

DC - Pressure Case Directional
PCGK - Pressure Case Gamma



1 : 600 / 1 : 240

[illegible]

WELL INFORMATION

MWD Run Number	100	200			
Date run completed	23-Oct-13	25-Oct-13			
Rig Bit Number	2	3			
Bit Size (in)	8.750	8.750			
Tool Nominal OD (in)	6.870	6.870			
Log Start Depth (TVD, ft)	999.97	5,816.38			
Log End Depth (TVD, ft)	5,816.38	6,592.36			
Drill or Wipe	Drill	Drill			
Drill/Wipe Start Date and Time	22-Oct-13 20:39	23-Oct-13 22:59			
Drill/Wipe End Date and Time	23-Oct-13 14:31	24-Oct-13 19:15			
Min Inc (deg) @ Depth (TVD, ft)	0.34 @ 4,242.60	1.47 @ 5,853.37			
Max Inc (deg) @ Depth (TVD, ft)	16.19 @ 3,039.01	83.38 @ 6,586.61			
Bit TFA(in2) / Bit Type	0.75 / PDC	0.86 / PDC			
Flow Rate (gpm)	595.86	542.67			
Max AV (fpm) / CV (fpm) @ MWD	N/A / N/A	N/A / N/A			
Fluid Type	Fresh Water Gel	Fresh Water Gel			
Density (ppg) / Viscosity (spqt)	8.95 / 32.00	10.50 / 41.00			
Filtrate CL (ppm)	2,300.00	2,450.00			
pH / Fluid Loss (mptm)	10.00 / 15	9.60 / 9			
PV (cP) / YP (lbf2)	5 / 3.00	12 / 10.00			
% Solids / % Sand	1.80 / 0.50	10.00 / 0.20			
% Oil / Oil:Water Ratio	N/A / N/A	N/A / N/A			
Rm @ Measured Temp (degF)	N/A @ N/A	N/A @ N/A			
Rmf @ Measured Temp (degF)	N/A @ N/A	N/A @ N/A			
Rmc @ Measured Temp (degF)	N/A @ N/A	N/A @ N/A			
Min Tool Temp (deg F) @ 100 ft	115.00 / 100 ft	120.00 / 100 ft			

Max Tool Temp (degF) / Source	145.90 / PCM	162.80 / PCM			
Rm @ Max Tool Temp (degF)	N/A @ 145.90	N/A @ 162.80			
Lead MWD Engineer	Robert Barnes	Robert Barnes			
Customer Representative	Jim Turner	Jim Turner			

SENSOR INFORMATION

Downhole Processor Information

Tool Type	PCM	PCM			
Software Version	5.84	5.84			
Sub Serial Number	11341336	11341336			
Insert Serial Number	11620297	11620297			
Date and Time Initialized	21-Oct-13 23:09	21-Oct-13 23:09			
Date and Time Read	25-Oct-13 02:01	25-Oct-13 02:01			
ECMB SW Version	N/A	N/A			

Directional Sensor Information

Tool Type	PCDC	PCDC			
Distance From Bit (ft)	58.00	55.00			
Software Version	6.21	6.21			
Sub Serial Number	11341336	11341336			
Sonde Serial Number	10859920	10859920			
Sensor ID Number	N/A	N/A			
Toolface Offset (deg)	15.48	20.36			

Gamma Ray Sensor Information

Tool Type	PCG	PCG			
Distance From Bit (ft)	51.24	48.62			
Recorded Sample Period (sec)	10	10			
Software Version	8.15	8.15			
Sub Serial Number	11341336	11341336			
Insert/Sonde Serial Number	12037423	12037423			

REMARKS

1. All depths are calibrated to driller's pipe tally and are true vertical depth from the Drill Floor.
2. No depth corrections have been made for pipe stretch or compression.
3. Critical annular velocities are calculated using the "Power Law" model for water based fluids and the "Brigham Plastic" model for oil and synthetic based fluids.
4. All data presented is recorded data unless otherwise specified.
5. The following smoothing parameters have been applied to the data:
1:600 Log
PGRC (Gamma CG) and ROPA (Average Rate of Penetration)
Interval Resolution: 1.0 ft
Interval Distance: 3.0 ft

1:240 Log
PGRC (Gamma CG):
Interval Resolution: 0.5 ft
Interval Distance: 0.6 ft

ROPA (Average Rate Of Penetration):
Interval Resolution: 0.5 ft

Interval Resolution: 1.2 ft

6. Insite Version v8.0.0

WARRANTY

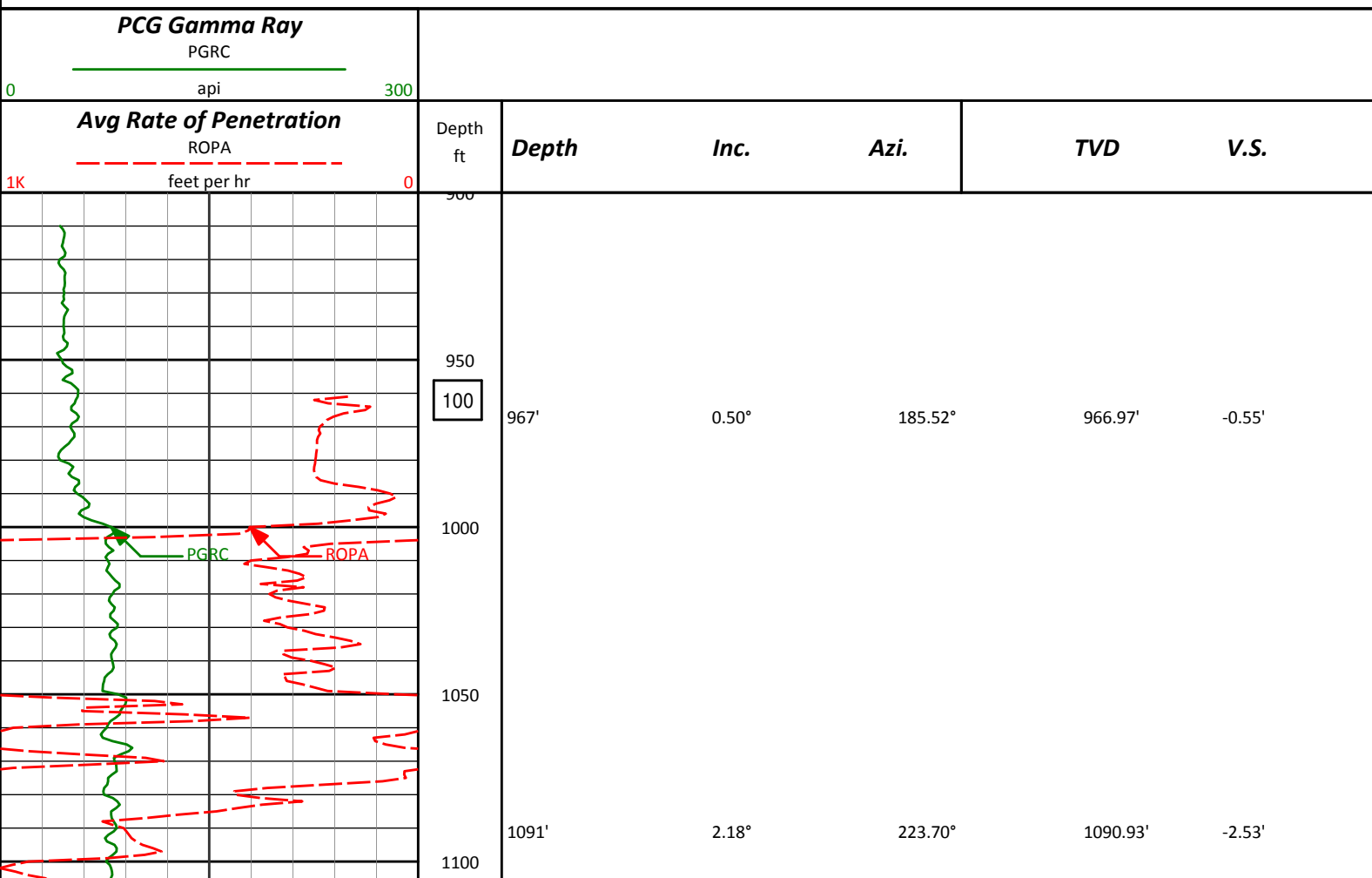
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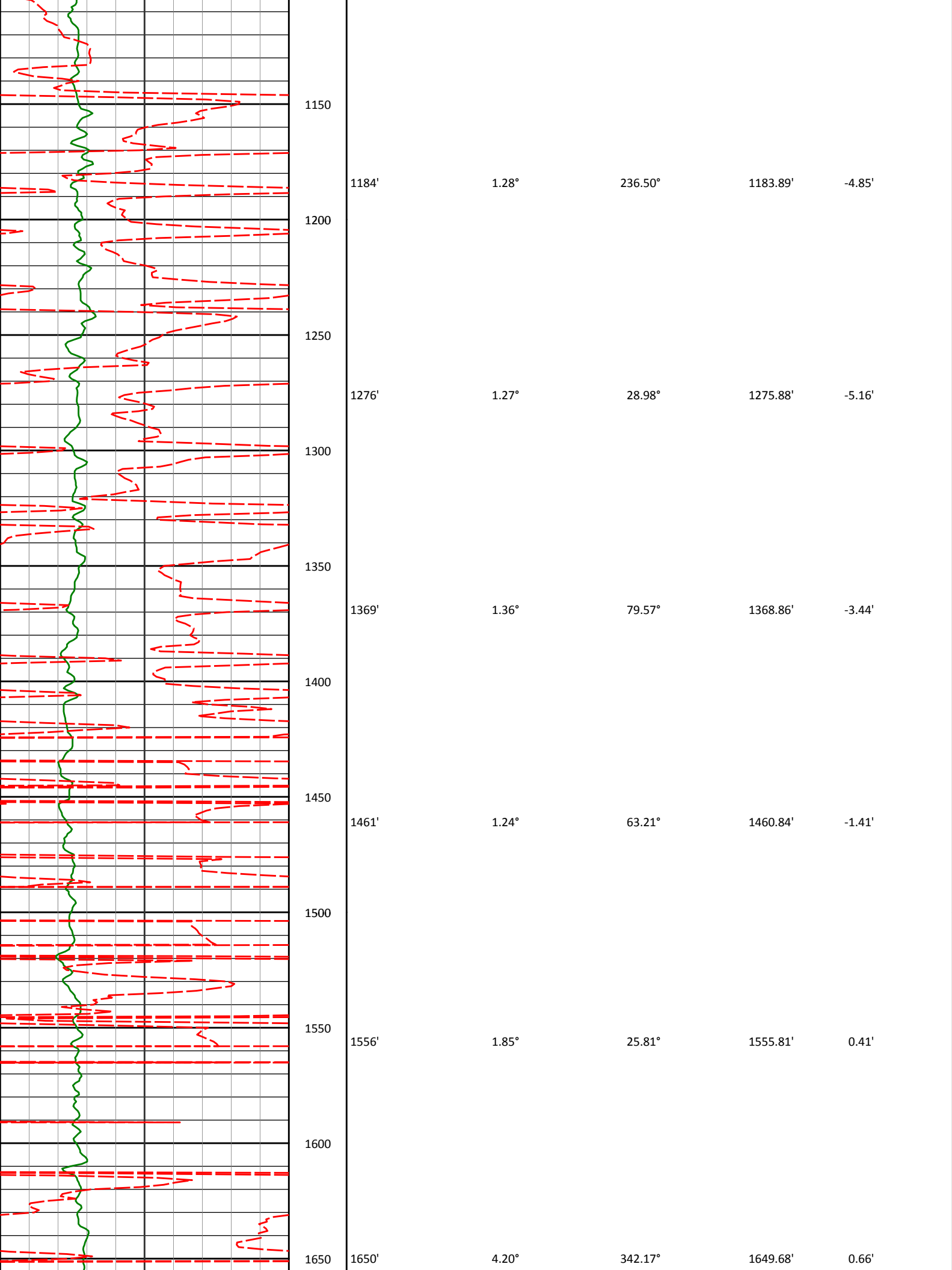
HALLIBURTON

