

**PCGK - Pressure Case Gamma**

1:240 / 1:600

[illegible]

## WELL INFORMATION

<b>MWD Run Number</b>	100	200			
<b>Date run completed</b>	22-Feb-13	23-Feb-13			
<b>Rig Bit Number</b>	2	3			
<b>Bit Size (in)</b>	8.750	8.750			
<b>Tool Nominal OD (in)</b>	6.500	6.750			
<b>Log Start Depth (TVD, ft)</b>	642.00	6,193.59			
<b>Log End Depth (TVD, ft)</b>	6,193.59	6,997.81			
<b>Drill or Wipe</b>	Drill	Drill			
<b>Drill/Wipe Start Date and Time</b>	21-Feb-13 03:38	22-Feb-13 11:30			
<b>Drill/Wipe End Date and Time</b>	22-Feb-13 01:27	23-Feb-13 07:36			
<b>Min Inc (deg) @ Depth (TVD, ft)</b>	.10 @ 1,454.99	10.40 @ 6,259.48			
<b>Max Inc (deg) @ Depth (TVD, ft)</b>	13.39 @ 6,075.23	82.53 @ 6,992.11			
<b>Bit TFA(in2) / Bit Type</b>	.75 / PDC	.86 / N/A			
<b>Flow Rate (gpm)</b>	587.67	568.62			
<b>Max AV (fpm) / CV (fpm) @ MWD</b>	N/A / N/A	484.9 / N/A			
<b>Fluid Type</b>	Fresh Water Gel	Fresh Water Gel			
<b>Density (ppg) / Viscosity (spqt)</b>	8.55 / 30.00	9.60 / 44.00			
<b>Filtrate CL (ppm)</b>	2,400.00	2,500.00			
<b>pH / Fluid Loss (mptm)</b>	8.20 / 17	9.70 / 9			
<b>PV (cP) / YP (lhf2)</b>	5 / 1.00	13 / 15.00			
<b>% Solids / % Sand</b>	4.50 / 0.23	6.50 / 0.40			
<b>% Oil / Oil:Water Ratio</b>	N/A / N/A	N/A / N/A			
<b>Rm @ Measured Temp (degF)</b>	N/A @ N/A	N/A @ N/A			
<b>Rmf @ Measured Temp (degF)</b>	N/A @ N/A	N/A @ N/A			
<b>Rmc @ Measured Temp (degF)</b>	N/A @ N/A	N/A @ N/A			
<b>Max Tool Temp (degF) / Source</b>	141.70 / PCM	171.20 / PCM			
<b>Rm @ Max Tool Temp (degF)</b>	N/A @ 141.70	N/A @ 171.20			
<b>Lead MWD Engineer</b>	Kyle Wass	Kyle Wass			
<b>Customer Representative</b>	Jim Turner	Jim Turner			

SENSOR INFORMATION

Downhole Processor Information

Tool Type	PCM	PCM			
Software Version	5.76	5.76			
Sub Serial Number	11341332	11341332			
Insert Serial Number	11400838	11400838			
Date and Time Initialized	19-Feb-13 14:46	19-Feb-13 14:46			
Date and Time Read	23-Jan-13 12:31	23-Feb-13 12:31			
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	11341332	11341332			
Sonde Serial Number	400925	400925			
Sensor ID Number	N/A	N/A			
Toolface Offset (deg)	274.49	94.65			

Gamma Ray Sensor Information

Tool Type	PCG	PCG			
Distance From Bit (ft)	50.74	47.79			
Recorded Sample Period (sec)	10	10			
Software Version	8.15	8.15			
Sub Serial Number	11341332	11341332			
Insert/Sonde Serial Number	11293307	11293307			

REMARKS

<div>1. All depths are calibrated to driller's pipe tally and are true vertical depth from the Drill Floor.</div> <div>2. No depth corrections have been made for pipe stretch or compression.</div> <div>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.</div> <div>4. All data presented is recorded data unless otherwise specified.</div> <div>5. The following smoothing parameters have been applied to the data:  PGRC (Gamma CG): Interval Resolution: 0.5 ft Interval Distance: 0.6 ft Gap Fill: 3.0 ft  ROPA (Average Rate Of Penetration): Interval Resolution: 0.5 ft Interval Distance: 1.2 ft Gap Fill: 3.0 ft</div> <div>6. Insite Version 7.4.1</div>
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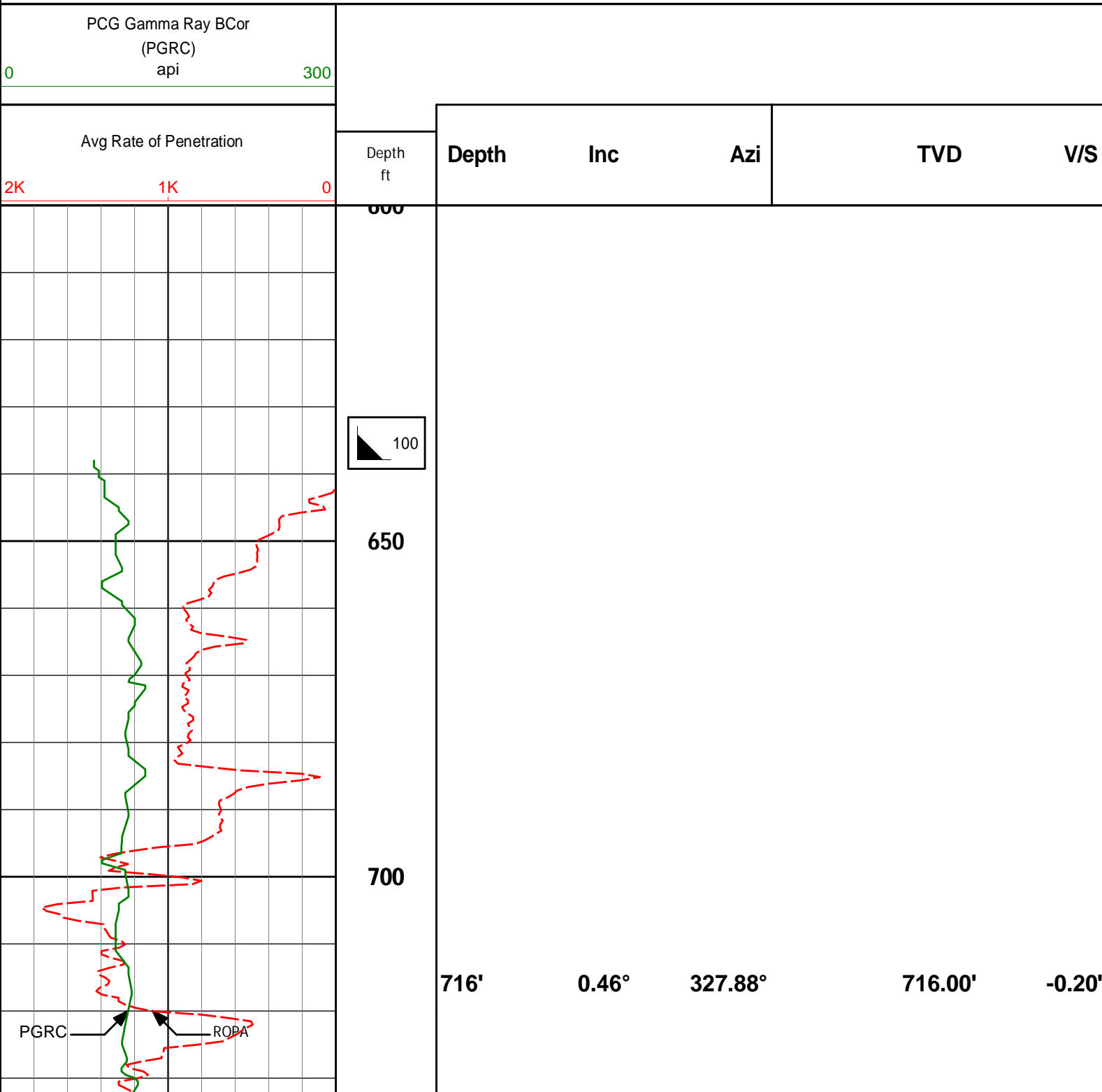
WARRANTY

