



# LWD MEMORY LOG

# Gamma Ray

Scale:	Company: Noble Energy														
	Well: Wells Ranch State AA32-745														
1:240		Field: Wattenberg													
Measured Depth		County:		Weld		Country: United States									
Depth Reference:		State:		Colorado											
Driller's Depth															
Status:		Surface Location:					Other Services:								
Final Print		Latitude: 40° 26' 05.568" N					Directional								
API No: 05-123-50172-00		Longitude: 104° 27' 43.344" W													
Job ID: 110158025		SEC:		5 TWN:		5N RGE:		63W							
Permanent Datum (P.D.):		Mean Sea Level		Elevation:		0.00 ft		Elev. KB:		N/A					
Log Measured From:		Rig Floor		Above P.D.:		4715.00 ft		Elev. DF:		4715.00 ft					
								Elev. GL:		4685.00 ft					
Dates		Interval				Magnetic Field Reference									
From: 2019-12-03		Drilled (ft)		Logged (ft)		Azi Reference North: Grid Dip Angle: (deg) 66.93									
To: 2019-12-04		Top: 1952.00		Top: 1952.00		Total Magnetic Field Strength: (nT) 52079									
Spud: 2019-11-28		Bottom: 17198.00		Bottom: 17185.00		Mag to Reference North Correction: (deg) 7.10									
Borehole Record												Casing Record			
Hole Size (in)		From (ft)		To (ft)		Size (in)		Weight (lb/ft)		From (ft)		To (ft)			
13.500		30.00		1952.00		9.625		36.00		30.00		1942.00			
8.500		1952.00		17198.00											
Mud Record												Deviation Record			
Type		From (ft)		To (ft)		Hole Size (in)		Interval (ft)		Inc   Az (Start)		Inc   Az (End)			
Oil Based Mud		1952.00		17198.00		8.500		15246.00		1.71   283.29		89.78   0.32			
Acquisition System												Software Version		Other	
Cadence		RT 5.4				Rig:		H&P 517		Contractor:		Helmerich & Payne Drilling Co			
Prior Studio		5.4.8632.4				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	Bottom	From	To	Start Logging	End Logging	
						(ft)	(ft)	(ft)	(ft)			
1	1	8.500	PDC	3.00	Rotary Steerable	1952.00	2318.00	1952.00	2331.00	2019-11-29 10:25	2019-11-29 17:30	7.60
2	2	8.500	PDC	3.00	Rotary Steerable	2318.00	15007.00	2331.00	15020.00	2019-11-29 22:15	2019-12-02 00:00	44.92
3	3	8.500	PDC	2.50	Rotary Steerable	15007.00	17185.00	15020.00	17198.00	2019-12-02 16:00	2019-12-03 01:20	11.73

## Crew

Name	Arrive Wellsite	Depart Wellsite	Name	Arrive Wellsite	Depart Wellsite	Name	Arrive Wellsite	Depart Wellsite
Adam Schlenz	2019-11-27	2019-12-03						

## 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+ (%)
2019-11-29 04:00	1	1952.00	Oil Based Mud	9.5	15	N/A	22.4	70.5/17.5	Active Pit	27211	0.00
2019-11-29 16:00	1	2295.00	Oil Based Mud	9.3	14	N/A	18.0	68/21.5	Active Pit	29923	0.00
2019-11-30 04:00	2	4487.00	Oil Based Mud	9.2	17	N/A	19.5	66.5/24.5	Active Pit	33557	0.00
2019-11-30 16:00	2	6471.00	Oil Based Mud	9.0	13	N/A	18.6	72/20	Active Pit	29923	0.00
2019-12-01 04:00	2	9670.00	Oil Based Mud	9.4	13	N/A	17.5	69.5/21	Active Pit	31853	0.00
2019-12-01 16:00	2	13262.00	Oil Based Mud	9.4	13	N/A	18.0	71/19	Active Pit	28958	0.00
2019-12-02 04:00	3	15020.00	Oil Based Mud	9.5	12	N/A	17.5	71.5/17	Active Pit	26239	0.00
2019-12-02 16:00	3	15020.00	Oil Based Mud	9.5	13	N/A	18.0	72/17	Active Pit	26239	0.00

## Equipment and Service Data

Run No	Tool	Serial Number	Measurement	Sensor Offset	Bit Offset	Max O.D.	Min I.D.
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No.	Number			Onset (ft)	Onset (ft)	O.D. (in)	I.D. (in)
1	AutoTrak Curve Steering Unit	14236913	Near Bit Inclination	5.93	6.73	7.000	4.330
1	AutoTrak Curve Steering Unit	14236913	Near Bit VSS	5.93	6.73	7.000	4.330
1	AutoTrak Curve MWD	12304740	Gamma (single)	2.76	12.91	7.000	3.250
1	AutoTrak Curve MWD	12304740	Directional (mag)	12.27	22.42	7.000	3.250
2	AutoTrak Curve Steering Unit	13867779	Near Bit Inclination	5.93	6.73	7.000	4.330
2	AutoTrak Curve Steering Unit	13867779	Near Bit VSS	5.93	6.73	7.000	4.330
2	AutoTrak Curve MWD	12271546	Gamma (single)	2.75	12.90	7.000	3.250
2	AutoTrak Curve MWD	12271546	Directional (mag)	12.27	22.42	7.000	3.250
3	AutoTrak Curve Steering Unit	11747241	Near Bit Inclination	5.93	6.73	7.000	4.330
3	AutoTrak Curve Steering Unit	11747241	Near Bit VSS	5.93	6.73	7.000	4.330
3	AutoTrak Curve MWD	12168856	Gamma (single)	2.76	12.90	7.000	3.250
3	AutoTrak Curve MWD	12168856	Directional (mag)	12.27	22.41	7.000	3.250

Service and Tool Mnemonics

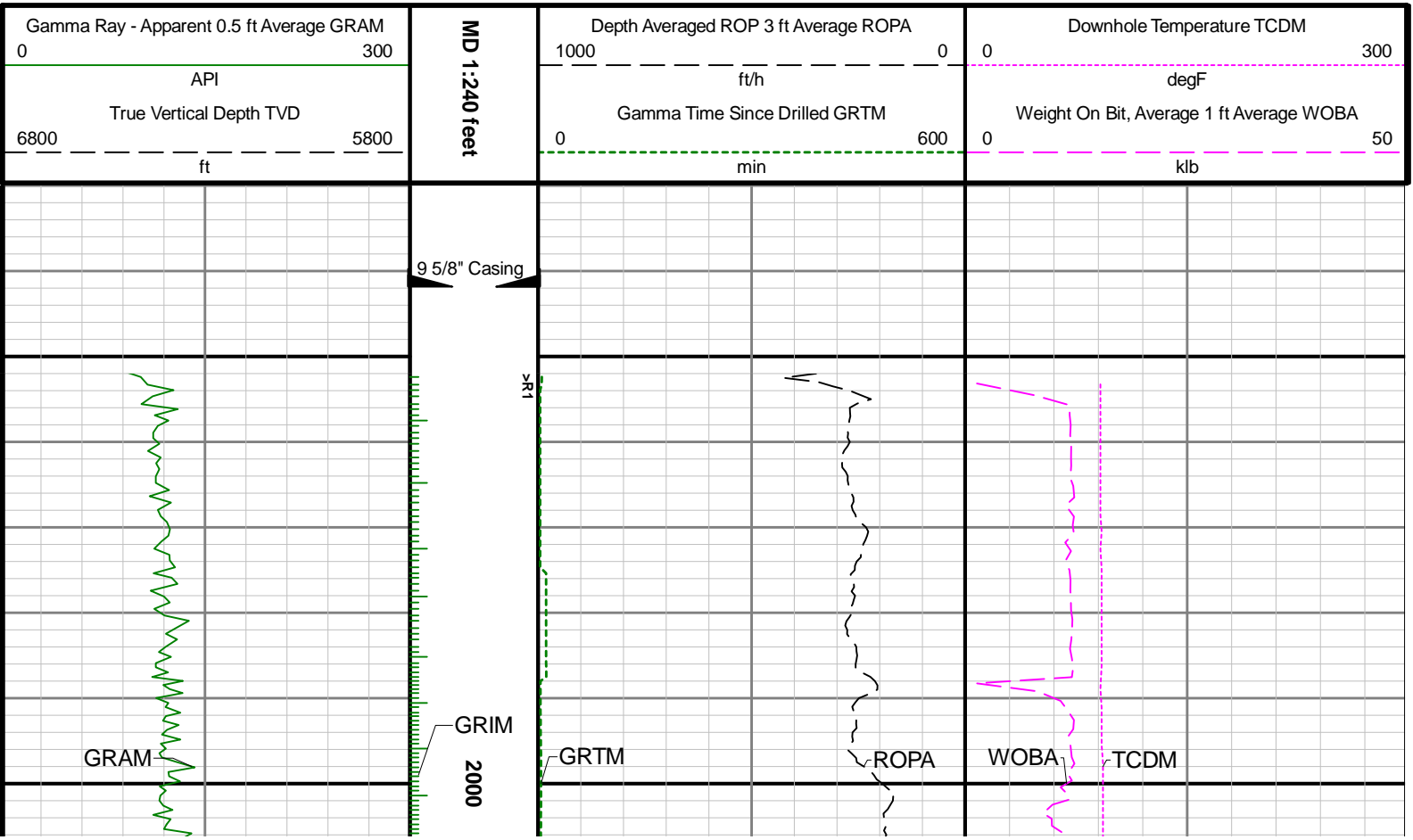
Mnemonic	Name	Description
ATC SU	AutoTrak Curve SU	Auto Trak Curve Steering Unit
ATC MWD	AutoTrak Curve MWD	Auto Trak Curve MWD
ATC LCPM	AutoTrak Curve LCPM	Auto Trak Curve LCPM

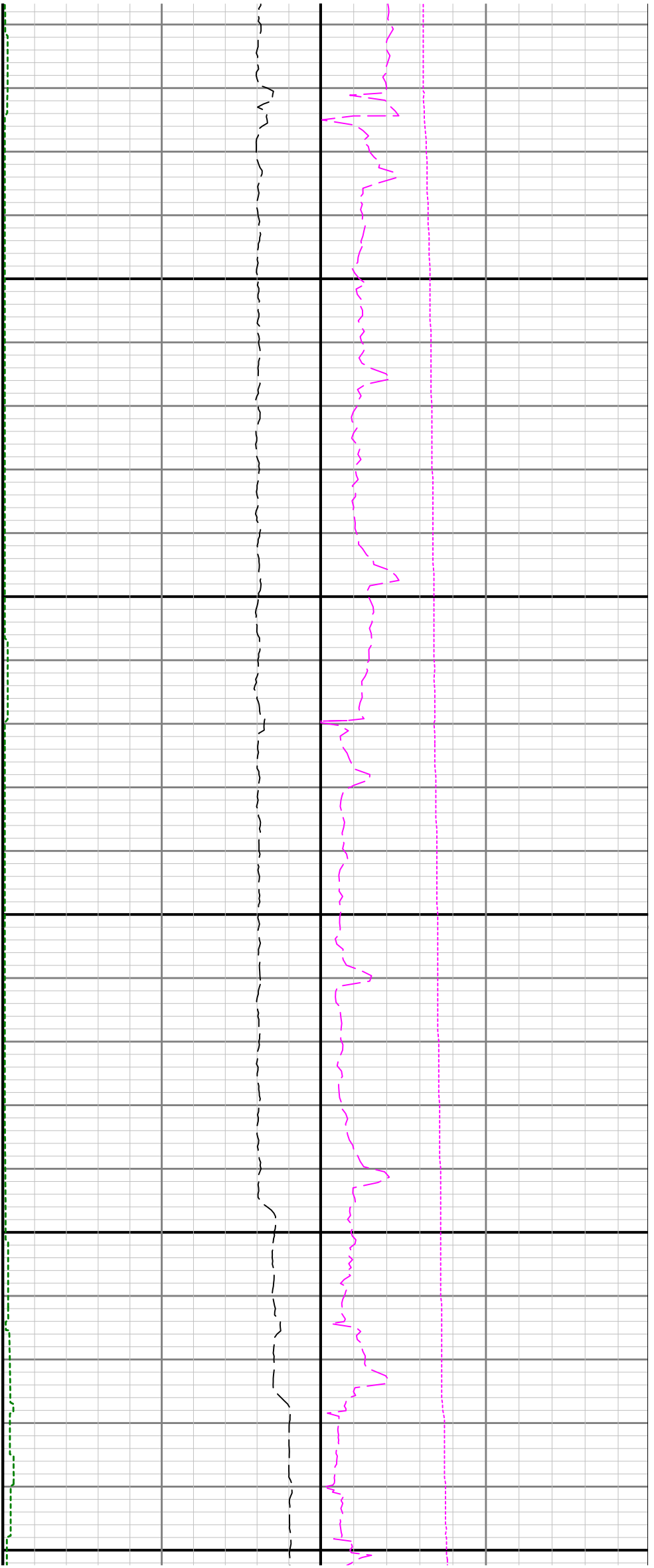
Comments

1	Depth measurements were obtained from a depth control system not supplied or operated by Baker Hughes. Due to the lack of control by Baker Hughes, depth calibrations and measurements could not be independently verified.
2	Baker Hughes LWD runs 1, 2, and 3 utilized a 6.75 inch NaviGamma service (Directional and Gamma Ray) behind a 8.5 inch bit and rotary steerable assembly from 1952 to 17198 feet MD (1952 to 6694 feet TVD).
3	The Gamma Ray Apparent (GRAM) data is presented 0 to 300 API, per the customer's request.

Remarks

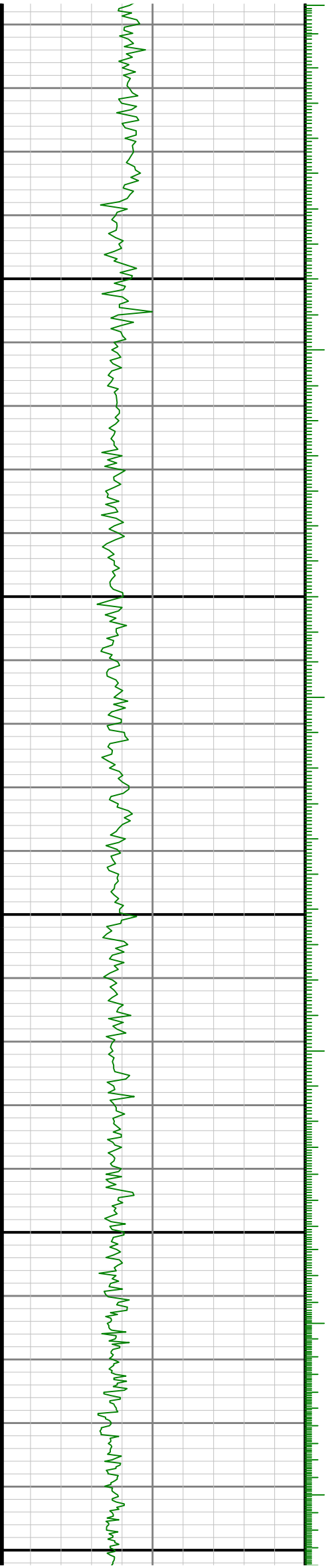
Number	Depth (ft)	Hole Section (in)	Run No.	Remark
1	3638.00	8.500	2	The interval from 3598 to 3625 feet MD ( 3562 to 3589 feet TVD) has a gap in gamma ray data, due to downlinking while drilling ahead and terminating power to LWD tool.
2	3921.00	8.500	2	The interval from 3834 to 3908 feet MD ( 3792 to 3864 feet TVD) has a gap in gamma ray data, due to downlinking while drilling ahead and terminating power to LWD tool.
3	6221.00	8.500	2	The interval from 6184 to 6208 feet MD ( 6116 to 6139 feet TVD) has a gap in gamma ray data, due to downlinking while drilling ahead and terminating power to LWD tool.
4	6908.00	8.500	2	The interval from 6872 to 6895 feet MD ( 6638 to 6647 feet TVD) has a gap in gamma ray data, due to downlinking while drilling ahead and terminating power to LWD tool.
5	15020.00	8.500	3	The interval from 15007 to 15020 feet MD (6691 feet TVD) was logged more than 10 hours after being drilled, due to a trip out of the hole to pick up a new bottom hole assembly.
6	17198.00	8.500	3	The interval from 17185 to 17198 feet MD (6694 feet TVD) was not logged after being drilled due to sensor to bit offset at well TD.

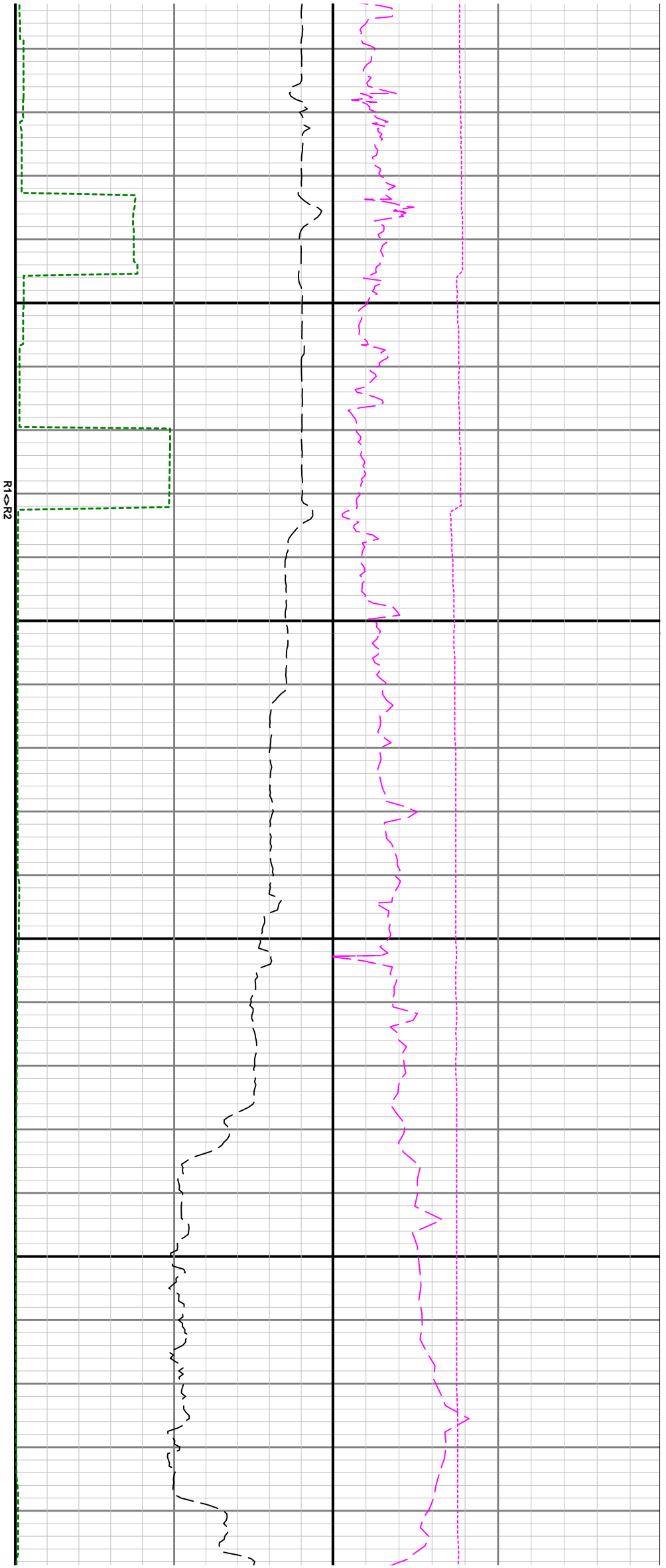




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2200



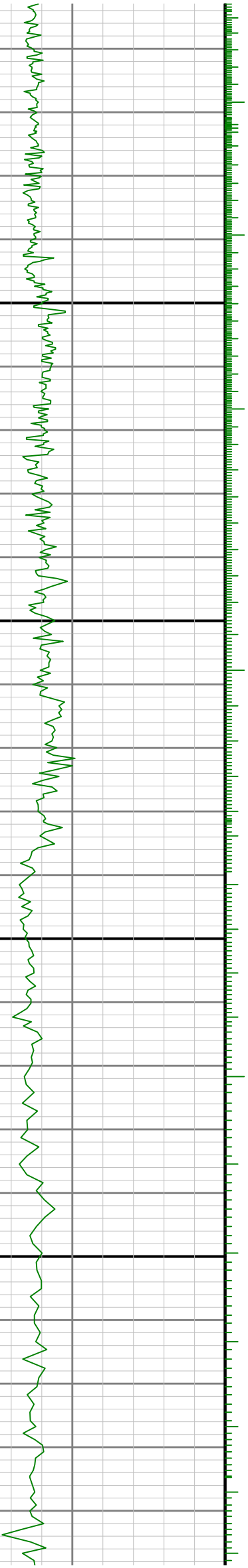


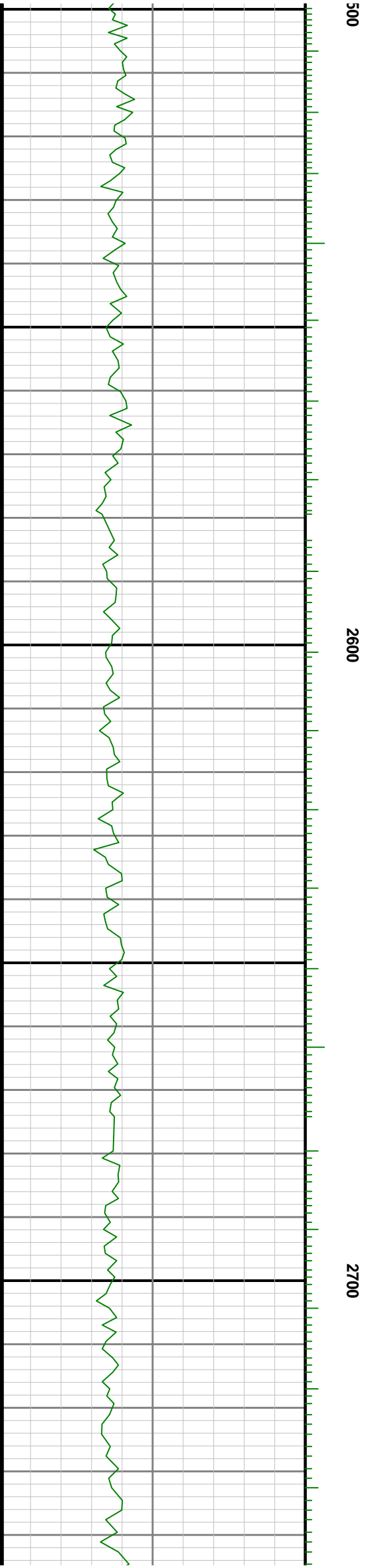
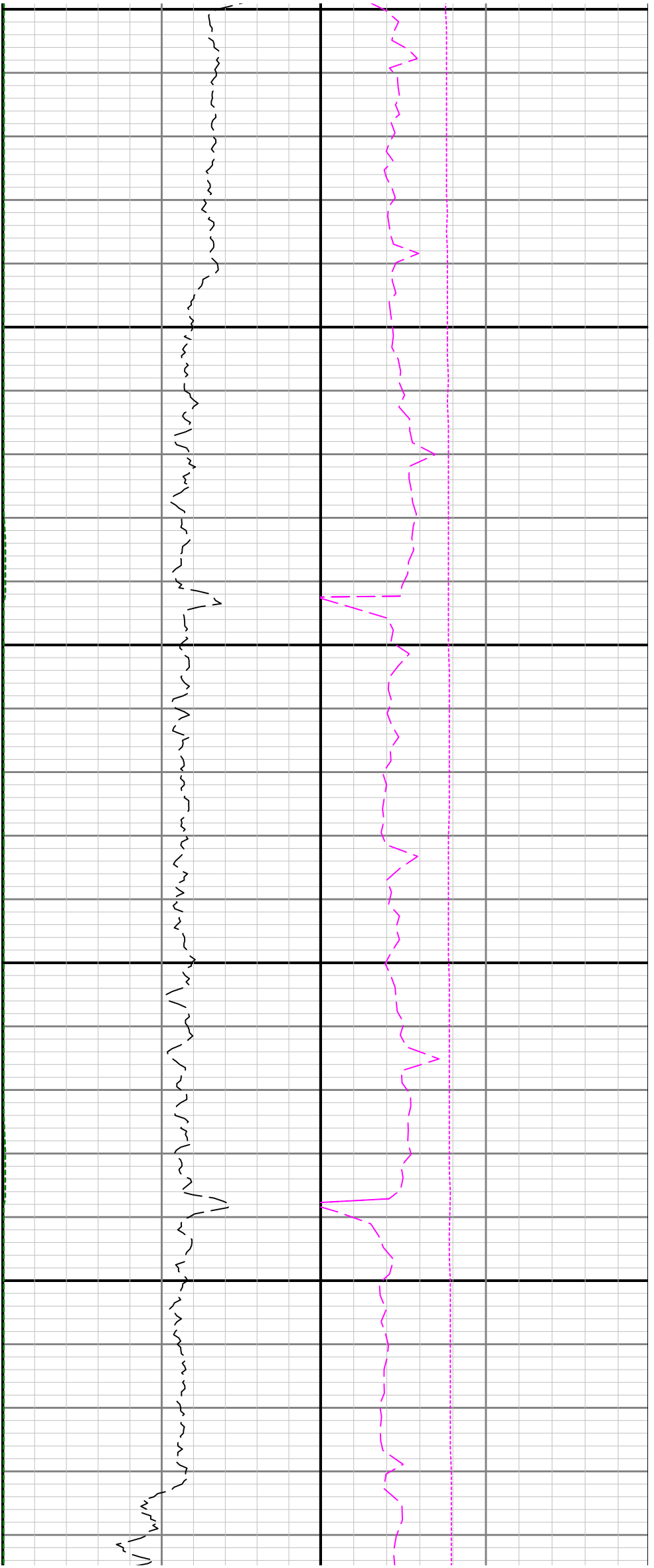
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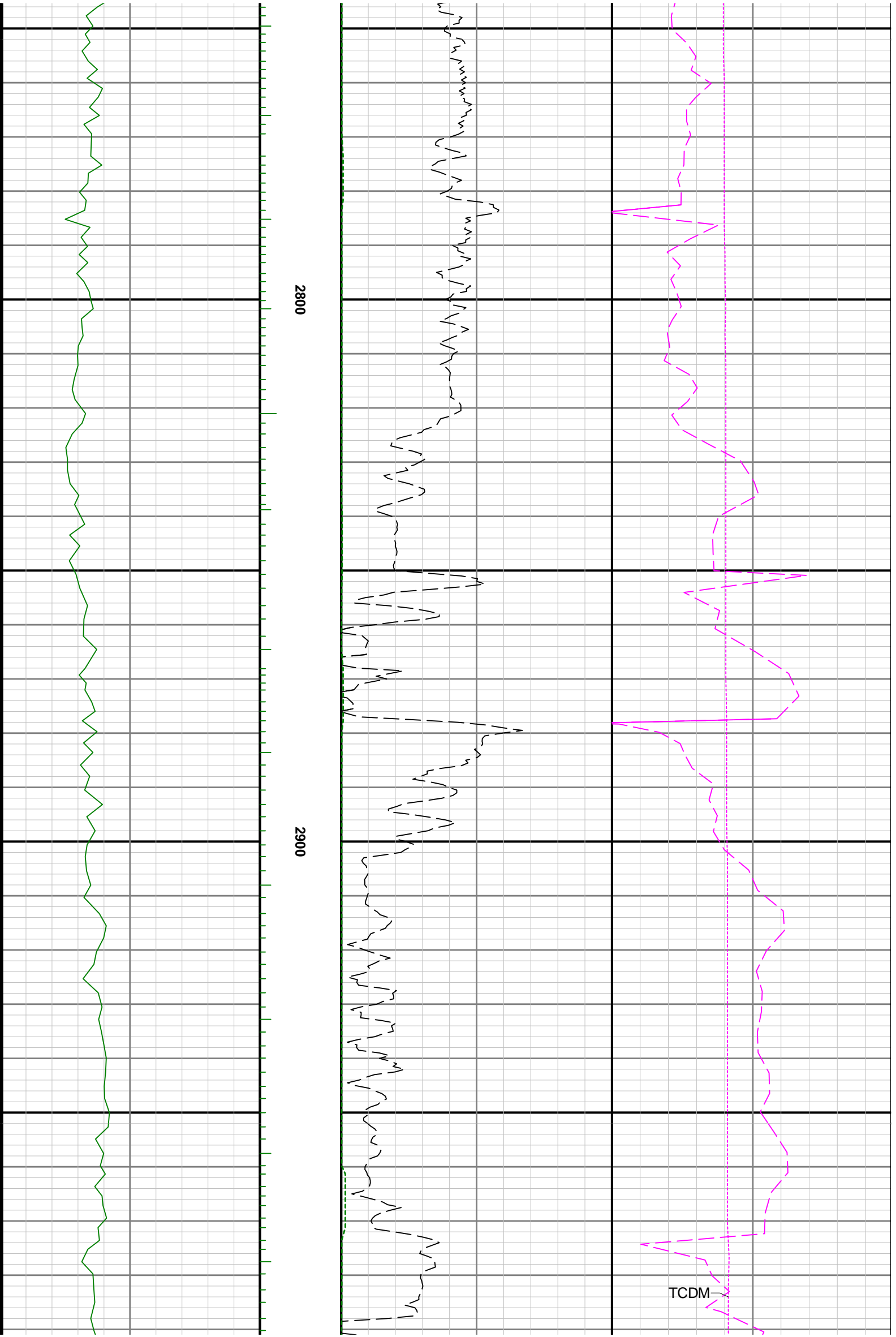
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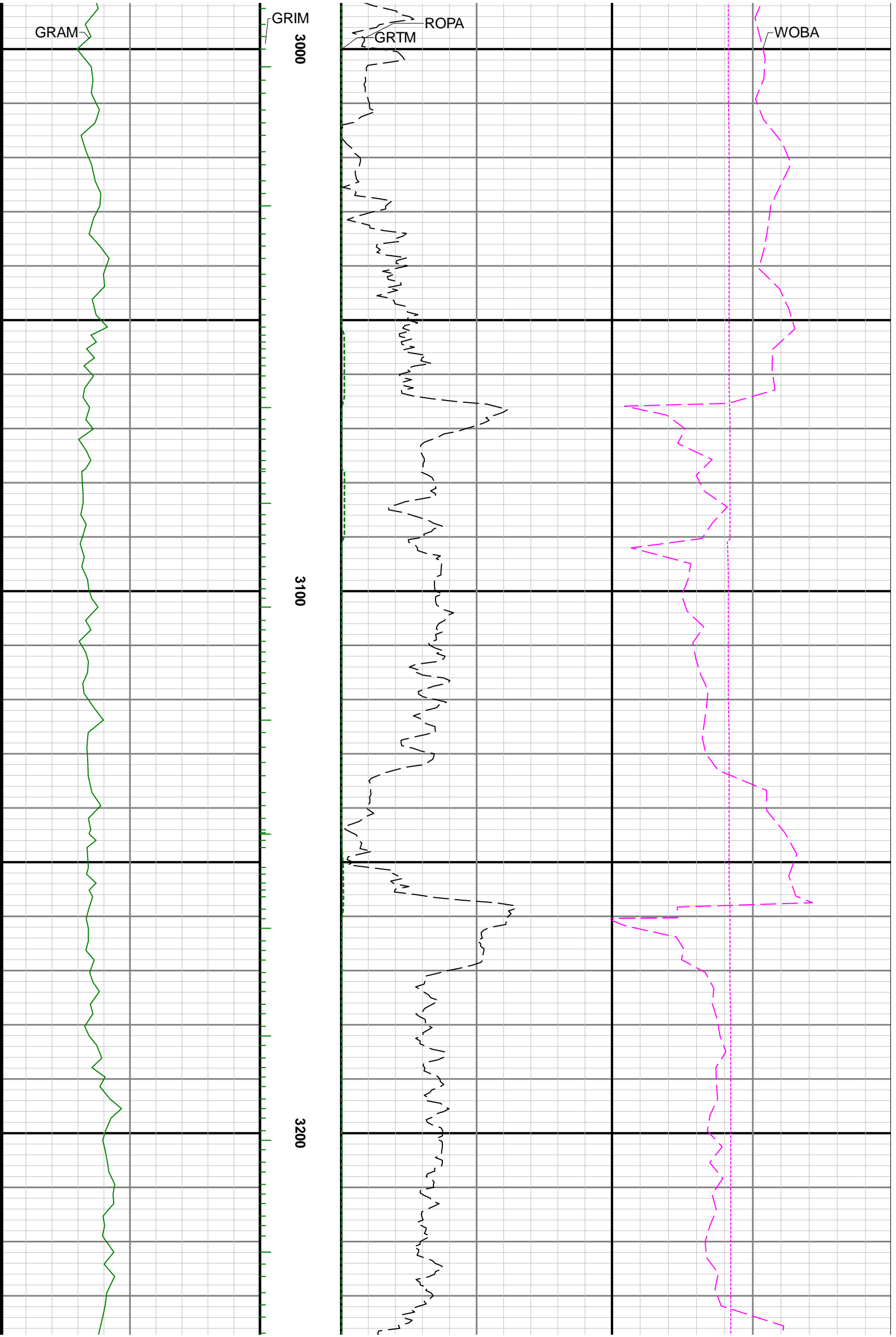
R1 > R2

