LWD MEMORY LOG

Multiple Propagation Resistivity
Gamma Ray

Scale: **1:240 MD**

Depth Reference: **Driller's Depth**

Company: Noble Energy
Well: Wells Ranch BB11-643
Field: Weld County(Noble NAD 83 Grid)
County: Weld **Country:** United States
State: Colorado

Status: **Final Print**

API No: 05-123-44962-00
Job ID: 8645686

Surface Location:
Latitude: 040° 24' 45.288" N
Longtitude: 104° 24' 45.468" W
SEC: 11 TWN: 5N RGE: 63W

Other Services:
Directional

Permanent Datum (P.D.): Ground Level
Log Measured From: Rig Floor
Elevation: 4668.00 ft
Above P.D. 30.00 ft

Elev. KB: N/A
Elev. DF: 4698.00 ft
Elev. GL: 4668.00 ft

Dates		Interval Logged		Magnetic Field Reference			
Date From:	2017-08-21	Top: (ft)	1930.00	Azi Reference North:	Grid	Dip Angle: (deg)	67.08
Date To:	2017-08-22	Bottom: (ft)	5770.00	Total Magnetic Field Strength: (nT)			52325
Spud Date:	2017-08-19			Mag to Reference North Correction: (deg)			7.29 E

Borehole Record

Hole Size (in)	From (ft)	To (ft)
13.500	30.00	1930.00
8.500	1930.00	13990.00

Casing Record

Size (in)	Weight (lb/ft)	From (ft)	To (ft)
9.625	36.00	30.00	1920.00

Mud Record

Type	From (ft)	To (ft)
Oil Based Mud	1930.00	13990.00

Deviation Record

Hole Size (in)	Interval (ft)	Inc | Az (Start)	Inc | Az (End)
8.500	12060.00	0.20 | 20.53	90.46 | 92.08

Acquisition System	Software Version
Baker Hughes Cadence	RT4.1
Plot Studio	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	2.00	OnTrak	1930.00	5770.00	10150.00	13990.00	2017-08-21 07:00	2017-08-22 05:20	19.97

Crew

Name	Arrive Wellsite	Depart Wellsite	Name	Arrive Wellsite	Depart Wellsite	Name	Arrive Wellsite	Depart Wellsite
Emi Iyalla	2017-08-18	2017-08-22	Mark Herpin	2017-08-21	2017-08-22			

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+ (%)
2017-08-20 03:00	1	1930.00	Oil Based Mud	9.3	12	N/A	21.2	80/20	Active Pit	26500	0.00
2017-08-20 13:00	1	3799.00	Oil Based Mud	9.1	10	N/A	16.4	80/20	Active Pit	25000	0.00
2017-08-21 03:00	1	7272.00	Oil Based Mud	9.0	9	N/A	15.6	82.4/17.6	Active Pit	25000	0.00
2017-08-21 13:00	1	9685.00	Oil Based Mud	9.3	11	N/A	16.0	83.1/16.9	Active Pit	25000	0.00
2017-08-22 03:00	1	13321.00	Oil Based Mud	9.4	11	N/A	18.0	84.1/15.9	Active Pit	22500	0.00

Mud Resistivity Record

Date / Time	Run No.	Measured Depth	Surface Temp	Downhole Rm @ BHCT	Downhole Rmf @ BHCT	Downhole Rmc @ BHCT
Surface Rm	Surface Rmf	Surface Rmc	BHCT			

		(ft)	(degF)	(ohm.m)	(ohm.m)	(ohm.m)	(degF)	(ohm.m)	(ohm.m)	(ohm.m)
2017-08-21 13:00	1	9685.00	140.0	100.000	N/A	N/A	250.0	100.000	N/A	N/A
2017-08-22 03:00	1	13321.00	135.0	100.000	N/A	N/A	250.0	100.000	N/A	N/A

Equipment and Service Data

Run No.	Tool	Serial Number	Measurement	Sensor Offset (ft)	Bit Offset (ft)	Max O.D. (in)	Min I.D. (in)
1	ATC_SU	12194650	Near Bit Inclination	5.93	6.73	7.000	4.330
1	ATC_SU	12194650	Near Bit VSS	5.93	6.73	7.000	4.330
1	ATC_MWD	12284825	Gamma (single)	2.75	12.90	7.000	3.250
1	ATC_MWD	12284825	Directional (mag)	12.27	22.42	7.000	3.250
1	OnTrak	12858682	Pressure	1.22	8215.60	6.750	0.000
1	OnTrak	12858682	Gamma (double)	2.11	8216.49	6.750	0.000
1	OnTrak	12858682	Resistivity (4tx)	6.15	8220.53	6.750	0.000
1	OnTrak	12858682	Directional (mag)	11.94	8226.32	6.750	0.000

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
OTK	OnTrak	Sensor Sub (Inc, Azi, Temp, Azimuthal GR, Res, AP, VSS), OnTrak Platform
BCPM	BCPM	Bi-Directional Communication and Power Module, OnTrak Platform

Comments

1 Depth measurements were obtained from a depth control system not supplied or operated by Baker Hughes. 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 OnTrak services (Multiple Propagation Resistivity, Gamma Ray, Annular Pressure and Directional) behind an 8 1/2 inch bit and rotary steerable assembly to perform a MAD (Measurement After Drilling) Pass from 1930 to 5770 feet MD (1930 to 5722 feet TVD). The data collected during this run was logged up to 26 hours after being drilled.

Curve Mnemonics

Presented Curves	Description	Units
CACLM	Conductivity Attenuation - Corrected - 400kHz	mmho/m
RACHM	Resistivity Attenuation - Corrected - 2MHz	ohm.m
RACLM	Resistivity Attenuation - Corrected - 400kHz	ohm.m
RPCHM	Resistivity Phase - Corrected - 2MHz	ohm.m
RPCLM	Resistivity Phase - Corrected - 400kHz	ohm.m
RPTHM	Resistivity Time Since Drilled	min
ROPA	Depth Averaged ROP 3 ft Average	ft/h
GRAM	OnTrak - Gamma Ray - Apparent - Memory 0.5 ft Average	API
GRIM	OnTrak - Gamma Ray - Data Point Indicator - Memory	unitless

