



1 : 240

[illegible]

<b>MWD Run Number</b>	100	200	300		
<b>Date run completed</b>	18-May-13	19-May-13	22-May-13		
<b>Rig Bit Number</b>	2	3	4		
<b>Bit Size (in)</b>	8.750	8.750	6.125		
<b>Tool Nominal OD (in)</b>	6.750	6.750	4.750		
<b>Log Start Depth (MD, ft)</b>	1,229.00	4,748.00	5,860.00		
<b>Log End Depth (MD, ft)</b>	4,748.00	5,860.00	9,505.00		
<b>Drill or Wipe</b>	Drill	Drill	Drill		
<b>Drill/Wipe Start Date and Time</b>	17-May-13 20:59	18-May-13 13:25	20-May-13 09:00		
<b>Drill/Wipe End Date and Time</b>	18-May-13 05:27	19-May-13 03:45	21-May-13 16:15		
<b>Min Inc (deg) @ Depth (MD, ft)</b>	.10 @ 750.00	2.17 @ 4,782.00	86.82 @ 6,851.00		
<b>Max Inc (deg) @ Depth (MD, ft)</b>	2.68 @ 4,219.00	79.79 @ 5,805.00	92.00 @ 9,443.00		
<b>Bit TFA(in2) / Bit Type</b>	.75 / PDC	.86 / PDC	.46 / PDC		
<b>Flow Rate (gpm)</b>	587.00	532.00	270.00		
<b>Max AV (fpm) / CV (fpm) @ MWD</b>	427.3 / 427.3	427.3 / 427.3	442.9 / 442.9		
<b>Fluid Type</b>	Fresh Water Gel	Fresh Water Gel	Fresh Water Gel		
<b>Density (ppg) / Viscosity (spqt)</b>	9.30 / 36.00	9.30 / 36.00	10.20 / 36.50		
<b>Filtrate CL (ppm)</b>	1,800.00	1,800.00	1,850.00		
<b>pH / Fluid Loss (mptm)</b>	9.90 / N/A	9.90 / N/A	8.90 / N/A		
<b>PV (cP) / YP (lbf2)</b>	11 / 7.00	11 / 7.00	11 / 10.00		
<b>% Solids / % Sand</b>	6.50 / 0.35	6.50 / 0.35	8.8 / 1		
<b>% Oil / Oil:Water Ratio</b>	N/A / N/A	N/A / N/A	N/A / N/A		
<b>Rm @ Measured Temp (degF)</b>	N/A @ N/A	N/A @ N/A	N/A @ N/A		
<b>Rmf @ Measured Temp (degF)</b>	N/A @ N/A	N/A @ N/A	N/A @ N/A		
<b>Rmc @ Measured Temp (degF)</b>	N/A @ N/A	N/A @ N/A	N/A @ N/A		
<b>Max Tool Temp (deg F) / S</b>	107.50 / PDM	100.00 / PDM	225.10 / PDM		

Max Tool Temp (degF) / Source	137.50 / PCM	160.83 / PCM	205.16 / PCM		
Rm @ Max Tool Temp (degF)	N/A @ N/A	N/A @ N/A	N/A @ N/A		
Lead MWD Engineer	Robert Ley	Robert Ley	Robert Ley		
Customer Representative	Charles Collver	Charles Collver	Charles Collver		

## SENSOR INFORMATION

### Downhole Processor Information

Tool Type	PCM	PCM	PCM		
Software Version	5.84	5.84	5.84		
Sub Serial Number	161211	161211	11718501		
Insert Serial Number	11145581	11145581	10868872		
Date and Time Initialized	16-May-13 21:20	16-May-13 21:20	19-May-13 09:35		
Date and Time Read	19-May-13 10:00	19-May-13 09:54	22-May-13 00:43		
ECMB SW Version	N/A	N/A	N/A		

### Directional Sensor Information

Tool Type	PCDC	PCDC	PCDC		
Distance From Bit (ft)	57.00	55.00	62.00		
Software Version	6.21	6.21	6.21		
Sub Serial Number	161211	161211	11718501		
Sonde Serial Number	11833052	11833052	11638497		
Sensor ID Number	N/A	N/A	N/A		
Toolface Offset (deg)	338.28	12.96	88.49		

### Gamma Ray Sensor Information

Tool Type	PCG	PCG	PCG		
Distance From Bit (ft)	50.18	48.59	55.13		
Recorded Sample Period (sec)	10	10	10		
Software Version	8.15	8.15	8.15		
Sub Serial Number	161211	161211	11718501		
Insert/Sonde Serial Number	11579768	11579768	11579852		

## REMARKS

1. All depths are measured depths and are calibrated to the driller' pipe tally and are measured from the drill floor.
2. No depth corrections have been made for pipe stretch or compression.
3. All data presented is recorded (memory data) unless otherwise stated.
4. The Following smoothing parameters have been applied to the data"

PGRC (Gamma Ray Corrected):

Interval Resolution: 0.5 feet  
Coercion Distance: 0.6 feet  
Gap Fill: 3.0 feet

ROPA (Rate of Penetration):

