



LWD Memory Logs

Multiple Propagation Resistivity

Scale: **1:240** **Measured Depth** **Well: Willow 22-5-4L** **Field: Wattenberg** **County: Weld** **Country: United States**

Depth Reference: **Driller's Depth** **State: Colorado** **Surface Location: 40° 01' 48.612" N** **Latitude: 104° 39' 19.476" W** **Other Services:**

Status: **Final Print** **API No: 05123509420000** **Longitude: N/A**

Job ID: 110892255 **SEC: 22** **TWVN: 1N** **RGE: 65W** **Elev. KB: N/A**

Permanent Datum (P.D.): Mean Sea Level **Elevation: 0.00 ft** **Elev. DF: 5118.00 ft**

Log Measured From: Rig Floor **Above P.D.: 5118.00 ft** **Elev. GL: 5095.00 ft**

**Dates** **Interval** **Magnetic Field Reference**

From: 2021-05-20 **Drilled (ft): 105.00** **Logged (ft): -11536.88** **Azi Reference North: True** **Dip Angle: (deg) 66.28**

To: 2021-06-21 **Top: 105.00** **Bottom: -11536.88** **Total Magnetic Field Strength: (nT) 51760**

Spud: 2021-05-20 **Bottom: 20206.00** **Mag to Reference North Correction: (deg) 7.96**

**Borehole Record** **Casing Record**

Hole Size (in)	From (ft)	To (ft)	Size (in)	Weight (lb/ft)	From (ft)	To (ft)
26.000	23.00	103.00	16.000	36.00	23.00	103.00
13.500	103.00	1574.00	9.625	36.00	23.00	1564.00

Type	From (ft)	To (ft)	Hole Size (in)	Interval (ft)	Inc   Az (Start)	Inc   Az (End)
Water Based Mud	103.00	1574.18	13.500	1471.18	0.51   157.56	3.10   211.84
Oil Based Mud	1574.00	20205.00	8.500	18631.00	3.10   211.84	90.74   0.22

Acquisition System	Software Version	Other
Cadence Plot Studio	RT 5.9 5.9.9111.3	Rig: Ensign 161 Contractor: Ensign Drilling District: RMA Unit: D&E

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Log Run Summary

Run No	Bit Run No.	Bit Size (in)	Bit Type	Bit Gauge Length (in)	Assembly Type	Logged Interval		Bit Depth Interval		Date / Time		Circ. Hours (h)
						Top (ft)	Bottom (ft)	From (ft)	To (ft)	Start Logging	End Logging	
1	1RR	13.500	PDC	3.00	Steerable	105.00	1574.00	105.00	1574.00	2021-05-20 16:56	2021-05-20 23:38	9.21
2	2	8.500	PDC	3.00	AutoTrak Curve	1562.00	20193.00	1575.00	20206.00	2021-06-16 12:04	2021-06-21 09:25	106.40

Crew

Name	Arrive Wellsite	Depart Wellsite	Name	Arrive Wellsite	Depart Wellsite	Name	Arrive Wellsite	Depart Wellsite
Adam Schlenz	2021-05-20	2021-05-21	David Browning	2021-06-16	2021-06-22			

Mud Properties Record

Date / Time	Run No.	Depth (ft)	Mud Type	Density (ppg)	Viscosity (cP)	pH	Fluid Loss (cm3)	Oil / Water	Source	Total Chlorides (ppm)	K+ (%)
2021-05-21 02:00	1	1574.00	Water Based Mud	9.2	N/A	7.5	N/A	99/1	Active Pit	695	0.00
2021-06-16 06:22	2	1564.00	Oil Based Mud	9.8	24	N/A	9.0	68.5/18.5	Active Pit	35000	0.00
2021-06-16 14:00	2	1905.00	Oil Based Mud	9.7	21	N/A	N/A	67/18	Active Pit	33000	0.00
2021-06-17 04:00	2	5929.00	Oil Based Mud	9.7	21	N/A	N/A	65/20	Active Pit	37000	0.00
2021-06-17 15:00	2	7450.00	Oil Based Mud	9.7	25	N/A	N/A	67/18.5	Active Pit	35000	0.00
2021-06-18 02:30	2	8685.00	Oil Based Mud	9.7	23	N/A	N/A	68/17.5	Active Pit	35000	0.00
2021-06-19 02:00	2	13092.00	Oil Based Mud	10.0	22	N/A	N/A	68/15.5	Active Pit	36000	0.00
2021-06-19 14:00	2	14632.00	Oil Based Mud	10.0	23	N/A	N/A	67/16	Active Pit	33000	0.00
2021-06-20 02:30	2	16453.00	Oil Based Mud	10.1	21	N/A	N/A	68/15.5	Active Pit	35000	0.00
2021-06-20 15:00	2	18405.00	Oil Based Mud	10.1	23	N/A	N/A	67/16	Active Pit	34000	0.00

#### Mud Resistivity Record

Date / Time	Run No.	Depth (ft)	Surface Temp (degF)	Surface			BHCT (degF)	Downhole		
				Rm (ohm.m)	Rmf (ohm.m)	Rmc (ohm.m)		Rm @ BHCT (ohm.m)	Rmf @ BHCT (ohm.m)	Rmc @ BHCT (ohm.m)
2021-06-17 14:16	2	5000.00	150.0	100.000	N/A	N/A	250.0	600.666	N/A	N/A

#### Equipment and Service Data

Run No.	Tool	Serial Number	Measurement	Sensor Offset (ft)	Bit Offset (ft)	Max O.D. (in)	Min I.D. (in)
1	NaviTrak	DHP 815	VSS	16.12	52.25	8.000	3.125
1	NaviTrak	DHP 815	Directional (mag)	16.12	52.25	8.000	3.125
2	OnTrak	13080165	Pressure	3.51	13106.95	6.750	0.000
2	OnTrak	13080165	Gamma (double)	4.40	13107.84	6.750	0.000
2	OnTrak	13080165	Resistivity (4tx)	8.44	13111.88	6.750	0.000
2	OnTrak	13080165	Directional (mag)	14.23	13117.67	6.750	0.000

#### Service and Tool Mnemonics

Mnemonic	Name	Description
NTK	NaviTrak	Probe Based Directional Module, NaviTrak Platform
OTK	OnTrak	Sensor Sub (Inc, Azi, Temp, Azimuthal GR, Res, AP, VSS), OnTrak Platform
BCPM	BCPM	Bi-Directional Communication and Power Module, OnTrak Platform

#### Comments

1	Depth measurements were obtained from a depth control system not supplied or operated by Baker Hughes Company. Due to a lack of control by Baker Hughes Company logging engineers, depth calibrations and measurements could not be independently verified and the unverified depths as supplied to Baker Hughes Company are being used to present logging data.
2	Baker Hughes Company run 2 utilized 6 ¾ inch NaviGamma services (Gamma Ray and Directional) behind an 8 ½ inch PDC bit and steerable assembly from 1574 to 20205 feet MD (1571 to 7435 feet TVD).

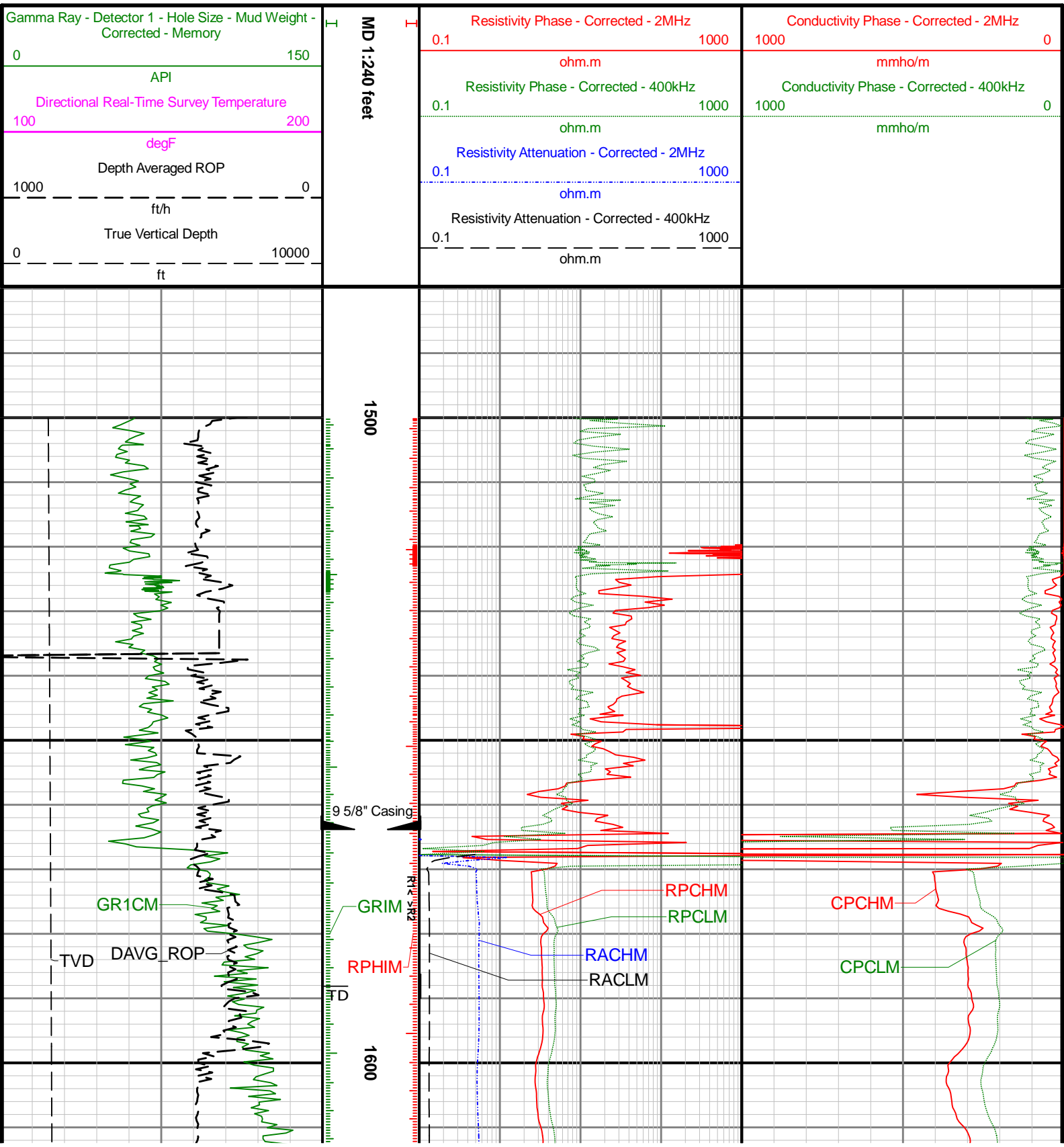
#### Remarks

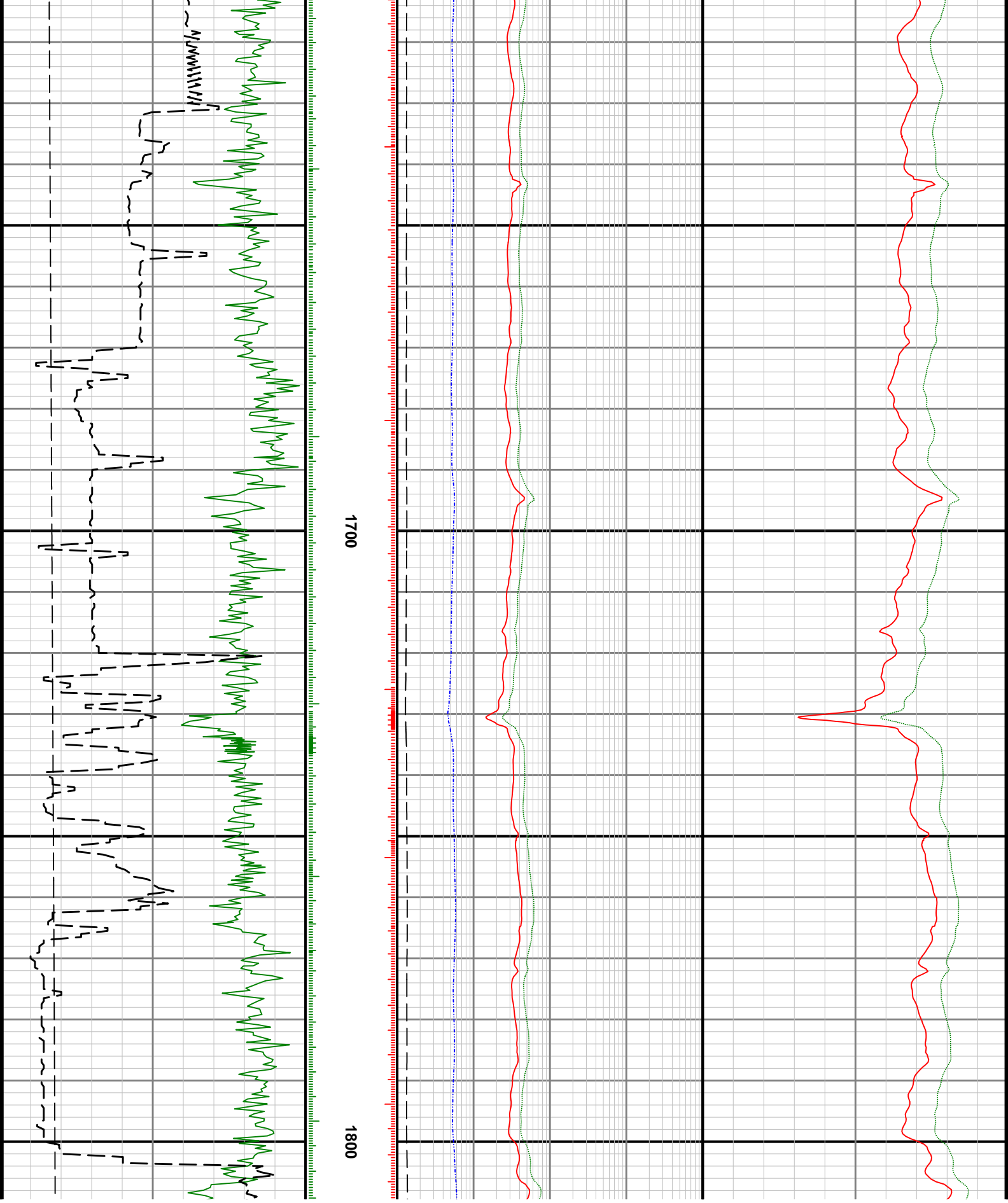
Number	Depth (ft)	Hole Section (in)	Run No.	Remark
1	5700.00	8.500	2	The gap in gamma ray data from 5690 to 5738 feet MD (5681 to 5729 feet TVD) is due to the AutoTrak Curve tool turning off during a downlink and not turning back on until pumps were recycled at the connection.
2	20205.00	8.500	2	The interval from 20193to 20205 feet MD 7436 feet TVD) was not logged due to sensor to bit offset at well TD.

