ThruBit
A Schlumberger Company

# ARRAY INDUCTION DENSITY / NEUTRON/GR WAVEFORM SONIC POROSITY MEMORY LOG

Company SHELL EXP. & PROD. CO., INC.
Well MORROW LAND 3007 28-1H
Field WILDCAT
County HARPER
State KANSAS

Company SHELL EXP. & PROD. CO., INC.

Well MORROW LAND 3007 28-1H

Field WILDCAT

County HARPER State KANSAS

Location: API # : 15-095-22244-01-00

W2, SE, SW, SE
330' FSL & 3500' FWL
SEC 28 TWP 30S RGE 7W

Other Services
SONIC

Elevation
K.B. 1653'
D.F. 1651'
G.L. 1630'

Permanent Datum G.L. Elevation 1630'
Log Measured From
Drilling Measured From K.B.

| | | | |
|---|---|---|---|
| Date | 17 DEC 2012 | | |
| Run Number | ONE | | |
| Depth Driller | 8708' | | |
| Depth Logger | 8687' | | |
| Bottom Logged Interval | 8676 | | |
| Top Log Interval | 4787' | | |
| Casing Driller | 4787' | | |
| Casing Logger | 4782' | | |
| Bit Size | 6.125 | | |
| Type Fluid in Hole | WBM | | |
| Density / Viscosity | 8.4 / 27 | | |
| pH / Fluid Loss | 7.5 / NA | | |
| Source of Sample | MUD SENSOR | | |
| Rm @ Meas. Temp | 1.40 OHM @ 60 DEGF | | |
| Rmf @ Meas. Temp | 1.05 OHM @ 60 DEGF | | |
| Rmc @ Meas. Temp | 1.89 OHM @ 60 DEGF | | |
| Source of Rmf / Rmc | CALCULATED | | |
| Rm @ BHT | .704 OHM @ 106 DEGF | | |
| Time Circulation Stopped | 09:00 17 DEC 2012 | | |
| Time Logger on Bottom | 2:29 20 NOV 2012 | | |
| Maximum Recorded Temperature | 135 DEGF | | |
| Equipment Number | T010 | | |
| Location | BRIGHTON, CO | | |
| Recorded By | K. BANGE | J. WELLBROCK | |
| Witnessed By | TYRONE RUSSELL | | |

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<<<

The use of and reliance upon this recorded-data by the herein named company (and any of its affiliates, partners, representatives, agents, consultants and employees) is subject to the terms and conditions agreed upon between Thrubit LLC and the company, including: (a) Restrictions on use of the recorded-data; (b) Disclaimers and waivers of warranties and representations regarding company's use of and reliance upon the recorded-data; and (c) Customer's full and sole responsibility for any inference drawn or decision made in connection with the use of this recorded-data.

Comments

SERVICE: LEVEL 4 HORIZONTAL PUMP DOWN MEMORY BIT DEPTH: 8687' LOGGED TO: 4787'
ALL SCALES AND PRESENTATIONS PER CLIENT REQUEST
LIMESTONE MATRIX, 2.71 g/cc. USED FOR POROSITY MEASUREMENTS
TOOLSTING RUN WITH SMALL DE-CENTRALIZER, KNUCKLES, S. CENTRALIZER AND NO STANDOFF
TBHV REPRESENTS TOTAL BORHOLE VOLUME, 840 ft3
ABHV REPRESENTS ANNULAR HOLE VOLUME, CALCULATED FOR 4.5" CSG., 413 ft3
RIGMINDER AND PASON USED TO ACQUIRE LOG DEPTH
CASING SIZE 7.00" 23.0 LB
RIG: PATTERSON UTI #264
CREW: K. BANGE J. WELLBROCK MARK BUCKENDORF TIM HATCH

Service Ticket No. 1618 API No. 15-095-22244-01-00 PGM Ver WARRIOR 7.0

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

EQUIPMENT DATA

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

| Run No. | ONE | Run No. | ONE | Run No. | ONE | Run No. | ONE |
|---|---|---|---|---|---|---|---|
| Serial No. | PS33T | Serial No. | PS12N | Serial No. | PS38D | Serial No. | PS03R |
| 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 | 8676' | 4782' | | 30 | |
| | | | | | |

| | GAMMA RAY | | NEUTRON | | DENSITY | | INDUCTION | |
|---|---|---|---|---|---|---|---|---|
| Pass | Scale | | Scale | | Scale | | Scale | |
| No. | L | R | L | R | L | R | L | L |
| ONE | 0 API | 150 API | 30 % | -10 % | 1.95 (g/cc) | 2.95 (g/cc) | 0.2 OHM-M | 2000 OHM-M |
| | | | | | | | | |

DIRECTIONAL INFORMATION

| Maximum Deviation | 90.89 | deg. @ | 4913' | KOP | 3790' |
|---|---|---|---|---|---|

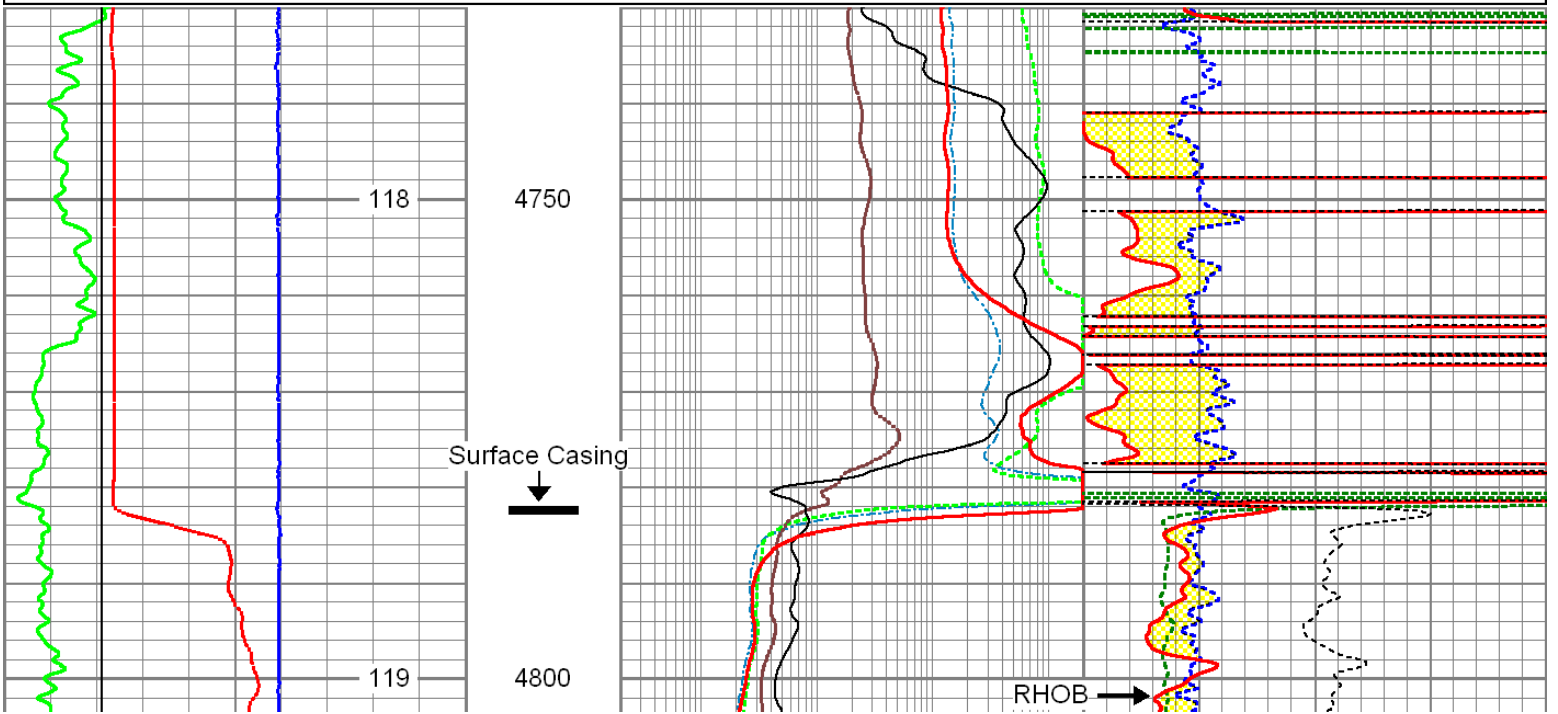
Warrior DatabaseIAk

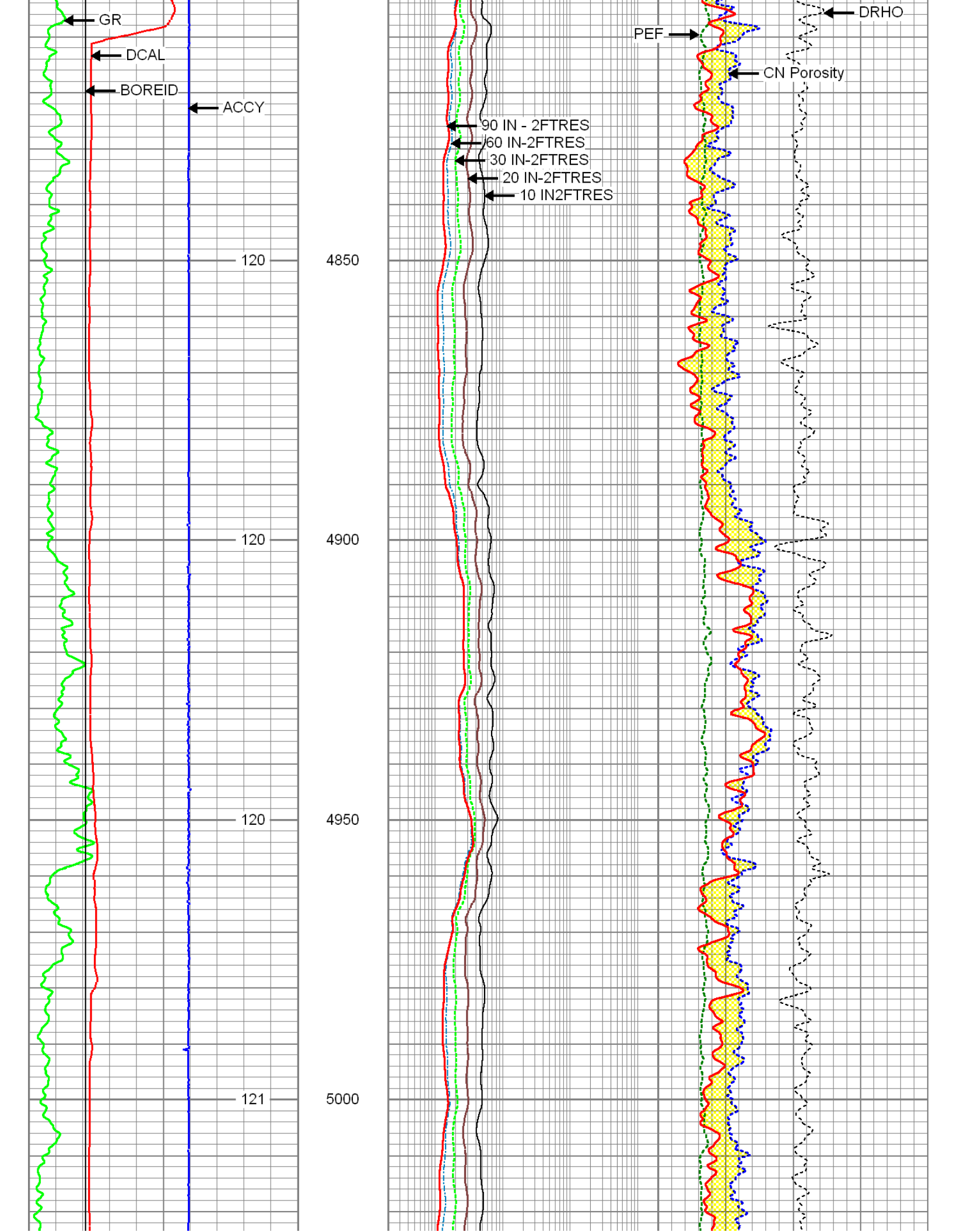
Database File: shell_morrow_land_3007_28-1h_mem3.db
Dataset Pathname: merge1.7
Presentation Format: 6_sh_tcom
Dataset Creation: Tue Dec 18 01:36:44 2012 by Calc Thrubit 110523
Charted by: Depth in Feet scaled 1:240