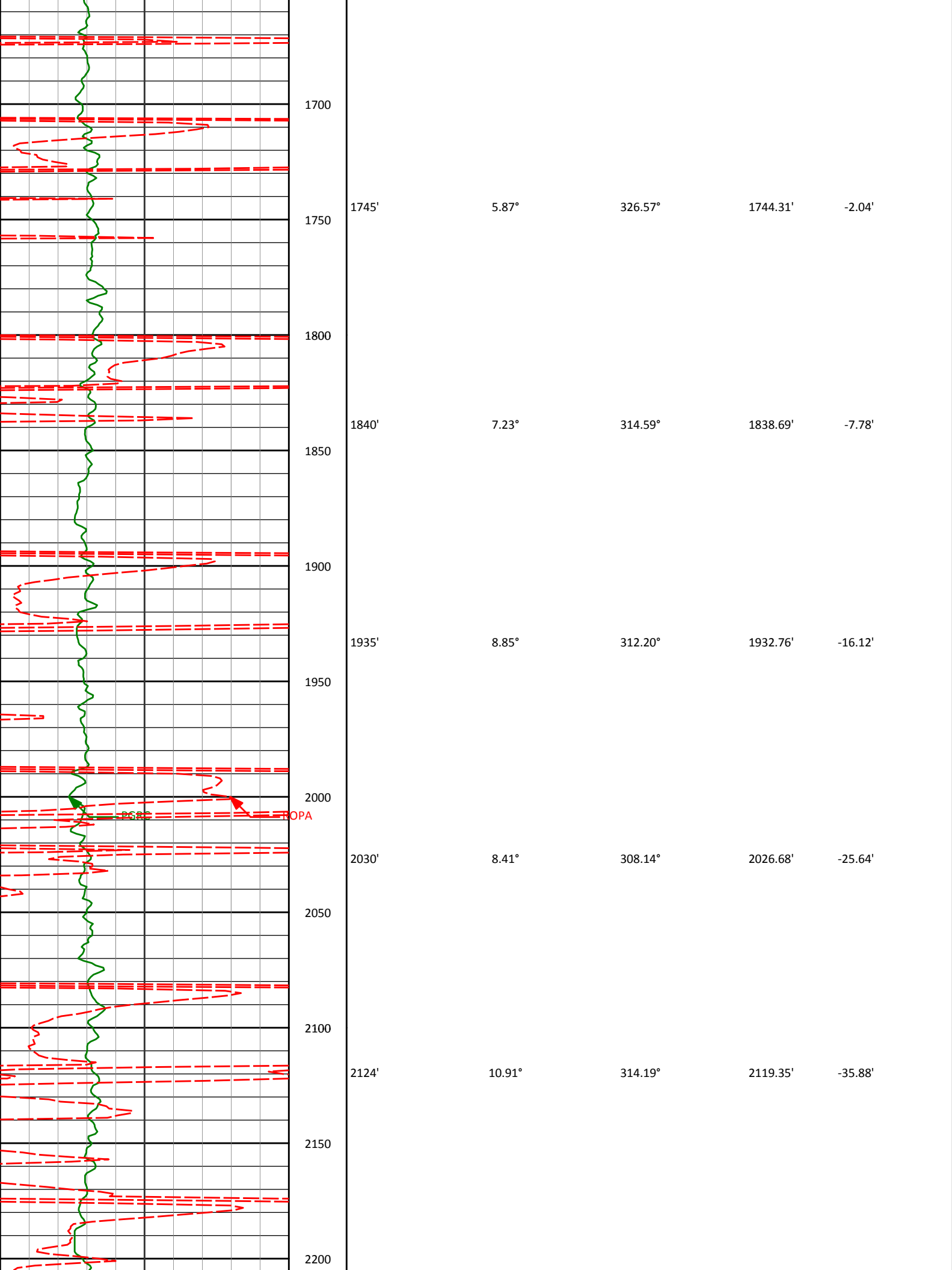
Sperry Drilling Services

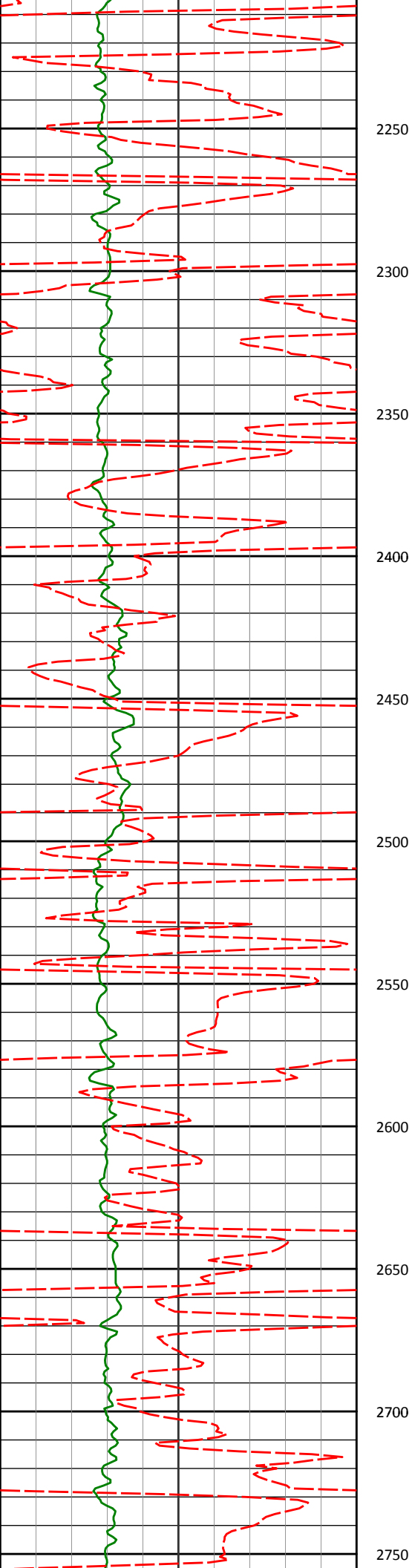
TVD Correlation Log 1:600

Noble Energy
Wells Ranch AE20-68HN
H&P 321
Sec. 20-T6N-R62W

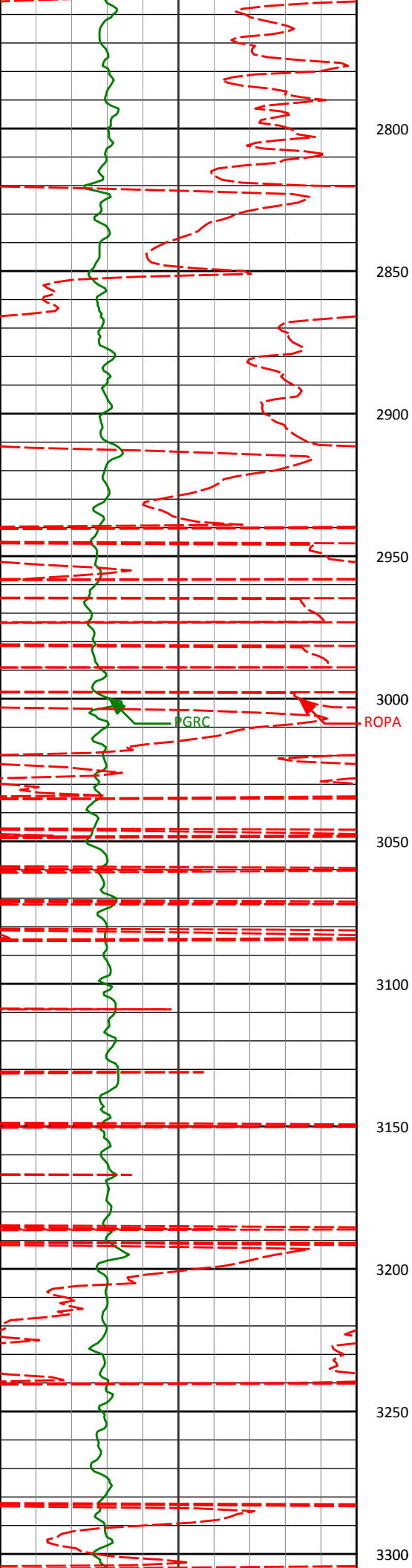




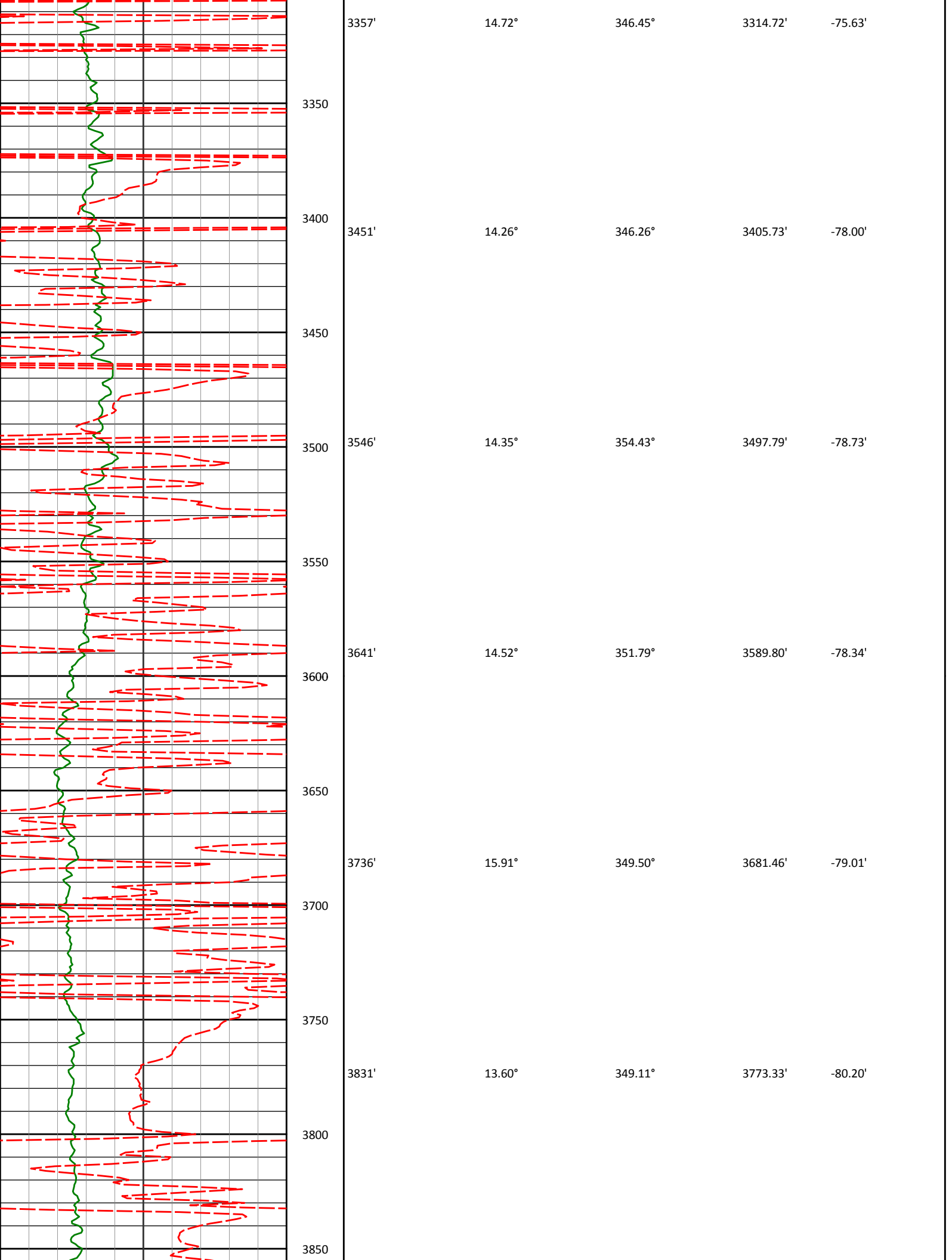


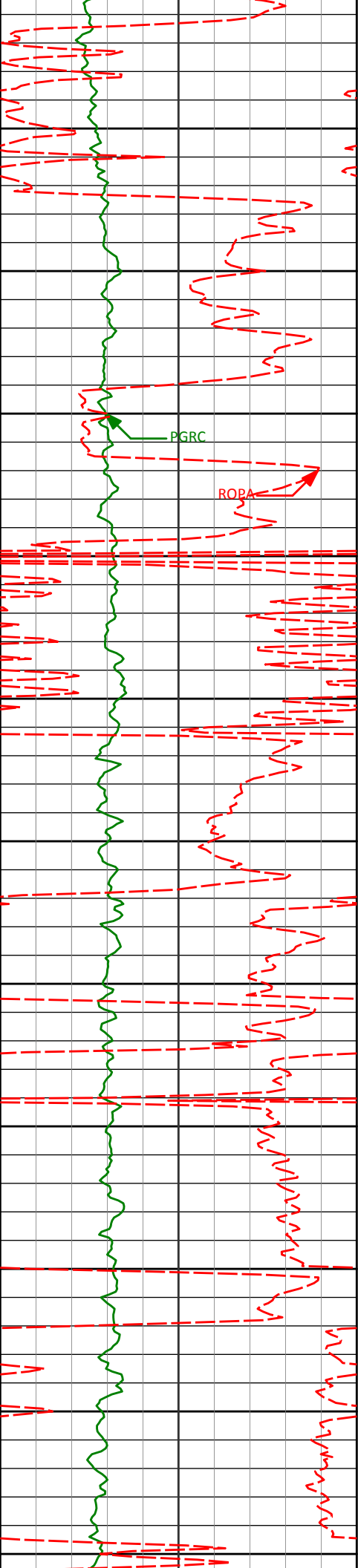


2219'	11.63°	321.27°	2212.52'	-46.33'
2314'	12.66°	327.37°	2305.39'	-55.60'
2409'	13.04°	333.73°	2398.02'	-63.35'
2504'	13.44°	342.96°	2490.50'	-68.49'
2598'	15.50°	348.48°	2581.52'	-71.04'
2693'	14.76°	353.85°	2673.23'	-71.49'

