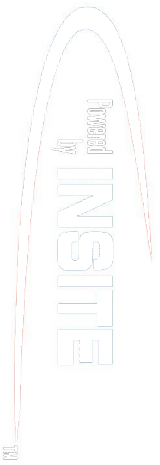


**PCDC - Pressure Case Directional  
PCGK - Pressure Case Gamma**



**1 : 600 / 1 : 240**

Country : USA		
Field : Wattenburg		
Location : Lat: 40° 28' 35.80" North Long: 104° 21' 18.68" West		
Well : Wells Ranch AE20-69HN		
Company : Noble Energy		
Rig : H&P 321		
LOCATION	Company : Noble Energy	Other Services <b>Directional Drilling</b>
	Rig : H&P 321	
	Well : Wells Ranch AE20-69HN	
	Field : Wattenburg	
	Country : USA	
	API Number : 05-123-37223	
	Latitude : 40° 28' 35.80" North Longitude : 104° 21' 18.68" West	
	UTM Easting = 3,318,472.587 ft UTM Northing = 1,418,525.625 ft	

Permanent Datum : Ground Level	Elevation : 4838.00 ft	Elev. KB N/A
Log Measured From : Drill Floor	30.00 ft Above Permanent Datum	DF 4868.00 ft
Drilling Measured From : Drill Floor		GL 4838.00 ft
		WD N/A

Depth Logged : 981.00 ft To 10,897.00 ft	Unit No. : 11210424	Job No. : CA-XX-0900829265
Date Logged : 09-Nov-13 To 16-Nov-13	Plot Type : Final	
Total Depth MD : 10,897.00 ft TVD : 6,571.65 ft	Plot Date : 16-Nov-13	
Spud Date : 09-Nov-13		

Run No.	Borehole Record (MD)		Run No.		Borehole Record (MD)	
	Size	From	To	Size	From	To
100	8.750 in	990.00 ft	5,892.00 ft			
200	8.750 in	5,892.00 ft	7,067.00 ft			
300	6.125 in	7,067.00 ft	10,897.00 ft			

Run No.	Casing Record (MD)		Run No.		Borehole Record (MD)	
	Size	Weight	From	To	From	To
	9.625	36.00	0.00		981.00	
	7.000	26.00	0.00		7057.00	

**WELL INFORMATION**

MWD Run Number	100	200	300
Date run completed	12-Nov-13	13-Nov-13	16-Nov-13
Rig Bit Number	2	3	4
Bit Size (in)	8.750	8.750	6.125
Tool Nominal OD (in)	6.860	6.860	4.780
Log Start Depth (MD, ft)	990.00	5,892.00	7,067.00
Log End Depth (MD, ft)	5,892.00	7,067.00	10,897.00
Drill or Wipe	Drill	Drill	Drill
Drill/Wipe Start Date and Time	11-Nov-13 02:45	12-Nov-13 14:30	14-Nov-13 17:07
Drill/Wipe End Date and Time	12-Nov-13 02:57	13-Nov-13 09:00	15-Nov-13 21:39
Min Inc (deg) @ Depth (MD, ft)	0.50 @ 1,090.00	11.58 @ 5,914.00	87.93 @ 9,368.00
Max Inc (deg) @ Depth (MD, ft)	14.06 @ 3,924.00	83.06 @ 7,013.00	92.71 @ 10,694.00
Bit TFA(in2) / Bit Type	0.75 / PDC	1.24 / PDC	0.65 / PDC
Flow Rate (gpm)	565.42	573.54	300.71
Max AV (fpm) / CV (fpm) @ MWD	NA / 0.0	NA / 0.0	NA / 0.0
Fluid Type	Fresh Water Gel	Fresh Water Gel	Fresh Water Gel
Density (ppg) / Viscosity (spqt)	8.60 / 32.00	9.90 / 45.00	9.10 / 37.00
Filtrate CL (ppm)	1,900.00	2,300.00	2,300.00
pH / Fluid Loss (mptm)	10.00 / 17	9.00 / 7	11.30 / 10
PV (cP) / YP (lhf2)	5 / 3.00	14 / 15.00	9 / 8.00
% Solids / % Sand	2.00 / 0.50	8.10 / 0.25	5.60 / 0.25
% Oil / Oil:Water Ratio	NA / NA	NA / NA	NA / NA
Rm @ Measured Temp (degF)	NA @ NA	NA @ NA	NA @ NA
Rmf @ Measured Temp (degF)	NA @ NA	NA @ NA	NA @ NA
Rmc @ Measured Temp (degF)	NA @ NA	NA @ NA	NA @ NA

Max Tool Temp (degF) / Source	137.50 / PCM	162.80 / PCM	213.40 / PCM		
Rm @ Max Tool Temp (degF)	NA @ 137.50	NA @ 162.80	NA @ 213.40		
Lead MWD Engineer	Kyle Wass	Kyle Wass	Kyle Wass		
Customer Representative	Stetson Nielsen	Stetson Nielsen	Stetson Nielsen		

## SENSOR INFORMATION

### Downhole Processor Information

Tool Type	PCM	PCM	PCM		
Software Version	5.84	5.84	5.84		
Sub Serial Number	11341339	11341339	12134697		
Insert Serial Number	11227512	11227512	11227512		
Date and Time Initialized	08-Nov-13 13:00	08-Nov-13 13:00	13-Nov-13 19:59		
Date and Time Read	13-Nov-13 14:26	13-Nov-13 14:26	16-Nov-13 07:30		
ECMB SW Version	N/A	N/A	N/A		

### Directional Sensor Information

Tool Type	PCDC	PCDC	PCDC		
Distance From Bit (ft)	56.00	54.00	63.00		
Software Version	6.21	6.21	6.21		
Sub Serial Number	11341339	11341339	12134697		
Sonde Serial Number	11902155	11902155	11902155		
Sensor ID Number	N/A	N/A	N/A		
Toolface Offset (deg)	215.67	32.44	247.31		

### Gamma Ray Sensor Information

Tool Type	PCG	PCG	PCG		
Distance From Bit (ft)	49.54	47.29	66.35		
Recorded Sample Period (sec)	10	10	10		
Software Version	8.15	8.15	8.15		
Sub Serial Number	11341339	11341339	12134697		
Insert/Sonde Serial Number	11293417	11293417	11293417		

## REMARKS

1. All depths are calibrated to driller's pipe tally and are Measured 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: 0.5 ft  
 Interval Distance: 1.2 ft

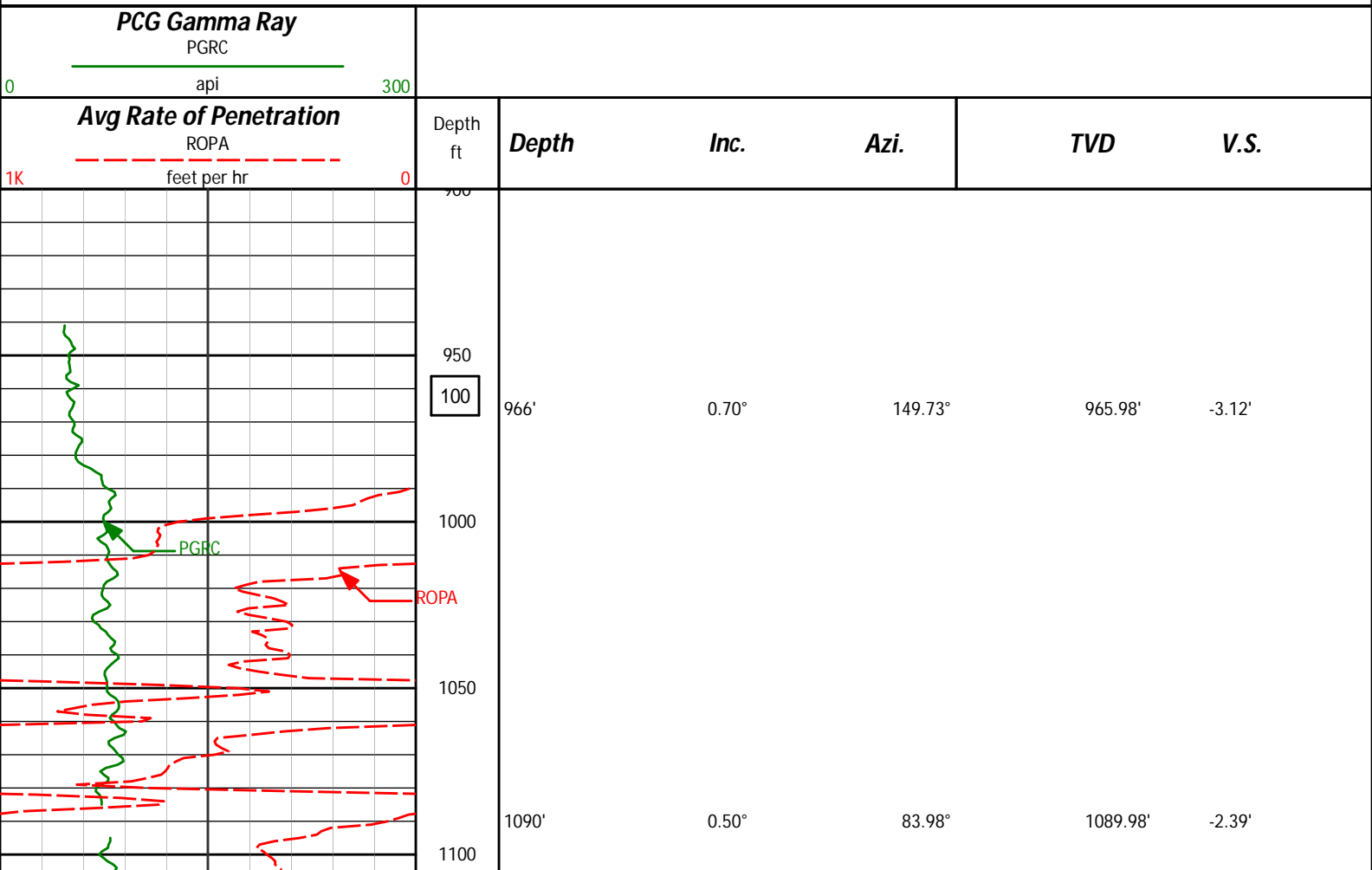
6. Insite Version V8.0.0

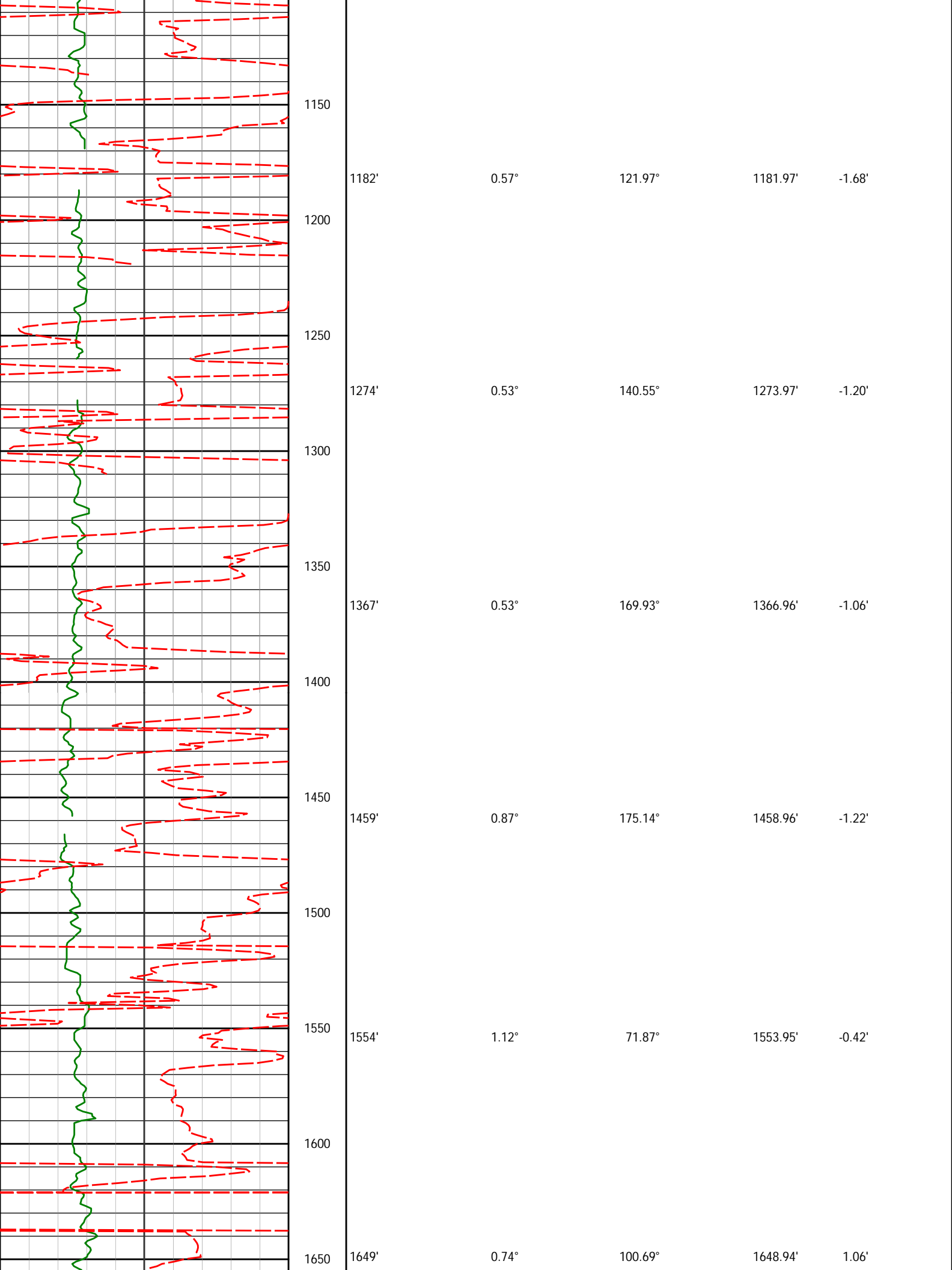
**WARRANTY**

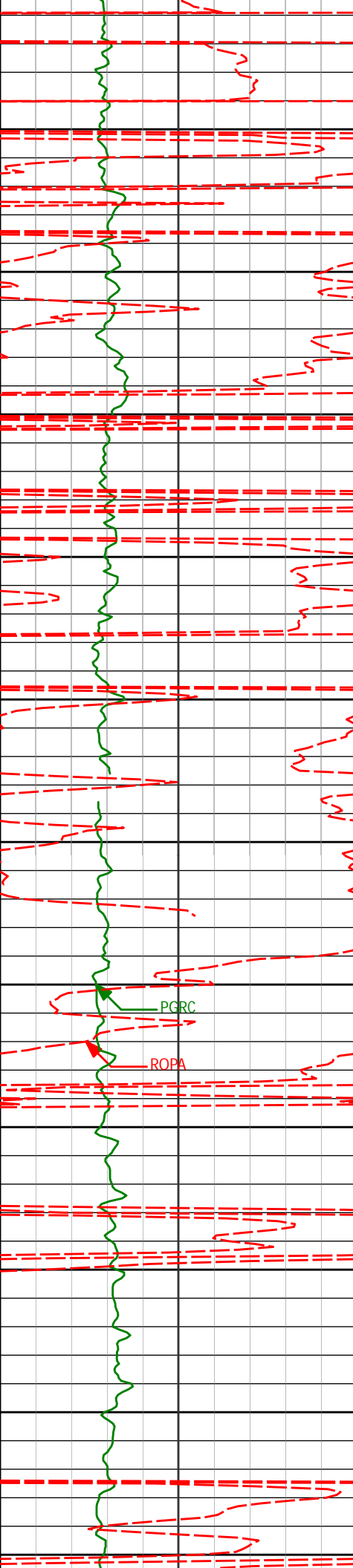
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**HALLIBURTON**  
**Sperry Drilling Services**  
 MD Correlation Log 1:600

Noble Energy  
 Wells Ranch AE20-69HN  
 H&P 321  
 Sec. 20-T6N-R62W







1700

1750

1800

1850

1900

1950

2000

2050

2100

2150

2200

1744'

1.04°

85.51°

1743.93'

2.46'

1838'

0.83°

109.87°

1837.91'

3.85'

1933'

0.73°

72.31°

1932.91'

5.02'

2028'

3.78°

15.25°

2027.83'

7.21'

2123'

3.30°

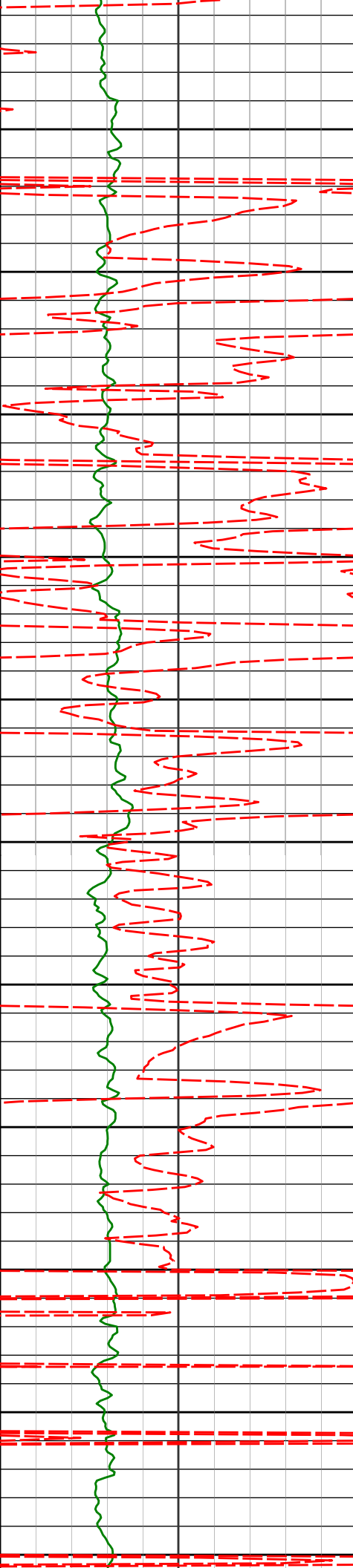
354.35°

2122.65'

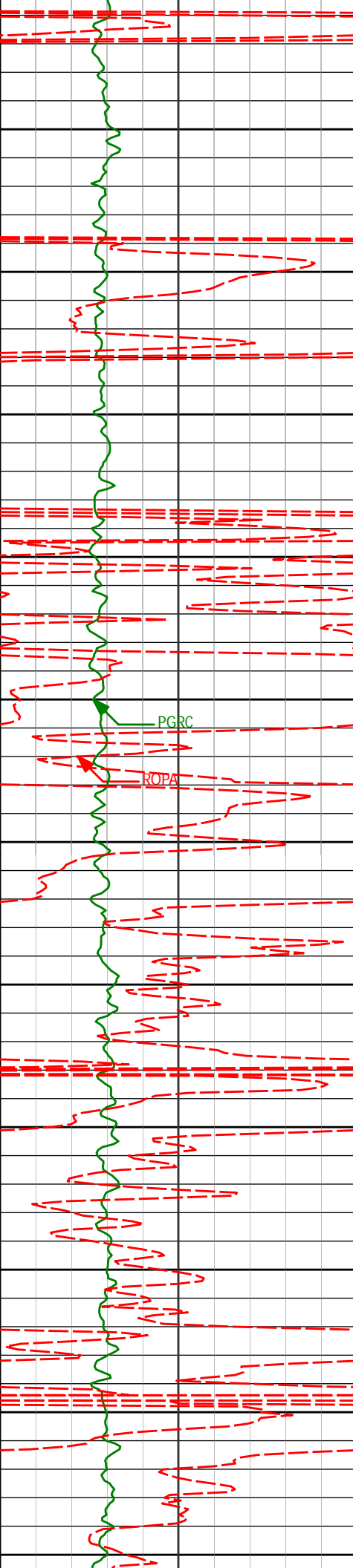
9.25'

