



# LWD MEMORY LOG

# Gamma Ray

Scale:	1:240	Measured Depth	Company: Noble Energy	Well: Vogler State D21-731	Field: Wattenberg	County: Weld	State: Colorado	Country: United States		
			Depth Reference:	Driller's Depth	Status:	API No: 05-123-48564-00	Job ID: 109660883	Permanent Datum (P.D.): Mean Sea Level	Log Measured From: Rig Floor	
			Surface Location:	Latitude: 040° 12' 22.428" N	Longitude: 104° 33' 20.340" W	SEC: 21	TWN: 3N	RGE: 64W	Elevation: 0.00 ft	Above P.D.: 4855.00 ft
			Other Services:	Directional	Elev. KB: N/A	Elev. DF: 4855.00 ft	Elev. GL: 4825.00 ft	Grid Dip Angle: (deg) 66.67	Total Magnetic Field Strength: (nT) 52058	Mag to Reference North Correction: (deg) 7.48
			Dates	Interval	Magnetic Field Reference	From: 2019-04-04	To: 2019-04-06	Spud: 2019-03-26	Drilled (ft) Top: 1973.00 Bottom: 17810.00	Logged (ft) Top: 1973.00 Bottom: 17797.00
Borehole Record	Hole Size (in)	From (ft)	To (ft)	Size (in)	Weight (lb/ft)	From (ft)	To (ft)	Casing Record		
	13.500	30.00	1973.00	9.625	36.00	30.00	1963.00			
	8.500	1973.00	17810.00							
Mud Record	Type	From (ft)	To (ft)	Hole Size (in)	Interval (ft)	Inc   Az (Start)	Inc   Az (End)			
	Oil Based Mud	1973.00	17810.00	8.500	15837.00	0.32   227.31	89.94   359.53			
Acquisition System	Software Version	Other	Cadence	RT 5.2	H&P 517	Rig: Contractor: District:	Helmerich & Payne Drilling Co	Unit: D&E		
	Plot Studio	5.2.8472.1								

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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
						Top	Bottom	From	To	Start Logging	End Logging	
						(ft)	(ft)	(ft)	(ft)			
1	1	8.500	PDC	3.00	Rotary Steerable	1973.00	17797.00	1973.00	17810.00	2019-04-04 11:50	2019-04-06 23:15	57.10

## Crew

Name	Arrive Wellsite	Depart Wellsite	Name	Arrive Wellsite	Depart Wellsite	Name	Arrive Wellsite	Depart Wellsite
Andrew Hays	2019-04-03	2019-04-06	Adam Schlenz	2019-04-06	2019-04-07			

## 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+ (%)
2019-04-04 13:00	1	2393.00	Oil Based Mud	9.5	17	N/A	16.0	71/18	Active Pit	24295	0.00
2019-04-05 04:00	1	6444.00	Oil Based Mud	9.2	12	N/A	17.0	72/18	Active Pit	24295	0.00
2019-04-05 15:00	1	8305.00	Oil Based Mud	9.4	13	N/A	18.0	71/17	Active Pit	25267	0.00
2019-04-06 04:00	1	12338.00	Oil Based Mud	9.6	15	N/A	17.0	71/16	Active Pit	22352	0.00
2019-04-06 15:00	1	15580.00	Oil Based Mud	9.8	18	N/A	19.0	72/15	Active Pit	21380	0.00

## 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	AutoTrak Curve Steering Unit	12124244	Near Bit Inclination	5.93	6.73	7.375	4.330
1	AutoTrak Curve Steering Unit	12124244	Near Bit VSS	5.93	6.73	7.375	4.330
1	AutoTrak Curve MWD	12332940	Gamma (single)	2.75	12.90	6.875	3.250
1	AutoTrak Curve MWD	12332940	Directional (mag)	12.27	22.42	6.875	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 run 1 utilized a 6.75 inch NaviGamma service (Directional and Gamma Ray) behind a 8.5 inch bit and rotary steerable assembly from 1973 to 17810 feet MD (1973 to 6844 feet TVD).
- 3

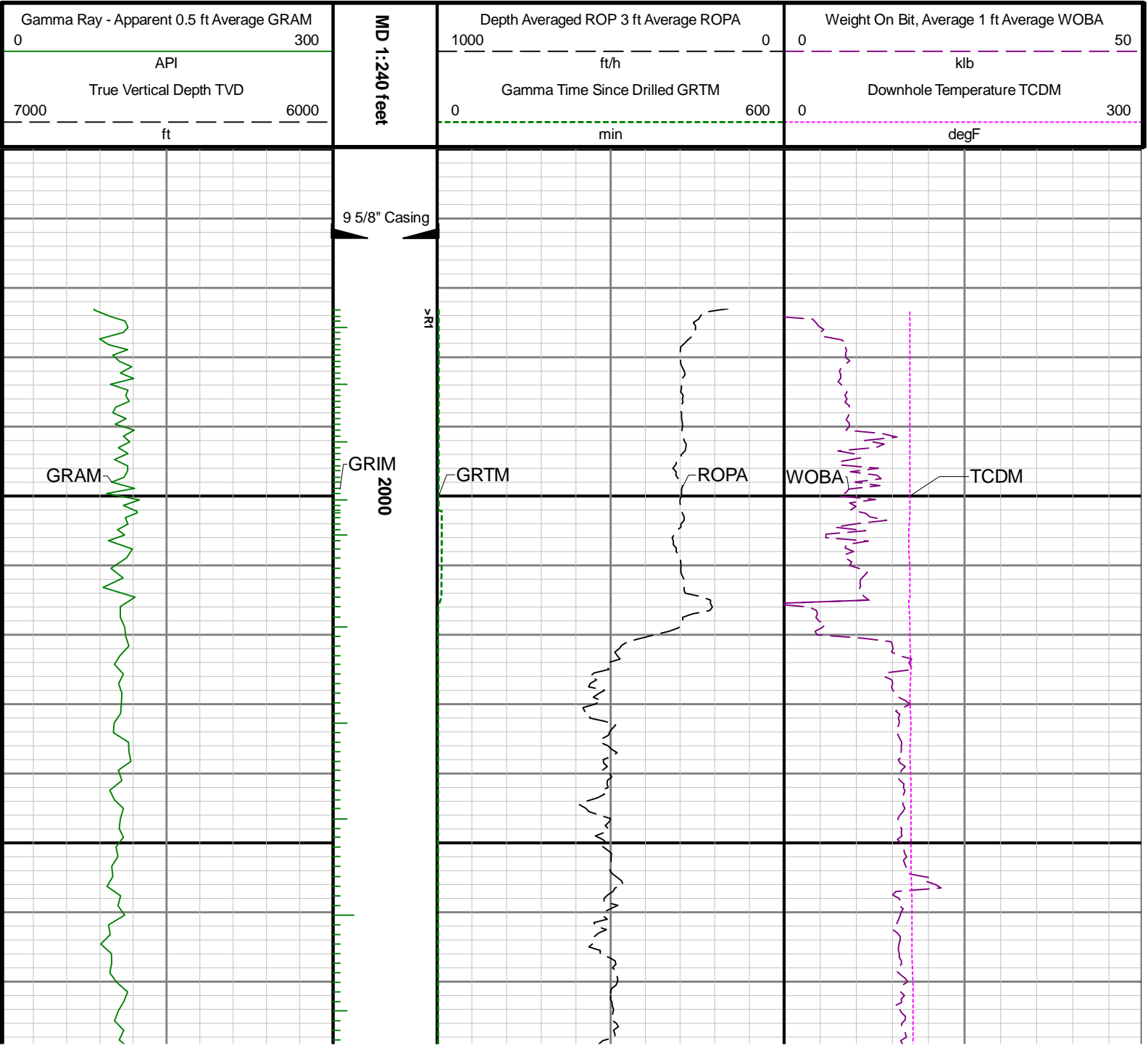
The Gamma Ray Apparent (GRAM) data is presented 0 to 300 API, per the customer's request.

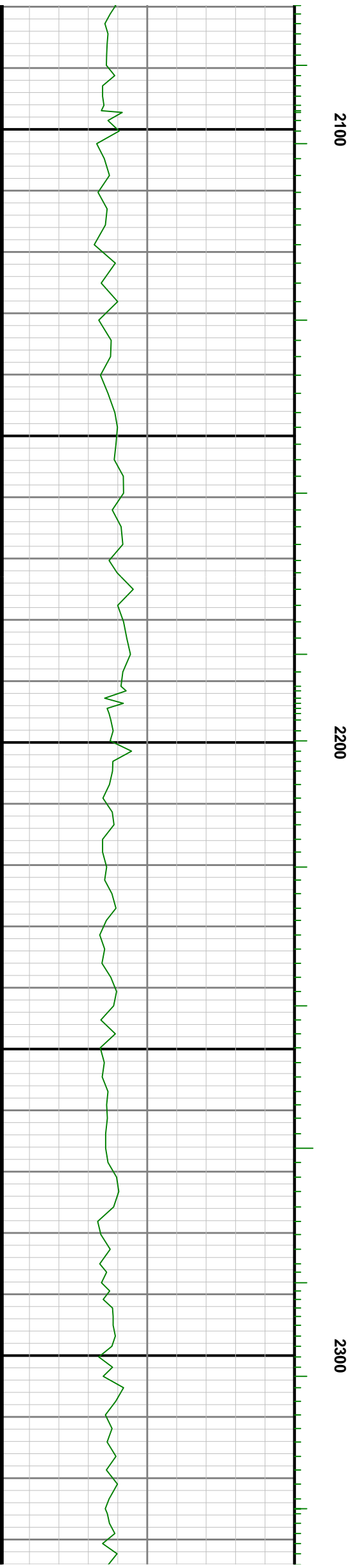
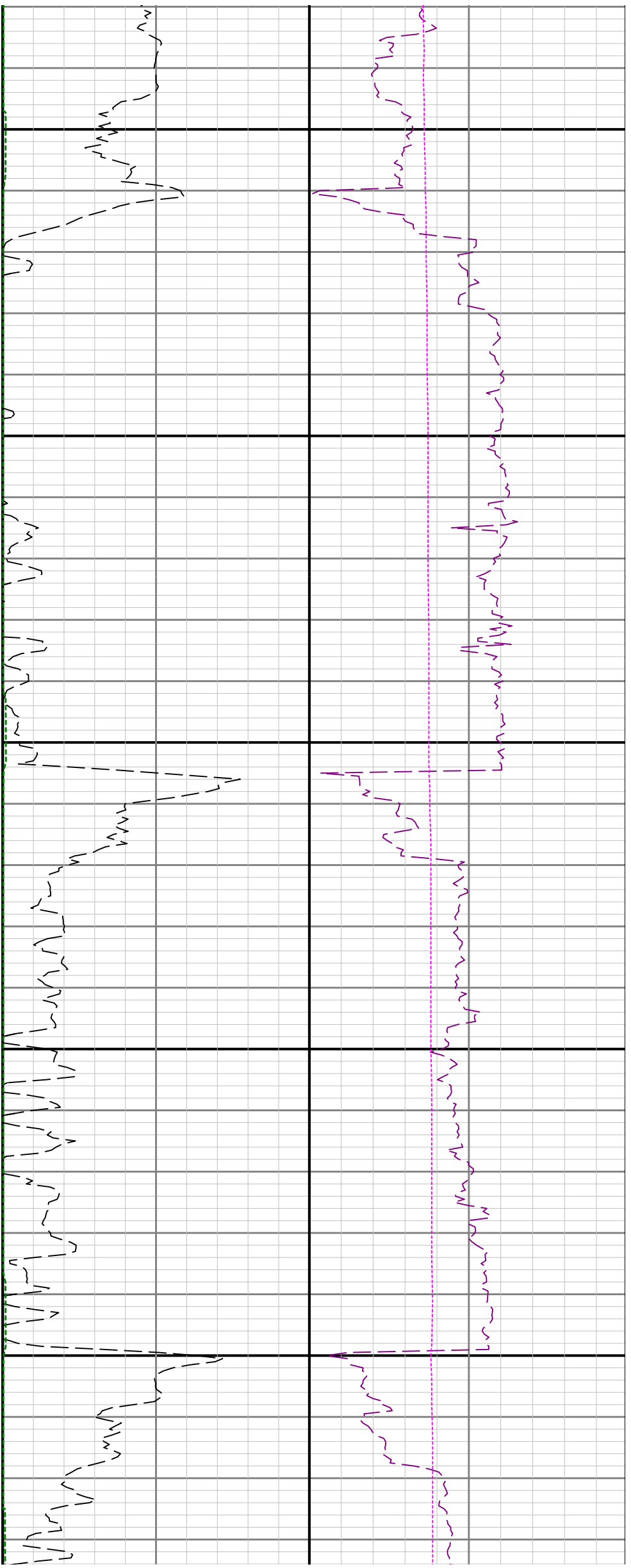
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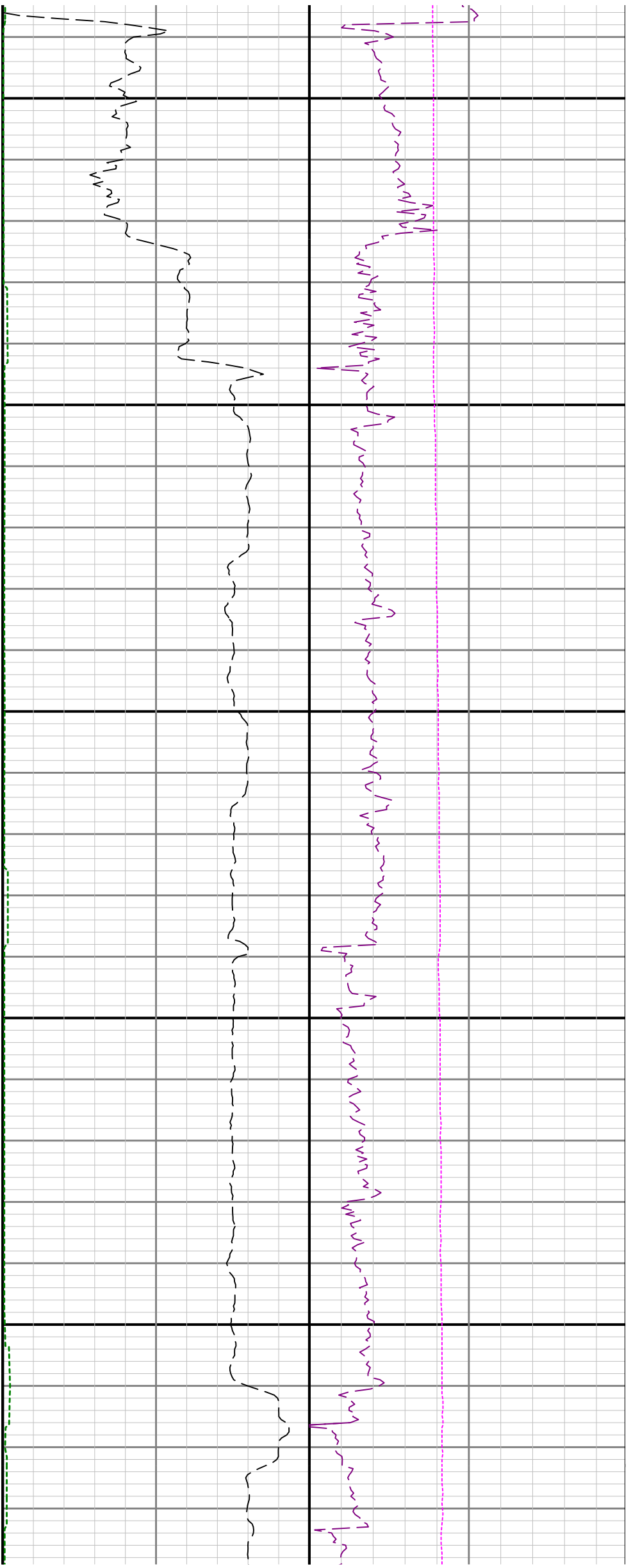
Number	Depth (ft)	Hole Section (in)	Run No.	Remark
1	3624.00	8.500	1	The interval from 3556 to 3611 feet MD (3522 to 3573 feet TVD) has a gap in gamma ray and gamma ray time since drilled due to the LWD assembly failing to power on while drilling ahead.
2	6876.00	8.500	1	The interval from 6854 to 6865 feet MD (6448 to 6458 feet TVD) has a gap in gamma ray and gamma ray time since drilled due to the LWD assembly failing to power on after an attempted downlink.
3	8124.00	8.500	1	The interval from 8086 to 8112 feet MD (6840 feet TVD) has a gap in gamma ray and gamma ray time since drilled due to the LWD assembly failing to power on after an attempted downlink.
4	17810.00	8.500	1	The interval from 17797 to 17810 feet MD (6844 feet TVD) was not logged after being drilled due to sensor to bit offset at well TD.

Curve Mnemonics

Presented Curves	Description	Units
ROPA	Depth Averaged ROP 3 ft Average	ft/h
TVD	True Vertical Depth	ft
WOBA	Weight On Bit, Average 1 ft Average	klb
GRAM	Gamma Ray - Apparent - Memory 0.5 ft Average	API
GRIM	Gamma Ray - Data Point Indicator - Memory	unitless
GRTM	Gamma Ray - Time Since Drilled - Memory	min
TCDM	Directional Real-Time Survey Temperature	degF

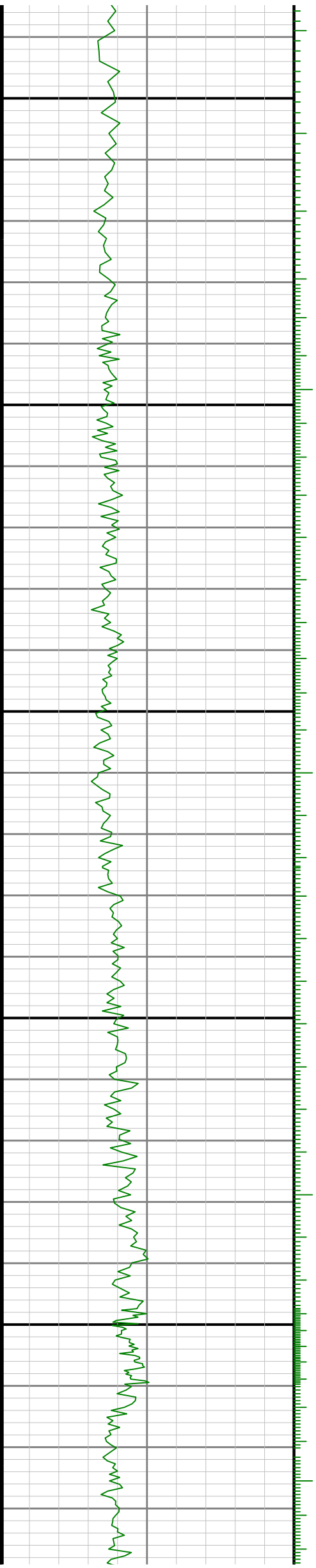


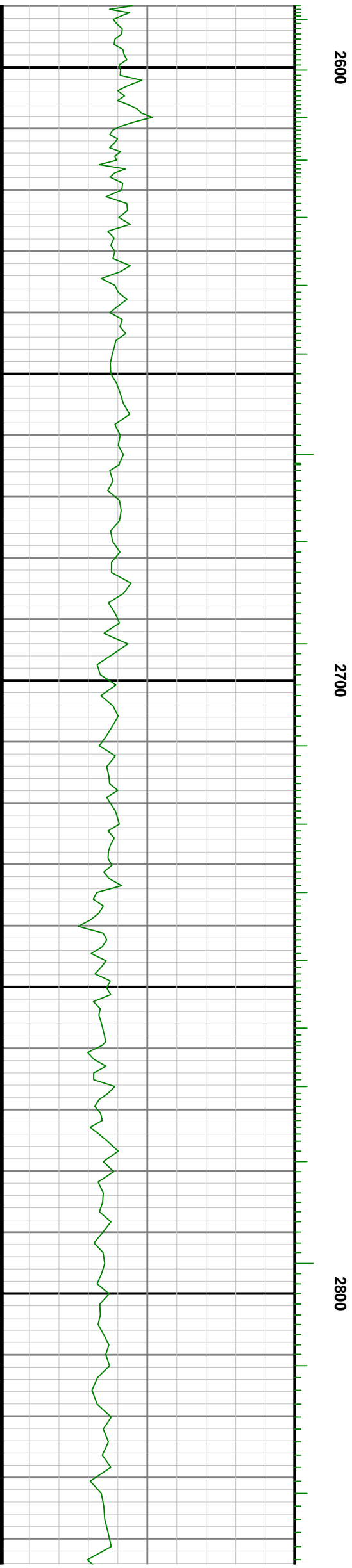
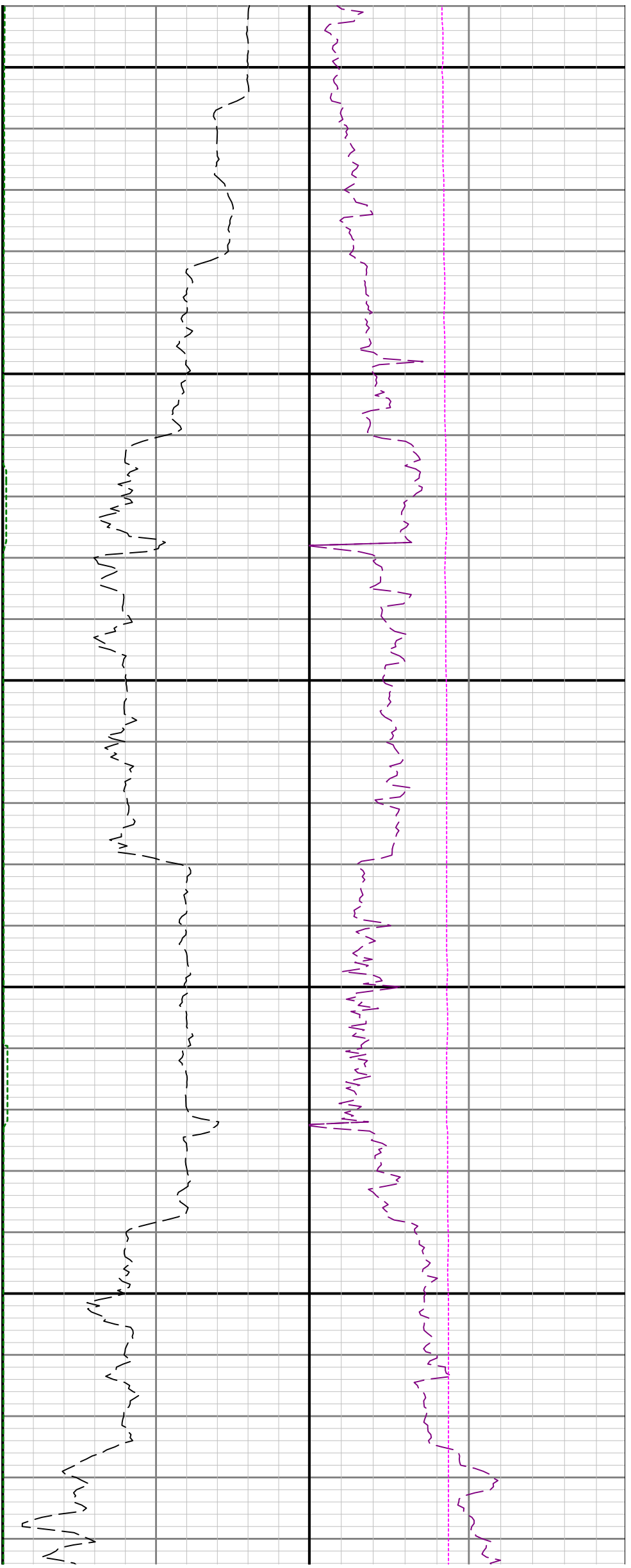


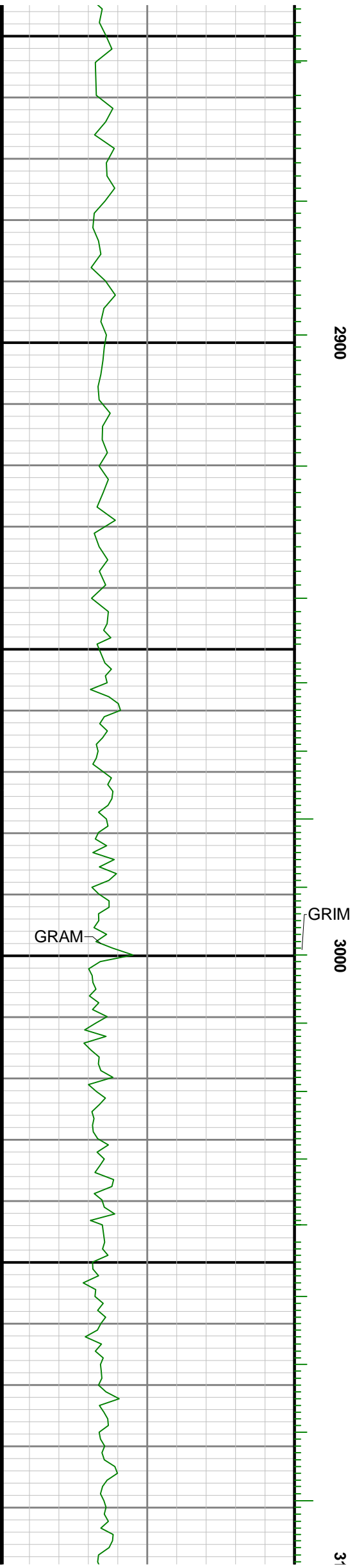
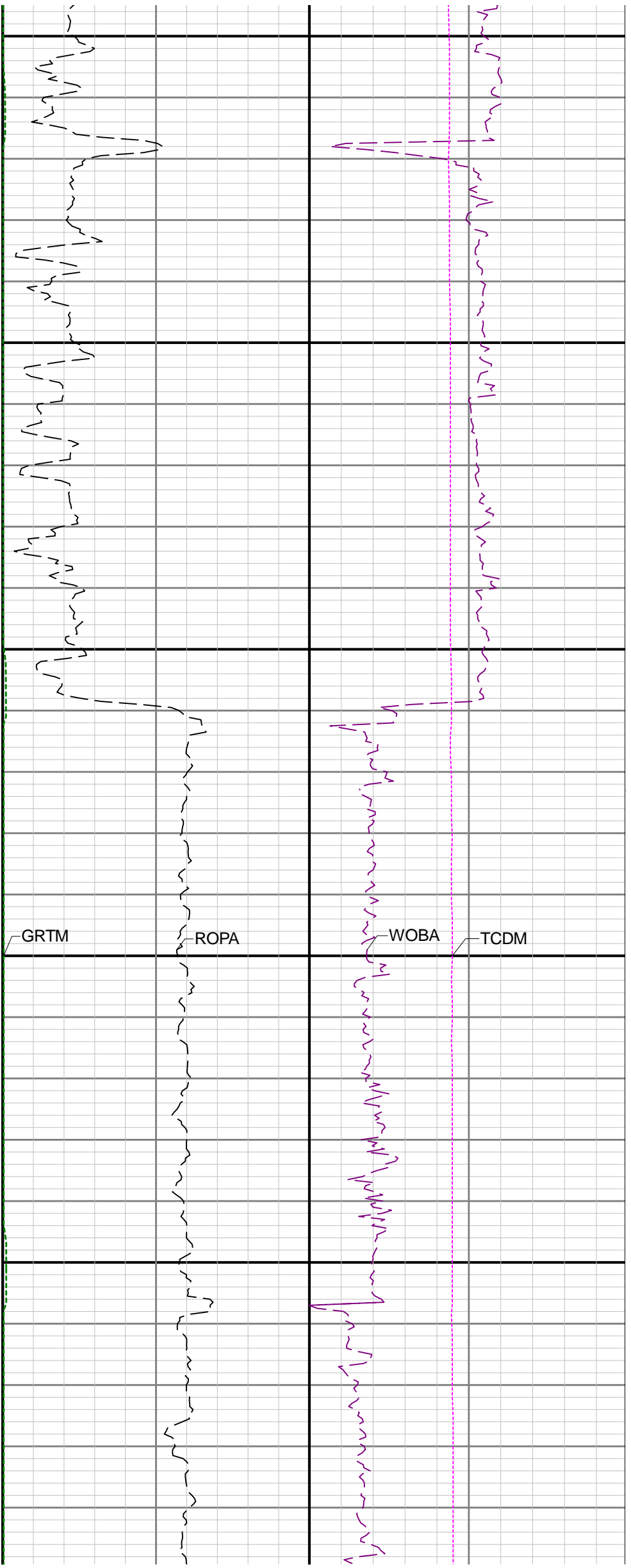


