LWD MEMORY LOG

Gamma Ray

Scale: 1:240 MD

Depth Reference: Driller's Depth

Company: Noble Energy
Well: Waste Management Y23-712
Field: Wattenberg
County: Weld County **Country:** United States
State: Colorado

Status: Final Print

API No: 05-123-44840-00
Job ID: 8797873

Surface Location:
Latitude: 040° 09' 28.764" N
Longtitude: 104° 30' 42.984" W
SEC: 11 TWN: 2N RGE: 64W

Other Services:
Directional

Permanent Datum (P.D.): Ground Level
Elevation: 4895.00 ft
Log Measured From: Rig Floor
Above P.D. 30.00 ft

Elev. KB: N/A
Elev. DF: 4925.00 ft
Elev. GL: 4895.00 ft

Dates

Date From: 2017-11-13
Date To: 2017-11-18
Spud Date: 2017-11-13

Interval Logged

Top: (ft) 2039.00
Bottom: (ft) 19916.00

Magnetic Field Reference

Azi Reference North: Grid
Dip Angle: (deg) 66.66
Total Magnetic Field Strength: (nT) 52262
Mag to Reference North Correction: (deg) 7.44 E

Borehole Record

Hole Size (in)	From (ft)	To (ft)
13.500	30.00	2039.00
8.500	2039.00	19916.00

Casing Record

Size (in)	Weight (lb/ft)	From (ft)	To (ft)
9.625	36.00	30.00	2029.00

Mud Record

Type	From (ft)	To (ft)
Oil Based Mud	2039.00	19916.00

Deviation Record

Hole Size (in)	Interval (ft)	Inc | Az (Start)	Inc | Az (End)
8.500	17877.00	0.34 | 46.97	89.72 | 181.07

Acquisition System / Software Version

Baker Hughes Cadence RT4.1
PlotStudio 4.1.7763.3

Other

Rig: H&P 517
Contractor: Helmerich & Payne Drilling Co
District: RMA Unit: D&E

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	3.00	AutoTrak Curve	2026.65	3025.90	2039.00	3038.25	2017-11-14 03:55	2017-11-14 08:10	4.44
2	1RR	8.500	PDC	3.00	AutoTrak Curve	3025.90	6882.43	3038.25	6894.78	2017-11-14 12:18	2017-11-15 07:00	17.33
3	1RR	8.500	PDC	3.00	AutoTrak Curve	6881.88	19903.10	6894.78	19916.00	2017-11-15 14:00	2017-11-18 20:35	74.13

Crew

Name	Arrive Wellsite	Depart Wellsite
Adam Schlenz	2017-11-12	2017-11-19

Name	Arrive Wellsite	Depart Wellsite
Mohammad Odetallah	2017-11-12	2017-11-19

Name	Arrive Wellsite	Depart Wellsite

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+ (%)
2017-11-14 02:00	1	2039.00	Oil Based Mud	9.0	10	N/A	21.0	75.5/24.5	Active Pit	21000	0.00
2017-11-14 13:00	2	3890.00	Oil Based Mud	8.8	10	N/A	18.5	73/27	Active Pit	20000	0.00
2017-11-15 02:00	2	6686.00	Oil Based Mud	9.0	9	N/A	17.5	75.3/24.7	Active Pit	24000	0.00
2017-11-15 13:00	3	6895.00	Oil Based Mud	9.1	11	N/A	14.0	75/25	Active Pit	25000	0.00
2017-11-16 02:00	3	8357.00	Oil Based Mud	8.9	11	N/A	12.5	76.5/23.5	Active Pit	25000	0.00
2017-11-16 13:30	3	9902.00	Oil Based Mud	9.0	10	N/A	16.3	76.6/23.4	Active Pit	24000	0.00
2017-11-17 02:00	3	12546.00	Oil Based Mud	9.0	10	N/A	18.9	75.8/24.2	Active Pit	22000	0.00
2017-11-17 14:30	3	14989.00	Oil Based Mud	9.2	10	N/A	18.4	75.3/24.7	Active Pit	21000	0.00
2017-11-18 02:00	3	16927.00	Oil Based Mud	9.3	10	N/A	21.3	74.8/25.2	Active Pit	21000	0.00

2017-11-18 15:00	3	19201.00	Oil Based Mud	9.3	10	N/A	21.5	74.7/25.3	Active Pit	24500	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	11781619	Near Bit Inclination	6.14	6.94	7.000	4.330
1	ATC_SU	11781619	Near Bit VSS	6.14	6.94	7.000	4.330
1	ATC_MWD	12109322	Gamma (single)	2.24	12.35	7.000	3.250
1	ATC_MWD	12109322	Directional (mag)	12.31	22.42	7.000	3.250
2	ATC_SU	12273681	Near Bit Inclination	5.93	6.73	7.000	4.330
2	ATC_SU	12273681	Near Bit VSS	5.93	6.73	7.000	4.330
2	ATC_MWD	12271546	Gamma (single)	2.22	12.35	7.000	3.250
2	ATC_MWD	12271546	Directional (mag)	12.27	22.40	7.000	3.250
3	ATC_SU	14279932	Near Bit Inclination	5.93	6.73	7.000	4.330
3	ATC_SU	14279932	Near Bit VSS	5.93	6.73	7.000	4.330
3	ATC_MWD	12914616	Gamma (single)	2.76	12.90	7.000	3.250
3	ATC_MWD	12914616	Directional (mag)	12.28	22.42	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 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 2039 to 19916 feet MD (2039 to 6985 feet TVD).

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

Remarks

Number	Measured Depth (ft)	Hole Section (in)	Run No.	Remark
1	9876.00	8.500	3	The interval from 9876 to 9908 feet MD (6985 to 6987 feet TVD) has a gap in gamma ray data due to, power not being provided to the rotary steerable tool.
2	19916.00	8.500	3	The interval from 19903 to 19916 feet MD (6985 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	Downhole Temperature	degF

