



Weatherford®

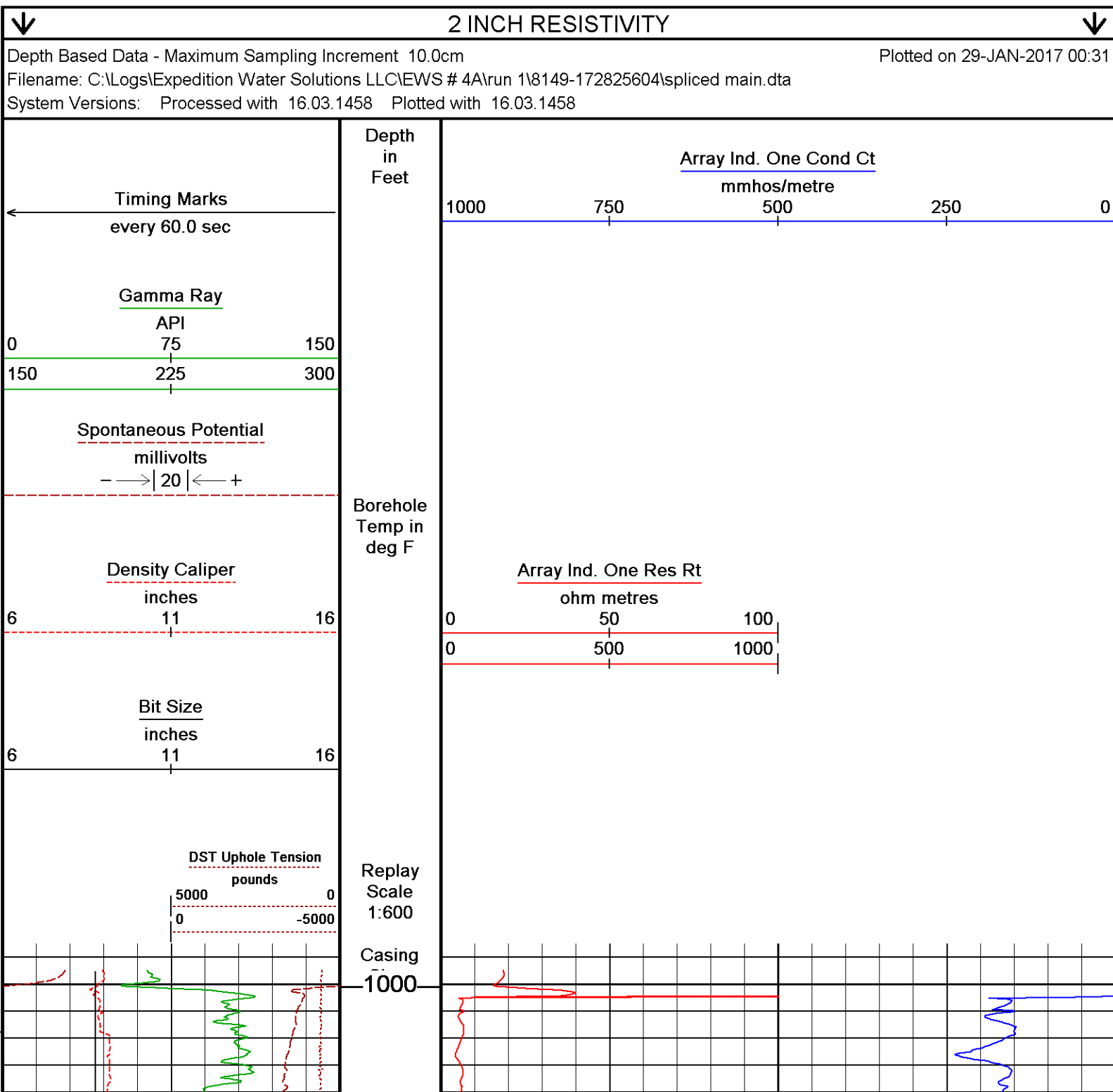
**ARRAY INDUCTION
LOG**

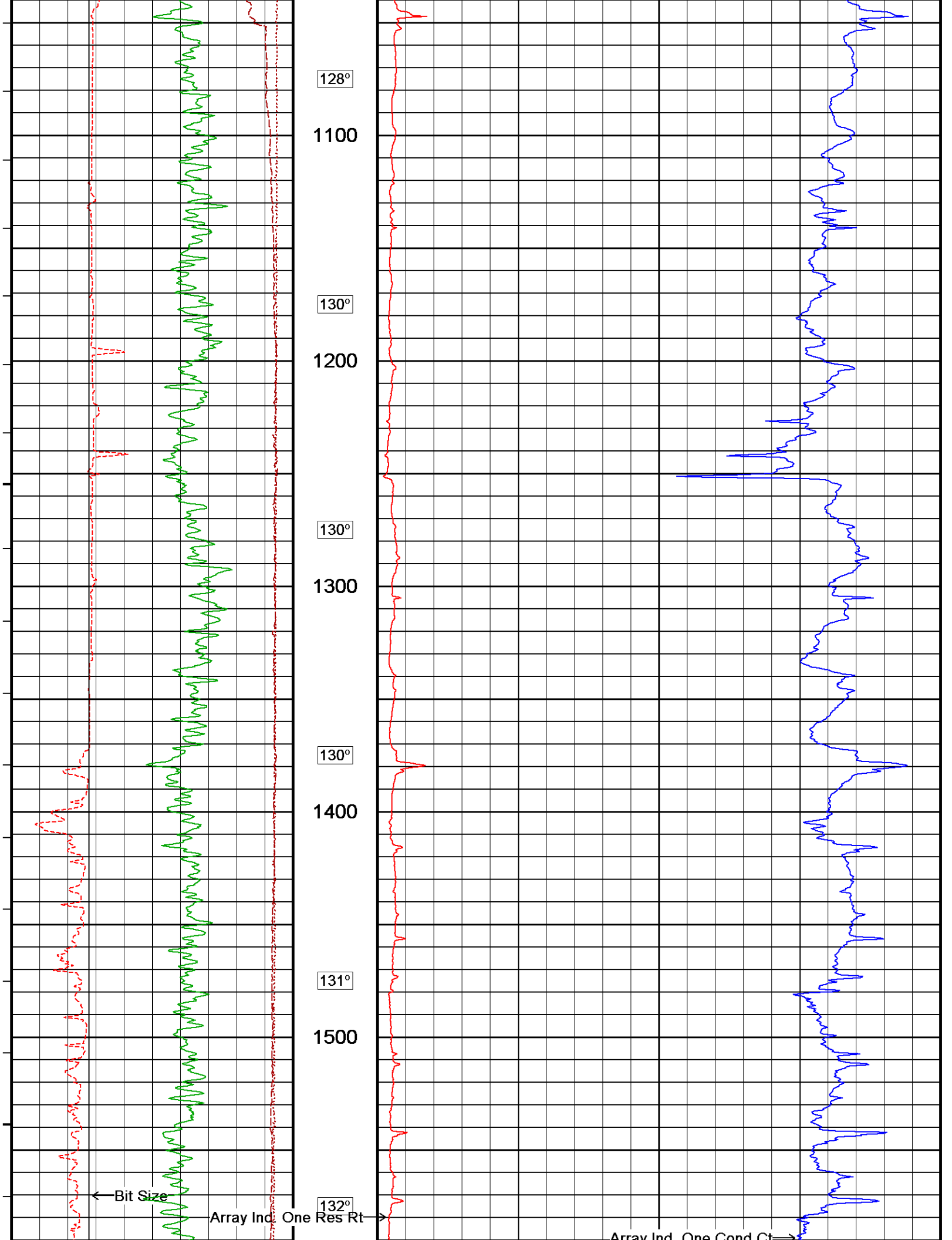
COMPANY			EXPEDITION WATER SOLUTIONS COLORADO LLC		
WELL			EWS # 4A		
FIELD			WATTENBERG		
PROVINCE/COUNTY			WELD		
COUNTRY/STATE			USA / COLORADO		
LOCATION			SHL: 2232' FNL & 2037' FWL		
SEC 17	TWP 2N	RGE 63W	Other Services		
Latitude	40.139470		DUAL SPACED NEUTRON		
Longitude	-104.463560		PHOTO DENSITY		
API Number	05-123-44047-00				
Permanent Datum GL, Elevation 4643 feet					
Log Measured From KB					
Drilling Measured From KB			Elevations: KB 4856.00 DF 4856.00 GL 4843.00		
Date	28-JAN-2017				
Run Number	ONE				
Service Order	8149-172825604				
Depth Driller	8501.00		feet		
Depth Logger	8510.00		feet		
First Reading	8507.00		feet		
Last Reading	1001.00		feet		
Casing Driller	1000.00		feet		
Casing Logger	1001.00		feet		
Bit Size	8.750		inches		
Hole Fluid Type	WBM				
Density / Viscosity	9.90		lb/USg	54.00	sec/Ct
PH / Fluid Loss	8.10			6.40	ml/30Min
Sample Source	FLOWLINE				
Rm @ Measured Temp	0.98 @ 86.4		ohm-m		
Rmf @ Measured Temp	0.78 @ 86.4		ohm-m		
Rmc @ Measured Temp	1.18 @ 86.4		ohm-m		
Source Rmf / Rmc	CALC		CALC		
Rm @ BHT	0.39 @224.0		ohm-m		
Time Since Circulation	4 HOURS				
Max Recorded Temp	224.00		deg F		
Equipment / Base	13173		CASPER		
Recorded By	D. BEANS				
Witnessed By	J. DEMUTH				

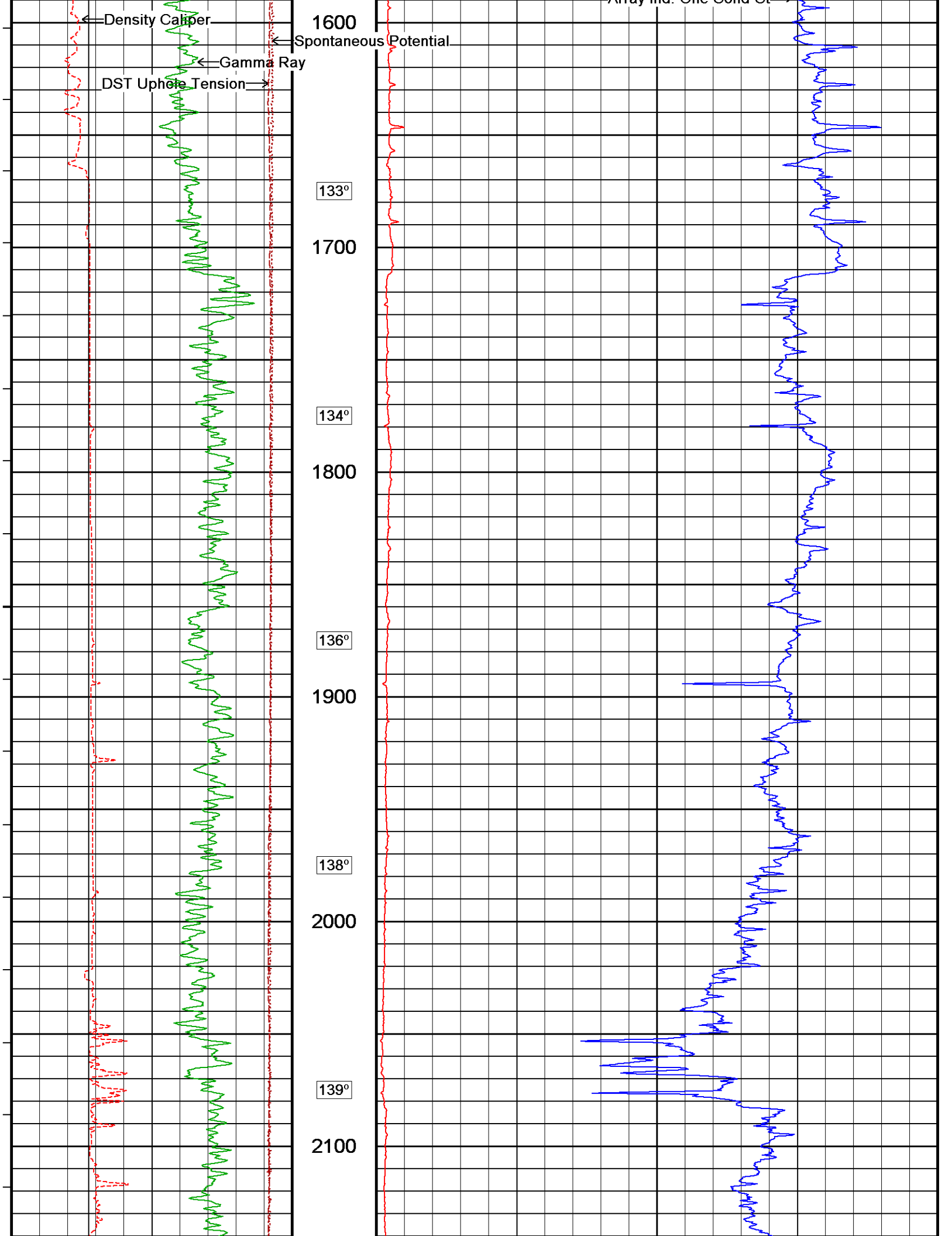
BOREHOLE RECORD					Last Edited: 28-JAN-2017 14:18
Bit Size inches		Depth From feet		Depth To feet	
8.750		1000.00		8501.00	
CASING RECORD					
Type	Size inches	Depth From feet	Shoe Depth feet	Weight pounds/ft	
SURFACE	9.625	0.00	1000.00	36.00	

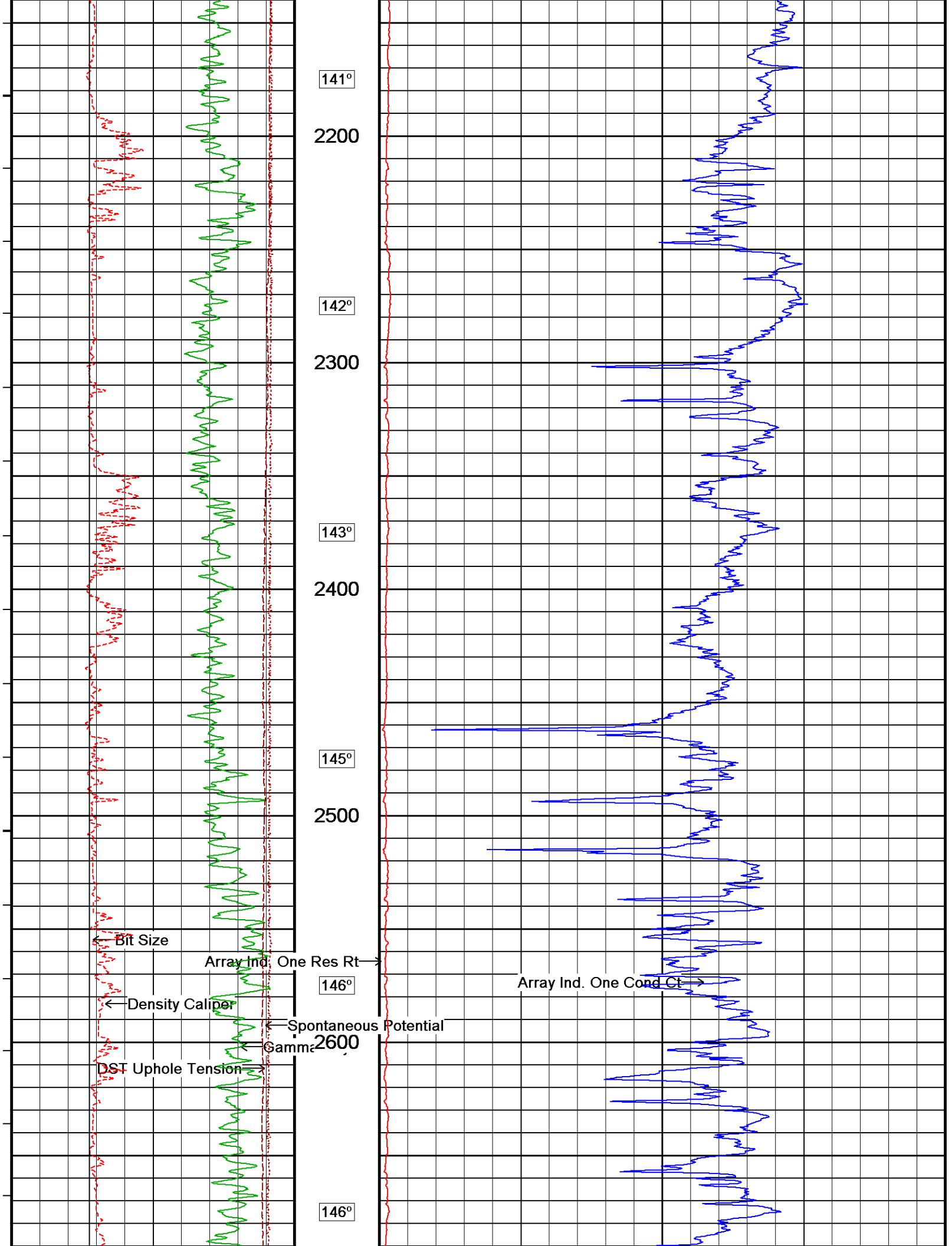
REMARKS	
SOFTWARE VERSION 16.03.1458	
TOOLS RUN: SHA, MCG, MDN, MPD, MVC, SKJ, MFE, AND MAI RUN IN COMBINATION.	
HARDWARE: MPD: 8" PROFILE PLATE USED. MDN: DUAL BOWSPRING MFE: 0.5" STANDOFF MAI: 2 x 0.5" STANDOFFS	
2.68 G/CC DENSITY MATRIX USED TO CALCULATE POROSITY	
TIGHT PULLS, BOREHOLE SIZE AND RUGOSITY WILL AFFECT REPEATABILITY AND DATA QUALITY.	
ALL INTERVALS LOGGED AND SCALED PER CUSTOMER'S REQUEST.	
TOTAL HOLE VOLUME FROM TD TO SURFACE CASING = 3190 CUBIC FEET	
ANNULAR VOLUME FROM TD TO SURFACE CASING WITH 7 INCH PRODUCTION CASING: 1180 CUBIC FEET	

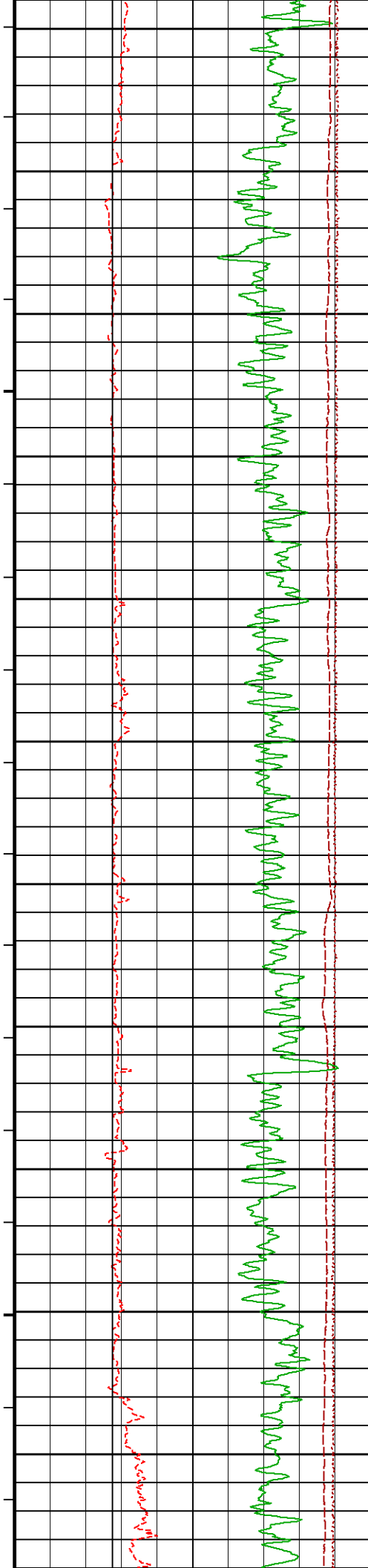
In interpreting, communicating or providing information and/or making recommendations, either written or oral, as to logs or test or other data, type or amount of material, or Work or other service to be furnished, or manner of performance, or in predicting results to be obtained, the Contractor will give the Company the benefit of the Contractor's best judgment based on its experience and will perform all such Work in a good and workmanlike manner. Any interpretation of test or other data, and any recommendation or reservoir description based upon such interpretations, are opinions based upon inferences from measurements and empirical relationships and assumptions, which inferences and assumptions are not infallible, and with respect to which professional engineers and analysts may differ. ACCORDINGLY ANY INTERPRETATION OR RECOMMENDATION RESULTING FROM THE SERVICES WILL BE AT THE SOLE RISK OF THE COMPANY, AND THE CONTRACTOR CANNOT AND DOES NOT WARRANT THE ACCURACY, CORRECTNESS OR COMPLETENESS OF ANY SUCH INTERPRETATION OR RECOMMENDATION, WHICH INTERPRETATIONS AND RECOMMENDATIONS SHOULD NOT, THEREFORE, UNDER ANY CIRCUMSTANCES BE RELIED UPON AS THE SOLE OR MAIN BASIS FOR ANY DRILLING, COMPLETION, WELL TREATMENT, PRODUCTION OR FINANCIAL DECISION, OR ANY PROCEDURE INVOLVING ANY RISK TO THE SAFETY OF ANY DRILLING ACTIVITY, DRILLING RIG OR ITS CREW OR ANY OTHER INDIVIDUAL. THE COMPANY HAS FULL RESPONSIBILITY FOR ALL DECISIONS CONCERNING THE SERVICES.











2700

147°

2800

149°

2900

150°

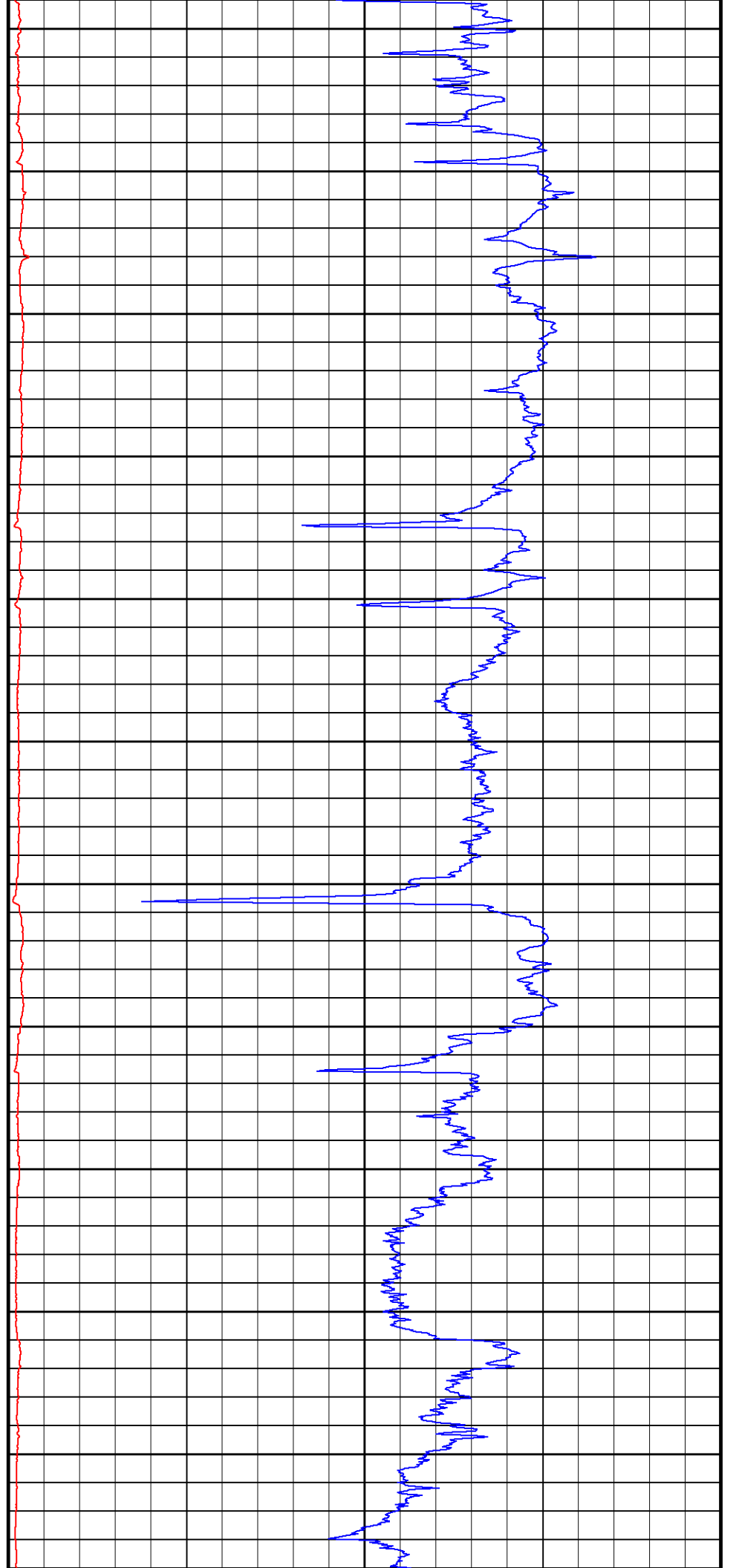
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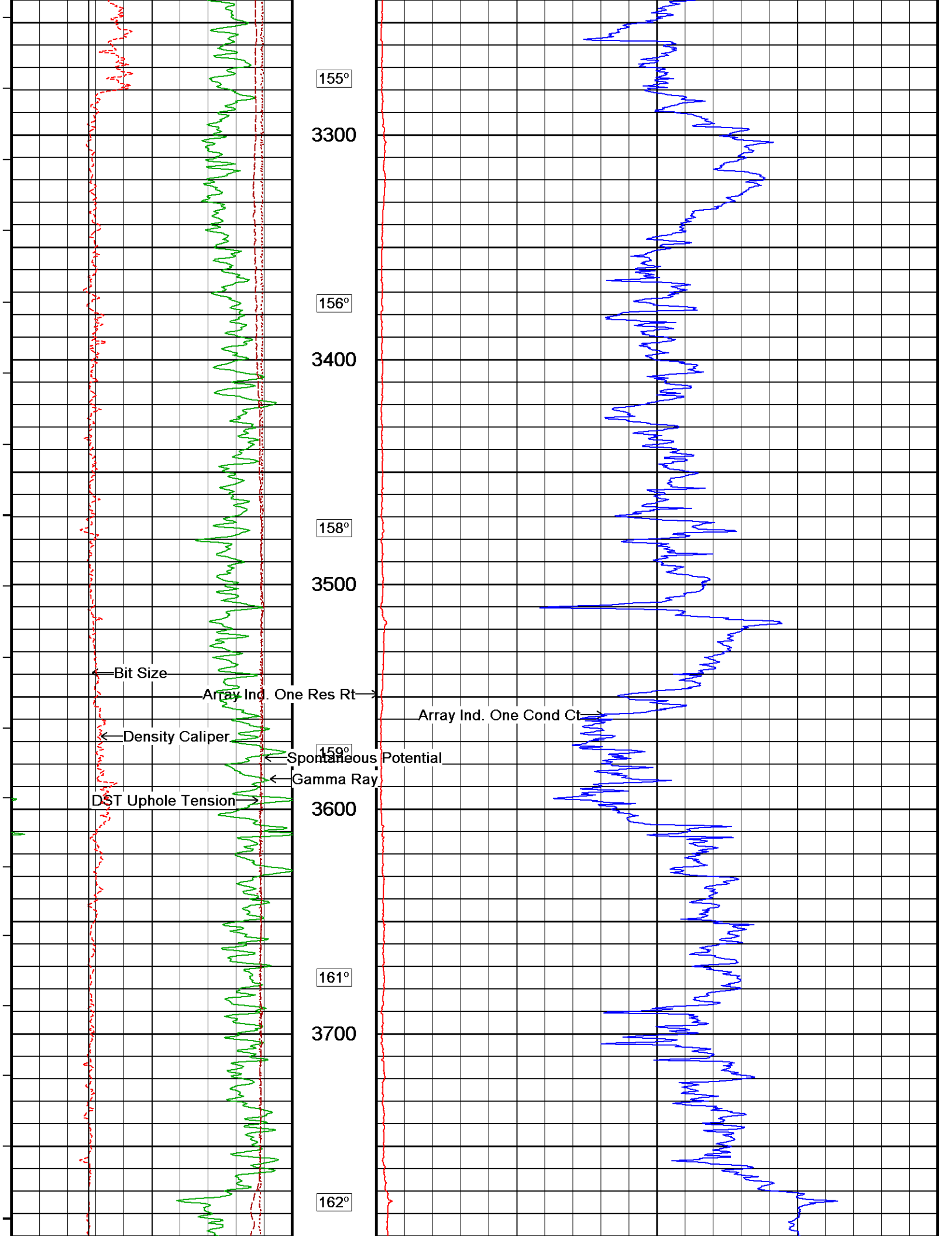
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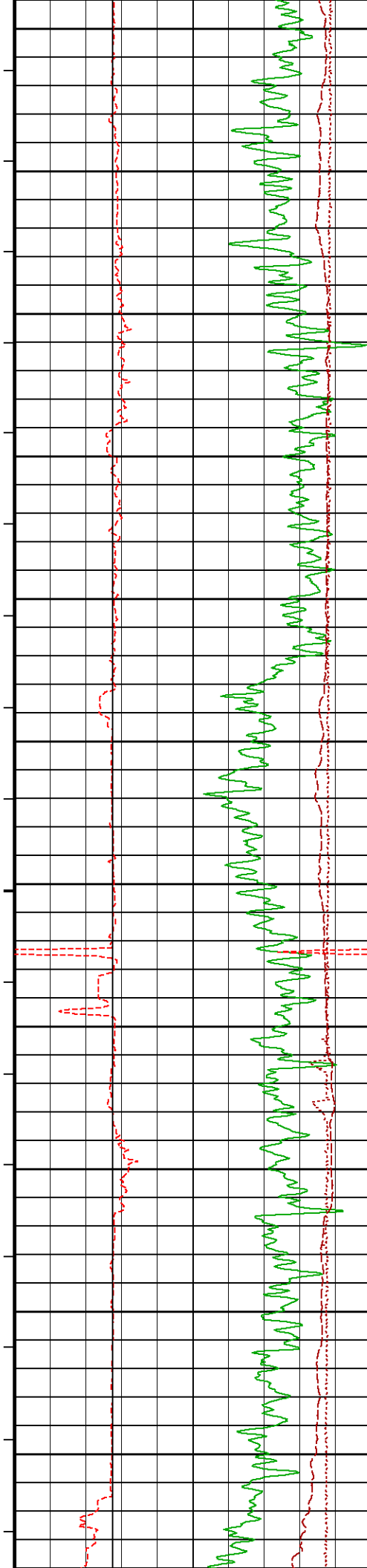
3100