Interval Resolution: 0.5 feet  
Coercion Distance: 1.2 feet  
Gap Fill: 3.0 feet

Insite Version 7.3.40 build 25

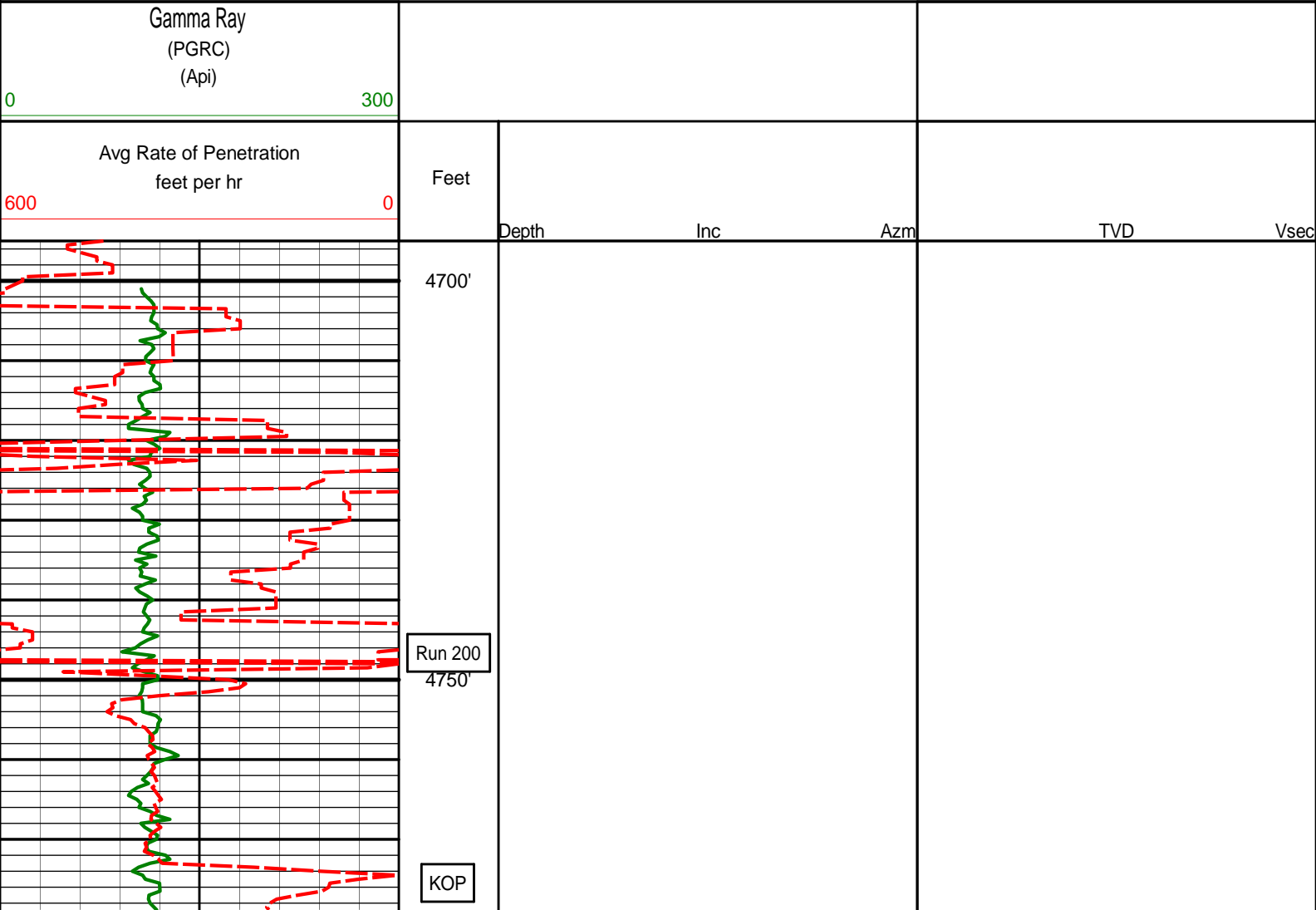
5. Survey at TD is projected to the bit

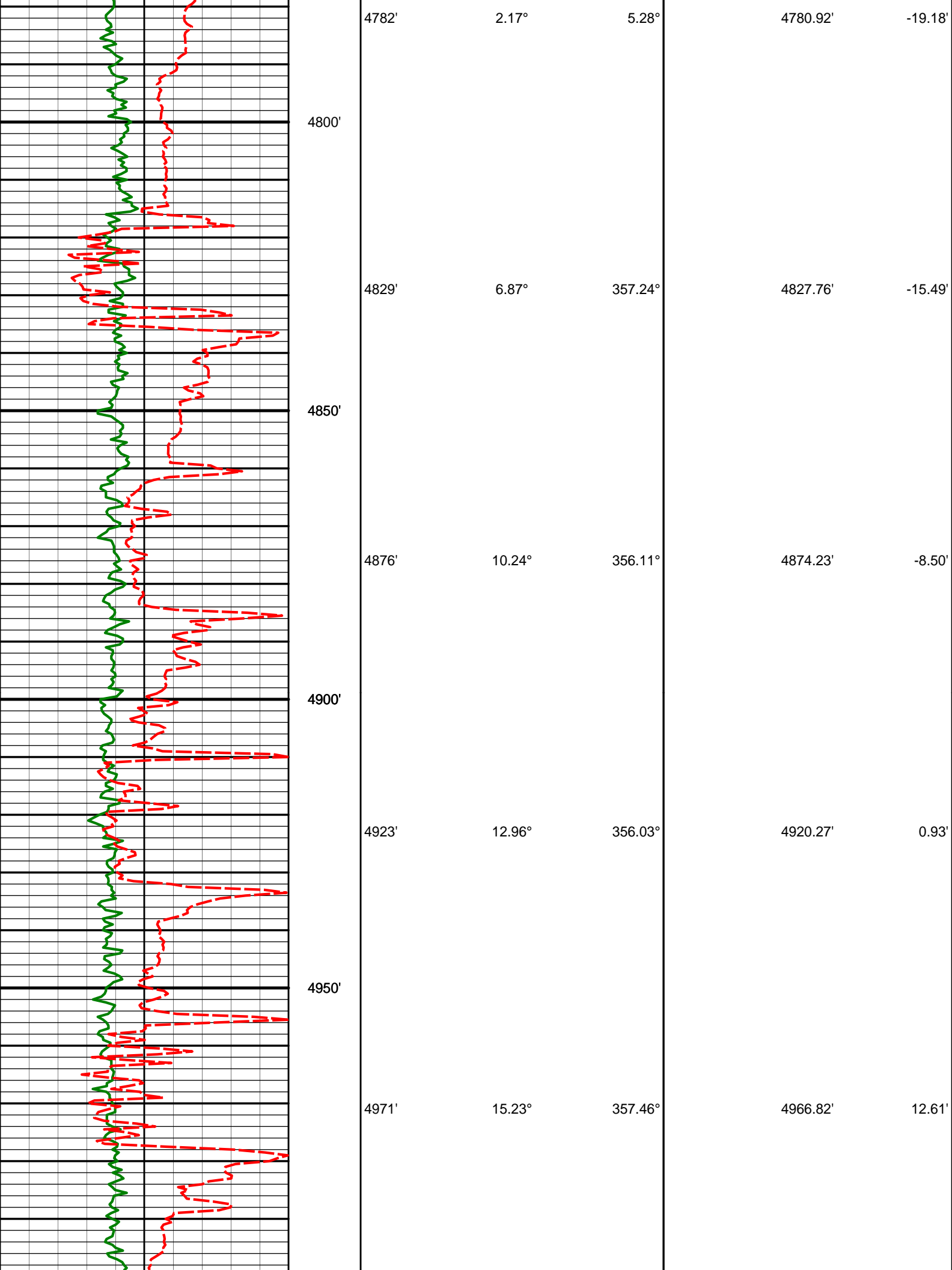
WARRANTY

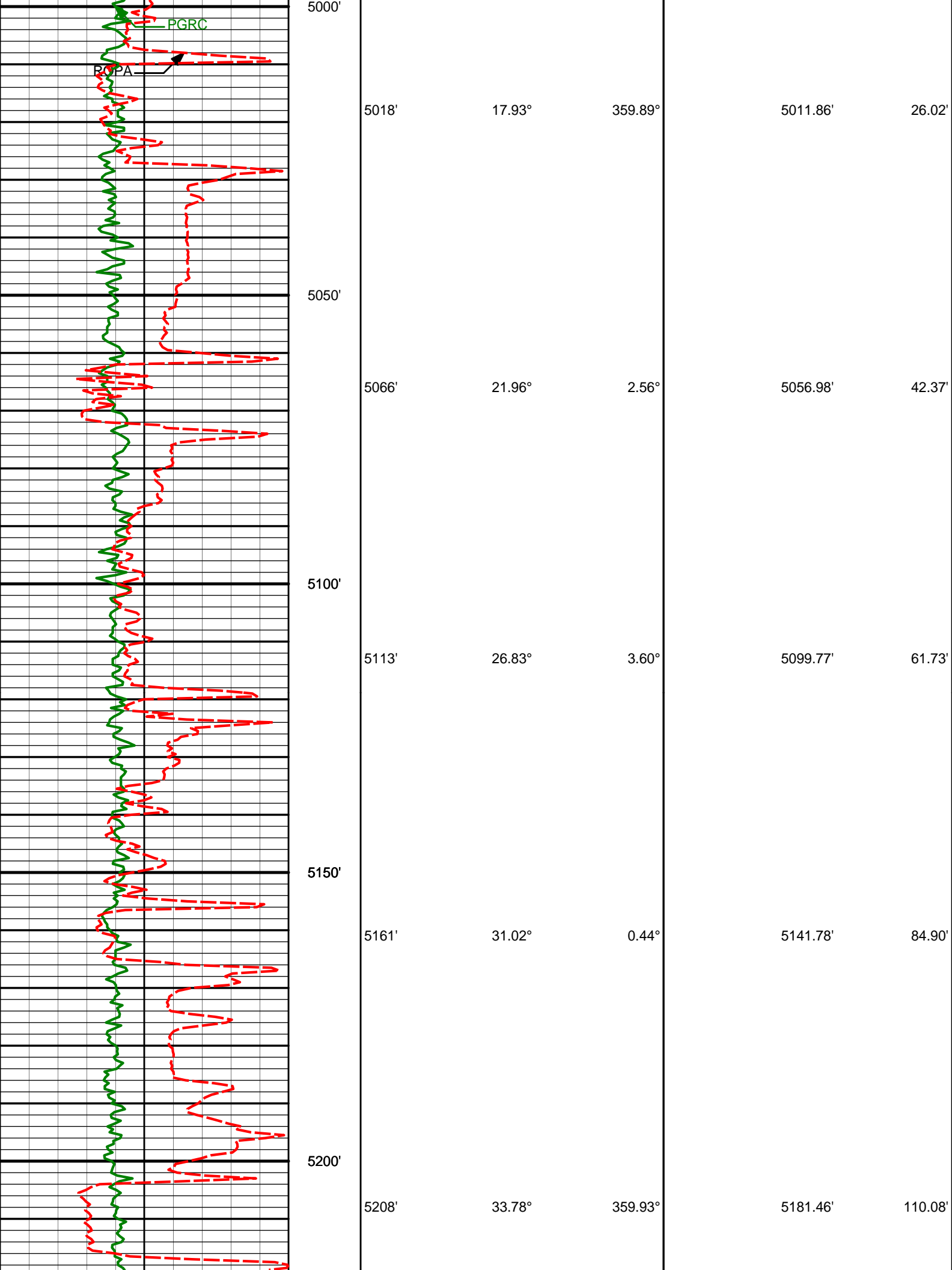
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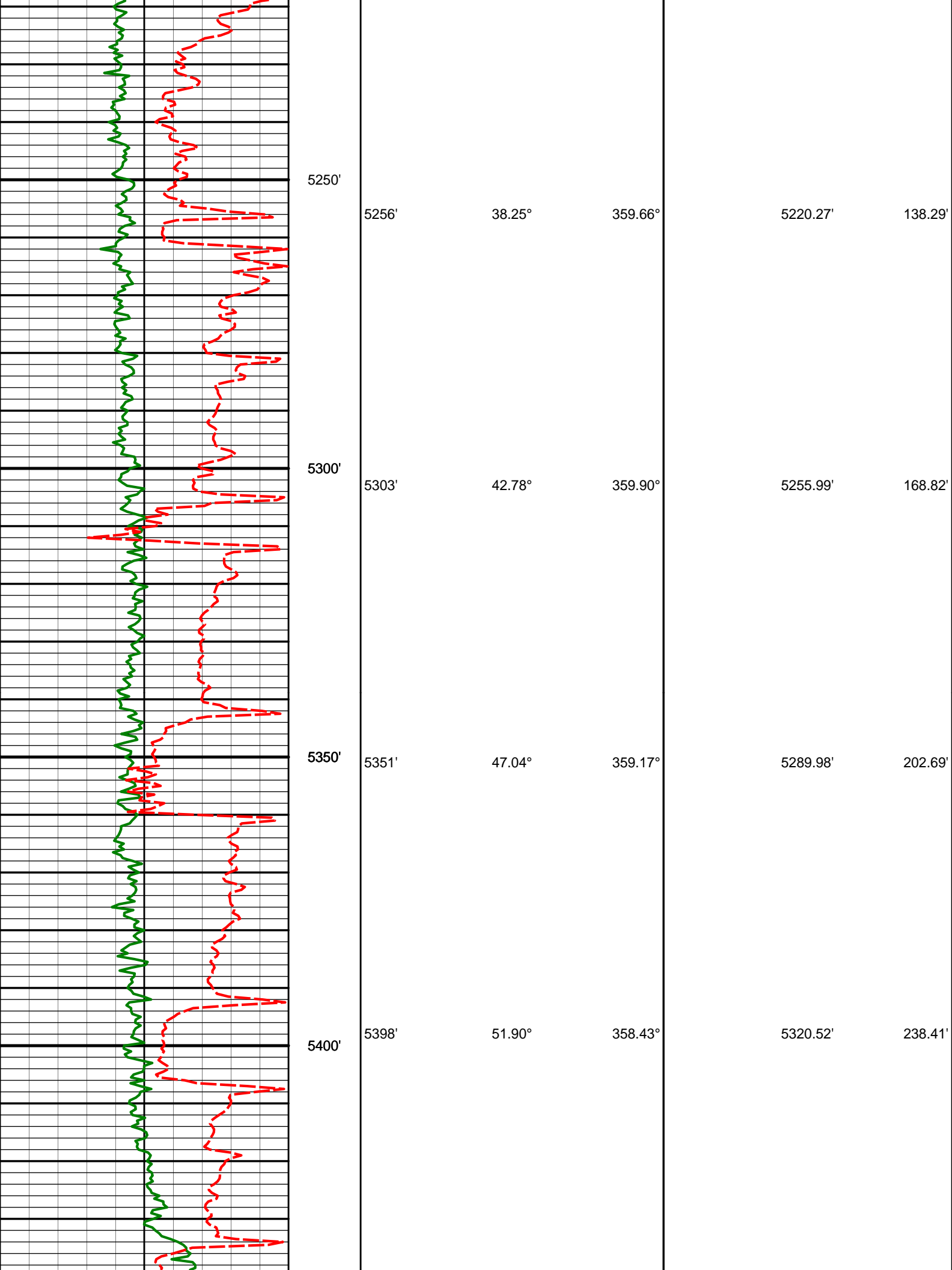
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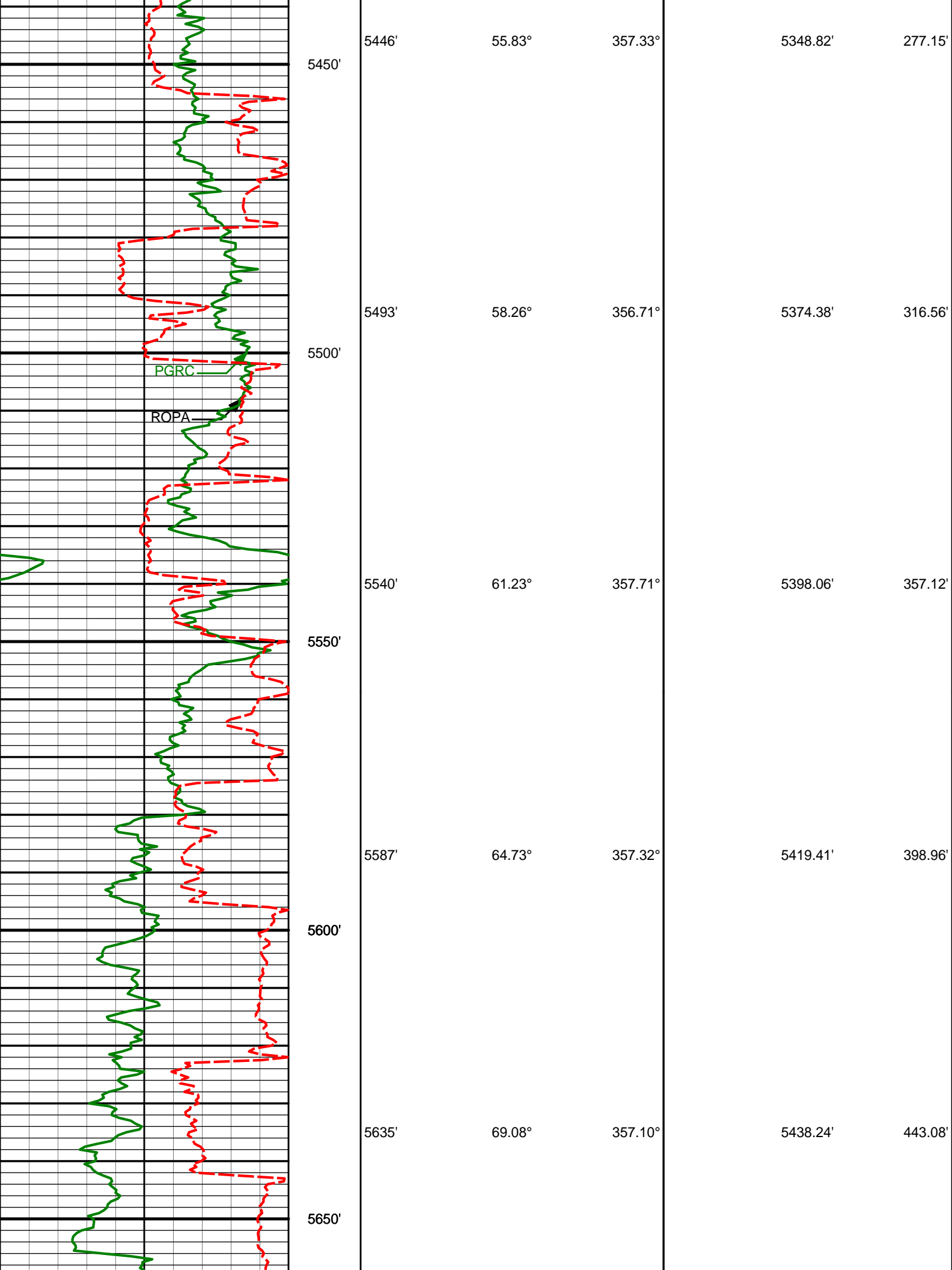
MD Detail Log 1:240