BAKER HUGHES

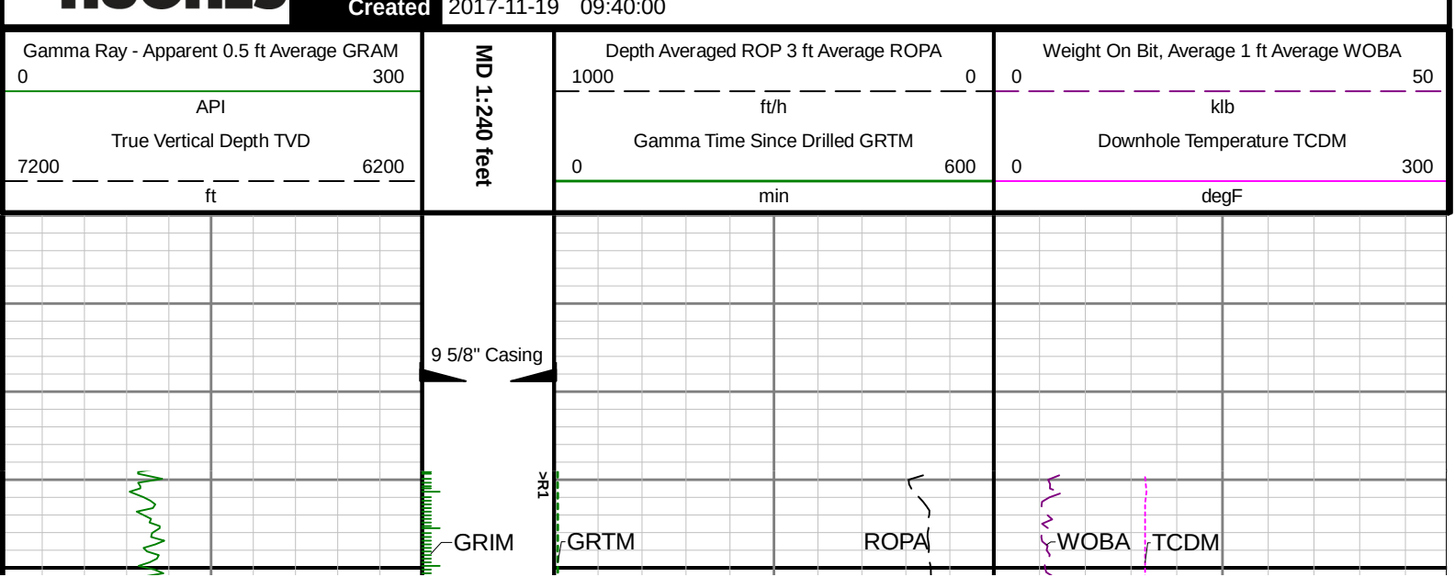
Company Noble Energy

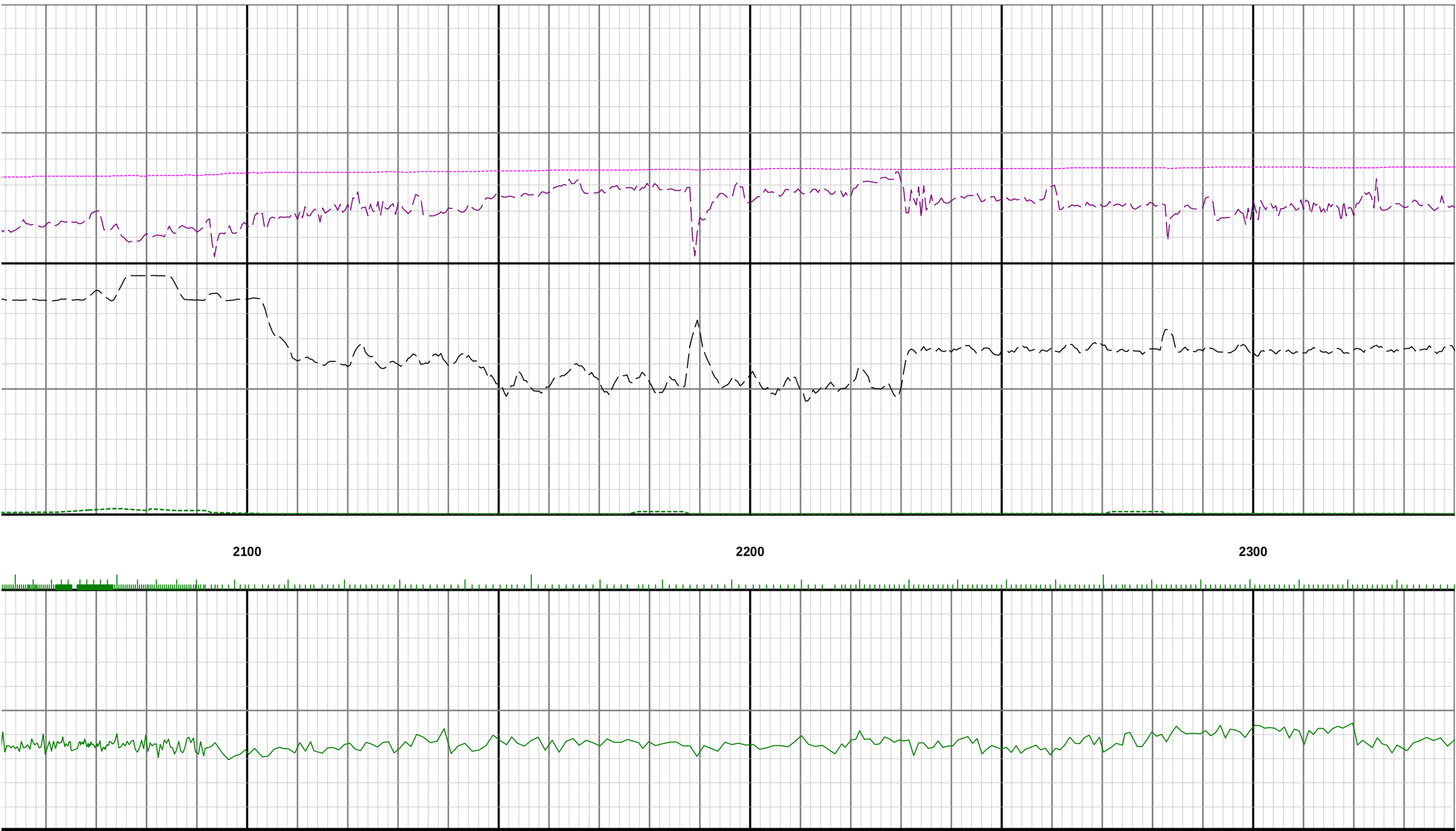
Well Waste Management Y23-712

Interval **Date From:** 2017-11-13 20:55:50 **Top:** 2039.00

Date To: 2017-11-18 13:33:27 **Bottom:** 19916.00

Created 2017-11-19 09:40:00

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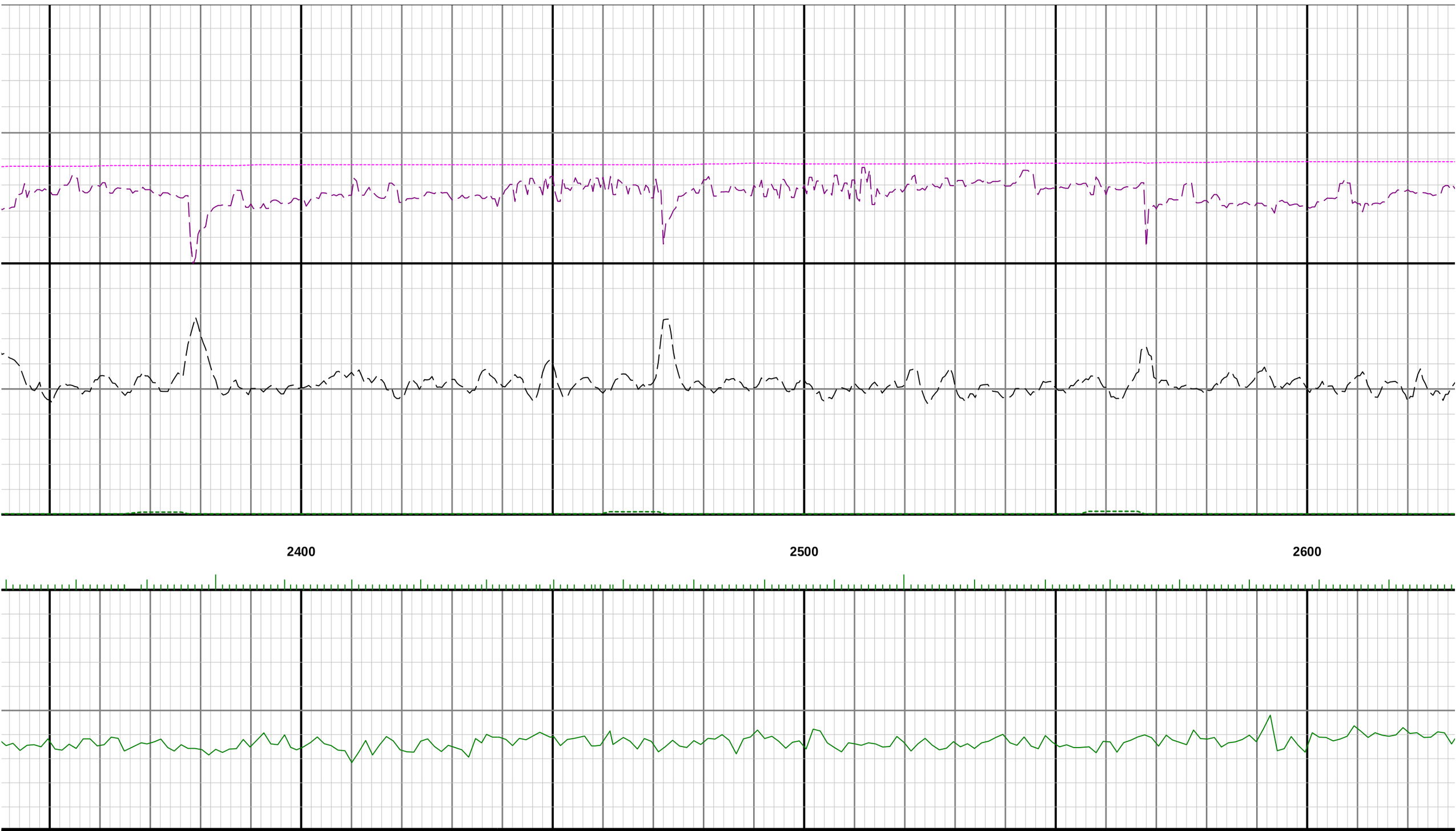
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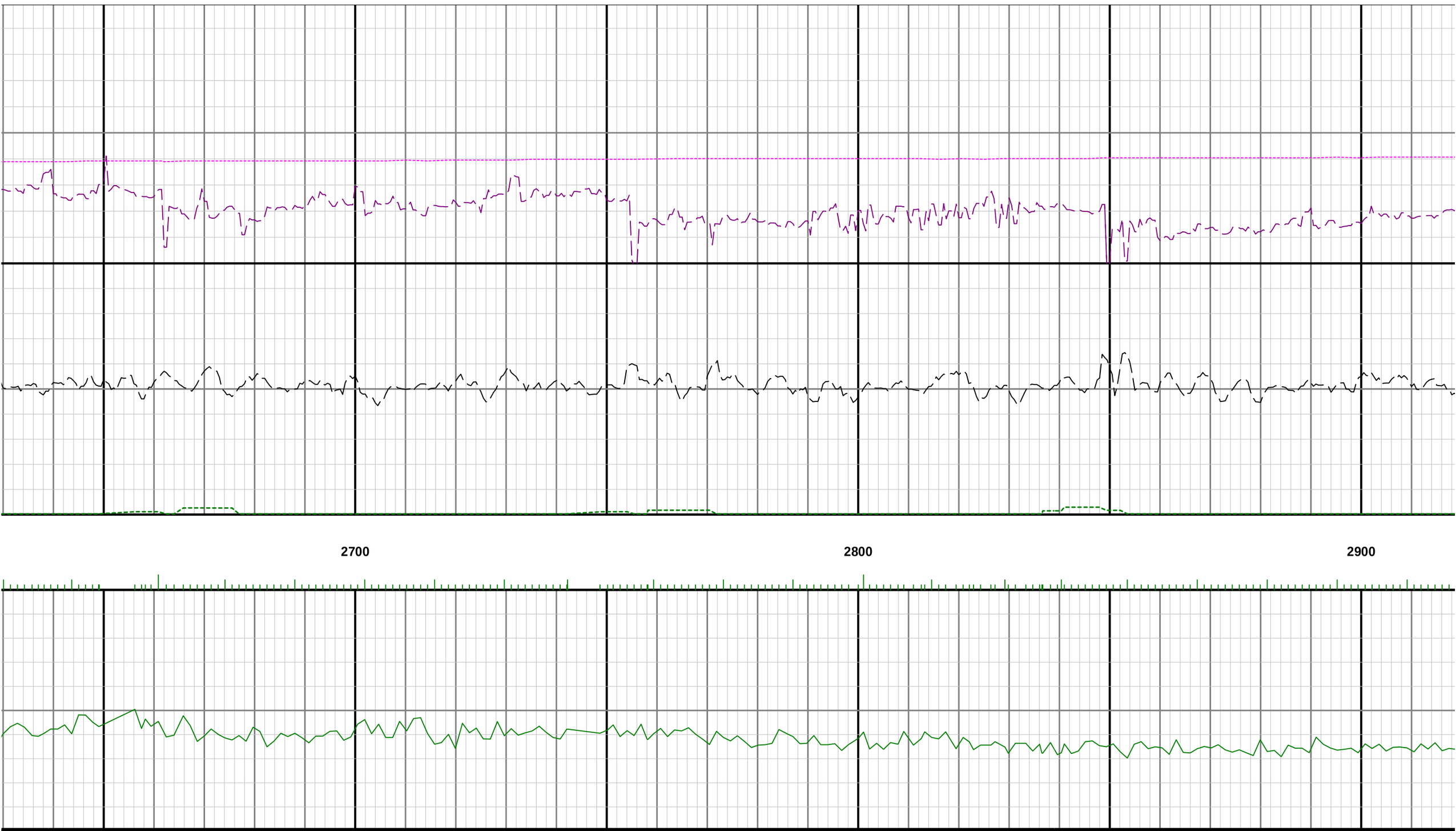
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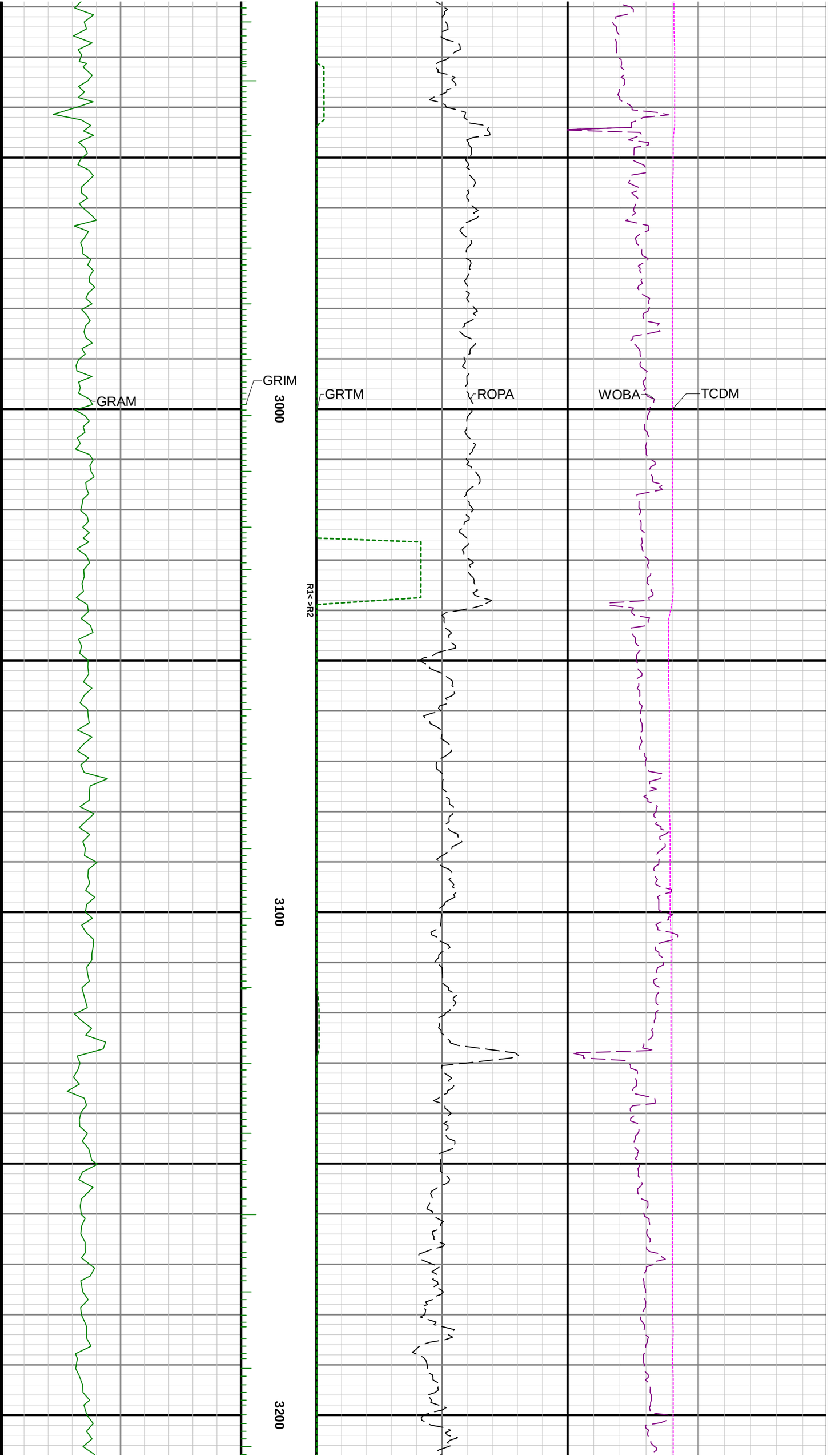
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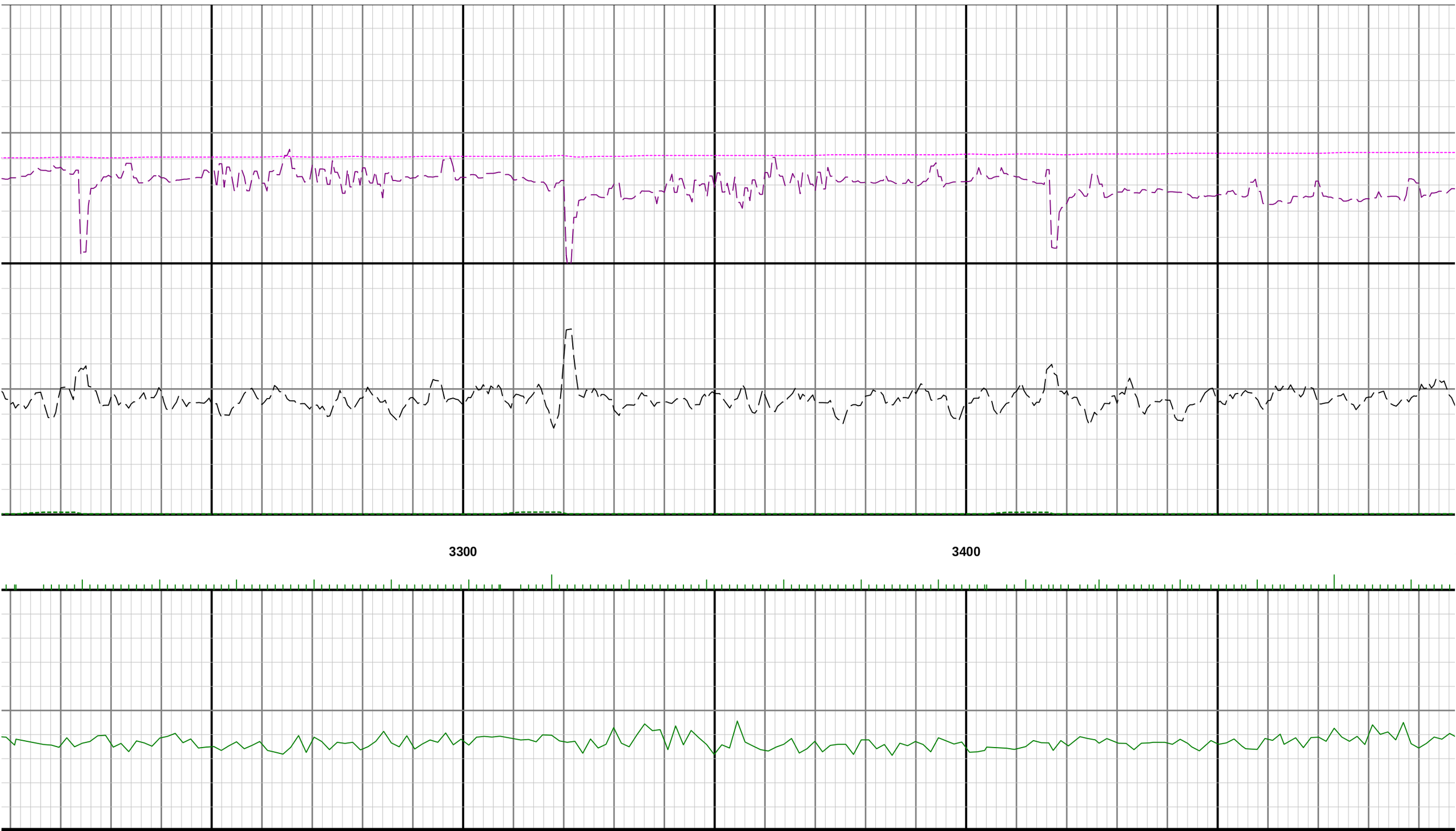
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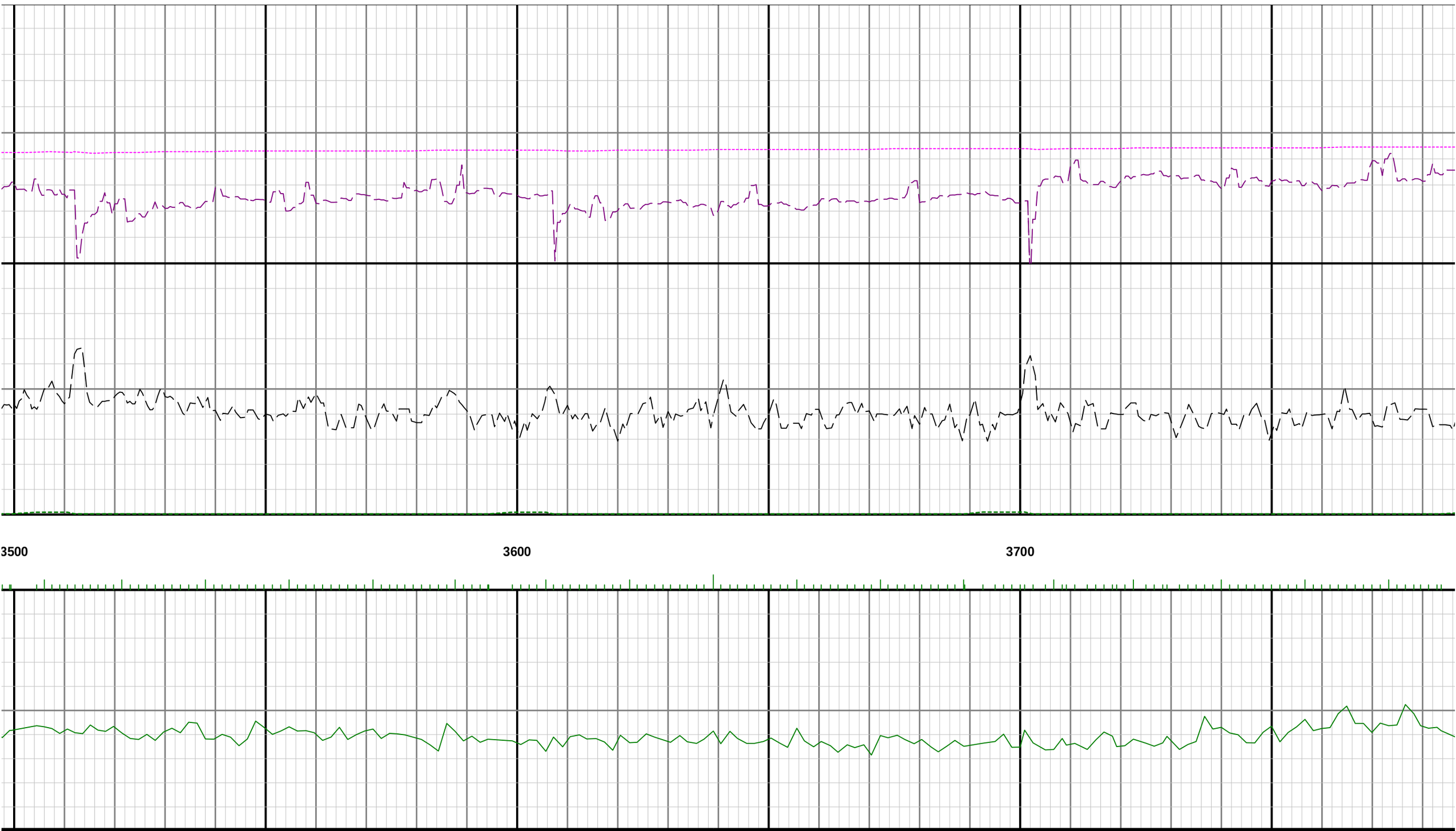
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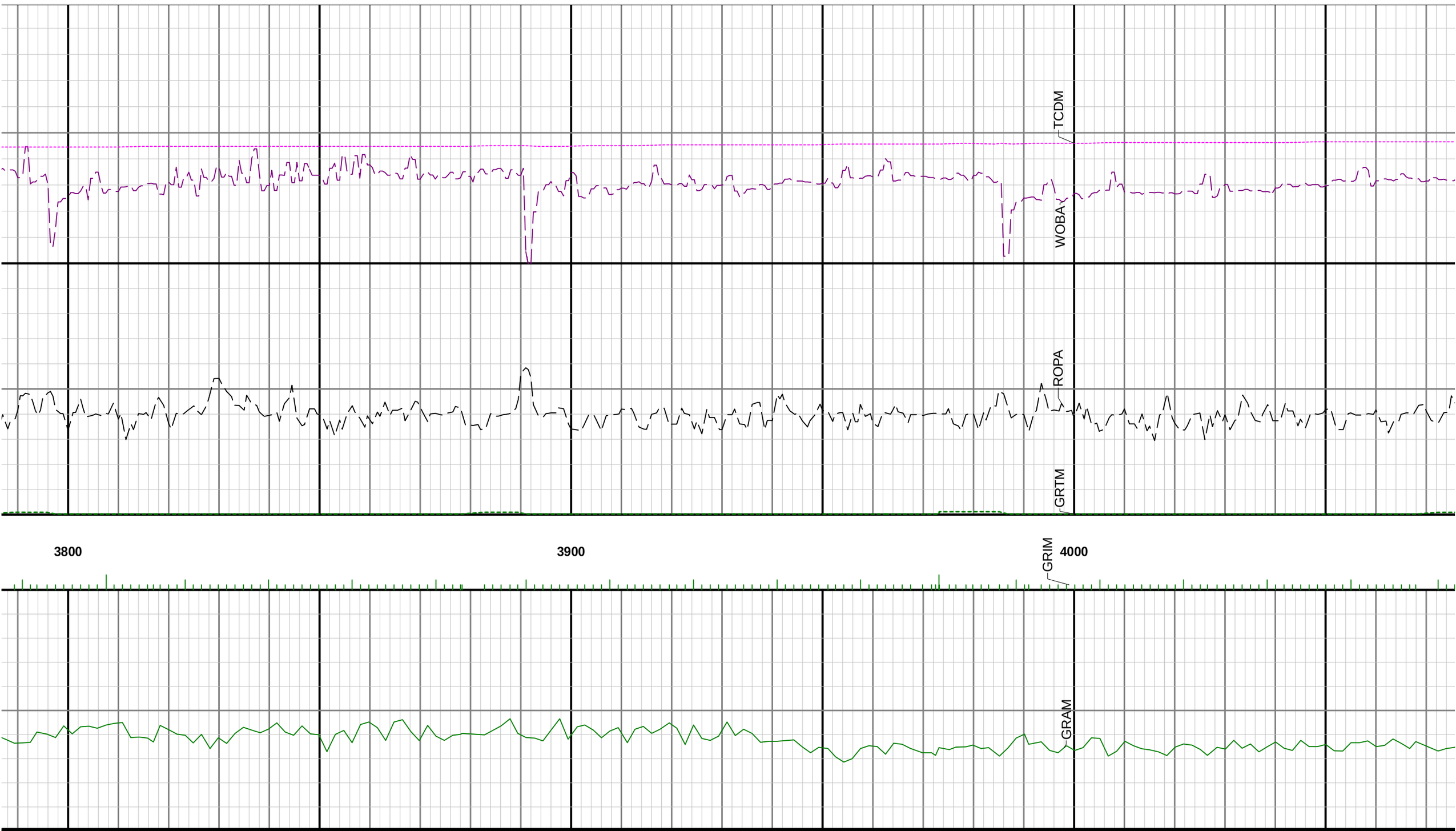