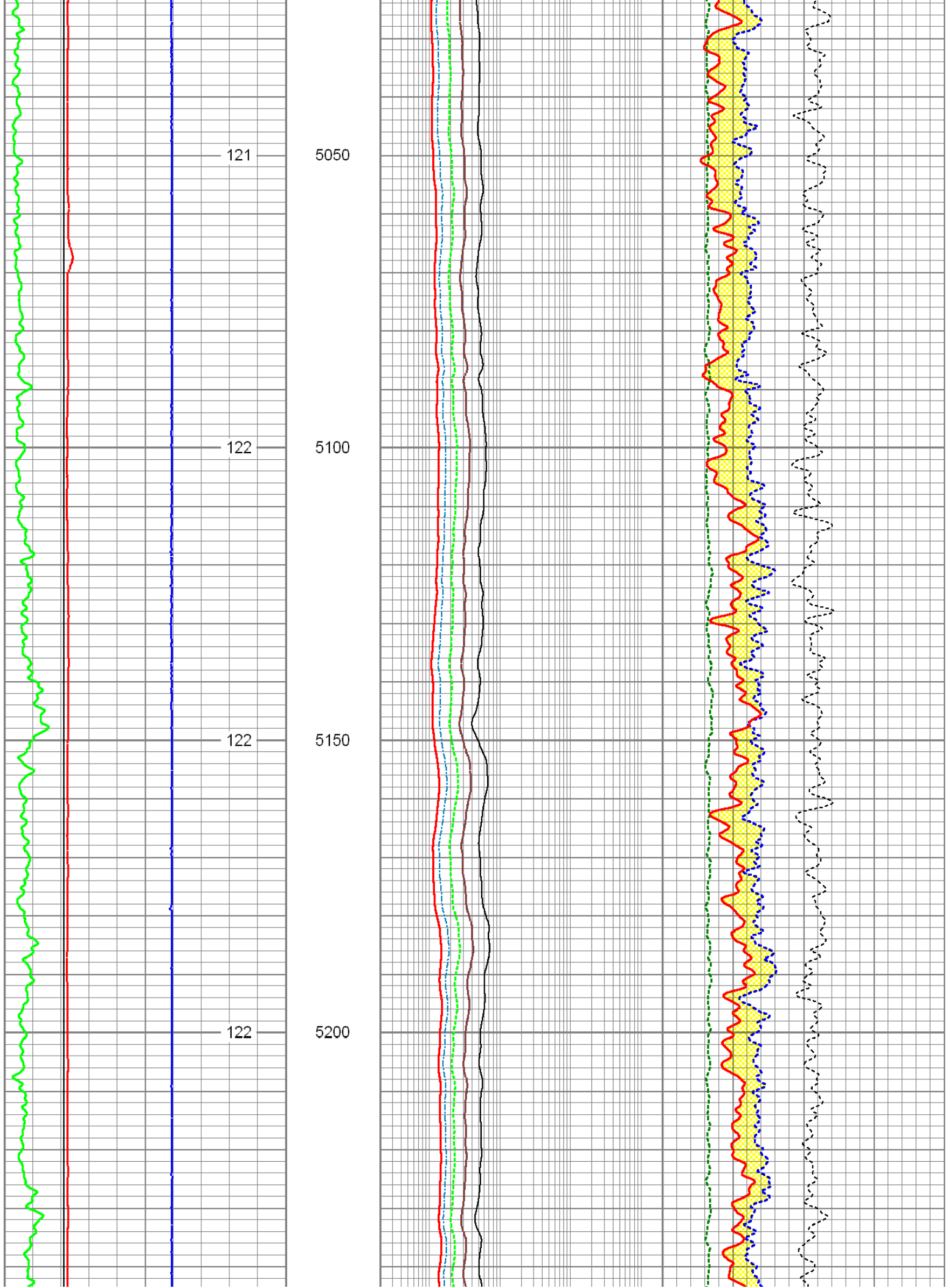
| | | |
|---|---|---|
| 0 | GR (GAPI) | 150 |
| -5 | ACCY | 5 |
| 4 | DCAL (in) | 14 |
| 4 | BOREID (in) | 14 |
| | GRTEMP (degF) | |

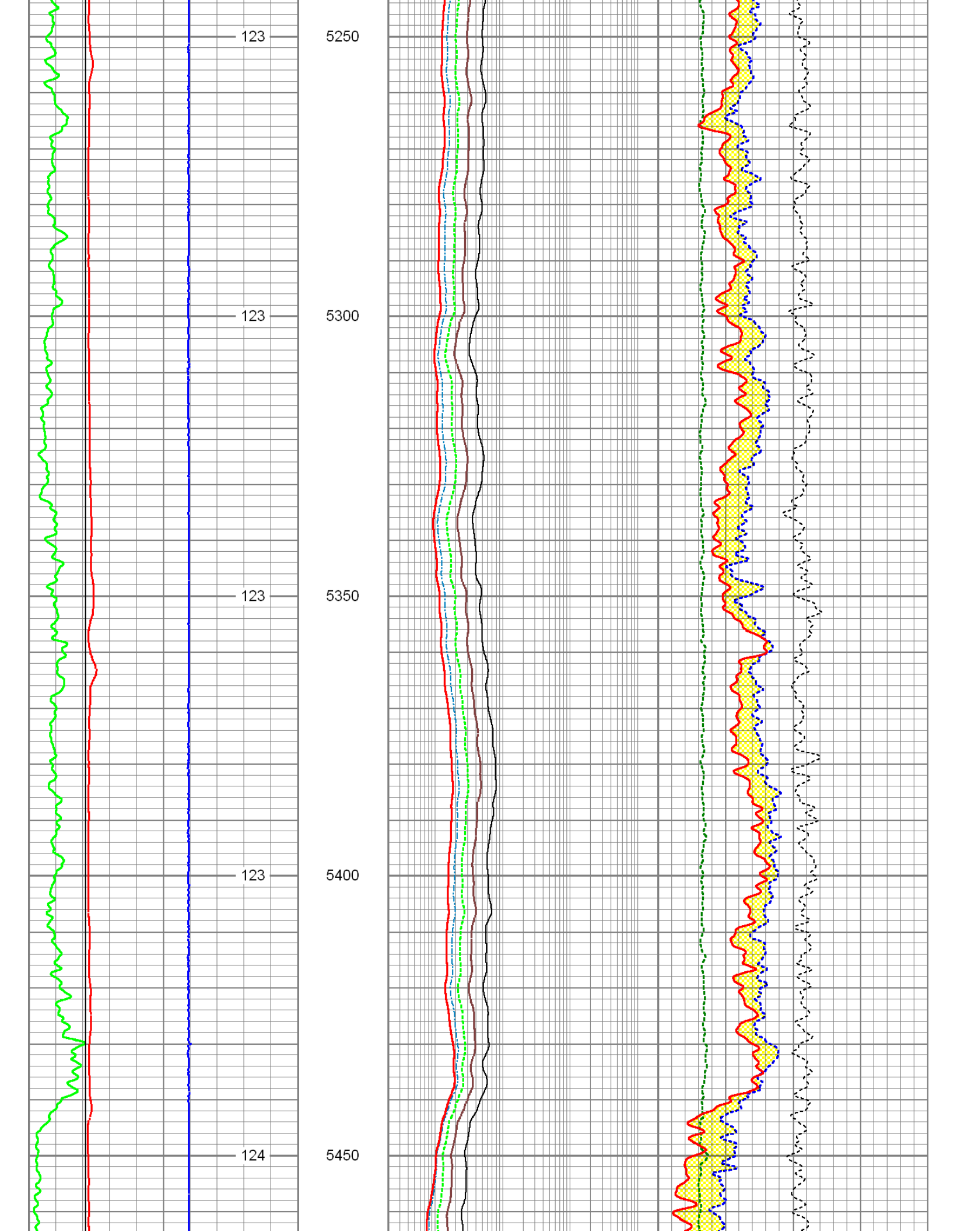
| | | |
|---|---|---|
| 0.2 | 60 IN-2FTRES (Ohm-m) | 2000 |
| 0.2 | 30 IN-2FTRES (Ohm-m) | 2000 |
| 0.2 | 20 IN-2FTRES (Ohm-m) | 2000 |
| 0.2 | 10 IN2FTRES (Ohm-m) | 2000 |
| 0.2 | 90 IN - 2FTRES (Ohm-m) | 2000 |

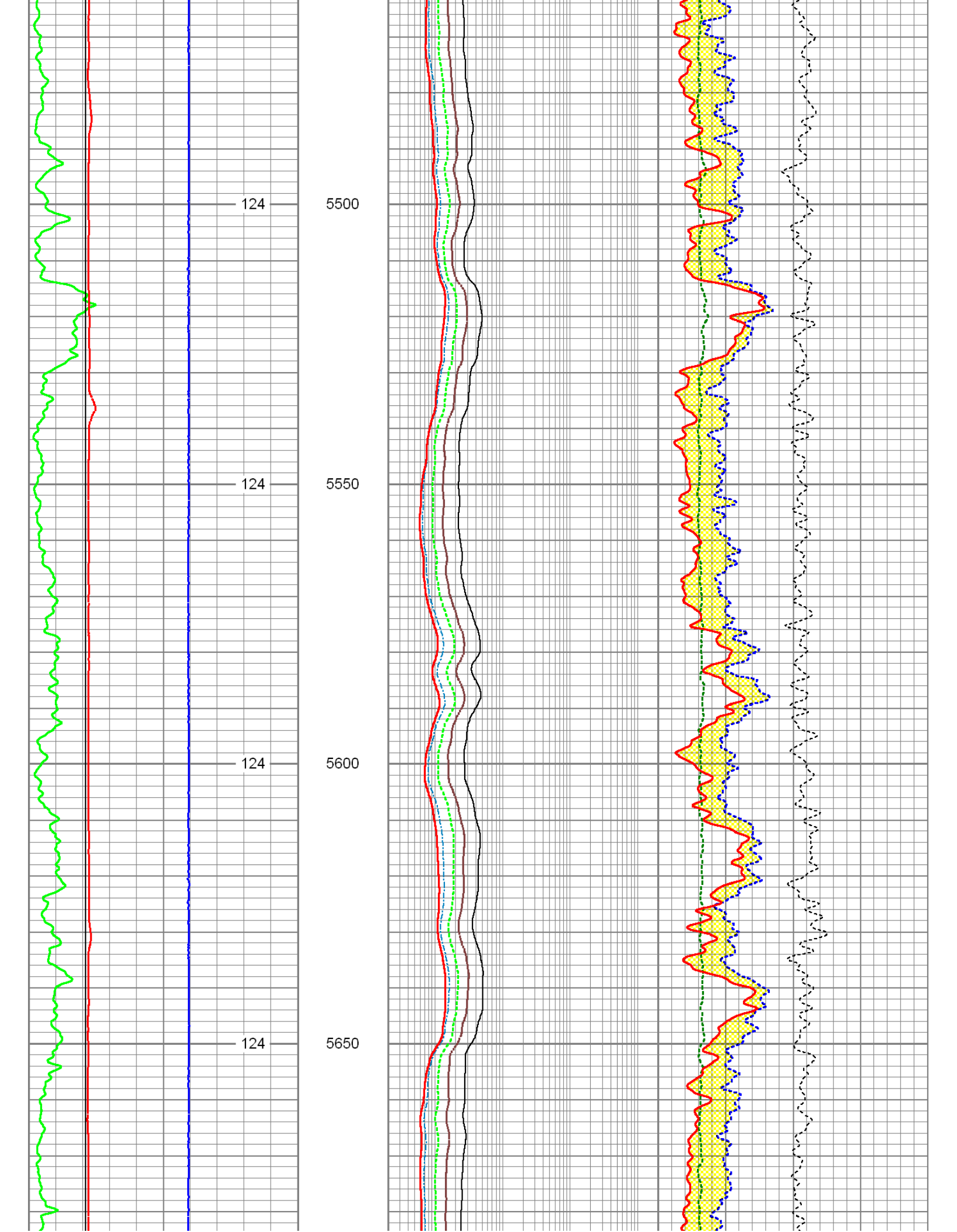
| | | |
|---|---|---|
| 45 | CN Porosity (pu) | -15 |
| 0 | PEF (barn) | 10 |
| 1.95 | RHOB (g/cc) | 2.95 |
| -0.25 | DRHO (g/cc) | 0.25 |

