

**Weatherford****ARRAY INDUCTION
LOGS**

COMPANY **EAST CHEYENNE GAS STORAGE LLC**
WELL **ECGS No 31-7 WPD005-1**
FIELD **PEETZ WEST**
PROVINCE/COUNTY **LOGAN**
COUNTRY/STATE **US/COLORADO**
LOCATION **1065' FSL & 2185' FEL**

SEC **31** TWP **12N** RGE **52W** Other Services
API Number **05-075-09410** MPD/MDN
Permit Number **CMI**

Permanent Datum GL, Elevation 4543 feet
Log Measured From KB
Drilling Measured From KB

Elevations:
KB 4557.00
DF 4556.00
GL 4543.00

Date	16-OCT-2012	
Run Number	ONE	
Depth Driller	5260.00	feet
Depth Logger	5254.00	feet
First Reading	5251.00	feet
Last Reading	1212.00	feet
Casing Driller	1212.00	feet
Casing Logger	1212.00	feet
Bit Size	8.750	inches
Hole Fluid Type	WBM	
Density / Viscosity	9.80 g/cc	48.00 CP
PH / Fluid Loss	9.00	7.40 ml/30Min
Sample Source	FLOWLINE	
Rm @ Measured Temp	6.46 @ 54.2	ohm-m
Rmf @ Measured Temp	5.17 @ 54.2	ohm-m
Rmc @ Measured Temp	7.75 @ 54.2	ohm-m
Source Rmf / Rmc	CALC	CALC
Rm @ BHT	2.42 @148.0	ohm-m
Time Since Circulation	4 HOURS	
Max Recorded Temp	148.00	deg F
Equipment Name	COMPACT	
Equipment / Base	13037	RK SPR
Recorded By	B. ROSSER	
Witnessed By	J. ASHBY	

BOREHOLE RECORD

Last Edited: 16-OCT-2012 14:49

Bit Size inches	Depth From feet	Depth To feet
8.750	1212.00	5260.00

CASING RECORD

Type	Size inches	Depth From feet	Shoe Depth feet	Weight pounds/ft
SURFACE	9.625	0.00	1212.00	36.00

REMARKS

SOFTWARE VERSION 13.03.6600

TOOLS RUN: SHA, MCG, MDN, MPD, MIS-A, SKJ, MIS-E, SKJ, SHA, MIM, MIE, SKJ, MFE, MAI RUN IN COMBINATION.

HARDWARE: MPD: 8" PROFILE PLATE USED.
MAI: TWO 1 INCH STANDOFFS USED.
MDN: DUAL BOWSPRING USED.
MIM: ONE NONMETALIC CENTRALIZING BASKET USED.
MIE: ONE 1 INCH STANDOFF USED

2.65 G/CC DENSITY MATRIX USED TO CALCULATE POROSITY FROM TD TO BOTTOM OF FORT HAYES FORMATION(5254FT TO 4700FT)

7/00/1/.

2.71 G/CC DENSITY MATRIX USED TO CALCULATE POROSITY IN FORT HAYES FORMATION (4700 FT TO 4200 FT).

TIGHT PULLS, BOREHOLE SIZE AND RUGOSITY WILL AFFECT REPEATABILITY AND DATA QUALITY.

ALL INTERVALS LOGGED AND SCALED PER CUSTOMER'S REQUEST.