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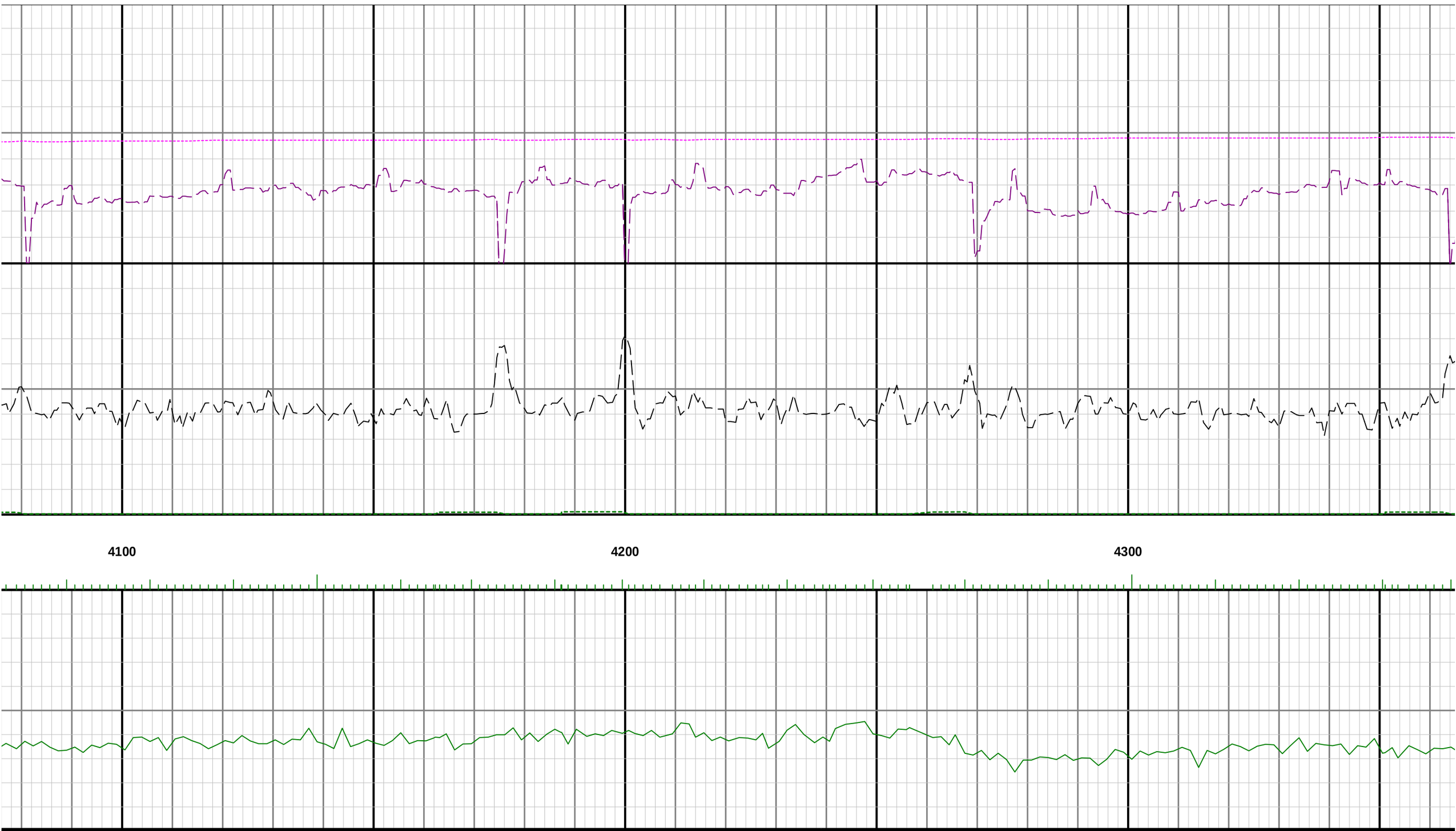
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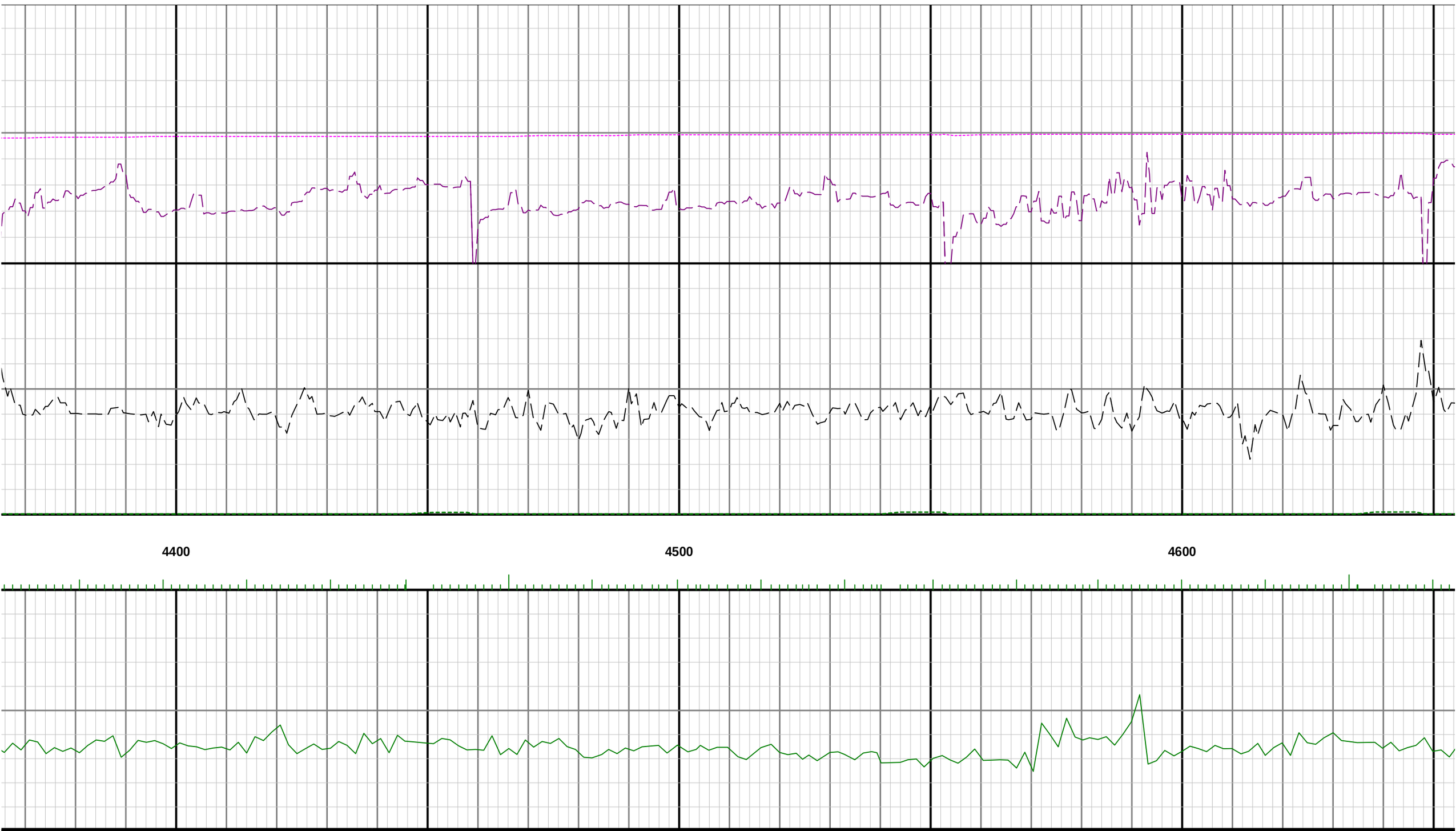
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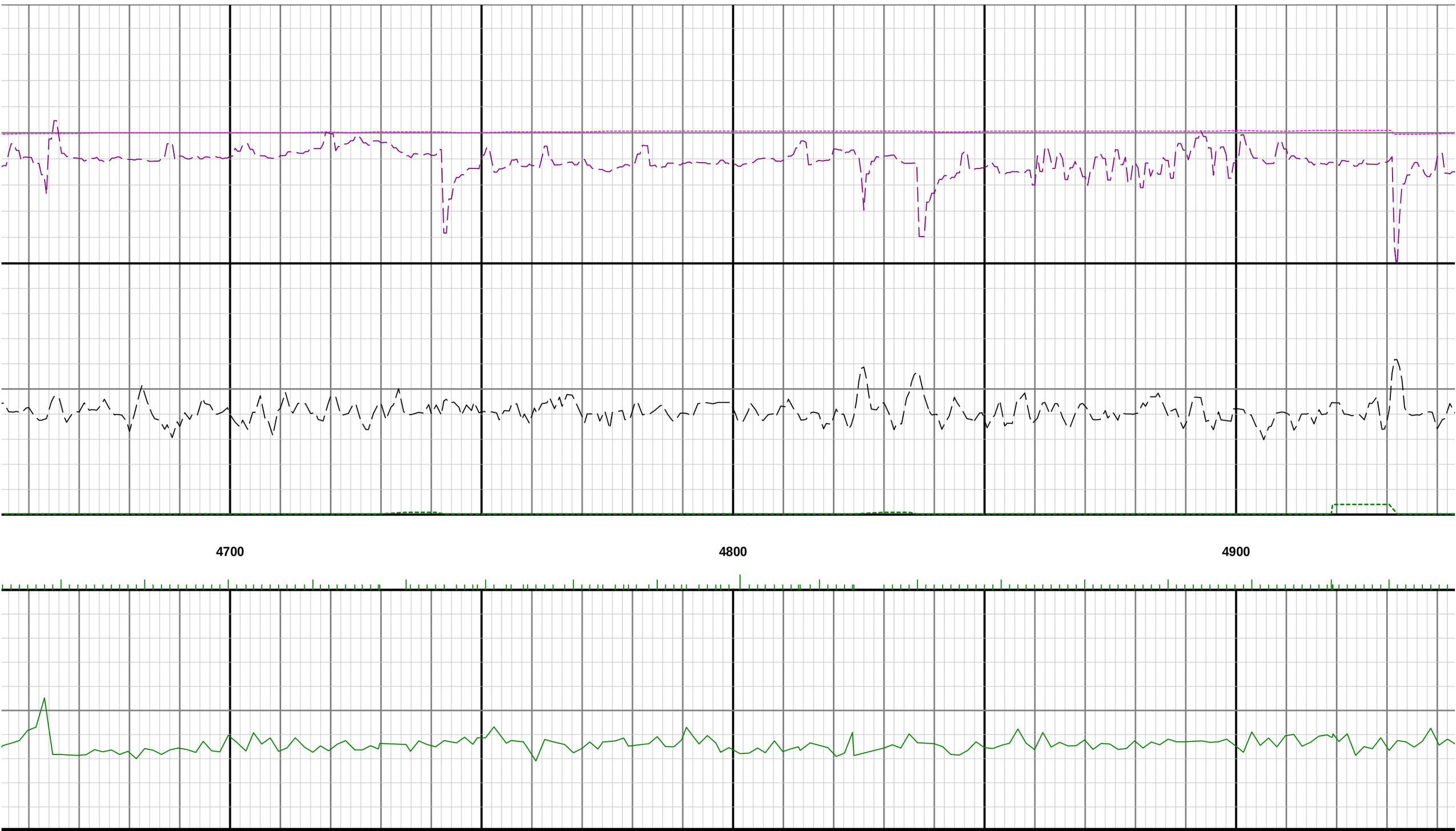
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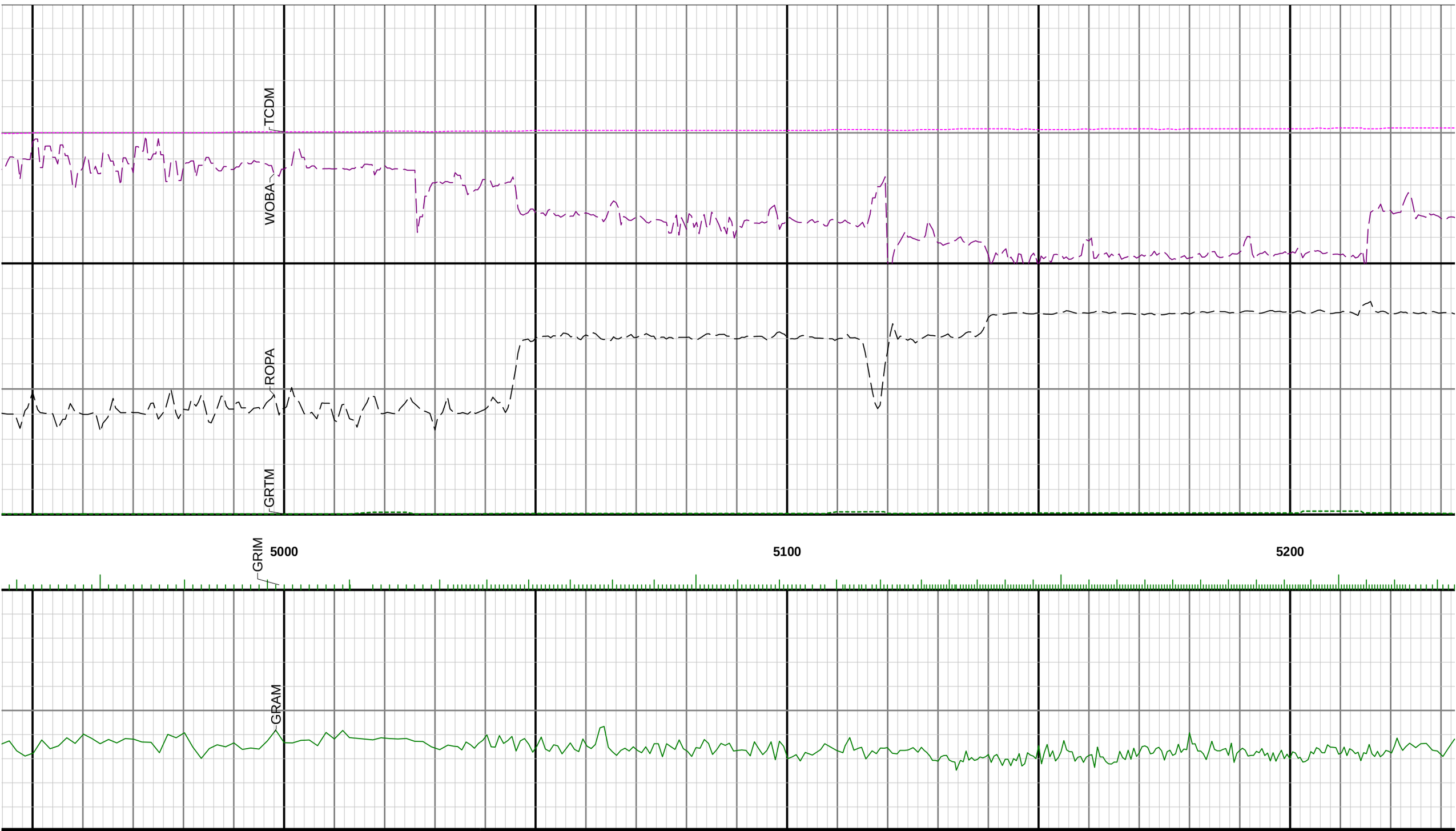
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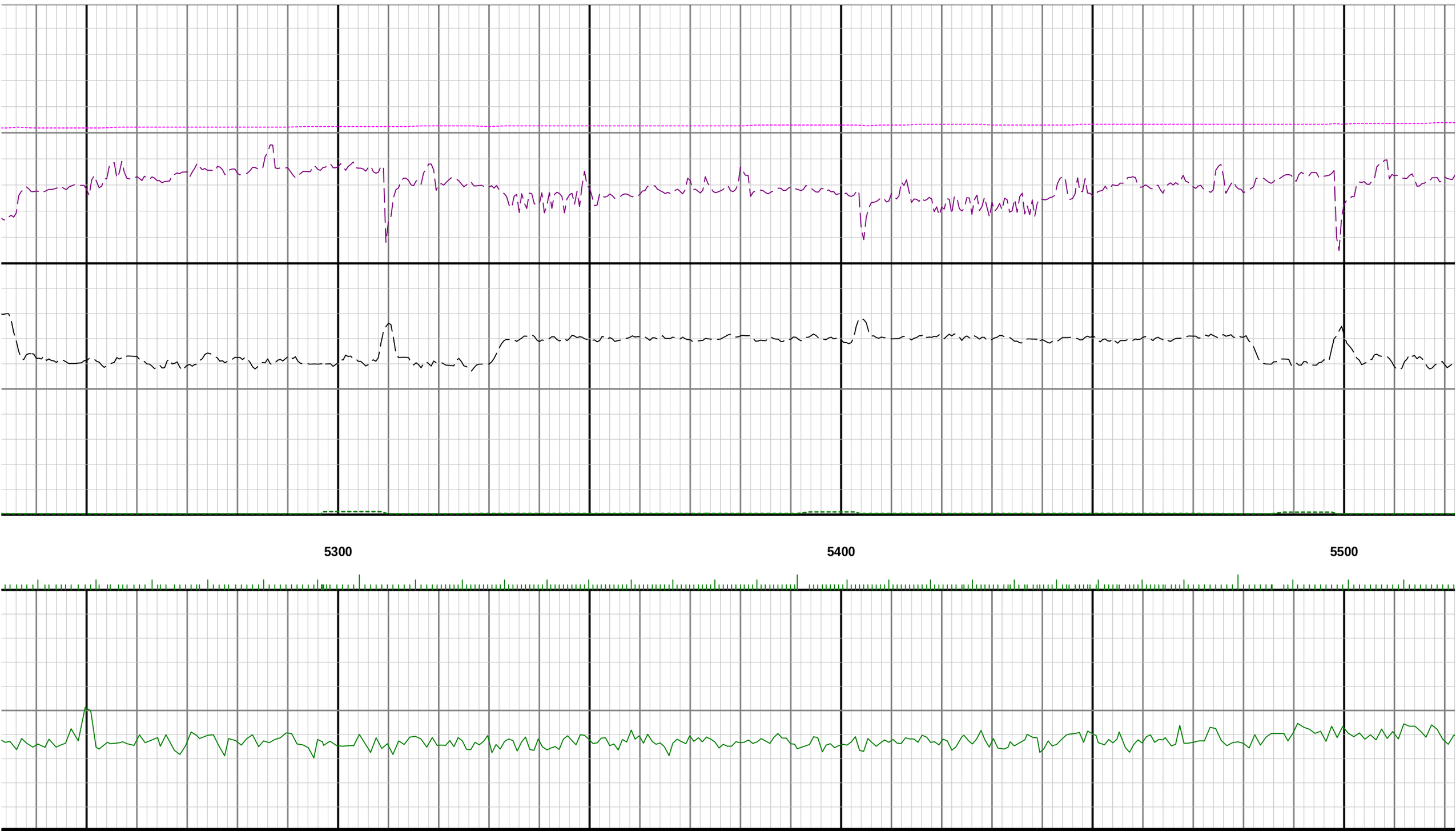
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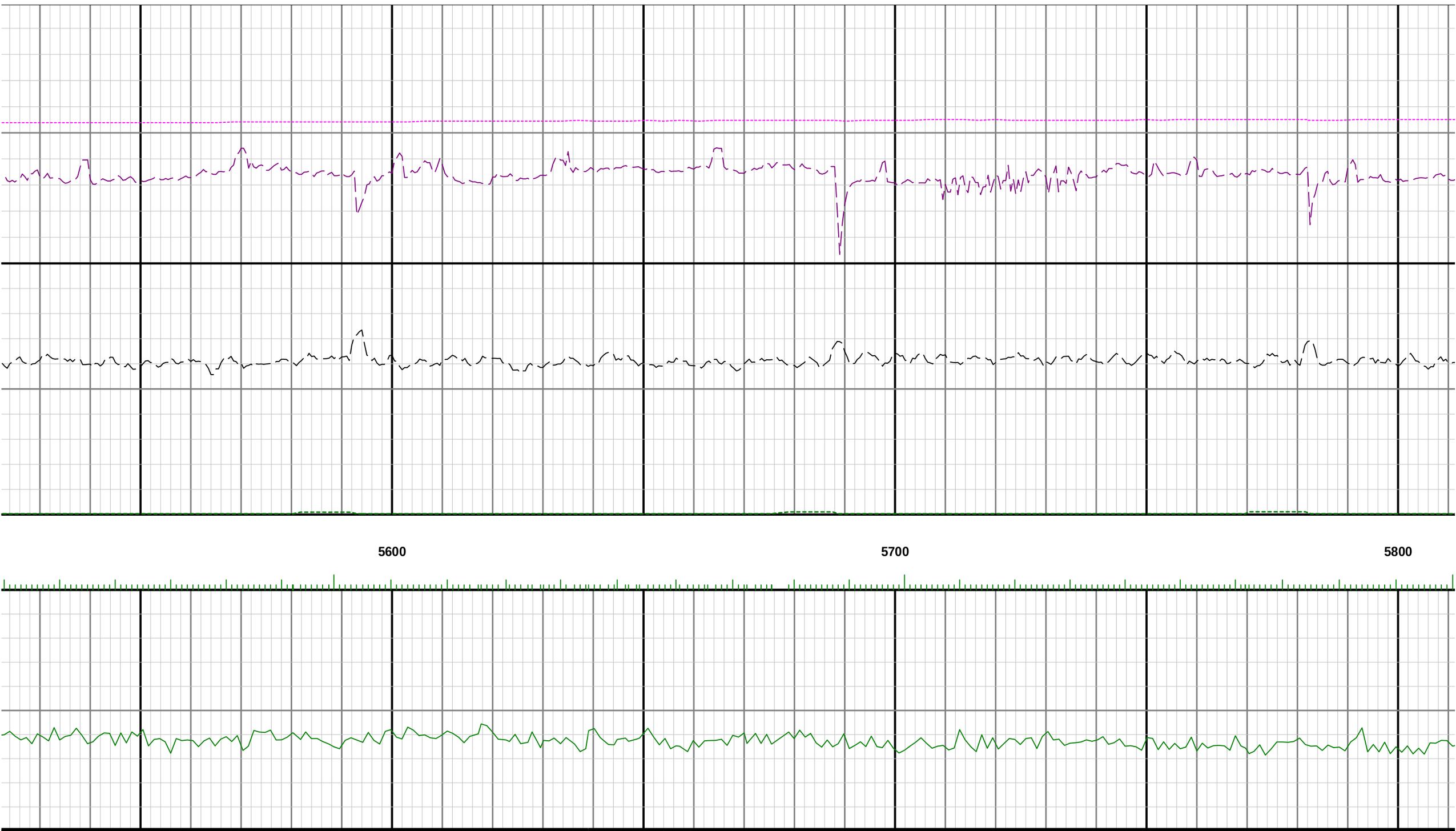
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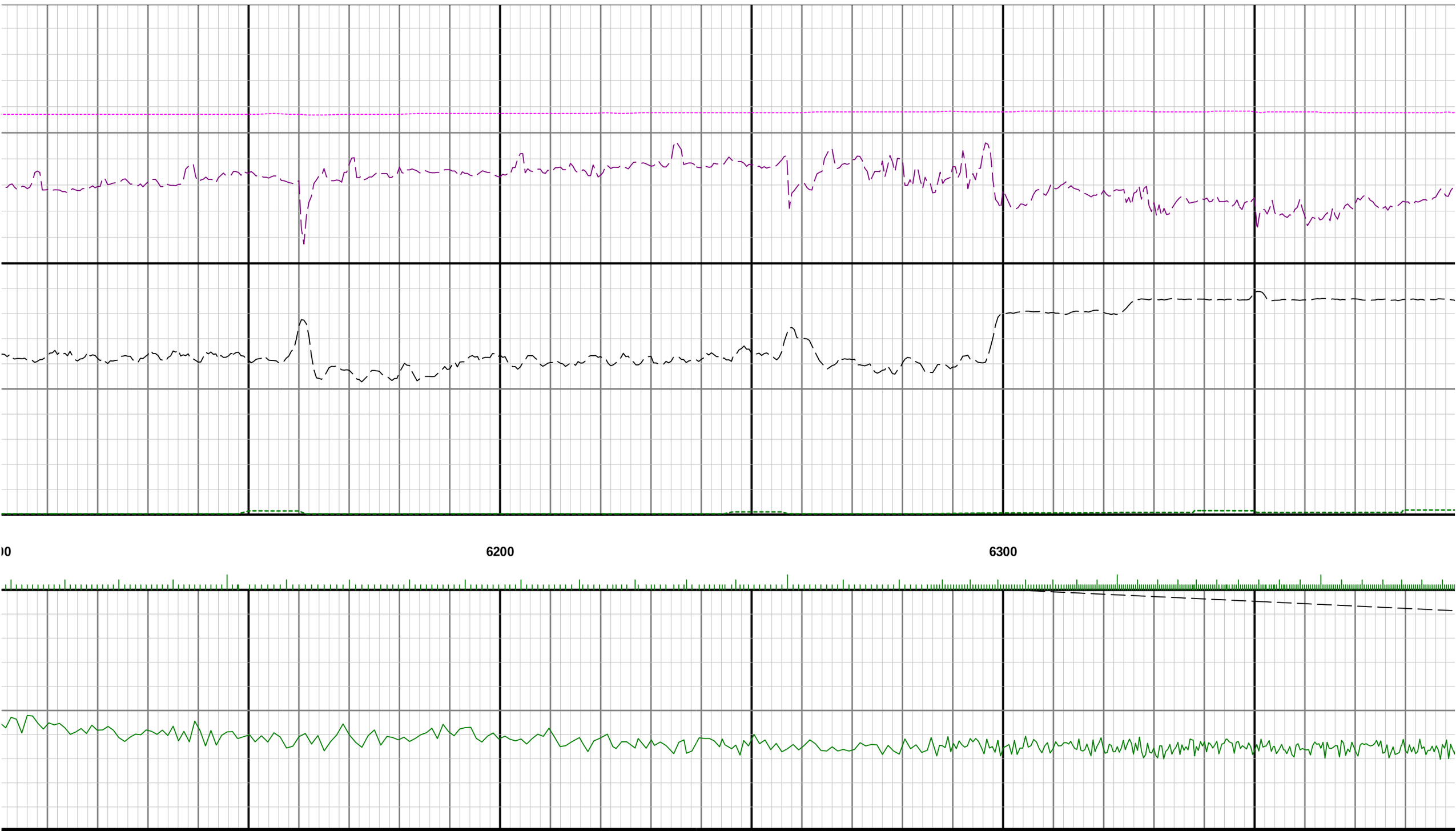
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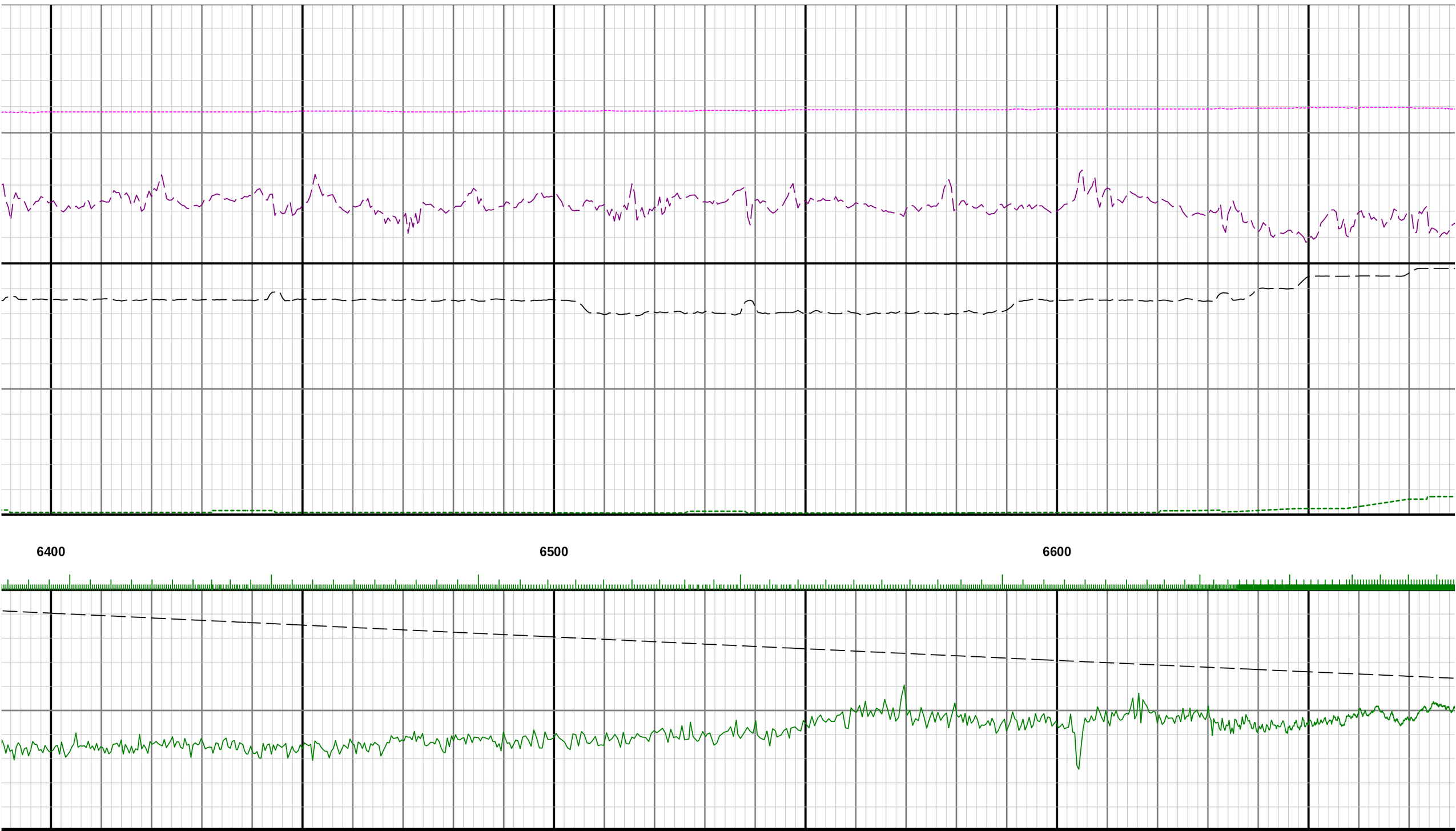
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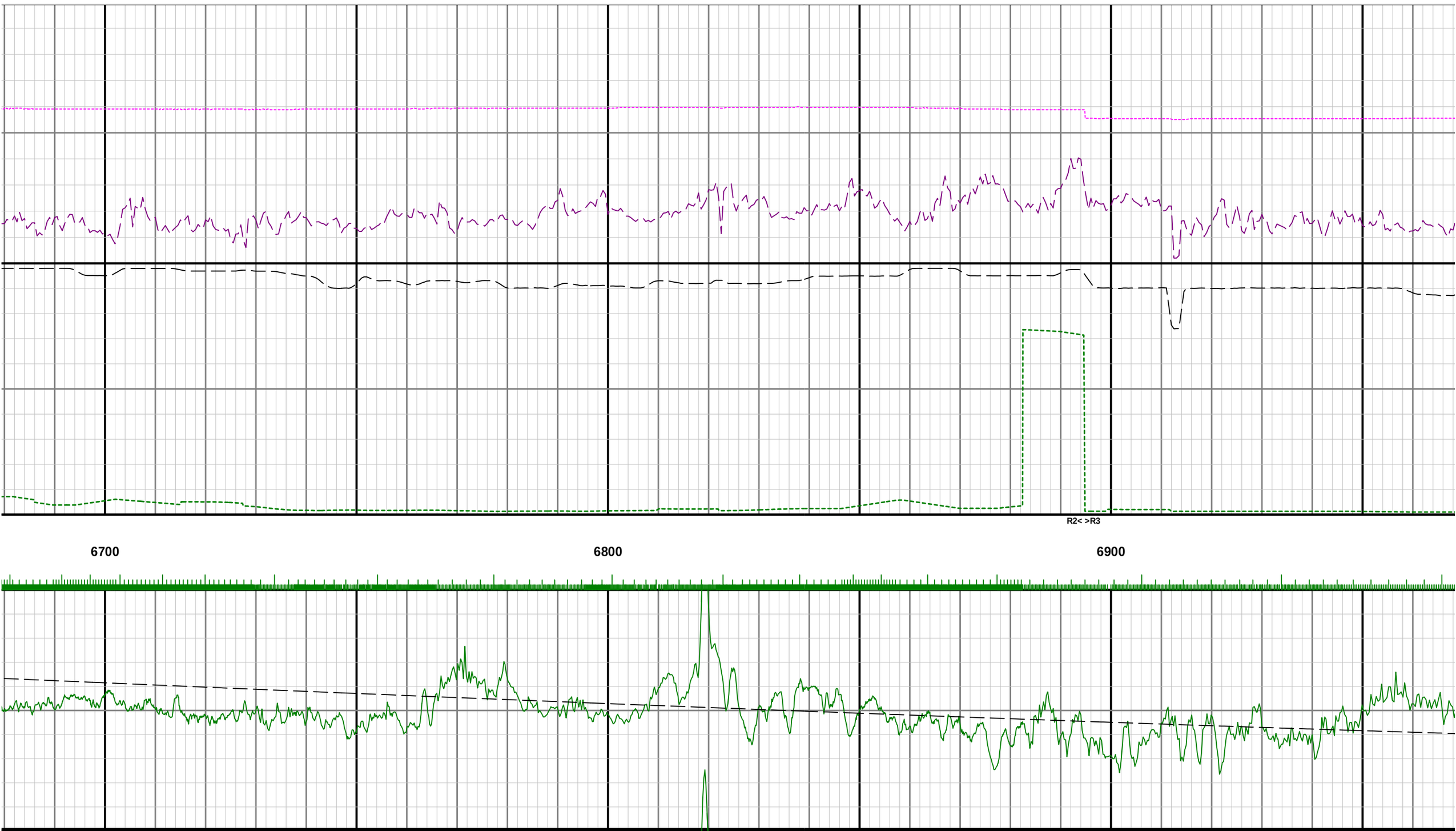