#### Curve Mnemonics

Presented Curves	Description	Units
CPCHM	Conductivity Phase - Corrected - 2MHz	mmho/m
CPCLM	Conductivity Phase - Corrected - 400kHz	mmho/m
RACHM	Resistivity Attenuation - Corrected - 2MHz	ohm.m
RACLM	Resistivity Attenuation - Corrected - 400kHz	ohm.m
RPCHM	Resistivity Phase - Corrected - 2MHz	ohm.m
RPCLM	Resistivity Phase - Corrected - 400kHz	ohm.m
RPHIM	Resistivity Phase - Data Point Indicator - 2MHz	unitless

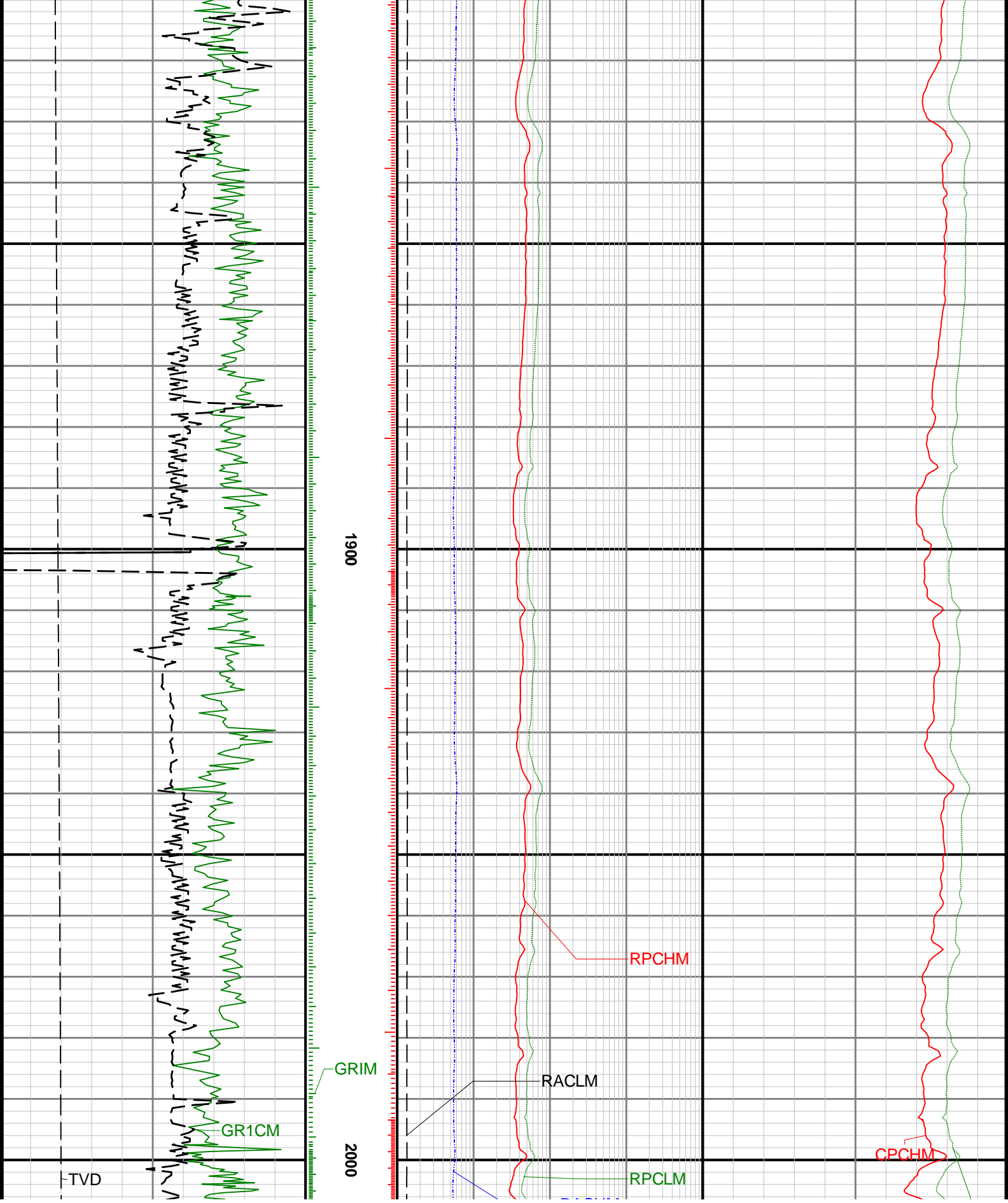
RPHIM	Resistivity Time Since Drilled	min
DAVG_ROP	Depth Averaged ROP	ft/h
GR1CM	Gamma Ray - Detector 1 - Hole Size - Mud Weight - Corrected - Memory	API
GRIM	Gamma Ray - Data Point Indicator - Memory	unitless
TCDM	Directional Real-Time Survey Temperature	degF
TVD	True Vertical Depth	ft

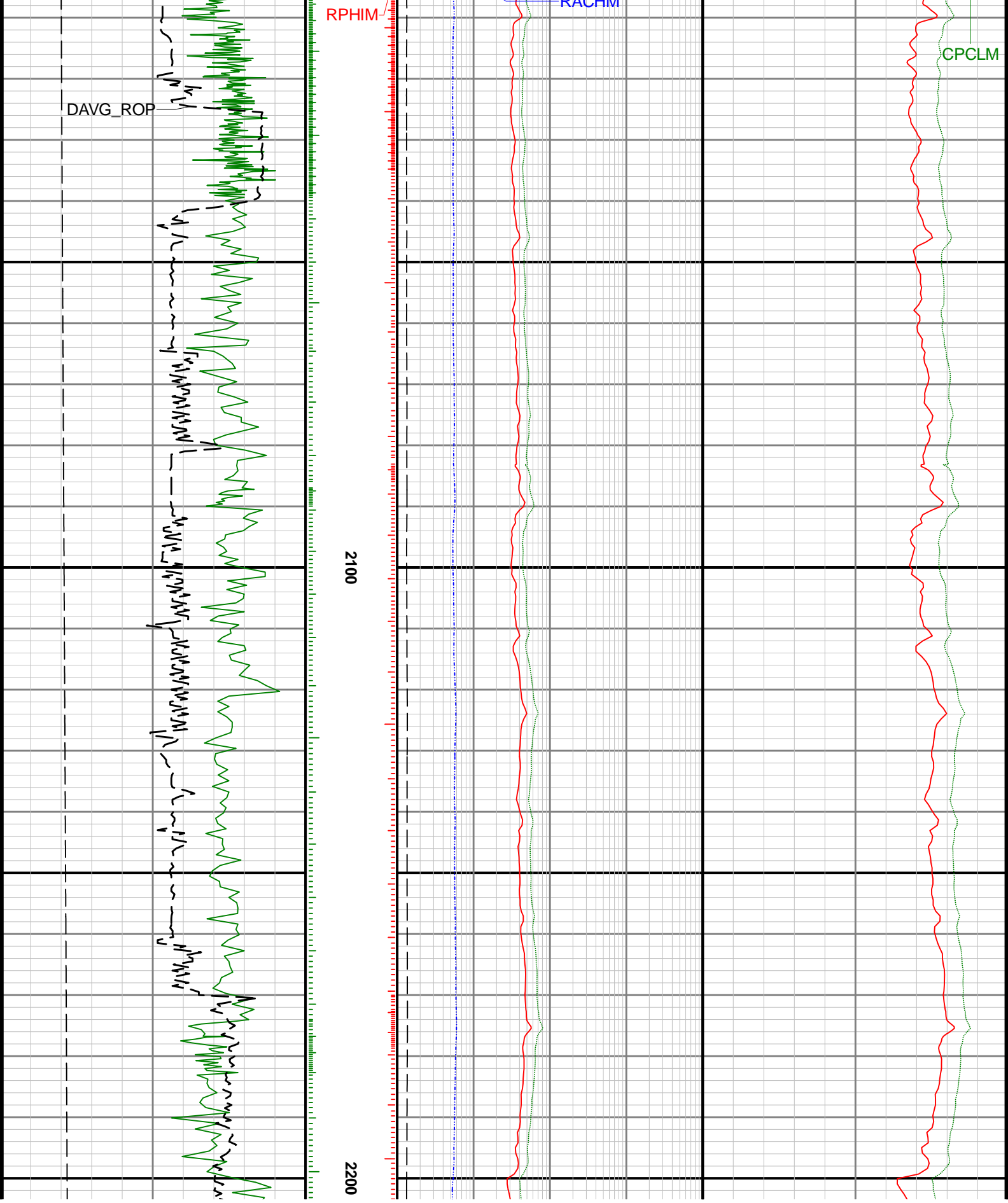


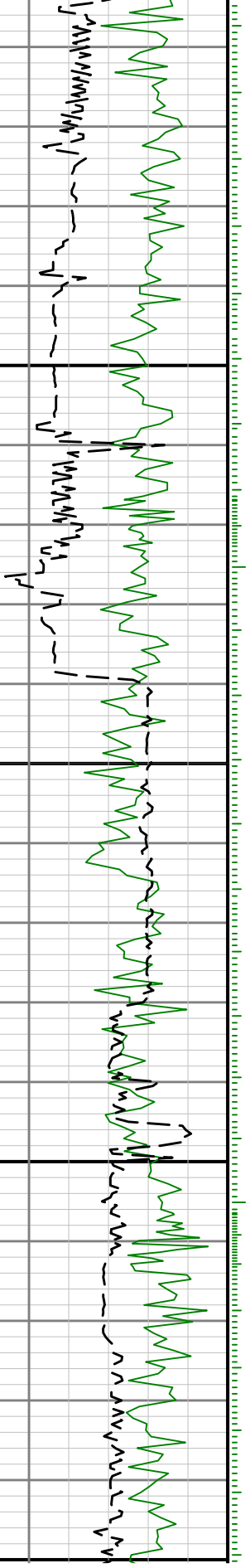
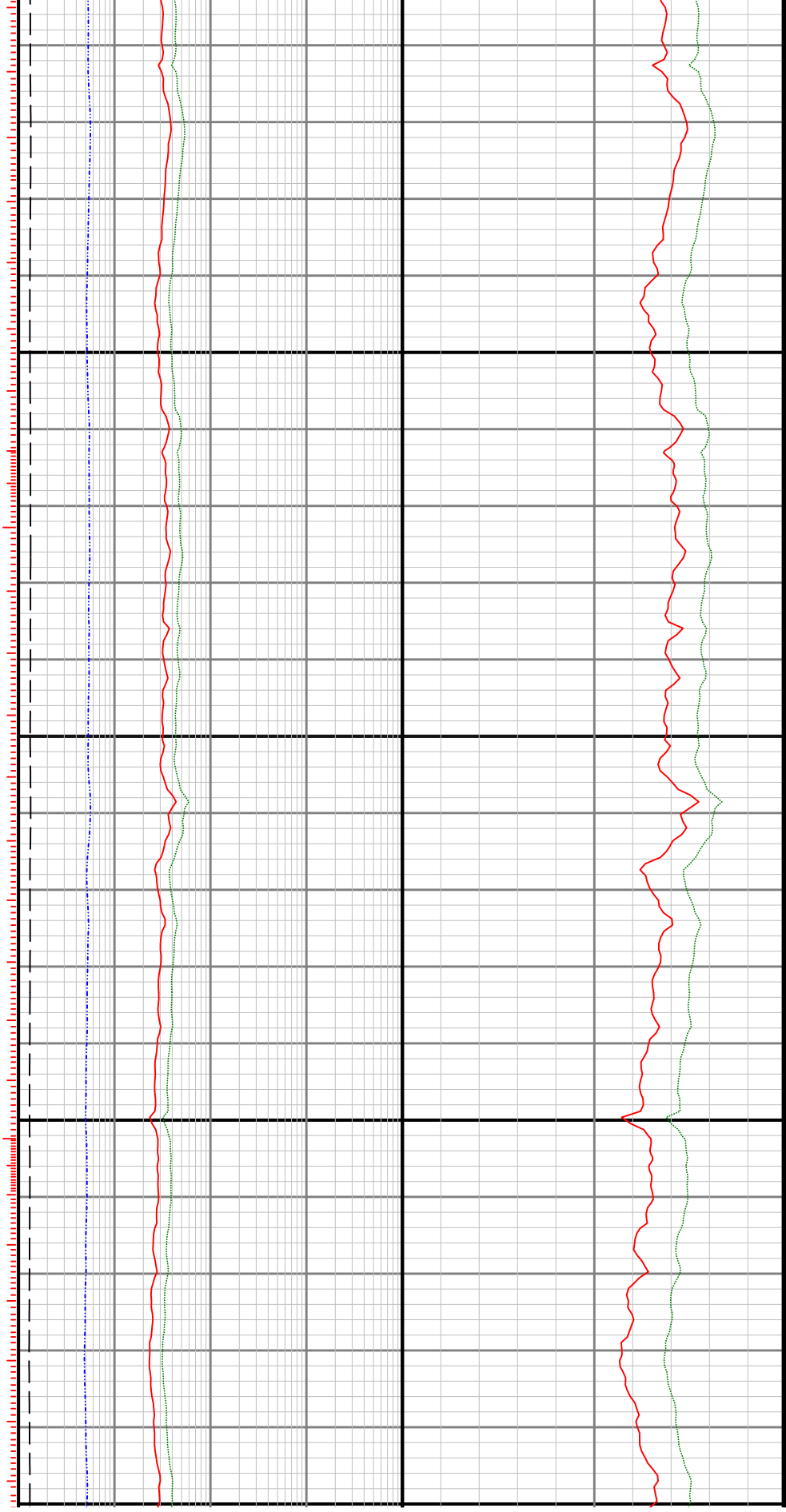