BAKER HUGHES

Company Noble Energy

Well Wells Ranch BB11-643

Interval

Date From: 2017-08-21 02:30:00 **Top:** 1930.00

Date To: 2017-08-22 07:30:00 **Bottom:** 5770.00

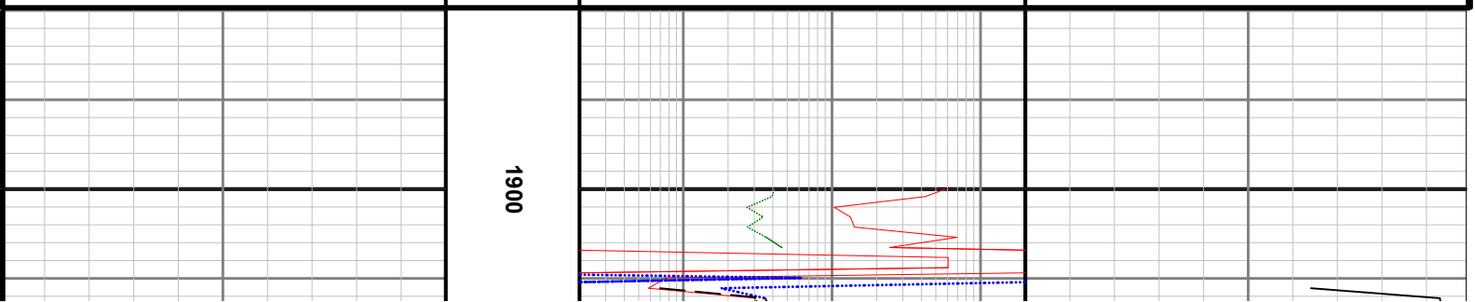
Created 2017-08-22 16:37:46

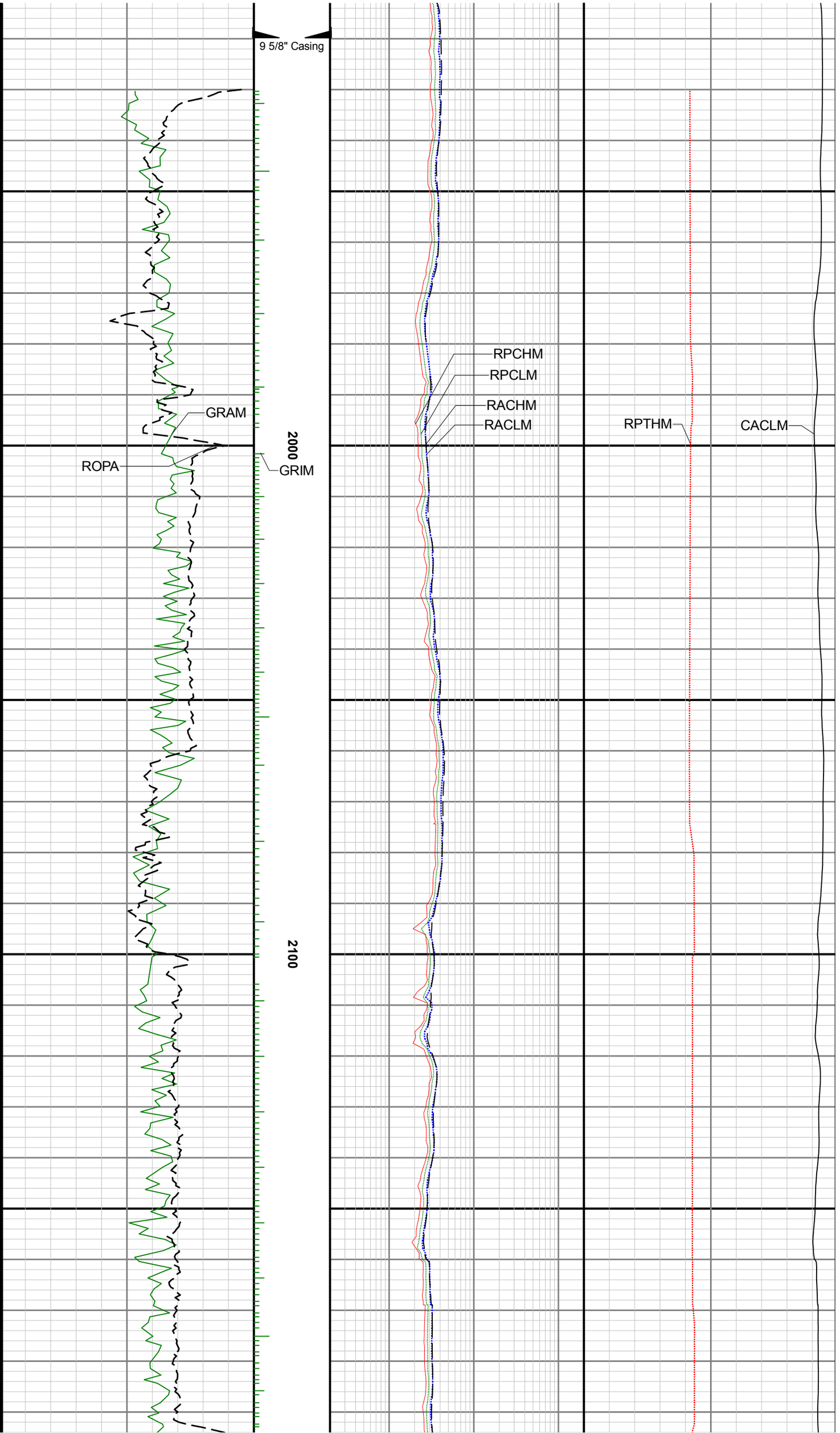
Gamma Ray - Apparent 0.5 ft Average [GRAM]
0 150
API
Depth Averaged ROP 3 ft Average [ROPA]
1200 0
ft/h

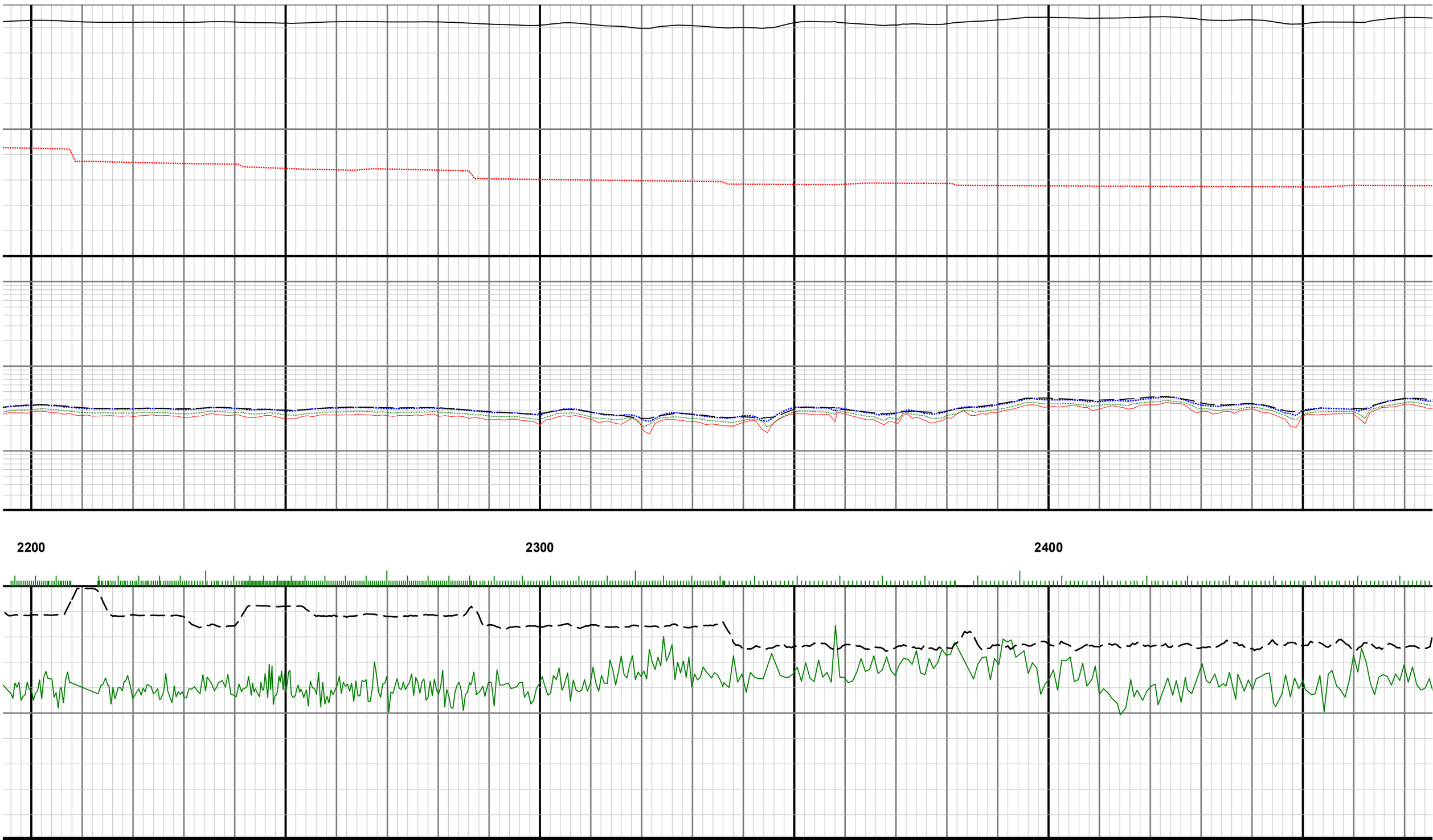
MD 1:240 feet

Resistivity Phase - Corrected - 2MHz [RPCHM]
0.2 200
ohm.m
Resistivity Phase - Corrected - 400kHz [RPCLM]
0.2 200
ohm.m
Resistivity Attenuation - Corrected - 2MHz [RACHM]
0.2 200
ohm.m
Resistivity Attenuation - Corrected - 400kHz [RACLM]
0.2 200
ohm.m

