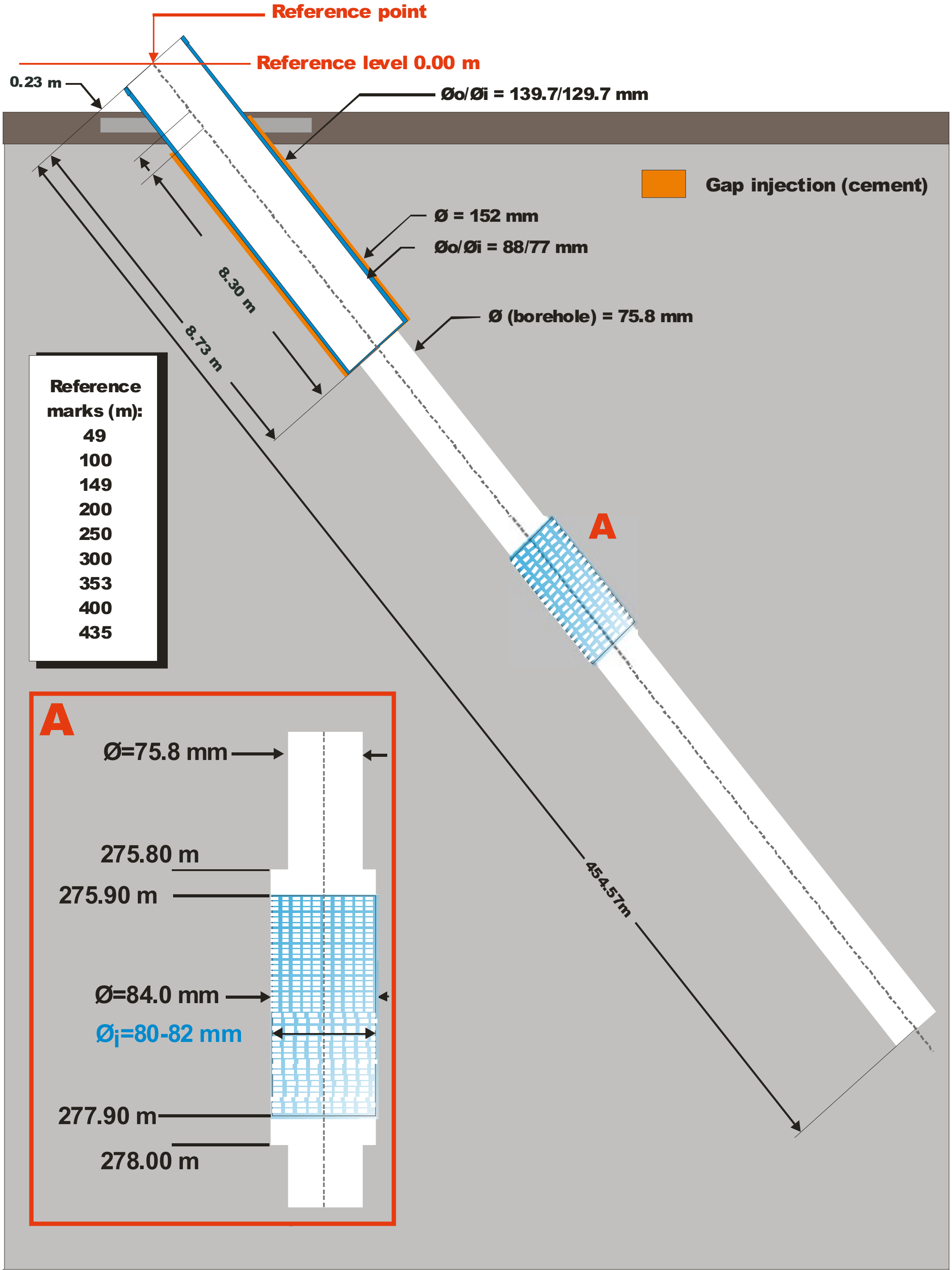
Drilling start date: 2008-08-15

Drilling stop date: 2008-08-26

Rev. 2008-08-27

Figure 1-5. Technical description of borehole KFR103.

Technical data
Borehole KFR104



Drilling reference point
Northing: 6701719.45 (m), RT90 2,5 gon V 0:-15
Easting: 1632879.34 (m), RT90 2,5 gon V 0:-15
Elevation: 2.83 (m), RHB 70

Orientation
Bearing (degrees): 133.78°
Inclination (degrees): -53.81°

Borehole
Length: 454.57 m

Rev. 2008-11-03

Percussion drilling period
Drilling start date: 2008-05-13
Drilling stop date: 2008-05-13

Core drilling period
Drilling start date: 2008-09-02
Drilling stop date: 2008-09-29

Stabilization Plex plate
Drilling start date: 2008-10-27
Drilling stop date: 2008-10-29

Figure 1-6. Technical description of borehole KFR104.

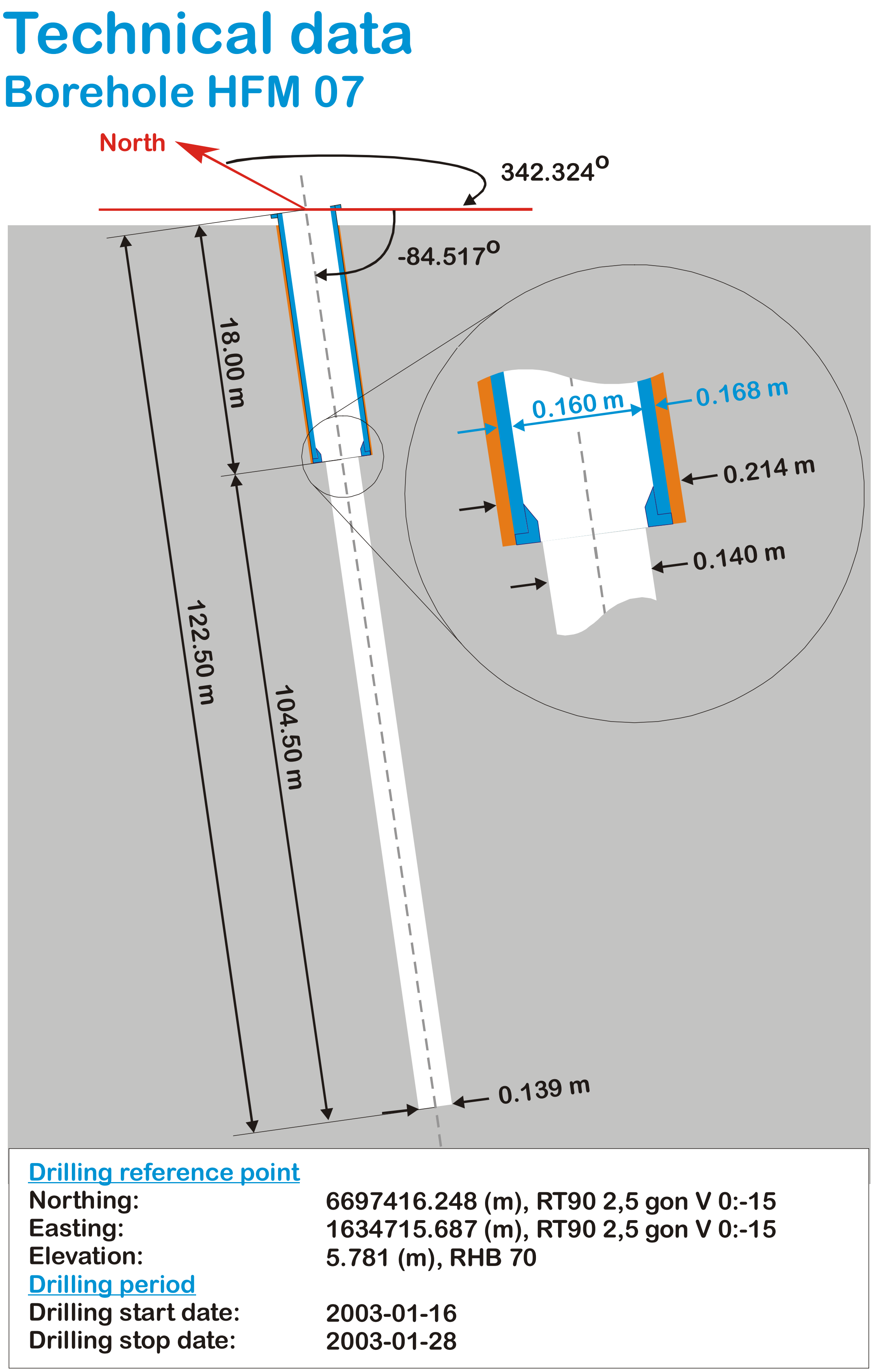


Figure 1-7. *Technical description of borehole HFM07.*

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 physical properties in the borehole fluid and the bedrock surrounding 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	Description
KFR102B	1.1	1	Scale 1:500
KFR103	2.1	2	Scale 1:500
KFR103	2.2	3	With OPTV scale 1:500
KFR103	2.3	4	With OPTV scale 1:2
KFR104	3.1	5	Scale 1:500
KFR27	4.1	6	Scale 1:500
KFR102A	5.1	7	Scale 1:500
HFM07	6.1	8	Scale 1:500

3 Equipment

The geophysical borehole logging program were performed with 5 multi tool probes and resulted in a suite of 15 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	Comment
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	
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	
GeoVista OPTV – Optical Televiewer	360°Optical Image. 720 pixels horizontal and natural gamma	163 × 5.3 cm			Only part of KFR103

4 Execution

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 periods October 6 to 8, 2008, January 13–14 and January 29, 2009. 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 downward 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 where the speed was 2 m/min.

The GeoVista Optical televiewer was only recorded in borehole KFR103 from the casing bottom to app. 125 m borehole length. The logging speed was 0.5 m/min, giving a pixel size of 0.33×0.33 mm.

Nonconformities

The logging has been performed in accordance with the activity plan AP SFR-08-018.

5 Results

5.1 Presentation

All relevant logging events were described in the daily report sheets, which were delivered separately. The logs presented in drawings no. 1.1–6.1 are summarized 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).

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.

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

Log	Log name short	Unit	Tool	Comment
Fluid temperature	TEMP(FL)	Deg C	9042	
Fluid resistivity	RES(FL)	Ohm-m	9042	
Magnetic susceptibility	MAGSUSCEP	$SI*10^{-5}$	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	
Natural gamma	GAM(NAT)	μR/h	HIRAT	
Focused guard log resistivity, 300 cm	RES(DG)	Ohm-m	9072	
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	
360° orientated optical image	OPTV	–	OPTV	Only part of KFR103

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.

5.3 Calculated log curves

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

5.3.1 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

Due to the special conditions in the boreholes at SFR, with very high fluid temperature (KFR104: 16°C) and fluid resistivity (KFR104: 30 ohm-m) in the casing, the mix-up of the water caused by the different log runs is worse than usual. The values from fluid temperature and resistivity logs are normally used in the conversion of data from the acoustical televiewer from Travel Time to Caliper. Due to the fluid mix-up in these boreholes, the standard formulas give unrealistic values. Therefore the compensation has been done the other way around, assuming that the borehole has a constant average value, a formula to compensate for fluid- and sonde internal traveltime has been derived and applied for each borehole.

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, 128 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	–
Focused guard log resistivity, 300 cm	–
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.
360° orientated acoustic travel time	–
360° orientated acoustic amplitude	–
360° orientated optical image	–

5.4 Borehole KFR102B

In order to obtain an exact length calibration in borehole KFR102B, 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 at the borehole lengths listed in 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 length scale. The new length 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 KFR102B, between all log runs, the obtained reference mark correlation is transferred to the other logs.

The complete log suite for borehole KFR102B 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.

5.5 Borehole KFR103

In order to obtain an exact length calibration in borehole KFR103, 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.

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 length scale. The new length scale is applied to the HiRAT file. In this way a perfect match between given length of the reference marks and the recorded data is obtained. By means of alignment of the observed gamma events in KFR103, between all log runs, the obtained reference mark correlation is transferred to the other logs.

The complete log suite for borehole KFR103 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.

5.6 Borehole KFR104

In order to obtain an exact length calibration in borehole KFR104, 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 at the borehole lengths listed in Table 5-4.

Table 5-3. The reference track marks in the borehole and the recorded track marks form the HiRAT in borehole KFR102B.

Reference mark	HIRAT recorded
13.95	13.95
50.00	50.019
100.00	100.045
149.00	149.036

Table 5-4. The reference track marks in the borehole and the recorded track marks form the HiRAT in borehole KFR104.

Reference mark	HIRAT recorded
49.00	49
100.00	100.038
149.00	149.086
200.00	200.101
250.00	250.151
300.00	300.206
353.00	353.256
400.00	400.254
435.00	435.23

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 length scale. The new length 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 KFR104, between all log runs, the obtained reference mark correlation is transferred to the other logs.

The complete log suite for borehole KFR104 is presented as composite log sheets in drawing 3.1 in Appendix 3. The logs presented in drawing no. 3.1 are listed in Table 5-1.

5.7 Borehole KFR27

In order to obtain an exact length calibration in borehole KFR27, 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 at the borehole lengths listed in Table 5-5.

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 length scale. The new length scale is applied to the HiRAT file. In this way a perfect match between given length of the reference marks and the recorded data is obtained. By means of alignment of the observed gamma events in KFR27, between all log runs, the obtained reference mark correlation is transferred to the other logs.

The complete log suite for borehole KFR27 is presented as composite log sheets in drawing 4.1 in Appendix 6. The logs presented in drawing no. 4.1 are listed in Table 5-1.

Table 5-5. The reference track marks in the borehole and the recorded track marks form the HiRAT in borehole KFR27.

Reference mark	HIRAT recorded
11.91	11.91
48.00	47.846
102.00	101.482
150.00	149.17
201.00	199.814
249.00	247.474
300.00	298.11
358.00	355.674
399.00	396.351
450.00	446.863
484.00	480.573

5.8 Borehole KFR102A

In order to obtain an exact length calibration in borehole KFR102A, 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 5-6.

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 length scale. The new length 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 KFR102A, between all log runs, the obtained reference mark correlation is transferred to the other logs.

The complete log suite for borehole KFR102A is presented as composite log sheets in drawing 5.1 in Appendix 7. The logs presented in drawing no. 5.1 are listed in Table 5-1.

5.9 Borehole HFM07

Using the natural gamma from the 9042 as reference, the natural gamma logs from the other probes are aligned to the same borehole length. A new length scale is added to each log and afterwards the logs are stretched using different gamma events.

The complete log suite for borehole HFM07 is presented as composite log sheet in drawing no. 6.1 in Appendix 8. The logs presented in drawing no. 6.1 are listed in Table 5-1.

Table 5-6. The reference track marks in the borehole and the recorded track marks form the HiRAT in borehole KFR102A.

Reference mark	HIRAT recorded
71.94	71.94
100.00	99.83
146.00	145.514
200.00	199.075
249.00	247.64
300.00	298.233
351.00	348.84
400.00	397.396
448.00	444.961
500.00	496.484
550.00	546.11
580.00	575.864

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	Recorded files in Century, Robertson or GeoVista format	Description
KFR102B	8622	Up	KFR102B_10-06-08_11-12_8622C_.02_-0.05_179.82_ORIG.log	Start Depth: 179.82 m. End Depth: –0.05 m
KFR102B	9042	Down	KFR102B_10-06-08_09-13_9042C_.02_0.22_180.11_ORIG.log	Start Depth: 0.22 m. End Depth: 180.11 m
KFR102B	9072	Up	KFR102B_10-06-08_10-28_9072C_.02_0.03_179.82_ORIG.log	Start Depth: 179.82 m. End Depth: 0.03 m
KFR102B	9139	Up	KFR102B_10-06-08_12-08_9139A_.02_-0.43_179.70_ORIG.log	Start Depth: 179.7 m. End Depth: –0.43 m
KFR102B	HiRAT	Up	KFR102B_HiRAT_120pixels_up_unaligned_run2.HED	Start Depth: 180 m. End Depth: 0 m
KFR103	8622	Up	KFR103_10-06-08_17-43_8622C_.02_0.29_200.47_ORIG.log	Start Depth: 200.47 m. End Depth: 0.29 m
KFR103	9042	Down	KFR103_10-06-08_14-54_9042C_.02_0.22_200.74_ORIG.log	Start Depth: 0.22 m. End Depth: 200.74 m
KFR103	9072	Up	KFR103_10-06-08_15-52_9072C_.02_0.31_201.43_ORIG.log	Start Depth: 201.43 m. End Depth: 0.31 m
KFR103	9139	Up	KFR103_10-06-08_16-46_9139A_.02_-0.01_200.07_ORIG.log	Start Depth: 200.07 m. End Depth: –0.01 m
KFR103	HiRAT	Up	KFR103_HiRAT_120pixels_up_unaligned_run2.HED	Start Depth: 200 m. End Depth: 0 m
KFR103	OPTICAL	Down	KFR103_OPTV_720pixels_0.33mm_down_alignedHS_run3.HED	Start Depth: 0 m. End Depth: 125 m
KFR104	8622	Up	KFR104_10-07-08_13-27_8622C_.02_0.01_457.26_ORIG.log	Start Depth: 457.26 m. End Depth: 0.01 m
KFR104	9042	Down	KFR104_10-07-08_08-08_9042C_.02_0.22_457.35_ORIG.log	Start Depth: 0.22 m. End Depth: 457.35 m
KFR104	9072	Up	KFR104_10-07-08_10-03_9072C_.02_-0.19_457.04_ORIG.log	Start Depth: 457.04 m. End Depth: –0.19 m
KFR104	9072	Up	KFR104_10-07-08_14-22_9072C_.02_0.31_157.81_ORIG.log	Start Depth: 157.81 m. End Depth: 0.31 m
KFR104	9139	Up	KFR104_10-07-08_11-30_9139A_.02_-0.66_455.27_ORIG.log	Start Depth: 455.27 m. End Depth: –0.66 m
KFR104	HiRAT	Up	KFR104_HiRAT_120pixels_up_unaligned_run2.HED	Start Depth: 450 m. End Depth: 5 m
KFR102A	8622	Up	KFR102A_01-13-09_17-39_8622C_.1_0.10_604.20_ORIG.log	Start Depth: 604.2 m. End Depth: 0.1 m
KFR102A	9042	Down	KFR102A_01-13-09_09-05_9042C_.1_0.20_464.40_ORIG.log	Start Depth: 0.2 m. End epth: 464.4 m
KFR102A	9072	Up	KFR102A_01-13-09_12-41_9072C_.1_-7.90_599.80_ORIG.log	Start Depth: 599.8 m. End Depth: –7.9 m
KFR102A	9139	Up	KFR102A_01-13-09_15-00_9139A_.1_-1.90_605.40_ORIG.log	Start Depth: 605.4 m. End Depth: –1.9 m
KFR102A	HiRAT	Up	KFR102A_HiRAT_120pix_up_unalgn_runA.HED	Start Depth: 592.5 m. End Depth: 65.56 m

Borehole	Probe	Log direction	Recorded files in Century, Robertson or GeoVista format	Description
KFR27	8622	Up	KFR27_01-14-09_16-41_8622C_.1_0.70_498.00_ORIG.log	Start Depth: 498 m. End Depth: 0.7 m
KFR27	9042	Down	KFR27_01-14-09_10-55_9042C_.1_0.20_503.60_ORIG.log	Start Depth: 0.2 m. End Depth: 503.6 m
KFR27	9072	Up	KFR27_01-14-09_15-21_9072C_.1_1.20_498.80_ORIG.log	Start Depth: 498.8 m. End Depth: 1.2 m
KFR27	9139	Up	KFR27_01-14-09_13-05_9139A_.1_-3.70_498.60_ORIG.log	Start Depth: 498.6 m. End Depth: –3.7 m
KFR27	HiRAT	Up	KFR27_HiRAT_120pix_up_unalgn_runA.HED	Start Depth: 500.15 m. End Depth: 5 m
HFM07	8622	Up	HFM07_01-14-09_20-50_8622C_.1_12.50_121.10_ORIG.log	Start Depth: 121.1 m. End Depth: 12.5 m
HFM07	9042	Down	HFM07_01-14-09_19-01_9042C_.1_0.20_121.30_ORIG.log	Start Depth: 0.2 m. End Depth: 121.3 m
HFM07	9072	Up	HFM07_01-14-09_19-32_9072C_.1_0.20_121.00_ORIG.log	Start Depth: 121.0 m. End Depth: 0.2 m
HFM07	9139	Up	HFM07_01-14-09_20-04_9139A_.1_12.70_120.70_ORIG.log	Start Depth: 120.7 m. End Depth: 12.7 m

Table 6-2. Drawing files in WellCad format.

Borehole	Drawing	WellCad file
KFR102B	1.1	KFR102B_Presentation.WCL
KFR103	2.1	KFR103_Presentation.WCL
KFR103	2.2	KFR103_Presentation_with_OPTV_1_to_2.WCL
KFR103	2.3	KFR103_Presentation_with_OPTV_1_to_2.WCL
KFM104	3.1	KFM104_Presentation.WCL
KFR27	4.1	KFR27_Presentation.WCL
KFR102A	5.1	KFR102A_Presentation.WCL
HFM07	6.1	HFM07_Presentation.WCL

Table 6-3. Data files in Sicada format.

Sheet	Comment
"BoreholeIDID"_CALIPER1_GP040 - Caliper logging.xls	
"BoreholeID"_CALIPER MEAN_GP041 - 3-D caliper.xls	
"BoreholeID"_TEMP(FL)_RES(FL)_GP060 – Fluid temperature and resistivity logging.xls	
"BoreholeID"_DENSITY_GP090 – Density logging.xls	
"BoreholeID"_MAGSUSCEP_GP110 - Magnetic susceptibility logging.xls	
"BoreholeID"_GAM(NAT)_GP120 - Natural gamma logging.xls	
"BoreholeID"_RES(SG)_GP159 – Resistivity, focused 128 cm.xls	
"BoreholeID"_RES(DG)_GP162 – Resistivity, focused 300 cm.xls	
"BoreholeID"_GP830 - Acoustic televiewer.xls	

Borehole No. KFM102B

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

Northing: 6701740.53m Easting: 1633343.91m Elevation: 2.51m, RHB70

Diameter:	75.8mm
Reaming Diameter:	
Outer Casing:	88mm
Inner Casing:	77mm
Casing Length:	13.95m
Borehole Length:	180.08m
Cone:	
Inclination at ground surface:	-54.14°
Azimuth:	344.87°
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	2008-11-04	JRI	UTN	UTN

Job	Scale
547310A	1:500

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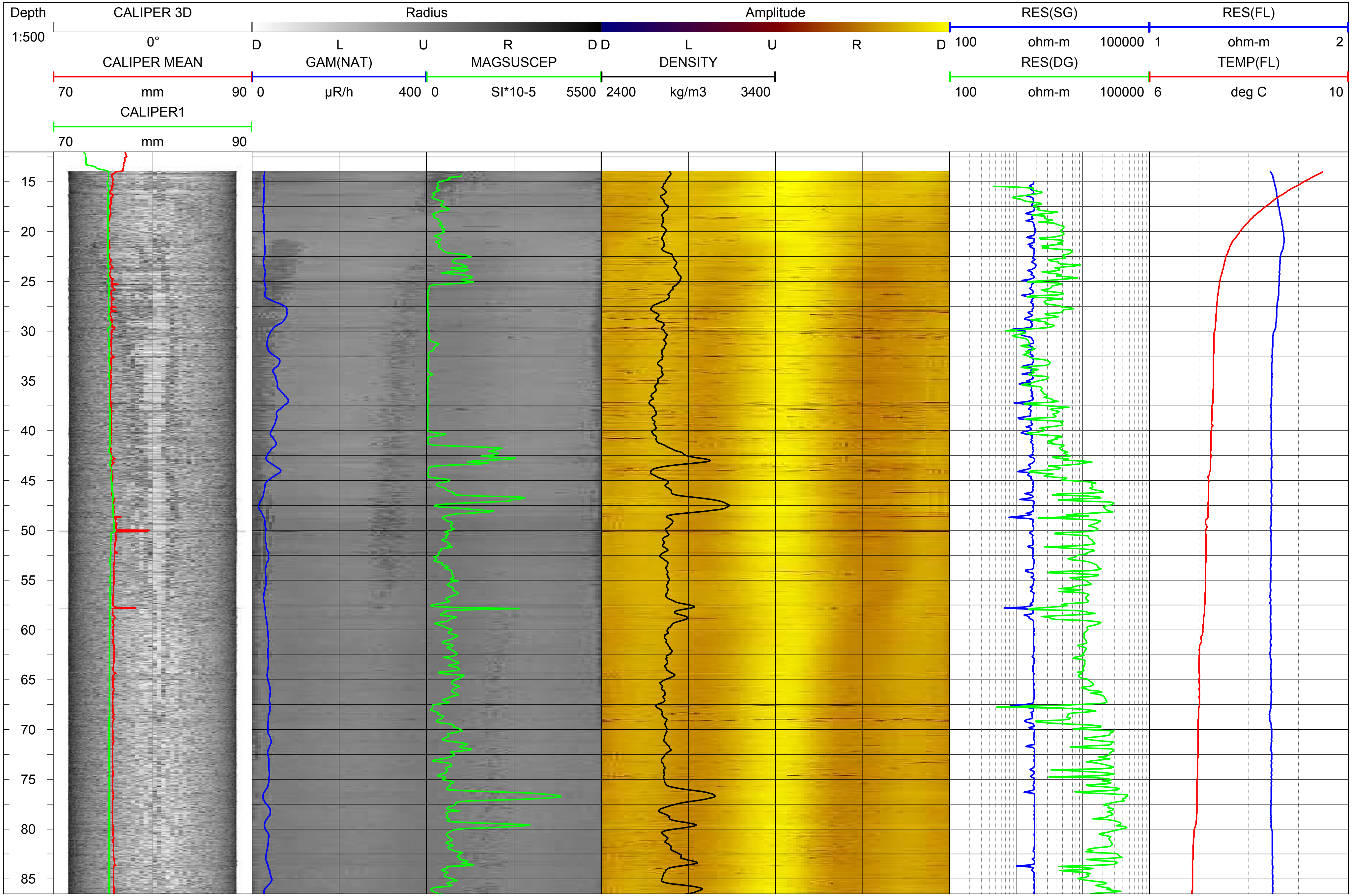
SKB geophysical borehole logging
Borehole KFR102B

Presentation

Filename:
KFR102B_Presentation.wcl

Drawing no.:
1.1



Depth
1:500
CALIPER 3D
0°
CALIPER MEAN
70 mm 90
CALIPER1
70 mm 90
Radius
D L U R D
GAM(NAT)
0 μR/h 400
MAGSUSCEP
0 SI*10-5 5500
Amplitude
D L U R D
DENSITY
2400 kg/m3 3400
RES(SG)
100 ohm-m 100000
RES(DG)
100 ohm-m 100000
RES(FL)
1 ohm-m 2
TEMP(FL)
6 deg C 10
15
20
25
30
35
40
45
50
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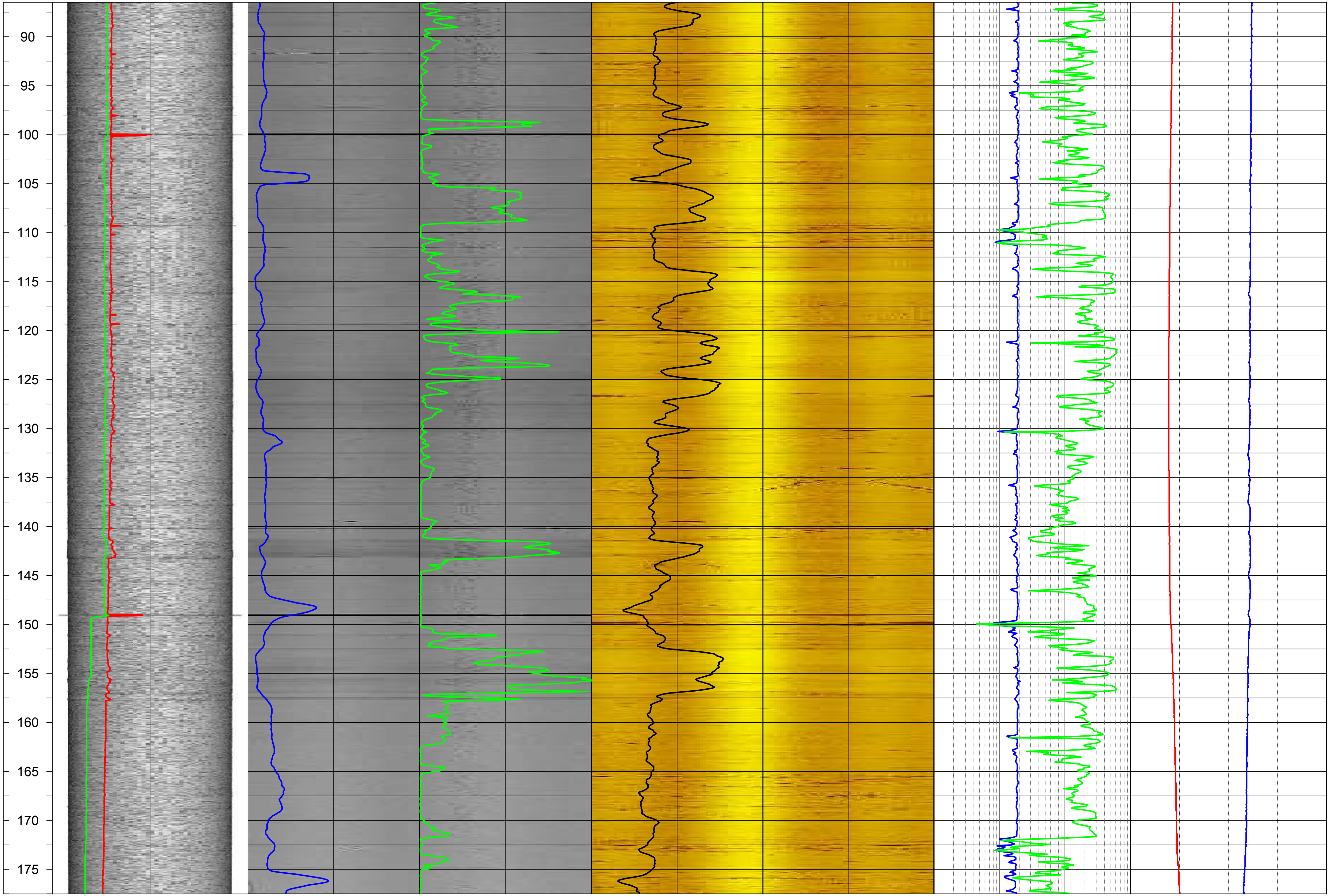
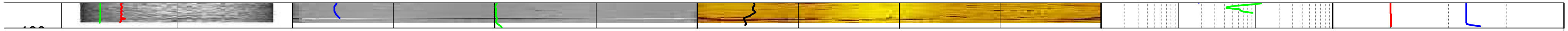
60
65
70
75
80
85


90
95
100
105
110
115
120
125
130
135
140
145
150
155
160
165
170
175



CALIPER1
70 mm 90

CALIPER MEAN
70 mm 90

GAM(NAT)
0 µR/h 400

MAGSUSCEP
0 SI*10-5 5500

DENSITY
2400 kg/m3 3400

RES(DG)
100 ohm-m 100000

TEMP(FL)
6 deg C 10

Depth
1:500

CALIPER 3D
0°

Radius
D L U R D

Amplitude
D L U R D

RES(SG)
100 ohm-m 100000

RES(FL)
1 ohm-m 2

Borehole No. KFM103

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

Northing: 6701737.13m Easting: 1633347.20m Elevation: 2.43m, RHB70

Diameter:	75.8mm
Reaming Diameter:	
Outer Casing:	88mm
Inner Casing:	77mm
Casing Length:	13.33m
Borehole Length:	200.50m
Cone:	
Inclination at ground surface:	-53.91°
Azimuth:	179.87°
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	2008-11-05	JRI	UTN	UTN

Job	Scale
547310A	1:500

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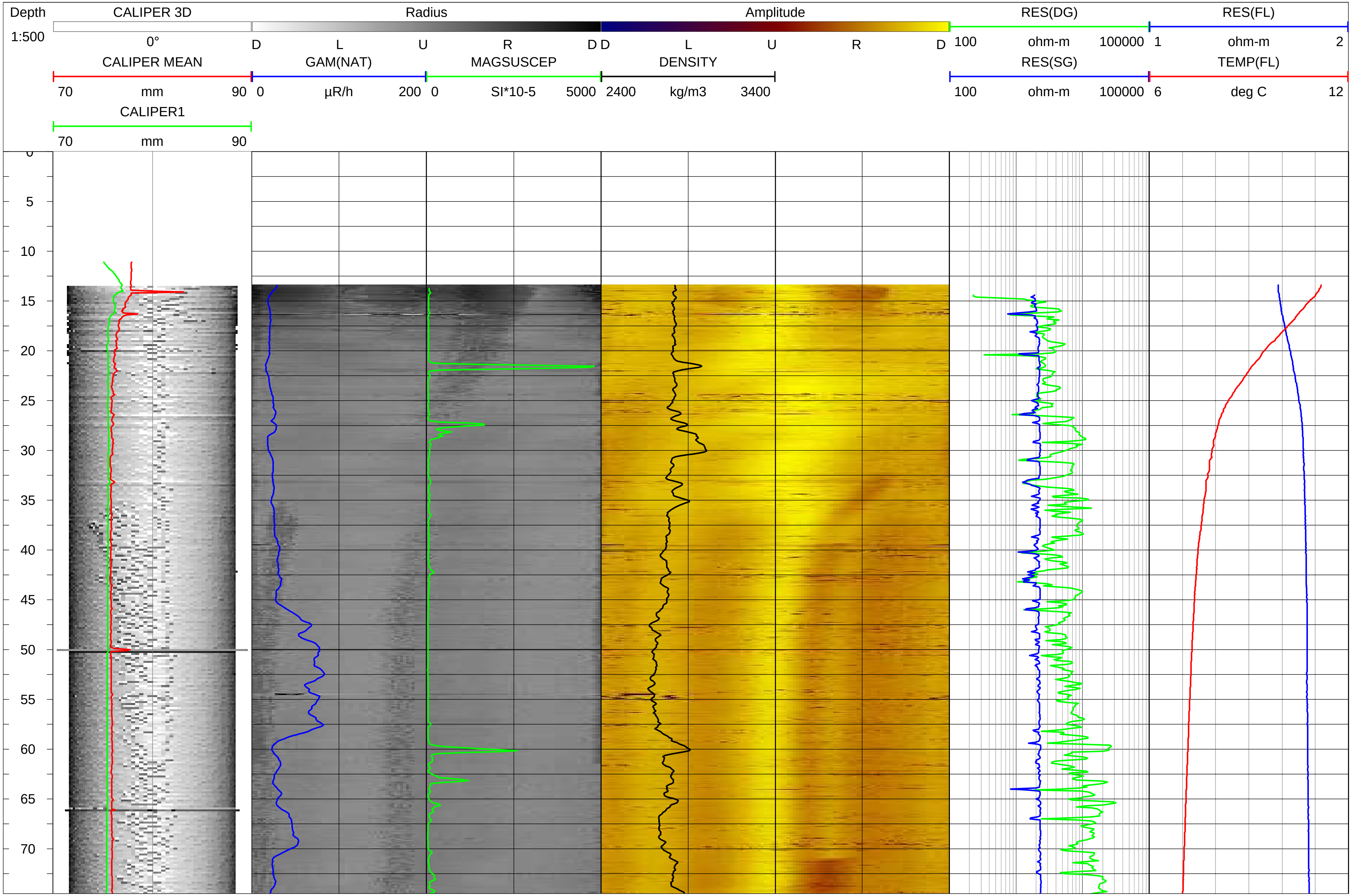
SKB geophysical borehole logging
Borehole KFR103

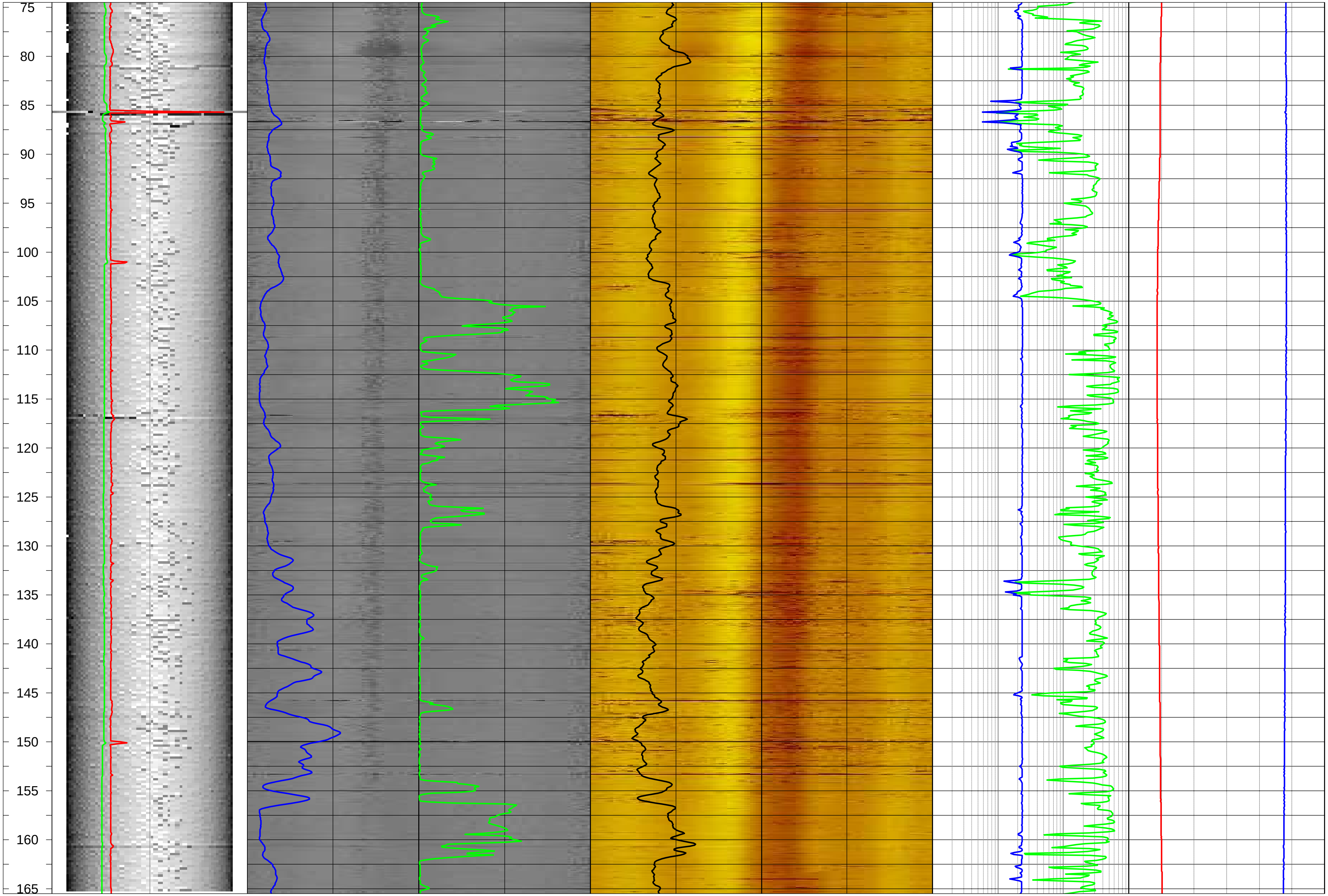
Presentation

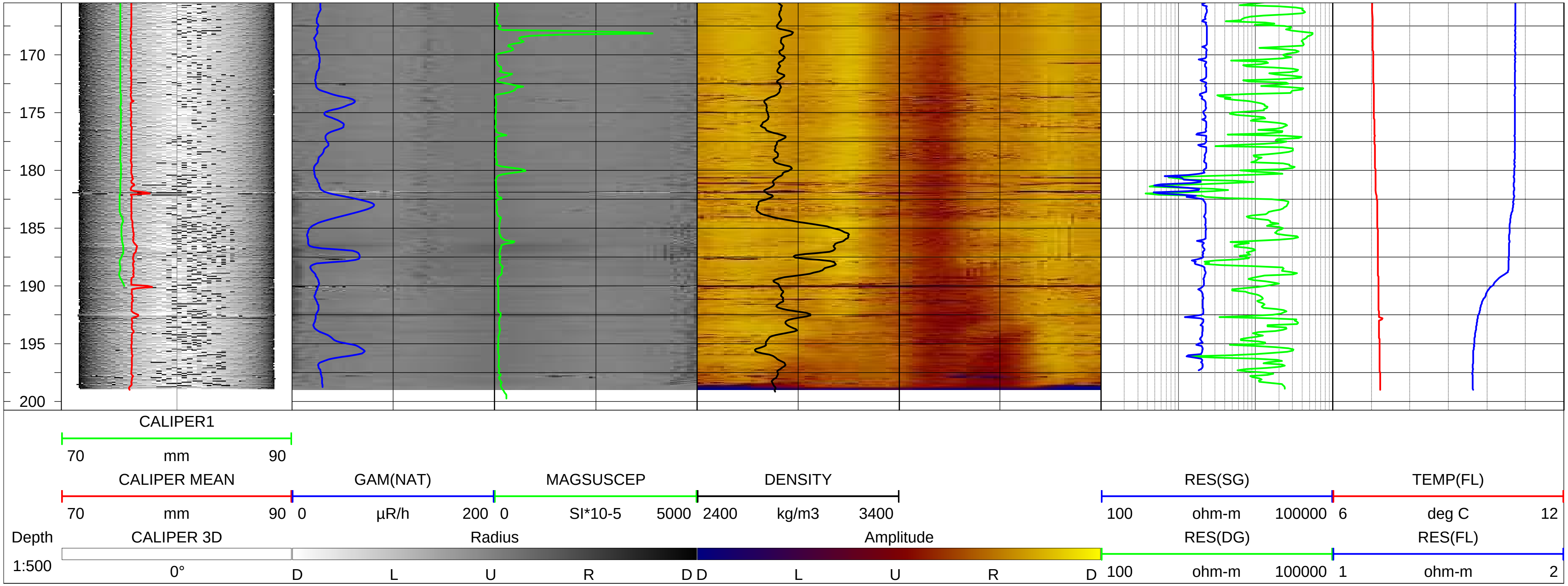
Filename:
KFR103_Presentation.wcl

Drawing no.:
2.1



Depth
1:500
CALIPER 3D
0°
CALIPER MEAN
70 mm 90
CALIPER1
70 mm 90
Radius
D L U R D
GAM(NAT)
0 µR/h 200
MAGSUSCEP
0 SI*10-5 5000
Amplitude
D L U R D
DENSITY
2400 kg/m3 3400
RES(DG)
100 ohm-m 100000
RES(SG)
100 ohm-m 100000
RES(FL)
1 ohm-m 2
TEMP(FL)
6 deg C 12
0
5
10
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
155
160
165


170
175
180
185
190
195
200
CALIPER1
70 mm 90
CALIPER MEAN
70 mm 90
GAM(NAT)
0 µR/h 200
MAGSUSCEP
0 SI*10-5 5000
DENSITY
2400 kg/m3 3400
RES(SG)
100 ohm-m 100000
TEMP(FL)
6 deg C 12
Depth
1:500
CALIPER 3D
0°
Radius
D L U R D
Amplitude
D L U R D
RES(DG)
100 ohm-m 100000
RES(FL)
1 ohm-m 2

Borehole No. KFR103

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

Northing: 6701737.13m Easting: 1633347.20m Elevation: 2.43m, RHB70

Diameter:	75.8mm
Reaming Diameter:	
Outer Casing:	88mm
Inner Casing:	77mm
Casing Length:	13.33m
Borehole Length:	200.50m
Cone:	
Inclination at ground surface:	-53.91°
Azimuth:	179.87°
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° orientated acoustic radius	HiRAT	mm
AMPLITUDE	360° orientated acoustic amplitude	HiRAT	-
OPTV	360° orientated optical image	OPTV	-
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
1	2009-03-26	JRI	UTN	UTN

Job	Scale
547310A	1:500

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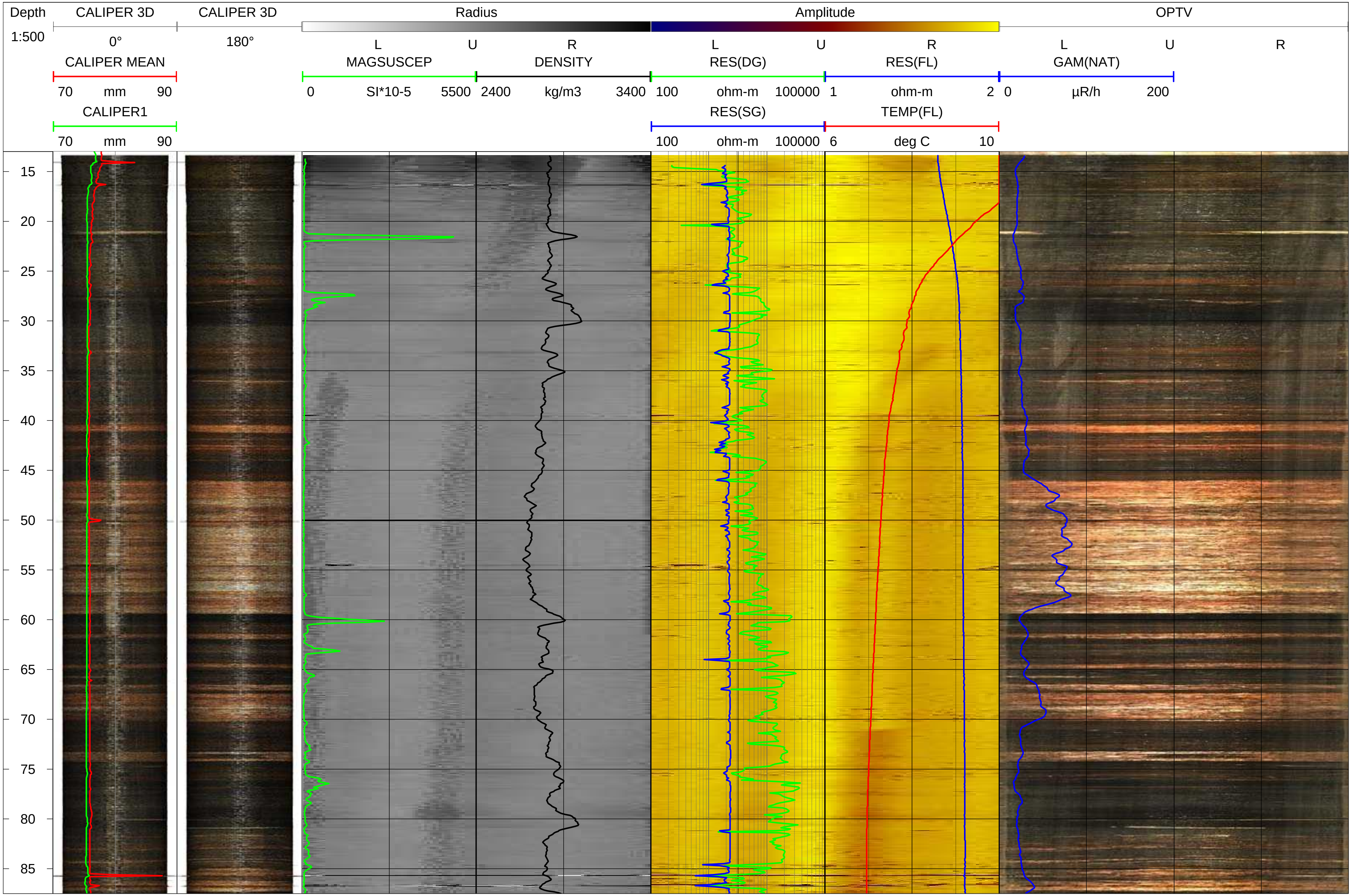
SKB geophysical borehole logging
Borehole KFR103

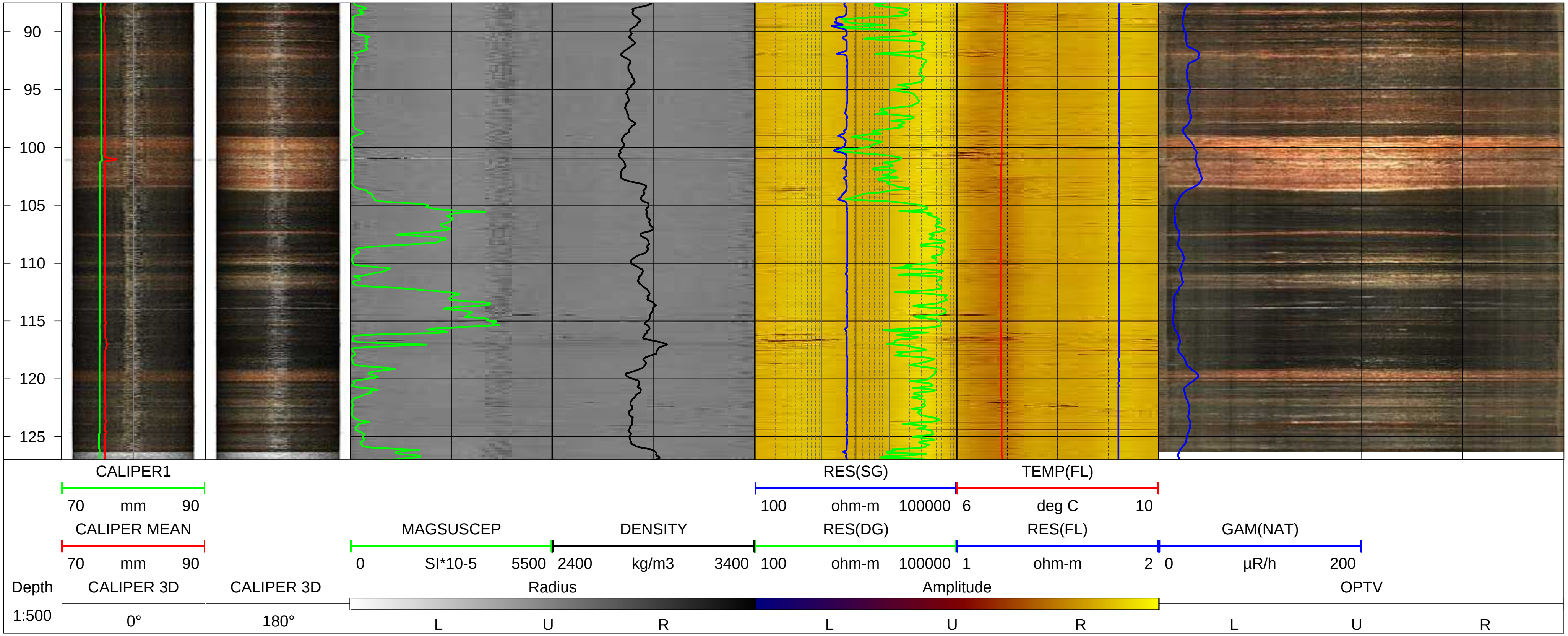
Presentation with optical televiewer

Filename:
KFR103_Presentation_with_optv.wcl

Drawing no.:
2.2



Depth
1:500
CALIPER 3D
0°
CALIPER MEAN
70 mm 90
CALIPER1
70 mm 90
CALIPER 3D
180°
Radius
L U R
MAGSUSCEP
0 SI*10-5 5500
DENSITY
2400 kg/m3 3400
Amplitude
L U R
RES(DG)
100 ohm-m 100000
RES(SG)
100 ohm-m 100000
RES(FL)
1 ohm-m 2
TEMP(FL)
6 deg C 10
OPTV
L U R
GAM(NAT)
0 µR/h 200
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85


90
95
100
105
110
115
120
125
CALIPER1
70 mm 90
CALIPER MEAN
70 mm 90
Depth
1:500
CALIPER 3D
0°
CALIPER 3D
180°
MAGSUSCEP
0 SI*10-5 5500
DENSITY
2400 kg/m3 3400
Radius
L U R
RES(SG)
100 ohm-m 100000
RES(DG)
100 ohm-m 100000
TEMP(FL)
6 deg C 10
RES(FL)
1 ohm-m 2
Amplitude
L U R
GAM(NAT)
0 µR/h 200
OPTV
L U R

Borehole No. KFR103

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

Northing: 6701737.13m Easting: 1633347.20m Elevation: 2.43m, RHB70

Diameter:	75.8mm
Reaming Diameter:	
Outer Casing:	88mm
Inner Casing:	77mm
Casing Length:	13.33m
Borehole Length:	200.50m
Cone:	
Inclination at ground surface:	-53.91°
Azimuth:	179.87°
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° orientated acoustic radius	HiRAT	mm
AMPLITUDE	360° orientated acoustic amplitude	HiRAT	-
OPTV	360° orientated optical image	OPTV	-
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
1	2009-03-26	JRI	UTN	UTN

Job	Scale
547310A	1:2

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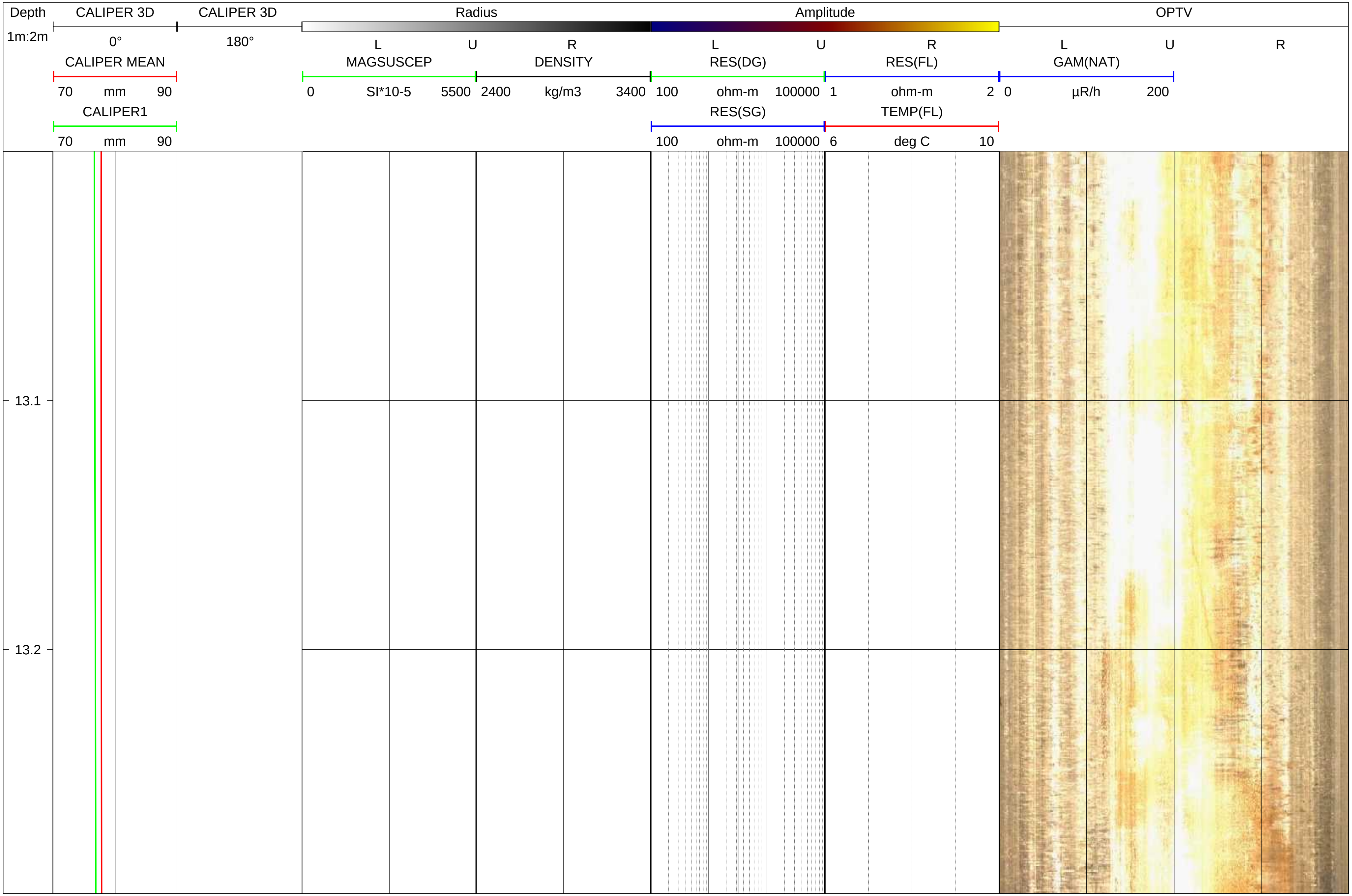
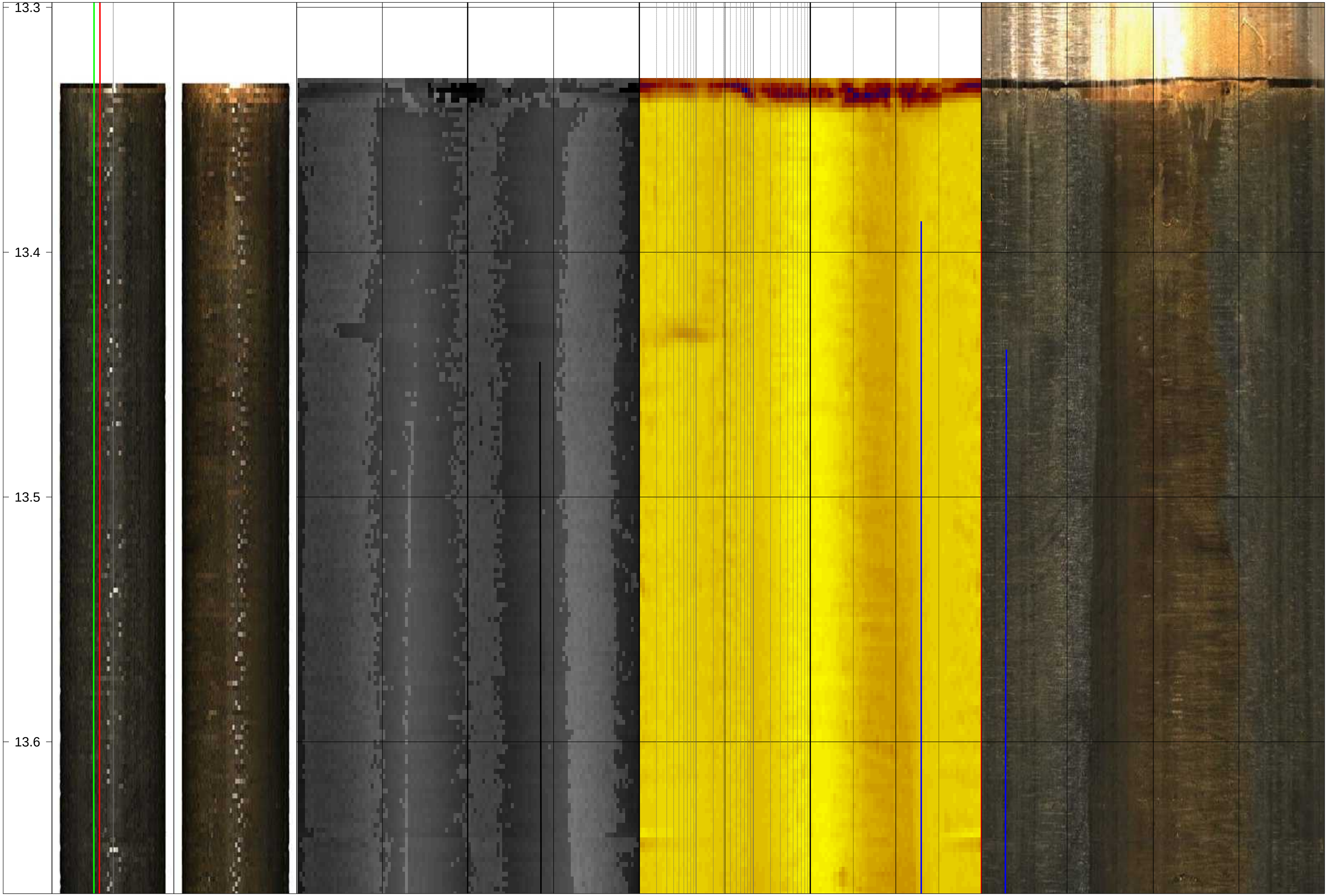
SKB geophysical borehole logging
Borehole KFR103

Presentation with optical televiewer

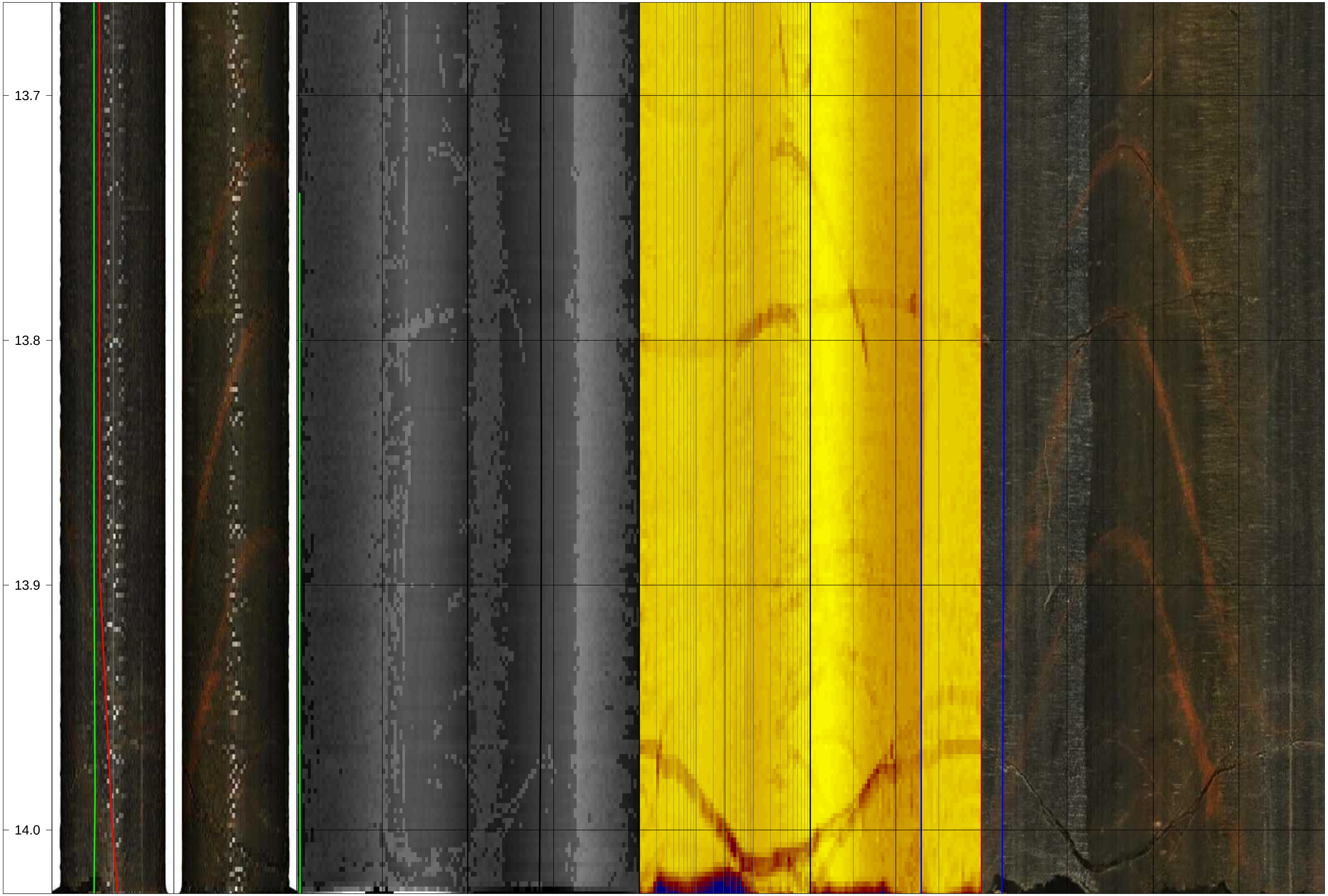
Filename:
KFR103_Presentation_with_optv.wcl

Drawing no.:
2.3


Depth
1m:2m
CALIPER 3D
0°
CALIPER 3D
180°
Radius
Amplitude
OPTV
L
U
R
L
U
R
L
U
R
CALIPER MEAN
70 mm 90
CALIPER1
70 mm 90
MAGSUSCEP
0 SI*10-5 5500
DENSITY
2400 kg/m3 3400
RES(DG)
100 ohm-m 100000
RES(SG)
100 ohm-m 100000
RES(FL)
1 ohm-m 2
TEMP(FL)
6 deg C 10
GAM(NAT)
0 µR/h 200
13.1
13.2



13.3
13.4
13.5
13.6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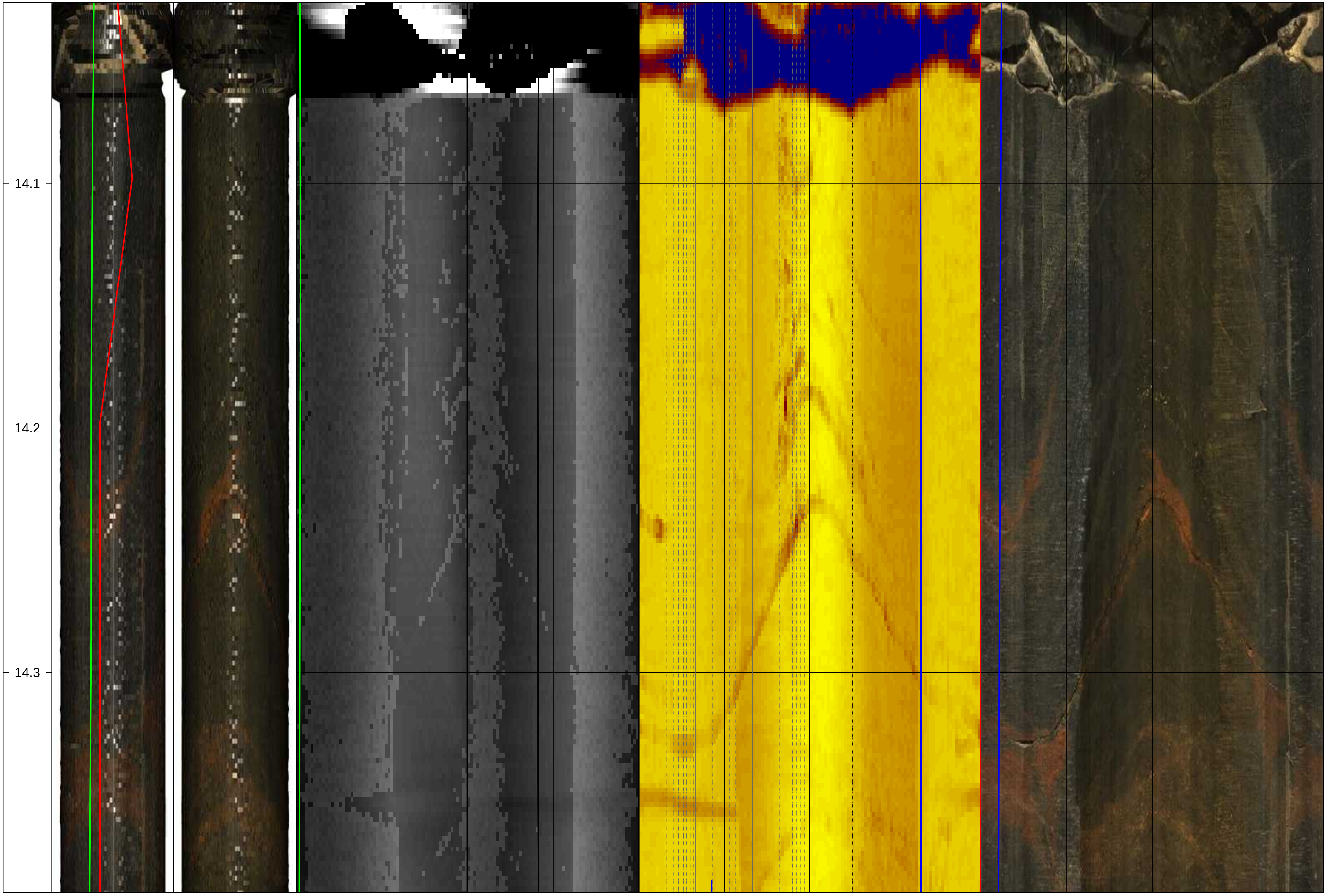

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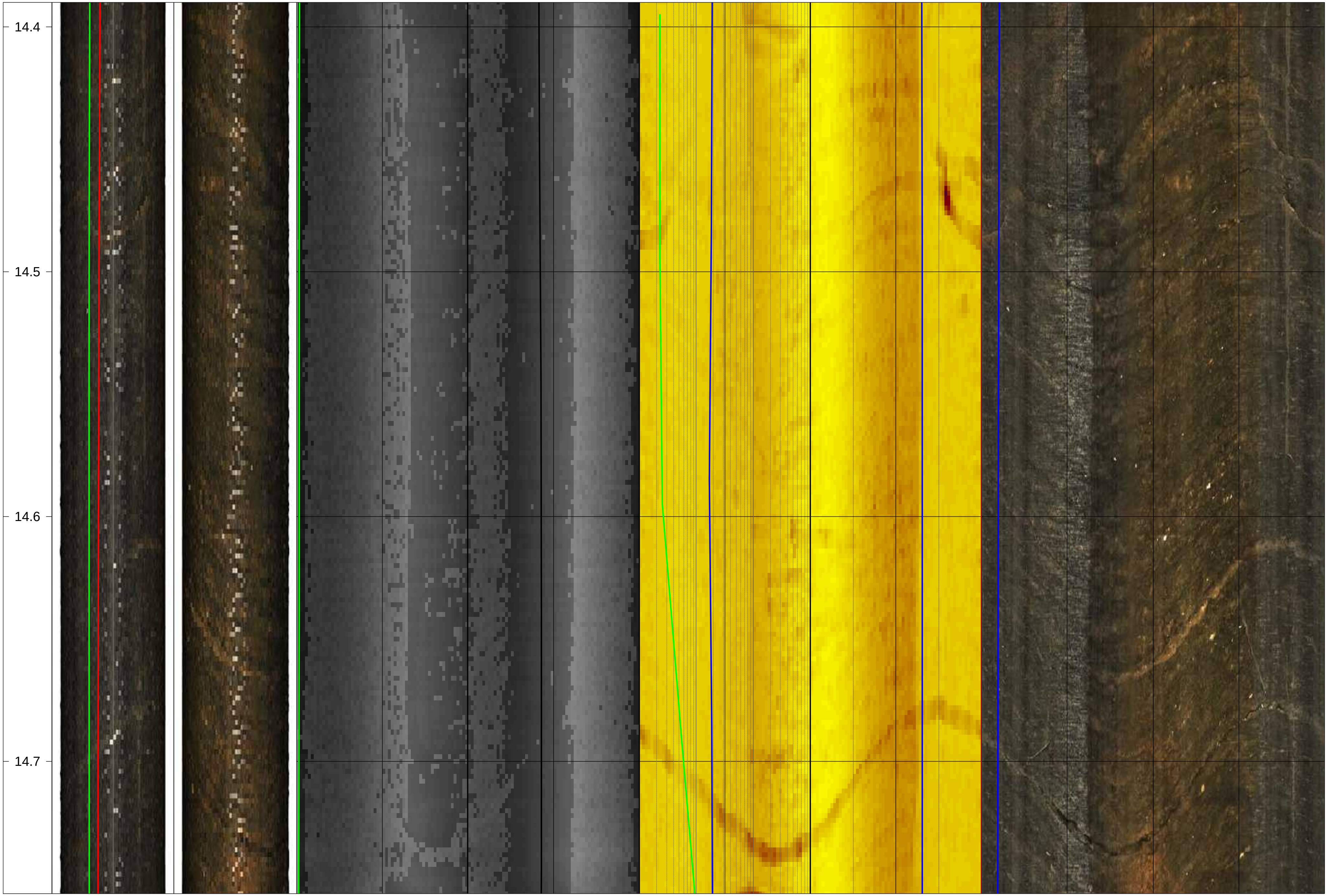
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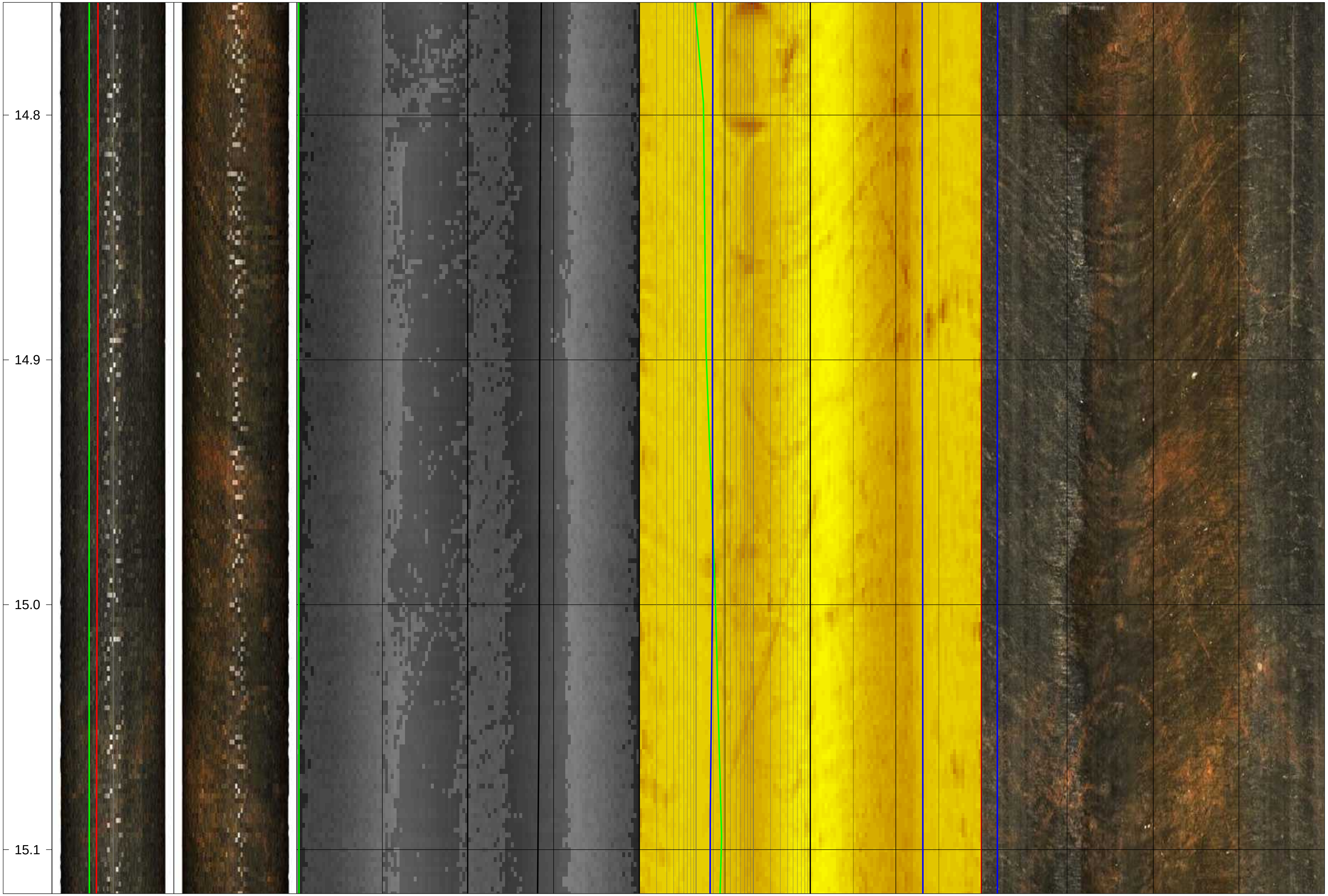
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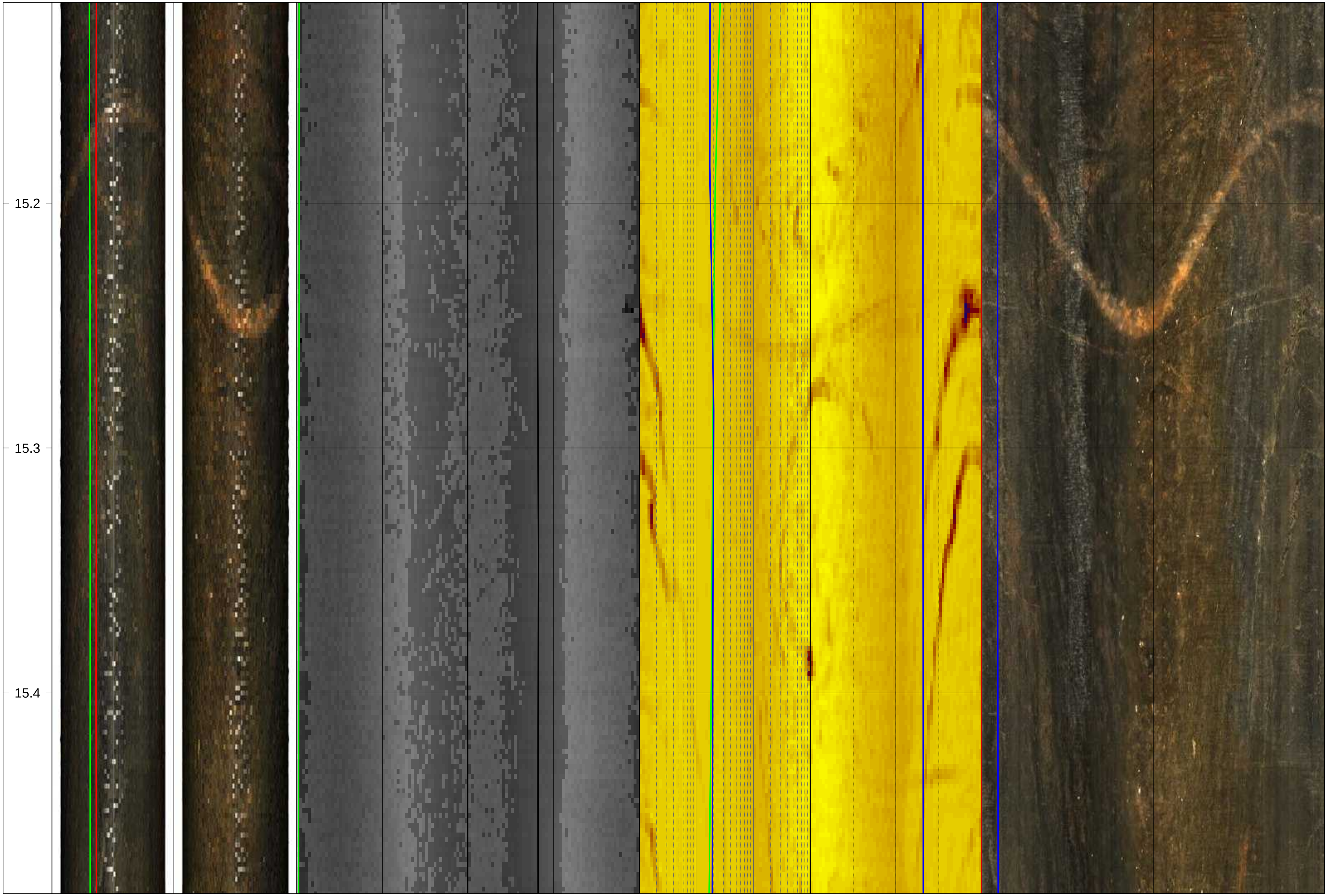

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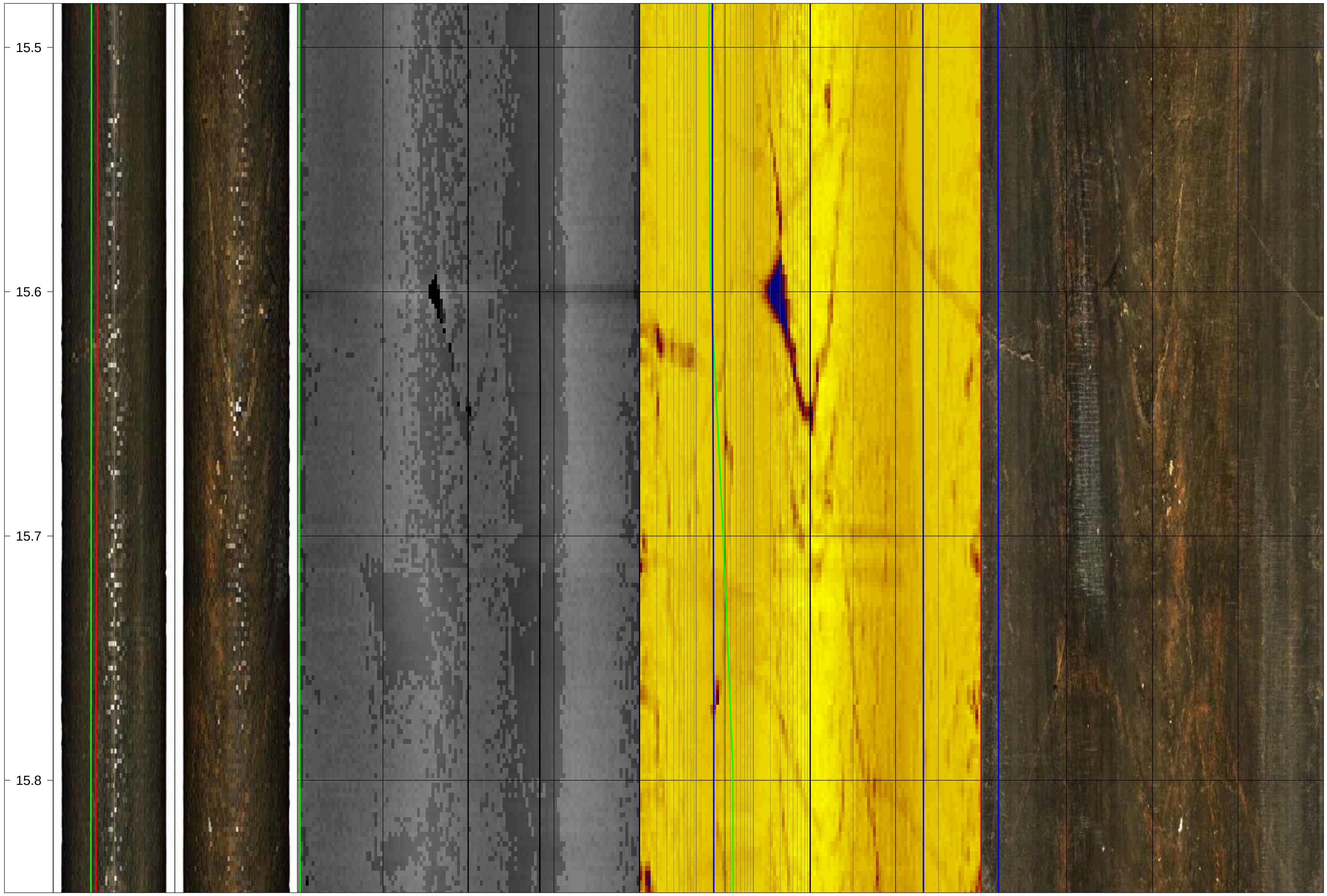
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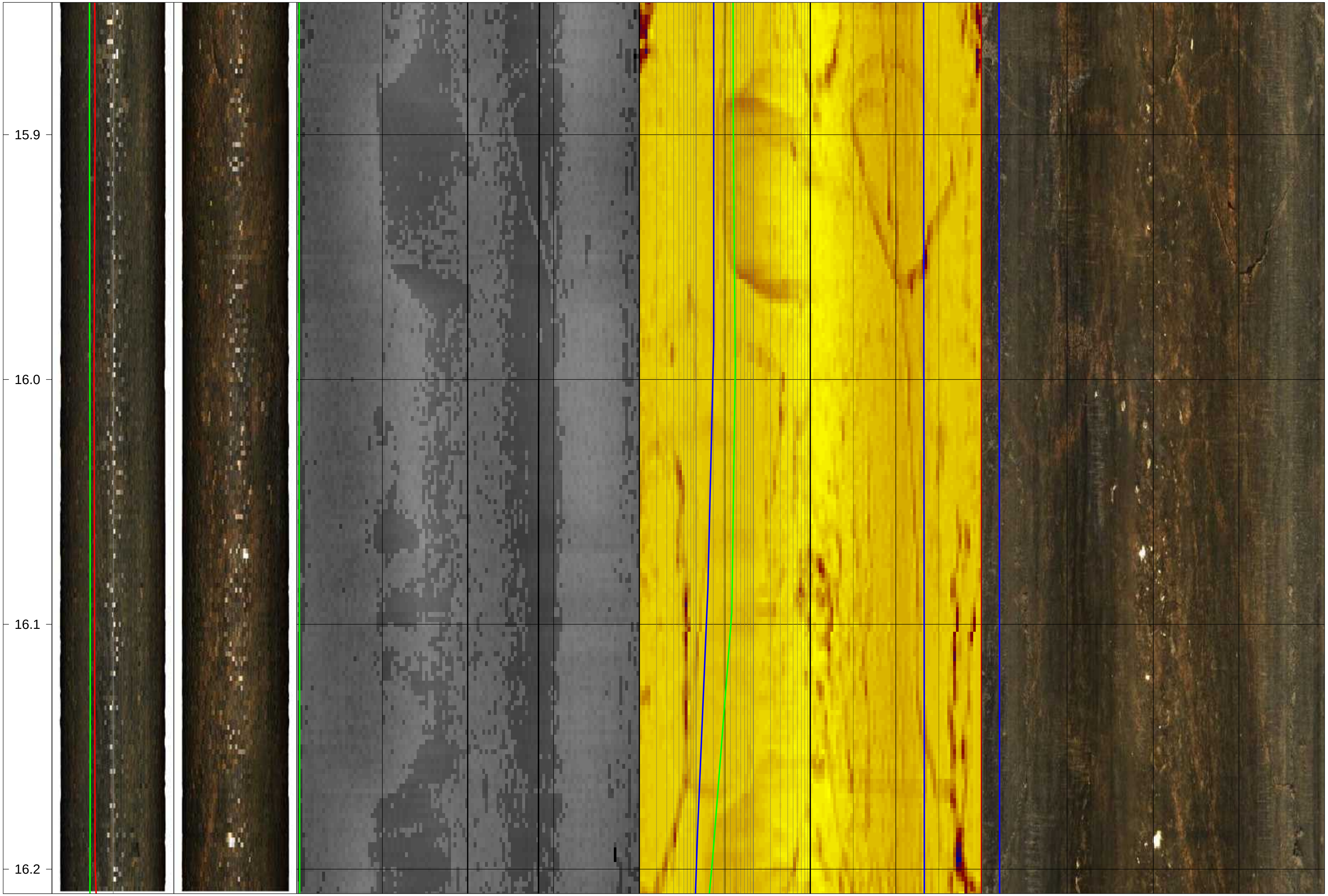
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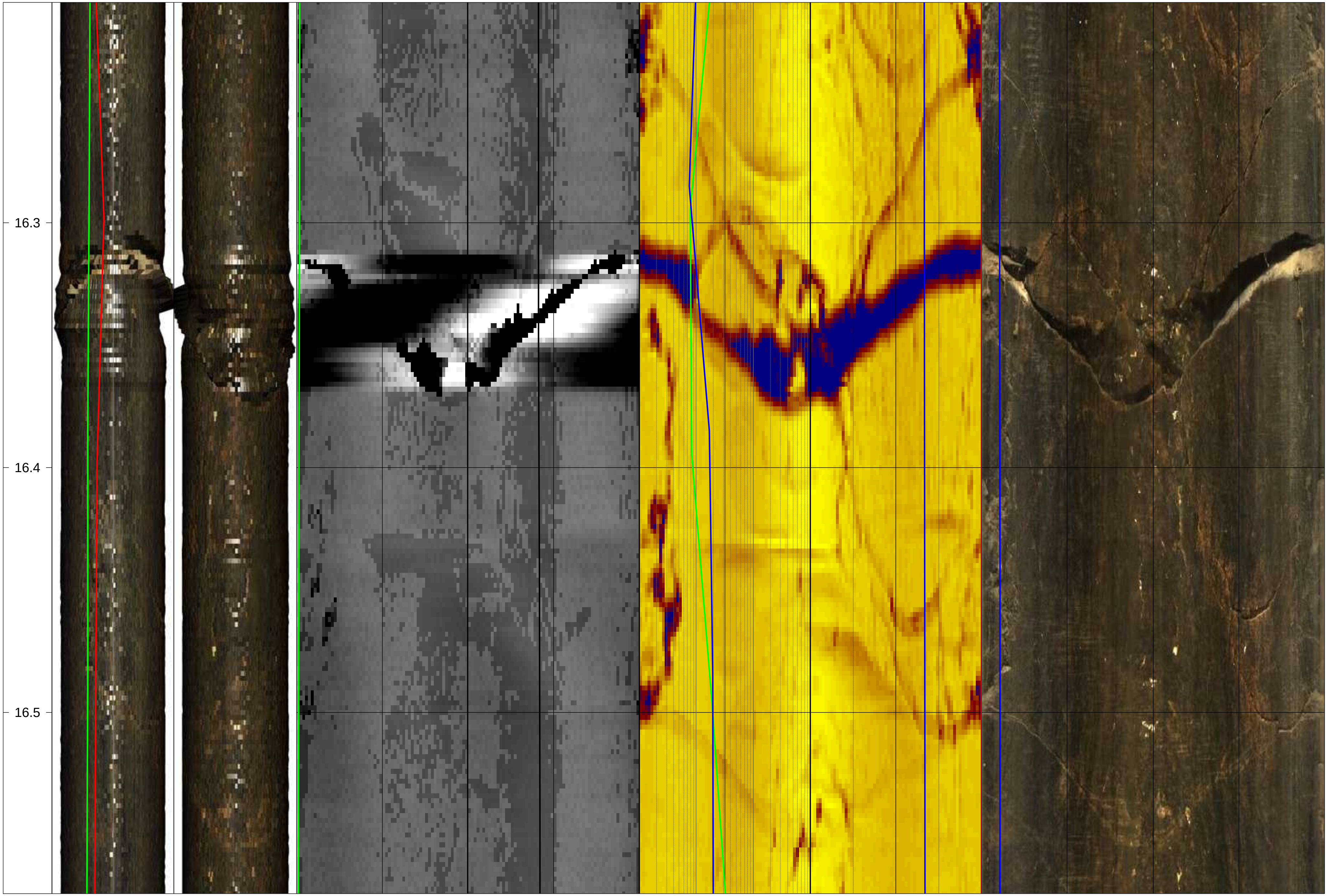
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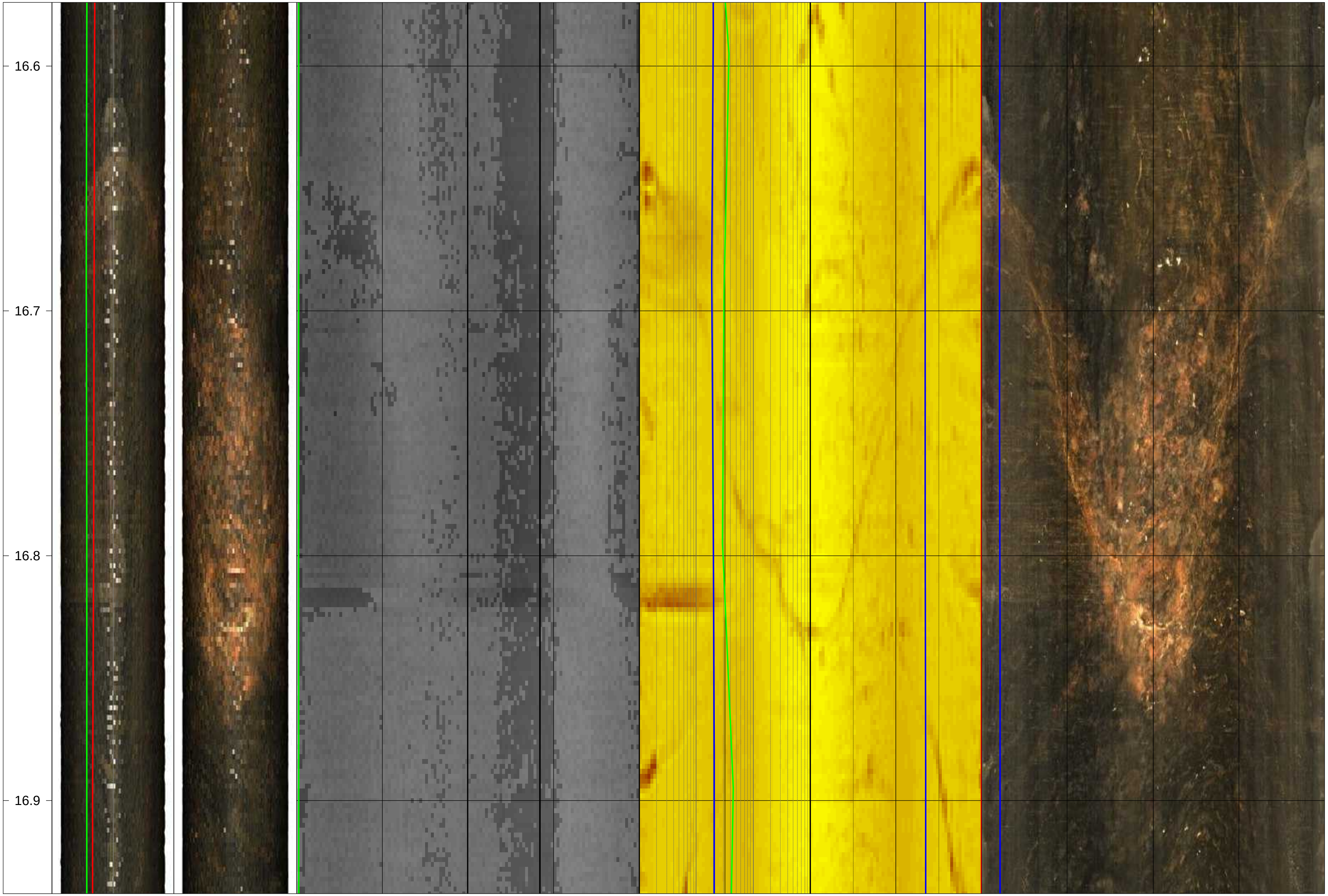
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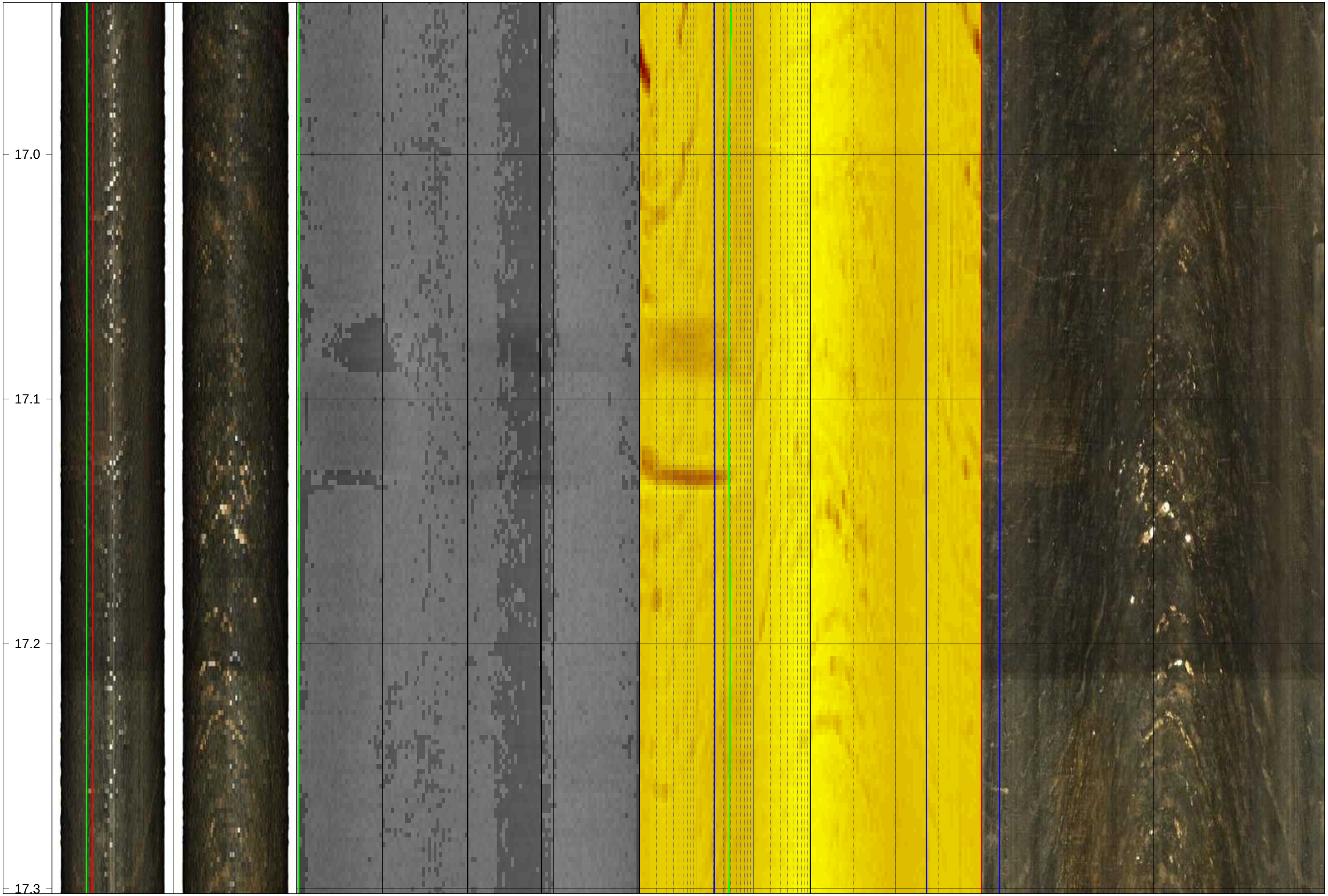
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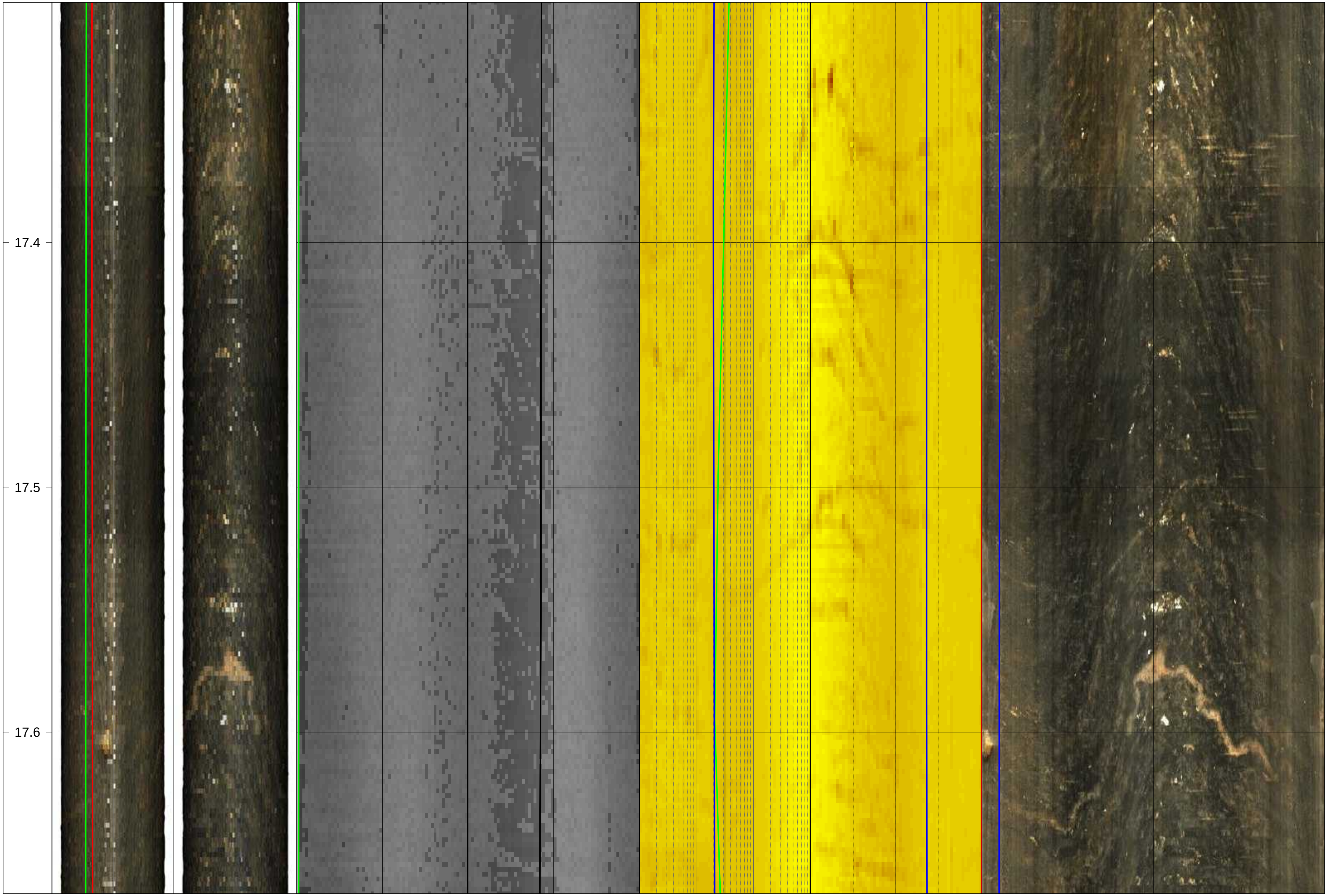
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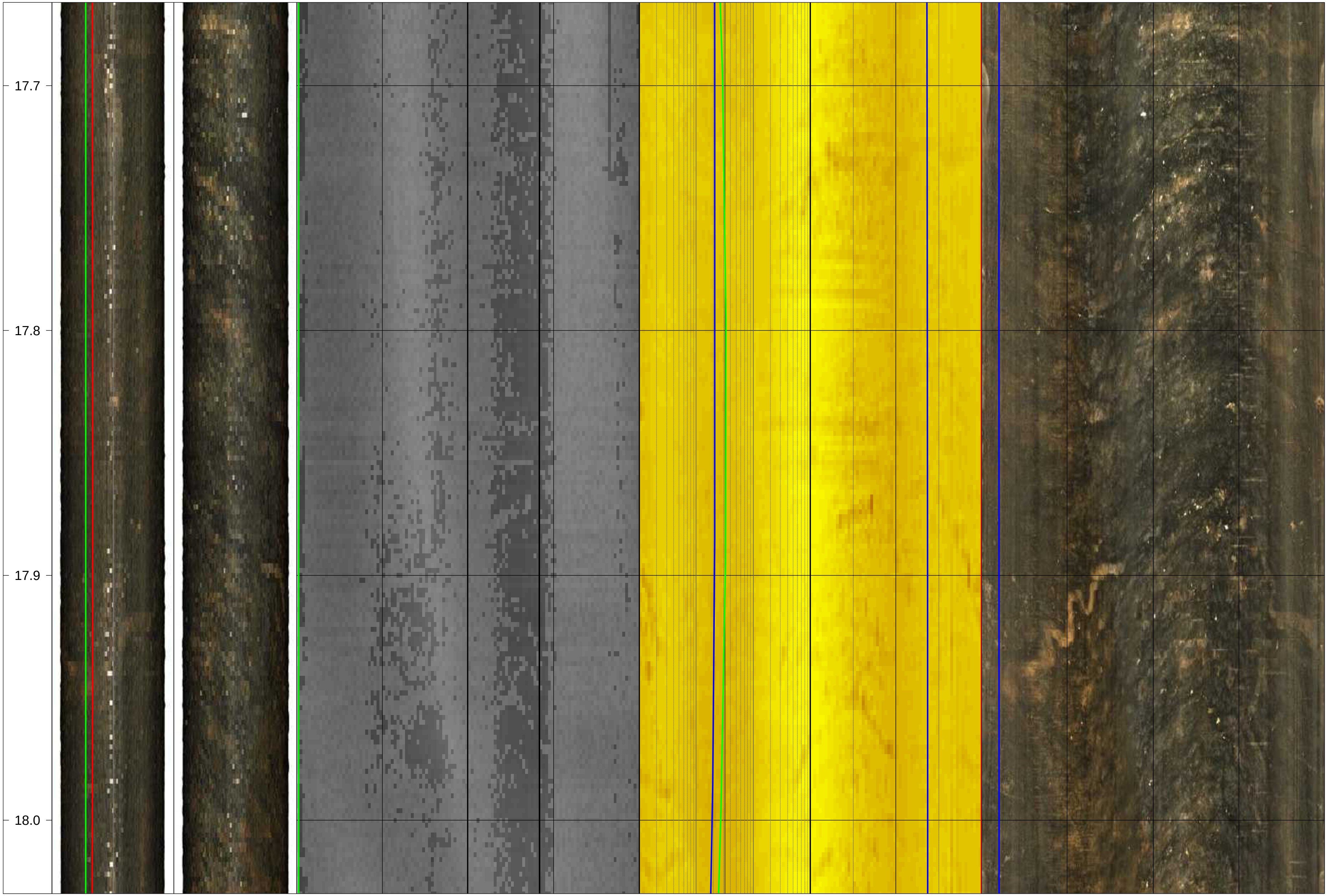
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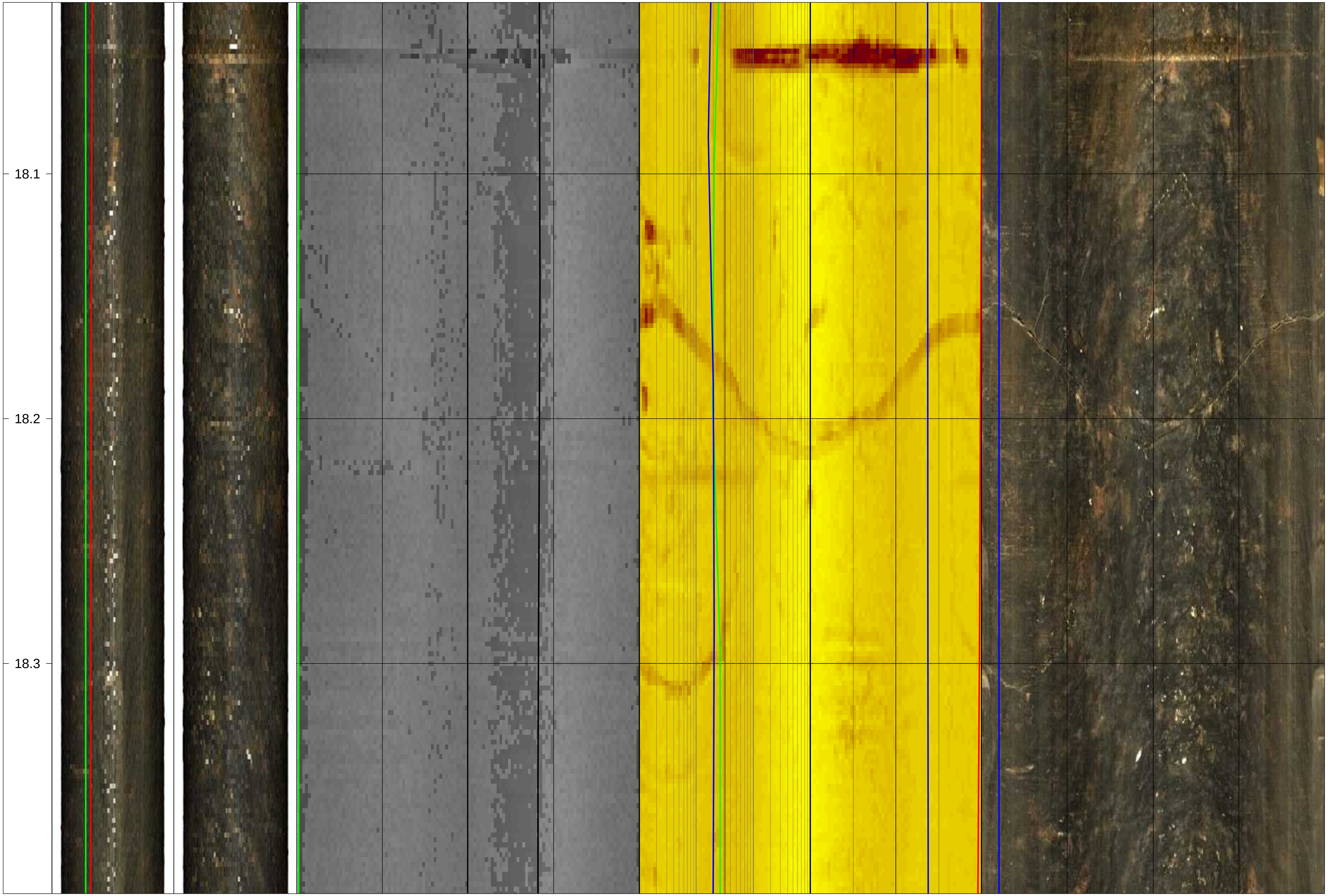
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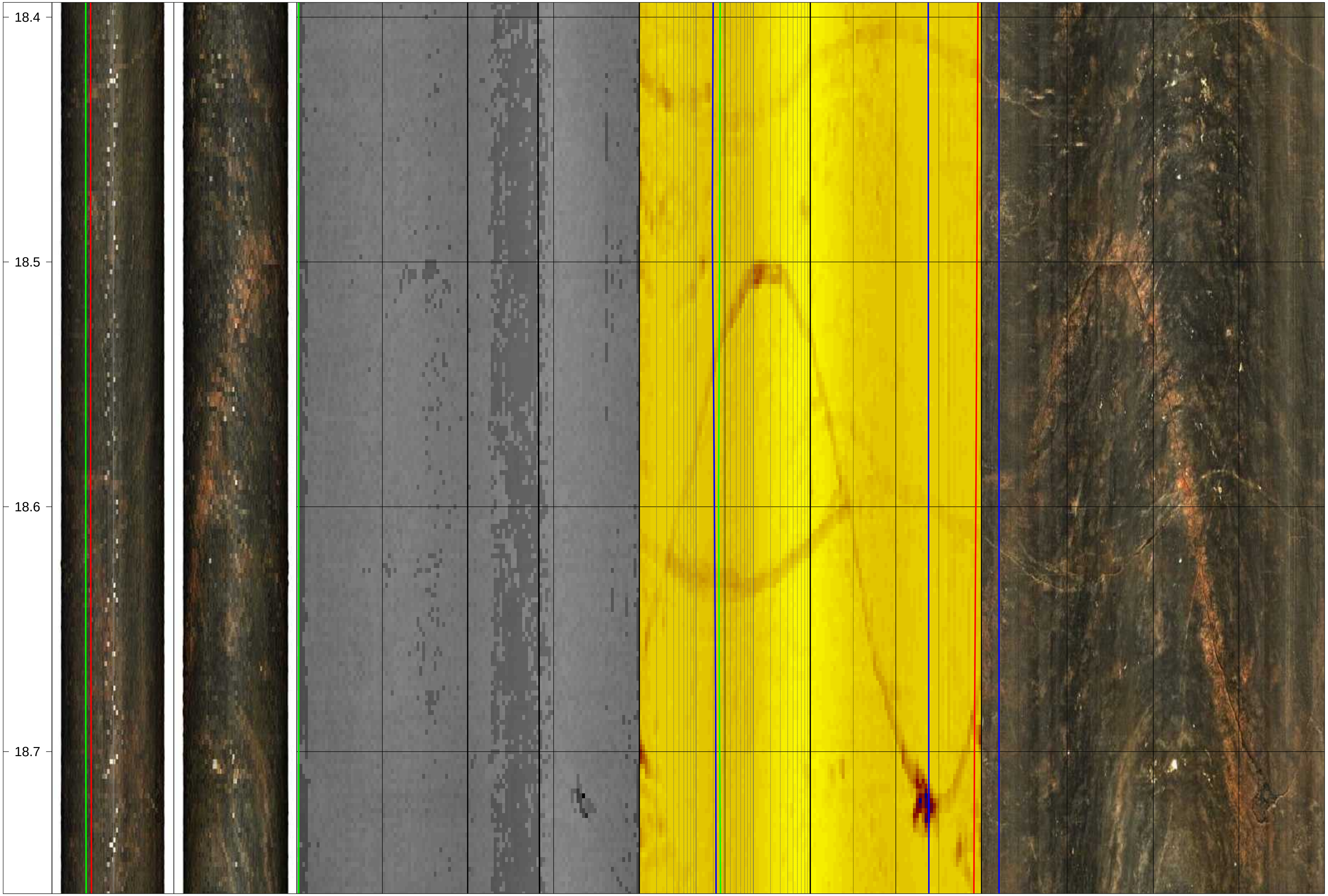
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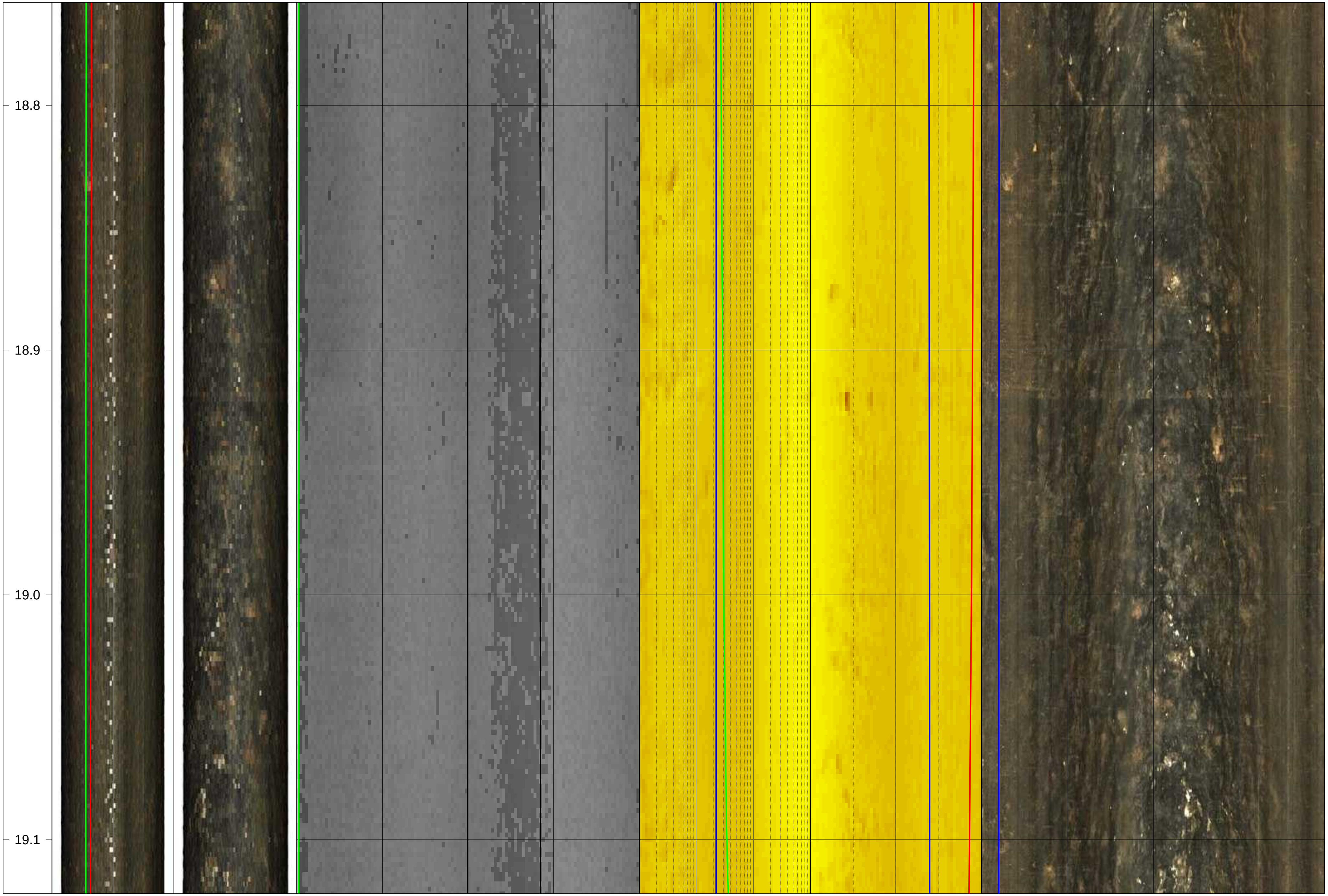
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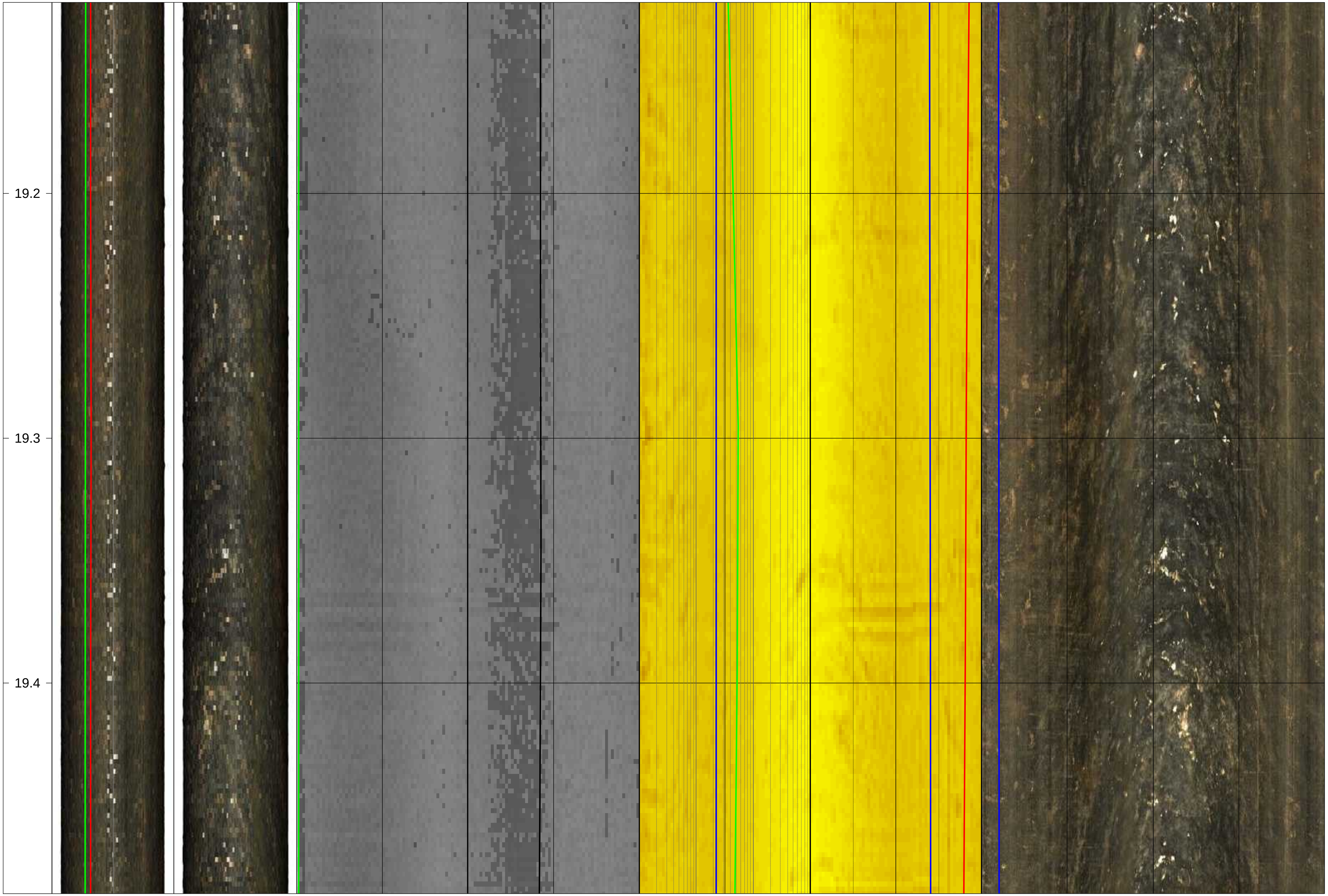
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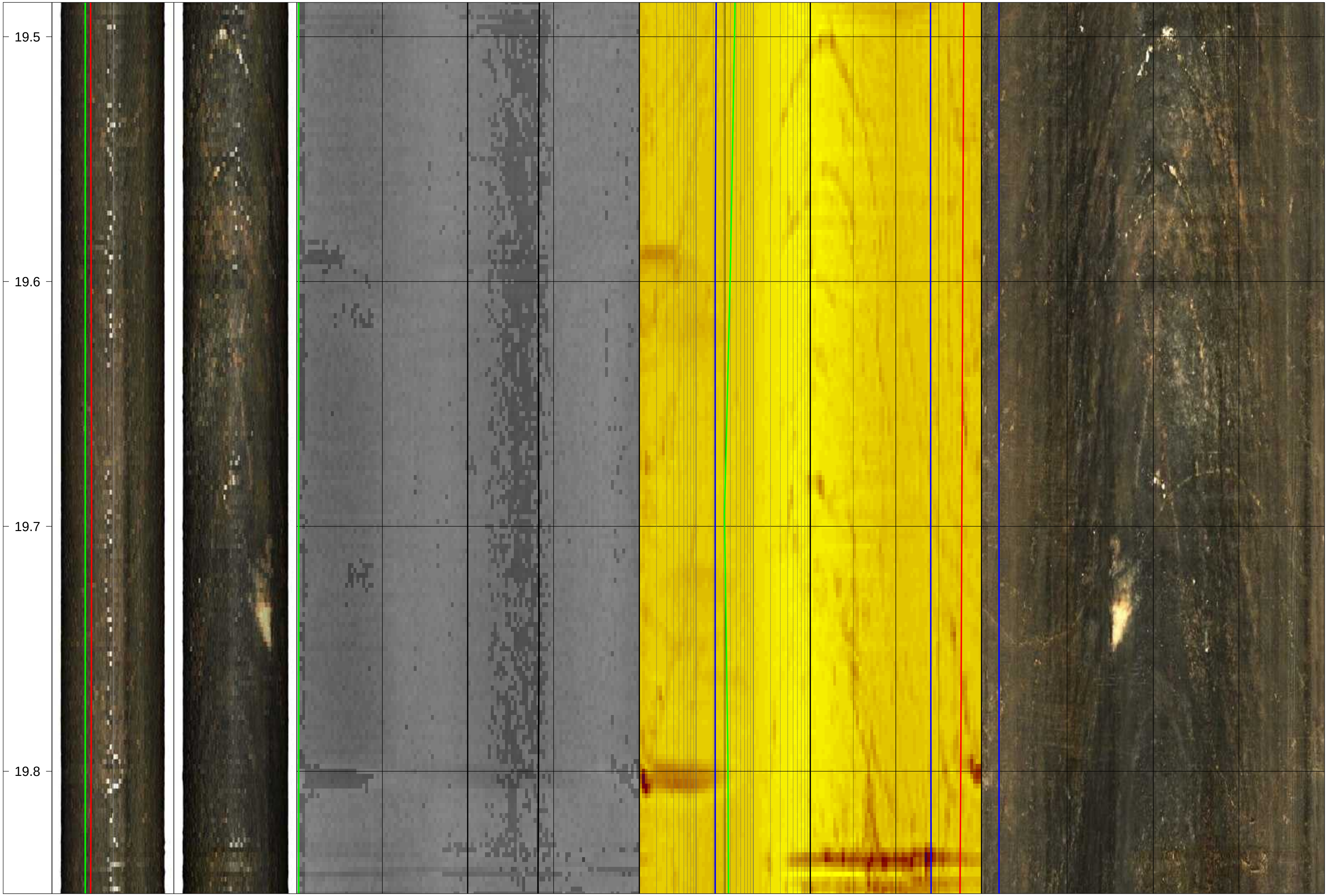
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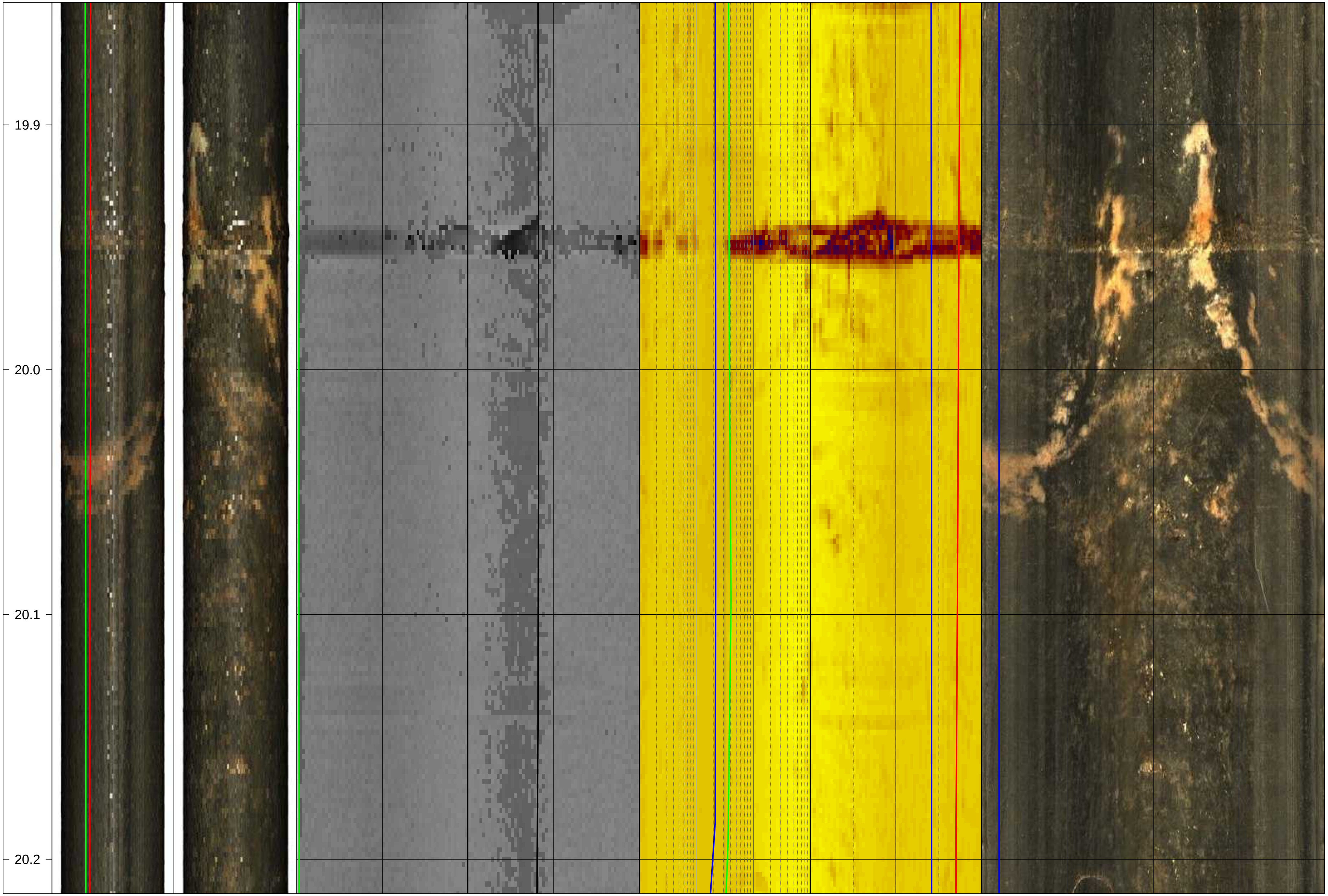
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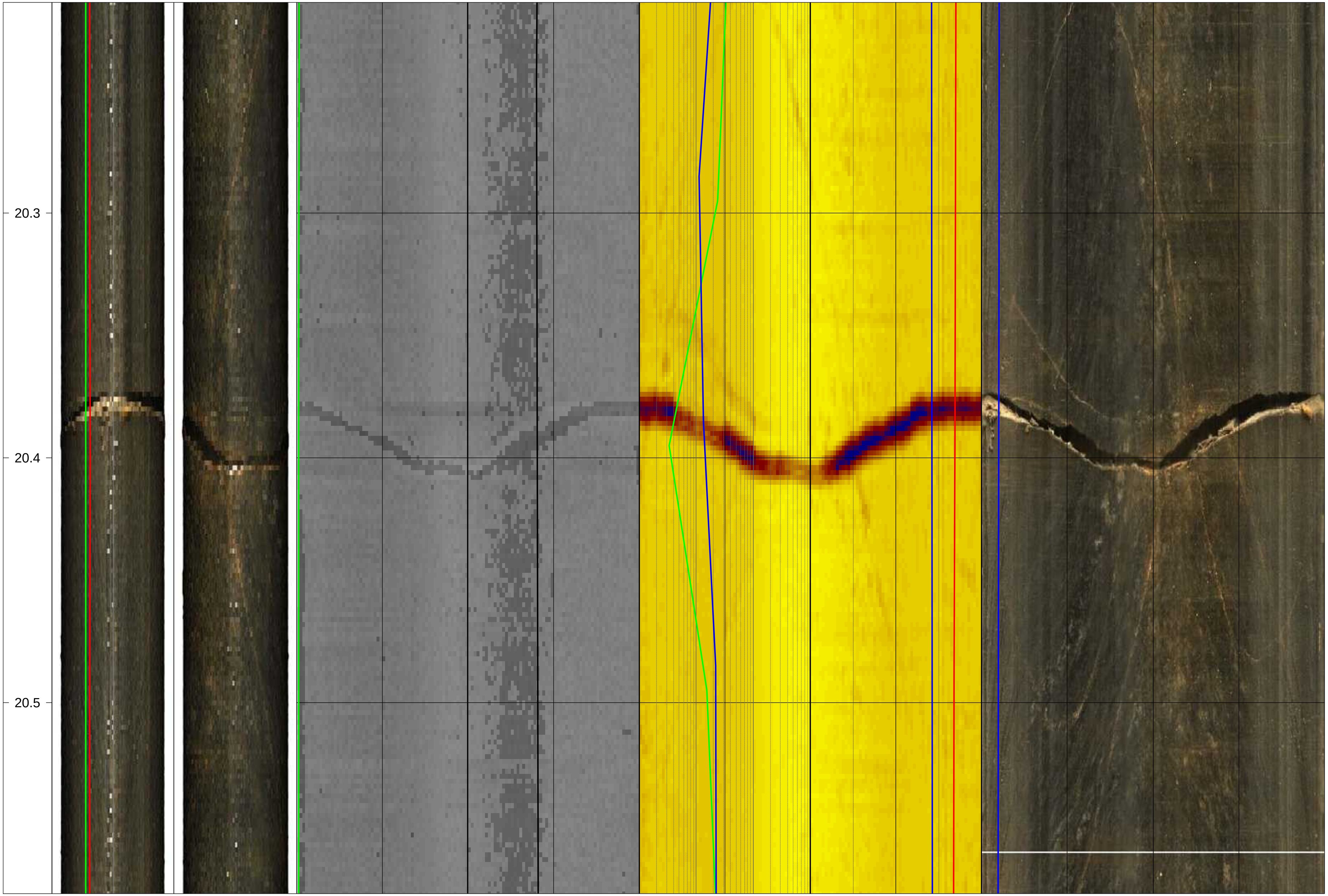

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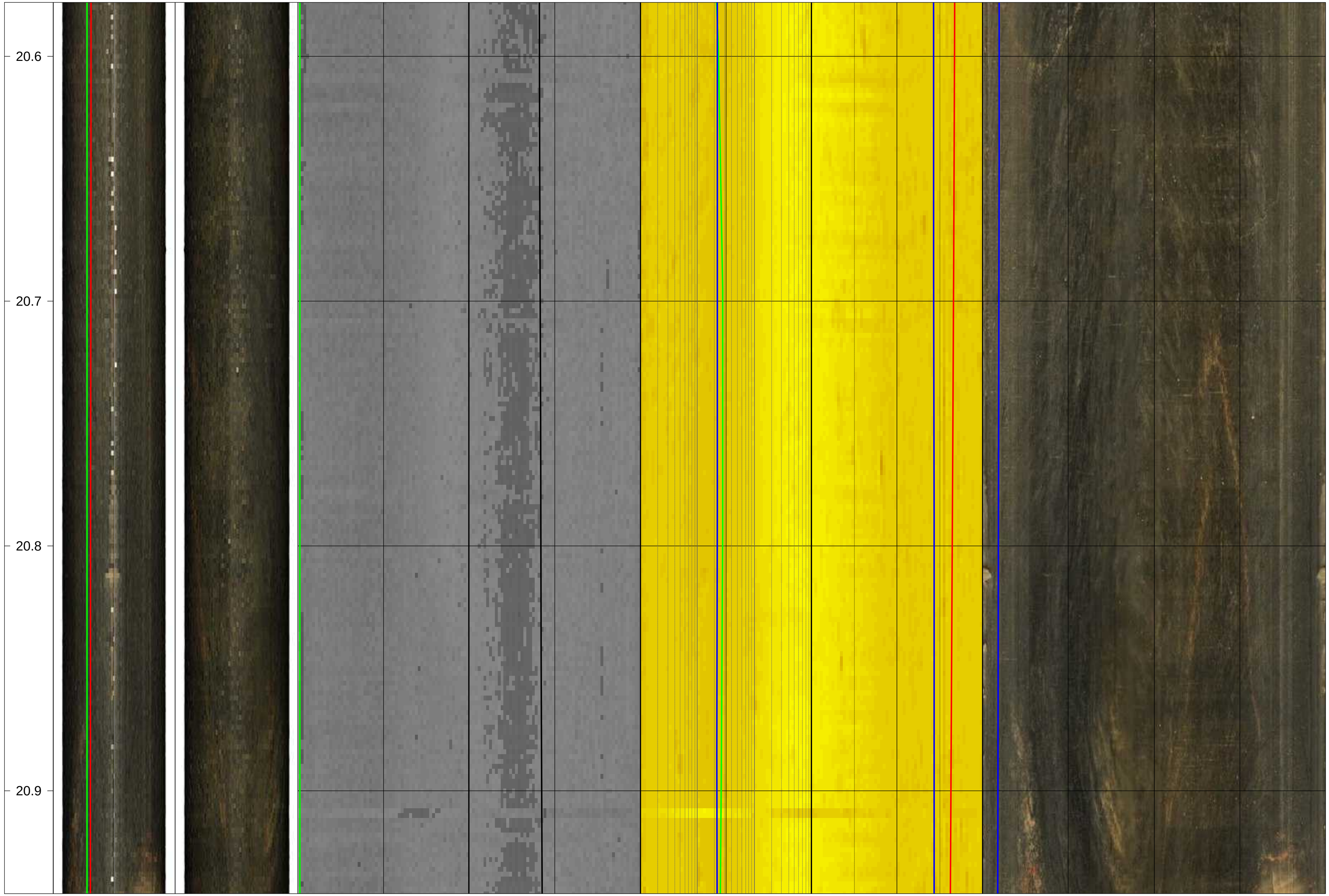

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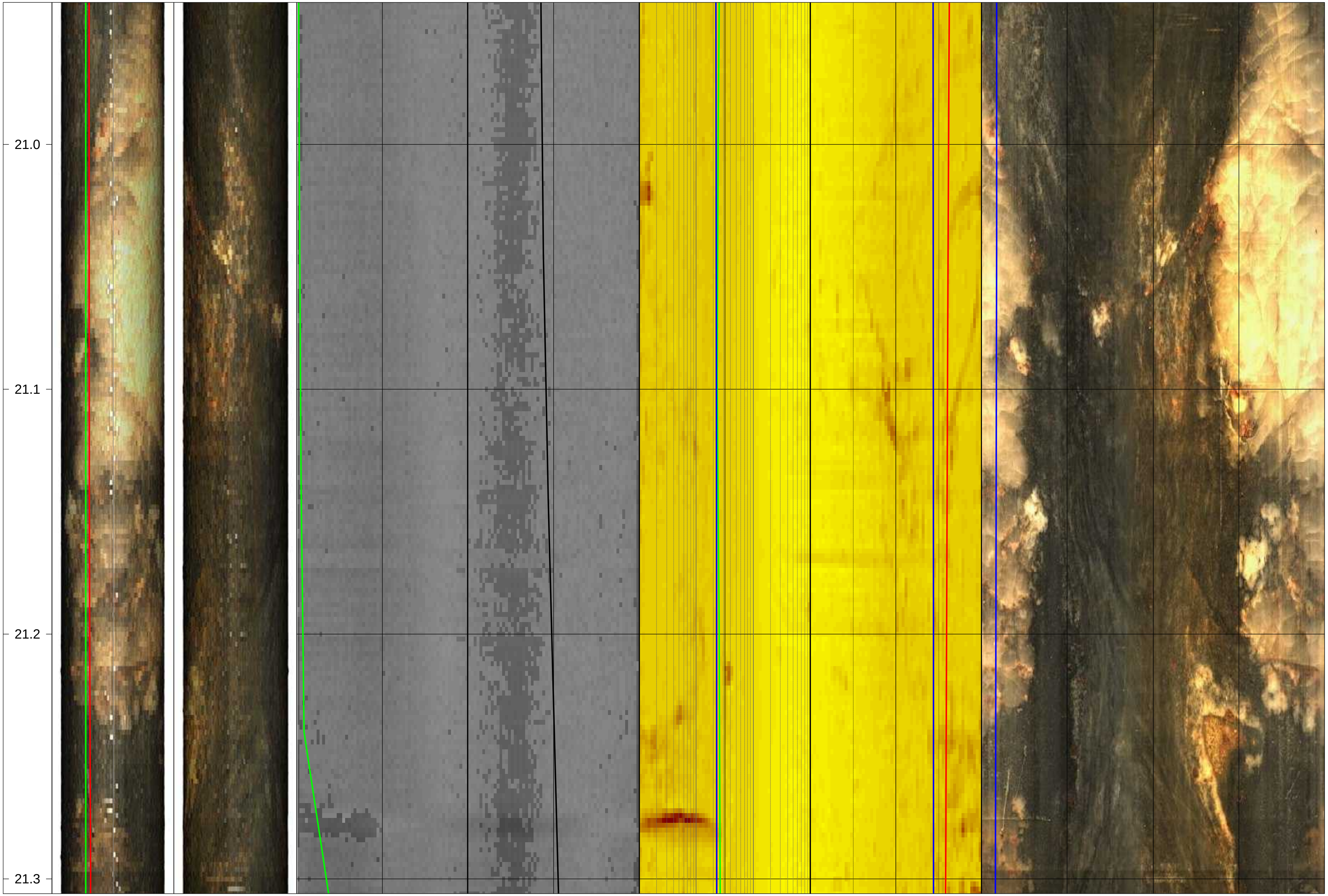
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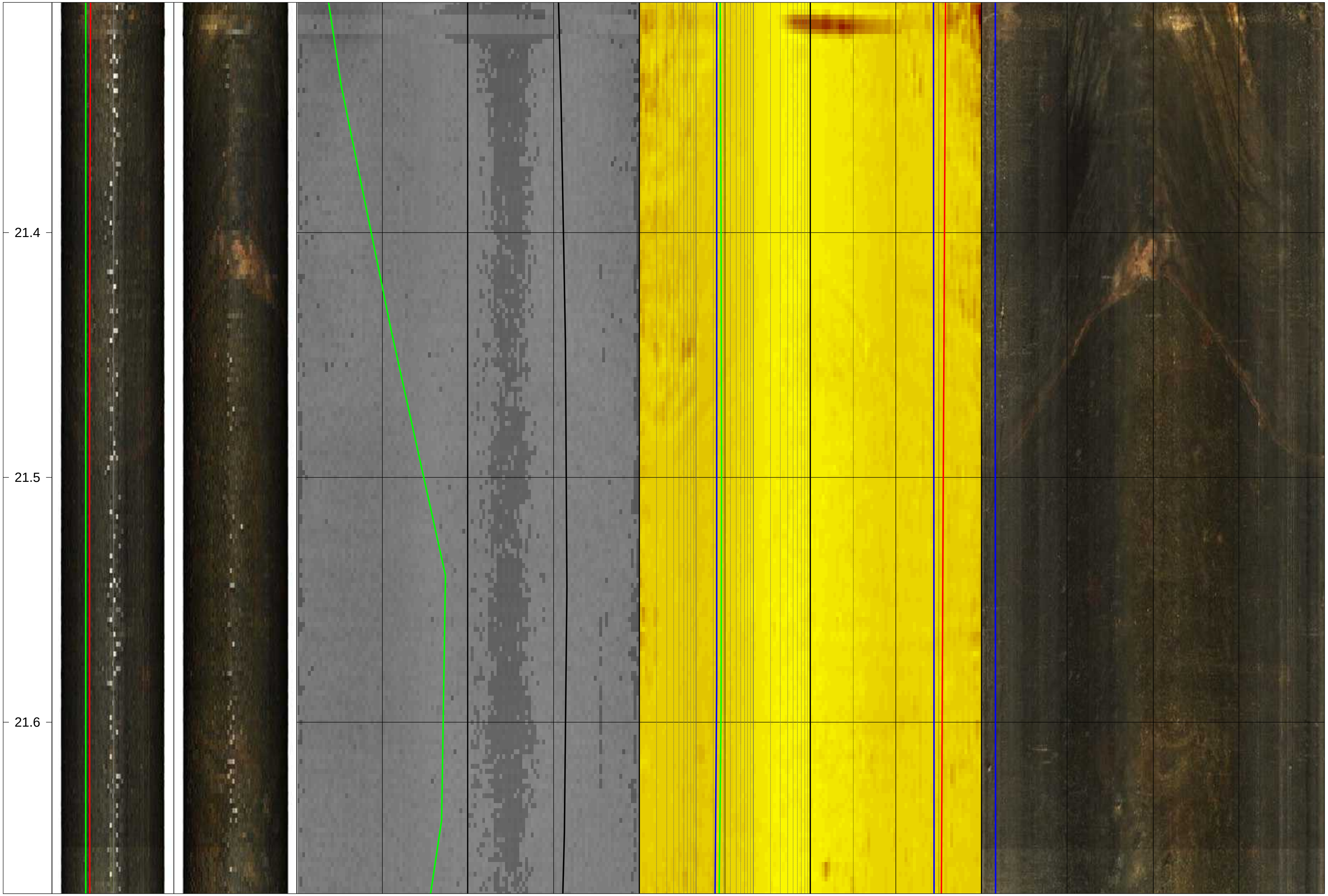
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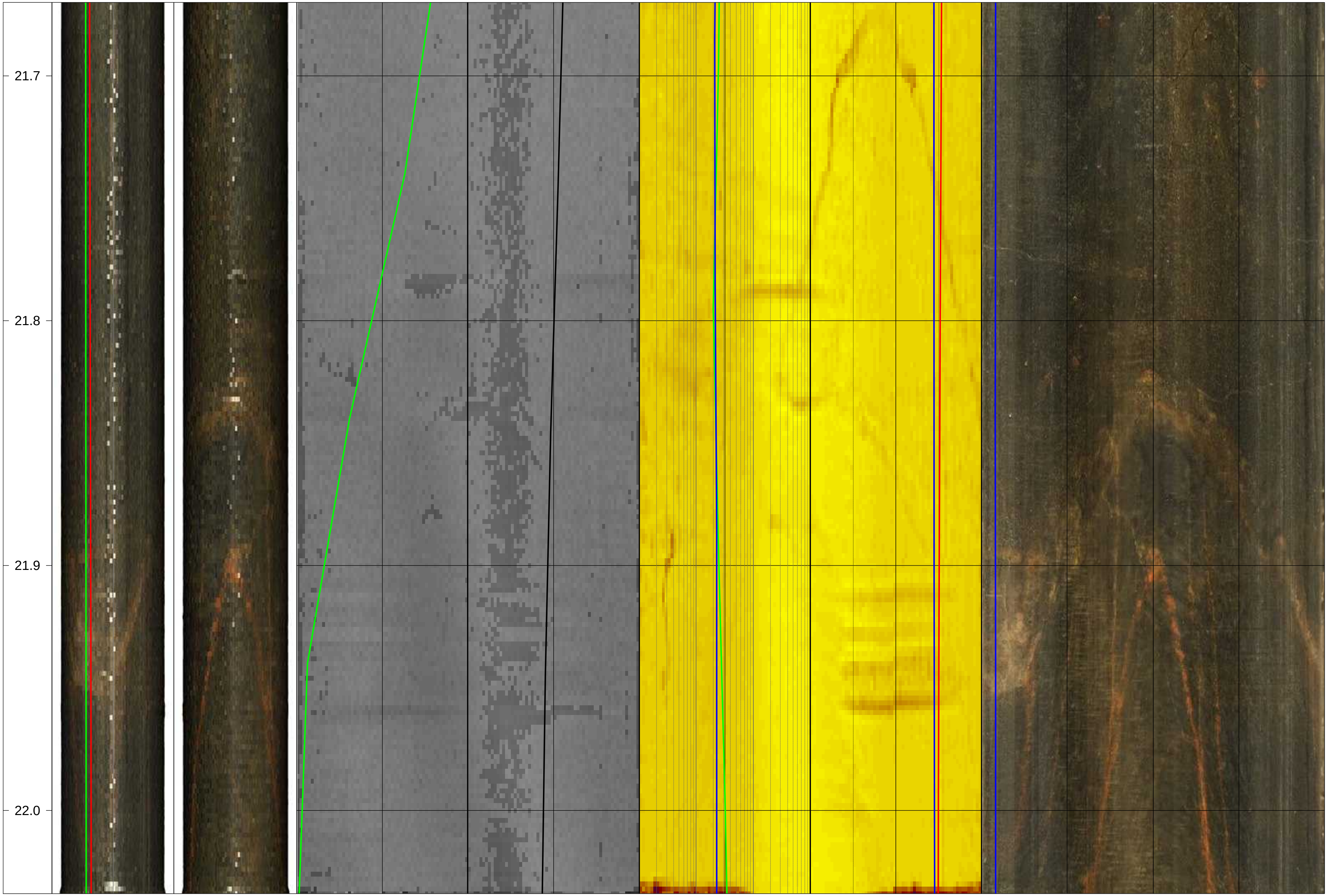

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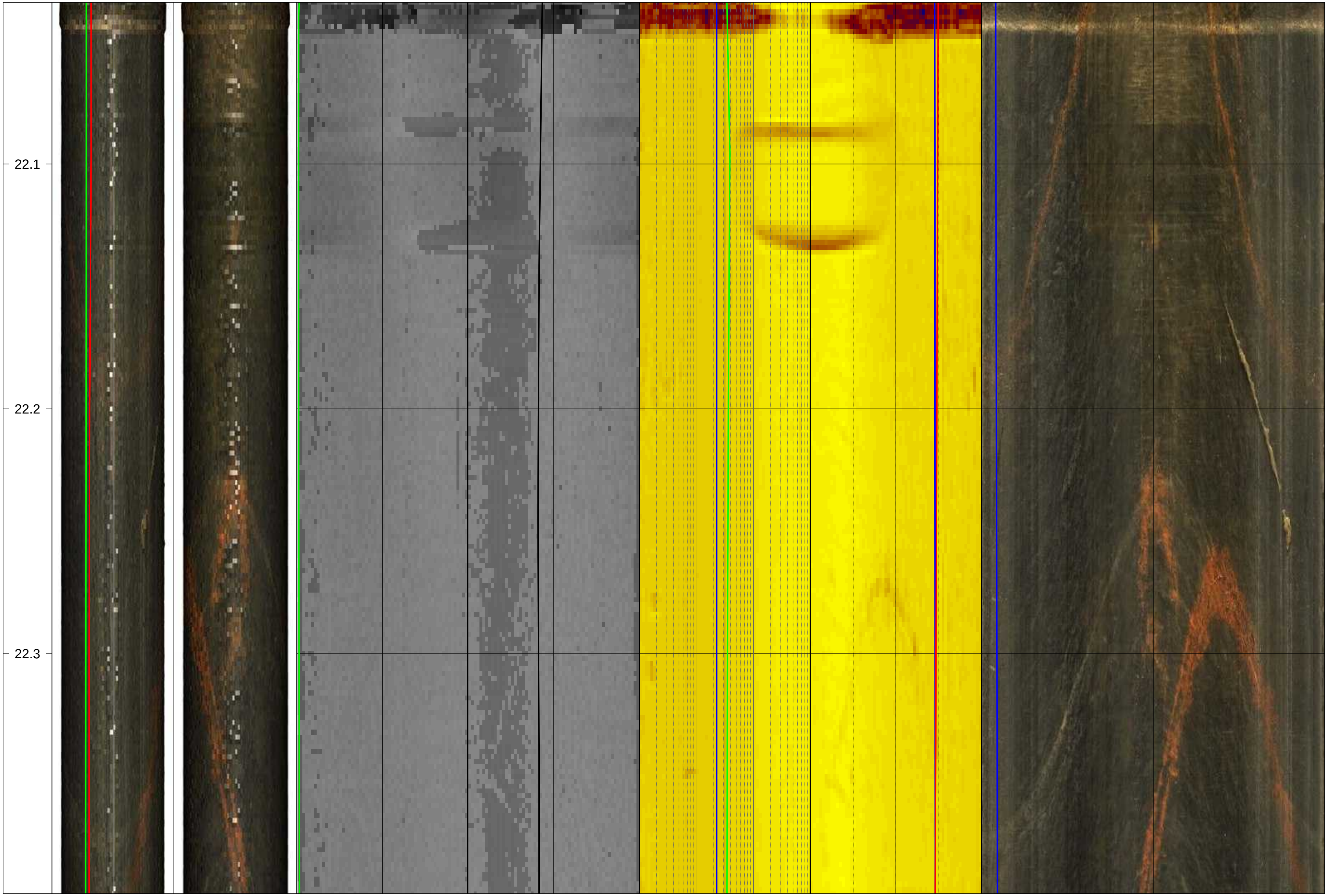
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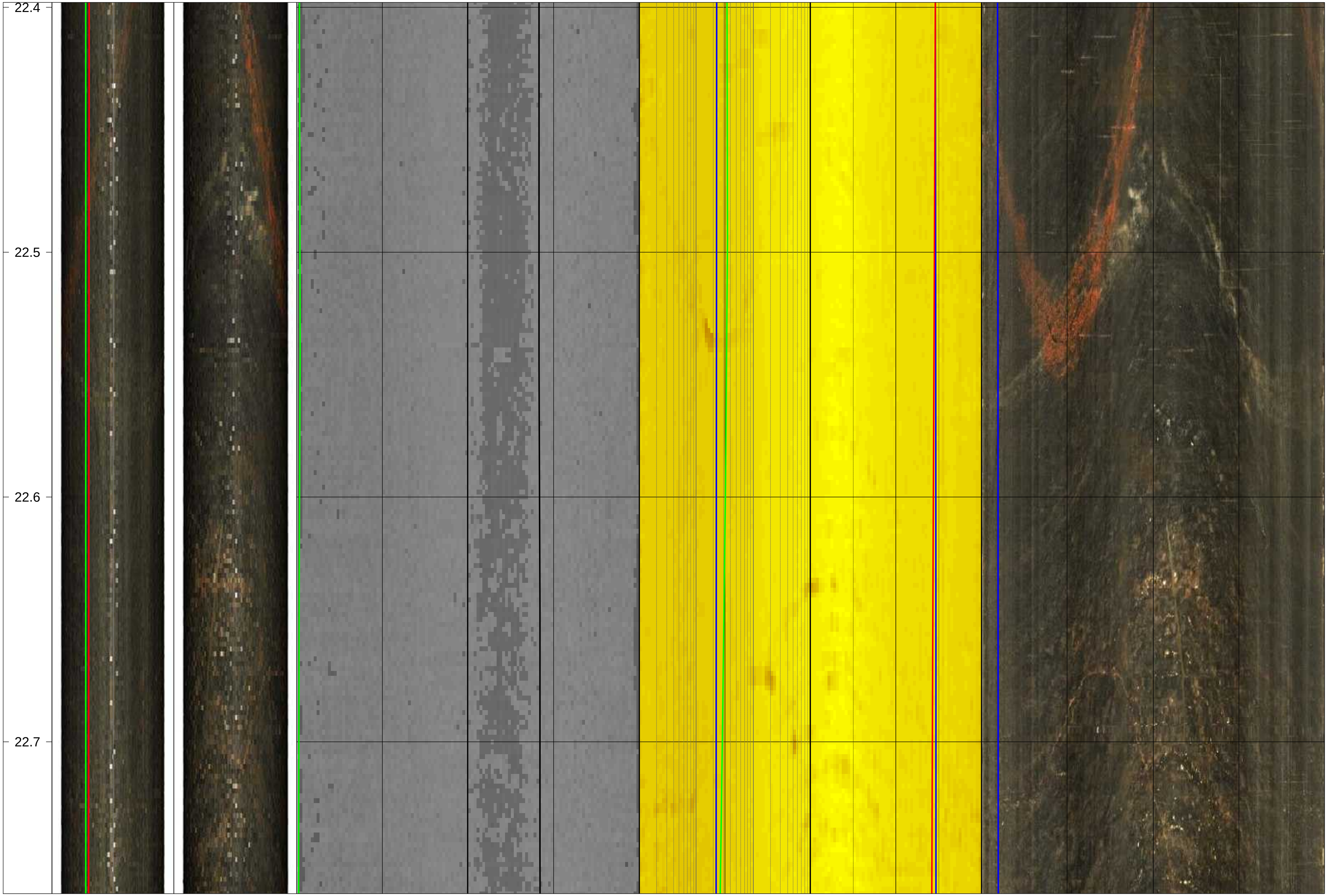

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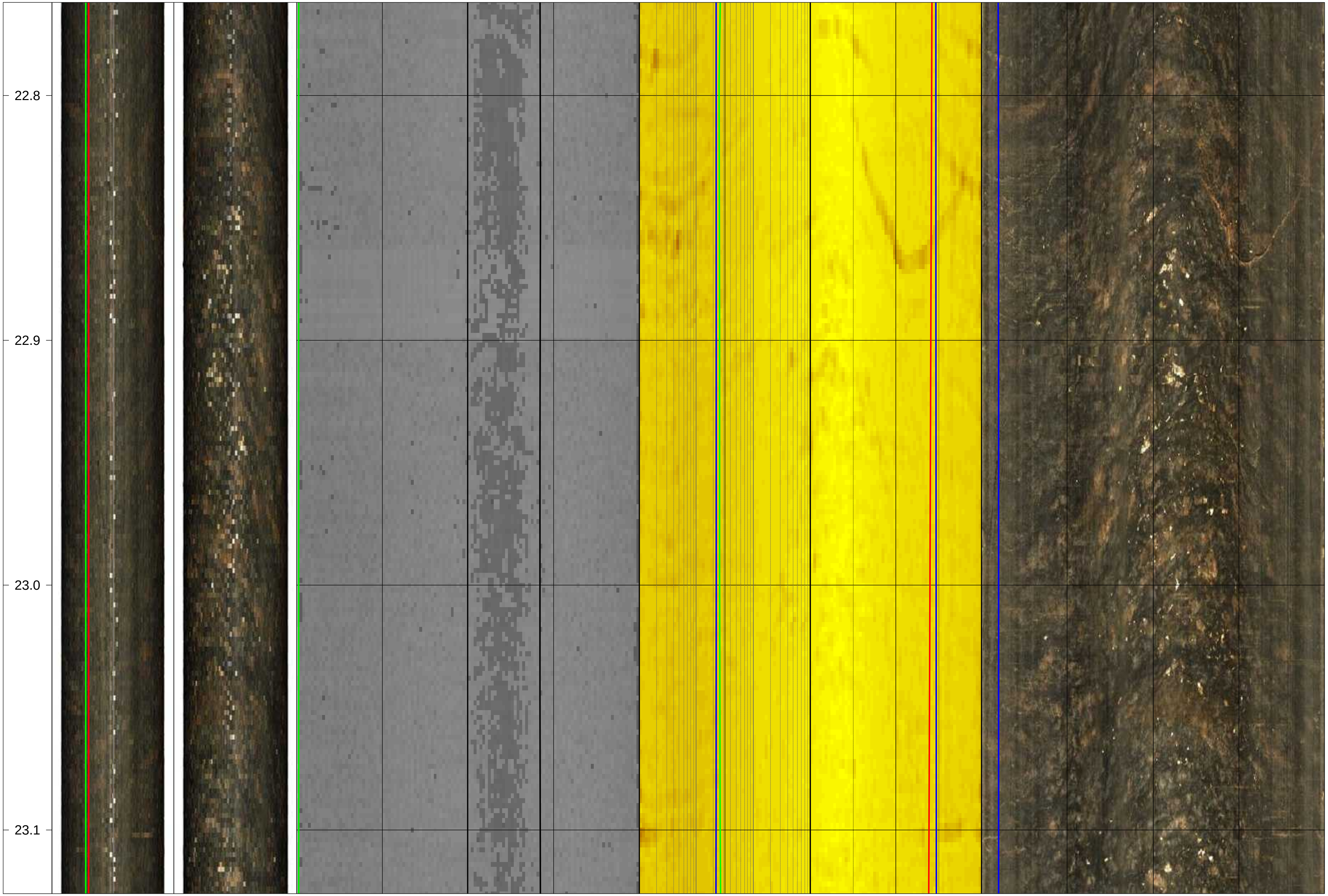
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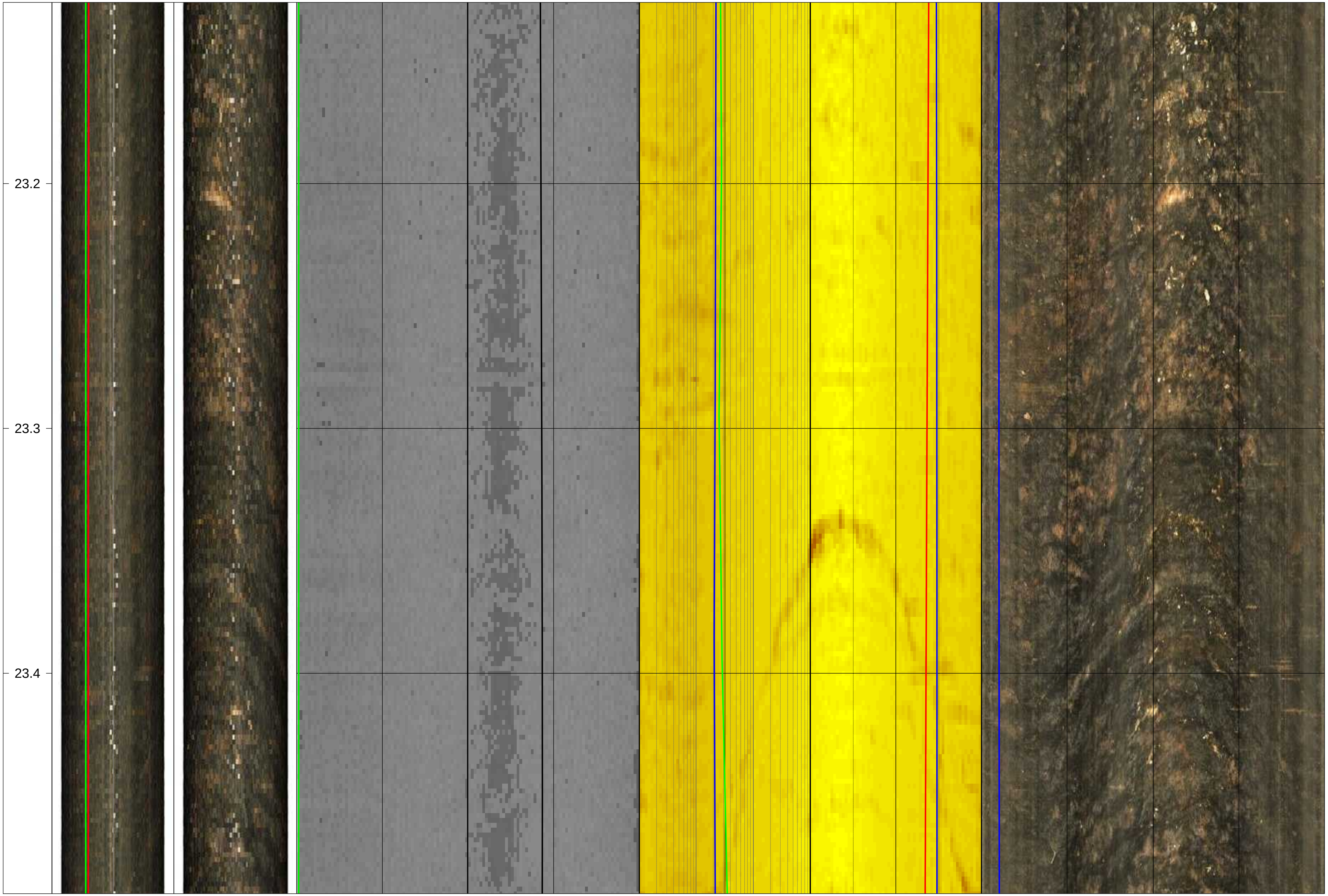
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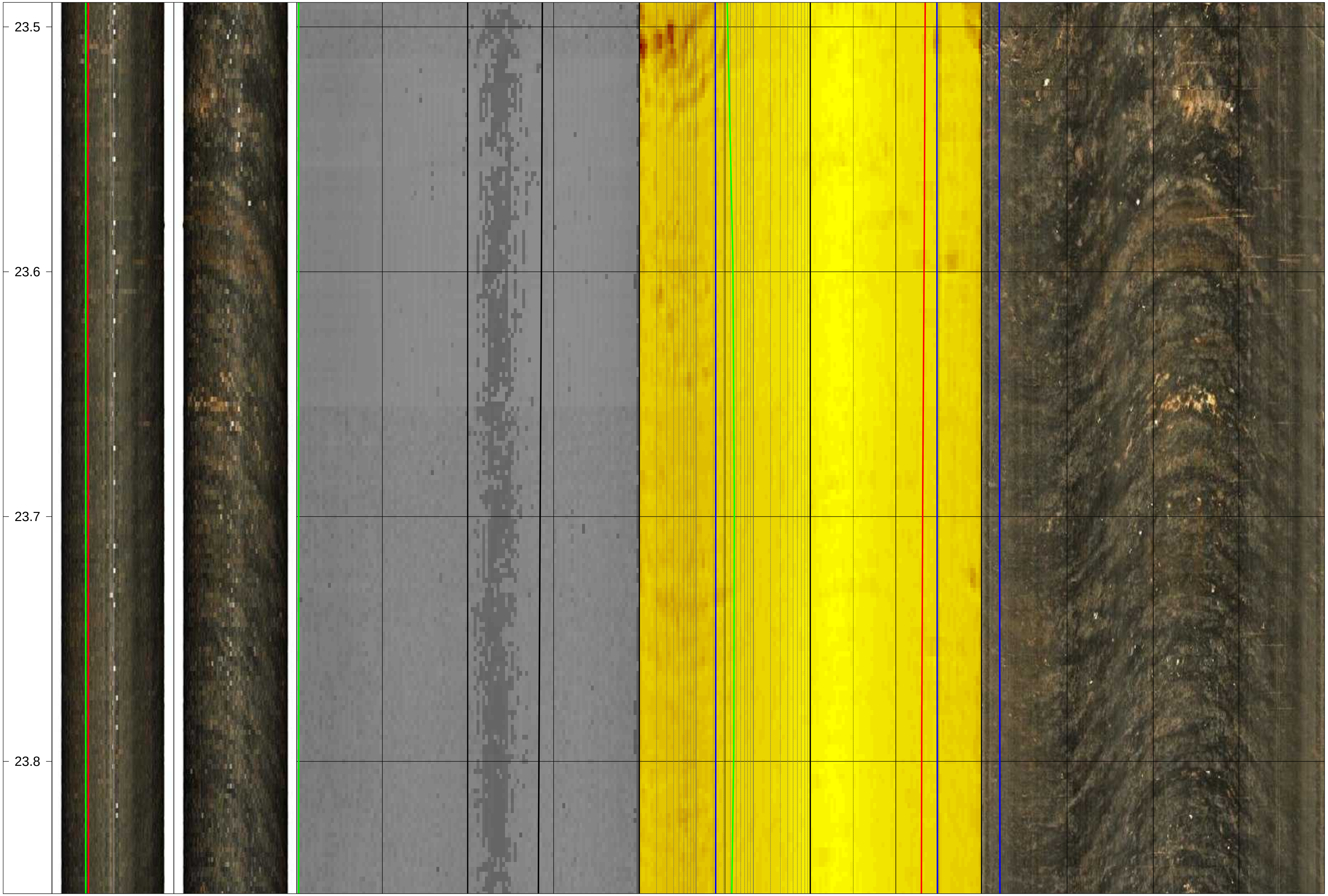
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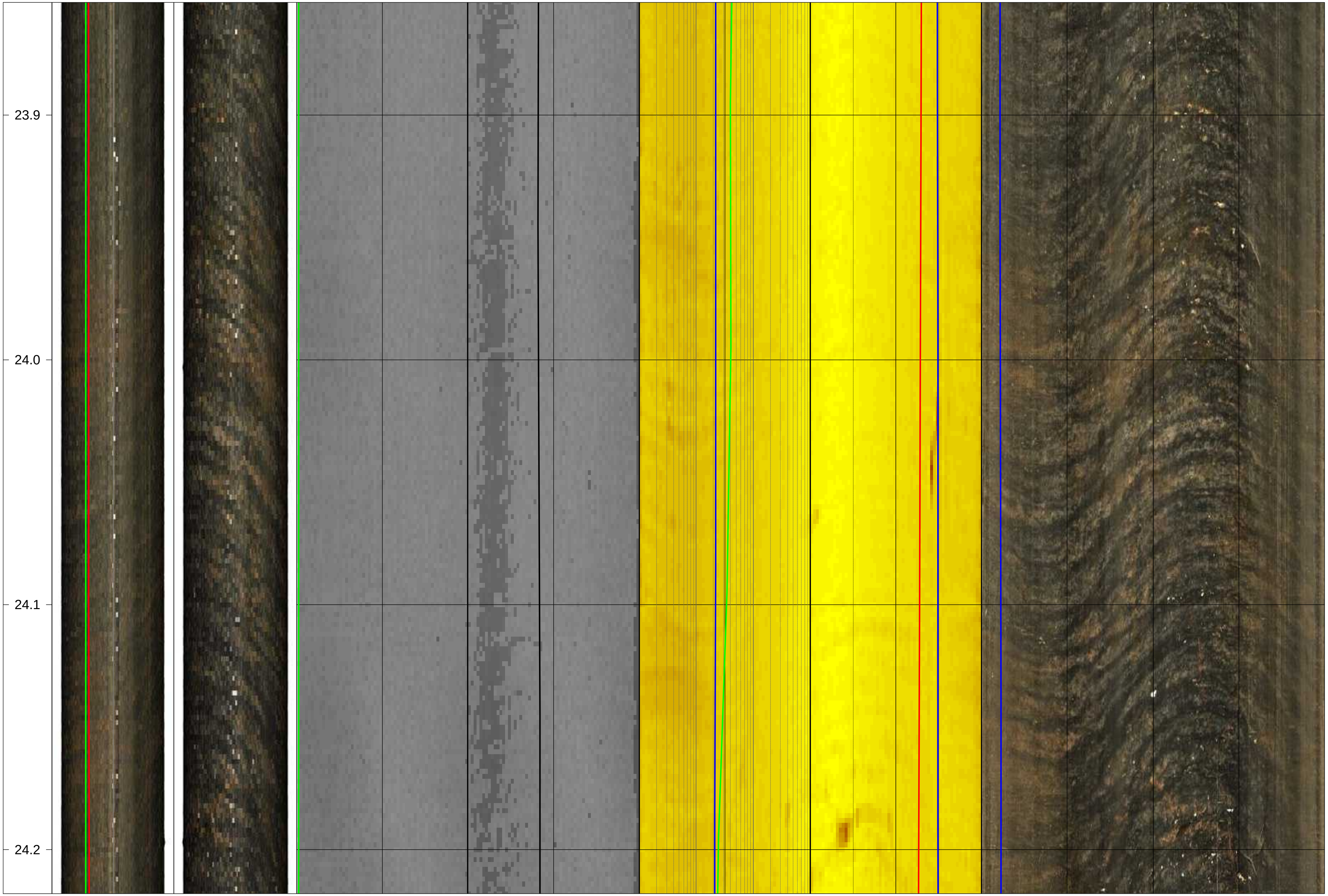

