

MEMO

To: Peter Britz and CLG

From: Mike Deyling, Chris Buckman

Re: Deep Bedrock Downhole Geophysics and Packer Sampling Intervals:MW-20/MW-21/MW-22

Date: August 27, 2018

As part of the phased approach to deep bedrock monitoring well design and installation in the north and western portions of the groundwater management zone (GMZ), CES, Inc. (CES) retained Northeast Geophysical Services, Inc. (NGS) to complete downhole geophysical logging of the recently installed deep bedrock borings. Three deep bedrock borings (MW-20, MW-21, and MW-22) were completed in areas within the GMZ based on results of surface geophysical methods employed to micro-locate these wells. The locations were determined following input and concurrence from the United States Environmental Protection Agency (USEPA) and New Hampshire Department of Environmental Services (NHDES). Borings at MW-20 and MW-21 were completed in sequence (June 19 to July 17, 2018) with MW-22 installed following property owner access permission (July 23-29, 2018). Each boring was completed 300 ft into bedrock with completion depths ranging between 310 and 315 ft below ground surface (bgs). The work was performed in accordance with the *Revised Draft Deep Bedrock Investigation Work Plan* dated May 31, 2018 and conditionally approved by the USEPA on July 17, 2018.

Interval packer sampling will consist of isolating specific sections of the bedrock boreholes with an inflatable packer assembly to facilitate collection of water-quality samples. Additionally, aquifer characteristics can be monitored by recording water levels within the isolated interval prior to and during sampling/pumping. A series of similar tests within a borehole allows for the definition of vertical distribution of water quality and pathways for potential water movement within the aquifer.

Packer sampling interval recommendations for MW-20, MW-21, and MW-22 are presented below and are based on geophysical logging data as supplied by NGS. Copies of the deep bedrock boring logs are included as **Attachment 1** with borehole geophysical logs included as **Attachment 2**. Borehole geophysical logs include interpreted structural information (e.g. strike/dip), fracture aperture size, and plots illustrating a summary of interpreted fracture information within each boring. Boring logs are based on driller observations made by the rig operator and by direct observation of rock chips made by the CES field geologist.

DOWNHOLE GEOPHYSICS

NGS completed two mobilizations to the Site, based on dates of boring completion, to perform the following geophysical logging suites:

- ◆ Borehole Caliper
- ◆ Fluid Temperature
- ◆ Fluid Conductivity
- ◆ Electrical Resistance
- ◆ Natural Gamma
- ◆ Heat Pulse Flowmeter (static and pumping)
- ◆ Acoustic Televiwer
- ◆ Optical Televiwer

Pumping rates recorded during flowmeter testing were estimated using a graduated five-gallon bucket and stopwatch and are considered representative of an average rate. It should be noted that pumping rates may have fluctuated due to variations in pump efficiency (resulting from changes in drawdown) and battery voltage.

Based on data generated from the downhole logging efforts, the following general findings can be made:

MW-20

- 1) Three features are considered to be a “likely transmissive zone” (Feature Nos. 20, 26, and 23) with three others classified as “possible transmissive zones” (Feature Nos. 24 and 27-28), meaning that flow meter testing suggested some flow entering or exiting the borehole from fractures identified by the downhole logging.
- 2) Measured heat pulse flowmeter data indicate ambient (natural) downward flow within the boring at rates between 0.04 and 0.07 gallons per minute (gpm) with flow under pumping conditions being upward at rates between 0.06 and 1.18 gpm.
- 3) No measurable flow was recorded below 230 ft bgs under ambient or pumping conditions.
- 4) The largest fractures, based on borehole diameter, are interpreted to be within the uppermost 70-80 ft of bedrock. In general, this is consistent (based on approximate depths below grade) with those observed during borehole geophysical logging of the neighboring Chinburg well located approximately 400 ft east of MW-20.

According to the lithologic log completed for MW-20 (**Attachment 1**), bedrock was encountered at approximately 10 feet below ground surface (bgs) with casing installed to 14 feet bgs to ensure a sufficient seal between overburden and bedrock. A majority of fractures identified in the downhole logging are grouped in relatively shallow bedrock between 14 and 80 feet bgs (**Attachment 2**), and in a smaller second interval from 225 and 230 feet. No “possible” or “likely” transmissive fractures were identified between 80 feet and 225 feet bgs.

Well yield information as estimated during drilling (**Attachment 1**) was between 5 and 10 gpm within the uppermost 45 ft of bedrock (14-60 ft bgs). Estimated yield increased at approximately 60 ft into bedrock (74 ft bgs), based on driller observations made during drilling, and is likely associated with fractures illustrated on the borehole geophysical logs in **Attachment 2**. Total well

yield on the drillers field log is estimated at greater than 25 gpm below 65 ft into bedrock. When fracture yields are low, total yield estimates from individual zones are difficult to estimate during the drilling process and would represent a composite of yield within the entire borehole. As a result, the driller only noted that total yield is greater than 25 gpm. However, the drilling log did not identify specific or unusually large increases in flow in the lower portion of the boring. Estimated yields should be considered with caution as they represent “air lift” rates completed by the driller and do not represent sustained yields or yields that may occur when the well is fully developed.

MW-21

- 1) Two (2) features are interpreted as a “likely transmissive zone” (Feature Nos. 36 and 49) and three (3) fractures considered to be a “possibly transmissive zone” (Feature Nos. 46 and 50-51), indicating that flow meter testing suggests some flow entering or exiting the borehole from fractures.
- 2) Measured heat pulse flowmeter data indicate ambient upward flow within the boring at rates between 0.06 and 0.16 gpm with flow under pumping conditions being upward at rates between 0.34 and 1.23 gpm.
- 3) No measurable flow was recorded between the bottom of casing and 90 ft bgs under ambient conditions with rates greater than 1.0 gpm under pumping conditions within the same interval.
- 4) Interpreted transmissive intervals are unevenly spaced throughout the open hole portion of this boring with two closely spaced fractures comprising the singular “possibly transmissive” zone located between 130 and 140 ft bgs.

According to the lithologic log completed for MW-21 (**Attachment 2**), bedrock was encountered at approximately 10 ft below ground surface (bgs) with casing installed to 12 feet bgs. Fractures identified in the downhole logging are found to be more evenly spaced throughout the boring as compared to those observed in MW-20. No “possible” or “likely” transmissive fractures were identified between 135 ft and 304 ft bgs.

Well yield information as estimated during drilling (**Attachment 1**) was between 4 and 5 gpm within the uppermost 85 ft of bedrock until a water-bearing fracture was encountered at approximately 95 ft bgs (85 ft into bedrock), increasing the yield to an estimated 25 gpm. Total well yield on the form is estimated at >25 gpm below 131 ft. This increase correlates to a highly fractured zone encountered at 131 ft bgs as illustrated on the borehole geophysical logs in **Attachment 2**.

MW-22

- 1) Four (4) features are interpreted as a “likely transmissive zone” (Feature Nos. 2,3,15, and 57) and two (2) fractures considered to be a “possibly transmissive zone” (Feature Nos. 47 and 55), indicating that flow meter testing suggests some flow entering or exiting the borehole from fractures.
- 2) Measured heat pulse flowmeter data indicate ambient downward flow within the boring at rates between 0.05 and 0.15 gpm with flow under pumping conditions being upward at rates between 0.54 and 1.25 gpm.

- 3) Two distinct zones of downward flow are observed in the flowmeter results based on calculated flow rates under ambient conditions. The uppermost interval is located between fractures at 23 and 79 ft bgs (0.05 – 0.06 gpm) with the lower interval located between fractures at 79 and 214 ft bgs (0.12 – 0.15 gpm).
- 4) No measurable flow was recorded from 218 ft and the bottom of the boring under ambient or pumping conditions.
- 5) Interpreted transmissive intervals are unevenly spaced throughout the open hole portion of this boring.

According to the lithologic log completed for MW-22 (**Attachment 2**), bedrock was encountered at approximately 15 feet below ground surface (bgs) with casing installed to 17.5 feet bgs. Fractures identified in the downhole logging are found to be more evenly spaced throughout the boring as compared to those observed in MW-20 and MW-21. No “possible” or “likely” transmissive fractures were identified in MW-22 below 216 feet bgs under ambient or pumping conditions.

Well yield information as estimated during drilling (**Attachment 1**) was 1.5 gpm or less within the uppermost 188 ft of bedrock until a water-bearing fracture was encountered at approximately 186 ft bgs (171 ft into bedrock), increasing the yield to an estimated 10 gpm. Total well yield for the well was estimated at approximately 24 gpm with rates varying during the last 12 feet of drilling. Increases in well yield correlate to more highly fractured zones encountered at 79, 87-98, 186, and 212-216 ft bgs as illustrated on the borehole geophysical logs in **Attachment 2**. These zones were likely complimented by contribution from smaller less highly fractured zones within the borehole. Higher yield rates in deeper portions of the boring were difficult to estimate during the drilling process and would have been a composite of yield within the entire borehole.

SAMPLING INTERVAL RECOMMENDATIONS

A primary reason for completing downhole geophysical logging is to identify hydraulically active fractures or fracture zones for future straddle packer (i.e., an upper and lower packer separated with perforated pipe or screen) placement to isolate transmissive zones and collect a groundwater sample for analytical testing.

As many of the fractures are unevenly spaced throughout the drilled open hole portion of the boring, we believe that fractures other than the “likely or possibly” transmissive fractures should also be considered for testing. Rationale for sampling other fractures is presented below. Because fractures in some zones are in close proximity, it is likely that some interconnection exists and that the zone is representative of individual fractures within it. Individual zones, as described below, will be isolated and sampled using a straddle packer system with a 6 ft separation between inflatable packers. This configuration is similar to that used within the Chinburg Well and was well suited for the size and types of fractures interpreted from the borehole geophysical logs.

MW-20

Zone 1 – 20 to 26 feet. Though no measurable static flow was recorded within this interval, relative rugosity of the borehole wall as determined from borehole caliper and fluid temperature trends observed immediately above and below (**Attachment 2**), makes this a zone to target for sampling. It is anticipated that analytical data from this interval may allow for direct comparison

to future groundwater analytical data from the adjacent overburden well and provide information to substantiate a hydraulic connection between overburden and fractured bedrock groundwater.

Zone 2 – 64 to 70 feet. Place packers to span this zone and isolate the “likely” transmissive zone (Feature No. 20) as indicated on the borehole geophysical logs (**Attachment 2**). This interval represents fractures (66.75 and 69.75 ft) where the estimated well yield increased from 10 to 25 gpm (**Attachment 1**) during drilling. This interval is within an area where measured flow transitioned from no measurable flow (NF) to ambient downflow, indicating a net contribution of groundwater to the well. In addition, optical televiewer images for this interval appear to indicate some areas of iron oxide staining that may be the result of water movement within this zone.

Zone 3 – 71 to 77 feet. Place packers to span this zone and isolate the “likely” transmissive zone (Feature Nos. 26-28) as indicated on the borehole geophysical logs (**Attachment 2**). This interval represents a fracture (69.75 ft) where the estimated well yield increased from 25 gpm to greater than 25 gpm (**Attachment 1**) during drilling. Acoustic and optical televiewer images for this fractured zone indicate a large aperture (82 mm) at 73.2 ft with the optical televiewer log showing several pieces of fractured rock contained within the opening of the fracture.

Zone 4 – 116 to 122 feet. This interval, though not highly fractured based on televiewer and caliper logs, contains an interval of anomalously low electrical resistivity (**Attachment 2**) that may represent an isolated interval of smaller “microfractures”. Though smaller in comparison to larger identified fractures in the boring, may still contribute flow into or out of the well.

Zone 5 – 130 to 136 feet. This interval, though not highly fractured, contains an interval of anomalously low electrical resistivity (**Attachment 2**) similar to that observed in Zone 4 above and may represent an isolated interval of smaller “microfractures” with flow contribution.

Zone 6 – 196 to 202 feet. This interval contains an interval of anomalously low electrical resistivity (**Attachment 2**) similar to that observed in Zones 4 and 5 and may represent an isolated interval of smaller “microfractures” with flow contribution to the well.

Zone 7 – 225 to 231 feet. Place packers to span this zone and isolate the “likely” transmissive zone (Feature No. 43) as indicated on the borehole geophysical logs (**Attachment 2**). This interval represents a fracture with an aperture of 19 mm at 228.2 ft where the measured flow within the well transitioned from ambient downflow to no measurable flow under both ambient and pumping conditions. This is indicative of an area where water may be exiting the borehole.

Zone 8 – 280 to 286 feet. This interval contains a zone of anomalously low electrical resistivity (**Attachment 2**) similar to that observed in Zones 4, 5, and 6 and may represent an isolated interval of smaller “microfractures”. This zone is within an interval of no measurable flow; however, contribution may be below the flow rate detection capabilities of the heat pulse flowmeter.

MW-21

Zone 1 – 20 to 26 feet. Similar to MW-20, though no measurable static flow was recorded within this interval, borehole caliper results and fluid conductivity trends observed immediately above and below (**Attachment 2**), makes this a zone to target for sampling. It is anticipated that analytical data from this interval may allow for direct comparison with future groundwater

analytical data from the adjacent overburden well and provide information to substantiate a hydraulic connection between overburden and fractured bedrock groundwater.

Zone 2 – 62 to 68 feet. This interval, though not highly fractured, contains an interval of anomalously low electrical resistivity (**Attachment 2**) that may represent an isolated interval of smaller “microfractures”. Though small in comparison to larger identified fractures in the boring (interval from 126 to 138 ft), may still contribute flow into or out of the well.

Zone 3 – 91 to 98 feet. Packers should be placed to span this interval and isolate the “likely” transmissive zone (Feature No. 36) as indicated on the borehole geophysical logs (**Attachment 2**). This interval represents a fracture with an aperture of 8 mm where the measured flow within the well transitioned from ambient upflow to no measurable flow under ambient conditions. This is indicative of an area where water may be exiting the borehole. In addition, optical televiewer images for this interval appear to indicate some areas of iron oxide staining that may be the result of water movement within this zone.

Zone 4 – 126 to 132 feet. Packers should be placed to span this interval and isolate the “possible” transmissive zone (Feature Nos. 46 and 49) as indicated on the borehole geophysical logs (**Attachment 2**). This zone is in close proximity to another large fracture; however, we believe that sufficient separation exists to isolate these as two separate sampling zones. The fracture of interest (130.8 ft bgs) appears to have a large aperture (approximately 4 inches), though there is no visual evidence of staining based on optical televiewer response.

Zone 5 – 132 to 138 feet. Packers should be placed to span this interval and isolate the “possible” transmissive zone (Feature Nos. 50 and 51) as indicated on the borehole geophysical logs (**Attachment 2**). This zone is near another large fracture (Zone 4 - 131 ft); however, we believe that sufficient separation exists to isolate these as two separate sampling zones.

Zone 6 – 166 to 172 feet. This interval is moderately fractured and contains an area of anomalously low electrical resistivity (**Attachment 2**). Though smaller in comparison to other identified fractures in the boring, may still contribute flow into or out of the well.

Zone 7 – 264.5 to 270.5 feet. This interval is moderately fractured and contains an area of increasing fluid conductivity (**Attachment 2**). Though smaller in comparison to larger identified fractures in the boring, may still contribute flow into or out of the well. Observed acoustic and optical televiewer response indicates a high angle fracture (based on amplitude of sine wave) with some aperture based on acoustic travel time response.

Zone 8 – 302 to 308 feet. Place packers to span this zone and isolate the “likely” transmissive zone as indicated on the borehole geophysical logs (**Attachment 2**). Though this interval may not be a large communicative fracture based on ambient or stressed conditions, represents an area of anomalous resistivity and fluid conductivity response.

MW-22

Zone 1 – 21 to 27 feet. This interval represents a “likely” transmissive zone with closely-spaced fractures (Feature Nos. 2 and 3) where measured flow within the boring transitioned from no measurable flow to downflow under ambient conditions (**Attachment 2**). It is also anticipated that analytical data from this interval may allow for direct comparison with groundwater analytical data from the adjacent overburden well and provide information to substantiate a hydraulic connection

between overburden and fractured bedrock groundwater. The fracture of interest within this zone (23 ft bgs) appears to be orthogonal to bedding as observed in the acoustic and optical televiewer logs.

Zone 2 – 77 to 83 feet. This “likely transmissive zone” contains a thin (<1 ft) interval of fracturing (**Attachment 2**) that represents an area of a more than twofold increase in downward ambient flow within the boring. This increase in downward flow may be representative of a fracture where groundwater is entering the borehole. This interval also represents an area where there is a measurable increase in fluid conductivity and an observed response in travel time from the acoustic televiewer log. Additionally, acoustic and optical televiewer images depict a feature (Feature No. 15) that may be representative of a fracture with potential flow contribution to the well.

Zone 3 – 86.5 to 92.5 feet. Packers should be placed to span this interval and isolate the zone of increased borehole diameter and as indicated on the borehole geophysical logs (**Attachment 2**), this zone is in close proximity to another large fracture (94-96.5 ft); however, we believe that sufficient separation exists to isolate these as two separate sampling zones.

Zone 4 – 92.5 to 98.5 feet. Packers should be placed to span this interval and isolate this zone of increased fracture density (**Attachment 2**). This zone is located near another large fracture interval (Zone 3); however, we believe that sufficient separation exists to isolate these as two separate sampling zones.

Zone 5 – 130 to 136 feet. This interval is minimally to moderately fractured and contains an area of anomalously low electrical resistivity (**Attachment 2**). Though smaller in comparison to larger identified fractures in the boring, based on observed travel time and both acoustic and optical televiewer response, represents a fracture with potential flow contribution to the well.

Zone 6 – 184 to 190 feet. Packers should be placed to span this interval and isolate the “possible” transmissive zone (Feature No. 47) as indicated on the borehole geophysical logs (**Attachment 2**). Though not as large in comparison to other fractures within MW-22, this fracture appears to represent a transition in downward ambient flow rate. In addition, optical televiewer images for this interval appear to indicate iron oxide staining and likely the result of water movement within this zone.

Zone 7 – 211 to 217 feet. Place packers to span this zone and isolate the “likely” transmissive zone (Feature Nos. 55 and 57) as indicated on the borehole geophysical logs (**Attachment 2**). This interval represents a fracture where the measured flow within the well transitioned from ambient downflow to no measurable flow under both ambient and pumping conditions and is indicative of an area where water may be exiting the borehole. This fracture also correlates to an increase in fluid conductivity from 112 microSiemens per centimeter (uS/cm) to greater than 140 uS/cm. Optical televiewer images for this interval appear to indicate isolated areas of staining that may be the result of water movement within this zone.

Zone 8 – 270 to 276 feet. This interval contains a small zone of anomalously low electrical resistivity (**Attachment 2**) and may represent an isolated interval of smaller “microfractures”. An increase in fluid conductivity within this interval may indicate a change in groundwater chemistry at depth. This zone is within an interval of no measurable flow; however, contribution may be below the flow rate detection capabilities of the heat pulse flowmeter.

PACKER SAMPLING PROCEDURE

Interval packer sampling will be performed in accordance with the project Sampling and Analysis Plan (SAP) and adhere to standard operating procedure (SOP) *SOP-14 Straddle Packer Testing*. NGS will provide inflatable packer equipment for interval sampling of groundwater from the selected test zones.

Groundwater samples will be collected directly from the pump discharge into pre-preserved, laboratory-supplied containers, and chilled to approximately 4°C for delivery to the analytical laboratory. Samples will be analyzed for 1,4-dioxane (low detection limit analysis), PFAS, arsenic, and manganese in accordance with the project SAP.

CONCLUSIONS

Based on the information observed in the field during drilling and borehole geophysical results as received from NGS, we believe there is sufficient information to provide recommended zones for interval packer sampling within the three completed borings. Collected borehole geophysical logs resulted in complimentary information to support the selection of intervals as described above. Physical characteristics of the borehole, inclusive of borehole fluid and bedrock, were recorded and used by CES in the selection of sampling intervals. Measured groundwater flow, both ambient and stressed, indicate there are zones where groundwater may be entering or exiting the borehole. Analytical results from groundwater sampling within these zones, in conjunction with water levels monitored during sampling and structural bedrock information as determined from geophysical logs will aid in further development of the deep bedrock groundwater conceptual site model and in determining the optimum depths for the permanent monitoring wells at these locations.

ATTACHMENT 1

BORING LOG

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Project: Coakley Landfill Deep Bedrock Program		Project No: 10424.016		Date: 6/19/18 – 6/23/18	Boring: MW-20D	
Driller: Parratt-Wolff, Inc. Operator: Wayne Nielson		CES Personnel: WEH			Notes: Total depth = 310 ft. BGS	
Date	Run #	Depth below ground surface (ft. BGS)	Lithology Description	Notes	Drill Rate (min/ft.)	Gallons Per Minute (GPM)
6/19/18	N/A	0-10	Brown SILTY TILL, some gravel/stones	Water in overburden (6-8 ft.). Casing set at 15 ft.	N/A	N/A
6/20/18	1	15-20	Metasedimentary rock (Rye Formation), approx 10% quartz, some darker minerals		1.5	5
6/20/18	2	20-25	Same as above		1.5	10
6/20/18	3	25-30	Same as above		1.5	10
6/20/18	4	30-35	Same as above		1.5	10
6/20/18	5	35-40	Same as above, but lighter, approx. 30% quartz		1.5	10
6/20/18	6	40-45	Same as above		1.5	10
6/20/18	7	45-50	Same as above		1.5	10
6/20/18	8	50-55	Same as above	Water is gray in color	1.5	10
6/20/18	9	55-60	Same as above		1.5	10
6/20/18	10	60-65	60-62: Same as above 62-65: Dark gray, micaceous, larger rock frags. 0.5 inches in diameter, <10% quartz, some iron oxide staining	Fracture encountered at 62 ft.	1.5	25
6/20/18	11	65-70	Same as above		1.5	>25
6/20/18	12	70-75	Same as above	Fracture encountered at 71 ft.	1.5	>25
6/20/18	13	75-80	75-77: Same as above 77-80: Same as above, but approx. 10% quartz		1.5	>25
6/20/18	14	80-85	80-82: Same as above 80-82: Same as above, but approx. 15% quartz	Drill rate change at 82 ft.	2	>25
6/20/18	15	85-90	Gray, micaceous rock, <5% quartz	Water is gray in color	2	>25
6/20/18	16	90-95	Same as above		2	>25
6/20/18	17	95-100	95-98: Same as above 98-100: Same as above, but 40% quartz		2	>25
6/20/18	18	100-105	100-103: Same as above 103-105: Gray, micaceous, <5% quartz		2	>25
6/20/18	19	105-110	Same as above		2	>25
6/20/18	20	110-115	110-114: Same as above 114-115: Dark, micaceous rock		2	>25

BORING LOG

Project: Coakley Landfill Deep Bedrock Program		Project No: 10424.016		Date: 6/19/18 – 6/23/18	Boring: MW-20B	
Driller: Parratt-Wolff, Inc. Operator: Wayne Nielson		CES Personnel: WEH			Notes: Total depth = 310 ft. BGS	
Date	Run #	Depth below ground surface (ft. BGS)	Lithology Description	Notes/Comments	Drill Rate (min/ft.)	Gallons Per Minute (GPM)
6/20/18	21	115-120	Same as above		2	>25
6/20/18	22	120-125	Same as above		2	>25
6/20/18	23	125-130	125-128: Same as above 128-130: Same as above, but approx. 15% quartz	Water is gray in color	2	>25
6/20/18	24	130-135	130-132: Light material, likely granite, 35-45% quartz, some pink minerals (likely potassium feldspar), uniform fragment size 132-135: Dark gray, micaceous rock, <10% quartz		2	>25
6/20/18	25	135-140	Same as above, but approx. 15% quartz		2	>25
6/20/18	26	140-145	140-141: Same as above 141-145: Dark gray, micaceous rock, <10% quartz		2	>25
6/20/18	27	145-150	Same as above		2	>25
6/20/18	28	150-155	Same as above		2	>25
6/20/18	29	155-160	Same as above		2	>25
6/21/18	30	160-165	Gray, micaceous rock, <5% quartz	Fracture at 160 ft. Gray water	2	>25
6/21/18	31	165-170	Same as above, but approx. 35-40% quartz		2	>25
6/21/18	32	170-175	Same as above		2	>25
6/21/18	33	175-180	Same as above		2	>25
6/21/18	34	180-185	Dark gray, micaceous rock, approx. 10-15% quartz		2	>25
6/21/18	35	185-190	185-186: Same as above 186-190: Gray, micaceous rock, <5% quartz		2	>25
6/21/18	40	190-195	190-192: Quartzite, approx. 20-25% mica (muscovite) 192-195: Dark gray, micaceous rock, approx. 10-15% quartz	Fracture at 192 ft. Water observed to be muddy	3.5	>25
6/21/18	41	195-200	195-198: Same as above 198-200: Quartzite, approx. 20-25% mica (muscovite)		3.5	>25
6/21/18	42	200-205	Same as above		3.5	>25
6/21/18	43	205-210	205-206: Same as above 206-210: Dark gray, micaceous rock, approx. 10-15% quartz		3.5	>25
6/21/18	44	210-215	Same as above		3.5	>25
6/21/18	45	215-220	Same as above		3.5	>25
6/22/18	46	220-225	Same as above		3.5	>25

BORING LOG

Project: Coakley Landfill Deep Bedrock Program		Project No: 10424.016		Date: 6/19/18 – 6/23/18		Boring: MW-20B	
Driller: Parratt-Wolff, Inc. Operator: Wayne Nielson		CES Personnel: WEH			Notes: Total depth = 310 ft. BGS		
Date	Run #	Depth below ground surface (ft. BGS)	Lithology Description	Notes/Comments	Drill Rate (min/ft.)	Gallons Per Minute (GPM)	
6/22/18	47	225-230	Gray, micaceous rock, <5% quartz		3.5	>25	
6/22/18	48	230-235	Same as above		3.5	>25	
6/22/18	49	235-240	Same as above	Rough rock, water is gray in color	4	>25	
6/22/18	50	240-245	Same as above	Fracture at 243 ft.	4	>25	
6/22/18	51	245-250	Same as above		4	>25	
6/22/18	52	250-255	Same as above		4	>25	
6/22/18	53	255-260	Same as above		4	>25	
6/22/18	54	260-265	Same as above, but <5% muscovite		4	>25	
6/22/18	55	265-270	Gray, micaceous rock, <5% quartz		4	>25	
6/22/18	56	270-275	270-273: Same as above 273-275: Light material, likely granite, 35-45% quartz, some pink minerals (likely potassium feldspar), uniform fragment size		4	>25	
6/22/18	57	275-280	Same as above		4	>25	
6/22/18	58	280-285	Same as above		4	>25	
6/22/18	59	285-290	Same as above		4	>25	
6/22/18	60	290-295	Same as above		4	>25	
6/22/18	61	295-300	Same as above		4	>25	
6/22/18	62	300-305	300-301: Same as above 301-305: Dark gray, micaceous rock, <5% quartz		4	>25	
6/23/18	63	305-310	Same as above		4	>25	

BORING LOG

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Project: Coakley Landfill Deep Bedrock Program

Project No: 10424.016

Date: 6/26/18 – 7/12/18

Boring: MW-21D

Driller: Parratt-Wolff, Inc.
Operator: Wayne Nielson

CES Personnel: DLC

Notes: Total depth = 310 ft. BGS

Date	Run #	Depth below ground surface (ft. BGS)	Lithology Description	Notes/Comments	Drill Rate (min/ft.)	Gallons Per Minute (GPM)
6/26/18	N/A	0-10	Overburden. Approximately 2 ft. diameter boulder encountered at 3 ft.	Casing set at 13 ft.	N/A	N/A
6/27/18	1	13-18	Gray/bluish gray rock with some mica, plagioclase and quartz		1.5	N/A
6/27/18	2	18-23	Same as above, but smaller chips		2	N/A
6/27/18	3	23-28	Same as above		2	N/A
6/27/18	4	28-33	Same as above		2	N/A
6/27/18	5	33-38	Same as above		2	N/A
6/27/18	6	38-43	Same as above		2	N/A
6/27/18	7	43-48	Same as above		2	N/A
6/27/18	8	48-53	Same as above		2	N/A
6/27/18	9	53-58	Same as above		2	N/A
6/27/18	10	58-63	Same as above		2	N/A
6/27/18	11	63-68	Same as above		2	N/A
6/27/18	12	68-73	Same as above		2	N/A
6/27/18	13	73-78	Same as above	Water encountered at 75 ft.	2	4
6/27/18	14	78-83	Same as above		2	4
6/27/18	15	83-88	Same as above		2	5
6/27/18	16	88-93	Same as above		2	5
6/27/18	17	93-98	Same as above	Water-bearing fracture encountered at 95.5 ft.	5	25
6/27/18	18	98-103	Same as above		5	25
6/27/18	19	103-108	Same as above		5	25
6/27/18	20	108-113	Same as above		5	25
6/27/18	21	113-118	Same as above		5	25
6/27/18	22	118-123	Same as above		5	25
6/27/18	23	123-128	Same as above		1.5	25
6/27/18	24	128-133	Same as above, but finer rock fragments and lighter in color (lighter minerals)	Fracture encountered at 131 ft. (rods lowered approximately 3 ft. suddenly).	1.5	>25
6/27/18	25	133-138	Same as above		1.5	>25

BORING LOG

Page 2 of 2

Project: Coakley Landfill Deep Bedrock Program

Project No: 10424.016

Date: 6/26/18 – 7/12/18

Boring: MW-21B

Driller: Parratt-Wolff, Inc.
Operator: Wayne Nielson

CES Personnel: DLC

Notes: Total depth = 310 ft. BGS

Date	Run #	Depth below ground surface (ft. BGS)	Lithology Description	Notes/Comments	Drill Rate (min/ft.)	Gallons Per Minute (GPM)
6/27/18	26	138-143	Same as above		1.5	>25
6/27/18	27	143-148	Same as above		1.5	>25
6/27/18	28	148-153	Same as above		1.5	>25
6/27/18	29	153-158	Same as above		1.5	>25
6/28/18	30	158-163	Relatively equal parts dark and light minerals (micas, quartz, plagioclase)		1.5	>25
6/28/18	31	163-168	Same as above		1.5	>25
6/28/18	32	168-173	Same as above		1.5	>25
6/28/18	33	173-178	Same as above		1.5	>25
6/28/18	34	178-183	Same as above		1.5	>25
6/28/18	35	183-188	Same as above	Fracture at 185 ft.	2	>25
6/28/18	36	188-193	Same as above		5	>25
6/28/18	37	193-198	Same as above		5	>25
6/28/18	38	198-203	Same as above		5	>25
6/28/18	39	203-208	Same as above		5	>25
6/28/18	40	208-213	Same as above		5	>25
7/9/18	41	213-218	Same as above	Drill rate fluctuating between 5 and 10 min/ft.	5-10	>25
7/10/18	42	218-223	Same as above, but more dark minerals		5-10	>25
7/10/18	43	223-228	Same as above		7	>25
7/10/18	44	228-233	Same as above		6	>25
7/10/18	45	233-238	Same as above		7	>25
7/10/18	46	238-243	Same as above		7	>25
7/10/18	47	243-248	Same as above		6	>25
7/10/18	48	248-253	Same as above		7	>25
7/10/18	49	253-258	Same as above		8	>25
7/10/18	50	258-263	Same as above		8	>25
7/10/18	51	263-268	Same as above		8	>25
7/10/18	52	268-273	Same as above		8	>25
7/10/18	53	273-278	Same as above		8	>25
7/10/18	54	278-283	Same as above		8	>25
7/11/18	55	283-288	Same as above		18	>25
7/11/18	56	288-293	Same as above		18	>25
7/12/18	57	293-298	Same as above		15	>25
7/12/18	58	298-303	Same as above		15	>25
7/12/18	59	303-308	Same as above		15	>25
7/12/18	60	308-310	Same as above		15	>25