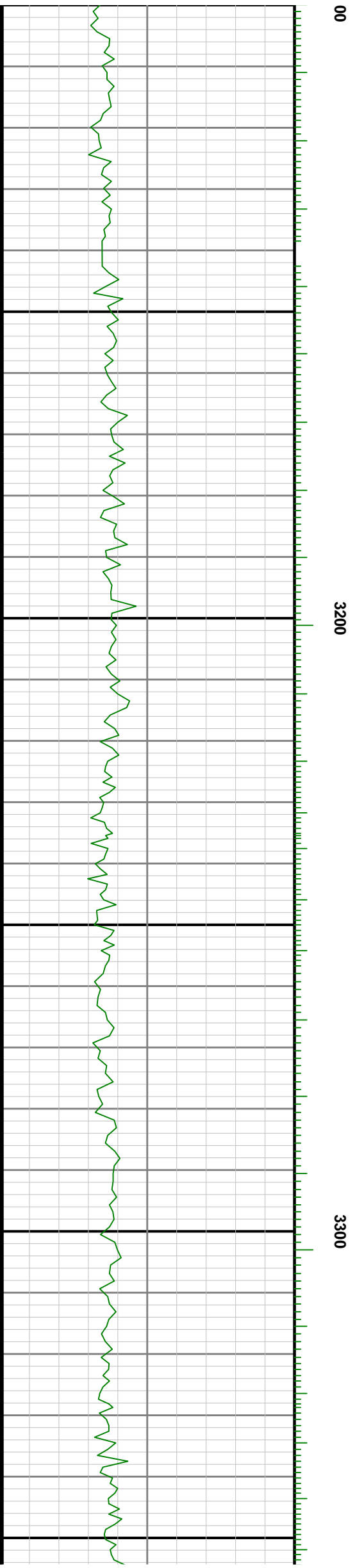
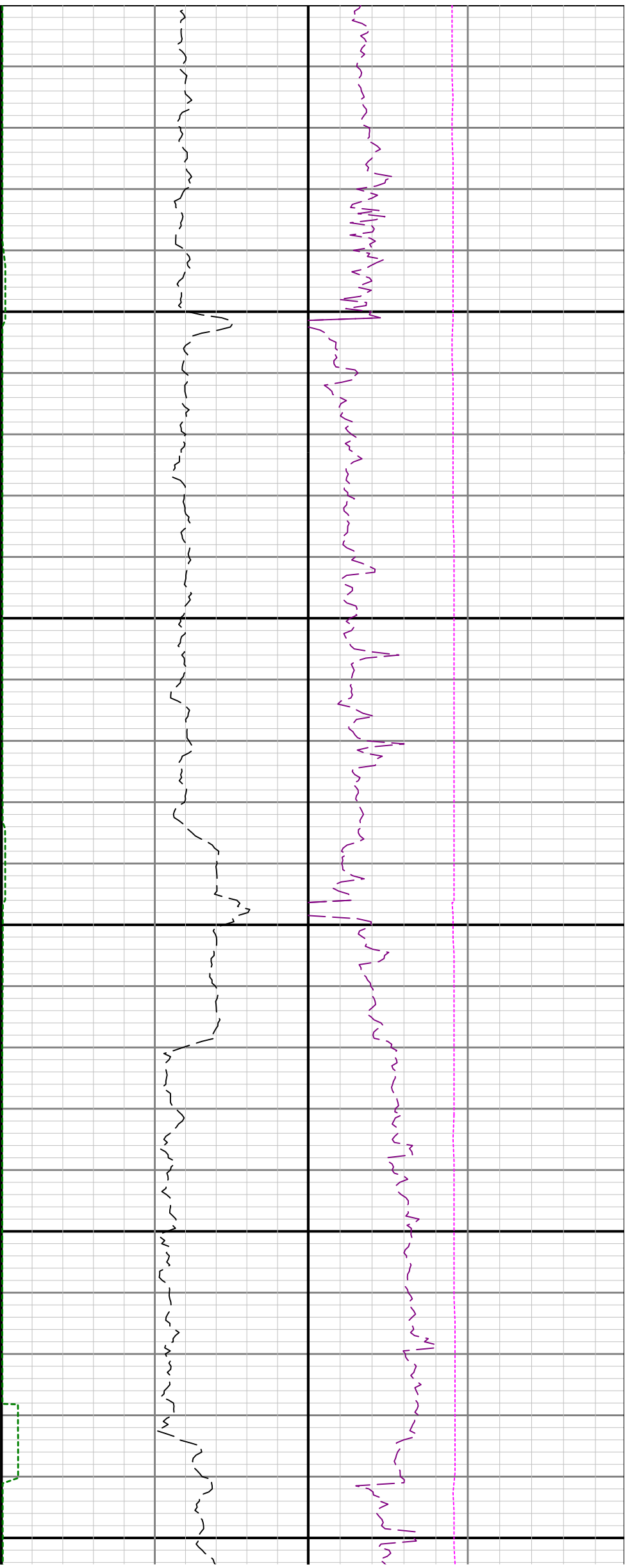
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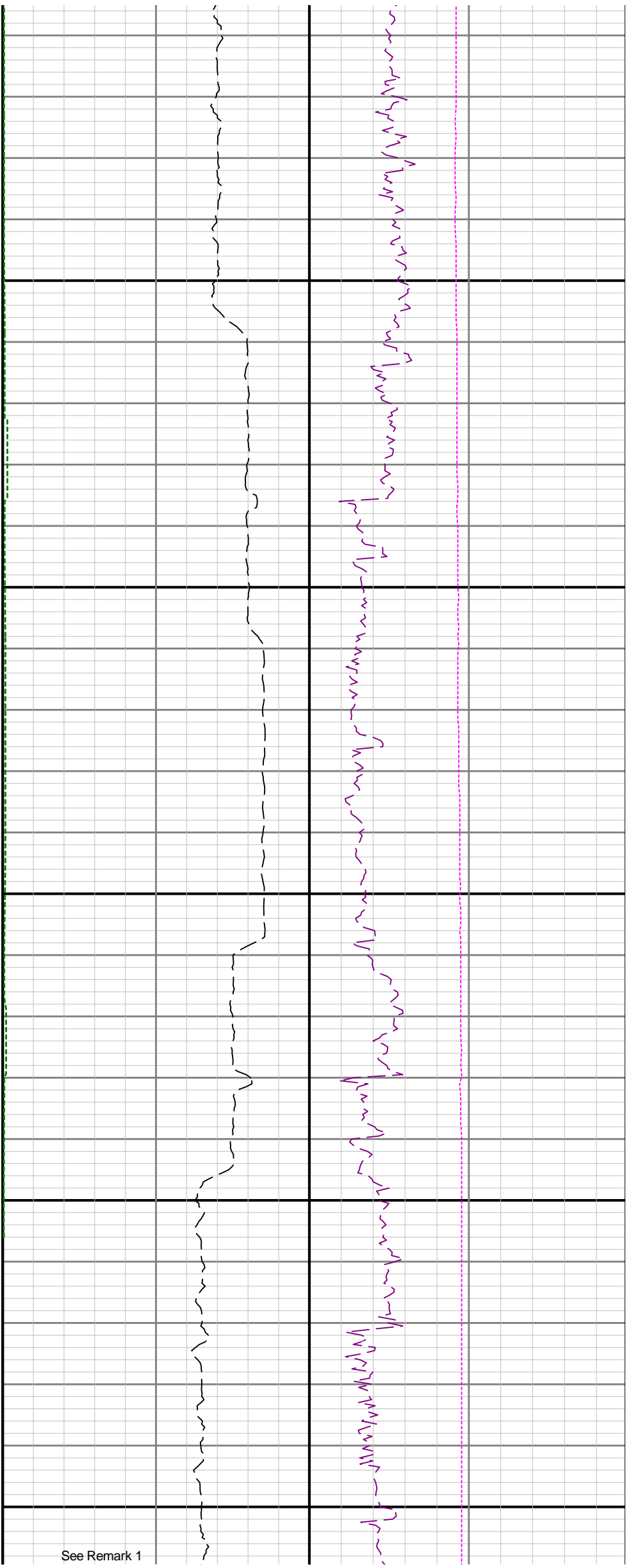
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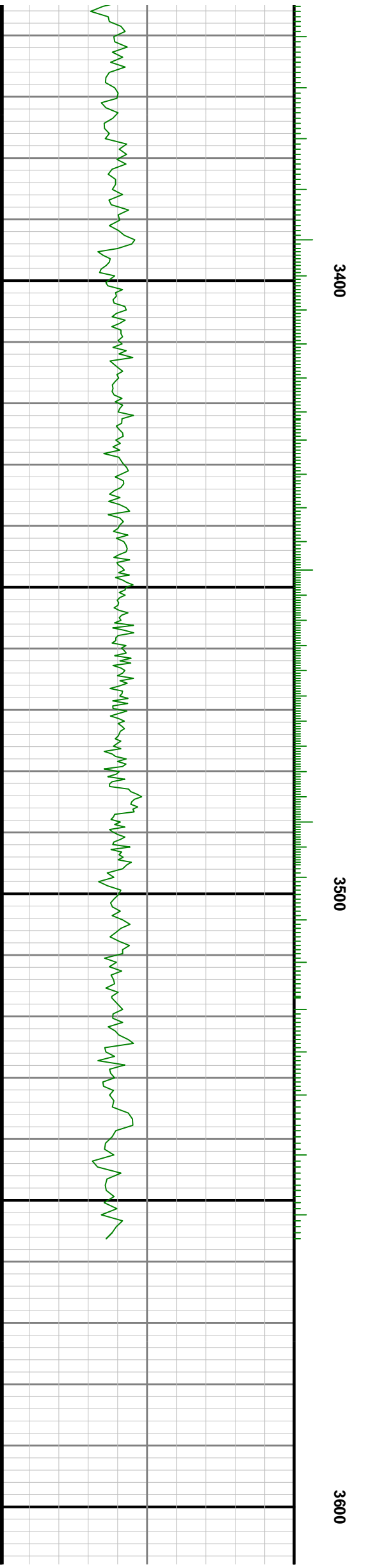








See Remark 1

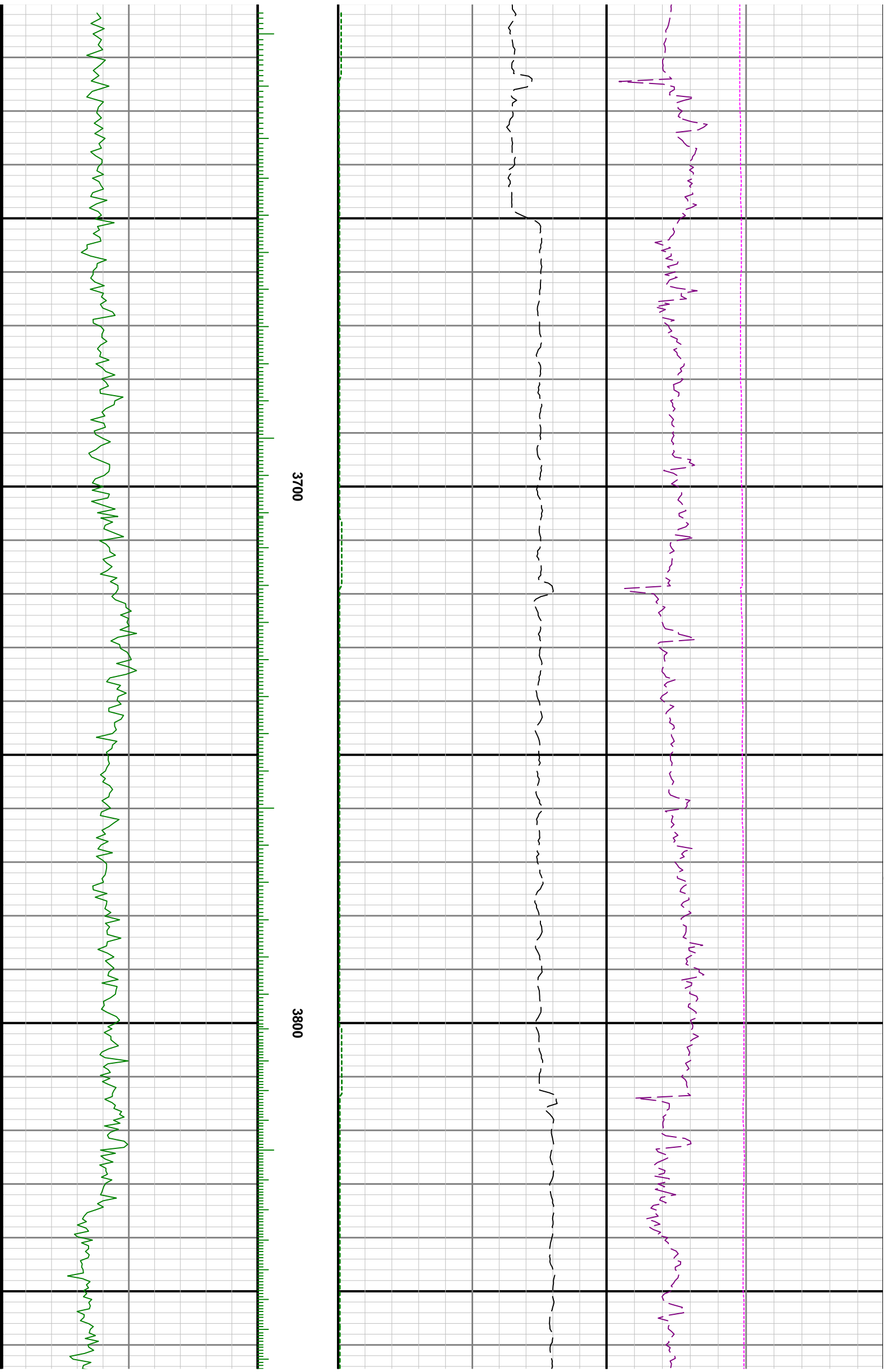


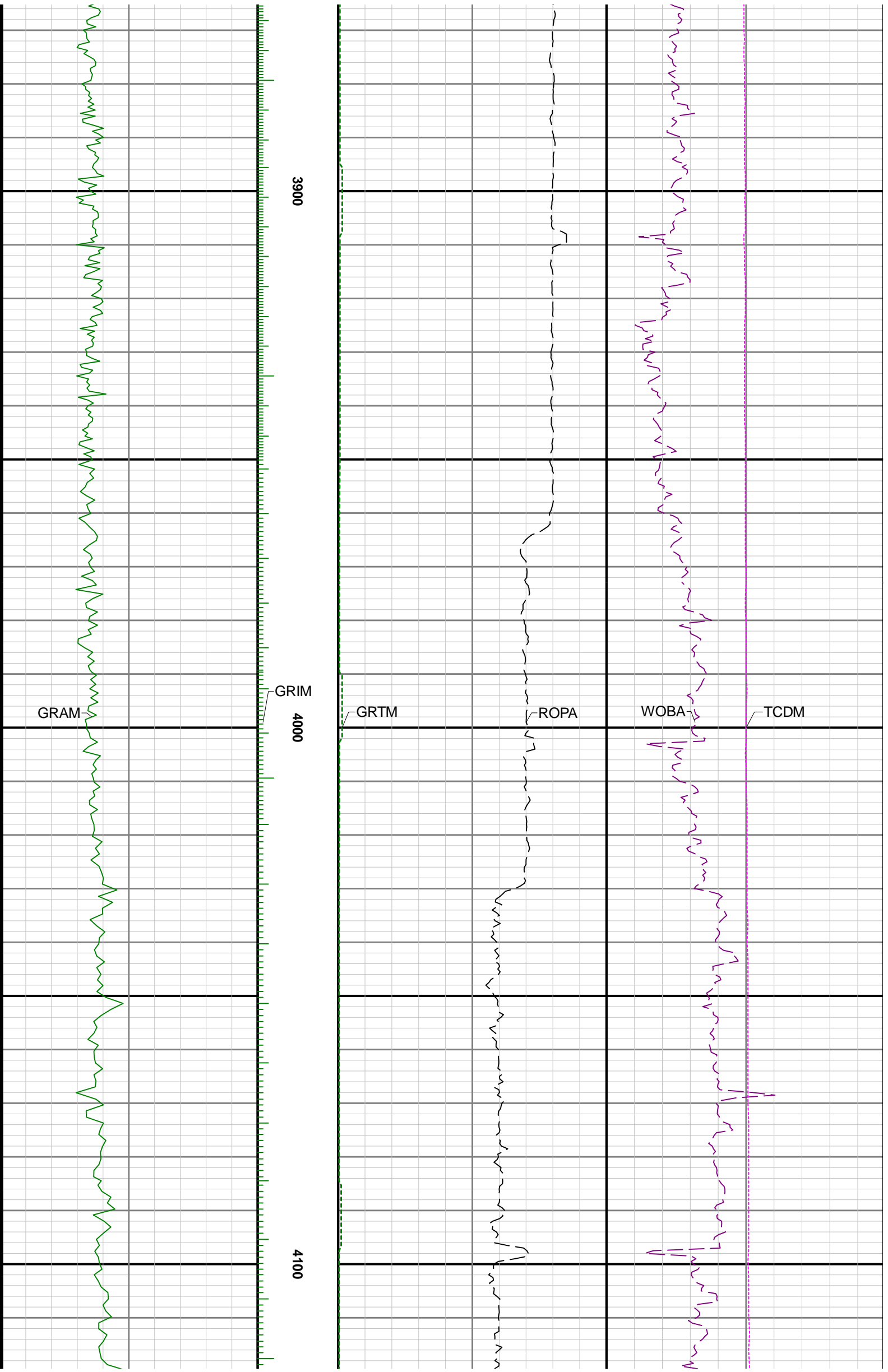
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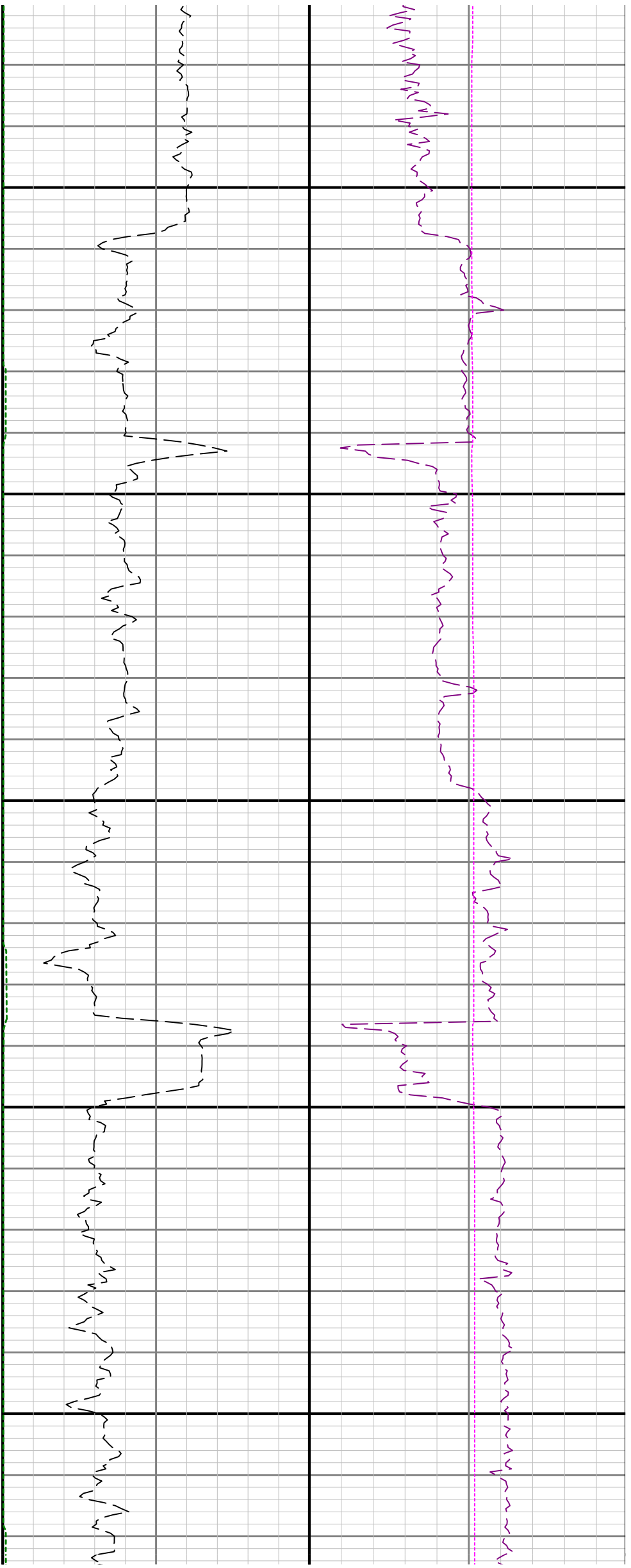
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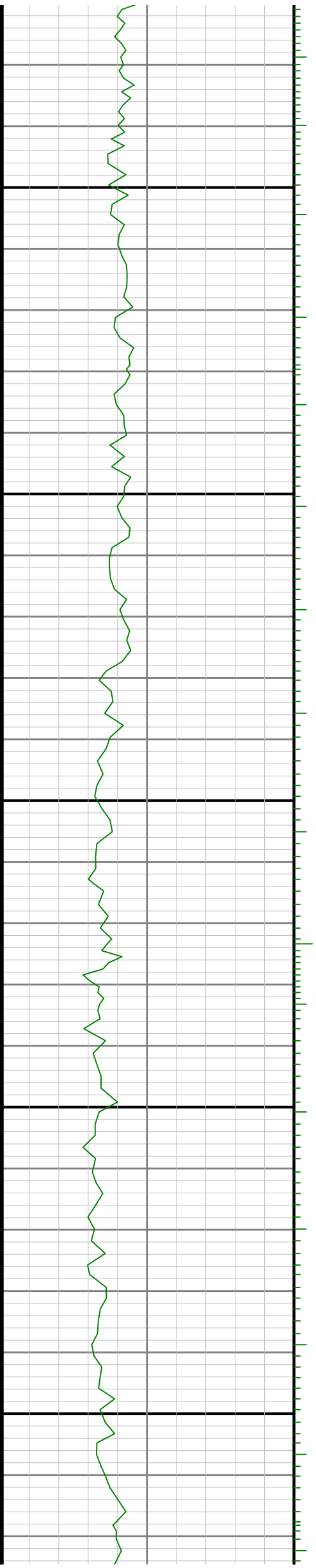


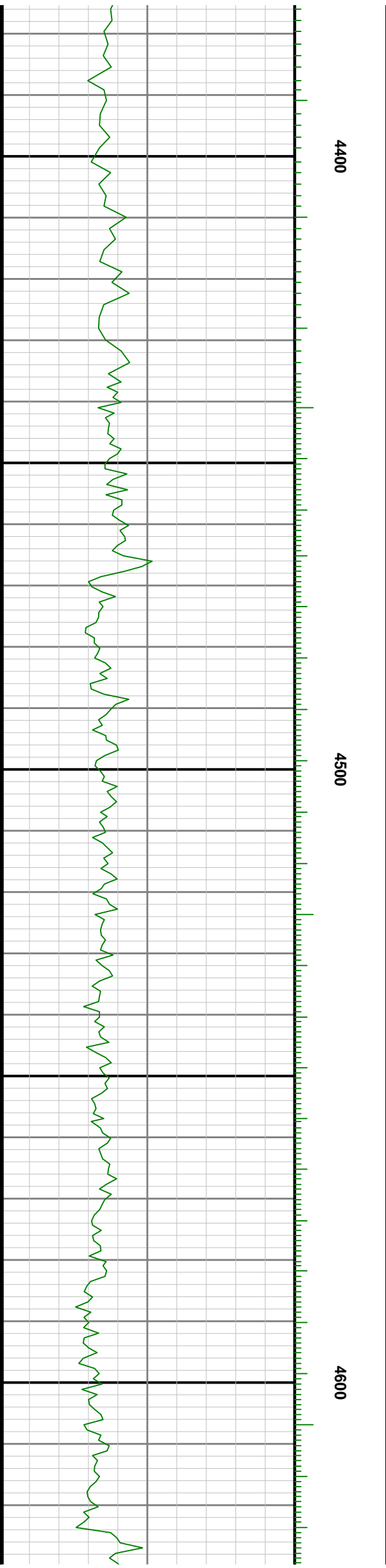
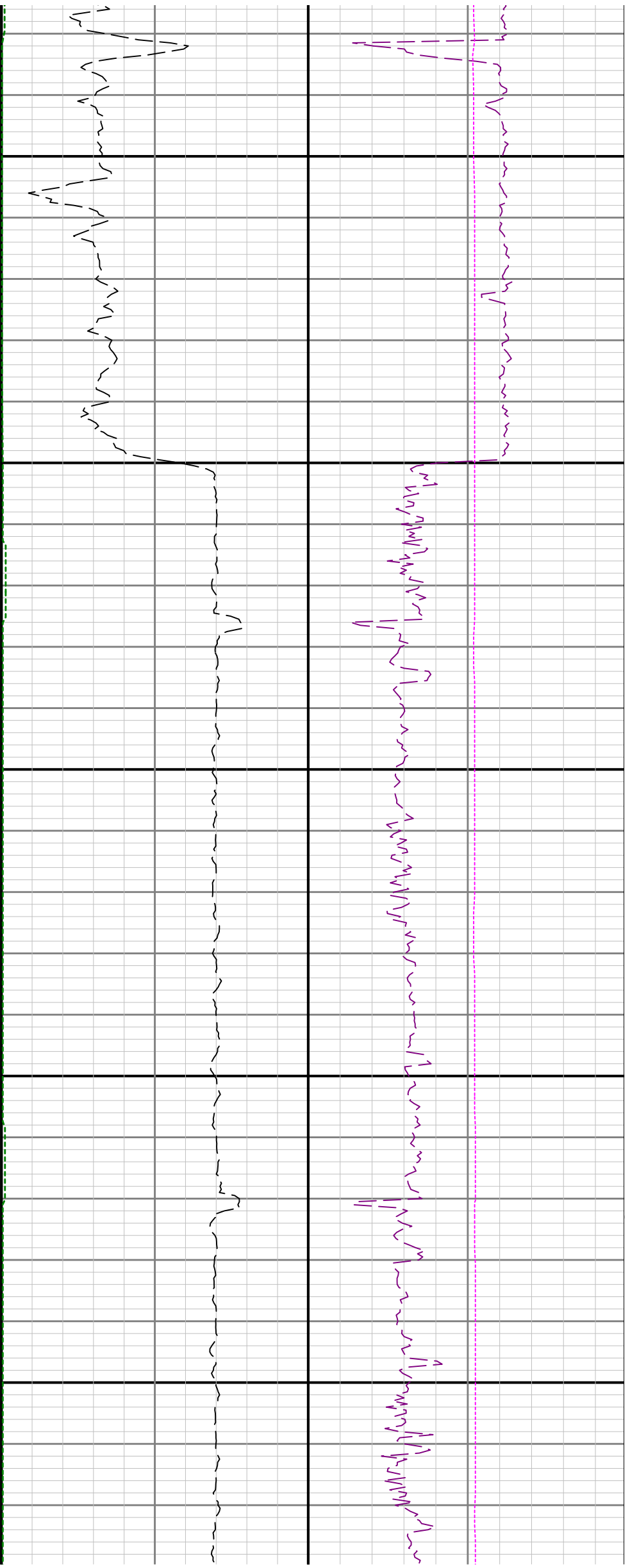


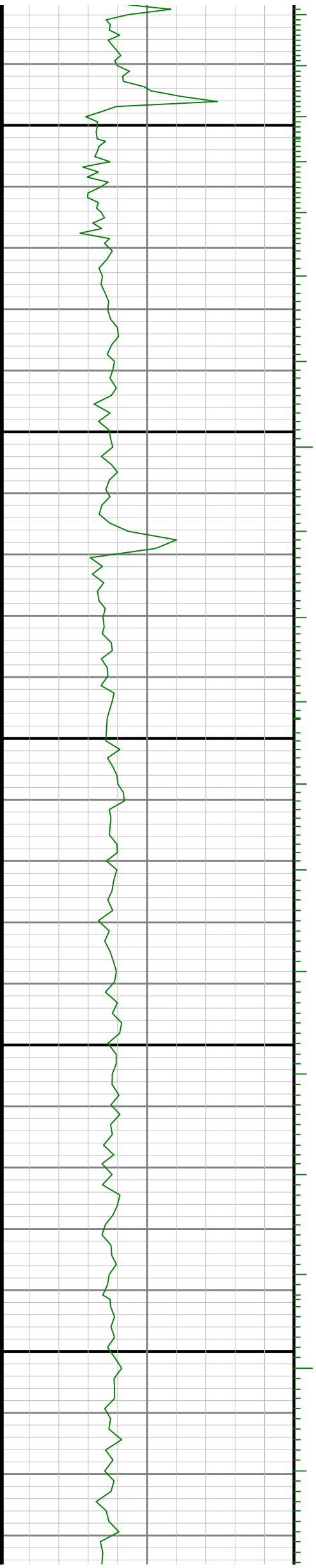
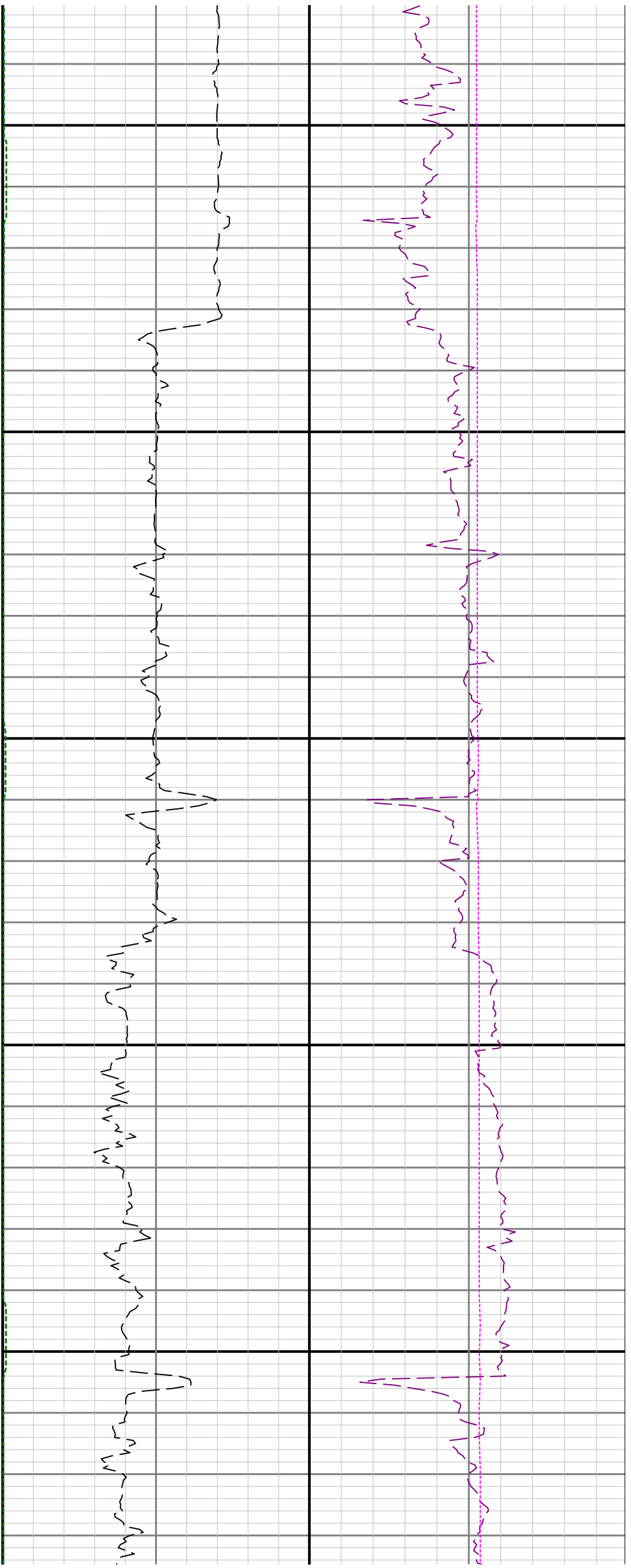


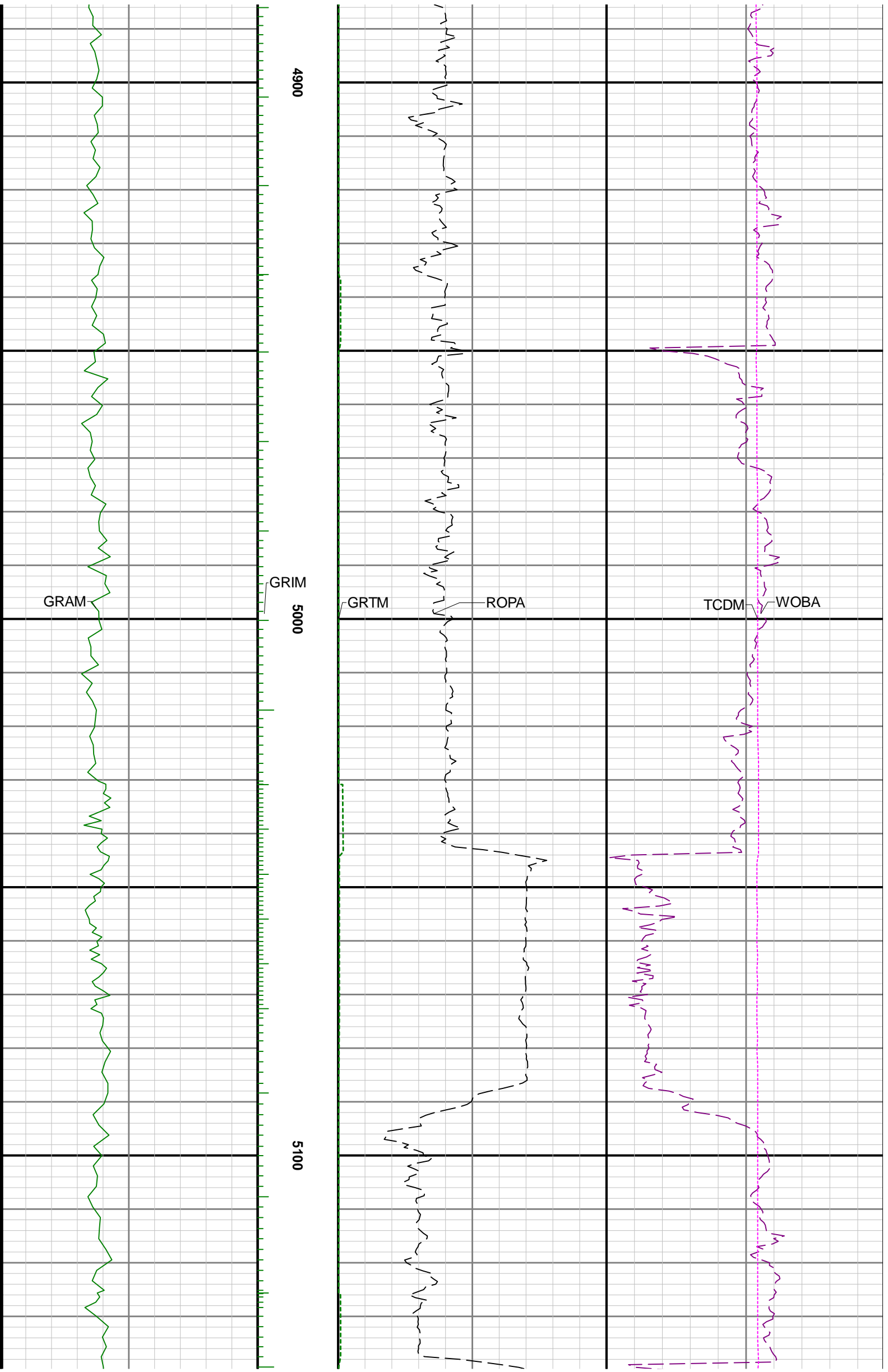
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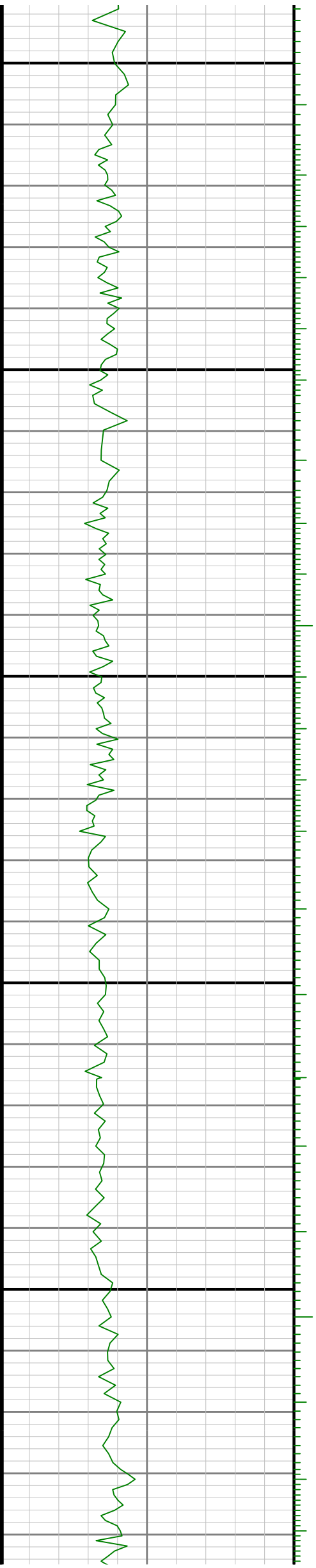
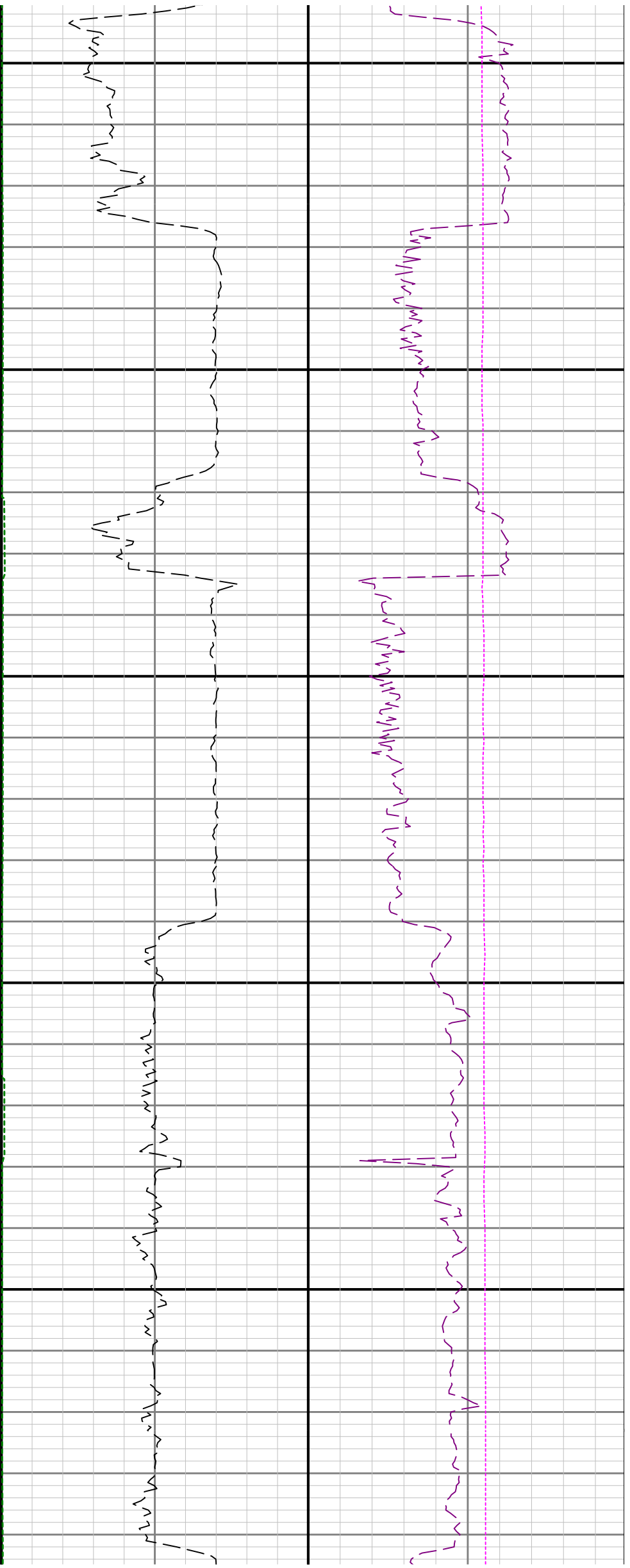
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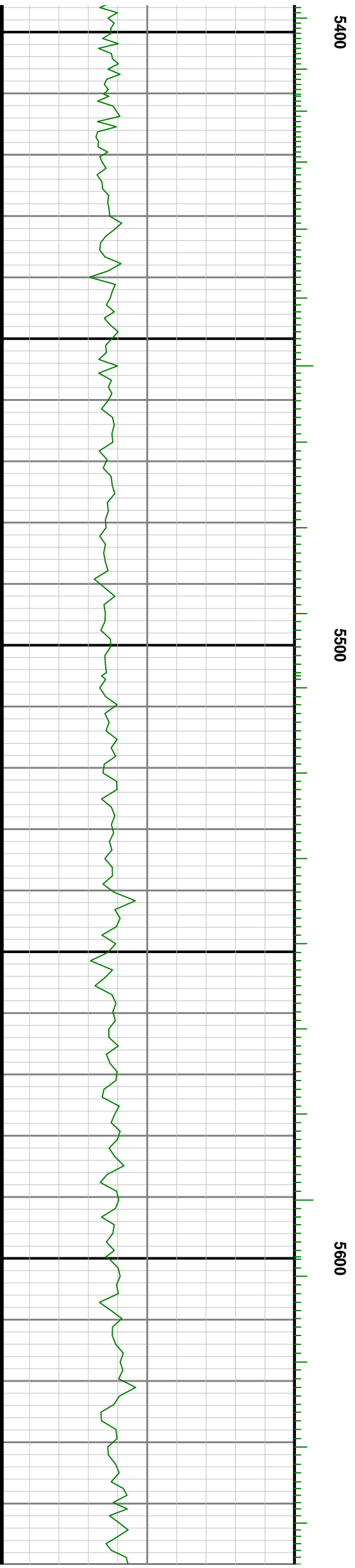




