Memory Log

Gamma Ray
Natural Formation Evaluation
Rotary Steerable

Scale: **1:240 MD**

Depth Reference: **Driller's Depth**

Company: Noble Energy
Well: Harper LD21-675
Field: Weld County
County: Weld County **State:** Colorado

Status: **Final Print**

API No: 0512343292
Job ID: 8096790

Surface Location:
Latitude: 040° 44' 21.660" N
Longtitude: 103° 51' 30.060" W
SEC: 22 TWN: 9N RGE: 58W

Other Services:
Directional
VSS

Permanent Datum (P.D.): Mean Sea Level Elevation: 0.00 ft
Log Measured From: Rig Floor Above P.D. 4806.00 ft

KB: N/A
DF: 4806.00 ft
GL: 4776.00 ft

Dates
Date From: 2016-09-11
Date To: 2016-09-13
Spud Date: 2016-09-10

Interval Logged
Top: (ft) 1938.00
Bottom: (ft) 10825.00

Magnetic Field Reference
Azi Reference North: Grid
Dip Angle: (deg) 67.21
Total Magnetic Field Strength: (nT) 52632
Mag to Reference North Correction: (deg) 6.50 E

Borehole Record

Hole Size (in)	From (ft)	To (ft)
13.500	0.00	1934.00

Casing Record

Size (in)	Weight (lb/ft)	From (ft)	To (ft)
9.625	36.00	0.00	1924.00

Mud Record

Type	From (ft)	To (ft)
Oil Based Mud	1934.00	10825.00

Deviation Record

Hole Size (in)	Interval (ft)	Inc | Az (Start)	Inc | Az (End)
8.500	8891.00	0.66 | 149.54	90.40 | 267.52

Acquisition System
Baker Hughes Cadence
PlotStudio

Software Version
G3.3
3.3.7410.1

Other
Rig: H&P 517
Contractor: Helmerich & Payne Drilling Co
District: RMD Unit: 1

Log Run Summary

Run No	Bit Run No.	Bit Size (in)	Bit Type	Bit Gauge Length (in)	Assembly Type	Logged Interval Top (ft)	Logged Interval Bottom (ft)	Bit Depth Interval From (ft)	Bit Depth Interval To (ft)	Date / Time Start Logging	Date / Time End Logging	Circ. Hours (h)
1	1	8.500	PDC	2.00	AutoTrak Curve	1933.83	10818.09	1946.00	10824.64	2016-09-11 12:15	2016-09-13 05:50	36.74

Crew

Name	Arrive Wellsite	Depart Wellsite
Alexander Osborne	2016-09-11	2016-09-13
Scott Sims	2016-09-11	2016-09-13

Crew

Name	Arrive Wellsite	Depart Wellsite
Hans Cary	2016-09-11	2016-09-13

Crew

Name	Arrive Wellsite	Depart Wellsite
Lenn Bennett	2016-09-11	2016-09-13

Mud Properties Record

Date / Time	Run No.	Measured Depth (ft)	Mud Type	Density (ppg)	Viscosity (cP)	pH	Fluid Loss (cm3)	Oil / Water	Source	Total Chlorides (ppm)	K+ (%)
2016-09-10 21:51	1	1934.00	Water Based Mud	9.5	29	9.5	0.0	0/1	Active Pit	1600	0.00
2016-09-11 10:00	1	1934.00	Oil Based Mud	9.9	58	0	0.0	0.66/0.34	Active Pit	29000	0.00
2016-09-11 20:00	1	4464.89	Oil Based Mud	9.4	57	0	0.0	0.67/0.33	Active Pit	26000	0.00
2016-09-12 08:00	1	6487.76	Oil Based Mud	9.5	47	0	0.0	0.65/0.35	Active Pit	31500	0.00
2016-09-12 20:00	1	8947.67	Oil Based Mud	9.5	49	0	0.0	0.75/0.25	Active Pit	40000	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	ATC_SU	12480148	Near Bit Inclination	5.93	6.55	7.000	4.330
1	ATC_SU	12480148	Near Bit VSS	5.93	6.55	7.000	4.330

1	ATC_SU	12480148	Near Bit VSS	5.93	6.55	7.000	4.330
1	ATC_MWD	12200463	Gamma (single)	2.20	12.17	7.000	3.250
1	ATC_MWD	12200463	Directional (mag)	12.27	22.24	7.000	3.250

Service and Tool Mnemonics

Mnemonic	Name	Description
ATC_SU	ATC_SU	Auto Trak Curve Steering Unit
ATC_MWD	ATC_MWD	Auto Trak Curve MWD
ATC_LCPM	ATC_LCPM	Auto Trak Curve LCPM

Comments

1 Baker HughesôRun 1 utilized a 6.75 inch AutoTrak Curve Rotary Steerable assembly tool behind a 8.50 inch bit from 1934 to 10825 ft MD (1933.96 to 5729.83 ft TVD).

2 Depth measurements obtained from a depth control system not supplied or operated by Baker Hughes. Due to lack of control by Baker Hughes logging engineers, depth calibrations and measurements could not be independently verified.

Remarks

Number	Measured Depth (ft)	Hole Section (in)	Run No.	Remark
1	1940.00	8.500	1	The interval from 1938 to 1950 ft MD (1938 to 1950 ft TVD) has no ROPA, WOBA, and TCDM data due to the Gamma Ray sensor to bit offset.
2	10820.00	8.500	1	The interval from 10812 to 10825 ft MD (5729.92 to 5729.83 ft TVD) has no gamma data due to sensor to bit offset.