BORING LOG

Page 1 of 3

Project: Coakley Landfill
Deep Bedrock Program

Project No: 10424.016

Date: 7/23/18 –
7/29/18

Boring: MW-22D

Driller: Parratt-Wolff, Inc.
Operator: Wayne Nielson

Logged By: DLC, CFB

Notes: Total depth = 315 ft. BGS

Date	Run #	Depth below ground surface (ft. BGS)	Lithology Description	Notes	Drill Rate (min/ft.)	Gallons Per Minute (GPM)
7/24/18	N/A	0-15	Overburden.	Casing set at 18 ft.	N/A	N/A
7/25/18	1	18-23	Gray/bluish gray micaceous rock, some quartz		2	N/A
7/25/18	2	23-28	Same as above, but wet at approximately 25 ft.		1.5	<1
7/25/18	3	28-33	Same as above		2	<1
7/25/18	4	33-38	Same as above		1.5	<1
7/25/18	5	38-43	Same as above		1.5	<1
7/25/18	6	43-48	Same as above		1.5	<1
7/25/18	7	48-53	Same as above		1.5	<1
7/25/18	8	53-58	Same as above		1.5	<1
7/25/18	9	58-63	Same as above		1.5	<1
7/25/18	10	63-68	Same as above		1.5	<1
7/25/18	11	68-73	Same as above		1.5	<1
7/25/18	12	73-78	Same as above		1.5	<1
7/25/18	13	78-83	Same as above		1.5	<1
7/25/18	14	83-88	Same as above		1.5	<1
7/25/18	15	88-93	Same as above		1.5	<1
7/25/18	16	93-98	Same as above		1.5	<1
7/25/18	17	98-103	Same as above	Flow rate increase at 100 ft.	2.5	1
7/25/18	18	103-108	Same as above		2.5	1.5
7/25/18	19	108-113	Same as above		2.5	1.5
7/25/18	20	113-118	Same as above		2.5	1.5
7/25/18	21	118-123	Same as above		2.5	1.5
7/26/18	22	123-128	Same as above, but darker (fewer light minerals)		3	1.5
7/26/18	23	128-133	Same as above		3	1.5
7/26/18	24	133-138	Same as above		3	1.5
7/26/18	25	138-143	Same as above		3	1.5
7/26/18	26	143-148	Same as above		3	1.5
7/26/18	27	148-153	Same as above		3	1.5
7/26/18	28	153-158	Same as above		3	1.5
7/26/18	29	158-163	Same as above		3	1.5
7/26/18	30	163-168	Same as above		3	1.5
7/26/18	31	168-173	Same as above		3	1.5
7/26/18	32	173-178	Same as above		3	1.5
7/28/18	33	178-183	Same as above		3	1.5
7/28/18	34	183-188	Same as above		3	10
7/28/18	35	188-193	Same as above		3	10
7/28/18	36	193-198	Same as above		4	10
7/28/18	37	198-203	Same as above		4	10

BORING LOG

Project: Coakley Landfill Deep Bedrock Program

Project No: 10424.016

Date: 7/23/18 – 7/29/18

Boring: MW-22D

Driller: Parratt-Wolff, Inc.
Operator: Wayne Nielson

Logged By: DLC, CFB

Notes: Total depth = 315 ft. BGS

Date	Run #	Depth below ground surface (ft. BGS)	Lithology Description	Notes	Drill Rate (min/ft.)	Gallons Per Minute (GPM)
7/28/18	38	203-208	Same as above		4	10
7/28/18	39	208-213	Same as above		4	10
7/28/18	40	213-218	Same as above		4	10
7/28/18	41	218-223	Same as above, with quartz/lighter minerals near fracture zone	Fracture at 219 ft.	4	15
7/28/18	42	223-228	Same as above		10	15
7/28/18	43	228-233	230: Mostly white/gray quartzite, some darker minerals (micas), larger rock frags. (small gravel in size). 231 ft: Mostly darker gray rock (micaceous).		5	15
7/28/18	44	233-238	Same as above		6	15
7/28/18	45	238-243	Mostly light quartzite, some darker minerals		9	15
7/28/18	46	243-248	Same as above		9	15
7/28/18	47	248-253	Same as above		9	15
7/28/18	48	253-258	Same as above		9	15
7/28/18	49	258-263	Same as above		9	15
7/28/18	50	263-268	Same as above		9	15
7/29/18	51	268-273	Same as above, but gray to light gray quartzite with trace iron oxide staining at 270.5 ft. Smaller rock frags. starting at 273		4.5 (at 268 ft.) 6 (at 270.5 ft.)	13.5-15
7/29/18	52	273-278	Same as above, but smaller fragments, transitioning to dark gray to gray, fine-grained quartzite, no staining, approx. 20% quartz		8	15.5
7/29/18	53	278-283	278 - 279.5: Dark gray, fine-grained quartzite, approx. 45% quartz, slight increase in secondary mineralization with depth 279.5 – 281: Same as above, with iron oxide staining at 280.5 281 – 283: Same as above, but 30-40% quartz		278 -279.5: 12 279.5 – 281: 12.5 281 – 283: 13	15
7/29/18	54	283-288	Same as above, but <10% quartz		12	15
7/29/18	55	288-293	Dark gray, fine grained quartzite, no observed staining, <10% quartz		12	15.5 – 16.5

BORING LOG

Page 3 of 3

Project: Coakley Landfill Deep
Bedrock Program

Project No: 10424.016

Date: 7/23/18 –
7/29/18

Boring: MW-22B

Driller: Parratt-Wolff, Inc.
Operator: Wayne Nielson

Logged By: DLC, CFB

Notes: Total depth = 315 ft. BGS

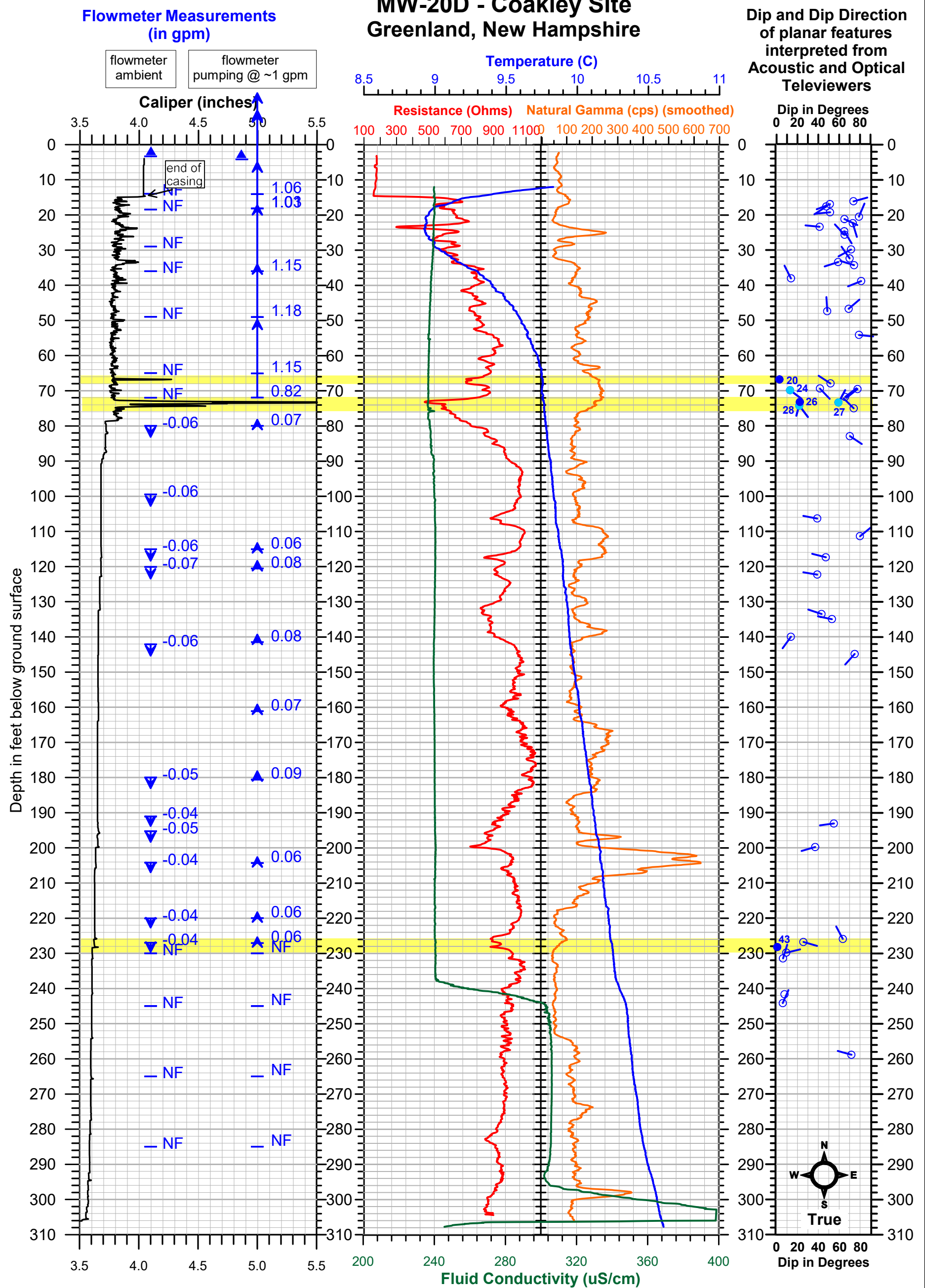
Date	Run #	Depth below ground surface (ft. BGS)	Lithology Description	Notes	Drill Rate (min/ft.)	Gallons Per Minute (GPM)
7/29/18	56	293-298	Same as above, trace chlorite/olivine, chips are <2mm in diameter, 10-15% quartz, few iron oxide-stained chips		10	17.5-18
7/29/18	57	298-303	Same as above, chips are 2-5 mm in diameter, approx. 40% quartz		10	17.5-18
7/29/18	58	303-308	Same as above, approx. 25% quartz		11	18-20
7/29/18	59	308-313	Same as above, approx. 25-35% quartz		6	20-22
7/29/18	60	313-315	Same as above		7	23-24


ATTACHMENT 2

BOREHOLE GEOPHYSICAL LOGS

MW-20D

COAKLEY LANDFILL SUPERFUND SITE



 = Likely transmissive zone


 = Possible transmissive zone

PLATE A-1
Borehole Geophysical Log
MW-20D - Coakley Site
Greenland, New Hampshire

Tadpole tail indicates dip direction.
The solid tadpoles with a feature number are the ones interpreted to be likely or possibly transmissive.

MW-20D Coakley Landfill Superfund Site Greenland, NH

PLATE A-2

Strike and Dip Direction
of all features

Based on 48 measurements in
MW-20D borehole

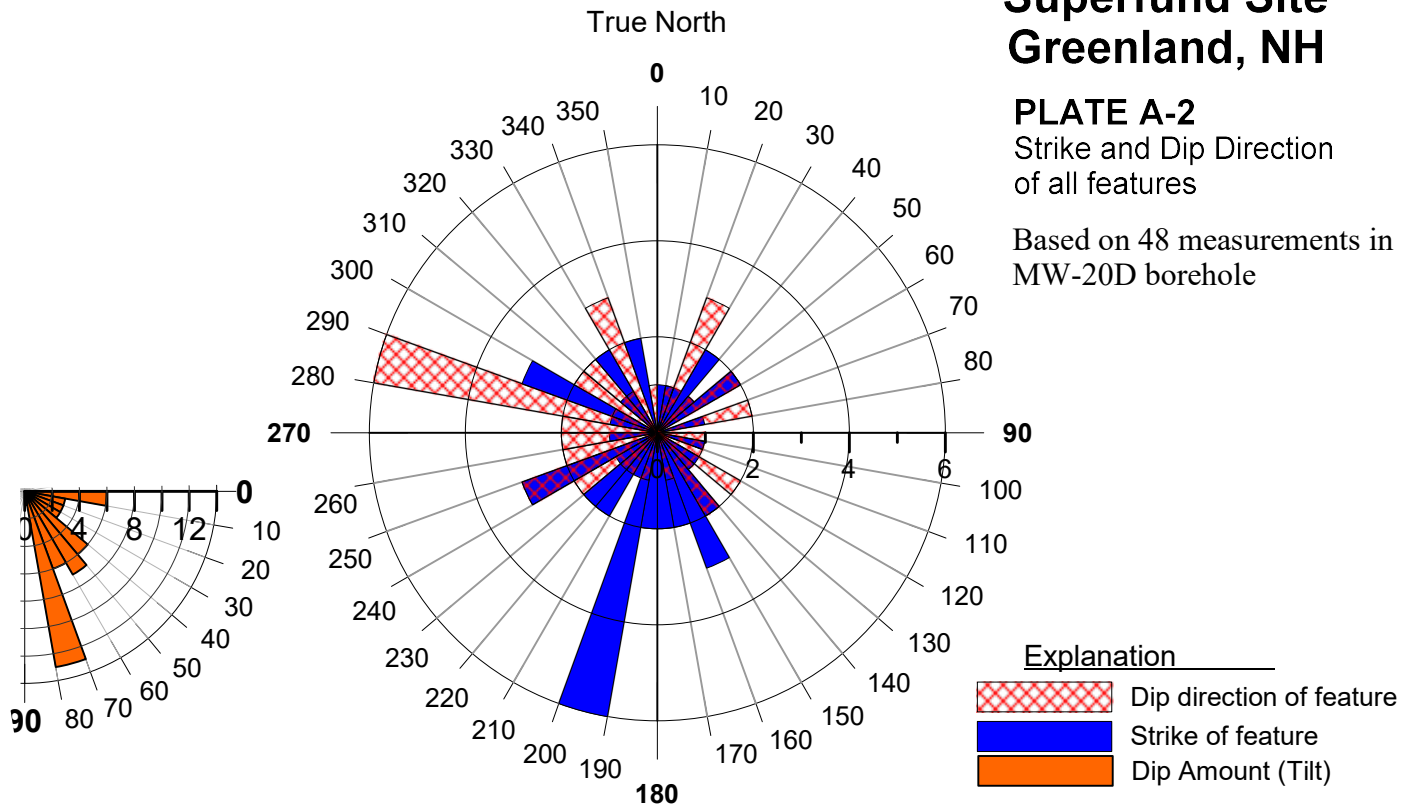
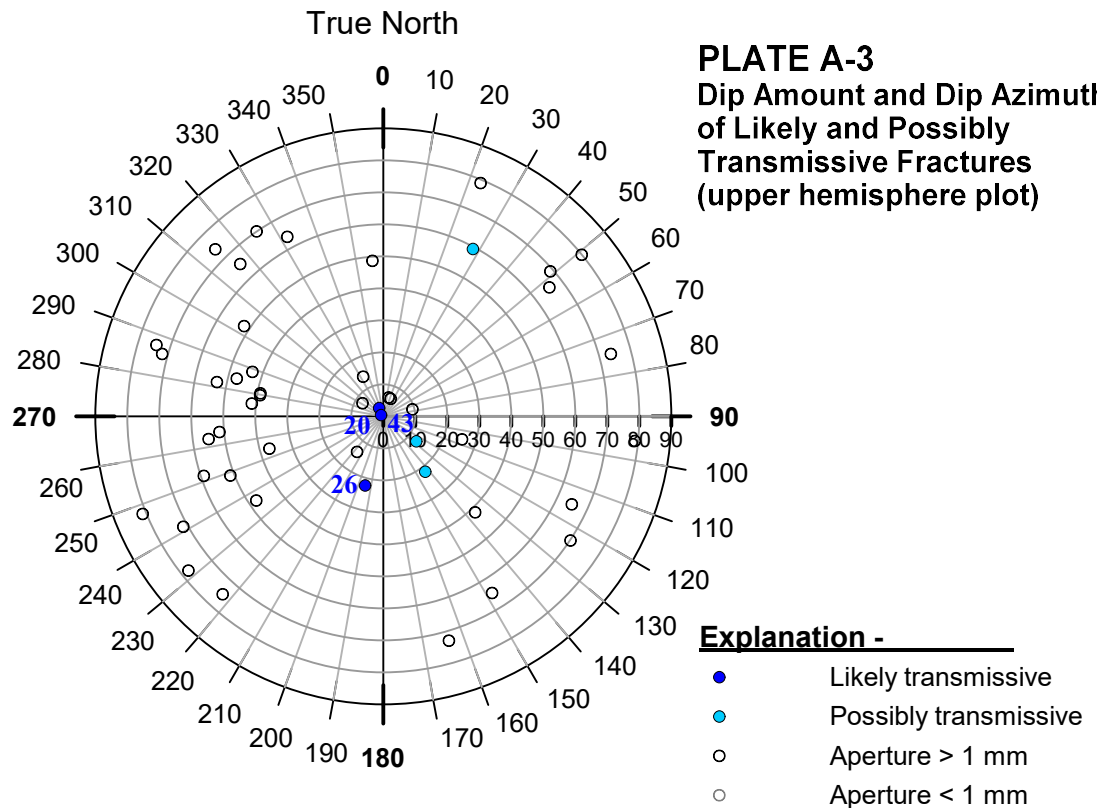
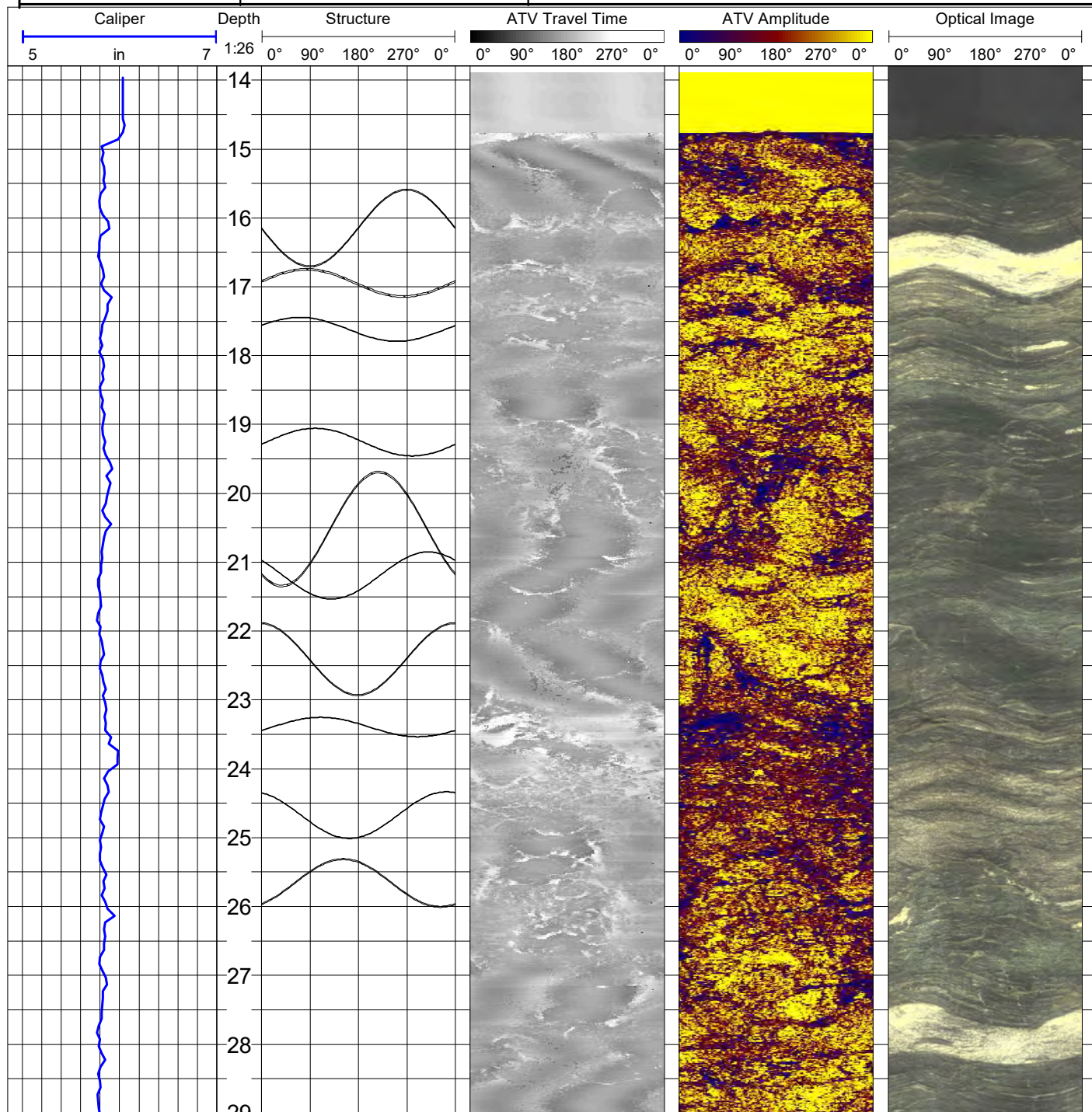


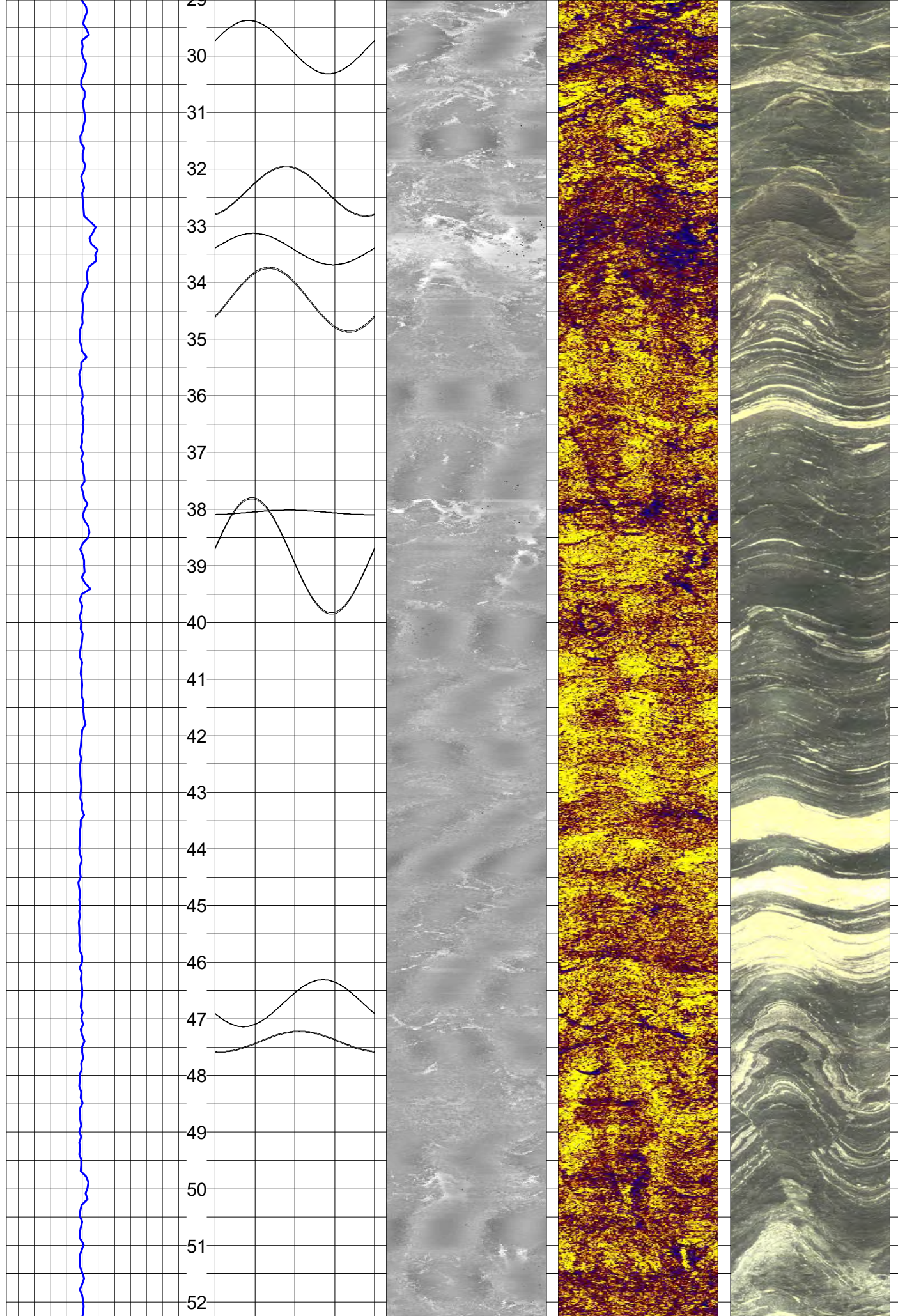
PLATE A-3

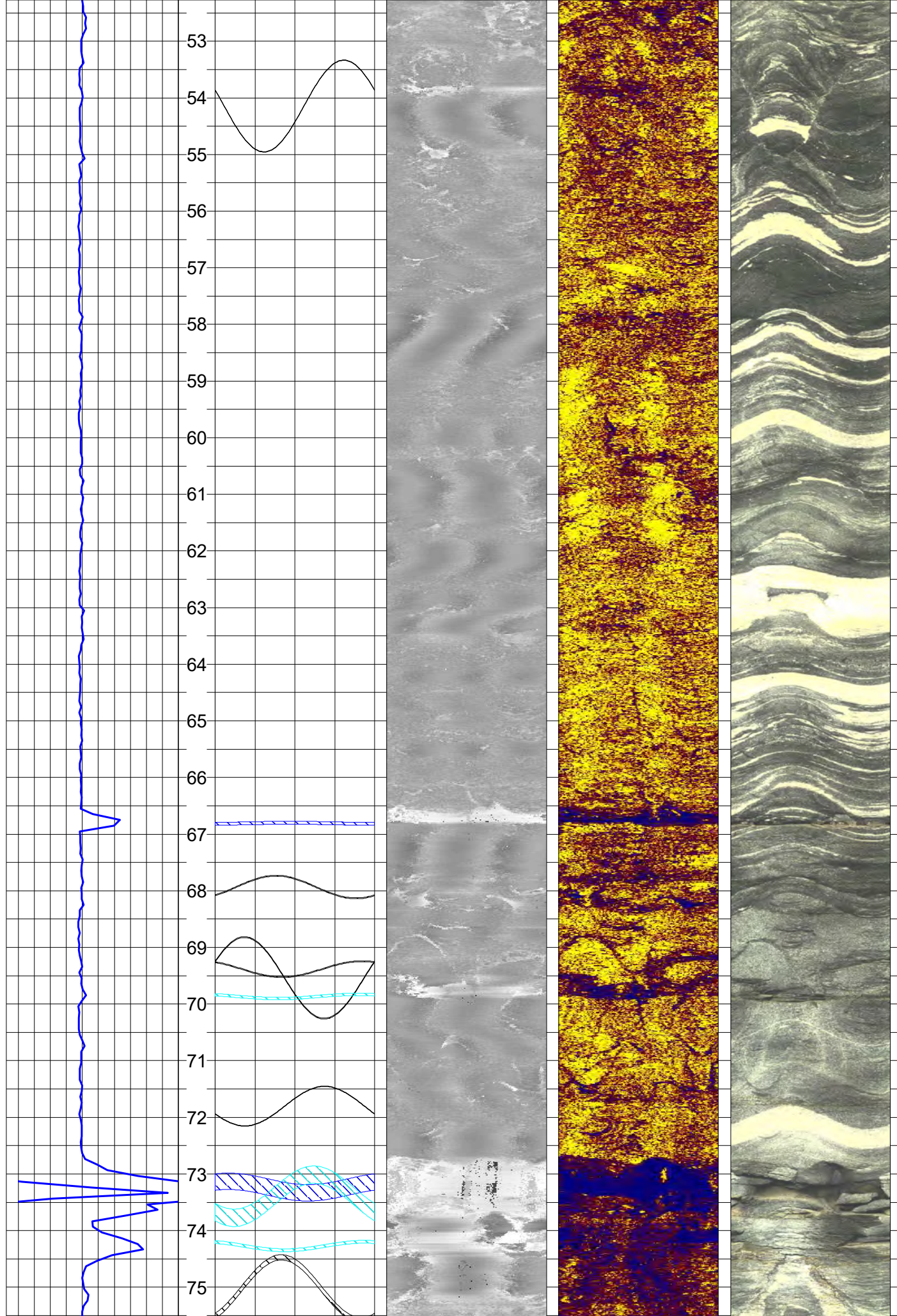
Dip Amount and Dip Azimuth
of Likely and Possibly
Transmissive Fractures
(upper hemisphere plot)