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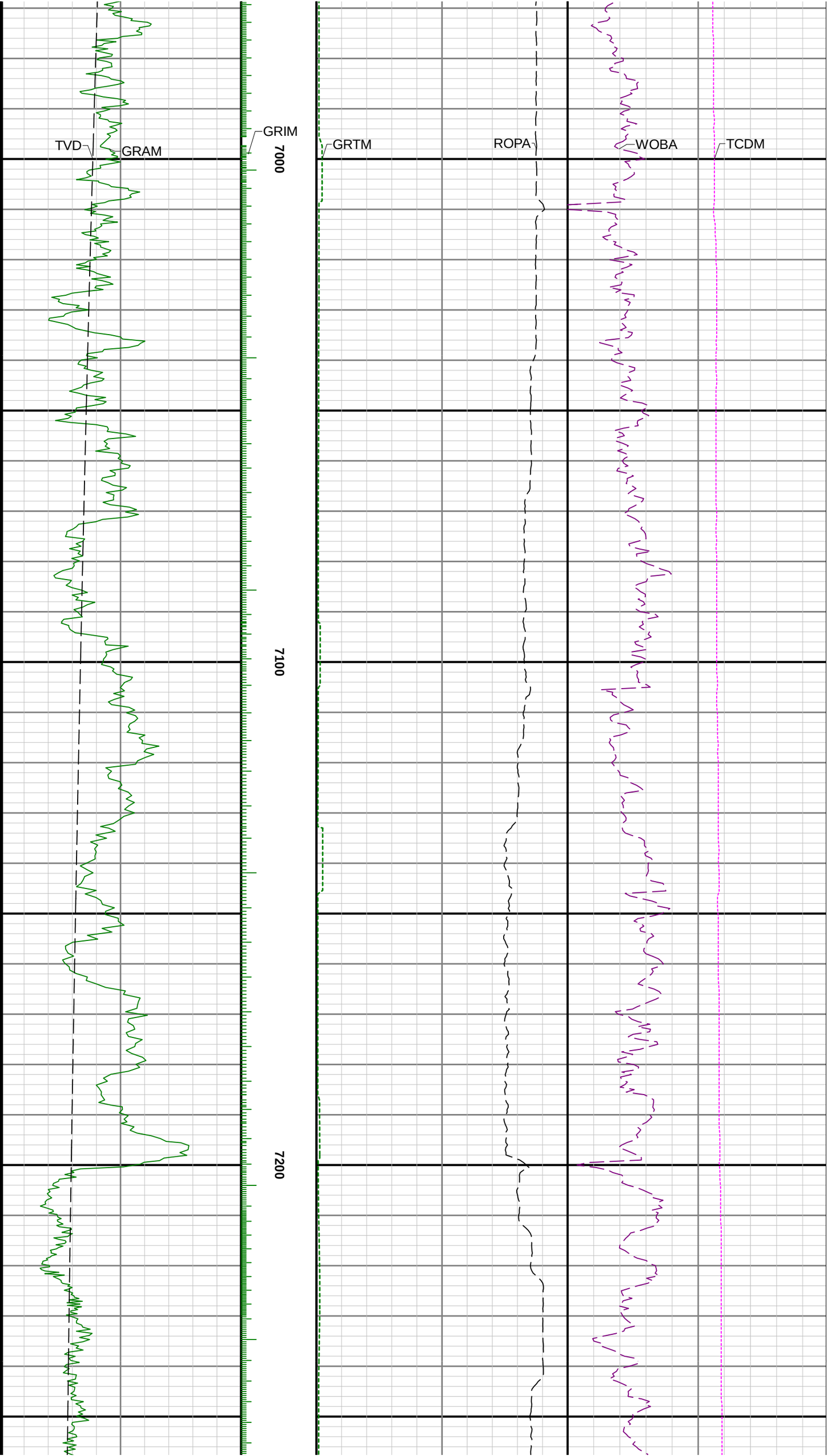
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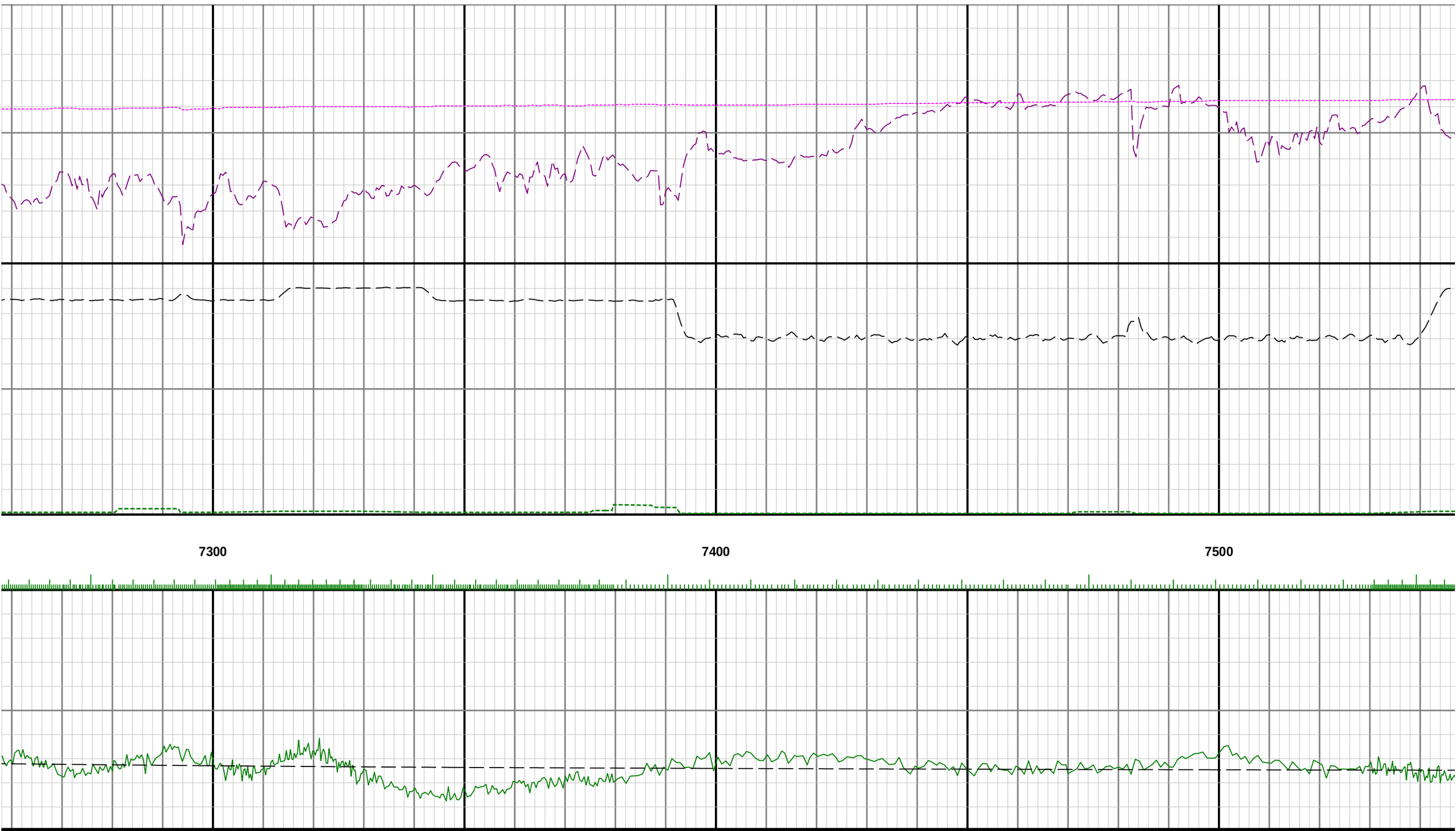
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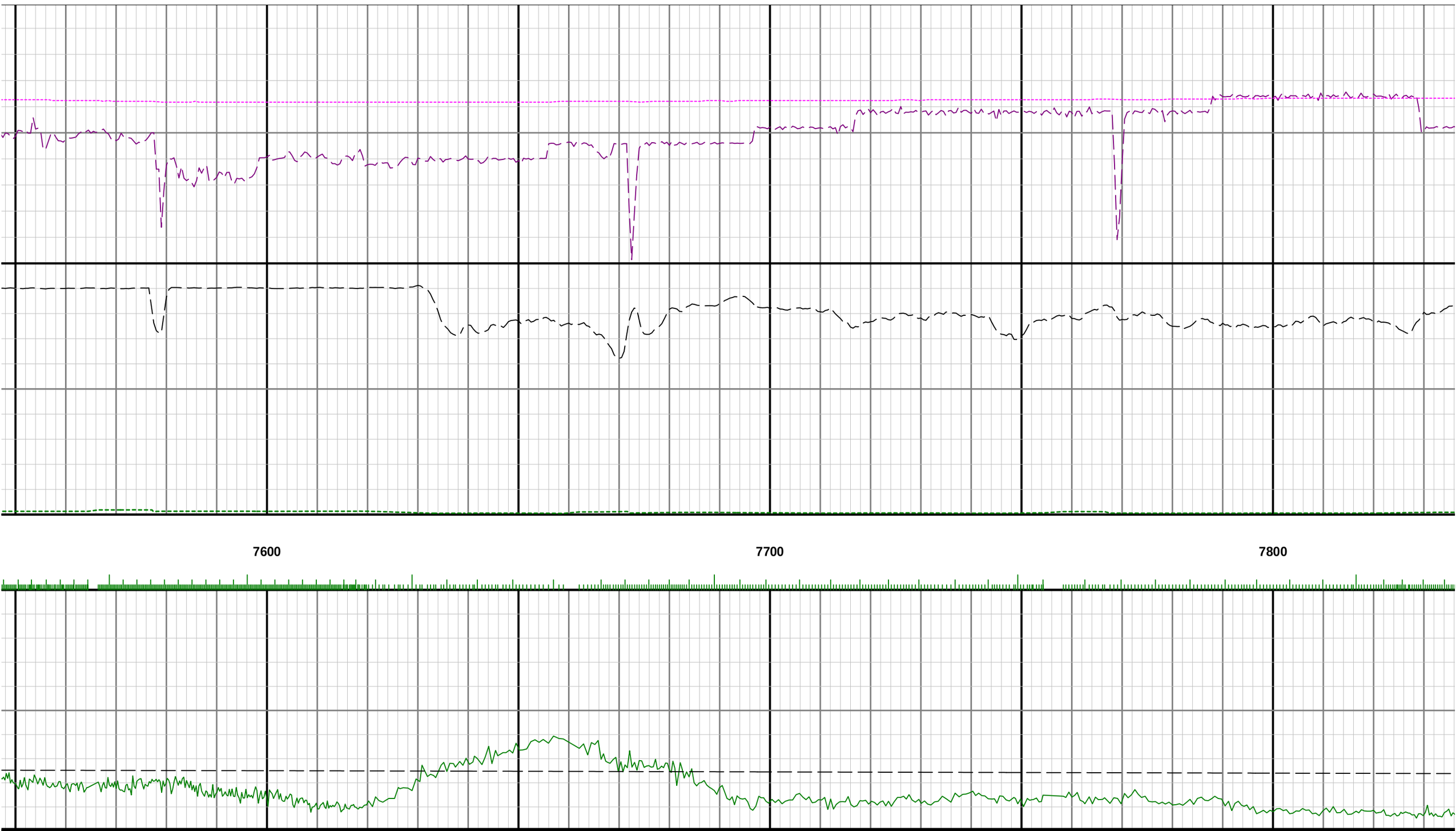
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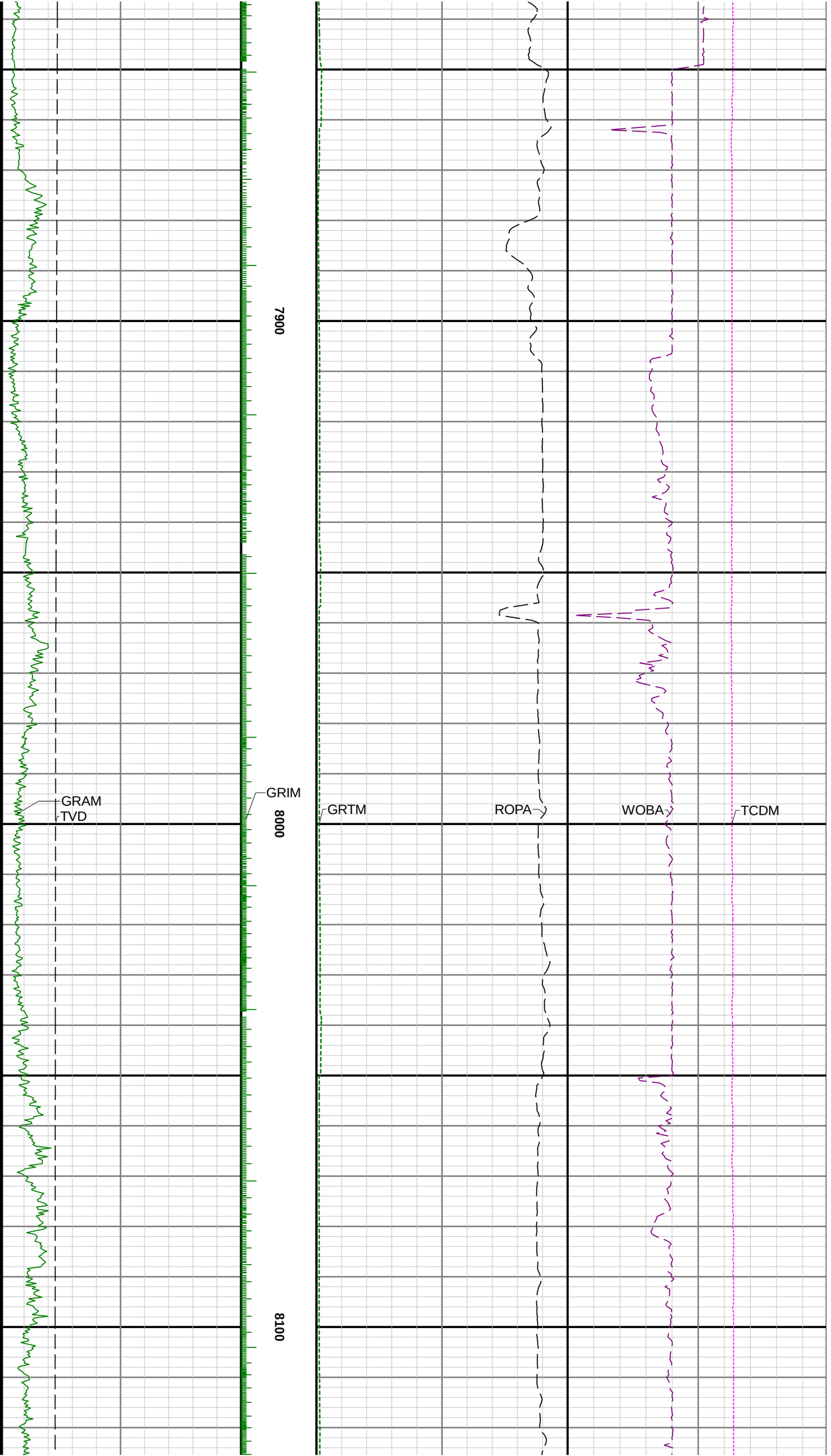
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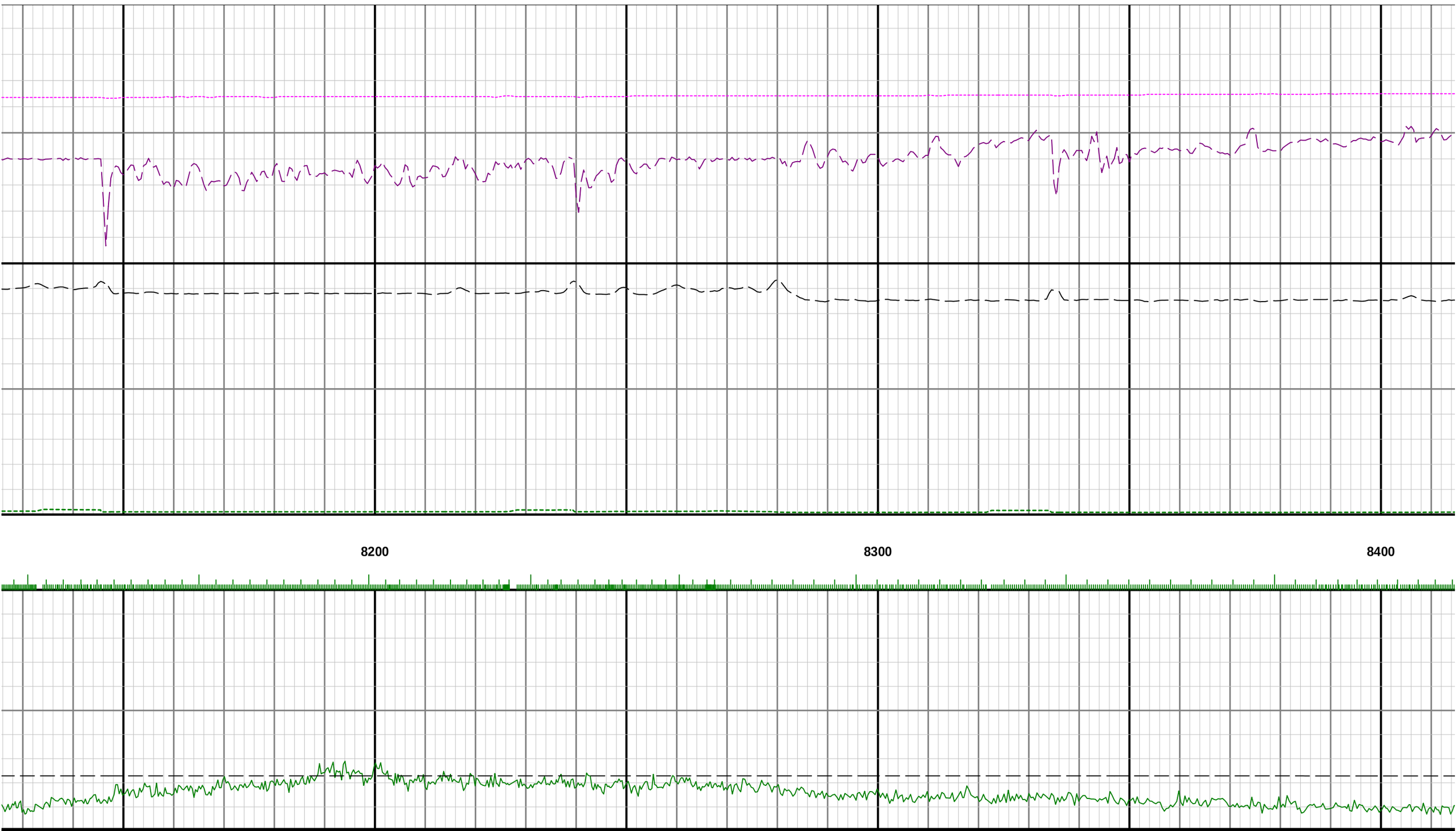
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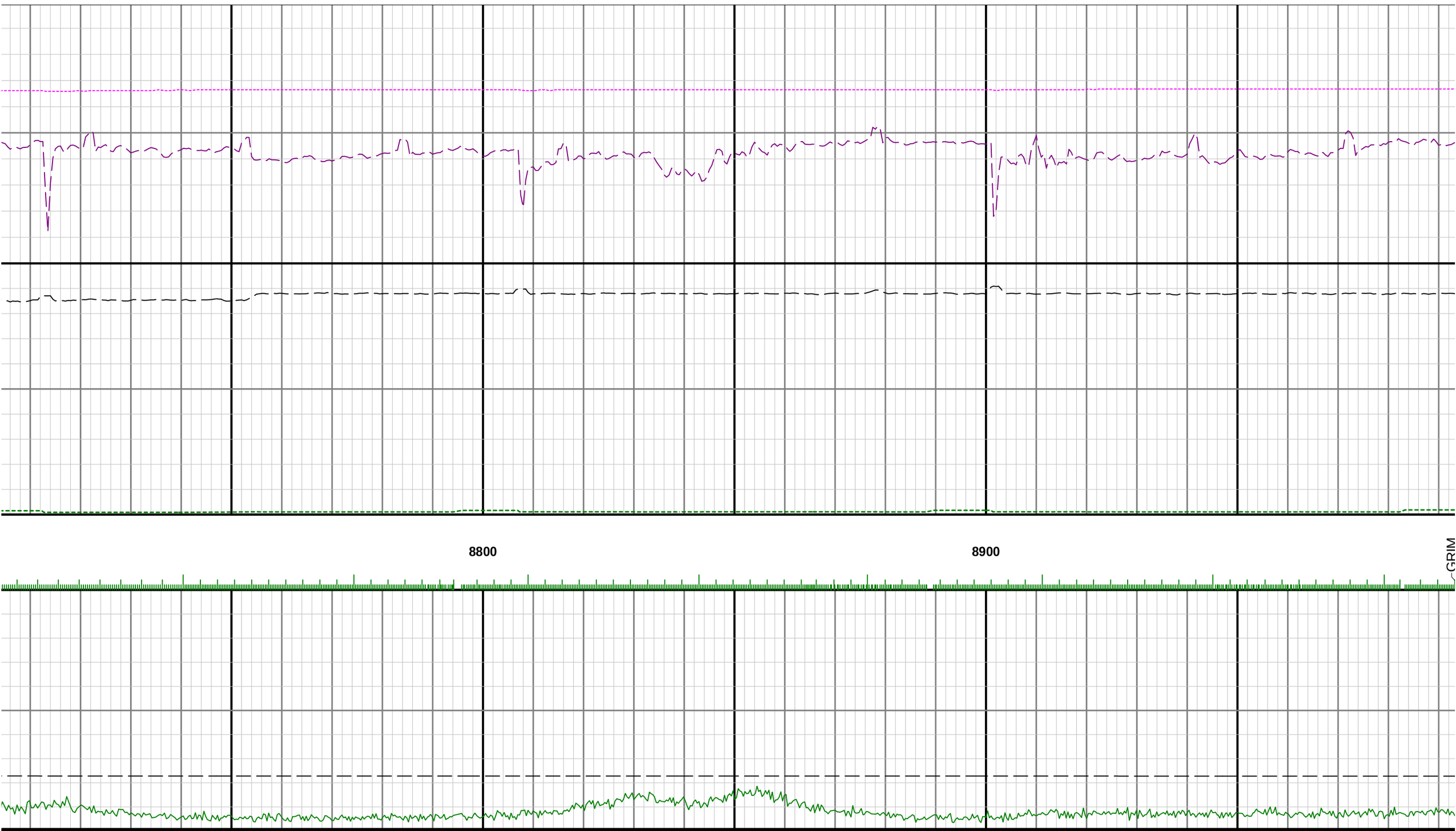
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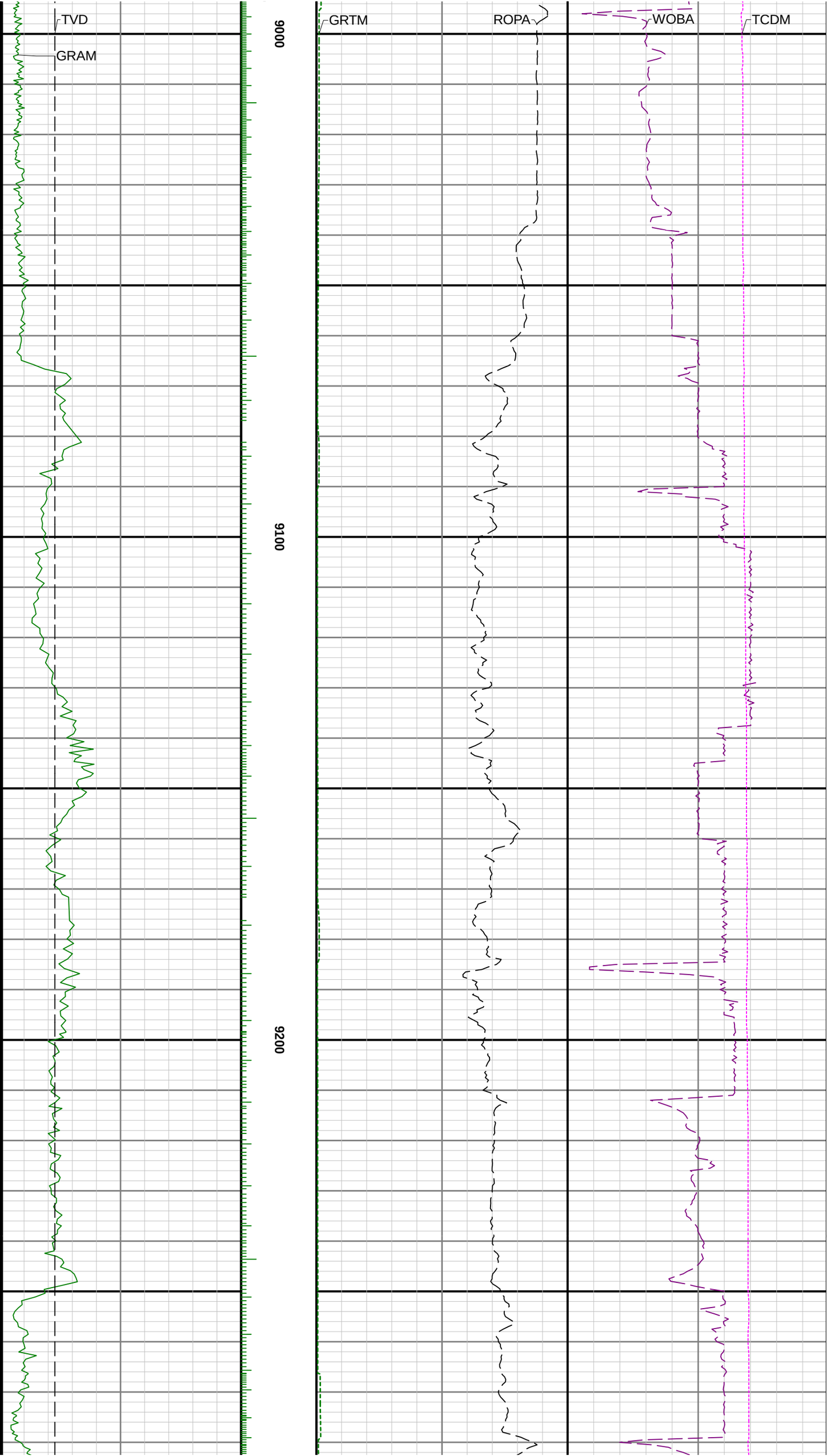
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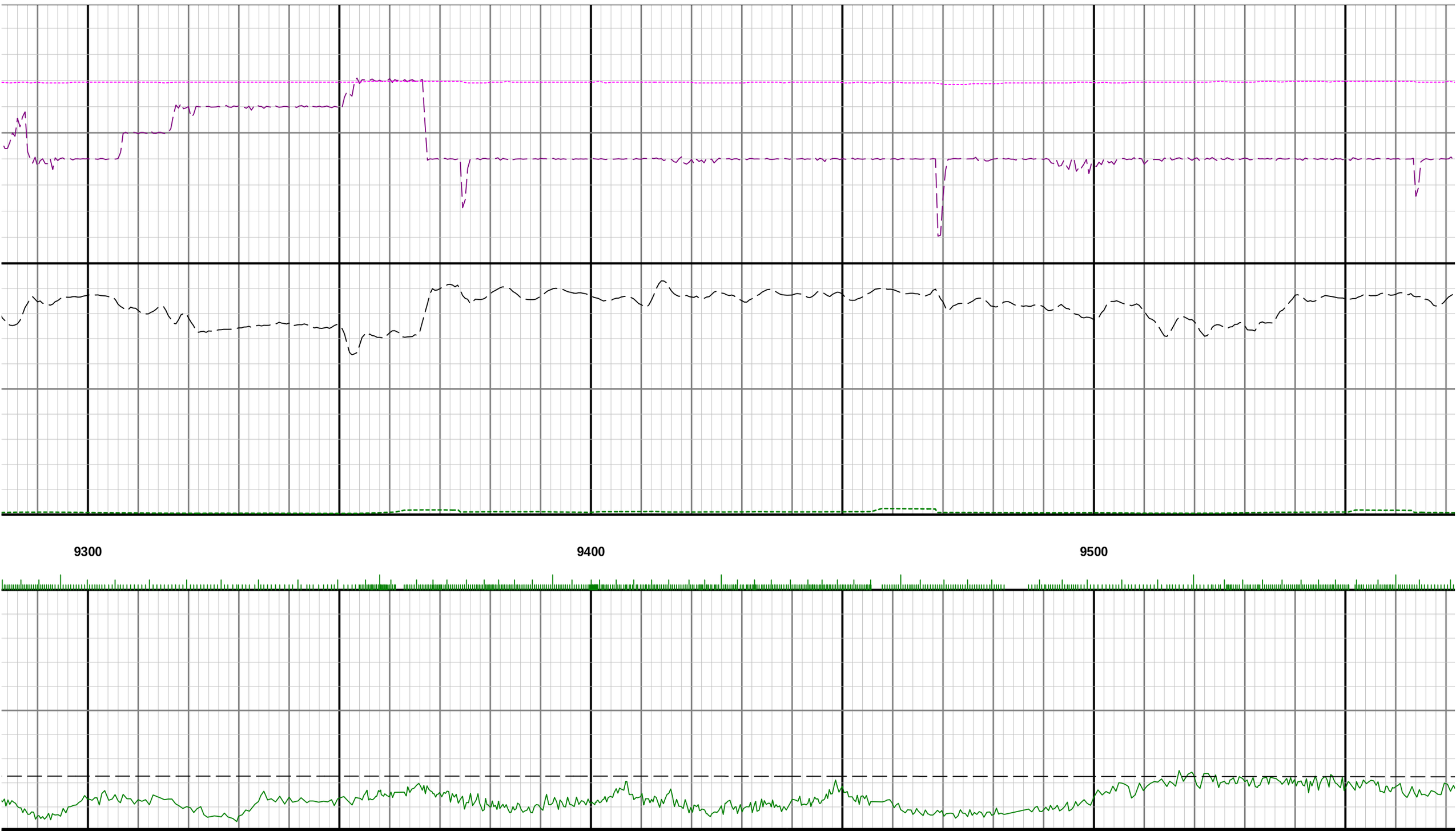
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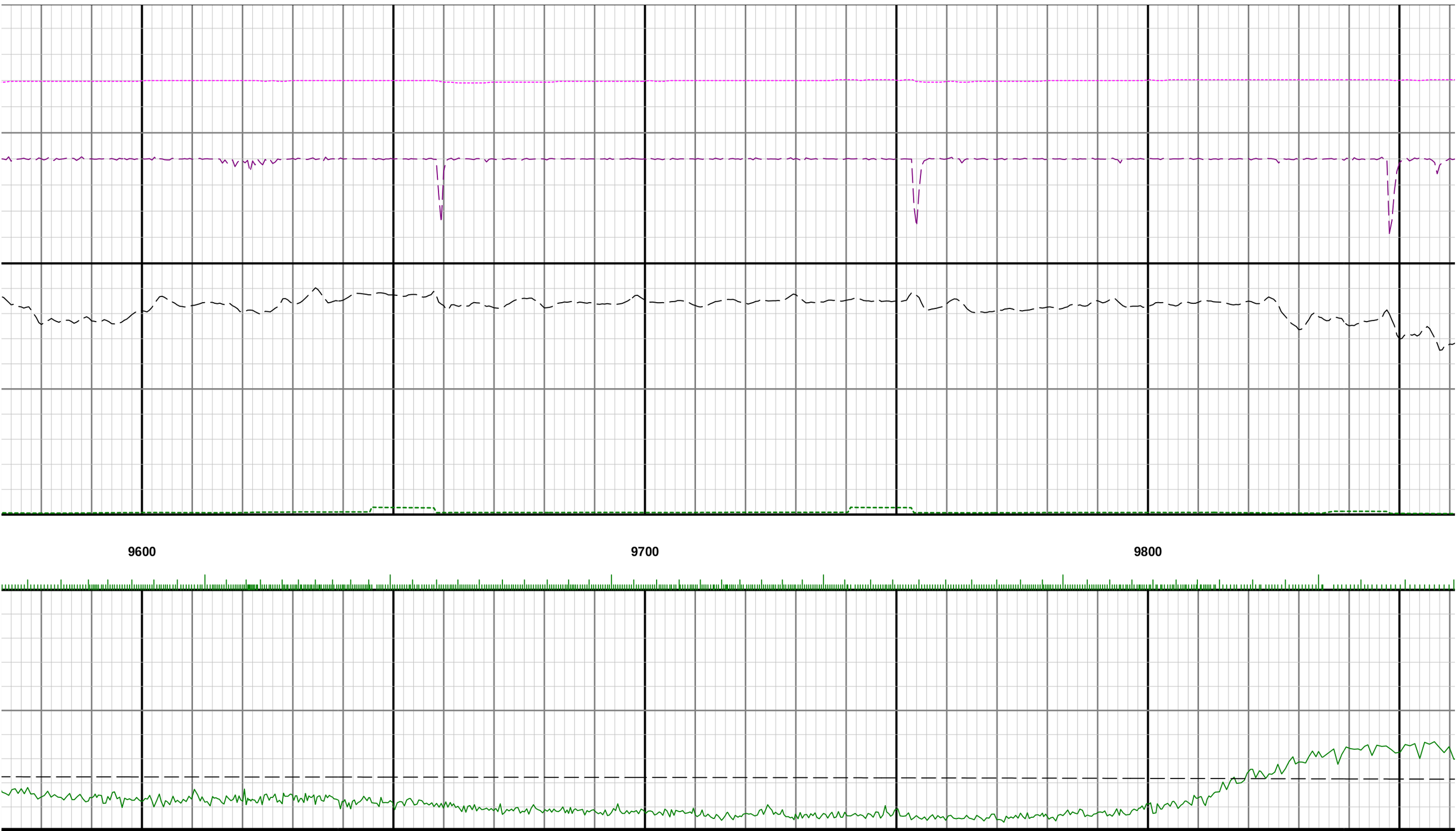
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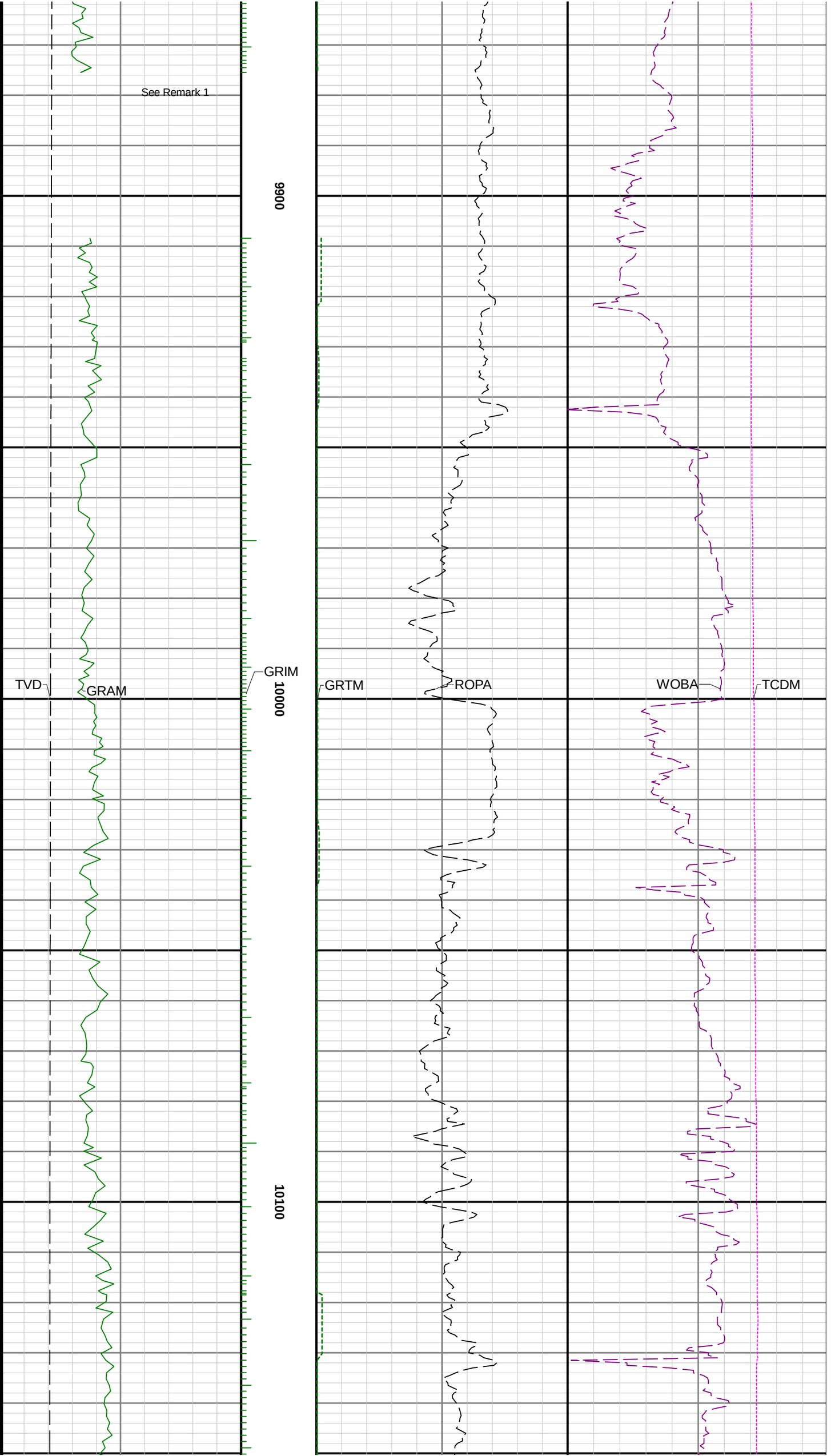