PGRC

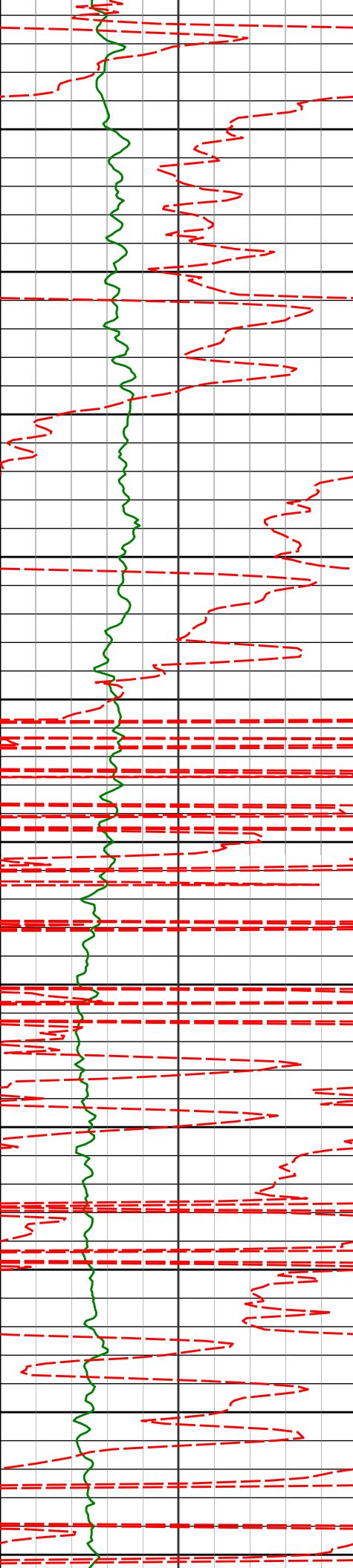
ROPA



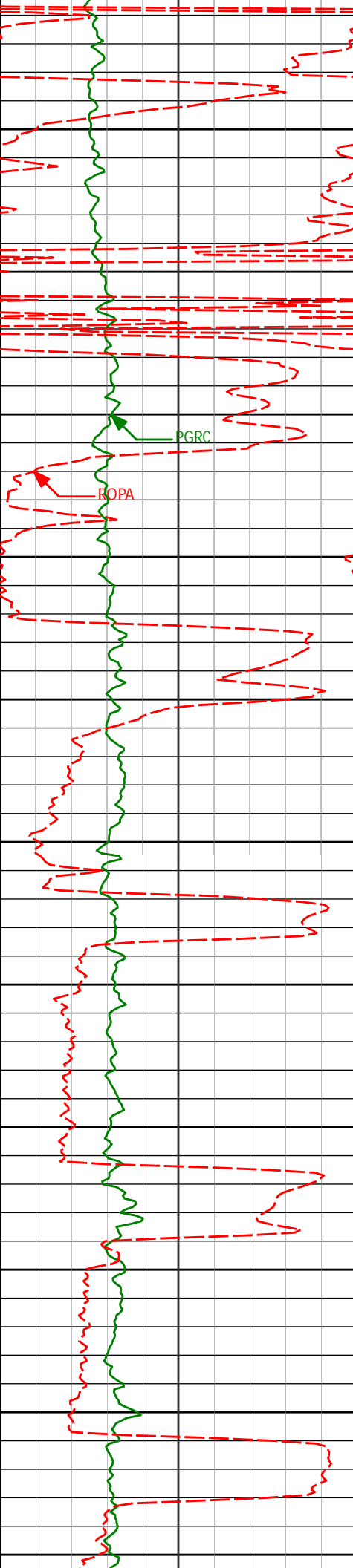
2218'	4.37°	339.71°	2217.44'	9.38'
2250				
2300				
2313'	7.16°	348.72°	2311.95'	9.45'
2350				
2400				
2407'	8.39°	347.80°	2405.08'	10.20'
2450				
2500				
2502'	10.08°	347.57°	2498.85'	10.95'
2550				
2600				
2597'	11.88°	349.43°	2592.11'	12.13'
2650				
2700				
2692'	11.57°	348.74°	2685.12'	13.55'
2750				



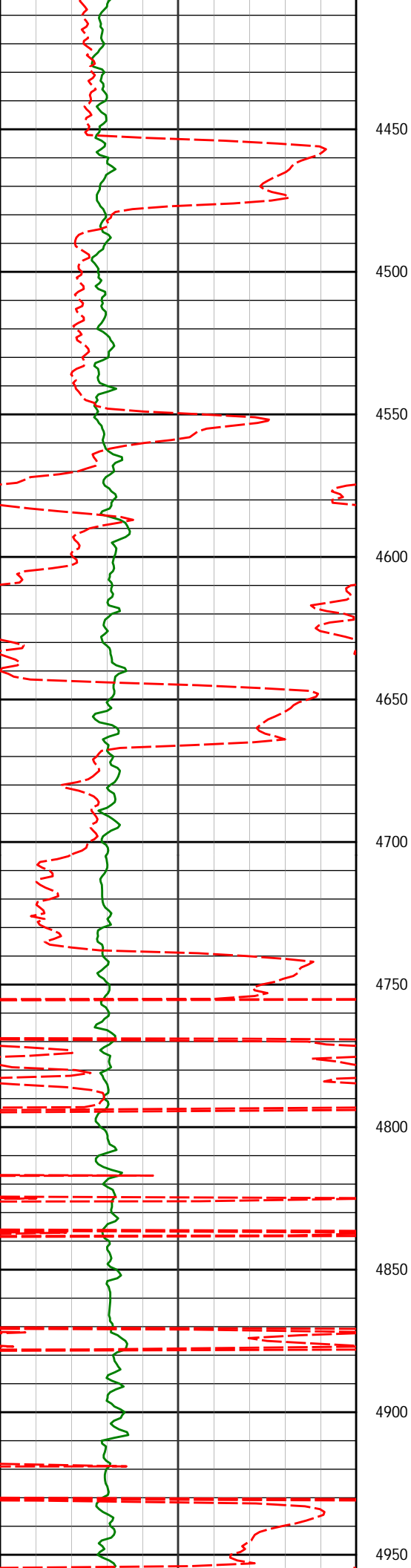
2786'	10.86°	346.01°	2777.33'	14.37'
2800				
2850				
2881'	12.26°	359.34°	2870.42'	17.08'
2900				
2950				
2976'	11.67°	356.21°	2963.35'	21.49'
3000				
3071'	13.01°	355.14°	3056.16'	25.30'
3100				
3150				
3166'	12.39°	352.54°	3148.83'	28.57'
3200				
3250				
3260'	11.99°	354.61°	3240.71'	31.57'
3300				



3350	3355'	10.19°	353.93°	3333.94'	34.57'
3400					
3450	3450'	10.94°	355.52°	3427.32'	37.57'
3500					
3550	3544'	12.40°	356.54°	3519.38'	41.27'
3600					
3650	3640'	12.63°	358.12°	3613.10'	45.76'
3700					
3750	3734'	13.20°	0.54°	3704.72'	51.02'
3800					
3850	3829'	13.38°	353.94°	3797.18'	55.70'



3900				
3924'	14.06°	352.97°	3889.47'	59.06'
3950				
4000				
4019'	13.13°	357.02°	3981.81'	62.97'
4050				
4100				
4114'	10.98°	0.30°	4074.71'	67.65'
4150				
4200				
4209'	10.40°	359.81°	4168.06'	72.28'
4250				
4300				
4304'	11.76°	0.68°	4261.29'	77.13'
4350				
4400				
4399'	12.29°	358.60°	4354.20'	82.17'



4450

4500

4550

4600

4650

4700

4750

4800

4850

4900

4950

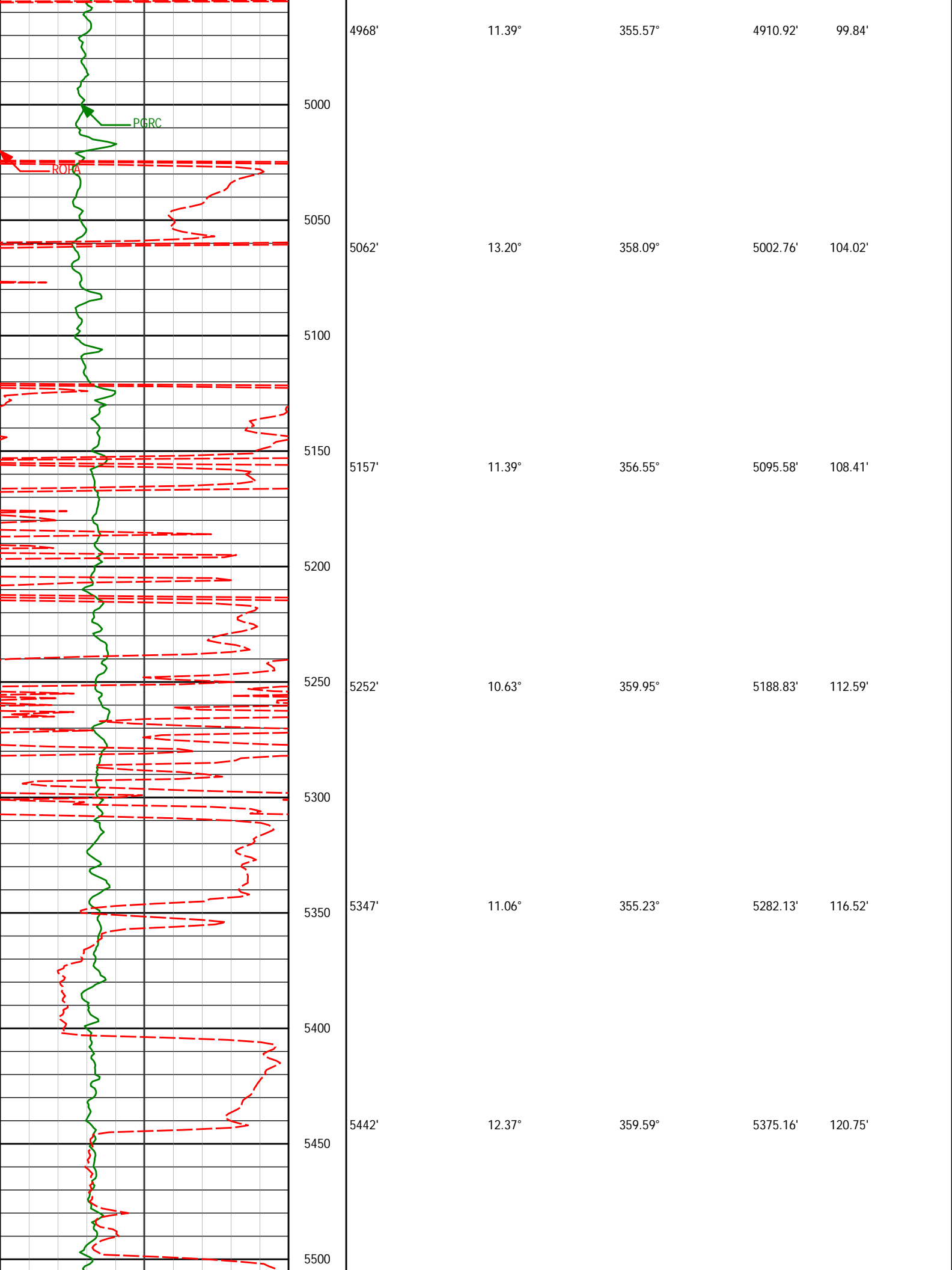
4493'      12.65°      347.84°      4446.00'      85.09'

4588'      11.30°      346.58°      4538.93'      85.91'

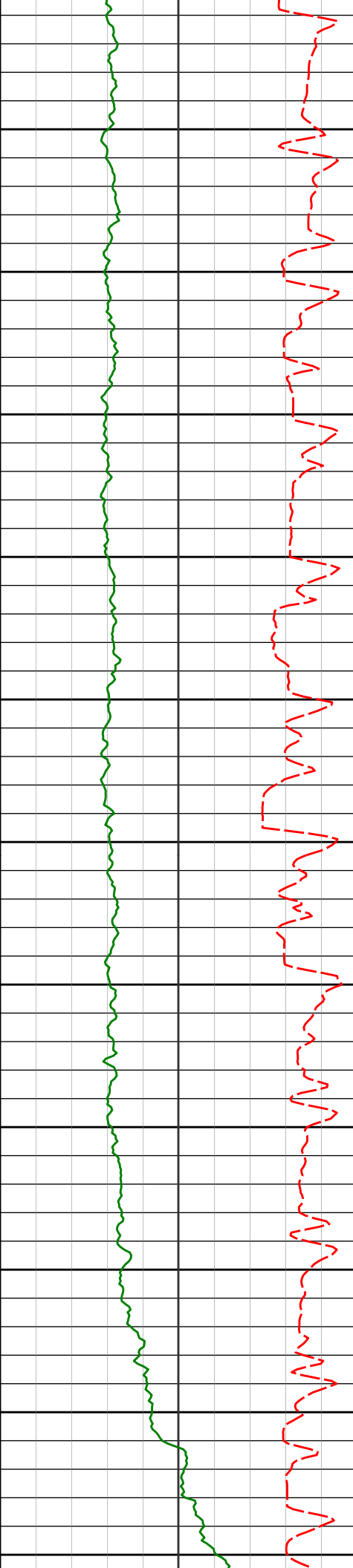
4683'      11.93°      357.61°      4632.00'      88.36'

4778'      12.61°      356.78°      4724.82'      92.68'

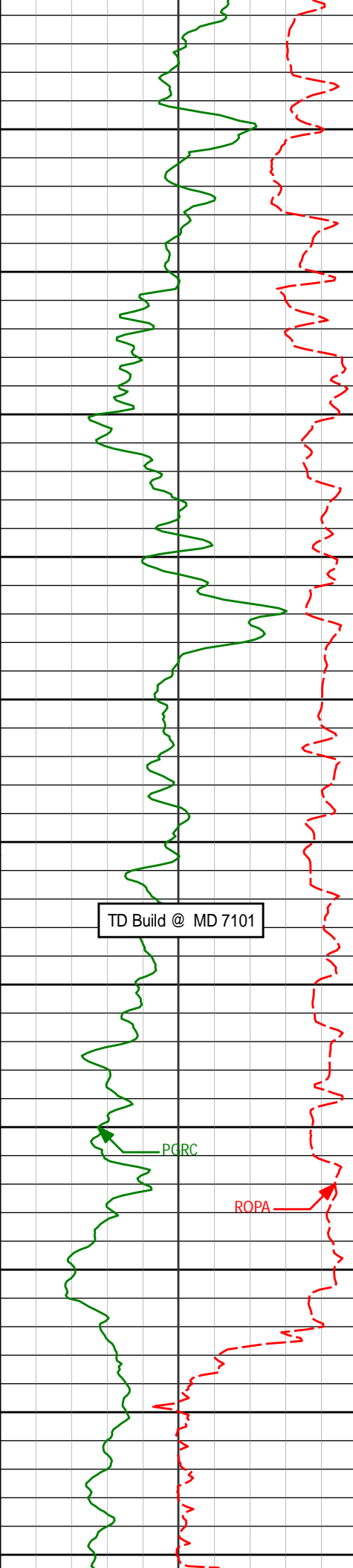
4873'      11.26°      355.01°      4817.77'      96.46'







6057'	22.61°	1.04°	5973.59'	151.34'	
6100	6104'	26.85°	6.13°	6016.28'	157.72'
6150	6152'	28.90°	16.18°	6058.73'	167.69'
6200	6198'	29.48°	25.40°	6098.91'	180.83'
6250	6246'	29.12°	30.79°	6140.77'	196.91'
6300	6293'	29.15°	35.75°	6181.83'	214.01'
6350	6341'	30.80°	40.95°	6223.42'	233.29'
6400	6388'	33.53°	45.05°	6263.21'	254.55'
6450	6436'	37.52°	50.54°	6302.27'	279.39'
6500	6483'	41.45°	58.39°	6338.56'	307.38'
6550	6531'	45.83°	66.81°	6373.32'	339.70'
6600	6578'	49.04°	71.25°	6405.12'	374.12'



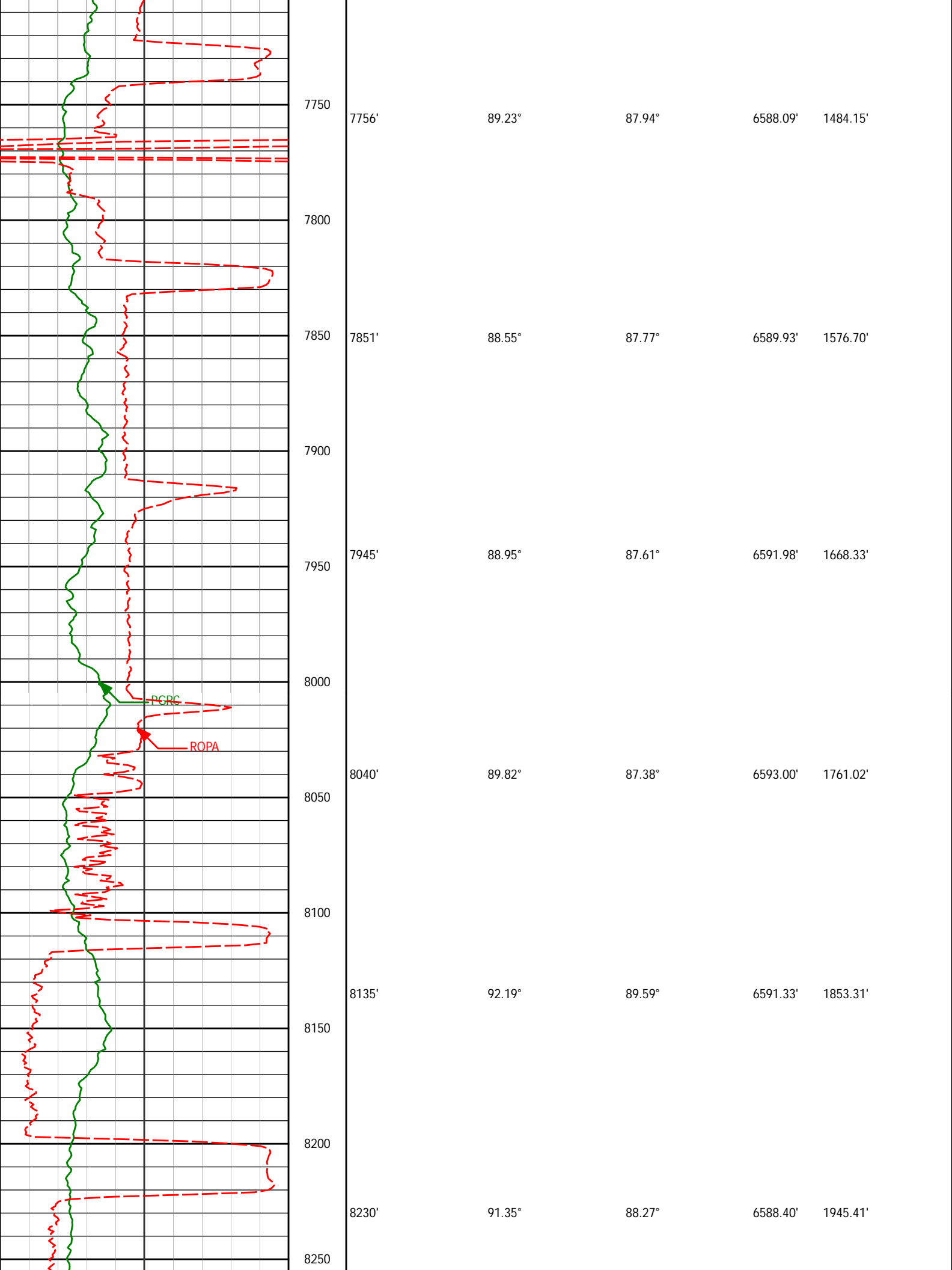
6626'	52.48°	72.37°	6435.48'	411.24'
6650				
6672'	55.54°	71.96°	6462.51'	448.41'
6700				
6720'	58.51°	73.50°	6488.63'	488.65'
6750				
6767'	61.55°	75.62°	6512.11'	529.35'
6800				
6815'	66.52°	77.98°	6533.12'	572.47'
6850				
6862'	72.51°	80.17°	6549.56'	616.35'
6900				
6910'	75.58°	81.99°	6562.75'	662.22'
6950				
6957'	78.54°	85.73°	6573.28'	707.45'
7000				
7013'	83.06°	88.42°	6582.23'	761.45'
7050				
7093'	88.37°	86.20°	6588.21'	839.32'
7100				
7150				