Conductivity Attenuation - Corrected - 400kHz [CACLM]
4000 0
mmho/m
Resistivity Time Since Drilled [RPTHM]
0 600
min




9 5/8" Casing
GRAM
ROPA
GRIM
2000
2100
RPCHM
RPCLM
RACHM
RACLM
RPTHM
CACLM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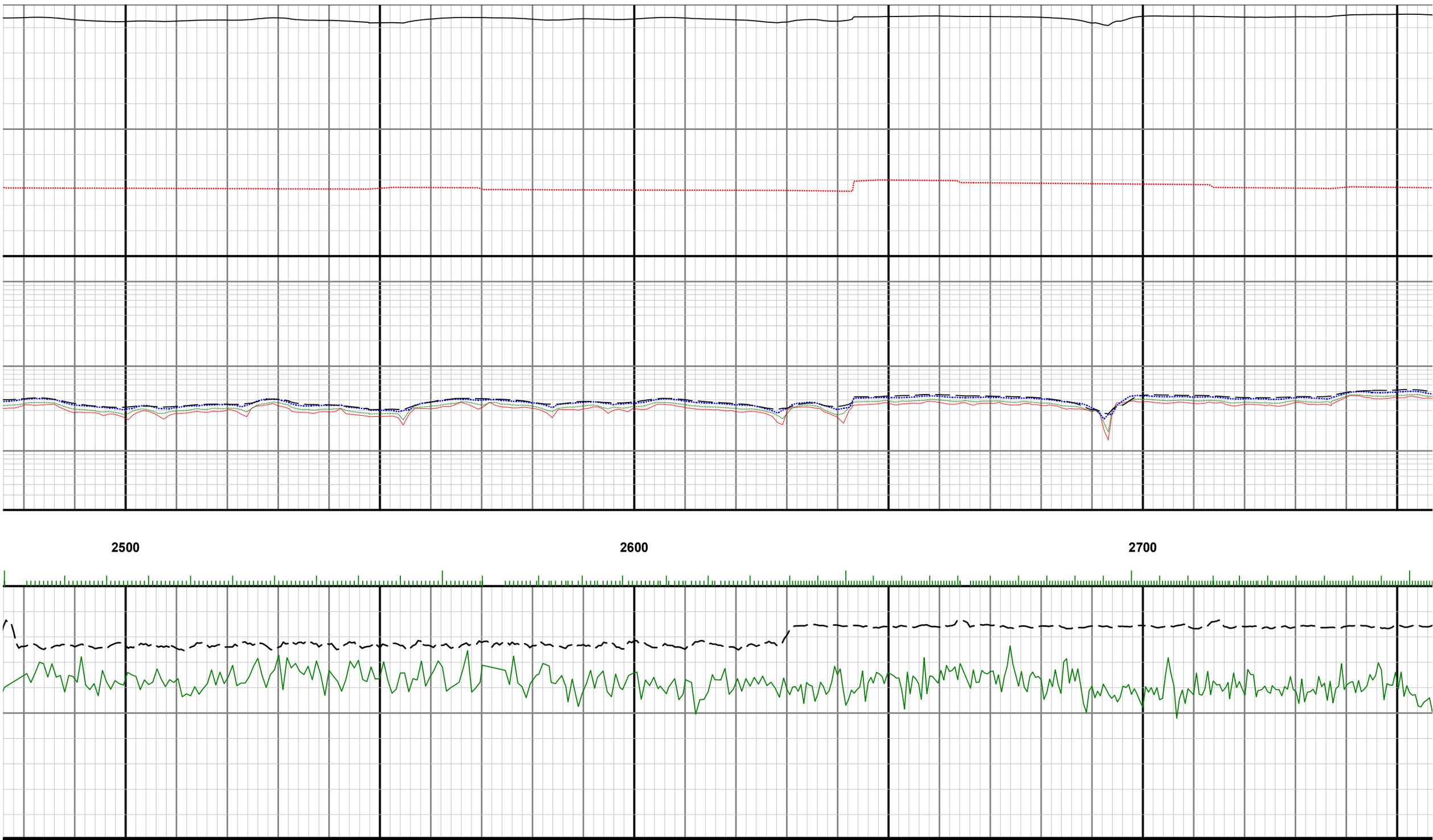