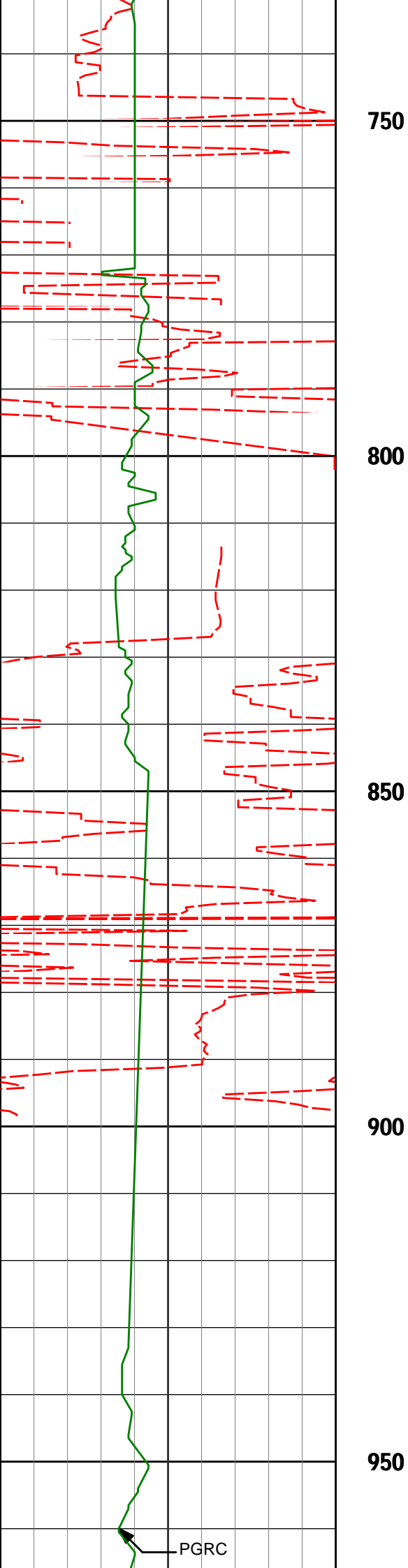
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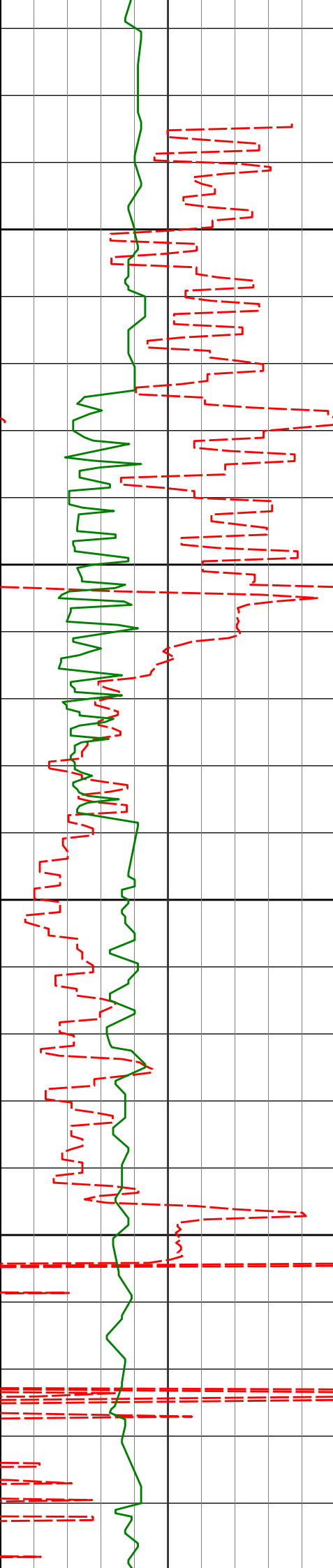
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**HALLIBURTON**  
**Sperry Drilling Services**  
**TVD Detail Log 1:240**

Noble Energy  
Knaub PC G04-64-1HN-A4  
HP 321  
T4N R65W







**1000**

**1050**

**1100**

**1150**

1200

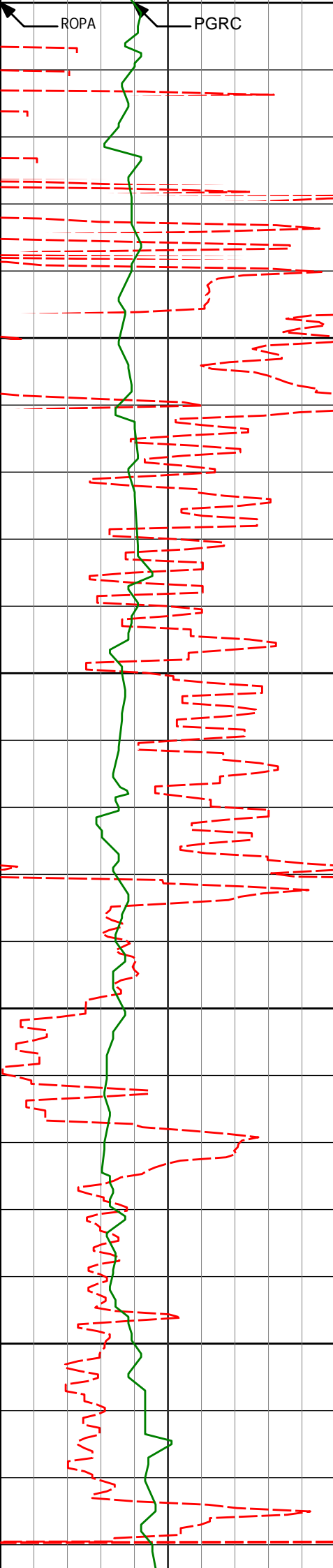
993'

**0.29°**

**50.31°**

**992.99'**

**-0.44'**



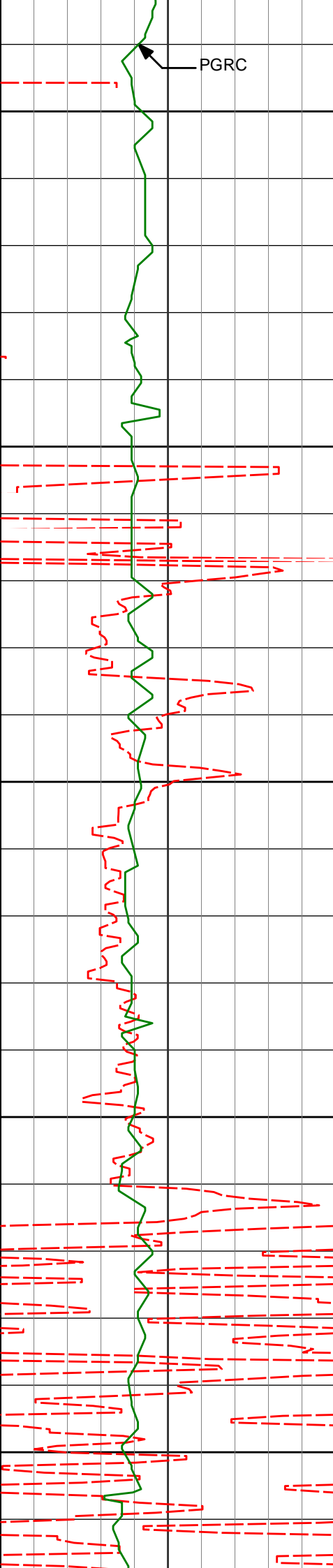
1269'

0.25°

71.45°

1268.99'

0.57'



1450

1455'

0.10°

86.80°

1454.99'

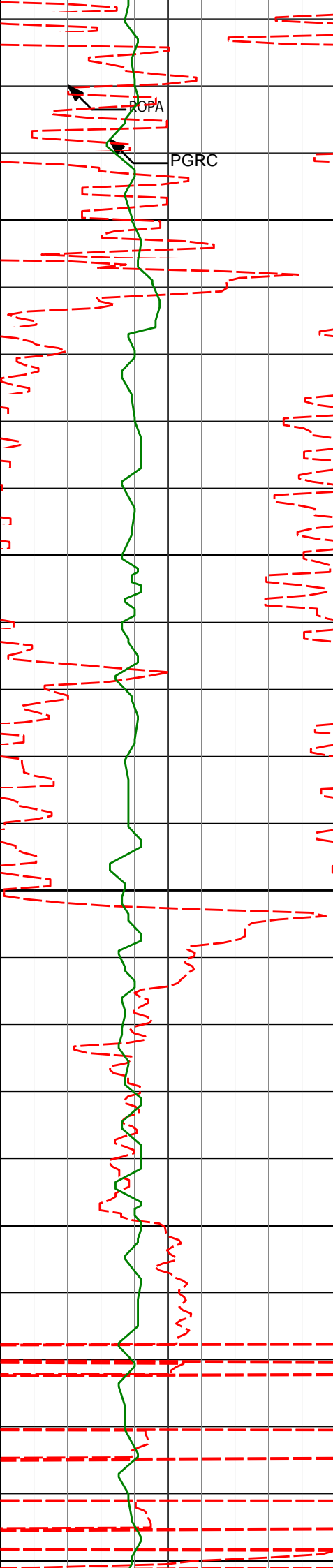
1.08'

1500

1550

1600

1650



1700

1750

1800

1850

1900

1739'

