ThruBit
A Schlumberger Company

# ARRAY INDUCTION GAMMA RAY MEMORY LOG

| | |
|---|---|
| Company | SANDRIDGE ENERGY |
| Well | MURRAY 3406 1-5H |
| Field | EASTHAM |
| County | HARPER |
| State | KANSAS |

Company SANDRIDGE ENERGY
Well MURRAY 3406 1-5H
Field EASTHAM
County HARPER State KANSAS
Location: API # : 15-077-21921-0100
200' FSL & 660' FEL
SEC 5 TWP 34S RGE 6W

| | | | |
|---|---|---|---|
| Permanent Datum | G.L. | Elevation | 1254' |
| Log Measured From | KB 15' ABOVE PERM DATUM | | |
| Drilling Measured From | KB | | |

Other Services
THRUBIT
PORTAL BIT

Elevation
K.B. 1269'
D.F. 1269'
G.L. 1254'

| | | | |
|---|---|---|---|
| Date | 22 APR 2013 | | |
| Run Number | ONE | | |
| Depth Driller | 8885' | | |
| Depth Logger | 8833' | | |
| Bottom Logged Interval | 8823' | | |
| Top Log Interval | 2500' | | |
| Casing Driller | 7.0" @ 5265' | | |
| Casing Logger | 5254' | | |
| Bit Size | 6.125" | | |
| Type Fluid in Hole | WBM | | |
| Density / Viscosity | 8.4 / 27 | | |
| pH / Fluid Loss | 9.0 / 60 | | |
| Source of Sample | PIT | | |
| Rm @ Meas. Temp | 7.69 OHM@65DEGF | | |
| Rmf @ Meas. Temp | 5.77 OHM@65DEGF | | |
| Rmc @ Meas. Temp | 9.61 OHM@65DEGF | | |
| Source of Rmf / Rmc | CALCULATED | | |
| Rm @ BHT | 3.82 OHM@138DEGF | | |
| Time Circulation Stopped | 11:00 22 APR 2013 | | |
| Time Logger on Bottom | 12:30 22 APR 2013 | | |
| Maximum Recorded Temperature | 138 DEGF | | |
| Equipment Number | T005 | | |
| Location | OKC, OK | | |
| Recorded By | S.JARSKI | | |
| Witnessed By | T.LEIJA | | |

<<< Fold Here >>>



## Comments

SERVICE: HORIZONTAL PUMP DOWN MEMORY BIT DEPTH: 8781' LOGGED TO: 2500'
ALL SCALES AND PRESENTATIONS PER CLIENT REQUEST
LIMESTONE MATRIX, 2.71 g/cc. USED FOR POROSITY MEASUREMENTS
TOOLSTING RAN WITH SWIVEL AND SMALL DE-CENTRALIZER
TBHV REPRESENTS TOTAL BOREHOLE VOLUME, ft3
ABHV REPRESENTS ANNULAR HOLE VOLUME, CALCULATED FOR 4.5" CSG., ft3
RIGMINDER USED TO ACQUIRE LOG DEPTH
LOG CORRELATED TO MWD GR
RIG: UNIT #310

CREW: S.JARSKI R.WILSON R.CRESSWELL I.HERNANDEZ

| | | | | | |
|---|---|---|---|---|---|
| Service Ticket No. | 1862 | API No. | 15-077-21921-0100 | PGM Ver | WARRIOR 7.0 |

The Well Name, Location, Borehole Description, and / or Cementing Data Furnished by Client

EQUIPMENT DATA

| GAMMA | NEUTRON | DENSITY | INDUCTION |
|---|---|---|---|

| Run No. | ONE | Run No. | ONE | Run No. | ONE | Run No. | ONE |
|---|---|---|---|---|---|---|---|
| Serial No. | PS27T | Serial No. | PS14N | Serial No. | PS01D | Serial No. | PS38R |
| Model No. | PS | Model No. | PS | Model No. | PS | Model No. | PS |
| Diameter | 2.125" | Diameter | 2.125" | Diameter | 2.125" | Diameter | 2.125" |

LOGGING DATA

General Data

| Pass | Depths | | Well Head | Speed | Logging Run Comments |
|---|---|---|---|---|---|
| No. | From | To | Pressure | Ft/Min | |
| ONE | 8833' | 2500' | 0 PSI | 30 FPM | |
| | | | | | |

| | GAMMA | | NEUTRON | | DENSITY | | INDUCTION | |
|---|---|---|---|---|---|---|---|---|
| Pass | Scale | | Scale | | Scale | | Scale | |
| No. | L | R | L | R | L | R | L | R |
| ONE | 0 API | 150 API | 30% | -10% | 30% | -10% | 0.2 OHMM | 2000 OHMM |
| | | | | | | | | |

DIRECTIONAL INFORMATION

| Maximum Deviation | 91.63 | deg. @ | 7024' | KOP | 3750' |
|---|---|---|---|---|---|

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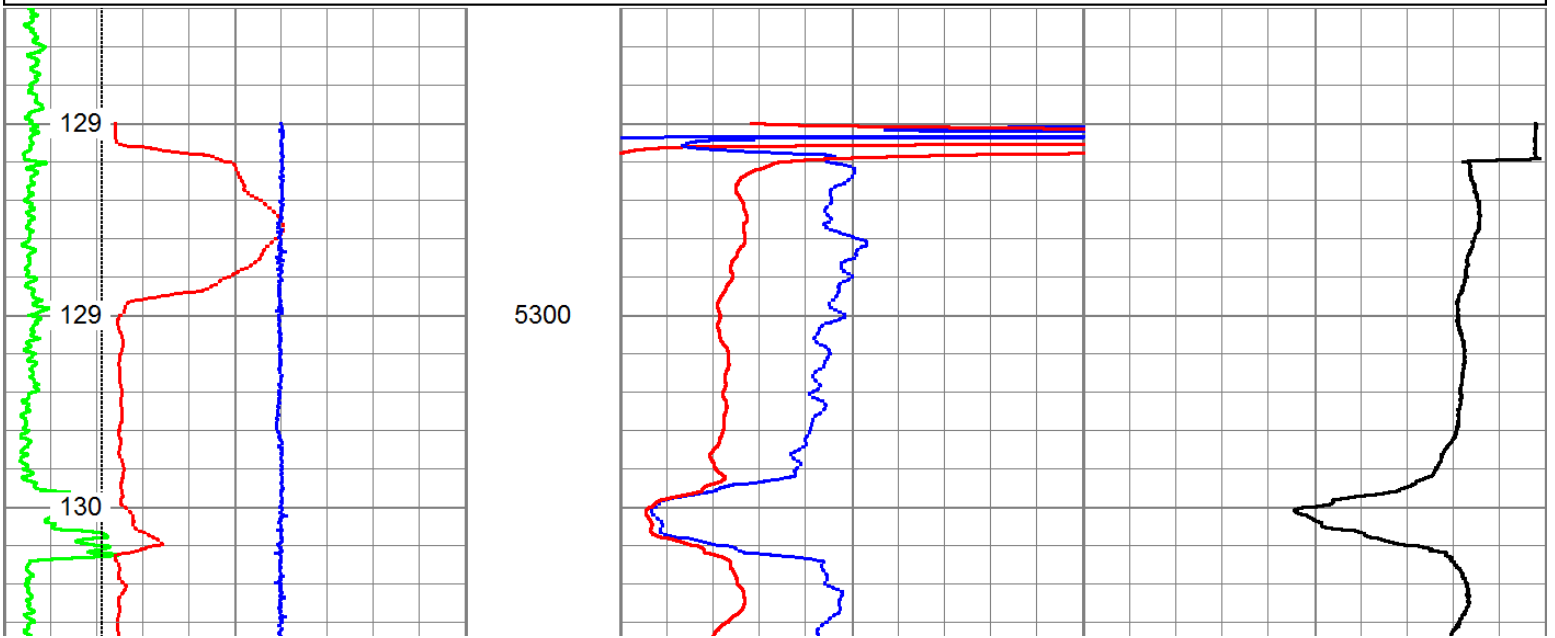
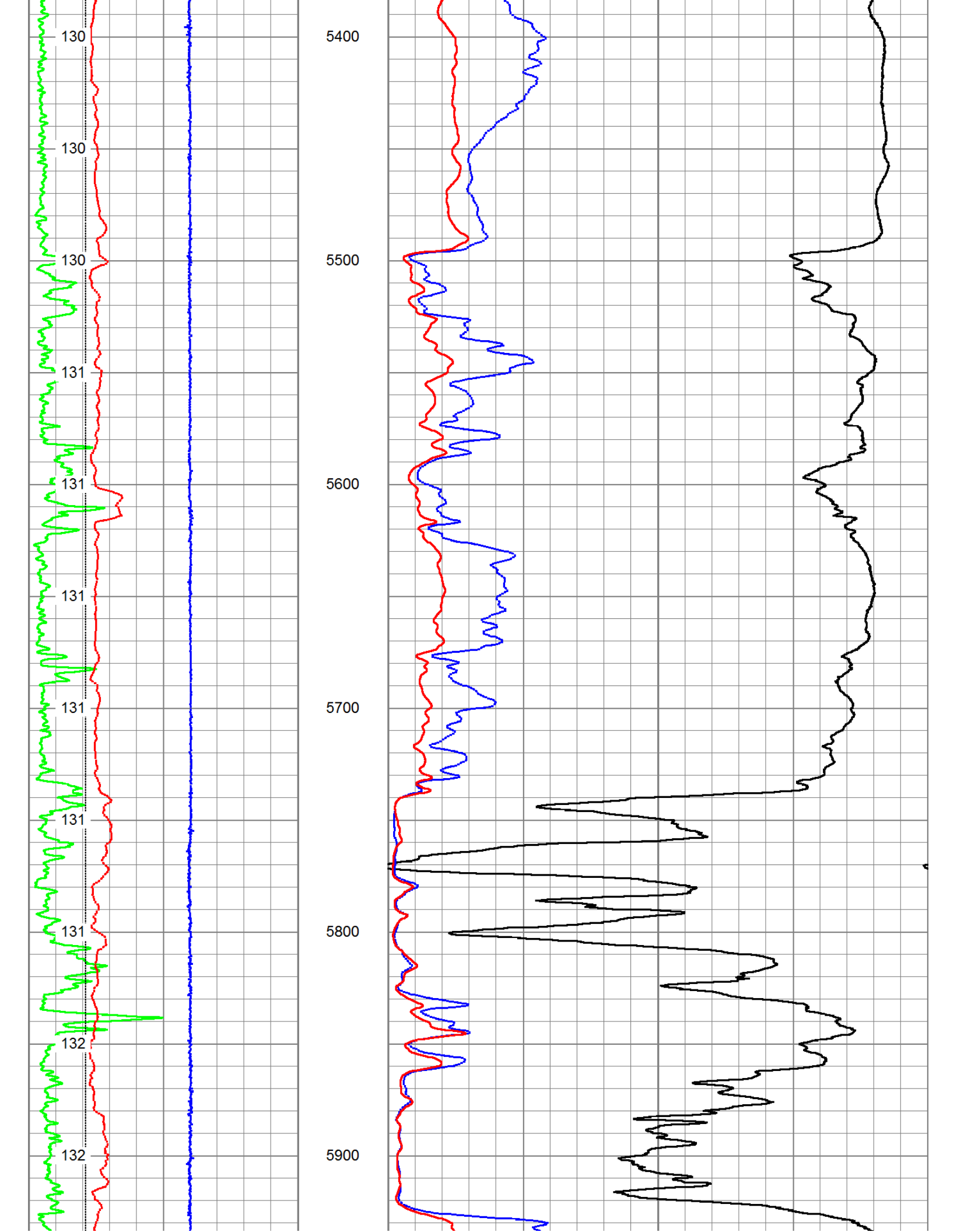
# MAIN PASS

Database File: murray_mem.db
Dataset Pathname: proc1/pass1.4
Presentation Format: 6_2r_chk
Dataset Creation: Mon Apr 22 20:56:58 2013
Charted by: Depth in Feet scaled 1:600

| | | |
|---|---|---|
| 0 | GR (GAPI) | 150 |
| 4 | DCAL (in) | 14 |
| -5 | ACCY | 5 |
| 4 | BOREID (in) | 14 |
| GRTEMP (degF) | | |

| | | |
|---|---|---|
| 50 | 20in 2ft Res (Ohm-m) | 500 |
| 50 | 90in 4ft Res (Ohm-m) | 500 |
| 1000 | DEEP COND (mmho/m) | 0 |
| 0 | 20in 4ft Res (Ohm-m) | 50 |
| 0 | 90in 4ft Res (Ohm-m) | 50 |