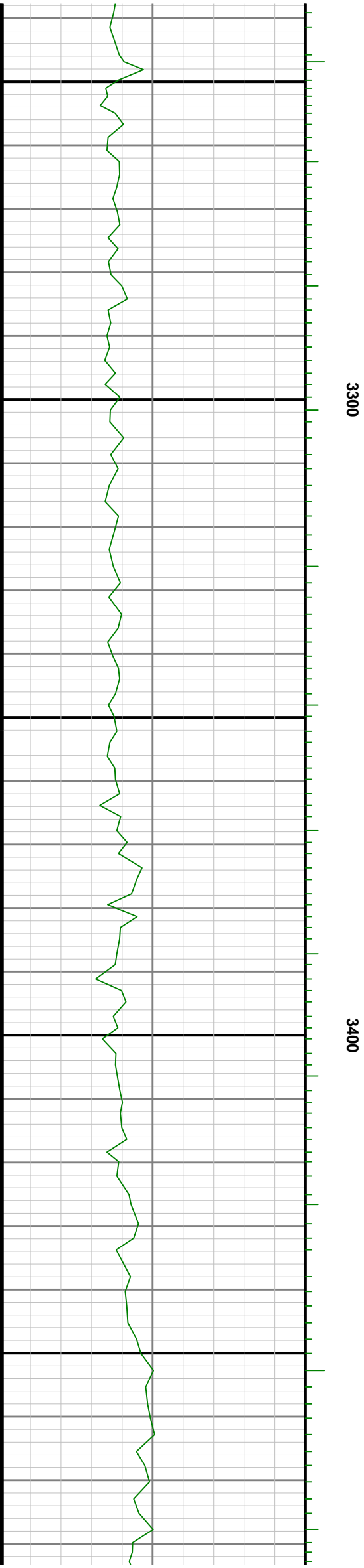
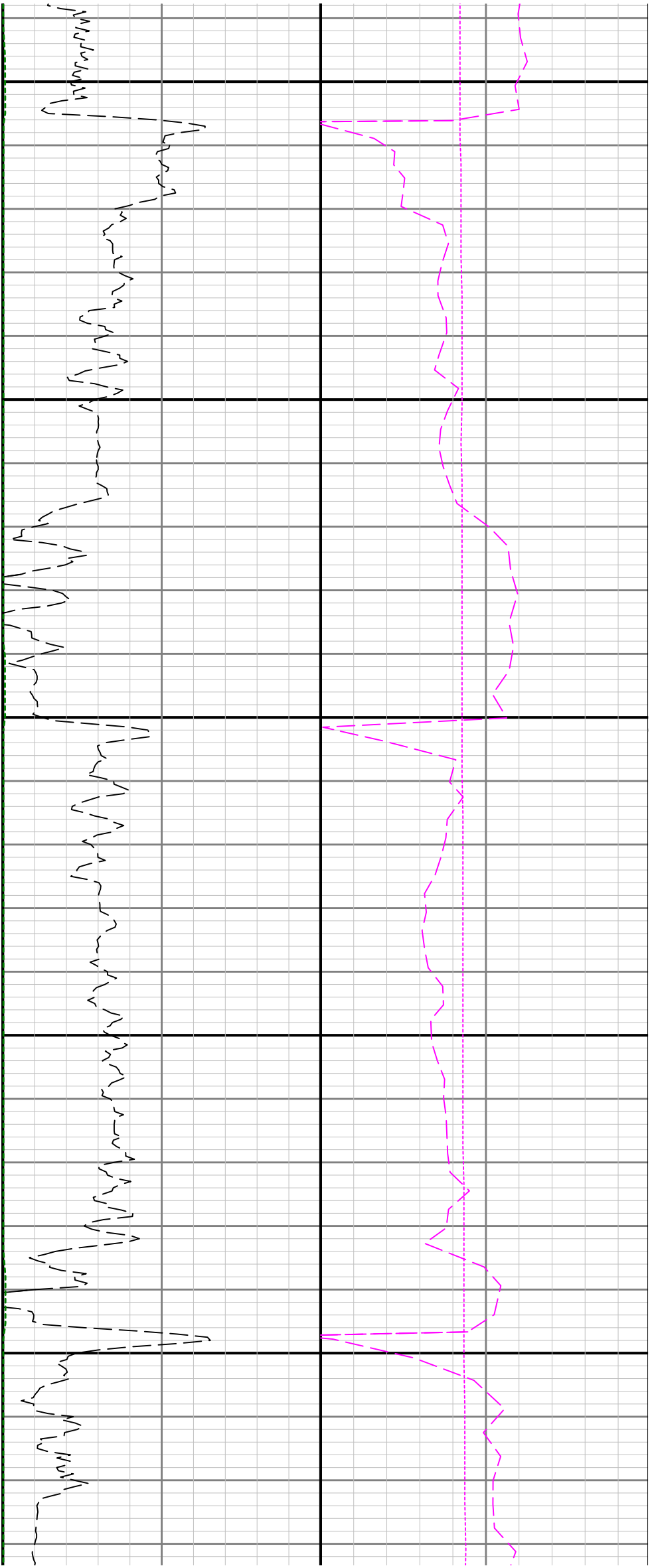
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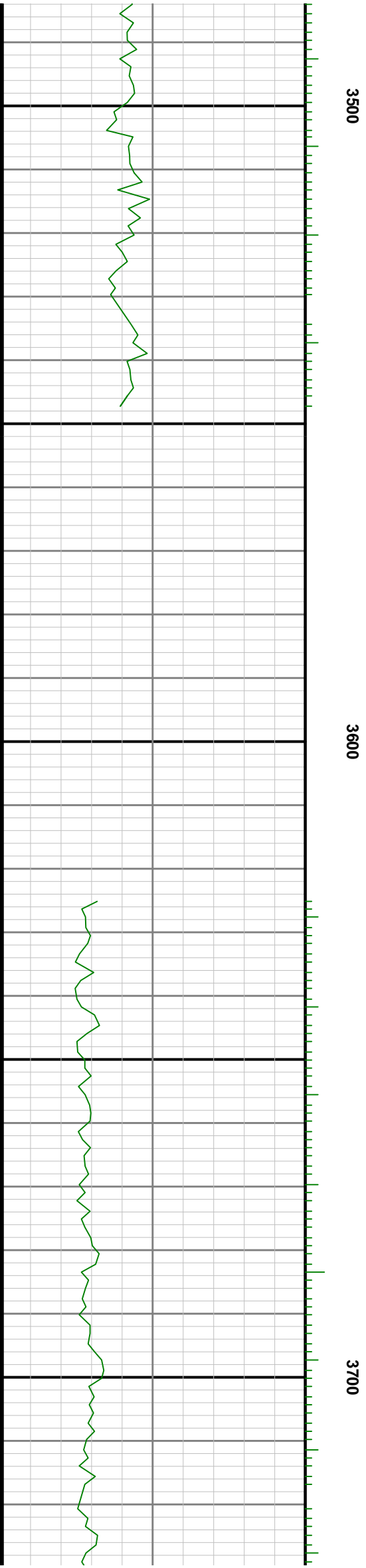
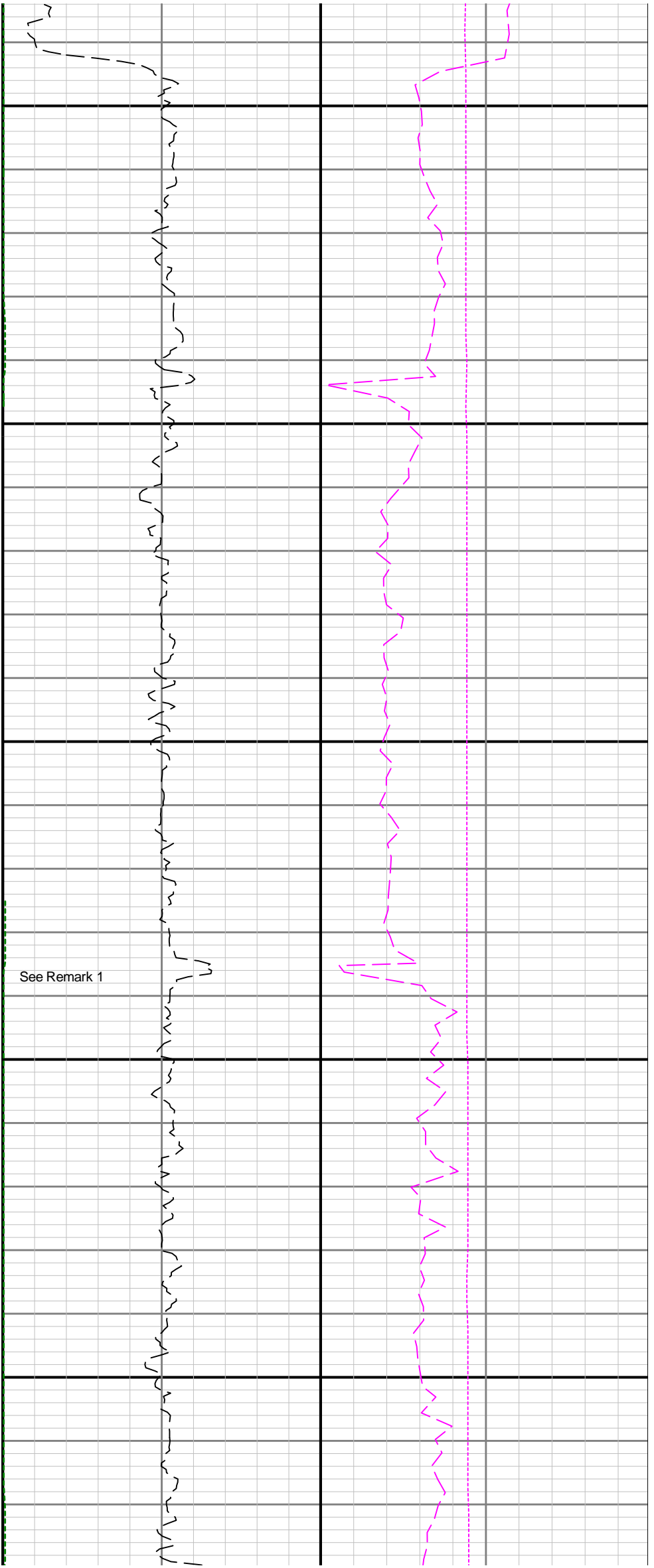


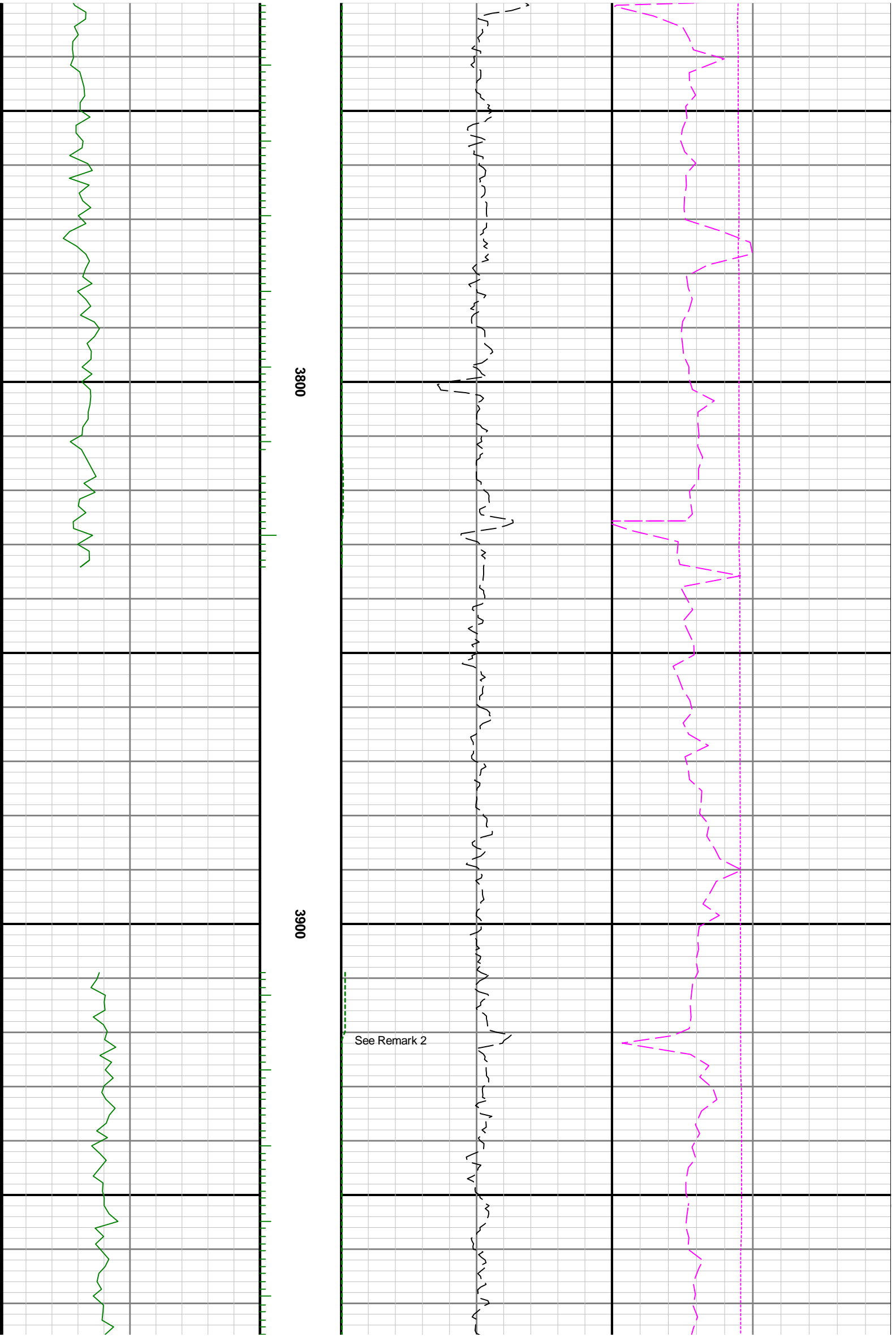


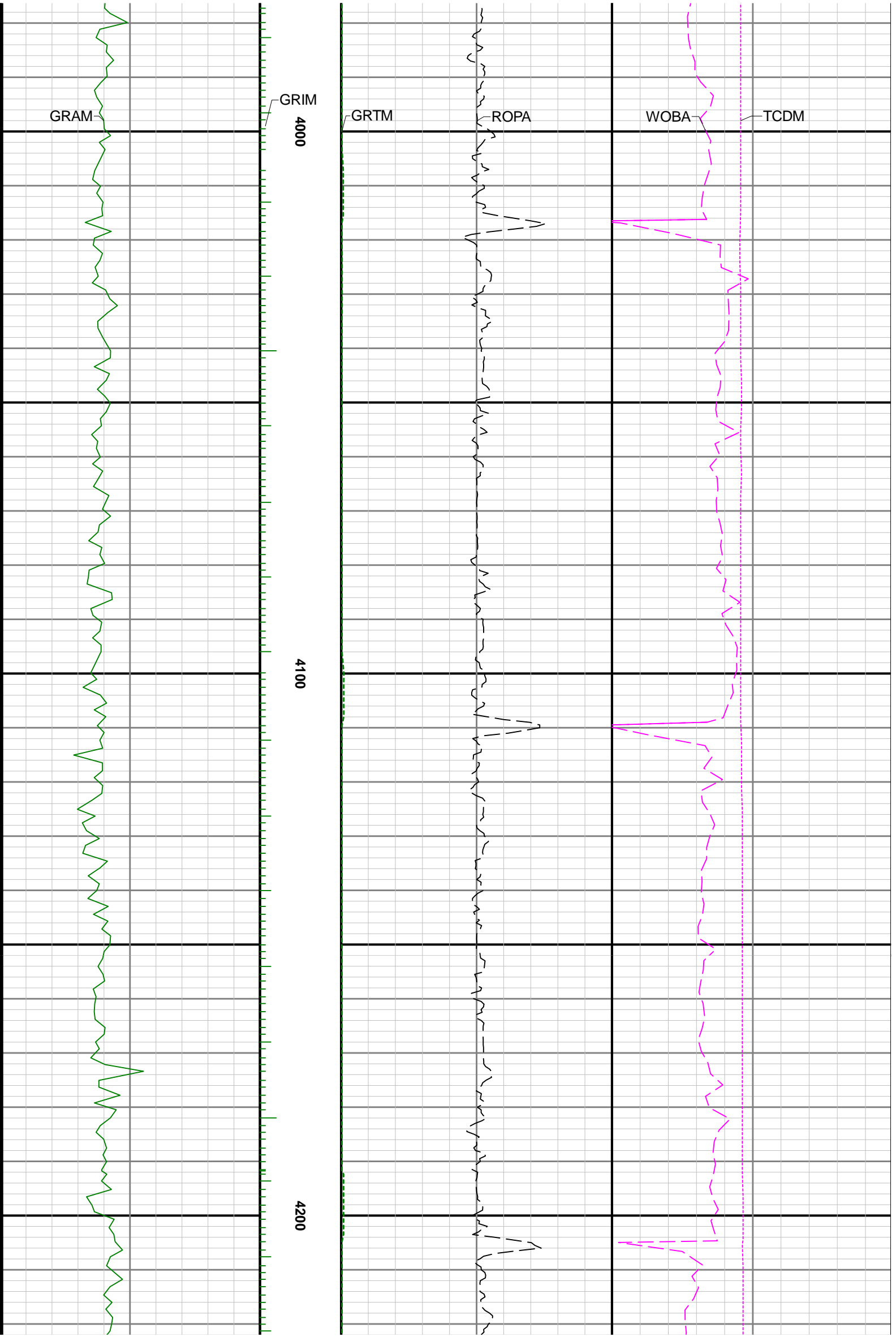


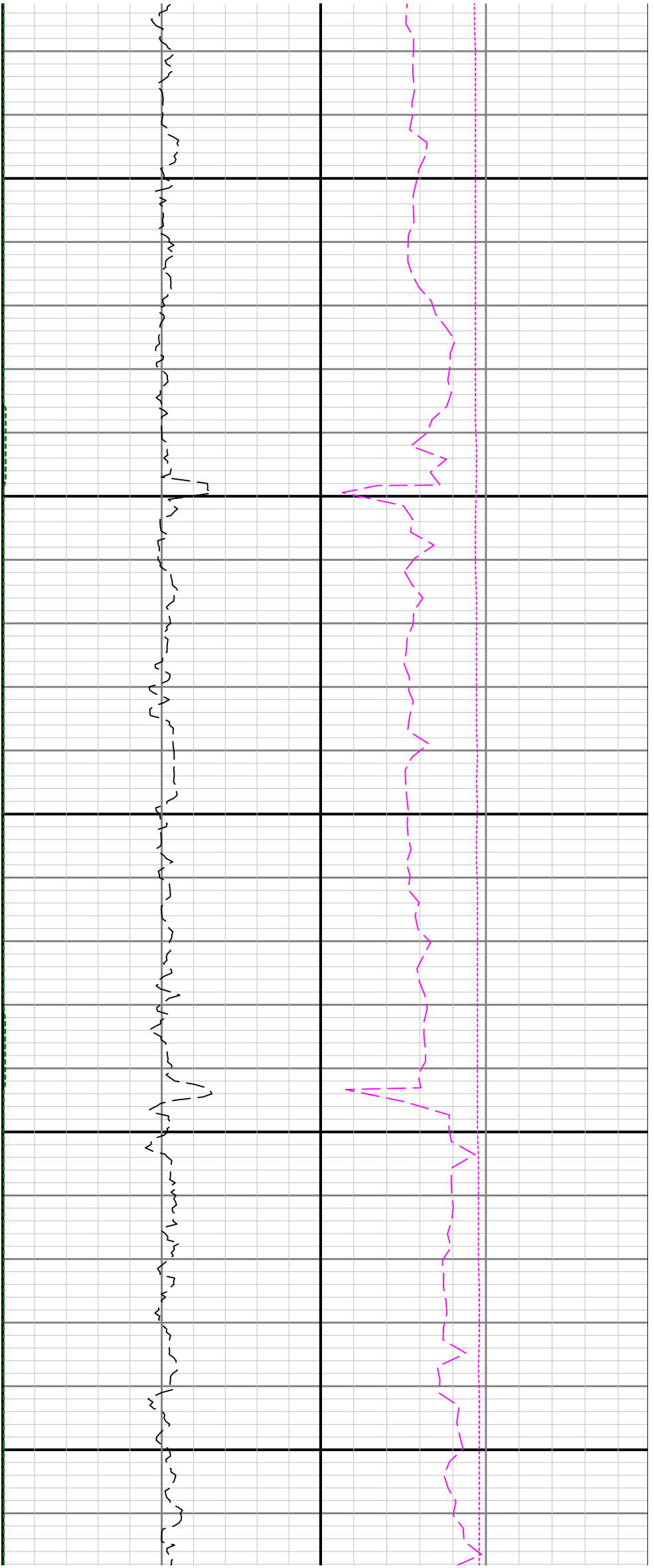






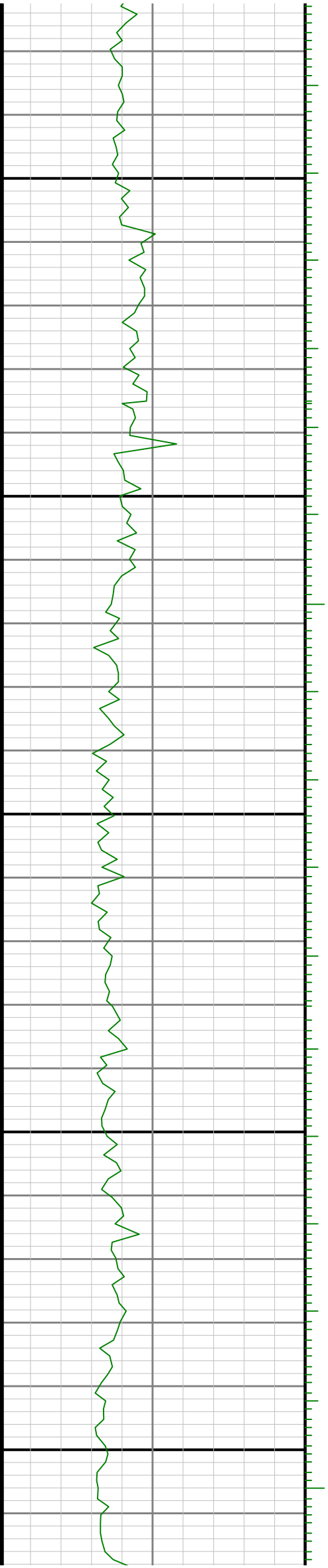


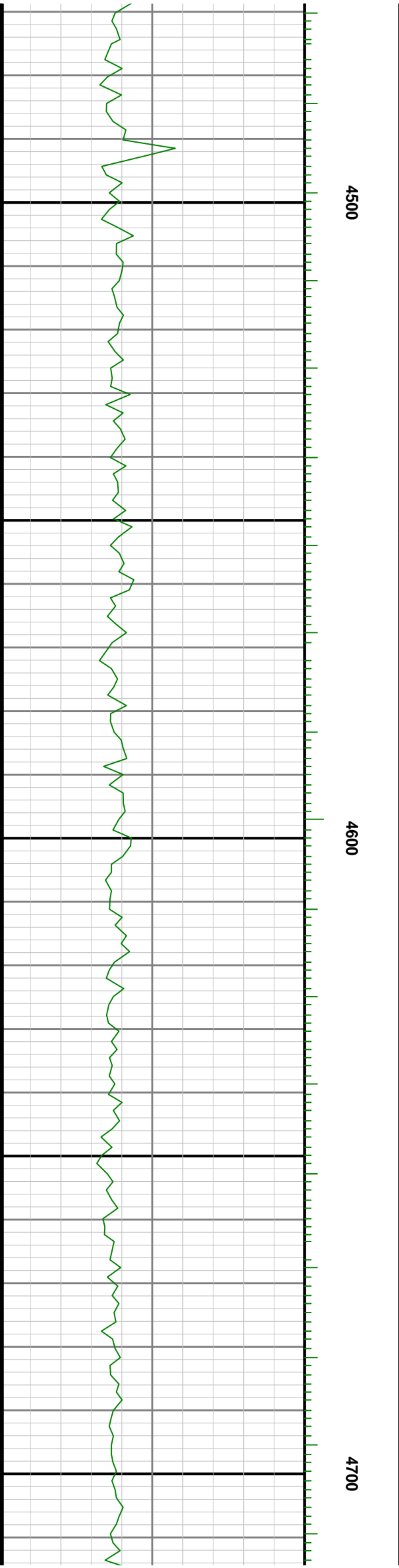
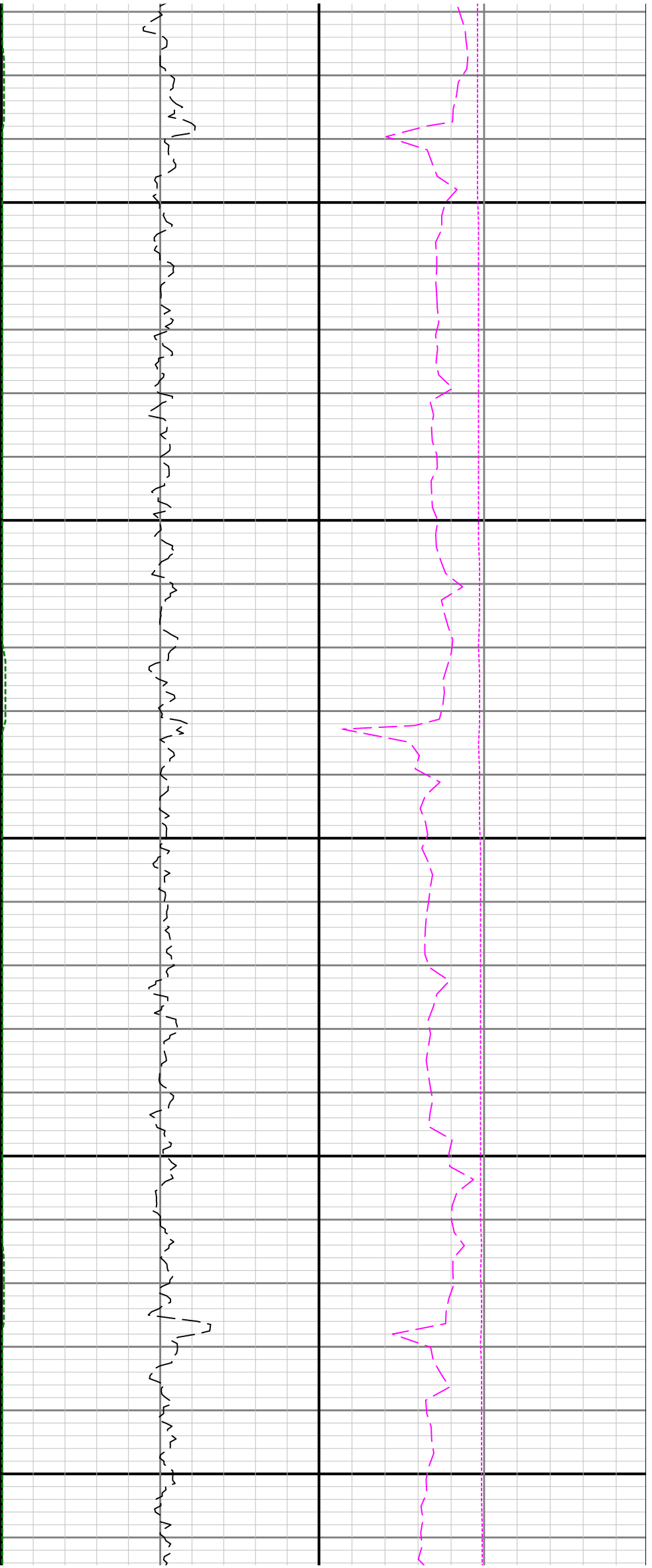