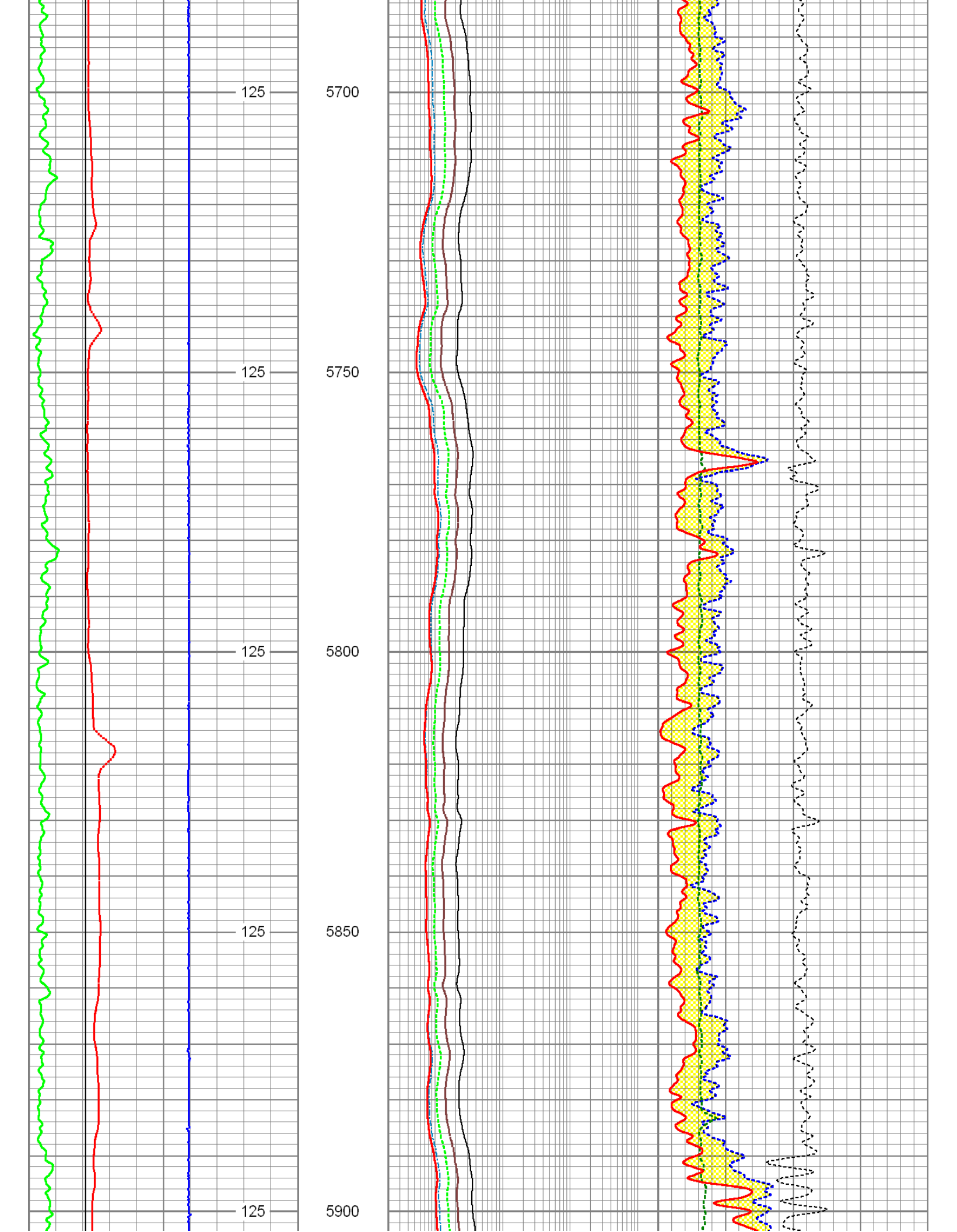


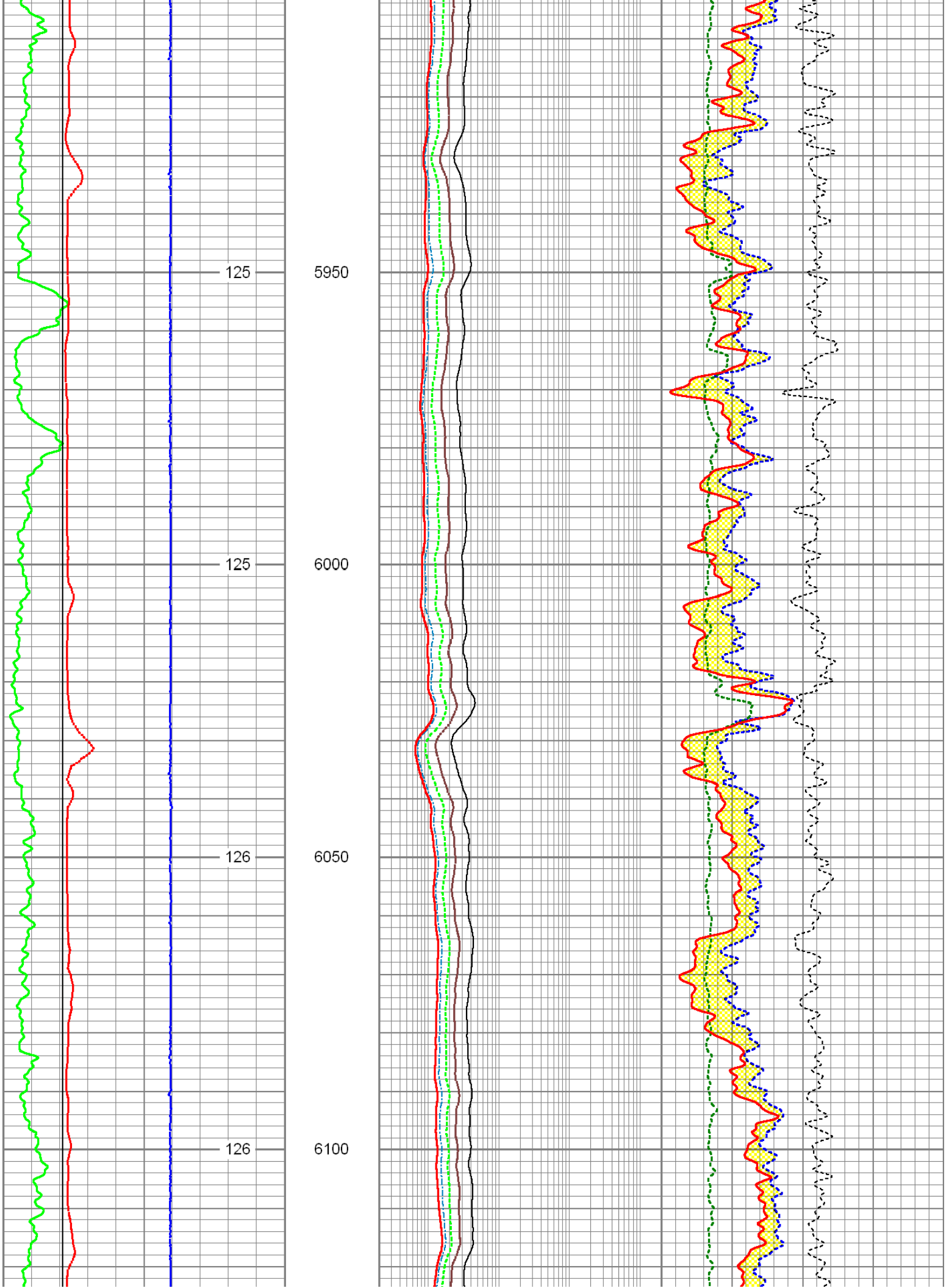

GR
DCAL
BOREID
ACCY
120
120
120
121
4850
4900
4950
5000
90 IN - 2FTRES
60 IN-2FTRES
30 IN-2FTRES
20 IN-2FTRES
10 IN2FTRES
PEF
DRHO
CN Porosity