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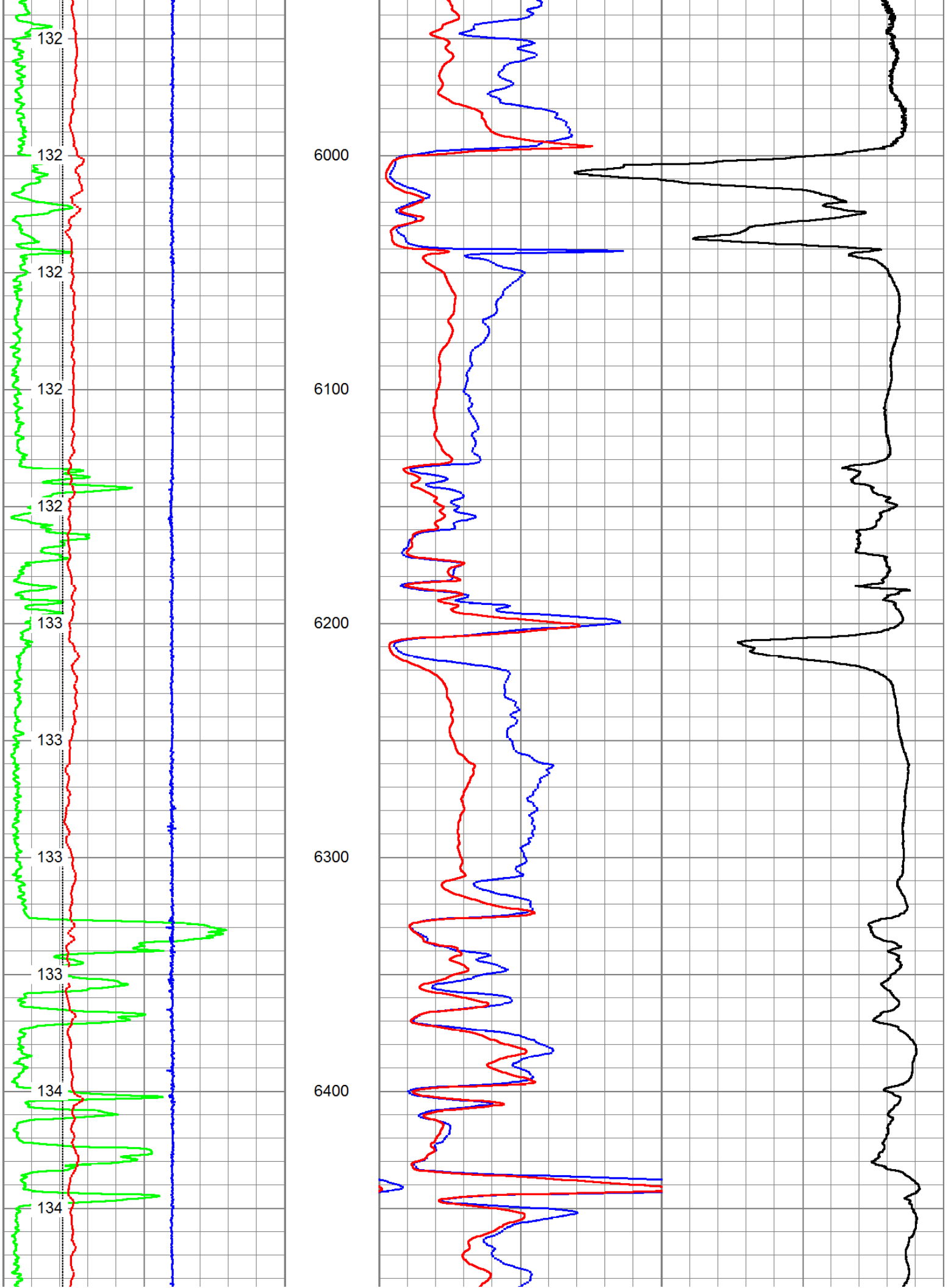
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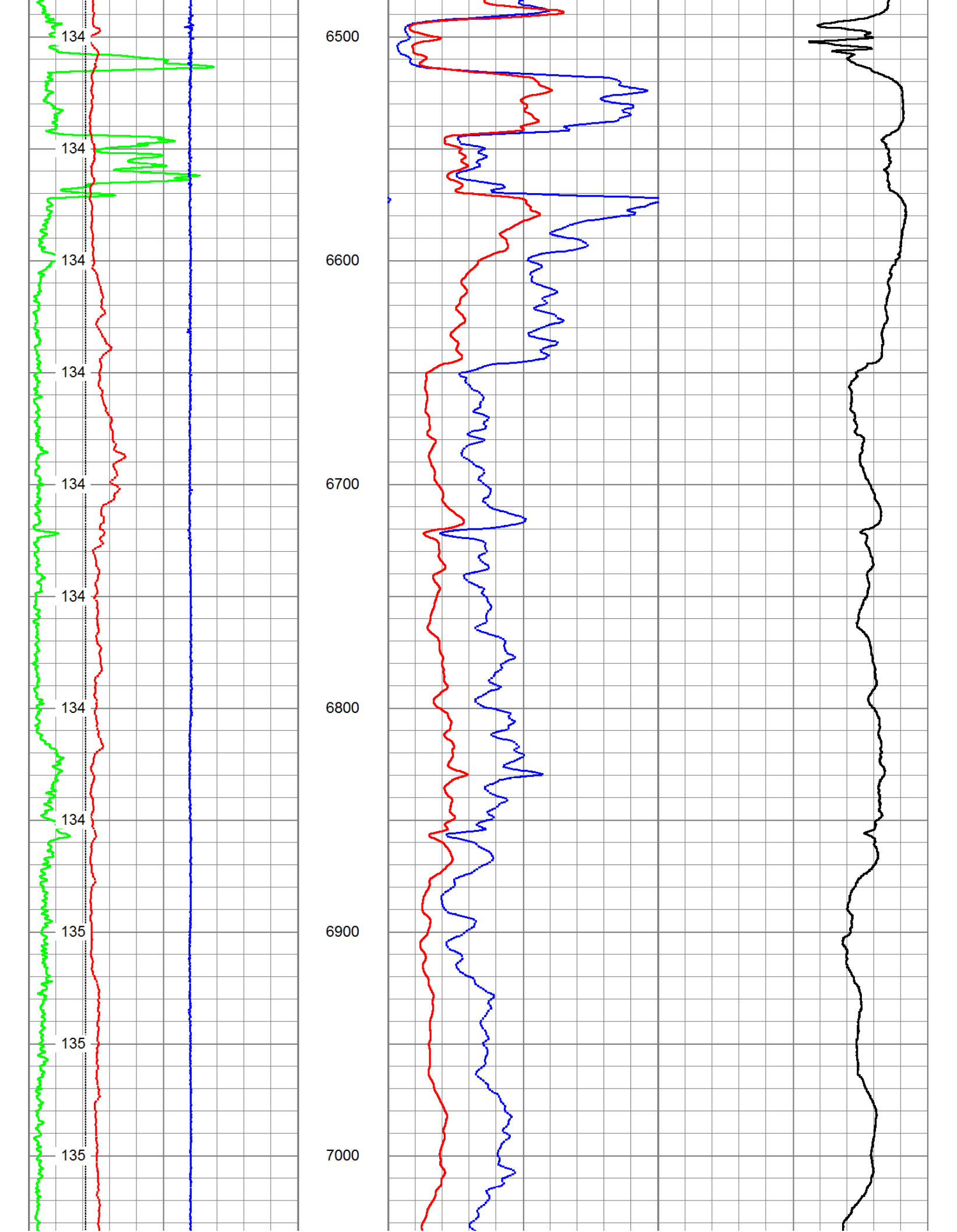
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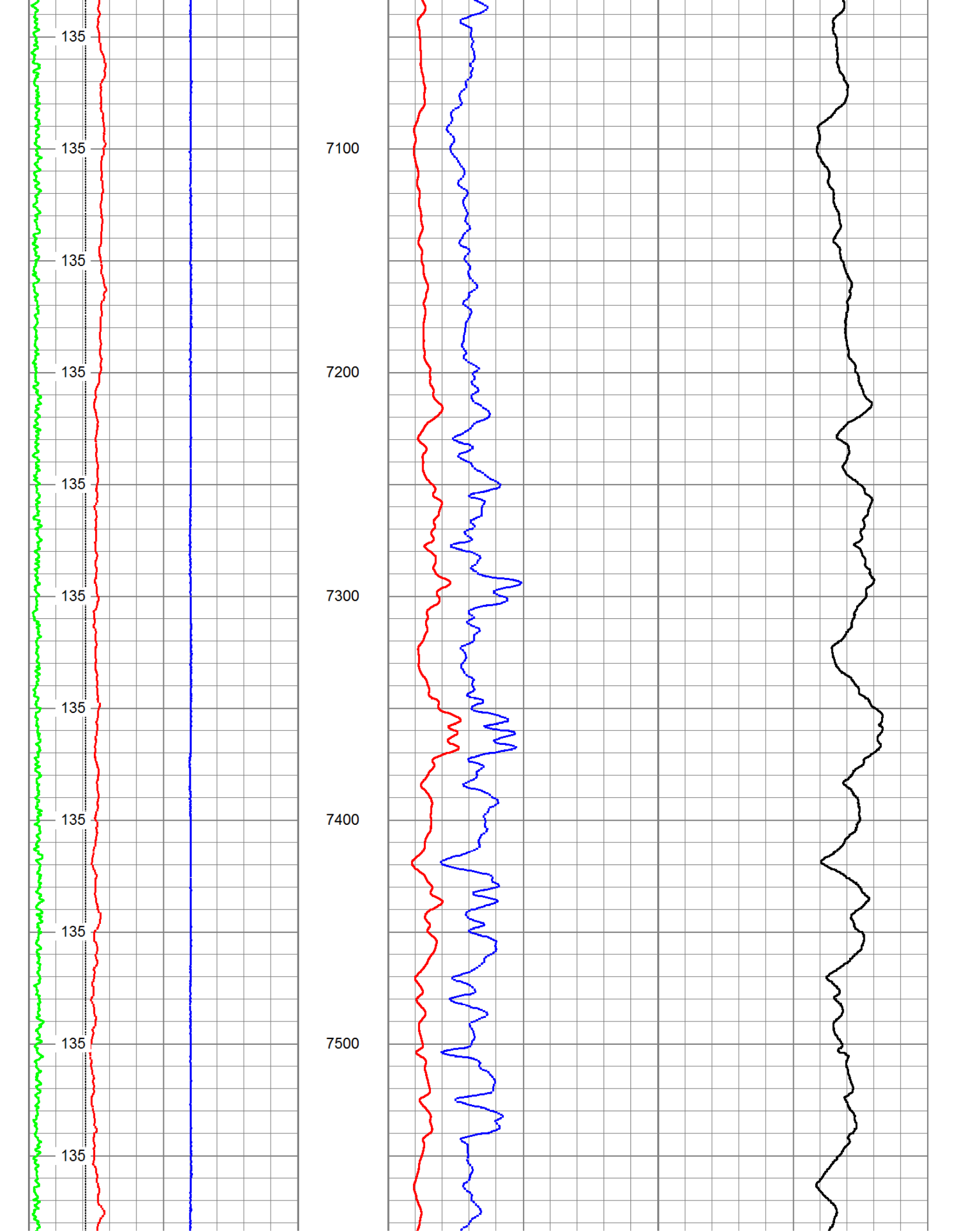
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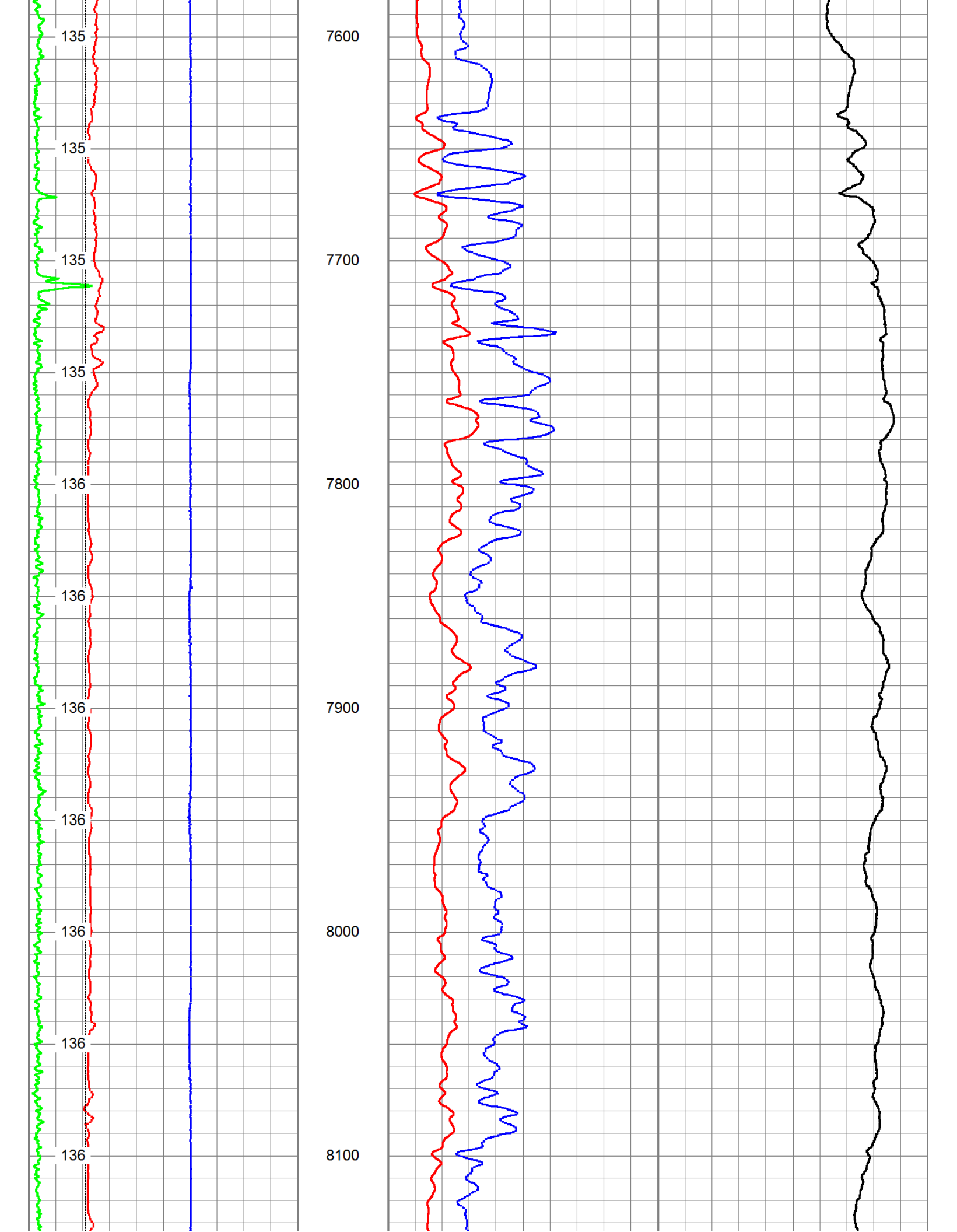
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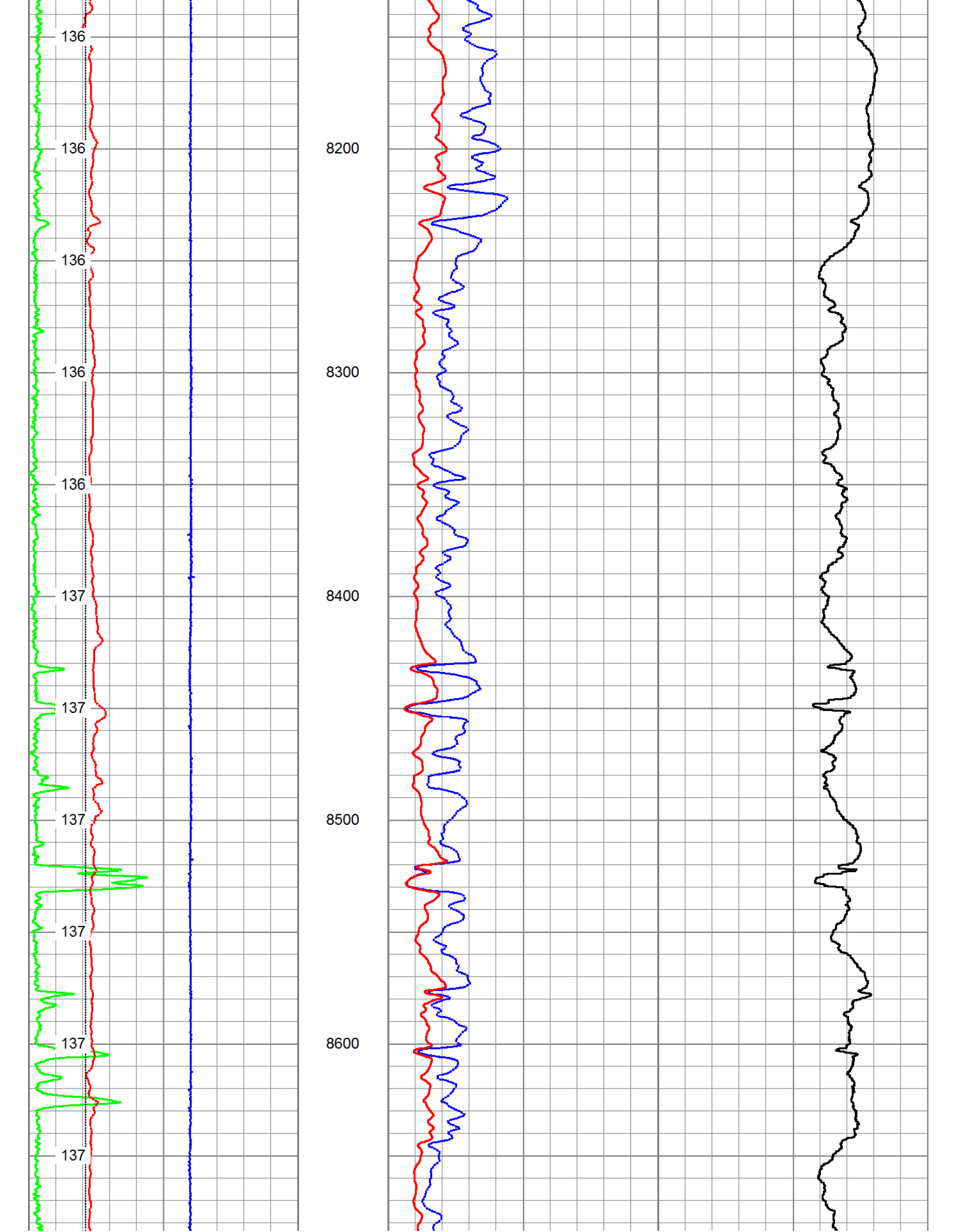
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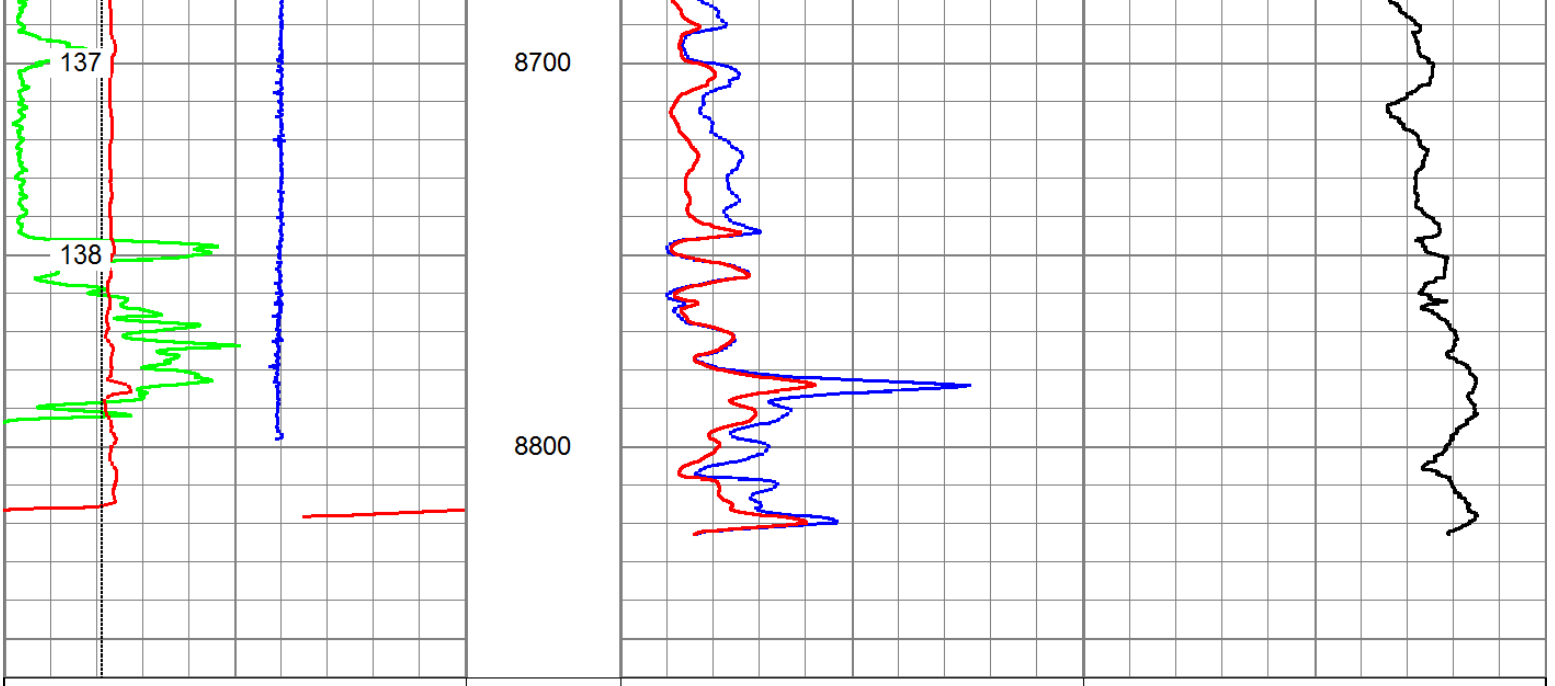