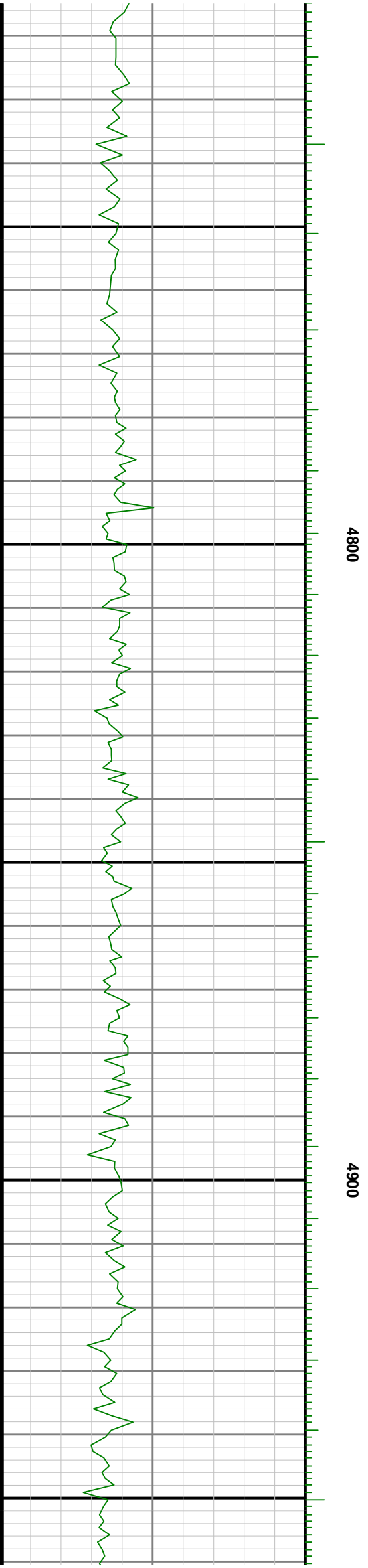
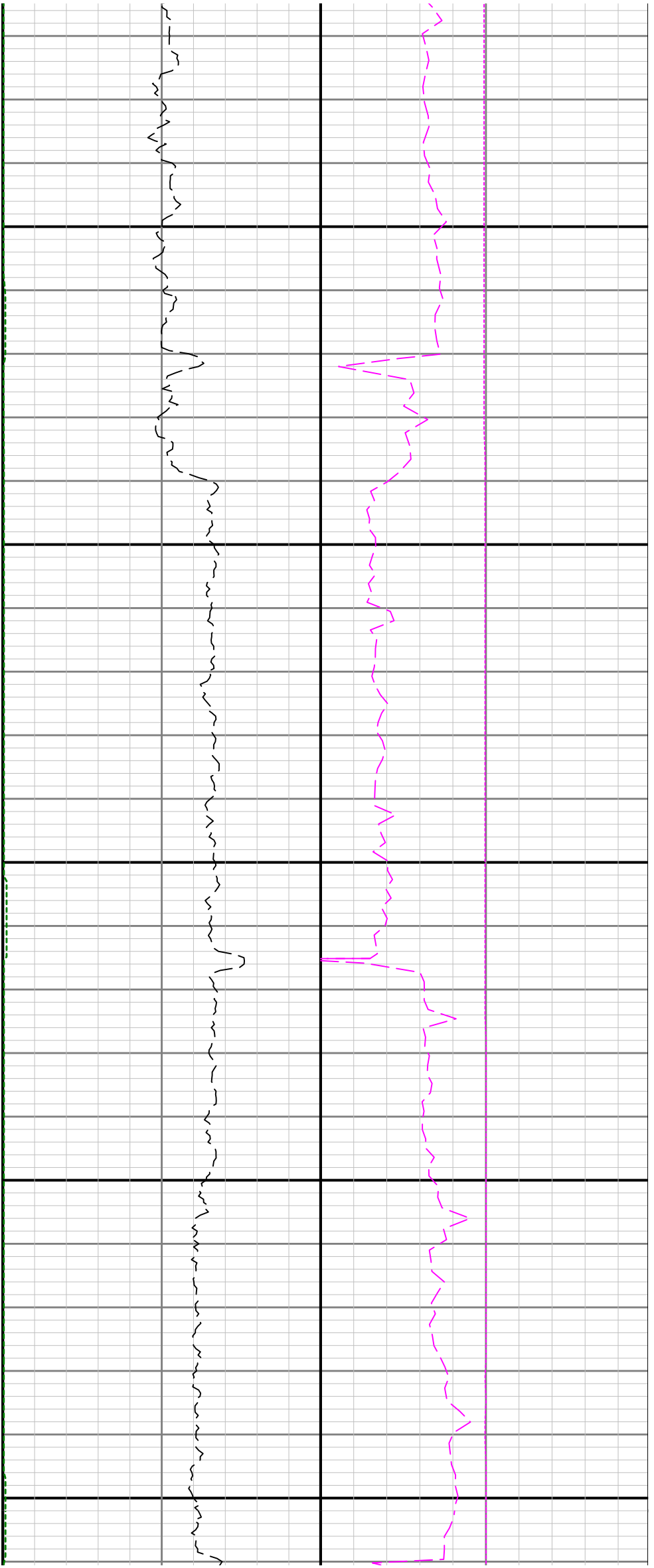


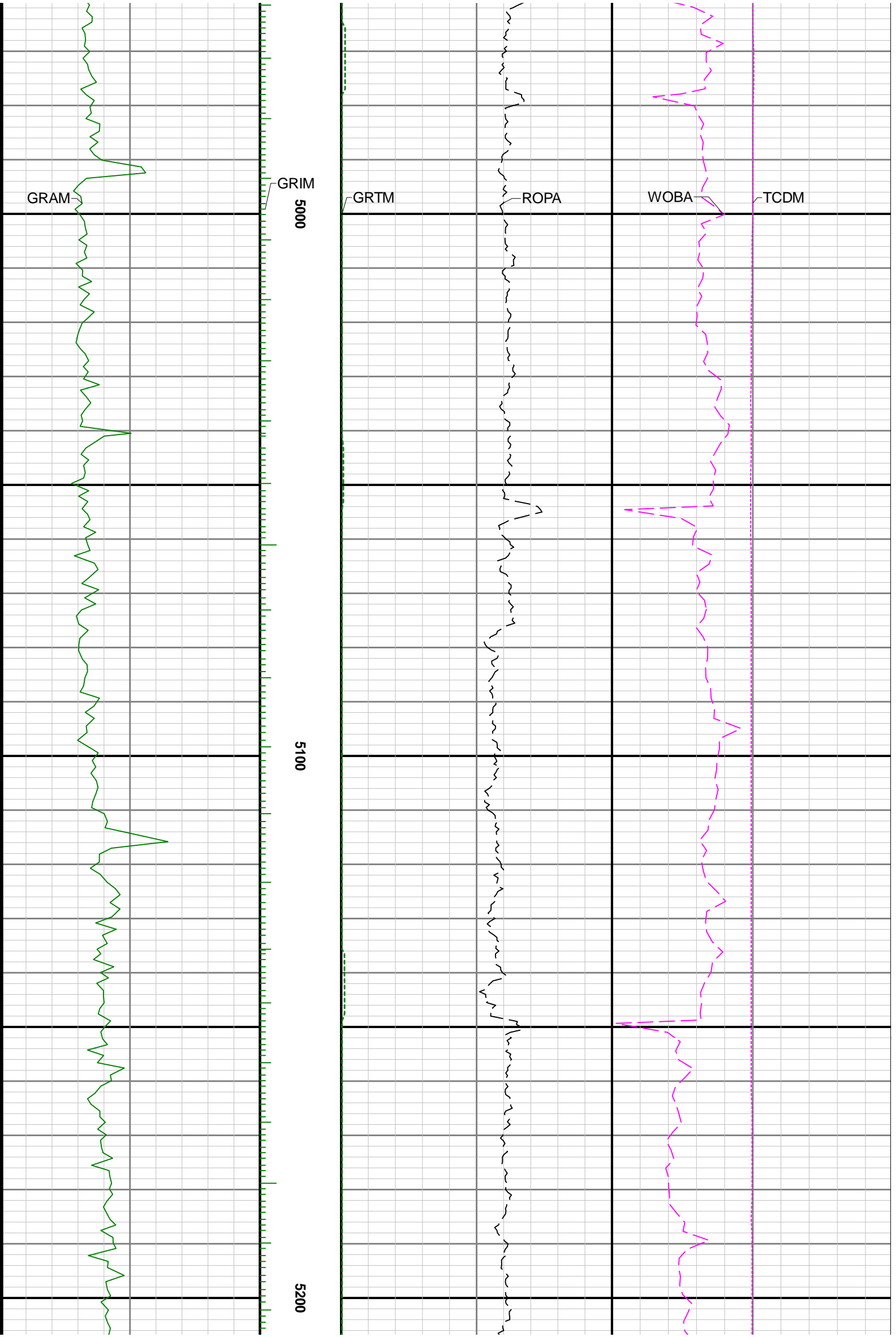
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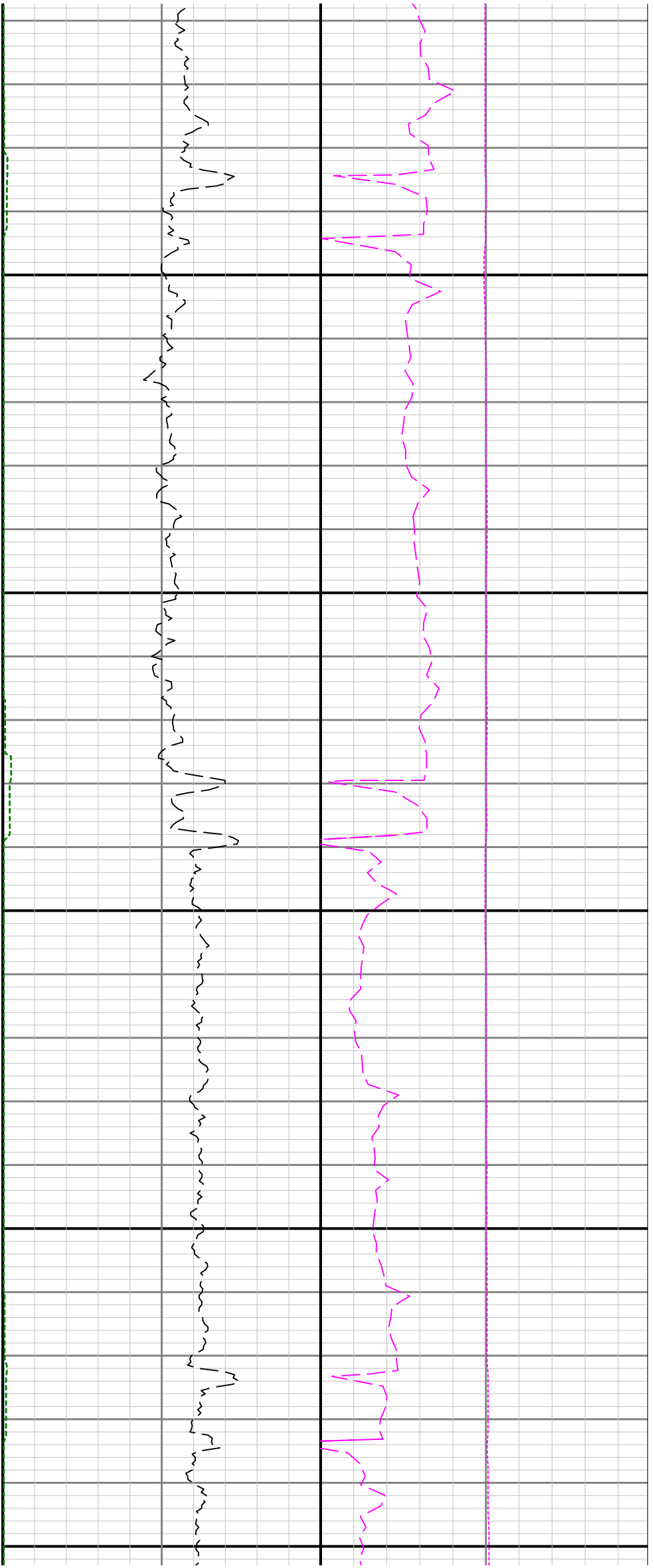
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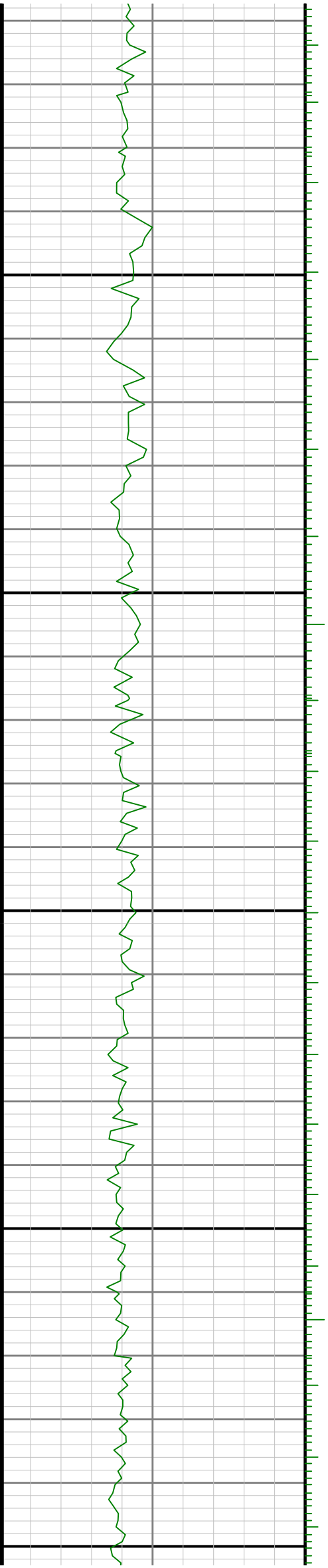




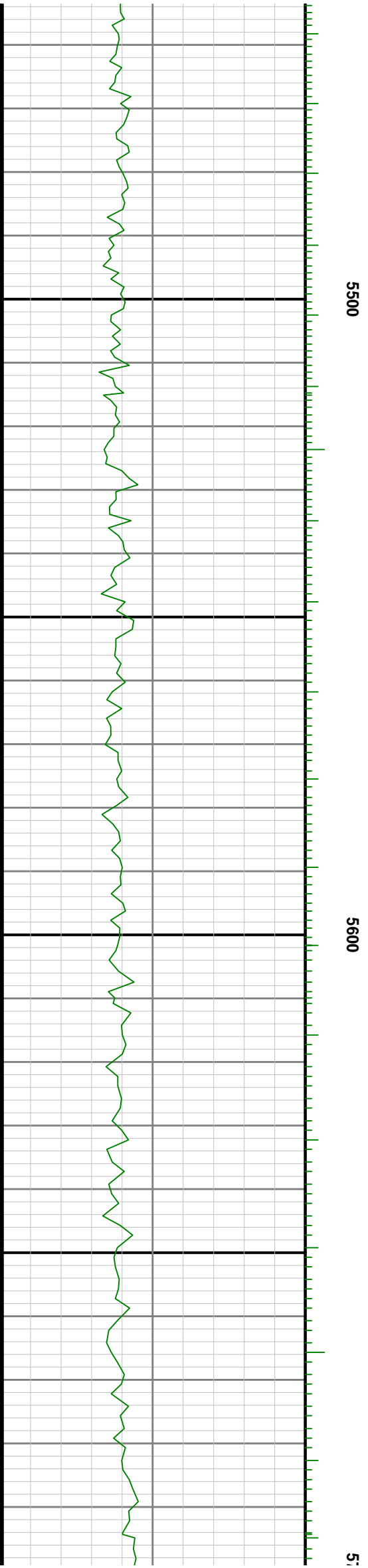


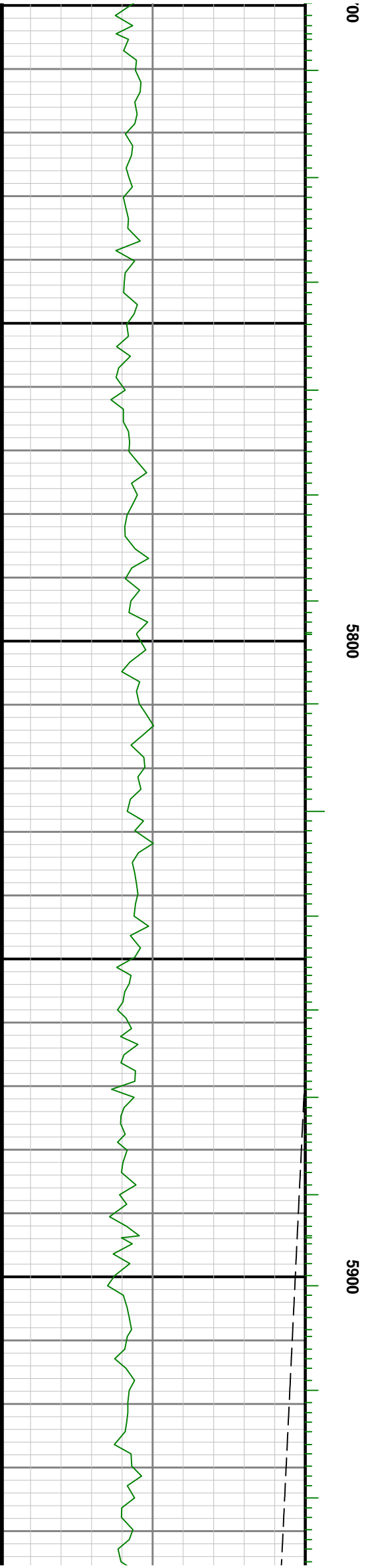
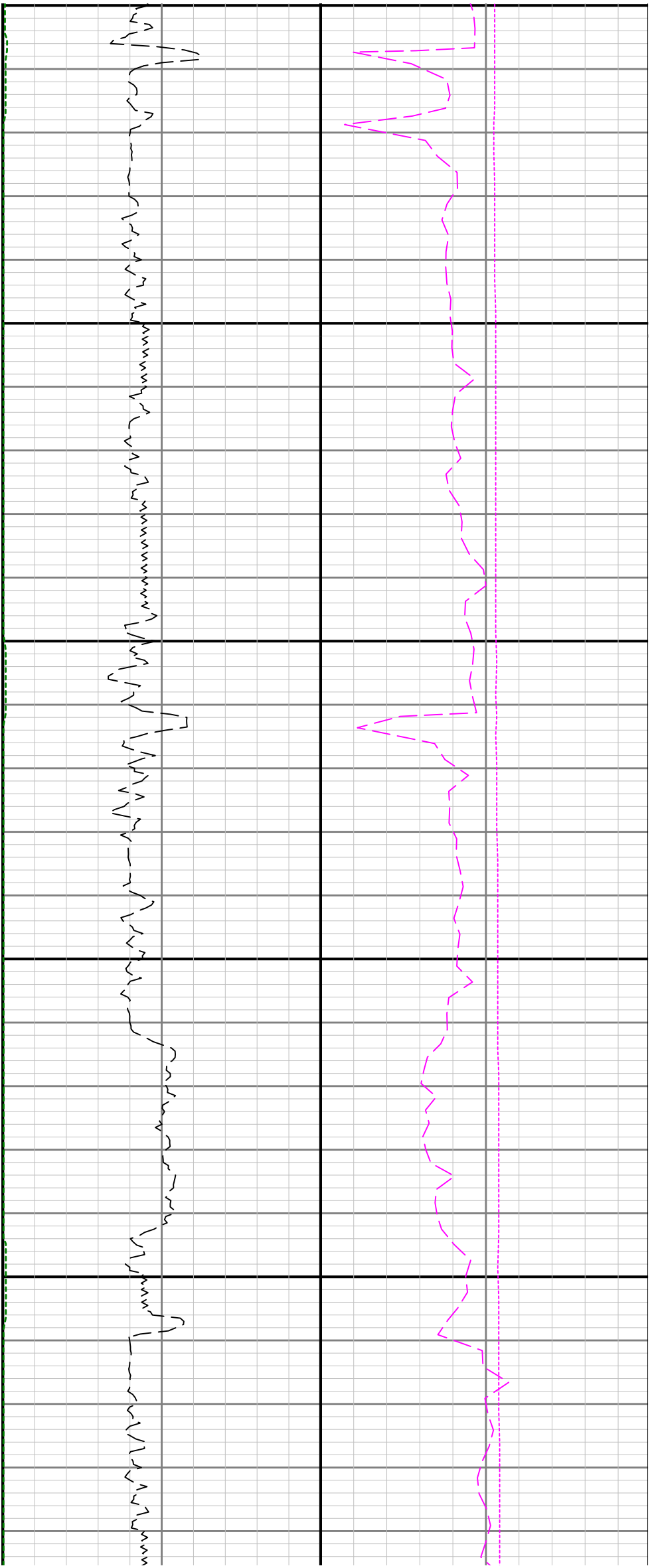
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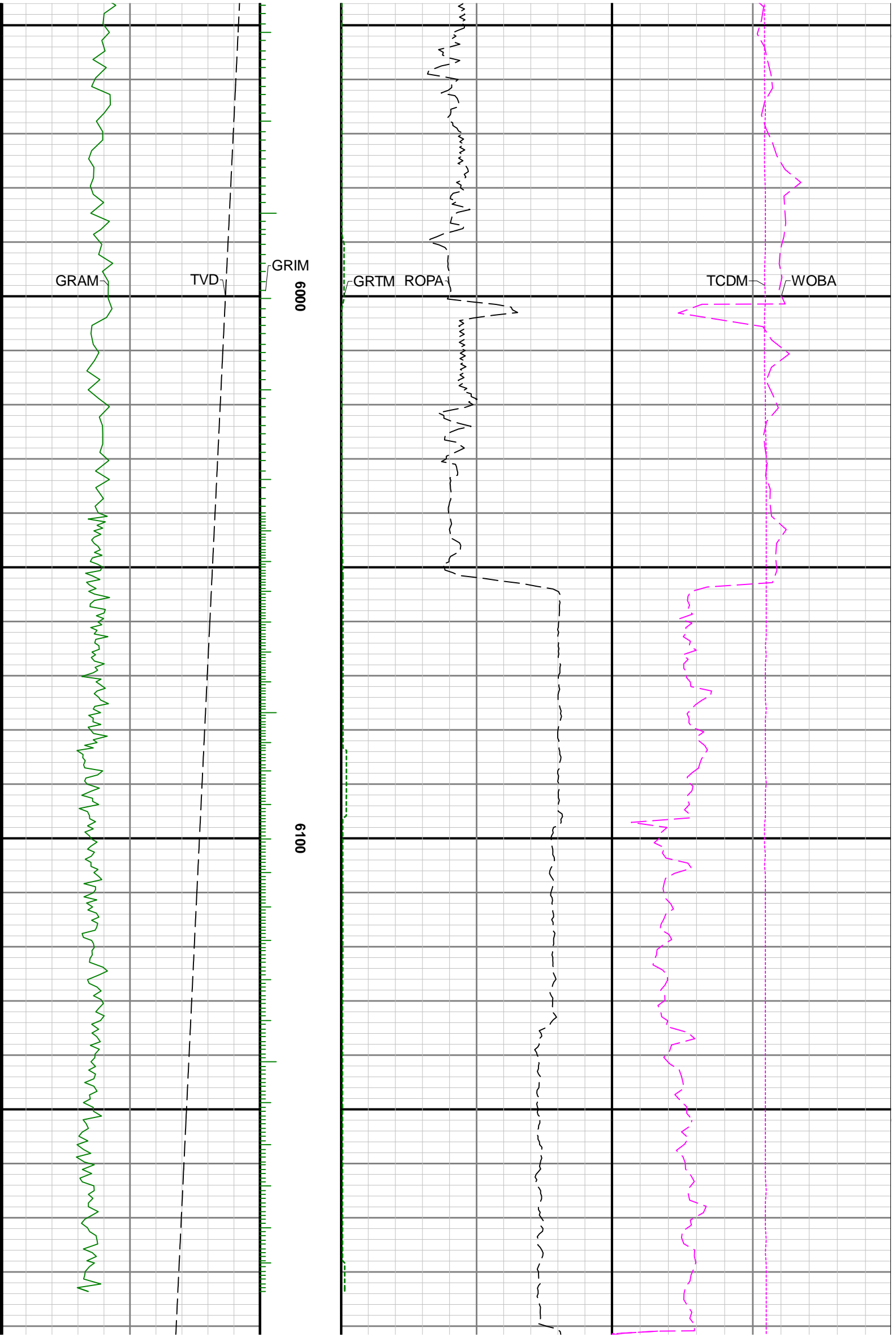
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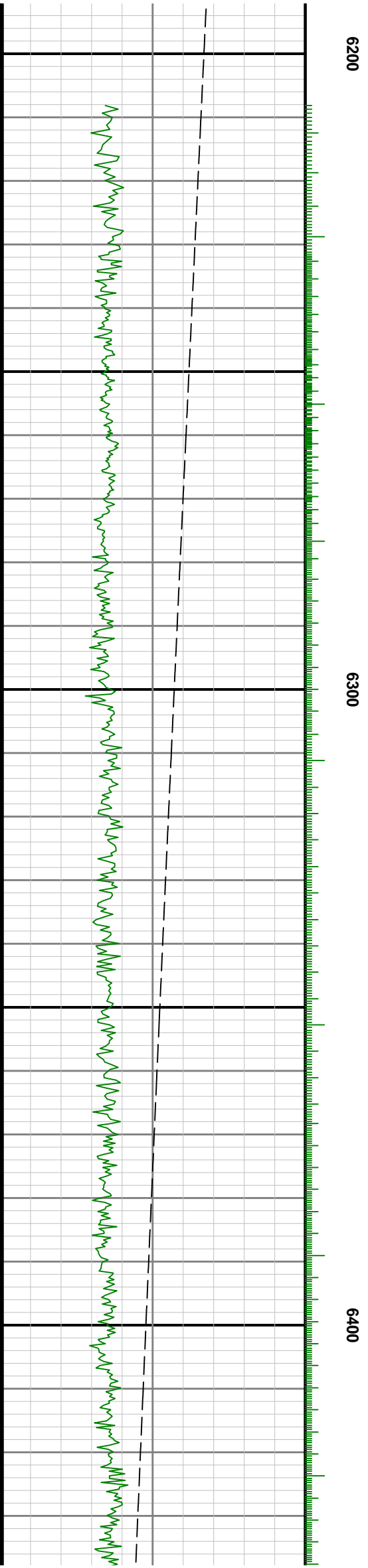
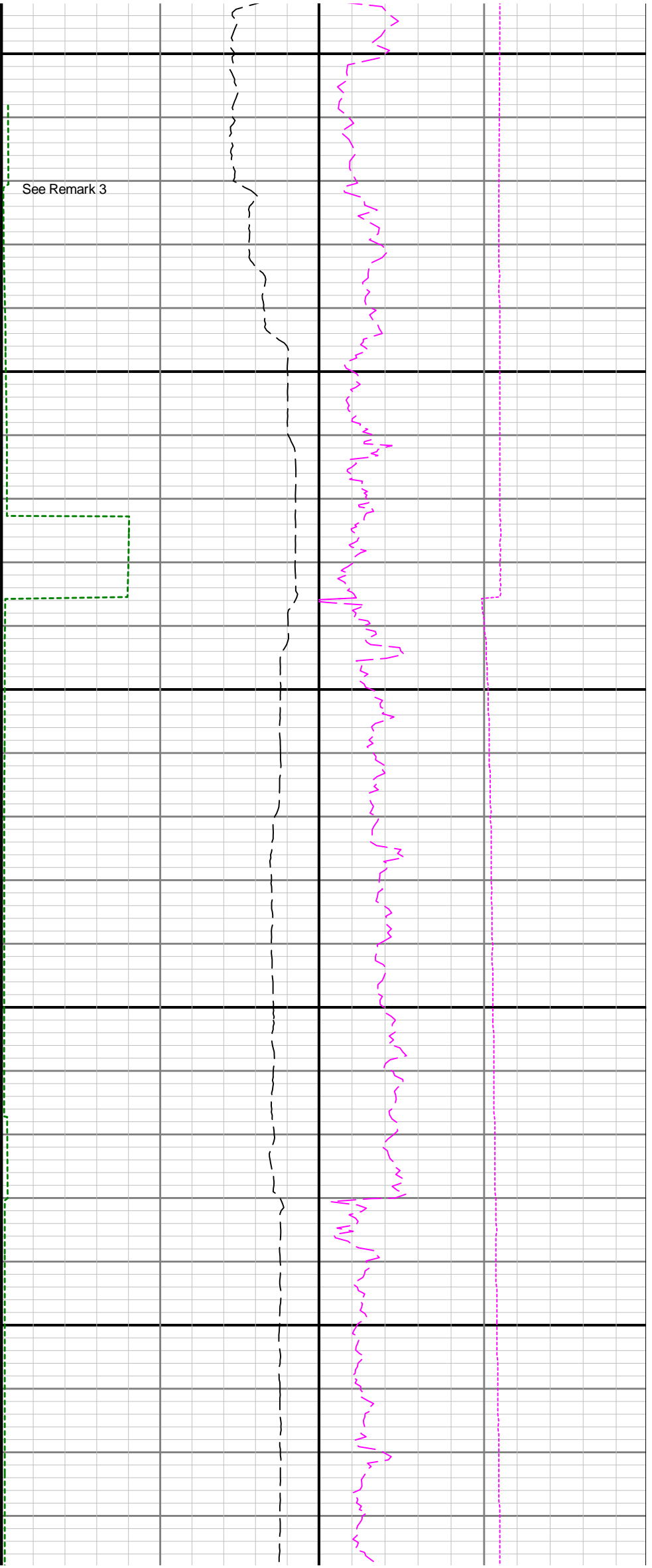