Curve Mnemonics

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

BAKER HUGHES

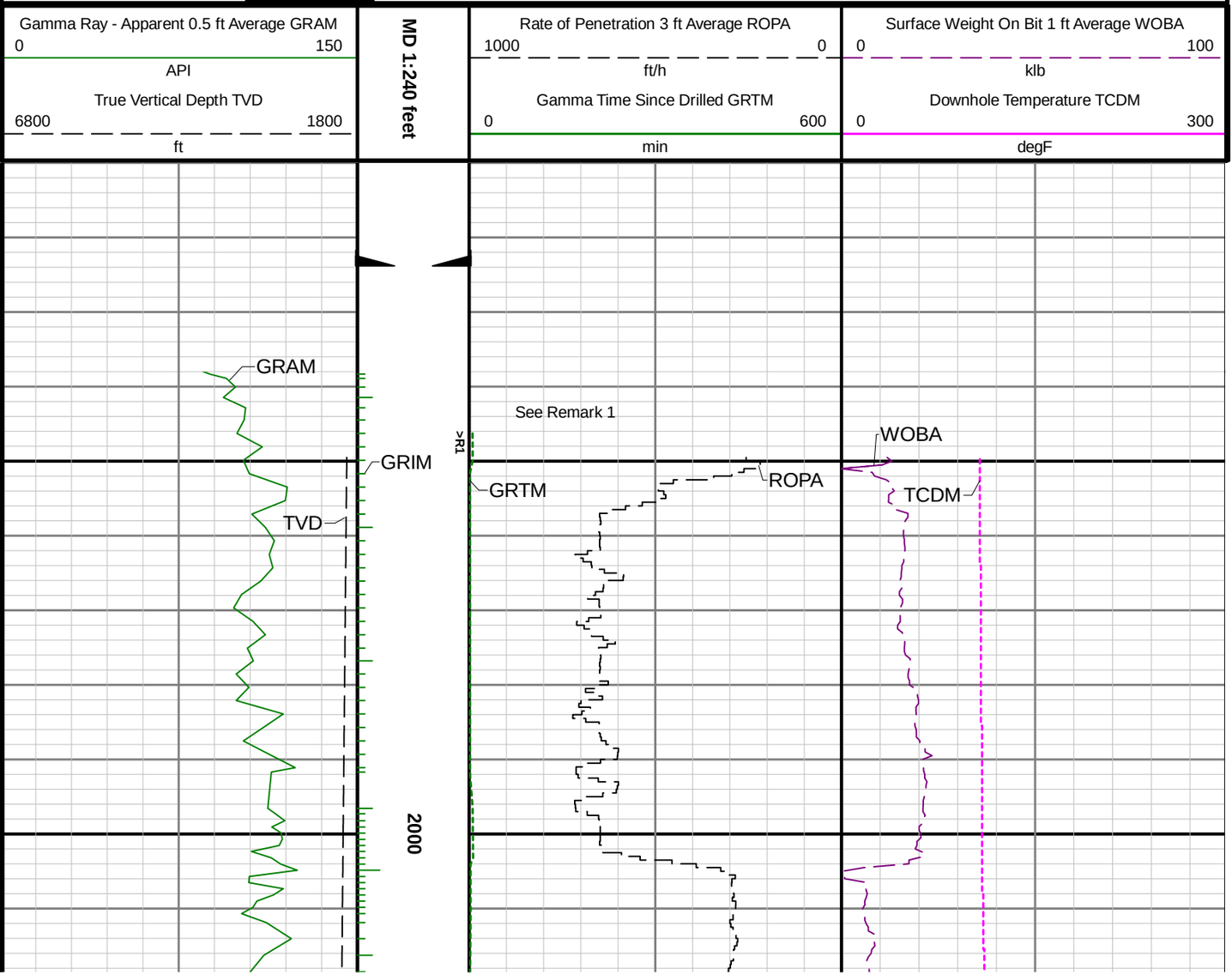
Company Noble Energy

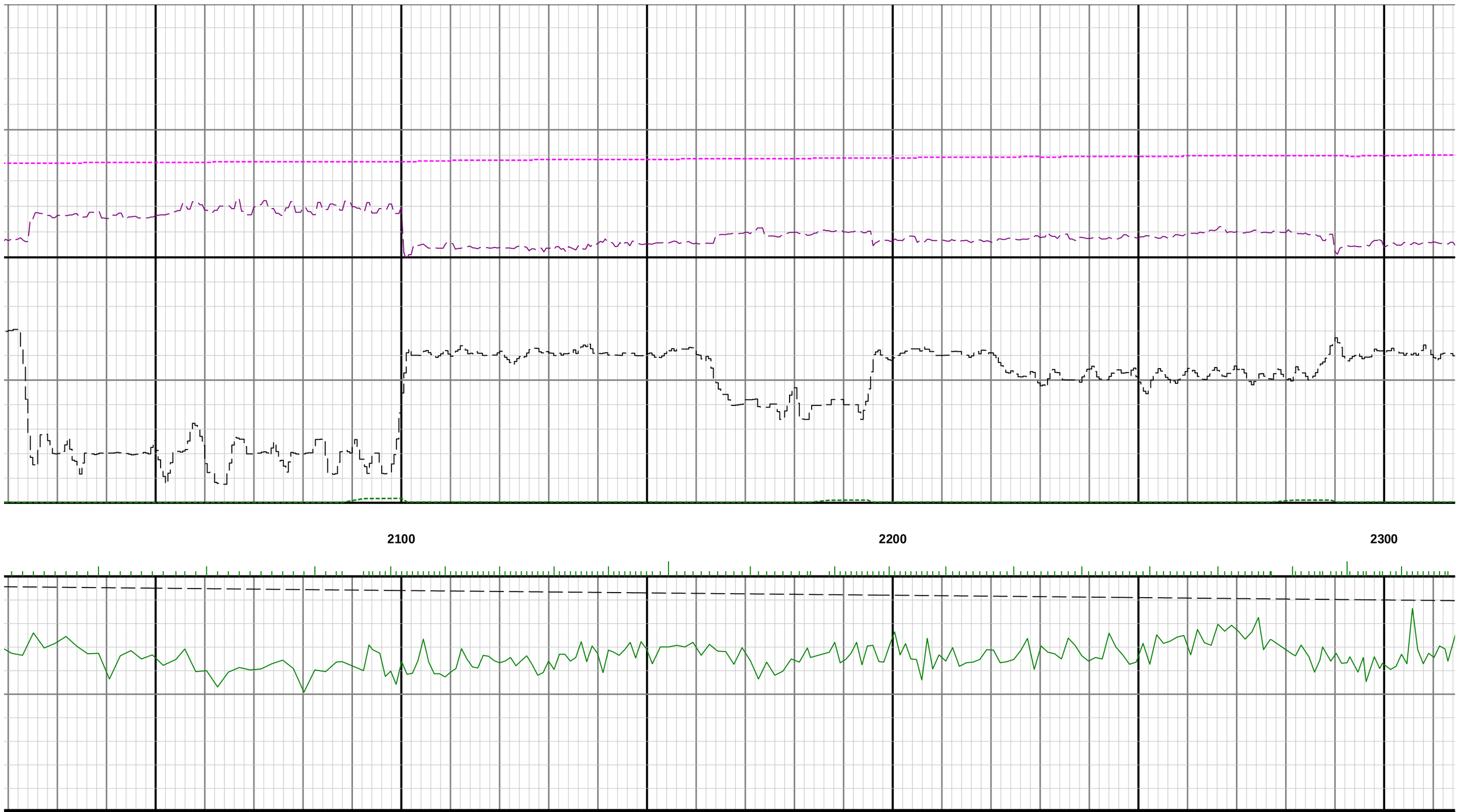
Well Harper LD21-675

Interval **Date From:** 2016-09-11 12:15:06 **Top:** 1938.00

Date To: 2016-09-13 05:50:59 **Bottom:** 10825.00

Created 2016-09-13 19:22

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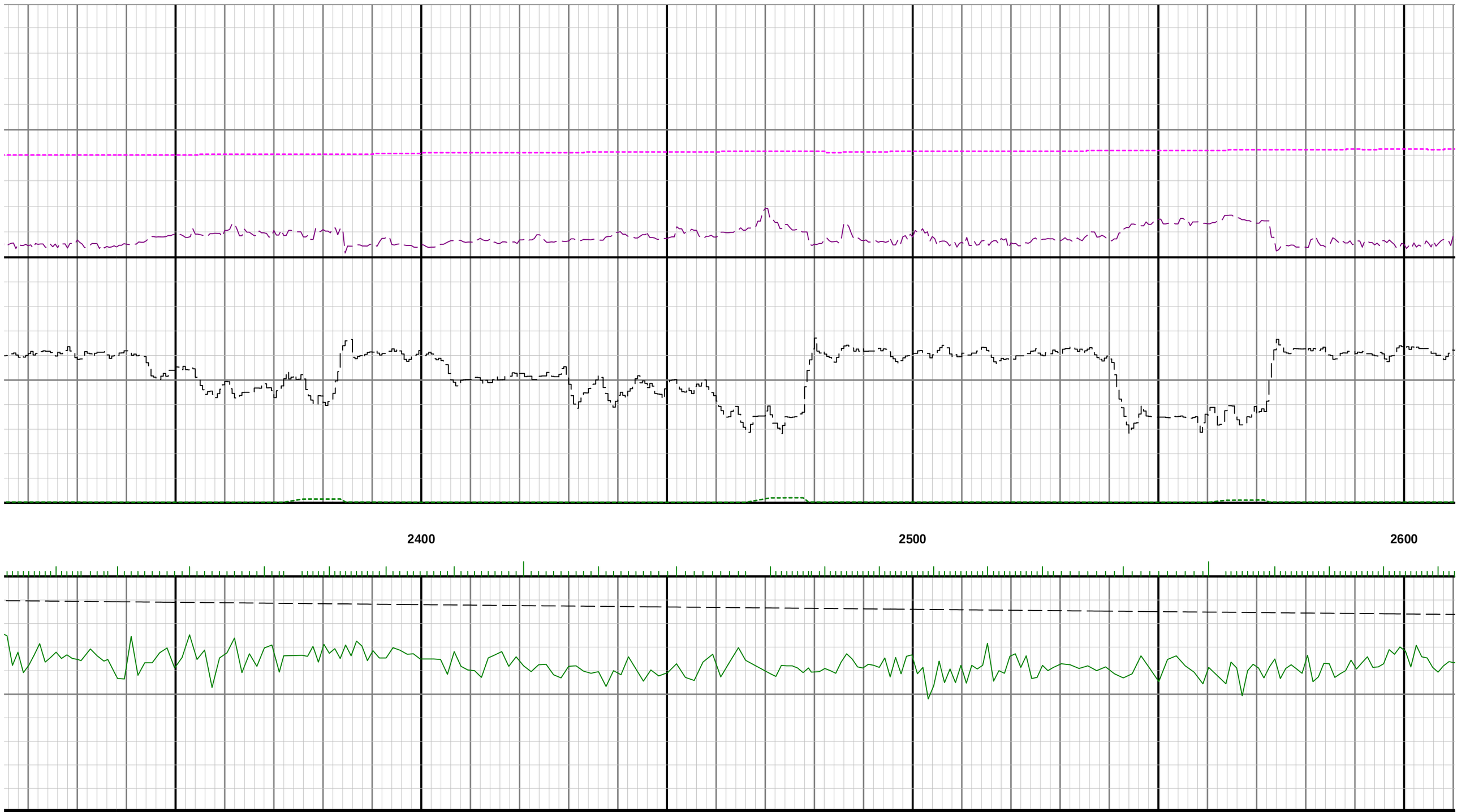