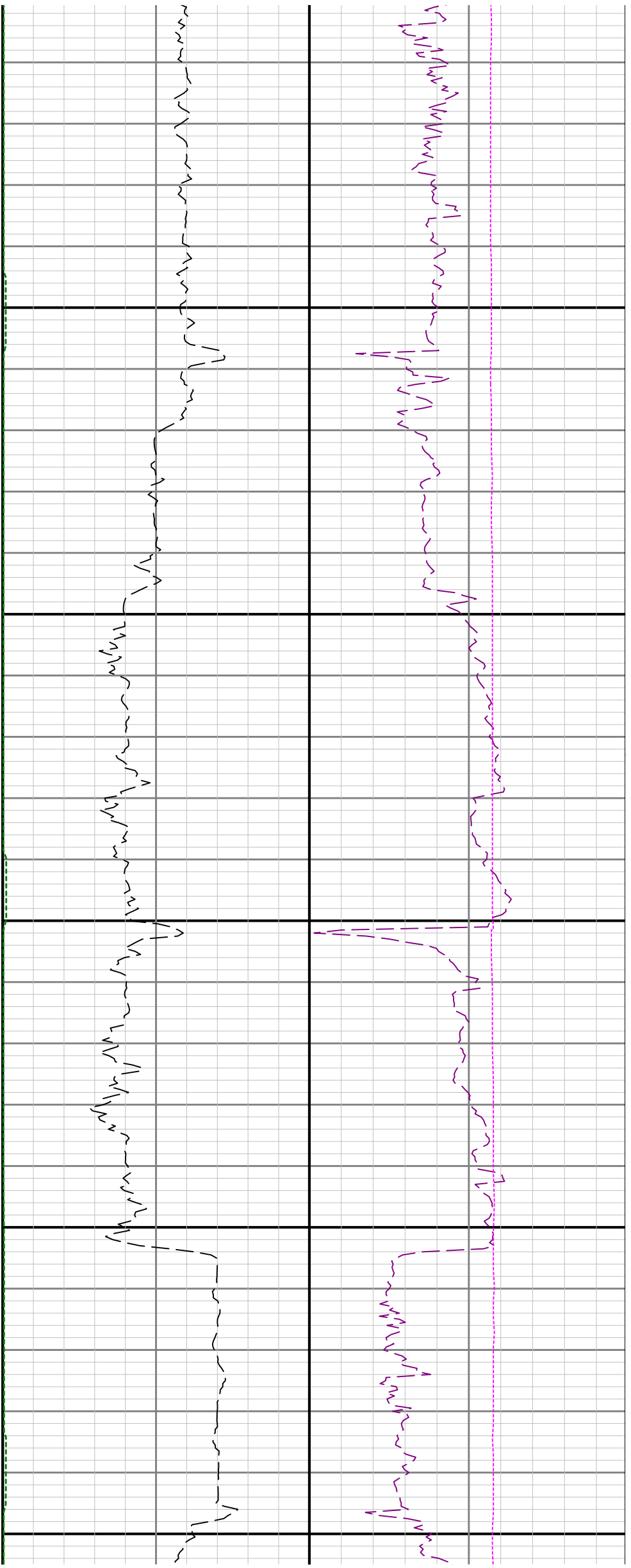








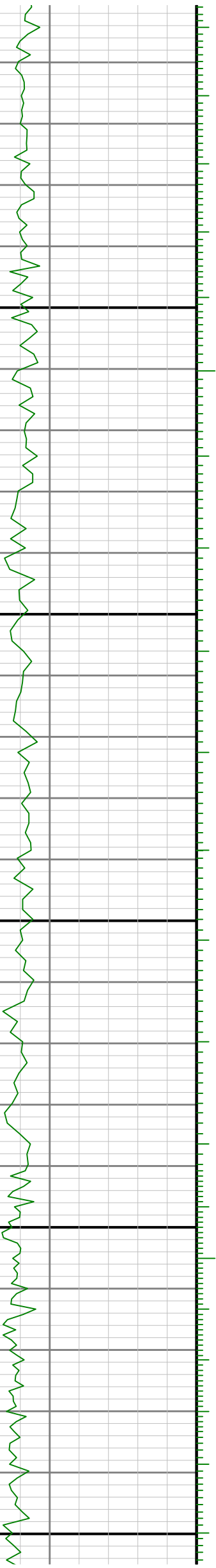


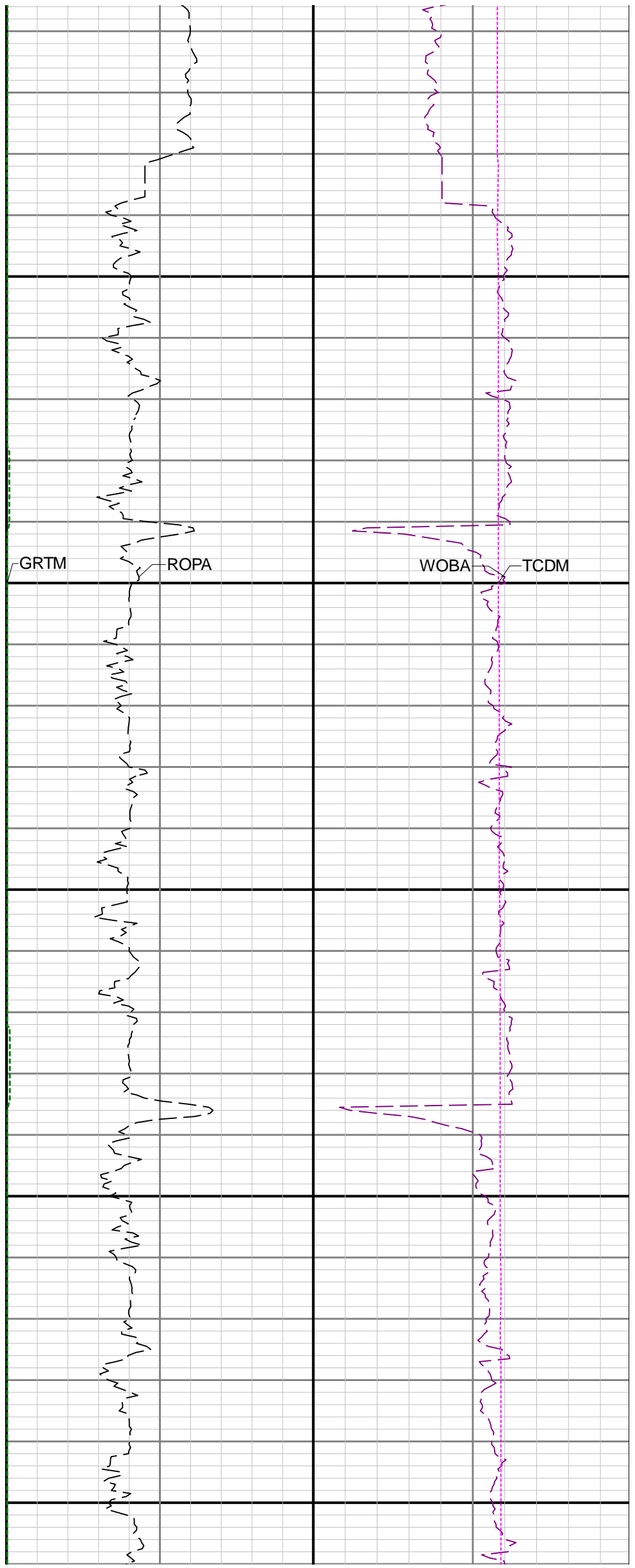
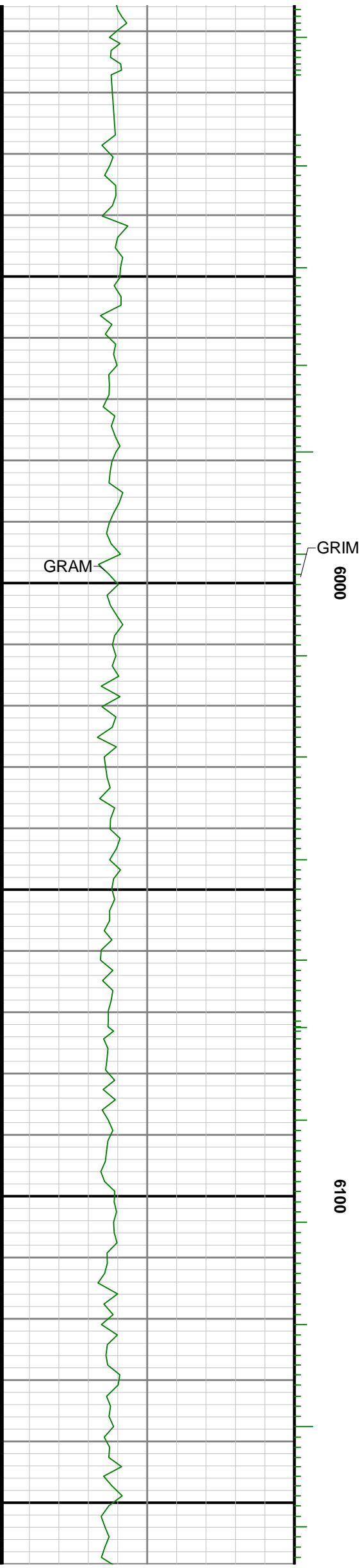


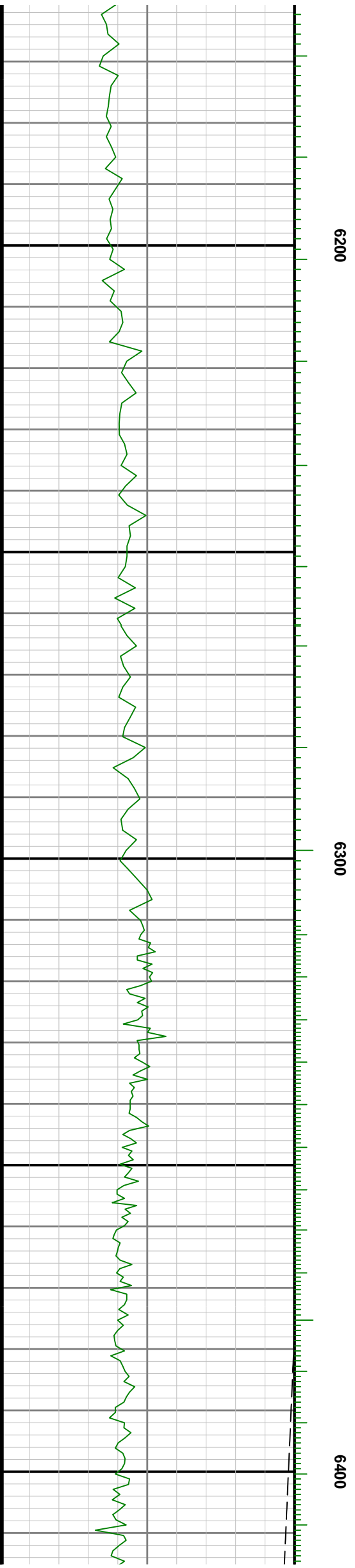
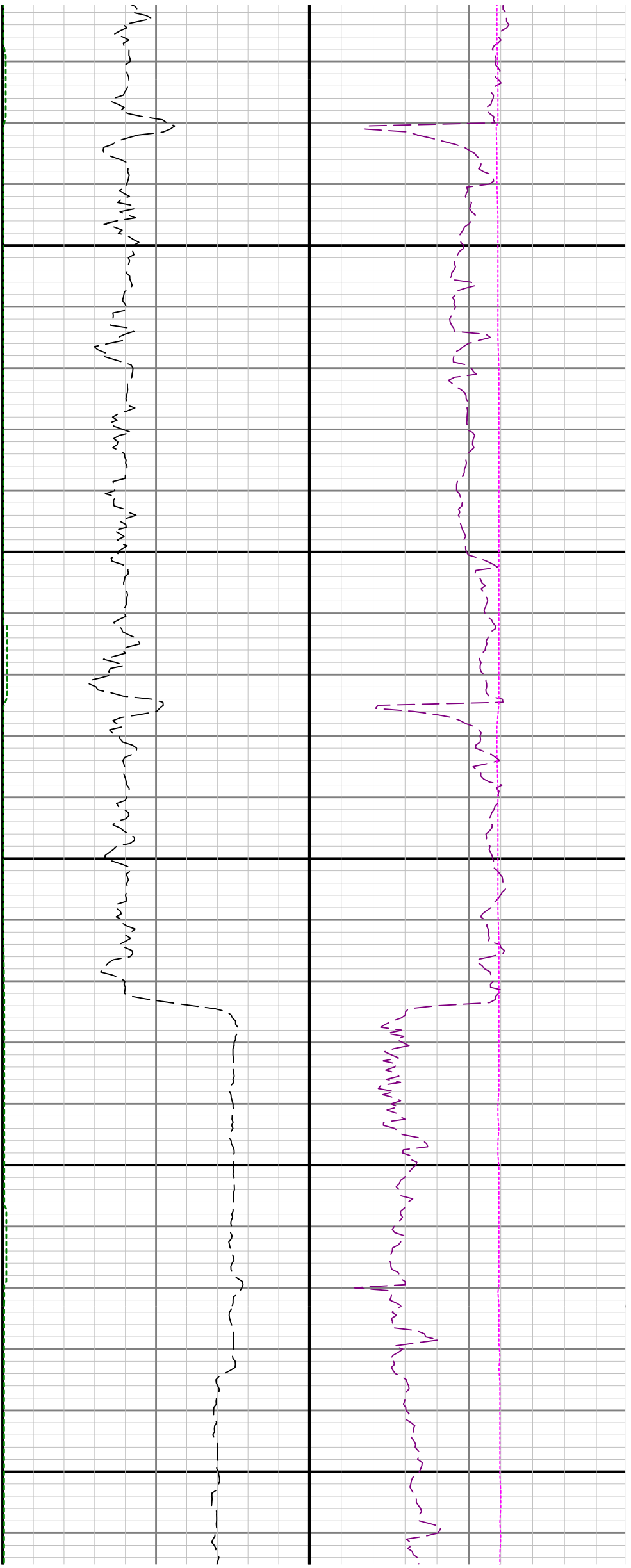
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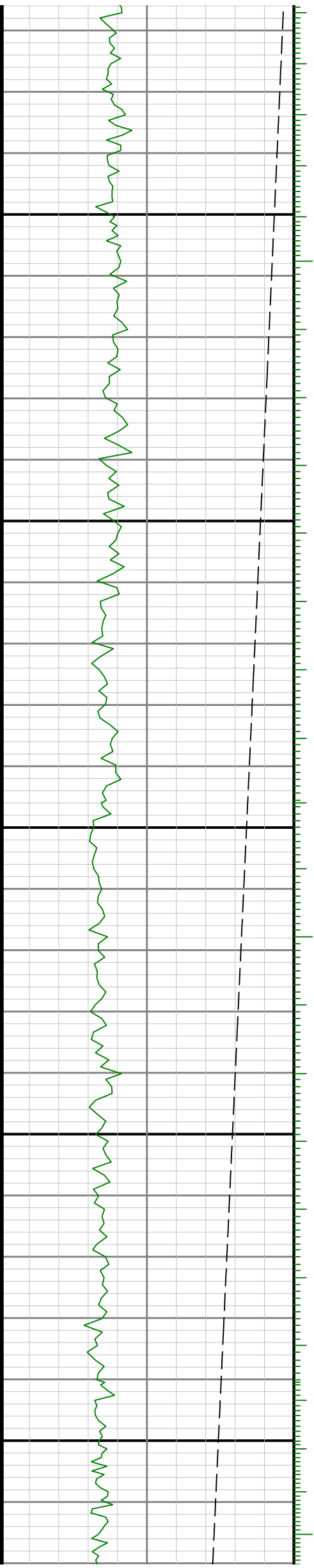
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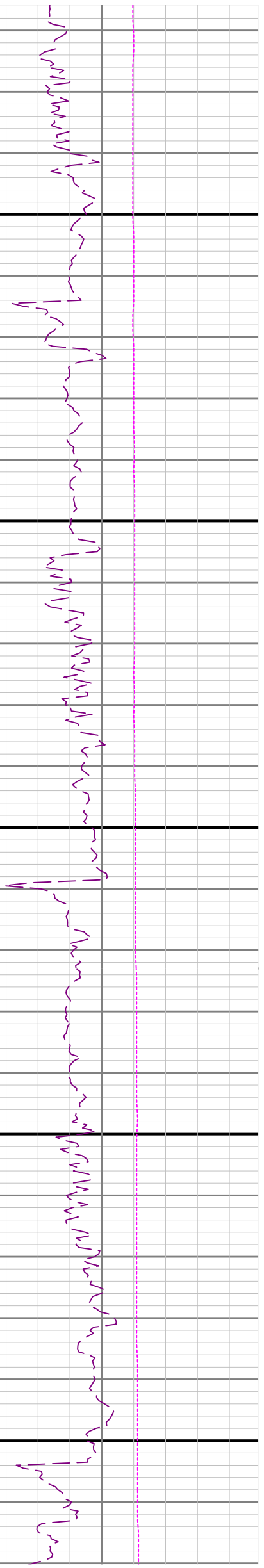
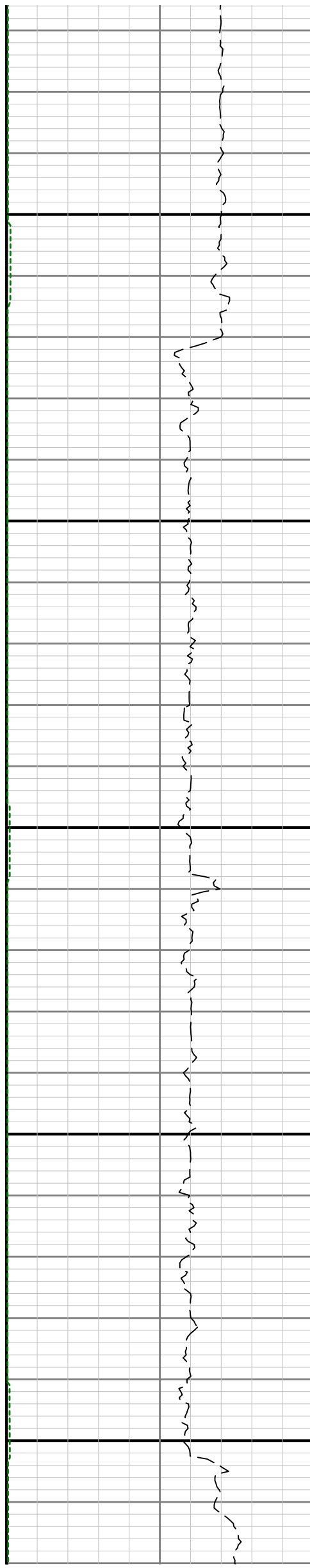


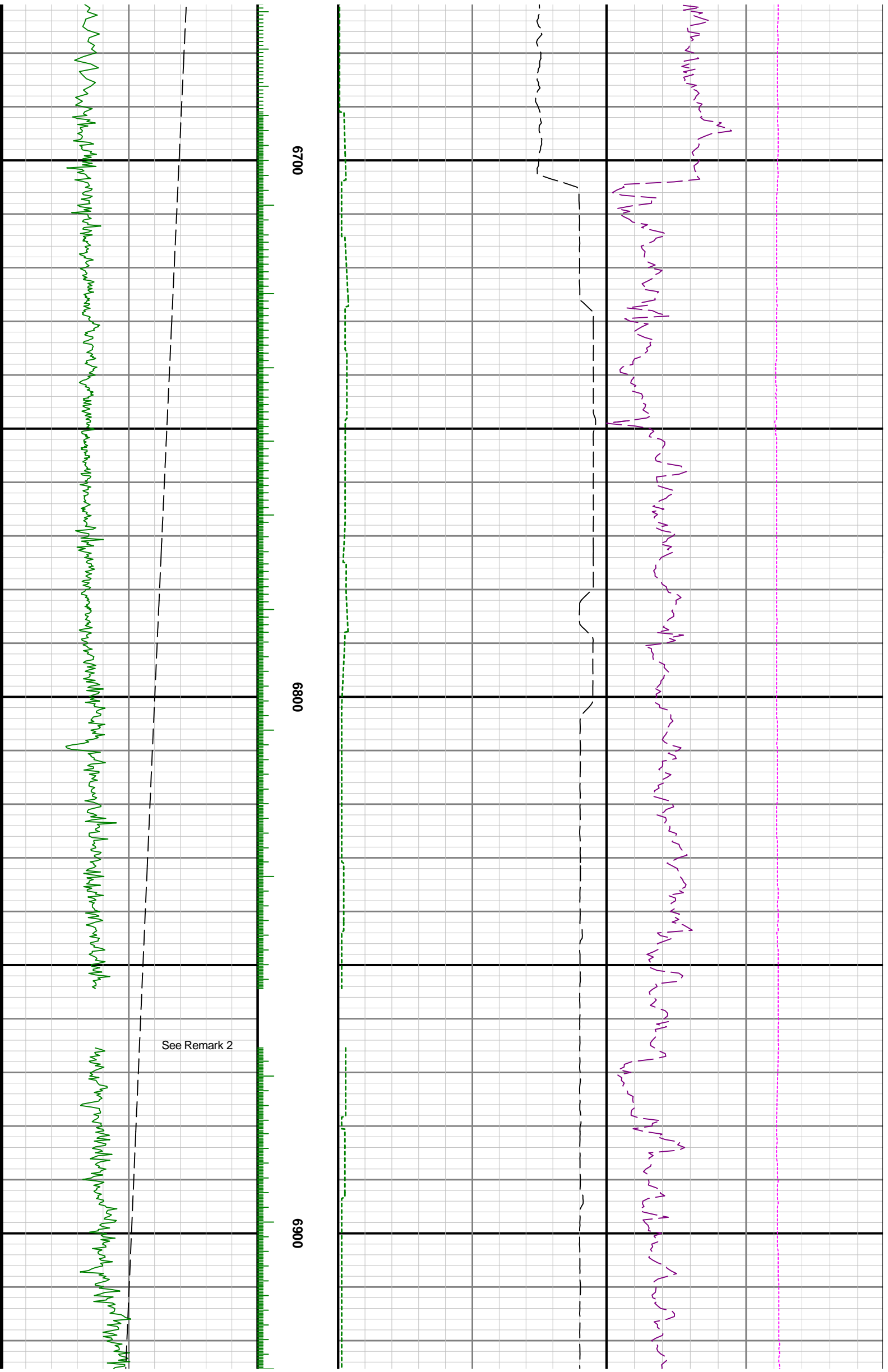


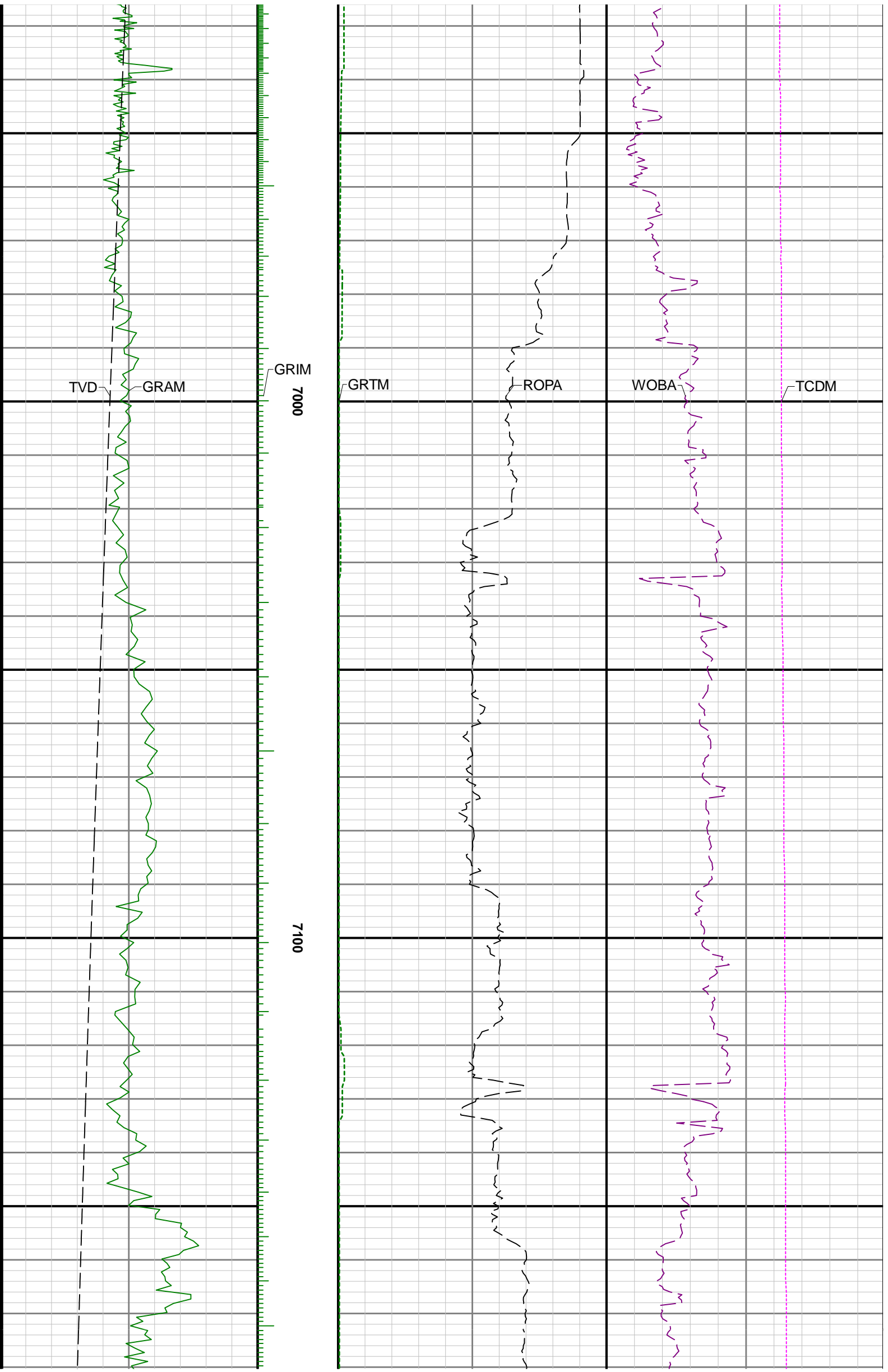


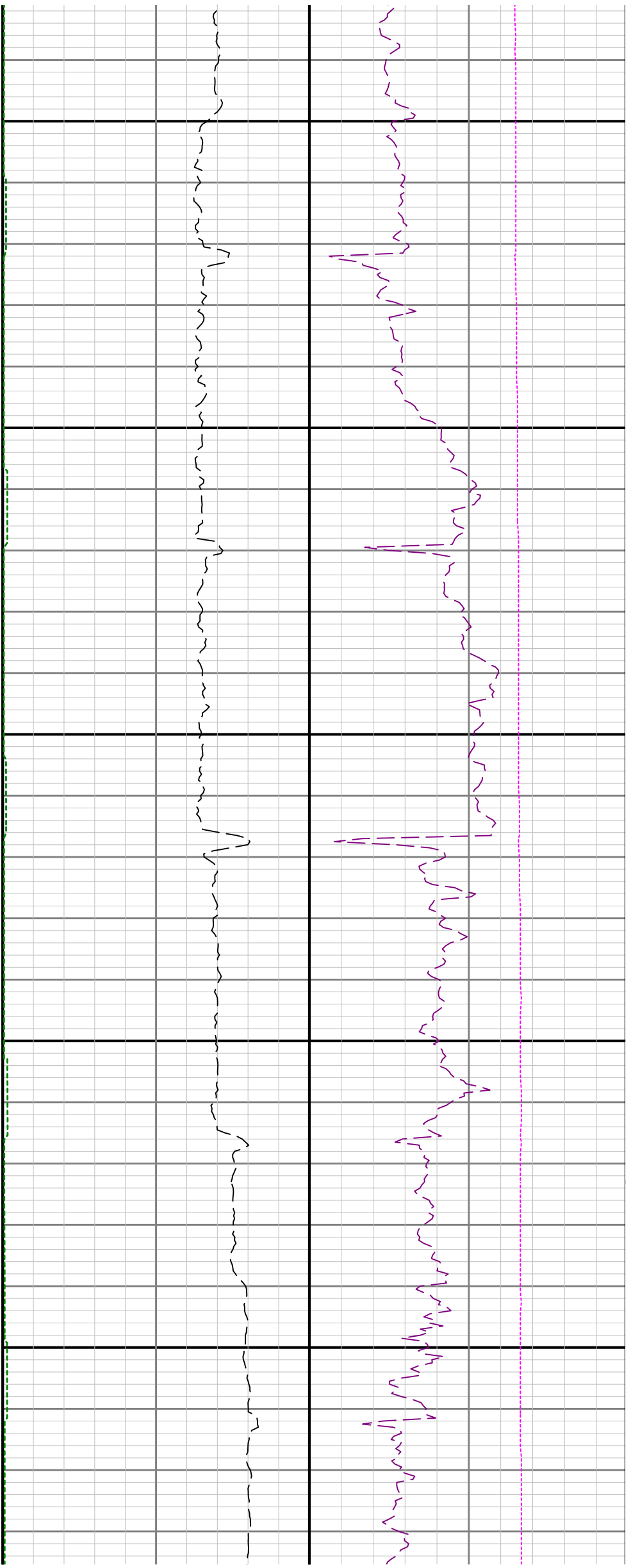
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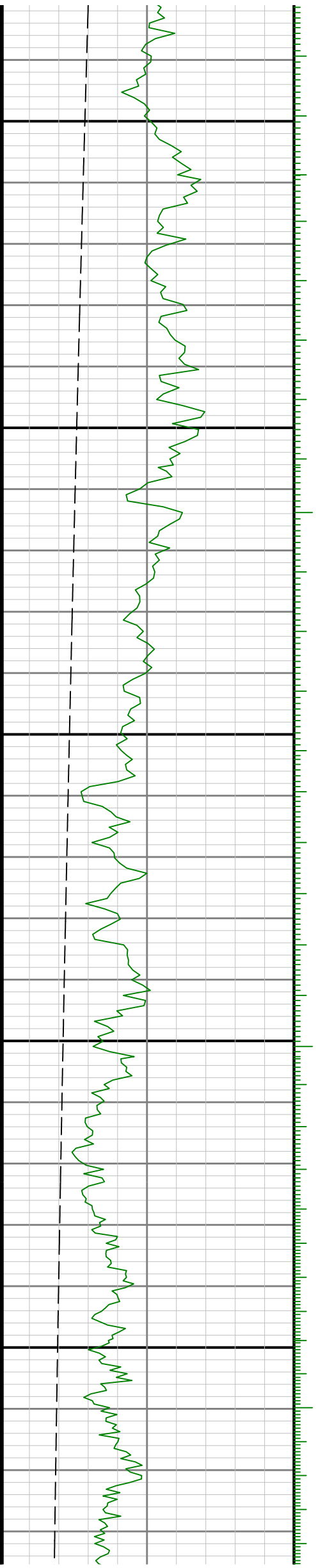