LAT/ LONG: 40.966620 / -103.221030

TOTAL HOLE VOLUME FROM TD TO SURFACE CASING =1026 CUBIC FEET

ANNULAR VOLUME WITH 7 INCH PRODUCTION CASING FROM TD TO SURFACE CASING = 655 CUBIC FEET

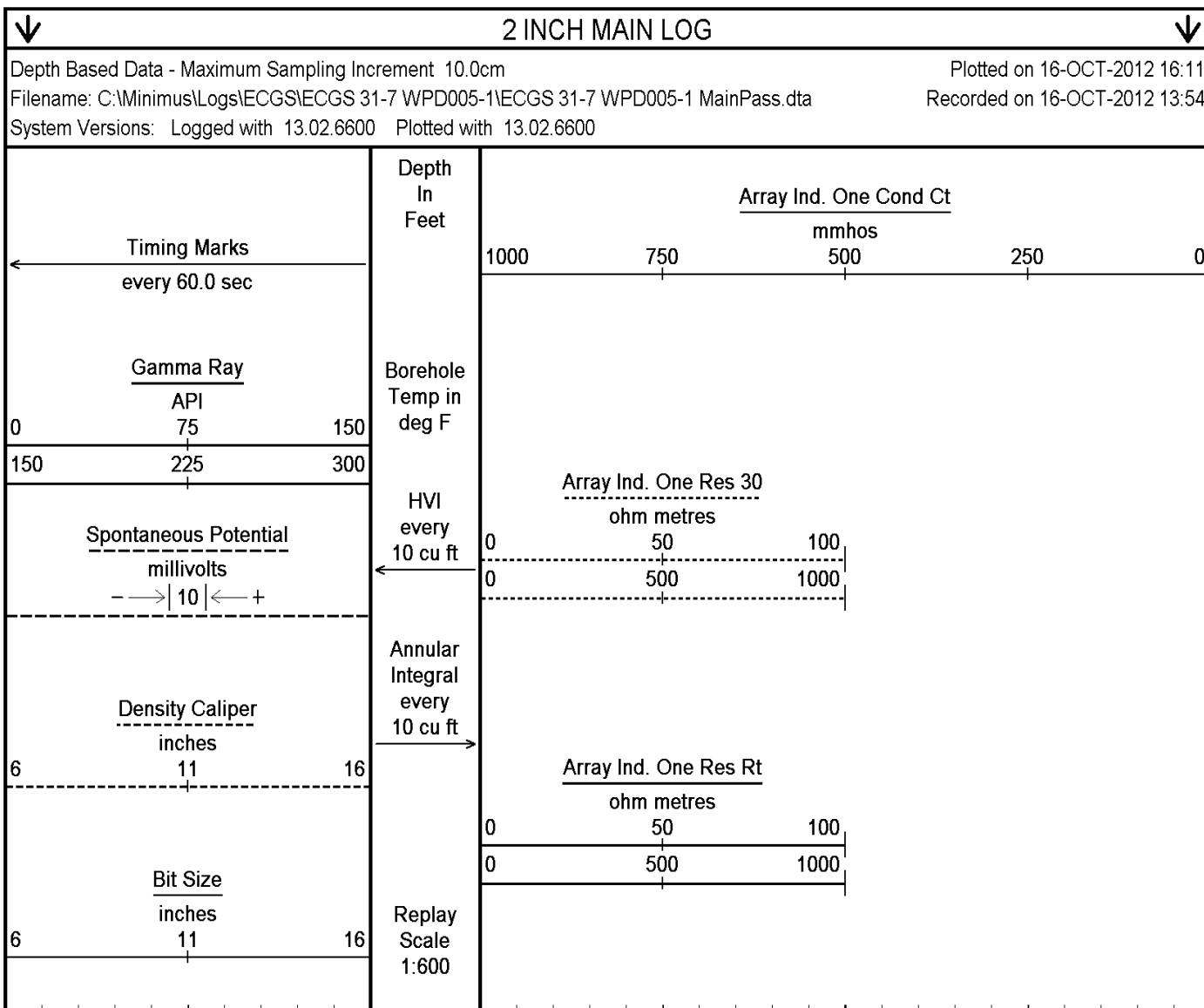
TOTAL VOLUME FROM TD TO 4200 FT = 410 CUBIC FEET

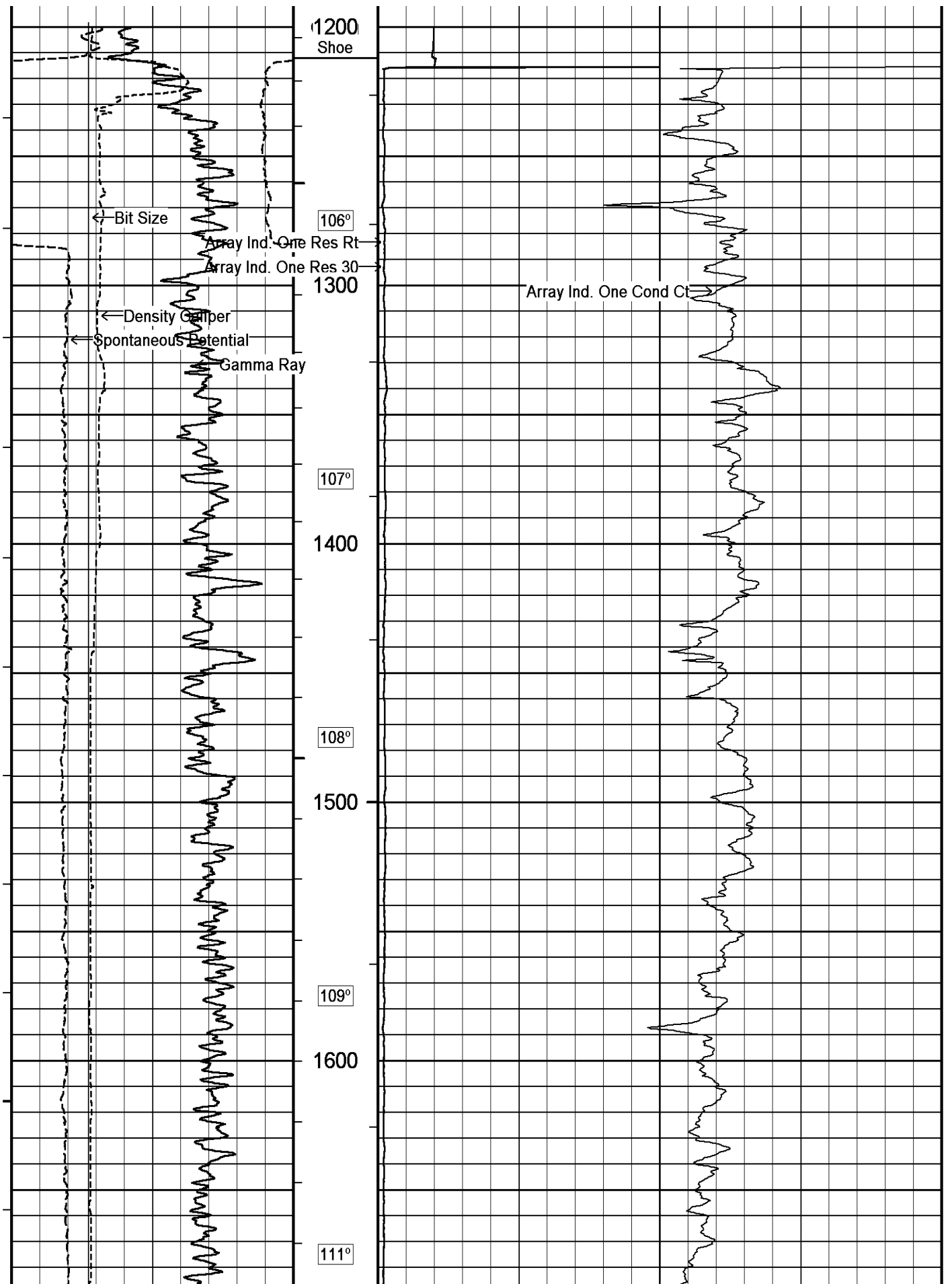
ANNULAR VOLUME WITH 7 INCH PRODUCTION CASING FROM TD TO 4200 FT = 140 CUBIC FEET