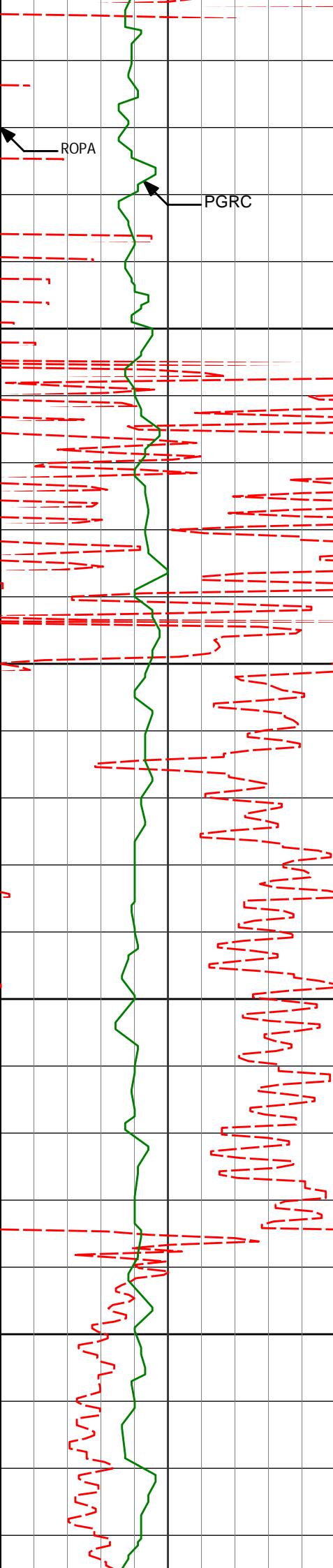
0.92°

284.78°

1738.98'

-0.94'





1900

1950

2000

2050

2100

ROPA

PGRC

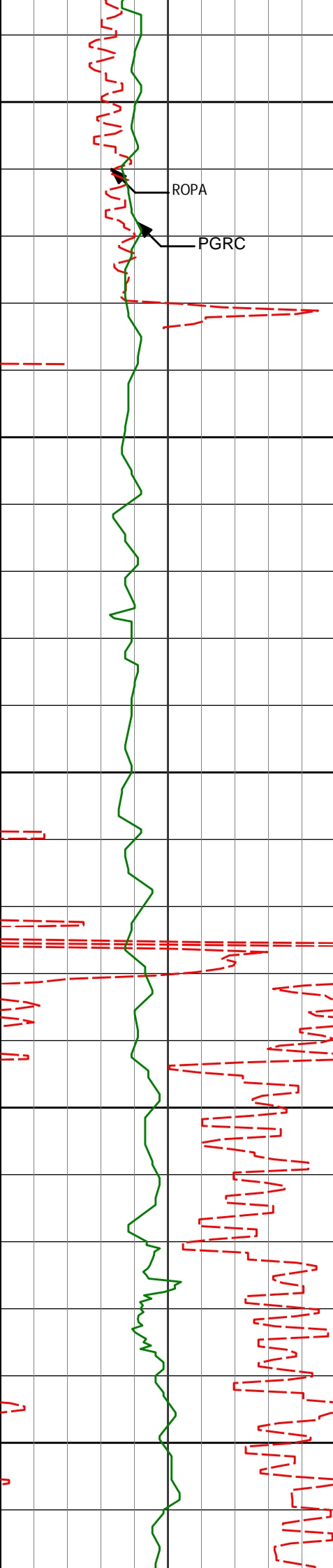
2024'

1.16°

262.59°

2023.93'

-5.99'



2150

ROPA

PGRC

2200

2250

2300

2350

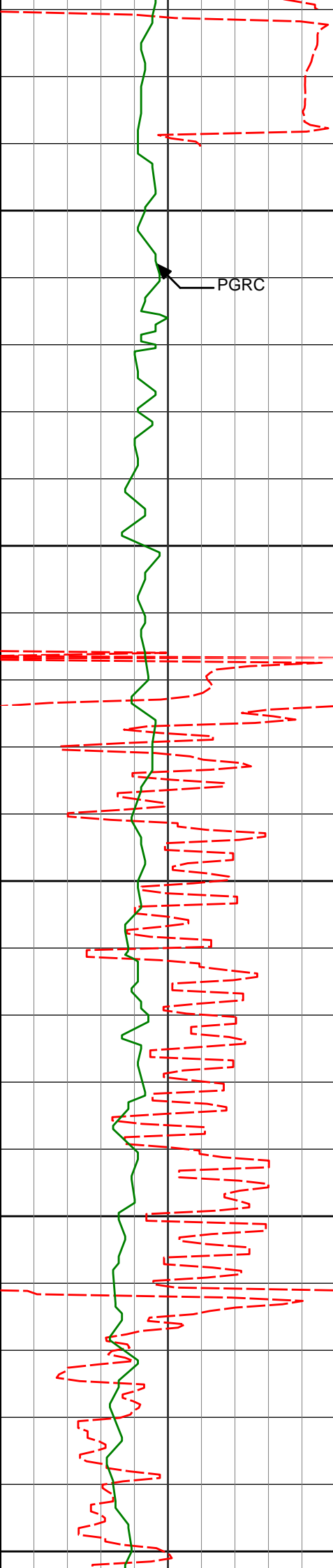
2309'

1.48°

236.32°

2308.86'

-11.51'



2400

2404'

0.57°

348.78°

2403.85'

-12.58'

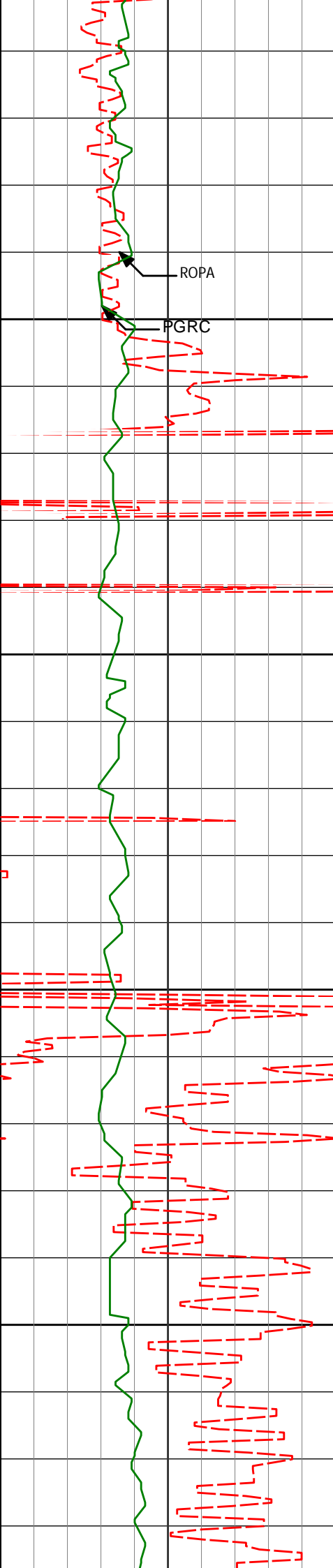
PGRC

2450

2500

2550

2600



ROPA

PGRC

2650

2700

2750

2800

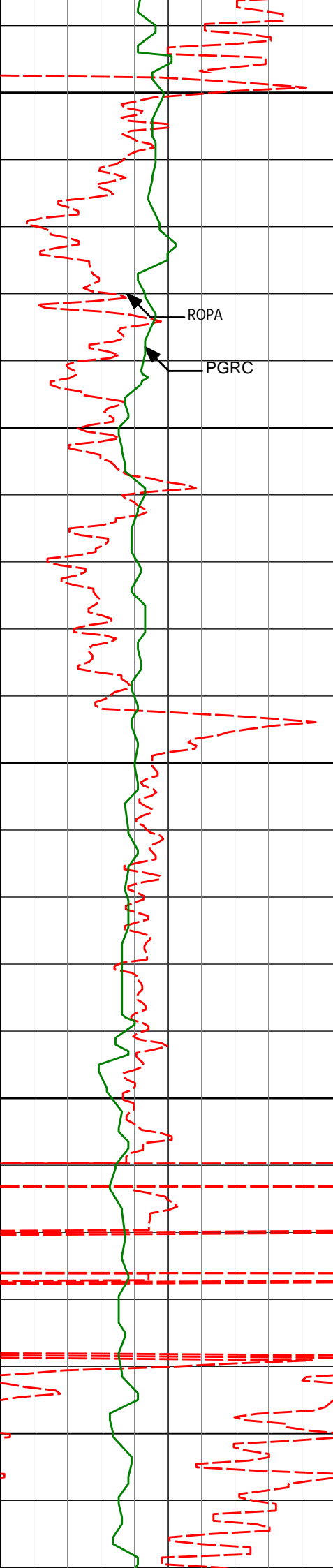
2688'

1.03°

309.92°

2687.82'

-15.21'