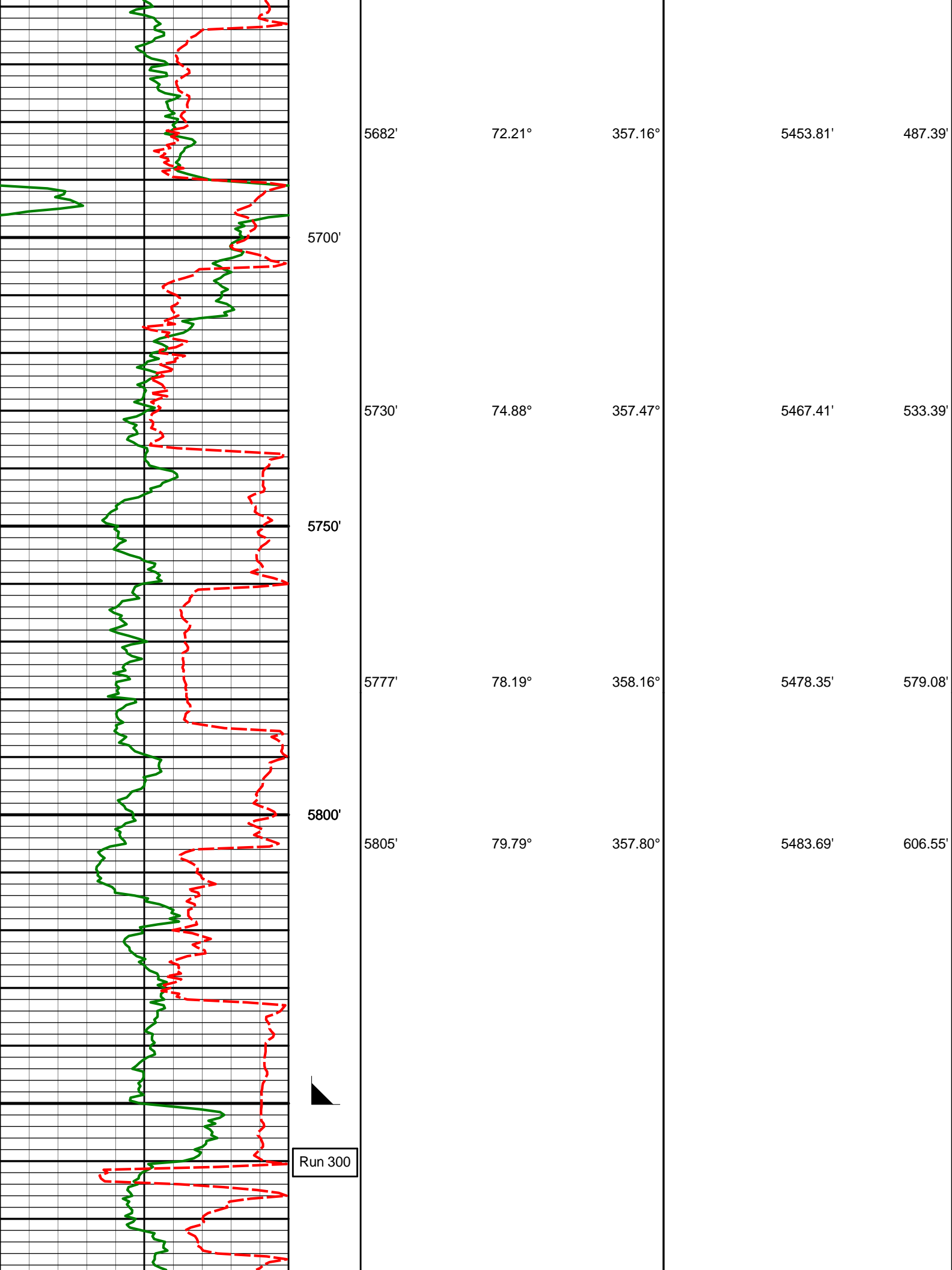


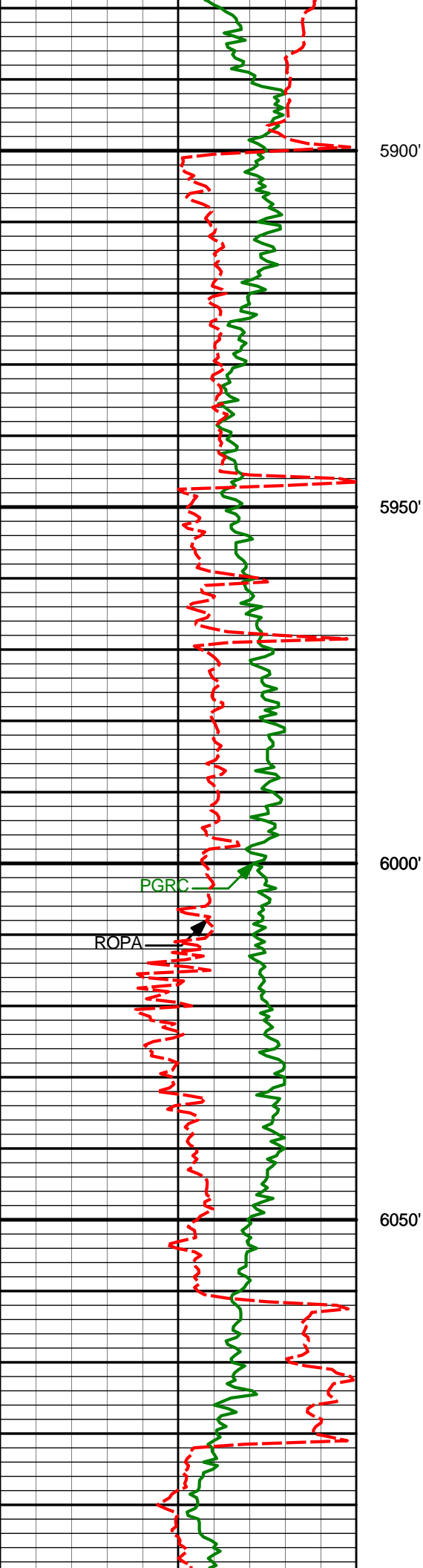


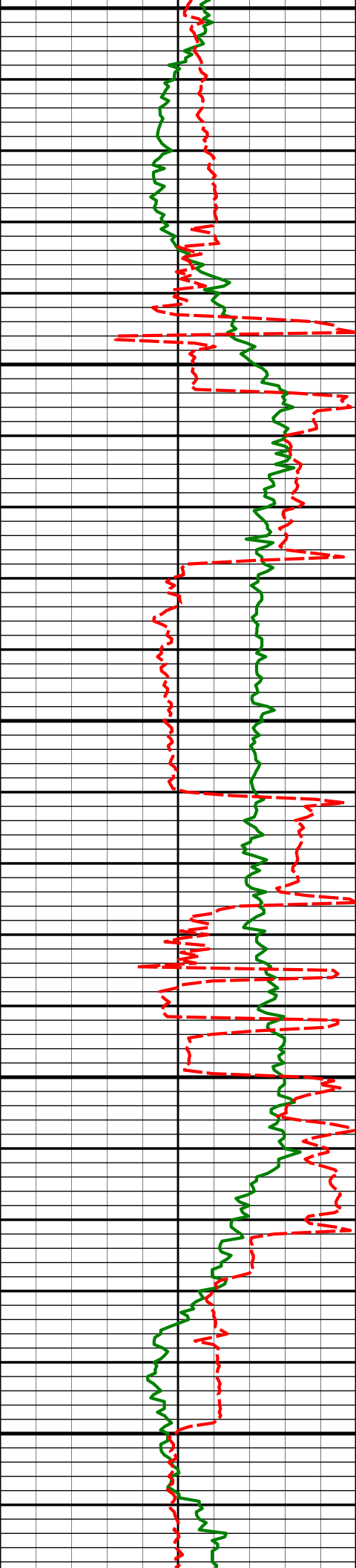












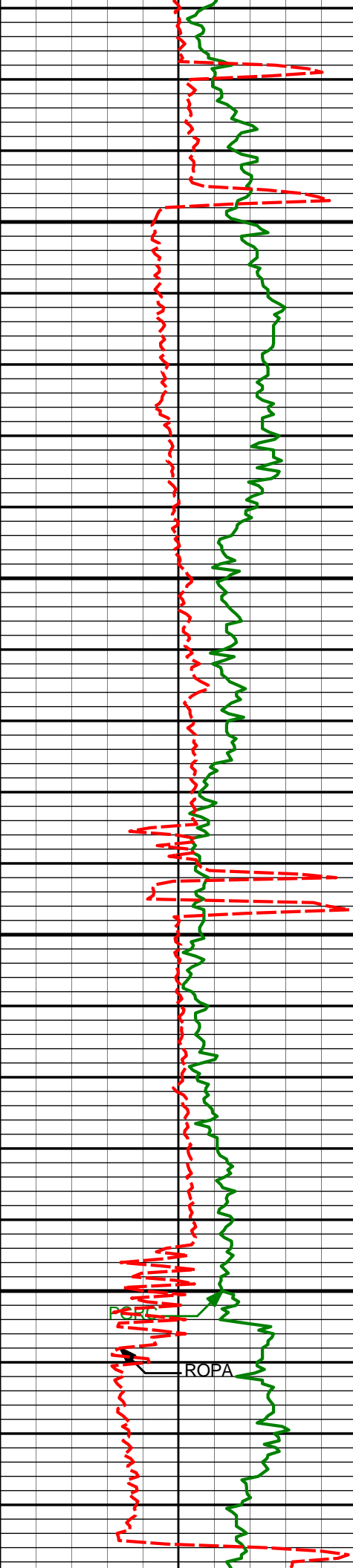
6100'