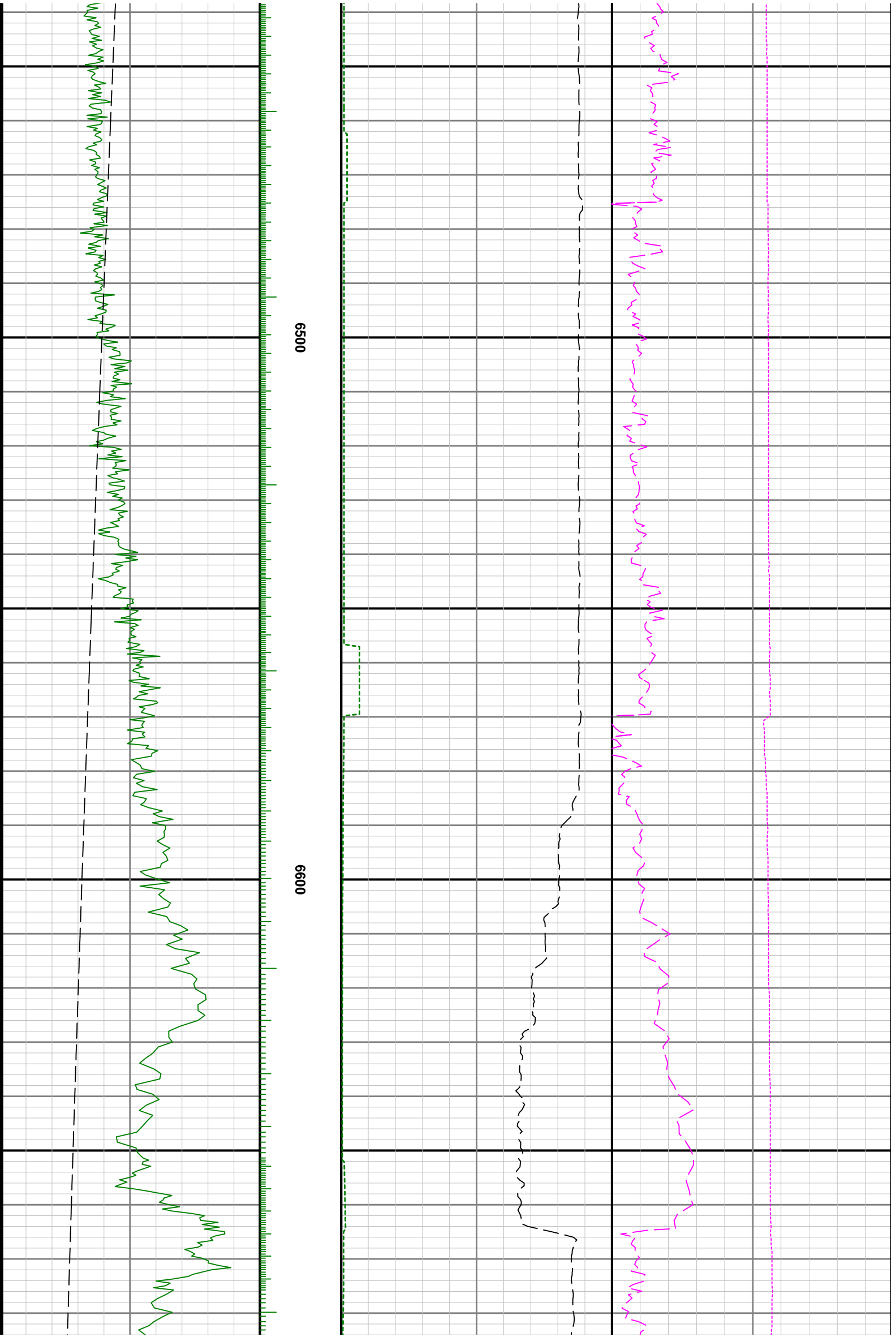


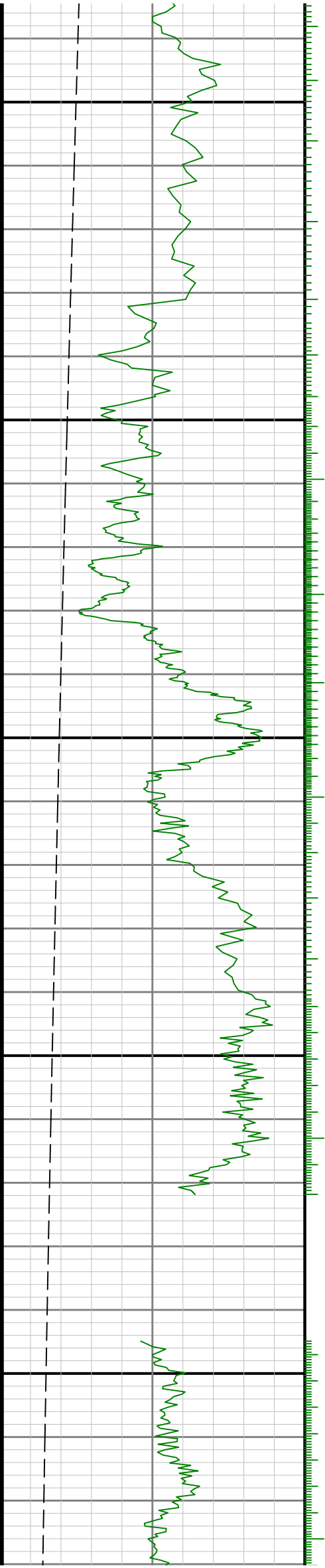








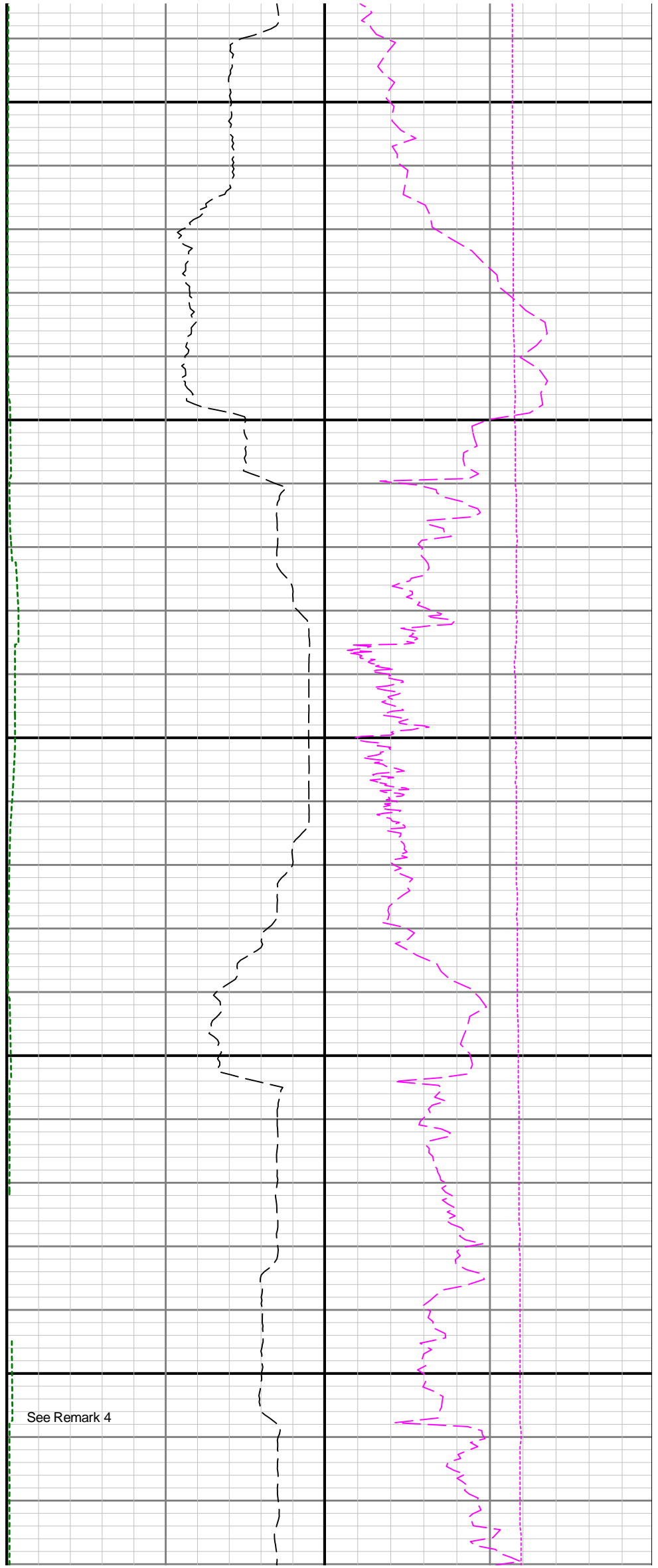




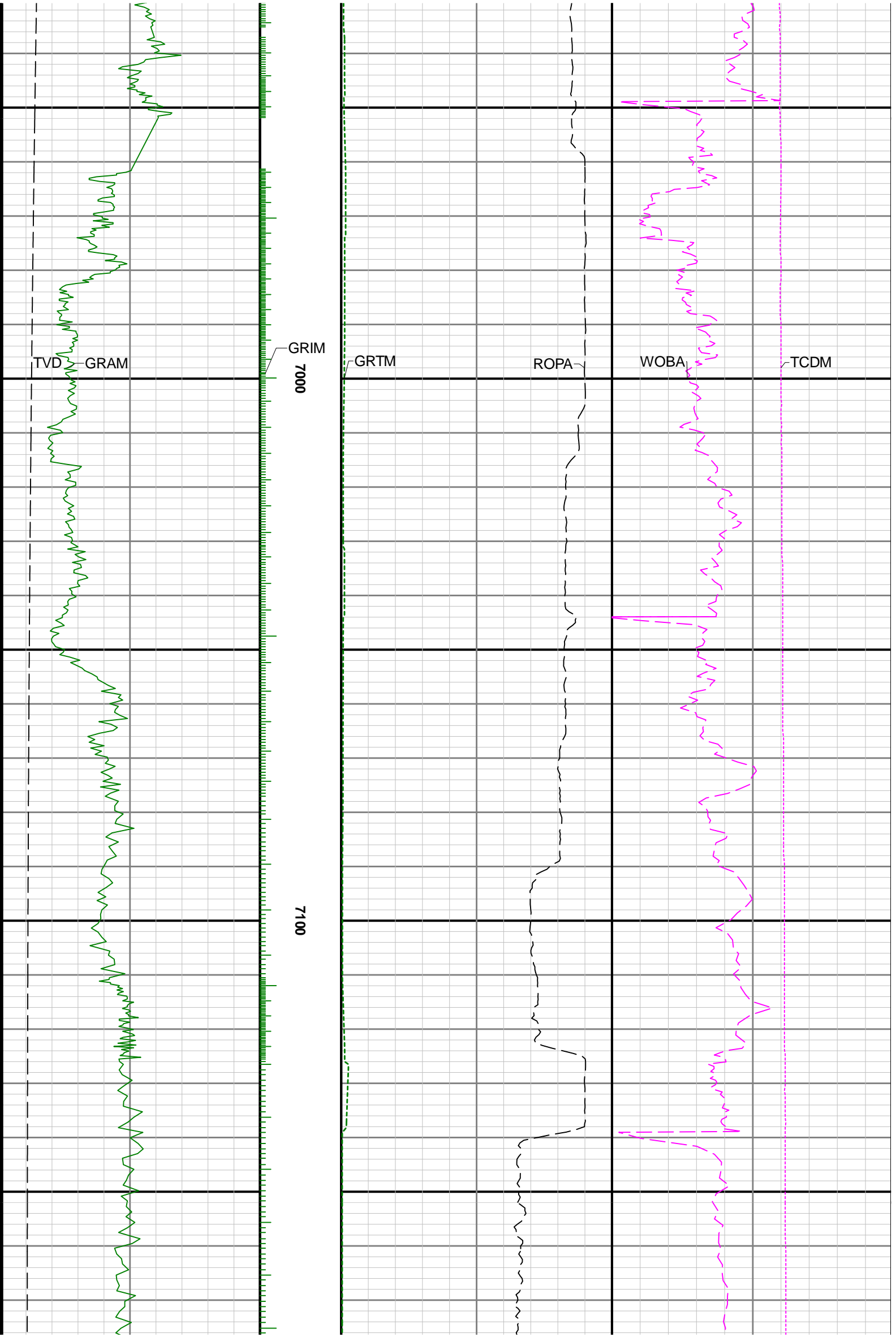
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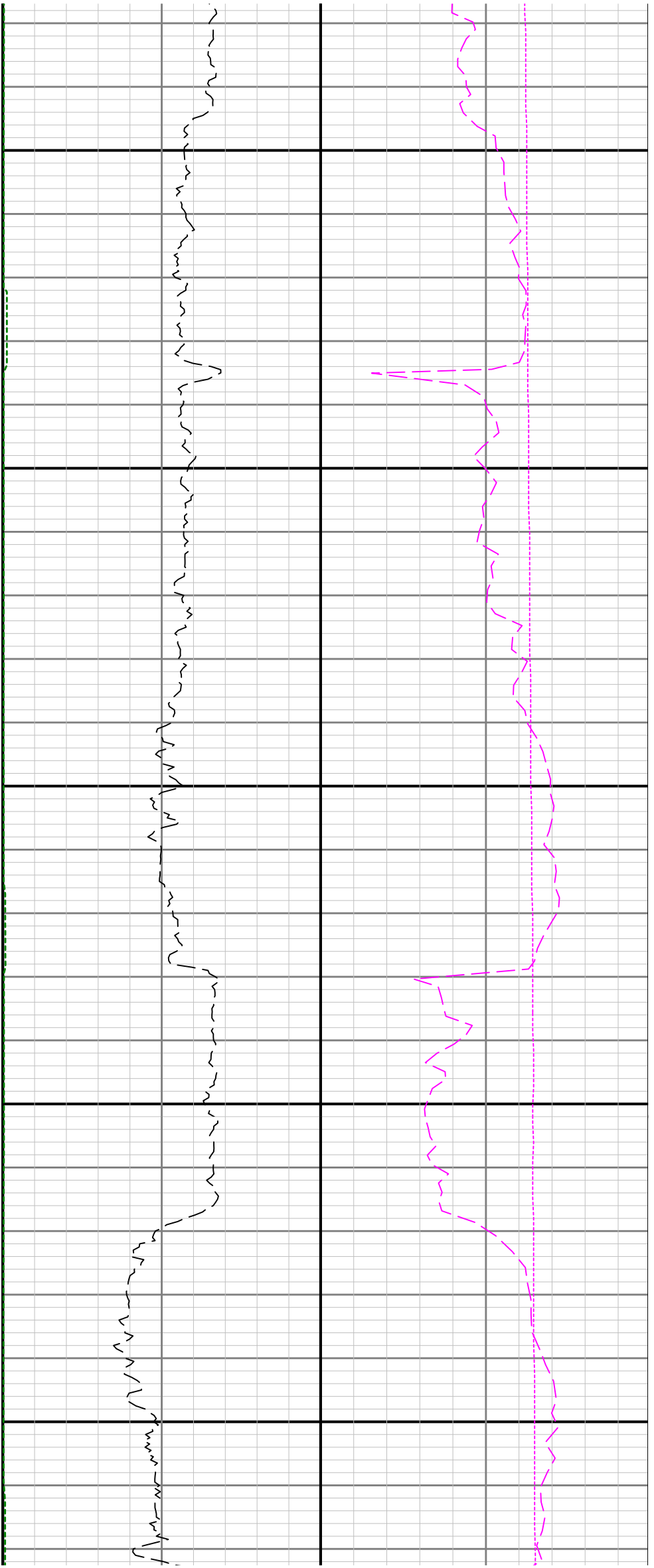
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See Remark 4

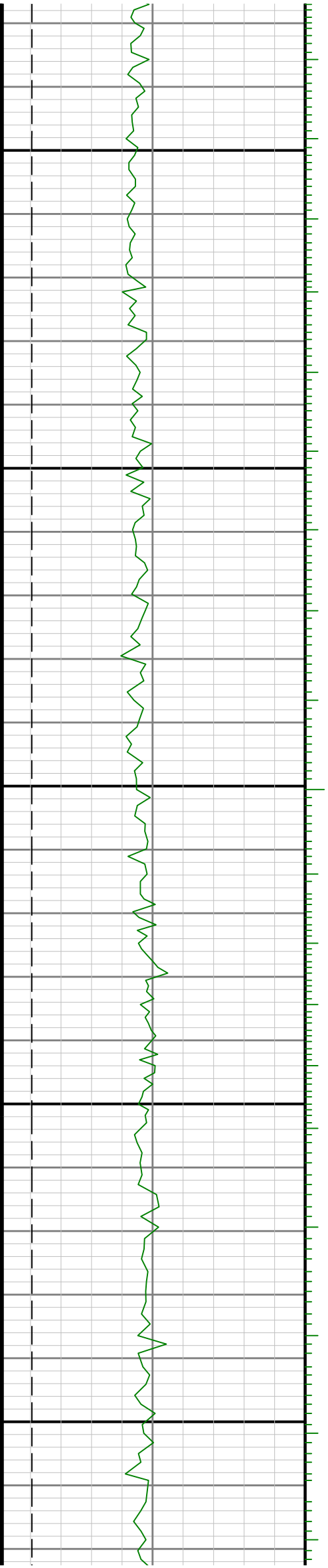




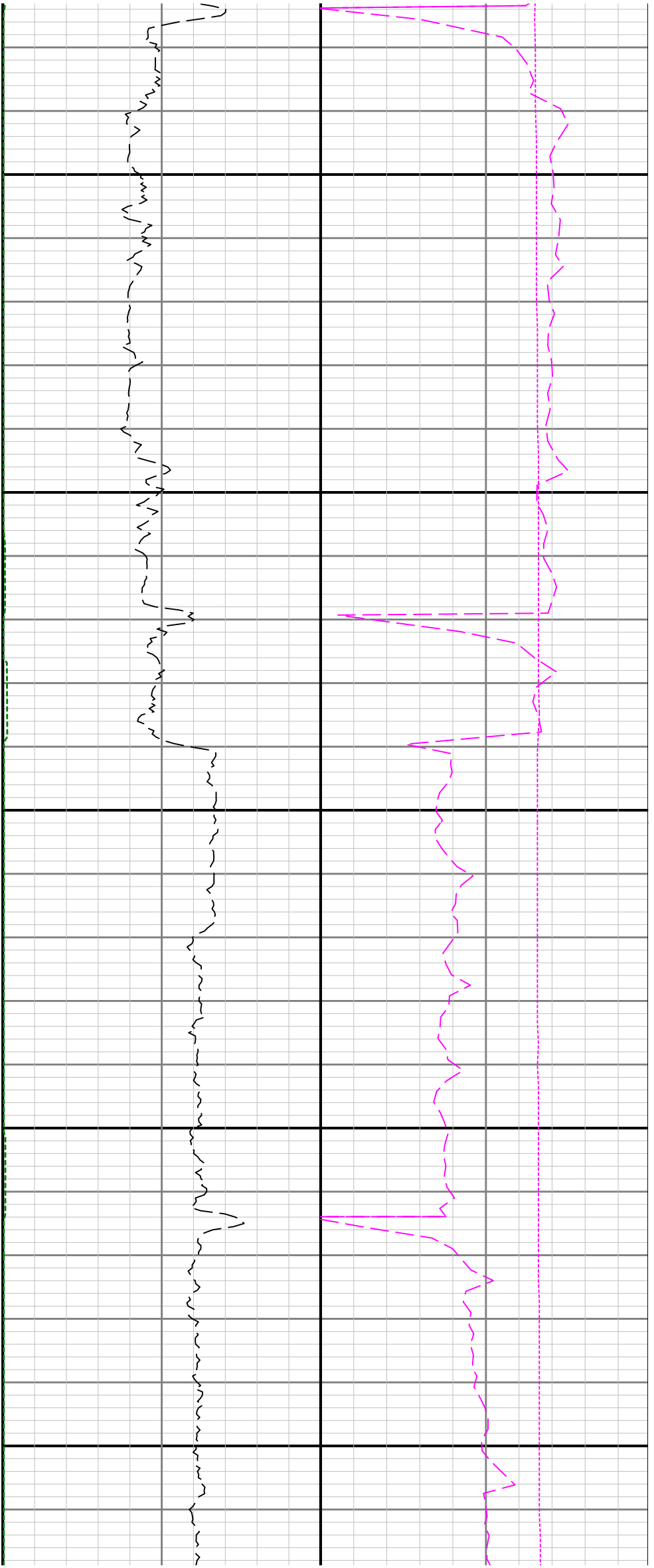
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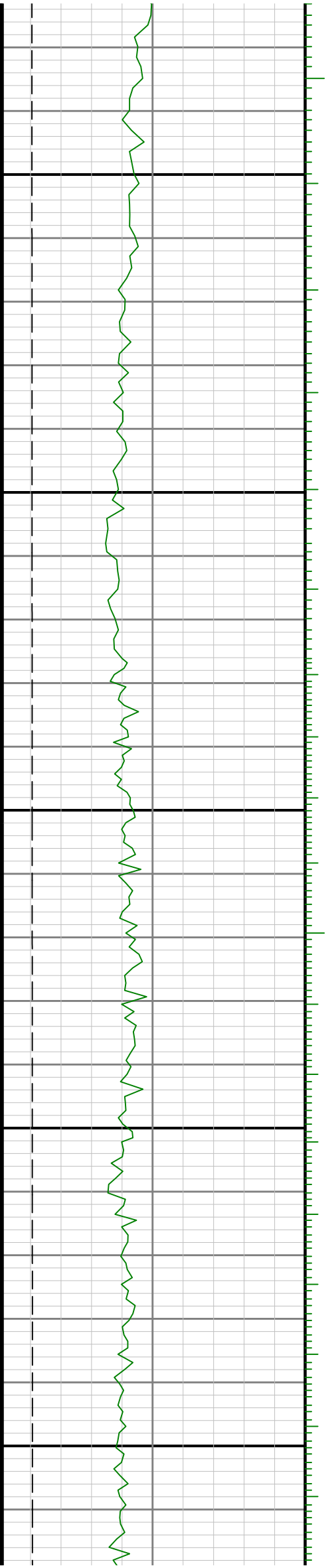


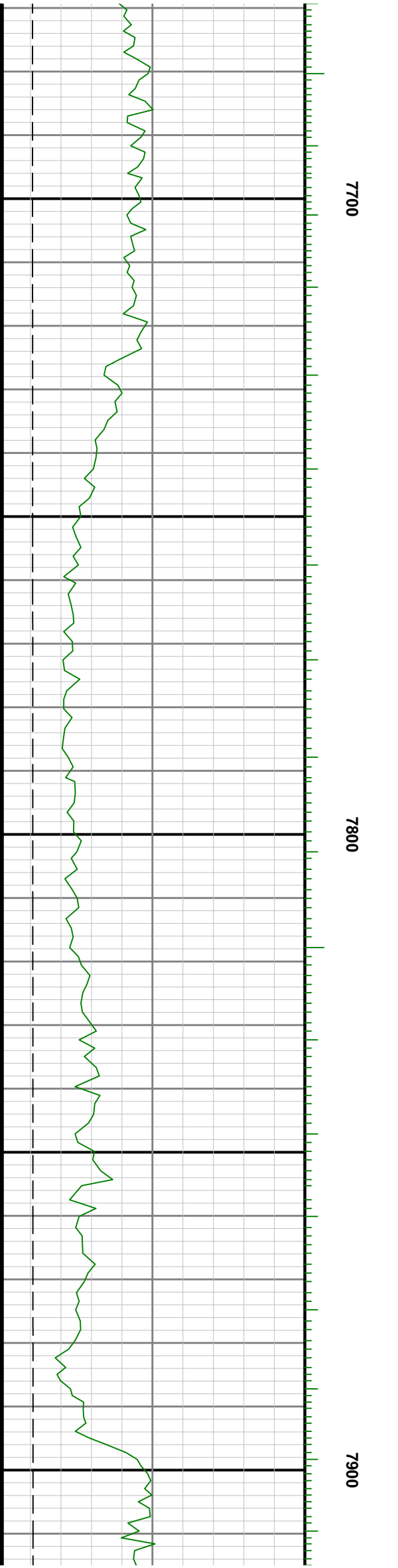


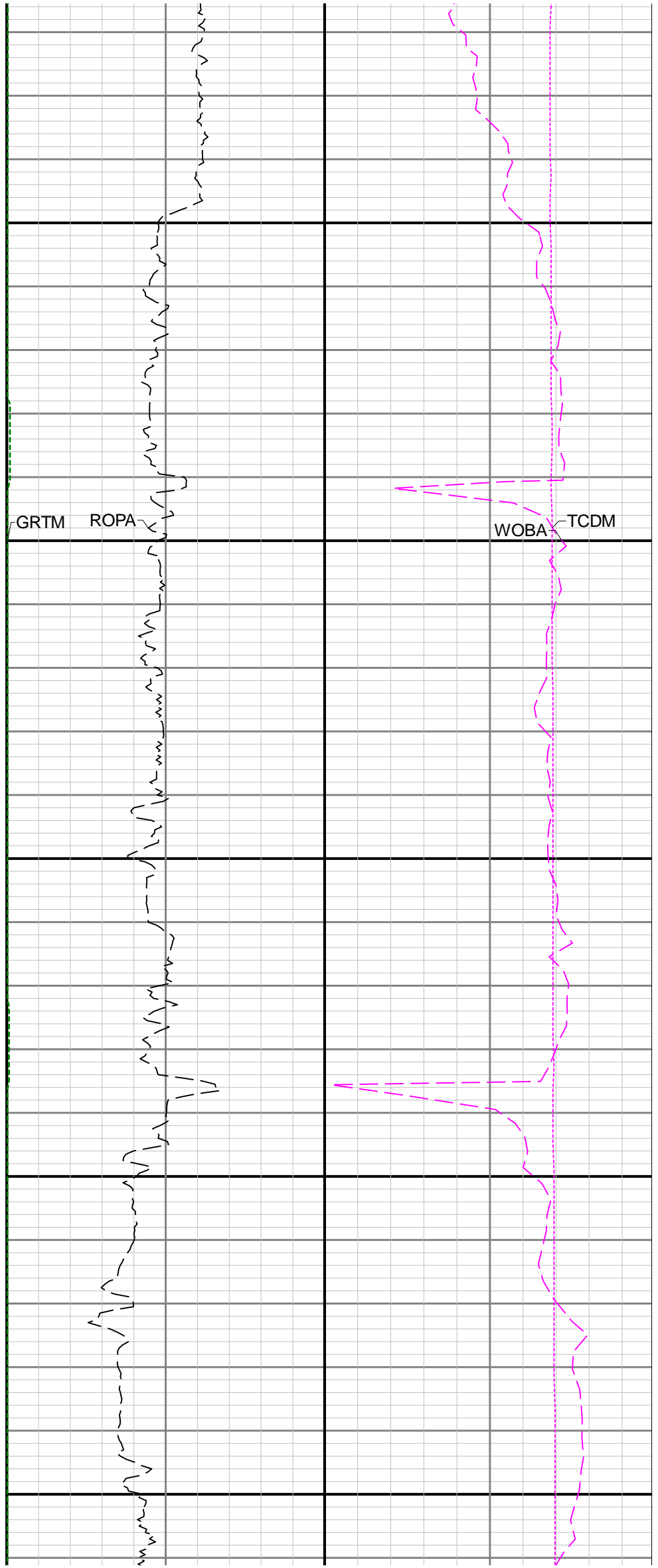
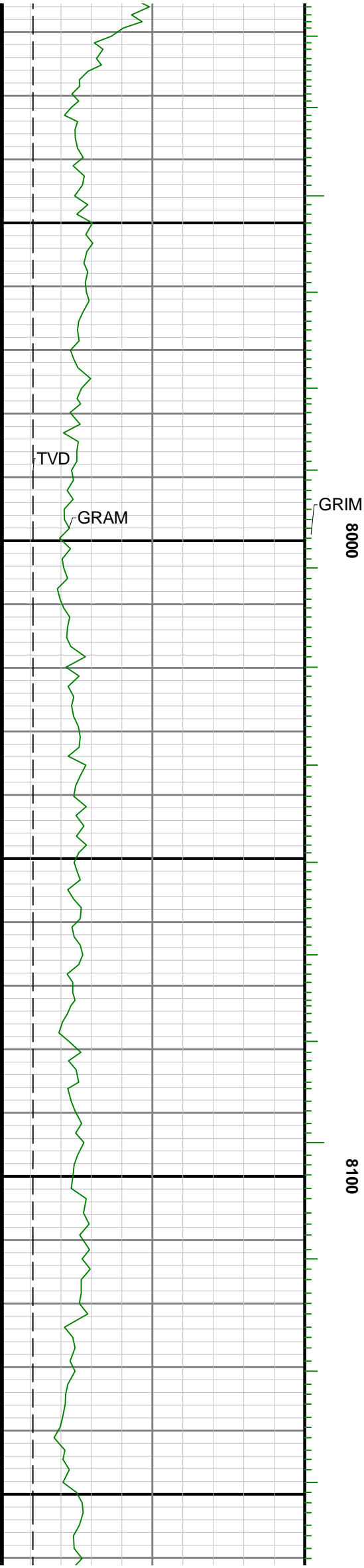