154°

3200







3800

163°

3900

164°

4000

165°

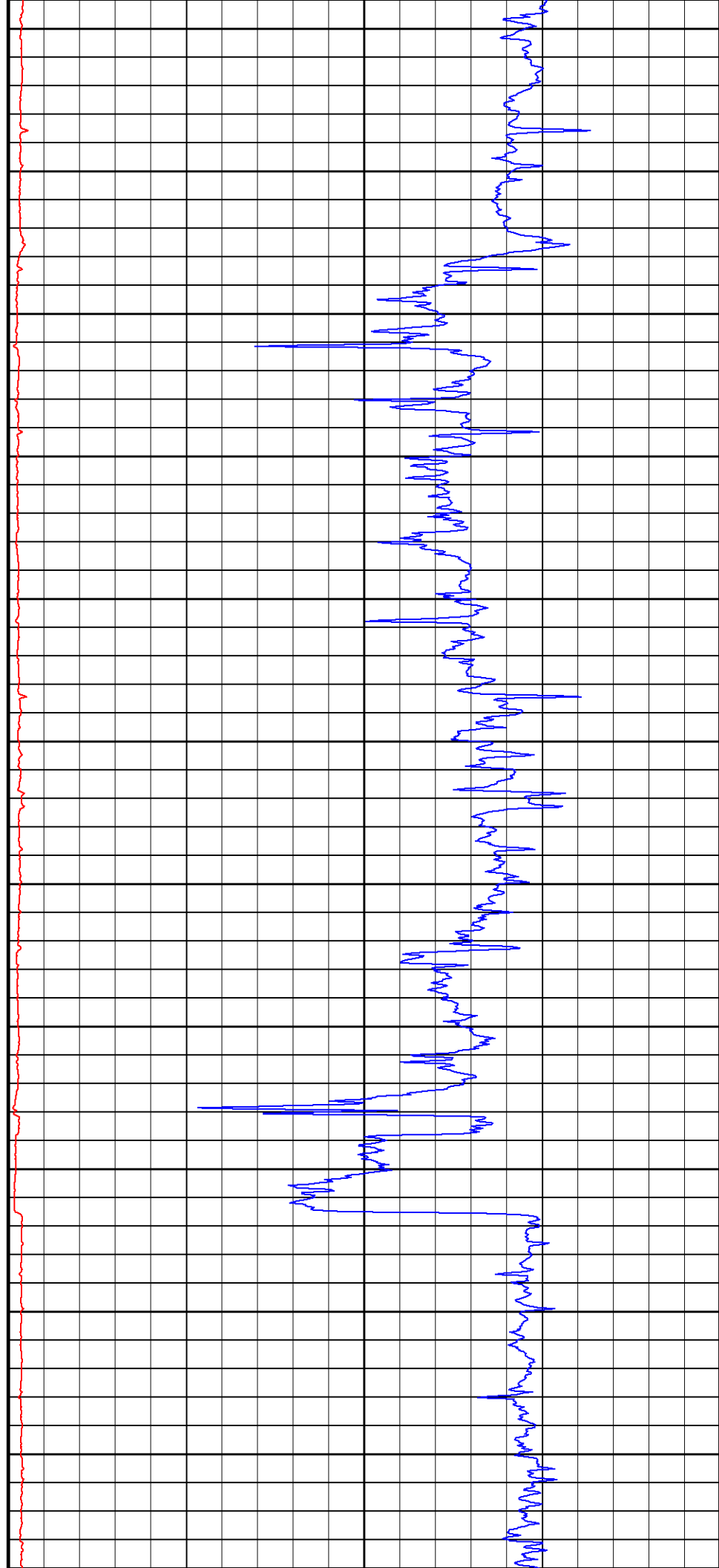
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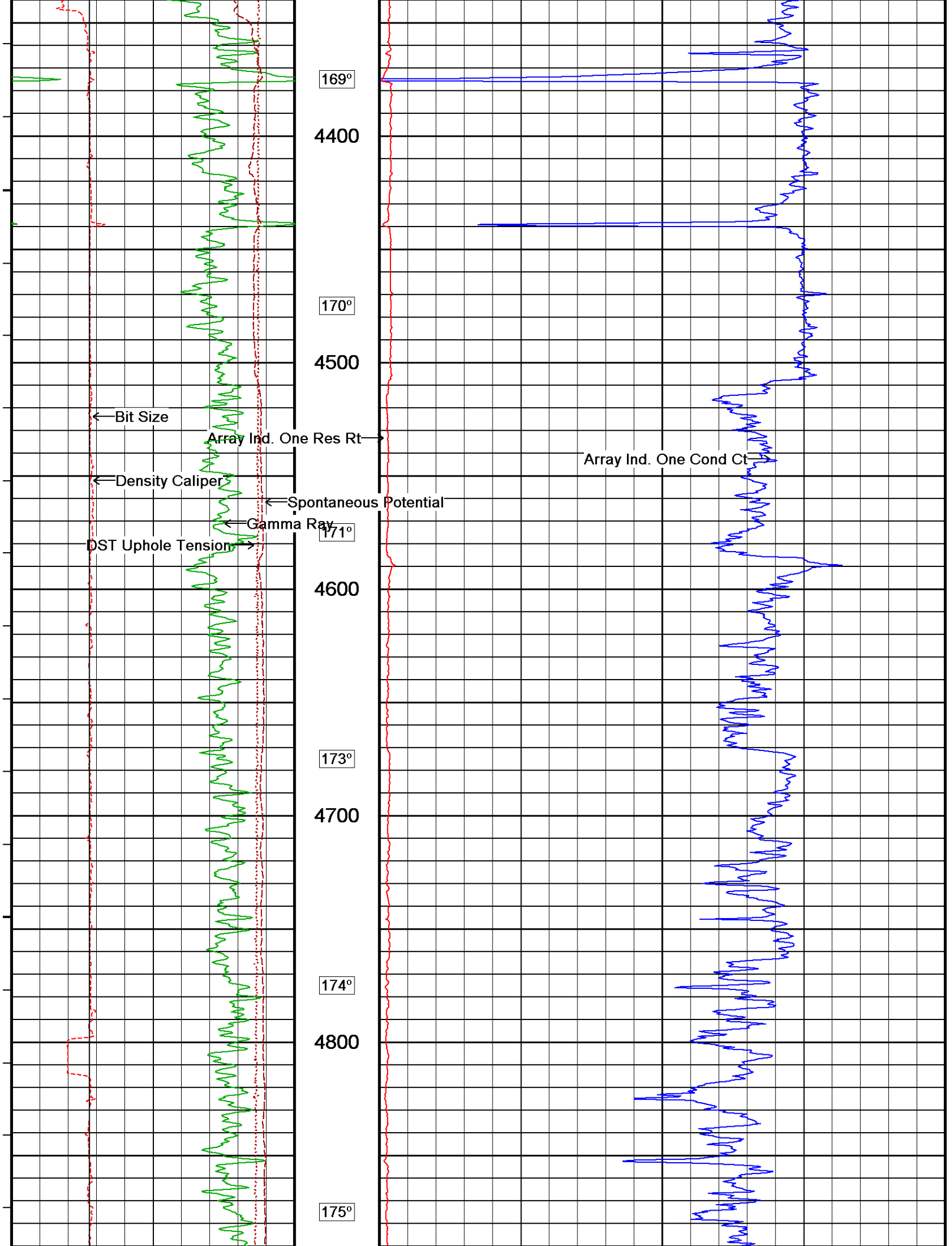
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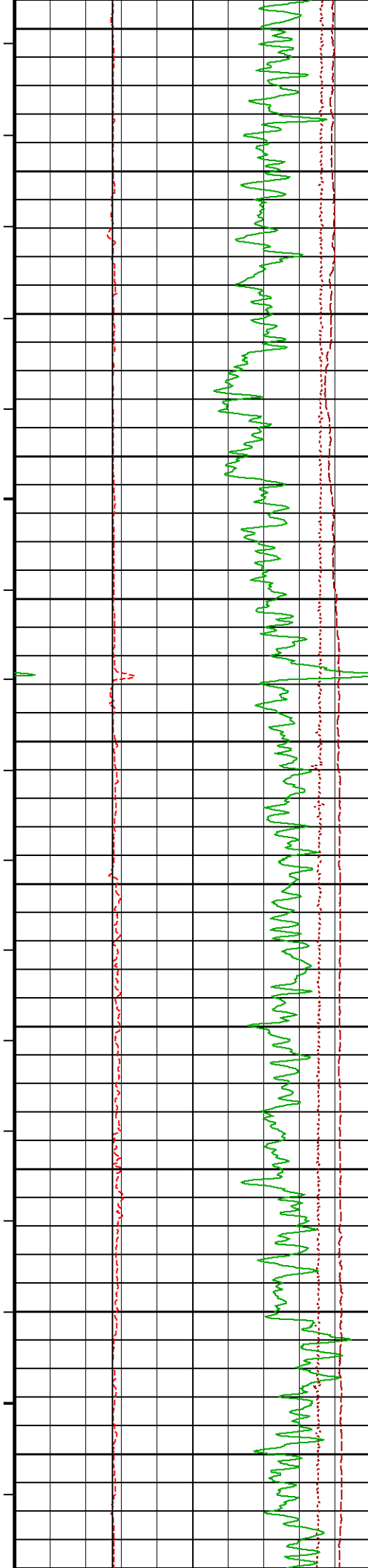
4200

168°

4300







4900

176°

5000

178°

5100

179°

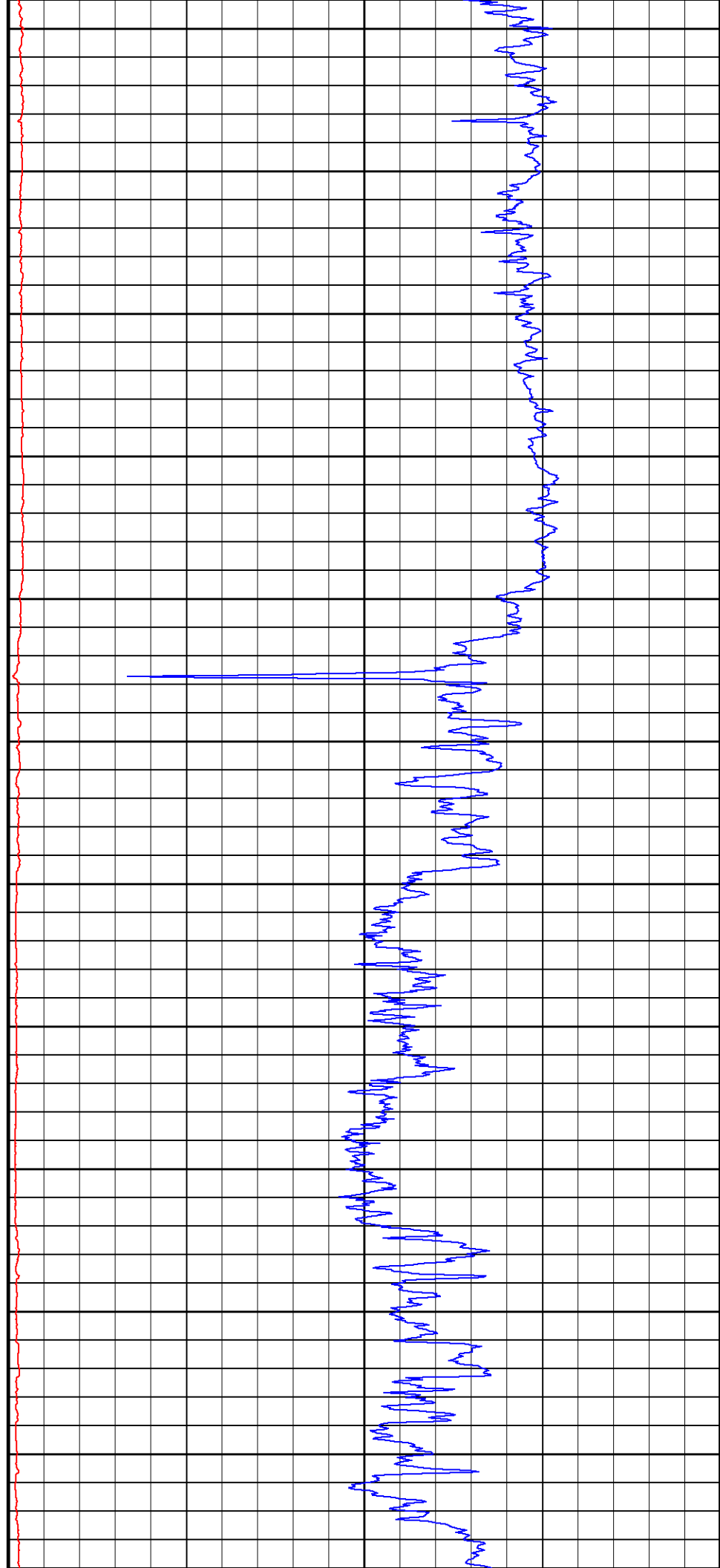
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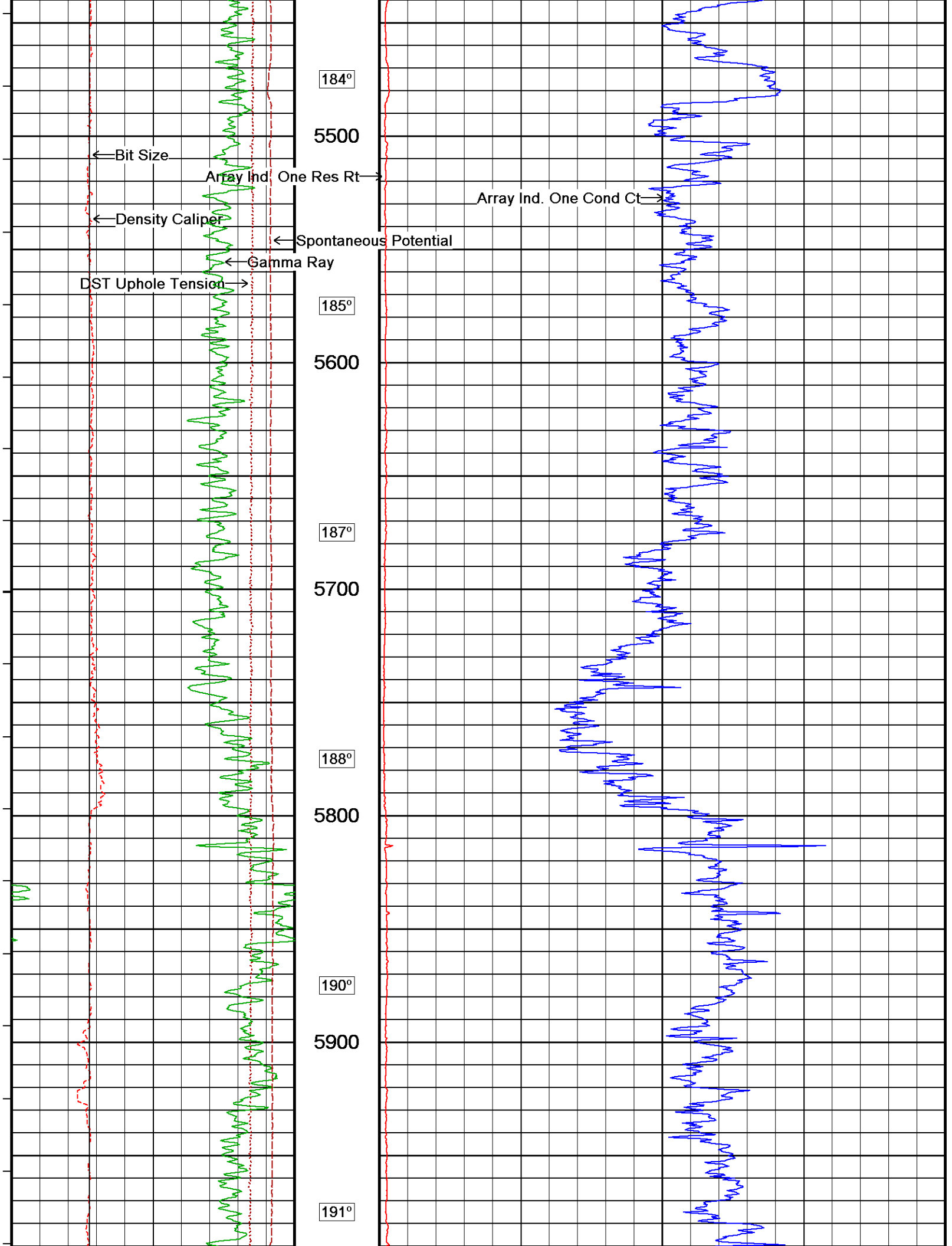
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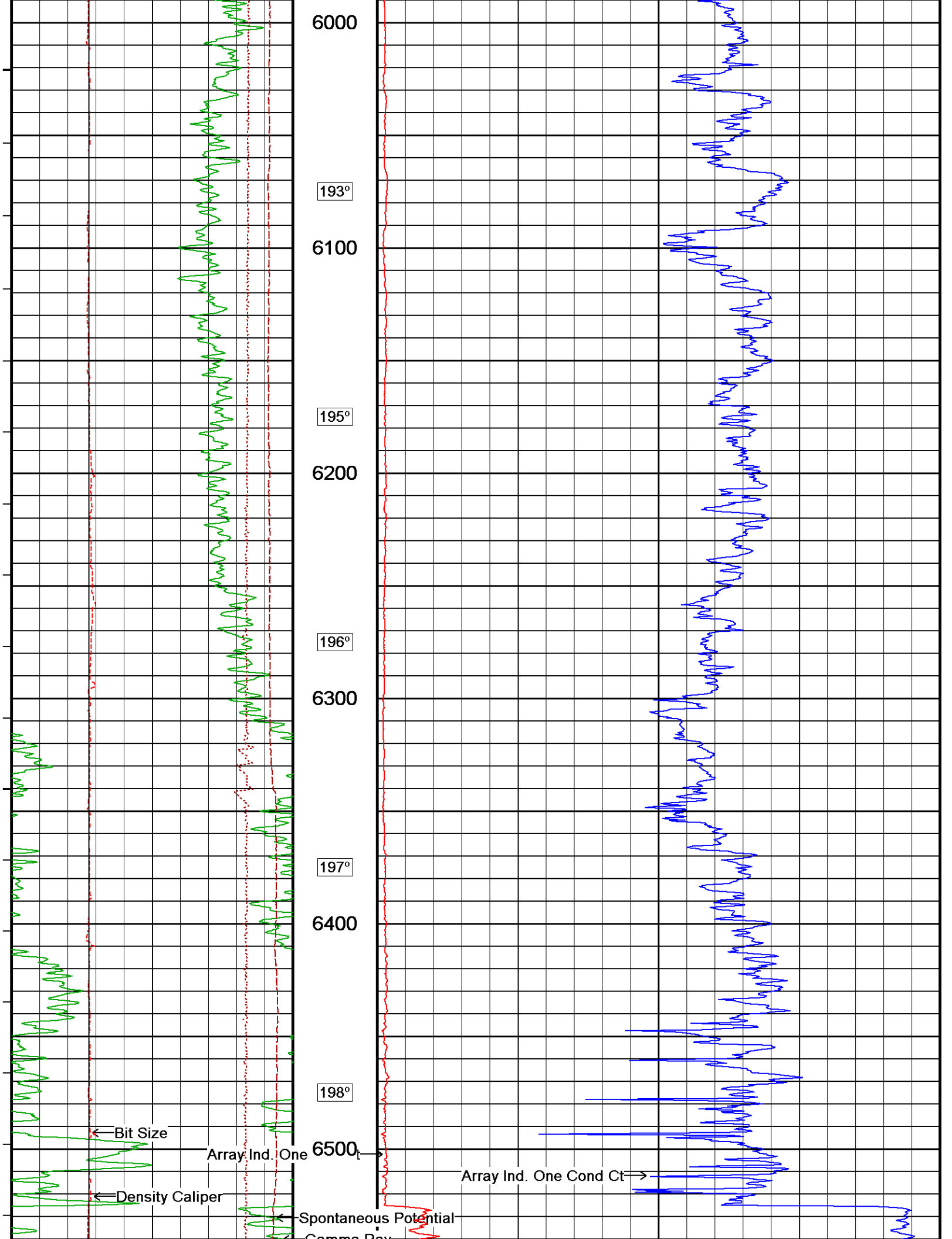
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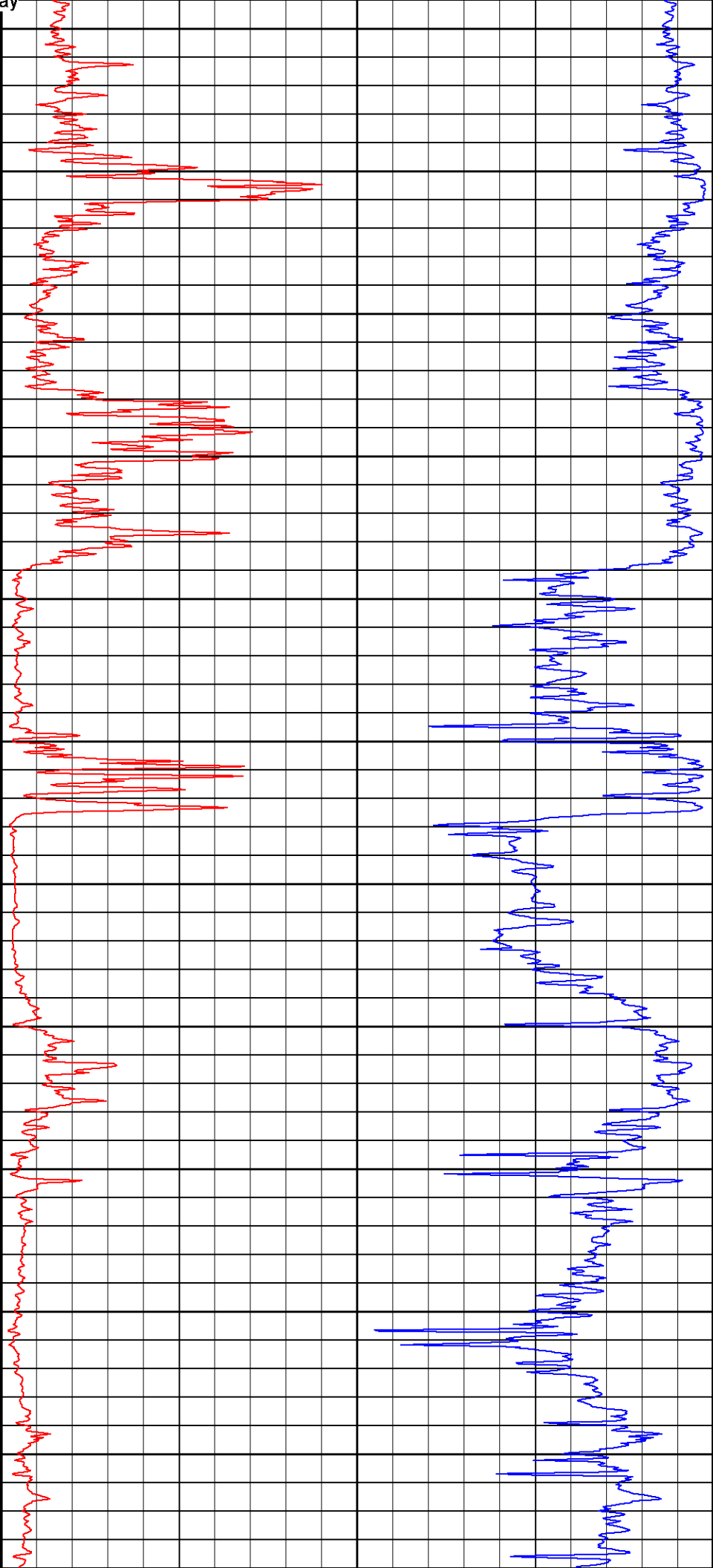
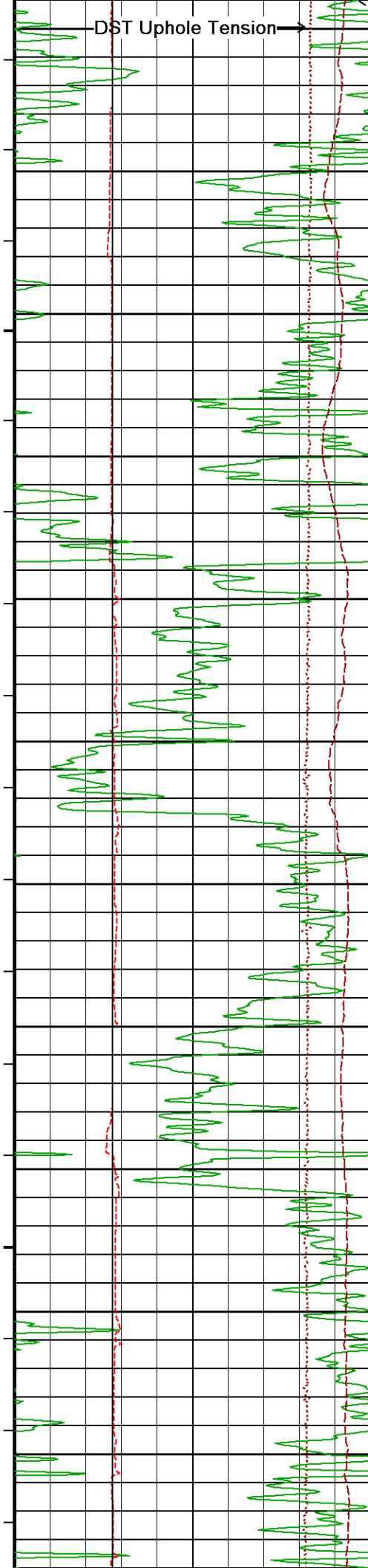
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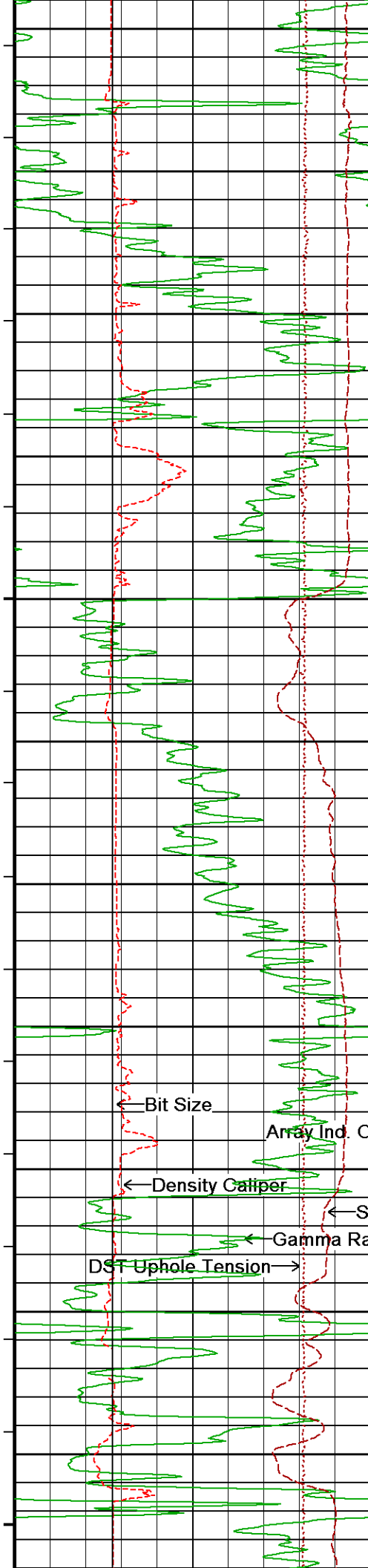
5400











7100

209°

7200

212°

7300

211°

7400

212°

7500

211°

7600

← Bit Size

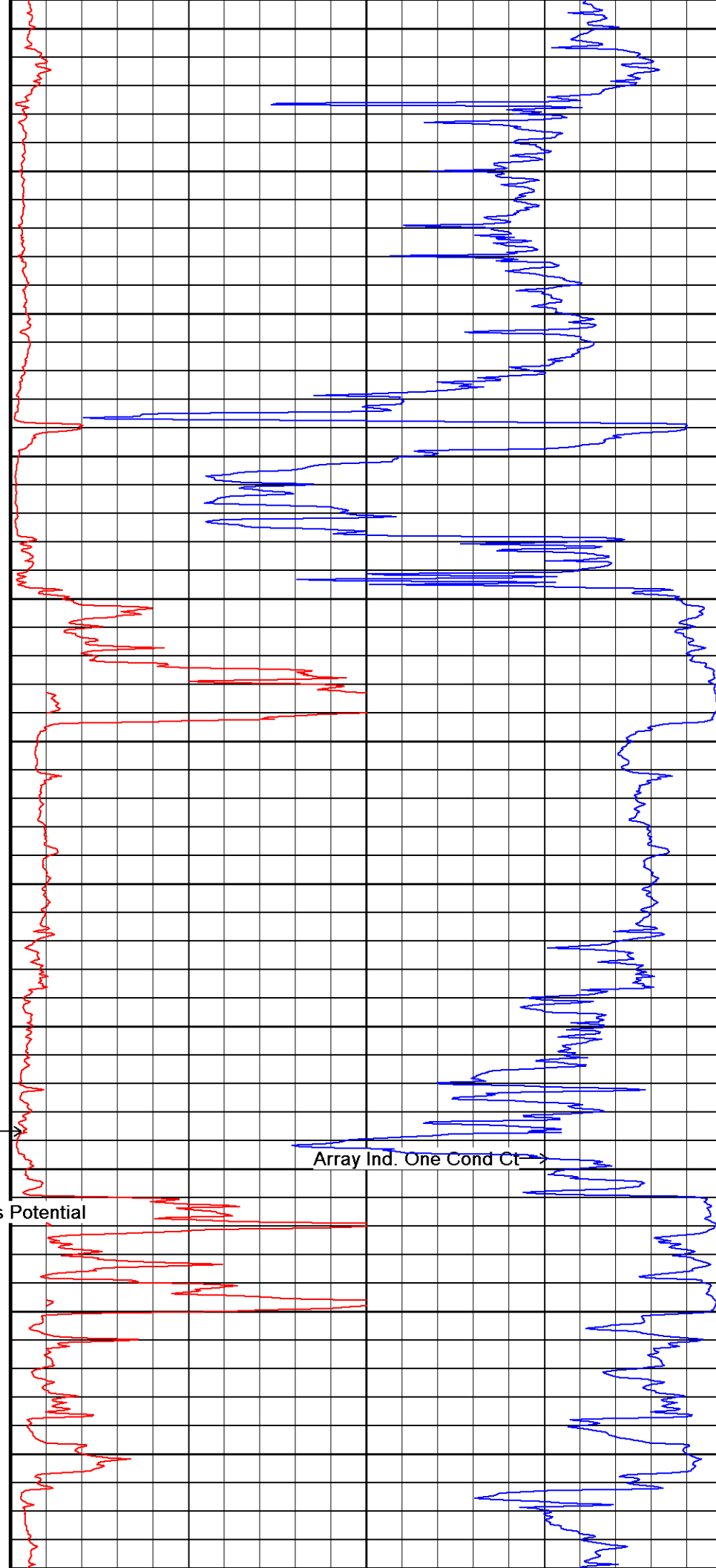
Array Ind. One Res Rt →

← Density

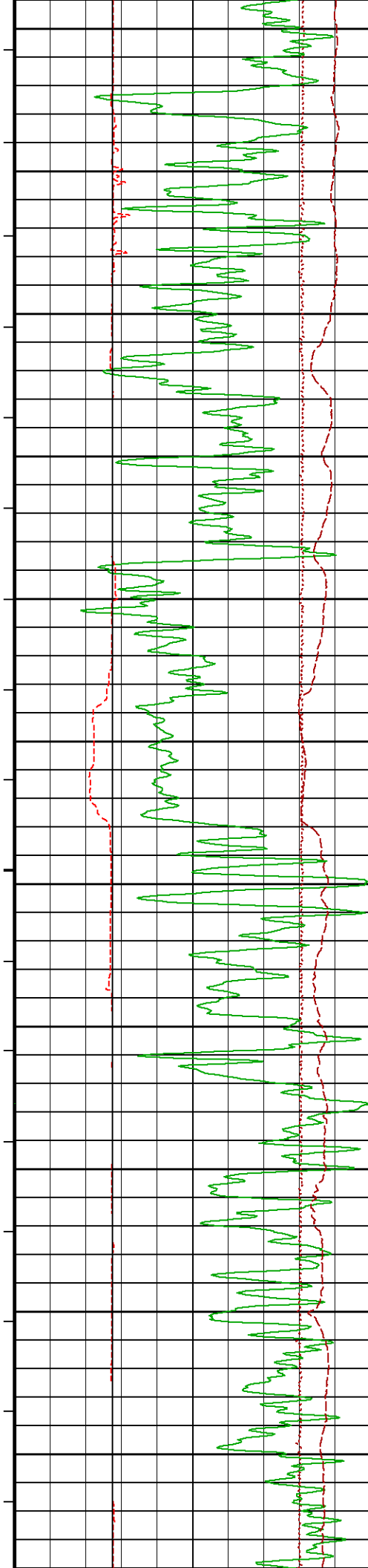
← Spontaneous Potential

← Gamma Ray

DST Uphole Tension →



Array Ind. One Cond Ct →



212°

7700

214°

7800

218°

7900

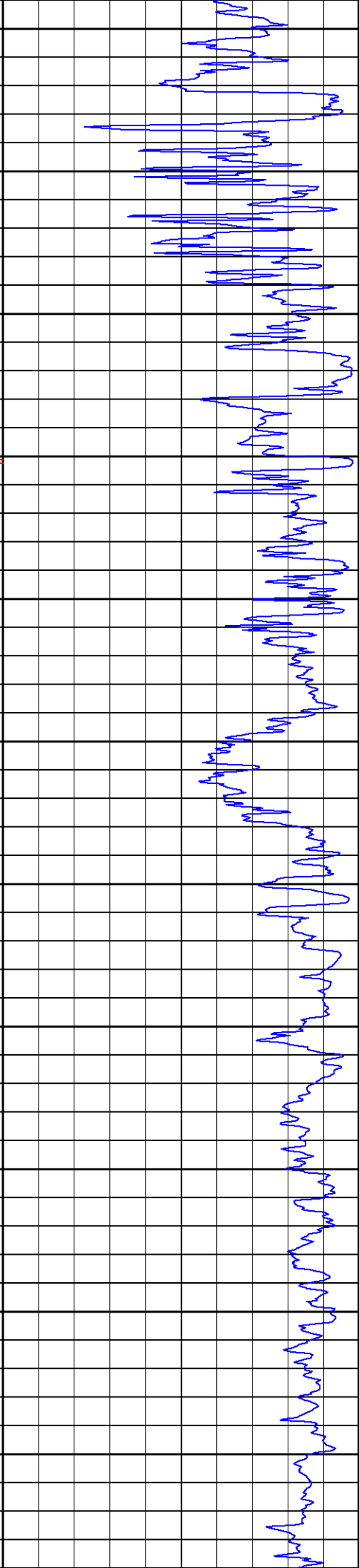
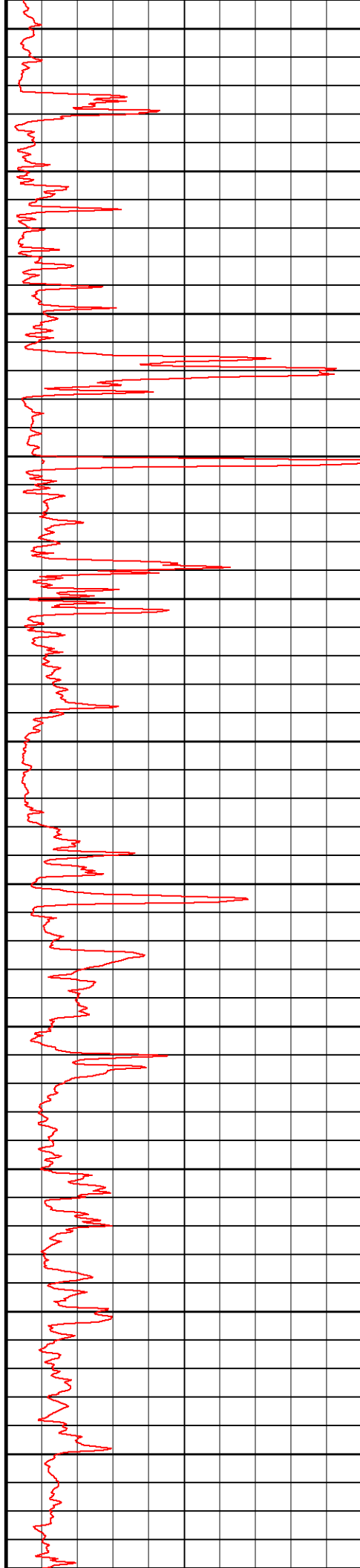
219°