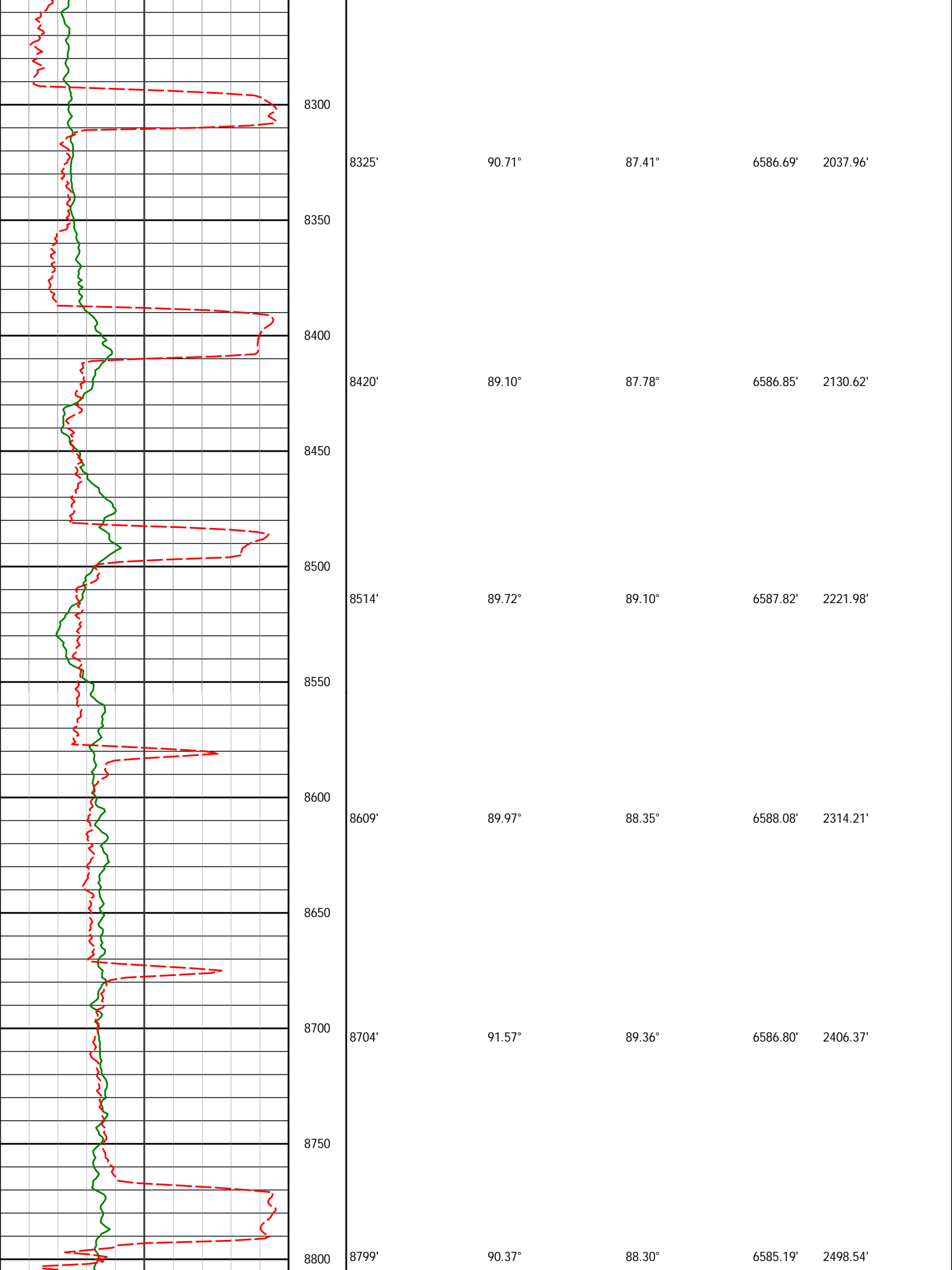
TD Build @ MD 7101

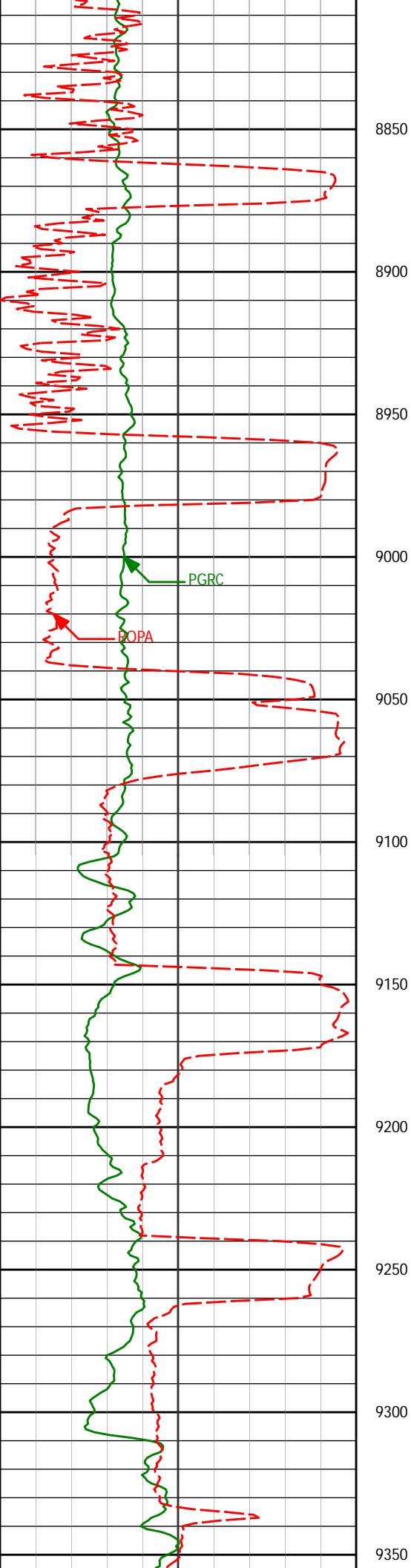
PGRC

ROPA





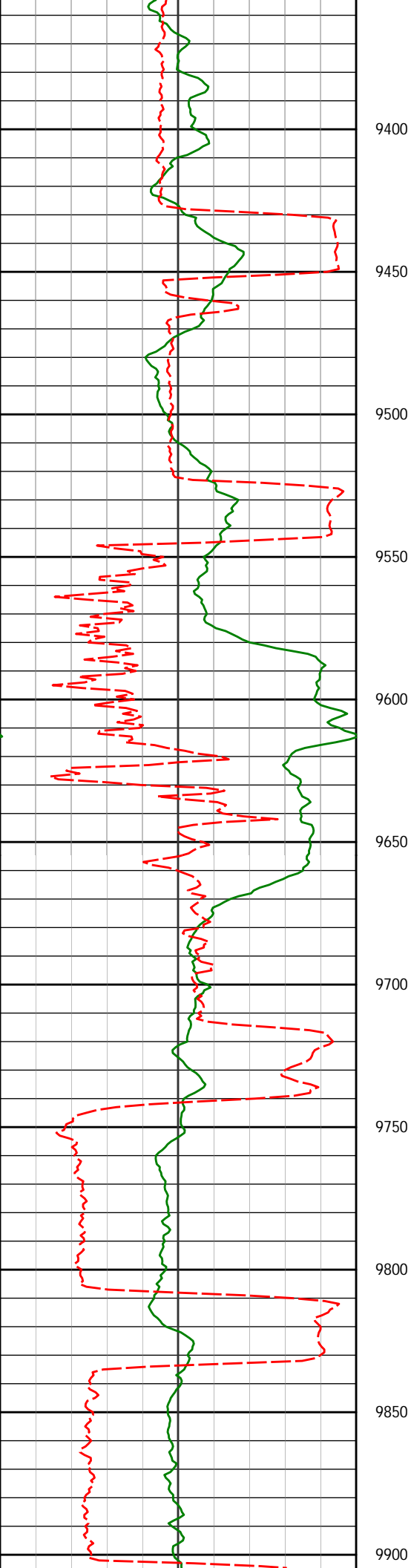




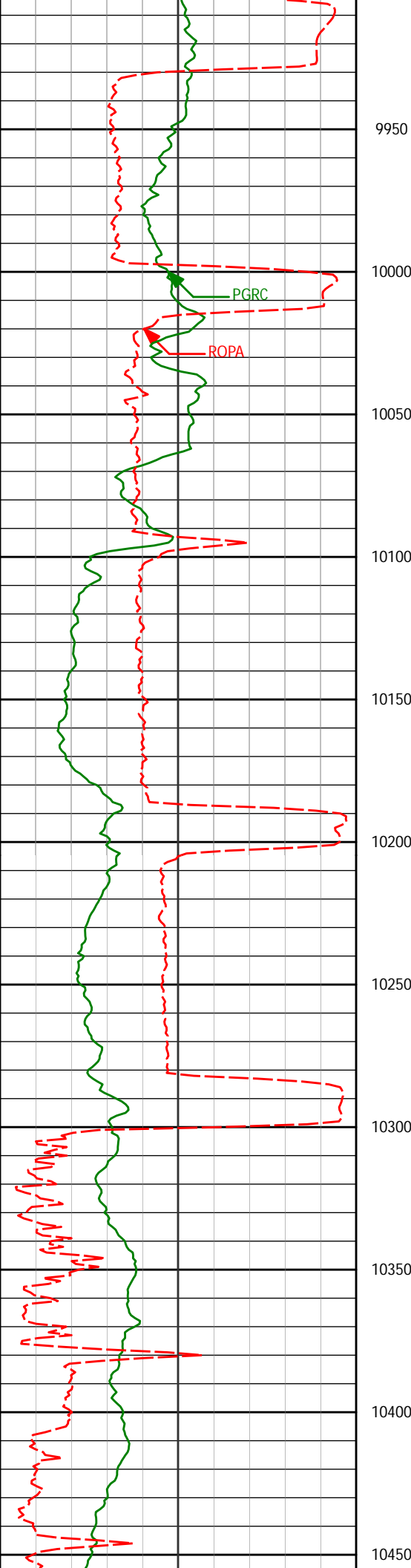
8894'	89.11°	85.08°	6585.62'	2591.50'
8989'	90.28°	87.30°	6586.13'	2684.64'
9083'	91.20°	88.53°	6584.91'	2776.20'
9178'	90.46°	87.27°	6583.54'	2868.73'
9273'	89.35°	89.03°	6583.69'	2961.18'

PGRC

POPA



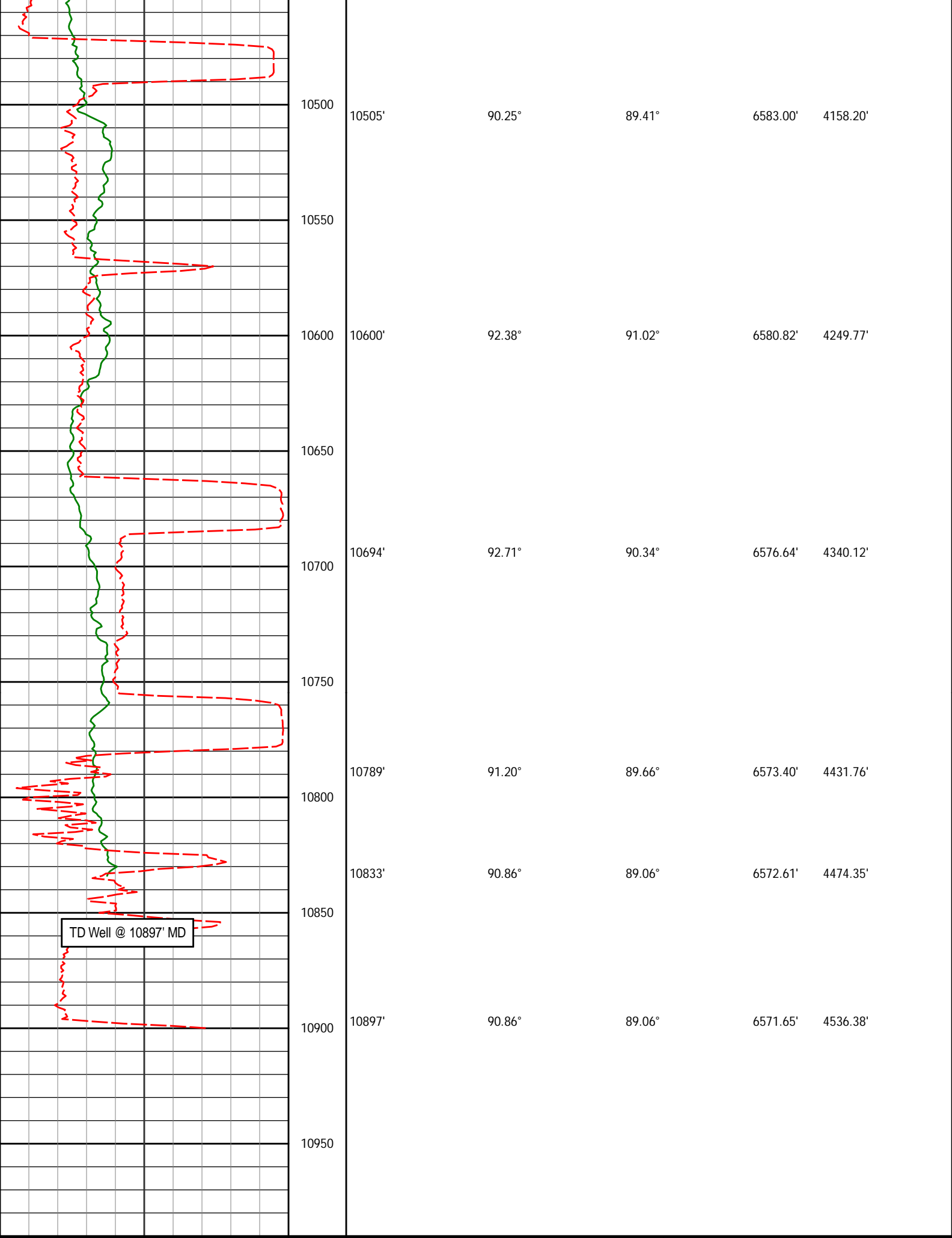
9368'	87.93°	88.72°	6585.95'	3053.32'
9400				
9450				
9463'	88.95°	88.88°	6588.54'	3145.48'
9500				
9550				
9558'	90.46°	88.16°	6589.02'	3237.79'
9600				
9650				
9652'	90.12°	86.79°	6588.55'	3329.51'
9700				
9747'	90.43°	87.22°	6588.09'	3422.38'
9800				
9842'	89.32°	87.80°	6588.30'	3515.07'
9900				



9937'	90.34°	88.58°	6588.58'	3607.50'
9950				
10000				
10031'	90.55°	89.33°	6587.85'	3698.66'
10050				
10100				
10126'	91.02°	88.55°	6586.55'	3790.80'
10150				
10200				
10221'	91.11°	89.46°	6584.78'	3882.89'
10250				
10300				
10316'	90.12°	89.38°	6583.77'	3974.83'
10350				
10400				
10410'	90.28°	88.34°	6583.44'	4066.03'
10450				

PGRC

ROPA



10505'	90.25°	89.41°	6583.00'	4158.20'
10600'	92.38°	91.02°	6580.82'	4249.77'
10694'	92.71°	90.34°	6576.64'	4340.12'
10789'	91.20°	89.66°	6573.40'	4431.76'
10833'	90.86°	89.06°	6572.61'	4474.35'
10897'	90.86°	89.06°	6571.65'	4536.38'

TD Well @ 10897' MD

**Avg Rate of Penetration**

ROPA

Depth

**Depth**

**Inc**

**Azi**

**TVD**

**V.S**

ROPA feet per hr 0 ft Depth Inc. Azi. TVD V.S.