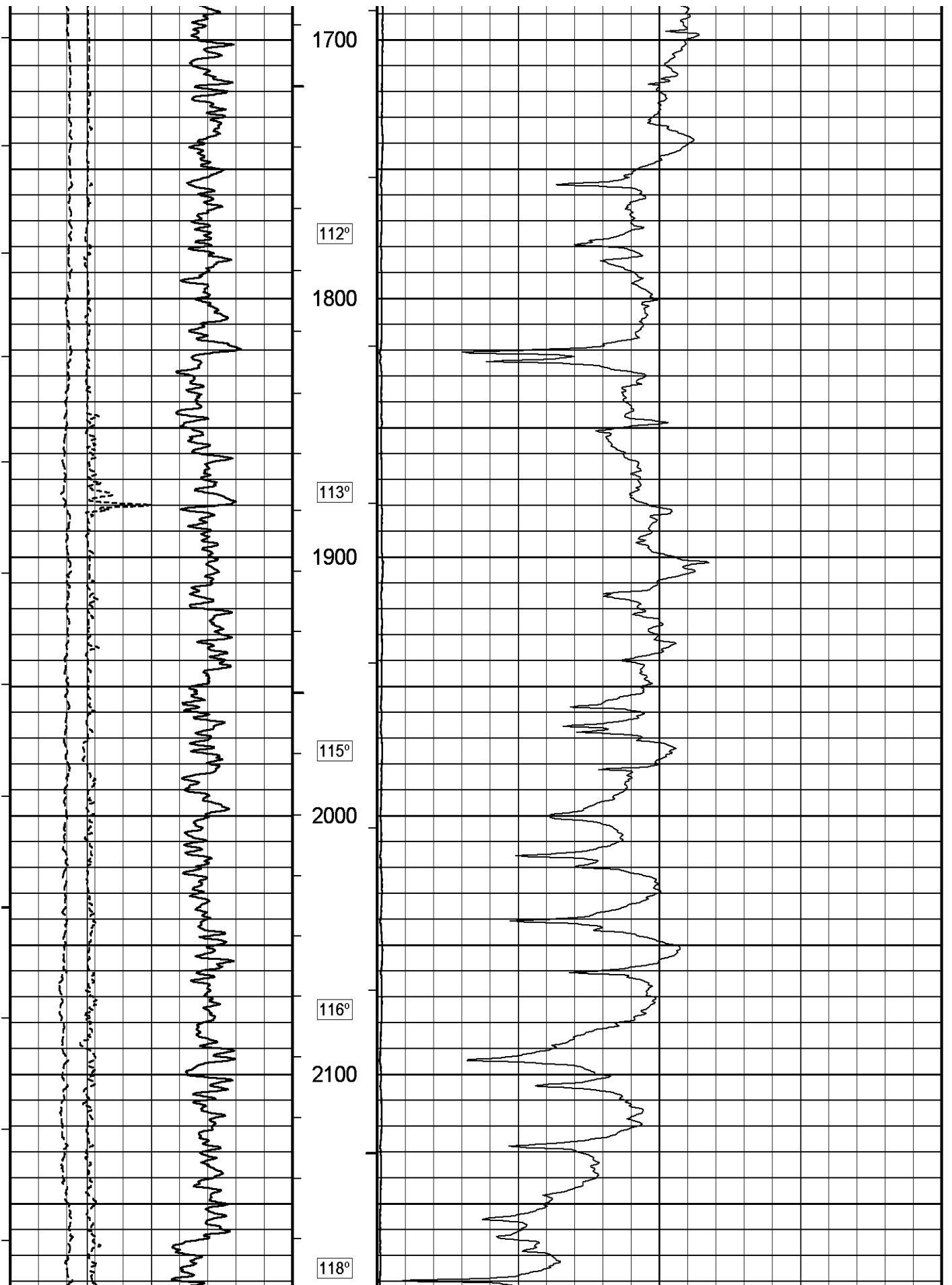
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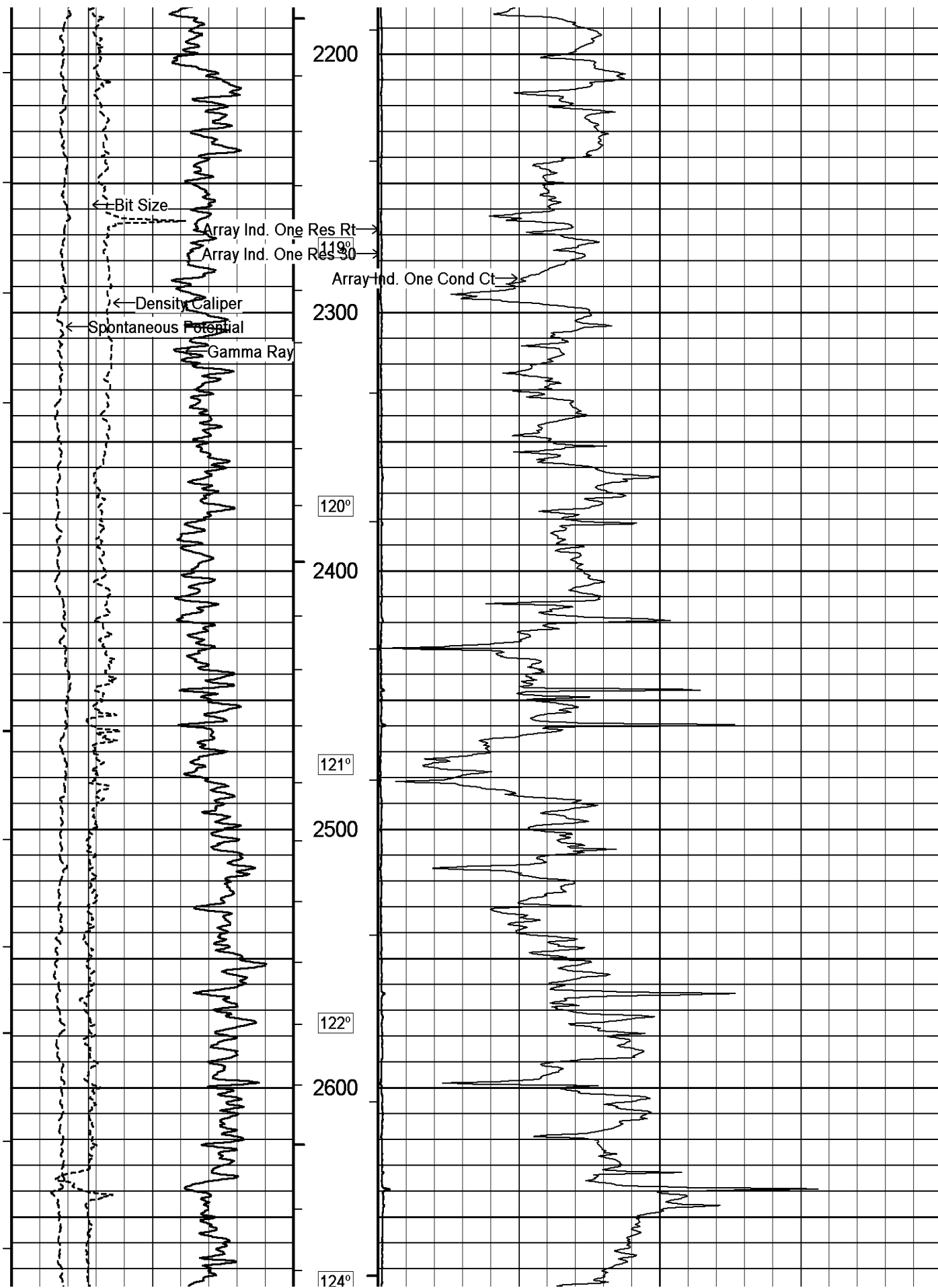
RIG: CADE 22