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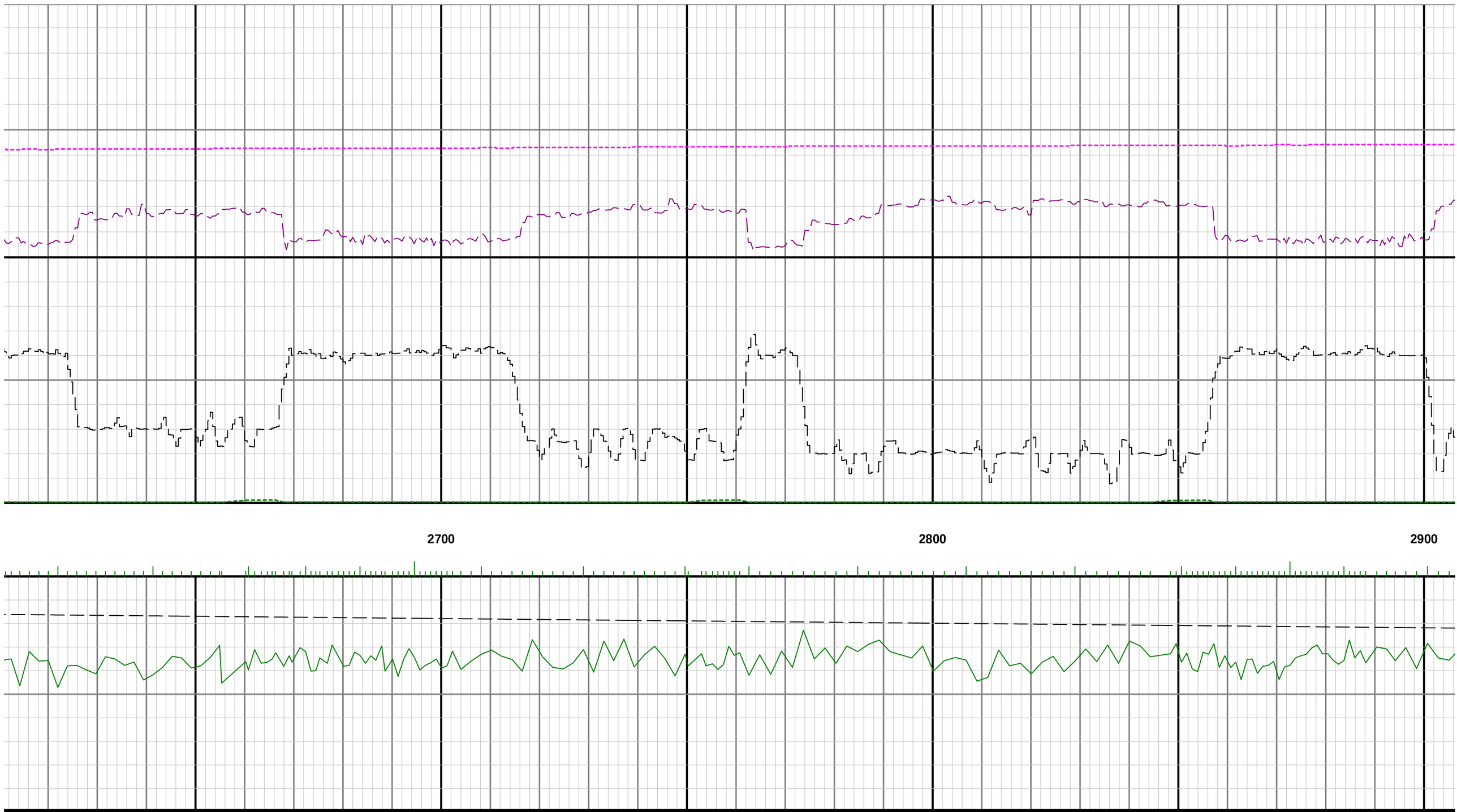
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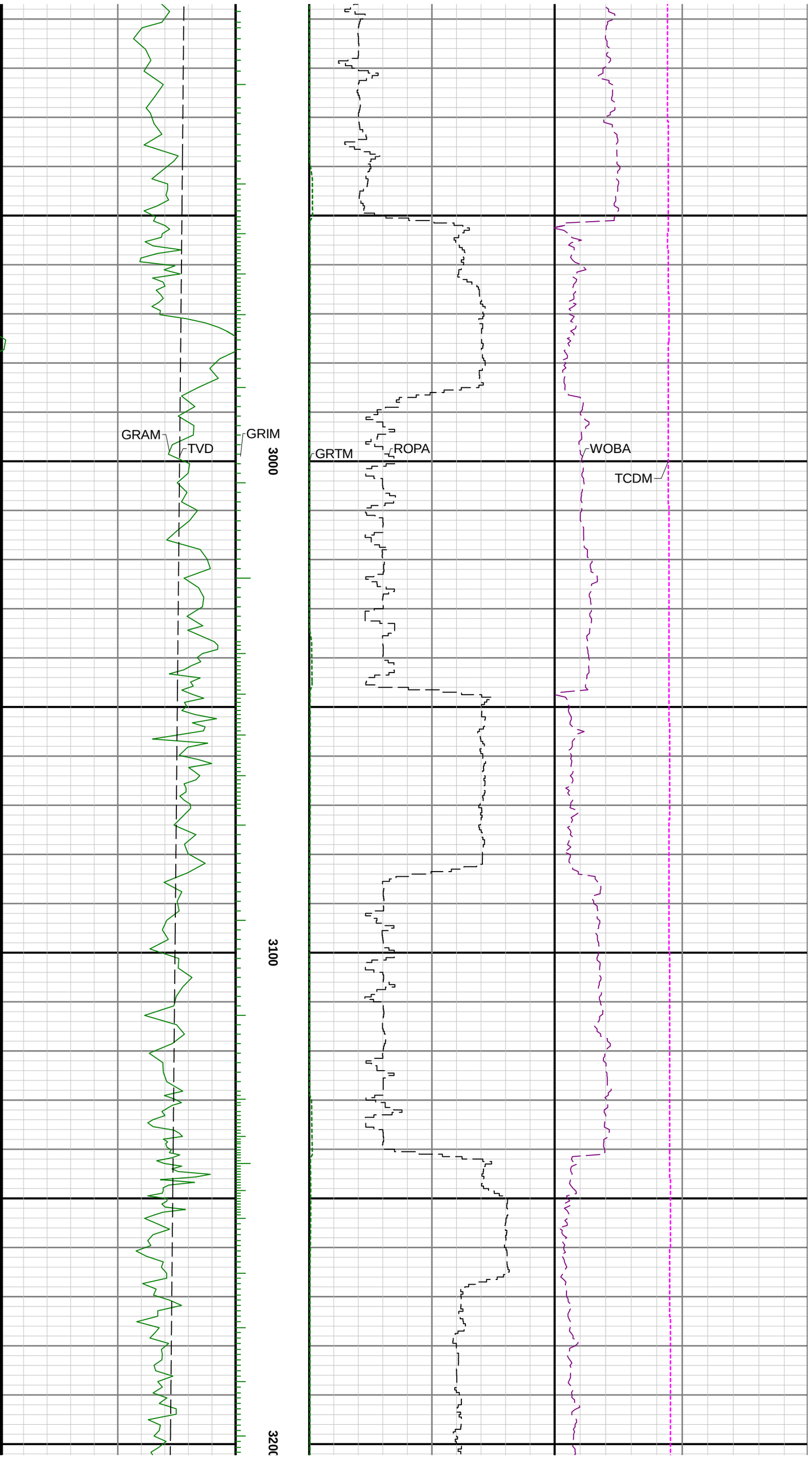
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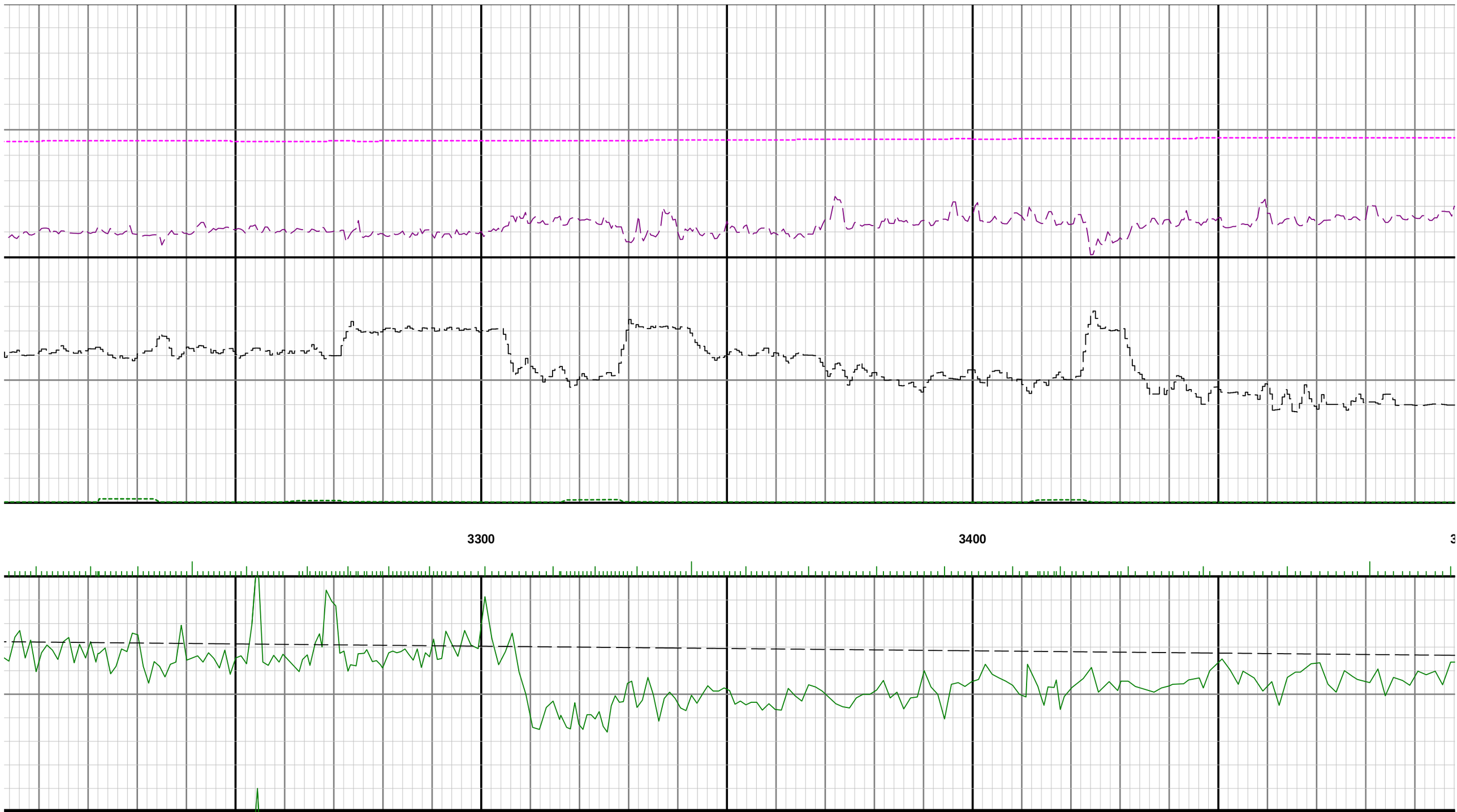
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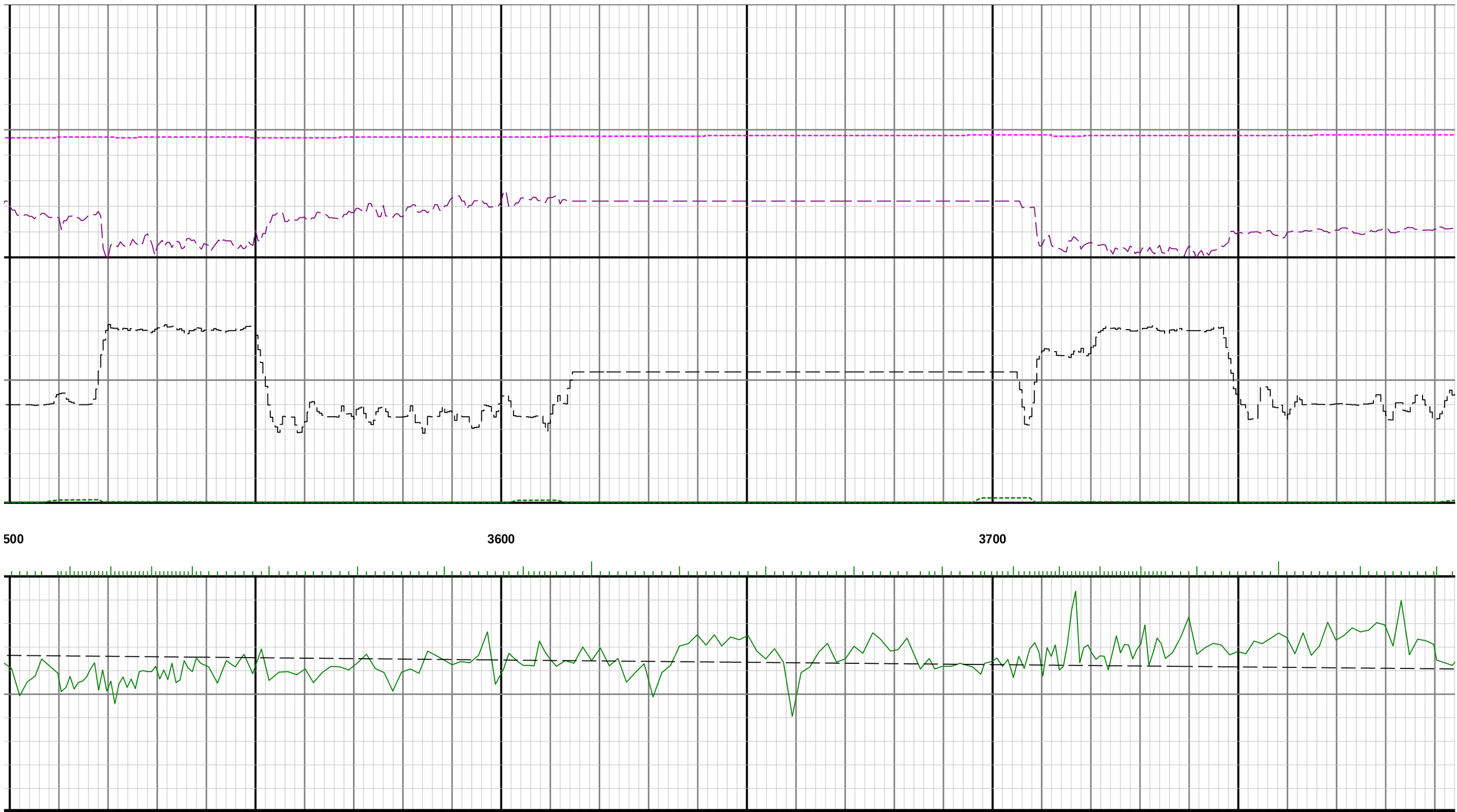
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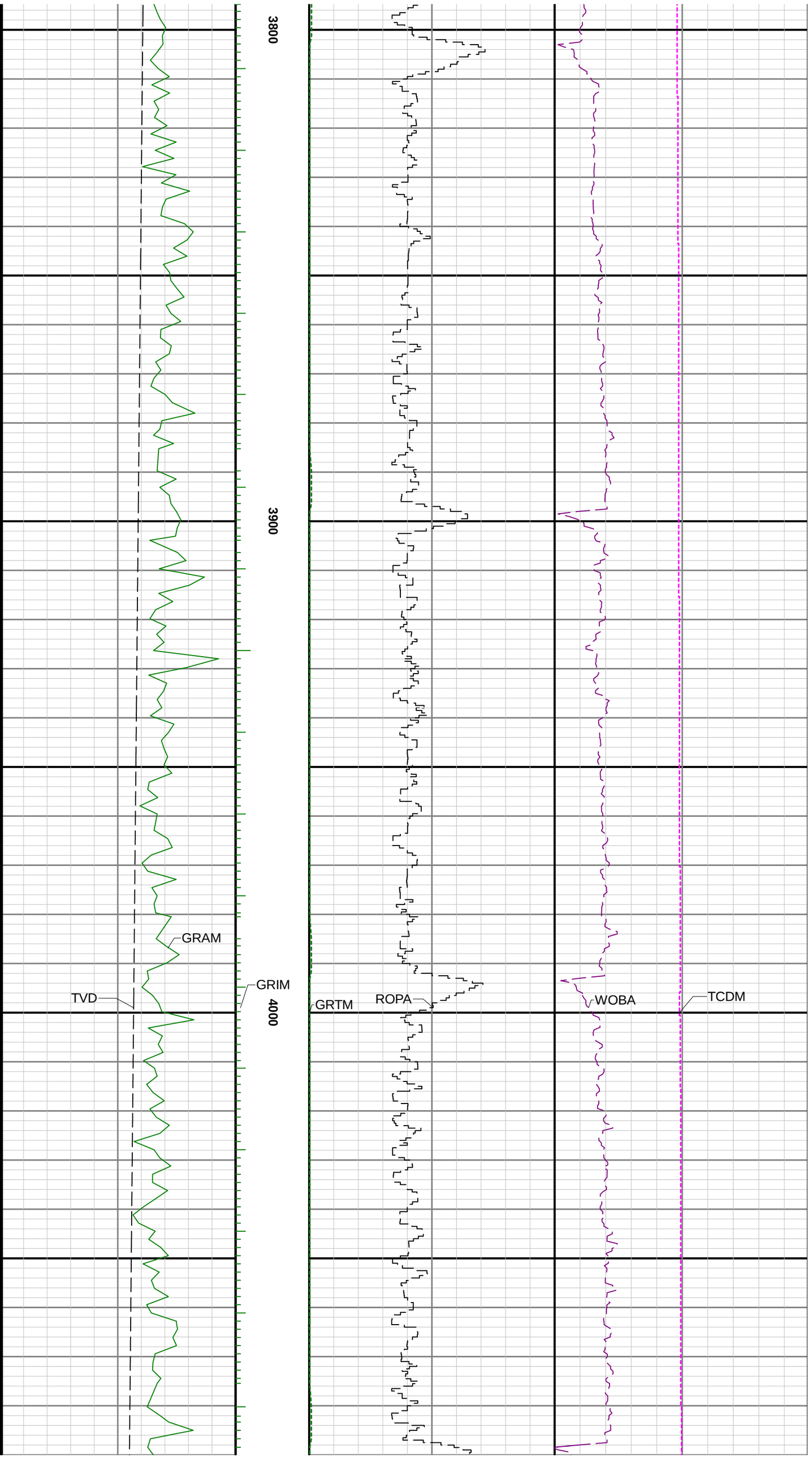