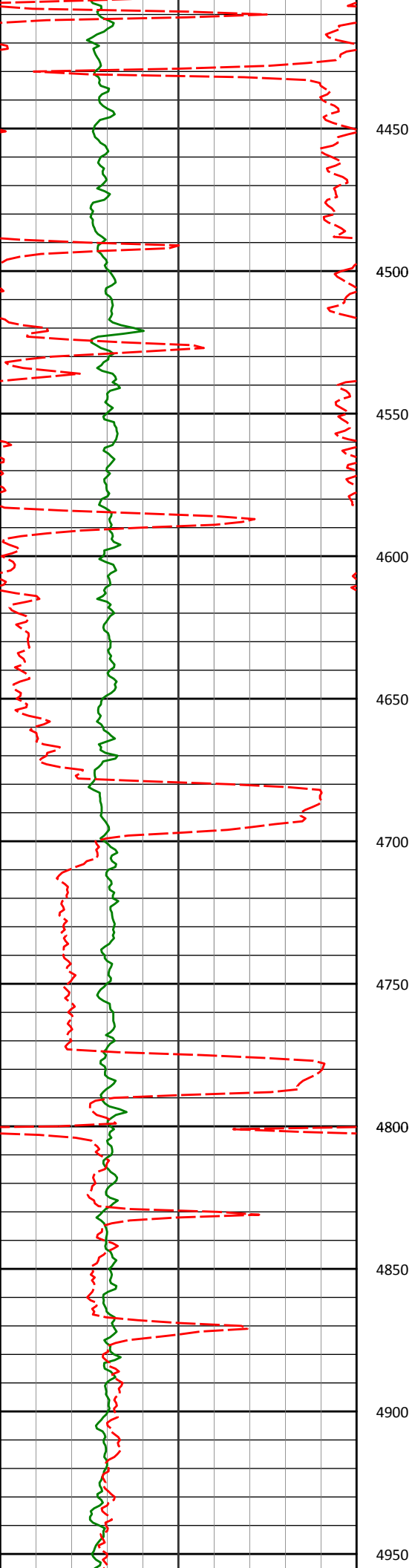


2788'	14.97°	350.74°	2765.05'	-71.43'
2800				
2850				
2883'	15.22°	348.88°	2856.78'	-72.44'
2900				
2950				
2978'	15.05°	352.82°	2948.48'	-73.00'
3000				
3072'	16.19°	351.83°	3039.01'	-72.93'
3050				
3100				
3167'	13.46°	349.68°	3130.84'	-73.47'
3150				
3200				
3262'	15.07°	351.00°	3222.91'	-74.19'
3250				
3300				

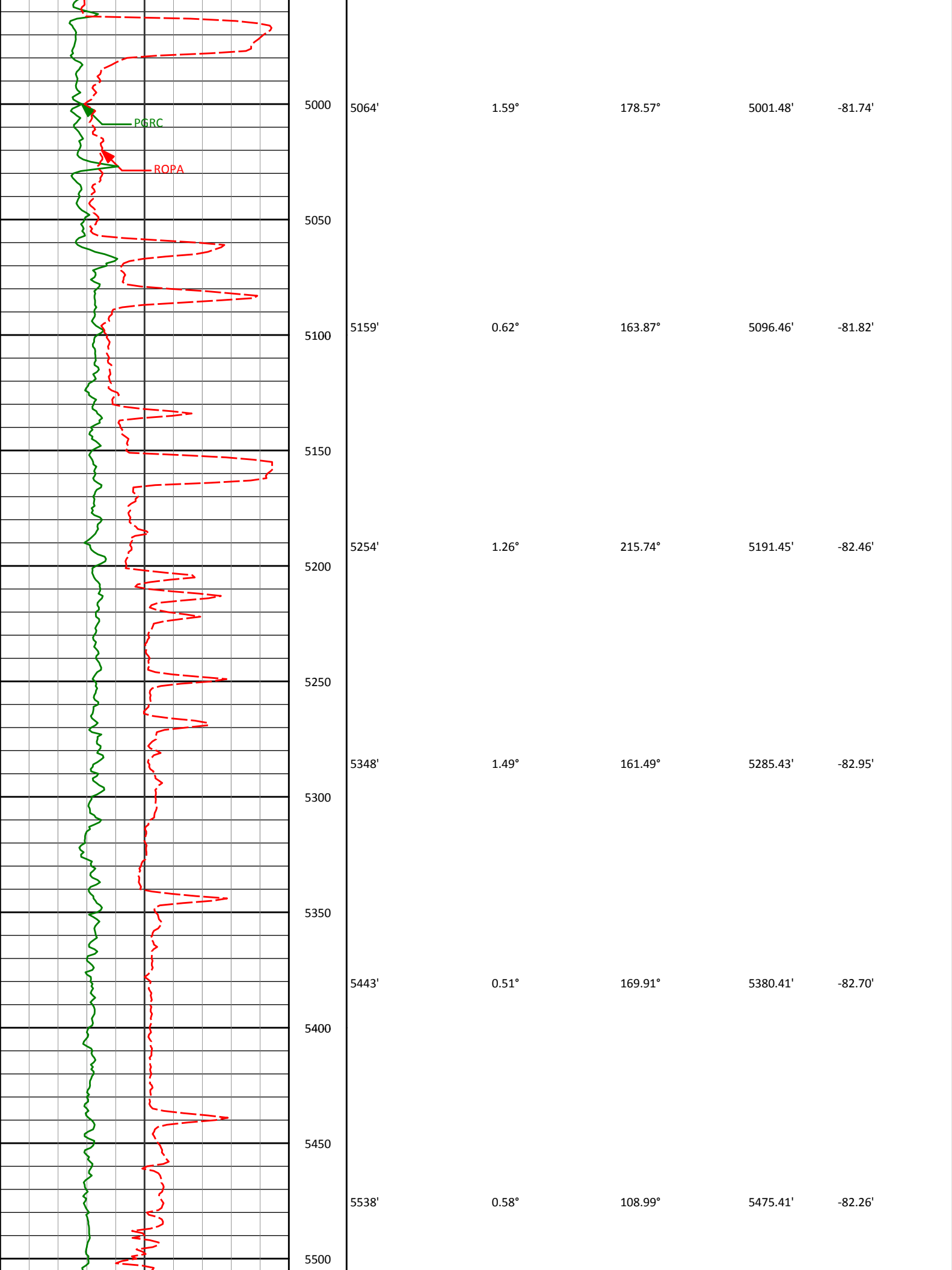


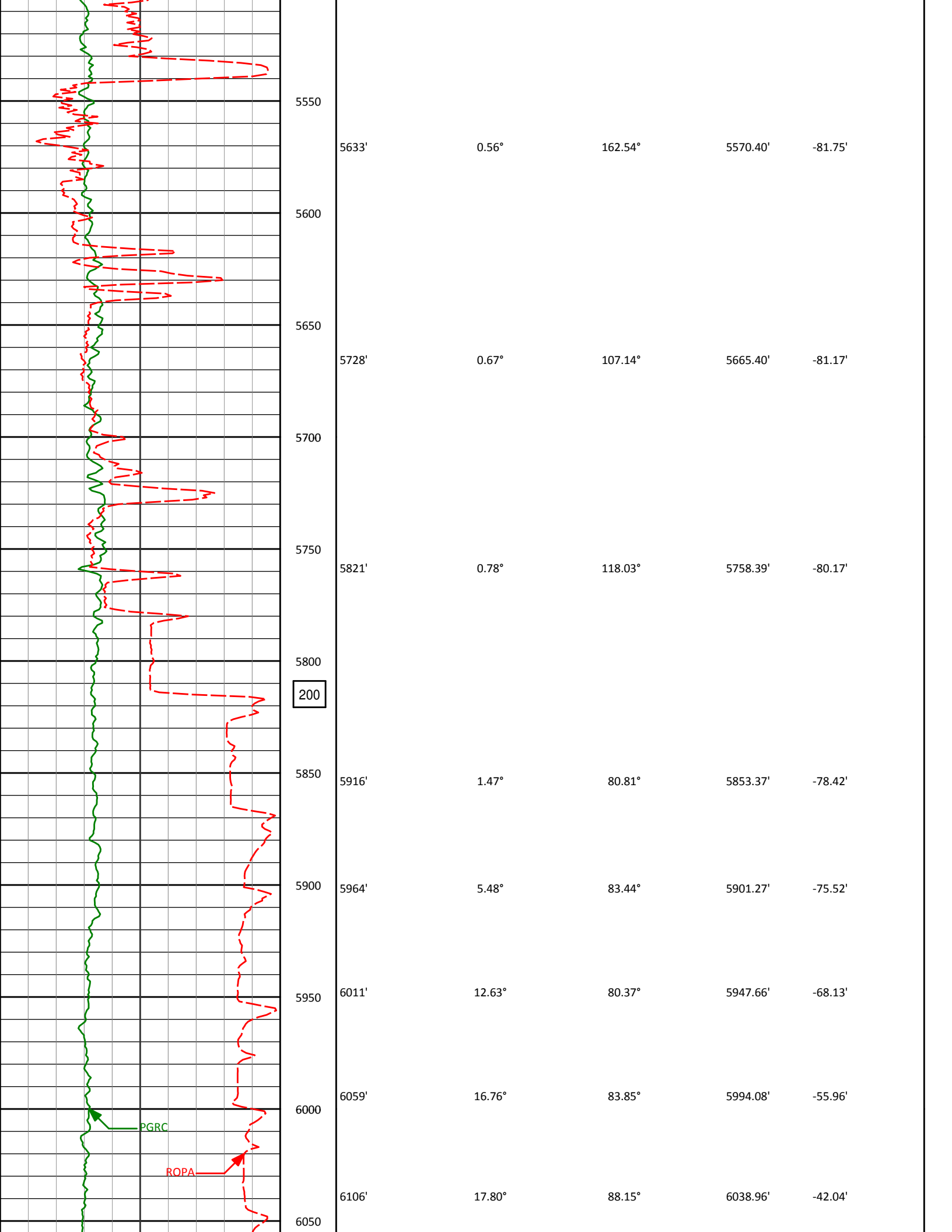


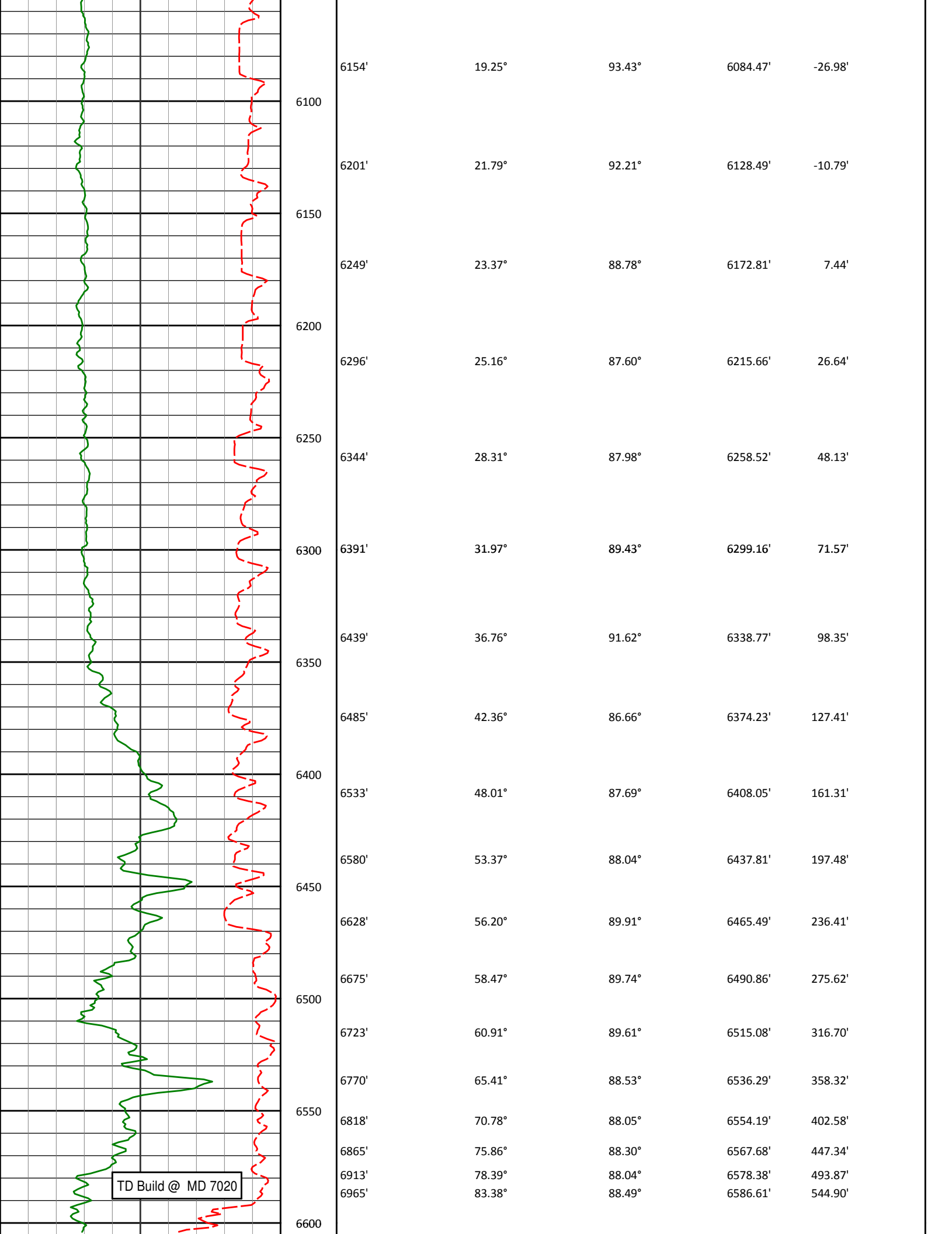
3926'	11.46°	345.01°	3866.06'	-81.96'
4020'	8.73°	349.80°	3958.60'	-83.41'
4115'	5.66°	350.53°	4052.84'	-83.84'
4210'	1.88°	316.37°	4147.62'	-84.88'
4305'	0.34°	291.03°	4242.60'	-86.04'
4400'	0.94°	184.04°	4337.60'	-86.44'