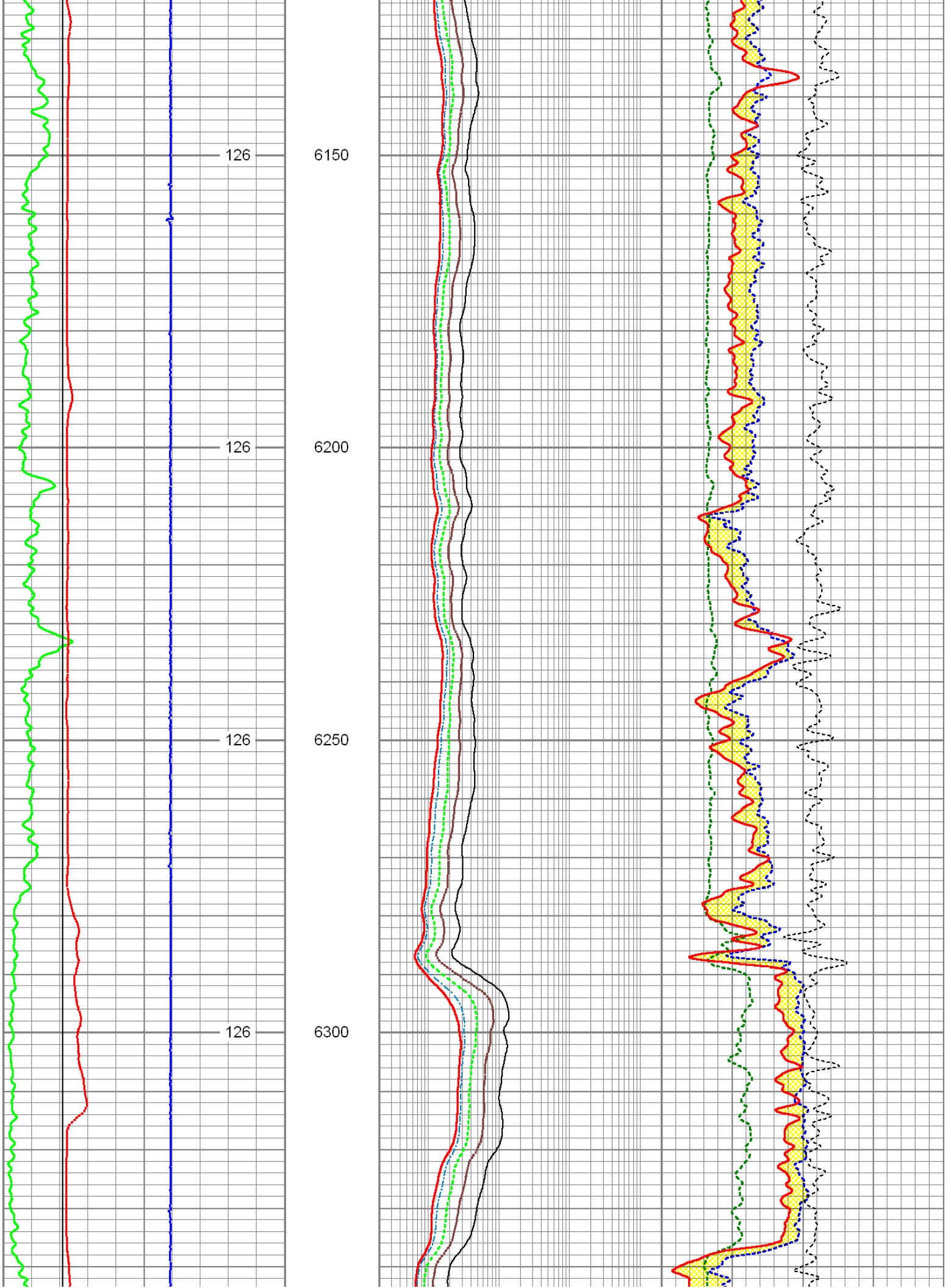

121
5050
122
5100
122
5150
122
5200

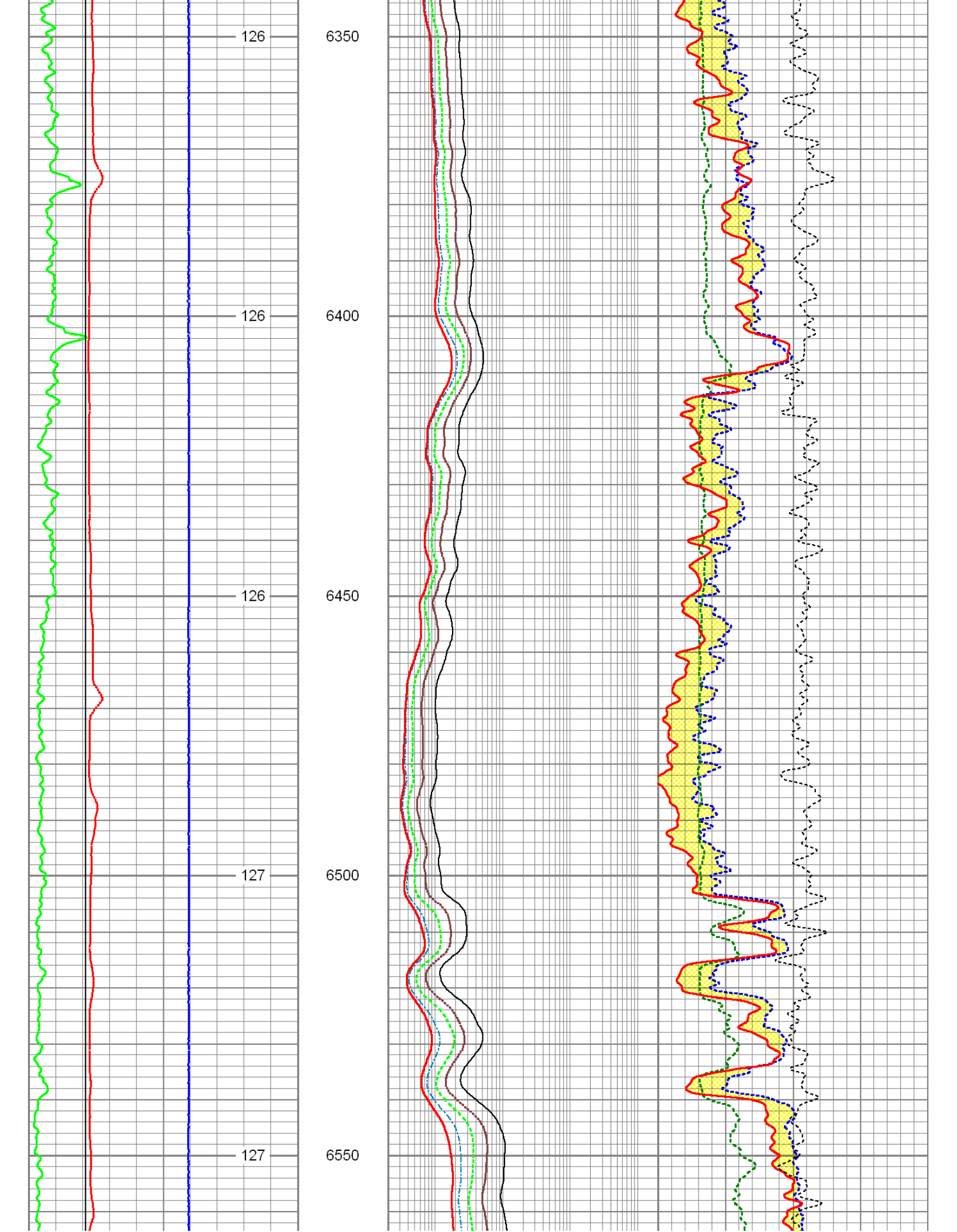

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5250
123
5300
123
5350
123
5400
124
5450

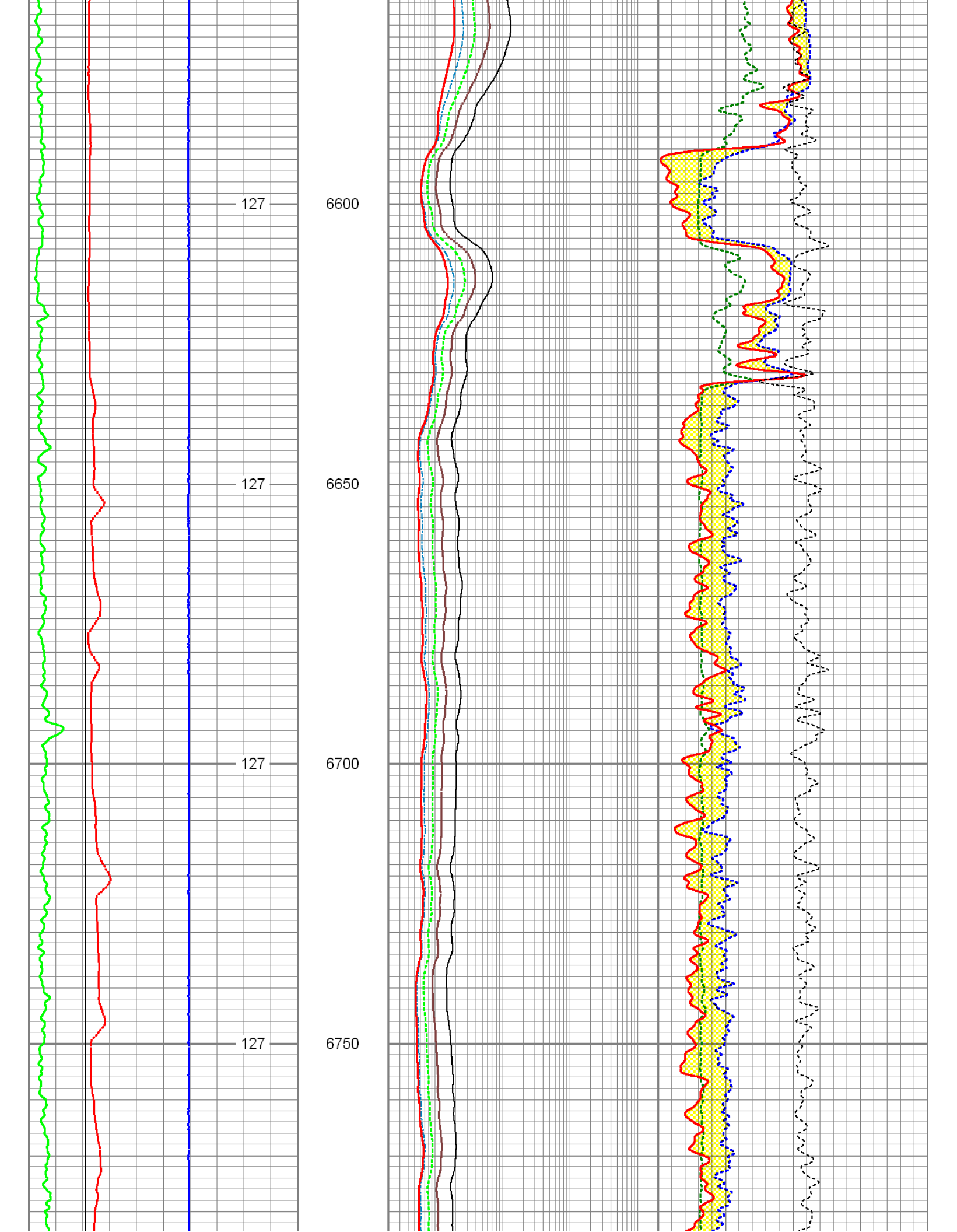

124
5500
124
5550
124
5600
124
5650

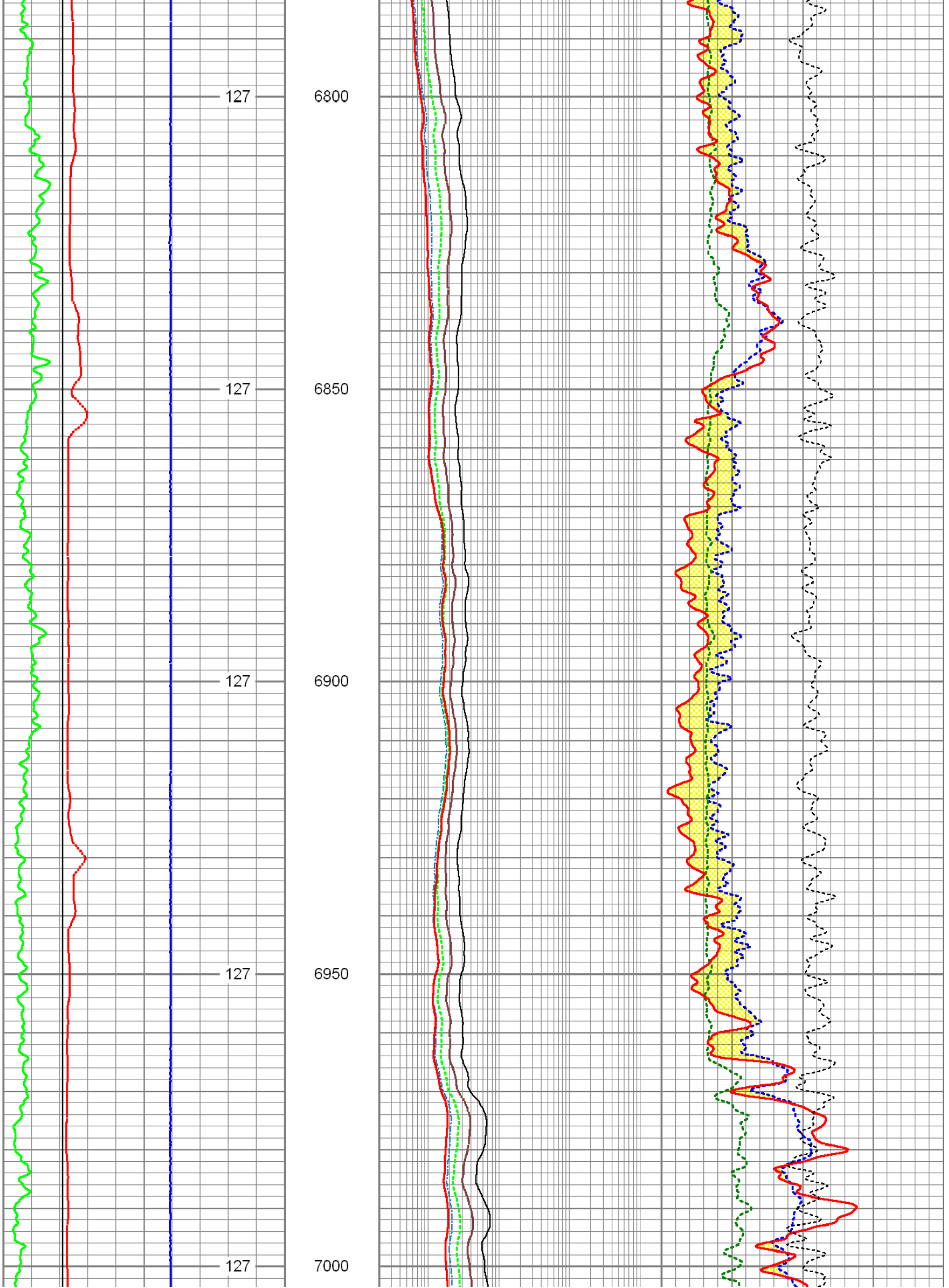

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5700
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5750
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5800
125
5850
125
5900