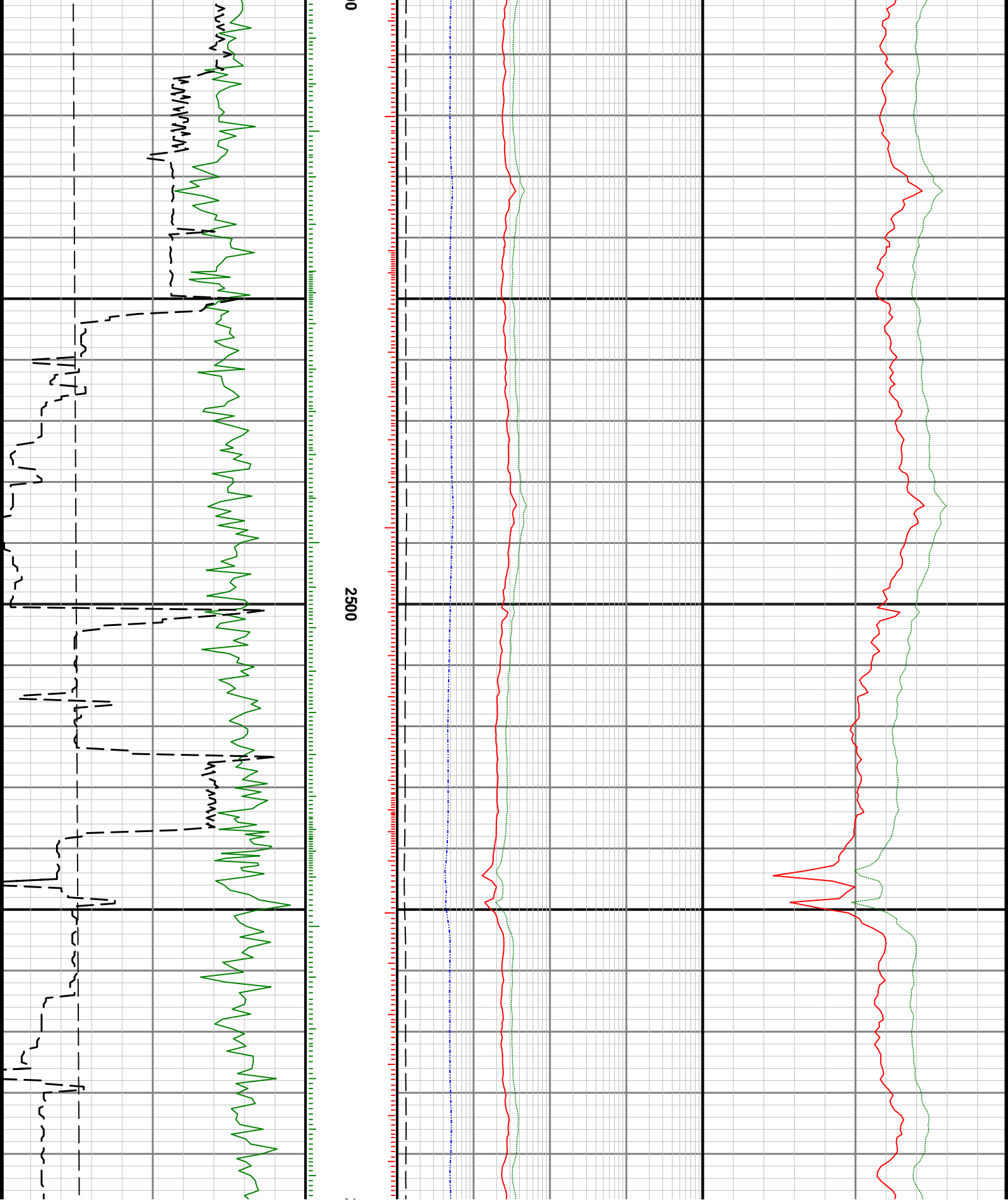
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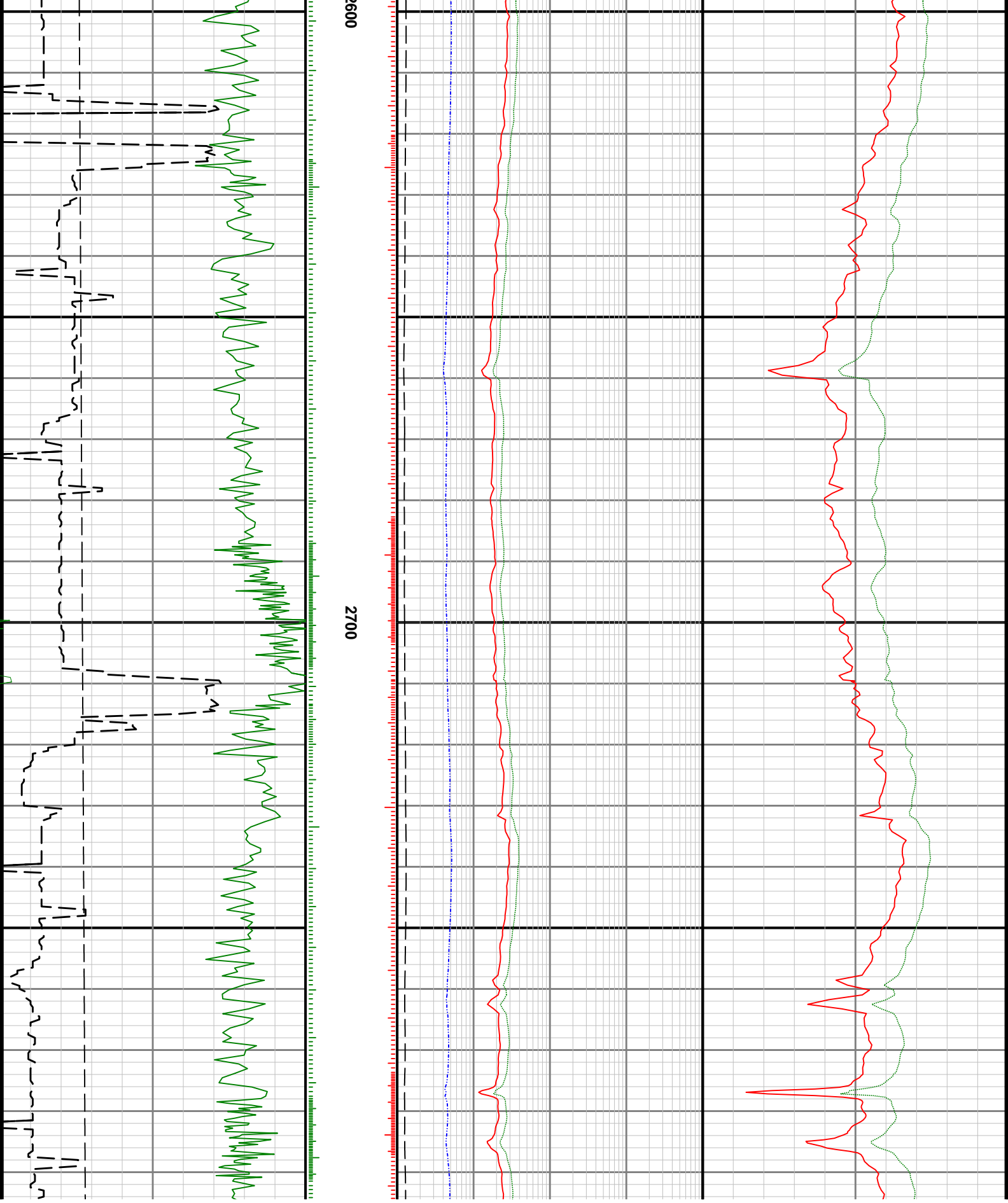
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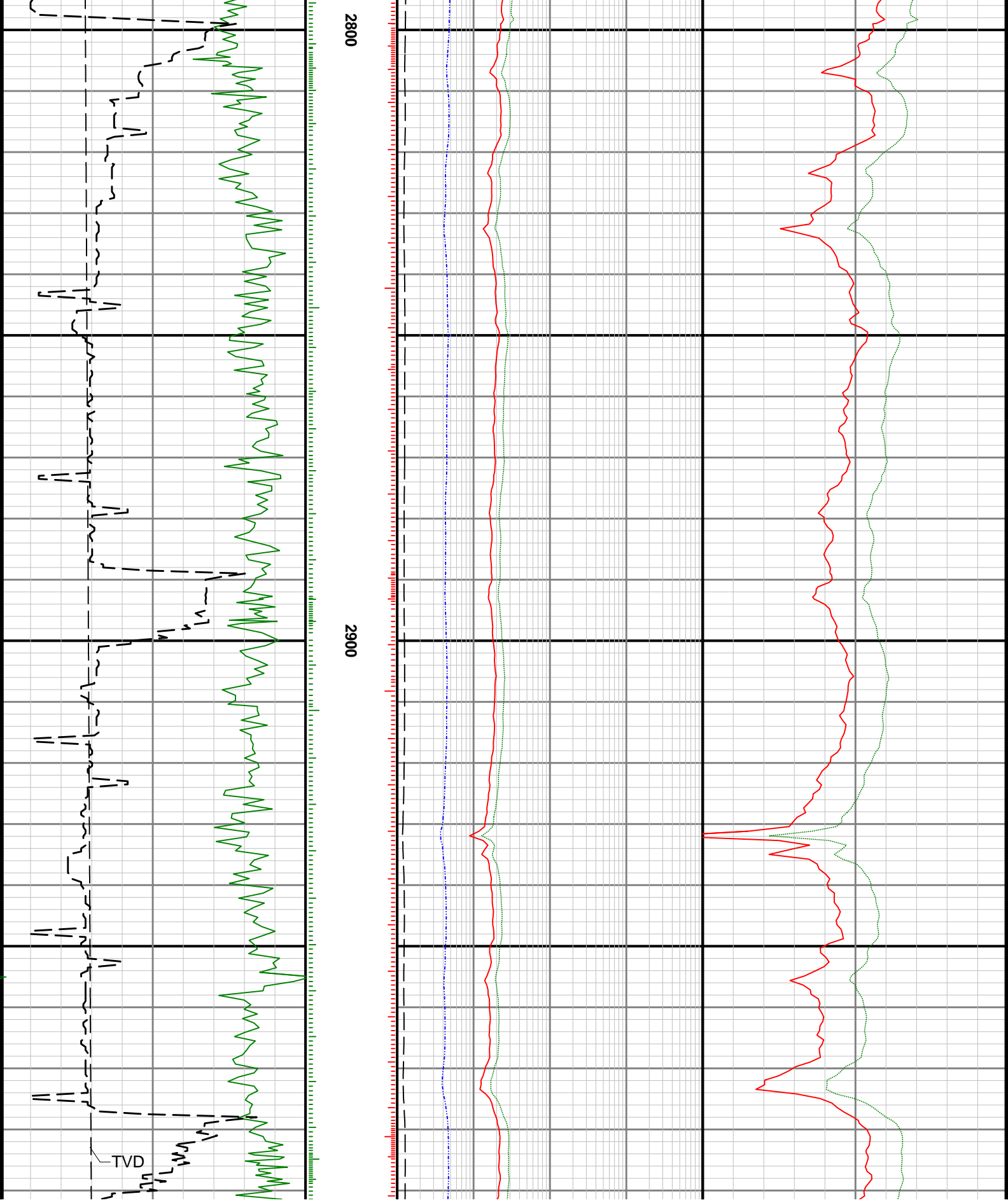