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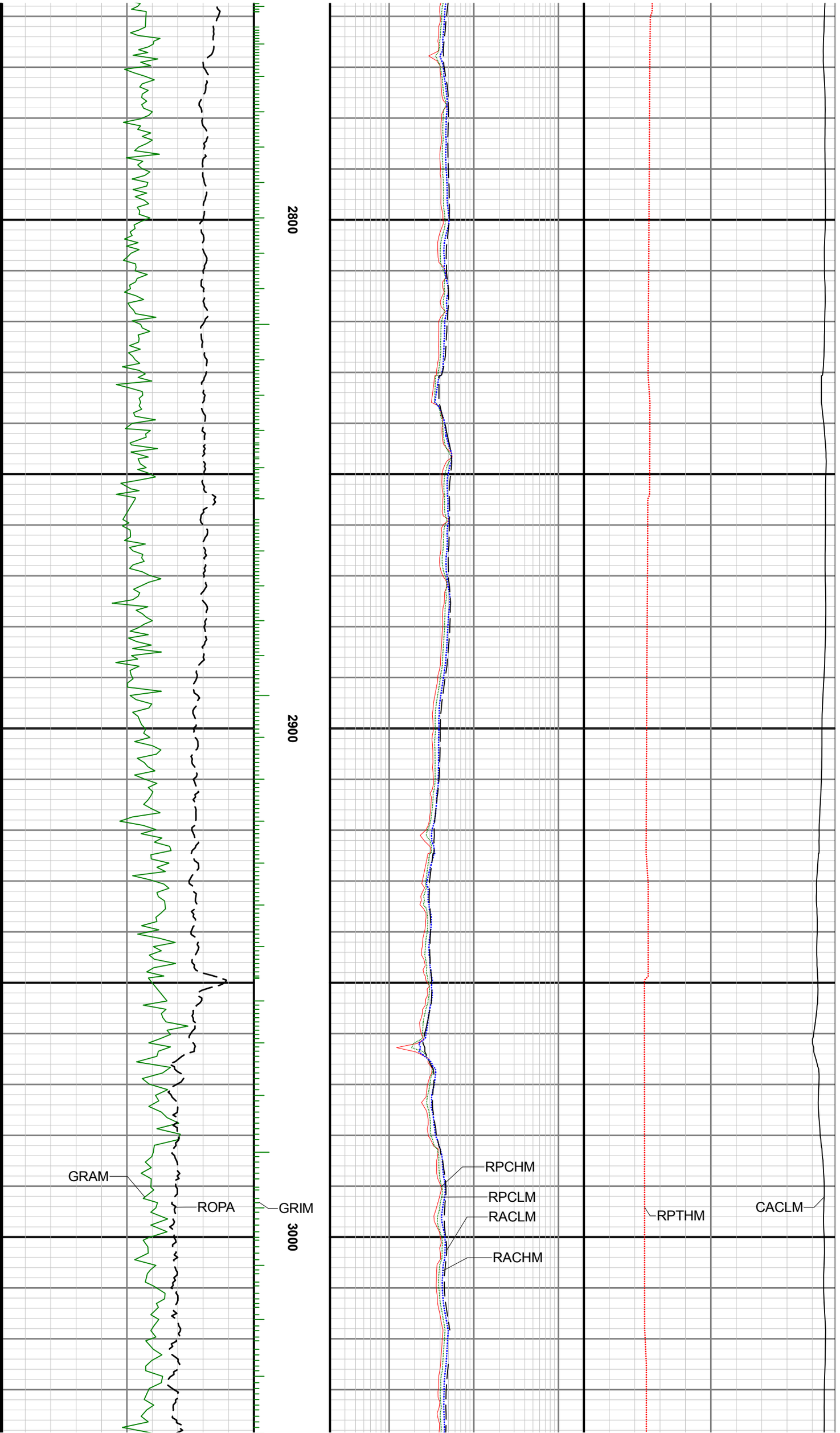
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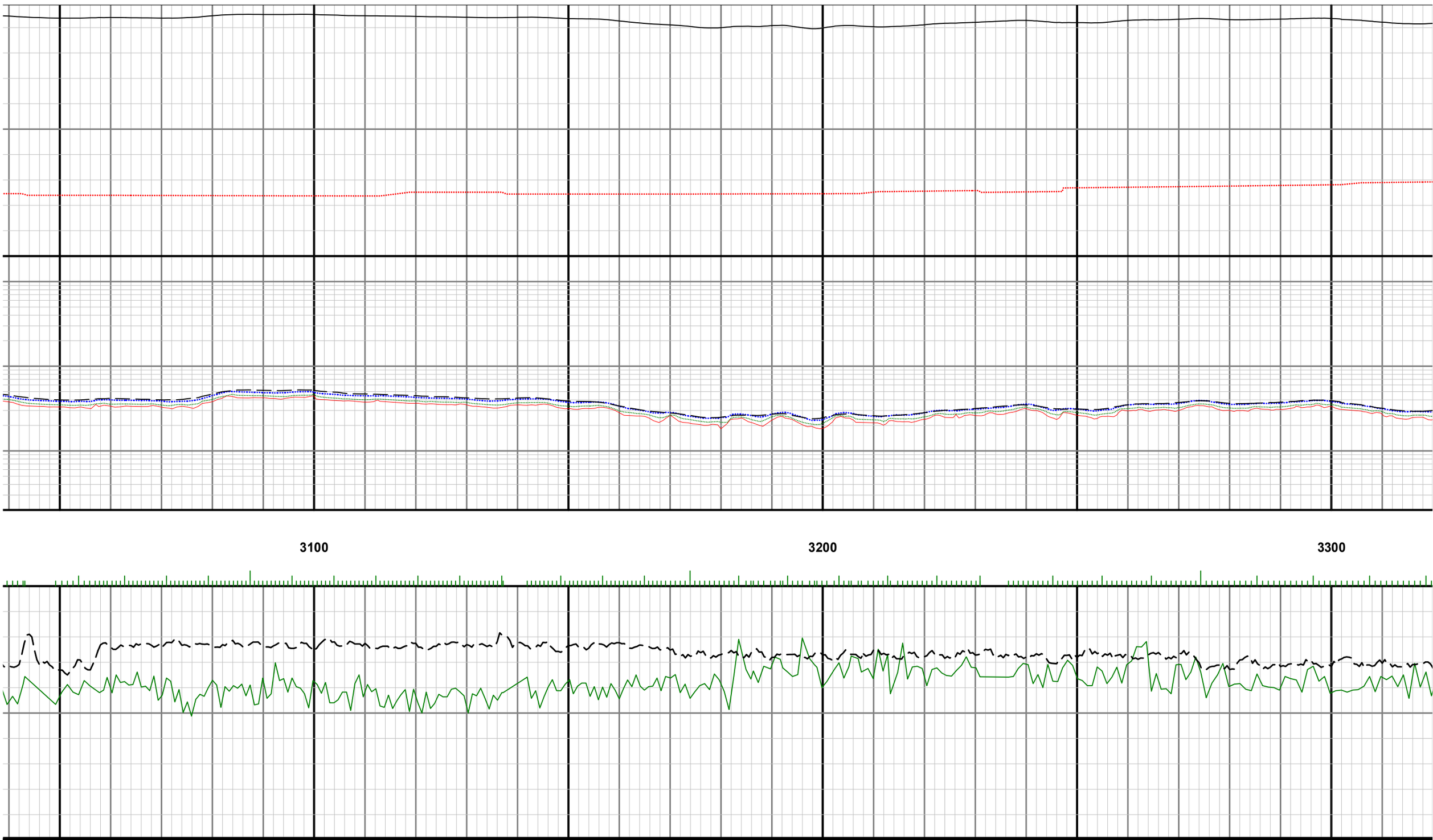
2900
3000
GRAM
ROPA
GRIM
RPCHM
RPCLM
RACLM
RACHM
RPTHM
CACLM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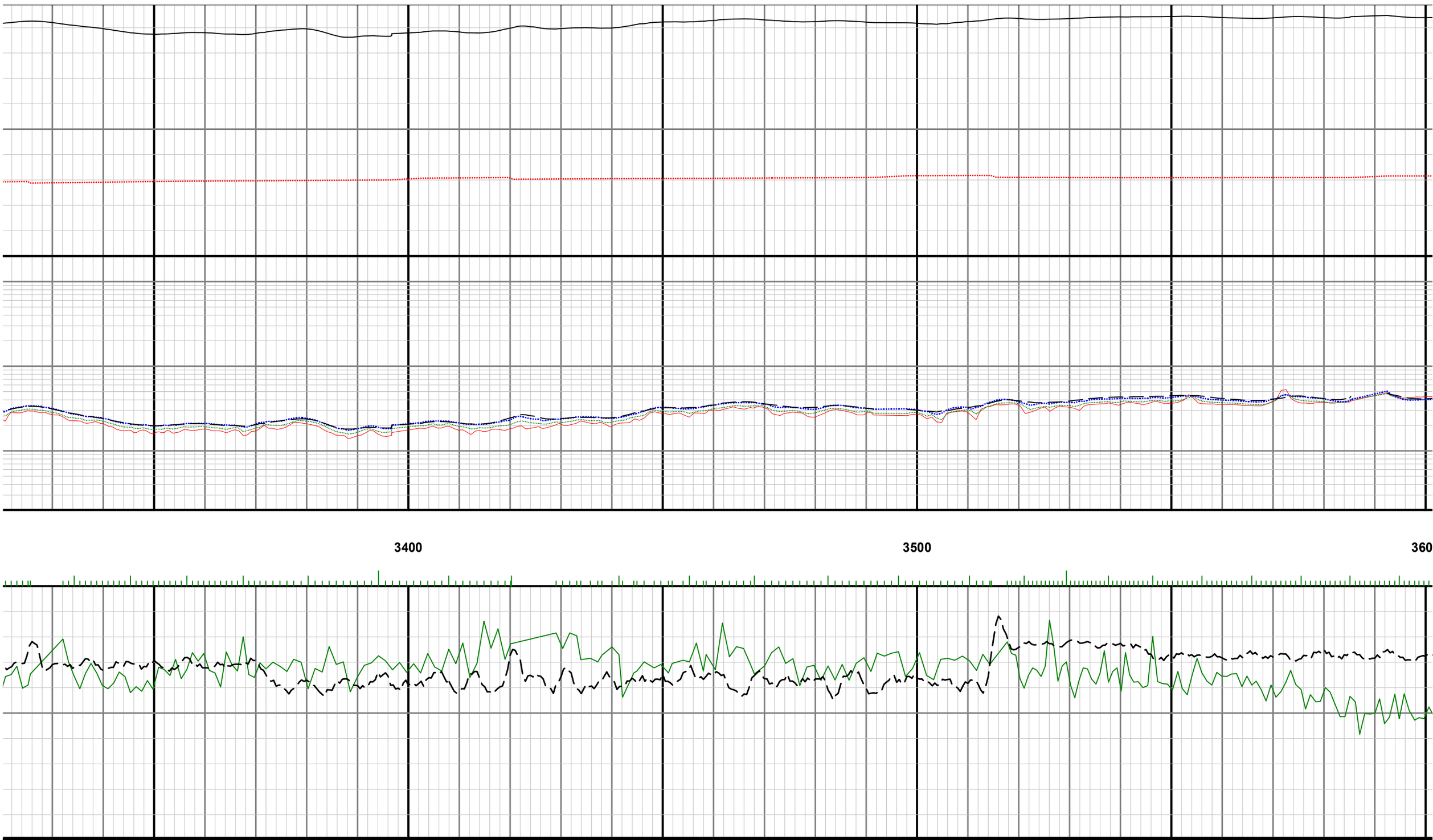