2850

ROPA

PGRC

2900

2950

3000

3050

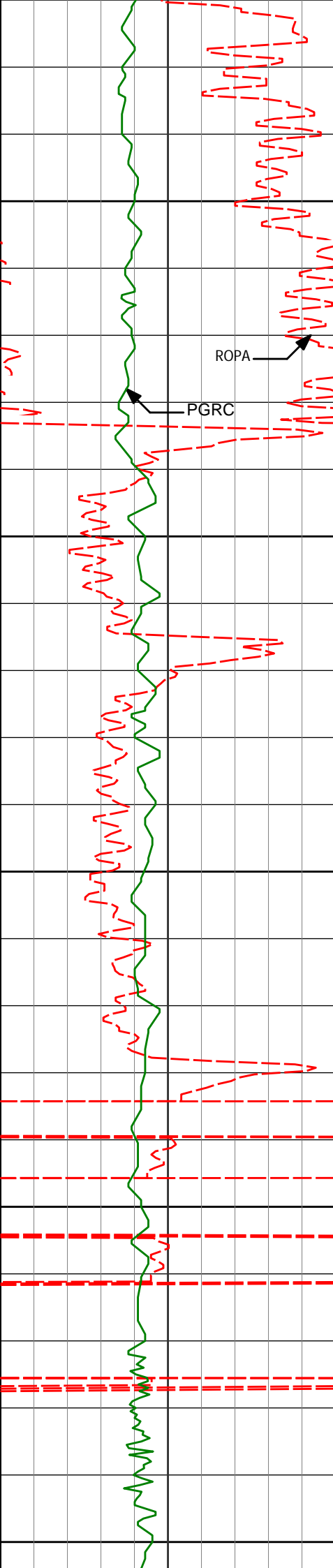
2973'

1.24°

275.60°

2972.77'

-20.44'



3100

ROPA

PGRC

3150

3200

3250

3300

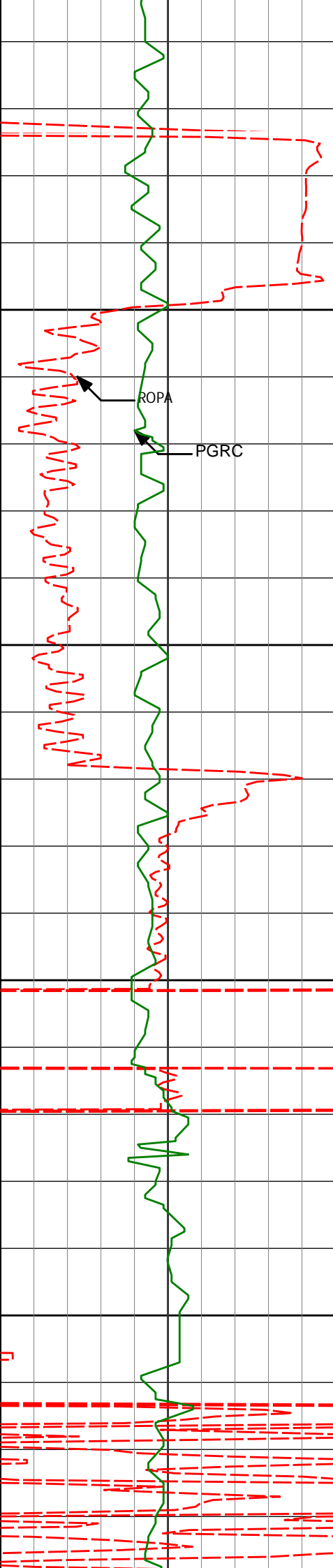
3258'

1.54°

264.08°

3257.69'

-27.24'



3350

3352'

0.83°

237.02°

3351.67'

-28.98'

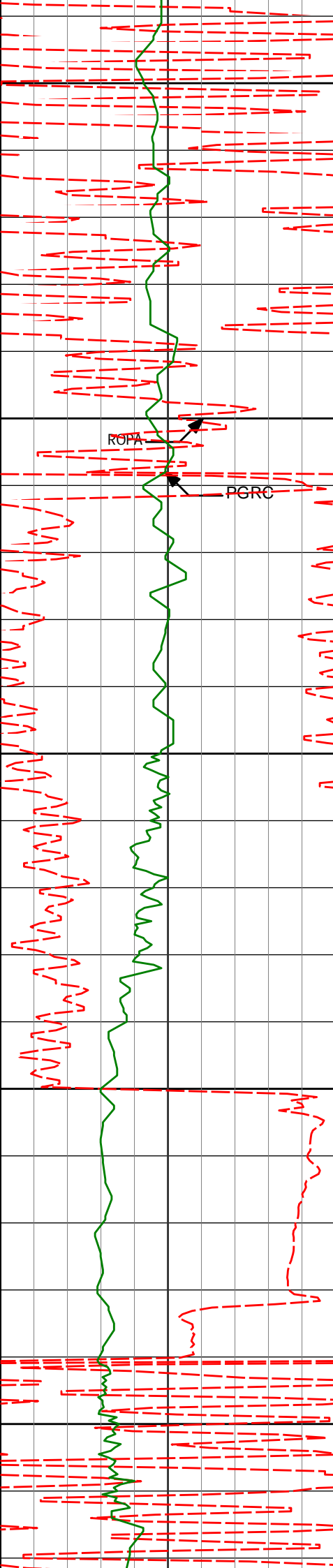
3400

3450

3500

ROPA

PGRC



3550

3600

ROPA

PGRC

3637'

1.77°

231.94°

3636.59'

-33.59'

3650

3700

3732'

1.23°

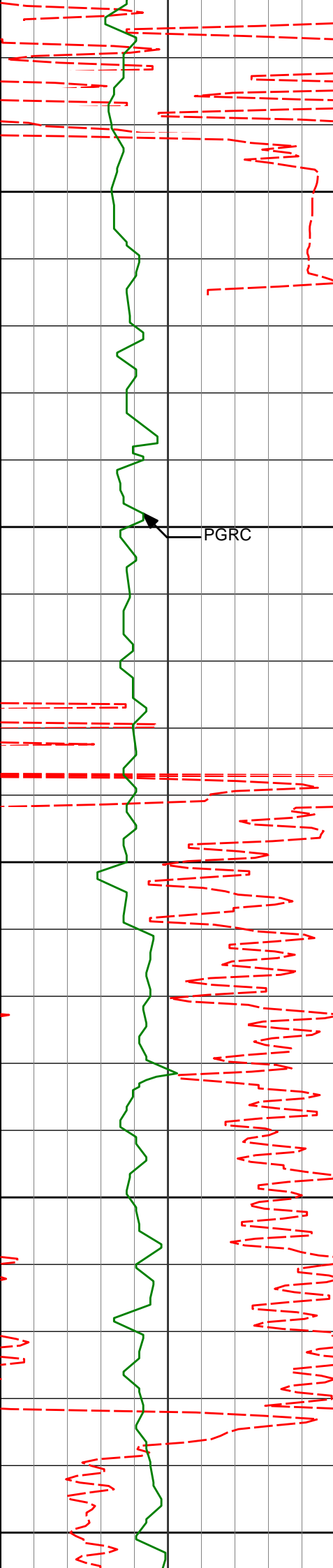
225.65°

3731.56'

-35.22'

3750





3800

3826'

1.28°

138.70°

3825.54'

-35.04'