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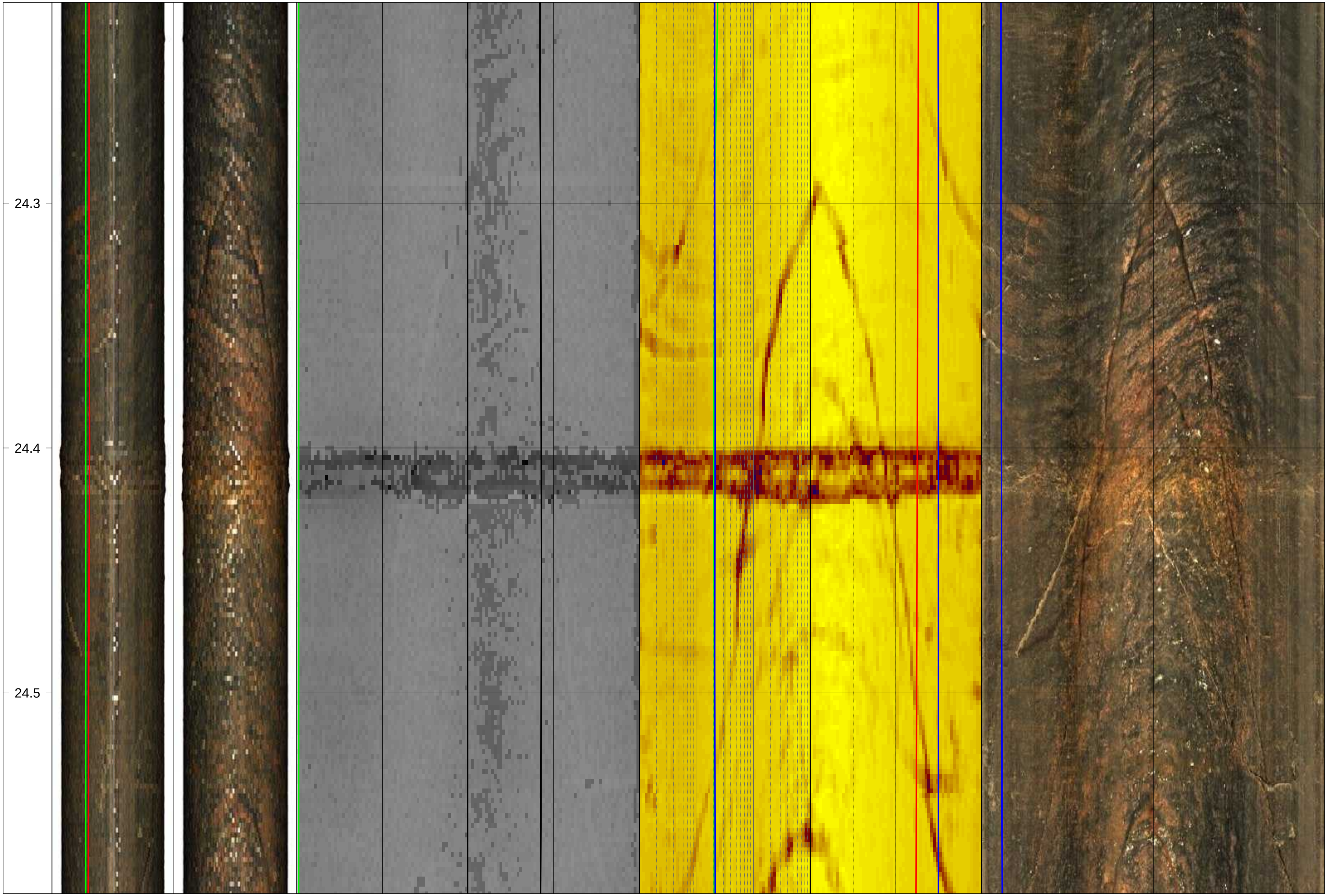
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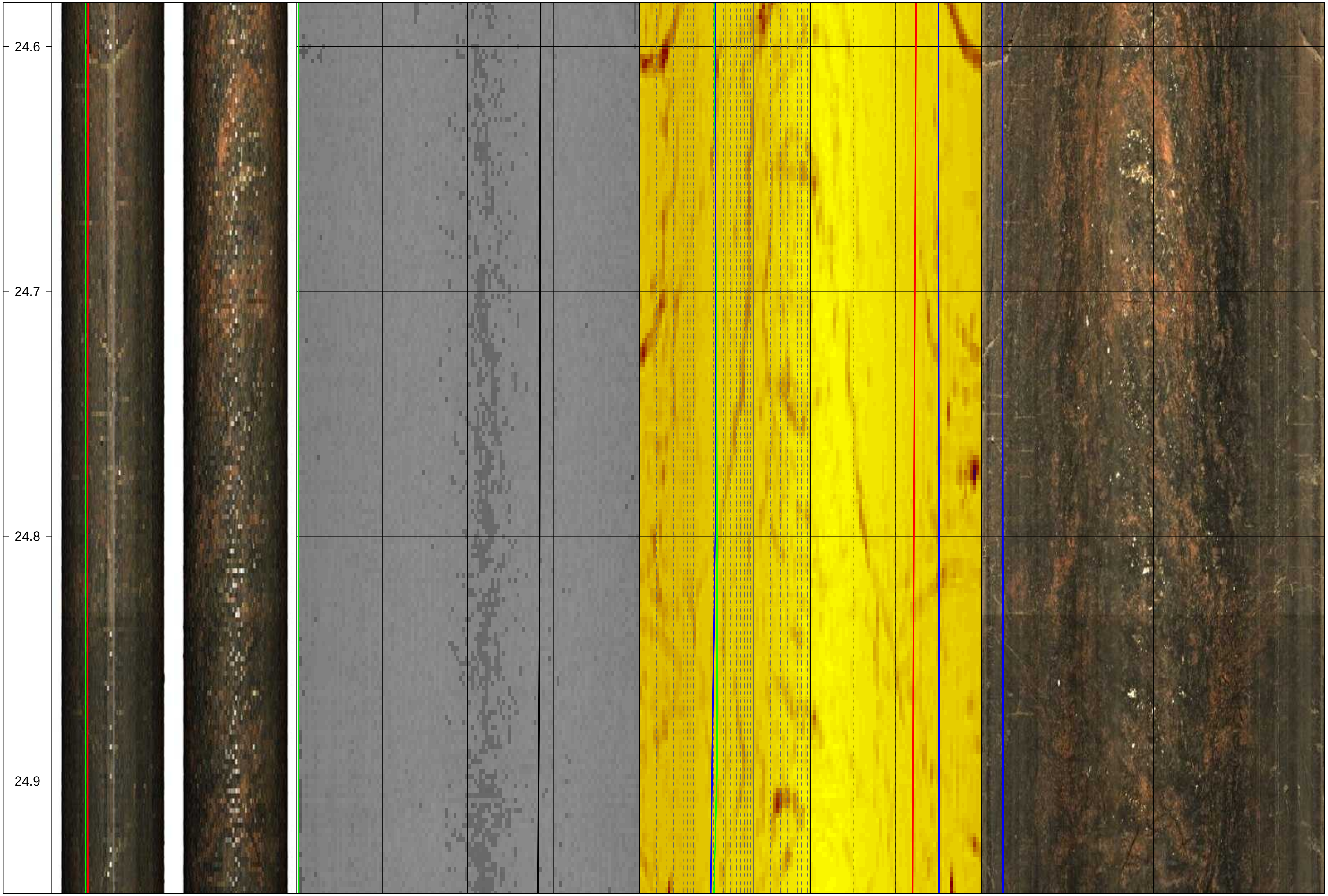
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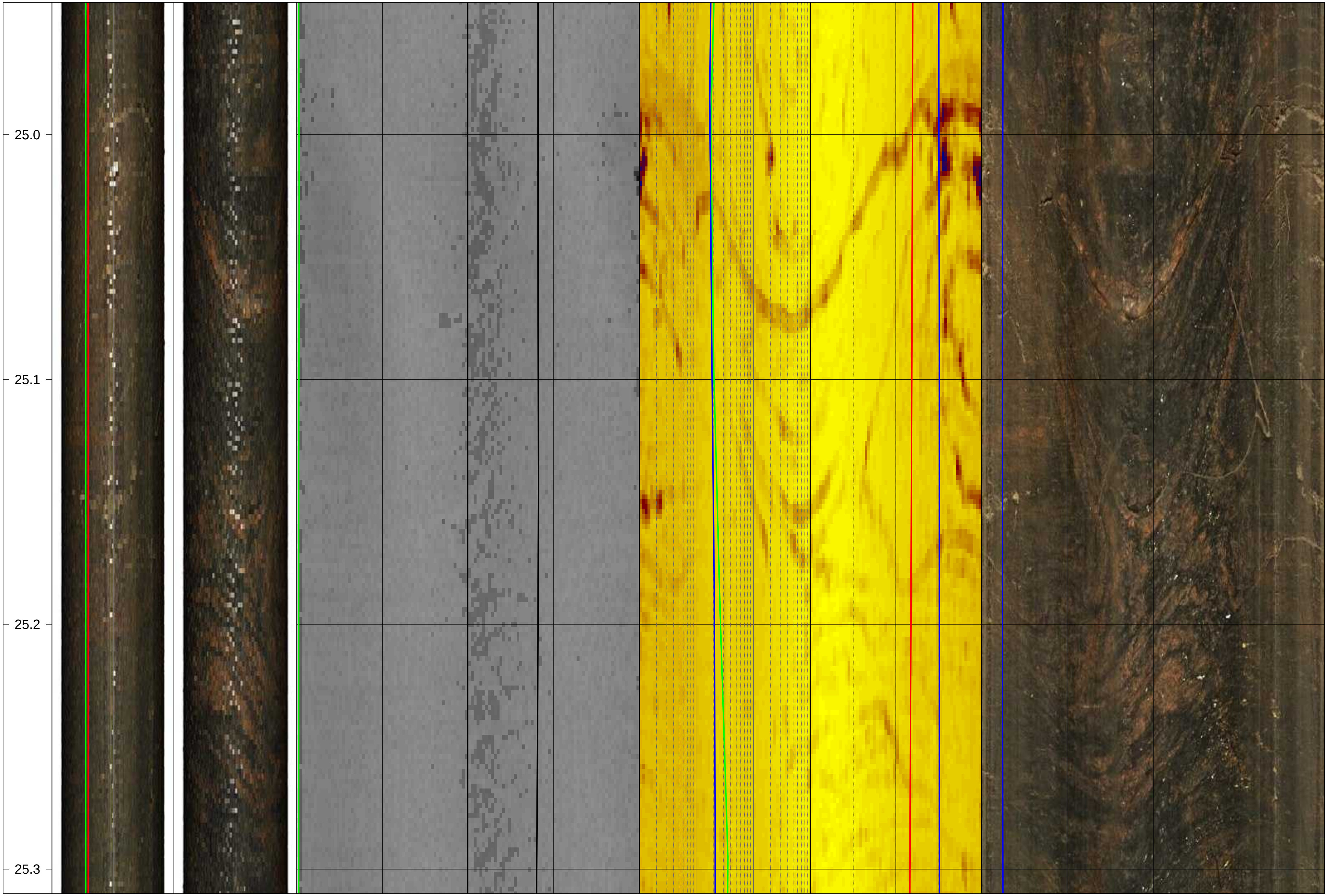
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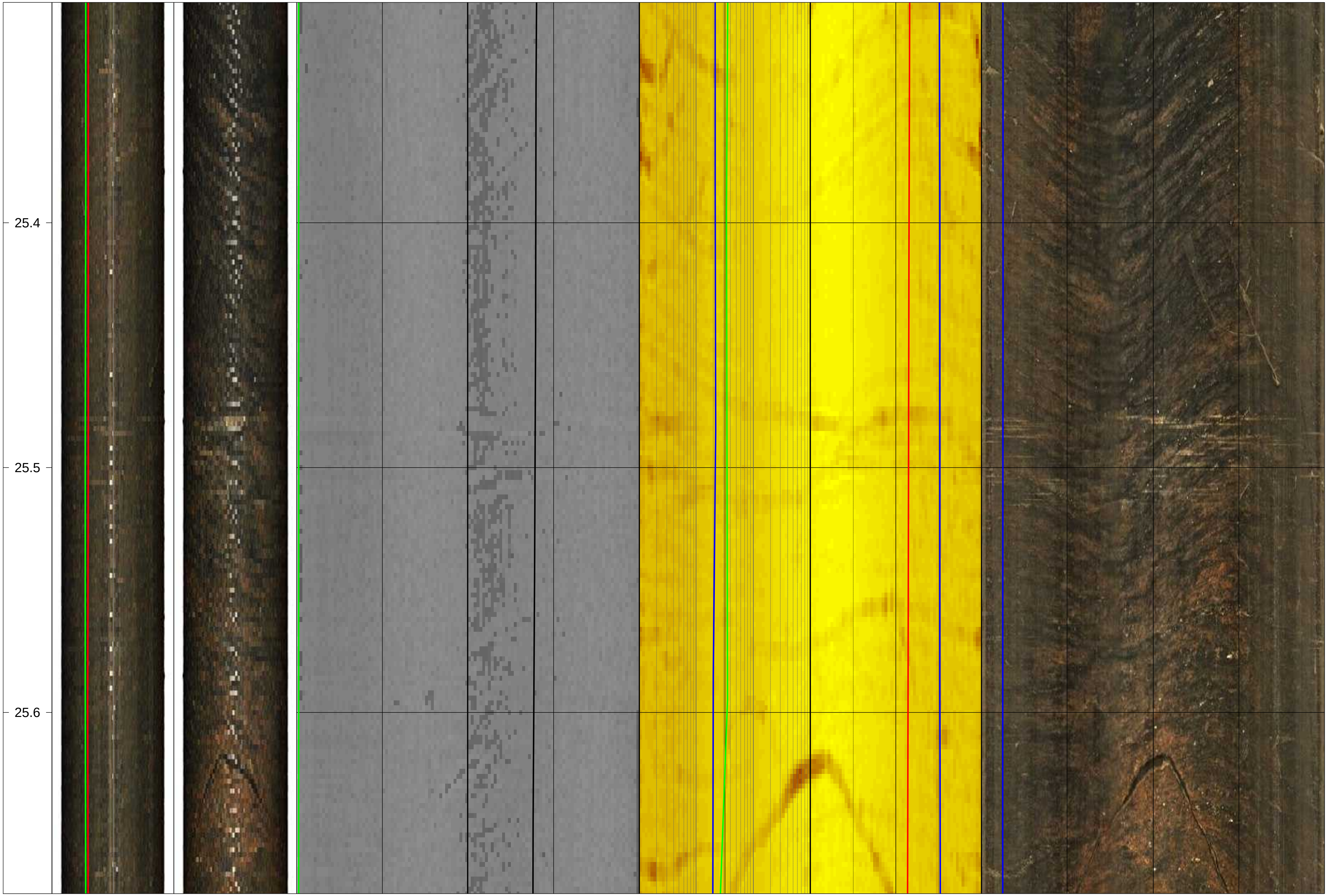
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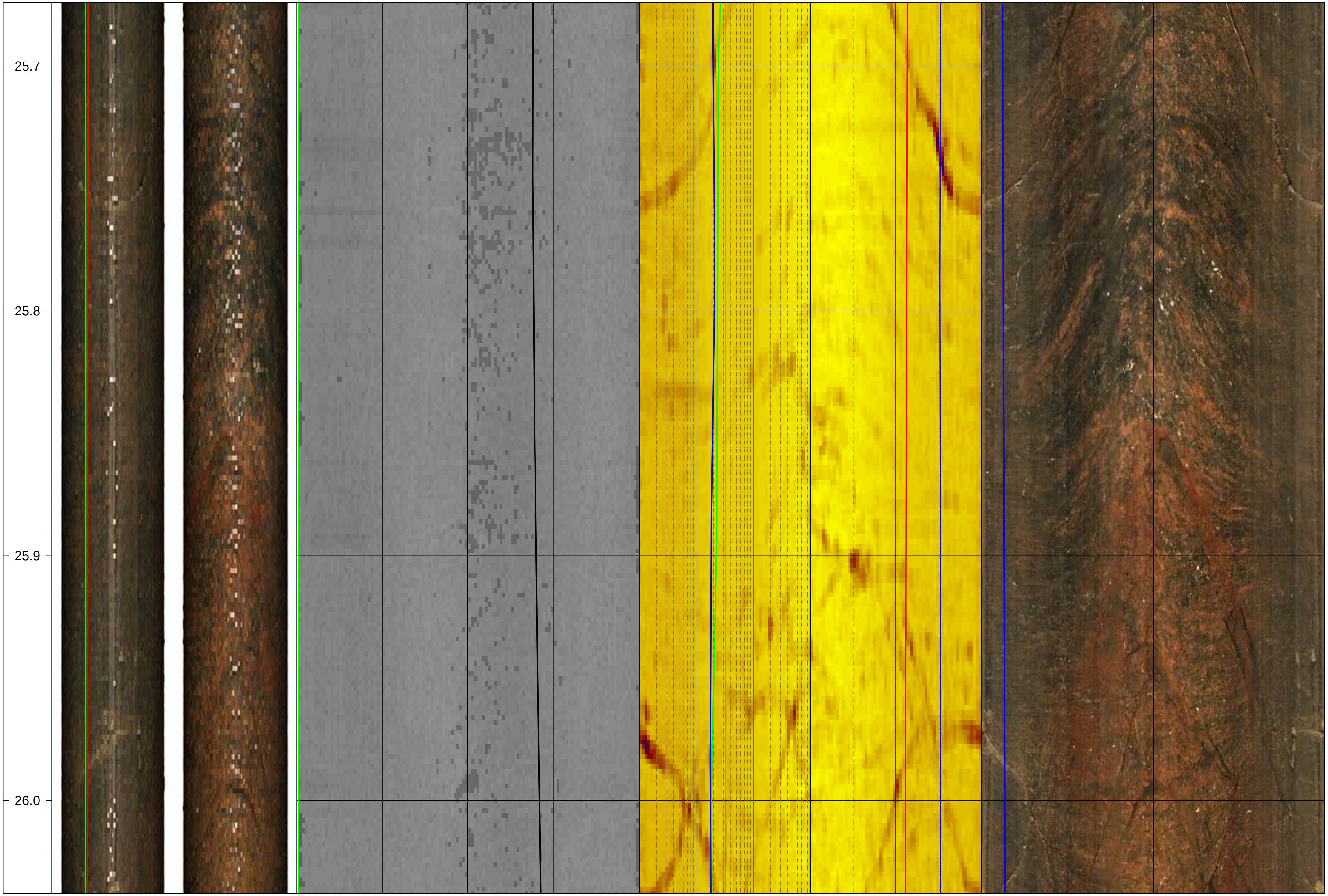
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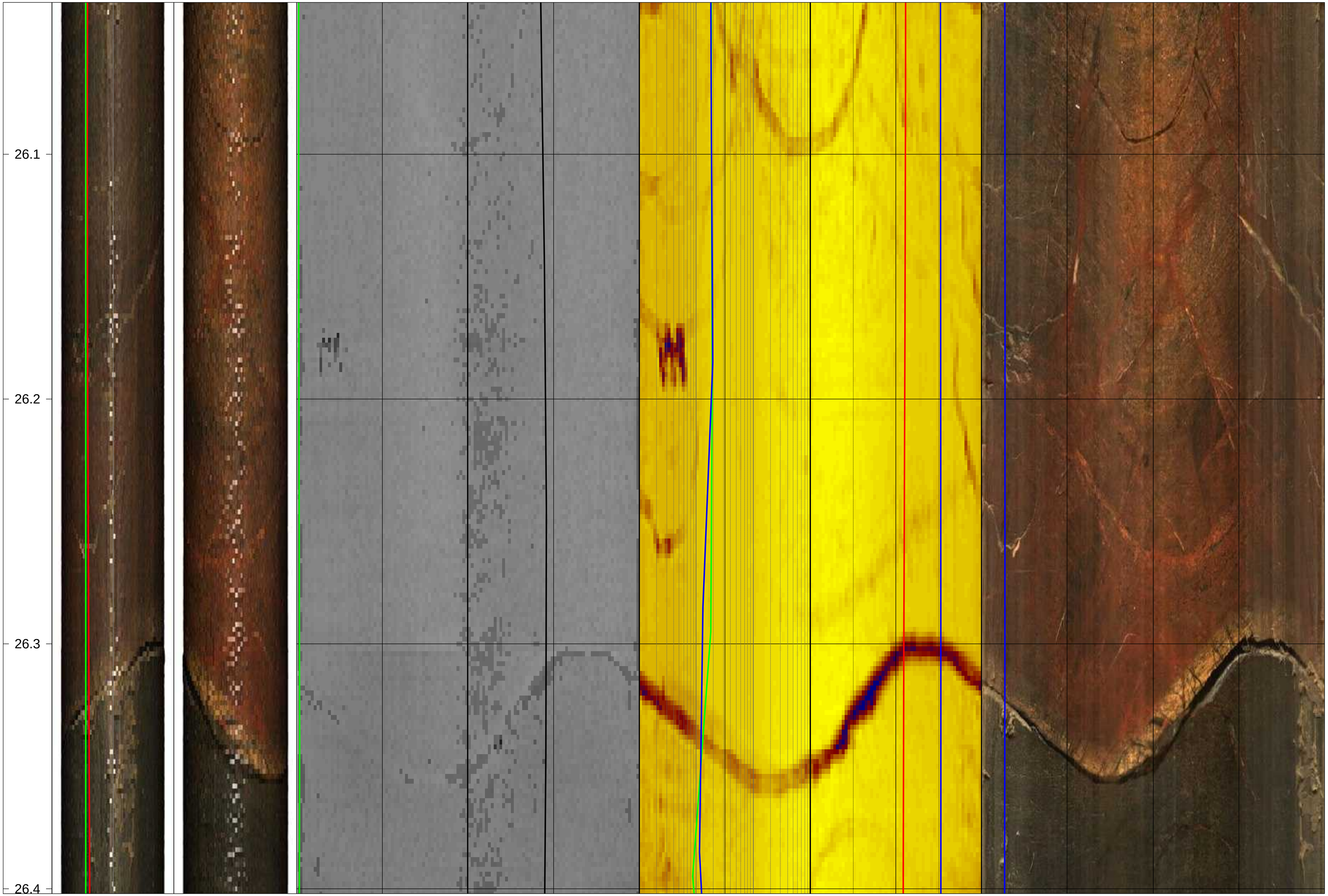
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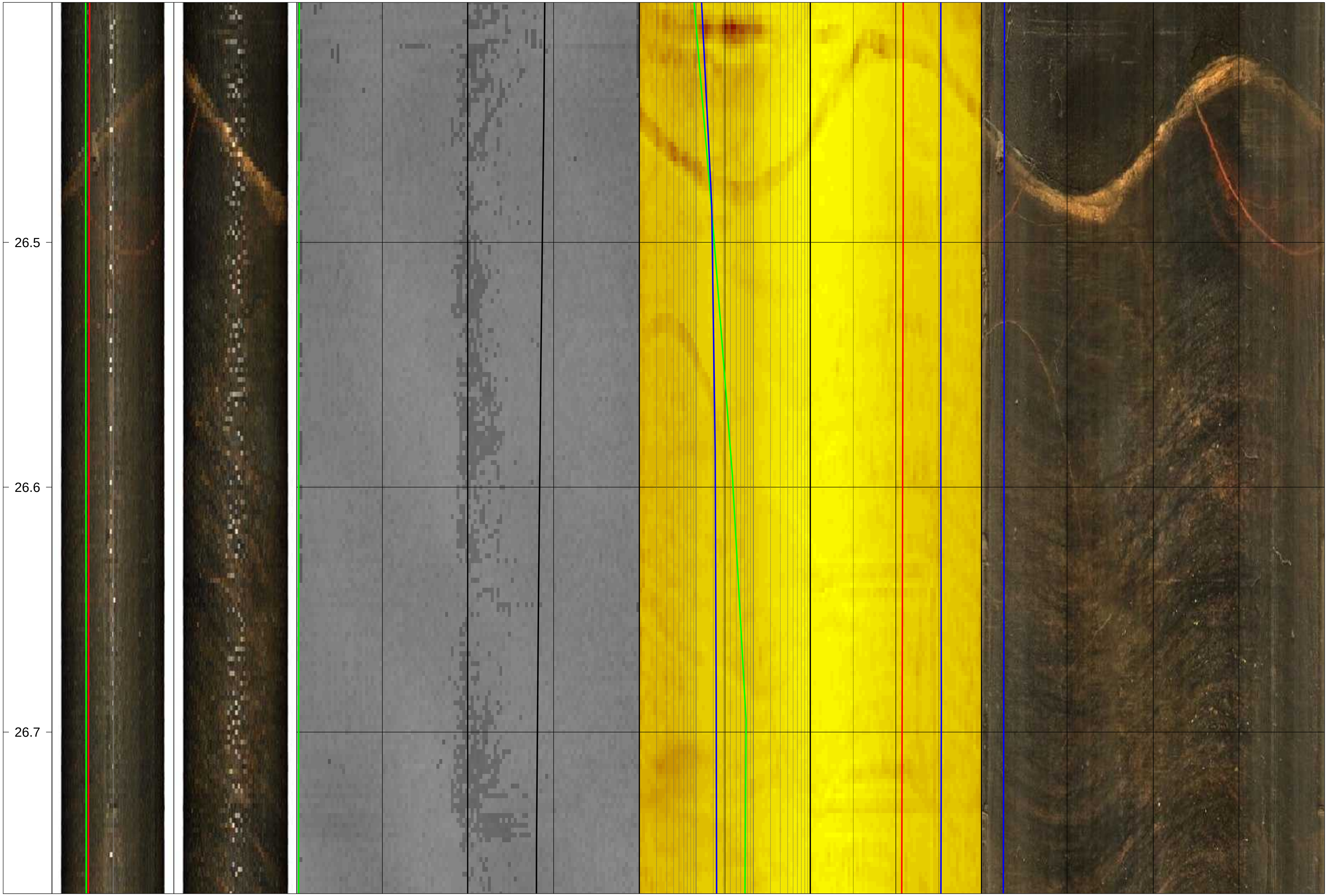
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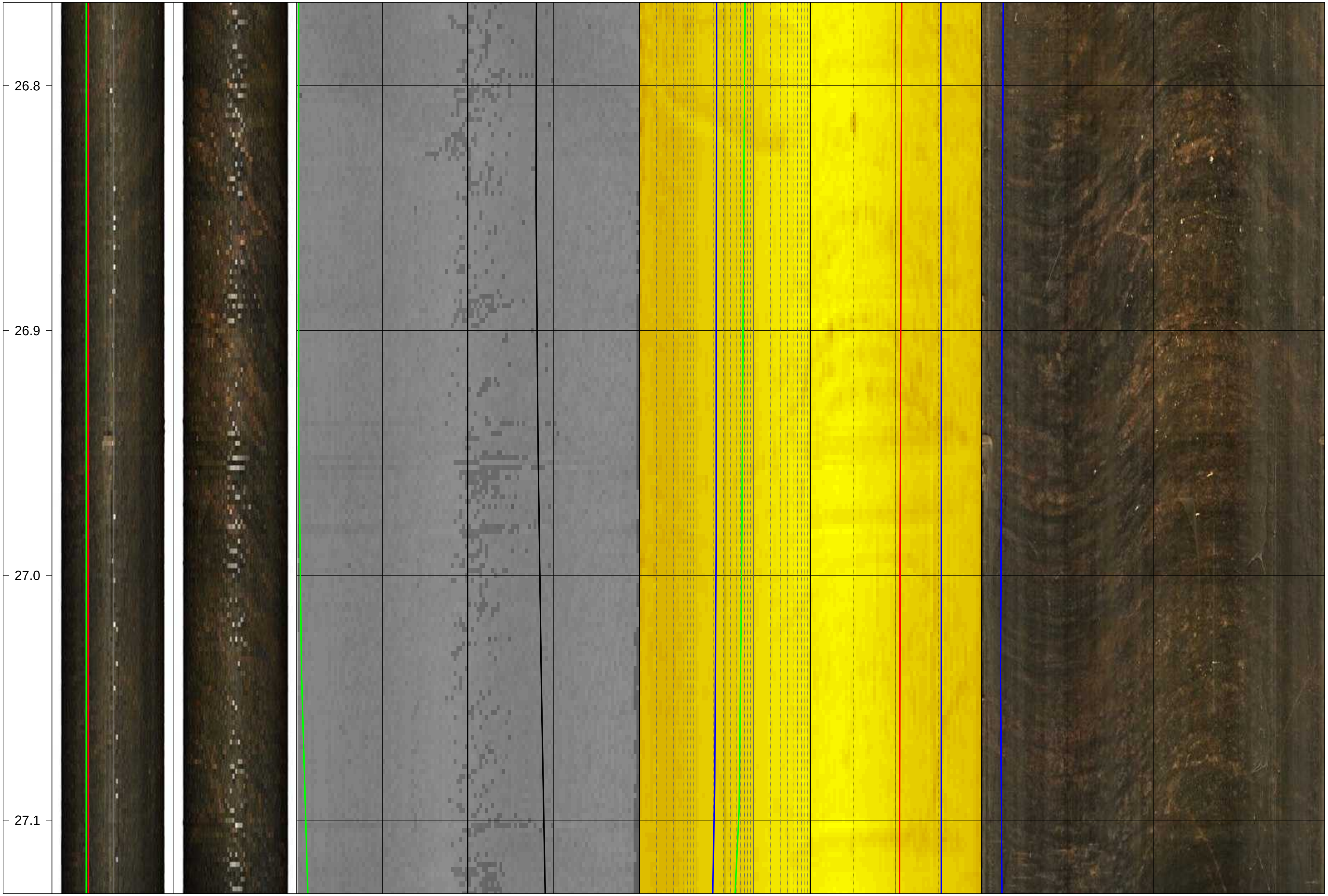
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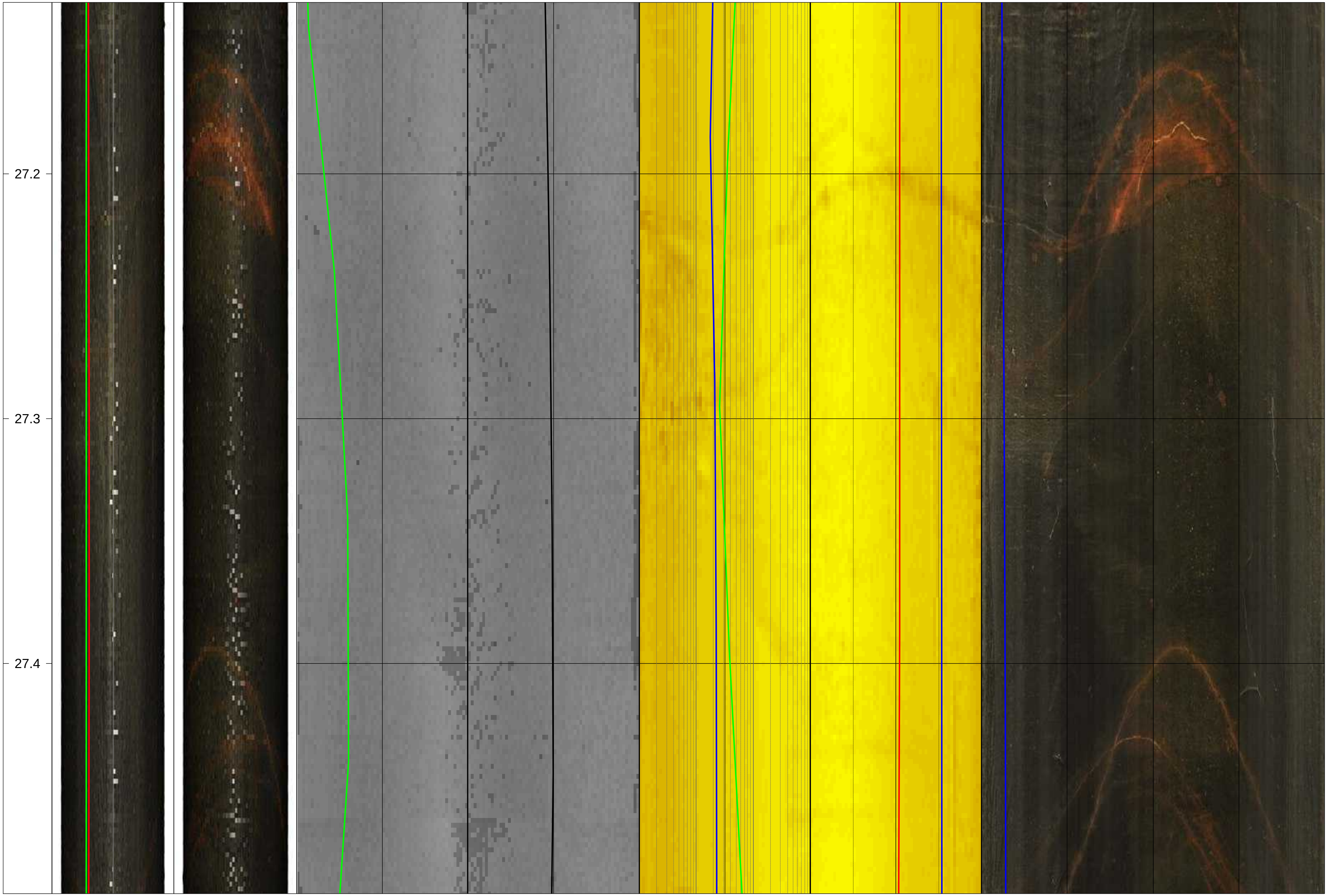
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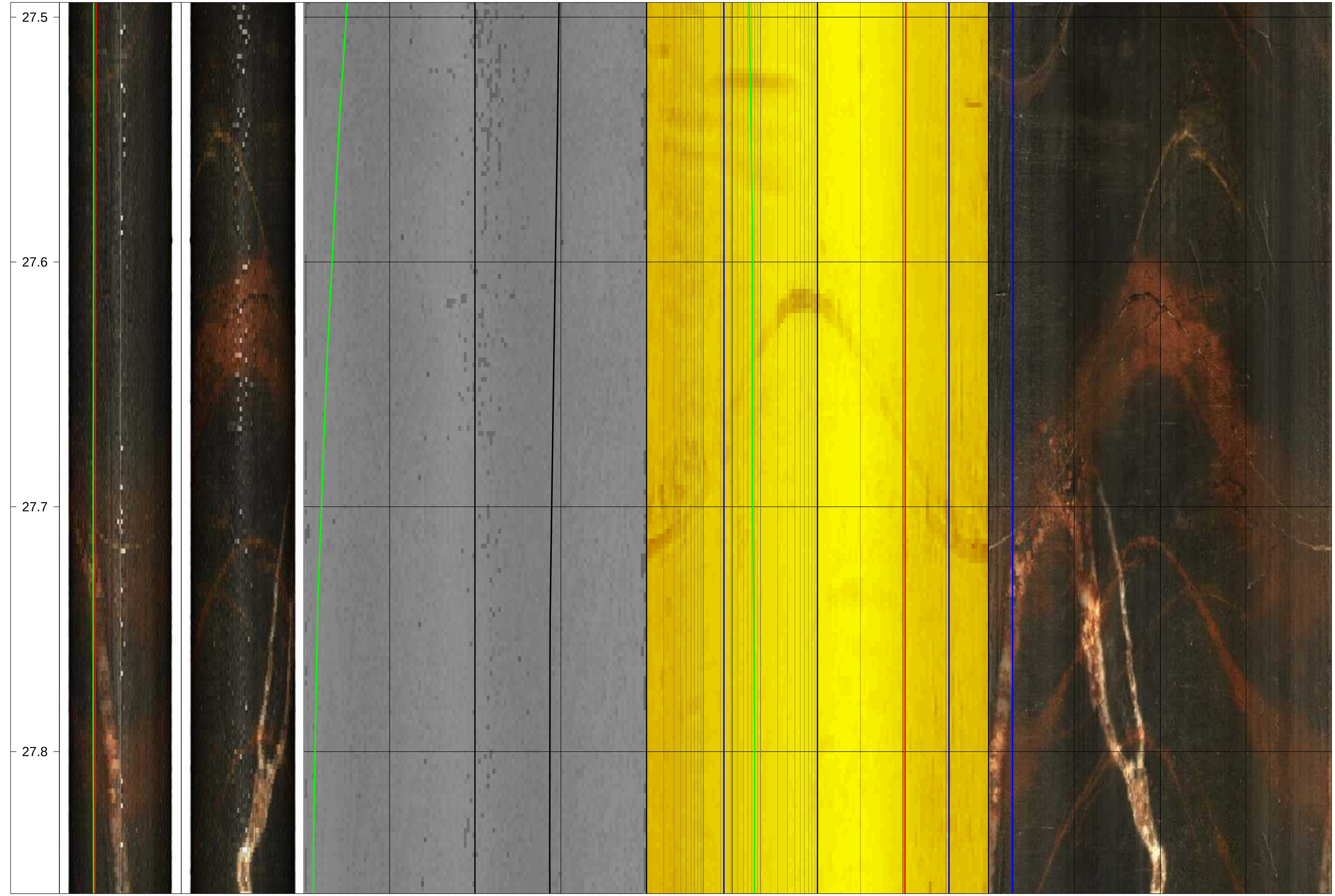
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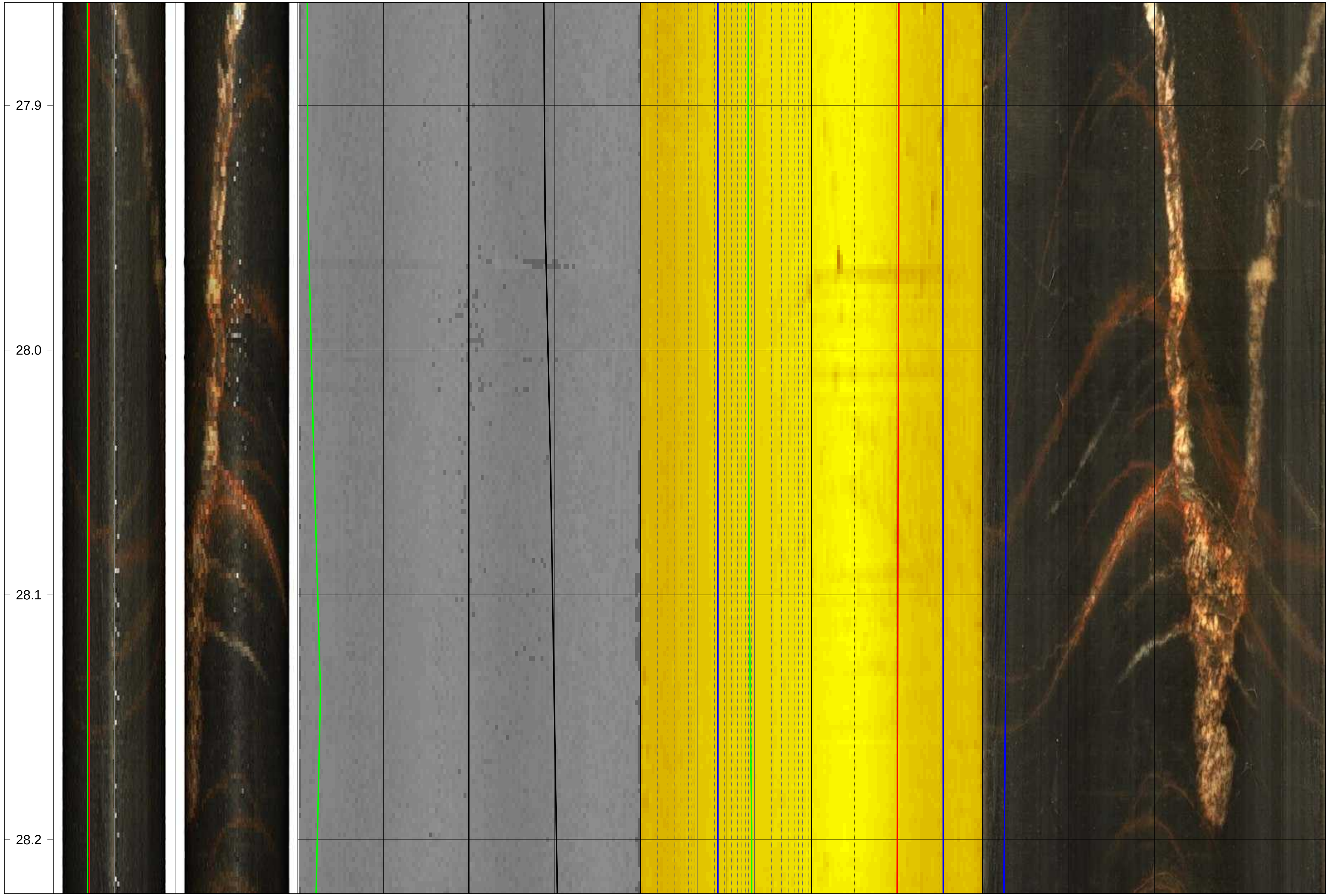
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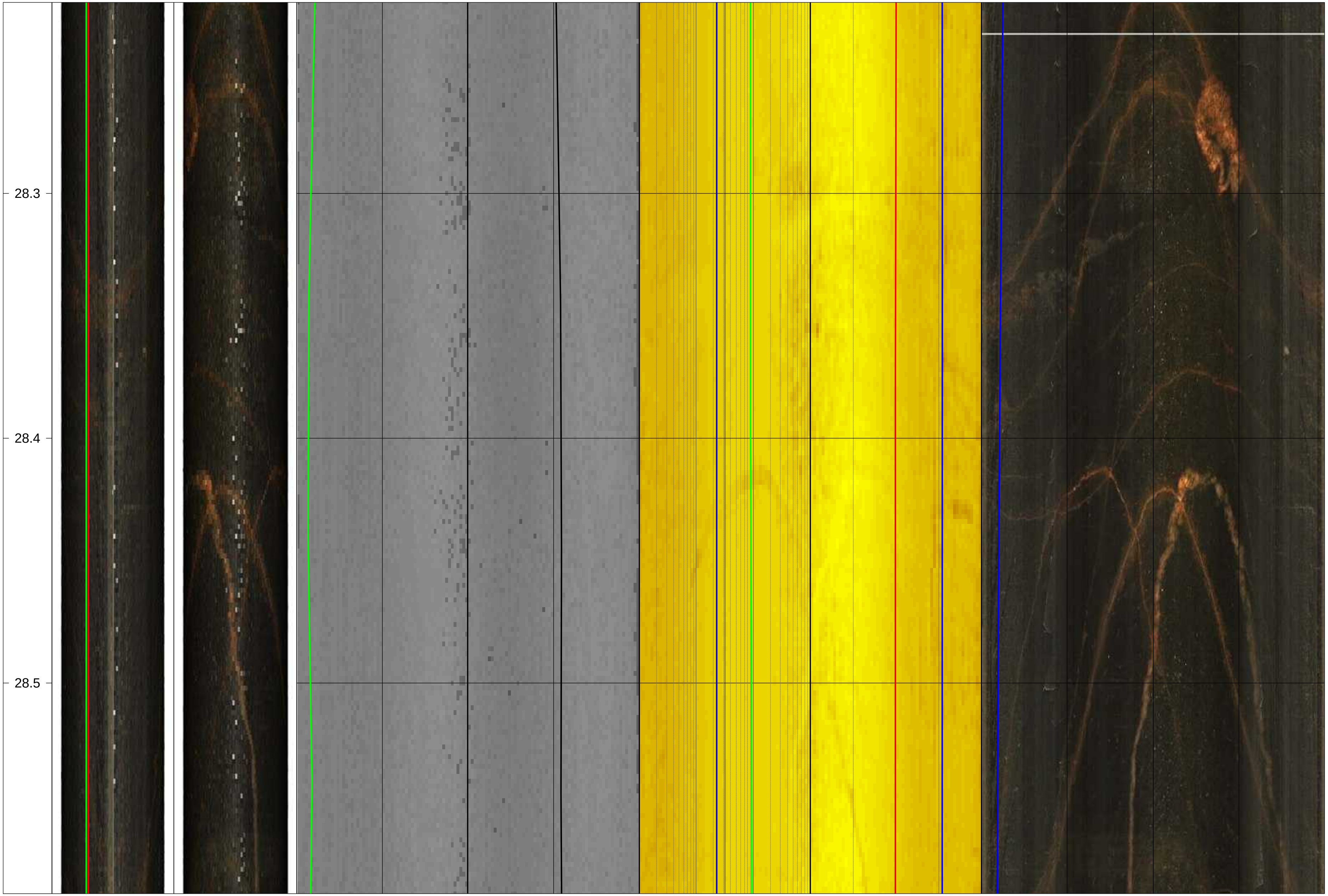
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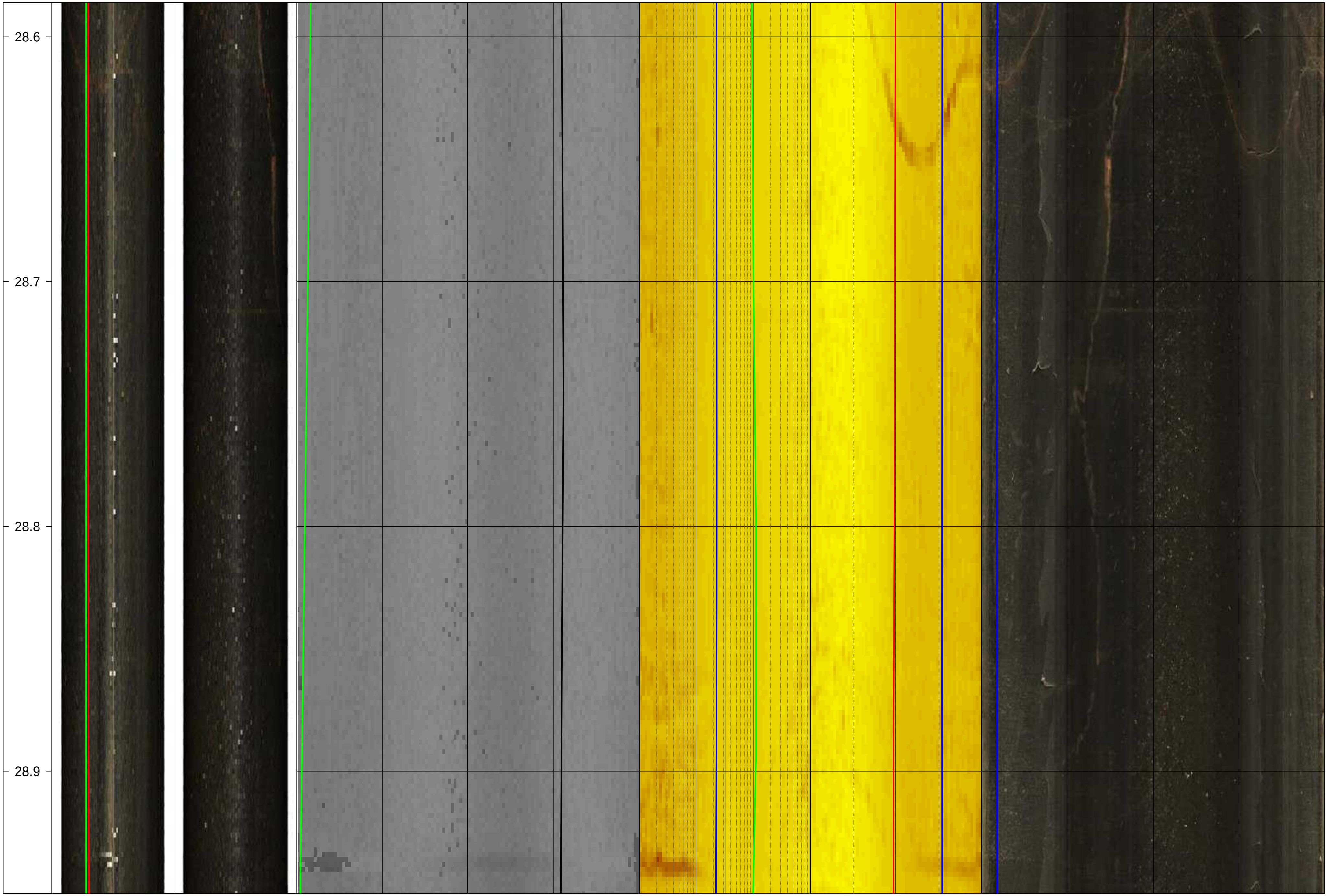

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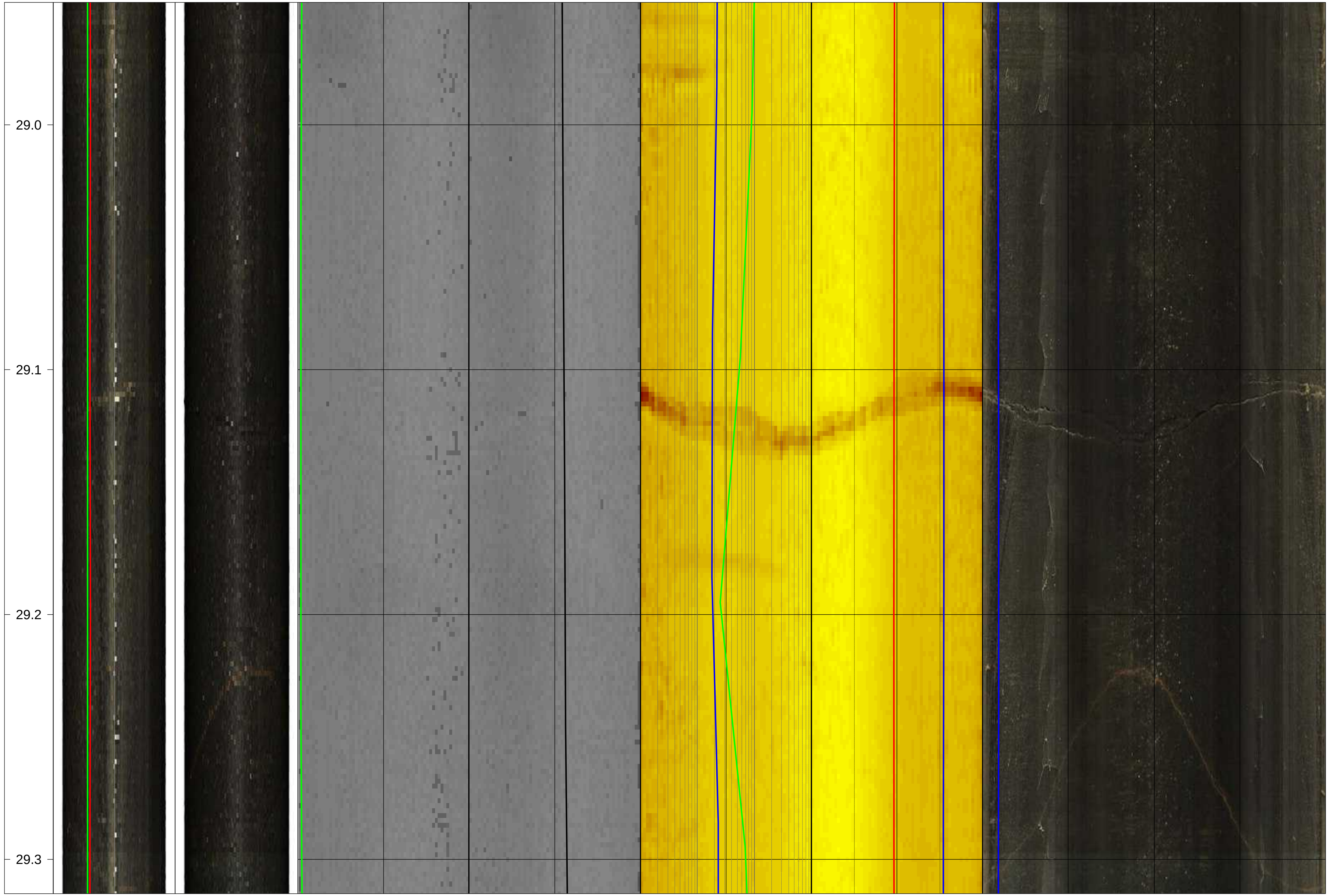
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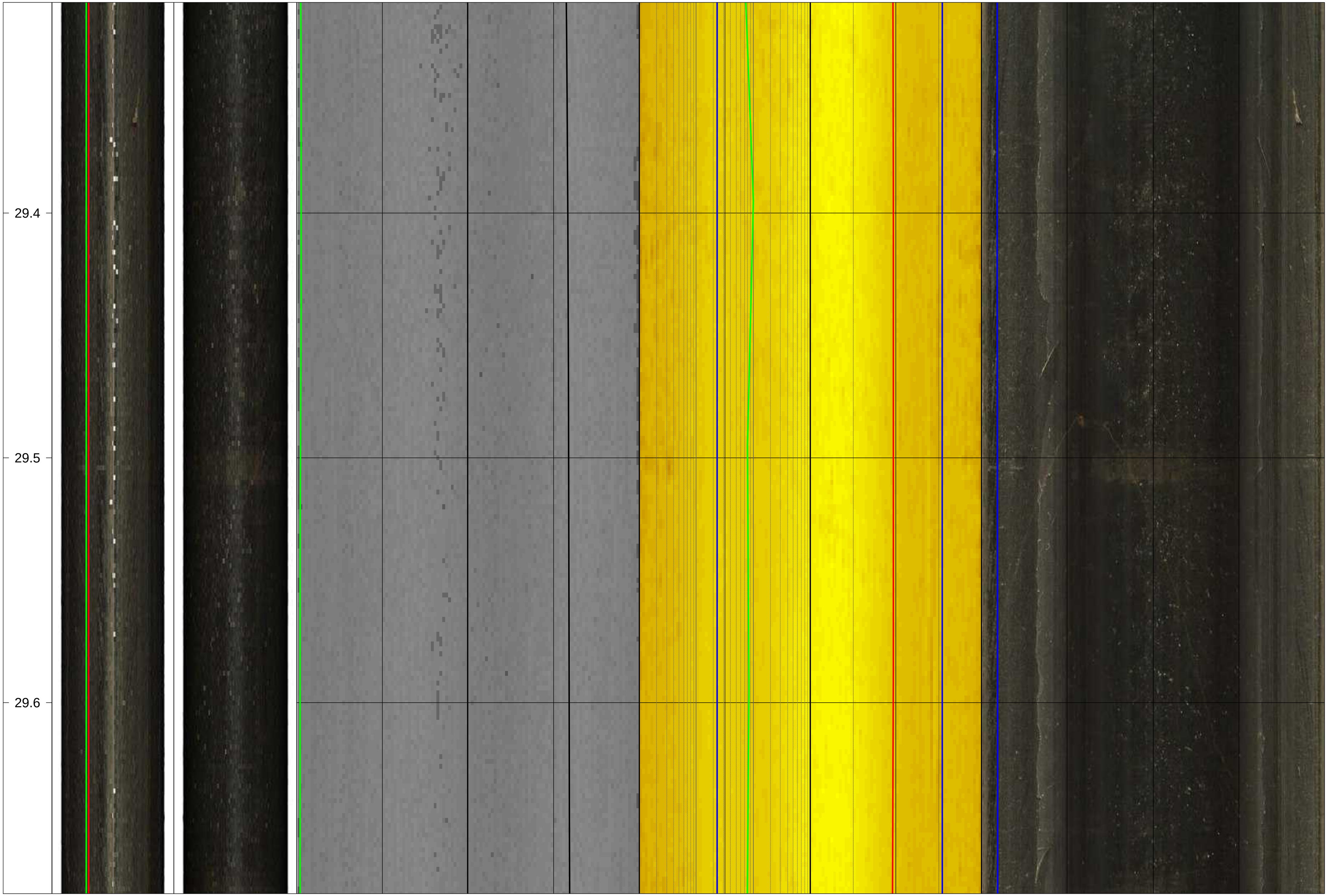

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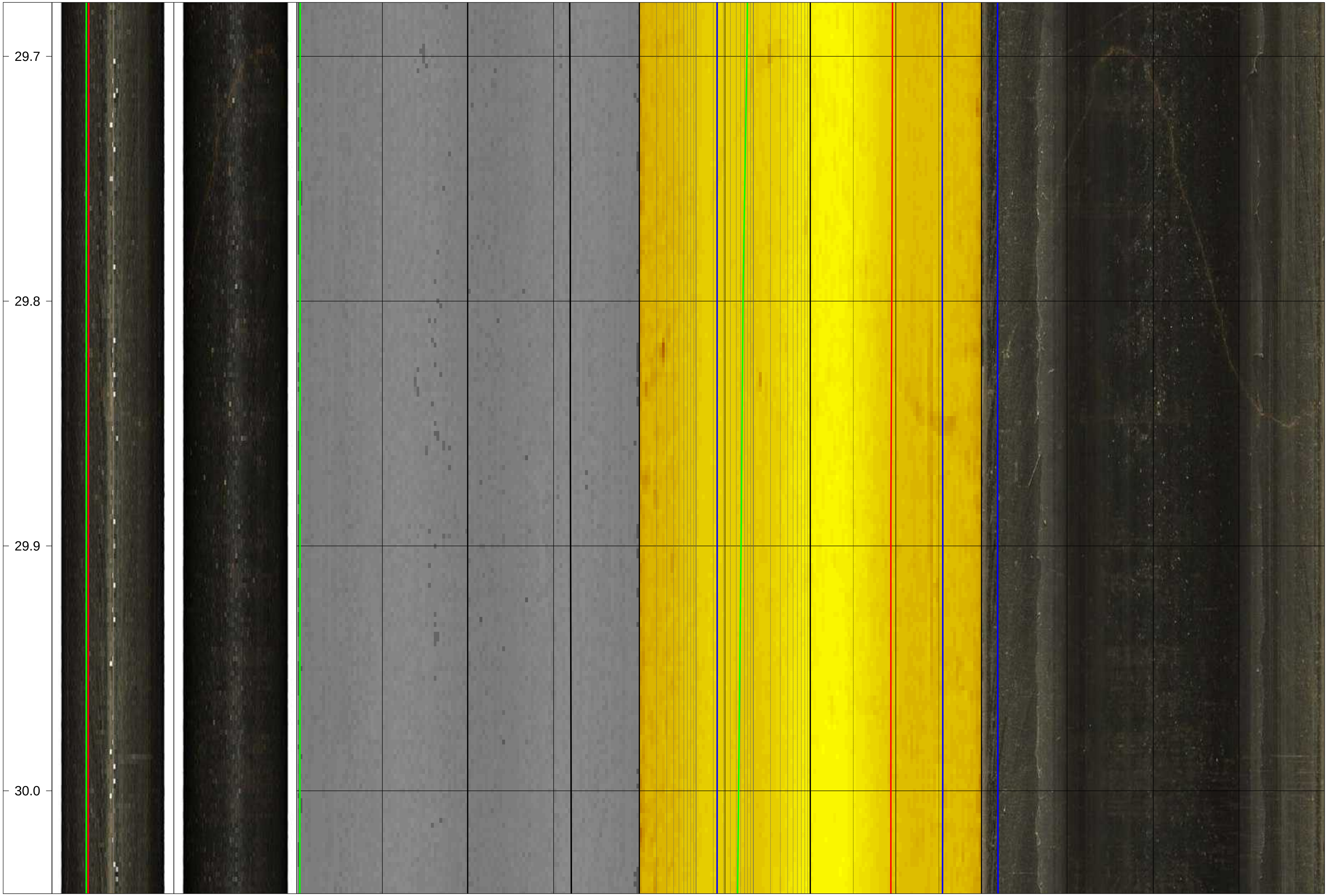
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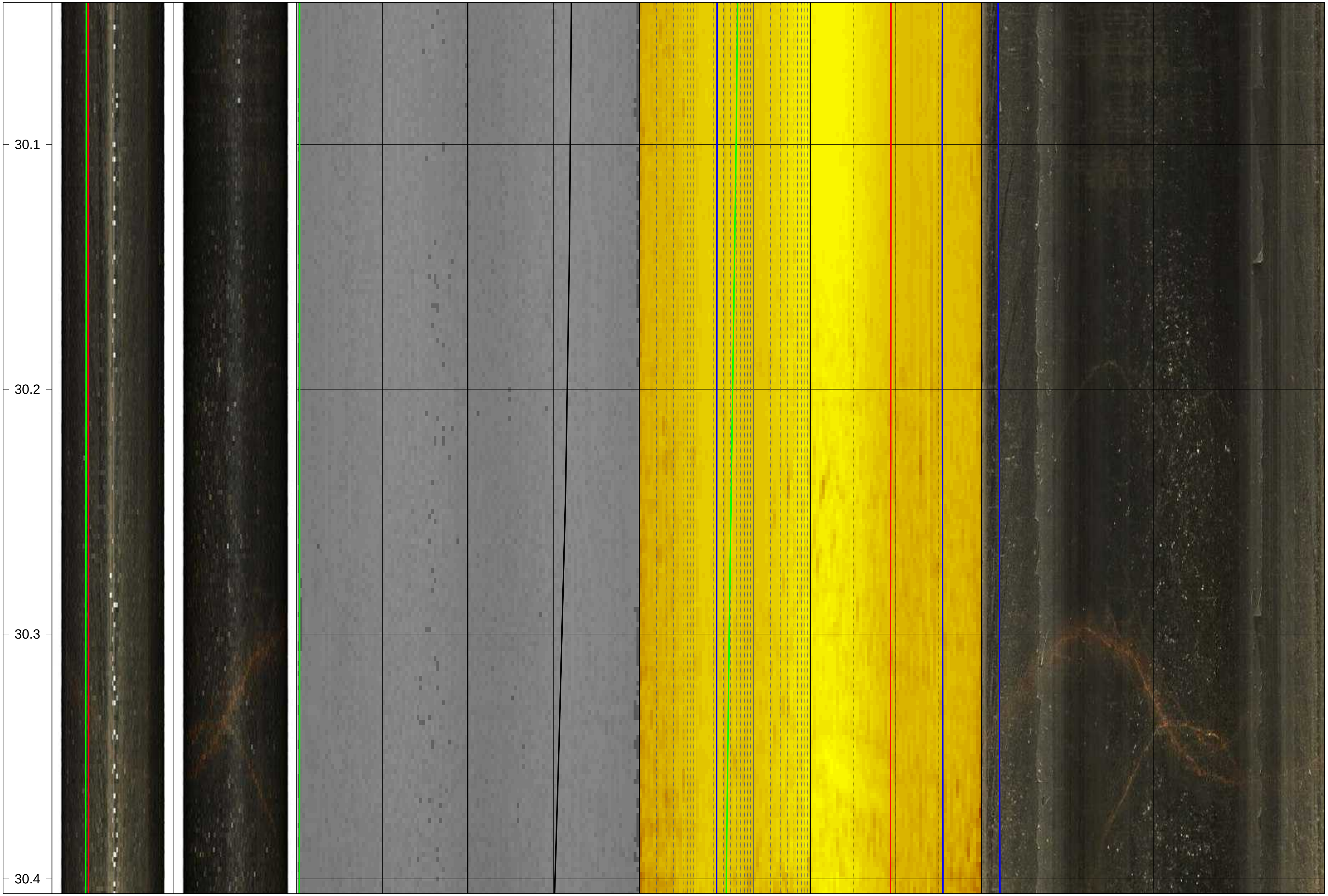
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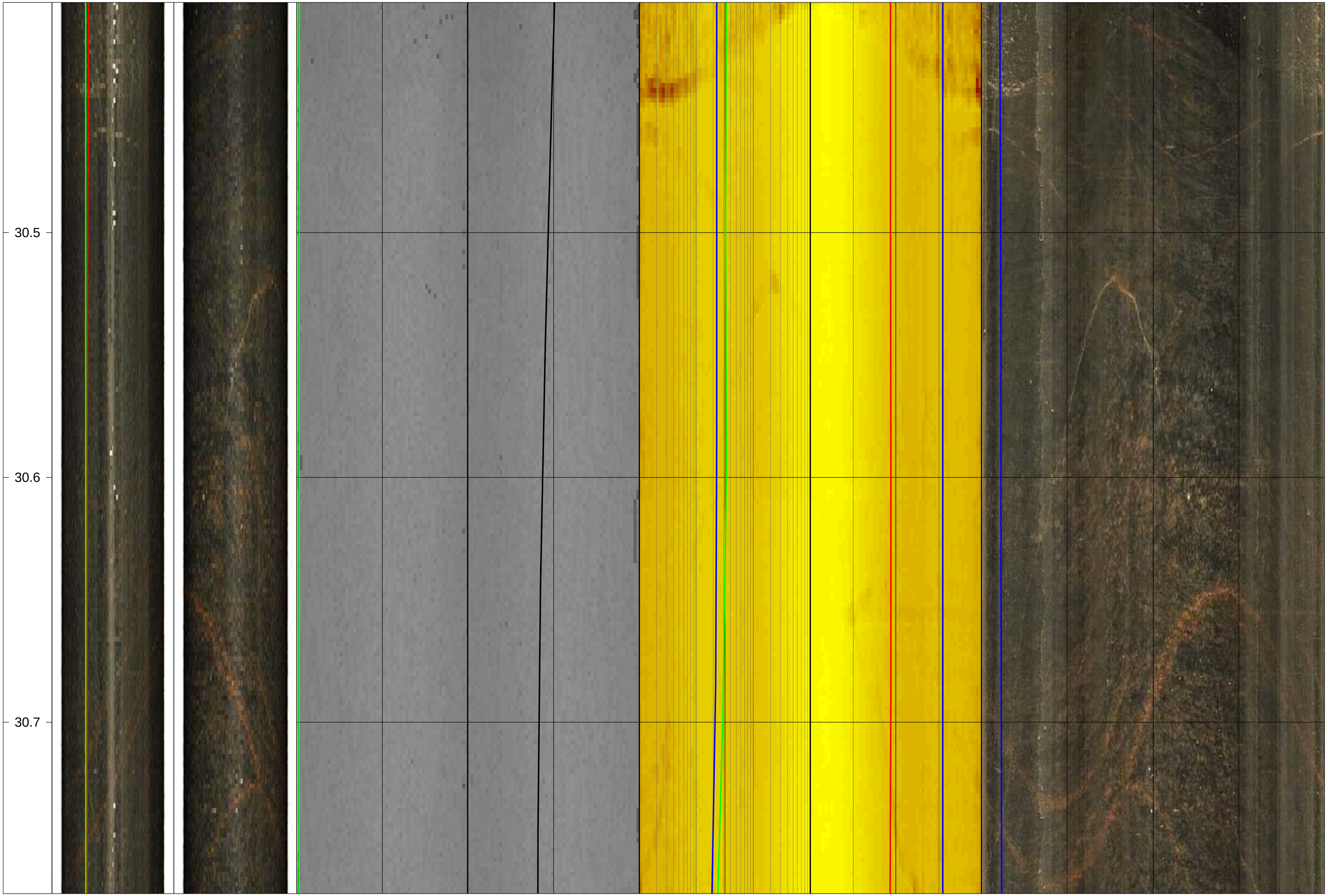
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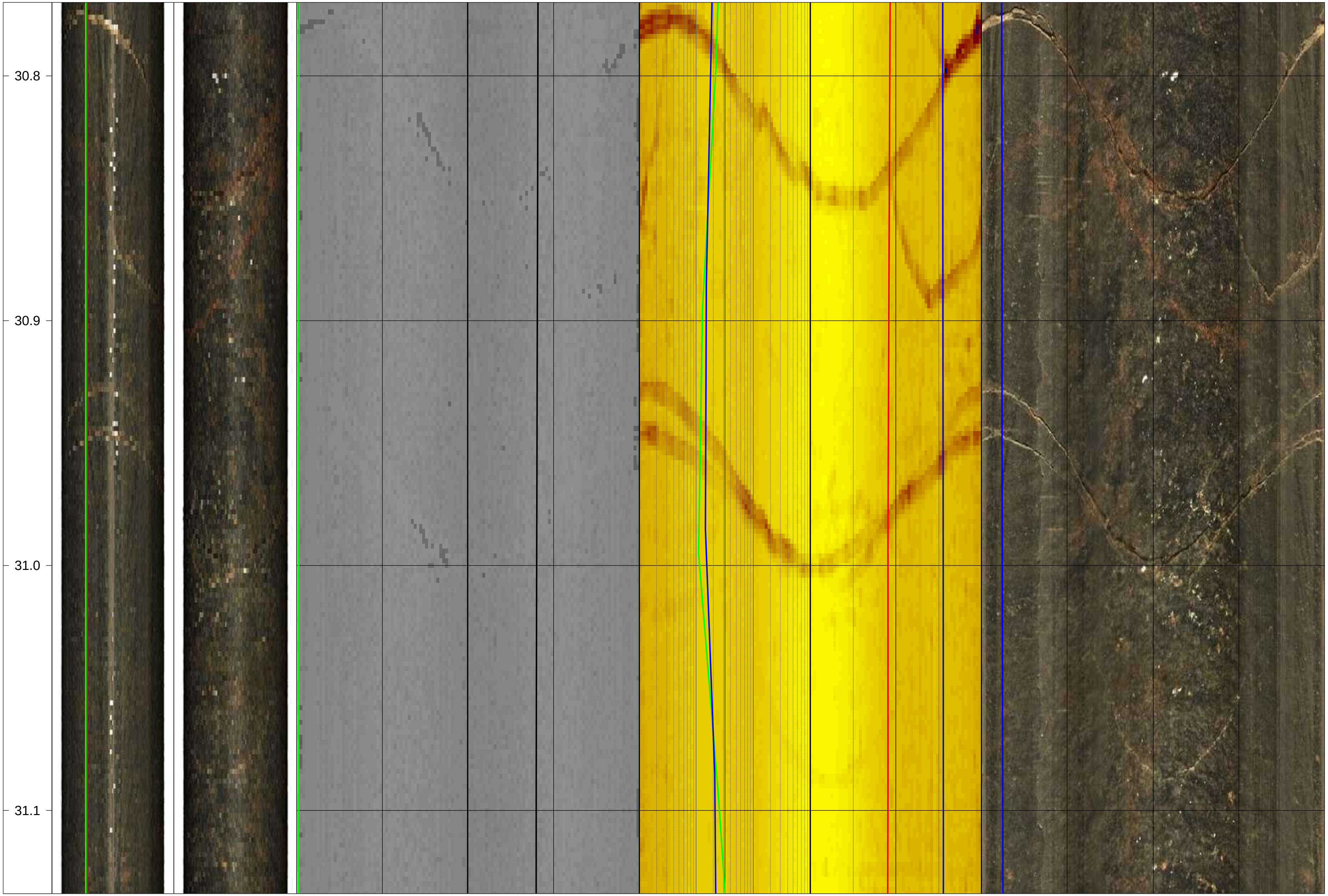

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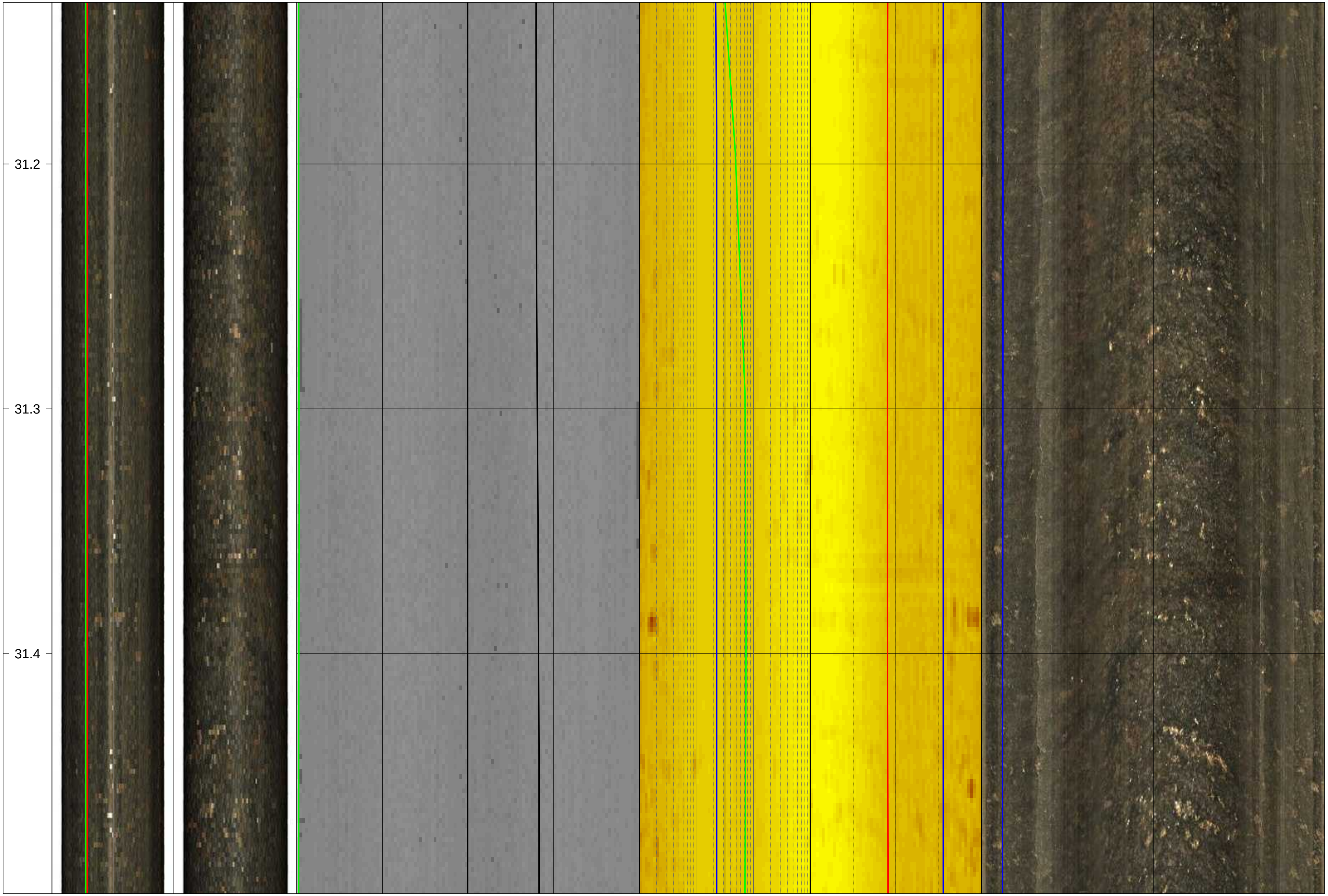

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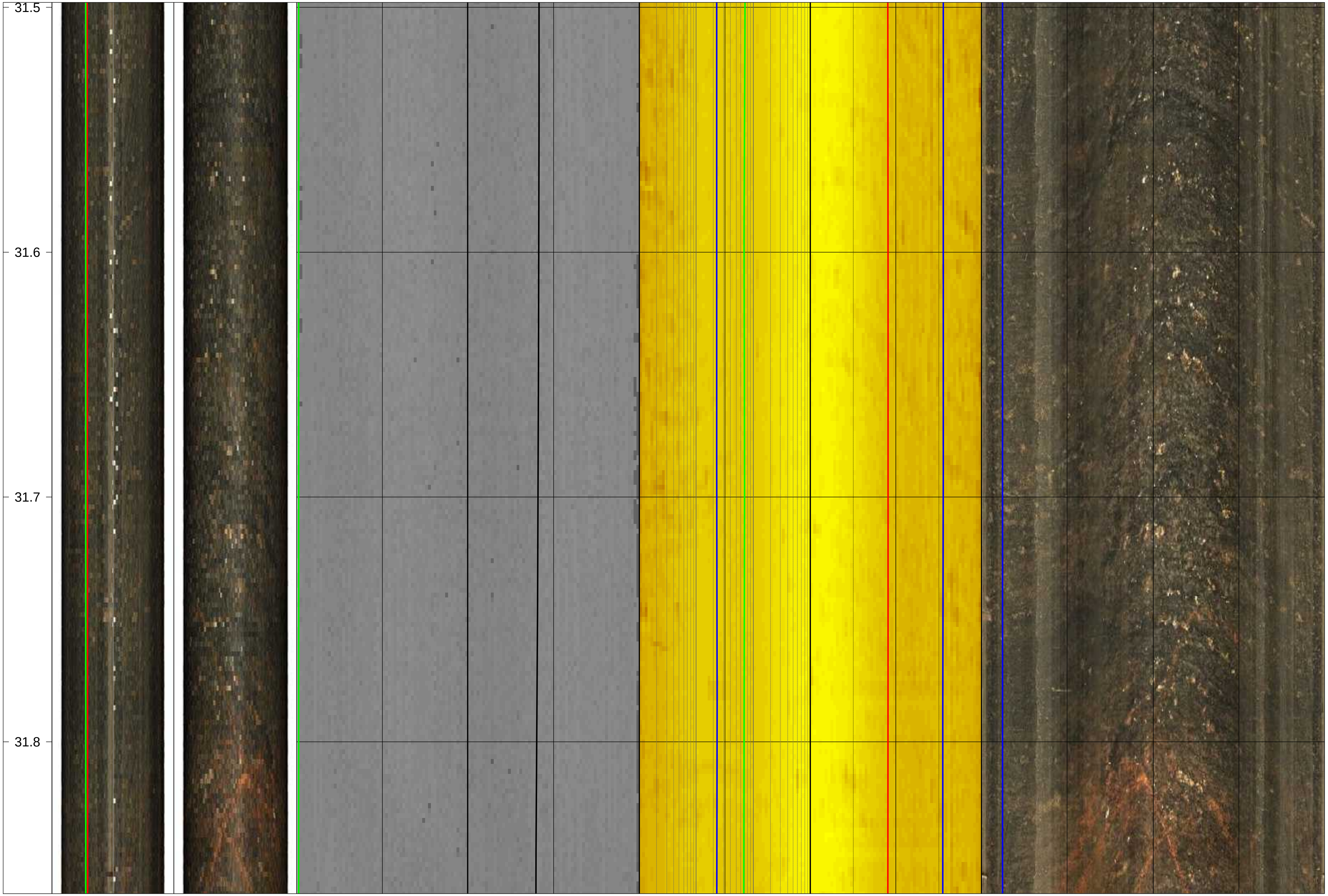
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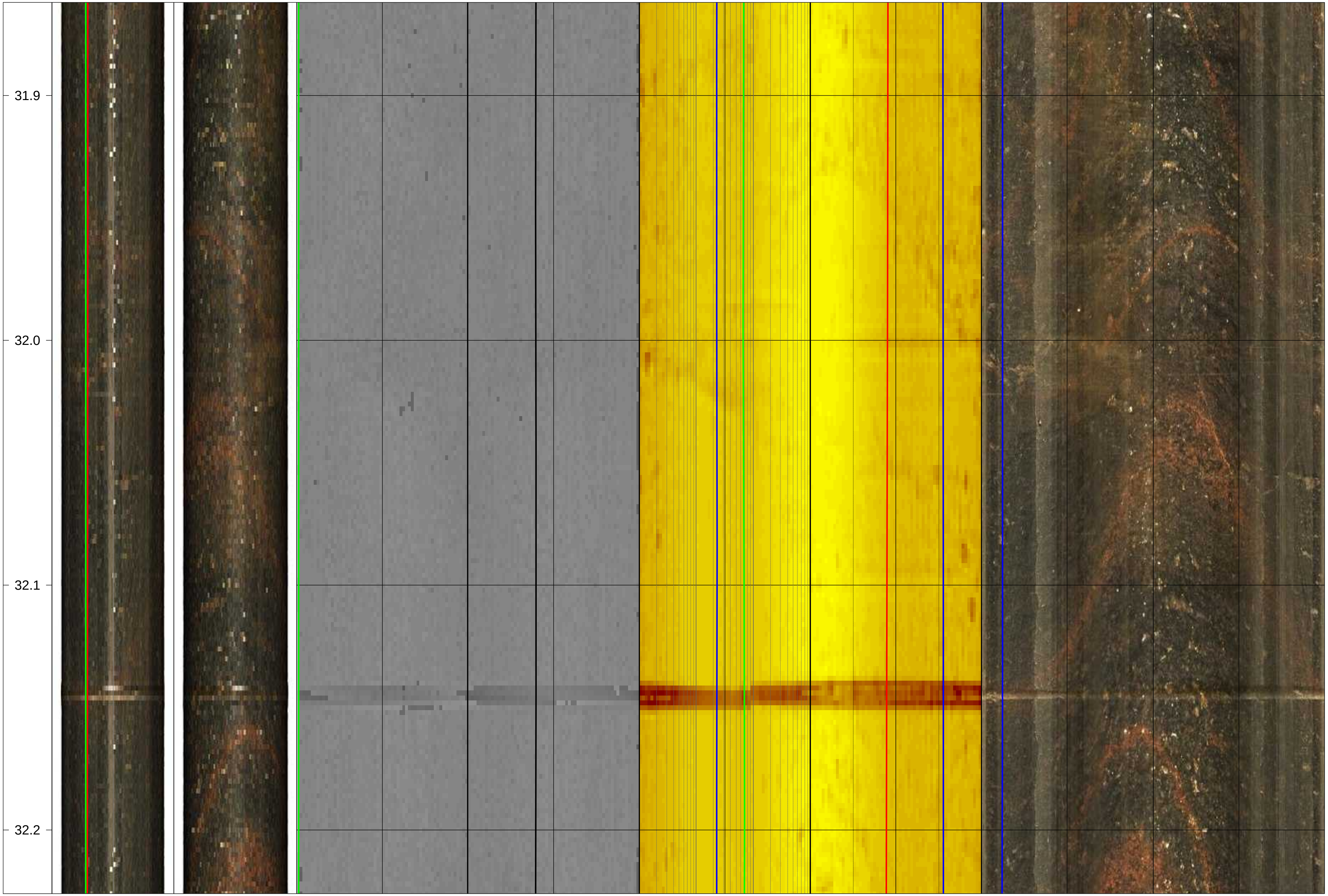
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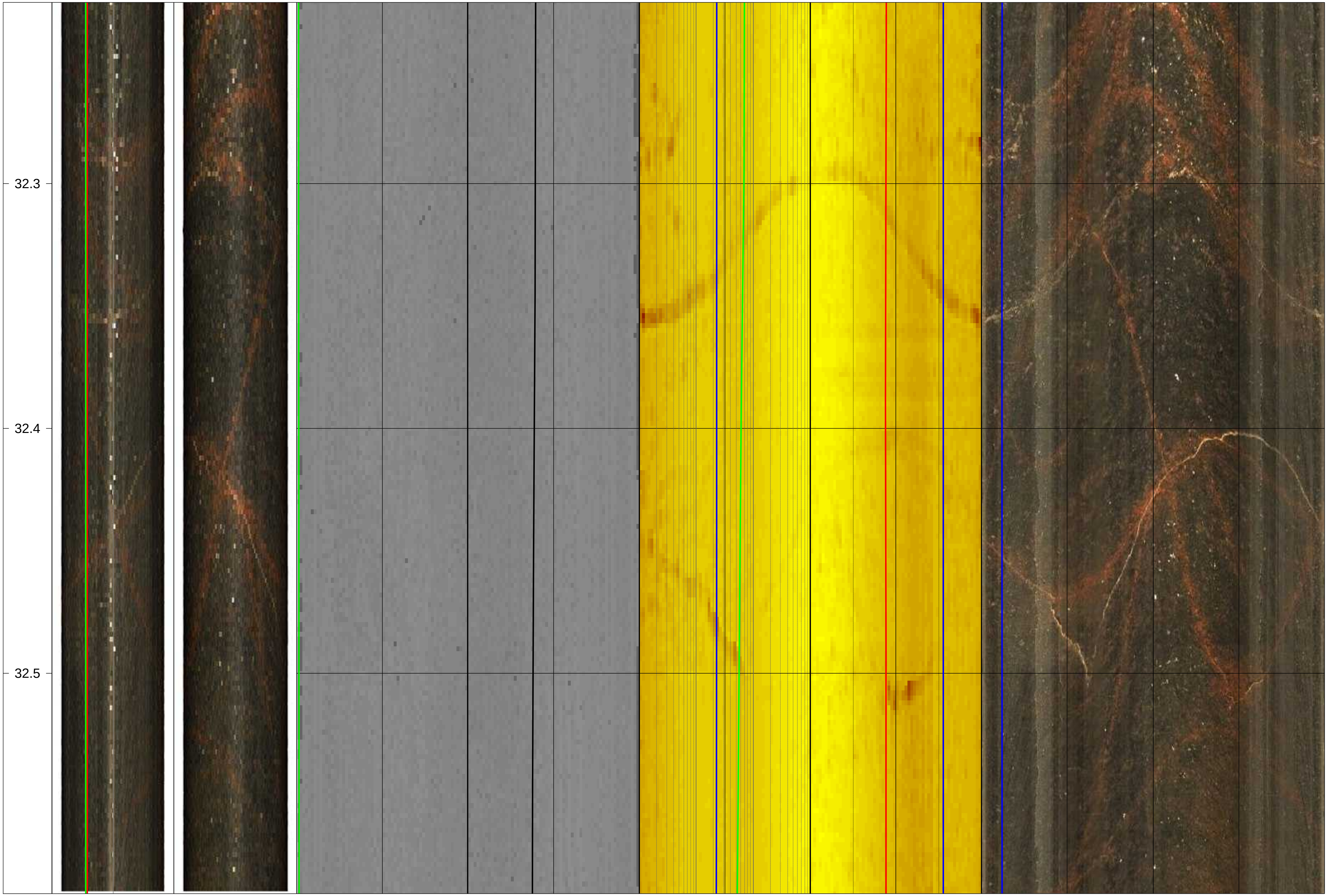
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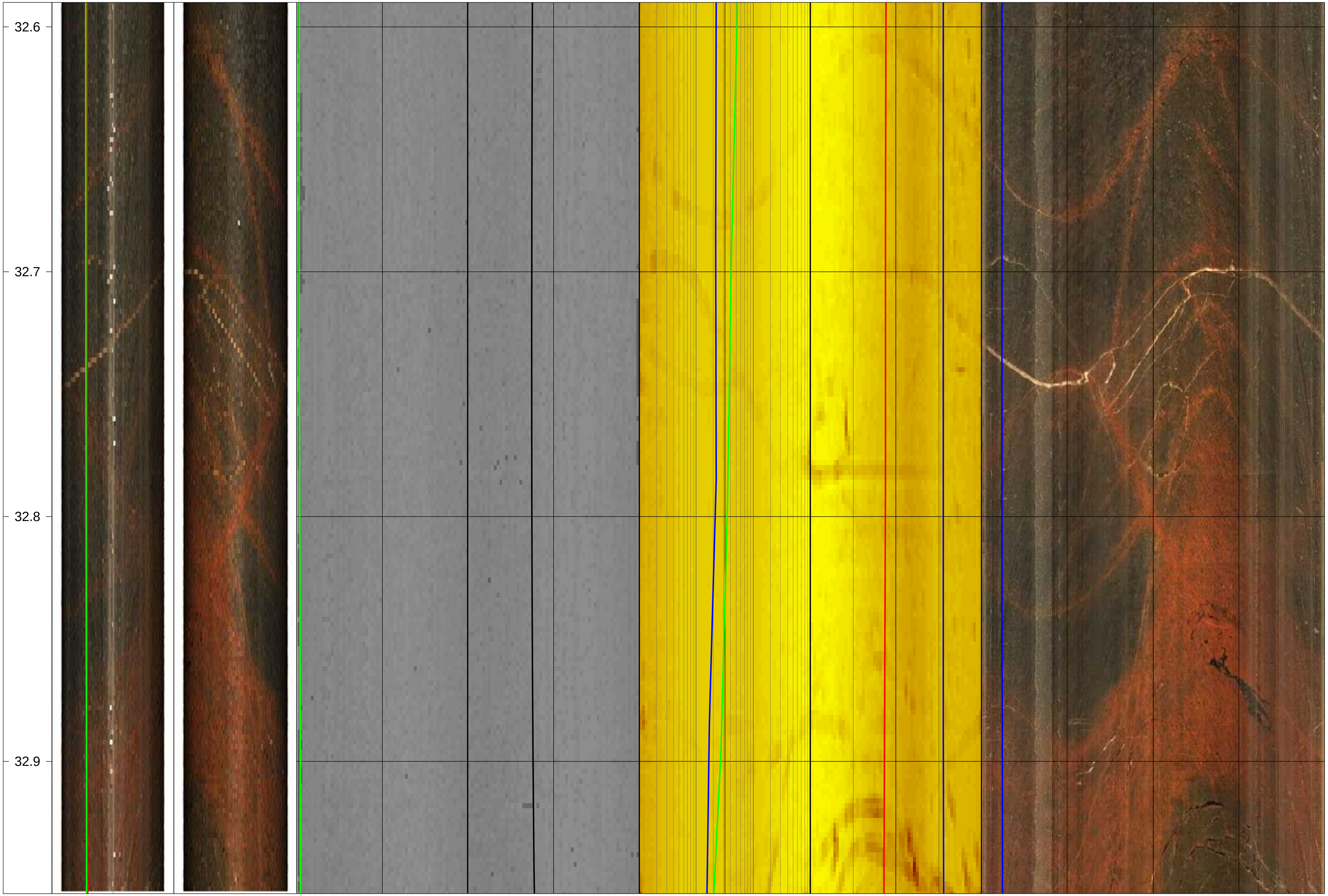
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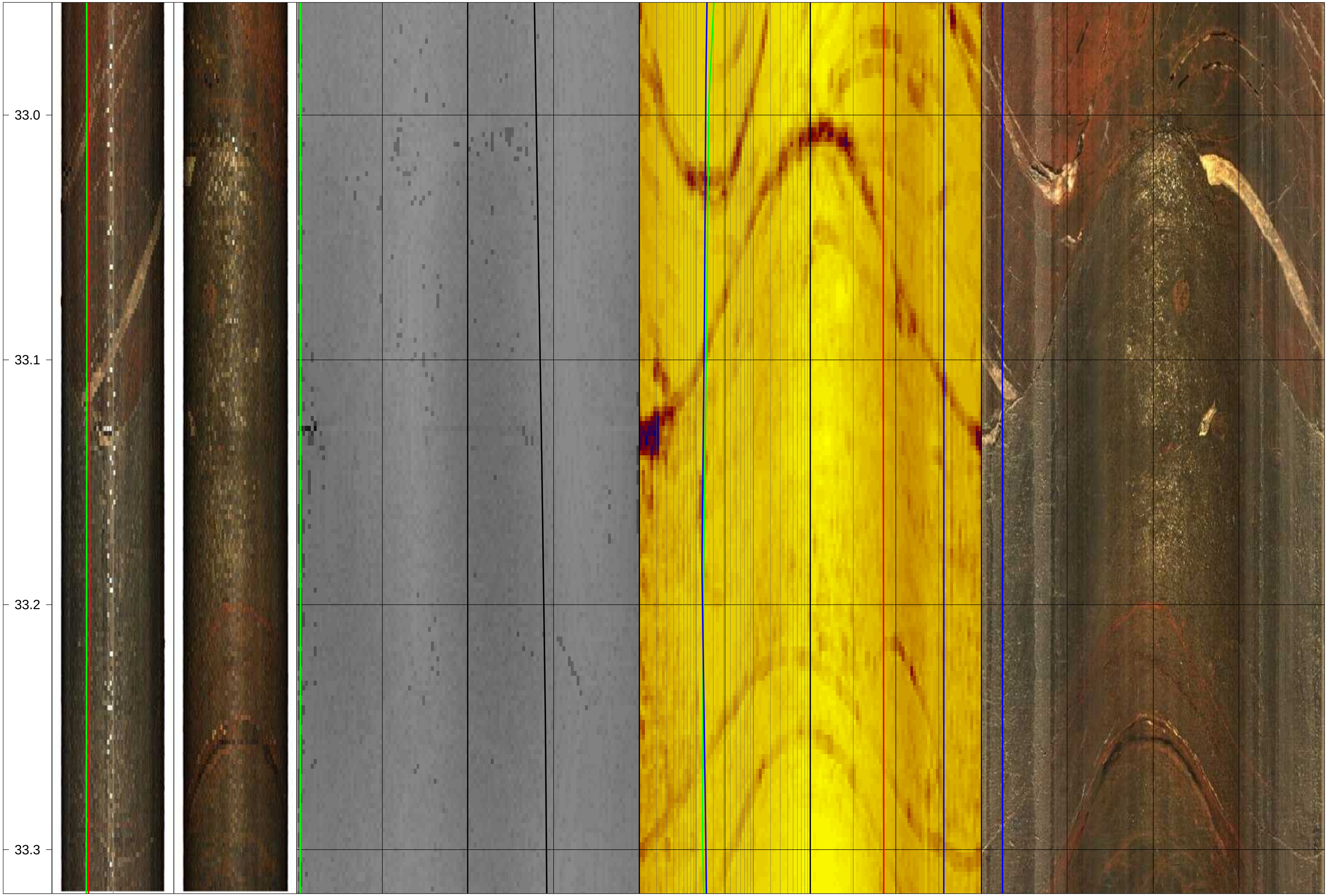
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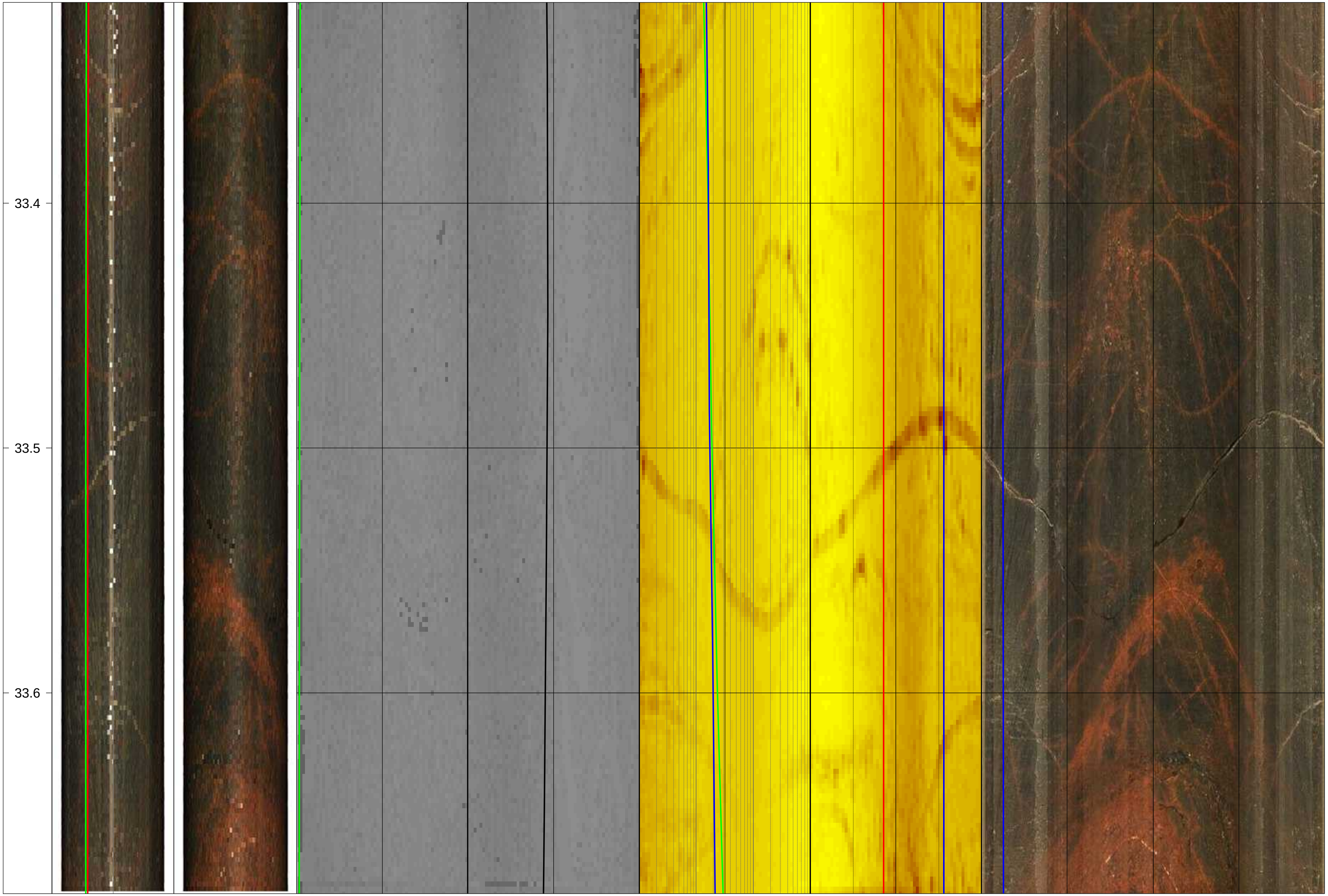
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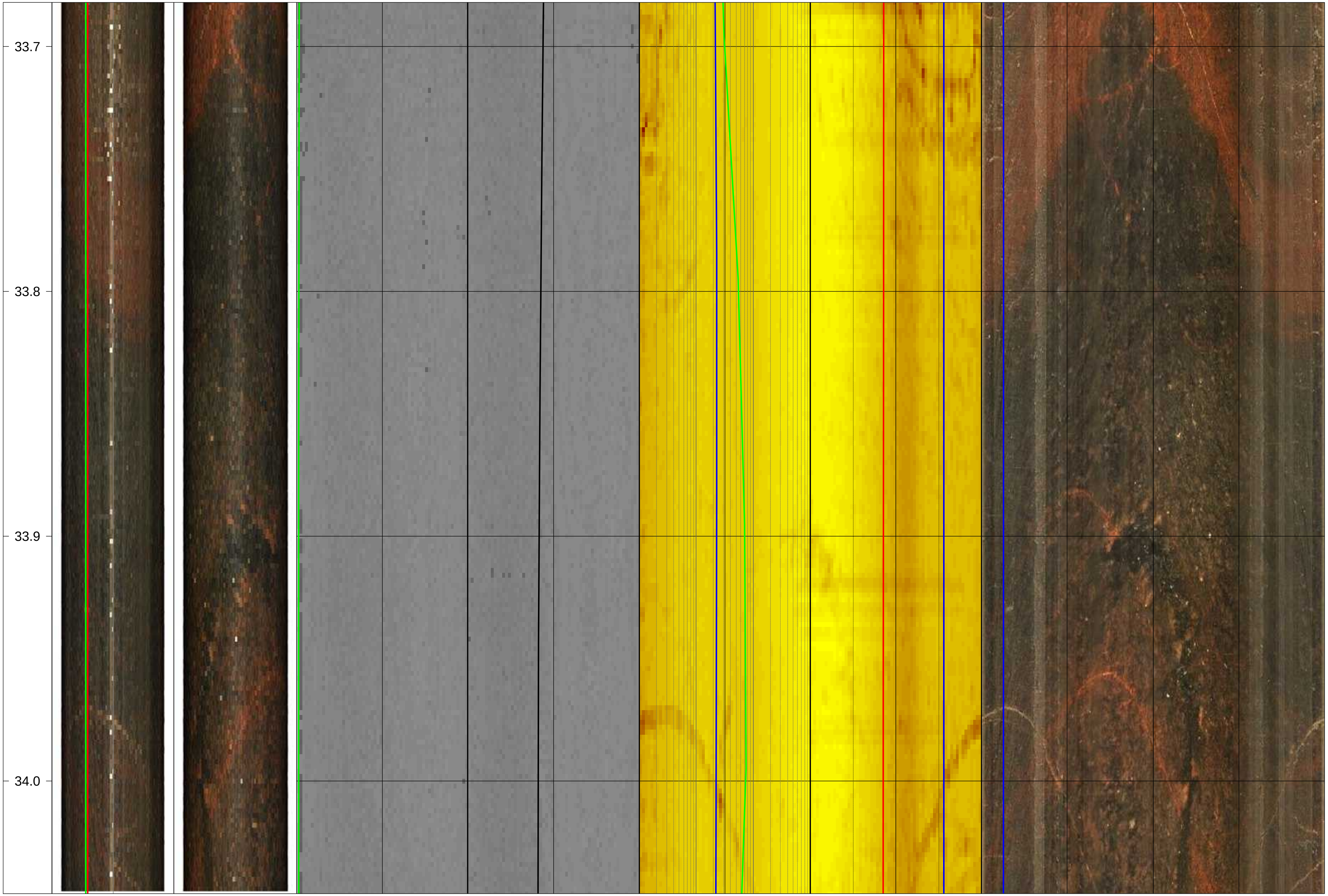
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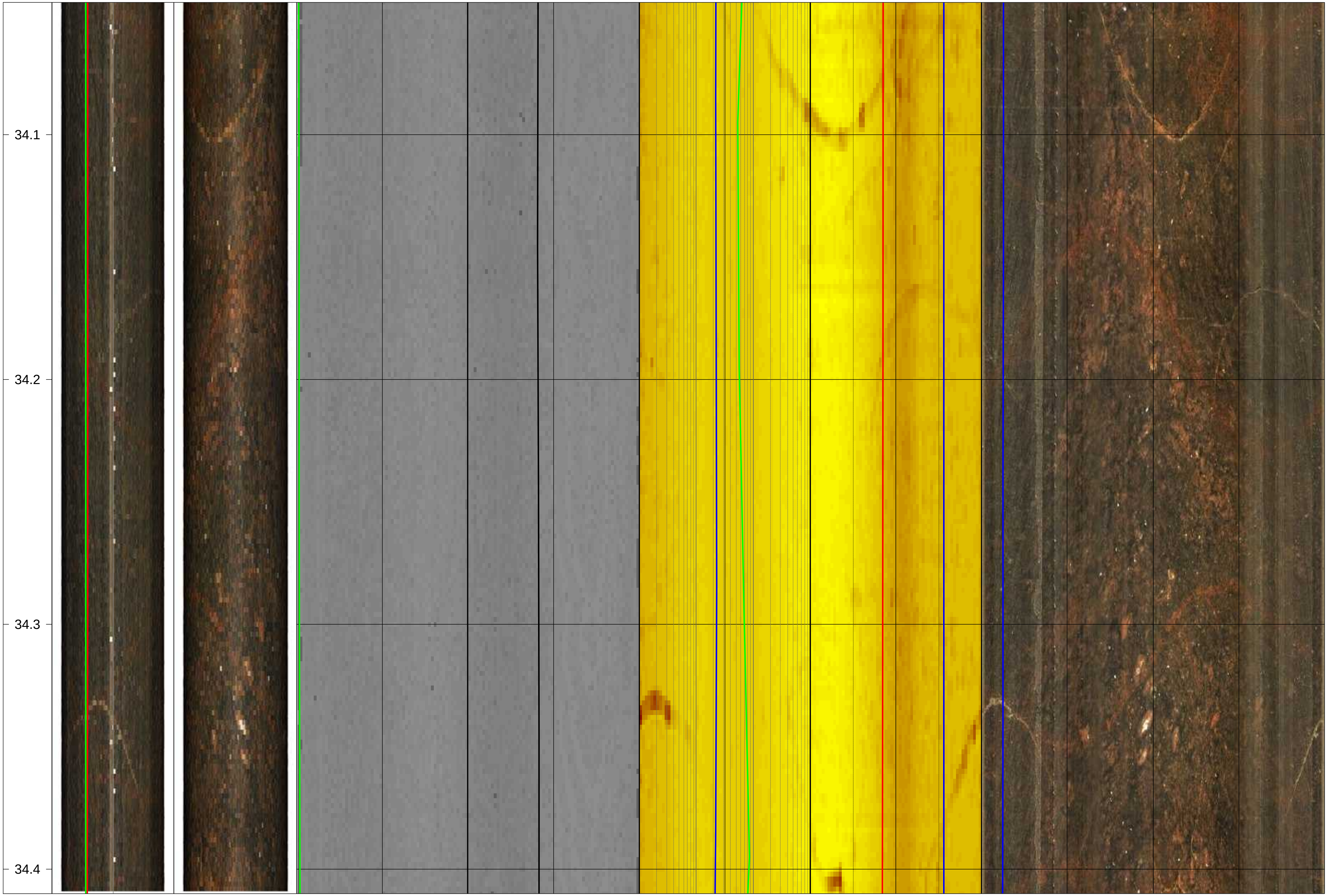
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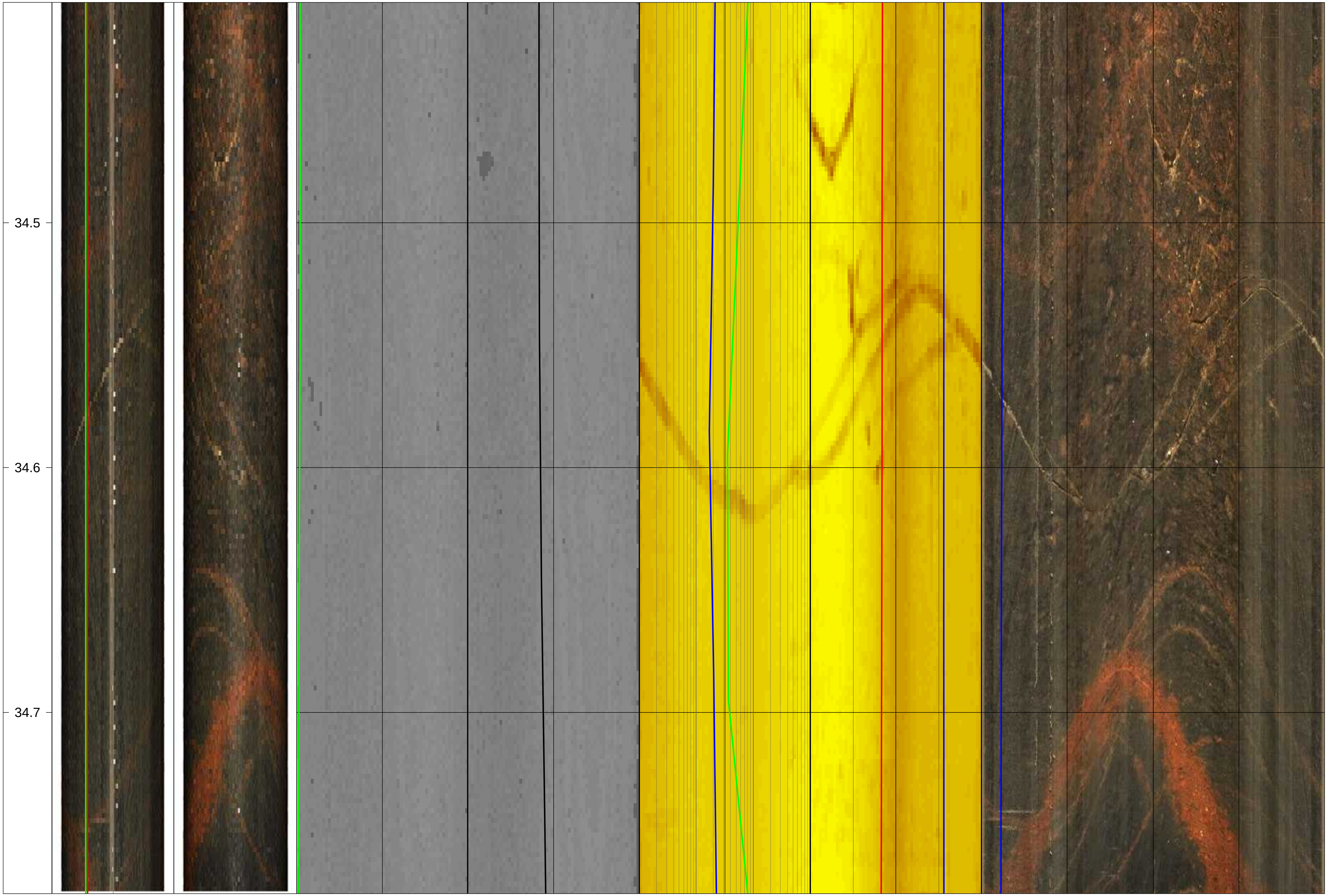
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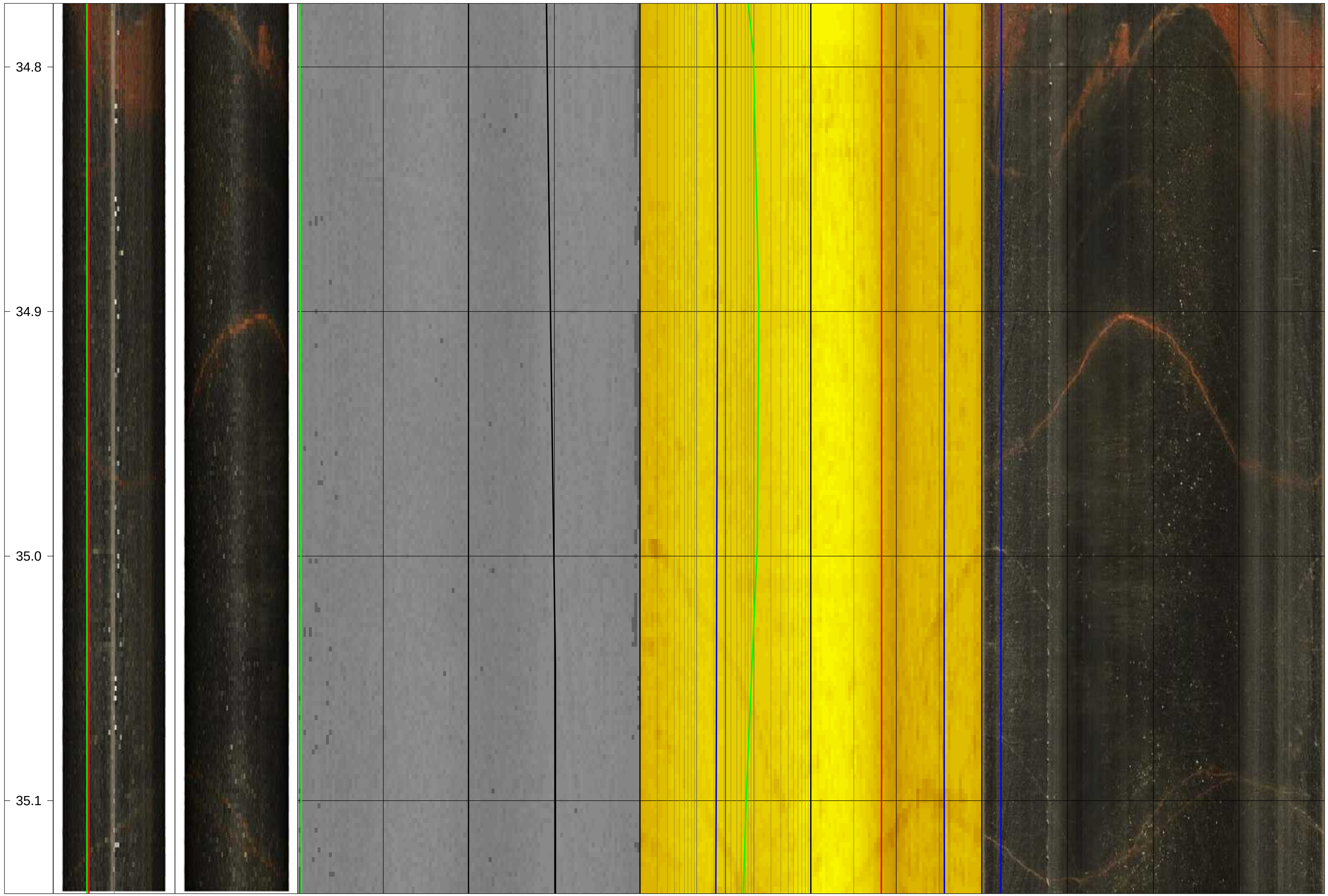
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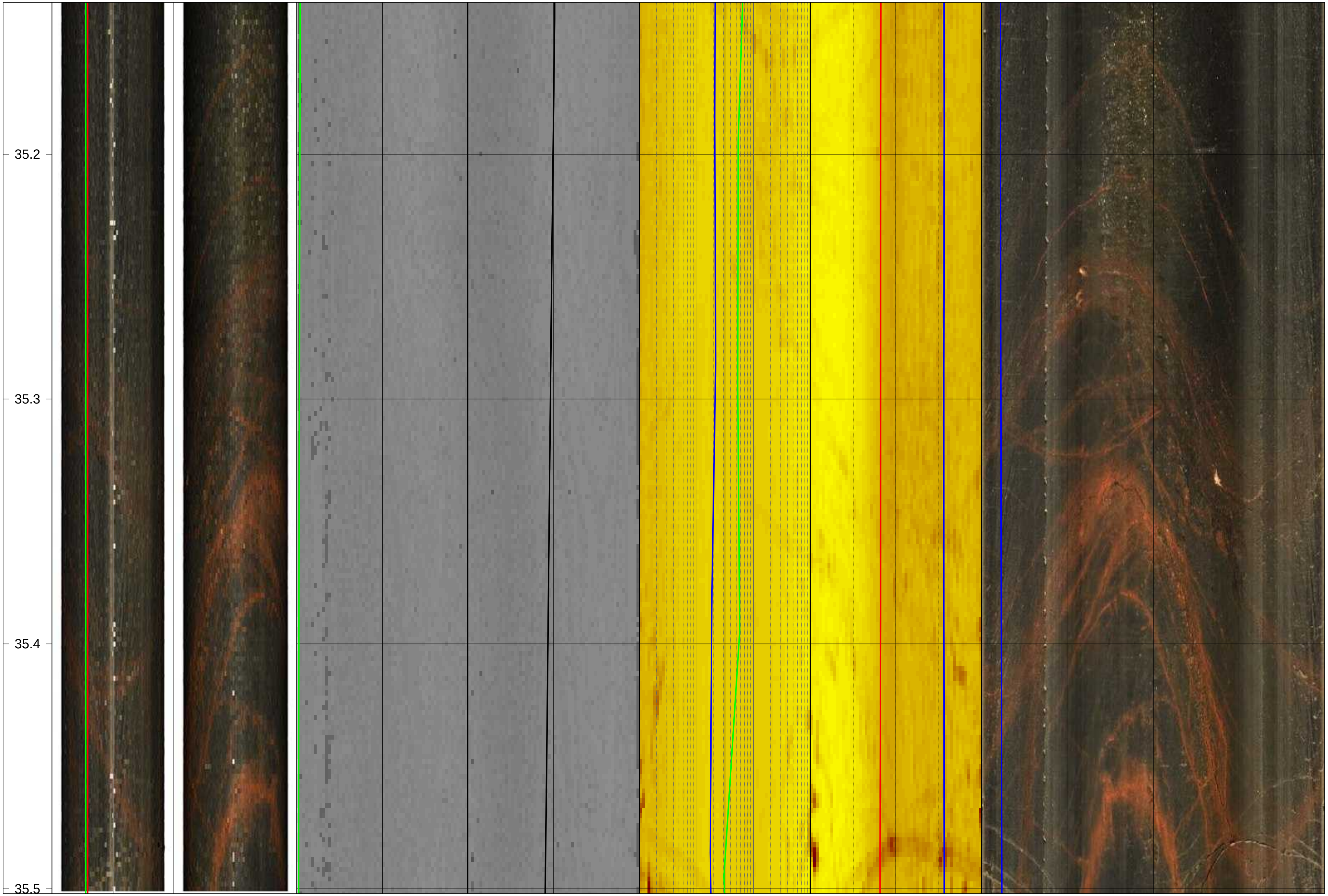
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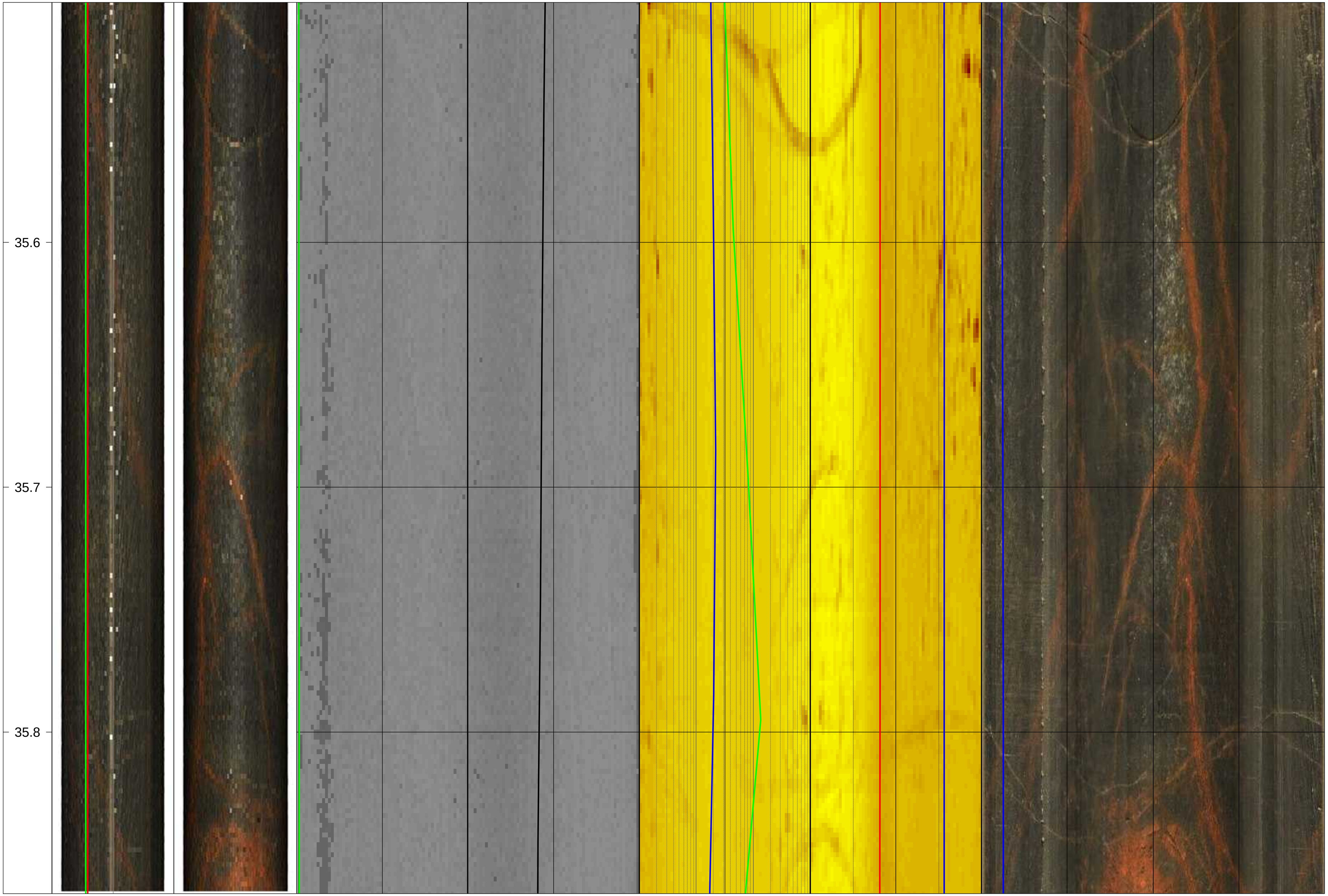
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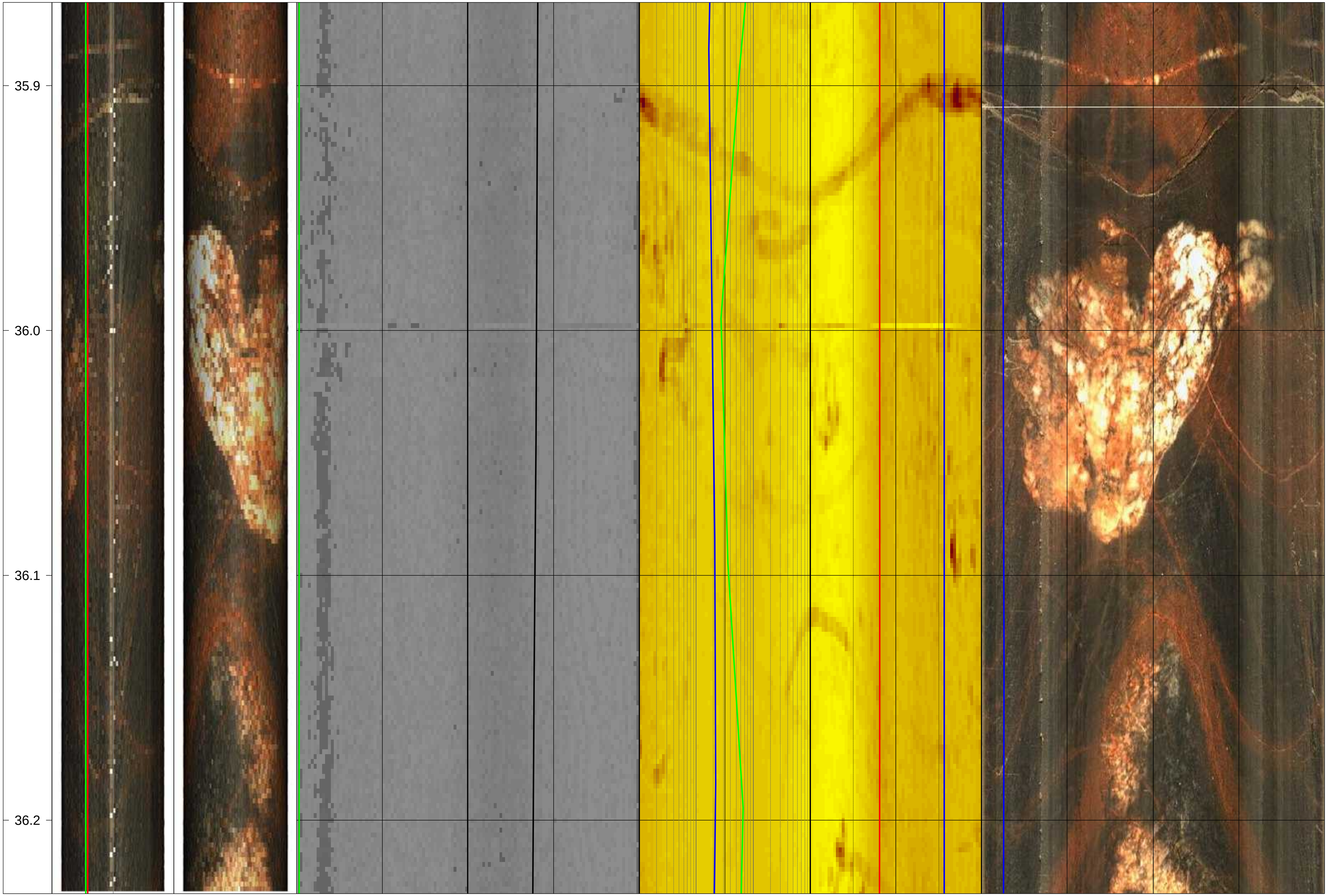
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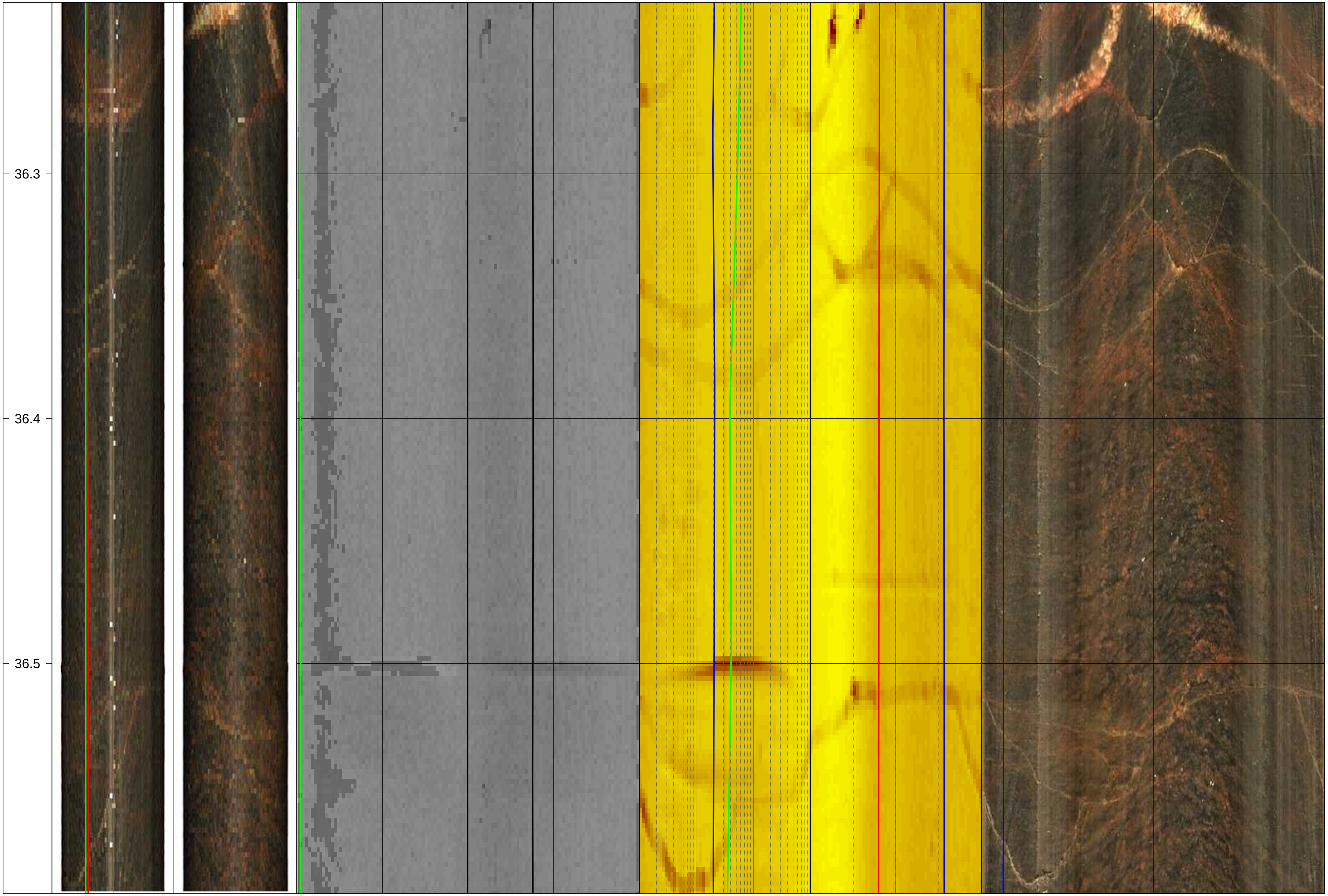
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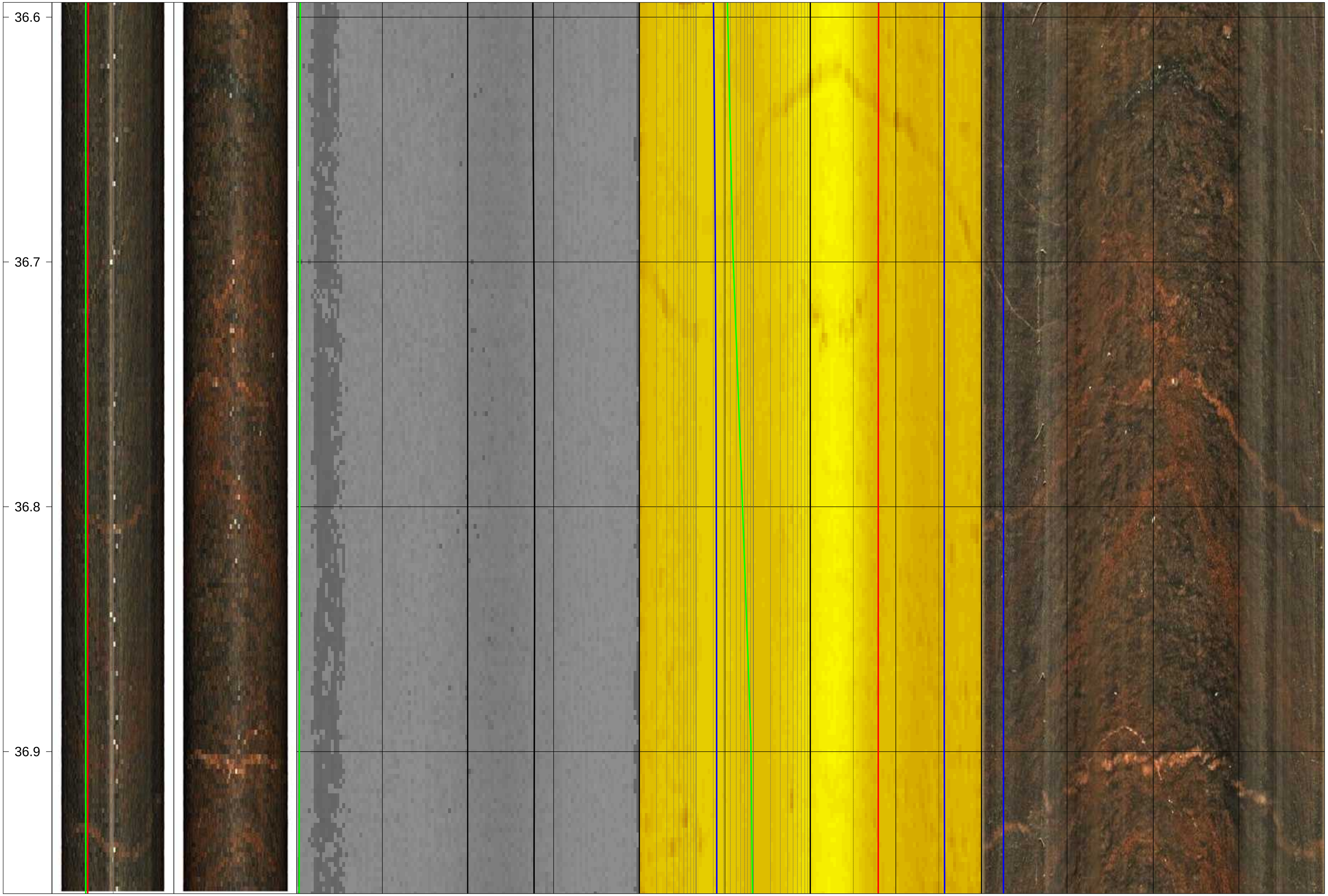
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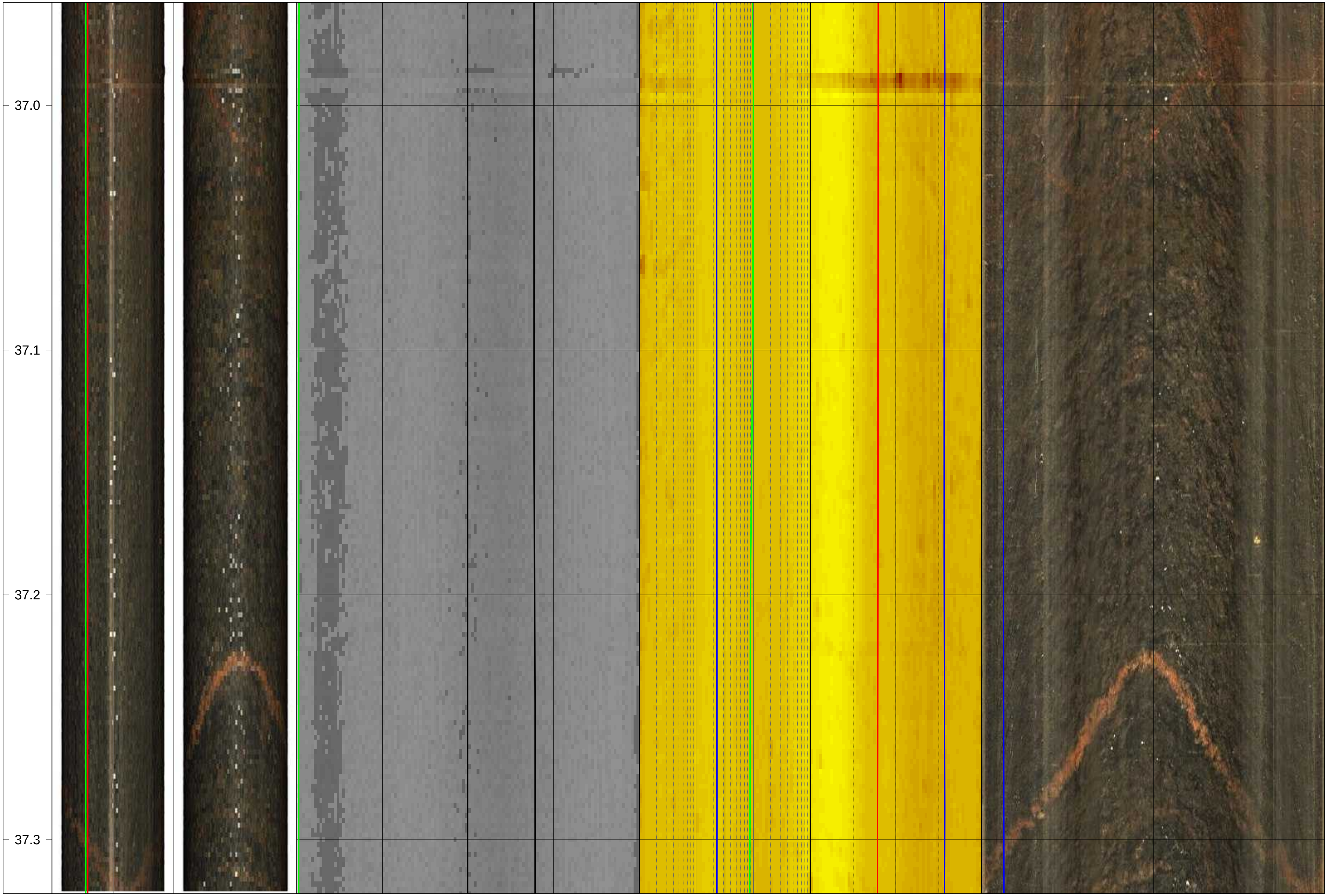
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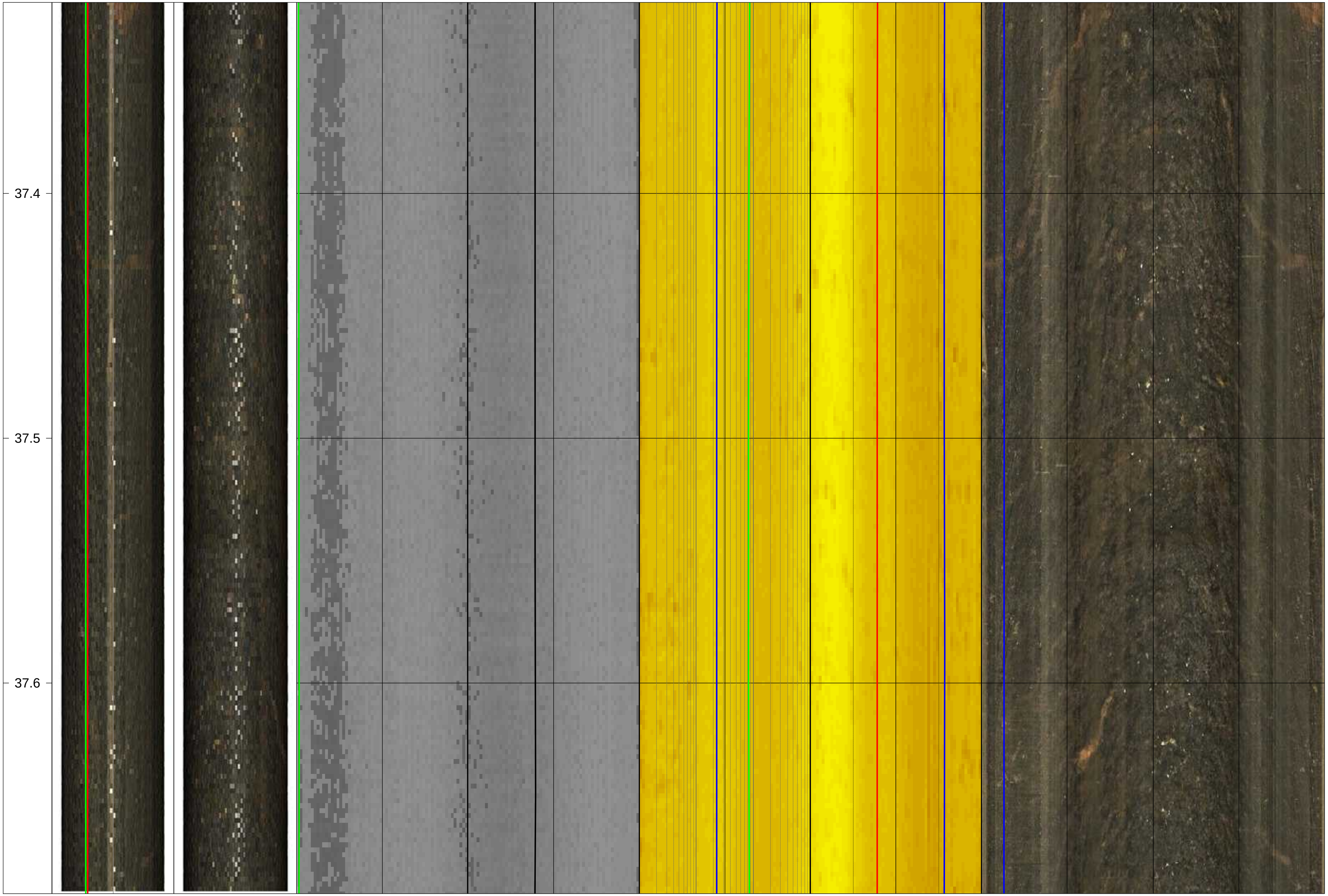
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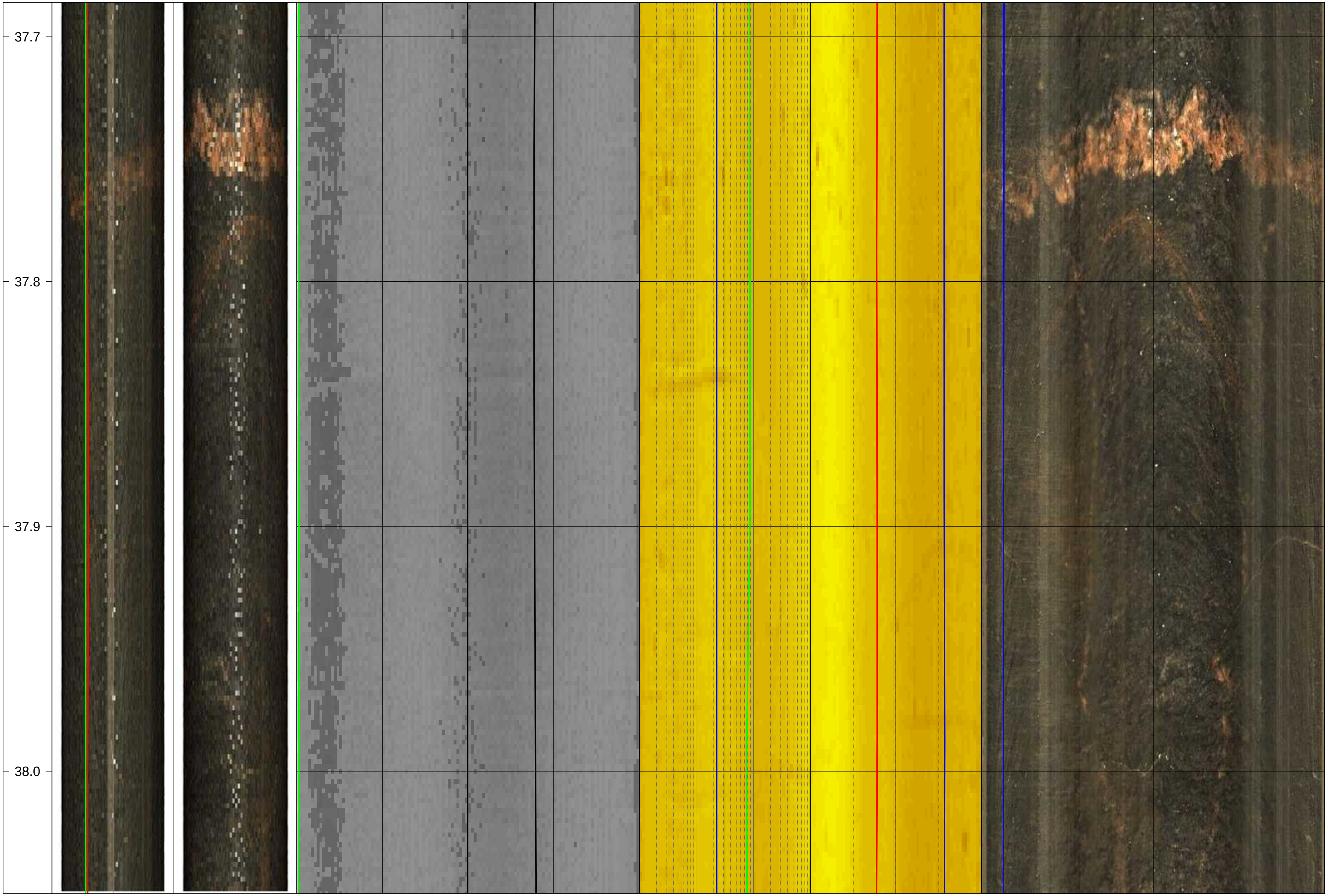
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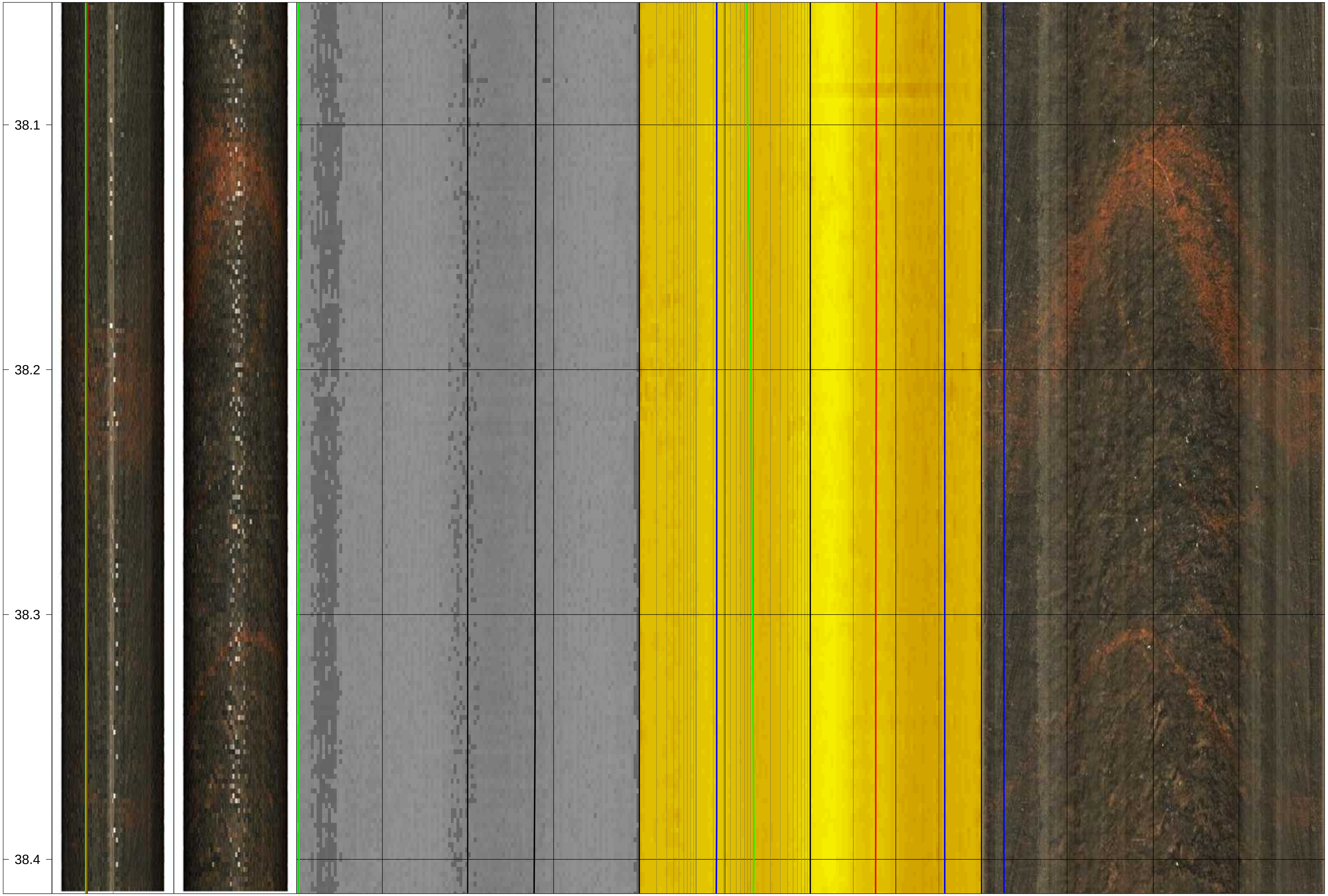
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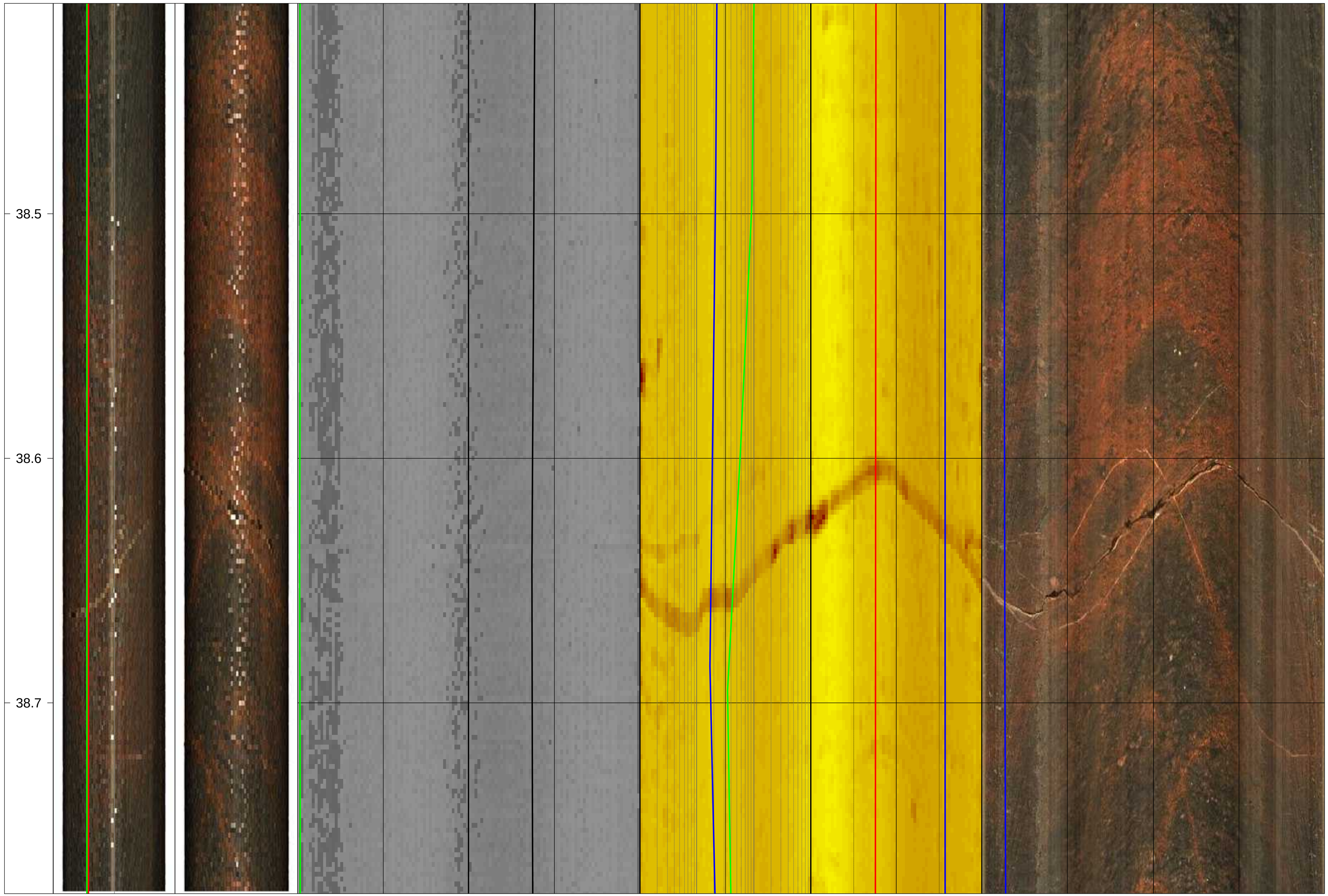

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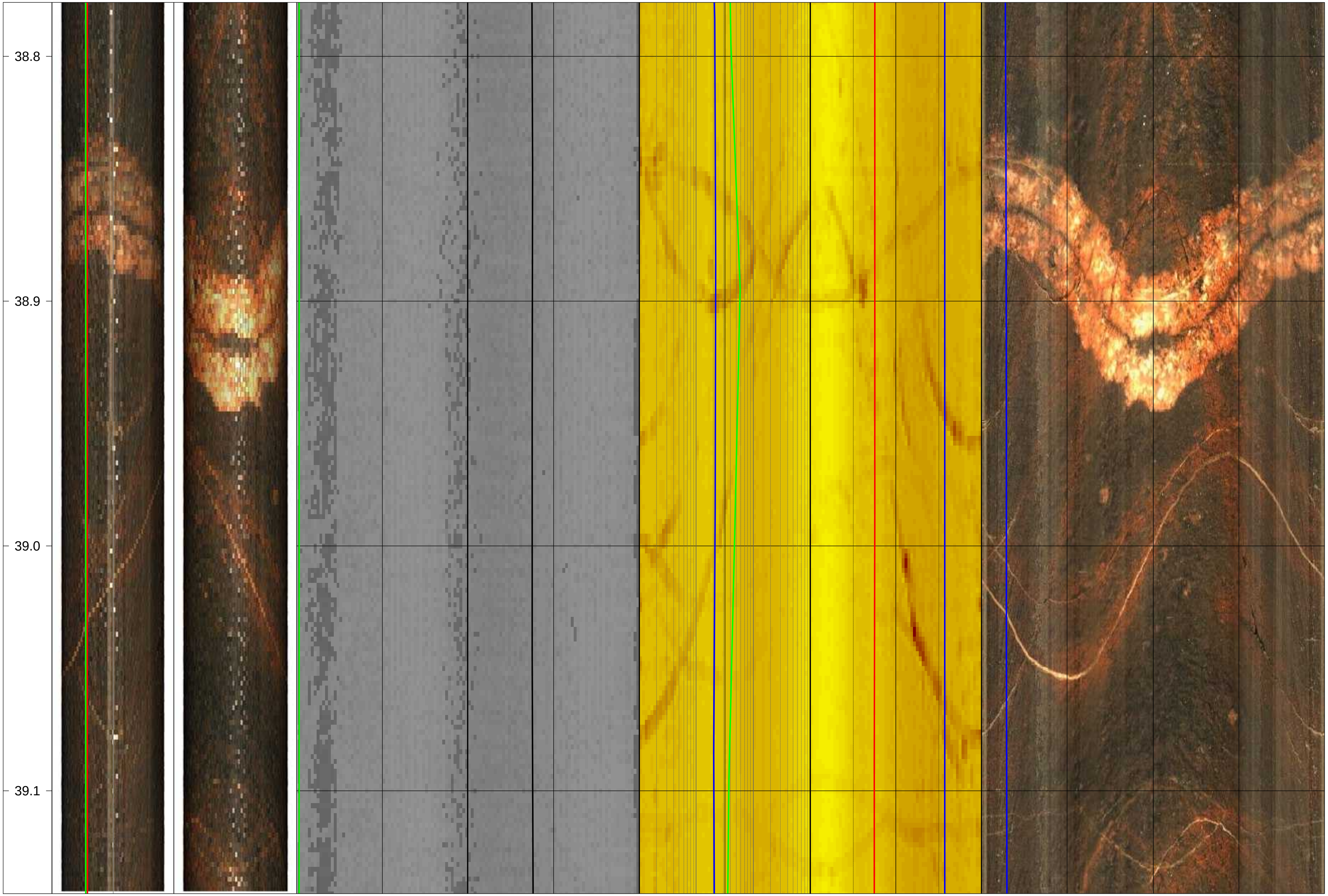
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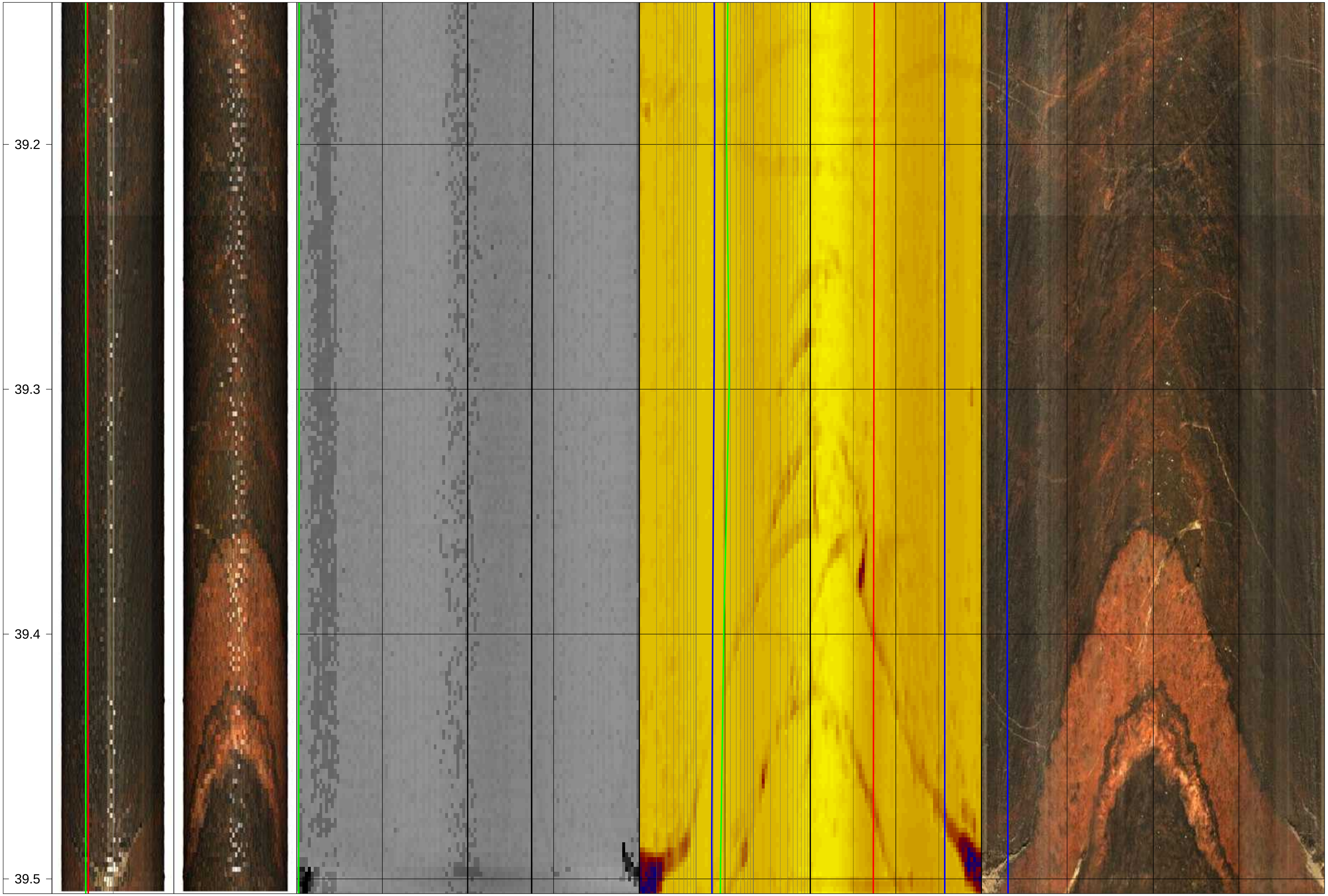
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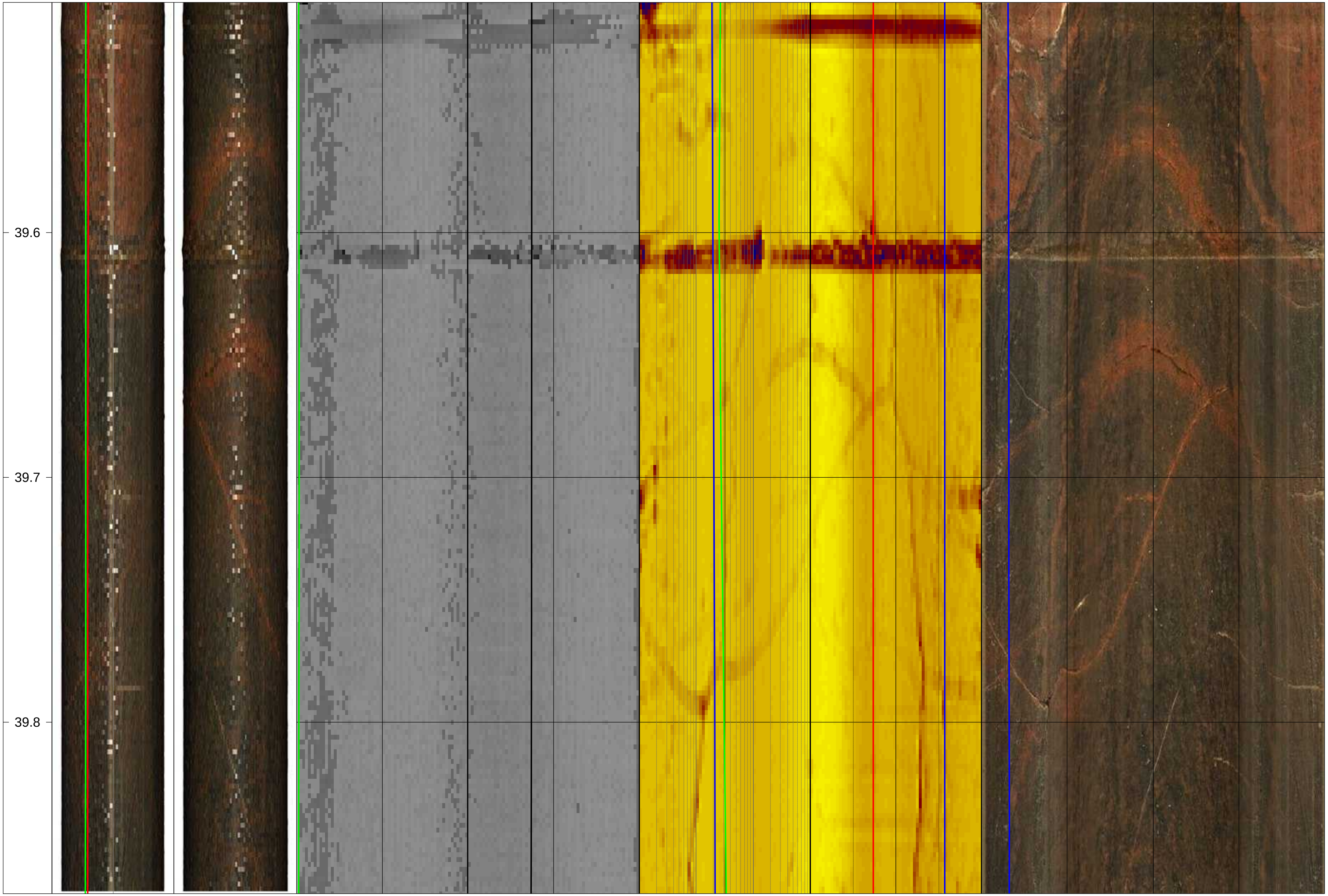