6150'

6200'

6250'

6300'



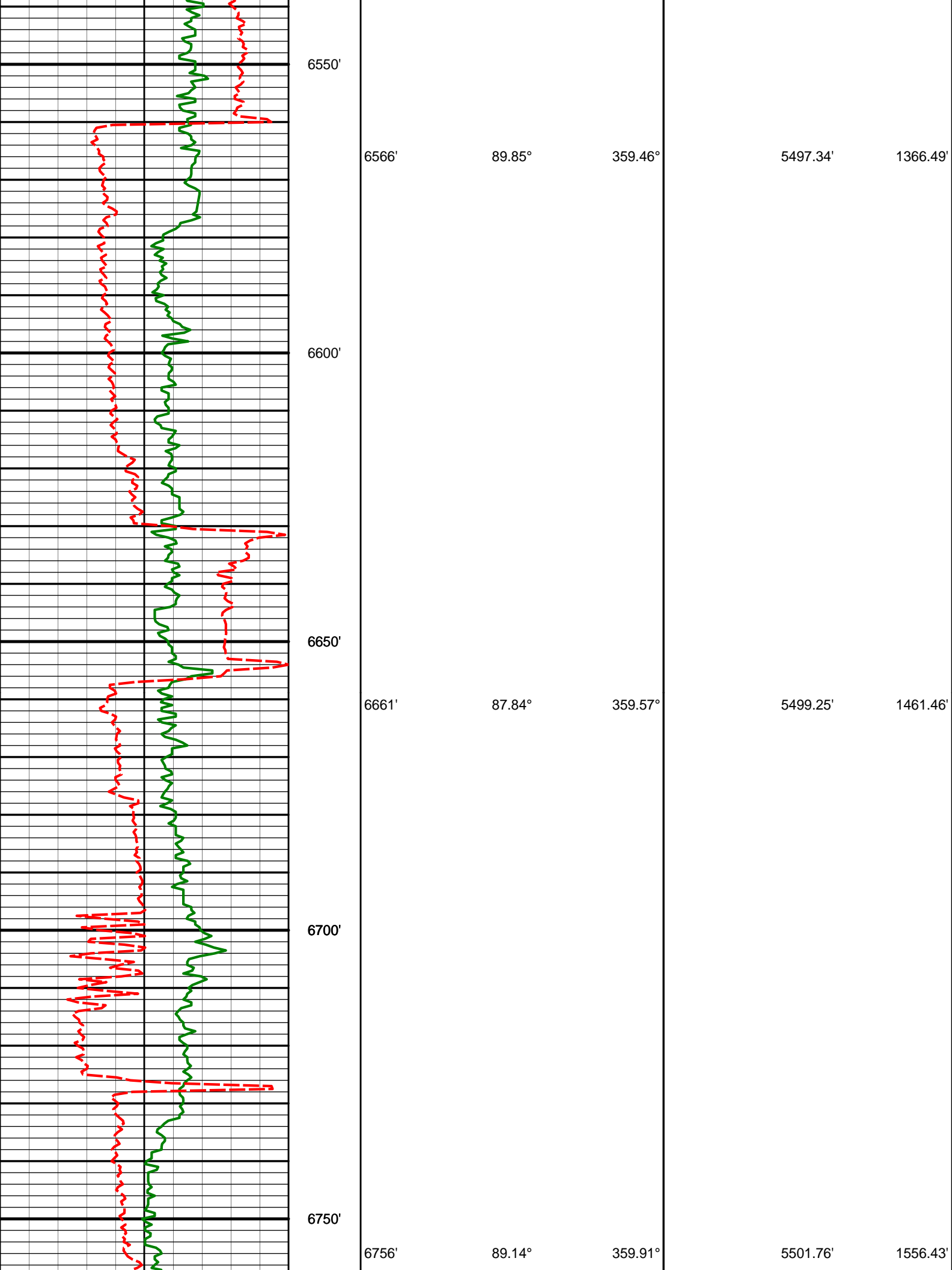
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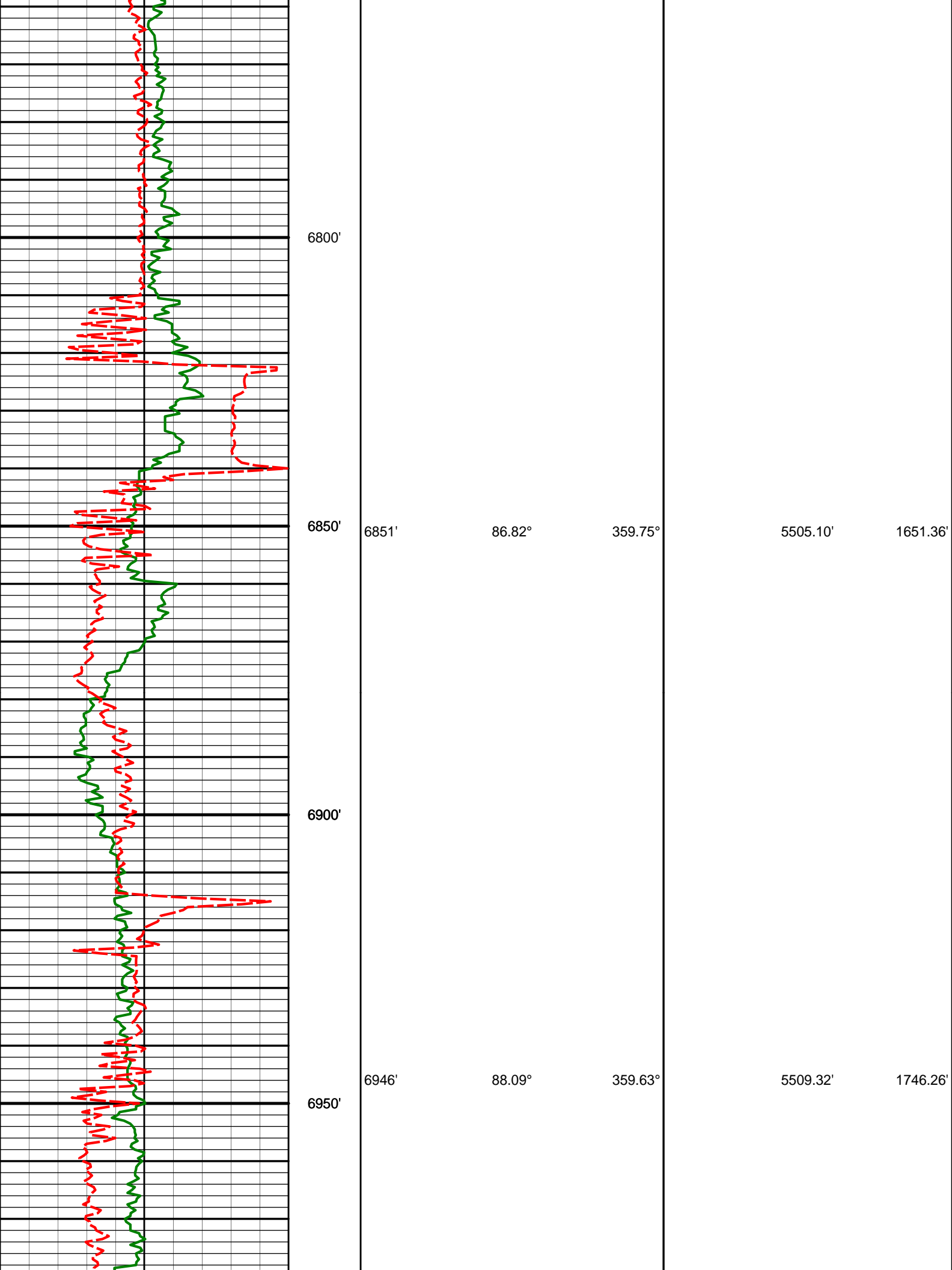
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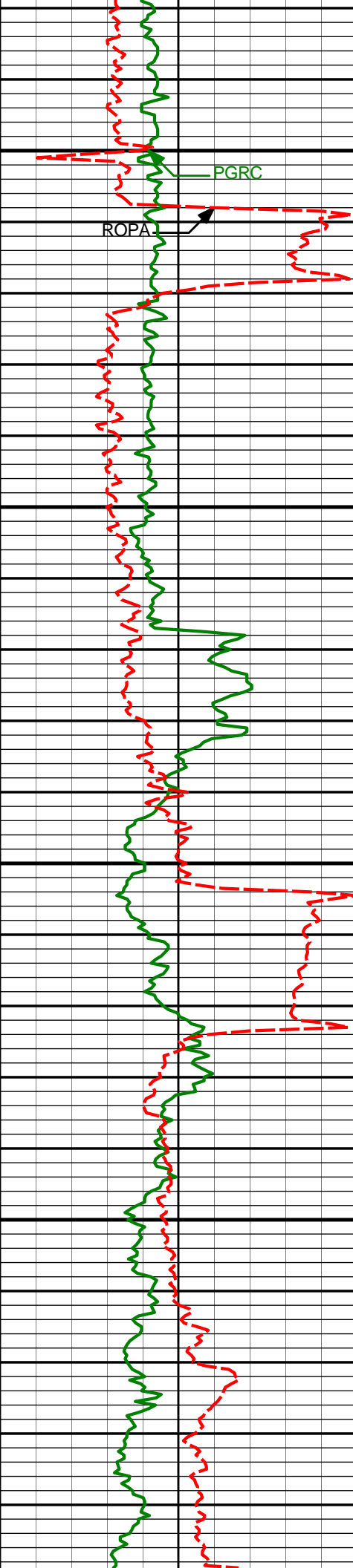
6450'

6500'

ROPA







7000'

PGRC

ROPA

7050'

7100'

7150'

7041'

88.89°

0.15°

5511.82'

1841.22'

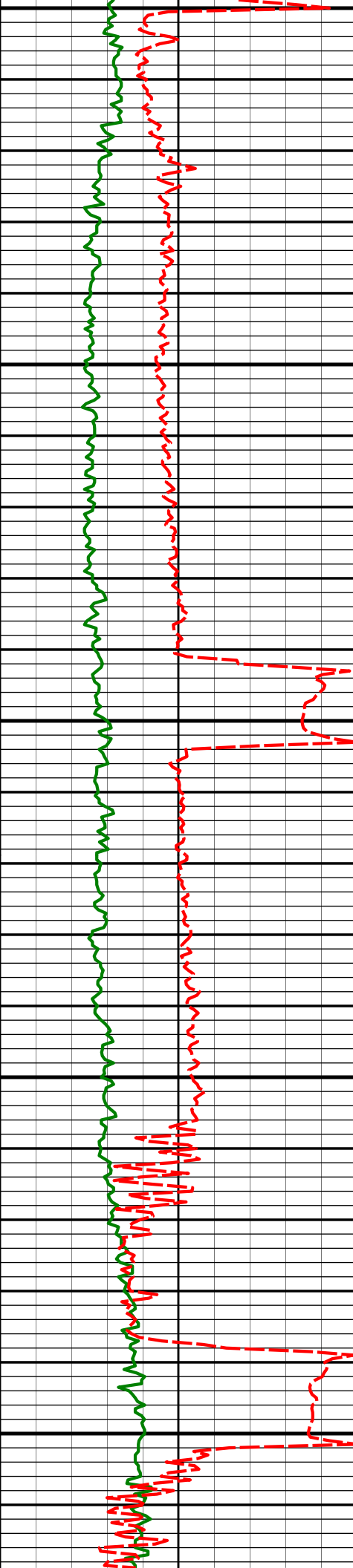
7135'