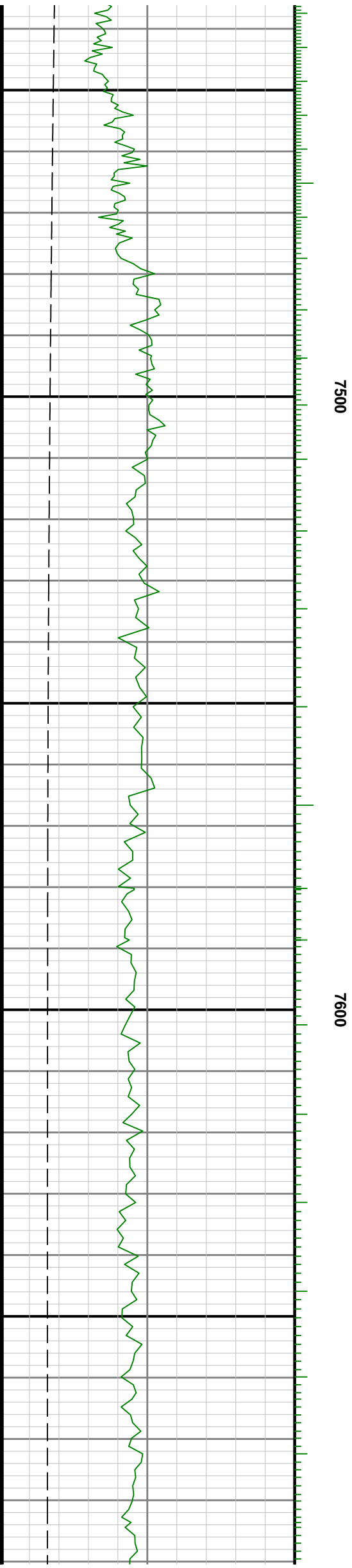
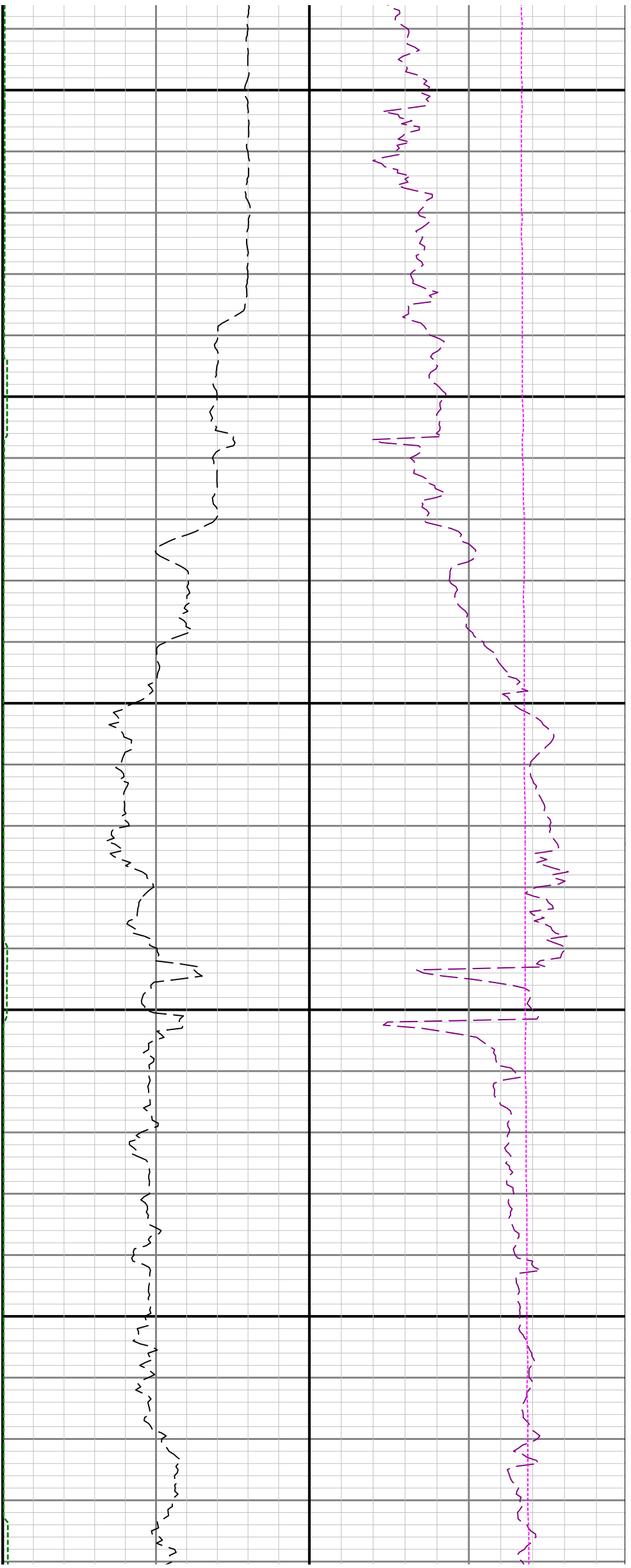


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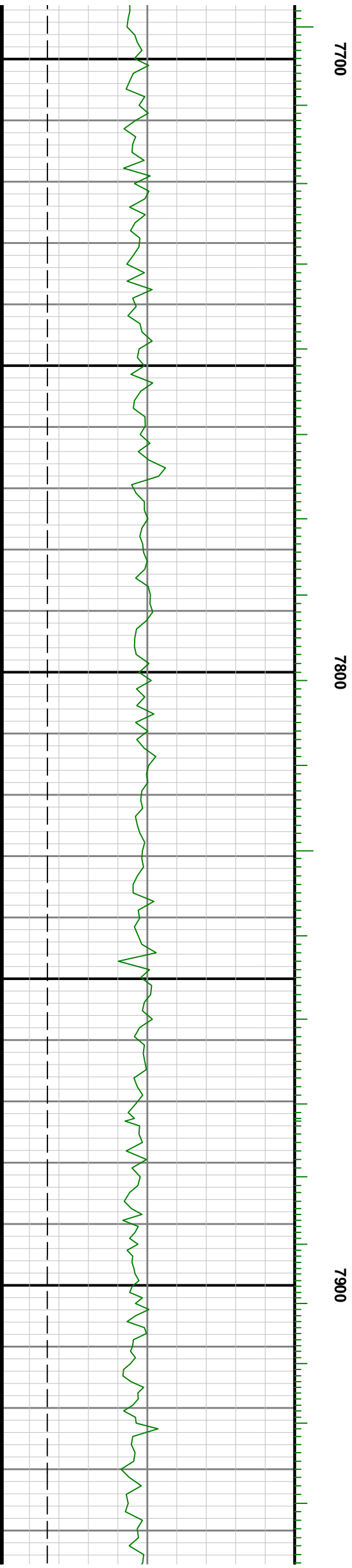
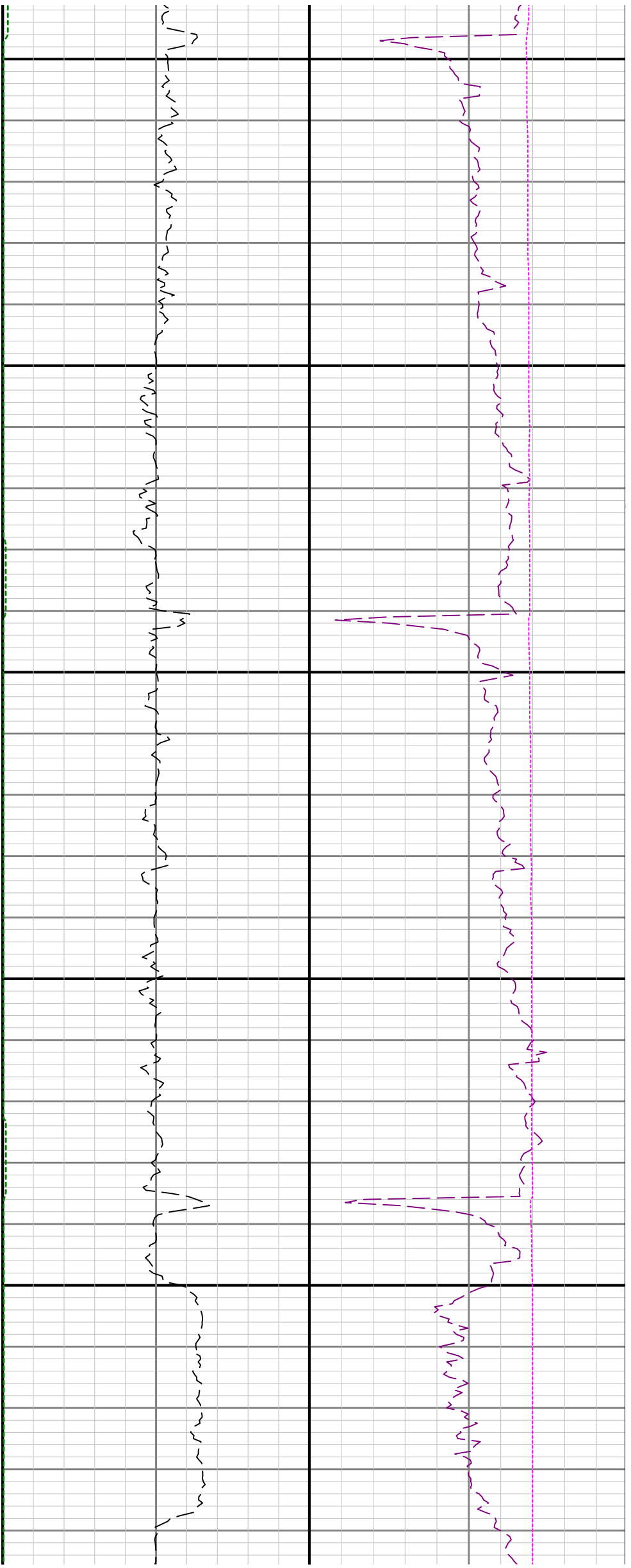
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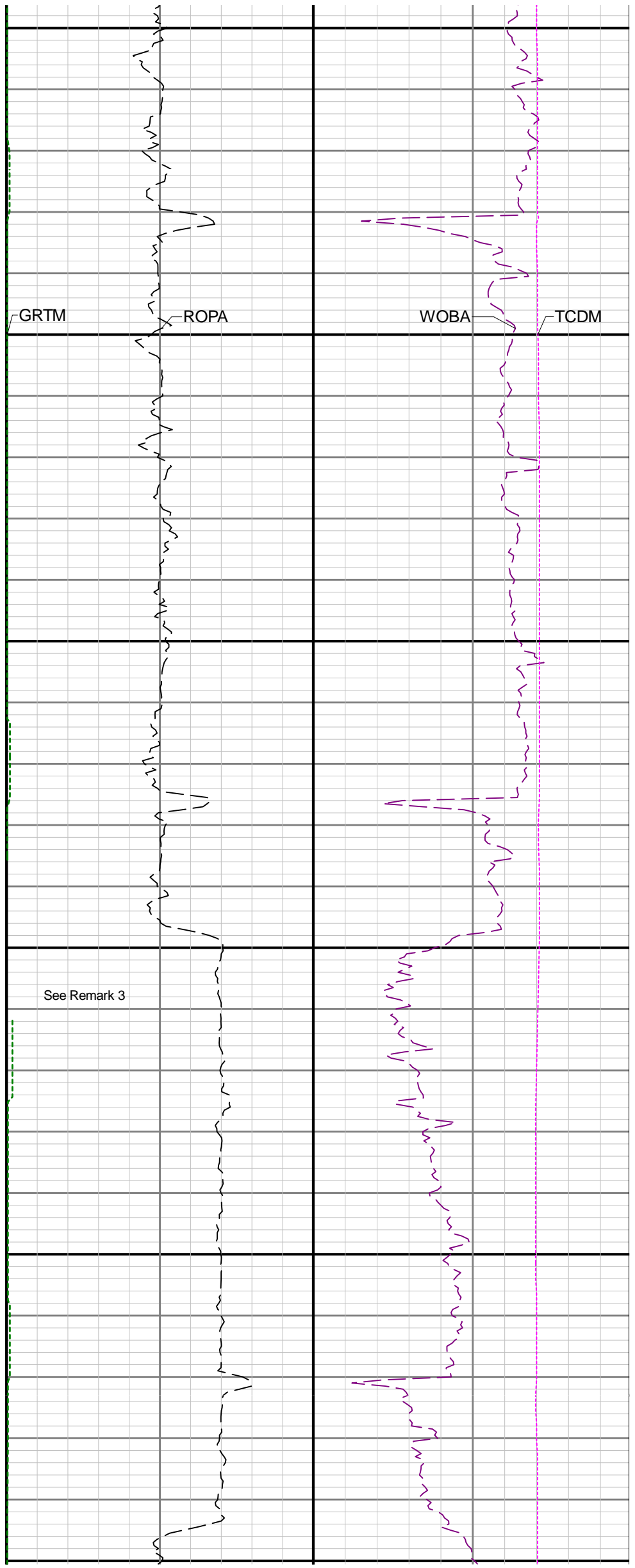
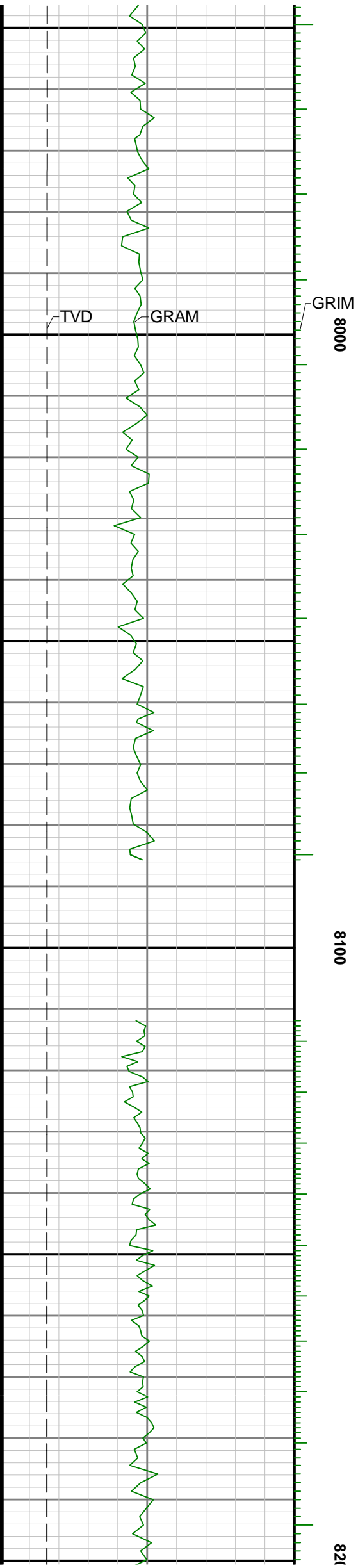
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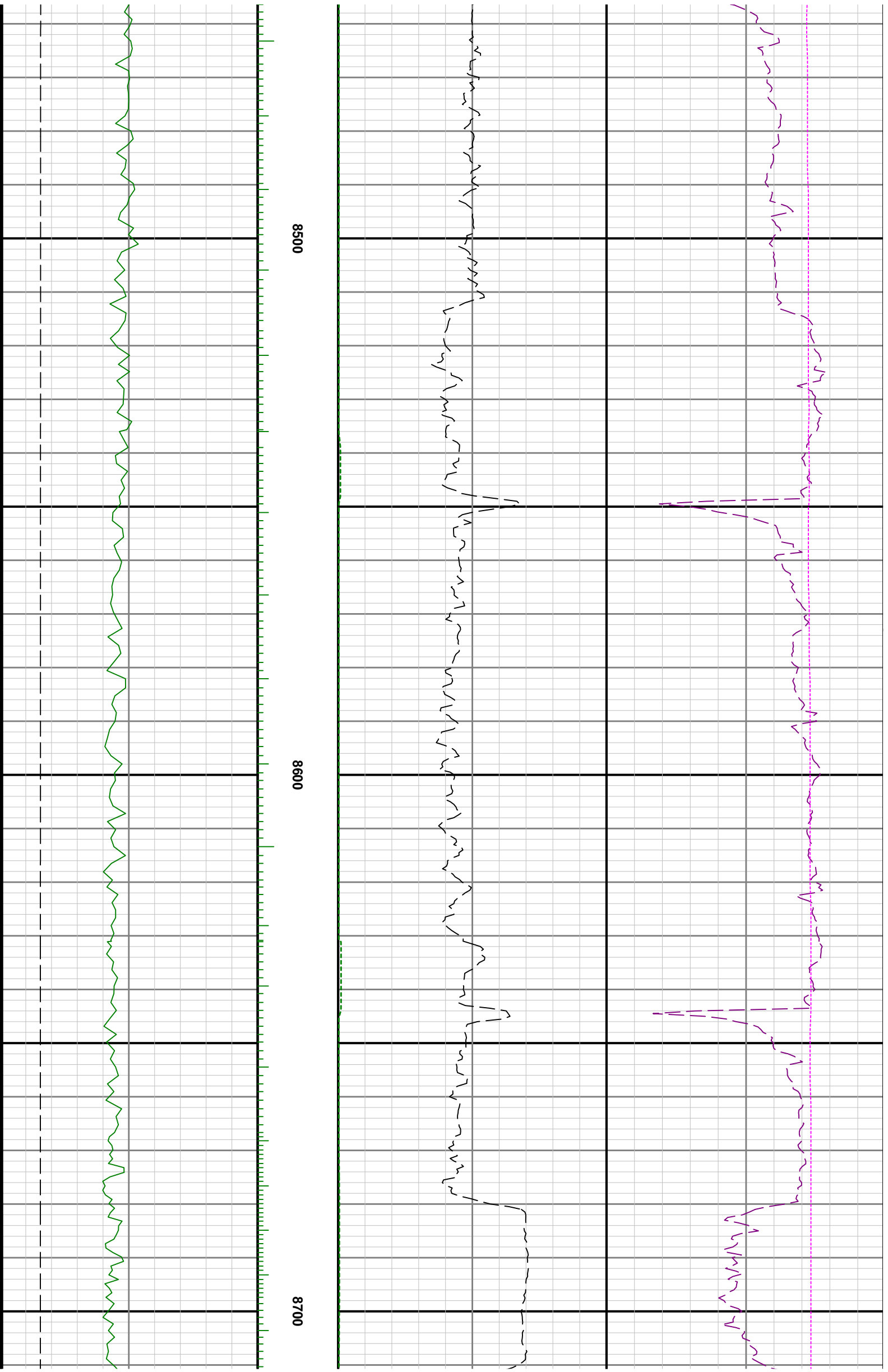


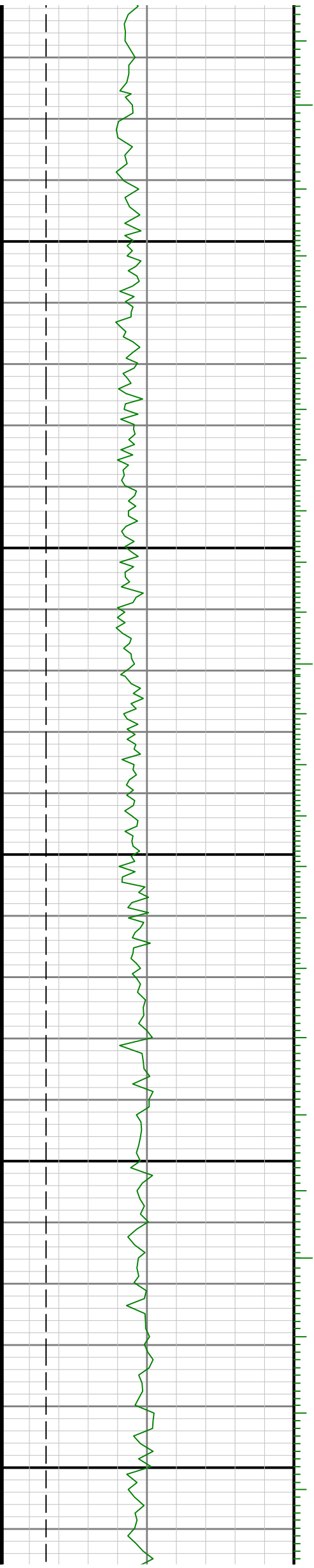






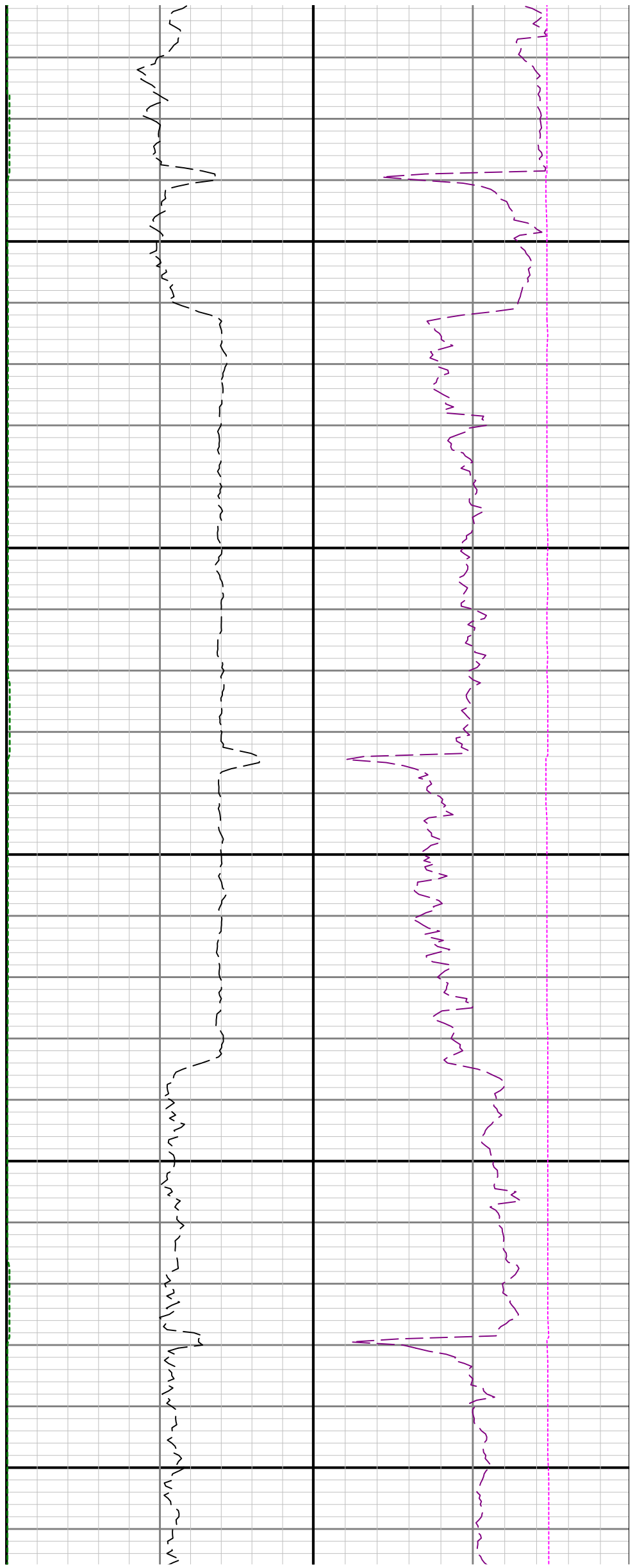


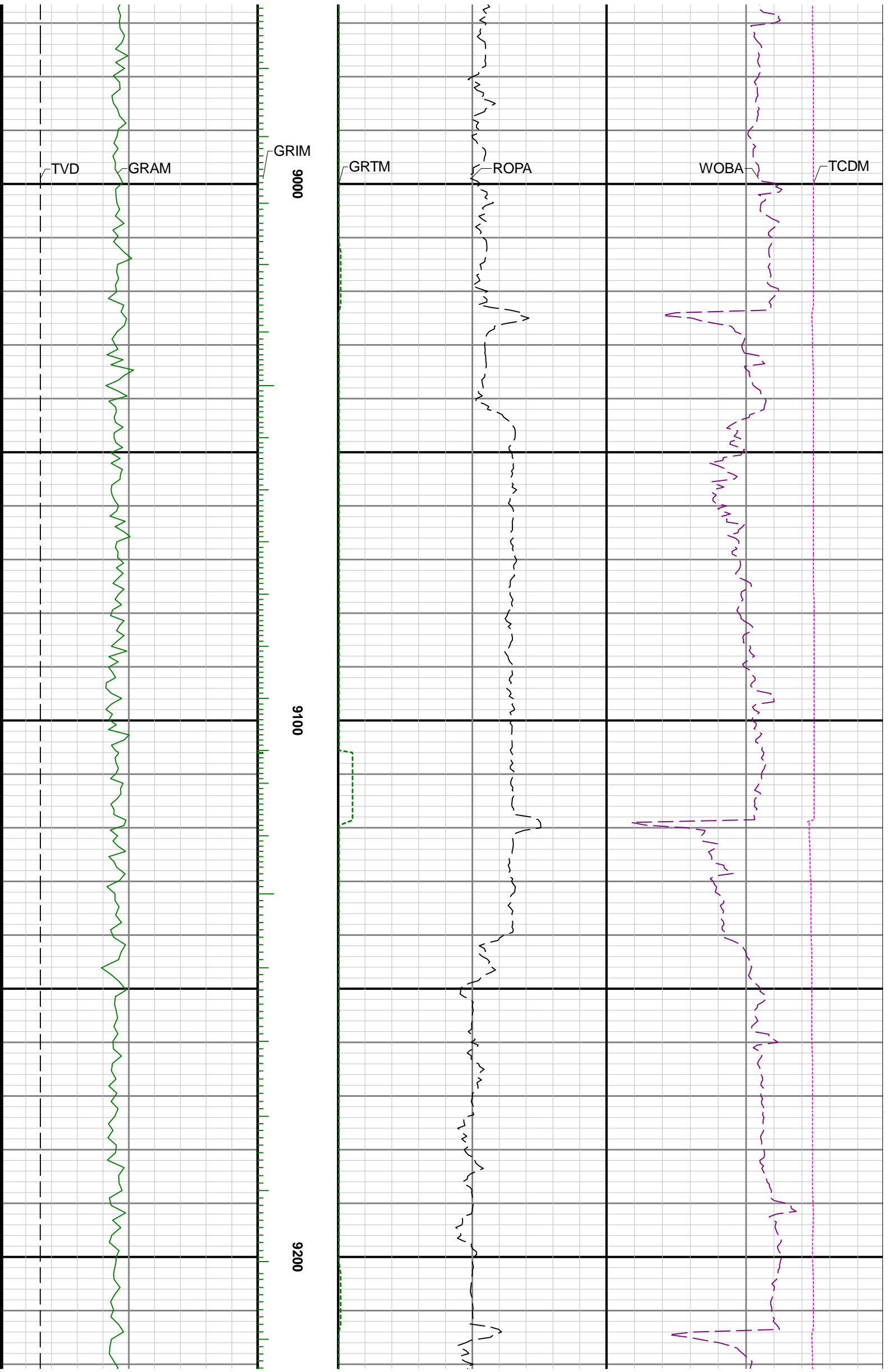


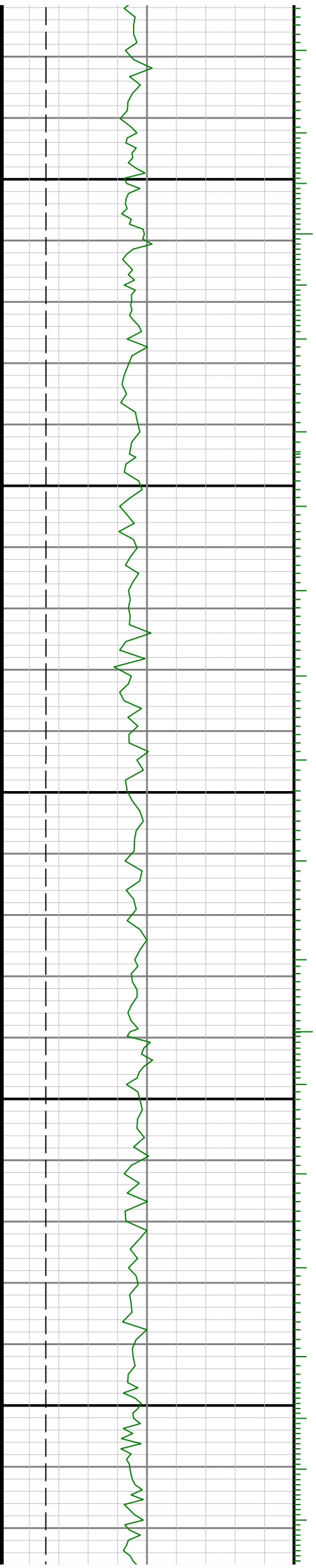
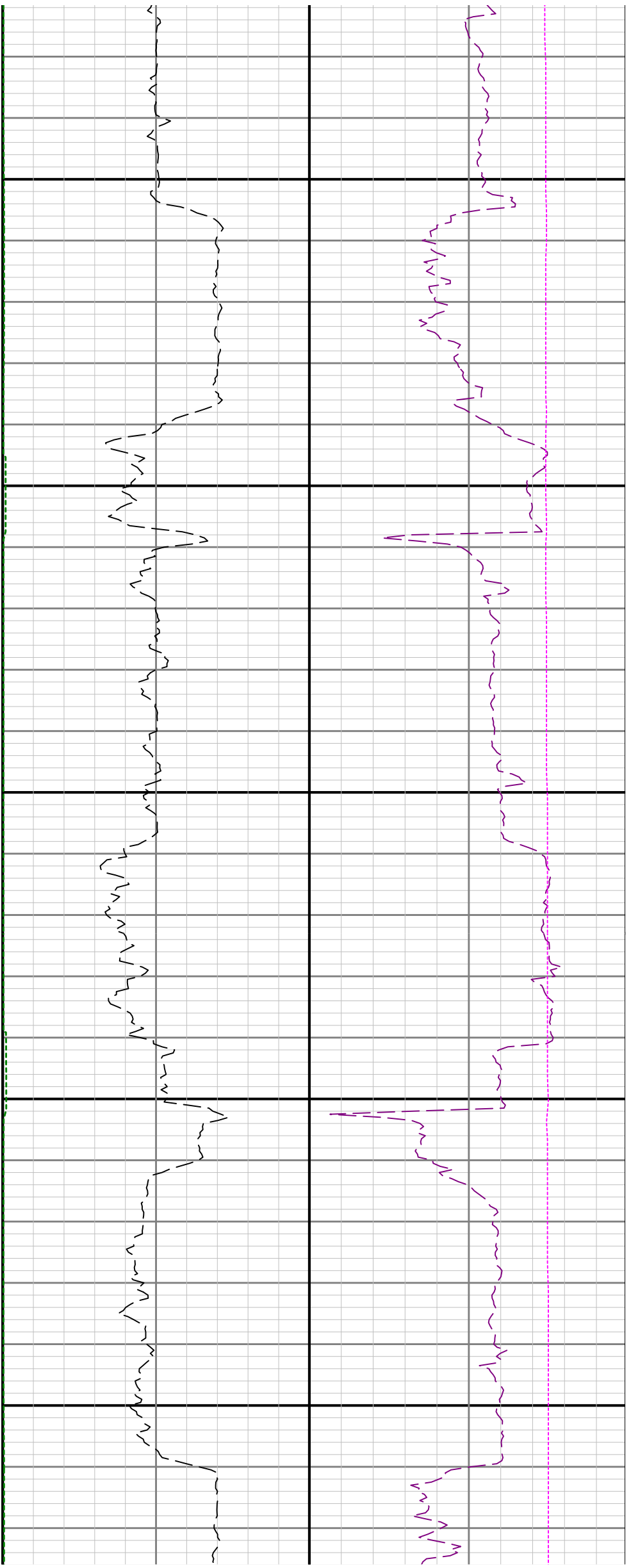