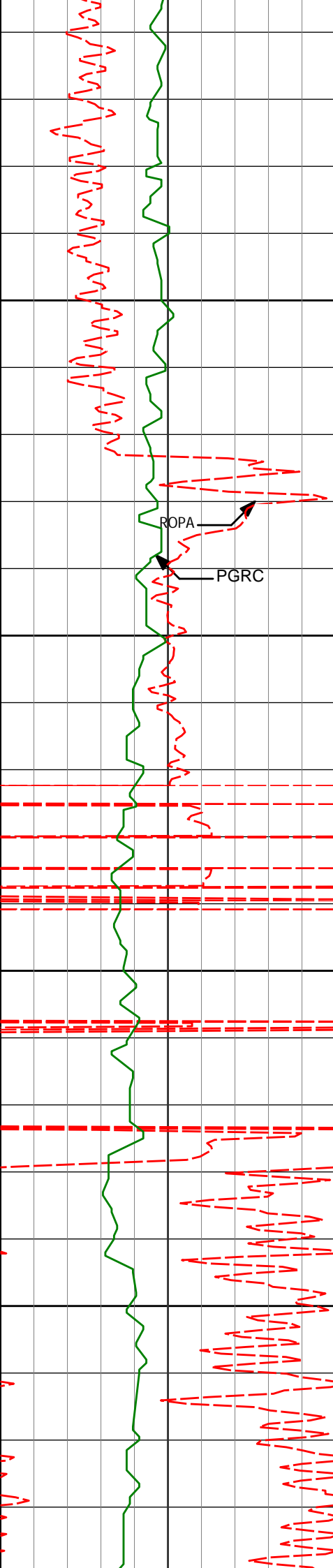
3850

PGRC

3900

3950

4000



4050

4100

4150

4200

ROPA

PGRC

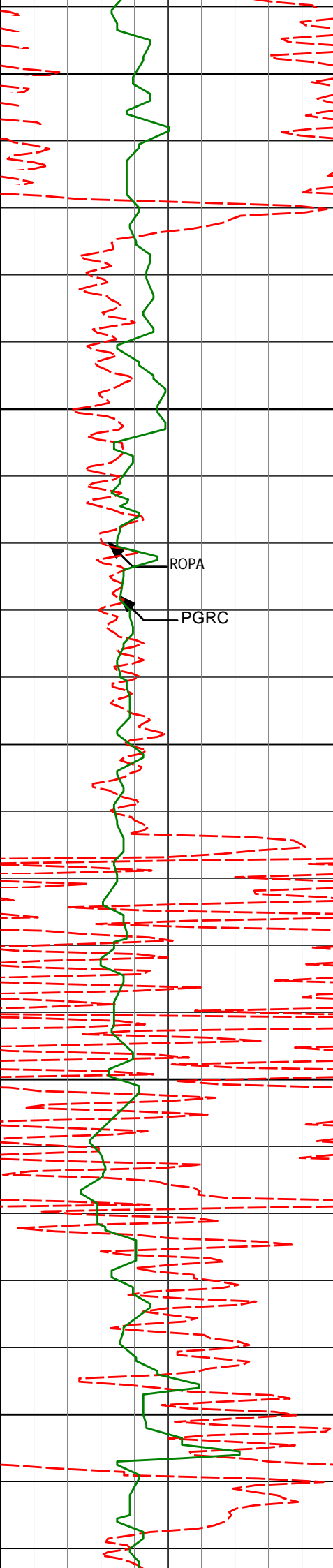
4111'

1.75°

111.92°

4110.45'

-28.40'



4250

4300

ROPA

PGRC

4350

4395'

2.29°

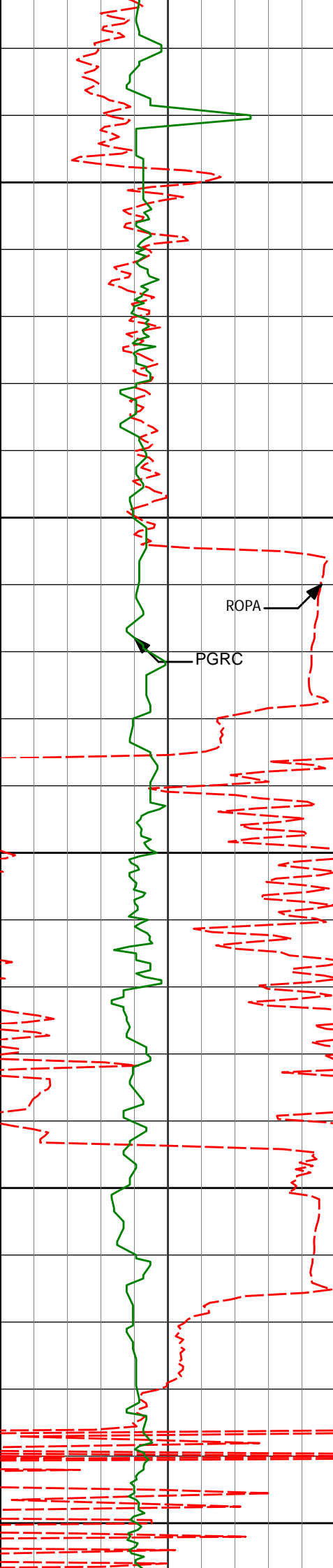
90.66°

4394.27'

-18.58'

4400

4450



4500

4550

4600

4650

4700

4490'

2.17°

69.40°

4489.20'

-15.12'

4585'

1.21°

152.14°

4584.17'

-12.96'

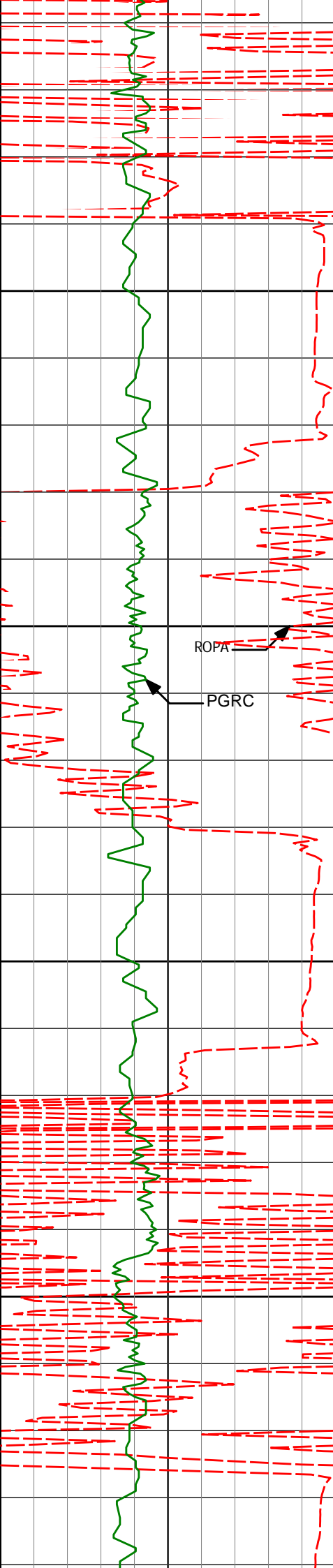
4680'

2.15°

181.00°

4679.13'

-12.15'



4750

4774'

3.97°

189.43°

4772.99'

-12.00'

4800

ROPA

PGRC

4850

4869'

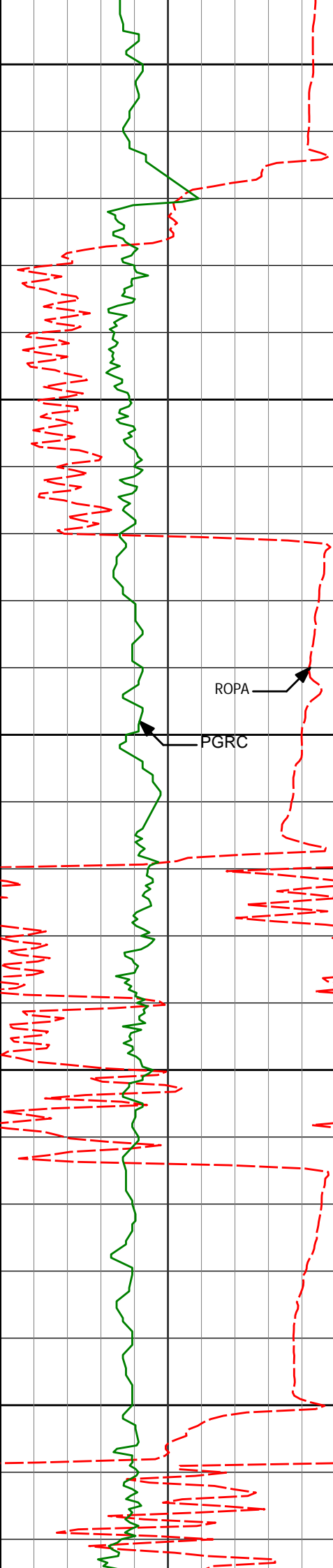
5.39°

195.07°

4867.67'

-12.62'

4900



4950

4964'

7.07°

202.54°

4962.11'

-14.62'

5000

ROPA

PGRC

5050

5059'

9.76°

205.15°

5056.08'

-18.45'

5100

5150

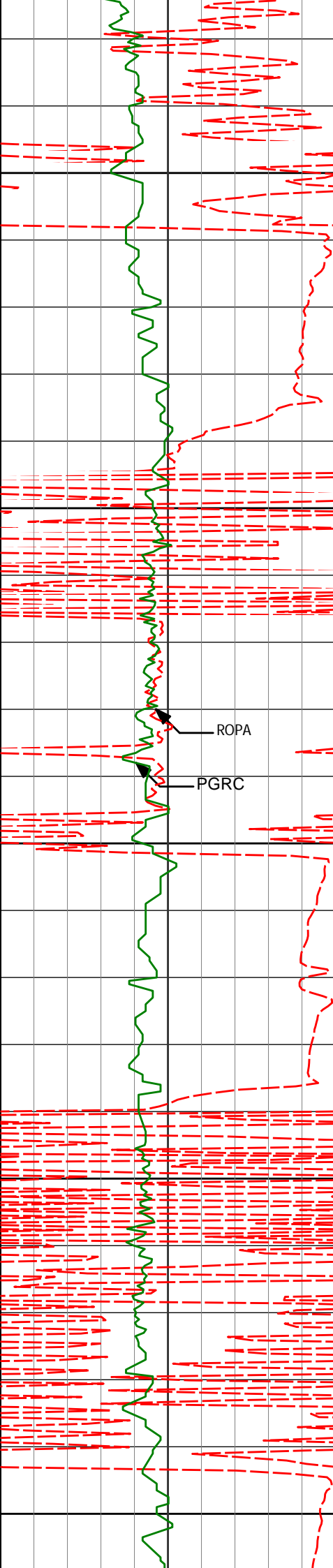
5153'

11.75°

209.51°

5148.42'

-24.28'



5200

5248'

11.59°

204.94°

5241.46'