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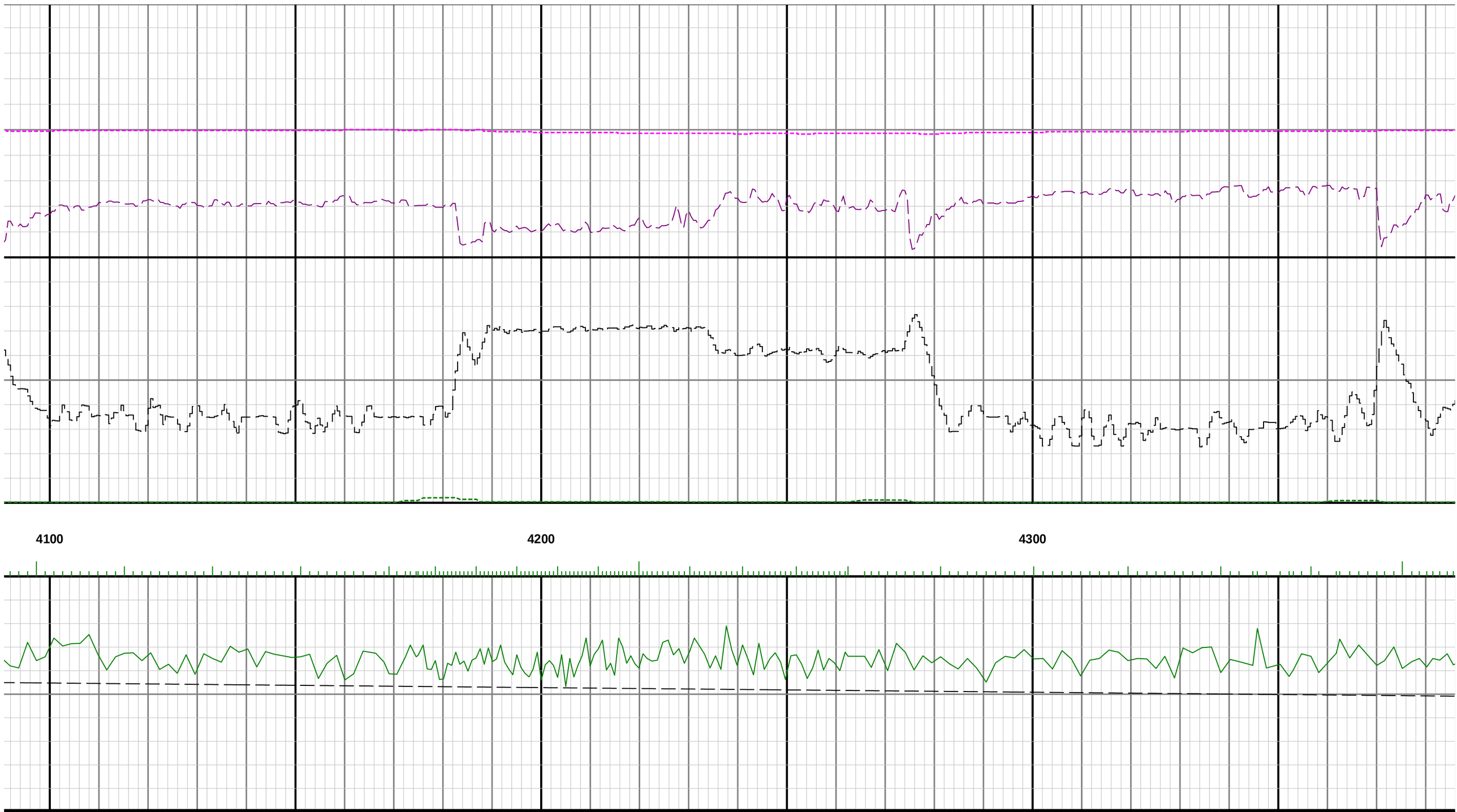
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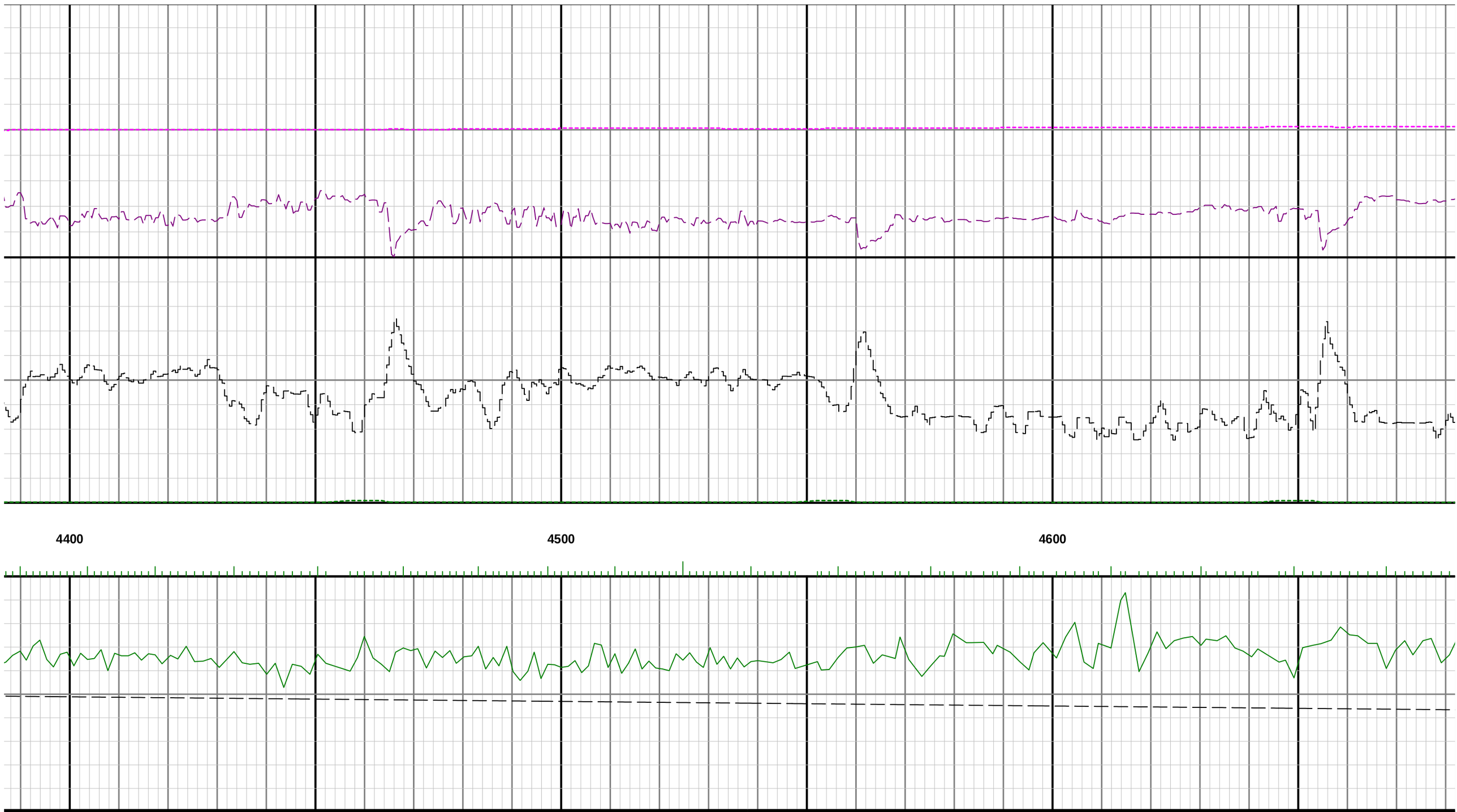
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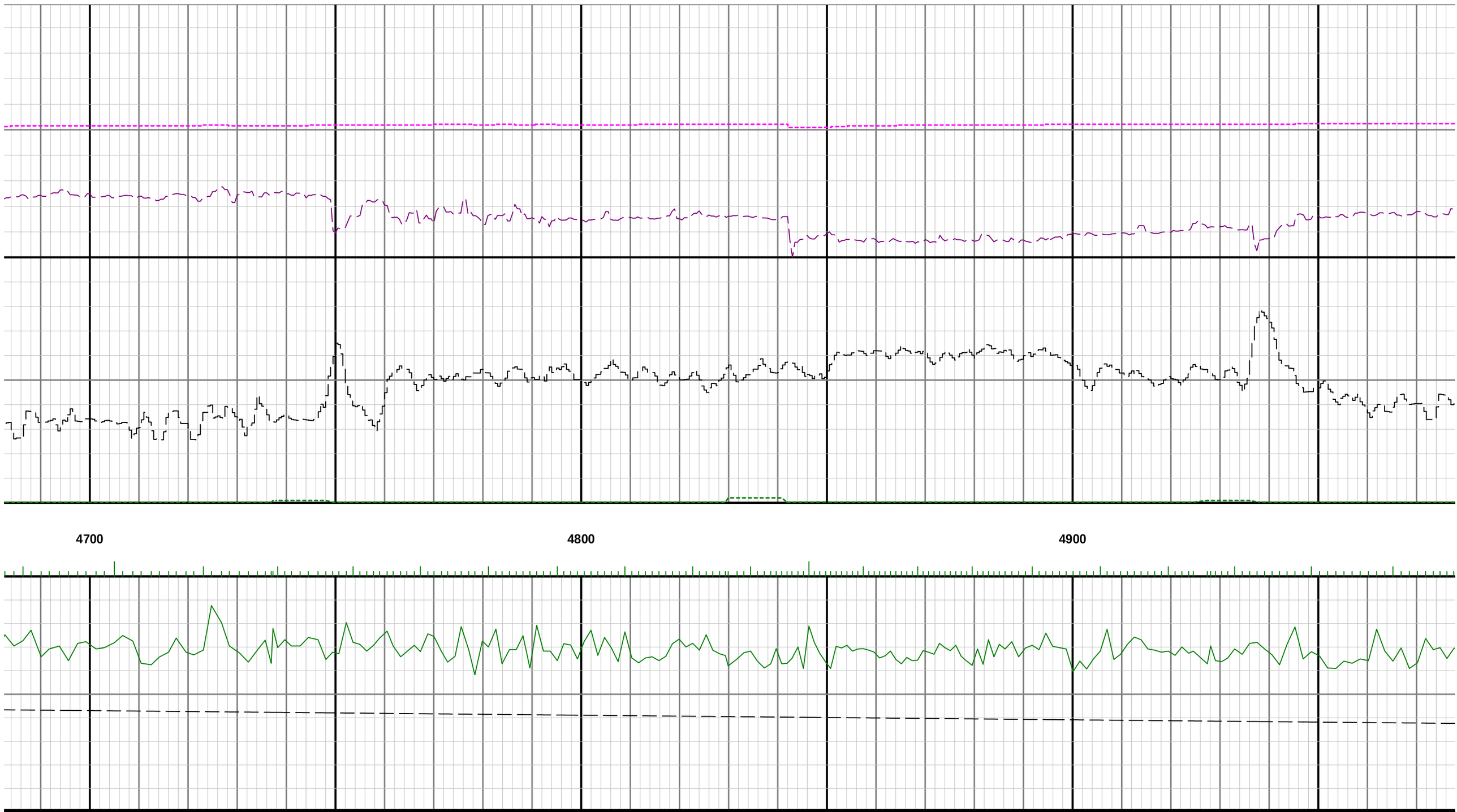
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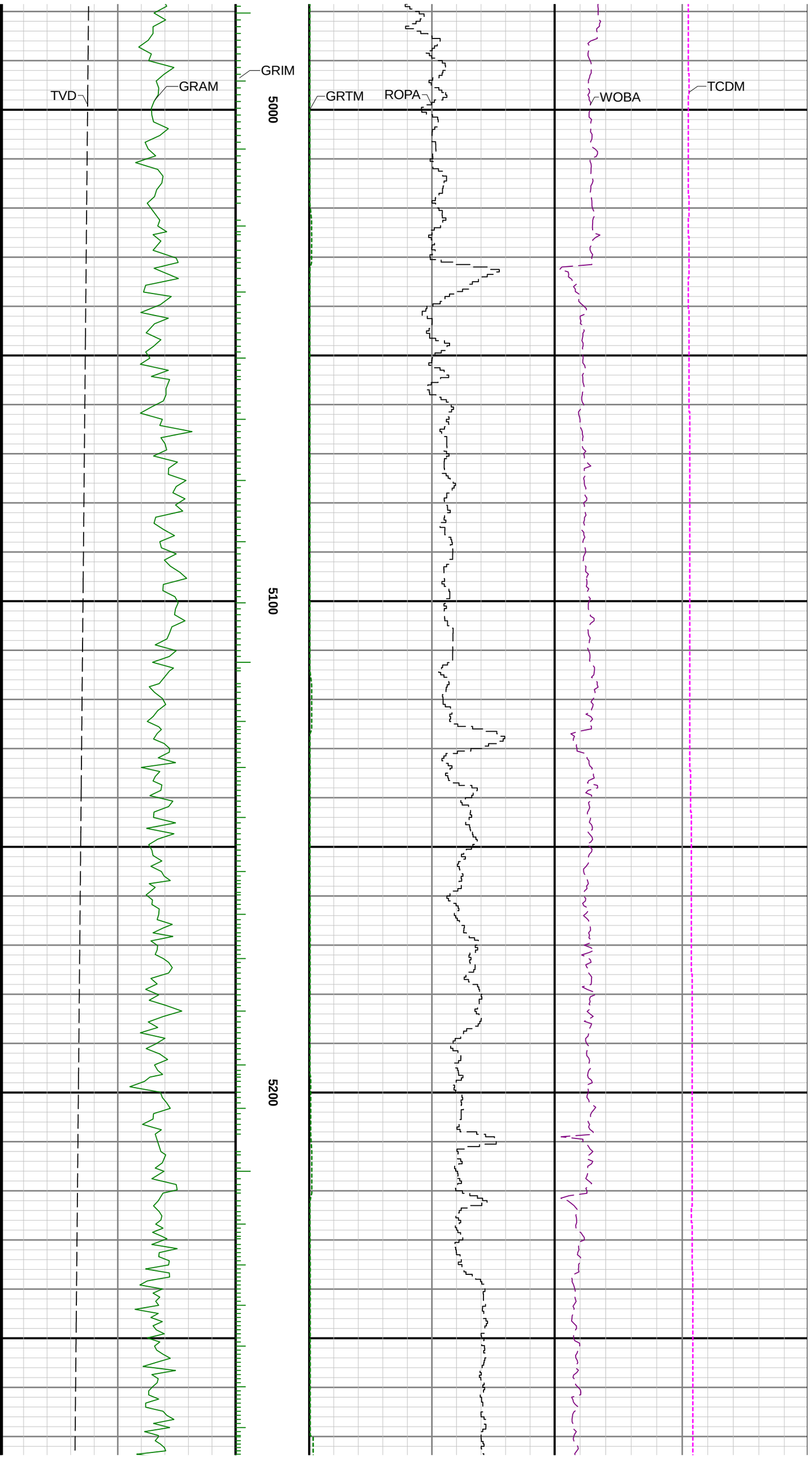
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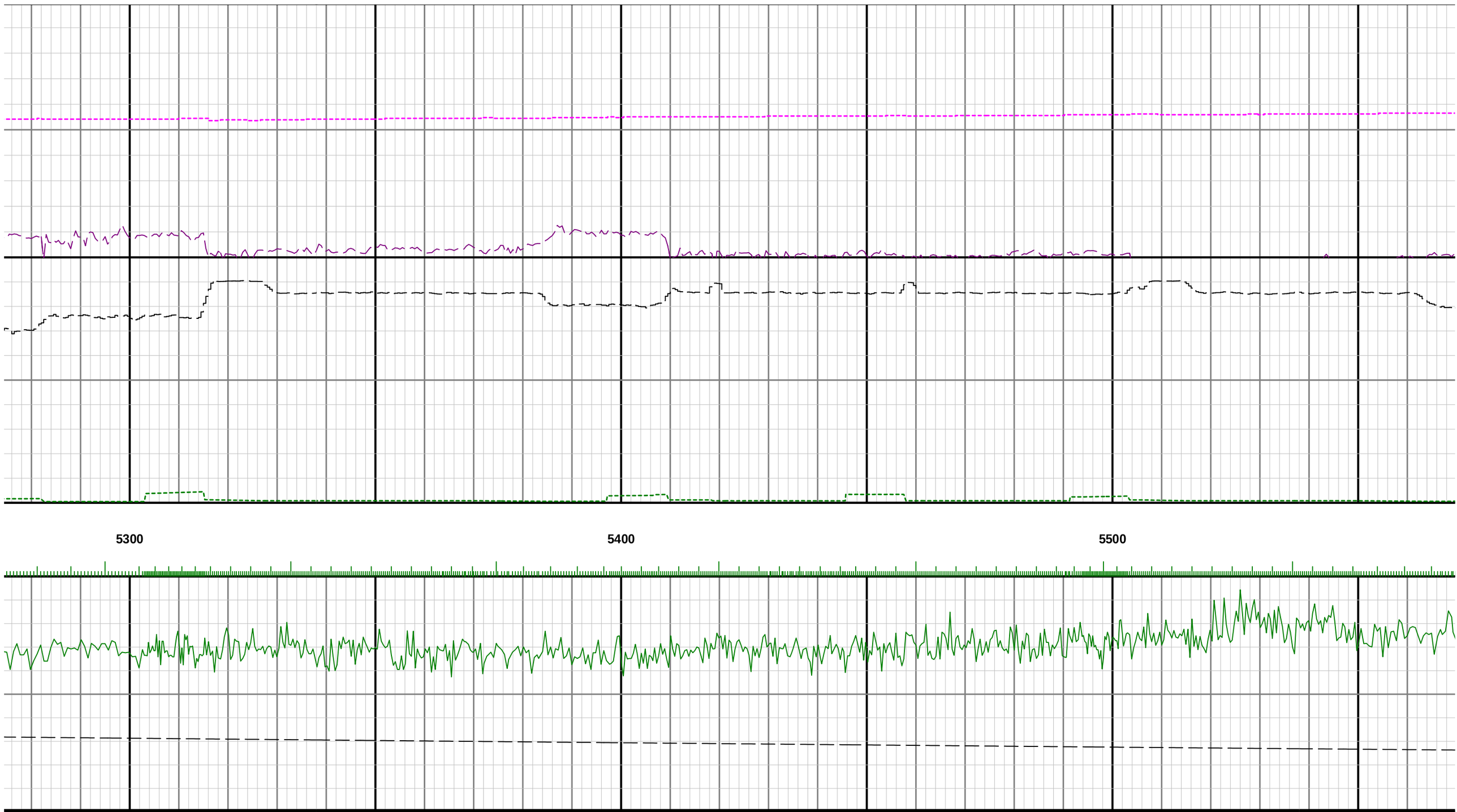