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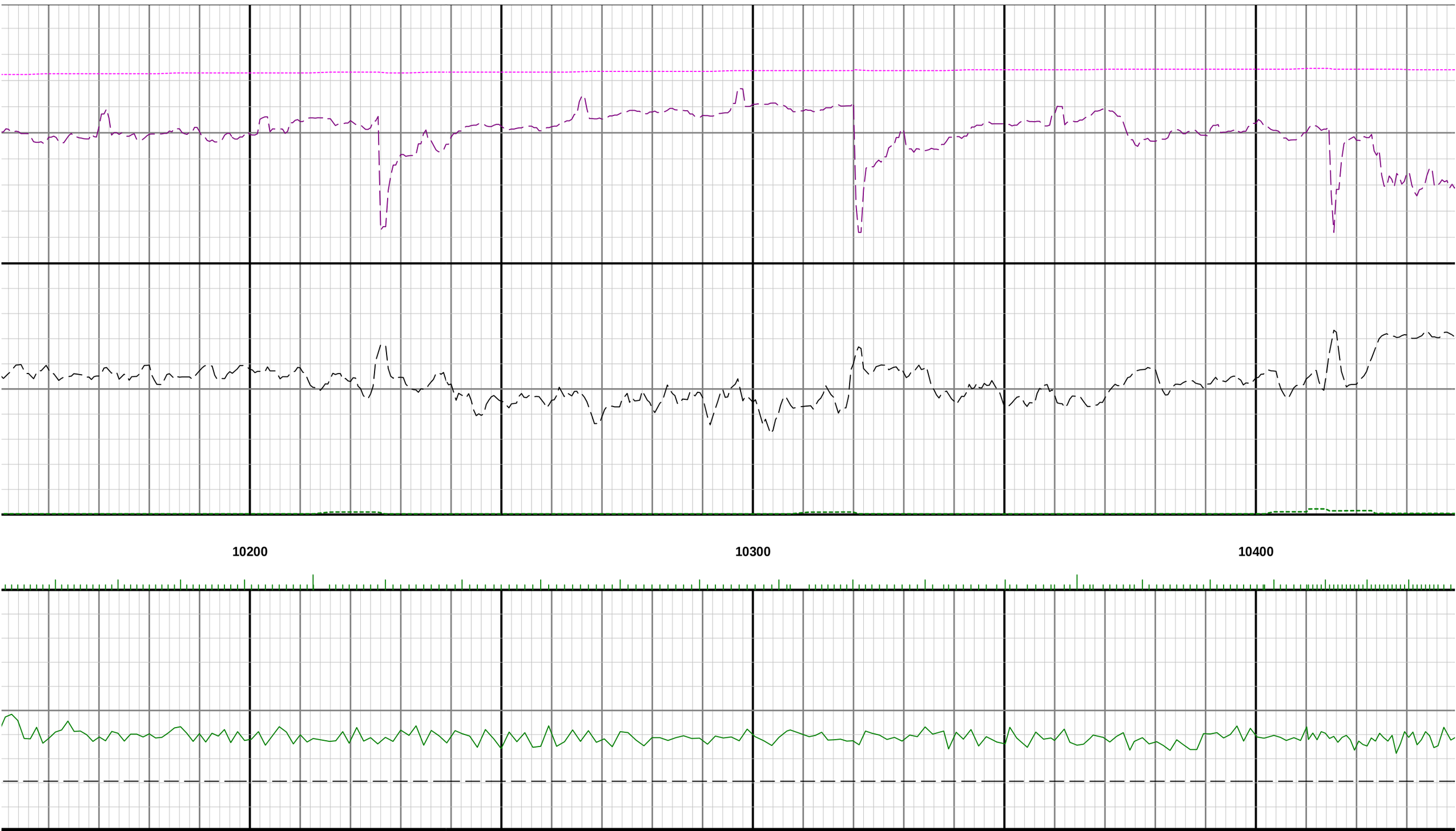
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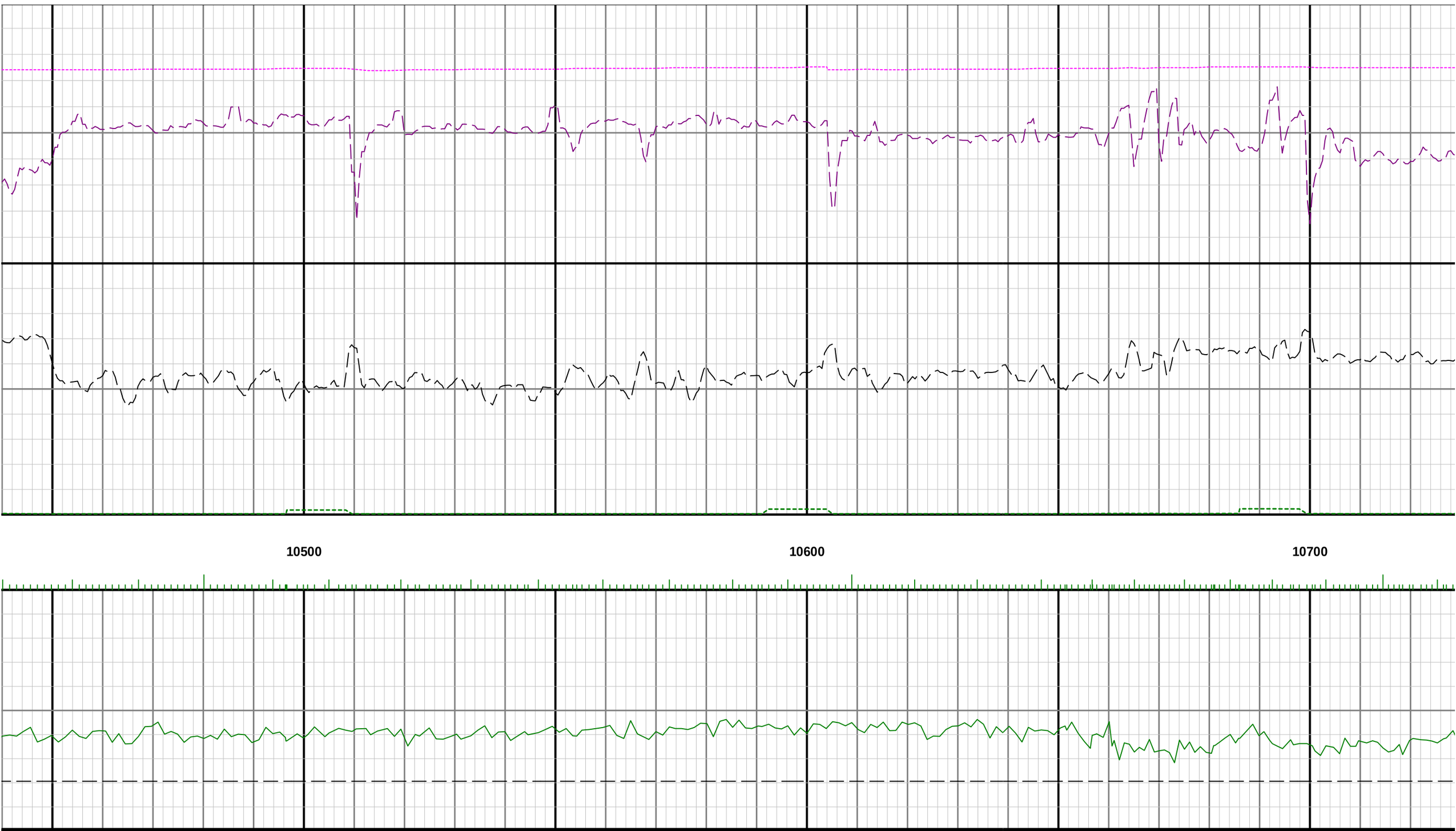
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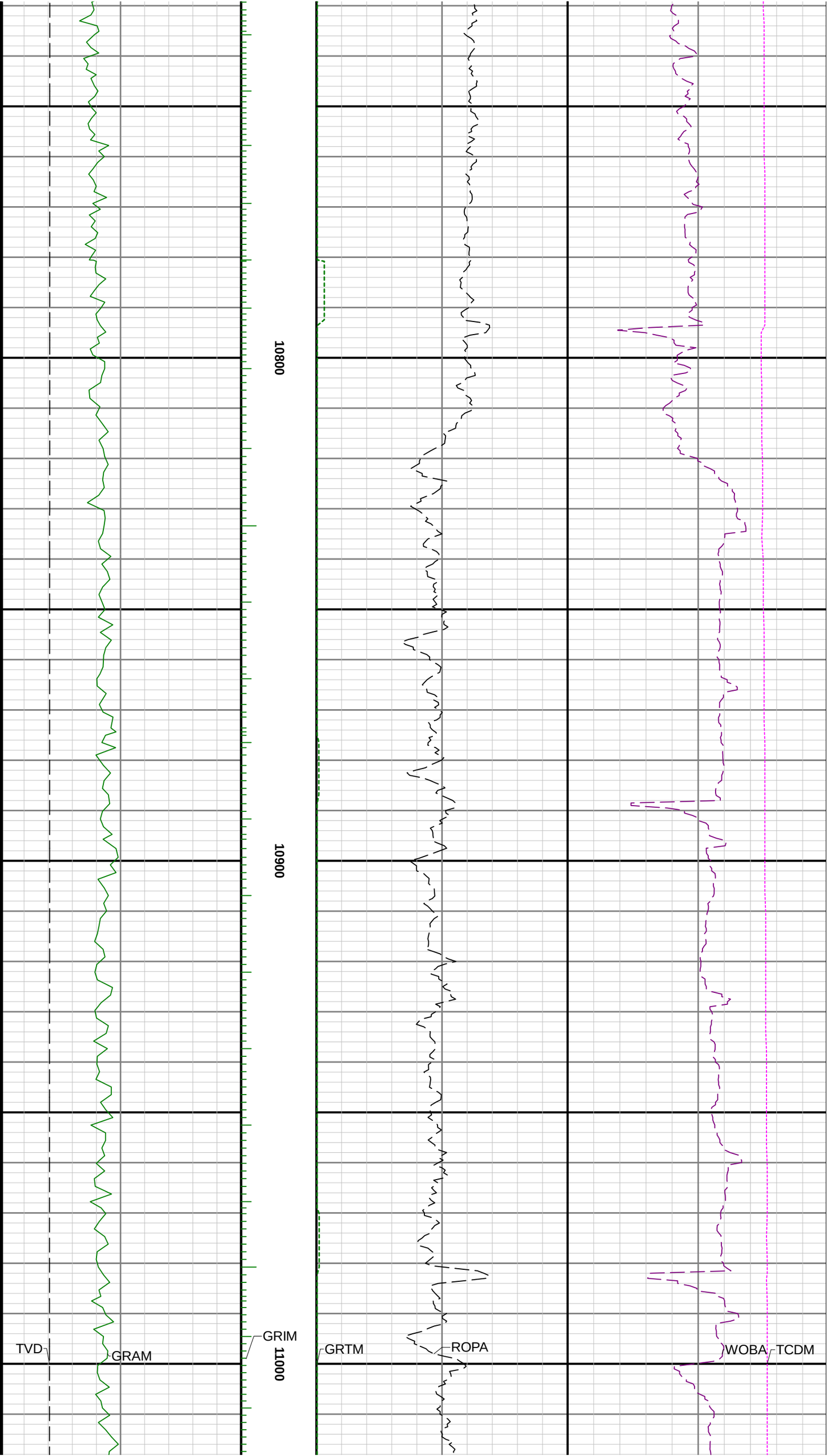
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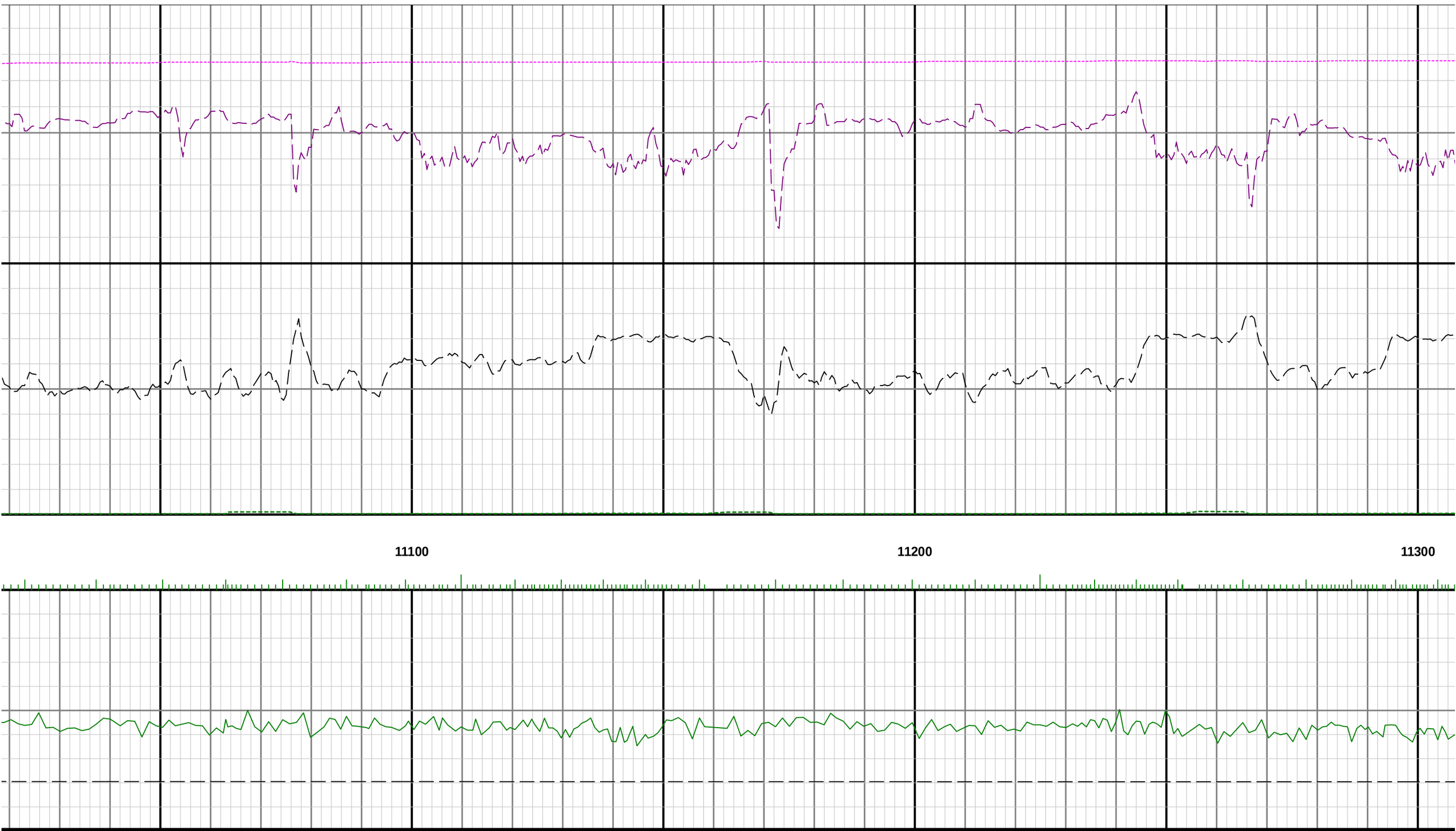
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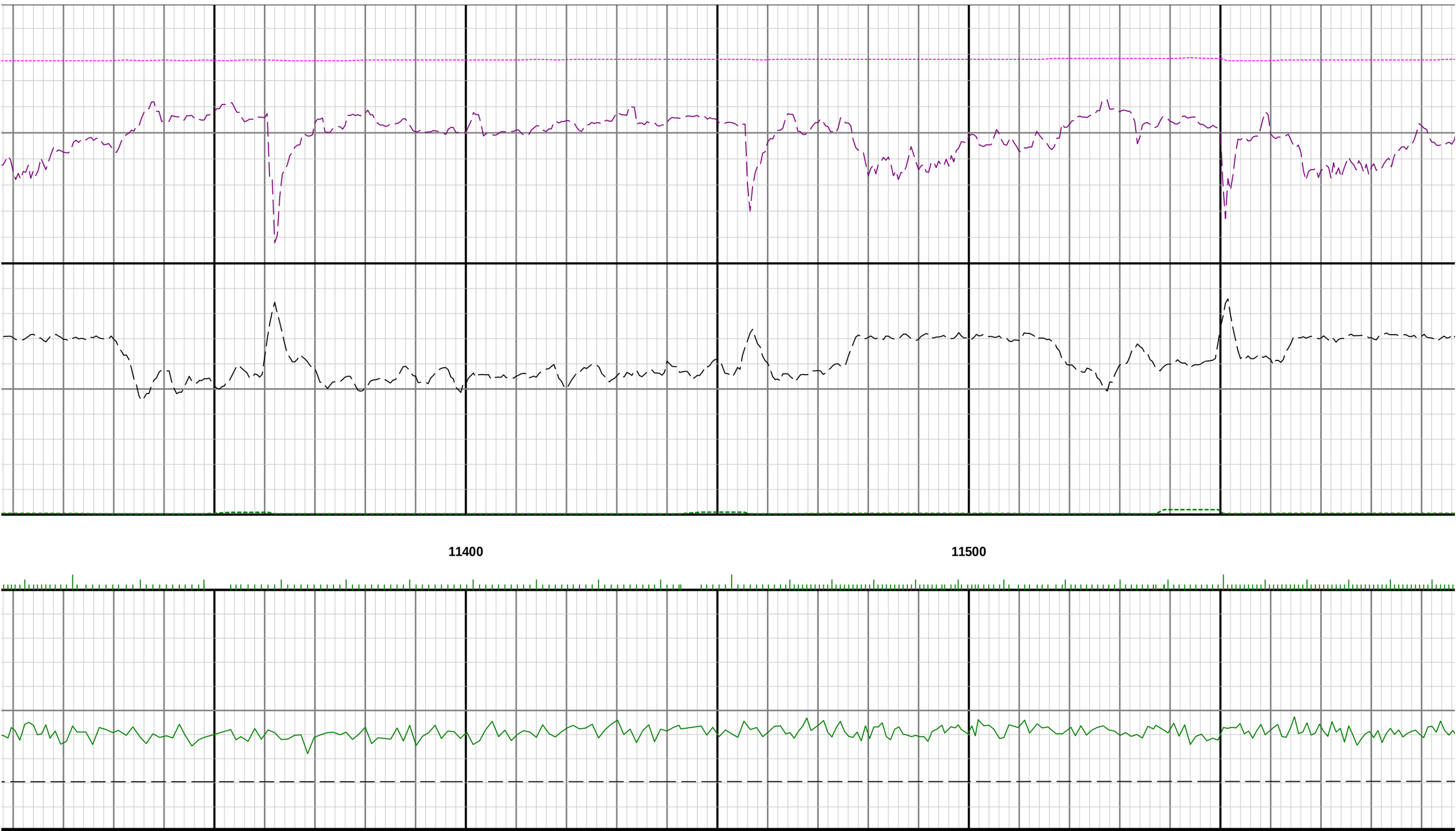
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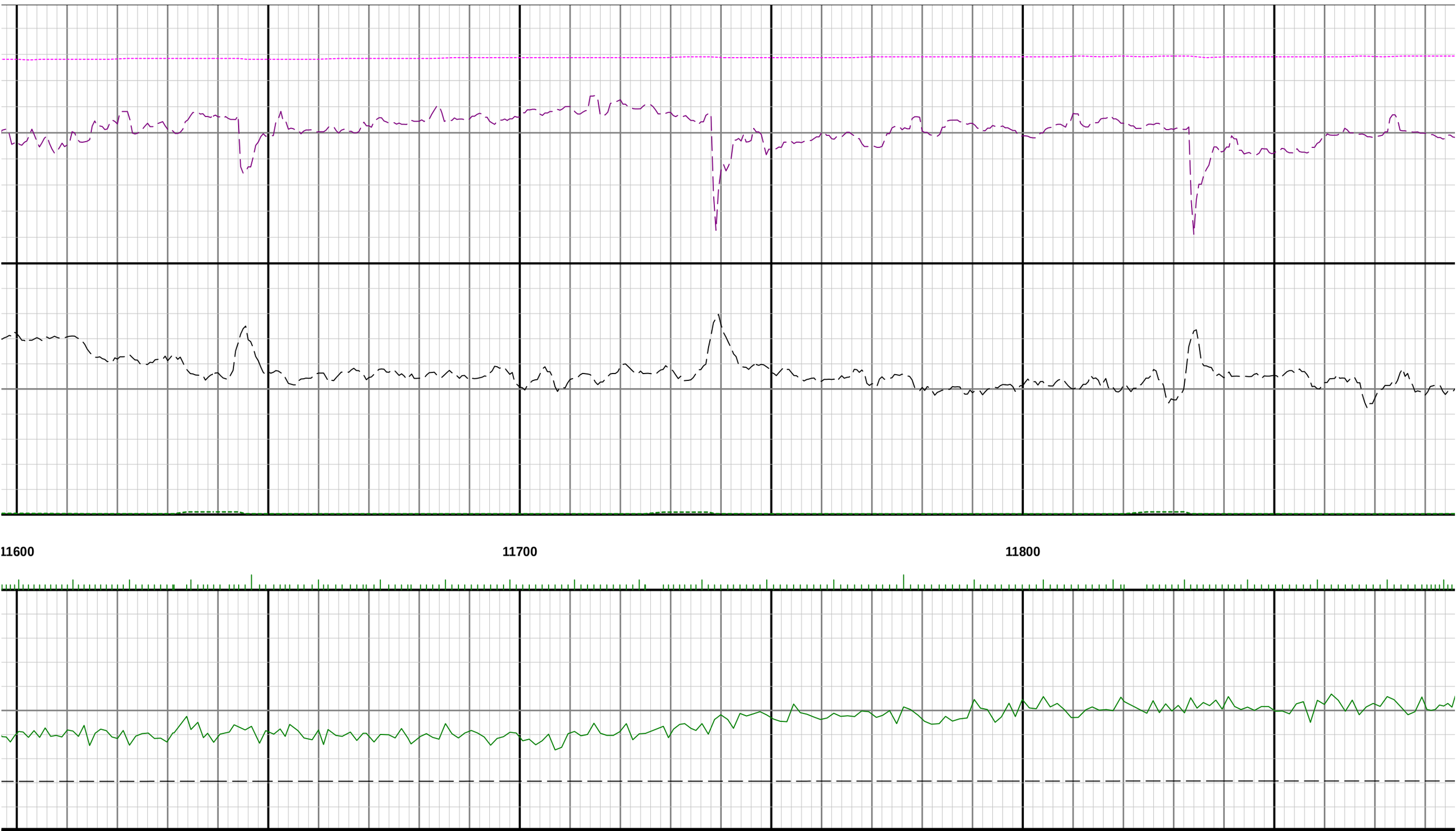
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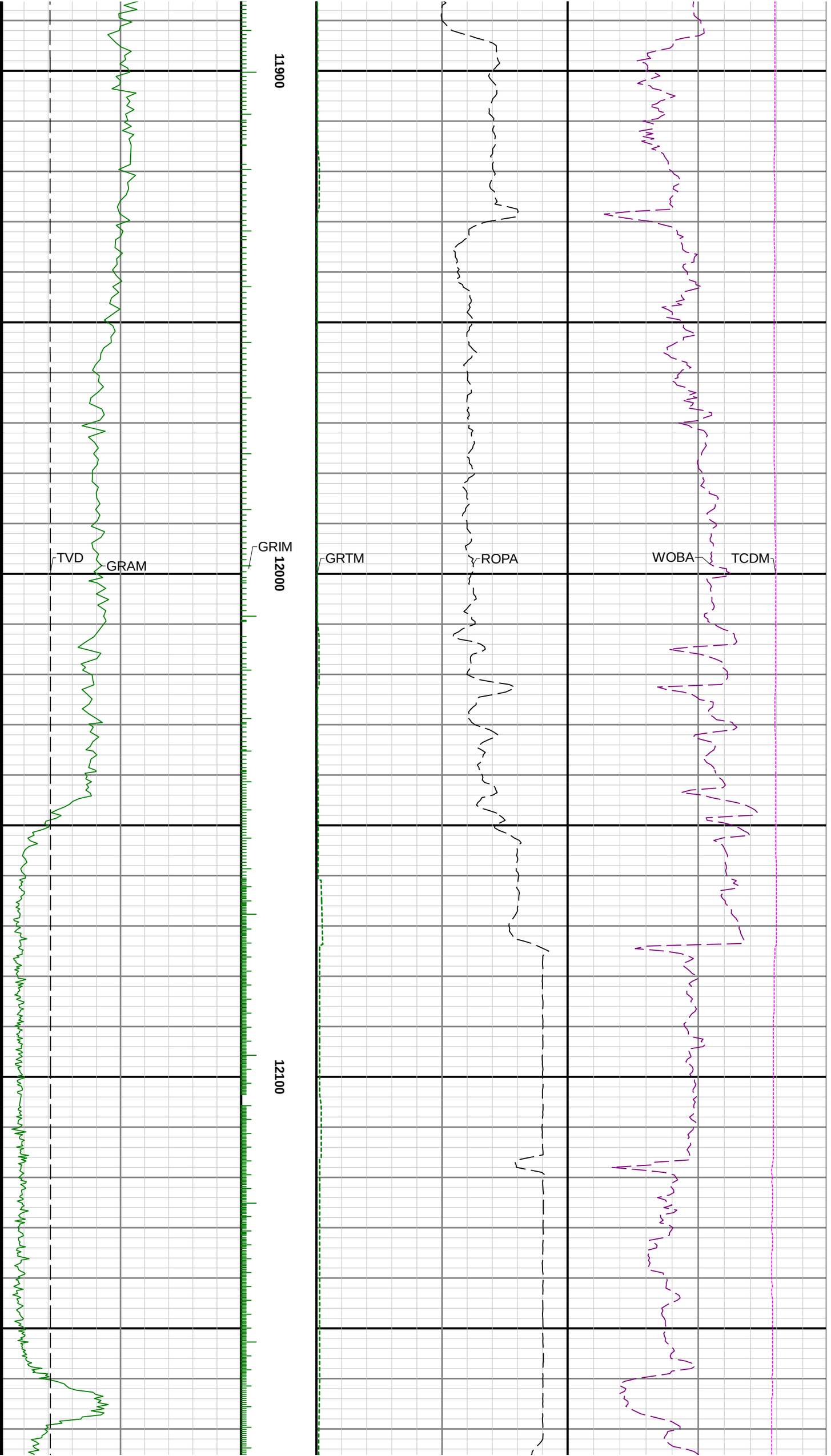
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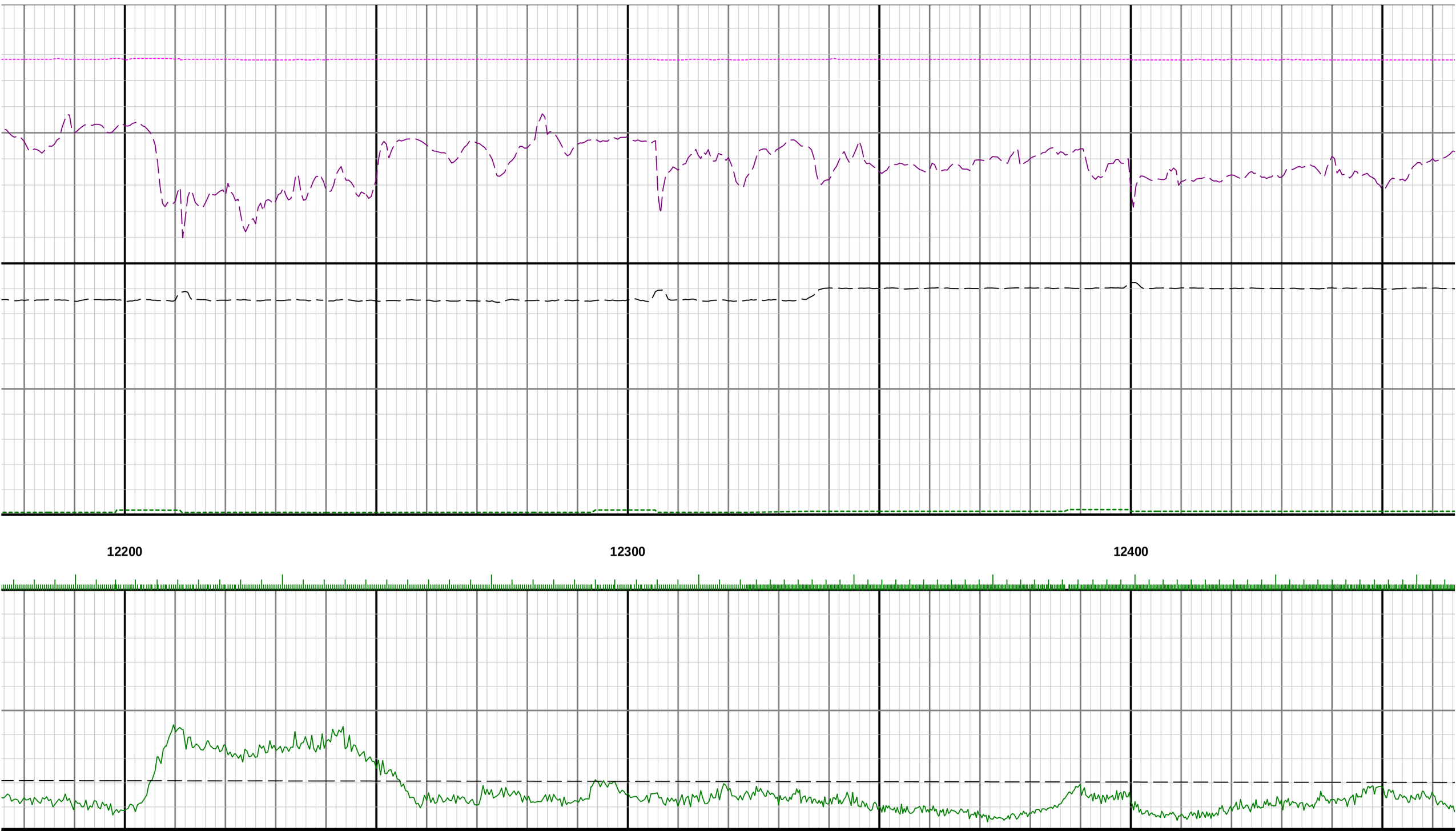
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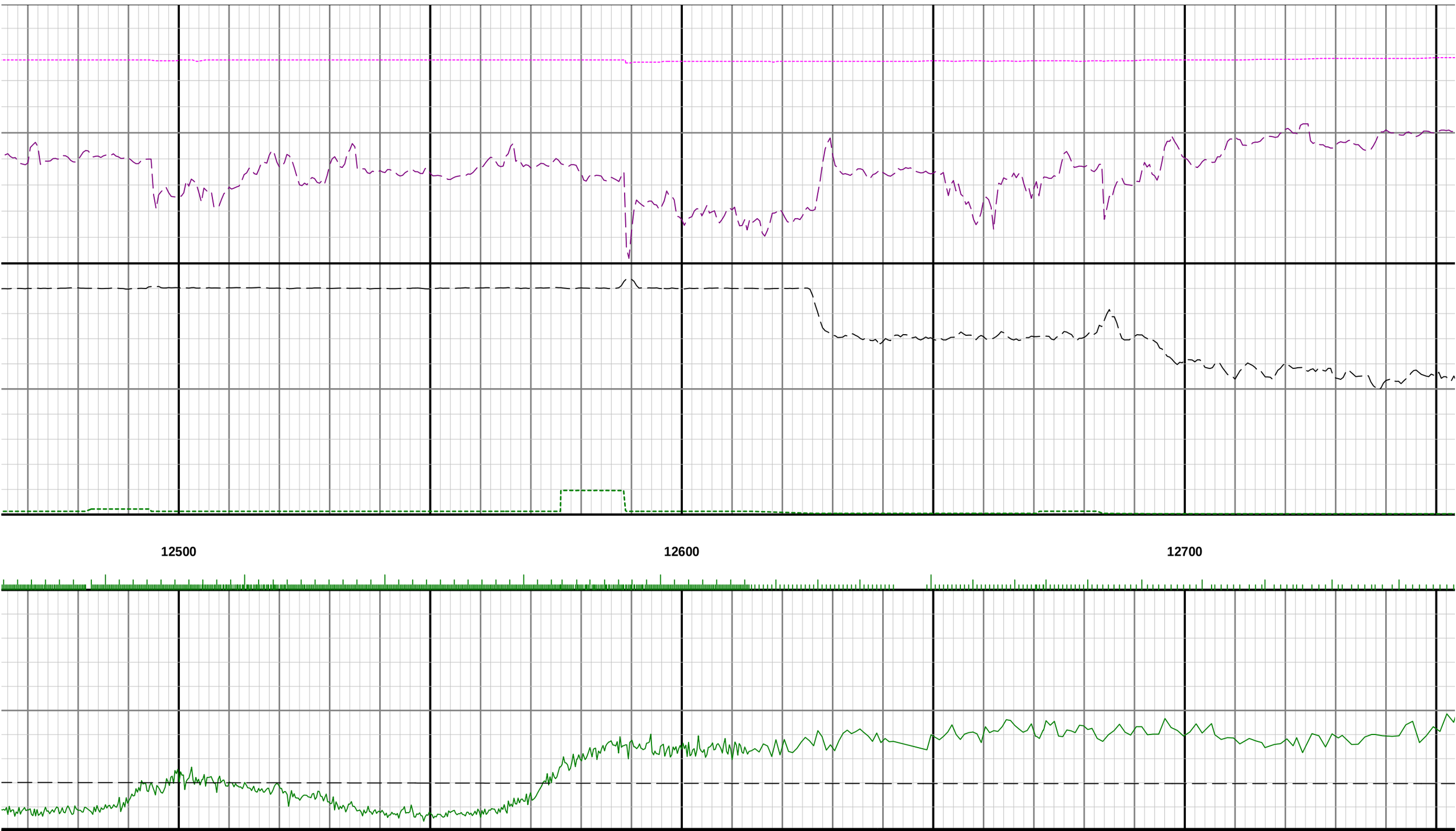