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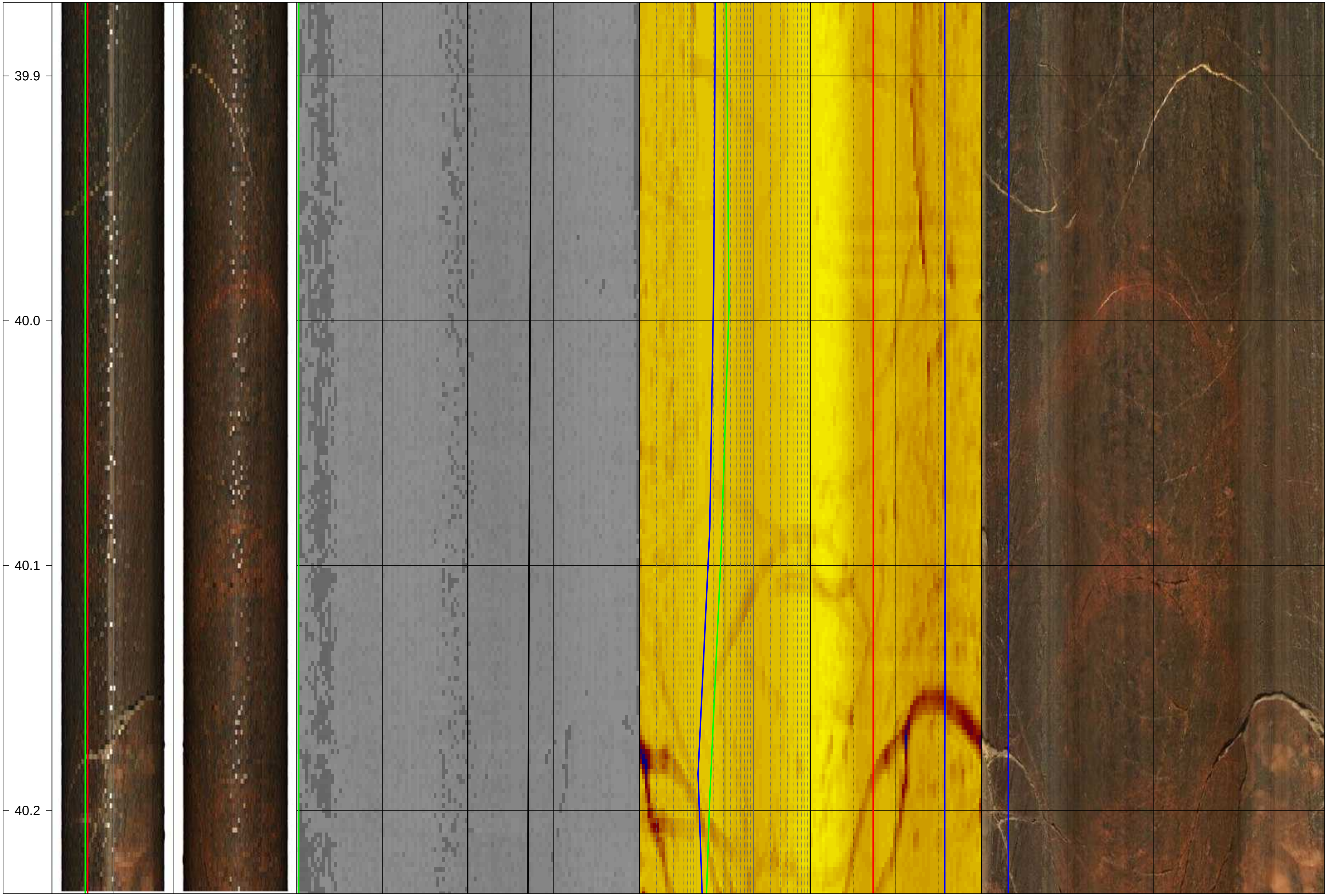

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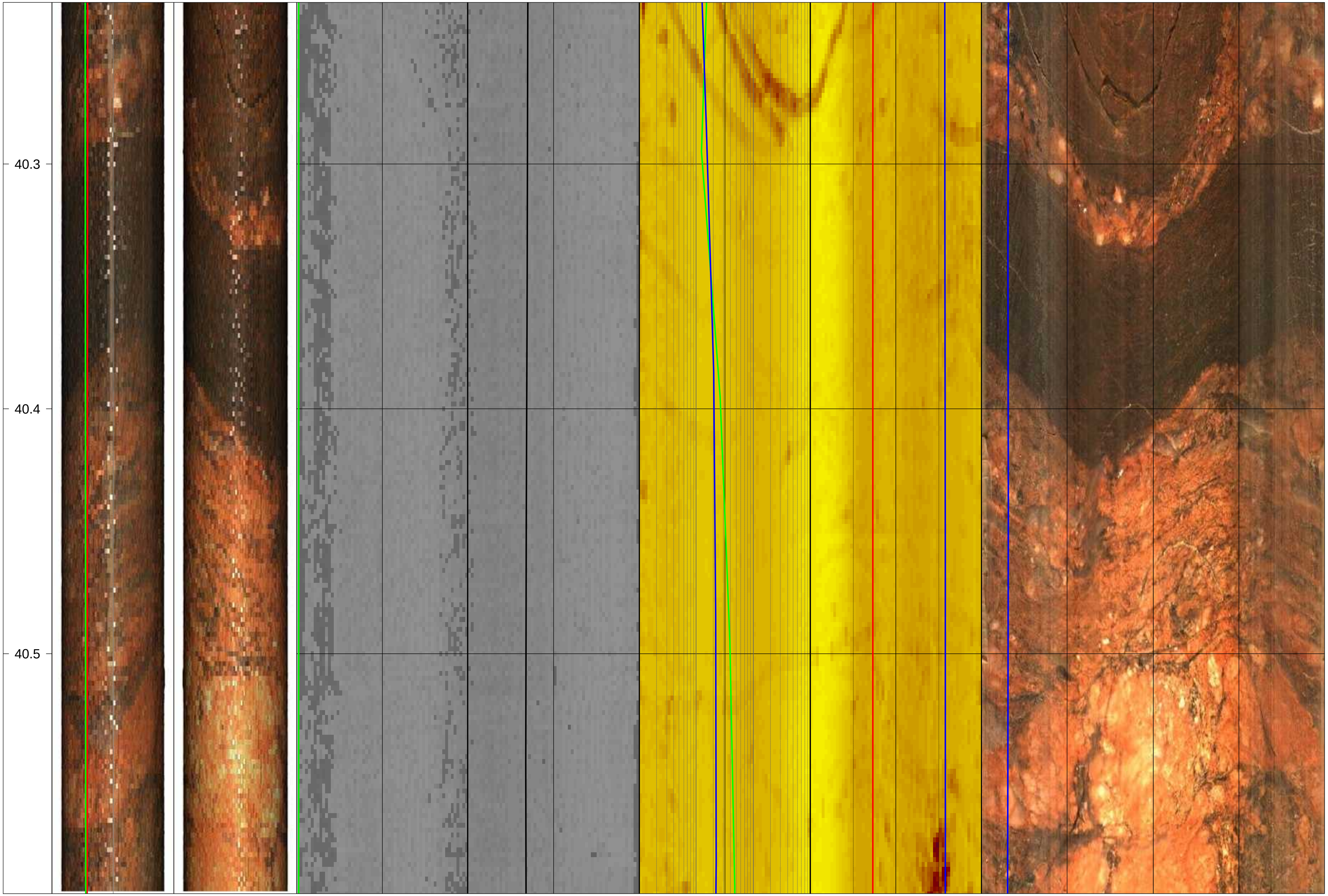

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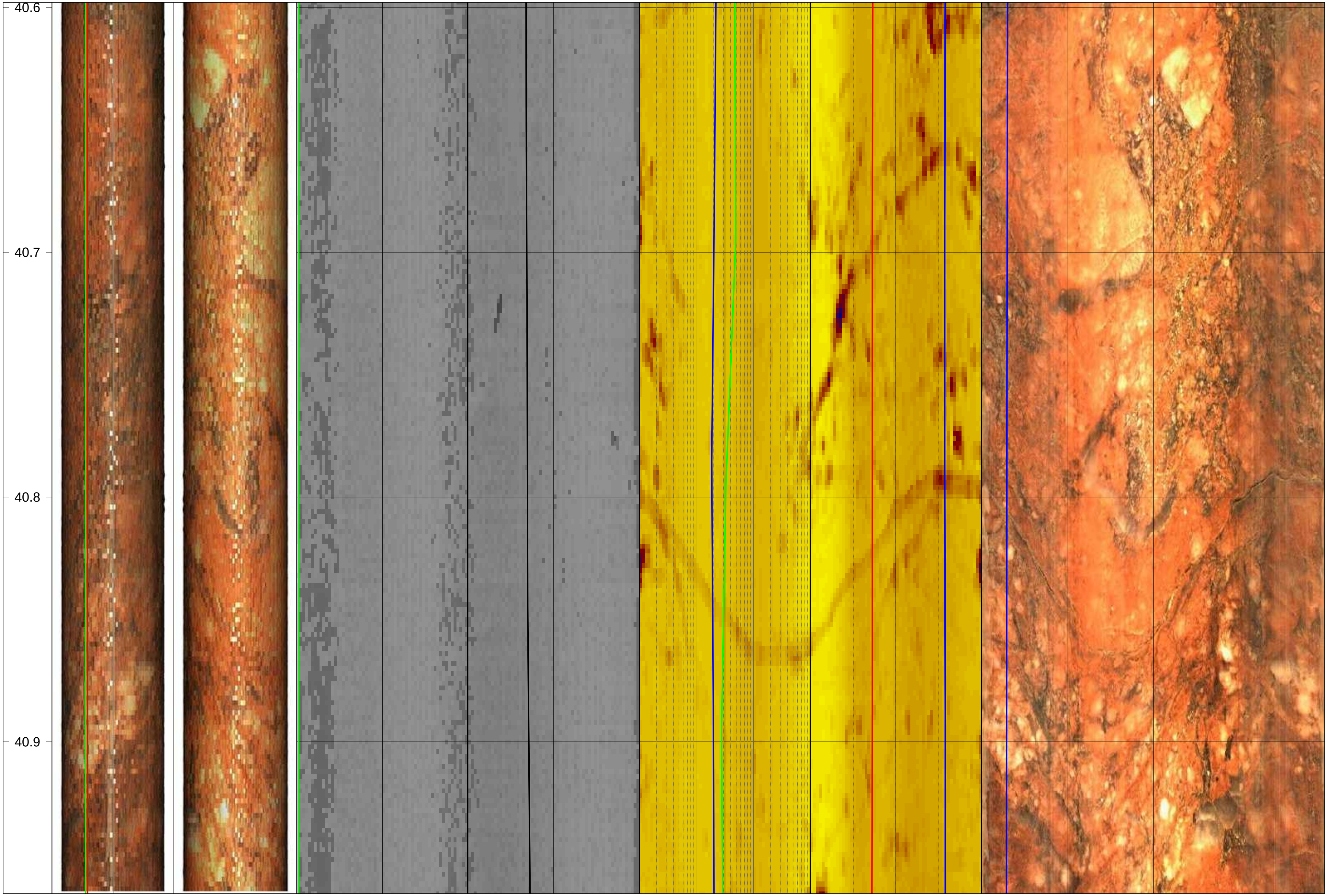
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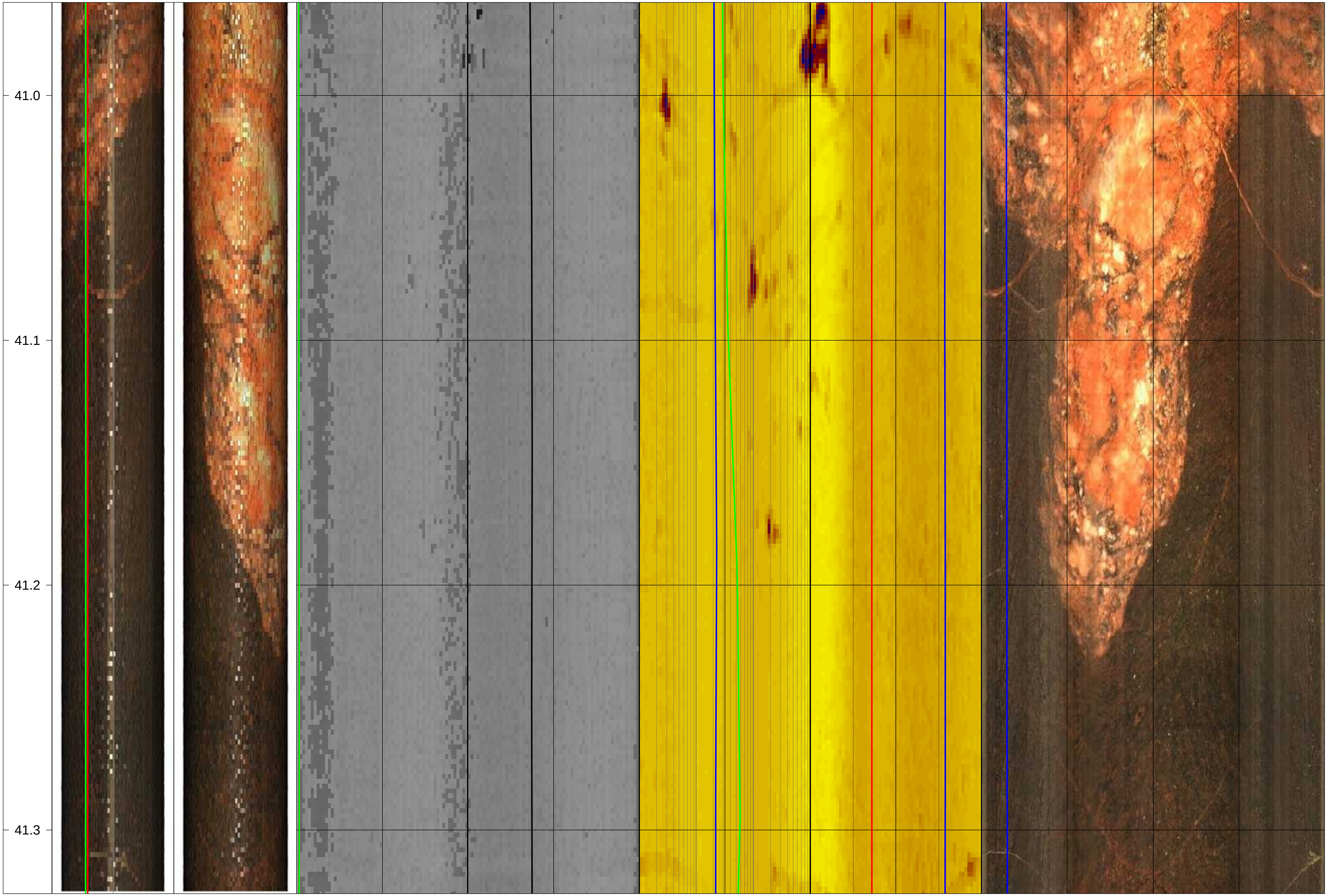
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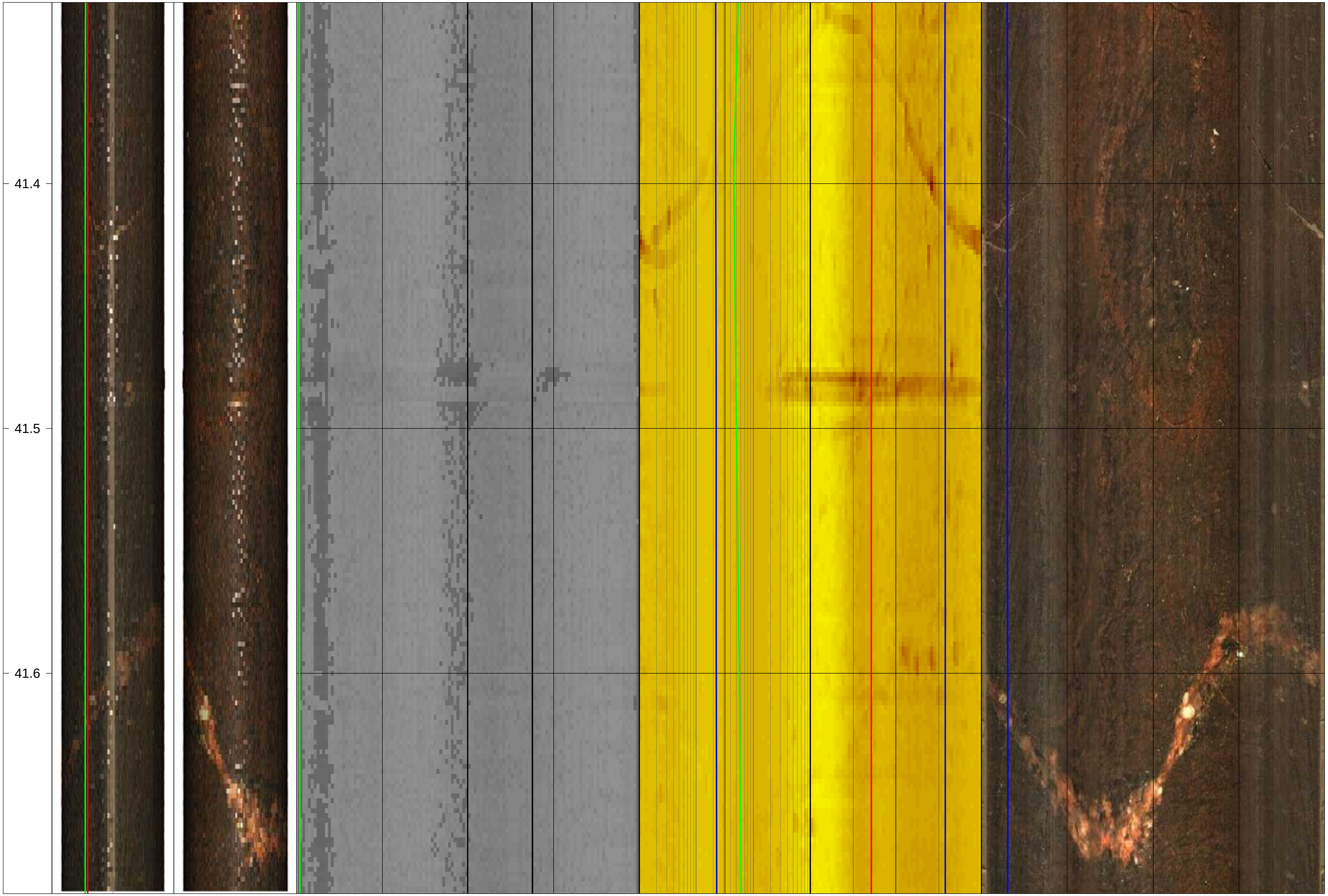
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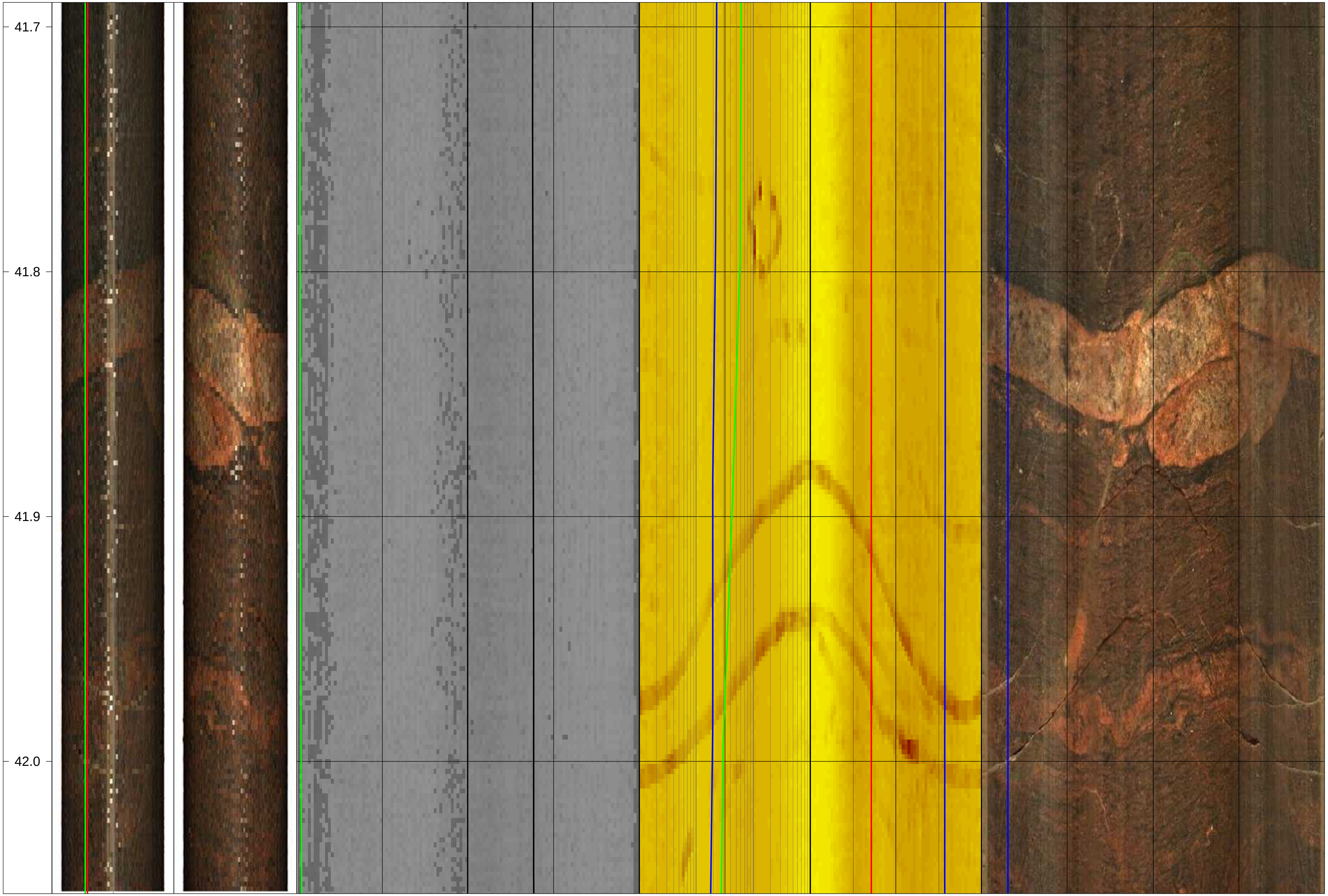
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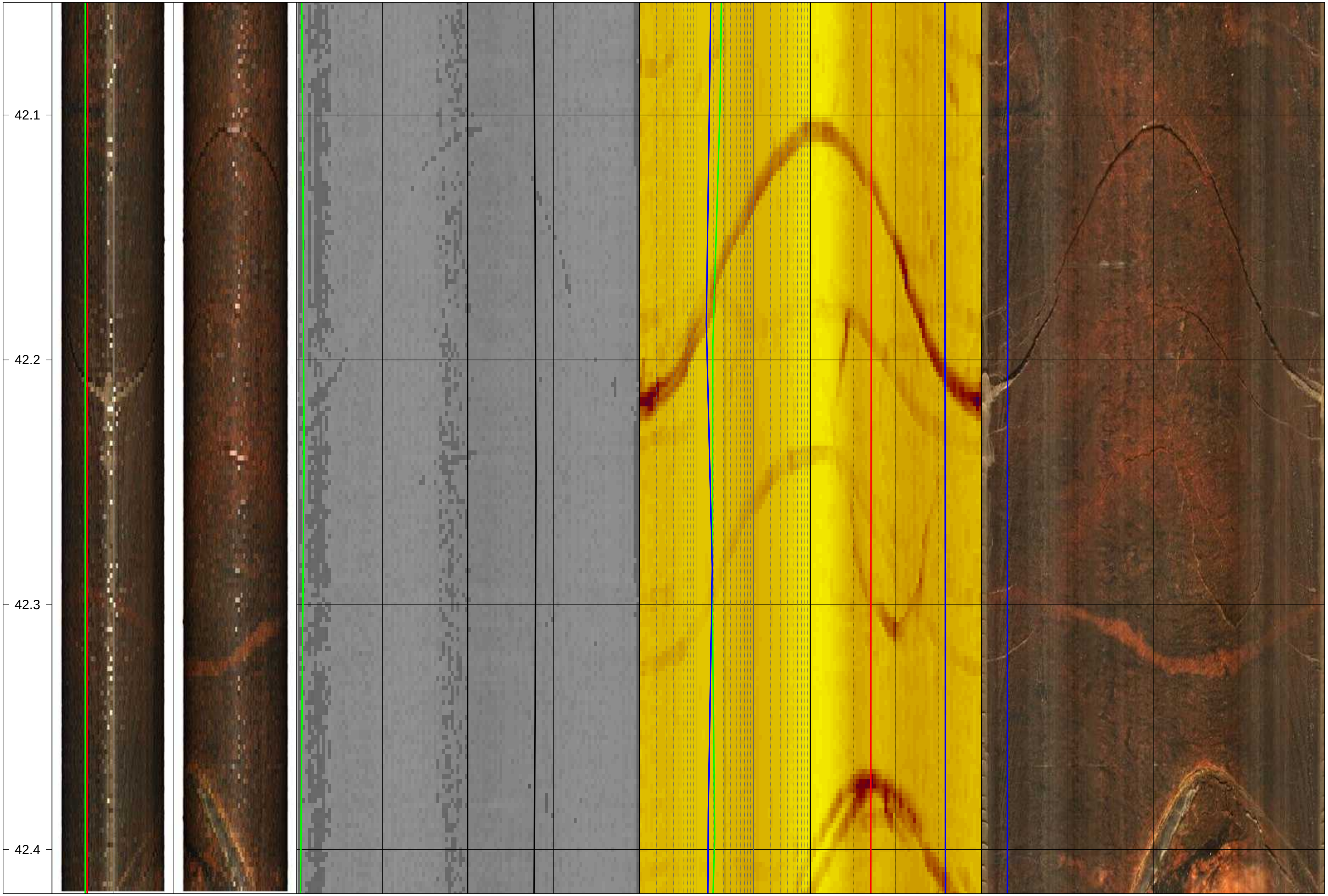
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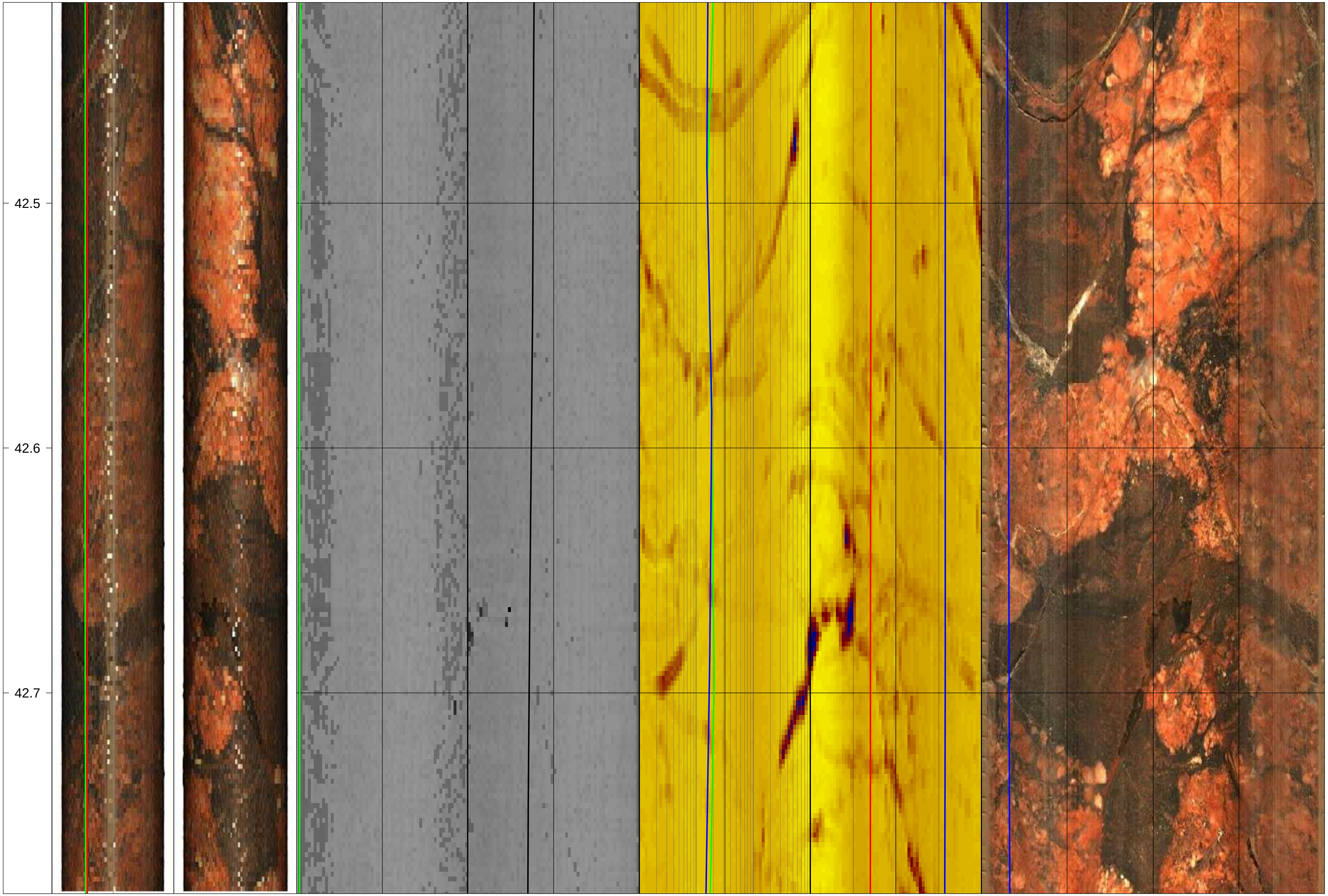

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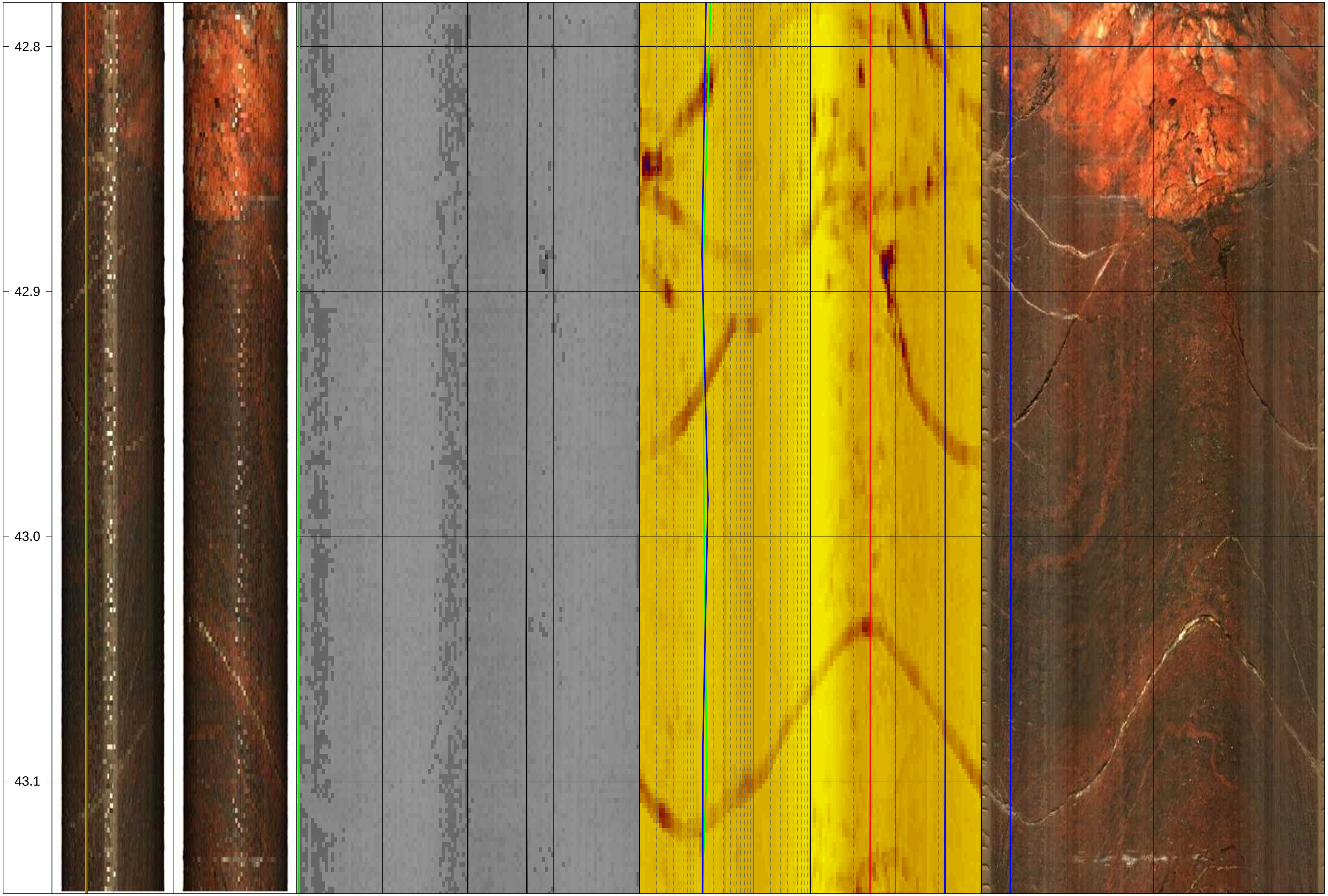
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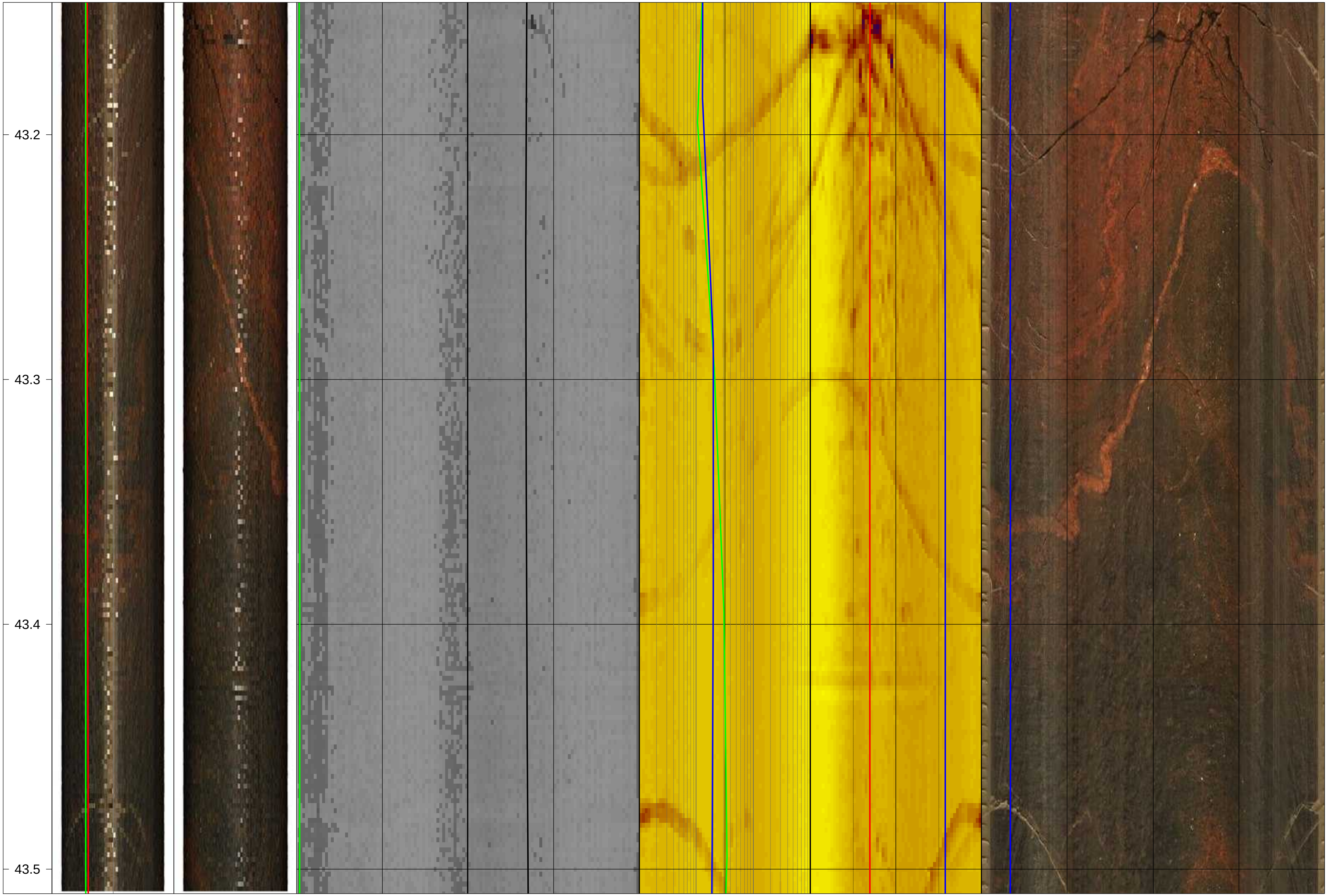
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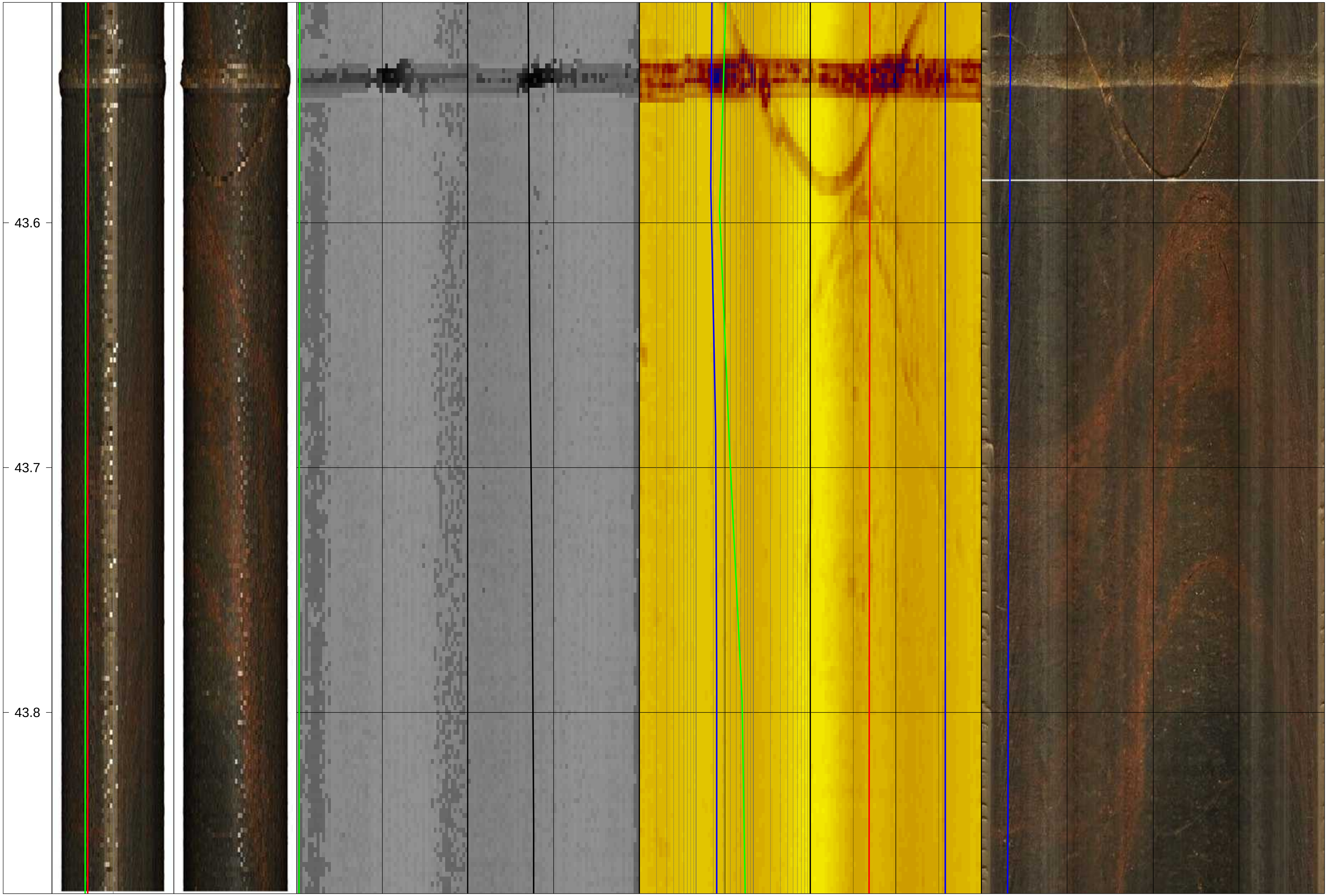
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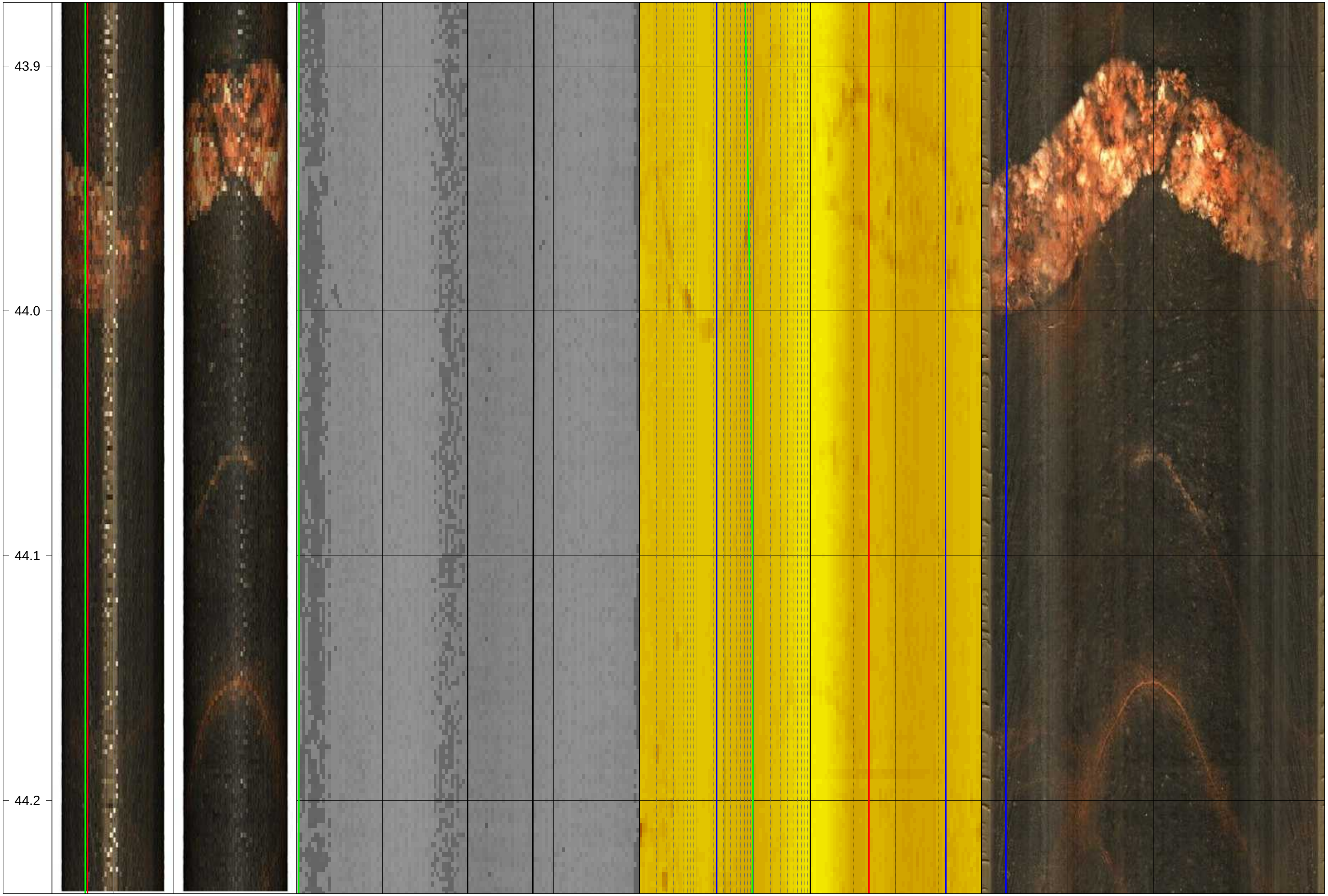
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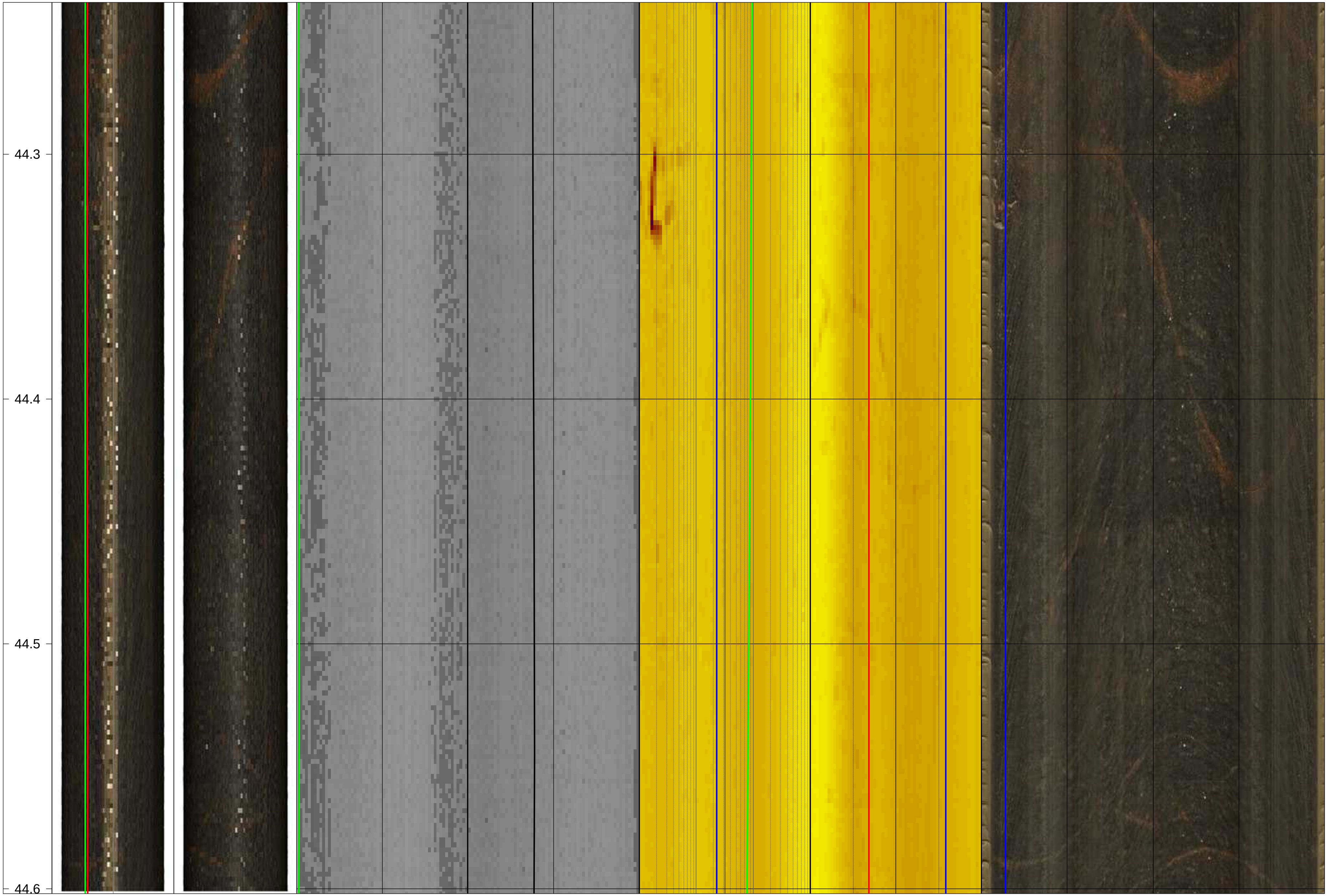
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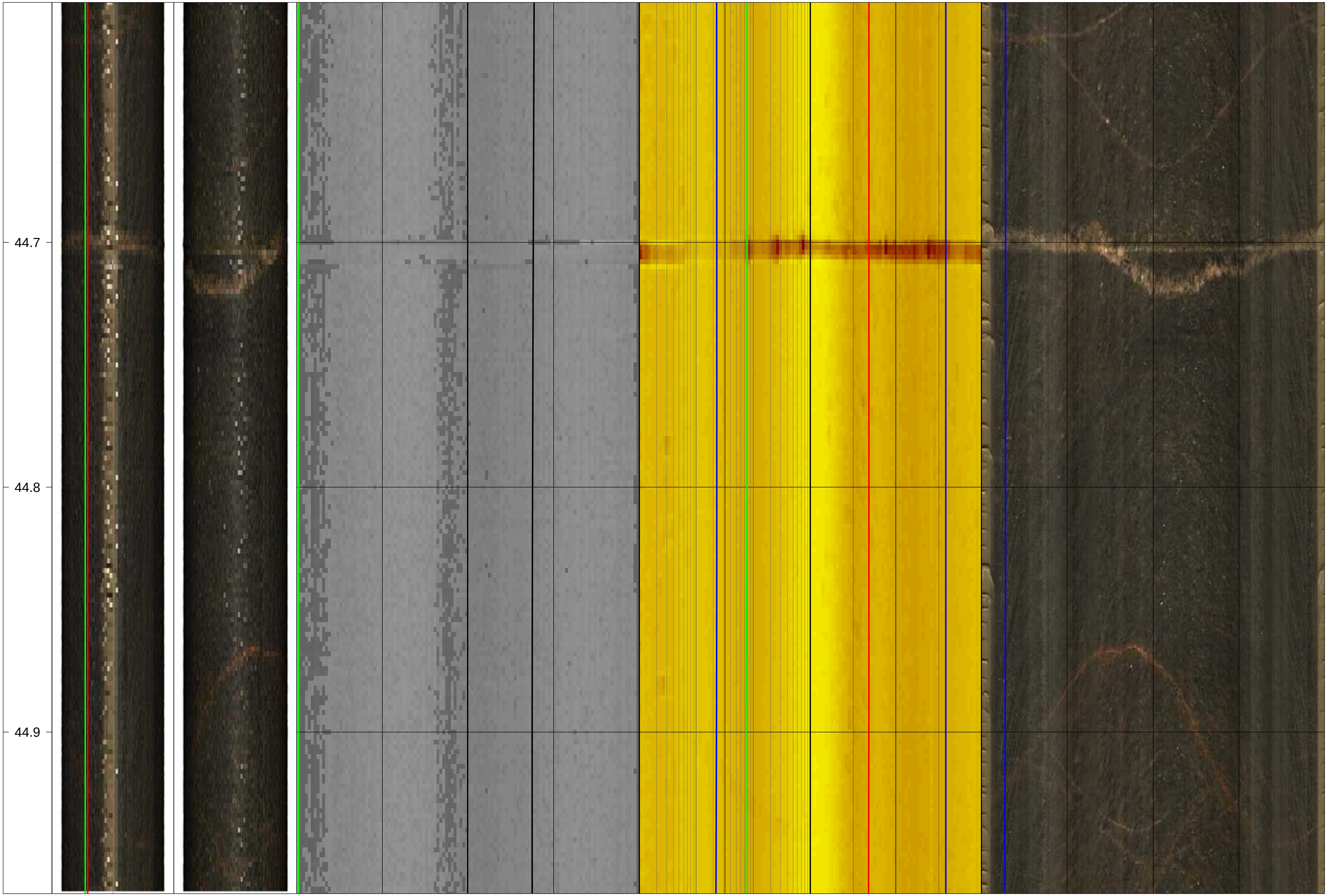
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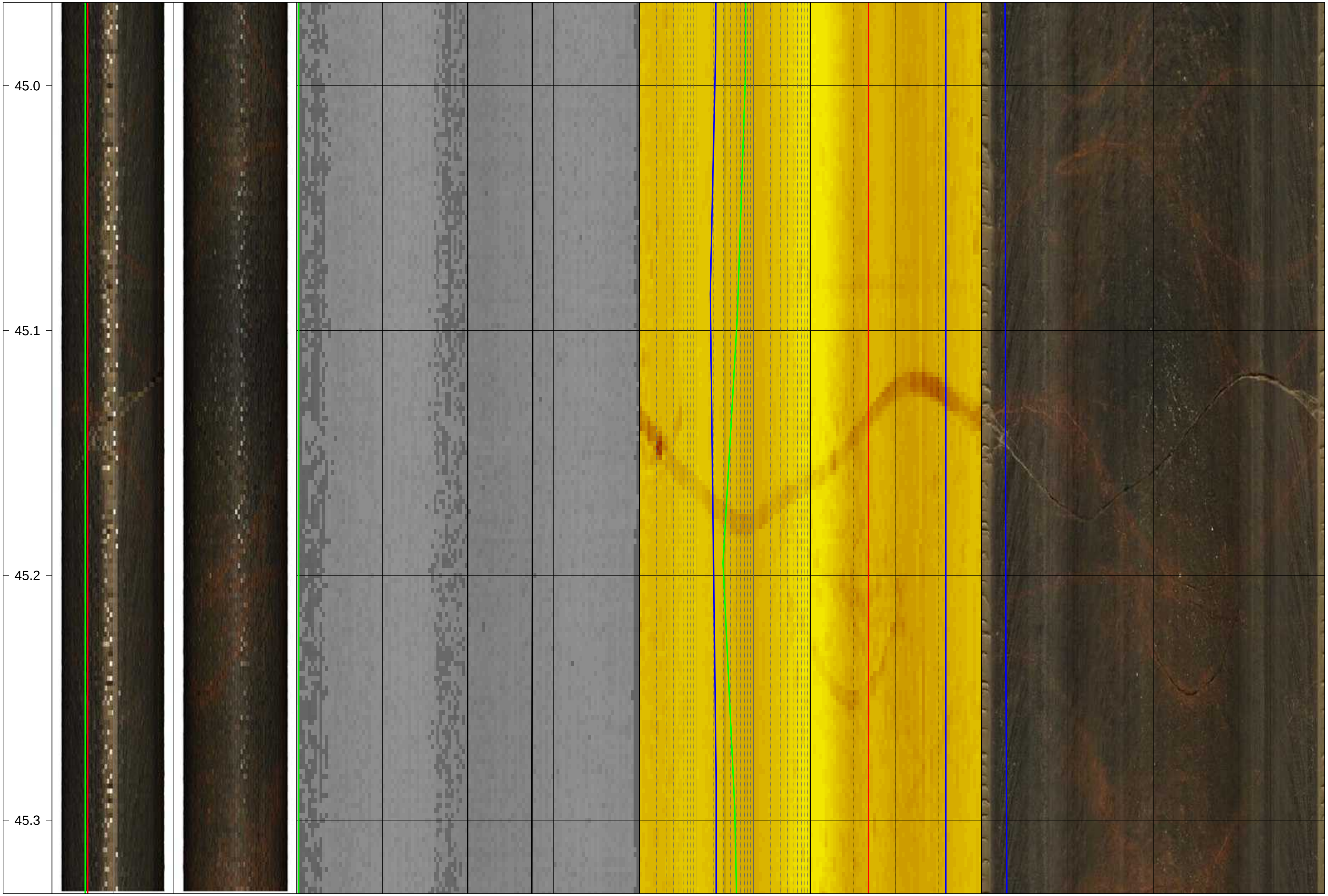
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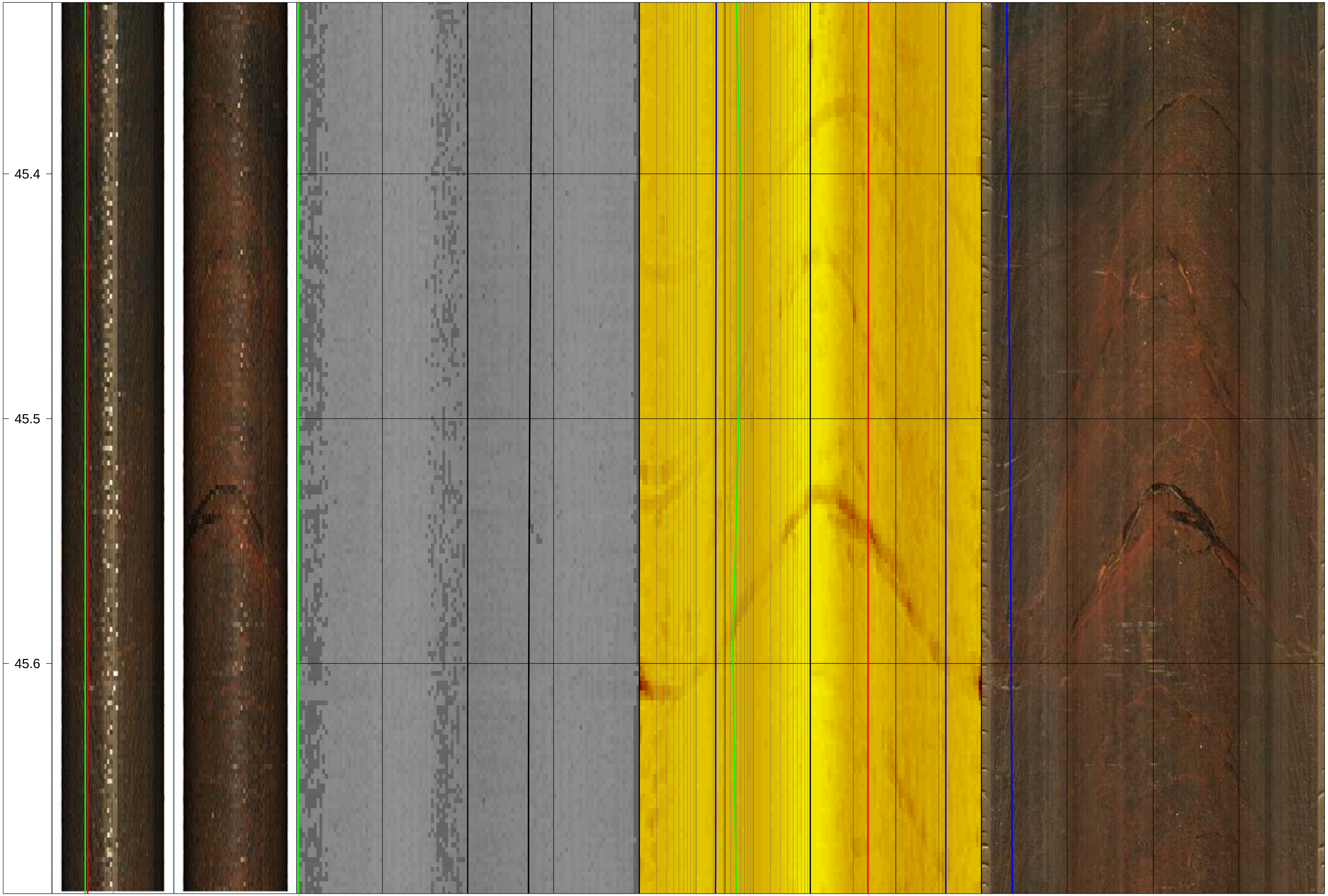
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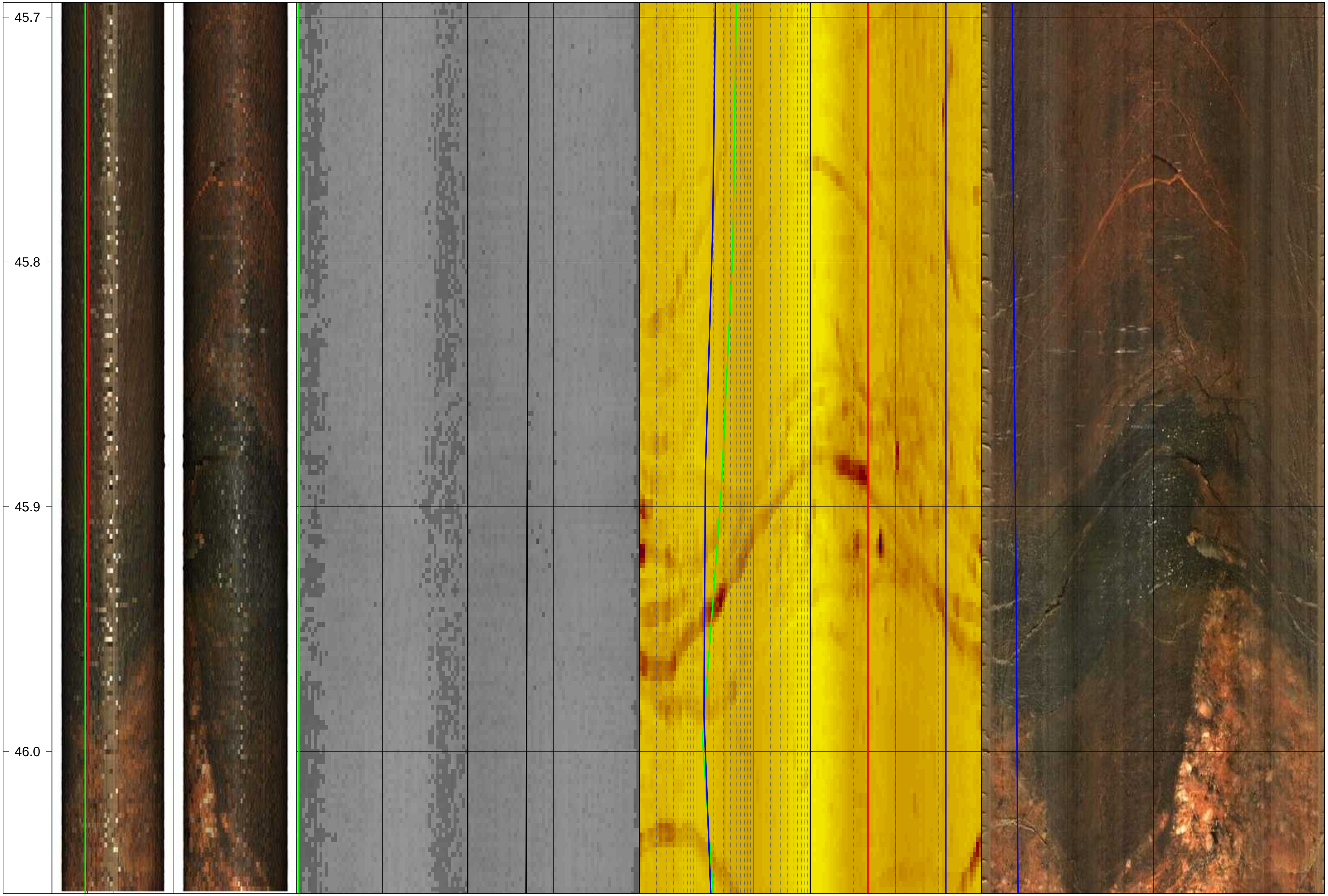
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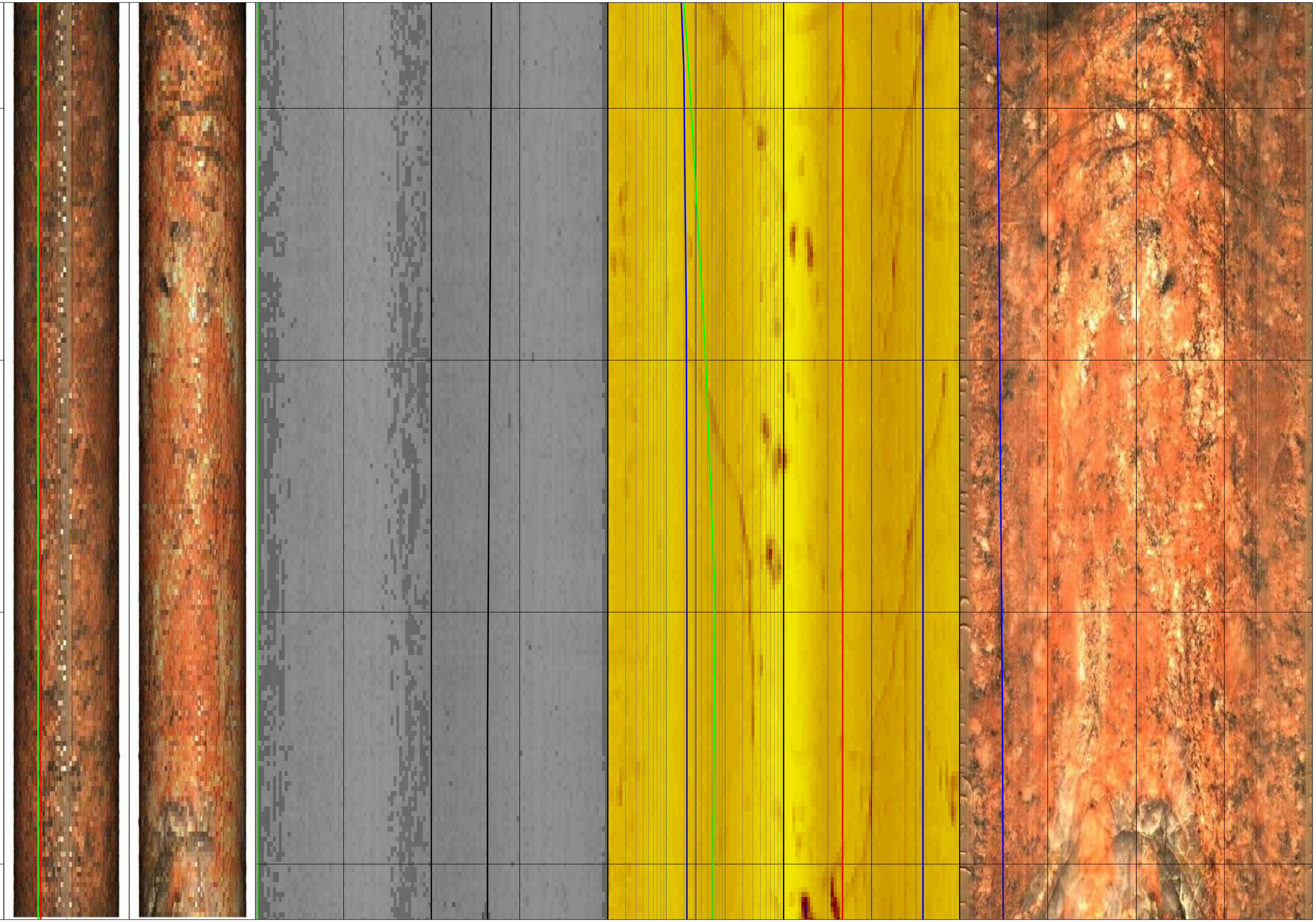

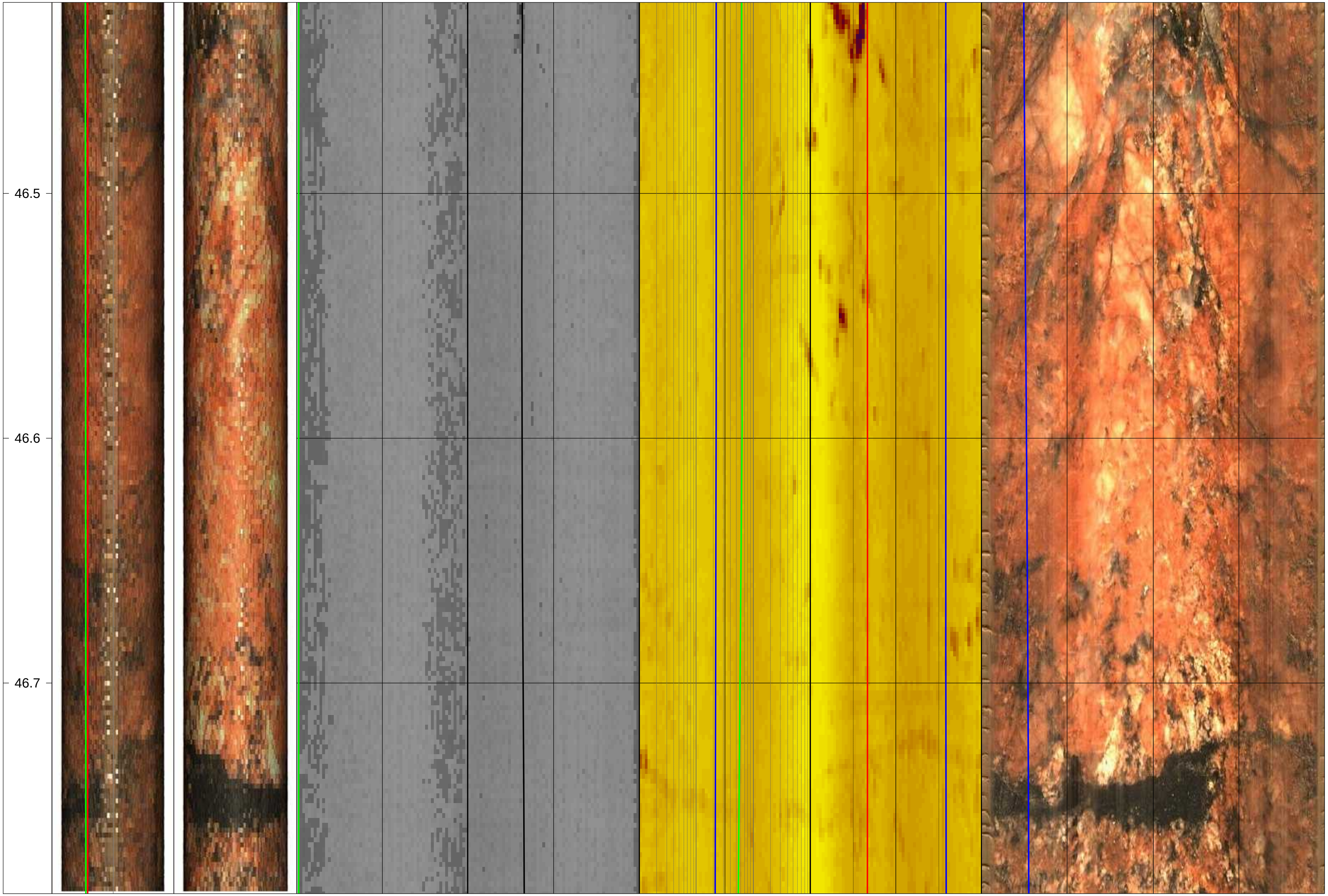
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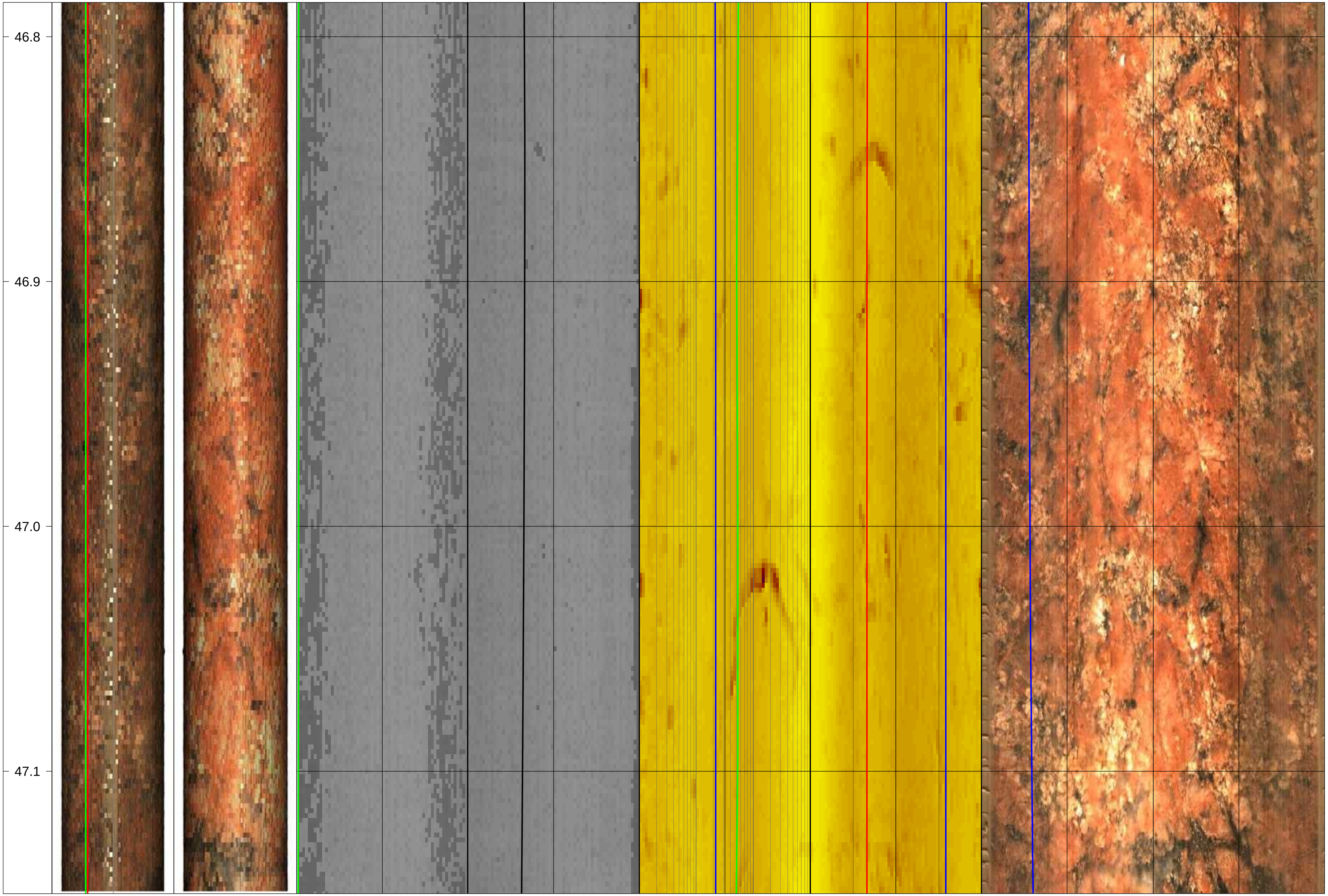
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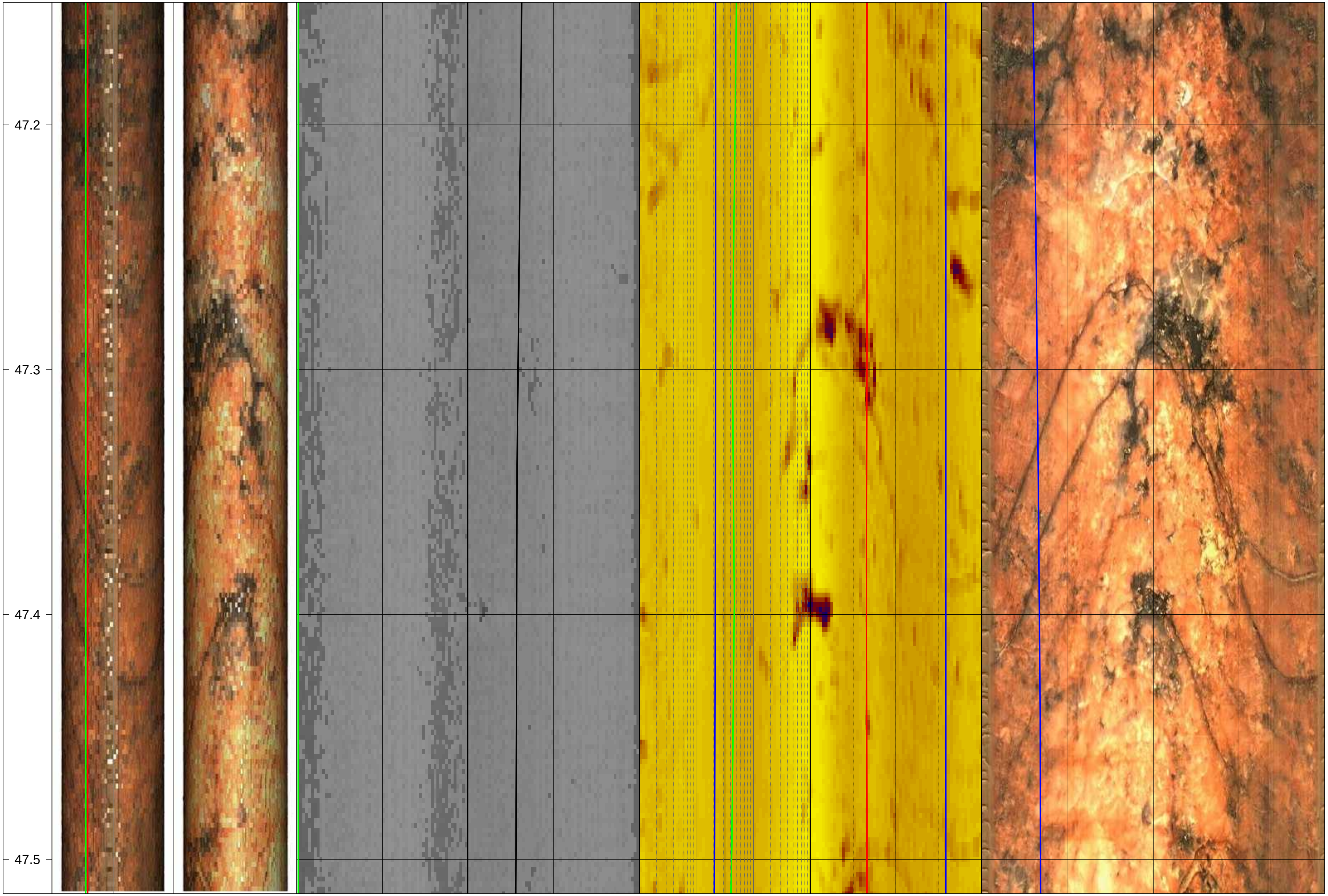
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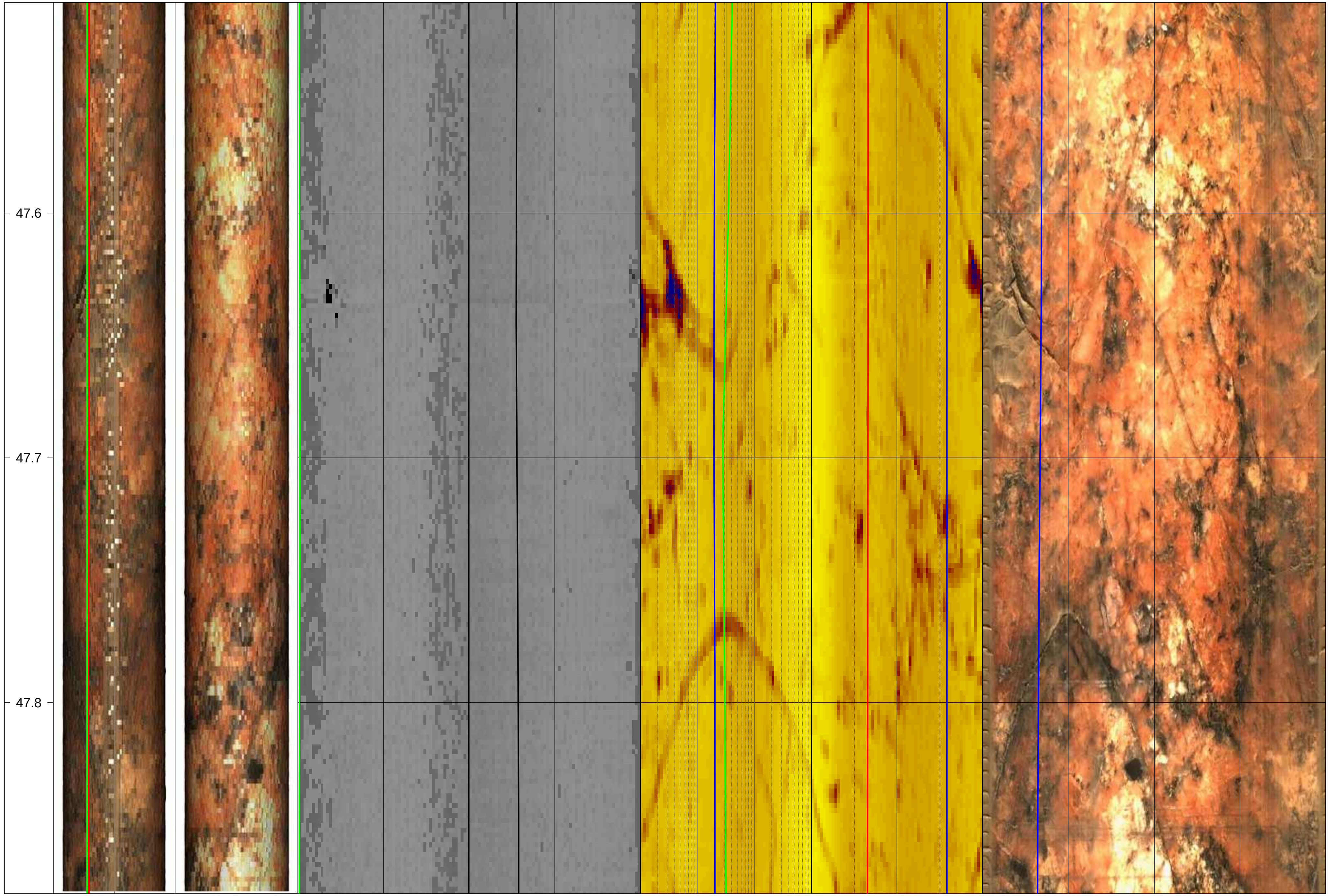
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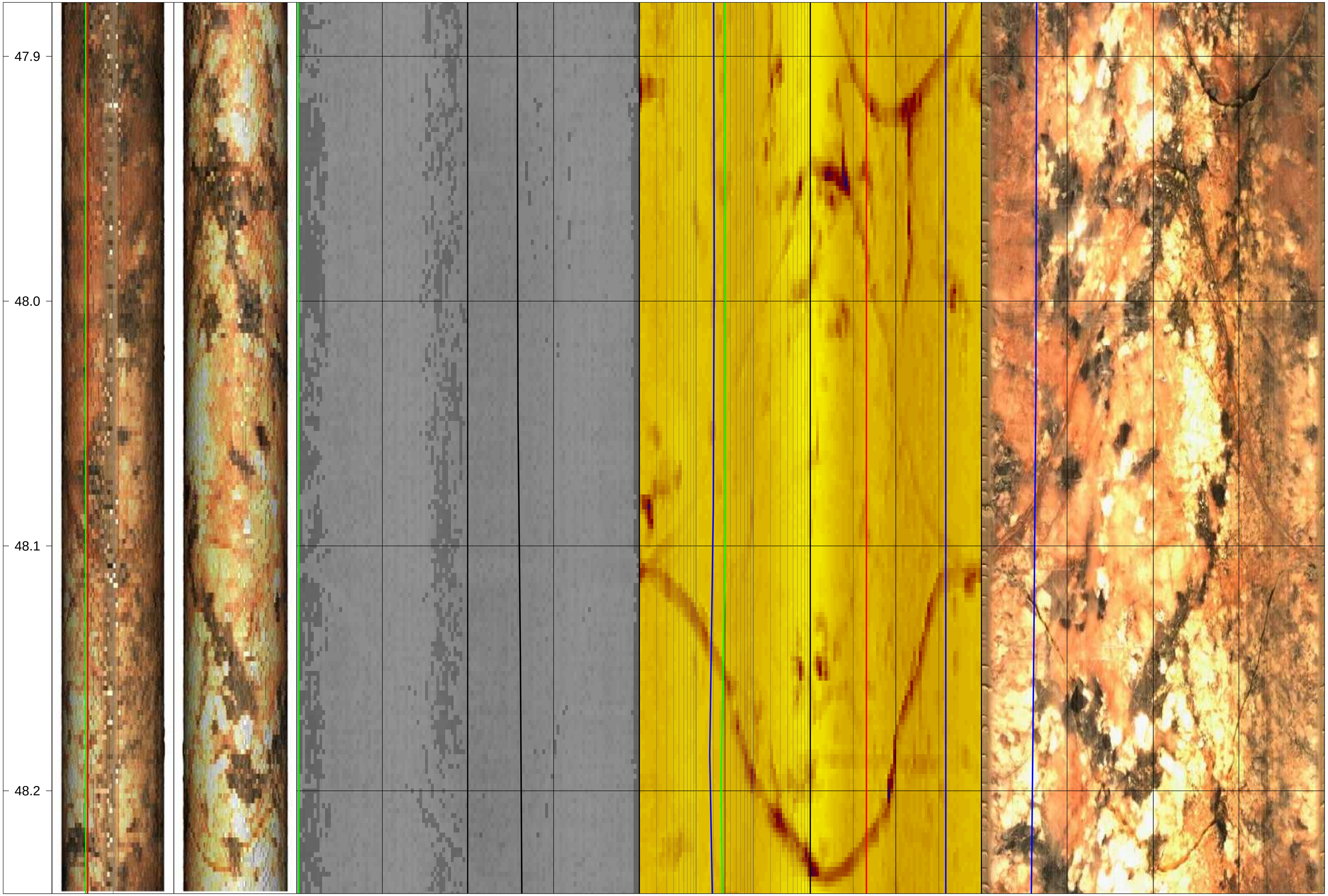
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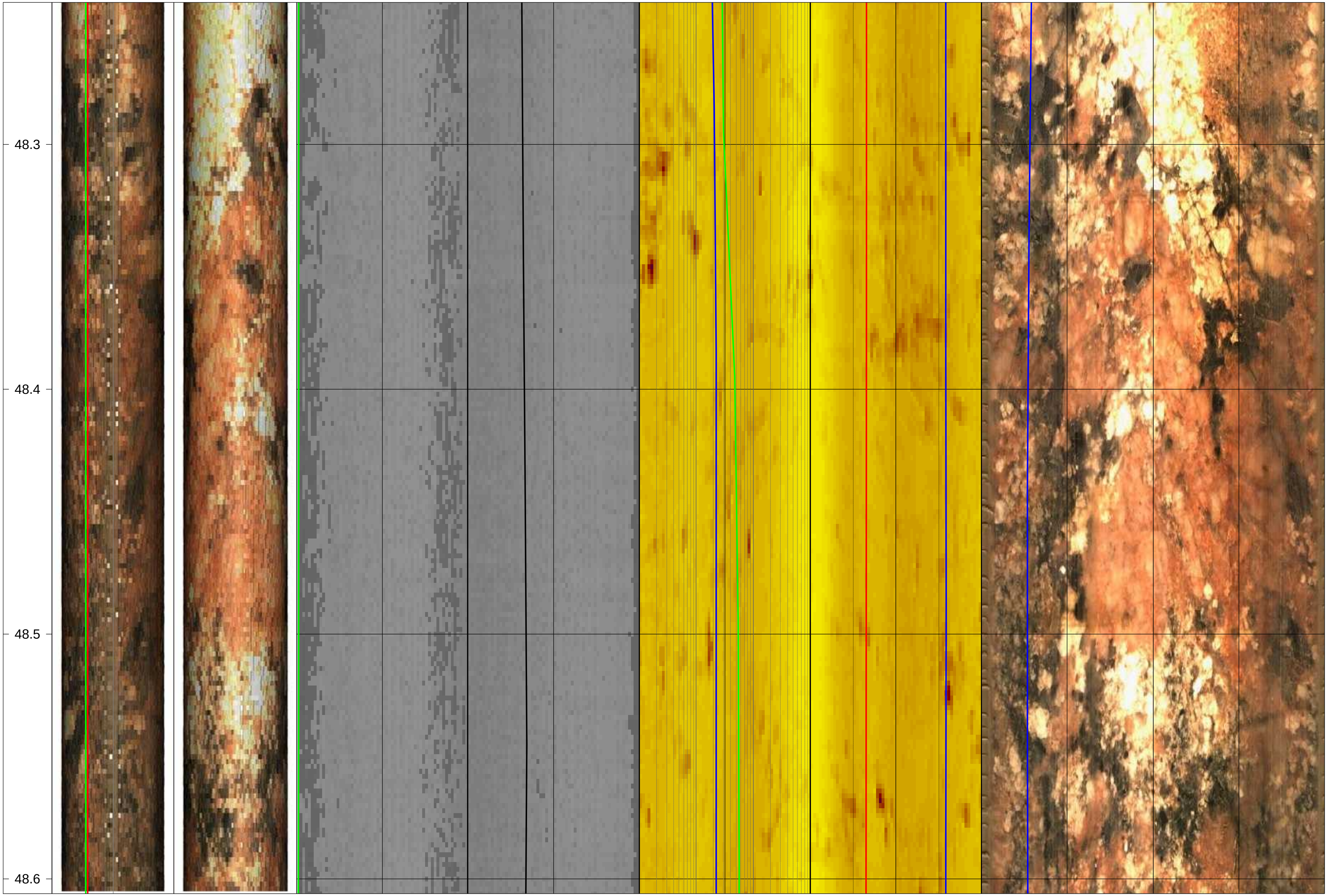

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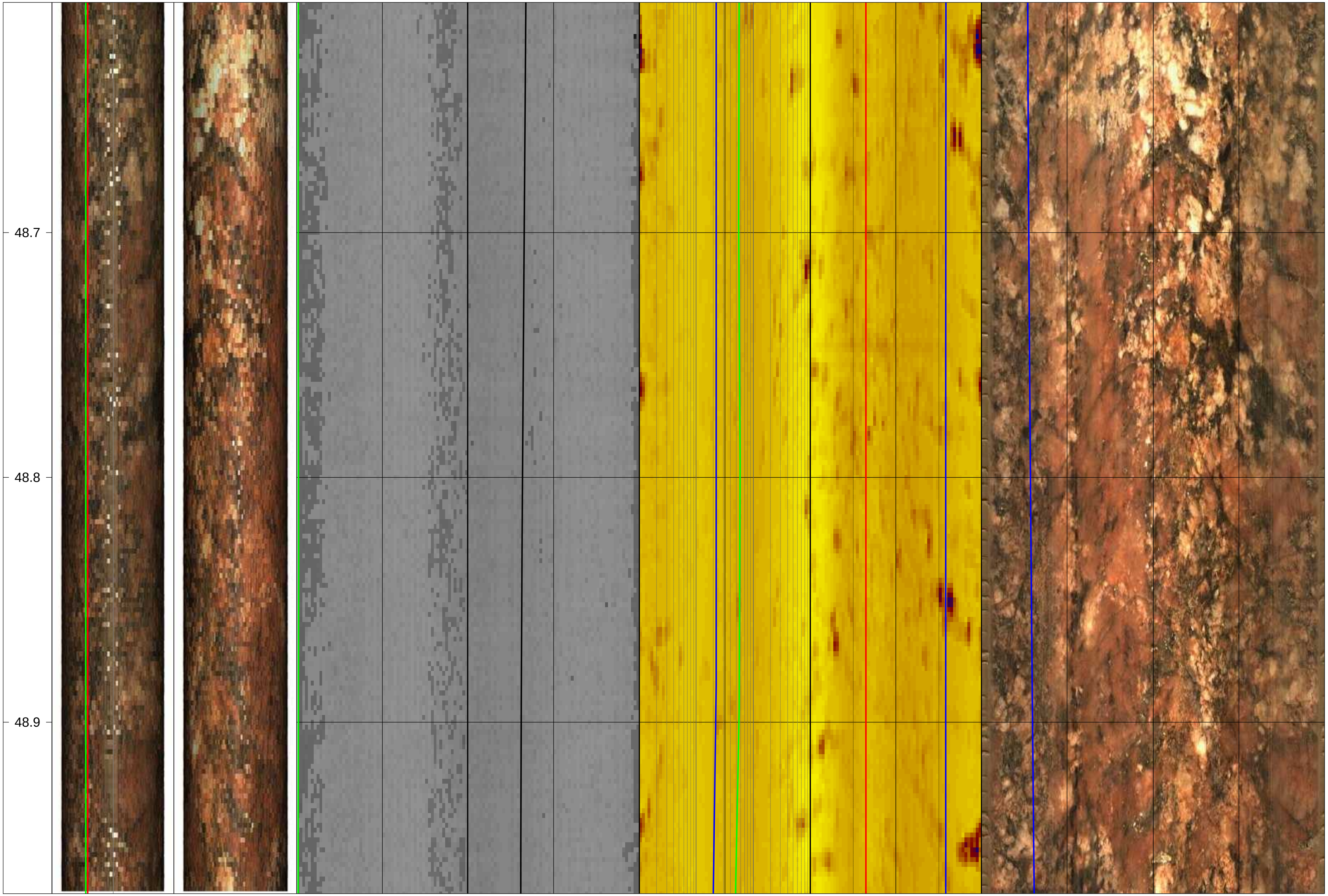
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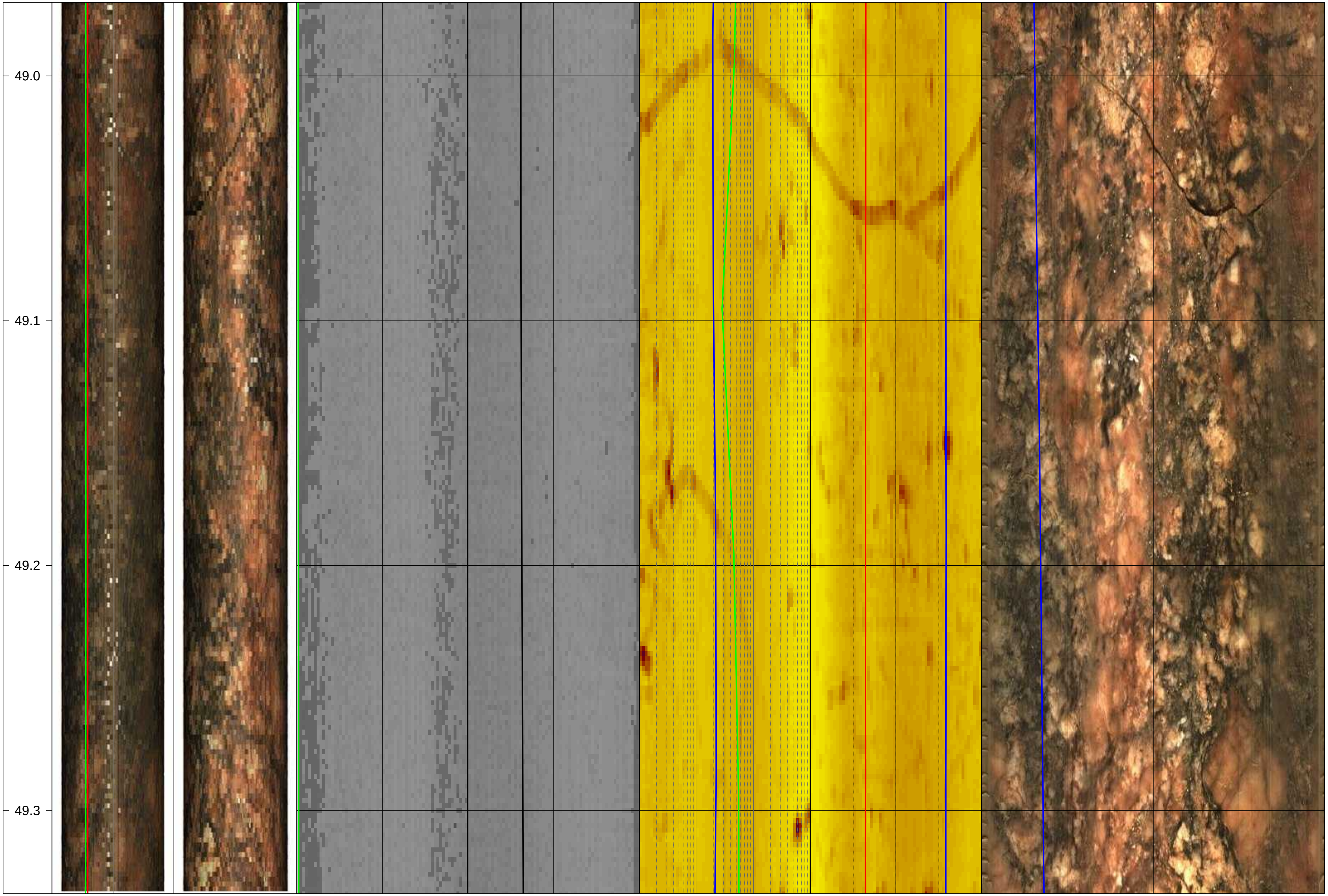

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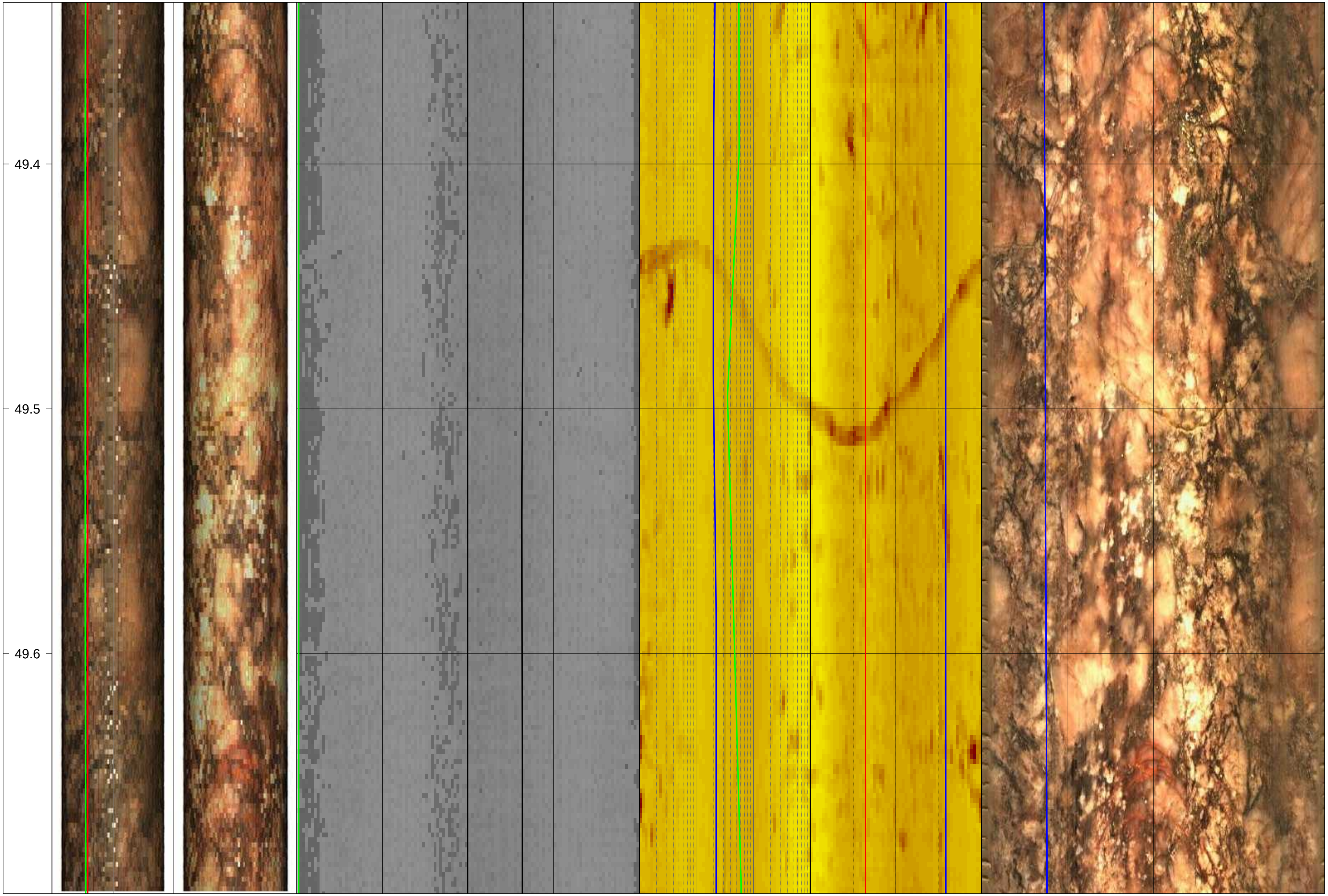
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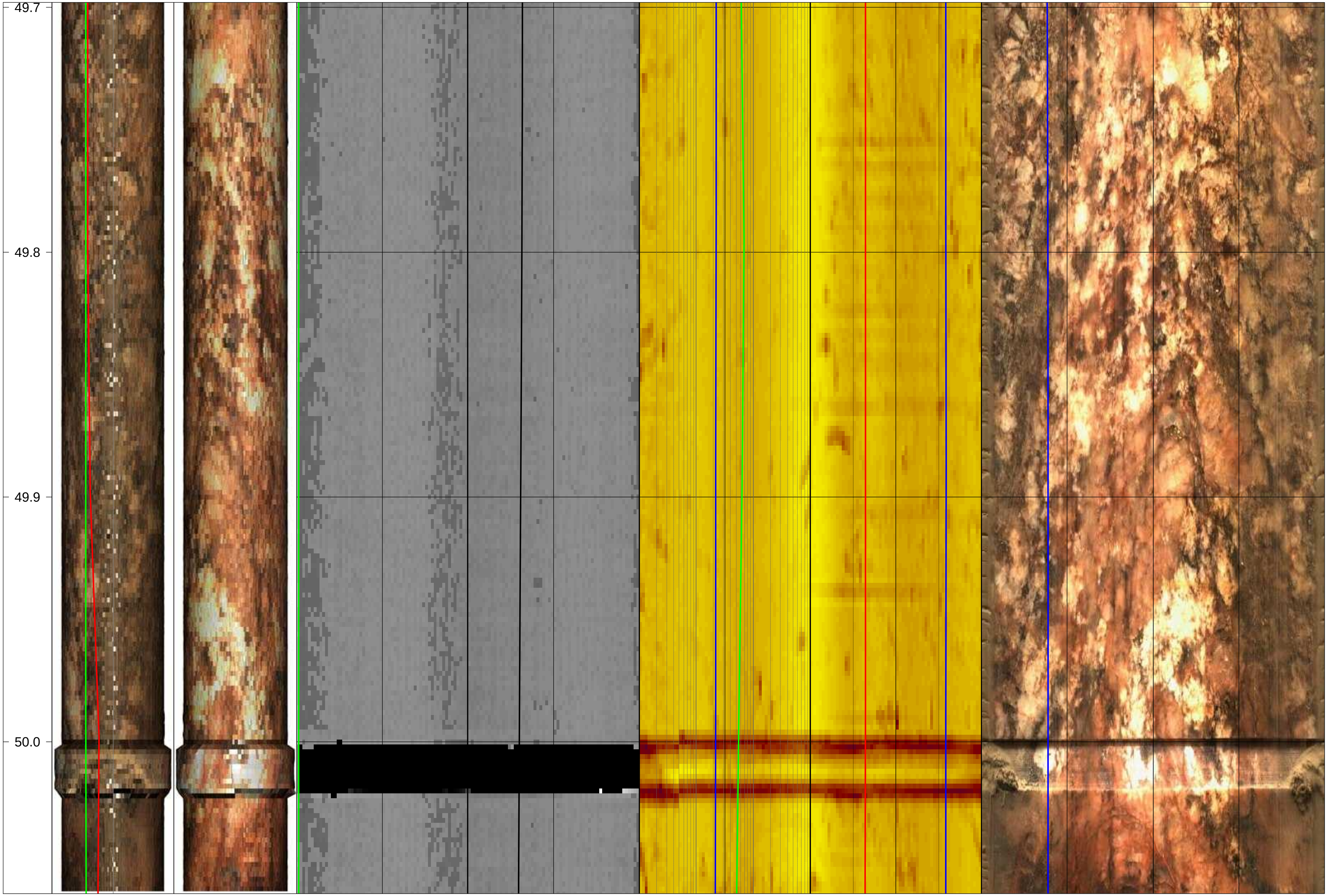

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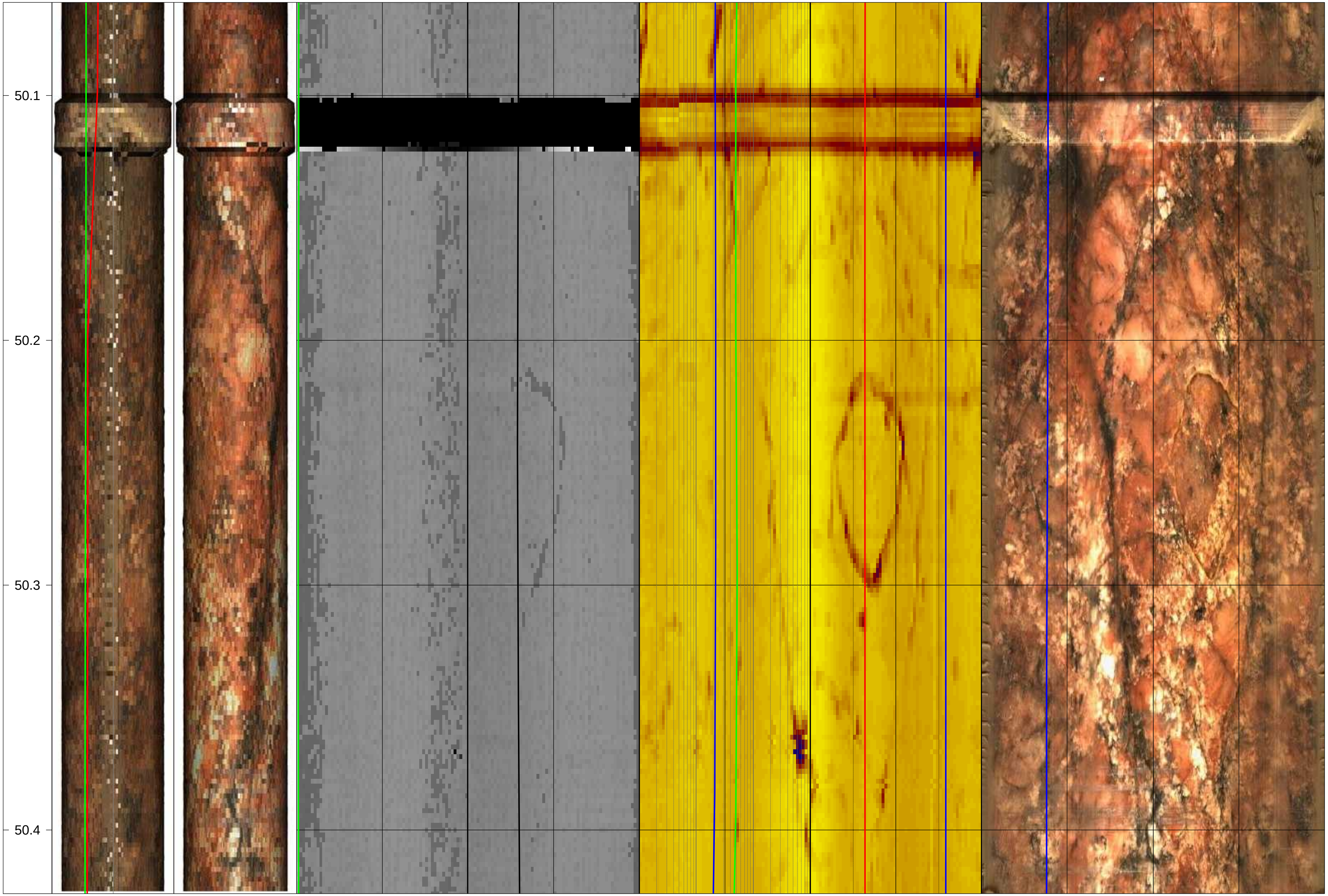

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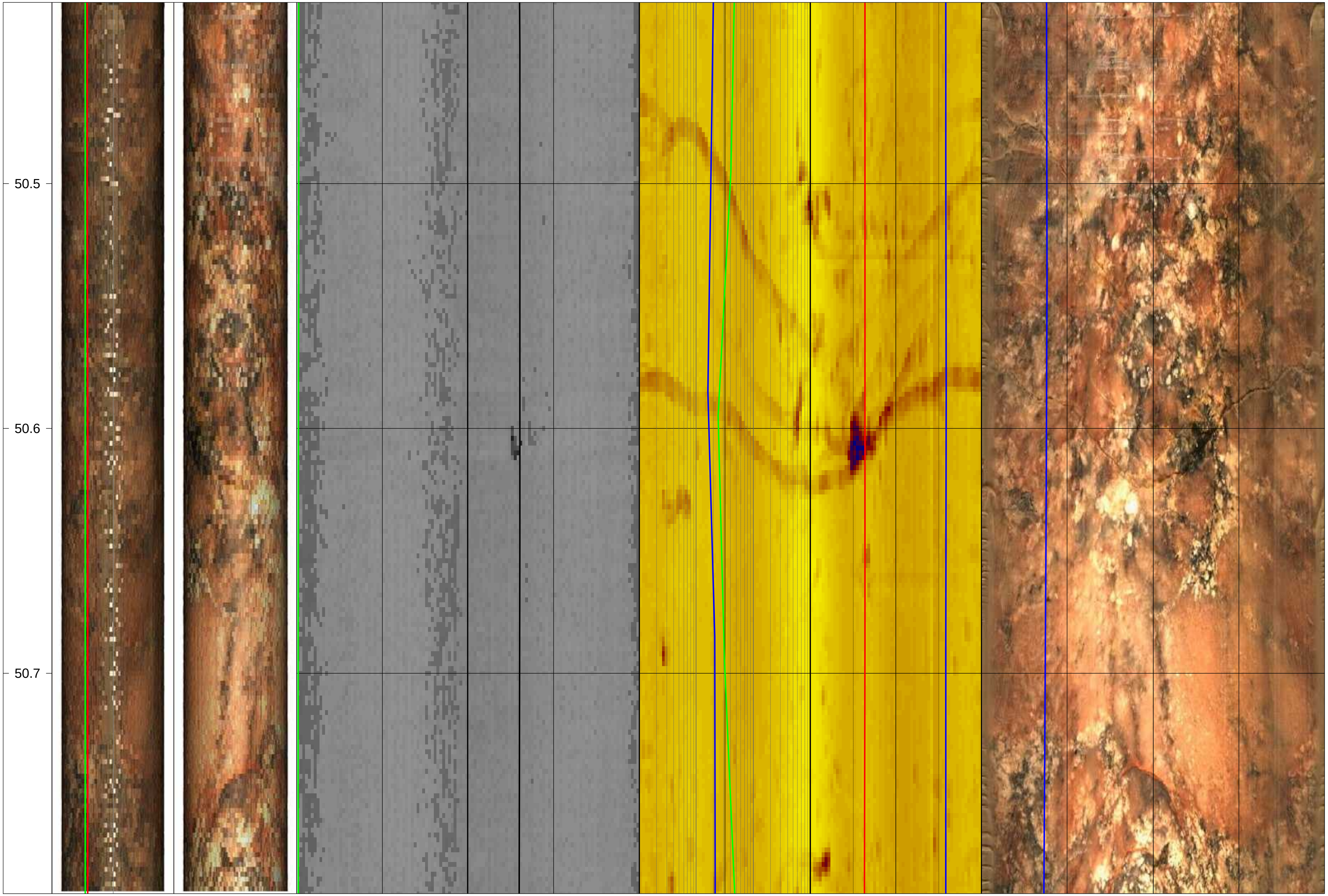
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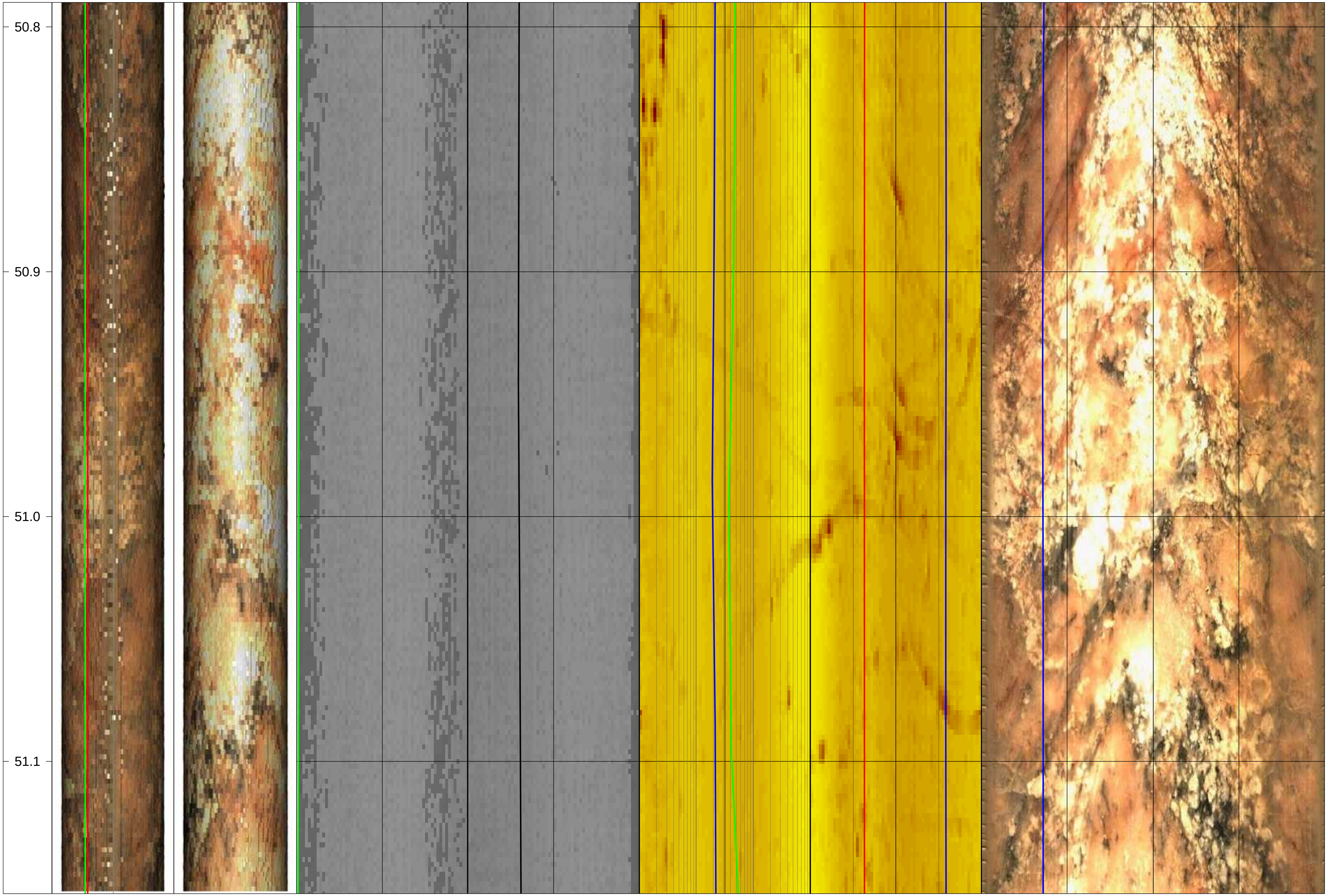
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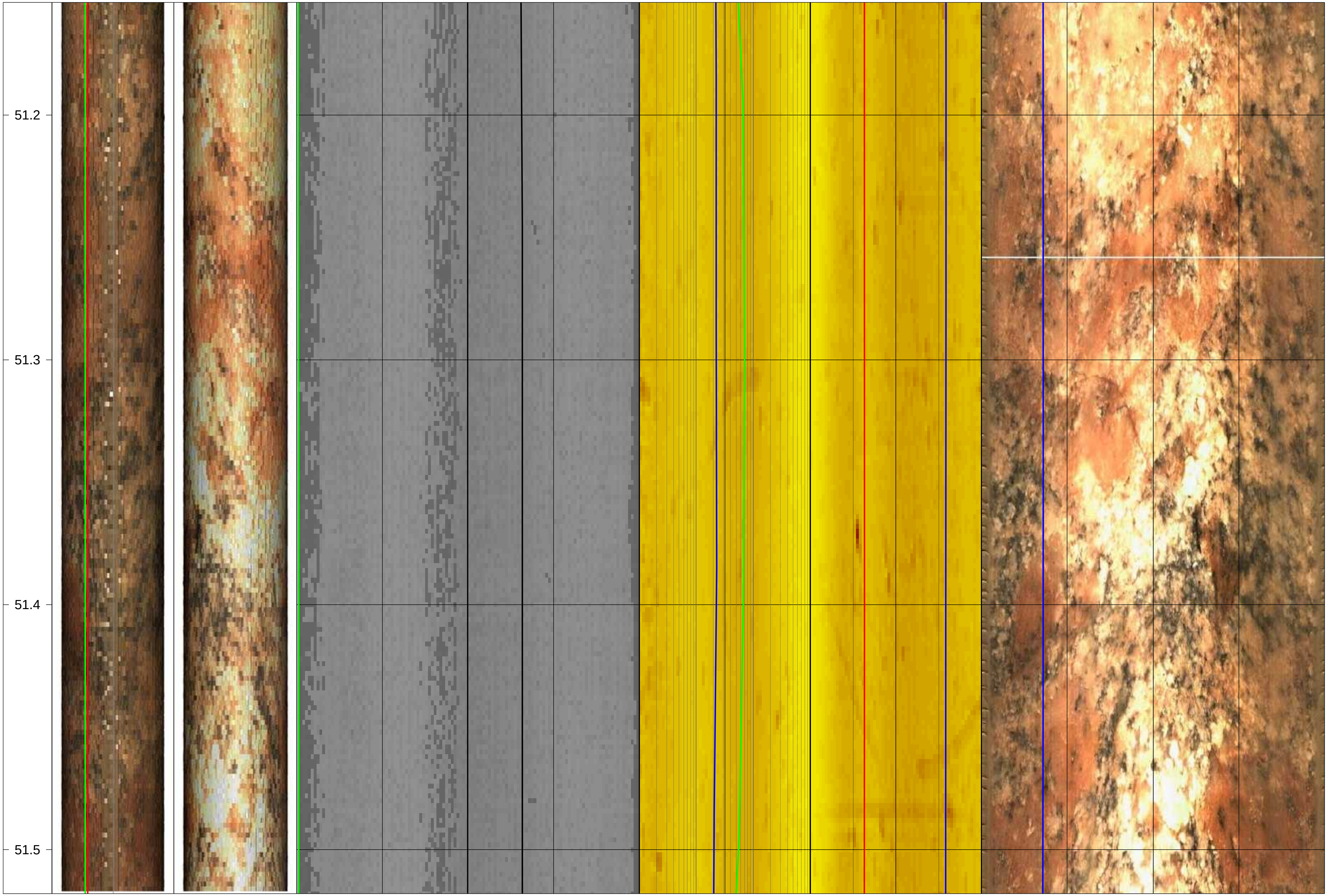
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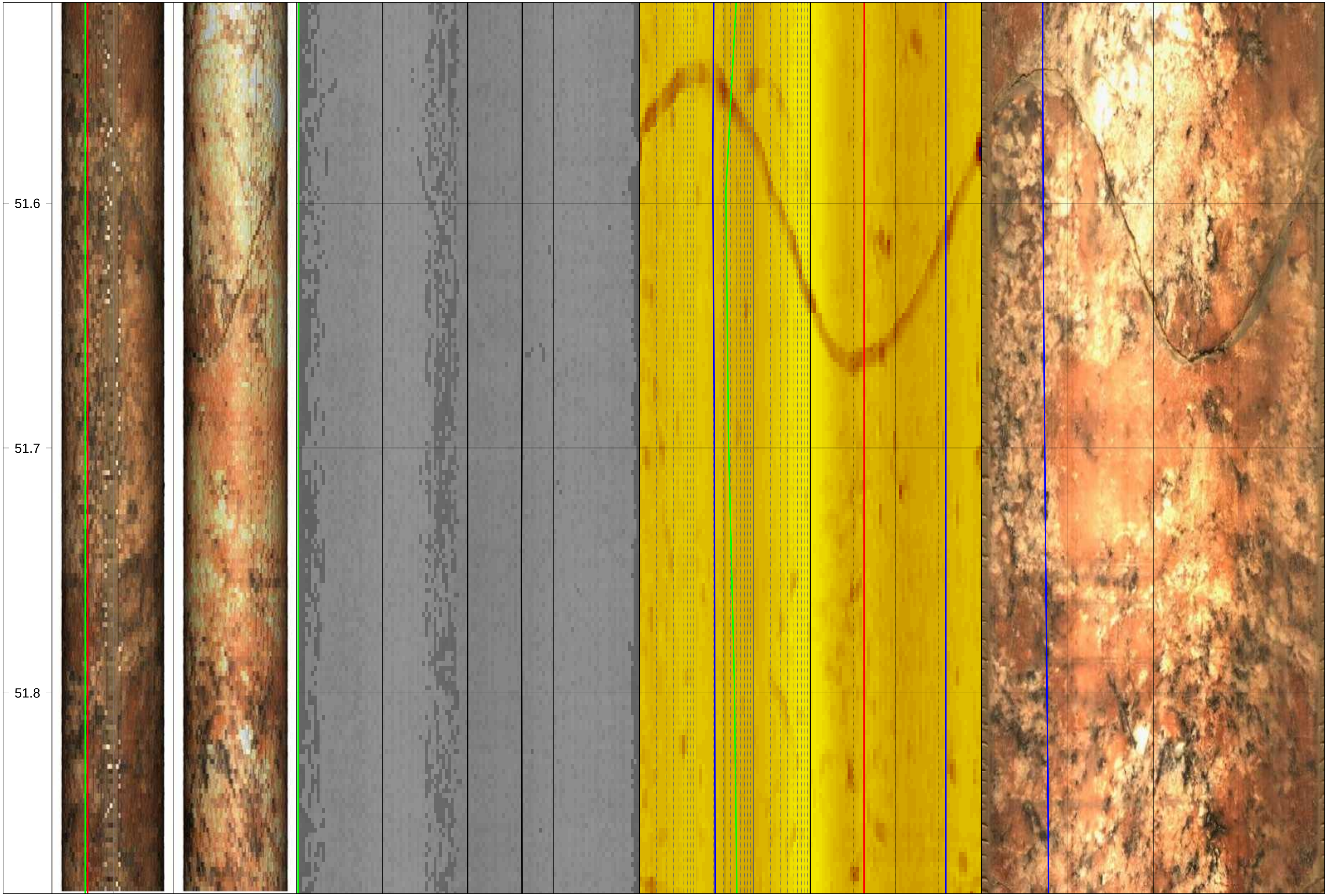
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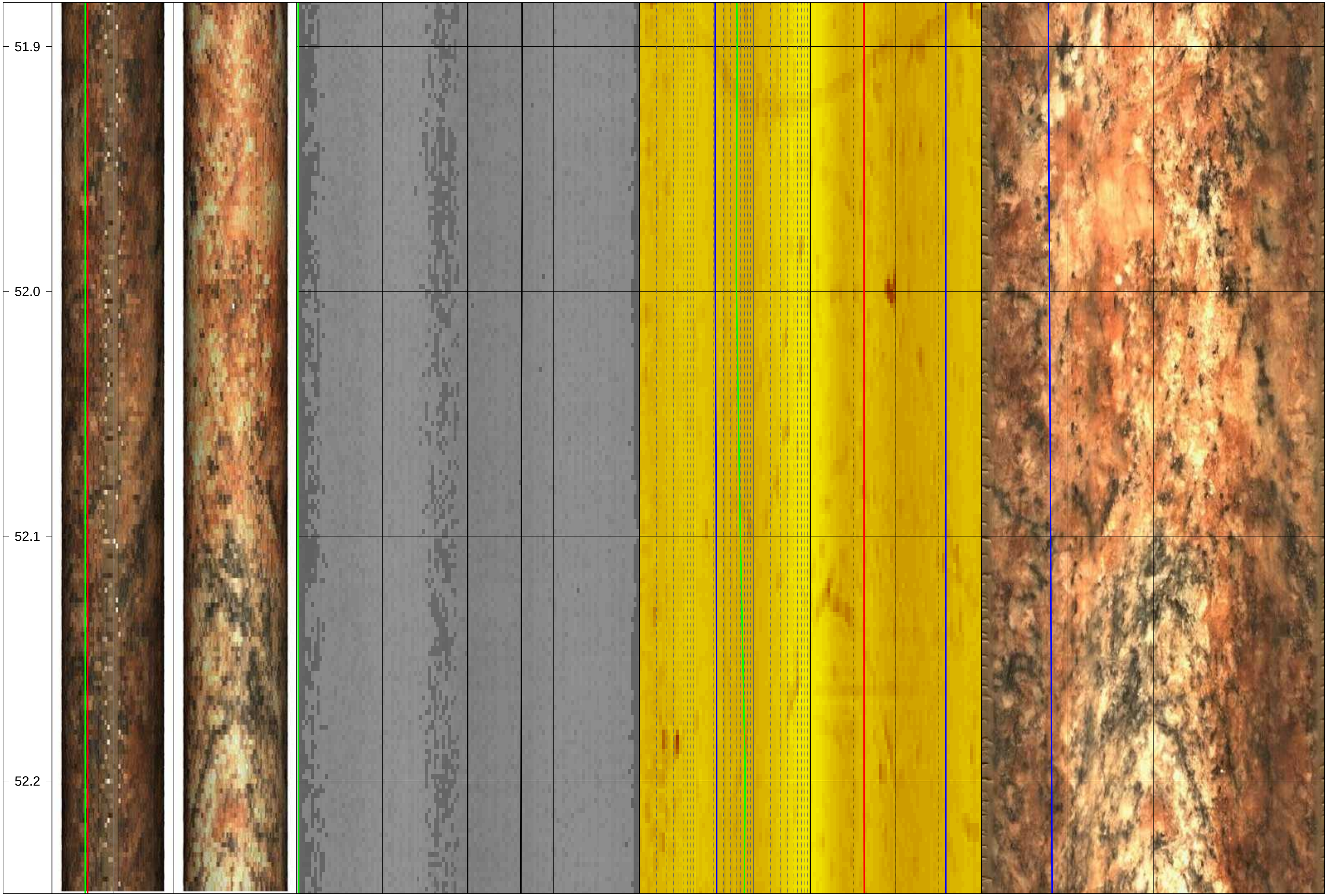
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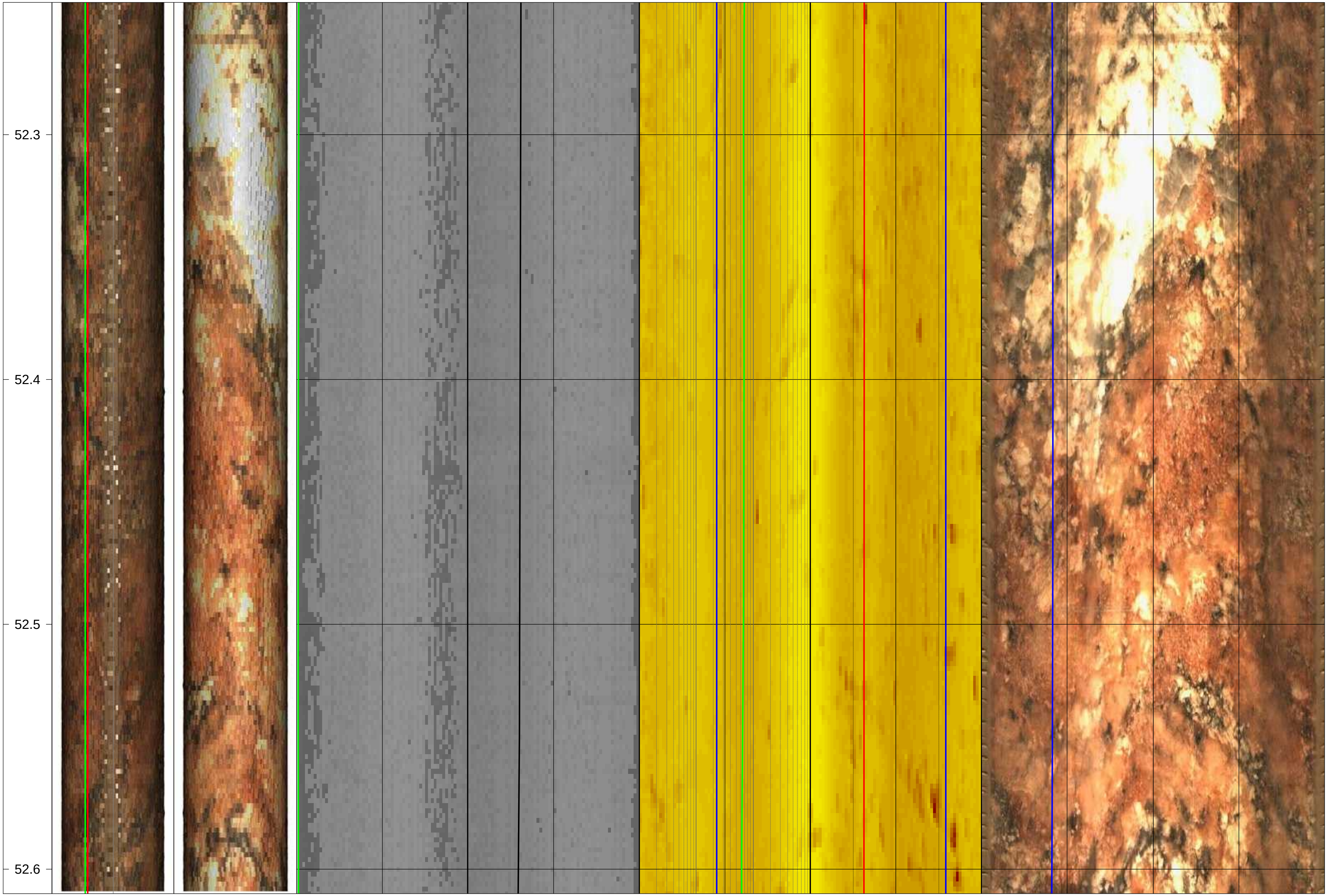
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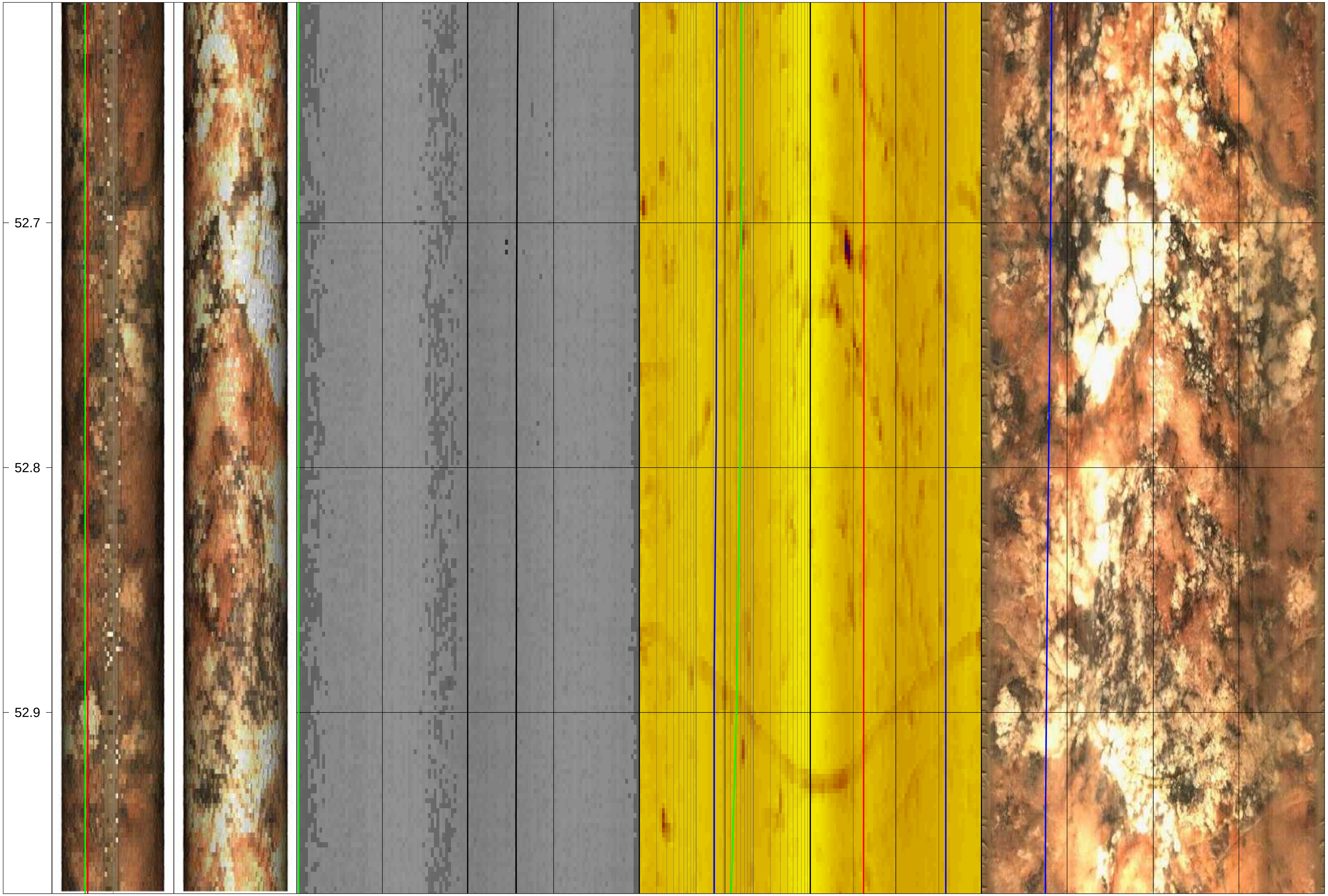

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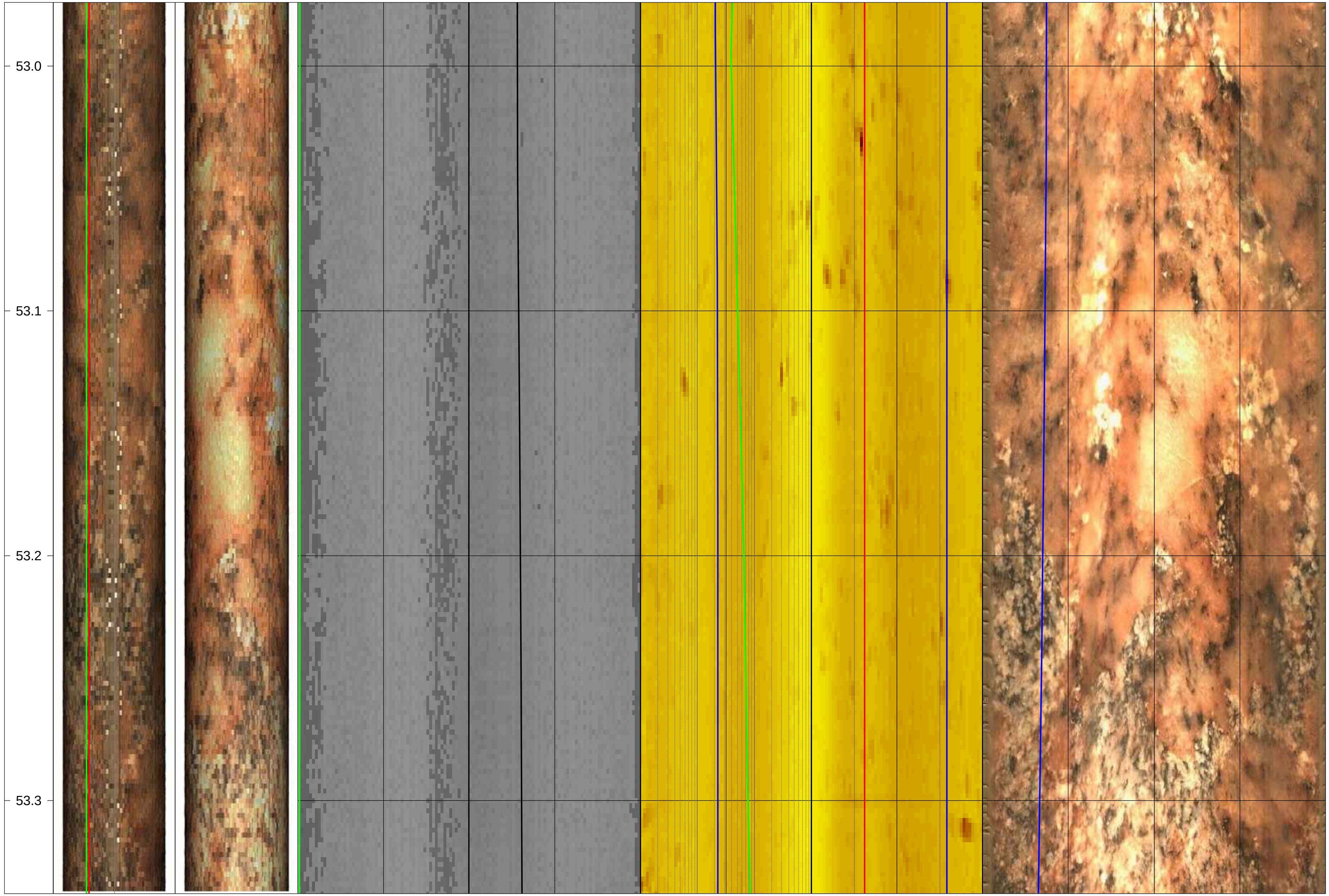
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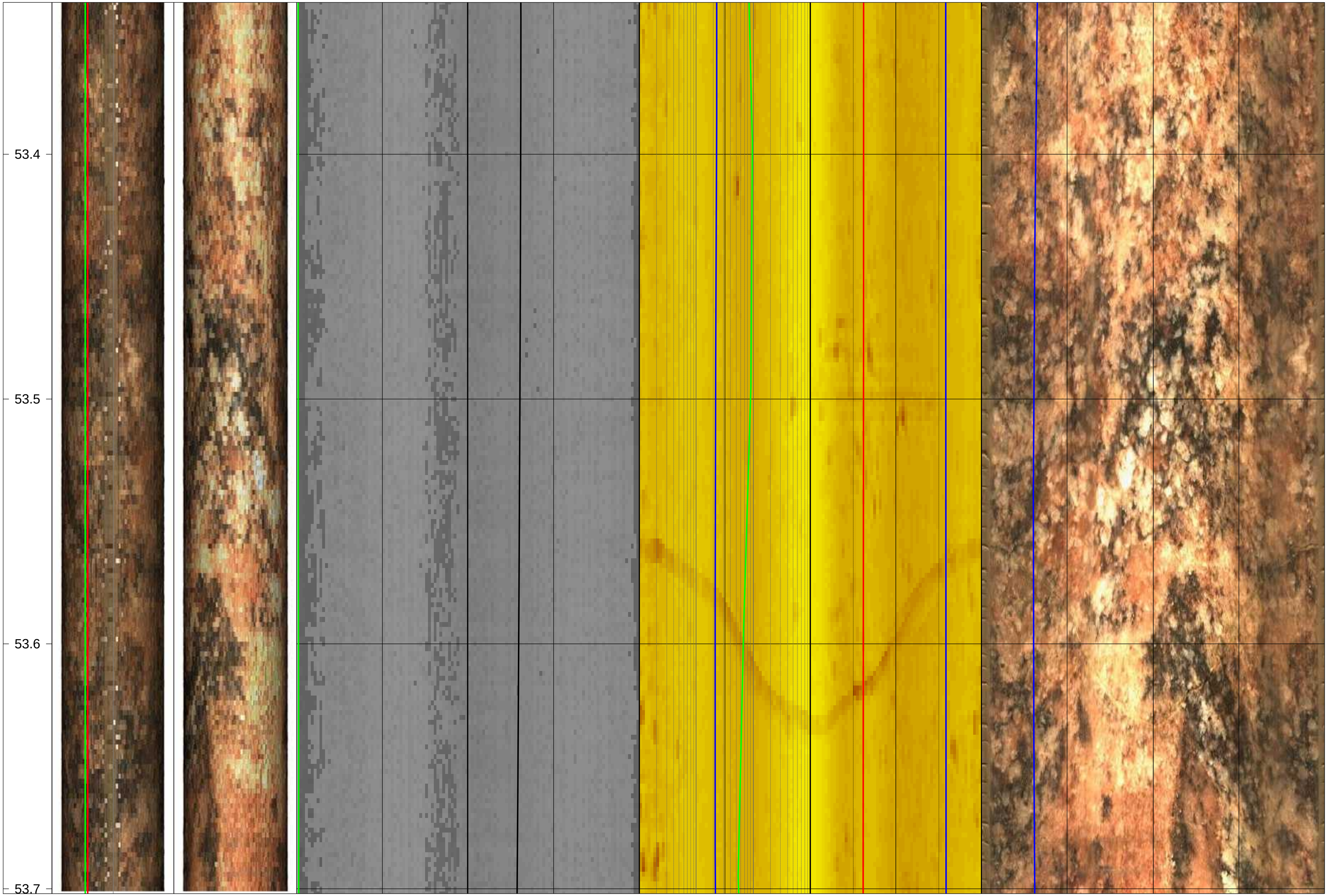
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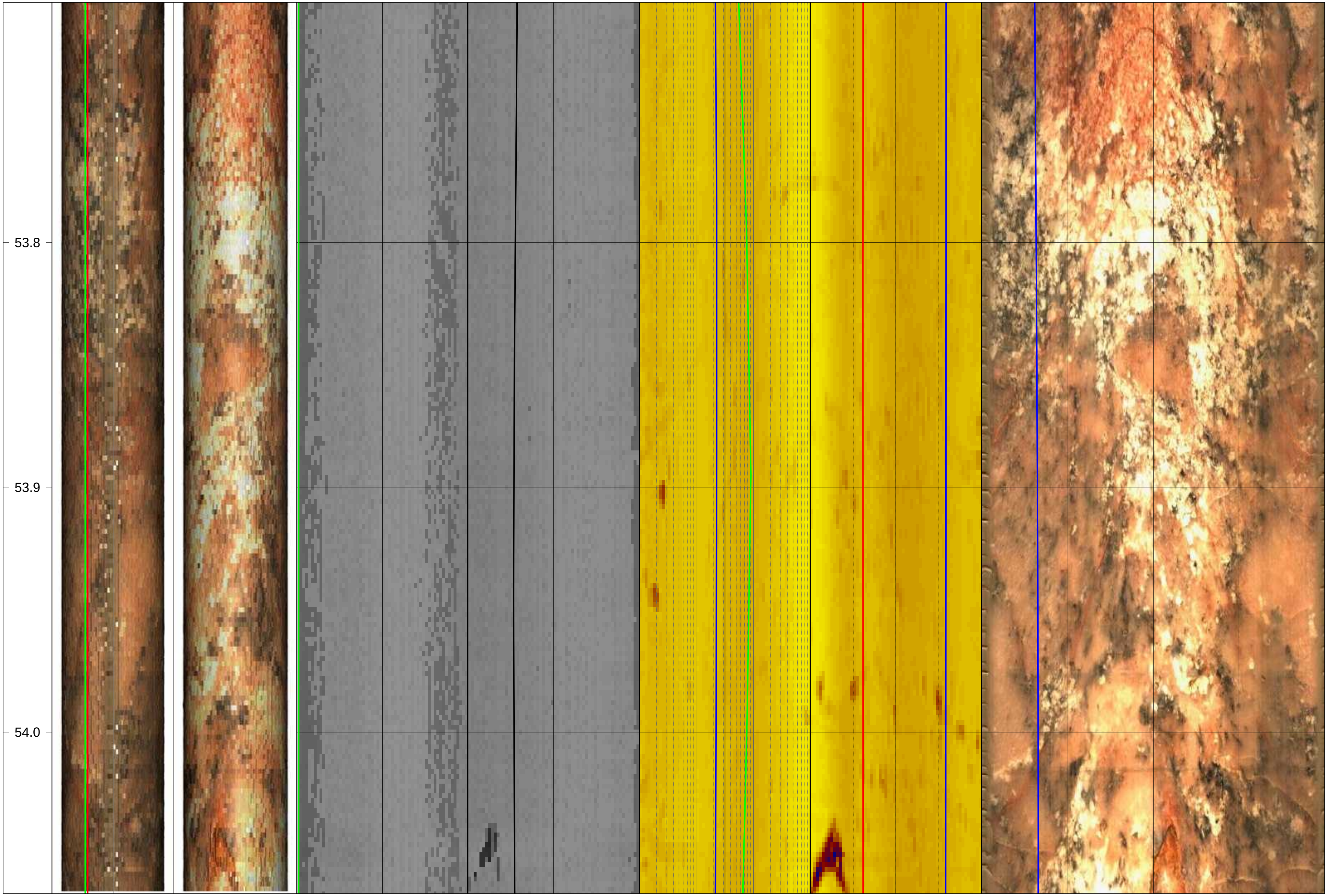
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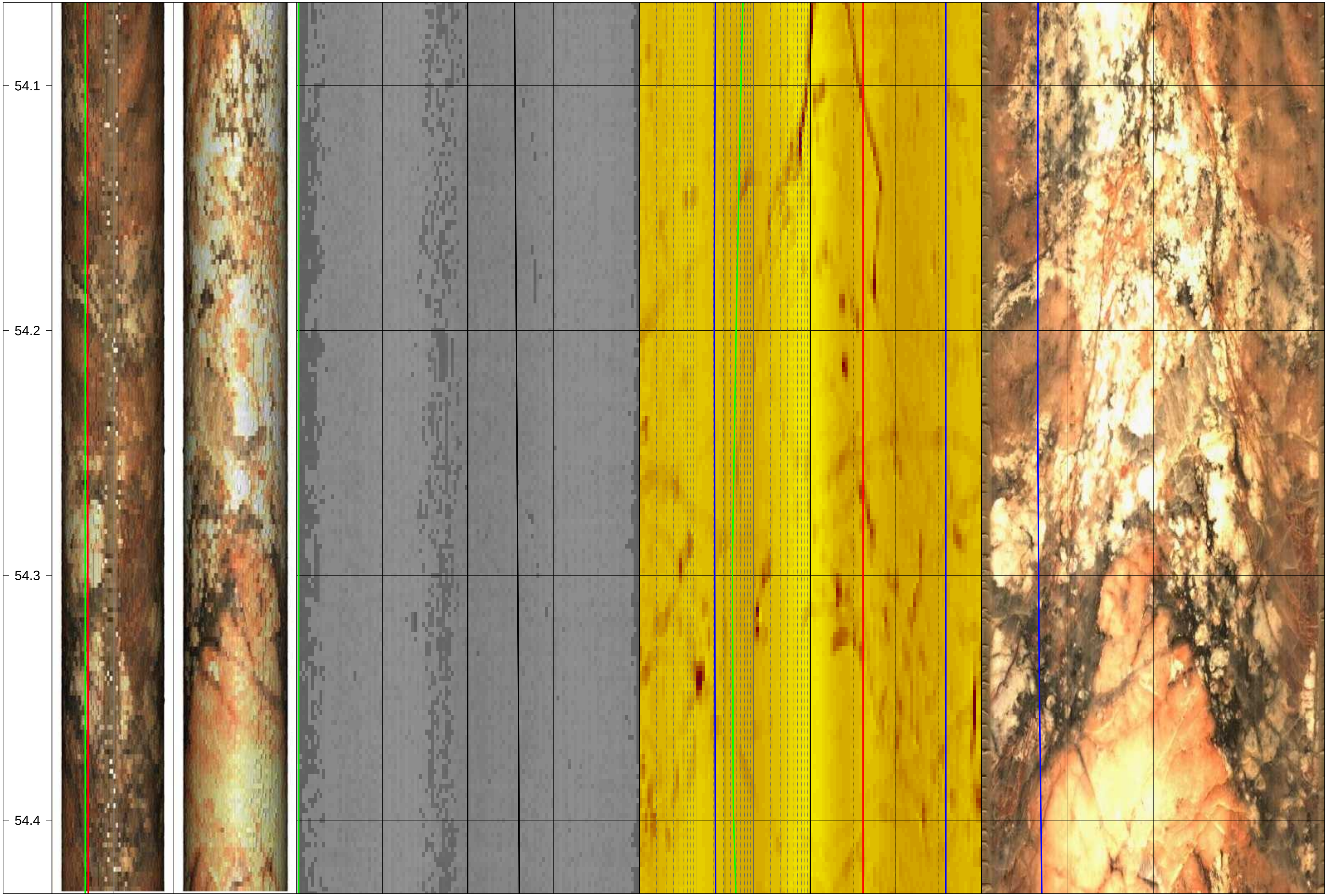
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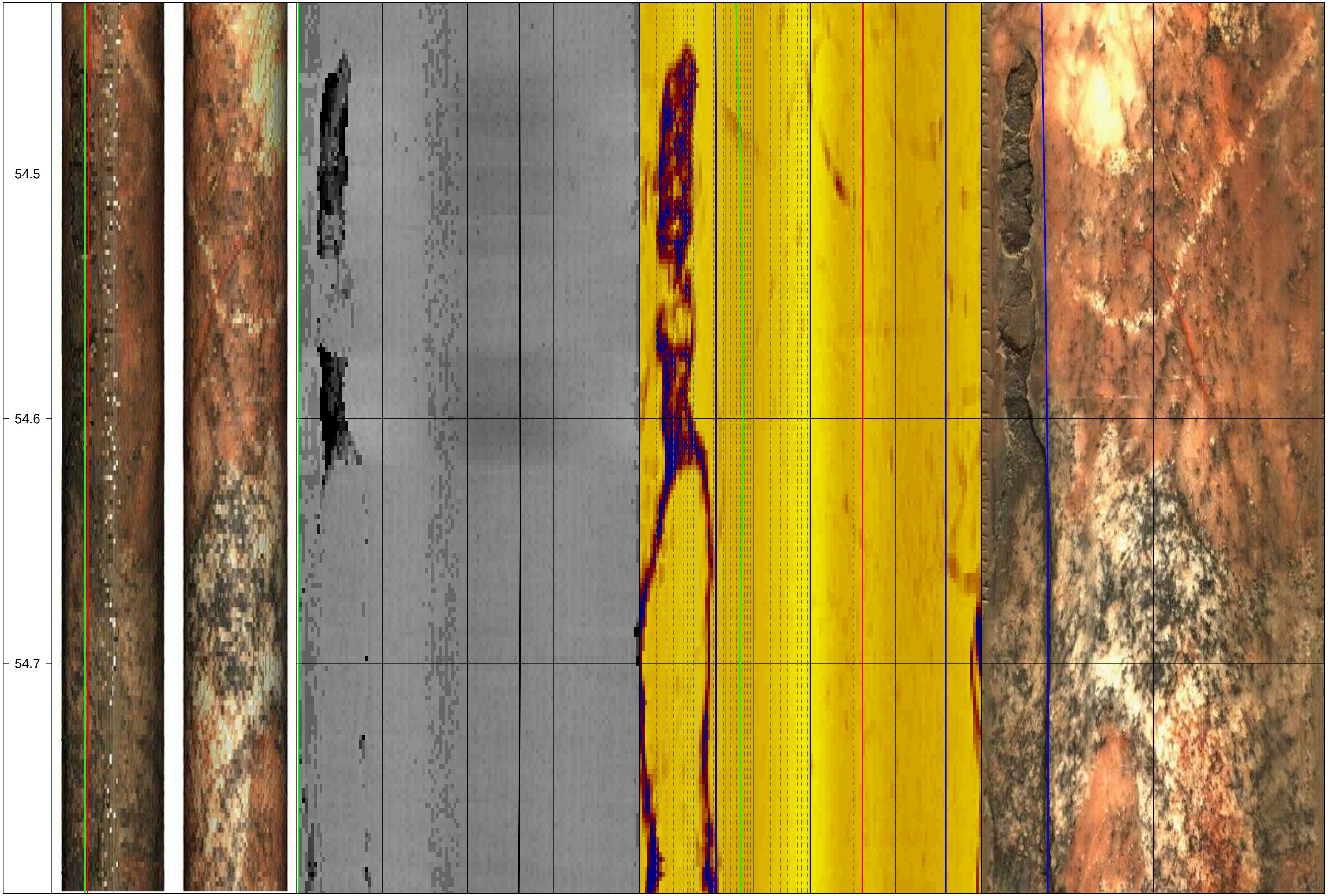

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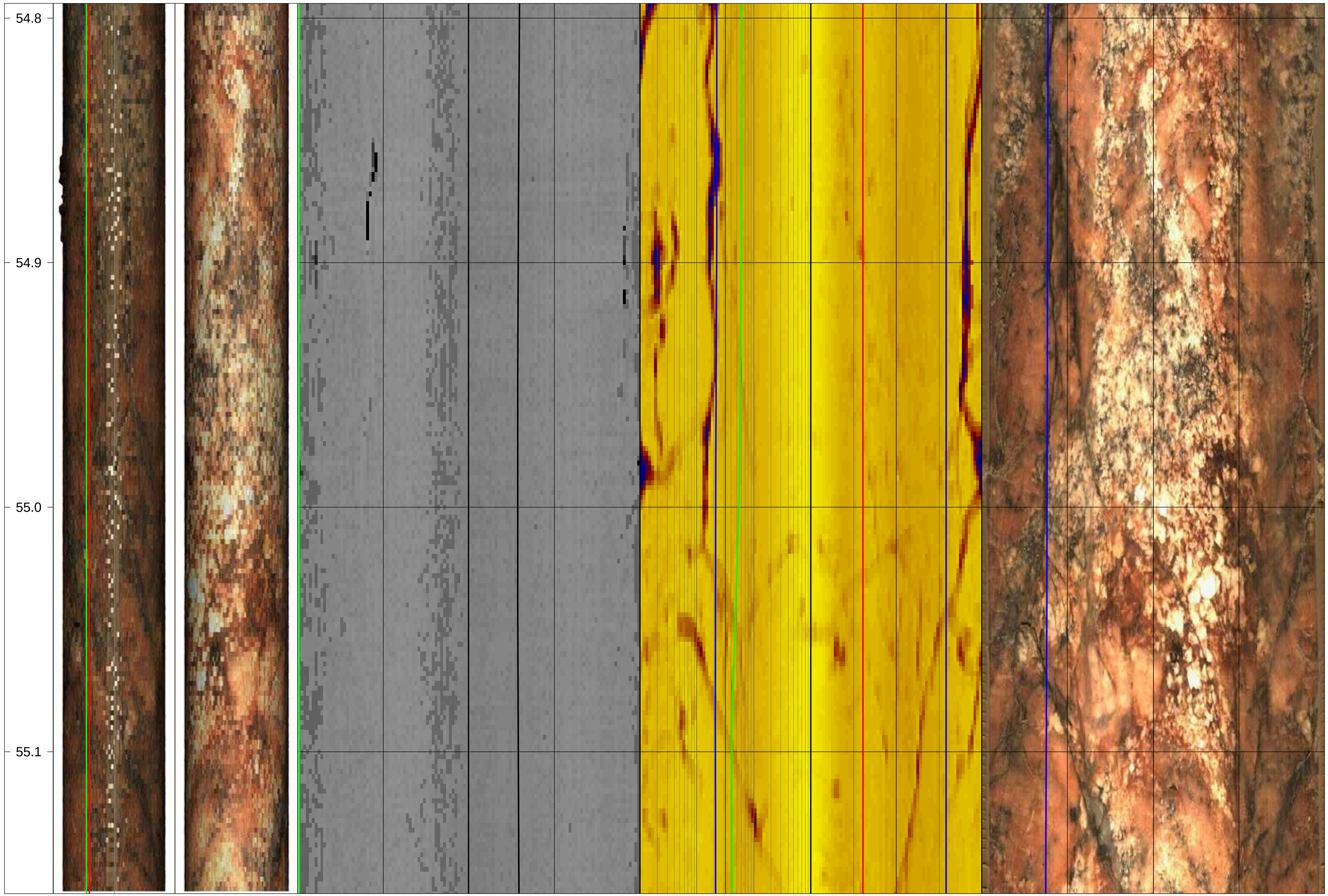
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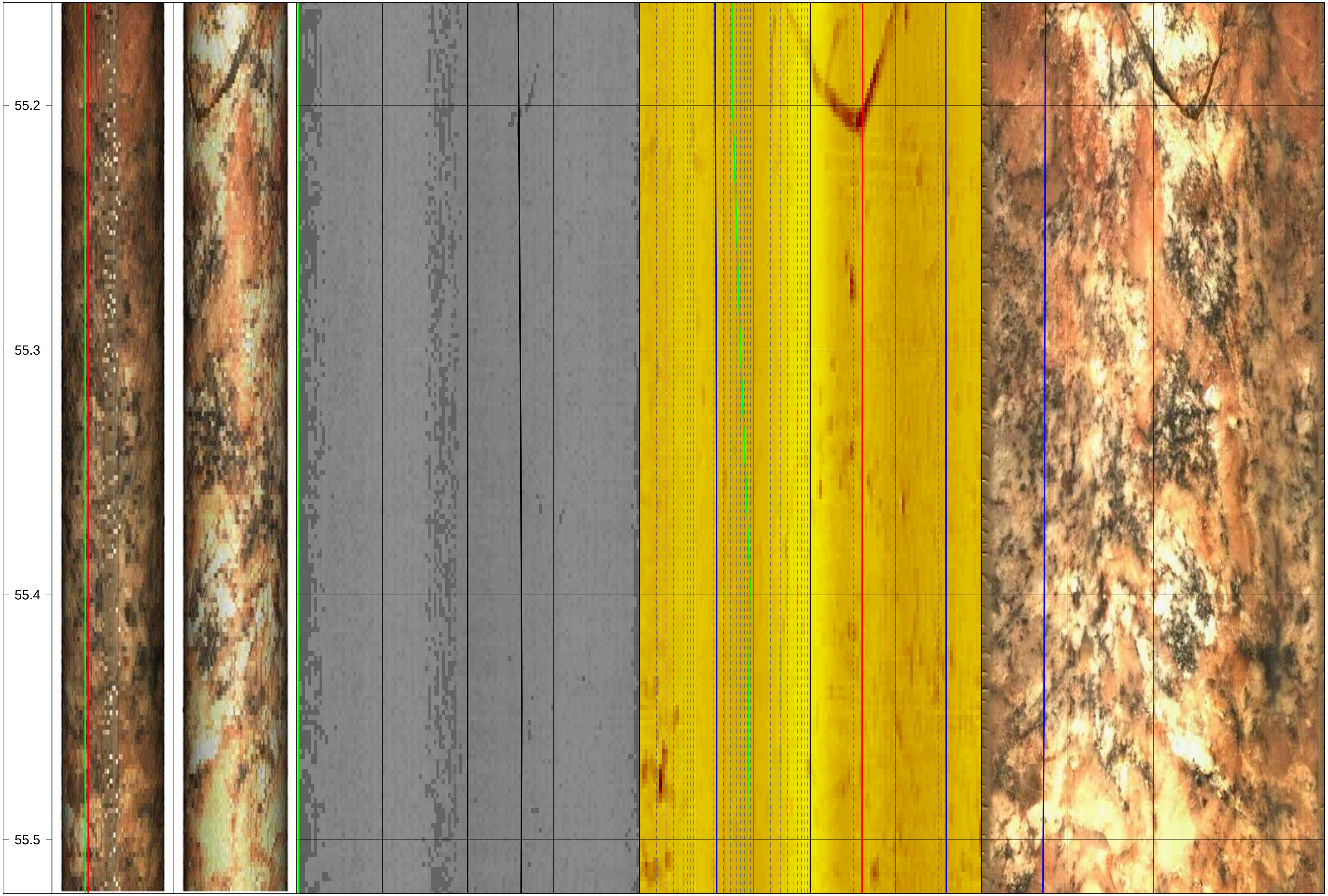