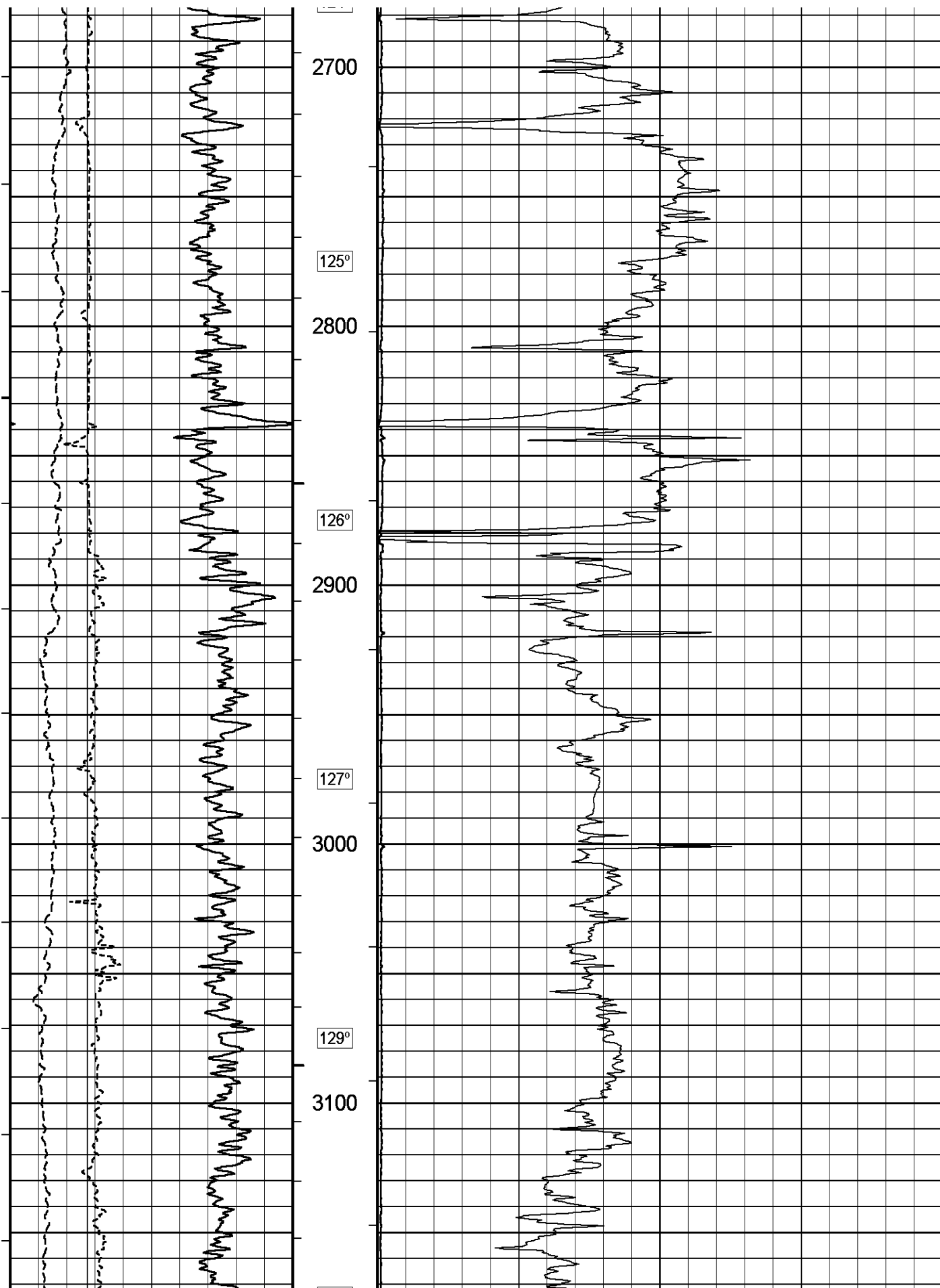
All interpretations are opinions based on inferences from electrical or other measurements and we cannot, and do not, guarantee the accuracy or correctness of any interpretations, and we shall not, except in the case of gross or wilful negligence on our part, be liable or responsible for any loss, costs, damages or expenses incurred or sustained by anyone resulting from any interpretation made by any of our officers, agents or employees. These interpretations are also subject to our general terms and conditions in our price schedule.