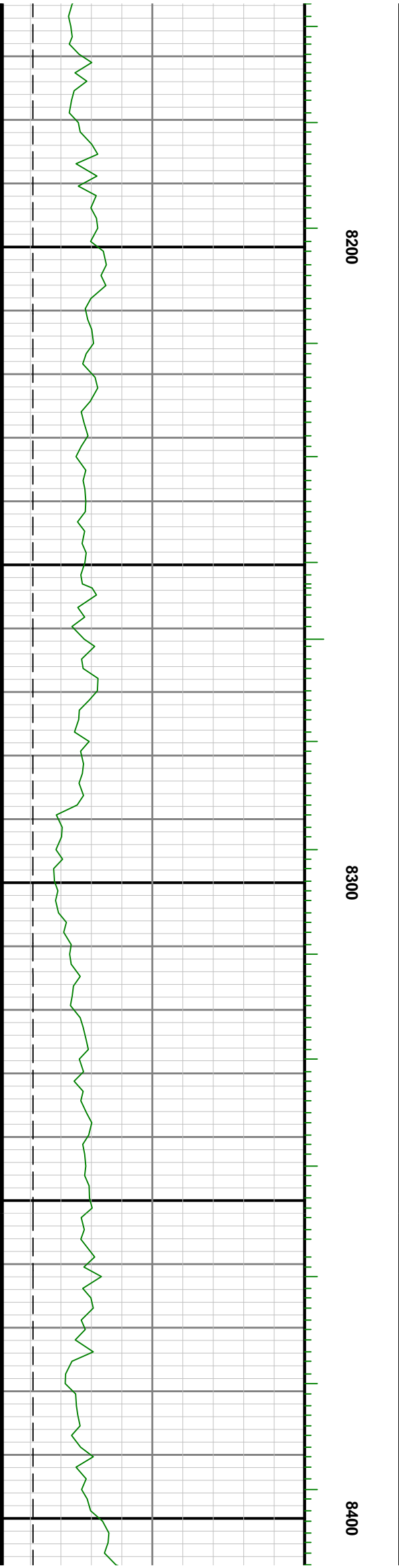
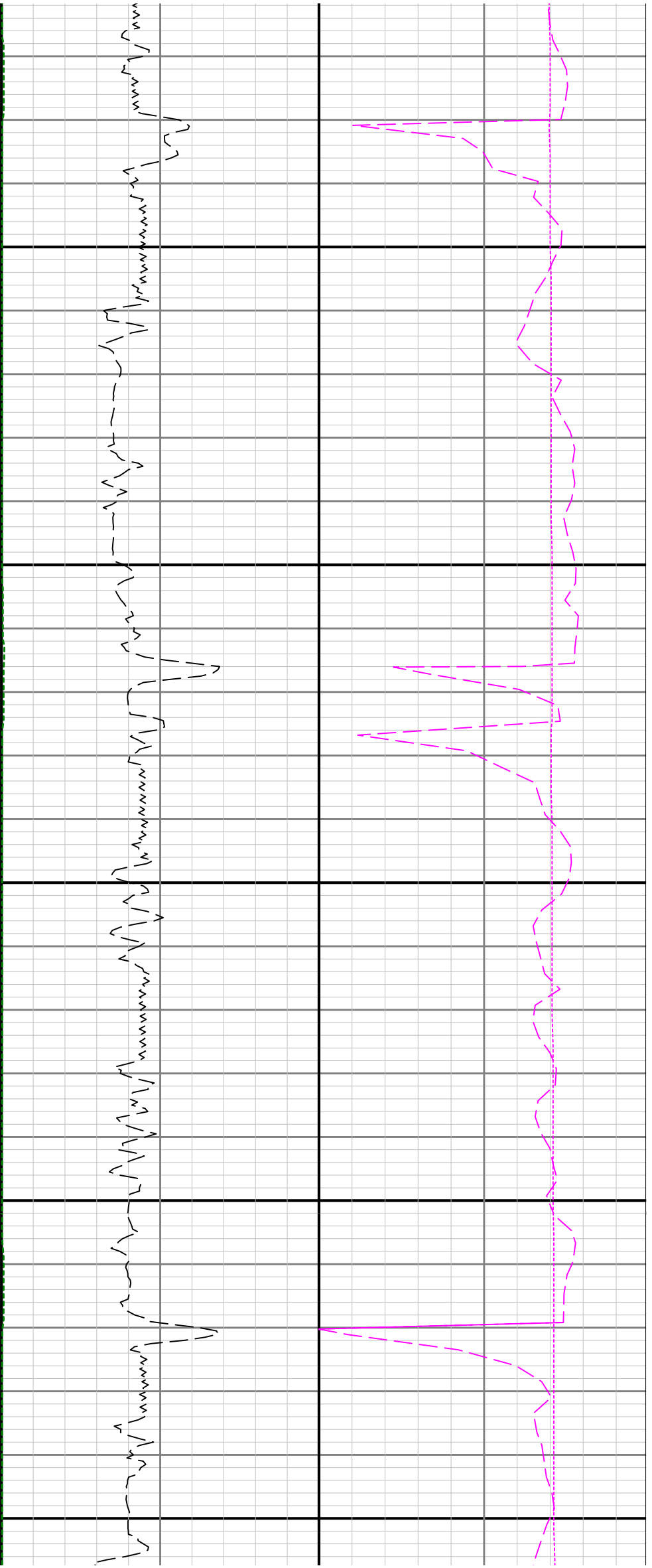
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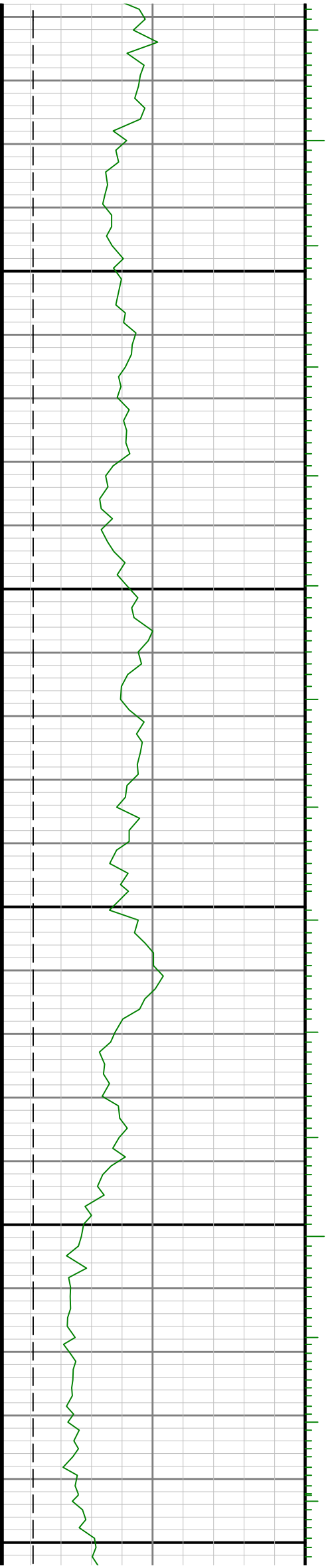
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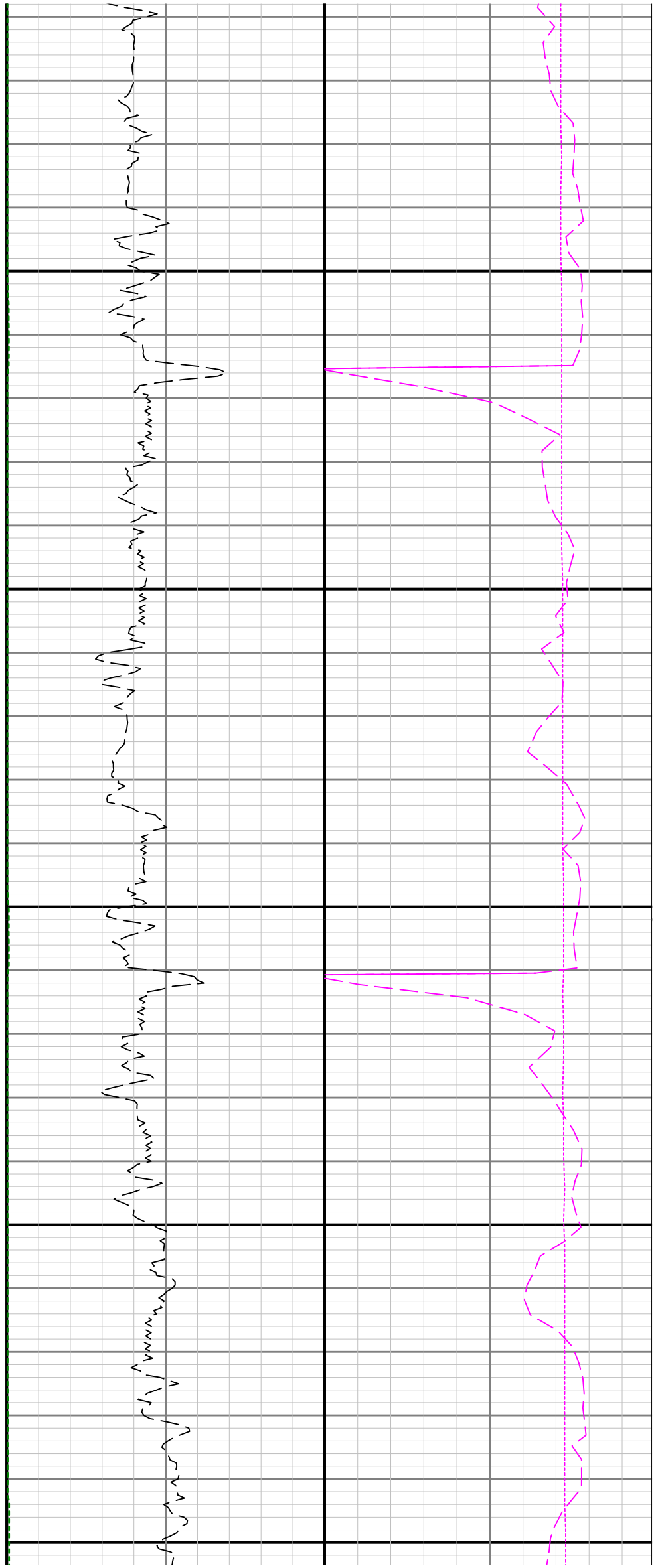


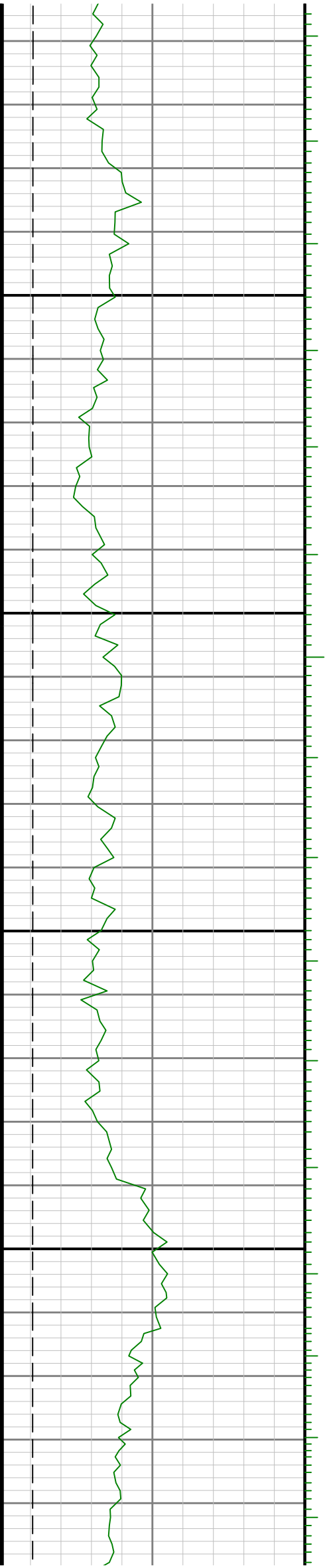




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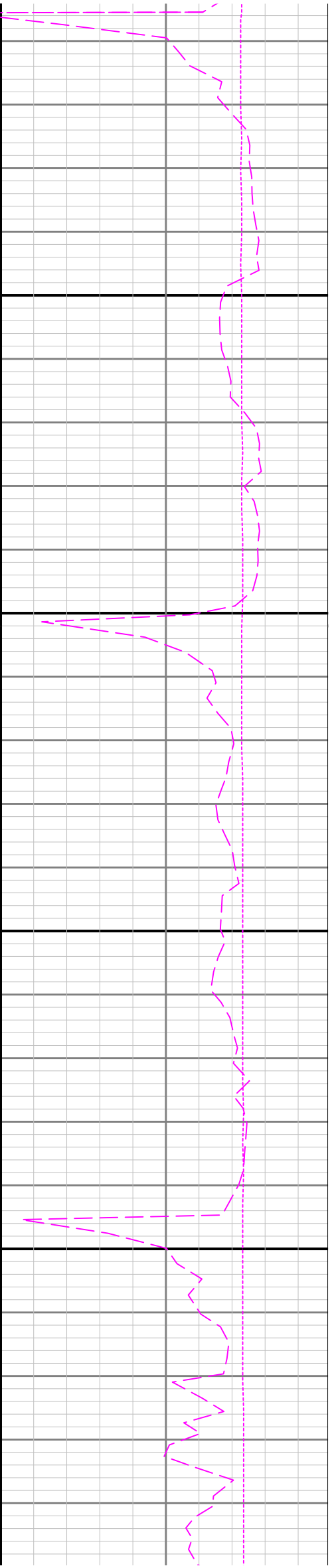
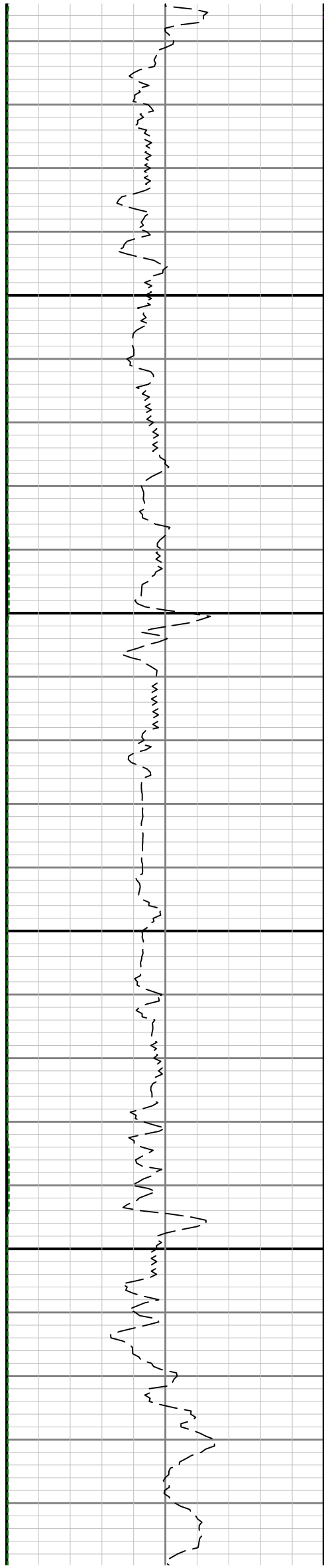


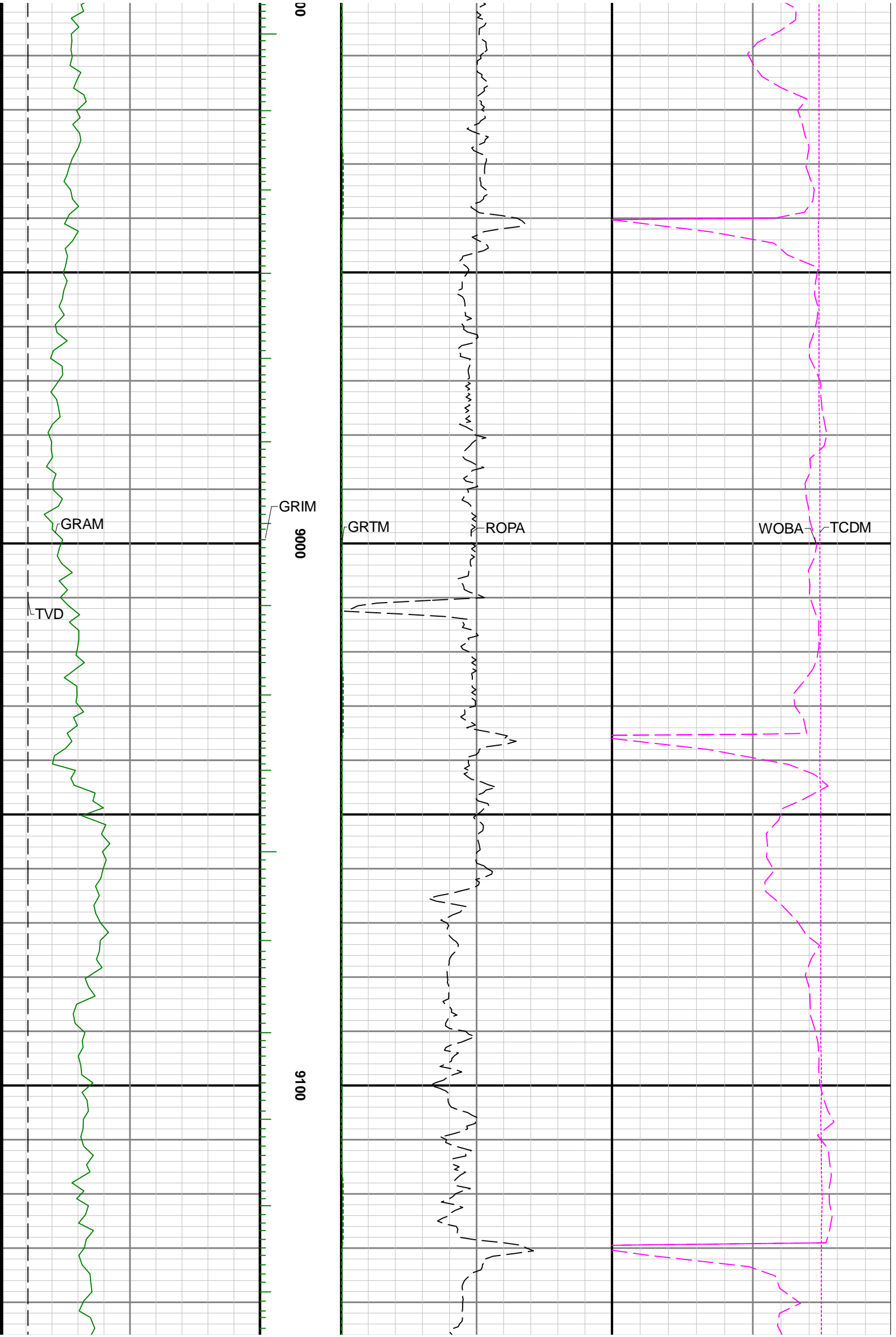


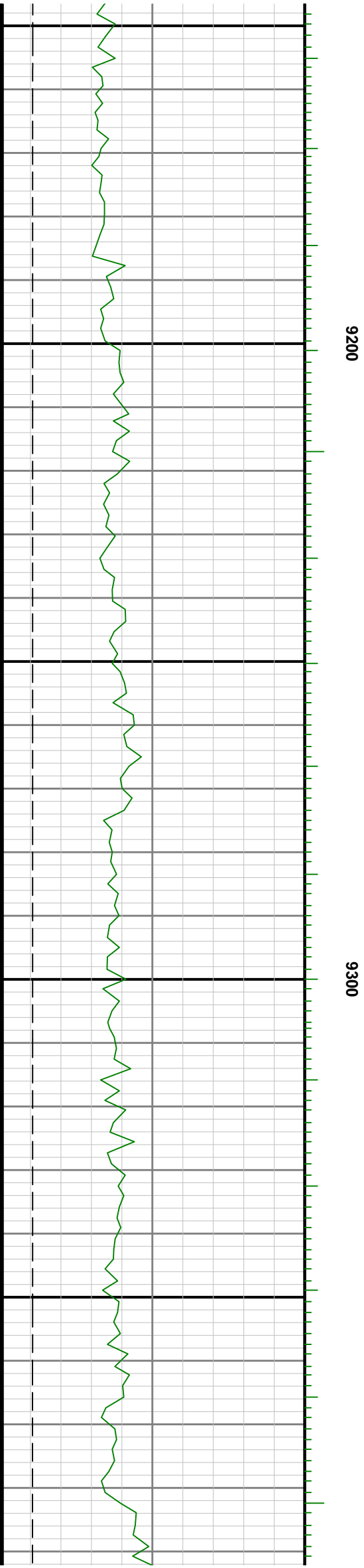
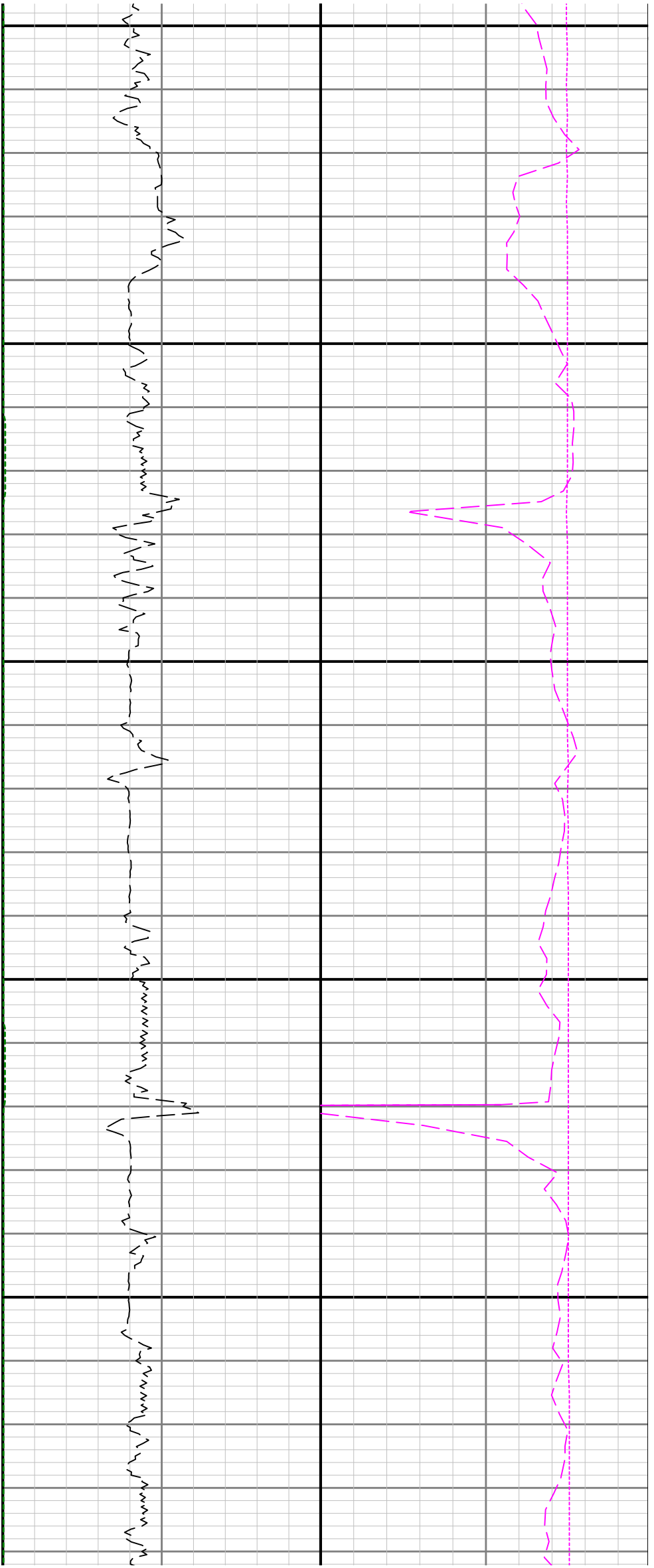
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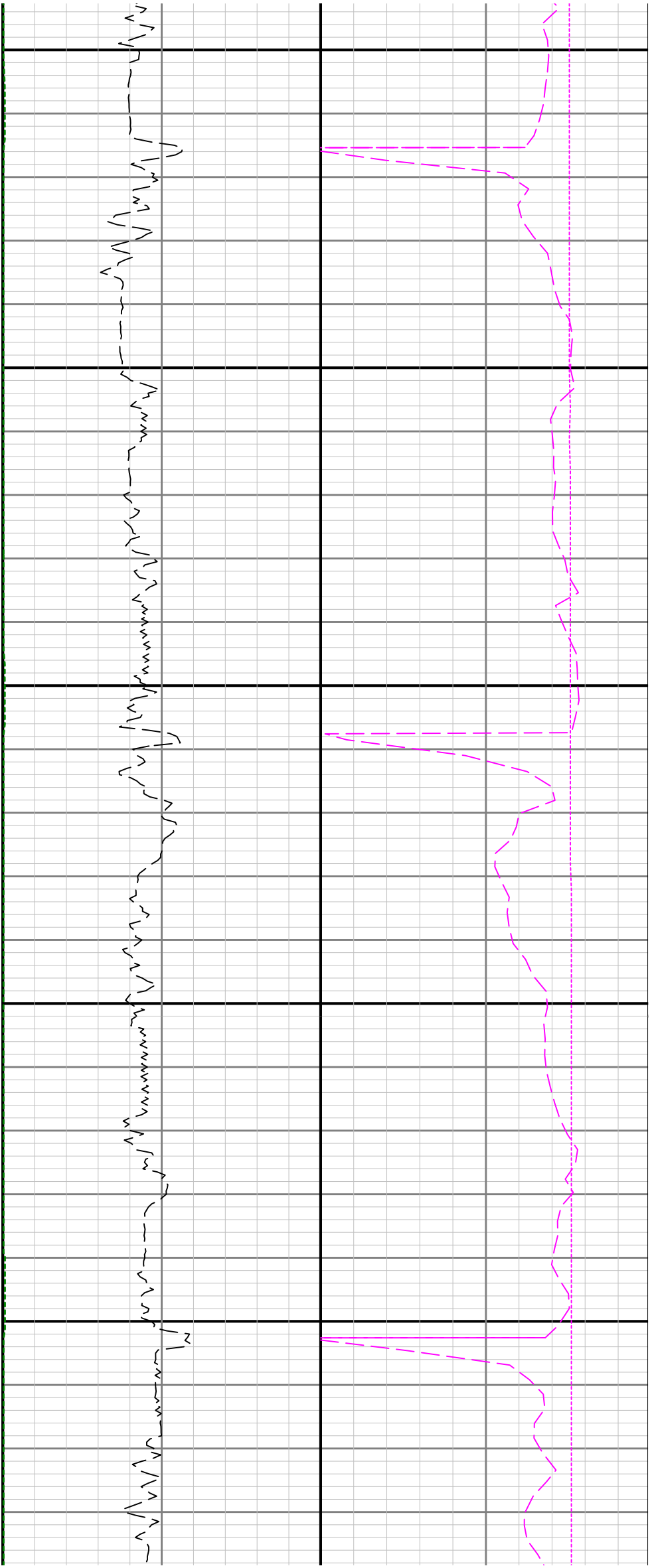
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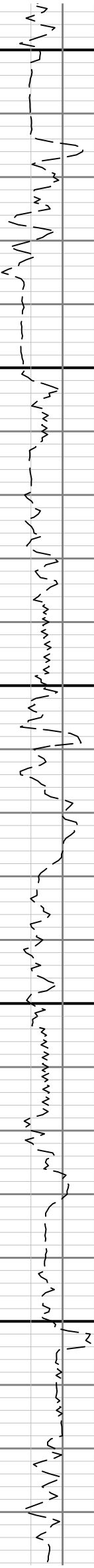


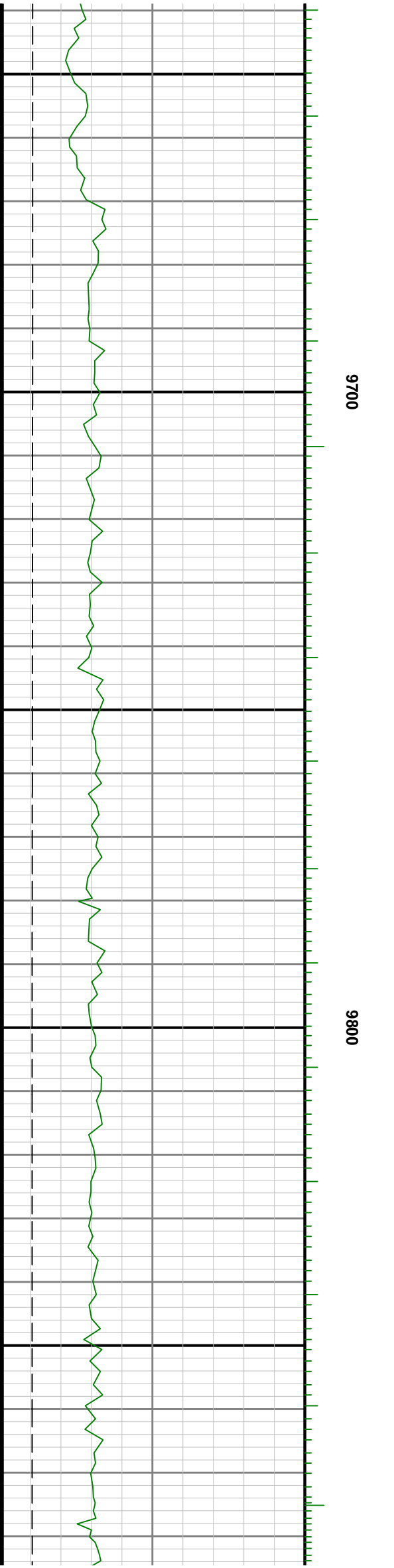
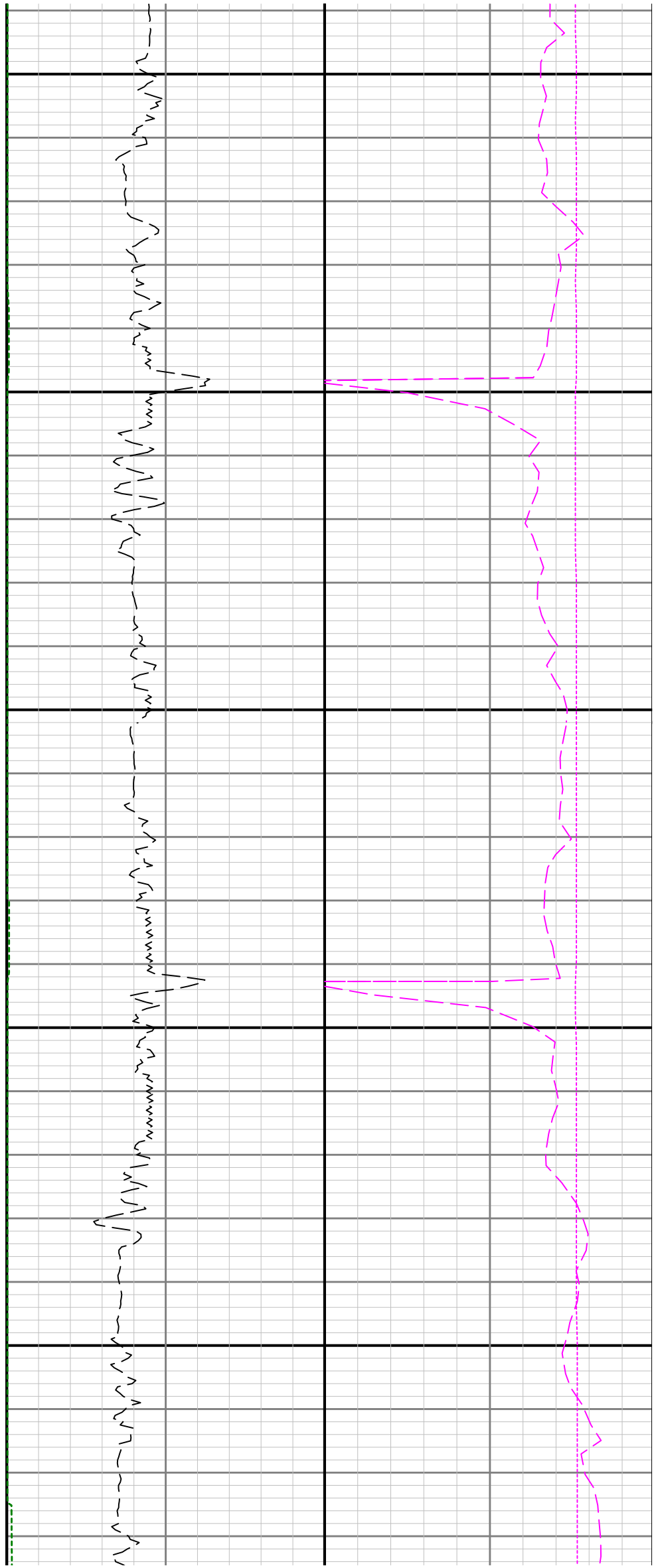