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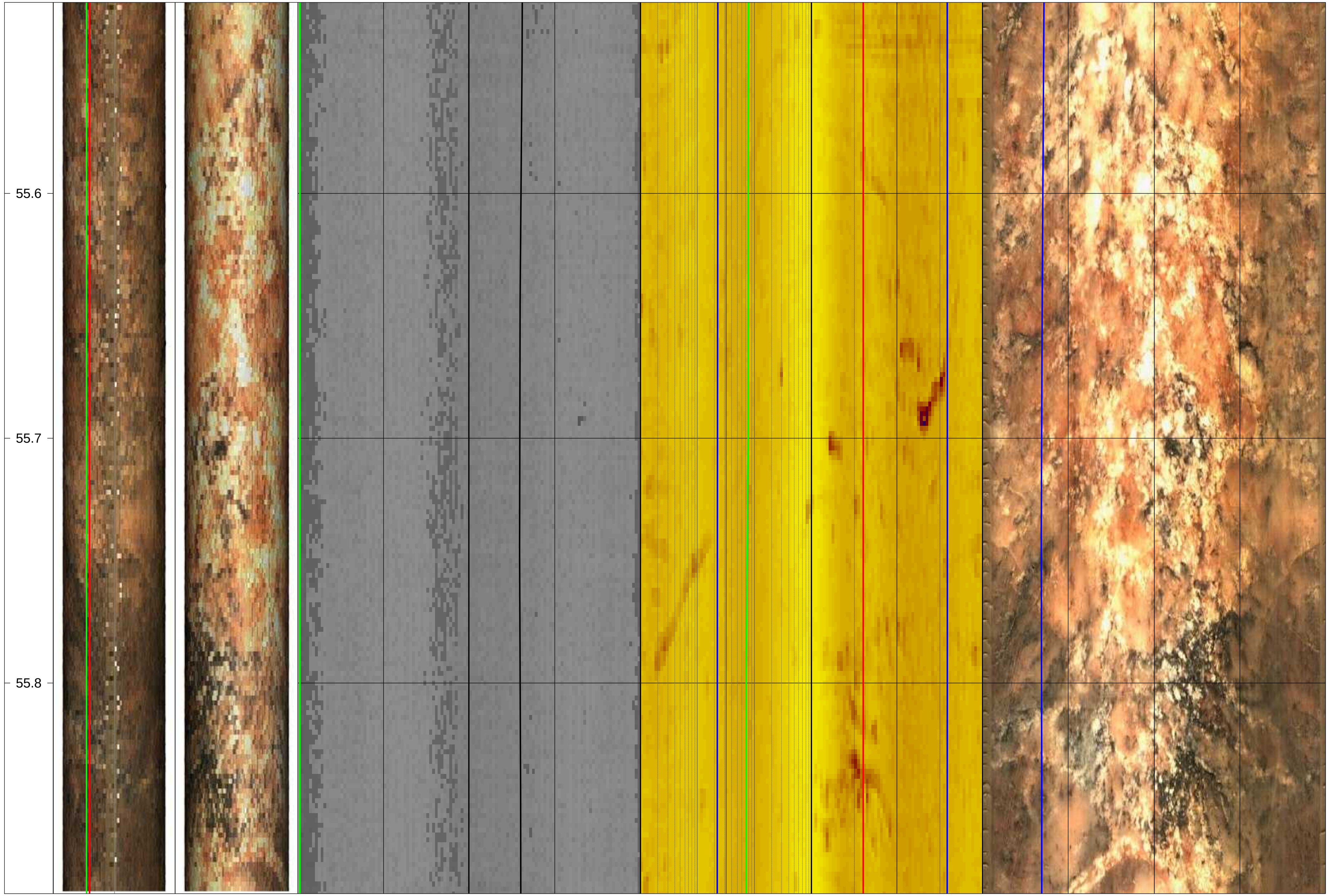
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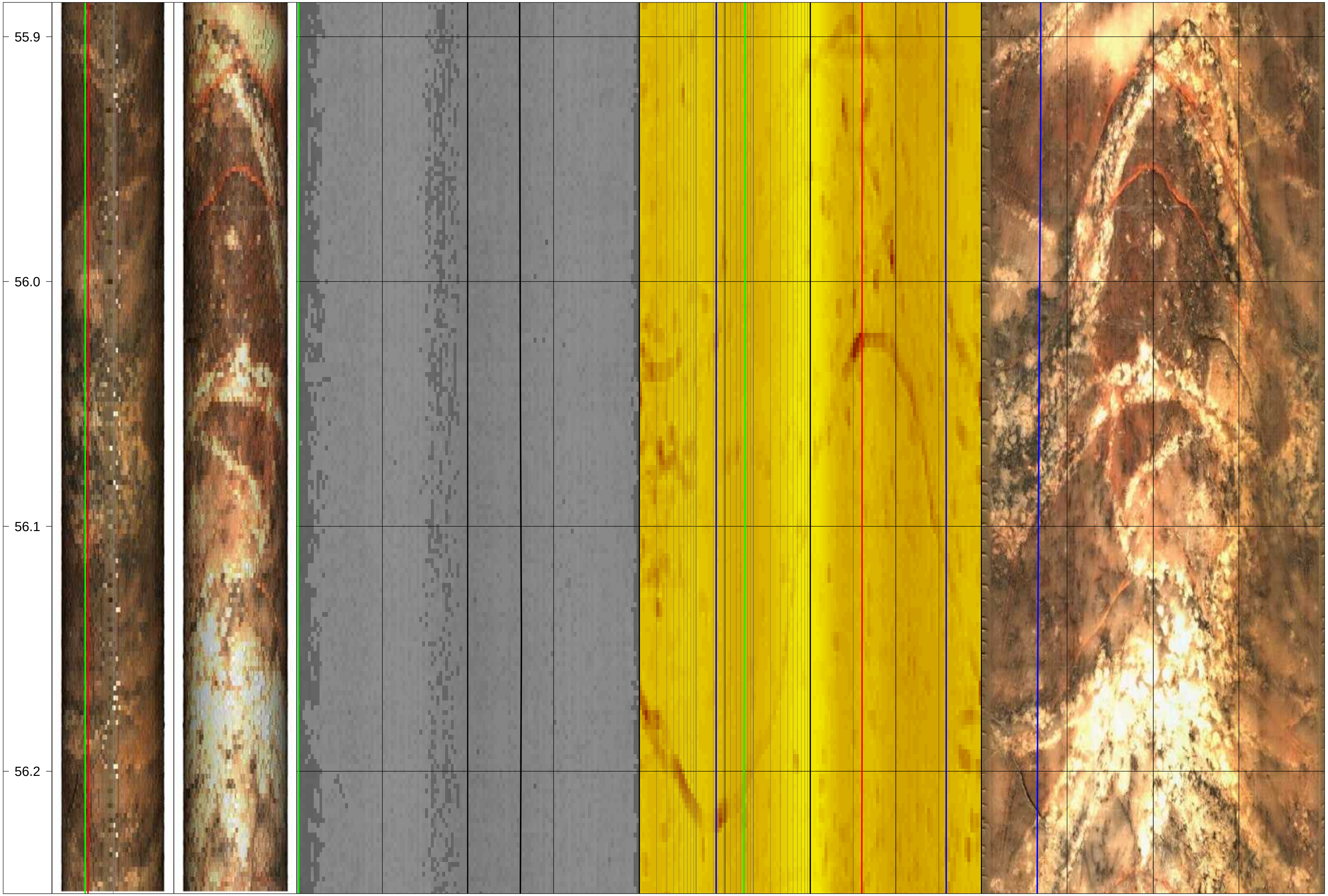
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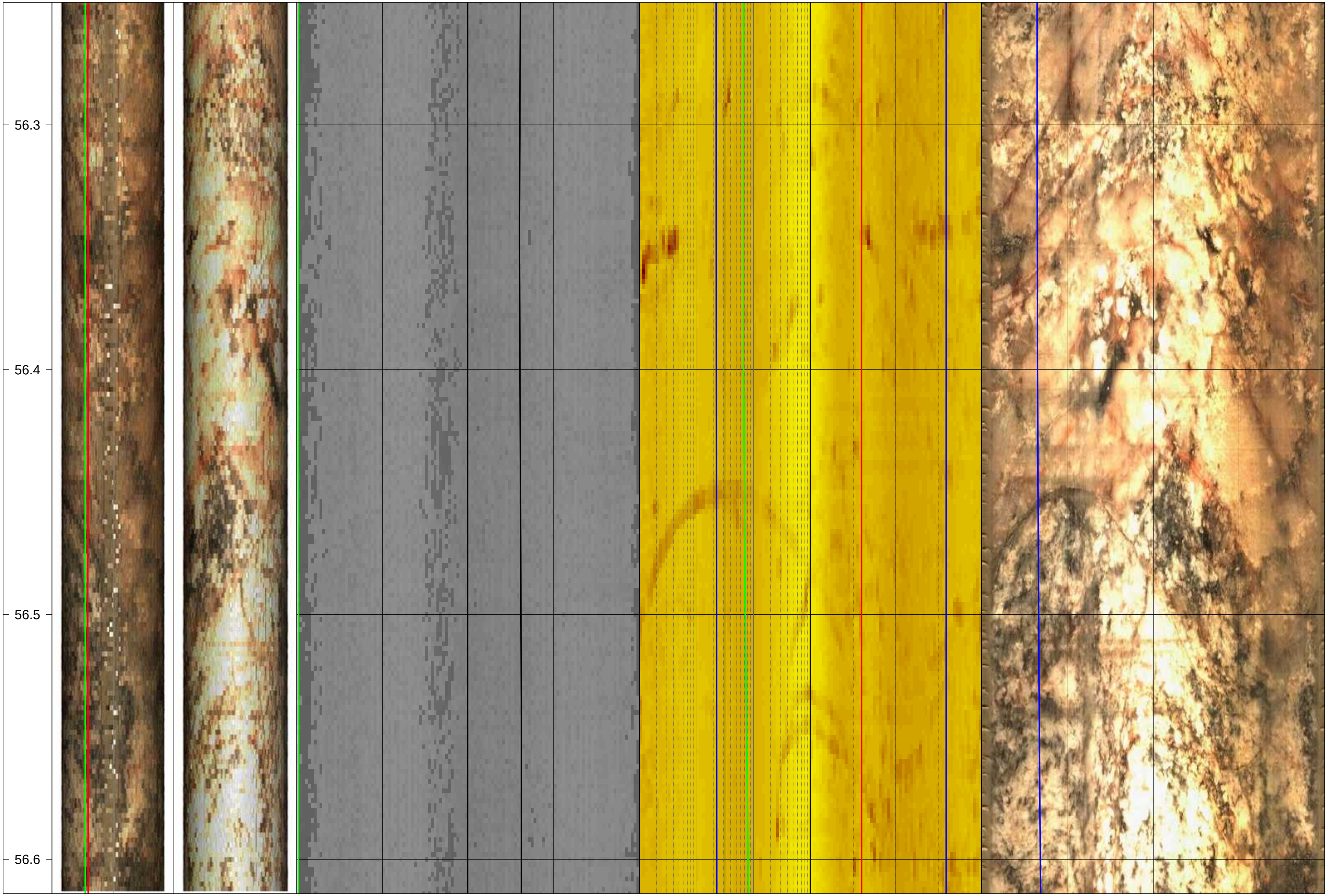

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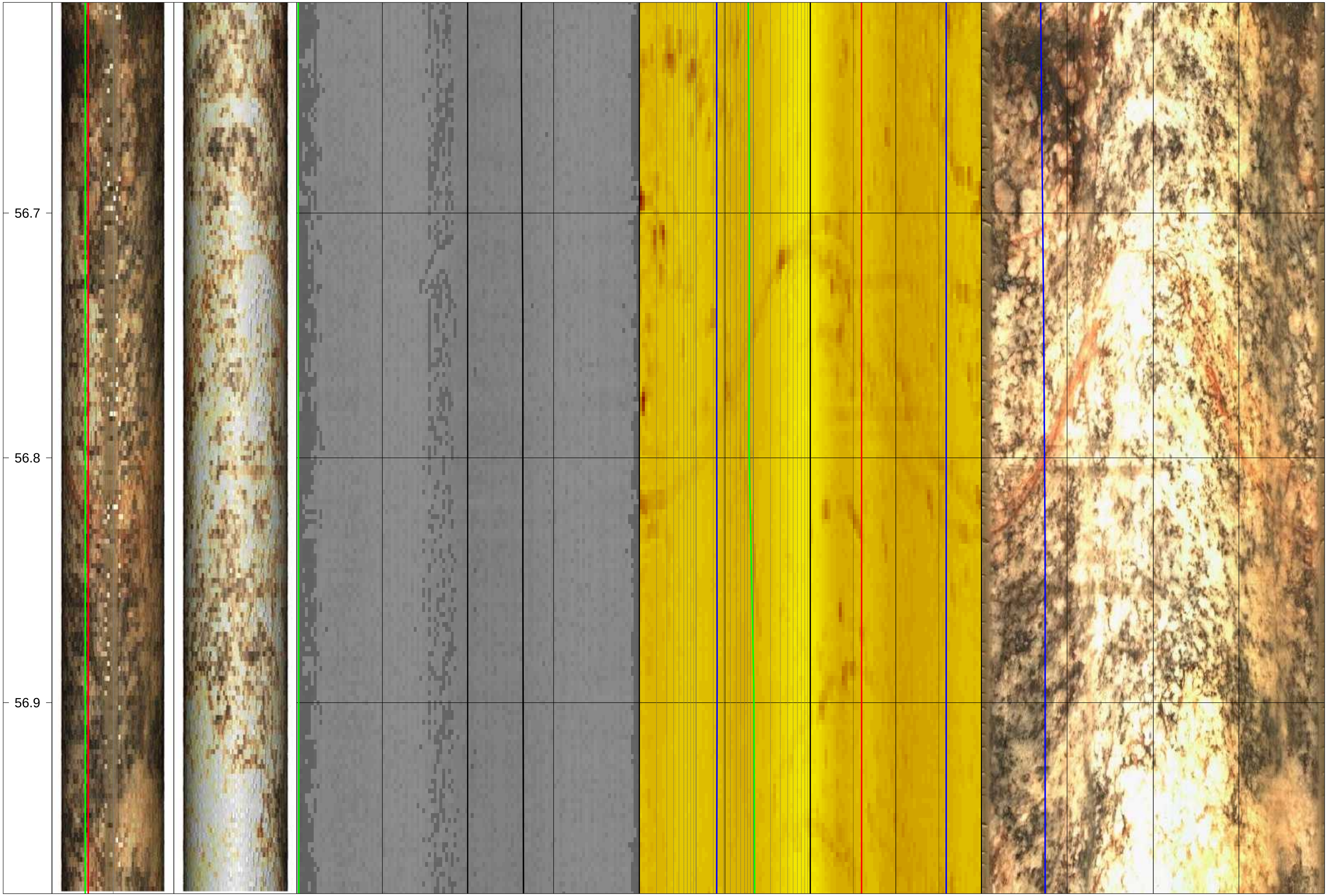
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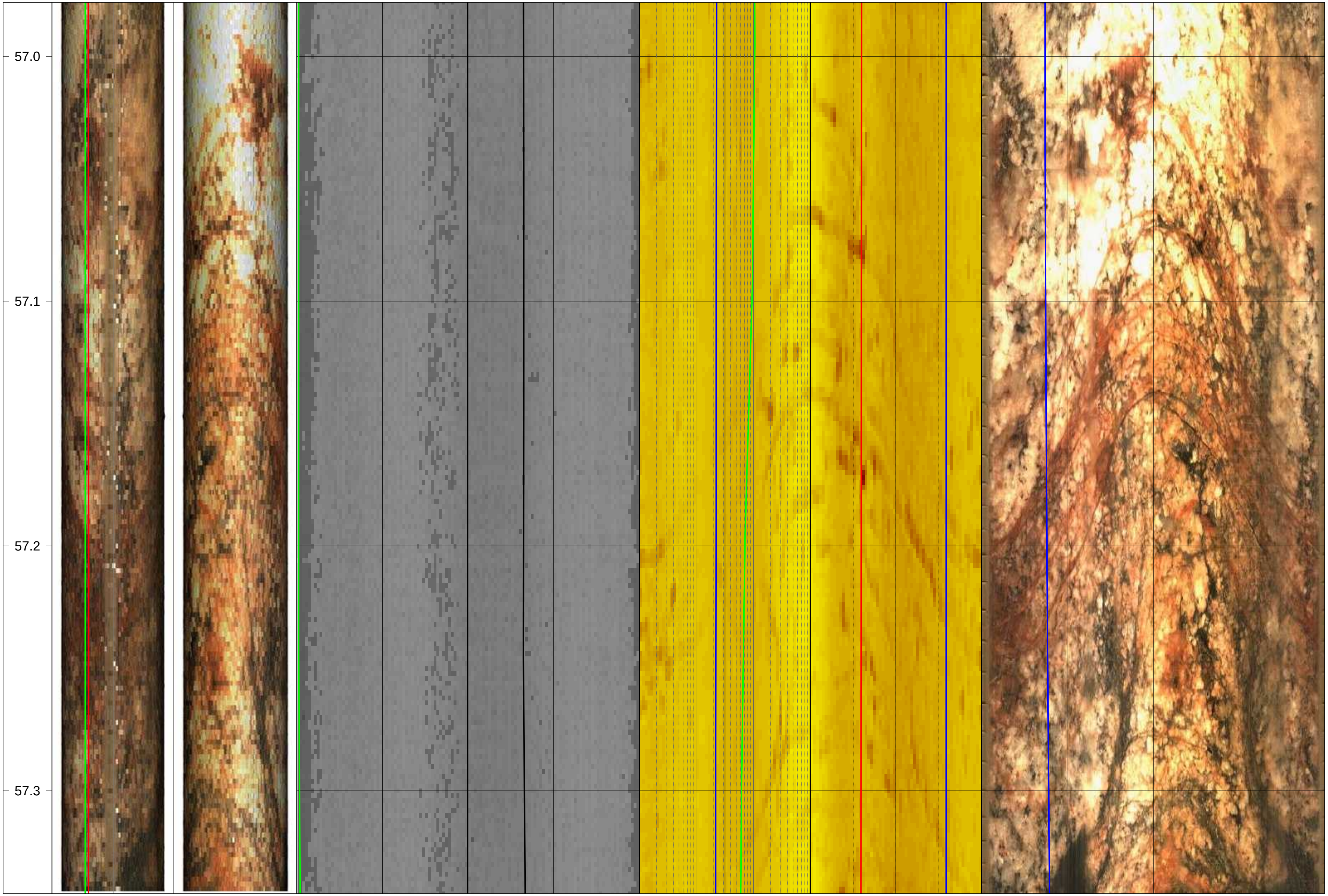
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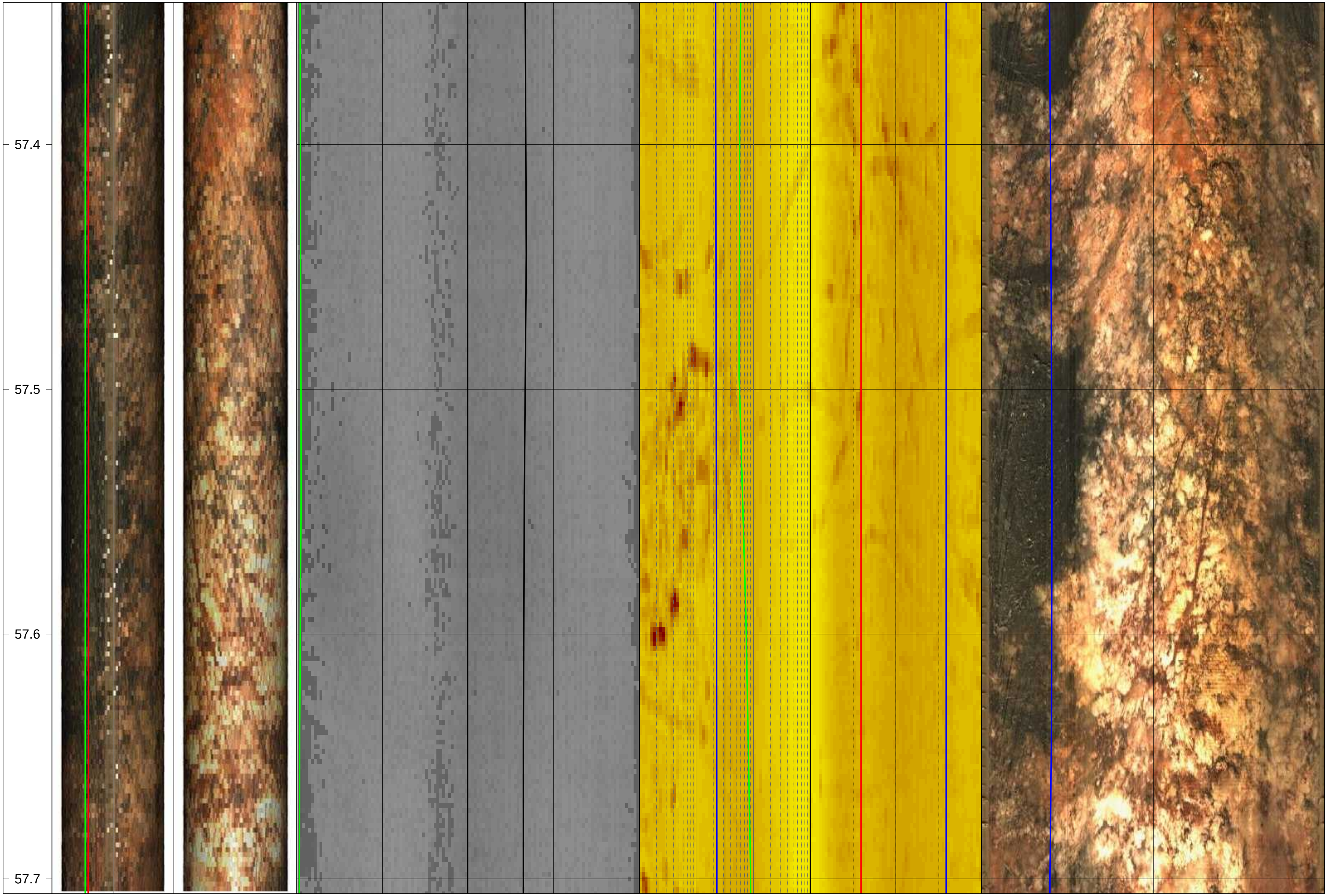

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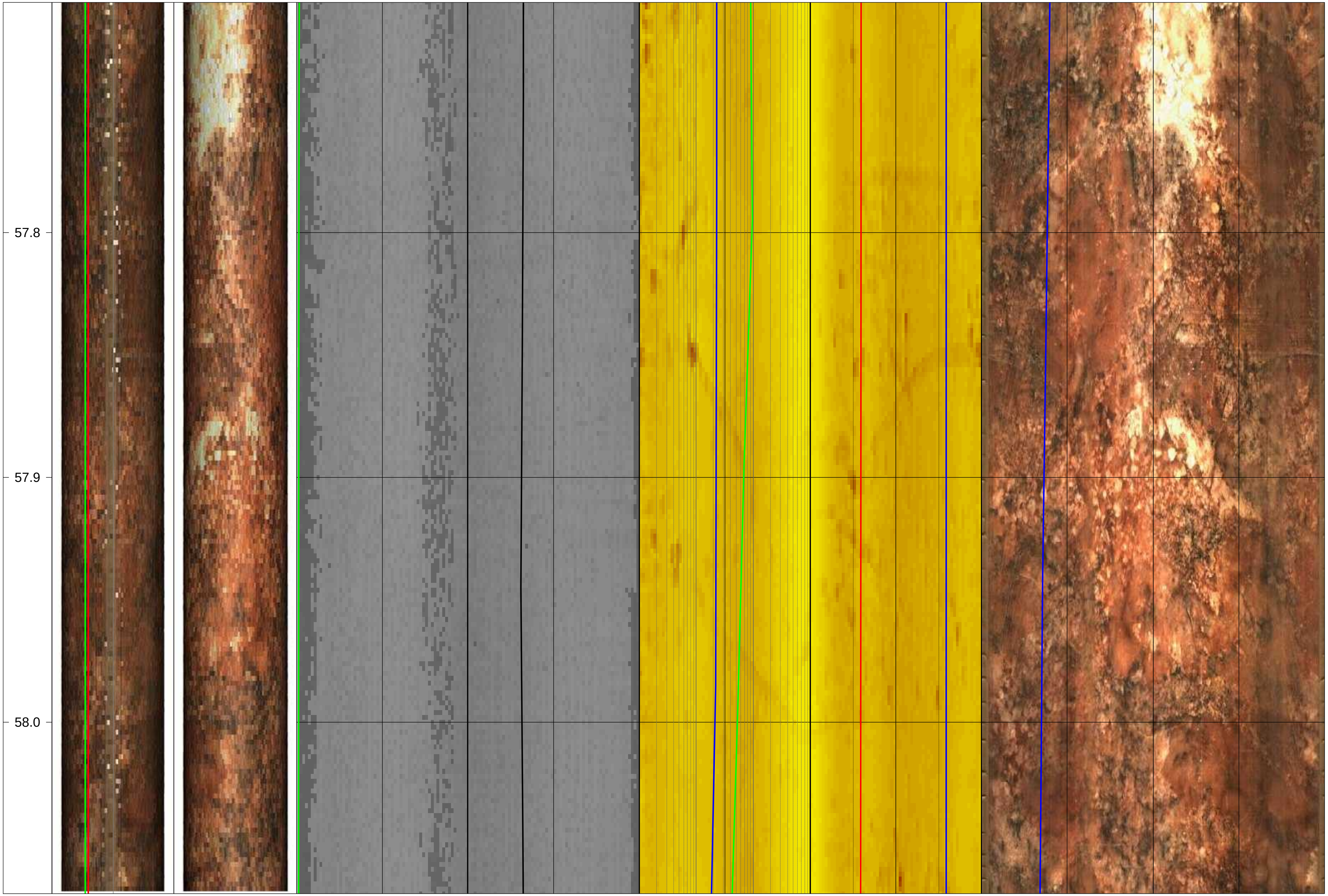
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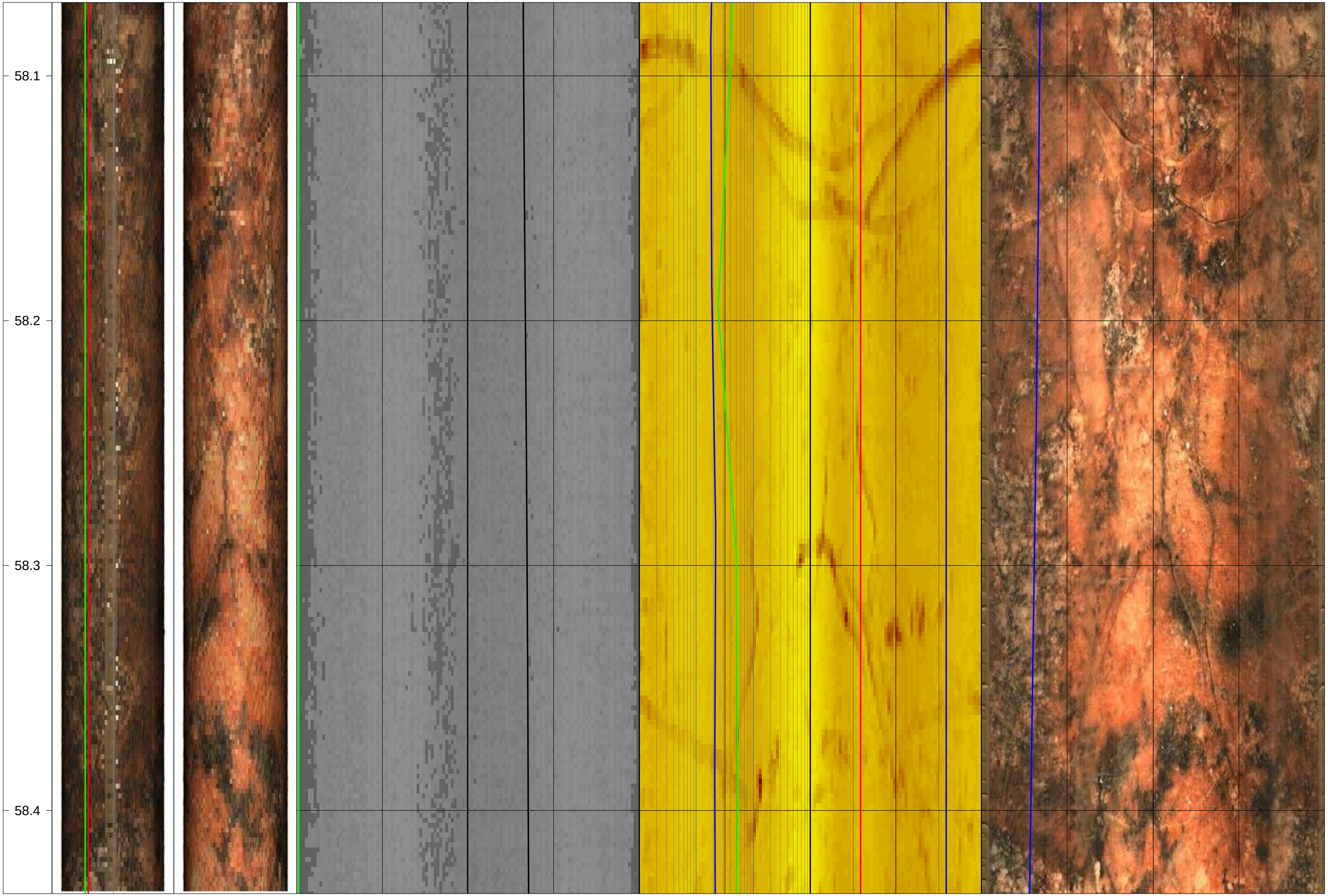
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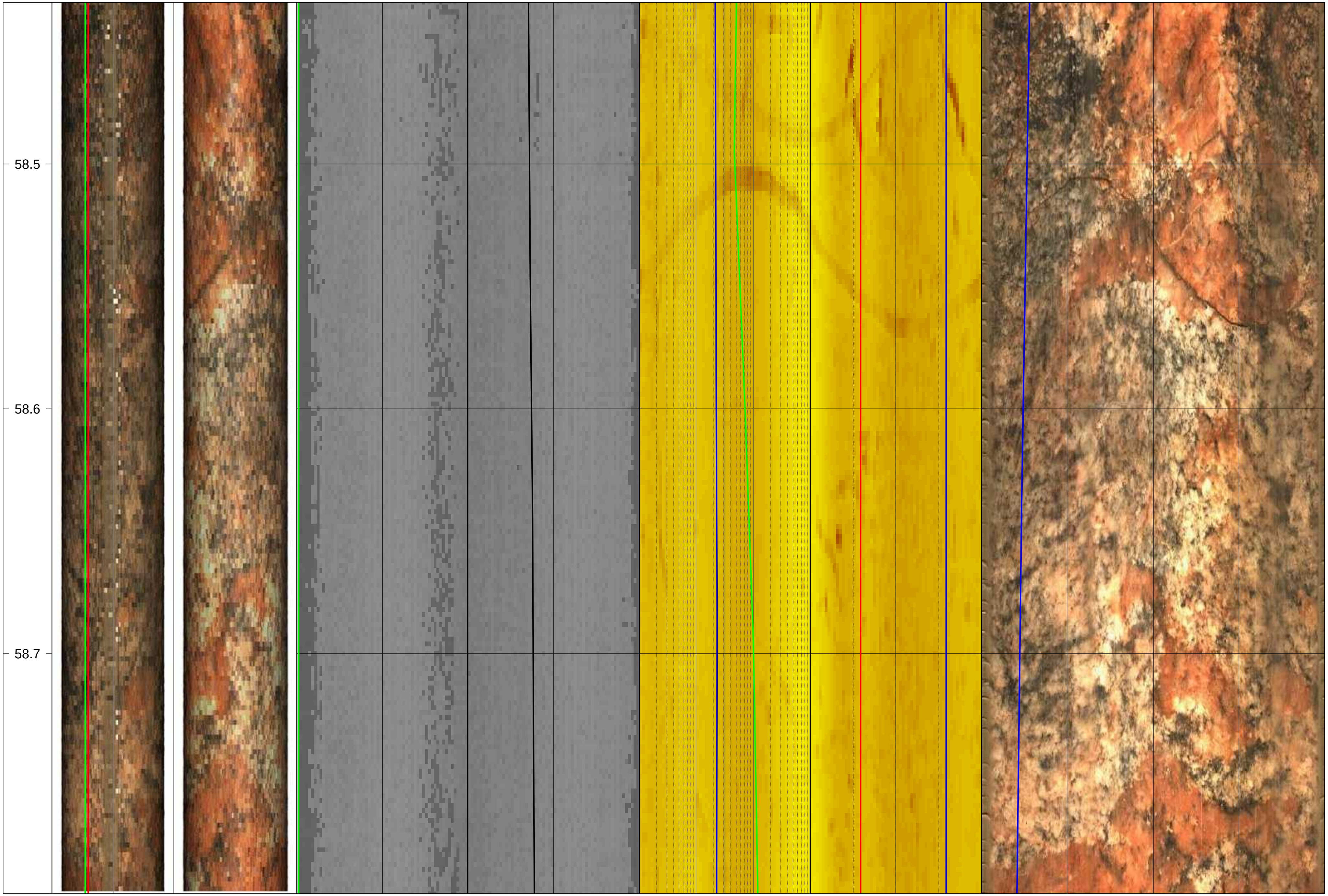
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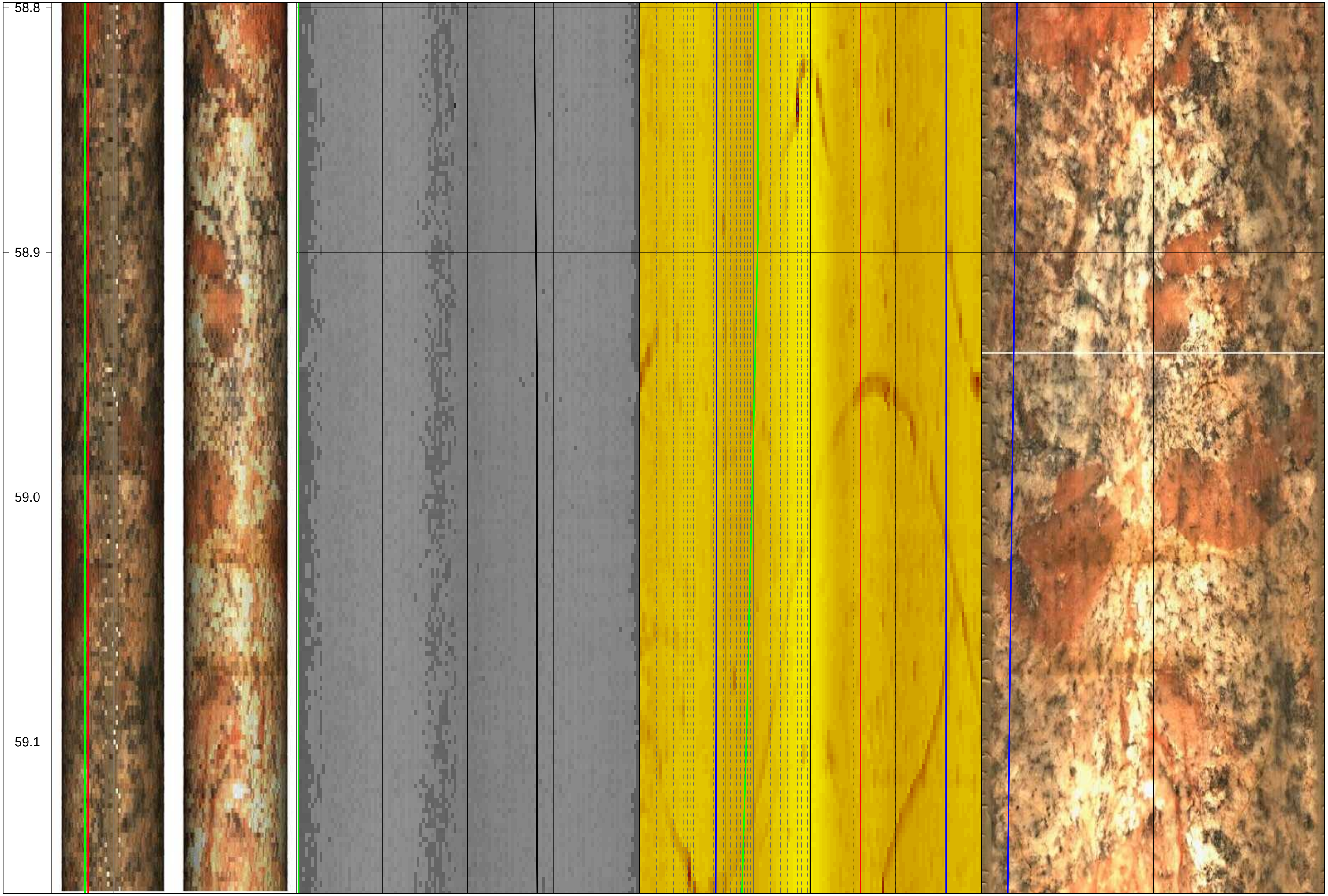

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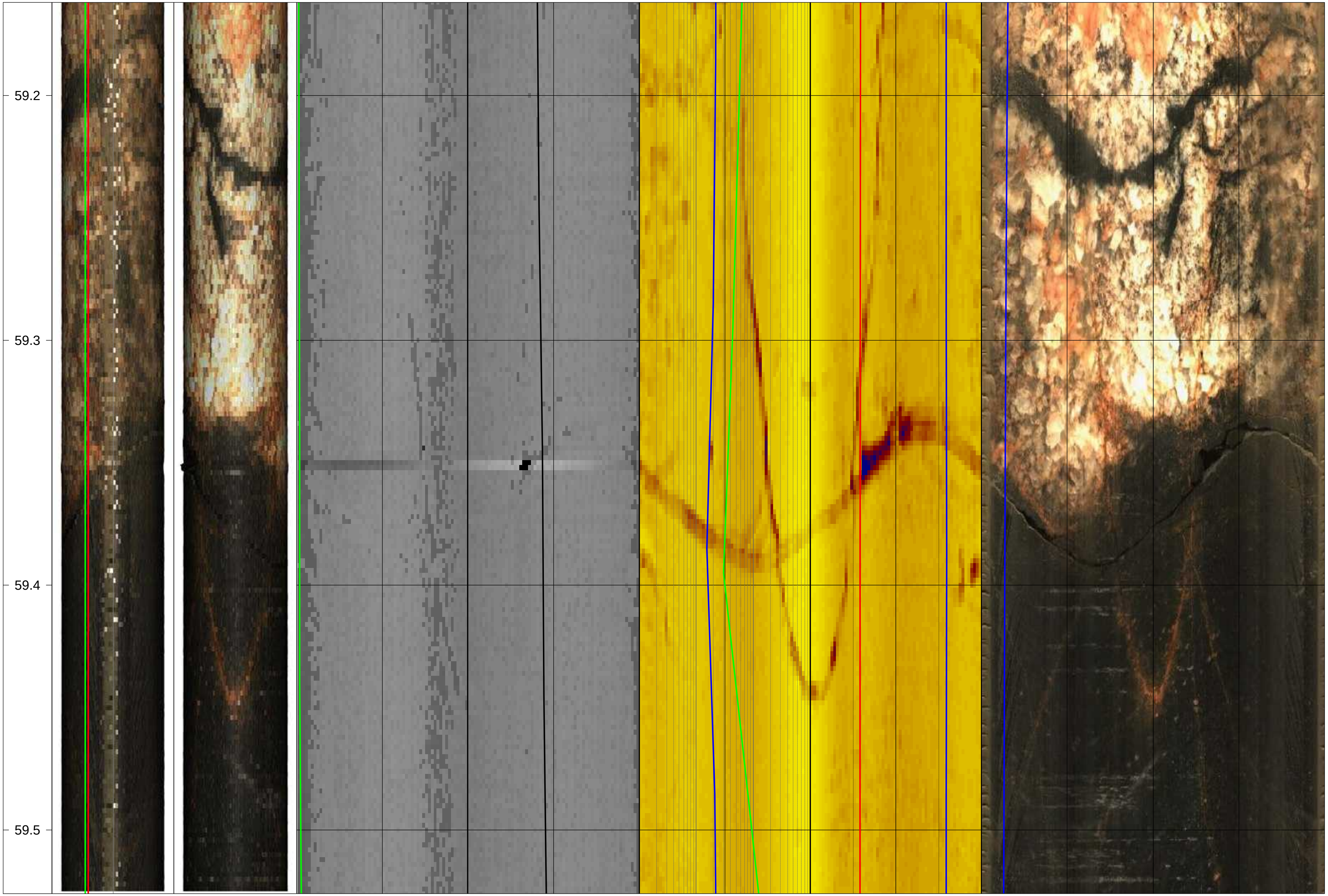
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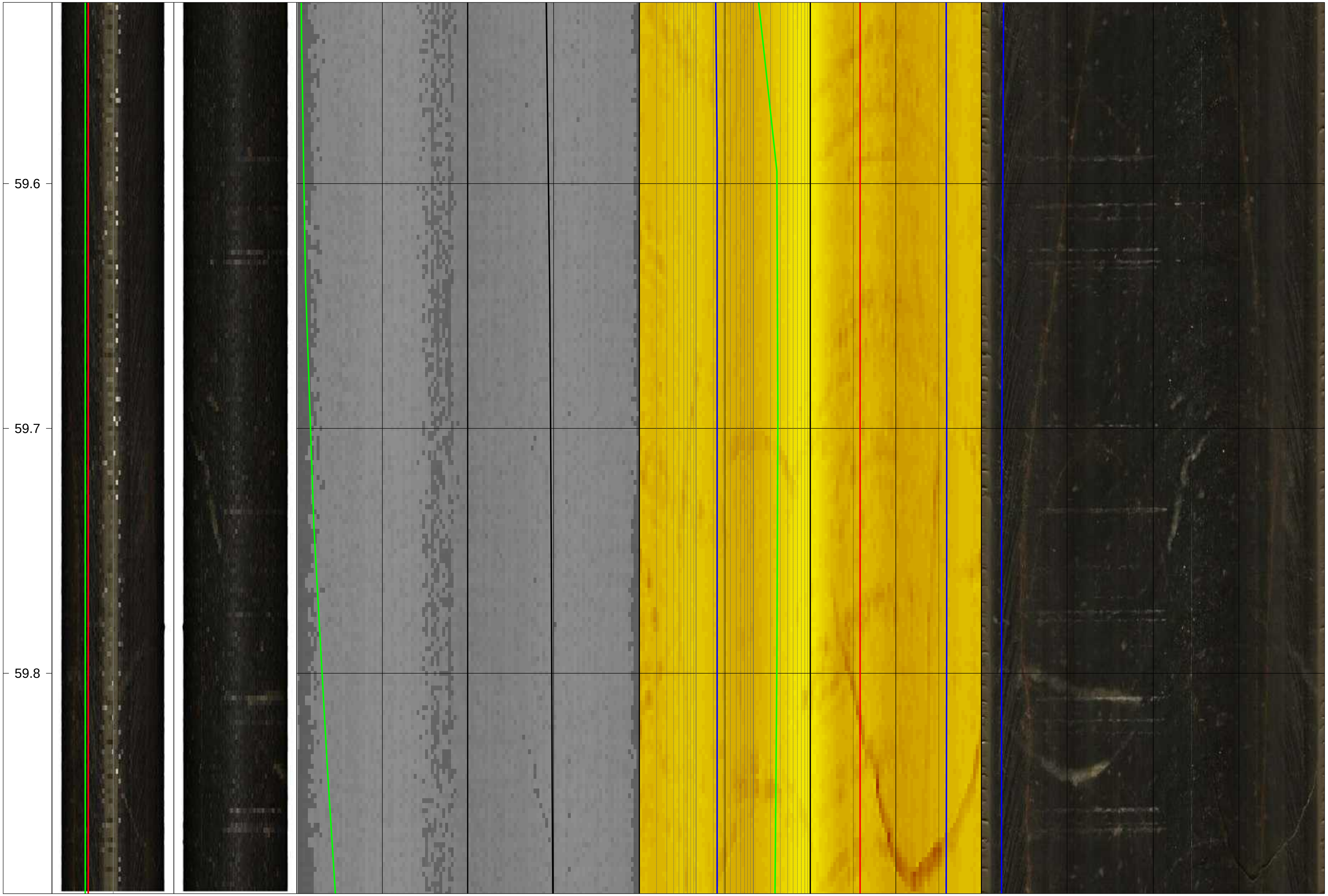
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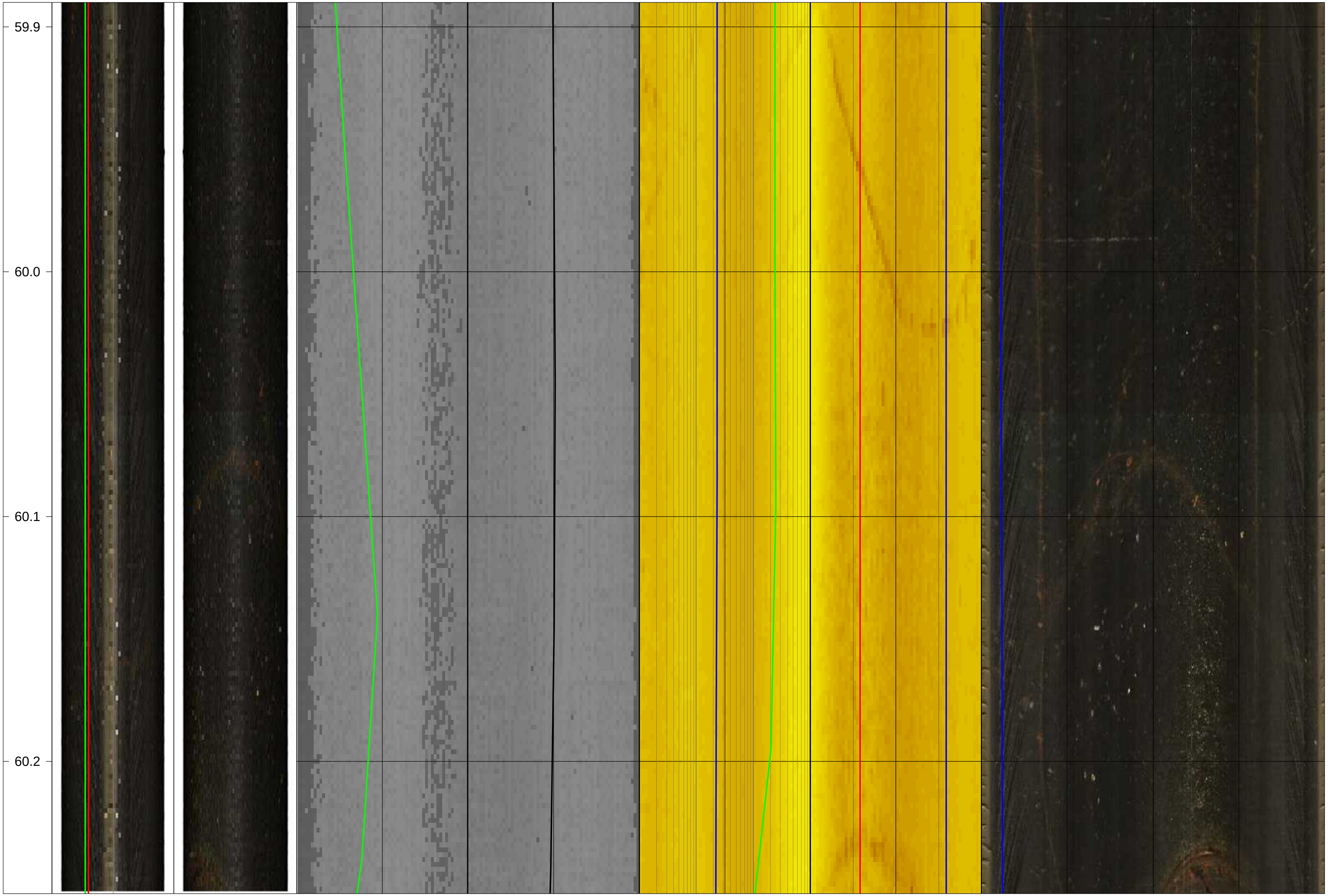
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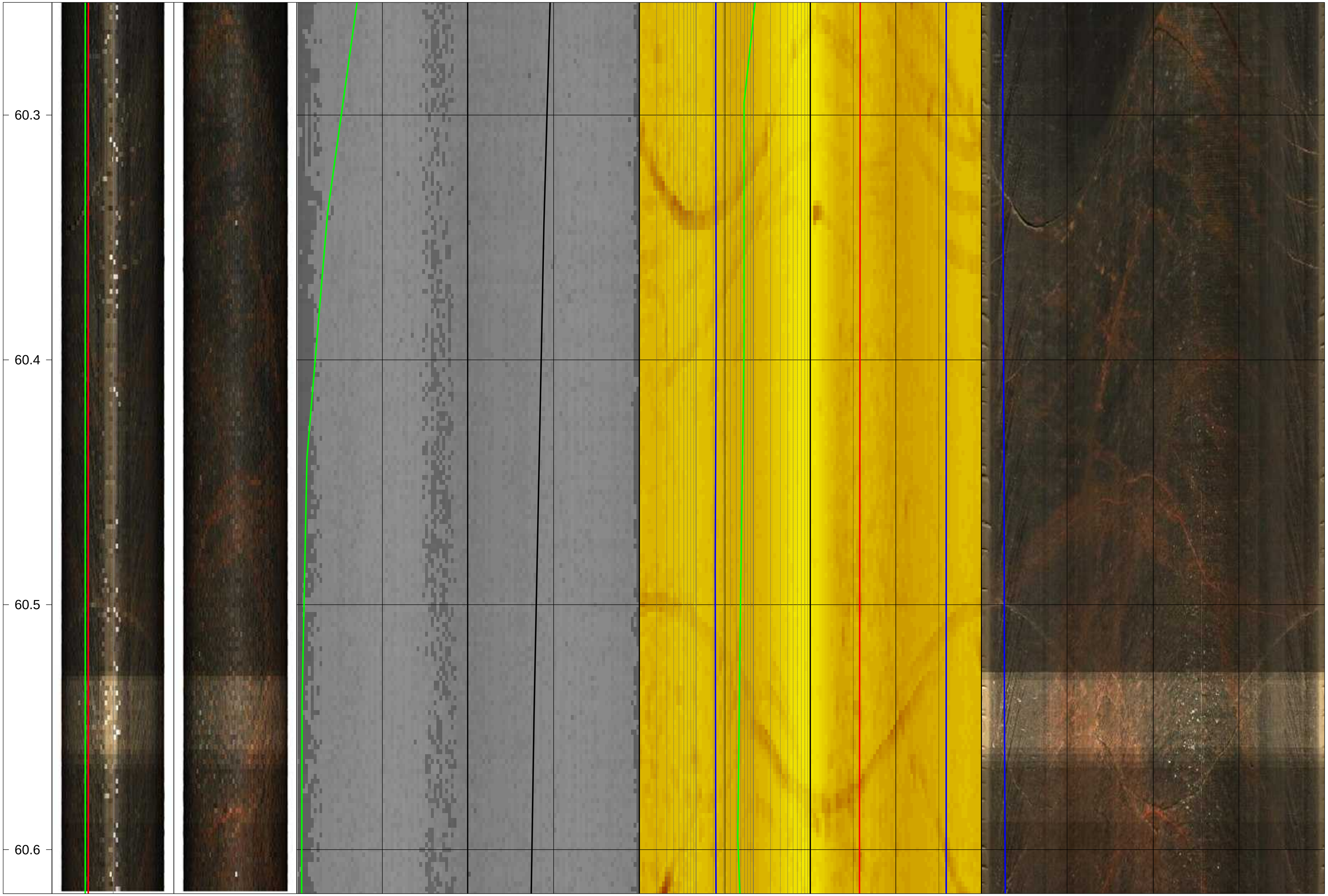
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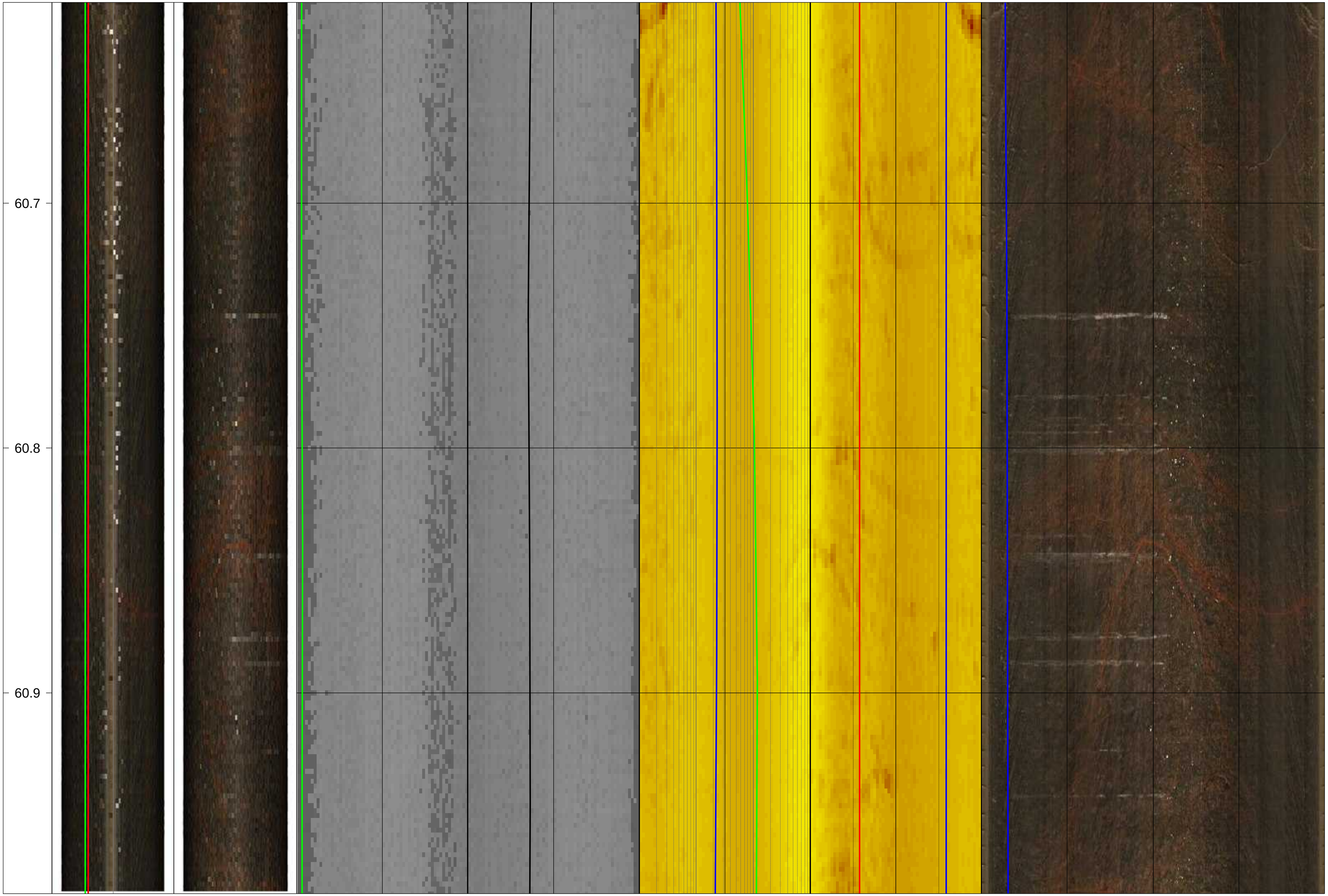

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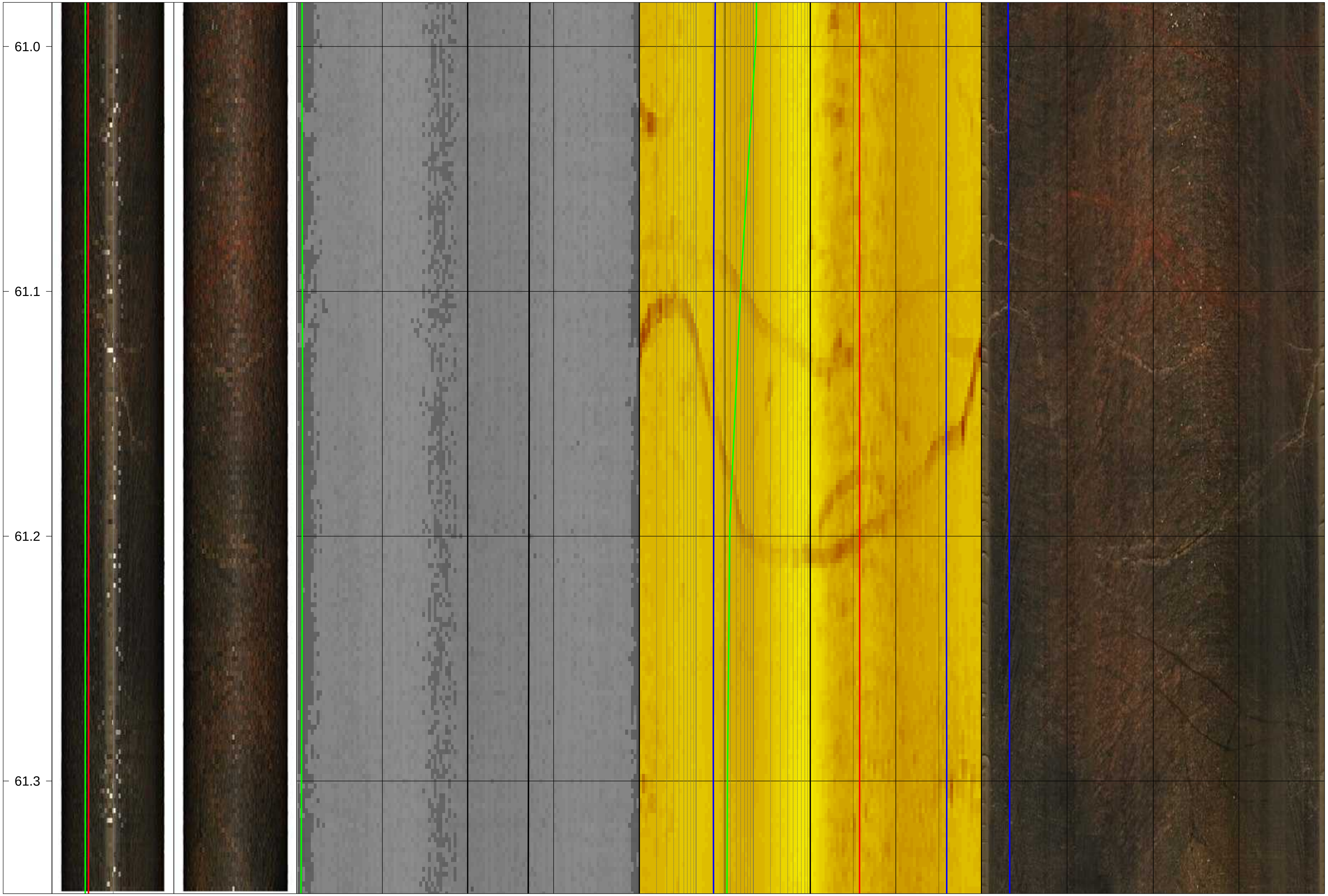
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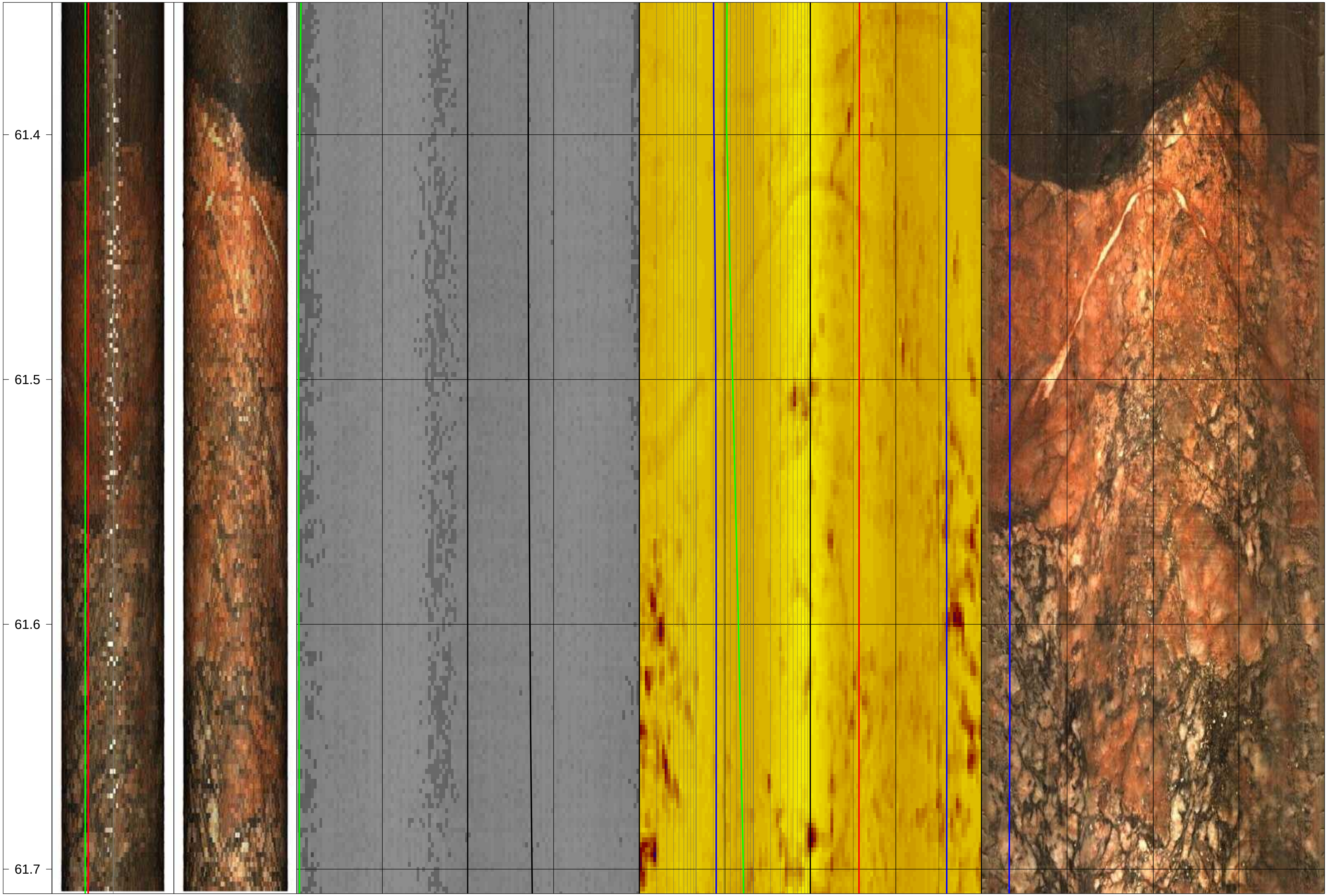
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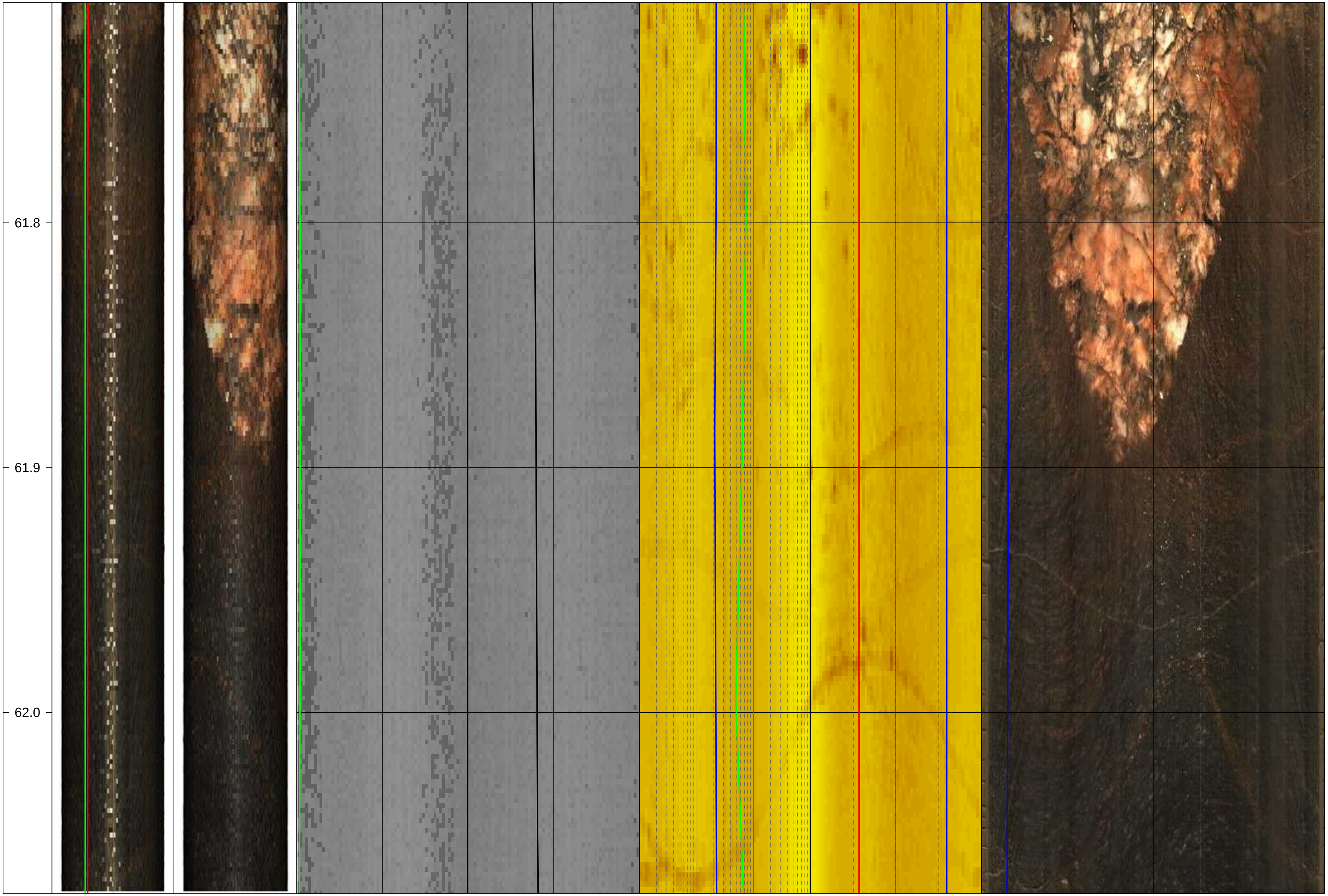
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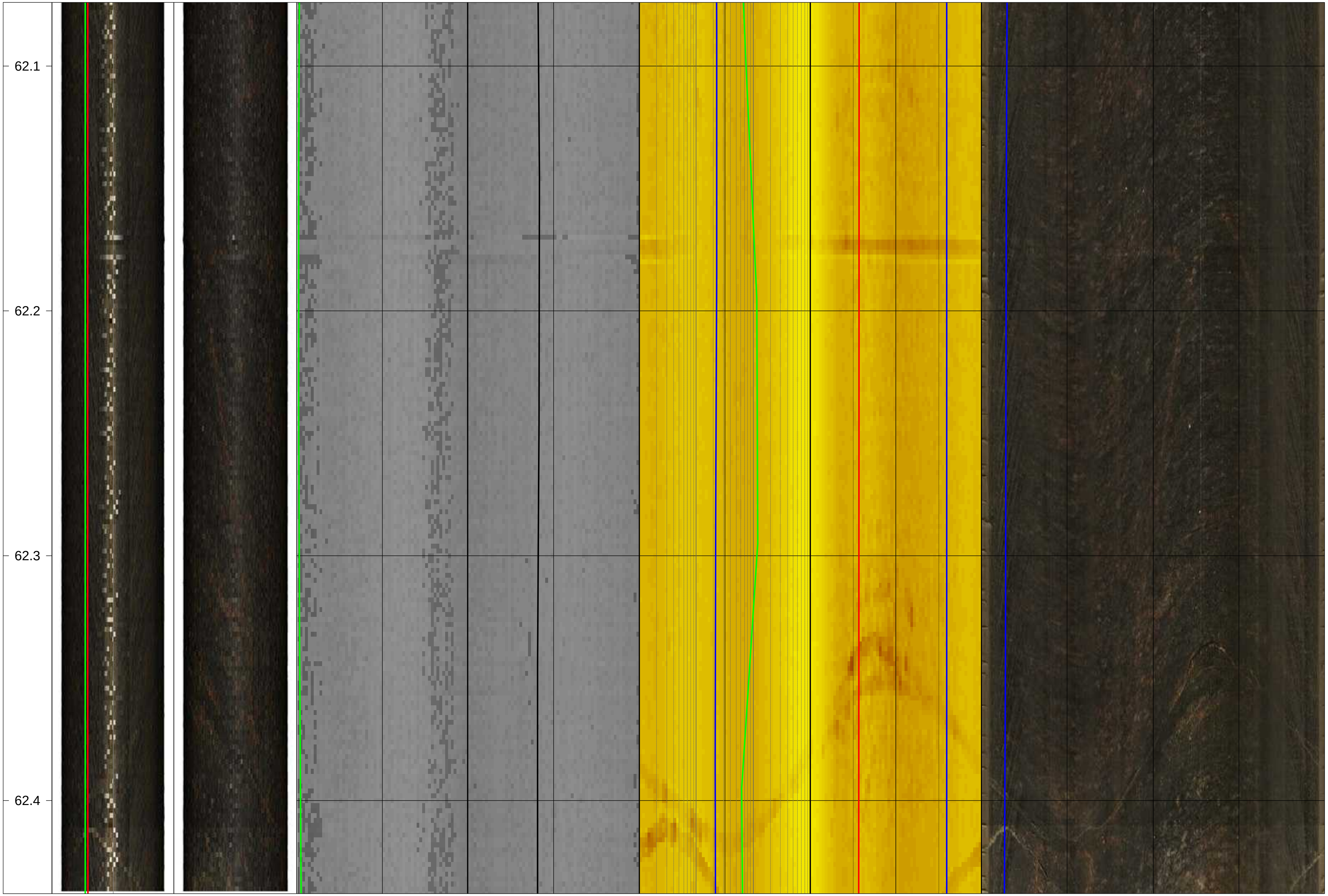
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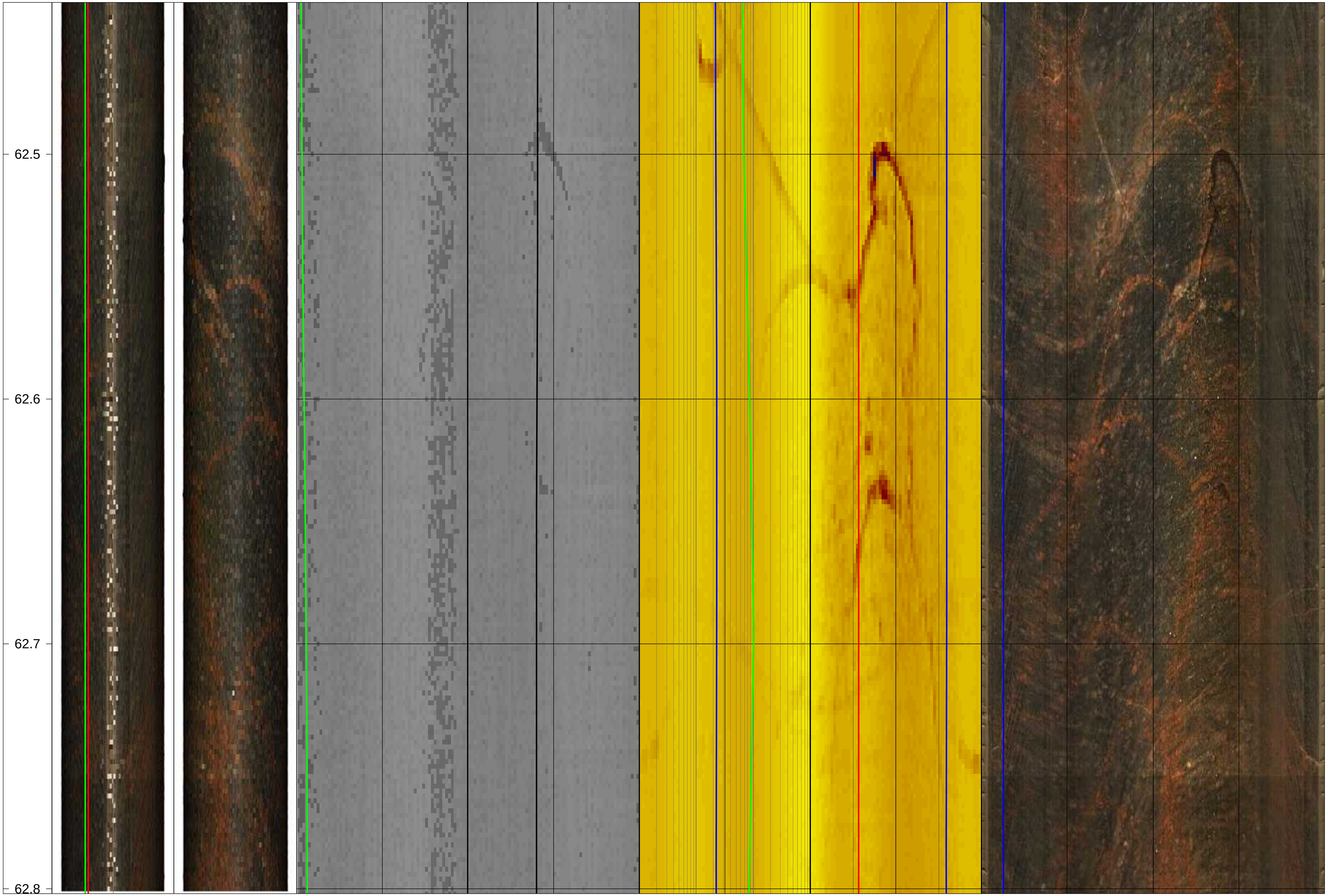
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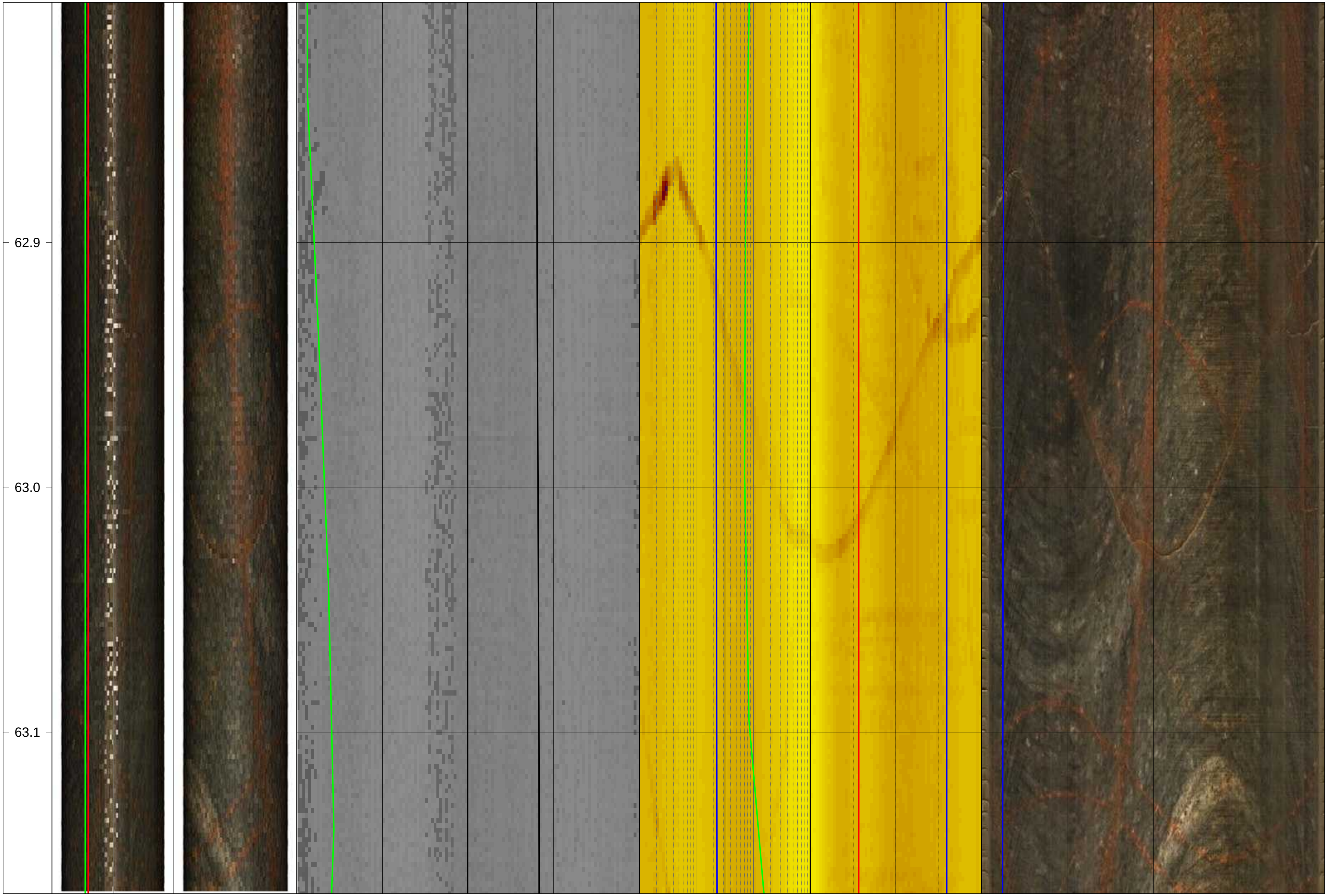
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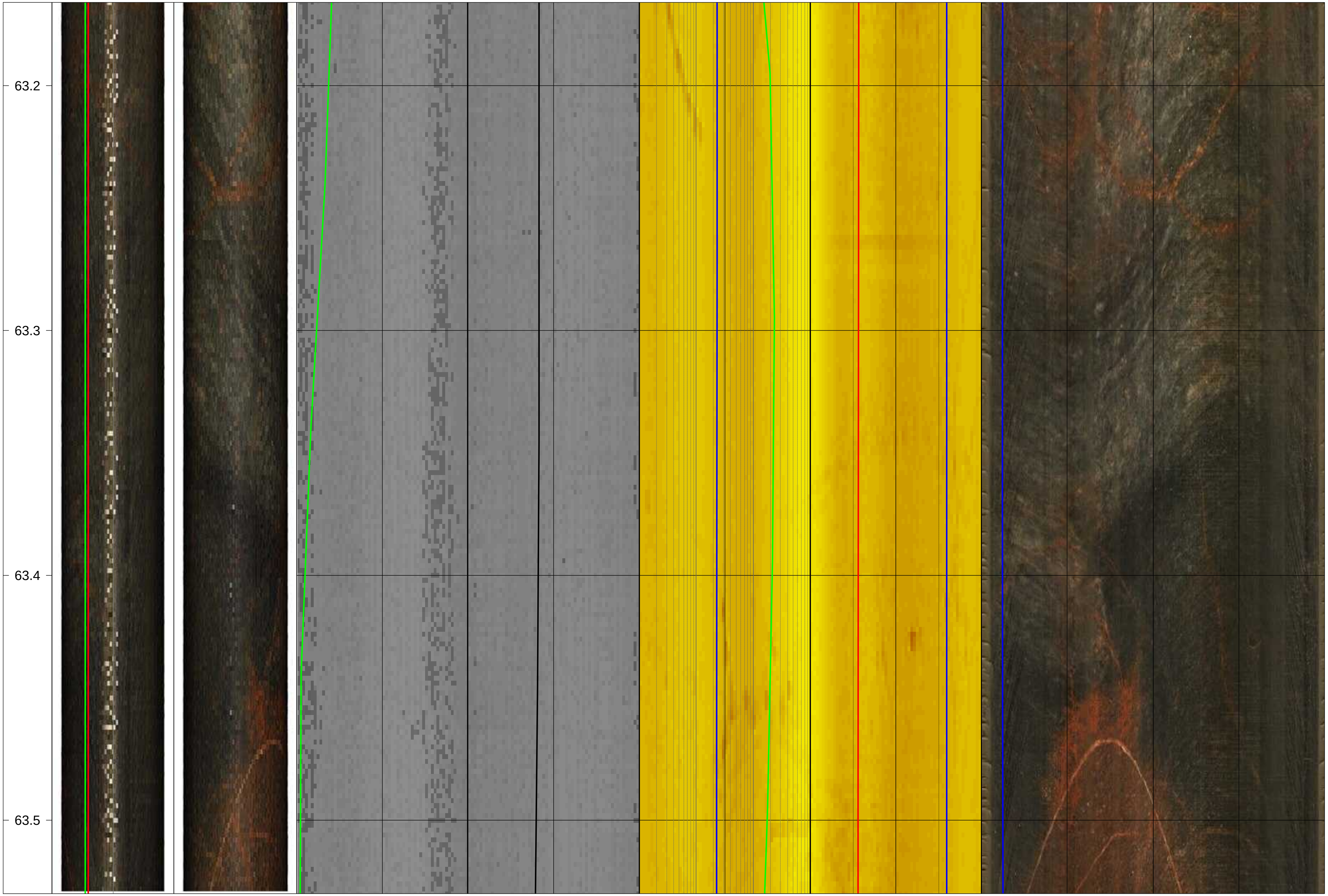

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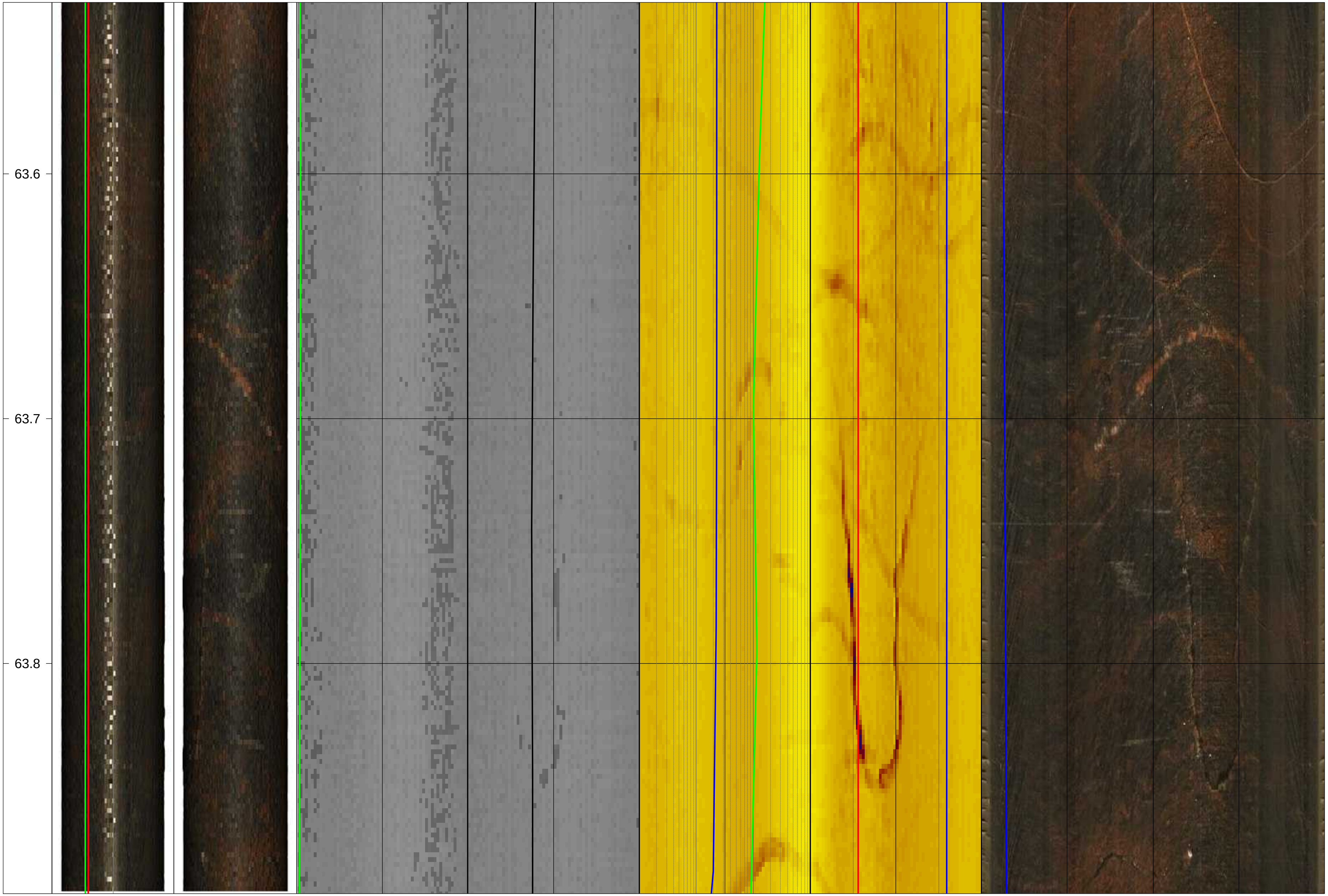
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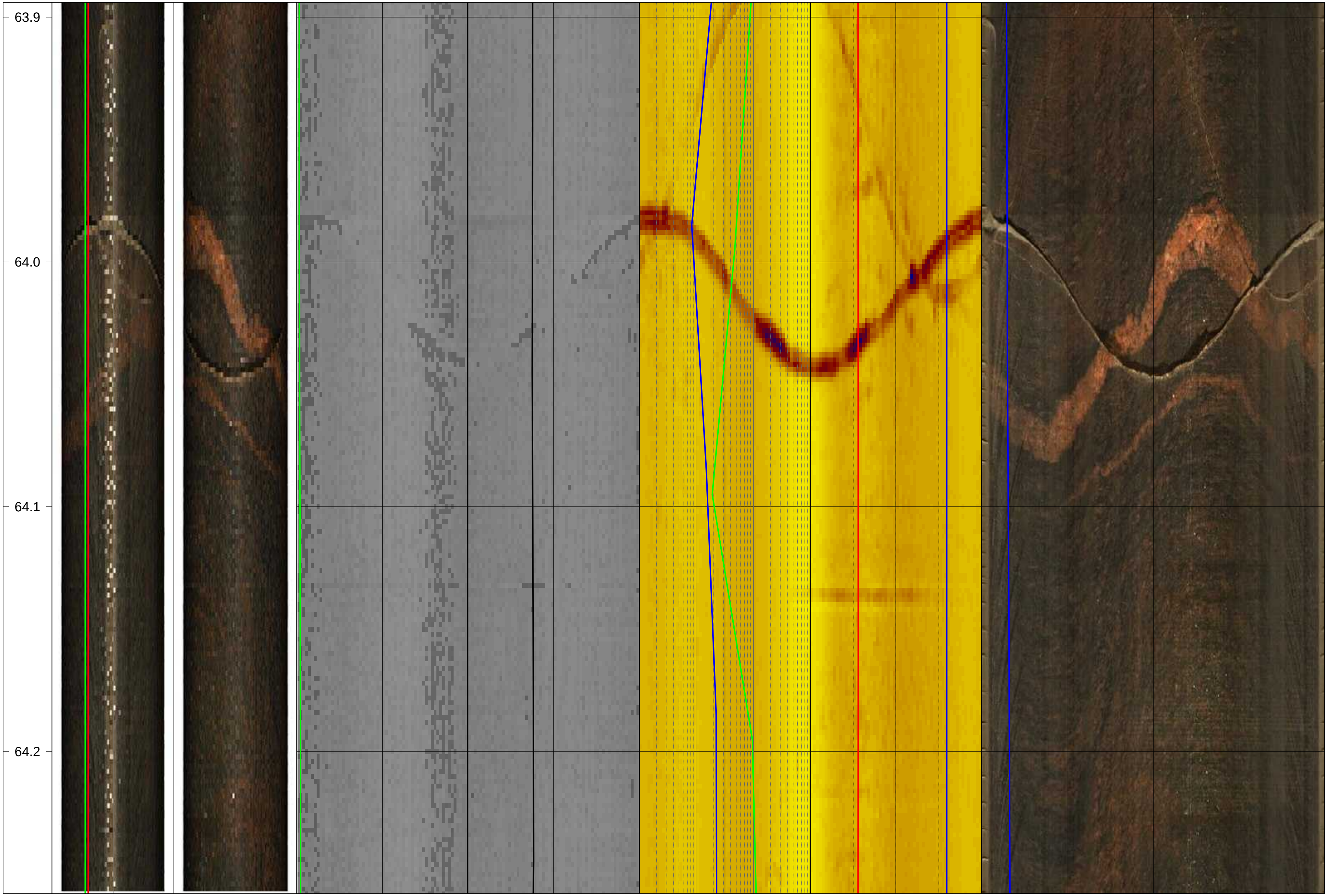
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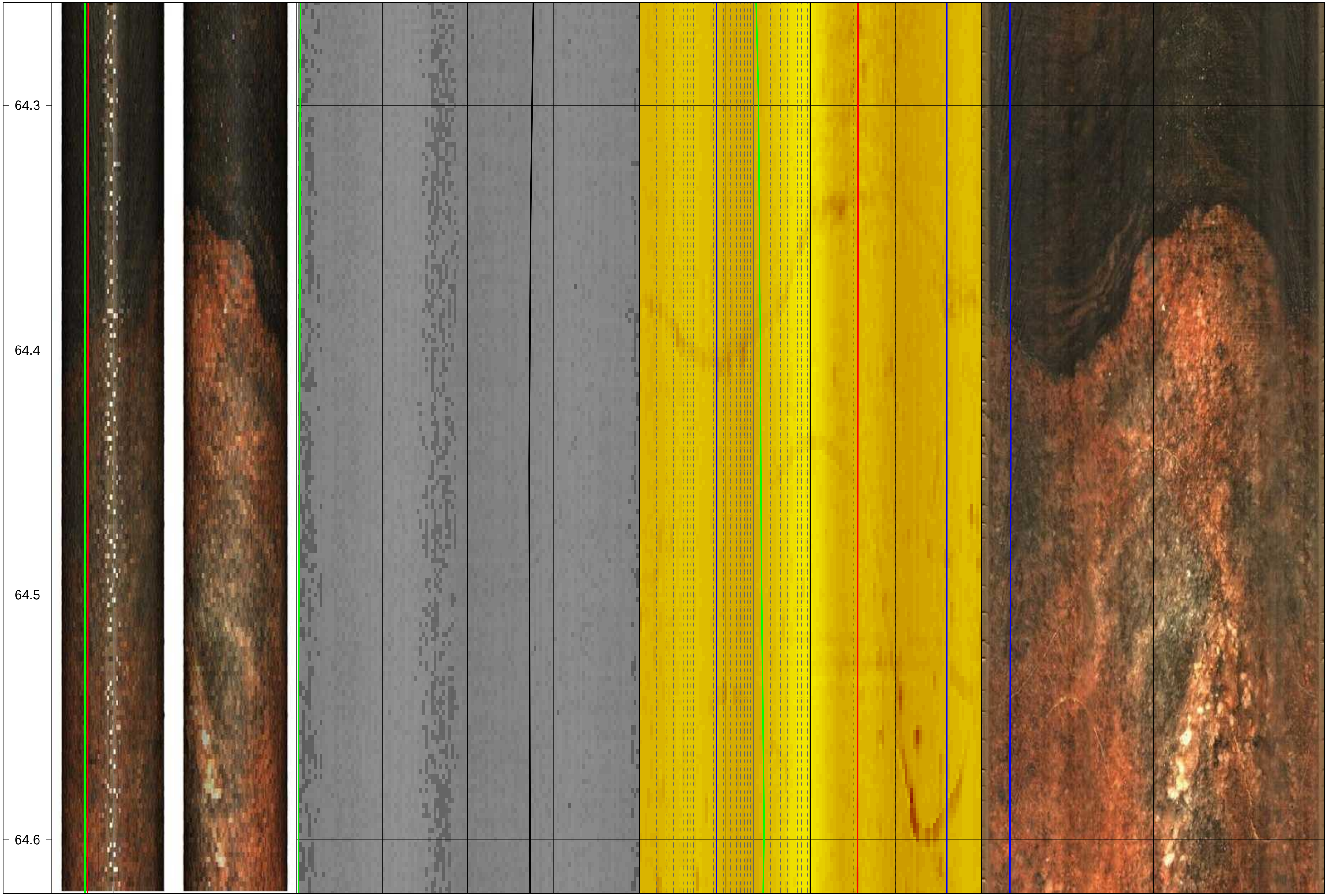
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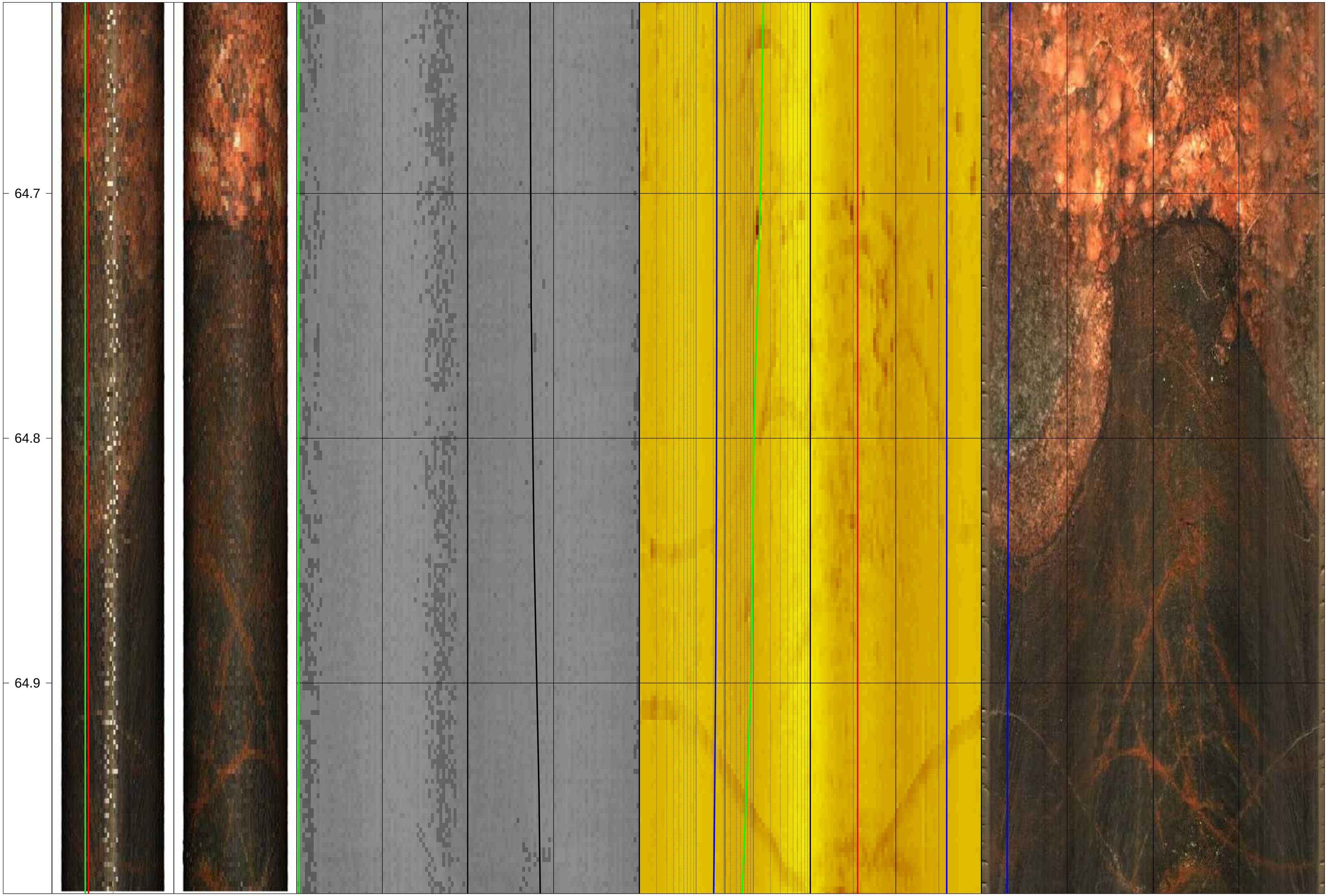
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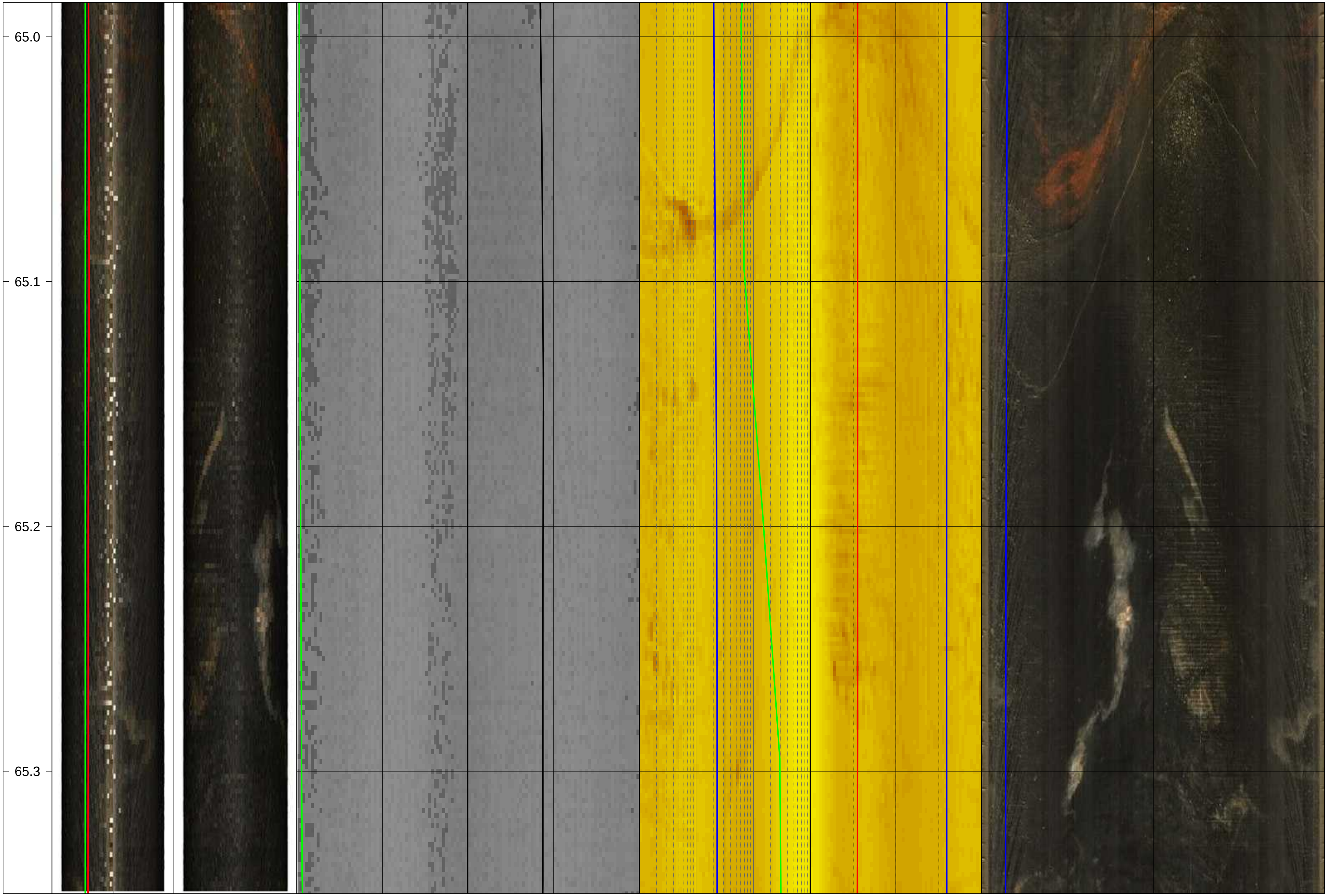
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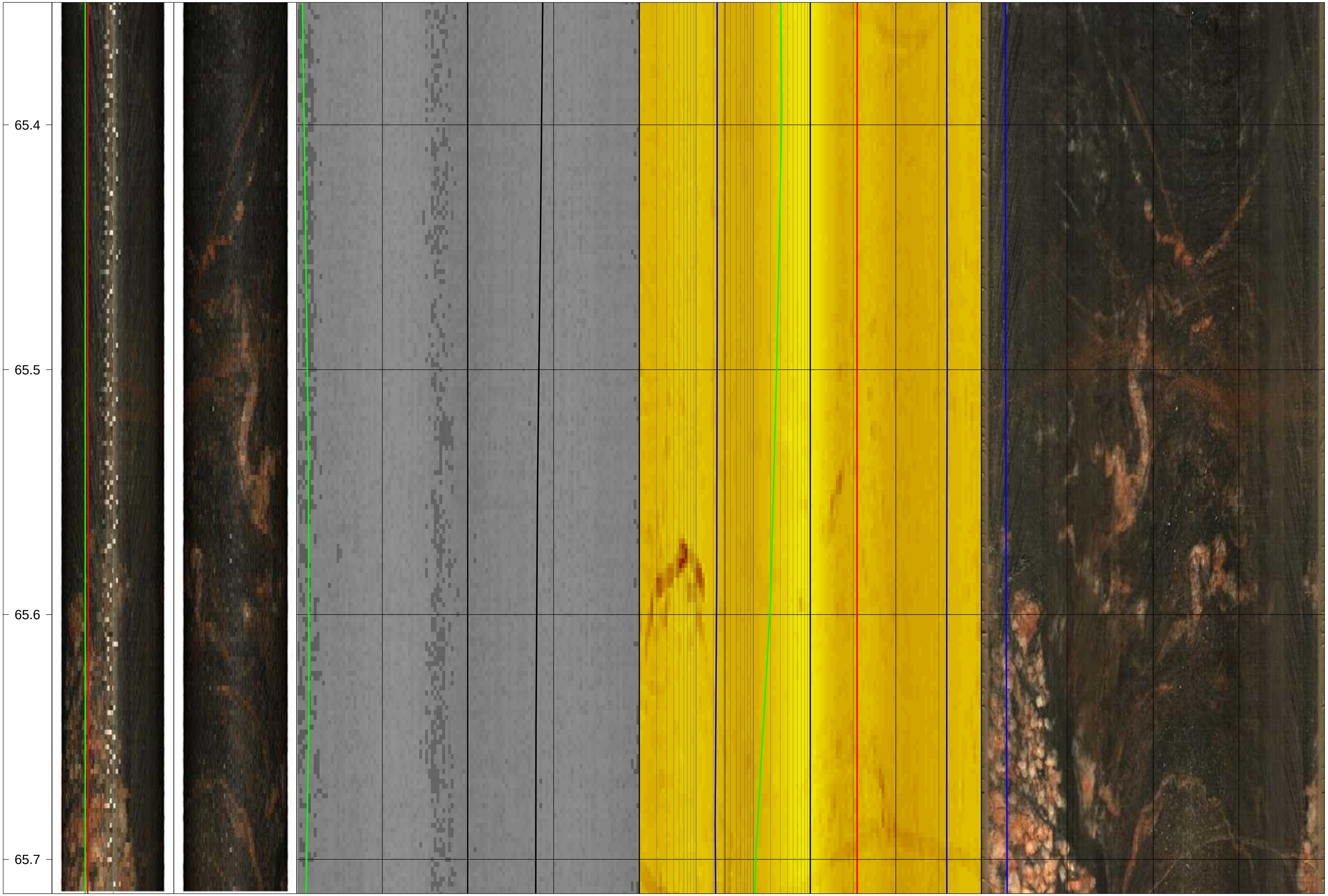
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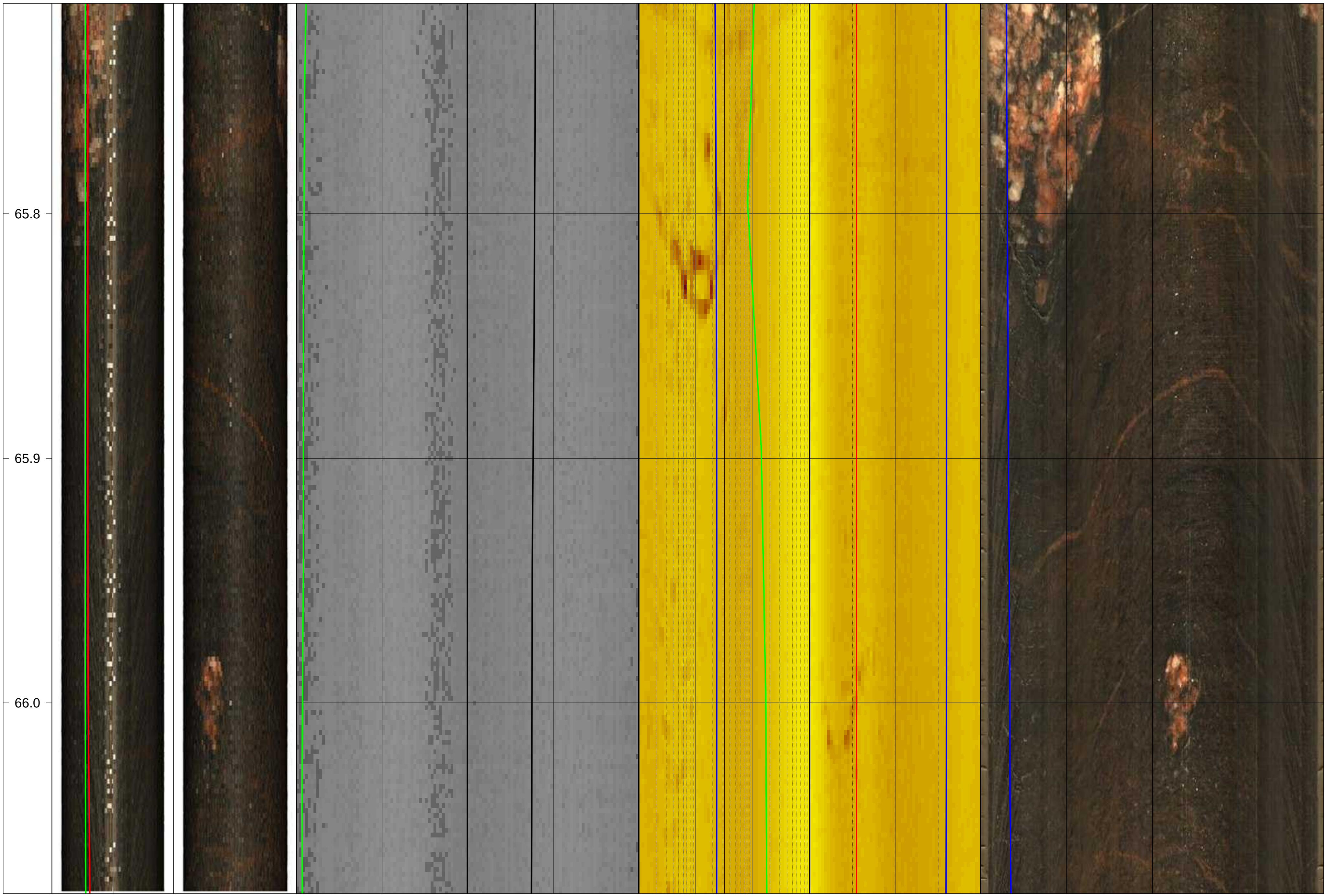

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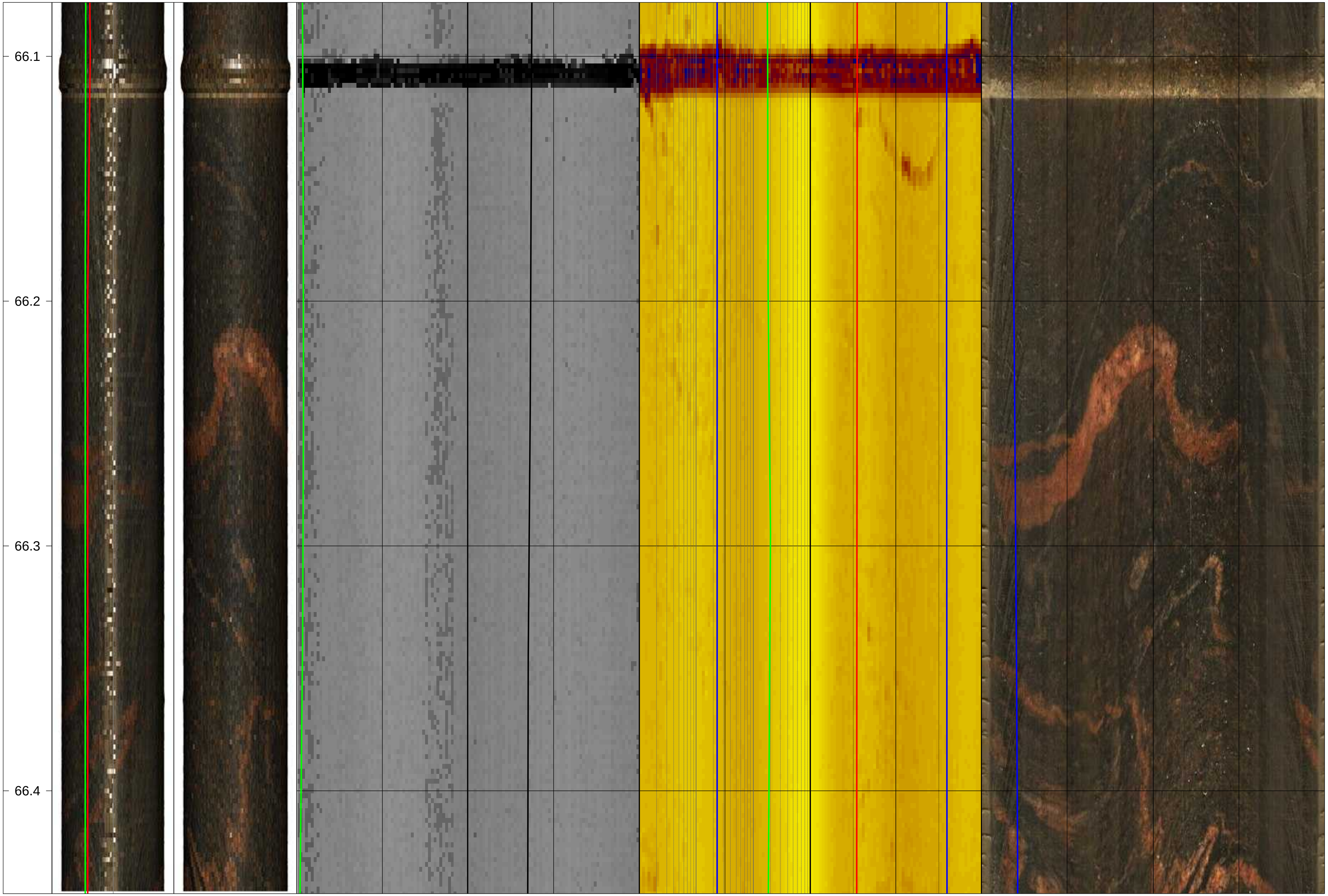
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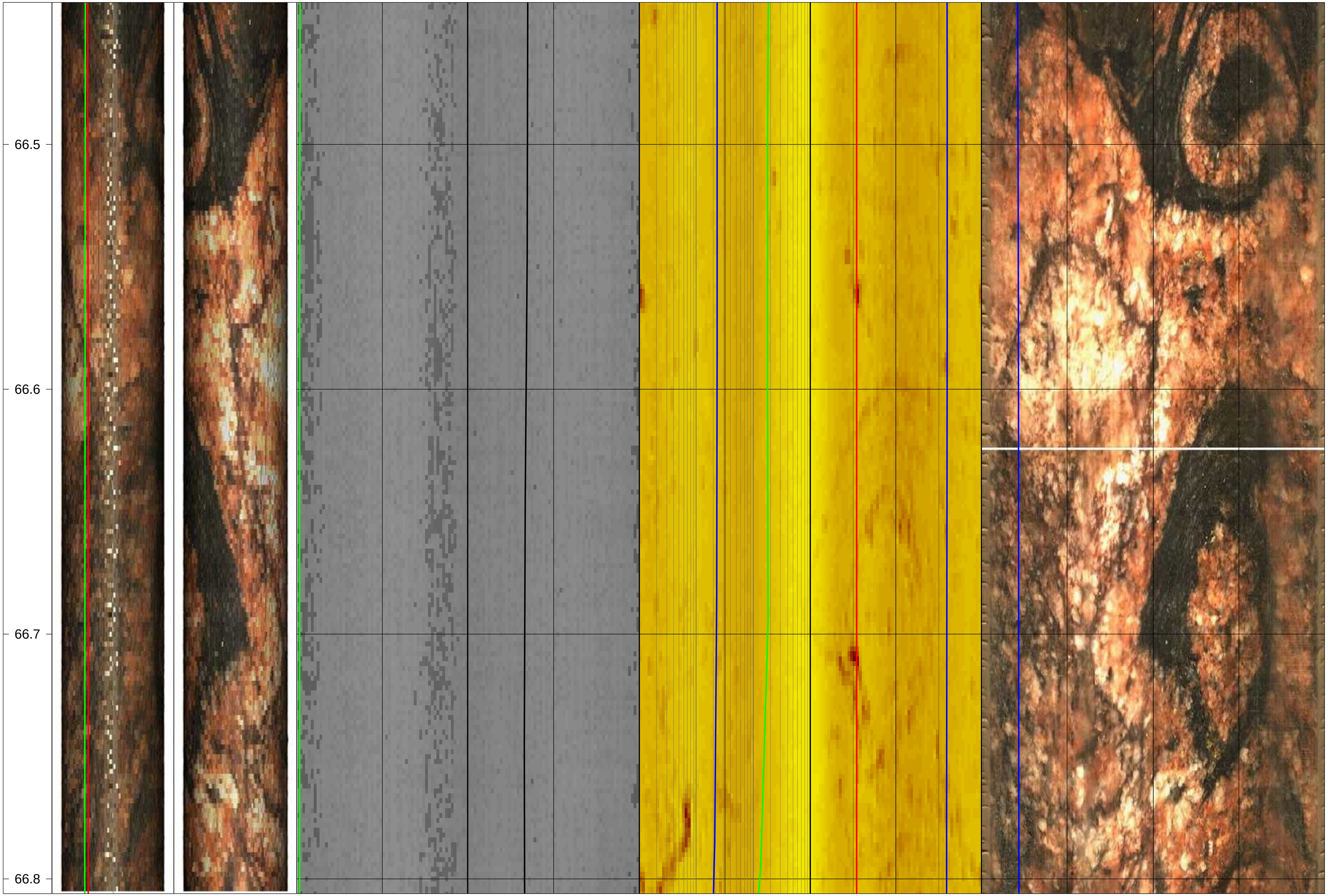
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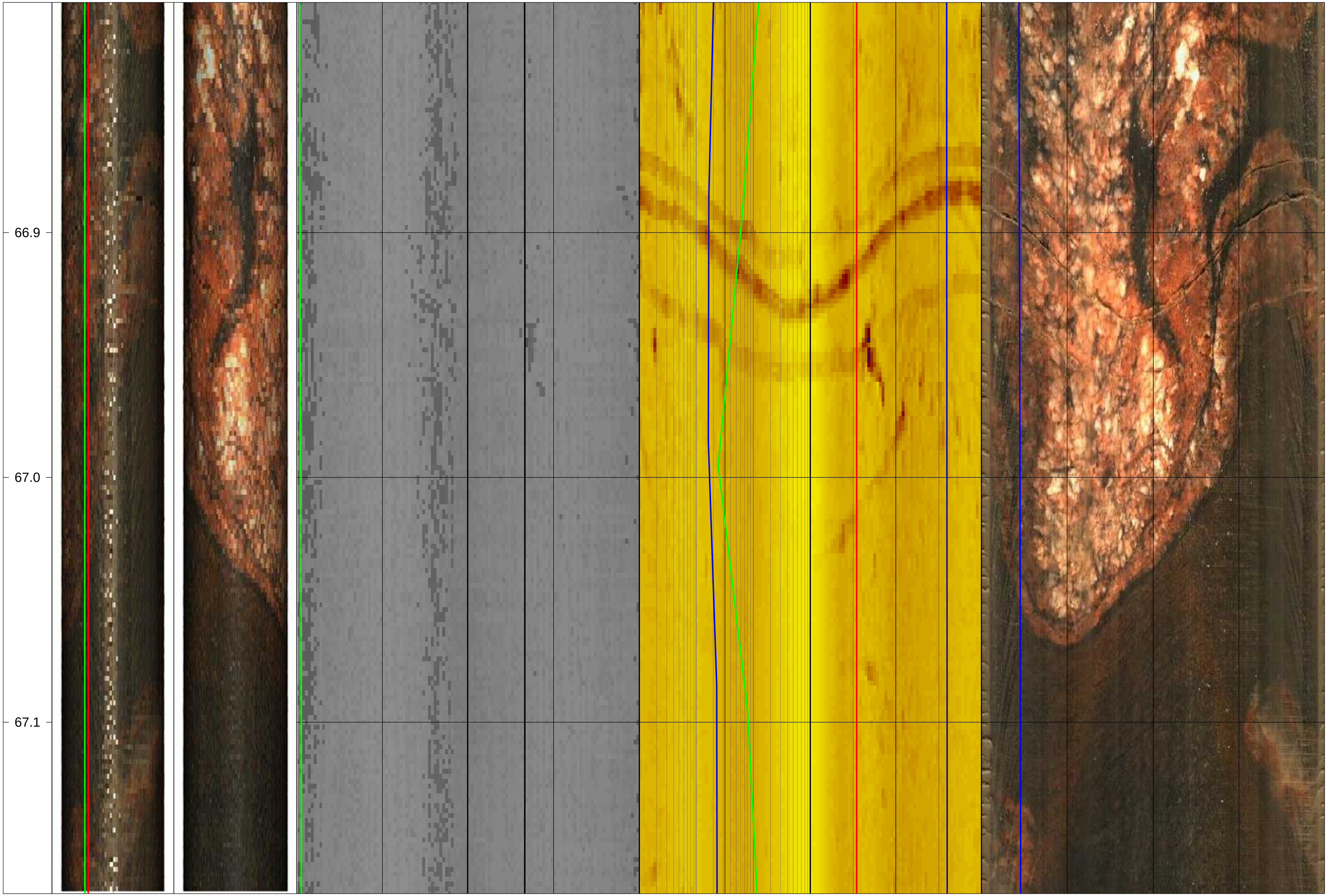

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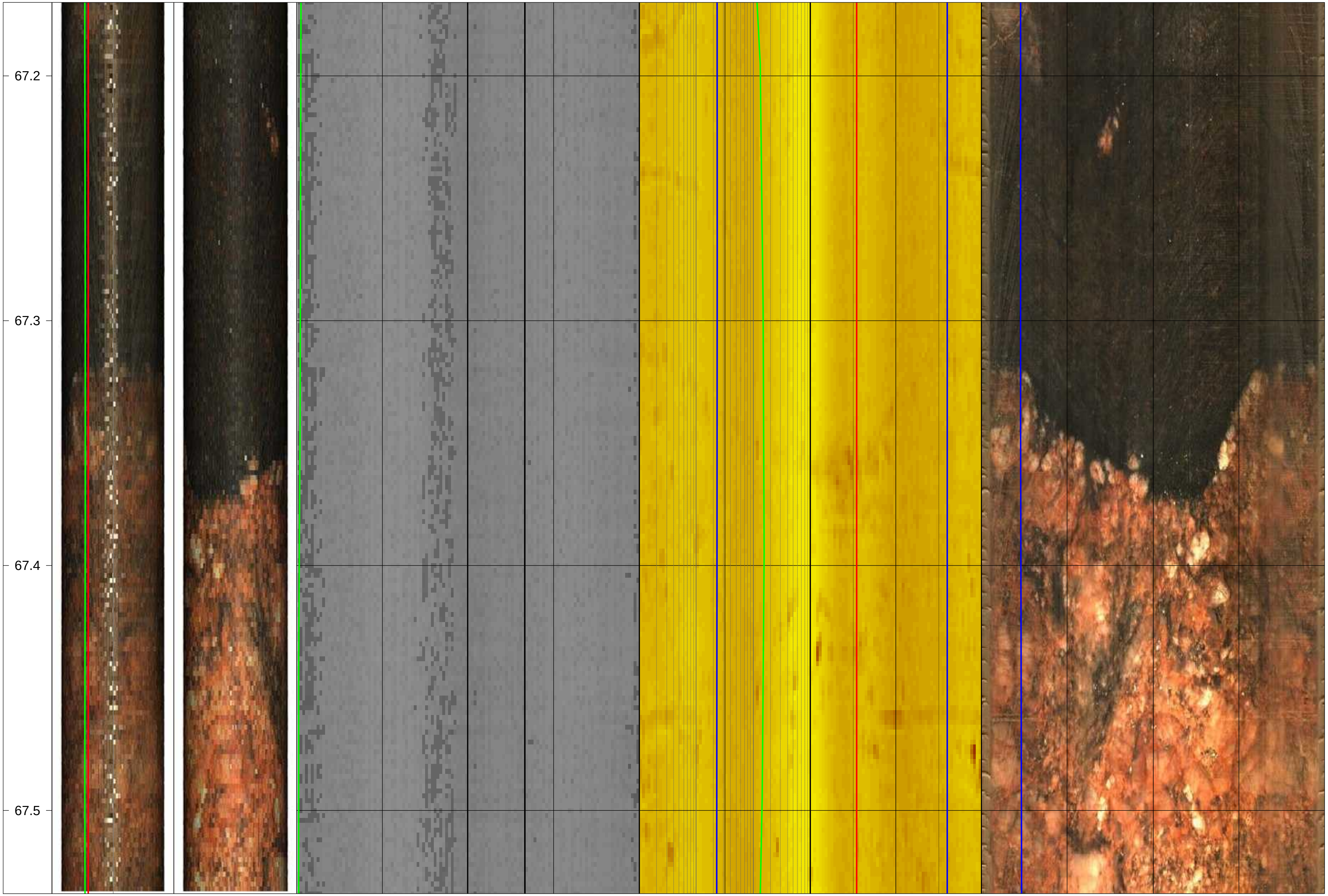
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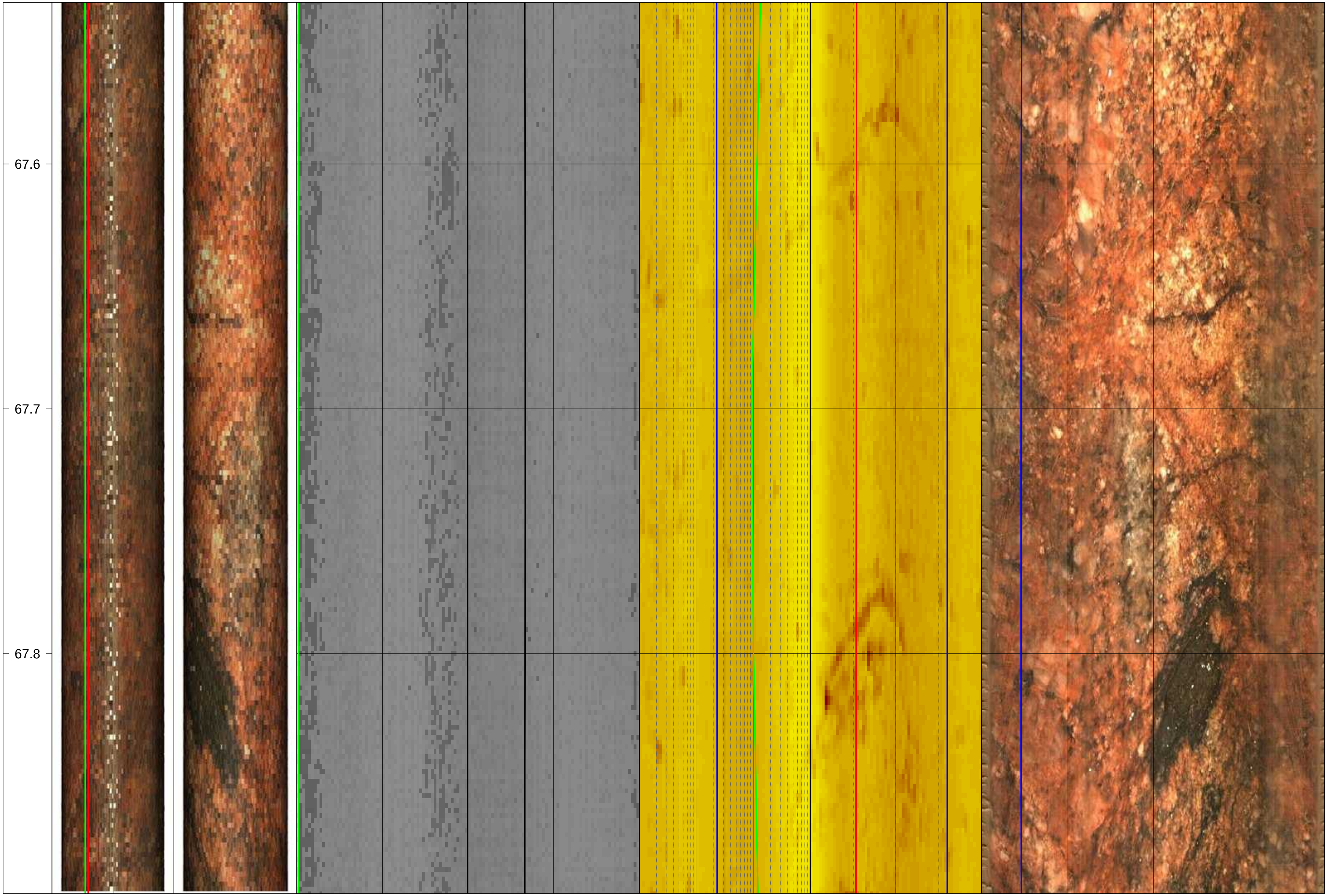
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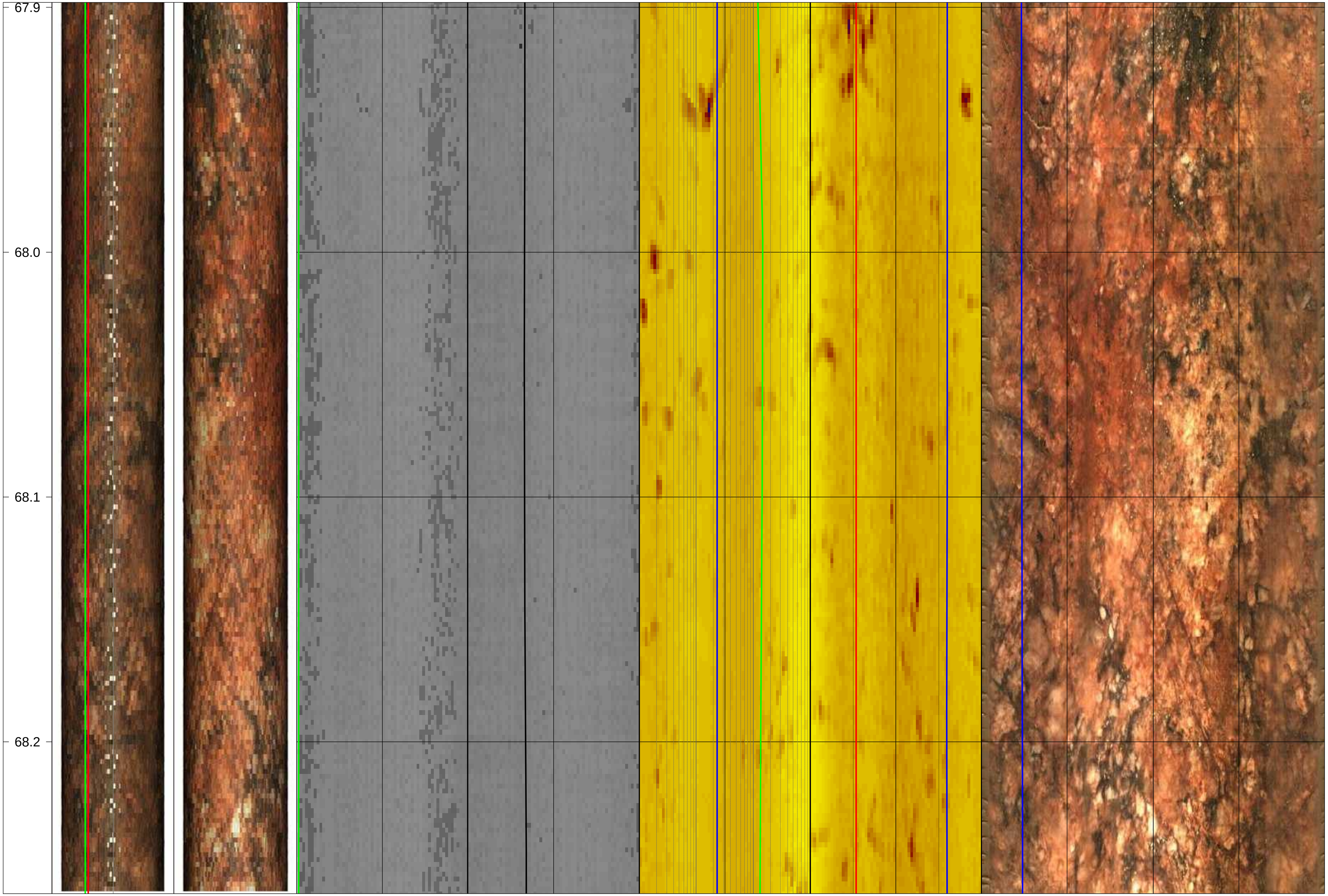
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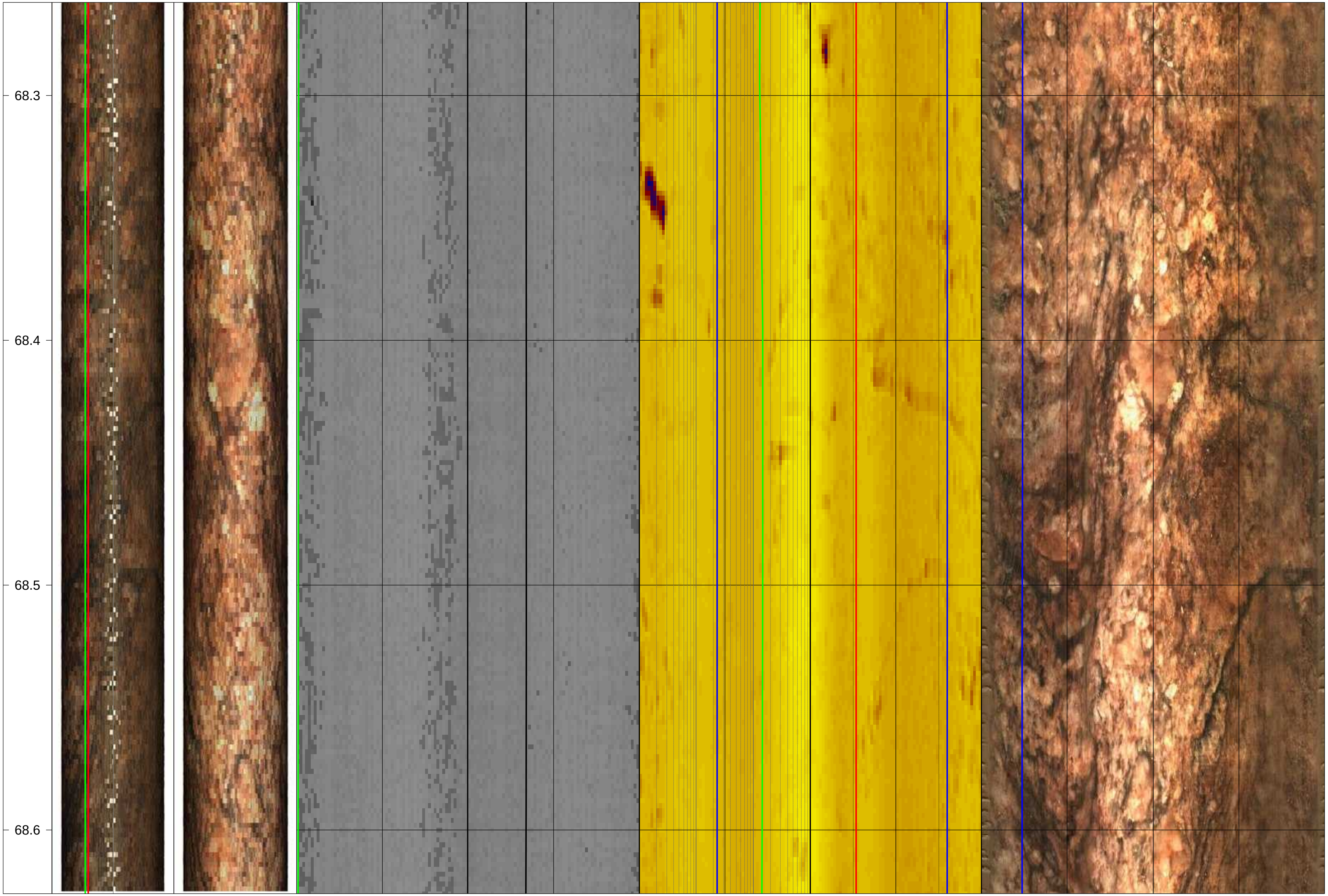
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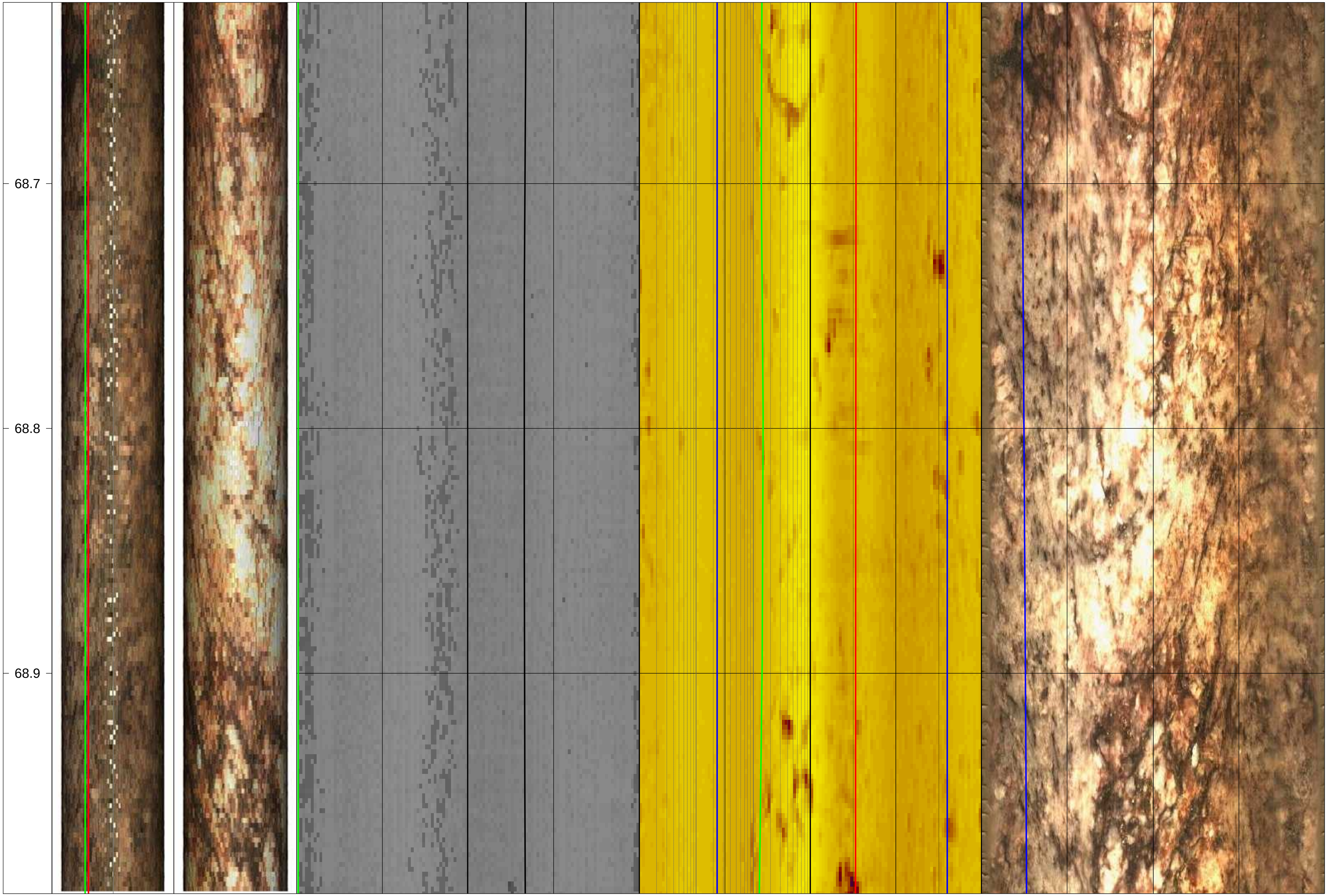
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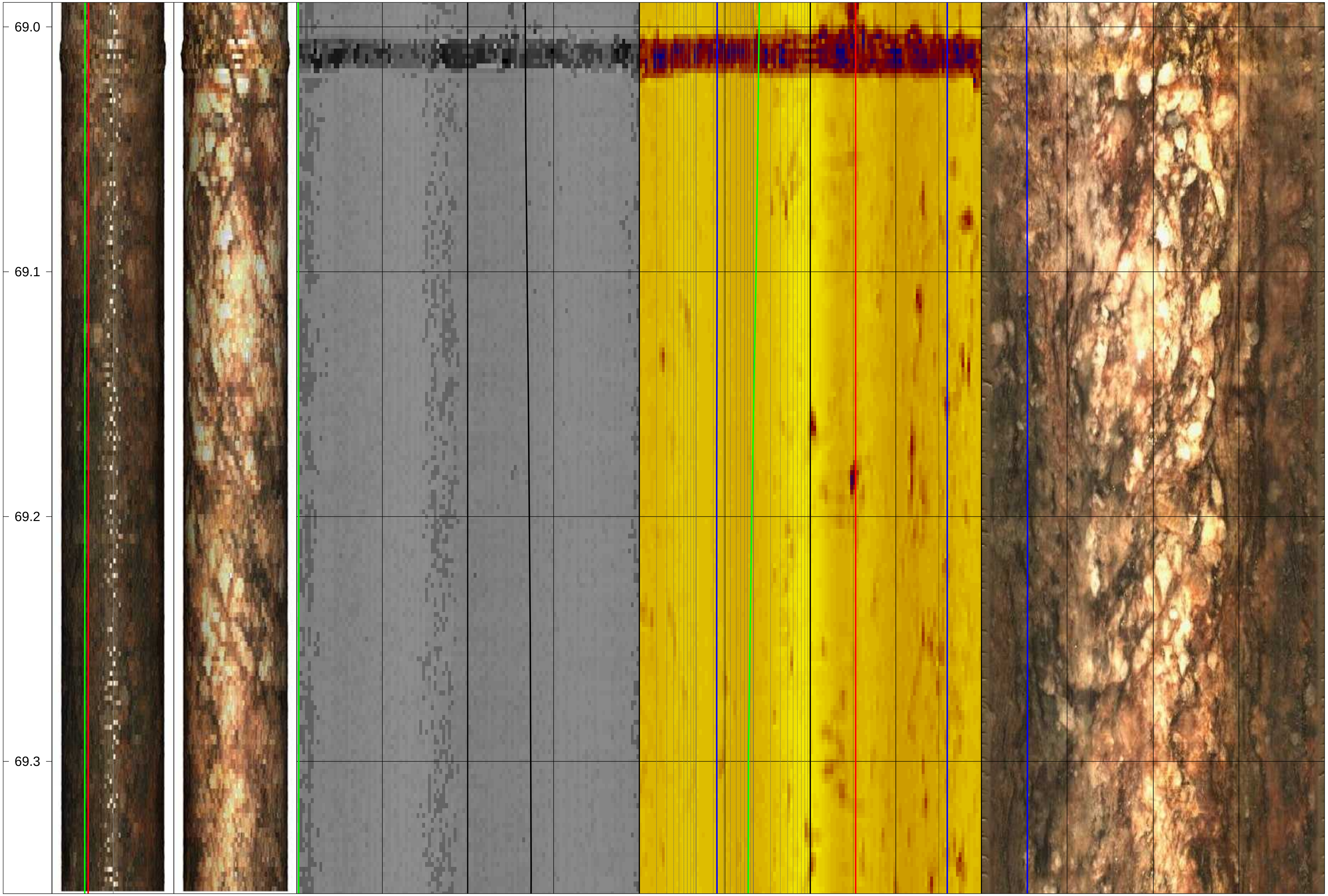
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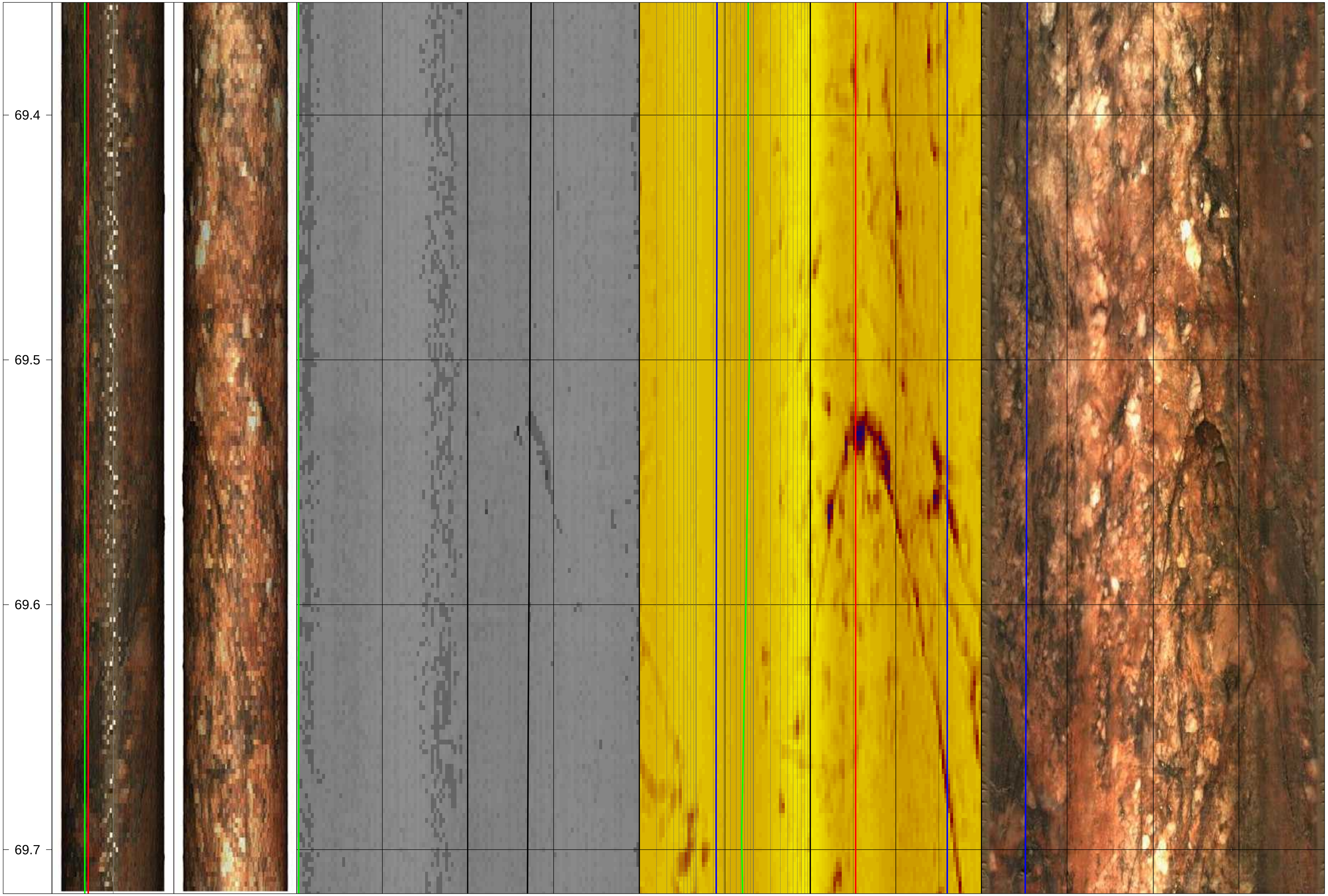

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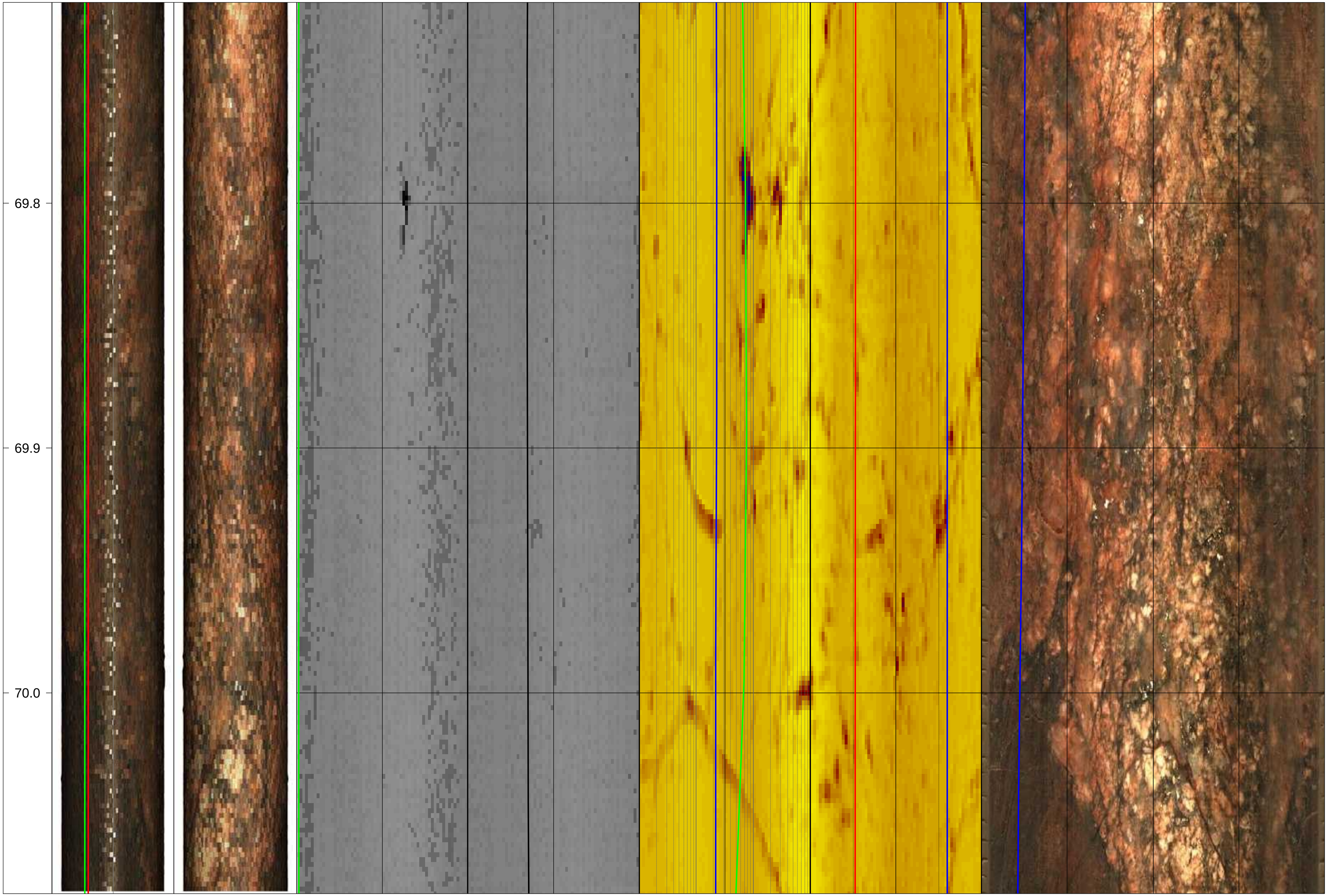
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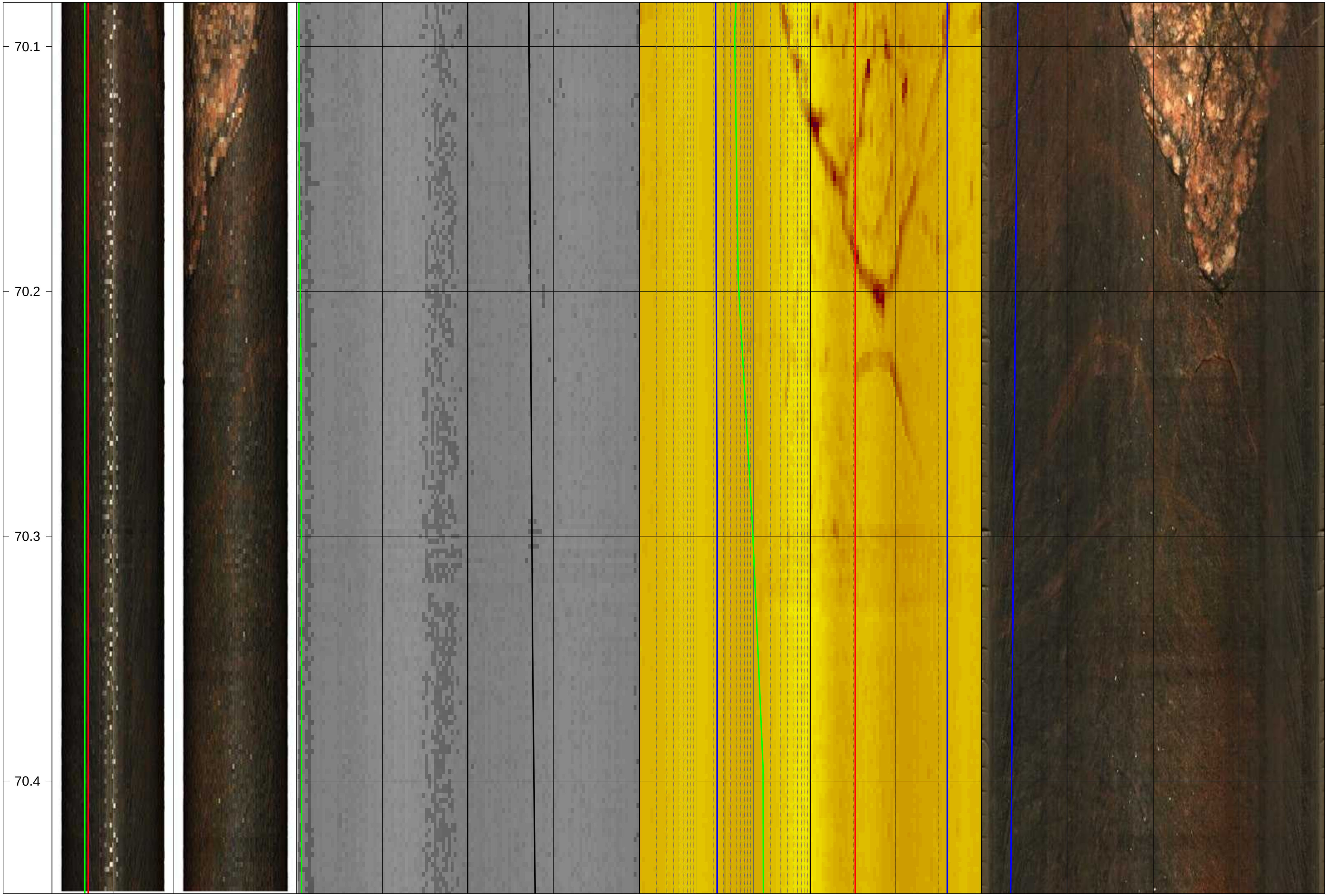

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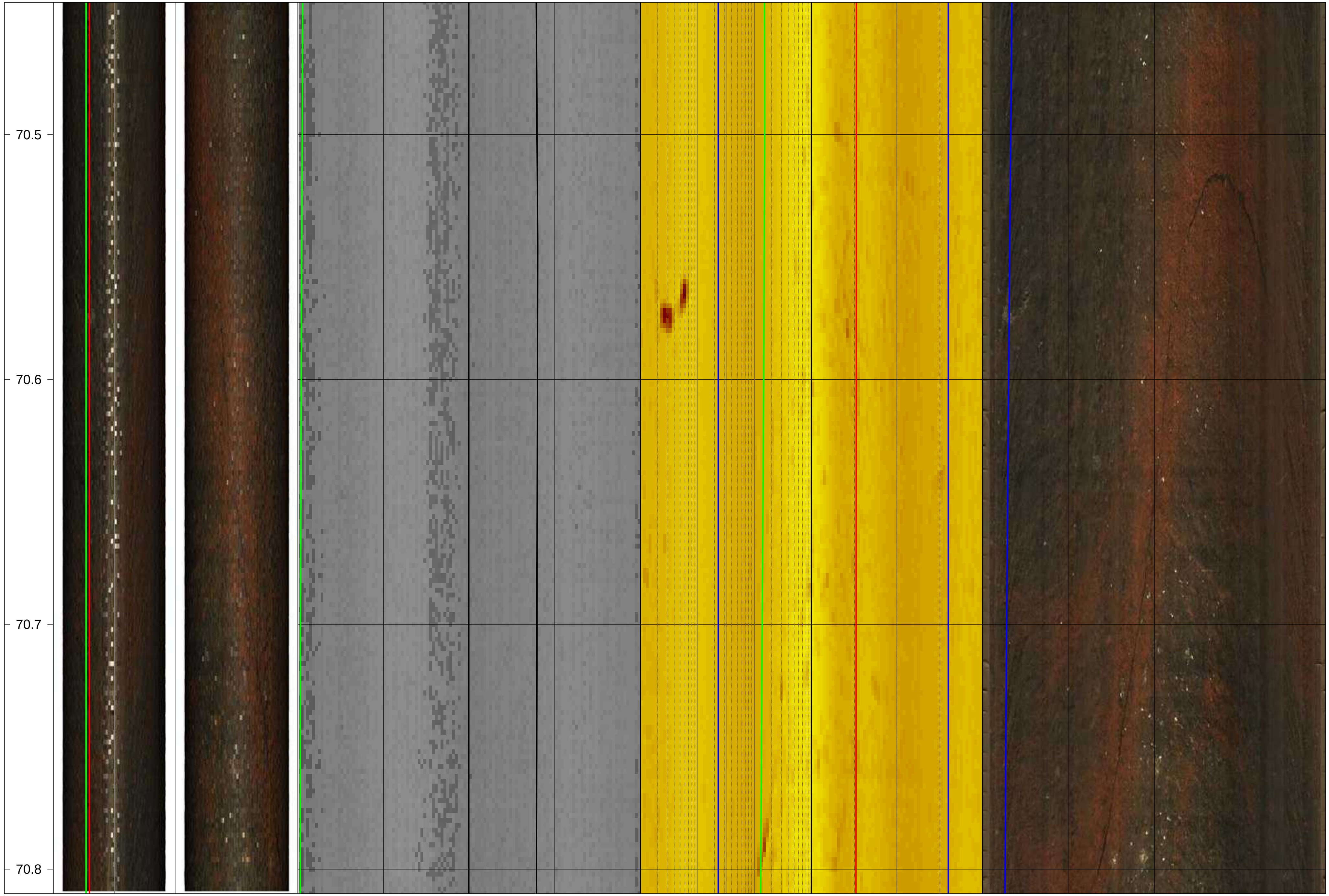
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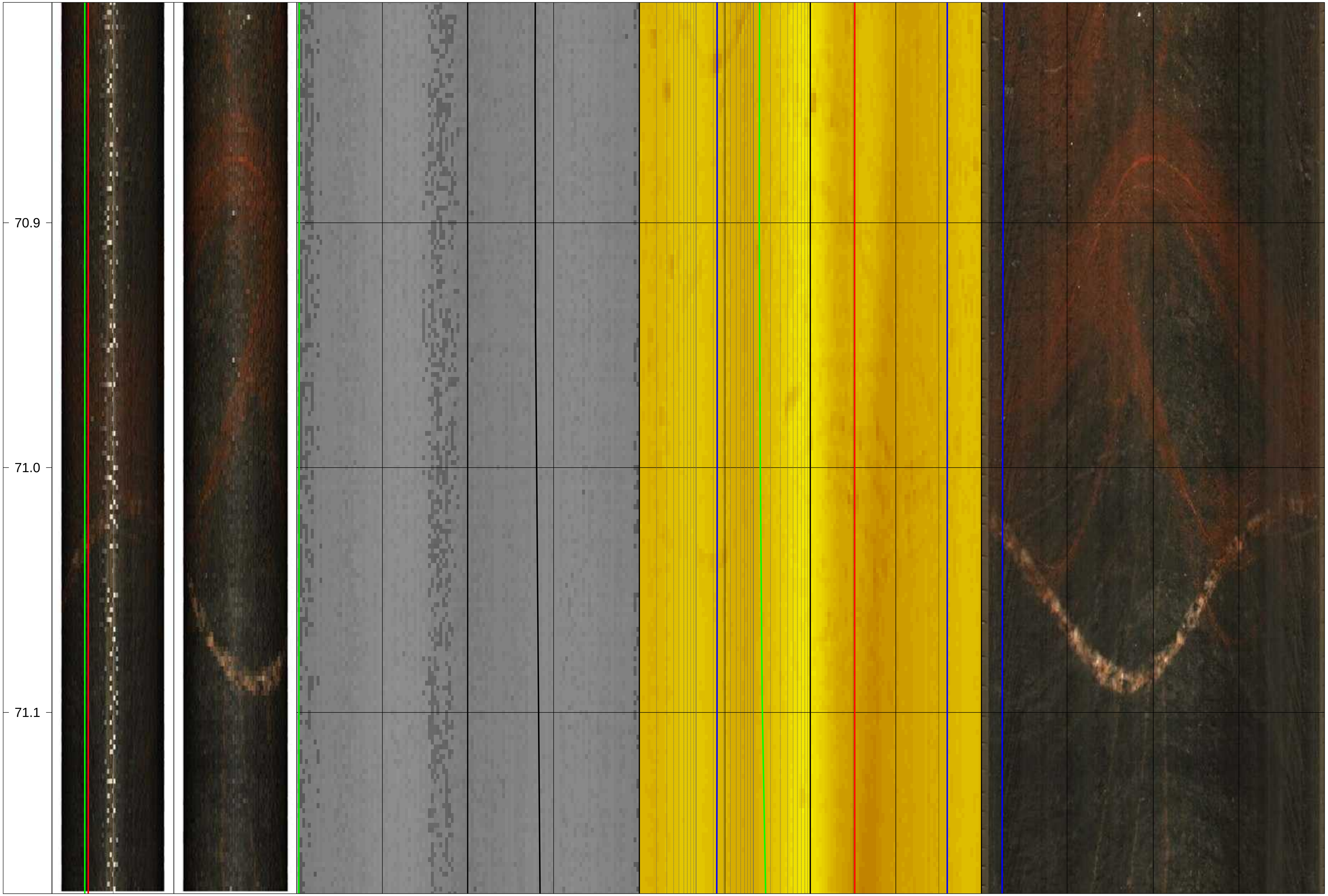
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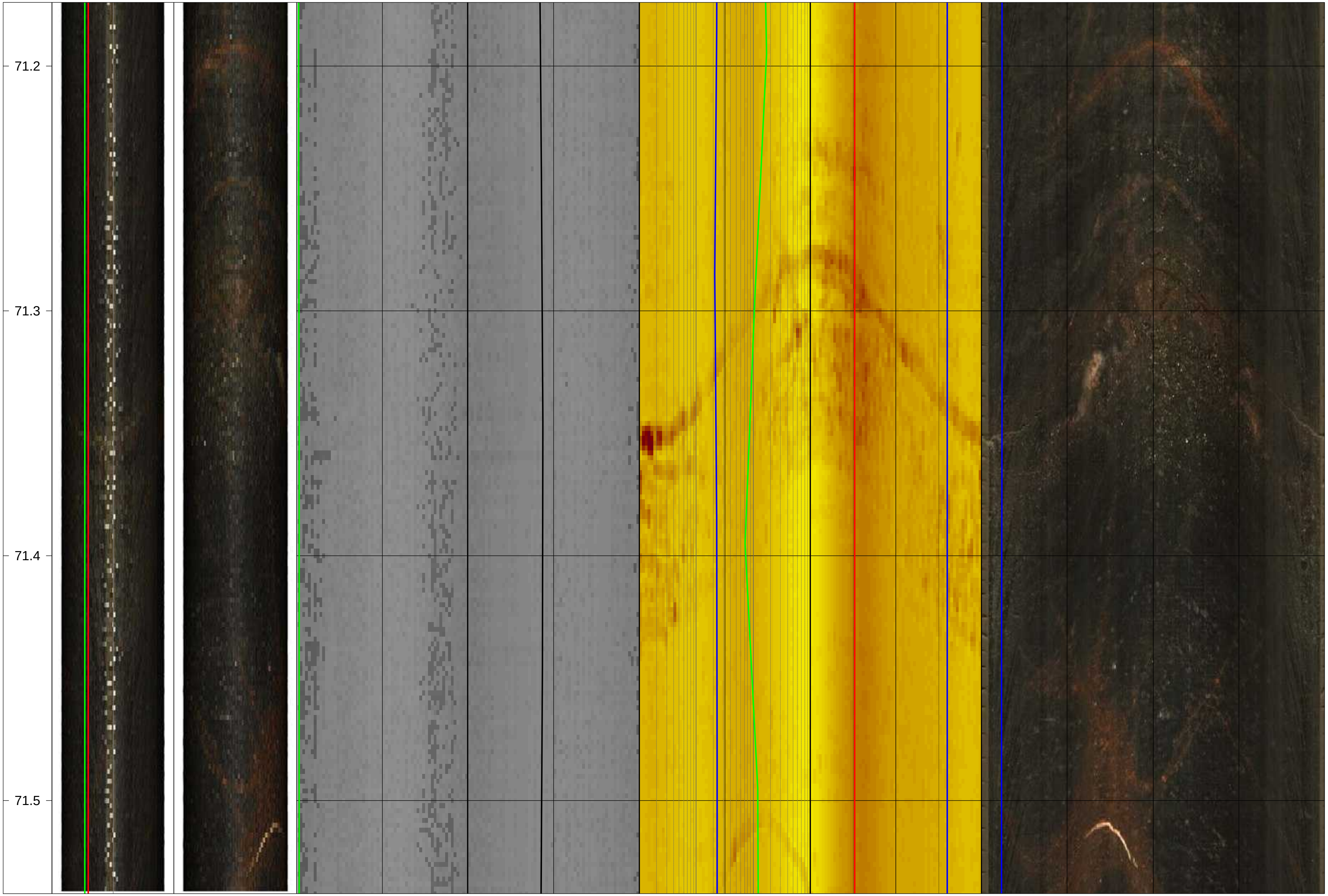