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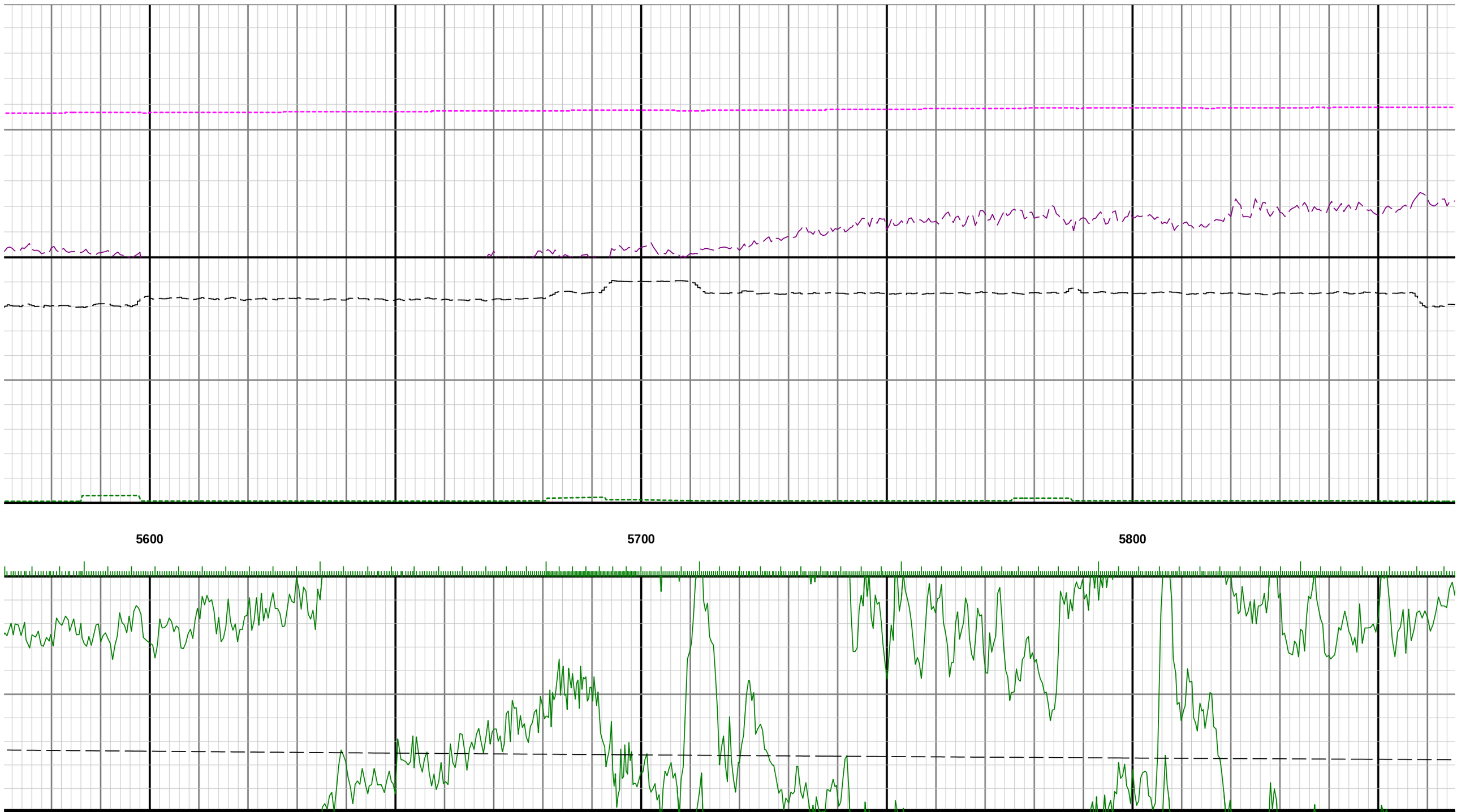
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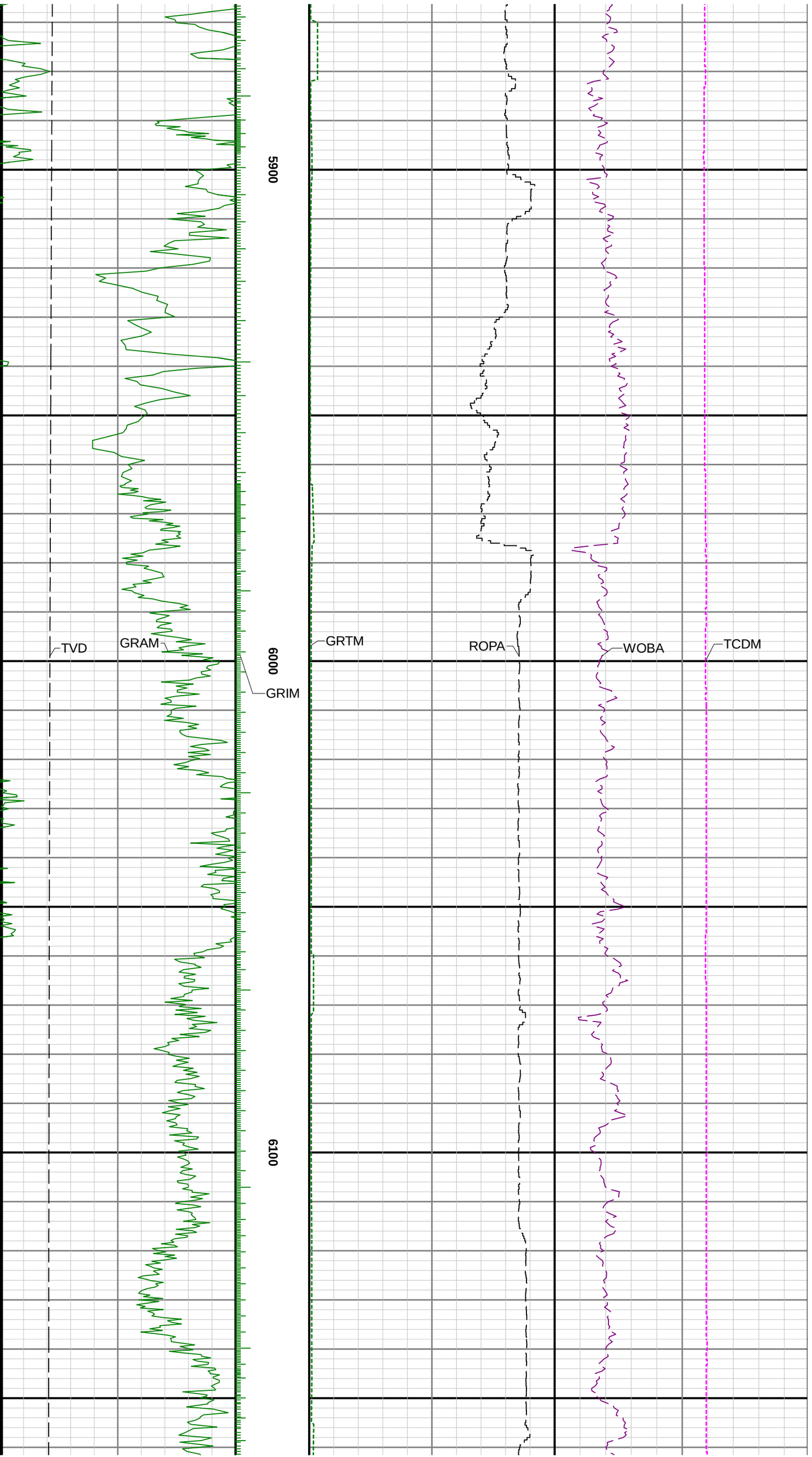
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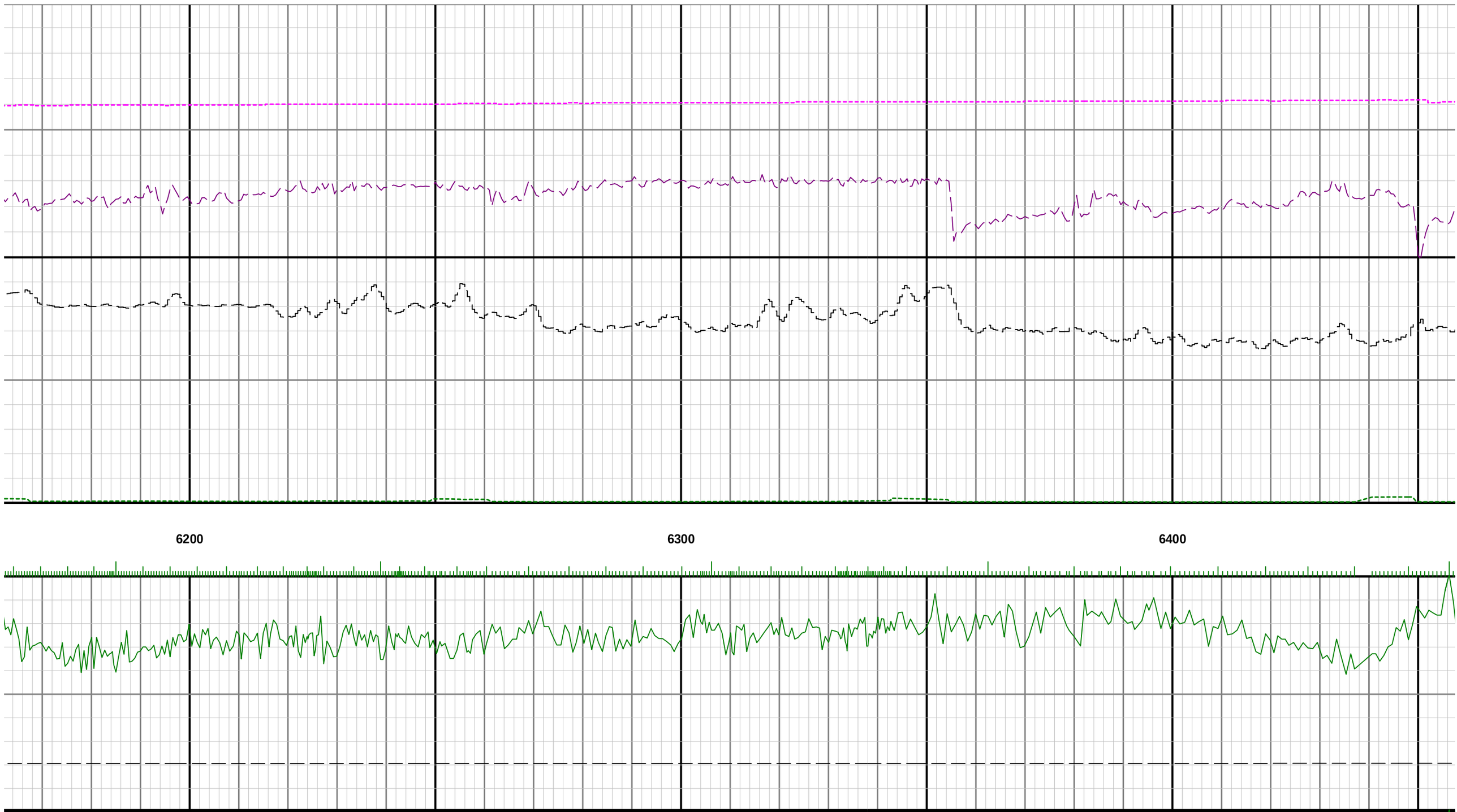
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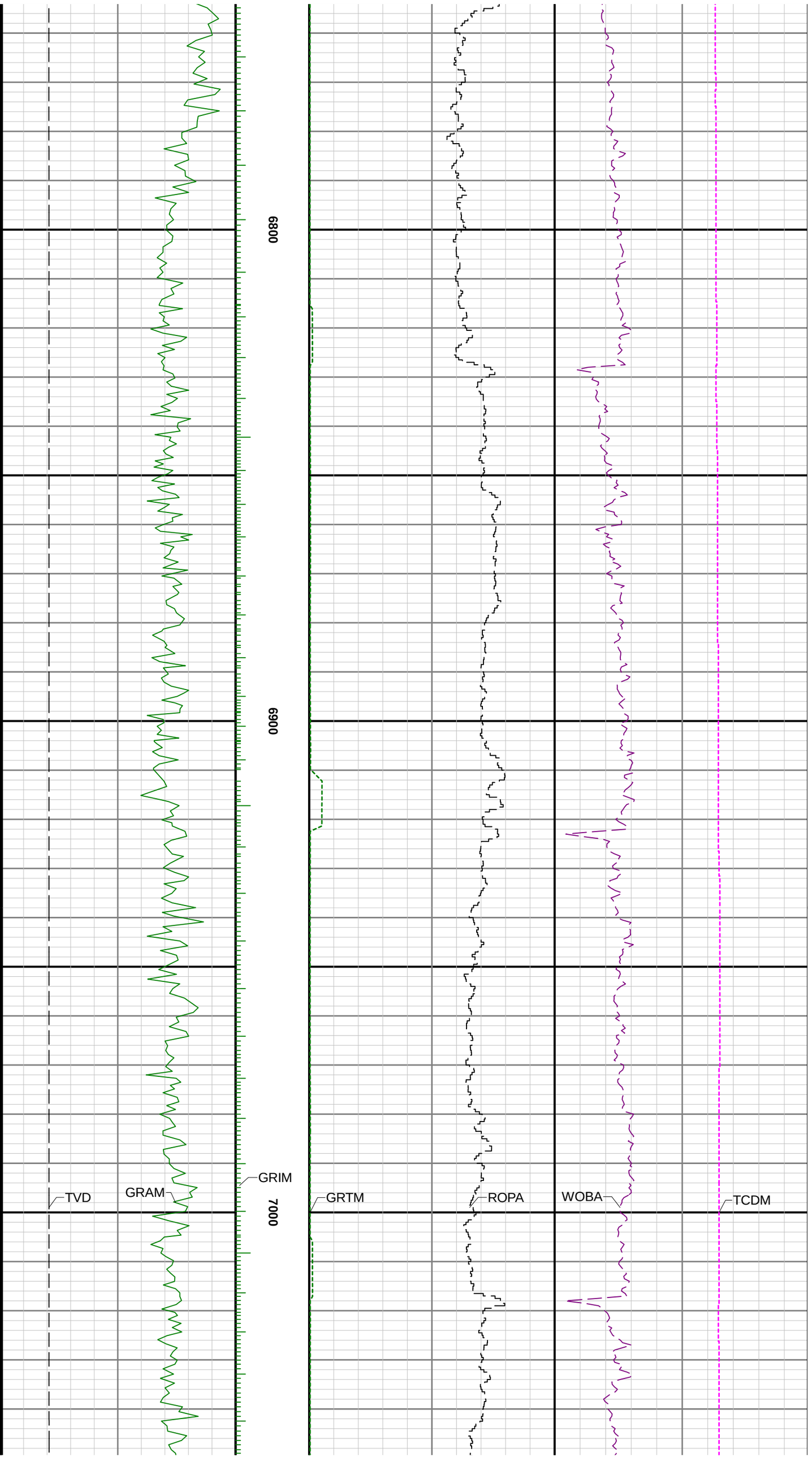
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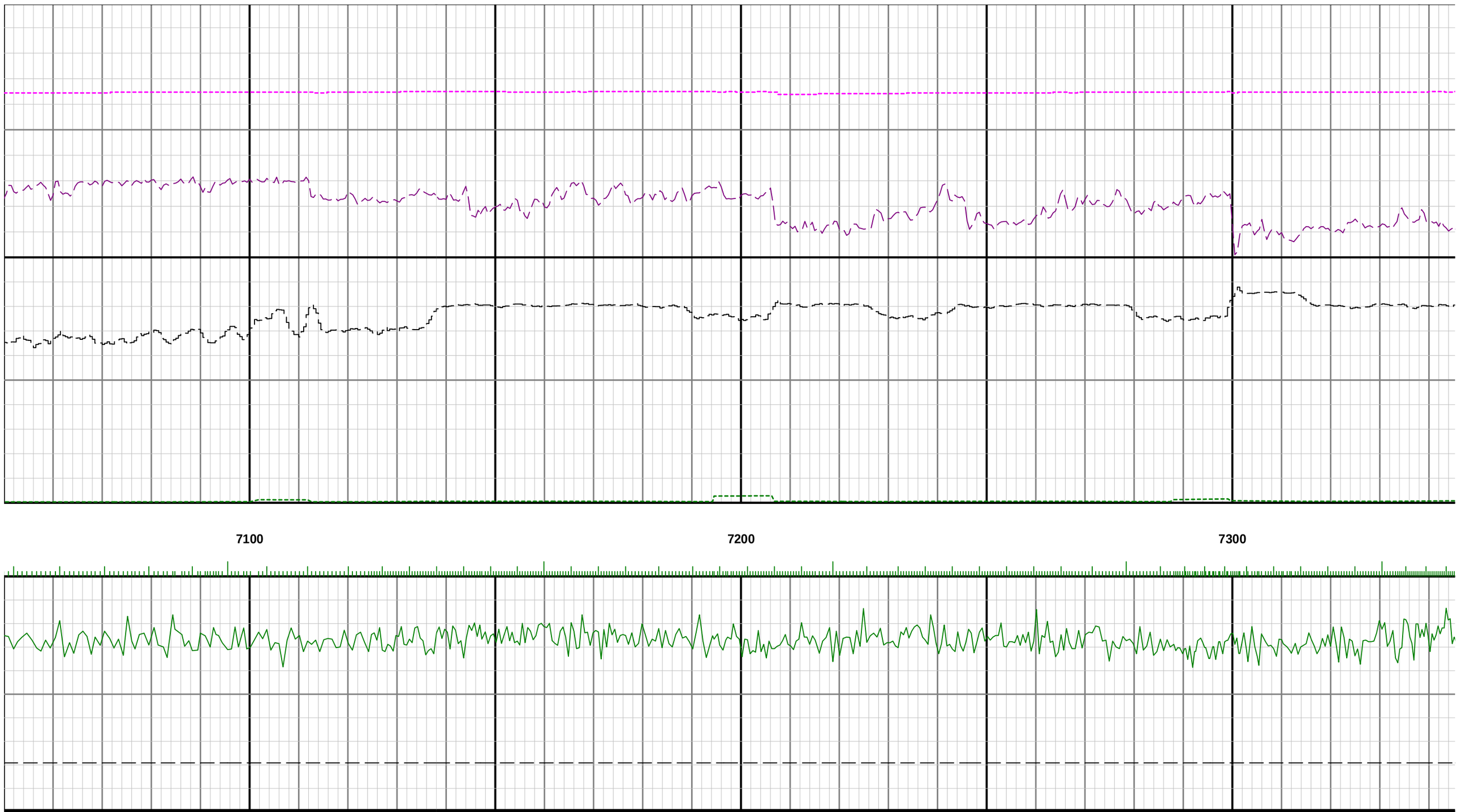