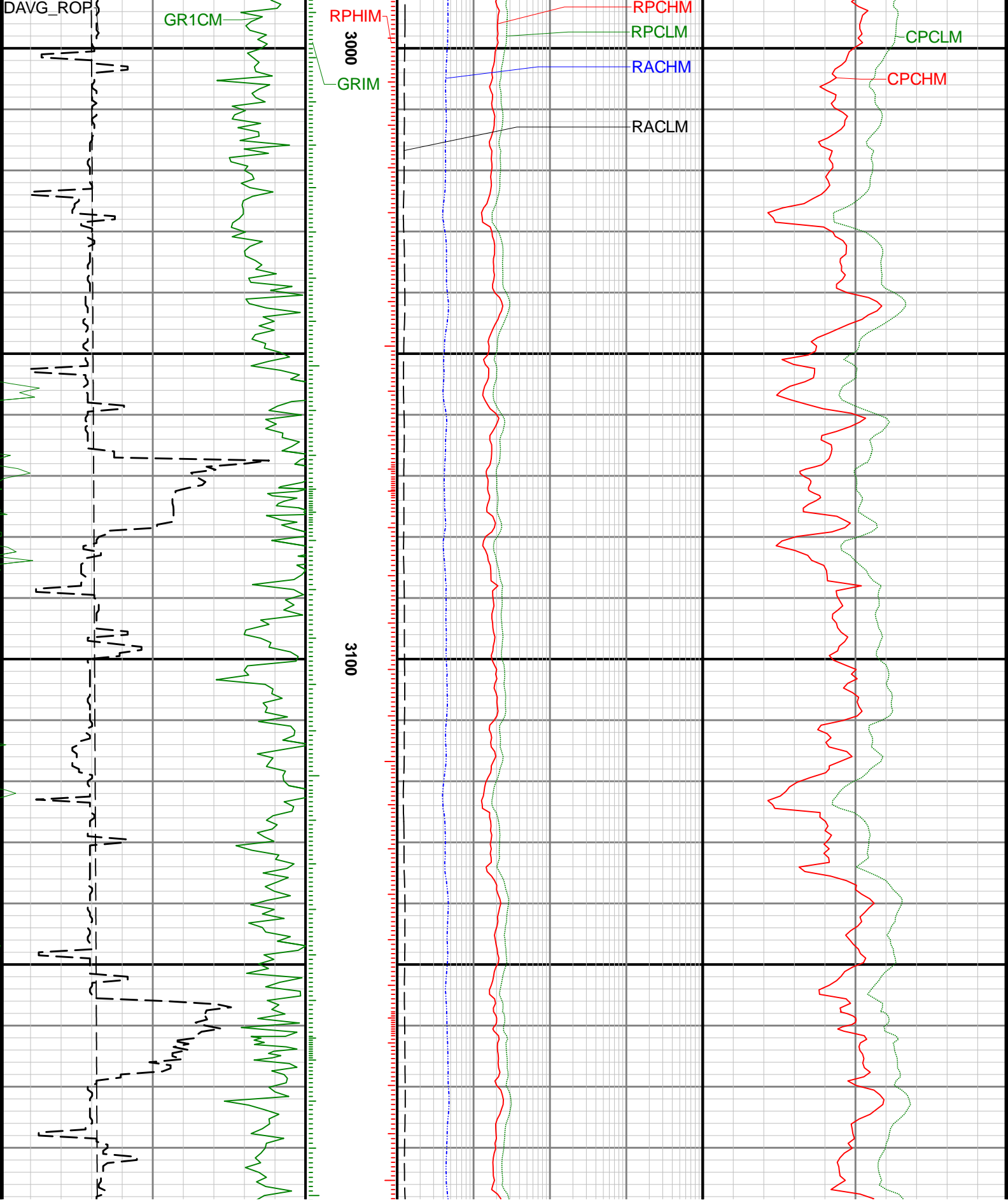


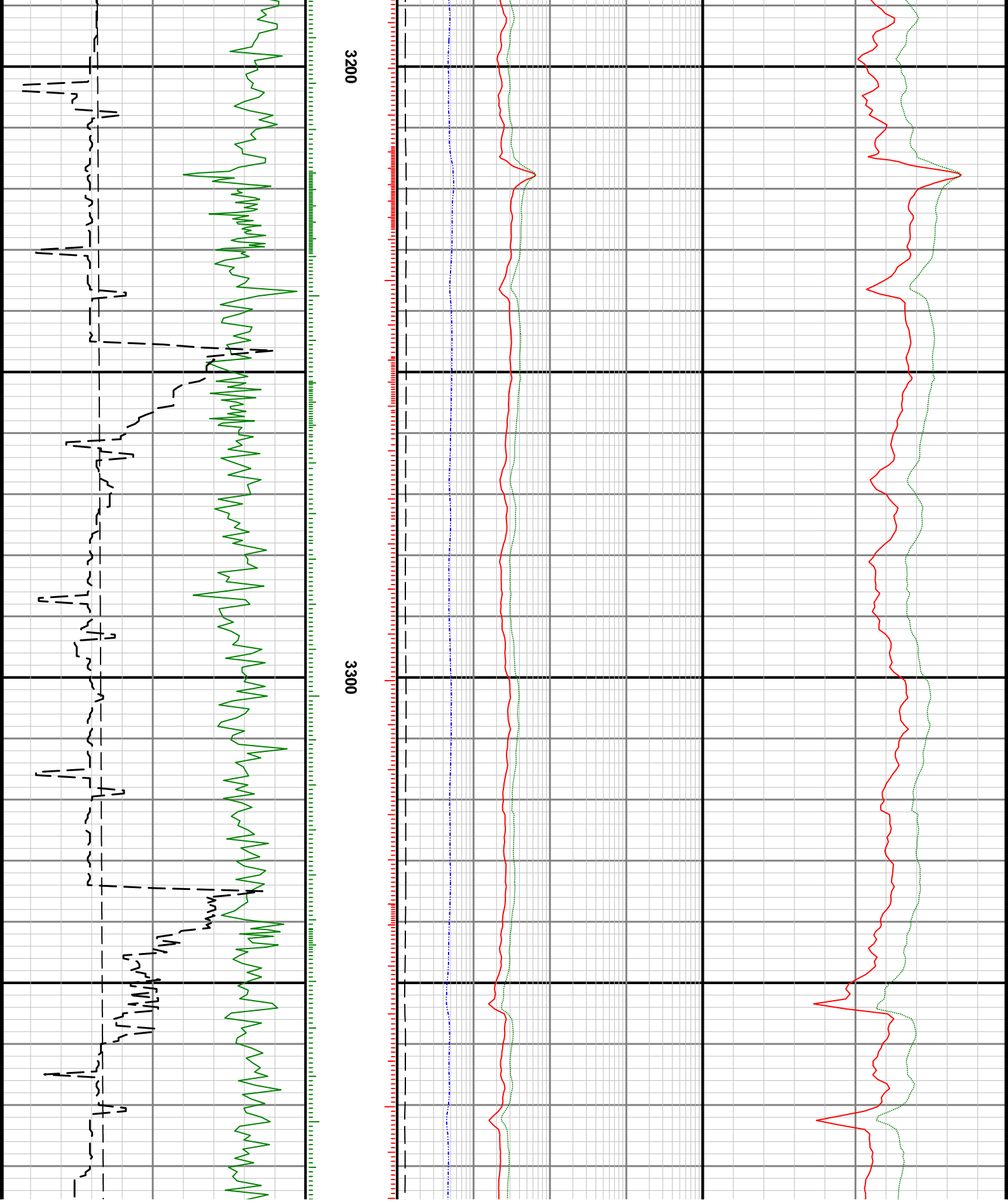


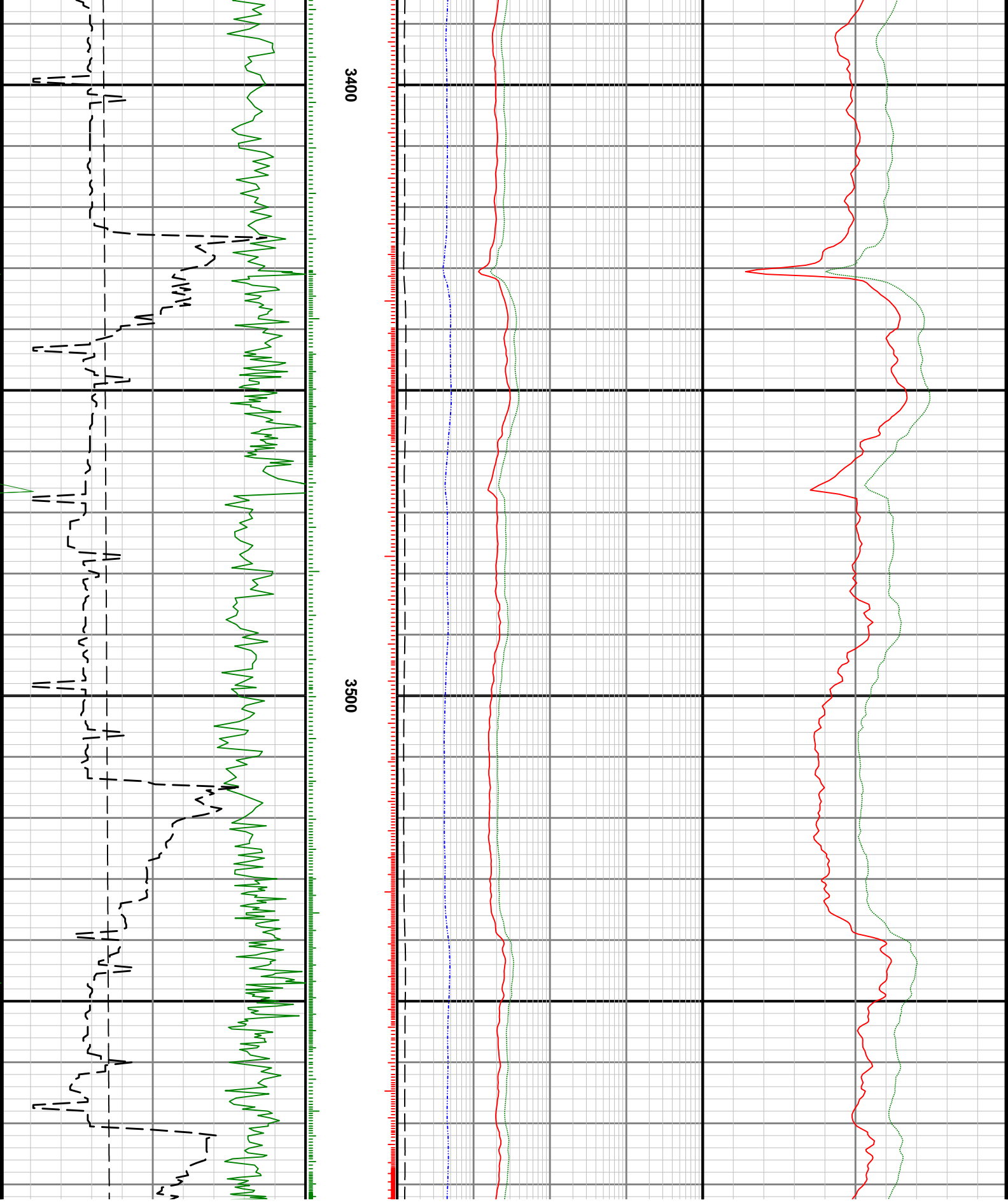


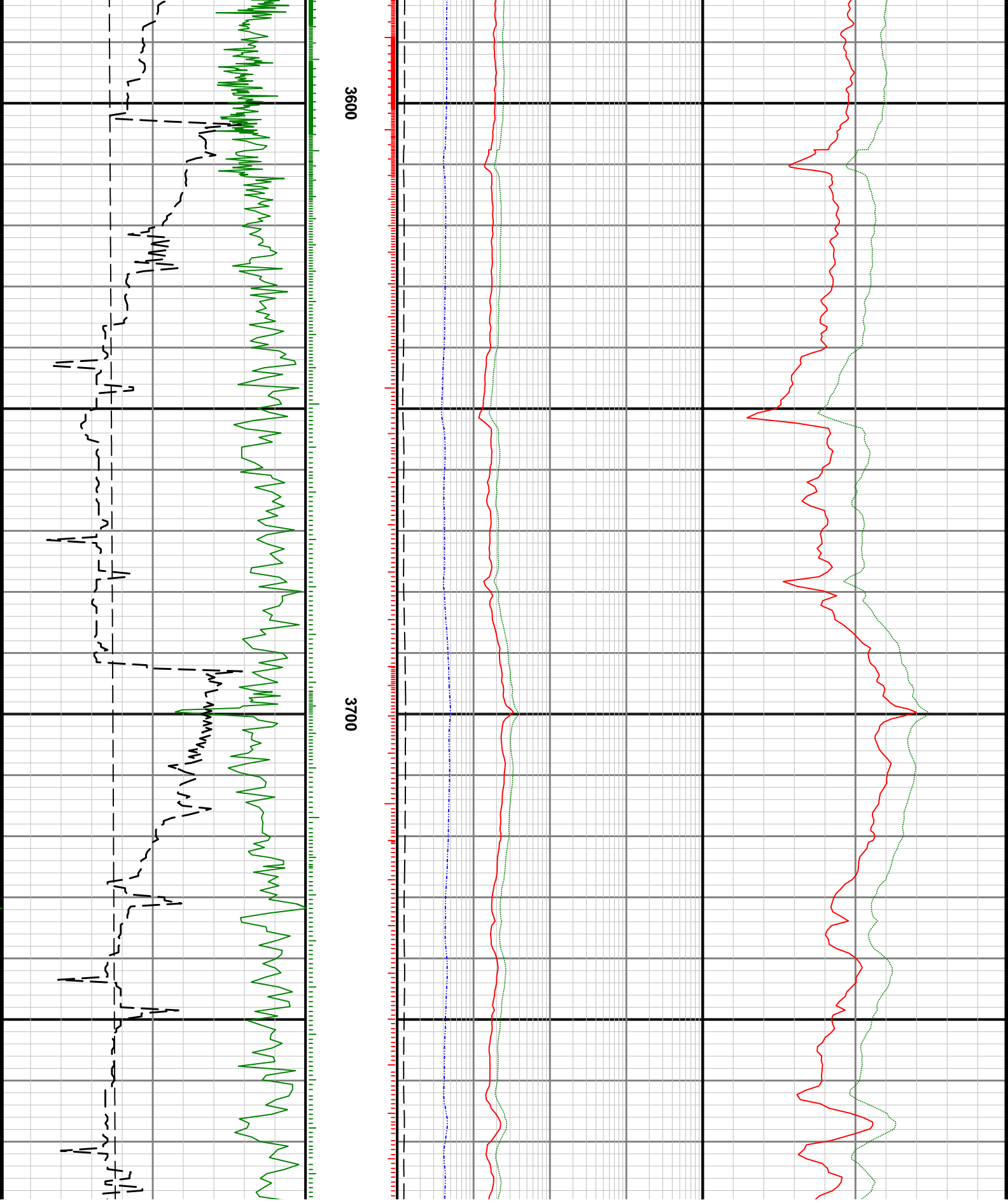


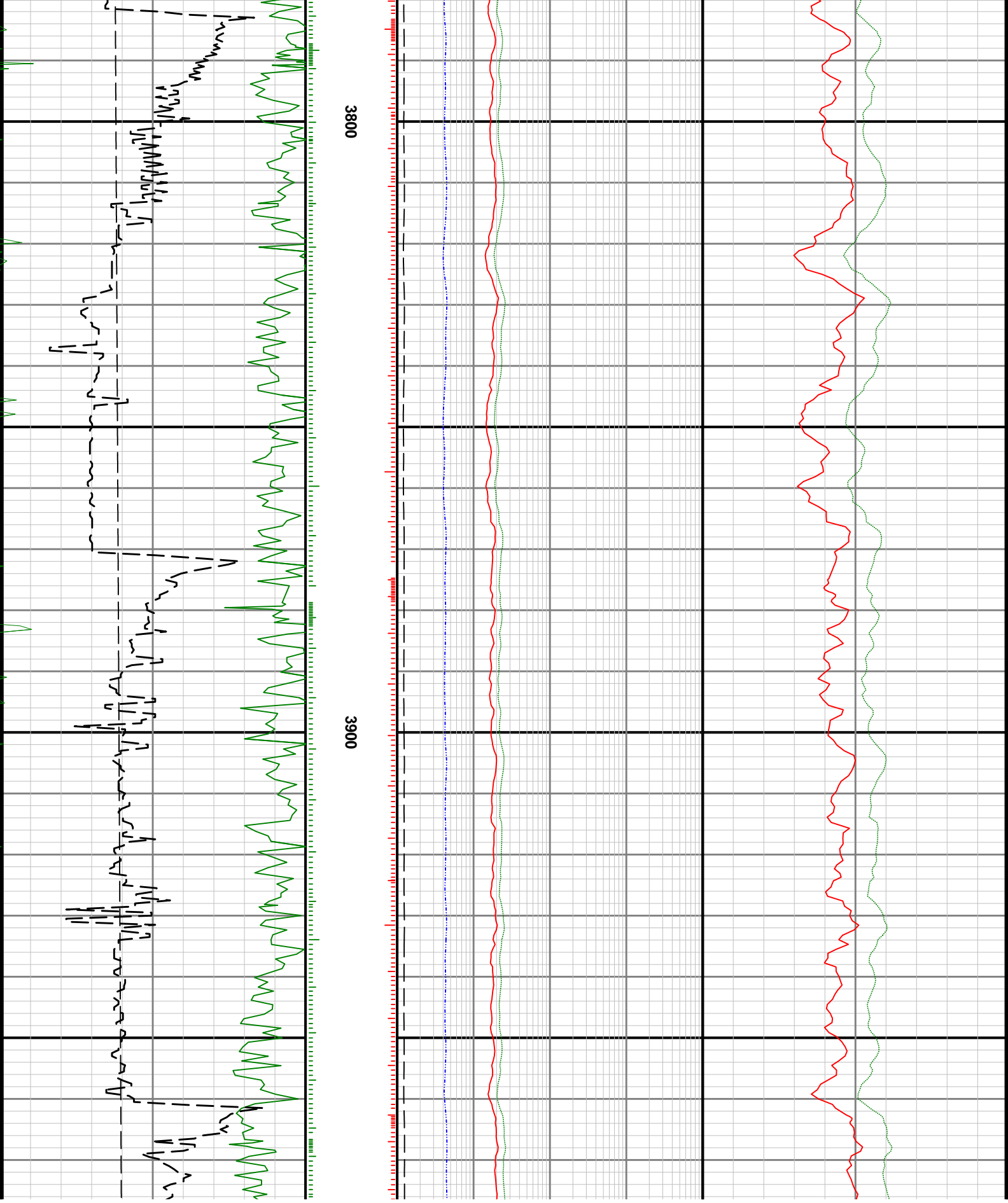