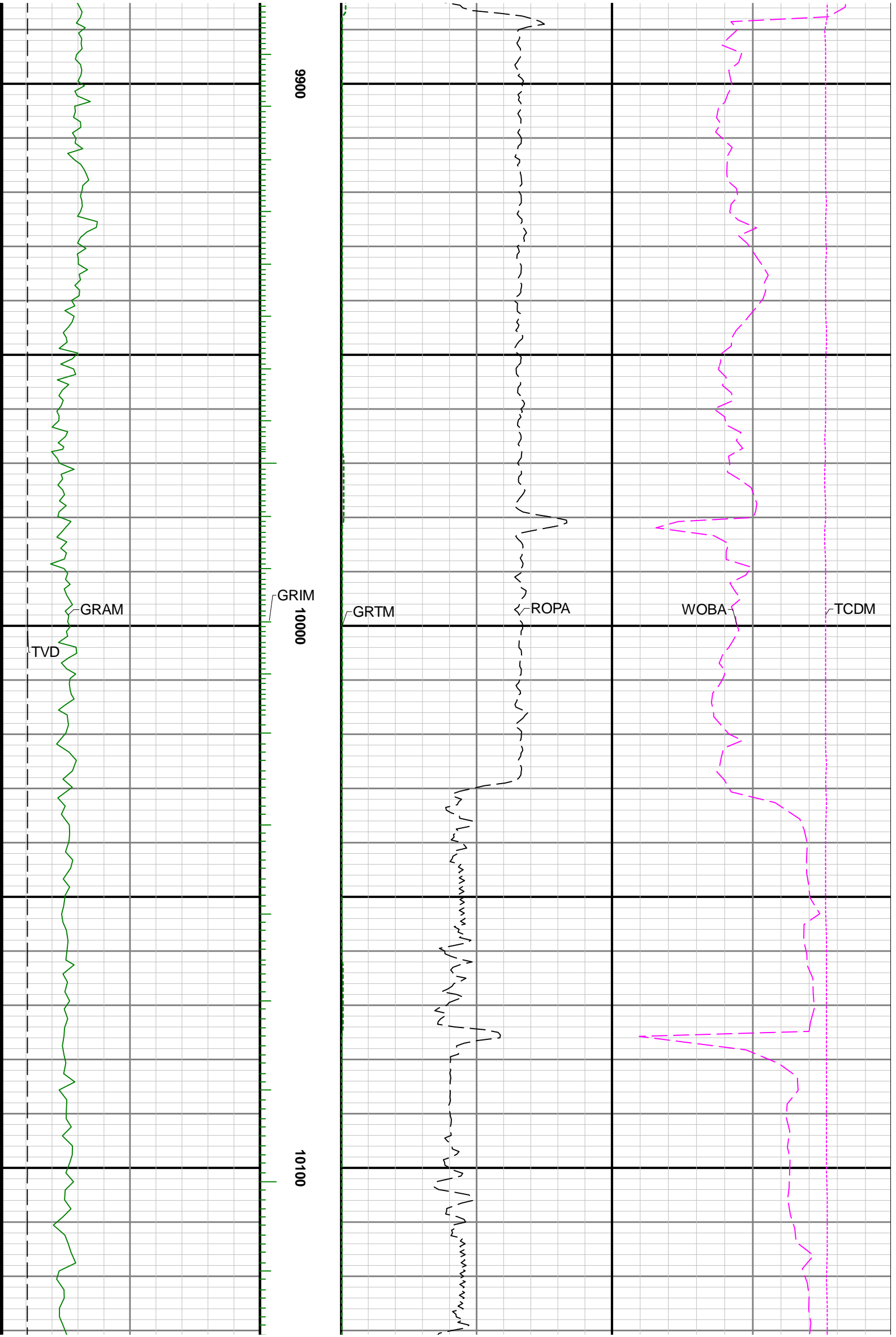
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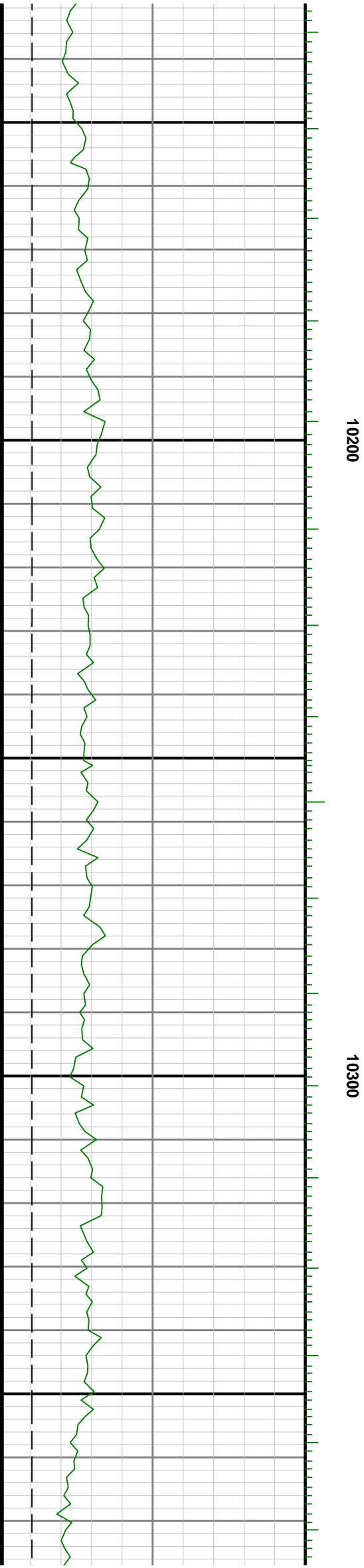
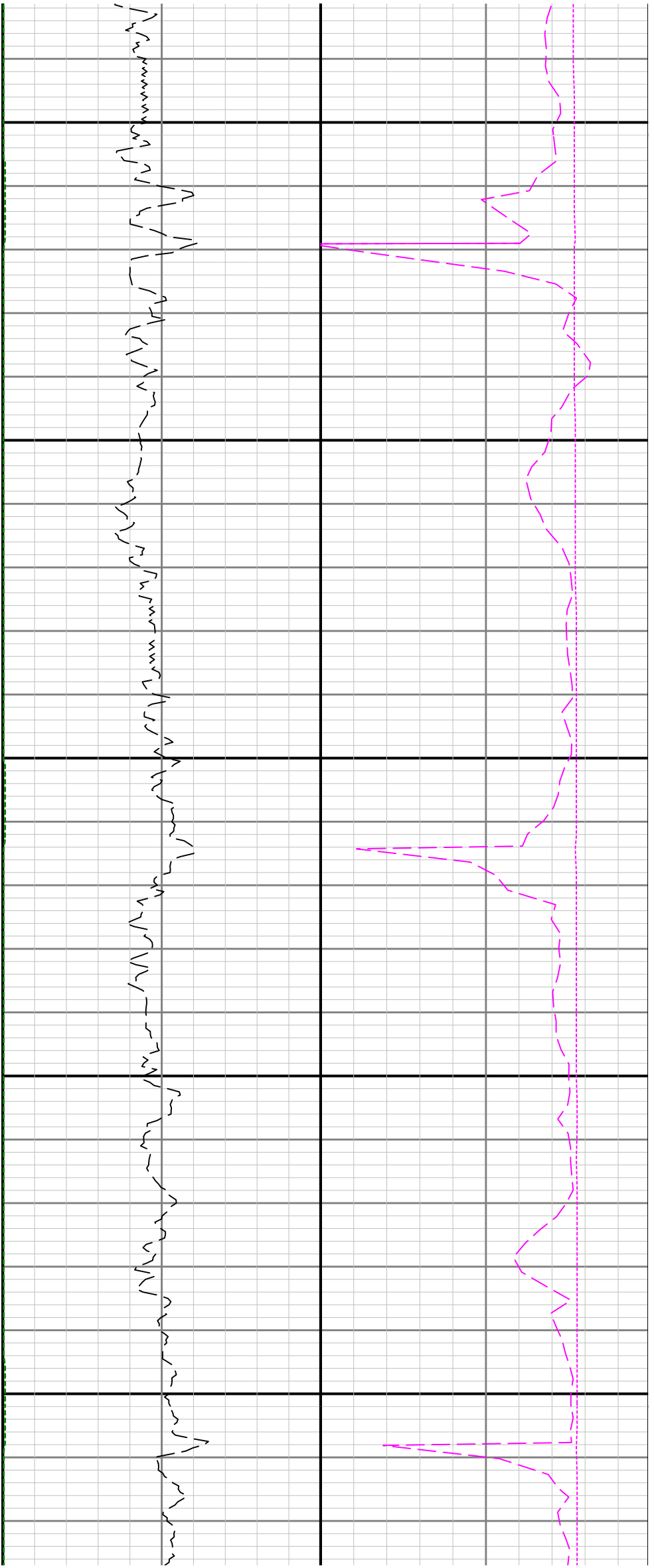
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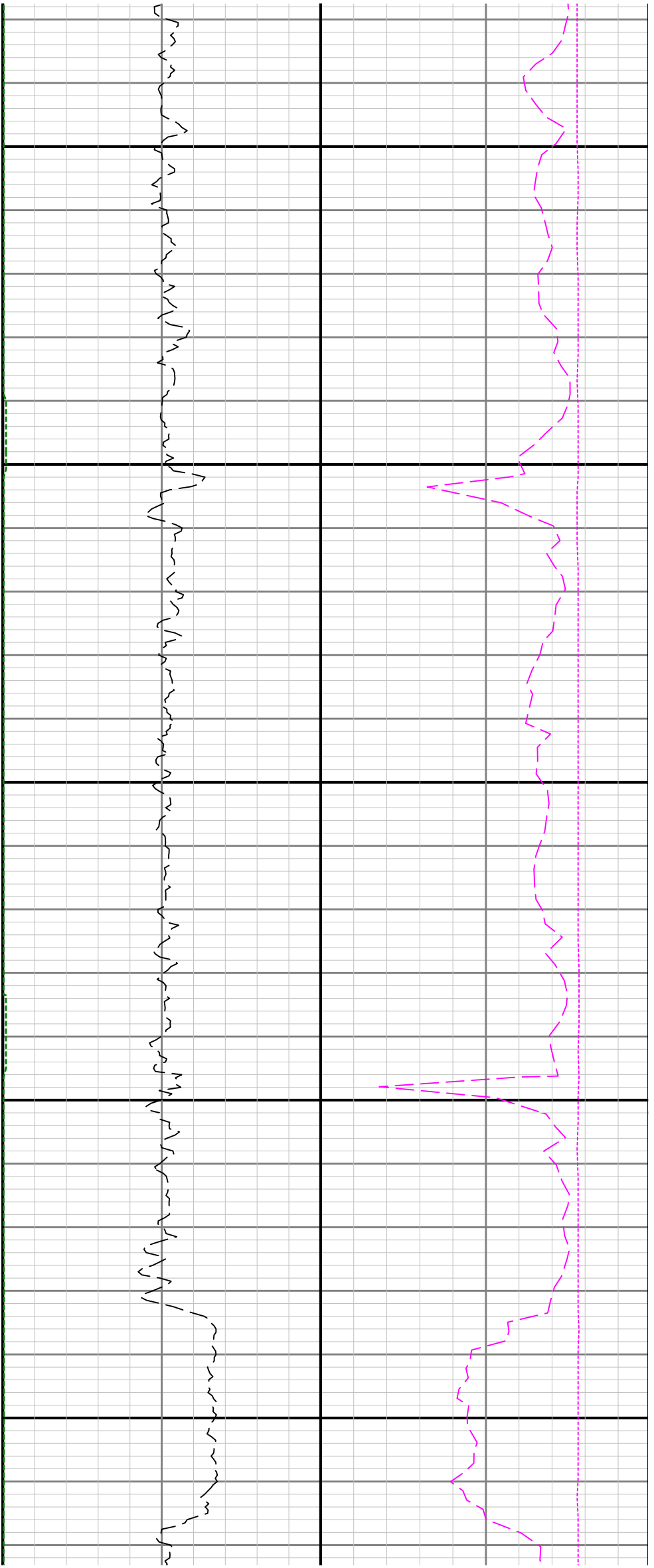
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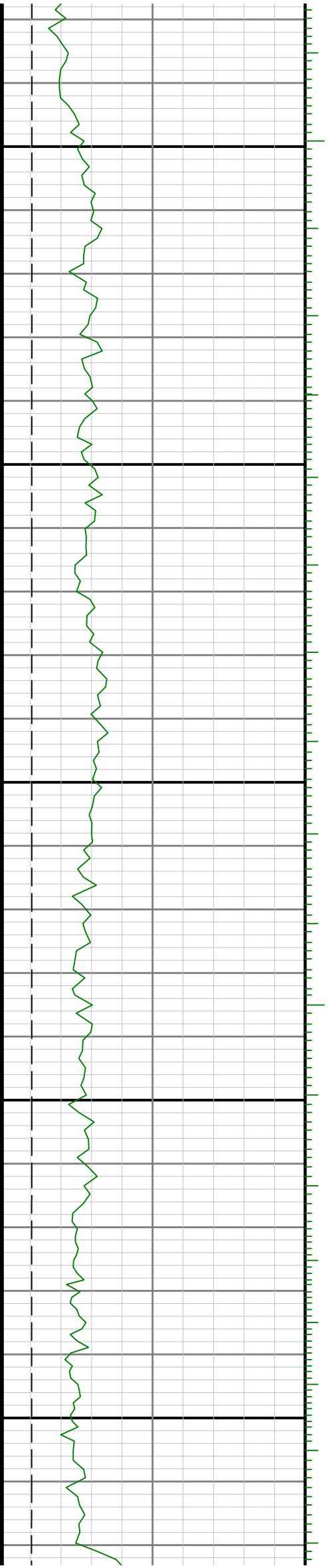


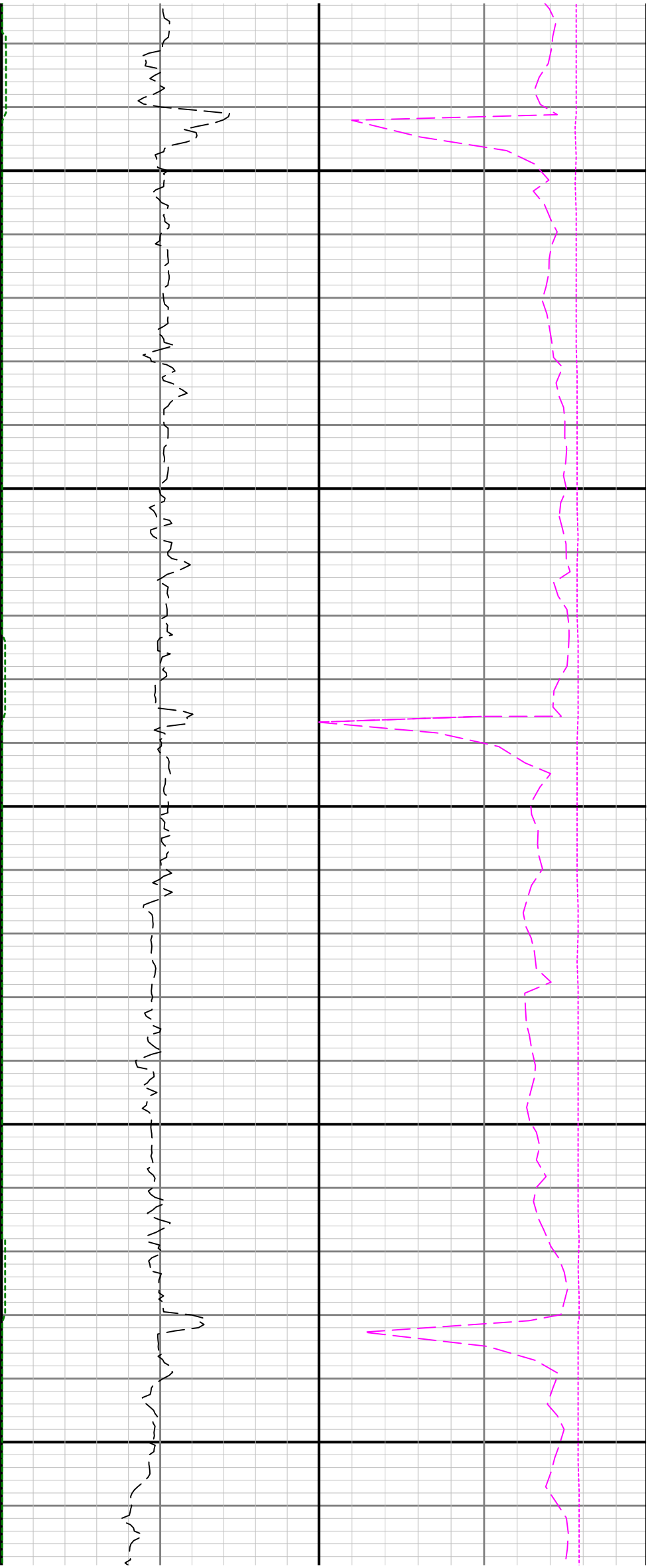


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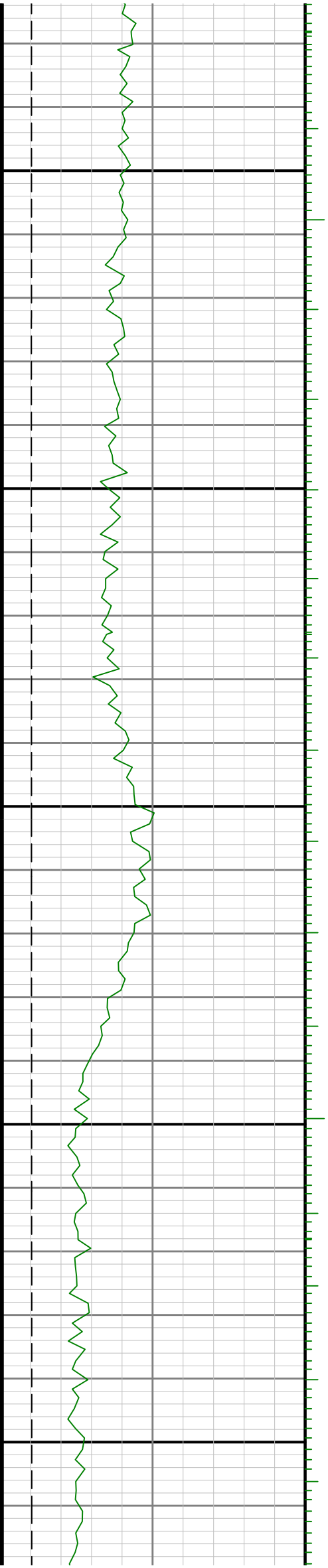
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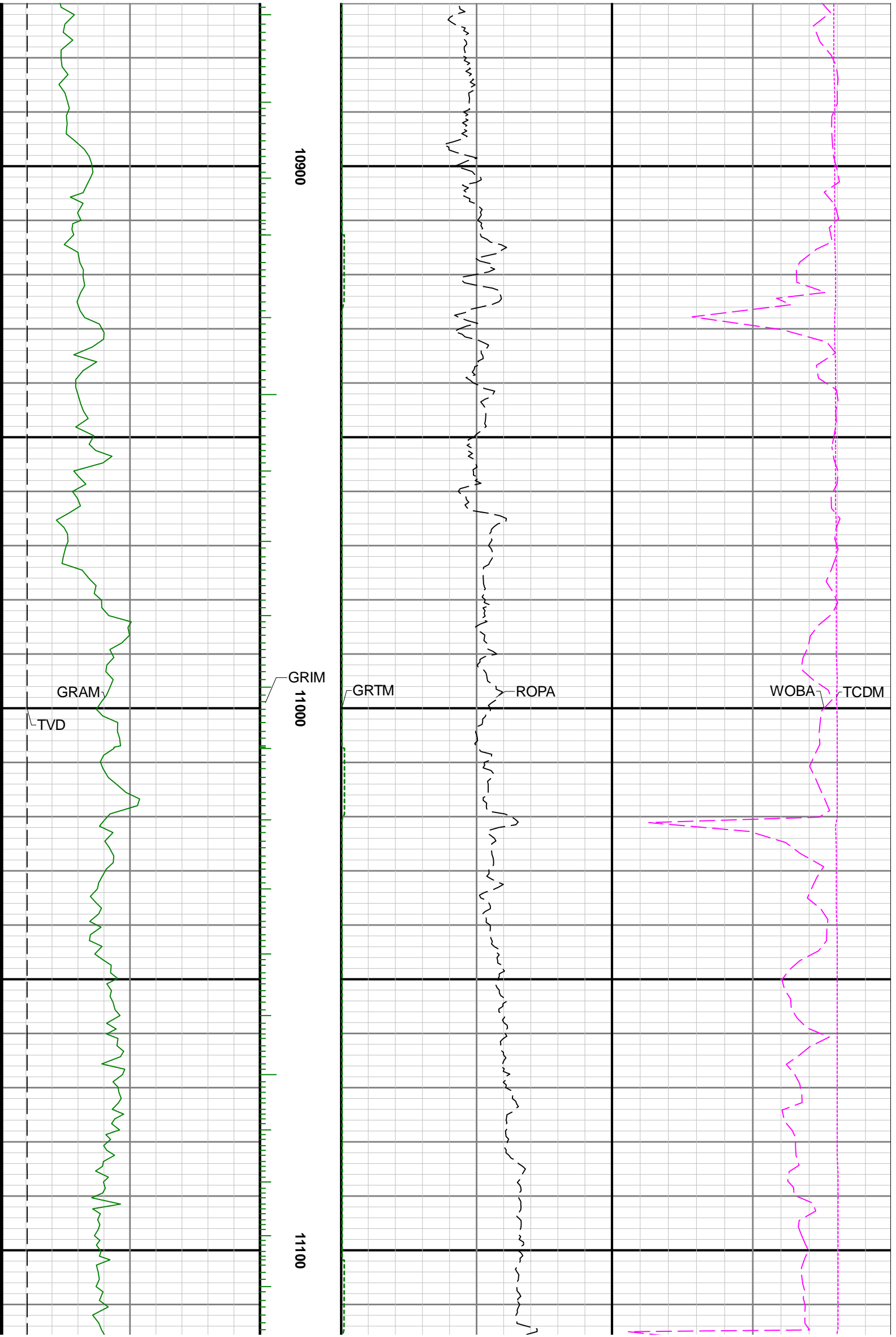


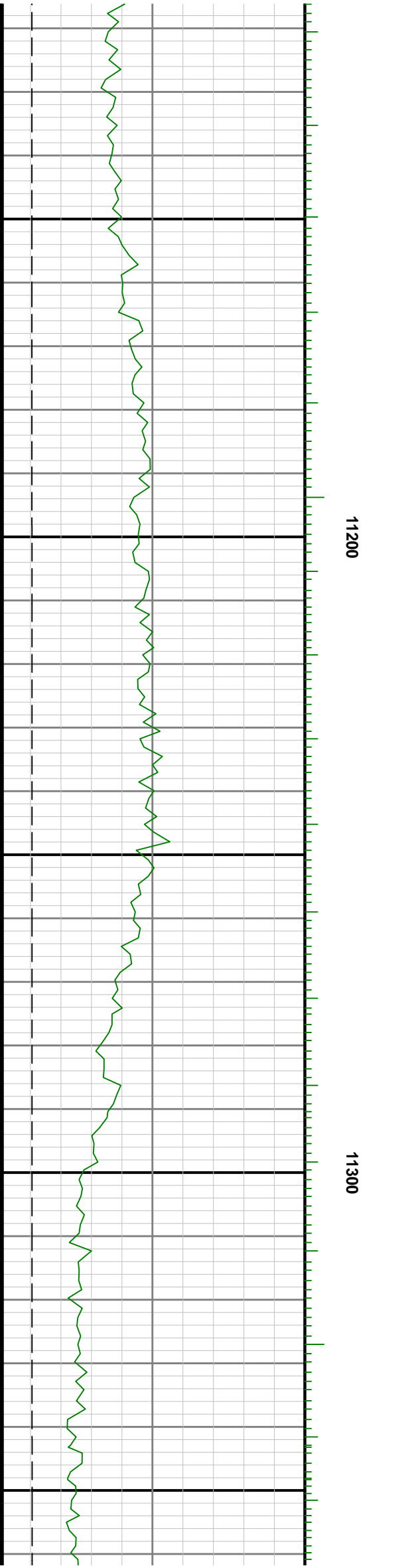


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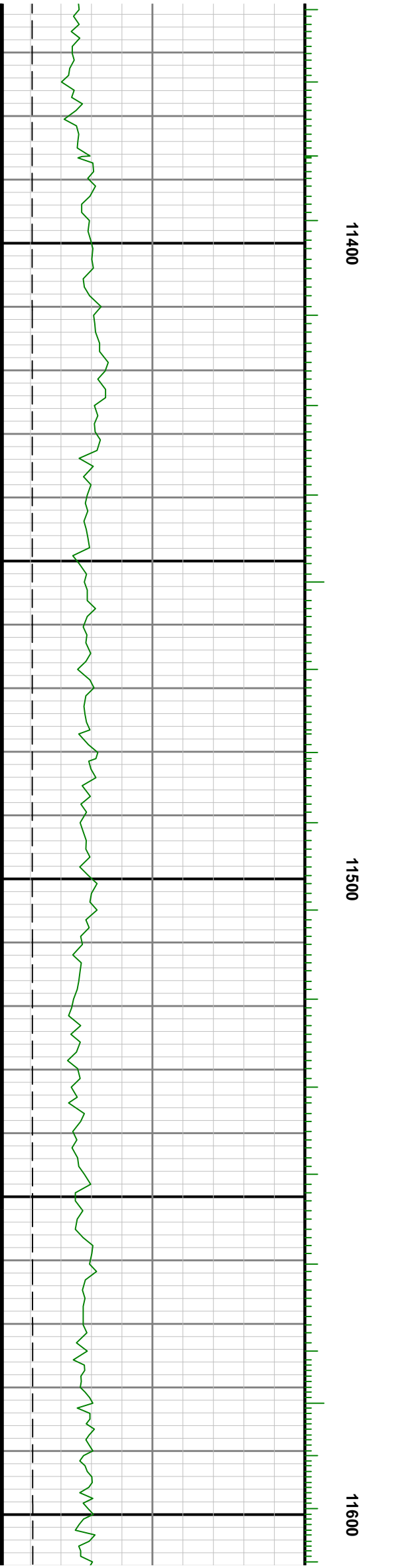
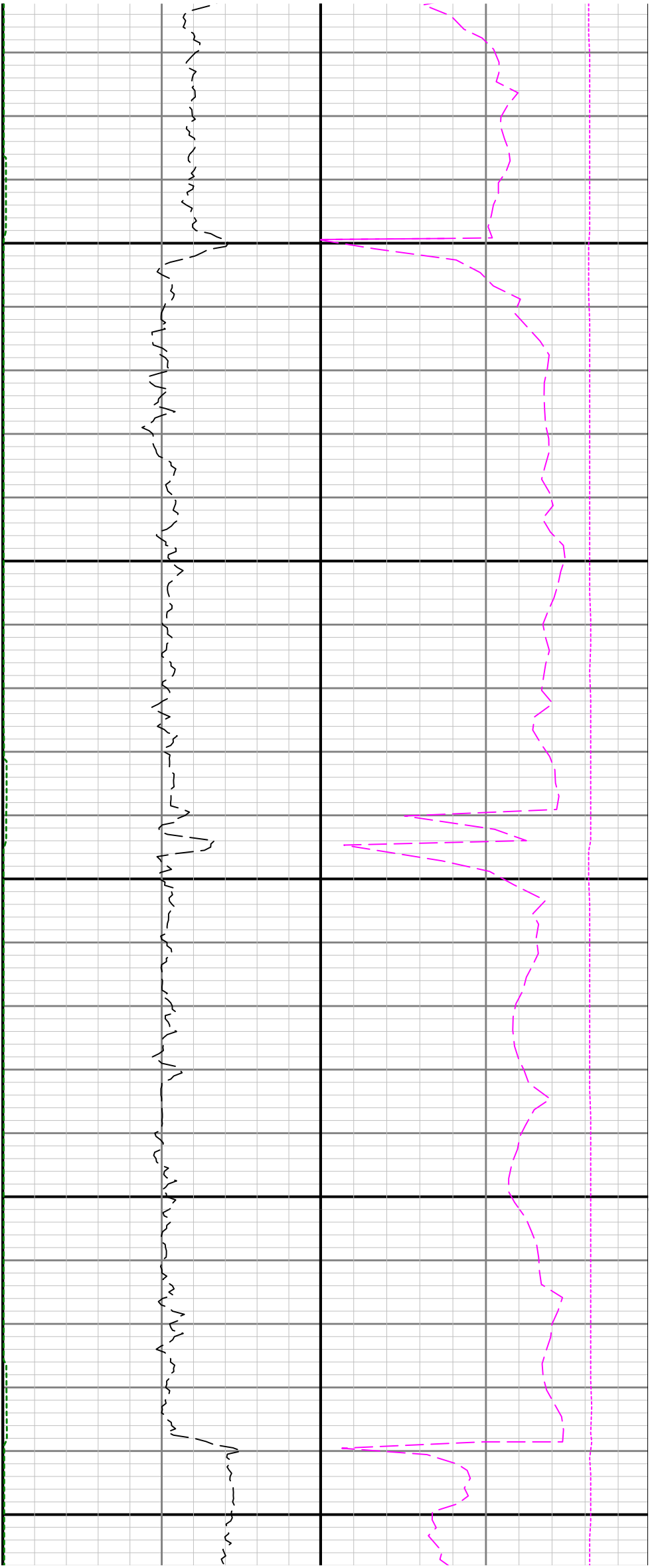
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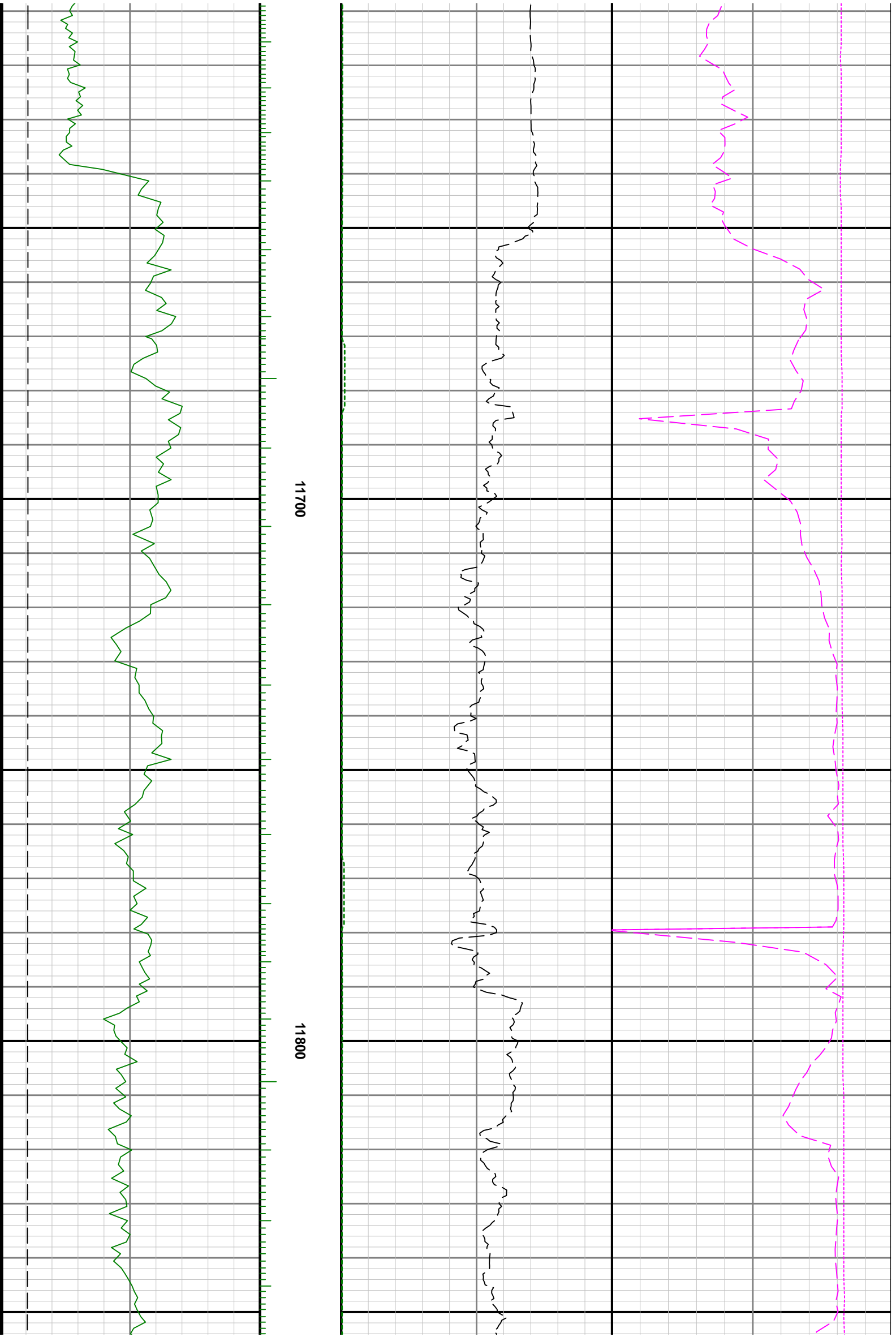