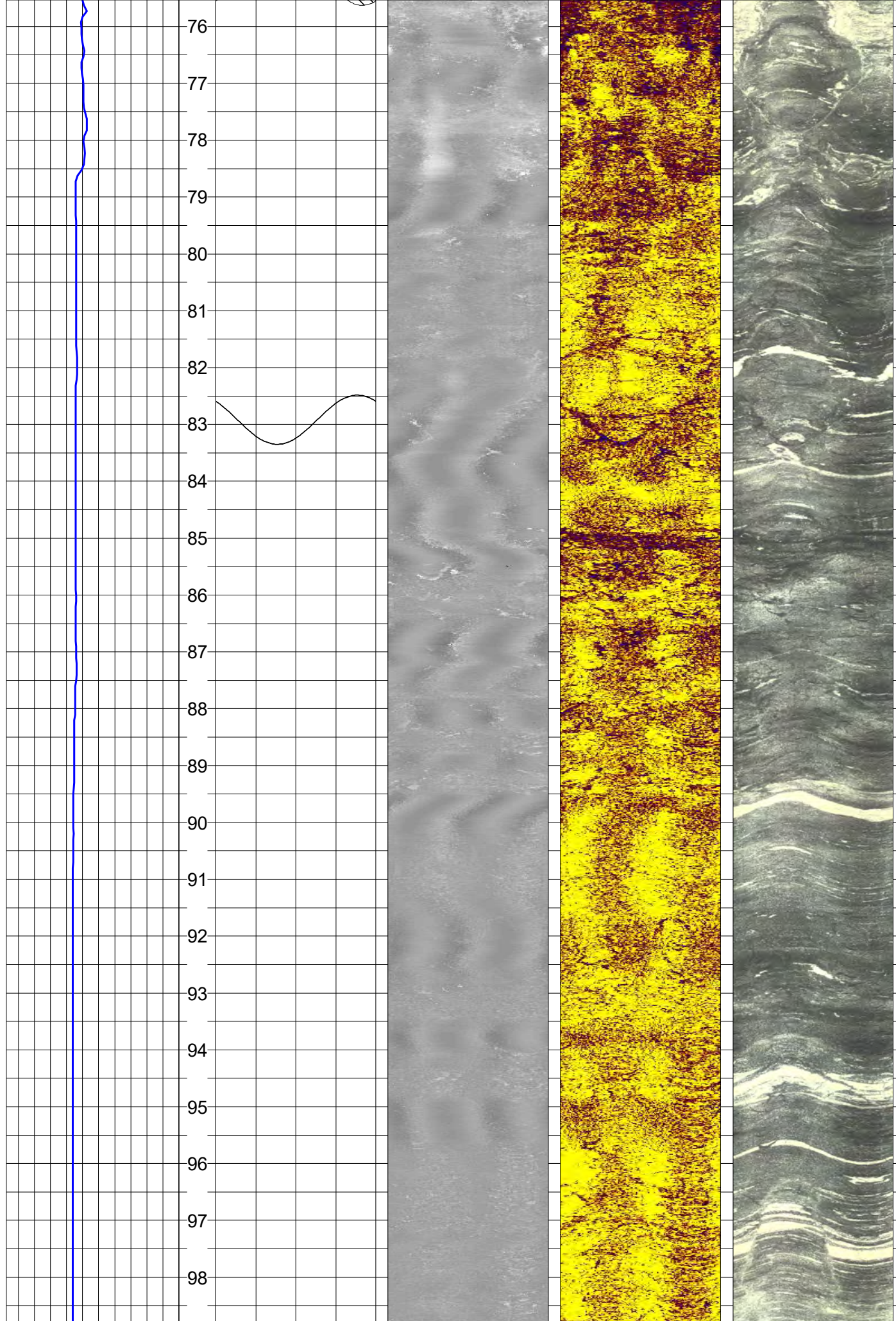


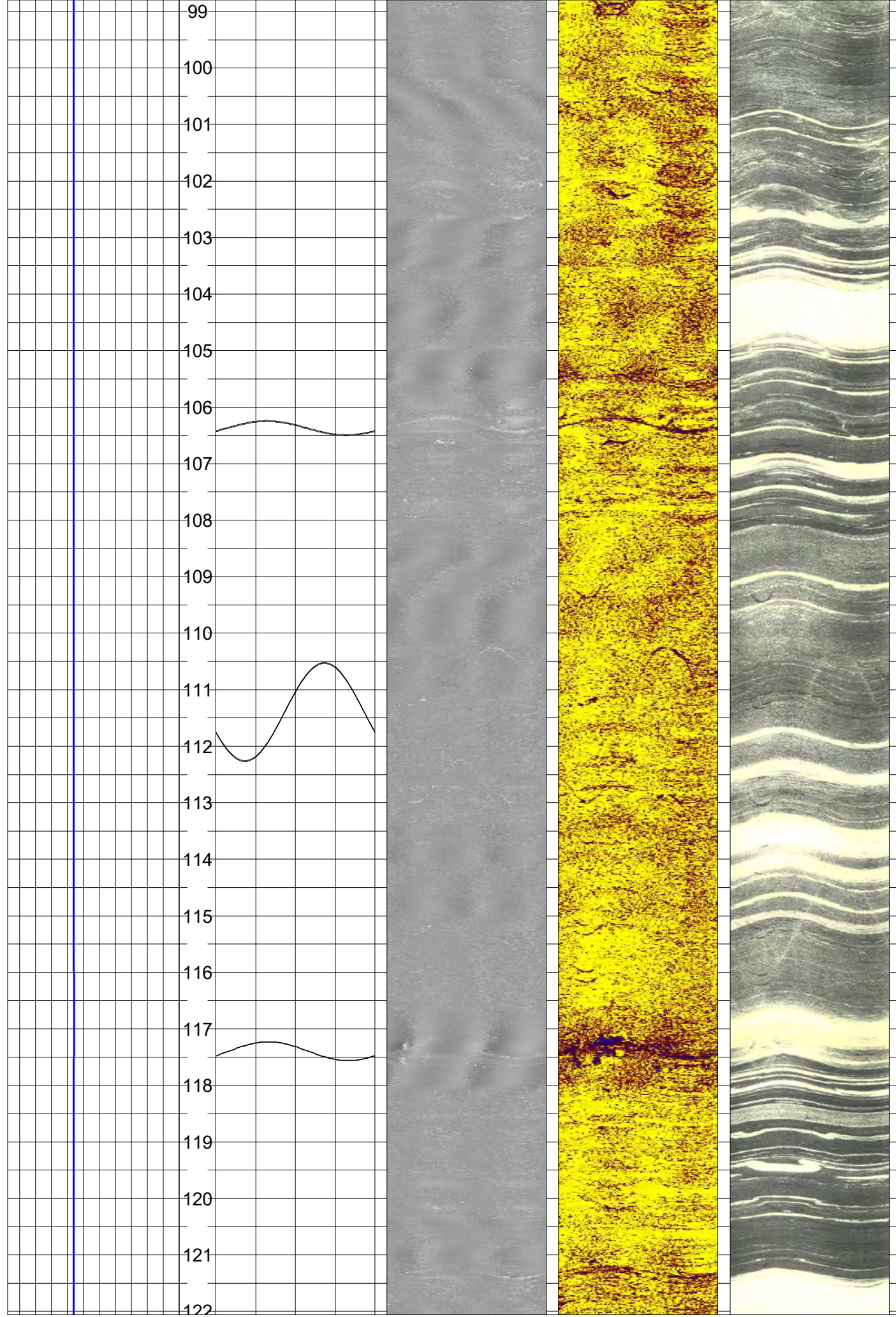
Northeast Geophysical Services 4 Union Street Bangor, Maine 04401 Tel. 207-942-2700 email: ngsinc@negeophysical.com		Log: Plate A-4 Televiwer & Caliper Logs	
		Well: MW-20D	
		Site: Coakley Landfill Superfund	
Date:	7/19/2018	Location: Greenland, NH	
Casing Depth:	15 ft.	For: CES	
Casing Type:	4 inch steel	Logged by: R. Rawcliffe	
Boring Depth:	308.2 ft.	Orientation: magnetic	
Meas. From:	ground	Structure Plots: black = planar features (faults, foliation, bedding, joints, etc) light blue = possibly transmissive fracture dark blue = likely transmissive fracture	
Stickup:	0.1 ft.		
Water Level:	3.05 ft.		

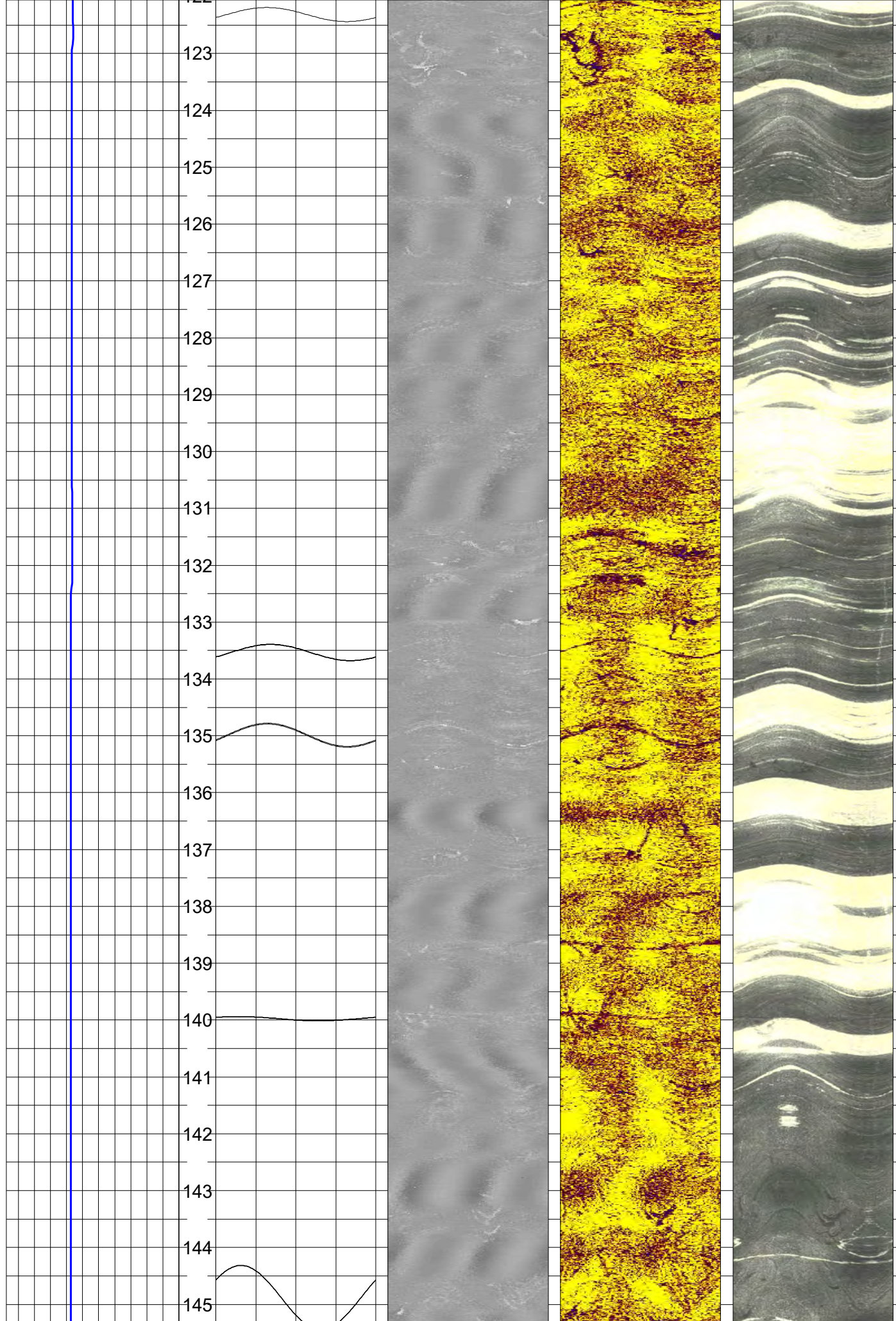


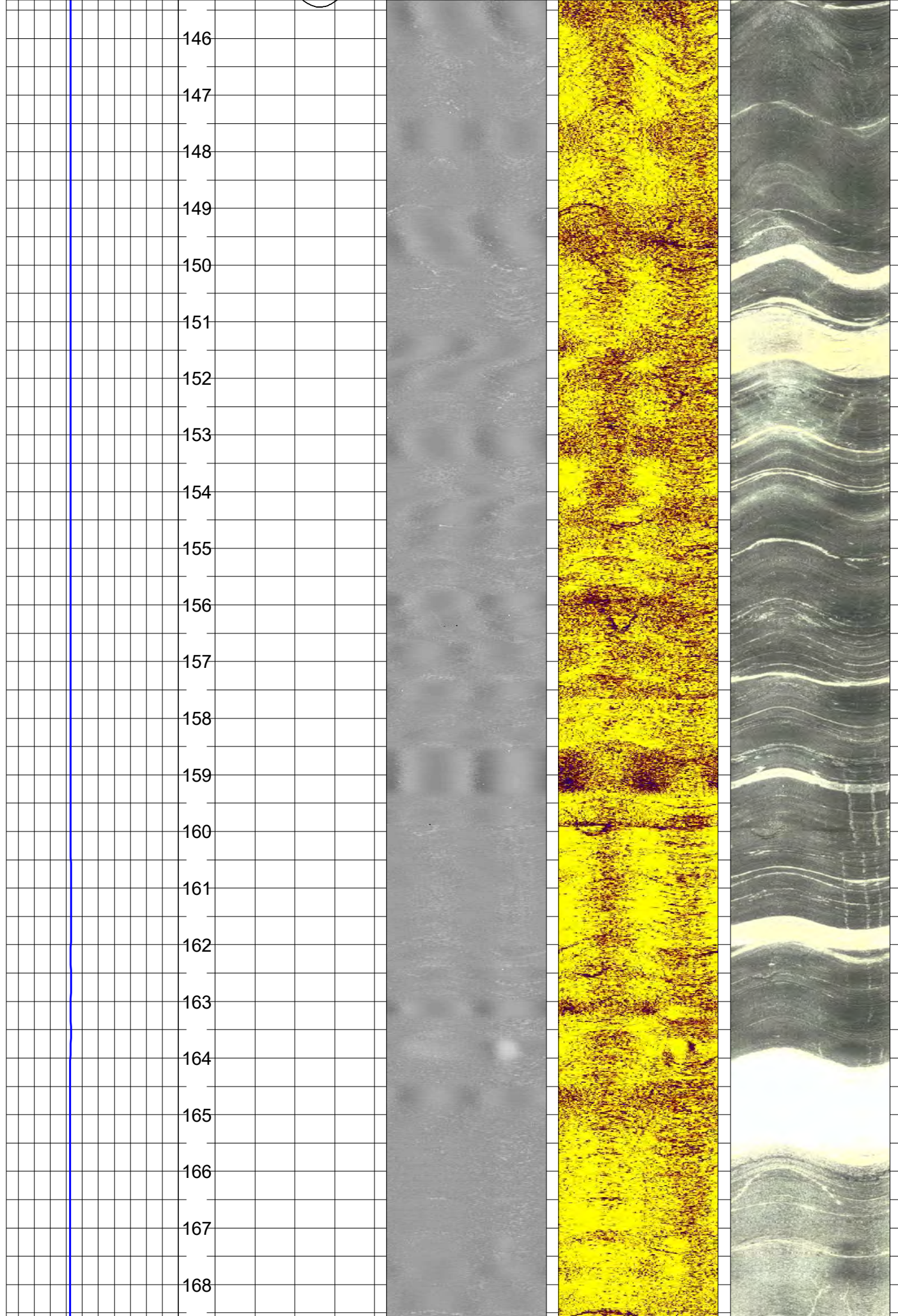


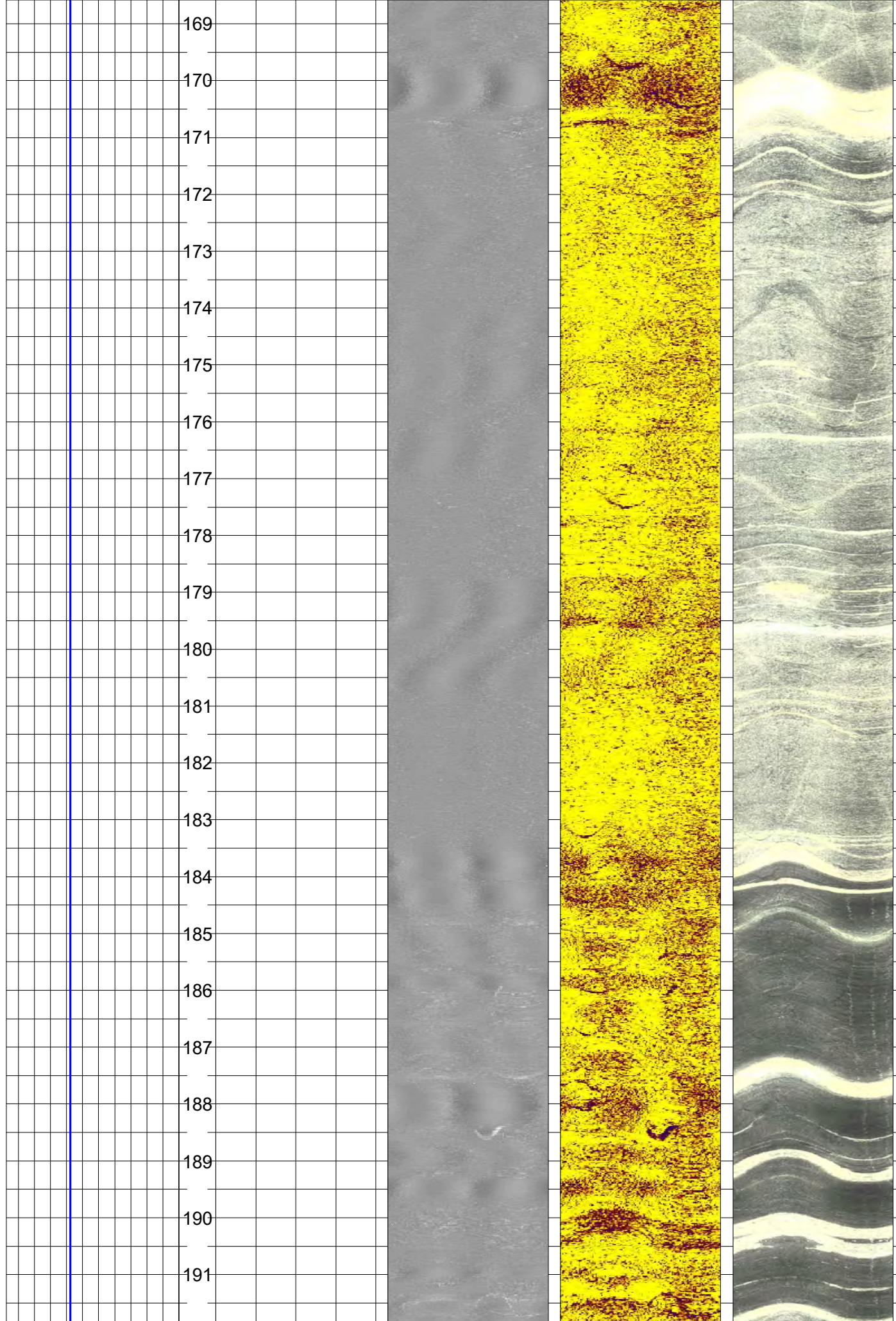


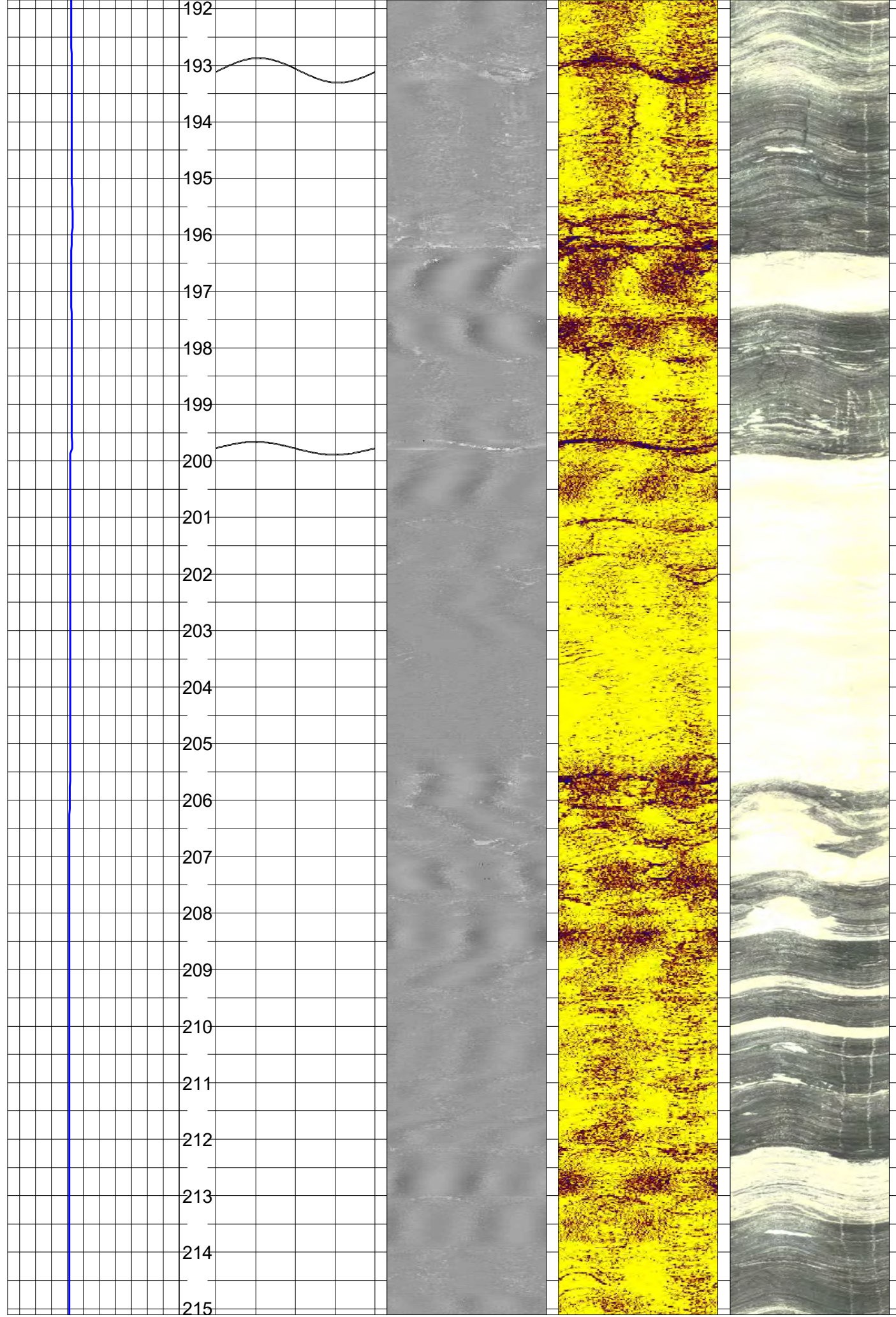


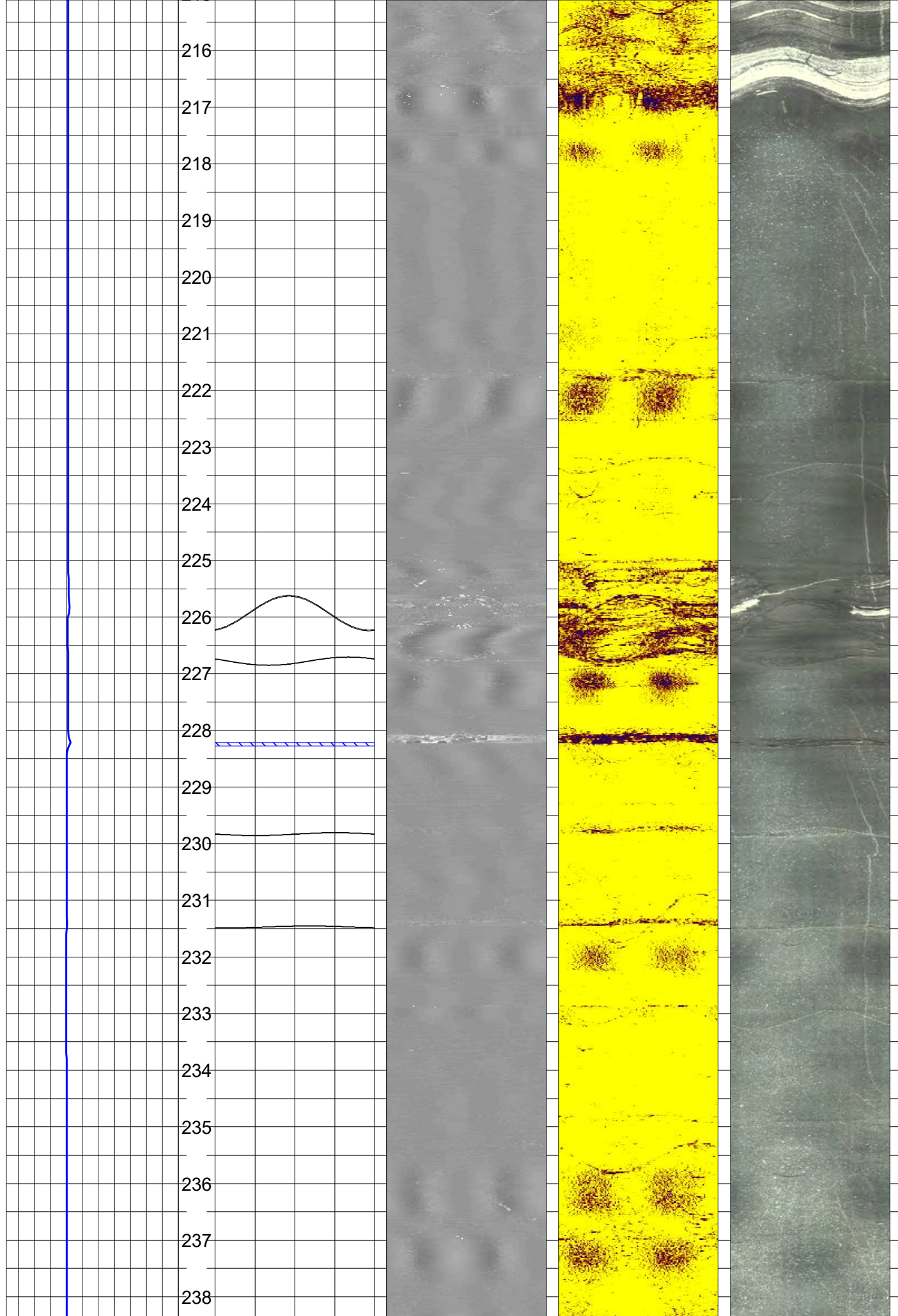


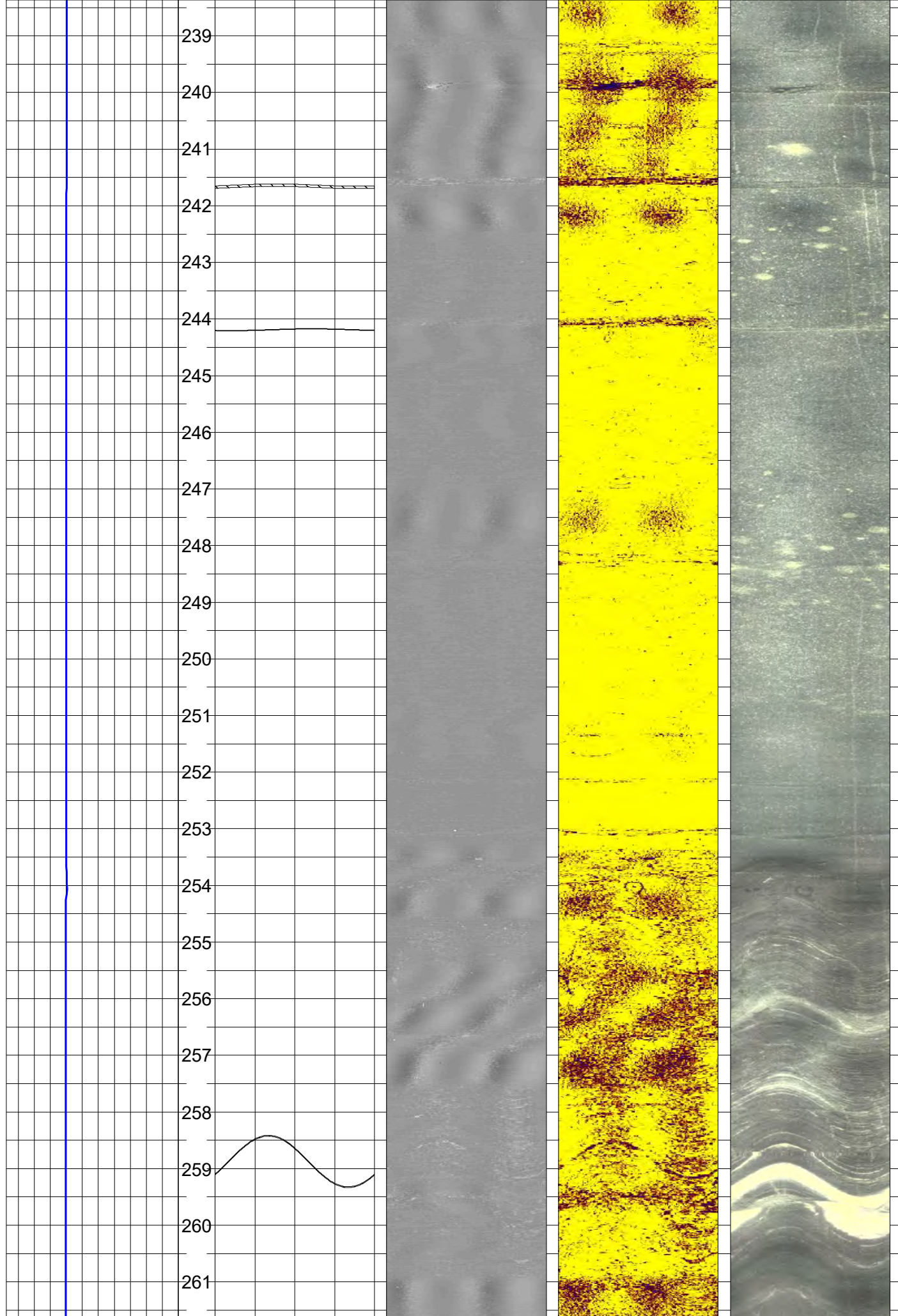


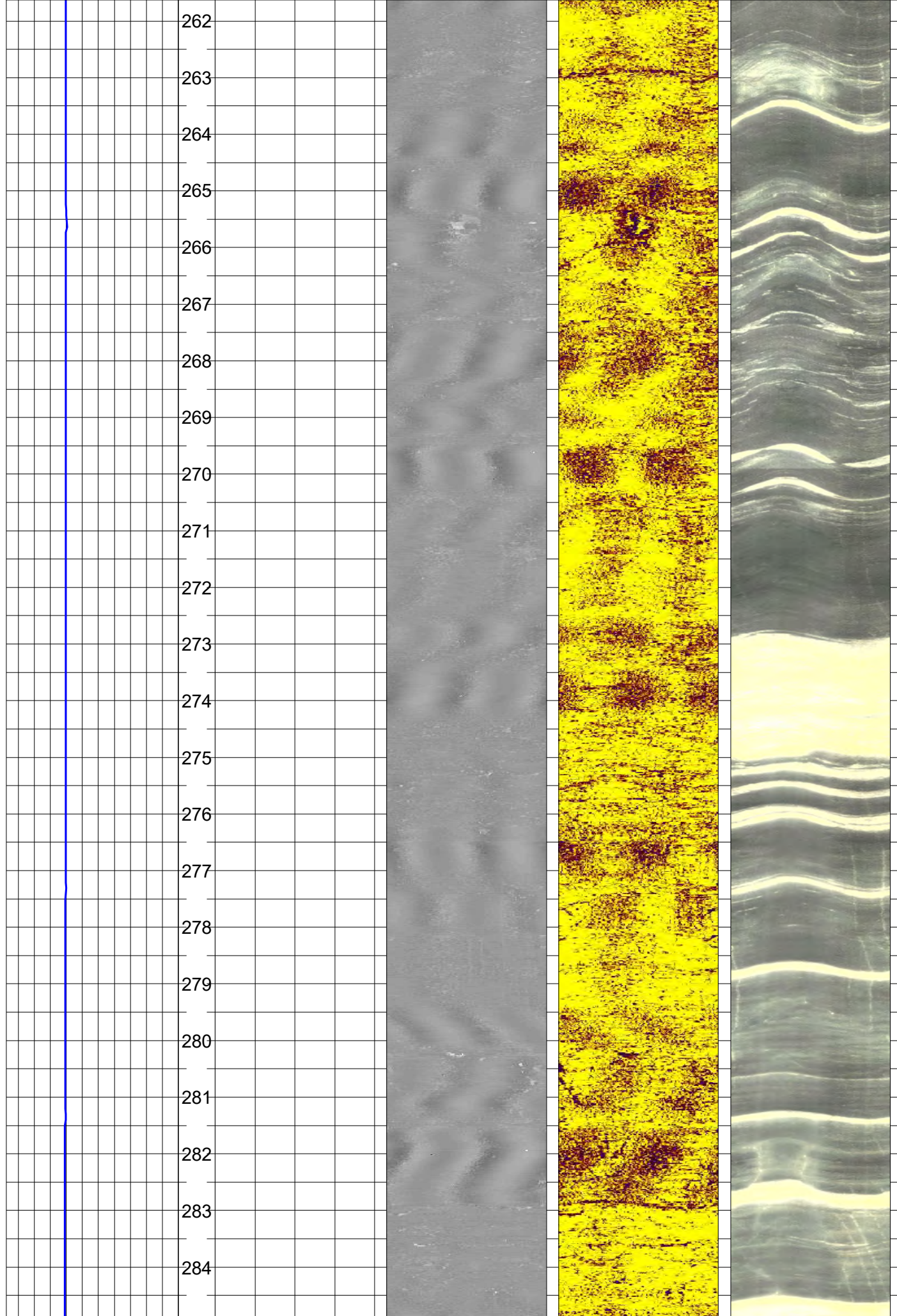












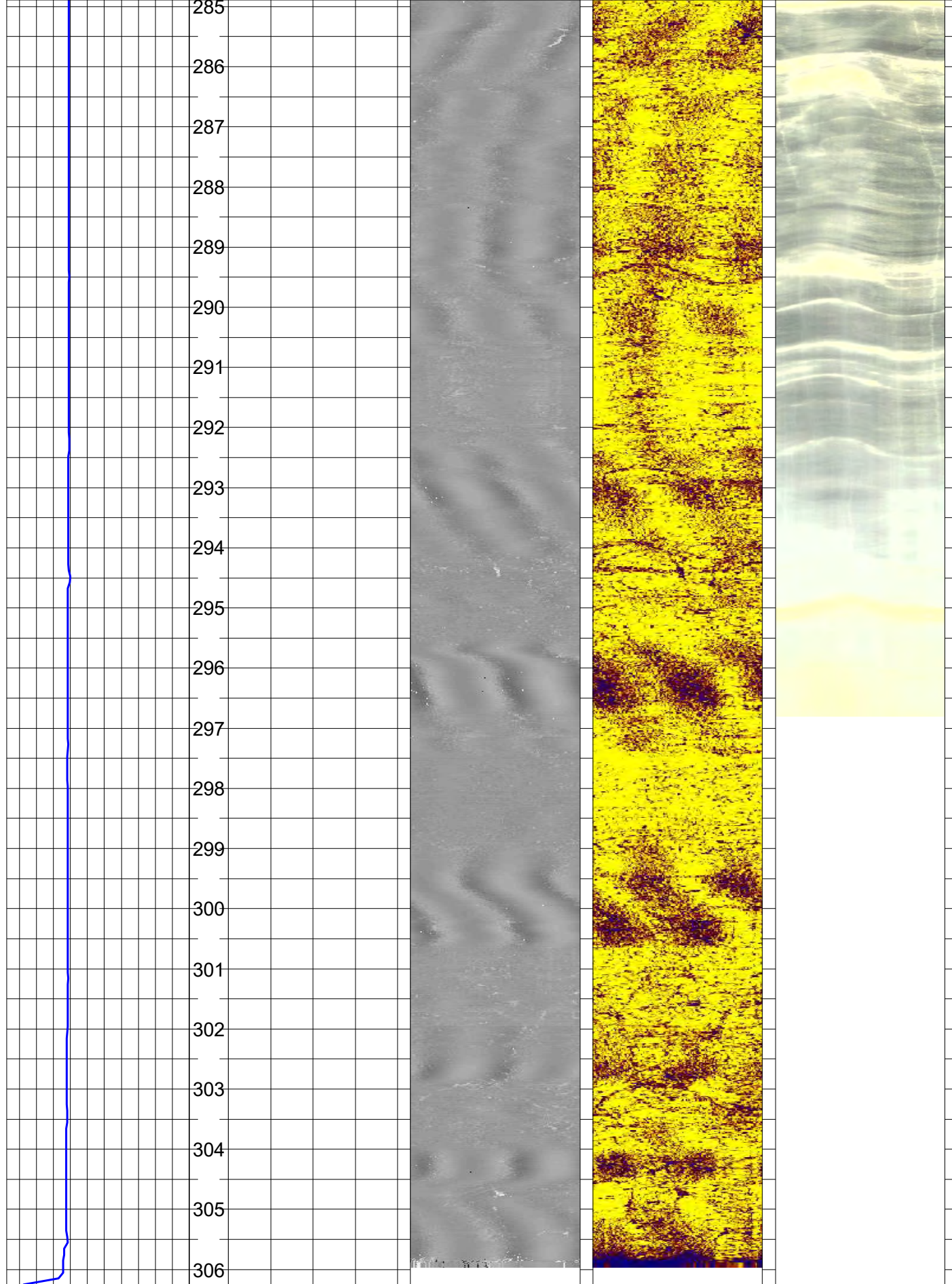


TABLE A-1 Planar features interpreted from acoustical and optical televiewers
Coakley Landfill Superfund Site - Greenland, NH