**PCG Gamma Ray**  
PGRC  
0 api 300

# HALLIBURTON

## Sperry Drilling Services

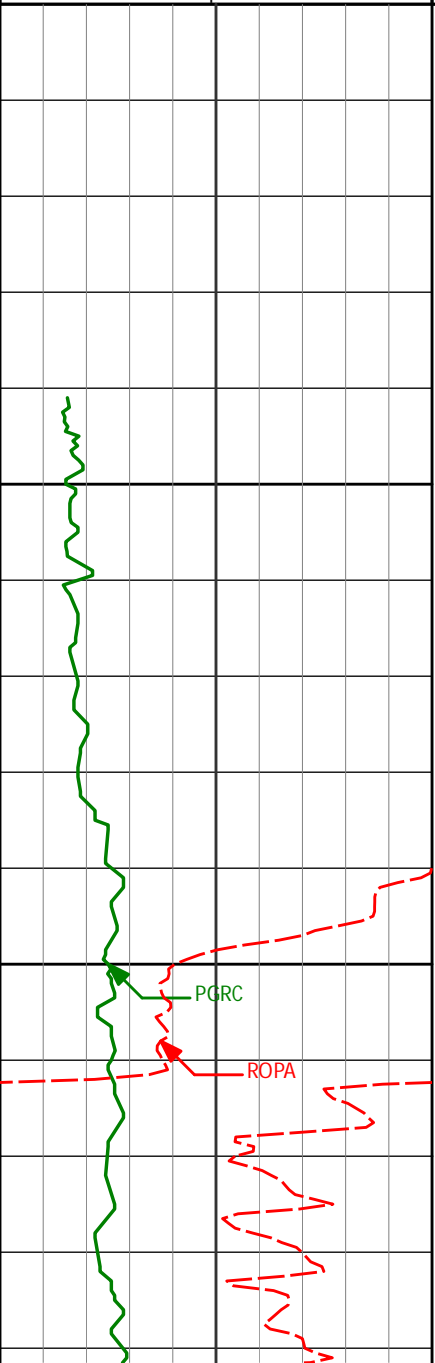
### MD Detail Log 1:240

Noble Energy  
Wells Ranch AE20-69HM  
H&P 321  
Sec. 20-T6N-R62W

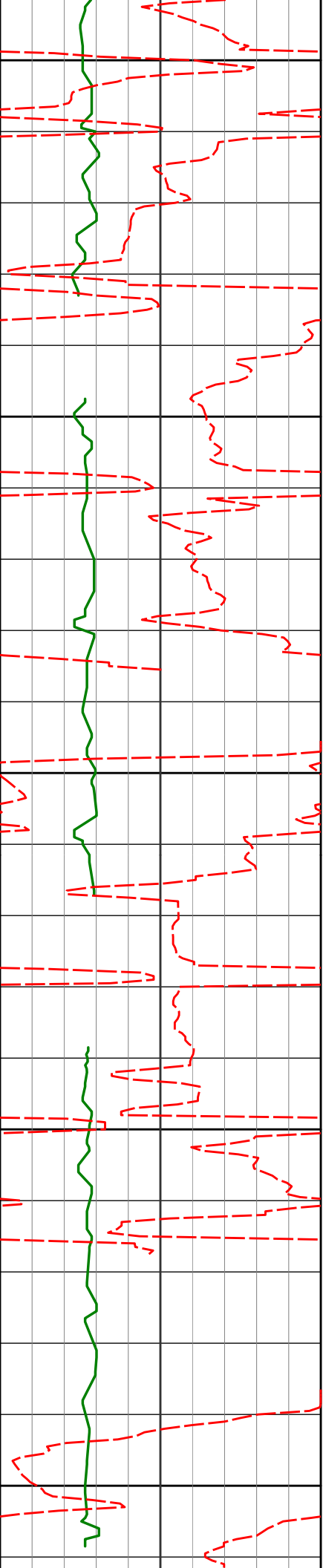
**PCG Gamma Ray**  
PGRC  
0 api 300

**Avg Rate of Penetration**  
ROPA  
1K feet per hr 0

Depth ft	Depth	Inc.	Azi.	TVD	V.S.
-------------	-------	------	------	-----	------



700					
950					
966'	0.70°	149.73°	965.98'	-3.12'	
1000					



1050

1090'

0.50°

83.98°

1089.98'

-2.39'

1100

1150

1182'

0.57°

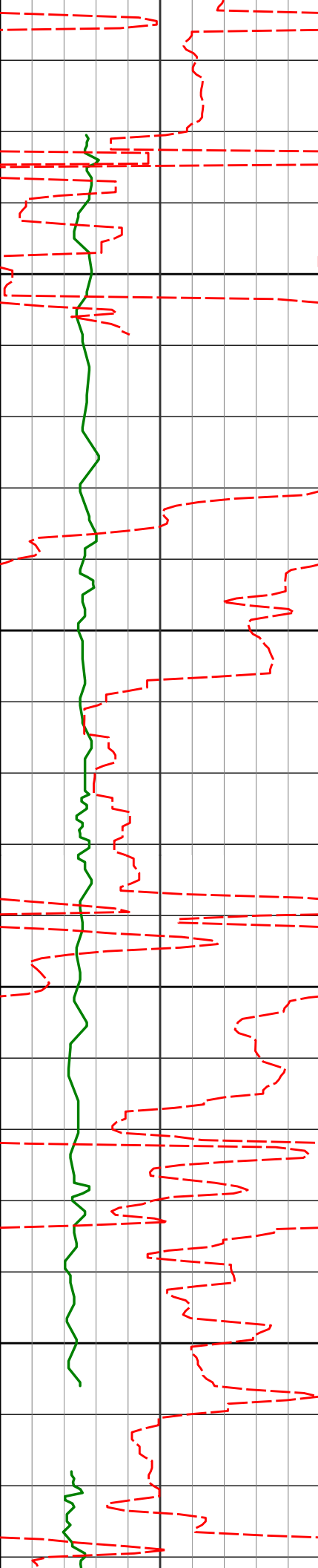
121.97°

1181.97'

-1.68'

1200

1250



1274'

0.53°

140.55°

1273.97'

-1.20'

1300

1350

1367'

0.53°

169.93°

1366.96'

-1.06'

1400

1450

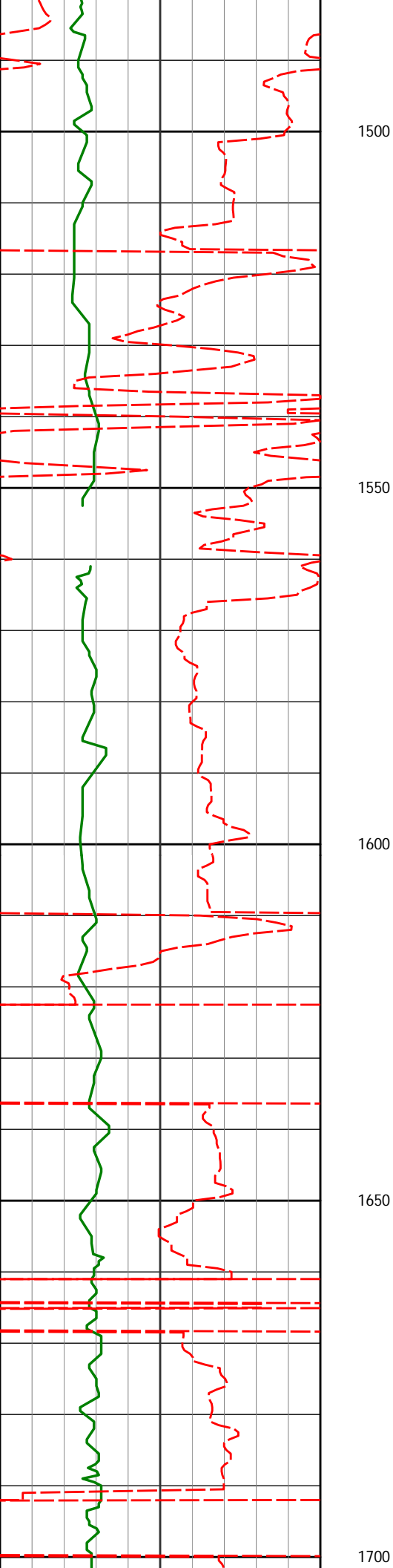
1459'

0.87°

175.14°

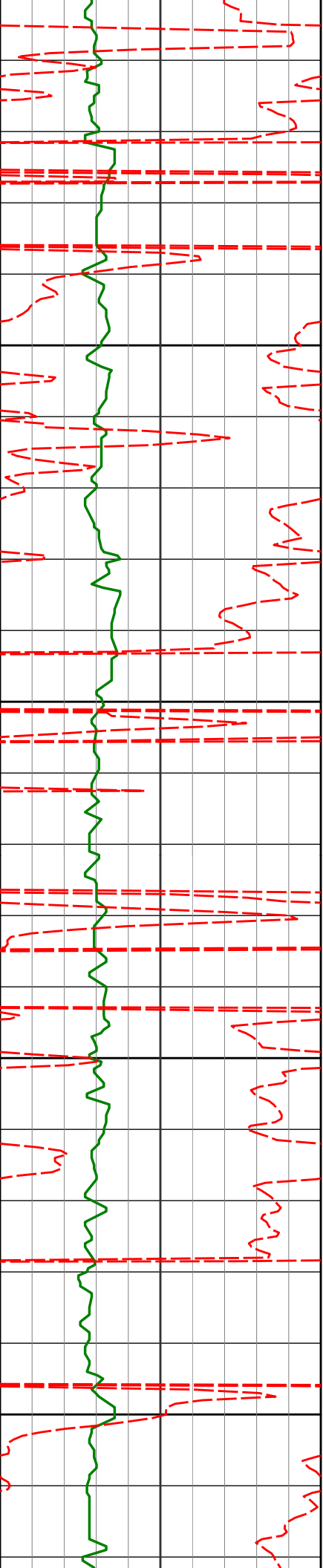
1458.96'

-1.22'



1554'      1.12°      71.87°      1553.95'      -0.42'

1649'      0.74°      100.69°      1648.94'      1.06'



1744'

1.04°

85.51°

1743.93'

2.46'

1750

1800

1838'

0.83°

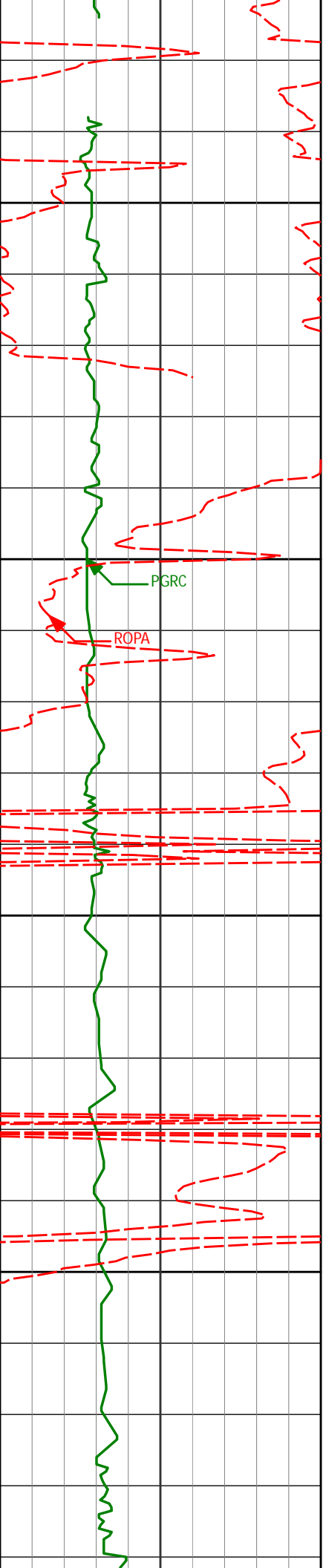
109.87°

1837.91'

3.85'

1850

1900



1933'

0.73°

72.31°

1932.91'

5.02'

1950

2000

PGRC

ROPA

2028'

3.78°

15.25°

2027.83'

7.21'

2050

2100

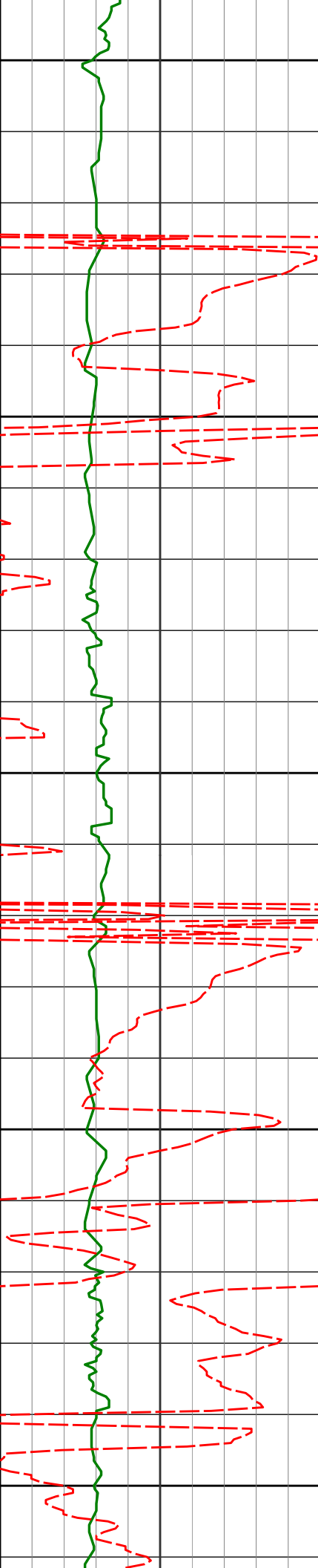
2123'

3.30°

354.35°

2122.65'

9.25'



2150

2200

2250

2300

2350

2218'

4.37°

339.71°

2217.44'

9.38'

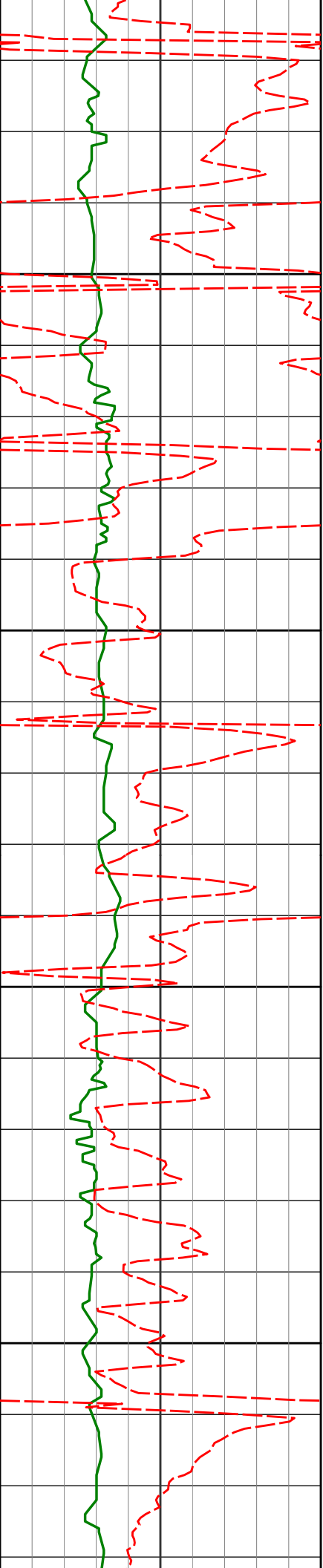
2313'

7.16°

348.72°

2311.95'

9.45'



2400

2407'

8.39°

347.80°

2405.08'

10.20'

2450

2500

2502'

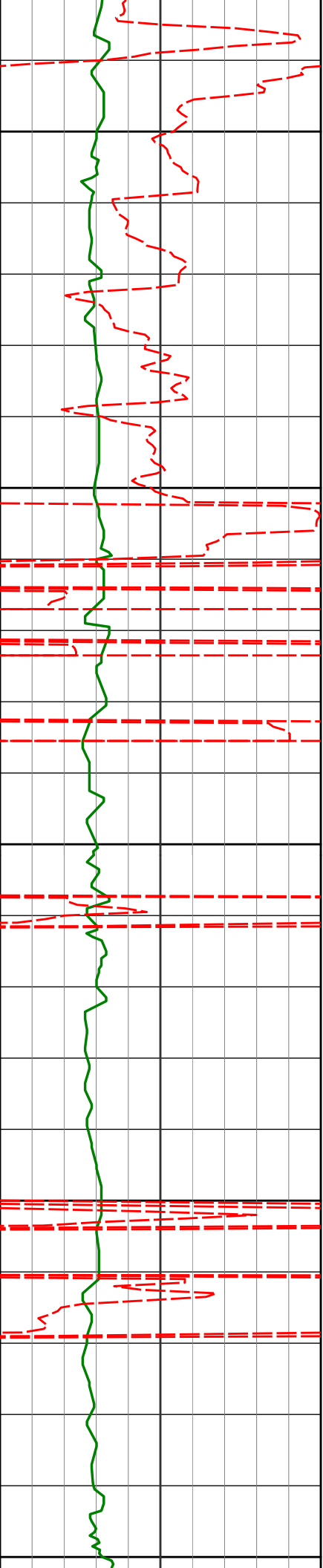
10.08°

347.57°

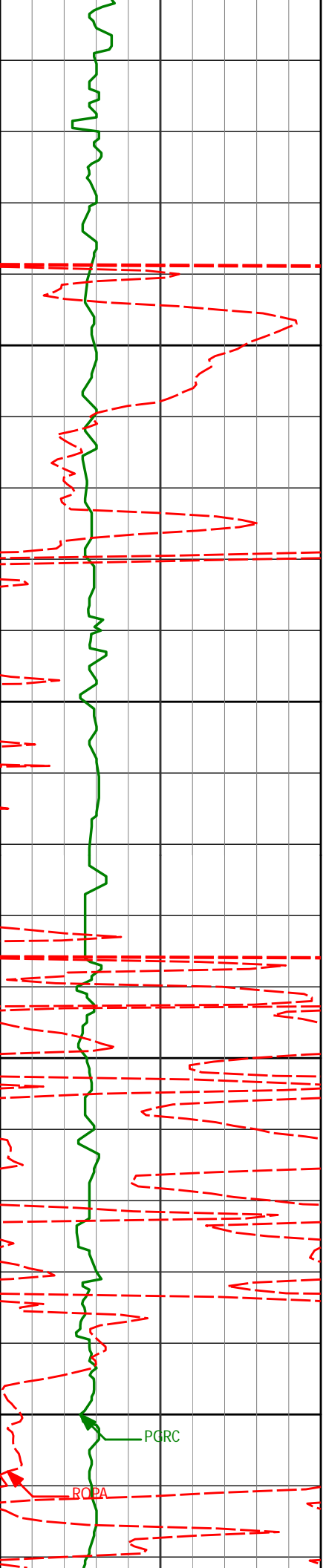
2498.85'

10.95'

2550



Y-Coordinate	Value 1	Value 2	Value 3	Value 4
2600	2597'	11.88°	349.43°	2592.11'
2650				
2700	2692'	11.57°	348.74°	2685.12'
2750				
2800	2786'	10.86°	346.01°	2777.33'



2850

2881'

12.26°

359.34°

2870.42'

17.08'

2900

2950

2976'

11.67°

356.21°

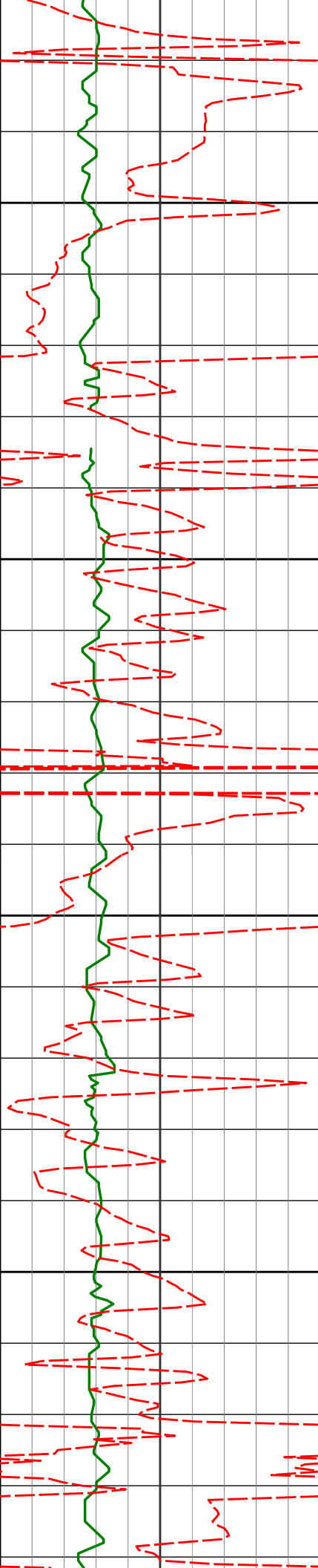
2963.35'