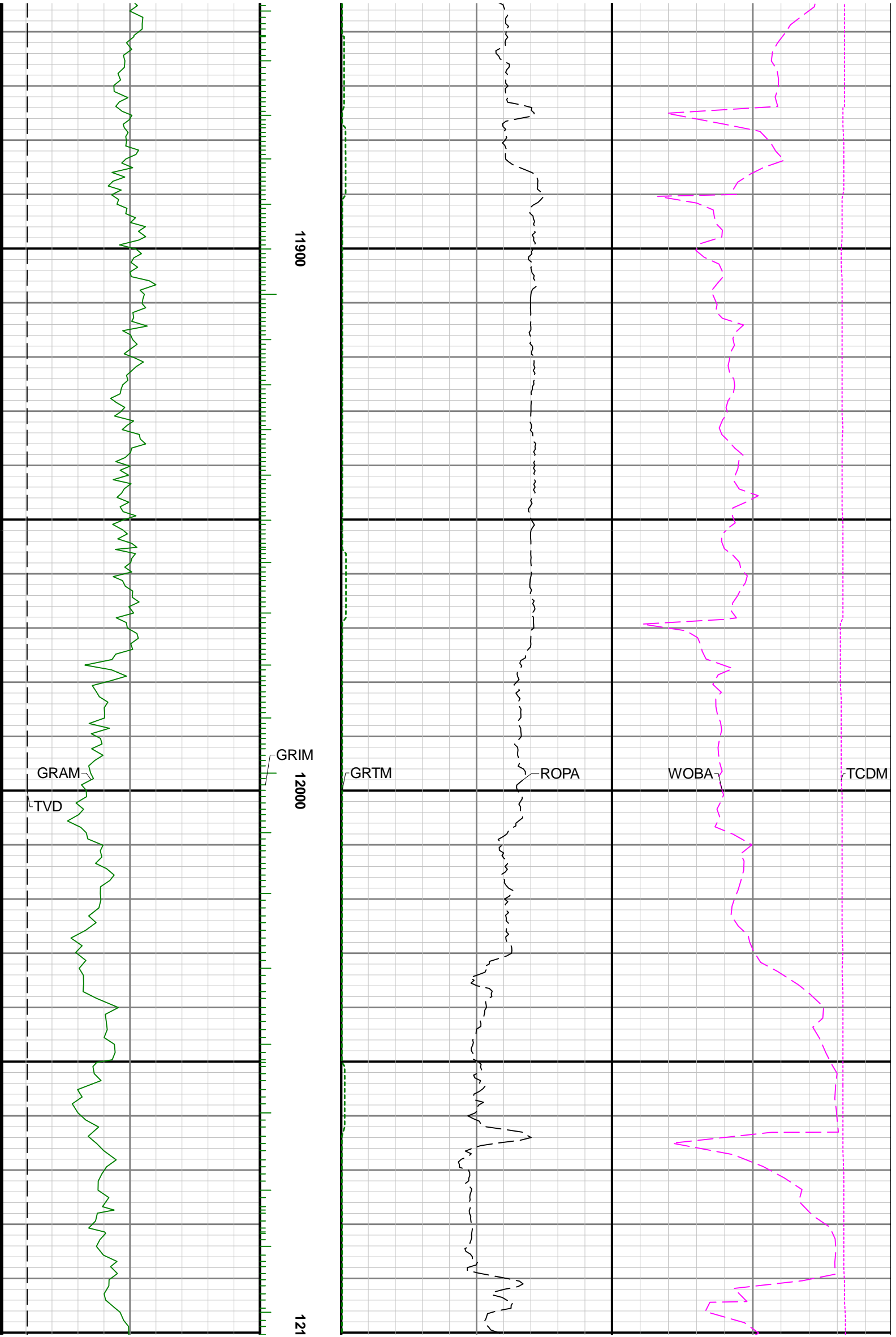




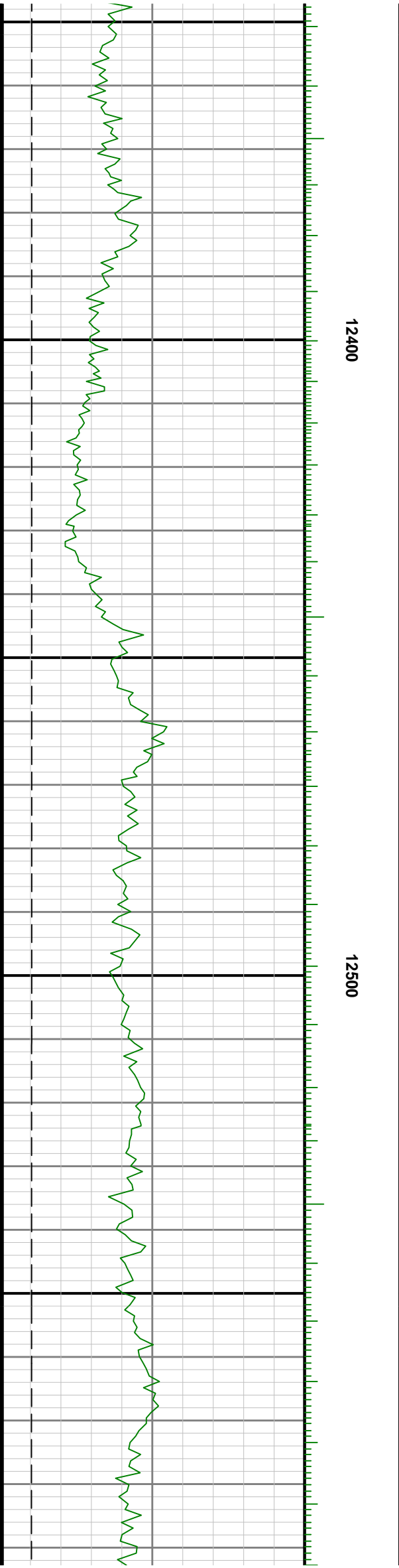
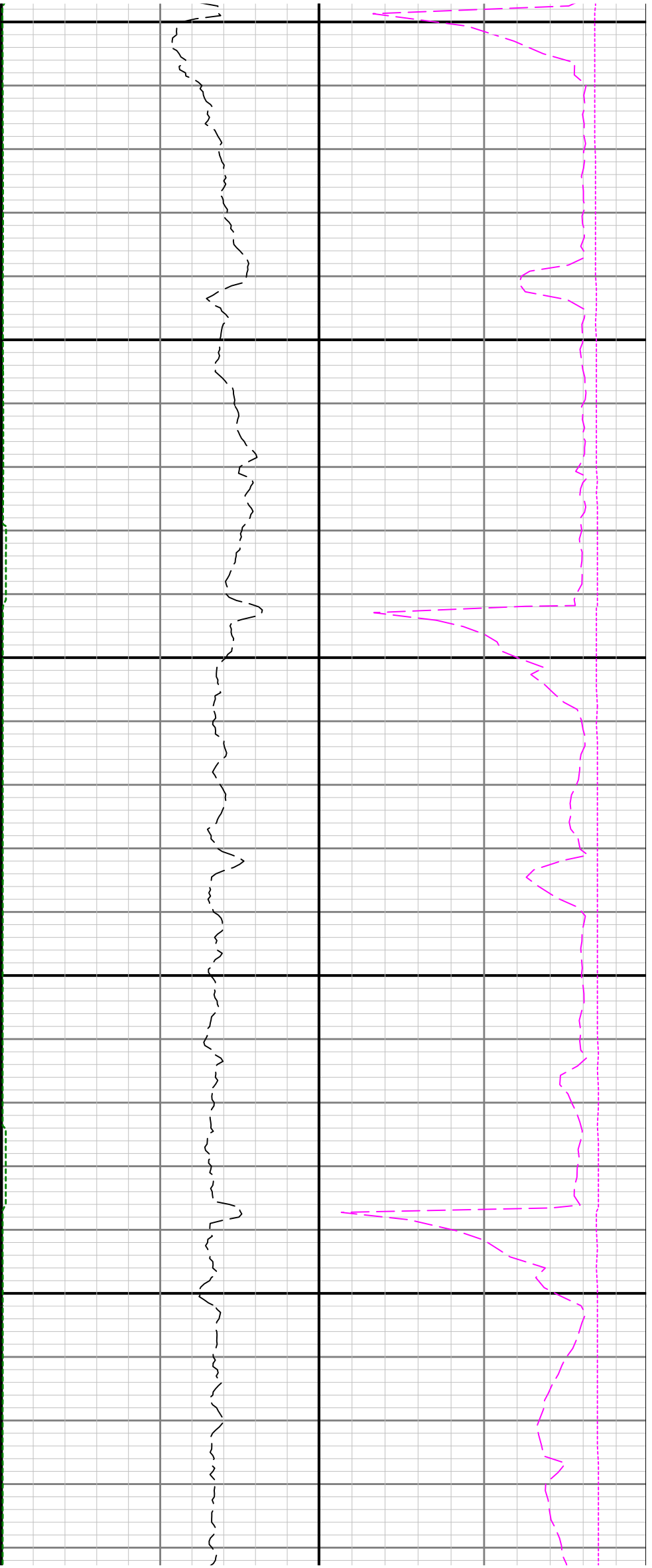


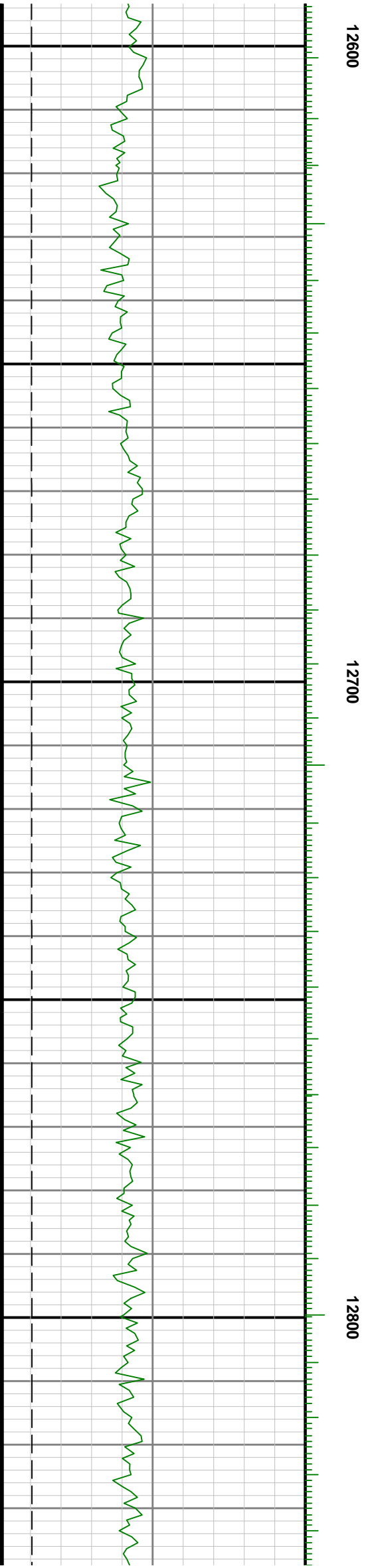
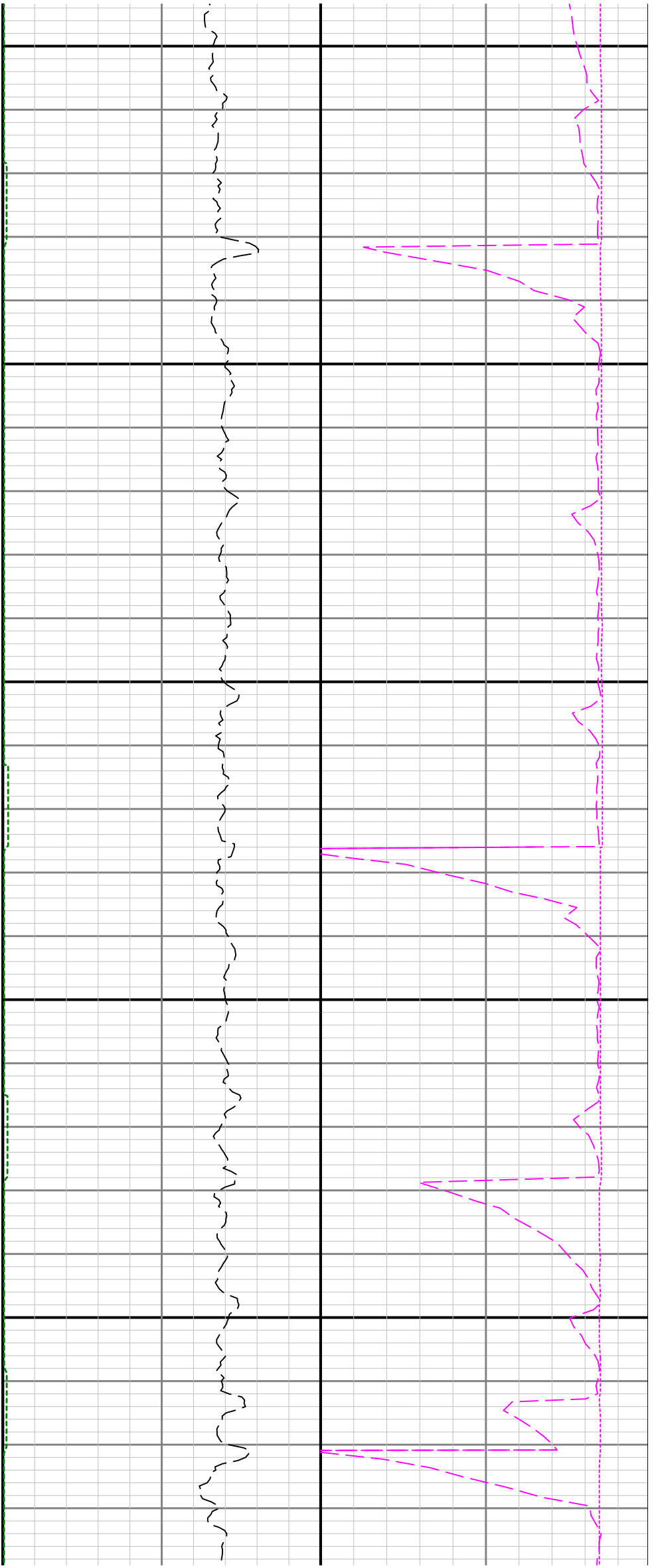


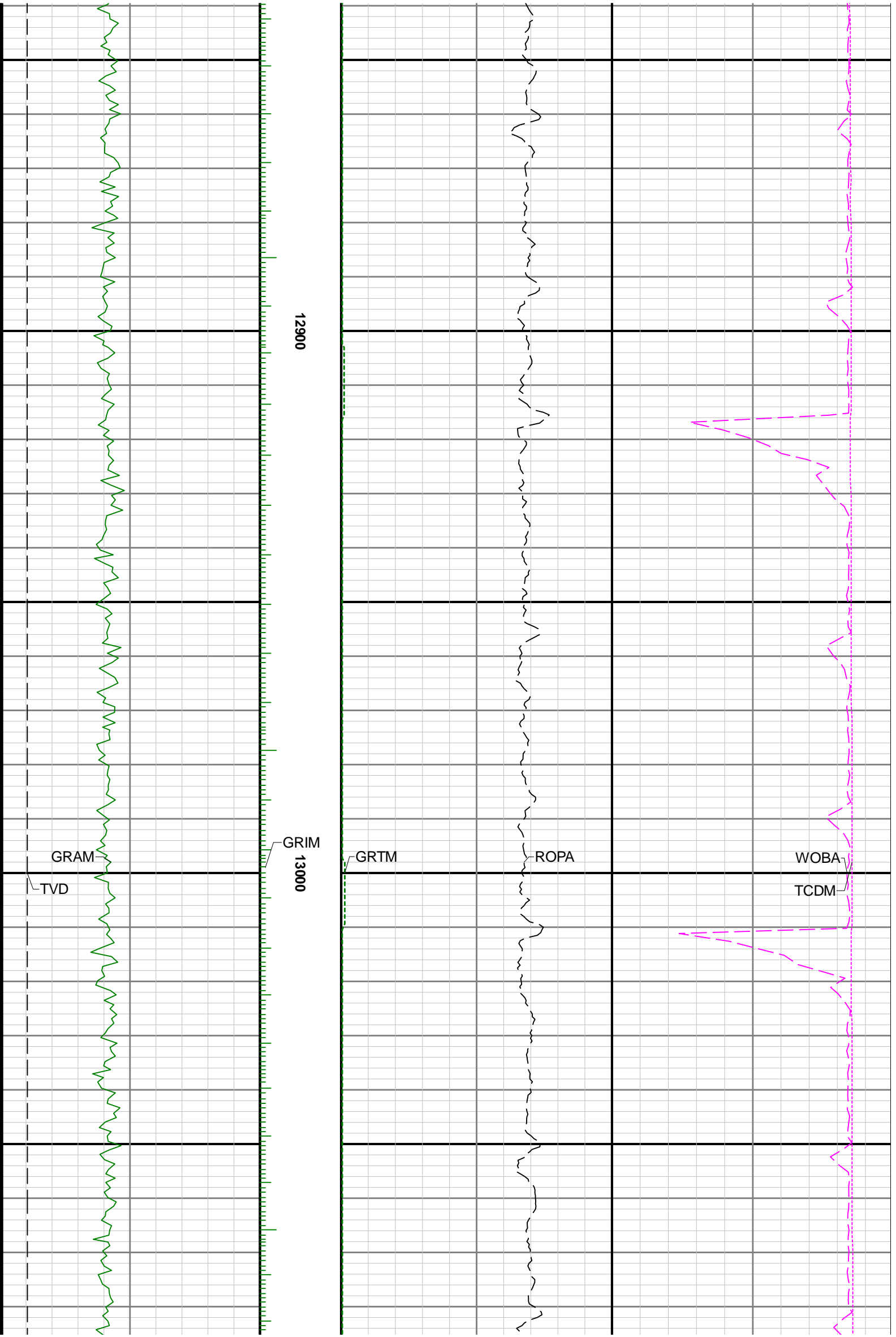


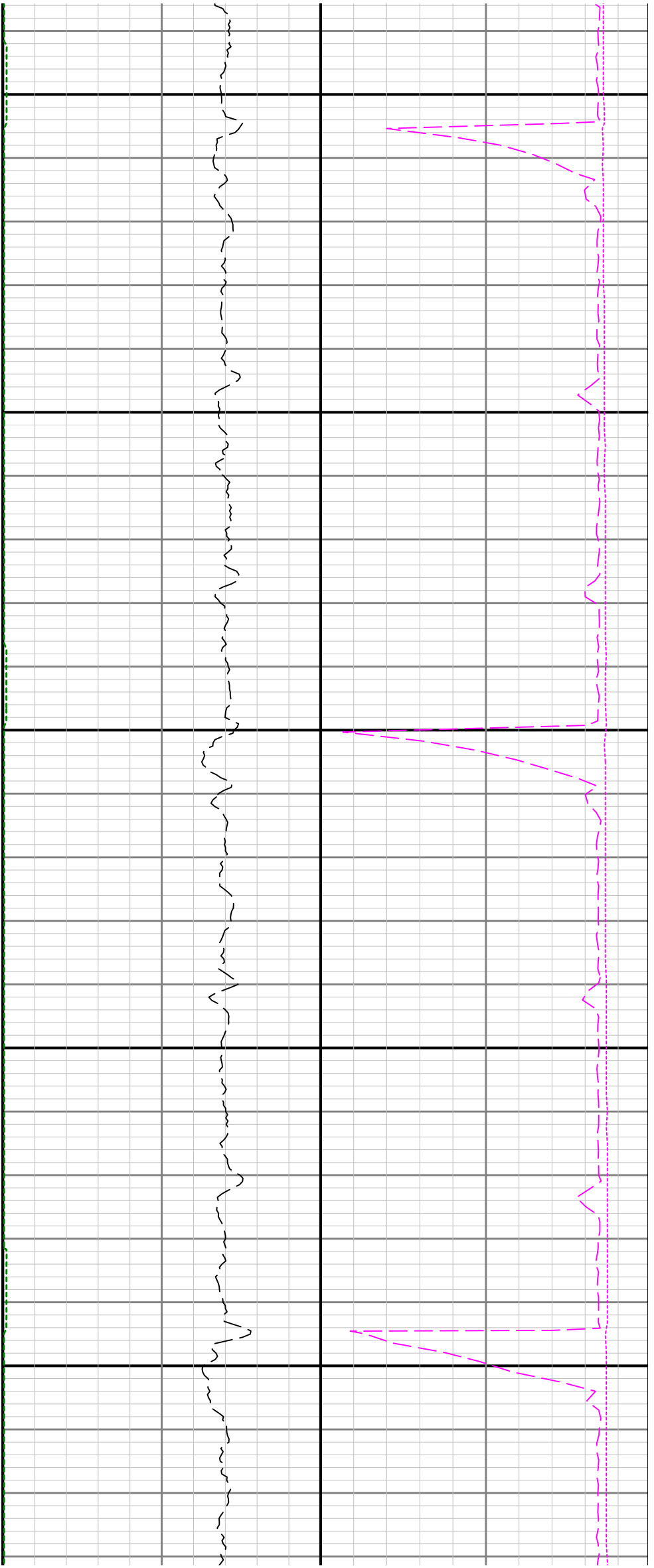








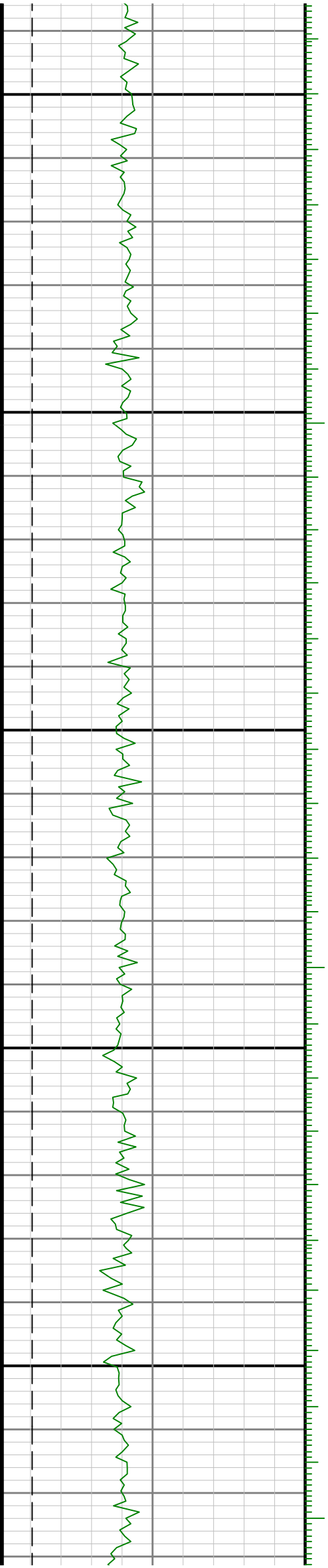




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13200

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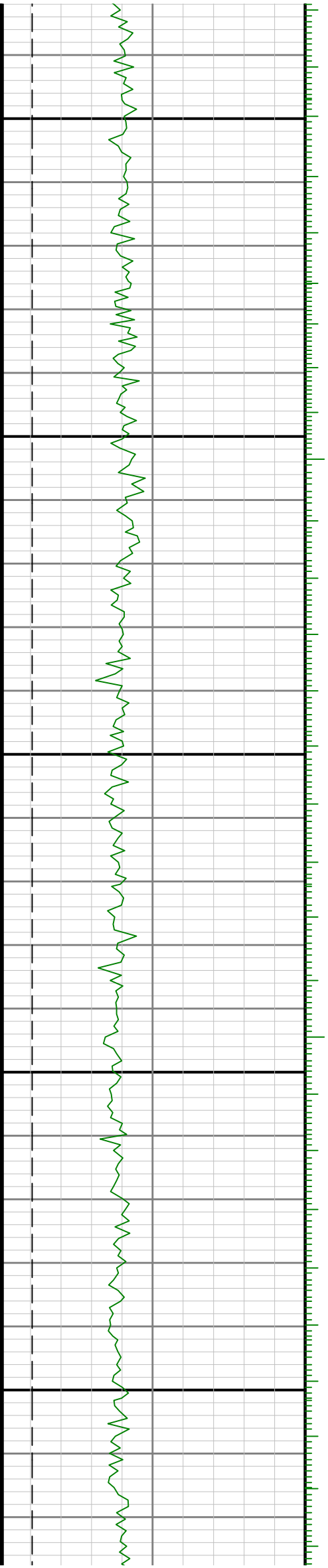