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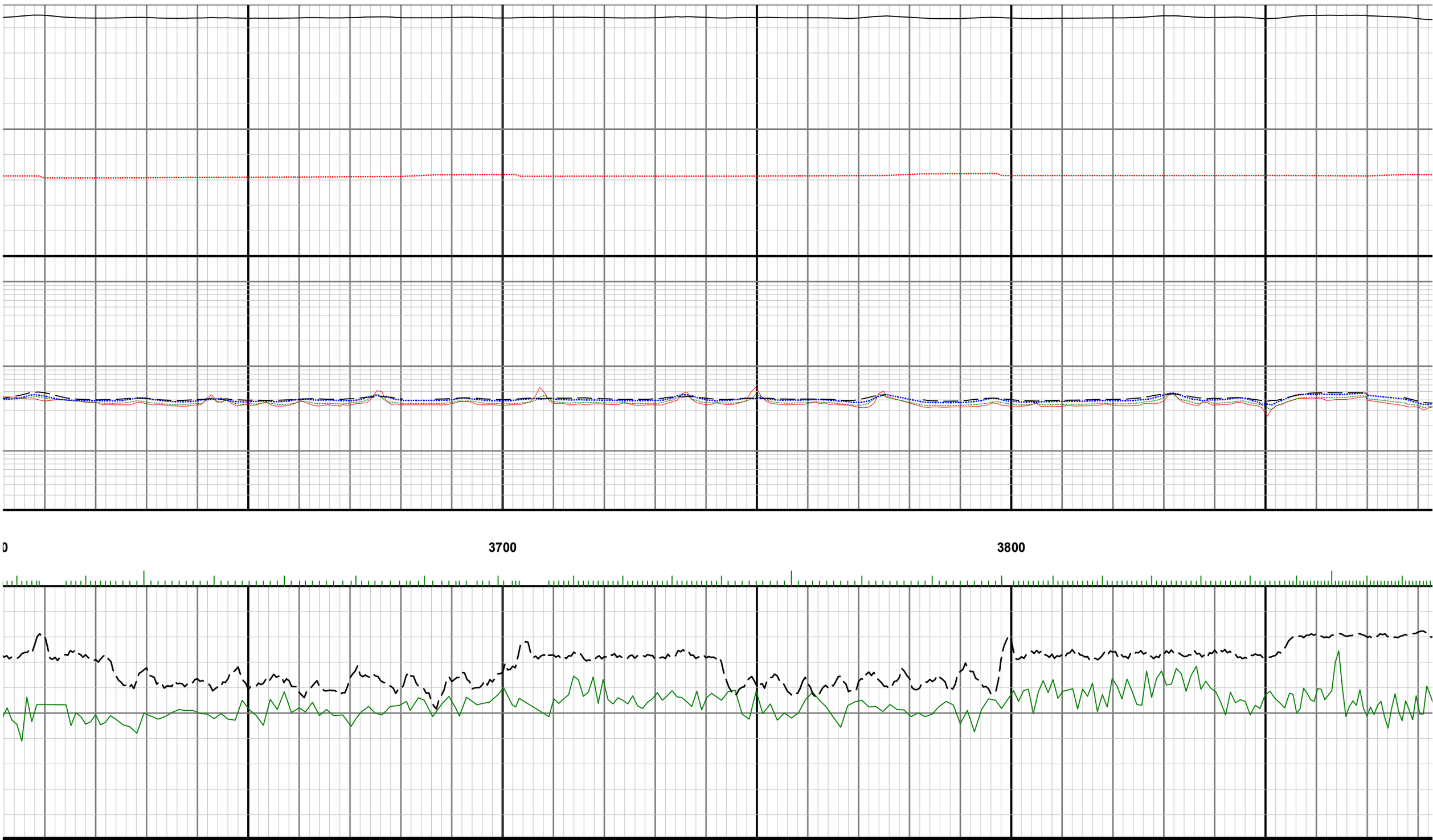
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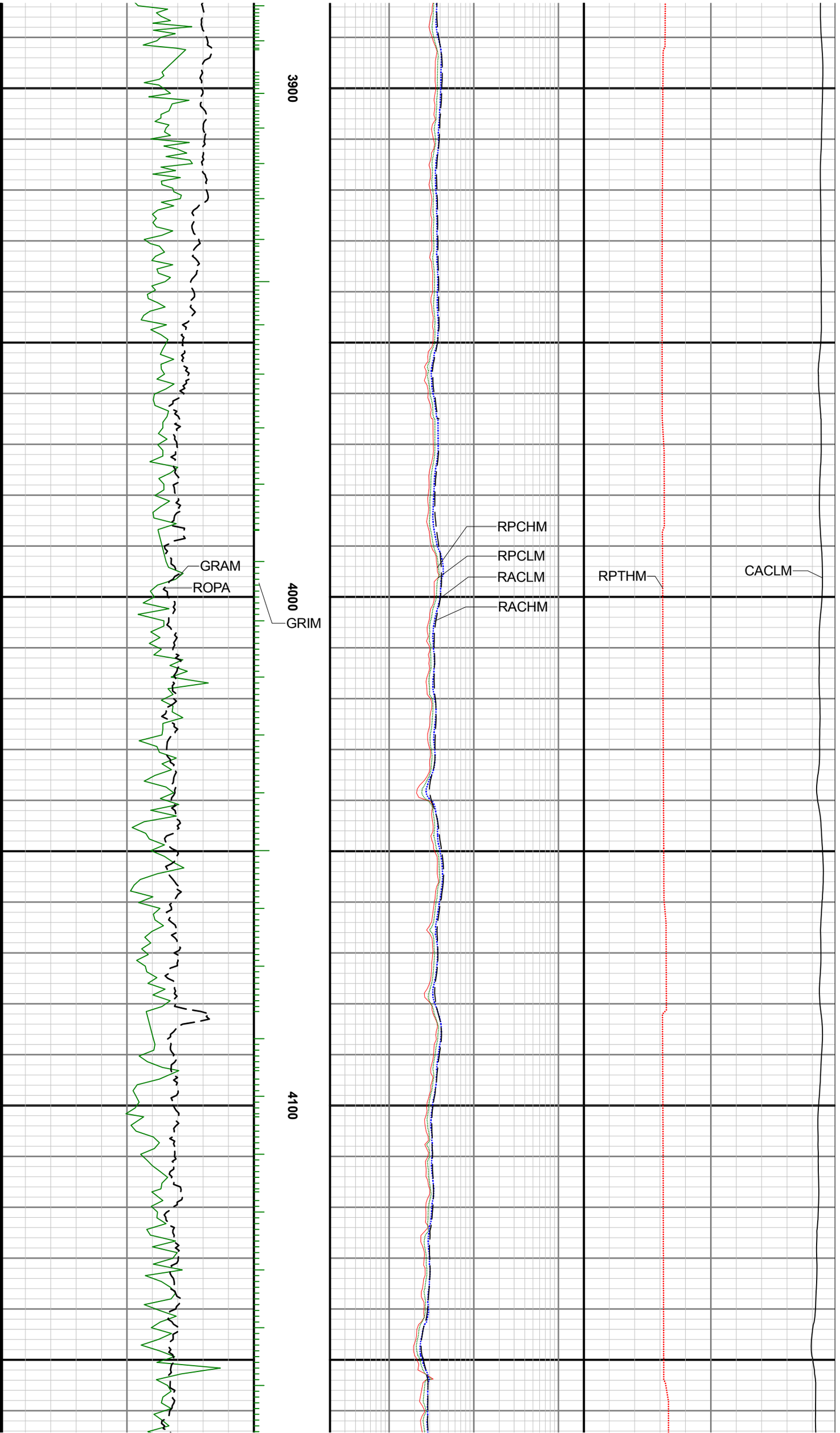
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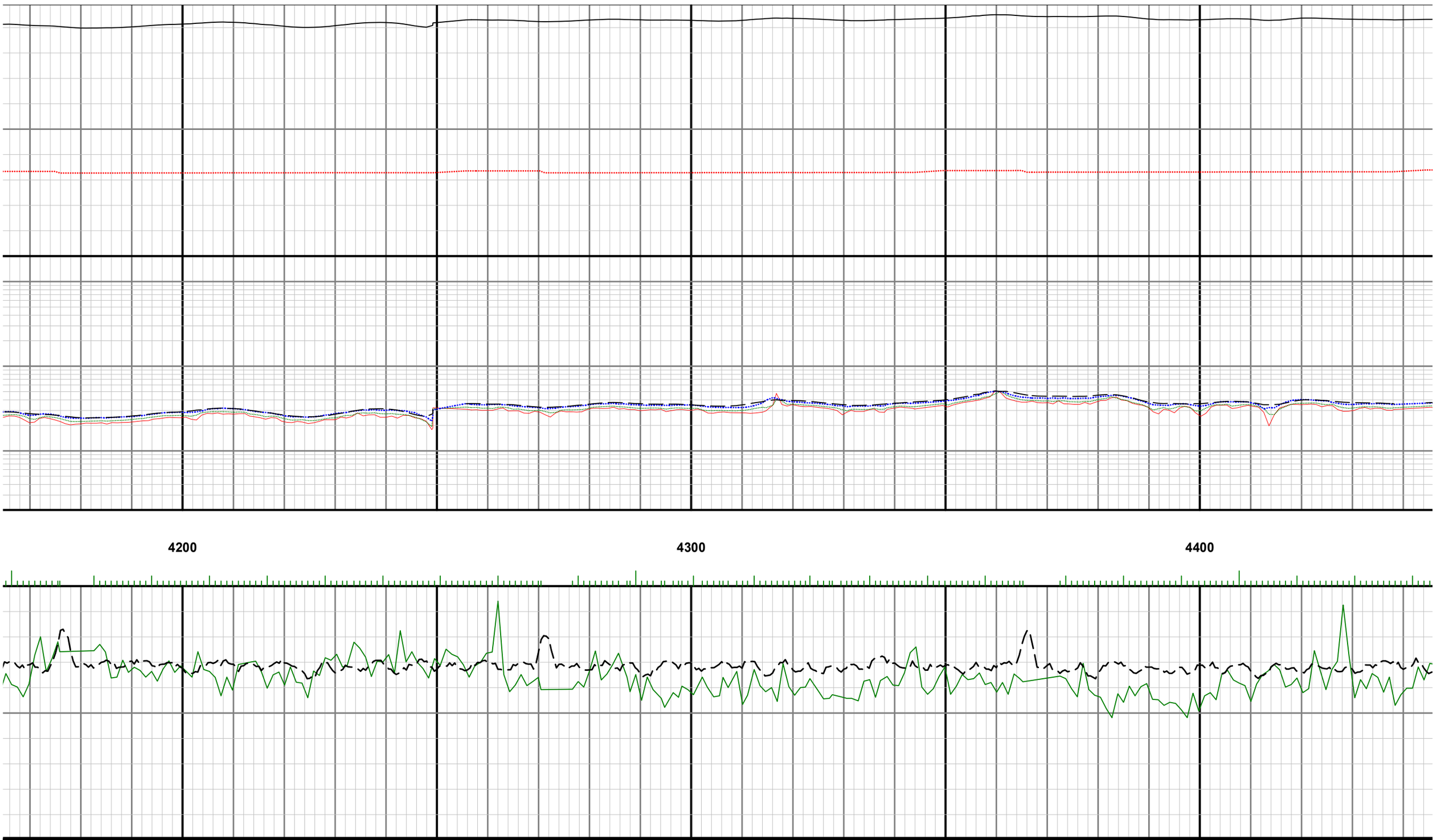
4000
4100
GRAM
ROPA
GRIM
RPCHM
RPCLM
RACLM
RACHM
RPTHM