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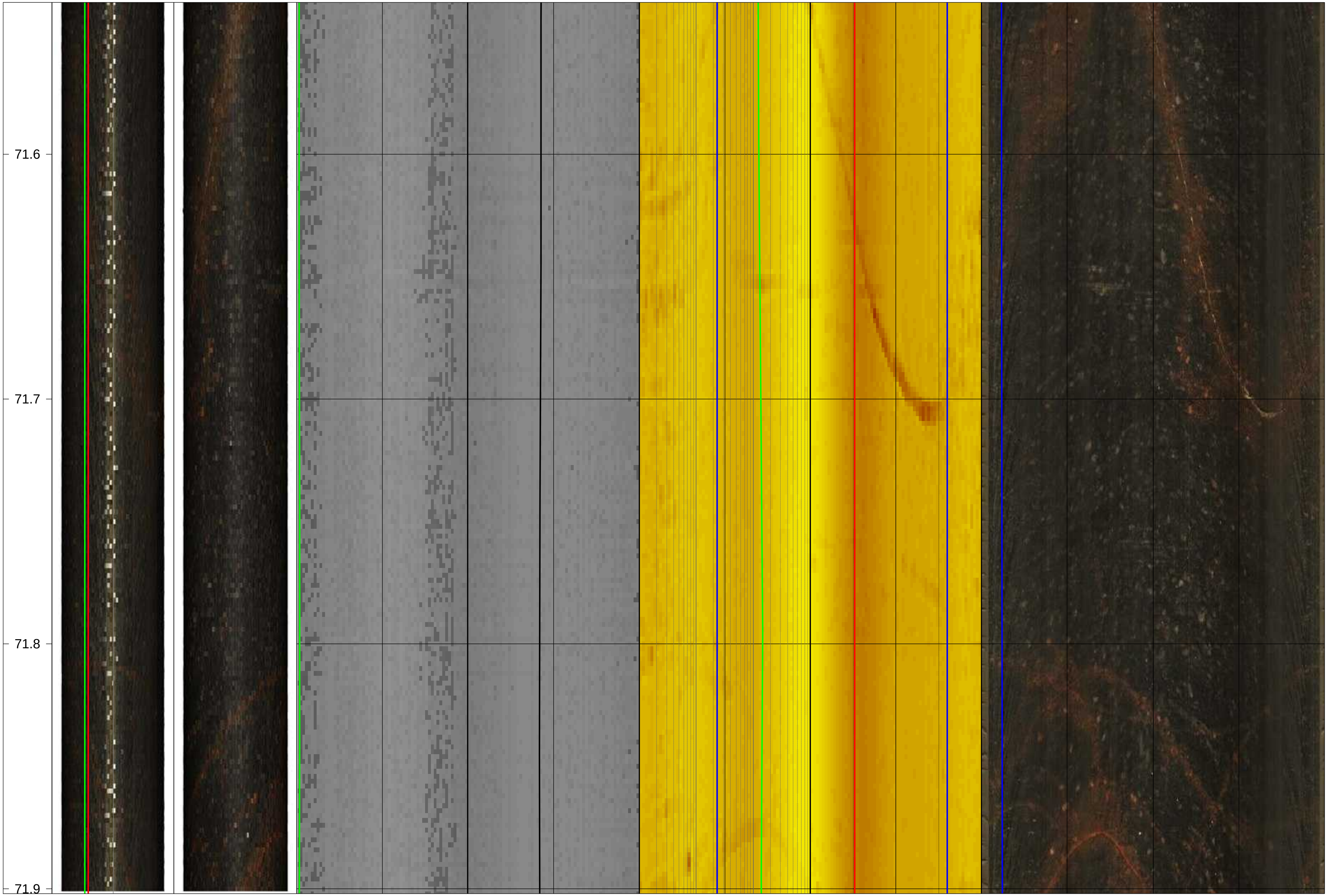

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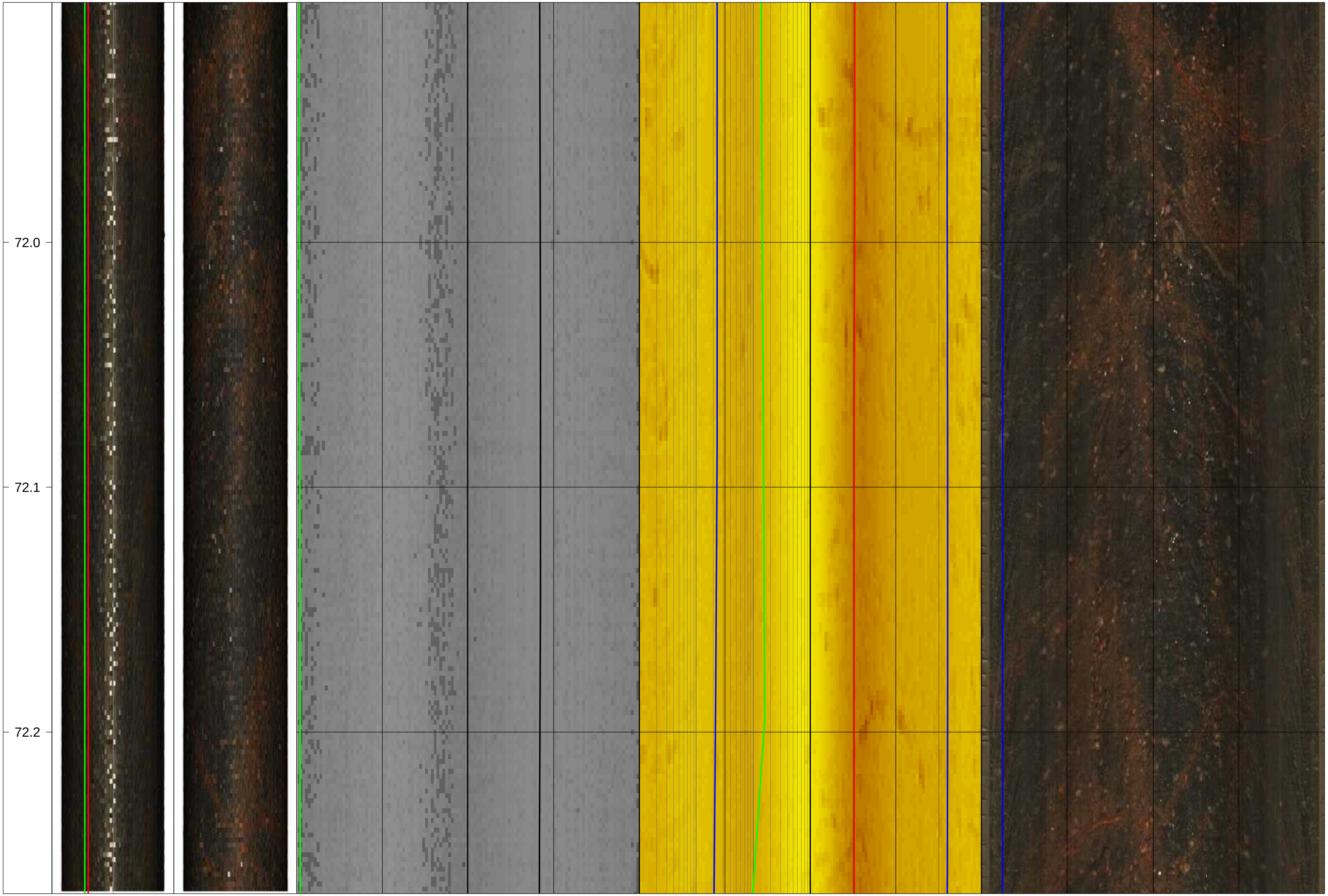
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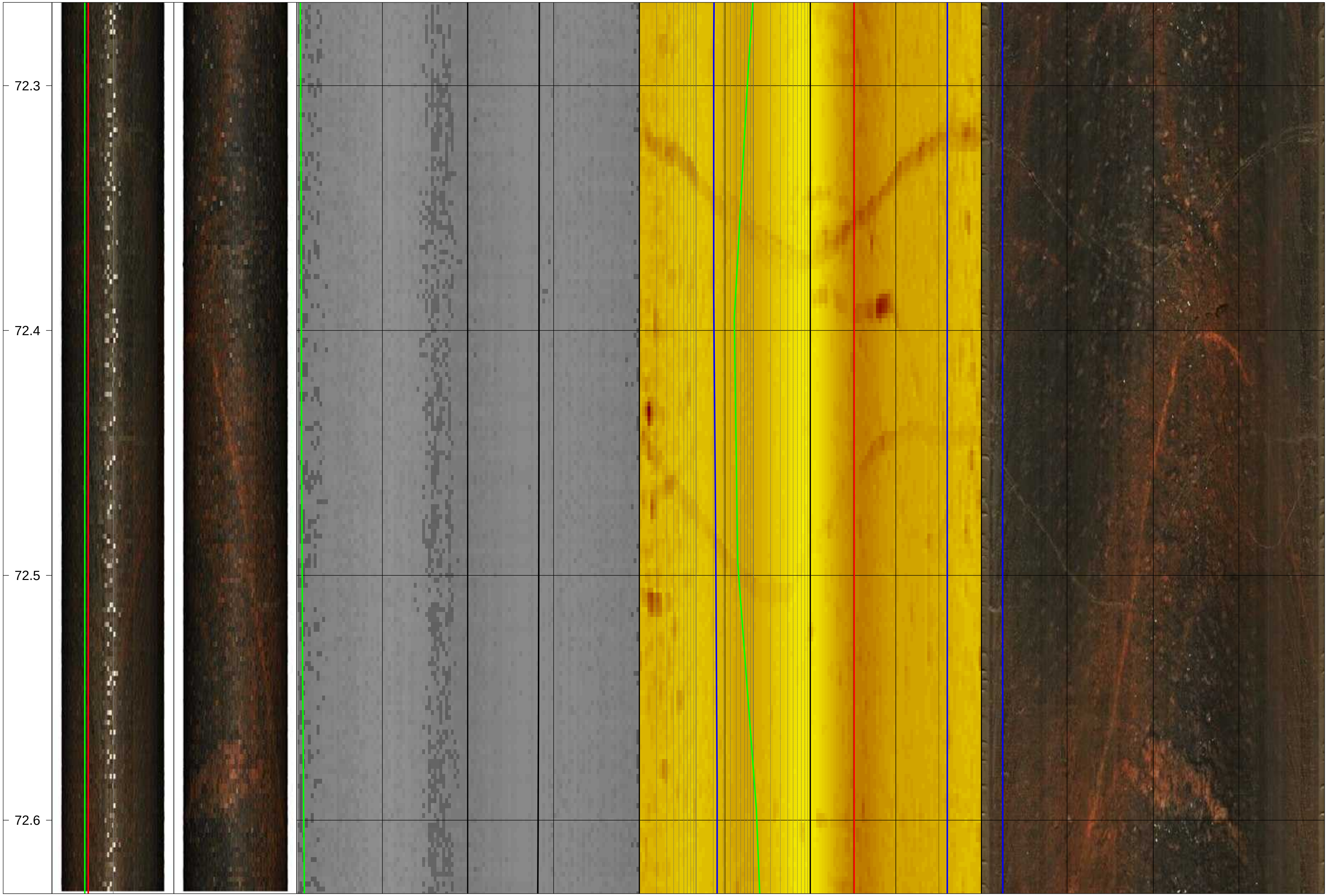

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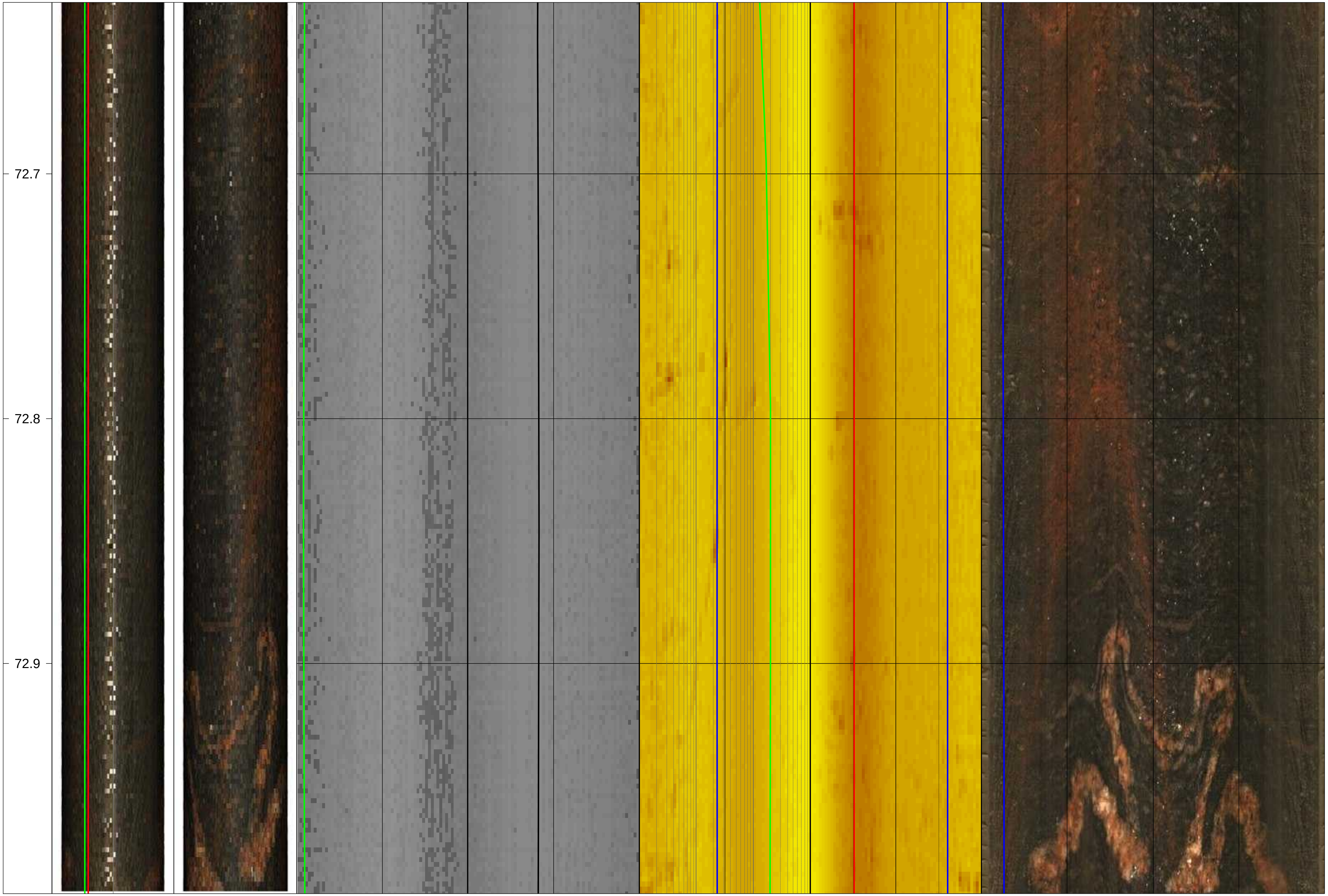

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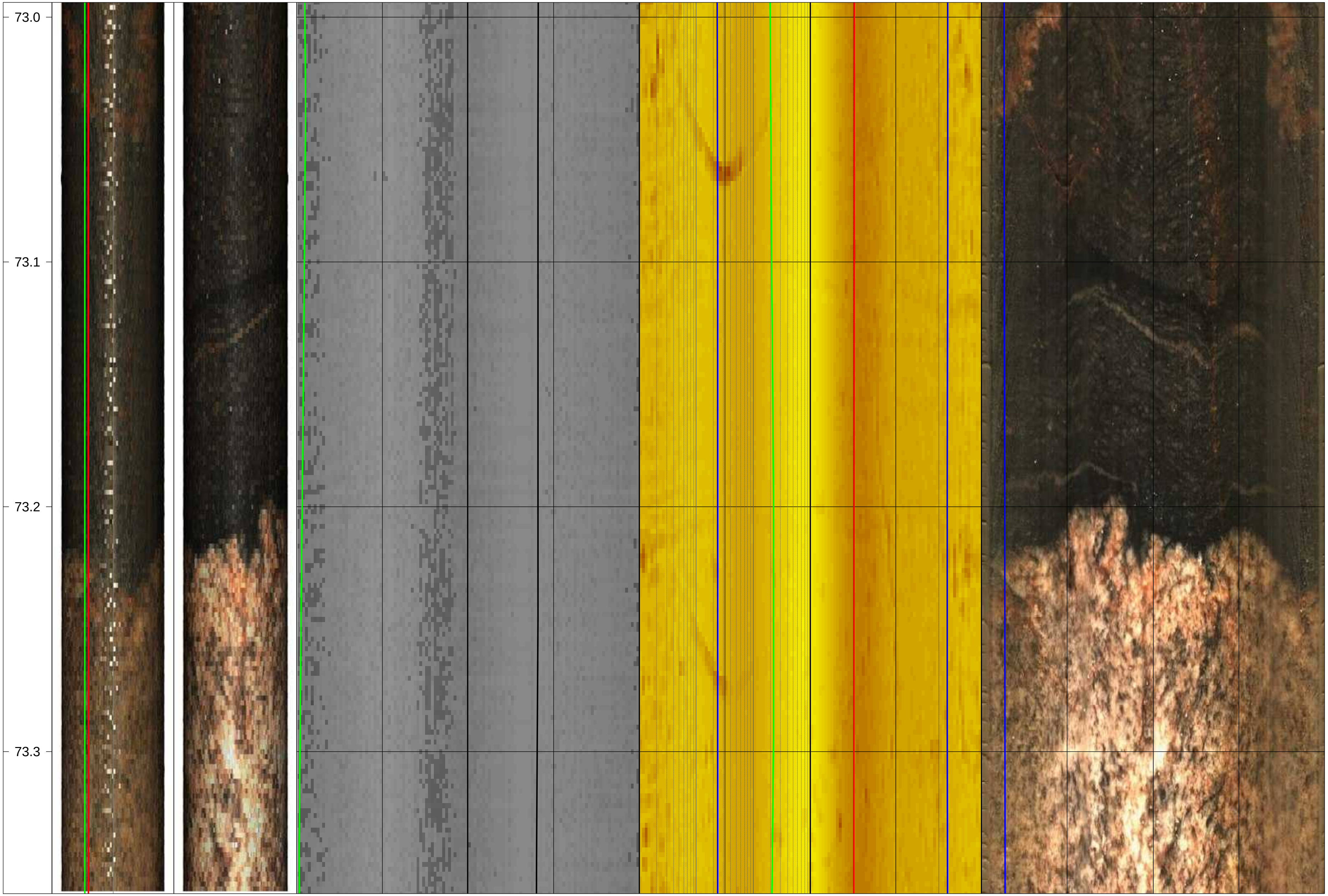
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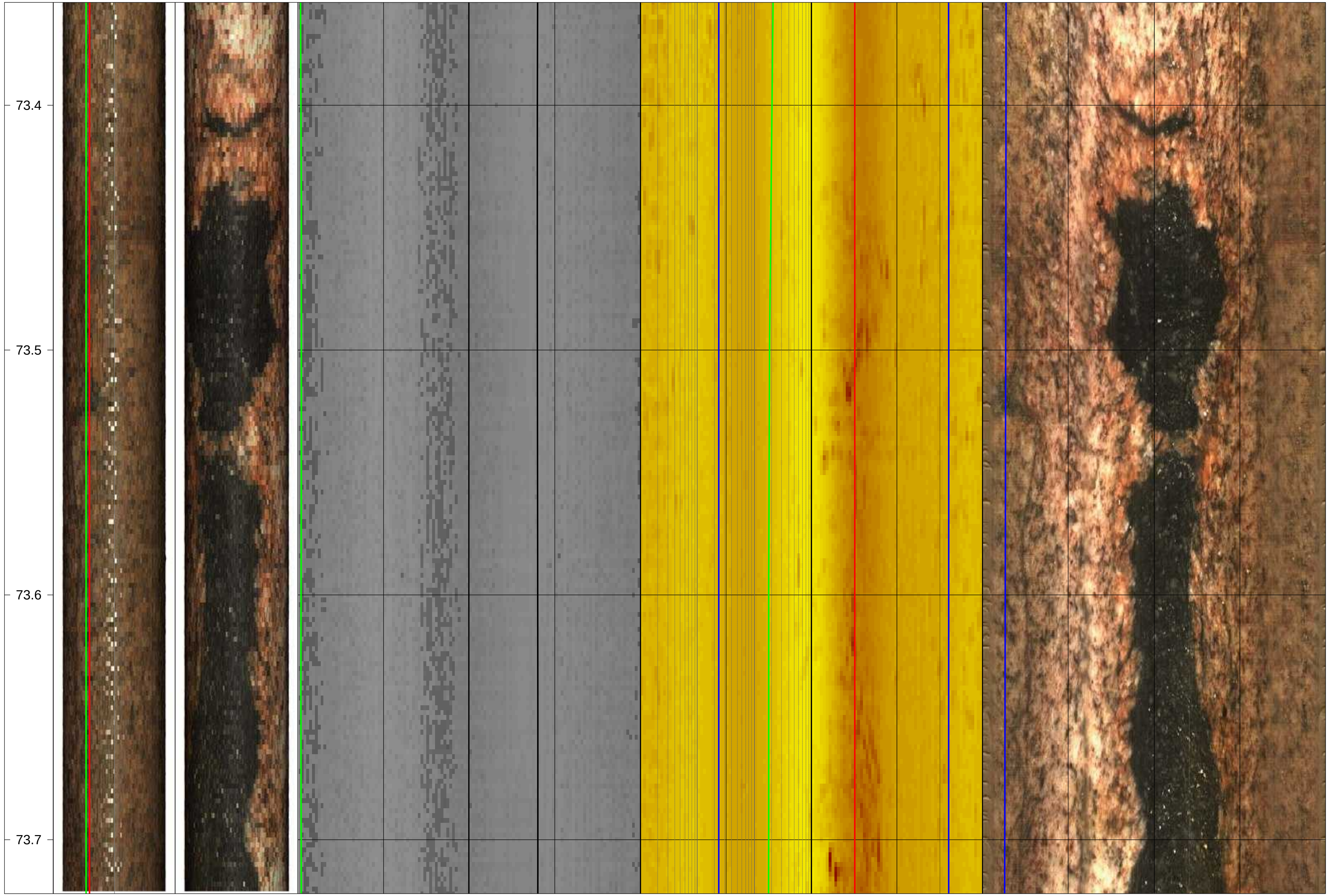

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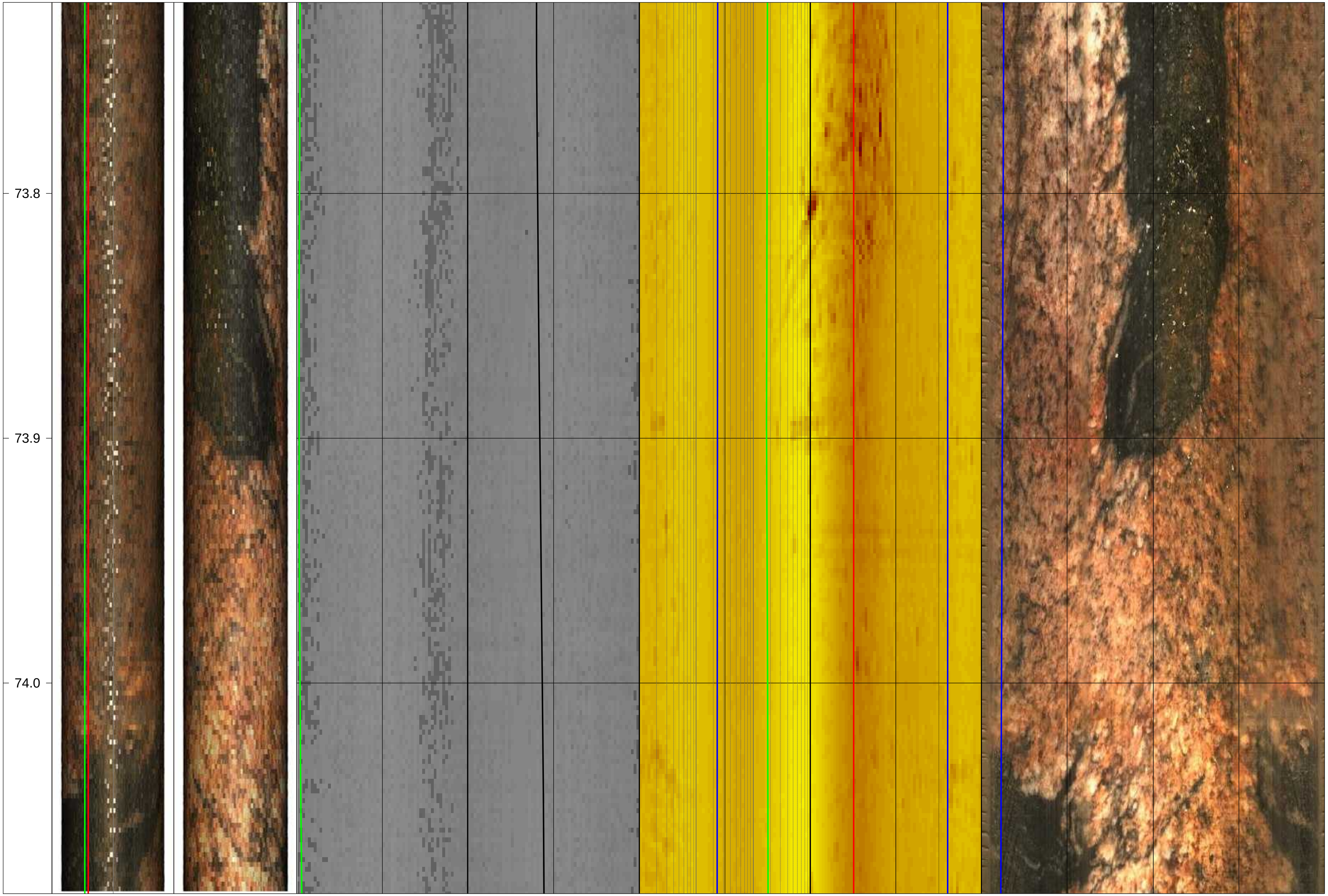
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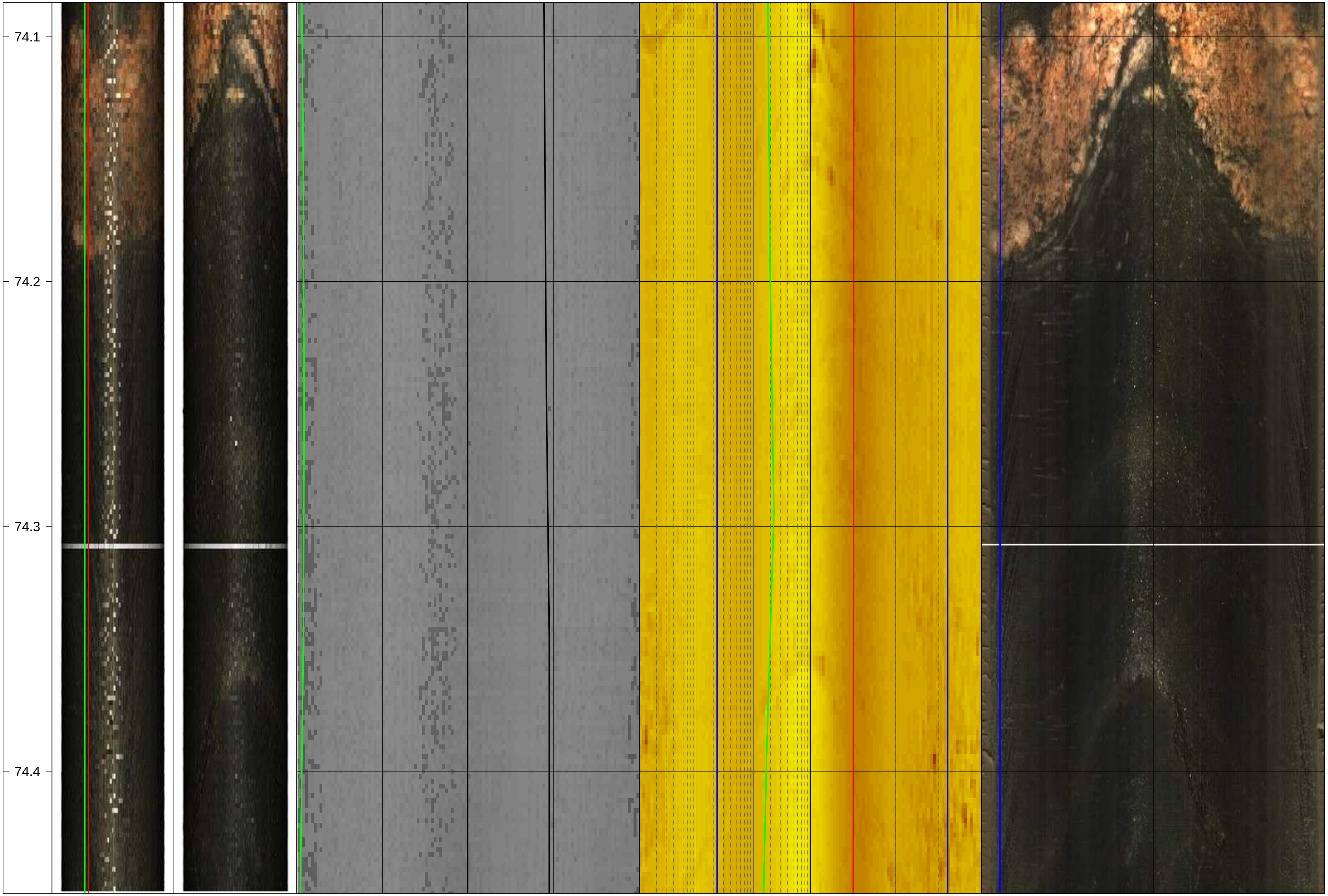

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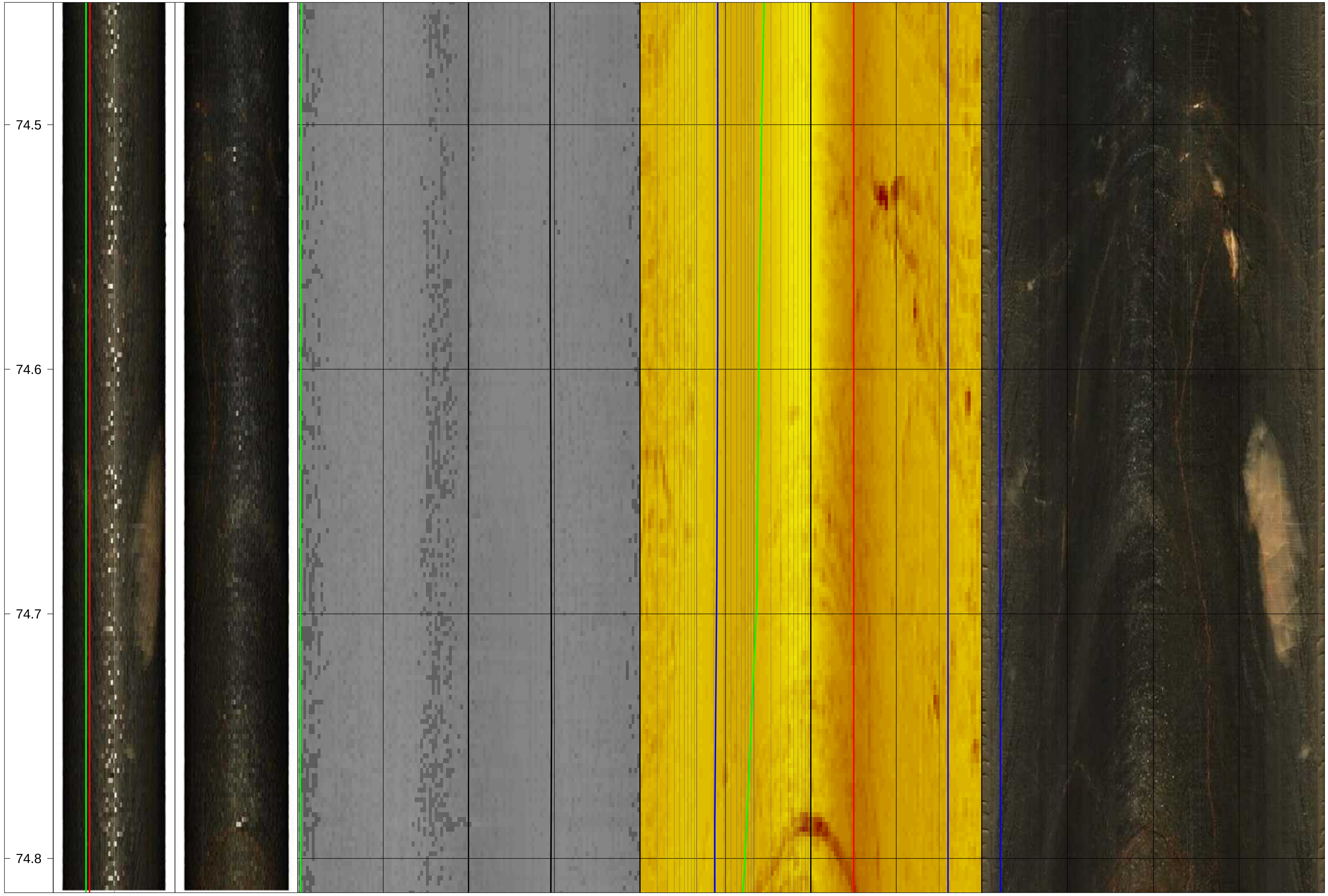
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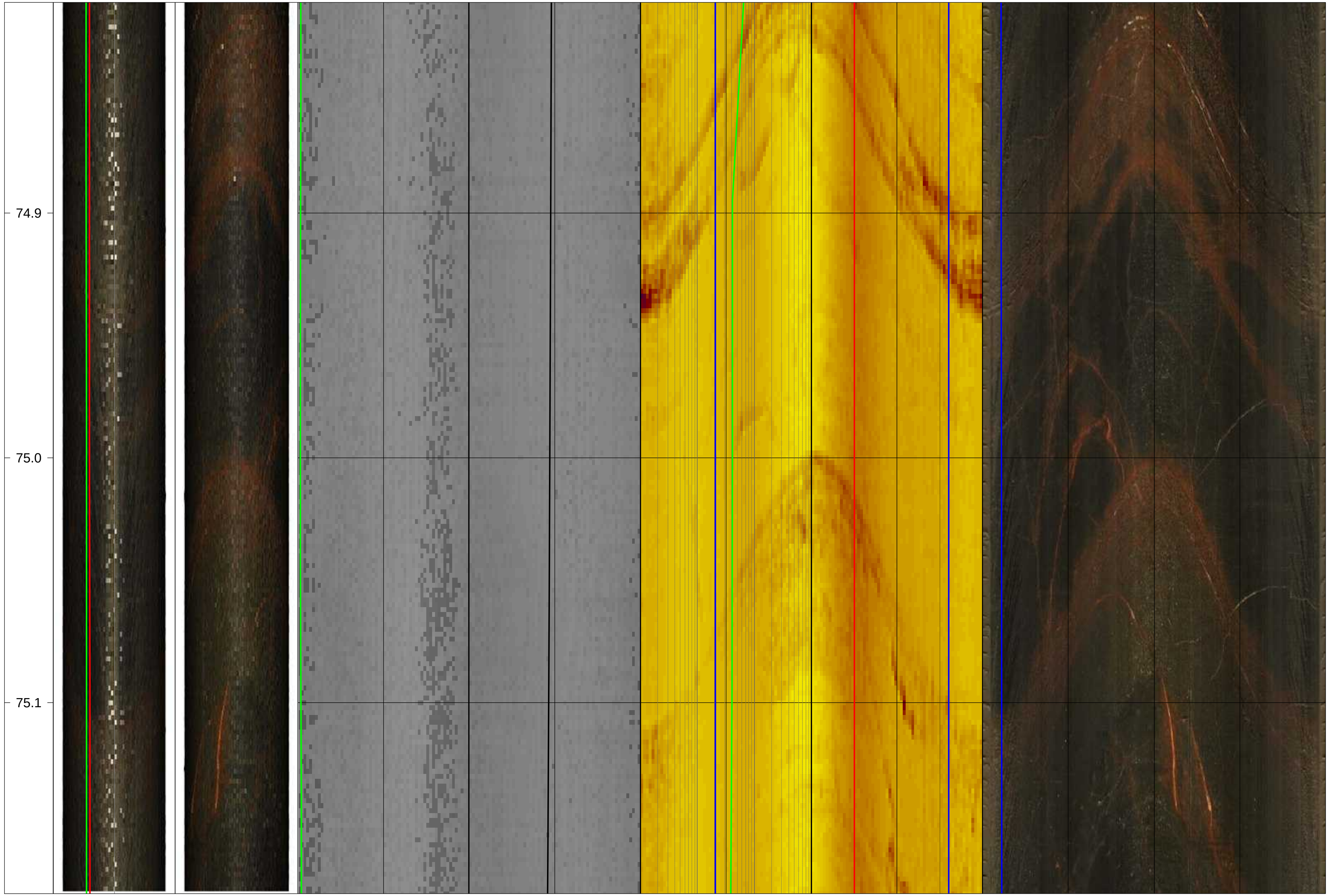
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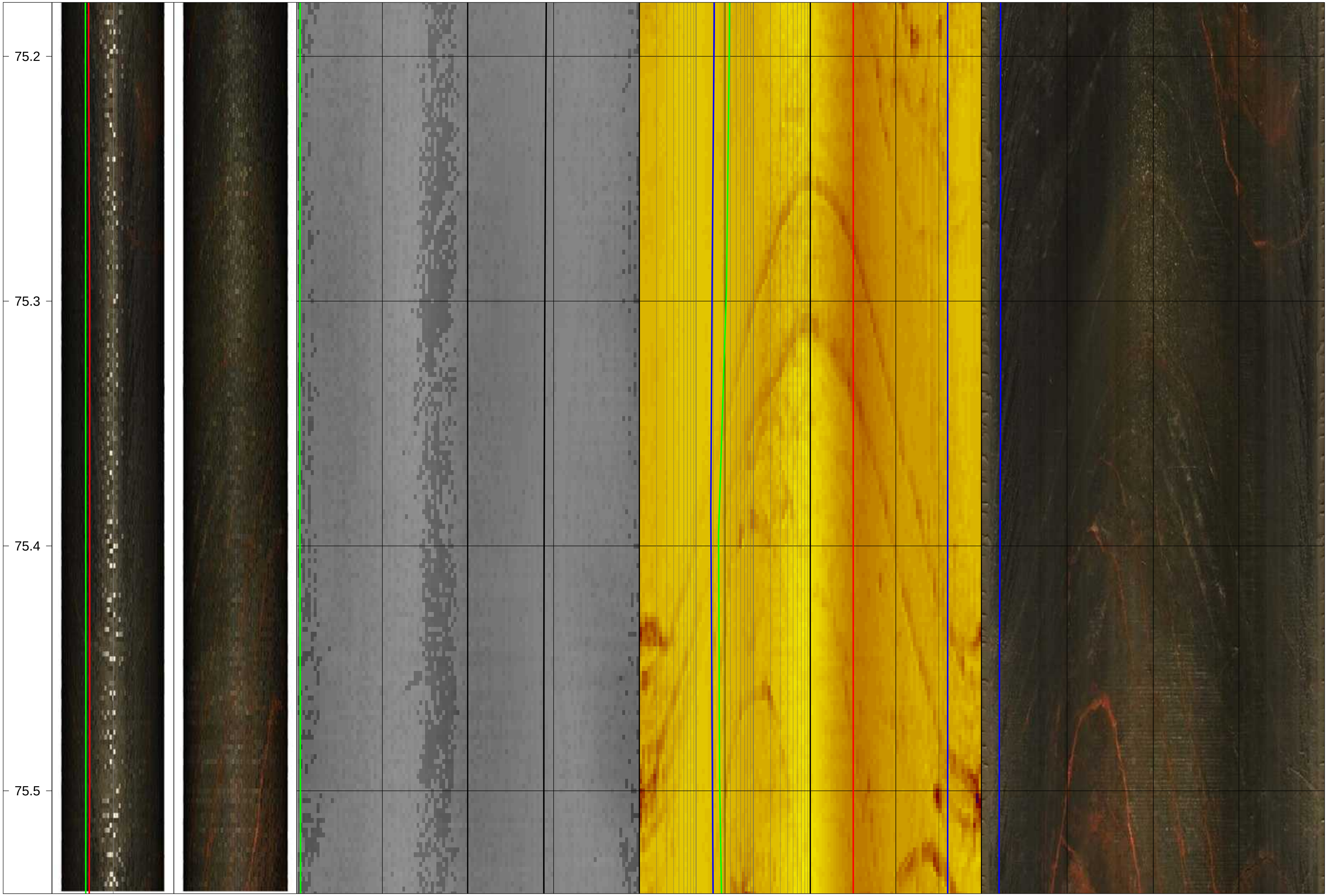
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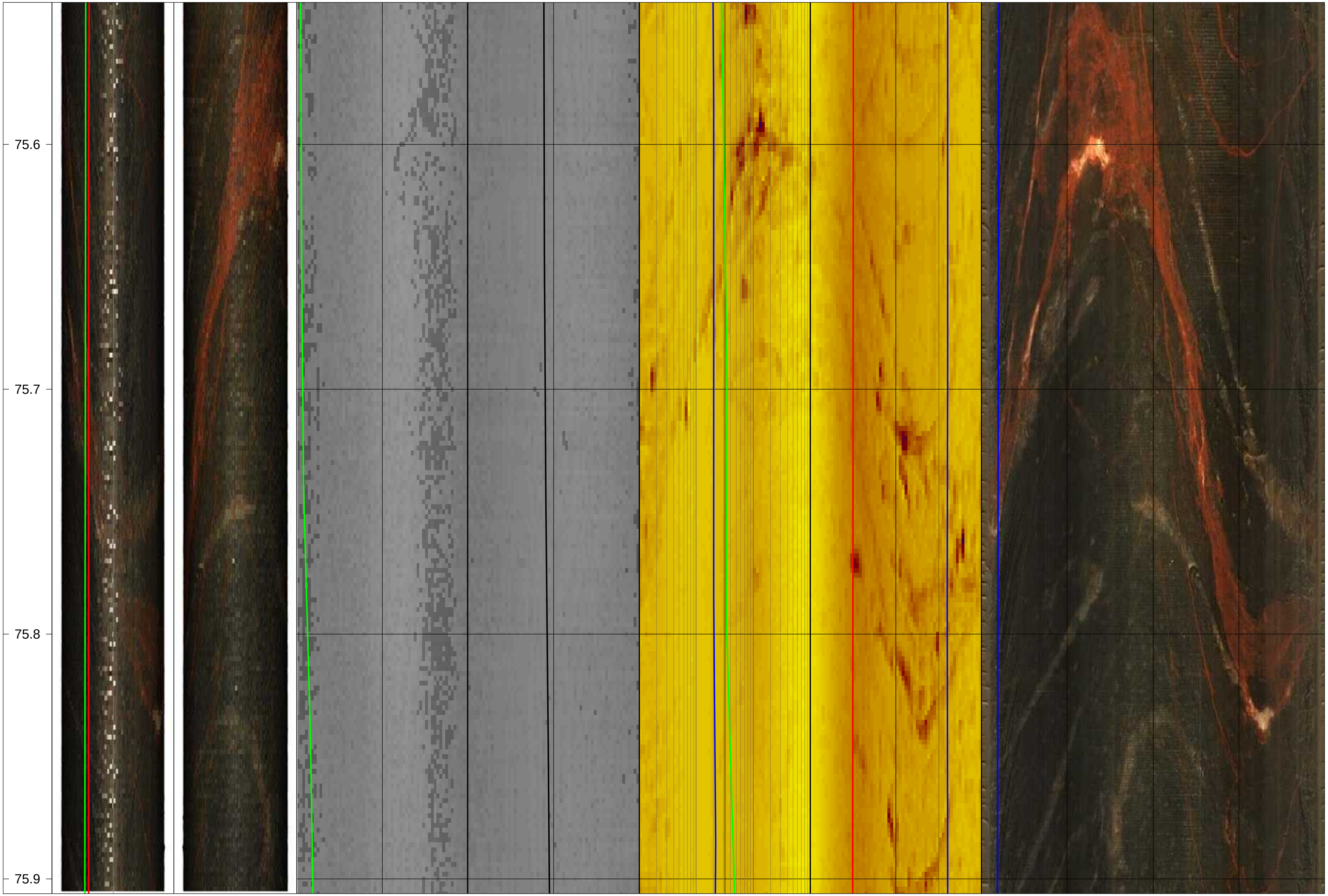
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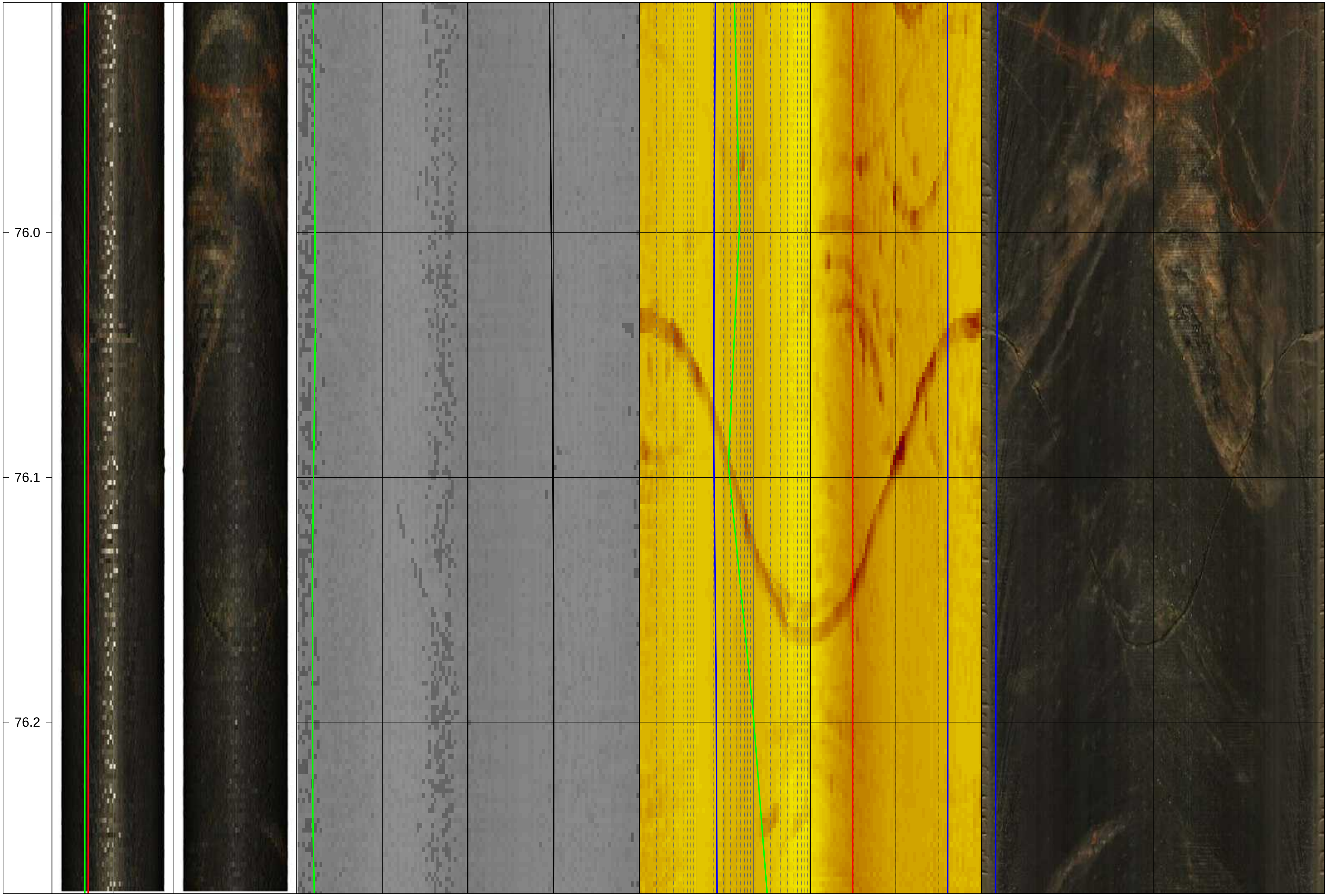
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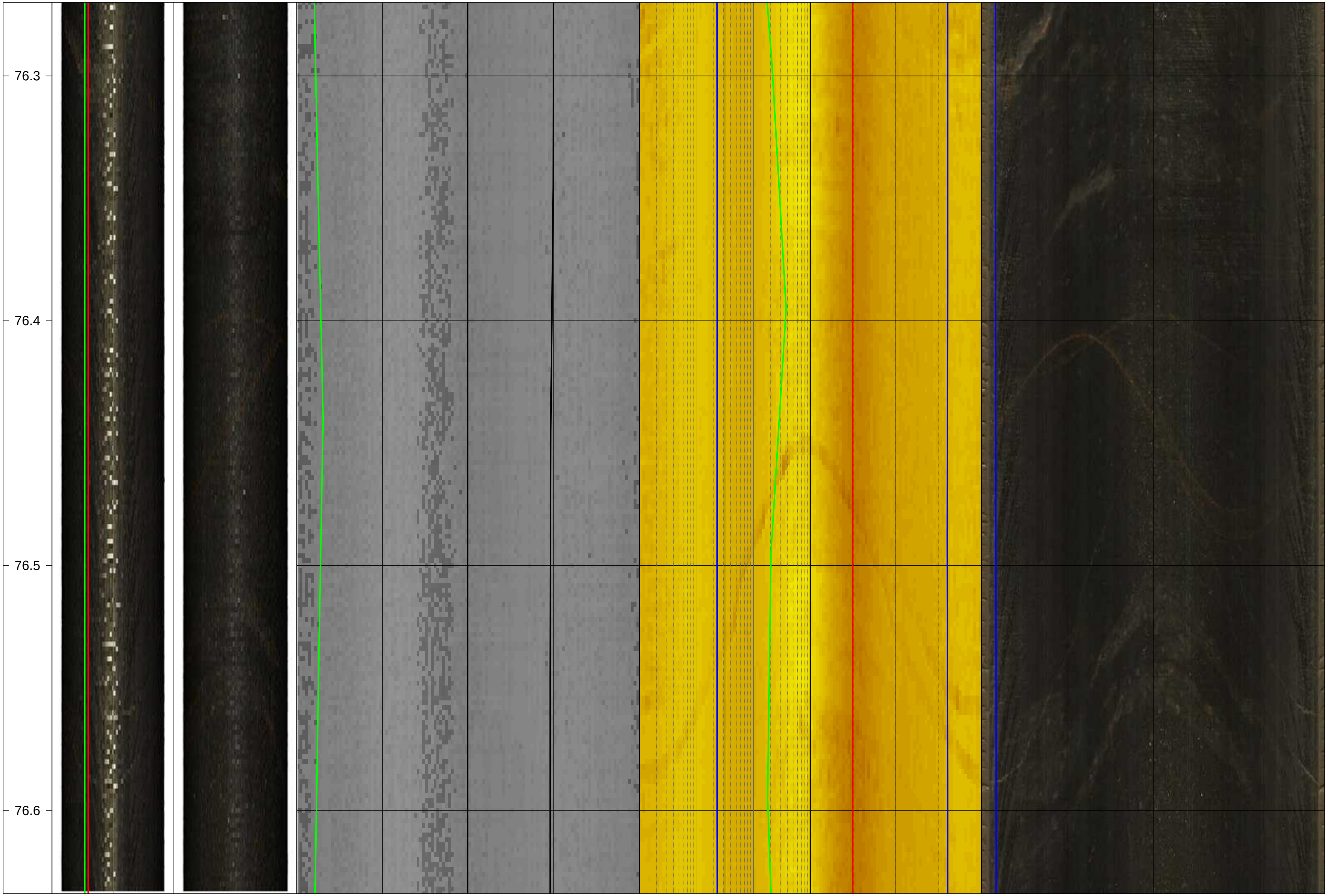
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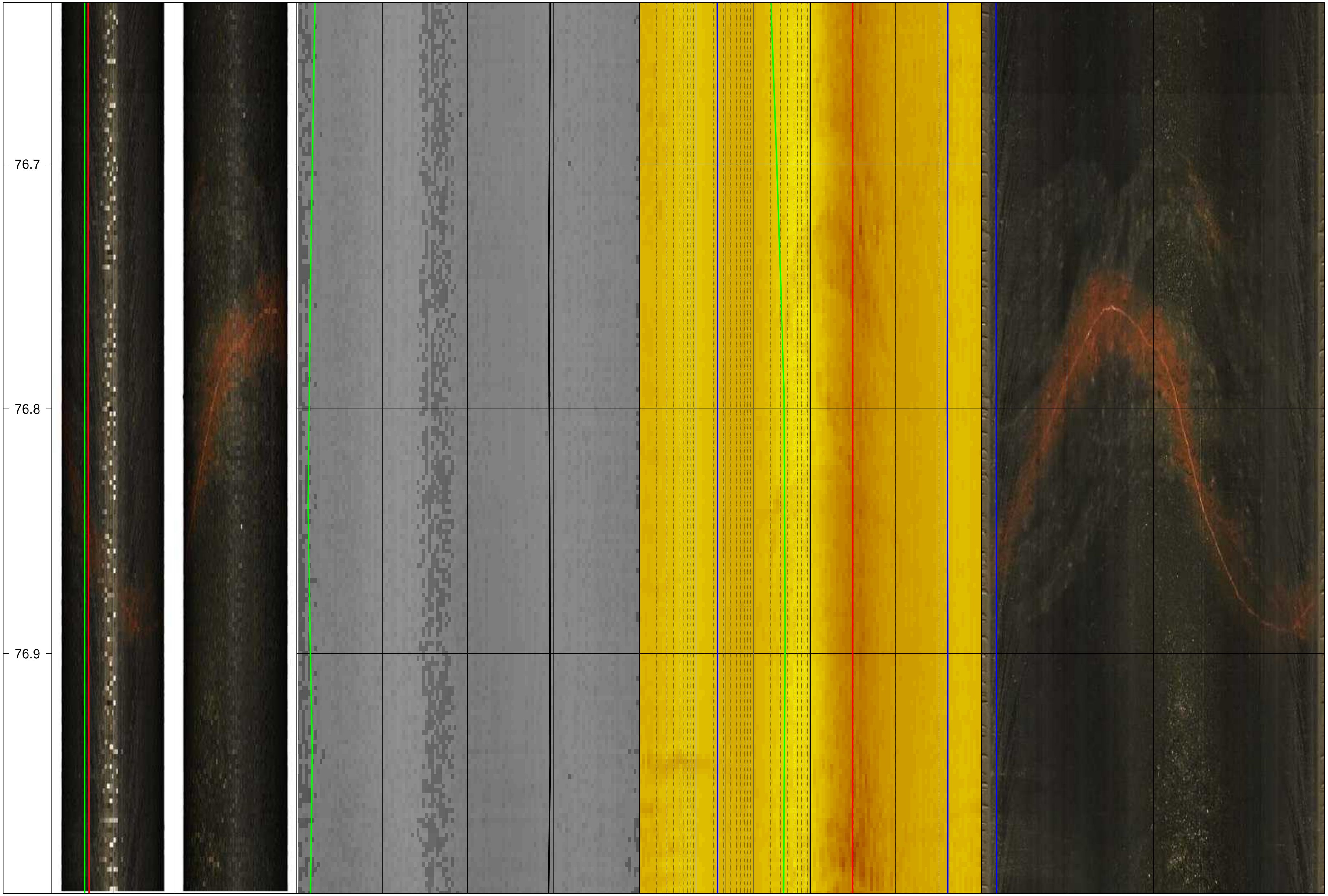

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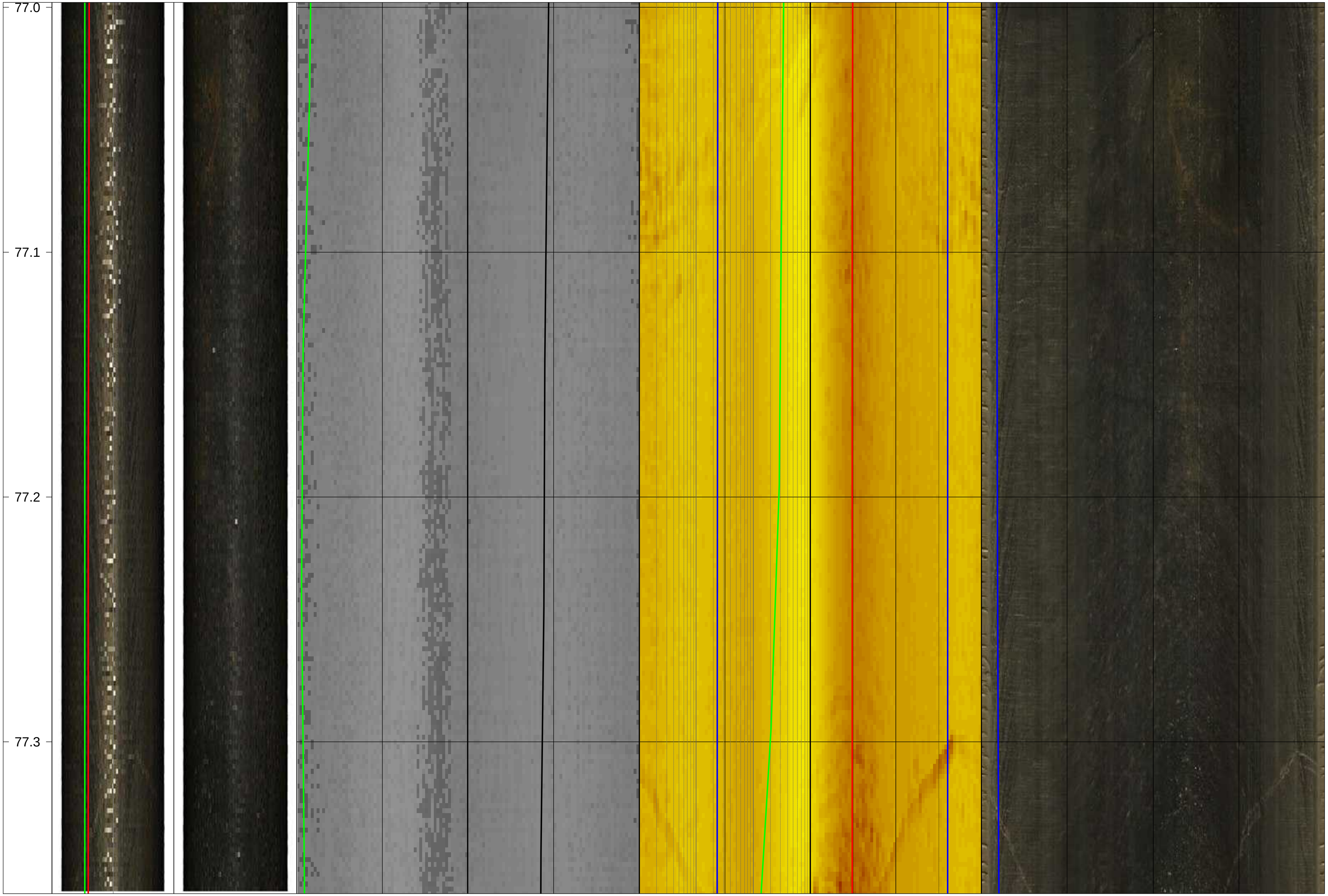

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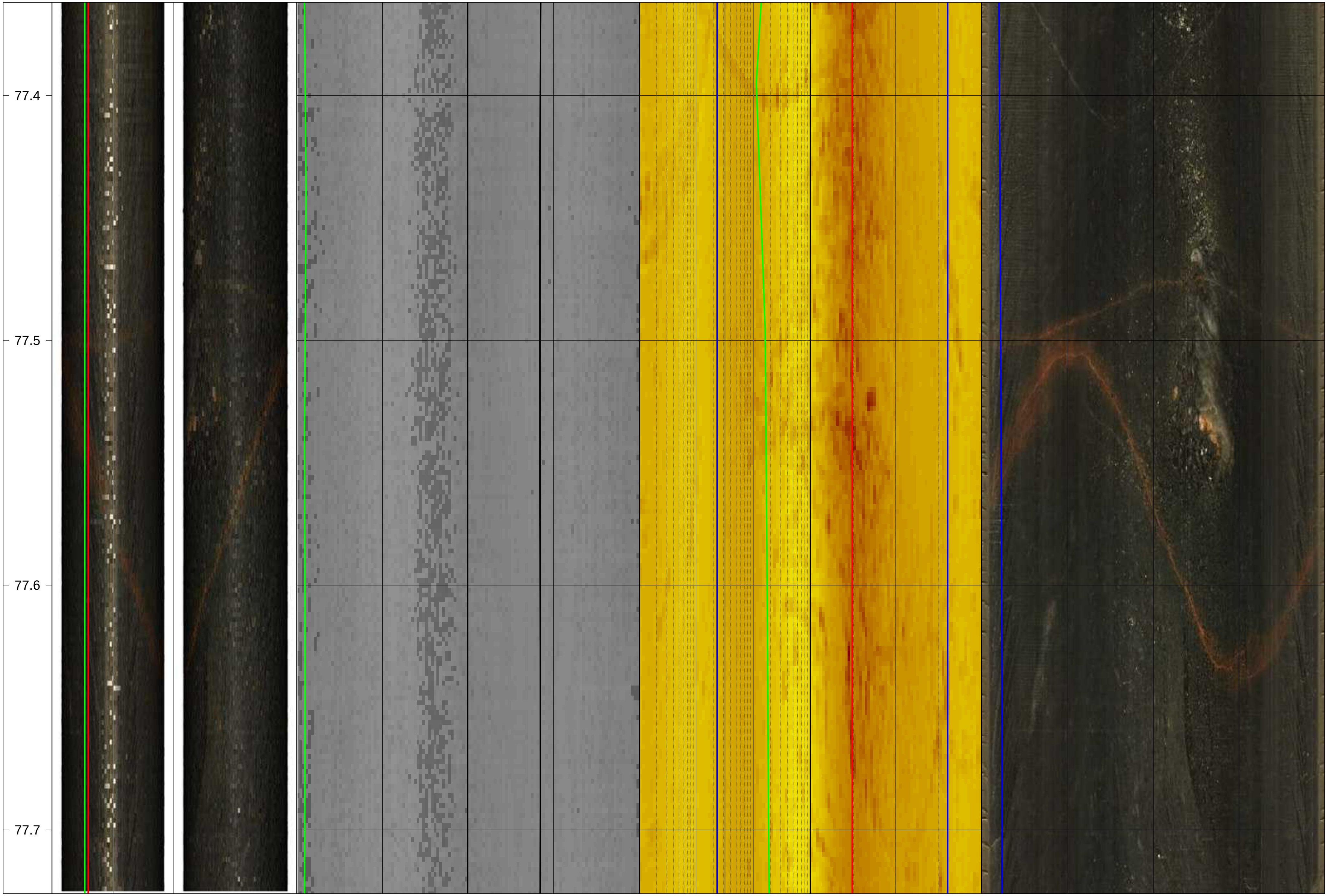
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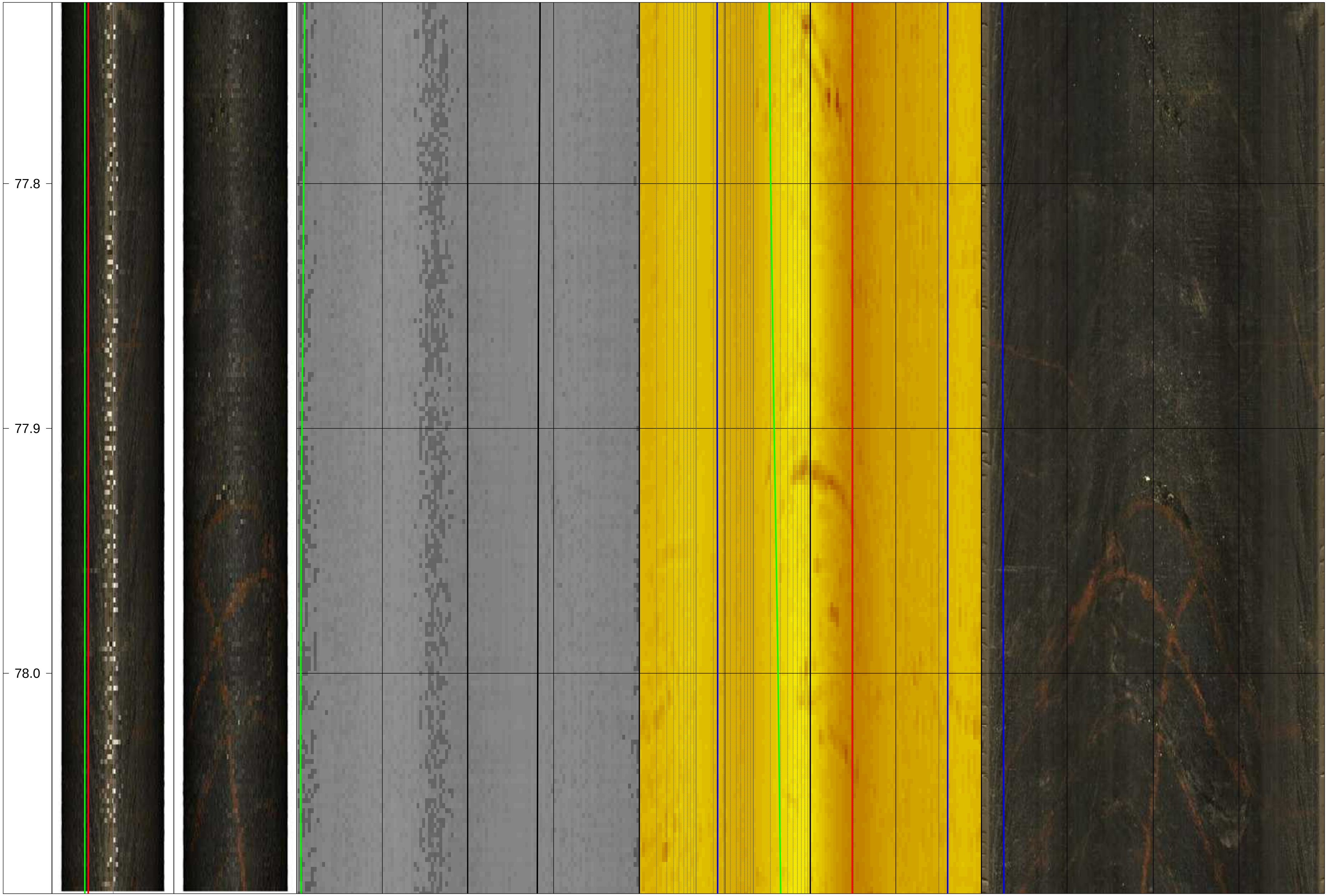
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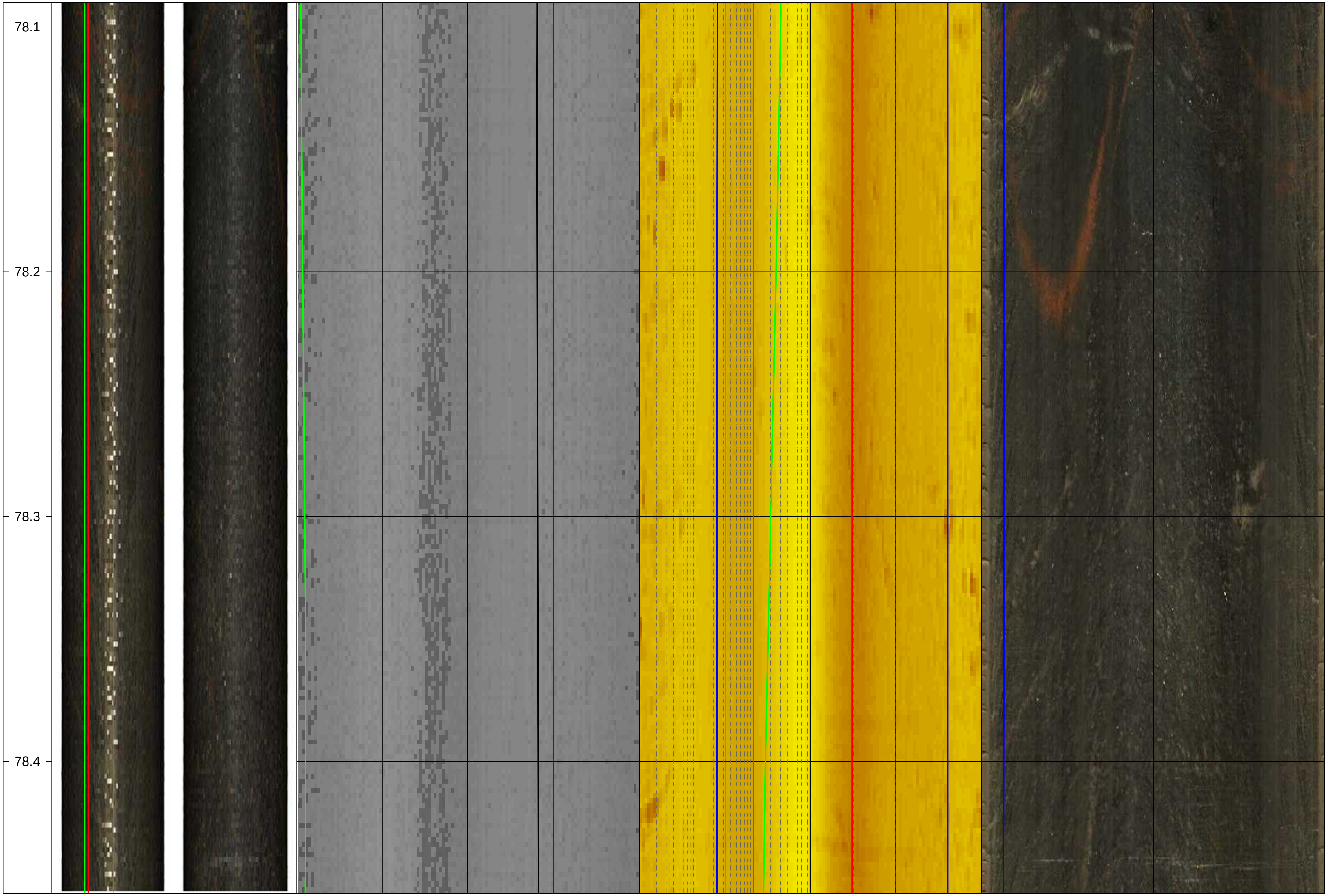
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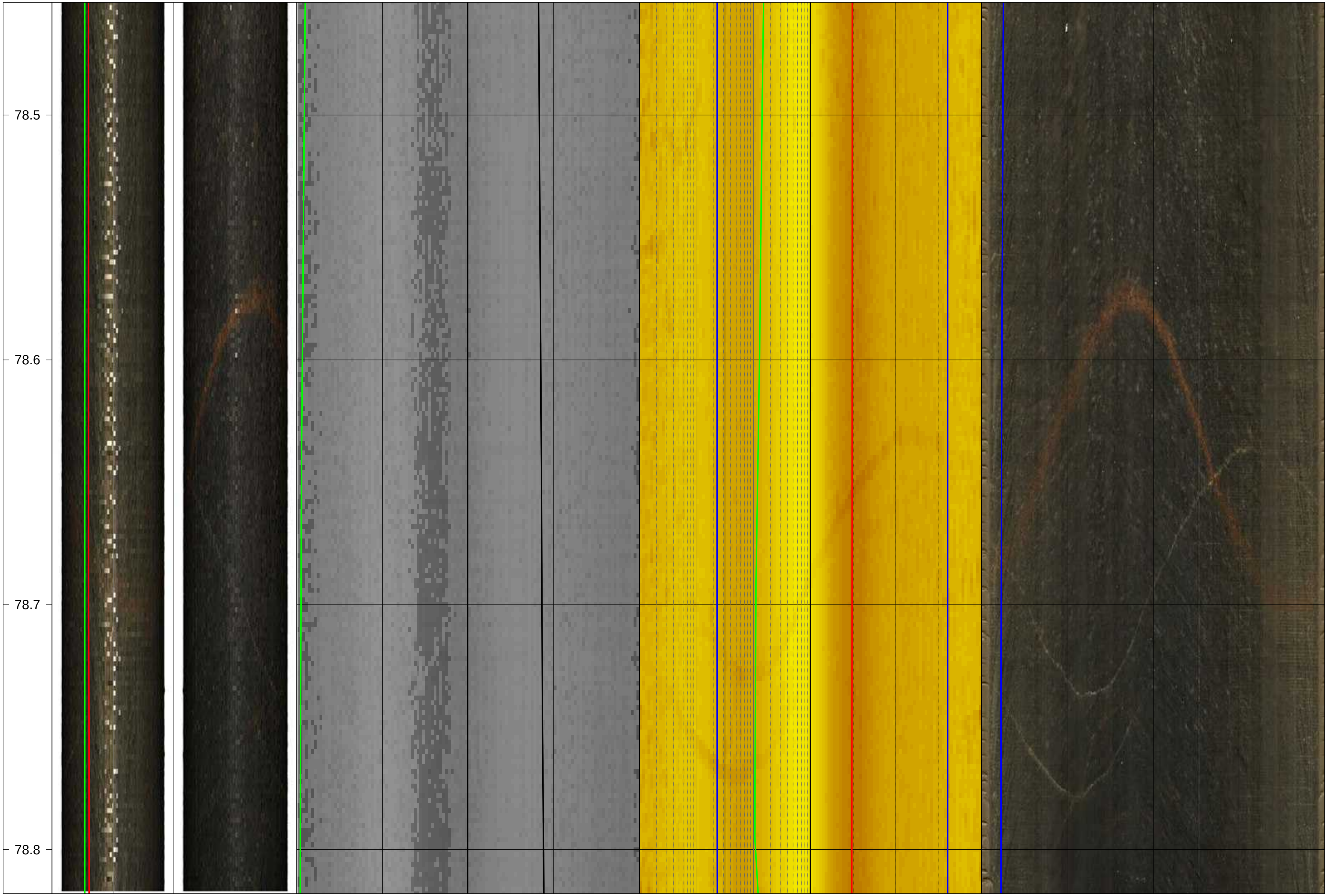
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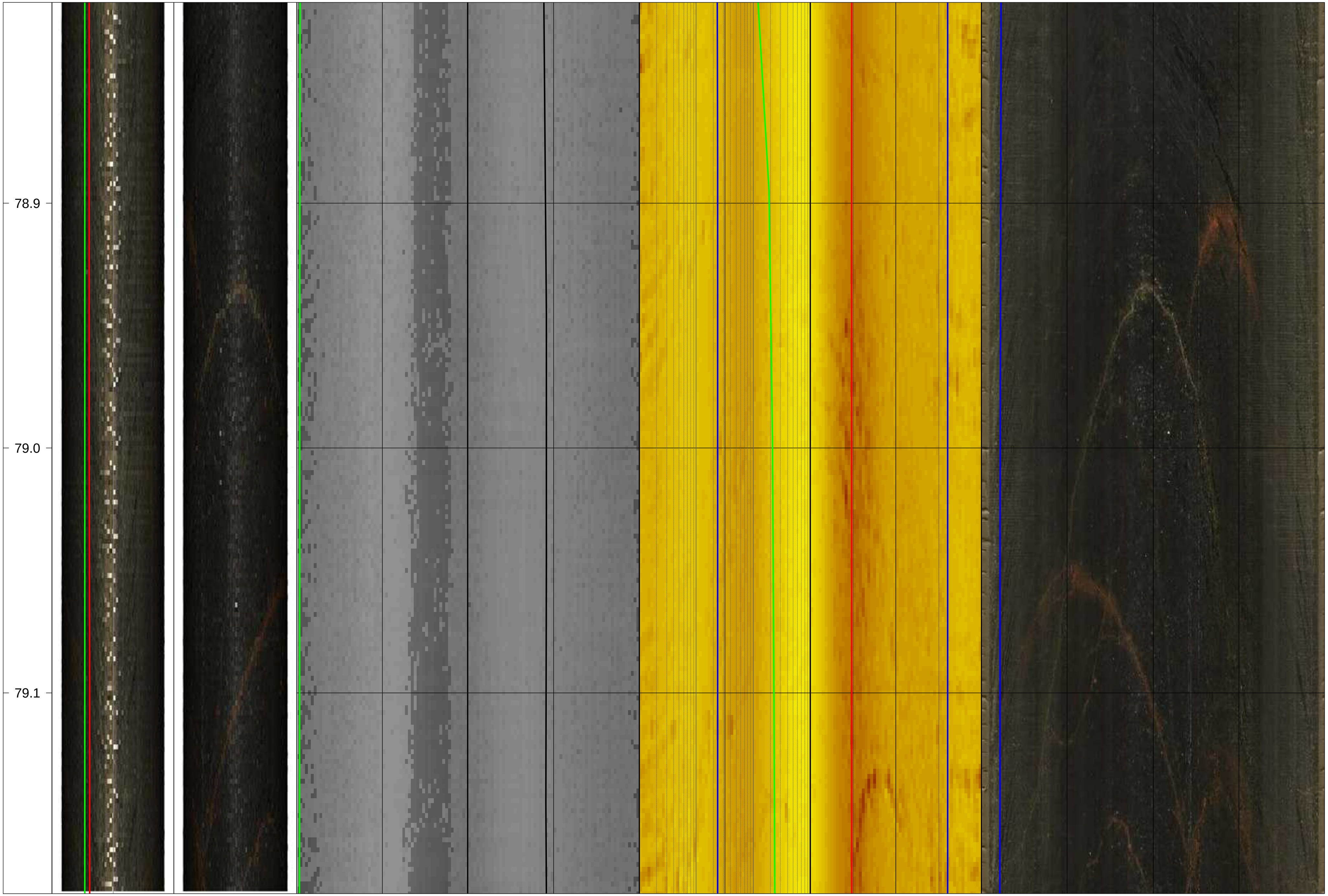

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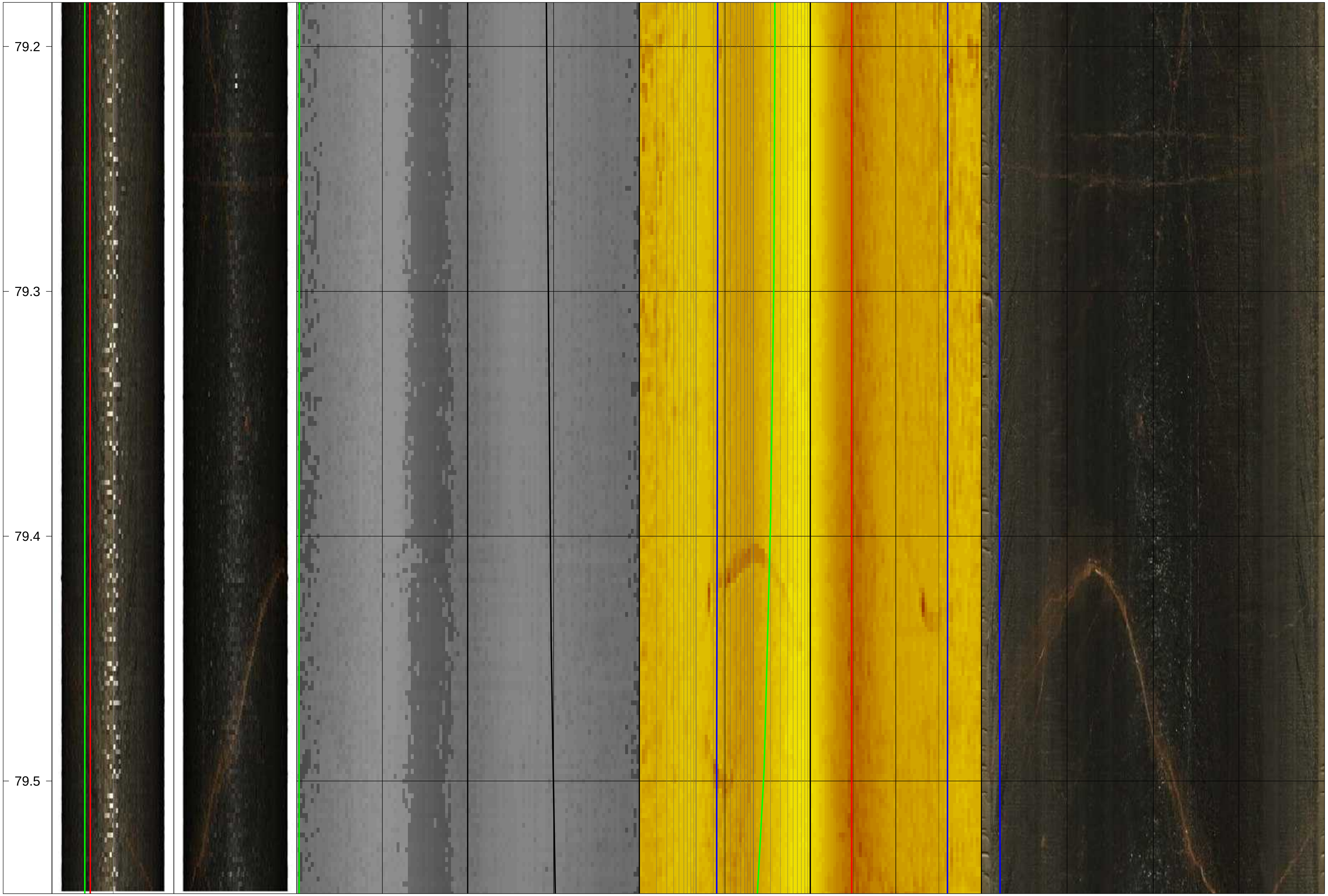
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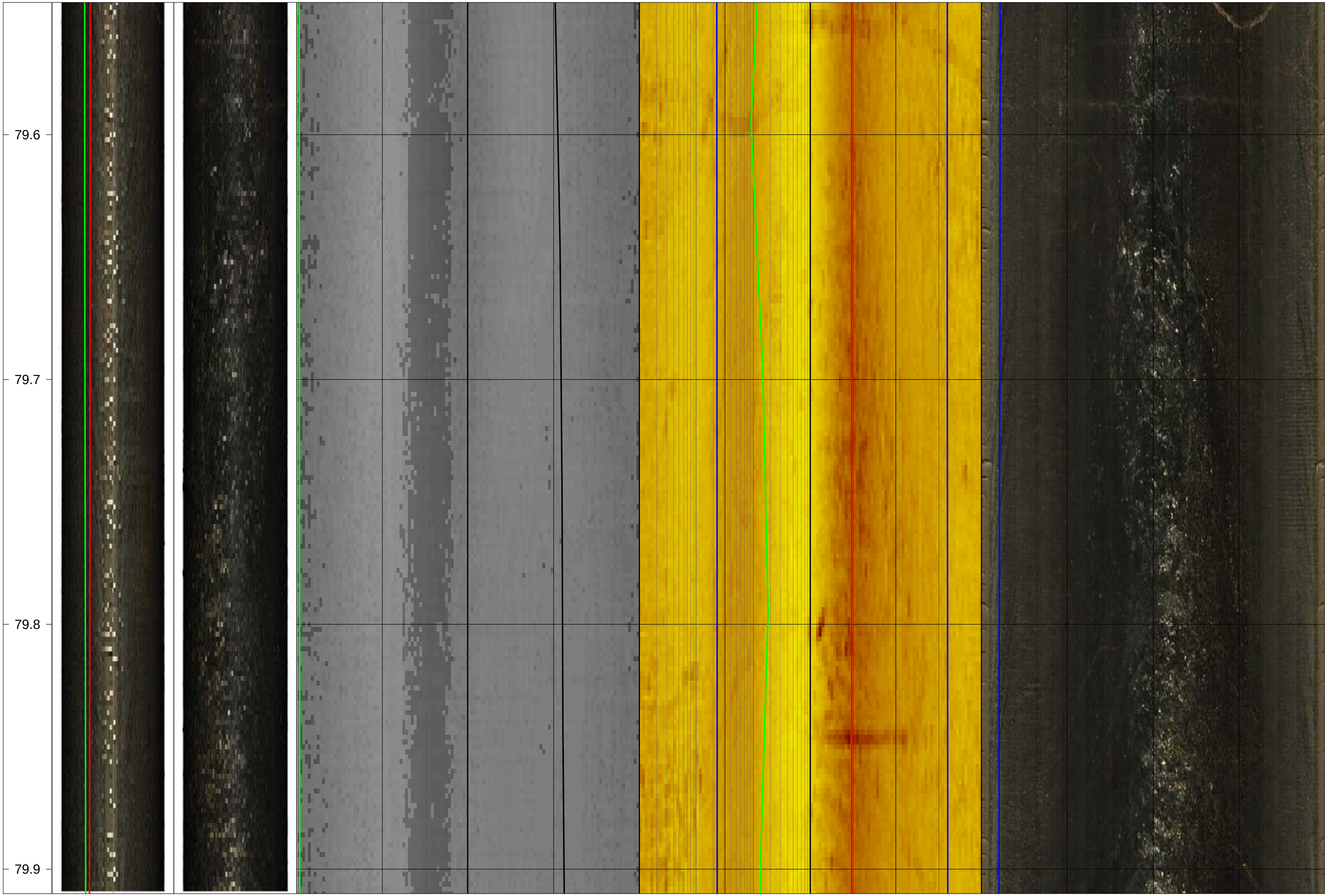
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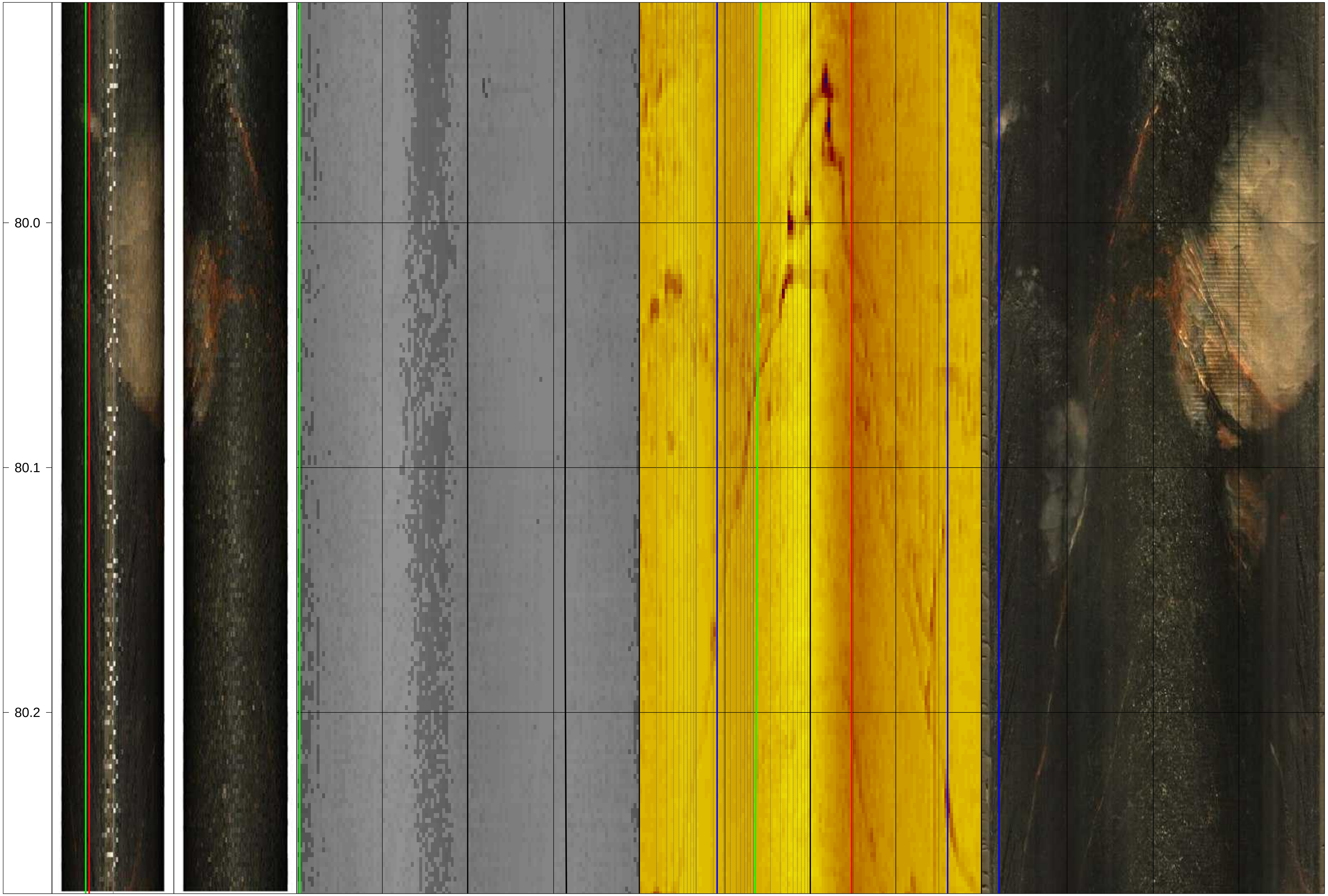
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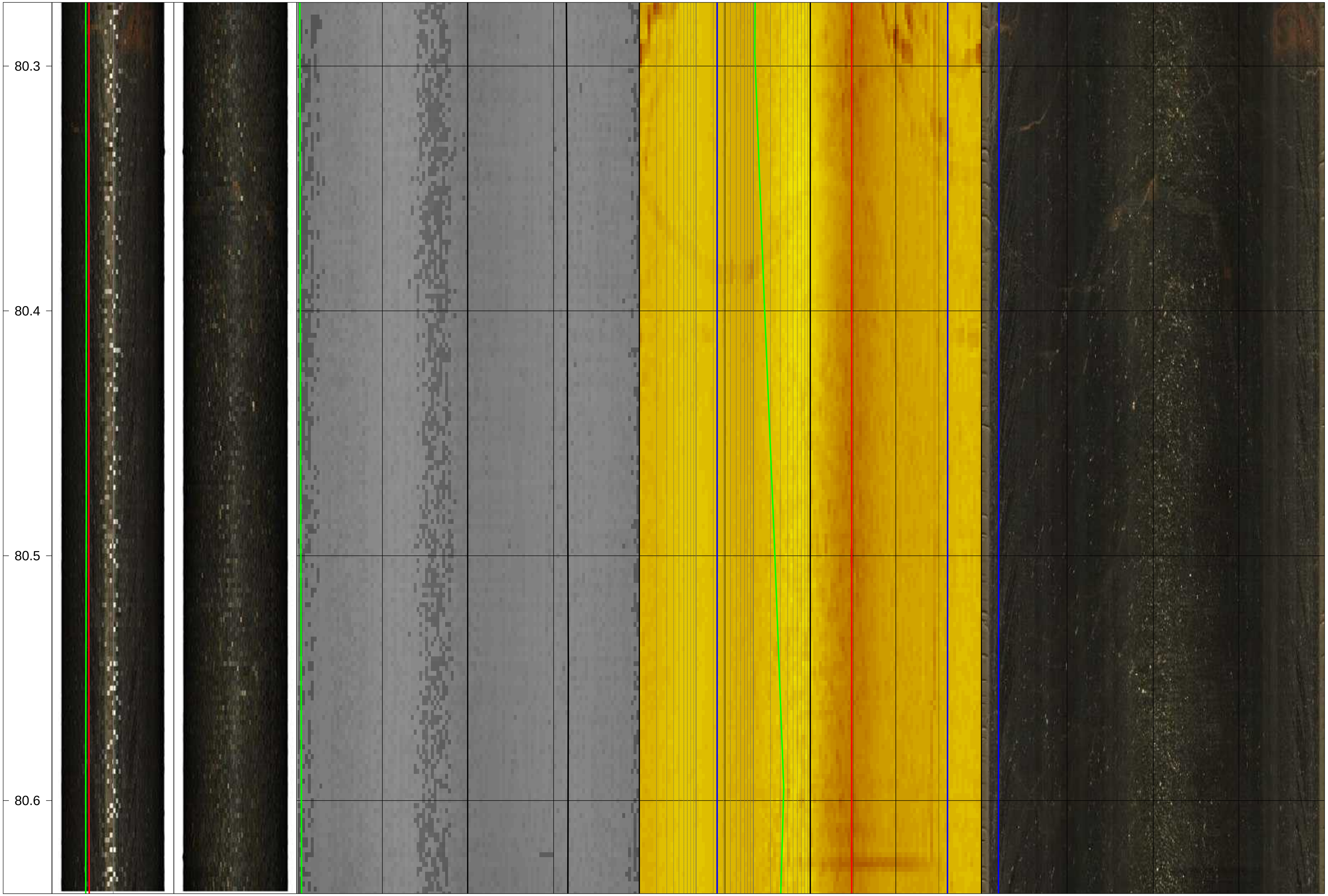
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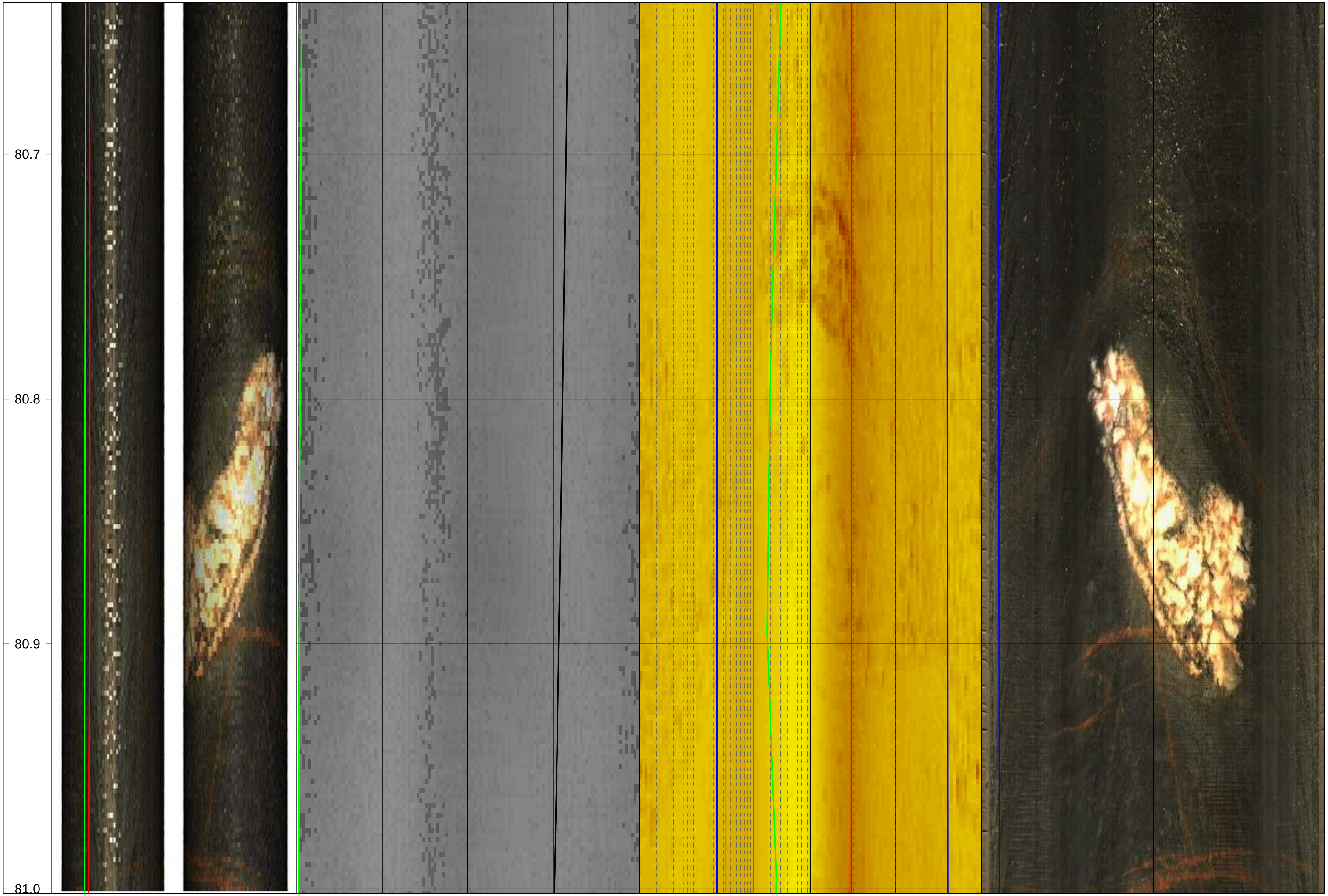

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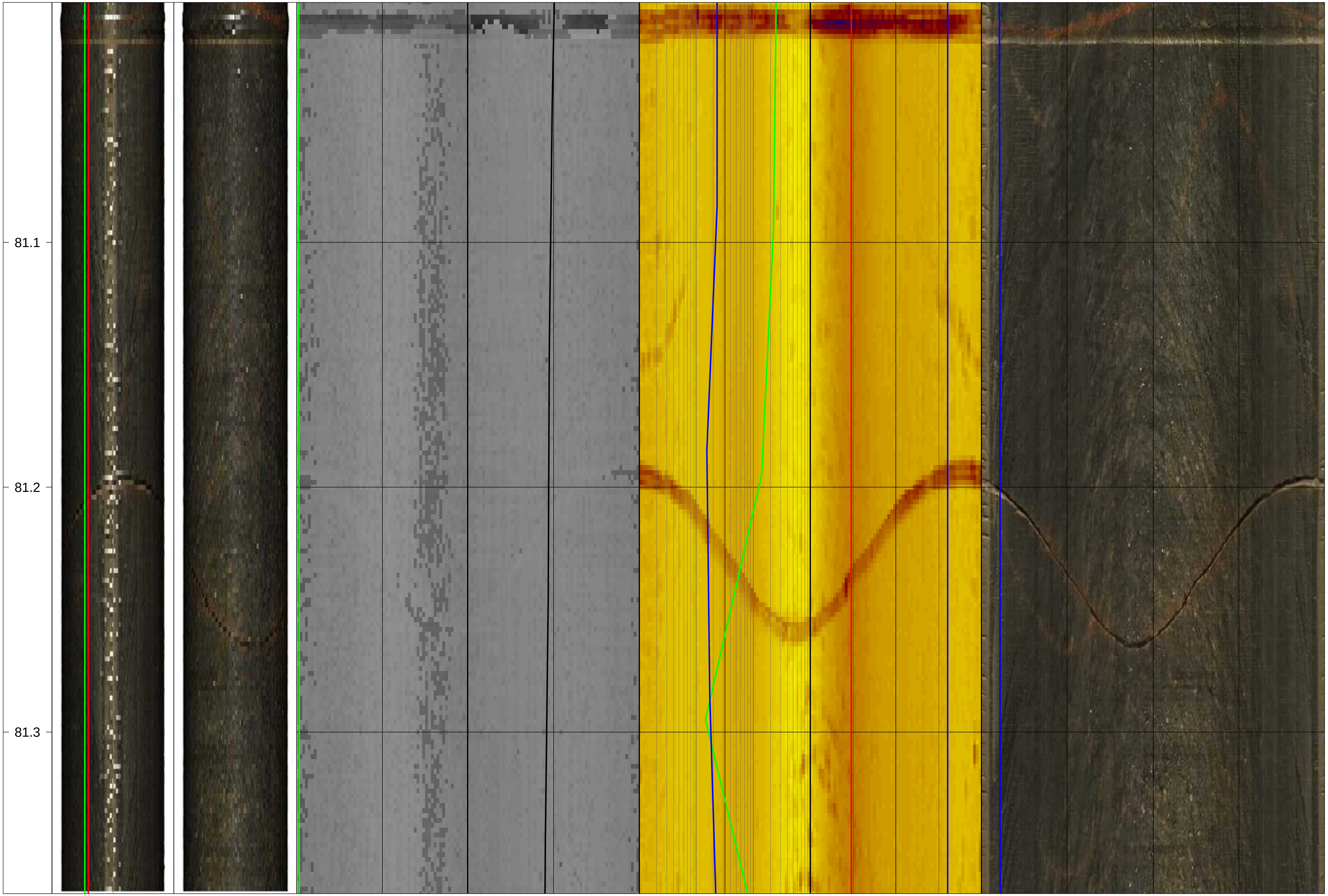
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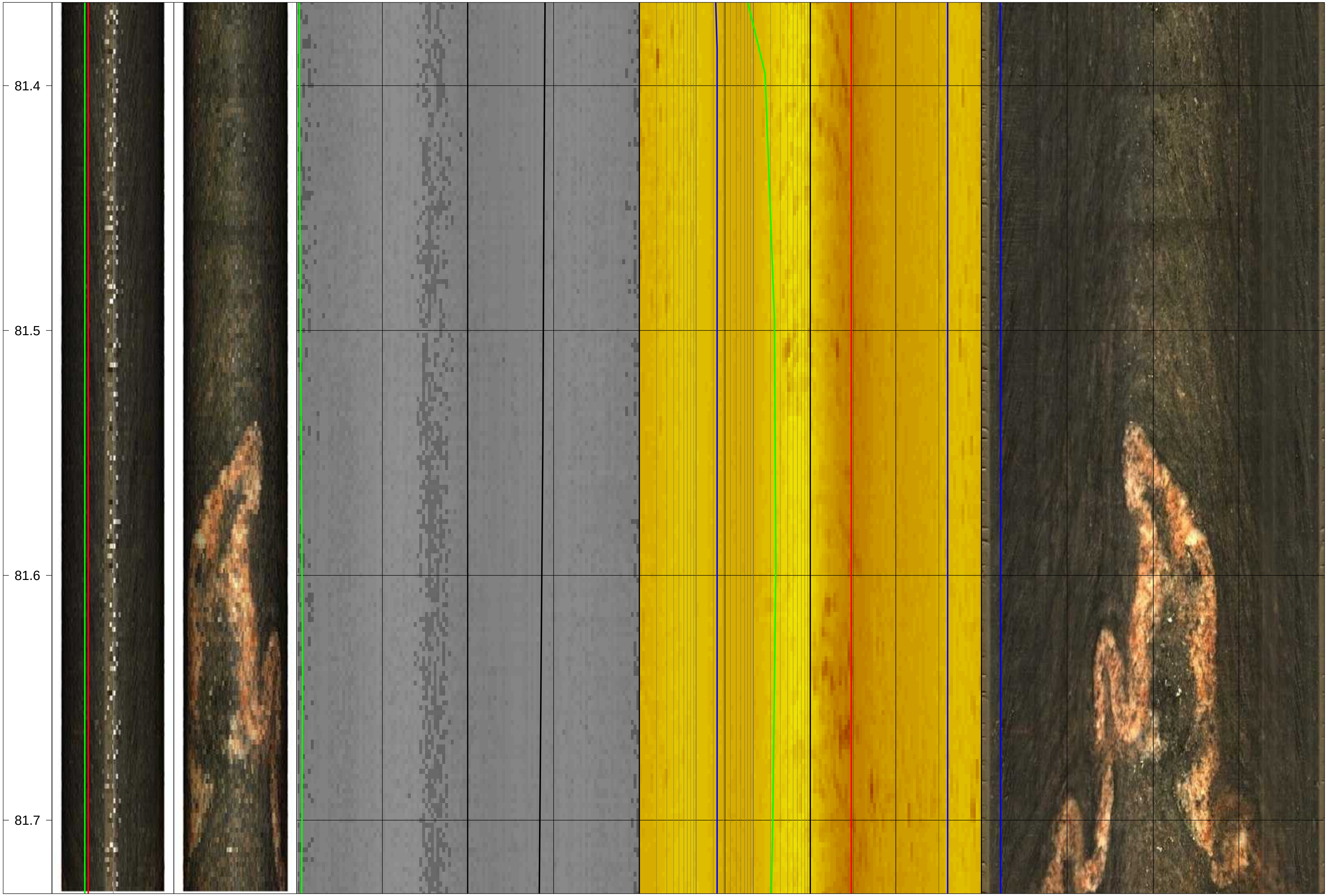
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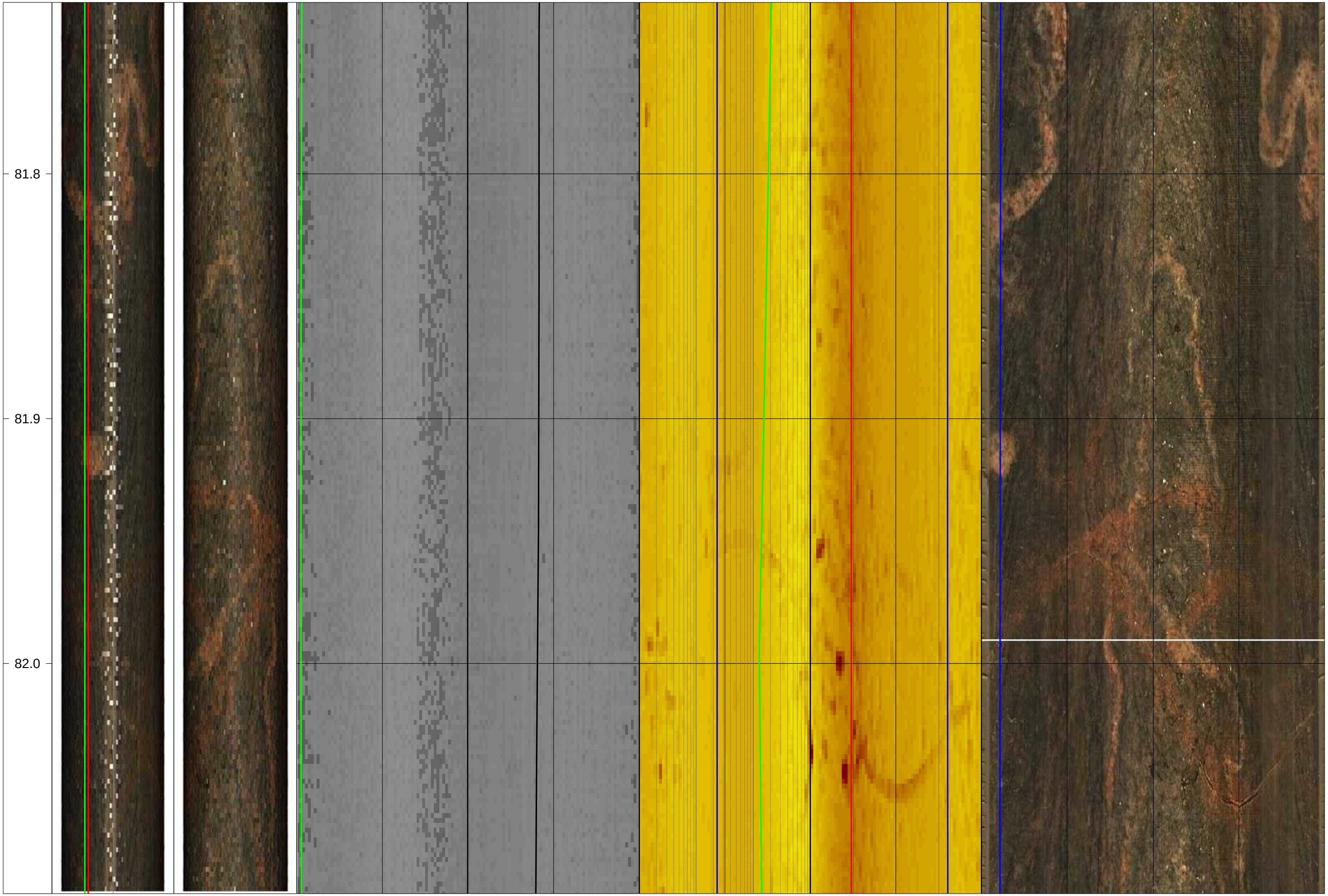

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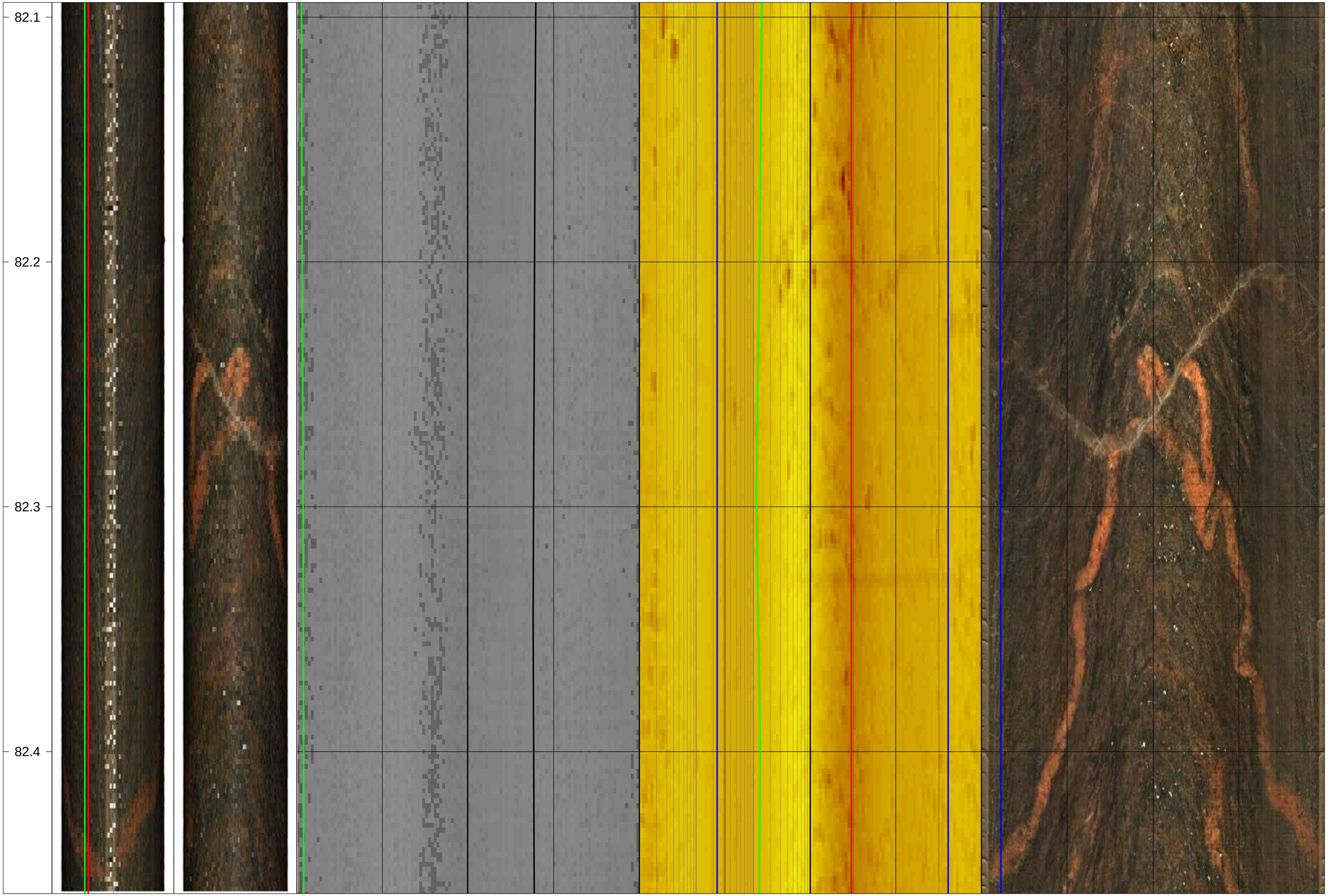

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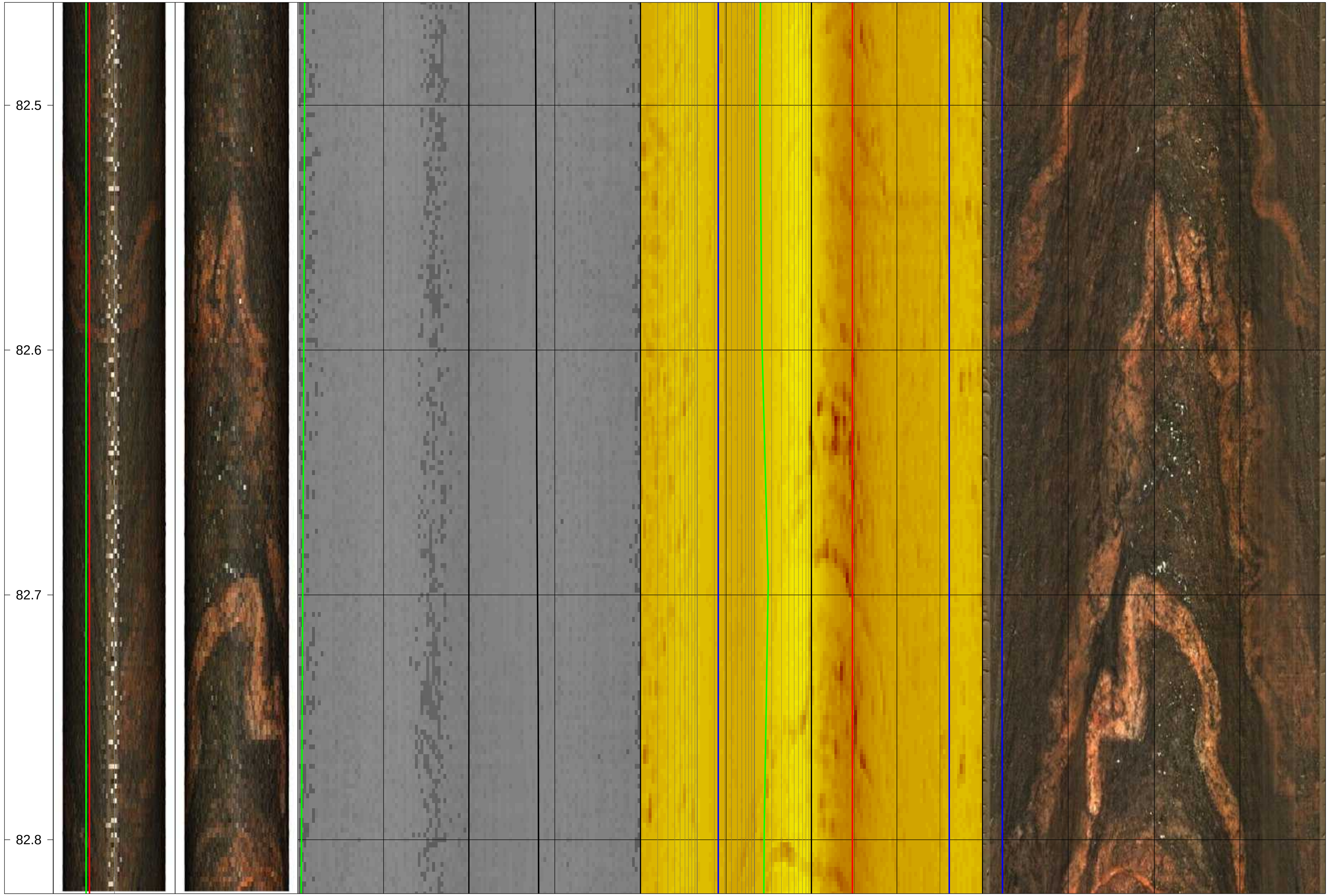

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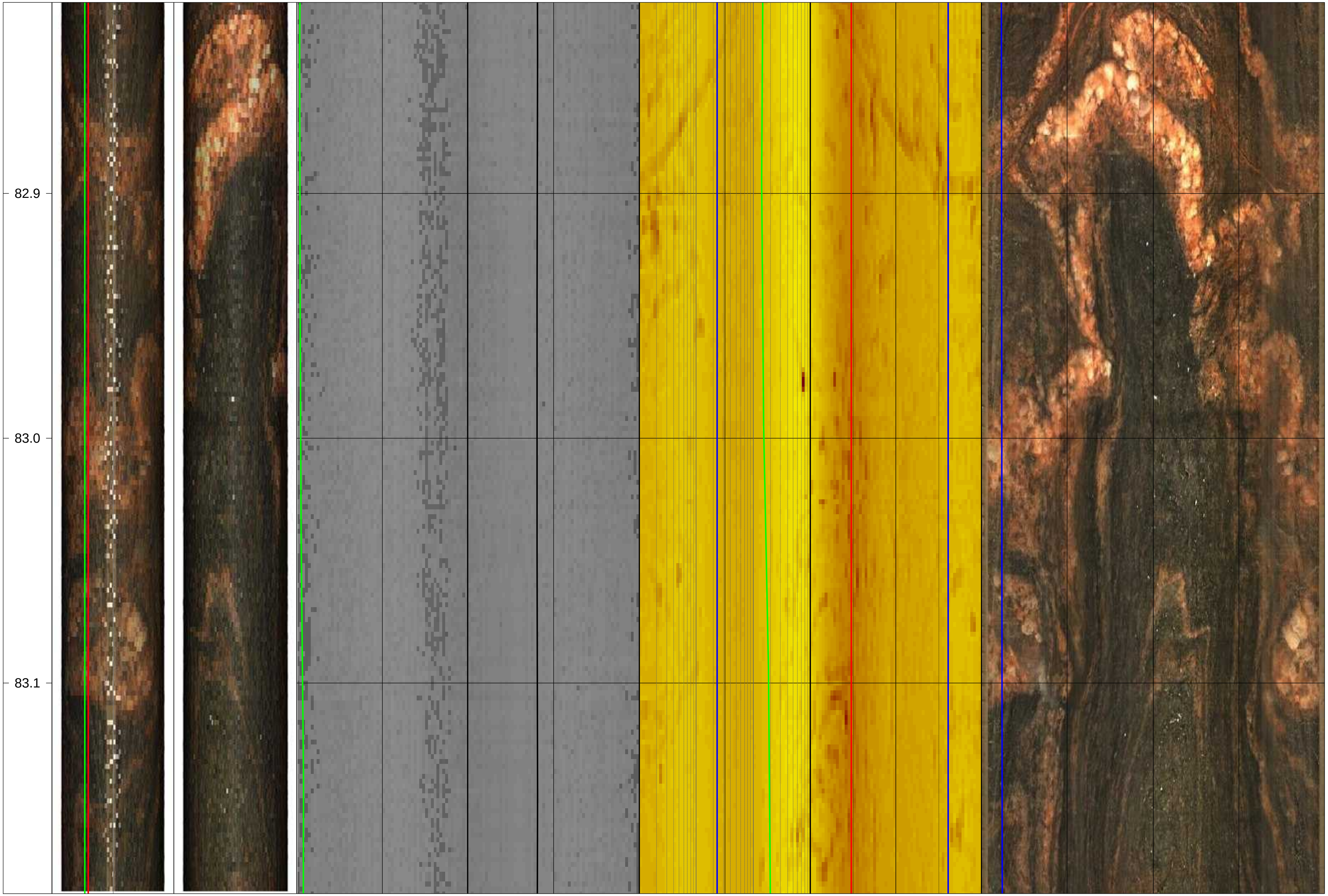

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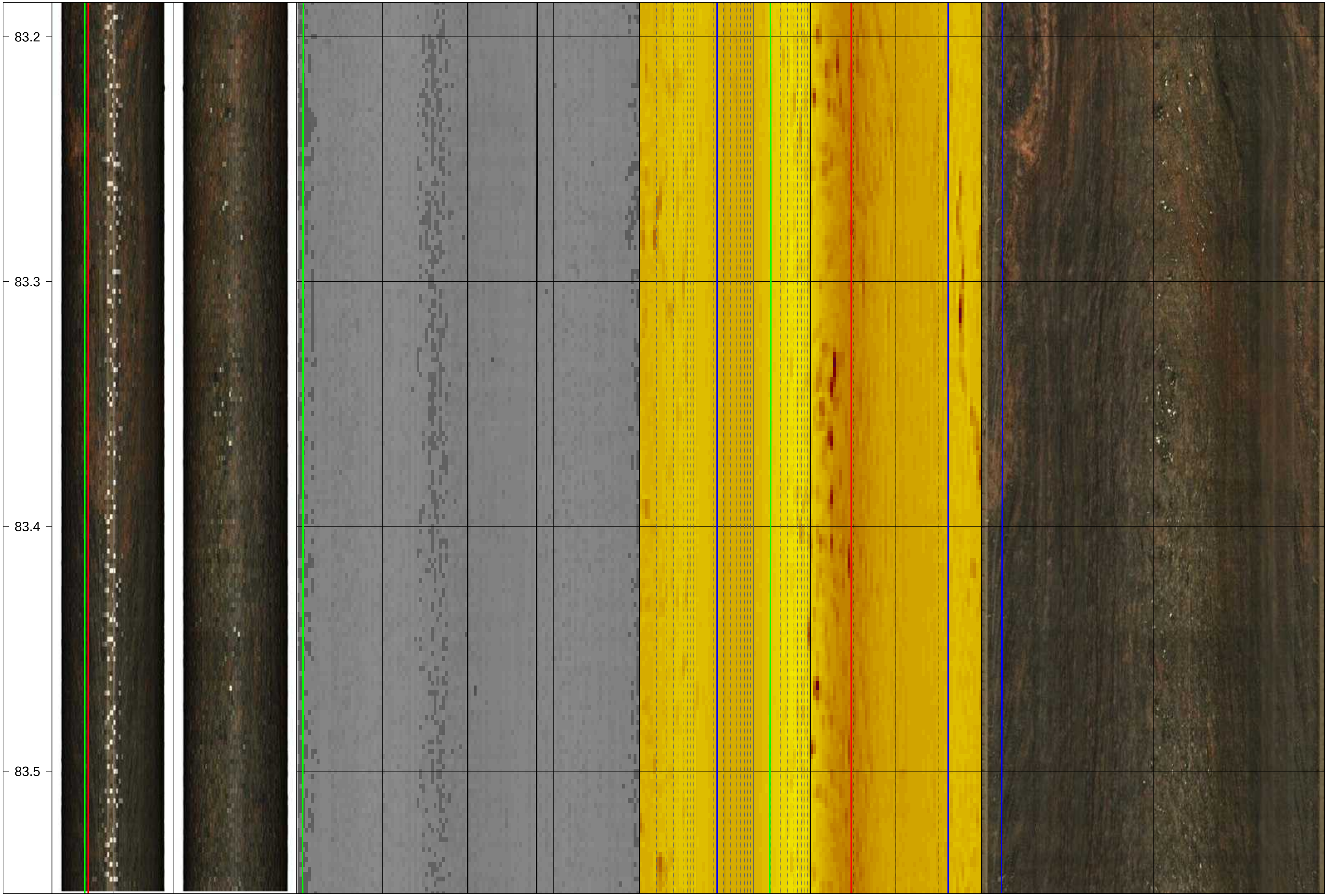

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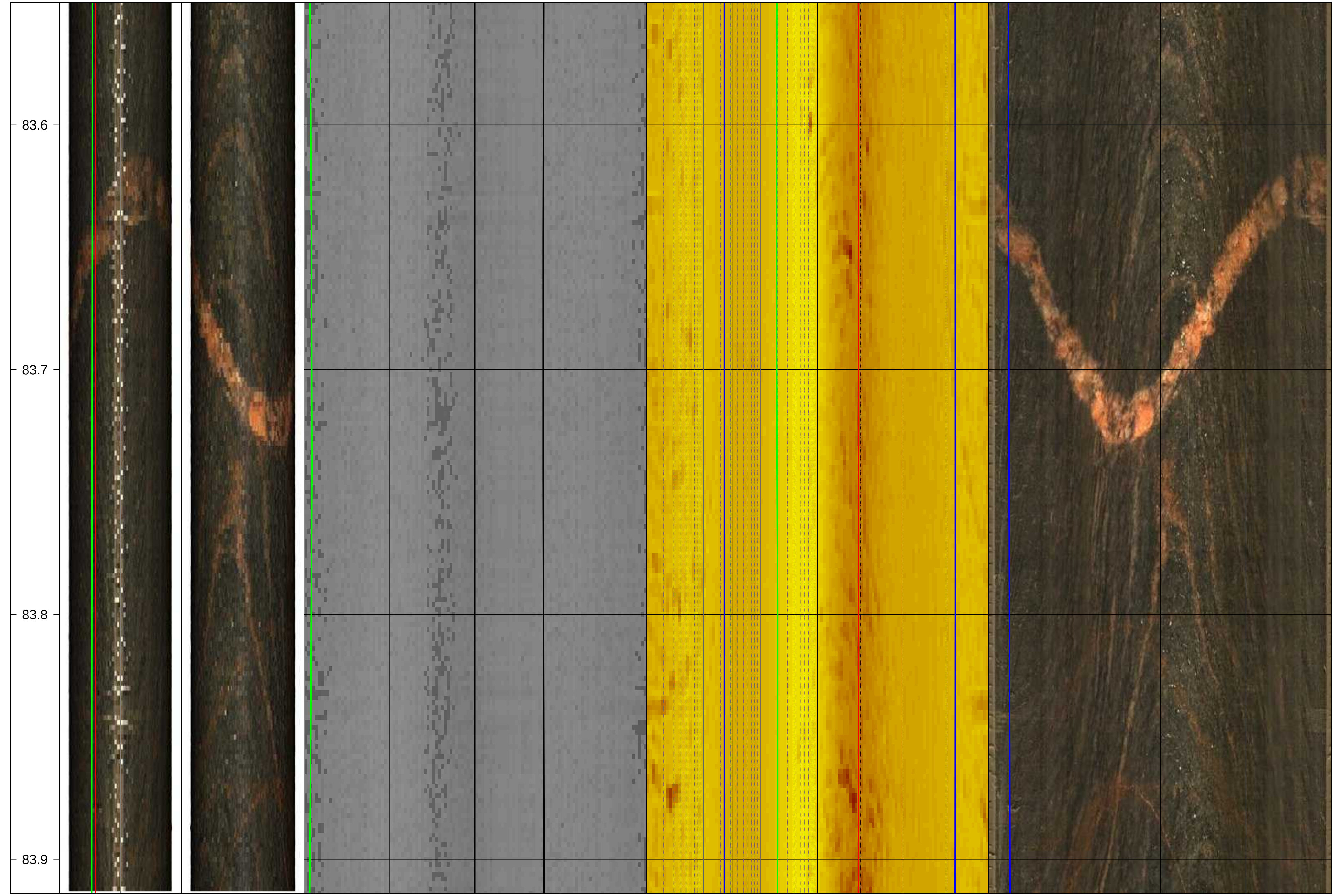

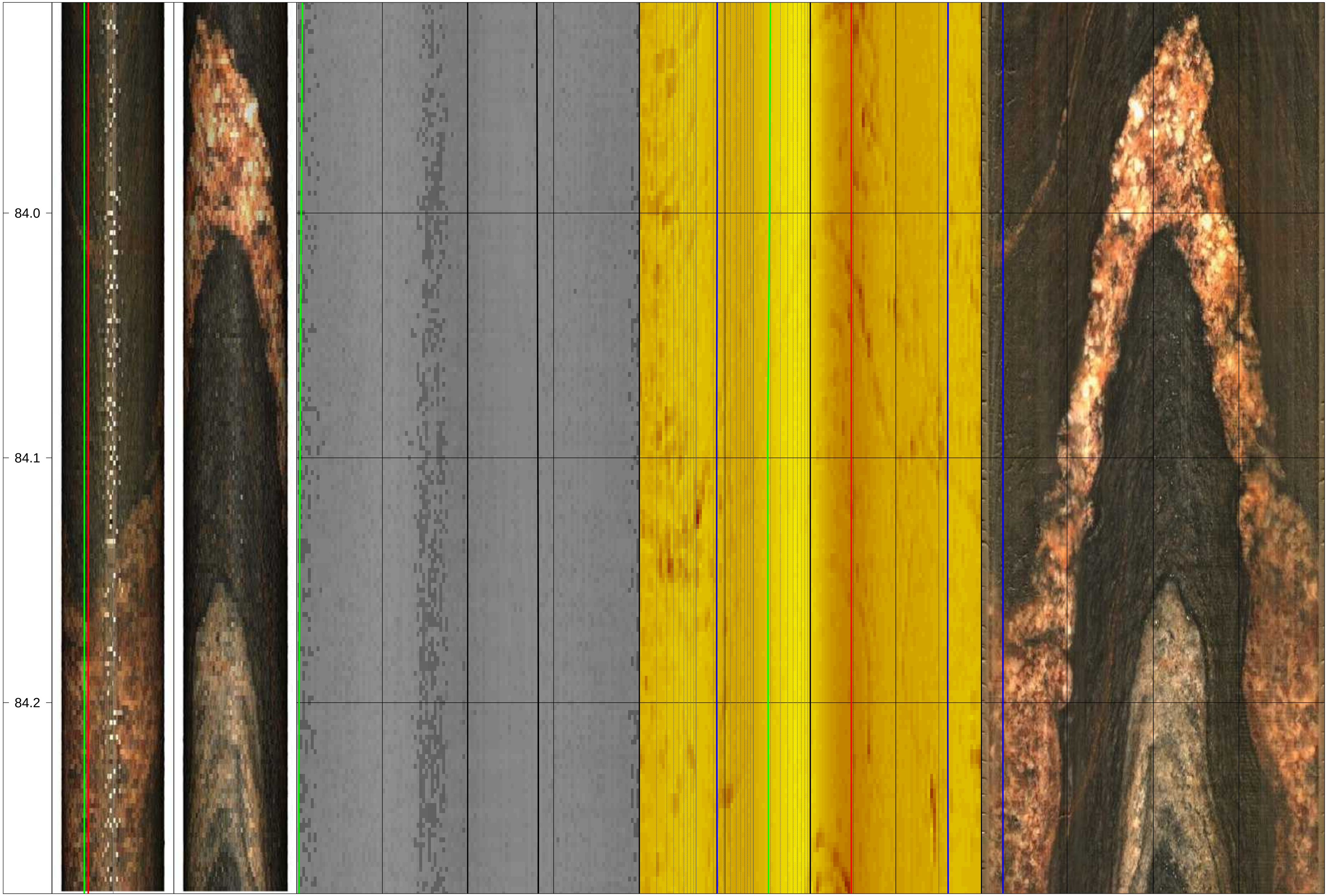

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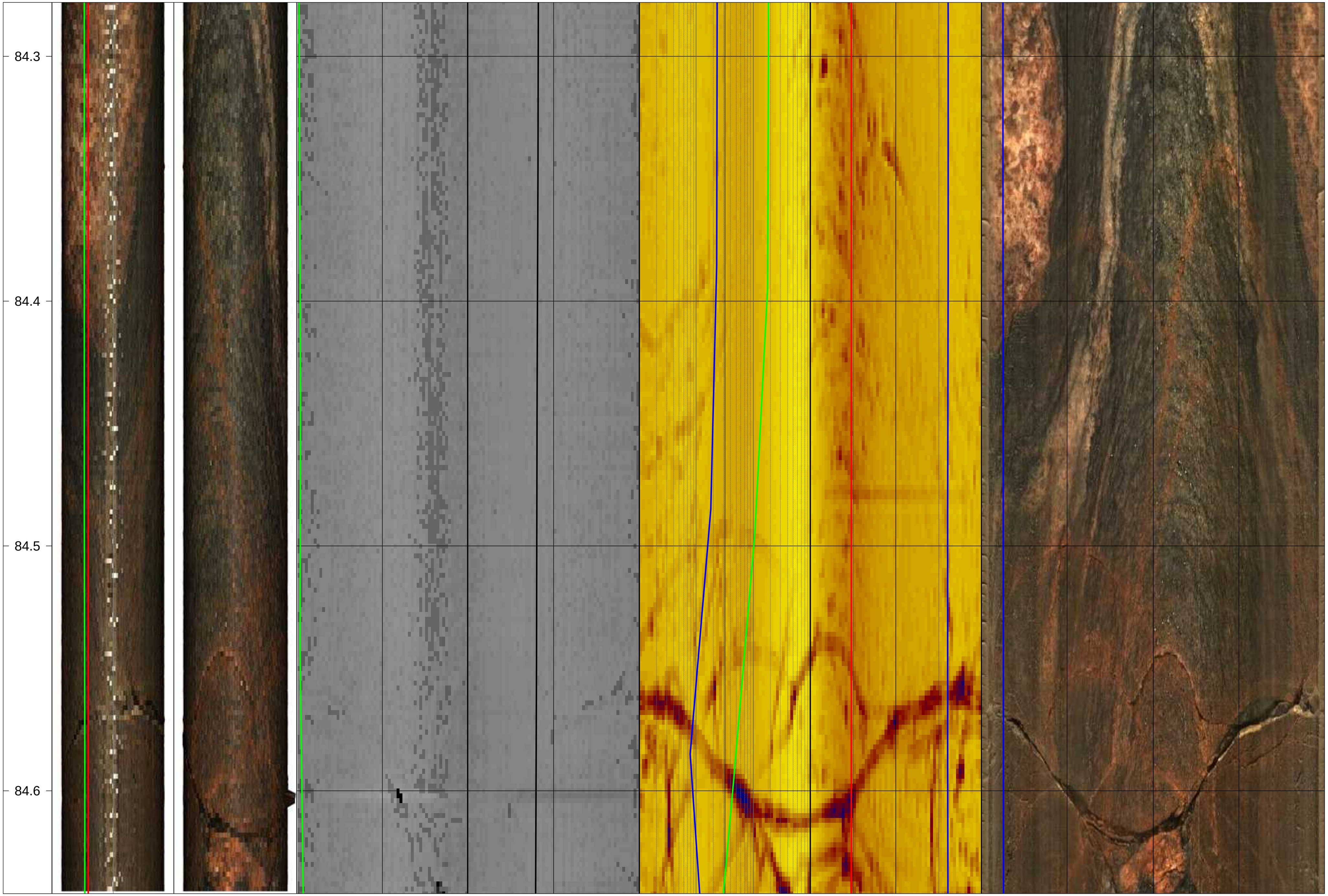
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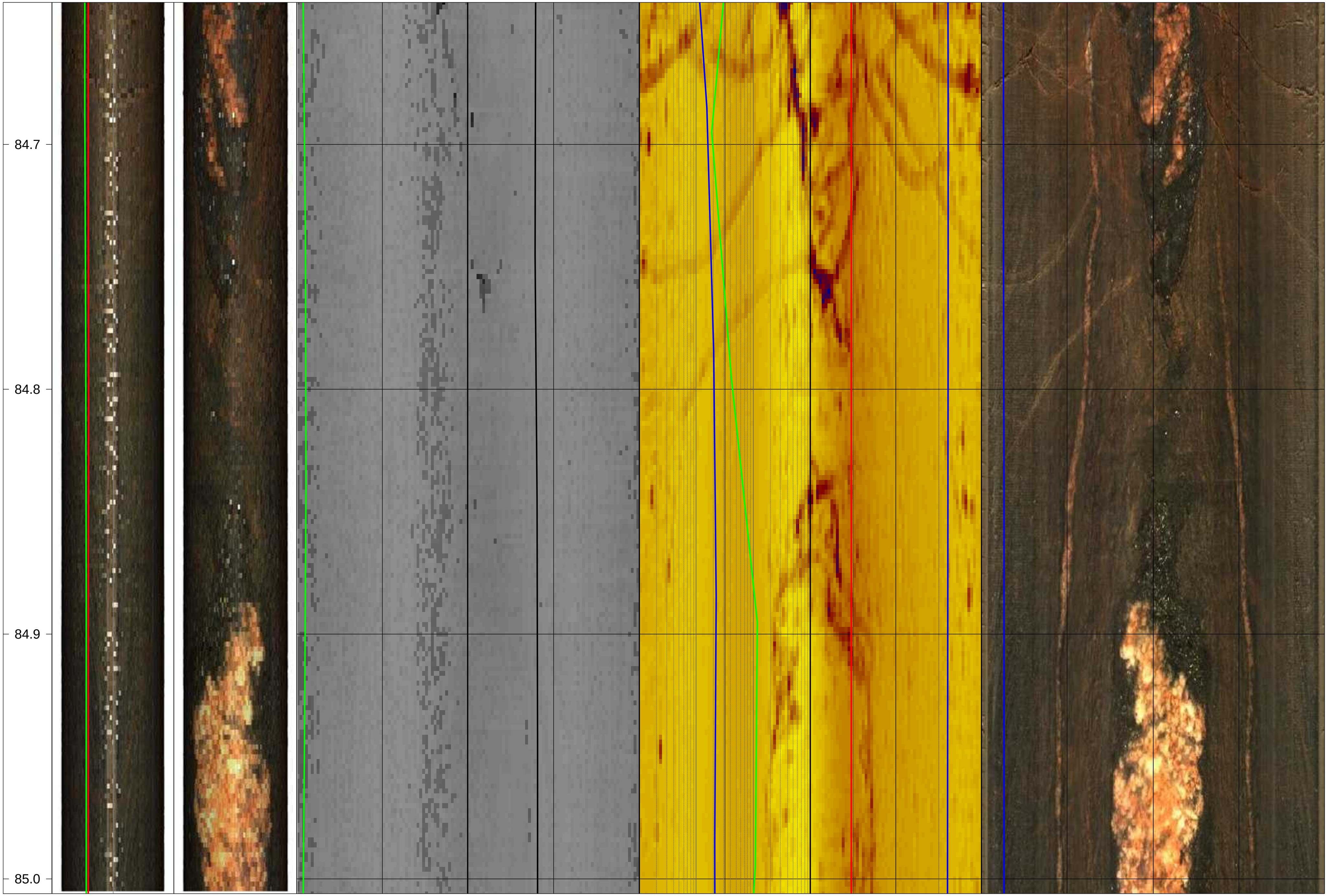
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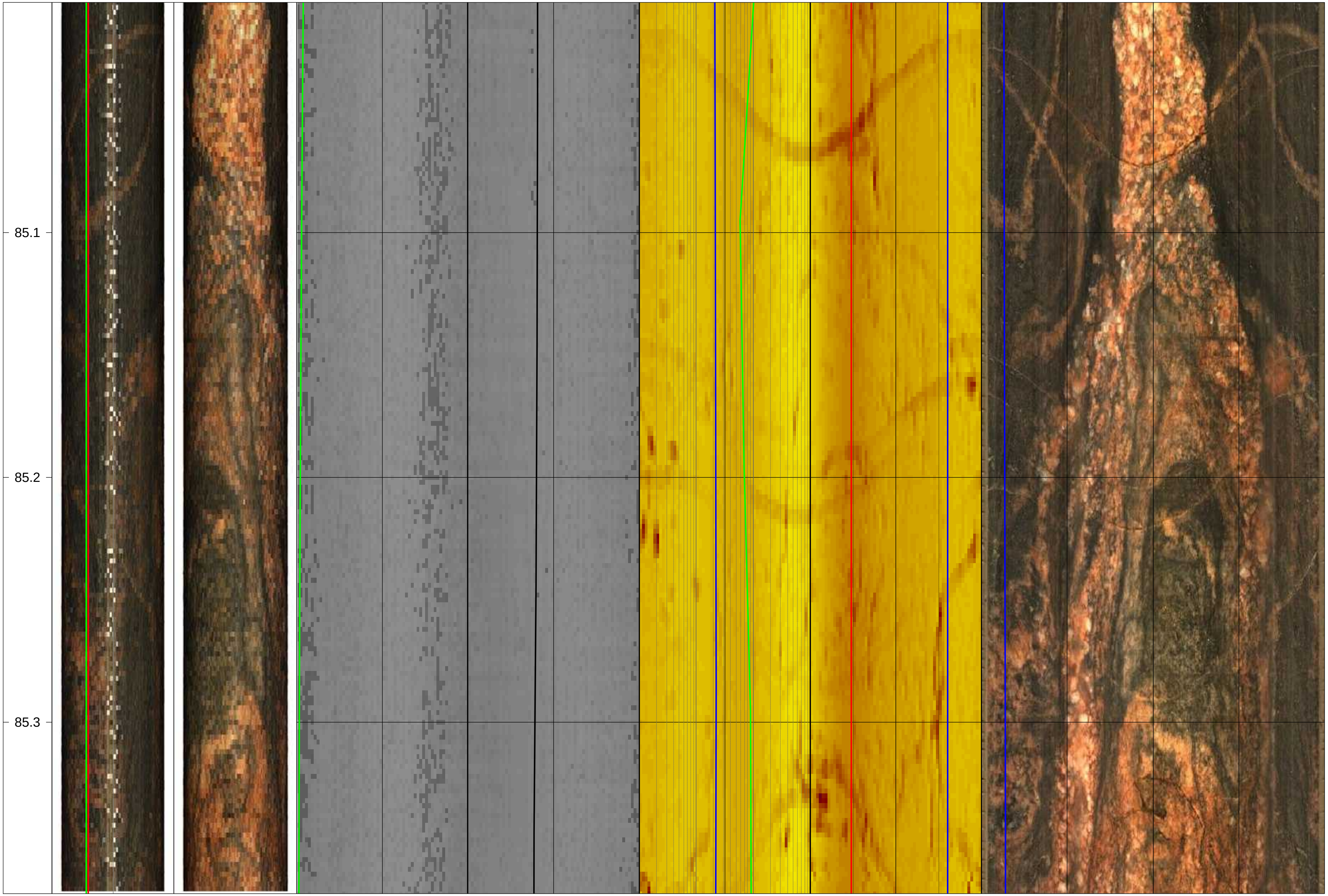
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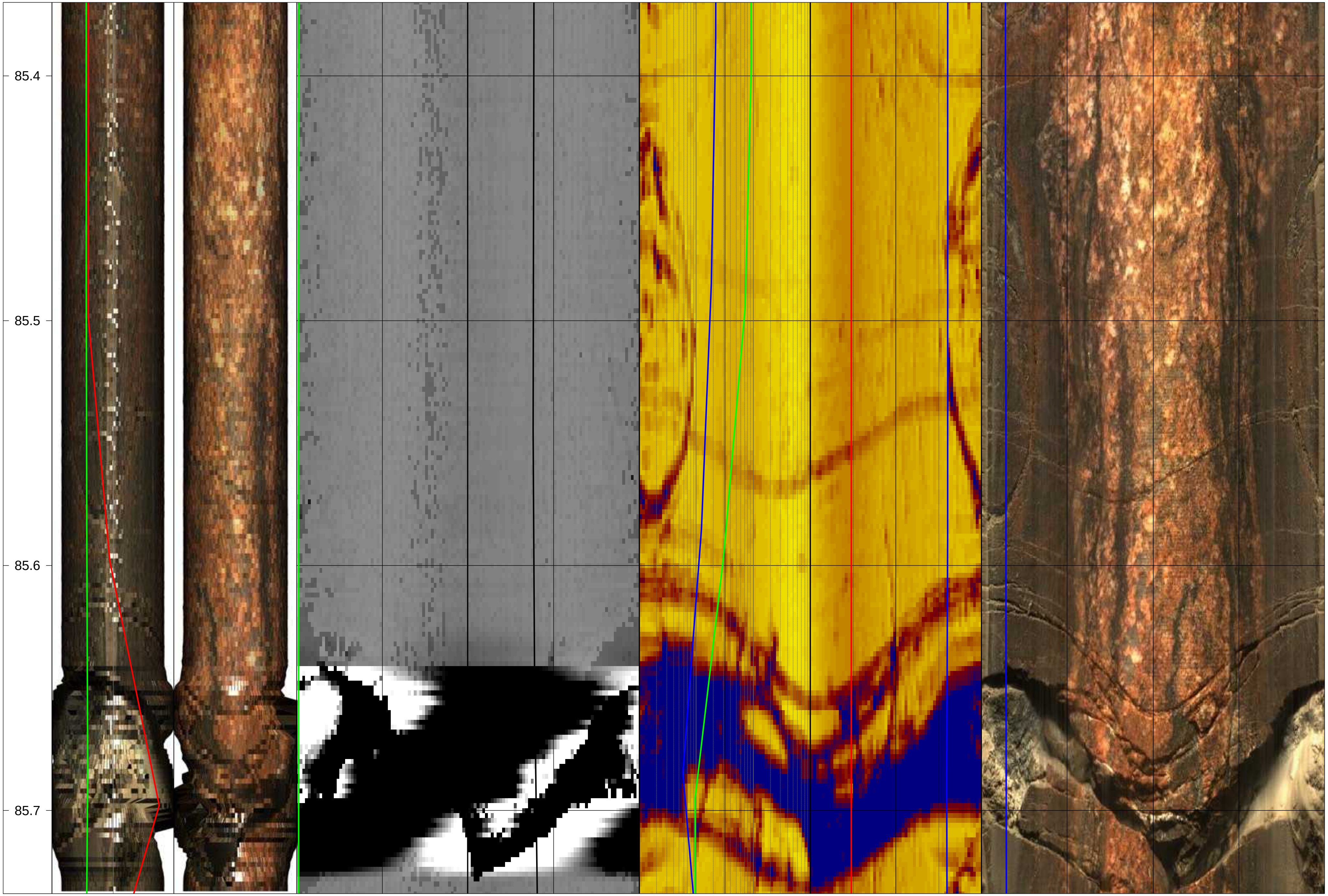

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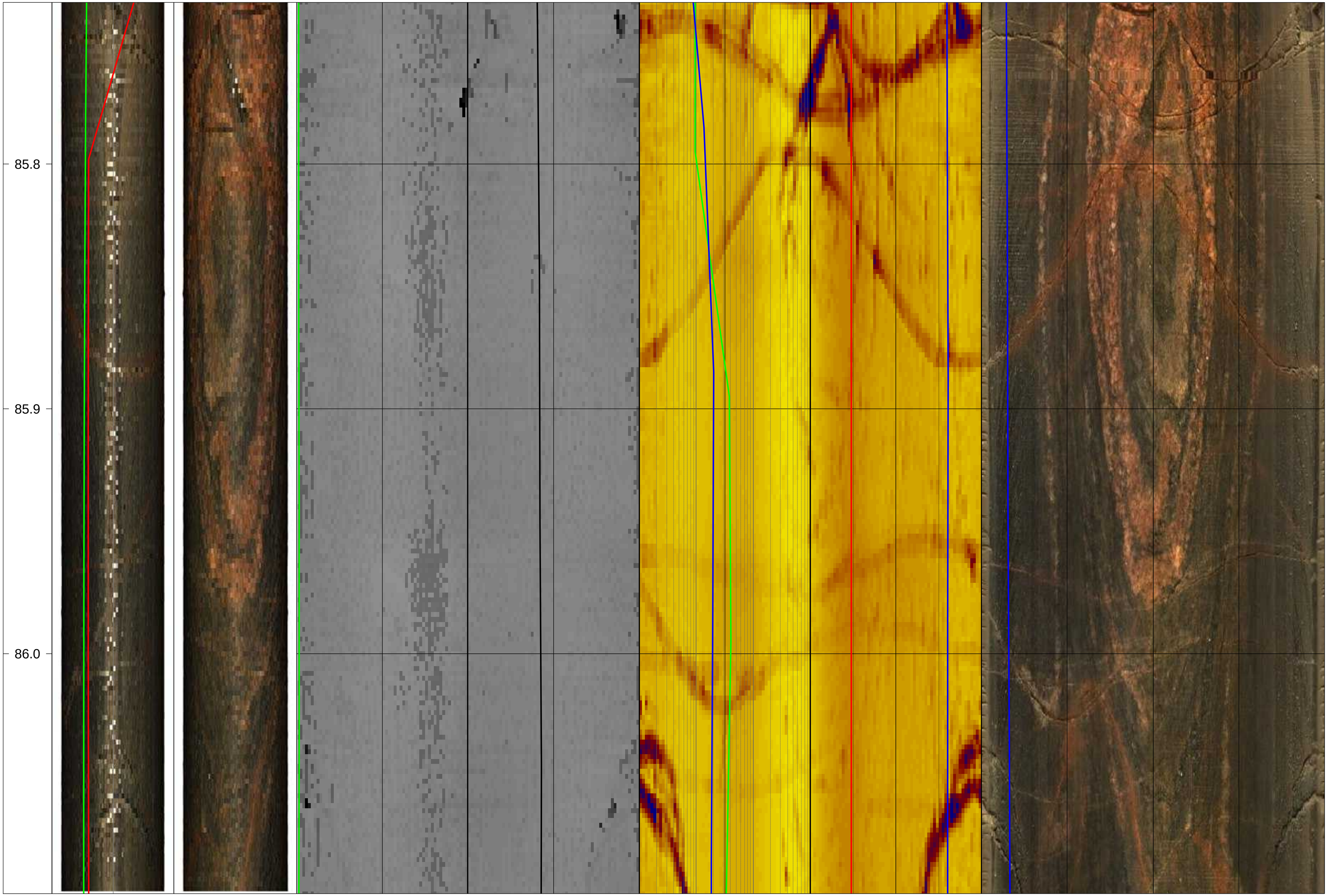
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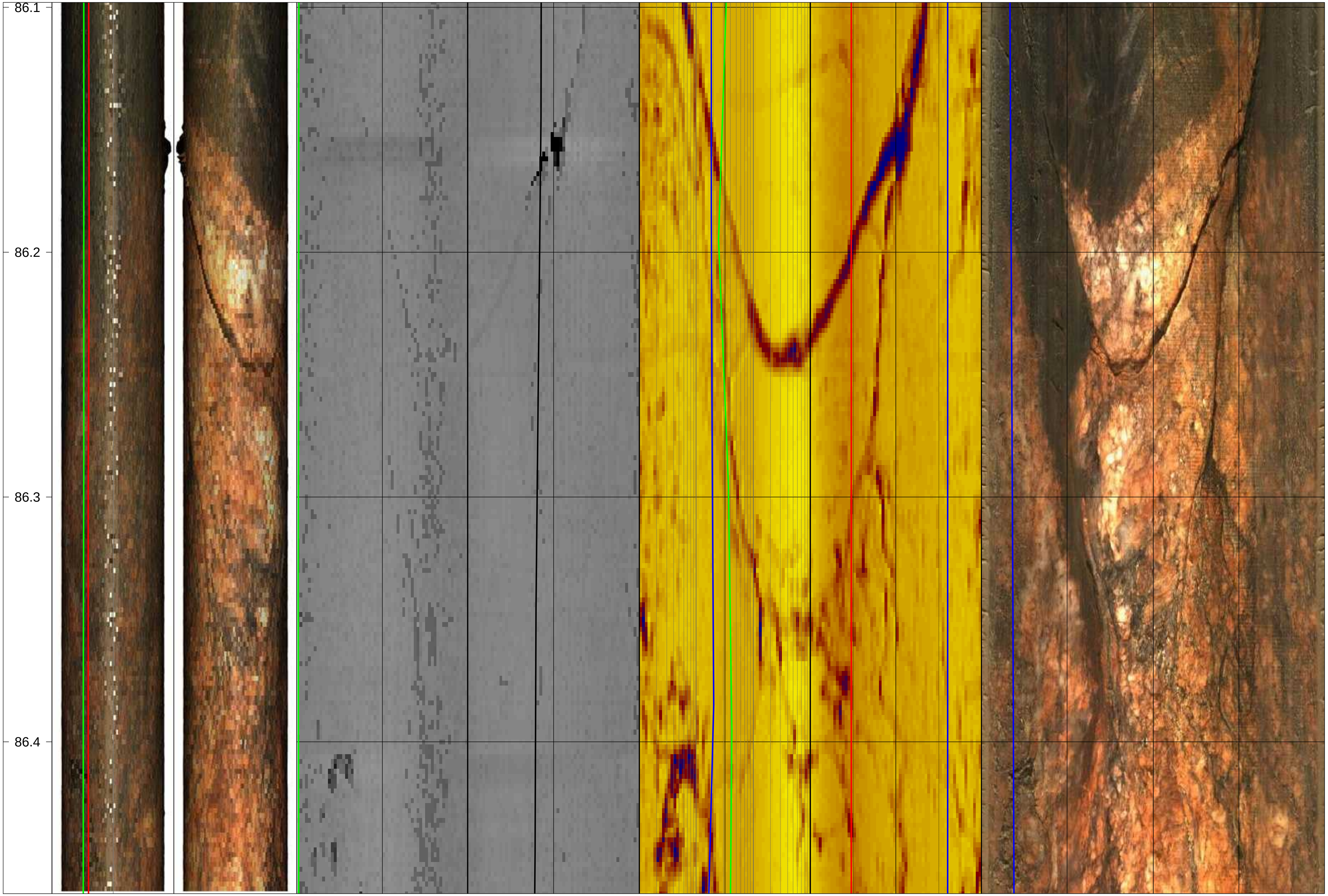
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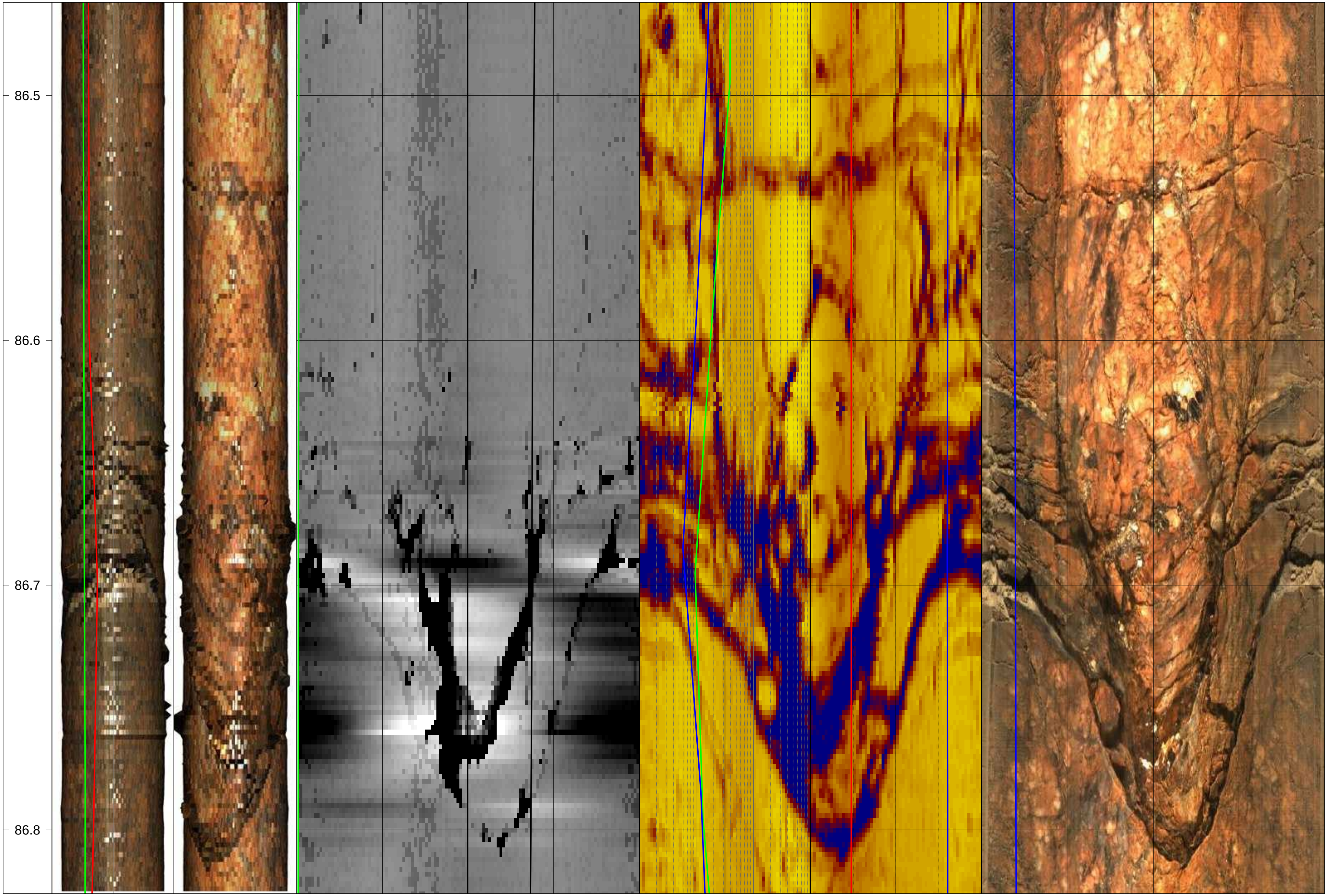