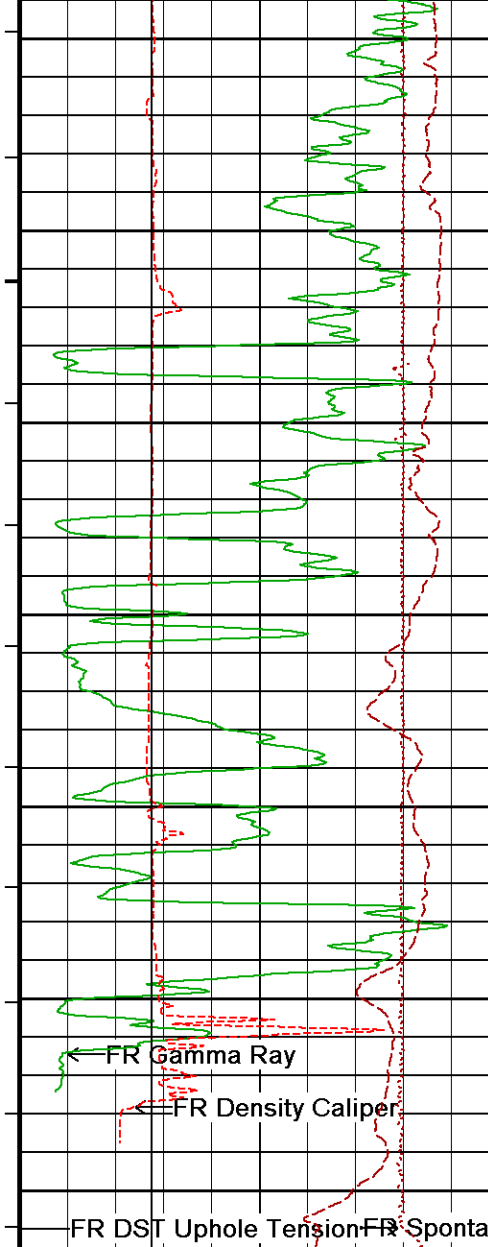
8000

220°

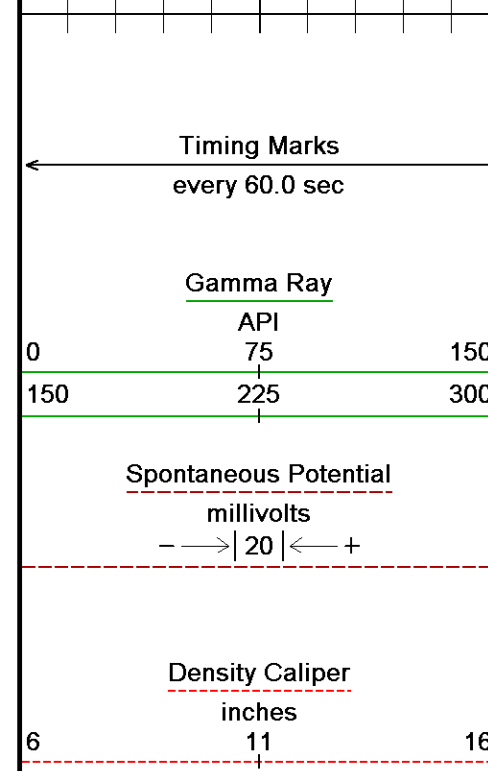
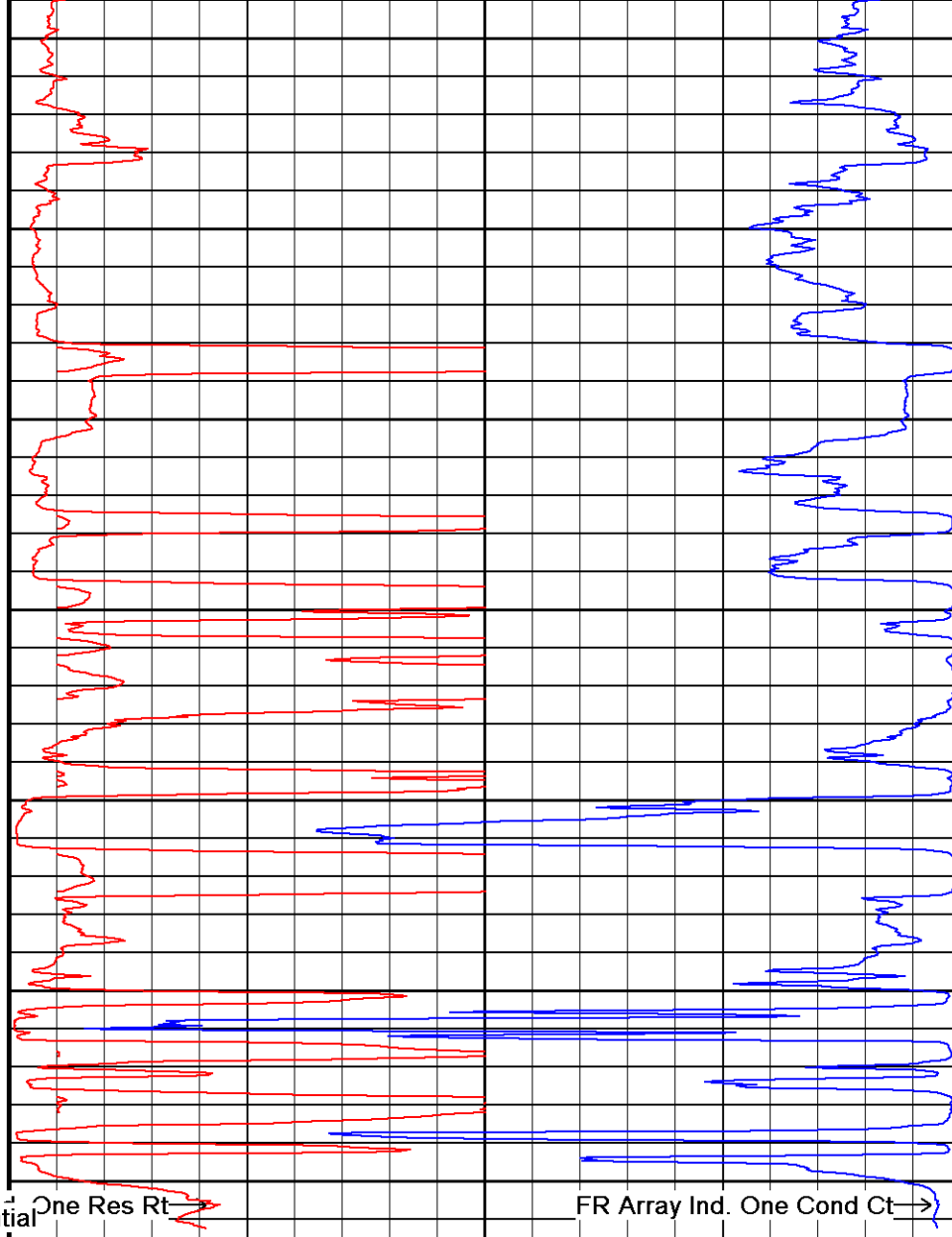
8100

222°

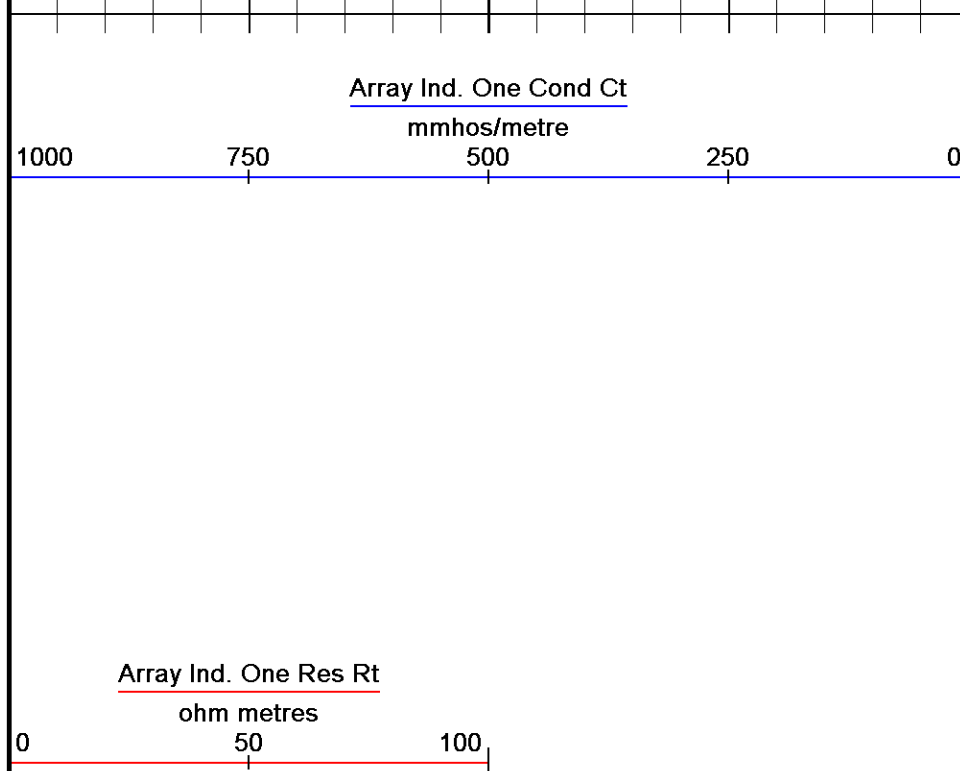


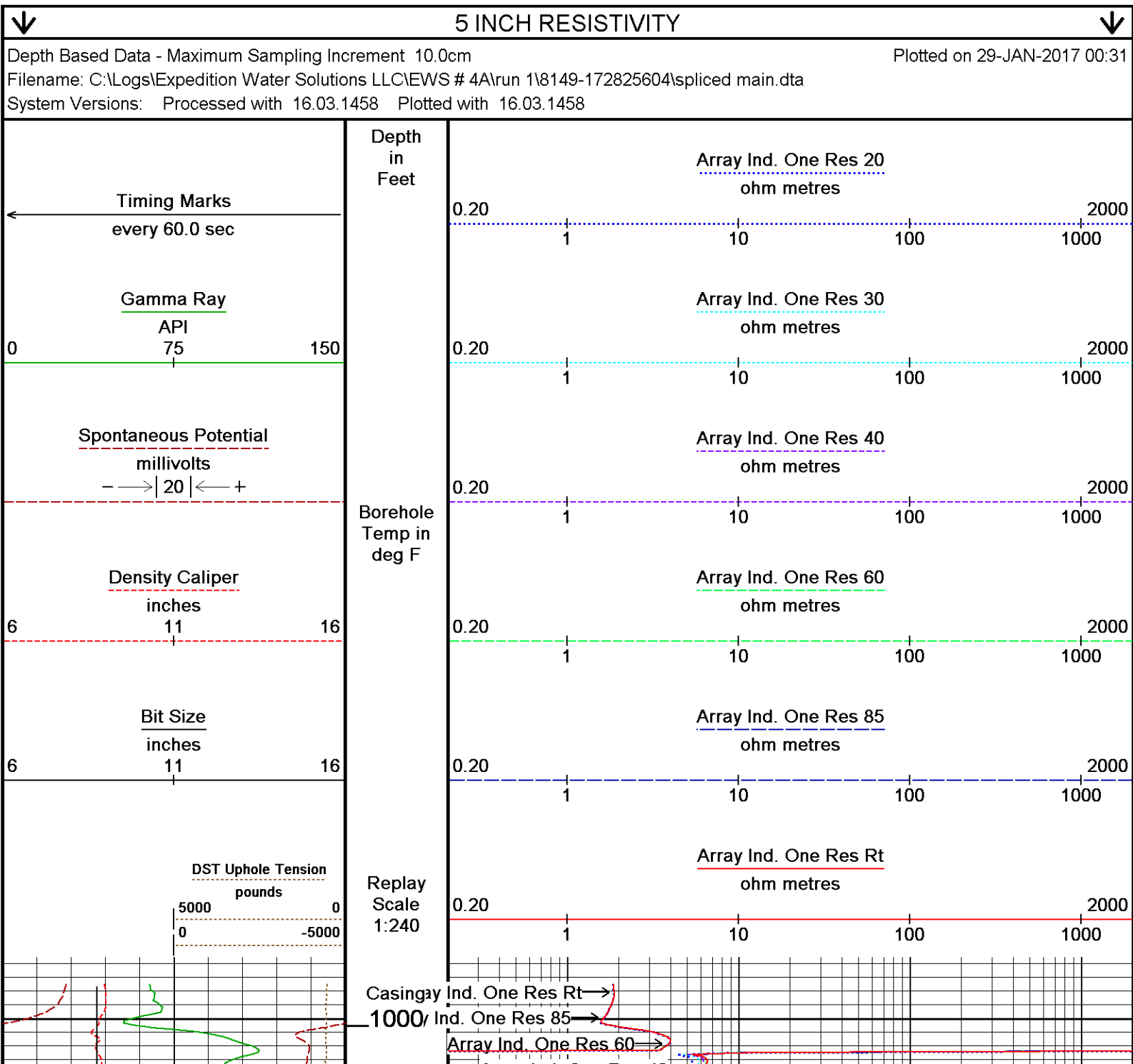
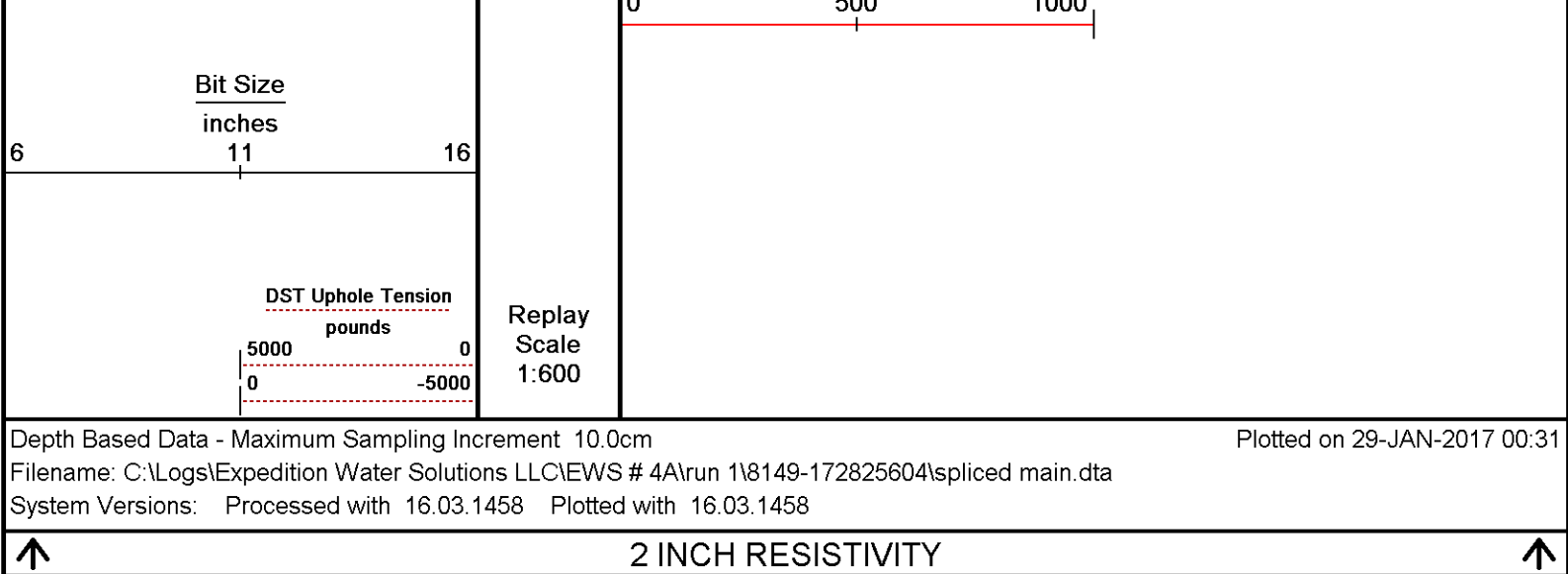


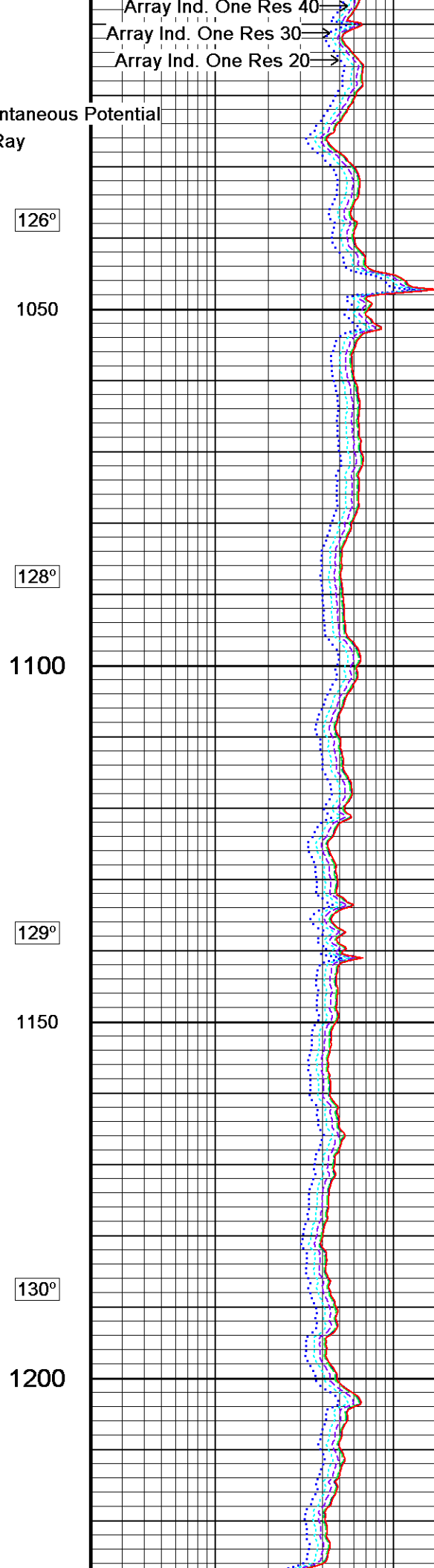
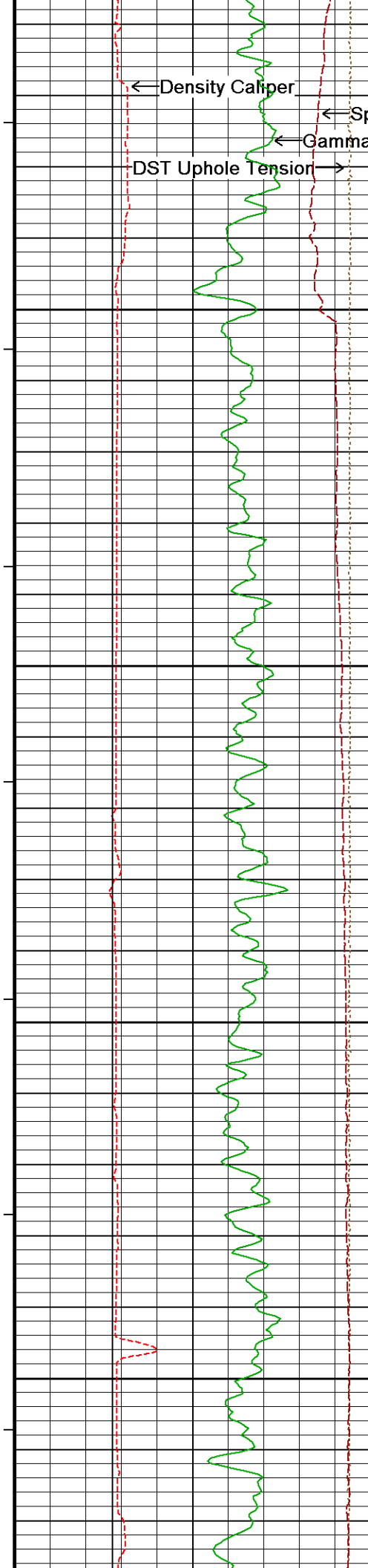
8200
 223°
 8300
 224°
 8400
 224°
 8500

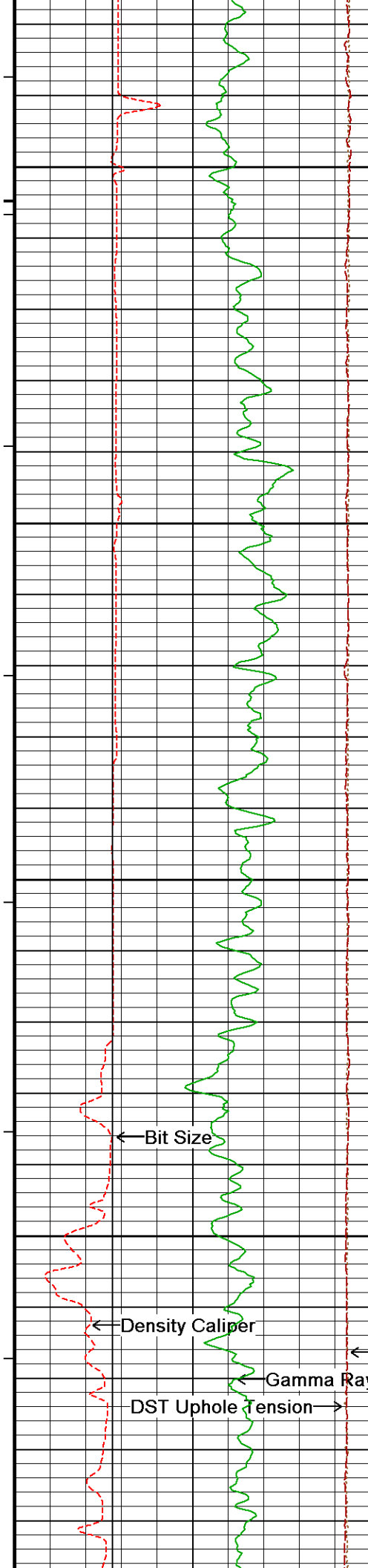


Depth
 in
 Feet
 Borehole
 Temp in
 deg F









130°

1250

130°

1300

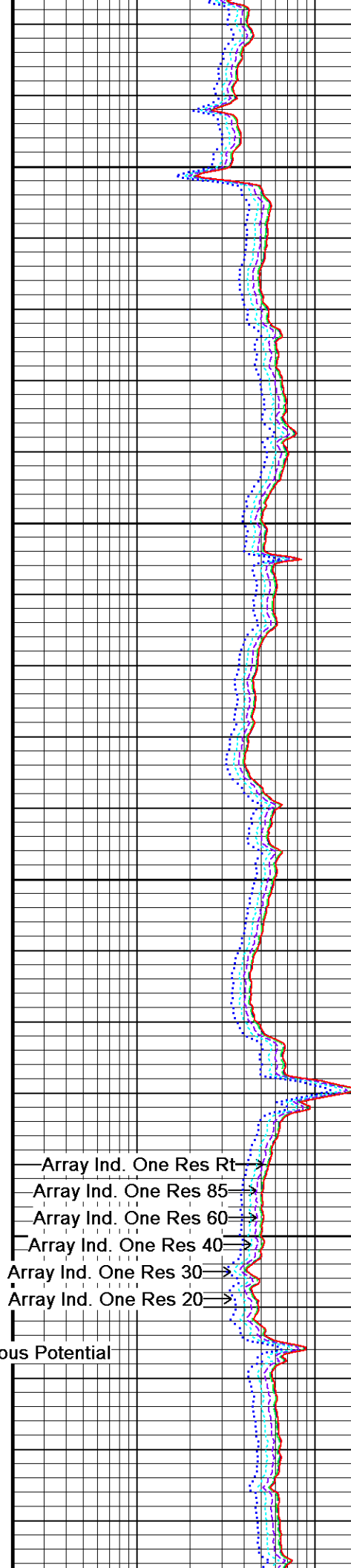
130°

1350

130°

1400

131°



Array Ind. One Res Rt

Array Ind. One Res 85

Array Ind. One Res 60

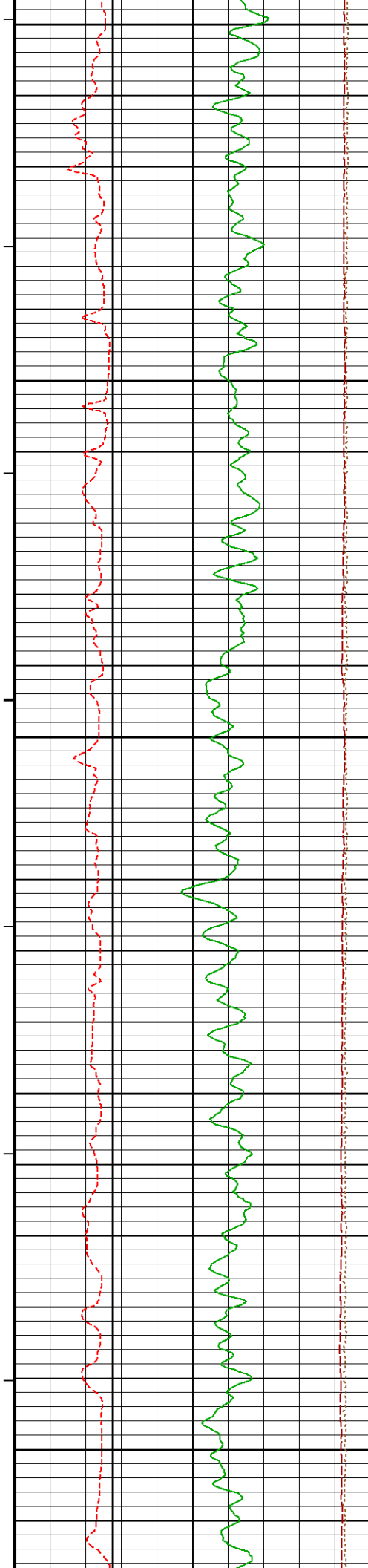
Array Ind. One Res 40

Array Ind. One Res 30

Array Ind. One Res 20

Spontaneous Potential

DST Uphole Tension



1450

131°

1500

132°

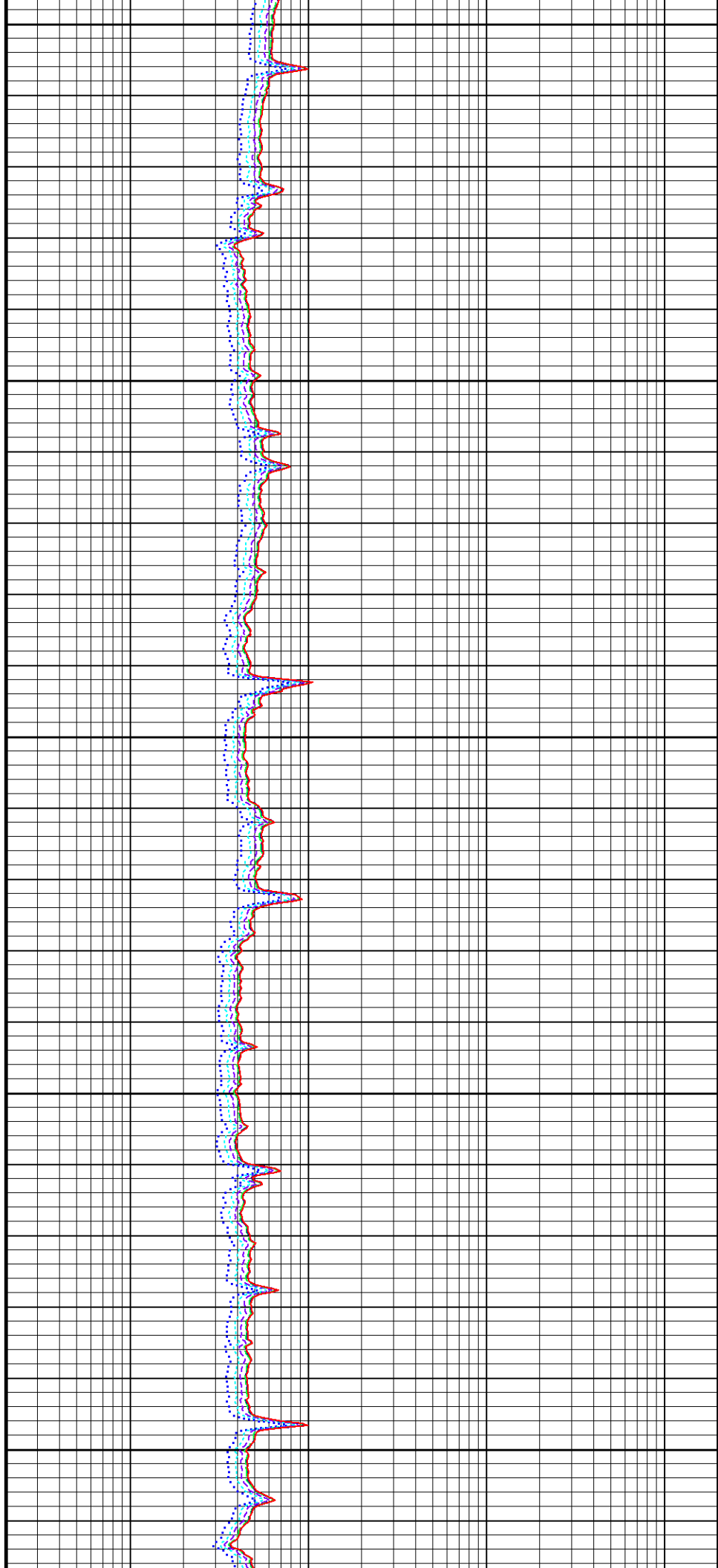
1550

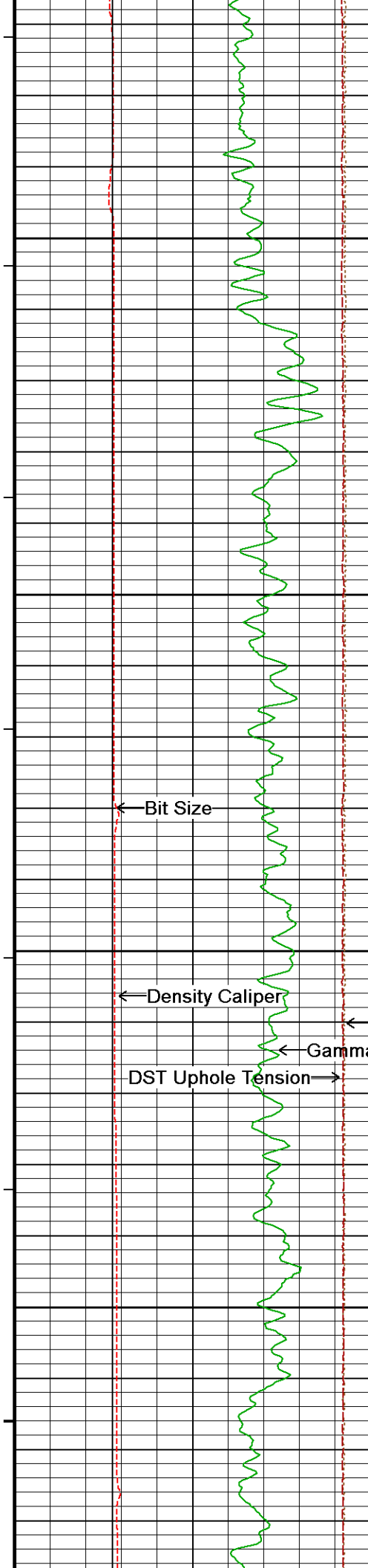
132°

1600

133°

1650





133°

1700

133°

1750

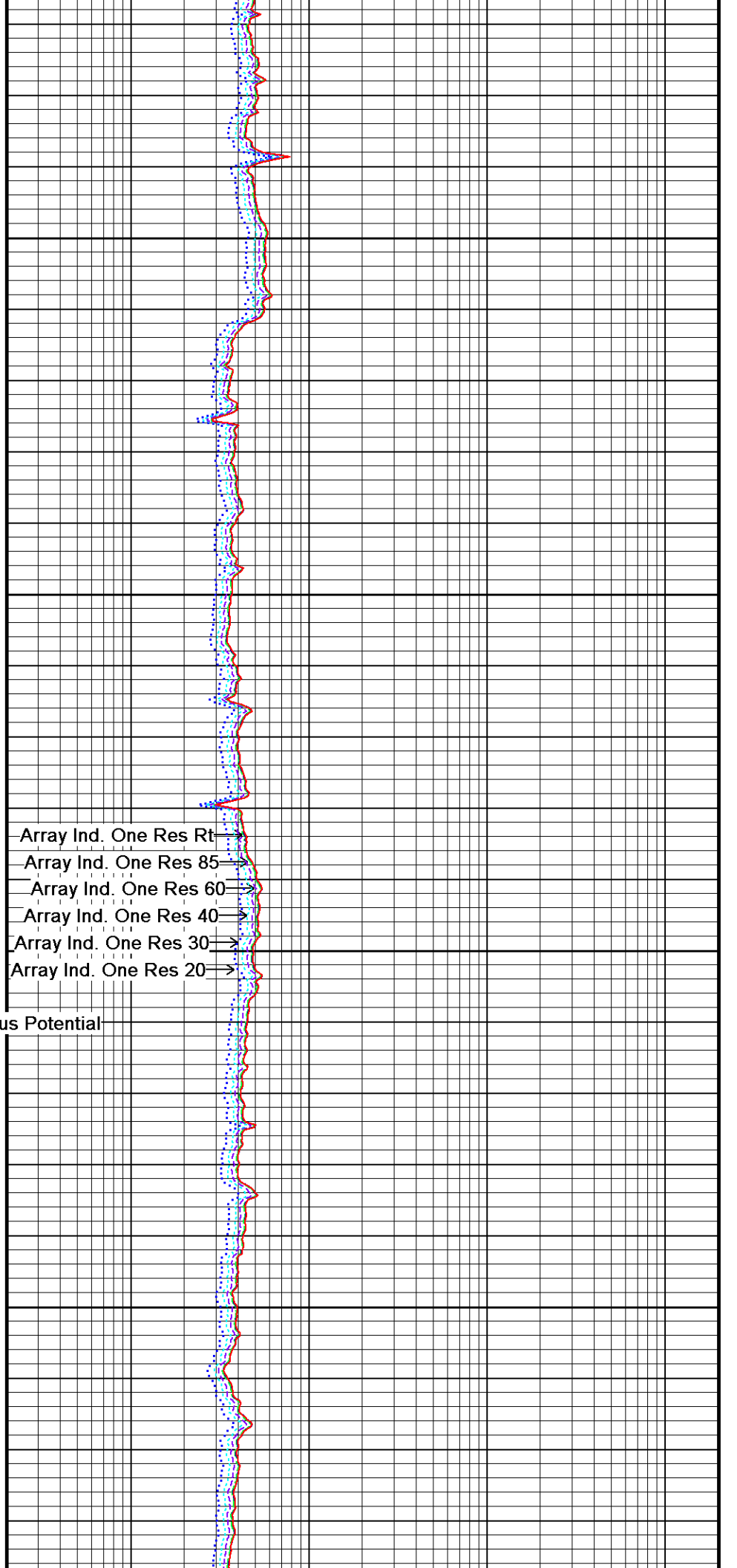
134°

1800

135°

1850

1900



Array Ind. One Res Rt
Array Ind. One Res 85
Array Ind. One Res 60
Array Ind. One Res 40
Array Ind. One Res 30
Array Ind. One Res 20