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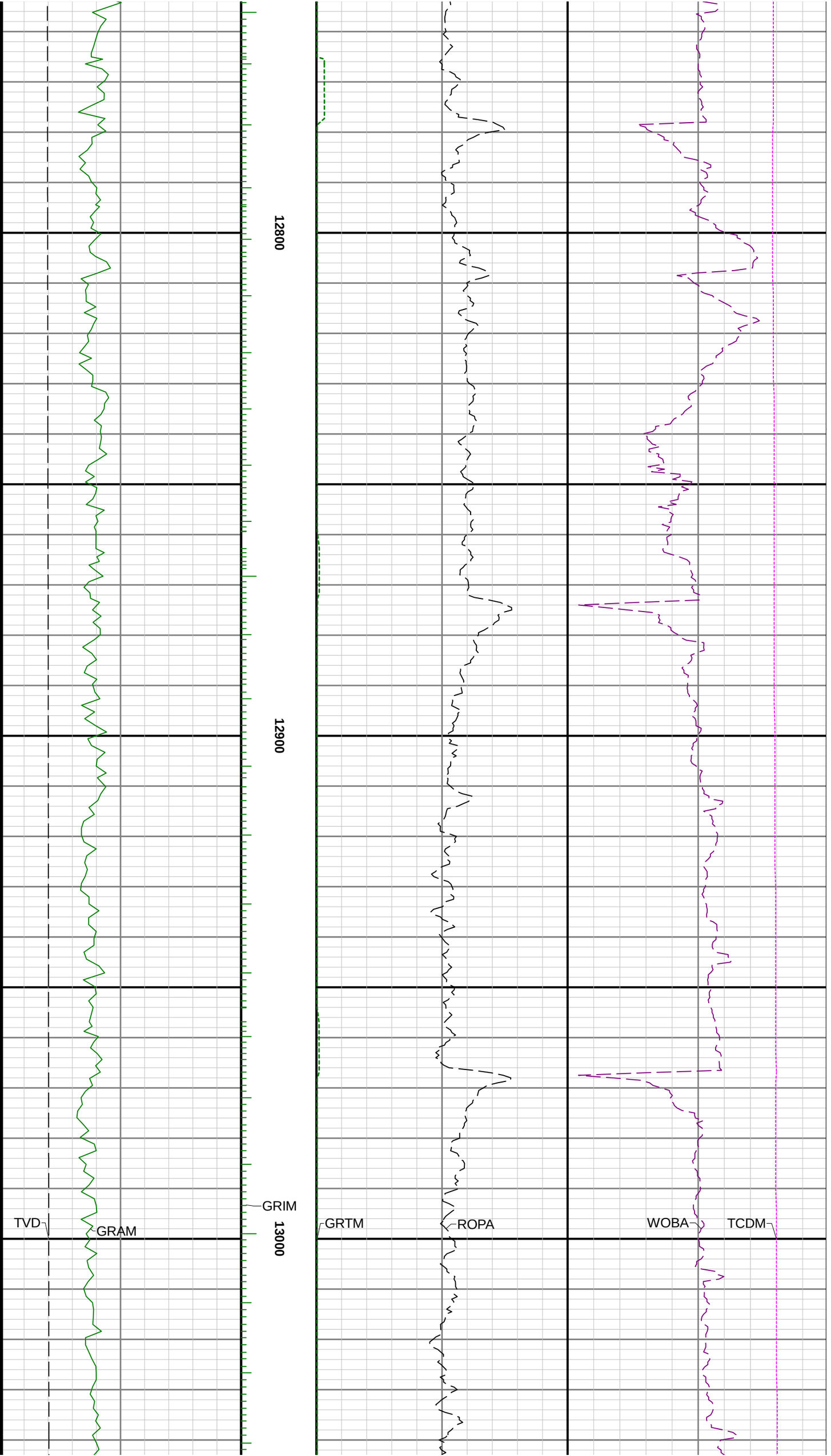
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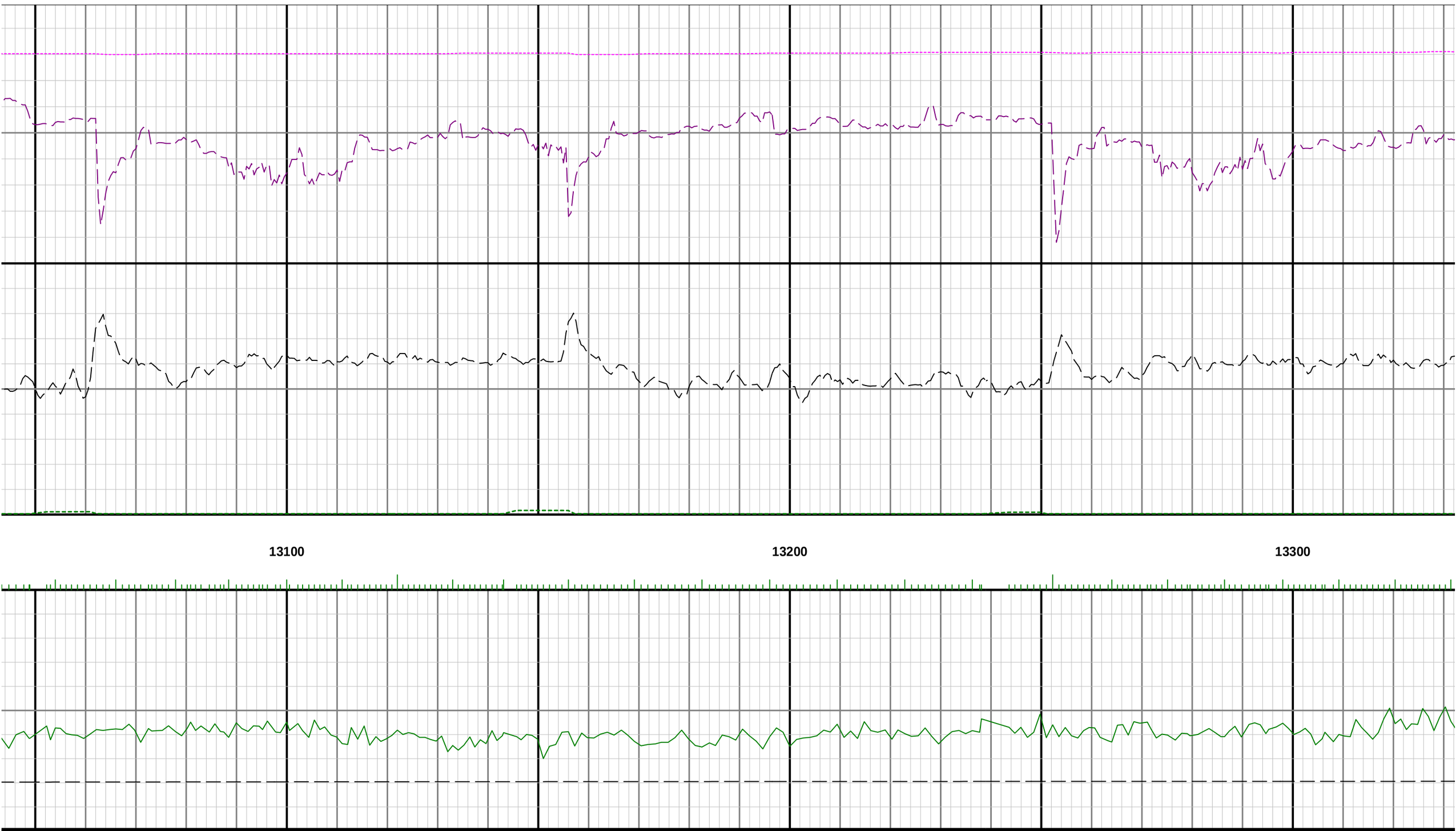
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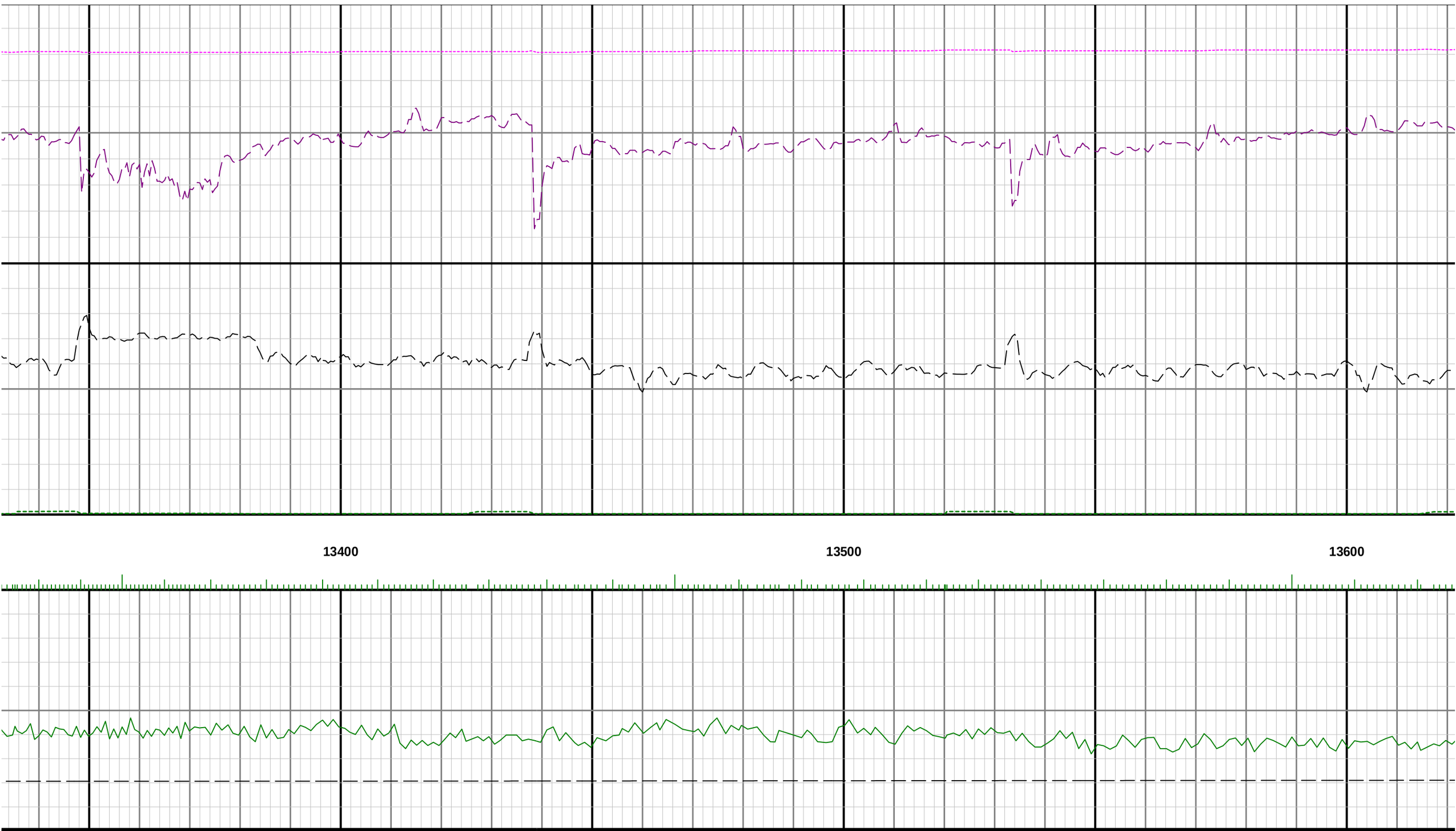
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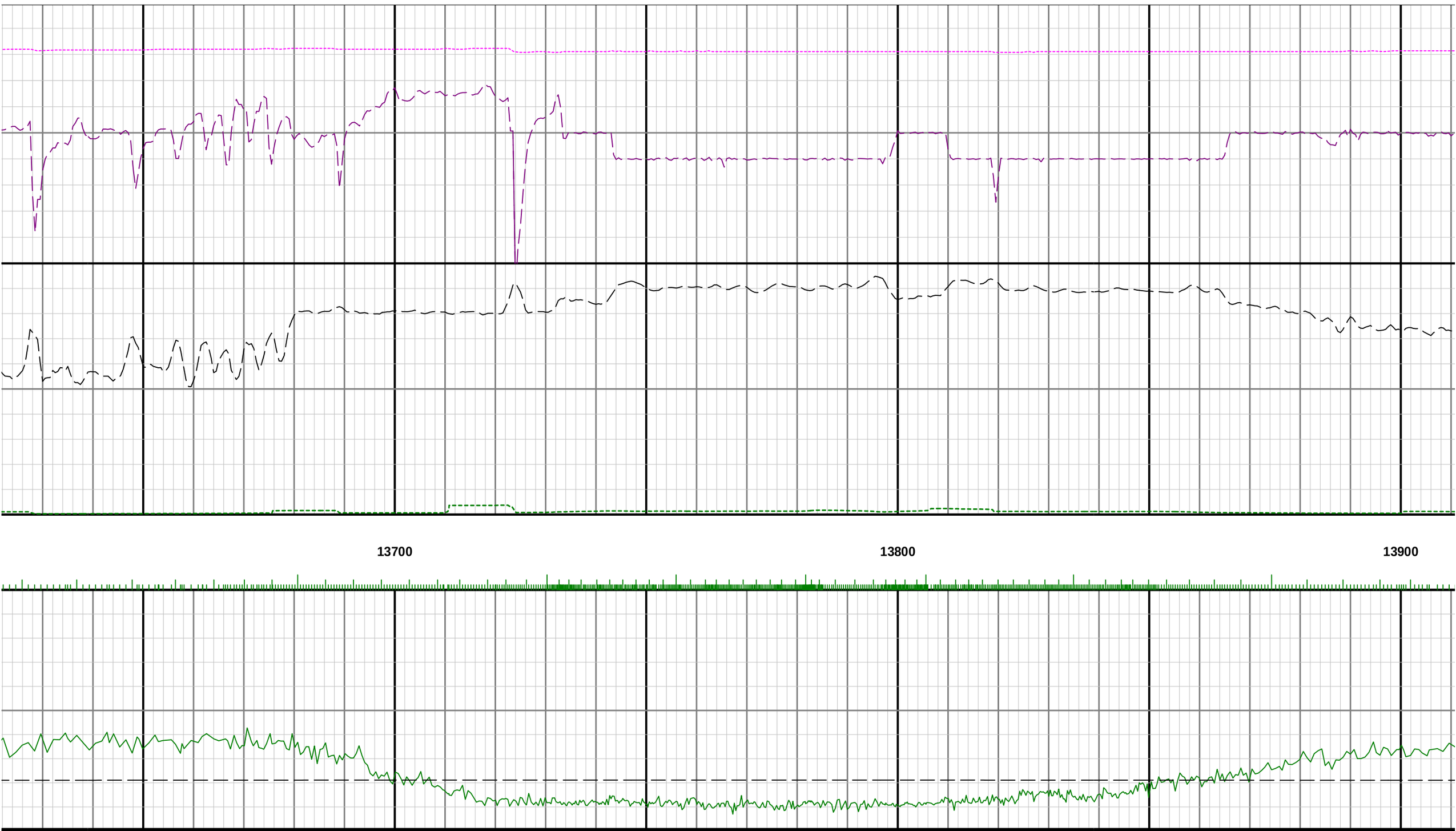
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ROPA
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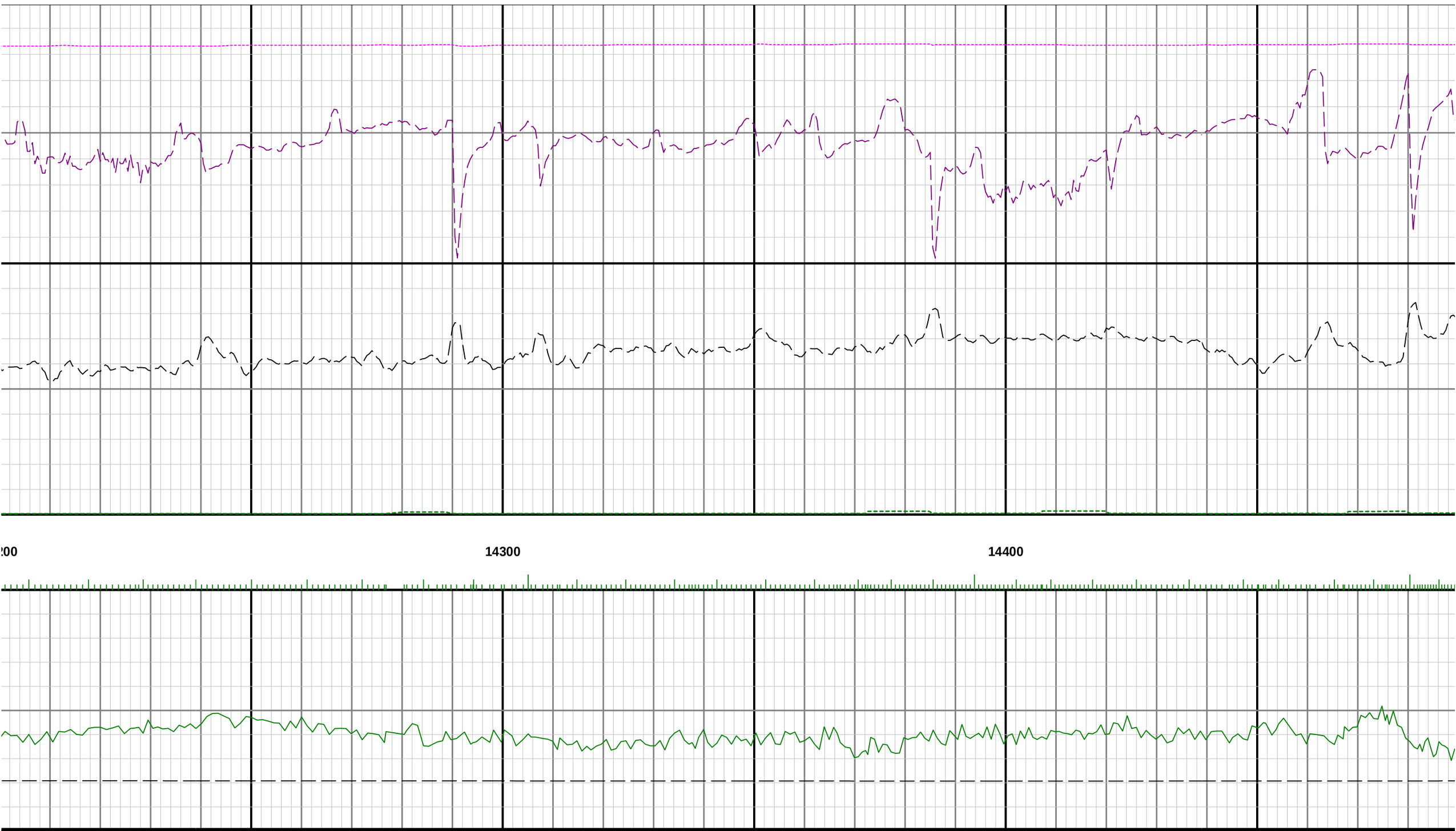
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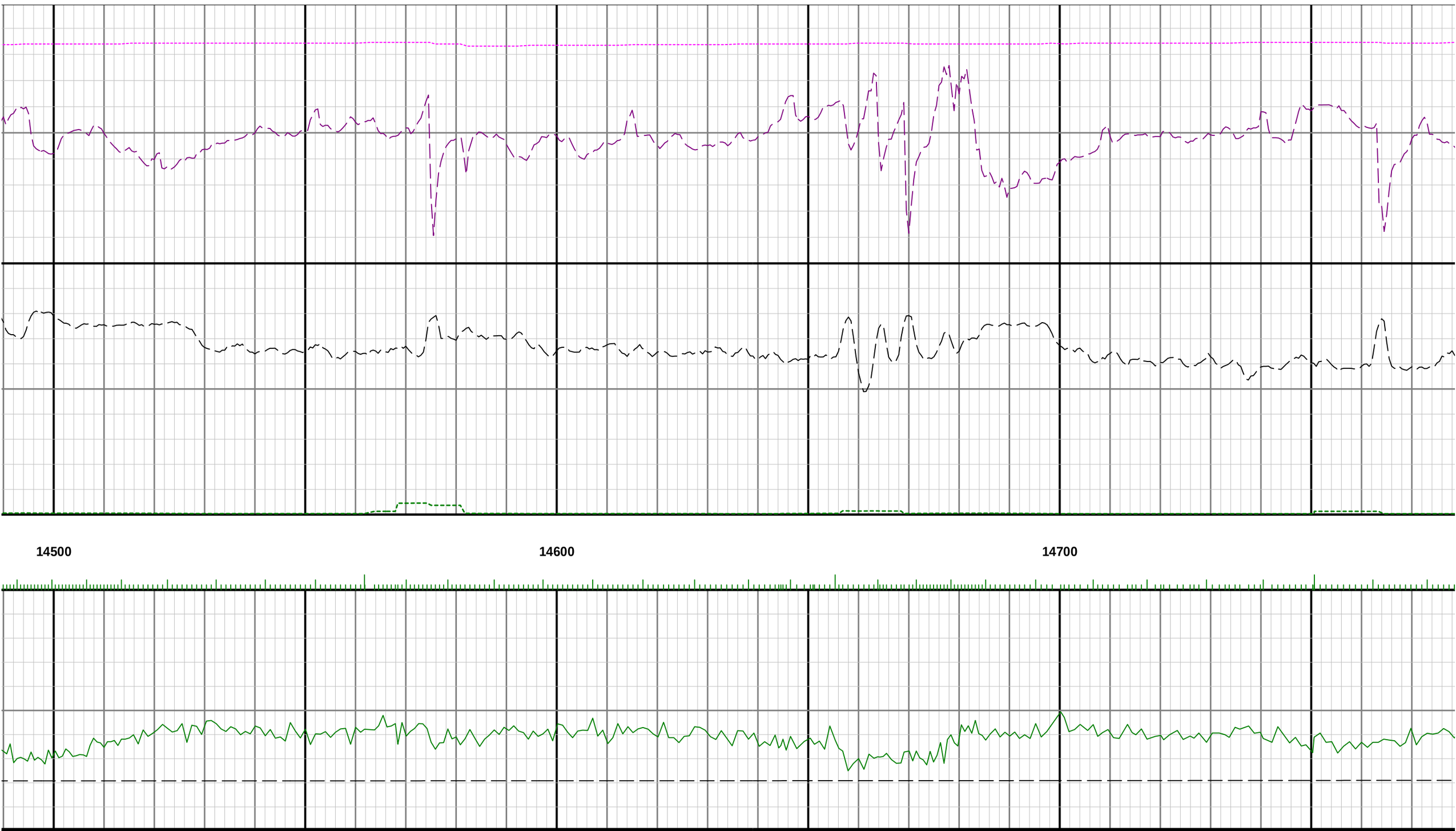
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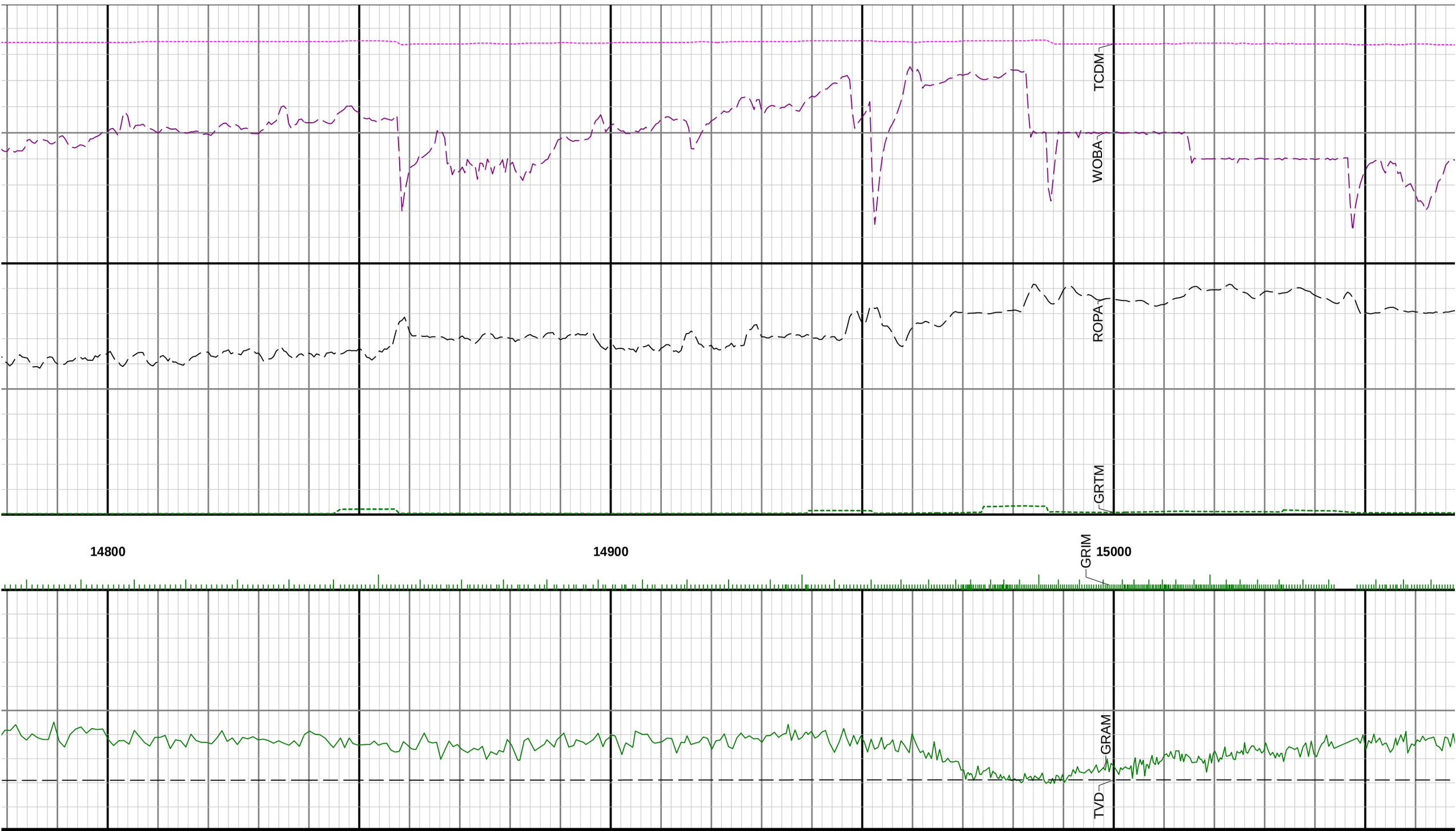
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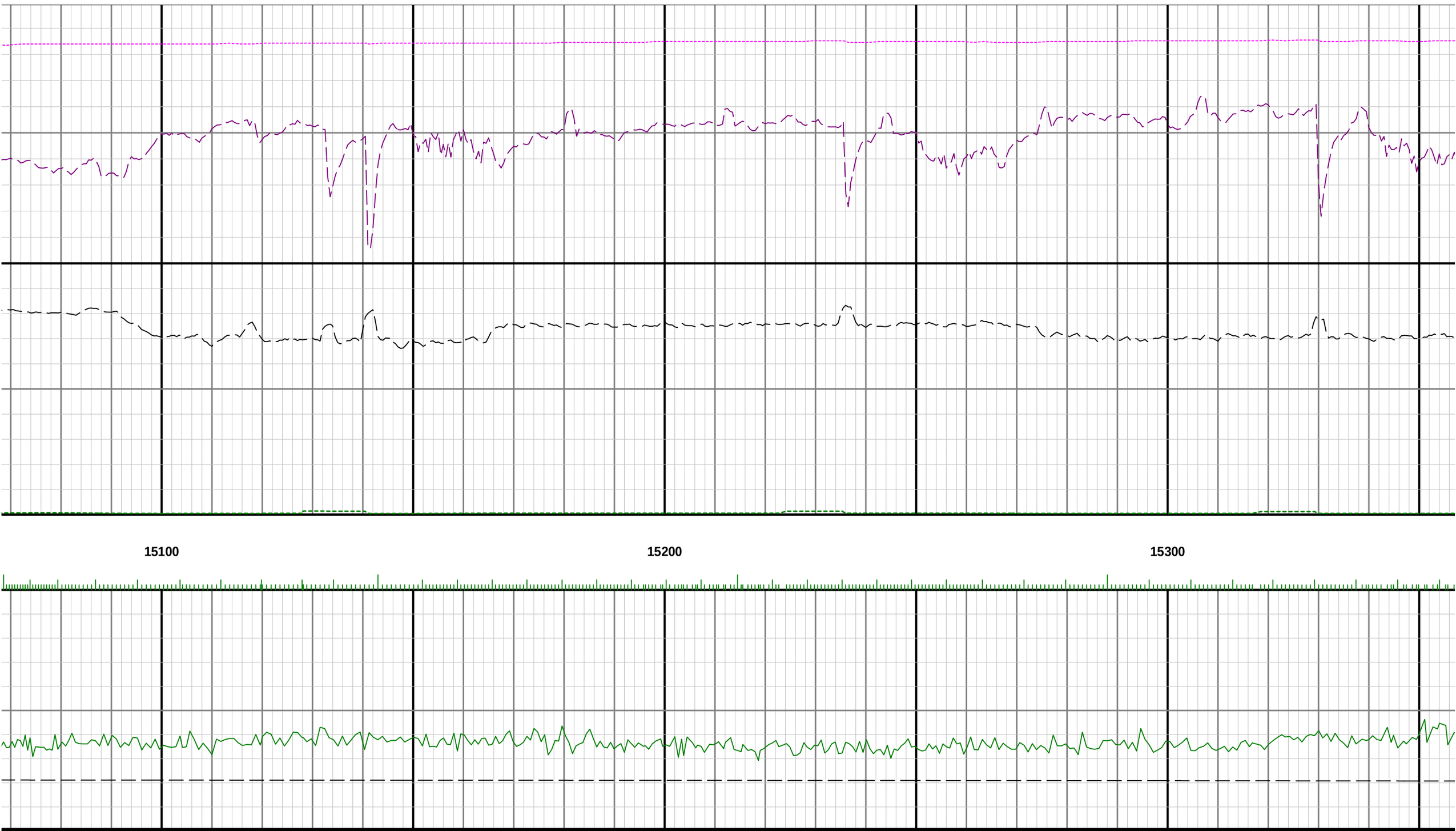
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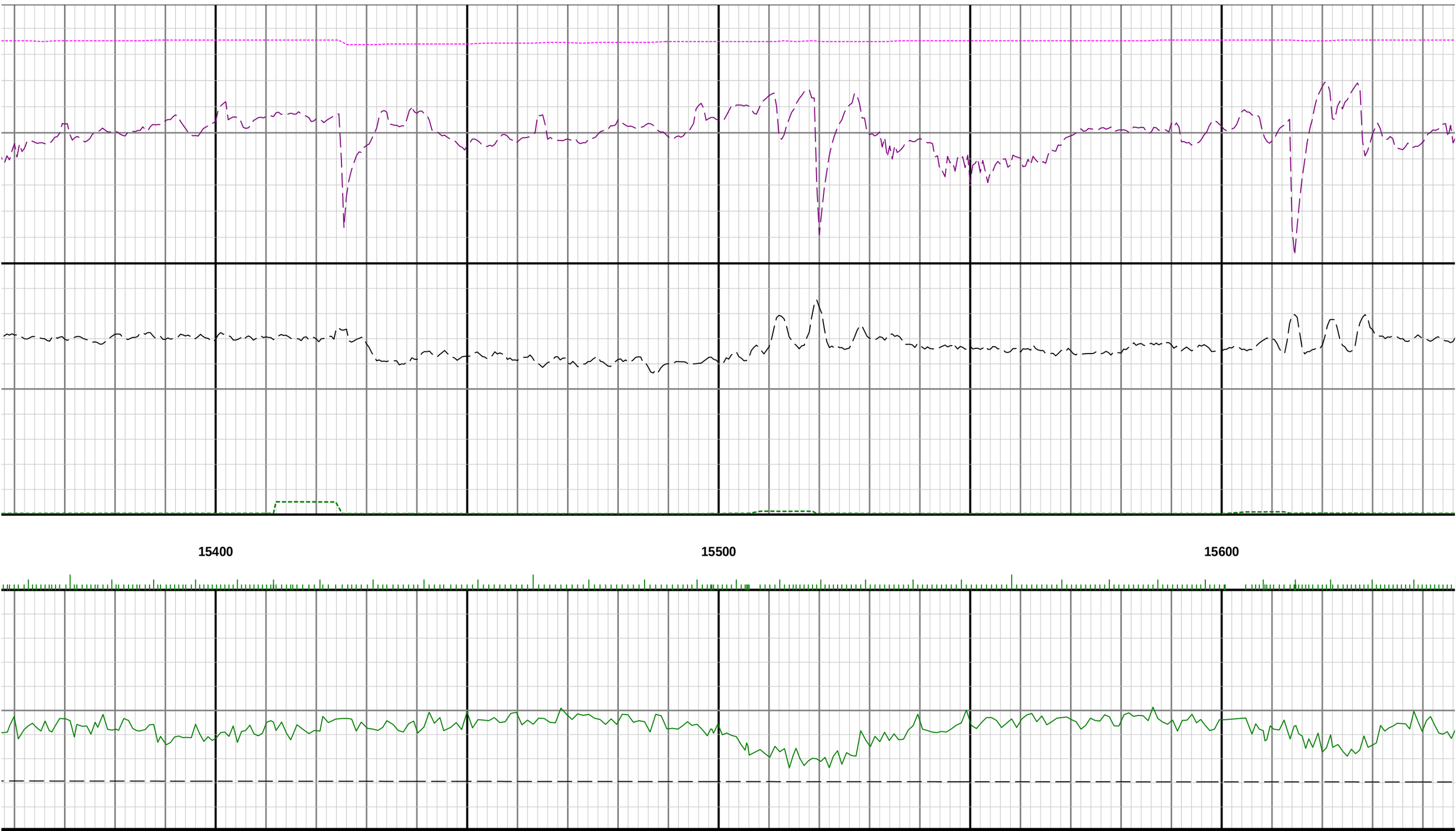