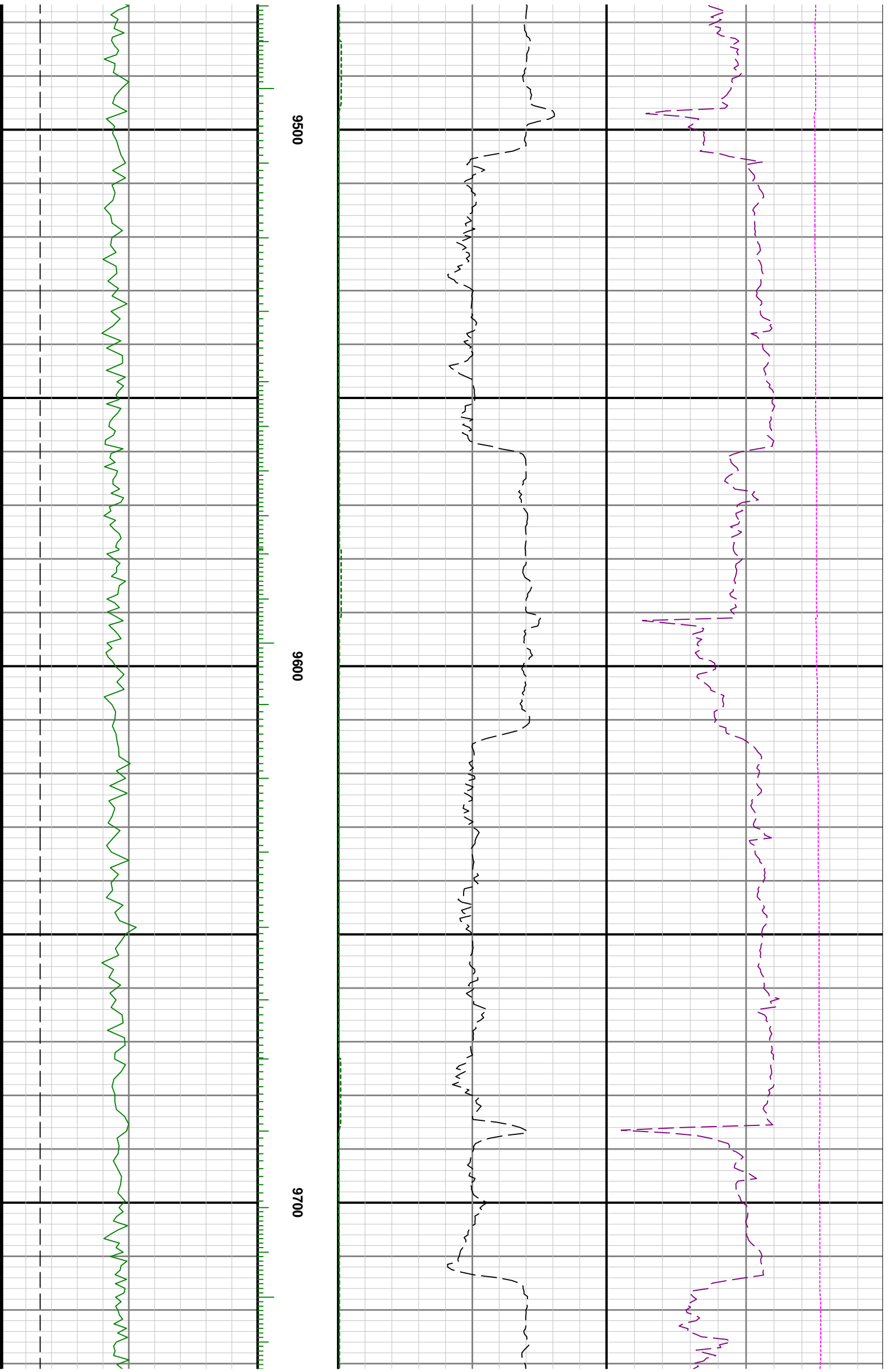
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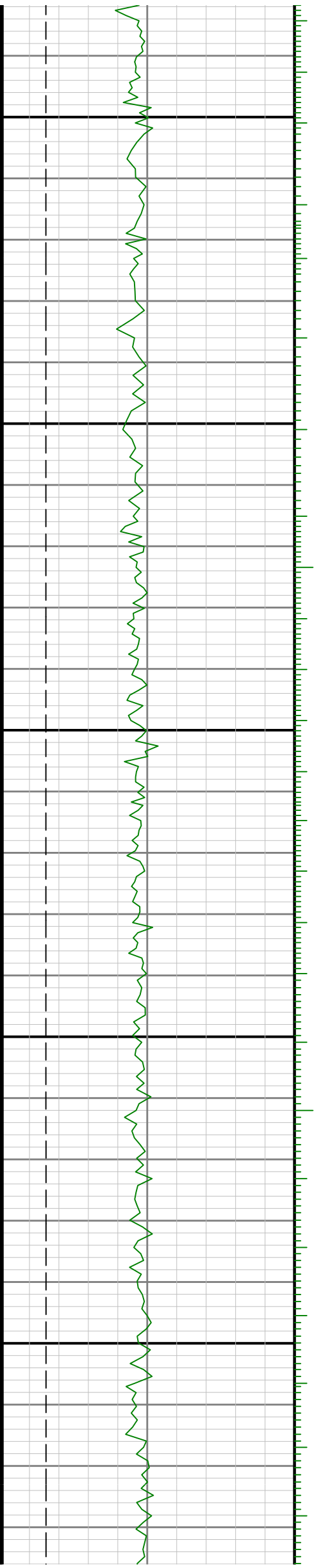






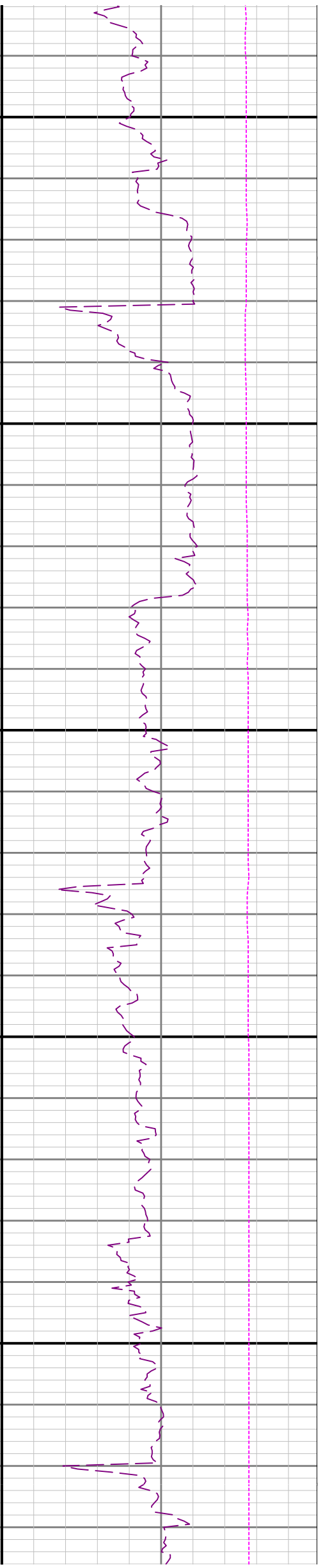
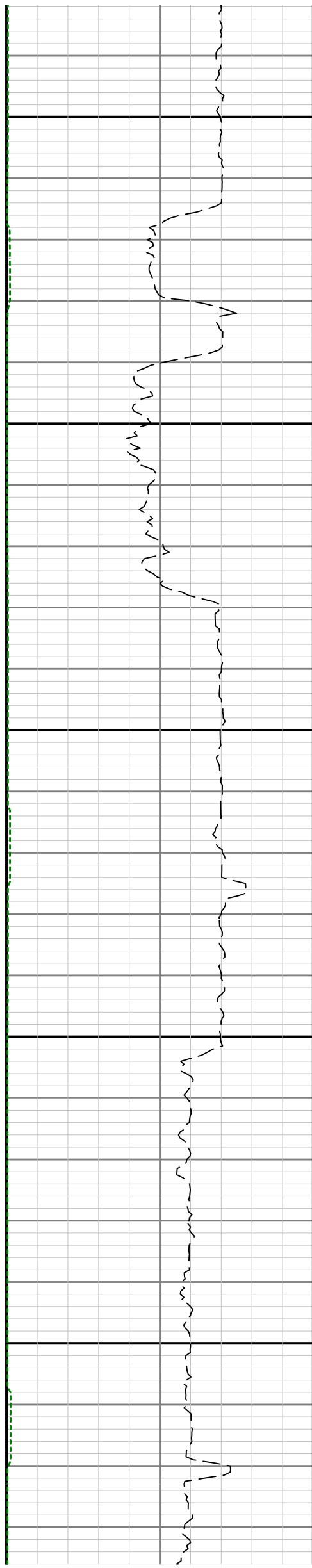


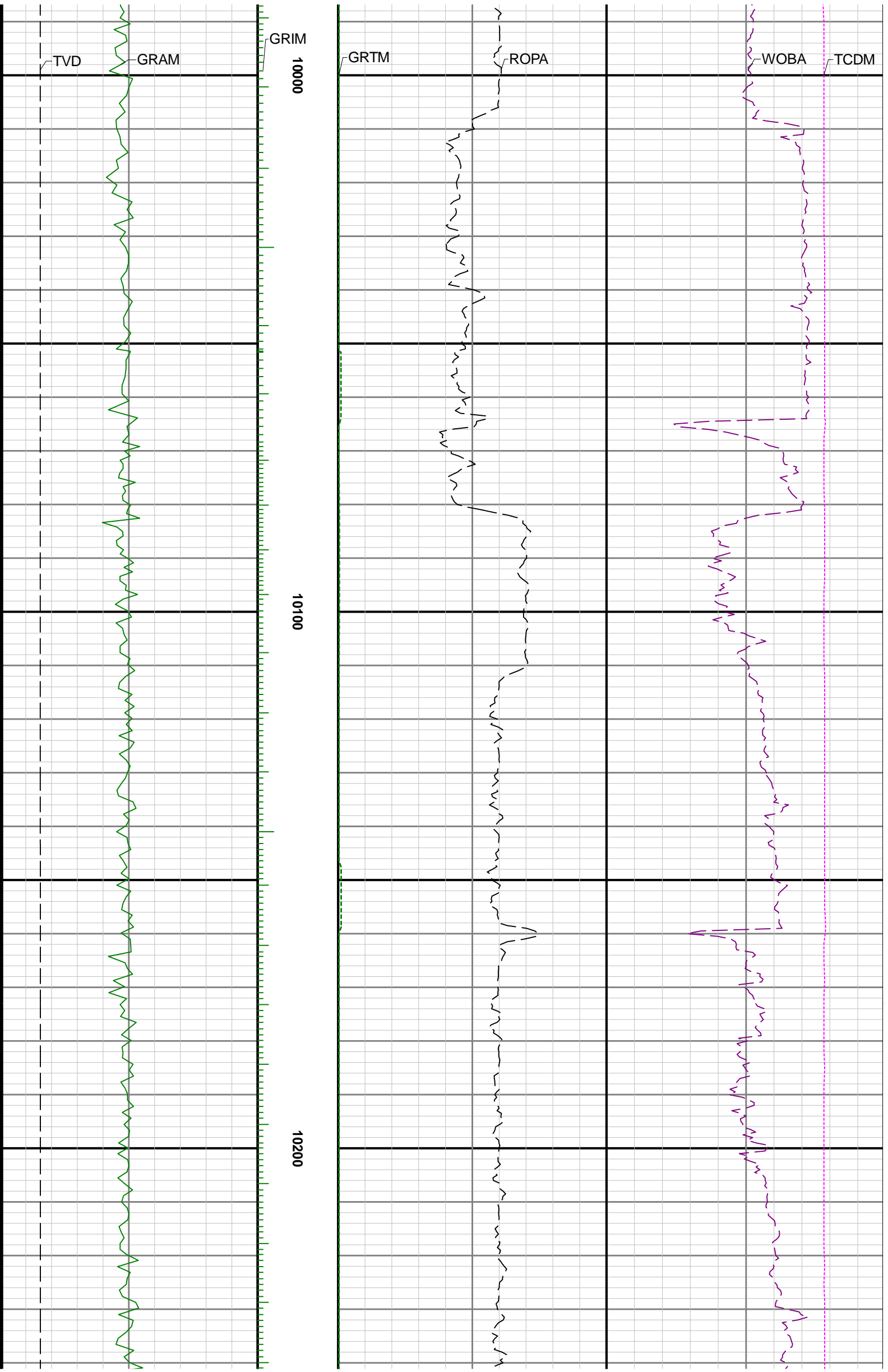


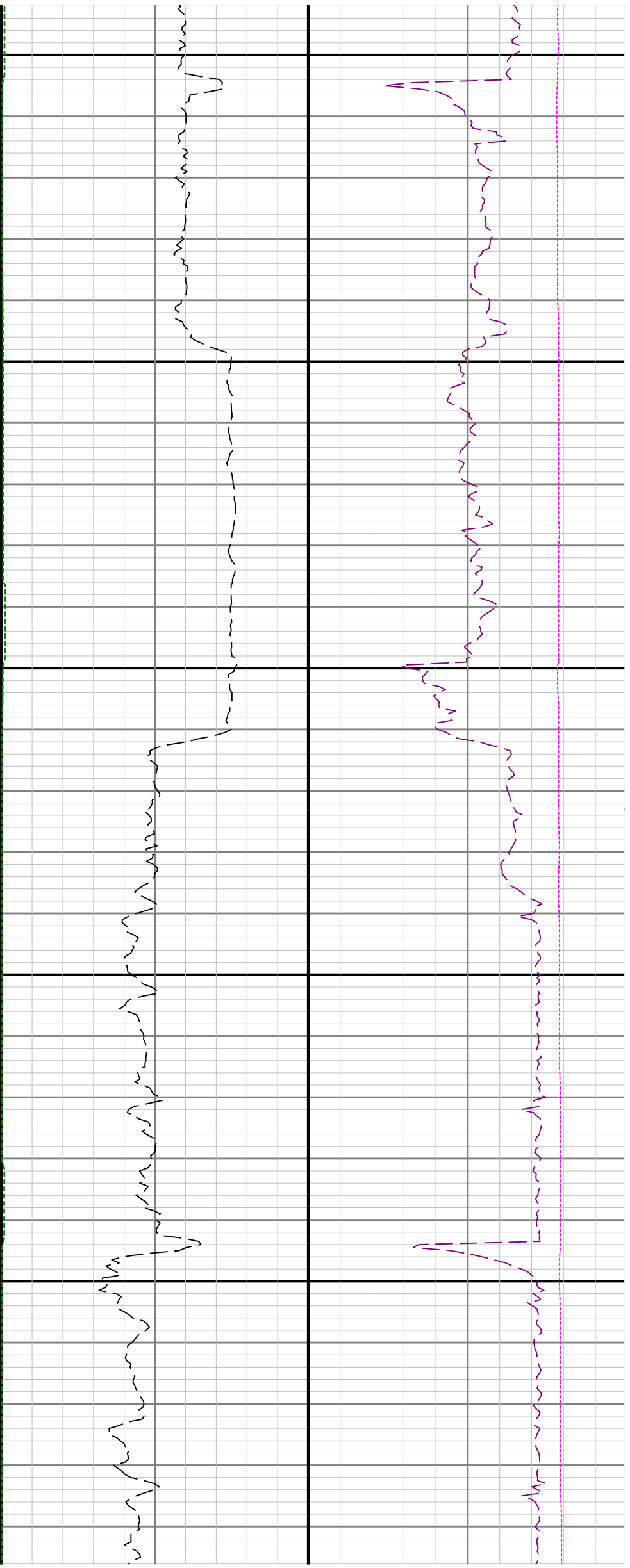


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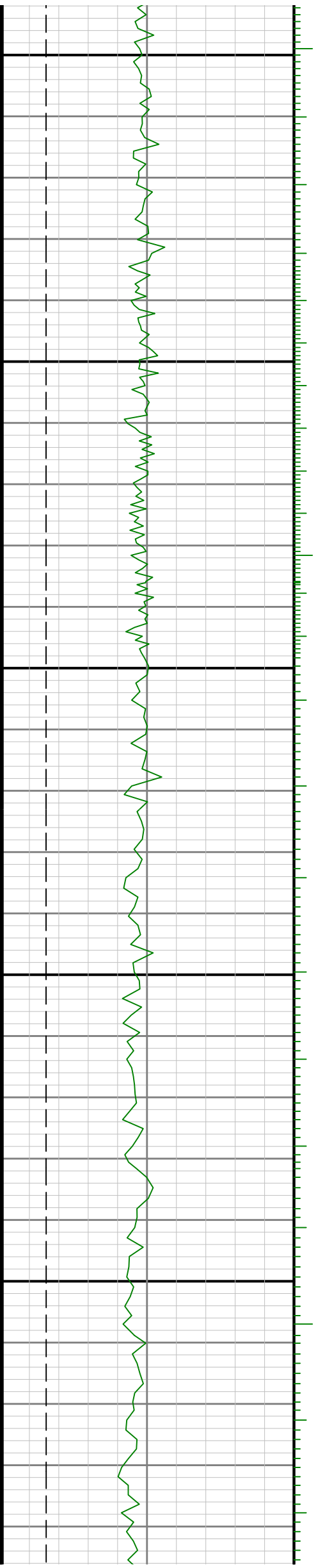


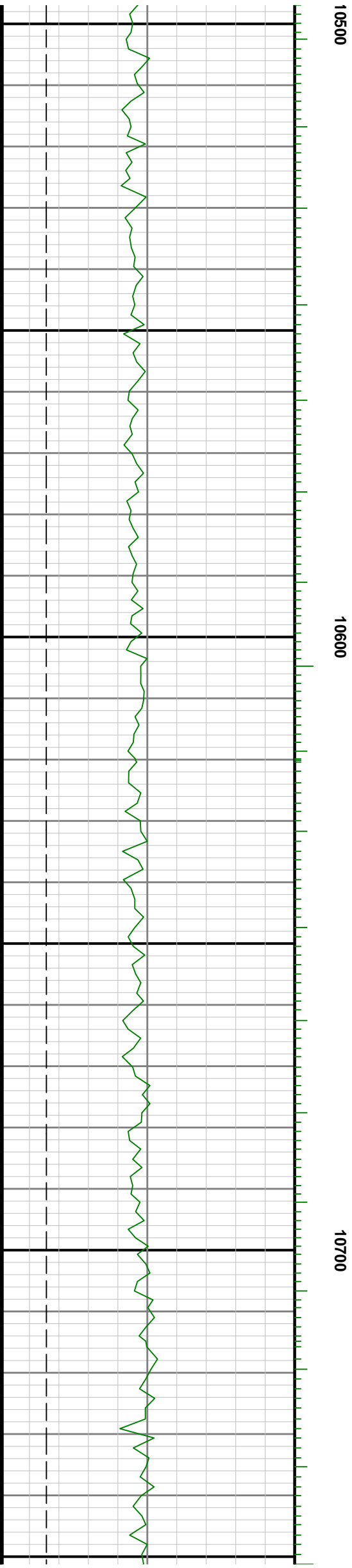
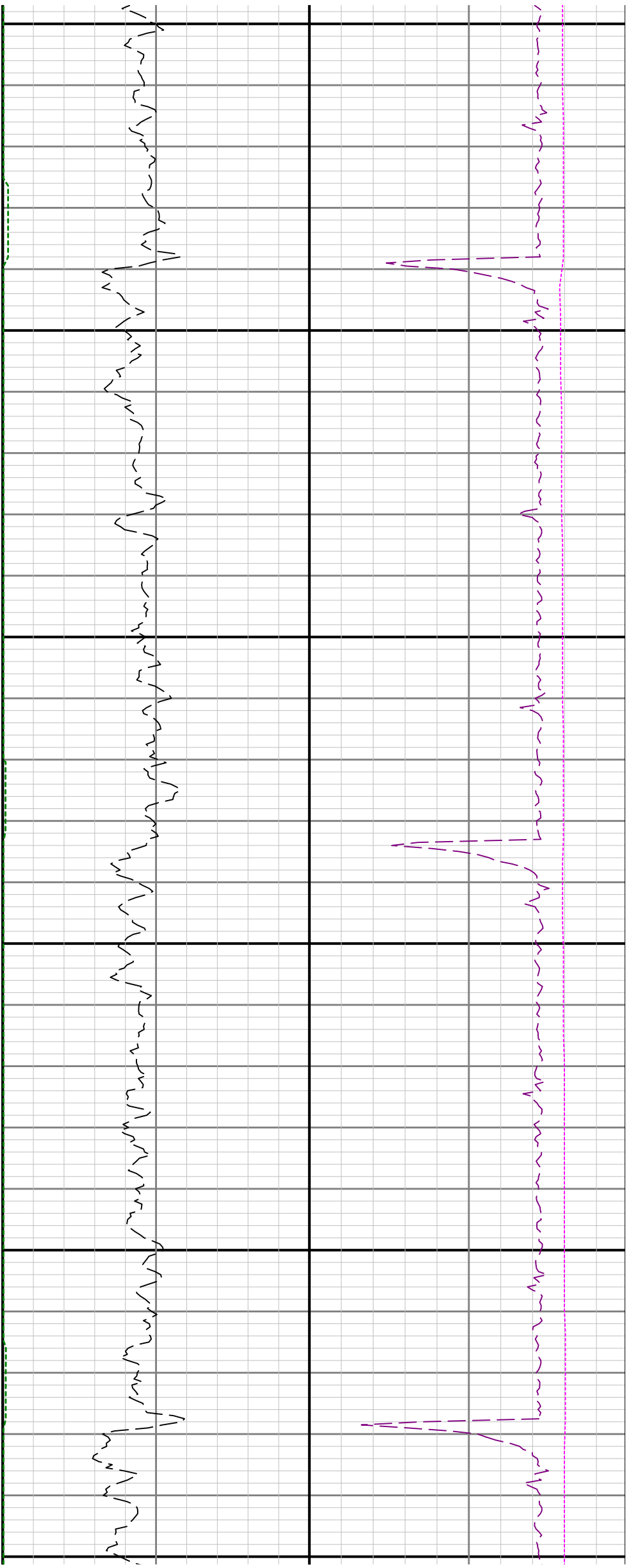


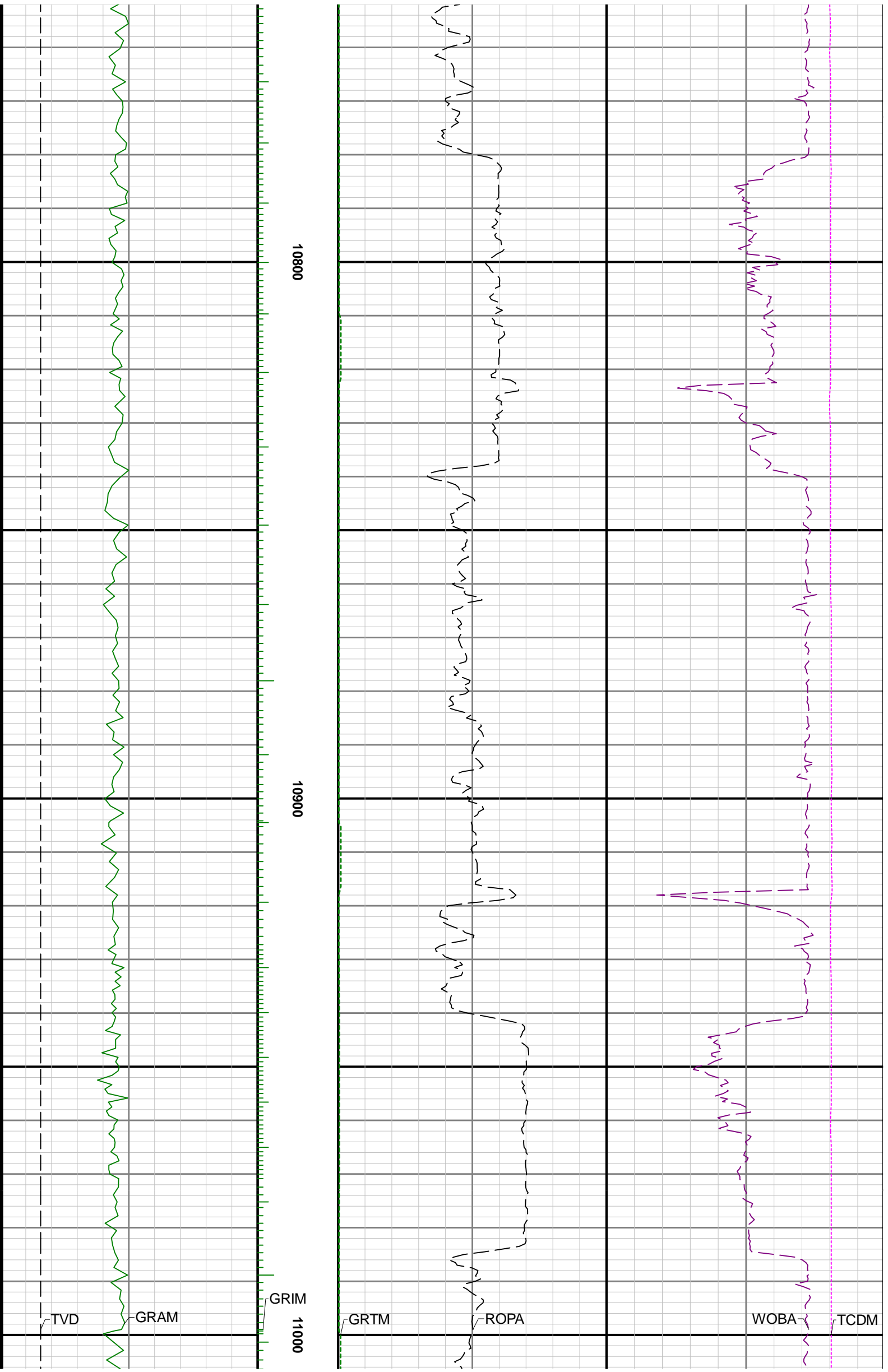


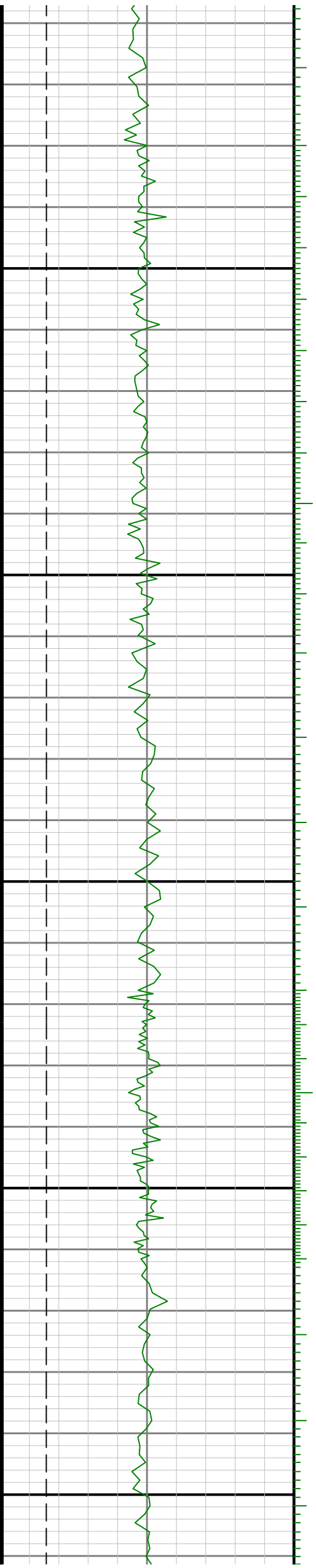
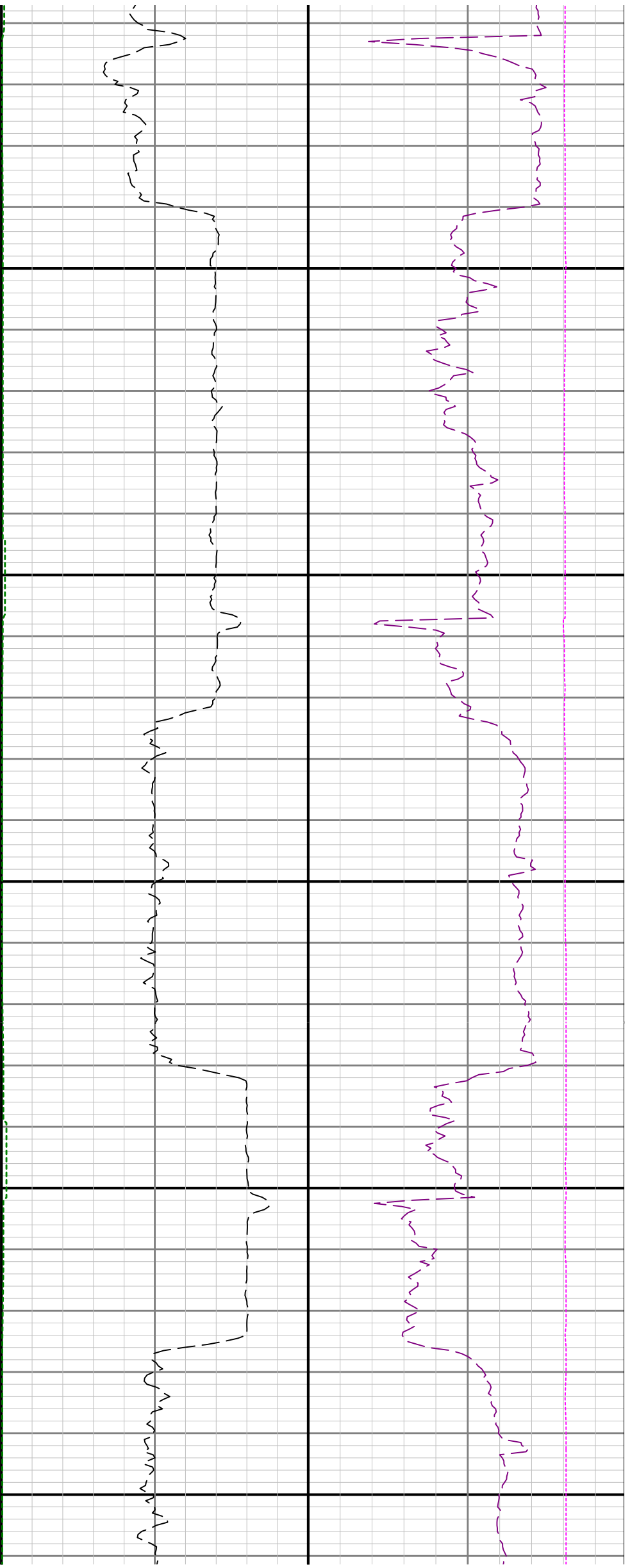
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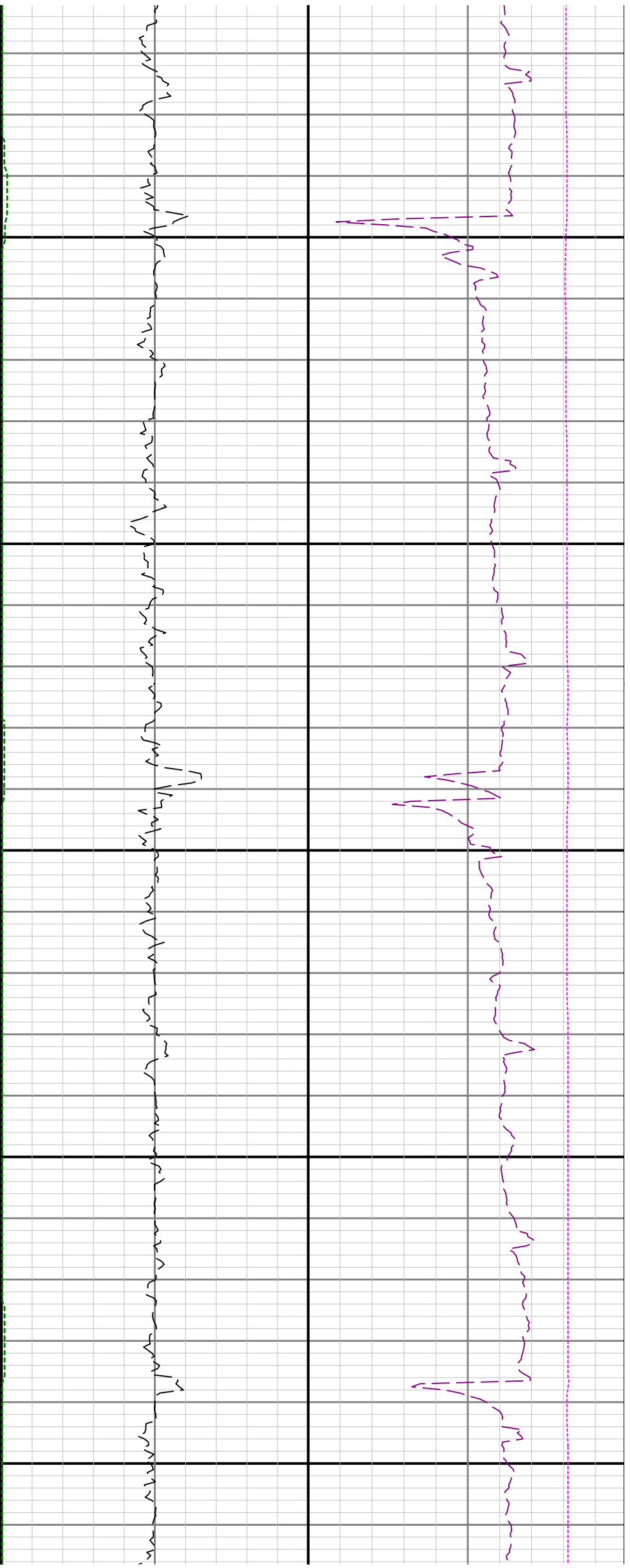
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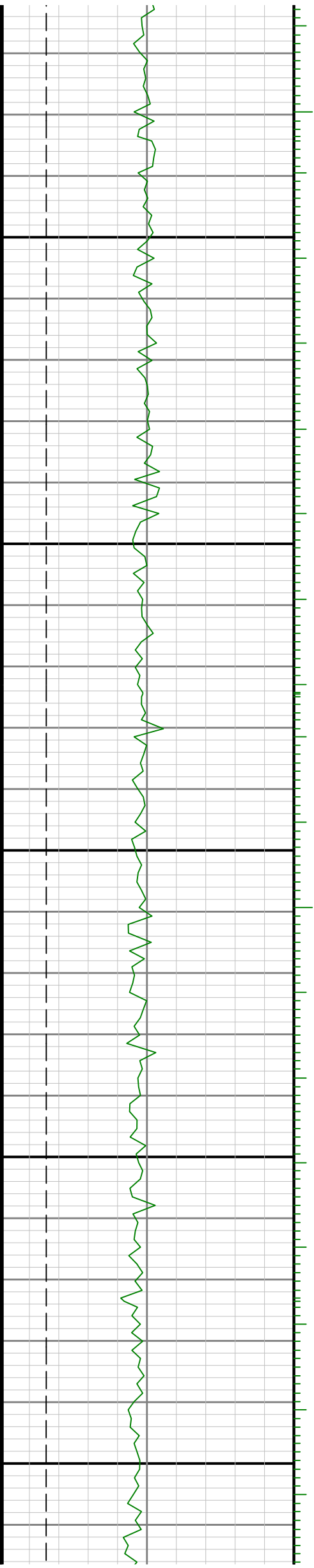