87.50°

0.82°

5514.78'

1935.15'



7200'

7230'

88.83°

0.85°

5517.82'

2030.06'

7250'

7300'

7325'

89.75°

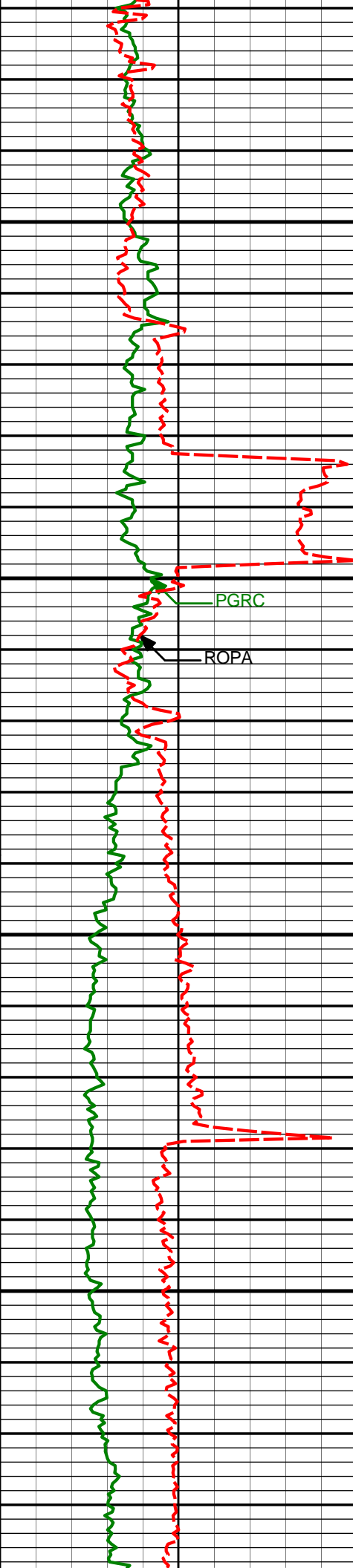
359.51°

5518.99'

2125.04'

7350'

7400'



7450'

7500'

7550'

7600'

PGRC

ROPA

7420'

90.03°

358.81°

5519.17'

2220.04'

7515'

89.14°

358.65°

5519.86'

2315.03'

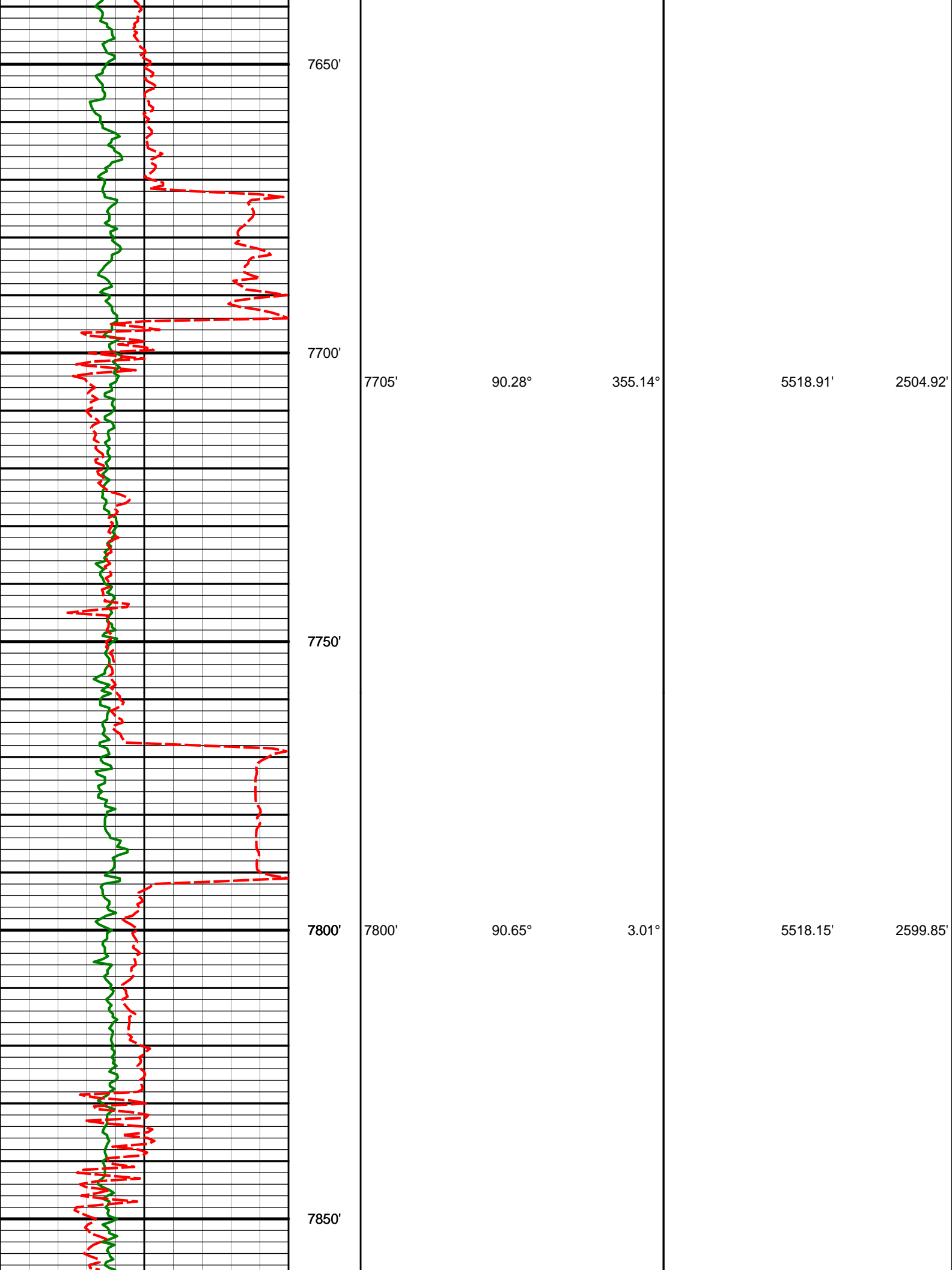
7610'