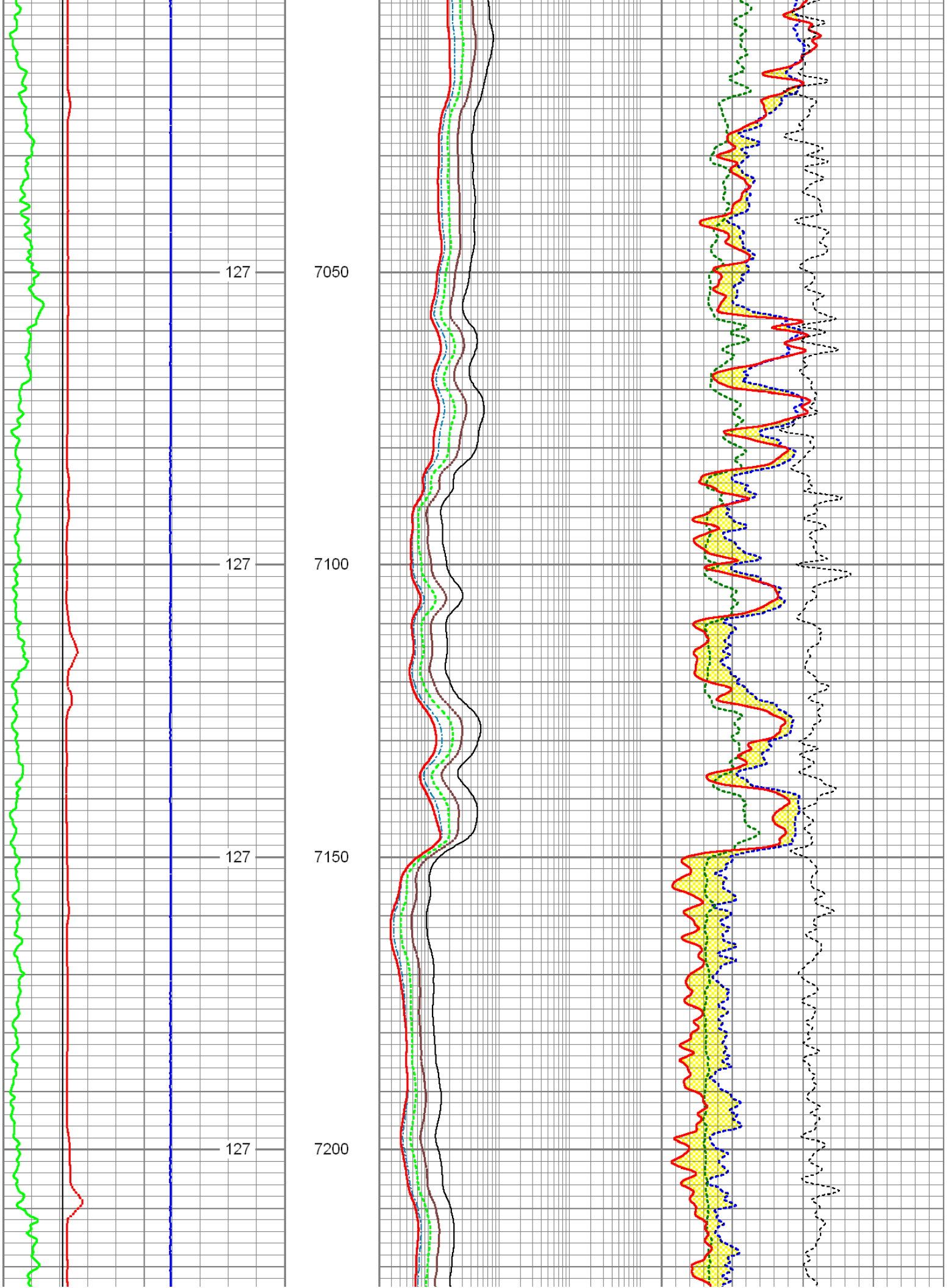

125
5950
125
6000
126
6050
126
6100

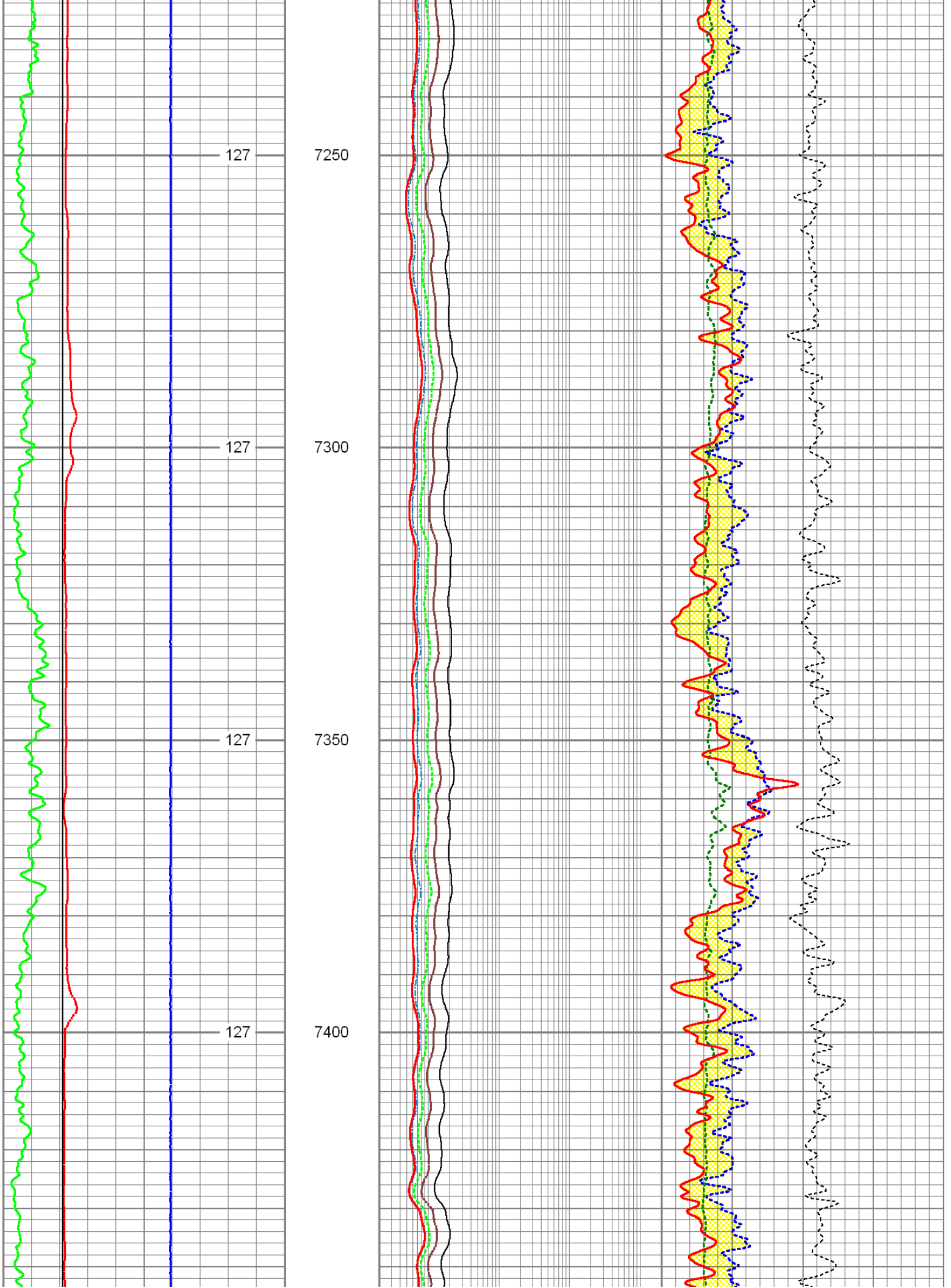

126
126
126
126
6150
6200
6250
6300

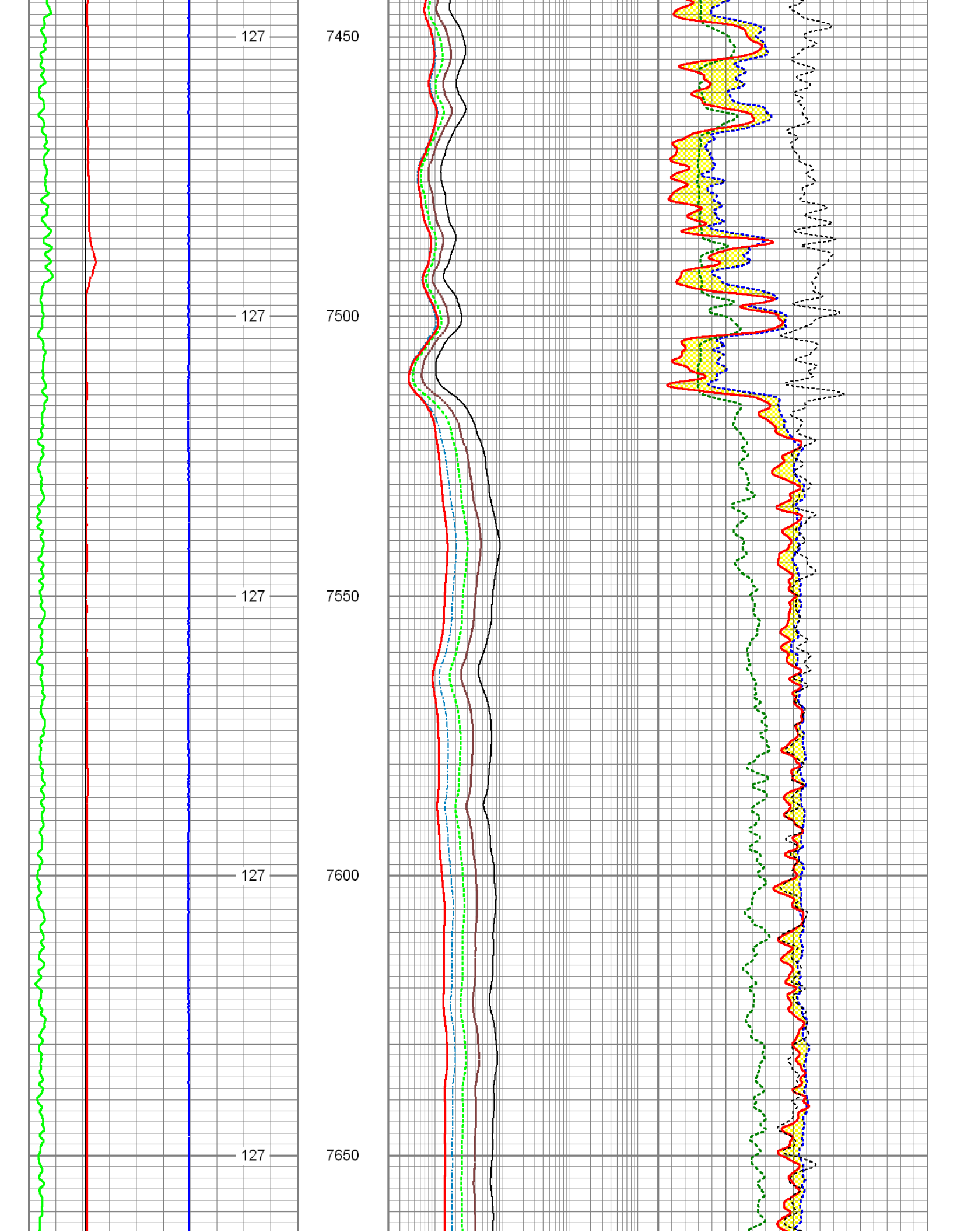

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6350
126
6400
126
6450
127
6500
127
6550