July, 2018

Declination: 14.9 degrees west

Borehole	Feature # Number	Feature depth Feet	Dip Degrees	Dip Azimuth magnetic	Strike magnetic	Dip Azimuth True	Strike True	Aperture mm	Category Type
MW-20D	1	16.2	74	90	360	75	345	1	101
MW-20D	2	17.0	51	264	174	249	159	4	101
MW-20D	3	17.6	48	251	161	236	146	2	101
MW-20D	4	19.3	51	279	189	264	174	2	101
MW-20D	5	20.5	79	38	308	23	293	1	101
MW-20D	6	21.2	65	130	40	115	25	1	101
MW-20D	7	22.4	73	179	89	164	74	1	101
MW-20D	8	23.4	41	290	200	276	186	3	101
MW-20D	9	24.7	65	163	73	148	58	2	101
MW-20D	10	25.7	65	332	242	317	227	3	101
MW-20D	11	29.8	71	256	166	241	151	1	101
MW-20D	12	32.4	70	340	250	326	236	2	101
MW-20D	13	33.4	59	266	176	252	162	2	101
MW-20D	14	34.3	74	302	212	287	197	2	101
MW-20D	15	38.1	14	348	258	333	243	2	101
MW-20D	16	38.8	81	263	173	248	158	1	101
MW-20D	17	46.7	69	64	334	49	319	1	101
MW-20D	18	47.4	49	11	281	356	266	3	101
MW-20D	19	54.2	79	111	21	96	6	1	101
MW-20D	20	66.8	3	349	259	335	245	14	107
MW-20D	21	67.9	52	318	228	303	213	3	101
MW-20D	22	69.4	42	151	61	136	46	3	101
MW-20D	23	69.5	78	246	156	232	142	1	101
MW-20D	24	69.9	13	142	52	127	37	12	108
MW-20D	25	71.8	66	67	337	52	322	1	101
MW-20D	26	73.2	22	210	120	195	105	82	107
MW-20D	27	73.4	59	43	313	28	298	48	108
MW-20D	28	74.3	22	158	68	143	53	14	108
MW-20D	29	75.0	74	330	240	315	225	8	101
MW-20D	30	82.9	70	138	48	124	34	1	101

TABLE A-1 Planar features interpreted from acoustical and optical televiewers**Coakley Landfill Superfund Site - Greenland, NH****July, 2018**

Declination: 14.9 degrees west

Borehole	Feature # Number	Feature depth Feet	Dip Degrees	Dip Azimuth magnetic	Strike magnetic	Dip Azimuth True	Strike True	Aperture mm	Category Type
MW-20D	31	106.4	39	296	206	281	191	3	101
MW-20D	32	111.4	80	66	336	51	321	1	101
MW-20D	33	117.4	47	299	209	284	194	2	101
MW-20D	34	122.3	39	295	205	280	190	1	101
MW-20D	35	133.5	43	304	214	289	199	2	101
MW-20D	36	135.0	53	296	206	282	192	3	101
MW-20D	37	140.0	14	231	141	216	126	2	101
MW-20D	38	144.9	75	237	147	222	132	1	101
MW-20D	39	193.1	55	277	187	262	172	3	101
MW-20D	40	199.8	37	269	179	254	164	4	101
MW-20D	41	225.9	64	347	257	332	242	2	101
MW-20D	42	226.8	26	121	31	106	16	2	101
MW-20D	43	228.2	1	312	222	297	207	19	107
MW-20D	44	229.8	9	92	2	77	347	2	101
MW-20D	45	231.5	6	32	302	17	287	2	101
MW-20D	46	241.7	8	317	227	302	212	14	101
MW-20D	47	244.2	6	38	308	24	294	2	101
MW-20D	48	258.9	72	301	211	286	196	1	101

Explanation:

Category 100 = planar feature (possible fracture, joint, foliation, bedding, etc.) aperture < 1 mm

Category 101 = planar feature (possible fracture, joint, foliation, bedding, etc.) aperture > 1 mm

Category 108 = Possible water bearing fracture

Category 107 = Likely water bearing feature

BOREHOLE GEOPHYSICAL LOGS

MW-21D

COAKLEY LANDFILL SUPERFUND SITE

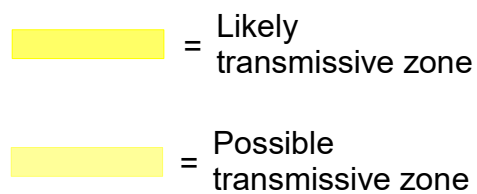
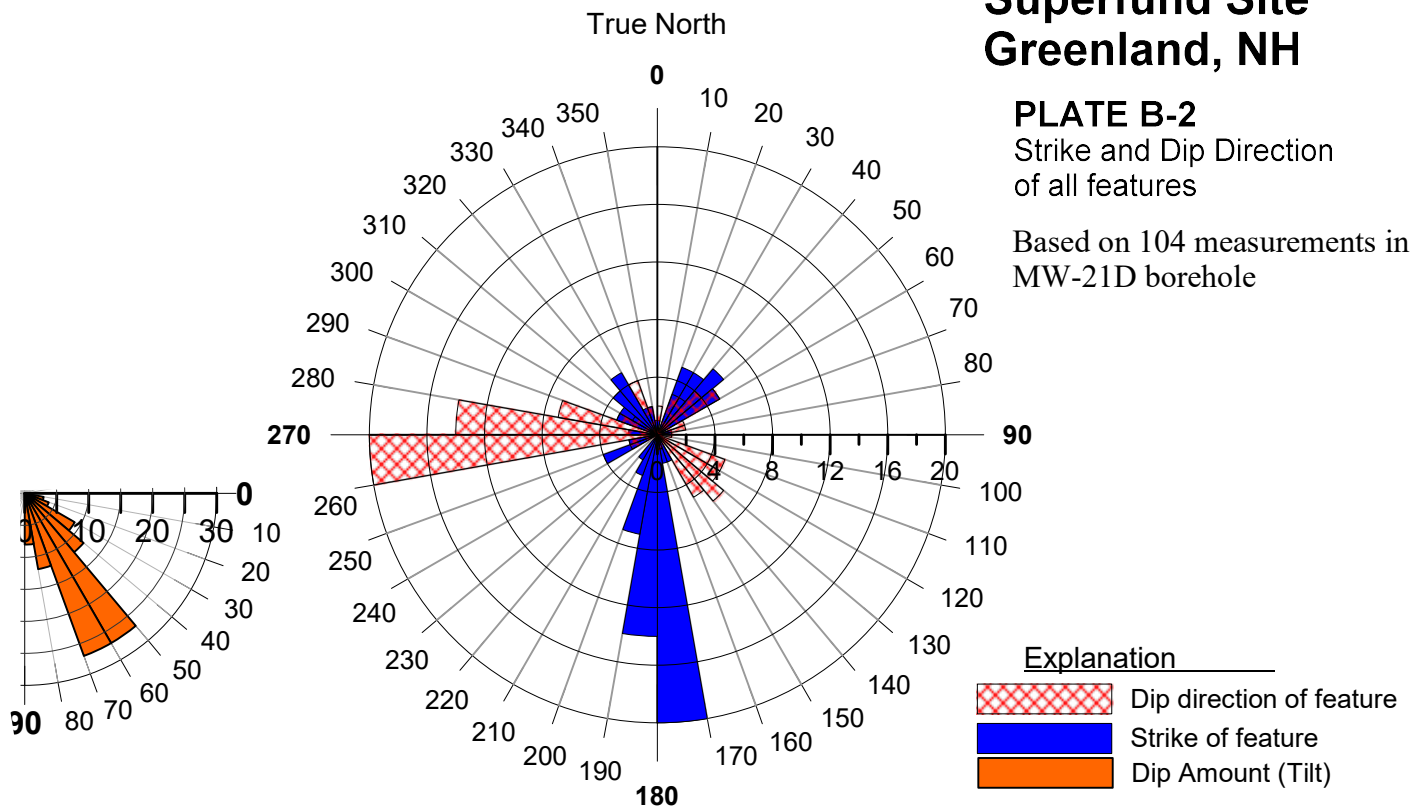


PLATE B-1
Borehole Geophysical Log
MW-21D - Coakley Site
Greenland, New Hampshire

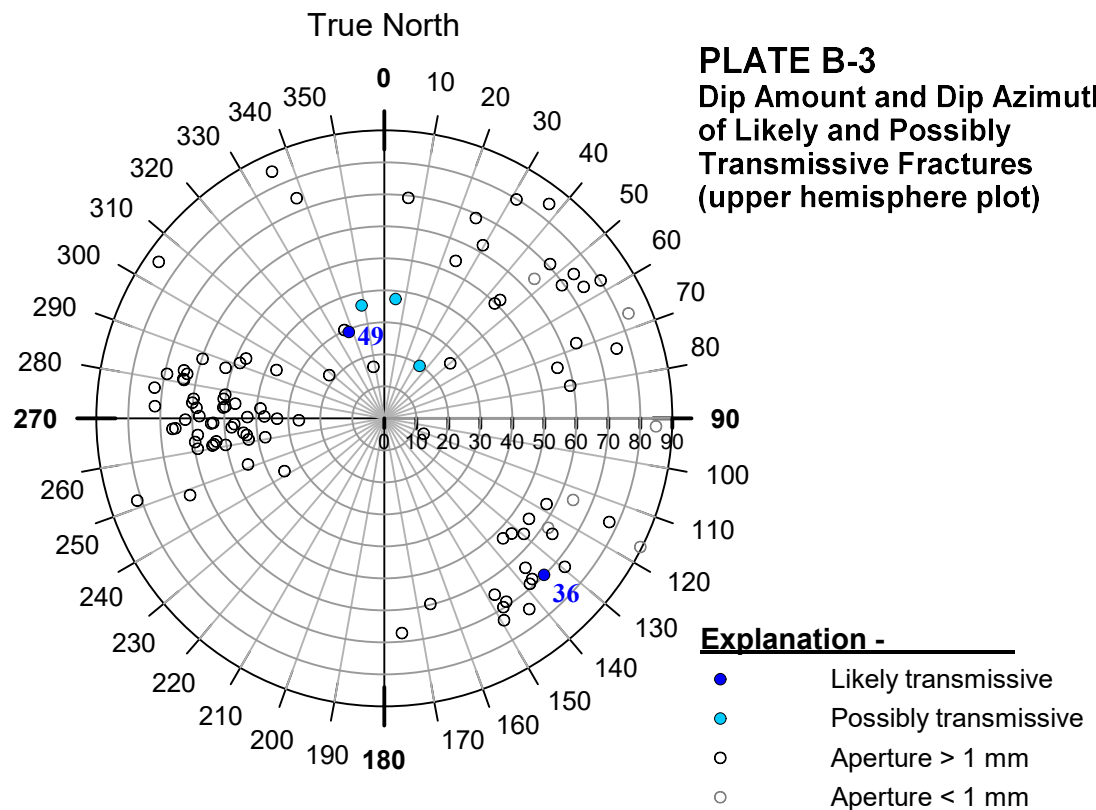
Tadpole tail indicates dip direction.
The solid tadpoles with a feature number are the ones interpreted to be likely or possibly transmissive.

Strike and Dip Direction of all features

Explanation

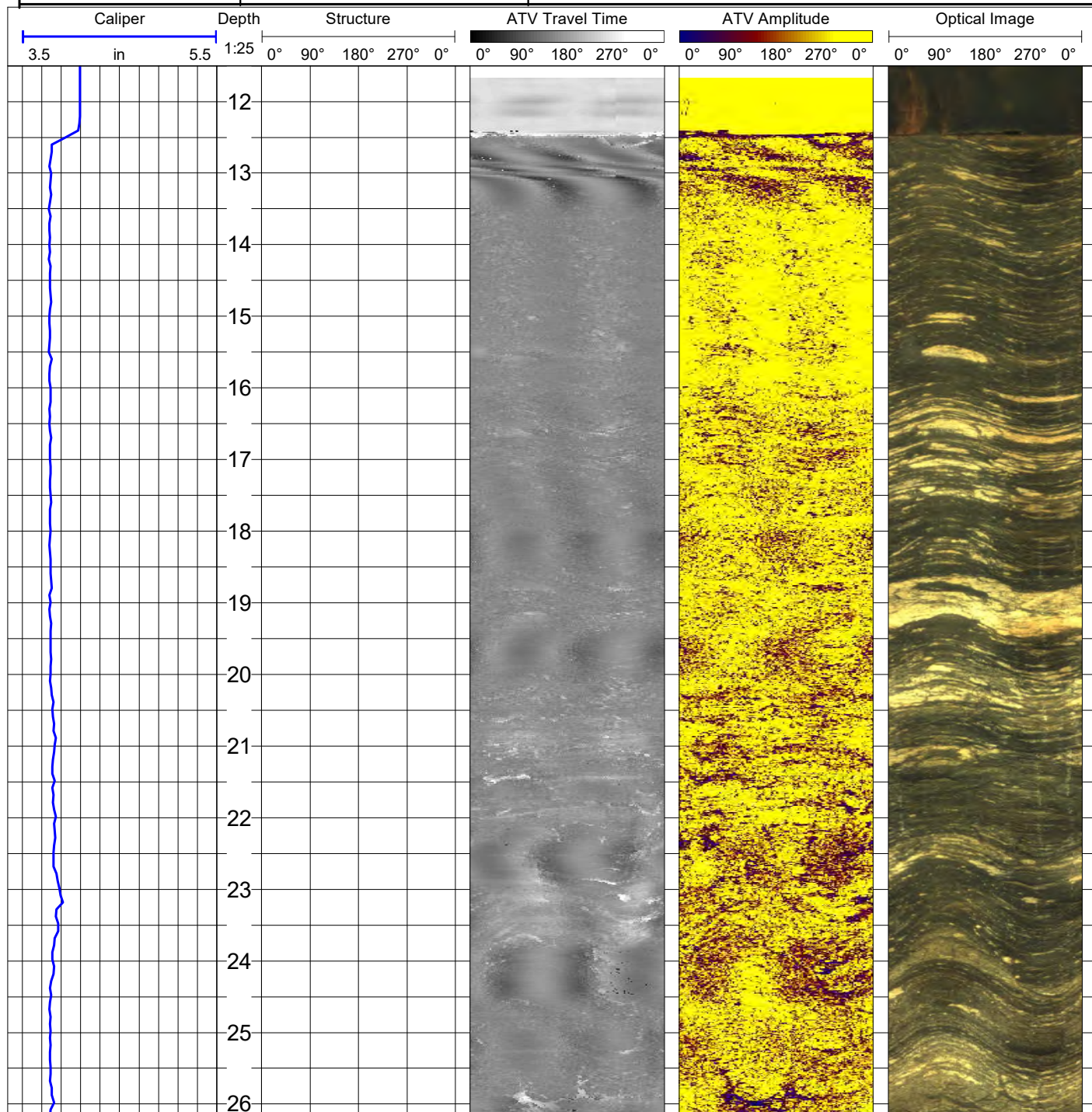


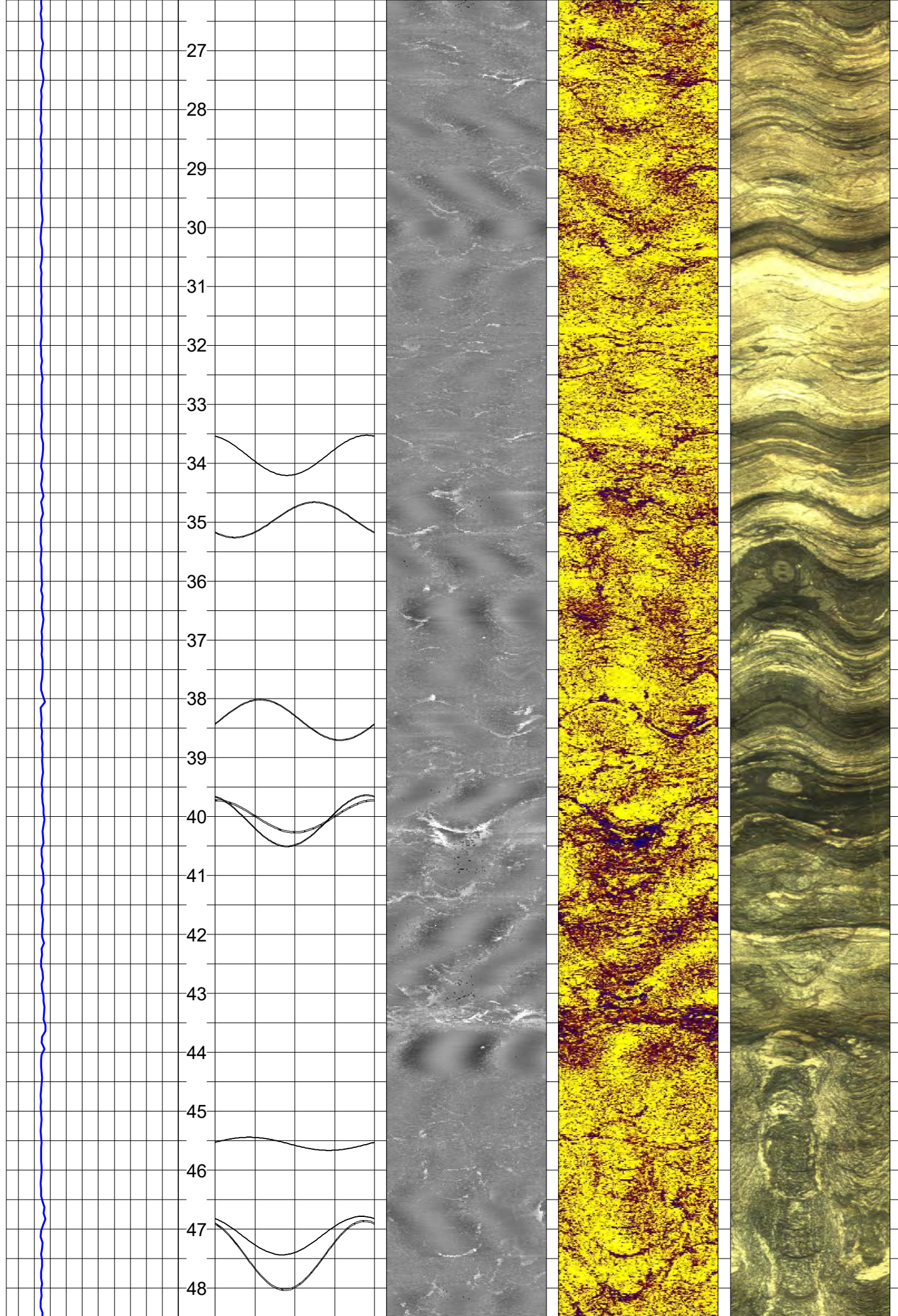
Dip Amount and Dip Azimuth of Likely and Possibly Transmissive Fractures (upper hemisphere plot)

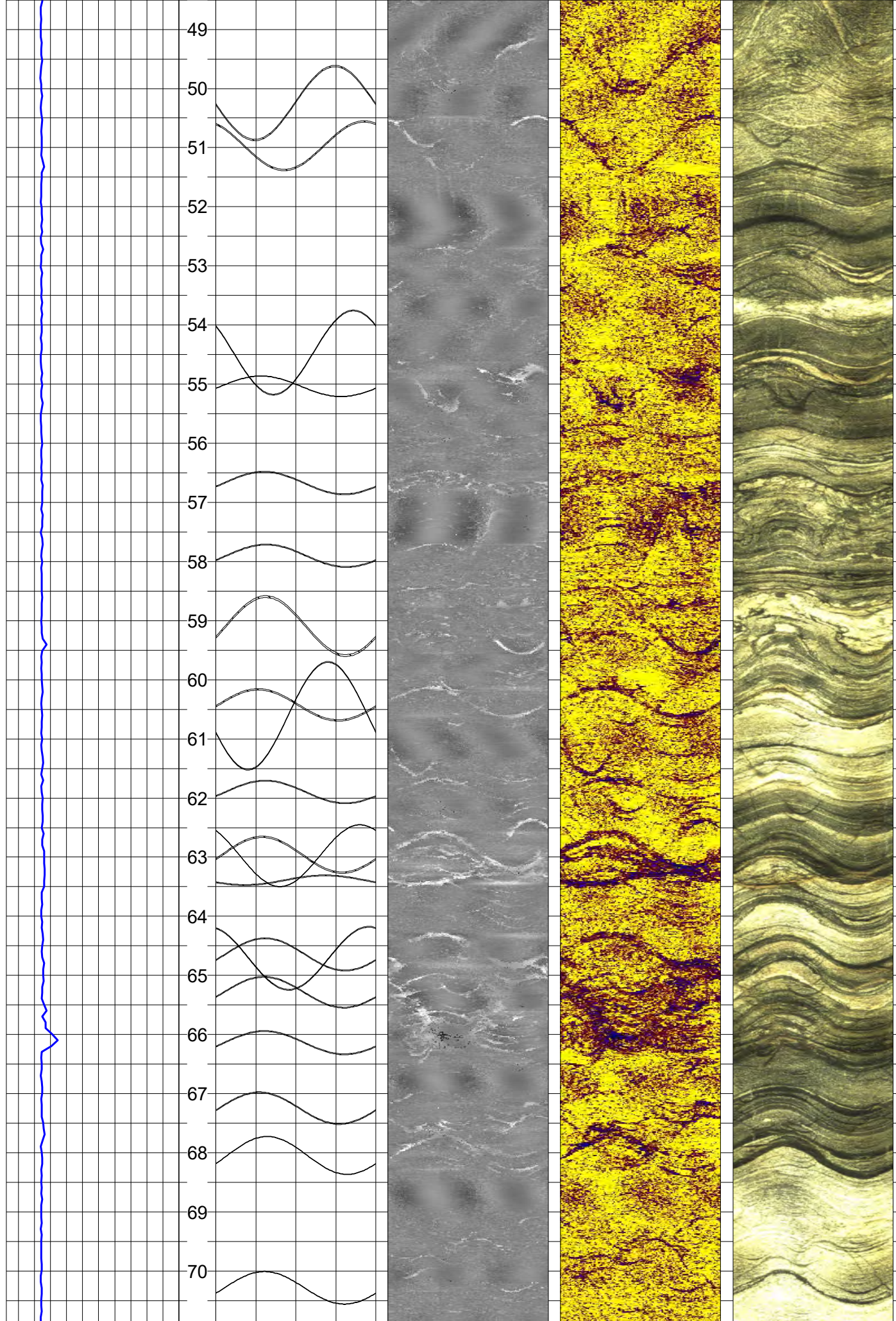


Declination: 14.9 degrees west

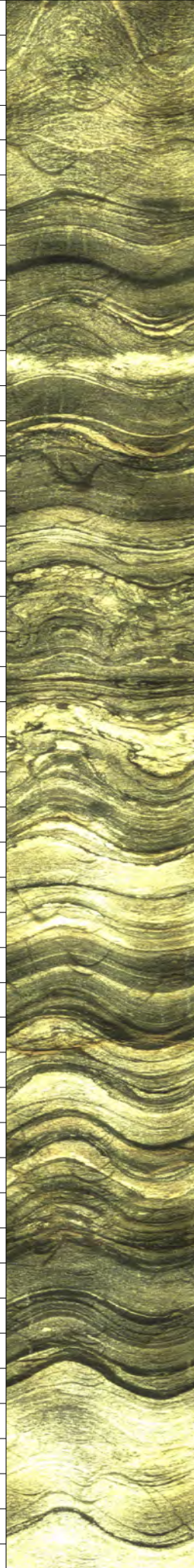
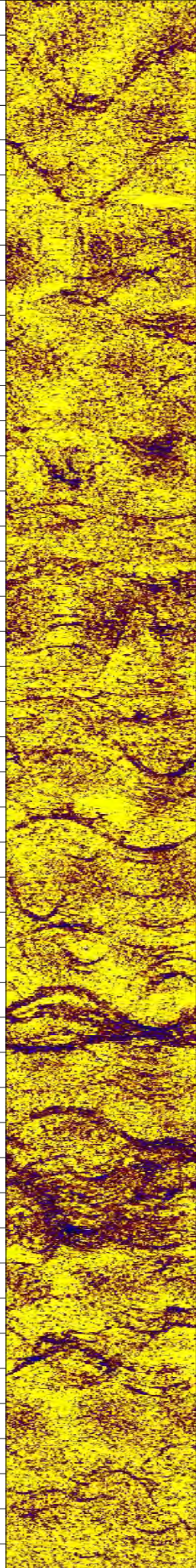
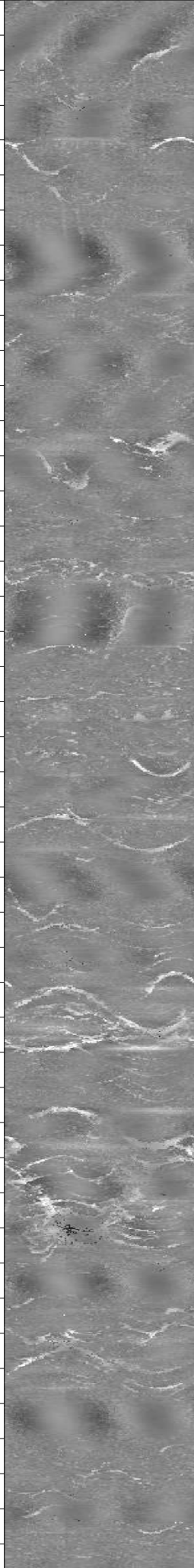
Northeast Geophysical Services 4 Union Street Bangor, Maine 04401 Tel. 207-942-2700 email: ngsinc@negeophysical.com		Log: Plate B-4 Caliper & Televiwer Logs	
		Well: MW-21D	
		Site: Coakley Landfill Superfund	
Date:	7/18/2018	Location: Greenland, NH	
Casing Depth:	12.5 ft.	For: CES	
Casing Type:	4 inch steel	Logged by: R. Rawcliffe	
Boring Depth:	308.4 ft.	Orientation: magnetic	
Meas. From:	ground	Structure Plots: black = planar features (faults, foliation, bedding, joints, etc) light blue = possibly transmissive fracture dark blue = likely transmissive fracture	
Stickup:	0.1 ft		
Water Level:	4.18 ft.		