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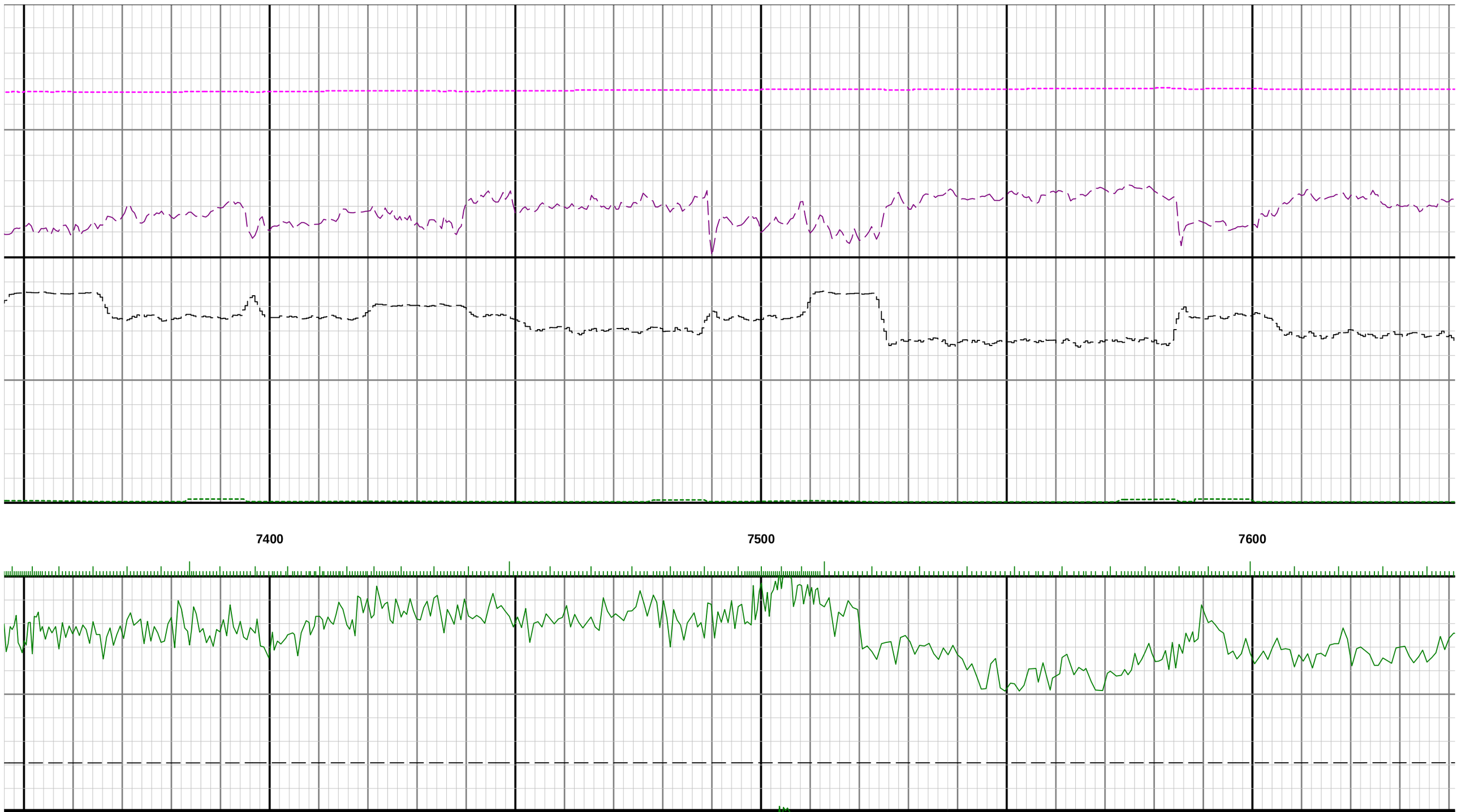
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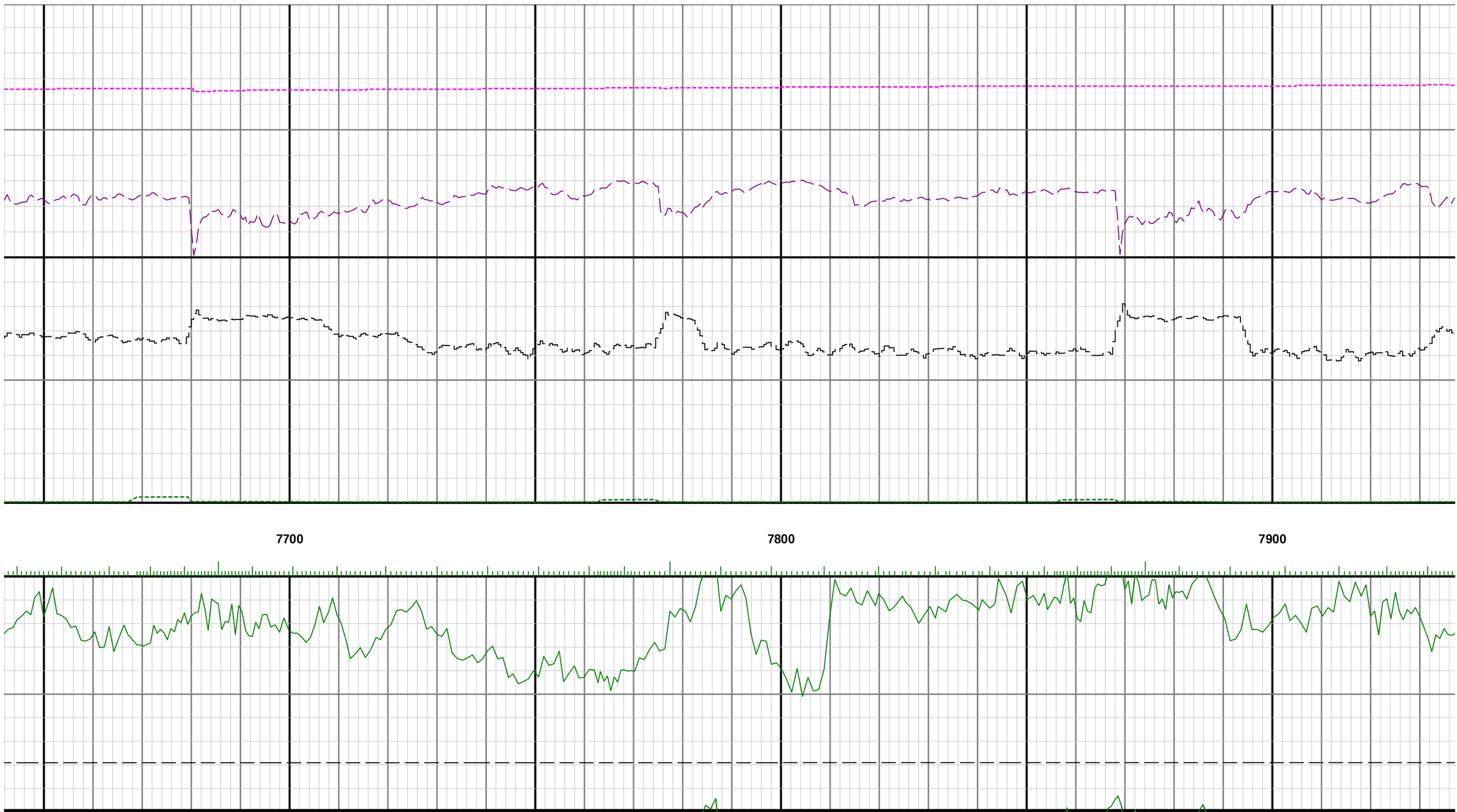
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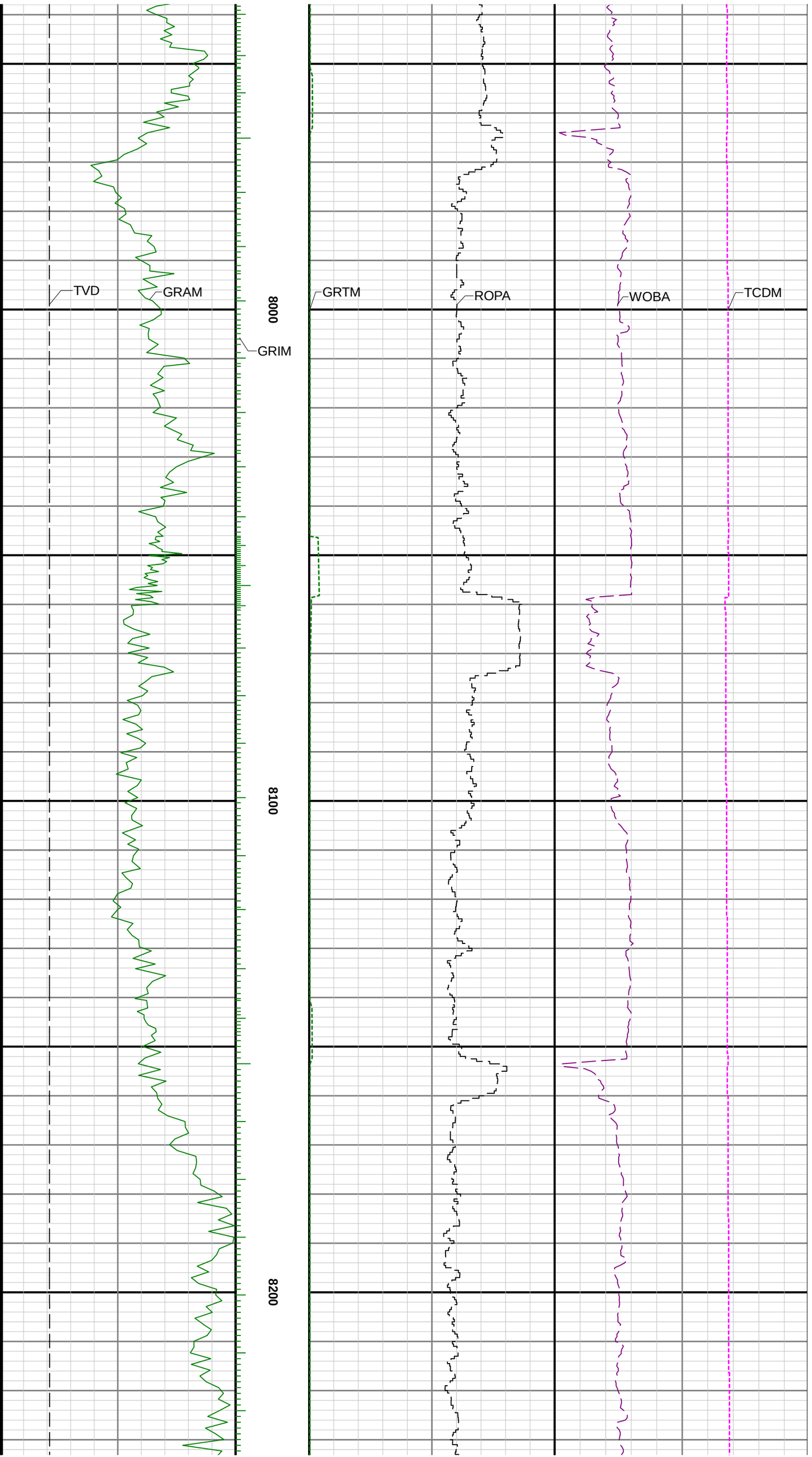
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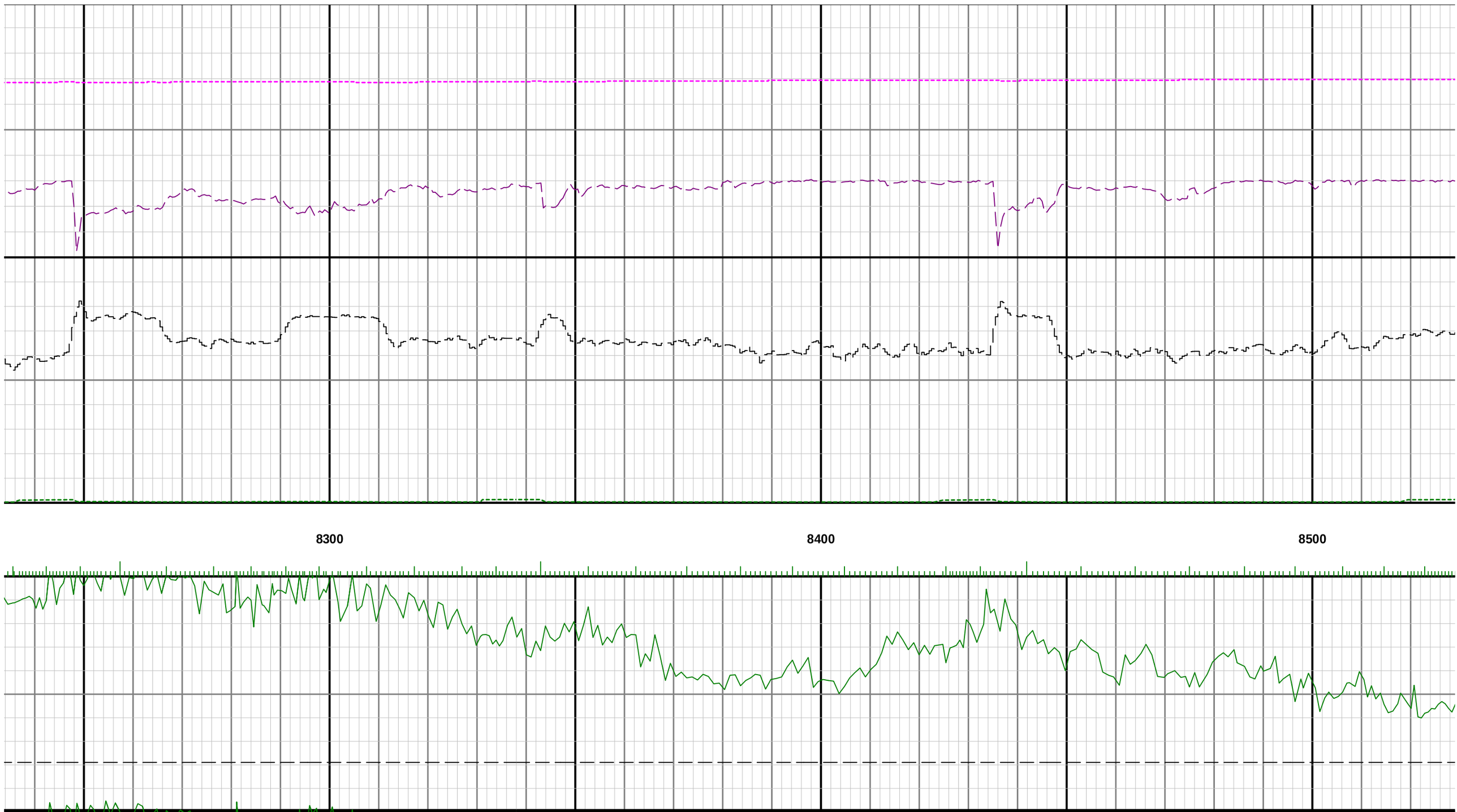