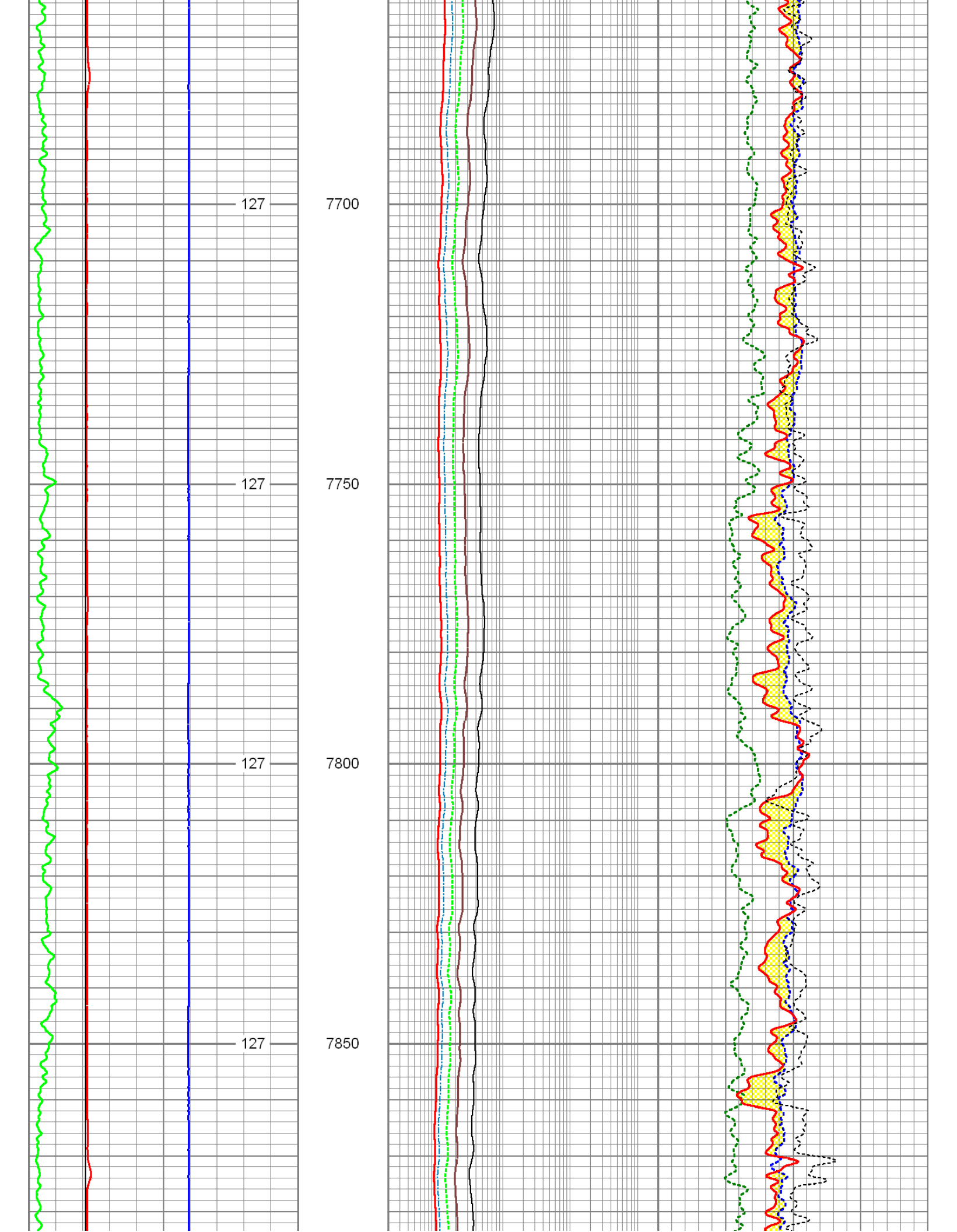

127
6600
127
6650
127
6700
127
6750

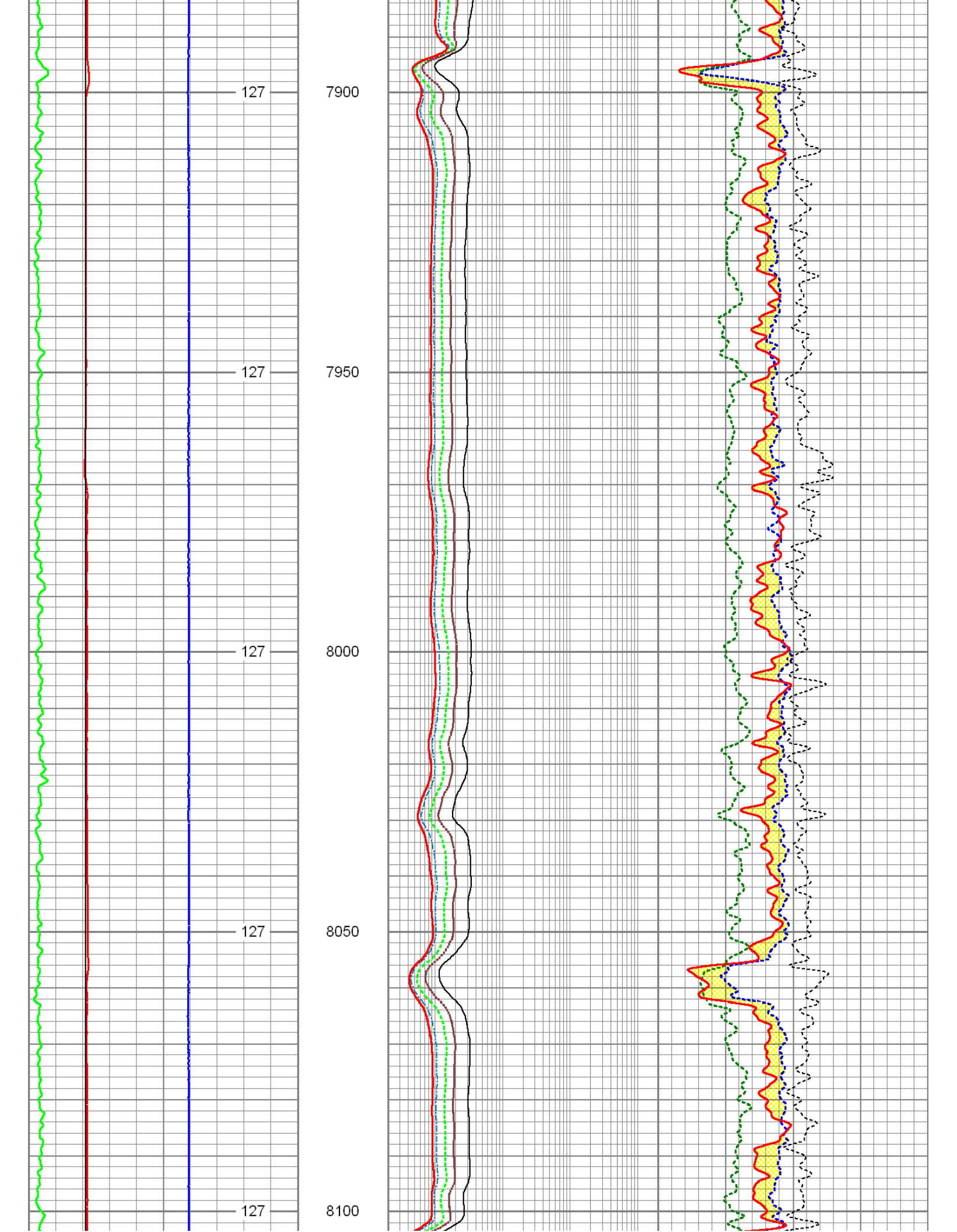

127
6800
127
6850
127
6900
127
6950
127
7000

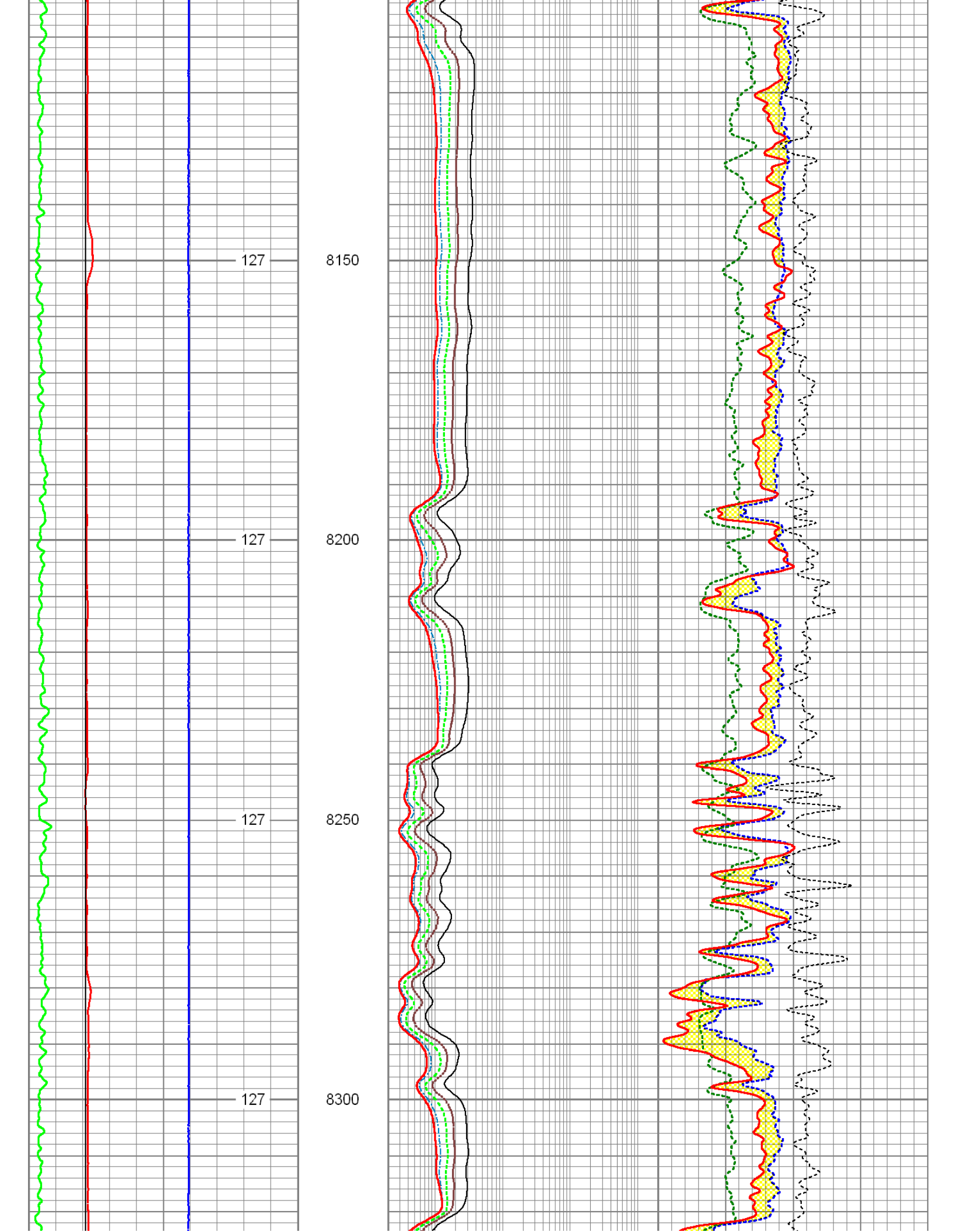

127
7050
127
7100
127
7150
127
7200

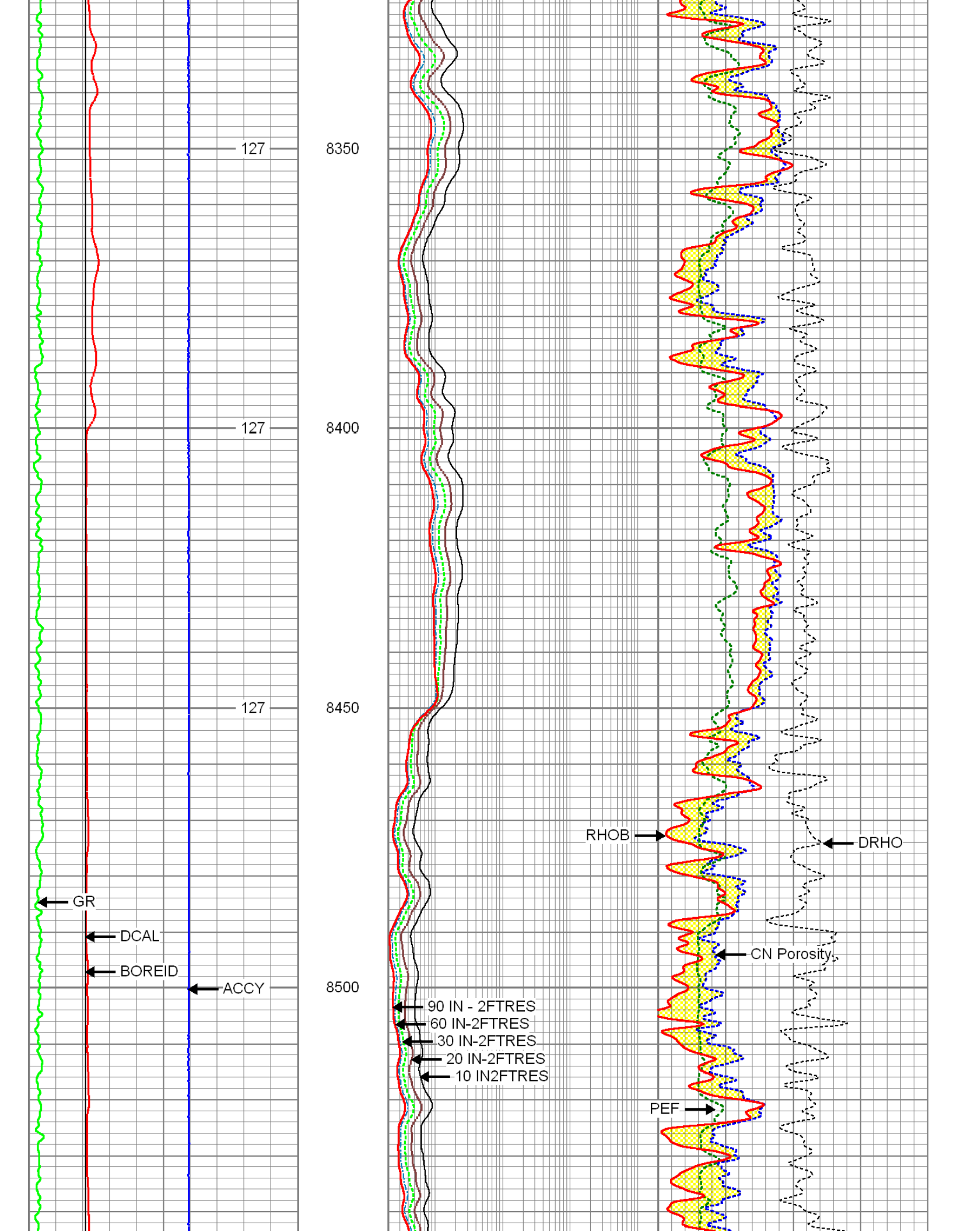

127
7250
127
7300
127
7350
127
7400

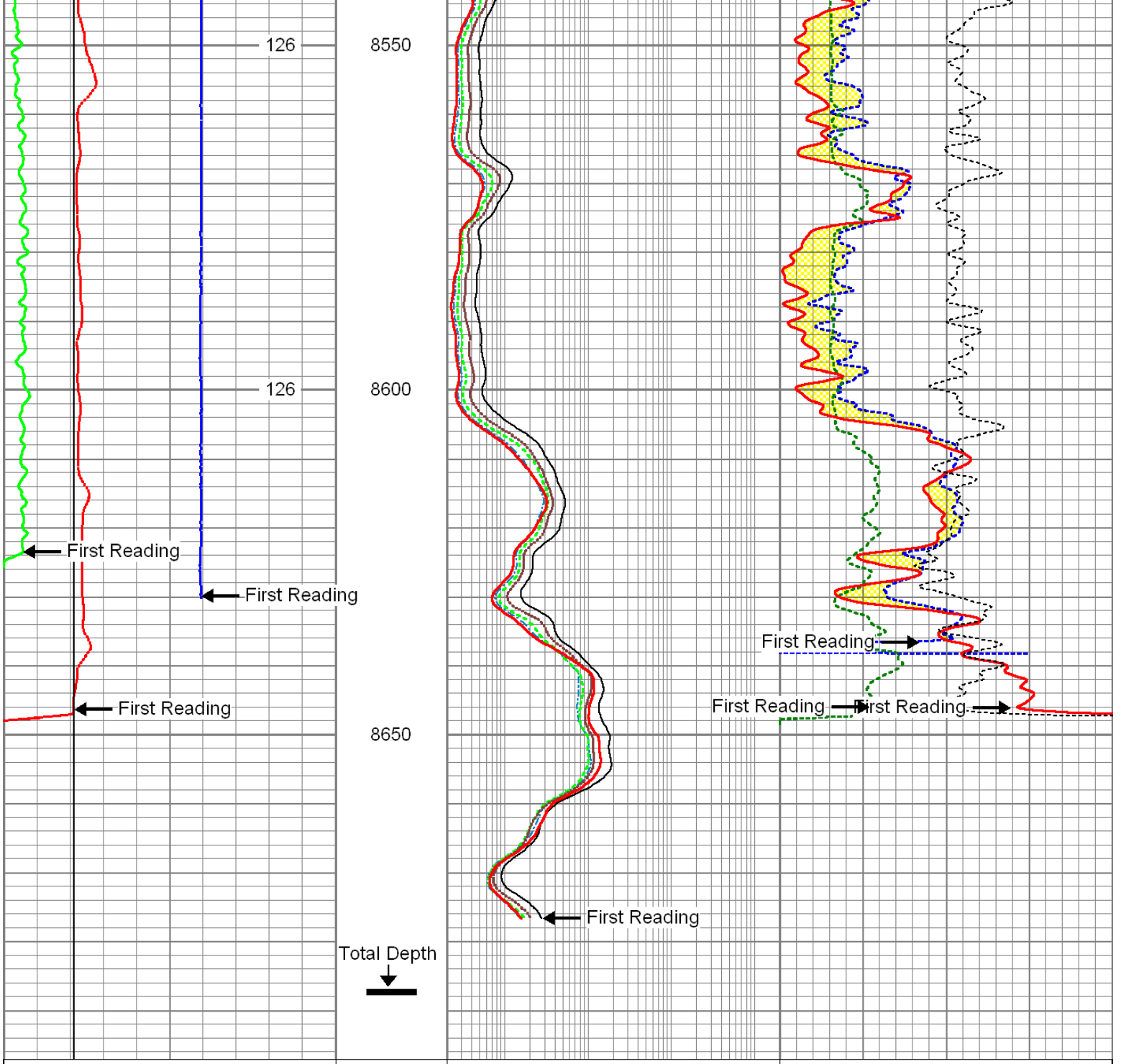

127
7450
127
7500
127
7550
127
7600
127
7650


127
7700
127
7750
127
7800
127
7850


127
7900
127
7950
127
8000
127
8050
127
8100


127
8150
127
8200
127
8250
127
8300


127
127
127
8350
8400
8450
8500
GR
DCAL
BOREID
ACCY
90 IN - 2FTRES
60 IN-2FTRES
30 IN-2FTRES
20 IN-2FTRES
10 IN2FTRES
RHOB
DRHO
CN Porosity
PEF




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

| | | |
|---|---|---|
| 0.2 | 60 IN-2FTRES (Ohm-m) | 2000 |
| 0.2 | 30 IN-2FTRES (Ohm-m) | 2000 |
| 0.2 | 20 IN-2FTRES (Ohm-m) | 2000 |
| 0.2 | 10 IN2FTRES (Ohm-m) | 2000 |
| 0.2 | 90 IN - 2FTRES (Ohm-m) | 2000 |

| | | |
|---|---|---|
| 45 | CN Porosity (pu) | -15 |
| 0 | PEF (barn) | 10 |
| 1.95 | RHOB (g/cc) | 2.95 |
| -0.25 | DRHO (g/cc) | 0.25 |