-30.58'

5250

ROPA

PGRC

5300

5343'

12.19°

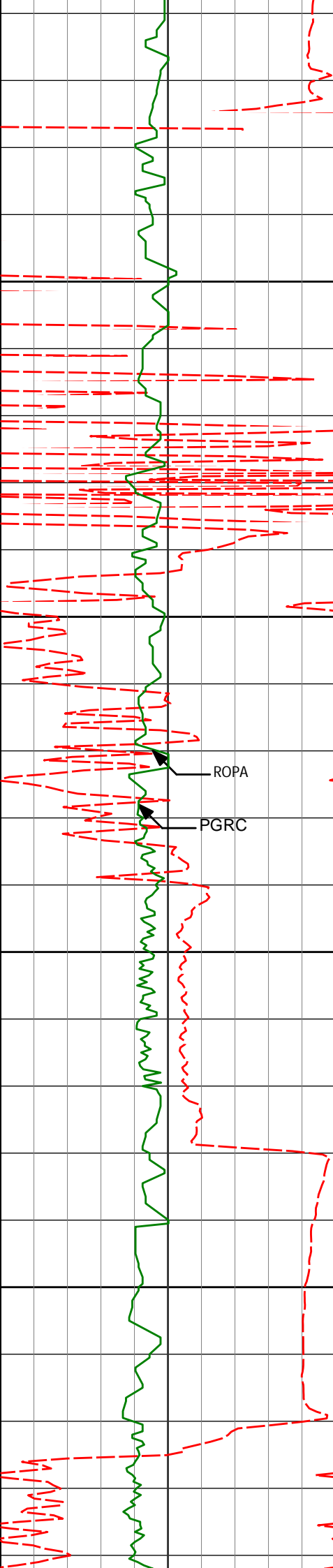
200.52°

5334.43'

-35.51'

5350

5400



5438'	13.17°	198.45°	5427.11'	-39.61'
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5450

5500

5532'	10.60°	194.85°	5519.09'	-42.56'
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ROPA

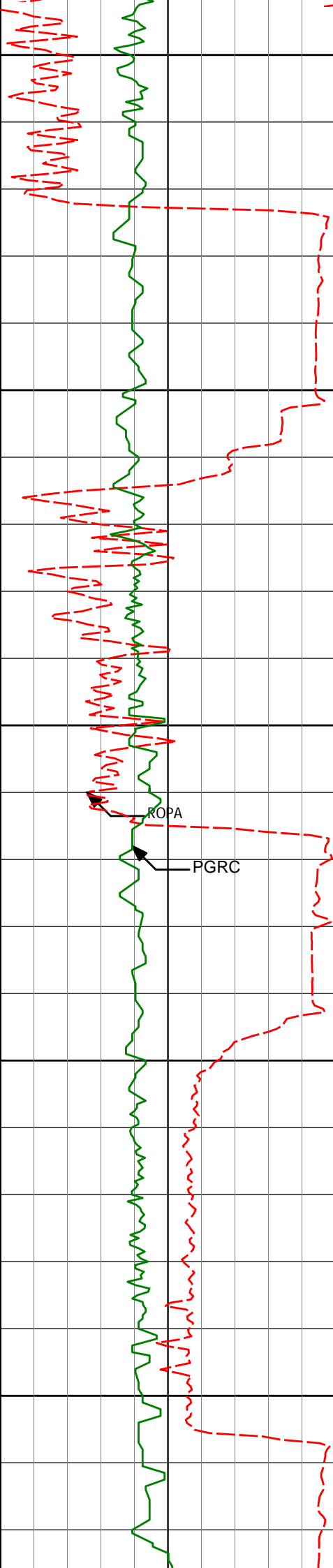
PGRC

5550

5600

5627'	12.56°	195.94°	5612.15'	-45.00'
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5650

5700

5750

5800

5850

5722'

12.91°

194.70°

5704.81'

-47.63'

ROPA

PGRC

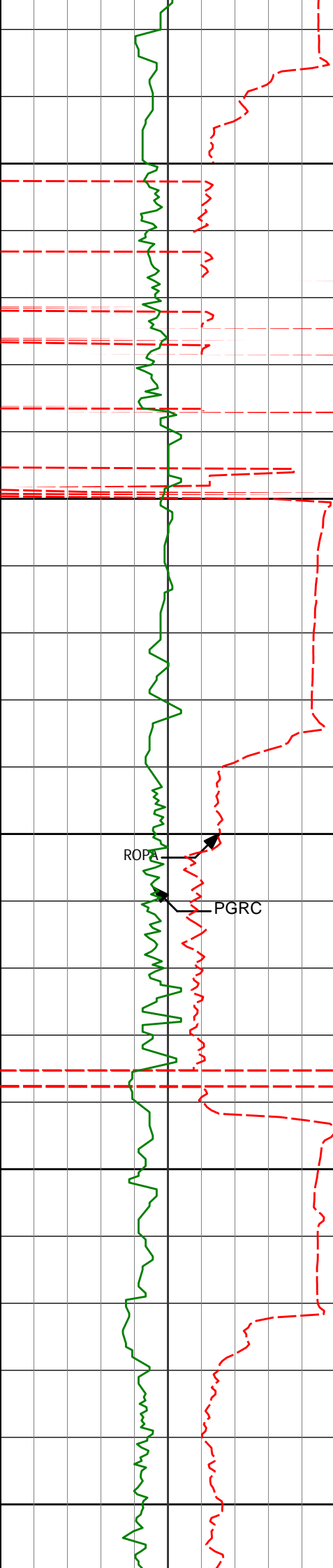
5817'

13.06°

193.01°

5797.38'

-49.77'



5900

5950

6000

6050

6100

5912'

12.56°

196.57°

5890.02'

-52.22'

6007'

12.81°

201.49°

5982.70'

-56.18'

6102'

13.39°

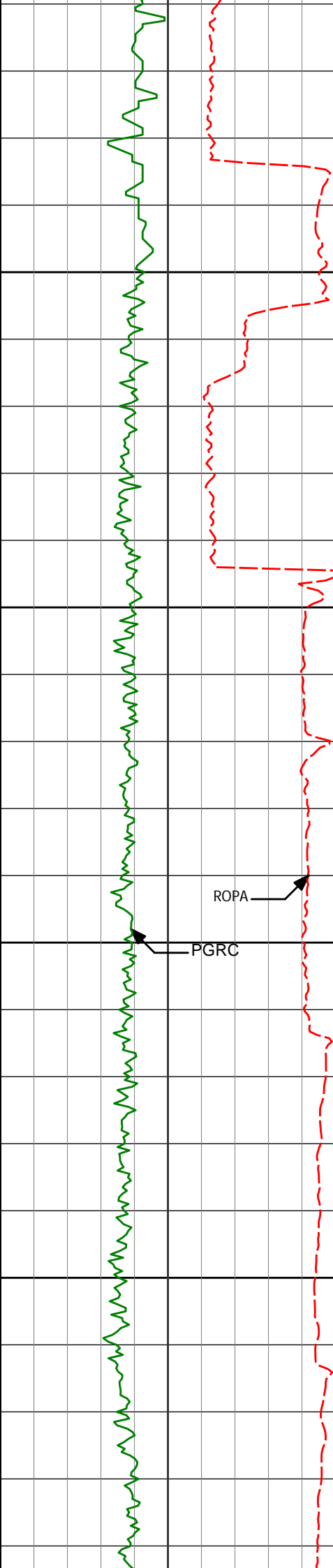
198.82°

6075.23'