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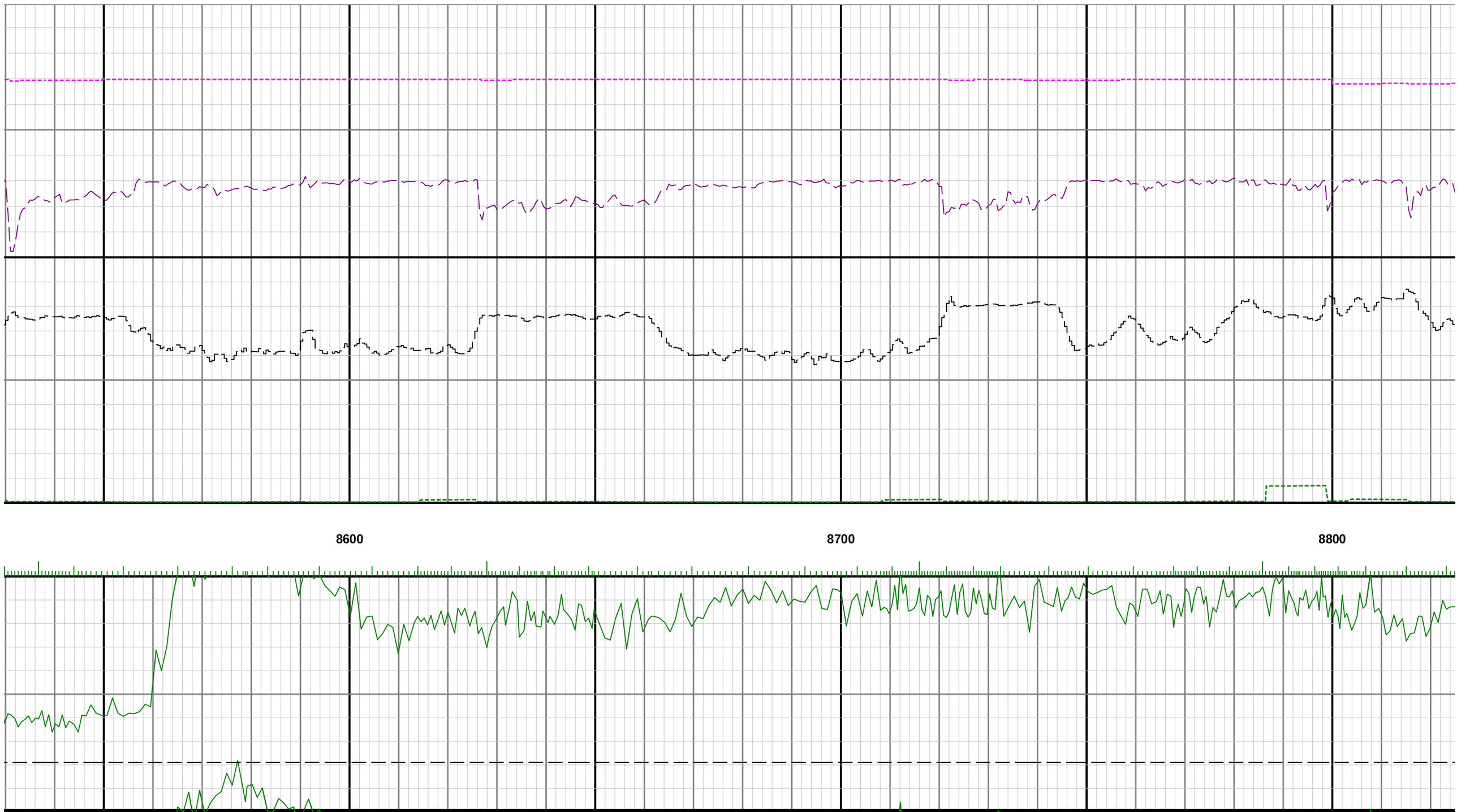
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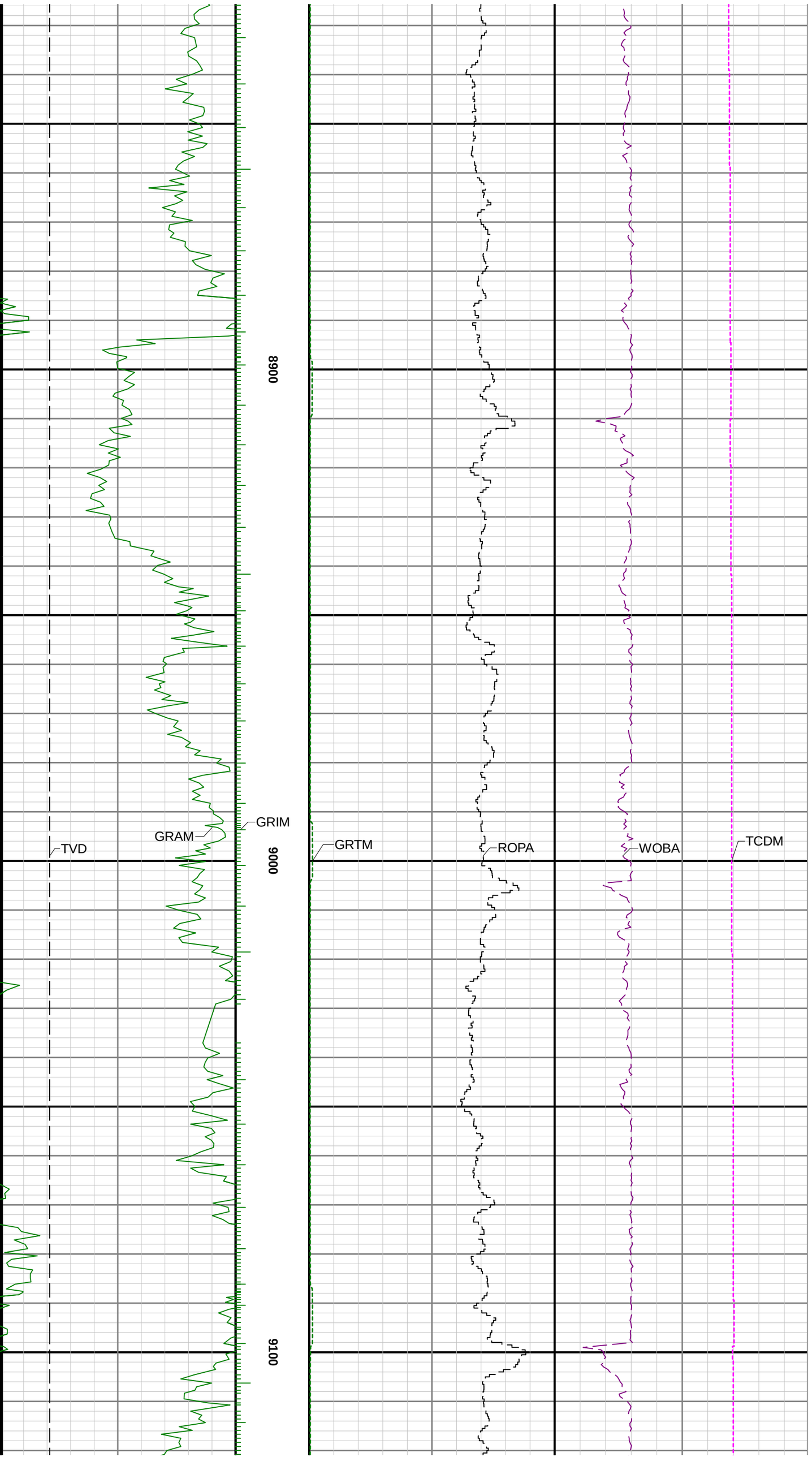
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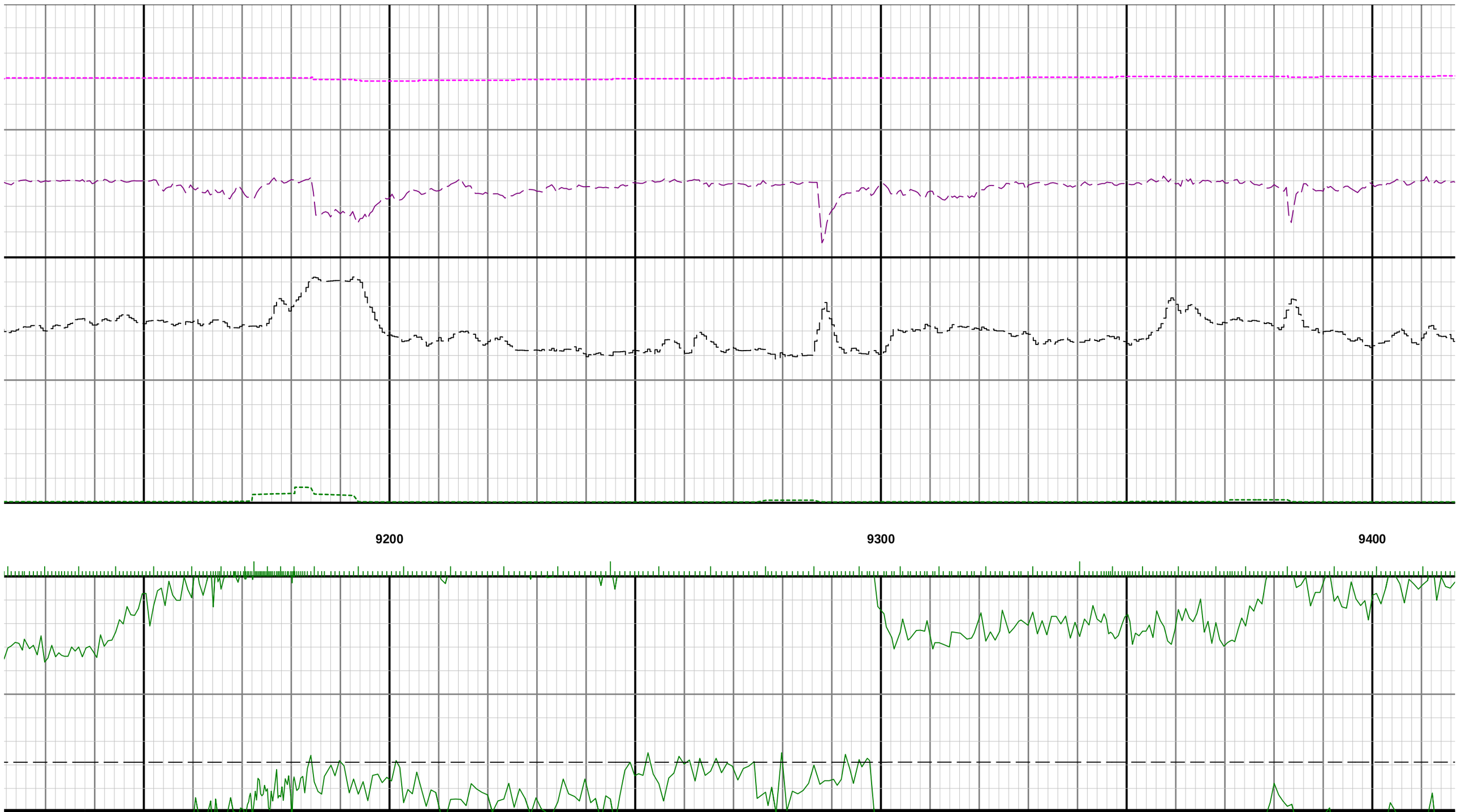
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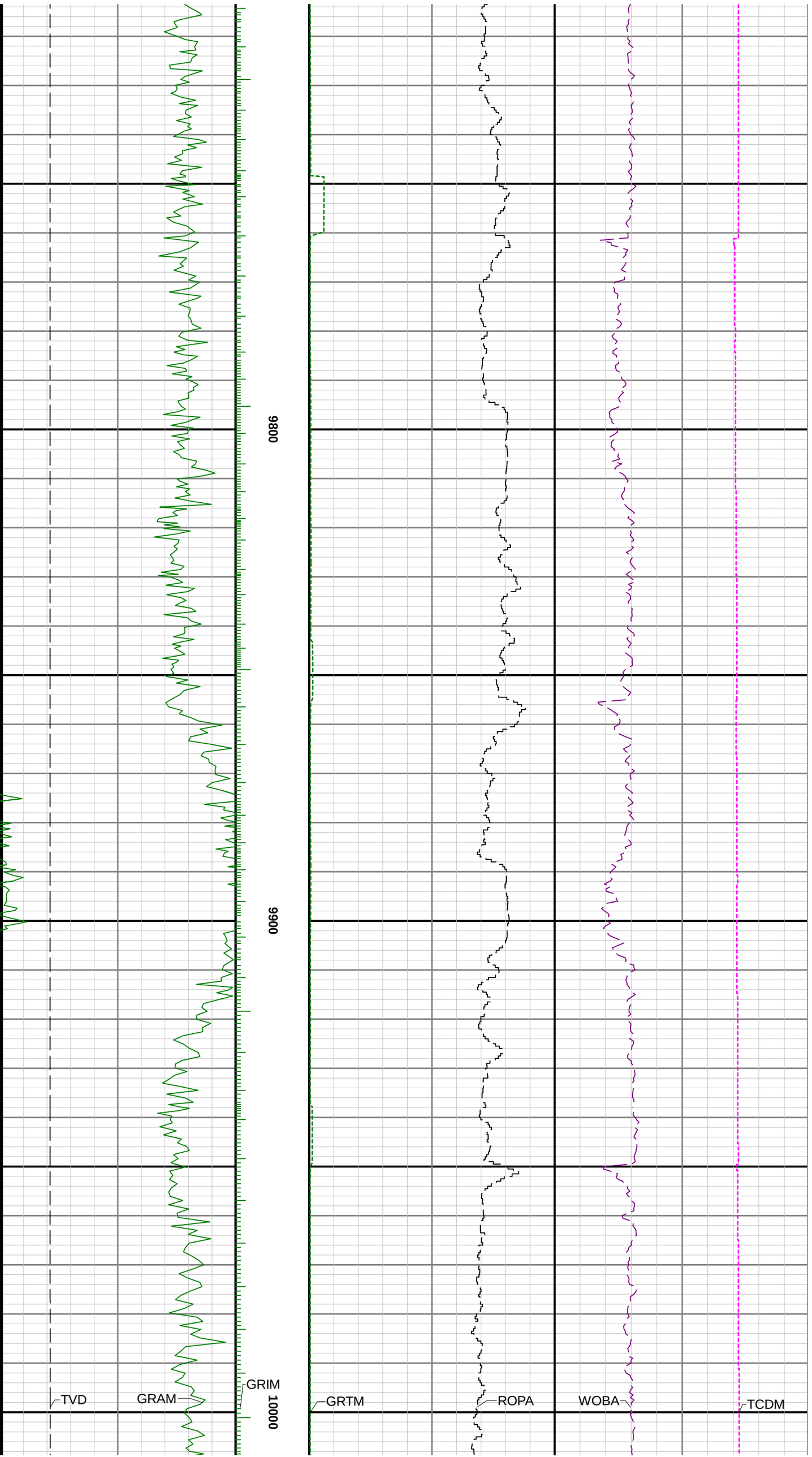
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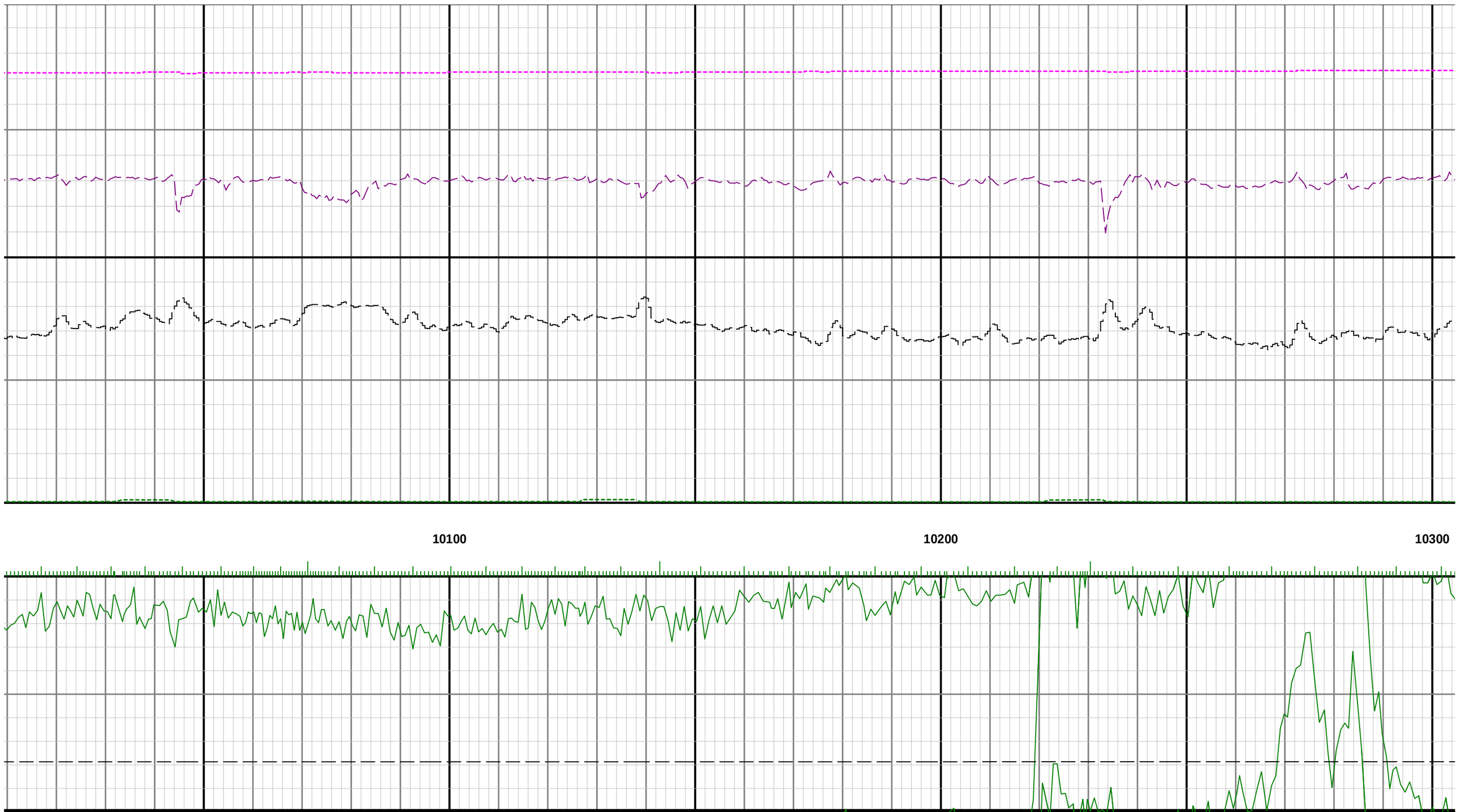