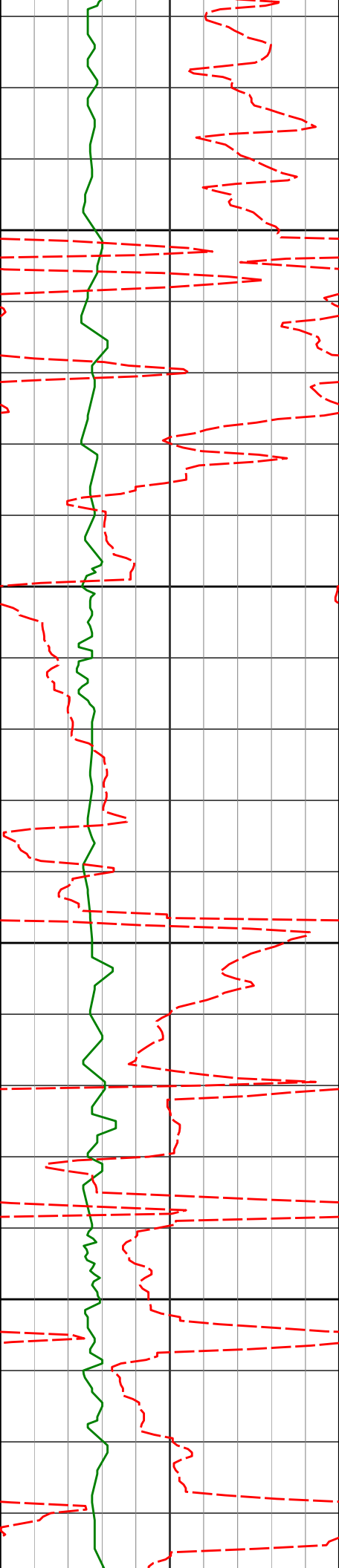
4495'	0.98°	143.40°	4432.59'	-86.22'
4450				
4500				
4590'	1.17°	156.87°	4527.57'	-85.57'
4550				
4600				
4685'	1.22°	98.03°	4622.55'	-84.34'
4650				
4700				
4780'	0.89°	138.96°	4717.54'	-82.96'
4750				
4800				
4874'	1.34°	181.56°	4811.52'	-82.74'
4850				
4900				
4969'	1.11°	125.80°	4906.50'	-82.26'
4950				







[illegible]



1050

1091'

2.18°

223.70°

1090.93'

-2.53'

1100

1150

1184'

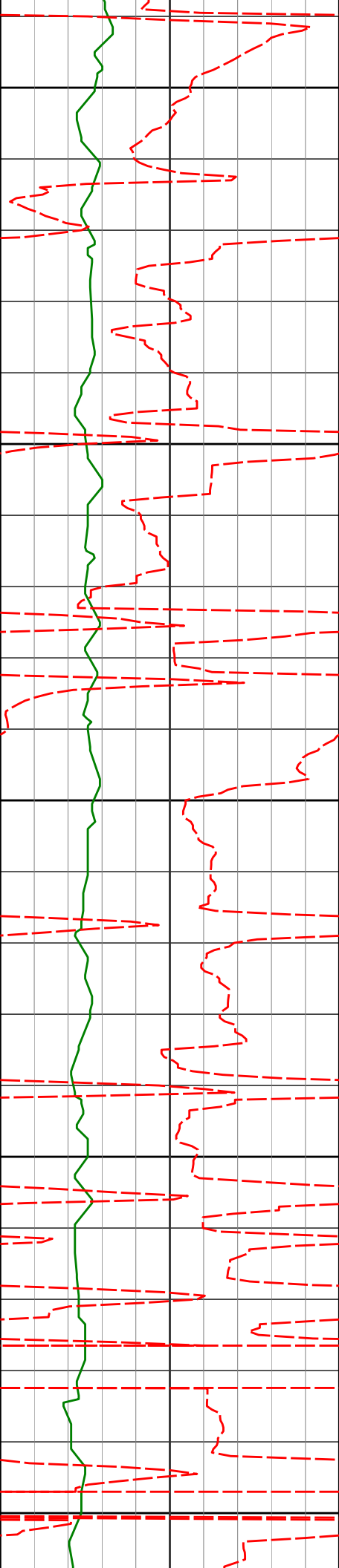
1.28°

236.50°

1183.89'

-4.85'

1200



1250

1276'

1.27°

28.98°

1275.88'

-5.16'

1300

1350

1369'

1.36°

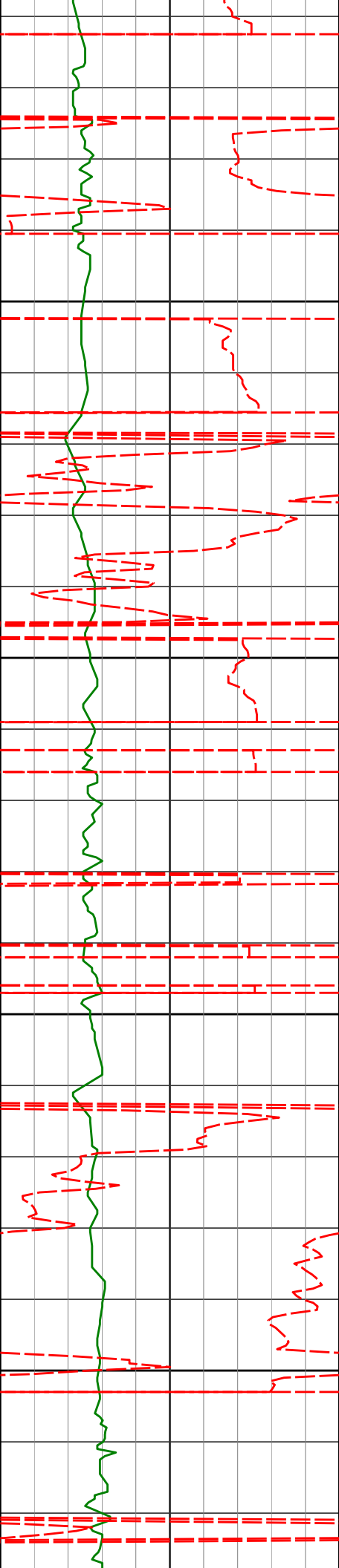
79.57°

1368.86'

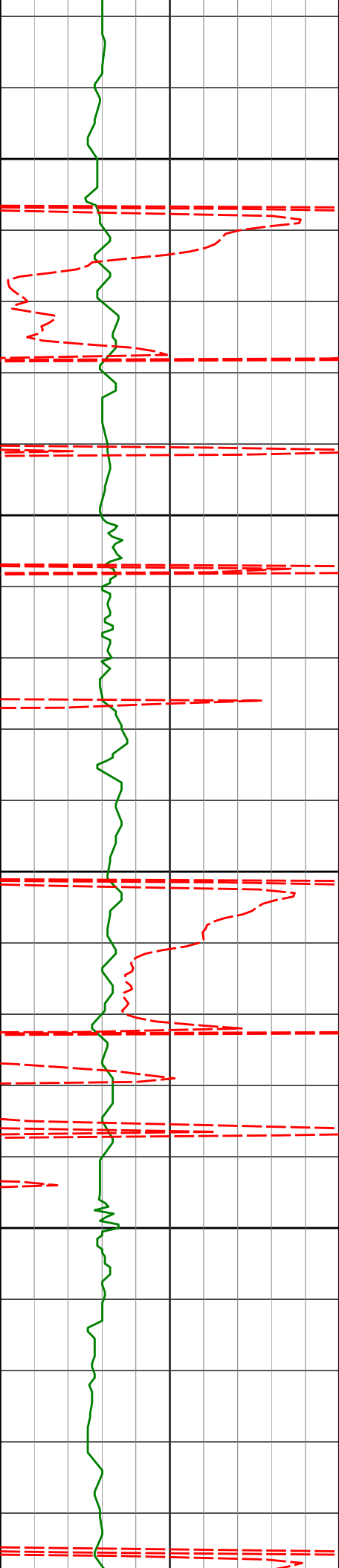
-3.44'

1400

1450



1461'	1.24°	63.21°	1460.84'	-1.41'
1556'	1.85°	25.81°	1555.81'	0.41'
1650'	4.20°	342.17°	1649.68'	0.66'



1700

1745'

5.87°

326.57°

1744.31'

-2.04'

1750

1800

1840'

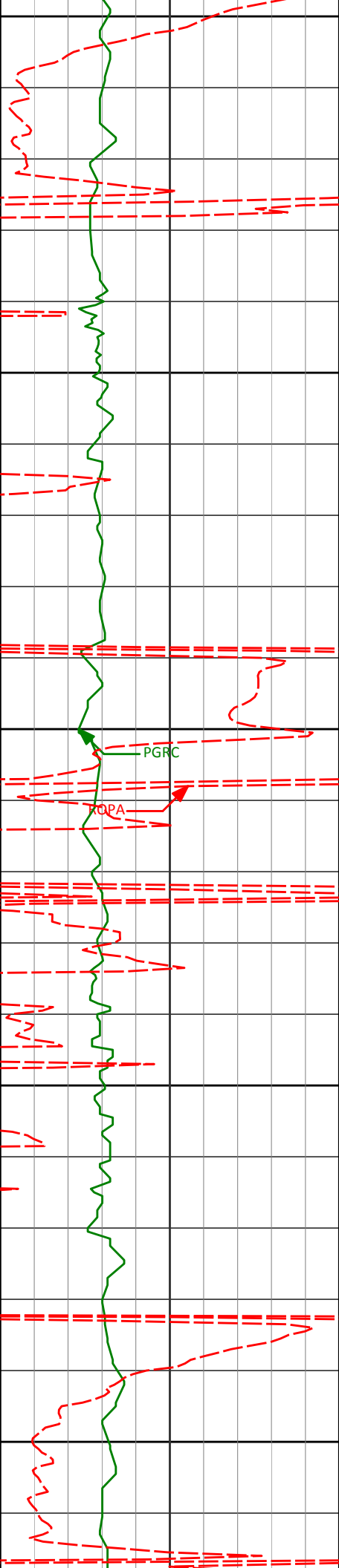
7.23°

314.59°

1838.69'

-7.78'

1850



1935'

8.85°

312.20°

1932.76'

-16.12'

1950

2000

2030'

8.41°

308.14°

2026.68'

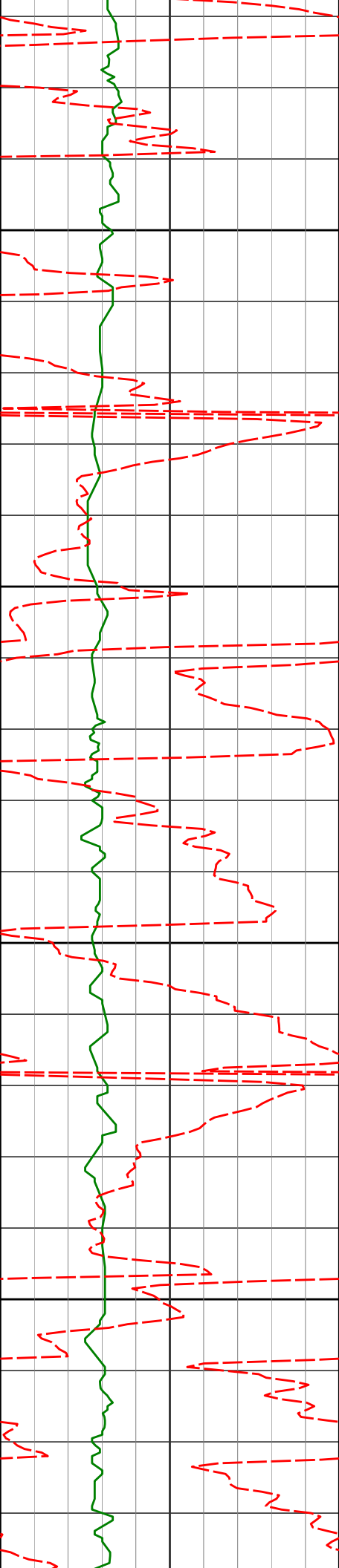
-25.64'