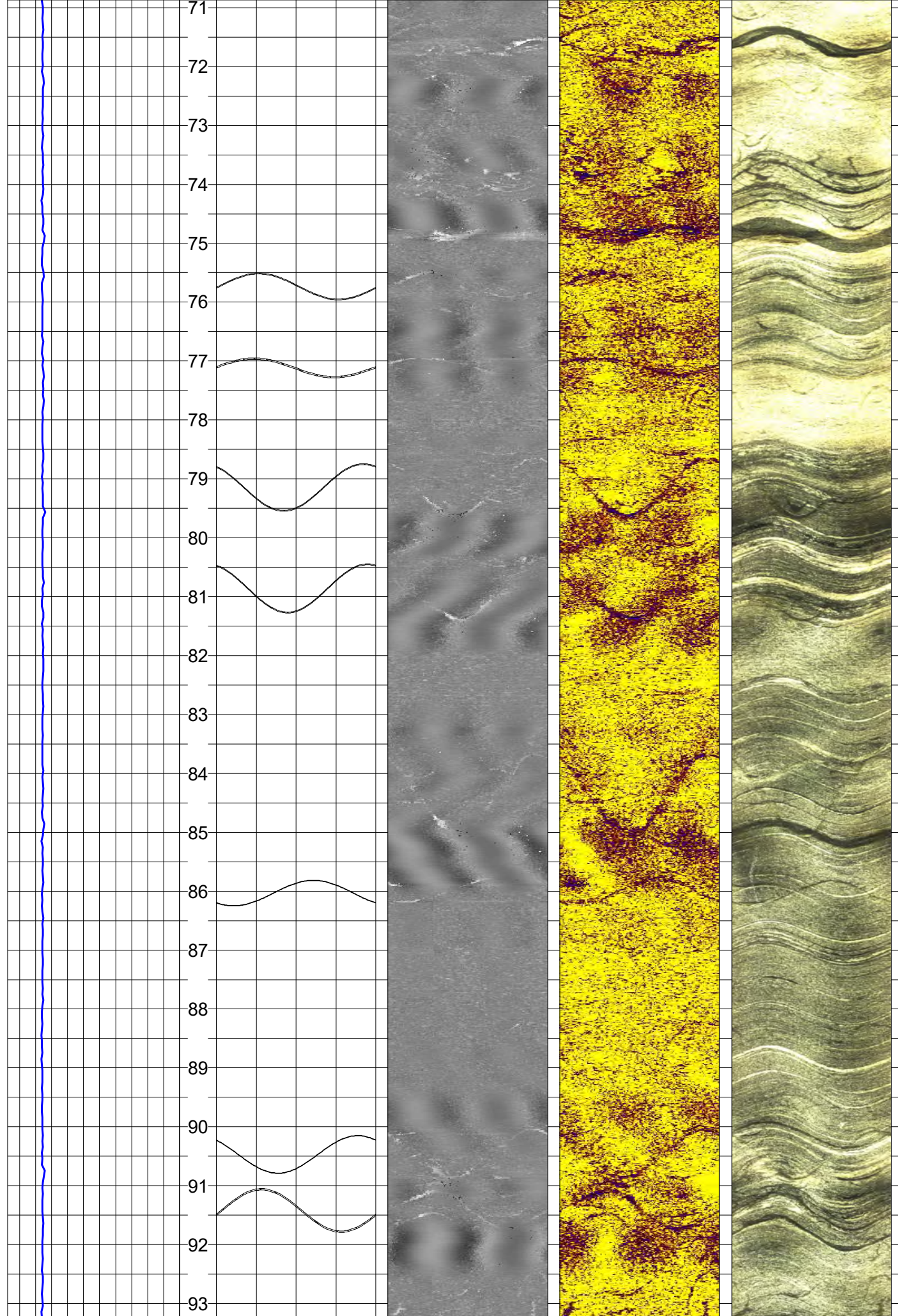


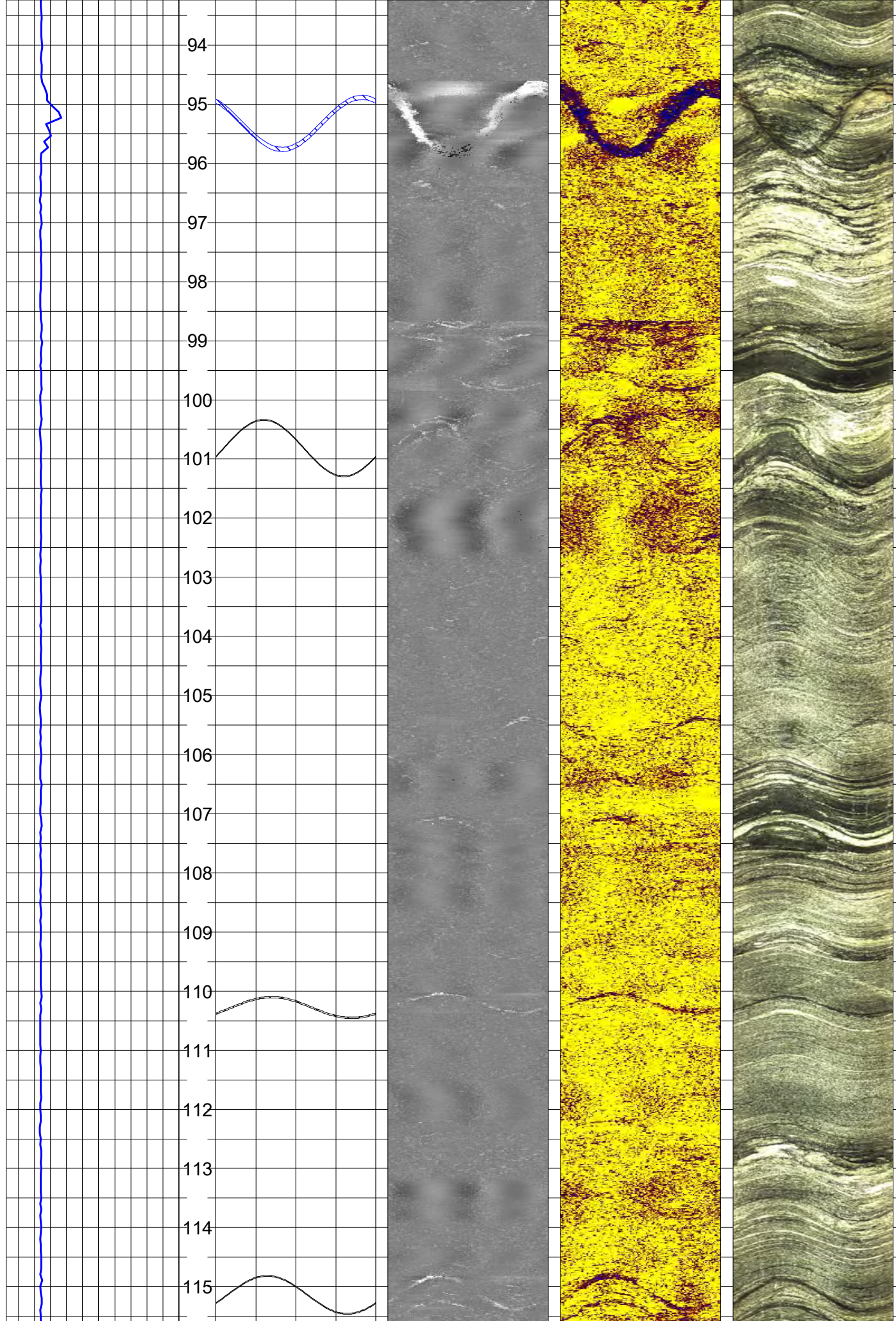


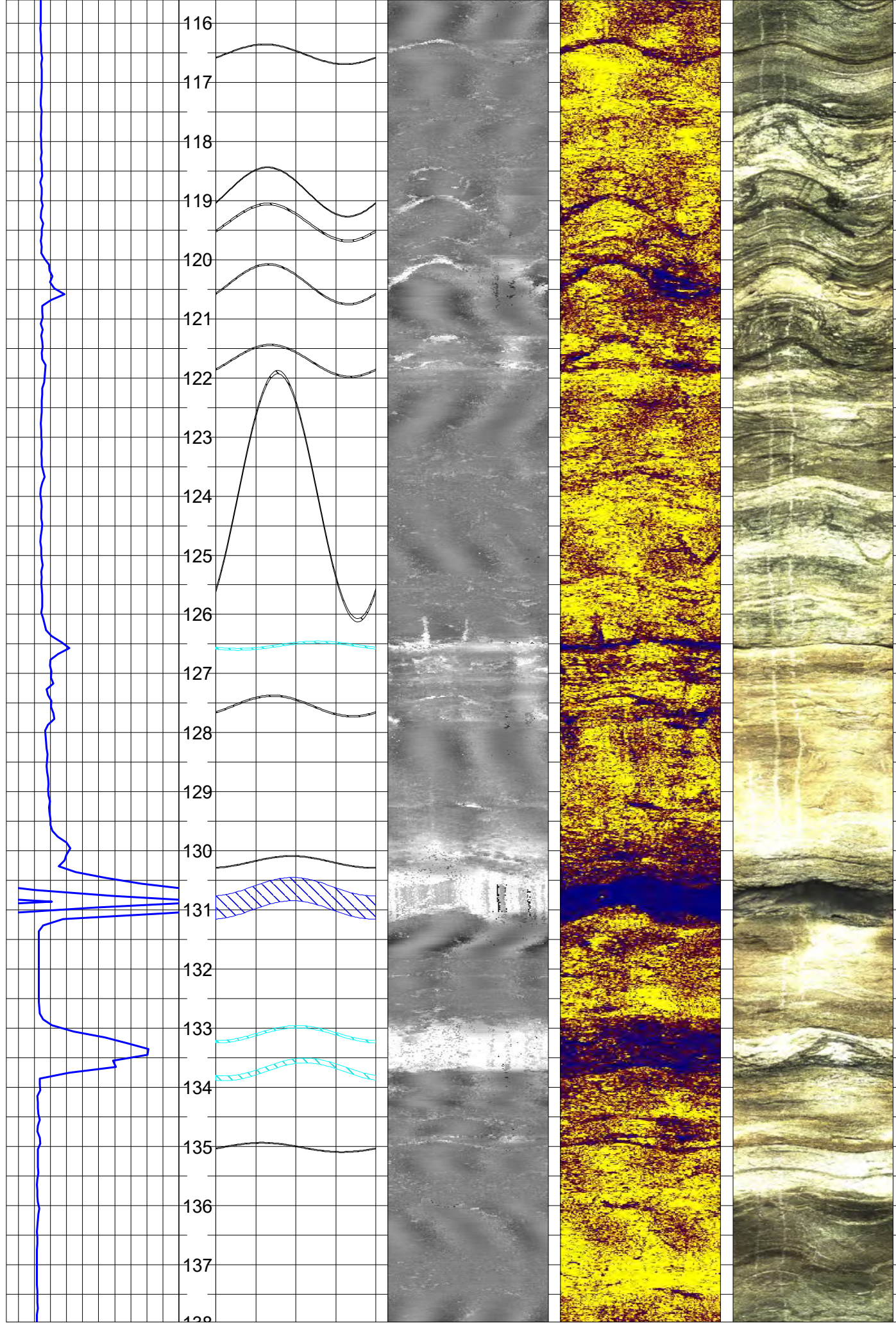


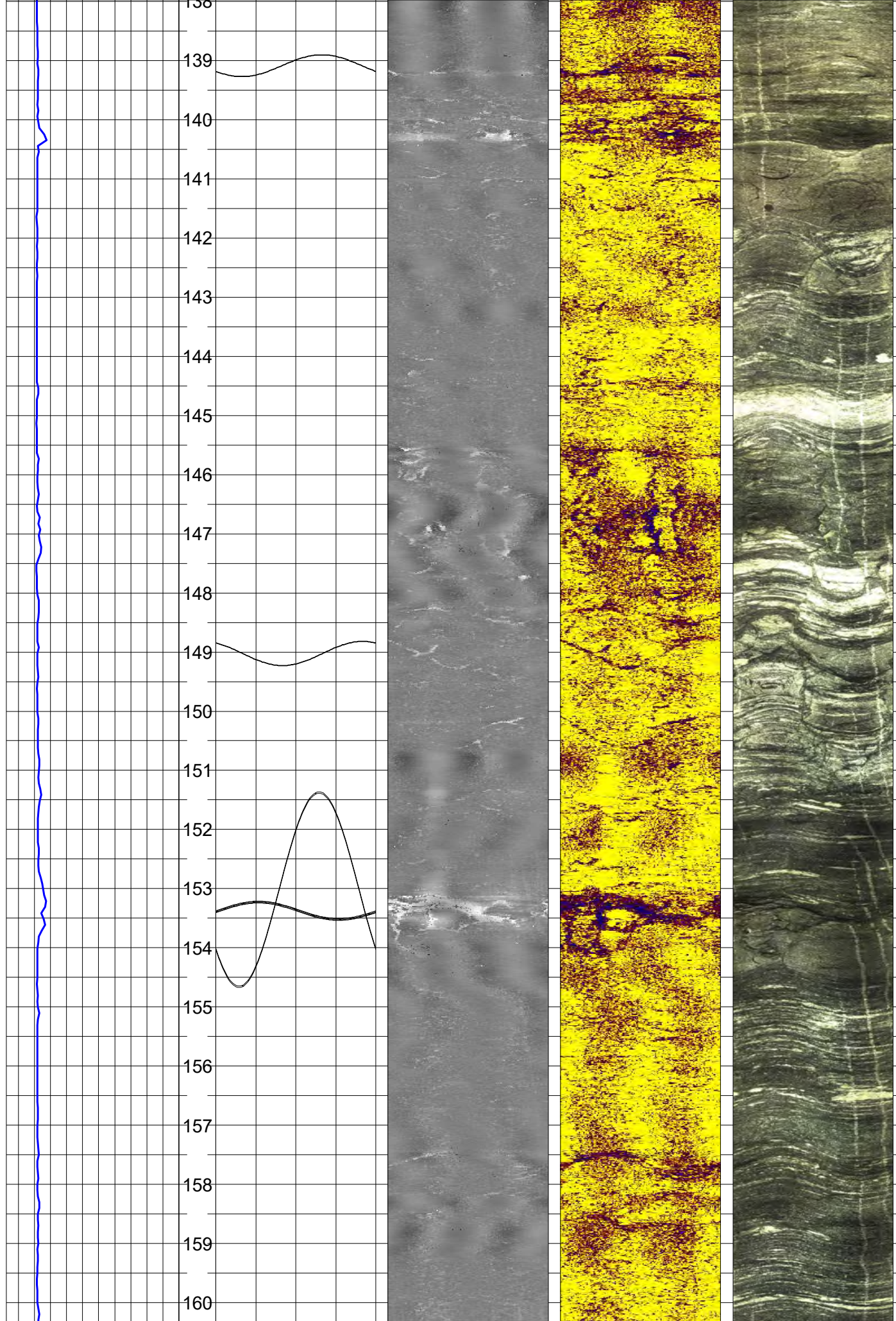
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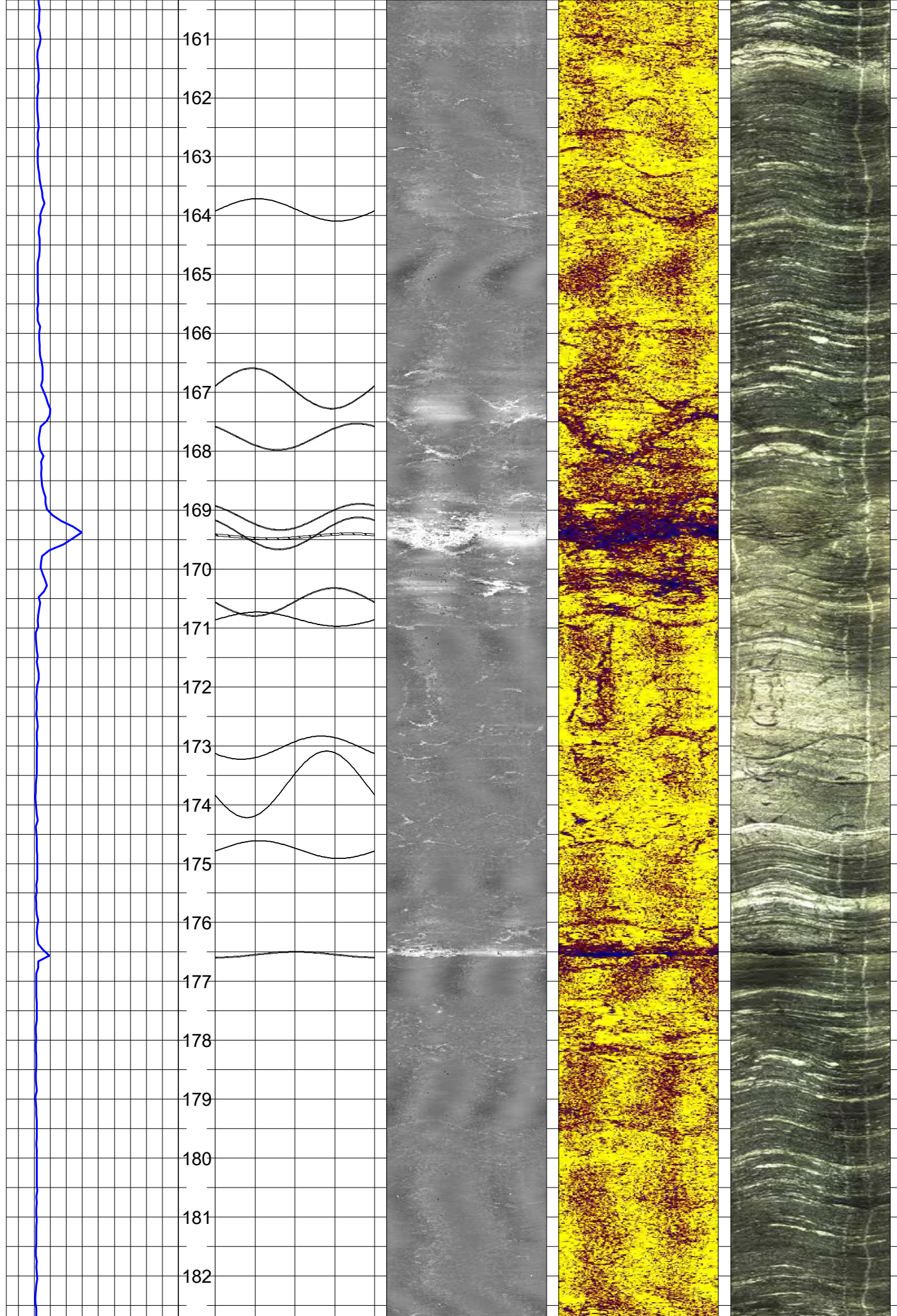