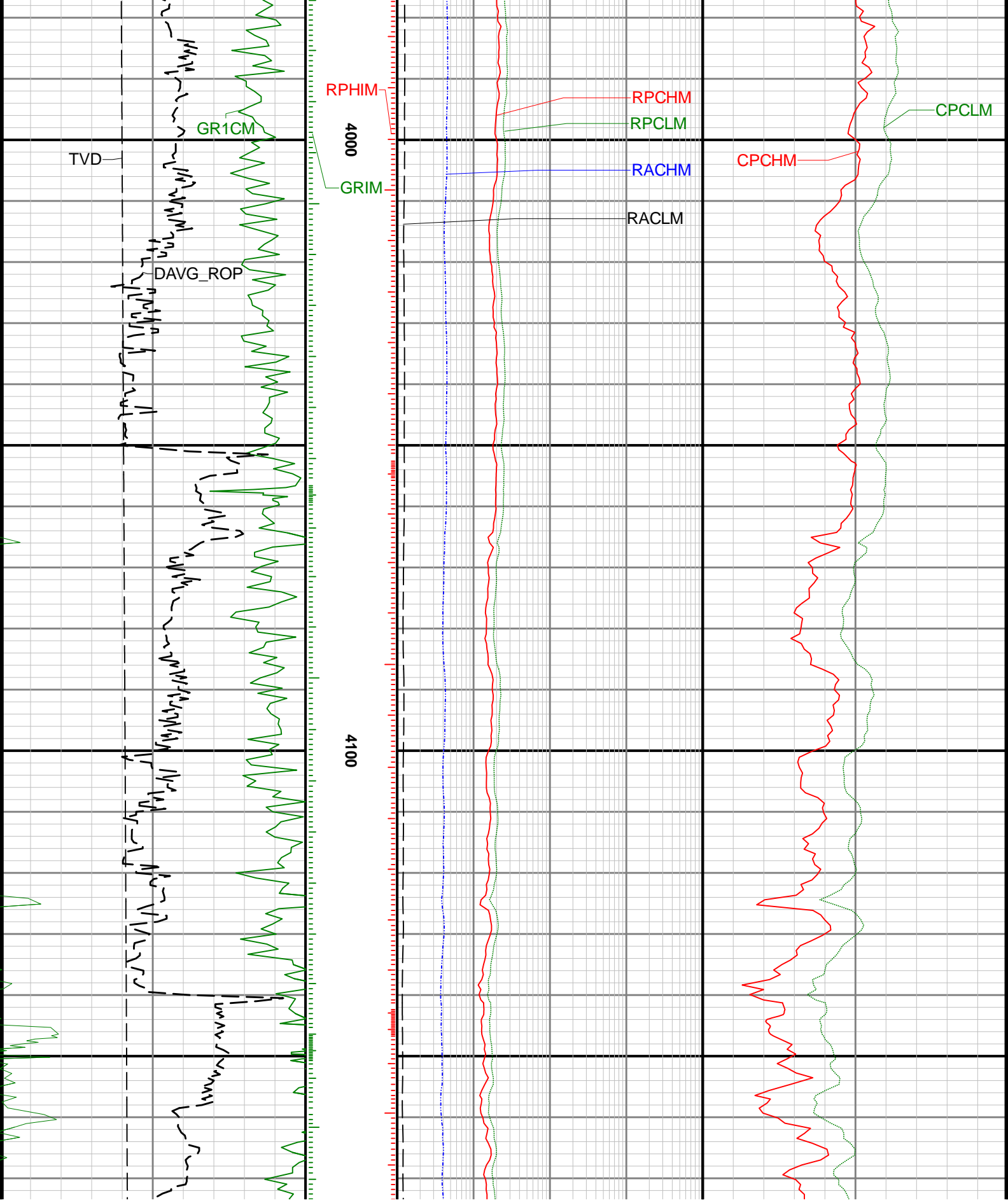


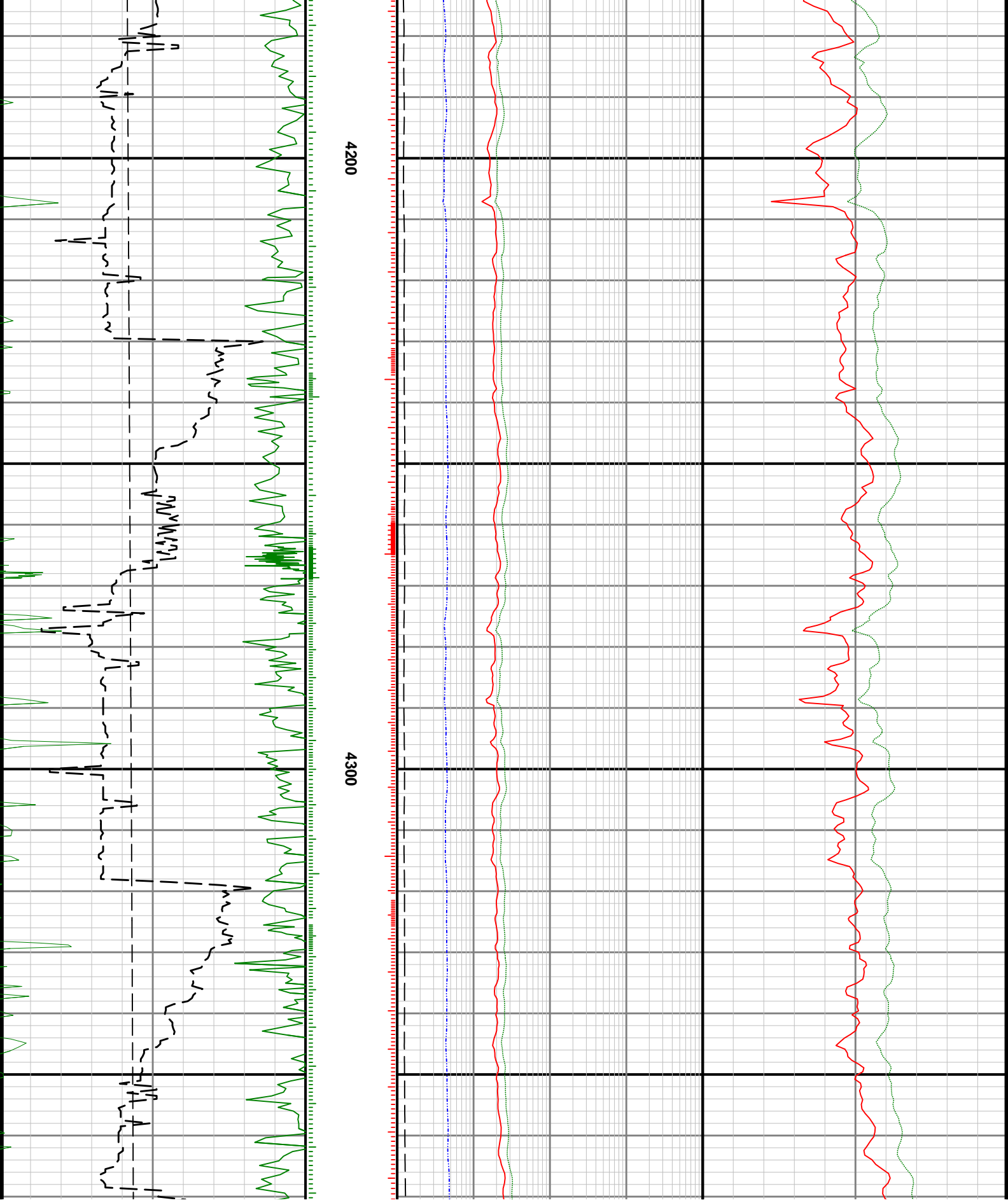


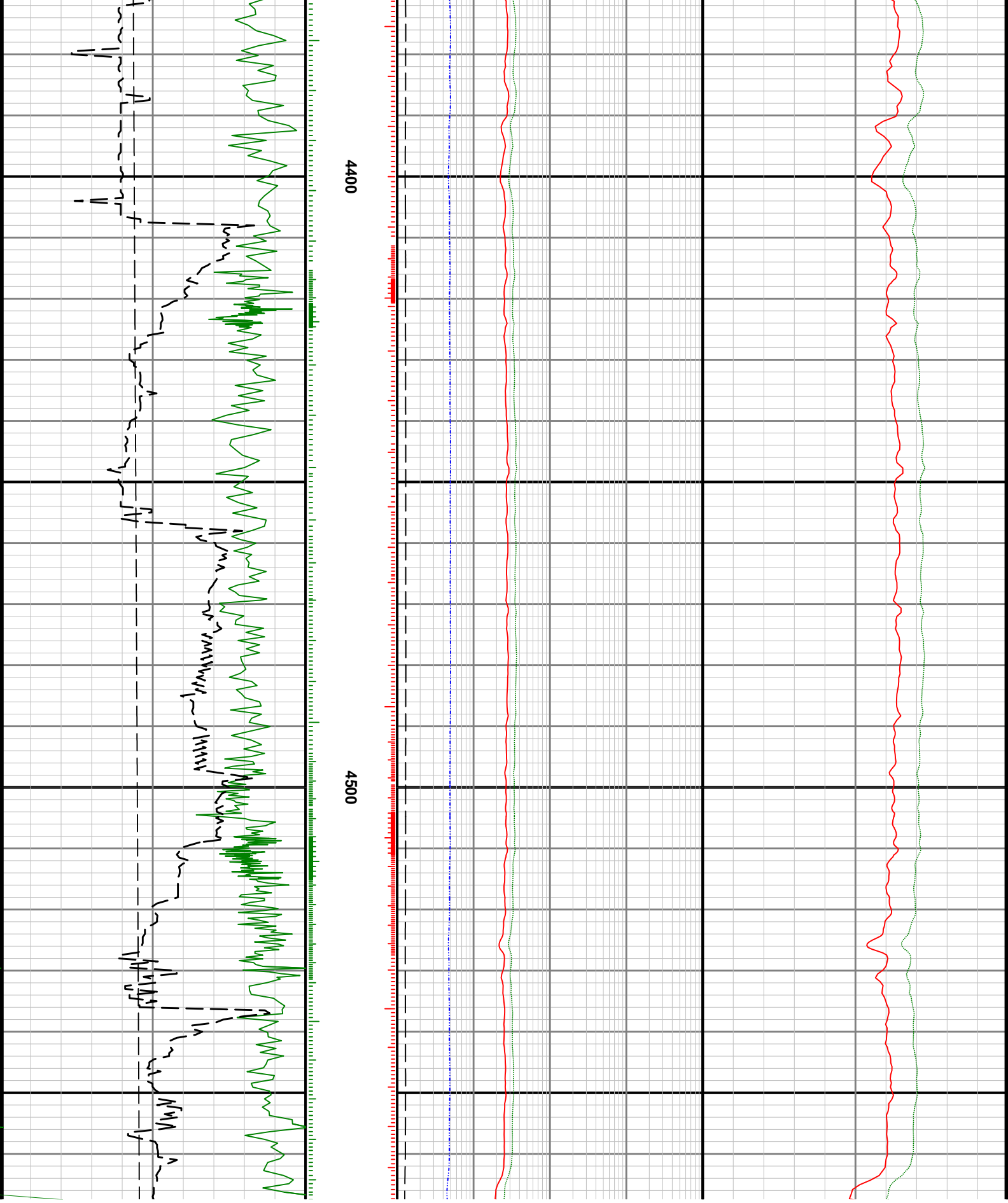


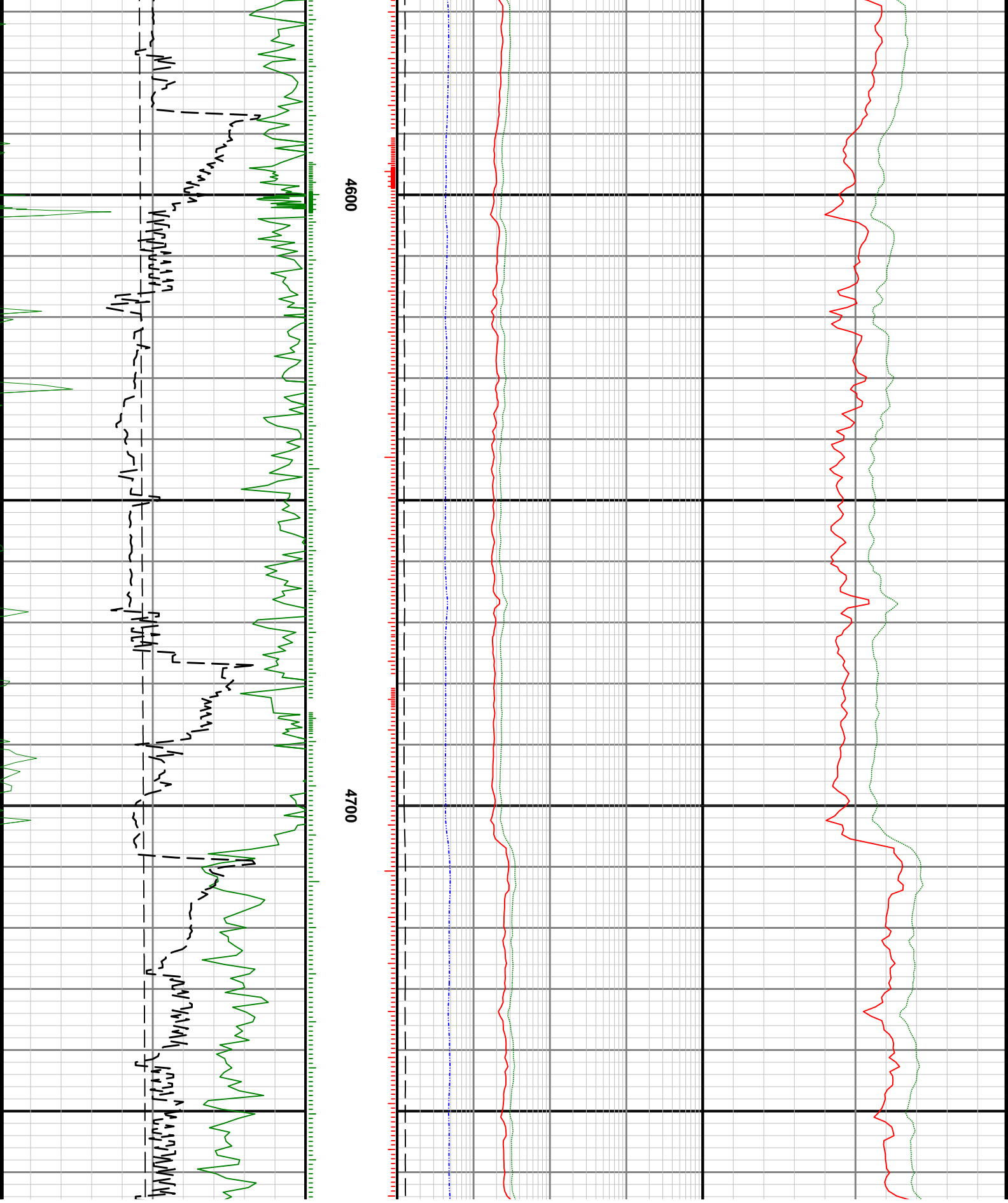


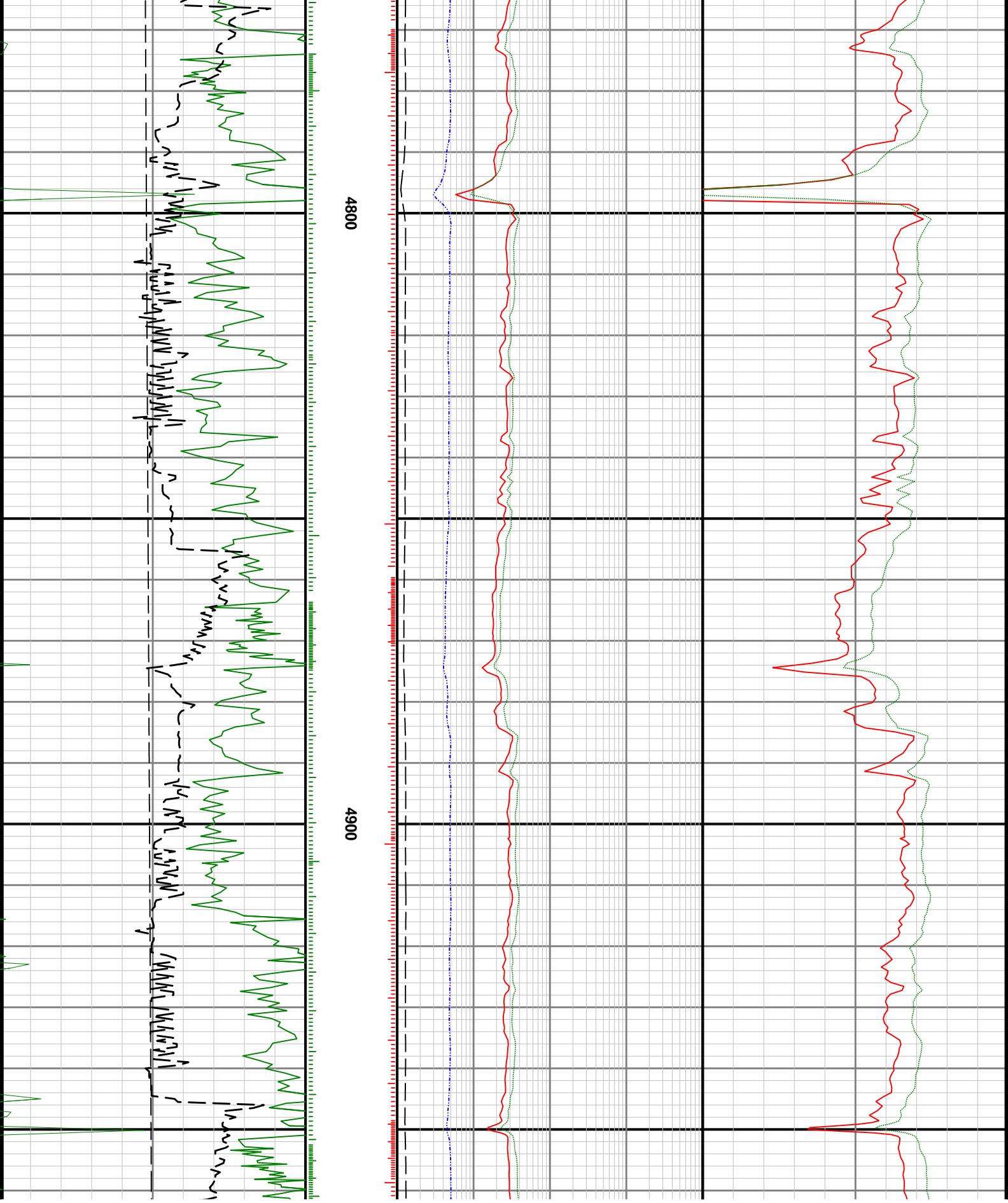