2050

2100

PGRC

RQPA



2124'

10.91°

314.19°

2119.35'

-35.88'

2150

2200

2219'

11.63°

321.27°

2212.52'

-46.33'

2250

2300

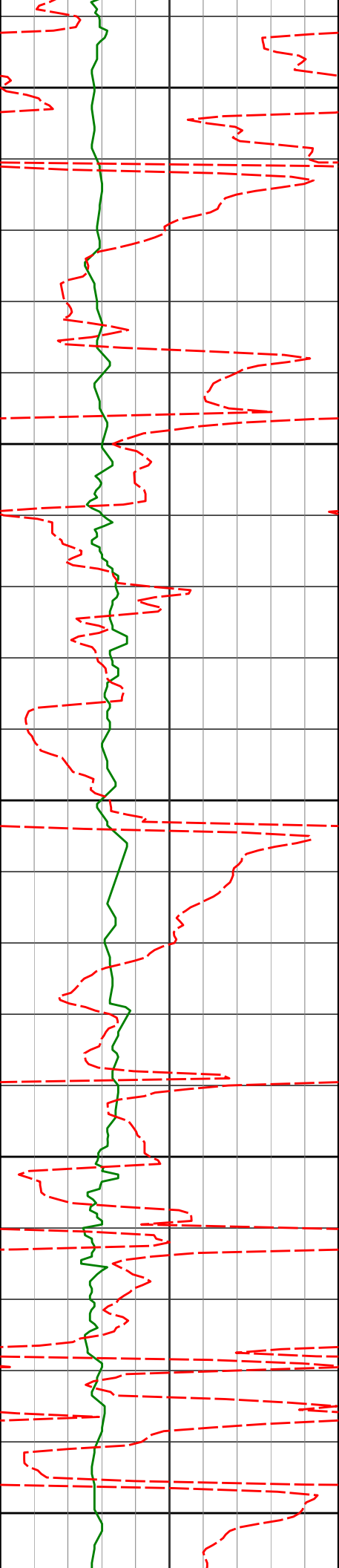
2314'

12.66°

327.37°

2305.39'

-55.60'



2350

2400

2450

2500

2550

2409'

13.04°

333.73°

2398.02'

-63.35'

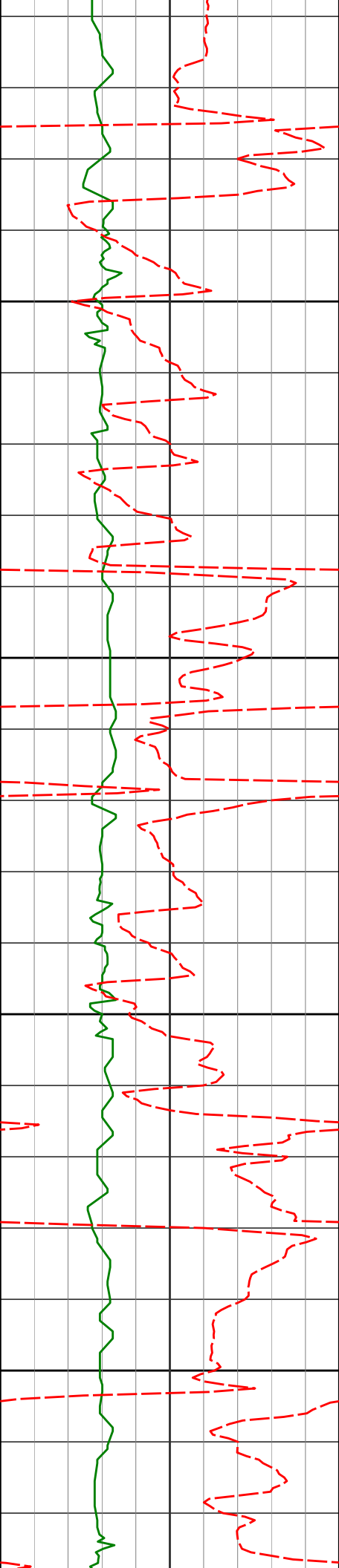
2504'

13.44°

342.96°

2490.50'

-68.49'



2598'

15.50°

348.48°

2581.52'

-71.04'

2600

2650

2693'

14.76°

353.85°

2673.23'

-71.49'

2700

2750

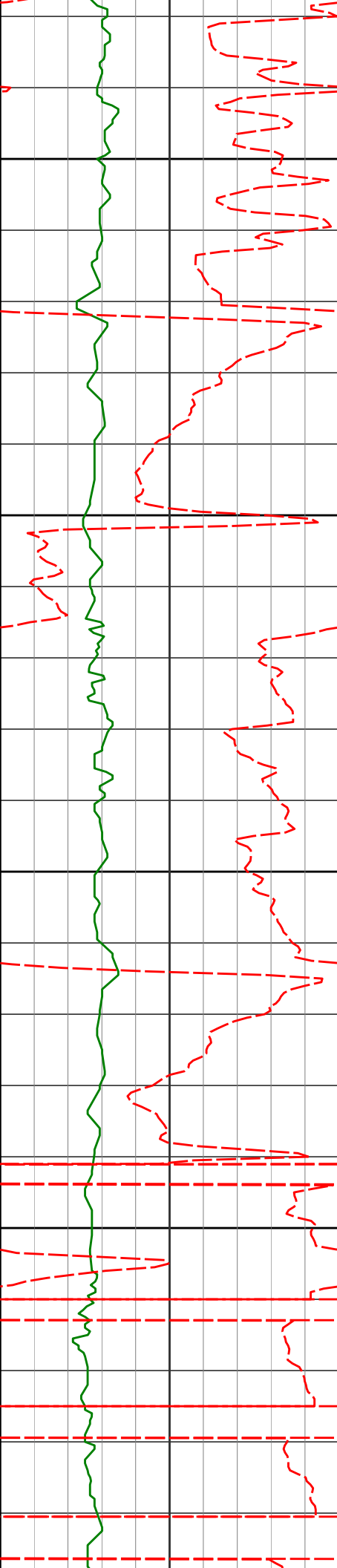
2788'

14.97°

350.74°

2765.05'

-71.43'



2800

2850

2900

2950

2883'

15.22°

348.88°

2856.78'

-72.44'

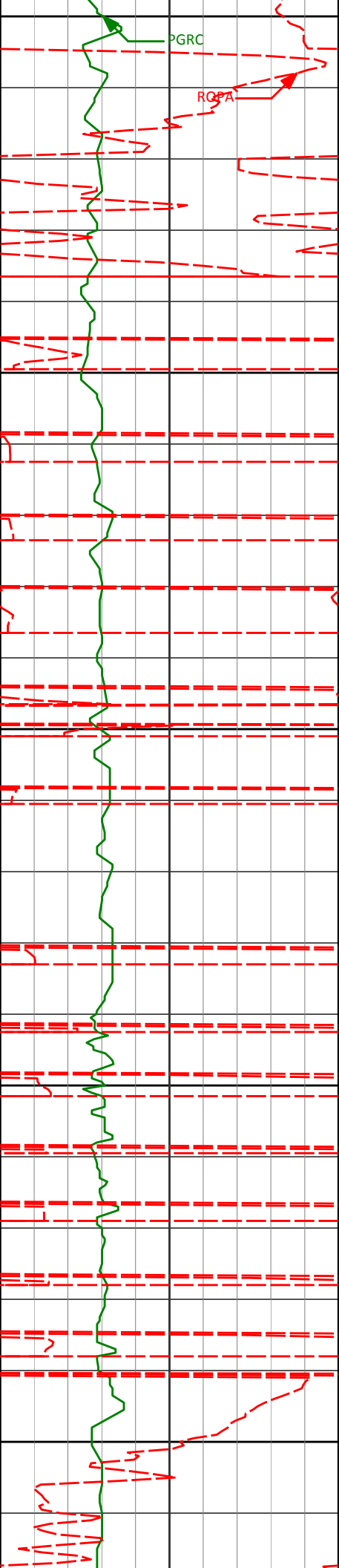
2978'

15.05°

352.82°

2948.48'

-73.00'



3000
3050
3100
3150
3200

3072'

16.19°

351.83°

3039.01'

-72.93'

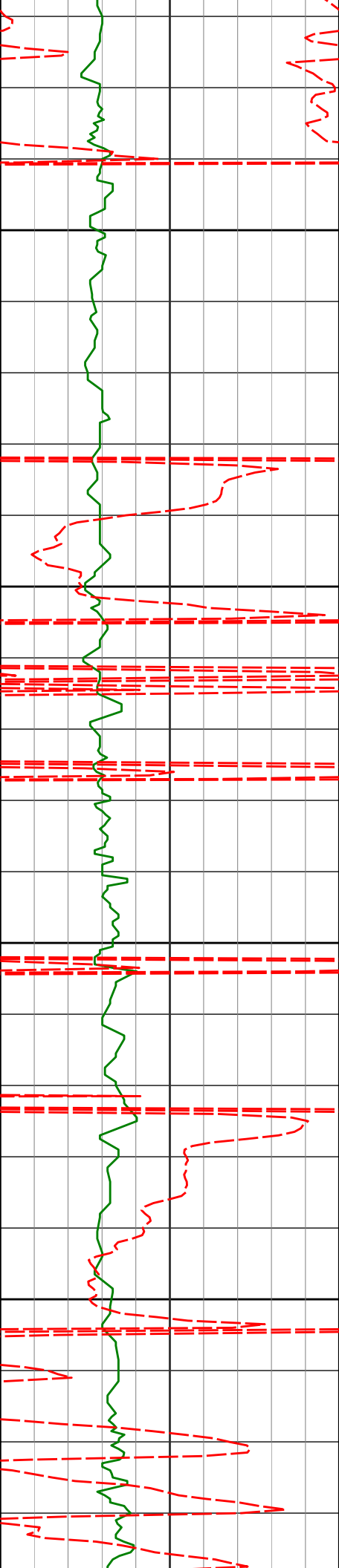
3167'

13.46°

349.68°

3130.84'

-73.47'



3262'

15.07°

351.00°

3222.91'

-74.19'

3250

3300

3357'

14.72°

346.45°

3314.72'

-75.63'

3350

3400

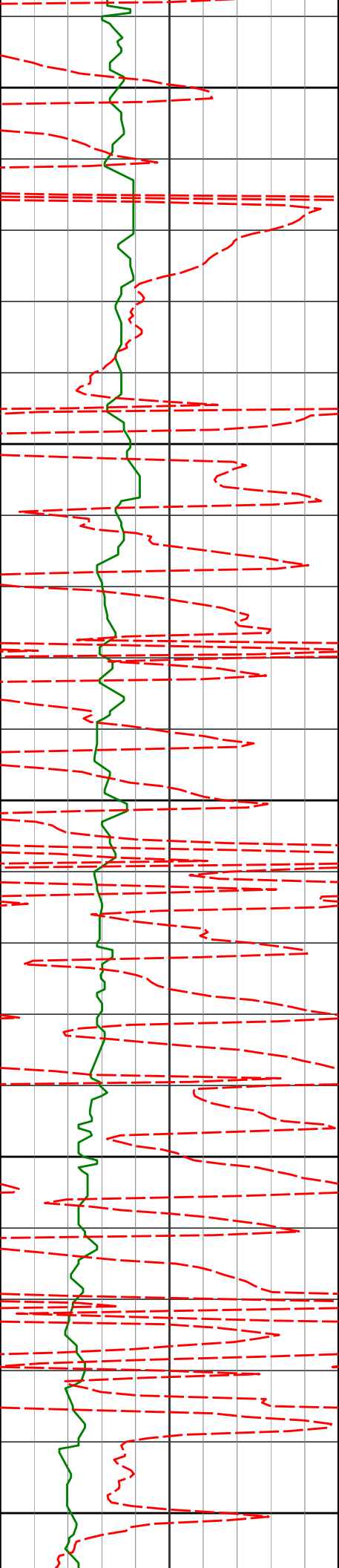
3451'

14.26°

346.26°

3405.73'

-78.00'



3450

3500

3550

3600

3650

3546'

14.35°

354.43°

3497.79'

-78.73'