# Log Variables

Database:C:\Warrior\Data\shell_morrow_land_3007_28-1h_mem3.db
Dataset: field/well/run1/merge1.7

**Top - Bottom**

| A | BHCOR | BHFL_TYPE | BHFLRES Ohm-m | BHFLRESSRC | BHIDSRC | BOREID in |
|---|---|---|---|---|---|---|
| 1 | On | WBM | 1 | MUDCELL | CURVE | 6.125 |

| BOTTEMP | CASED? | CASEOD | CASETHCK | CEMWATERSA | CMNTTHCK | DNBHC? |
|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| degF<br>126 | <br>No | in<br>4.5 | in<br>0 | kppm<br>0 | in<br>0 | <br>NO |
| DPORSEL<br><br>RHOB | FLUIDDEN<br>g/cc<br>1 | FRMSALIN<br>kppm<br>0 | LATNOR<br><br>Off | M<br><br>2 | MATRXDEN<br>g/cc<br>2.71 | MUDSALIN<br>kppm<br>0.4 |
| MudWgt<br>lb/gal<br>8.4 | NPORSEL<br><br>Limestone | PEBHC?<br><br>YES | PERFS<br><br>0 | RESTMPSRC<br><br>INTERNAL | SO<br>in<br>0.5 | SRFTEMP<br>degF<br>65 |
| SZCOR<br><br>On | TDEPTH<br>ft<br>8708 | TMPCOR<br><br>On | TOOLPOS<br><br>Ec-centered | | | |

Calibration Report

Database File: shell_morrow_land_3007_28-1h_mem3.db
Dataset Pathname: merge1.7
Dataset Creation: Tue Dec 18 01:36:44 2012 by Calc Thrubit 110523