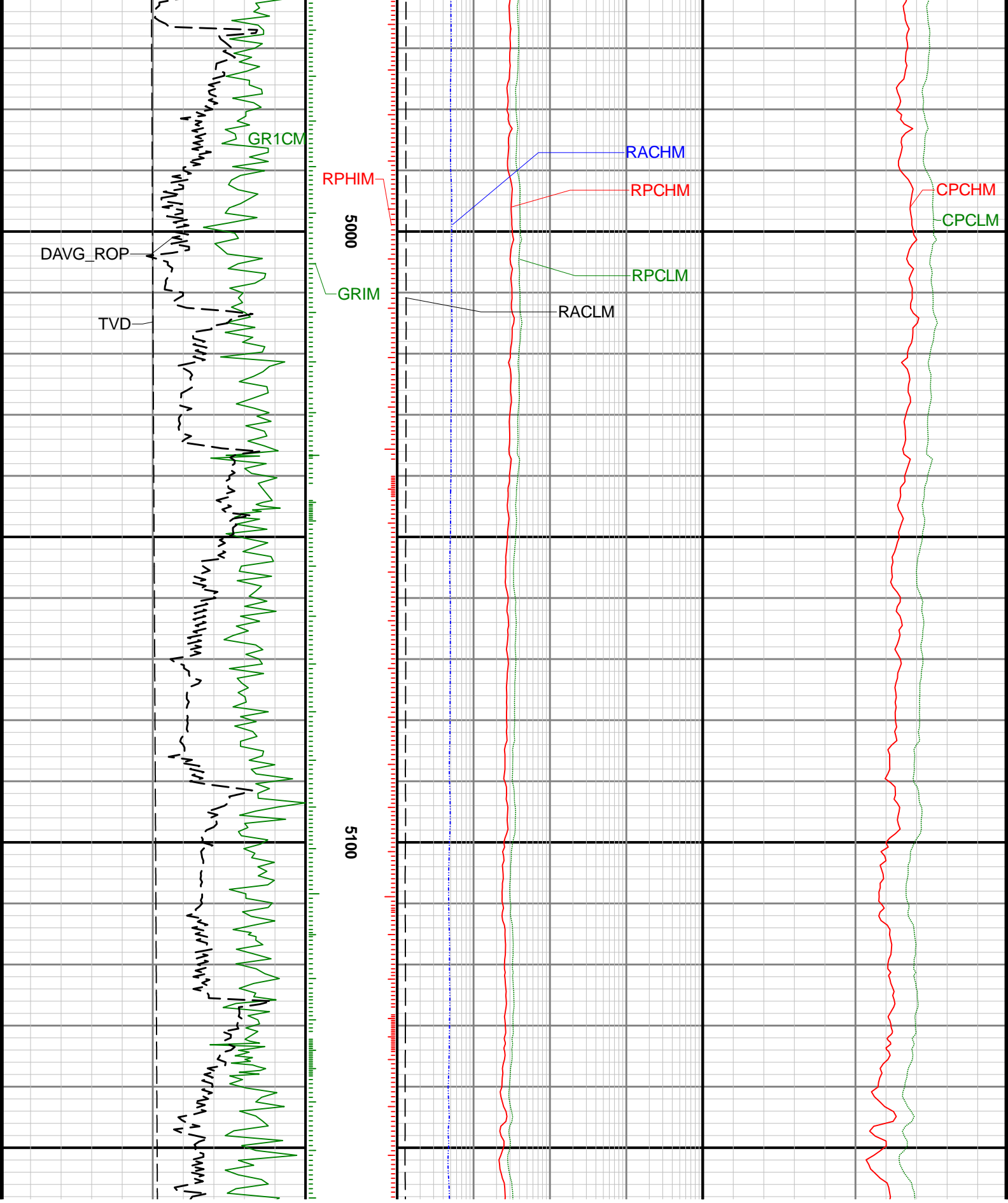


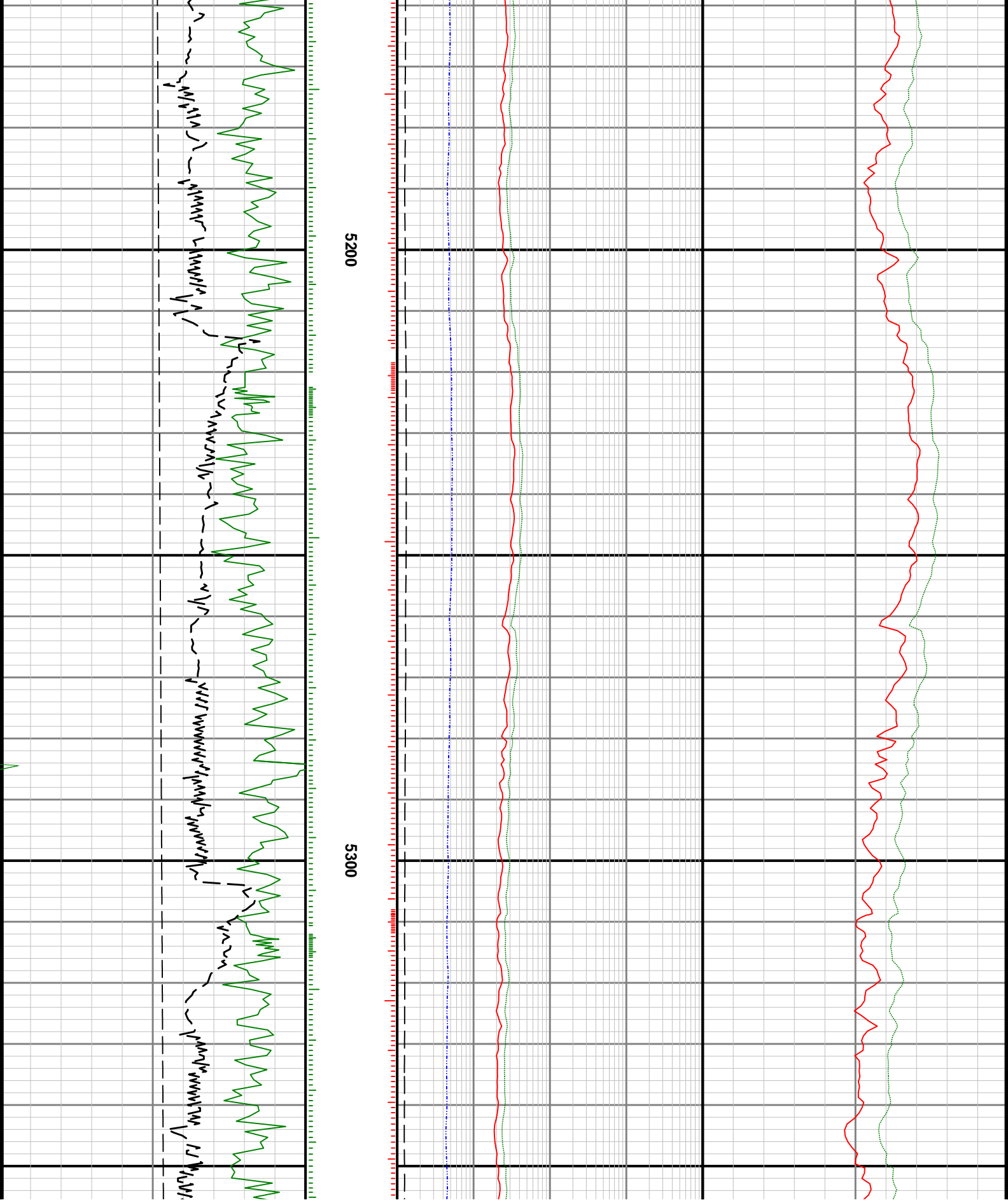


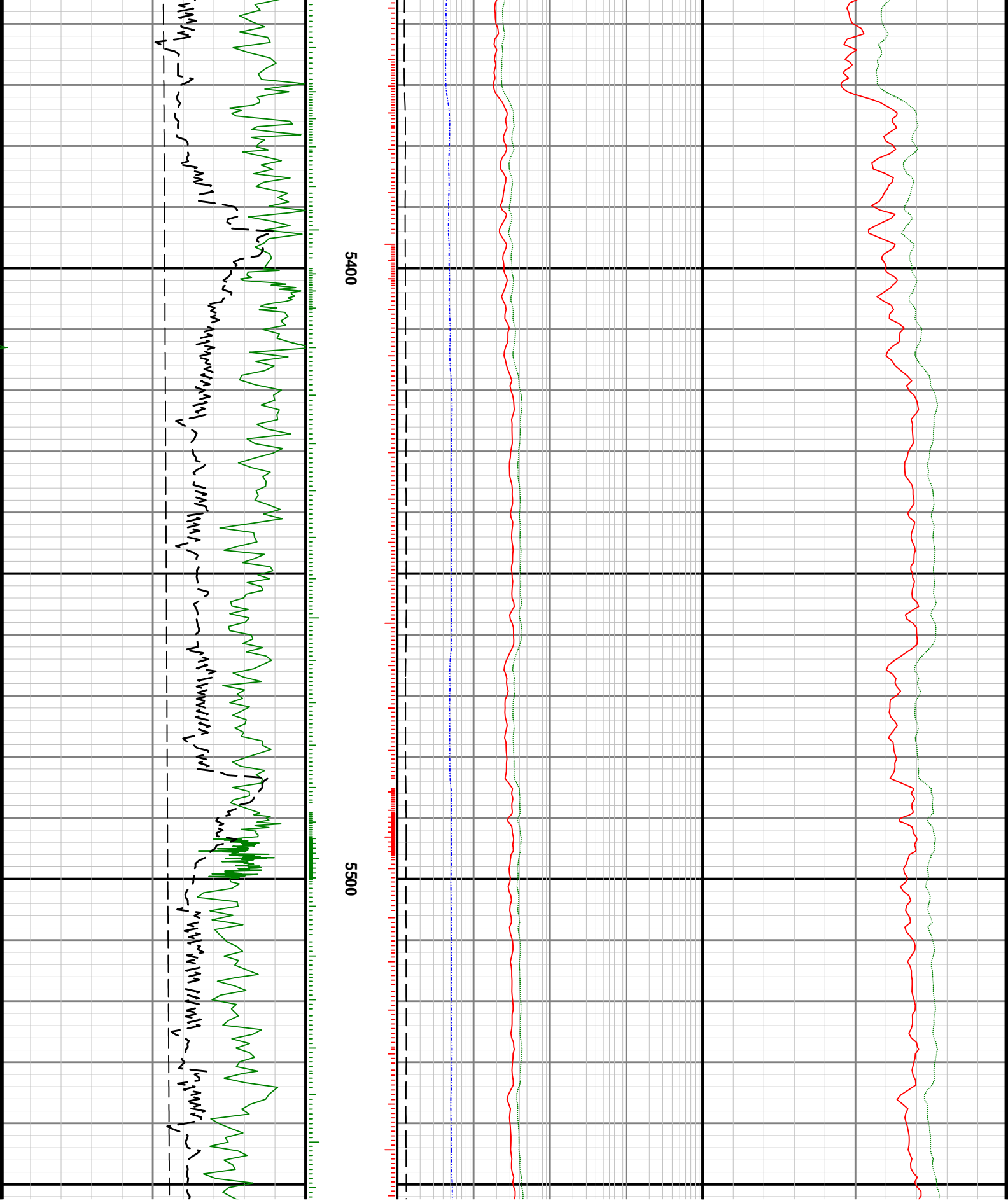


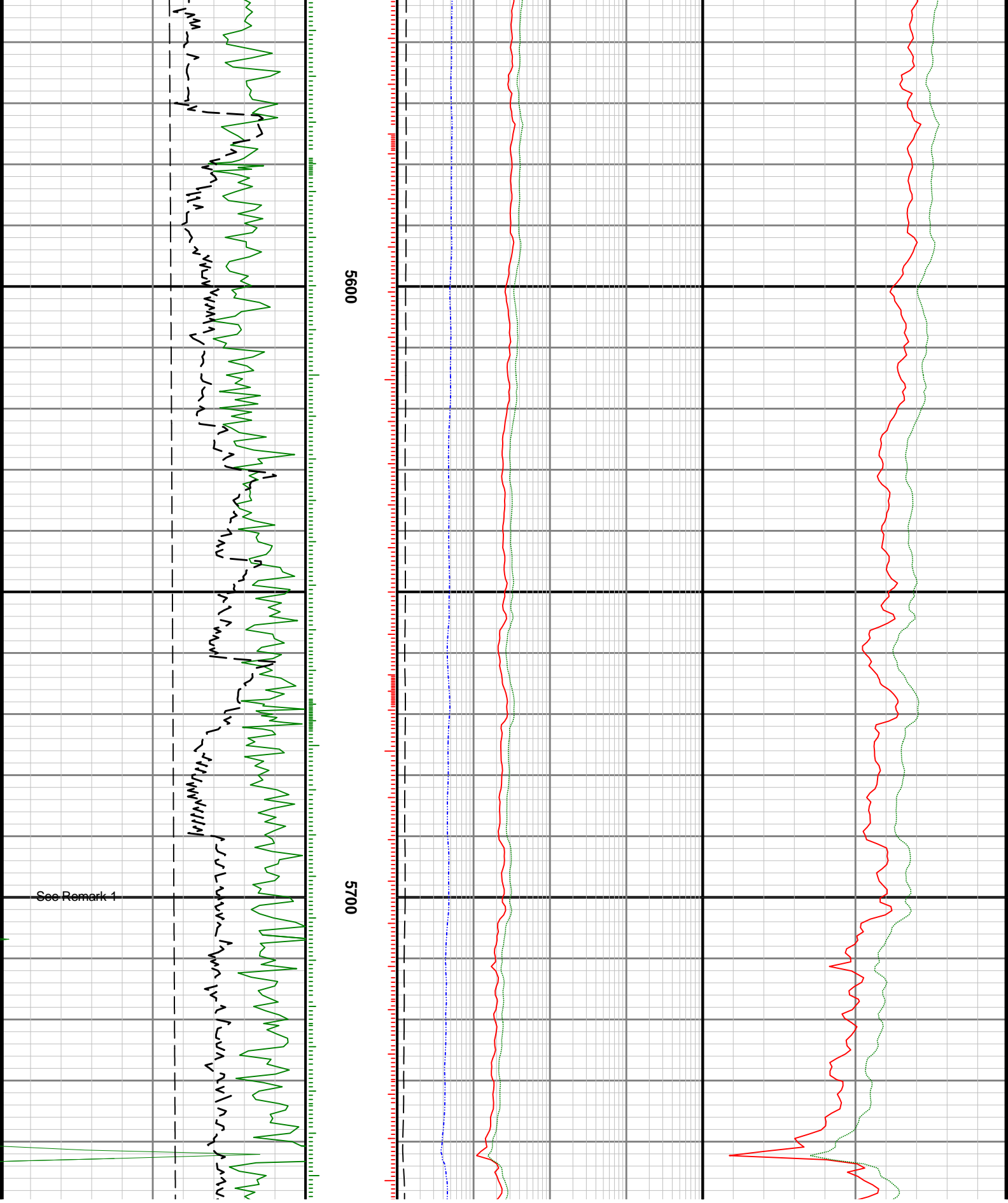








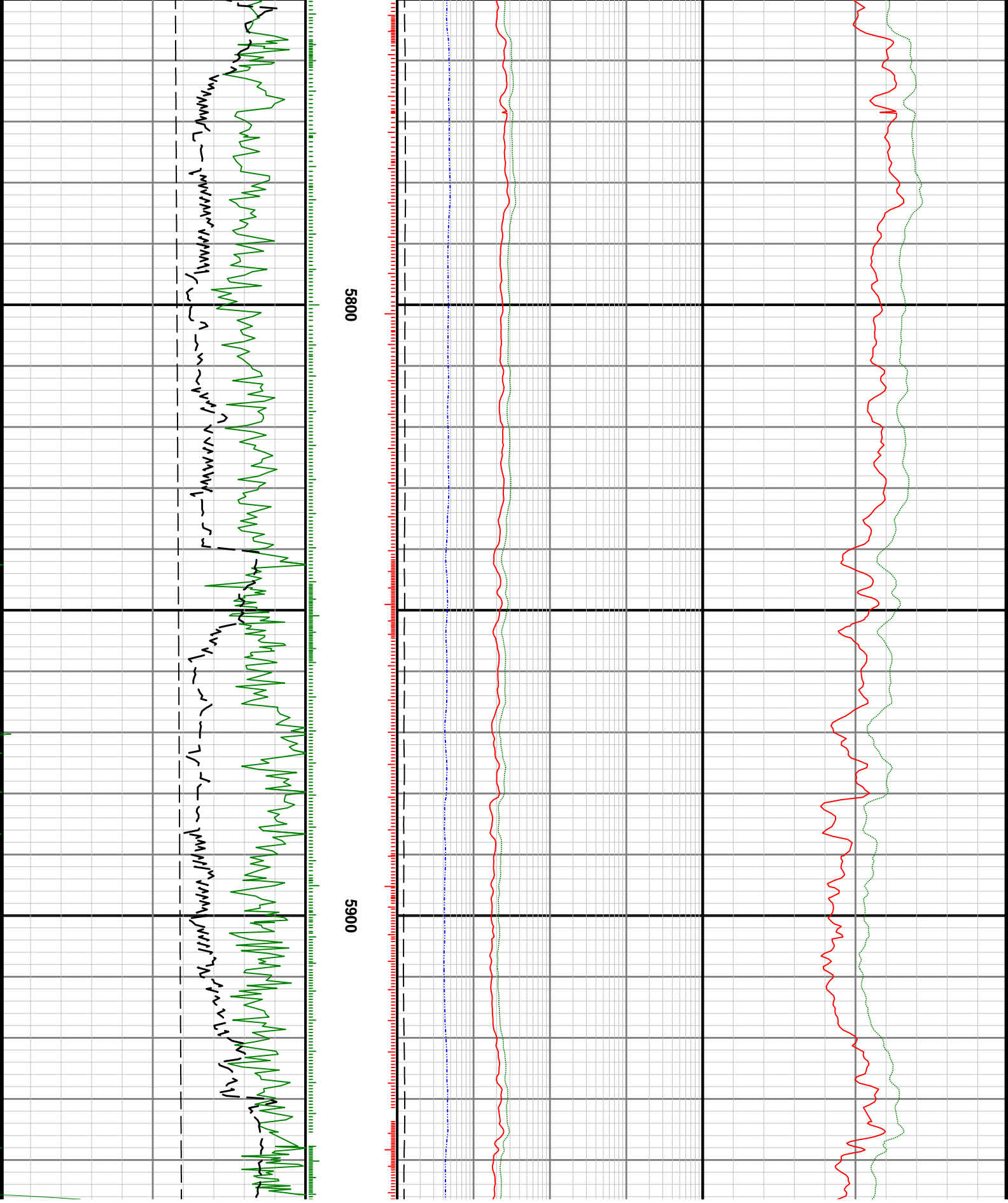