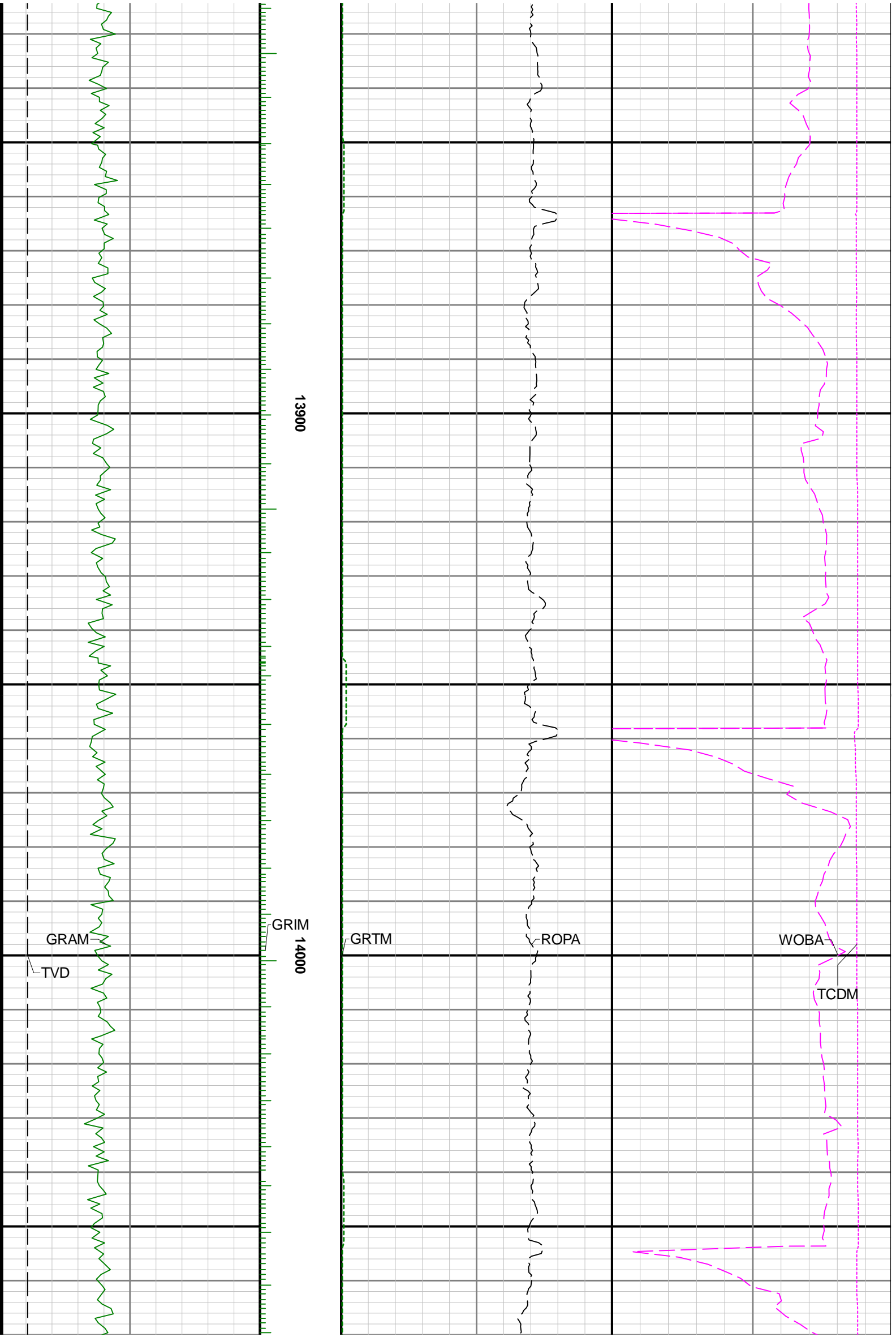


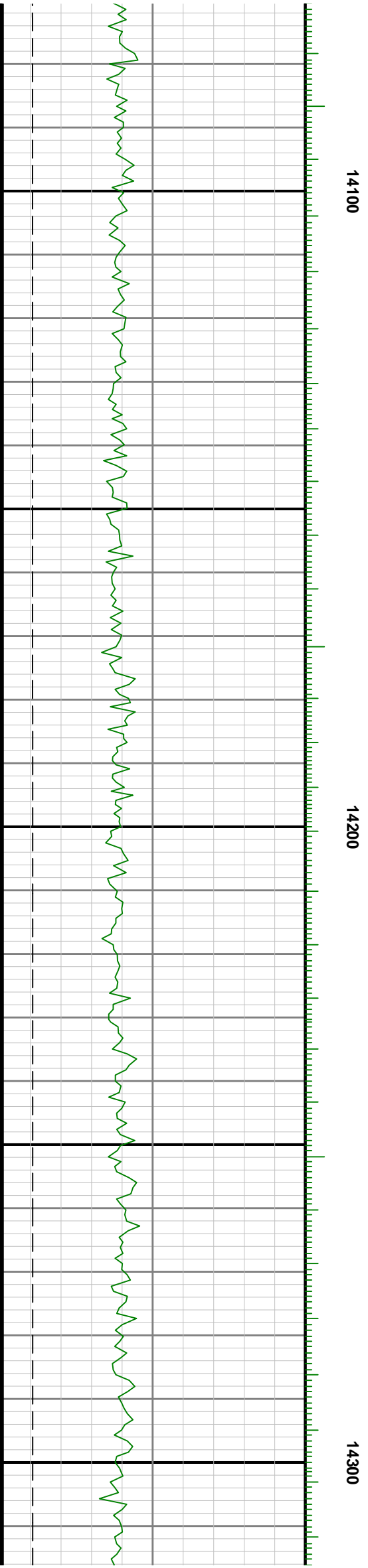
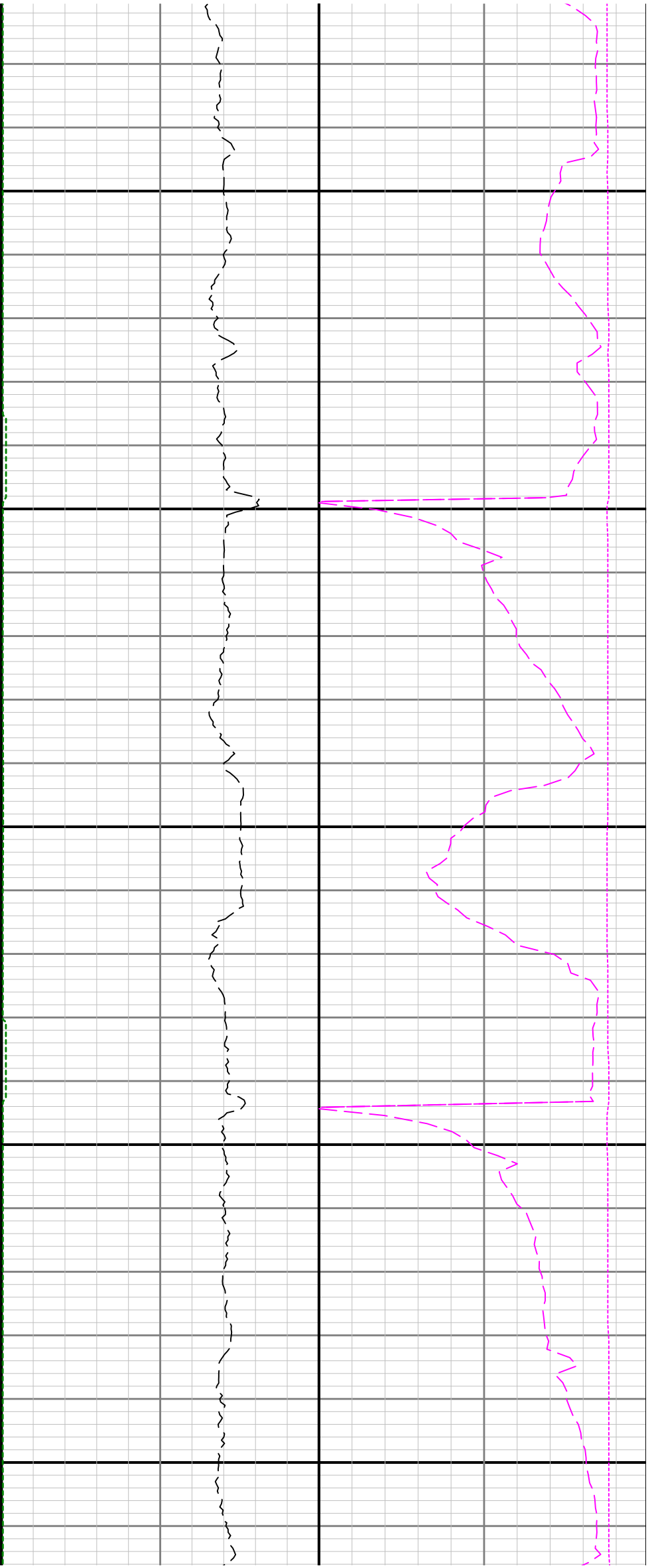
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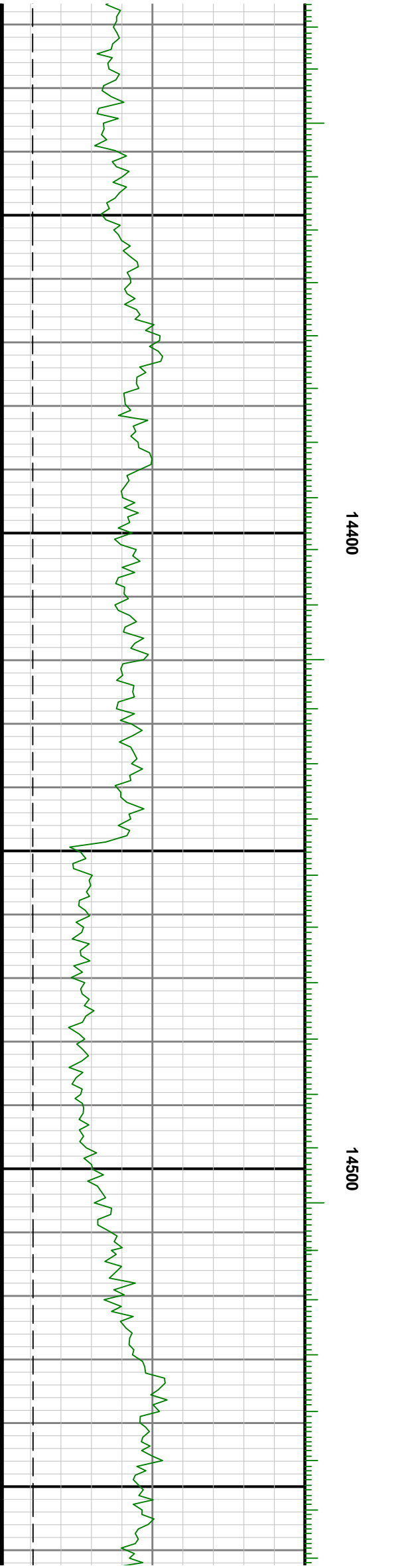
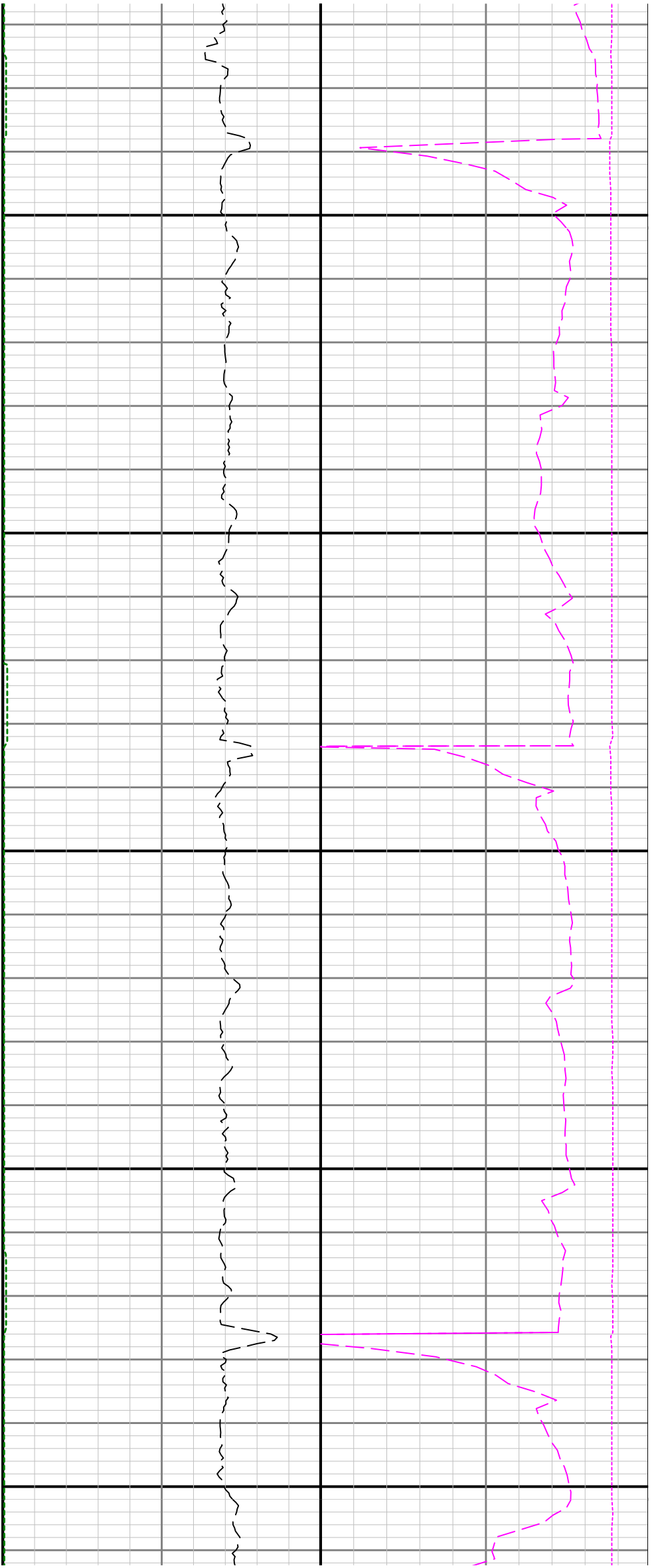
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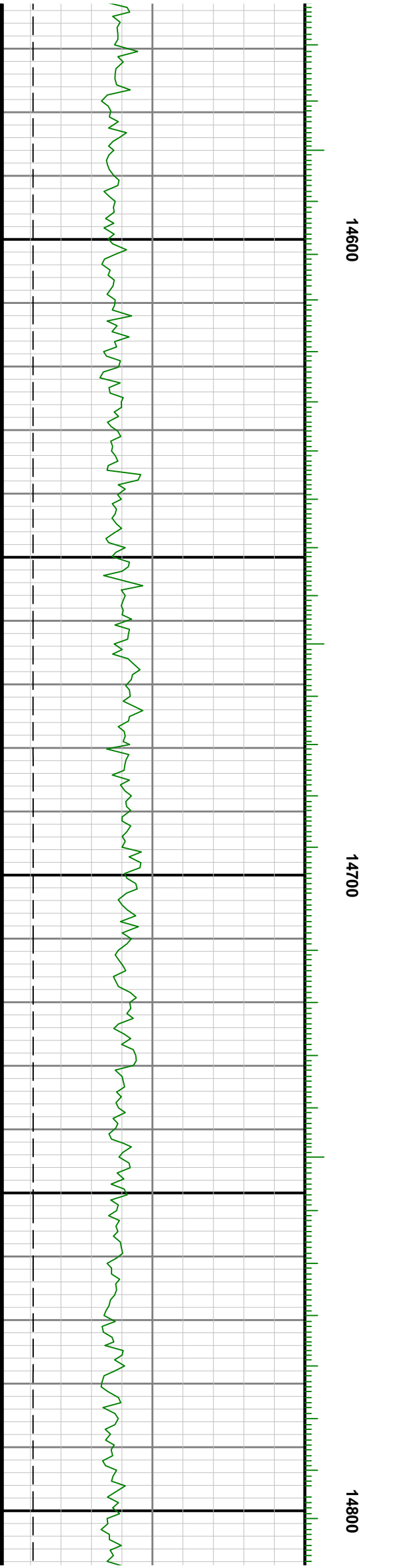
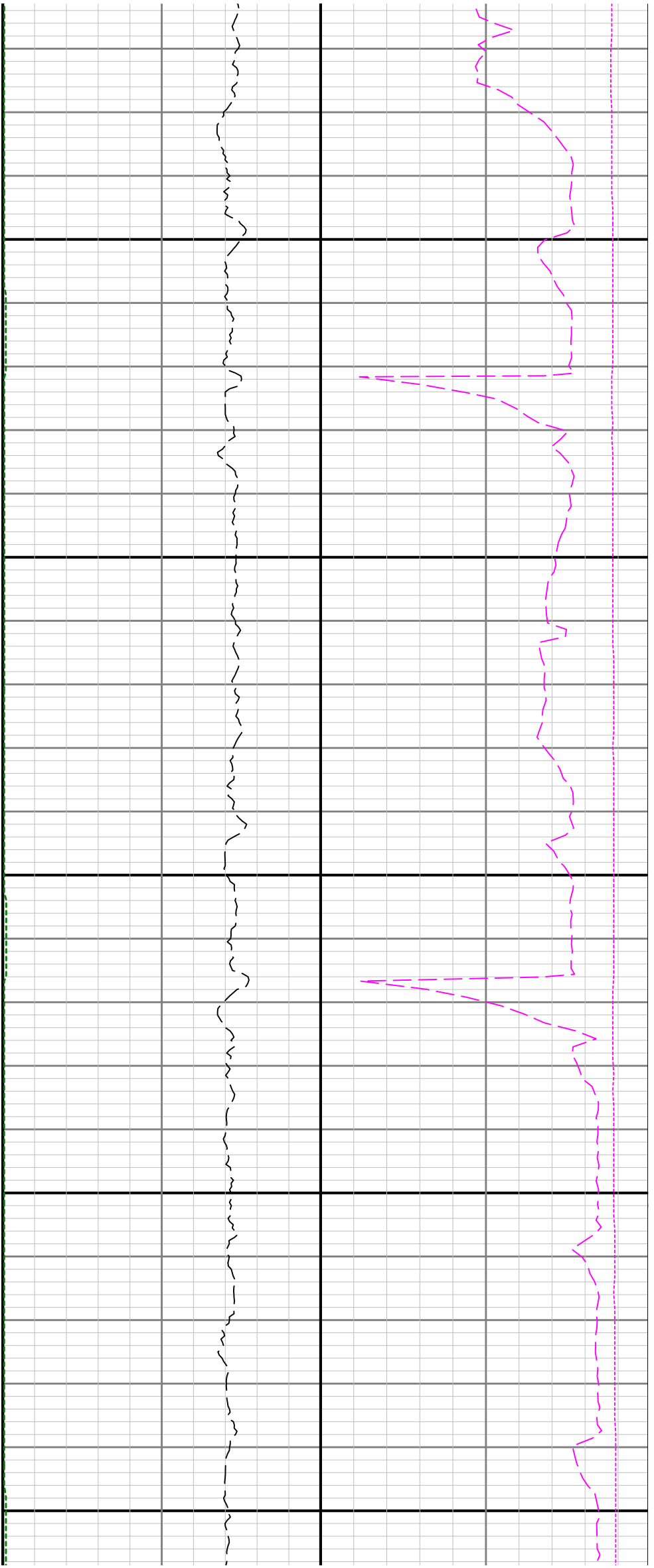


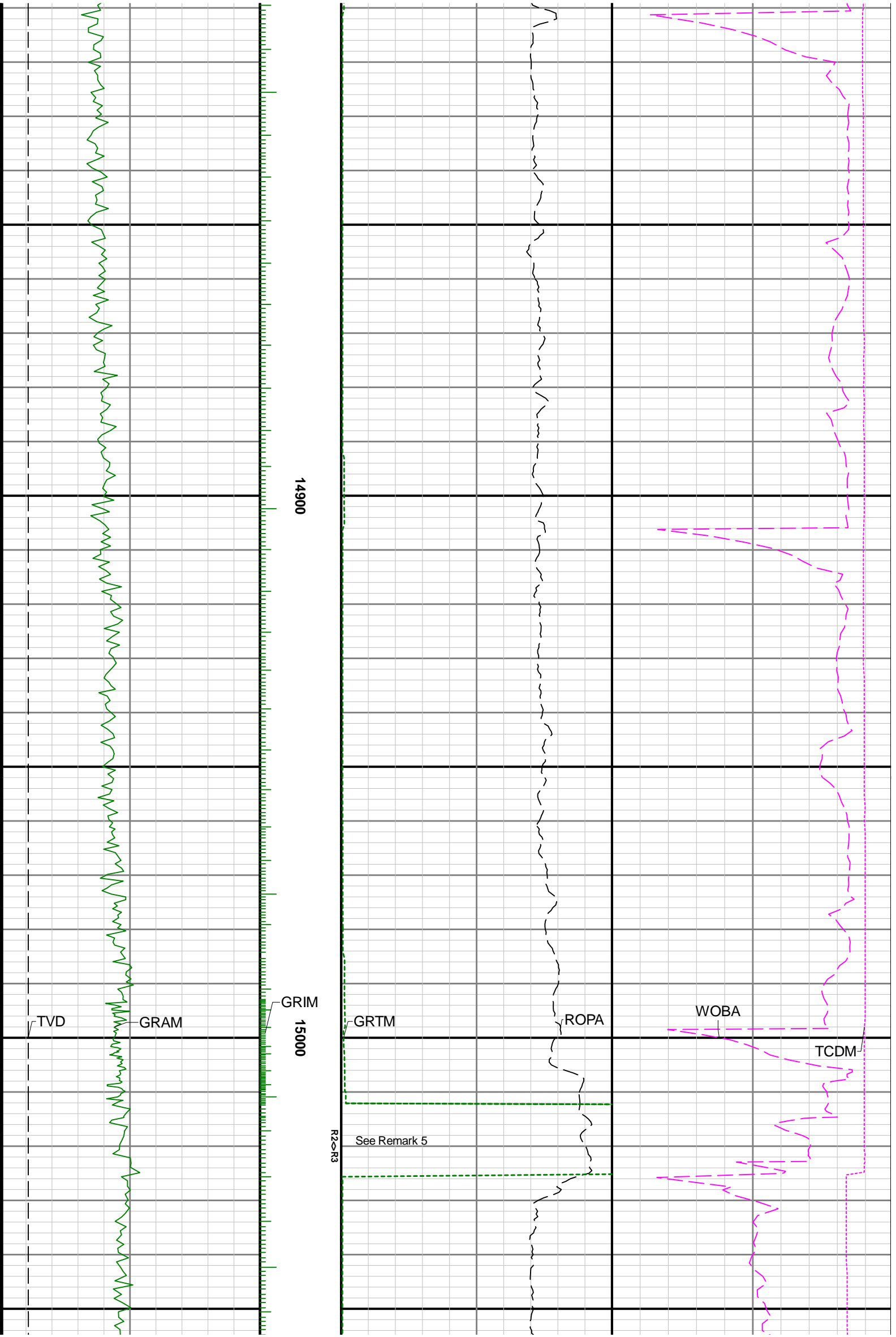


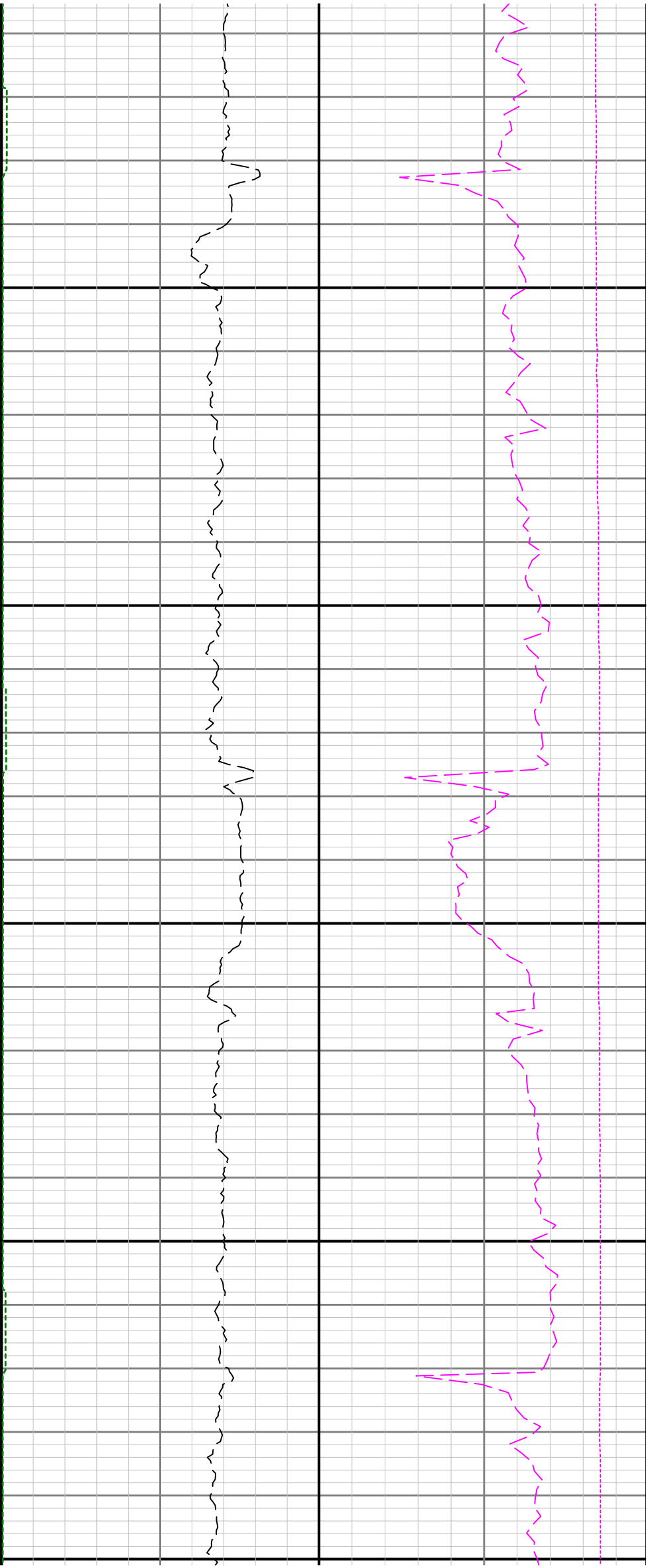








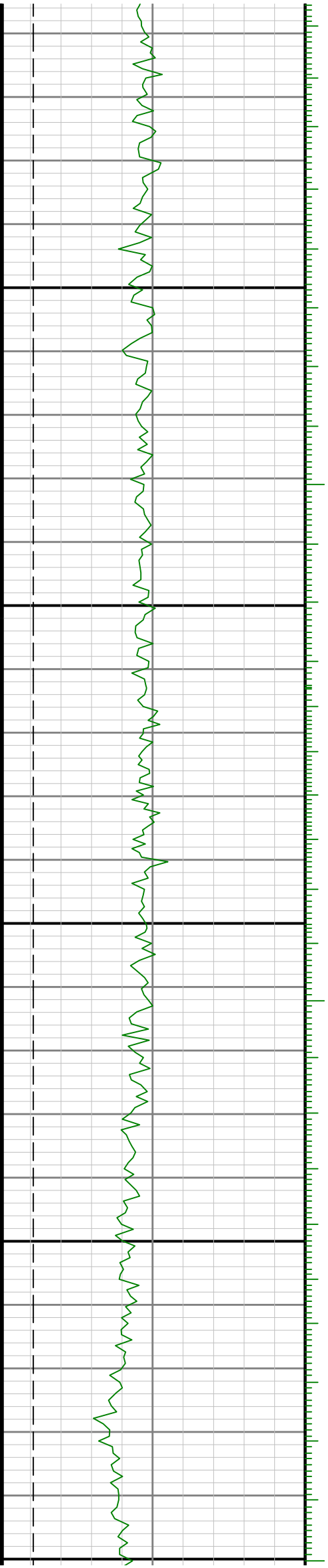




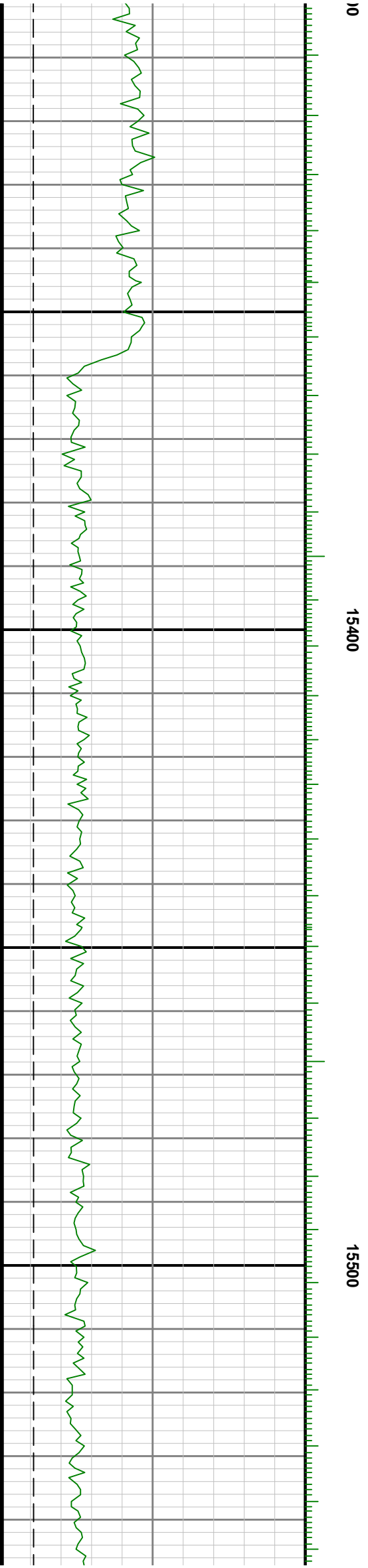
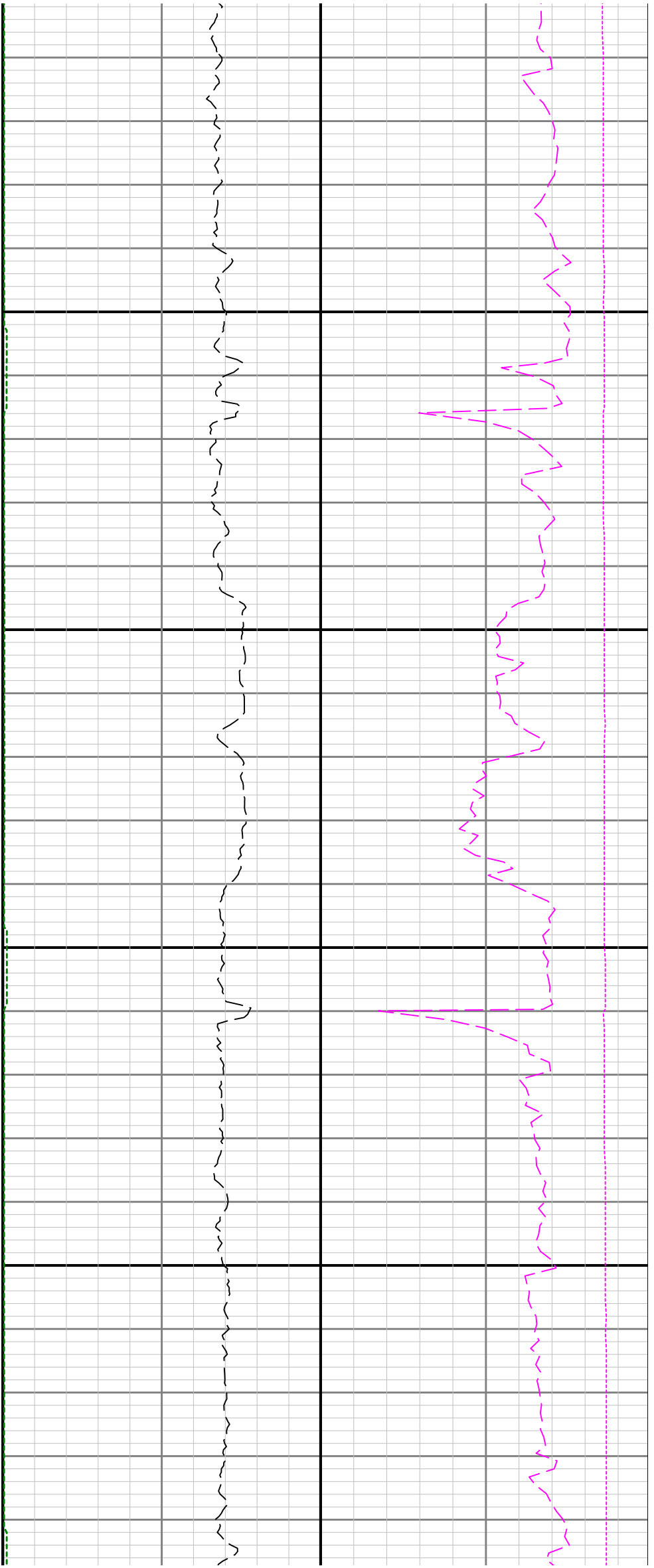
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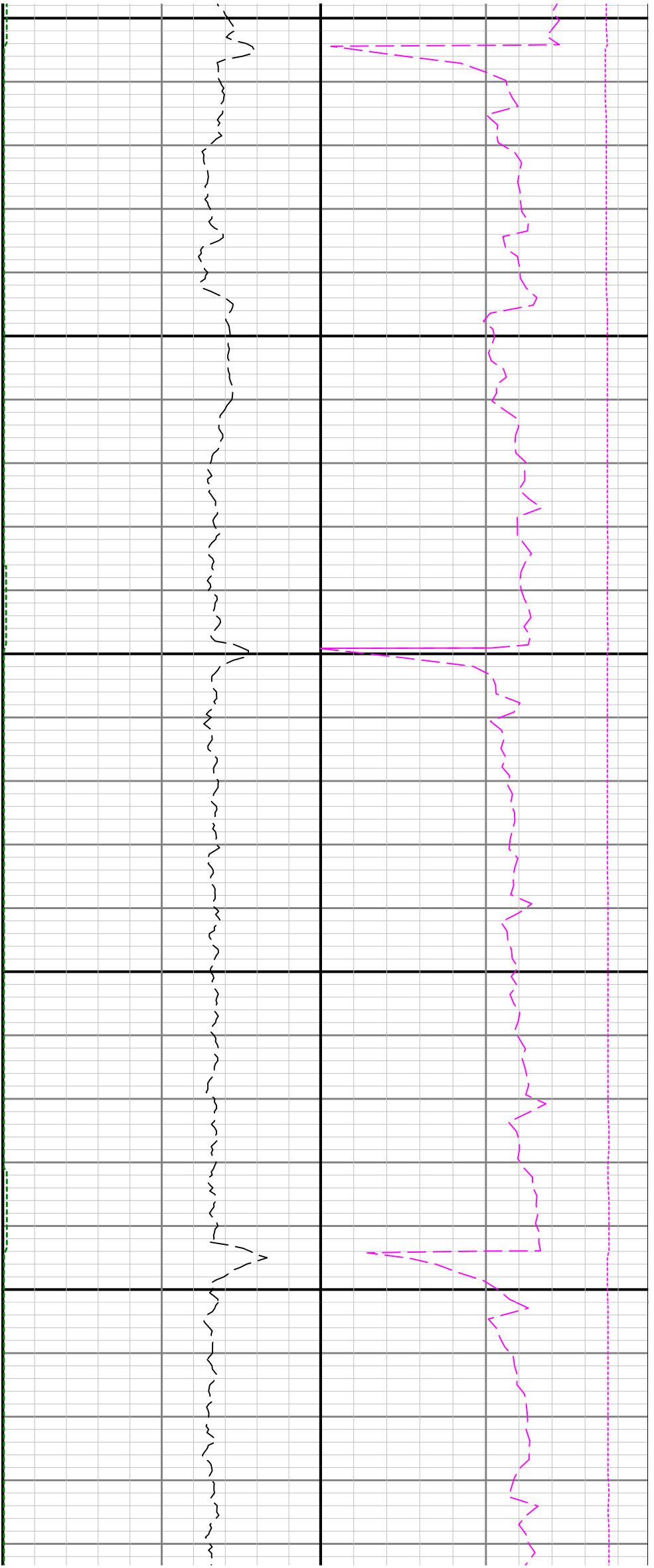
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153









15600

15700