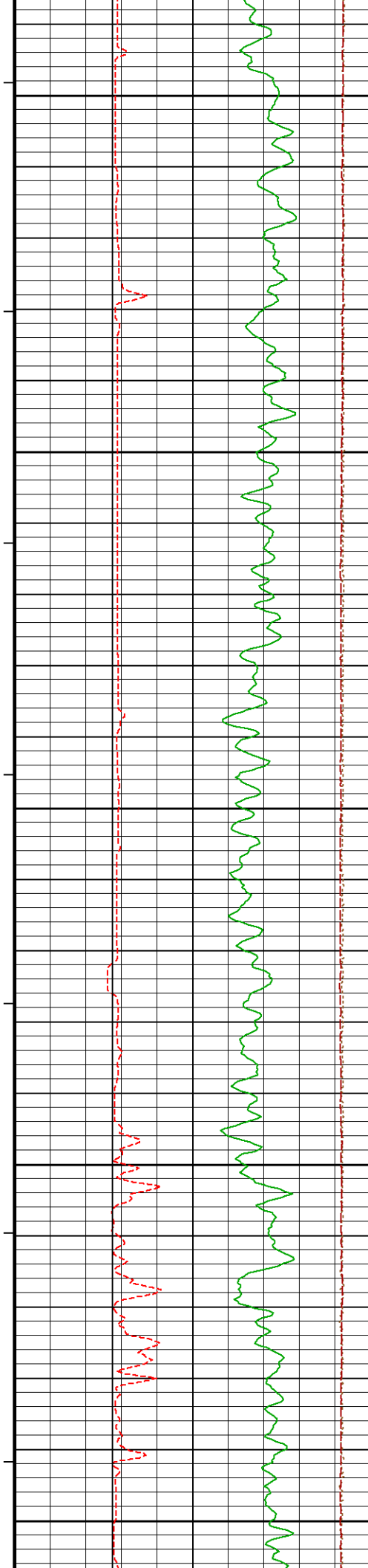
← Bit Size

← Density Caliper

← Spontaneous Potential

← Gamma Ray

DST Uphole Tension →



136°

1900

137°

1950

138°

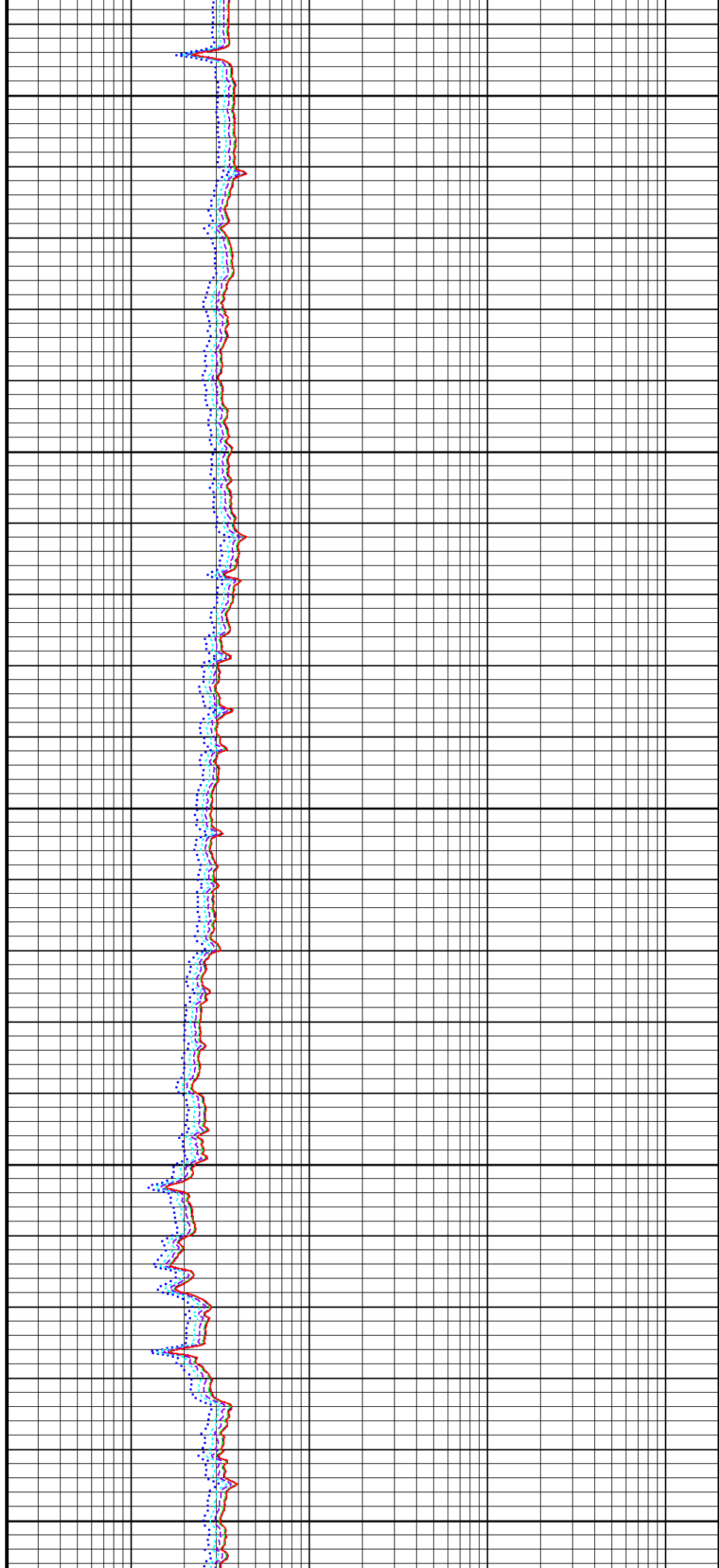
2000

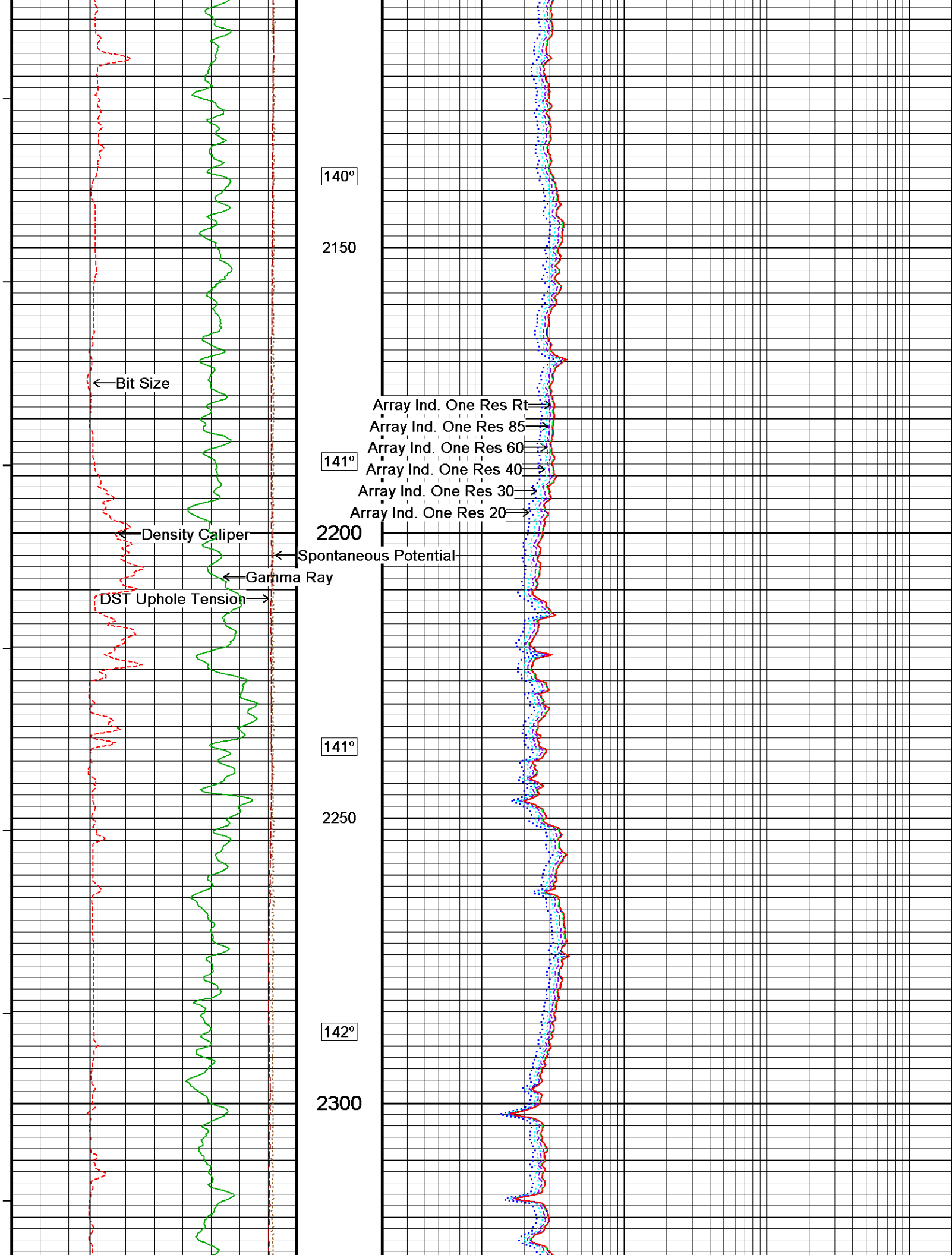
139°

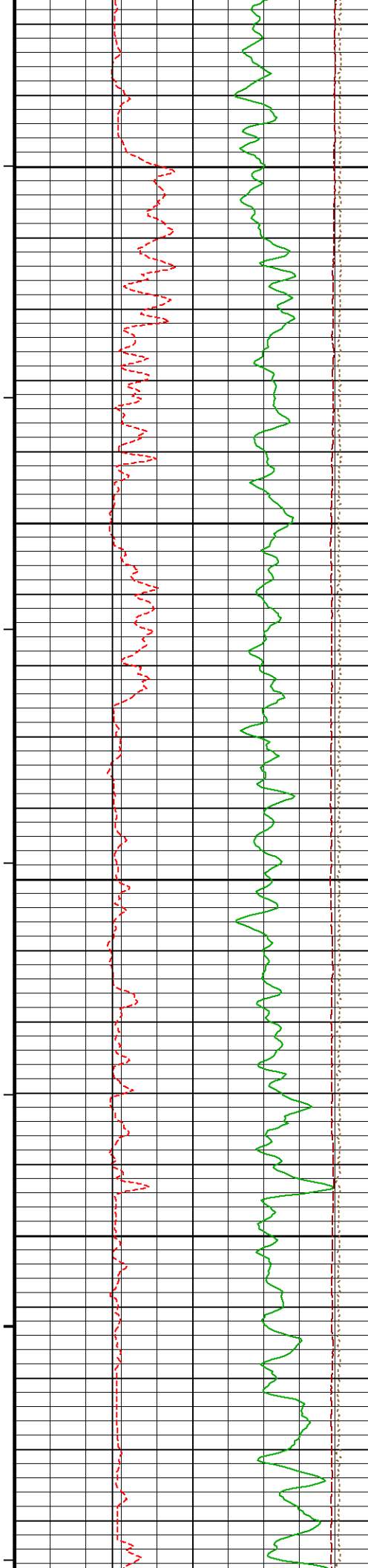
2050

139°

2100







143°

2350

143°

2400

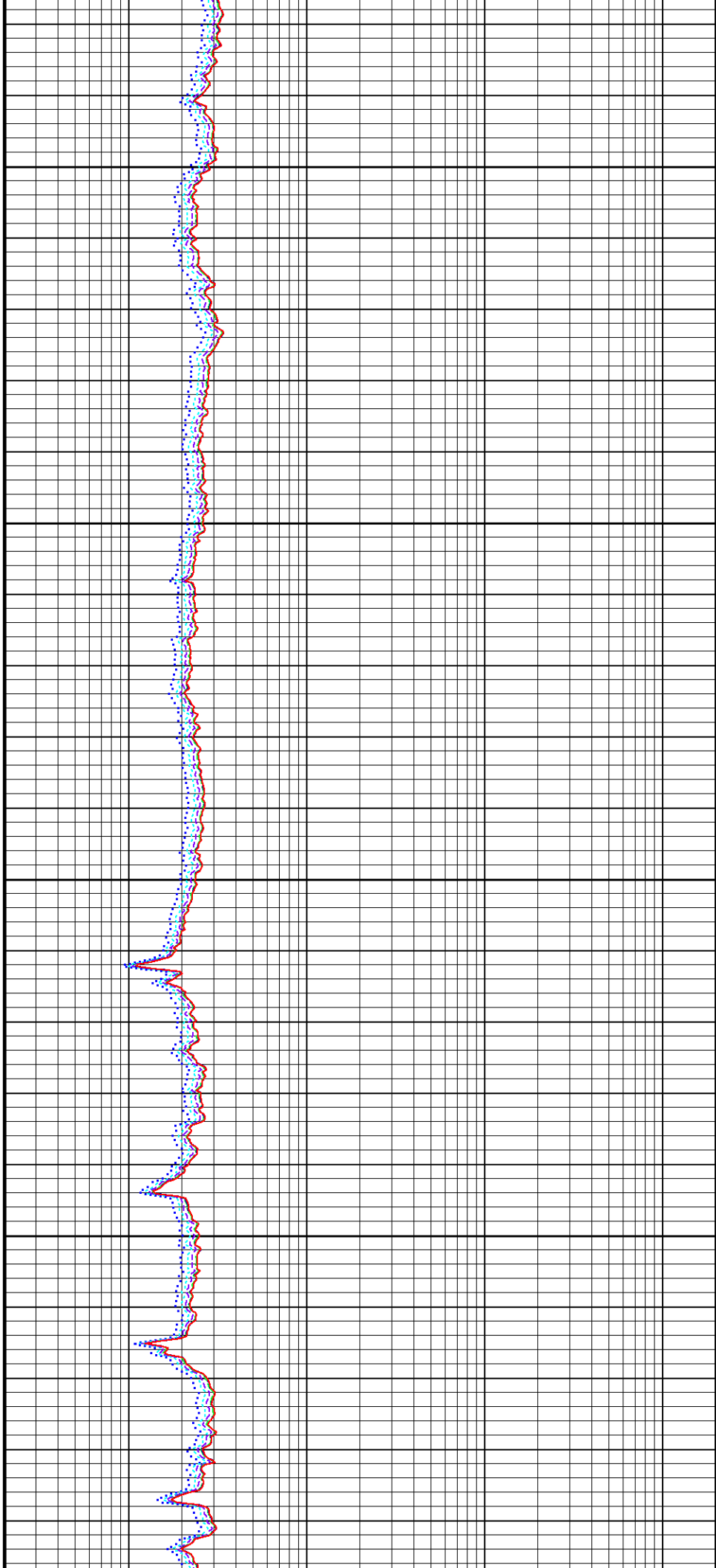
144°

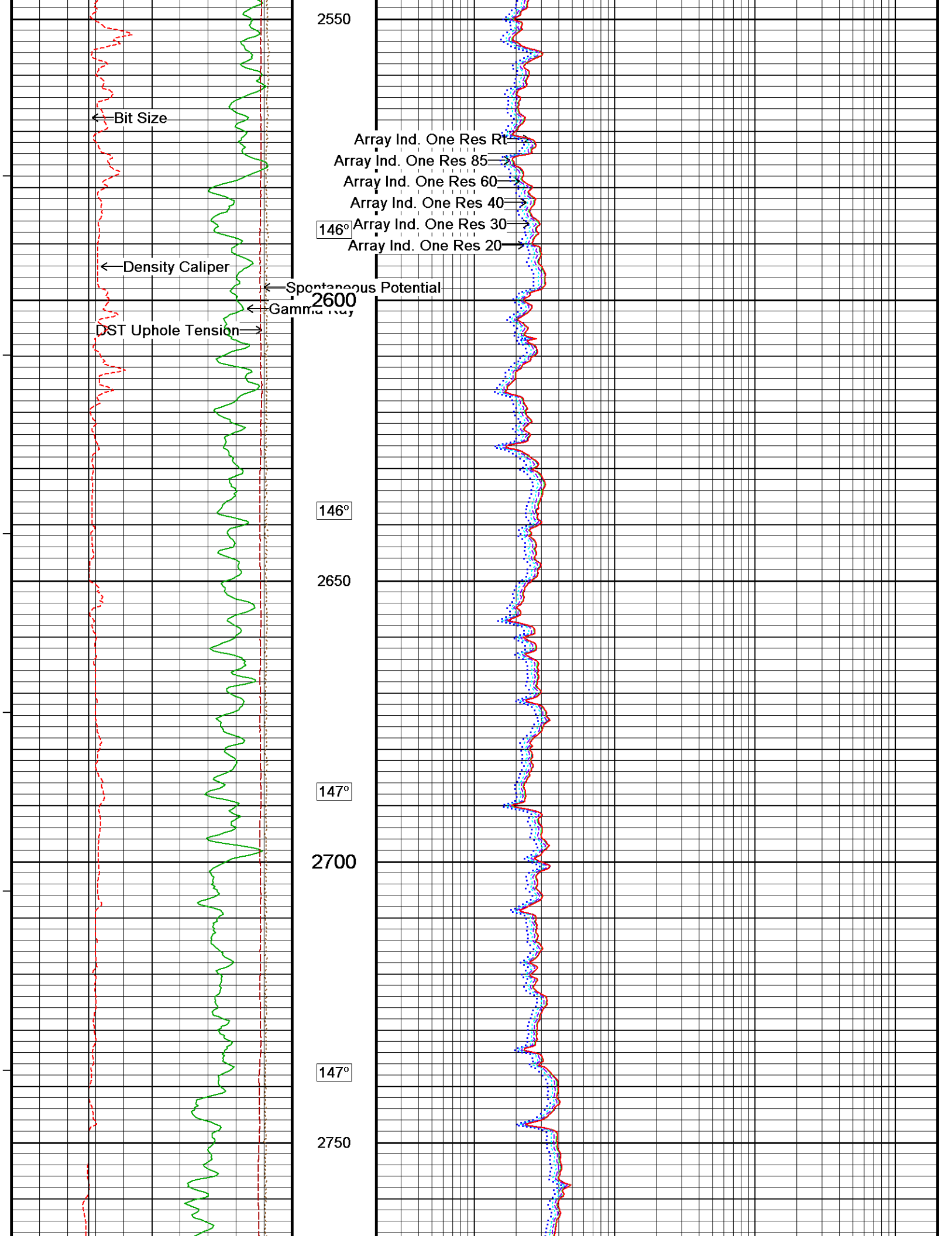
2450

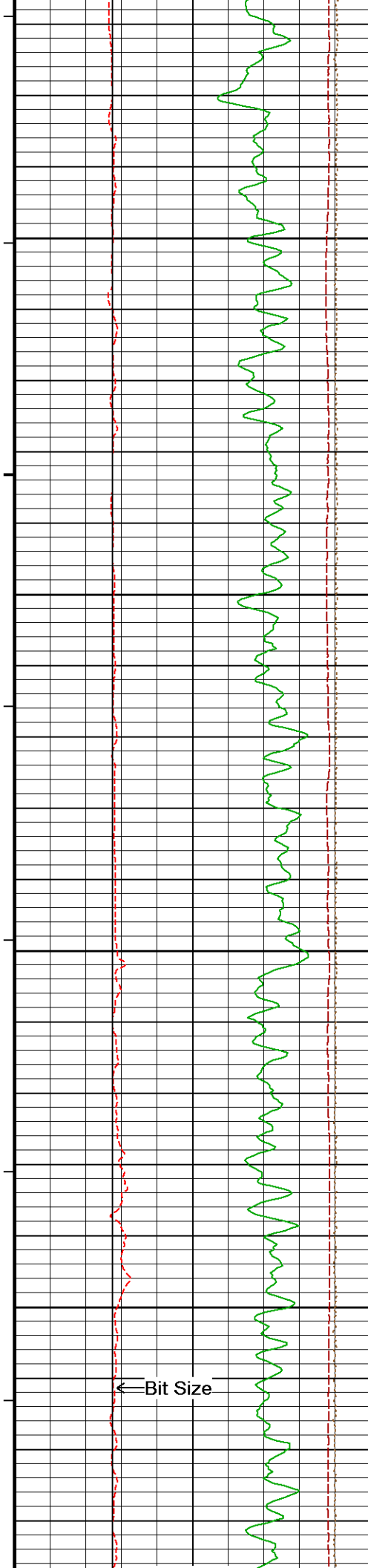
145°

2500

145°







148°

2800

148°

2850

149°

2900

150°

2950

Array Ind. One Res Rt →

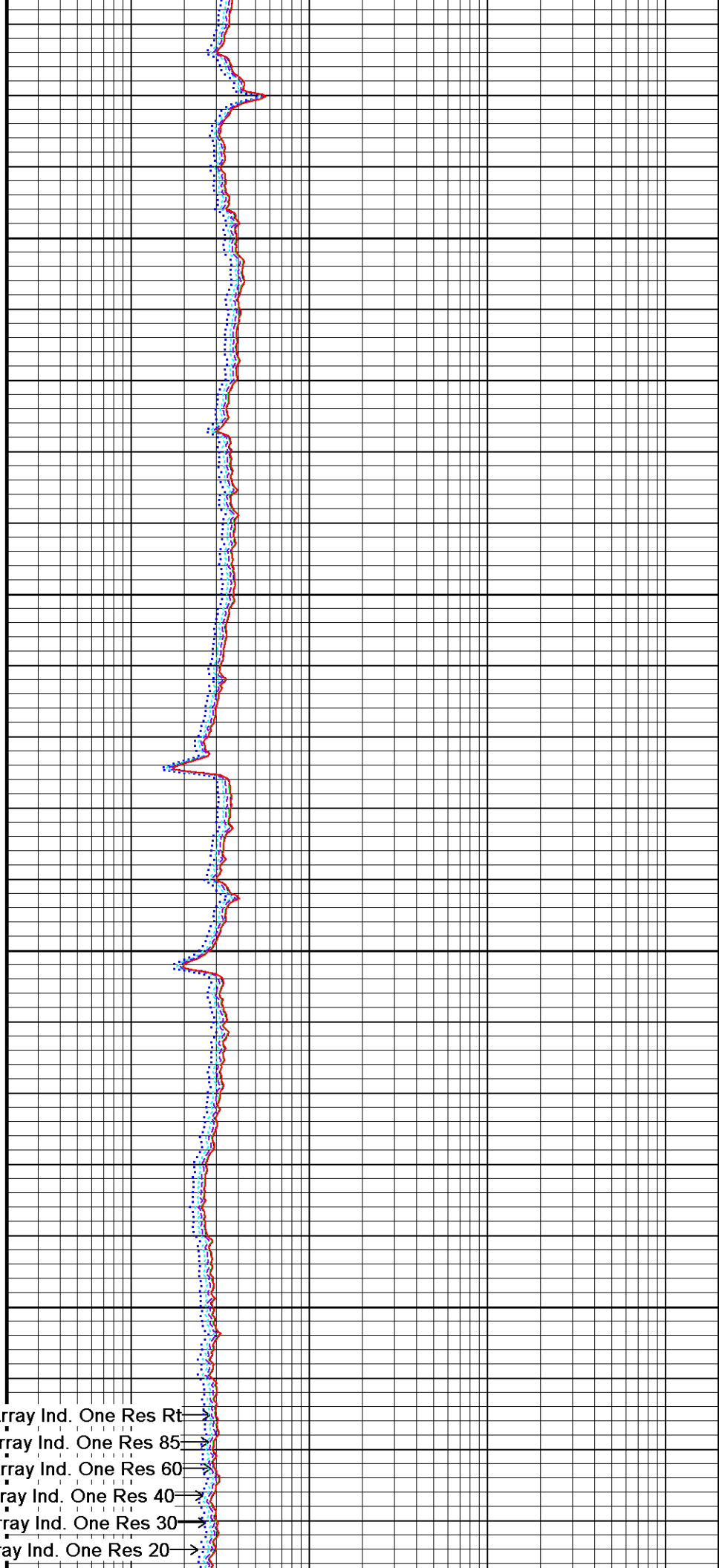
Array Ind. One Res 85 →

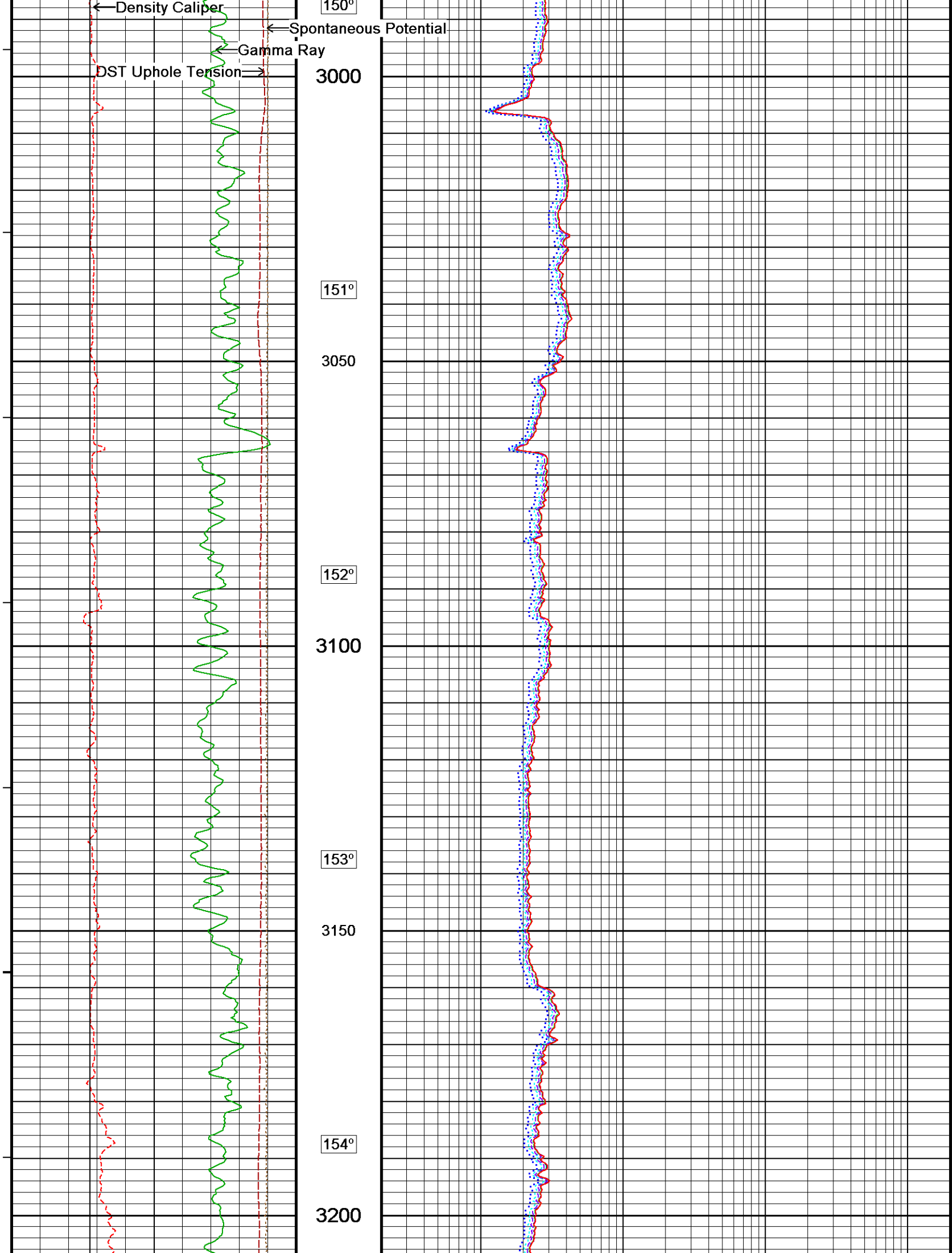
Array Ind. One Res 60 →

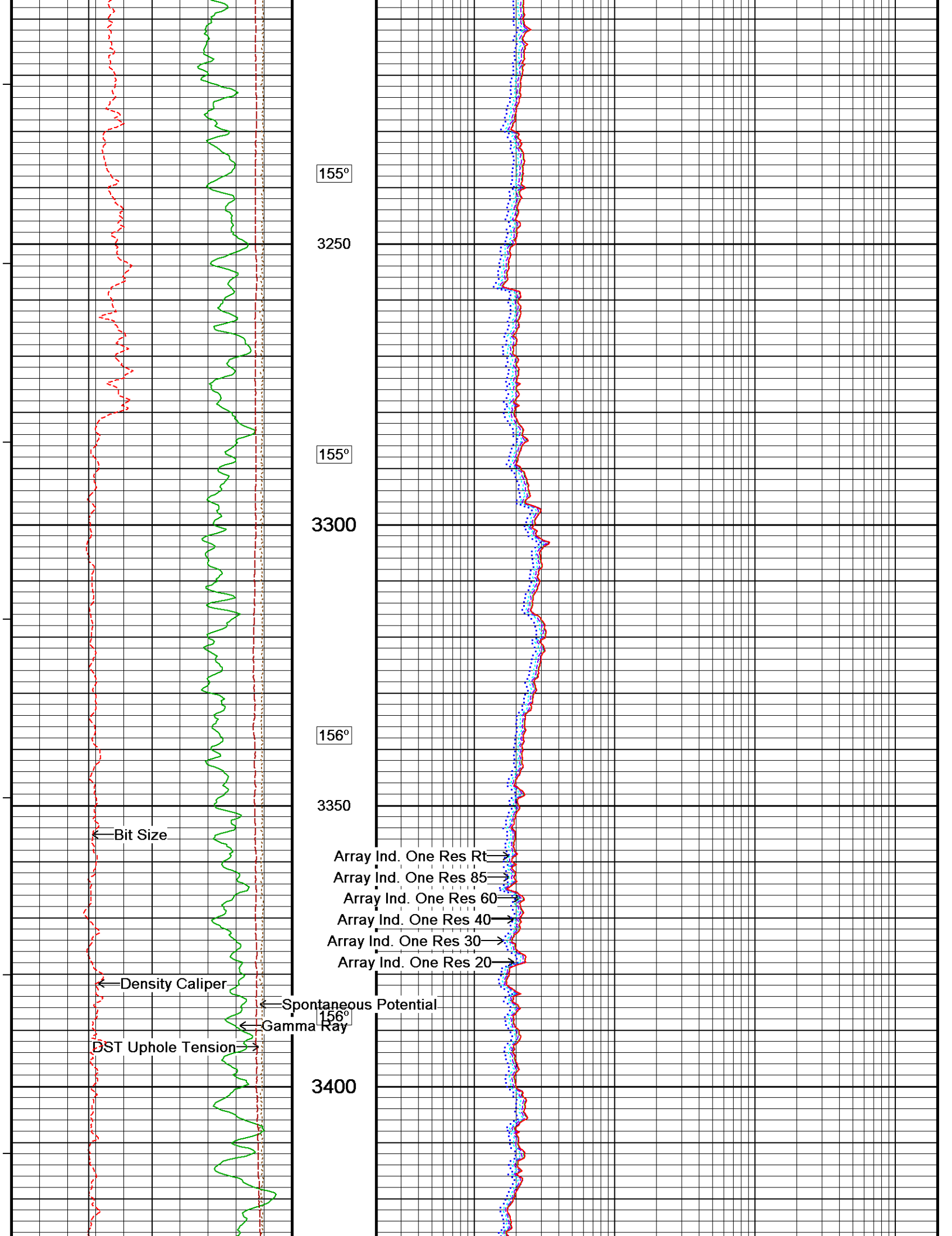
Array Ind. One Res 40 →

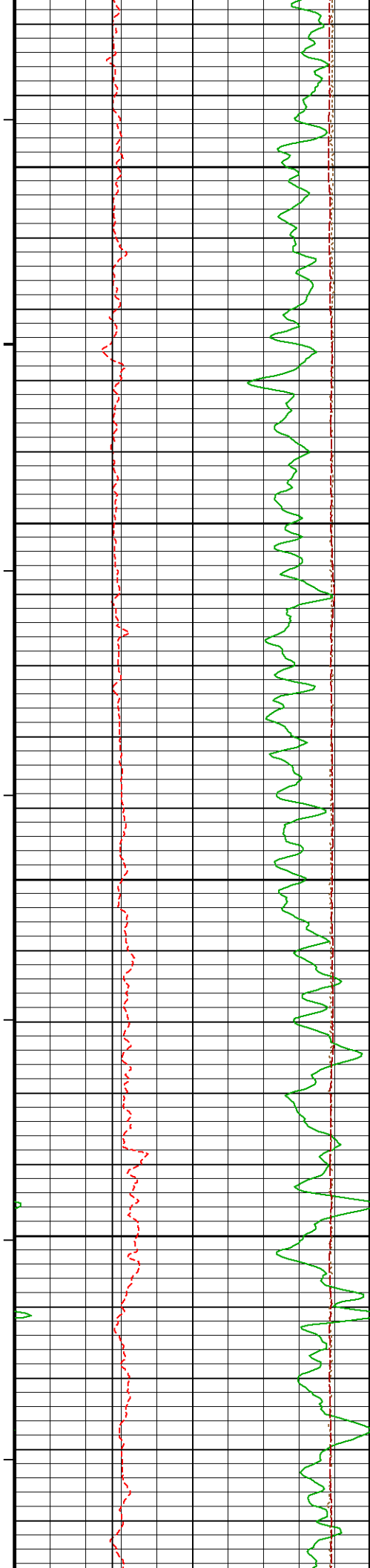
Array Ind. One Res 30 →

Array Ind. One Res 20 →