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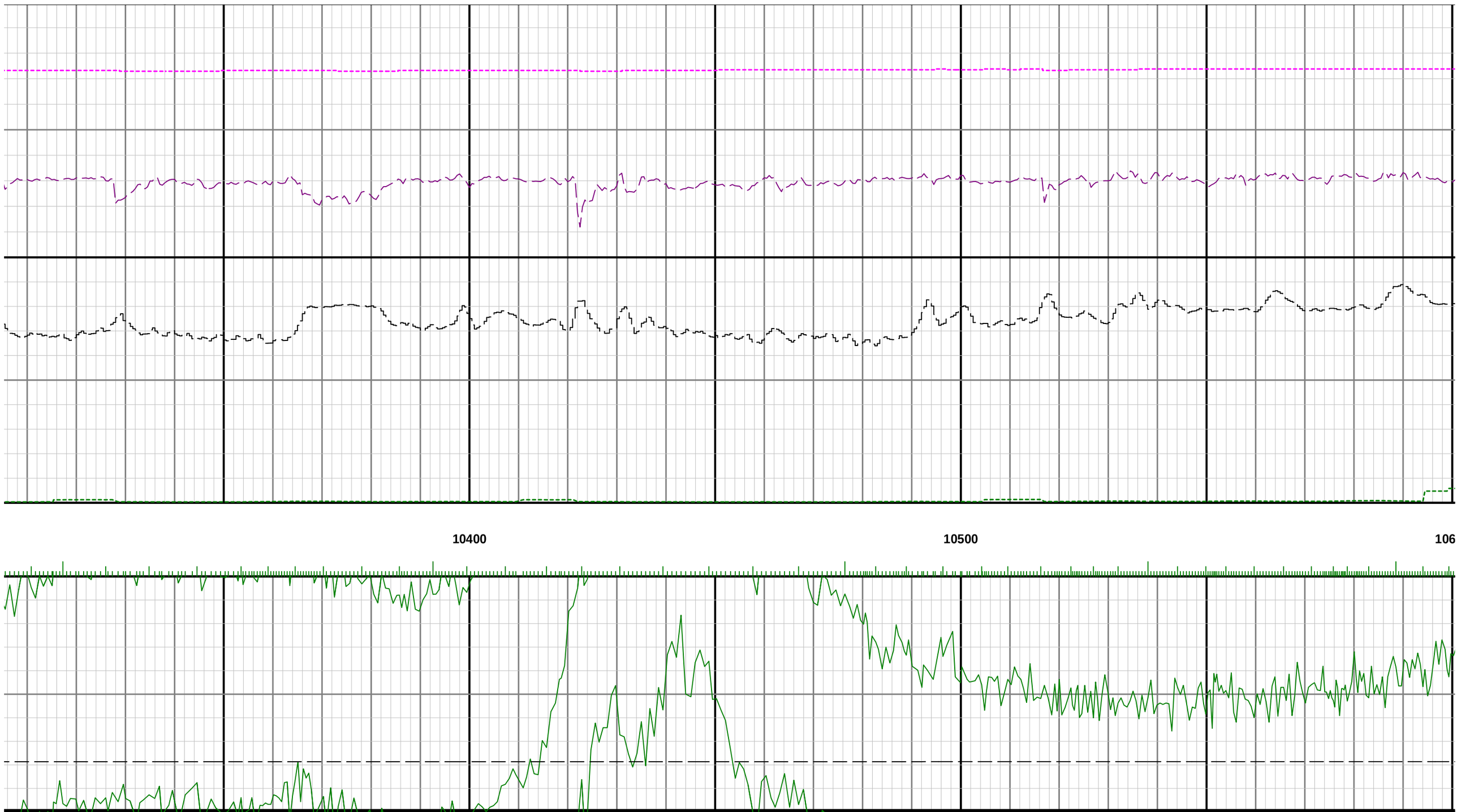
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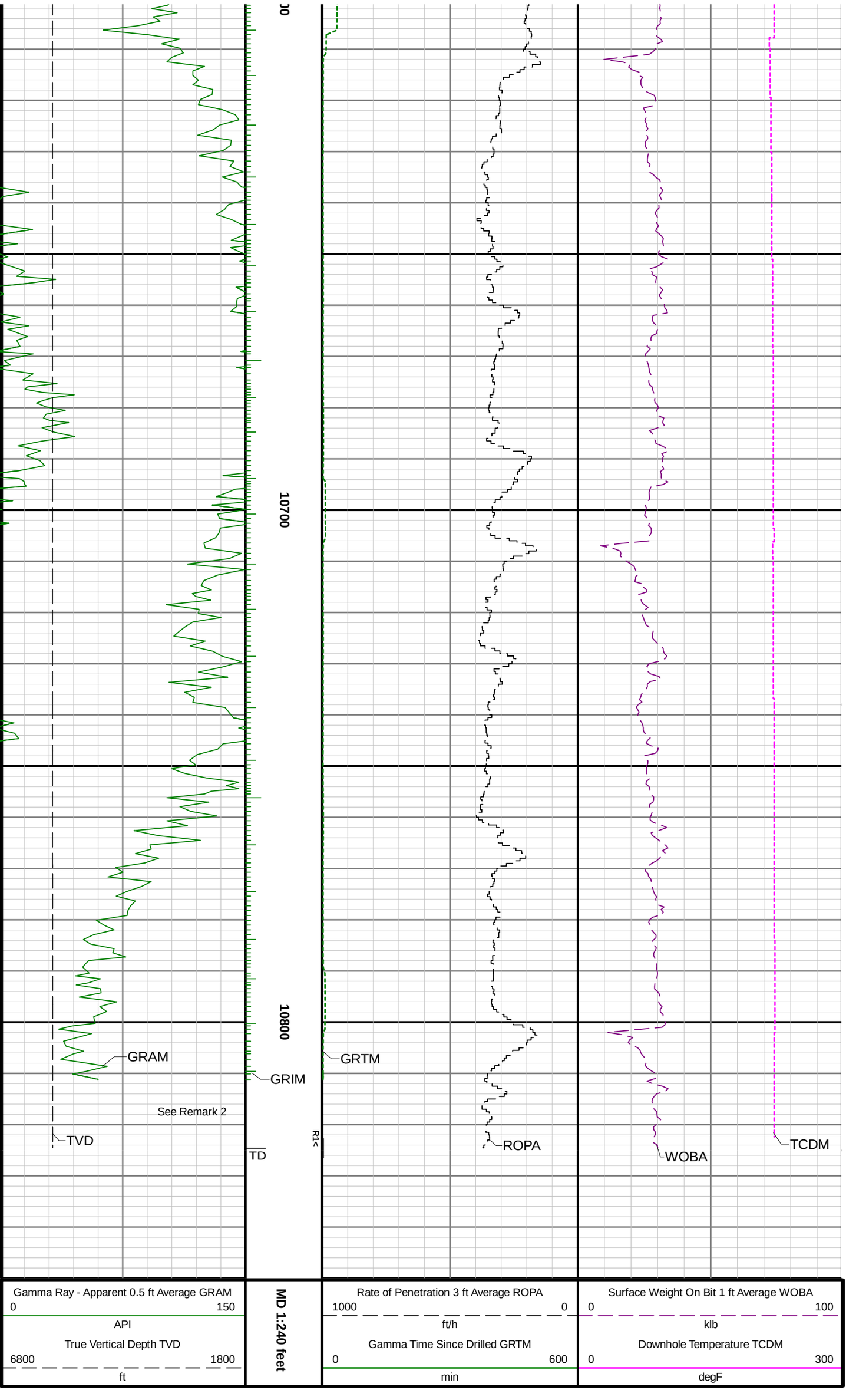

Gamma Ray - Apparent 0.5 ft Average GRAM	MD 1:240 feet	Rate of Penetration 3 ft Average ROPA	Surface Weight On Bit 1 ft Average WOBA
0 — 150		1000 — 0	0 — 100
API		ft/h	klb
True Vertical Depth TVD		Gamma Time Since Drilled GRTM	Downhole Temperature TCDM
6800 — 1800		0 — 600	0 — 300
ft		min	degF