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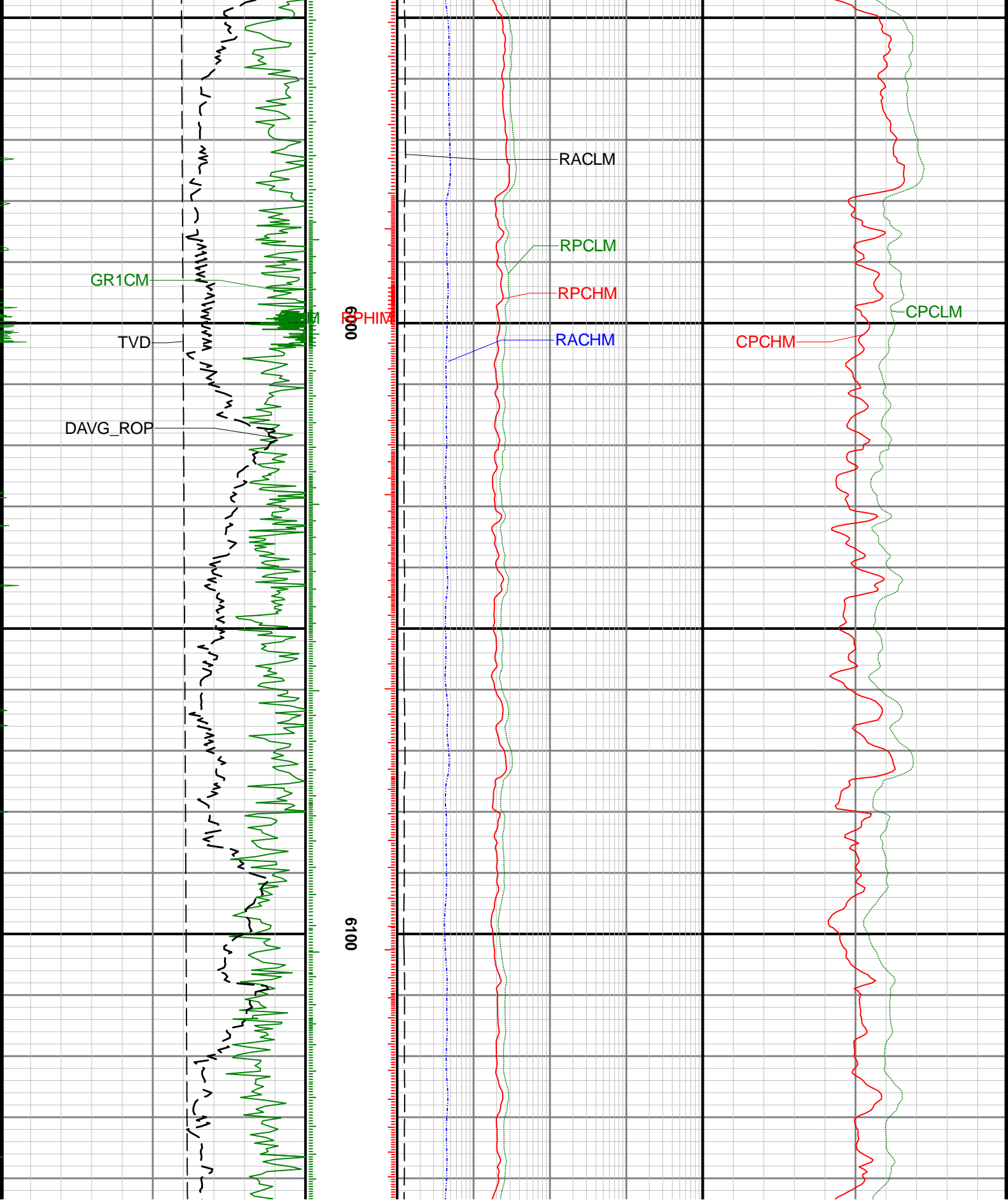
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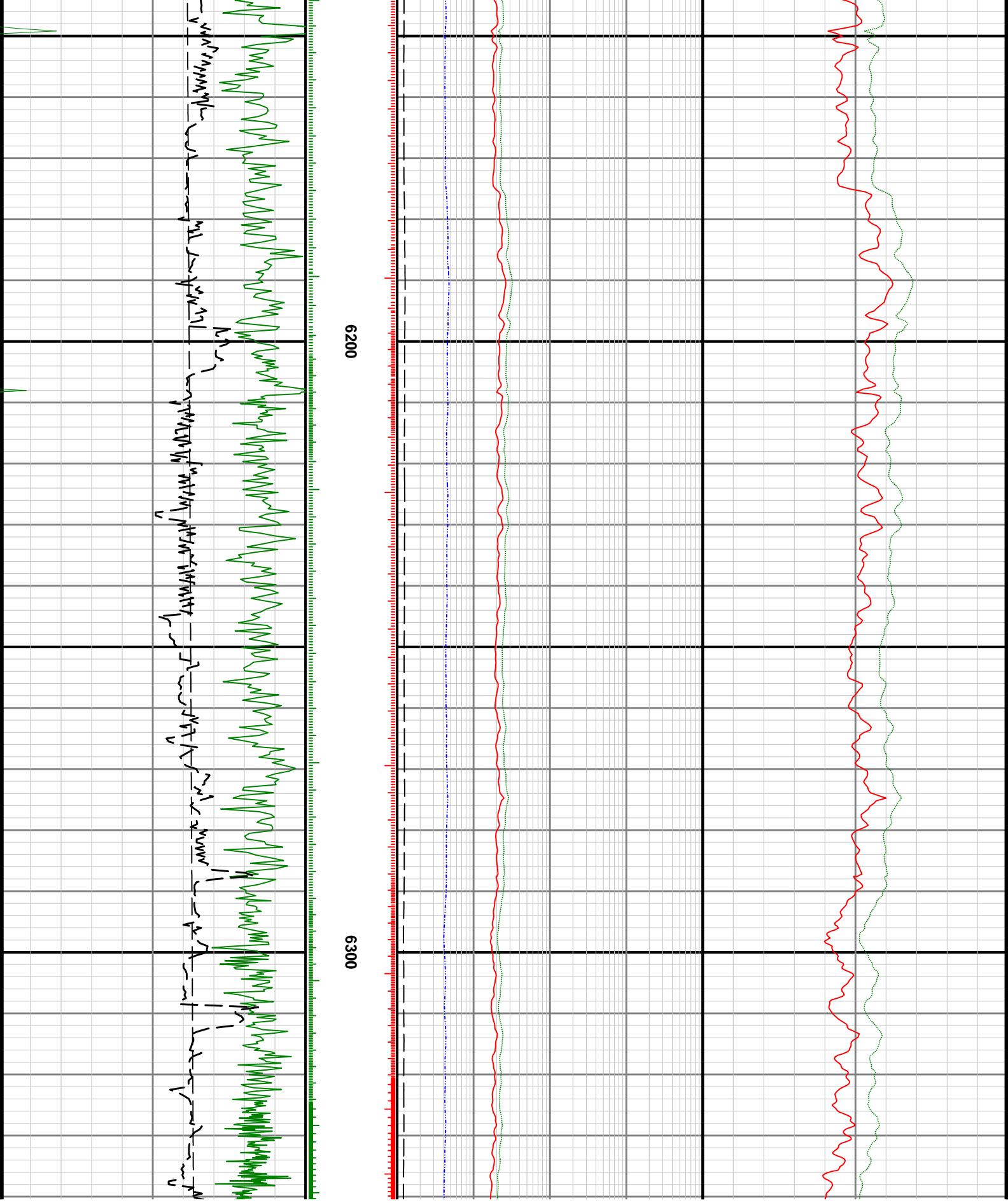
See Remark 1