157°

3450

158°

3500

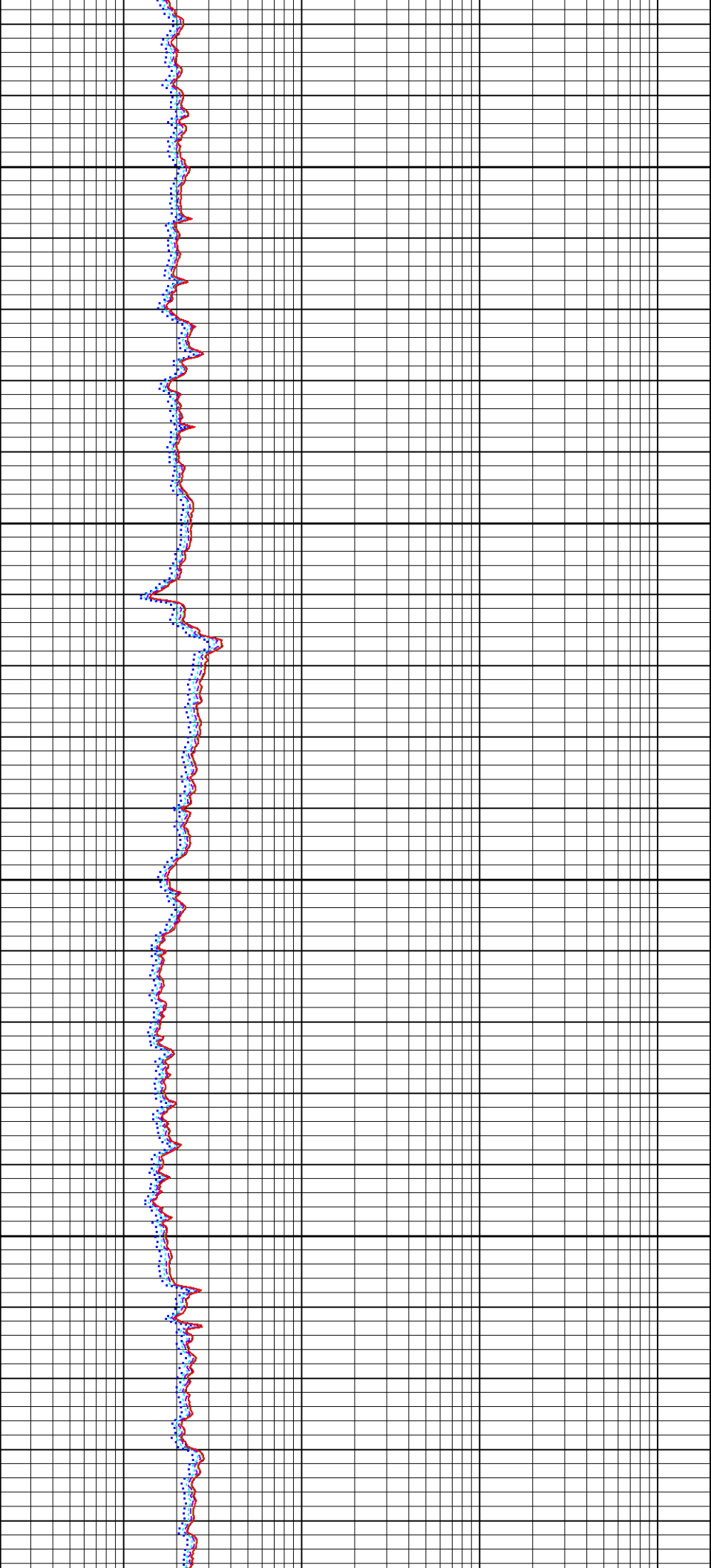
159°

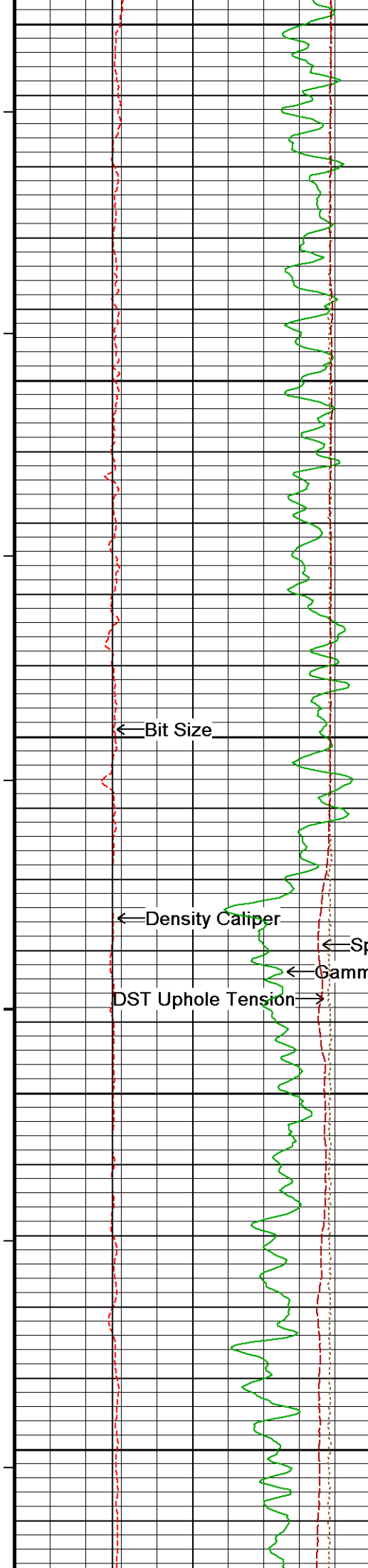
3550

159°

3600

160°





3650

161°

3700

161°

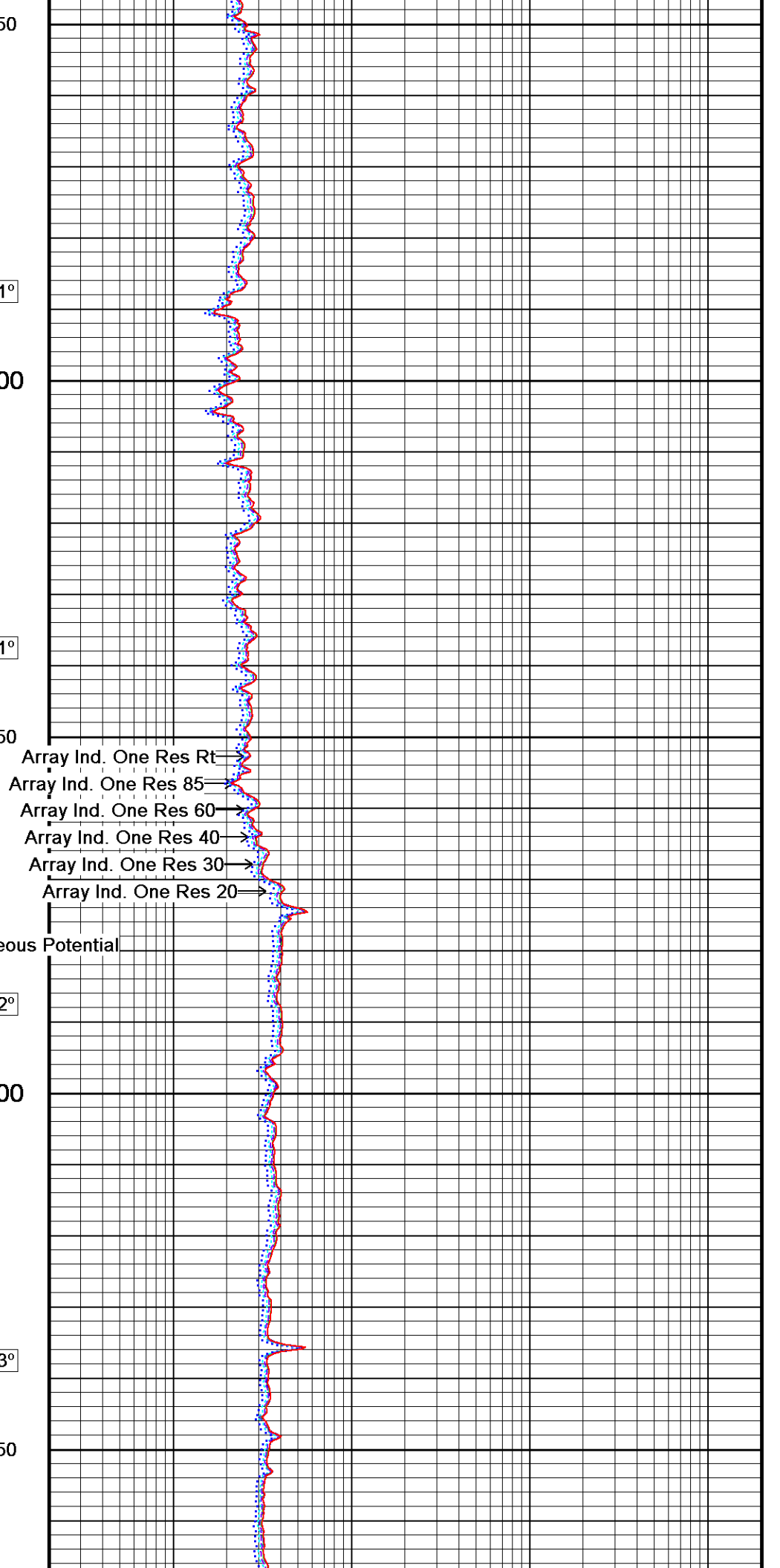
3750

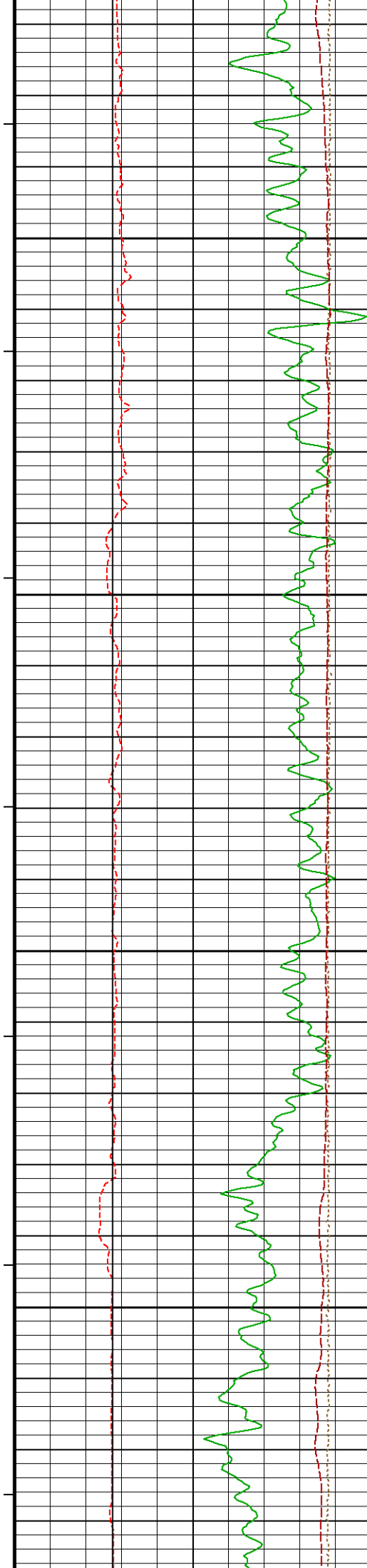
162°

3800

163°

3850





163°

3900

164°

3950

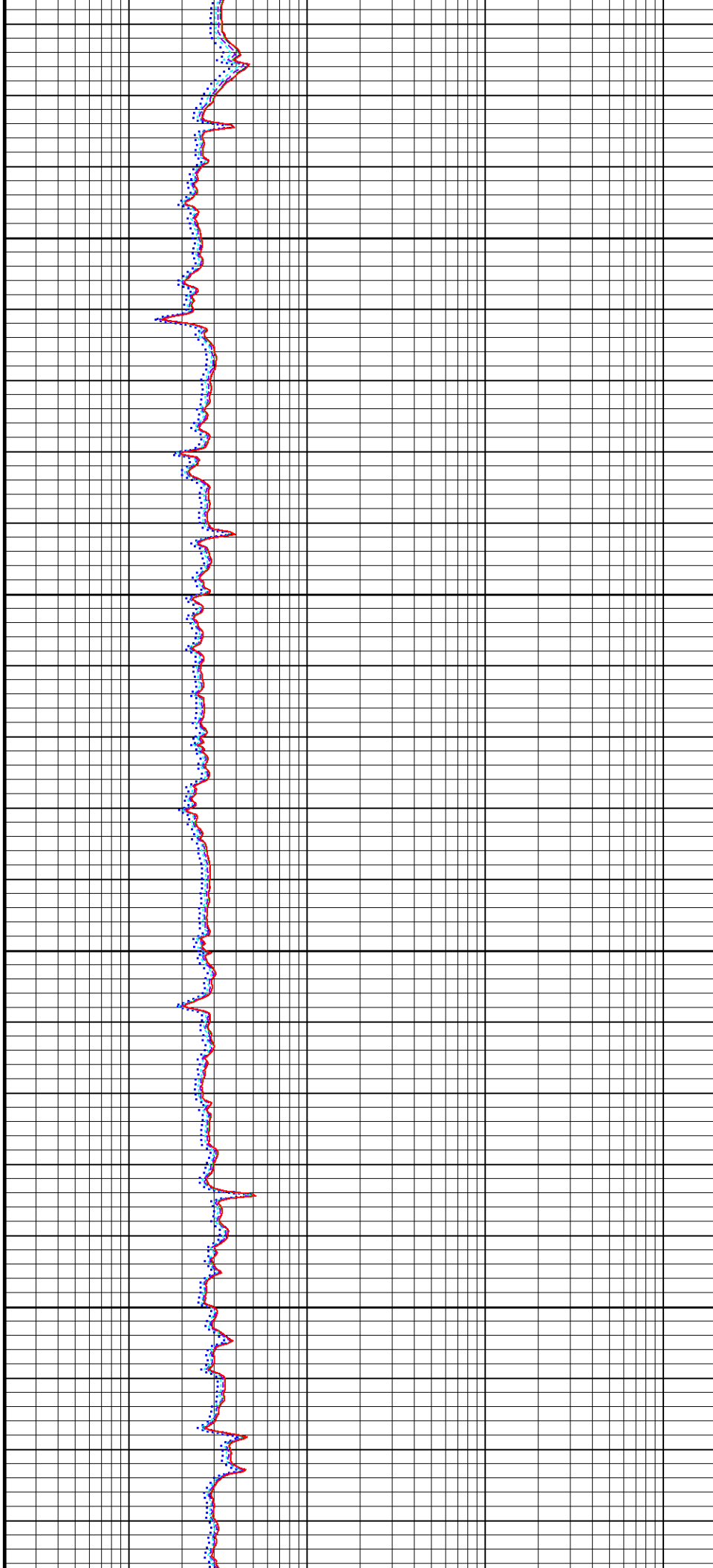
164°

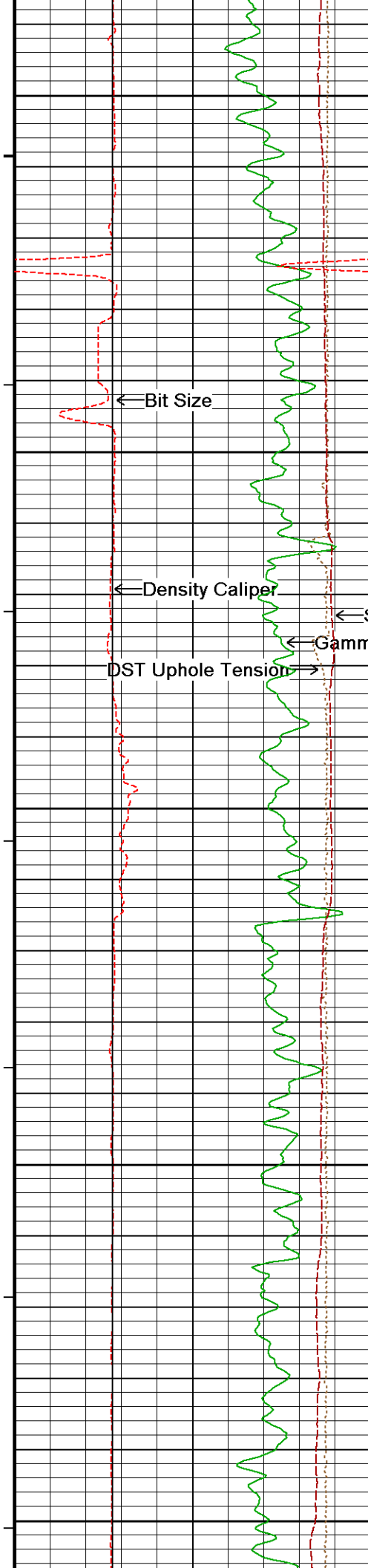
4000

165°

4050

165°





165°

4100

166°

Array Ind. One Res Rt
4150 Array Ind. One Res 85
Array Ind. One Res 60
Array Ind. One Res 40
Array Ind. One Res 30
Array Ind. One Res 20

Spontaneous Potential

Gamma Ray

167°

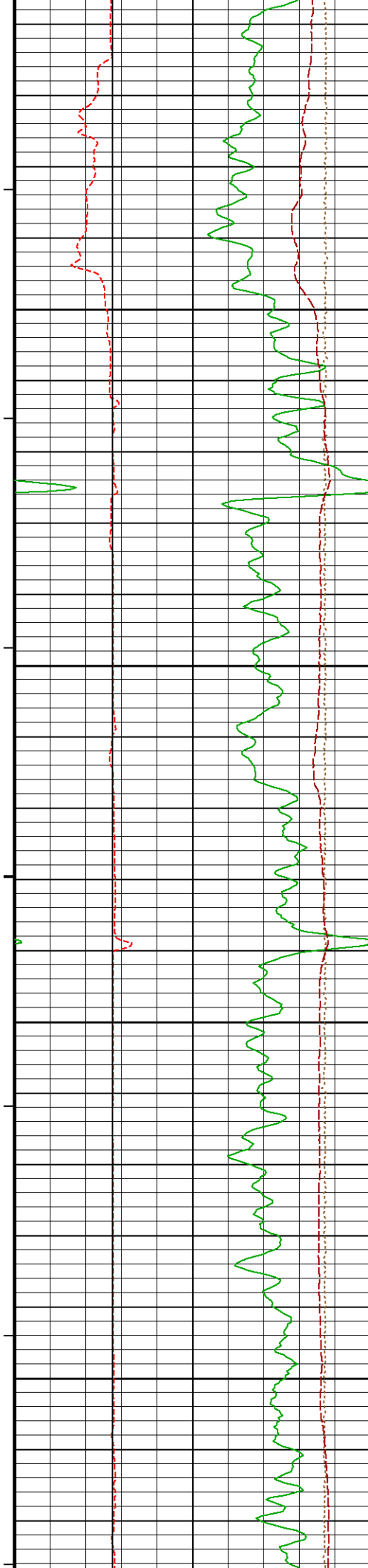
4200

167°

4250

168°

4300



168°

4350

169°

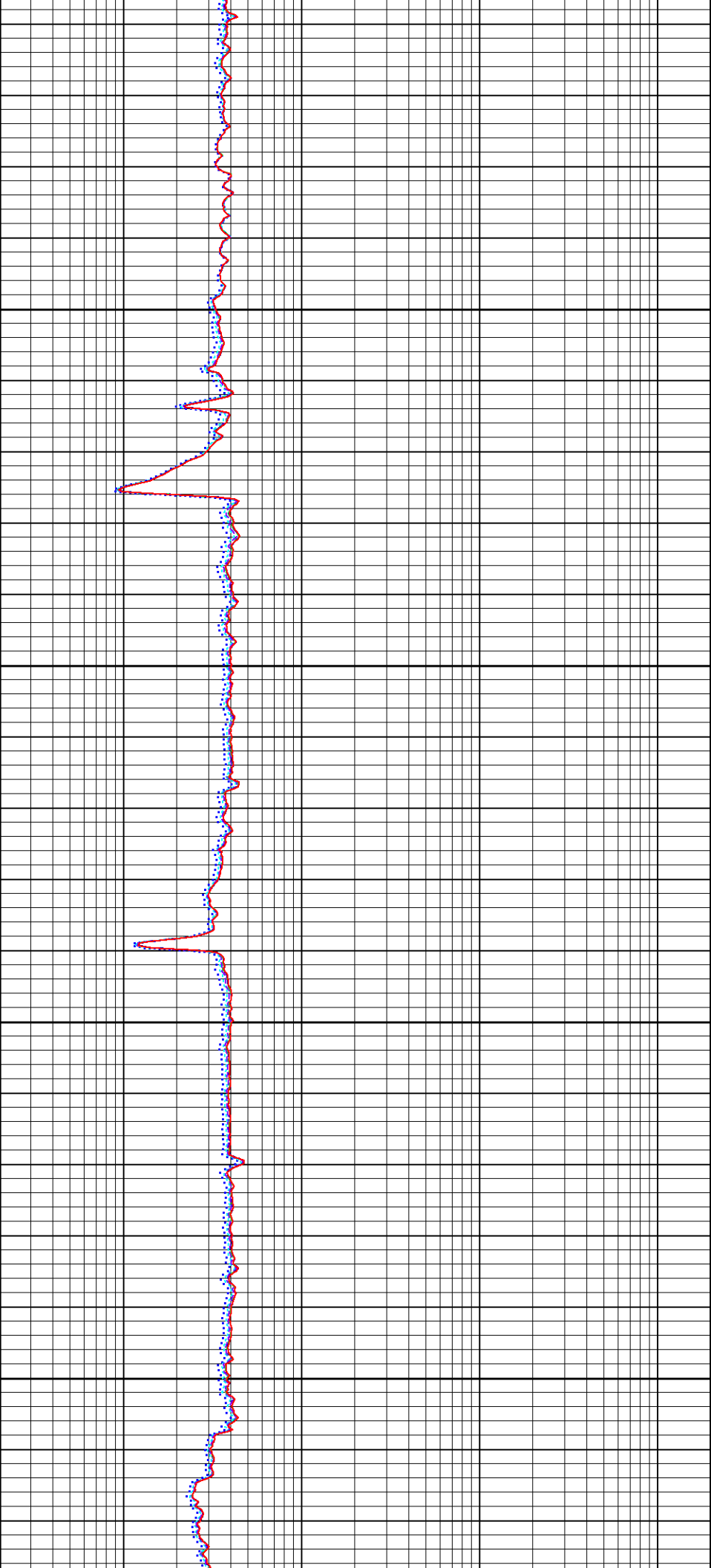
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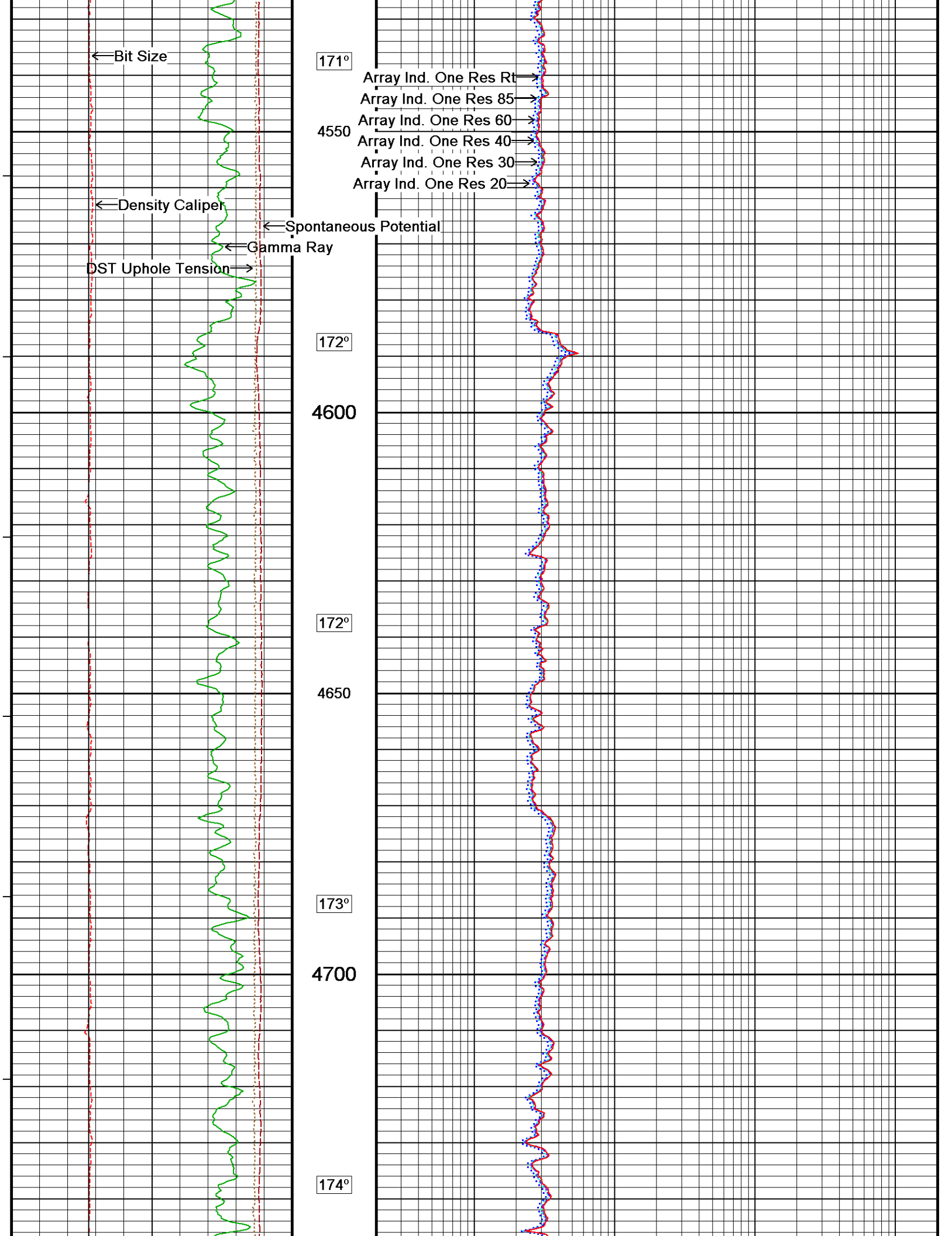
170°