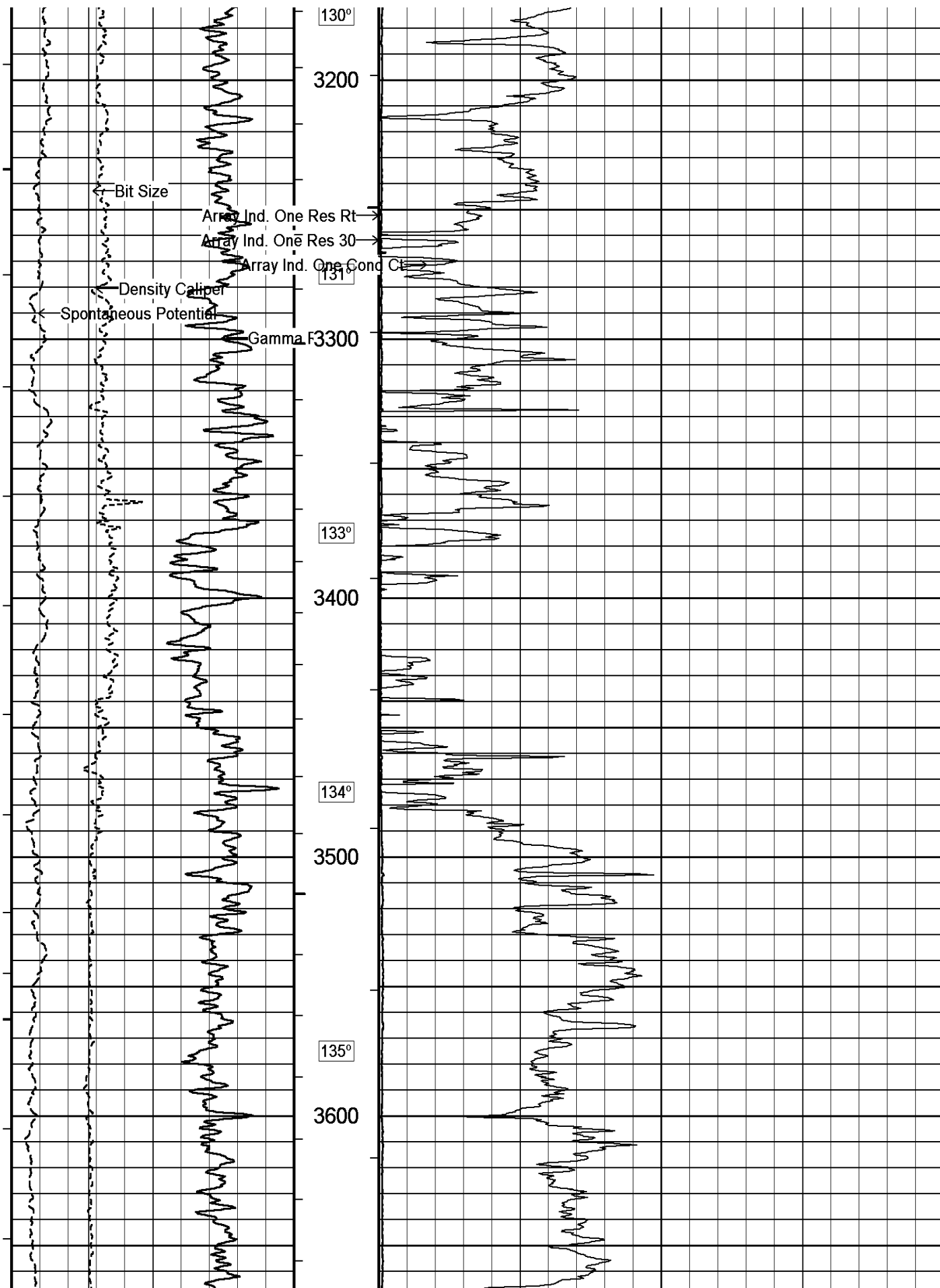


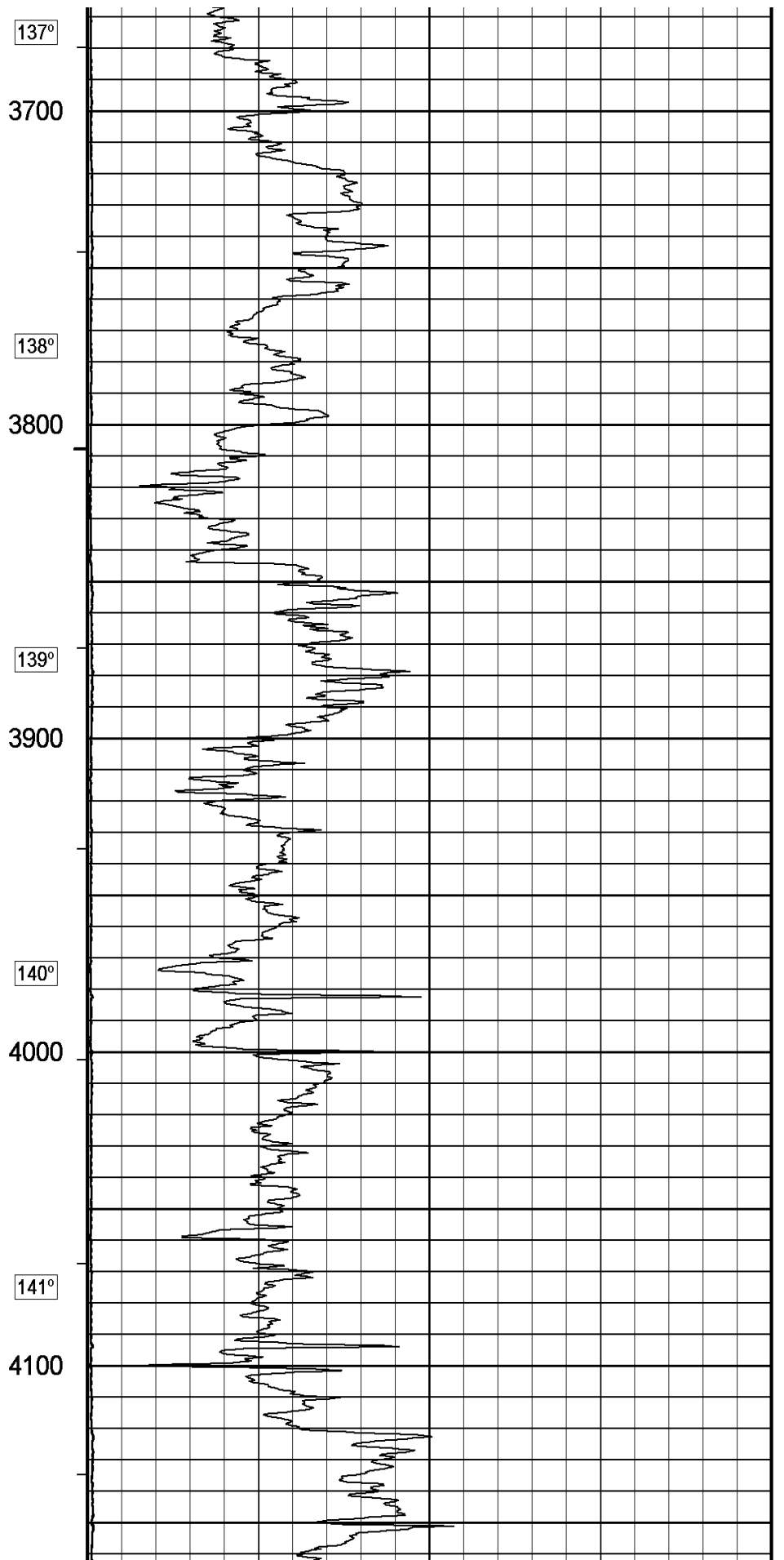