| | | |
|---|---|---|
| 0 | GR (GAPI) | 150 |
| 4 | DCAL (in) | 14 |
| -5 | ACCY | 5 |
| 4 | BOREID (in) | 14 |
| GRTEMP (degF) | | |

| | | |
|---|---|---|
| 50 | 20in 2ft Res (Ohm-m) | 500 |
| 50 | 90in 4ft Res (Ohm-m) | 500 |
| 1000 | DEEP COND (mmho/m) | 0 |
| 0 | 20in 4ft Res (Ohm-m) | 50 |
| 0 | 90in 4ft Res (Ohm-m) | 50 |

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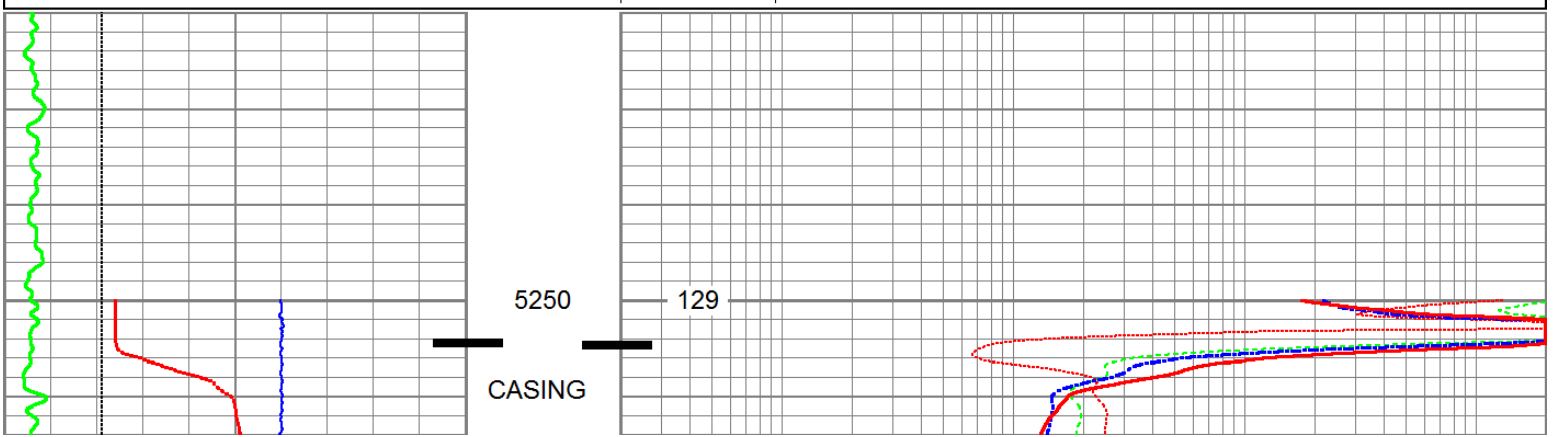
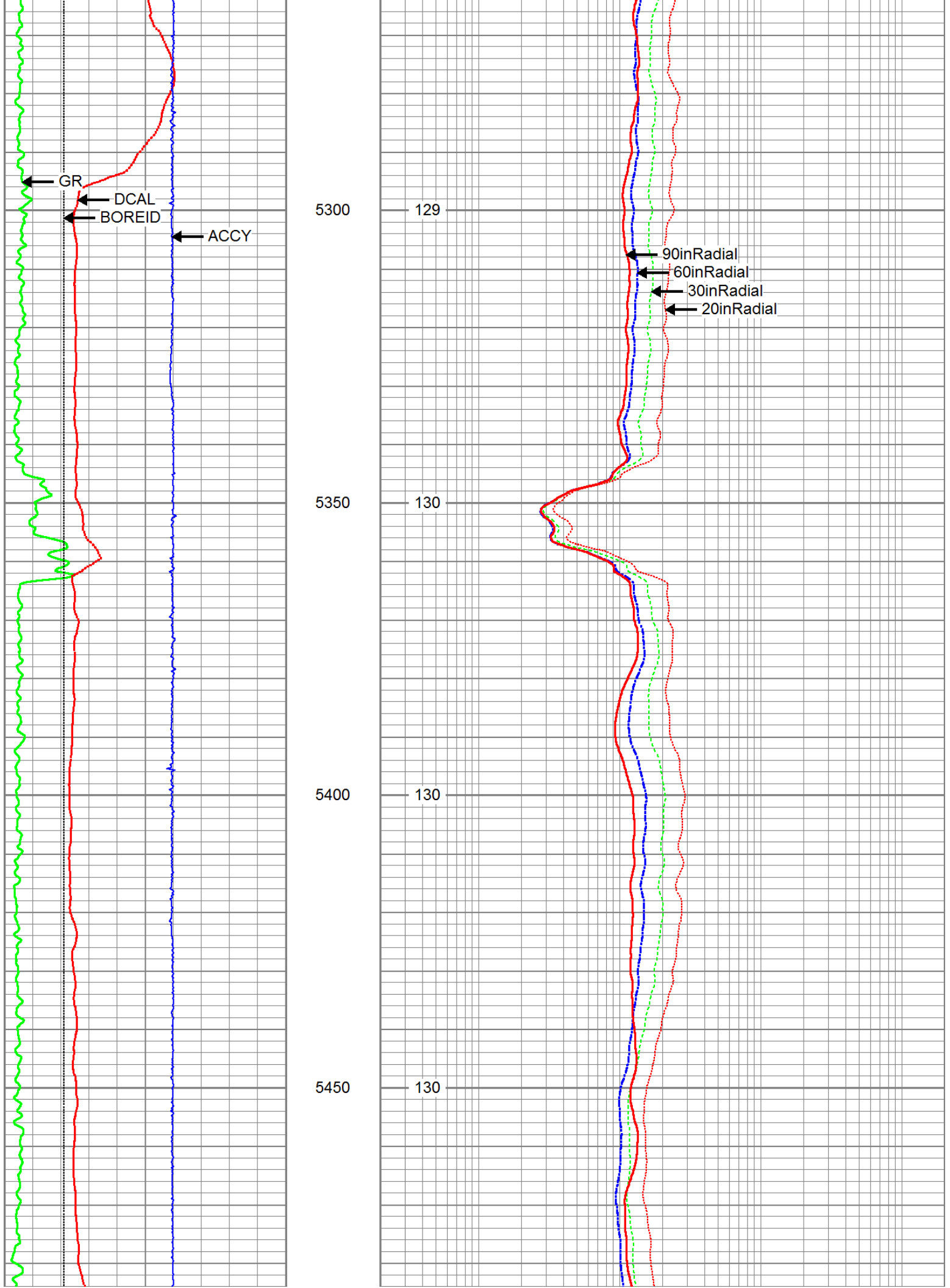
# MAIN PASS

| | |
|---|---|
| Database File: | murray_mem.db |
| Dataset Pathname: | proc1/pass1.4 |
| Presentation Format: | 6_5r_chk |
| Dataset Creation: | Mon Apr 22 20:56:58 2013 |
| Charted by: | Depth in Feet scaled 1:240 |

| | | |
|---|---|---|
| 0 | GR (GAPI) | 150 |
| 4 | BOREID (in) | 14 |
| 4 | DCAL (in) | 14 |
| -5 | ACCY | 5 |

| | | |
|---|---|---|
| 0.2 | 20inRadial (Ohm-m) | 2000 |
| 0.2 | 30inRadial (Ohm-m) | 2000 |
| 0.2 | 60inRadial (Ohm-m) | 2000 |
| 0.2 | 90inRadial (Ohm-m) | 2000 |
| GRTEMP (degF) | | |