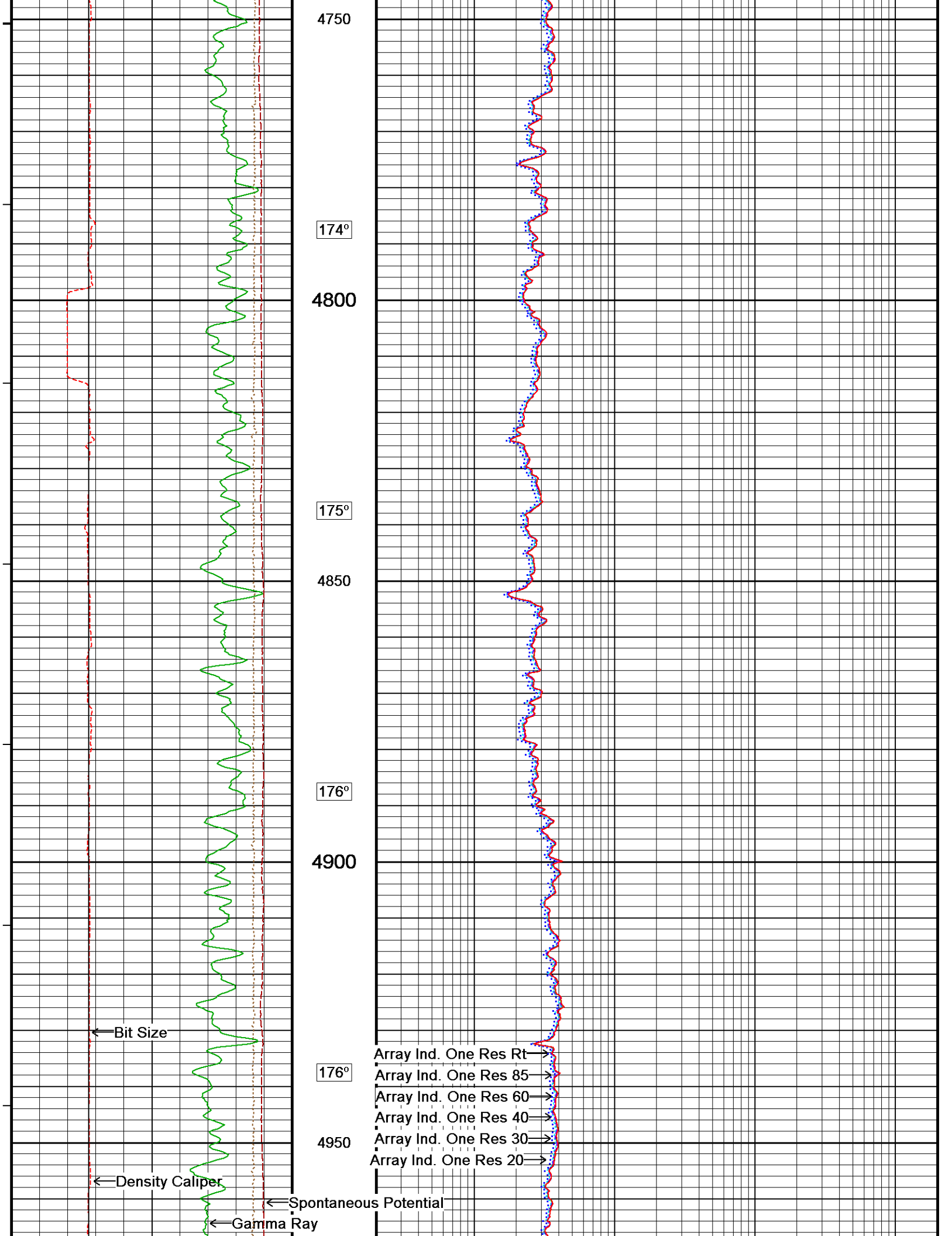
4450

170°

4500







DST Uphole Tension →

177°

5000

177°

5050

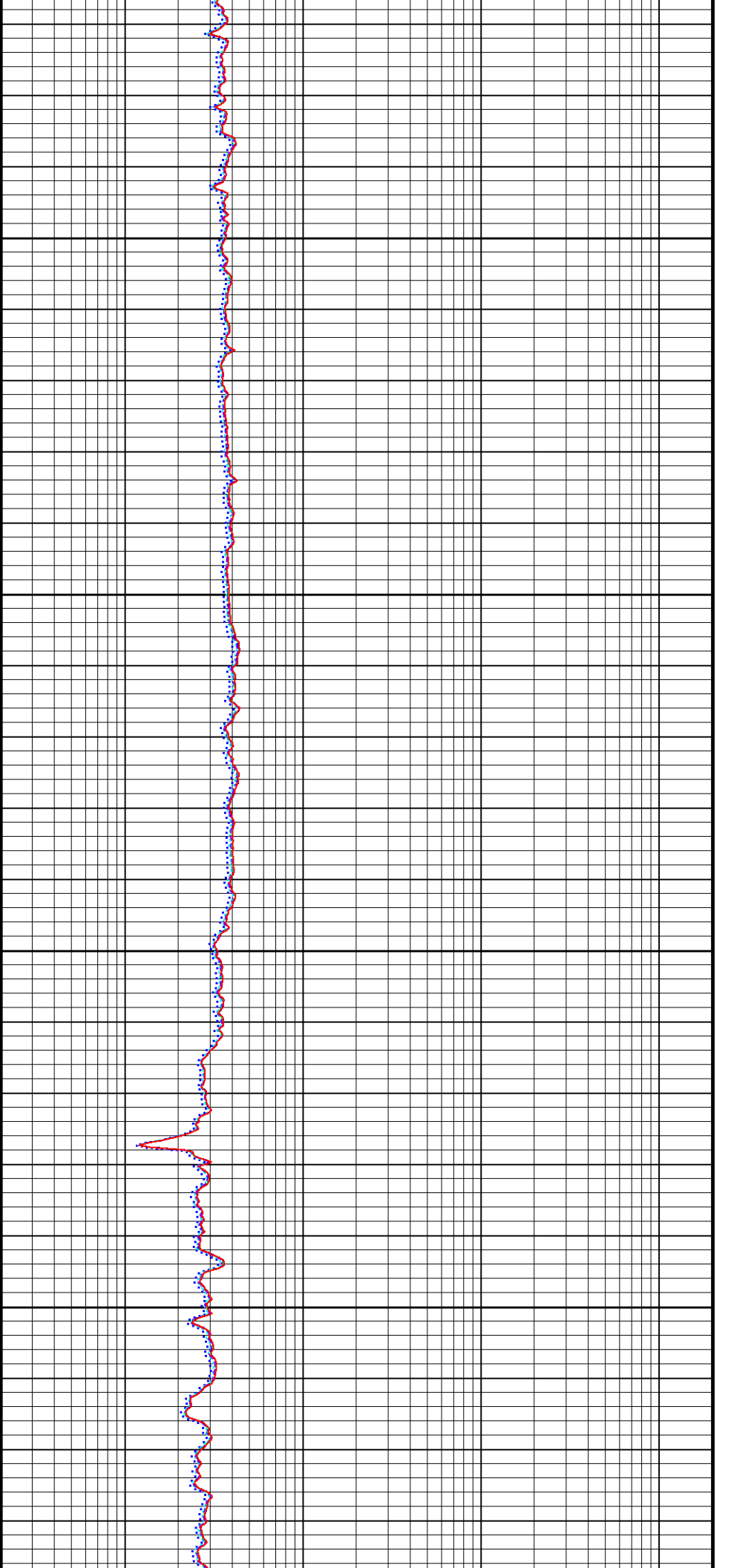
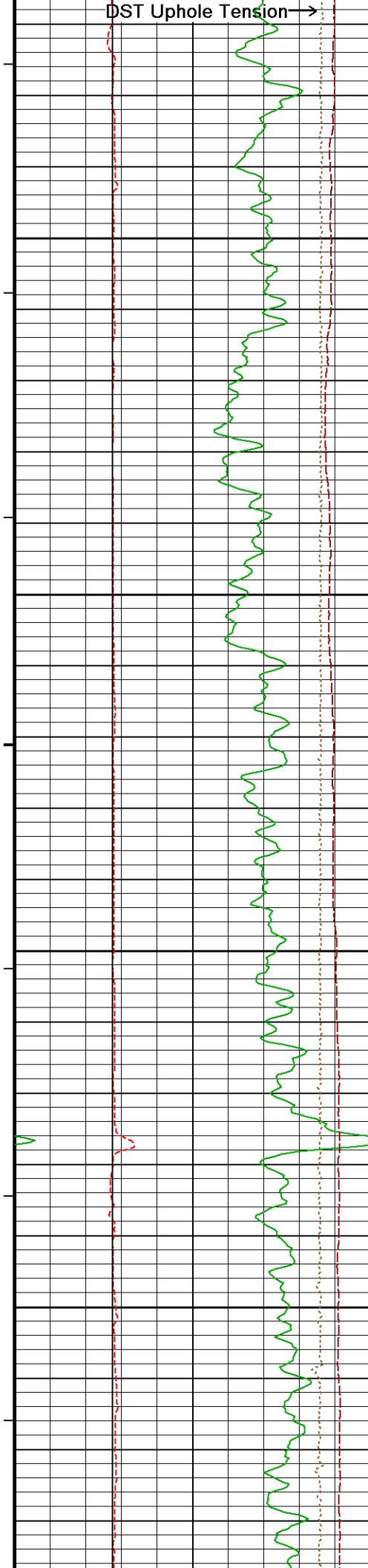
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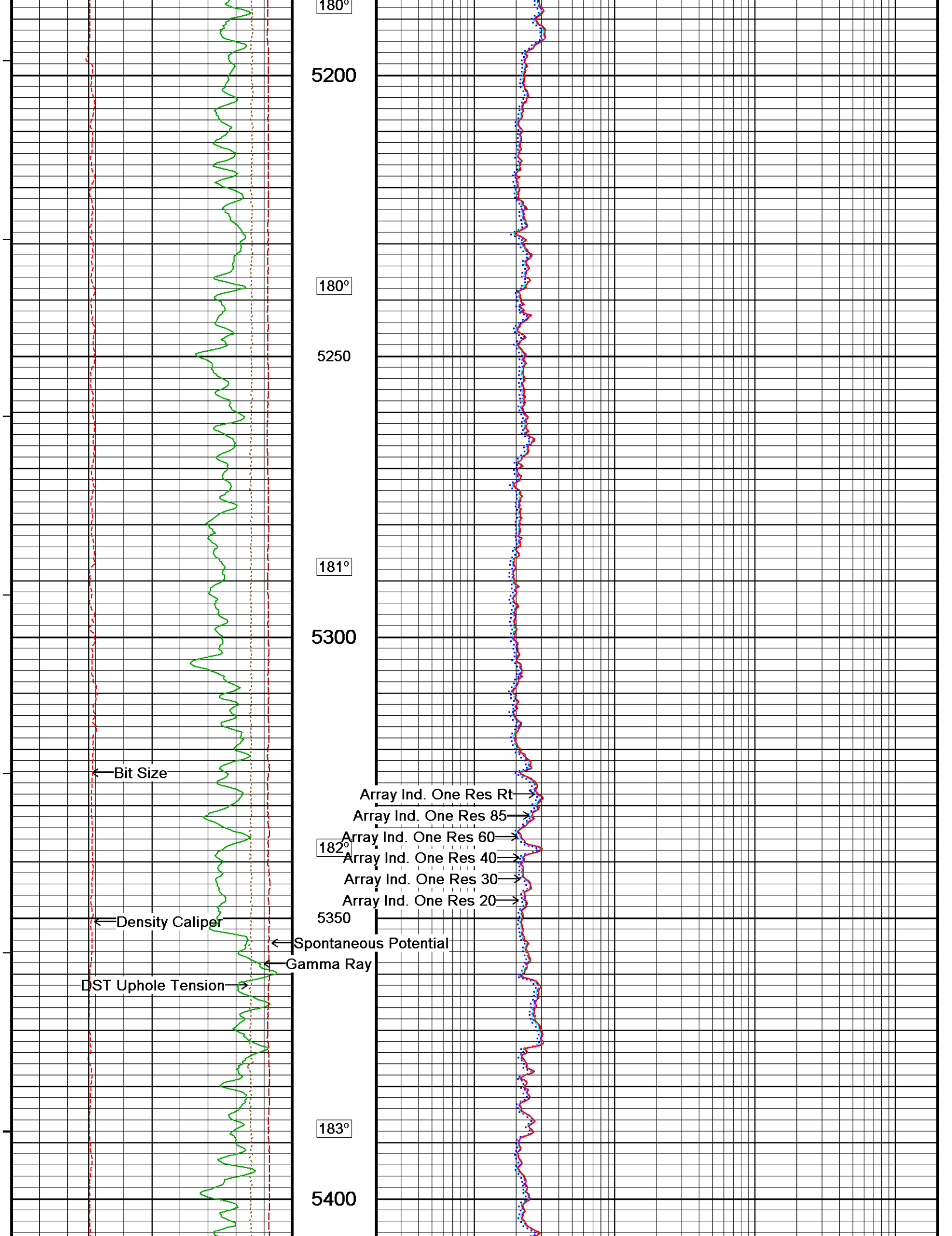
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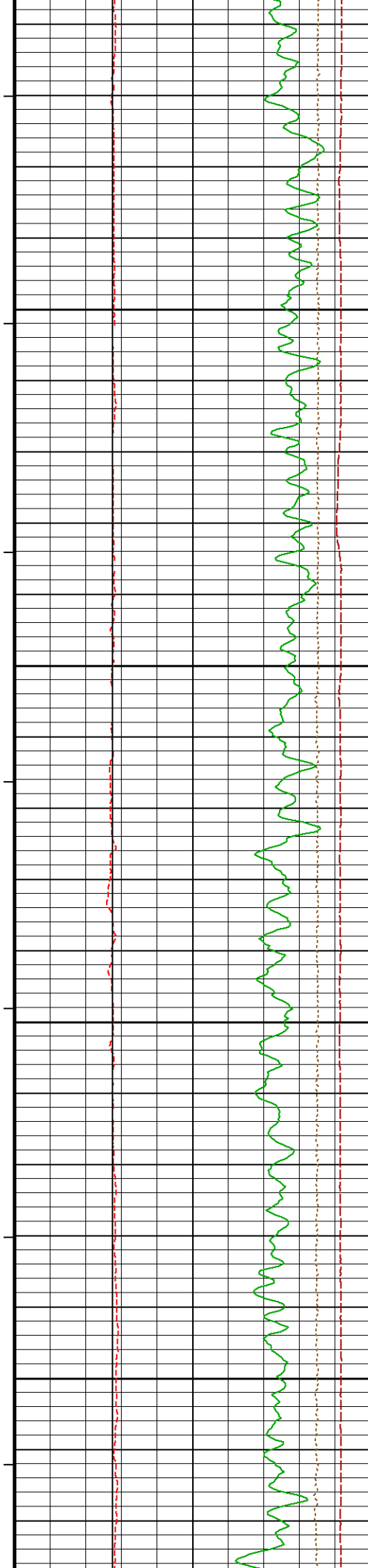
179°

5150

5200







183°

5450

184°

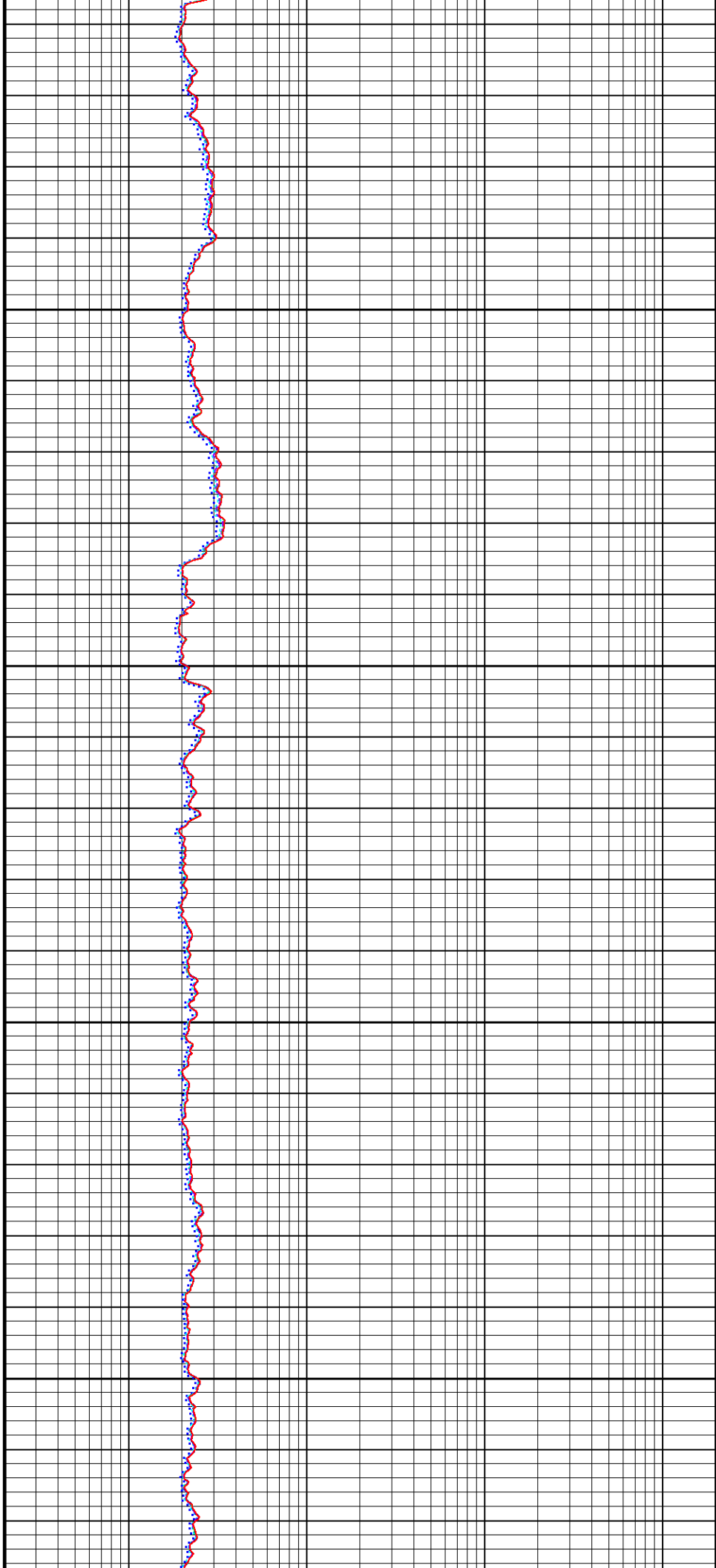
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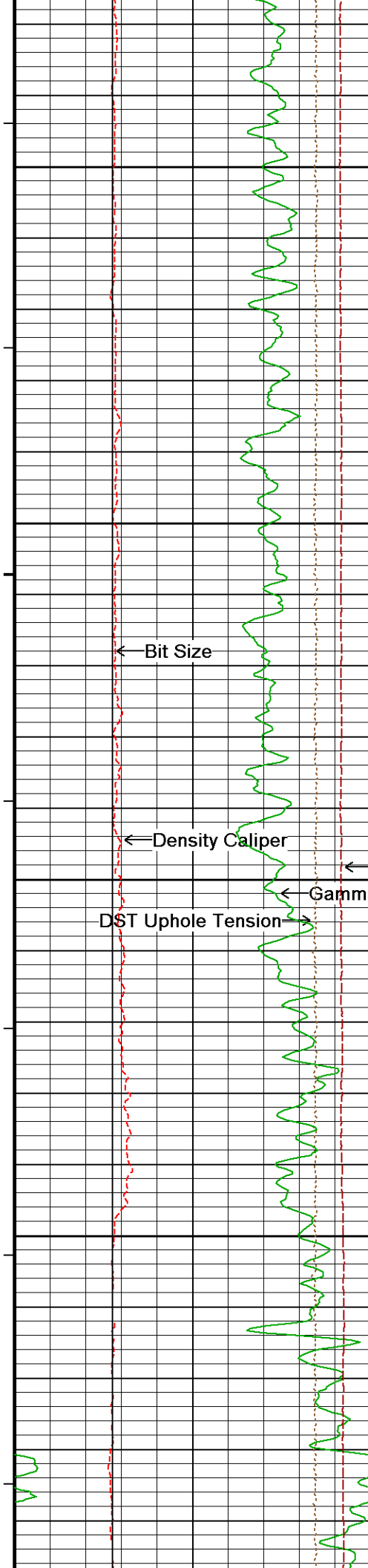
185°

5550

186°

5600





186°

5650

187°

5700

← Bit Size

Array Ind. One Res Rt →

Array Ind. One Res 85 →

Array Ind. One Res 60 →

Array Ind. One Res 40 →

Array Ind. One Res 30 →

Array Ind. One Res 20 →

← Density Caliper

← Spontaneous Potential

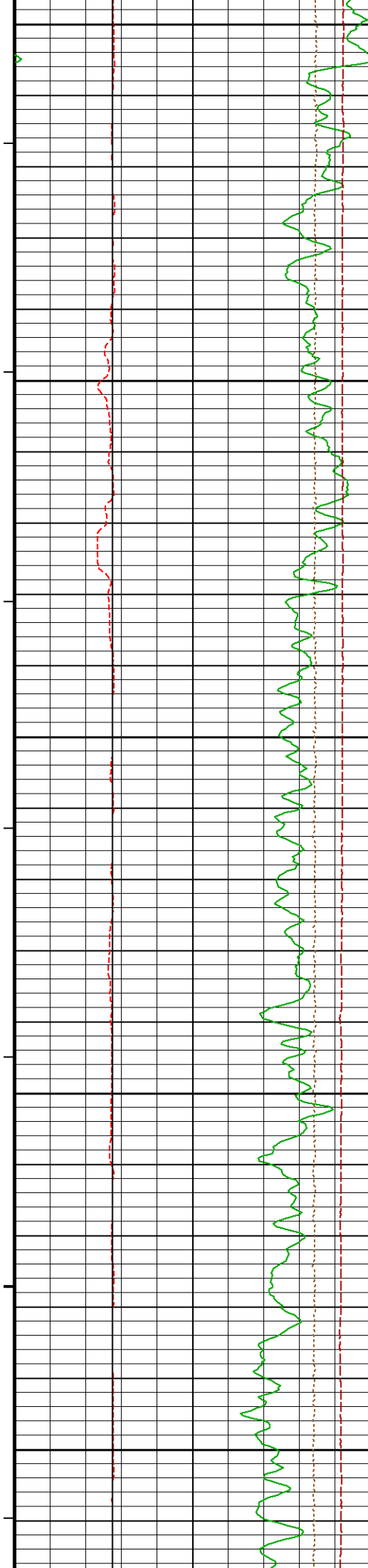
← Gamma Ray

DST Uphole Tension →

188°

5800

189°



5850

190°

5900

191°

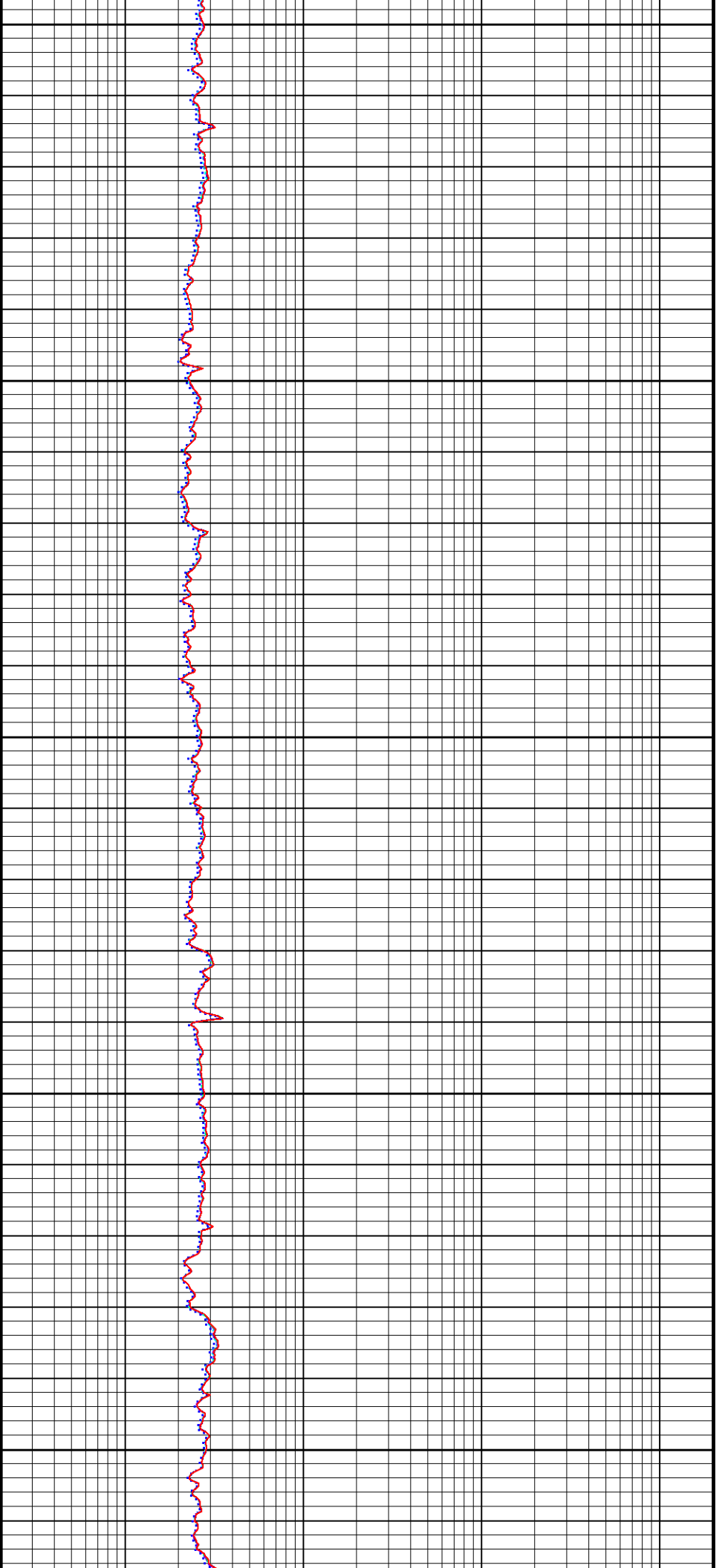
5950

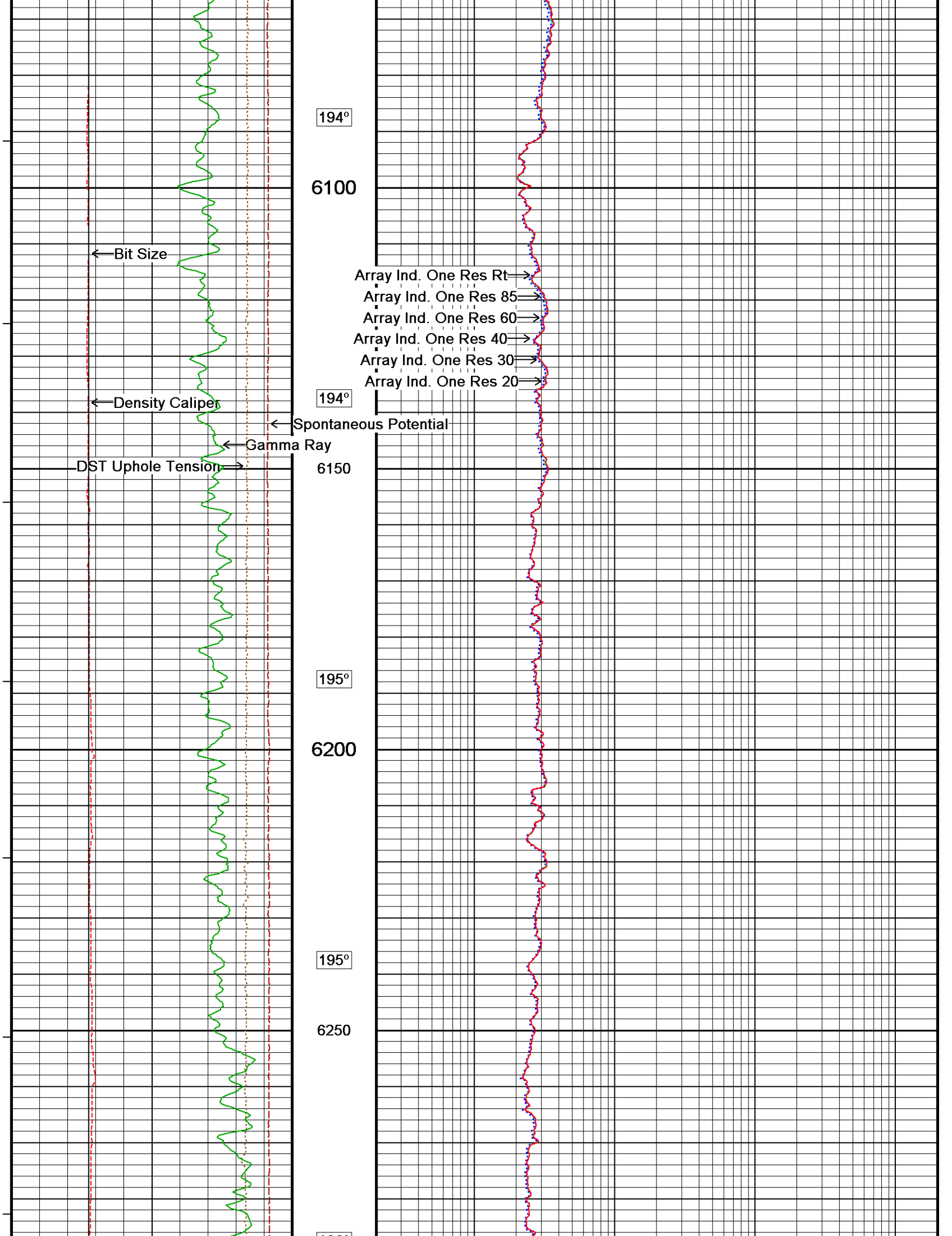
191°

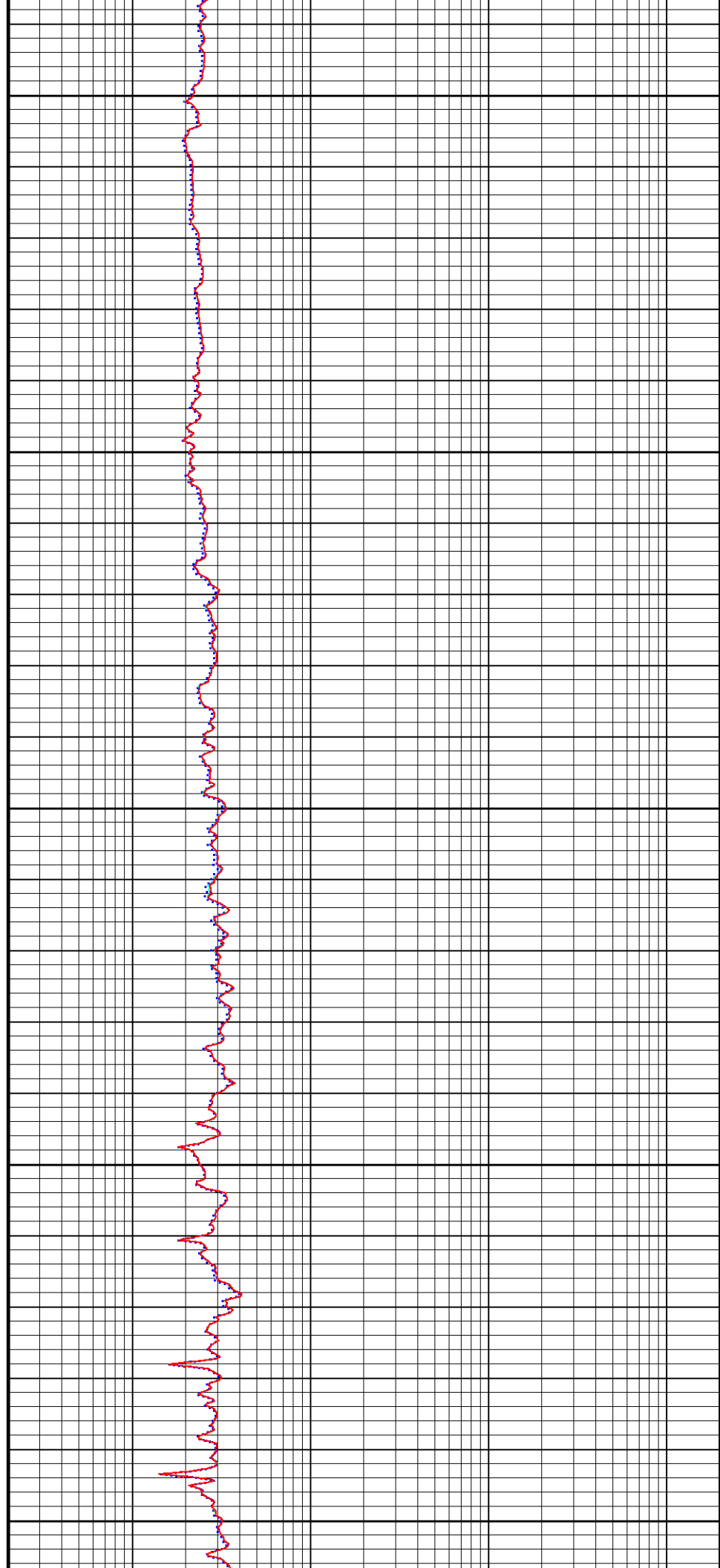
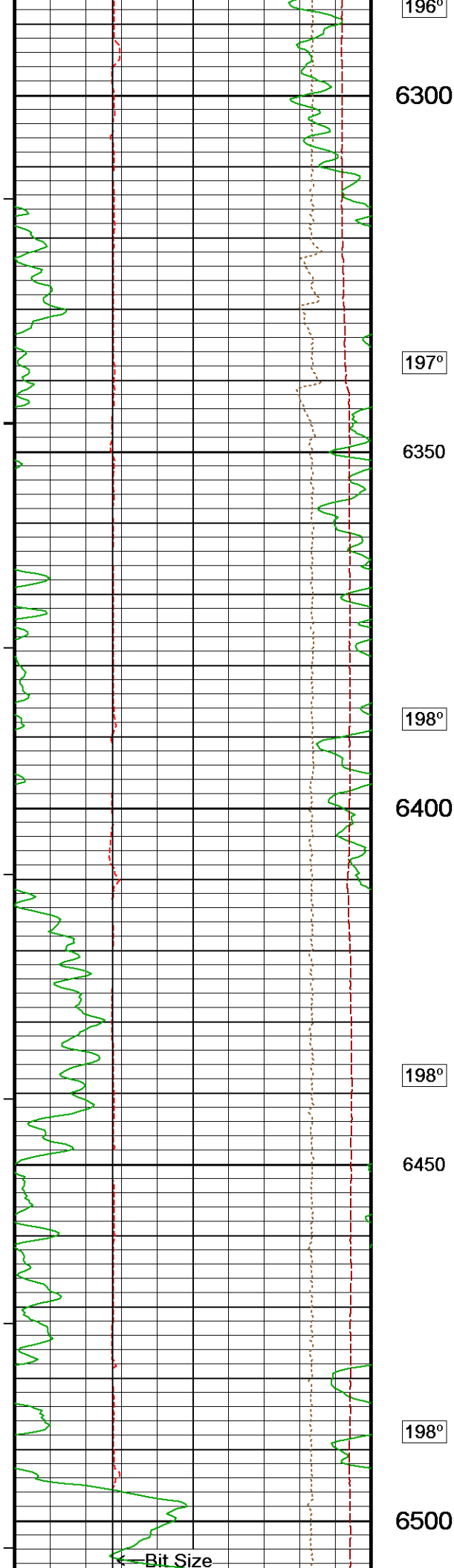
6000

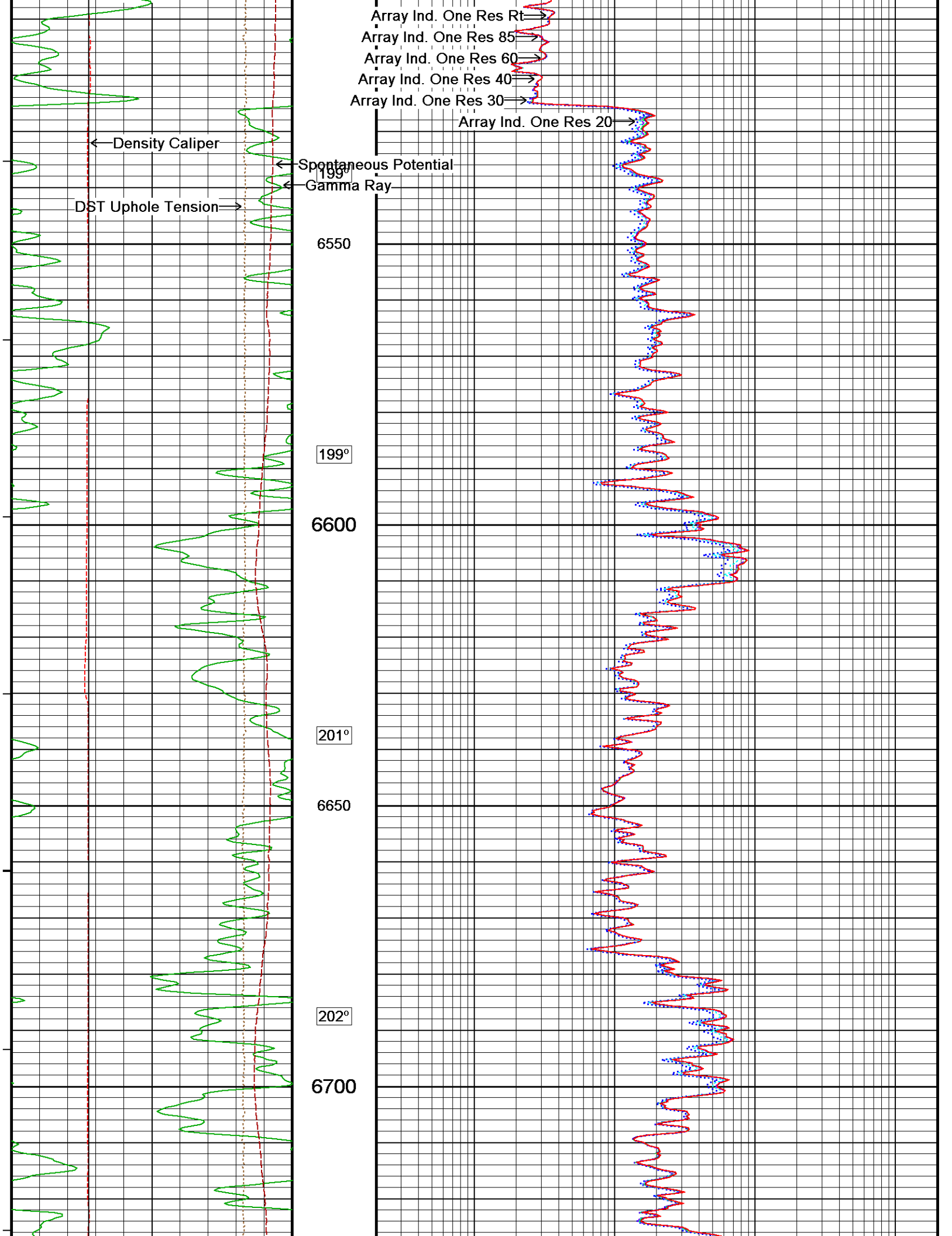
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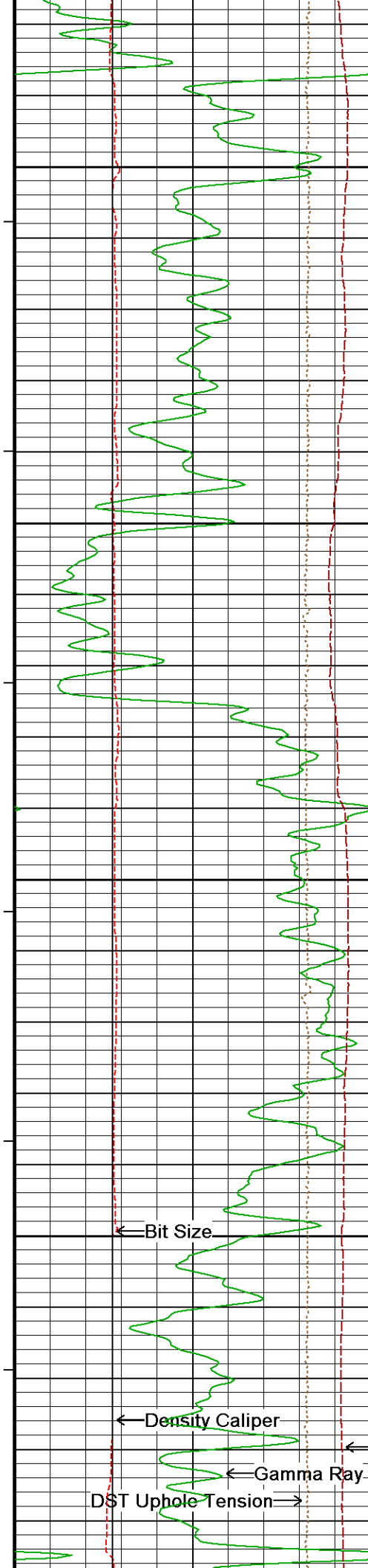
6050