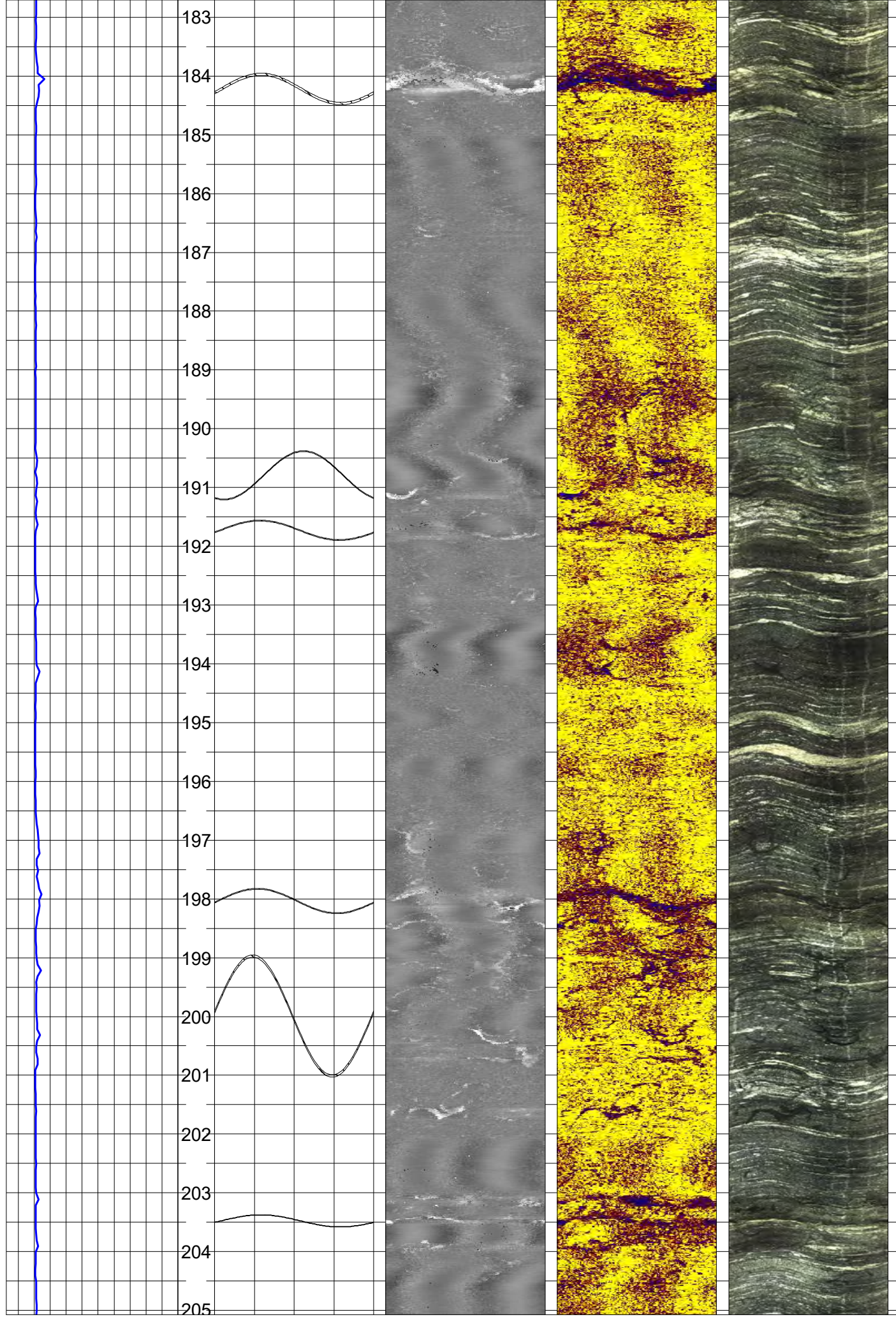


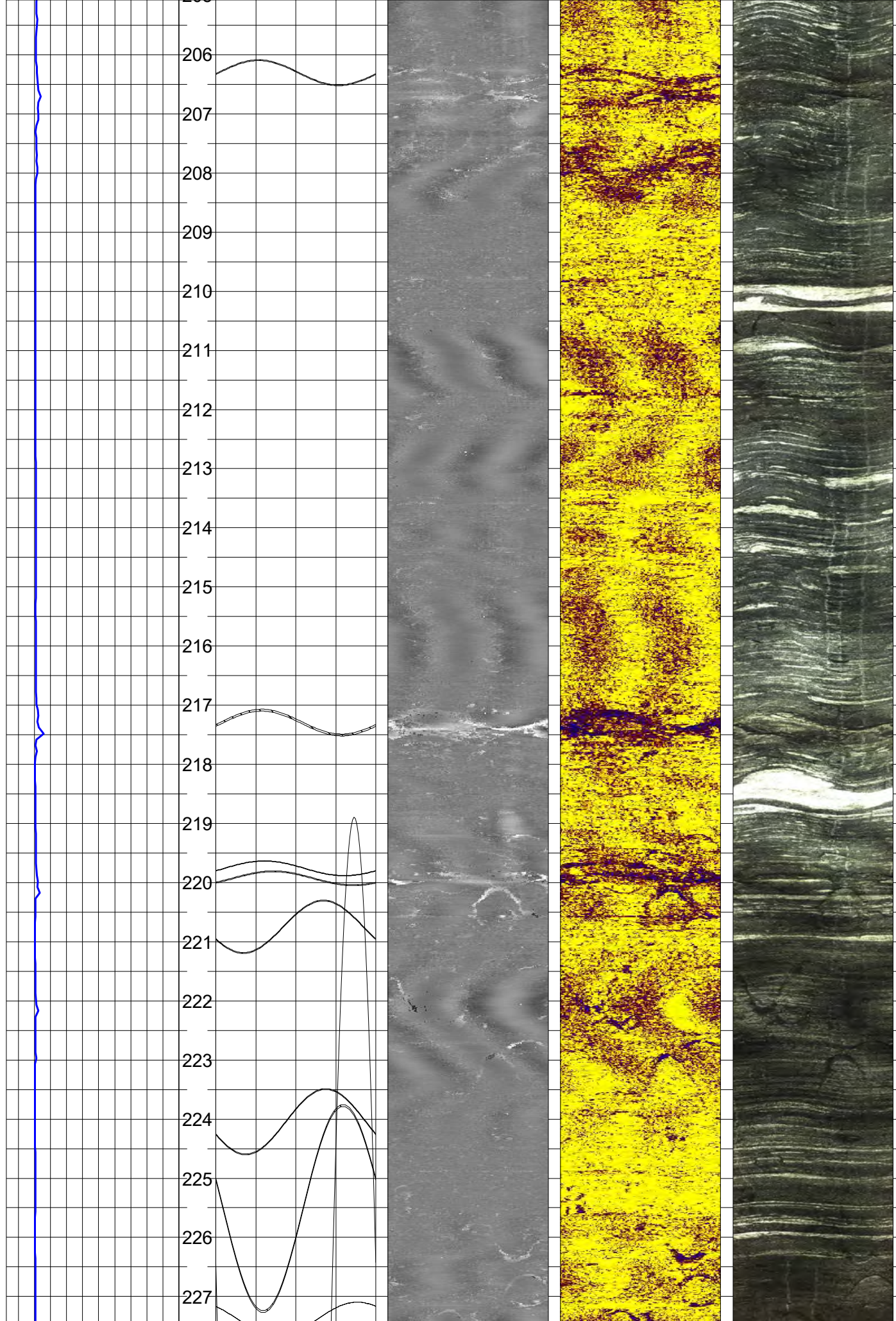


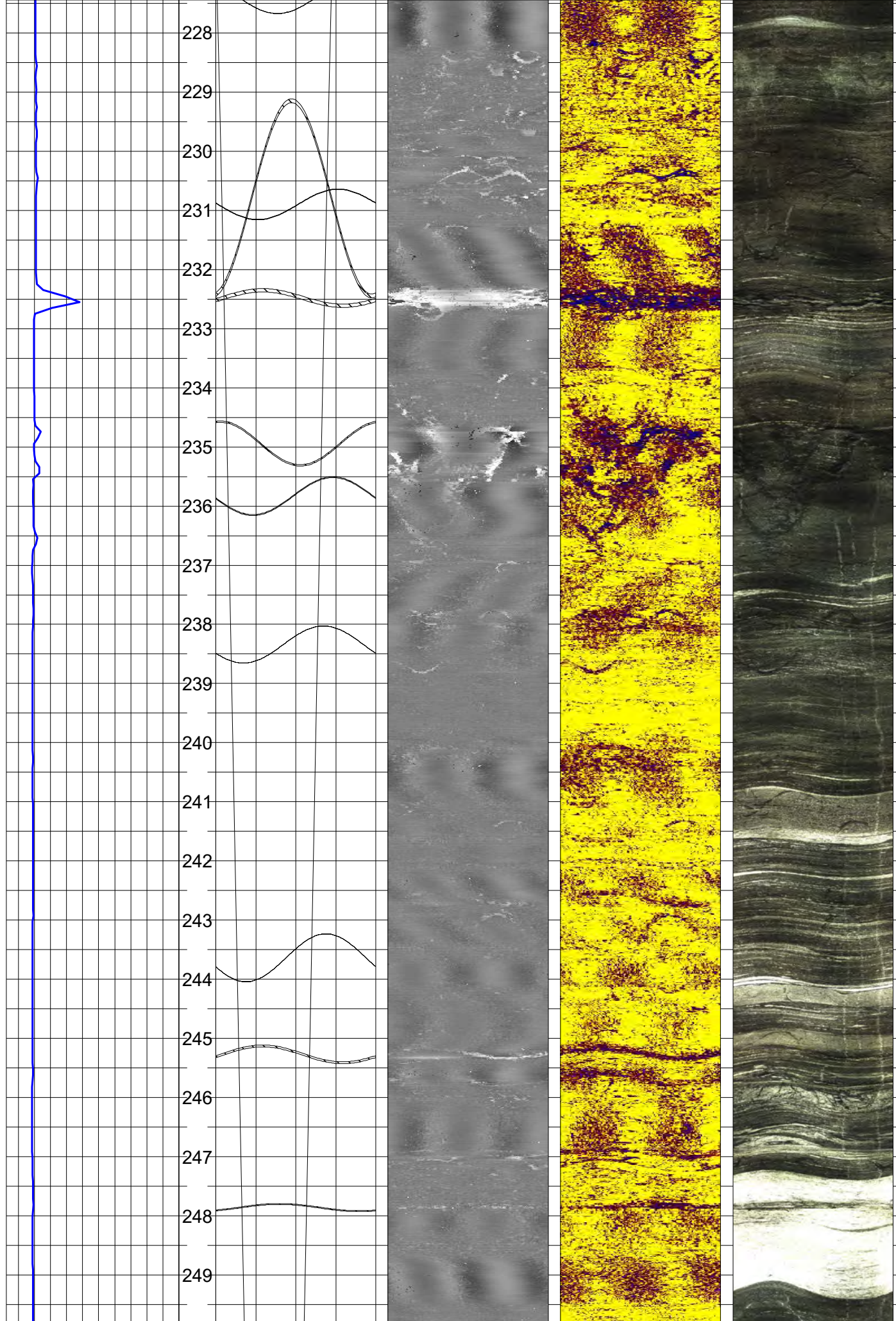


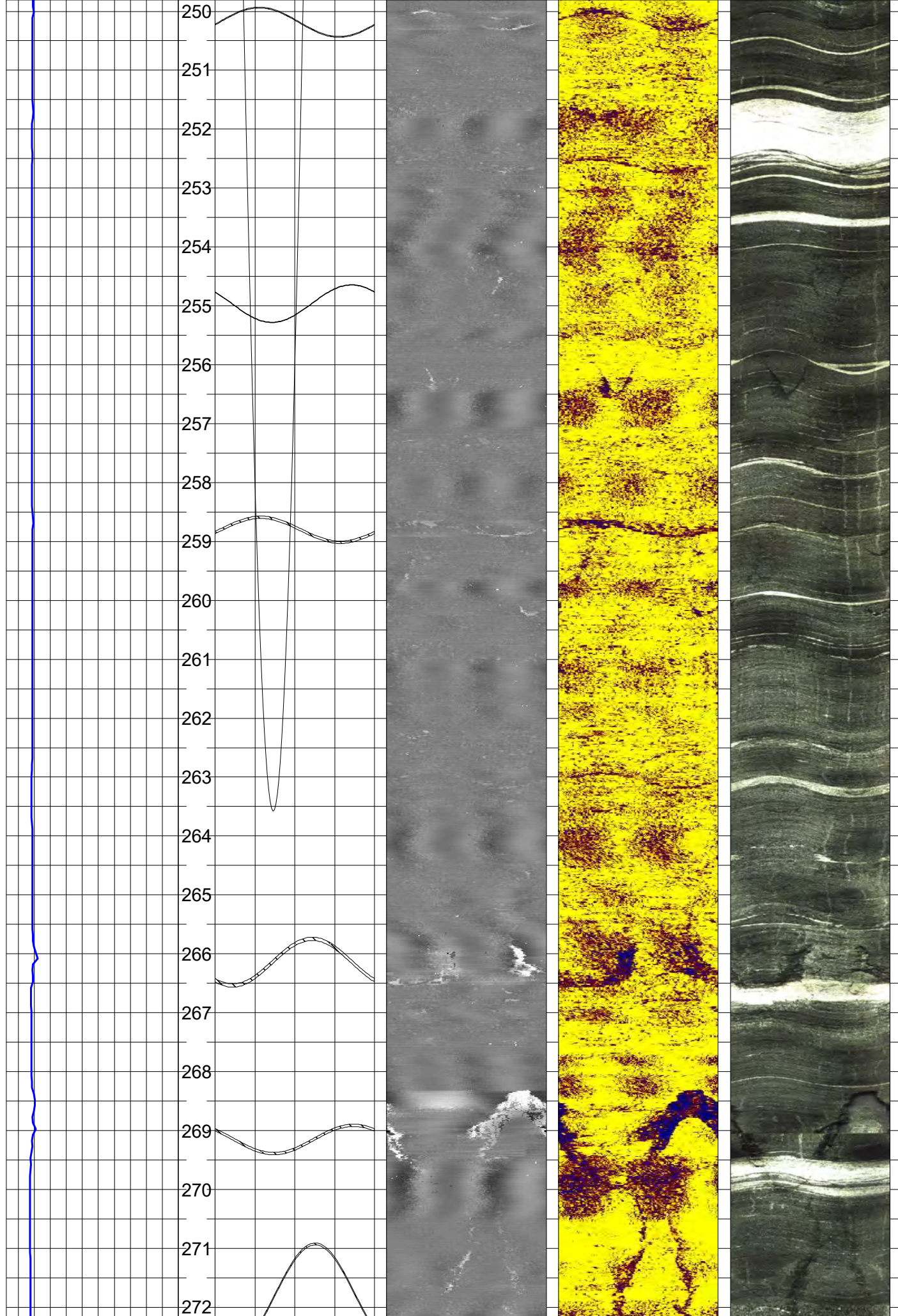


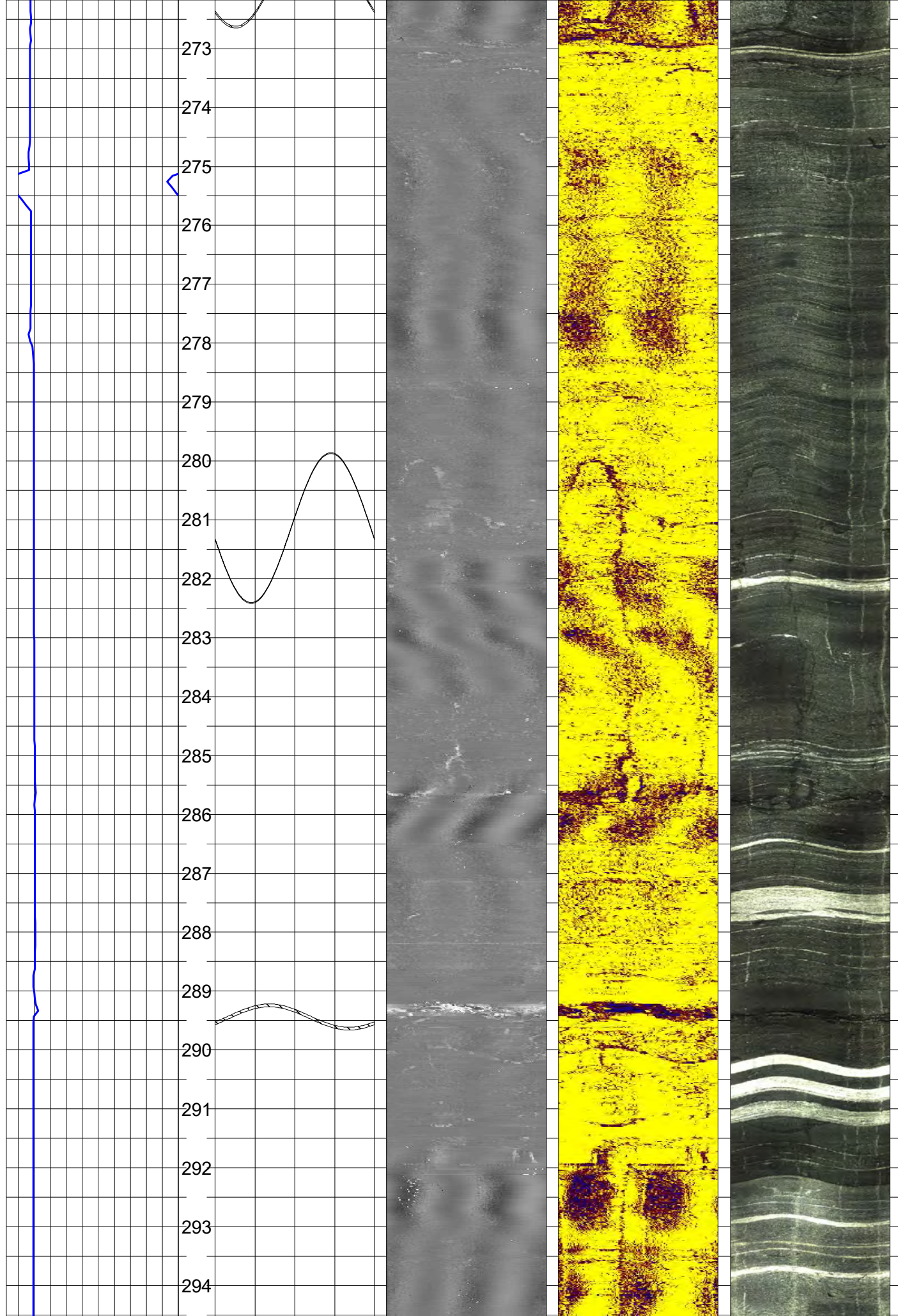












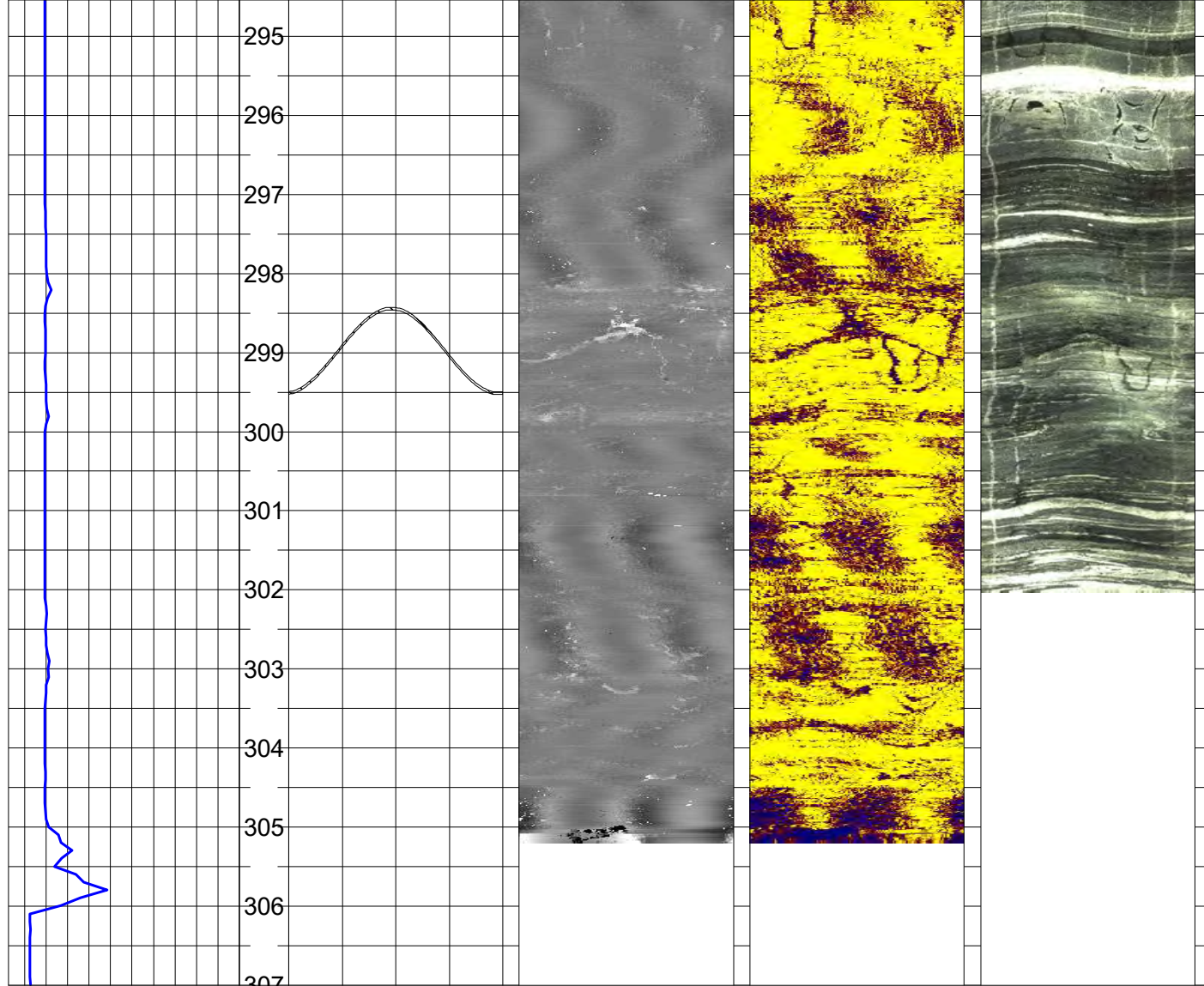


TABLE B-1 Planar features interpreted from acoustical and optical televiewers
Coakley Landfill Superfund Site - Greenland, NH

July, 2018

Declination: 14.9 degrees west

Borehole	Feature # Number	Feature depth Feet	Dip Degrees	Dip Azimuth magnetic	Strike magnetic	Dip Azimuth True	Strike True	Aperture mm	Category Type
MW-21D	1	33.9	65	163	73	148	58	1	101
MW-21D	2	35.0	62	45	315	30	300	2	101
MW-21D	3	38.4	65	282	192	267	177	2	101
MW-21D	4	40.0	60	181	91	166	76	3	101
MW-21D	5	40.1	70	163	73	148	58	2	101
MW-21D	6	45.6	35	257	167	242	152	2	101
MW-21D	7	47.1	64	151	61	137	47	2	101
MW-21D	8	47.5	75	158	68	143	53	2	101
MW-21D	9	50.3	76	88	358	73	343	2	101
MW-21D	10	51.0	69	153	63	139	49	3	101
MW-21D	11	54.5	77	130	40	115	25	1	101
MW-21D	12	55.0	48	281	191	267	177	2	101
MW-21D	13	56.7	50	289	199	274	184	4	101
MW-21D	14	57.9	50	293	203	278	188	3	101
MW-21D	15	59.1	72	292	202	278	188	2	101
MW-21D	16	60.4	59	276	186	261	171	4	101
MW-21D	17	60.6	80	72	342	58	328	1	101
MW-21D	18	61.9	51	292	202	277	187	3	101
MW-21D	19	63.0	62	284	194	270	180	4	101
MW-21D	20	63.0	73	144	54	129	39	1	101
MW-21D	21	63.4	27	65	335	50	320	4	101
MW-21D	22	64.7	60	291	201	276	186	3	101
MW-21D	23	64.7	73	164	74	149	59	2	101
MW-21D	24	65.3	59	288	198	273	183	2	101
MW-21D	25	66.1	50	289	199	274	184	3	101
MW-21D	26	67.3	60	278	188	263	173	2	101
MW-21D	27	68.0	64	296	206	281	191	1	101
MW-21D	28	70.3	60	290	200	275	185	1	101
MW-21D	29	75.7	54	276	186	261	171	3	101
MW-21D	30	77.1	45	266	176	251	161	4	101

TABLE B-1 Planar features interpreted from acoustical and optical televiewers
Coakley Landfill Superfund Site - Greenland, NH

July, 2018

Declination: 14.9 degrees west

Borehole	Feature # Number	Feature depth Feet	Dip Degrees	Dip Azimuth magnetic	Strike magnetic	Dip Azimuth True	Strike True	Aperture mm	Category Type
MW-21D	31	79.2	68	152	62	137	47	2	101
MW-21D	32	80.9	69	161	71	146	56	2	101
MW-21D	33	86.0	54	39	309	24	294	2	101
MW-21D	34	90.5	64	139	49	125	35	1	101
MW-21D	35	91.4	66	282	192	267	177	2	101
MW-21D	36	95.3	70	149	59	134	44	8	107
MW-21D	37	100.8	72	288	198	273	183	2	101
MW-21D	38	110.3	48	306	216	291	201	4	101
MW-21D	39	115.1	64	296	206	281	191	2	101
MW-21D	40	116.5	47	291	201	276	186	4	101
MW-21D	41	118.9	69	296	206	282	192	2	101
MW-21D	42	119.4	63	298	208	283	193	4	101
MW-21D	43	120.4	64	298	208	283	193	4	101
MW-21D	44	121.7	60	303	213	288	198	4	101
MW-21D	45	124.0	86	320	230	305	215	1	101
MW-21D	46	126.5	20	49	319	34	304	8	108
MW-21D	47	127.6	47	308	218	293	203	4	101
MW-21D	48	130.2	30	350	260	336	246	4	101
MW-21D	49	130.8	29	353	263	338	248	105	107
MW-21D	50	133.1	36	4	274	349	259	11	108
MW-21D	51	133.7	37	20	290	5	275	19	108
MW-21D	52	135.0	27	283	193	269	179	3	101
MW-21D	53	139.1	50	59	329	44	314	1	101
MW-21D	54	149.0	53	150	60	135	45	3	101
MW-21D	55	153.0	84	52	322	38	308	1	101
MW-21D	56	153.4	43	276	186	261	171	7	101
MW-21D	57	153.4	43	278	188	263	173	4	101
MW-21D	58	163.9	50	275	185	261	171	2	101
MW-21D	59	166.9	65	263	173	248	158	2	101
MW-21D	60	167.8	55	140	50	125	35	2	101

TABLE B-1 Planar features interpreted from acoustical and optical televiewers**Coakley Landfill Superfund Site - Greenland, NH****July, 2018**

Declination: 14.9 degrees west

Borehole	Feature # Number	Feature depth Feet	Dip Degrees	Dip Azimuth magnetic	Strike magnetic	Dip Azimuth True	Strike True	Aperture mm	Category Type
MW-21D	61	169.1	54	147	57	132	42	2	101
MW-21D	62	169.4	57	144	54	130	40	2	101
MW-21D	63	169.5	13	126	36	111	21	10	101
MW-21D	64	170.6	56	89	359	74	344	3	101
MW-21D	65	170.9	38	276	186	261	171	1	101
MW-21D	66	173.0	52	59	329	44	314	2	101
MW-21D	67	173.7	75	72	342	57	327	1	101
MW-21D	68	174.8	44	279	189	264	174	2	101
MW-21D	69	176.6	16	3	273	348	258	6	101
MW-21D	70	184.2	58	286	196	271	181	7	101
MW-21D	71	190.8	69	21	291	6	276	2	101
MW-21D	72	191.7	47	283	193	268	178	4	101
MW-21D	73	198.0	53	277	187	262	172	3	101
MW-21D	74	200.0	81	266	176	252	162	2	101
MW-21D	75	203.5	33	285	195	270	180	4	101
MW-21D	76	206.3	54	276	186	261	171	3	101
MW-21D	77	217.3	53	283	193	268	178	6	101
MW-21D	78	219.8	39	289	199	274	184	2	101
MW-21D	79	219.9	37	309	219	294	204	4	101
MW-21D	80	220.8	71	62	332	47	317	2	101
MW-21D	81	224.0	74	68	338	53	323	1	101
MW-21D	82	225.5	85	107	17	92	2	1	100
MW-21D	83	227.4	62	139	49	124	34	1	100
MW-21D	84	230.8	85	350	260	336	246	2	101
MW-21D	85	230.9	59	95	5	80	350	1	101
MW-21D	86	232.5	38	286	196	271	181	14	101
MW-21D	87	234.9	67	190	100	175	85	3	101
MW-21D	88	235.8	64	84	354	69	339	2	101
MW-21D	89	238.3	64	62	332	47	317	1	100
MW-21D	90	241.2	90	132	42	117	27	<1 mm	100

TABLE B-1 Planar features interpreted from acoustical and optical televiewers
Coakley Landfill Superfund Site - Greenland, NH

July, 2018

Declination: 14.9 degrees west

Borehole	Feature # Number	Feature depth Feet	Dip Degrees	Dip Azimuth magnetic	Strike magnetic	Dip Azimuth True	Strike True	Aperture mm	Category Type
MW-21D	91	243.6	69	68	338	53	323	1	101
MW-21D	92	245.3	43	285	195	271	181	6	101
MW-21D	93	247.9	22	323	233	308	218	5	101
MW-21D	94	250.2	58	280	190	265	175	2	101
MW-21D	95	255.0	64	128	38	113	23	1	100
MW-21D	96	258.8	54	283	193	268	178	6	101
MW-21D	97	266.1	69	39	309	25	295	6	101
MW-21D	98	269.2	57	133	43	118	28	6	101
MW-21D	99	271.8	80	46	316	31	301	2	101
MW-21D	100	281.1	83	82	352	67	337	1	100
MW-21D	101	289.4	52	303	213	288	198	9	101
MW-21D	102	299.0	74	353	263	338	248	3	101
MW-21D	103	306.0	unknown	unknown	unknown	unknown	unknown	unknown	107

Explanation:

	Category 100 = planar feature (possible fracture, joint, foliation, bedding, etc.) aperture < 1 mm
	Category 101 = planar feature (possible fracture, joint, foliation, bedding, etc.) aperture > 1 mm
	Category 108 = Possible water bearing fracture
	Category 107 = Likely water bearing feature

BOREHOLE GEOPHYSICAL LOGS

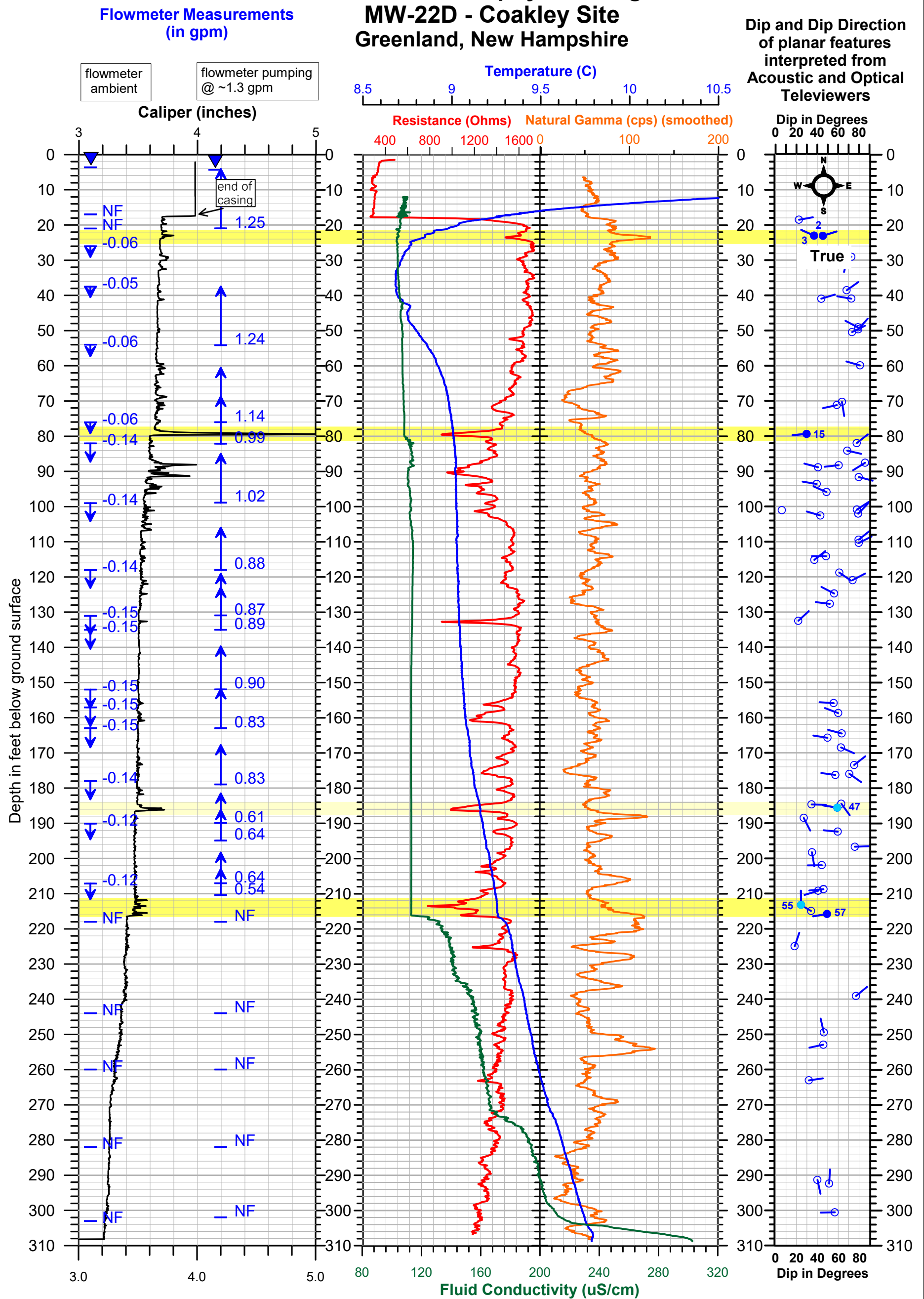
MW-22D

COAKLEY LANDFILL SUPERFUND SITE

Borehole Geophysical Log

MW-22D - Coakley Site

Greenland, New Hampshire



 = Likely transmissive zone

 = Possible transmissive zone

PLATE C-1
Borehole Geophysical Log
MW-22D - Coakley Site
Greenland, New Hampshire

Tadpole tail indicates dip direction.
The solid tadpoles with a feature number are the ones interpreted to be likely or possibly transmissive.

Strike and Dip Direction of all features

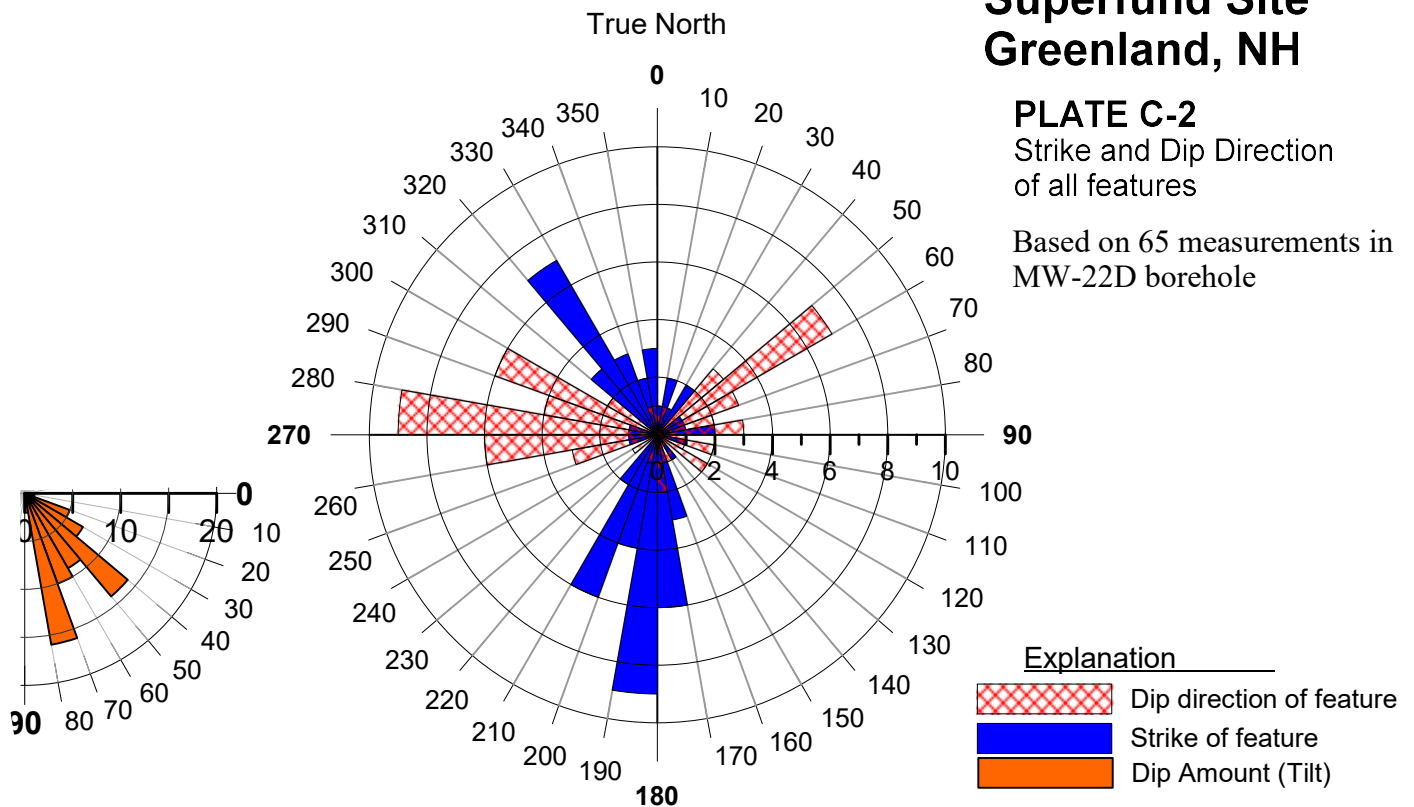
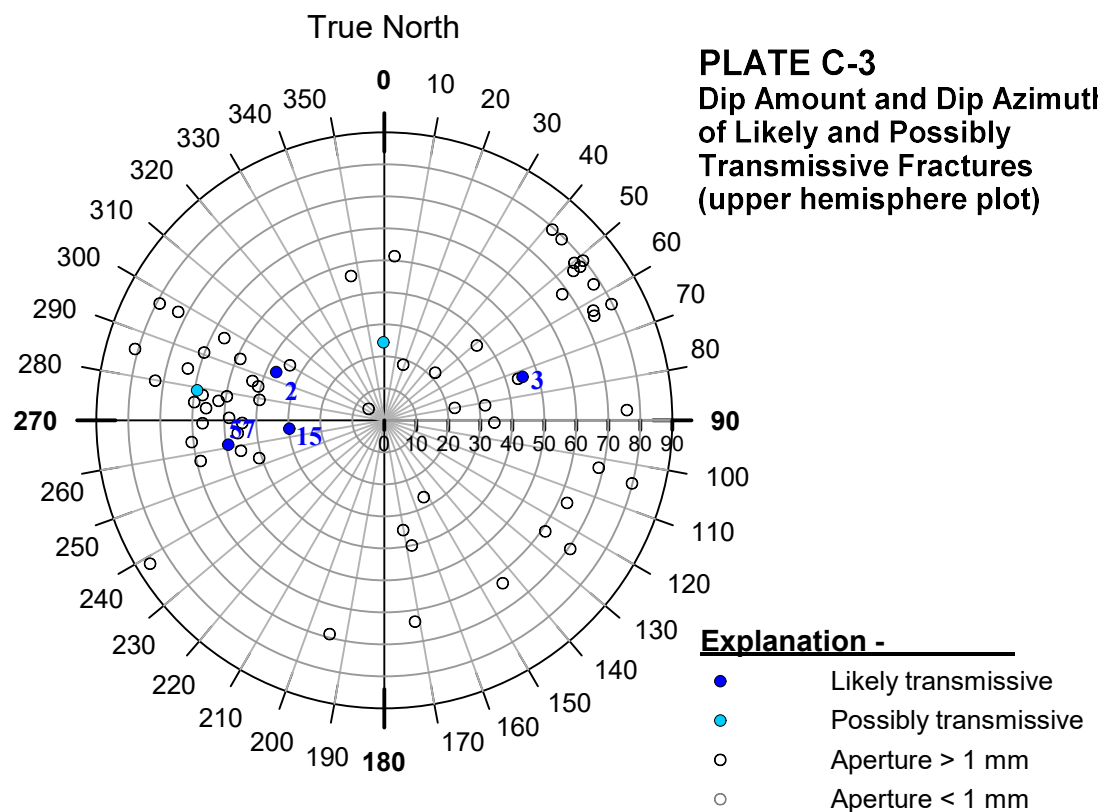
Explanation

PLATE C-3
Dip Amount and Dip Azimuth
of Likely and Possibly
Transmissive Fractures
(upper hemisphere plot)



Declination: 14.9 degrees west

Northeast Geophysical Services

4 Union Street Bangor, Maine 04401
Tel. 207-942-2700
email: ngsinc@negeophysical.com

Log: Plate C-4 TelevIEWER & Caliper Logs

Well: MW-22D

Site: Coakley Landfill Superfund

Date: 8/7/2018

Location: Greenland, NH

Casing Depth: 17.6 ft

For: CES

Casing Type: 4 inch

Logged by: R. Rawcliffe

Boring Depth: 309.3 ft.

Orientation: magnetic

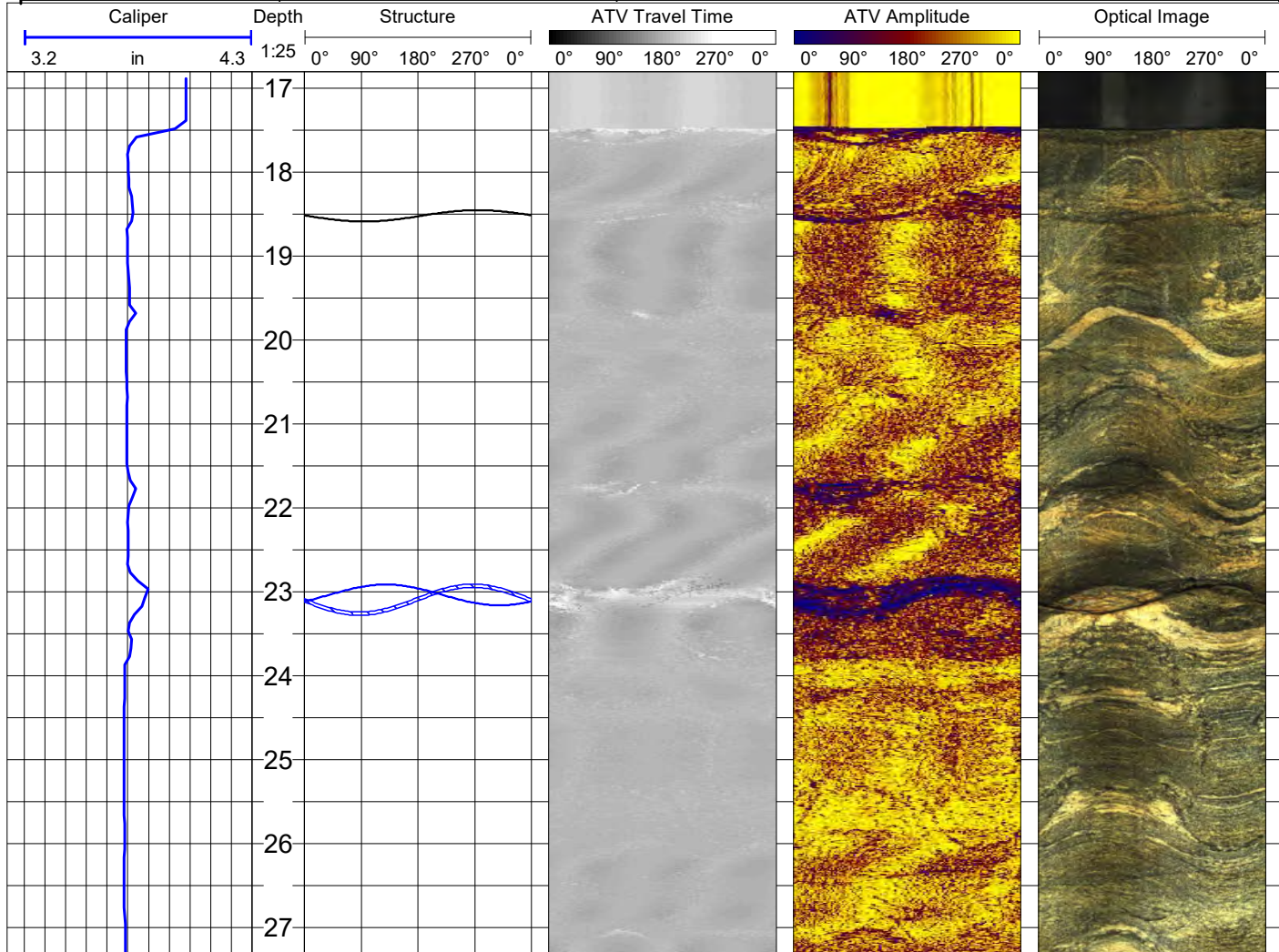
Meas. From: ground

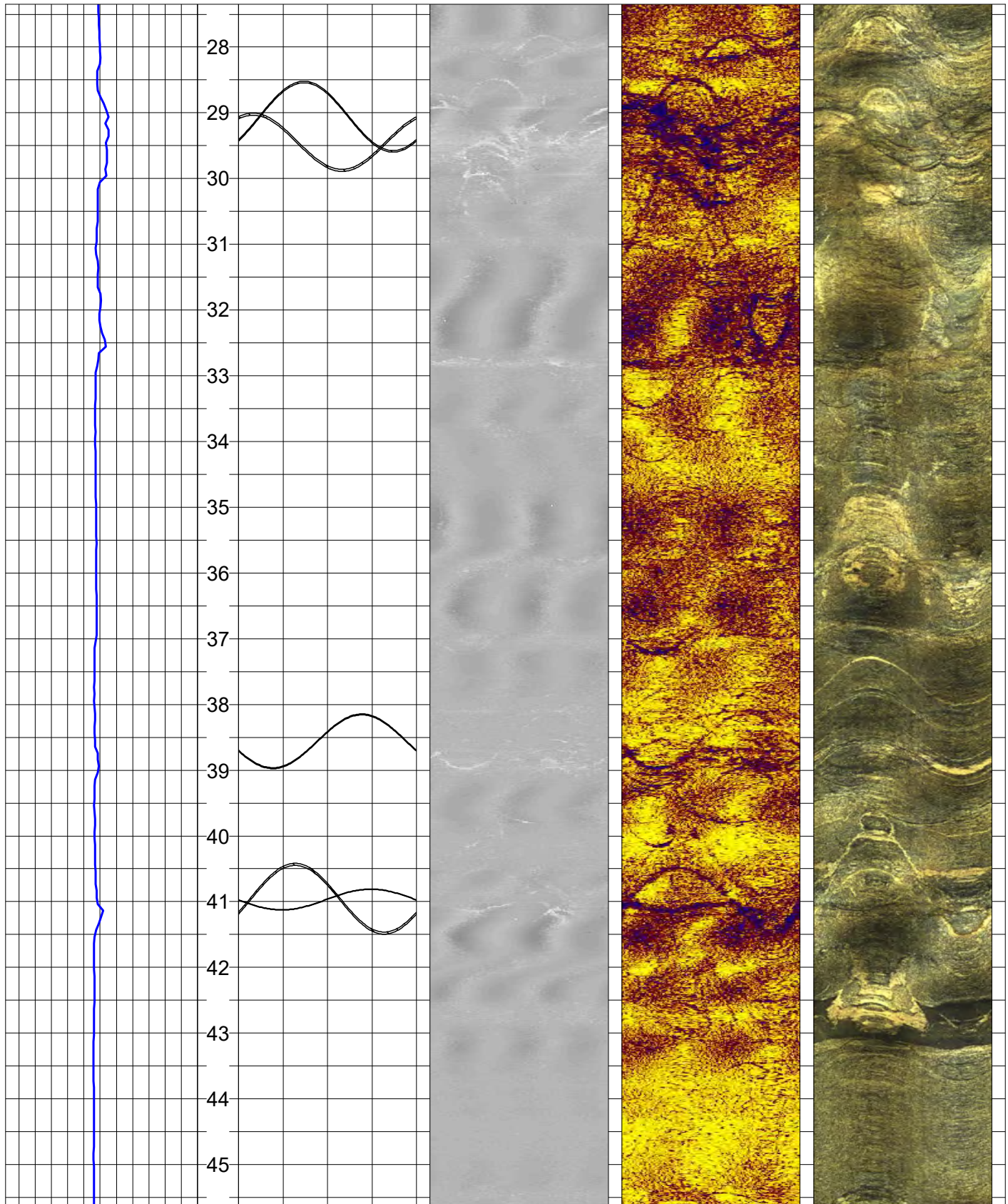
Structure Plots:

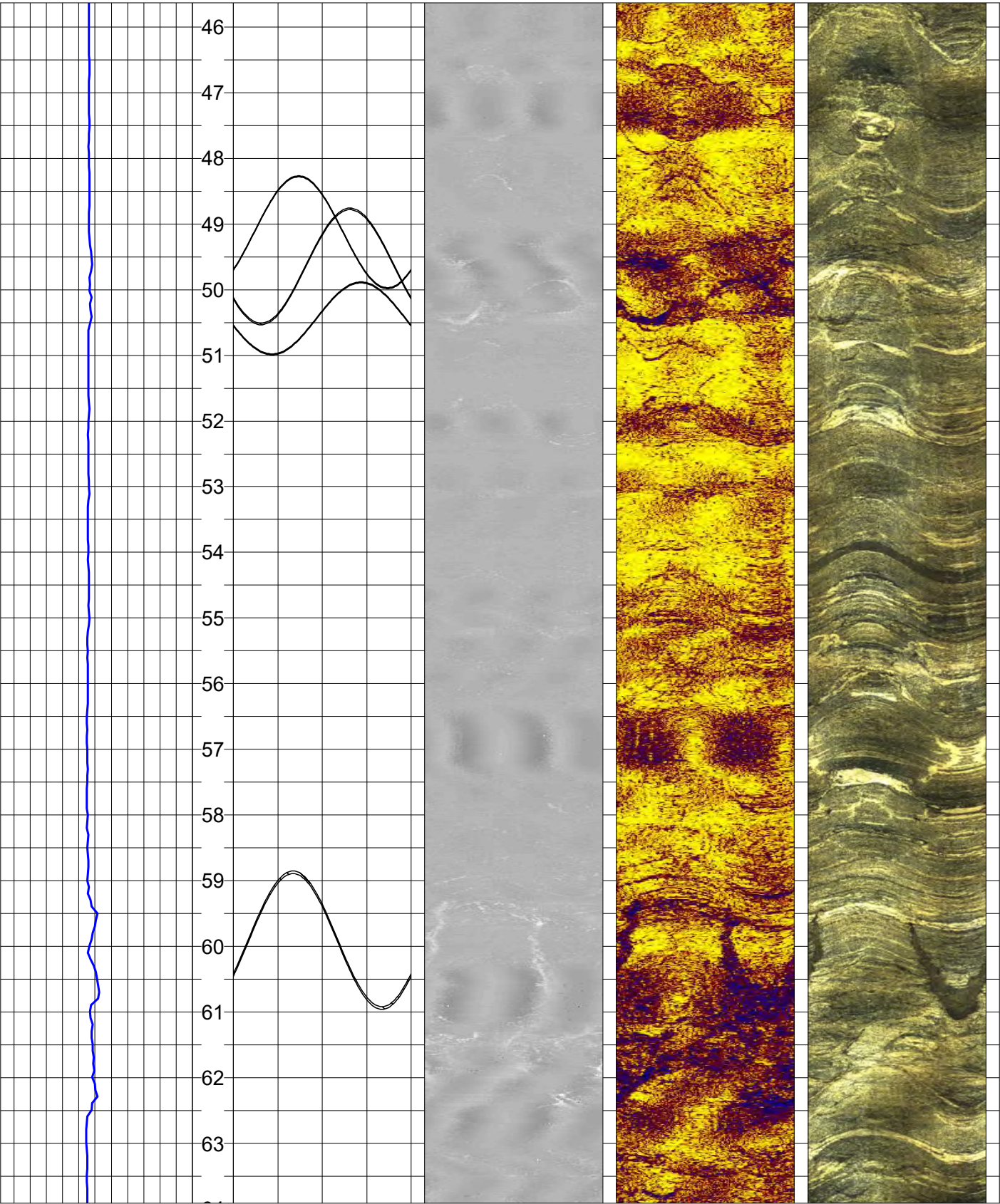
Stickup: 2.14 ft.

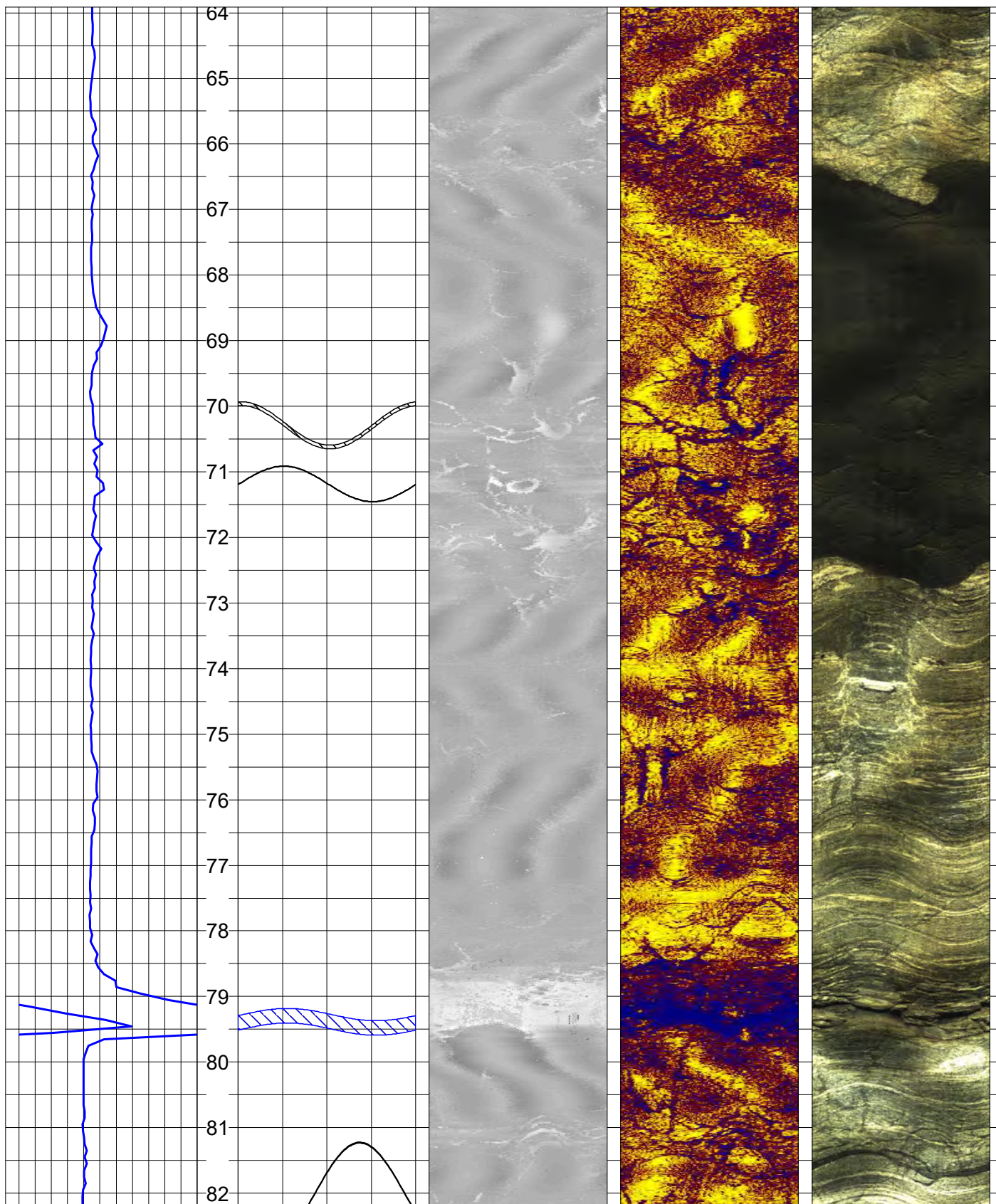
black = planar features (faults, foliation, bedding, joints, etc)
light blue = possibly transmissive fracture
dark blue = likely transmissive fracture