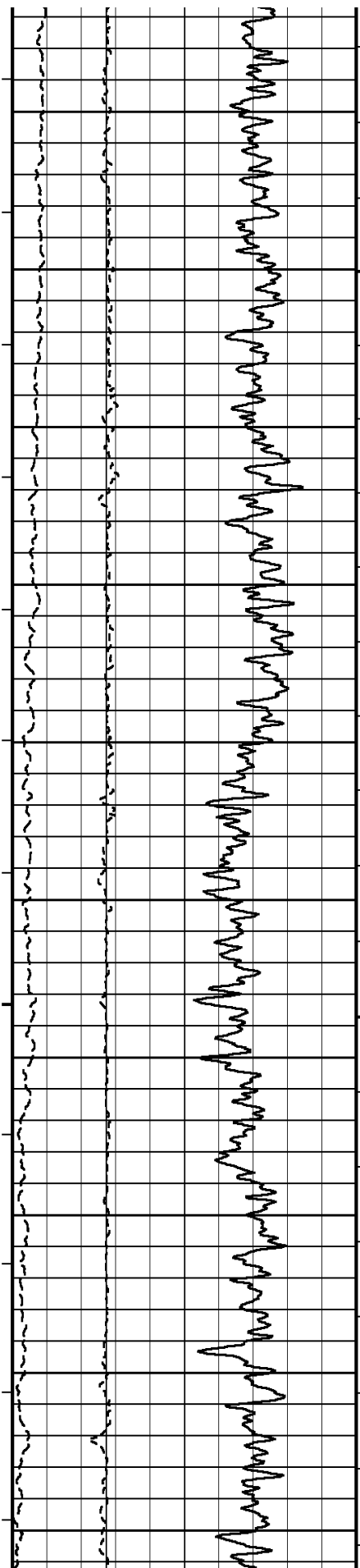