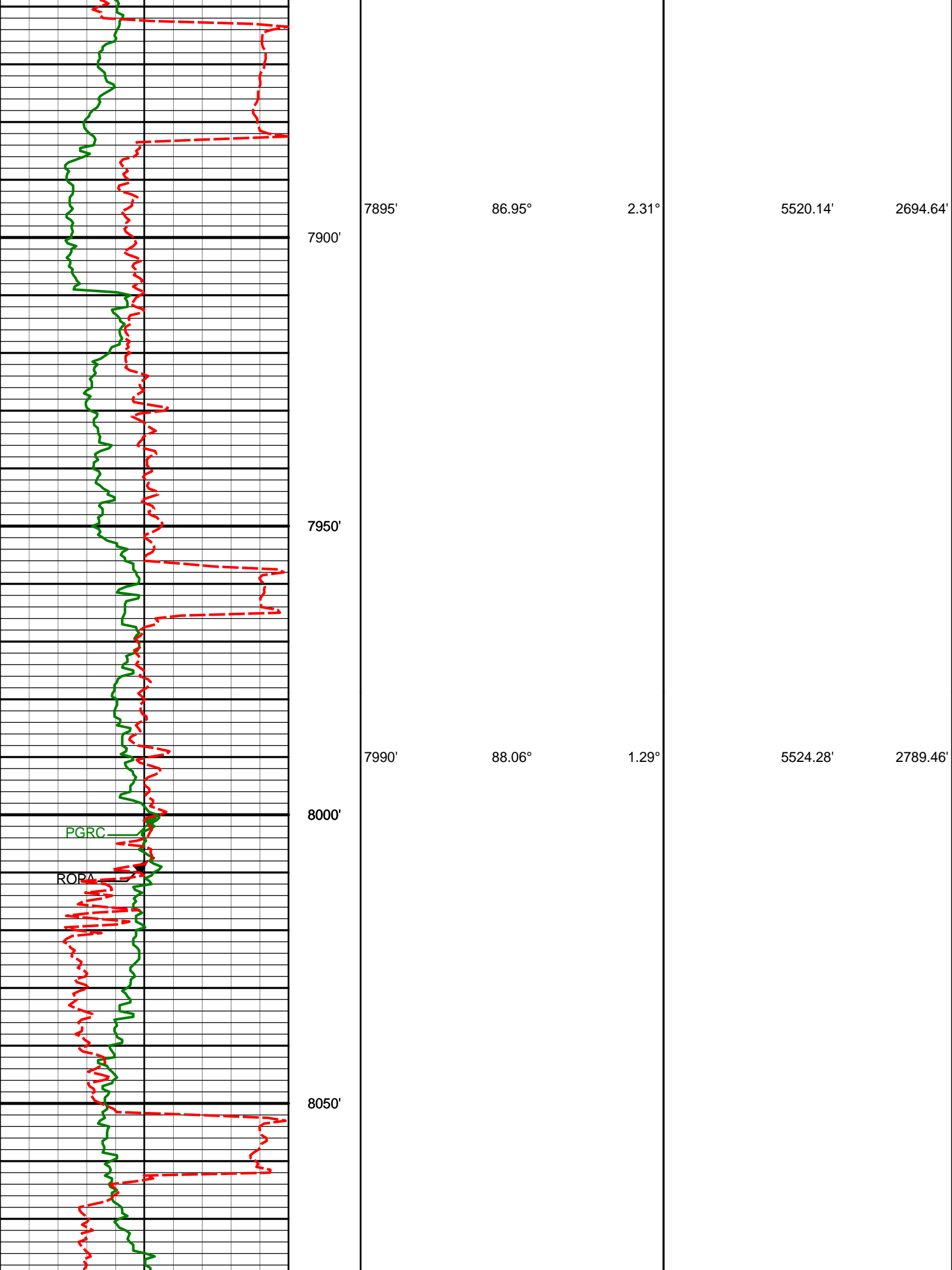
90.86°

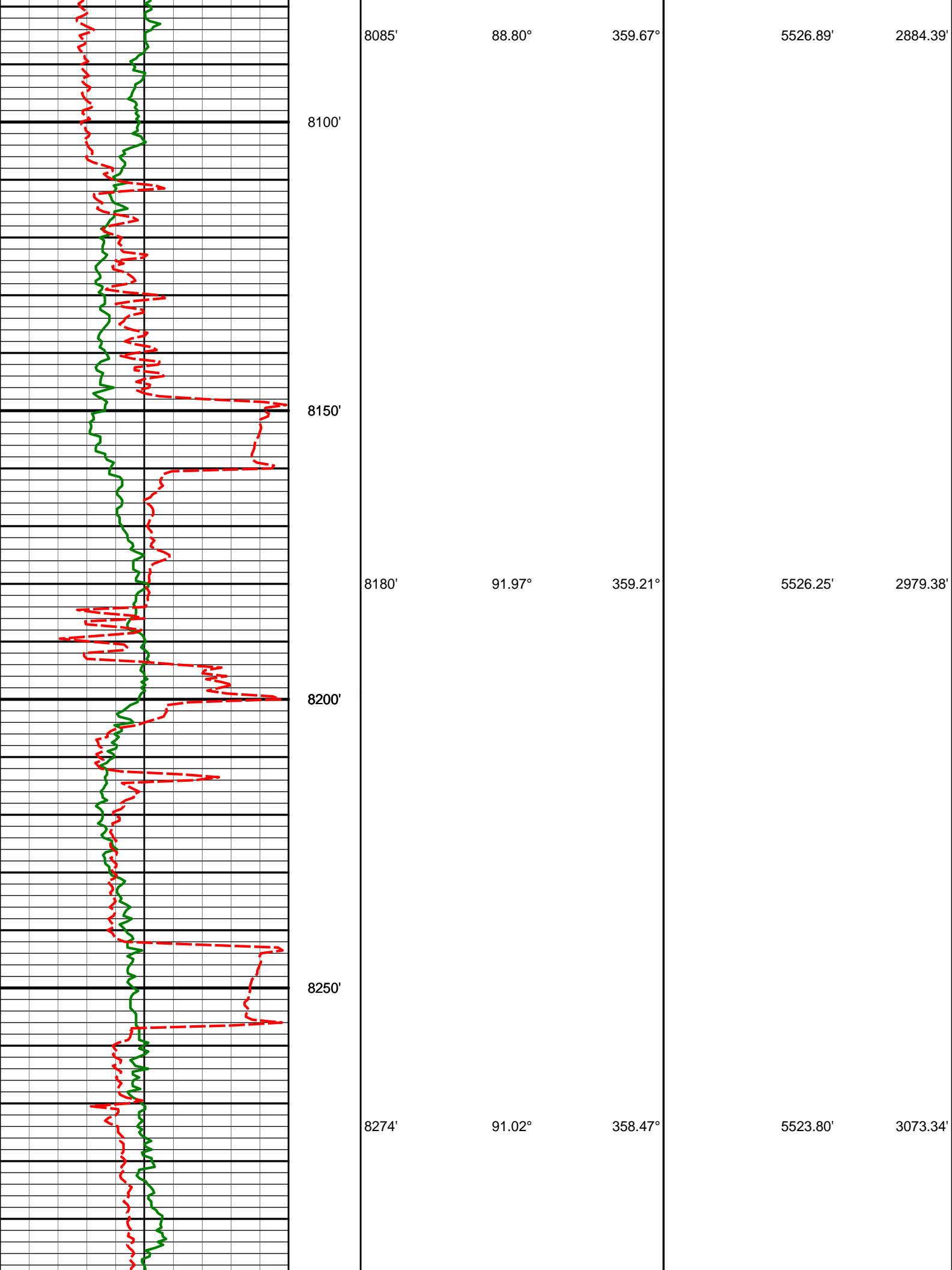
358.83°

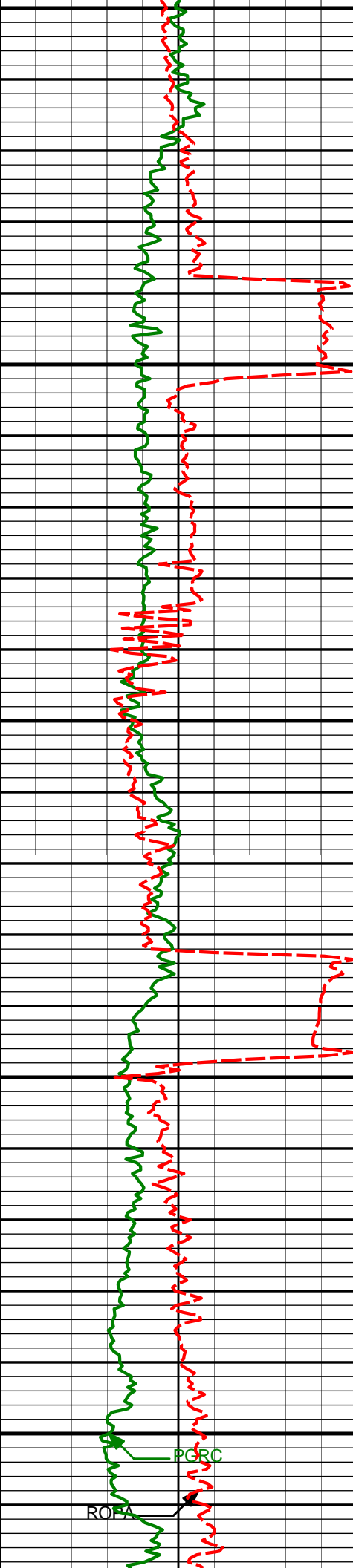
5519.86'

2410.02'









8300'

8350'

8400'

8450'

8500'

8369'

90.71°

356.96°

5522.37'

3168.29'

8464'

91.33°

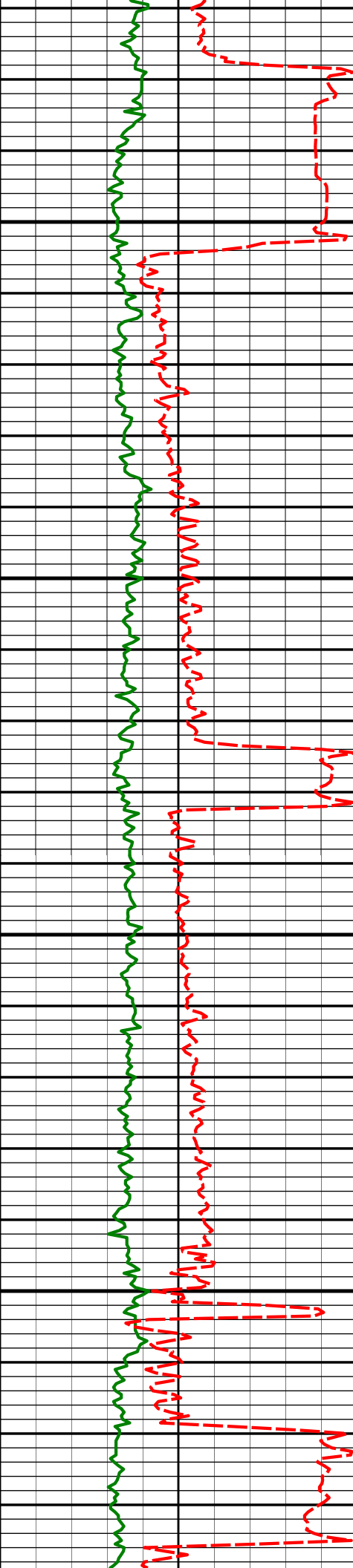
358.23°

5520.68'

3263.24'

PORC

ROFA



8550'

8559'

89.26°

358.13°

5520.20'

3358.21'

8600'

8650'

8654'