21.49'

3000

PGRC

ROPA



3050

3071'

13.01°

355.14°

3056.16'

25.30'

3100

3150

3166'

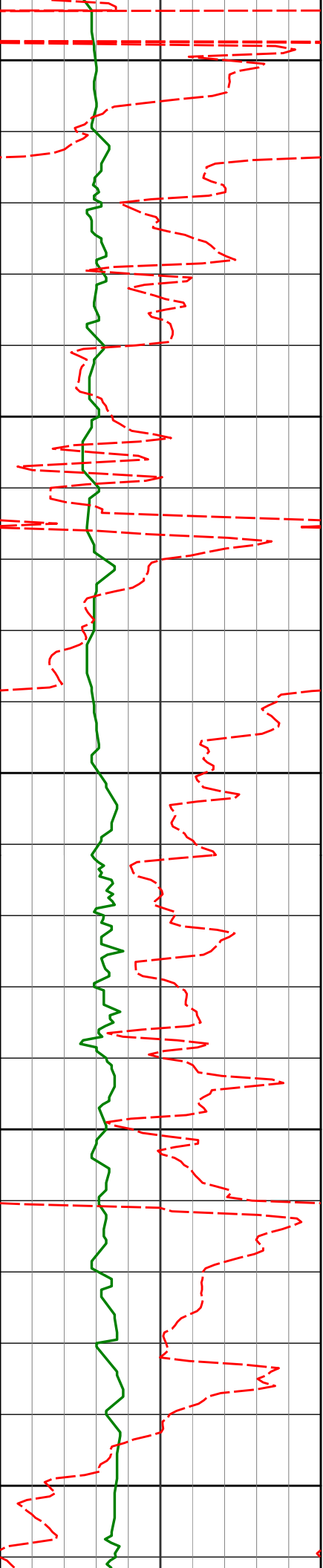
12.39°

352.54°

3148.83'

28.57'

3200



3250

3260'

11.99°

354.61°

3240.71'

31.57'

3300

3350

3355'

10.19°

353.93°

3333.94'

34.57'

3400

3450

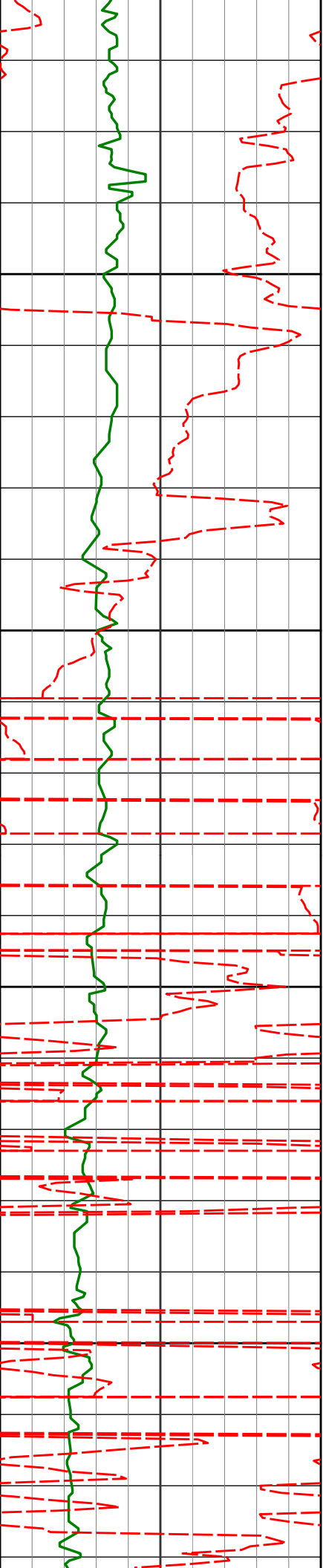
3450'

10.94°

355.52°

3427.32'

37.57'



3500

3544'

12.40°

356.54°

3519.38'

41.27'

3550

3600

3640'

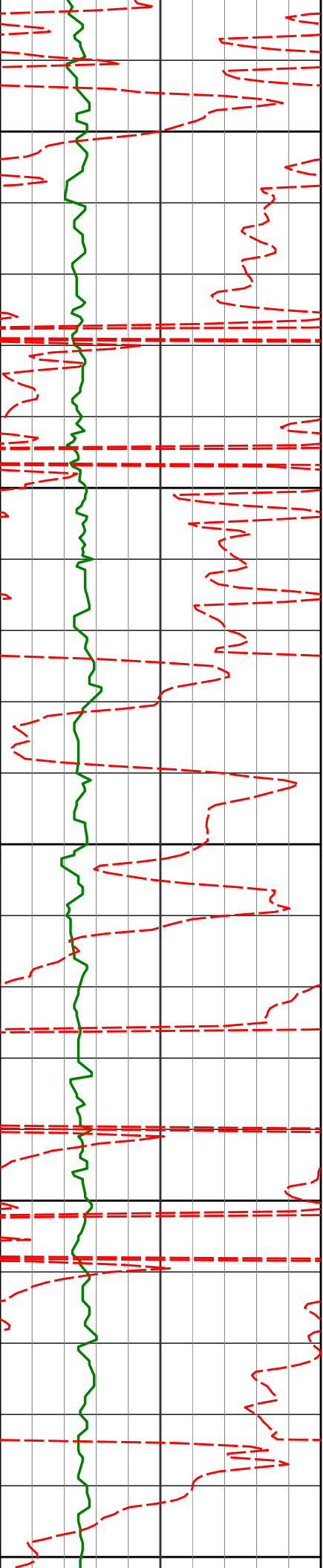
12.63°

358.12°

3613.10'

45.76'

3650



3700

3734'

13.20°

0.54°

3704.72'

51.02'

3750

3800

3829'

13.38°

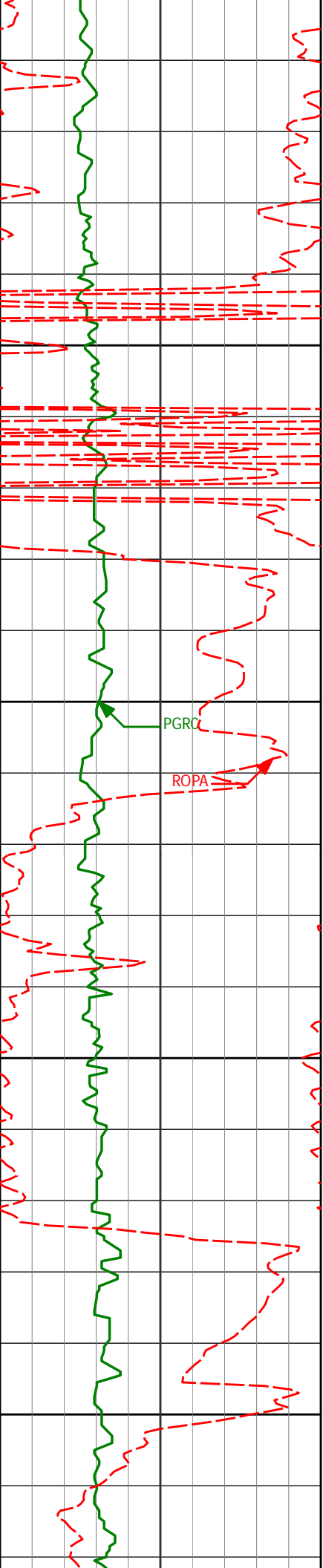
353.94°

3797.18'

55.70'

3850

3900



3924'

14.06°

352.97°

3889.47'

59.06'

3950

4000

PGRC

ROPA

4019'

13.13°

357.02°

3981.81'

62.97'

4050

4100

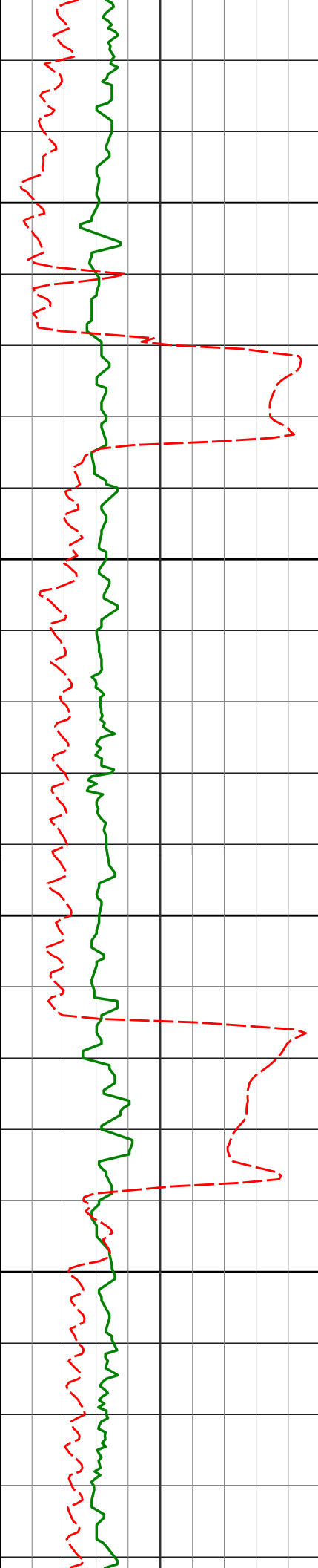
4114'

10.98°

0.30°

4074.71'

67.65'



4150

4200

4250

4300

4209'

10.40°

359.81°

4168.06'

72.28'

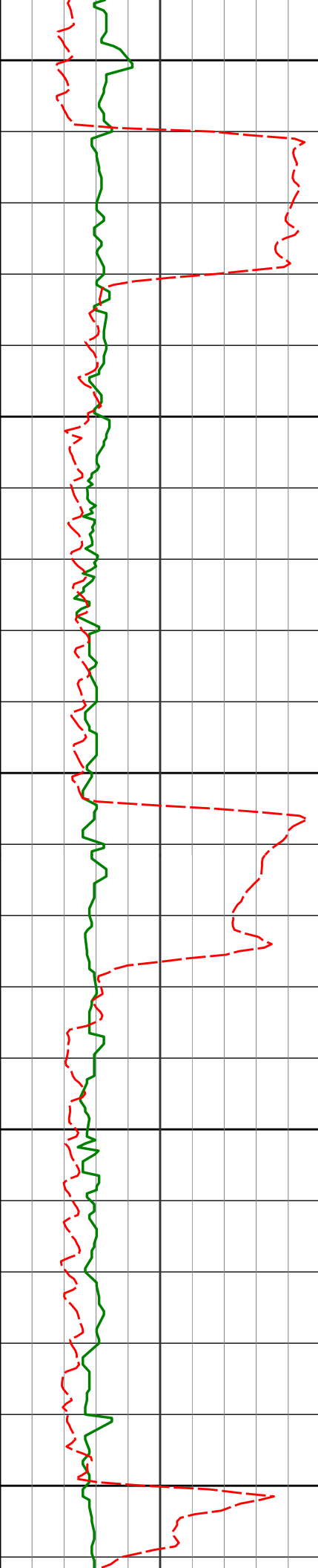
4304'

11.76°

0.68°

4261.29'

77.13'



4350

4400

4450

4500

4550

4399'

12.29°

358.60°

4354.20'

82.17'

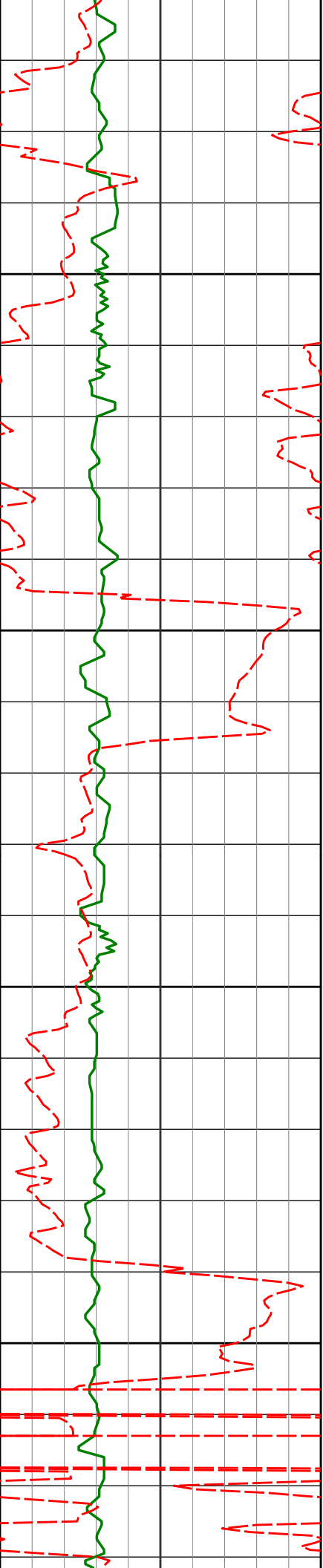
4493'

12.65°

347.84°

4446.00'

85.09'



4588'

11.30°

346.58°

4538.93'

85.91'

4600

4650

4683'

11.93°

357.61°

4632.00'

88.36'

4700

4750

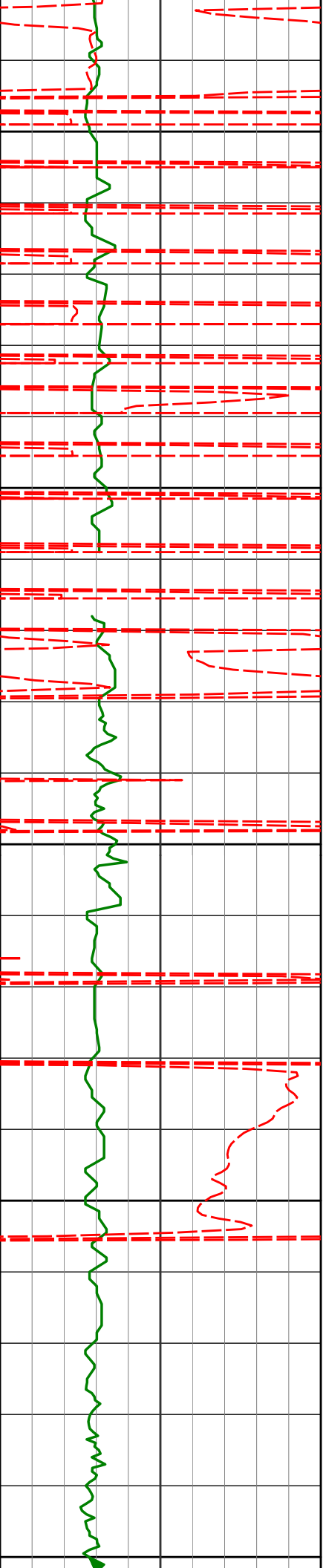
4778'

12.61°

356.78°

4724.82'

92.68'



4800

4850

4900

4950

5000

4873'

11.26°

355.01°

4817.77'

96.46'

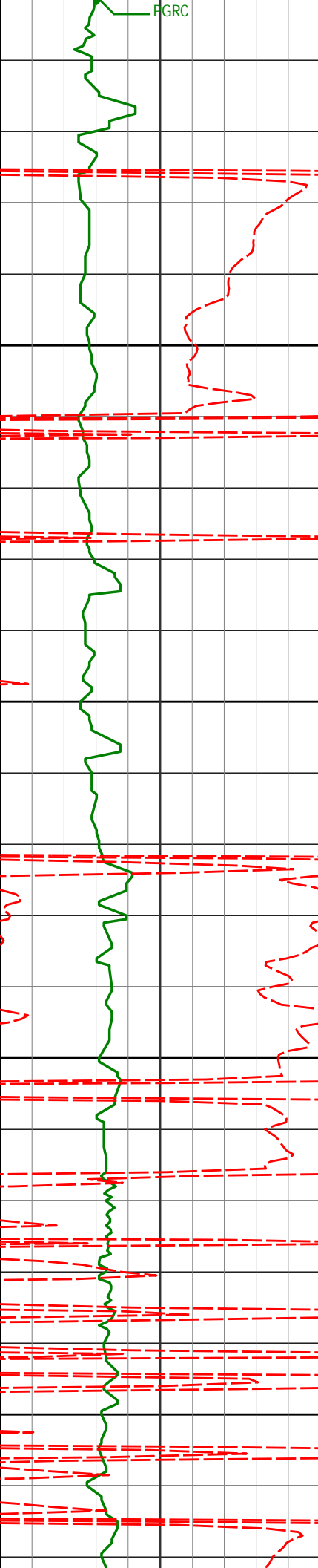
4968'

11.39°

355.57°

4910.92'

99.84'



FGRC

5050

5100

5150

5200

5062'

13.20°

358.09°

5002.76'

104.02'

5157'

11.39°

356.55°

5095.58'

108.41'



5250

5252'

10.63°

359.95°

5188.83'

112.59'

5300

5350

5347'

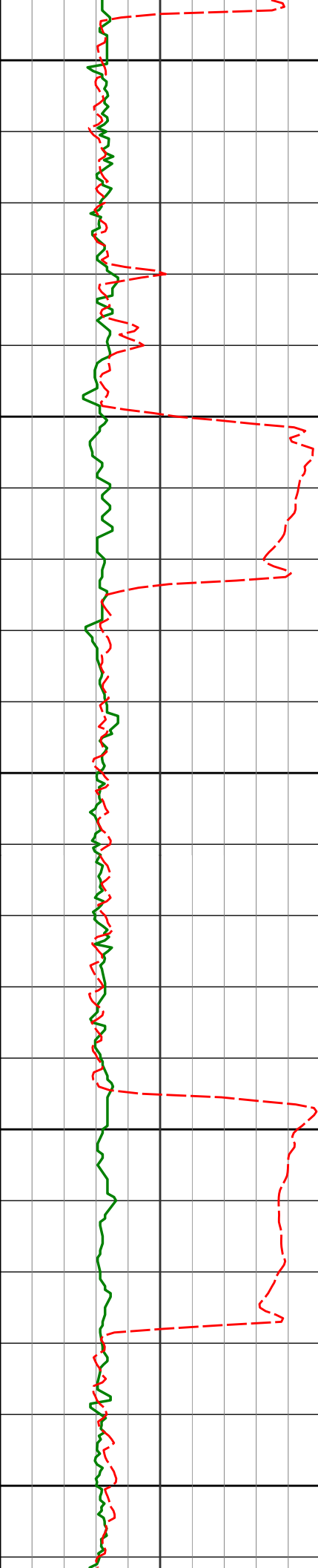
11.06°

355.23°

5282.13'

116.52'