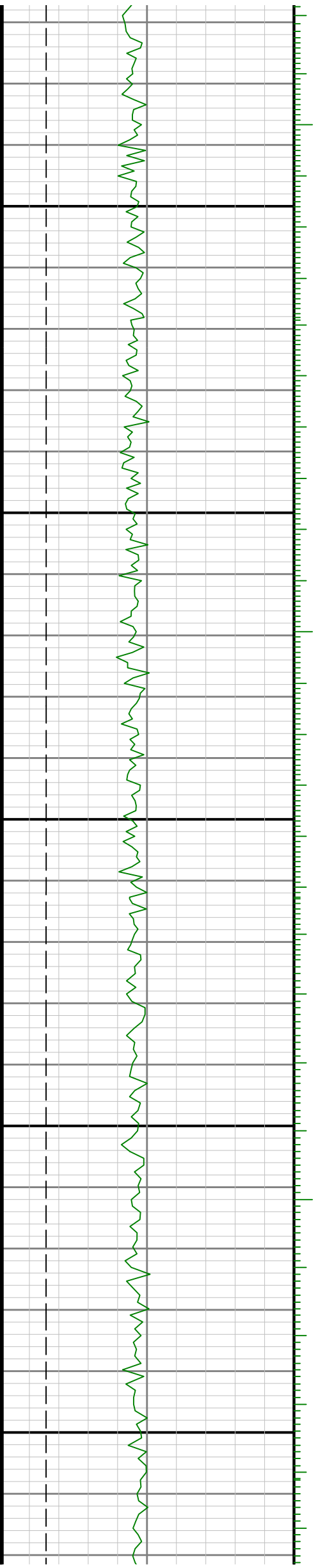
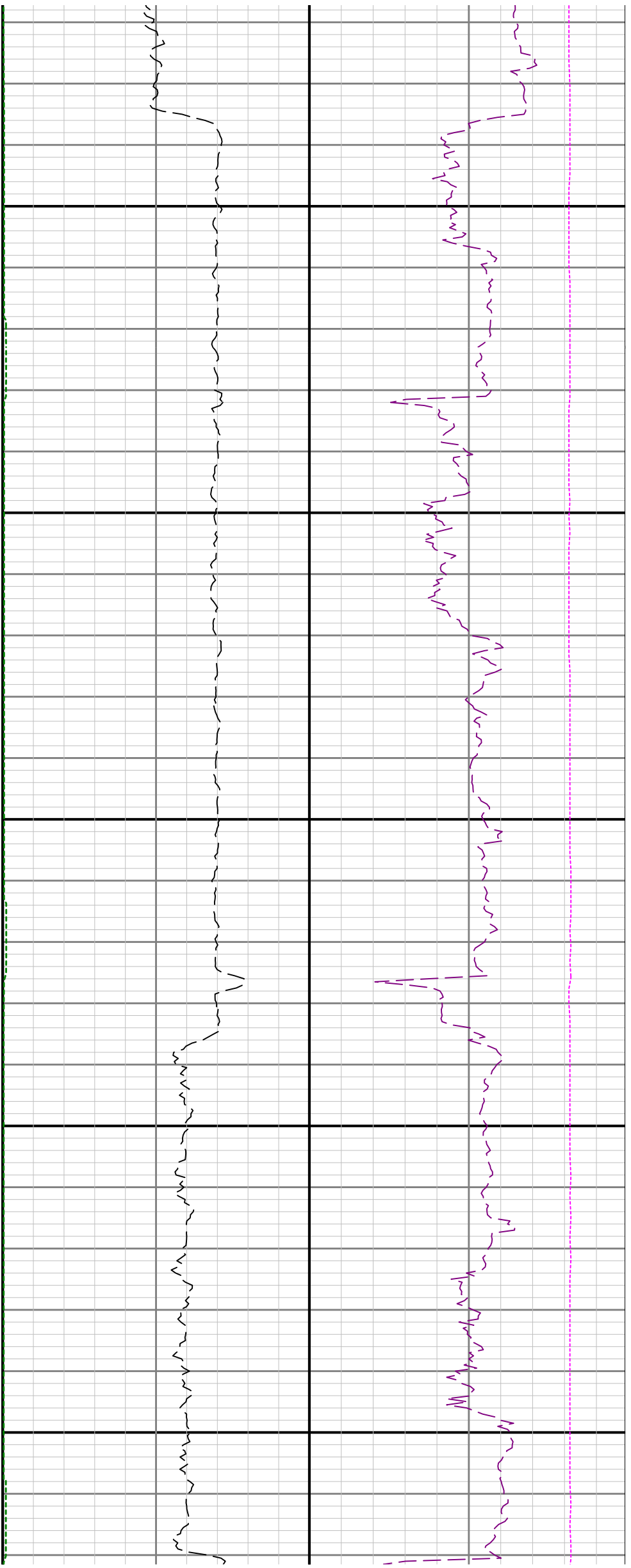


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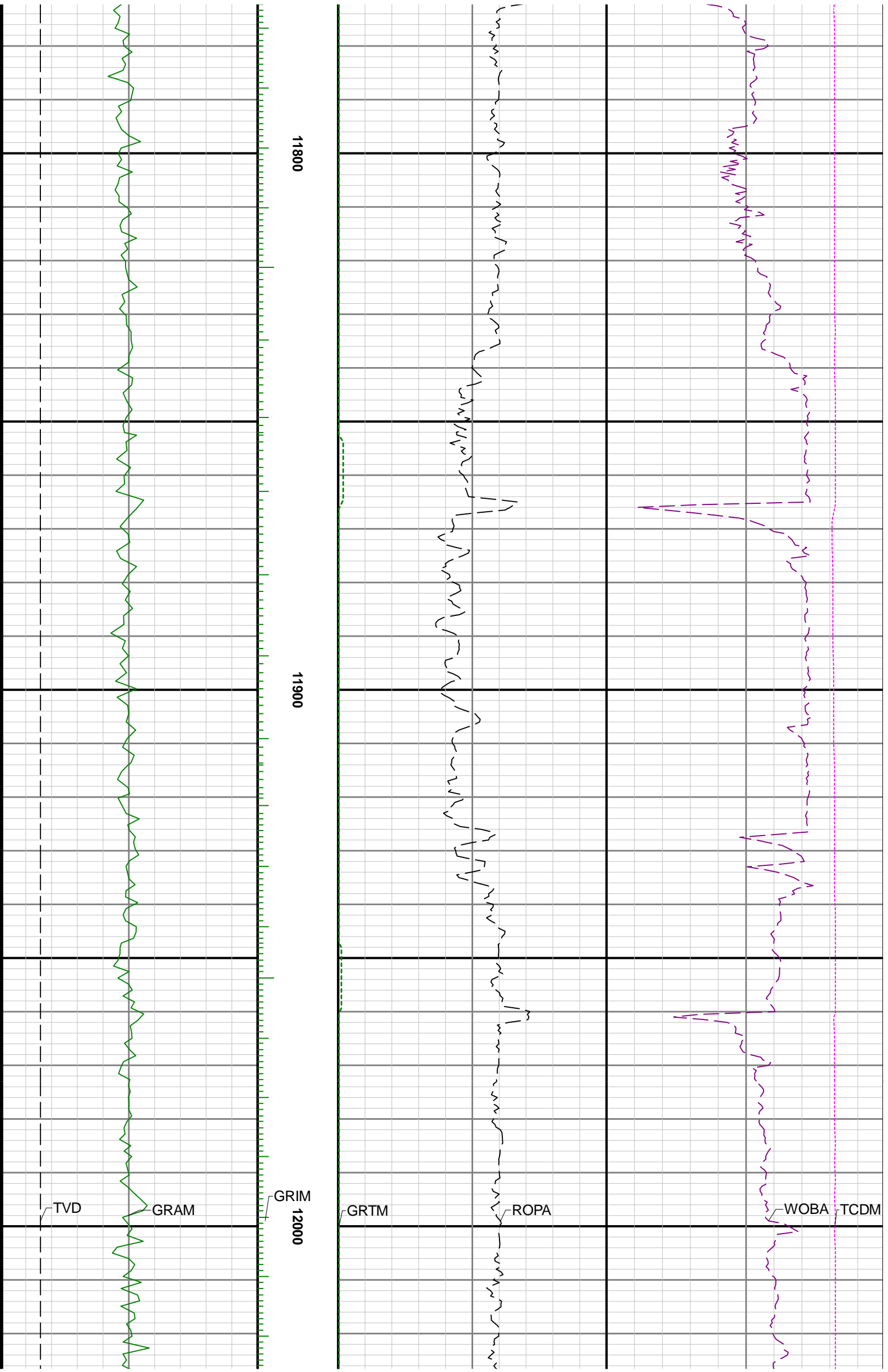
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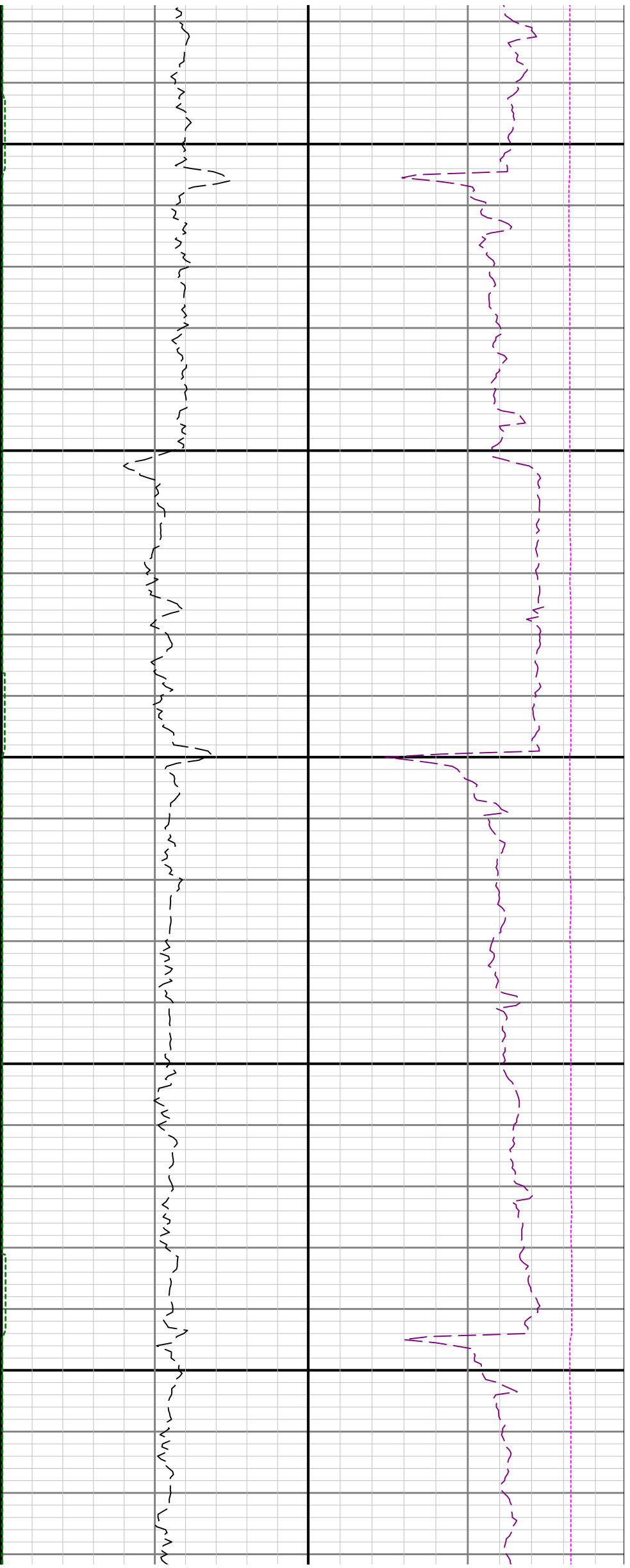
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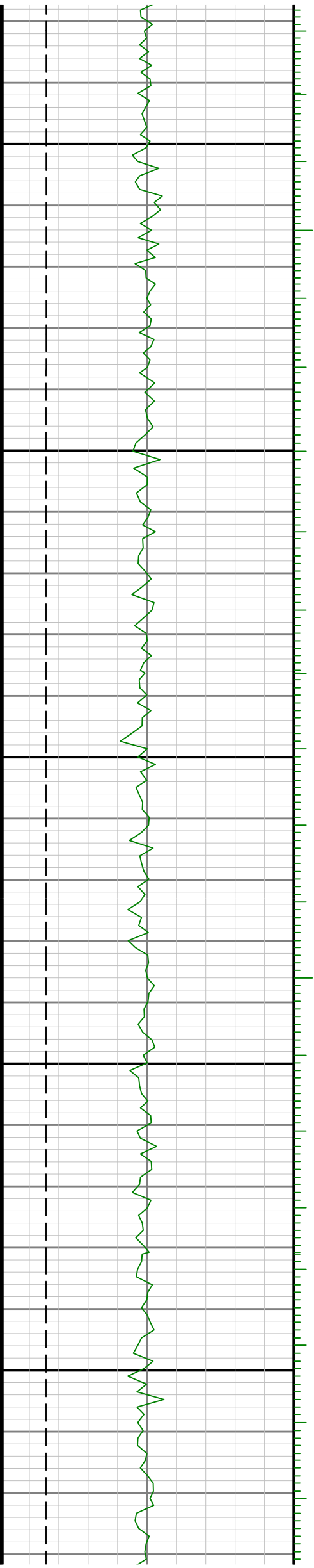


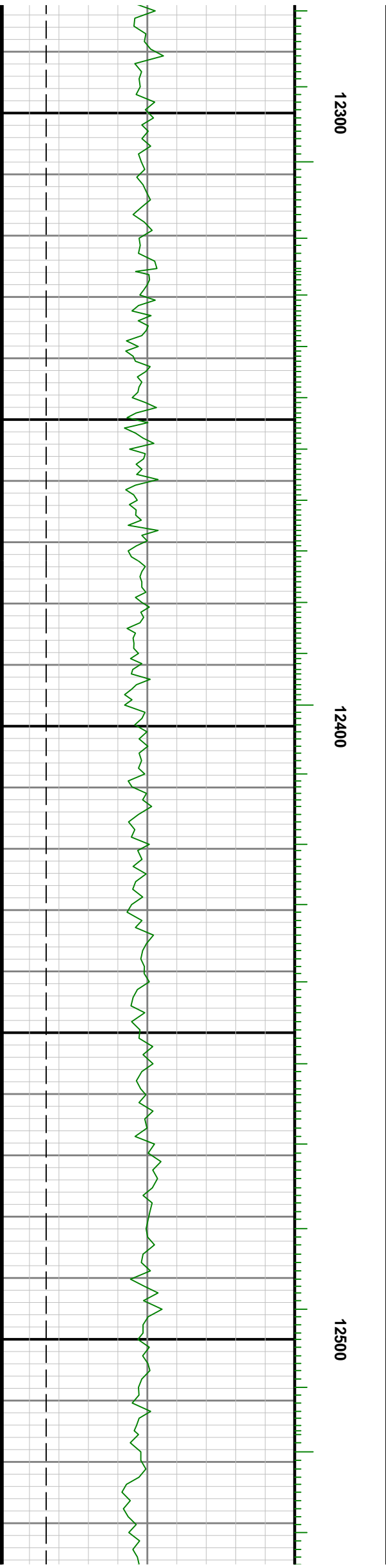
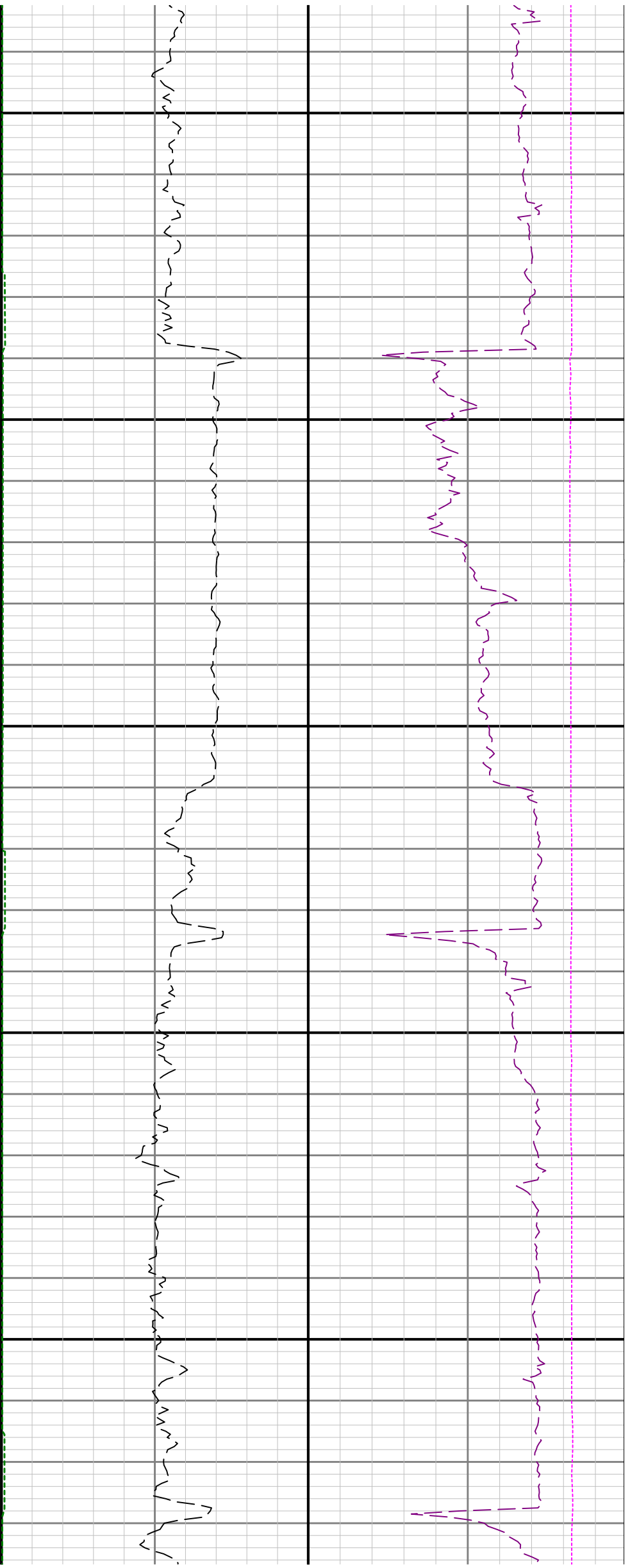


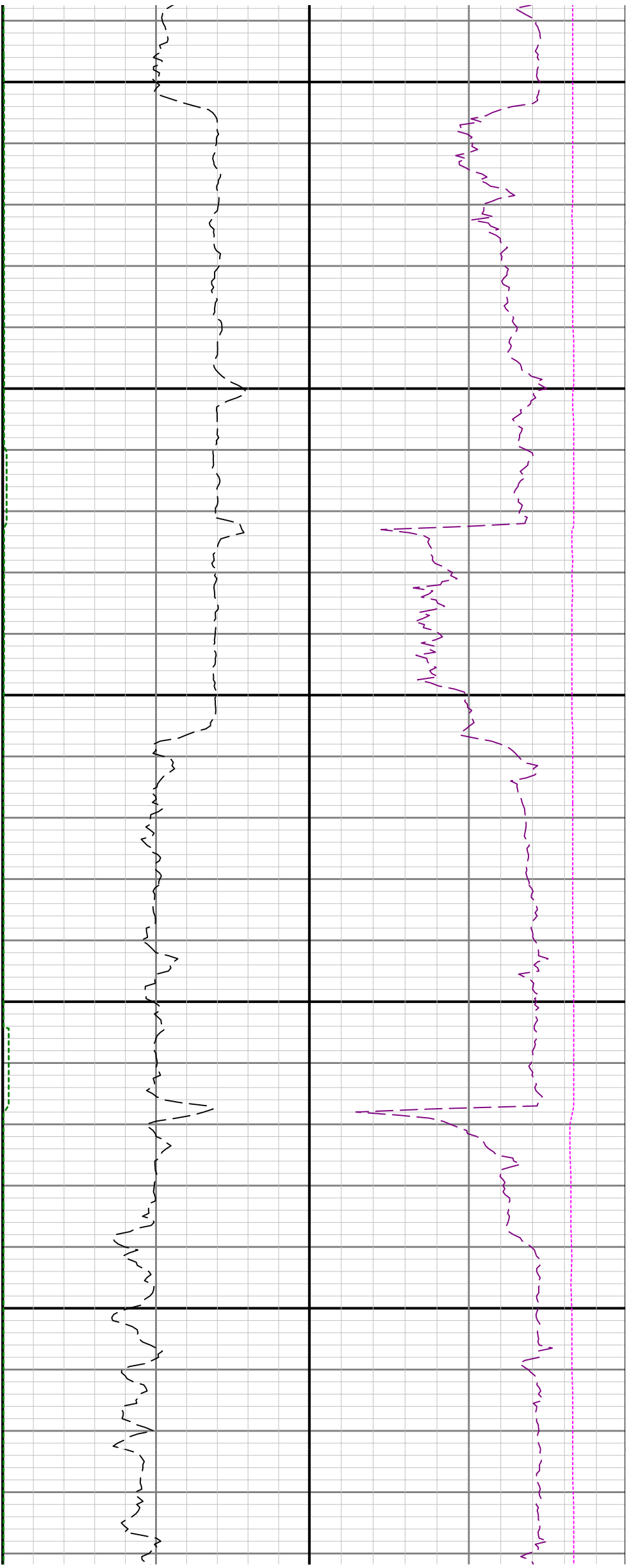


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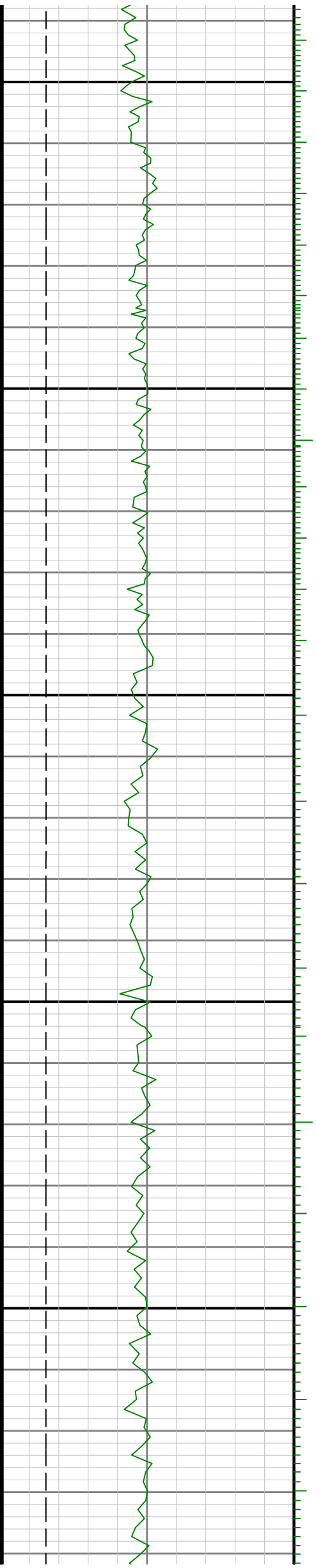


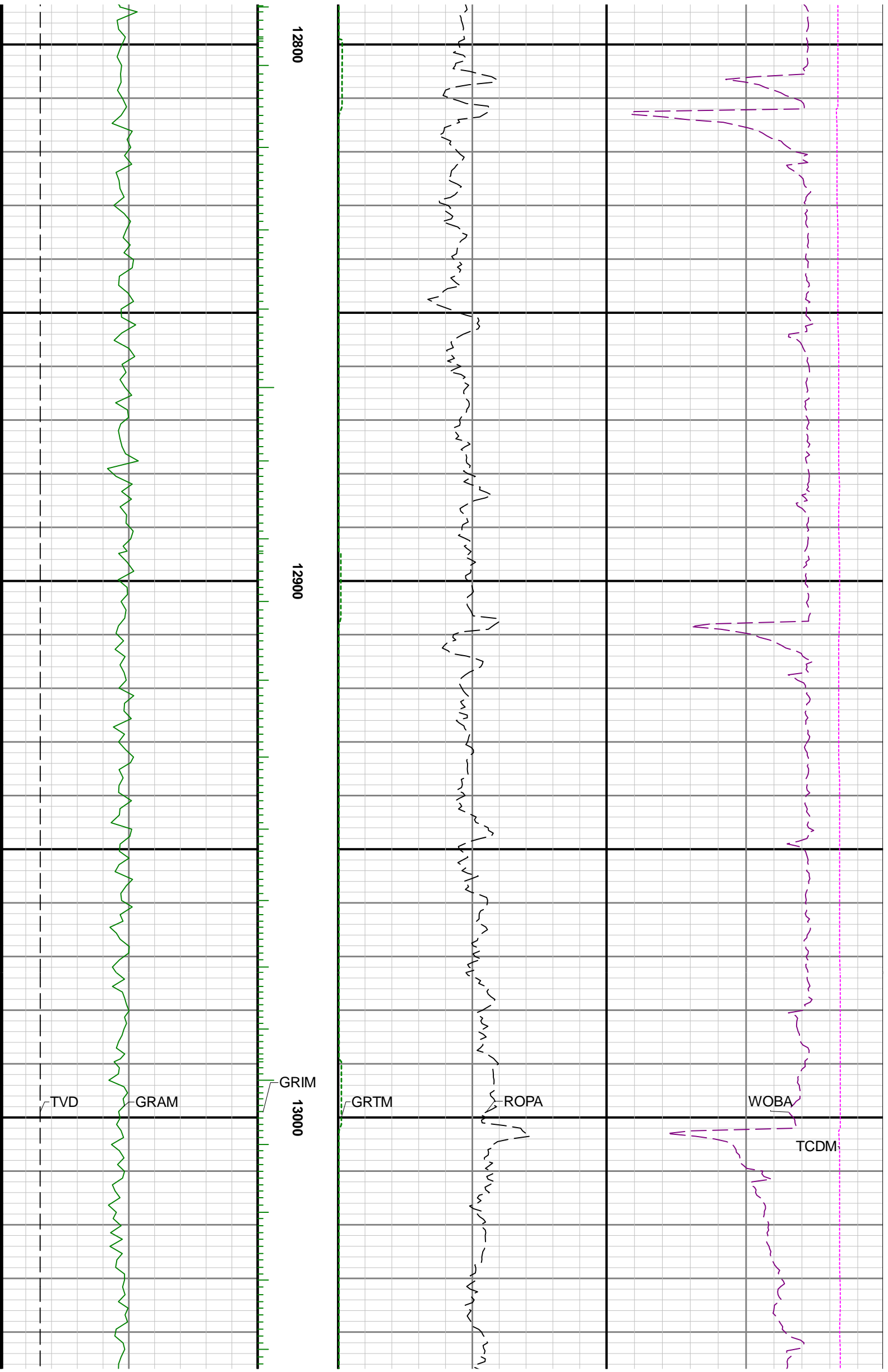


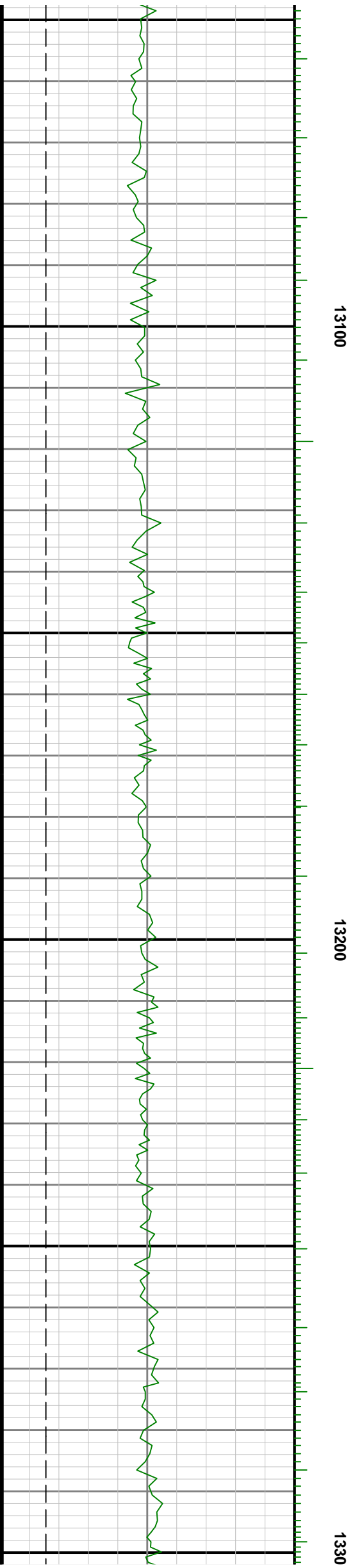


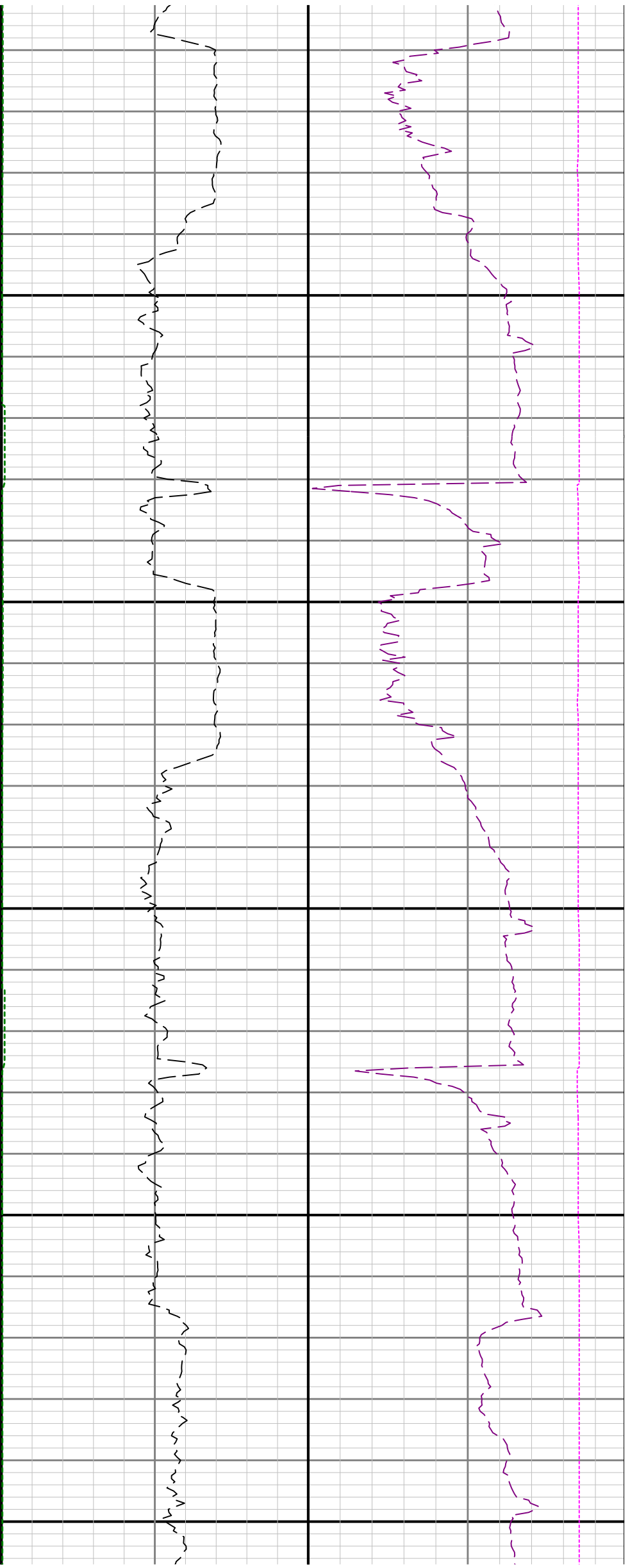
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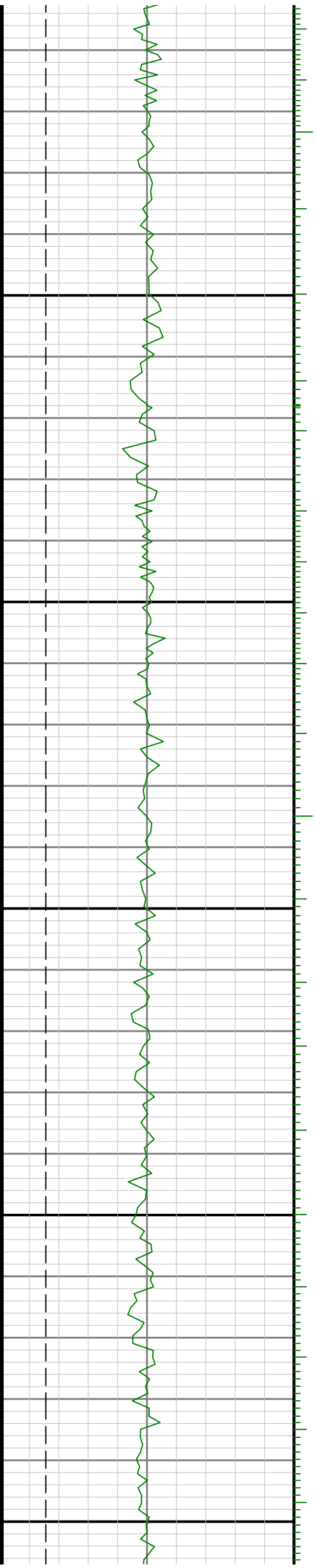