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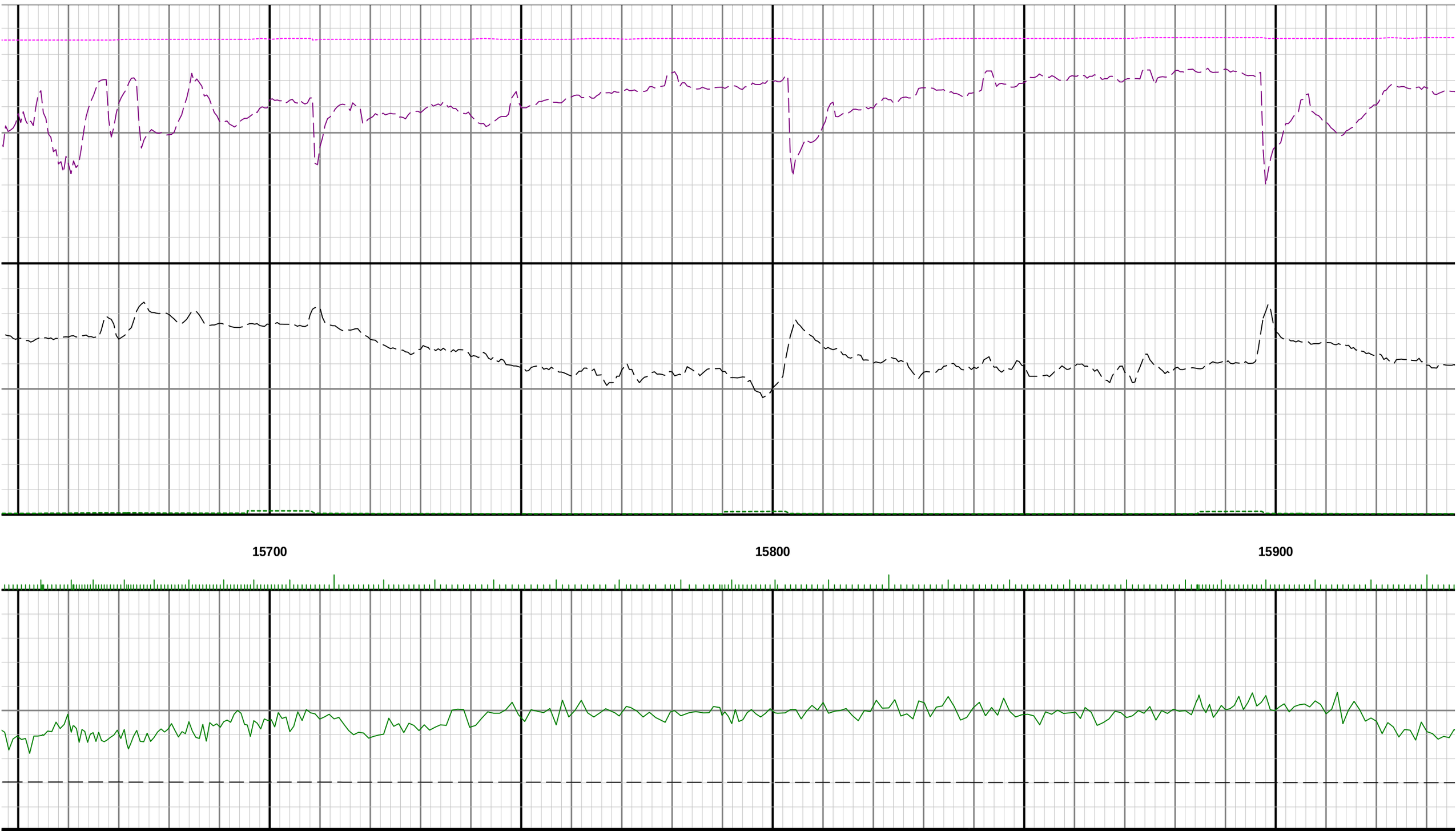
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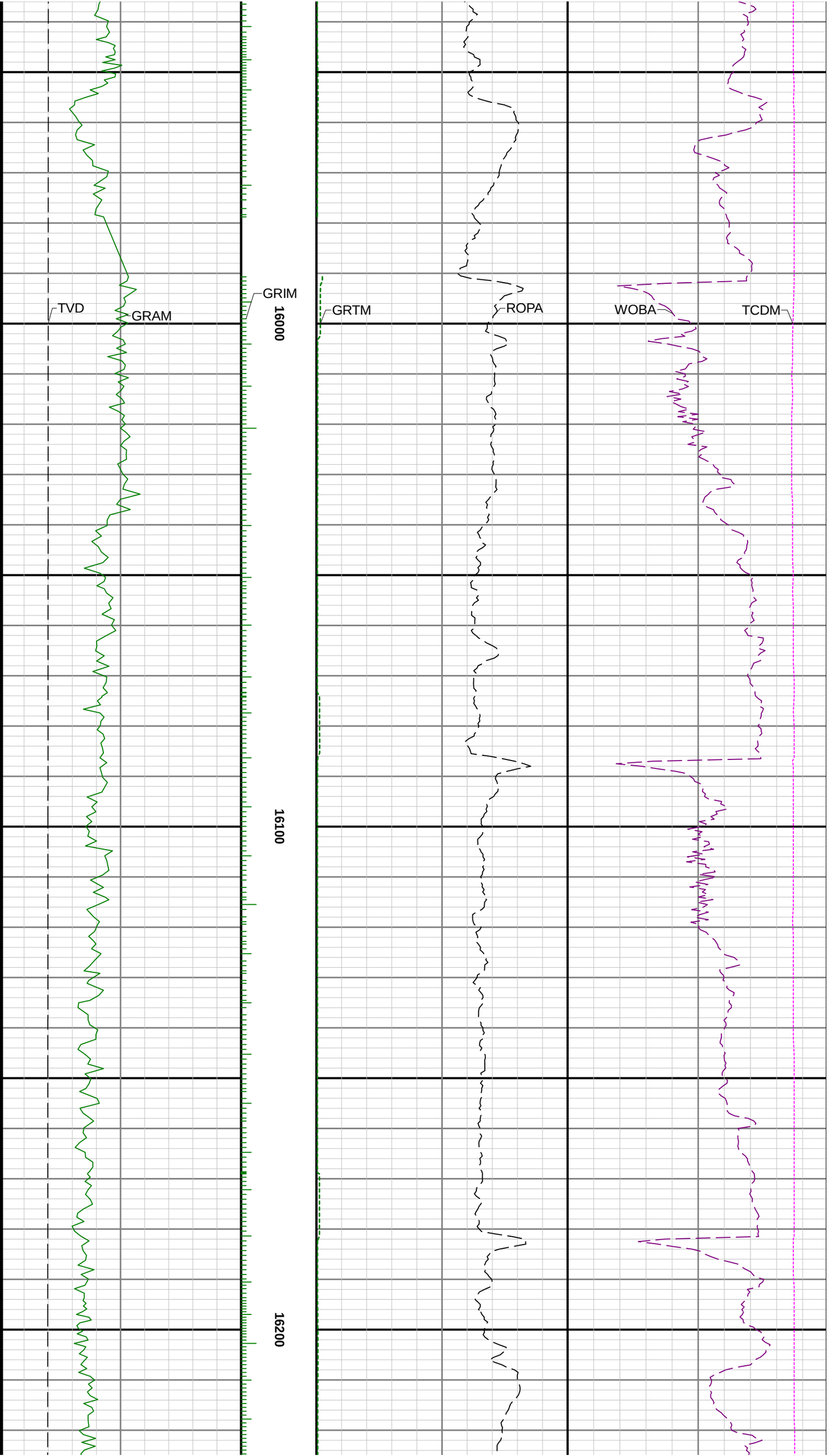
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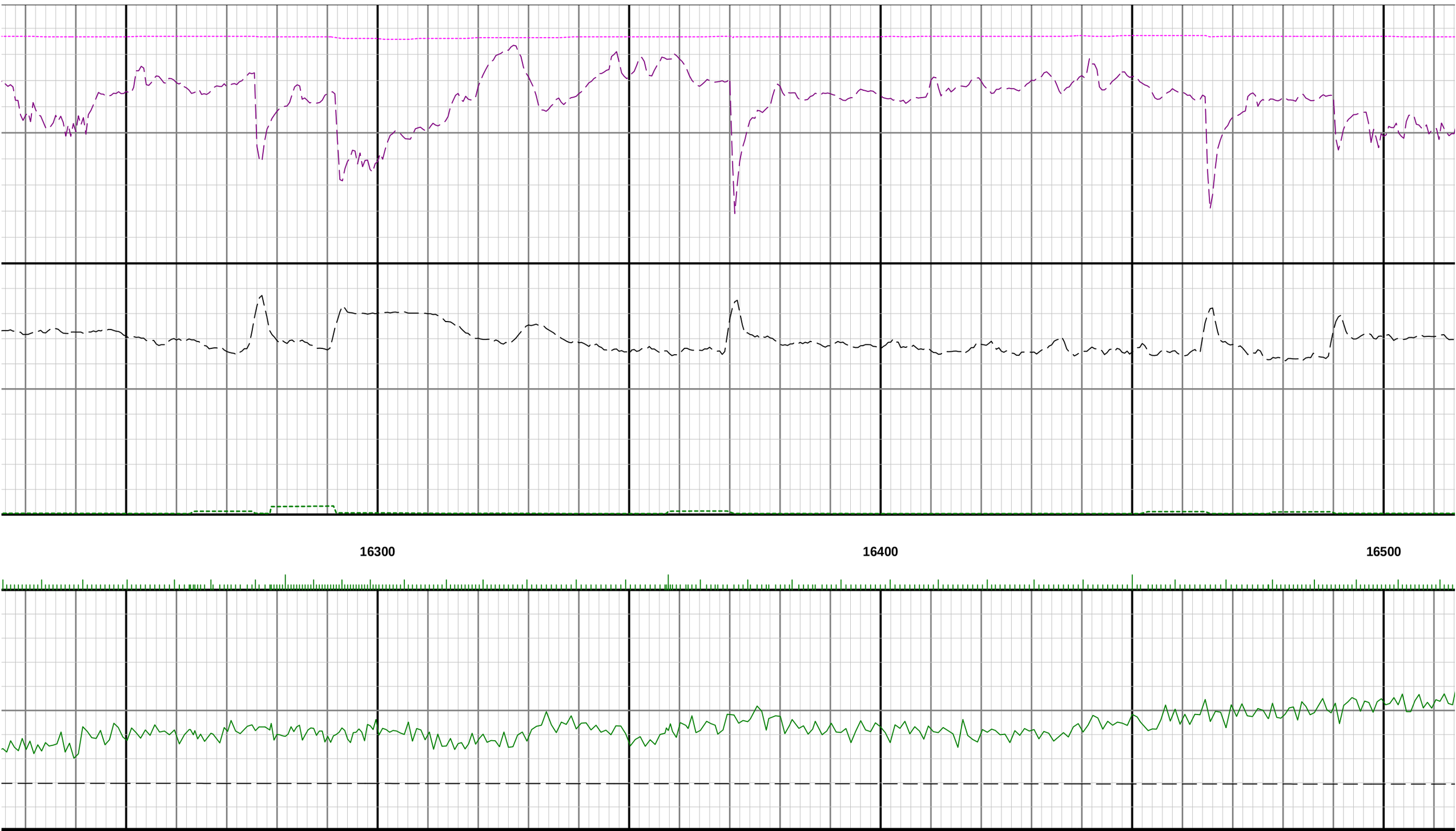
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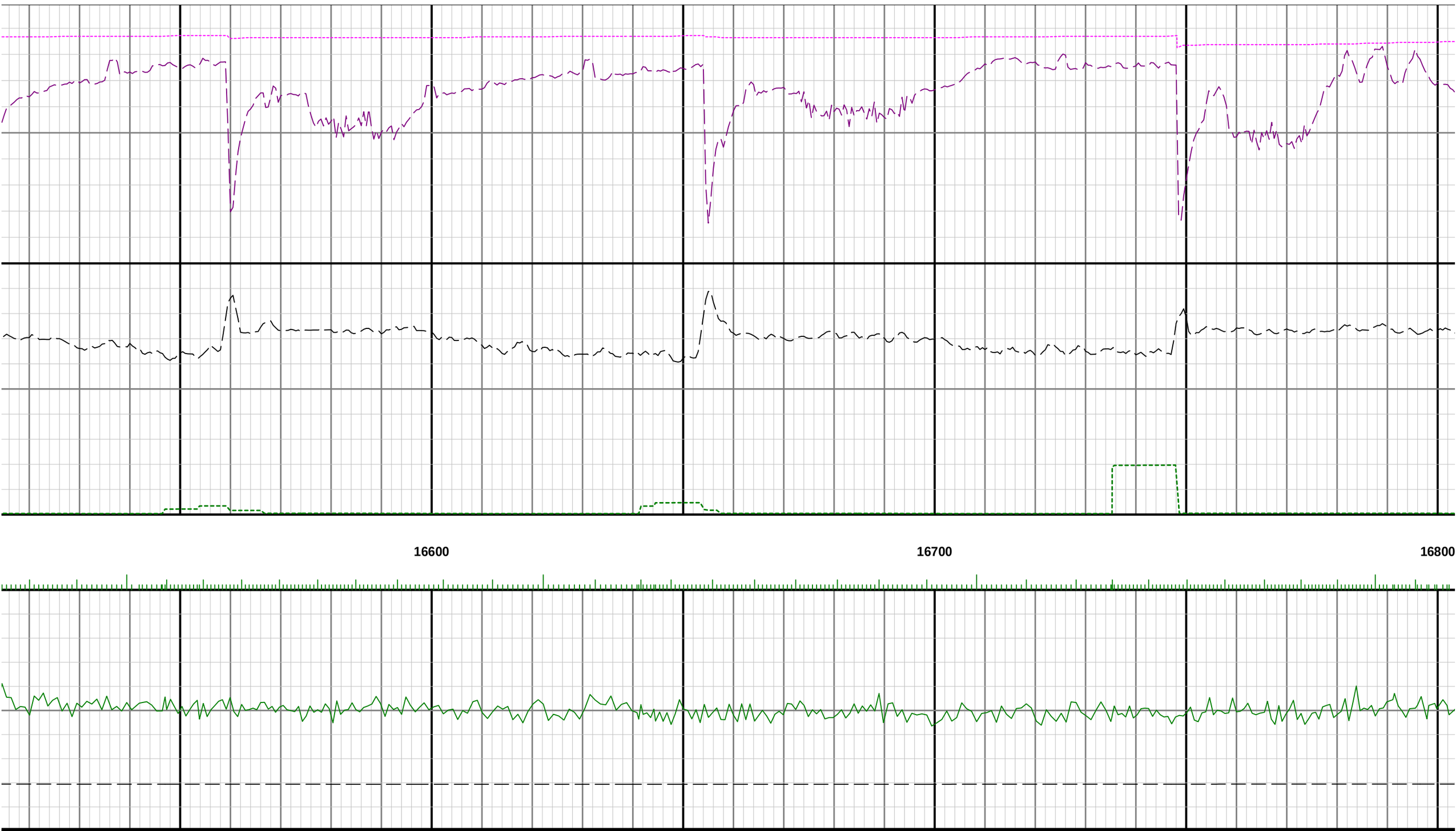
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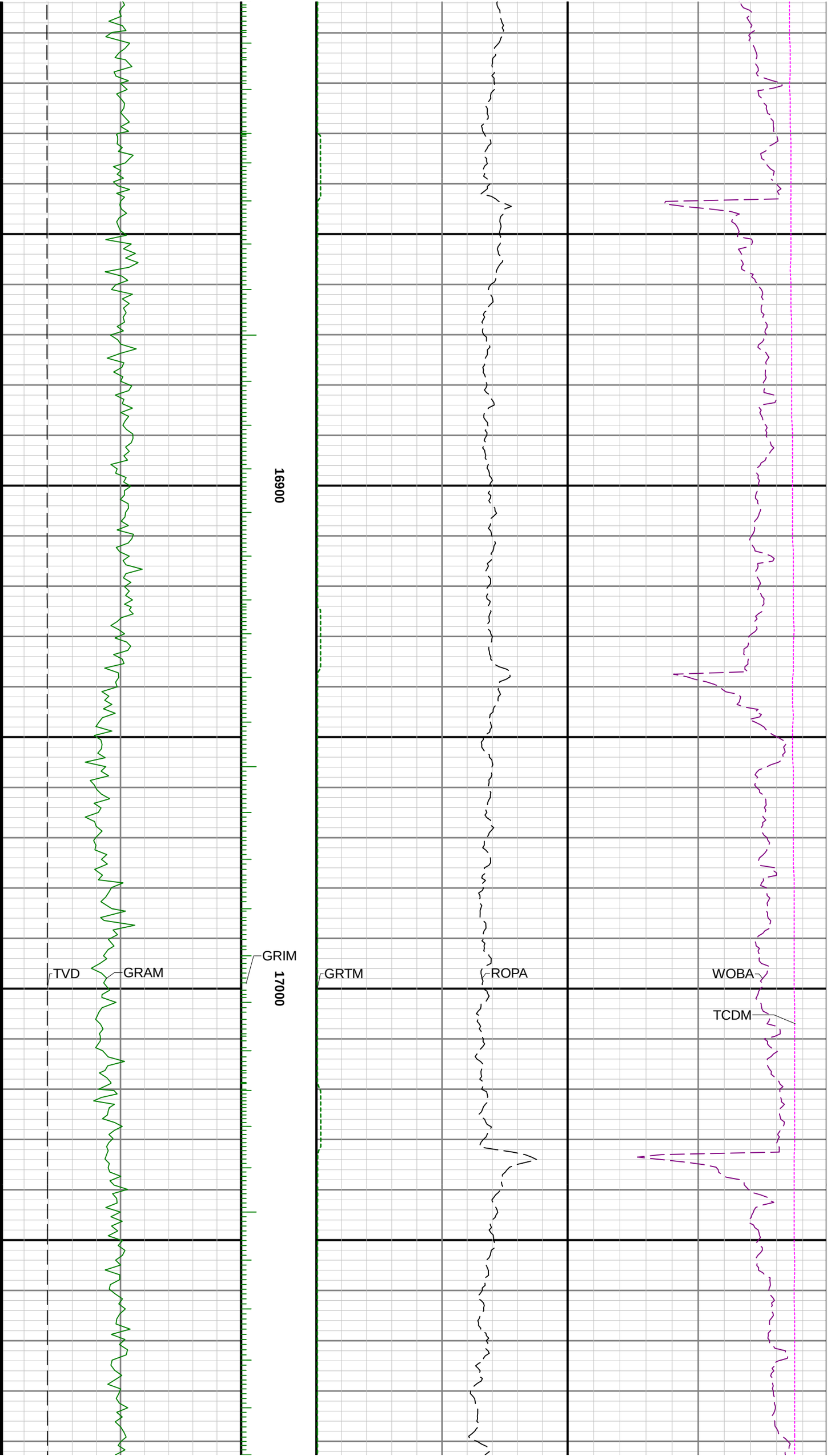
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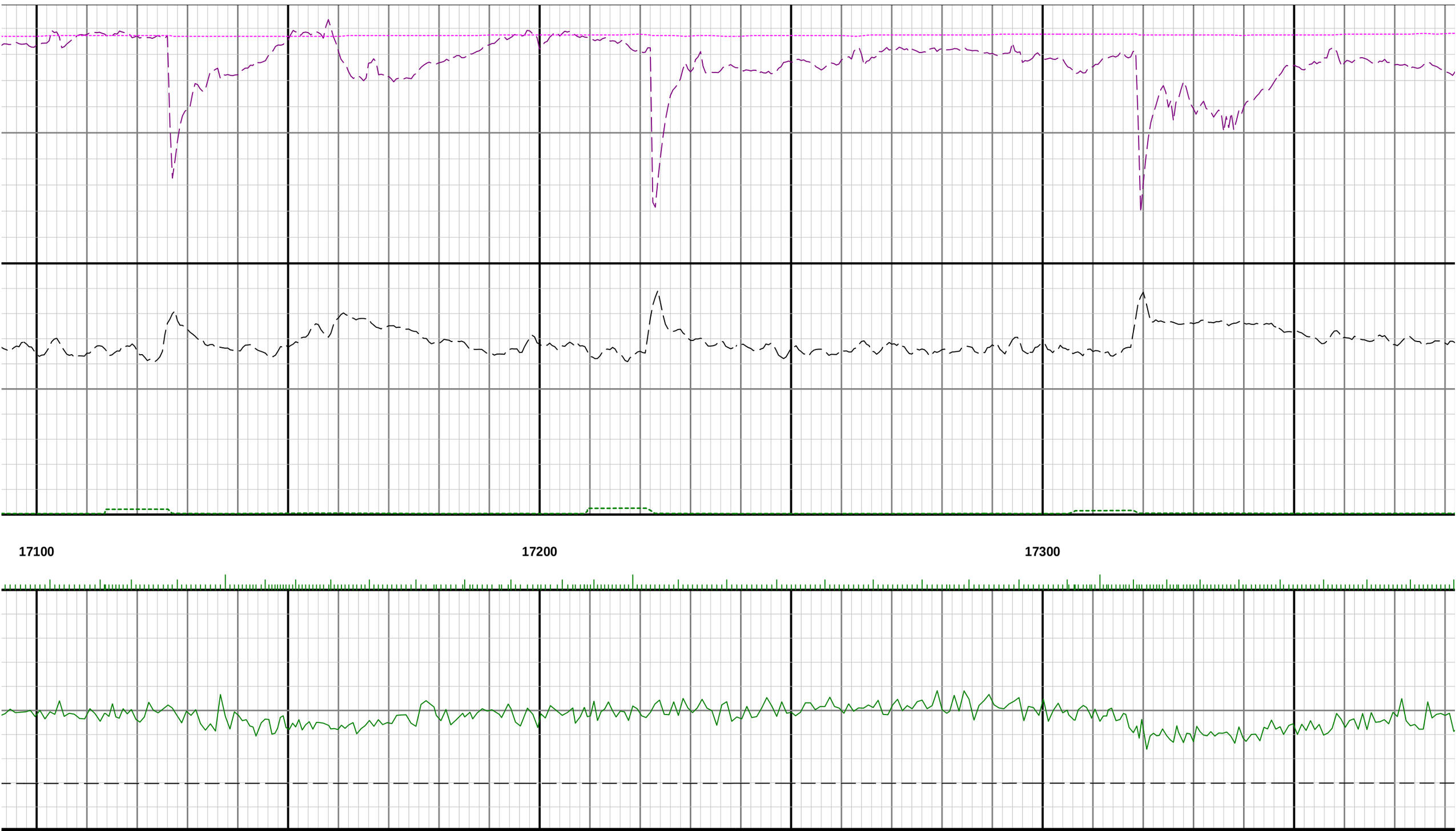
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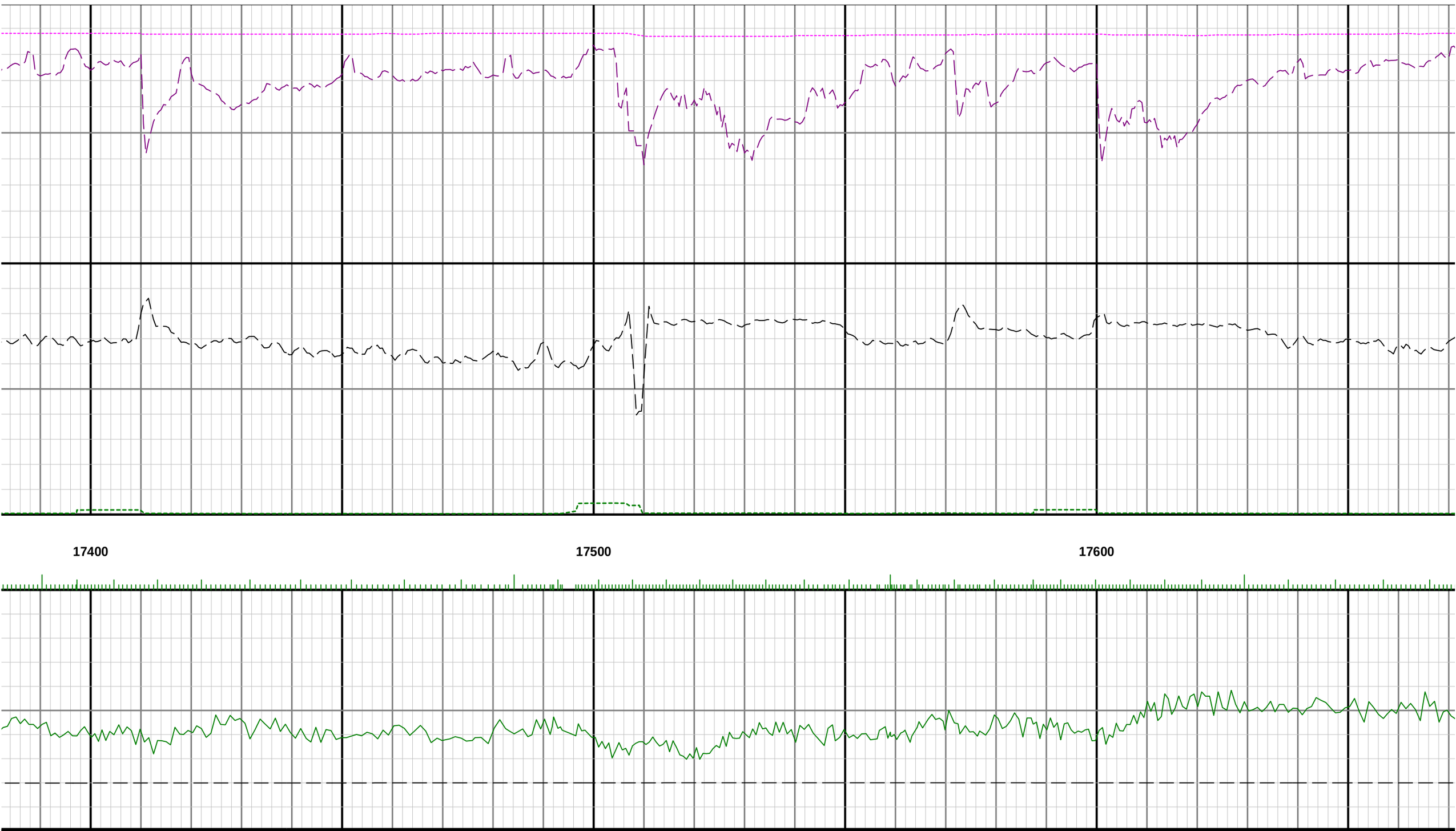
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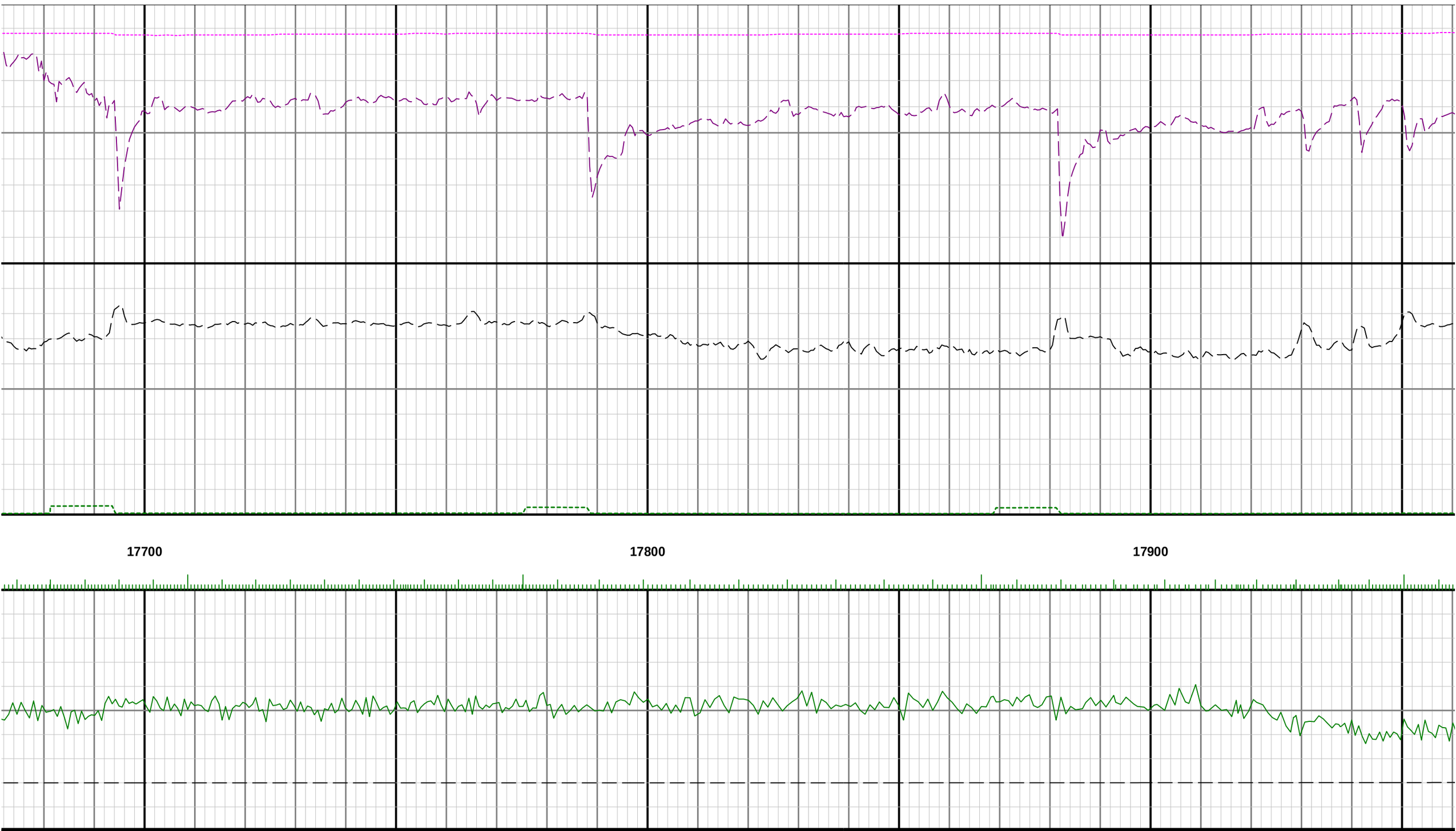
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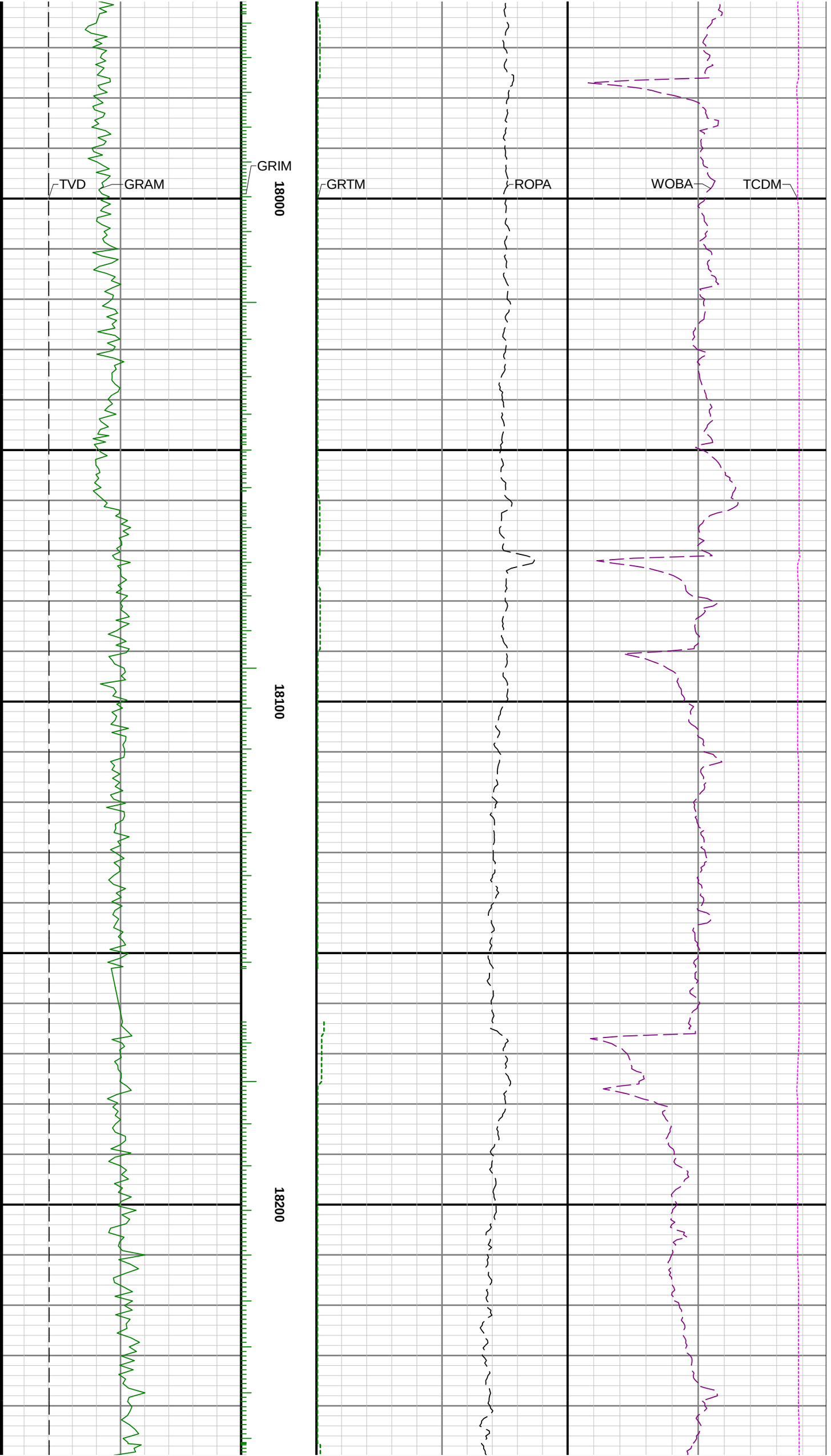