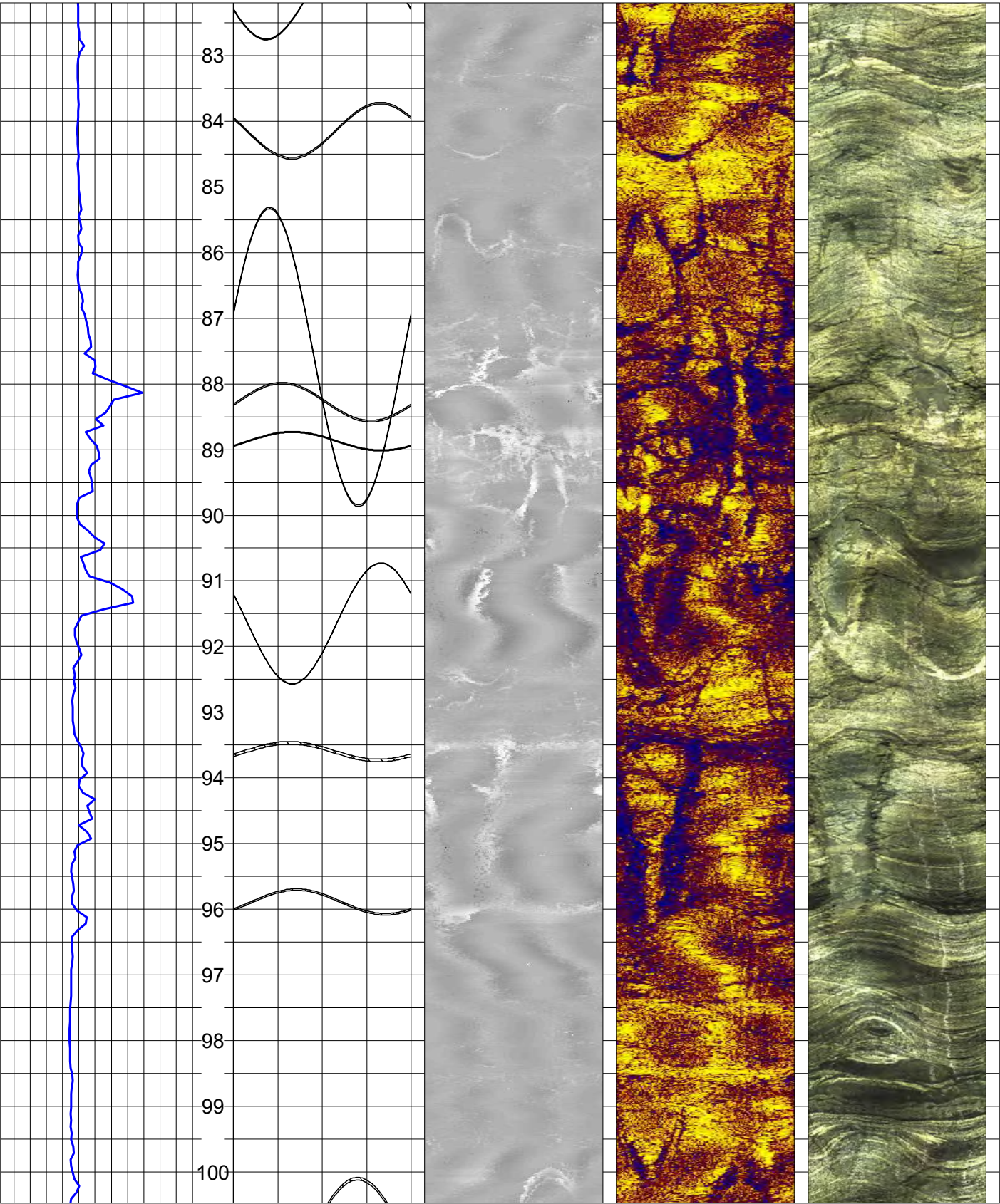
Water Level: 1.5 ft

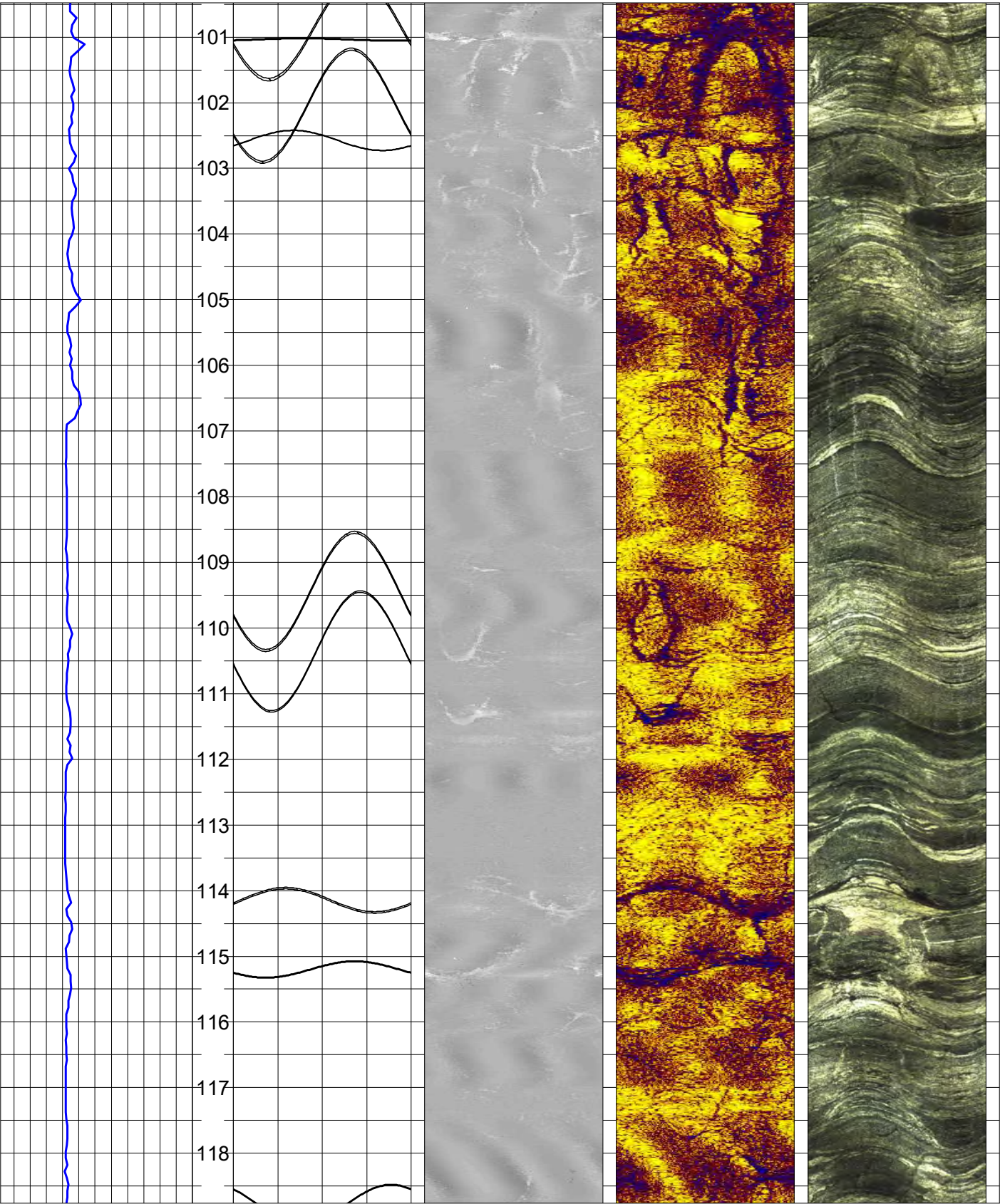


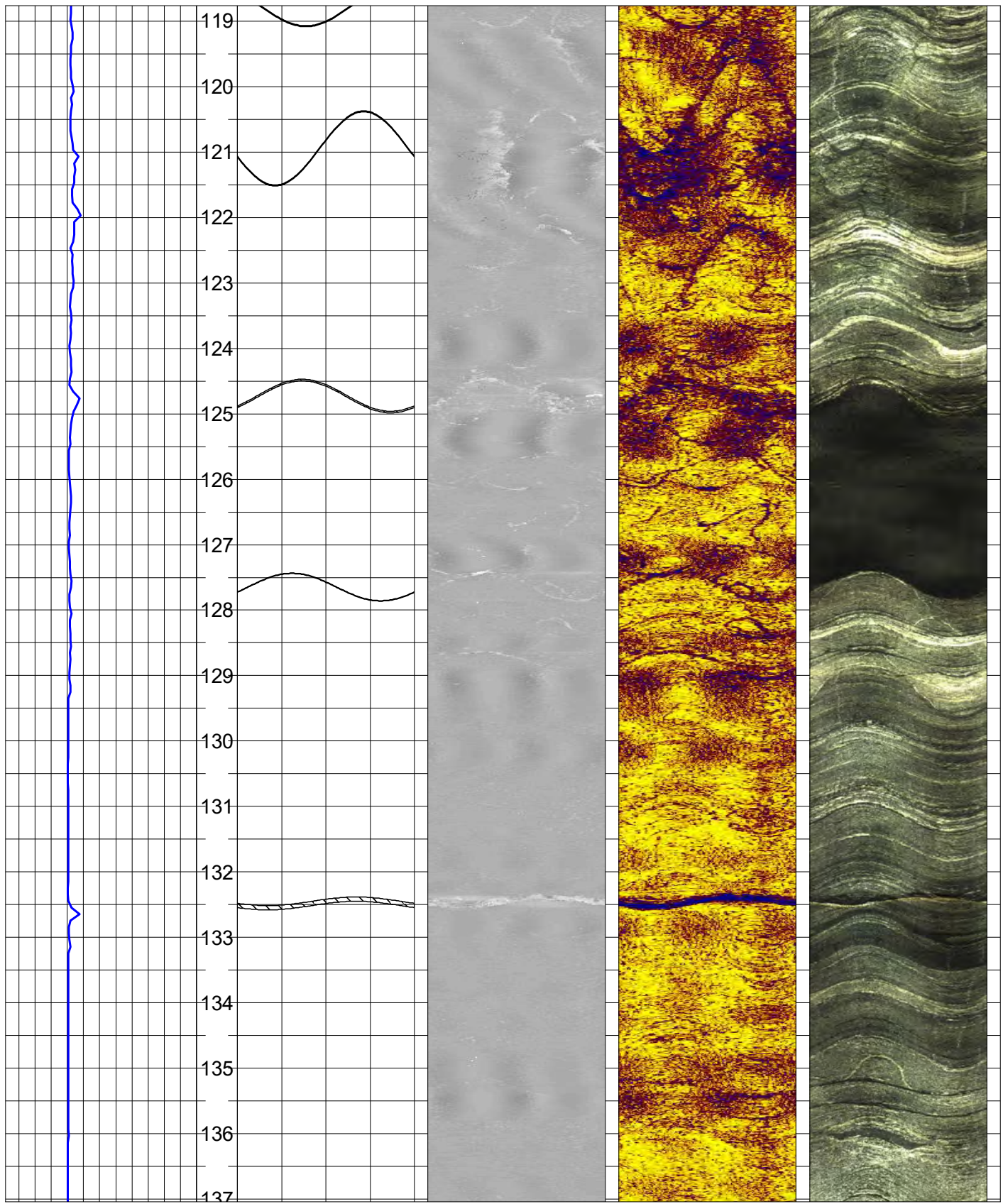


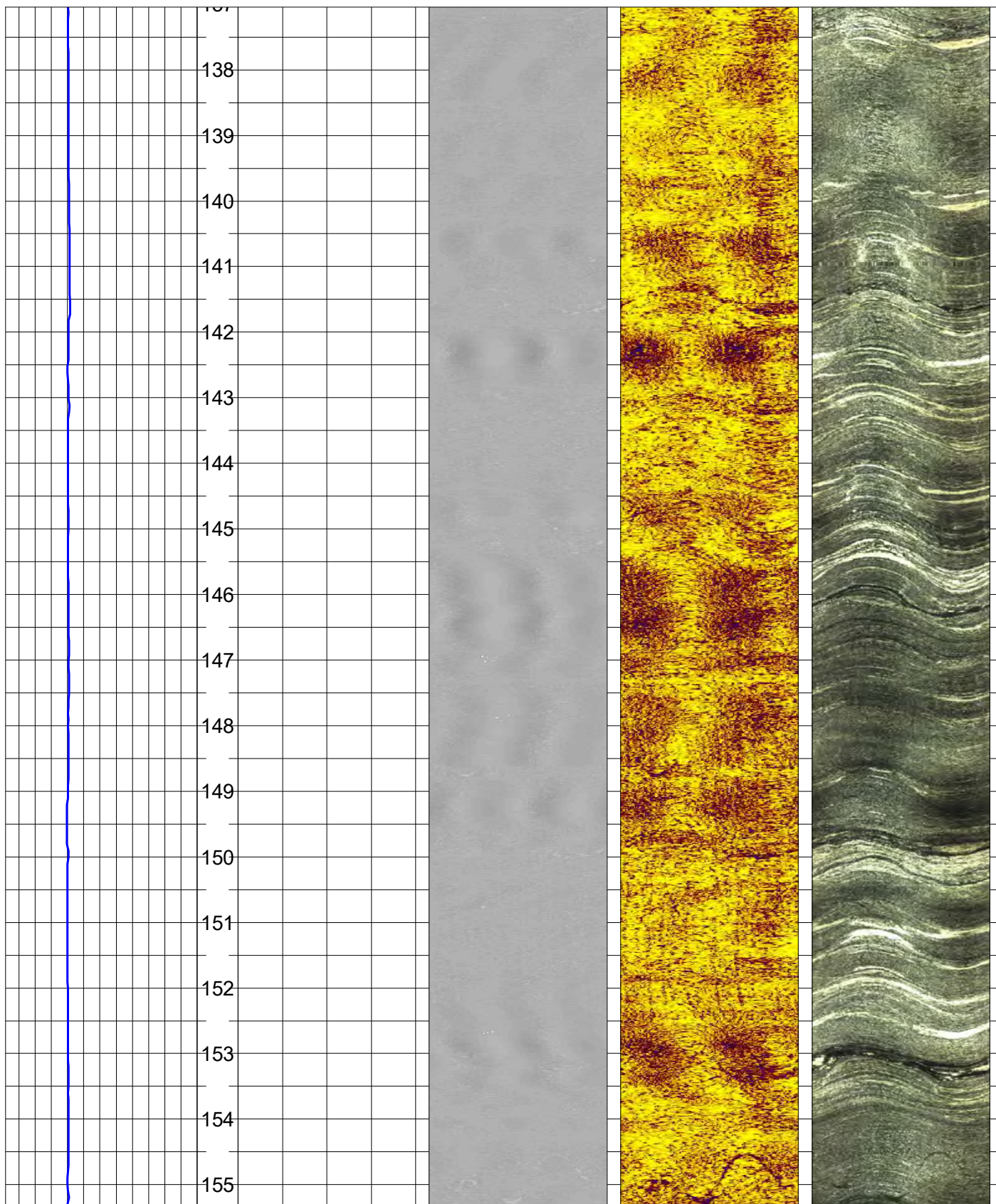


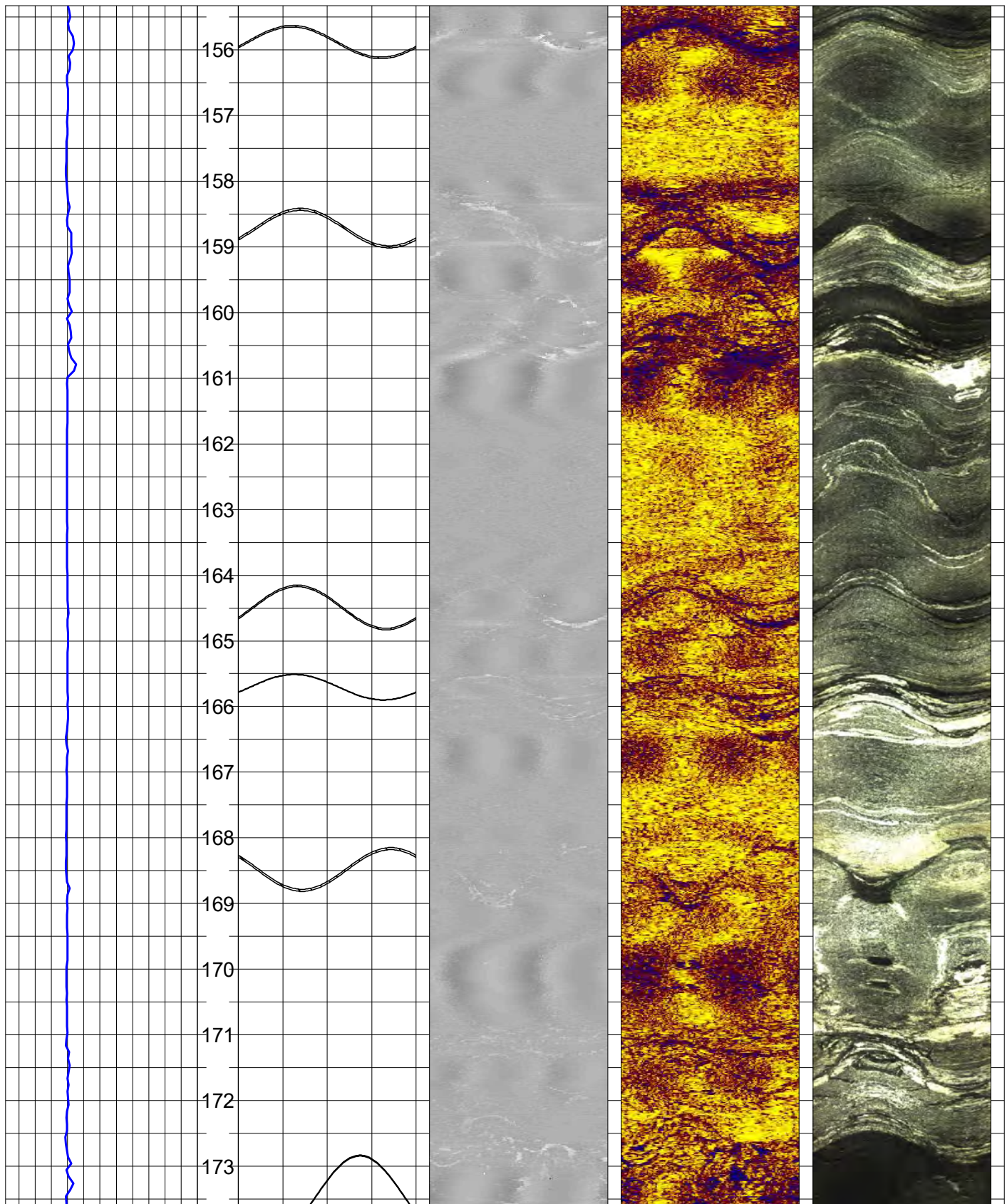


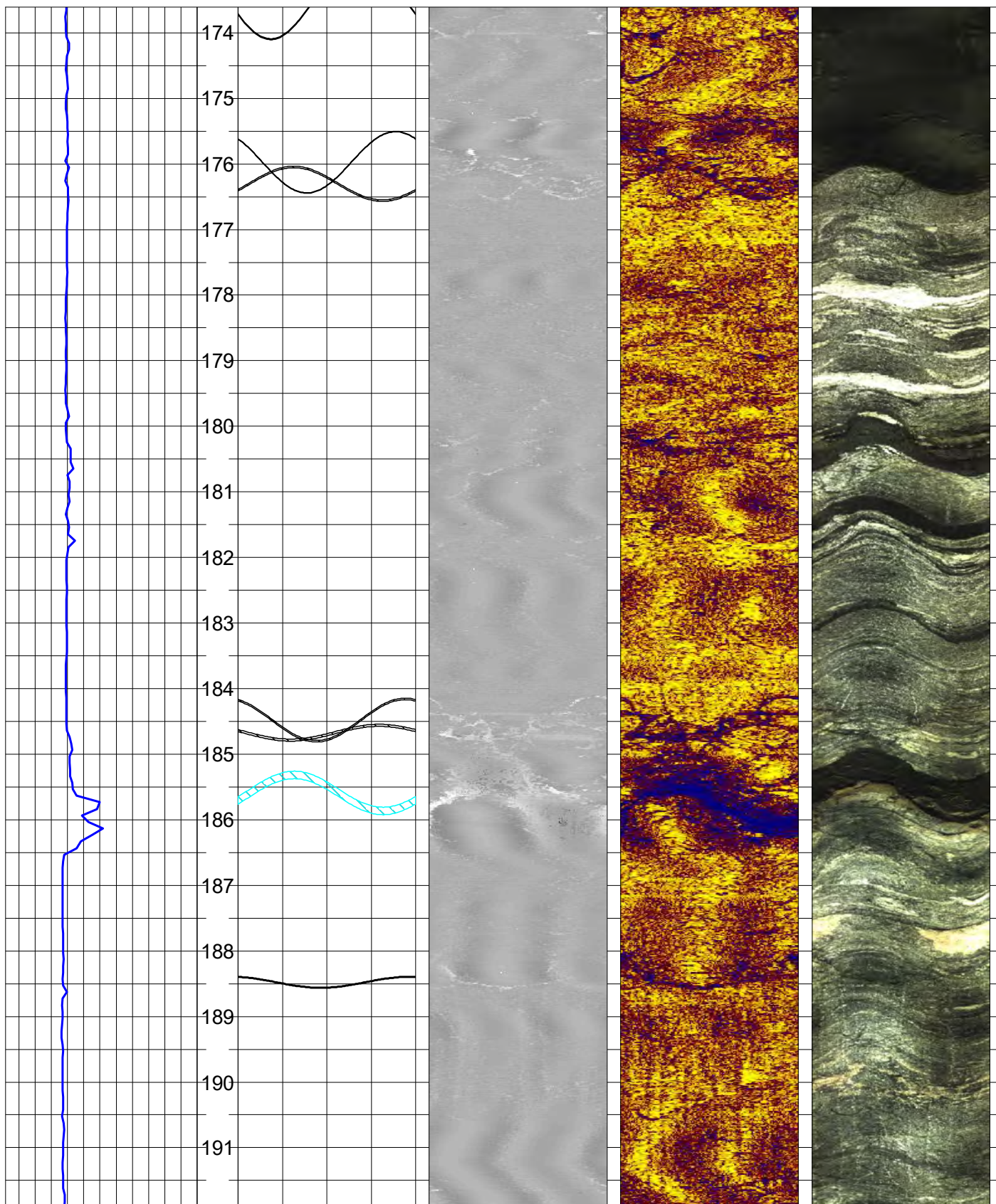


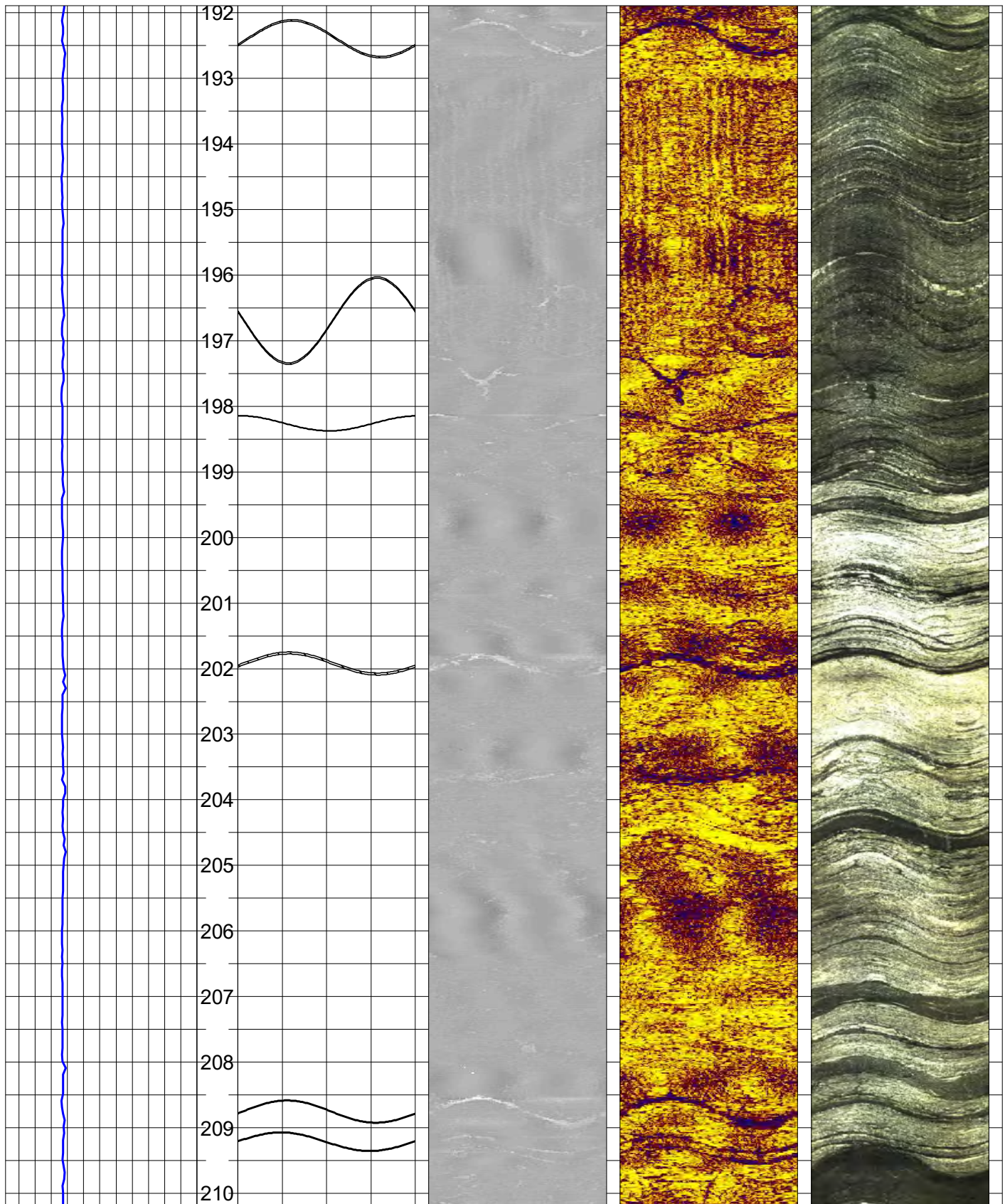


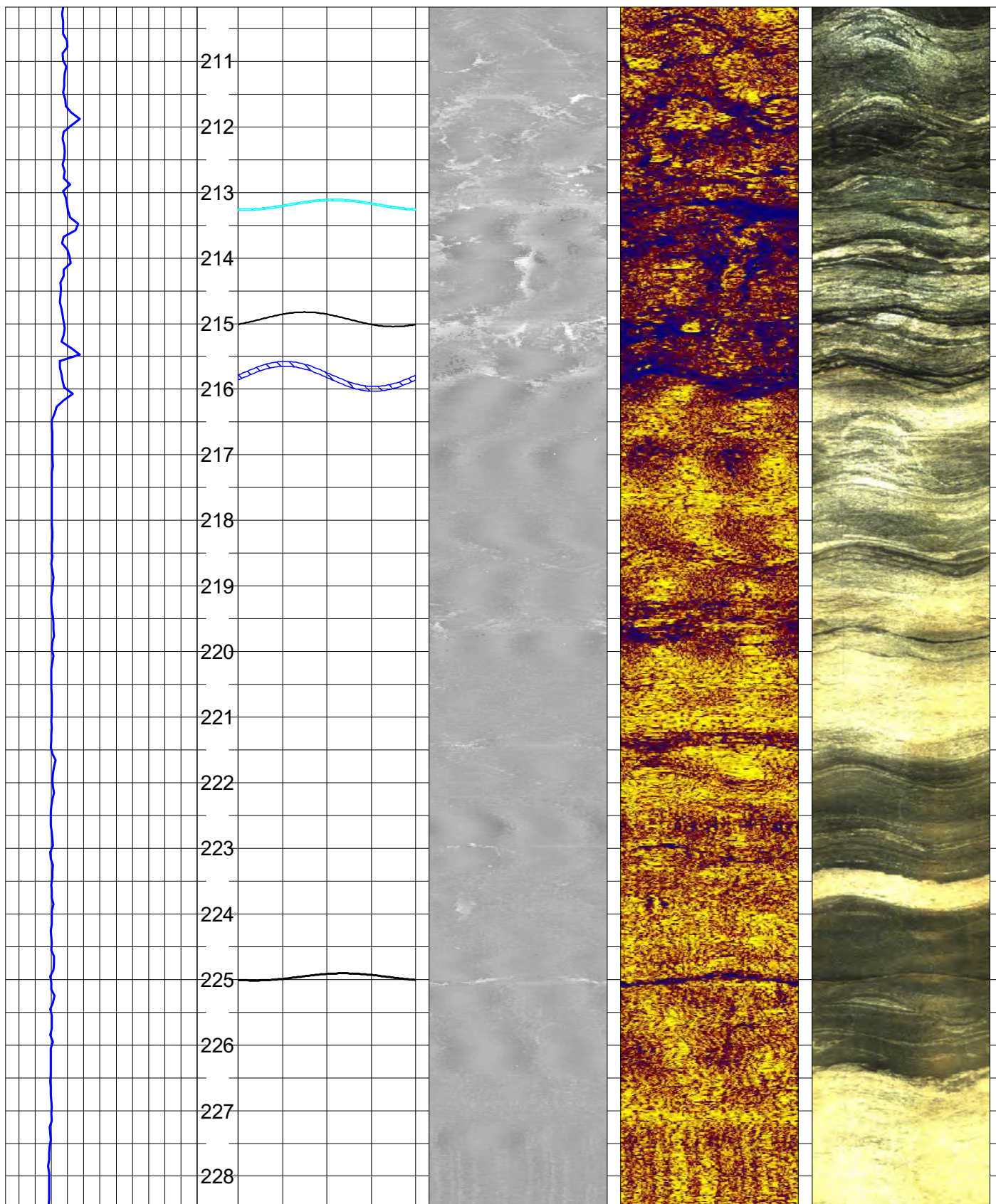


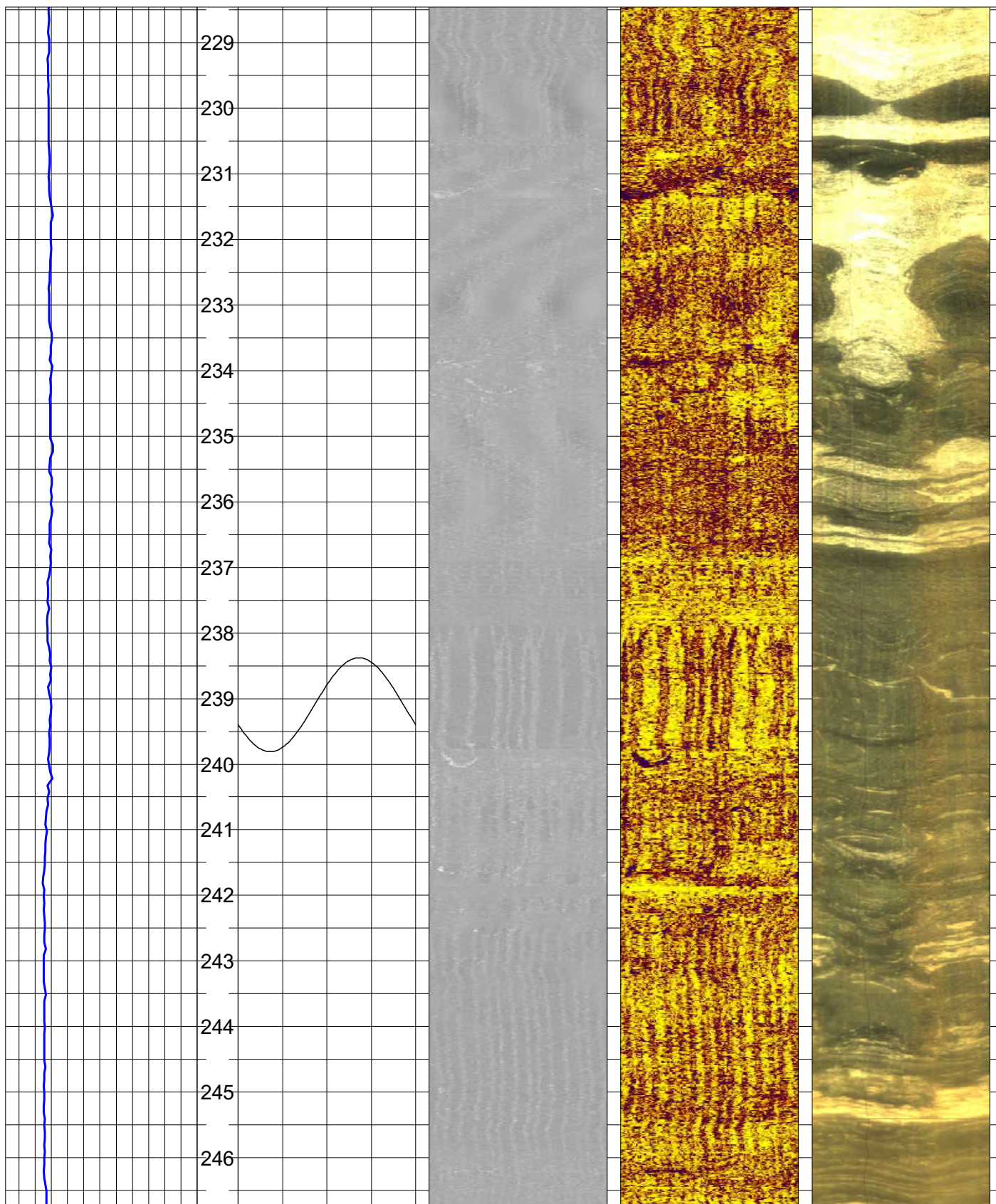


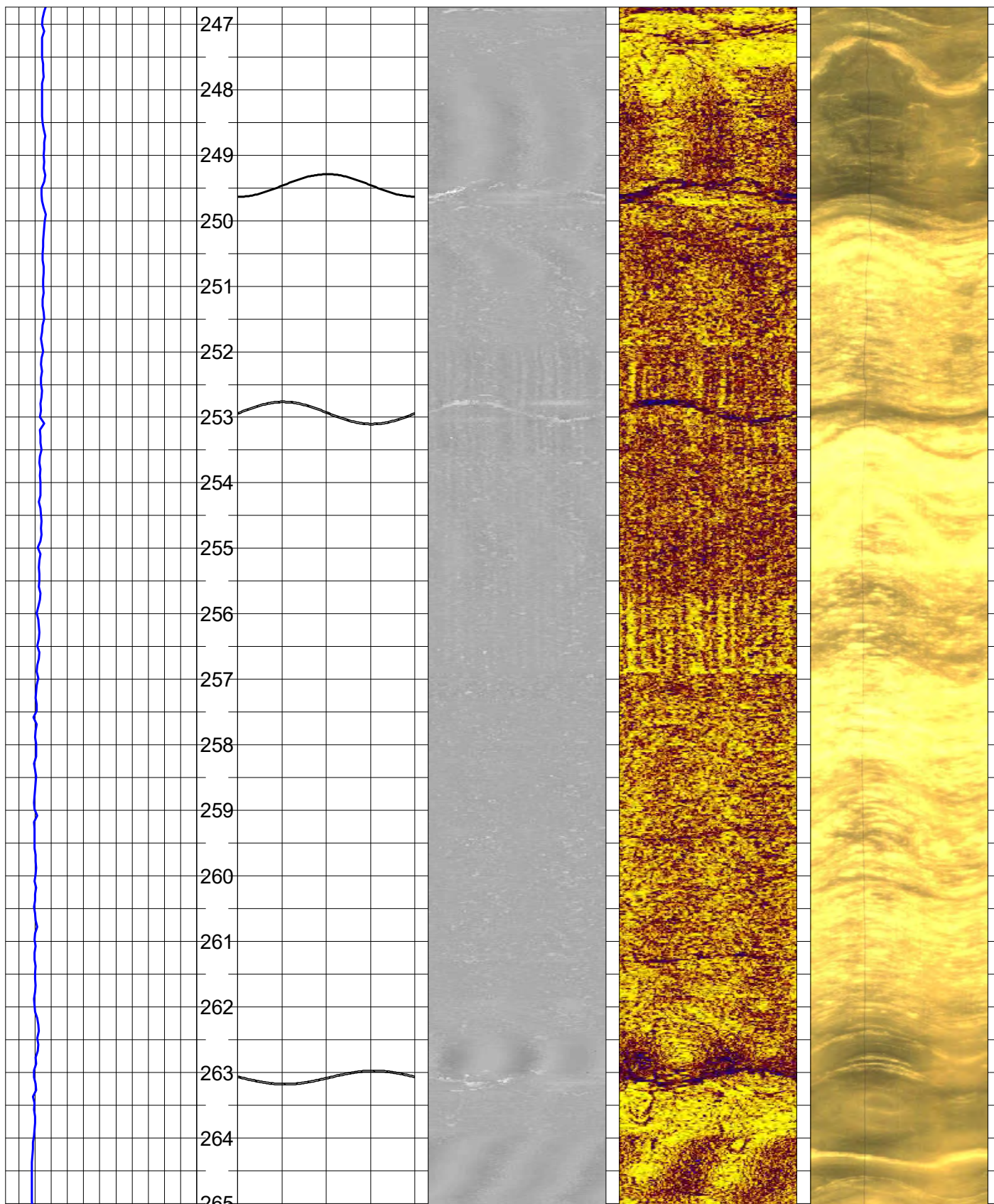


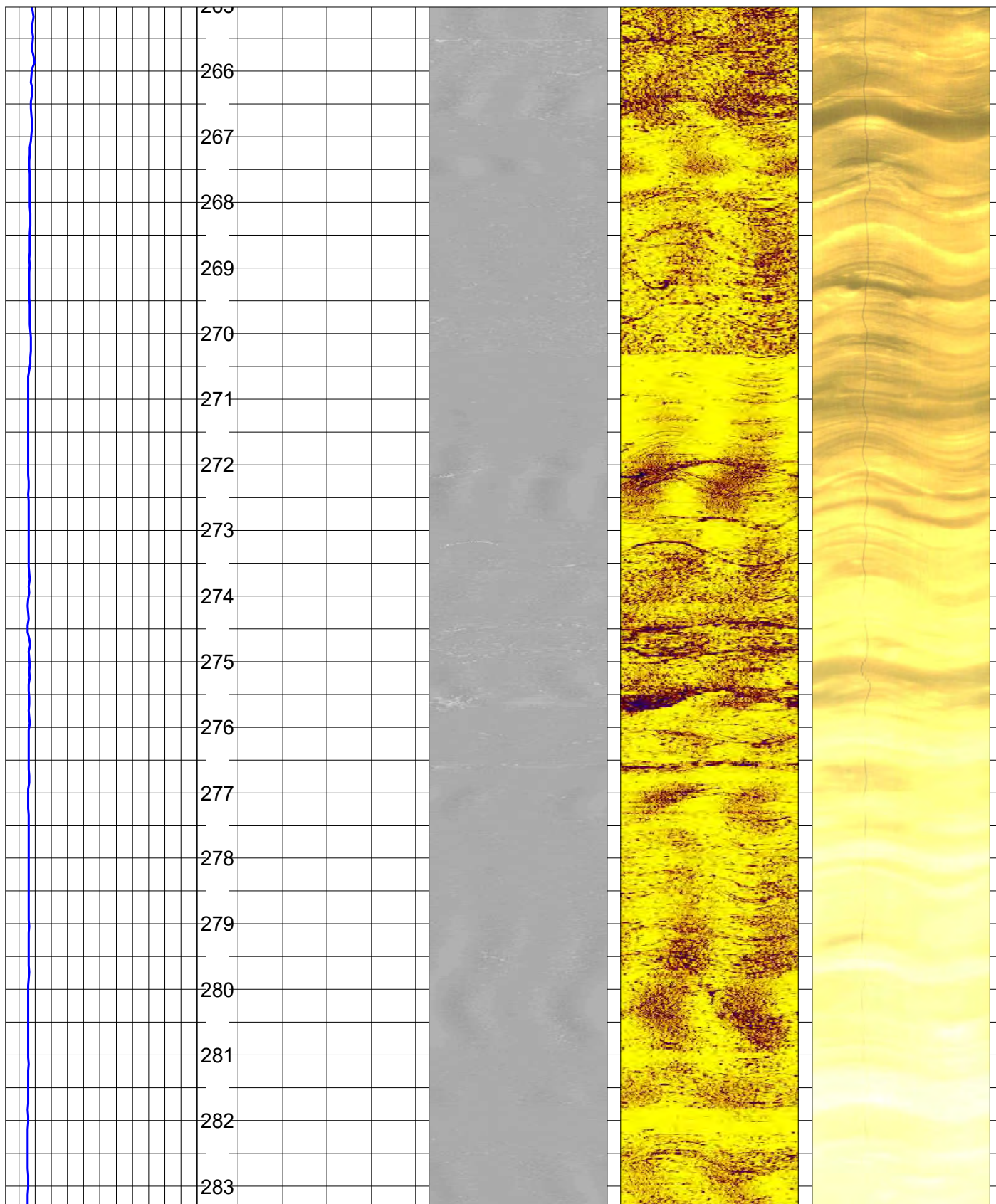


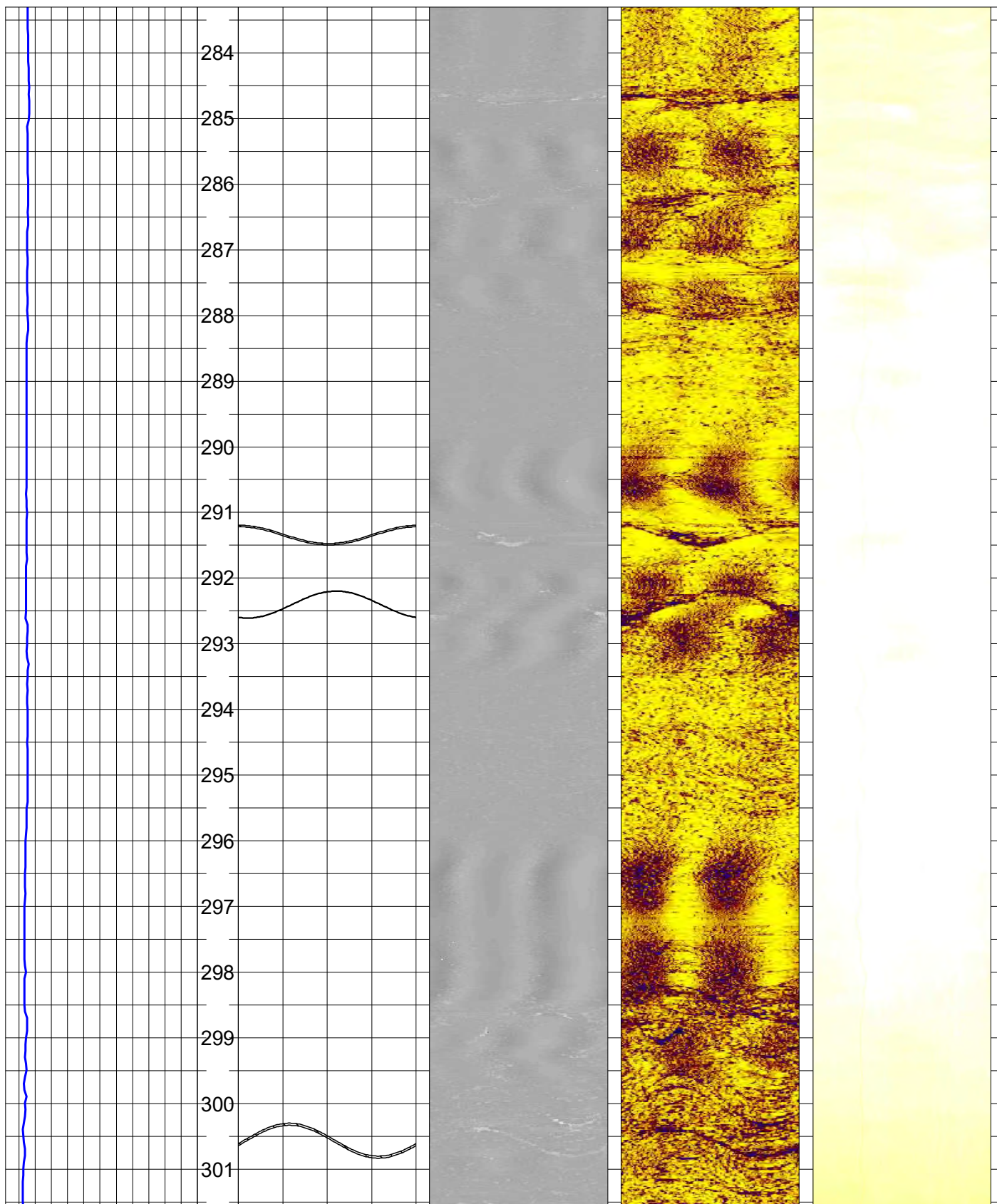












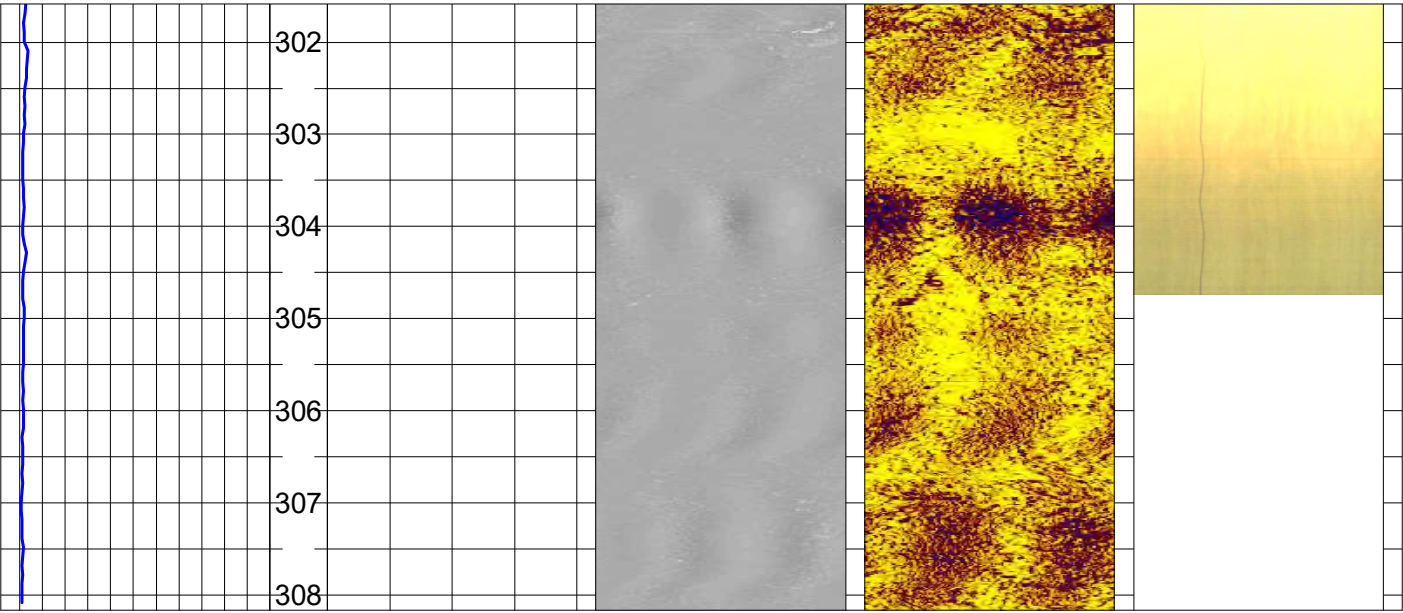


TABLE C-1 Planar features interpreted from acoustical and optical televiewers
Coakley Landfill Superfund Site - Greenland, NH

August, 2018

Declination: 14.9 degrees west

Borehole	Feature # Number	Feature depth Feet	Dip Degrees	Dip Azimuth magnetic	Strike magnetic	Dip Azimuth True	Strike True	Aperture mm	Category Type
MW-22D	1	18.5	22	95	5	80	350	4	101
MW-22D	2	23.0	37	309	219	294	204	3	107
MW-22D	3	23.1	45	87	357	73	343	9	107
MW-22D	4	29.1	73	313	223	298	208	2	101
MW-22D	5	29.5	69	209	119	194	104	3	101
MW-22D	6	38.6	68	70	340	55	325	1	101
MW-22D	7	41.0	73	295	205	280	190	3	101
MW-22D	8	41.0	44	88	358	73	343	2	101
MW-22D	9	49.1	79	312	222	297	207	1	101
MW-22D	10	49.7	79	56	326	41	311	1	101
MW-22D	11	50.4	73	78	348	64	334	2	101
MW-22D	12	59.9	81	301	211	286	196	2	101
MW-22D	13	70.3	64	186	96	171	81	7	101
MW-22D	14	71.2	59	272	182	258	168	2	101
MW-22D	15	79.4	30	280	190	265	175	60	107
MW-22D	16	82.0	78	67	337	52	322	1	101
MW-22D	17	84.1	69	117	27	103	13	3	101
MW-22D	18	87.6	86	253	163	239	149	<1 mm	100
MW-22D	19	88.3	61	278	188	263	173	4	101
MW-22D	20	88.9	41	300	210	285	195	4	101
MW-22D	21	91.7	80	119	29	104	14	<1 mm	100
MW-22D	22	93.6	39	294	204	279	189	9	101
MW-22D	23	95.9	49	308	218	293	203	4	101
MW-22D	24	100.9	78	72	342	57	327	2	101
MW-22D	25	101.0	6	321	231	306	216	7	101
MW-22D	26	102.0	79	59	329	44	314	2	101
MW-22D	27	102.6	43	301	211	287	197	3	101
MW-22D	28	109.4	80	66	336	51	321	2	101
MW-22D	29	110.4	80	78	348	63	333	1	101
MW-22D	30	114.2	48	286	196	271	181	4	101

TABLE C-1 Planar features interpreted from acoustical and optical televiewers
Coakley Landfill Superfund Site - Greenland, NH

August, 2018

Declination: 14.9 degrees west

Borehole	Feature # Number	Feature depth Feet	Dip Degrees	Dip Azimuth magnetic	Strike magnetic	Dip Azimuth True	Strike True	Aperture mm	Category Type
MW-22D	31	115.2	37	66	336	51	321	4	101
MW-22D	32	118.8	61	140	50	125	35	1	101
MW-22D	33	120.9	74	77	347	62	332	2	101
MW-22D	34	124.7	56	312	222	297	207	3	101
MW-22D	35	127.7	52	292	202	277	187	2	101
MW-22D	36	132.5	22	62	332	47	317	18	101
MW-22D	37	155.9	56	289	199	274	184	5	101
MW-22D	38	158.7	60	306	216	291	201	4	101
MW-22D	39	164.5	63	300	210	285	195	4	101
MW-22D	40	165.7	50	294	204	279	189	2	101
MW-22D	41	168.5	63	129	39	114	24	4	101
MW-22D	42	173.5	75	67	337	52	322	1	101
MW-22D	43	176.0	71	140	50	125	35	1	101
MW-22D	44	176.3	57	293	203	278	188	3	101
MW-22D	45	184.5	63	159	69	144	54	2	101
MW-22D	46	184.7	34	106	16	91	1	8	101
MW-22D	47	185.6	59	294	204	279	189	18	108
MW-22D	48	188.5	27	168	78	153	63	3	101
MW-22D	49	192.4	60	290	200	275	185	4	101
MW-22D	50	196.7	76	103	13	88	358	2	101
MW-22D	51	198.3	35	185	95	170	80	3	101
MW-22D	52	201.9	44	284	194	269	179	7	101
MW-22D	53	208.8	46	280	190	265	175	3	101
MW-22D	54	209.2	41	268	178	253	163	4	101
MW-22D	55	213.2	24	14	284	359	269	6	108
MW-22D	56	214.9	34	315	225	300	210	3	101
MW-22D	57	215.8	49	276	186	261	171	15	107
MW-22D	58	225.0	18	34	304	19	289	4	101
MW-22D	59	239.1	77	65	335	50	320	<1 mm	100
MW-22D	60	249.5	46	2	272	347	257	3	101

TABLE C-1 Planar features interpreted from acoustical and optical televiewers**Coakley Landfill Superfund Site - Greenland, NH****August, 2018**

Declination: 14.9 degrees west

Borehole	Feature # Number	Feature depth Feet	Dip Degrees	Dip Azimuth magnetic	Strike magnetic	Dip Azimuth True	Strike True	Aperture mm	Category Type
MW-22D	61	252.9	46	273	183	258	168	5	101
MW-22D	62	263.1	32	96	6	82	352	6	101
MW-22D	63	291.4	40	182	92	168	78	6	101
MW-22D	64	292.4	51	18	288	4	274	2	101
MW-22D	65	300.6	57	284	194	269	179	5	101

Explanation:

	Category 100 = planar feature (possible fracture, joint, foliation, bedding, etc.) aperture < 1 mm
	Category 101 = planar feature (possible fracture, joint, foliation, bedding, etc.) aperture > 1 mm
	Category 108 = Possible water bearing fracture
	Category 107 = Likely water bearing feature