202°

6750

203°

6800

203°

6850

204°

6900

← Bit Size

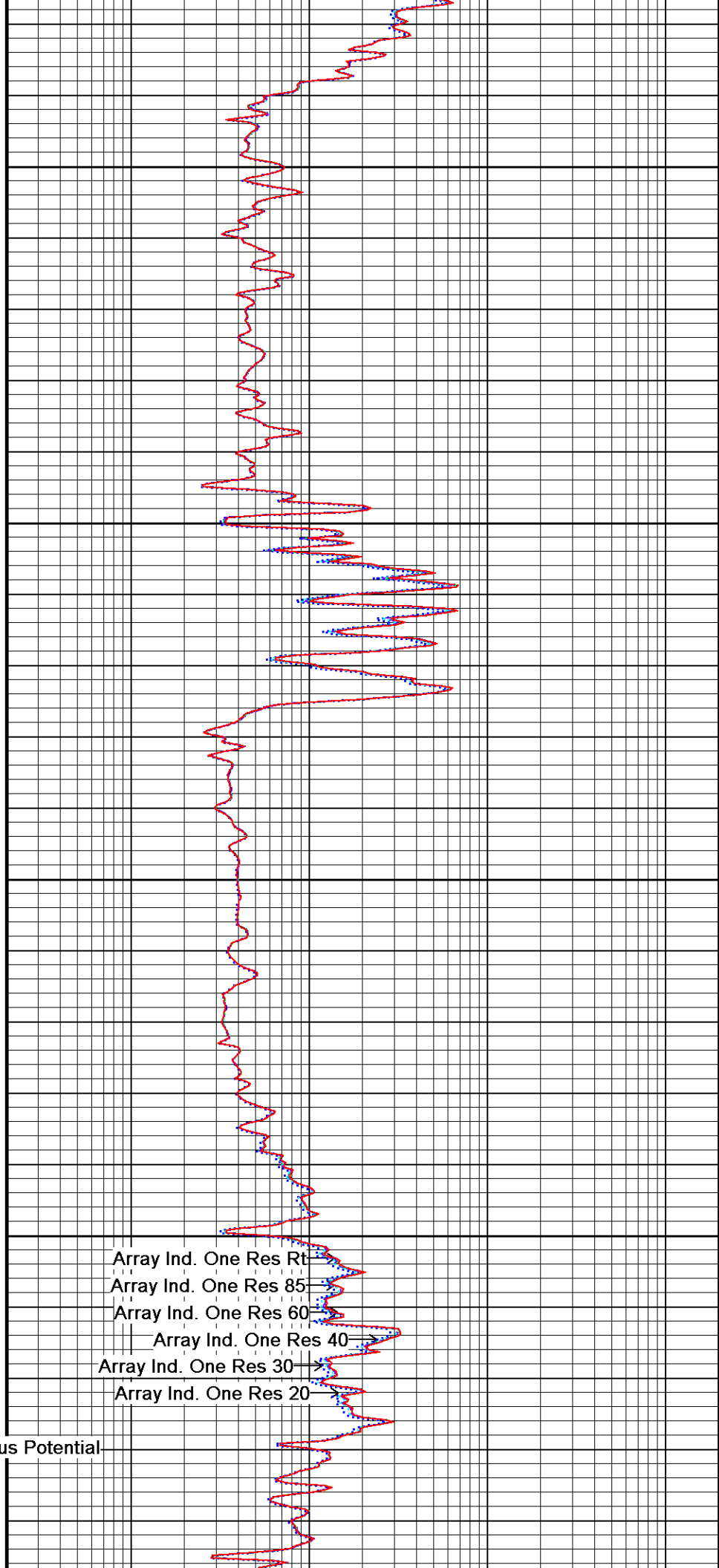
← Density Caliper

← Gamma Ray

DST Uphole Tension →

← Spontaneous Potential

205°



Array Ind. One Res Rt

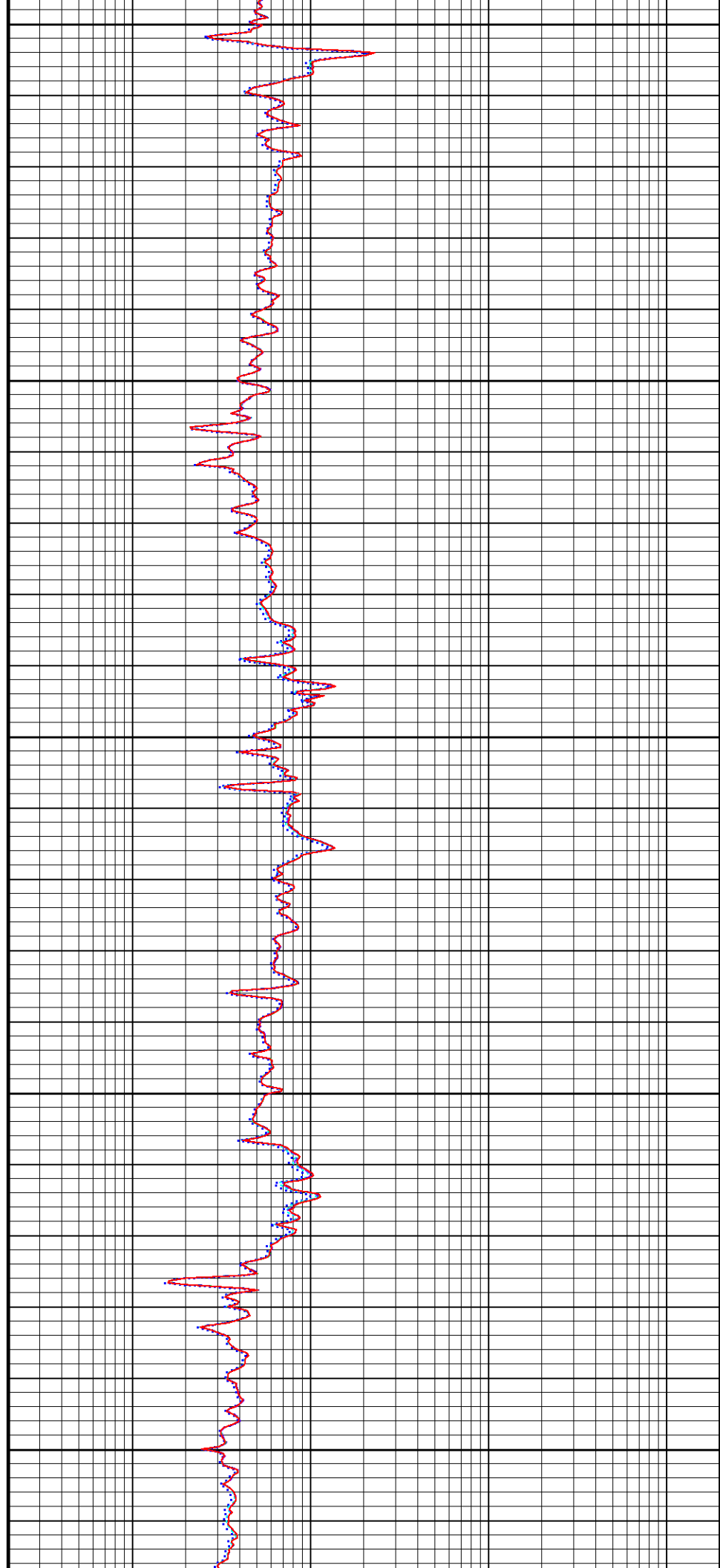
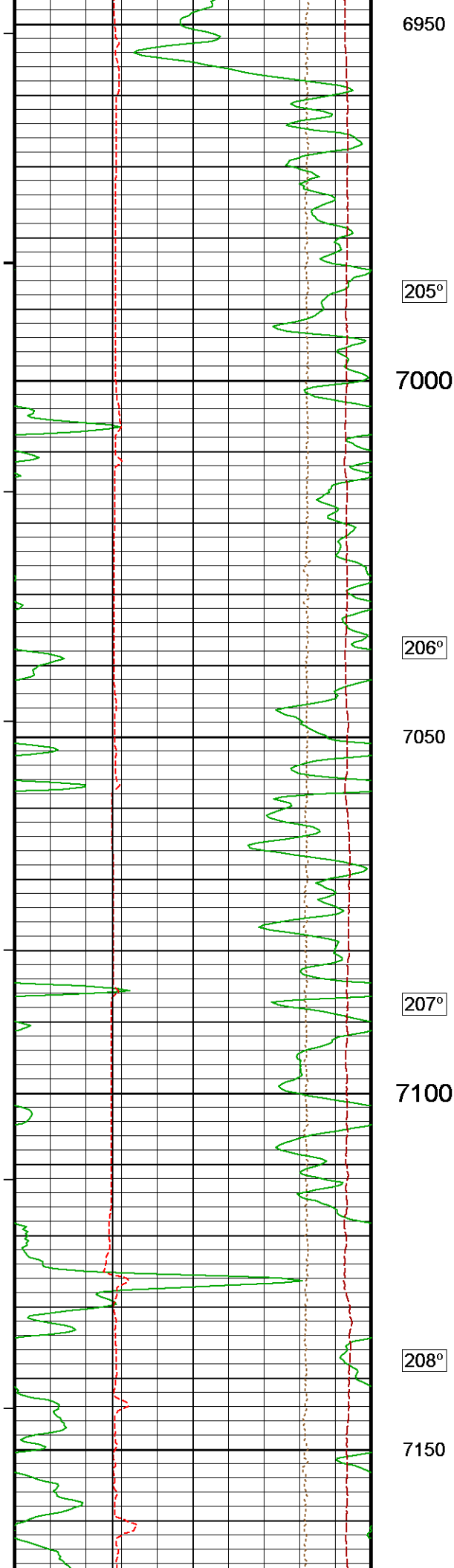
Array Ind. One Res 85

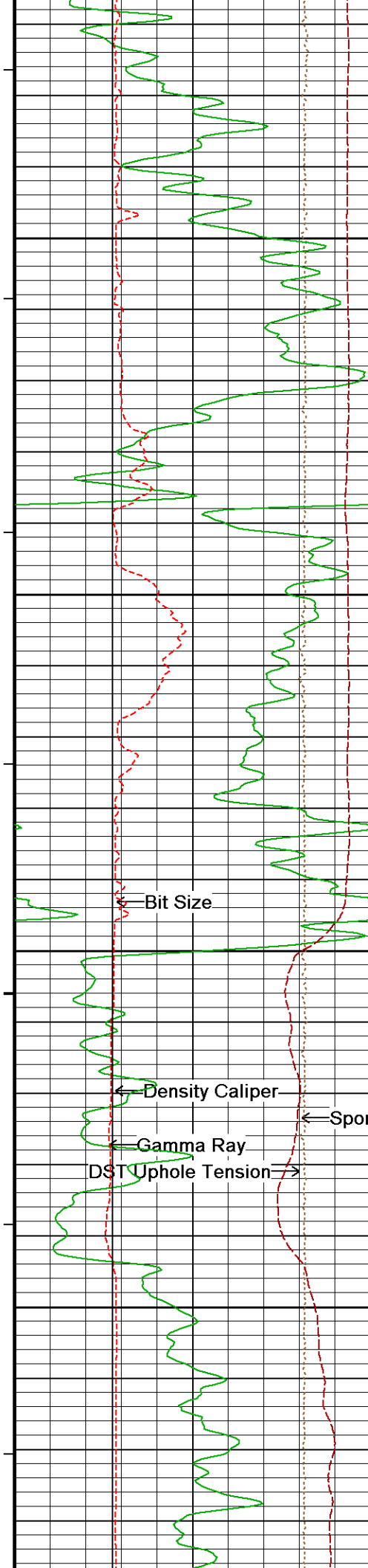
Array Ind. One Res 60

Array Ind. One Res 40

Array Ind. One Res 30

Array Ind. One Res 20





209°

7200

211°

7250

212°

7300

← Bit Size

← Density Caliper

← Gamma Ray

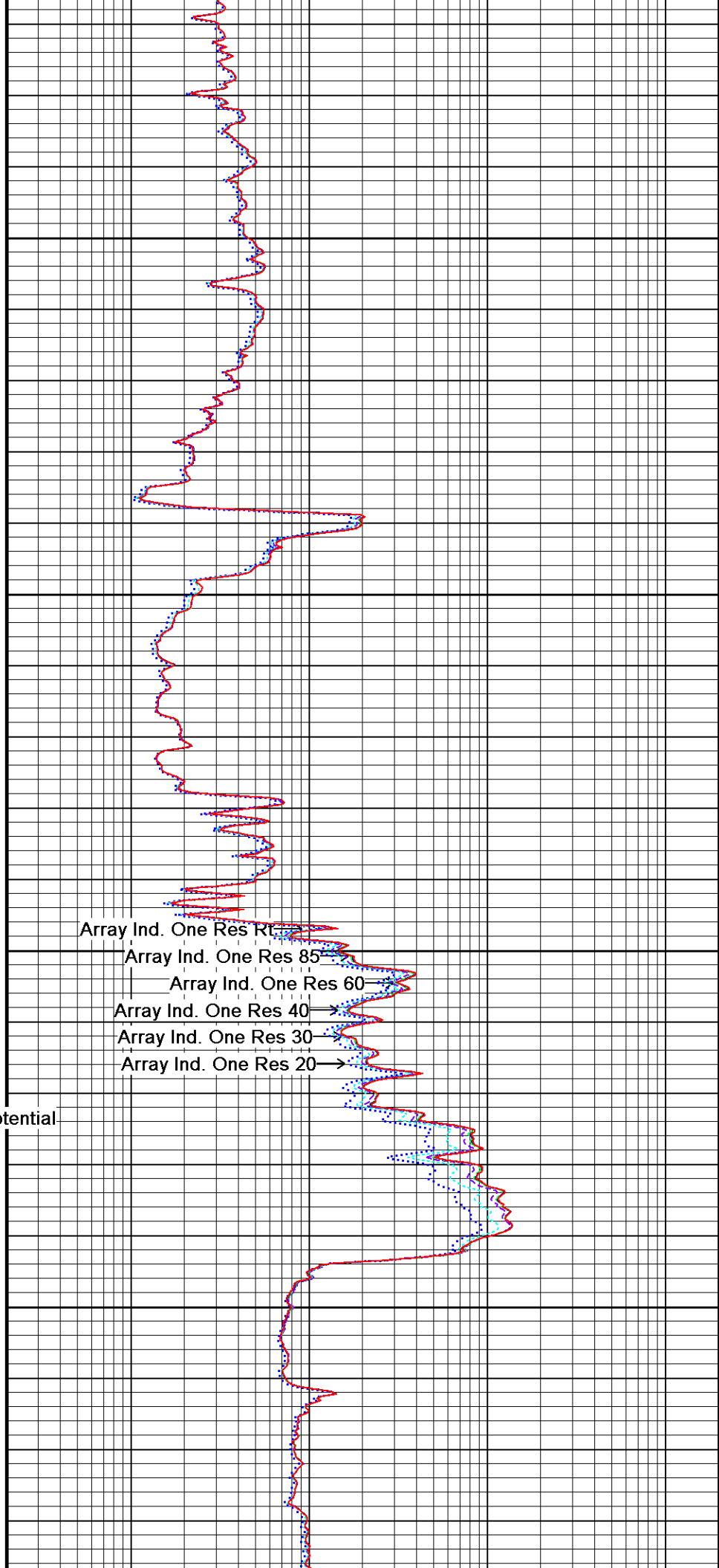
DST Uphole Tension →

← Spontaneous Potential

212°

7350

7400



Array Ind. One Res Rt

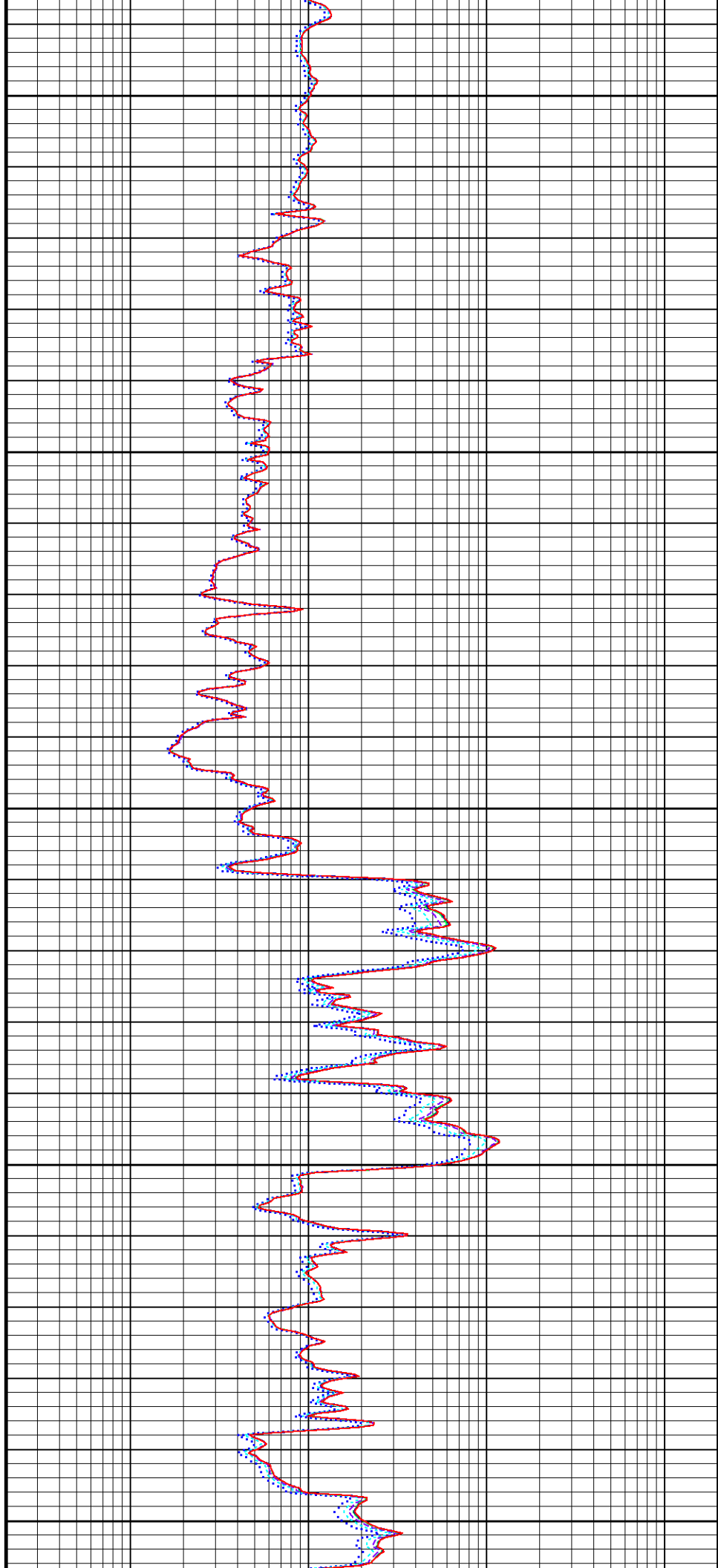
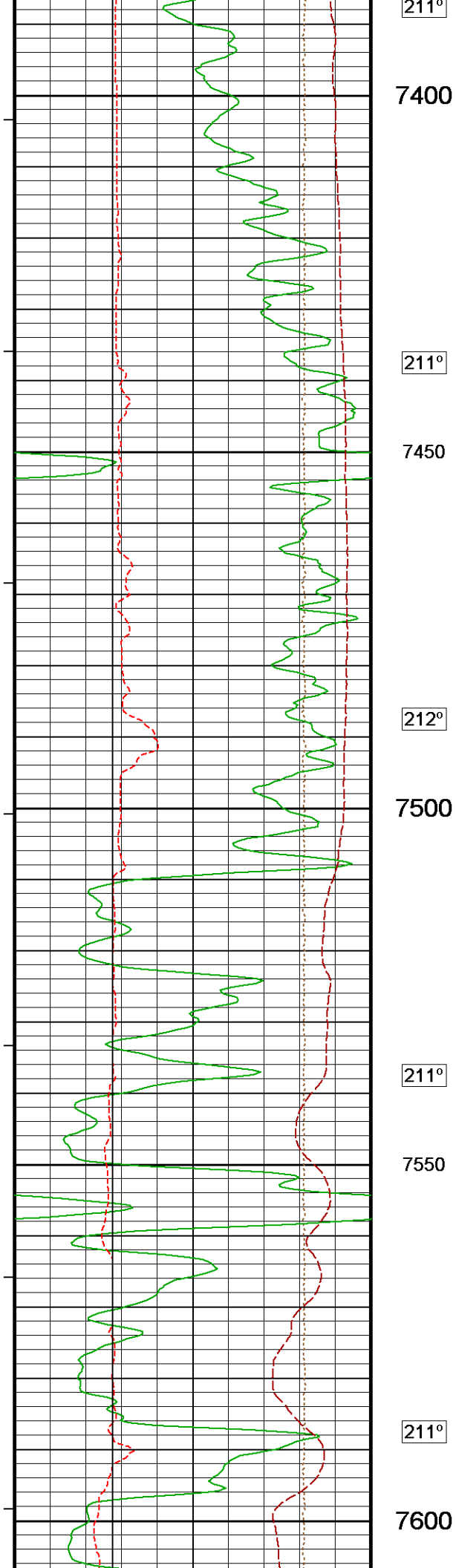
Array Ind. One Res 85

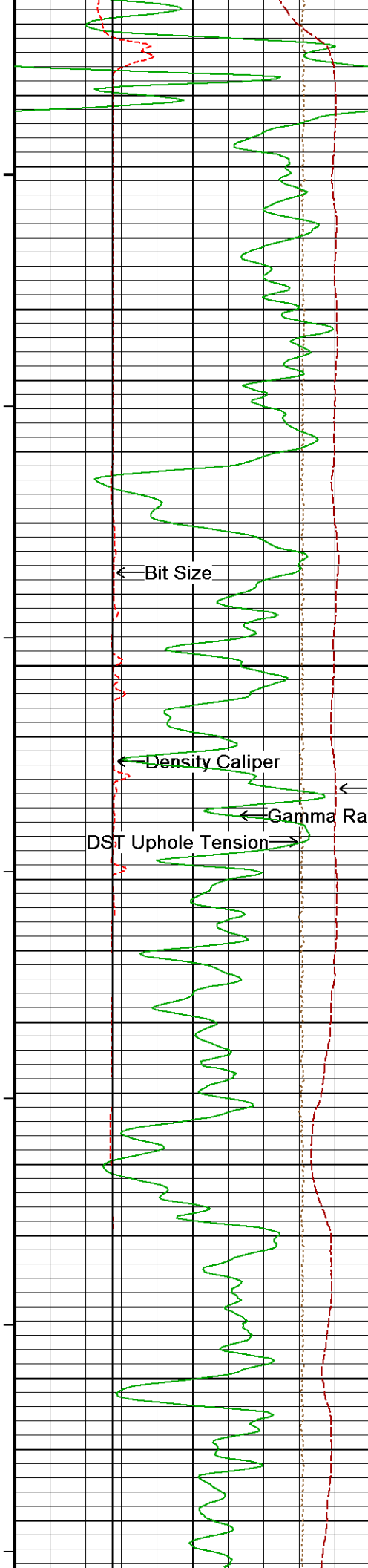
Array Ind. One Res 60

Array Ind. One Res 40

Array Ind. One Res 30

Array Ind. One Res 20





212°

7650

212°

7700

213°

7750

214°

7800

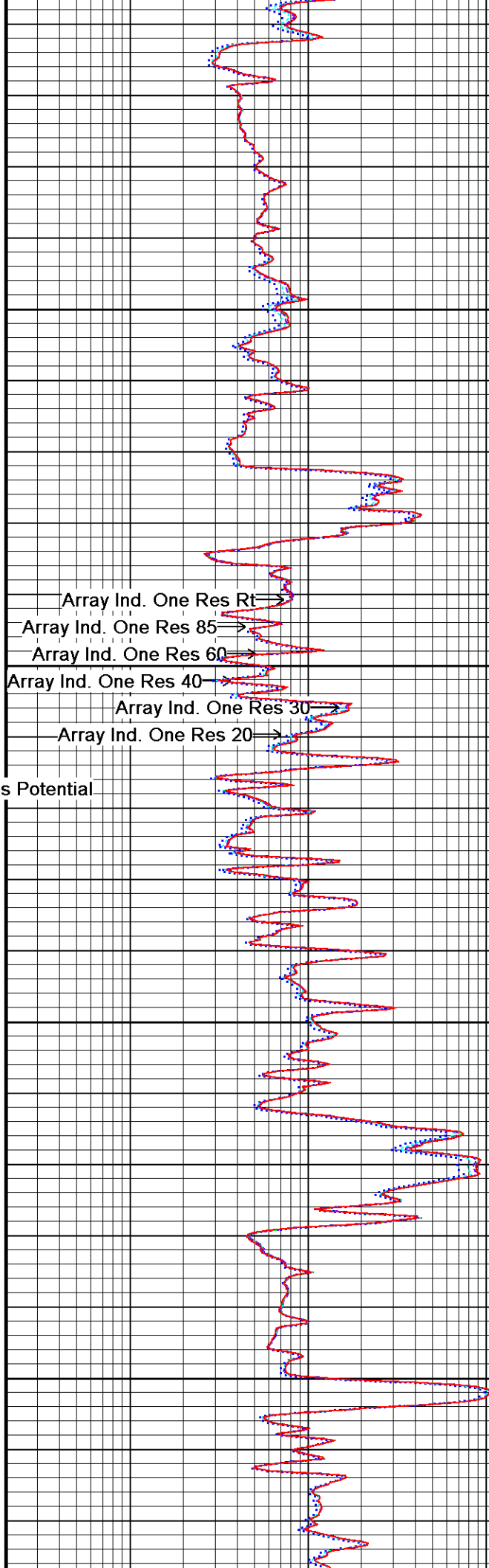
← Bit Size

← Density Caliper

DST Uphole Tension →

← Gamma Ray

← Spontaneous Potential



Array Ind. One Res Rt →

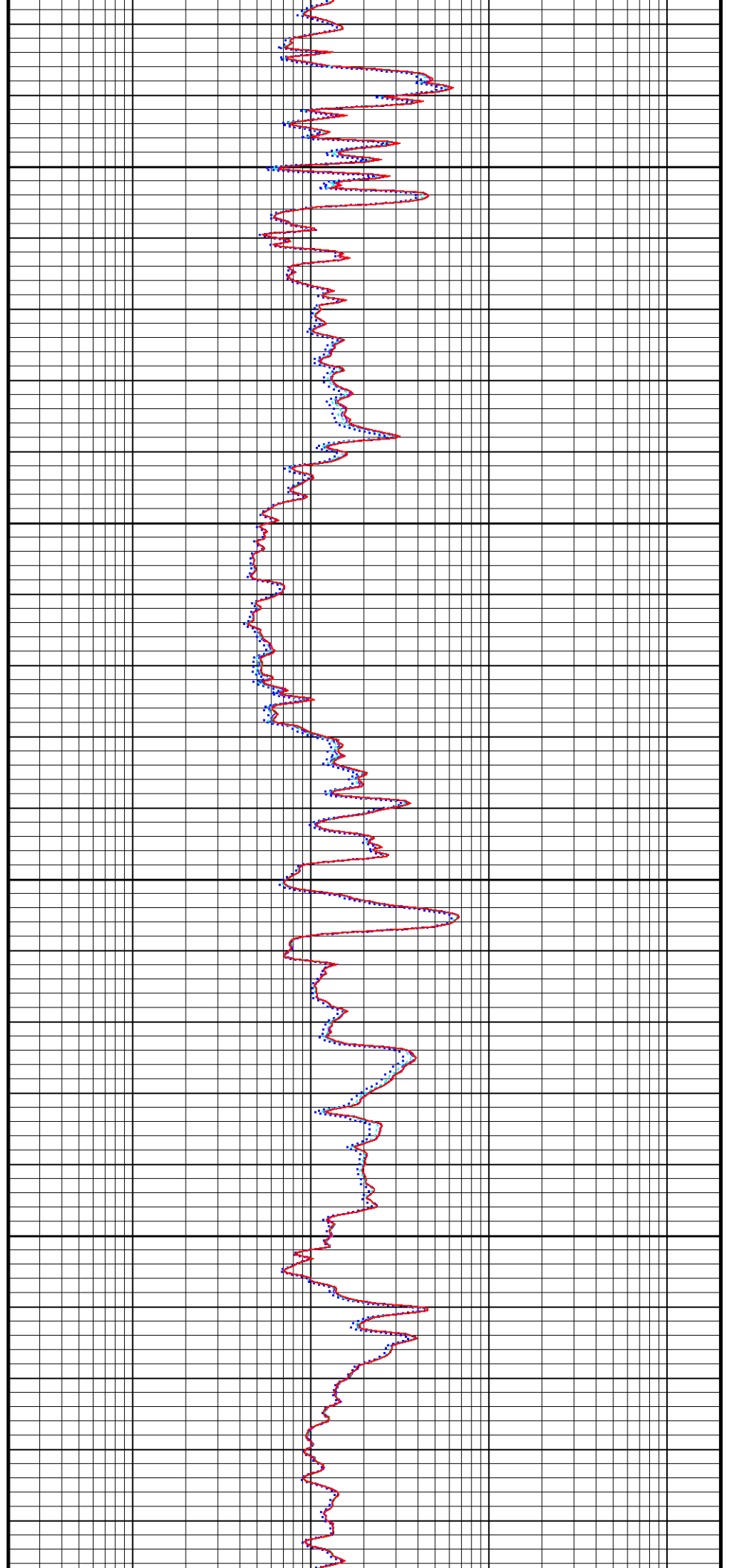
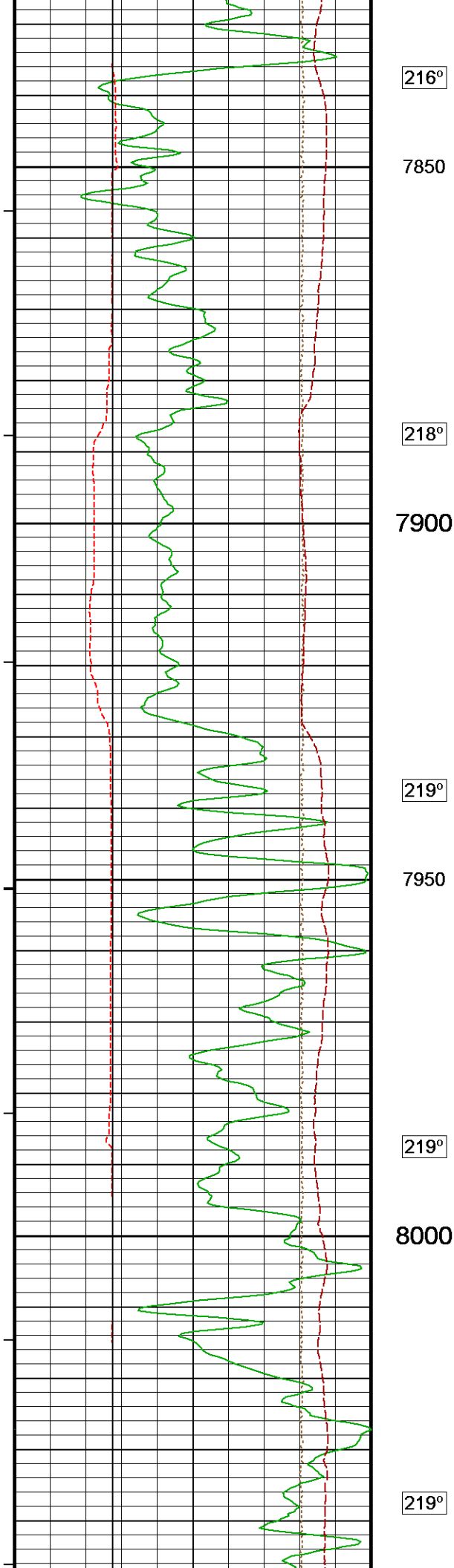
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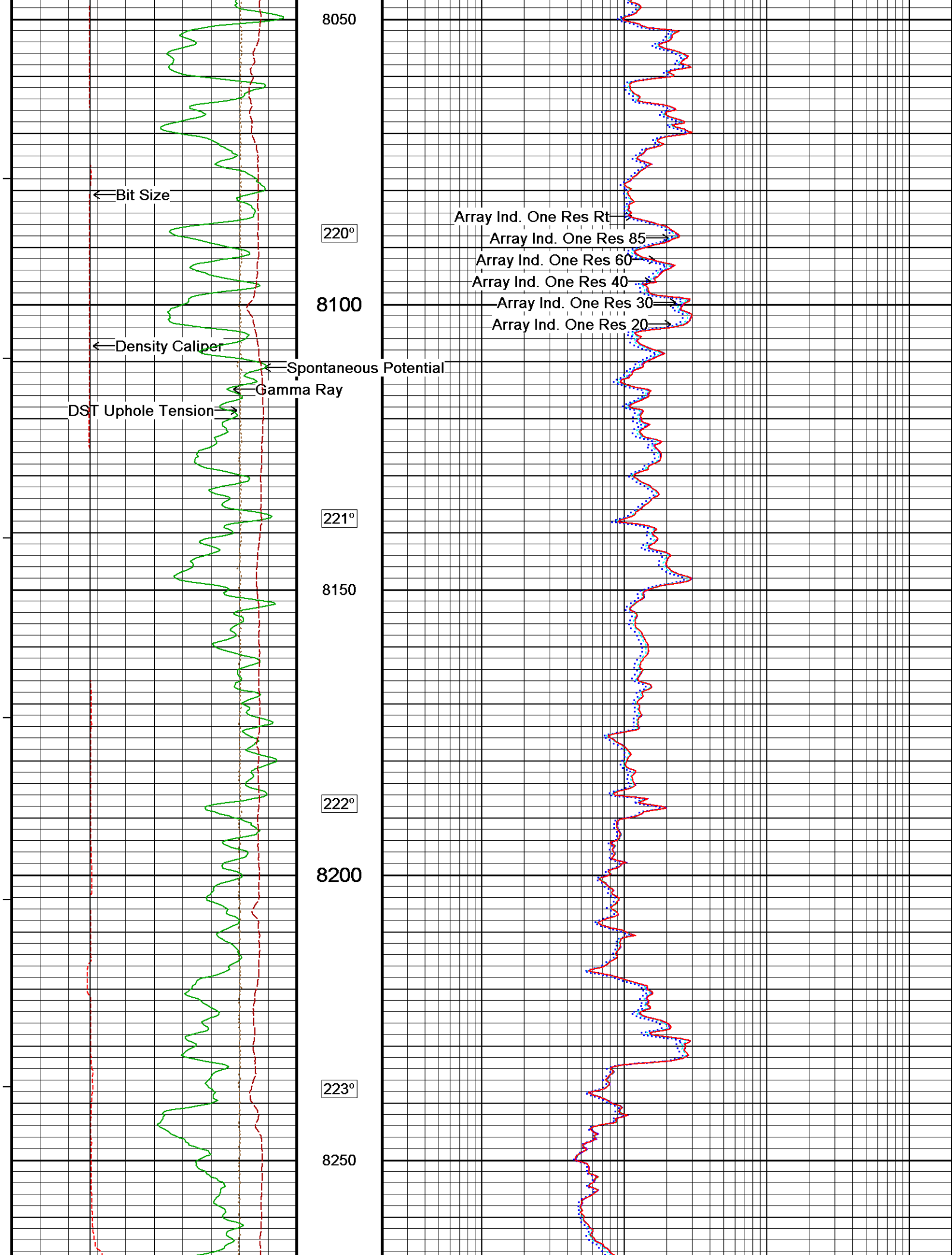
Array Ind. One Res 60 →