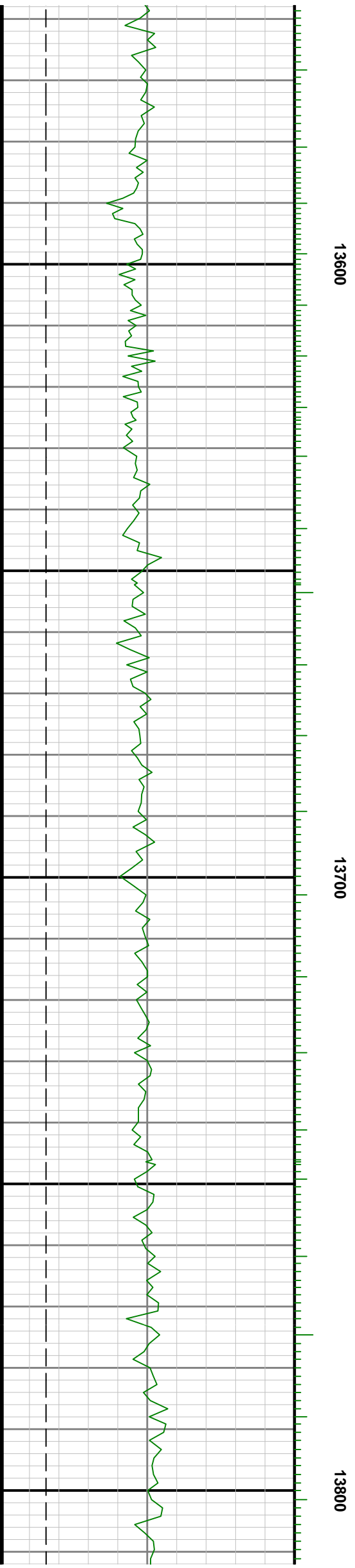
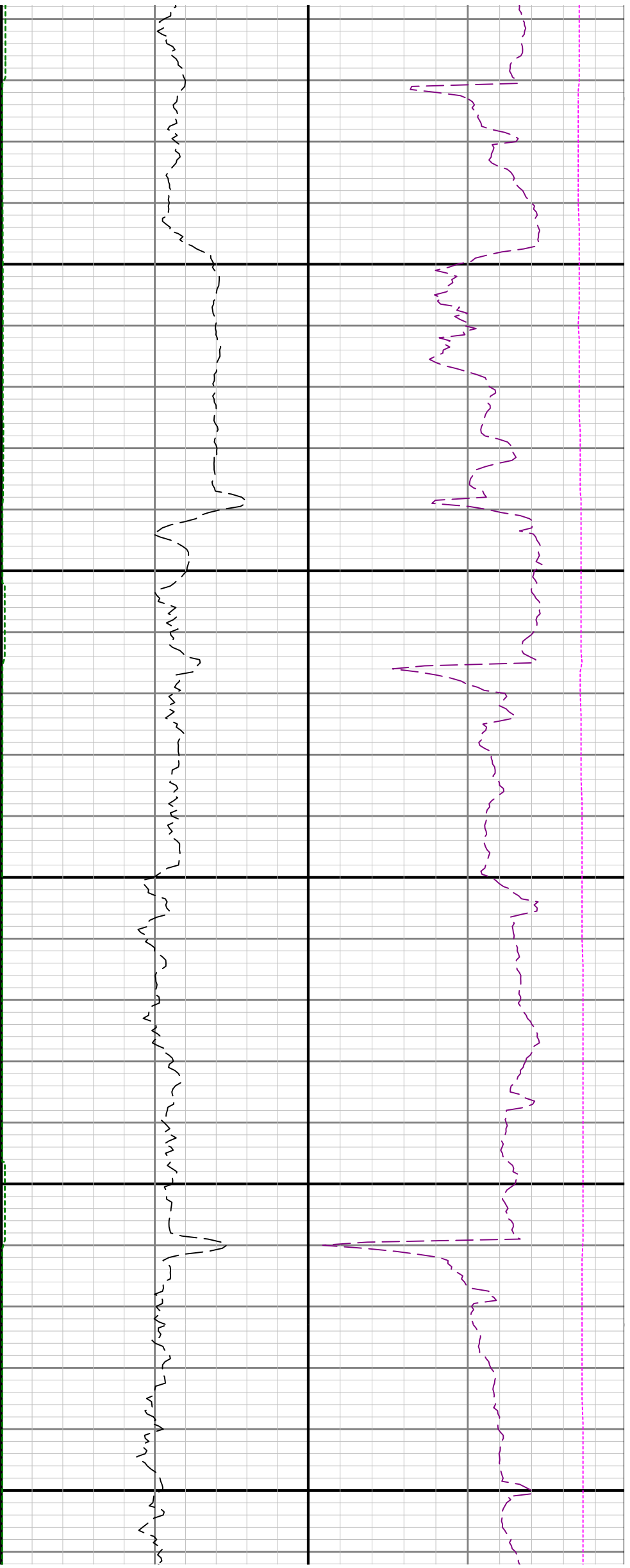




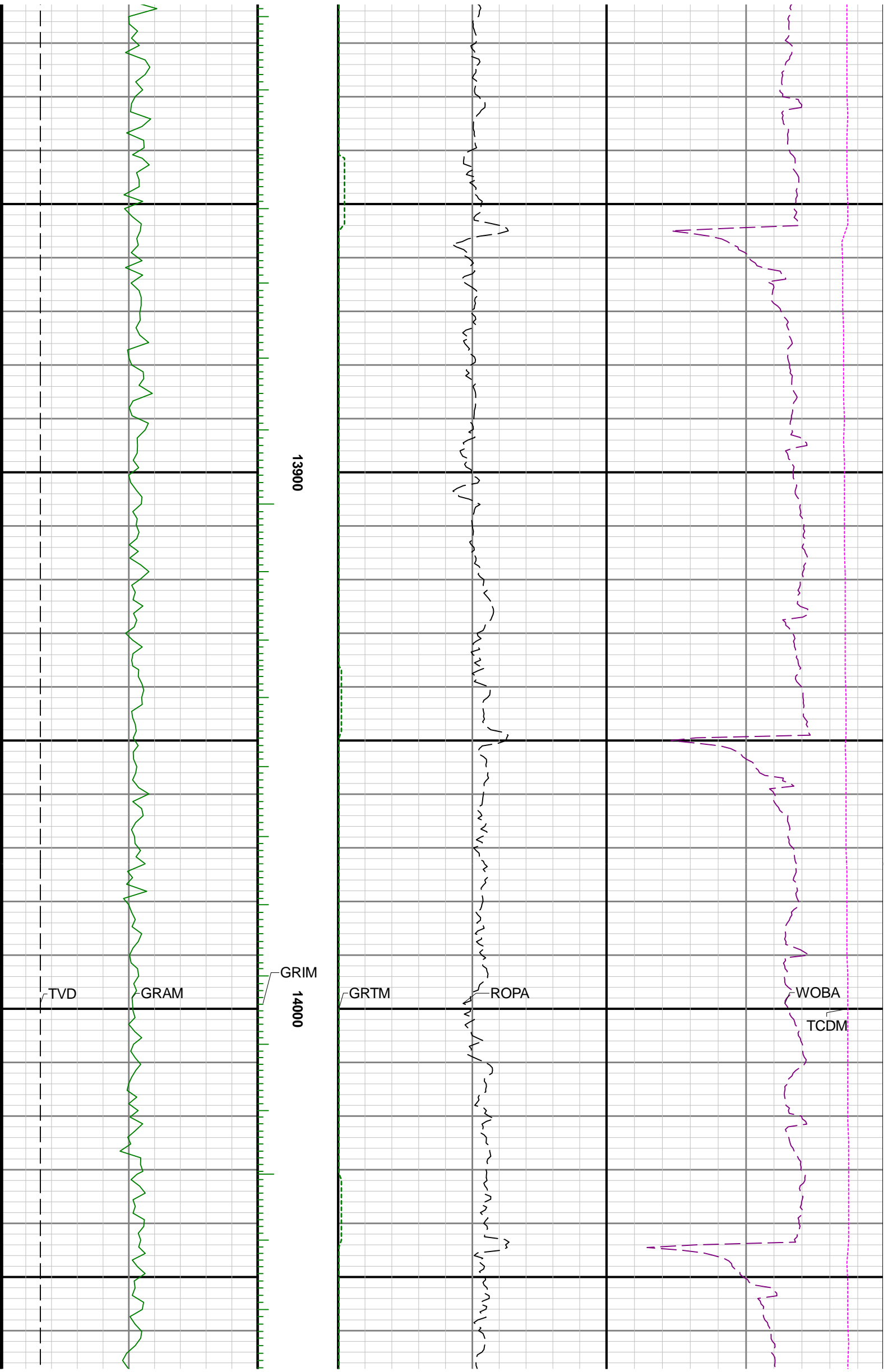
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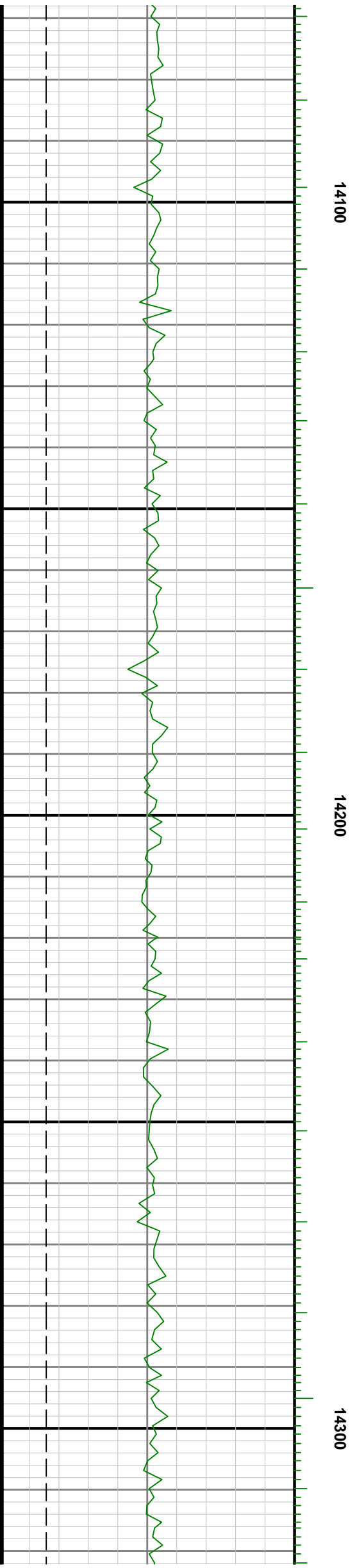
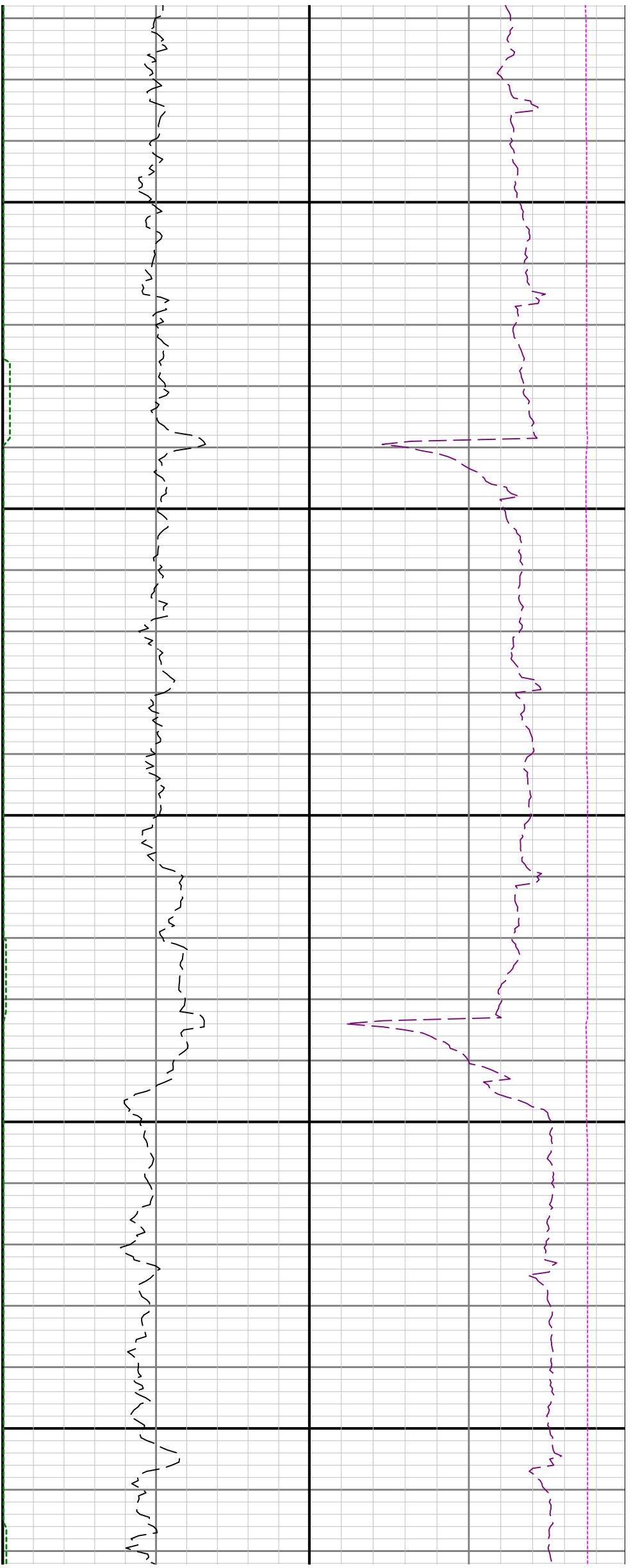
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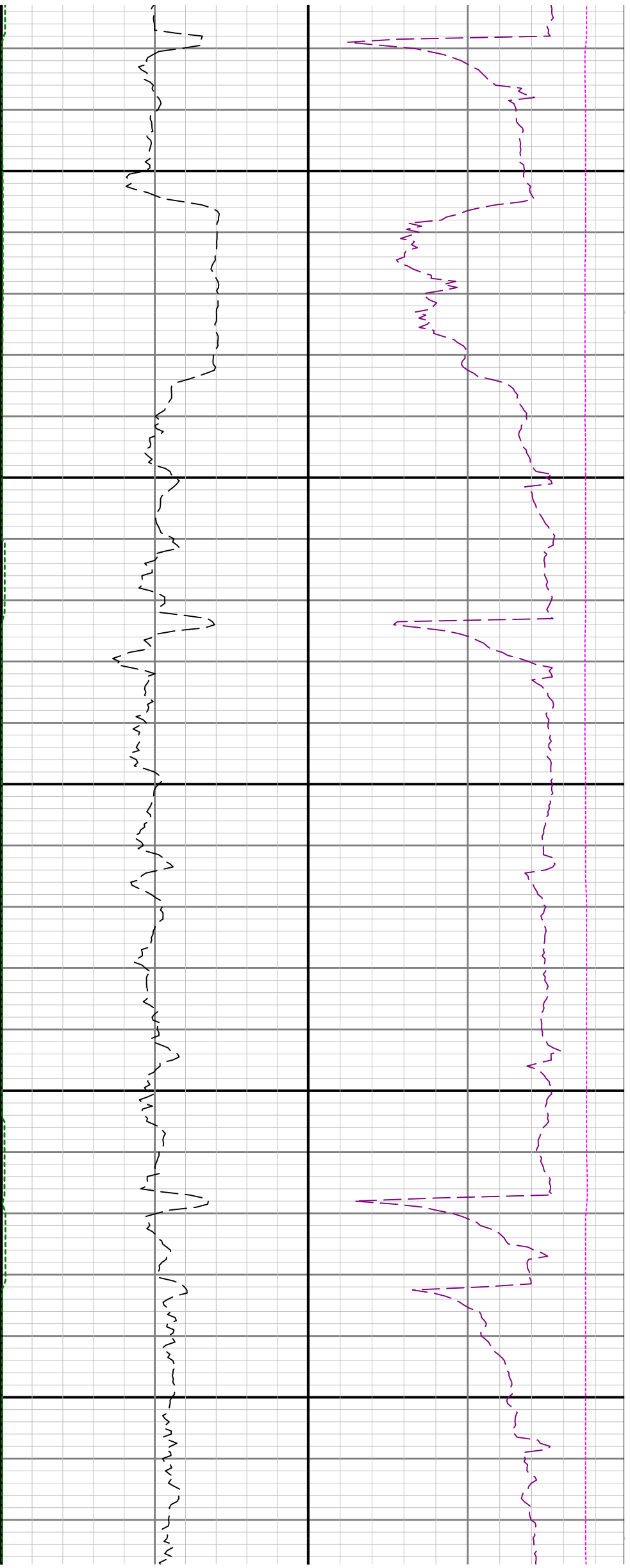






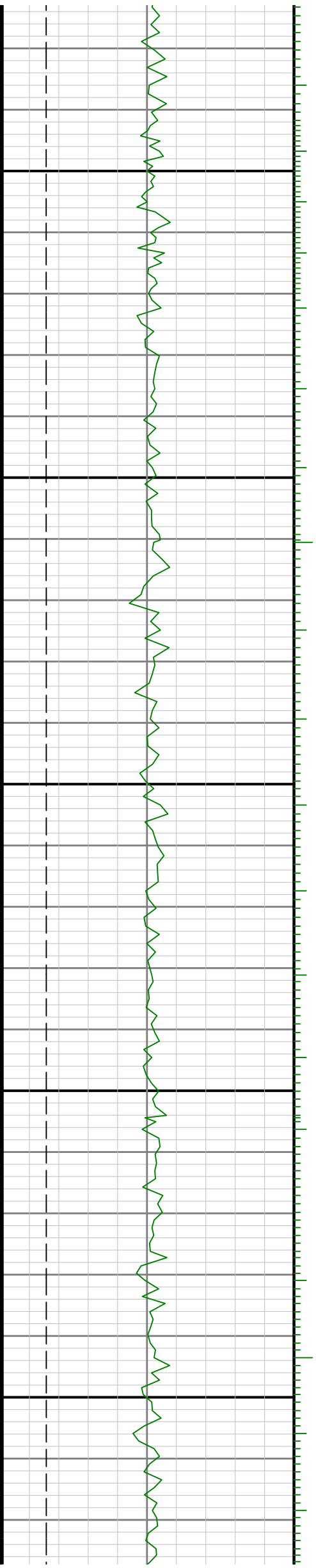


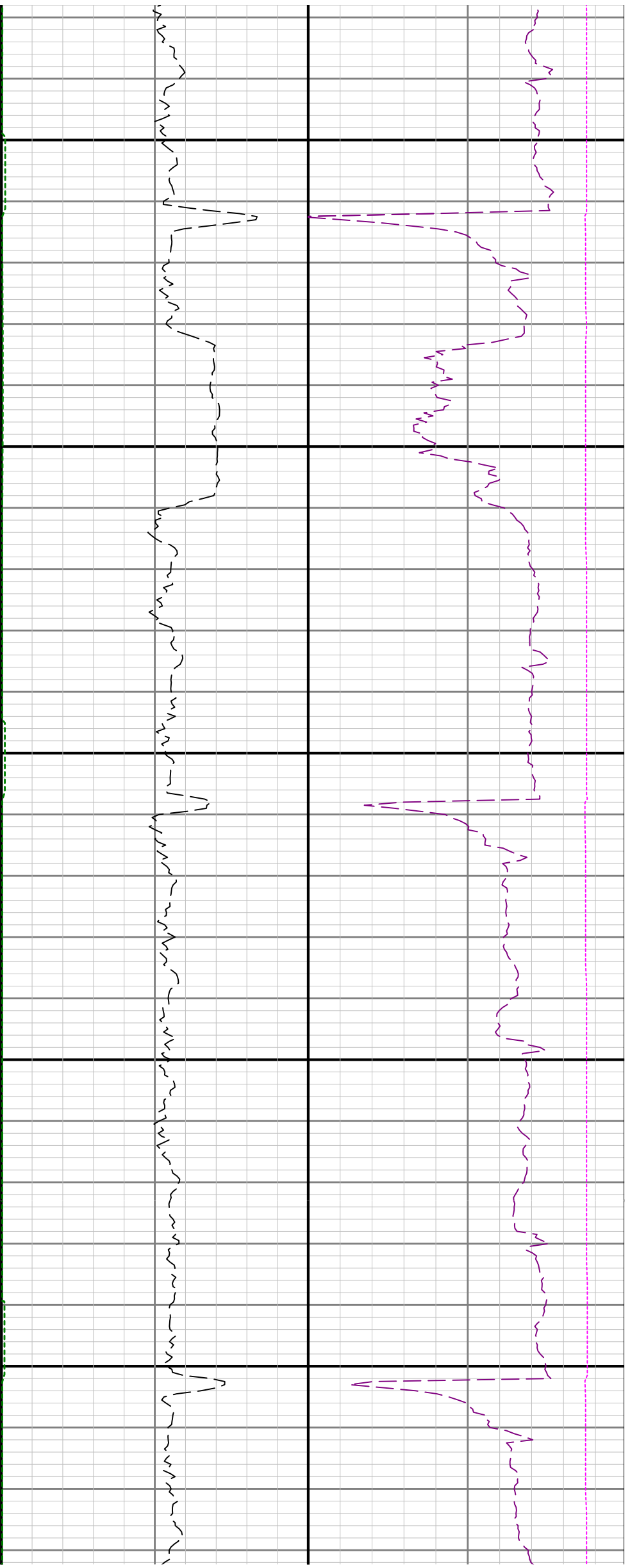




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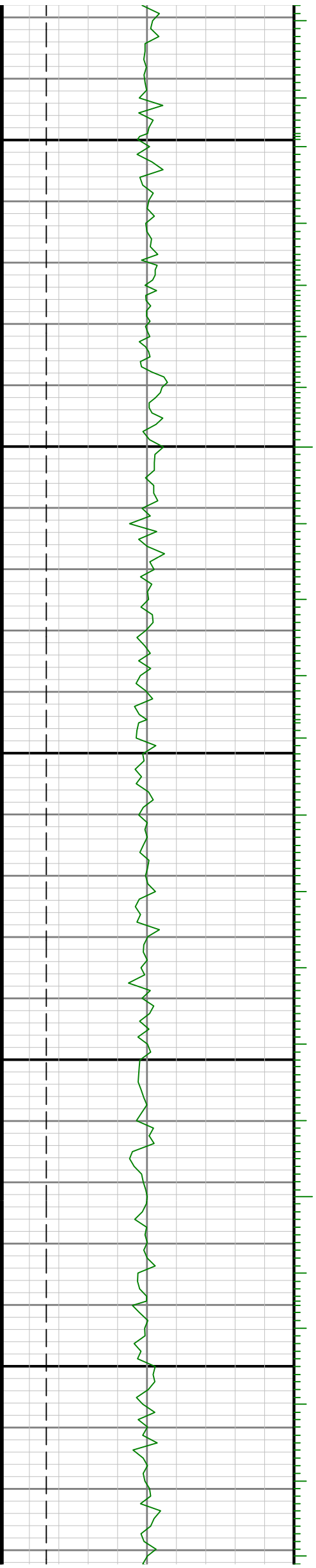