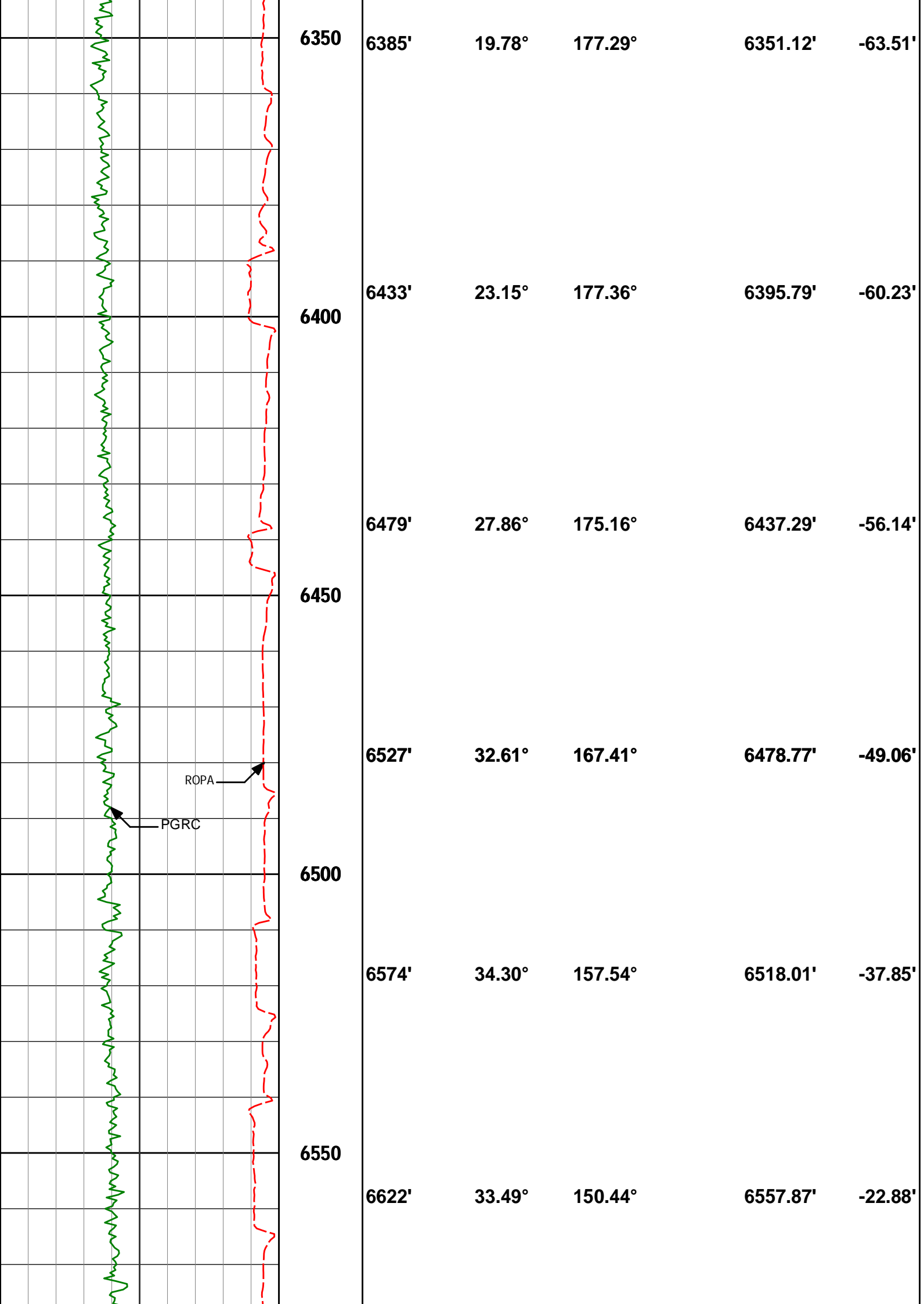
-60.67'