5400



5450

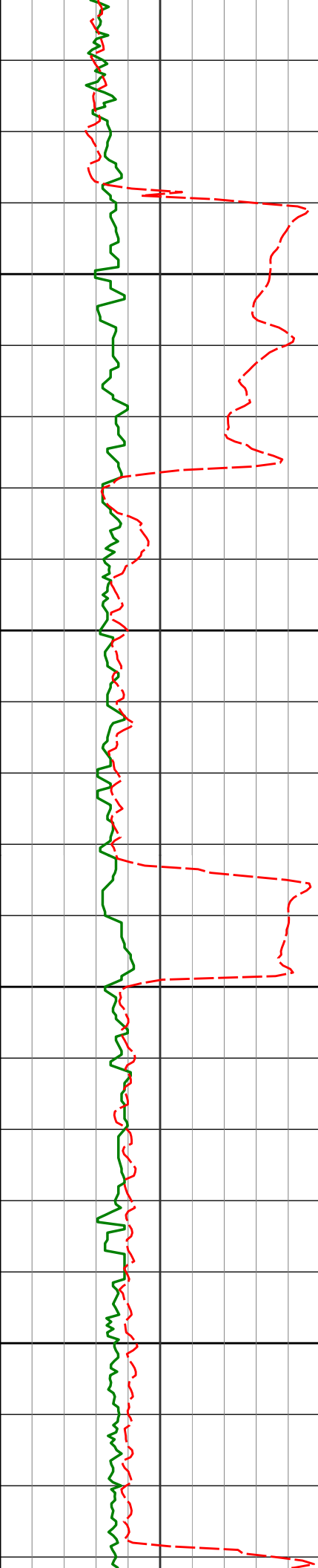
5500

5550

5600

5650

5442'	12.37°	359.59°	5375.16'	120.75'
5536'	11.79°	355.71°	5467.07'	125.12'
5631'	11.90°	351.53°	5560.05'	128.09'



5700

5726'

12.96°

355.01°

5652.83'

131.11'

5750

5800

5836'

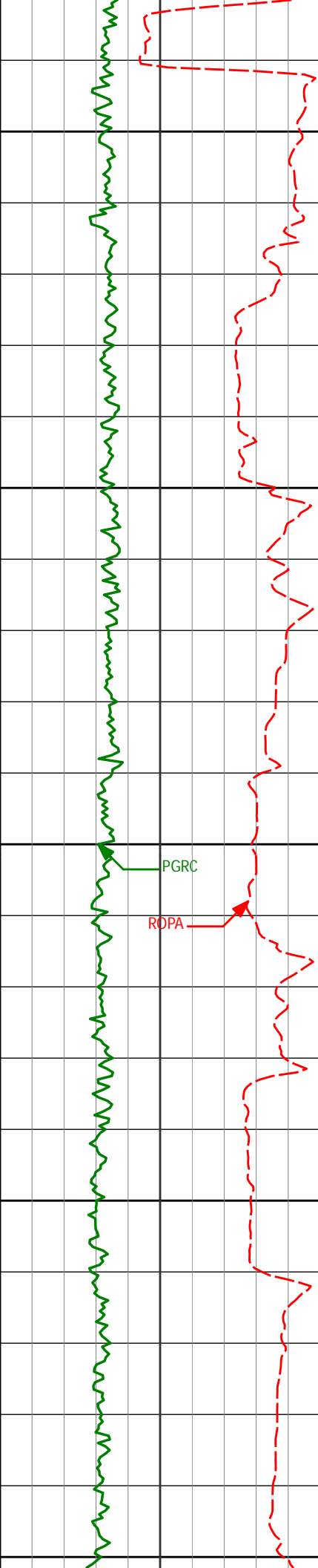
10.50°

357.55°

5760.52'

135.49'

5850



5900

5914'      11.58°      1.92°      5837.08'      139.35'

5950



5962'      14.29°      1.87°      5883.86'      142.50'

200

6000

6009'      19.54°      1.57°      5928.81'      146.46'

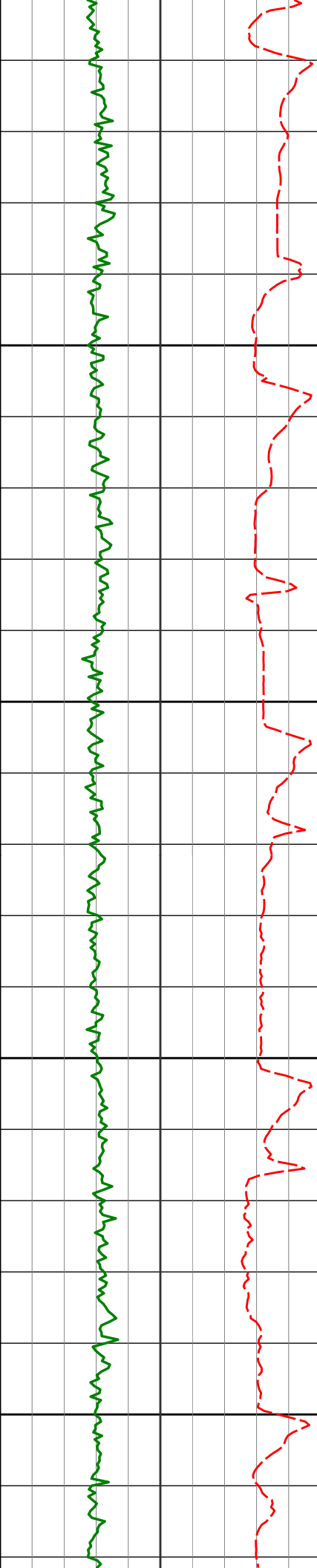
PGRC

ROPA

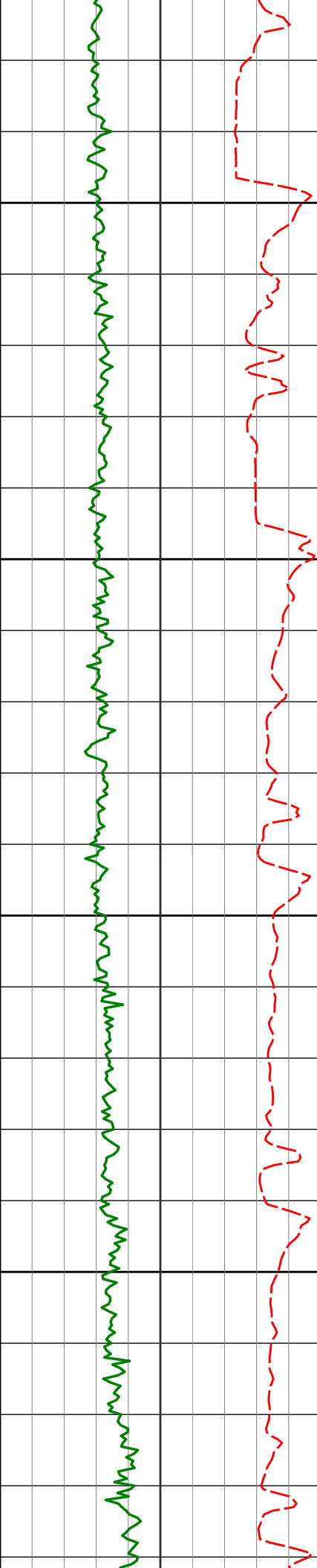
6050

6057'      22.61°      1.04°      5973.59'      151.34'

6100



6104'	26.85°	6.13°	6016.28'	157.72'	
6150	6152'	28.90°	16.18°	6058.73'	167.69'
6200	6198'	29.48°	25.40°	6098.91'	180.83'
6250	6246'	29.12°	30.79°	6140.77'	196.91'
6300	6293'	29.15°	35.75°	6181.83'	214.01'



6341'

30.80°

40.95°

6223.42'

233.29'

6350

6388'

33.53°

45.05°

6263.21'

254.55'

6400

6436'

37.52°

50.54°

6302.27'

279.39'

6450

6483'

41.45°

58.39°

6338.56'

307.38'

6500

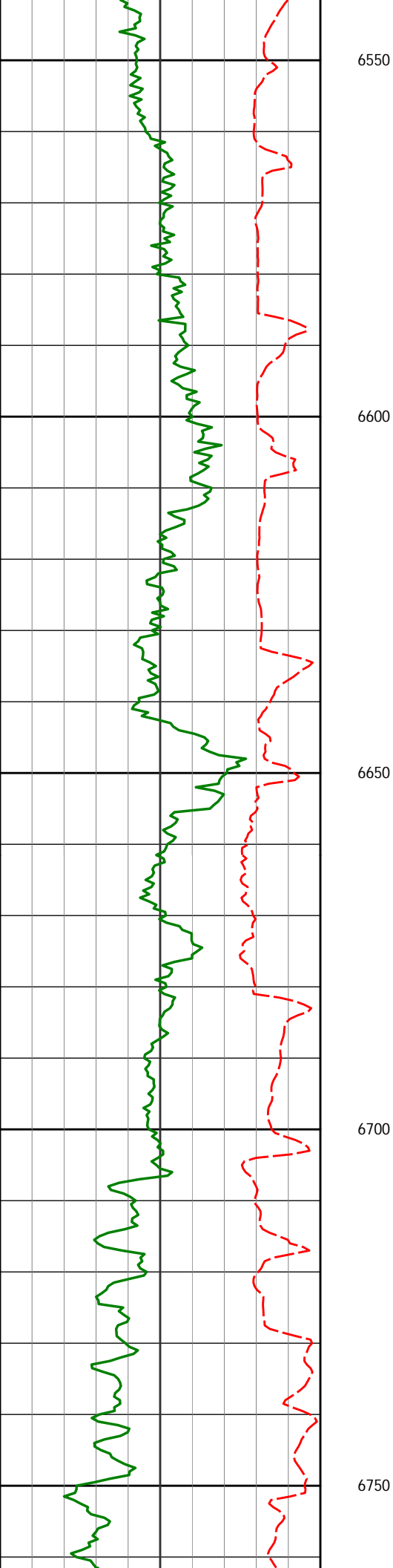
6531'

45.83°

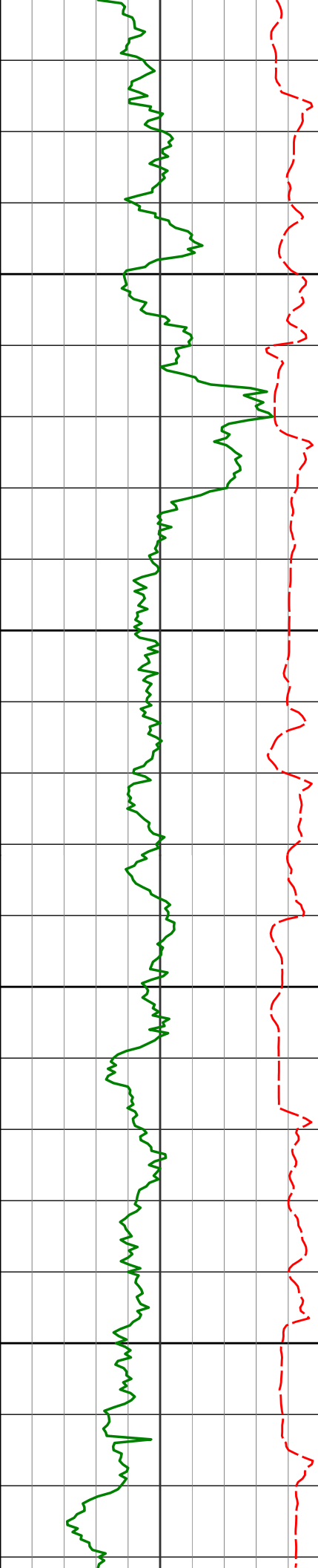
66.81°

6373.32'

339.70'



6578'	49.04°	71.25°	6405.12'	374.12'
6626'	52.48°	72.37°	6435.48'	411.24'
6672'	55.54°	71.96°	6462.51'	448.41'
6720'	58.51°	73.50°	6488.63'	488.65'



6767'

61.55°

75.62°

6512.11'

529.35'

6800

6815'

66.52°

77.98°

6533.12'

572.47'

6850

6862'

72.51°

80.17°

6549.56'

616.35'

6900

6910'

75.58°

81.99°

6562.75'

662.22'

6950

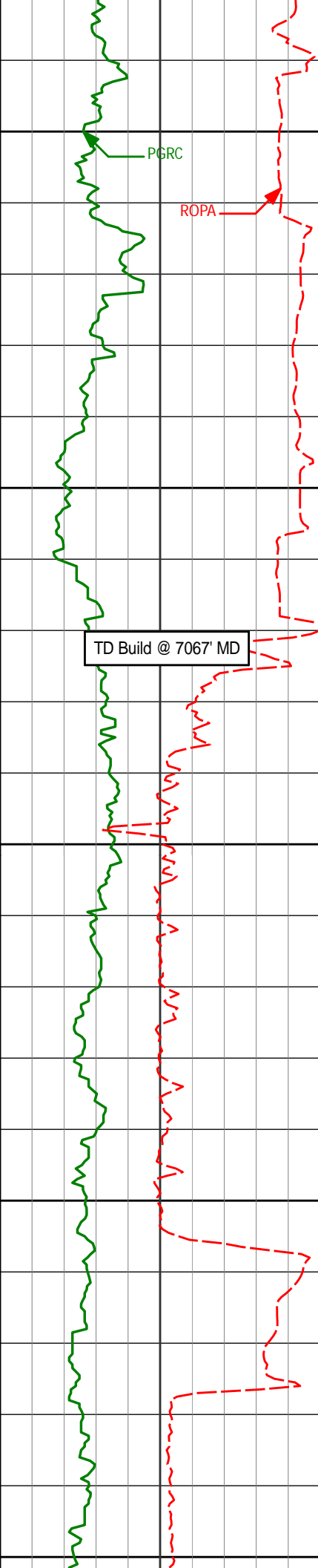
6957'

78.54°

85.73°

6573.28'

707.45'



7000

PGRC

ROPA

7013'

83.06°

88.42°

6582.23'

761.45'

7050

TD Build @ 7067' MD

7093'

88.37°

86.20°

6588.21'

839.32'

7100

7150

7187'

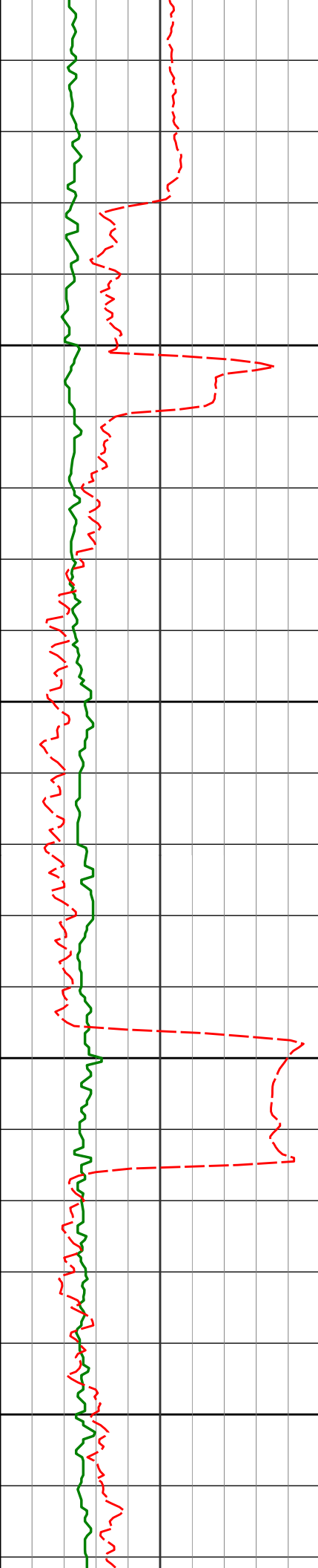
89.41°

88.34°

6590.03'

931.09'

7200



7250

7282'

91.48°

87.99°

6589.29'

1023.53'

7300

7350

7377'

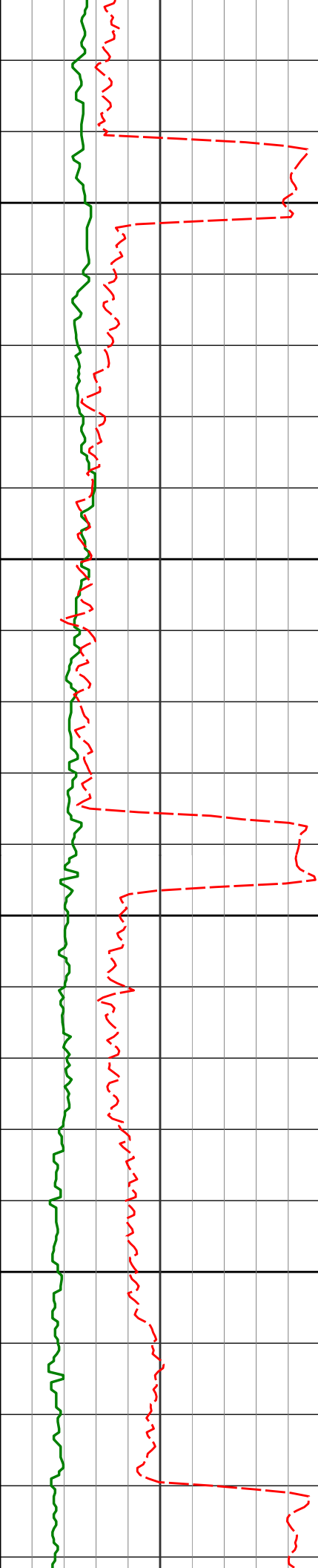
90.65°

88.48°

6587.53'

1115.93'

7400



7450

7472'

89.94°

88.82°

6587.04'

1208.19'

7500

7550

7567'

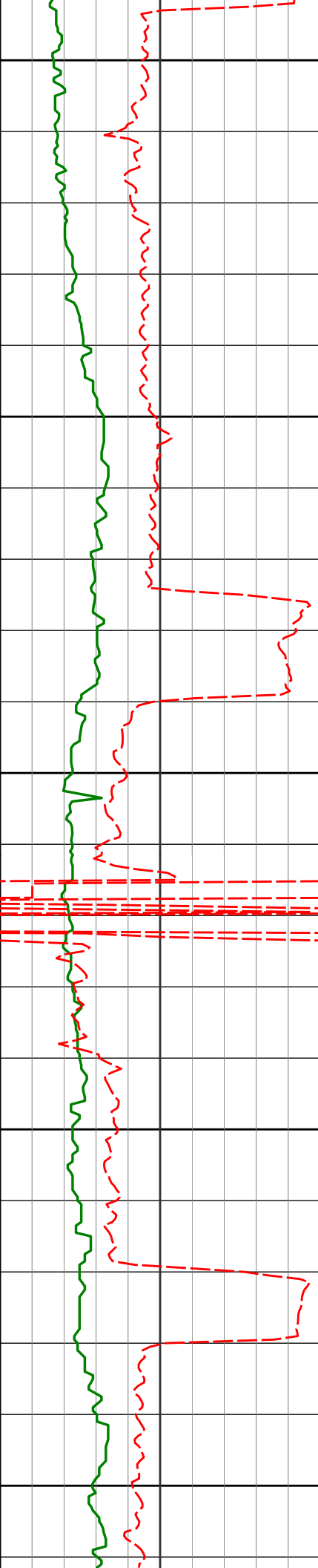
89.72°

88.87°

6587.32'

1300.37'

7600



7650

7661'

90.06°

88.27°

6587.50'

1391.69'

7700

7750

7756'

89.23°

87.94°

6588.09'

1484.15'