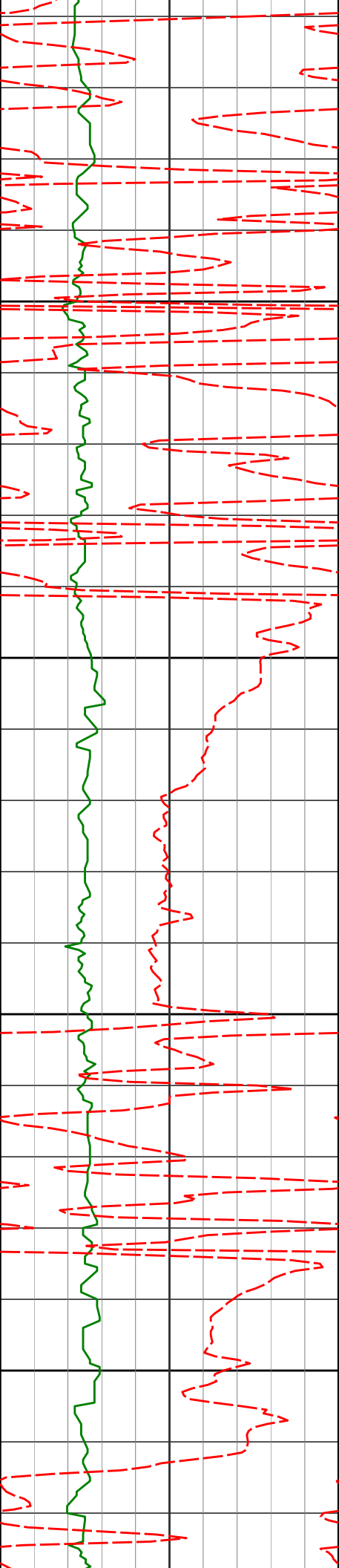
3641'

14.52°

351.79°

3589.80'

-78.34'



3736'

15.91°

349.50°

3681.46'

-79.01'

3700

3750

3831'

13.60°

349.11°

3773.33'

-80.20'

3800

3850

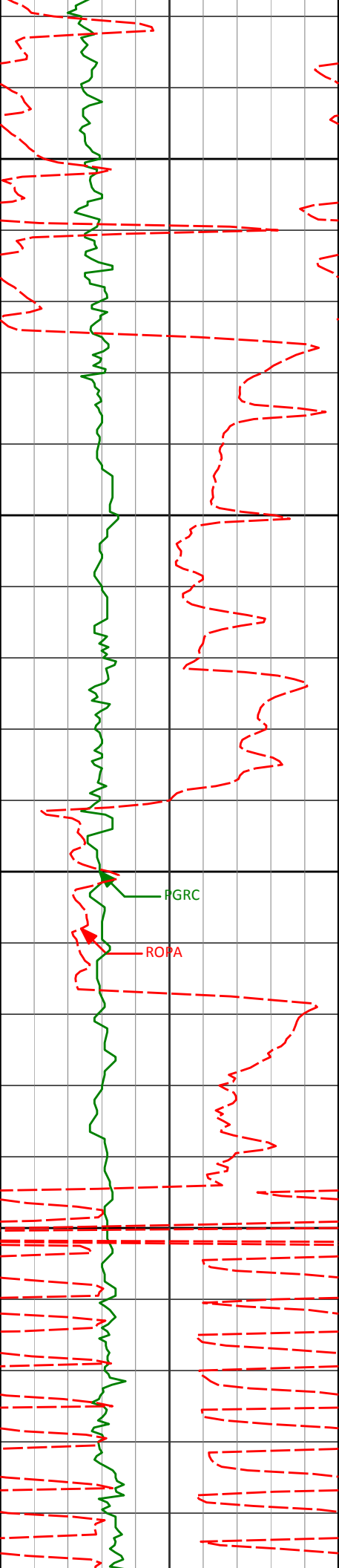
3926'

11.46°

345.01°

3866.06'

-81.96'



3900

3950

4000

4050

4020'

8.73°

349.80°

3958.60'

-83.41'

PGRC

ROPA

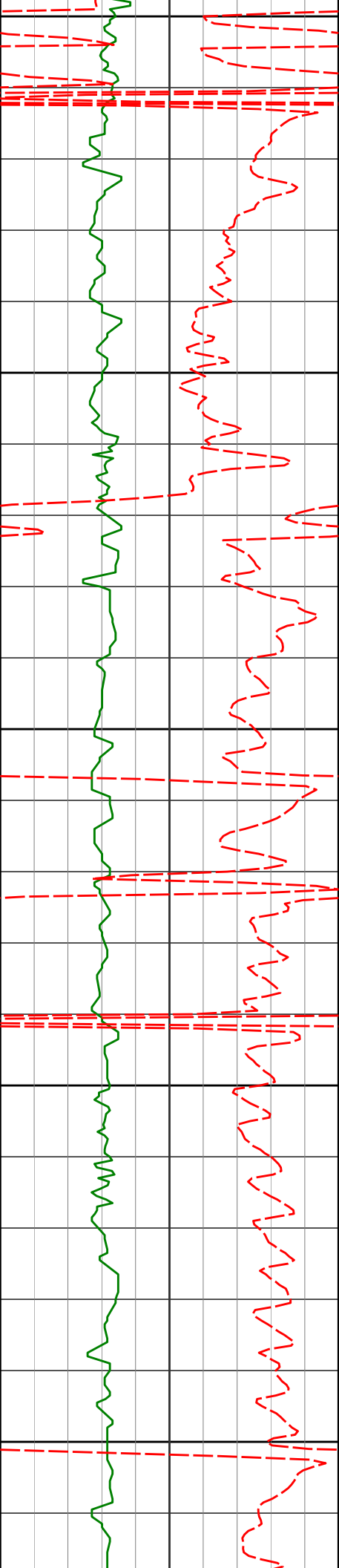
4115'

5.66°

350.53°

4052.84'

-83.84'



4100

4150

4200

4250

4300

4210'

1.88°

316.37°

4147.62'

-84.88'

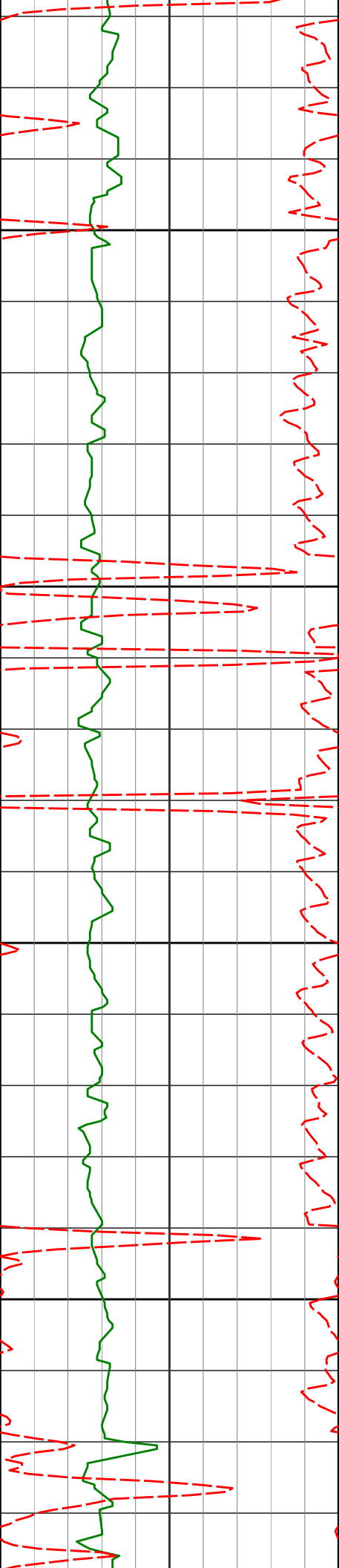
4305'

0.34°

291.03°

4242.60'

-86.04'



4400'

0.94°

184.04°

4337.60'

-86.44'

4350

4400

4495'

0.98°

143.40°

4432.59'

-86.22'

4450

4500

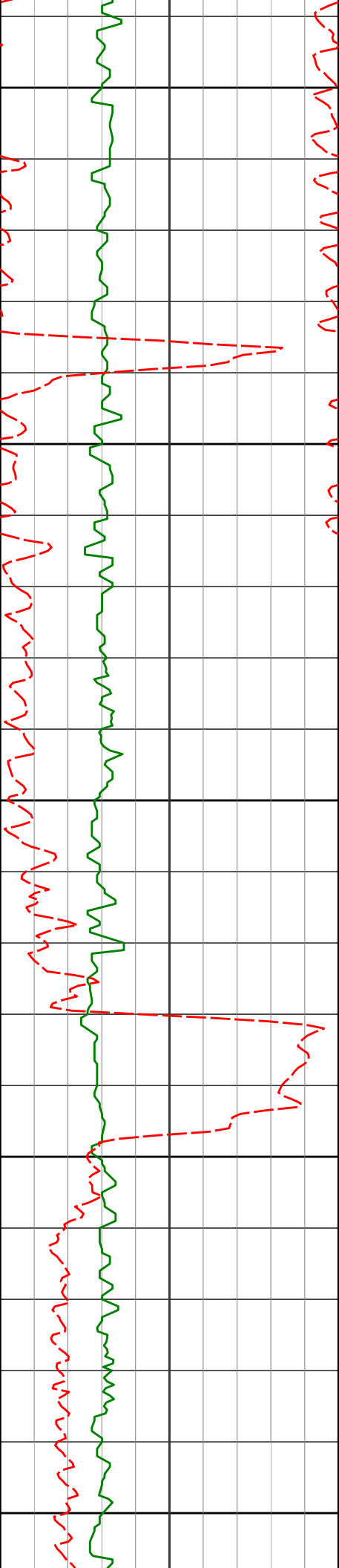
4590'

1.17°

156.87°

4527.57'

-85.57'



4550

4600

4650

4700

4750

4685'

1.22°

98.03°

4622.55'

-84.34'

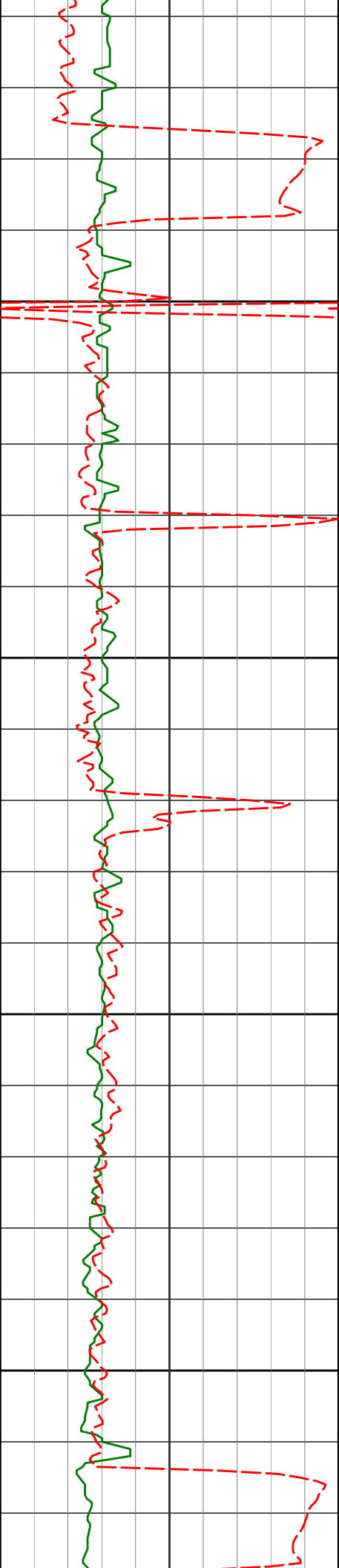
4780'

0.89°

138.96°

4717.54'

-82.96'



4800

4874'

1.34°

181.56°

4811.52'

-82.74'

4850

4900

4969'

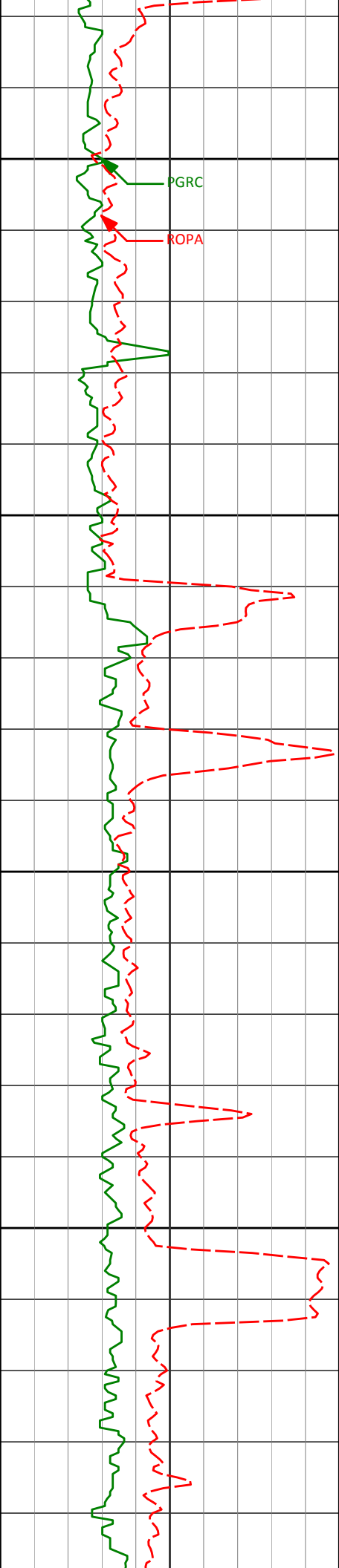
1.11°

125.80°

4906.50'