CACLM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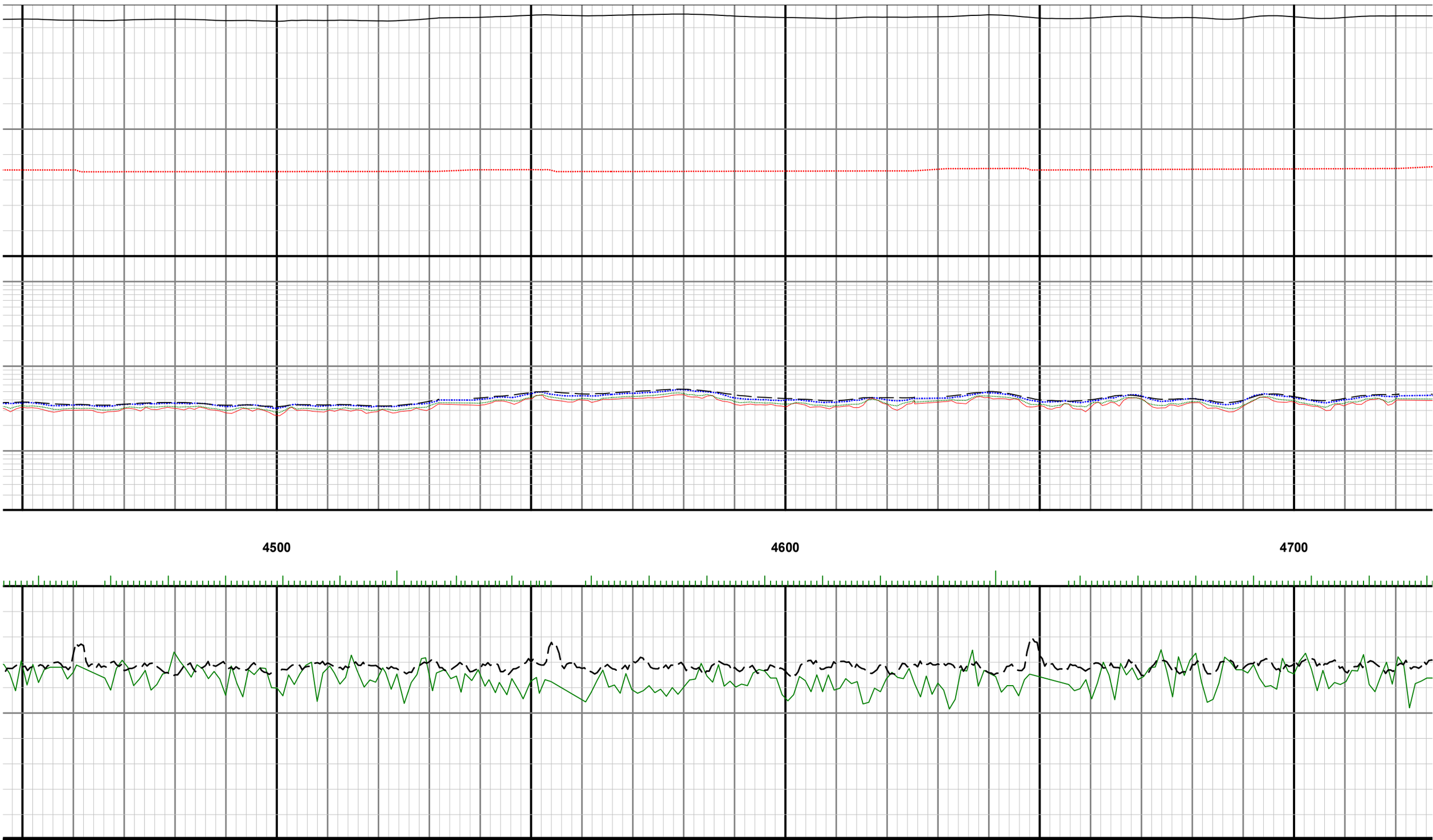
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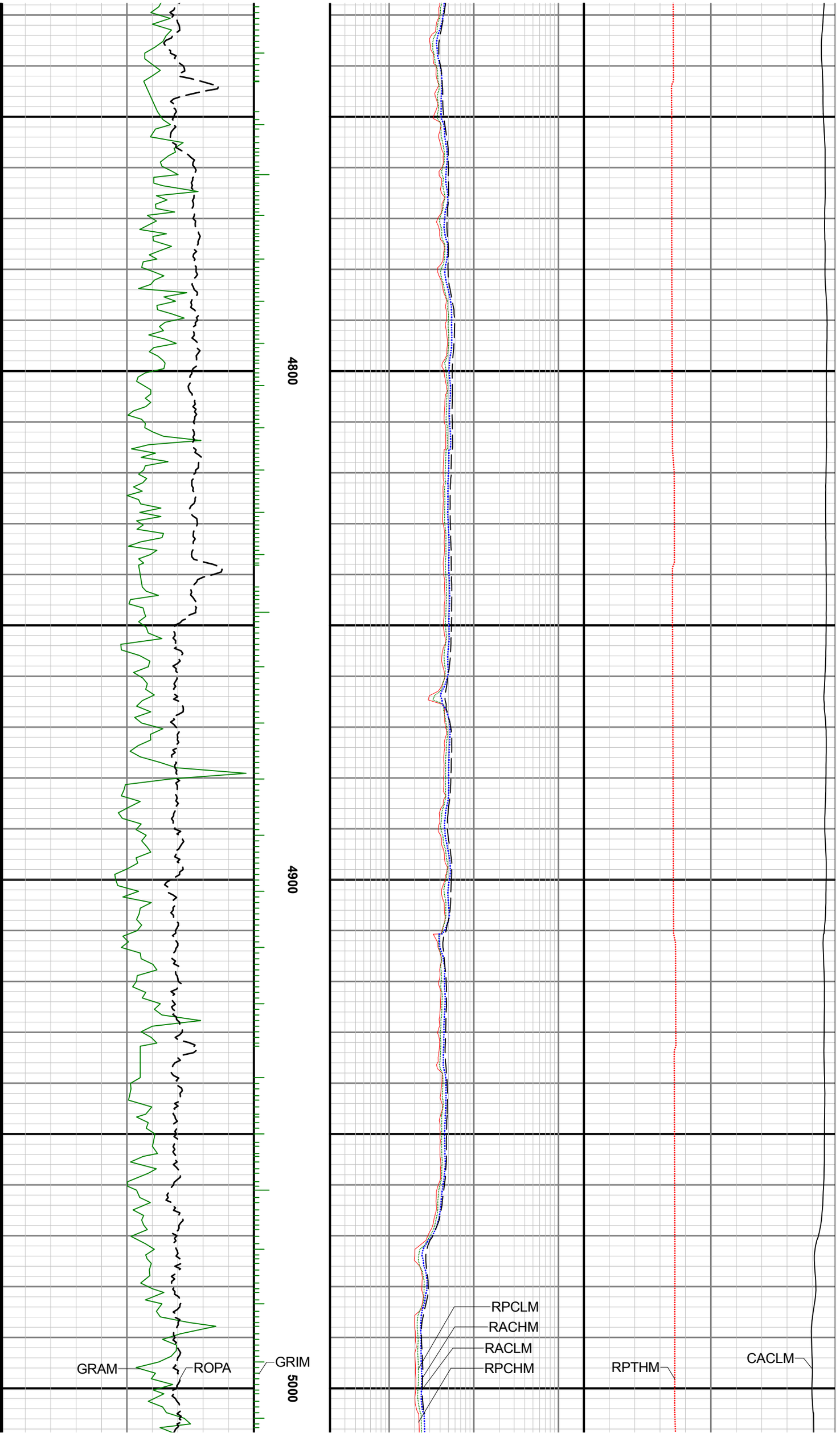
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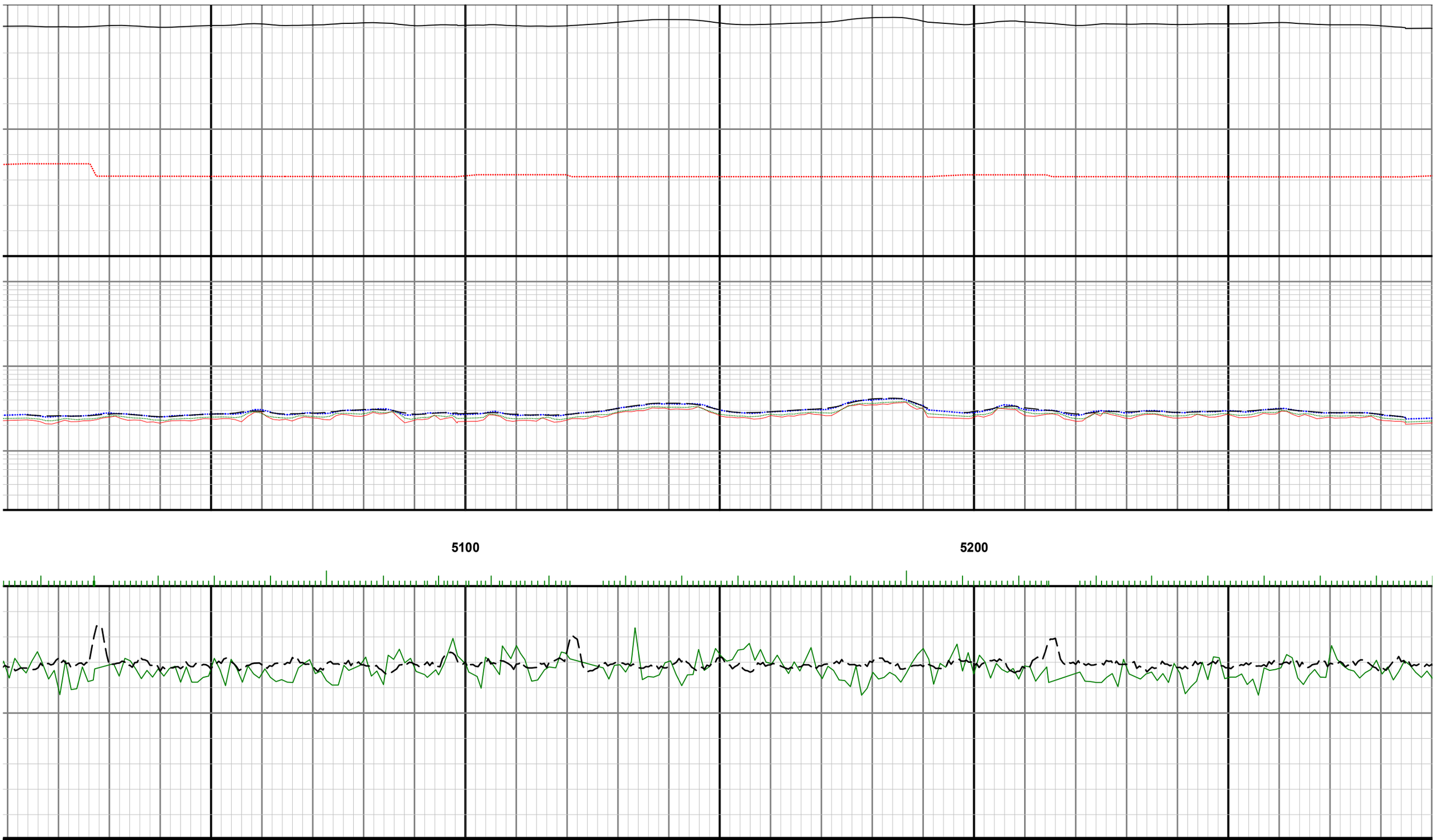
4900
5000
GRAM
ROPA
GRIM
RPCLM
RACHM
RACLM
RPCHM
RPTHM