7800

7850

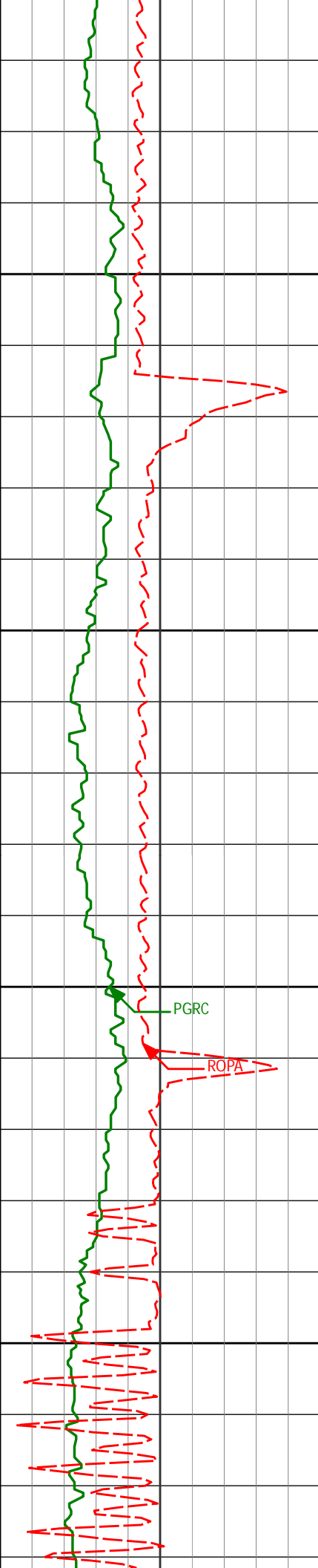
7851'

88.55°

87.77°

6589.93'

1576.70'



7900

7945'

88.95°

87.61°

6591.98'

1668.33'

7950

8000

PGRC

ROPA

8040'

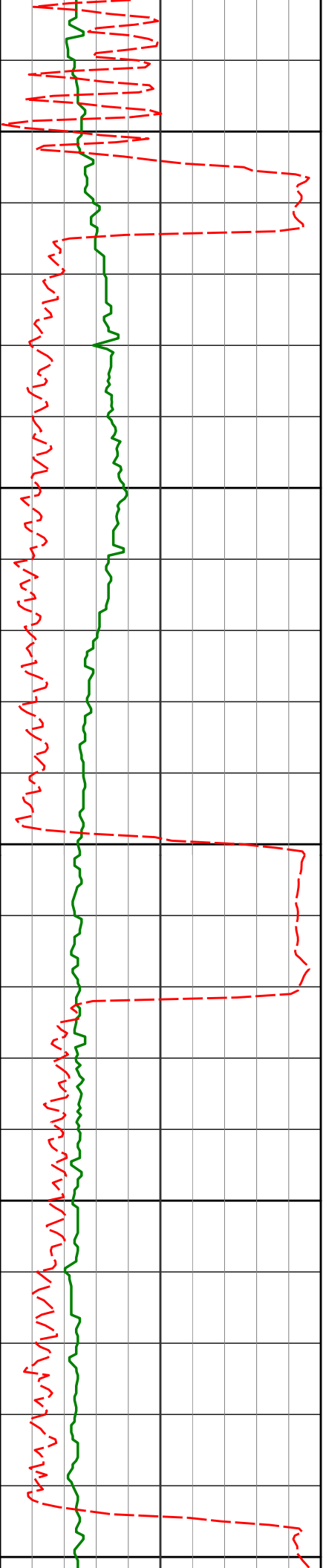
89.82°

87.38°

6593.00'

1761.02'

8050



8100

8135'

92.19°

89.59°

6591.33'

1853.31'

8150

8200

8230'

91.35°

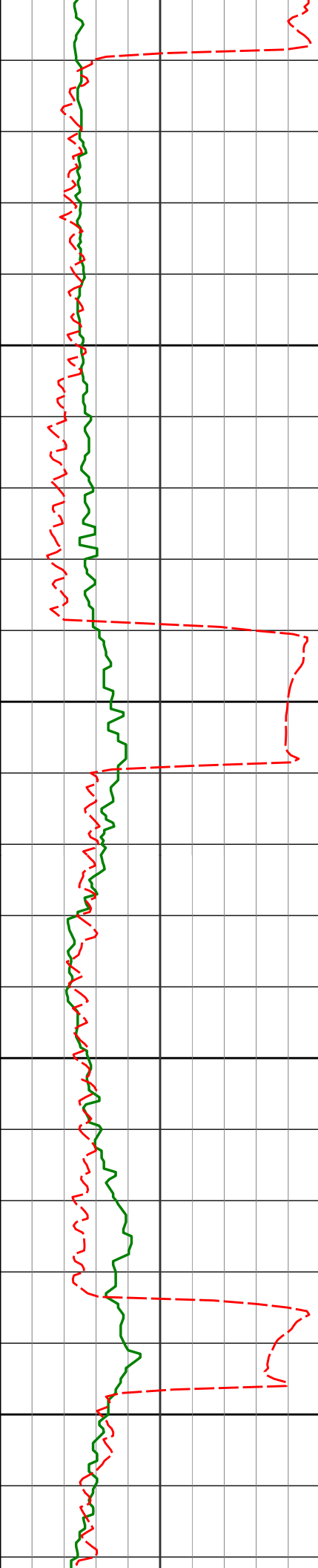
88.27°

6588.40'

1945.41'

8250

8300



8325'

90.71°

87.41°

6586.69'

2037.96'

8350

8400

8420'

89.10°

87.78°

6586.85'

2130.62'

8450

8500

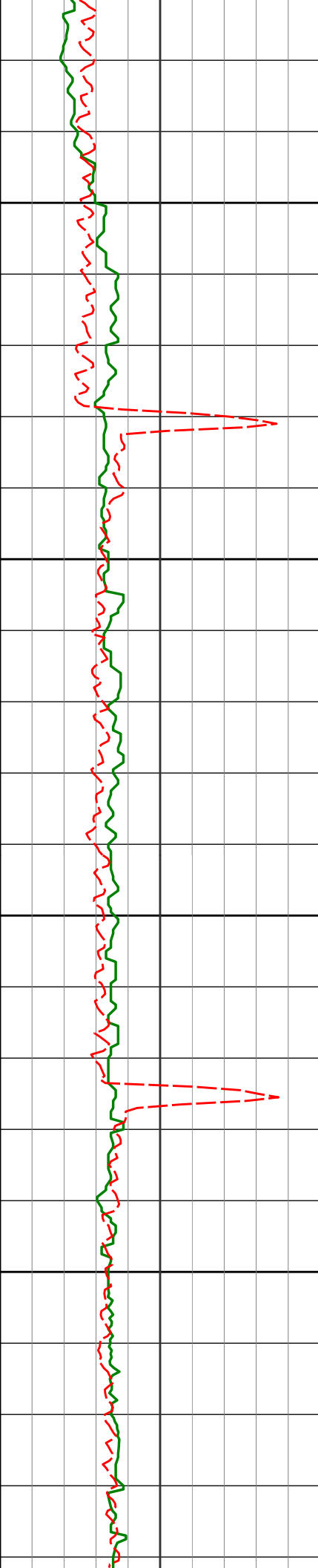
8514'

89.72°

89.10°

6587.82'

2221.98'



8550

8600

8650

8700

8609'

89.97°

88.35°

6588.08'

2314.21'

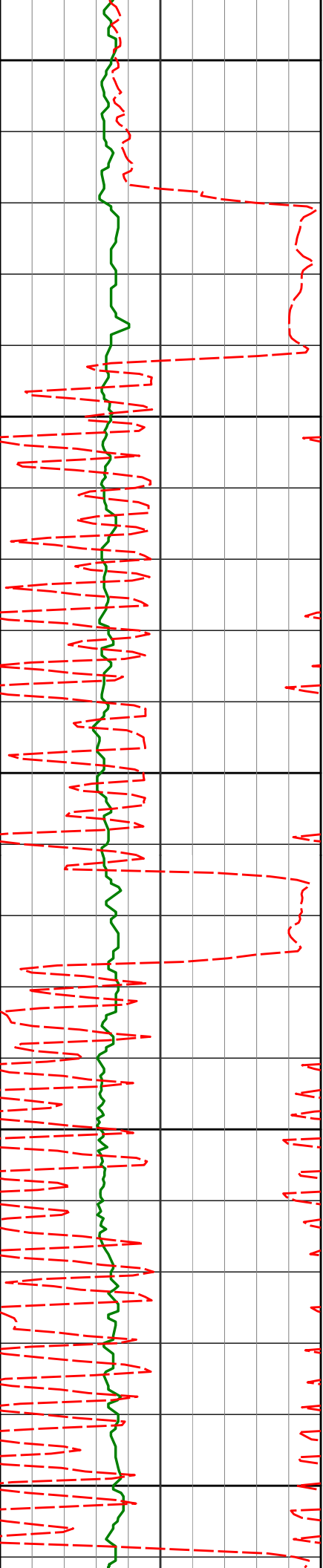
8704'

91.57°

89.36°

6586.80'

2406.37'



8750

8800

8850

8900

8950

8799'

90.37°

88.30°

6585.19'

2498.54'

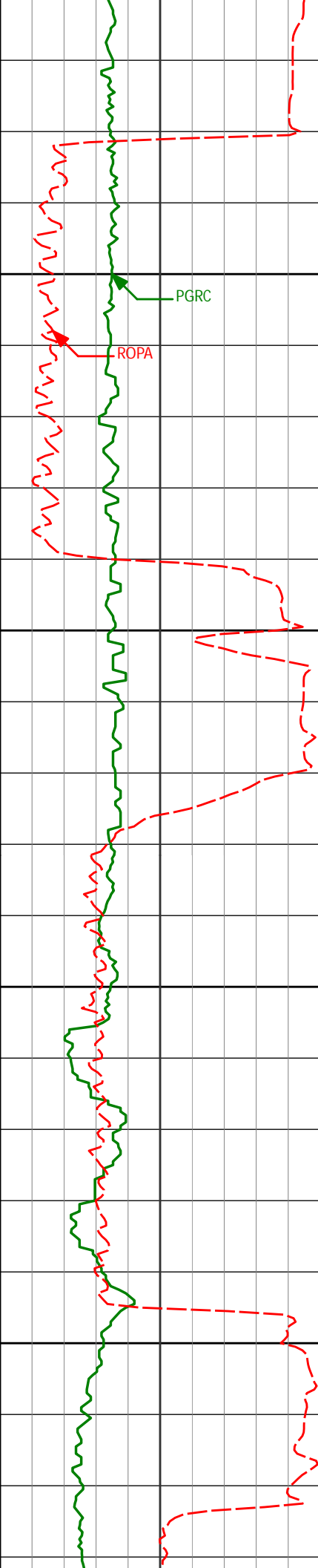
8894'

89.11°

85.08°

6585.62'

2591.50'



8989'

90.28°

87.30°

6586.13'

2684.64'

9000

PGRC

ROPA

9050

9083'

91.20°

88.53°

6584.91'

2776.20'

9100

9150

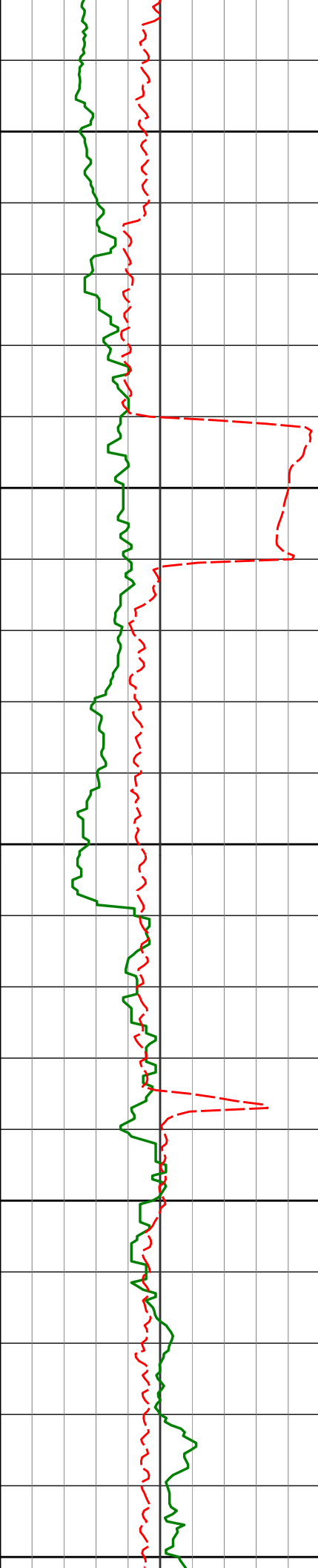
9178'

90.46°

87.27°

6583.54'

2868.73'



9200

9250

9300

9350

9400

9273'

89.35°

89.03°

6583.69'

2961.18'

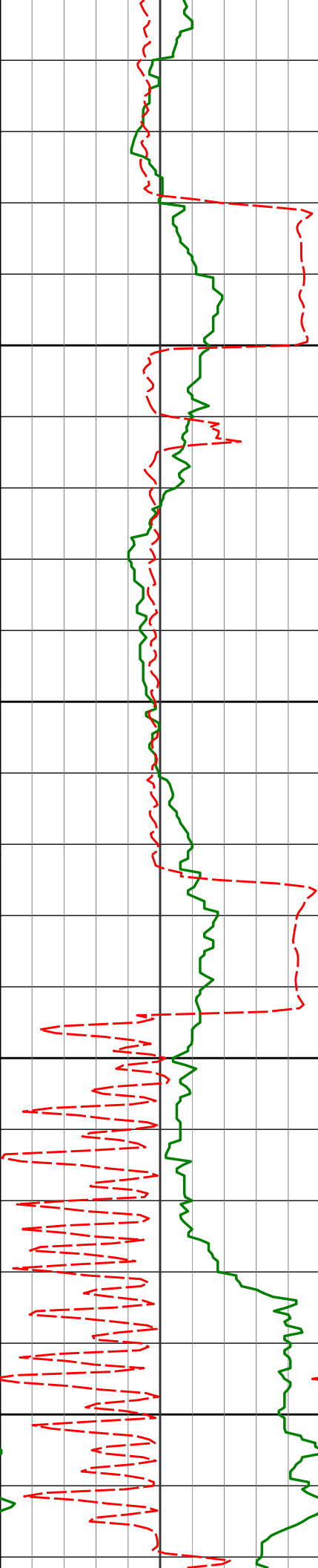
9368'

87.93°

88.72°

6585.95'

3053.32'



9450

9463'

88.95°

88.88°

6588.54'

3145.48'

9500

9550

9558'

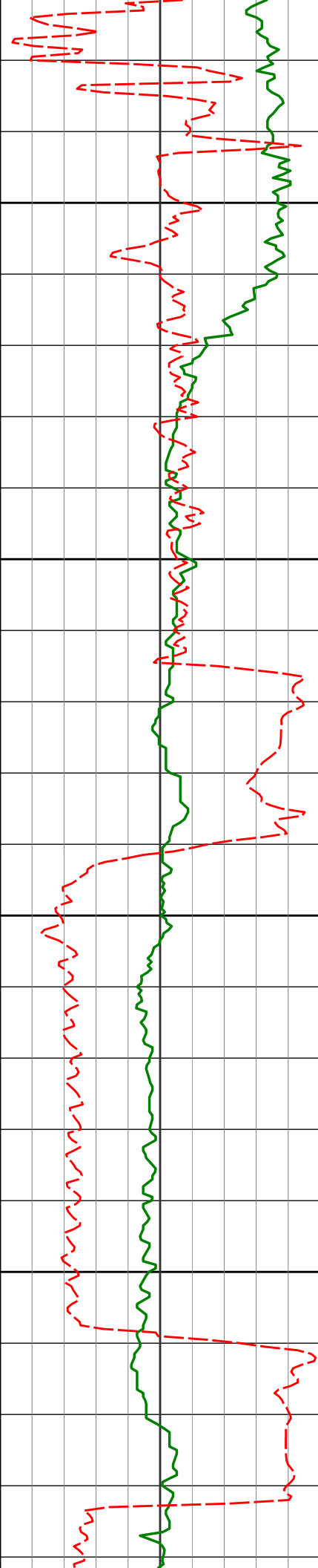
90.46°

88.16°

6589.02'

3237.79'

9600



9650

9652'

90.12°

86.79°

6588.55'

3329.51'

9700

9750

9747'

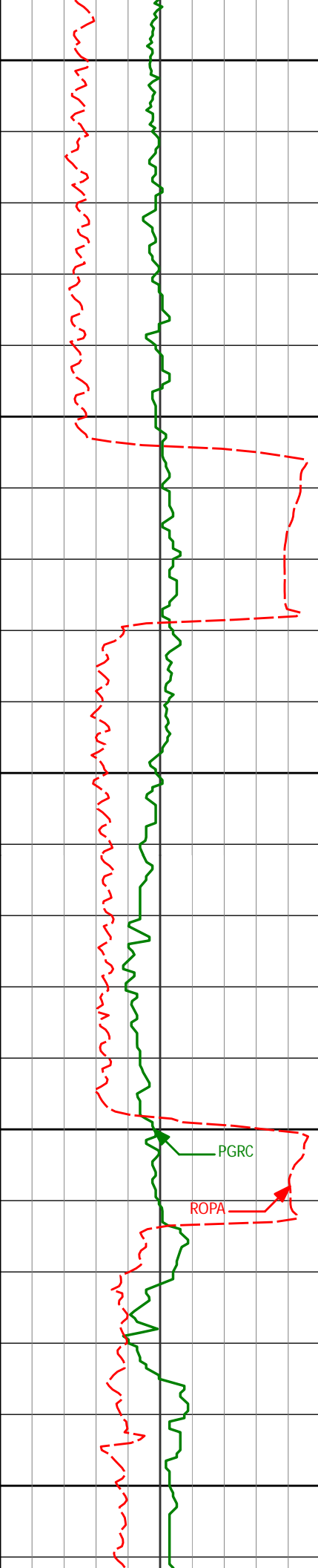
90.43°

87.22°

6588.09'

3422.38'

9800



9850

9900

9950

10000

10050

9937'

90.34°

88.58°

6588.58'

3607.50'

10031'

90.55°

89.33°

6587.85'

3698.66'

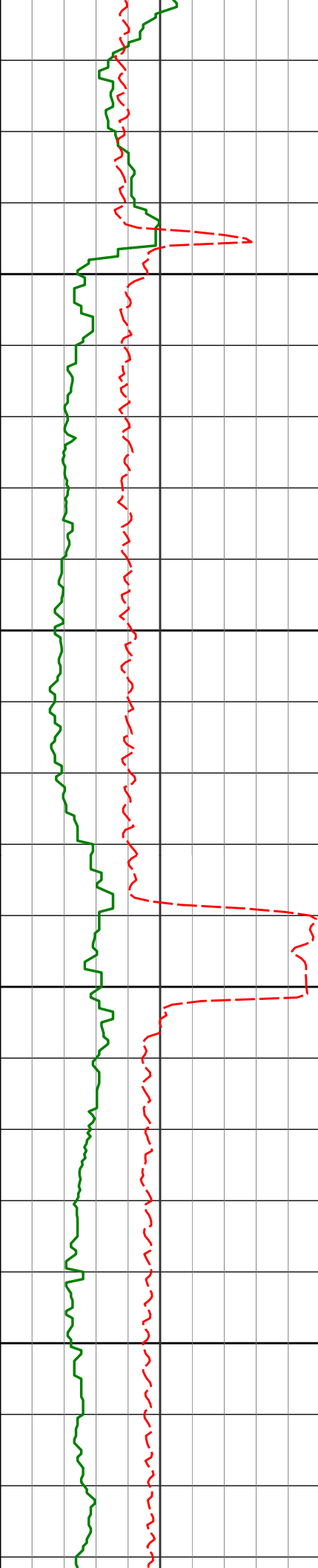
9842'