-82.26'

4950



5000

5064'

1.59°

178.57°

5001.48'

-81.74'

5050

5100

5159'

0.62°

163.87°

5096.46'

-81.82'

5150

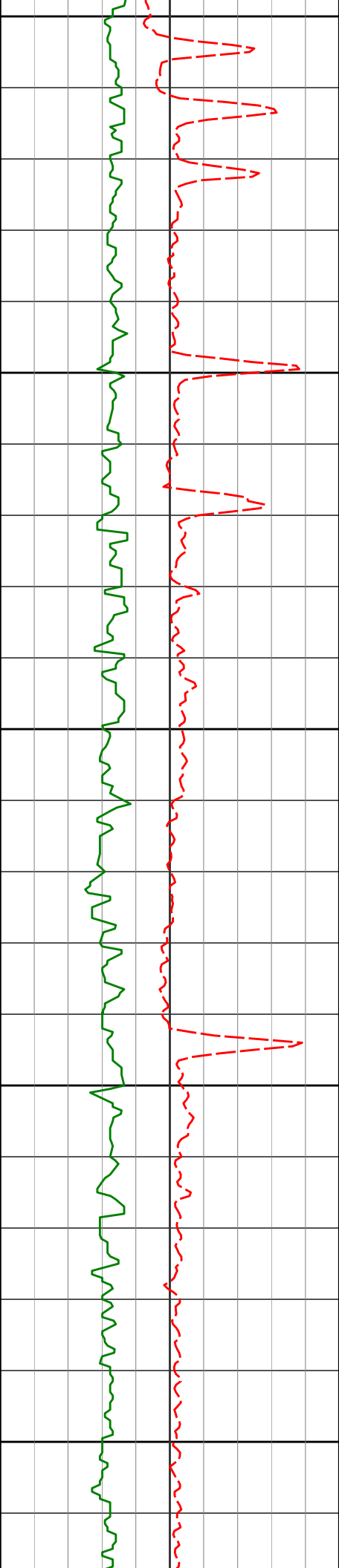
5254'

1.26°

215.74°

5191.45'

-82.46'



5200

5250

5348'

5300

5350

5443'

5400

1.49°

161.49°

5285.43'

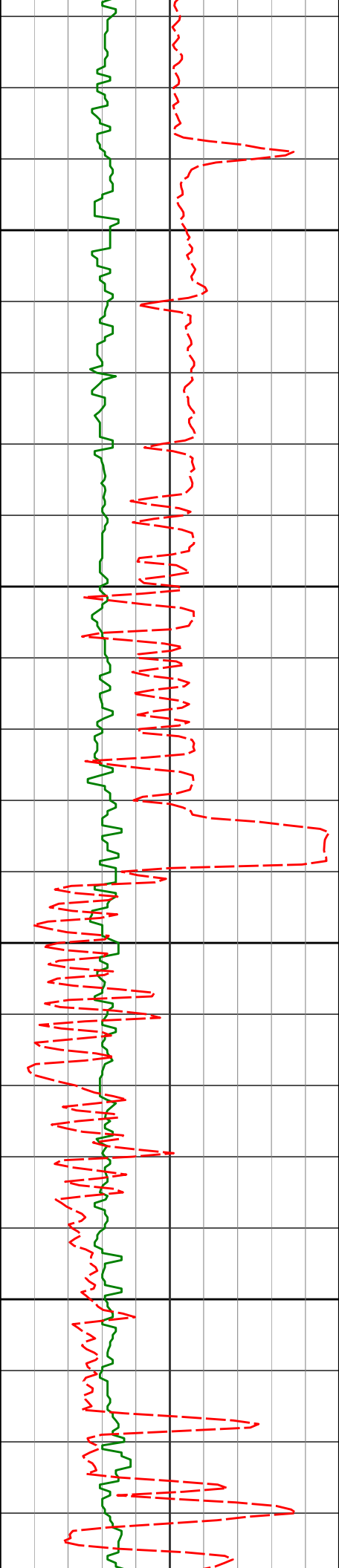
-82.95'

0.51°

169.91°

5380.41'

-82.70'



5450

5538'

0.58°

108.99°

5475.41'

-82.26'

5500

5550

5633'

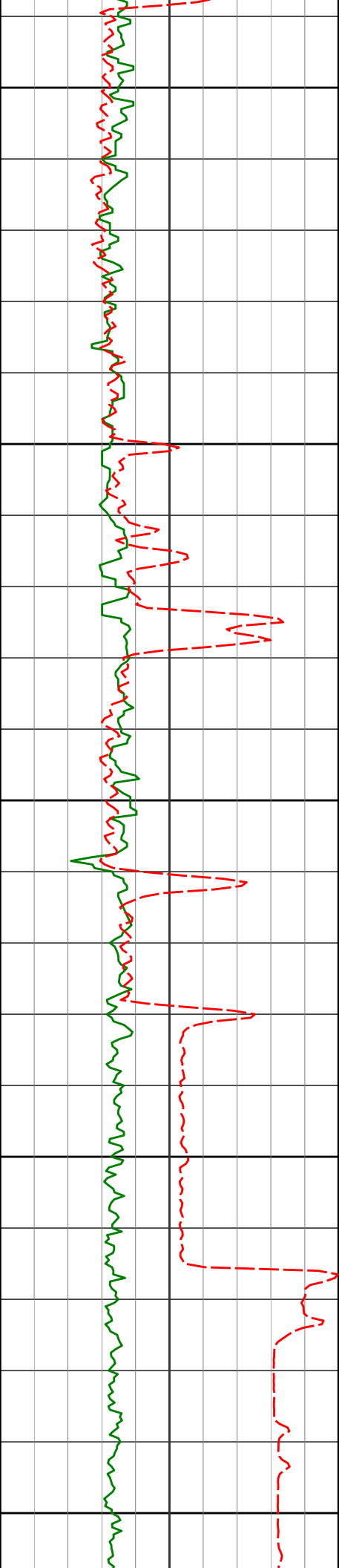
0.56°

162.54°

5570.40'

-81.75'

5600



5650

5728'

0.67°

107.14°

5665.40'

-81.17'

5700

5750

5821'

0.78°

118.03°

5758.39'

-80.17'

5800

200

5850

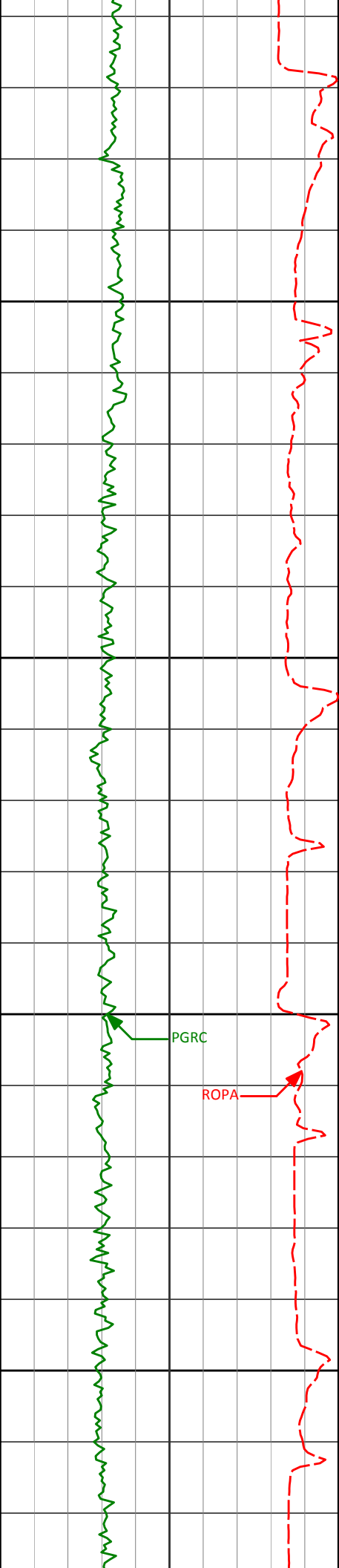
5916'

1.47°

80.81°

5853.37'

-78.42'



5900

5964'

5.48°

83.44°

5901.27'

-75.52'

5950

6011'

12.63°

80.37°

5947.66'

-68.13'

6000

6059'

16.76°

83.85°

5994.08'

-55.96'

6050

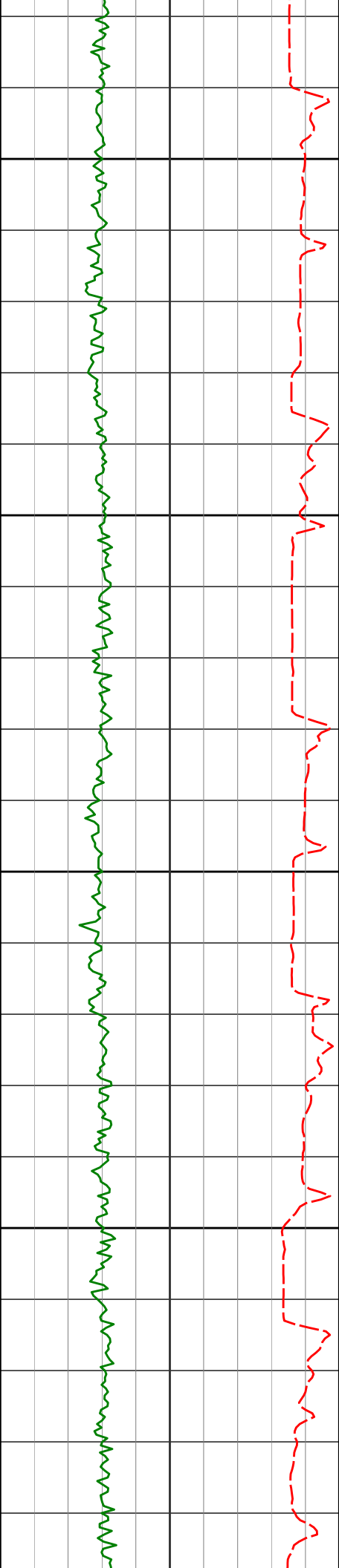
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17.80°

88.15°

6038.96'

-42.04'



6100

6154'

19.25°

93.43°

6084.47'

-26.98'

6201'

21.79°

92.21°

6128.49'

-10.79'

6150

6249'

23.37°

88.78°

6172.81'

7.44'

6200

6296'

25.16°

87.60°

6215.66'

26.64'

6250

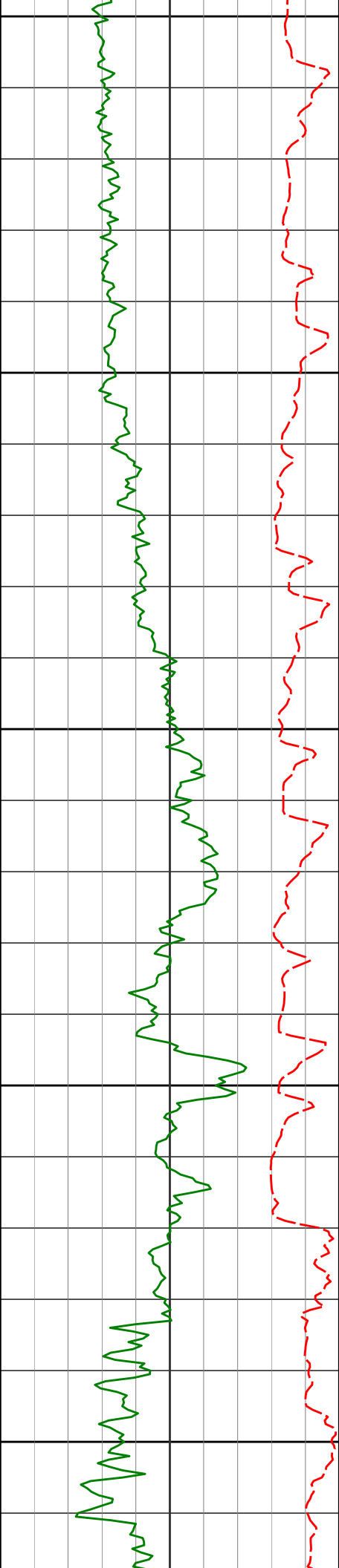
6344'