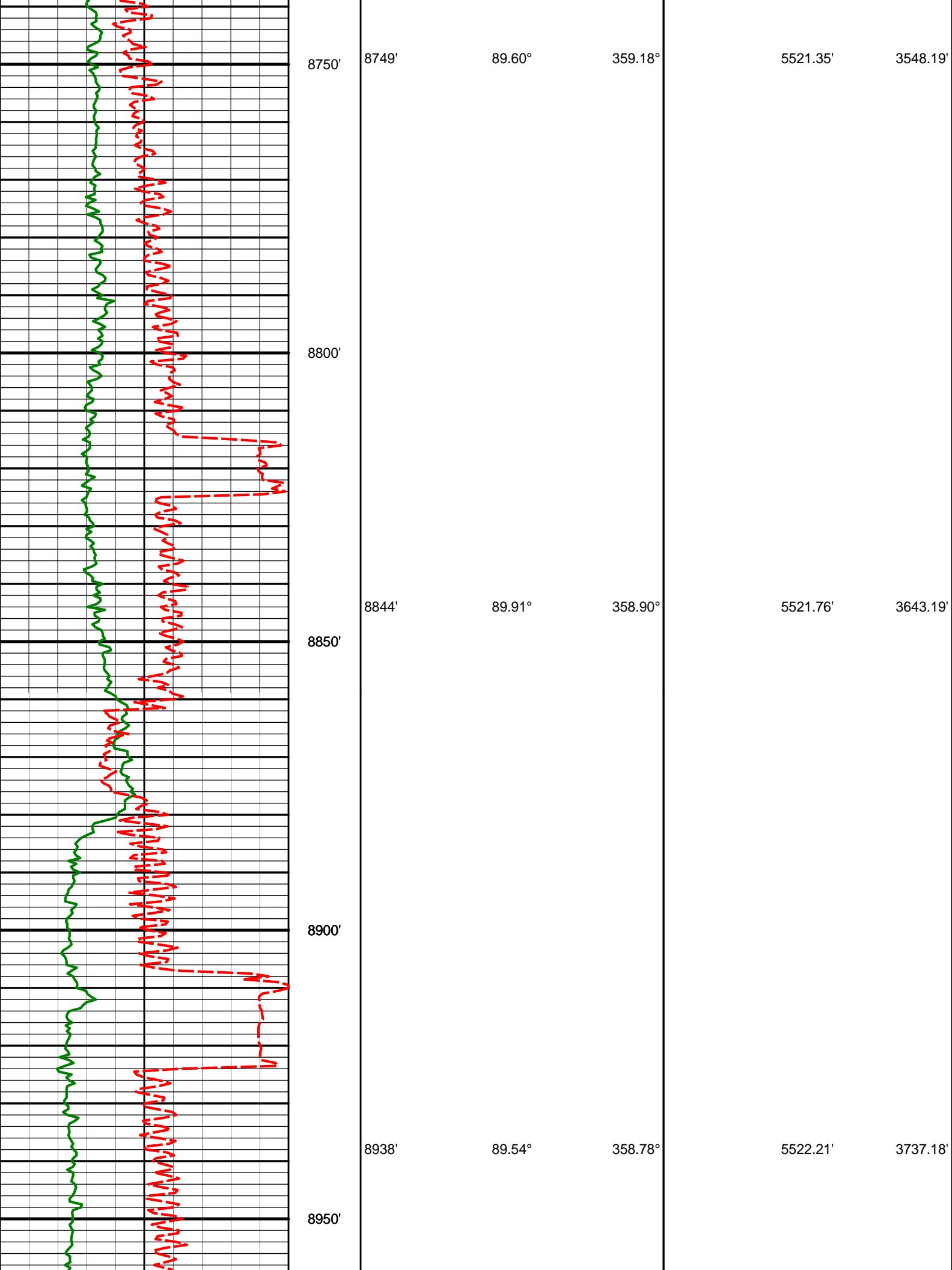
89.88°

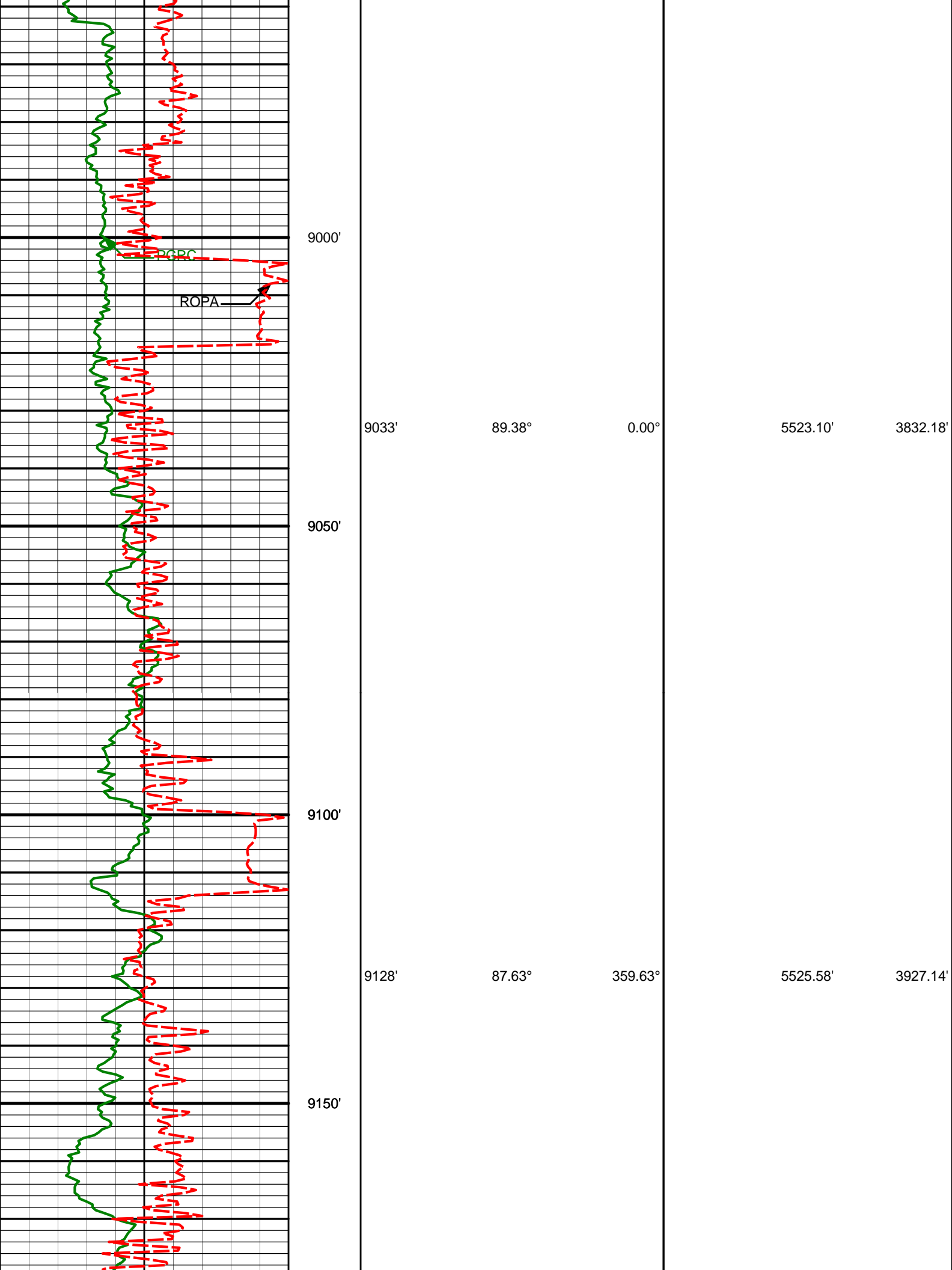
358.35°

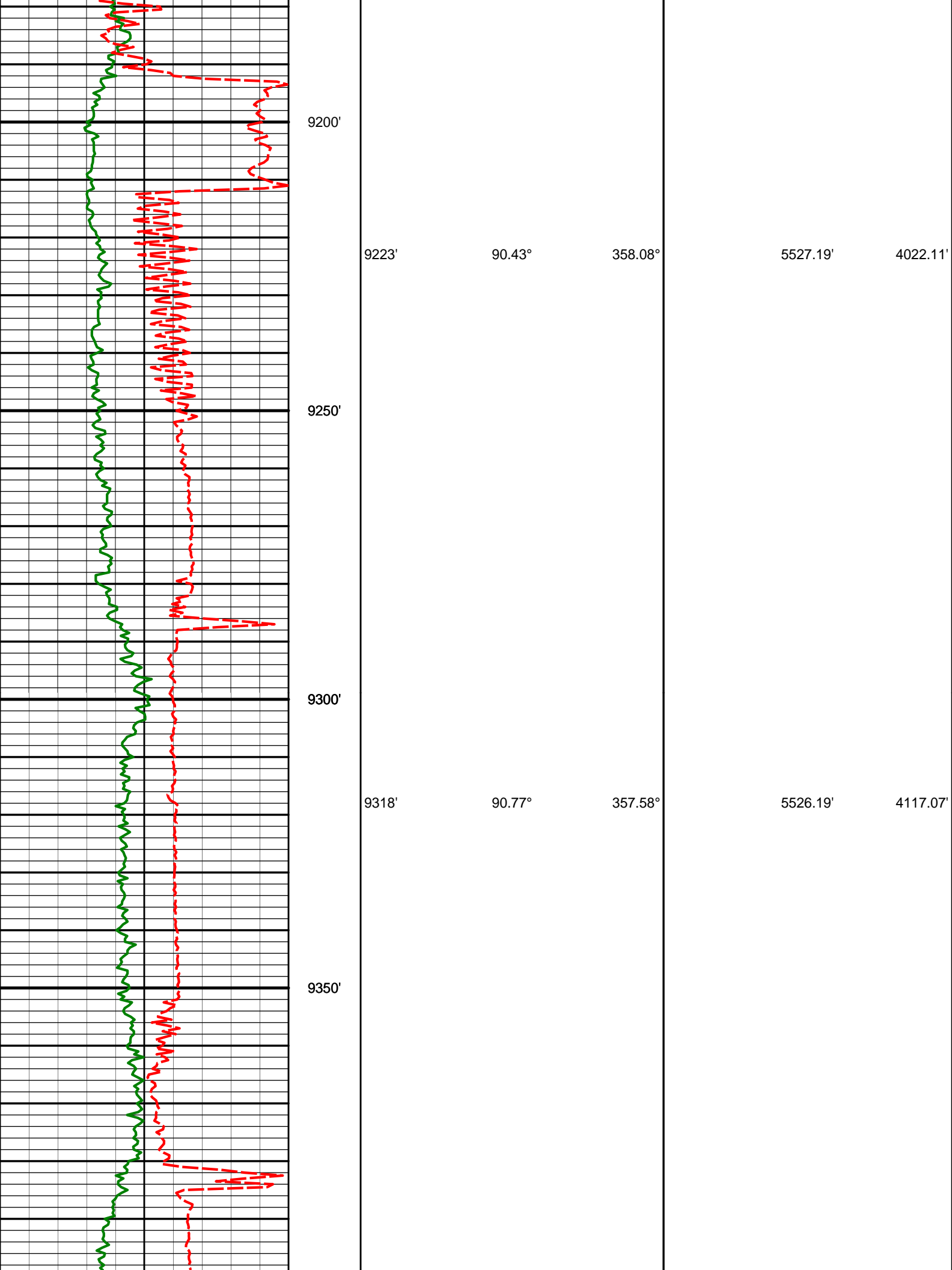
5520.91'

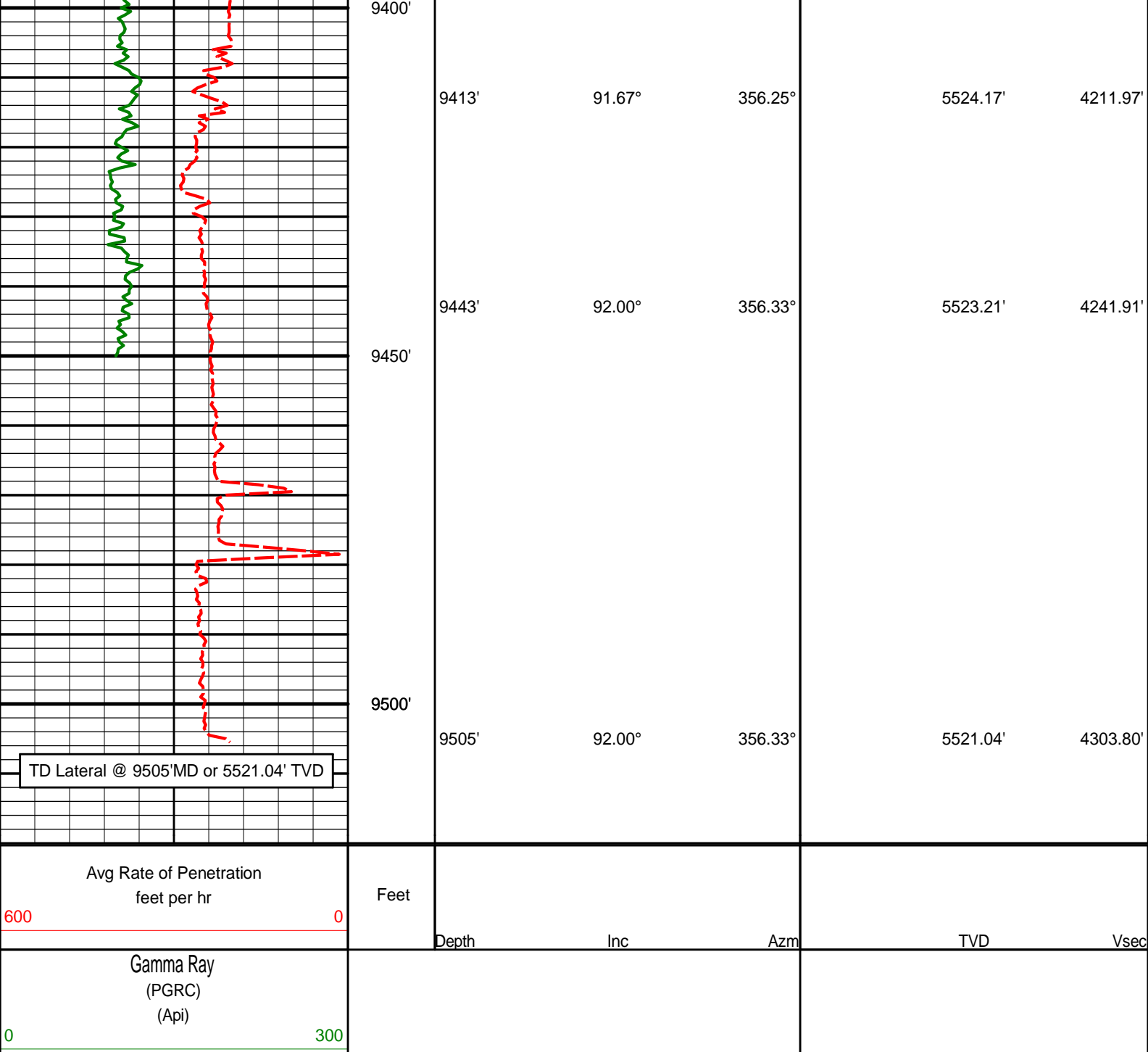
3453.20'