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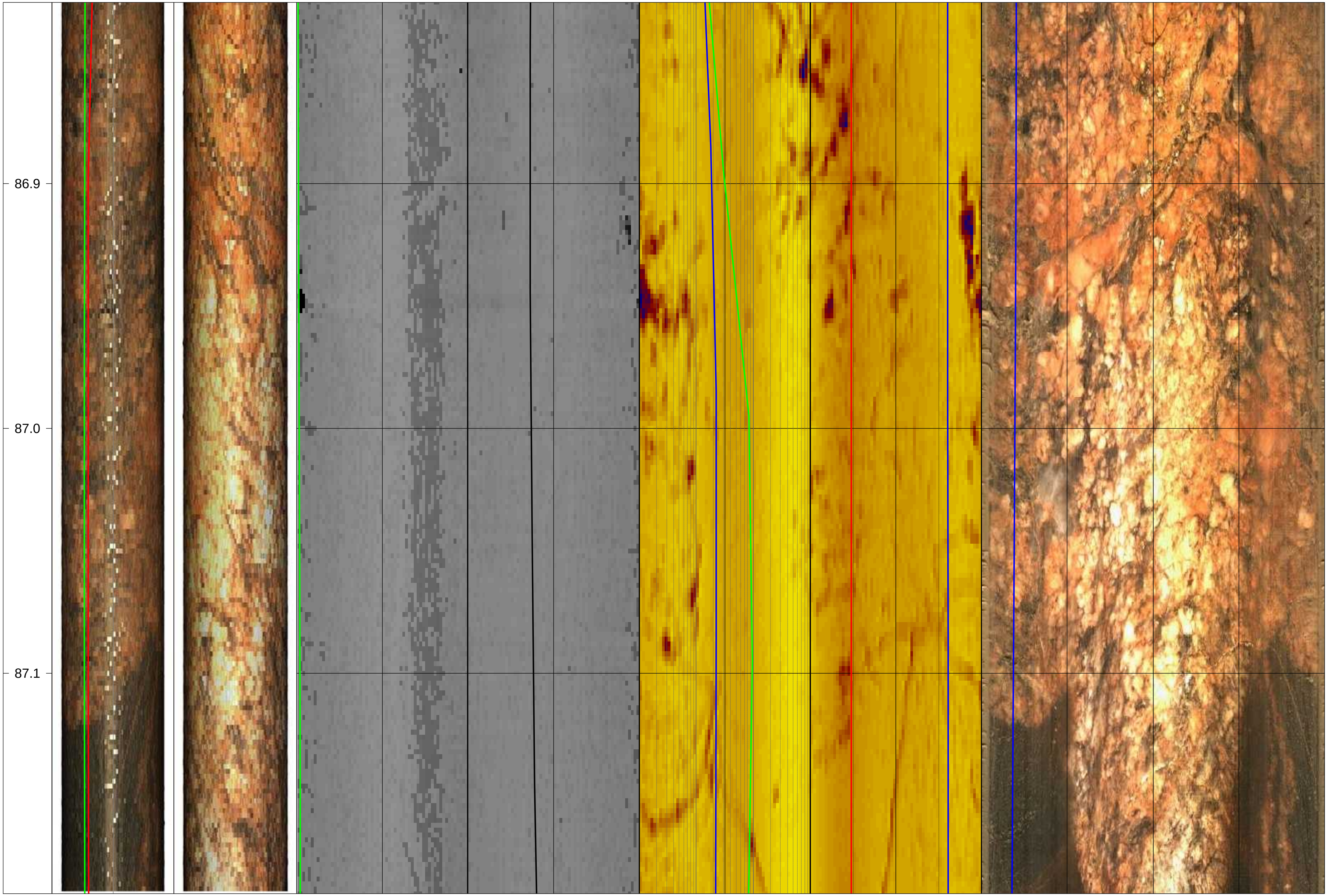
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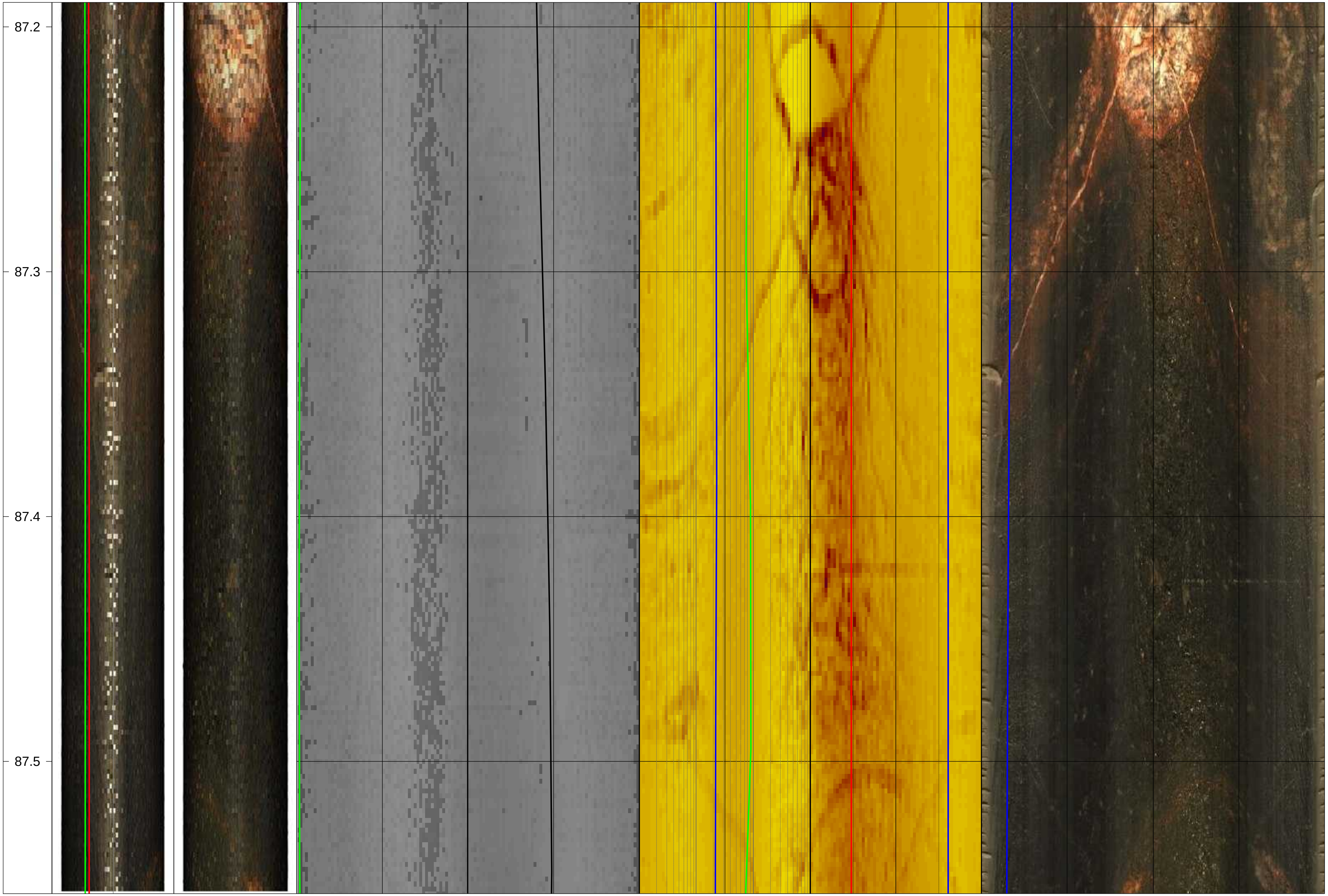

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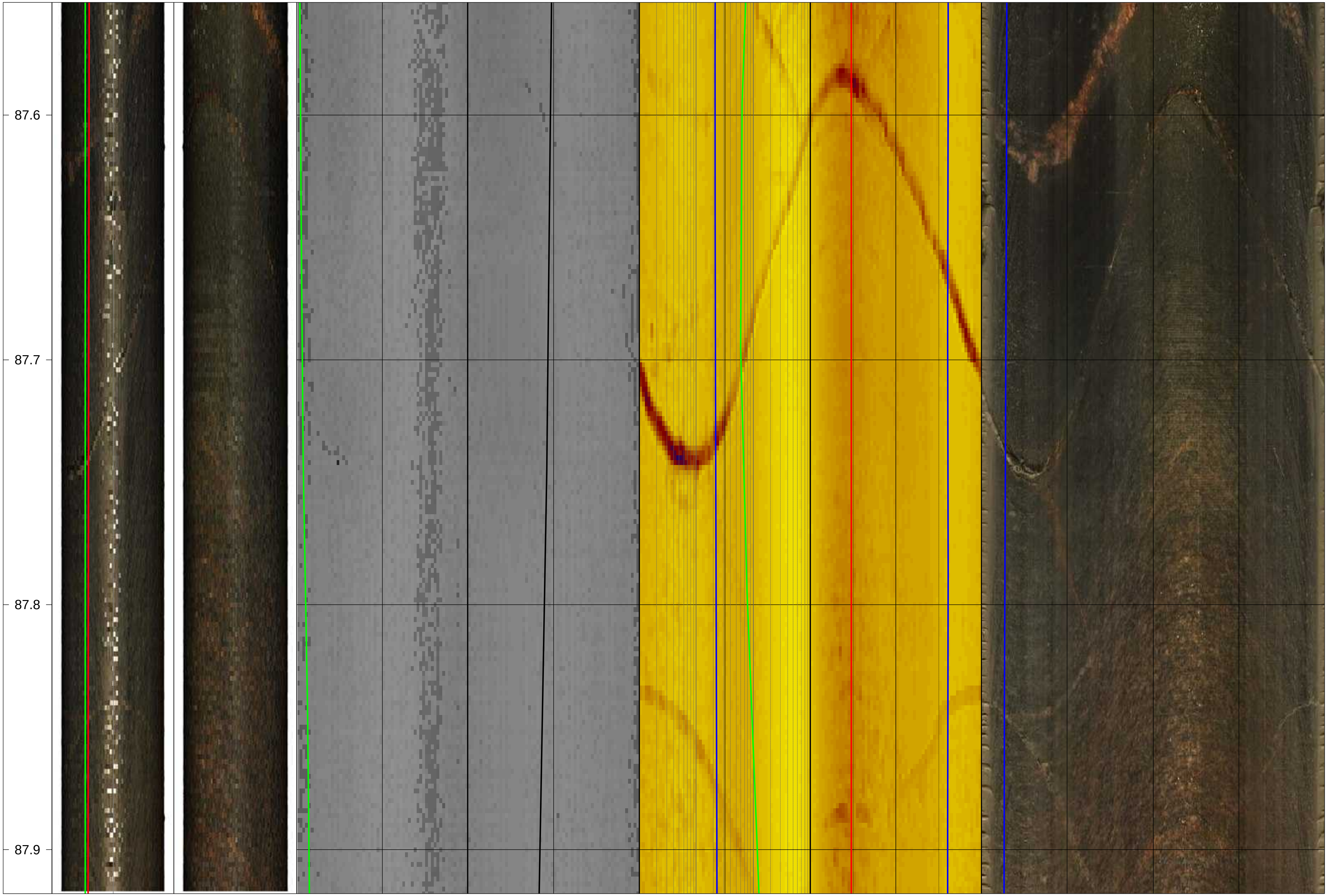
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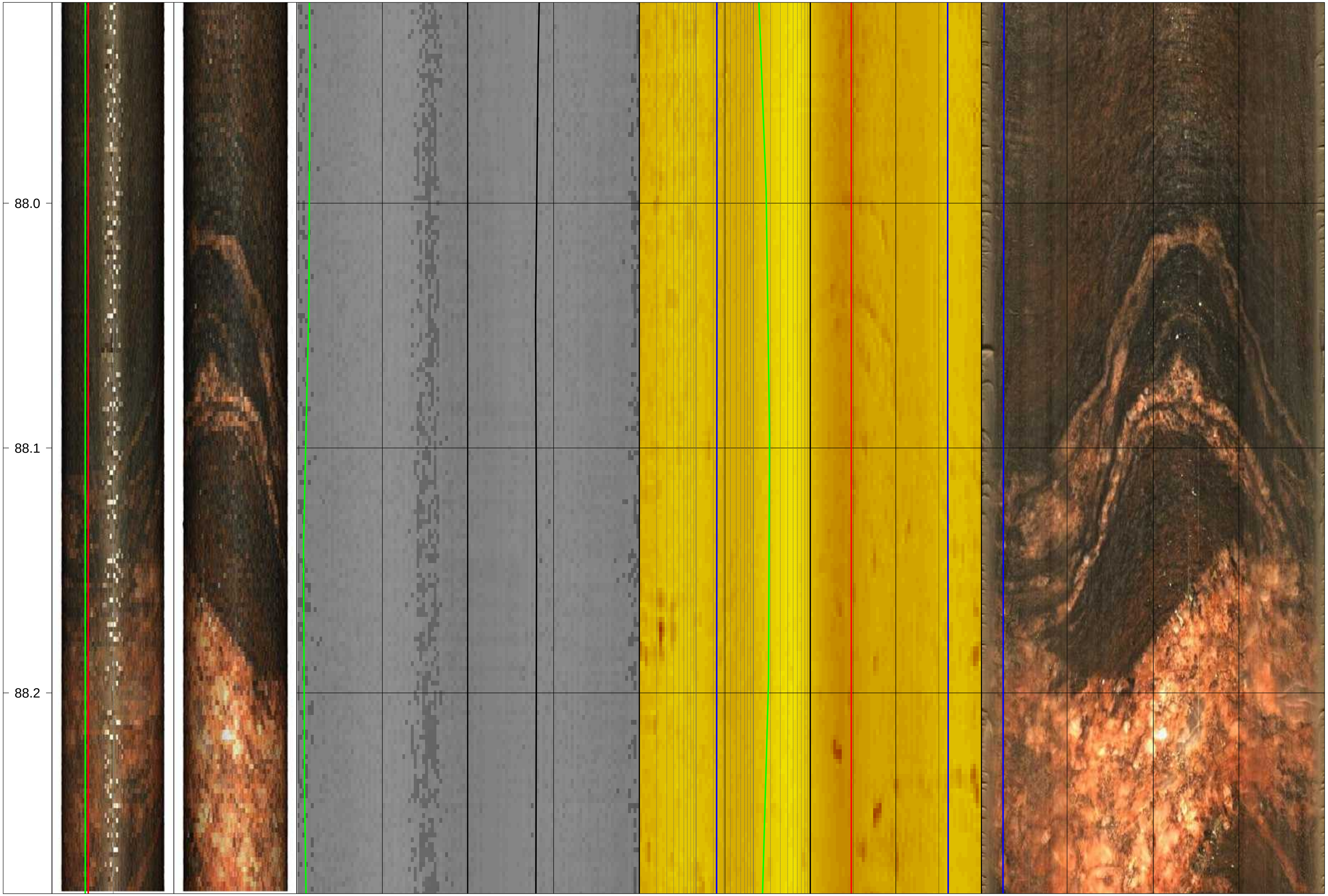

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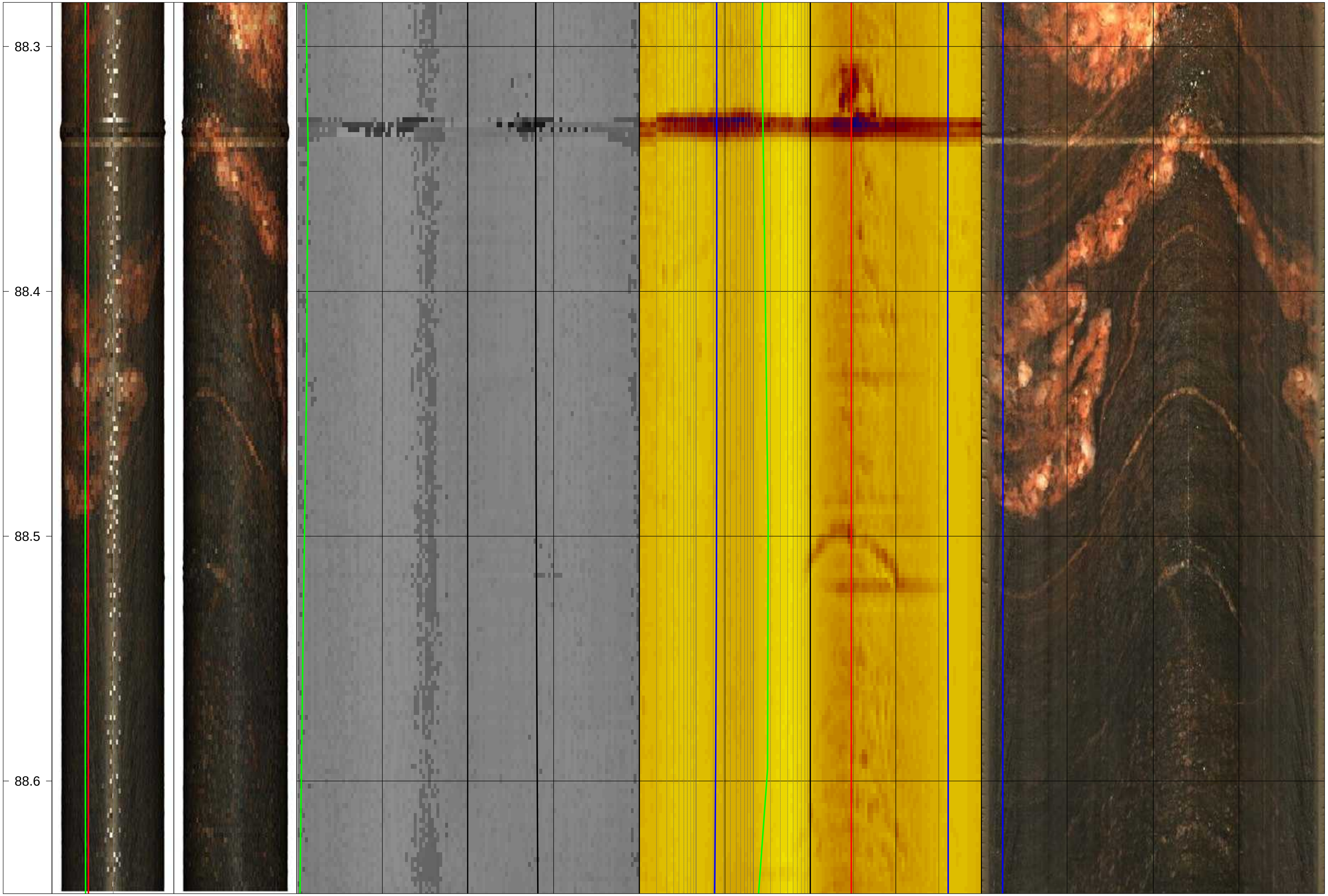
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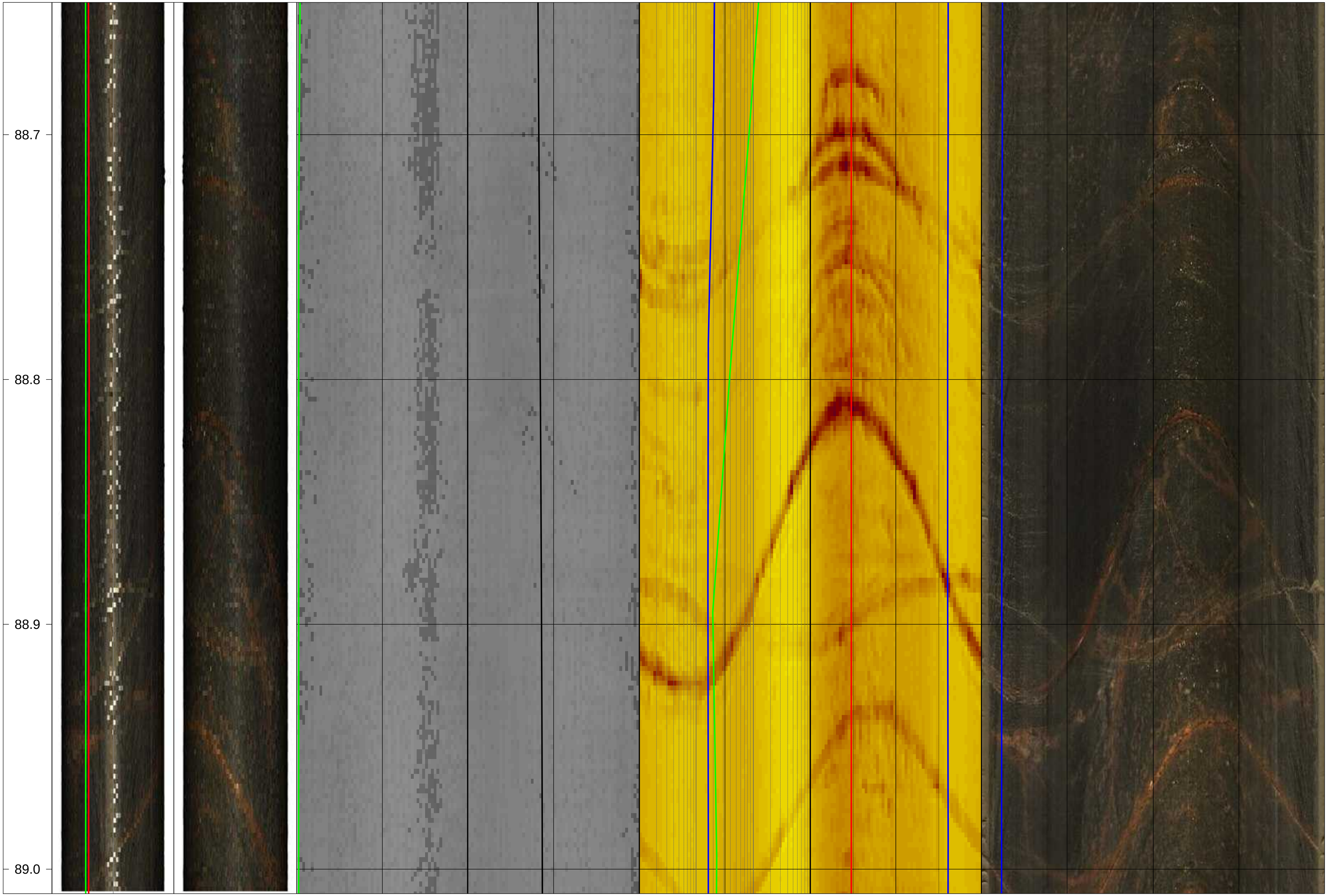
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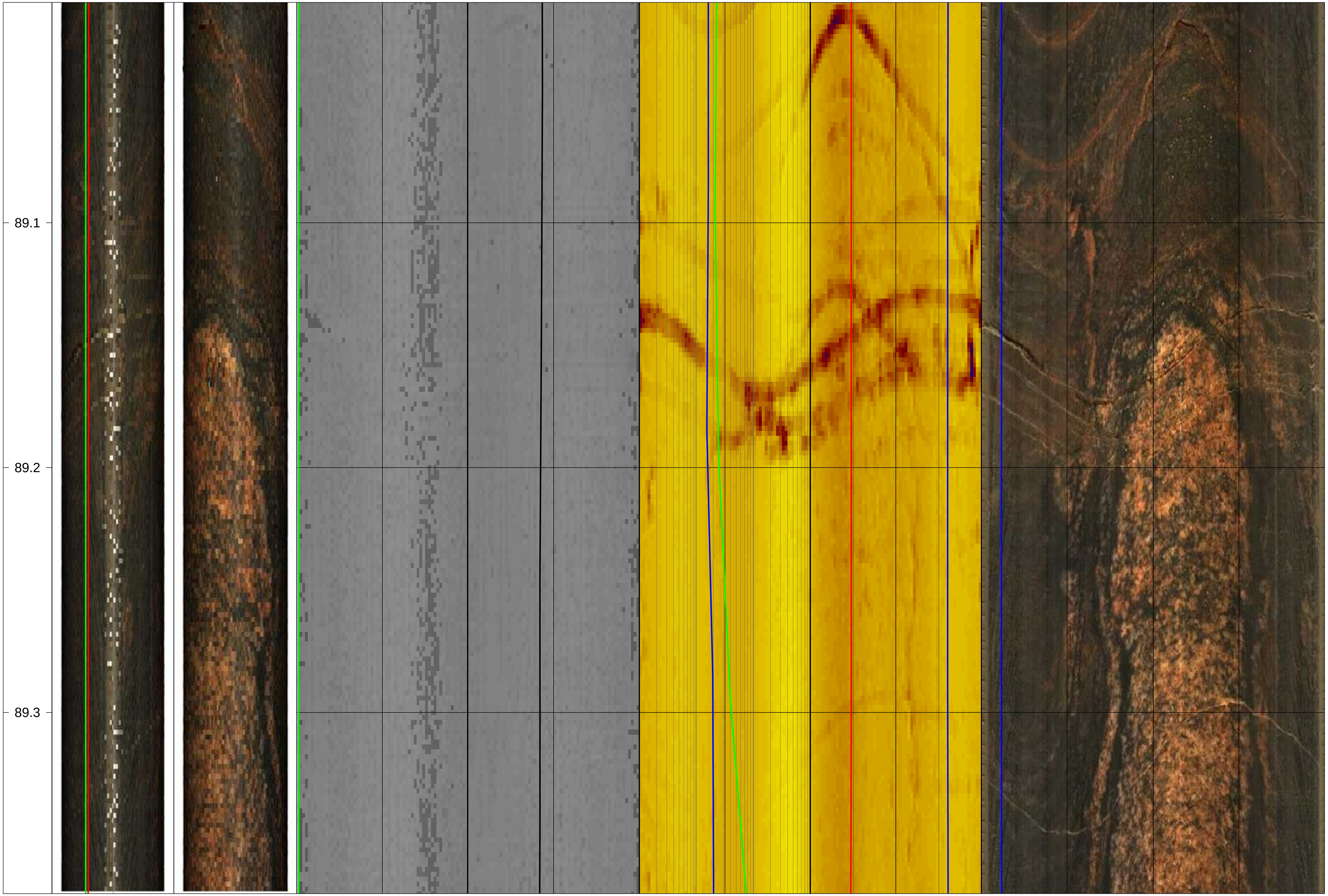
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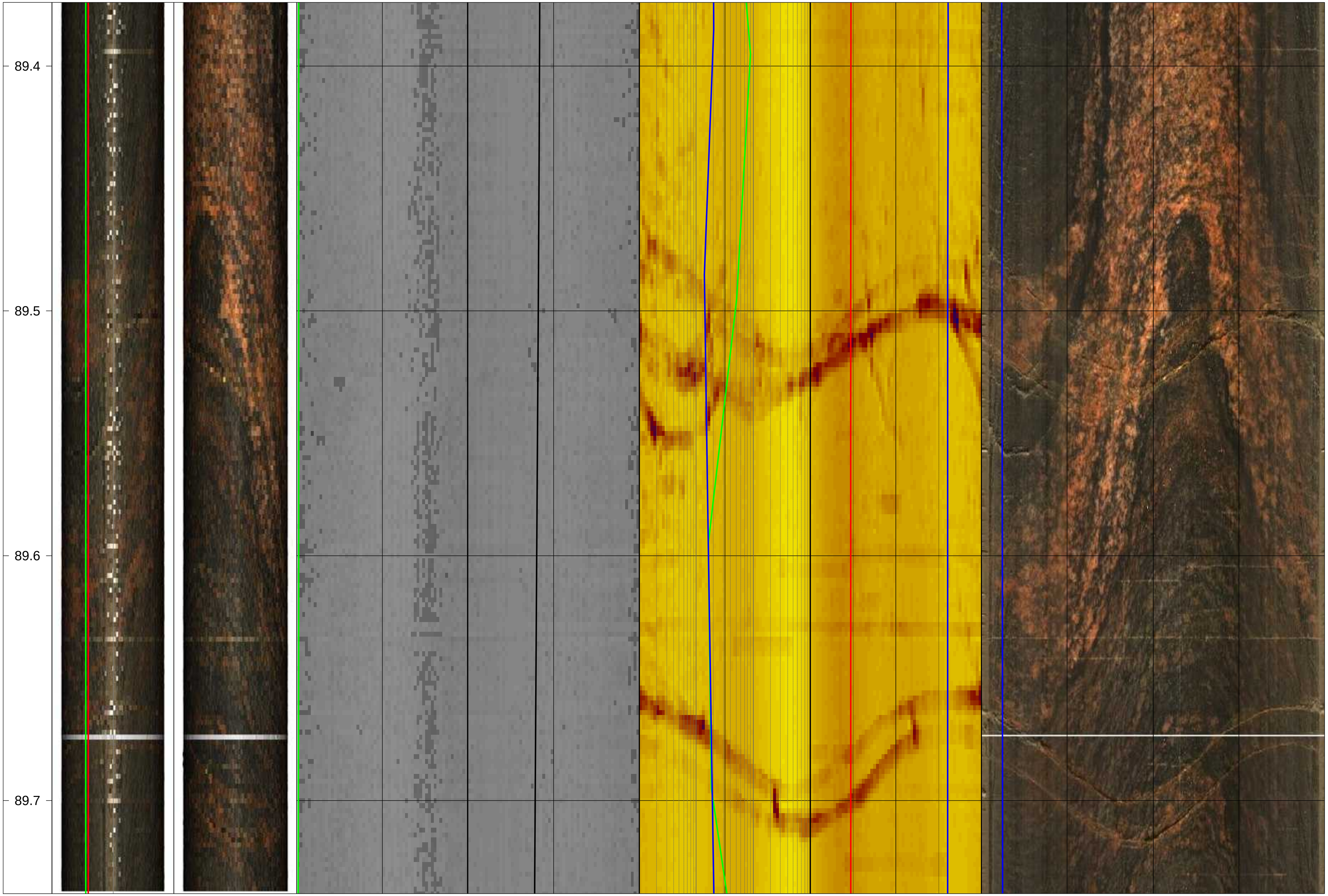
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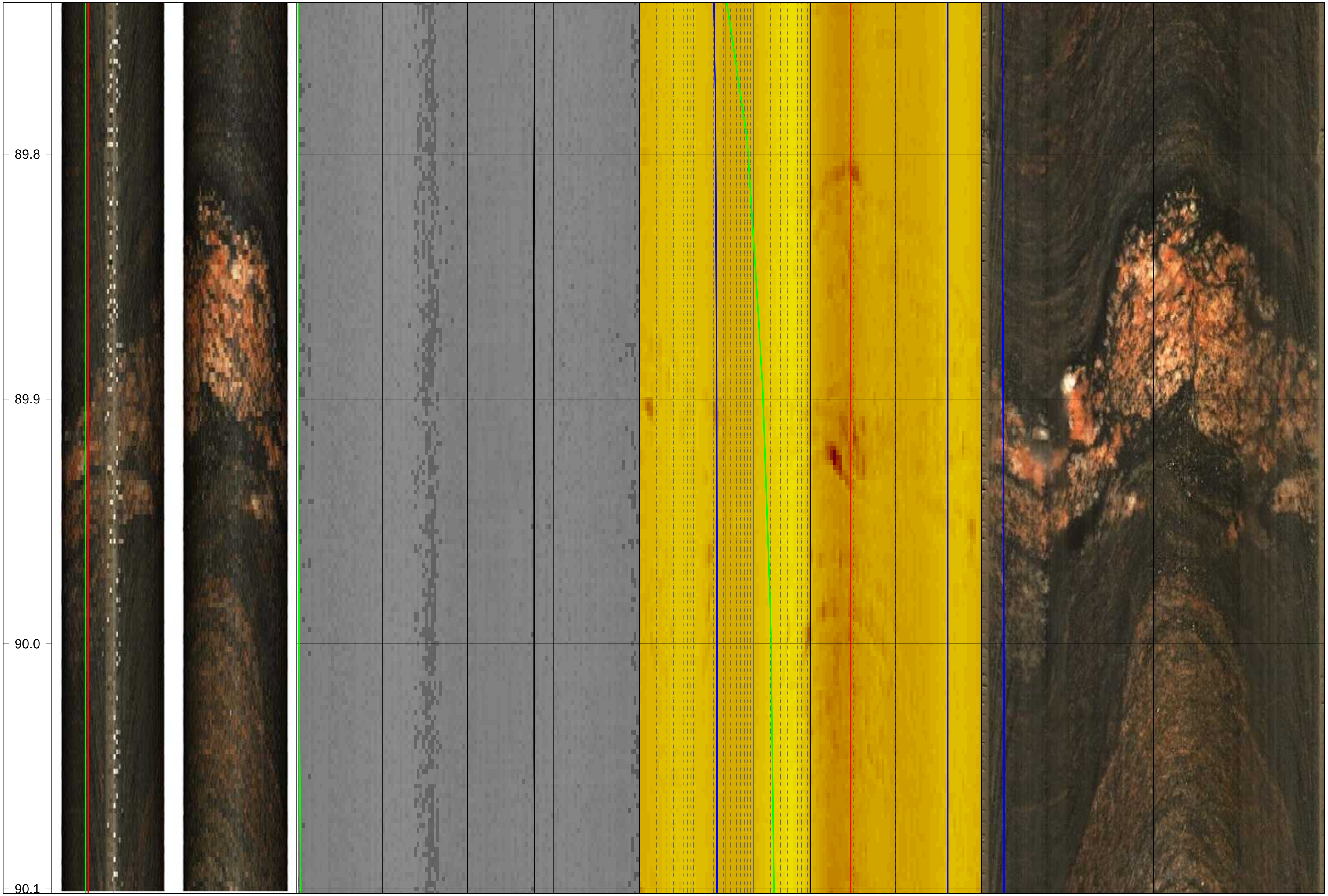
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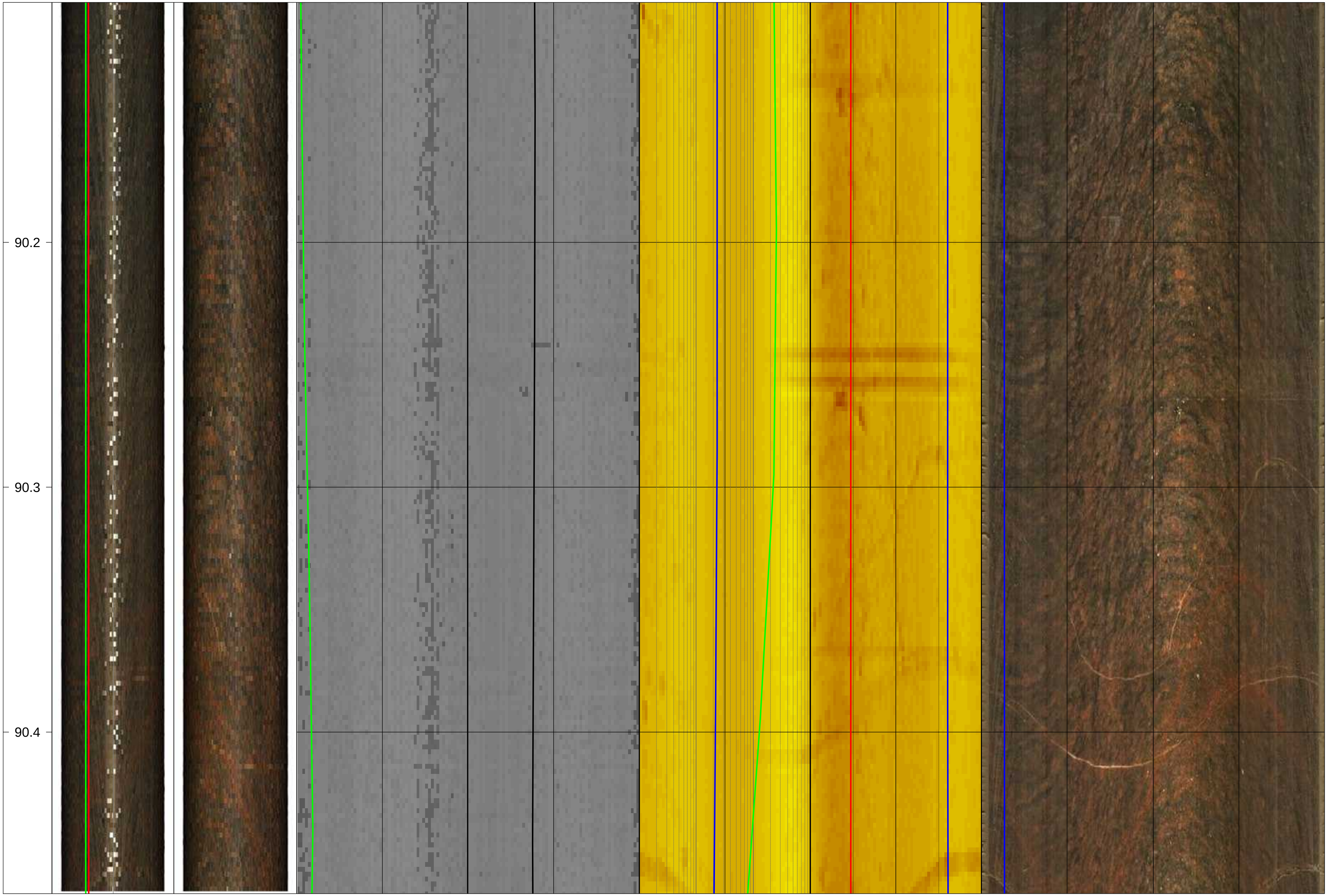
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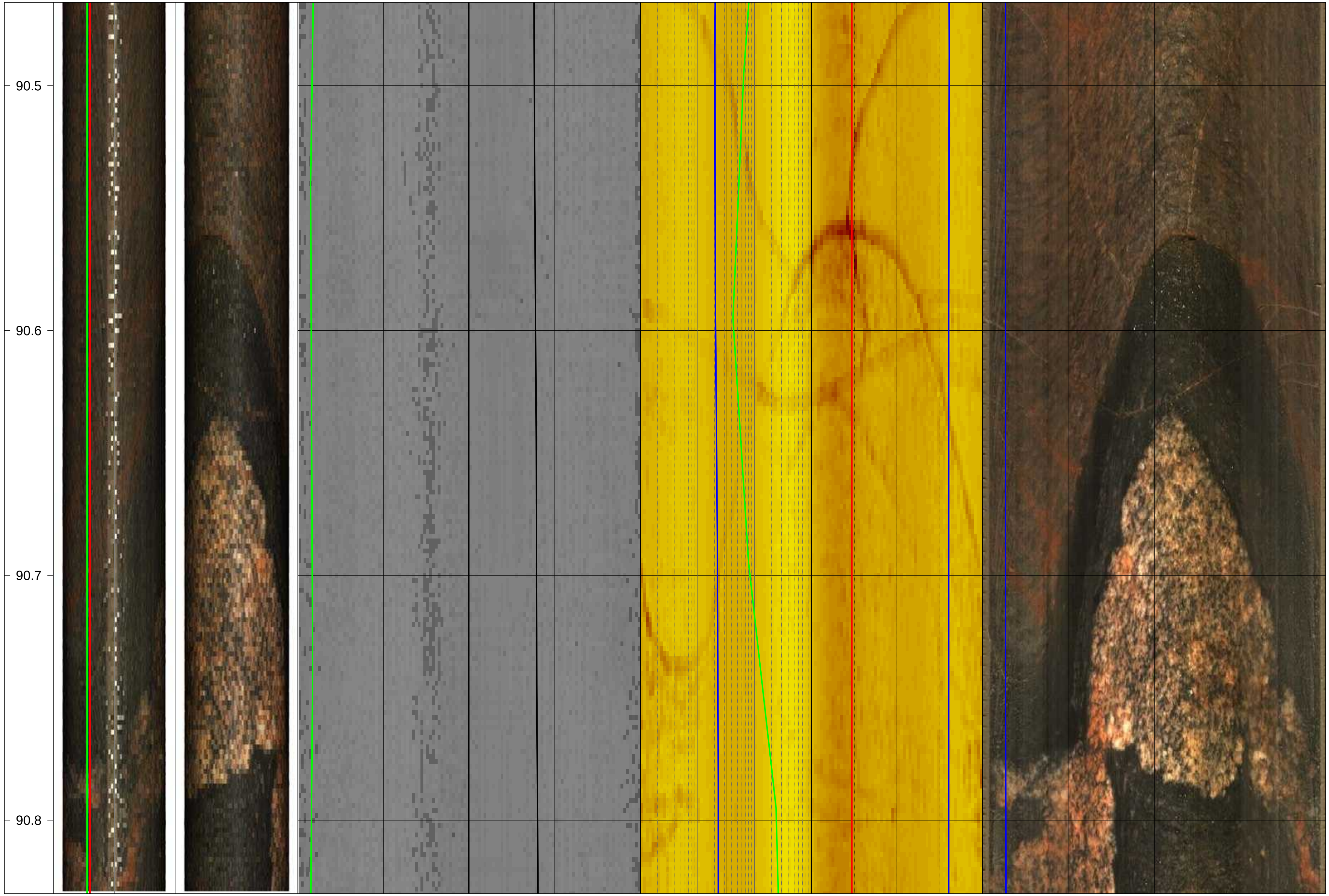

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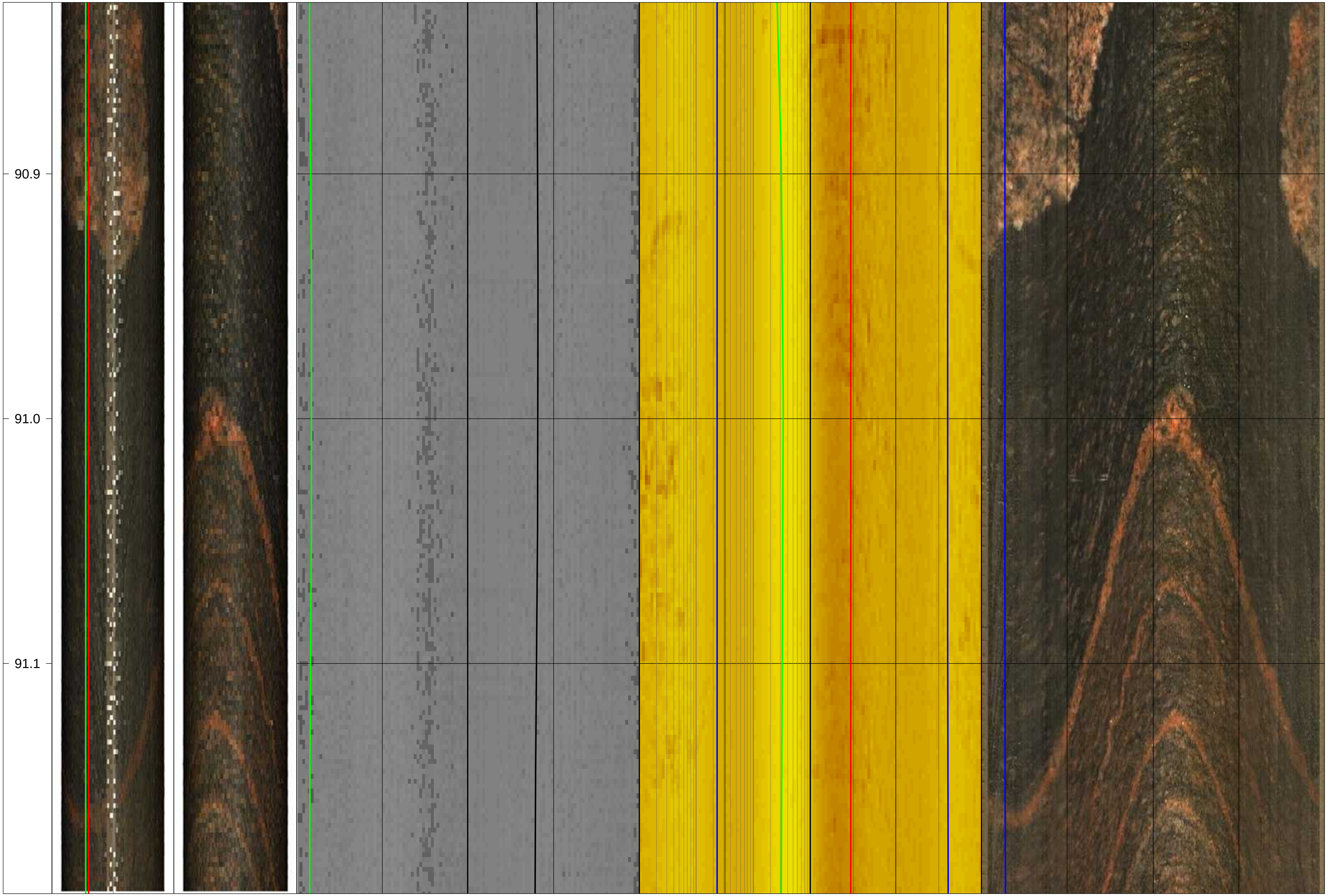
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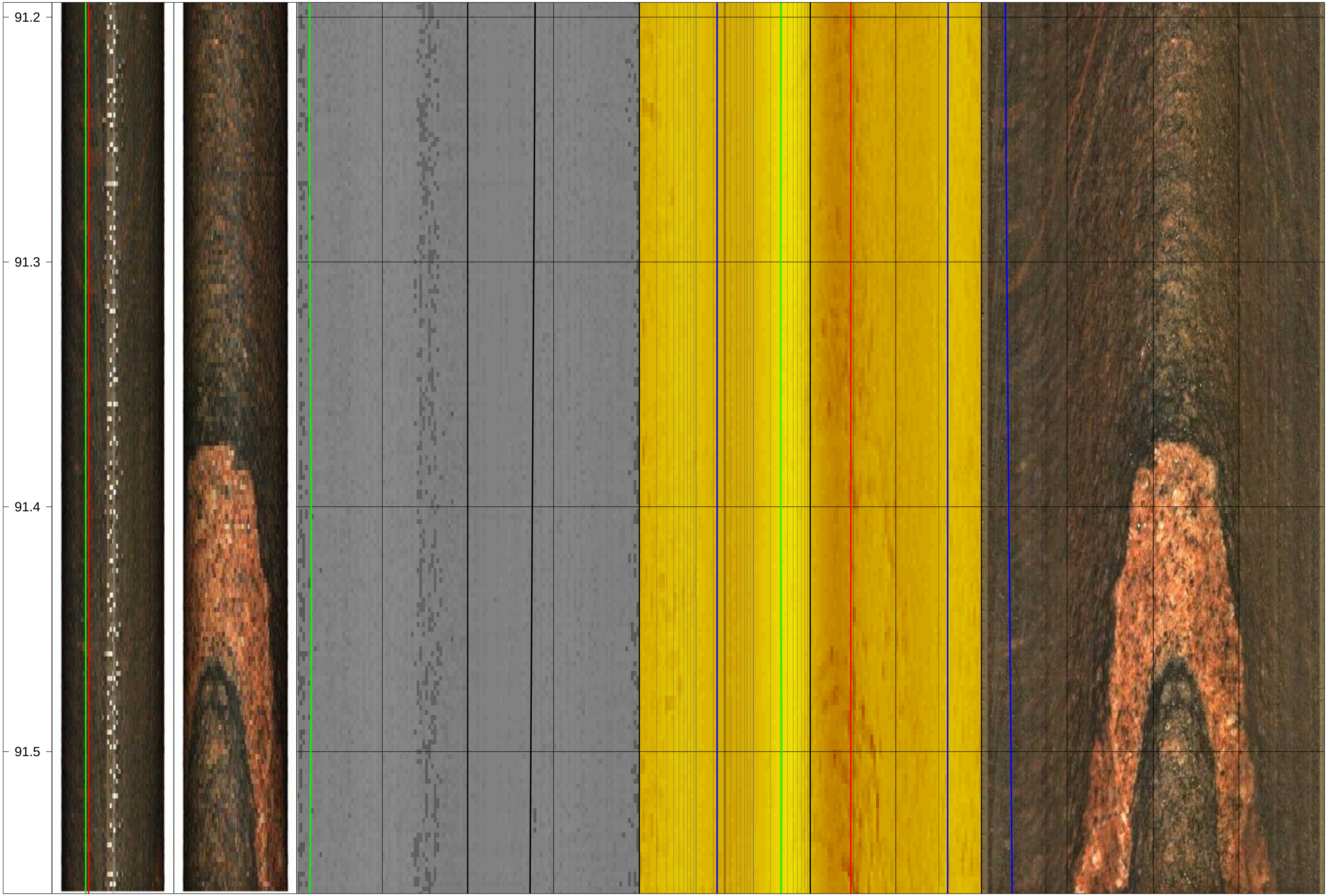
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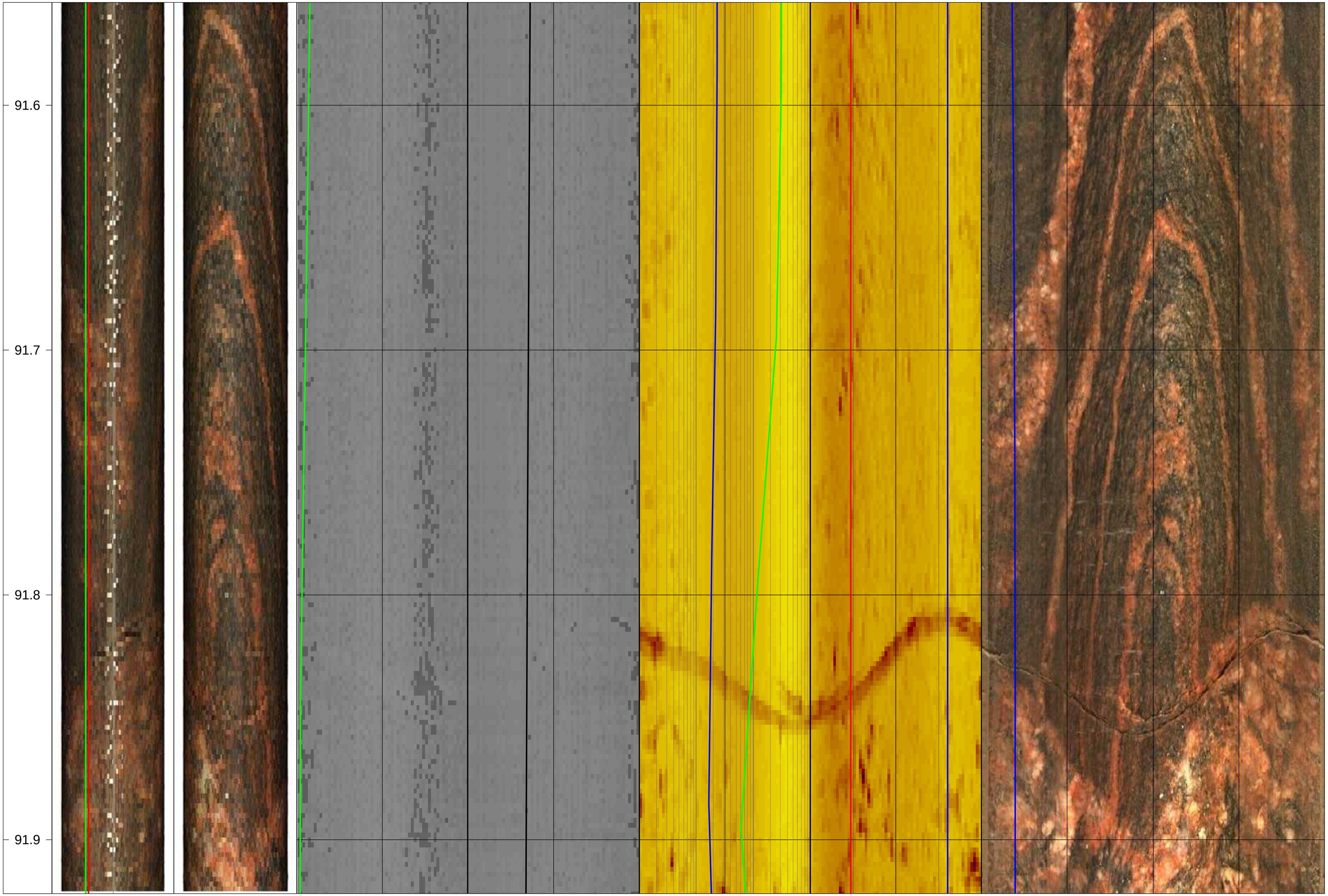
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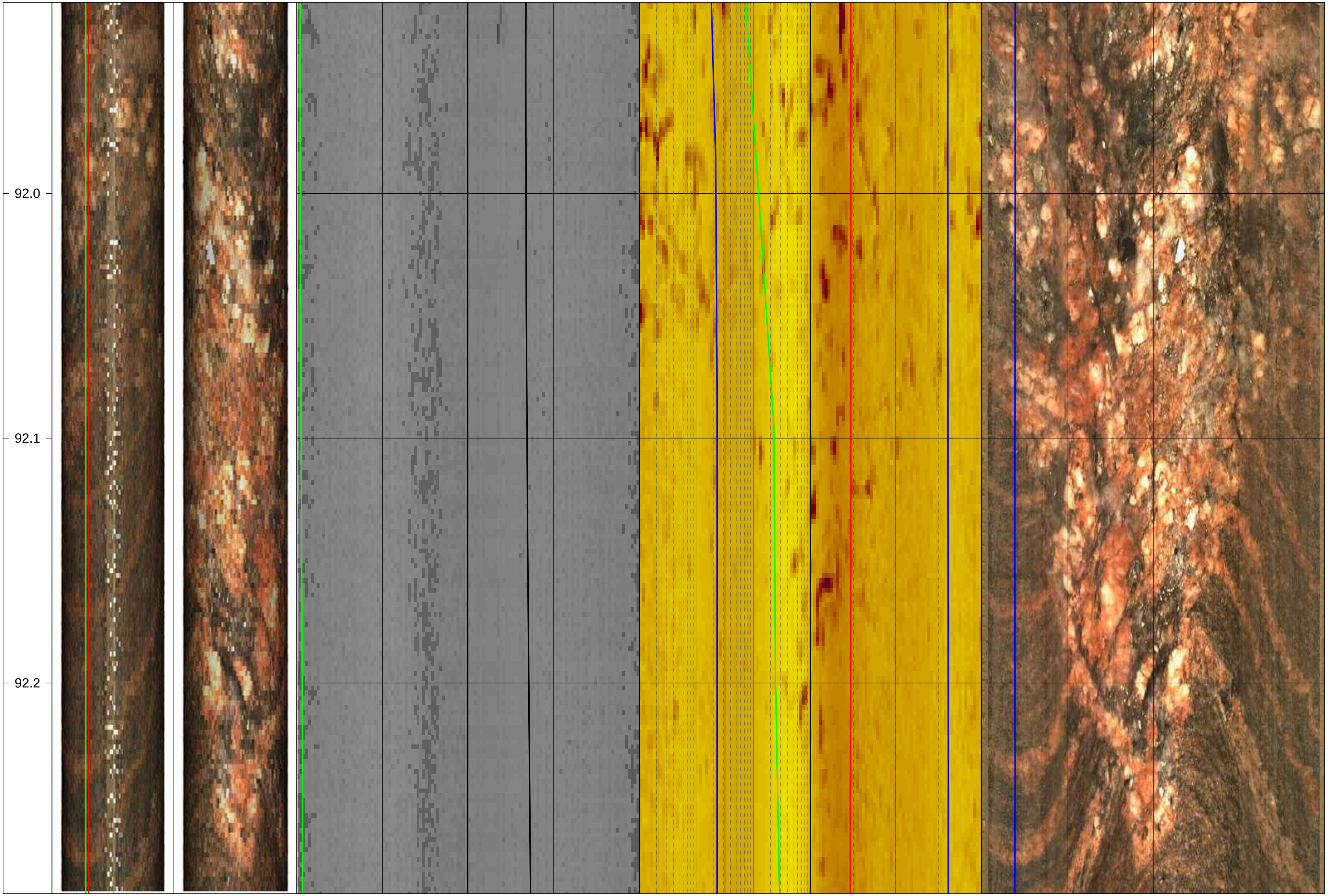
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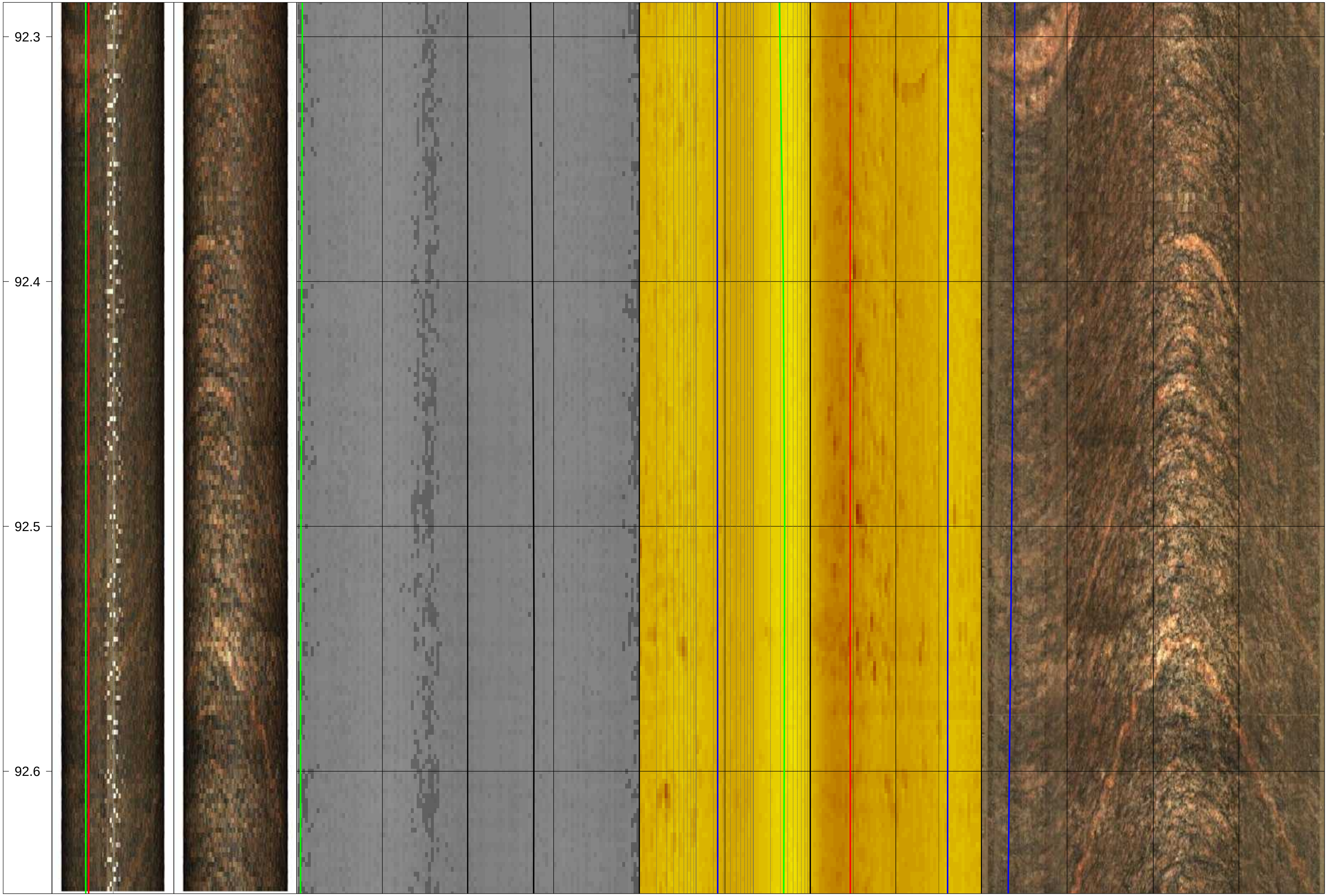
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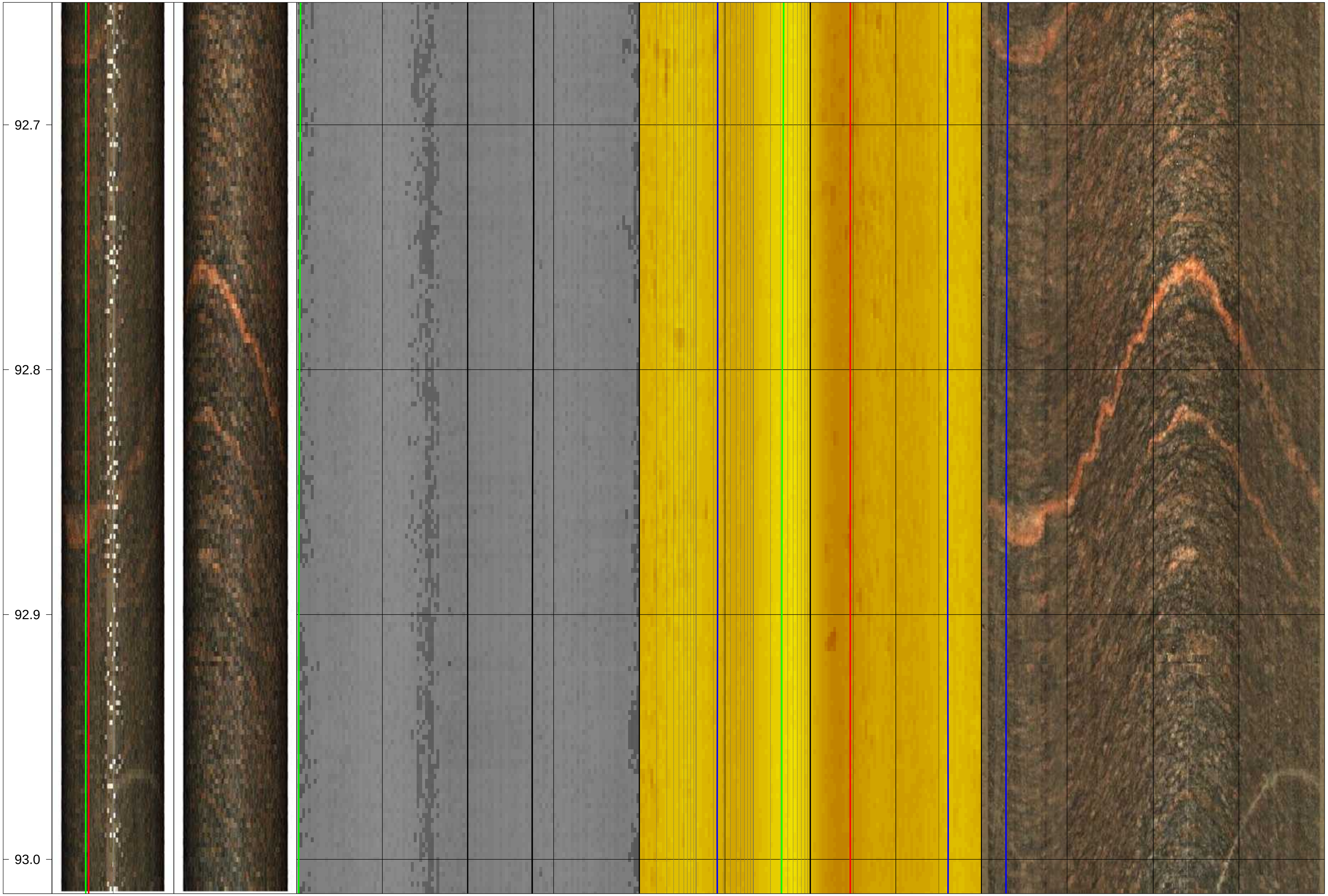
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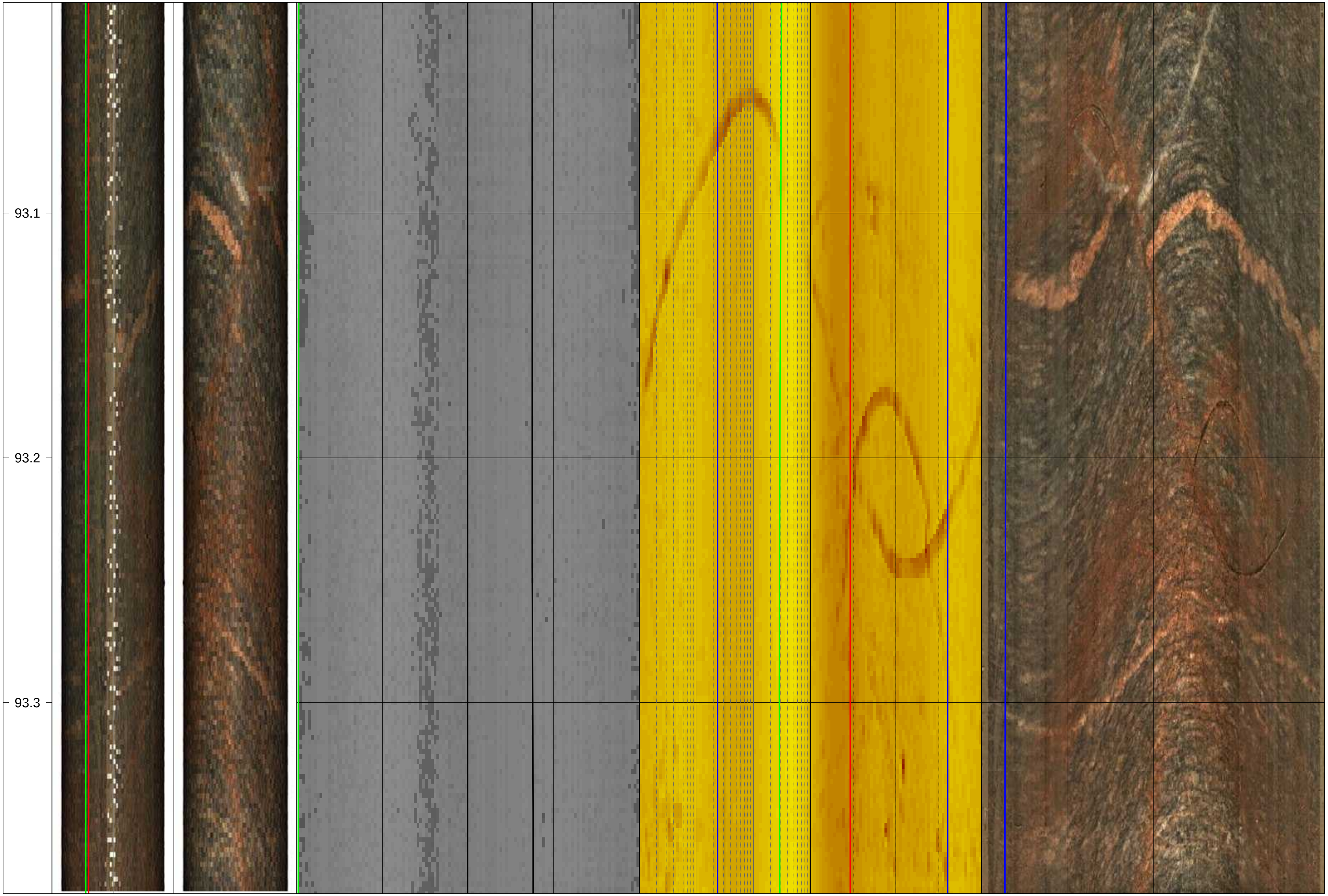
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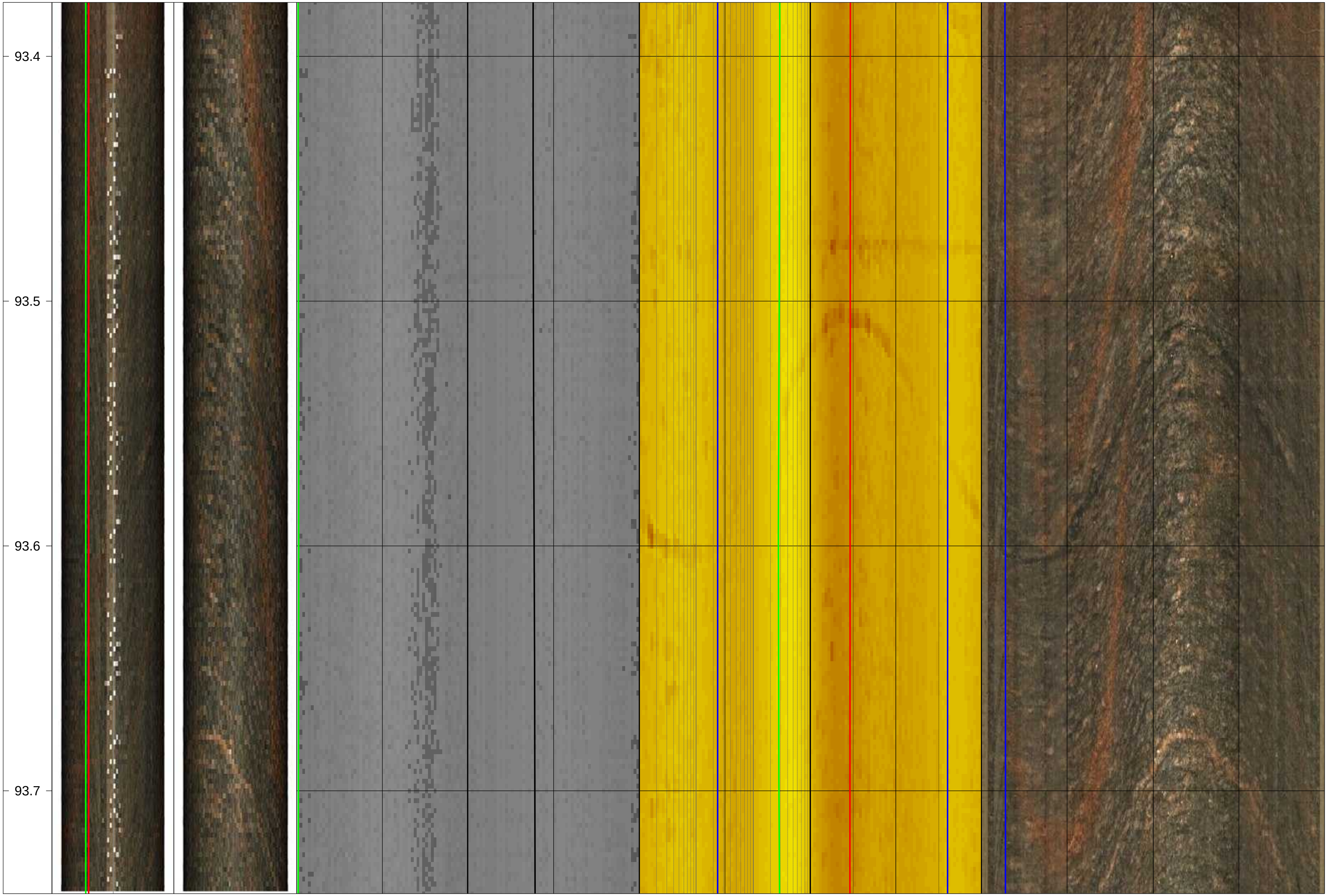

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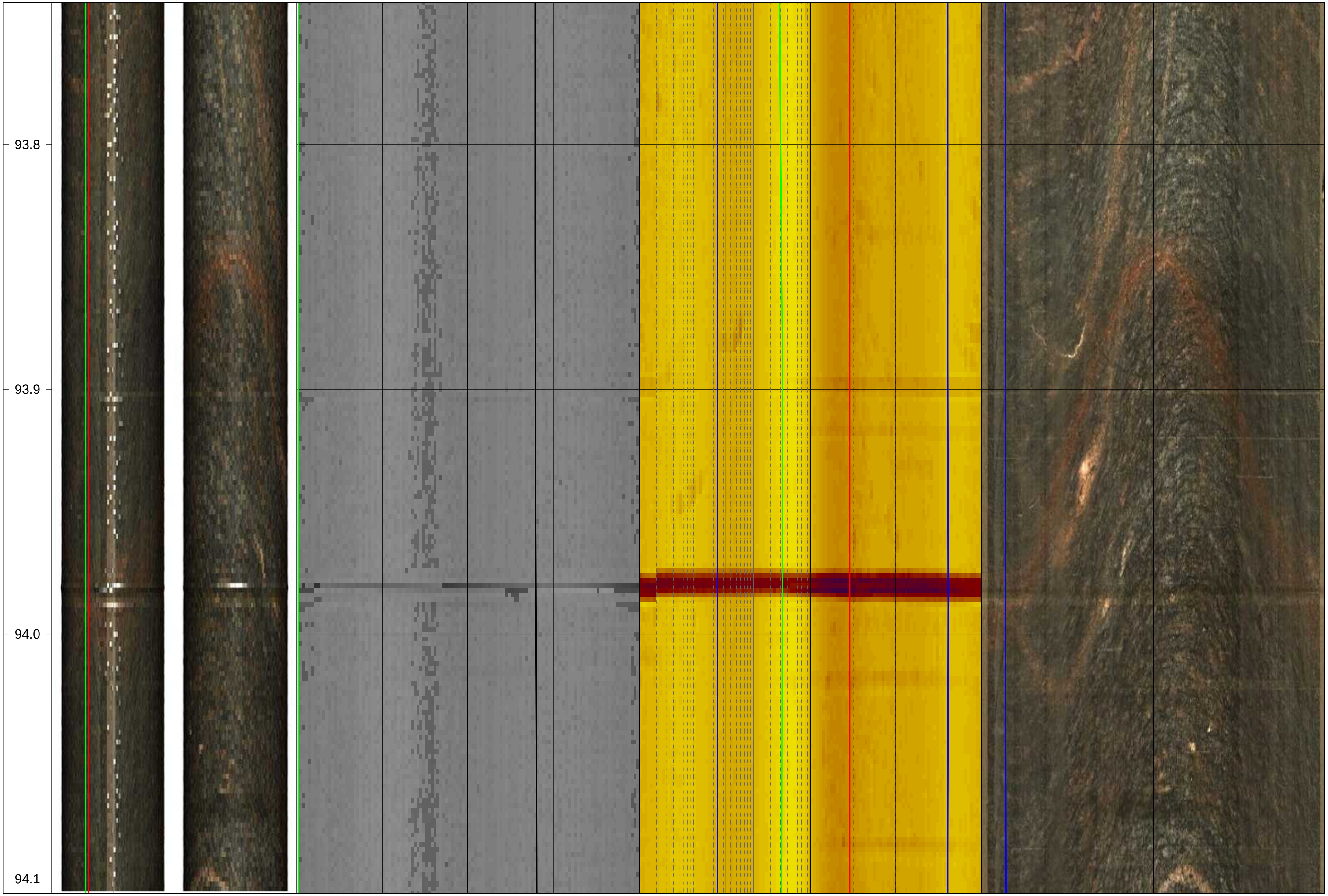

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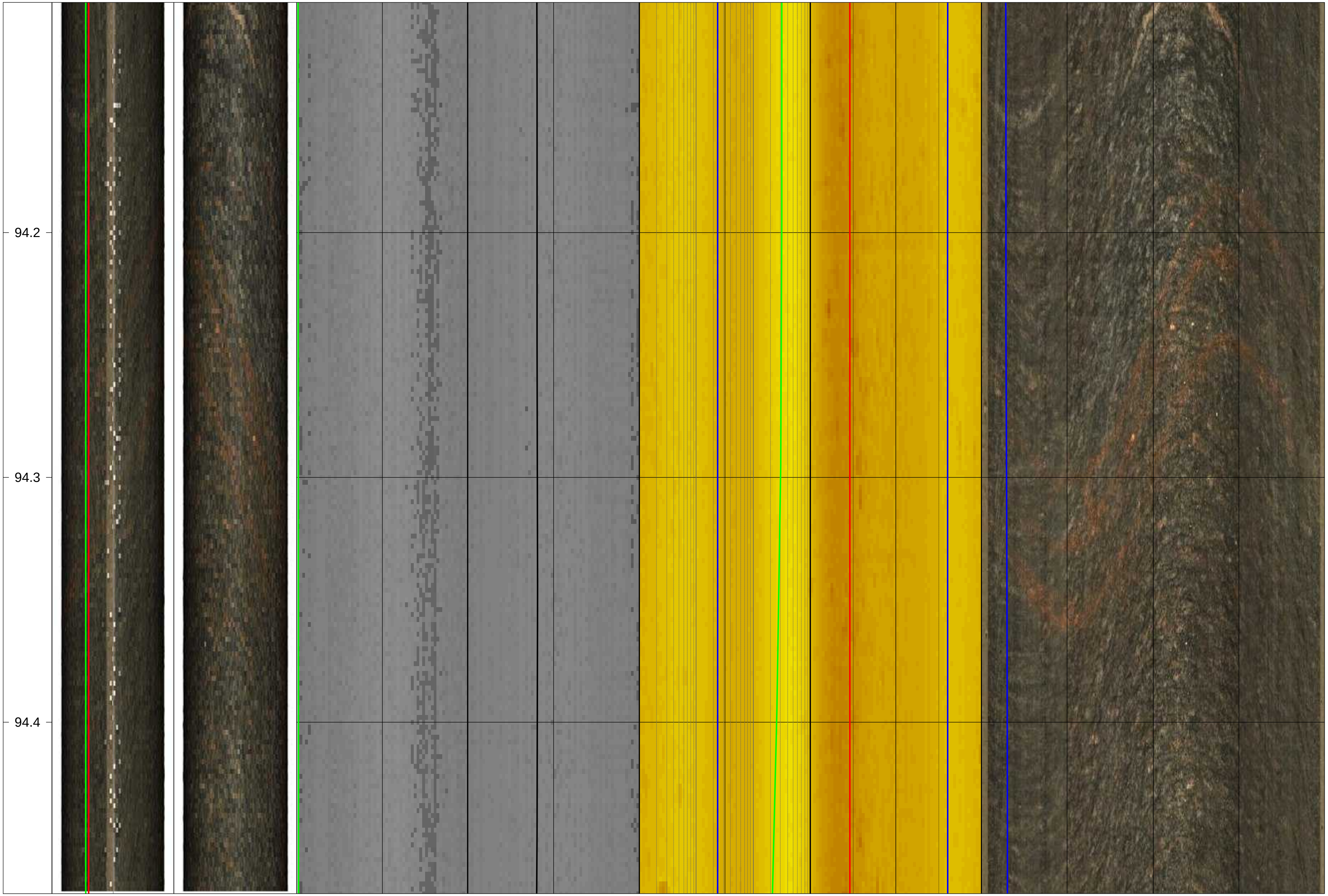

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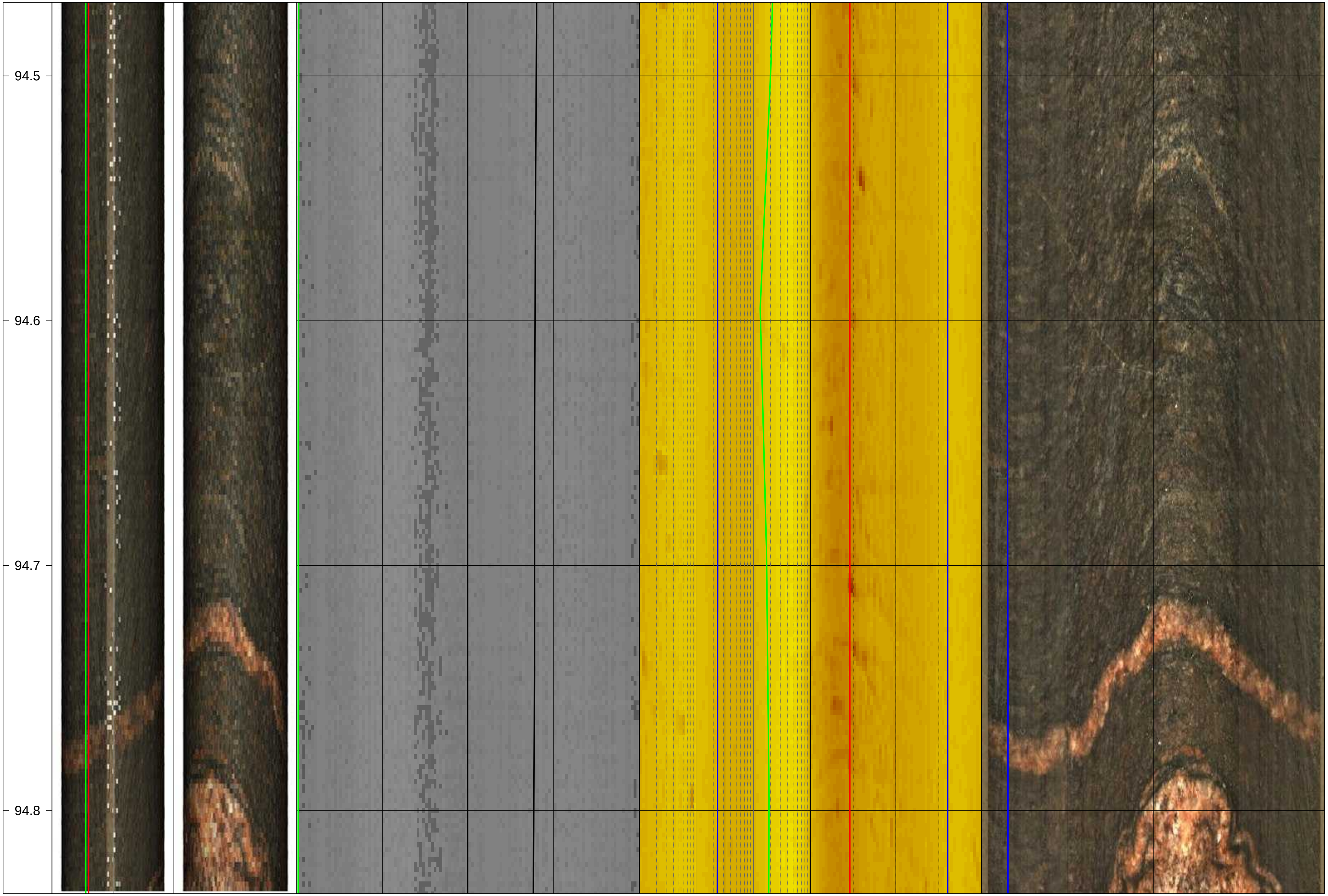
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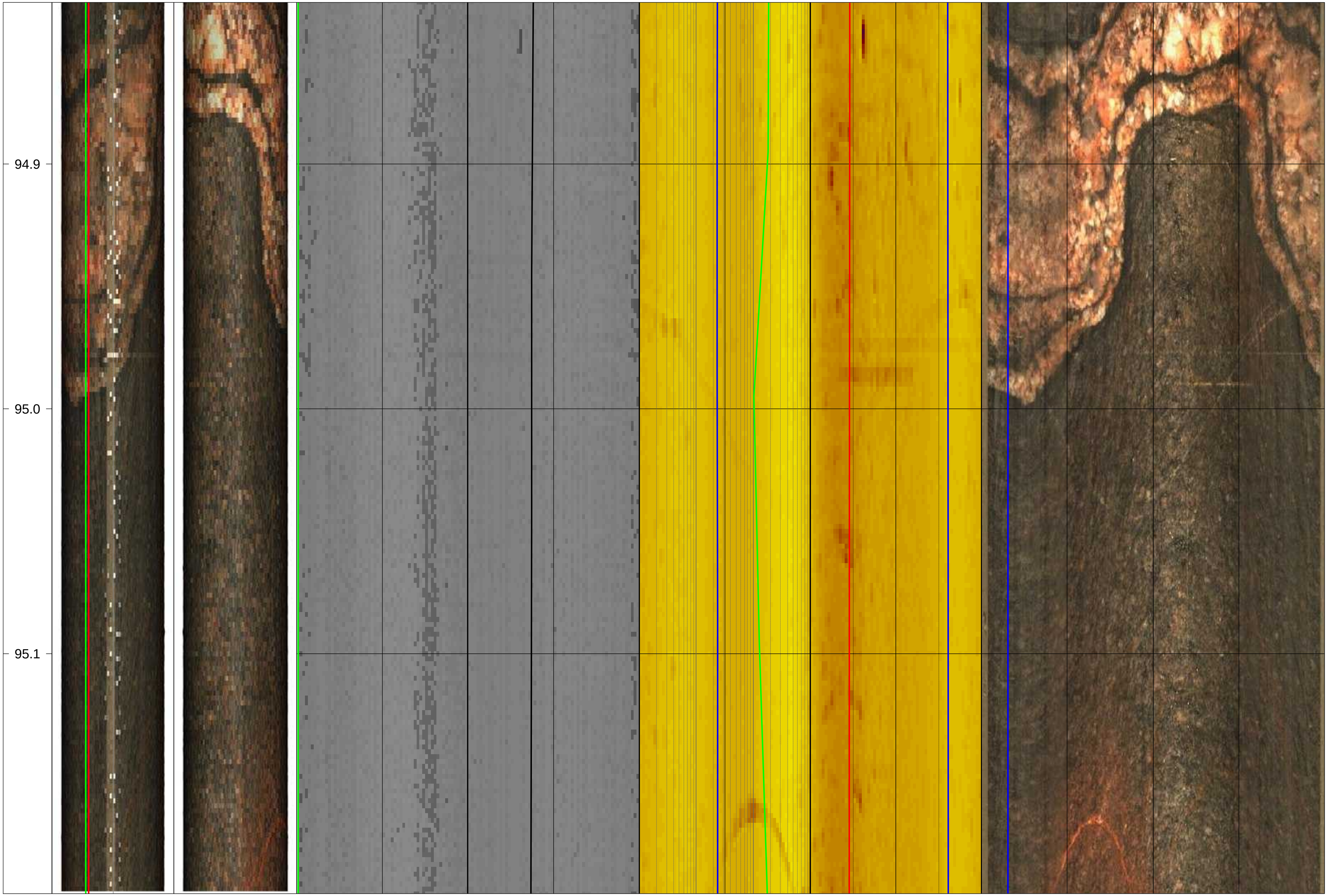
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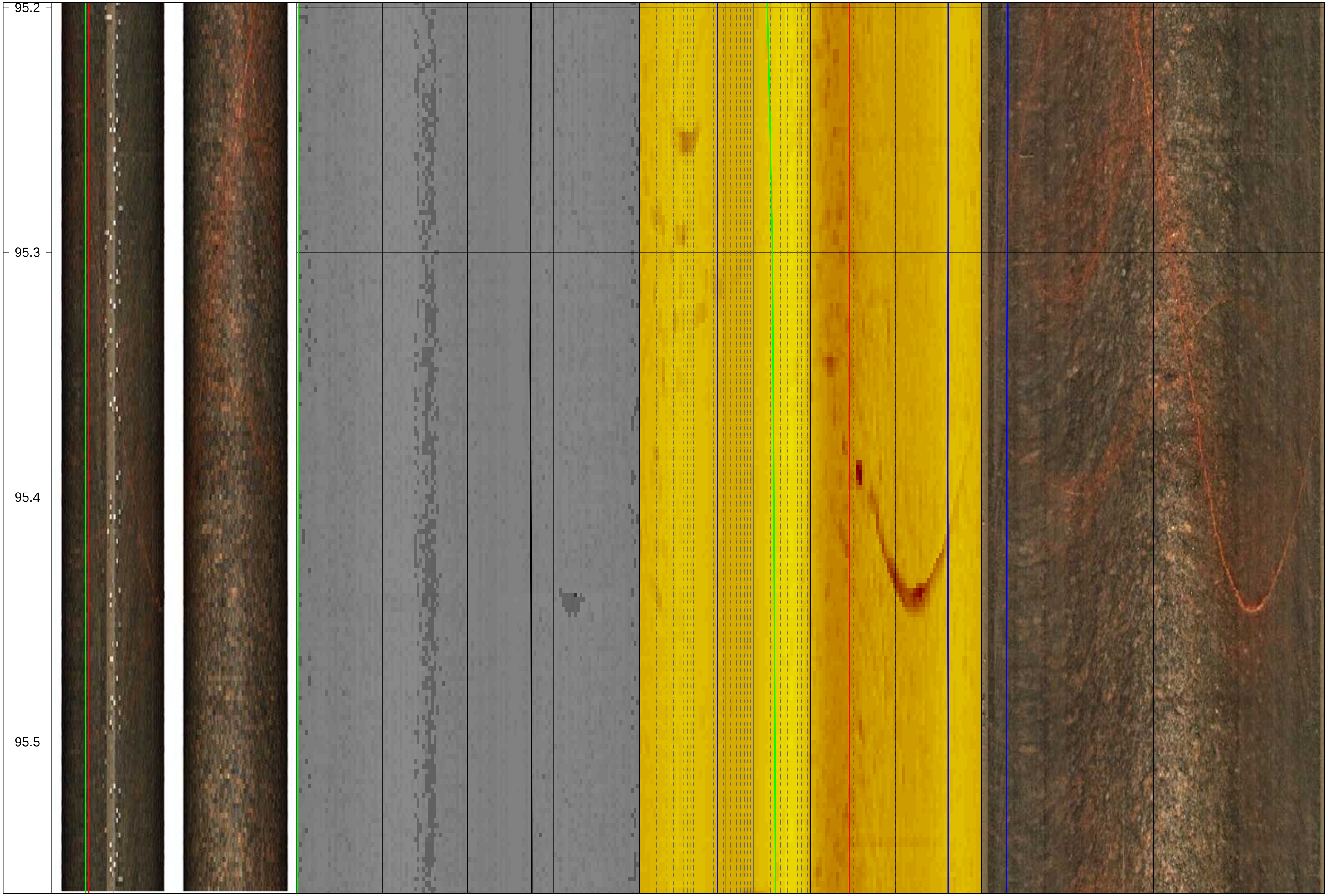

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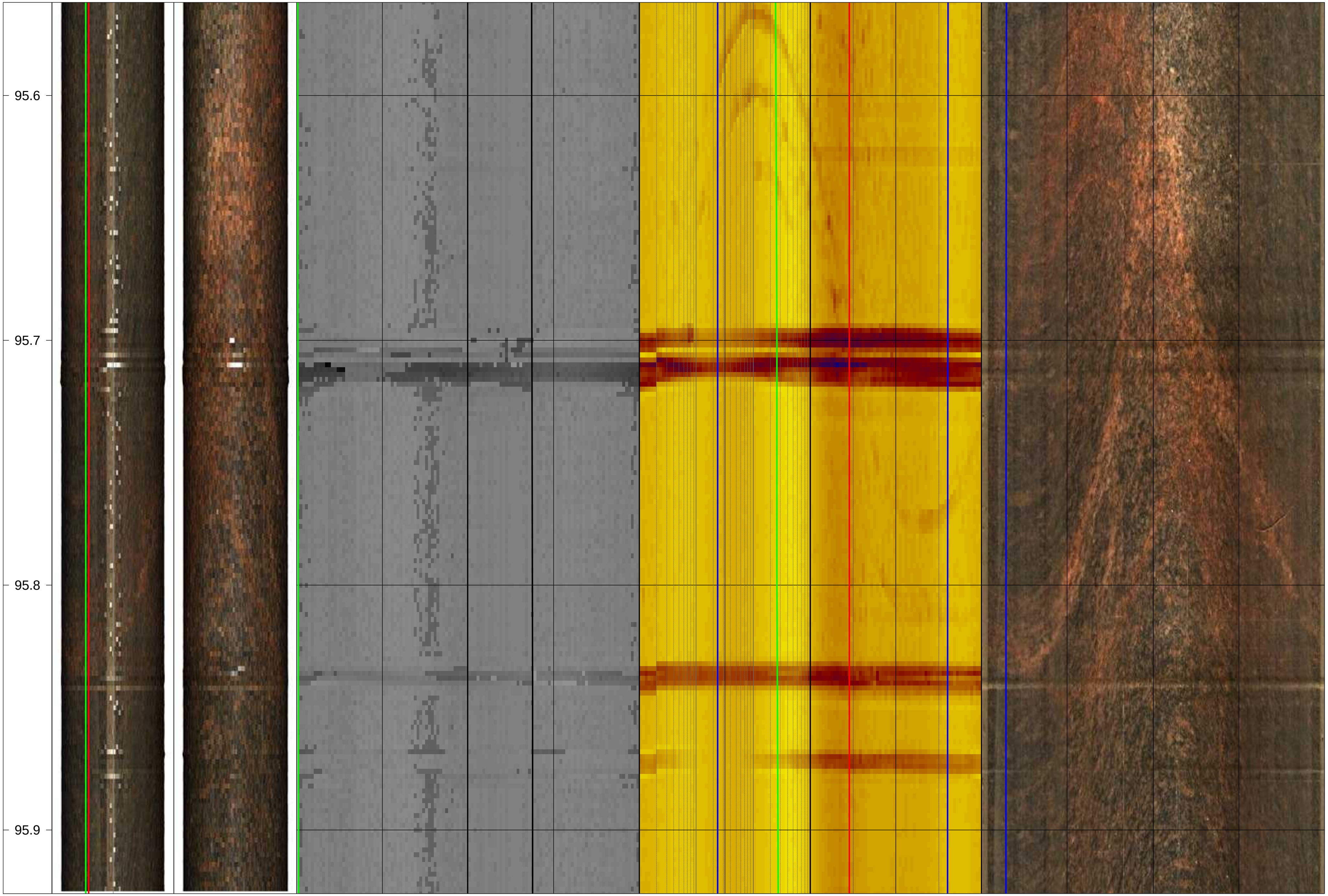
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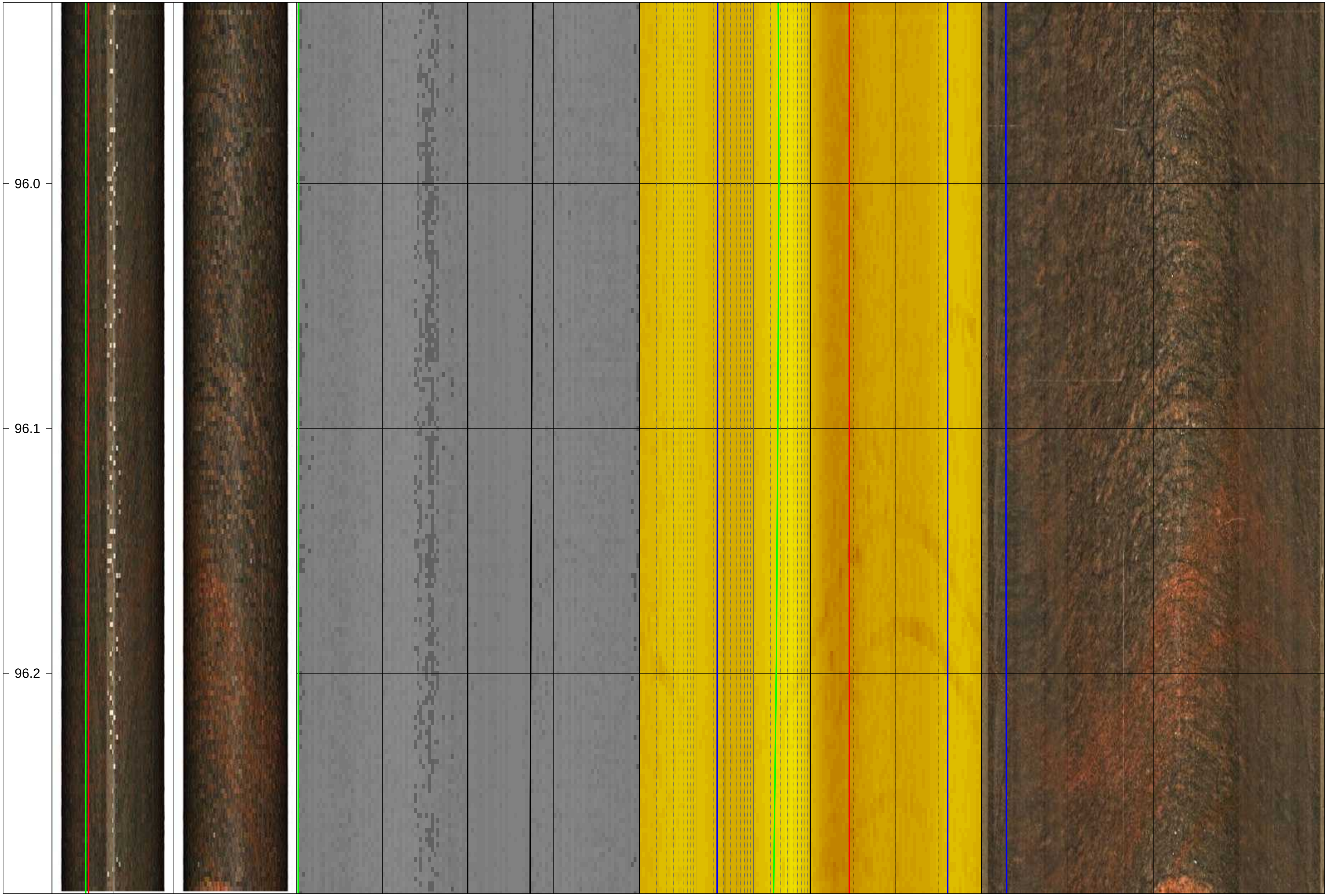
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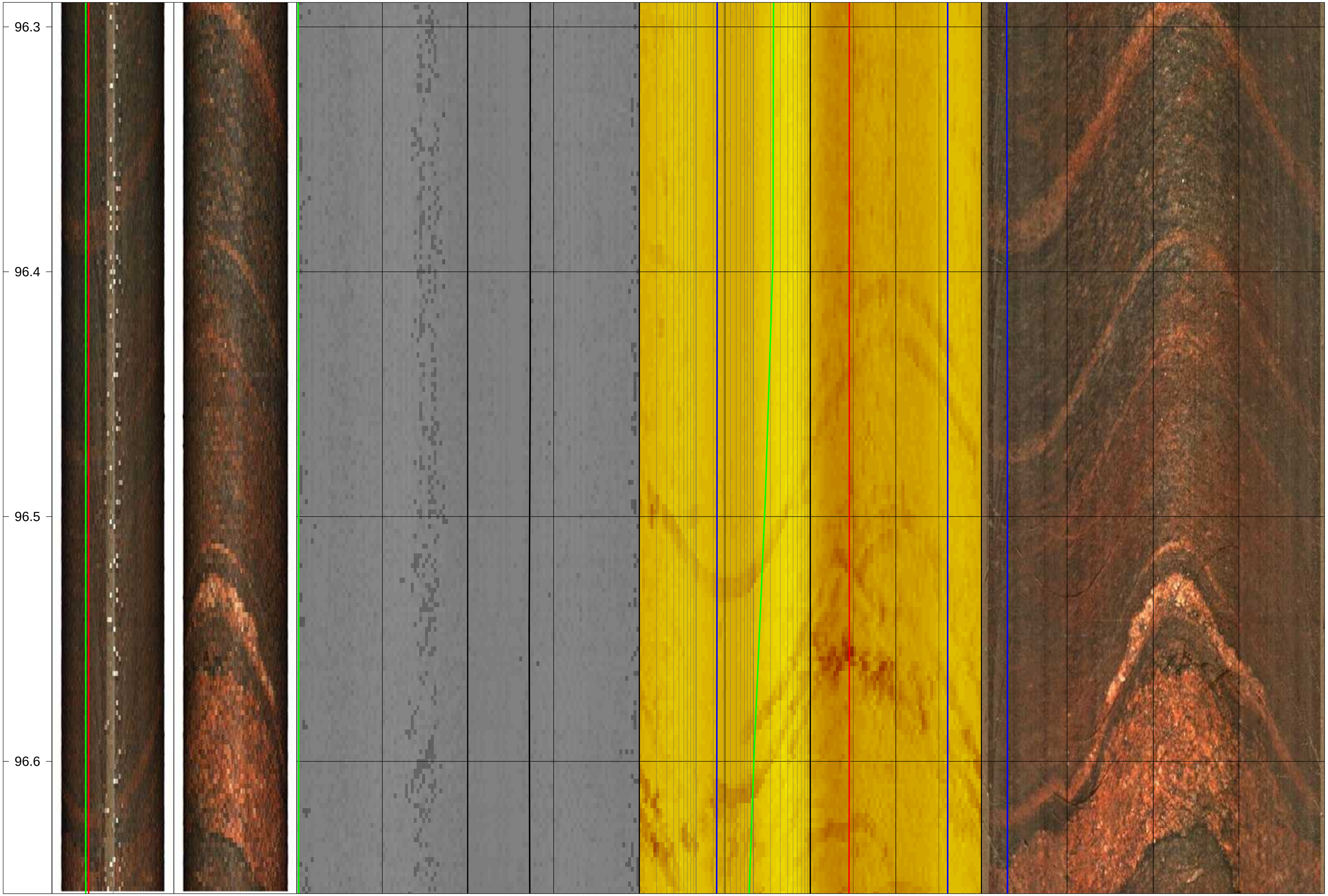
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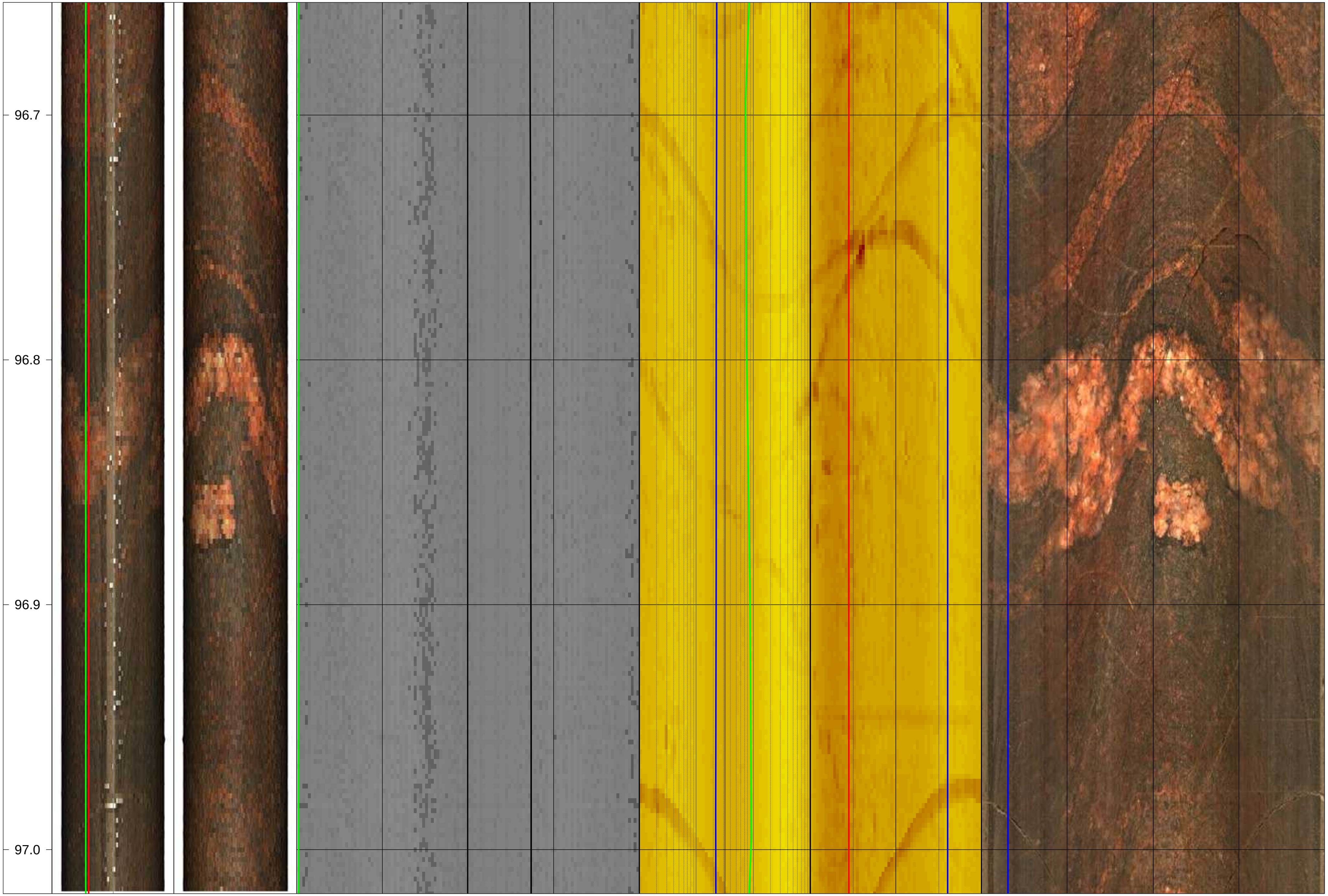
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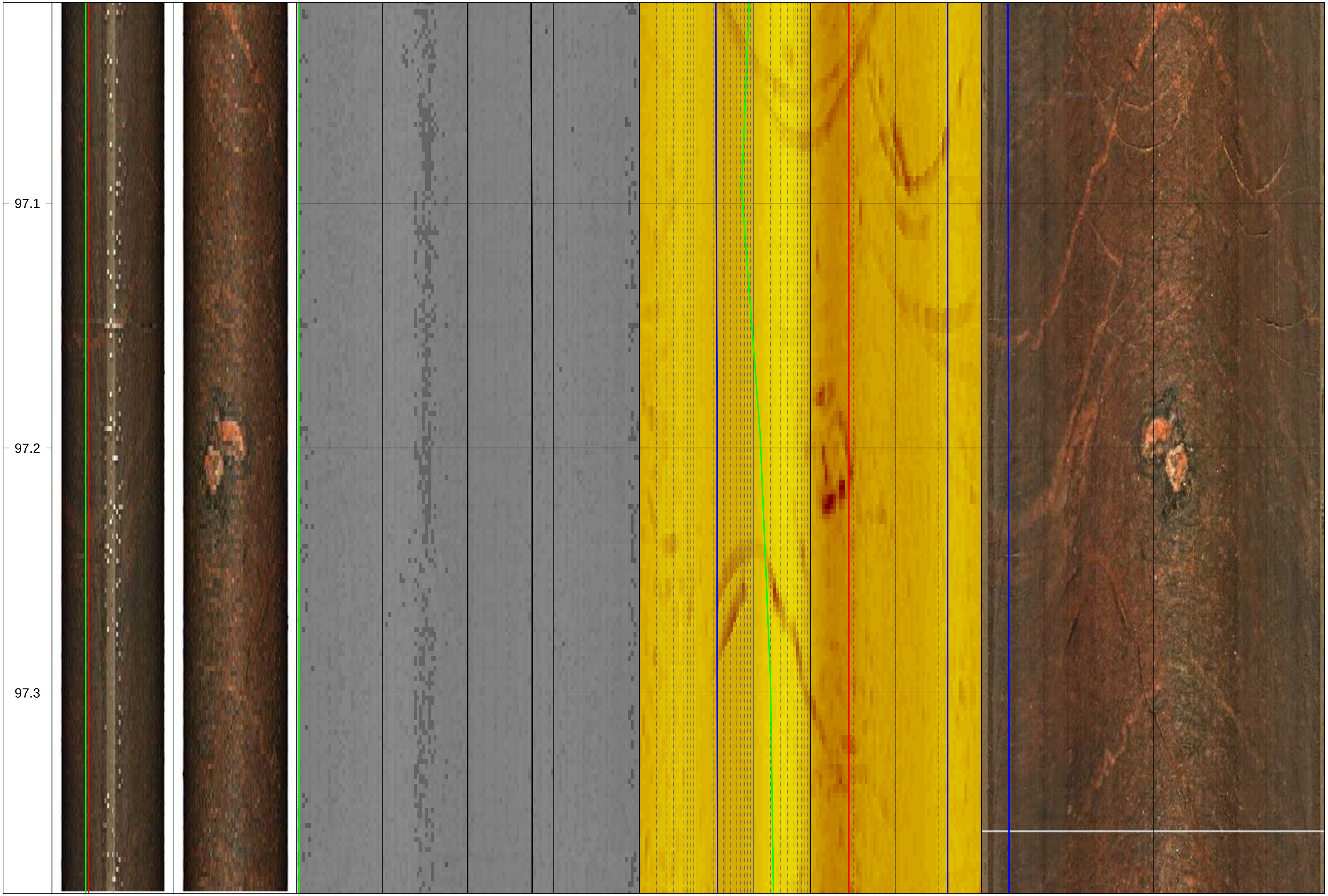
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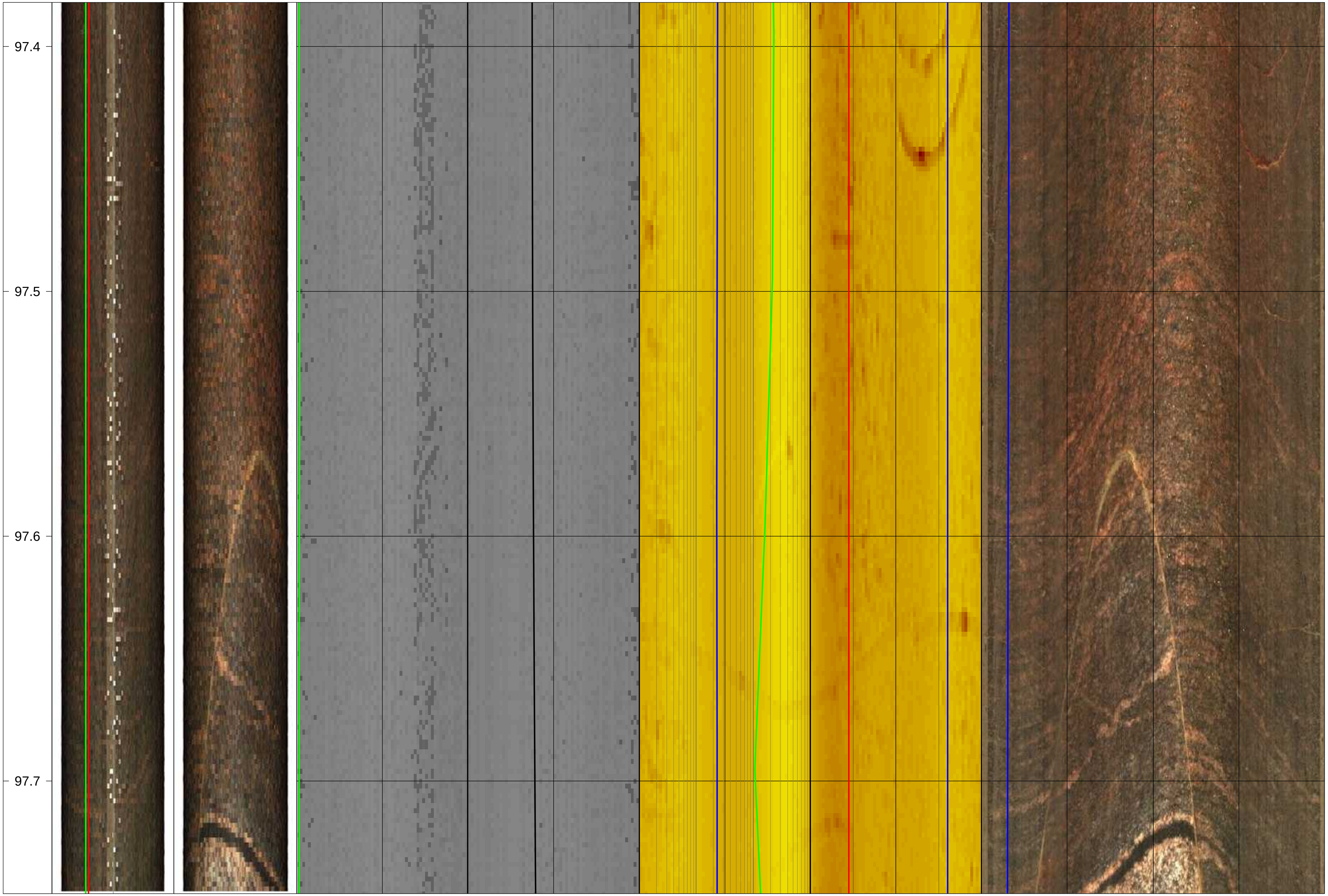
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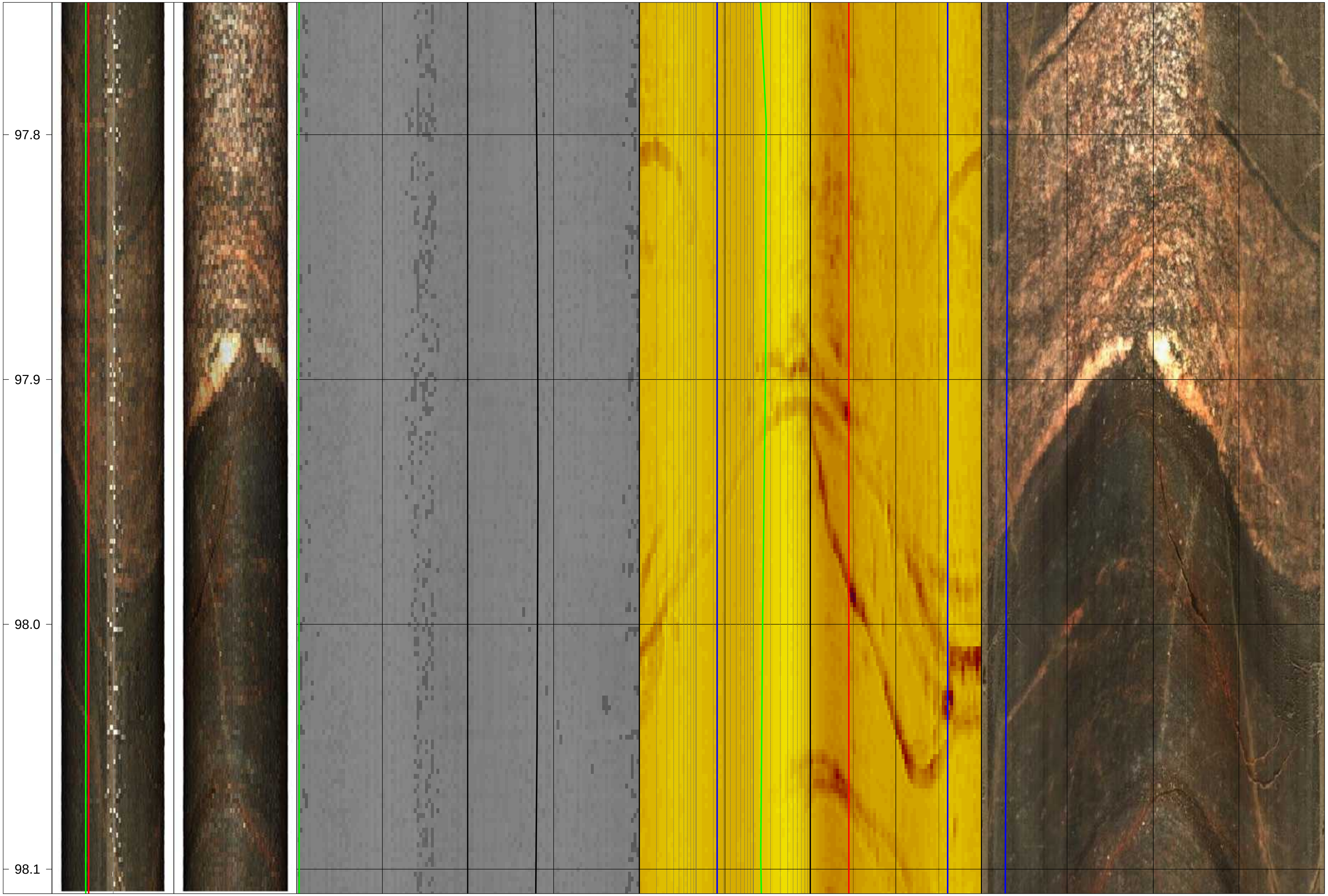
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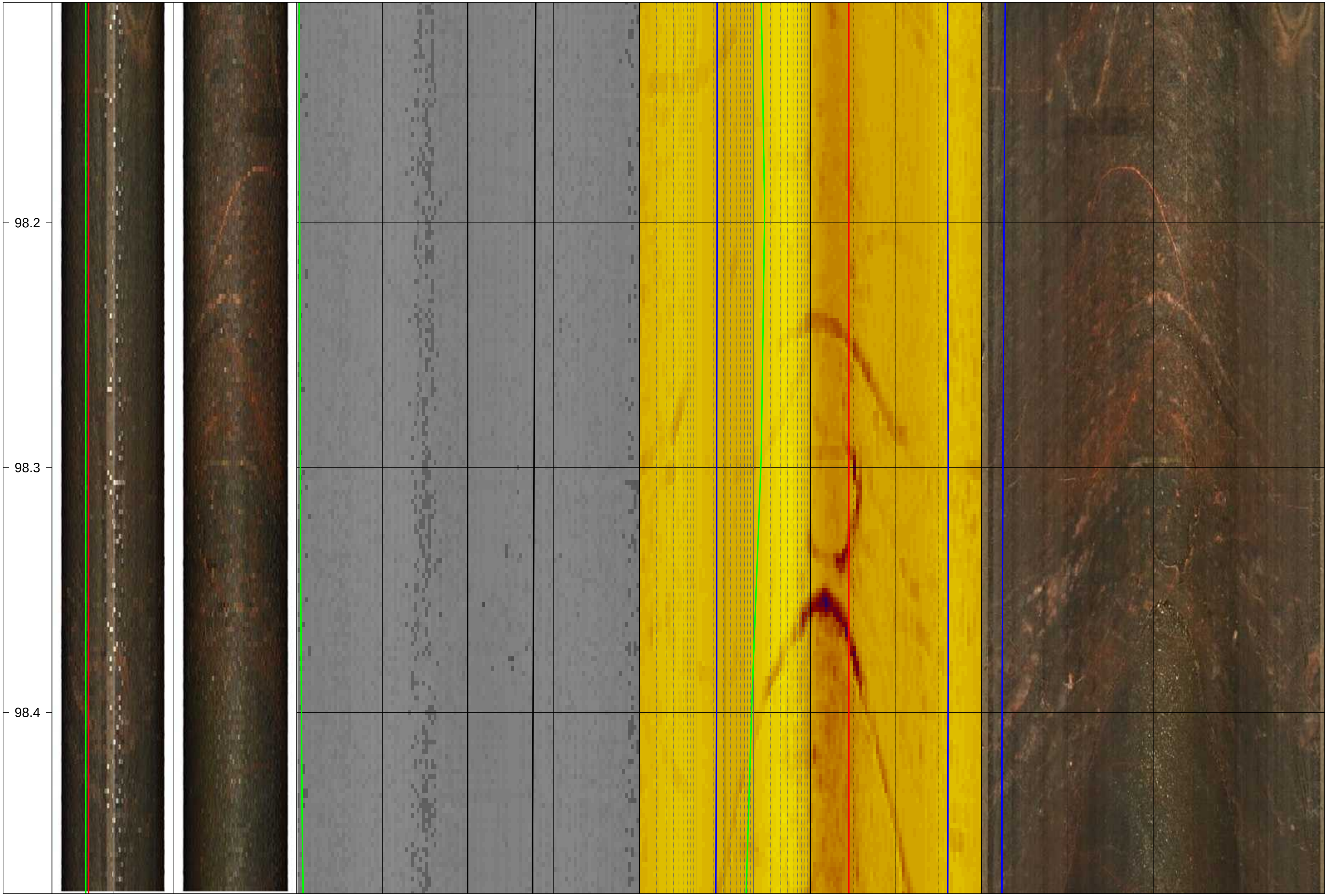
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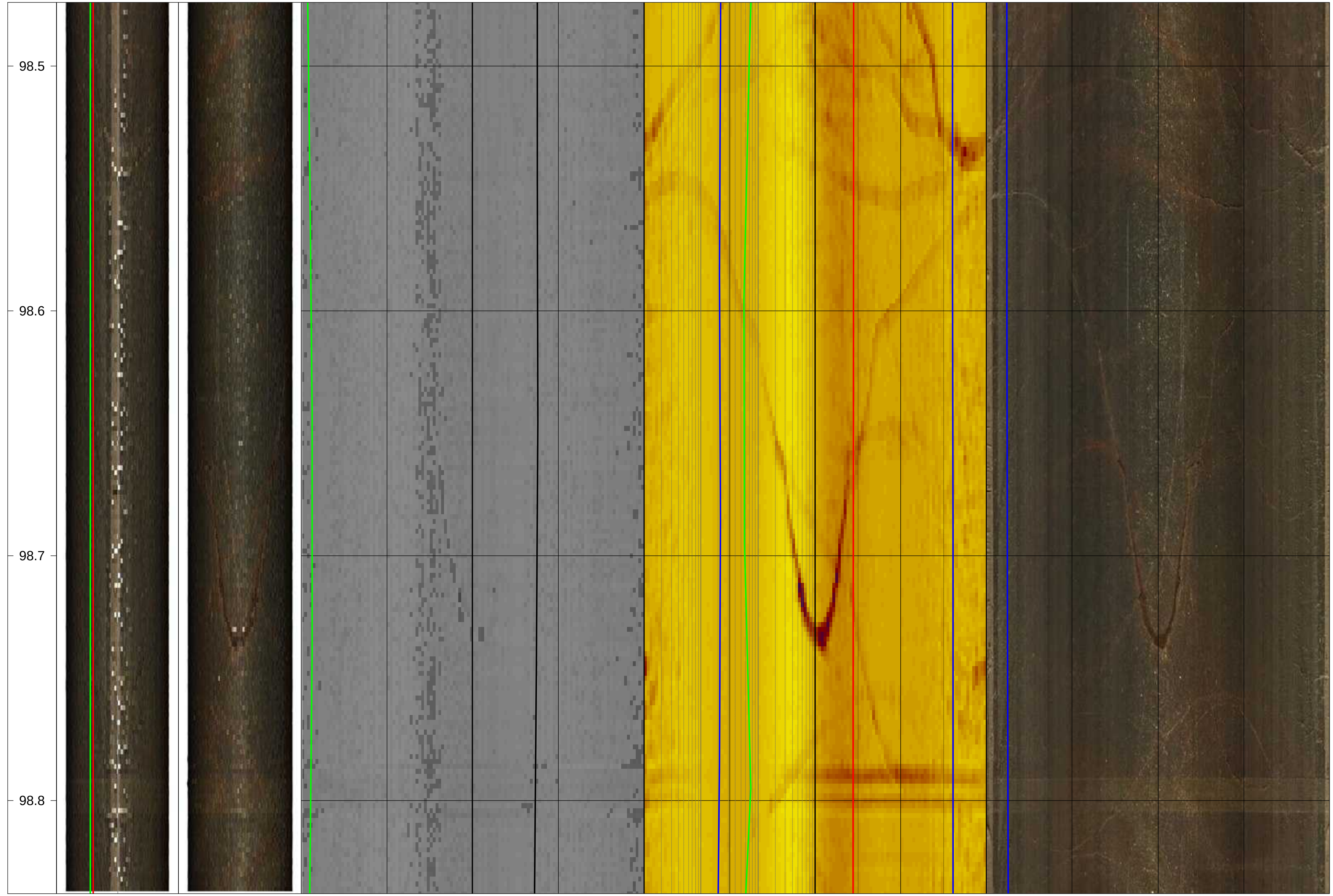
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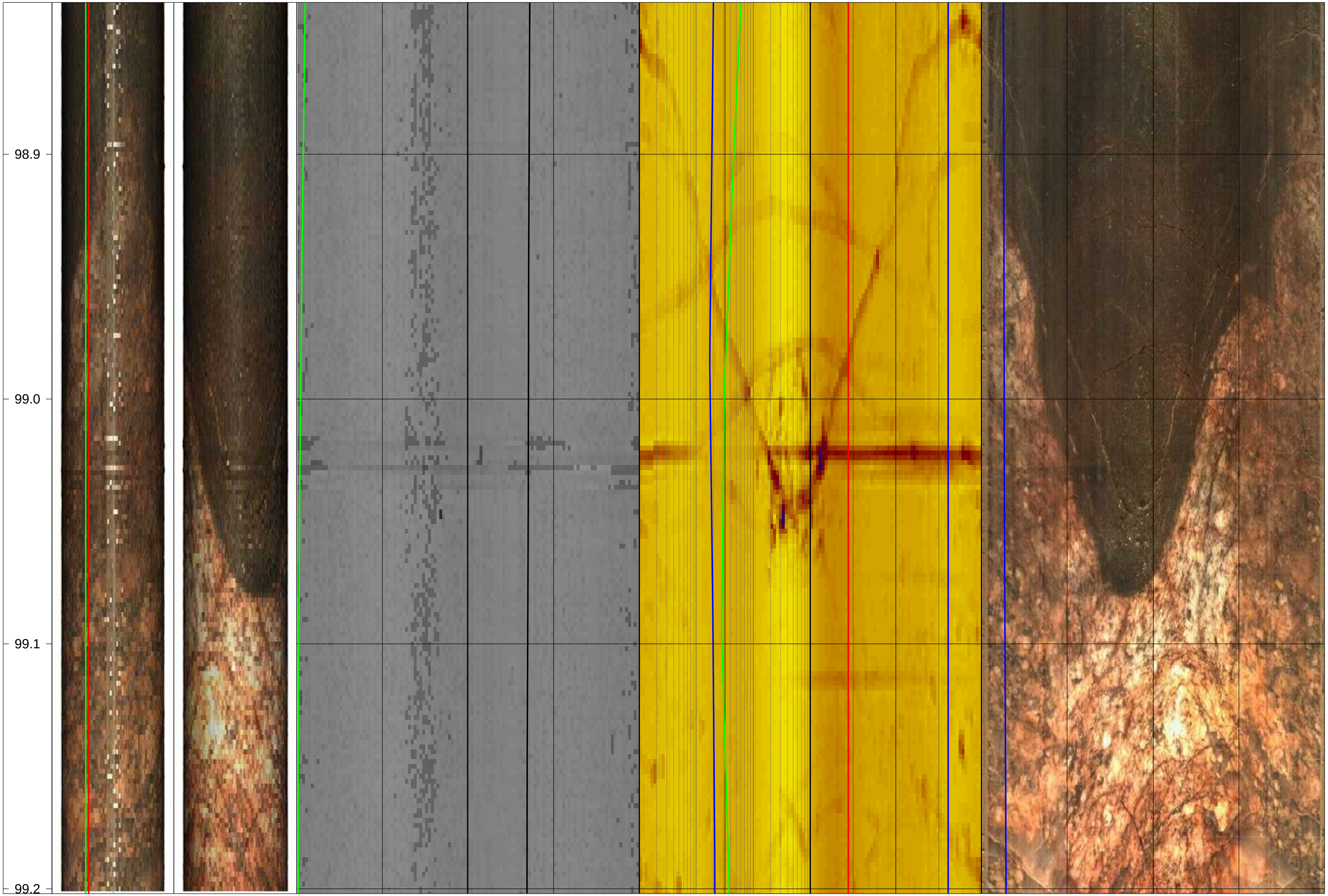

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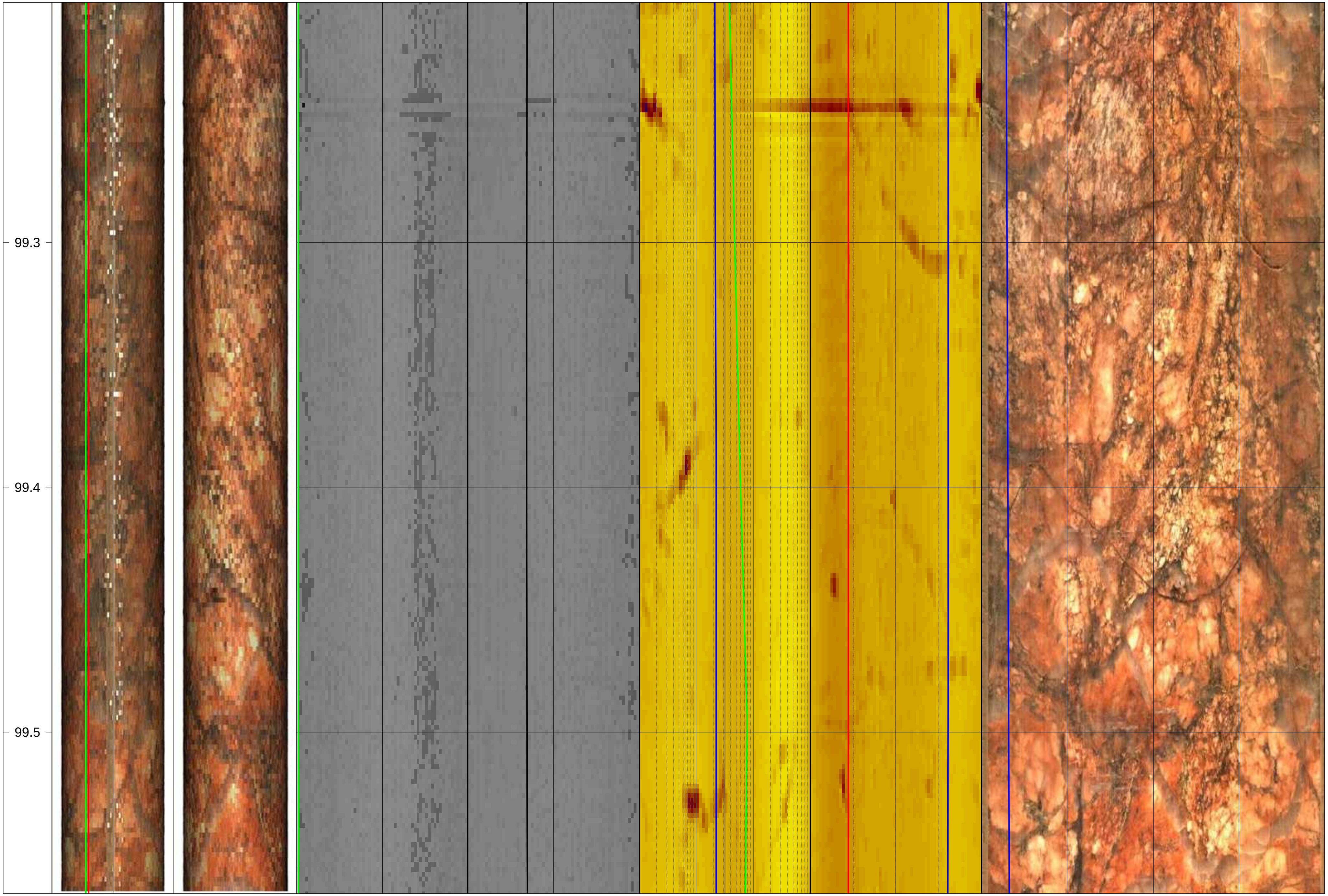
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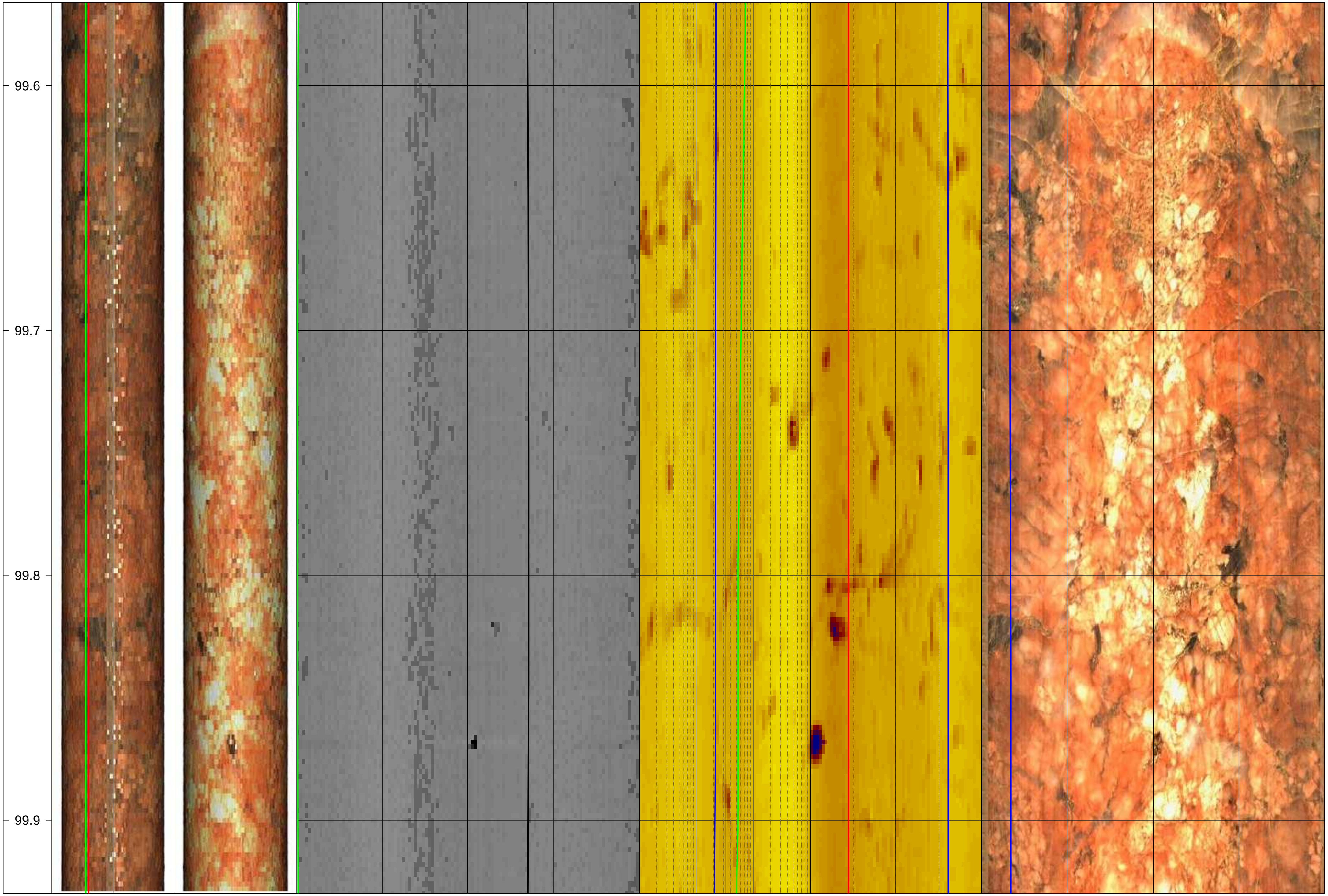

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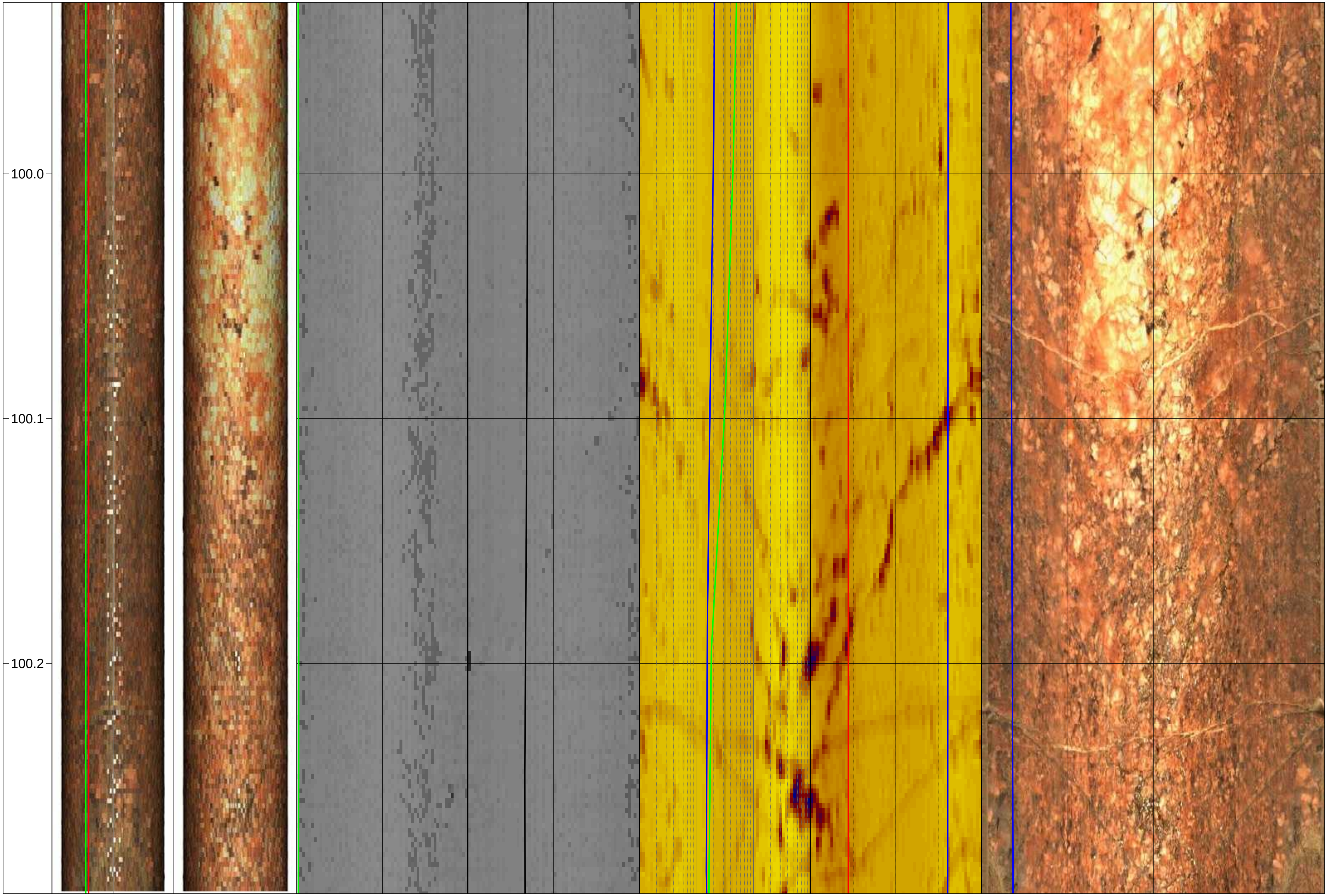

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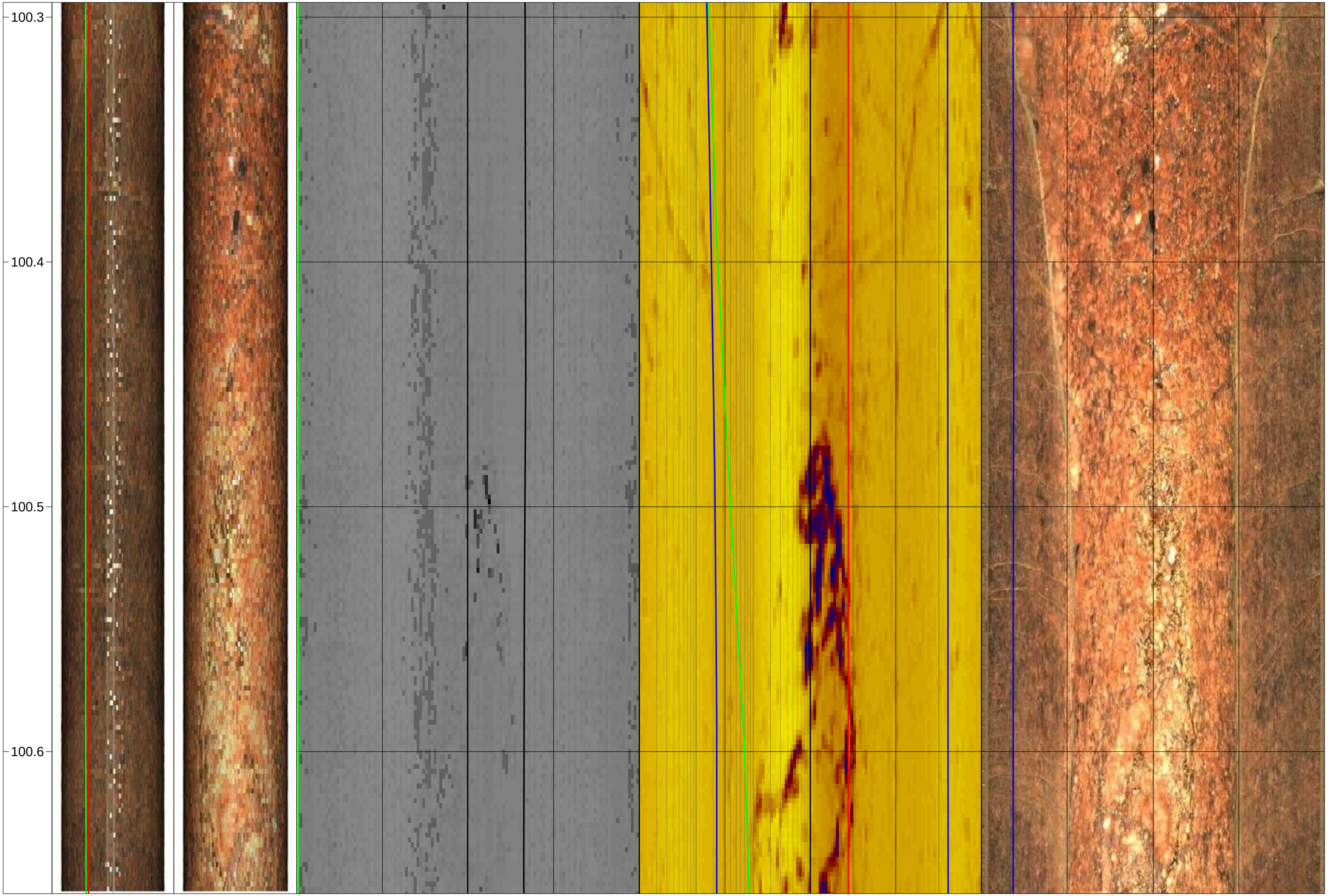
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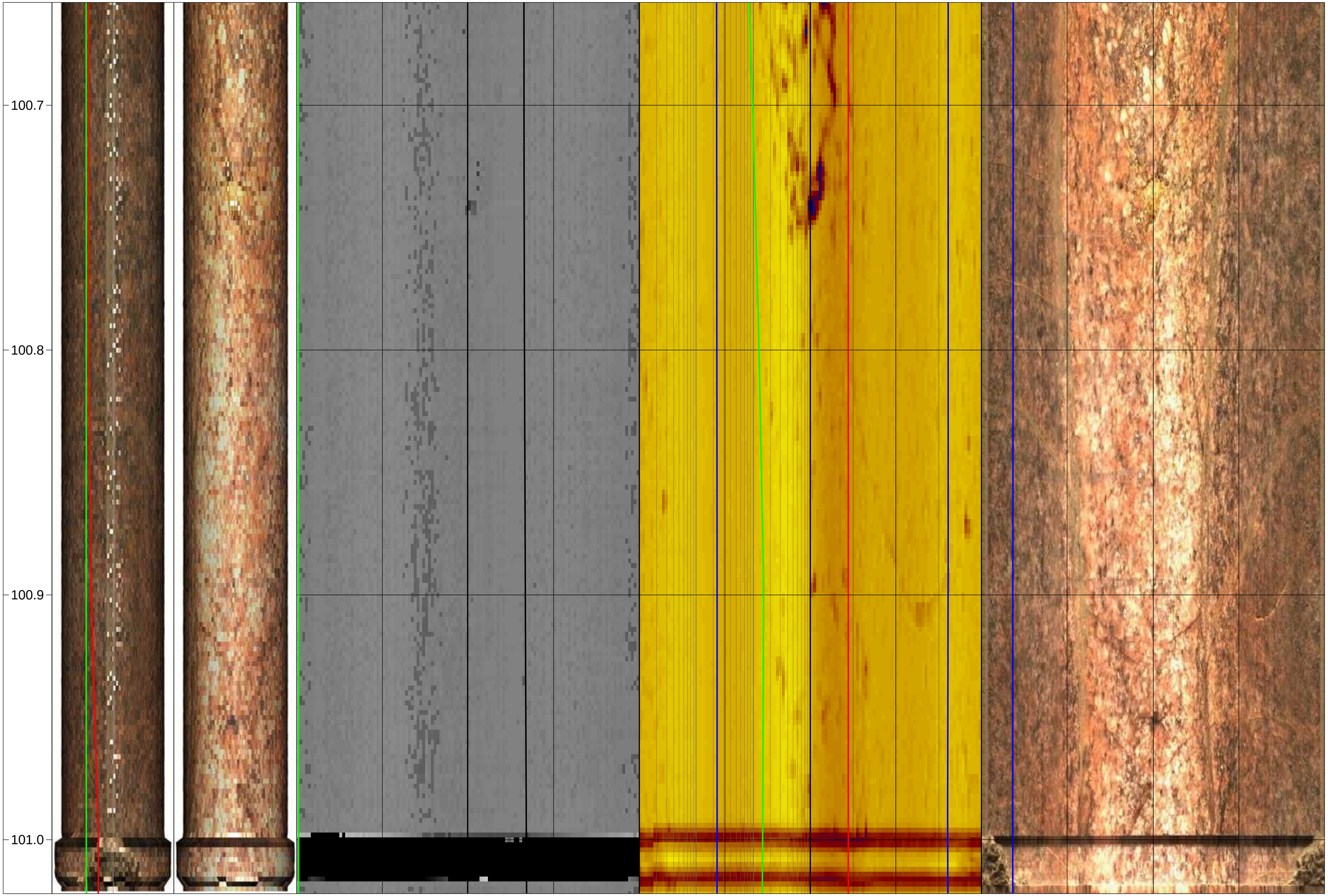

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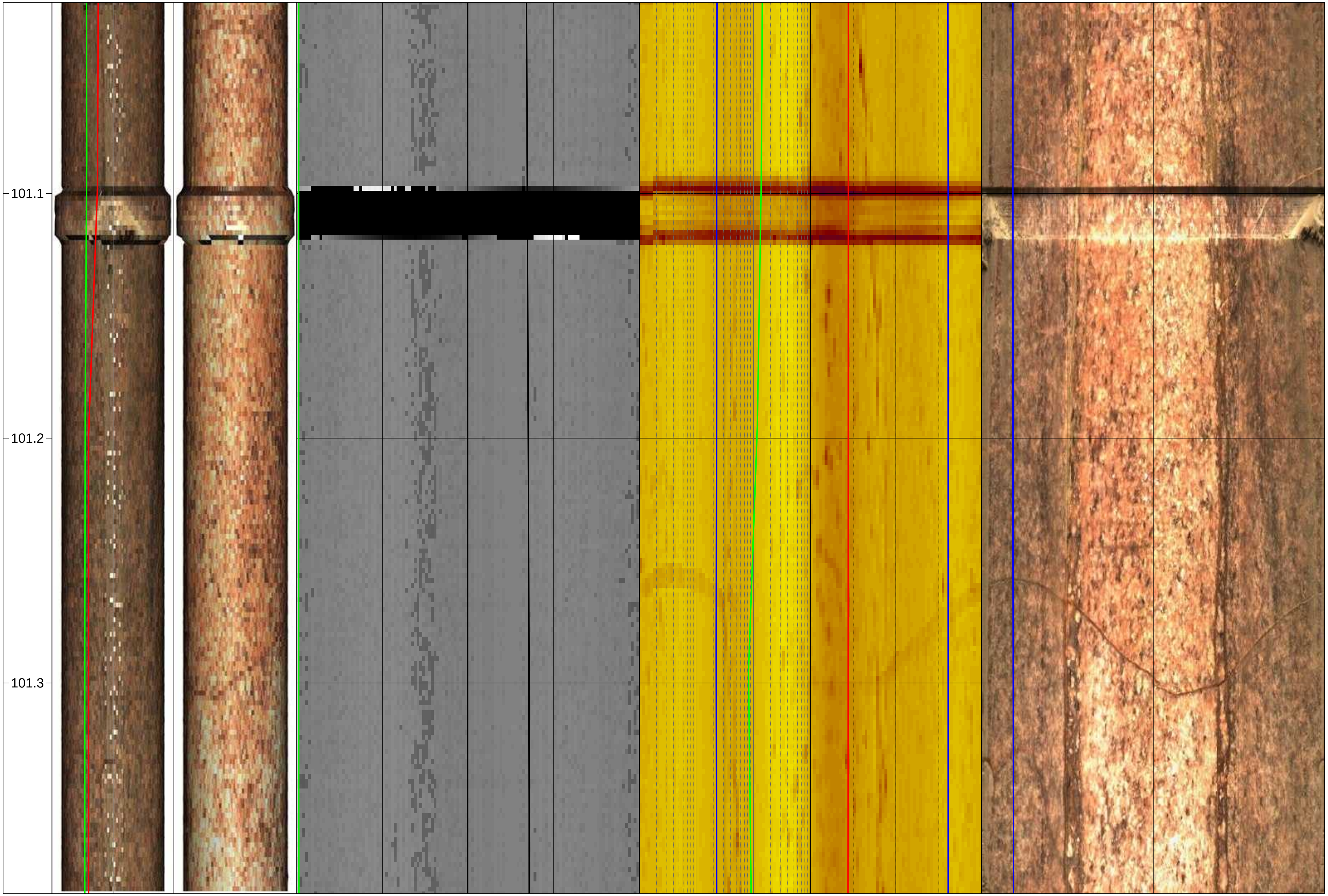
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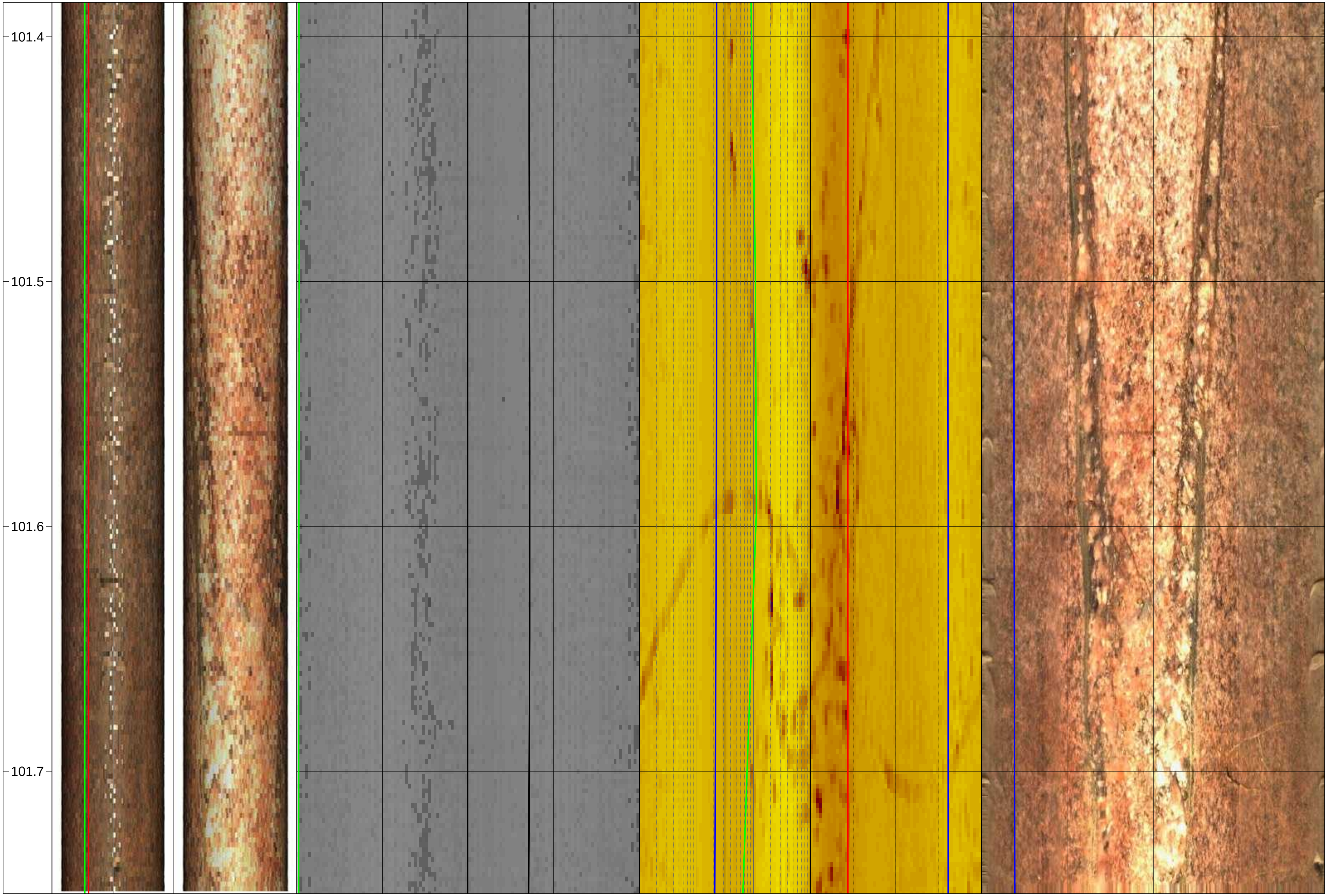
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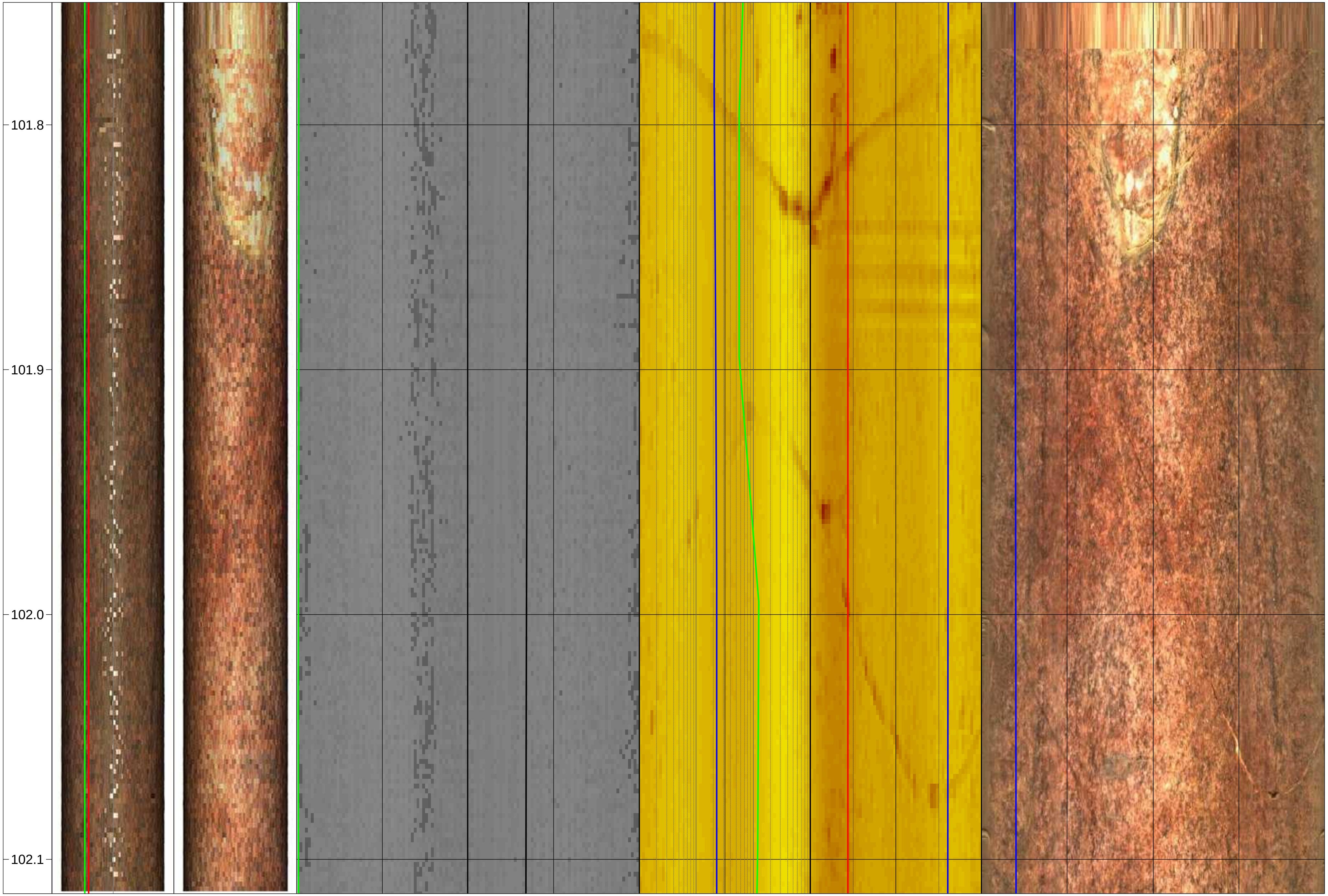
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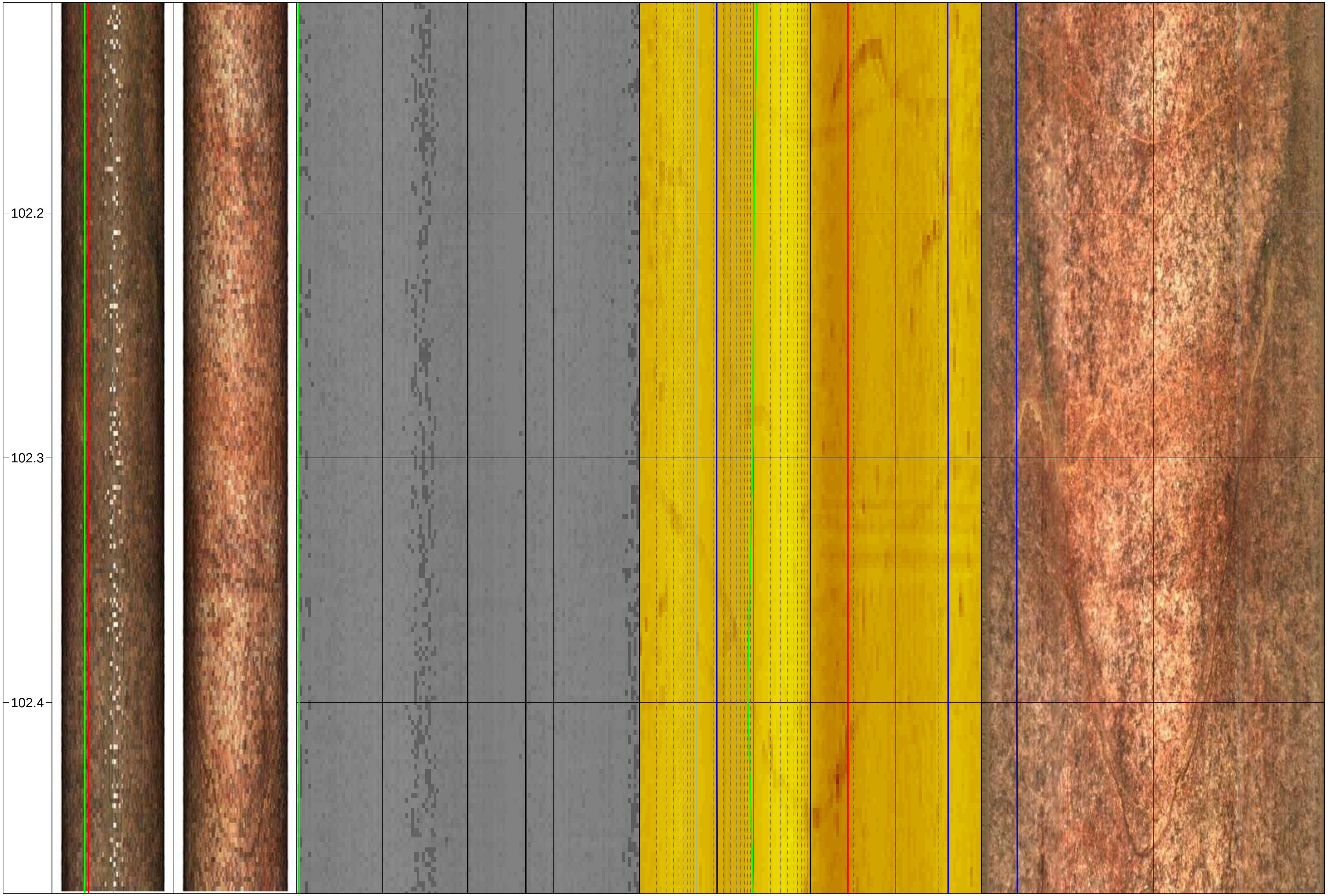
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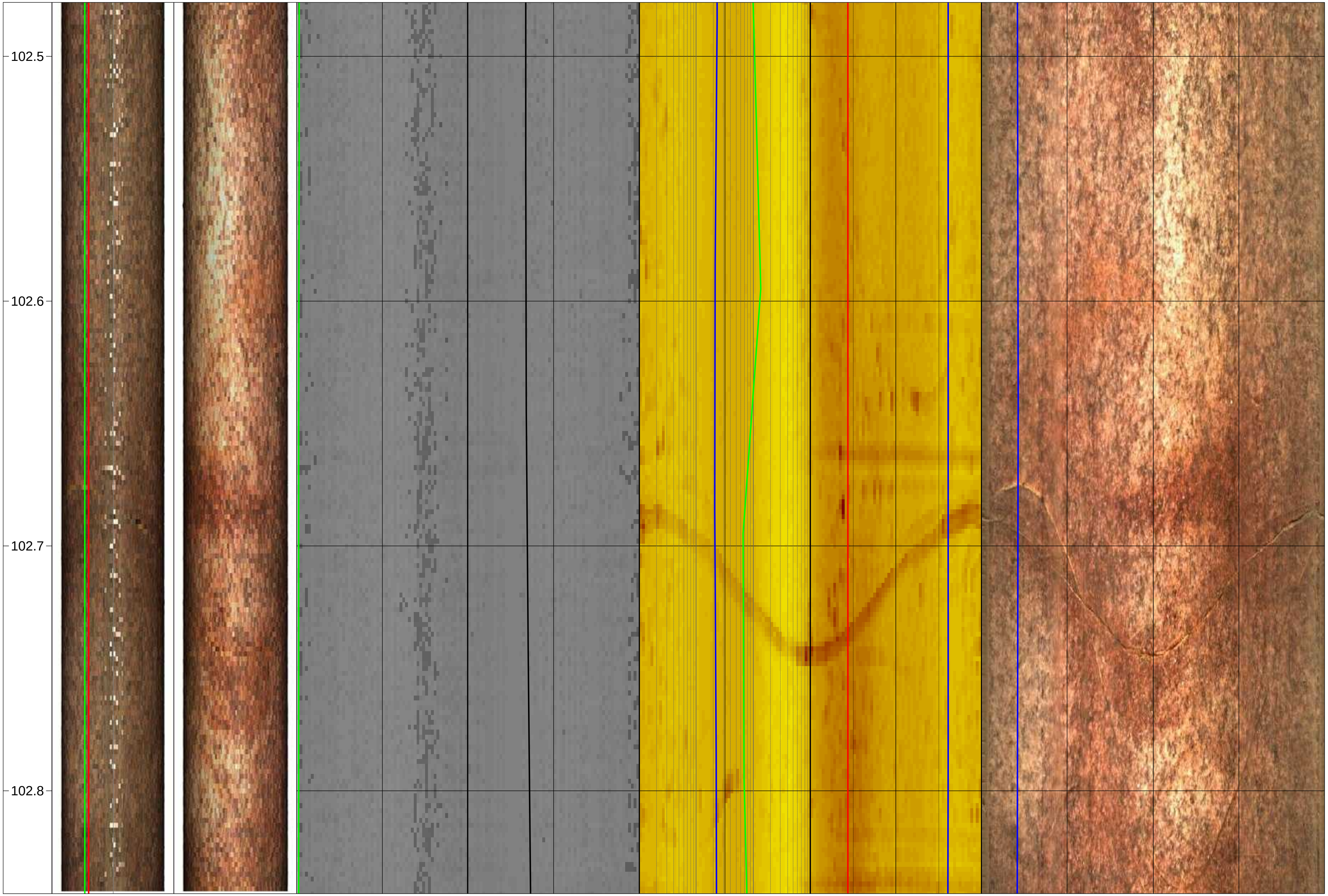
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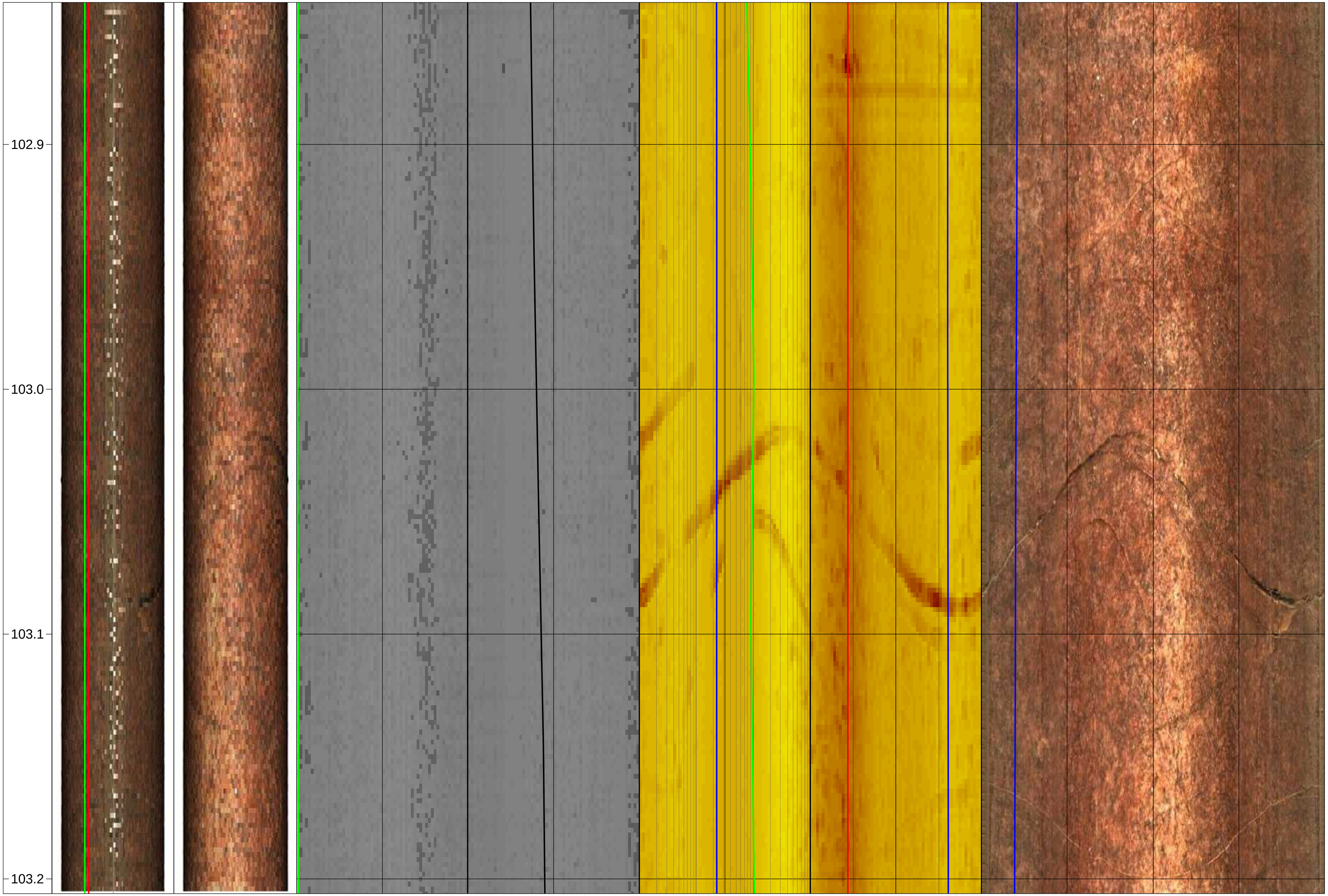