GR
DCAL
BOREID
ACCY
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5400
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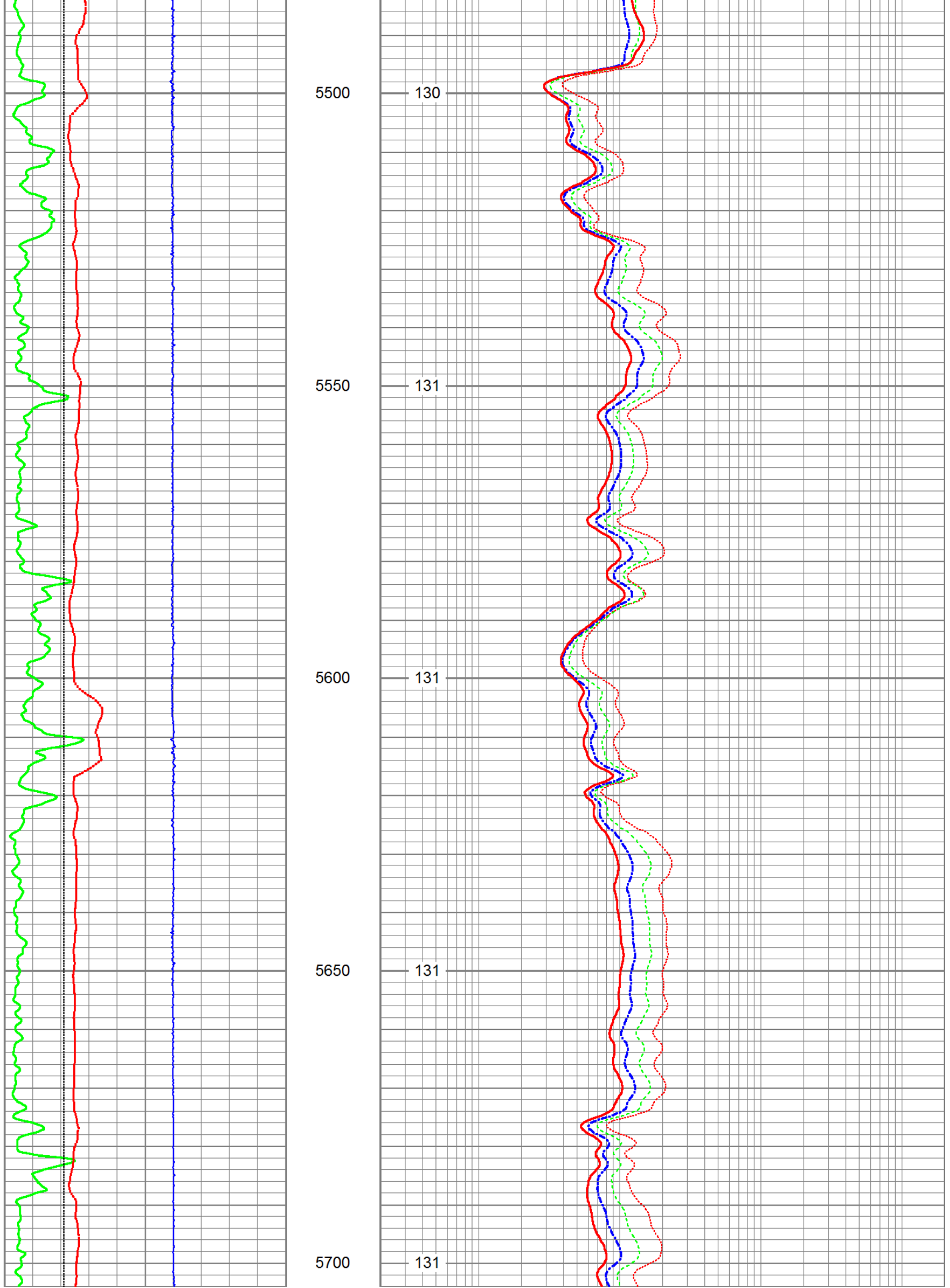
130
130
130
90inRadial
60inRadial
30inRadial
20inRadial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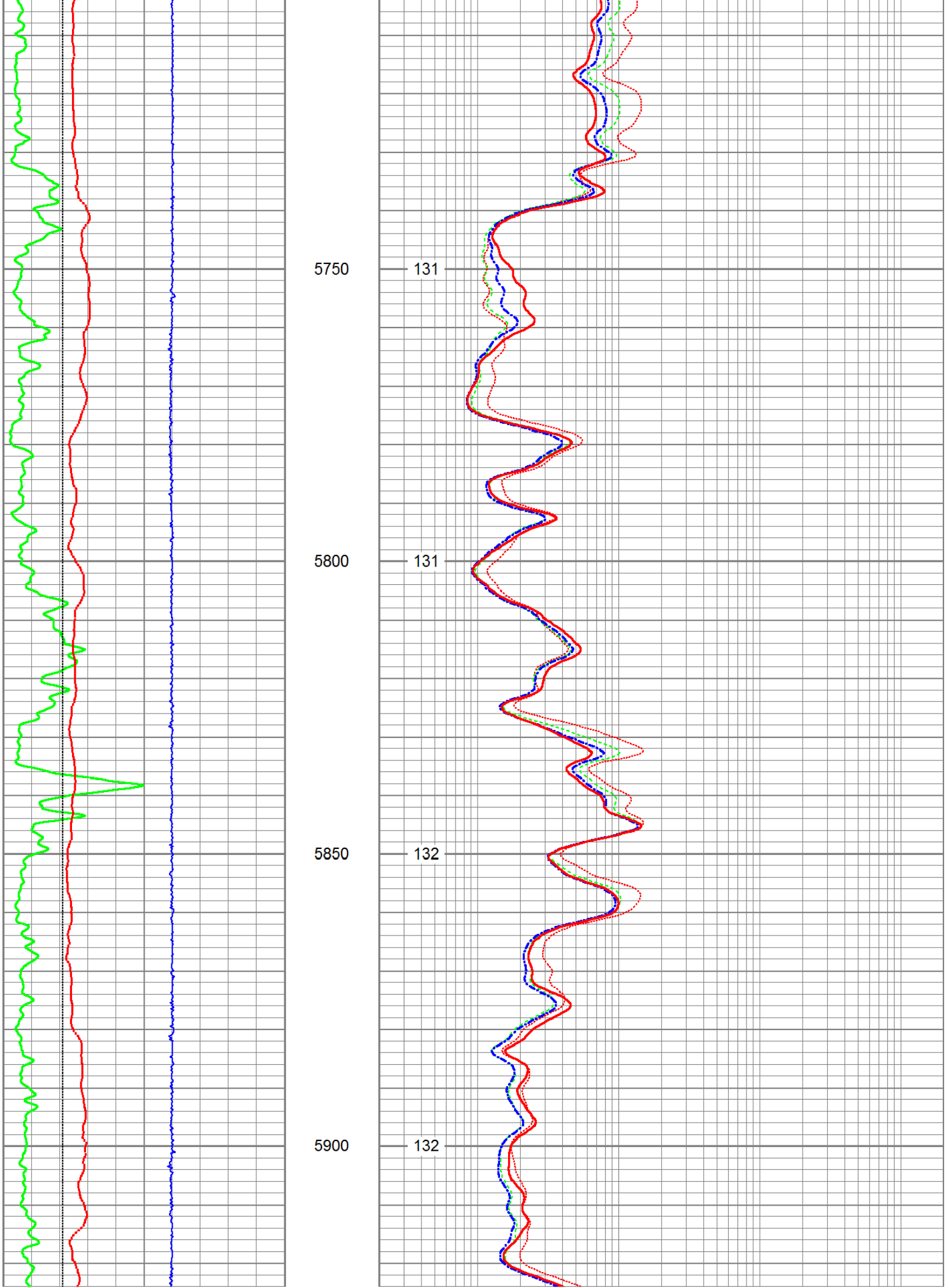
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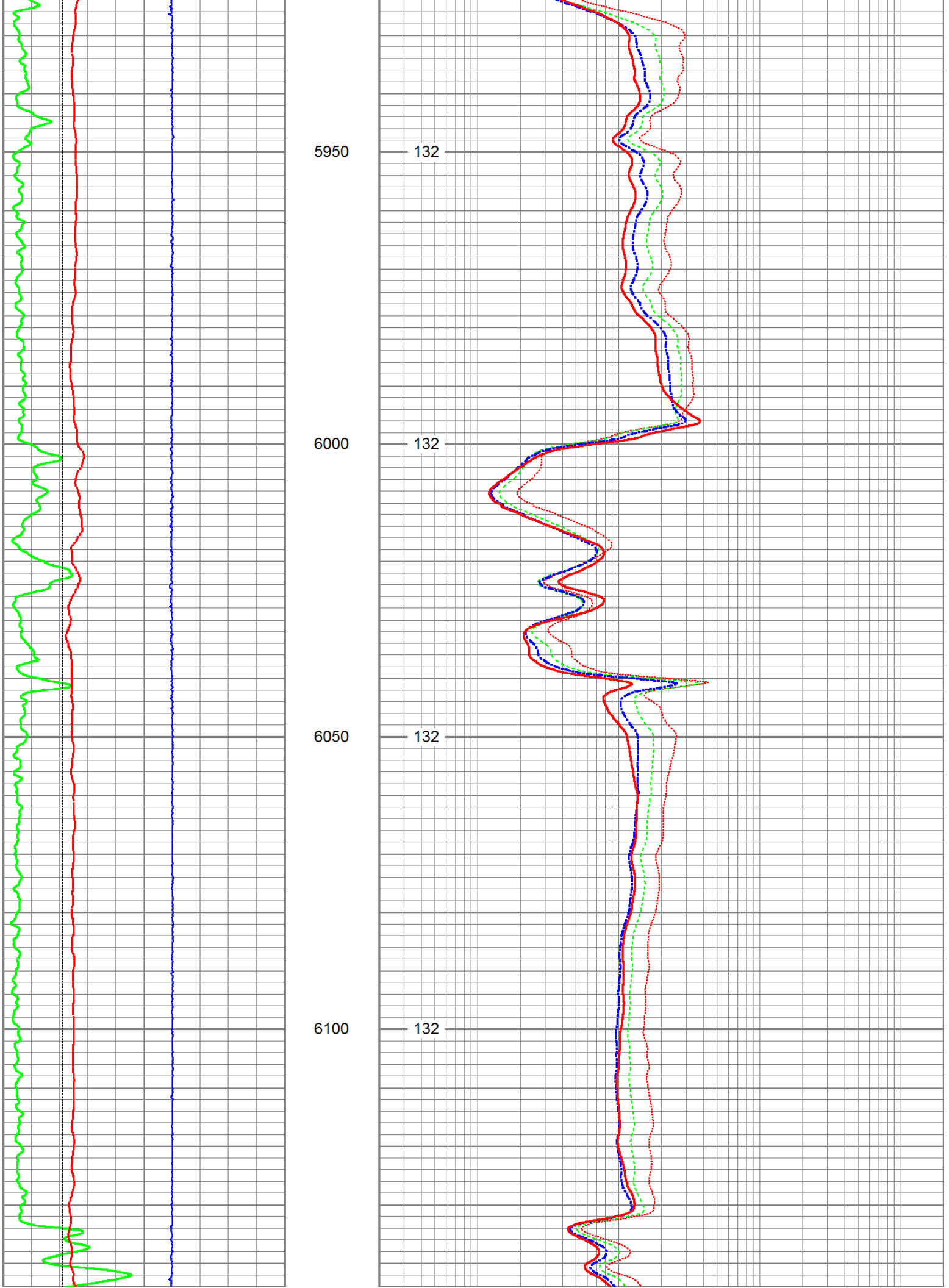
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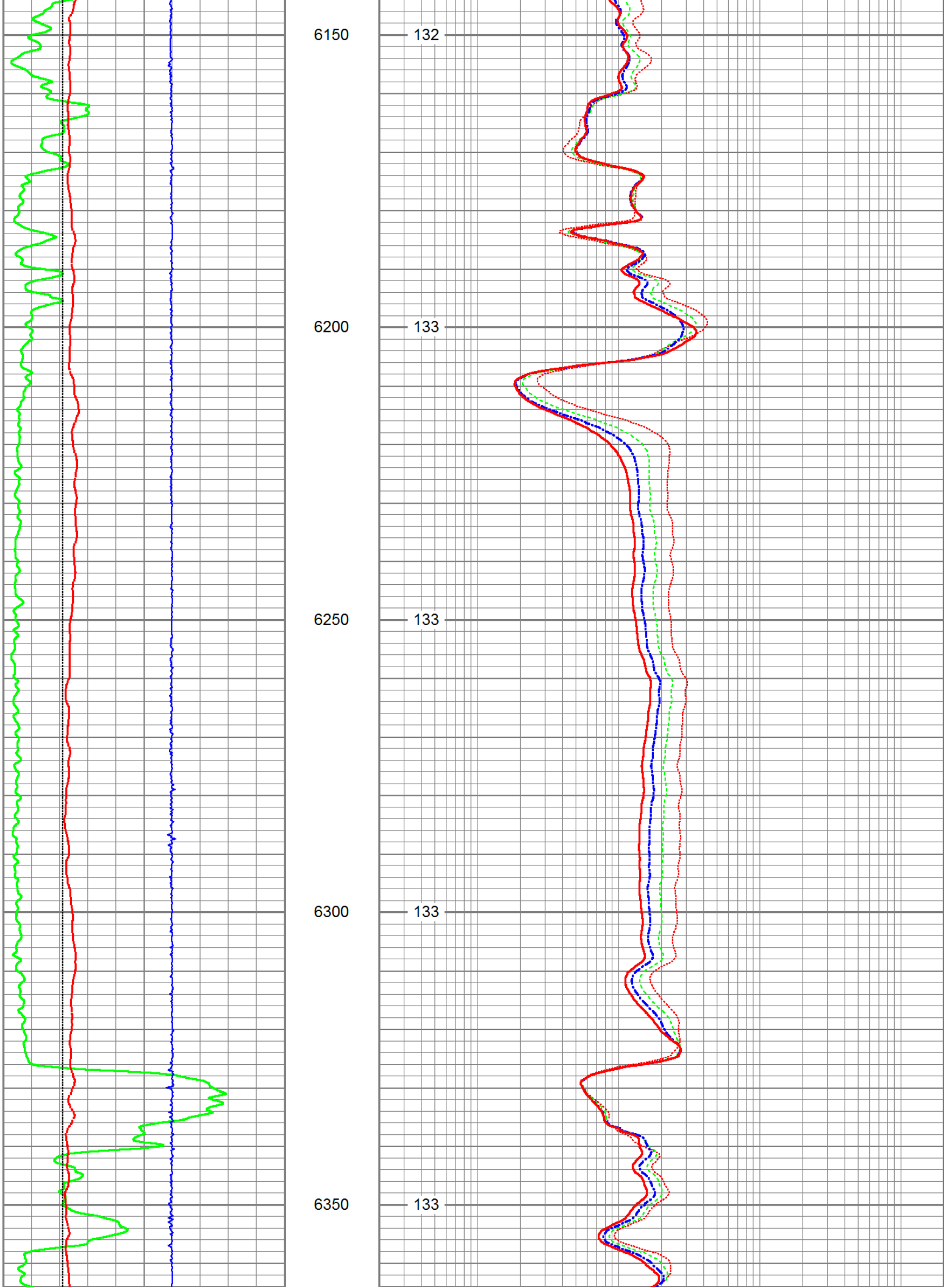
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6350
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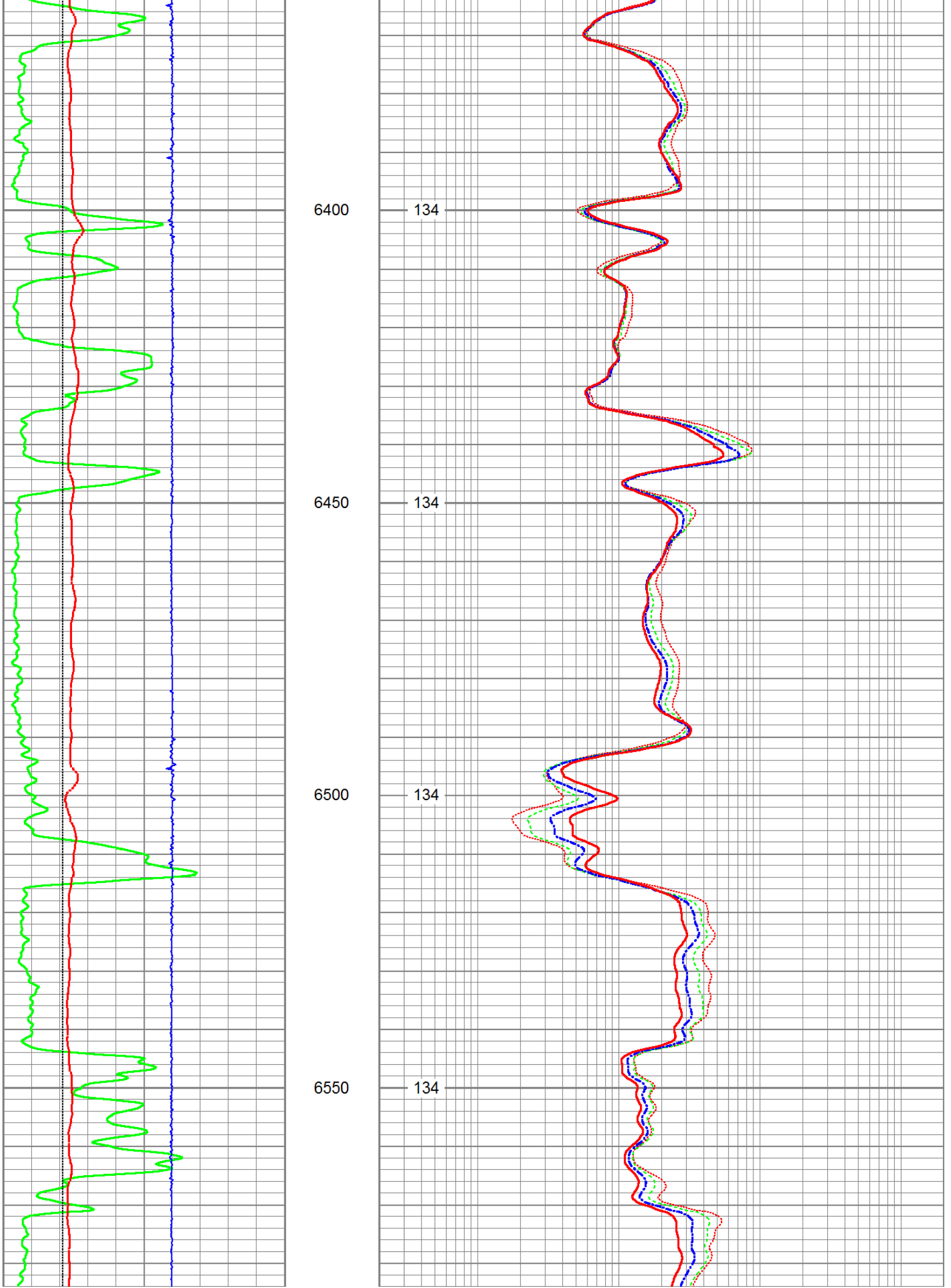