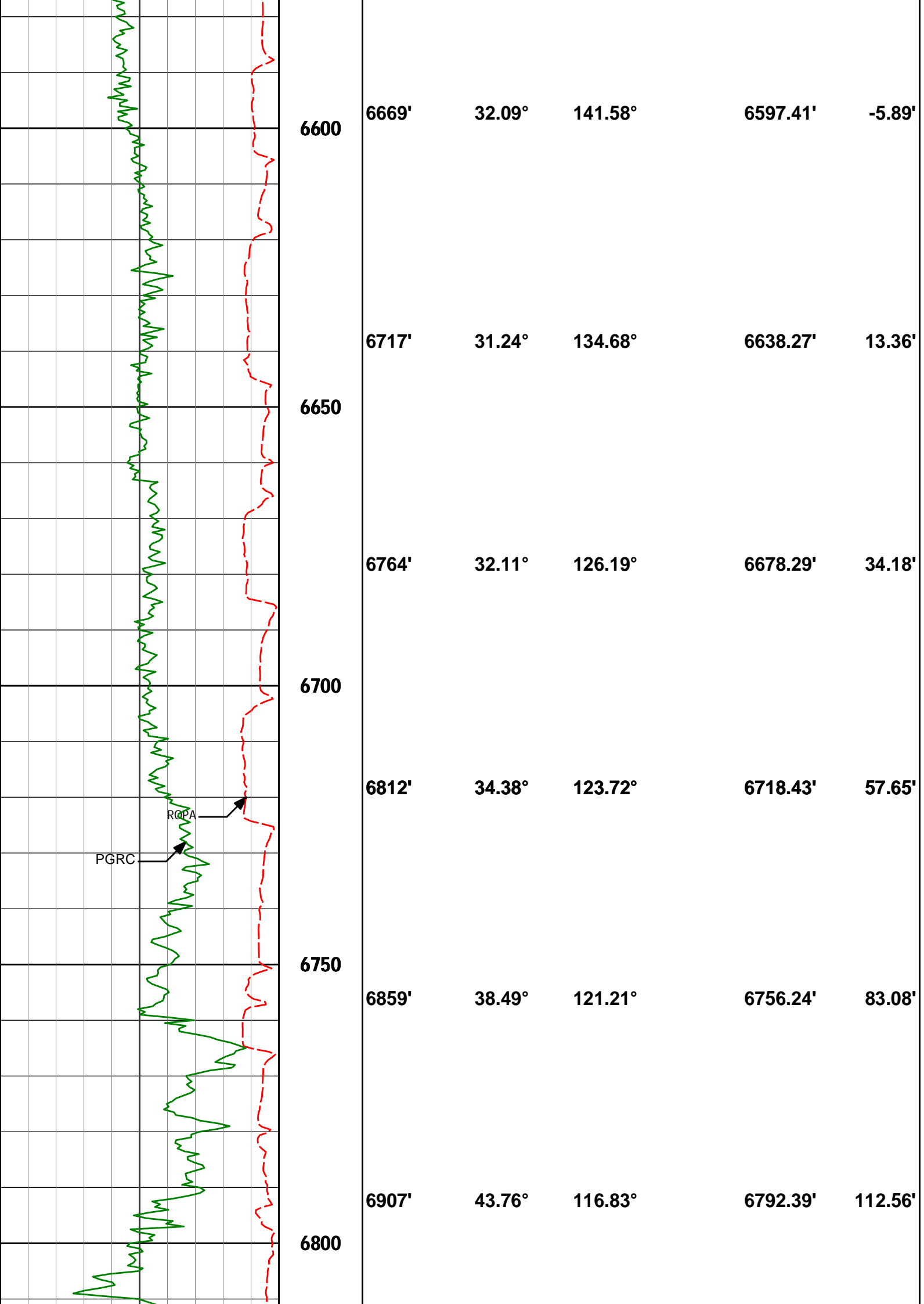
ROPE

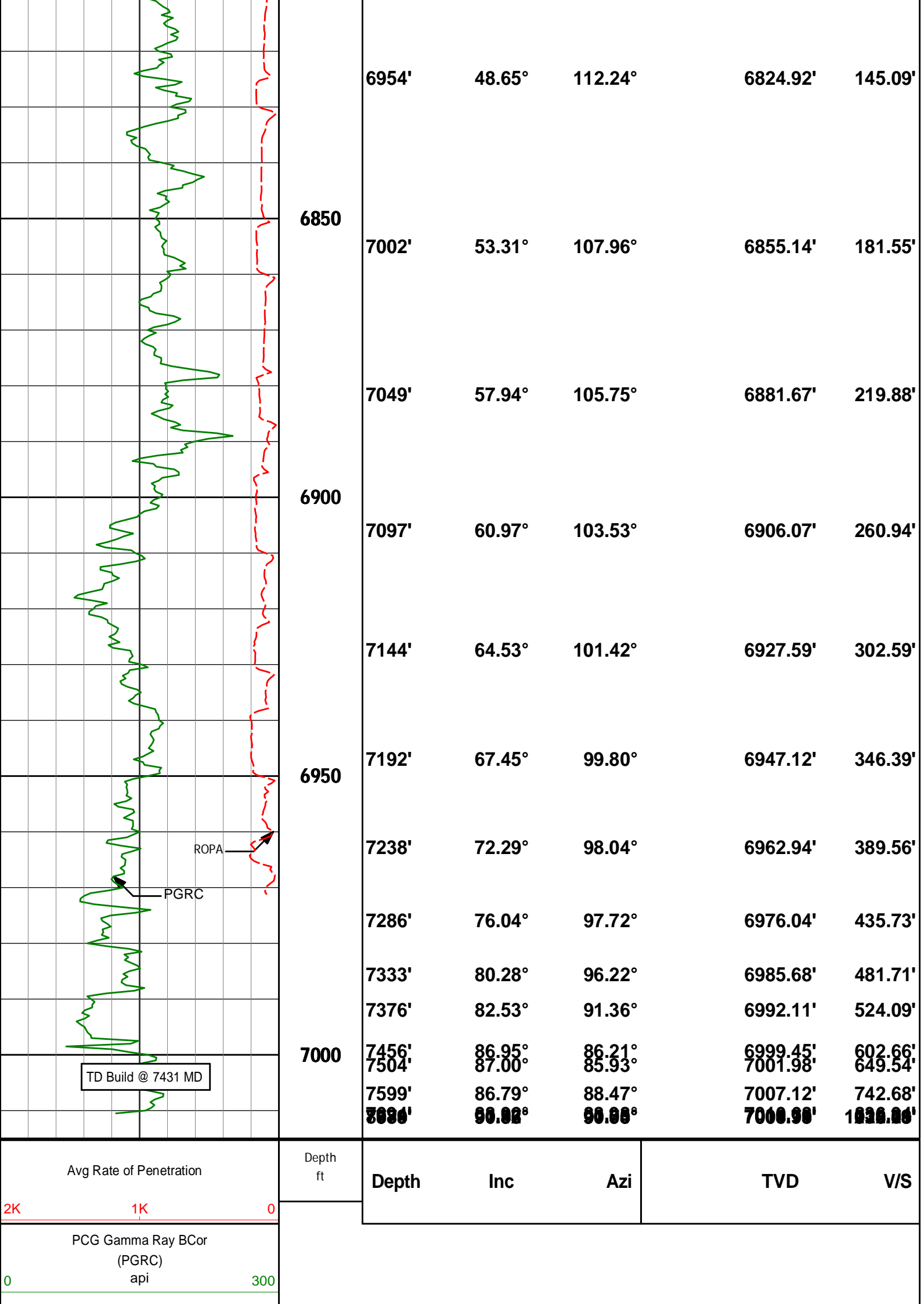
PGRC



6165'	11.81°	198.44°	6136.71'	-63.19'
6150				
6200				
6238'	10.45°	194.80°	6208.34'	-65.30'
200				
6250				
6290'	10.40°	190.79°	6259.48'	-66.08'
6300				
6338'	15.08°	182.16°	6306.29'	-65.64'









# HALLIBURTON

## DIRECTIONAL SURVEY REPORT

Noble Energy  
Knaub PC G04-64-1HN-A4  
Wattenburg  
Weld Colorado  
USA  
CA-XX-0900145816

<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>
637.00	0.00	0.00	637.00	0.00 N	0.00 E	0.00	TIE-IN
716.00	0.46	327.88	716.00	0.27 N	0.17 W	-0.20	0.58
993.00	0.29	50.31	992.99	1.65 N	0.21 W	-0.44	0.18
1269.00	0.25	71.45	1268.99	2.29 N	0.90 E	0.57	0.04
1455.00	0.10	86.80	1454.99	2.43 N	1.44 E	1.08	0.08
1739.00	0.92	284.78	1738.98	3.02 N	0.52 W	-0.94	0.36
2024.00	1.16	262.59	2023.93	3.23 N	5.59 W	-5.99	0.16
2309.00	1.48	236.32	2308.86	0.82 N	11.51 W	-11.51	0.24
2404.00	0.57	348.78	2403.85	0.60 N	12.62 W	-12.58	1.87
2688.00	1.03	309.92	2687.82	3.61 N	14.85 W	-15.21	0.24
2973.00	1.24	275.60	2972.77	5.54 N	19.86 W	-20.44	0.24
3258.00	1.54	264.08	3257.69	5.45 N	26.74 W	-27.24	0.14
3352.00	0.83	237.02	3351.67	4.95 N	28.57 W	-28.98	0.94
3637.00	1.77	231.94	3636.59	1.11 N	33.77 W	-33.59	0.33
3732.00	1.23	225.65	3731.56	0.51 S	35.65 W	-35.22	0.60
3826.00	1.28	138.70	3825.54	2.00 S	35.68 W	-35.04	1.83
4111.00	1.75	111.92	4110.45	6.01 S	29.54 W	-28.40	0.29
4395.00	2.29	90.66	4394.27	7.70 S	19.86 W	-18.58	0.32
4490.00	2.17	69.40	4489.20	7.09 S	16.28 W	-15.12	0.87
4585.00	1.21	152.14	4584.17	7.35 S	14.13 W	-12.96	2.47
4680.00	2.15	181.00	4679.13	10.02 S	13.69 W	-12.15	1.30
4774.00	3.97	189.43	4772.99	14.99 S	14.26 W	-12.00	1.99
4869.00	5.39	195.07	4867.67	22.54 S	15.95 W	-12.62	1.57
4964.00	7.07	202.54	4962.11	32.25 S	19.35 W	-14.62	1.96
5059.00	9.76	205.15	5056.08	44.94 S	25.02 W	-18.45	2.86
5153.00	11.75	209.51	5148.42	60.49 S	33.12 W	-24.28	2.29
5248.00	11.59	204.94	5241.46	77.57 S	41.92 W	-30.58	0.99
5343.00	12.19	200.52	5334.43	95.61 S	49.46 W	-35.51	1.14
5438.00	13.17	198.45	5427.11	115.27 S	56.39 W	-39.61	1.14
5532.00	10.60	194.85	5519.09	133.78 S	62.00 W	-42.56	2.85
5627.00	12.56	195.94	5612.15	152.16 S	67.08 W	-45.00	2.08
5722.00	12.91	194.70	5704.81	172.36 S	72.61 W	-47.63	0.47
5817.00	13.06	193.01	5797.38	193.09 S	77.72 W	-49.77	0.43
5912.00	12.56	196.57	5890.02	213.45 S	83.08 W	-52.22	0.98
6007.00	12.81	201.49	5982.70	233.15 S	89.89 W	-56.18	1.17
6102.00	13.39	198.82	6075.23	253.36 S	97.30 W	-60.67	0.88
6165.00	11.81	198.44	6136.71	266.38 S	101.69 W	-63.19	2.50
6238.00	10.45	194.80	6208.34	279.87 S	105.74 W	-65.30	2.10
6290.00	10.40	190.79	6259.48	289.04 S	107.83 W	-66.08	1.40
6338.00	15.08	182.16	6306.29	299.55 S	108.87 W	-65.64	10.49
6385.00	19.78	177.29	6351.12	313.61 S	108.73 W	-63.51	10.46
6433.00	23.15	177.36	6395.79	331.15 S	107.91 W	-60.23	7.03
6479.00	27.86	175.16	6437.29	350.90 S	106.59 W	-56.14	10.44
6527.00	32.61	167.41	6478.77	374.72 S	102.82 W	-49.06	12.78
6574.00	34.30	157.54	6518.01	399.34 S	94.99 W	-37.85	12.11
6622.00	33.49	150.44	6557.87	423.36 S	83.29 W	-22.88	8.42
6669.00	32.09	141.58	6597.41	444.44 S	69.12 W	-5.89	10.62
6717.00	31.24	134.68	6638.27	463.18 S	52.34 W	13.36	7.74
6764.00	32.11	126.19	6678.29	479.14 S	33.59 W	34.18	9.66
6812.00	34.38	123.72	6718.43	494.20 S	12.02 W	57.65	5.50
6859.00	38.49	121.21	6756.24	509.15 S	11.54 E	83.08	9.30
6907.00	43.76	116.83	6792.39	524.40 S	39.15 E	112.56	12.52
6954.00	48.65	112.24	6824.92	538.42 S	70.01 E	145.09	12.55
7002.00	53.31	107.96	6855.14	551.19 S	105.03 E	181.55	11.93
7049.00	57.94	105.75	6881.67	562.41 S	142.14 E	219.88	10.59
7097.00	60.97	103.53	6906.07	572.84 S	182.14 E	260.94	7.46
7144.00	64.53	101.42	6927.59	581.85 S	222.93 E	302.59	8.56
7192.00	67.45	99.80	6947.12	589.92 S	266.02 E	346.39	6.82

7238.00	72.29	98.04	6962.94	596.60 S	308.67 E	389.56	11.12
7286.00	76.04	97.72	6976.04	602.93 S	354.41 E	435.73	7.84
7333.00	80.28	96.22	6985.68	608.51 S	400.06 E	481.71	9.55
7376.00	82.53	91.36	6992.11	611.31 S	442.46 E	524.09	12.34
7456.00	86.95	86.21	6999.45	609.61 S	522.06 E	602.66	8.46
7504.00	87.00	85.93	7001.98	606.33 S	569.88 E	649.54	0.59
7599.00	86.79	88.47	7007.12	601.69 S	664.62 E	742.68	2.68
7694.00	88.92	88.98	7010.68	599.58 S	759.53 E	836.34	2.31
7789.00	90.46	90.04	7011.19	598.76 S	854.52 E	930.28	1.97
7884.00	91.33	91.55	7009.71	600.08 S	949.49 E	1024.49	1.83
7979.00	91.97	91.03	7006.98	602.21 S	1044.43 E	1118.78	0.87
8073.00	90.52	90.70	7004.93	603.62 S	1138.39 E	1212.01	1.58

**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 CLOSURE OF 117.93 DEGREES (GRID)  
A TOTAL CORRECTION OF 8.10 DEG FROM MAGNETIC NORTH TO GRID NORTH HAS BEEN APPLIED**

**HORIZONTAL DISPLACEMENT IS RELATIVE TO THE WELL HEAD.  
HORIZONTAL DISPLACEMENT(CLOSURE) AT 8073.00 FEET  
IS 1288.52 FEET ALONG 117.93 DEGREES (GRID)**

**Surveys Tied on @ Casing Shoe**