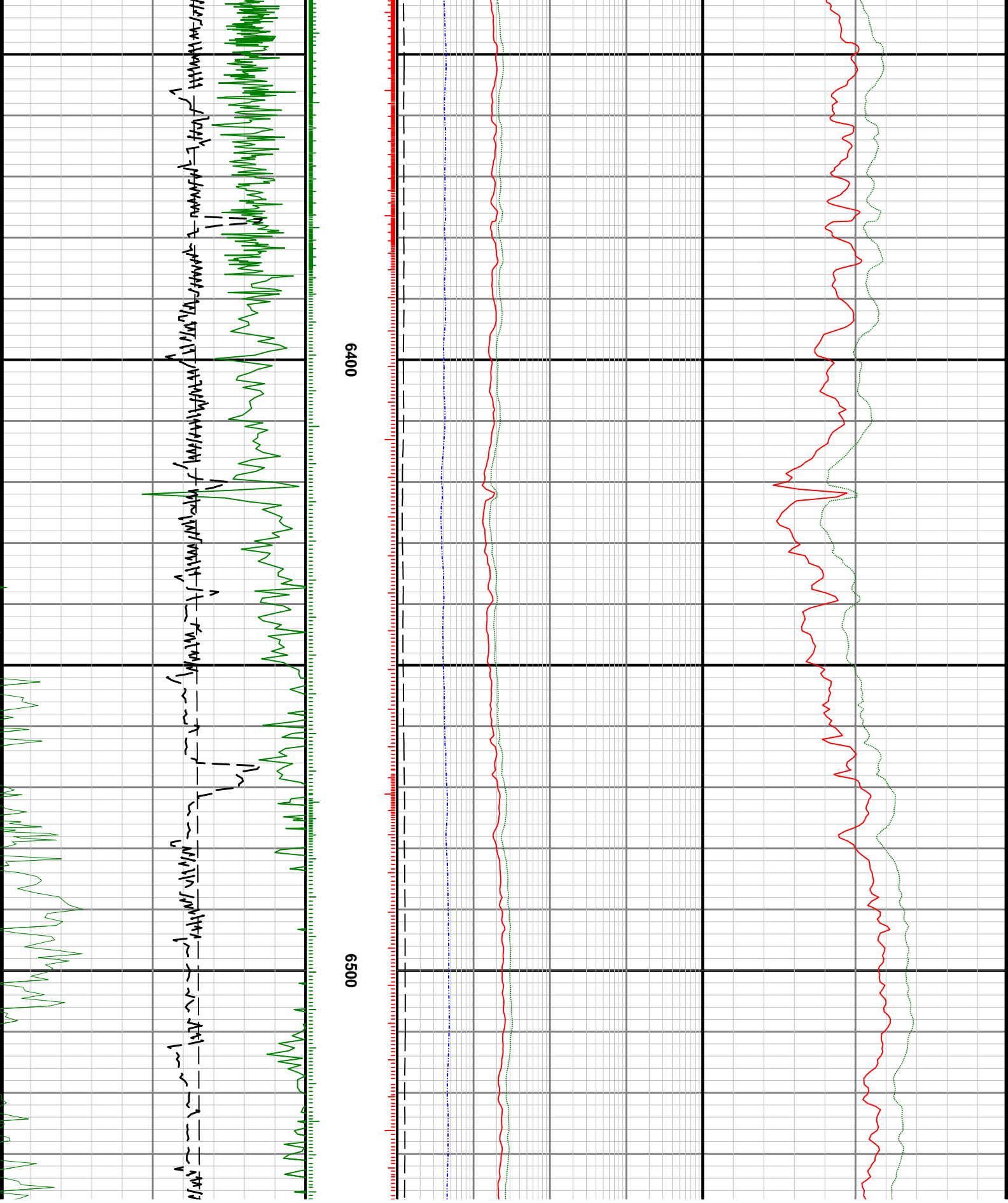


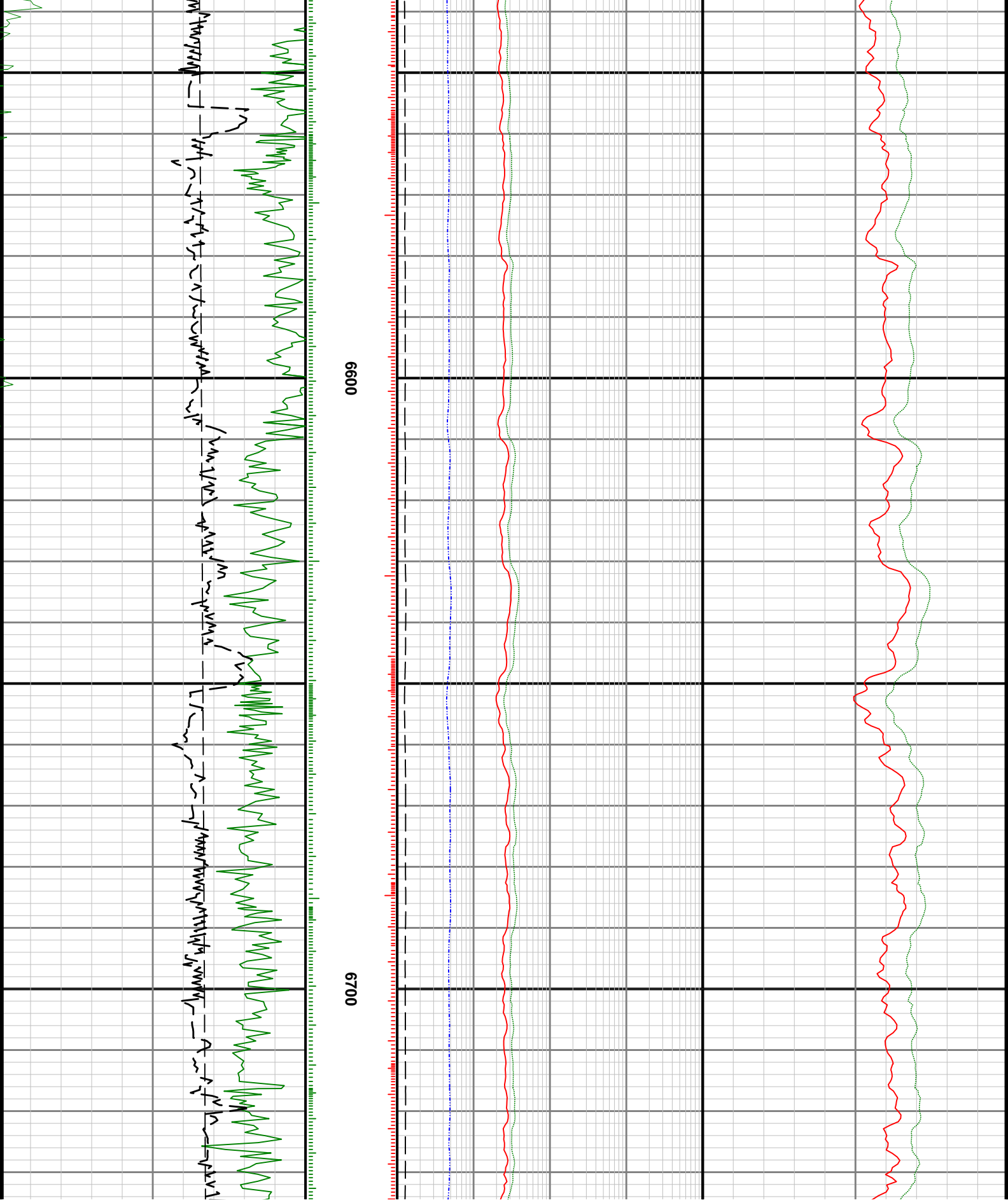
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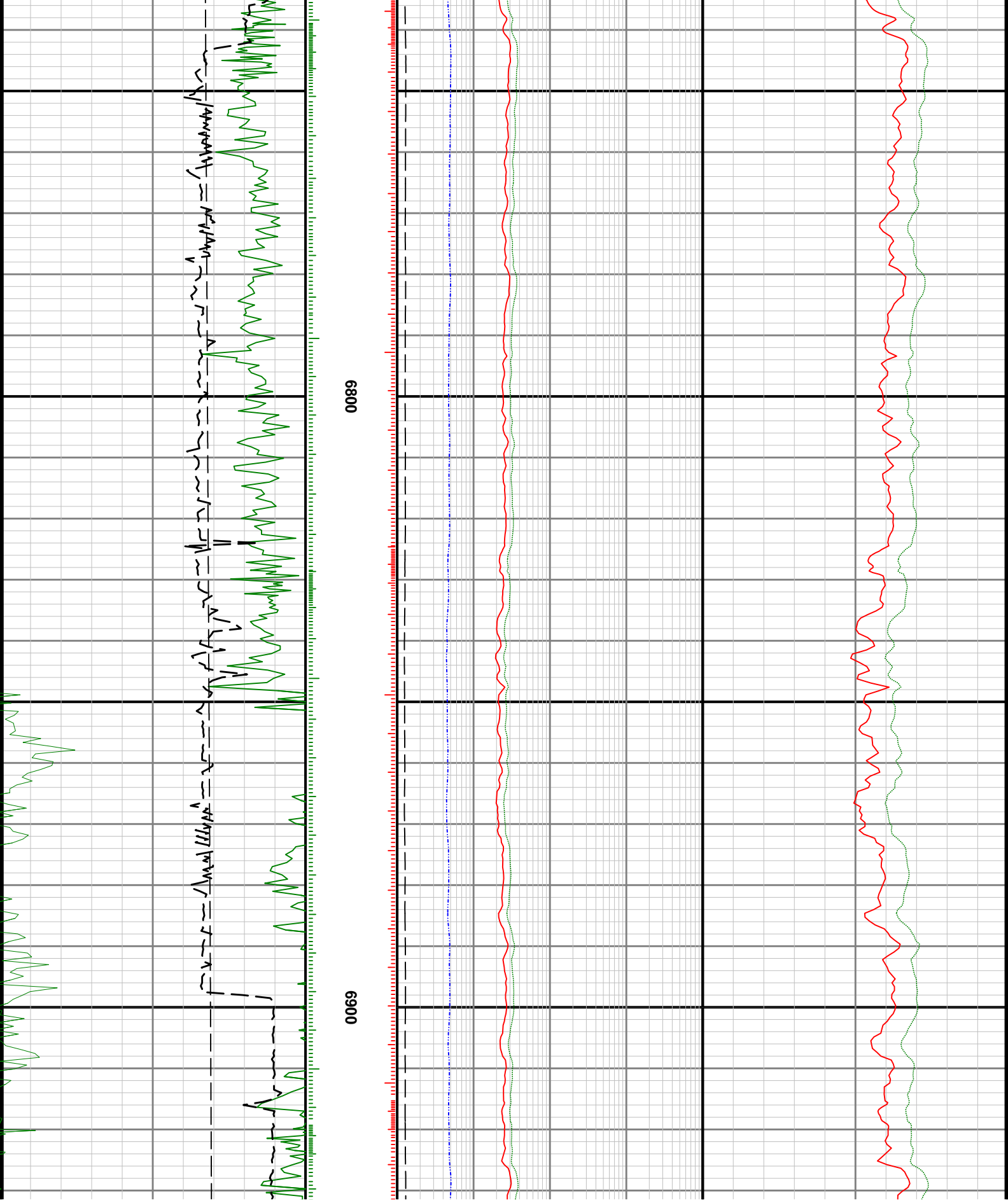
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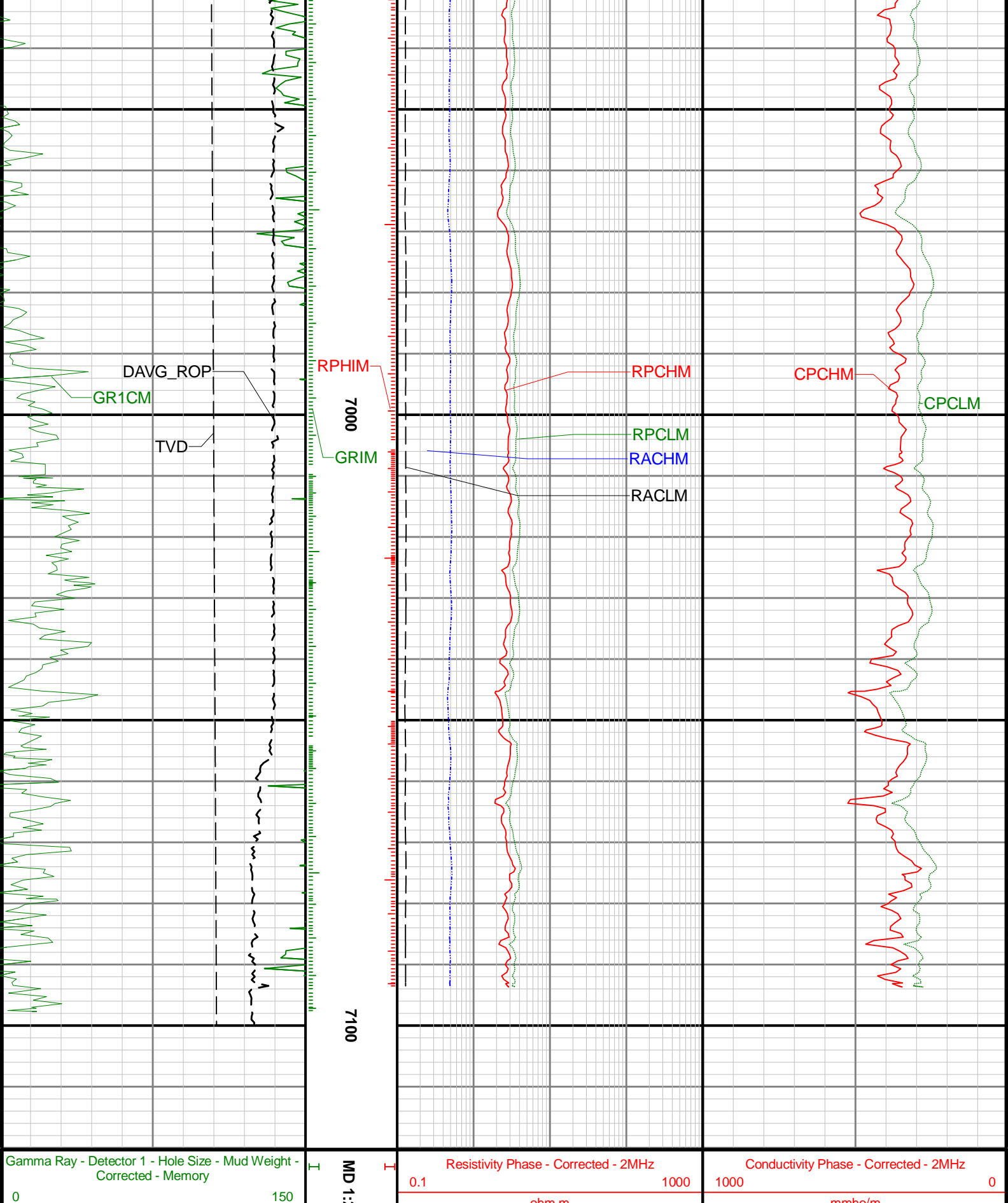


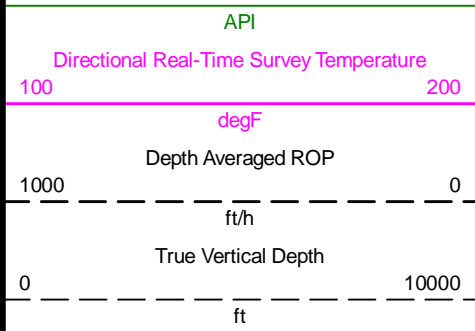




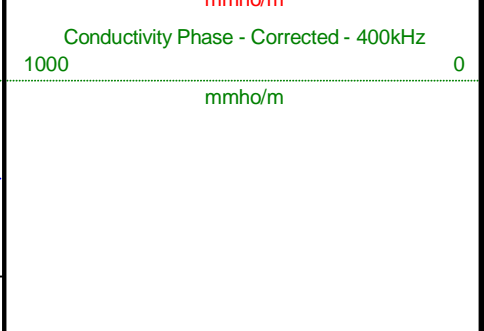
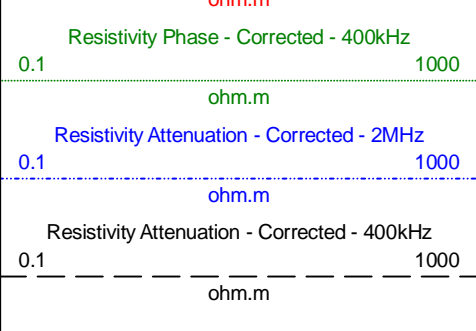








240 feet



### Gamma Ray Pre-run / Post-run Verification

Tool Size:	6.750	Tool Type:	OnTrak	Asset No:	13080165	Build No:	N/A
		<b>Sensor #1</b>				<b>Sensor #2</b>	
		<b>Background</b>	<b>Standard</b>	<b>Background</b>	<b>Standard</b>		
<b>Post-run</b>	<b>Pre-run</b>	<b>Date/Time</b>	<b>(cps)</b>	<b>Deviation</b>	<b>(cps)</b>	<b>Deviation</b>	
			0.1	10	0.1	10	

### Propagation Resistivity Primary Calibration Summary

Tool Size:	6.750	Tool Type:	OnTrak	Asset No:	13080165	Build No:	N/A	Date/Time:	2021-06-18 14:00
Firmware:	N/A	Location:	Ensign	Temp:	95.0	Unit:	Shop	Software:	N/A

2 MHz Air Offsets

	Transmitter 1	Transmitter 2	Transmitter 3	Transmitter 4
Phase R1 (deg)	-171.883730	-176.930010	-167.848820	-174.993060
Phase R2 (deg)	-167.075580	-174.069460	-163.016160	-170.119920
Attn. R1 (dB)	-0.542750	-1.058180	-0.636770	9.600020
Attn. R2 (dB)	2.193540	-1.164630	3.275290	3.124160
P. Diff T1 (deg)	-4.808150	2.860550	-4.832660	4.873140
Attn. T1 (dB)	2.736290	0.106450	3.912060	6.475860
CP T1T2 (deg)	-0.973800	CA T1T2 (dB) 1.421370	CP T3T4 (deg) 0.020240	CA T3T4 (dB) 5.193960
	-0.25 0.25	5.30 5.70	0.10 0.60	8.30 8.70

400 kHz Air Offsets

	Transmitter 1	Transmitter 2	Transmitter 3	Transmitter 4
Phase R1 (deg)	166.063540	168.519270	-176.565870	-176.584050
Phase R2 (deg)	166.370010	169.596080	-175.684830	-176.024260
Attn. R1 (dB)	-0.553100	-1.101350	-0.666900	9.254720
Attn. R2 (dB)	1.922440	-1.174450	2.985360	2.700930
P. Diff T1 (deg)	-0.306470	1.076810	-0.881040	0.559790
Attn. T1 (dB)	2.475540	0.073100	3.652260	6.553790
CP T1T2 (deg)	0.385170	CA T1T2 (dB) 1.274320	CP T3T4 (deg) -0.160625	CA T3T4 (dB) 5.103025
	-0.25 0.25	5.30 5.70	-0.25 0.25	8.30 8.70