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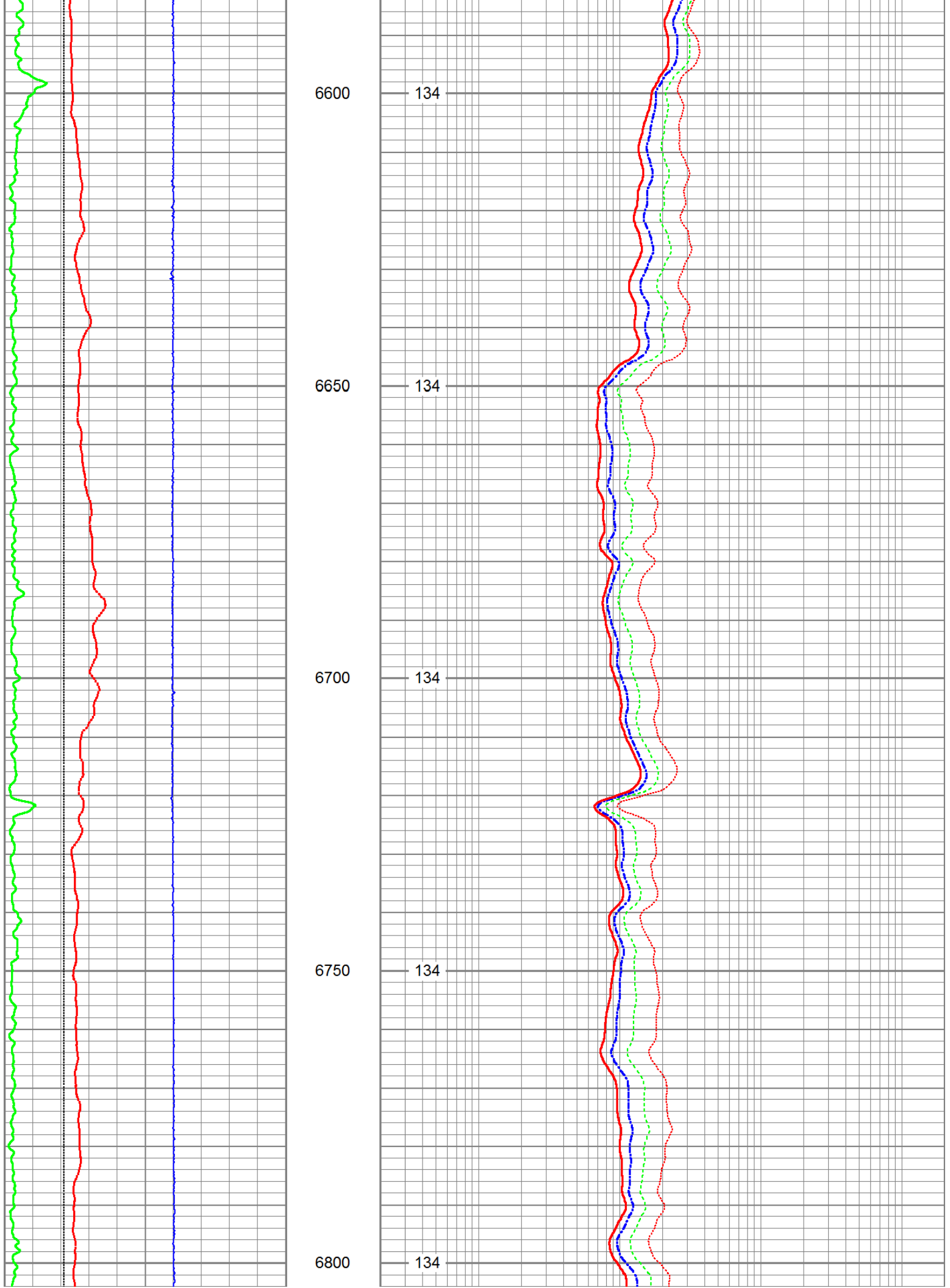
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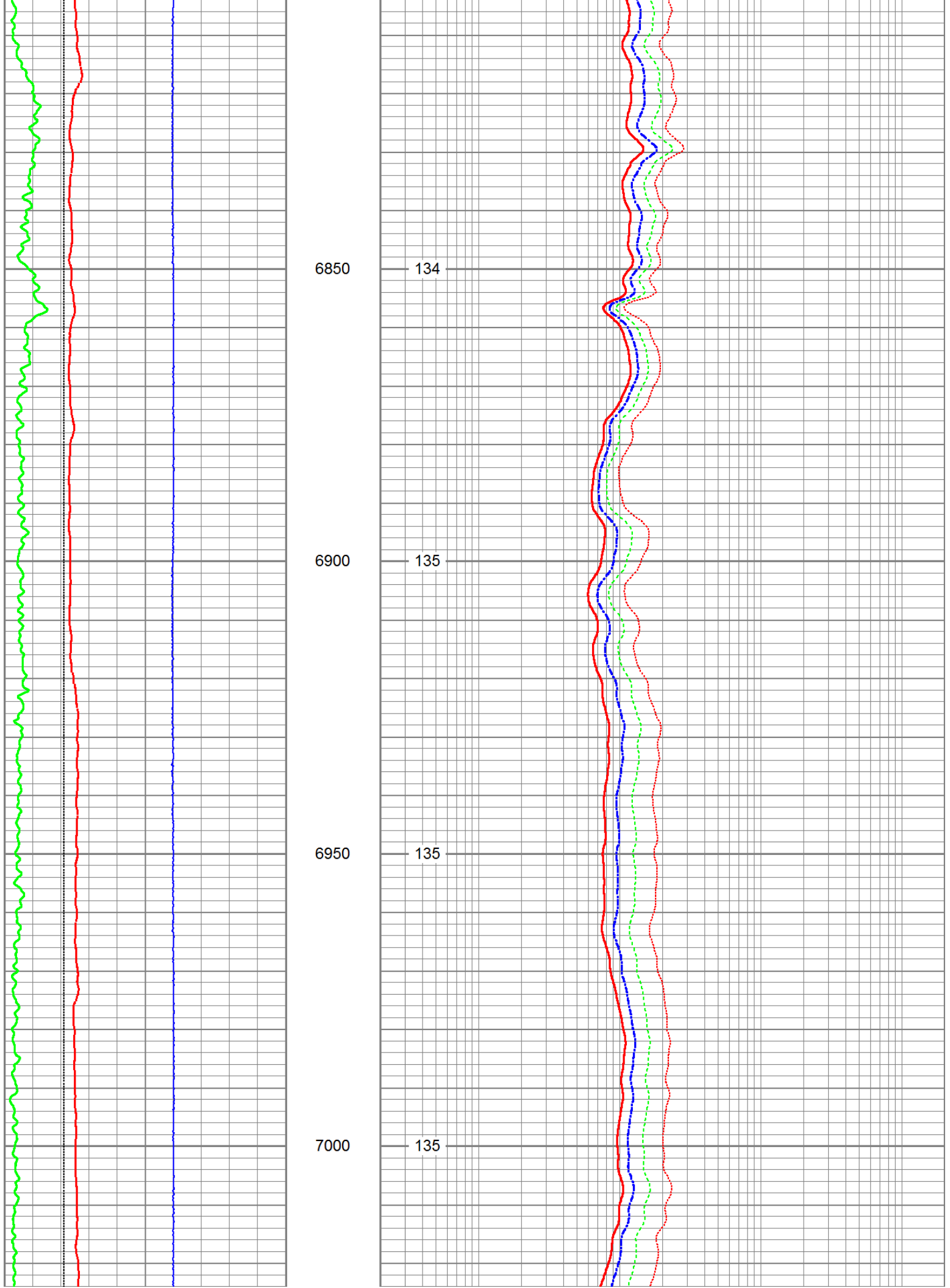
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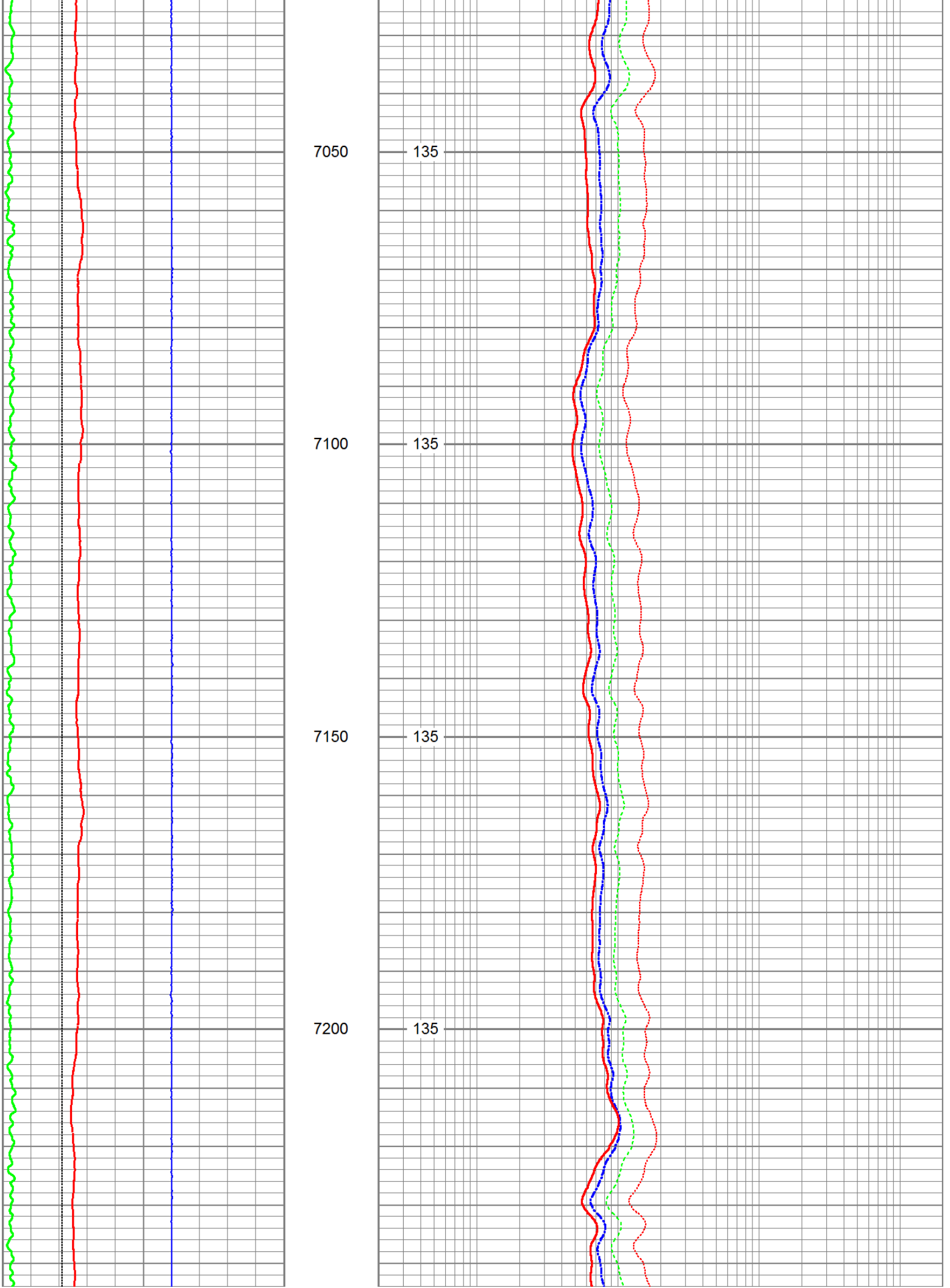
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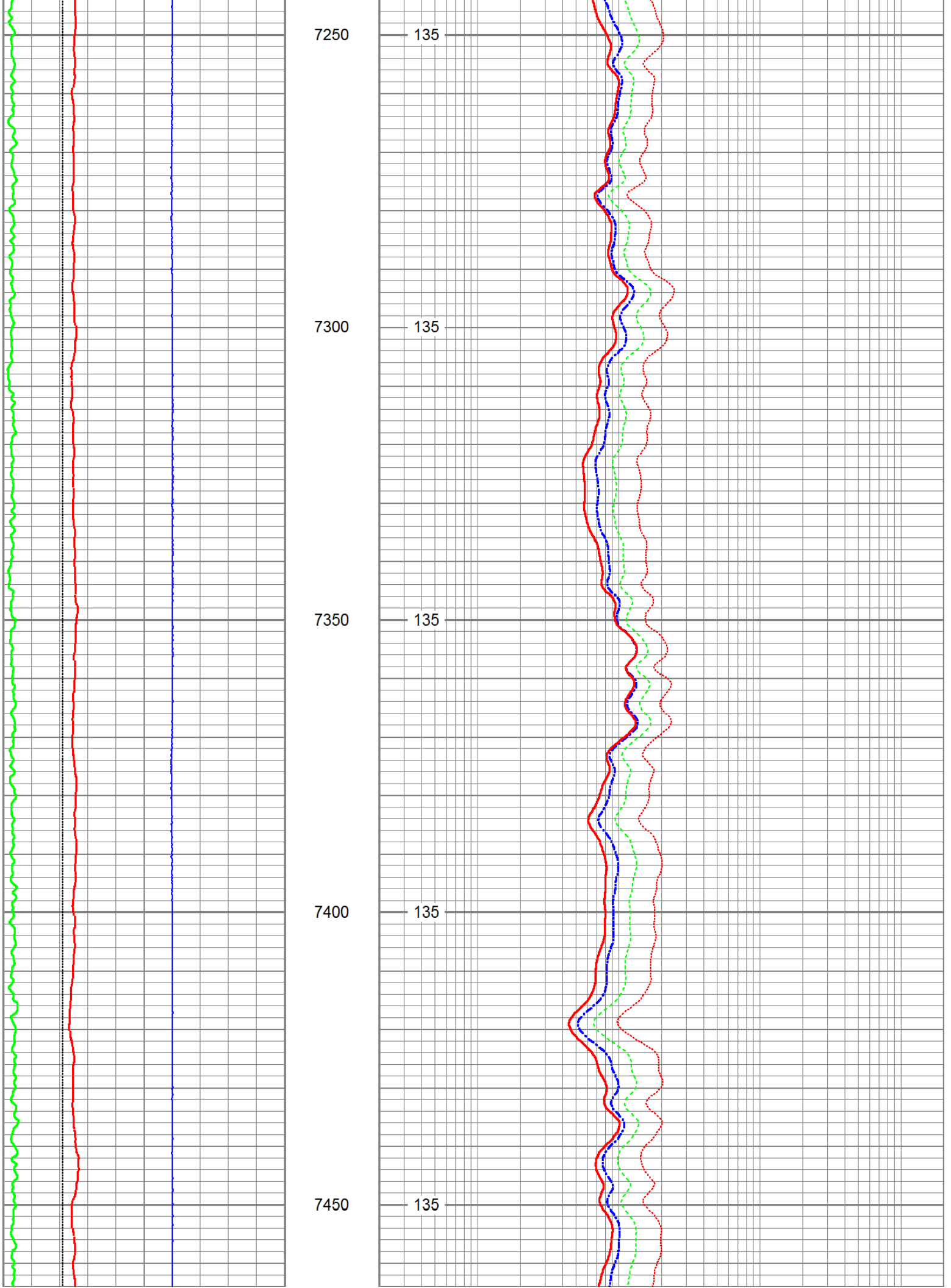
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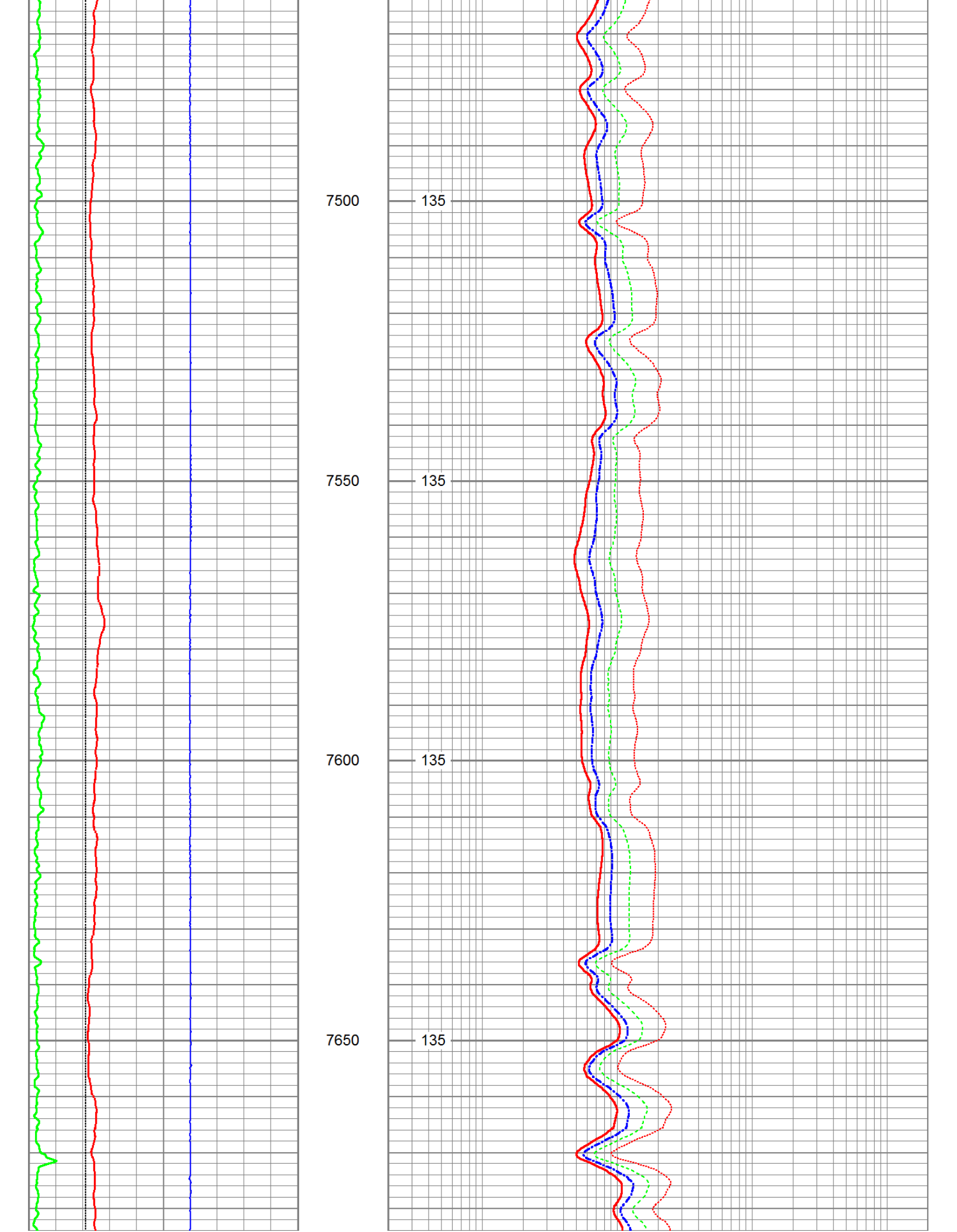
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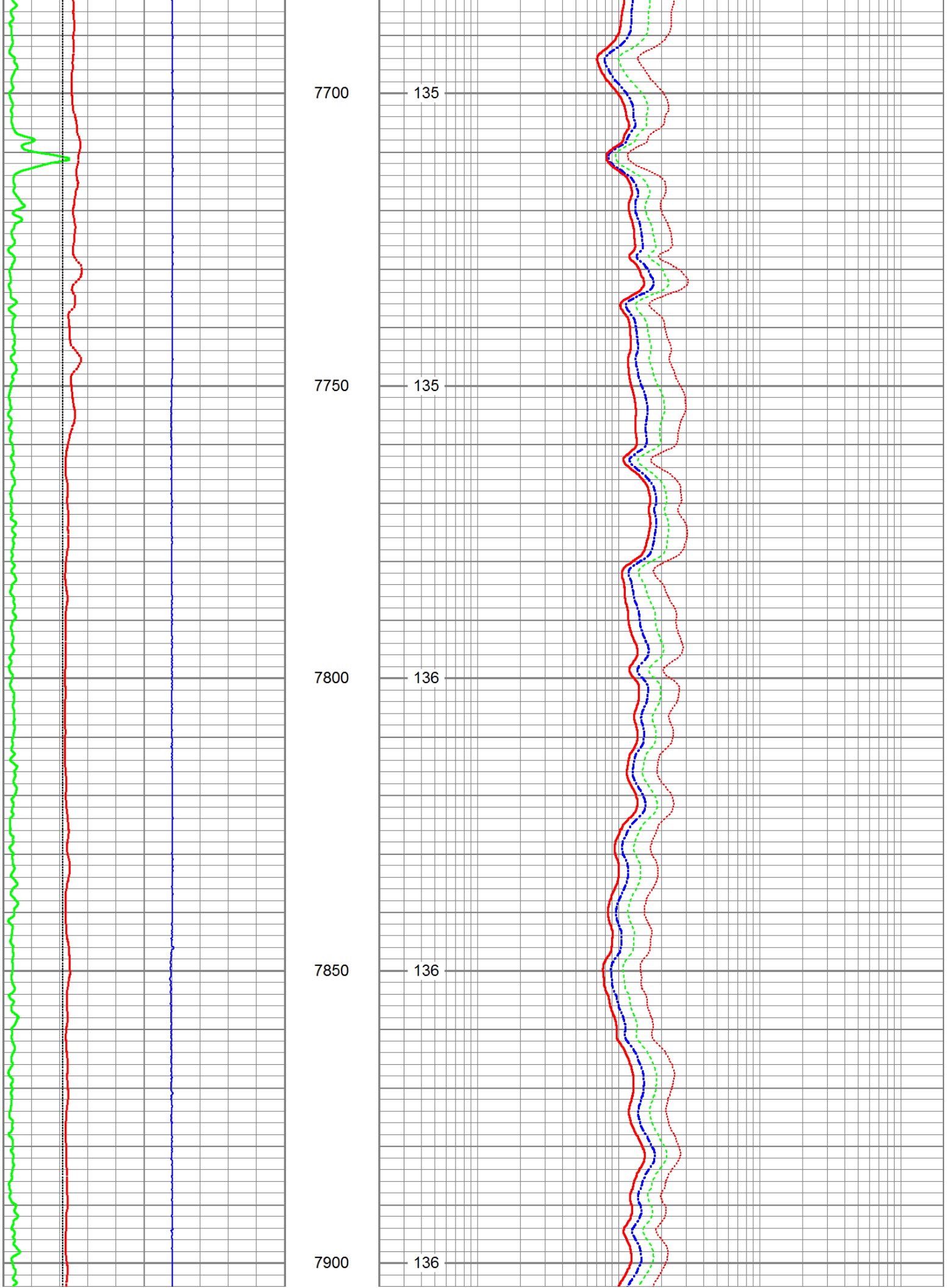
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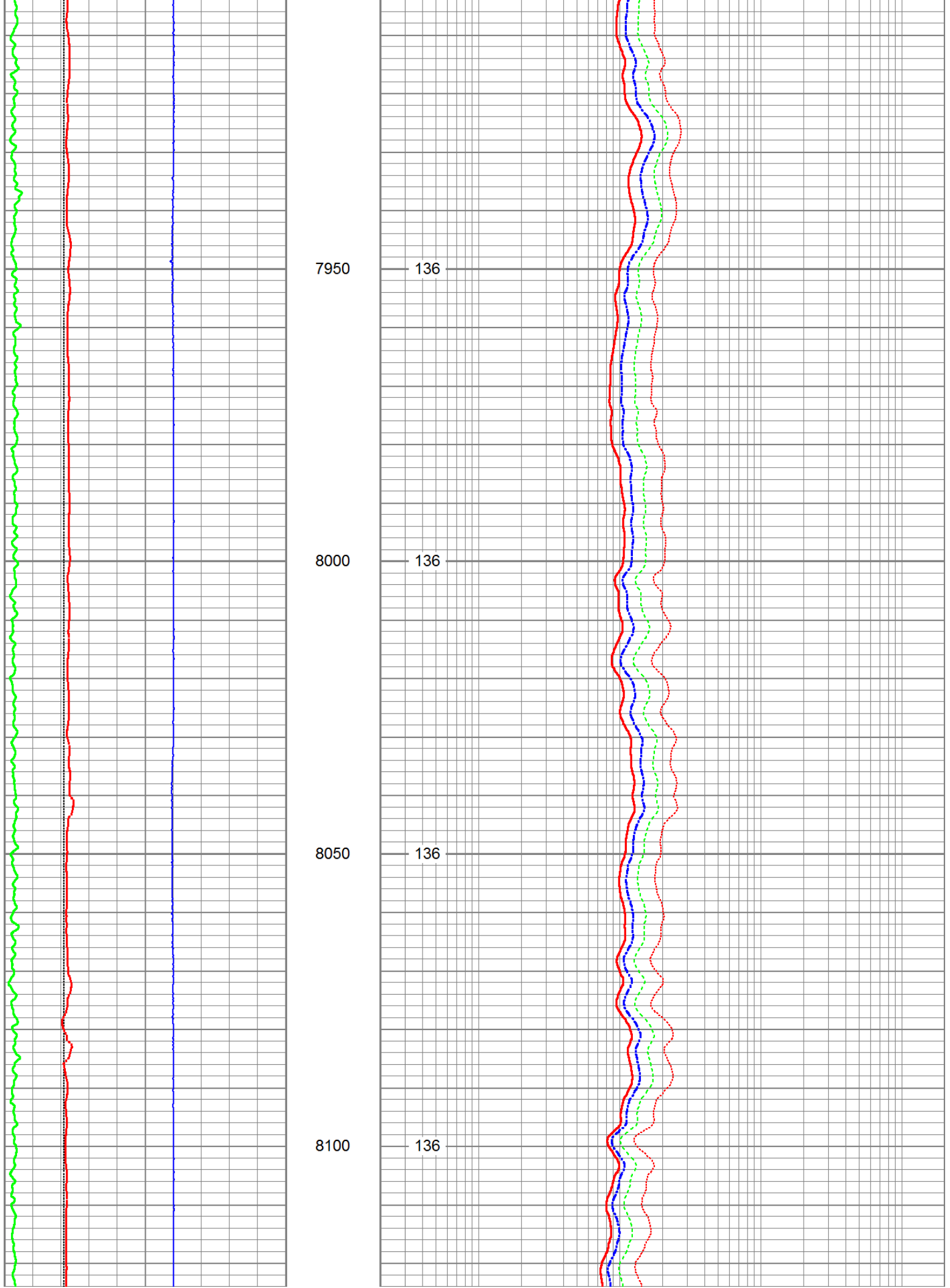