CACLM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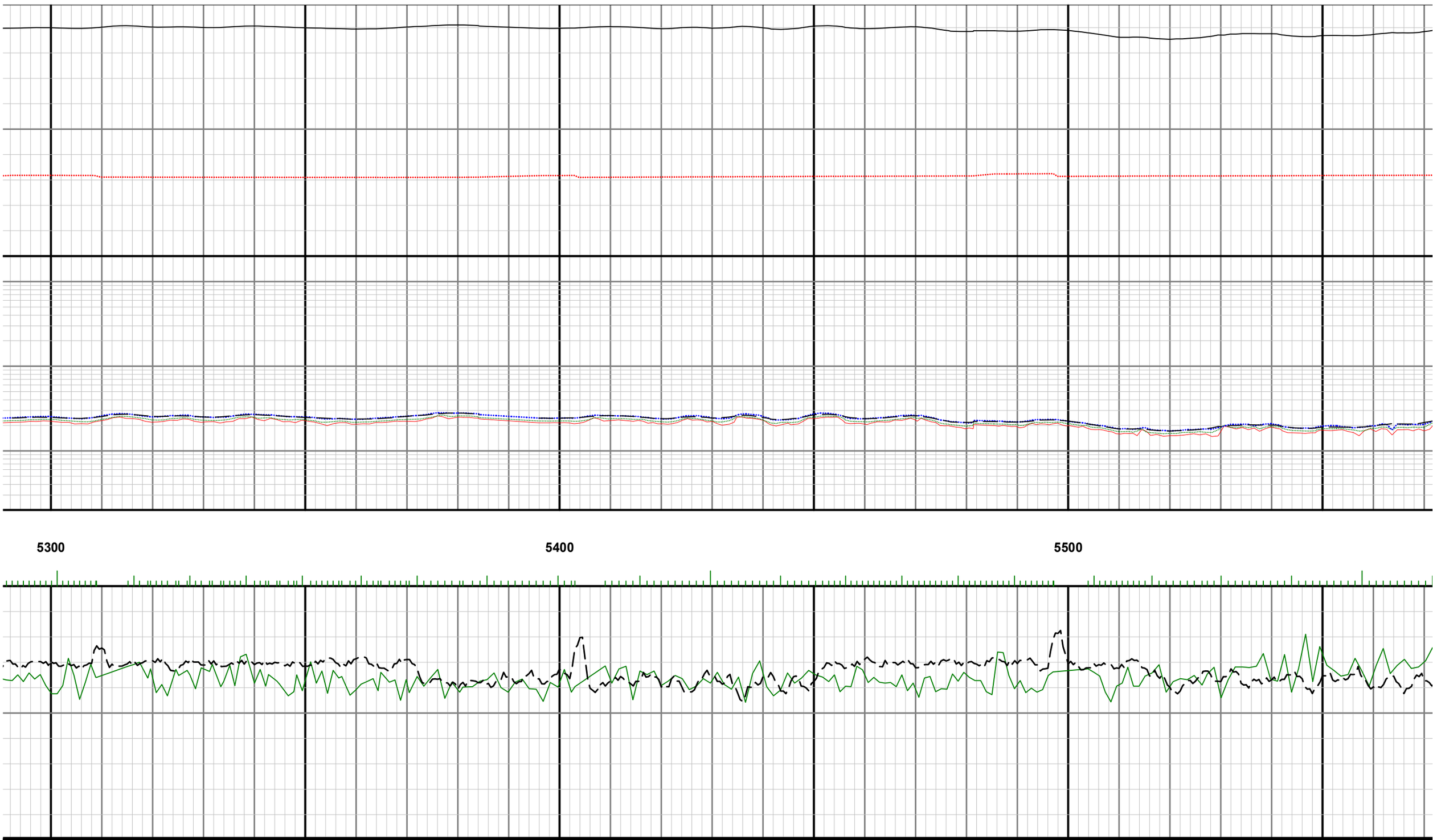
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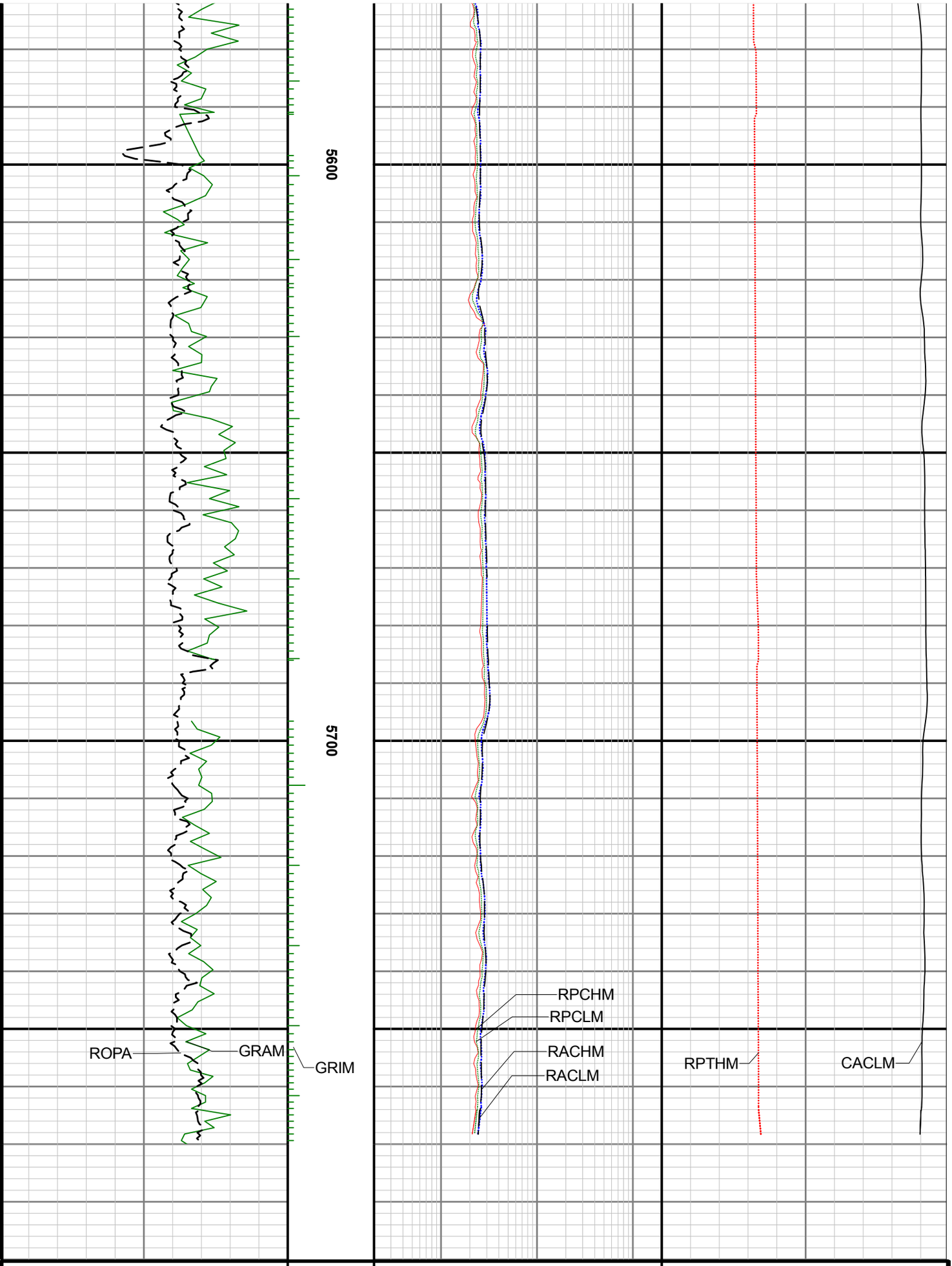

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0 150
API
Depth Averaged ROP 3 ft Average [ROPA]
1200 0
ft/h

MD 1:240 feet

Resistivity Phase - Corrected - 2MHz [RPCHM]
0.2 200
ohm.m
Resistivity Phase - Corrected - 400kHz [RPCLM]
0.2 200
ohm.m
Resistivity Attenuation - Corrected - 2MHz [RACHM]
0.2 200
ohm.m
Resistivity Attenuation - Corrected - 400kHz [RACLM]
0.2 200
ohm.m

Conductivity Attenuation - Corrected - 400kHz [CACLM]
4000 0
mmho/m
Resistivity Time Since Drilled [RPTHM]
0 600
min