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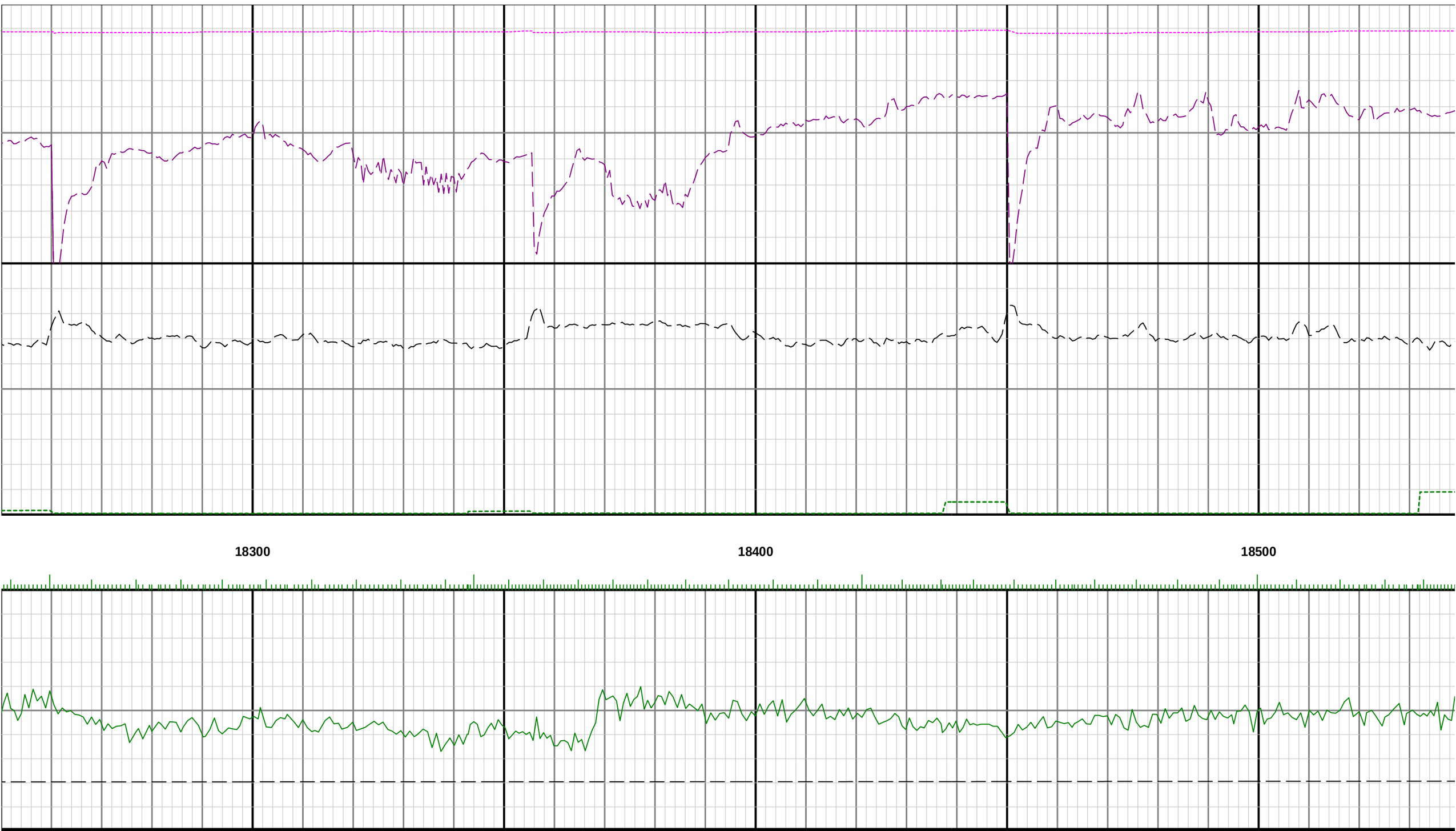
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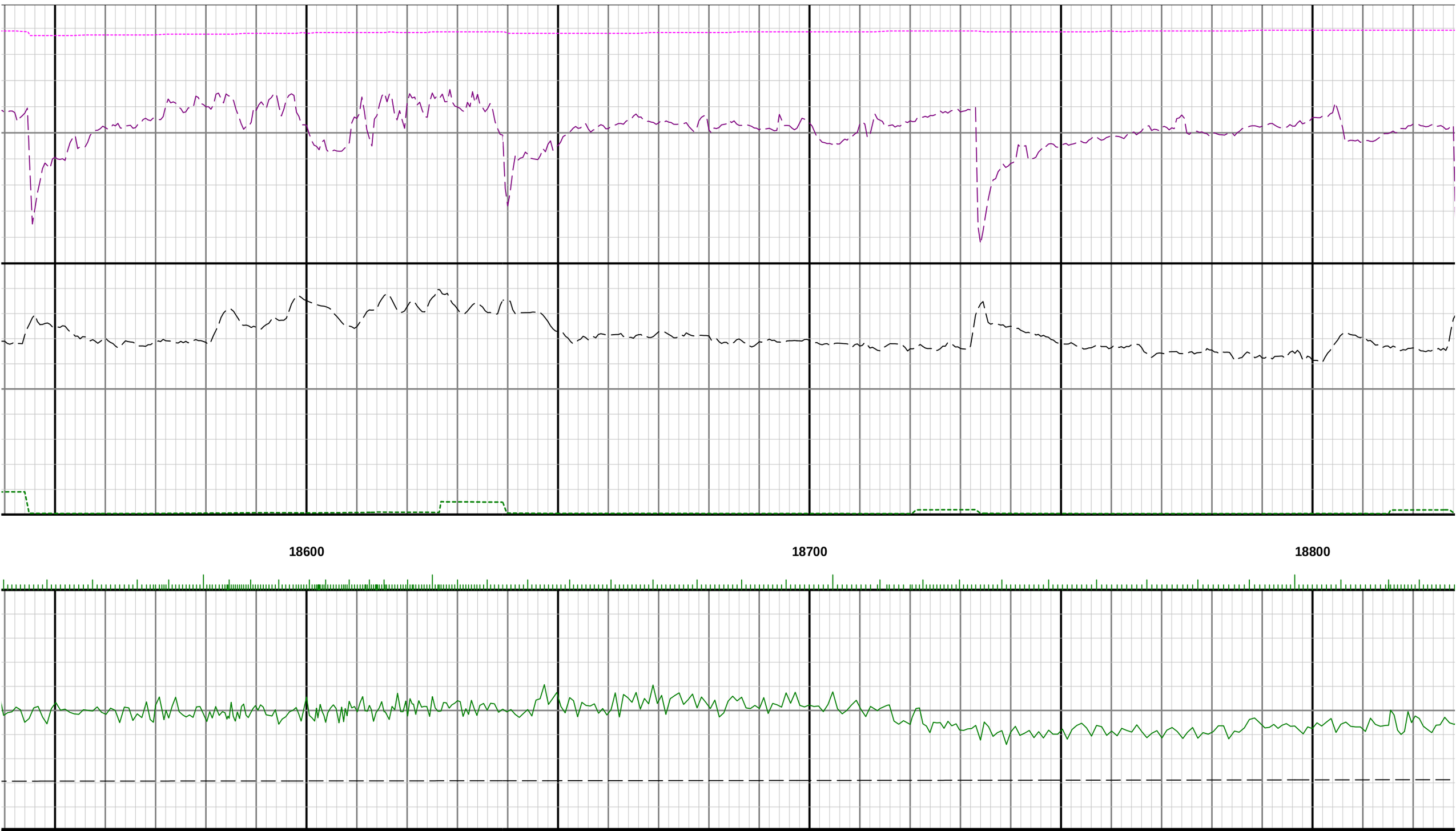
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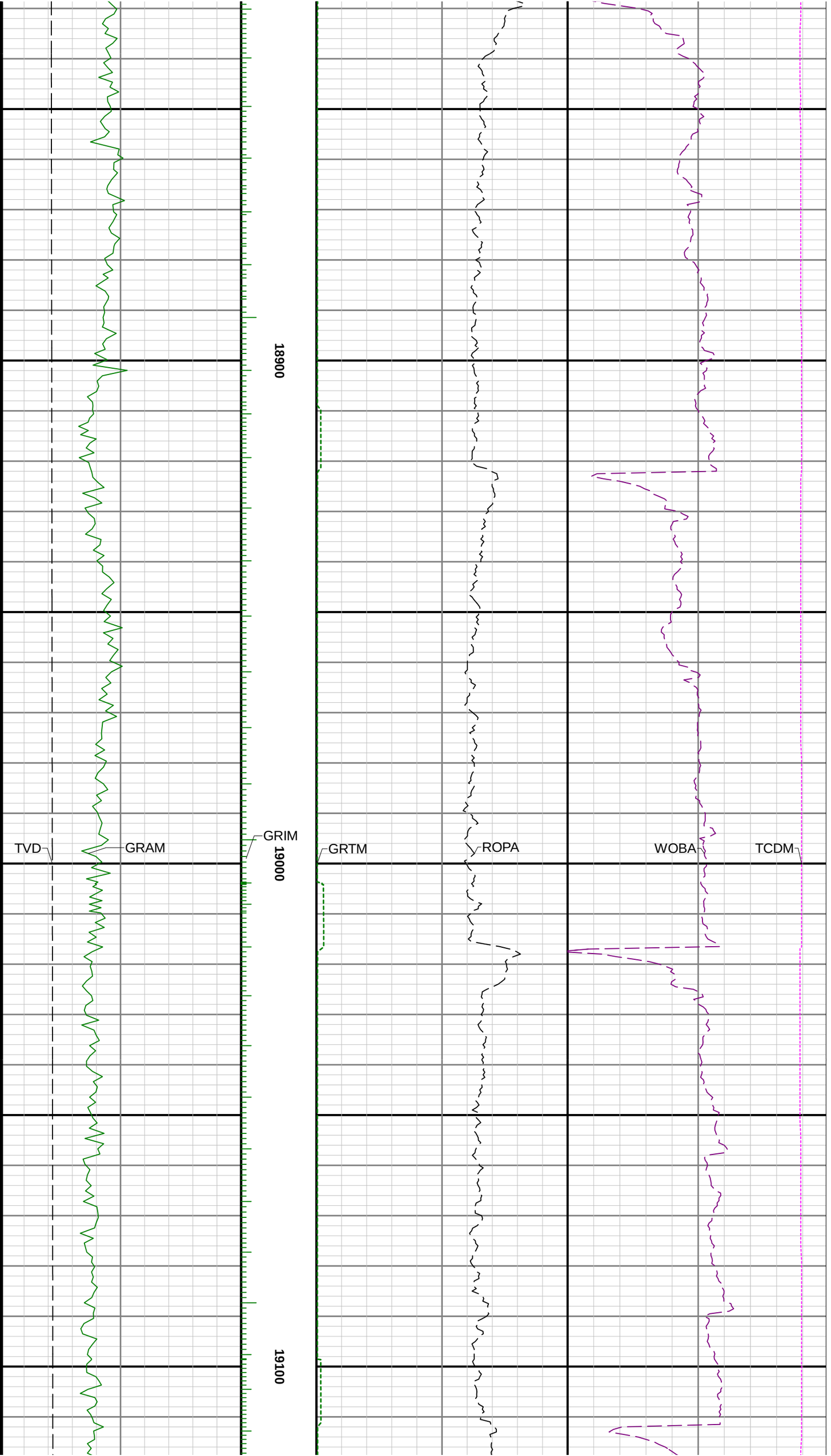
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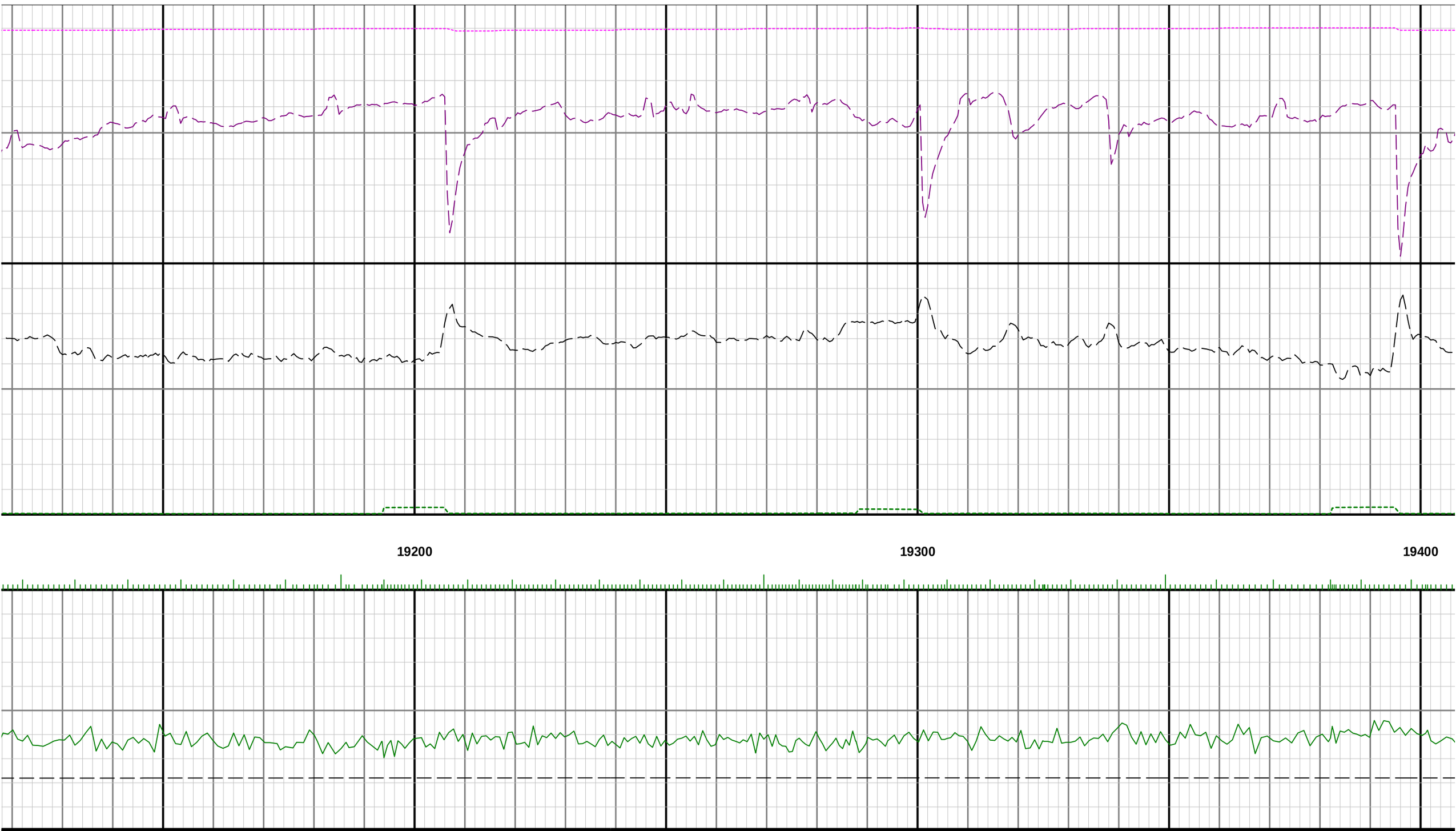
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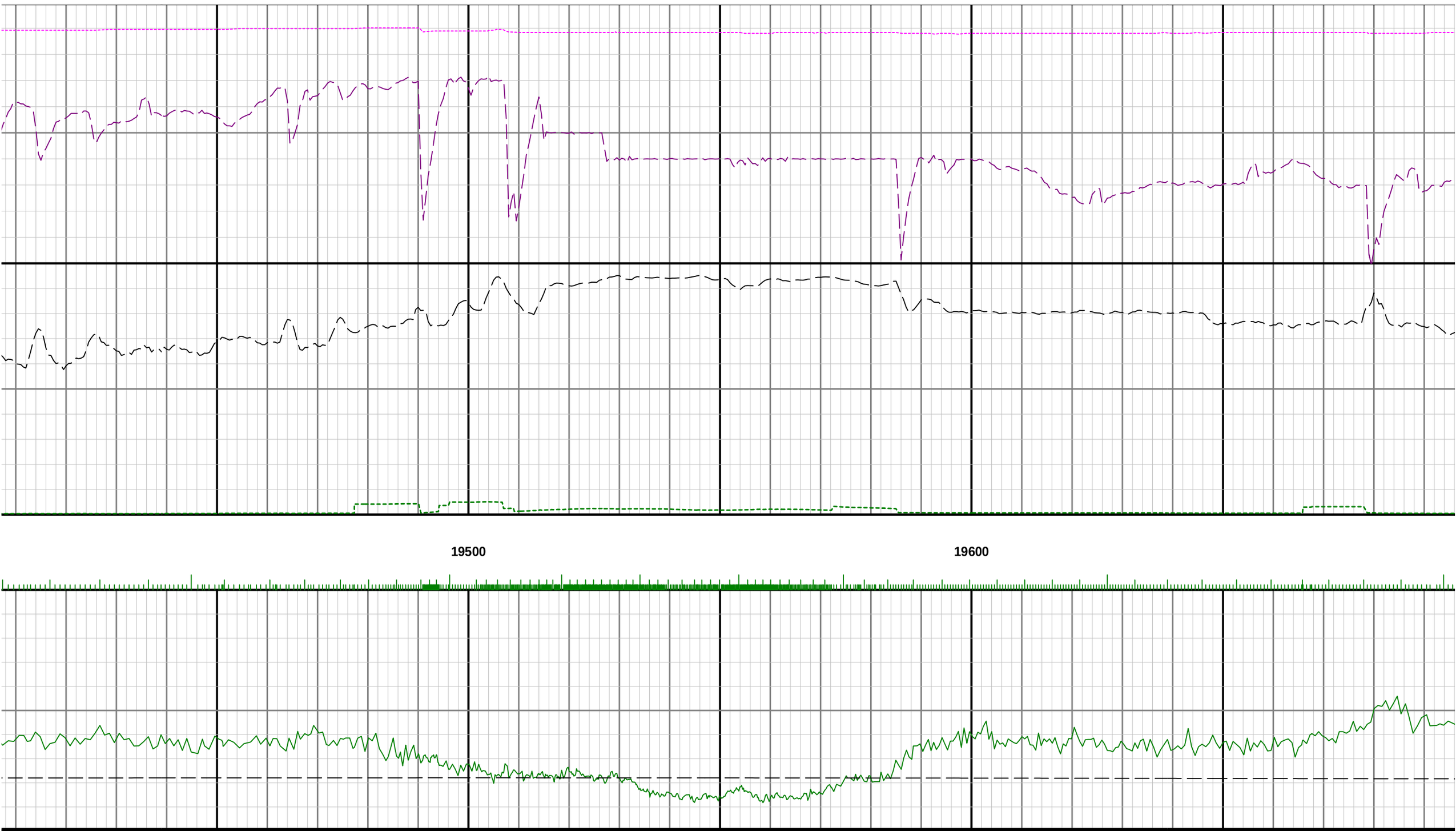
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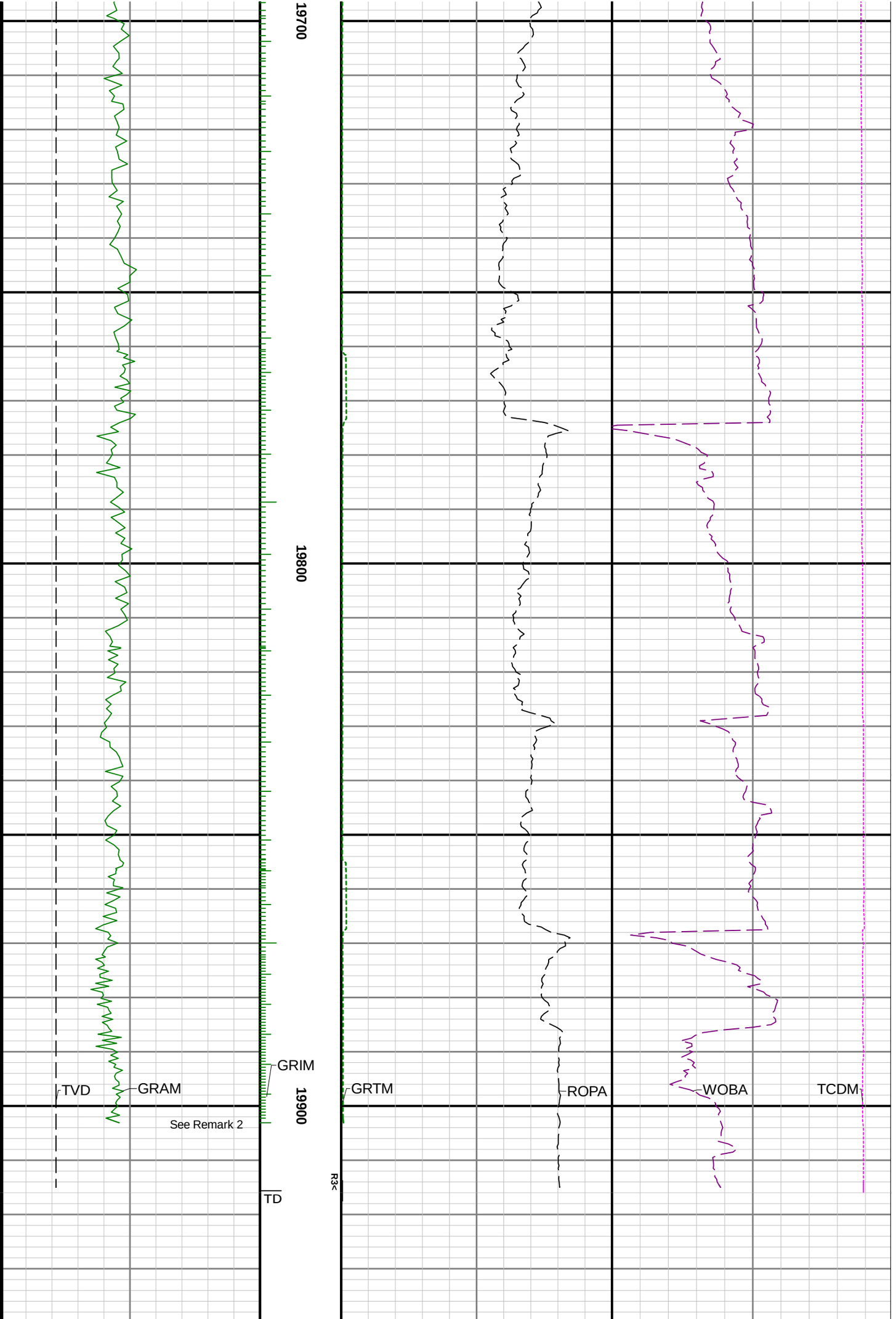

Gamma Ray - Apparent 0.5 ft Average GRAM	MD 1:240 feet	Depth Averaged ROP 3 ft Average ROPA	Weight On Bit, Average 1 ft Average WOBA
0 — 300		1000 — 0	0 — 50
API		ft/h	klb
True Vertical Depth TVD		Gamma Time Since Drilled GRTM	Downhole Temperature TCDM
7200 — 6200		0 — 600	0 — 300
ft		min	degF