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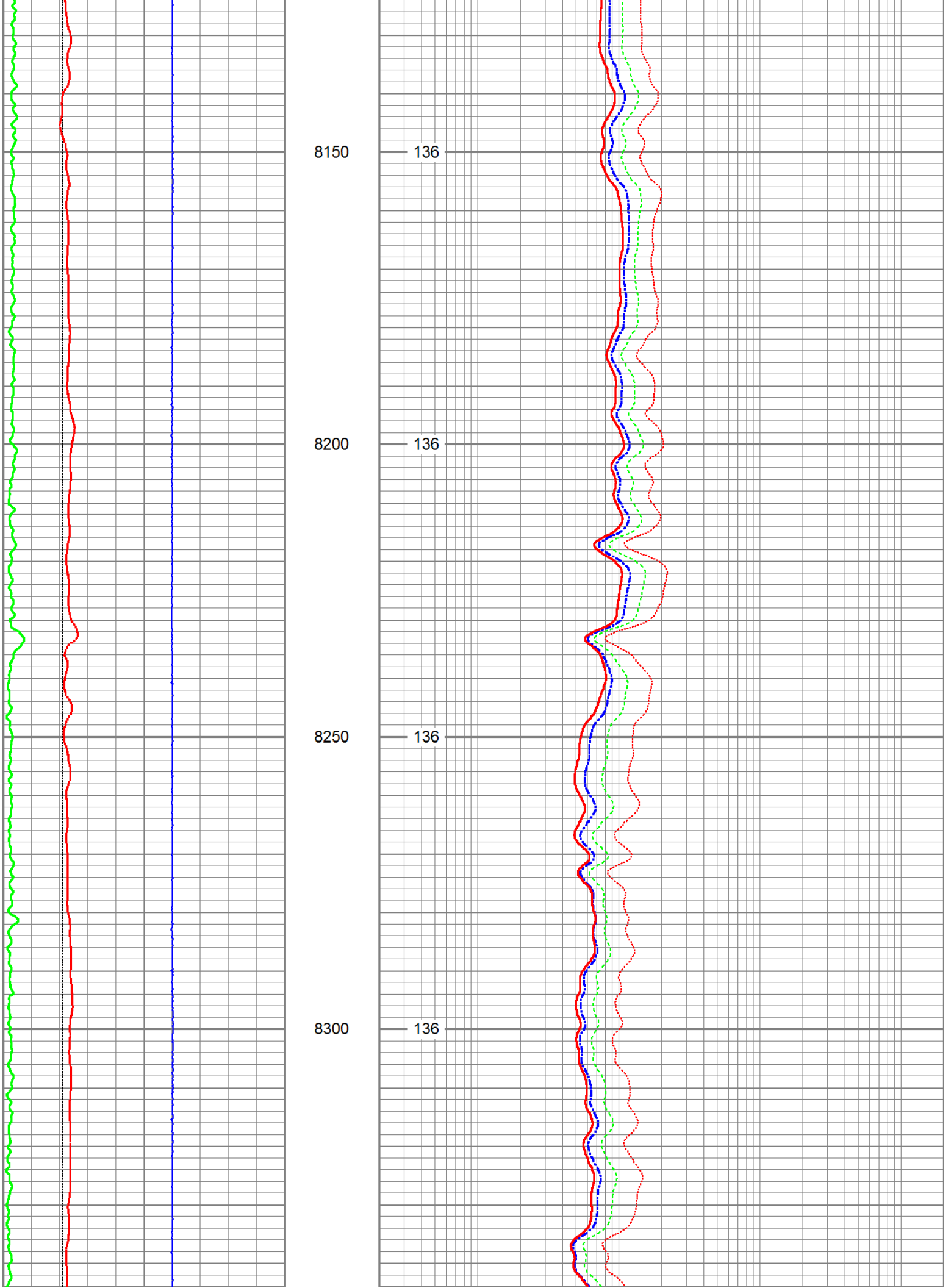
8150
136
8200
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8250
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8300
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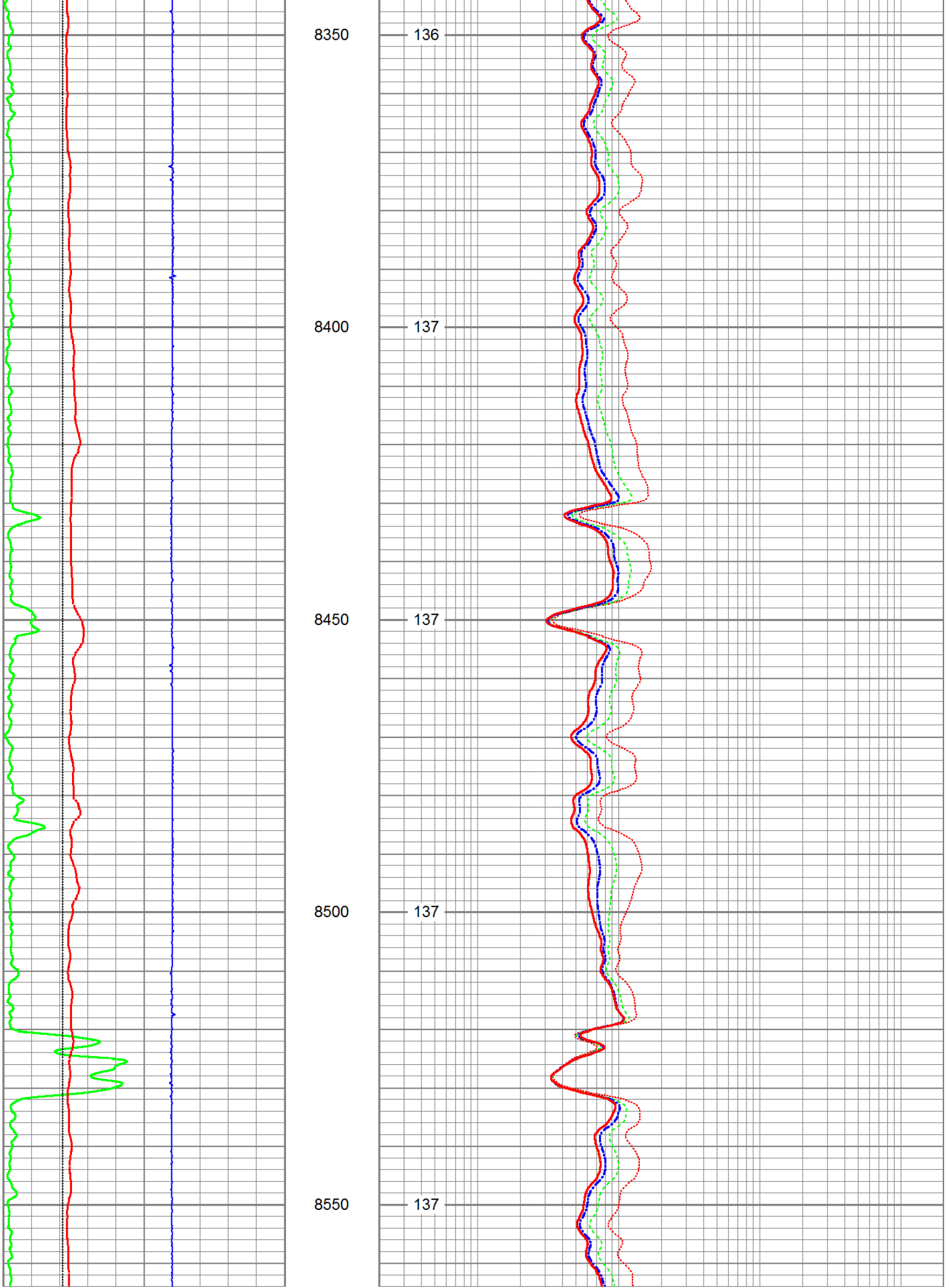
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8400
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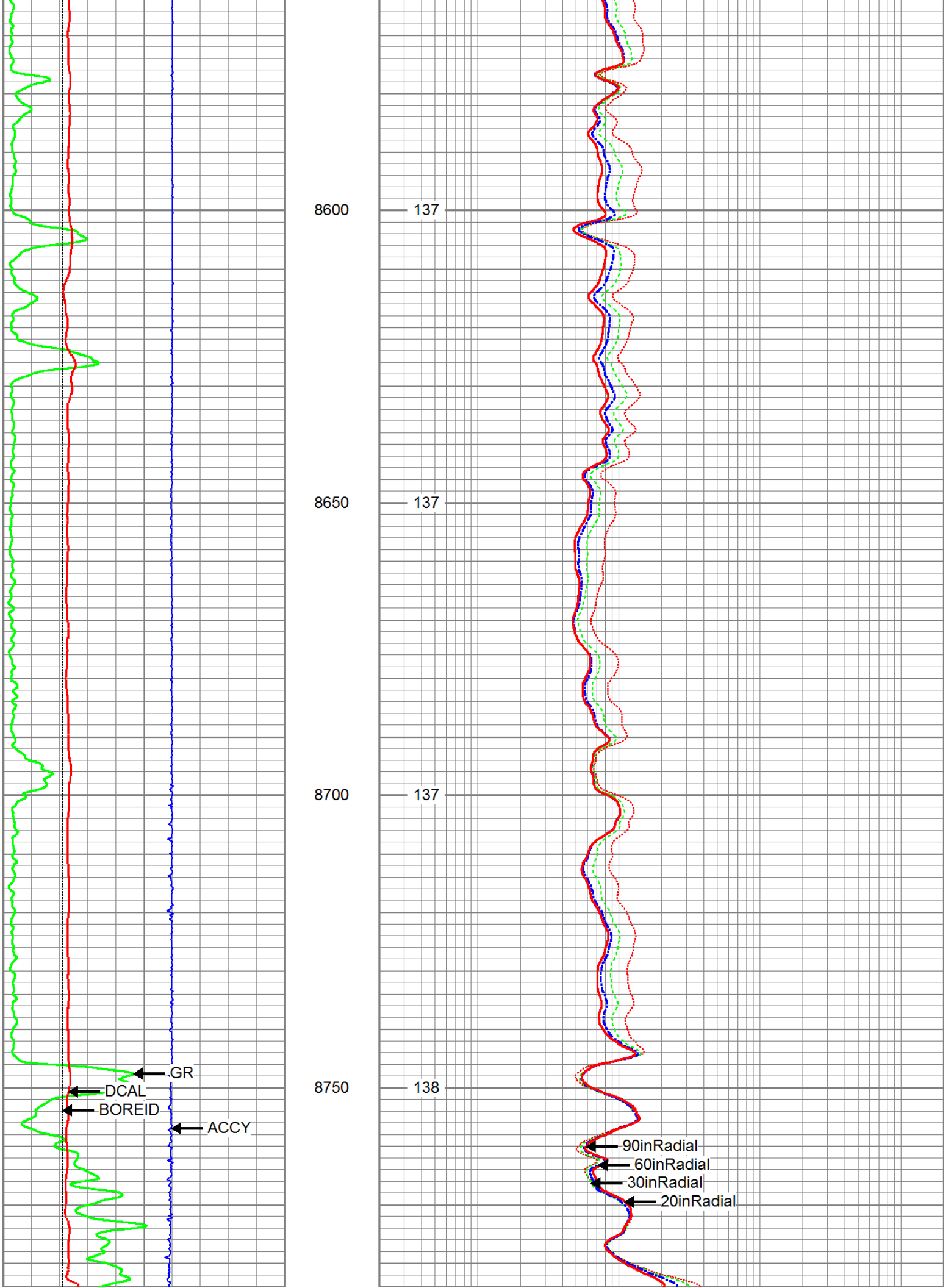
8600
137
8650
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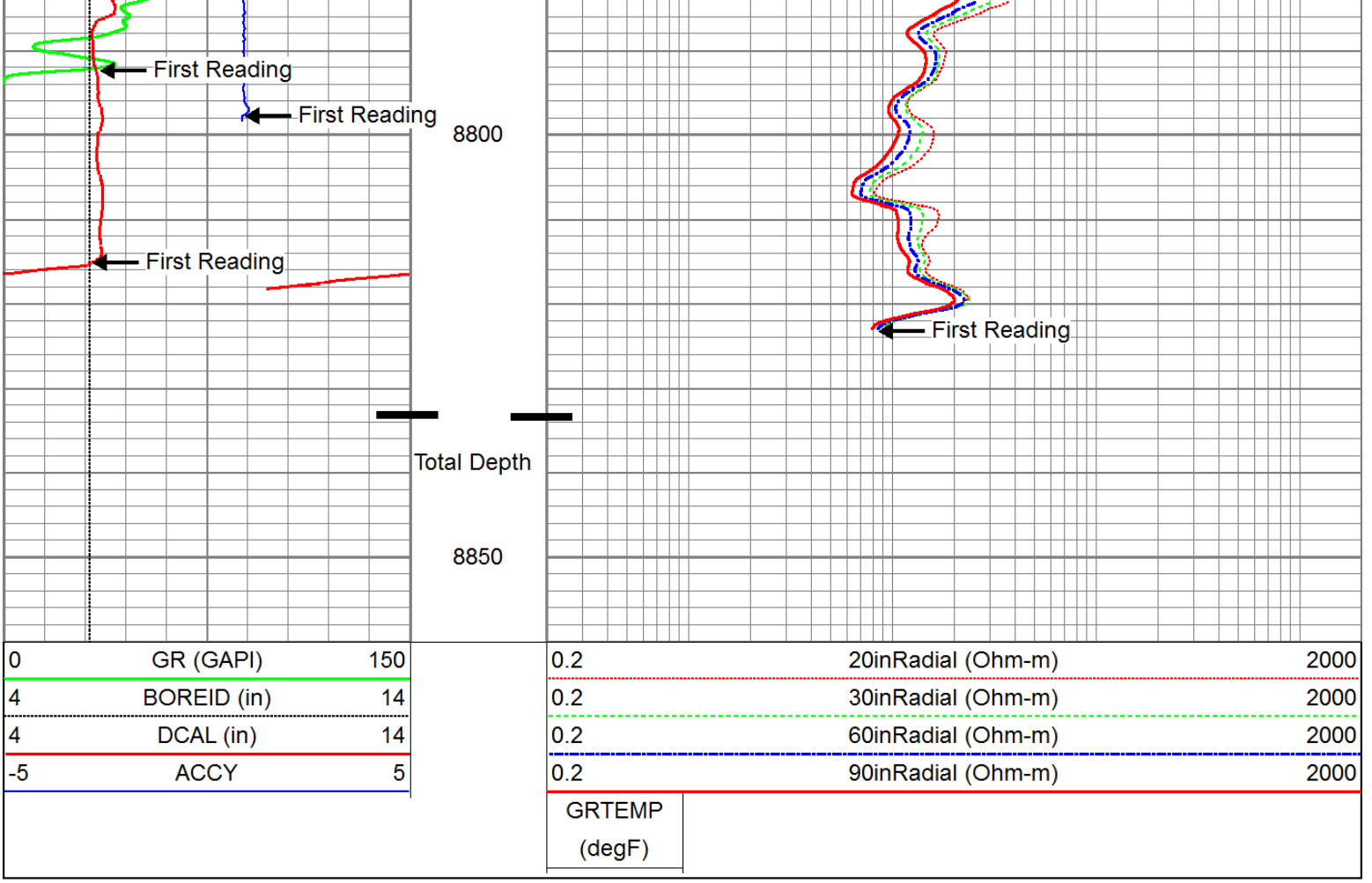
8700
137
8750
138
GR
DCAL
BOREID
ACCY
90inRadial
60inRadial
30inRadial
20inRadial