Array Ind. One Res 40 →

Array Ind. One Res 30 →

Array Ind. One Res 20 →







223°

8300

223°

8350

224°

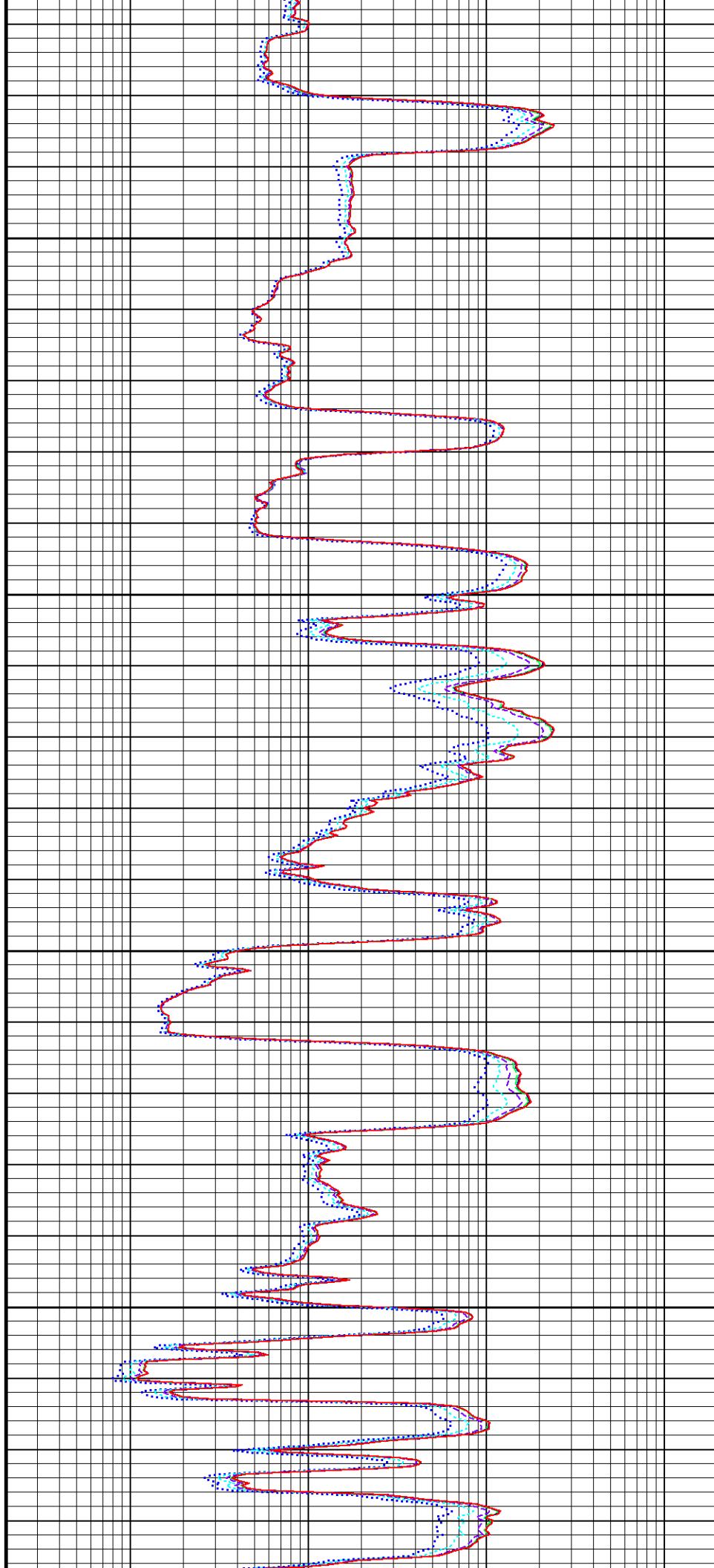
8400

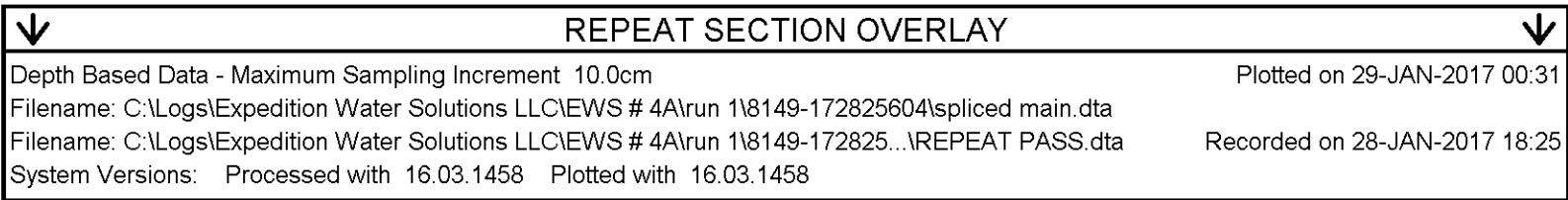
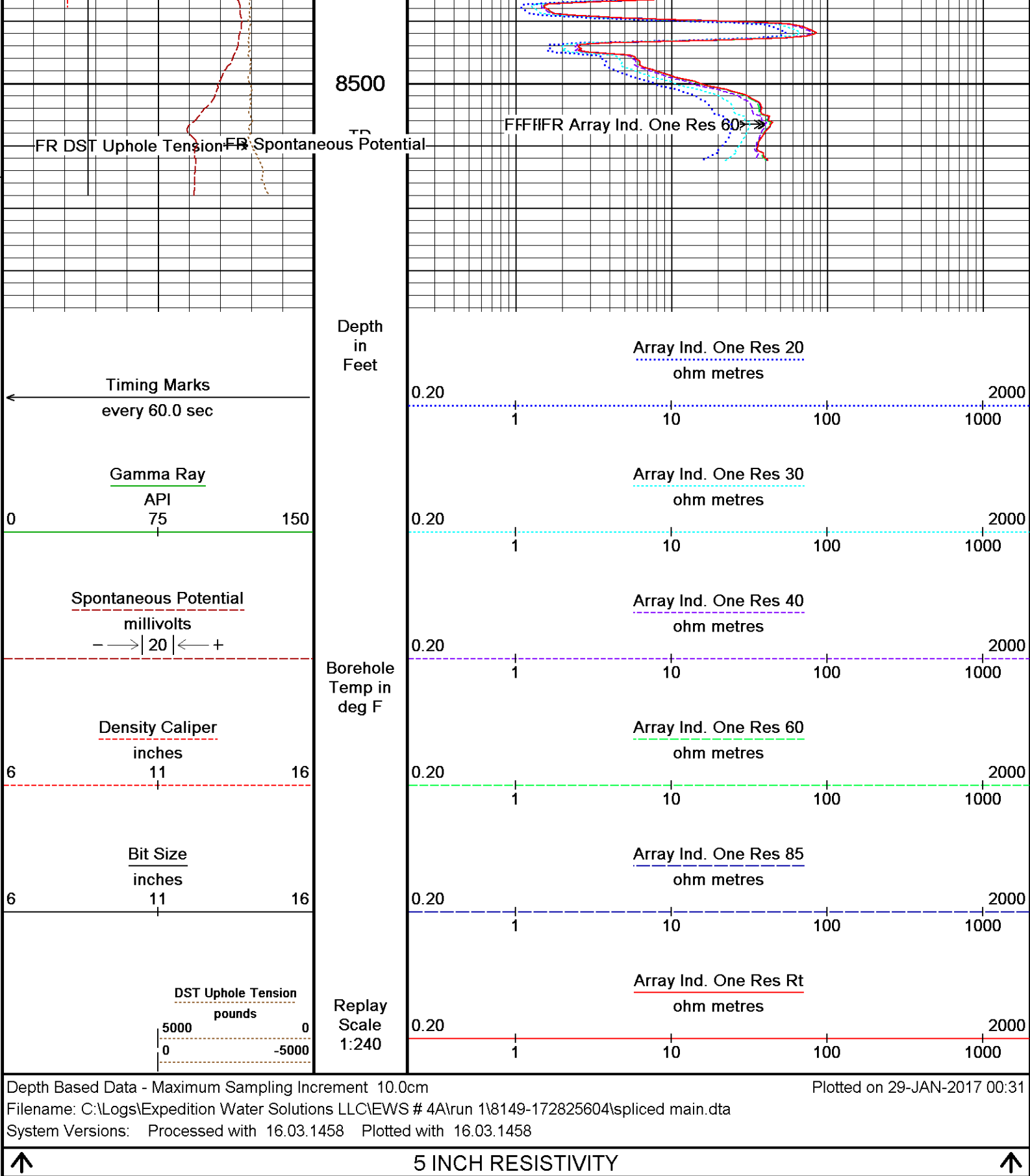
224°

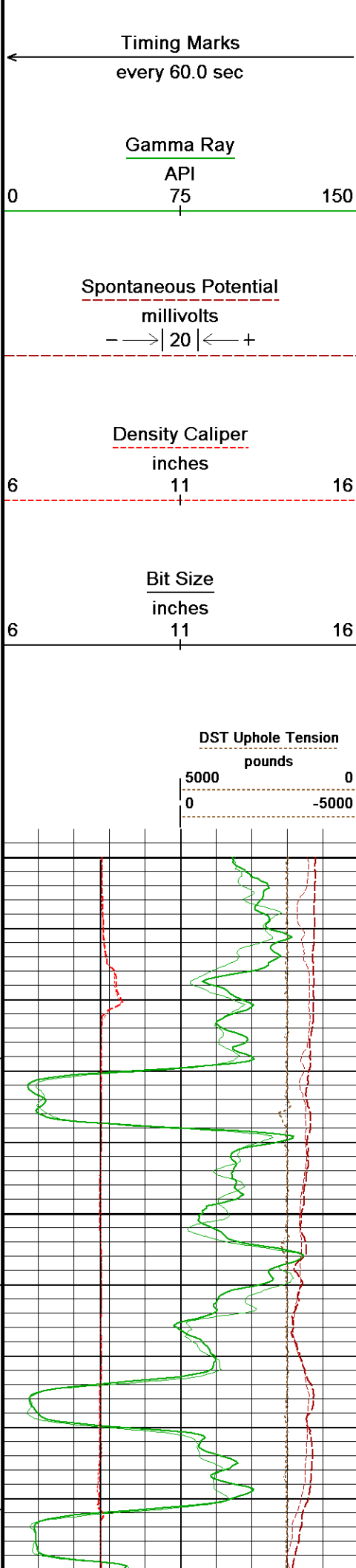
8450

←FR Gamma Ray

←FR Density Caliper







Feet

Borehole Temp in deg F

Replay Scale 1:240

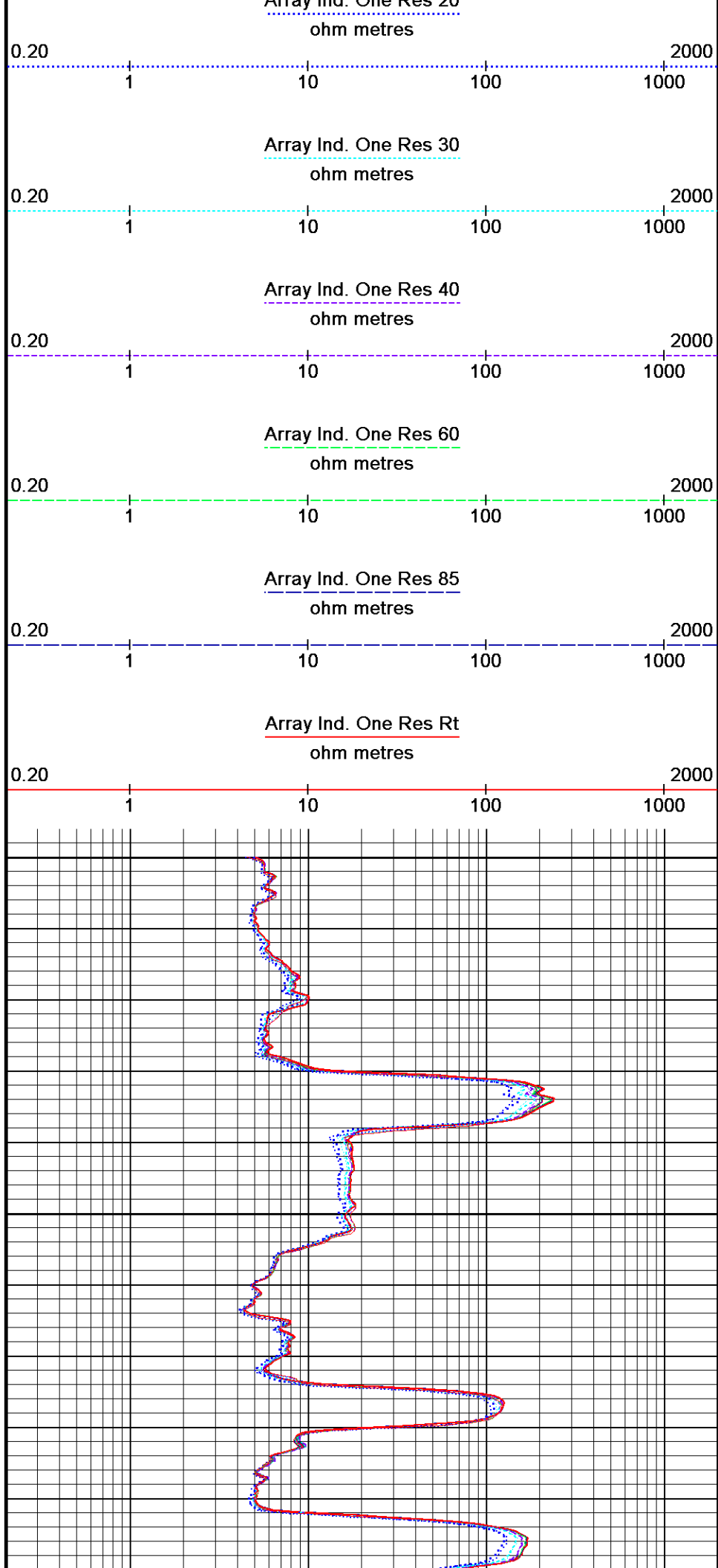
8250

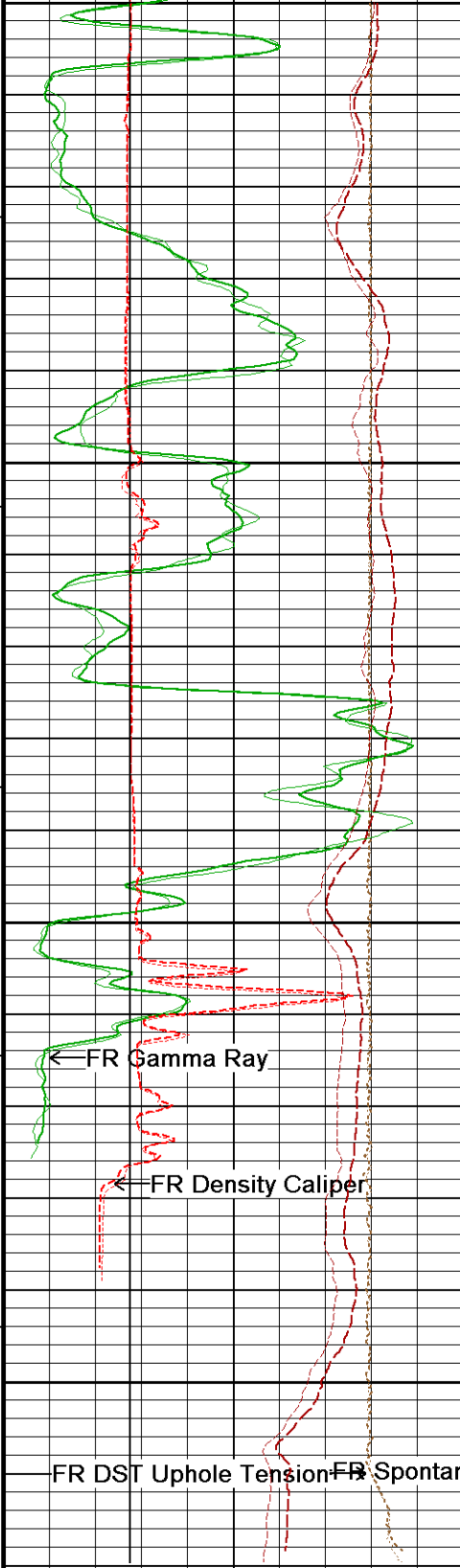
223°

8300

223°

8350



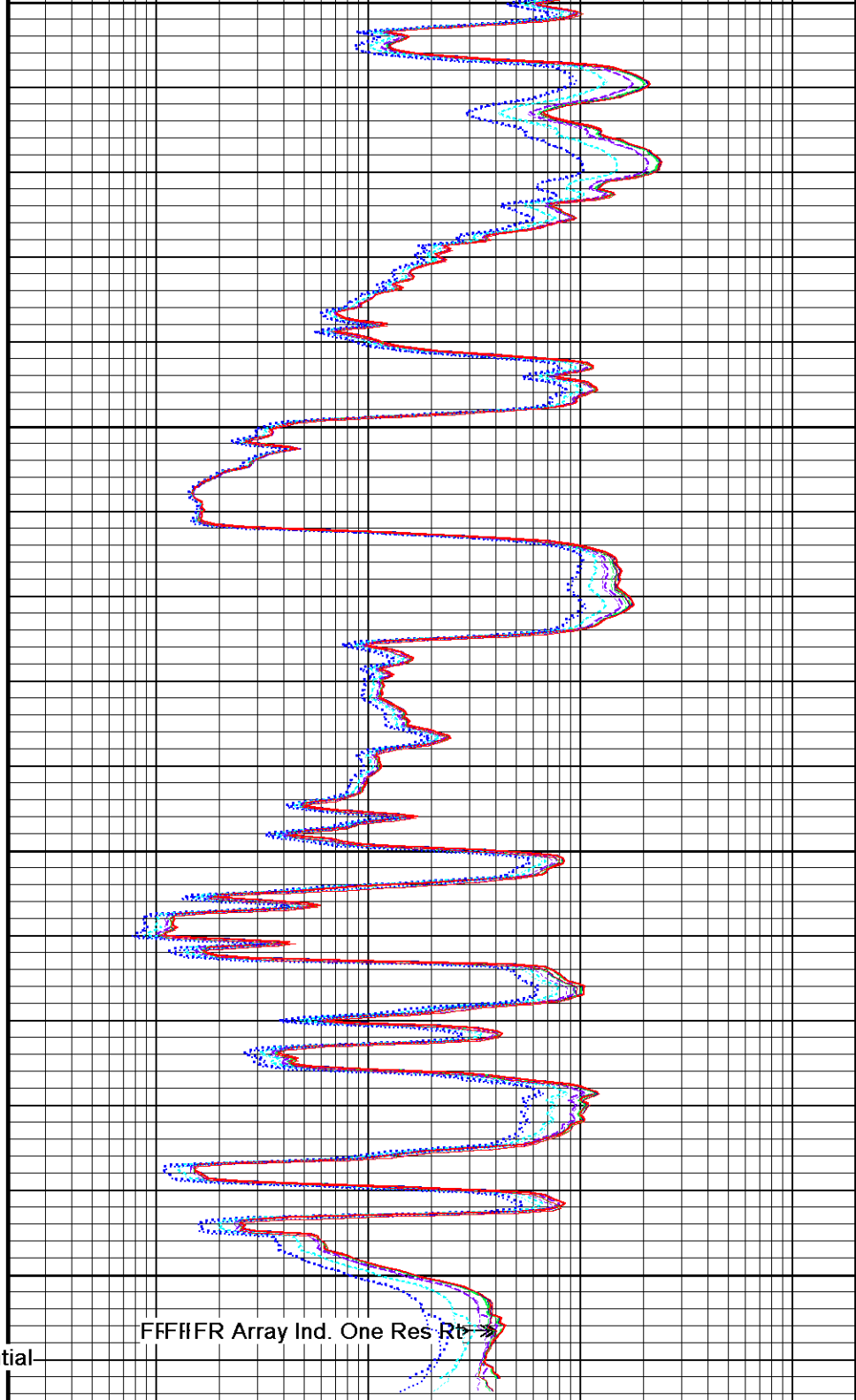


8350
224°
8400
224°
8450
8500

Depth
in
Feet

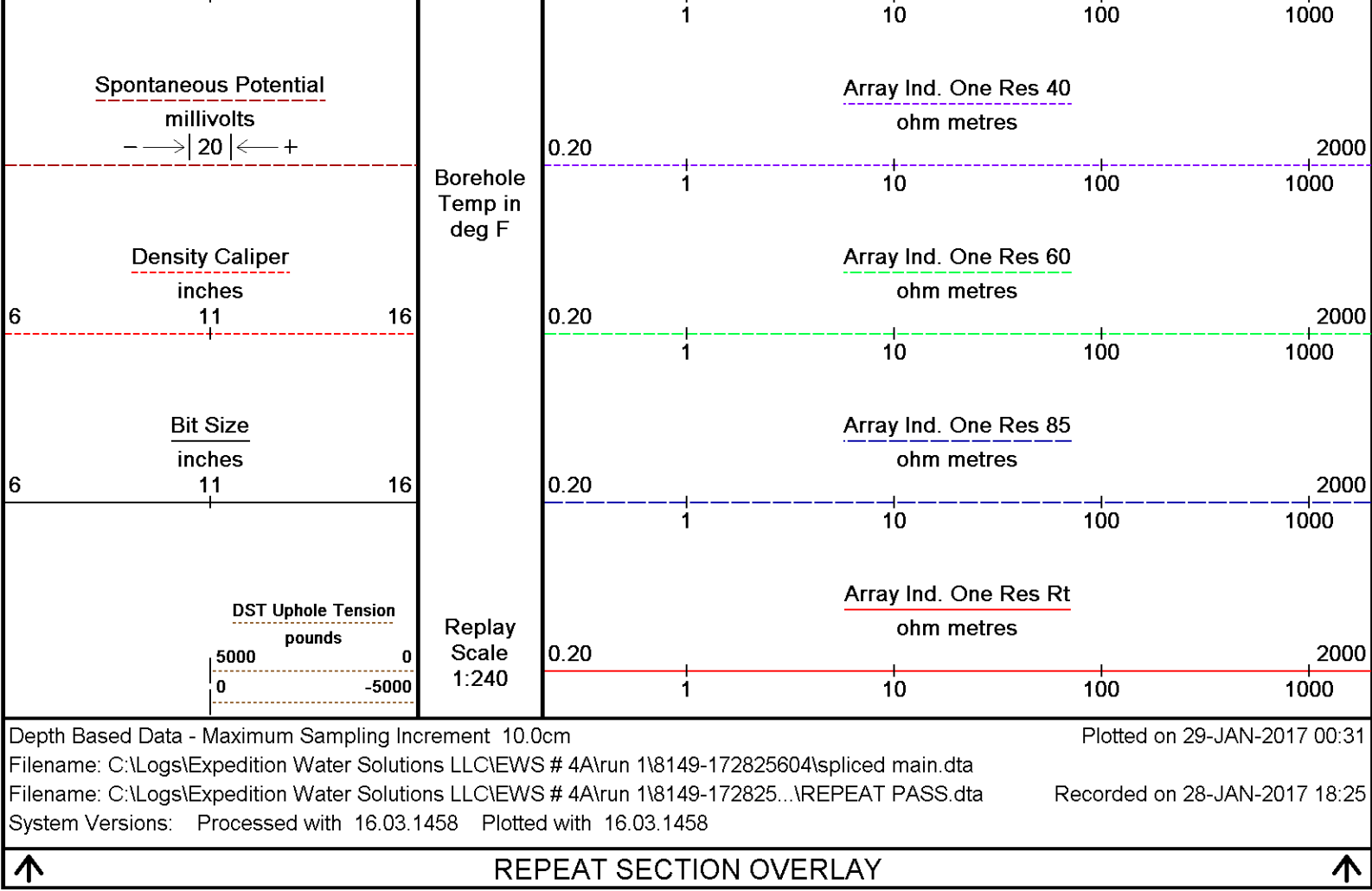
Timing Marks
every 60.0 sec

Gamma Ray
API
0 75 150



Array Ind. One Res 20
ohm metres
0.20 1 10 100 1000 2000

Array Ind. One Res 30
ohm metres
0.20 1 10 100 1000 2000



BEFORE SURVEY CALIBRATION			C:\Logs\Expedition Water Solutions LLC\EWS # 4A\run 1\8149-172825604\setup.dta
General Constants All 000		Last Edited on 28-JAN-2017,14:17	
General Parameters			
Mud Resistivity	0.980	ohm-metres	
Mud Resistivity Temperature	86.400	degrees F	
Water Level	0.000	feet	
Borehole Fluid Processing	Wet Hole		
Hole/Annular Volume and Differential Caliper Parameters			
HVOL Method	Single Caliper		
HVOL Caliper 1	Density Caliper		
HVOL Caliper 2	N/A		
Annular Volume Diameter	7.000	inches	
Caliper for Differential Caliper	Density Caliper		
Rwa Parameters			
Porosity used	Base Density Porosity		
Resistivity used	Deep Induction		
RWA Constant A	0.610		
RWA Constant M	2.150		
SW/APOR Tool Source	0.000		
High Resolution Temperature Calibration MCG-D.K 483		Field Calibration on 10-SEP-2015,22:02	
	Measured	Calibrated(Deg F)	
Lower	55.00	55.00	
Upper	80.00	80.00	
High Resolution Temperature Constants MCG-D.K 483		Last Edited on 02-OCT-2012,09:19	
Pre-filter Length	11		

Gamma Calibration MCG-D.K 483

Field Calibration on 28-JAN-2017,14:14

	Measured	Calibrated (API)
Background	126	86
Calibrator (Gross)	1048	712
Calibrator (Net)	922	626

Gamma Calibration Tolerances MCG-D.K 483

Ratio	1.473	<div><div></div><div></div><div></div><div></div></div>	Counts/API
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Gamma Constants MCG-D.K 483

Last Edited on 28-JAN-2017,14:14

Gamma Calibrator Number	GRC.C.072	
GRC-M Calibrator Jig in Use?	NO	
Inactive Background Jig in Use?	NO	
Mud Density	1.19	gm/cc
Caliper Source for Processing	Density Caliper	
Tool Position	Eccentred	
Potassium Equivalence	Chloride	
K Mud Concentration	0.00	%

Induction Calibration MAI-C.A 456

Base Calibration on 06-JAN-2017,04:52

Field Check on 28-JAN-2017 13:51

Base Calibration

Test Loop Calibration

Channel	Measured		Calibrated (mmho/m)	
	Low	High	Low	High
1	16.2	452.6	9.3	966.2
2	5.6	366.0	7.6	821.4
3	2.9	251.0	5.2	566.0
4	1.3	130.8	2.6	279.2

Array Temperature 73.2 Deg F

Test Loop Calibration Verified

Channel	Base Check (mmho/m)		Field Check (mmho/m)	
	Low	High	Low	High
1	0.0	0.0	-5.5	2132.5
2	0.0	0.0	14.6	1964.3
3	0.0	0.0	15.5	1680.9
4	0.0	0.0	11.2	1125.9
Deep	0.0	0.0	9.3	1071.3
Medium	0.0	0.0	24.4	2237.0
Shallow	0.0	0.0	21.4	2939.0

Array Temperature 0.0 42.7 Deg F

Induction Calibration Tolerances MAI-C.A 456

Low Conductivity 1	16.2	<div><div></div><div></div><div></div><div></div></div>	mmho/m	High Conductivity 1	452.6	<div><div></div><div></div><div></div><div></div></div>	mmho/m
Low Conductivity 2	5.6	<div><div></div><div></div><div></div><div></div></div>	mmho/m	High Conductivity 2	366.0	<div><div></div><div></div><div></div><div></div></div>	mmho/m
Low Conductivity 3	2.9	<div><div></div><div></div><div></div><div></div></div>	mmho/m	High Conductivity 3	251.0	<div><div></div><div></div><div></div><div></div></div>	mmho/m
Low Conductivity 4	1.3	<div><div></div><div></div><div></div><div></div></div>	mmho/m	High Conductivity 4	130.8	<div><div></div><div></div><div></div><div></div></div>	mmho/m
Background Vx 1	0.0	<div><div></div><div></div><div></div><div></div></div>	mmho/m	Phase Check Loop 1	0.0	<div><div></div><div></div><div></div><div></div></div>	%
Background Vx 2	0.0	<div><div></div><div></div><div></div><div></div></div>	mmho/m	Phase Check Loop 2	0.0	<div><div></div><div></div><div></div><div></div></div>	%
Background Vx 3	0.0	<div><div></div><div></div><div></div><div></div></div>	mmho/m	Phase Check Loop 3	0.0	<div><div></div><div></div><div></div><div></div></div>	%
Background Vx 4	0.0	<div><div></div><div></div><div></div><div></div></div>	mmho/m	Phase Check Loop 4	0.0	<div><div></div><div></div><div></div><div></div></div>	%

Induction Constants MAI-C.A 456

Last Edited on 28-JAN-2017,13:49

Induction Model	RtAP-WBM	
Borehole Correction Constants		
Tool Centred	No	
Hole Size Source	Density Caliper	
Hole Size Constant Value	N/A	inches
Stand-off Type	Fins	
Stand-off	0.50	inches

Stand-off	0.00	inches
Number of Fins on Stand-off	6.0000	
Stand-off Fin Angle	60.00	degrees
Stand-off Fin Width	0.5000	inches
Rm Source	Global Value: Temperature Corrected	
Temp. for Rm Corr.	MCG External Temperature	
Squasher Start	0.0020	mhos/metre
Squasher Offset	N/A	mhos/metre
Borehole Normalisation		
DRM1	0.0000	DRC1 0.0000
DRM2	0.0000	DRC2 0.0000
MRM1	0.0000	MRC1 0.0000
MRM2	0.0000	MRC2 0.0000
SRM1	0.0000	SRC1 0.0000
SRM2	0.0000	SRC2 0.0000

Calibration Site Corrections		
Channel 1	0.00	mmhos/metre
Channel 2	0.00	mmhos/metre
Channel 3	0.00	mmhos/metre
Channel 4	0.00	mmhos/metre

Symmetrised Receiver Gains	
Receiver 1	1.00
Receiver 2	1.00
Receiver 3	1.00
Receiver 4	1.00

Apparent Porosity and Water Saturation Constants		
Archie Constant (A)	1.00	
Cementation Exponent (M)	2.00	
Saturation Exponent (N)	2.00	
Saturation of Water for Apor	100.00	percent
Resistivity of Water for Apor and Sw	0.05	ohm-m
Resistivity of Mud Filtrate for Sw	0.00	ohm-m
Source for Rt	0.00	
Source for Rxo	0.00	

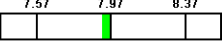
Caliper Calibration MPD-D.A 478

Base Calibration on 22-JAN-2017,13:20
Field Calibration on 28-JAN-2017 14:01

Base Calibration		
Reading No	Measured	Calibrator Size (in)
1	17153	3.98
2	25843	5.96
3	34378	7.97
4	42515	9.84
5	51814	11.91
6	N/A	N/A

Field Calibration		
	Measured Caliper (in)	Actual Caliper (in)
	7.92	7.97

Caliper Calibration Tolerances MPD-D.A 478

Long Arm Field Cal. 7.92  in

DOWNHOLE EQUIPMENT

C:\Logs\Expedition Water Solutions LLC\EWS # 4A\run 1\8149-172825604\setup.dta

Cablehead, 11 pin
CBH-C 0 LG: 2.40 ft WT: 24.3 lb OD: 2.244 in

Compact Swivel Head Adaptor
SHA-J.B 573 LG: 2.30 ft WT: 22.0 lb OD: 2.244 in



45.13 ft GRGC - MCG Gamma Ray

Compact Comms Gamma
MCG-D.K 483 LG: 8.70 ft WT: 63.9 lb OD: 2.244 in

Compact Neutron
MDN-C.A 464 LG: 5.04 ft WT: 50.7 lb OD: 2.244 in

Compact Density/Caliper
MPD-D.A 478 LG: 9.59 ft WT: 90.4 lb OD: 2.449 in

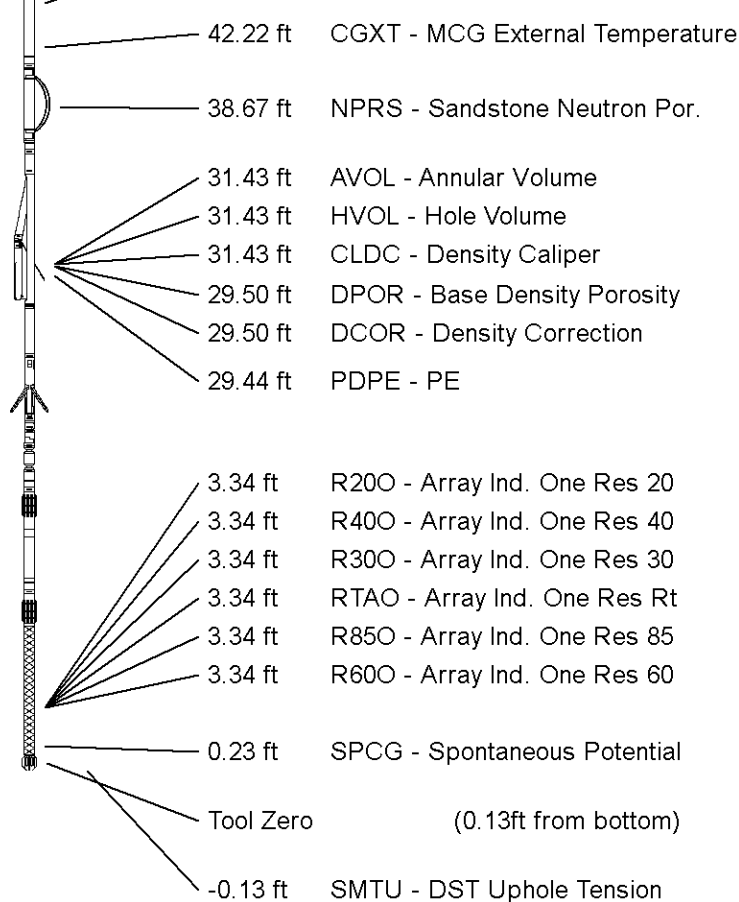
Compact Vee Arm Caliper
MVC-A.A 142 LG: 8.06 ft WT: 61.7 lb OD: 2.244 in

Compact Knuckle Joint
SKJ-E.B 534 LG: 2.17 ft WT: 24.3 lb OD: 2.244 in

Compact Focussed Electric
MFE-C.A 416 LG: 6.05 ft WT: 48.5 lb OD: 2.244 in

Compact Induction
MAI-C.A 456 LG: 10.81 ft WT: 48.5 lb OD: 2.240 in

Total Length: 55.11 ft Weight: 434.3 lb



All measurements relative to tool zero.

COMPANY	EXPEDITION WATER SOLUTIONS COLORADO LLC
WELL	EWS # 4A
FIELD	WATTENBERG
PROVINCE/COUNTY	WELD
COUNTRY/STATE	USA / COLORADO

Elevation Kelly Bushing	4856	feet	First Reading	8507.00	feet
Elevation Drill Floor	4856	feet	Depth Driller	8501.00	feet
Elevation Ground Level	4843	feet	Depth Logger	8510.00	feet



Weatherford®

ARRAY INDUCTION
LOG