8700'









**HALLIBURTON**

## DIRECTIONAL SURVEY REPORT

Noble Energy  
Castor LD12-78HN  
Wattenberg  
Weld Colorado  
USA  
CA-XX-0900392418

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
250.00	0.20	304.70	250.00	0.25 N	0.36 W	0.25	0.08
530.00	0.60	264.10	529.99	0.38 N	2.22 W	0.40	0.17
750.00	0.10	233.00	749.99	0.14 N	3.52 W	0.19	0.23
1006.00	0.30	152.80	1005.99	0.59 S	3.39 W	-0.54	0.12

	1225.00	0.10	258.40	1224.99	1.14 S	3.32 W	-1.09	0.16
	1279.00	0.66	218.02	1278.98	1.39 S	3.55 W	-1.35	1.09
	1372.00	0.52	228.41	1371.98	2.10 S	4.20 W	-2.04	0.19
	1560.00	0.88	184.04	1559.97	4.11 S	4.95 W	-4.05	0.33
	1655.00	0.96	148.69	1654.95	5.52 S	4.59 W	-5.46	0.59
	1750.00	1.49	151.54	1749.93	7.28 S	3.59 W	-7.23	0.56
	1845.00	1.97	131.94	1844.89	9.45 S	1.79 W	-9.43	0.79
	1940.00	1.31	73.74	1939.86	10.24 S	0.47 E	-10.25	1.78
	2034.00	1.62	85.64	2033.83	9.84 S	2.82 E	-9.87	0.46
	2129.00	2.06	79.04	2128.78	9.41 S	5.83 E	-9.49	0.52
	2224.00	1.27	343.50	2223.75	8.08 S	7.21 E	-8.17	2.66
	2319.00	1.09	14.60	2318.73	6.20 S	7.14 E	-6.29	0.69
	2414.00	1.13	23.63	2413.71	4.46 S	7.74 E	-4.56	0.19
	2509.00	1.33	28.66	2508.69	2.64 S	8.64 E	-2.75	0.24
	2604.00	0.90	328.31	2603.68	1.04 S	8.78 E	-1.16	1.24
	2699.00	0.65	350.73	2698.67	0.12 N	8.30 E	0.01	0.40
	2794.00	0.22	336.94	2793.66	0.82 N	8.15 E	0.72	0.47
	2889.00	0.37	341.59	2888.66	1.28 N	7.98 E	1.18	0.16
	2984.00	0.75	345.20	2983.66	2.17 N	7.72 E	2.07	0.40
	3079.00	1.00	335.41	3078.65	3.53 N	7.22 E	3.43	0.30
	3174.00	1.23	287.51	3173.63	4.58 N	5.90 E	4.51	0.98
	3364.00	1.68	253.86	3363.57	4.42 N	1.28 E	4.40	0.50
	3459.00	2.22	216.66	3458.52	2.56 N	1.16 W	2.57	1.42
	3554.00	1.70	217.58	3553.47	0.04 S	3.11 W	0.00	0.55
	3649.00	1.50	229.98	3648.43	1.95 S	4.93 W	-1.89	0.42
	3744.00	1.17	212.99	3743.40	3.57 S	6.41 W	-3.49	0.54
	3839.00	2.00	167.91	3838.37	6.01 S	6.59 W	-5.92	1.51
	3934.00	2.28	165.91	3933.30	9.46 S	5.79 W	-9.38	0.31
	4029.00	2.19	167.71	4028.23	13.06 S	4.94 W	-13.00	0.12
	4219.00	2.68	175.61	4218.06	21.03 S	3.83 W	-20.98	0.31
	4313.00	1.16	187.40	4312.00	24.16 S	3.78 W	-24.11	1.66
	4408.00	0.35	343.72	4407.00	24.83 S	3.99 W	-24.78	1.56
	4503.00	1.03	35.81	4501.99	23.85 S	3.57 W	-23.81	0.91
	4598.00	1.27	53.41	4596.97	22.53 S	2.22 W	-22.50	0.44
	4691.00	1.02	51.54	4689.95	21.40 S	0.75 W	-21.39	0.27
	4782.00	2.17	5.28	4780.92	19.18 S	0.05 E	-19.18	1.80
	4829.00	6.87	357.24	4827.76	15.49 S	0.01 W	-15.49	10.08
	4876.00	10.24	356.11	4874.23	8.51 S	0.43 W	-8.50	7.18
	4923.00	12.96	356.03	4920.27	0.92 N	1.08 W	0.93	5.78
	4971.00	15.23	357.46	4966.82	12.59 N	1.73 W	12.61	4.79
	5018.00	17.93	359.89	5011.86	25.99 N	2.02 W	26.02	5.93
	5066.00	21.96	2.56	5056.98	42.35 N	1.63 W	42.37	8.60
	5113.00	26.83	3.60	5099.77	61.73 N	0.57 W	61.73	10.40
	5161.00	31.02	0.44	5141.78	84.91 N	0.21 E	84.90	9.29
	5208.00	33.78	359.93	5181.46	110.09 N	0.29 E	110.08	5.90
	5256.00	38.25	359.66	5220.27	138.31 N	0.18 E	138.29	9.33
	5303.00	42.78	359.90	5255.99	168.83 N	0.07 E	168.82	9.64
	5351.00	47.04	359.17	5289.98	202.71 N	0.21 W	202.69	8.94
	5398.00	51.90	358.43	5320.52	238.41 N	0.97 W	238.41	10.42
	5446.00	55.83	357.33	5348.82	277.14 N	2.41 W	277.15	8.39
	5493.00	58.26	356.71	5374.38	316.52 N	4.46 W	316.56	5.28
	5540.00	61.23	357.71	5398.06	357.07 N	6.43 W	357.12	6.58
	5587.00	64.73	357.32	5419.41	398.89 N	8.25 W	398.96	7.50
	5635.00	69.08	357.10	5438.24	442.98 N	10.40 W	443.08	9.06
	5682.00	72.21	357.16	5453.81	487.26 N	12.62 W	487.39	6.66
	5730.00	74.88	357.47	5467.41	533.24 N	14.78 W	533.39	5.60
	5777.00	78.19	358.16	5478.35	578.91 N	16.52 W	579.08	7.19
	5805.00	79.79	357.80	5483.69	606.38 N	17.48 W	606.55	5.83
	5906.00	88.43	359.71	5494.05	706.72 N	19.65 W	706.92	8.76
	5999.00	89.85	359.68	5495.45	799.71 N	20.15 W	799.90	1.52
	6092.00	91.36	359.60	5494.48	892.70 N	20.74 W	892.89	1.63
	6187.00	90.09	1.36	5493.28	987.68 N	19.95 W	987.86	2.29
	6282.00	88.31	1.84	5494.61	1082.63 N	17.29 W	1082.76	1.95
	6376.00	88.86	1.71	5496.93	1176.56 N	14.38 W	1176.64	0.61
	6471.00	90.40	2.20	5497.54	1271.50 N	11.14 W	1271.53	1.70
	6566.00	89.85	359.46	5497.34	1366.48 N	9.76 W	1366.49	2.94
	6661.00	87.84	359.57	5499.25	1461.45 N	10.56 W	1461.46	2.11
	6756.00	89.14	359.91	5501.76	1556.41 N	10.99 W	1556.43	1.40
	6851.00	86.82	359.75	5505.10	1651.35 N	11.27 W	1651.36	2.44
	6946.00	88.09	359.63	5509.32	1746.25 N	11.79 W	1746.26	1.34
	7041.00	88.89	0.15	5511.82	1841.22 N	11.97 W	1841.22	1.01
	7135.00	87.50	0.82	5514.78	1935.16 N	11.17 W	1935.15	1.64
	7230.00	88.83	0.85	5517.82	2030.10 N	9.78 W	2030.06	1.40
	7325.00	89.75	359.51	5518.99	2125.09 N	9.49 W	2125.04	1.72
	7420.00	90.03	358.81	5519.17	2220.08 N	10.88 W	2220.04	0.79

7515.00	89.14	358.65	5519.86	2315.05 N	12.99 W	2315.03	0.96
7610.00	90.86	358.83	5519.86	2410.03 N	15.08 W	2410.02	1.83
7705.00	90.28	355.14	5518.91	2504.87 N	20.07 W	2504.92	3.94
7800.00	90.65	3.01	5518.15	2599.78 N	21.60 W	2599.85	8.29
7895.00	86.95	2.31	5520.14	2694.64 N	17.20 W	2694.64	3.96
7990.00	88.06	1.29	5524.28	2789.50 N	14.22 W	2789.46	1.59
8085.00	88.80	359.67	5526.89	2884.46 N	13.43 W	2884.39	1.87
8180.00	91.97	359.21	5526.25	2979.44 N	14.36 W	2979.38	3.38
8274.00	91.02	358.47	5523.80	3073.39 N	16.26 W	3073.34	1.29
8369.00	90.71	356.96	5522.37	3168.30 N	20.05 W	3168.29	1.62
8464.00	91.33	358.23	5520.68	3263.20 N	24.04 W	3263.24	1.49
8559.00	89.26	358.13	5520.20	3358.14 N	27.05 W	3358.21	2.18
8654.00	89.88	358.35	5520.91	3453.10 N	29.96 W	3453.20	0.69
8749.00	89.60	359.18	5521.35	3548.07 N	32.01 W	3548.19	0.92
8844.00	89.91	358.90	5521.76	3643.06 N	33.60 W	3643.19	0.44
8938.00	89.54	358.78	5522.21	3737.04 N	35.50 W	3737.18	0.41
9033.00	89.38	0.00	5523.10	3832.03 N	36.51 W	3832.18	1.29
9128.00	87.63	359.63	5525.58	3926.99 N	36.81 W	3927.14	1.89
9223.00	90.43	358.08	5527.19	4021.94 N	38.70 W	4022.11	3.37
9318.00	90.77	357.58	5526.19	4116.87 N	42.30 W	4117.07	0.64
9413.00	91.67	356.25	5524.17	4211.71 N	47.41 W	4211.97	1.68
9443.00	92.00	356.33	5523.21	4241.63 N	49.35 W	4241.91	1.16
9505.00	92.00	356.33	5521.04	4303.47 N	53.32 W	4303.80	0.01

**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 359.26 DEGREES (GRID)  
A TOTAL CORRECTION OF 7.09 DEG FROM MAGNETIC NORTH TO GRID NORTH HAS BEEN APPLIED**

**HORIZONTAL DISPLACEMENT IS RELATIVE TO THE WELL HEAD.  
HORIZONTAL DISPLACEMENT(CLOSURE) AT 9505.00 FEET  
IS 4303.80 FEET ALONG 359.29 DEGREES (GRID)**

**Casing set at 5850 ft.**

**Surveys at 250 ft, 530 ft, 750 ft, 1006 ft and 1225 ft were taken and provided by HP 322 while they were drilling the surface hole.**