# Log Variables

Database:C:\Warrior\Data\murray_mem.db
Dataset: field/well/proc1/pass1.4

**Top - Bottom**

| A | BHCOR | BHFL_TYPE | BHFLRES Ohm-m | BHFLRESSRC | BHIDSRC | BOREID in |
|---|---|---|---|---|---|---|
| 1 | On | WBM | 1 | MUDCELL | CURVE | 6.125 |
| BOTTEMP degF | CASED? | CASEOD in | CASETHCK in | CEMWATERSA kppm | CMNTTHCK in | DNBHC? |
| 138 | No | 4.5 | 0 | 0 | 0 | NO |
| DPORSEL | FLUIDDEN g/cc | FRMSALIN kppm | LATNOR | M | MATRXDEN g/cc | MUDSALIN kppm |
| RHOB | 1 | 0 | Off | 2 | 2.71 | 0.8 |
| MudWgt lb/gal | NPORSEL | PEBHC? | PERFS | RESTMPSRC | SO in | SRFTEMP degF |
| 8.4 | Limestone | YES | 0 | INTERNAL | 0.5 | 65 |
| SZCOR | TDEPTH ft | TMPCOR | TOOLPOS | | | |
| On | 8885 | On | Ec-centered | | | |

Calibration Report

Database File: murray_mem.db
Dataset Pathname: proc1/pass1.4
Dataset Creation: Mon Apr 22 20:56:58 2013

ThruBit Induction Calibration Report

| | |
|---|---|
| Tool Model-Serial Number: | PS-PS38R |
| Shop Calibration Performed: | Fri Mar 01 12:30:29 2013 |

BASELINE

| | R | Expected | X | Expected |
|---|---|---|---|---|
| Freq 1 | | | | |
| A1 | -478.4900 | [-500.00, -400.00] | 175.3190 | [-500.00, 500.00] |
| A2 | -135.7360 | [-180.00, -100.00] | 302.3650 | [-500.00, 500.00] |
| A3 | -26.2781 | [-50.00, -10.00] | -65.5454 | [-500.00, 500.00] |
| A4 | -16.7549 | [-30.00, -10.00] | 254.1780 | [-500.00, 500.00] |
| A5 | -14.3211 | [-30.00, -10.00] | 151.4720 | [-500.00, 500.00] |
| Freq 2 | | | | |
| A1 | -252.3300 | [-280.00, -180.00] | 90.6894 | [-500.00, 500.00] |
| A2 | -86.4805 | [-130.00, -50.00] | 170.3340 | [-500.00, 500.00] |
| A3 | -19.2593 | [-50.00, -10.00] | -94.3423 | [-500.00, 500.00] |
| A4 | -19.7630 | [-30.00, -10.00] | 78.5474 | [-500.00, 500.00] |
| A5 | -19.2330 | [-30.00, -10.00] | 2.2441 | [-500.00, 500.00] |
| Freq 3 | | | | |
| A1 | -162.5760 | [-180.00, -80.00] | -2.4436 | [-500.00, 500.00] |
| A2 | -65.8174 | [-130.00, -30.00] | 84.6667 | [-500.00, 500.00] |
| A3 | -15.1583 | [-50.00, -10.00] | -126.5820 | [-500.00, 500.00] |
| A4 | -21.2009 | [-30.00, -10.00] | -38.0339 | [-500.00, 500.00] |
| A5 | -21.8735 | [-30.00, -10.00] | -105.2590 | [-500.00, 500.00] |
| Freq 4 | | | | |
| A1 | -89.4241 | [-120.00, -40.00] | -152.8680 | [-500.00, 500.00] |
| A2 | -46.8994 | [-110.00, -10.00] | -29.1757 | [-500.00, 500.00] |
| A3 | -12.3098 | [-50.00, -10.00] | -189.9740 | [-500.00, 500.00] |
| A4 | -23.7794 | [-30.00, -10.00] | -211.1800 | [-500.00, 500.00] |
| A5 | -26.9272 | [-30.00, -10.00] | -283.6760 | [-500.00, 500.00] |

CALIBRATION COEFFICIENTS

| | R | Expected | X | Expected |
|---|---|---|---|---|
| Freq 1 | | | | |
| A1 | 0.9910 | [0.95, 1.05] | 0.0019 | [-0.05, 0.05] |
| A2 | 0.9910 | [0.95, 1.05] | 0.0018 | [-0.05, 0.05] |
| A3 | 1.0009 | [0.95, 1.05] | -0.0054 | [-0.05, 0.05] |
| A4 | 0.9885 | [0.95, 1.05] | 0.0047 | [-0.05, 0.05] |
| A5 | 0.9939 | [0.95, 1.05] | 0.0015 | [-0.05, 0.05] |
| Freq 2 | | | | |
| A1 | 0.9860 | [0.95, 1.05] | -0.0059 | [-0.05, 0.05] |
| A2 | 0.9858 | [0.95, 1.05] | -0.0055 | [-0.05, 0.05] |
| A3 | 0.9901 | [0.95, 1.05] | -0.0051 | [-0.05, 0.05] |
| A4 | 0.9836 | [0.95, 1.05] | -0.0030 | [-0.05, 0.05] |
| A5 | 0.9887 | [0.95, 1.05] | -0.0069 | [-0.05, 0.05] |
| Freq 3 | | | | |
| A1 | 0.9930 | [0.95, 1.05] | -0.0045 | [-0.05, 0.05] |
| A2 | 0.9931 | [0.95, 1.05] | -0.0041 | [-0.05, 0.05] |
| A3 | 0.9966 | [0.95, 1.05] | -0.0041 | [-0.05, 0.05] |
| A4 | 0.9891 | [0.95, 1.05] | -0.0015 | [-0.05, 0.05] |
| A5 | 0.9978 | [0.95, 1.05] | -0.0052 | [-0.05, 0.05] |
| Freq 4 | | | | |
| A1 | 0.9848 | [0.95, 1.05] | -0.0070 | [-0.05, 0.05] |
| A2 | 0.9844 | [0.95, 1.05] | -0.0066 | [-0.05, 0.05] |
| A3 | 0.9901 | [0.95, 1.05] | -0.0084 | [-0.05, 0.05] |
| A4 | 0.9809 | [0.95, 1.05] | -0.0036 | [-0.05, 0.05] |

| | | | | |
|---|---|---|---|---|
| A5 | 0.9965 | [0.95, 1.05] | -0.0100 | [-0.05, 0.05] |

Temperature 34.5229 degC

## ThruBit Density Calibration Report

Tool Model-Serial Number: PS-PS01D

Source Number:

Shop Calibration Performed: Tue Apr 16 14:16:56 2013

REFERENCE

| | Density | Units |
|---|---|---|
| Aluminium | 2.607 | g/cc |
| Magnesium | 1.752 | g/cc |

READINGS

| Outputs | Counts | Units | Expected |
|---|---|---|---|
| SS1 Background | 134.71 | cps | [130.00, 170.00] |
| LS1 Background | 144.11 | cps | [130.00, 170.00] |
| LS4 Background | 30.89 | cps | [27.00, 35.00] |
| SS1 Aluminium | 4829.85 | cps | [4500.00, 5500.00] |
| LS1 Aluminium | 888.69 | cps | [750.00, 950.00] |
| LS4 Aluminium | 1022.63 | cps | [843.00, 1068.00] |
| SS1 Magnesium | 7979.36 | cps | [7000.00, 9000.00] |
| LS1 Magnesium | 5766.10 | cps | [5250.00, 6250.00] |
| LS1 Al + Fe | 765.36 | cps | [650.00, 800.00] |
| LS4 Al + Fe | 479.51 | cps | [382.00, 471.00] |

RESULTS

| | | |
|---|---|---|
| SS Slope | 1.67 | [1.52, 1.77] |
| LS Slope | 0.42 | [0.38, 0.45] |
| PEF K Factor | 4.926 | [3.510, 6.170] |
| PEF B Factor | -0.639 | [-0.700, -0.410] |

Caliper Shop Calibration performed: Tue Apr 16 14:16:56 2013

RESULTS

| Reference | Reading | Units |
|---|---|---|
| 12.00 | 1835.24 | in |
| 9.00 | 1997.22 | in |
| 6.00 | 2157.79 | in |

DENSITY PRE-SURVEY CHECK Performed: Fri Apr 19 12:10:09 2013

| Outputs | Counts | Units | Expected |
|---|---|---|---|
| SS1 Background | 133.35 | cps | [130.67, 138.76] |
| LS1 Background | 142.37 | cps | [139.79, 148.43] |
| LS4 Background | 30.68 | cps | [29.03, 32.74] |

CALIPER PRE-SURVEY CHECK Performed: Fri Apr 19 12:07:48 2013

| Reference | Readings | Units | Expected |
|---|---|---|---|
| 6.00 | 6.02 | in | [5.80, 6.20] |

| | | | |
|---|---|---|---|
| 6.00 | 6.02 | in | [5.80, 6.20] |

## Compensated Neutron Calibration Report

| | |
|---|---|
| Tool Model-Serial Number: | PS-PS14N |
| Source Number: | |
| Calibration Tank Temperature: | 63.7 degF |
| Shop Calibration Performed: | Mon Mar 18 10:54:09 2013 |

BACKGROUND MEASUREMENT

| Outputs | Measured | Units | Expected |
|---|---|---|---|
| SS Counts | 0.1 | cps | <10 |
| LS Counts | 0.1 | cps | <4 |

WATER TANK REFERENCE

| Outputs | Measured | Units | Expected |
|---|---|---|---|
| SS Counts | 786.5 | cps | |
| LS Counts | 26.1 | cps | |
| Tank Ratio Ref | 30.9580 | SS/LS | |
| Tank Ratio | 30.1063 | SS/LS | |
| Tank Ratio Gain | 1.0283 | | [0.85, 1.15] |

ALUMINUM SLEEVE REFERENCE

| Outputs | Measured | Units | Expected |
|---|---|---|---|
| SS Counts | 8812.9 | cps | |
| LS Counts | 832.9 | cps | |
| Al Ratio Ref | 10.797 | SS/LS | |
| Al Ratio | 10.880 | SS/LS | |
| Al Ratio Gain | 0.99 | | [0.90, 1.10] |
| Sleeve Porosity | 14.46 | pu | |

PRE-SURVEY BACKGROUND CHECK Performed: Fri Apr 19 12:07:16 2013

| Outputs | Measured | Units | Expected |
|---|---|---|---|
| SS Counts | 0.1 | cps | <10 |
| LS Counts | 0.1 | cps | <4 |