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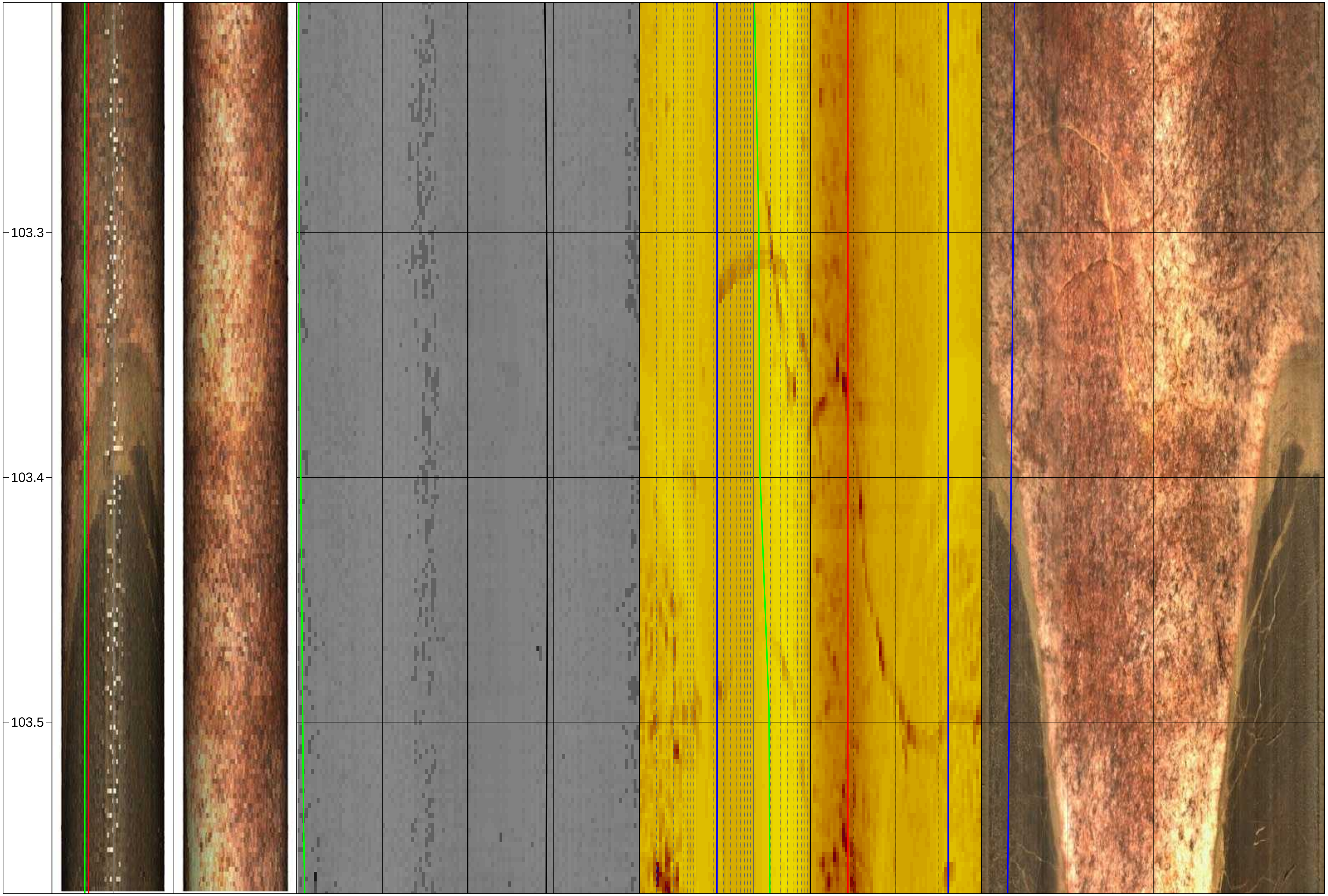
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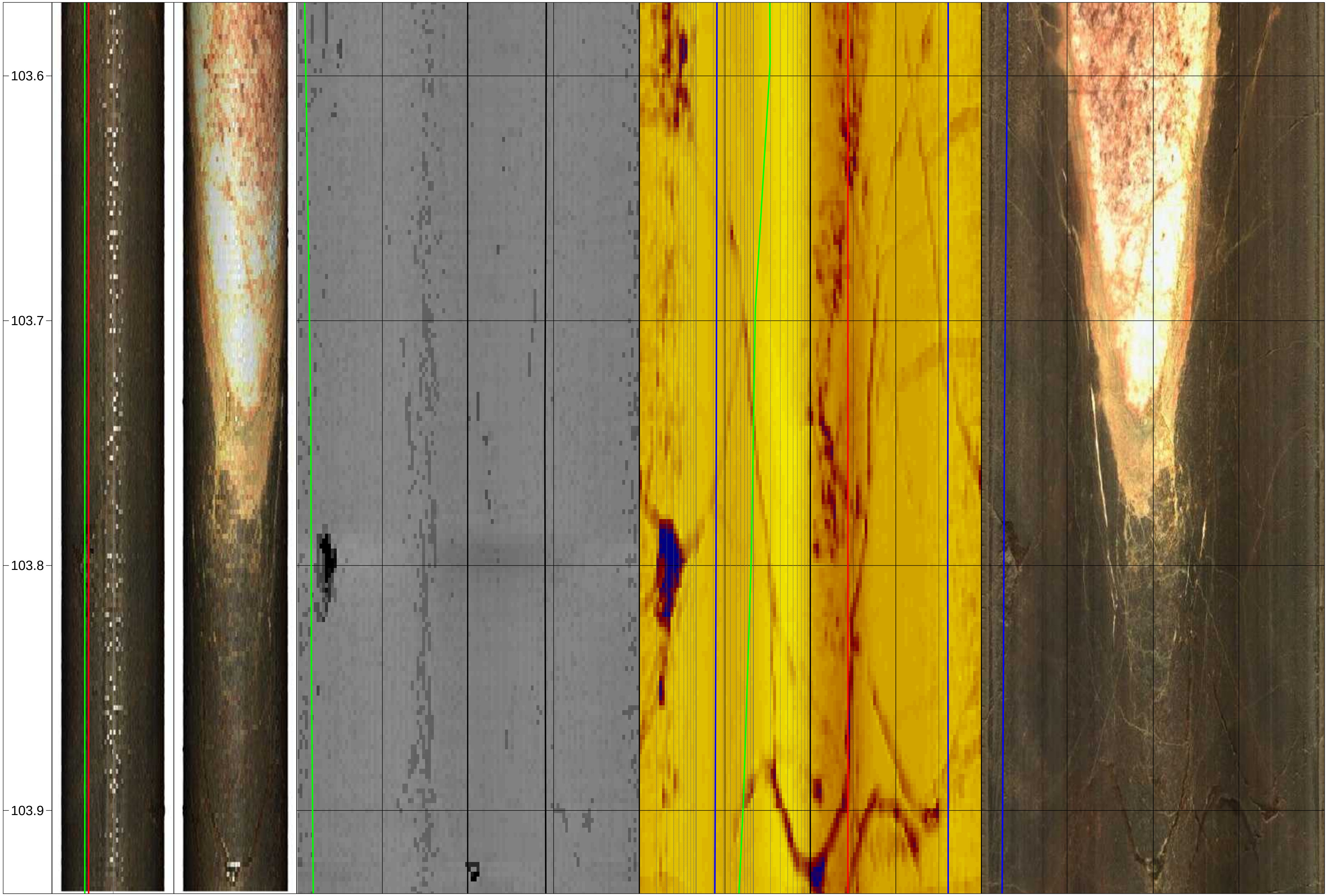
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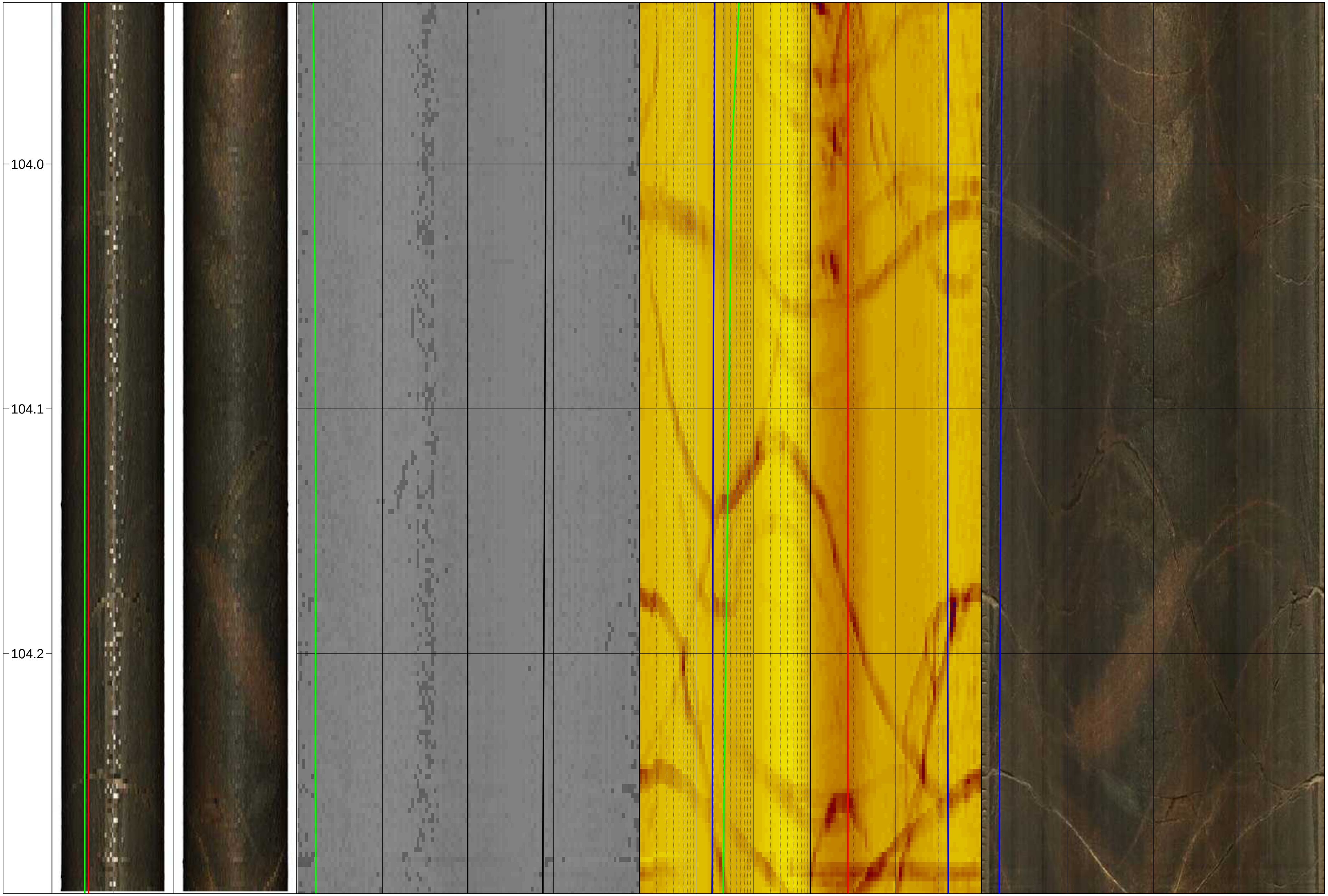

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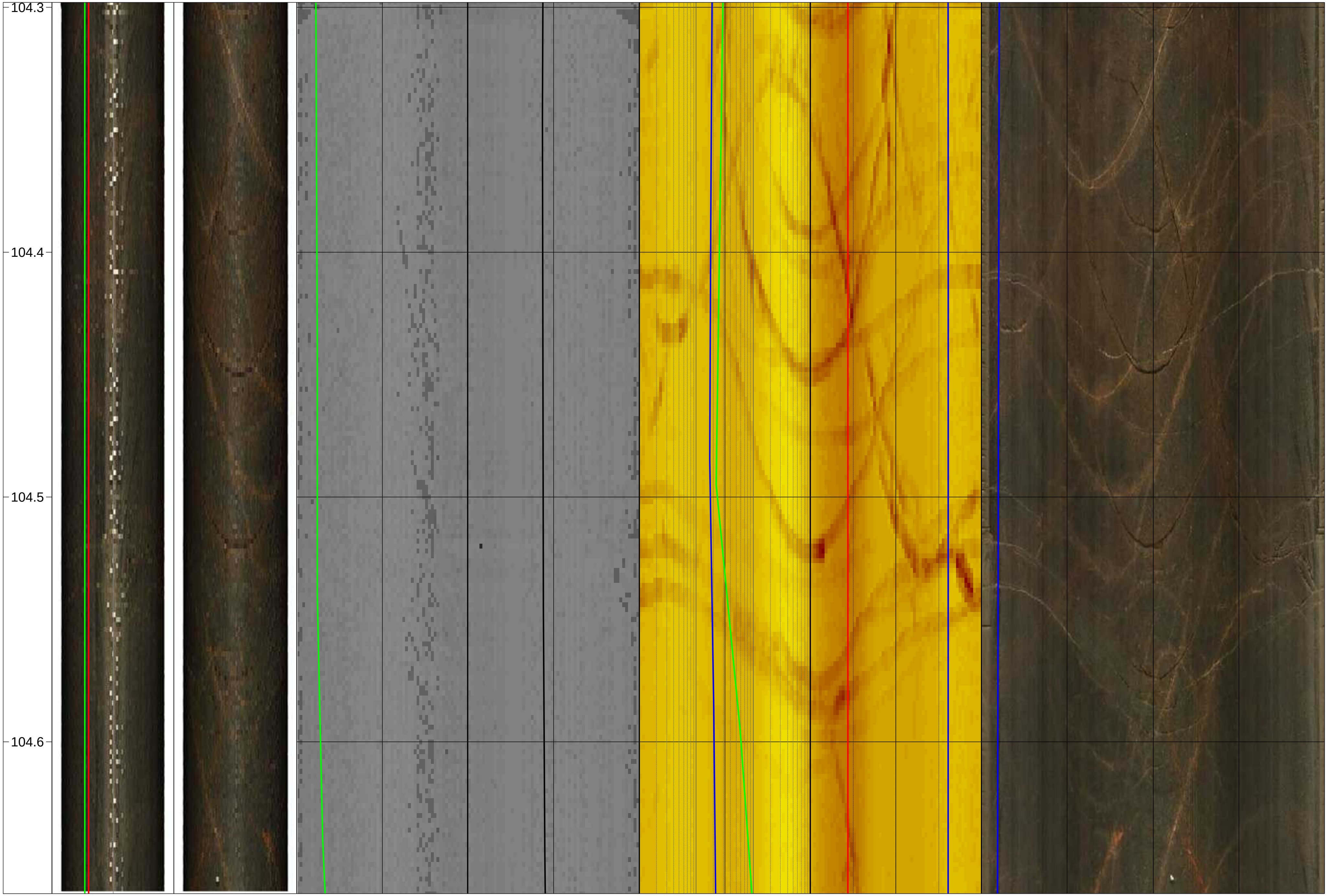
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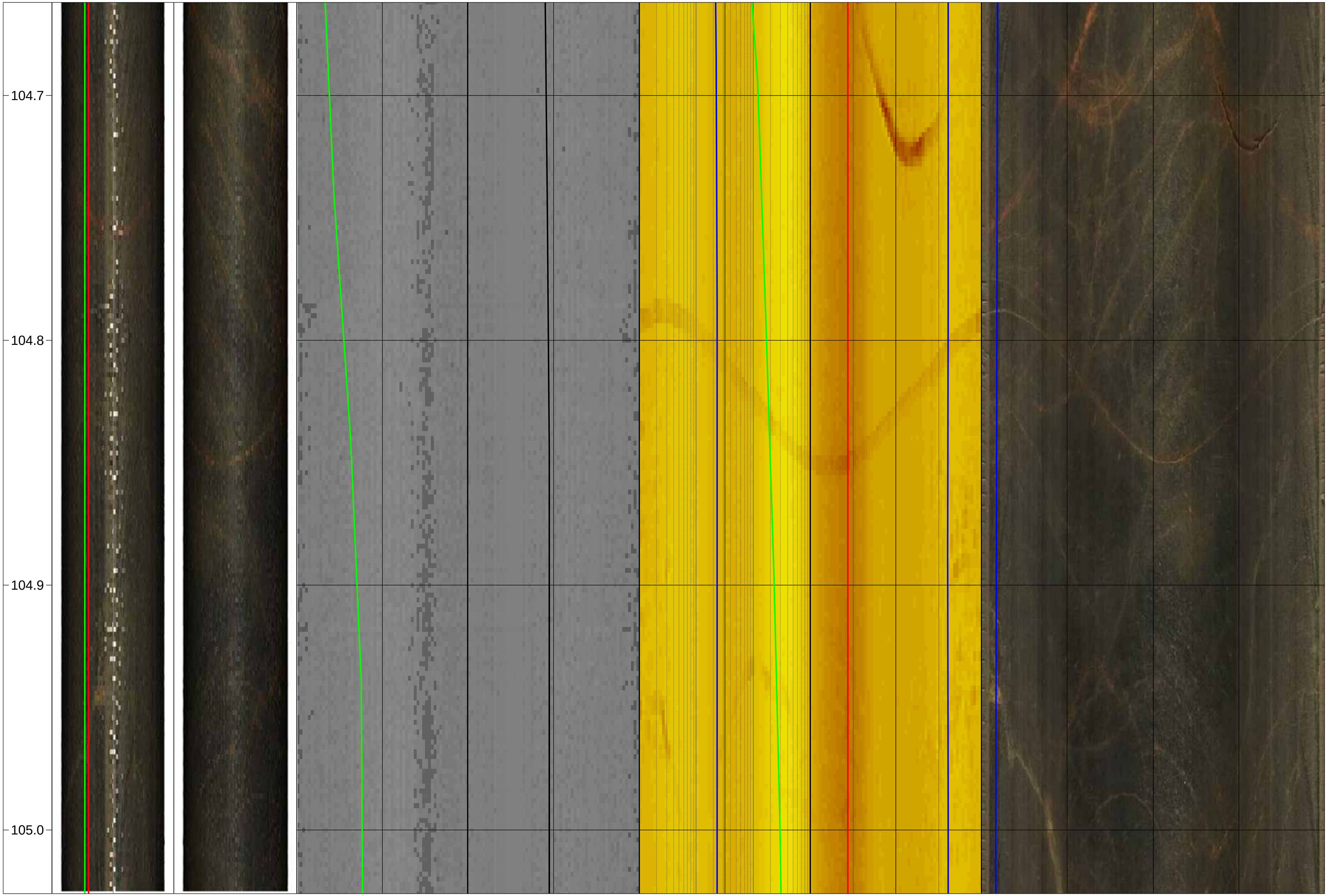
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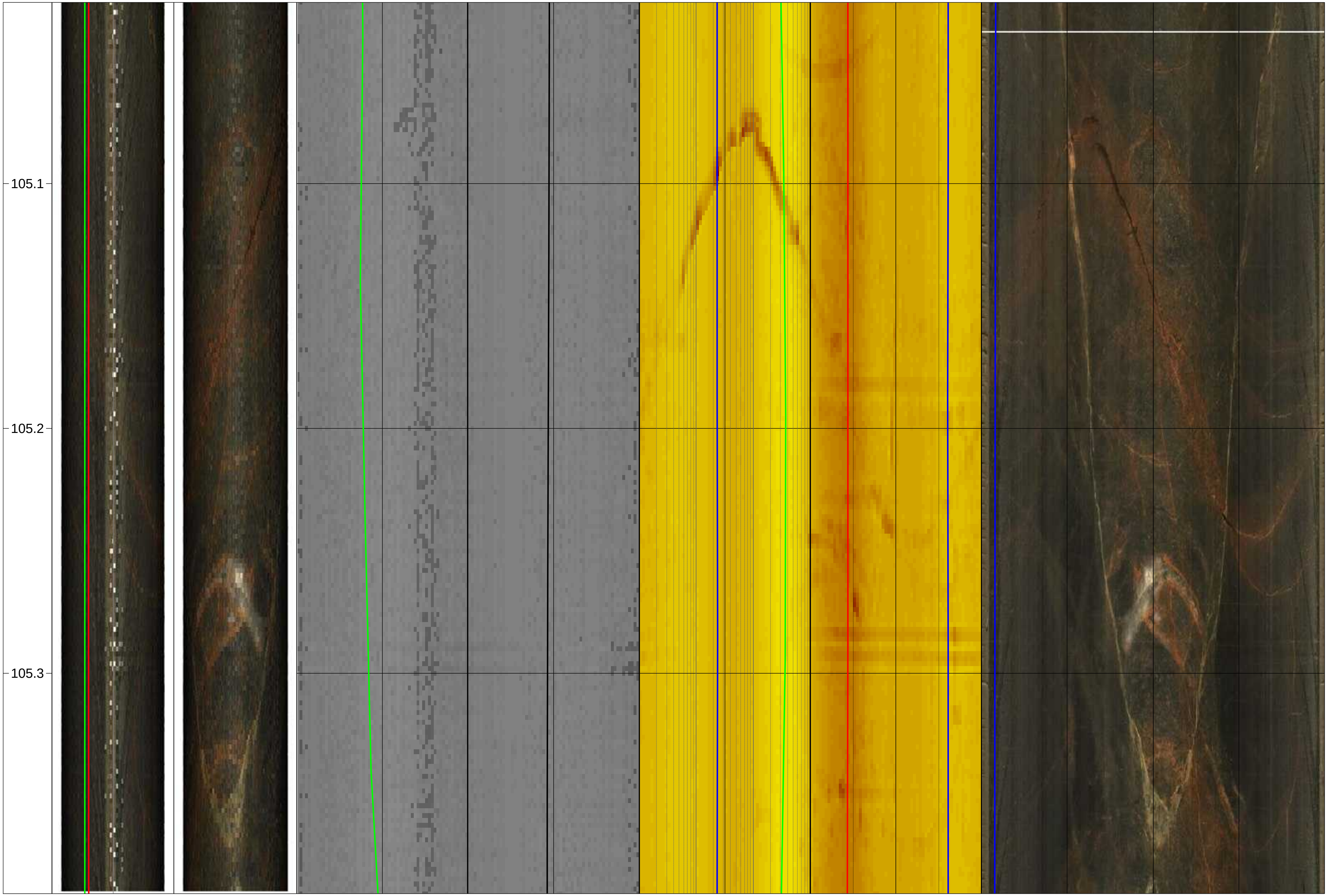
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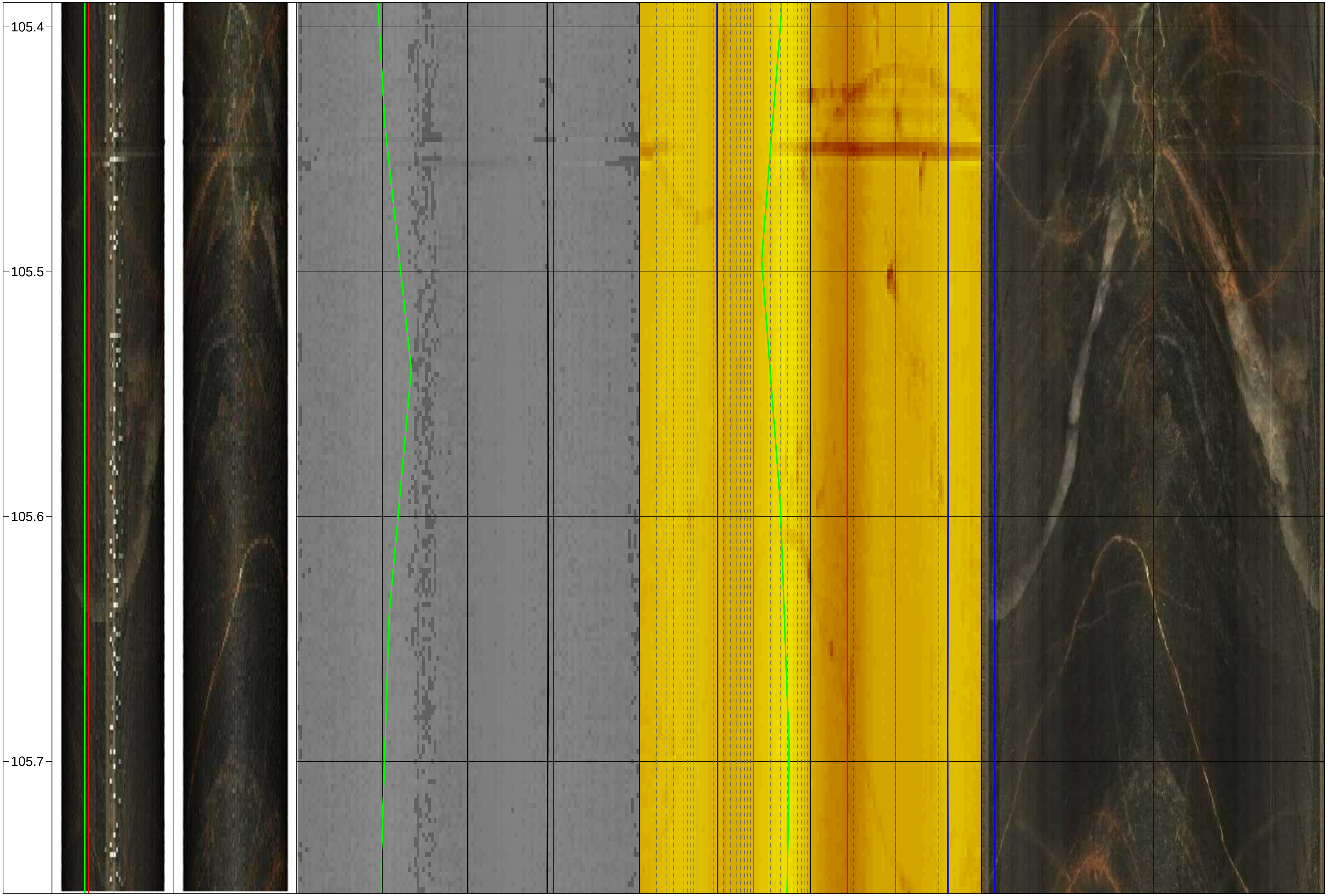
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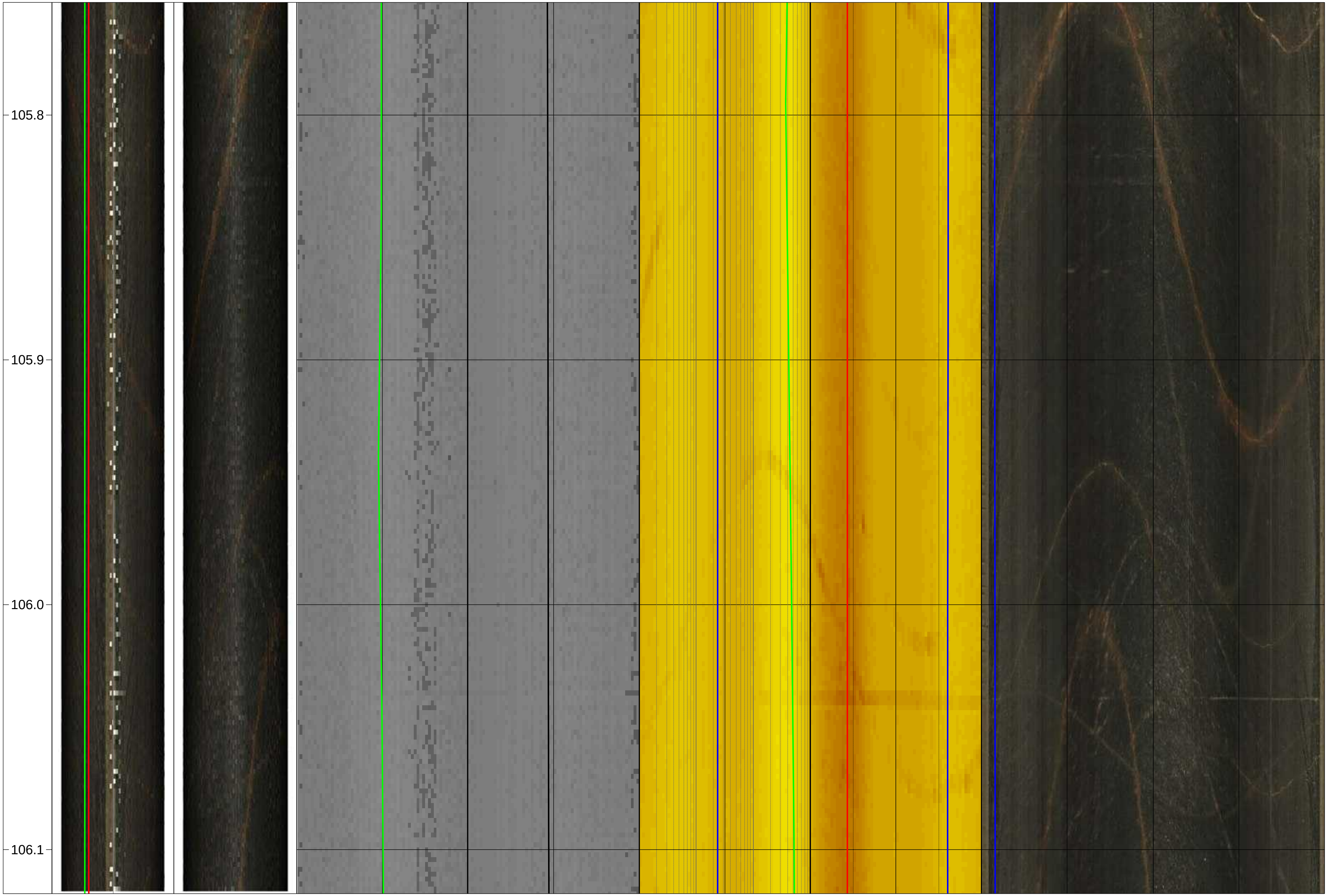
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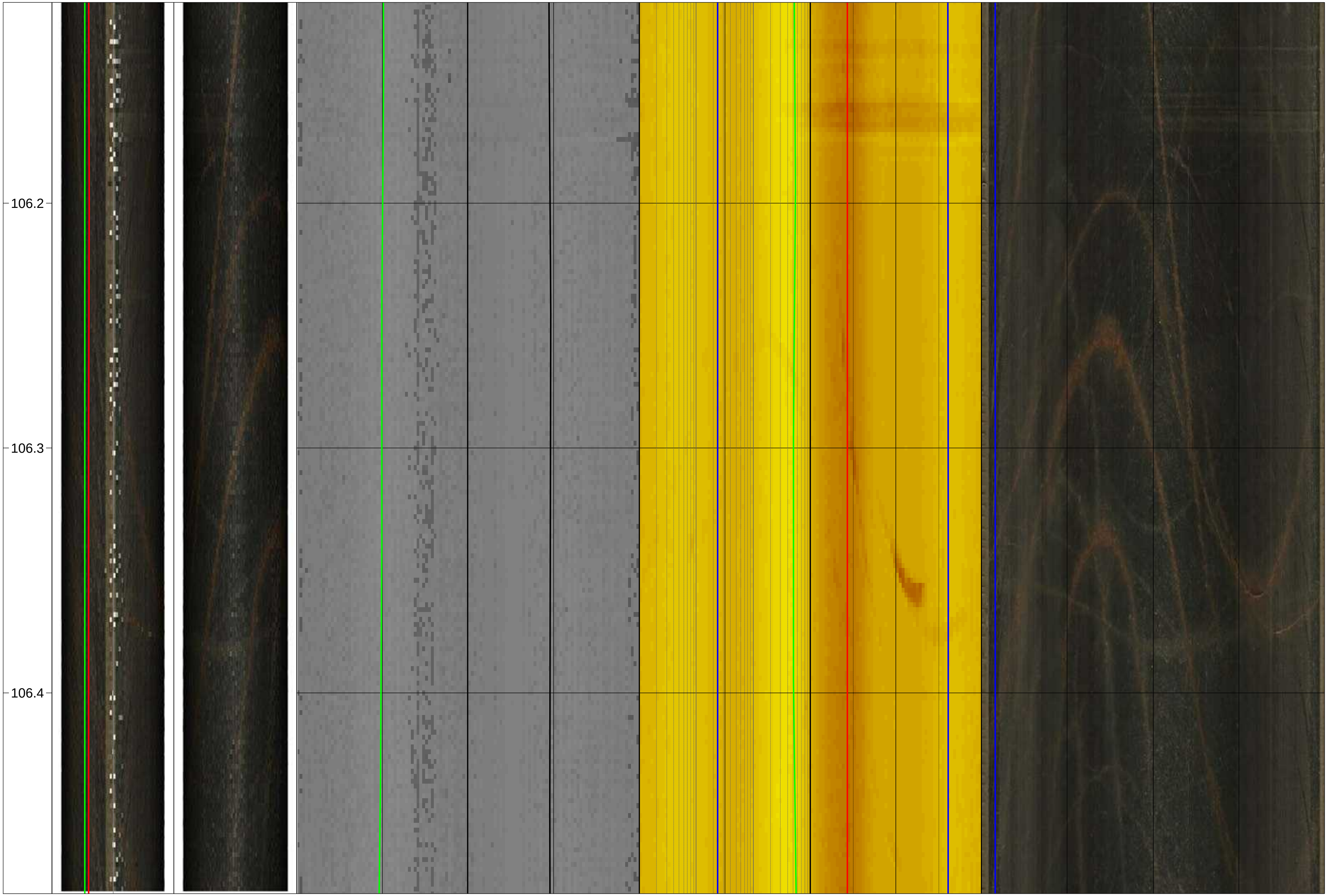
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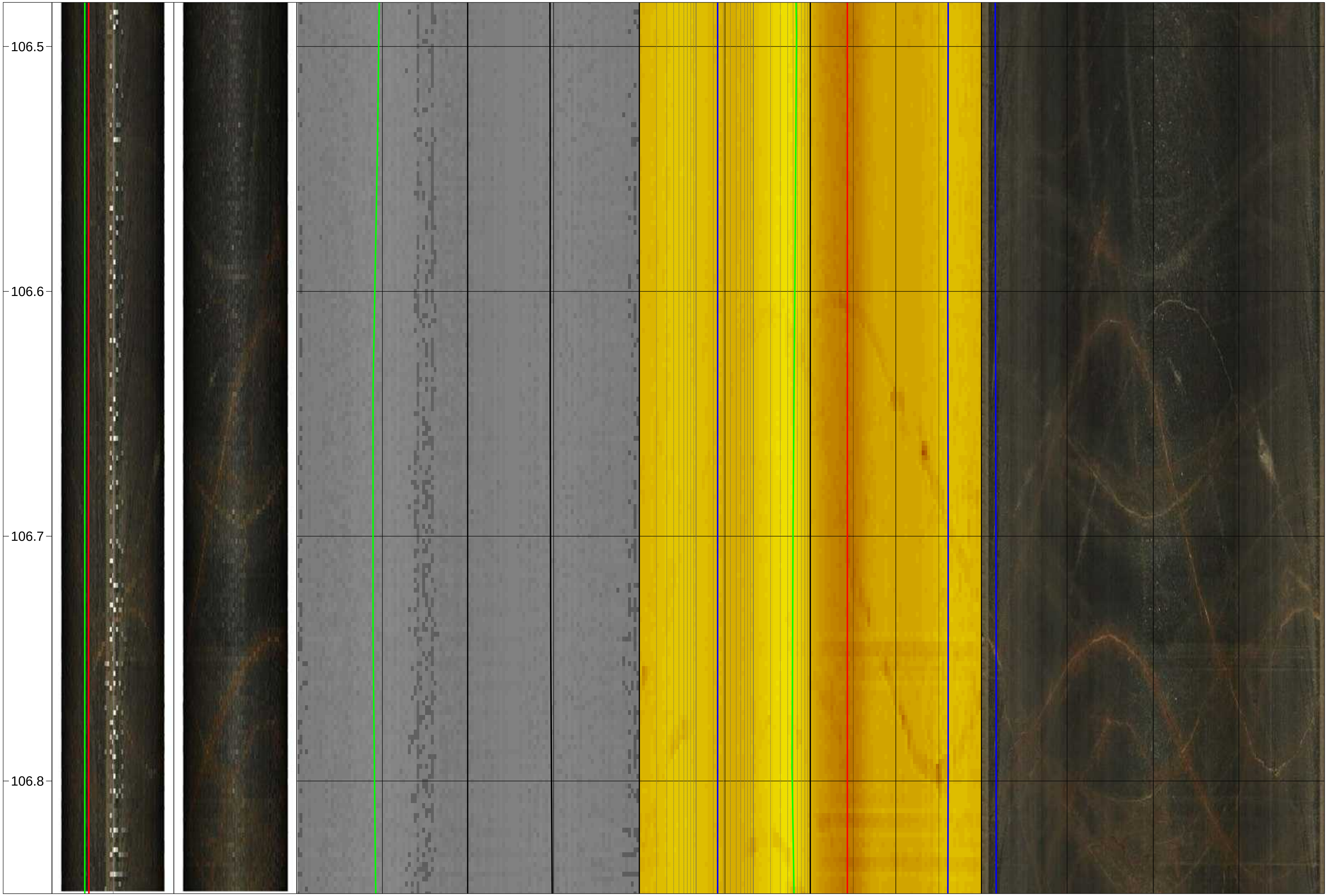
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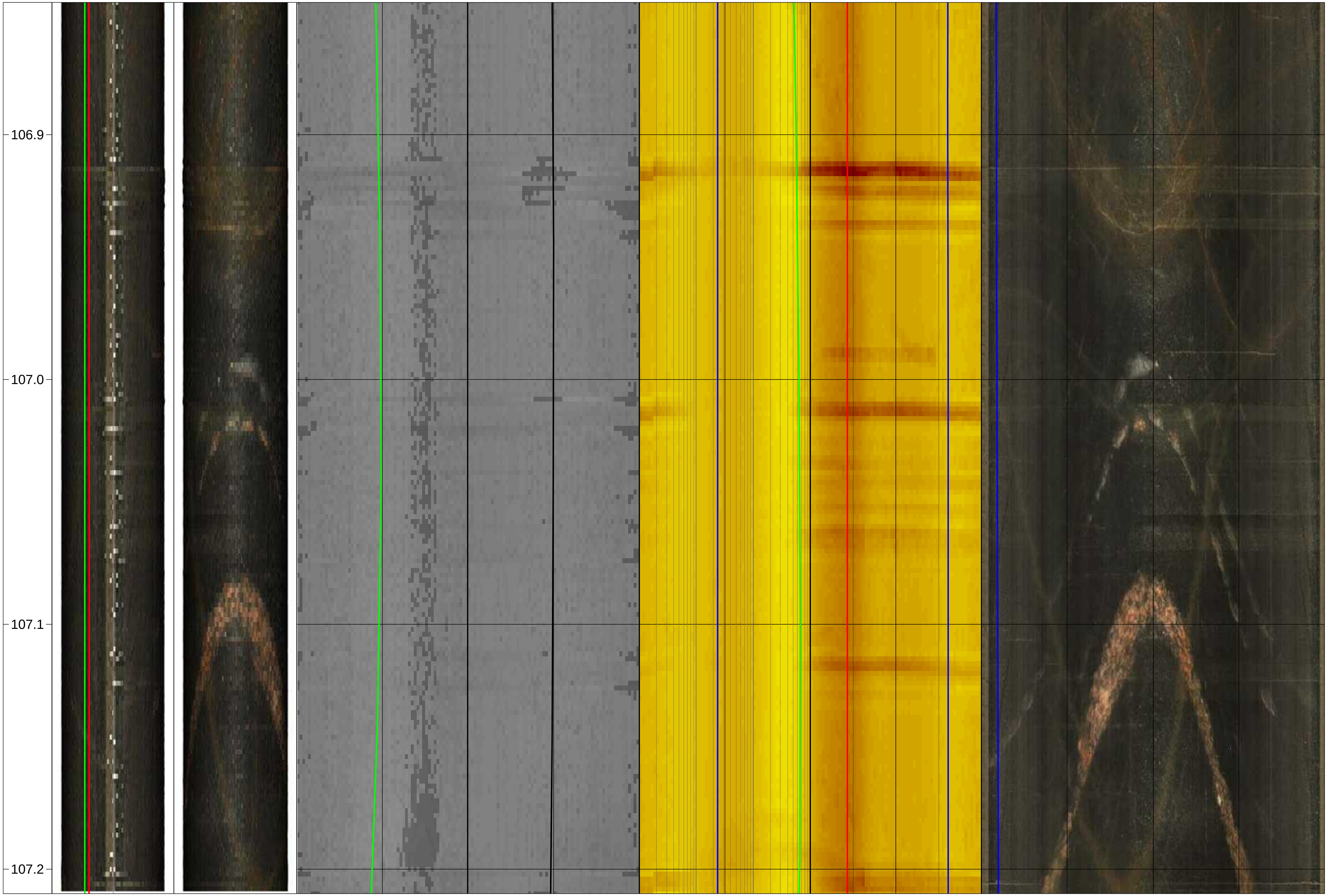
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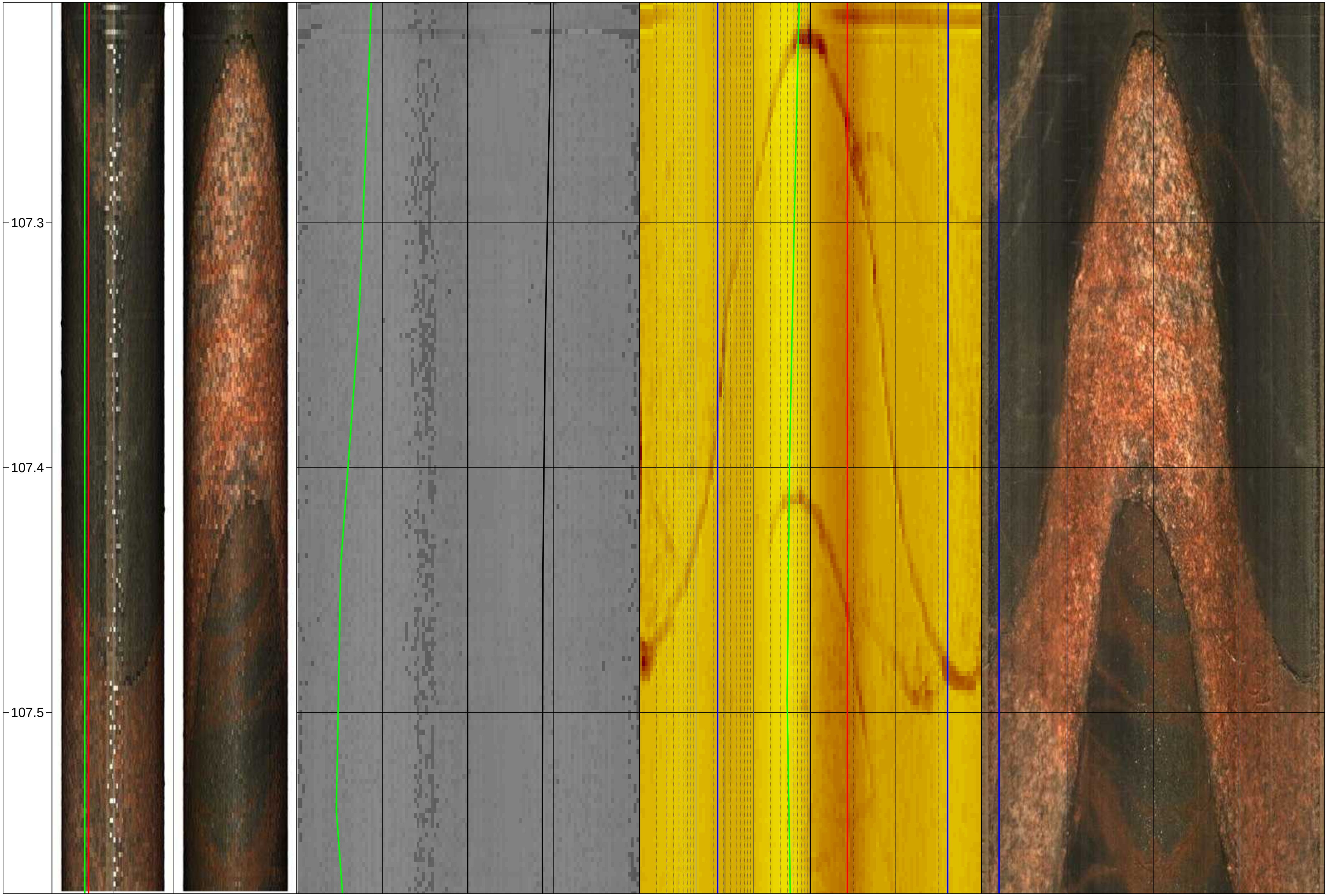
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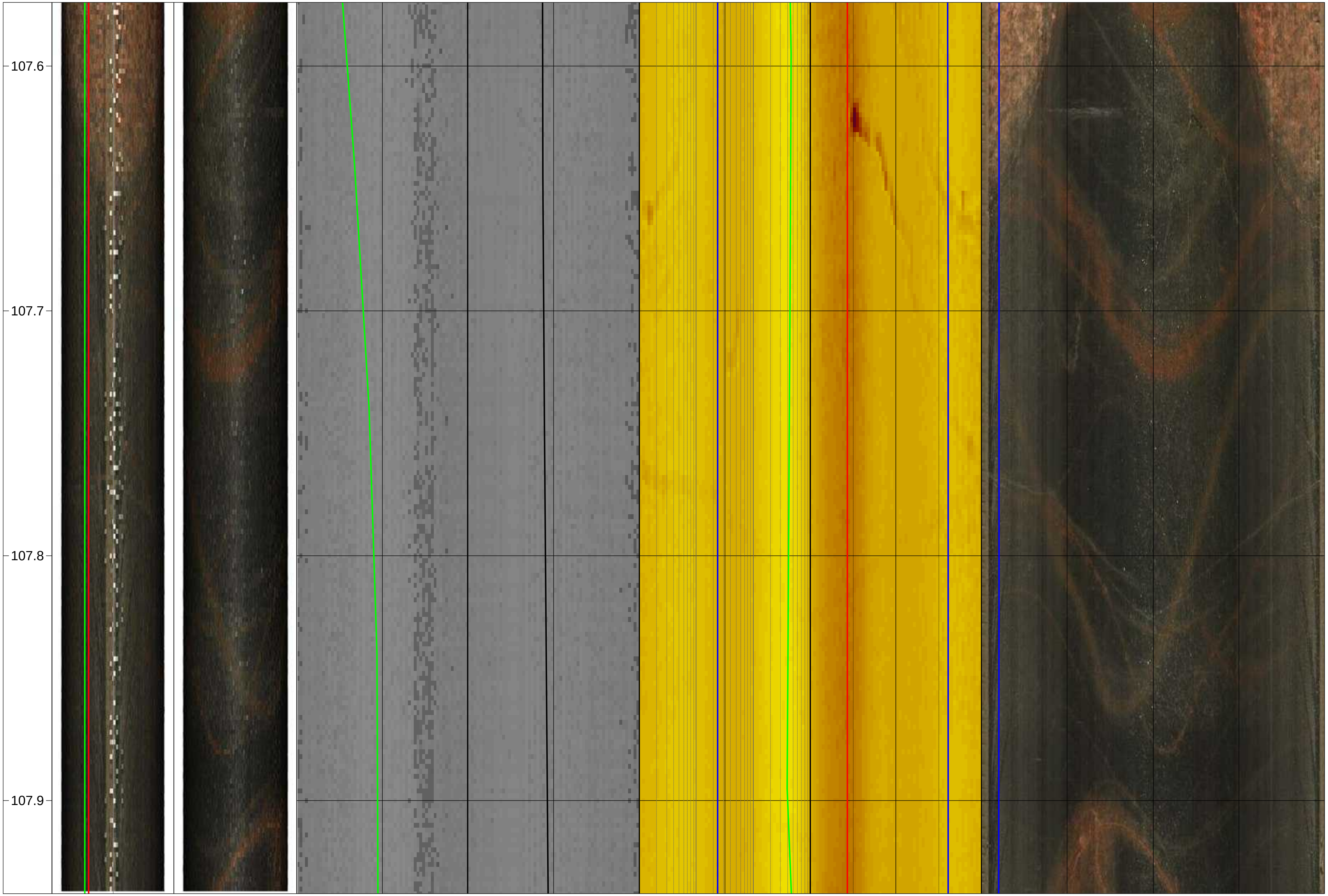
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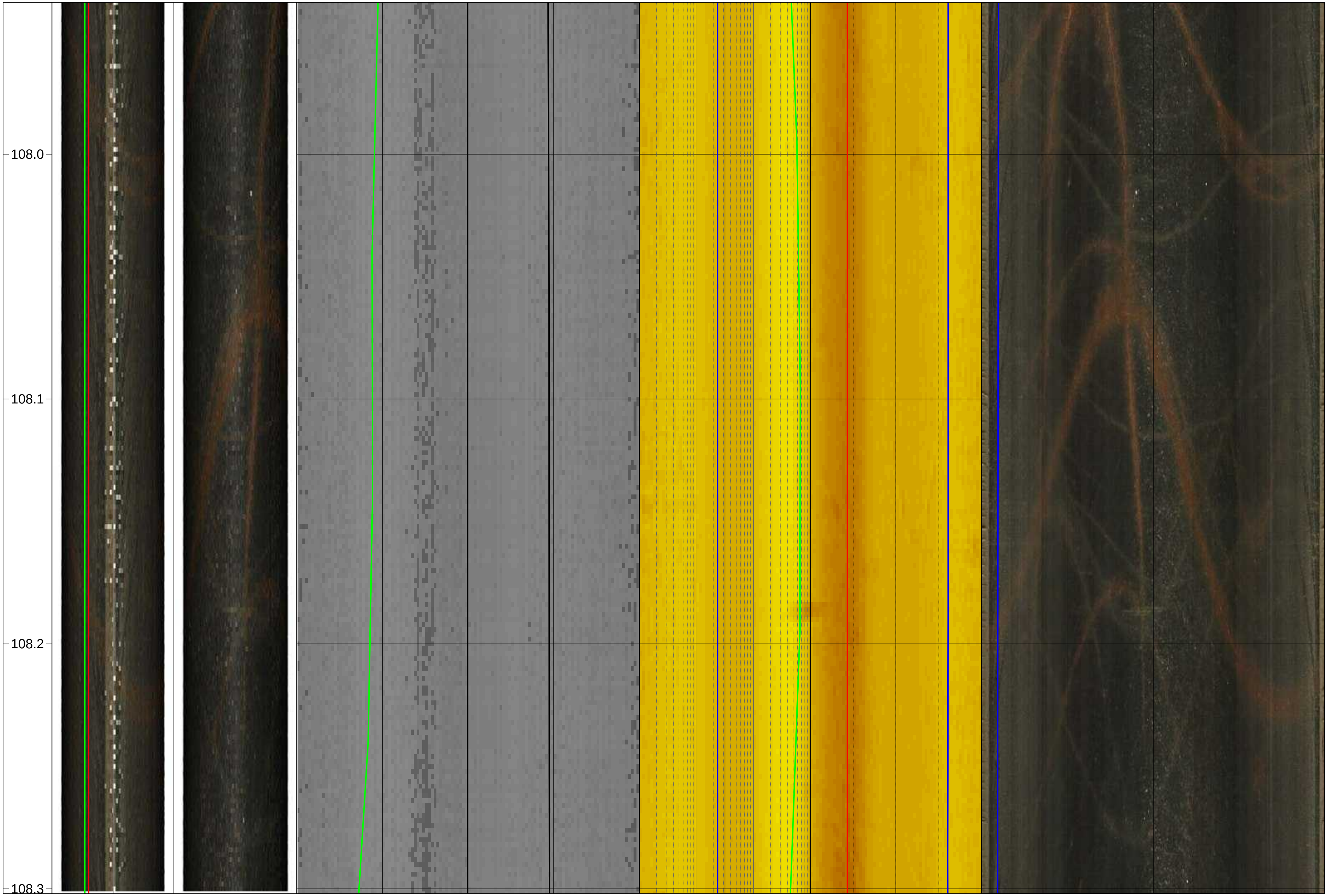
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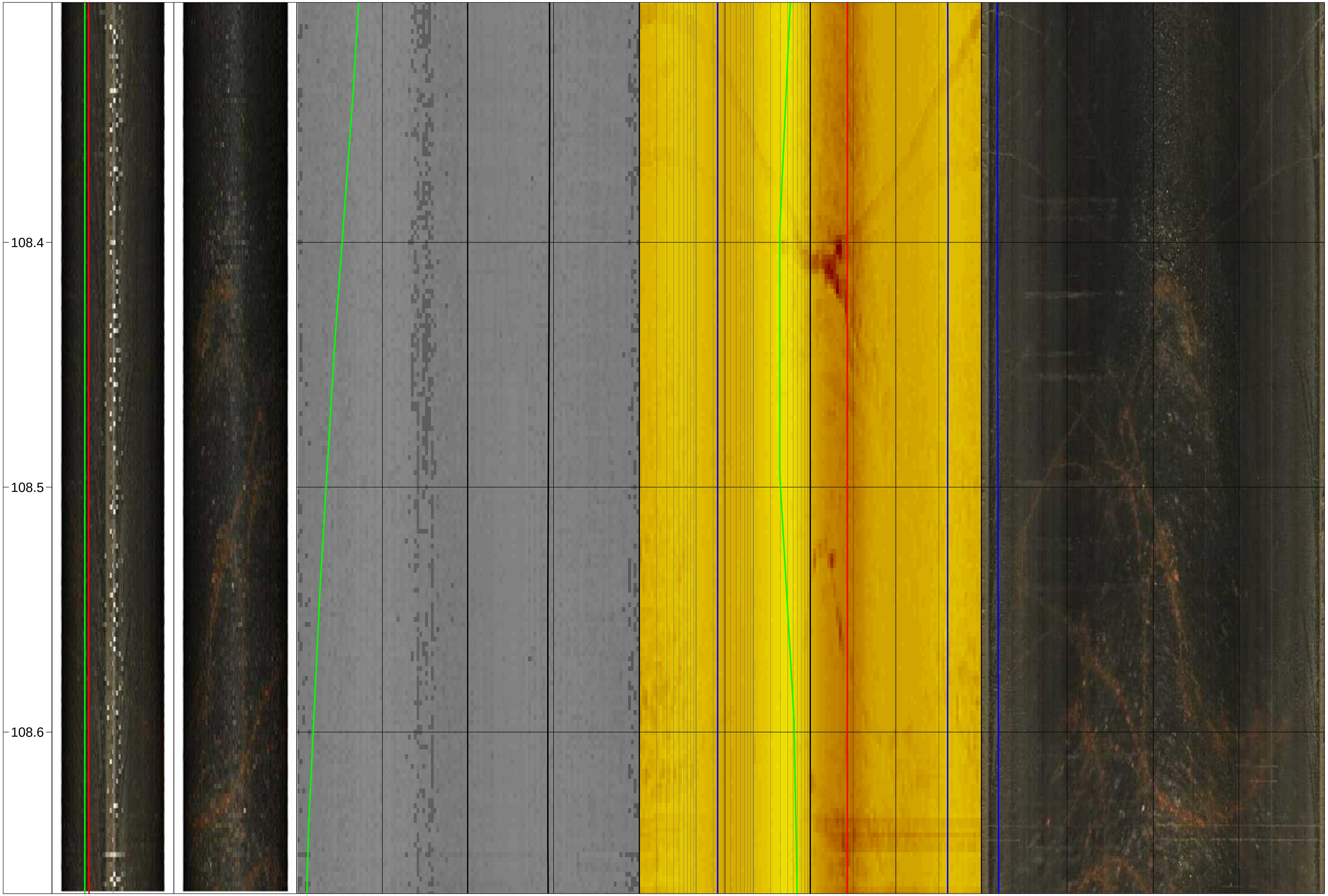
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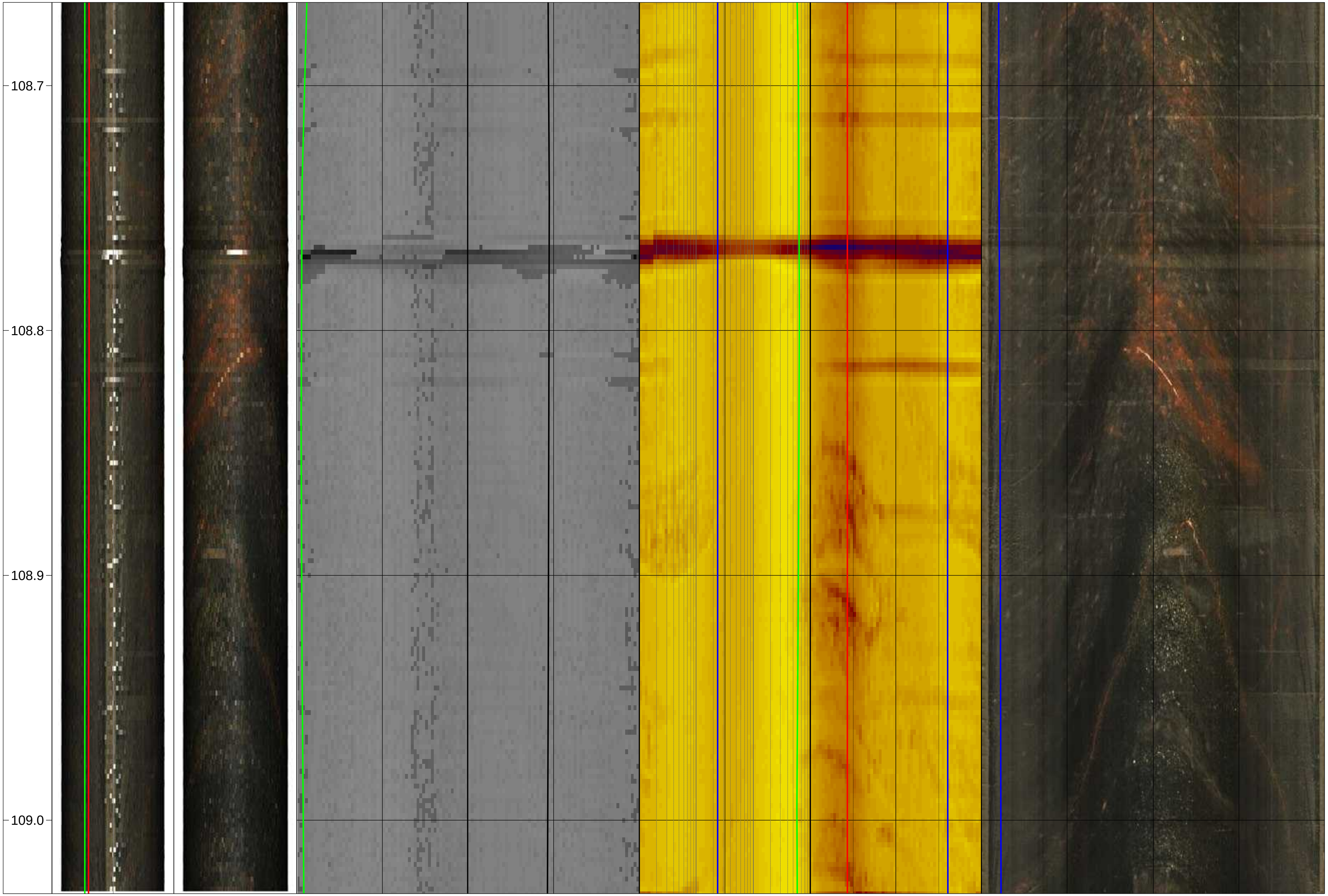
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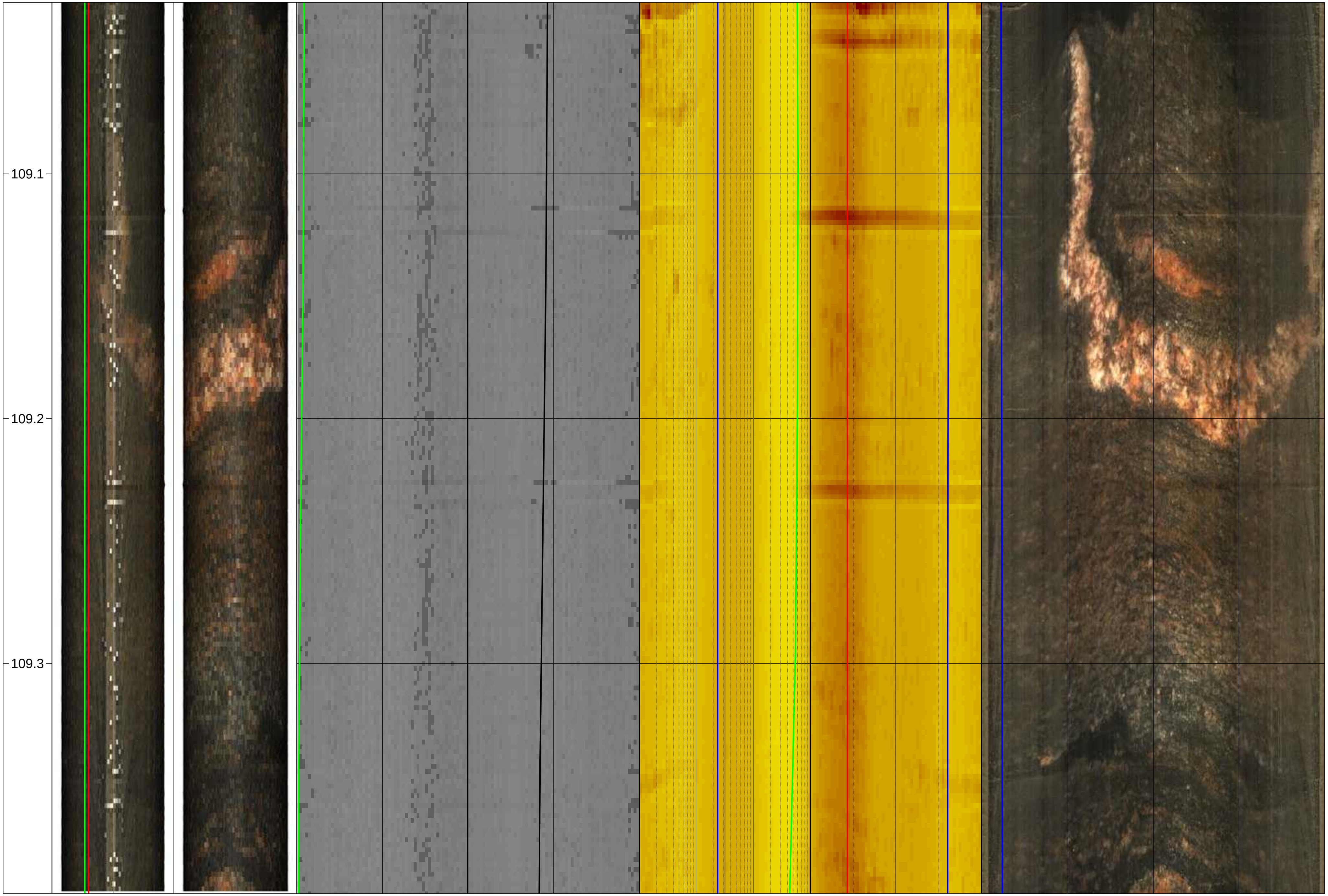

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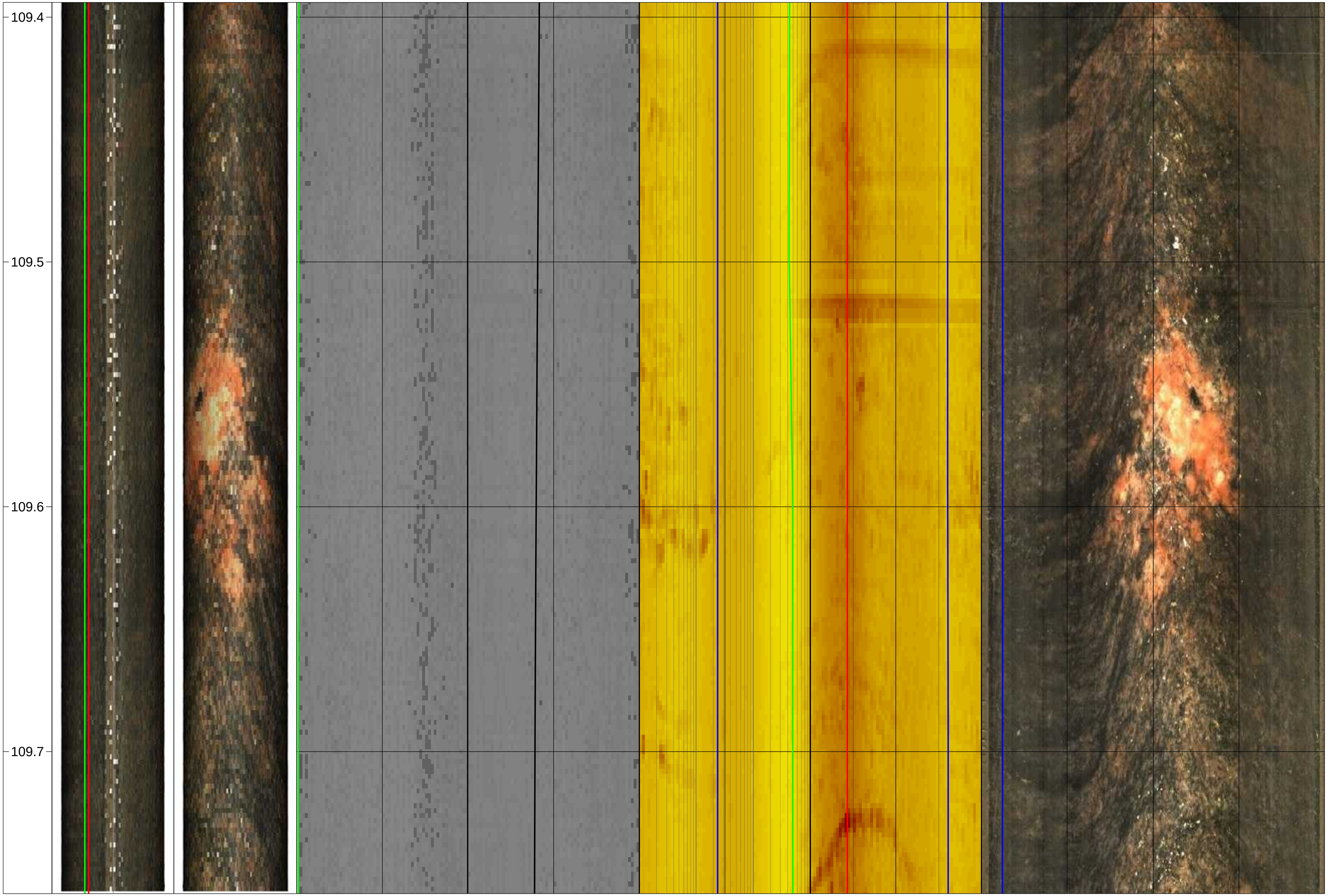
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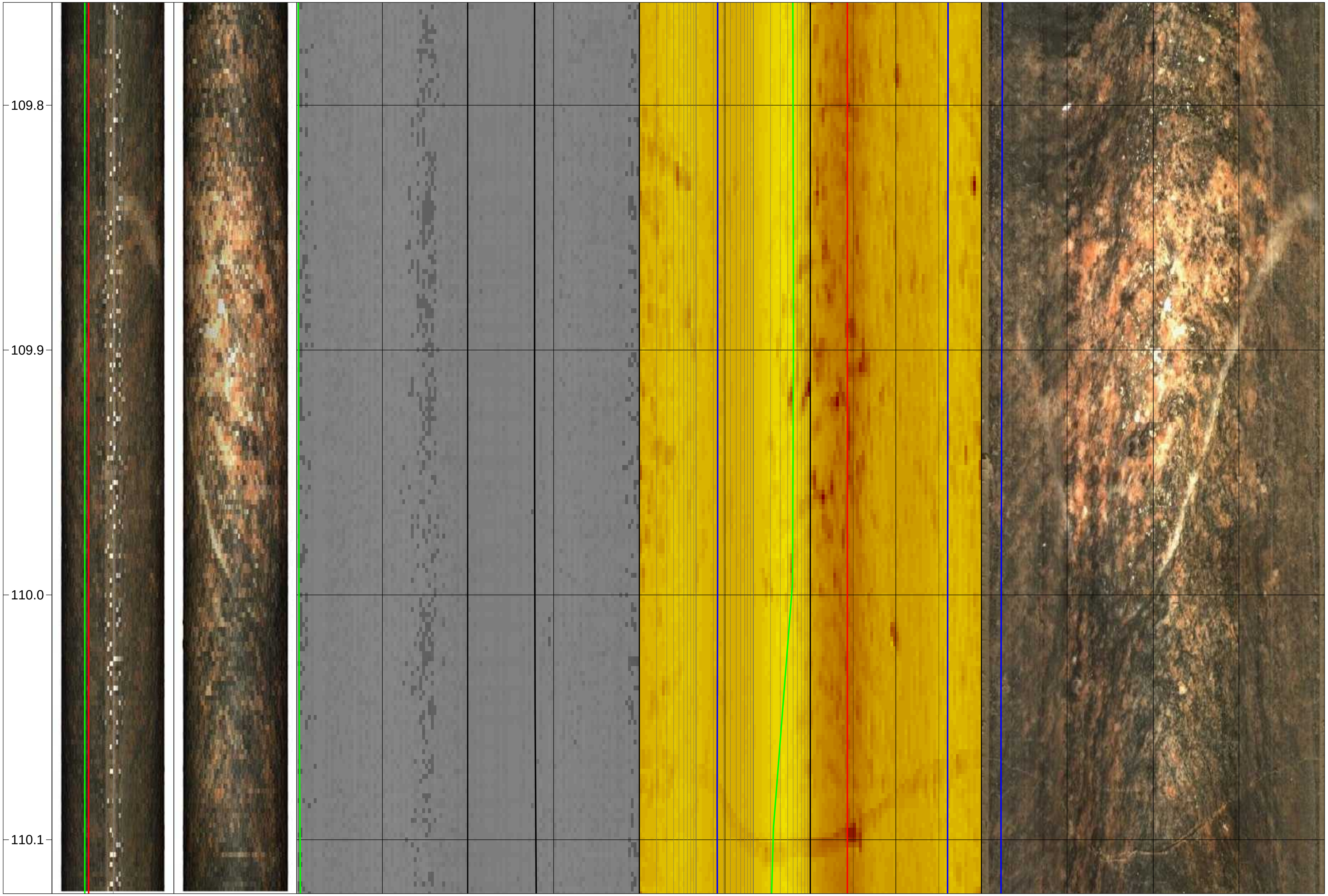
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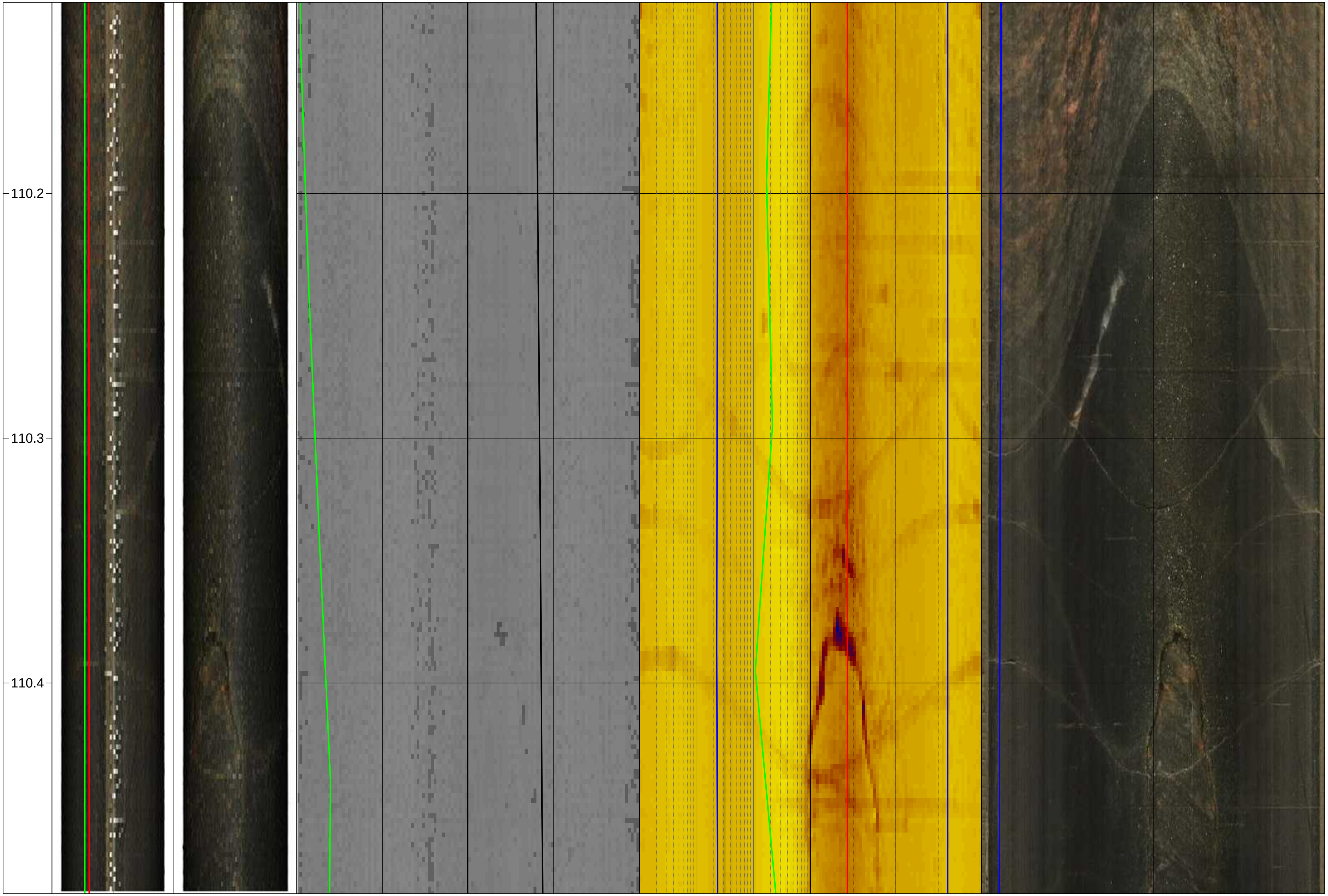
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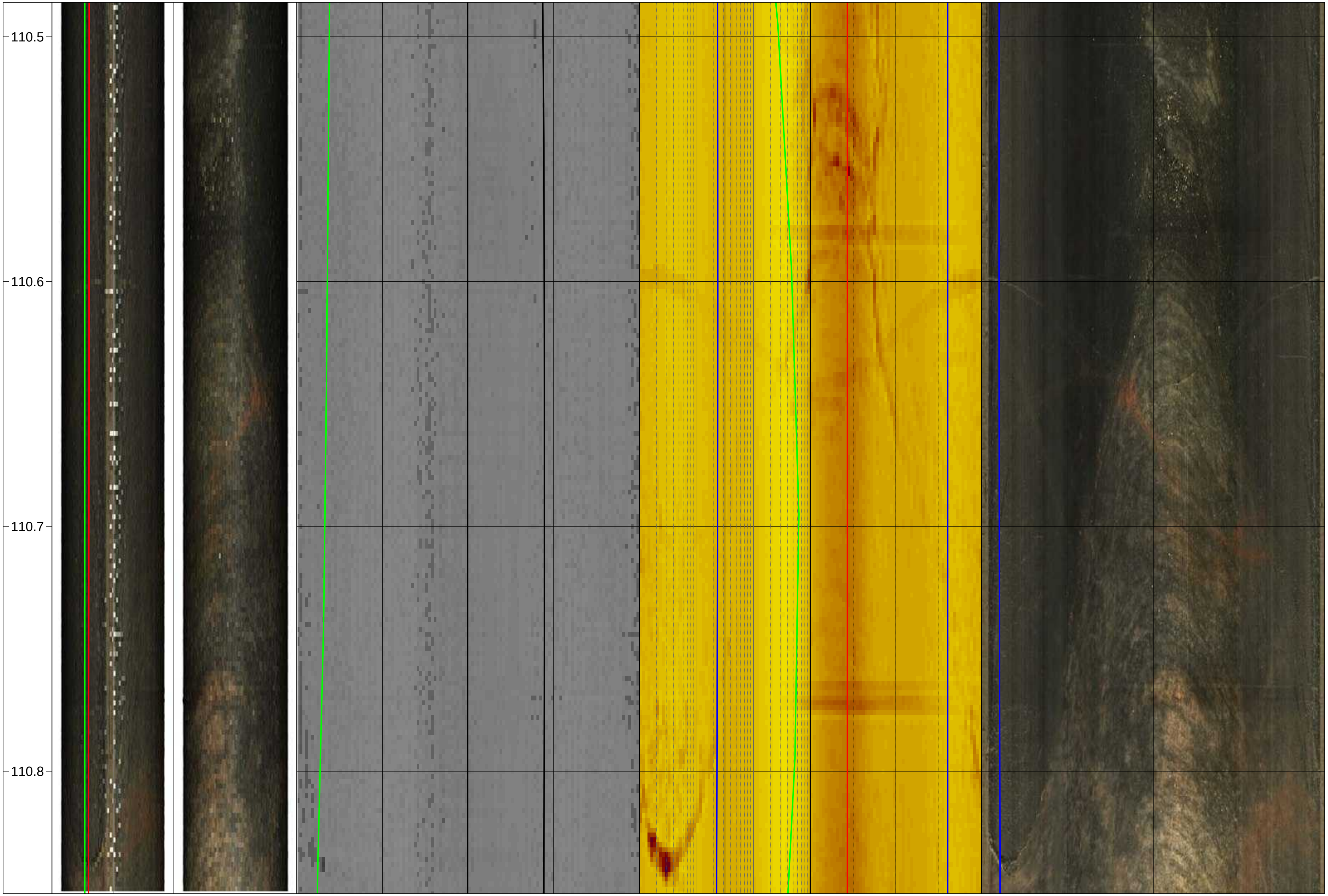
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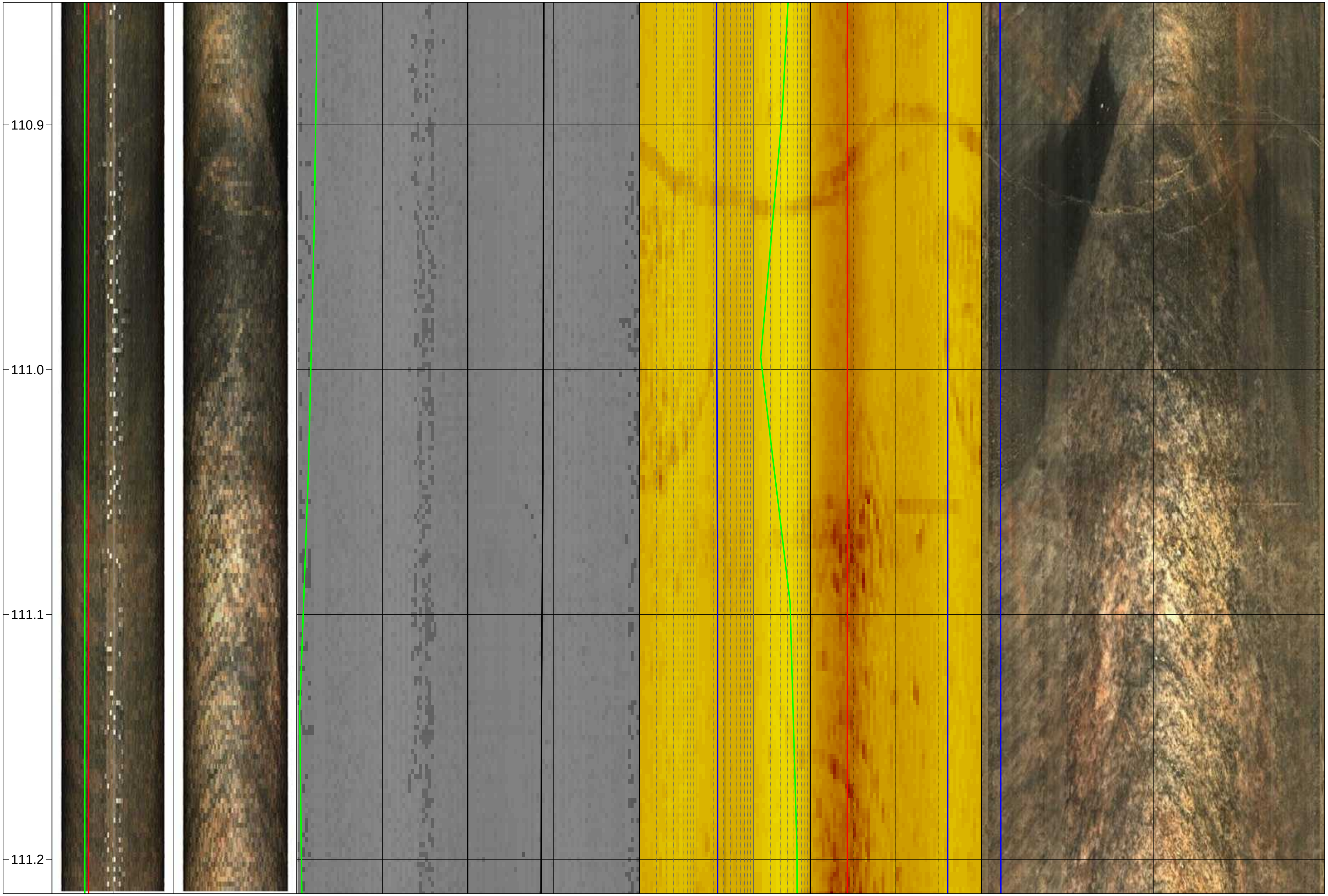
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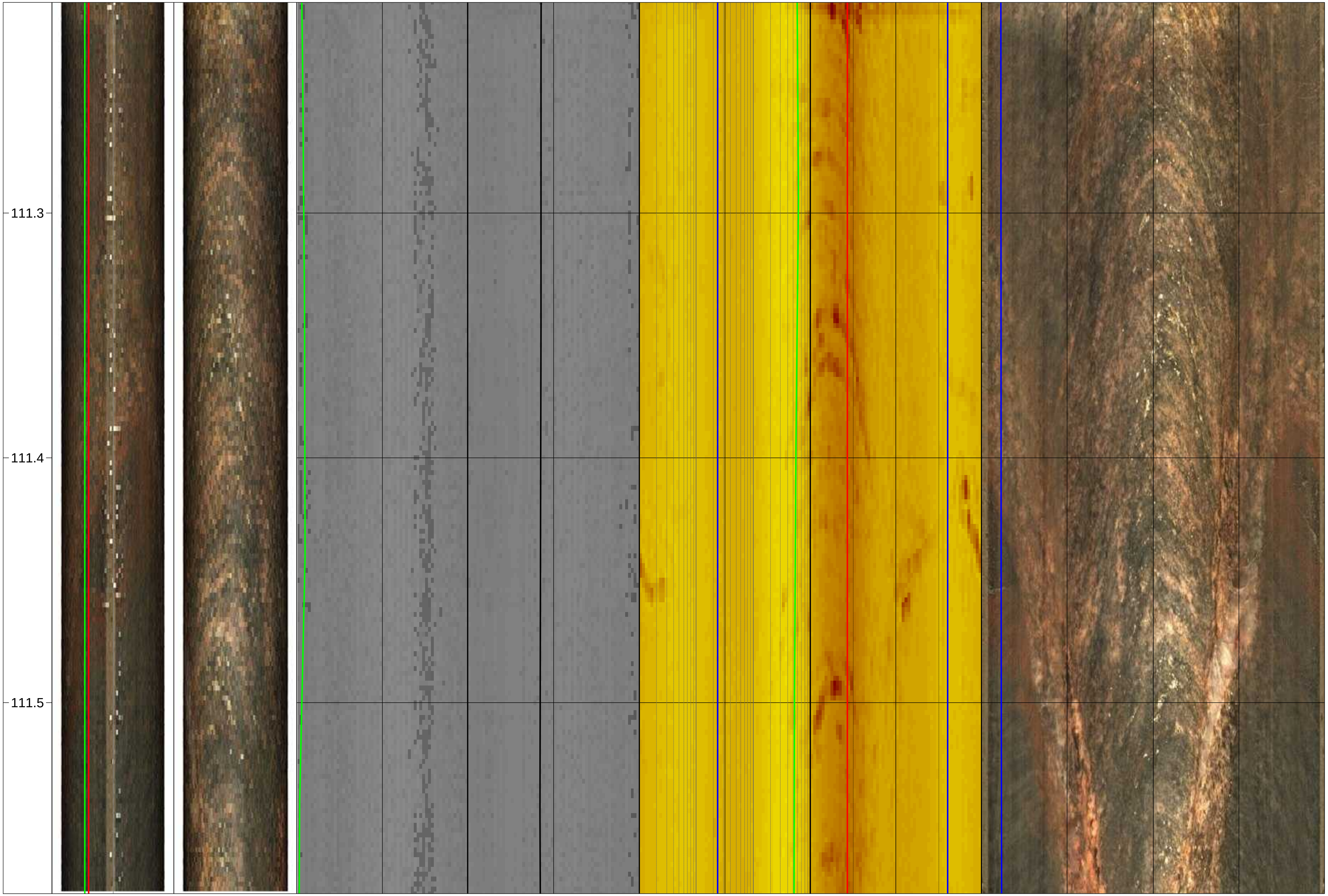
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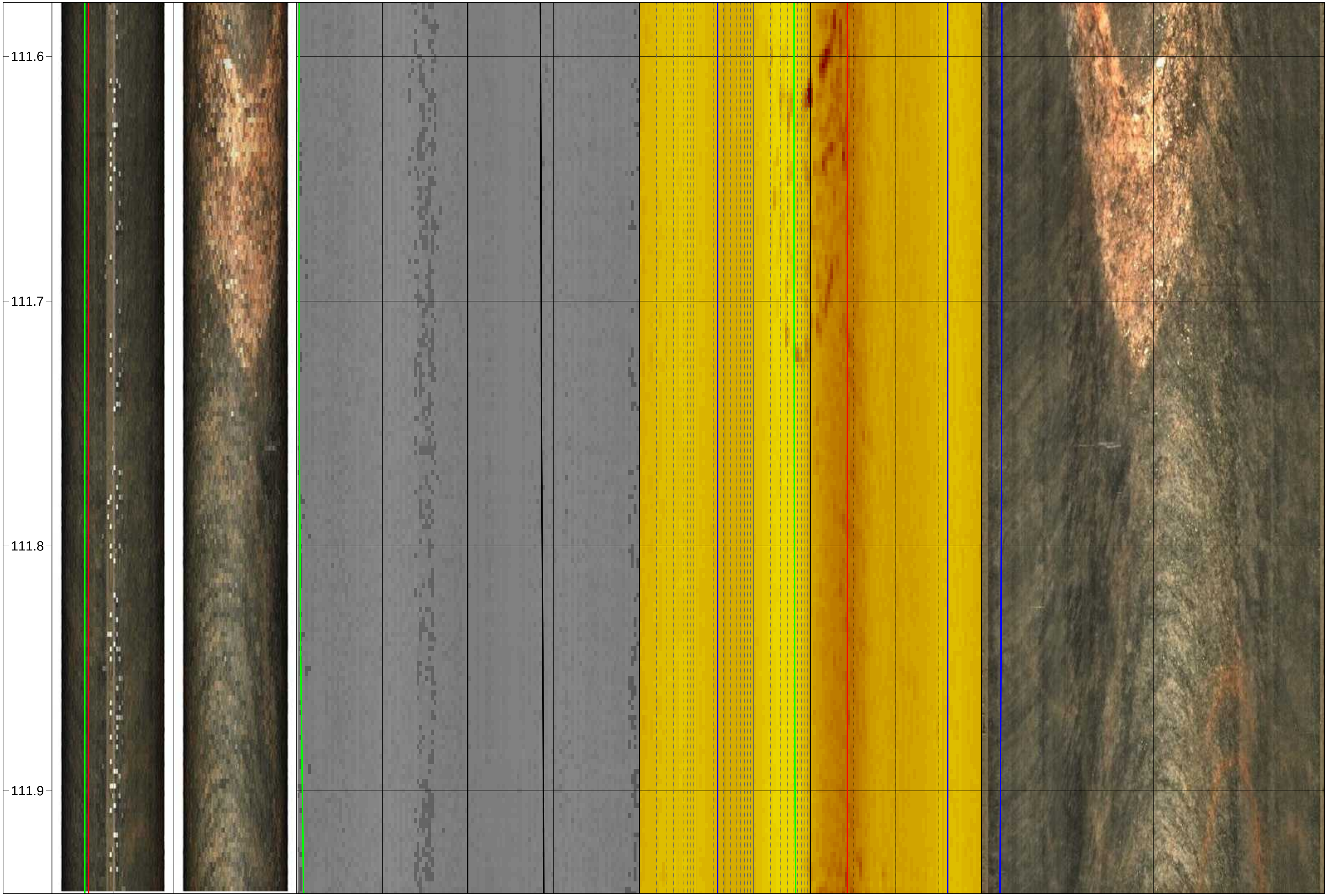
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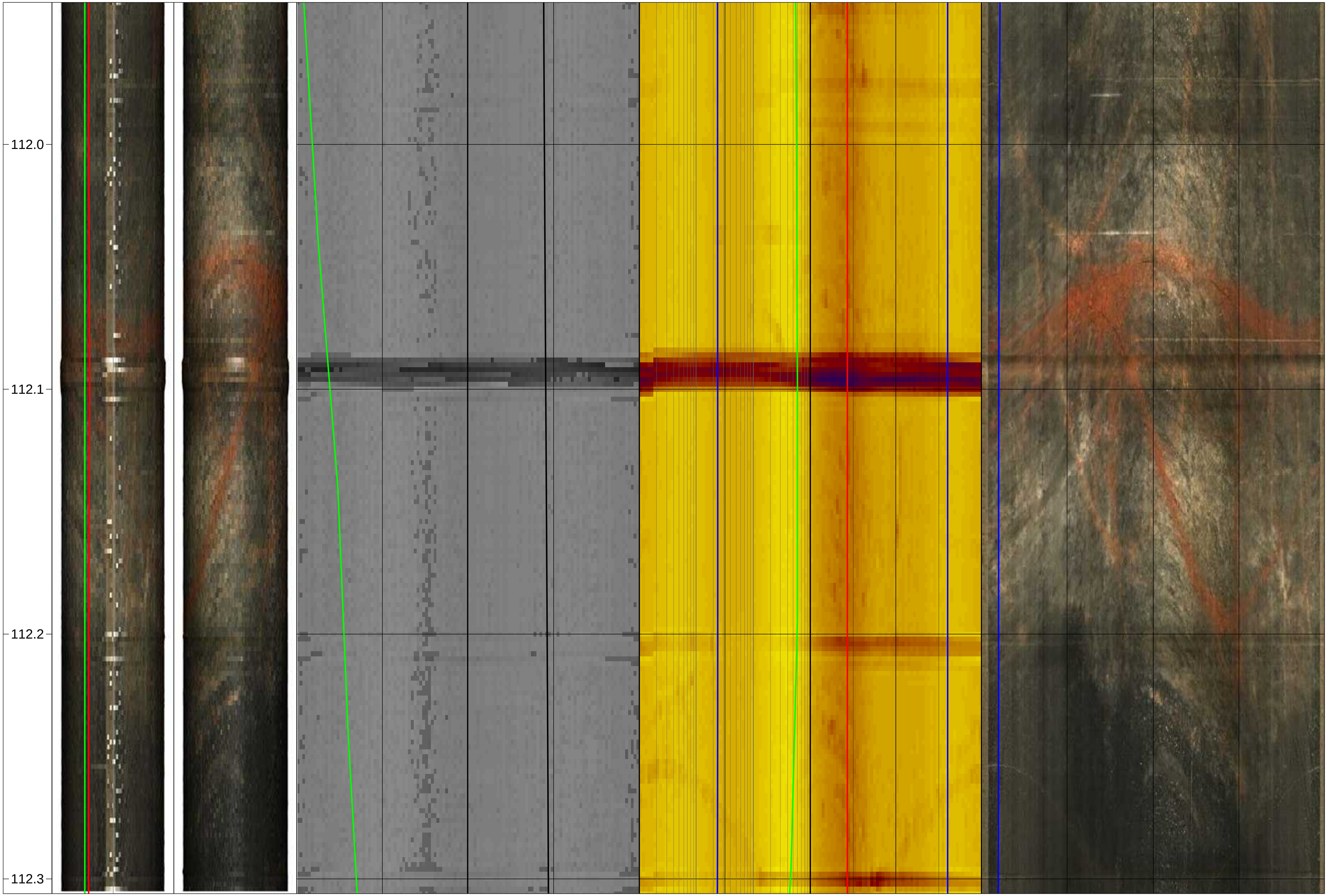
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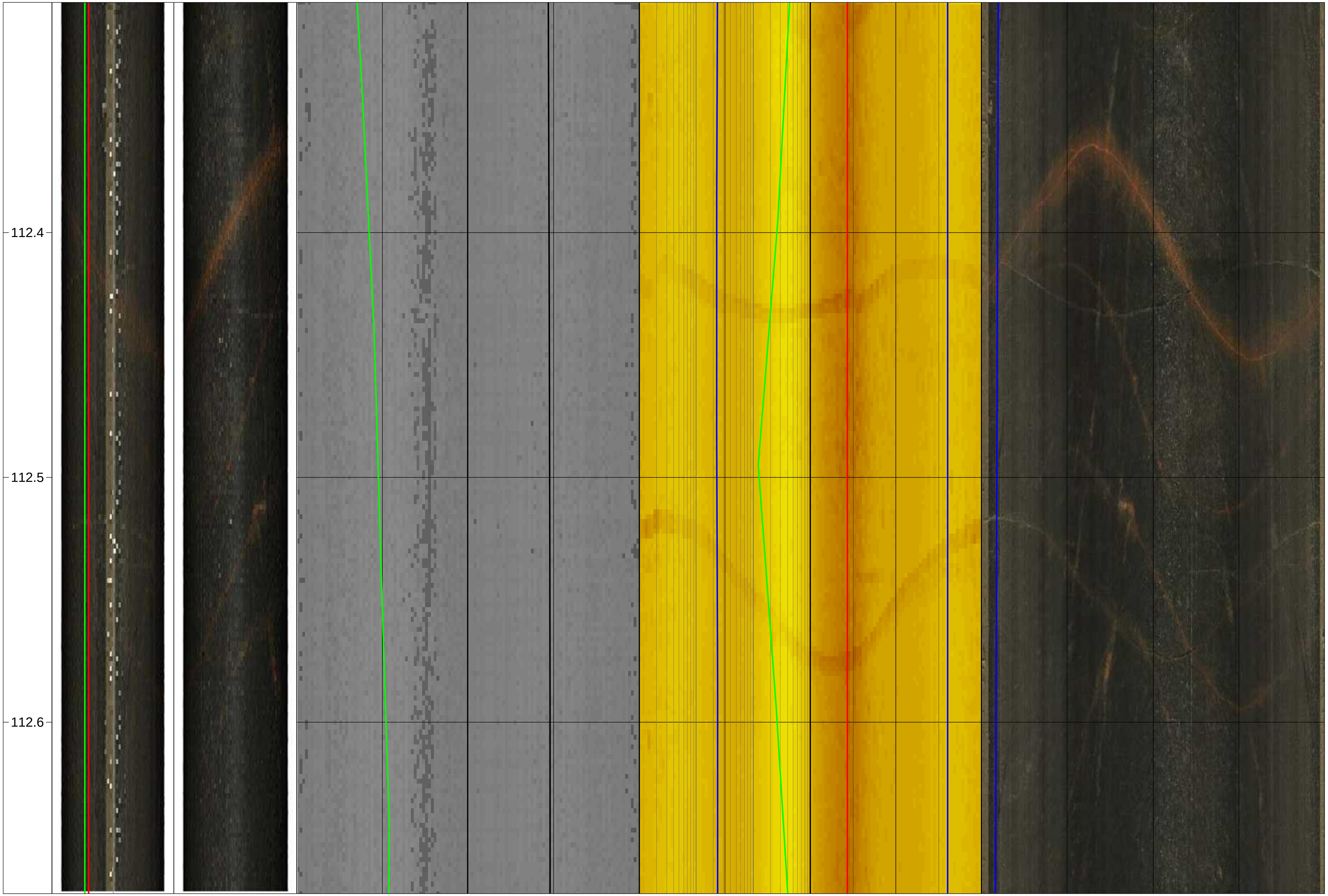
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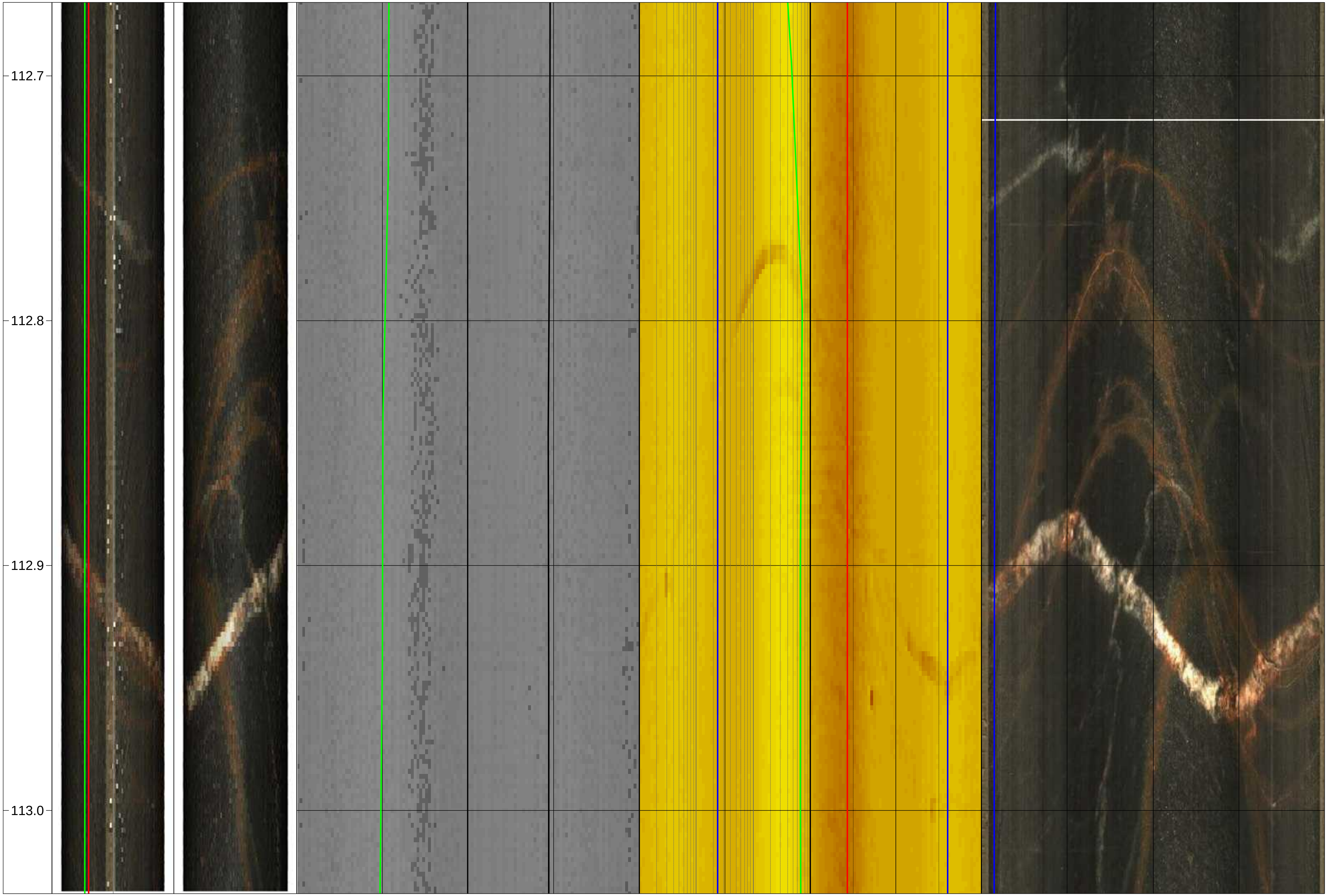

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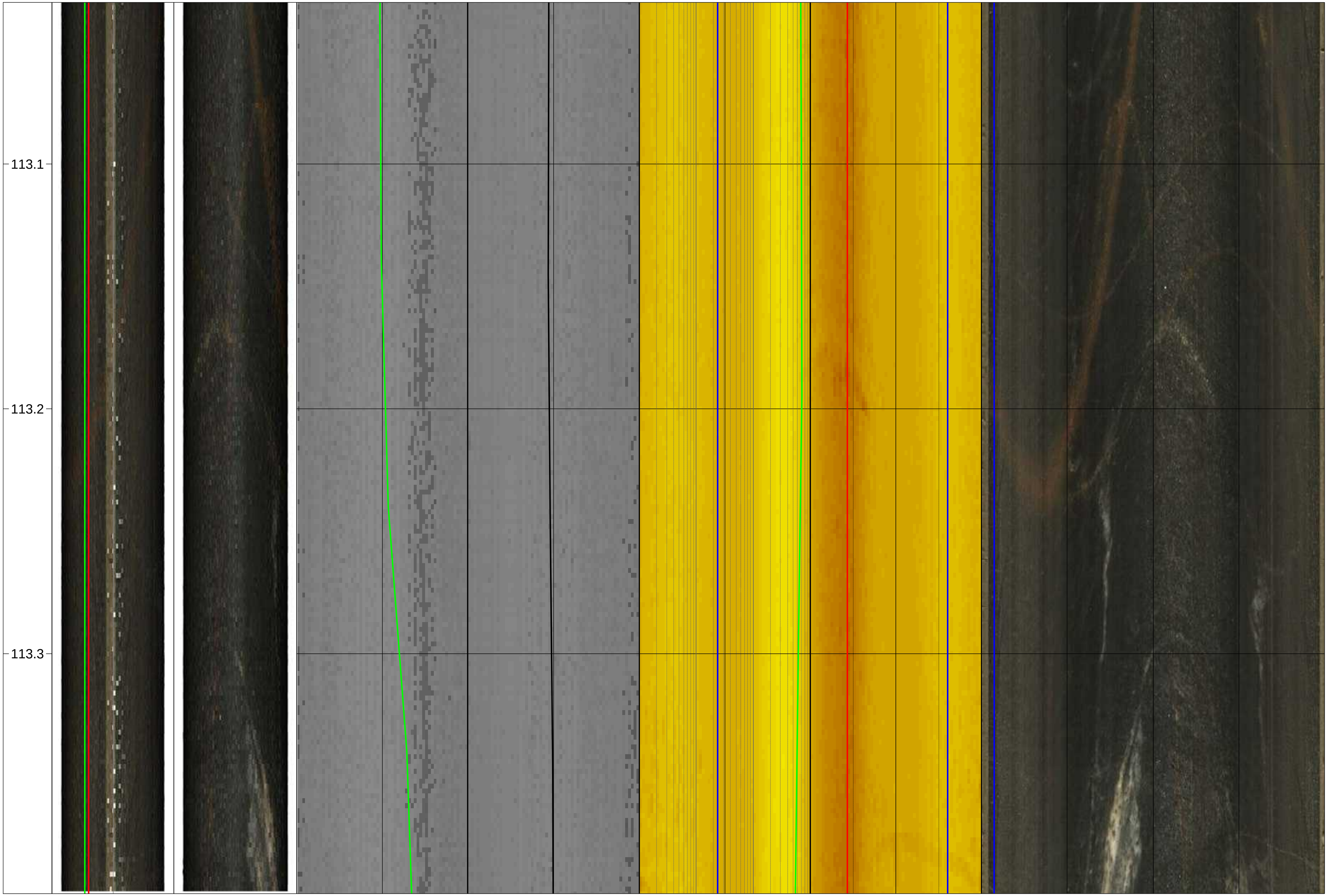
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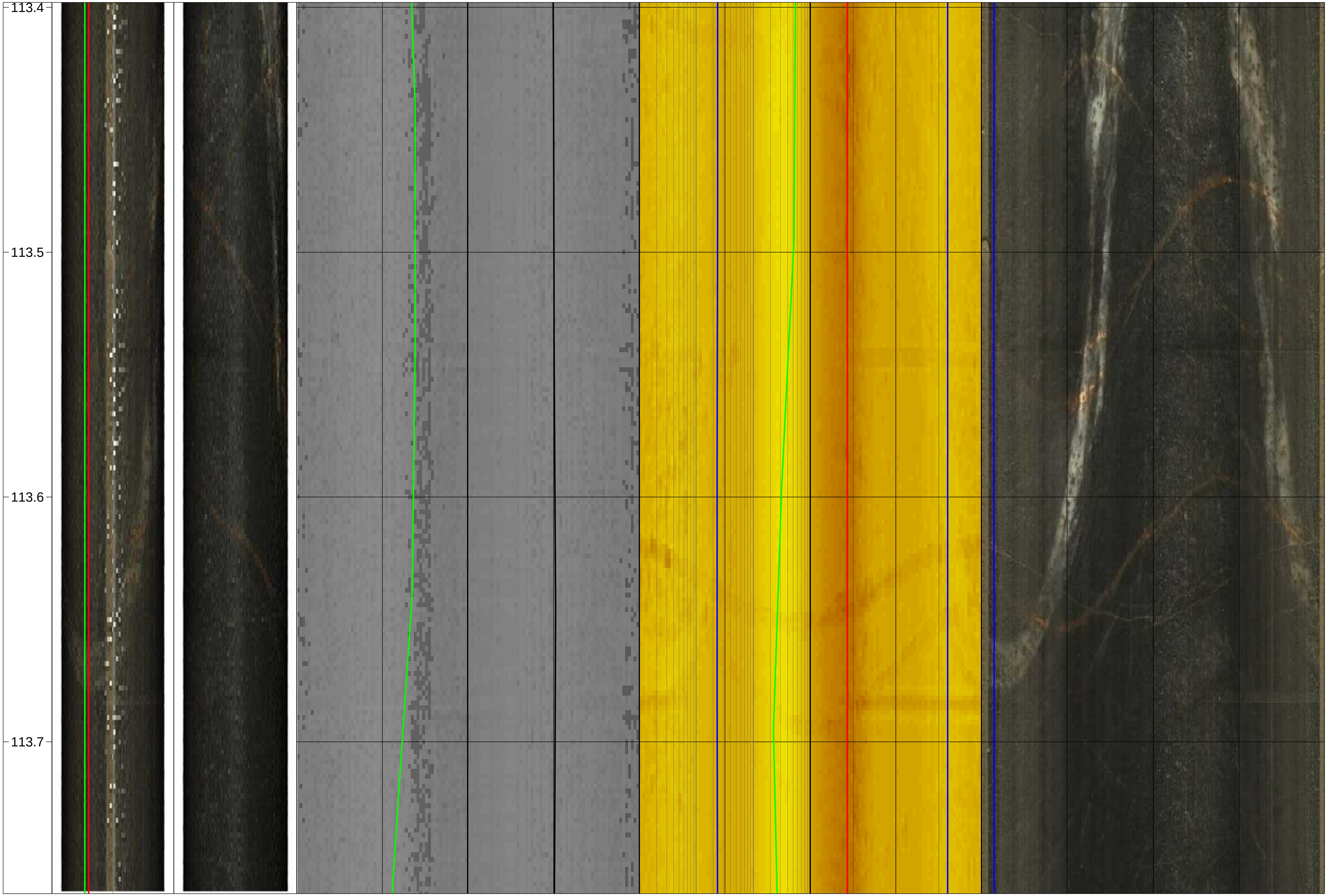
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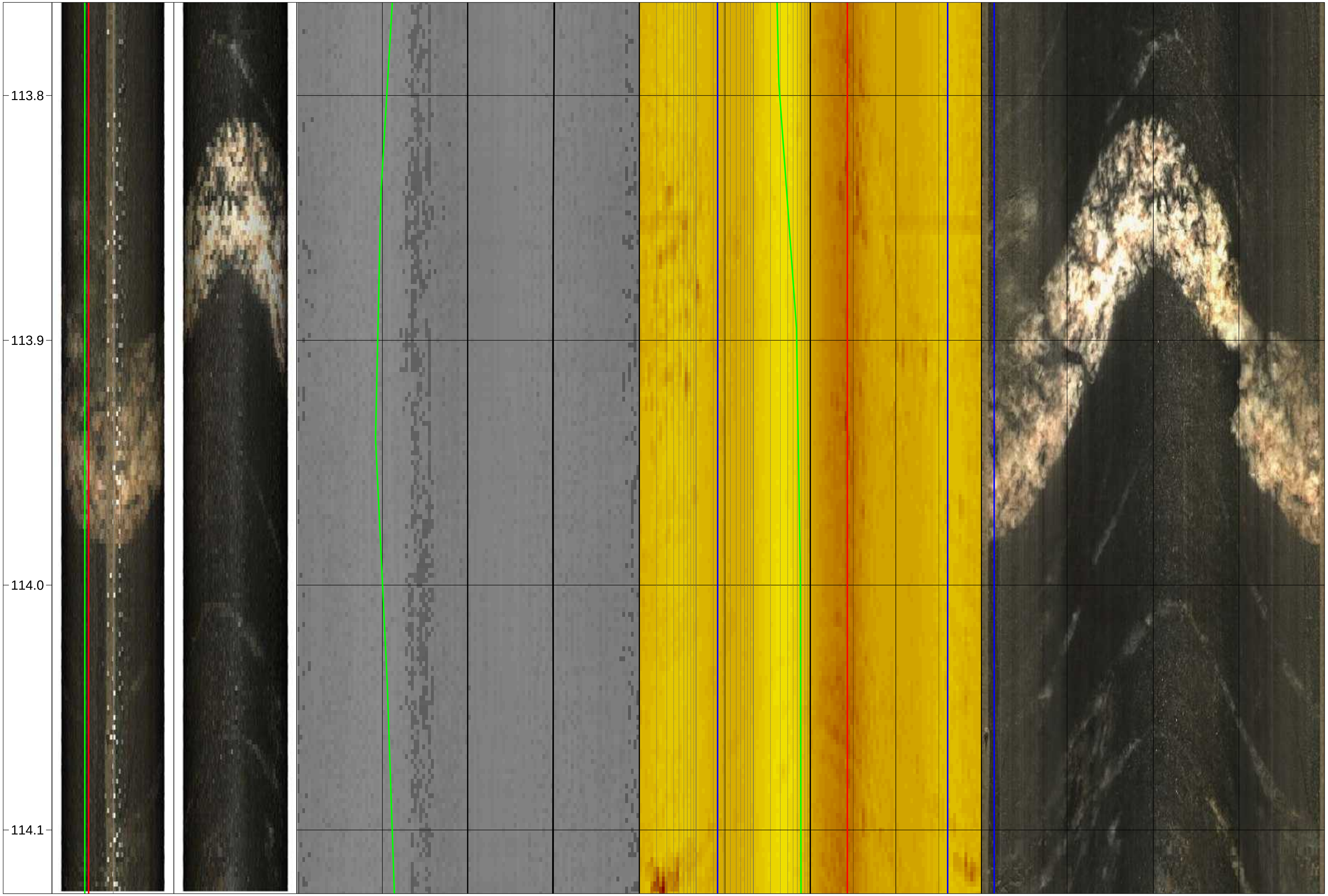
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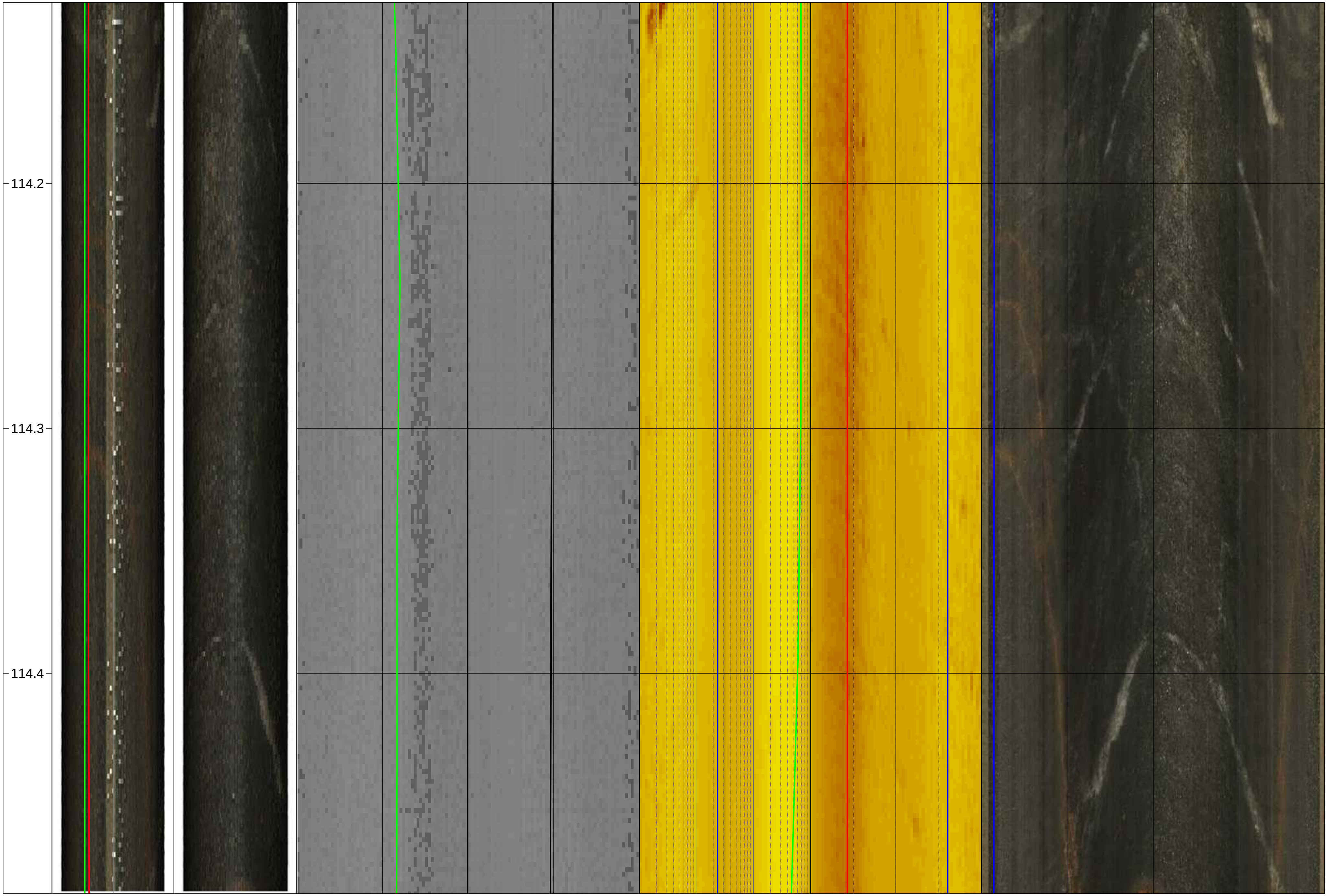
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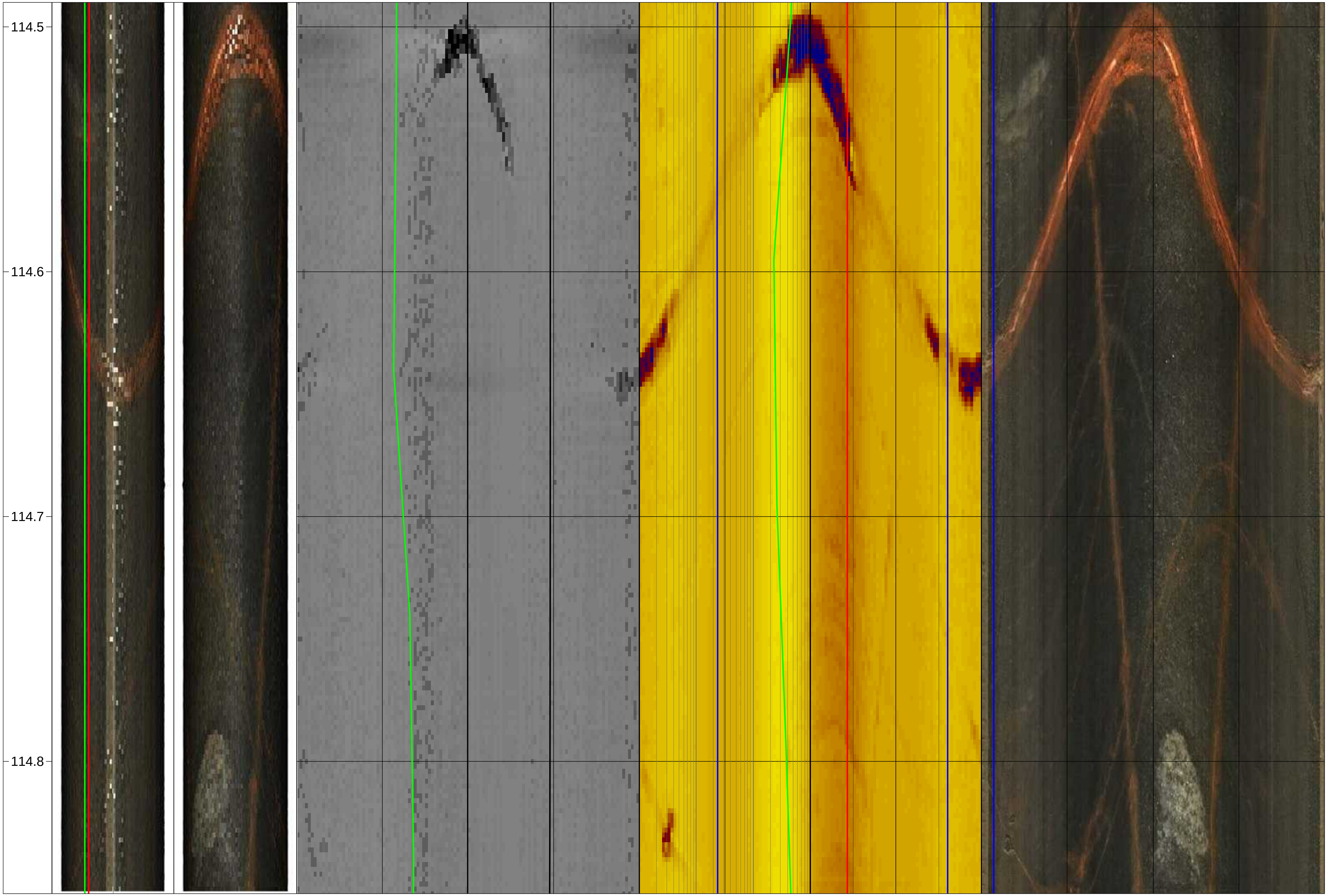
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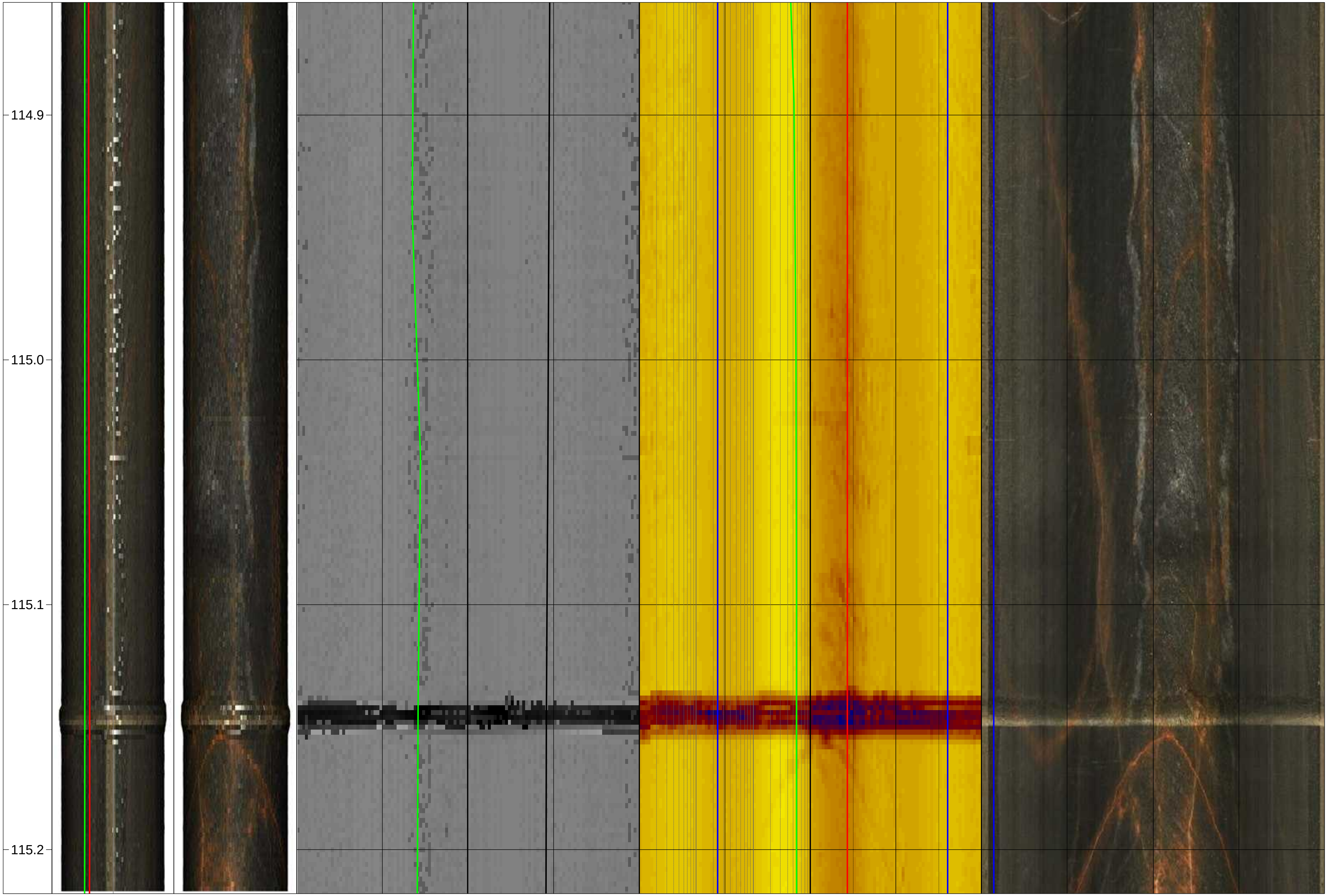
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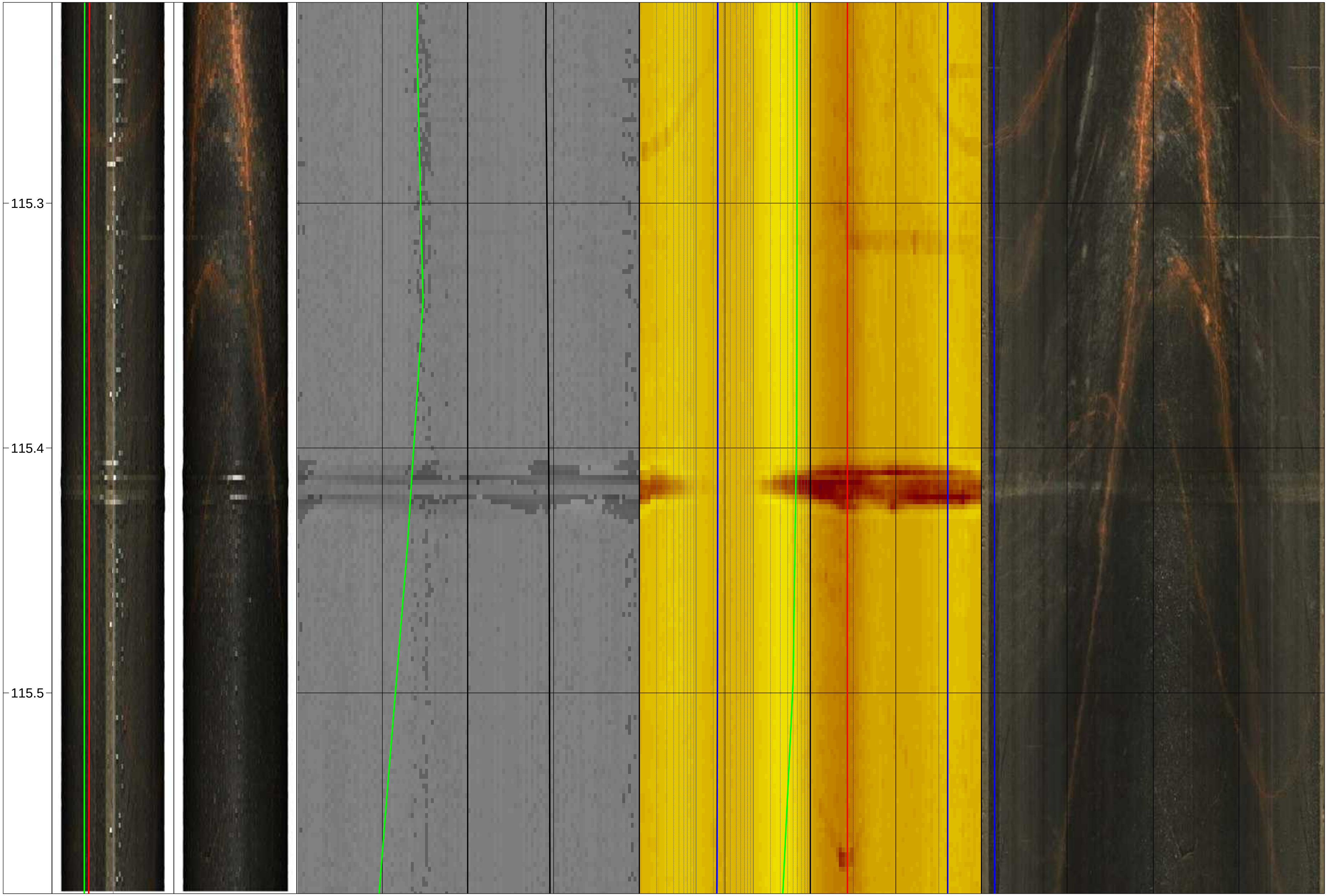
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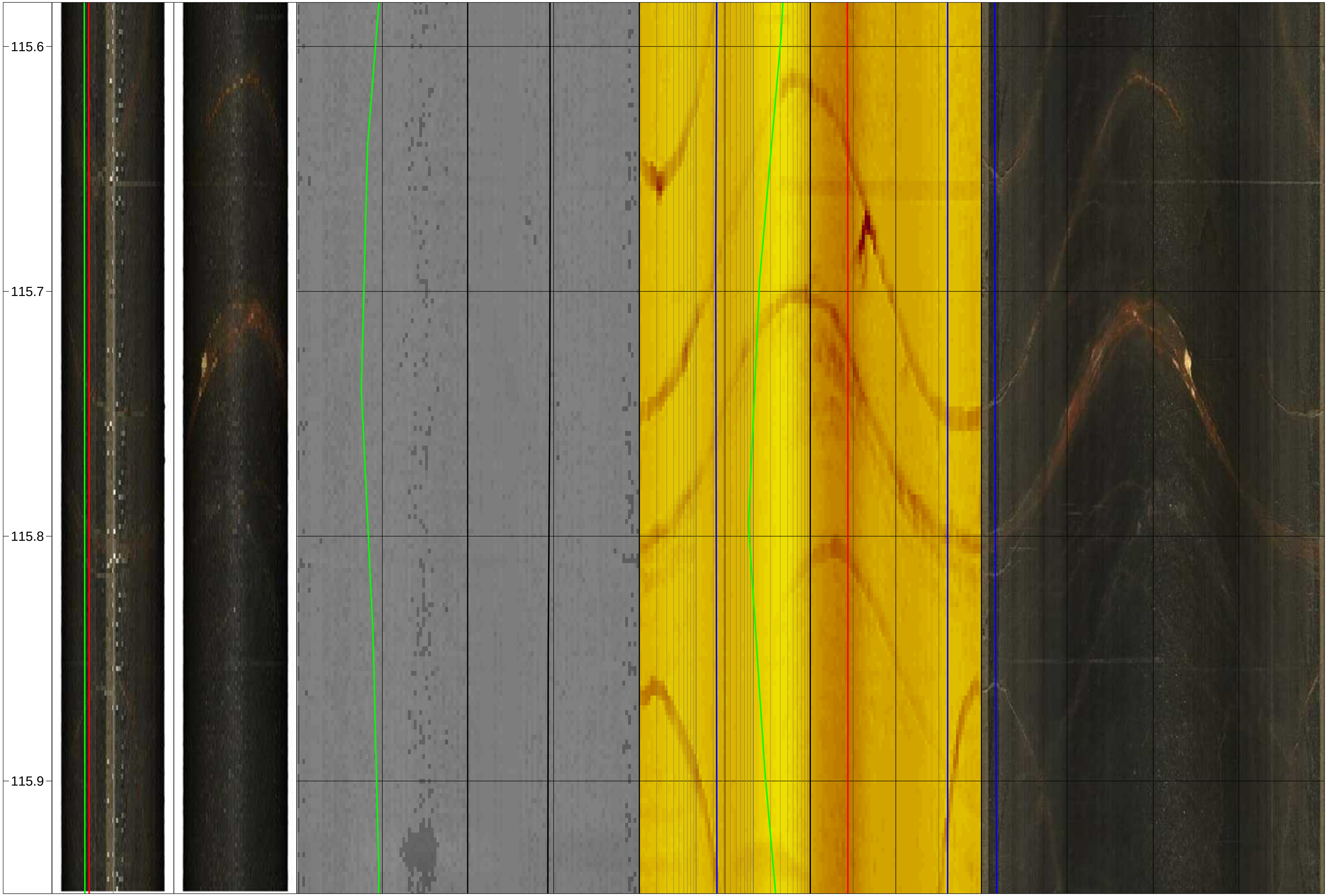
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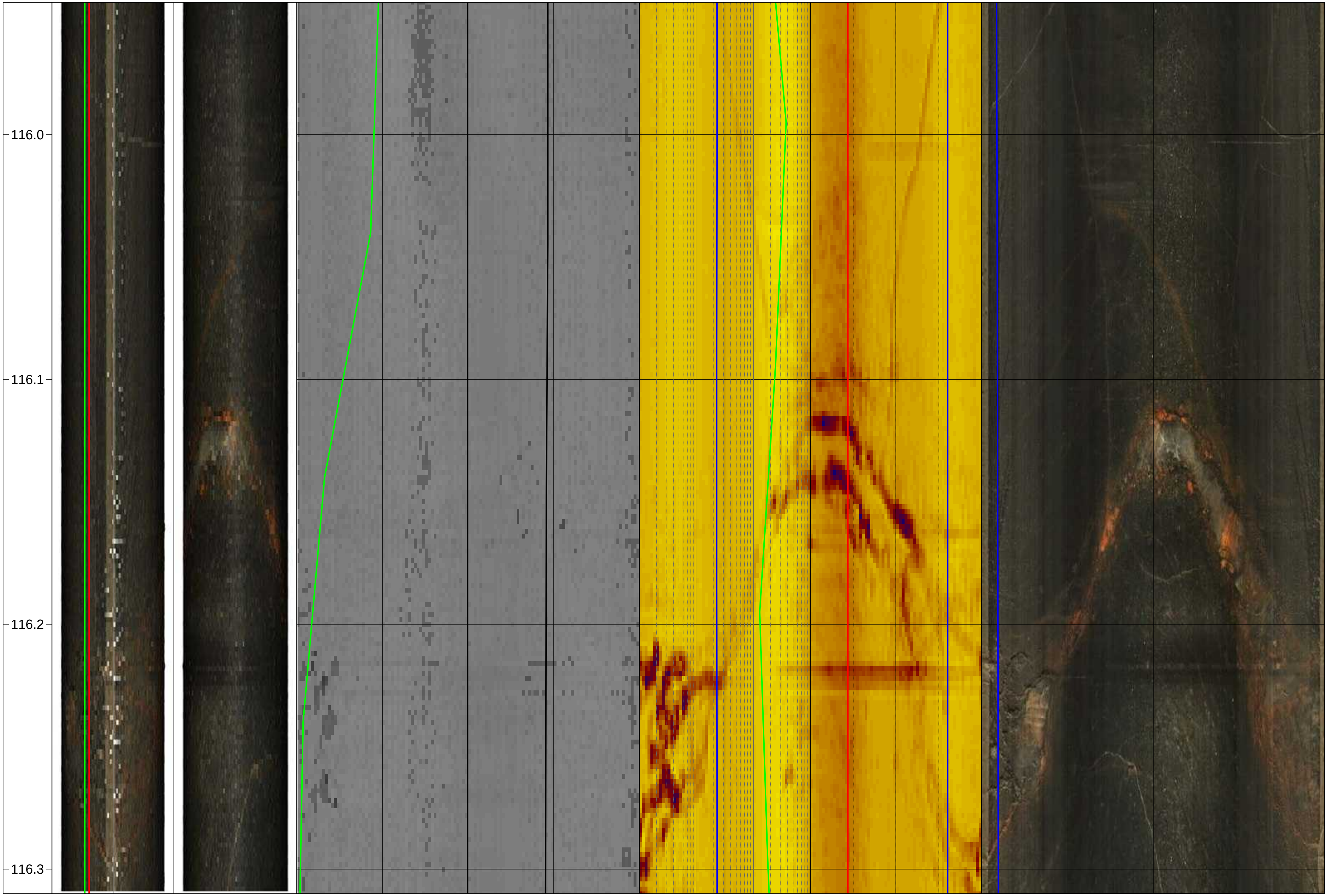

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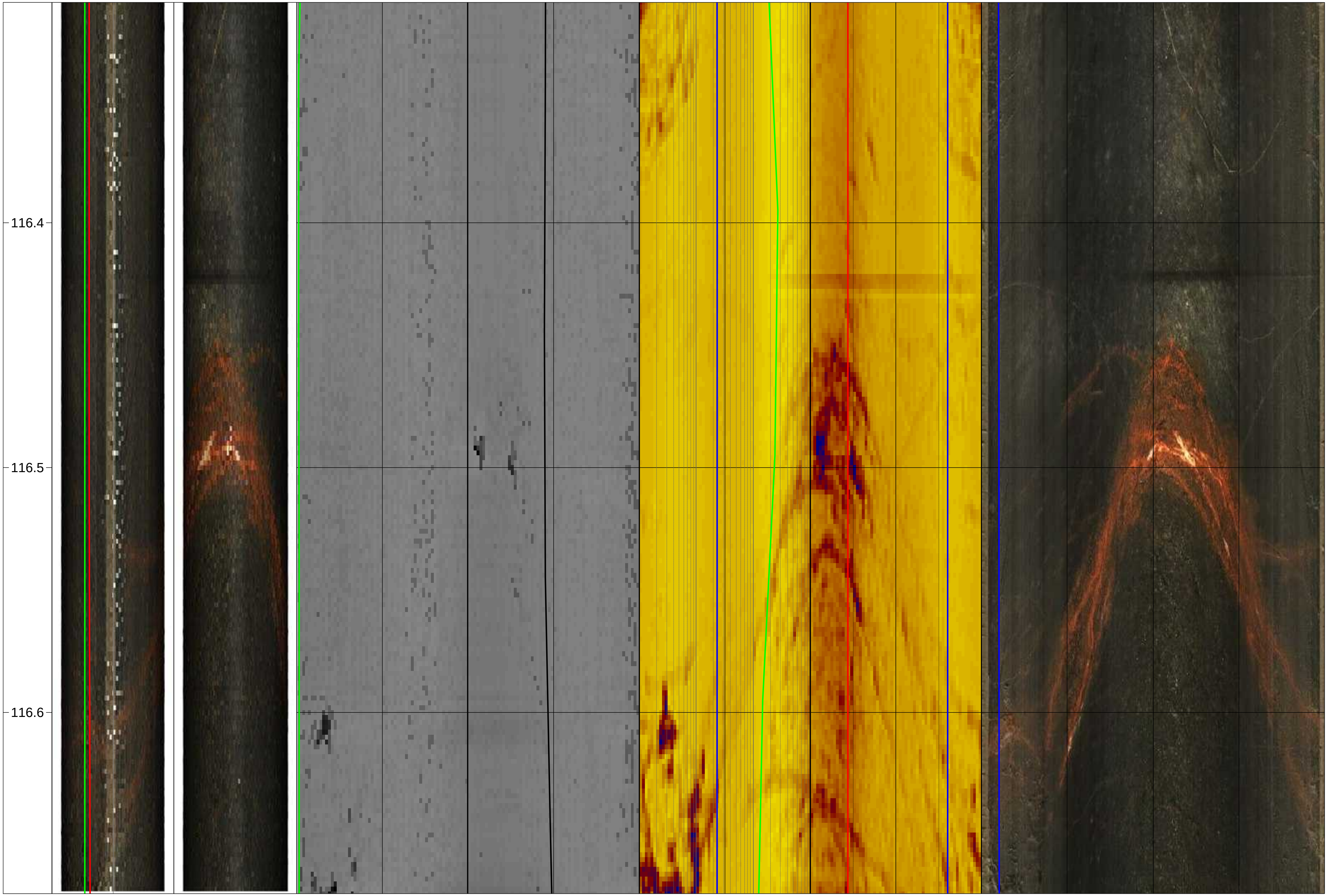
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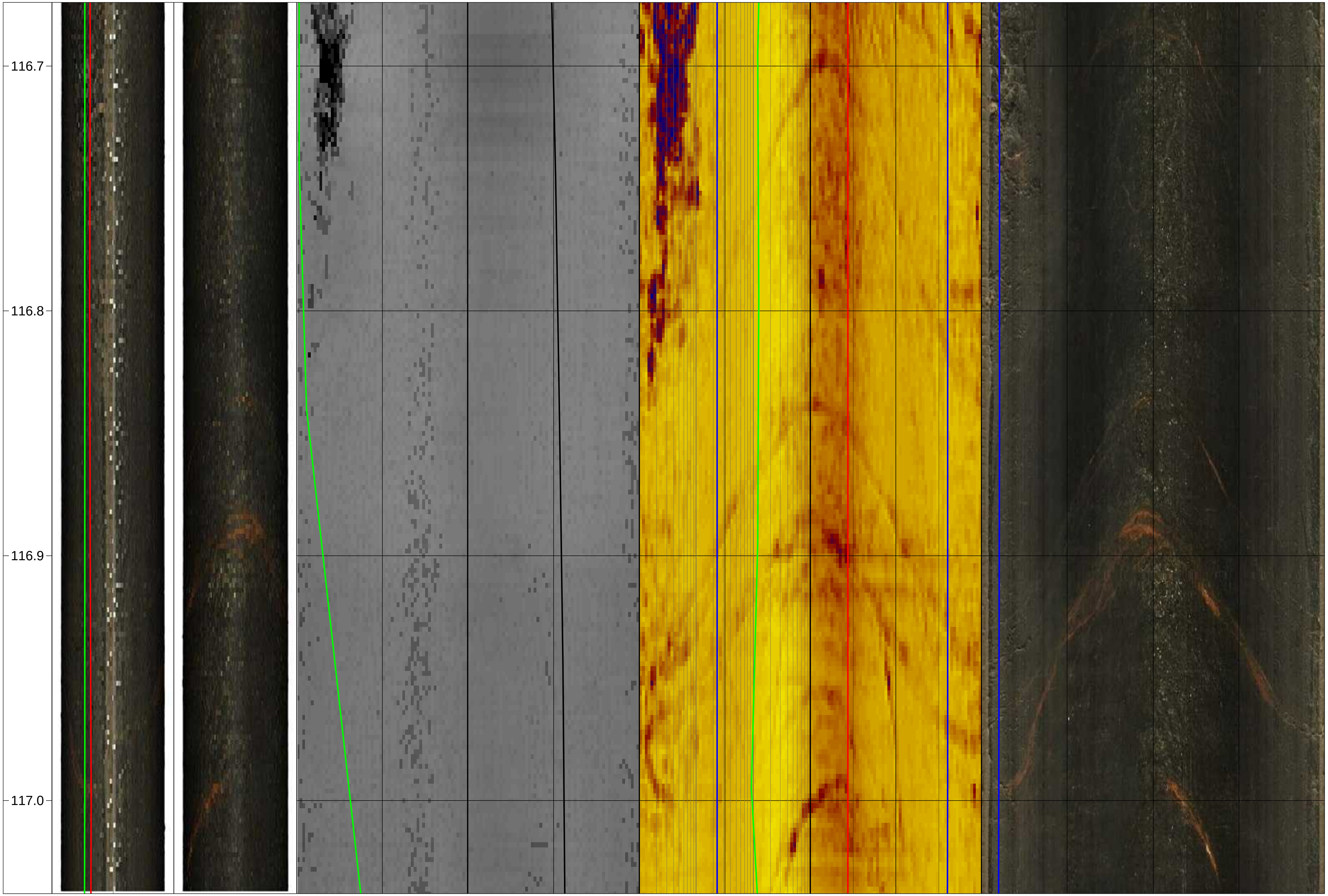
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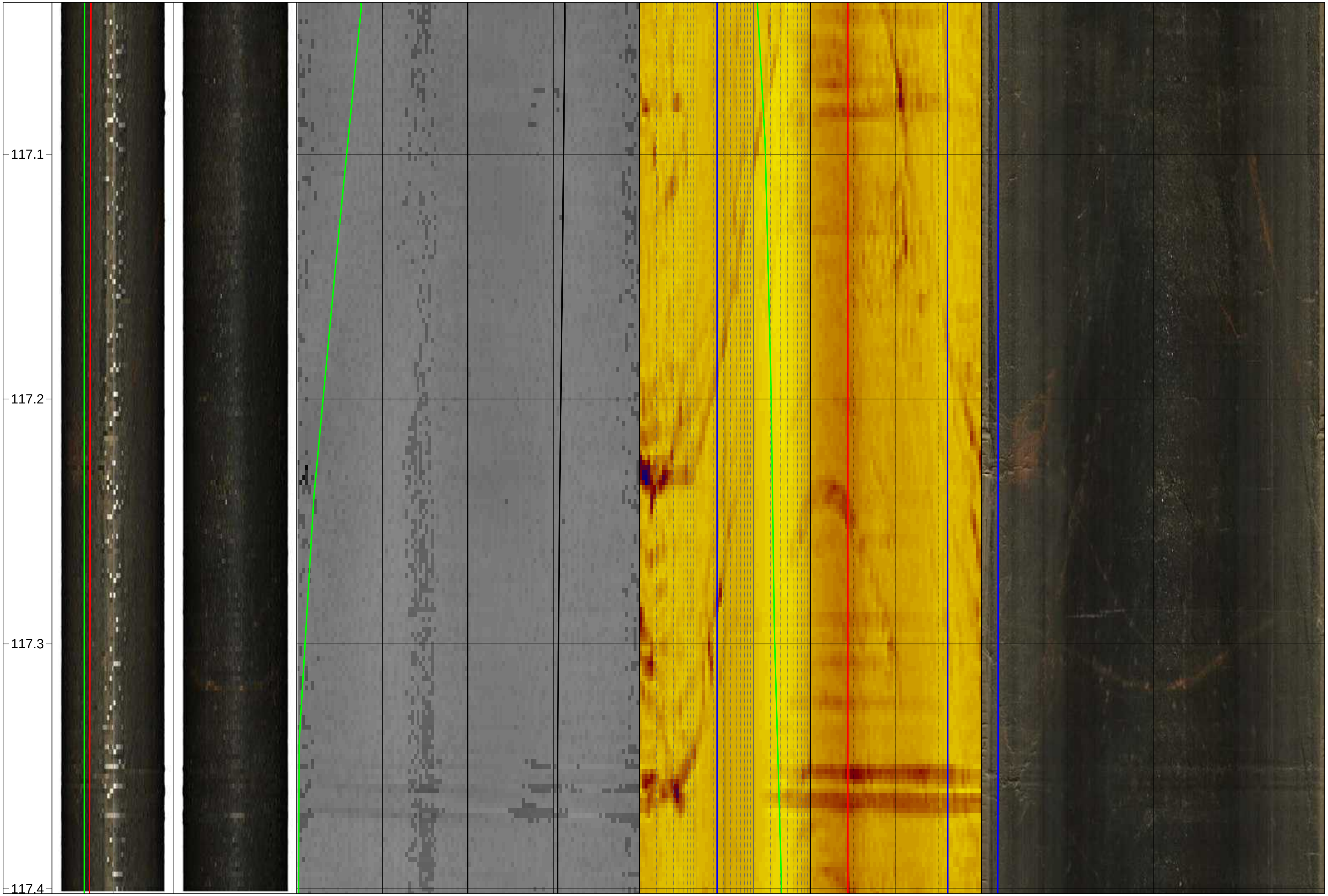
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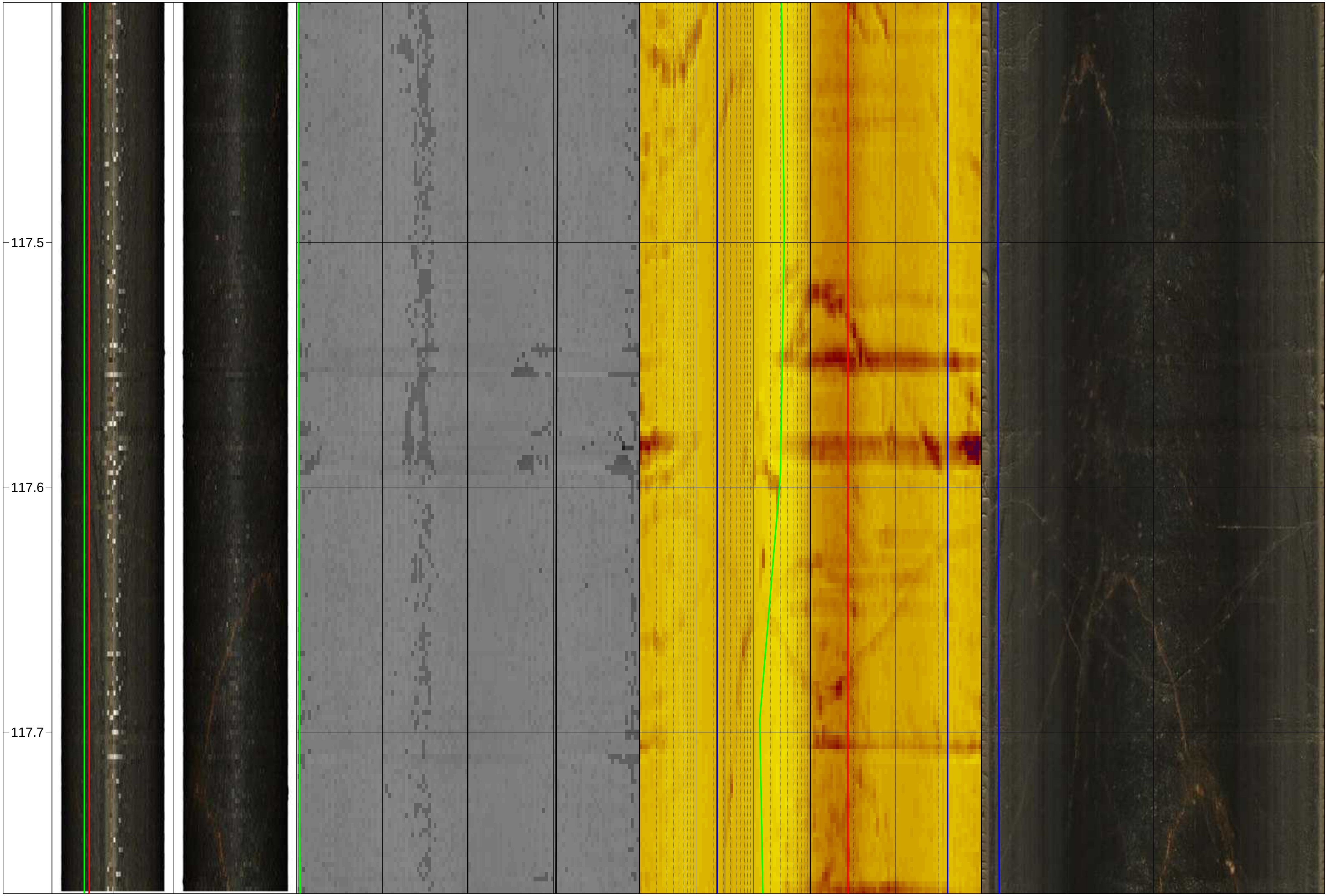
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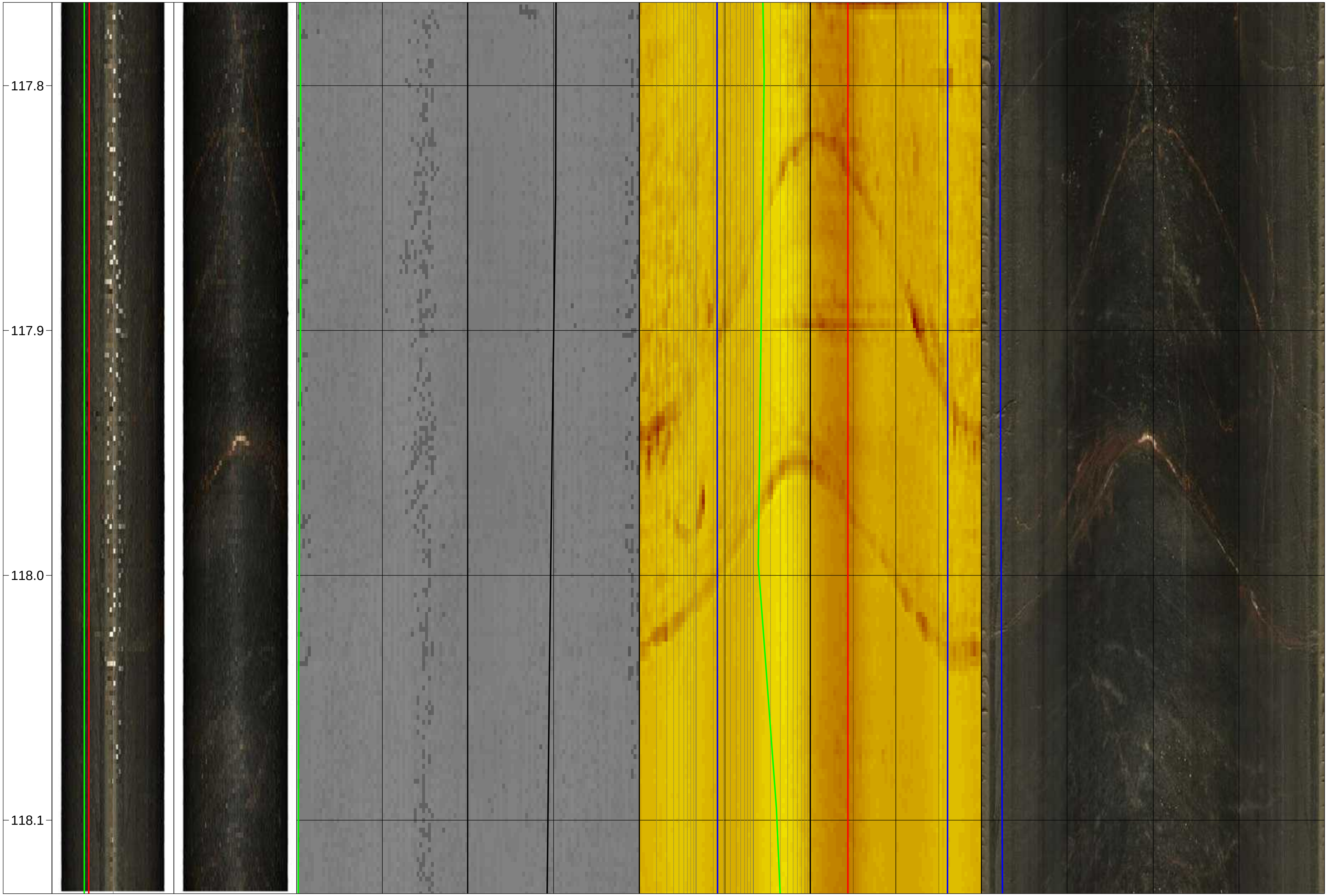
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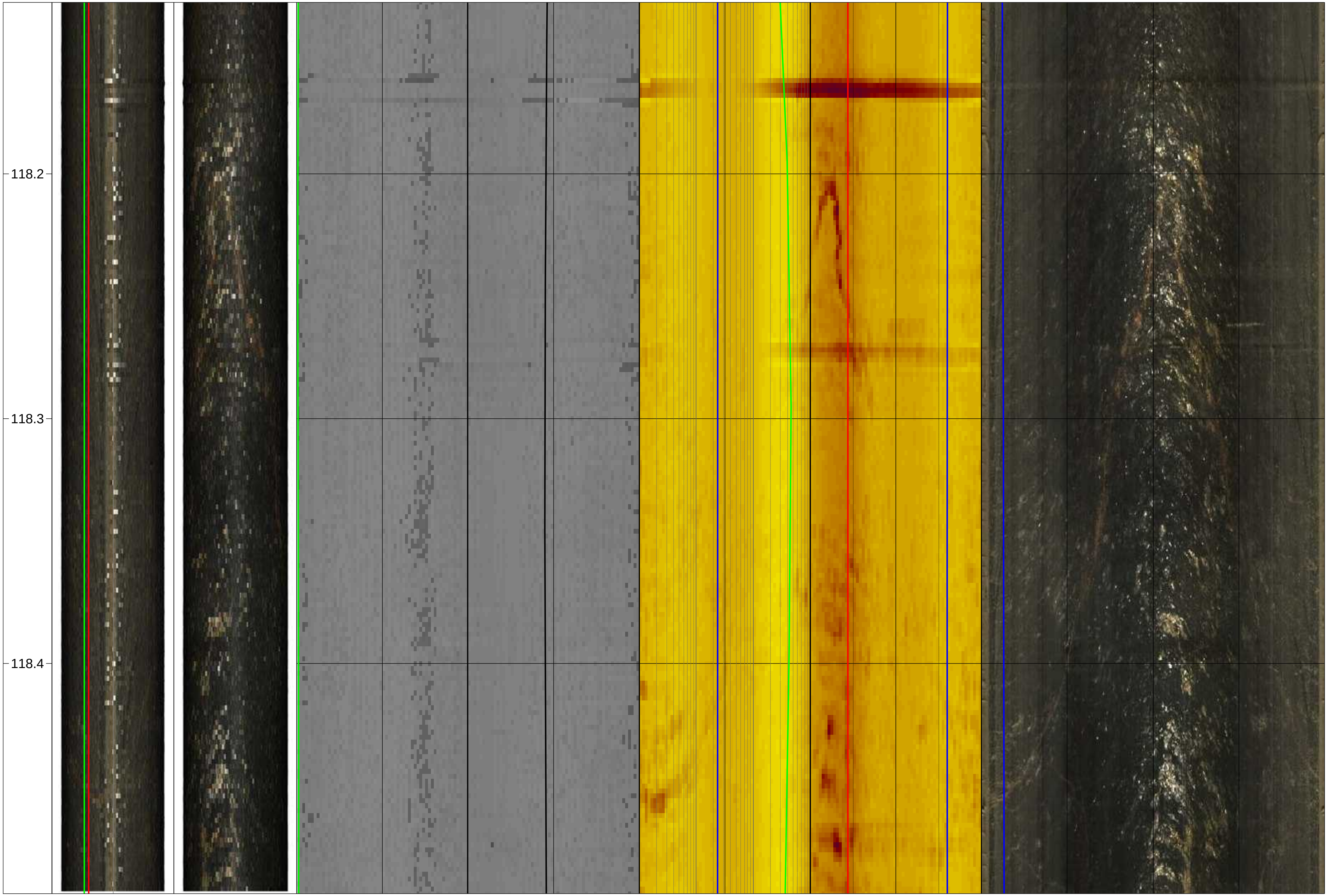