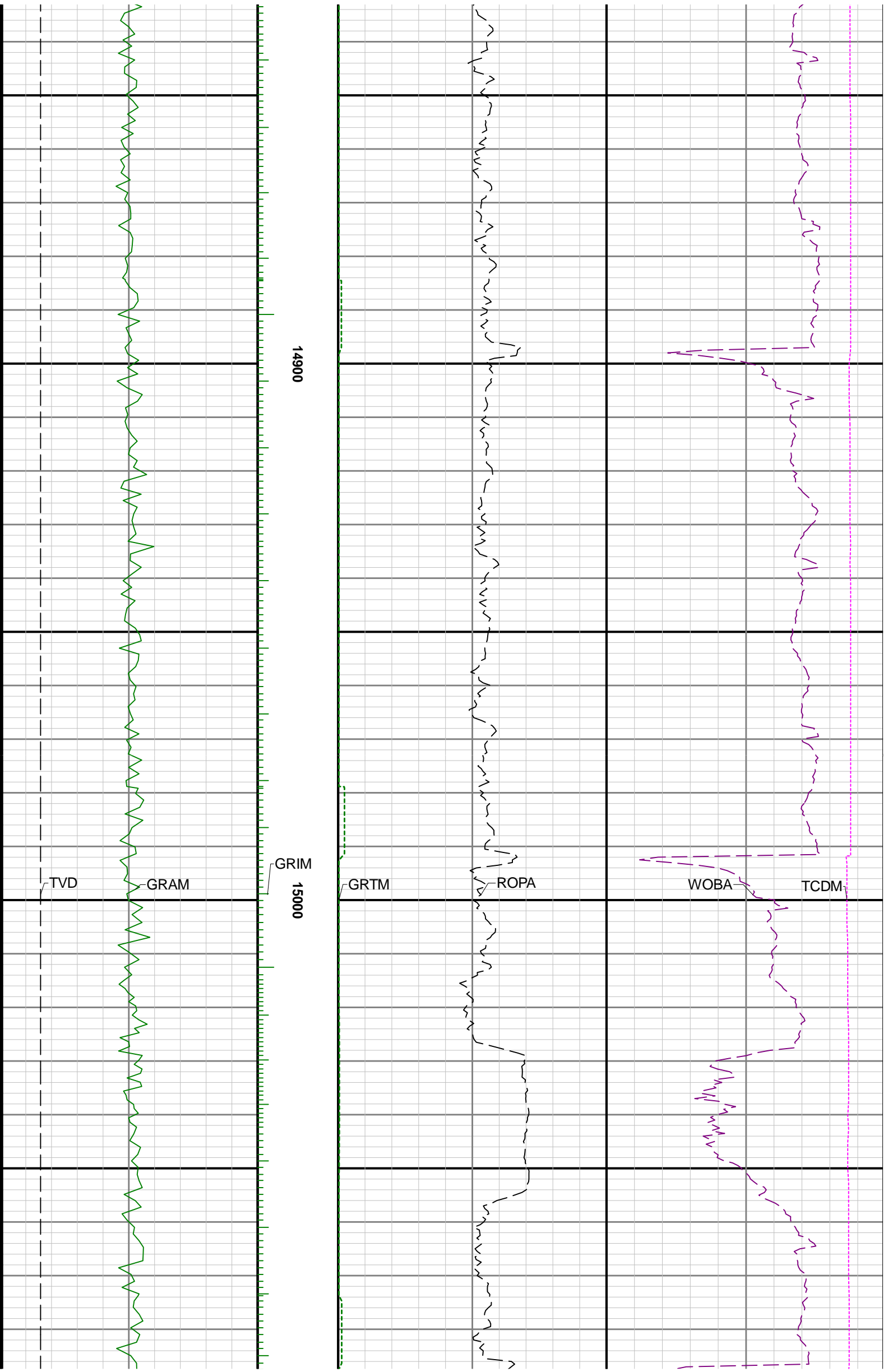


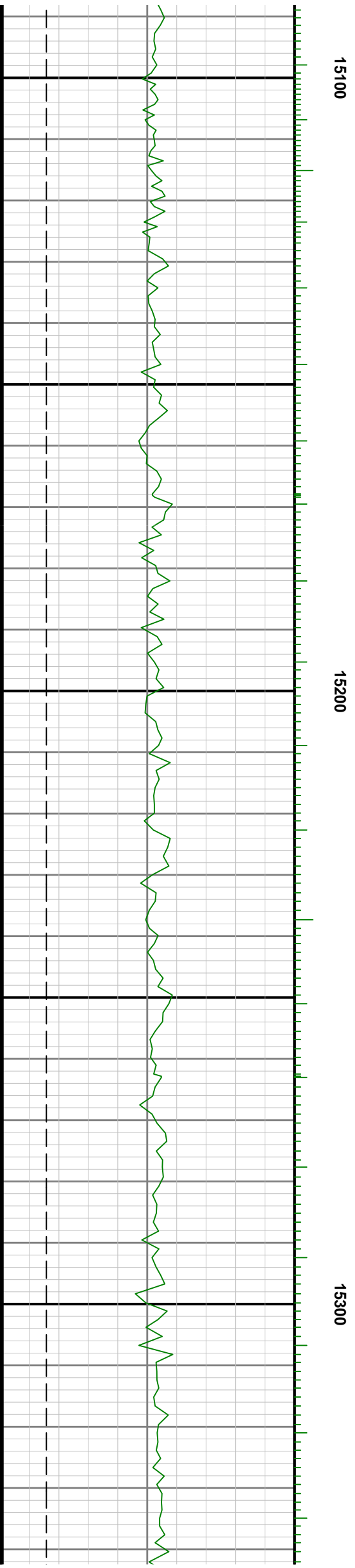
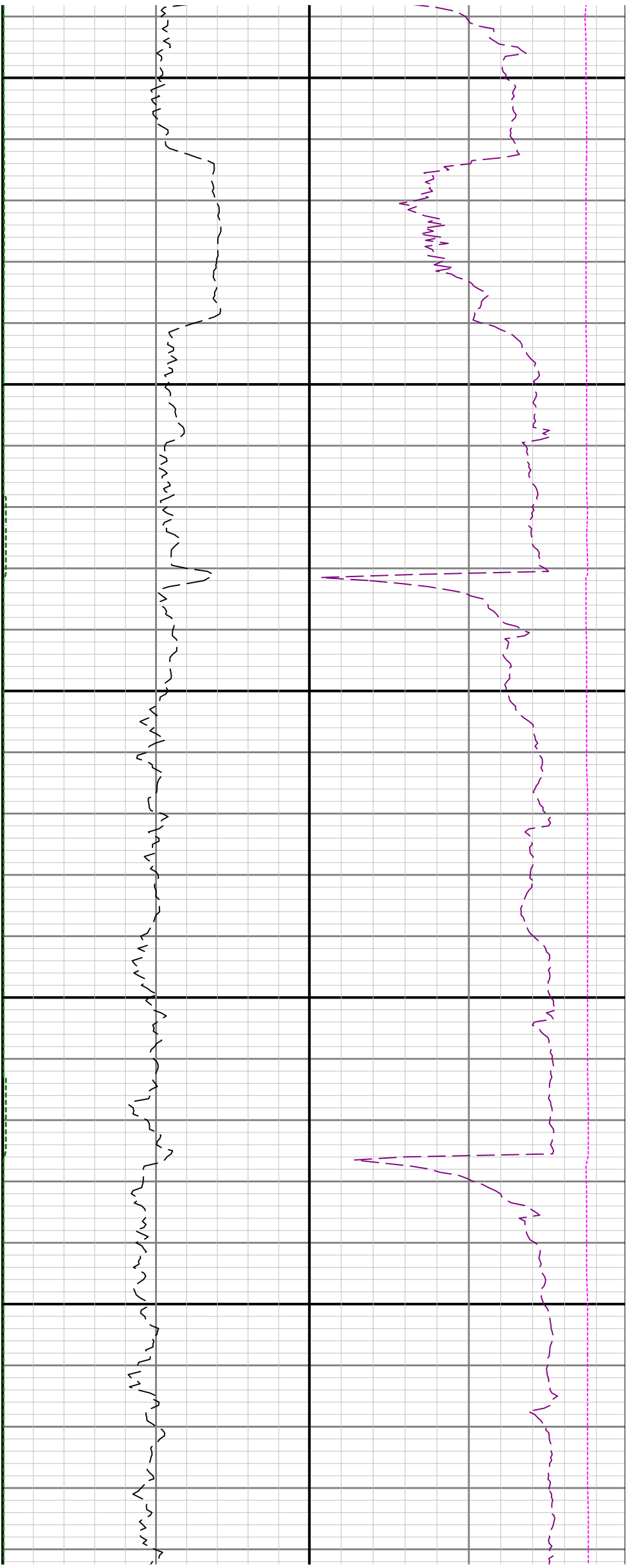
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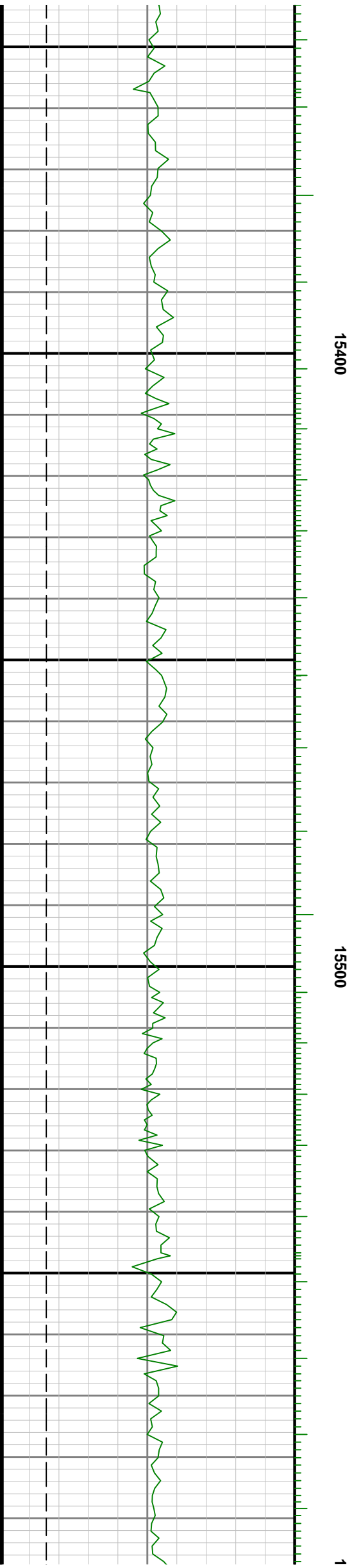
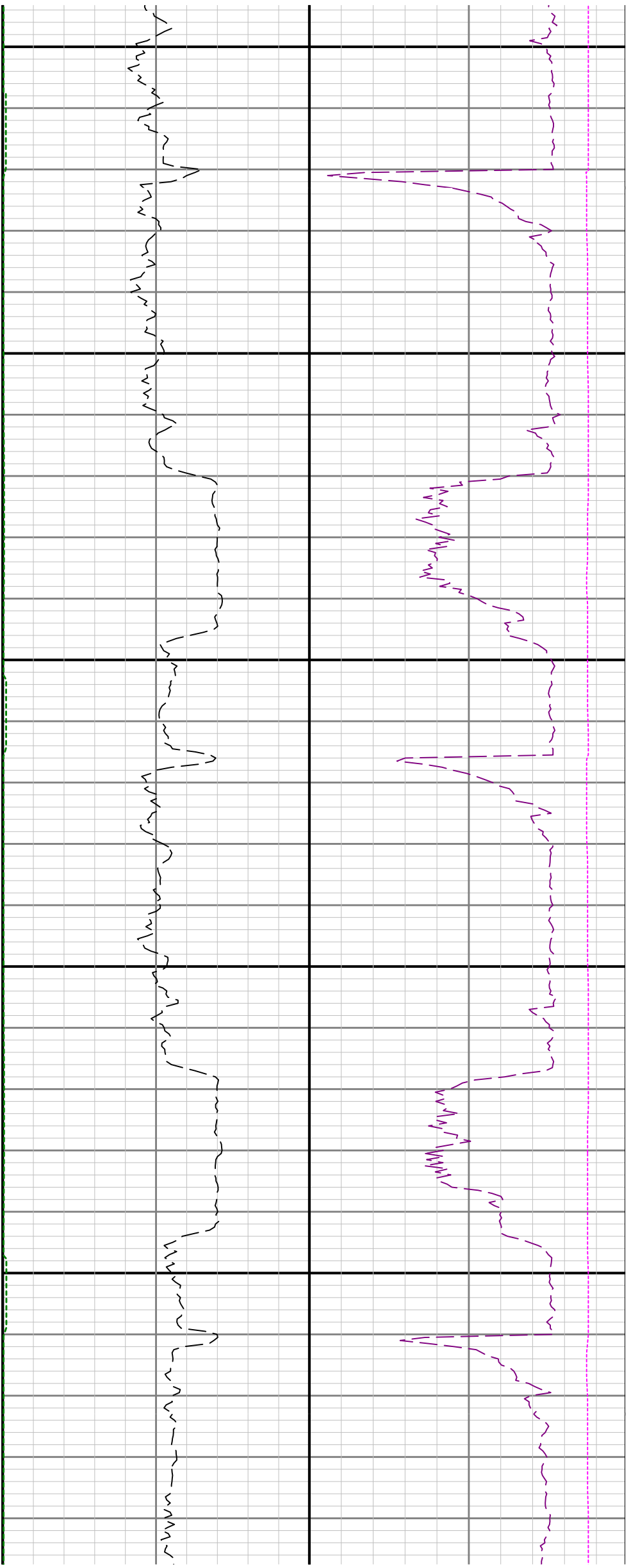
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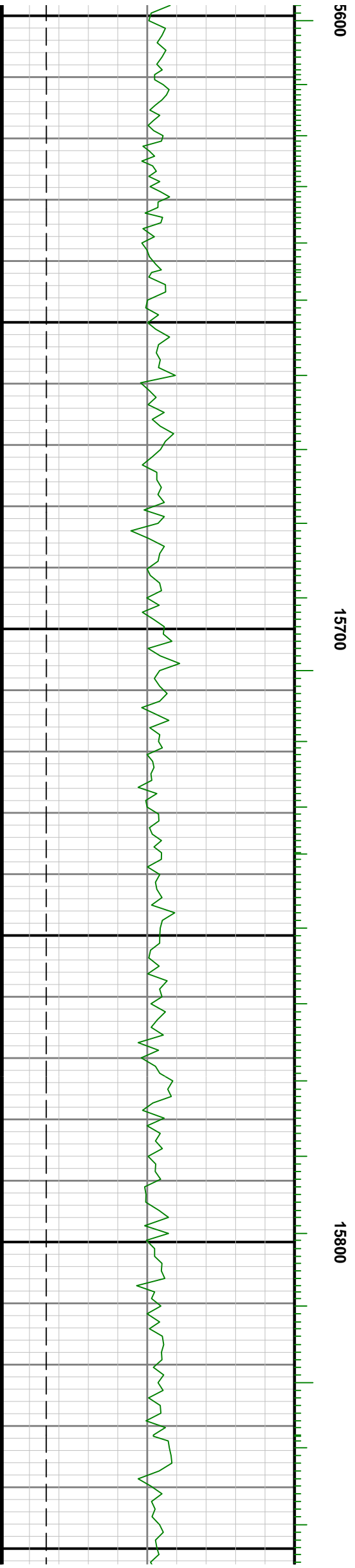
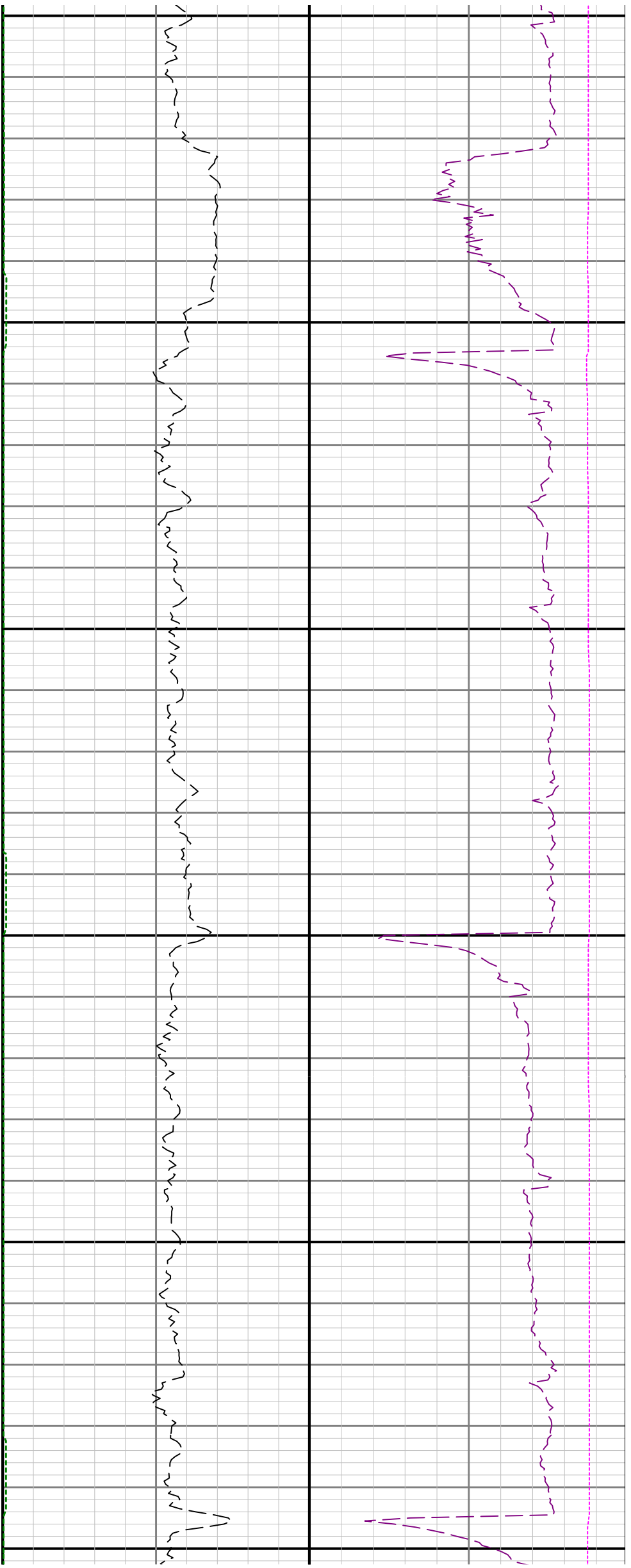
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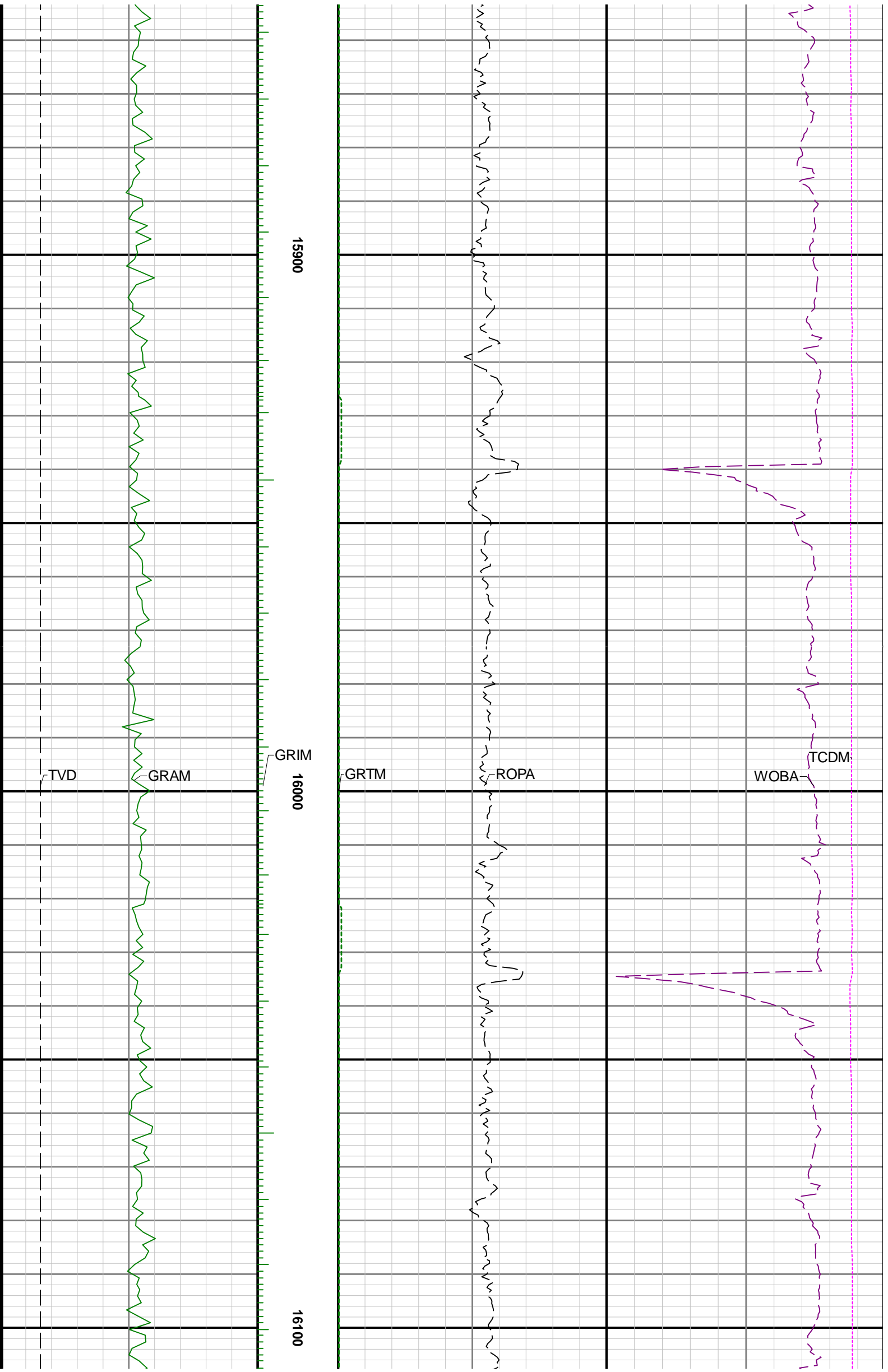








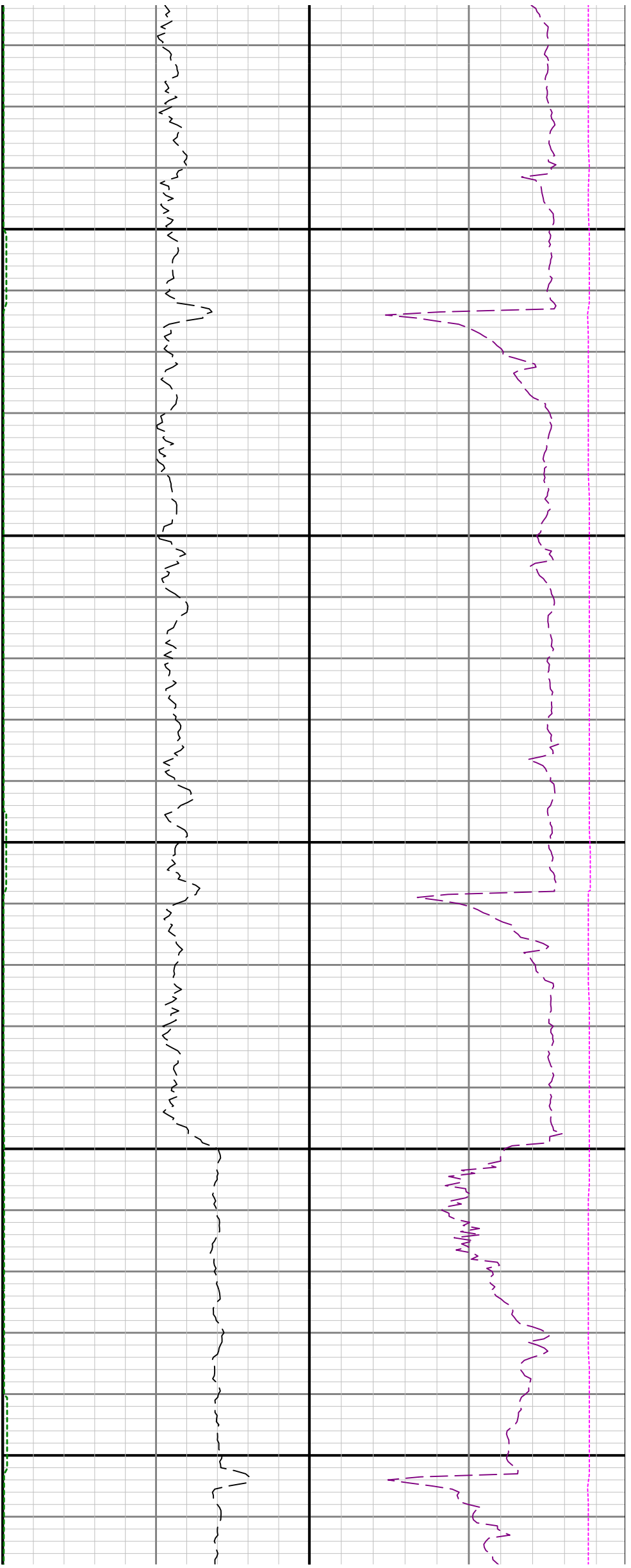






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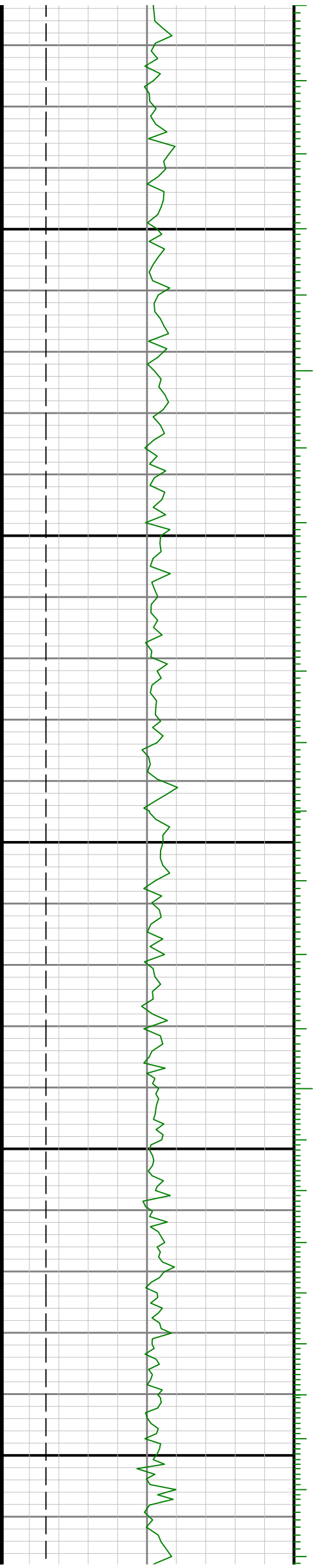
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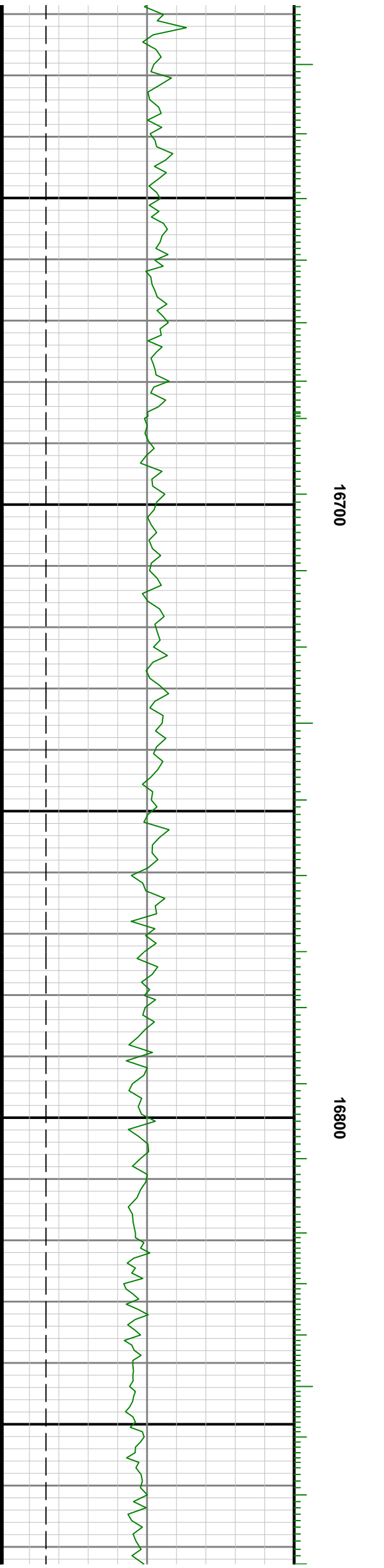
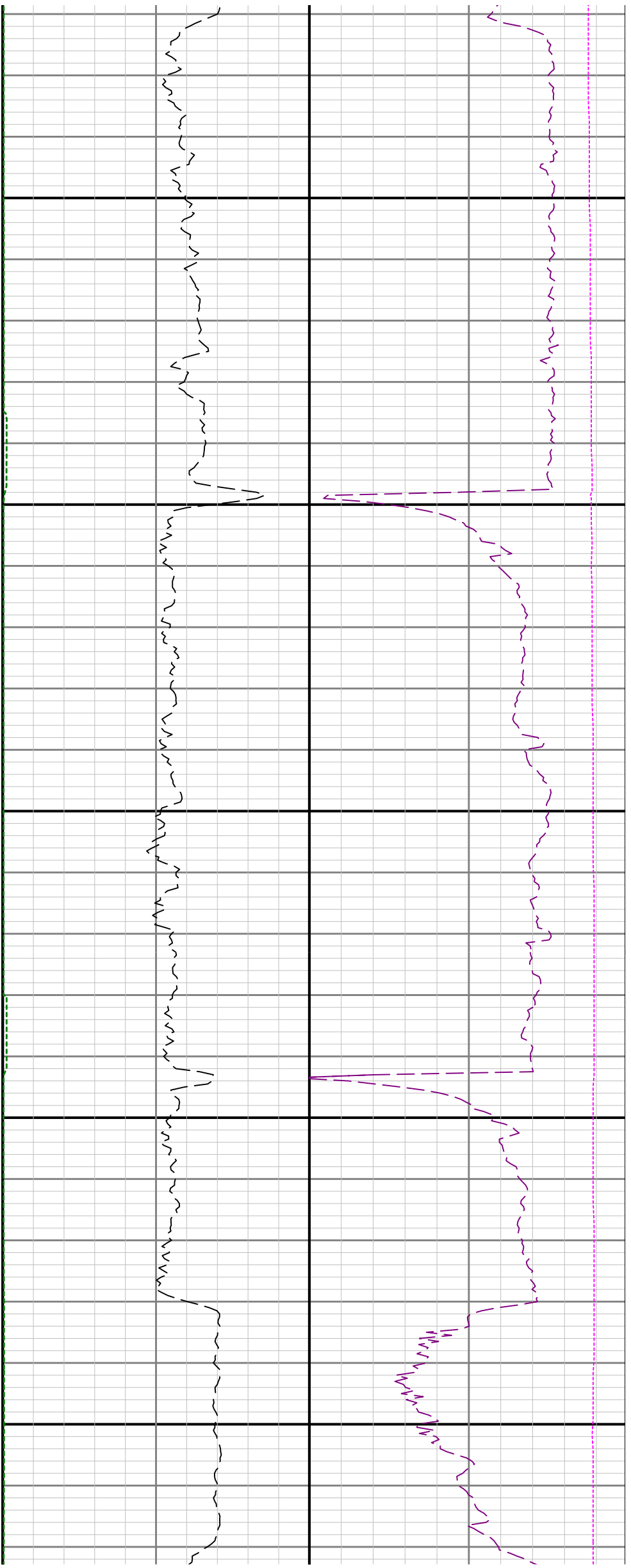


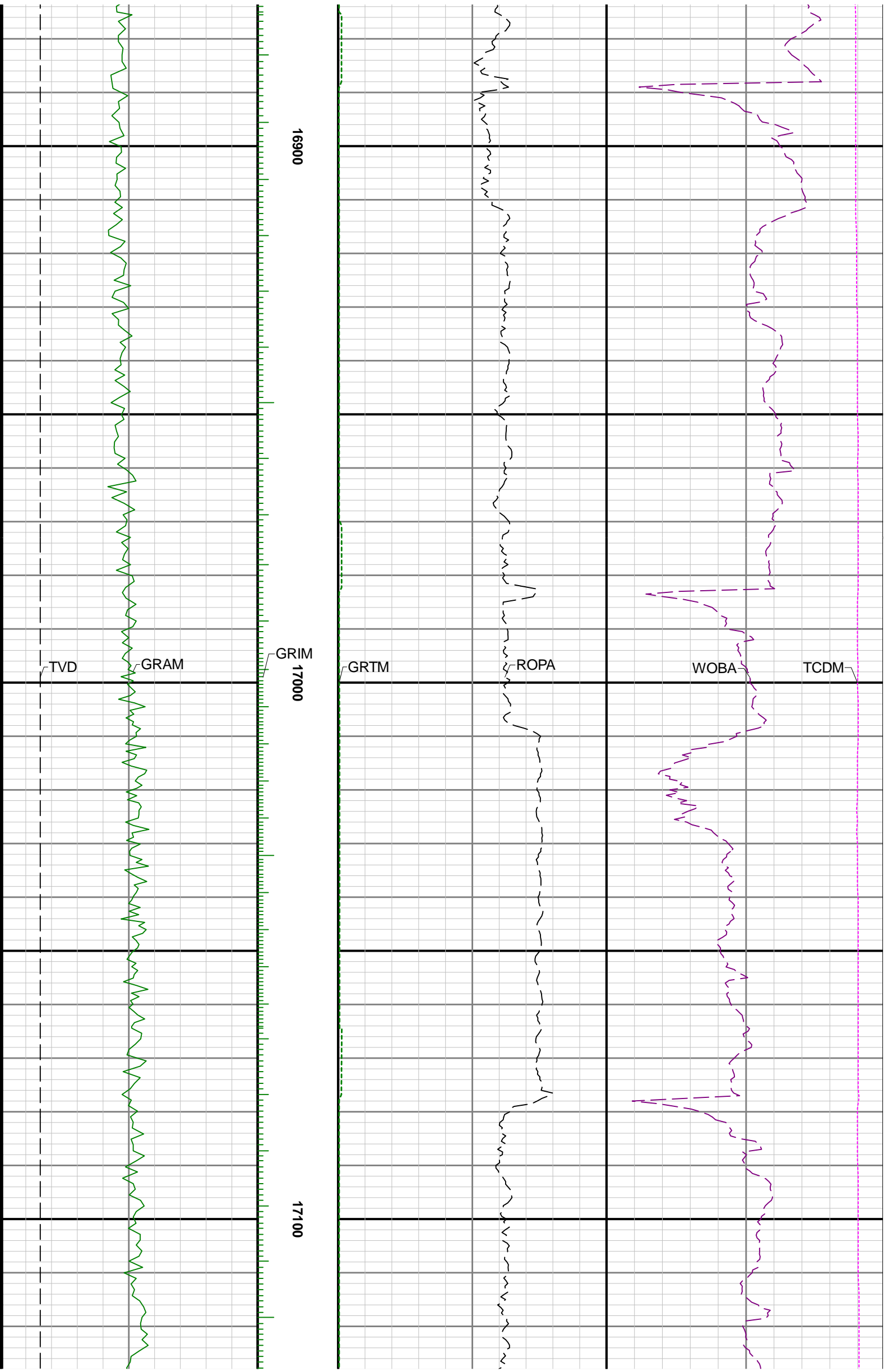
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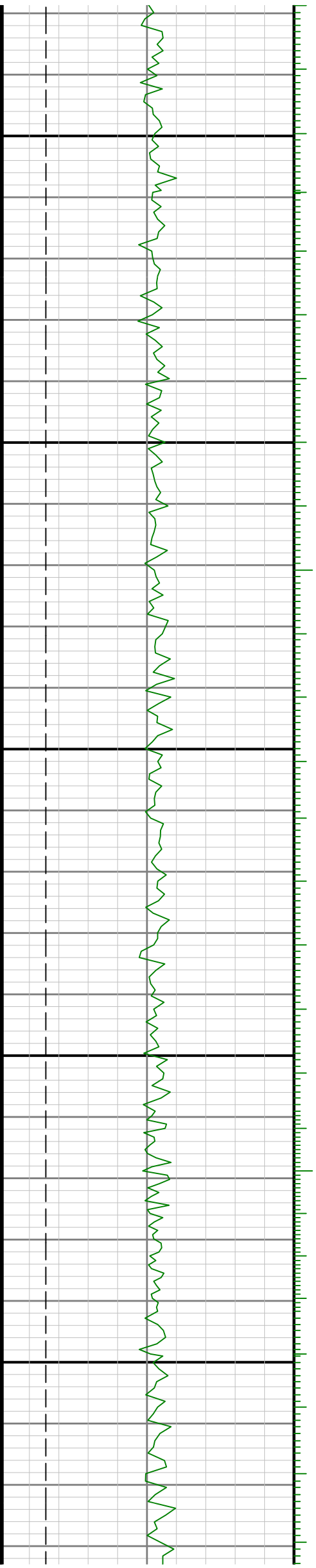


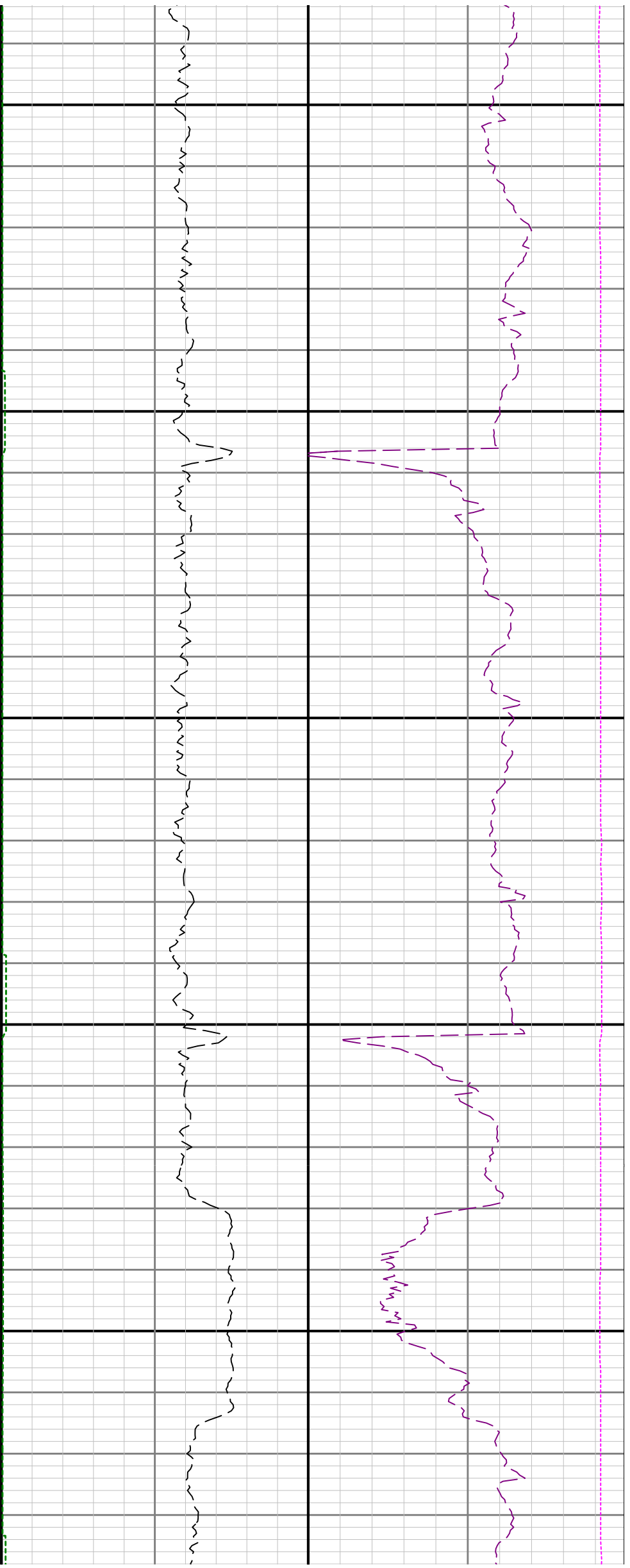




17200

17300





17400

17500

17600