## Gamma Ray Calibration Report

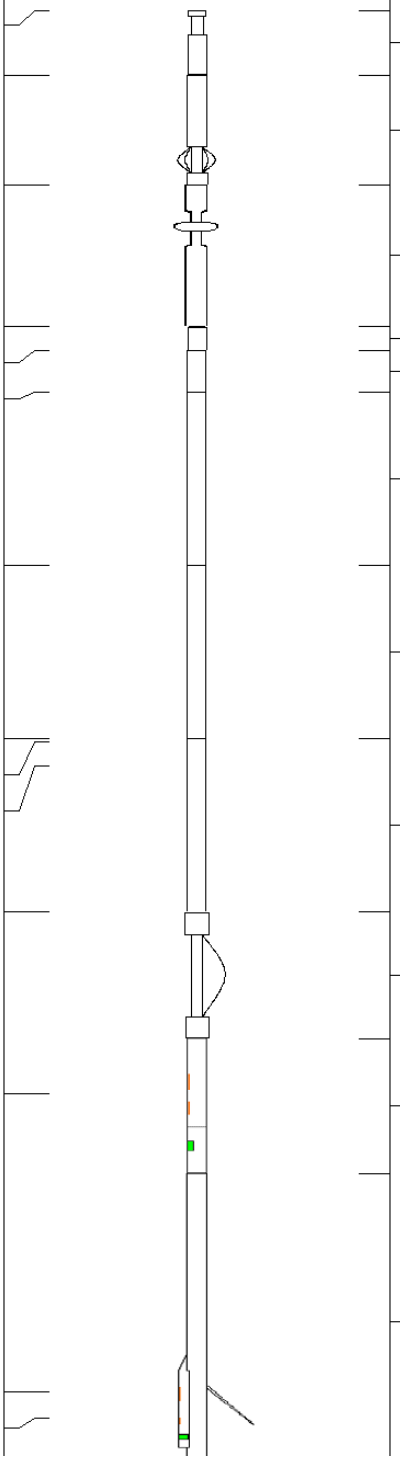
| | | |
|---|---|---|
| Tool Model-Serial Number: | PS-PS27T | |
| Performed: | Mon Apr 08 09:54:28 2013 | |
| Calibrator Value: | 165.0 | GAPI |
| Background Reading: | 47.8 | cps |
| Calibrator Reading: | 250.6 | cps |

| | | |
|---|---|---|
| Calibrator Reading: | 359.6 | cps |
| Sensitivity: | 0.3750 | GAPI/cps |

## Inclinometer Calibration Report

Performed: Sun Jun 13 14:33:21 1993

| | Low Read. | High Read. | Low Ref. | High Ref. | |
|---|---|---|---|---|---|
| X Accelerometer | 0.00 | 1.00 | 0.00 | 1.00 | gee |
| Y Accelerometer | 0.00 | 1.00 | 0.00 | 1.00 | gee |
| Z Accelerometer | 0.00 | 1.00 | 0.00 | 1.00 | gee |

| Sensor | Offset (ft) | Schematic | Description | Len (ft) | OD (in) | Wt (lb) |
|---|---|---|---|---|---|---|
| Thrubit | 66.92 |  | Cablehead-S<br>Solid Weakpoint | 2.31 | 2.13 | 5.00 |
| Thrubit | 64.61 | | PSBDOT | 3.87 | 2.25 | 35.00 |
| Thrubit | 60.75 | | HangOff_Tool | 5.00 | 2.38 | 60.00 |
| Thrubit | 55.75 | | 10-1 | 0.88 | 2.13 | 3.95 |
| Thrubit | 54.87 | | Universal Joint | 1.46 | 2.06 | 15.00 |
| TBBAT | 53.41 | | TBBAT-A (PS13B)<br>Thrubit Battery | 6.13 | 2.13 | 38.20 |
| TBBAT2 | 47.29 | | TBBAT2-A (PS33B)<br>Thrubit Battery | 6.13 | 2.13 | 40.00 |
| TMG | 41.16 | | TMG-PS (PS27T)<br>ThruBit Telemetry Gamma Ray | 6.13 | 2.13 | 45.00 |
| GR | 41.04 | | | | | |
| GRTEMP | 40.20 | | | | | |
| Thrubit | 35.04 | | Decentralizer<br>Decentralizer (Small) | 4.50 | 2.13 | 70.00 |
| CNLSC | 28.60 | | TBN-PS (PS14N)<br>ThruBit Neutron | 4.77 | 2.13 | 63.00 |
| | | | TBD-PS (PS01D)<br>Thrubit Density | 10.48 | 2.13 | 91.00 |
| LSW1 | 18.04 | | | | | |
| DCAL | 17.13 | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| A1_P | 10.60 | | | TBI-PS (PS38R)<br>Thrubit Induction | 15.29 | 2.13 | 94.00 |
| A2_P | 10.10 | | | | | | |
| A3_P | 9.35 | | | | | | |
| A4_P | 8.35 | | | | | | |
| A5_P | 6.60 | | | | | | |

| | |
|---|---|
| Dataset: | murray_mem.db: field/well/proc1/pass1.4 |
| Total Length: | 66.92 ft |
| Total Weight: | 560.15 lb |
| O.D. | 2.38 in |

ThruBit
A Schlumberger Company

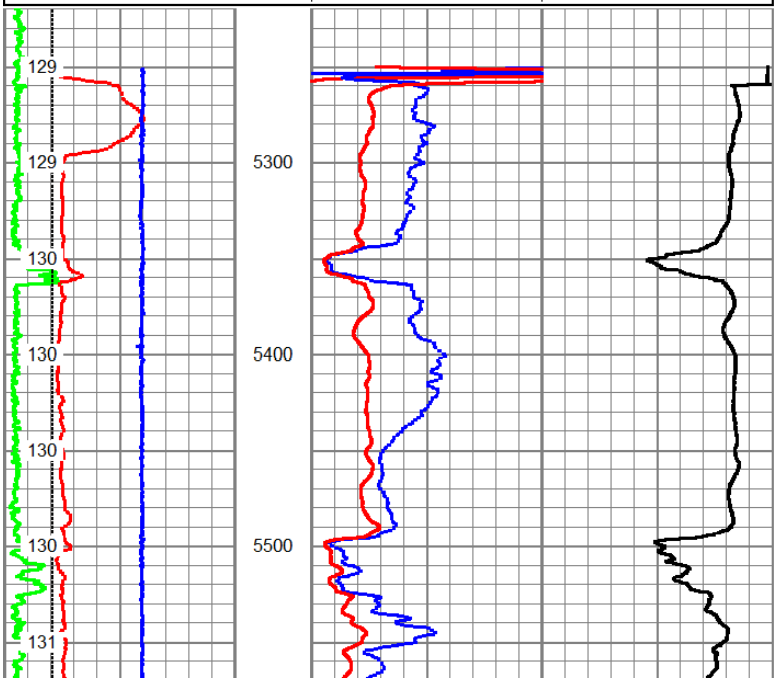
| | |
|---|---|
| Company | SANDRIDGE ENERGY |
| Well | MURRAY 3406 1-5H |
| Field | EASTHAM |
| County | HARPER |
| State | KANSAS |

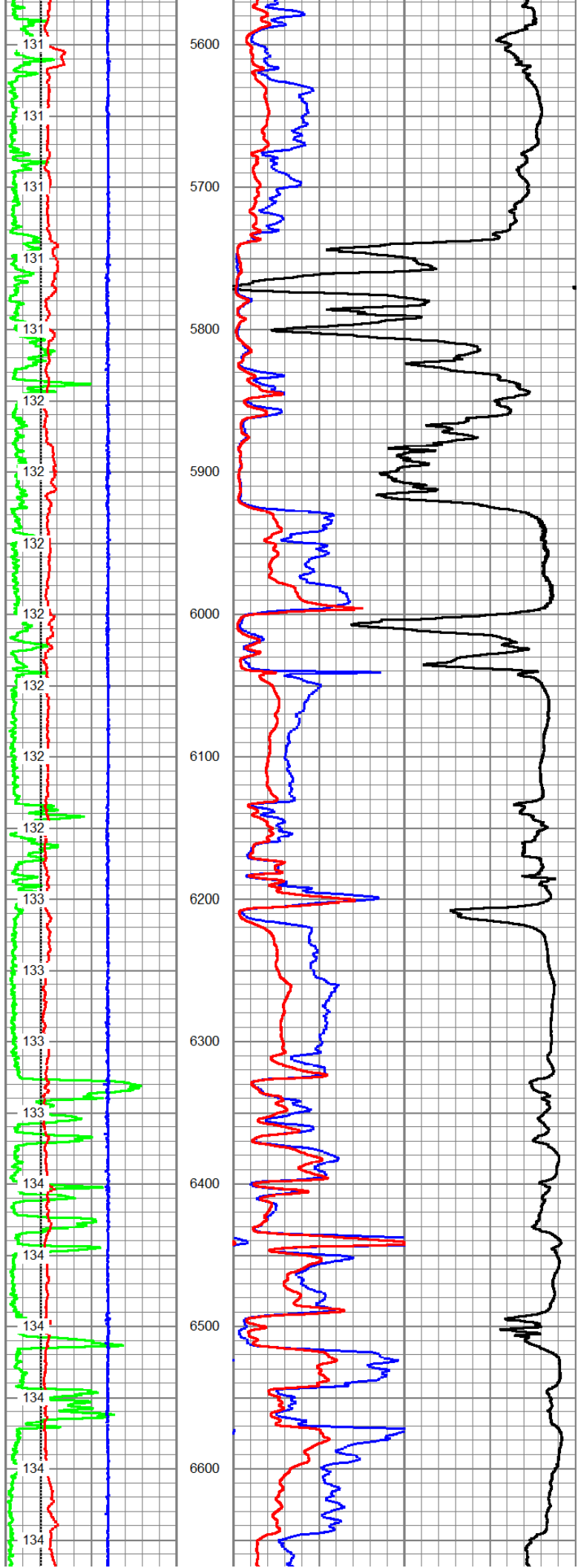
ThruBit
A Schlumberger Company

# MAIN PASS

| | |
|---|---|
| Database File: | murray_mem.db |
| Dataset Pathname: | proc1/pass1.4 |
| Presentation Format: | 6_2r_chk |
| Dataset Creation: | Mon Apr 22 20:56:58 2013 |
| Charted by: | Depth in Feet scaled 1:1200 |

| | | |
|---|---|---|
| 0 GR (GAPI) 150 | 20in 2ft Res | |
| 4 DCAL (in) 14 | 50 (Ohm-m) 500 | |
| -5 ACCY 5 | 90in 4ft Res | |
| 4 BOREID (in) 14 | 50 (Ohm-m) 500 | |
| GRTEMP (degF) | 1000 DEEP COND (mmho/m) 0 | |
| | 0 20in 4ft Res (Ohm-m) 50 | |
| | 0 90in 4ft Res (Ohm-m) 50 | |

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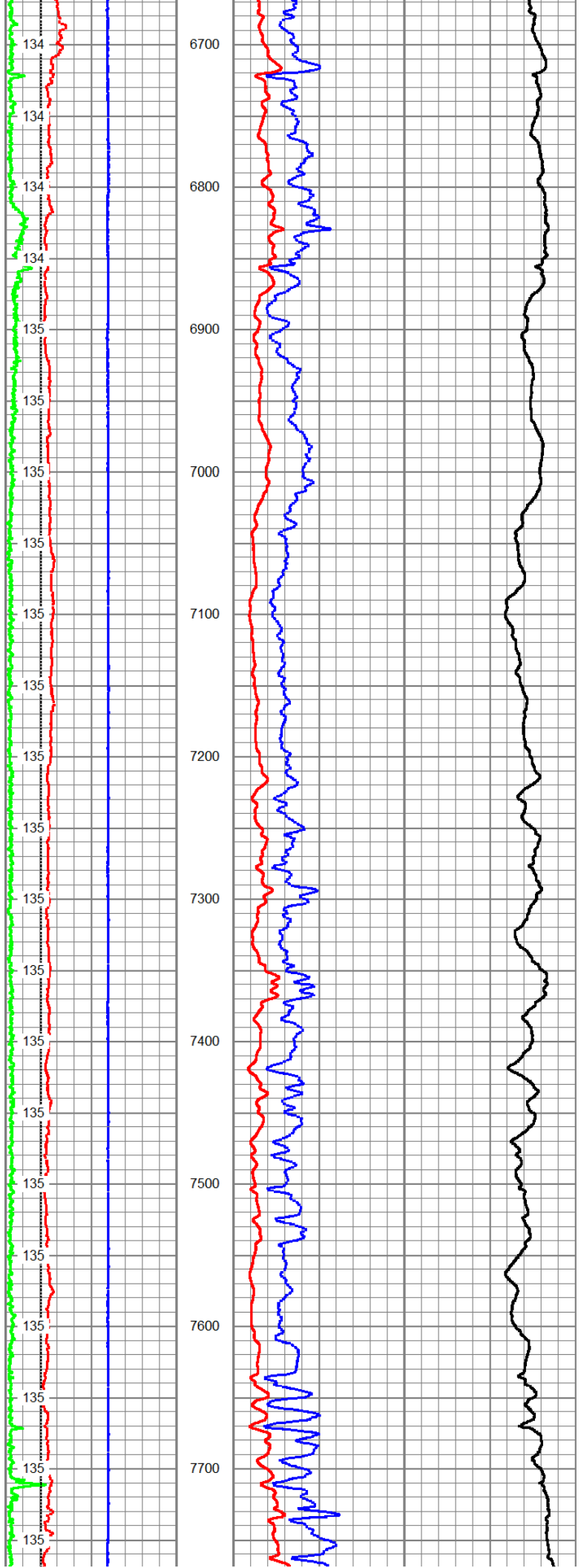
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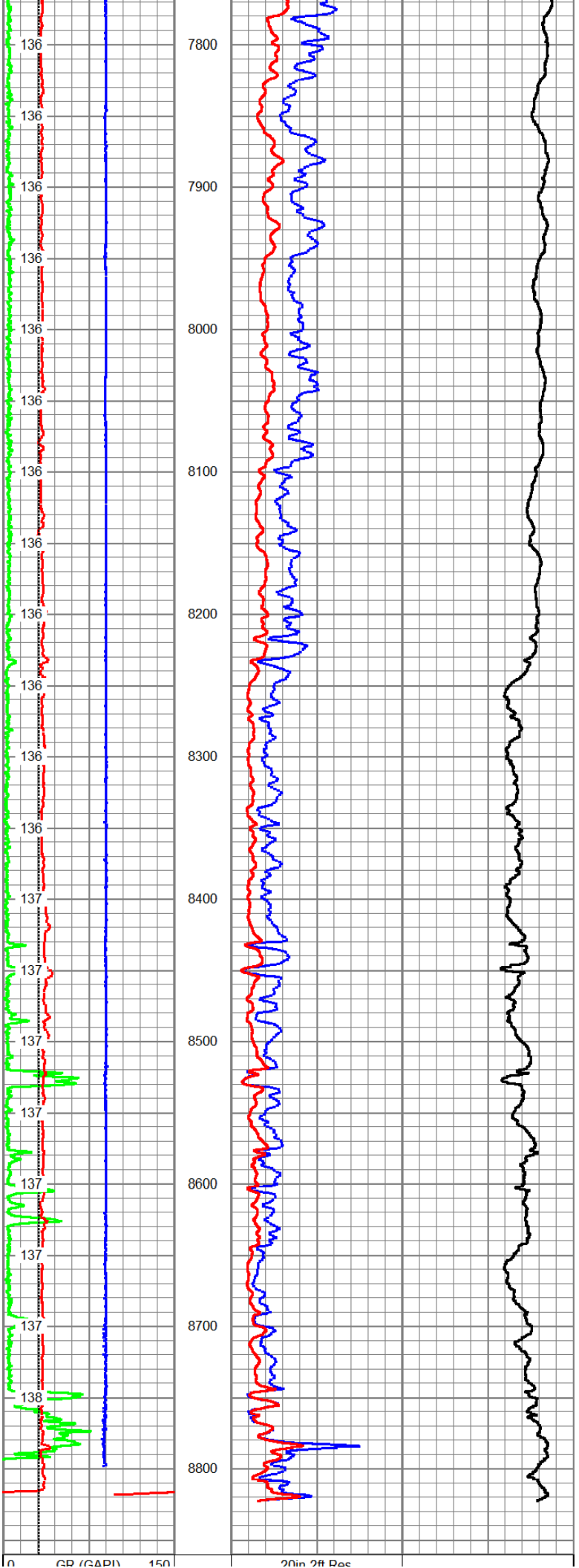
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7800
7900
8000
8100
8200
8300
8400
8500
8600
8700
8800
0
GR (GAPI)
150
20in 2ft Res

| | | |
|---|---|---|
| 0 | GR (GAPI) | 150 |
| 4 | DCAL (in) | 14 |
| -5 | ACCY | 5 |
| 4 | BOREID (in) | 14 |

GRTEMP (degF)

| | | |
|---|---|---|
| | 20in 2ft Res | |
| 50 | (Ohm-m) | 500 |
| | 90in 4ft Res | |
| 50 | (Ohm-m) | 500 |

1000 DEEP COND (mmho/m) 0

| | | |
|---|---|---|
| 0 | 20in 4ft Res (Ohm-m) | 50 |
| 0 | 90in 4ft Res (Ohm-m) | 50 |