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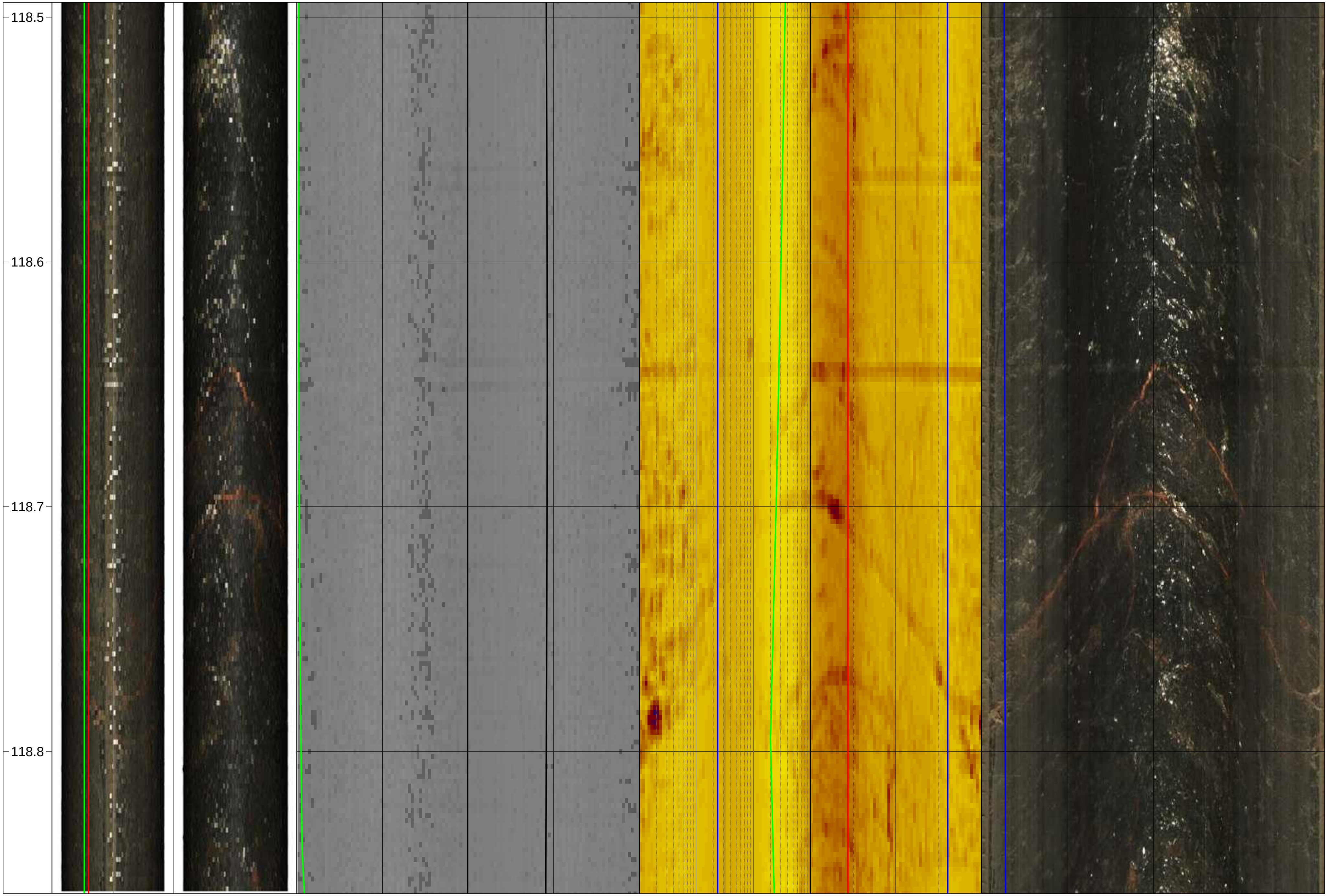
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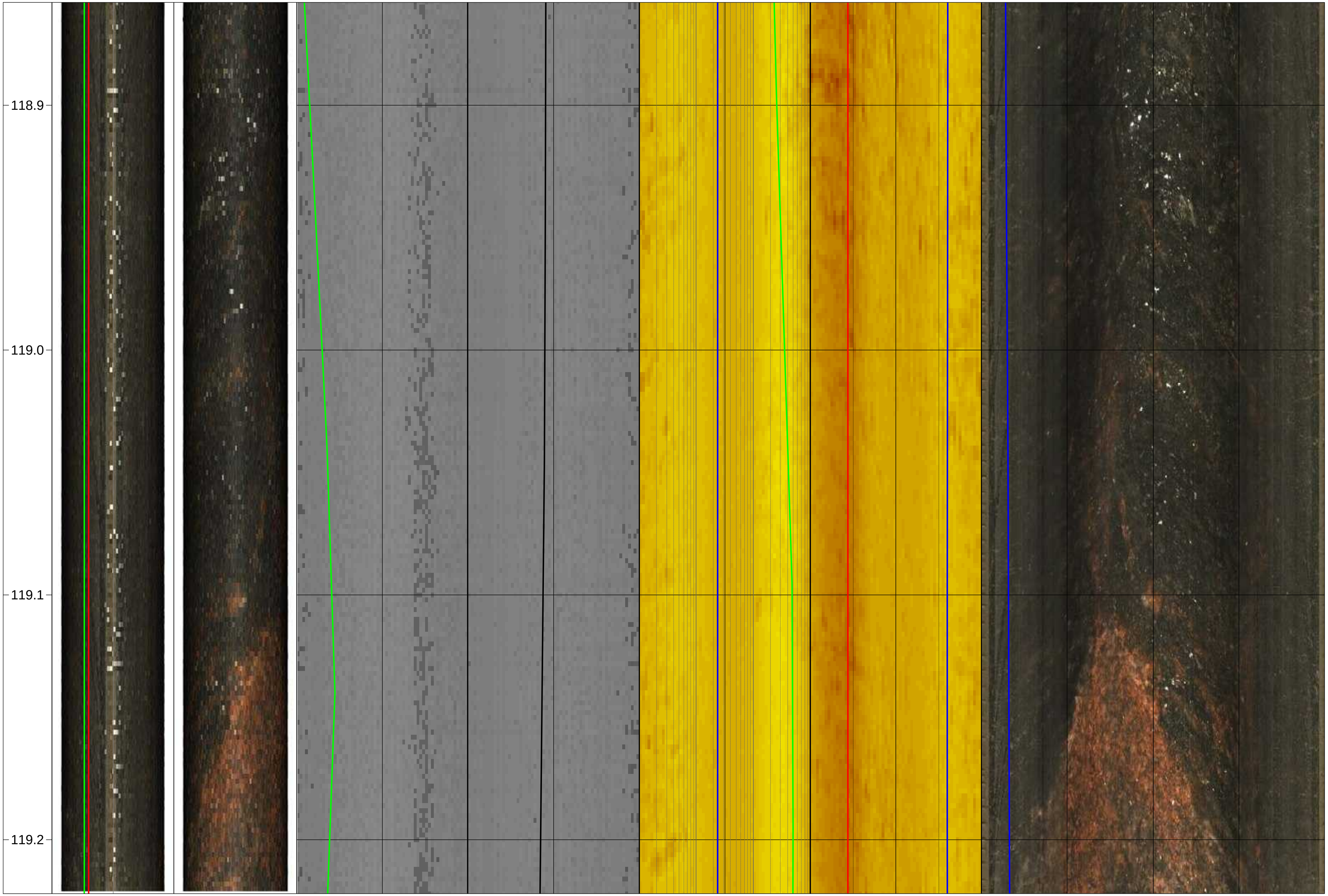

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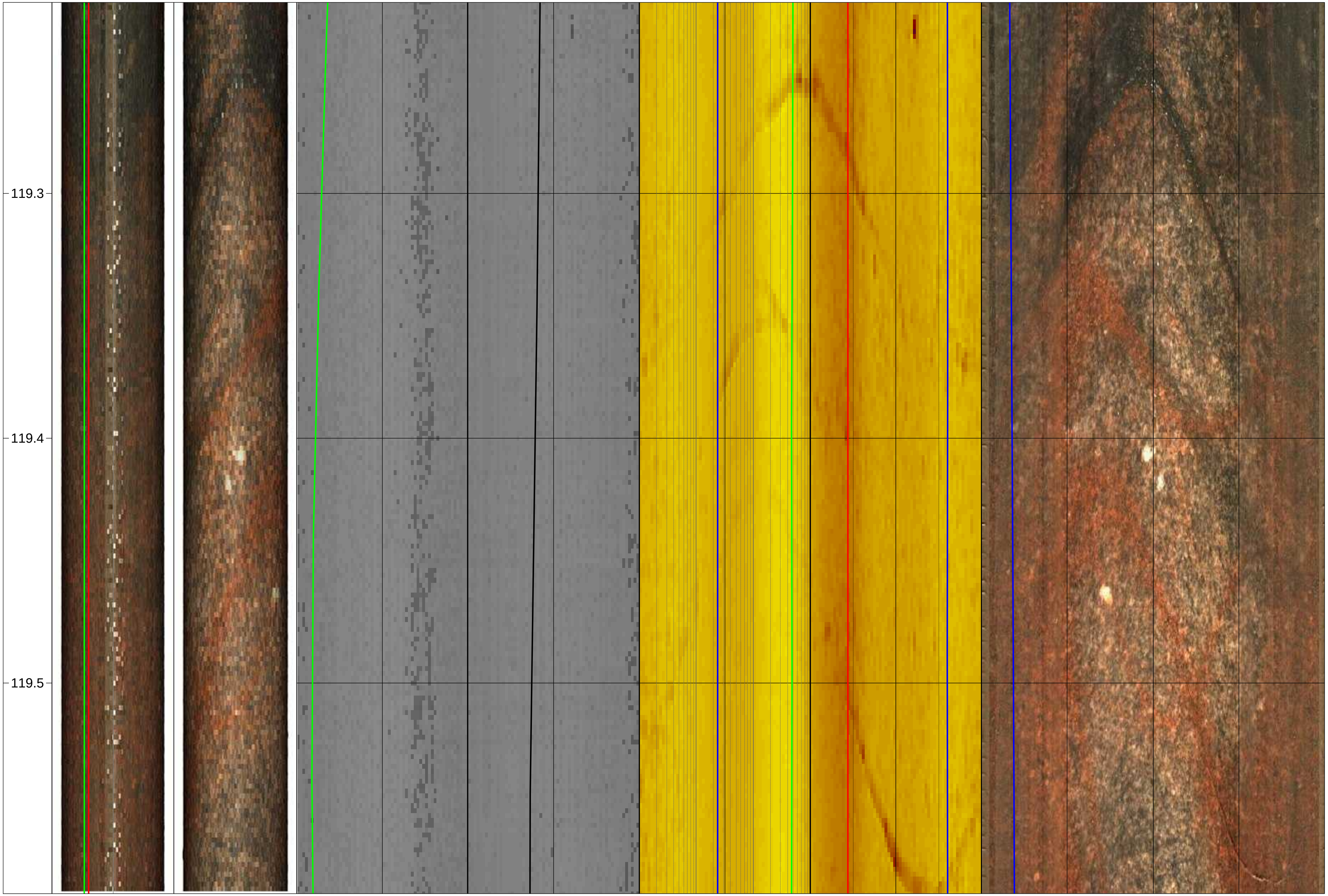
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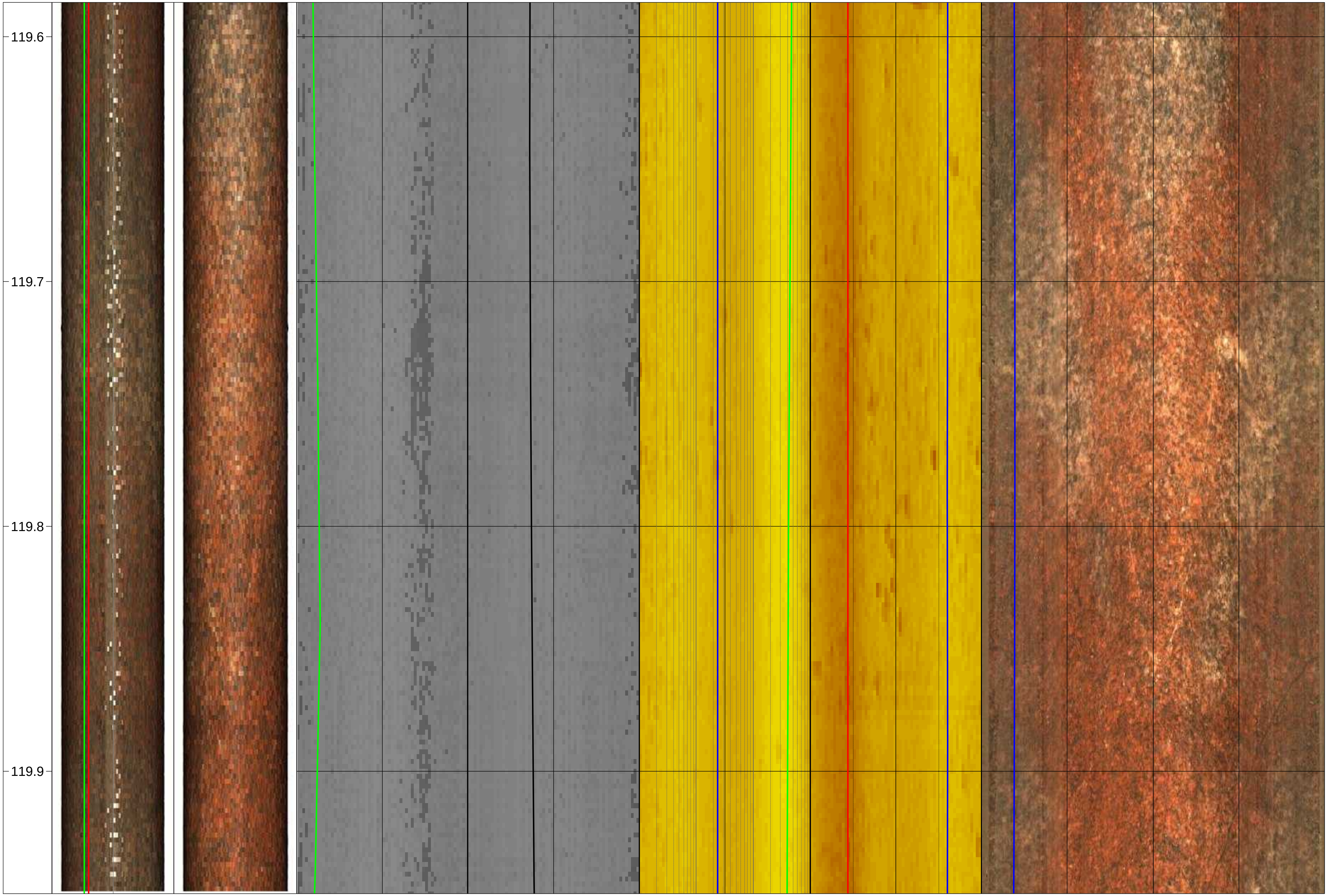
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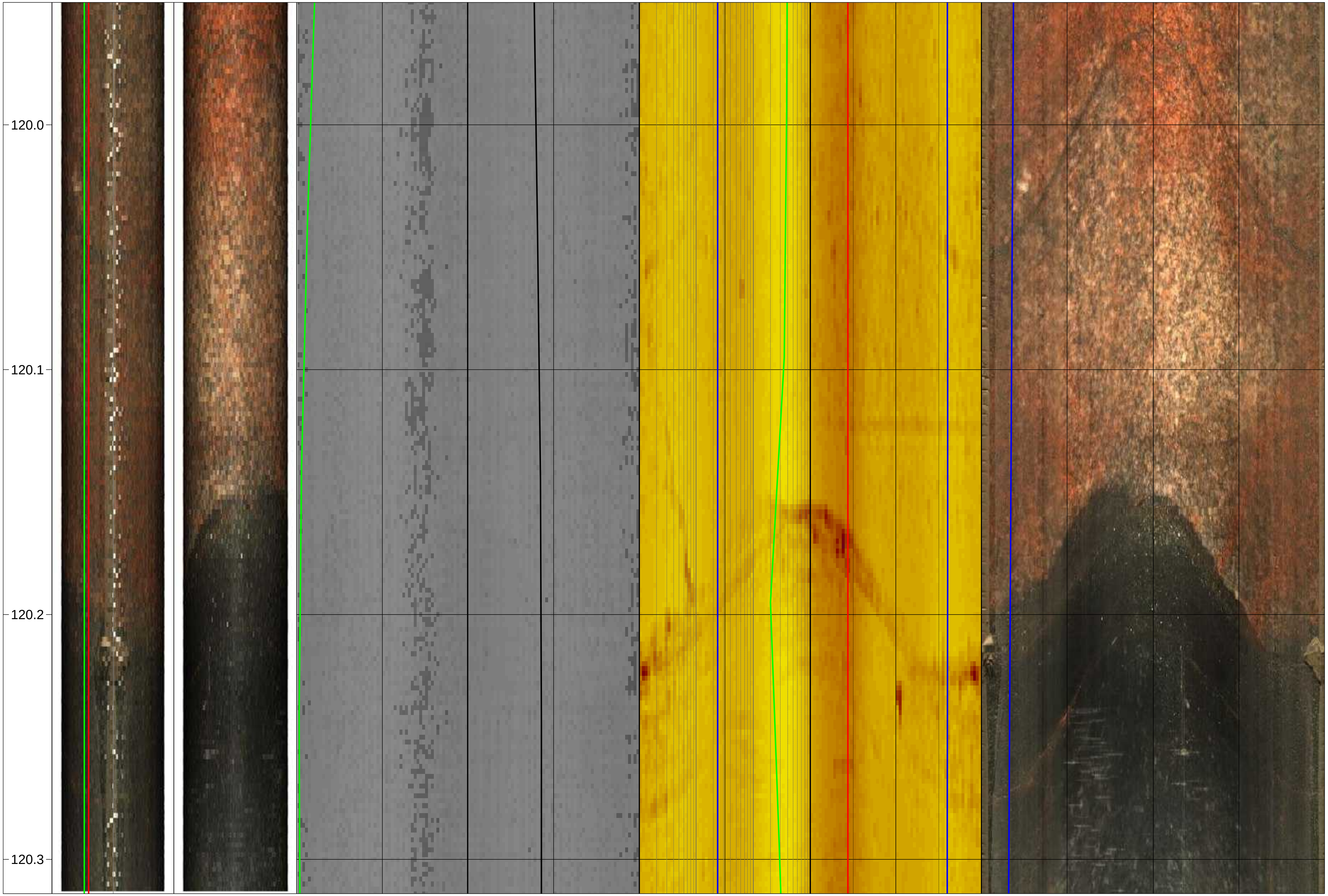
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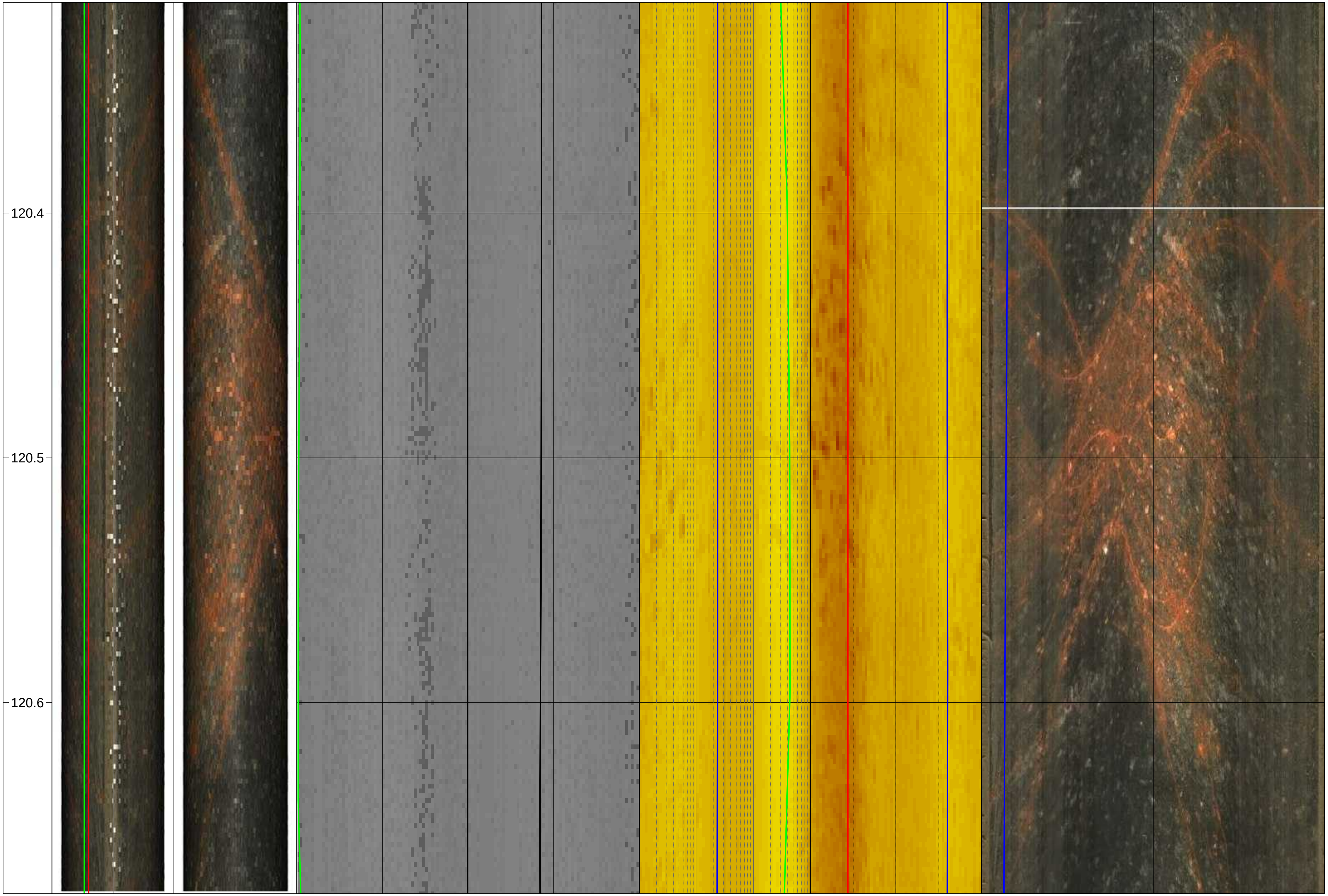
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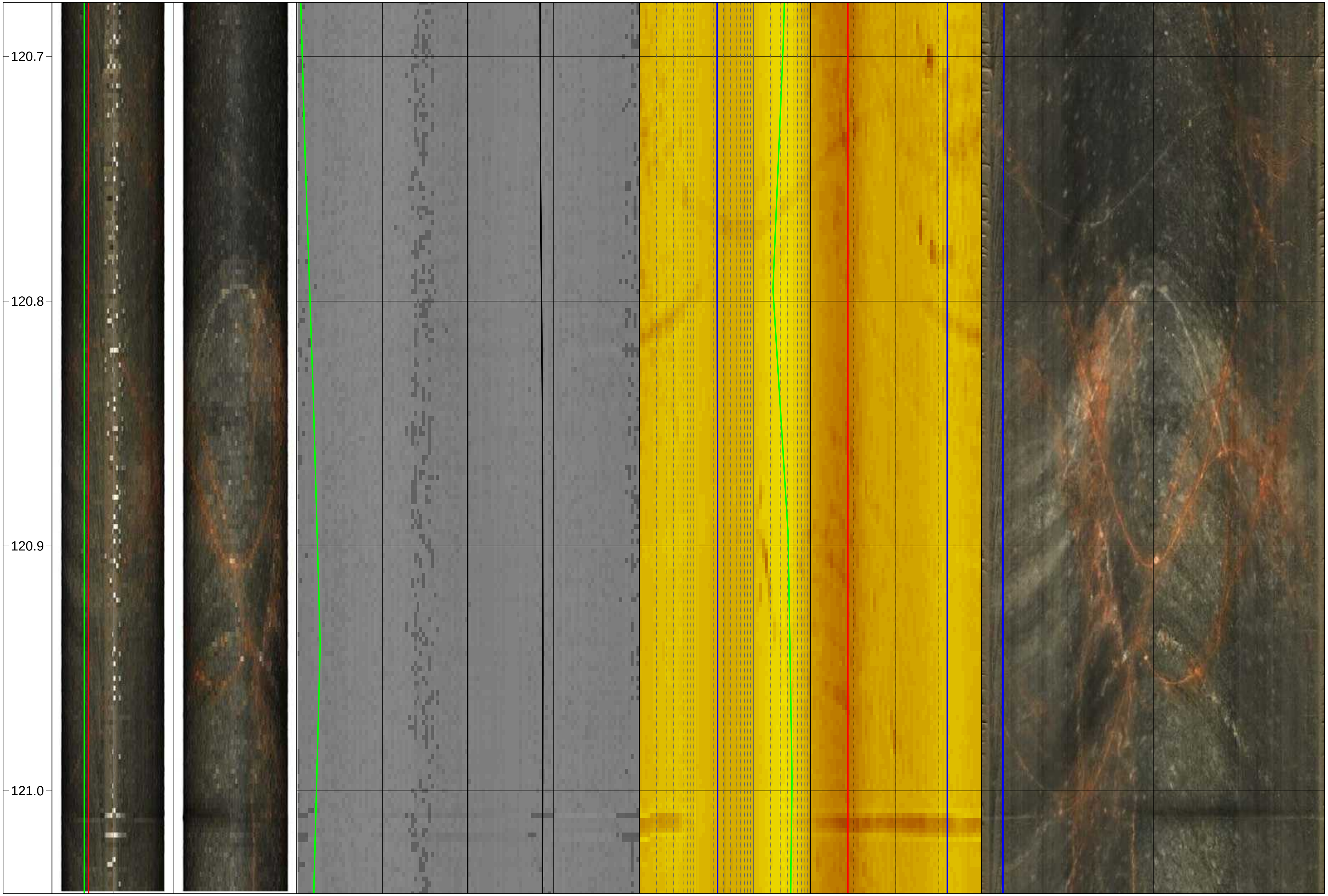
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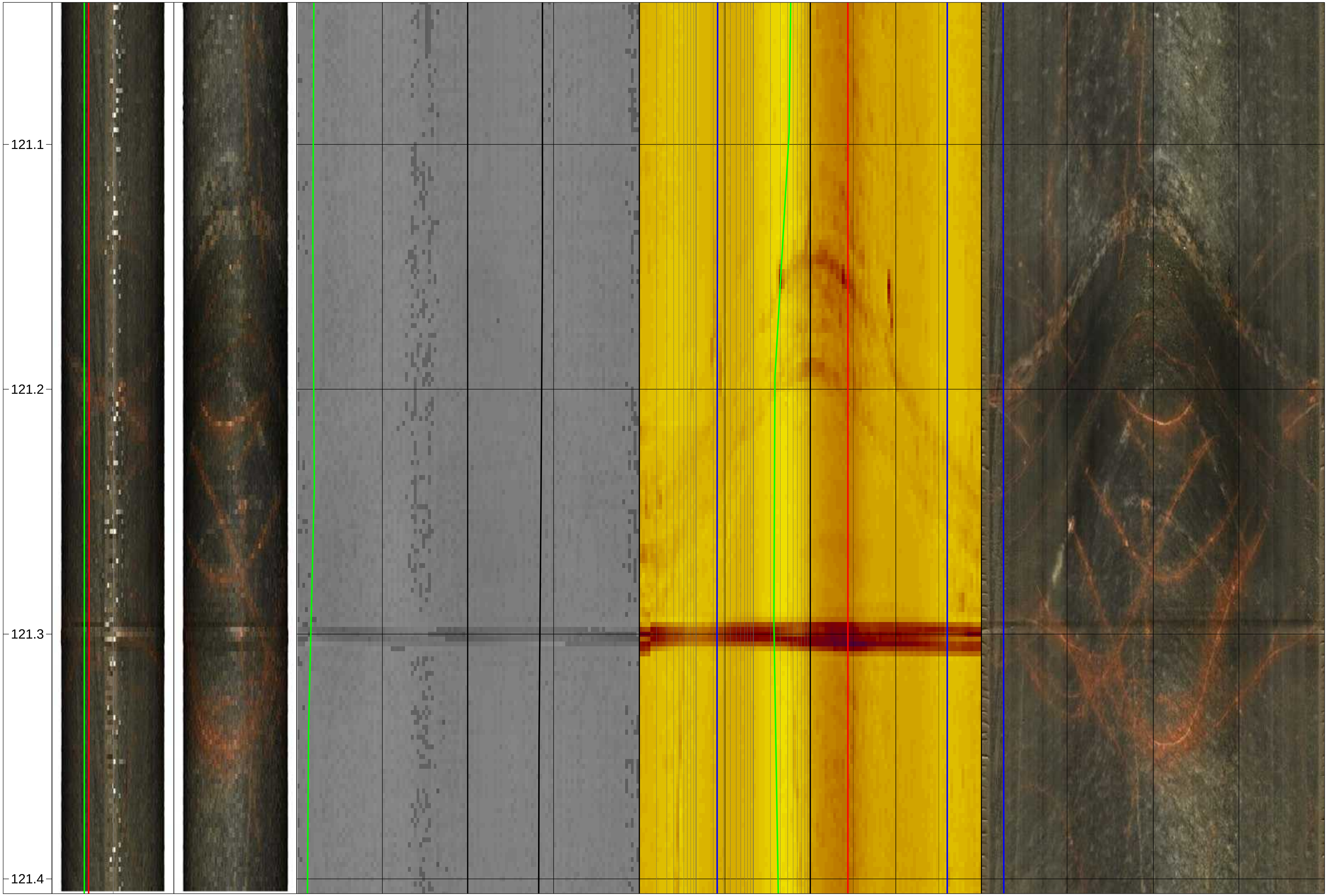
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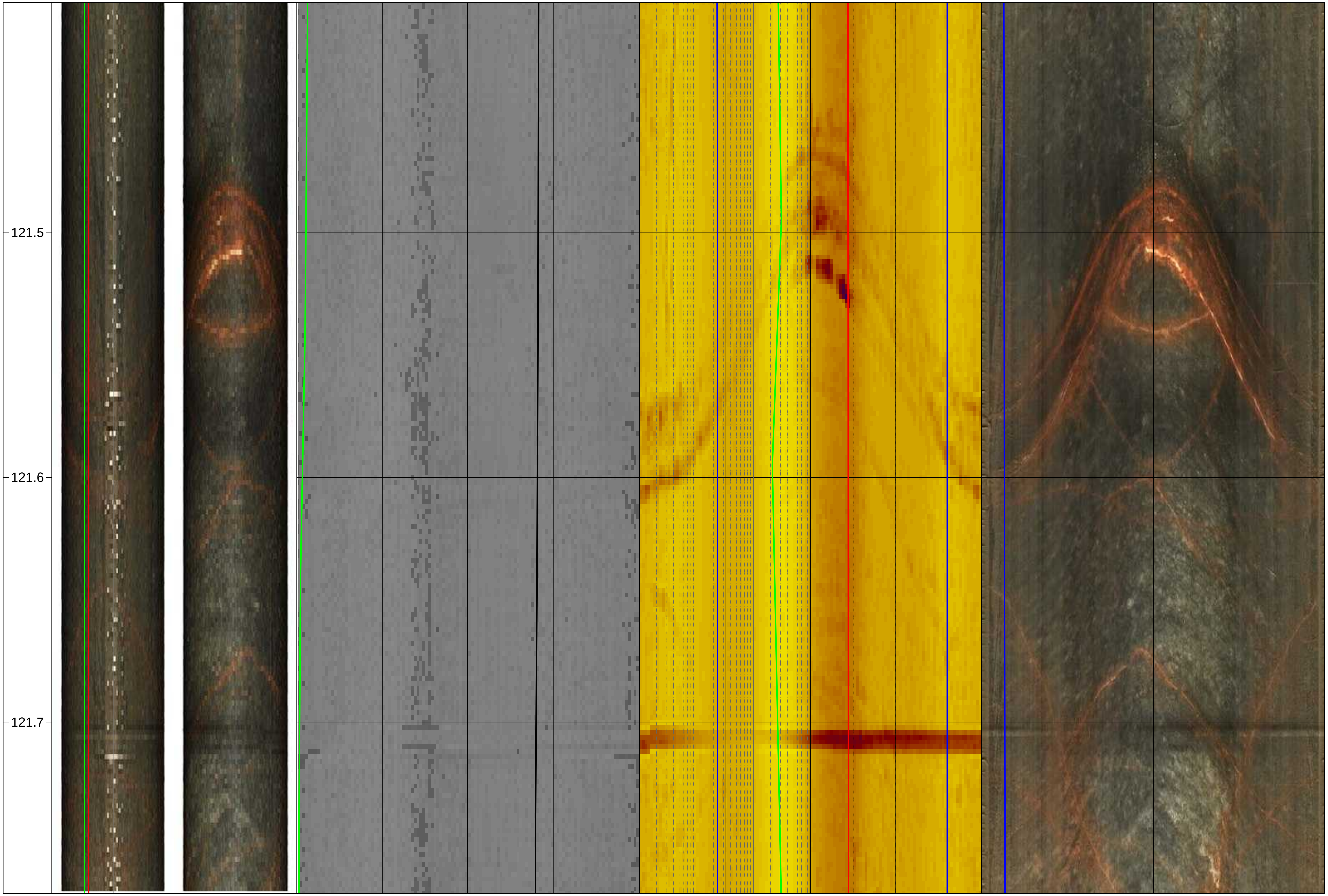

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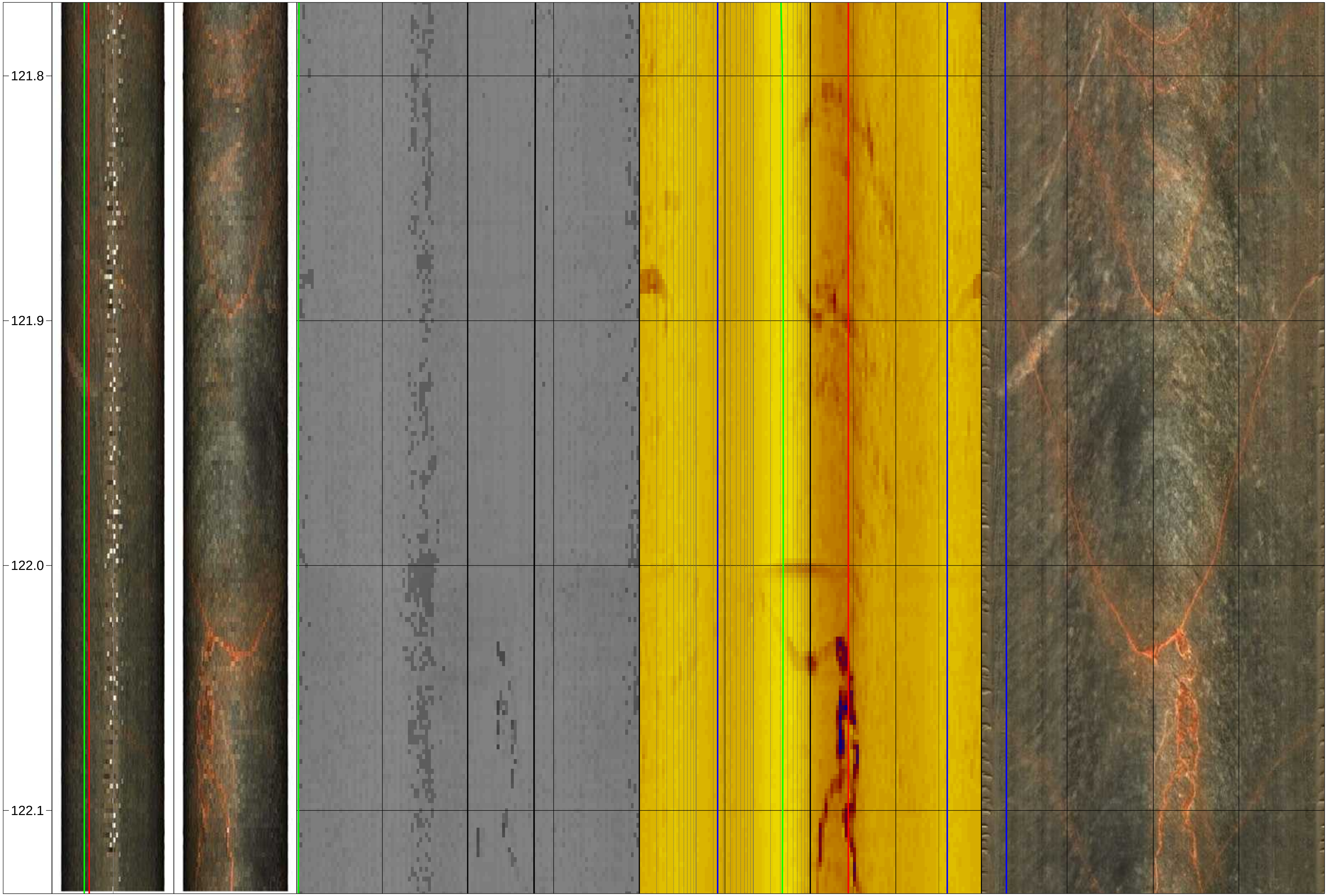
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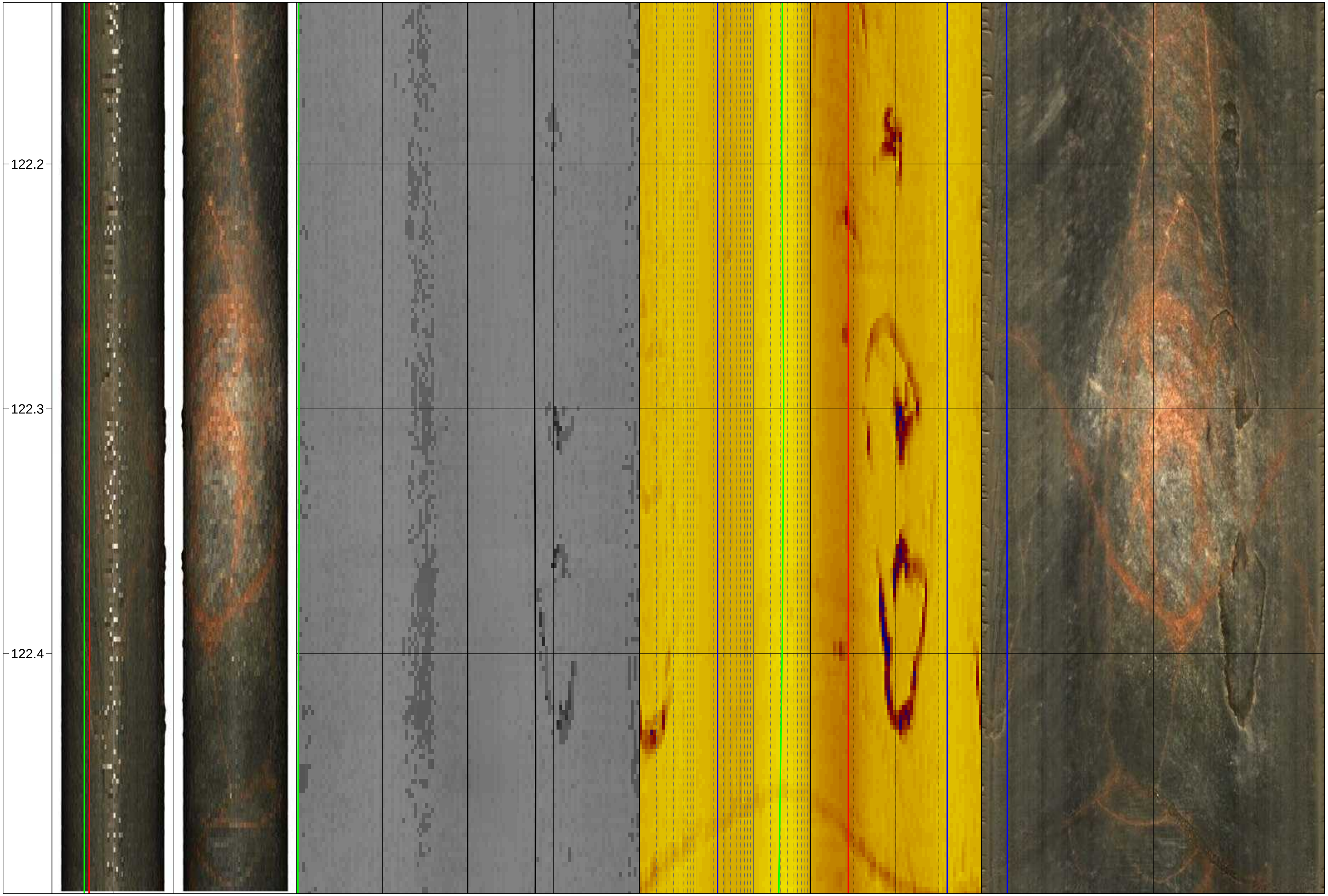
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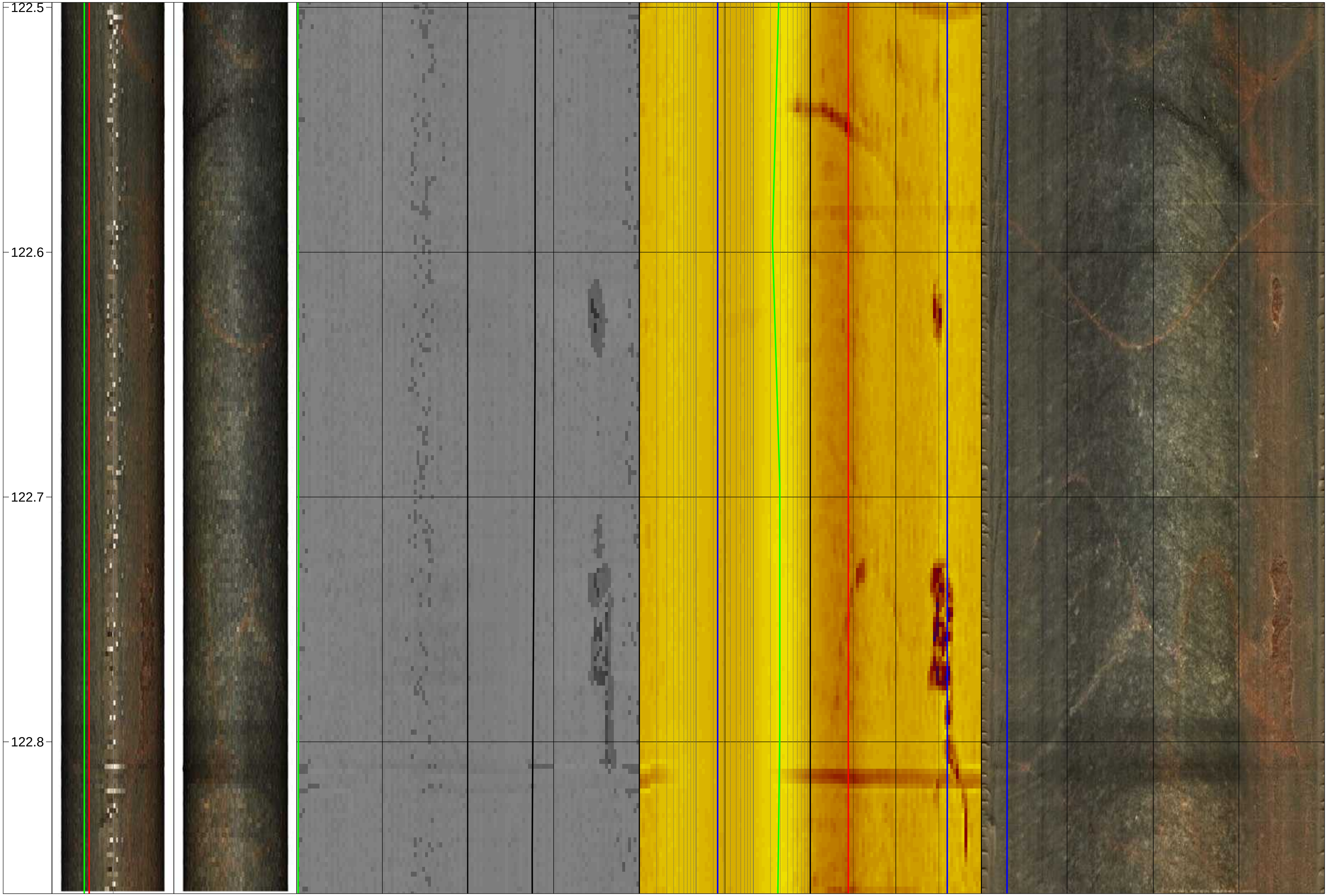
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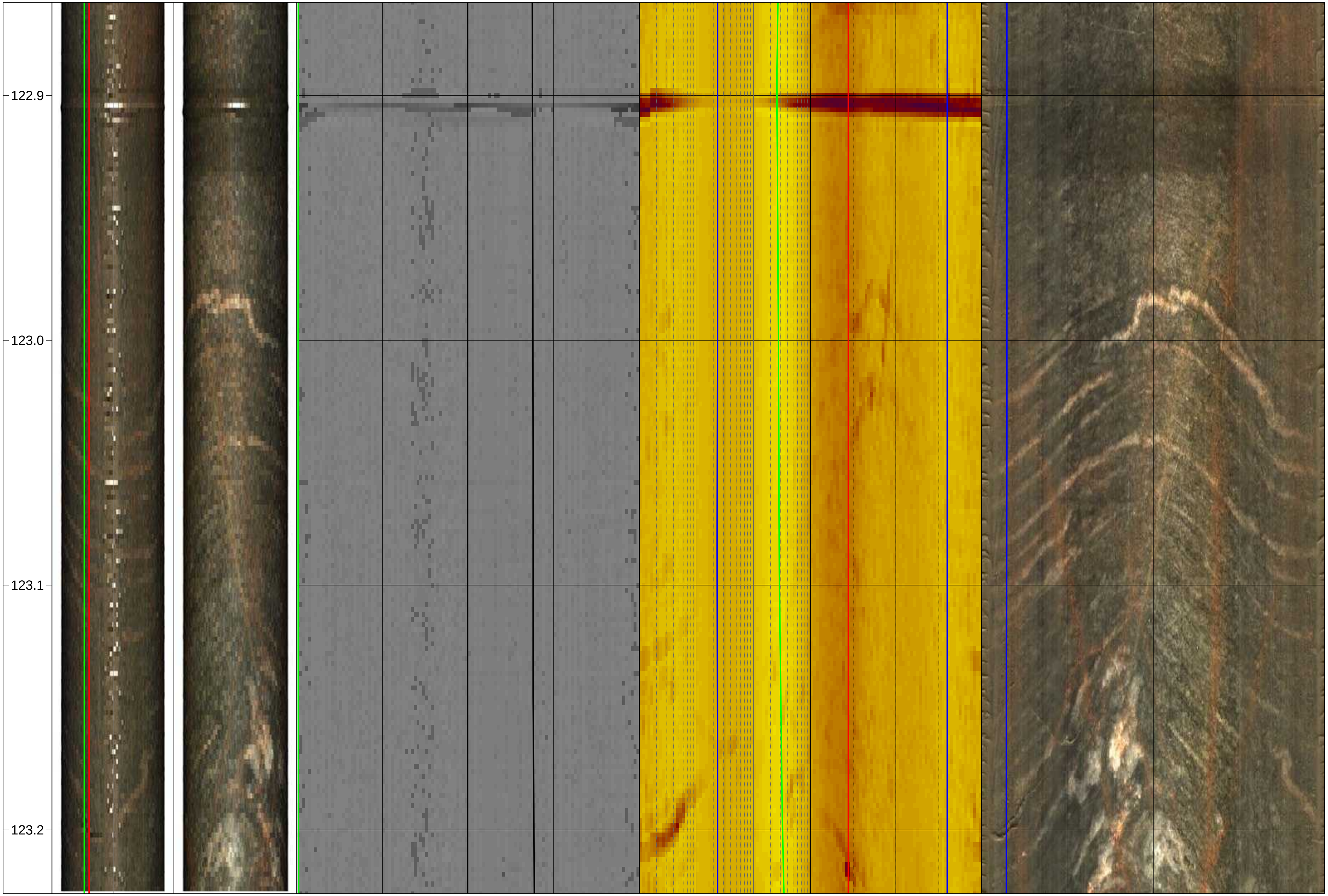
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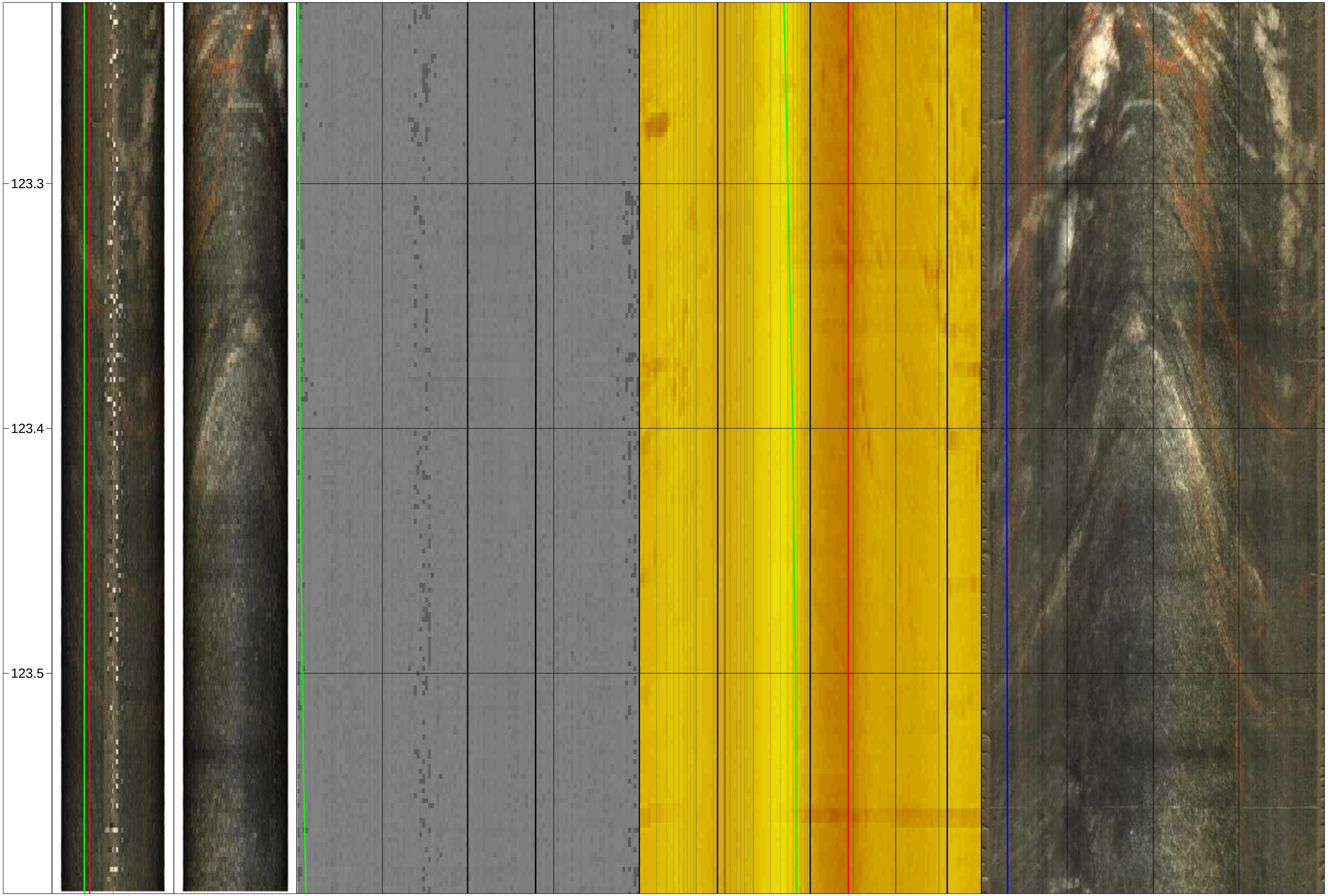
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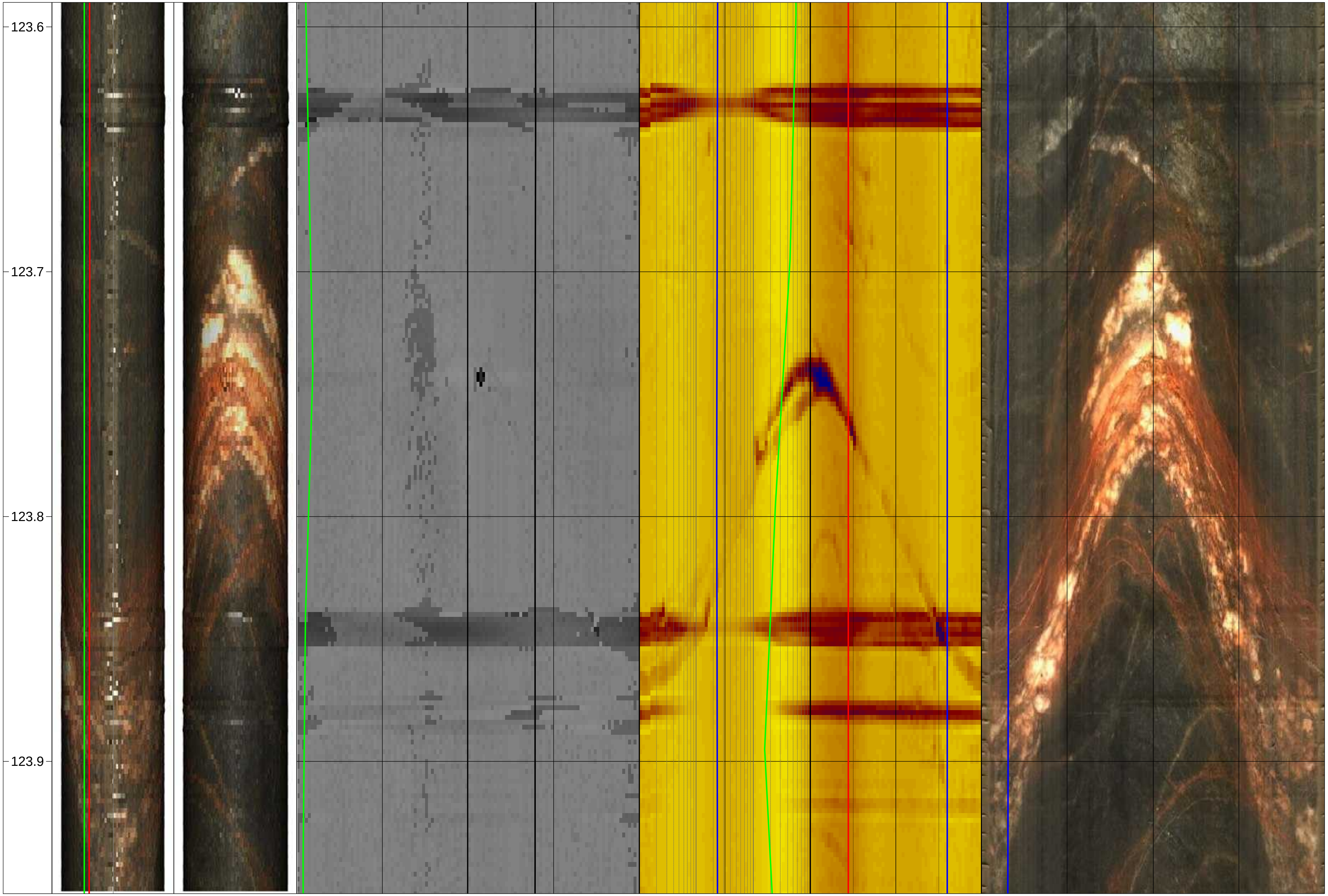

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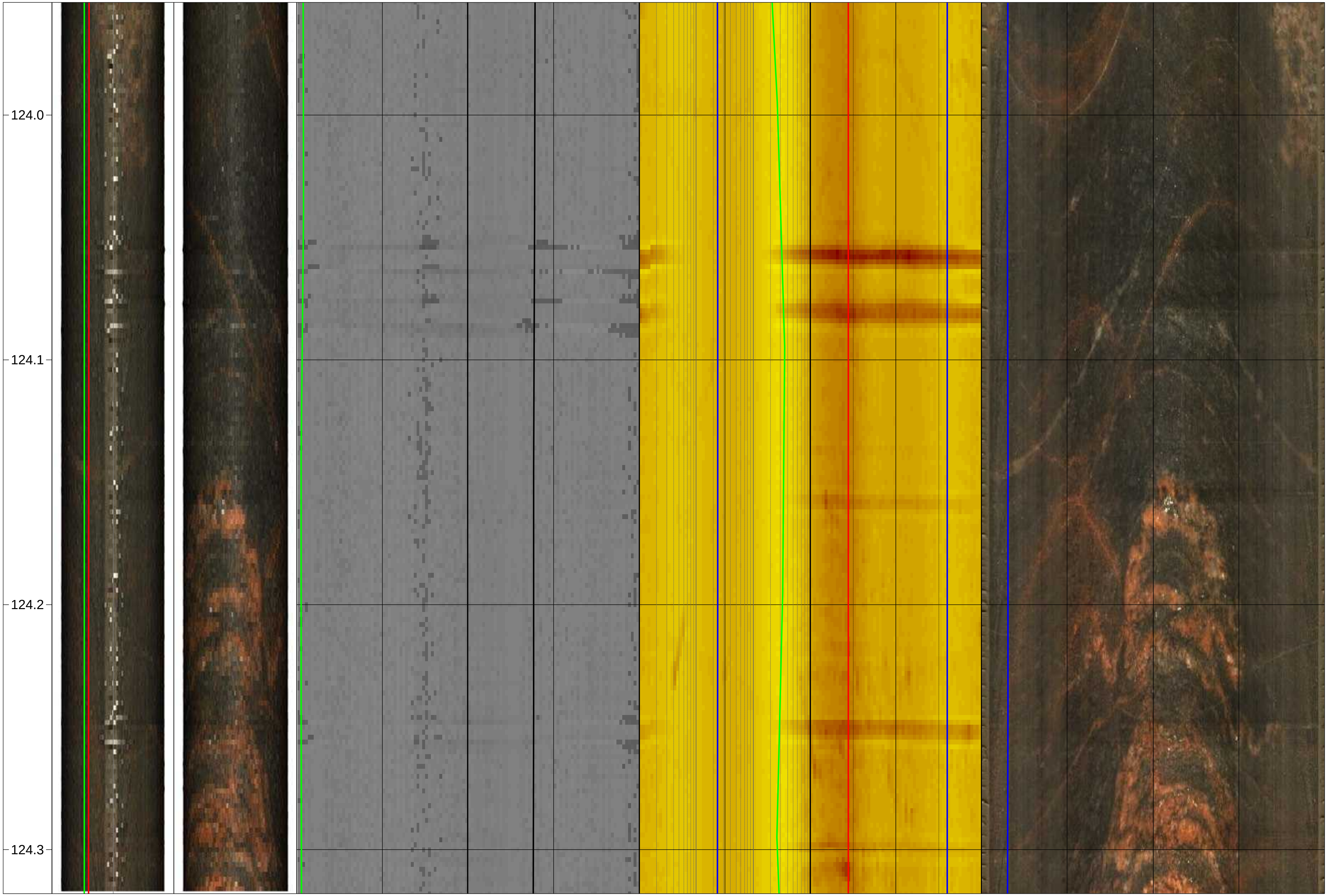
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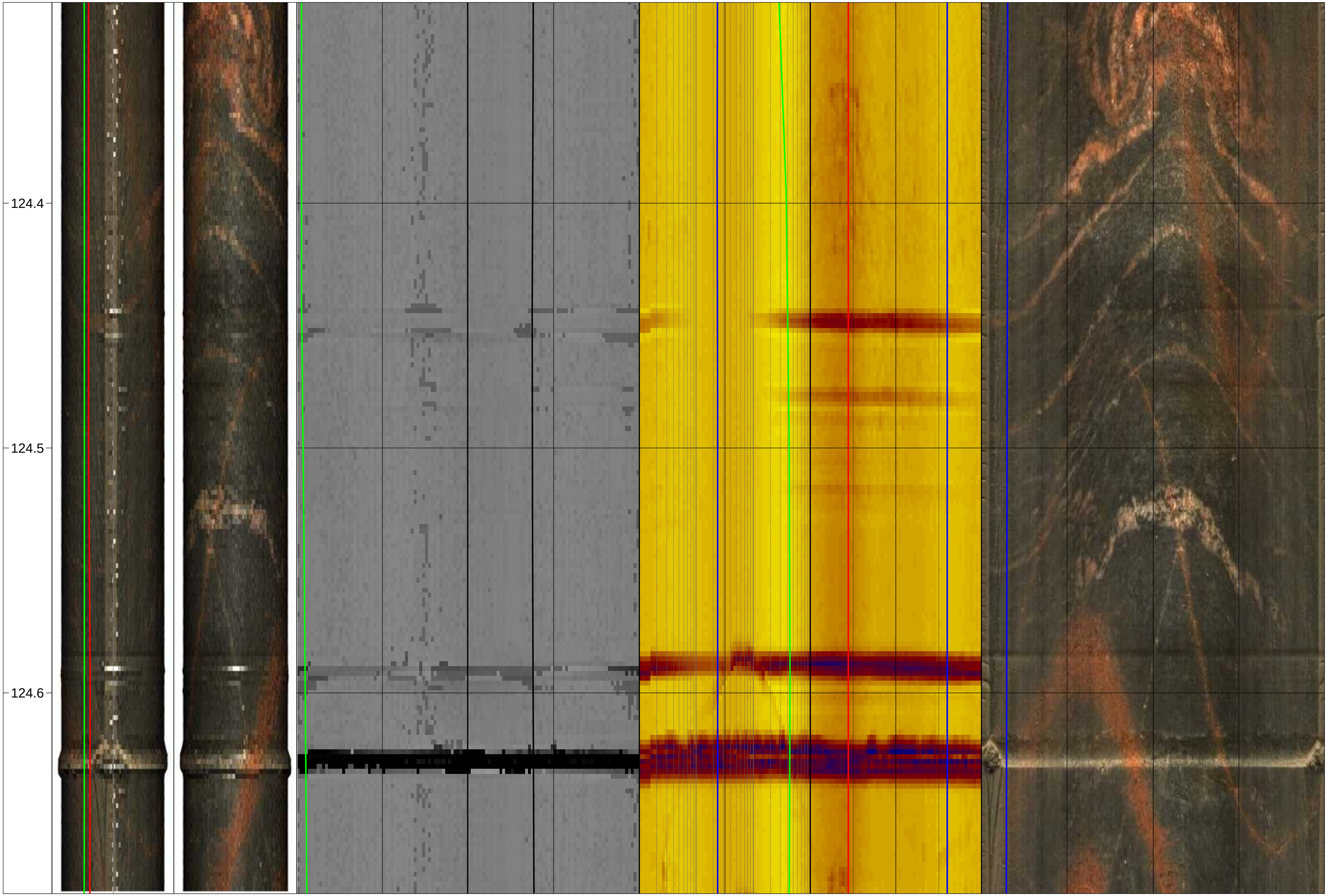
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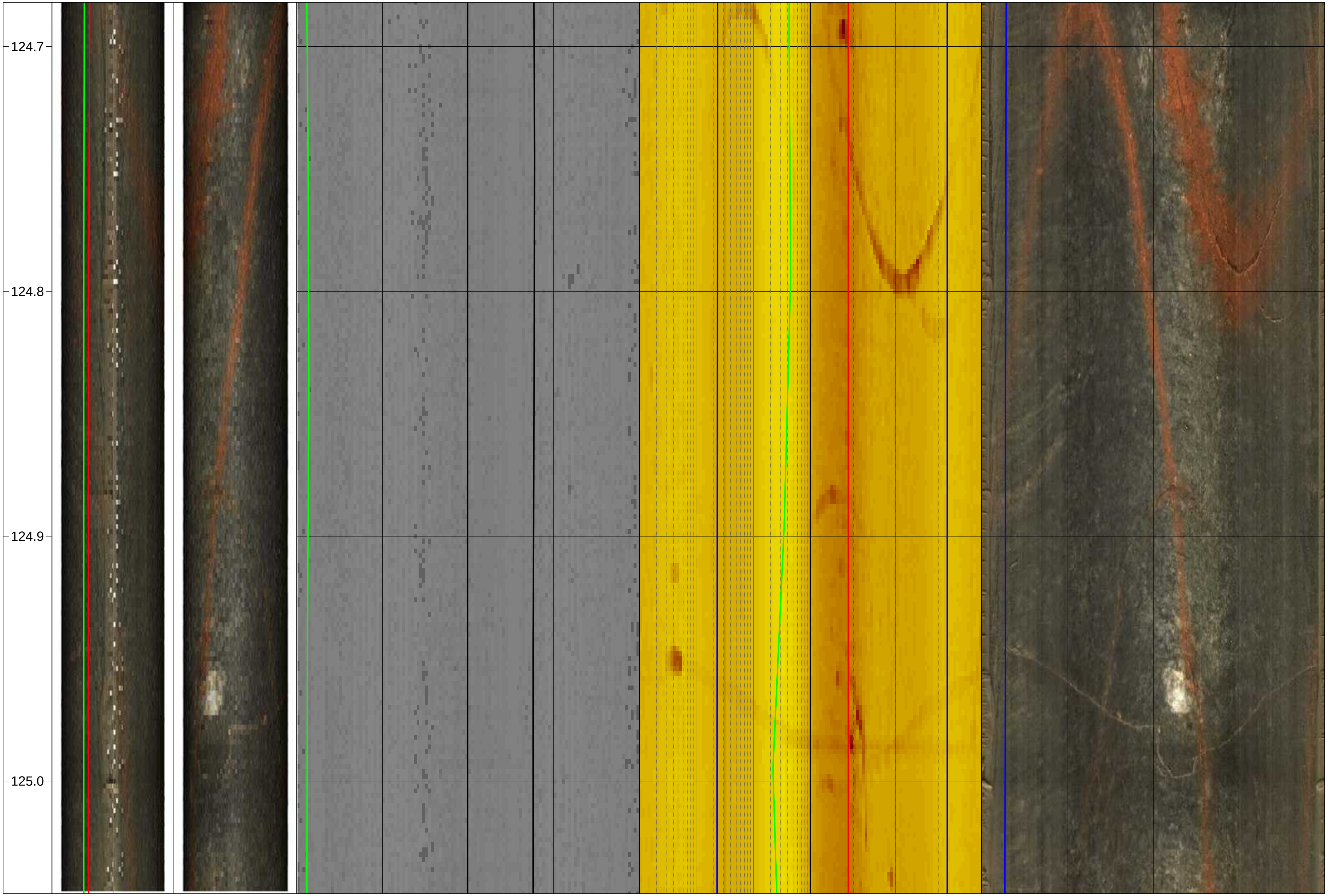

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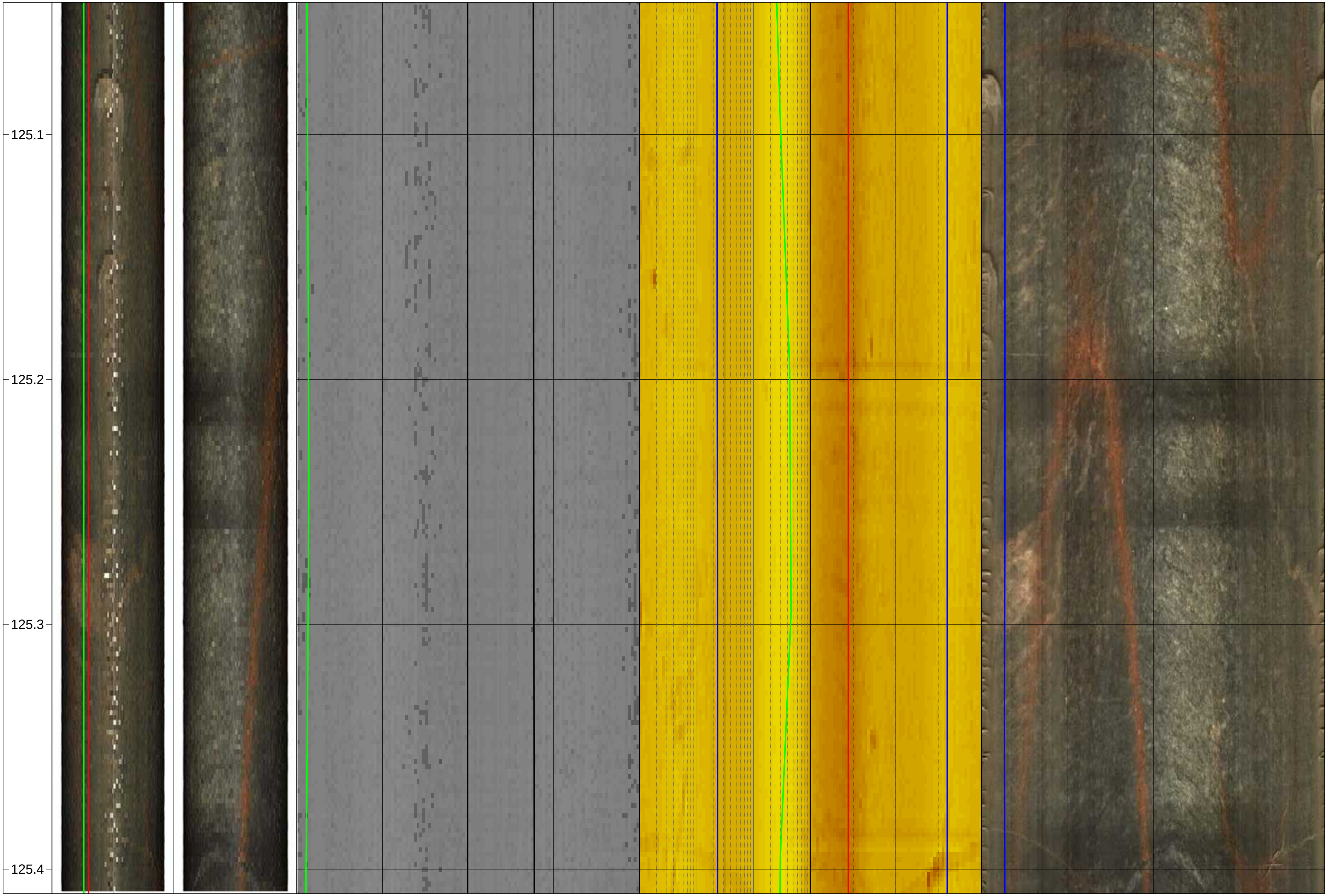
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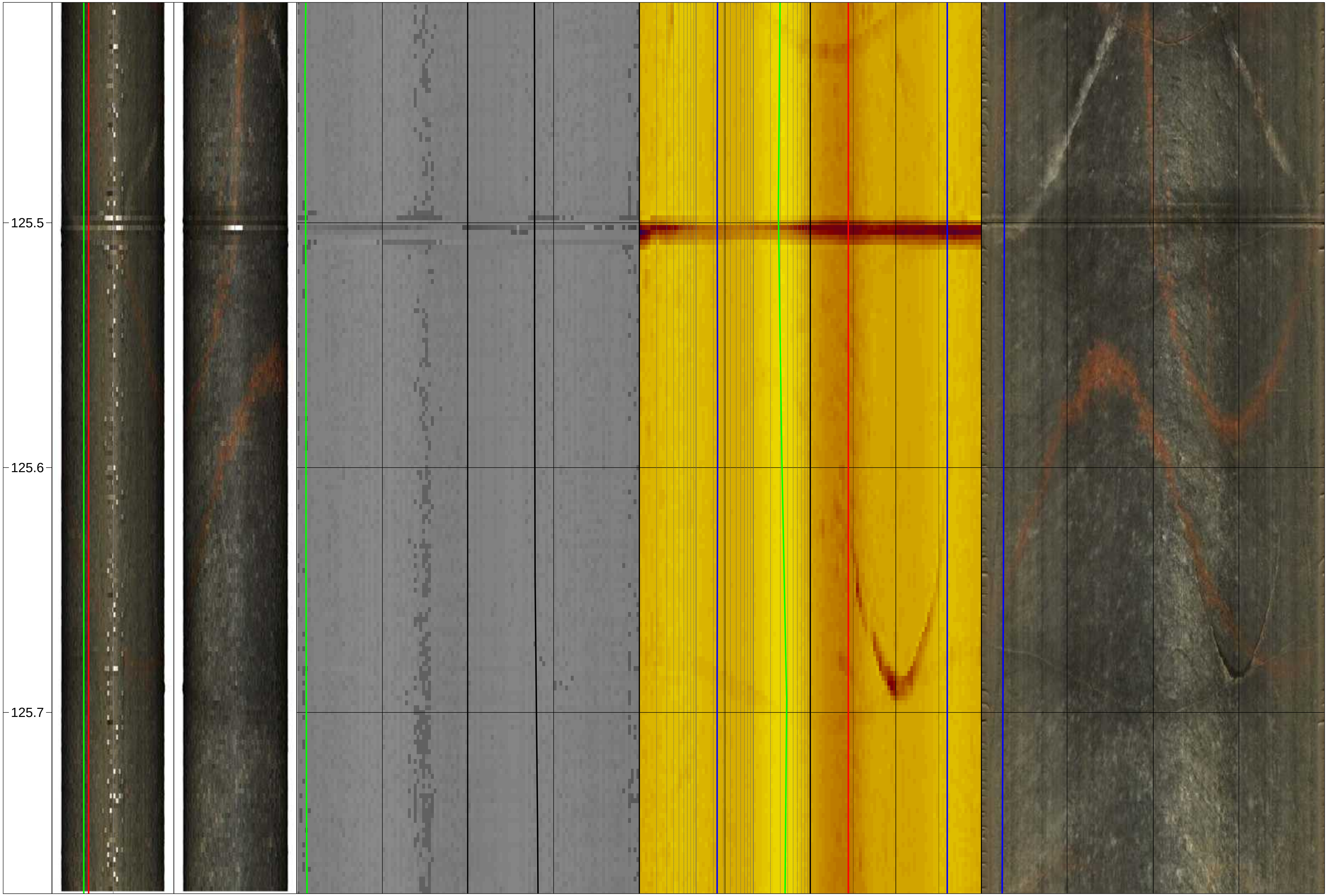
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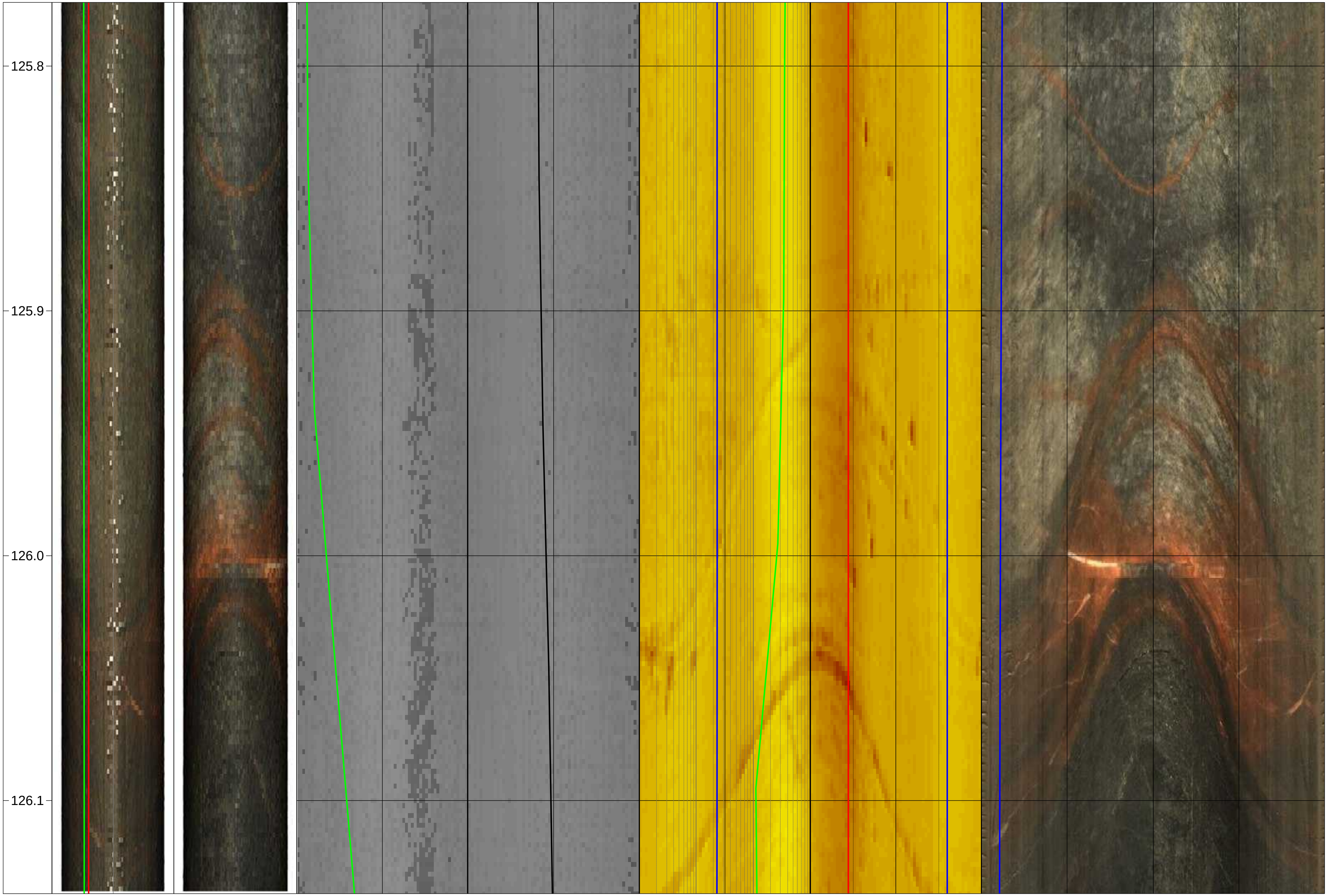
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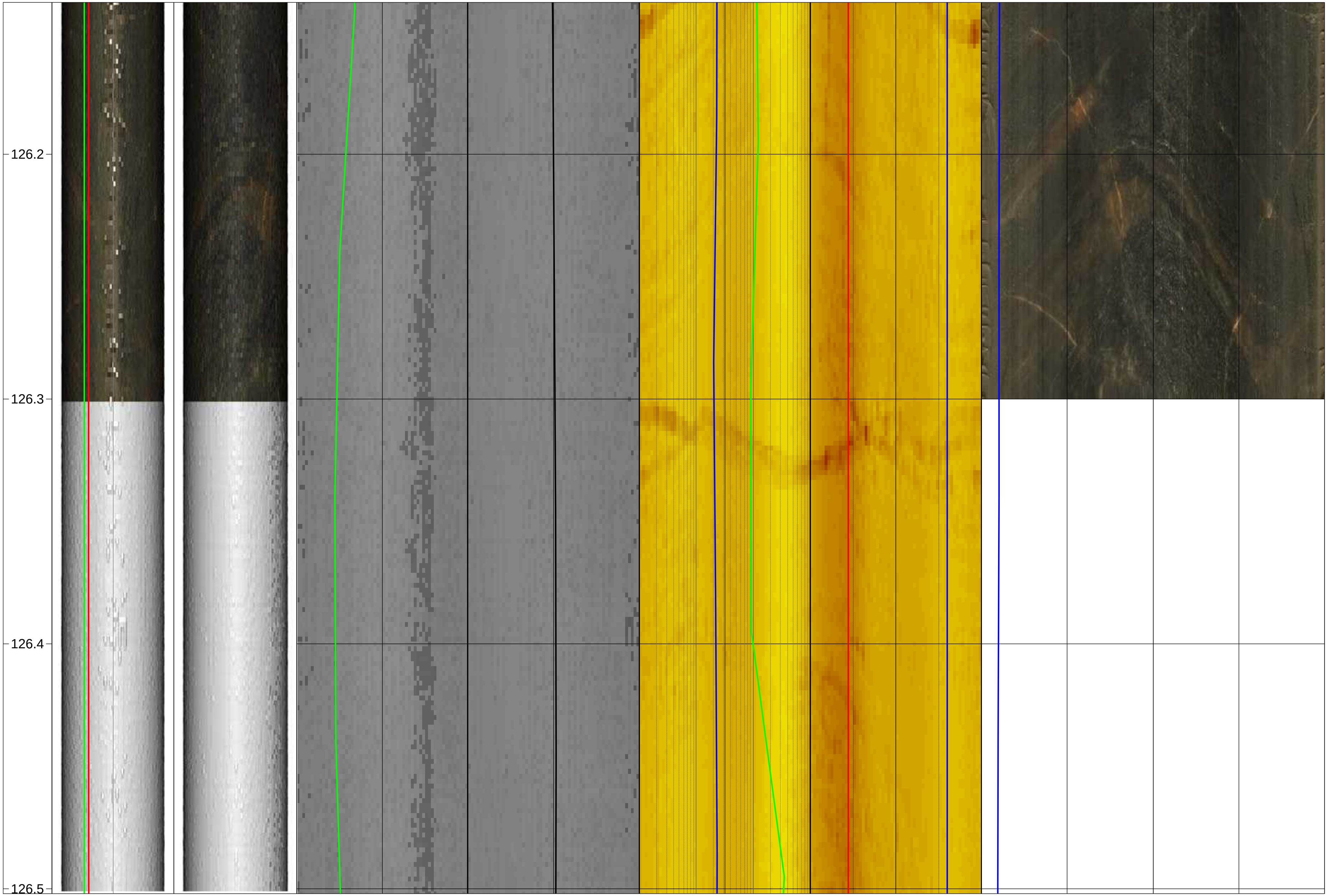
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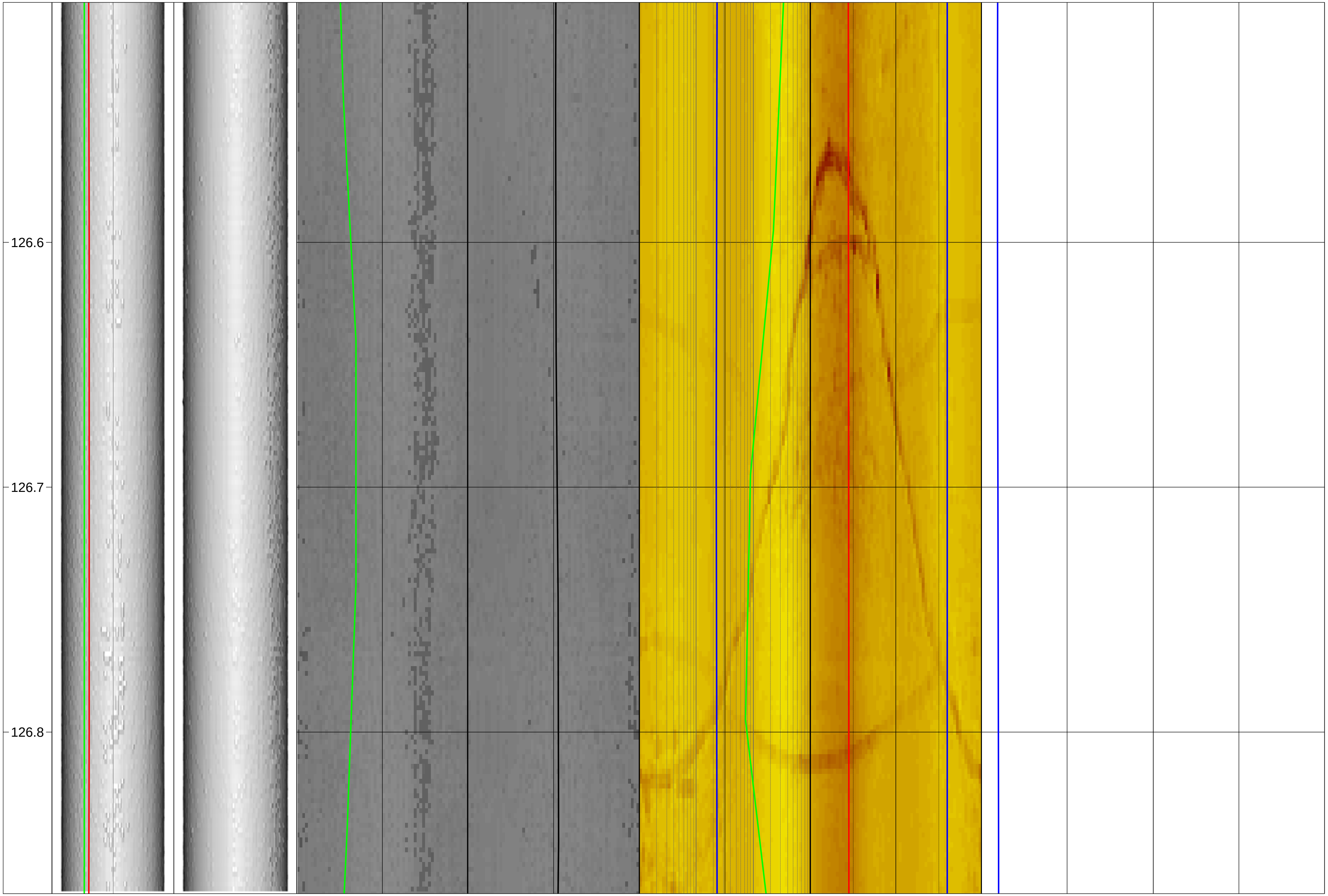
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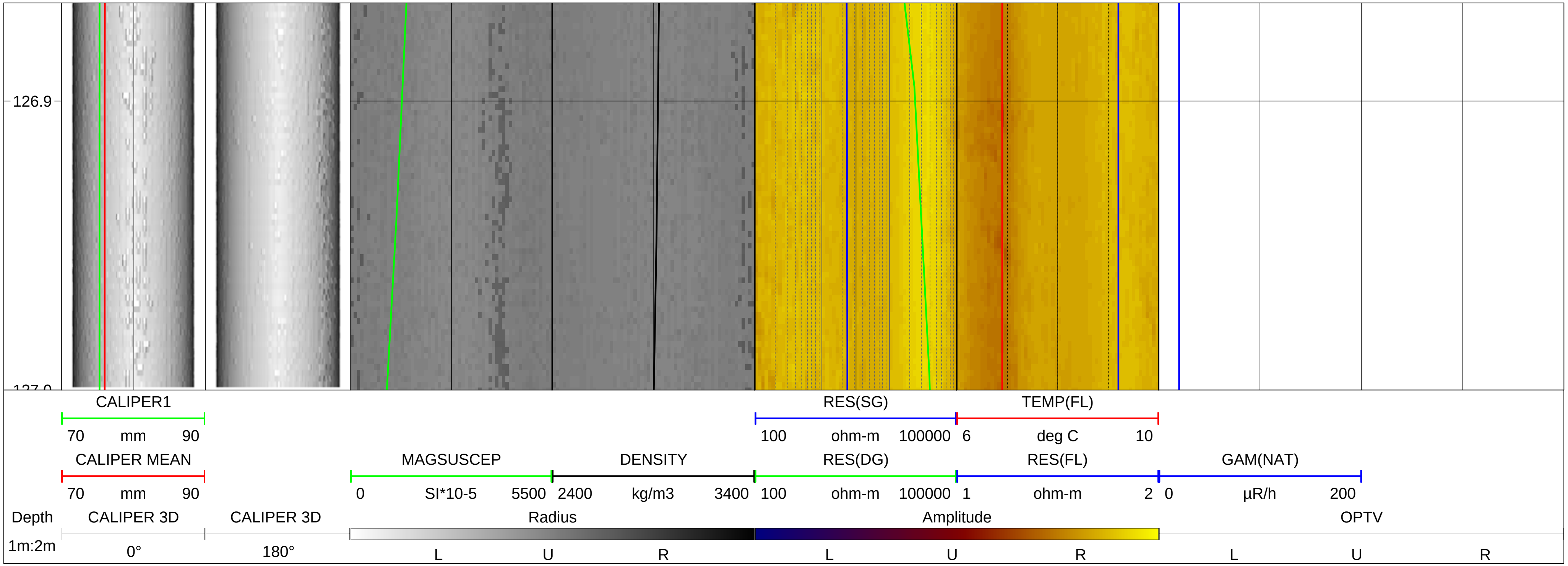


126.9
127.0
CALIPER1
70 mm 90
CALIPER MEAN
70 mm 90
RES(SG)
100 ohm-m 100000
TEMP(FL)
6 deg C 10
MAGSUSCEP
0 SI*10-5 5500
DENSITY
2400 kg/m3 3400
RES(DG)
100 ohm-m 100000
RES(FL)
1 ohm-m 2
GAM(NAT)
0 µR/h 200
Depth
1m:2m
CALIPER 3D
0°
CALIPER 3D
180°
Radius
L U R
Amplitude
L U R
OPTV
L U R

Borehole No. KFR104

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

Northing: 6701719.45m Easting: 1632879.34m Elevation: 2.83m, RHB70

Diameter:	75.8mm
Reaming Diameter:	
Outer Casing:	88mm
Inner Casing:	77mm
Casing Length:	8.73m
Borehole Length:	454.57m
Cone:	
Inclination at ground surface:	-53.81°
Azimuth:	133.78°
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	2008-11-10	JRI	UTN	UTN

Job	Scale
547310A	1:500

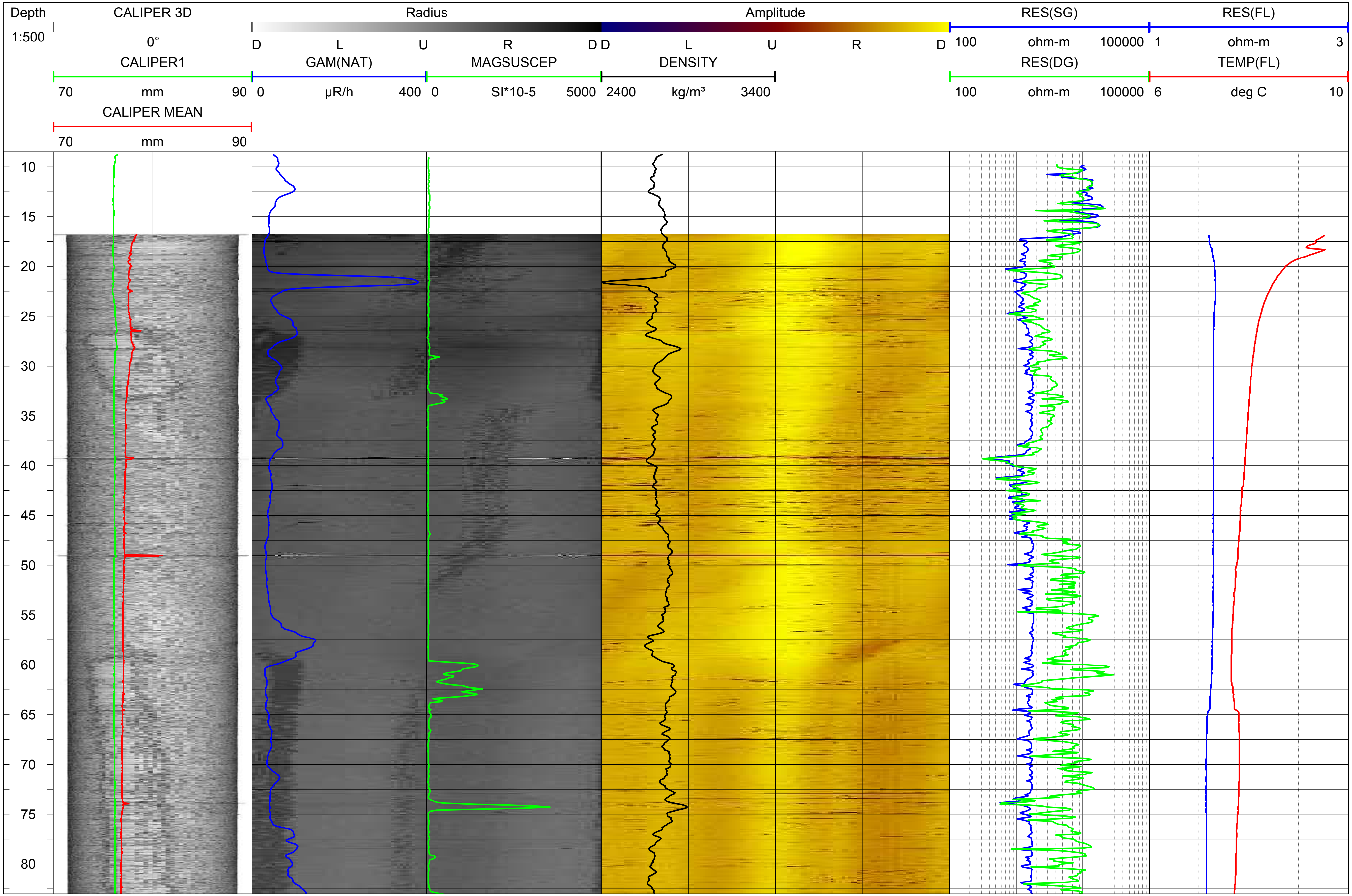
RAMBØLL
Rambøll, Bredevej 2, DK-2830 Virum
Phone + 45 45 98 60 00, Fax + 45 45 98 67 00

SKB geophysical borehole logging
Borehole KFR104

Presentation

Filename:
KFR104_Presentation.wcl

Drawing no.:
3.1



Depth
1:500
CALIPER 3D
0°
Radius
D L U R D
Amplitude
D L U R D
RES(SG)
100 ohm-m 100000
RES(FL)
1 ohm-m 3
CALIPER1
70 mm 90
GAM(NAT)
0 µR/h 400
MAGSUSCEP
0 SI*10-5 5000
DENSITY
2400 kg/m³ 3400
RES(DG)
100 ohm-m 100000
TEMP(FL)
6 deg C 10
CALIPER MEAN
70 mm 90
10
15
20
25
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45
50
55
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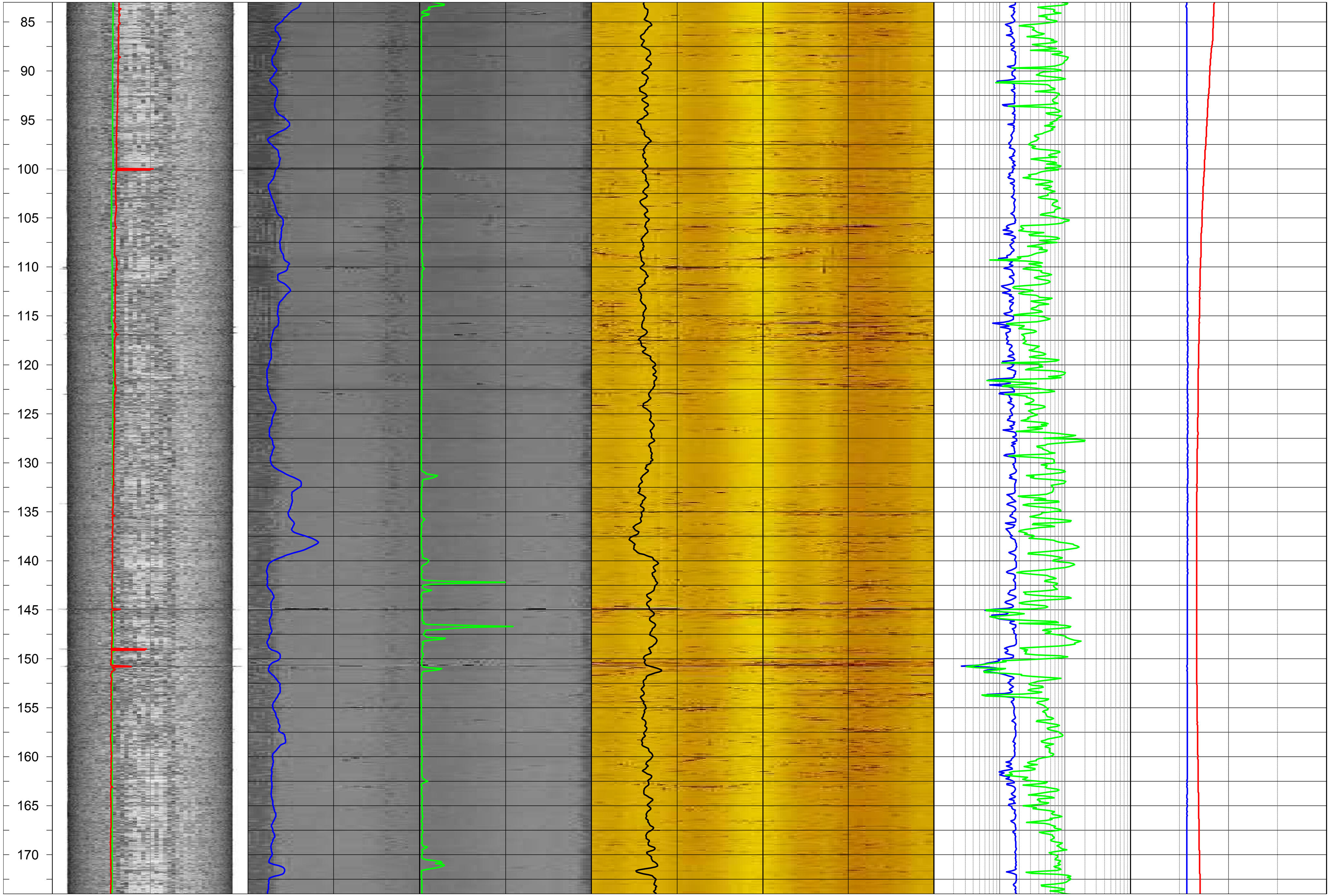
65
70
75
80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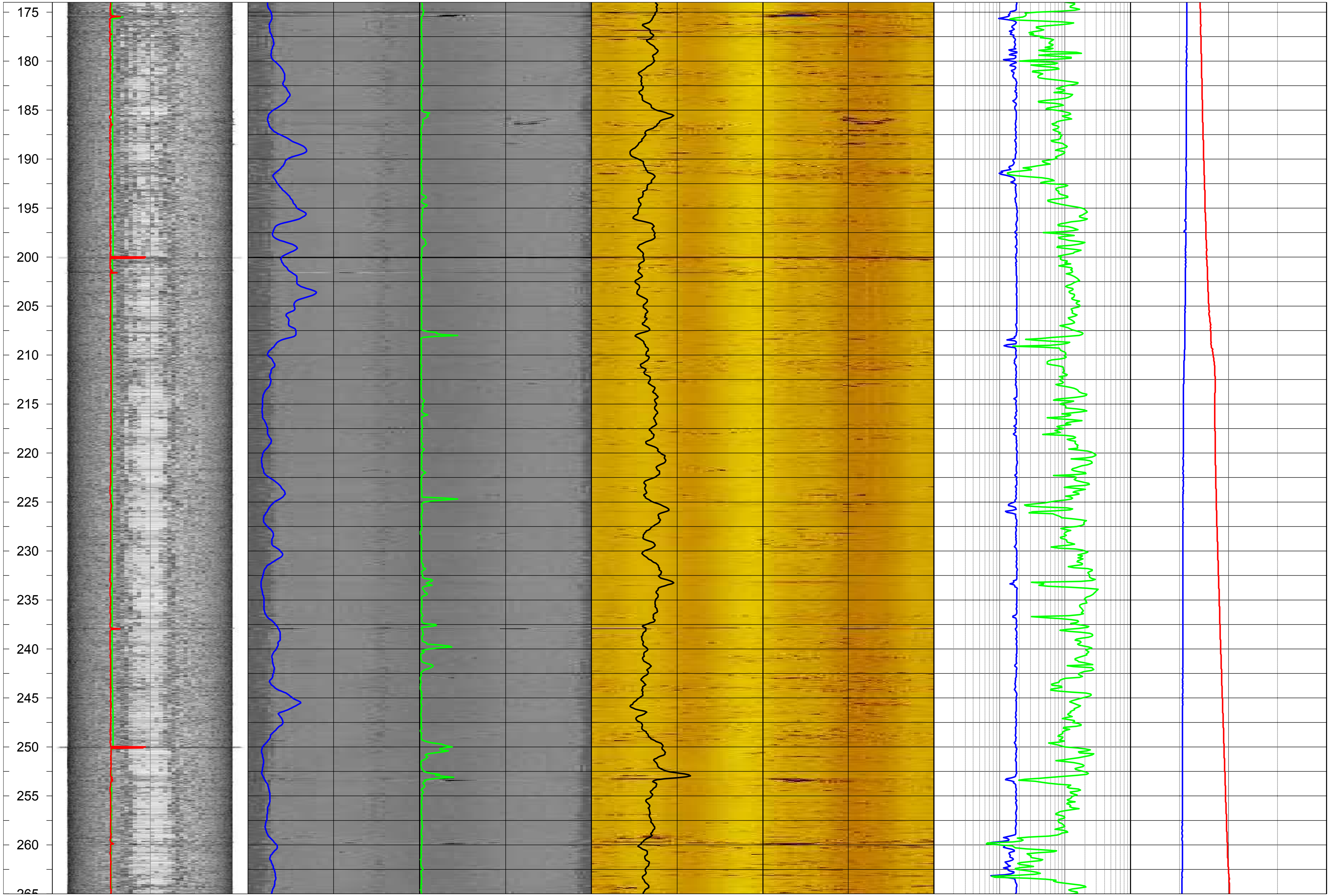
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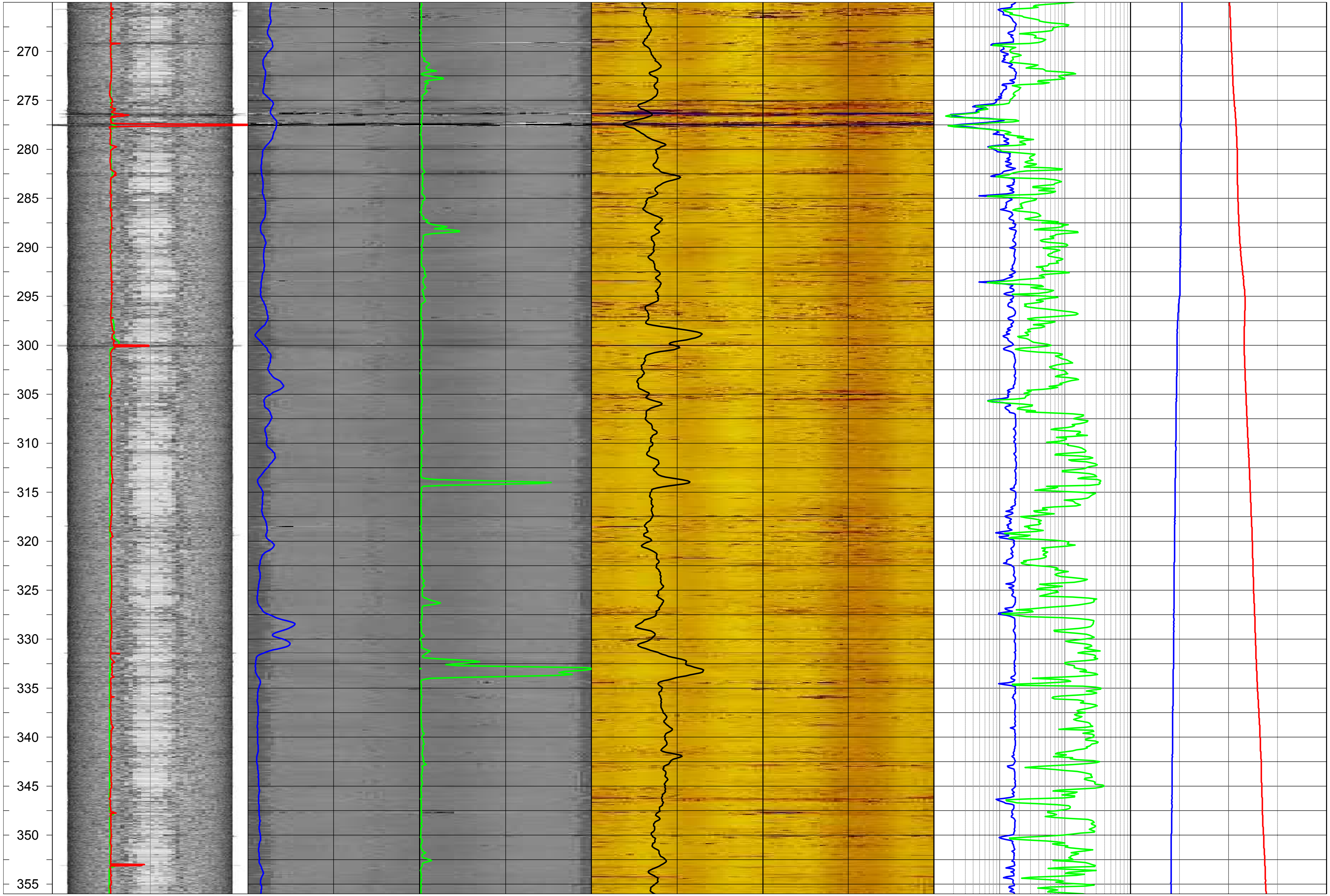
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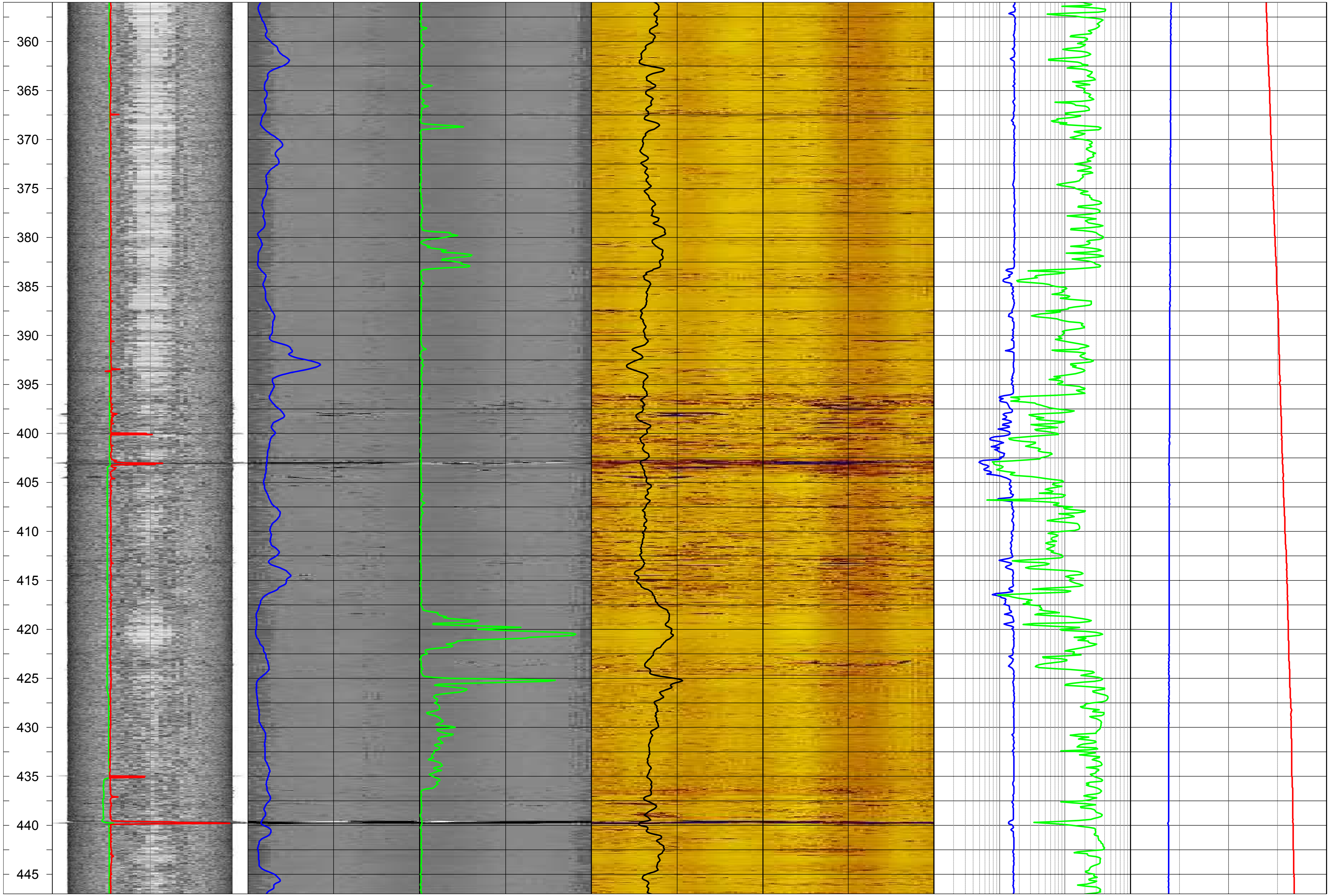
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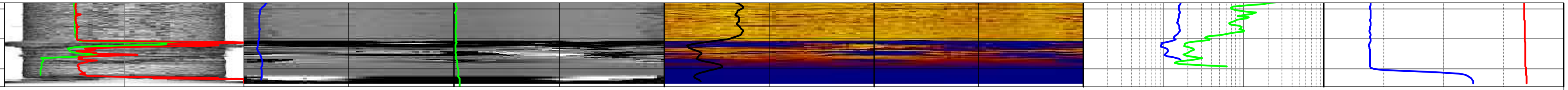
450



CALIPER MEAN
70 mm 90

CALIPER1
70 mm 90

GAM(NAT)
0 μR/h 400

MAGSUSCEP
0 SI*10-5 5000

DENSITY
2400 kg/m³ 3400

RES(DG)
100 ohm-m 100000

TEMP(FL)
6 deg C 10

Depth
1:500

CALIPER 3D
0°

Radius
D L U R D

Amplitude
D L U R D

RES(SG)
100 ohm-m 100000

RES(FL)
1 ohm-m 3

Borehole No. KFR27

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

Northing: 6701714.42m Easting: 1633175.52m Elevation: 2.87m, RHB70

Diameter:	75.8-76.8mm
Reaming Diameter:	
Outer Casing:	84mm
Inner Casing:	77mm
Casing Length:	11.91m
Borehole Length:	501.64m
Cone:	
Inclination at ground surface:	-87.42°
Azimuth:	248.20°
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	2009-02-92	JRI	UTN	UTN

Job 547310A **Scale** 1:500

RAMBØLL

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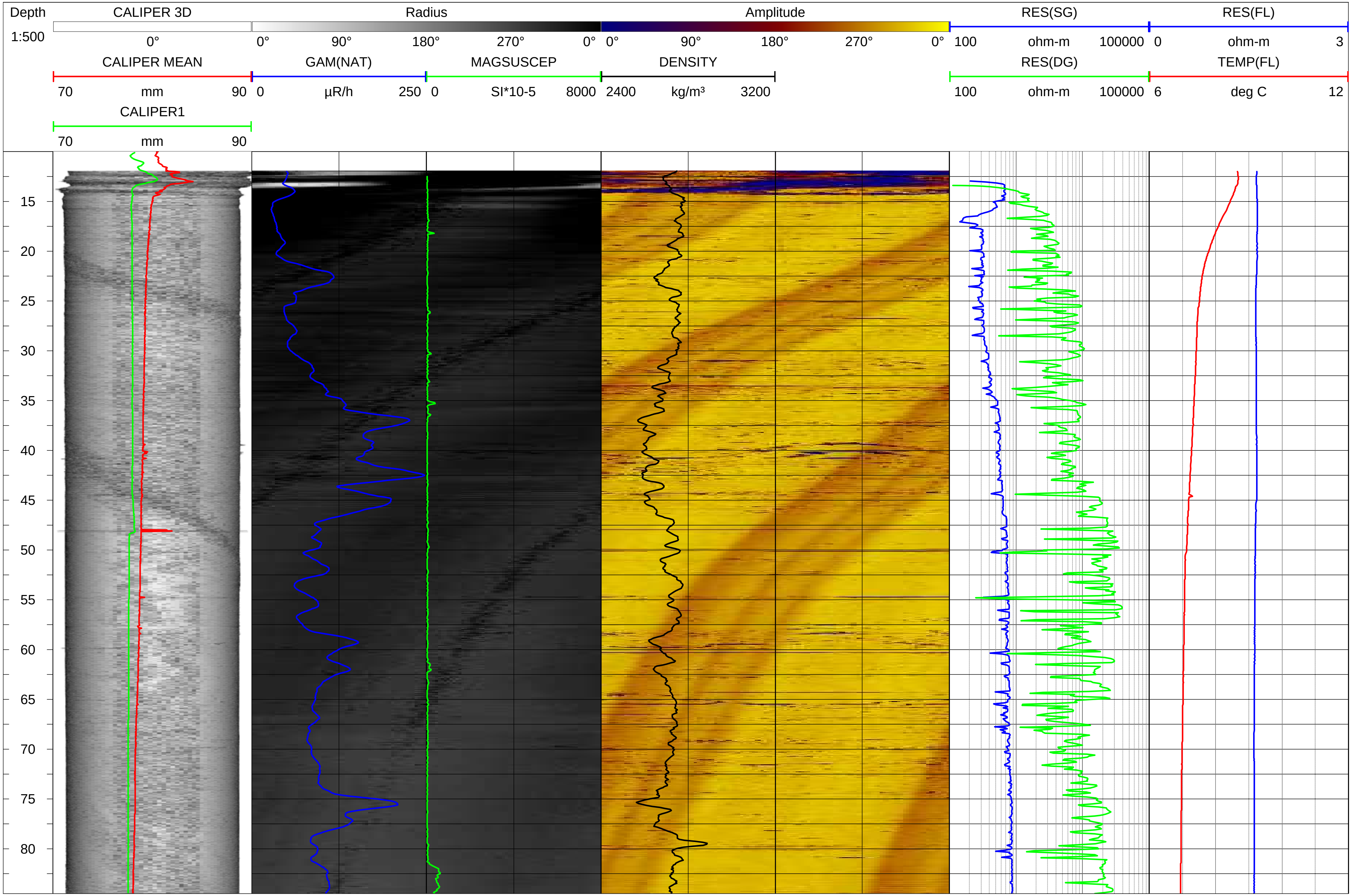
SKB geophysical borehole logging
Borehole KFR27

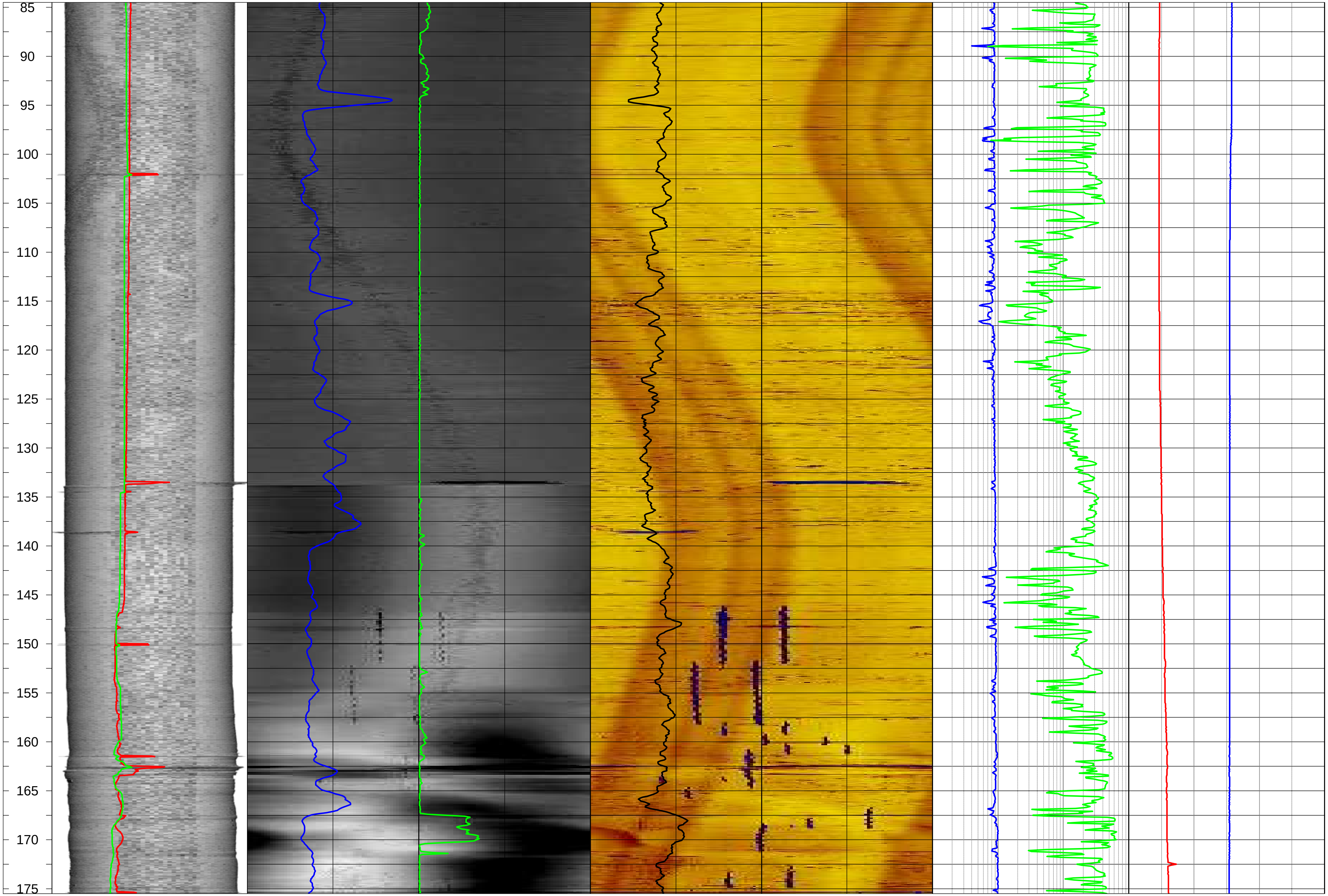
Presentation

Filename: KFR27_Presentation.wcl

Drawing no.: **4.1**



Depth
1:500
CALIPER 3D
0°
CALIPER MEAN
70 mm 90
CALIPER1
70 mm 90
Radius
0° 90° 180° 270° 0°
GAM(NAT)
0 µR/h 250
MAGSUSCEP
0 SI*10-5 8000
Amplitude
0° 90° 180° 270° 0°
DENSITY
2400 kg/m³ 3200
RES(SG)
100 ohm-m 100000
RES(DG)
100 ohm-m 100000
RES(FL)
0 ohm-m 3
TEMP(FL)
6 deg C 12
15
20
25
30
35
40
45
50
55
60
65
70
75
80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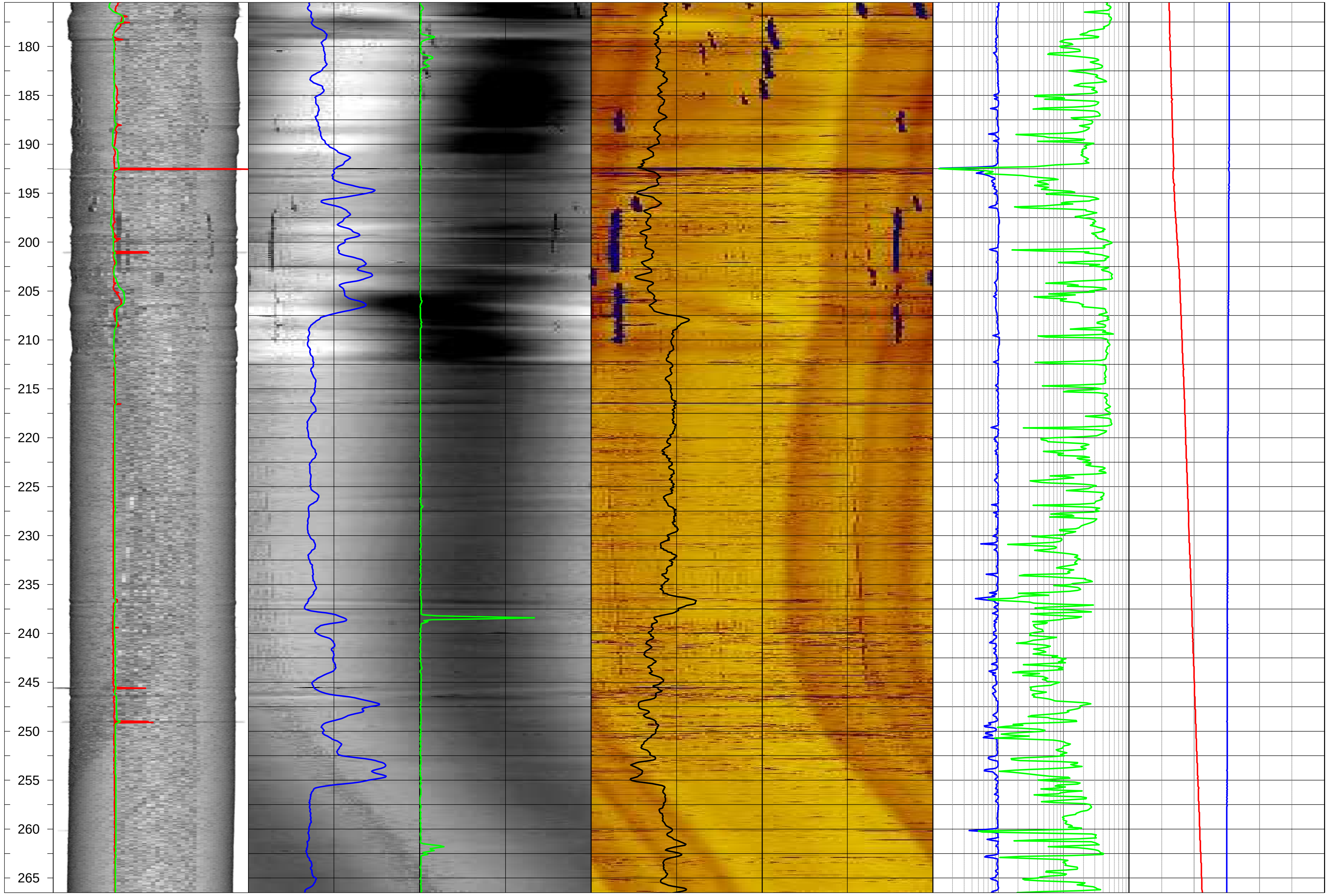

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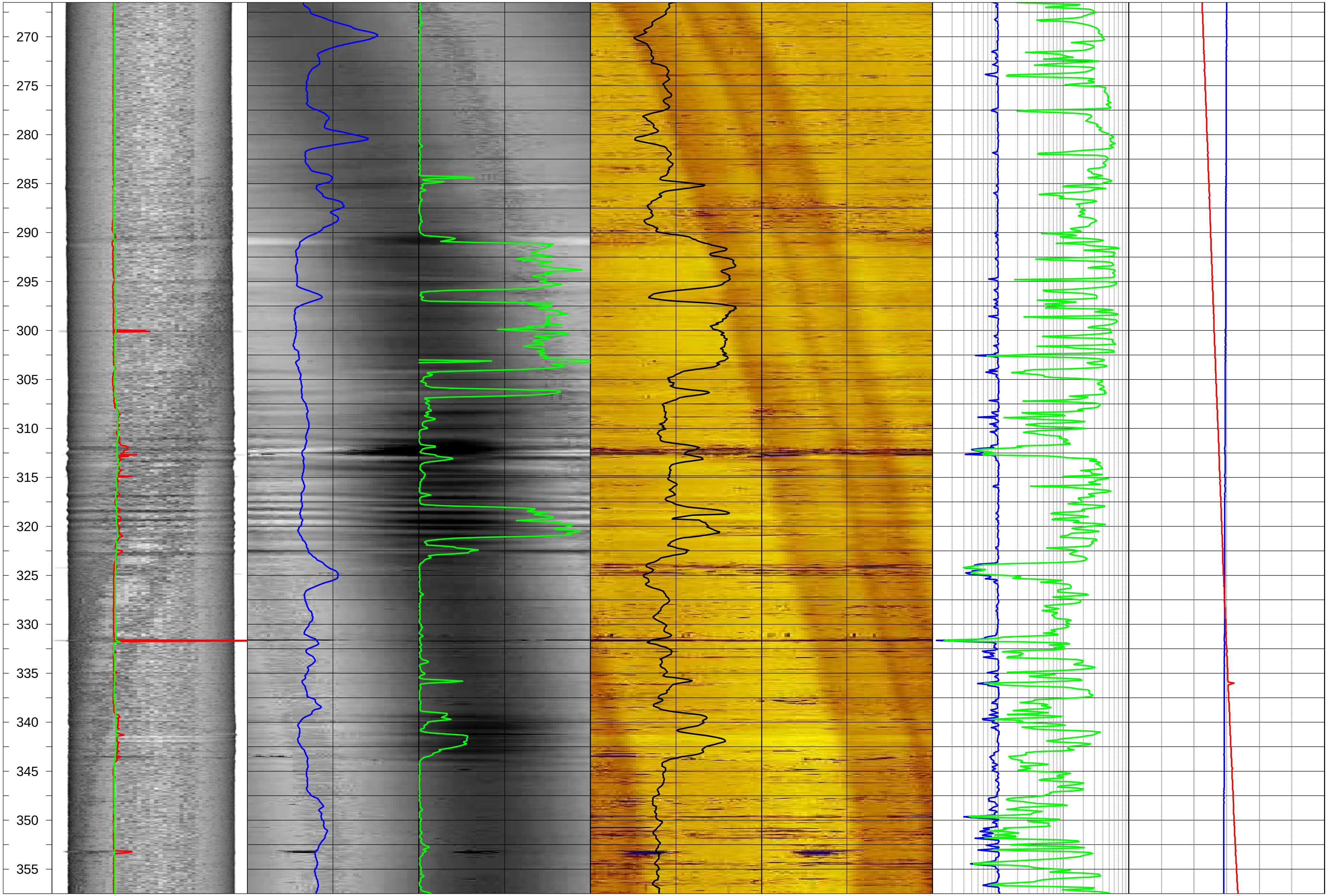
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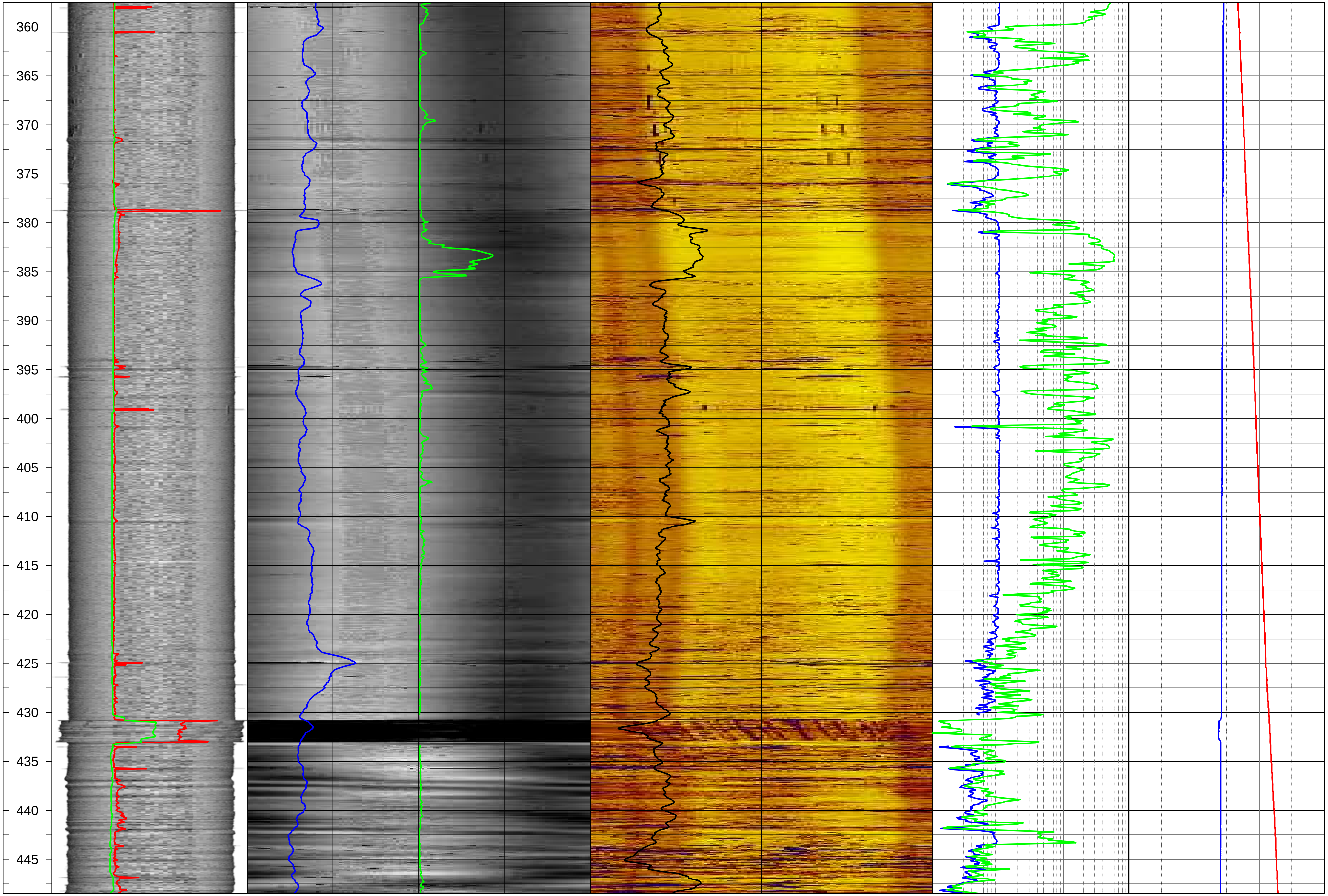
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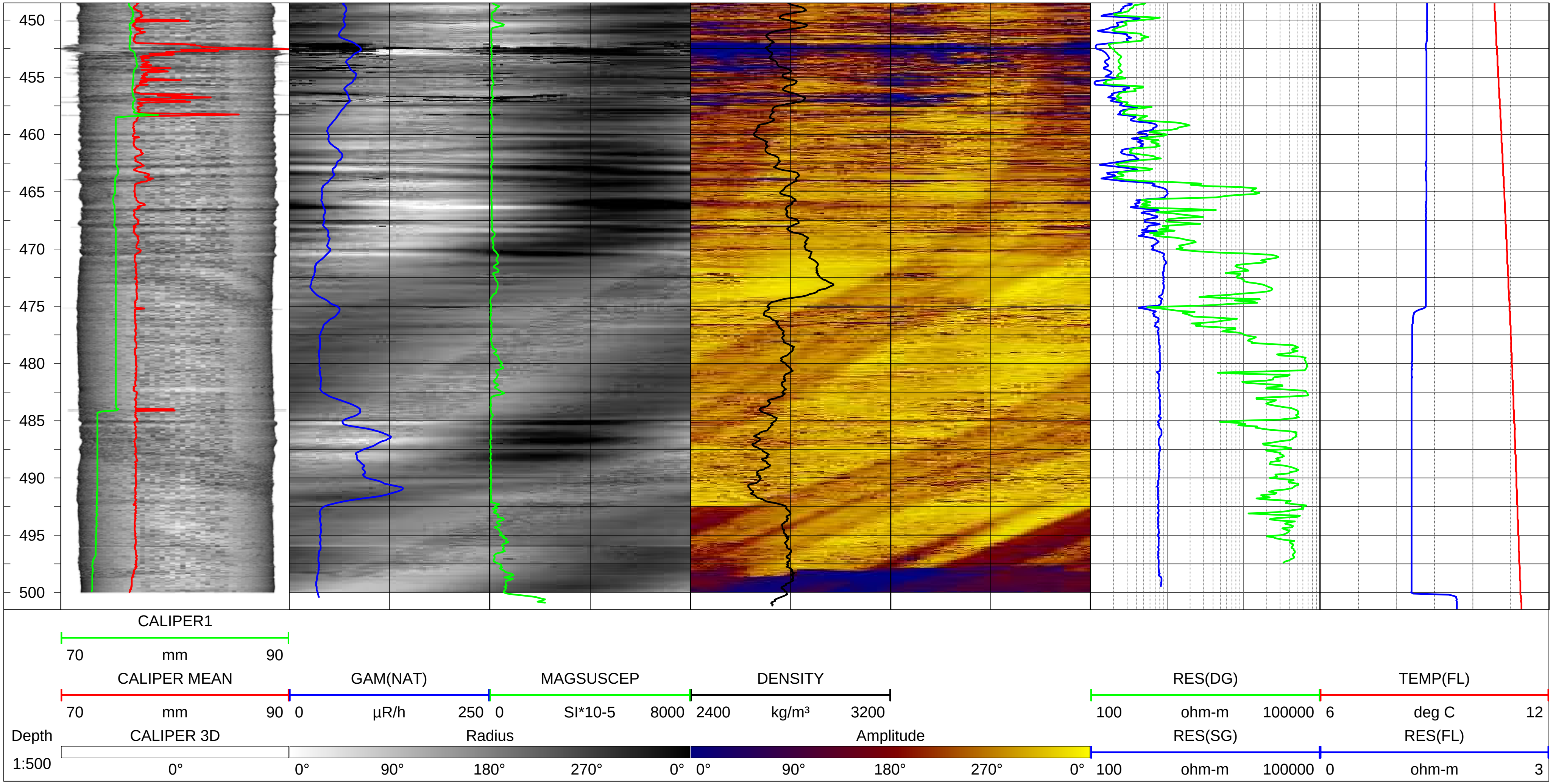

450
455
460
465
470
475
480
485
490
495
500
CALIPER1
70 mm 90
CALIPER MEAN
70 mm 90
GAM(NAT)
0 µR/h 250
MAGSUSCEP
0 SI*10-5 8000
DENSITY
2400 kg/m³ 3200
RES(DG)
100 ohm-m 100000
TEMP(FL)
6 deg C 12
Depth
1:500
CALIPER 3D
0°
Radius
0° 90° 180° 270° 0°
Amplitude
0° 90° 180° 270° 0°
RES(SG)
100 ohm-m 100000
RES(FL)
0 ohm-m 3

Borehole No. KFR102A

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

Northing: 6701730.30m Easting: 1633330.21m Elevation: 2.66m, RHB70

Diameter:	75.8mm
Reaming Diameter:	
Outer Casing:	
Inner Casing:	
Casing Length:	71.94m
Borehole Length:	600.83m
Cone:	
Inclination at ground surface:	-65.41°
Azimuth:	302.26°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	2009-02-04	JRI	UTN	UTN

Job	Scale
547310A	1:500

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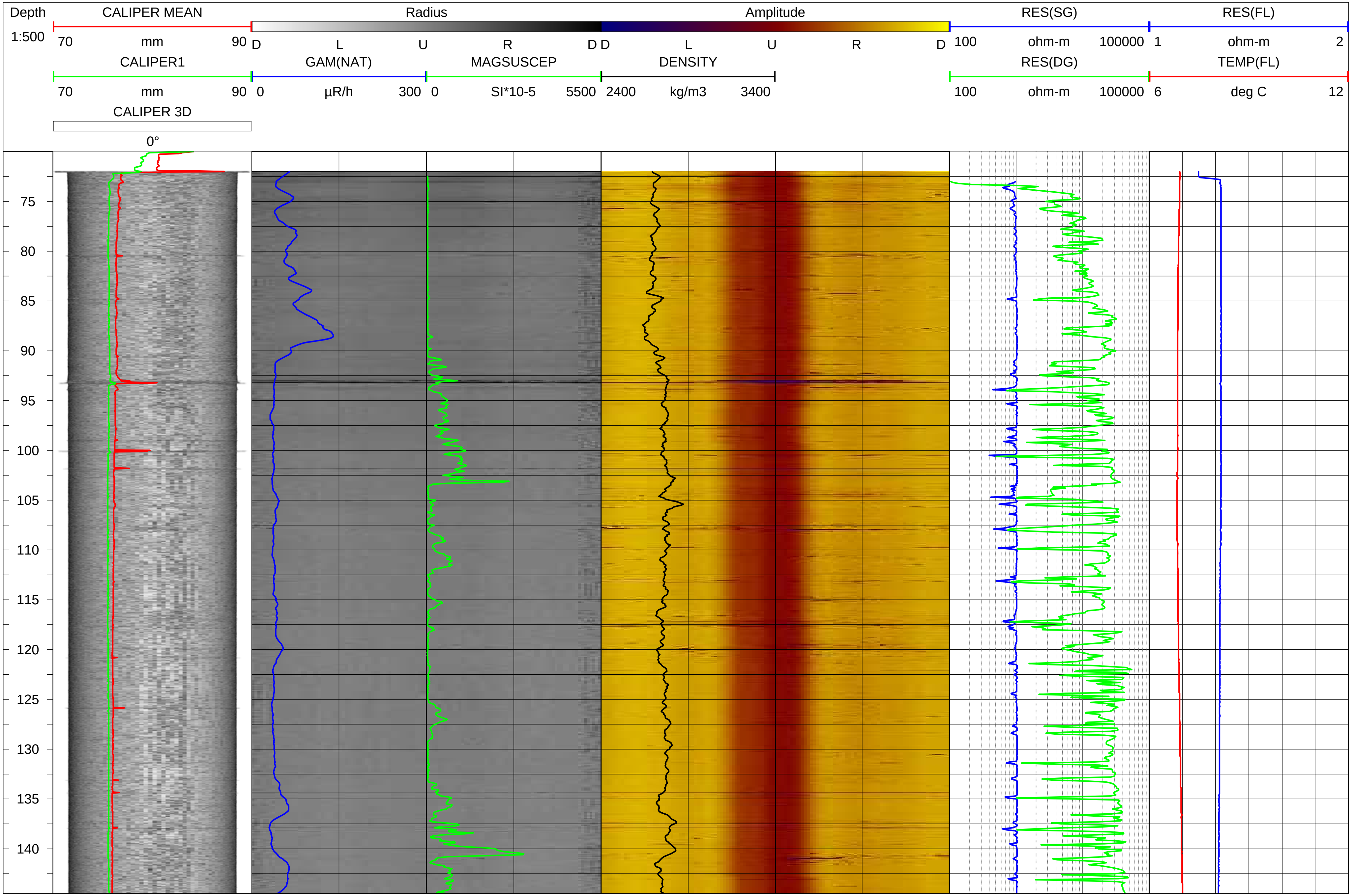
SKB geophysical borehole logging
Borehole KFR102A

Presentation

Filename:
KFR102A_Presentation.wcl

Drawing no.:
5.1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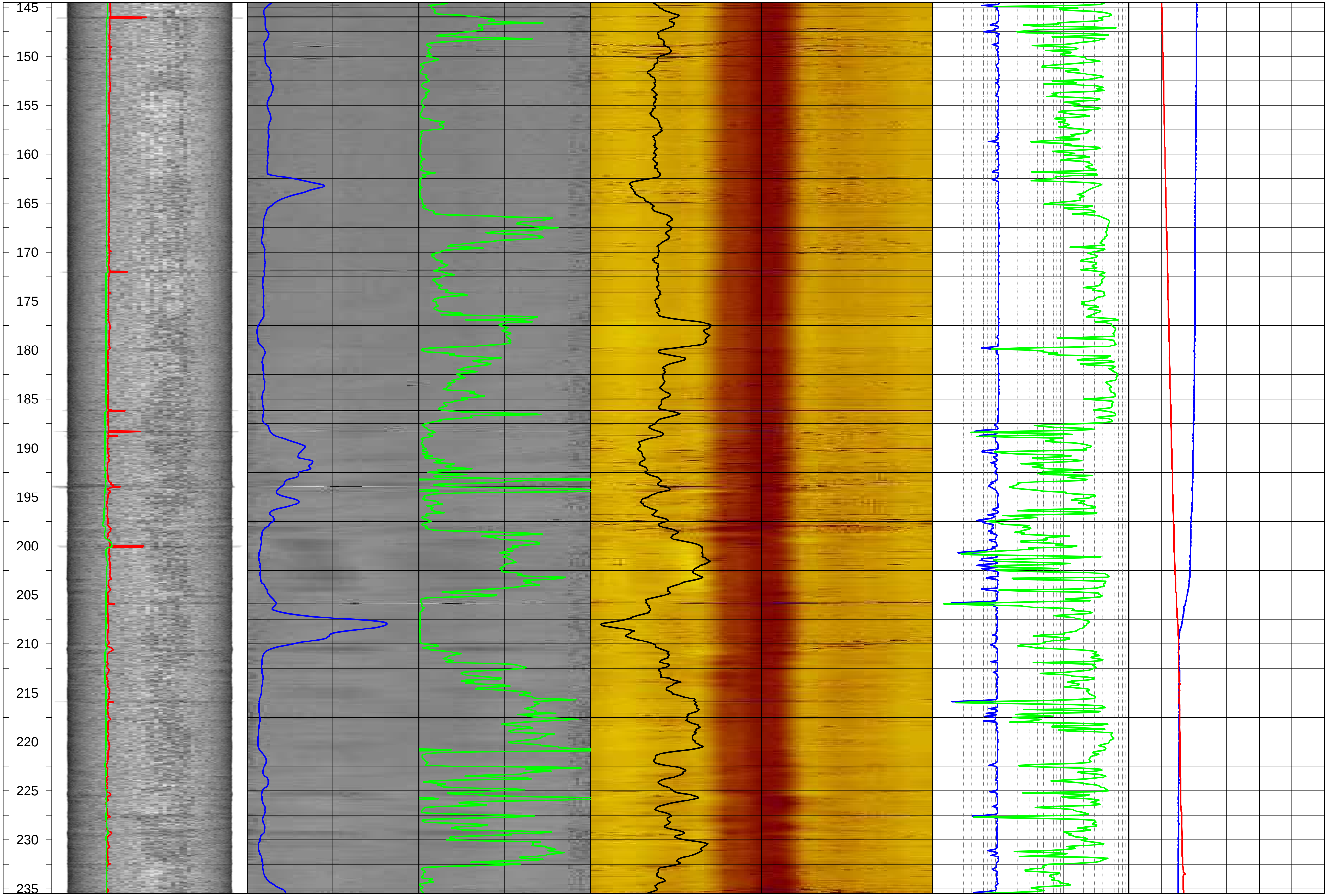
1:500
CALIPER MEAN
70 mm 90
CALIPER1
70 mm 90
CALIPER 3D
0°
Radius
D L U R D
GAM(NAT)
0 µR/h 300
MAGSUSCEP
0 SI*10-5 5500
Amplitude
D L U R D
DENSITY
2400 kg/m3 3400
RES(SG)
100 ohm-m 100000
RES(DG)
100 ohm-m 100000
RES(FL)
1 ohm-m 2
TEMP(FL)
6 deg C 12
75
80
85
90
95
100
105
110
115
120
125
130
135
140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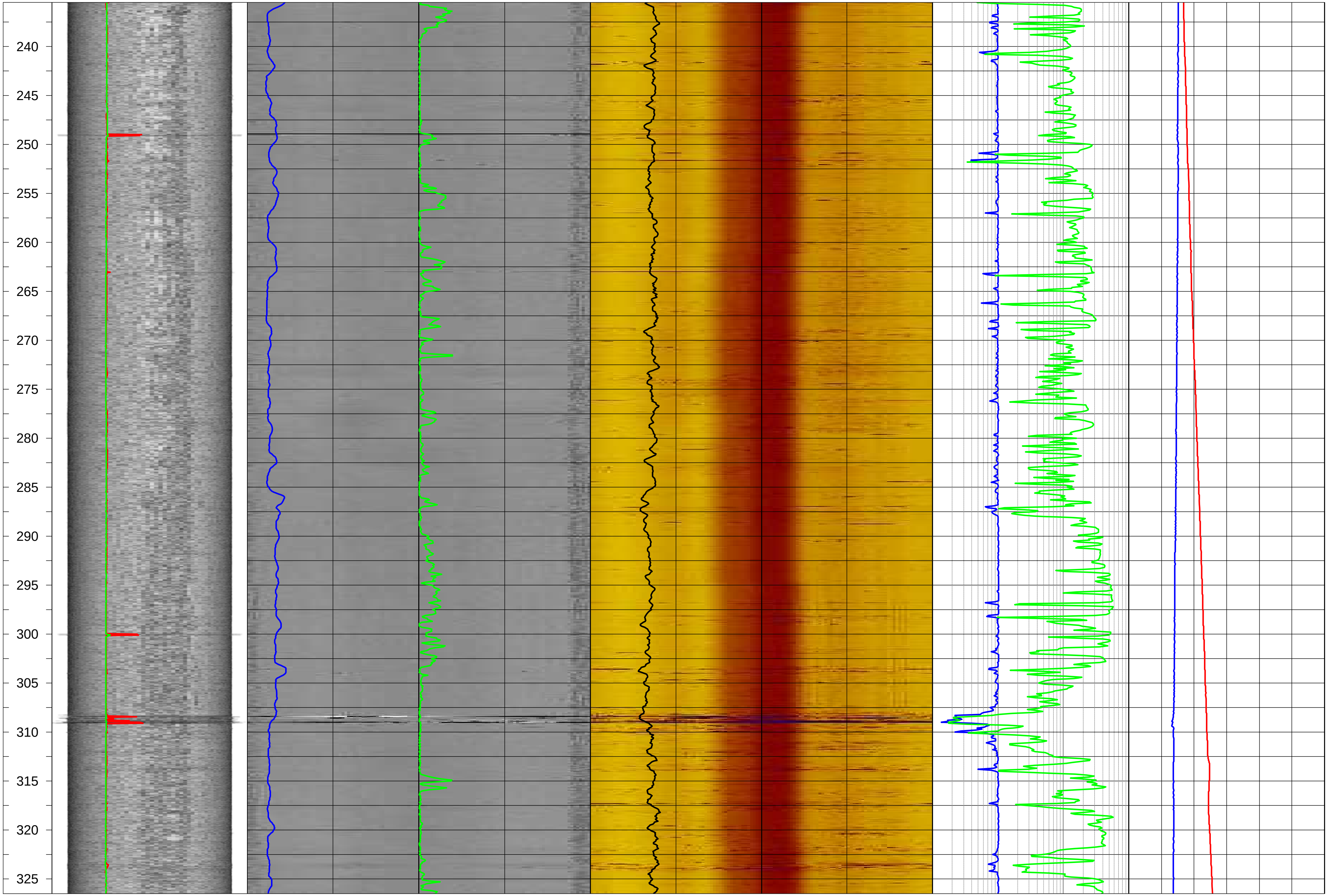
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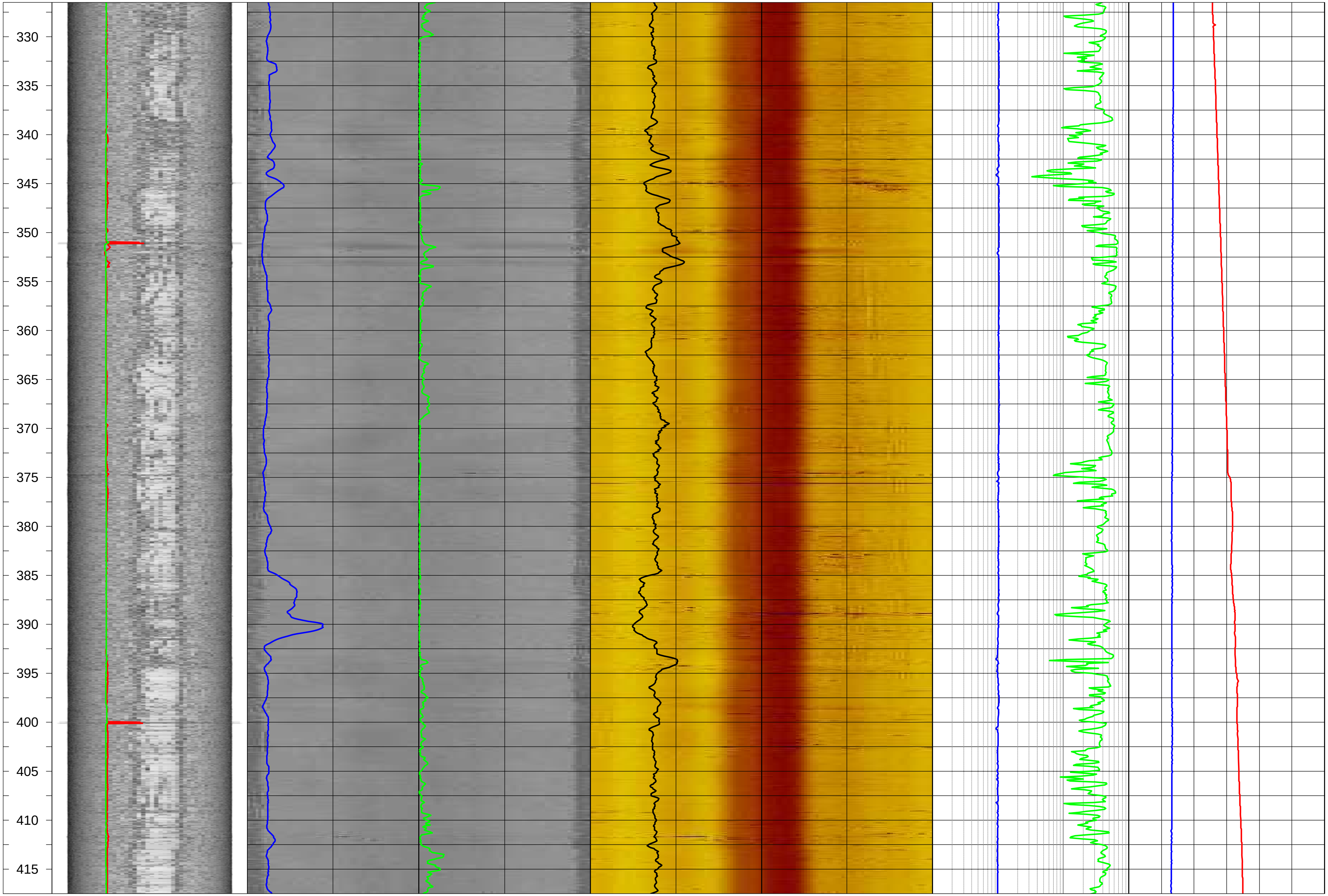
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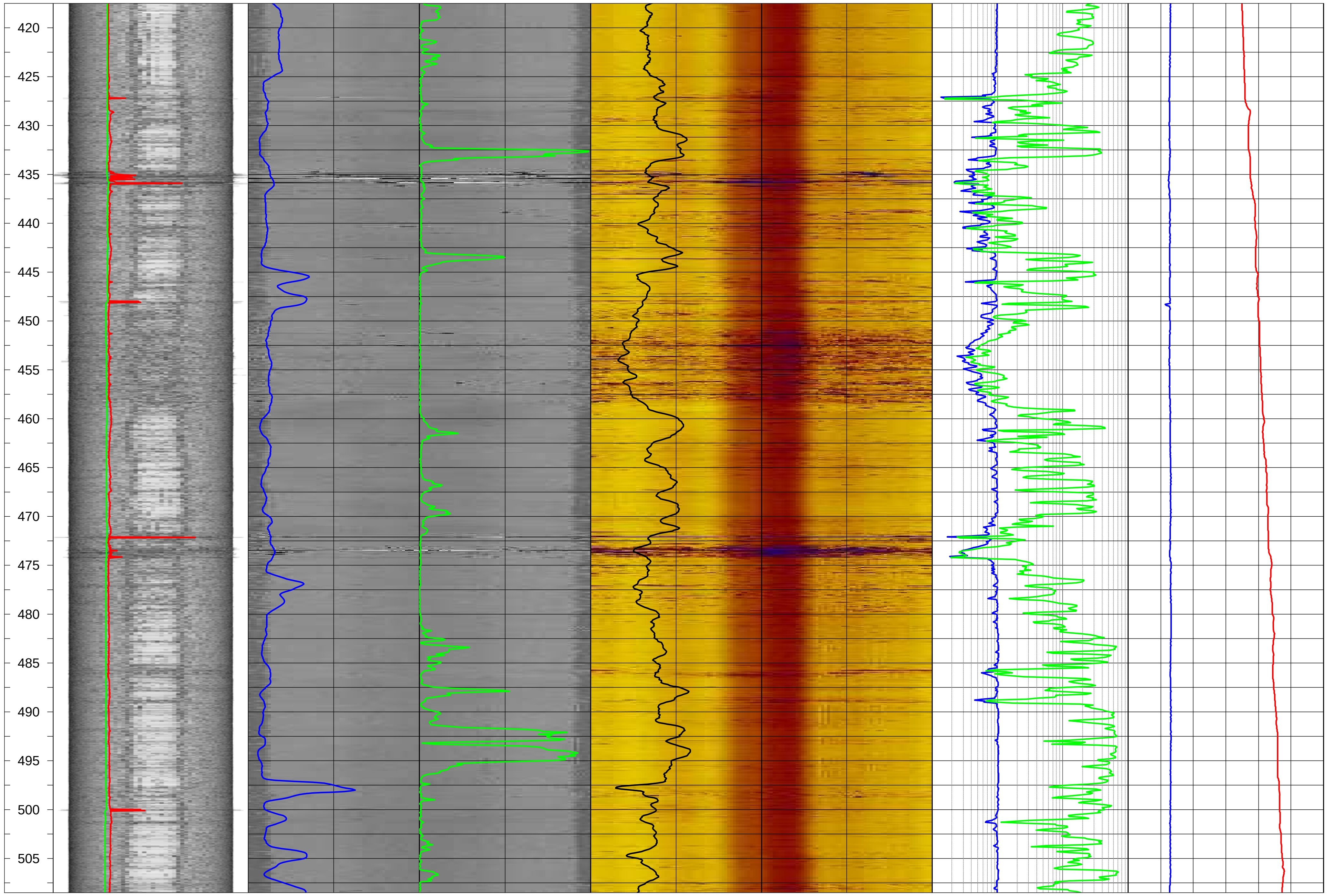
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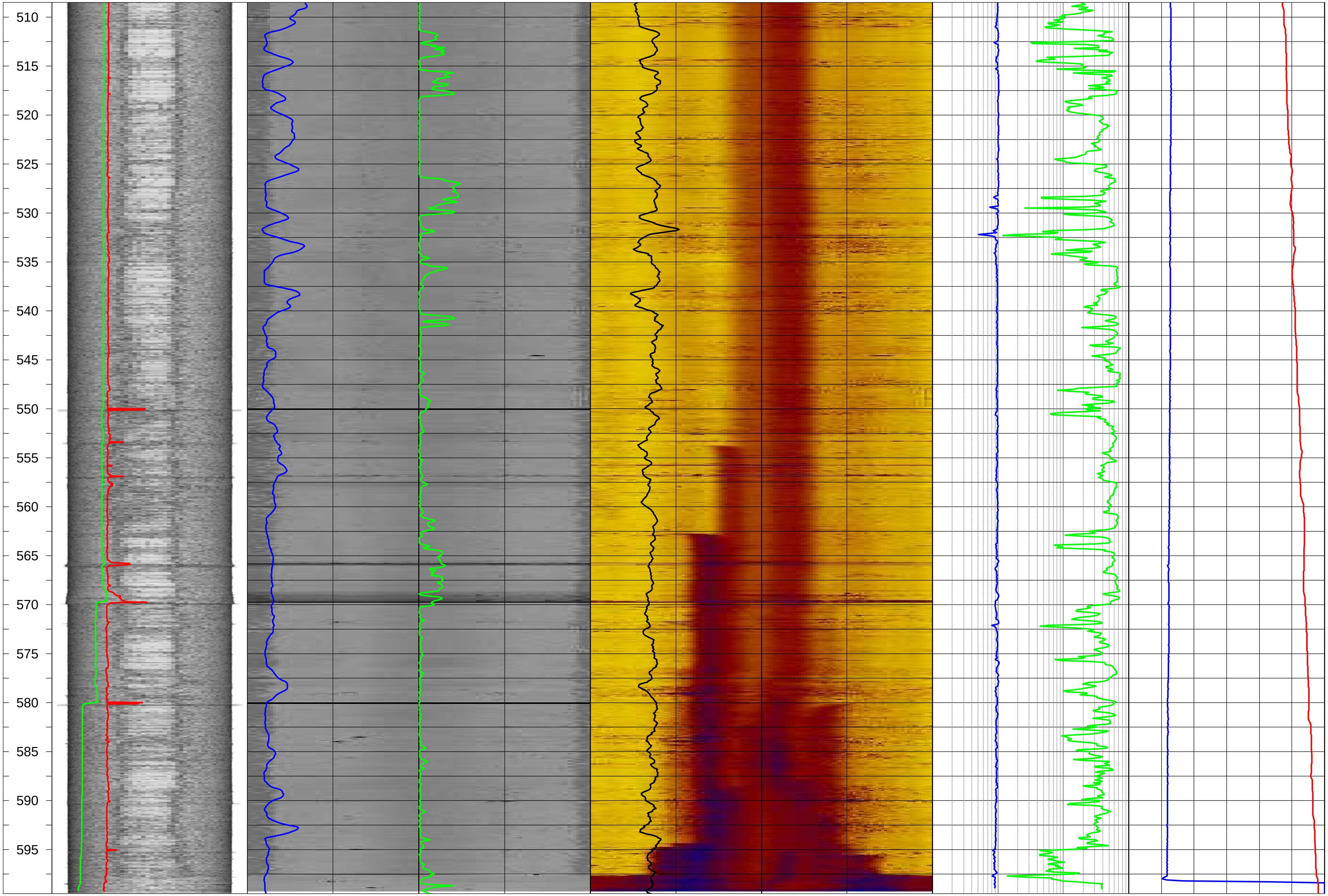
505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550
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560
565
570
575
580
585
590
595

600							
	CALIPER 3D 0°						
	CALIPER1 70 mm 90	GAM(NAT) 0 µR/h 300	MAGSUSCEP 0 SI*10-5 5500	DENSITY 2400 kg/m3 3400		RES(DG) 100 ohm-m 100000	TEMP(FL) 6 deg C 12
Depth 1:500	CALIPER MEAN 70 mm 90	Radius D L U R D		Amplitude D L U R D		RES(SG) 100 ohm-m 100000	RES(FL) 1 ohm-m 2

Borehole No. HFM07

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

Northing: 6697416.248m Easting: 1634715.687m Elevation: 5.781m, RHB70

Diameter:	139 mm
Reaming Diameter:	214 mm
Outer Casing:	168 mm
Inner Casing:	160 mm
Casing Length:	18 m
Borehole Length:	122.5 m
Cone:	
Inclination at ground surface:	-84.517°
Azimuth:	342.324°
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	2009-02-23	JRI	UTN	UTN

Job	Scale
547310A	1:500

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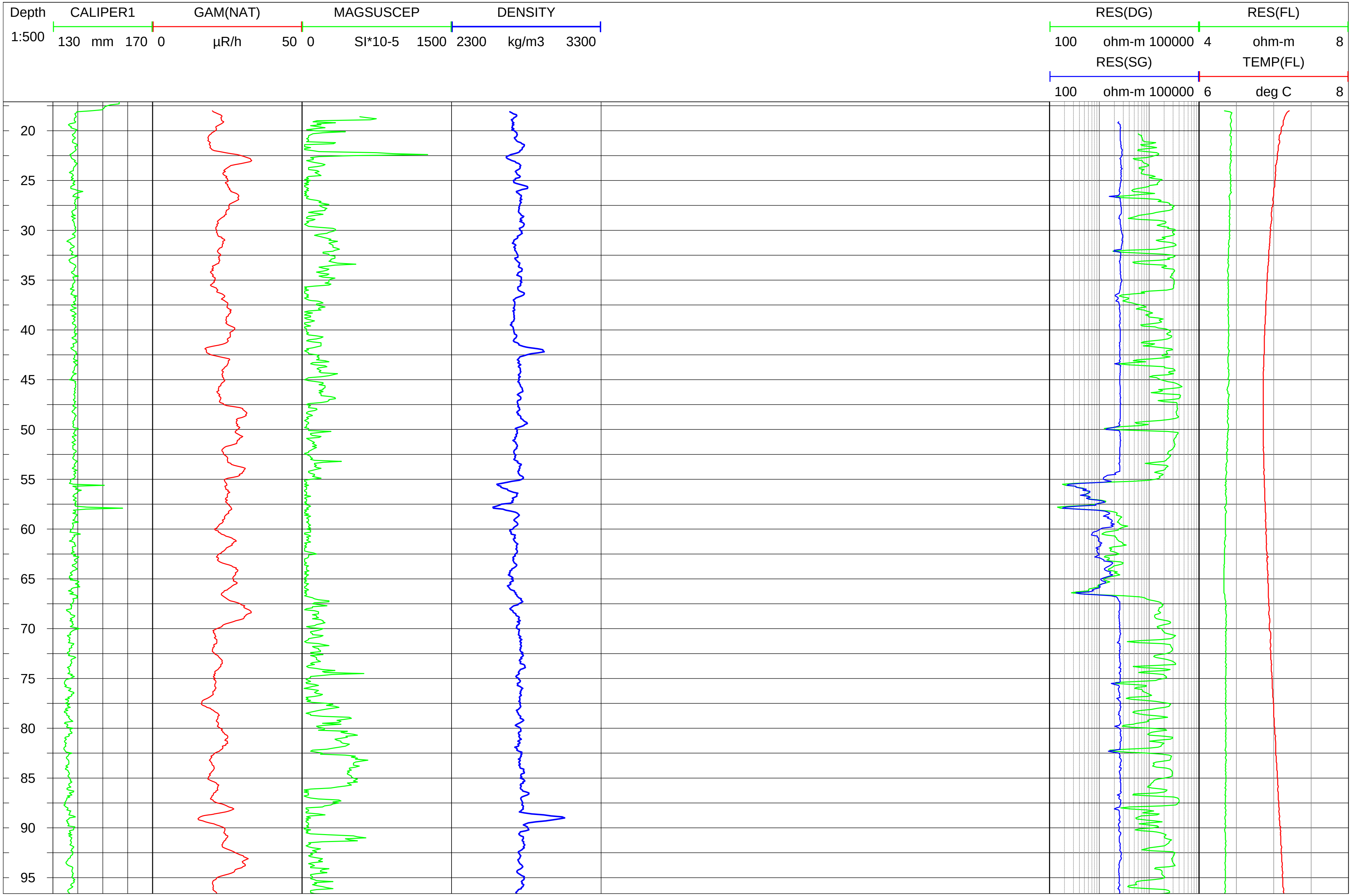
SKB geophysical borehole logging
Borehole HFM07

Presentation

Filename:
HFM07_Presentation_Jan_2009.wcl

Drawing no.:
6.1



Depth
1:500
CALIPER1
130 mm 170
GAM(NAT)
0 µR/h 50
MAGSUSCEP
0 SI*10-5 1500
DENSITY
2300 kg/m3 3300
RES(DG)
100 ohm-m 100000
RES(SG)
100 ohm-m 100000
RES(FL)
4 ohm-m 8
TEMP(FL)
6 deg C 8
20
25
30
35
40
45
50
55
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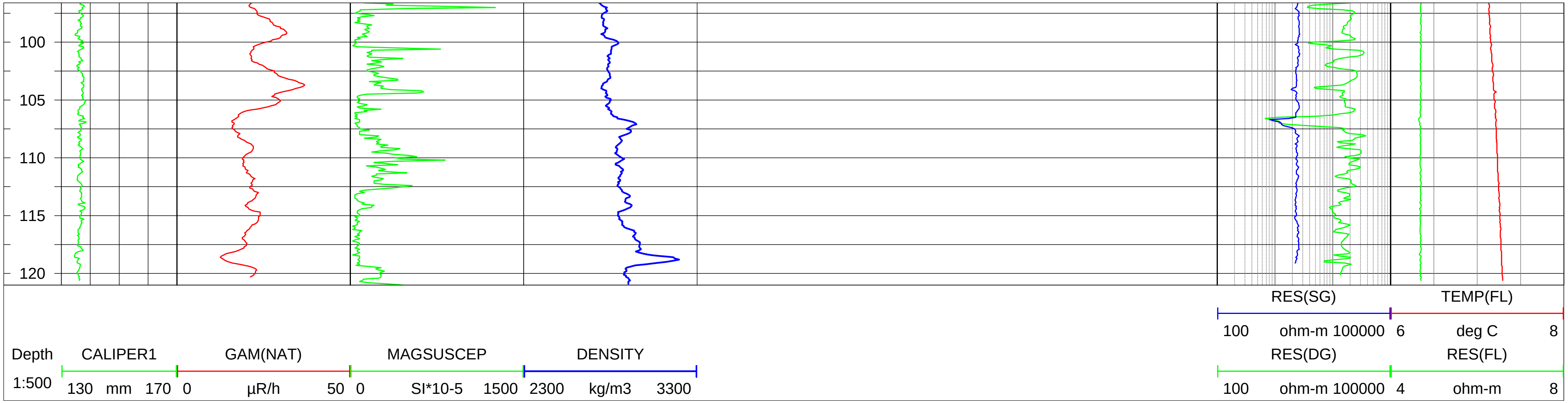
75
80
85
90
95



100
105
110
115
120
RES(SG)
TEMP(FL)
100 ohm-m 100000
6 deg C 8
Depth
1:500
CALIPER1
130 mm 170
GAM(NAT)
0 µR/h 50
MAGSUSCEP
0 SI*10-5 1500
DENSITY
2300 kg/m3 3300
RES(DG)
100 ohm-m 100000
RES(FL)
4 ohm-m 8