ThruBit Induction Calibration Report

Tool Model-Serial Number: PS-PS03R

Shop Calibration Performed: Fri Sep 07 08:11:14 2012

BASELINE

| | R | Expected | X | Expected |
|---|---|---|---|---|
| Freq 1 | | | | |
| A1 | -467.9590 | [-500.00, -400.00] | 72.5308 | [-500.00, 500.00] |
| A2 | -133.1610 | [-180.00, -100.00] | 200.3710 | [-500.00, 500.00] |
| A3 | -26.4378 | [-50.00, -10.00] | 142.1040 | [-500.00, 500.00] |
| A4 | -15.2329 | [-30.00, -10.00] | 226.4550 | [-500.00, 500.00] |
| A5 | -15.2155 | [-30.00, -10.00] | 137.9460 | [-500.00, 500.00] |
| Freq 2 | | | | |
| A1 | -243.5850 | [-280.00, -180.00] | 14.2330 | [-500.00, 500.00] |
| A2 | -86.1157 | [-130.00, -50.00] | 98.3850 | [-500.00, 500.00] |
| A3 | -20.6126 | [-50.00, -10.00] | 43.4232 | [-500.00, 500.00] |
| A4 | -20.2505 | [-30.00, -10.00] | 55.4580 | [-500.00, 500.00] |
| A5 | -21.4331 | [-30.00, -10.00] | -11.2270 | [-500.00, 500.00] |
| Freq 3 | | | | |
| A1 | -153.8680 | [-180.00, -80.00] | -62.8596 | [-500.00, 500.00] |
| A2 | -65.8440 | [-130.00, -30.00] | 27.2019 | [-500.00, 500.00] |
| A3 | -16.9032 | [-50.00, -10.00] | -23.2061 | [-500.00, 500.00] |
| A4 | -23.1157 | [-30.00, -10.00] | -59.3128 | [-500.00, 500.00] |
| A5 | -25.0492 | [-30.00, -10.00] | -119.2680 | [-500.00, 500.00] |
| Freq 4 | | | | |
| A1 | -85.8093 | [-120.00, -40.00] | -203.3080 | [-500.00, 500.00] |
| A2 | -48.8829 | [-110.00, -10.00] | -73.6973 | [-500.00, 500.00] |
| A3 | -13.6539 | [-50.00, -10.00] | -119.7800 | [-500.00, 500.00] |
| A4 | -28.4004 | [-30.00, -10.00] | -232.1780 | [-500.00, 500.00] |
| A5 | -33.6531 | [-30.00, -10.00] | -300.6700 | [-500.00, 500.00] |

CALIBRATION COEFFICIENTS

| | R | Expected | X | Expected |
|---|---|---|---|---|
| Freq 1 | | | | |

| | | | | |
|---|---|---|---|---|
| A1 | 1.0167 | [0.95, 1.05] | -0.0057 | [-0.05, 0.05] |
| A2 | 1.0167 | [0.95, 1.05] | -0.0043 | [-0.05, 0.05] |
| A3 | 1.0150 | [0.95, 1.05] | -0.0111 | [-0.05, 0.05] |
| A4 | 1.0119 | [0.95, 1.05] | -0.0017 | [-0.05, 0.05] |
| A5 | 1.0147 | [0.95, 1.05] | -0.0043 | [-0.05, 0.05] |
| Freq 2 | | | | |
| A1 | 1.0079 | [0.95, 1.05] | -0.0153 | [-0.05, 0.05] |
| A2 | 1.0076 | [0.95, 1.05] | -0.0137 | [-0.05, 0.05] |
| A3 | 1.0003 | [0.95, 1.05] | -0.0136 | [-0.05, 0.05] |
| A4 | 1.0038 | [0.95, 1.05] | -0.0125 | [-0.05, 0.05] |
| A5 | 1.0075 | [0.95, 1.05] | -0.0152 | [-0.05, 0.05] |
| Freq 3 | | | | |
| A1 | 1.0184 | [0.95, 1.05] | -0.0086 | [-0.05, 0.05] |
| A2 | 1.0185 | [0.95, 1.05] | -0.0074 | [-0.05, 0.05] |
| A3 | 1.0109 | [0.95, 1.05] | -0.0079 | [-0.05, 0.05] |
| A4 | 1.0138 | [0.95, 1.05] | -0.0067 | [-0.05, 0.05] |
| A5 | 1.0181 | [0.95, 1.05] | -0.0088 | [-0.05, 0.05] |
| Freq 4 | | | | |
| A1 | 1.0066 | [0.95, 1.05] | -0.0134 | [-0.05, 0.05] |
| A2 | 1.0071 | [0.95, 1.05] | -0.0121 | [-0.05, 0.05] |
| A3 | 1.0008 | [0.95, 1.05] | -0.0153 | [-0.05, 0.05] |
| A4 | 1.0042 | [0.95, 1.05] | -0.0119 | [-0.05, 0.05] |
| A5 | 1.0115 | [0.95, 1.05] | -0.0169 | [-0.05, 0.05] |
| Temperature | 25.1408 degC | | | |

## ThruBit Density Calibration Report

| | |
|---|---|
| Tool Model-Serial Number: | PS-PS38D |
| Source Number: | |
| Shop Calibration Performed: | Tue Dec 11 10:10:25 2012 |

REFERENCE

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

READINGS

| Outputs | Counts | Units | Expected |
|---|---|---|---|
| SS1 Background | 144.02 | cps | [130.00, 170.00] |
| LS1 Background | 146.96 | cps | [130.00, 170.00] |
| LS4 Background | 31.47 | cps | [27.00, 35.00] |
| SS1 Aluminium | 4667.80 | cps | [4500.00, 5500.00] |
| LS1 Aluminium | 852.70 | cps | [750.00, 950.00] |
| LS4 Aluminium | 956.70 | cps | [843.00, 1068.00] |
| SS1 Magnesium | 7774.56 | cps | [7000.00, 9000.00] |
| LS1 Magnesium | 5580.90 | cps | [5250.00, 6250.00] |
| LS1 Al + Fe | 714.39 | cps | [650.00, 800.00] |
| LS4 Al + Fe | 424.39 | cps | [382.00, 471.00] |

RESULTS

| | | |
|---|---|---|
| SS Slope | 1.64 | [1.52, 1.77] |
| LS Slope | 0.42 | [0.38, 0.45] |
| PEF K Factor | 4.984 | [3.510, 6.170] |
| PEF B Factor | -0.562 | [-0.700, -0.410] |

Caliper Shop Calibration performed: Tue Dec 11 10:10:25 2012

RESULTS

| Reference | Reading | Units |
|---|---|---|
| 12.00 | 1896.00 | in |
| 9.00 | 2055.69 | in |
| 6.00 | 2225.47 | in |

DENSITY PRE-SURVEY CHECK Performed: Mon Dec 17 06:33:55 2012

| Outputs | Counts | Units | Expected |
|---|---|---|---|
| SS1 Background | 146.23 | cps | [139.70, 148.34] |
| LS1 Background | 148.43 | cps | [142.55, 151.37] |
| LS4 Background | 33.57 | cps | [29.58, 33.36] |

CALIPER PRE-SURVEY CHECK Performed: Wed Nov 28 15:36:55 2012

| Reference | Readings | Units | Expected |
|---|---|---|---|
| 9.00 | 8.84 | in | [8.80, 9.20] |

## Compensated Neutron Calibration Report

Tool Model-Serial Number: PS-PS12N
Source Number:

Calibration Tank Temperature: 70.0 degF
Shop Calibration Performed: Wed Dec 05 12:28:41 2012

BACKGROUND MEASUREMENT

| Outputs | Measured | Units | Expected |
|---|---|---|---|
| SS Counts | 0.5 | cps | <10 |
| LS Counts | 1.1 | cps | <4 |

WATER TANK REFERENCE

| Outputs | Measured | Units | Expected |
|---|---|---|---|
| SS Counts | 3194.6 | cps | |
| LS Counts | 104.5 | cps | |
| Tank Ratio Ref | 30.9580 | SS/LS | |
| Tank Ratio | 30.5647 | SS/LS | |
| Tank Ratio Gain | 1.0129 | | [0.85, 1.15] |

ALUMINUM SLEEVE REFERENCE

| Outputs | Measured | Units | Expected |
|---|---|---|---|
| SS Counts | 36124.5 | cps | |
| LS Counts | 3282.9 | cps | |
| Al Ratio Ref | 10.797 | SS/LS | |
| Al Ratio | 11.145 | SS/LS | |

| | | | |
|---|---|---|---|
| Al Ratio Gain | 0.97 | | [0.90, 1.10] |
| Sleeve Porosity | 14.46 | pu | |

PRE-SURVEY BACKGROUND CHECK Performed: Mon Dec 17 06:40:14 2012

| Outputs | Measured | Units | Expected |
|---|---|---|---|
| SS Counts | 1.1 | cps | <10 |
| LS Counts | 2.4 | cps | <4 |

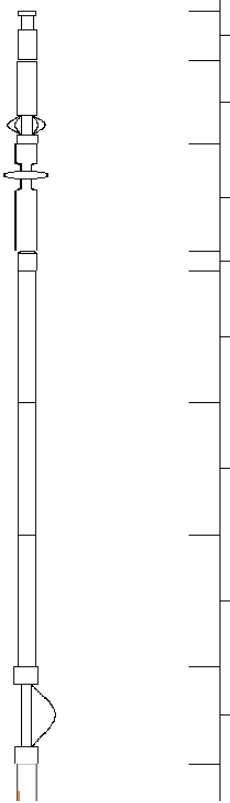
## Gamma Ray Calibration Report

| | | |
|---|---|---|
| Tool Model-Serial Number: | PS-PS33T | |
| Performed: | Mon Nov 19 10:10:25 2012 | |
| Calibrator Value: | 211.0 | GAPI |
| Background Reading: | 120.0 | cps |
| Calibrator Reading: | 682.6 | cps |
| Sensitivity: | 0.3750 | GAPI/cps |

## Inclinometer Calibration Report

Performed: Sun Jun 13 13:33:21 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 | 87.72 |  | Cablehead-S<br>Solid Weakpoint | 2.31 | 2.13 | 5.00 |
| Thrubit | 85.41 | | PSBDOT | 3.87 | 2.25 | 35.00 |
| Thrubit | 81.54 | | HangOff_Tool | 5.00 | 2.38 | 60.00 |
| Thrubit | 76.54 | | 10-1 | 0.88 | 2.13 | 3.95 |
| TBBAT | 75.67 | | TBBAT-A (PS03B)<br>Thrubit Battery | 6.13 | 2.13 | 38.20 |
| TBBAT2 | 69.54 | | TBBAT2-A (PS25B)<br>Thrubit Battery | 6.13 | 2.13 | 80.00 |
| TMG | 63.42 | | | | | |
| GR | 63.29 | | TMG-PS (PS33T)<br>ThruBit Telemetry Gamma Ray | 6.13 | 2.13 | 45.00 |
| GRTEMP | 62.46 | | | | | |
| Thrubit | 57.29 | | Decentralizer<br>Decentralizer (Small) | 4.50 | 2.13 | 70.00 |
| QNLSG | 52.85 | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| CNLSC | 50.85 | TBN-PS (PS12N)<br>ThruBit Neutron | 4.77 | 2.13 | 63.00 |
| | | TBD-PS (PS38D)<br>Thrubit Density | 10.48 | 2.13 | 91.00 |
| LSW1 | 40.29 | | | | |
| DCAL | 39.38 | | | | |
| Thrubit | 37.54 | Knuckle | 1.42 | 2.13 | 11.50 |
| Thrubit | 36.13 | Knuckle | 1.42 | 2.13 | 11.50 |
| DT | 28.04 | | | | |
| TT | 28.04 | TBS-A (TBS19)<br>Thrubit Sonic -- Initial Support | 16.46 | 2.13 | 75.00 |
| RmbPk | 28.04 | | | | |
| WVF1 | 28.04 | | | | |
| WVF2 | 28.04 | | | | |
| WVF3 | 28.04 | | | | |
| WVF4 | 28.04 | Sonic Centralizer | 2.96 | 2.13 | 22.60 |
| WVF5 | 28.04 | | | | |
| WVF6 | 28.04 | | | | |
| WVF7 | 28.04 | | | | |
| Thrubit | 18.25 | | | | |
| A1_P | 10.60 | | | | |
| A2_P | 10.10 | TBI-PS (PS03R)<br>Thrubit Induction | 15.29 | 2.13 | 94.00 |
| A3_P | 9.35 | | | | |
| A4_P | 8.35 | | | | |
| A5_P | 6.60 | | | | |

| | |
|---|---|
| Dataset: | shell_morrow_land_3007_28-1h_mem3.db: field/well/run1/merge1.7 |
| Total Length: | 87.72 ft |
| Total Weight: | 705.75 lb |
| O.D. | 2.38 in |

ThruBit
A Schlumberger Company

| | |
|---|---|
| Company | SHELL EXP. & PROD. CO., INC. |
| Well | MORROW LAND 3007 28-1H |
| Field | WILDCAT |
| County | HARPER |
| State | KANSAS |