89.32°

87.80°

6588.30'

3515.07'



10100

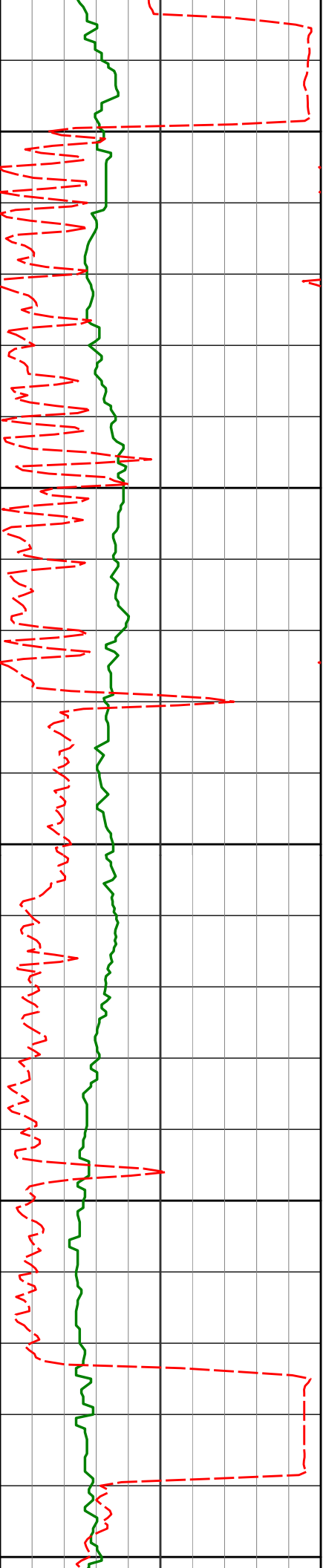
10126'      91.02°      88.55°      6586.55'      3790.80'

10150

10200

10221'      91.11°      89.46°      6584.78'      3882.89'

10250



10300

10316'

90.12°

89.38°

6583.77'

3974.83'

10350

10400

10410'

90.28°

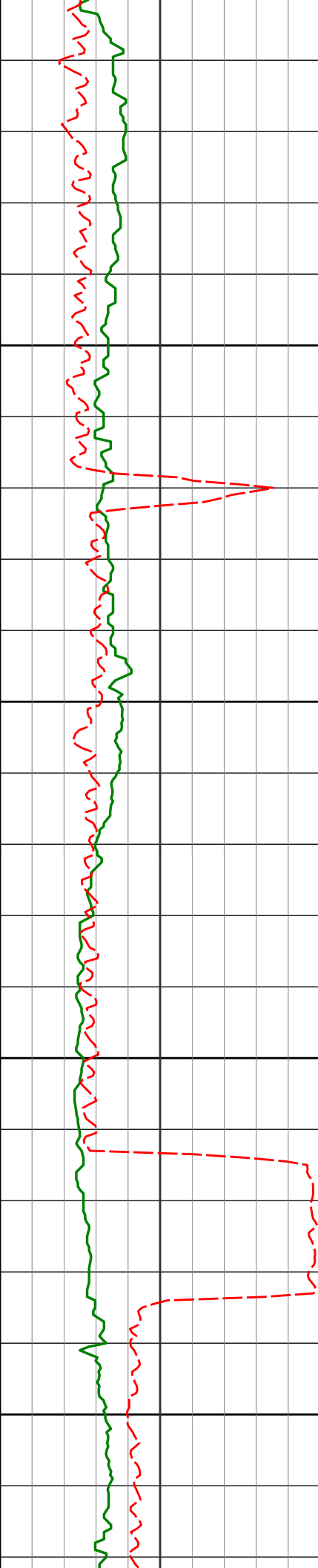
88.34°

6583.44'

4066.03'

10450

10500



10505'

90.25°

89.41°

6583.00'

4158.20'

10550

10600

10600'

92.38°

91.02°

6580.82'

4249.77'

10650

10700

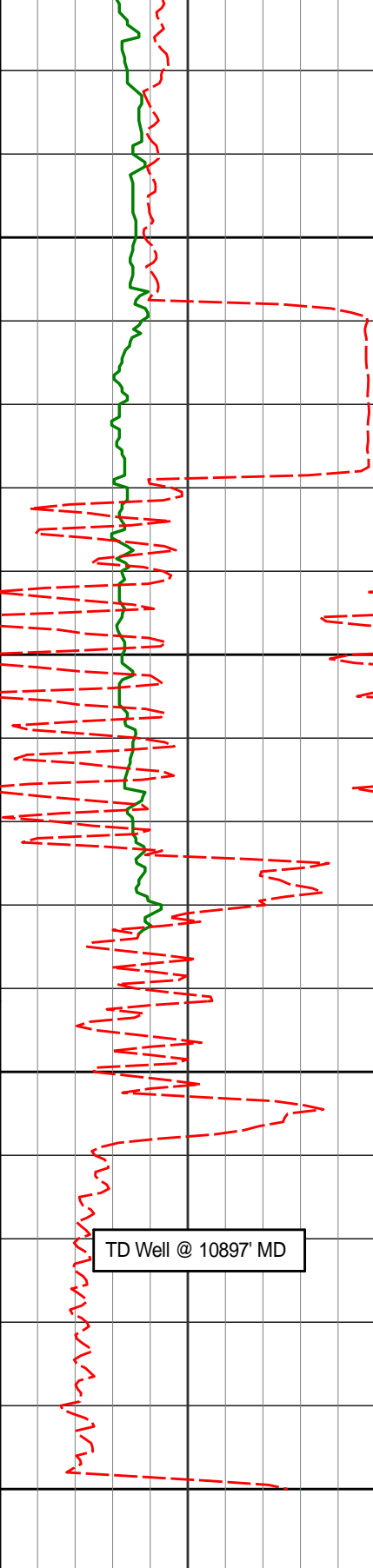
10694'

92.71°

90.34°

6576.64'

4340.12'



10750

10789'

91.20°

89.66°

6573.40'

4431.76'

10800

10833'

90.86°

89.06°

6572.61'

4474.35'

10850

10900

10897'

90.86°

89.06°

6571.65'

4536.38'

**Avg Rate of Penetration**

ROPA

feet per hr

**PCG Gamma Ray**

PGRC

api

Depth  
ft

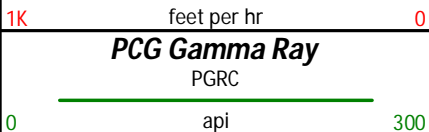
**Depth**

**Inc.**

**Azi.**

**TVD**

**V.S.**



# HALLIBURTON

## DIRECTIONAL SURVEY REPORT

Noble Energy  
Wells Ranch AE20-69HN  
Wattenburg  
Weld Colorado  
USA  
CA-XX-0900829265

<i>Measured Depth (feet)</i>	<i>Inclination (degrees)</i>	<i>Direction (degrees)</i>	<i>Vertical Depth (feet)</i>	<i>Latitude (feet)</i>	<i>Departure (feet)</i>	<i>Vertical Section (feet)</i>	<i>Dogleg (deg/100ft)</i>
0.00	0.00	0.00	0.00	0.00 N	0.00 E	0.00	TIE-IN
353.00	0.40	209.03	353.00	1.08 S	0.60 W	-0.86	0.11
660.00	0.60	306.23	659.99	1.06 S	2.41 W	-2.61	0.25
966.00	0.70	149.73	965.98	1.73 S	2.76 W	-3.12	0.42
1090.00	0.50	83.98	1089.98	2.33 S	1.84 W	-2.39	0.54
1182.00	0.57	121.97	1181.97	2.53 S	1.06 W	-1.68	0.39
1274.00	0.53	140.55	1273.97	3.10 S	0.40 W	-1.20	0.20
1367.00	0.53	169.93	1366.96	3.86 S	0.05 W	-1.06	0.29
1459.00	0.87	175.14	1458.96	4.97 S	0.08 E	-1.22	0.38
1554.00	1.12	71.87	1553.95	5.40 S	1.03 E	-0.42	1.65
1649.00	0.74	100.69	1648.94	5.23 S	2.51 E	1.06	0.62
1744.00	1.04	85.51	1743.93	5.27 S	3.97 E	2.46	0.40
1838.00	0.83	109.87	1837.91	5.44 S	5.46 E	3.85	0.47
1933.00	0.73	72.31	1932.91	5.49 S	6.69 E	5.02	0.54
2028.00	3.78	15.25	2027.83	2.28 S	8.09 E	7.21	3.62
2123.00	3.30	354.35	2122.65	3.46 N	8.64 E	9.25	1.44
2218.00	4.37	339.71	2217.44	9.58 N	7.12 E	9.38	1.52
2313.00	7.16	348.72	2311.95	18.78 N	4.71 E	9.45	3.08
2407.00	8.39	347.80	2405.08	31.23 N	2.11 E	10.20	1.32
2502.00	10.08	347.57	2498.85	46.12 N	1.14 W	10.95	1.78
2597.00	11.88	349.43	2592.11	63.86 N	4.73 W	12.13	1.93
2692.00	11.57	348.74	2685.12	82.81 N	8.38 W	13.55	0.36
2786.00	10.86	346.01	2777.33	100.65 N	12.36 W	14.37	0.94
2881.00	12.26	359.34	2870.42	119.42 N	14.64 W	17.08	3.16
2976.00	11.67	356.21	2963.35	139.10 N	15.39 W	21.49	0.92
3071.00	13.01	355.14	3056.16	159.34 N	16.94 W	25.30	1.43
3166.00	12.39	352.54	3148.83	180.10 N	19.16 W	28.57	0.89
3260.00	11.99	354.61	3240.71	199.82 N	21.39 W	31.57	0.63
3355.00	10.19	353.93	3333.94	218.00 N	23.21 W	34.57	1.90
3450.00	10.94	355.52	3427.32	235.35 N	24.80 W	37.57	0.85
3544.00	12.40	356.54	3519.38	254.31 N	26.11 W	41.27	1.57
3640.00	12.63	358.12	3613.10	275.09 N	27.07 W	45.76	0.43
3734.00	13.20	0.54	3704.72	296.10 N	27.31 W	51.02	0.84
3829.00	13.38	353.94	3797.18	317.87 N	28.37 W	55.70	1.61
3924.00	14.06	352.97	3889.47	340.26 N	30.94 W	59.06	0.76
4019.00	13.13	357.02	3981.81	362.49 N	32.91 W	62.97	1.40
4114.00	10.98	0.30	4074.71	382.31 N	33.43 W	67.65	2.37
4209.00	10.40	359.81	4168.06	399.93 N	33.41 W	72.28	0.62
4304.00	11.76	0.68	4261.29	418.19 N	33.32 W	77.13	1.44
4399.00	12.29	358.60	4354.20	437.98 N	33.45 W	82.17	0.72
4493.00	12.65	347.84	4446.00	458.04 N	35.87 W	85.09	2.50
4588.00	11.30	346.58	4538.93	477.27 N	40.22 W	85.91	1.45
4683.00	11.93	357.61	4632.00	496.13 N	42.79 W	88.36	2.43
4778.00	12.61	356.78	4724.82	516.30 N	43.78 W	92.68	0.74
4873.00	11.26	355.01	4817.77	535.89 N	45.17 W	96.46	1.47
4968.00	11.39	355.57	4910.92	554.48 N	46.70 W	99.84	0.18
5062.00	13.20	358.09	5002.76	574.47 N	47.77 W	104.02	2.01
5157.00	11.39	356.55	5095.58	594.67 N	48.70 W	108.41	1.94
5252.00	10.63	359.95	5188.83	612.80 N	49.27 W	112.59	1.05
5347.00	11.06	355.23	5282.13	630.64 N	50.04 W	116.52	1.04
5442.00	12.37	359.59	5375.16	649.90 N	50.87 W	120.75	1.66
5536.00	11.79	355.71	5467.07	669.55 N	51.66 W	125.12	1.06
5631.00	11.90	351.53	5560.05	688.91 N	53.83 W	128.09	0.91
5726.00	12.96	355.01	5652.83	709.21 N	56.20 W	131.11	1.37
5836.00	10.50	357.55	5760.52	731.52 N	57.70 W	135.49	2.28
5914.00	11.58	1.92	5837.08	746.44 N	57.74 W	139.35	1.75

5962.00	14.29	1.87	5883.86	757.18 N	57.39 W	142.50	5.65
6009.00	19.54	1.57	5928.81	770.85 N	56.98 W	146.46	11.17
6057.00	22.61	1.04	5973.59	788.10 N	56.59 W	151.34	6.41
6104.00	26.85	6.13	6016.28	807.70 N	55.30 W	157.72	10.09
6152.00	28.90	16.18	6058.73	829.63 N	50.90 W	167.69	10.67
6198.00	29.48	25.40	6098.91	850.54 N	42.95 W	180.83	9.85
6246.00	29.12	30.79	6140.77	871.25 N	31.90 W	196.91	5.54
6293.00	29.15	35.75	6181.83	890.36 N	19.36 W	214.01	5.14
6341.00	30.80	40.95	6223.42	909.14 N	4.47 W	233.29	6.41
6388.00	33.53	45.05	6263.21	927.40 N	12.61 E	254.55	7.43
6436.00	37.52	50.54	6302.27	946.07 N	33.29 E	279.39	10.64
6483.00	41.45	58.39	6338.56	963.34 N	57.61 E	307.38	13.50
6531.00	45.83	66.81	6373.32	978.46 N	87.01 E	339.70	15.15
6578.00	49.04	71.25	6405.12	990.81 N	119.32 E	374.12	9.75
6626.00	52.48	72.37	6435.48	1002.41 N	154.64 E	411.24	7.39
6672.00	55.54	71.96	6462.51	1013.81 N	190.06 E	448.41	6.69
6720.00	58.51	73.50	6488.63	1025.75 N	228.51 E	488.65	6.75
6767.00	61.55	75.62	6512.11	1036.58 N	267.75 E	529.35	7.56
6815.00	66.52	77.98	6533.12	1046.41 N	309.76 E	572.47	11.26
6862.00	72.51	80.17	6549.56	1054.73 N	352.97 E	616.35	13.47
6910.00	75.58	81.99	6562.75	1061.88 N	398.55 E	662.22	7.36
6957.00	78.54	85.73	6573.28	1066.77 N	444.08 E	707.45	9.99
7013.00	83.06	88.42	6582.23	1069.58 N	499.27 E	761.45	9.36
7093.00	88.37	86.20	6588.21	1073.33 N	578.93 E	839.32	7.19
7187.00	89.41	88.34	6590.03	1077.81 N	672.79 E	931.09	2.53
7282.00	91.48	87.99	6589.29	1080.85 N	767.74 E	1023.53	2.21
7377.00	90.65	88.48	6587.53	1083.77 N	862.68 E	1115.93	1.01
7472.00	89.94	88.82	6587.04	1086.01 N	957.65 E	1208.19	0.83
7567.00	89.72	88.87	6587.32	1087.93 N	1052.63 E	1300.37	0.24
7661.00	90.06	88.27	6587.50	1090.27 N	1146.60 E	1391.69	0.73
7756.00	89.23	87.94	6588.09	1093.41 N	1241.54 E	1484.15	0.94
7851.00	88.55	87.77	6589.93	1096.97 N	1336.46 E	1576.70	0.74
7945.00	88.95	87.61	6591.98	1100.76 N	1430.36 E	1668.33	0.46
8040.00	89.82	87.38	6593.00	1104.91 N	1525.26 E	1761.02	0.95
8135.00	92.19	89.59	6591.33	1107.42 N	1620.20 E	1853.31	3.41
8230.00	91.35	88.27	6588.40	1109.19 N	1715.14 E	1945.41	1.65
8325.00	90.71	87.41	6586.69	1112.77 N	1810.05 E	2037.96	1.13
8420.00	89.10	87.78	6586.85	1116.76 N	1904.96 E	2130.62	1.74
8514.00	89.72	89.10	6587.82	1119.32 N	1998.92 E	2221.98	1.55
8609.00	89.97	88.35	6588.08	1121.43 N	2093.90 E	2314.21	0.83
8704.00	91.57	89.36	6586.80	1123.33 N	2188.87 E	2406.37	1.99
8799.00	90.37	88.30	6585.19	1125.27 N	2283.83 E	2498.54	1.69
8894.00	89.11	85.08	6585.62	1130.75 N	2378.66 E	2591.50	3.64
8989.00	90.28	87.30	6586.13	1137.07 N	2473.44 E	2684.64	2.64
9083.00	91.20	88.53	6584.91	1140.49 N	2567.36 E	2776.20	1.63
9178.00	90.46	87.27	6583.54	1143.97 N	2662.29 E	2868.73	1.54
9273.00	89.35	89.03	6583.69	1147.03 N	2757.23 E	2961.18	2.19
9368.00	87.93	88.72	6585.95	1148.90 N	2852.18 E	3053.32	1.53
9463.00	88.95	88.88	6588.54	1150.89 N	2947.13 E	3145.48	1.09
9558.00	90.46	88.16	6589.02	1153.34 N	3042.09 E	3237.79	1.76
9652.00	90.12	86.79	6588.55	1157.48 N	3136.00 E	3329.51	1.50
9747.00	90.43	87.22	6588.09	1162.44 N	3230.87 E	3422.38	0.56
9842.00	89.32	87.80	6588.30	1166.57 N	3325.77 E	3515.07	1.32
9937.00	90.34	88.58	6588.58	1169.57 N	3420.72 E	3607.50	1.35
10031.00	90.55	89.33	6587.85	1171.29 N	3514.70 E	3698.66	0.83
10126.00	91.02	88.55	6586.55	1173.04 N	3609.68 E	3790.80	0.96
10221.00	91.11	89.46	6584.78	1174.69 N	3704.65 E	3882.89	0.96
10316.00	90.12	89.38	6583.77	1175.66 N	3799.63 E	3974.83	1.05
10410.00	90.28	88.34	6583.44	1177.53 N	3893.61 E	4066.03	1.12
10505.00	90.25	89.41	6583.00	1179.39 N	3988.59 E	4158.20	1.13
10600.00	92.38	91.02	6580.82	1179.03 N	4083.56 E	4249.77	2.81
10694.00	92.71	90.34	6576.64	1177.92 N	4177.46 E	4340.12	0.80
10789.00	91.20	89.66	6573.40	1177.92 N	4272.40 E	4431.76	1.74
10833.00	90.86	89.06	6572.61	1178.41 N	4316.39 E	4474.35	1.57
10897.00	90.86	89.06	6571.65	1179.46 N	4380.37 E	4536.38	0.00

**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 74.85 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 10897.00 FEET  
IS 4536.39 FEET ALONG 74.93 DEGREES (GRID)

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

Depth 353 Inc 0.40 Azi 209.03

Depth 660 Inc 0.60 Azi 306.23

Depth 966 Inc 0.70 Azi 149.73

Tied in @ Surface

Magnetic direction of 7.63 has been added to AZI for grid direction correction.

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