28.31°

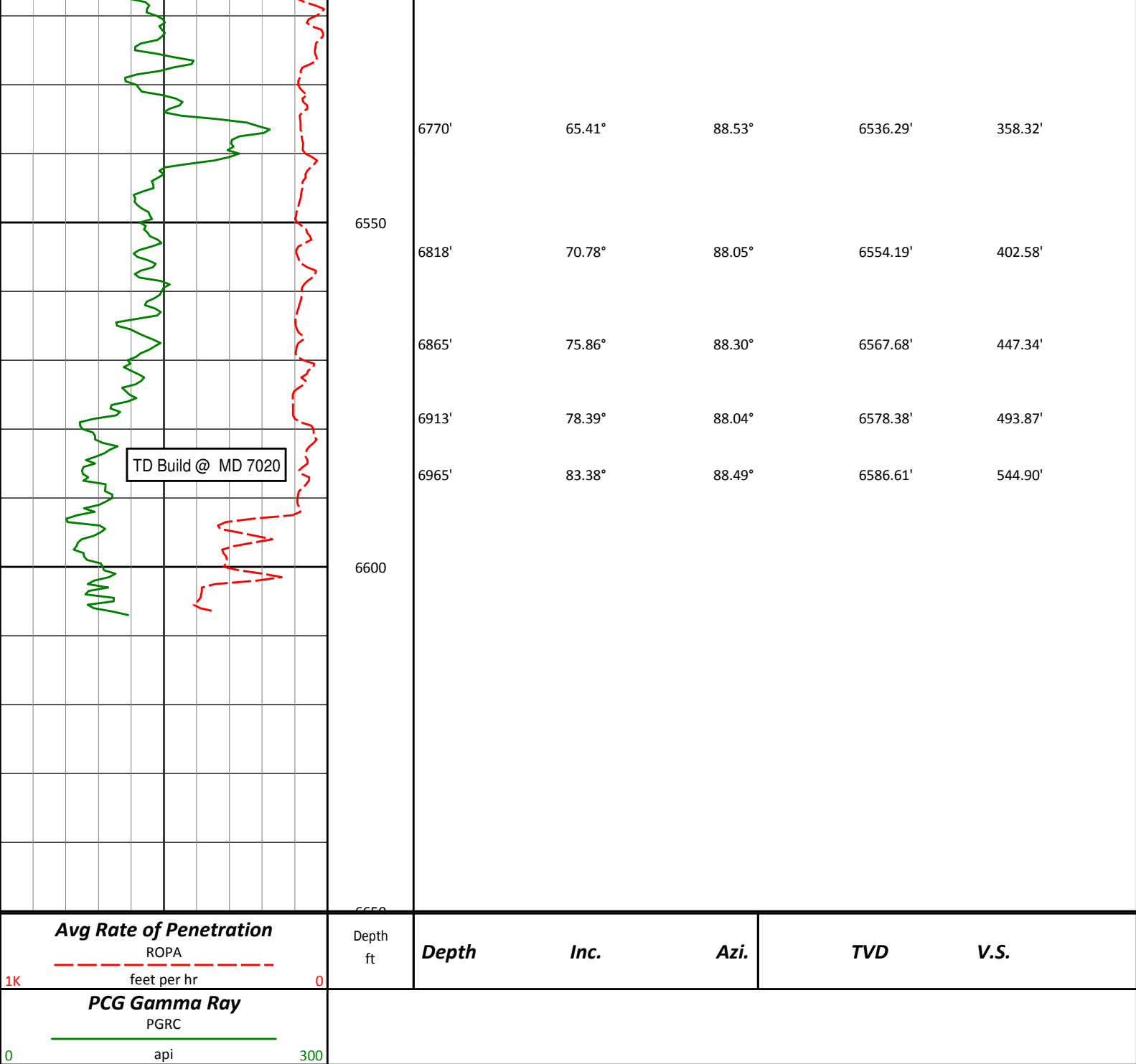
87.98°

6258.52'

48.13'



6300	6391'	31.97°	89.43°	6299.16'	71.57'
	6439'	36.76°	91.62°	6338.77'	98.35'
6350					
	6485'	42.36°	86.66°	6374.23'	127.41'
6400					
	6533'	48.01°	87.69°	6408.05'	161.31'
	6580'	53.37°	88.04°	6437.81'	197.48'
6450					
	6628'	56.20°	89.91°	6465.49'	236.41'
	6675'	58.47°	89.74°	6490.86'	275.62'
6500					
	6723'	60.91°	89.61°	6515.08'	316.70'



HALLIBURTON

DIRECTIONAL SURVEY REPORT

Noble Energy
Wells Ranch AE20-68HN
Wattenburg
Weld Colorado
USA
CA-XX-0900775412

Measured Depth (feet)	Inclination (degrees)	Direction (degrees)	Vertical Depth (feet)	Latitude (feet)	Departure (feet)	Vertical Section (feet)	Dogleg (deg/100ft)
0.00	0.00	0.00	0.00	0.00 N	0.00 E	0.00	TIE-IN
356.00	0.70	225.72	355.99	1.52 S	1.56 W	-1.75	0.20
663.00	0.60	101.82	662.98	3.16 S	1.33 W	-1.75	0.37
967.00	0.50	185.52	966.97	4.80 S	0.10 E	-0.55	0.24

1091.00	2.18	223.70	1090.93	7.05 S	1.58 W	-2.53	1.46
1184.00	1.28	236.50	1183.89	8.90 S	3.67 W	-4.85	1.05
1276.00	1.27	28.98	1275.88	8.57 S	4.03 W	-5.16	2.69
1369.00	1.36	79.57	1368.86	7.47 S	2.44 W	-3.44	1.21
1461.00	1.24	63.21	1460.84	6.83 S	0.48 W	-1.41	0.42
1556.00	1.85	25.81	1555.81	4.98 S	1.10 E	0.41	1.21
1650.00	4.20	342.17	1649.68	0.34 S	0.71 E	0.66	3.33
1745.00	5.87	326.57	1744.31	7.03 N	3.03 W	-2.04	2.26
1840.00	7.23	314.59	1838.69	15.28 N	9.97 W	-7.78	2.02
1935.00	8.85	312.20	1932.76	24.39 N	19.64 W	-16.12	1.74
2030.00	8.41	308.14	2026.68	33.59 N	30.52 W	-25.64	0.79
2124.00	10.91	314.19	2119.35	44.03 N	42.30 W	-35.88	2.87
2219.00	11.63	321.27	2212.52	57.77 N	54.74 W	-46.33	1.64
2314.00	12.66	327.37	2305.39	74.01 N	66.35 W	-55.60	1.73
2409.00	13.04	333.73	2398.02	92.39 N	76.70 W	-63.35	1.54
2504.00	13.44	342.96	2490.50	112.56 N	84.68 W	-68.49	2.26
2598.00	15.50	348.48	2581.52	135.31 N	90.39 W	-71.04	2.64
2693.00	14.76	353.85	2673.23	159.78 N	94.22 W	-71.49	1.67
2788.00	14.97	350.74	2765.05	183.93 N	97.50 W	-71.43	0.87
2883.00	15.22	348.88	2856.78	208.27 N	101.88 W	-72.44	0.57
2978.00	15.05	352.82	2948.48	232.74 N	105.82 W	-73.00	1.10
3072.00	16.19	351.83	3039.01	257.83 N	109.21 W	-72.93	1.25
3167.00	13.46	349.68	3130.84	281.82 N	113.07 W	-73.47	2.93
3262.00	15.07	351.00	3222.91	304.89 N	116.99 W	-74.19	1.73
3357.00	14.72	346.45	3314.72	328.83 N	121.75 W	-75.63	1.28
3451.00	14.26	346.26	3405.73	351.68 N	127.29 W	-78.00	0.49
3546.00	14.35	354.43	3497.79	374.77 N	131.22 W	-78.73	2.13
3641.00	14.52	351.79	3589.80	398.27 N	134.06 W	-78.34	0.72
3736.00	15.91	349.50	3681.46	422.86 N	138.13 W	-79.01	1.59
3831.00	13.60	349.11	3773.33	446.64 N	142.62 W	-80.20	2.43
3926.00	11.46	345.01	3866.06	466.73 N	147.17 W	-81.96	2.44
4020.00	8.73	349.80	3958.60	482.77 N	150.85 W	-83.41	3.04
4115.00	5.66	350.53	4052.84	494.49 N	152.90 W	-83.84	3.23
4210.00	1.88	316.37	4147.62	500.24 N	154.74 W	-84.88	4.46
4305.00	0.34	291.03	4242.60	501.47 N	156.08 W	-86.04	1.66
4400.00	0.94	184.04	4337.60	500.79 N	156.40 W	-86.44	1.15
4495.00	0.98	143.40	4432.59	499.36 N	155.97 W	-86.22	0.70
4590.00	1.17	156.87	4527.57	497.82 N	155.10 W	-85.57	0.33
4685.00	1.22	98.03	4622.55	496.79 N	153.72 W	-84.34	1.24
4780.00	0.89	138.96	4717.54	496.09 N	152.24 W	-82.96	0.84
4874.00	1.34	181.56	4811.52	494.44 N	151.79 W	-82.74	0.97
4969.00	1.11	125.80	4906.50	492.79 N	151.07 W	-82.26	1.22
5064.00	1.59	178.57	5001.48	490.93 N	150.29 W	-81.74	1.34
5159.00	0.62	163.87	5096.46	489.12 N	150.12 W	-81.82	1.06
5254.00	1.26	215.74	5191.45	487.78 N	150.58 W	-82.46	1.06
5348.00	1.49	161.49	5285.43	485.78 N	150.80 W	-82.95	1.35
5443.00	0.51	169.91	5380.41	484.20 N	150.33 W	-82.70	1.04
5538.00	0.58	108.99	5475.41	483.62 N	149.80 W	-82.26	0.59
5633.00	0.56	162.54	5570.40	483.02 N	149.21 W	-81.75	0.54
5728.00	0.67	107.14	5665.40	482.42 N	148.54 W	-81.17	0.61
5821.00	0.78	118.03	5758.39	481.96 N	147.46 W	-80.17	0.19
5916.00	1.47	80.81	5853.37	481.85 N	145.69 W	-78.42	1.02
5964.00	5.48	83.44	5901.27	482.21 N	142.80 W	-75.52	8.36
6011.00	12.63	80.37	5947.66	483.33 N	135.50 W	-68.13	15.24
6059.00	16.76	83.85	5994.08	484.95 N	123.44 W	-55.96	8.79
6106.00	17.80	88.15	6038.96	485.91 N	109.52 W	-42.04	3.50
6154.00	19.25	93.43	6084.47	485.67 N	94.29 W	-26.98	4.62
6201.00	21.79	92.21	6128.49	484.87 N	77.83 W	-10.79	5.48
6249.00	23.37	88.78	6172.81	484.73 N	59.41 W	7.44	4.28
6296.00	25.16	87.60	6215.66	485.35 N	40.11 W	26.64	3.95
6344.00	28.31	87.98	6258.52	486.17 N	18.53 W	48.13	6.57
6391.00	31.97	89.43	6299.16	486.69 N	5.06 E	71.57	7.94
6439.00	36.76	91.62	6338.77	486.41 N	32.14 E	98.35	10.30
6485.00	42.36	86.66	6374.23	486.93 N	61.40 E	127.41	13.97
6533.00	48.01	87.69	6408.05	488.59 N	95.39 E	161.31	11.87
6580.00	53.37	88.04	6437.81	489.94 N	131.72 E	197.48	11.42
6628.00	56.20	89.91	6465.49	490.63 N	170.92 E	236.41	6.70
6675.00	58.47	89.74	6490.86	490.75 N	210.49 E	275.62	4.84
6723.00	60.91	89.61	6515.08	490.99 N	251.92 E	316.70	5.09
6770.00	65.41	88.53	6536.29	491.67 N	293.84 E	358.32	9.79
6818.00	70.78	88.05	6554.19	493.01 N	338.34 E	402.58	11.23

6865.00	75.86	88.30	6567.68	494.44 N	383.32 E	447.34	10.82
6913.00	78.39	88.04	6578.38	495.93 N	430.09 E	493.87	5.30
6965.00	83.38	88.49	6586.61	497.49 N	481.39 E	544.90	9.63

CALCULATION BASED ON MINIMUM CURVATURE METHOD

**SURVEY COORDINATES RELATIVE TO WELL SYSTEM REFERENCE POINT
TVD VALUES GIVEN RELATIVE TO DRILLING MEASUREMENT POINT**

**VERTICAL SECTION RELATIVE TO WELL HEAD
VERTICAL SECTION IS COMPUTED ALONG A DIRECTION OF 82.14 DEGREES (GRID)
A TOTAL CORRECTION OF 7.62 DEG FROM MAGNETIC NORTH TO GRID NORTH HAS BEEN APPLIED**

**HORIZONTAL DISPLACEMENT IS RELATIVE TO THE WELL HEAD.
HORIZONTAL DISPLACEMENT(CLOSURE) AT 6965.00 FEET
IS 692.27 FEET ALONG 44.06 DEGREES (GRID)**

First three survey's are from 3rd party source (Muulti Shot EMS) and provided by CO-man on location before drilling.

Depth 356 Inc 0.70 Azi 225.72

Depth 663 Inc 0.60 Azi 101.82

Depth 967 Inc 0.50 Azi 185.52

Tied in @ Surface

Magnettic direction of 7.621 has been added to AZI for grid direction correction.

Date Printed:29 October 2013