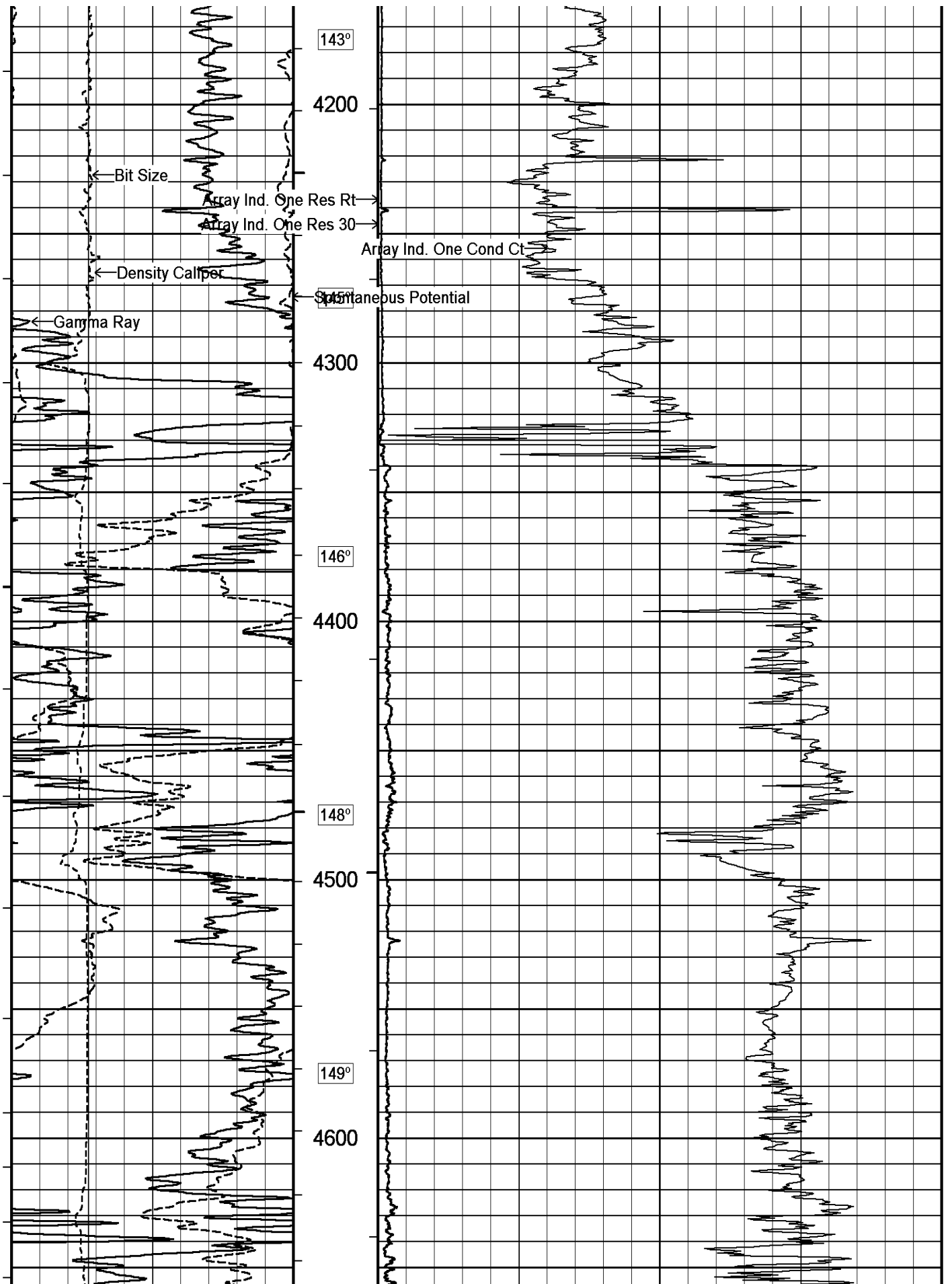


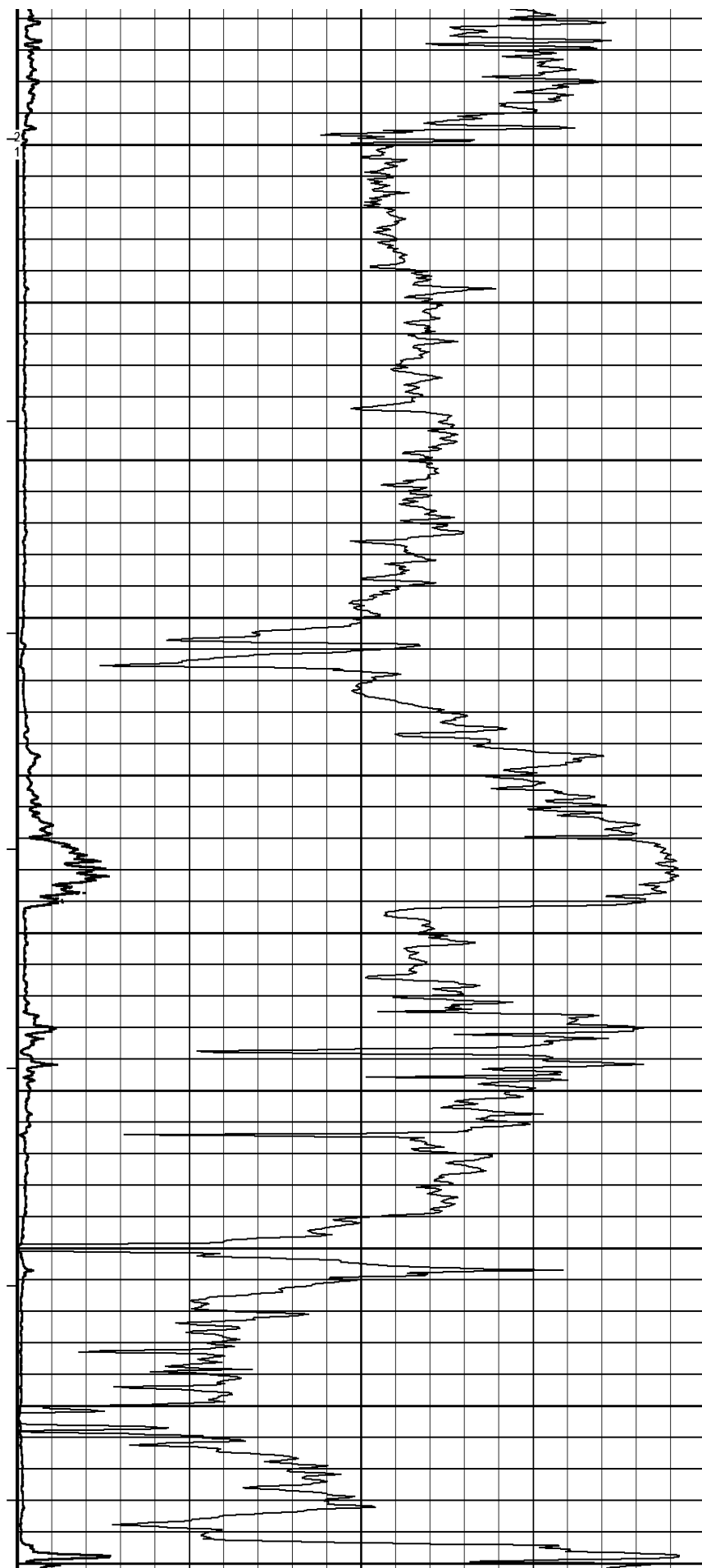
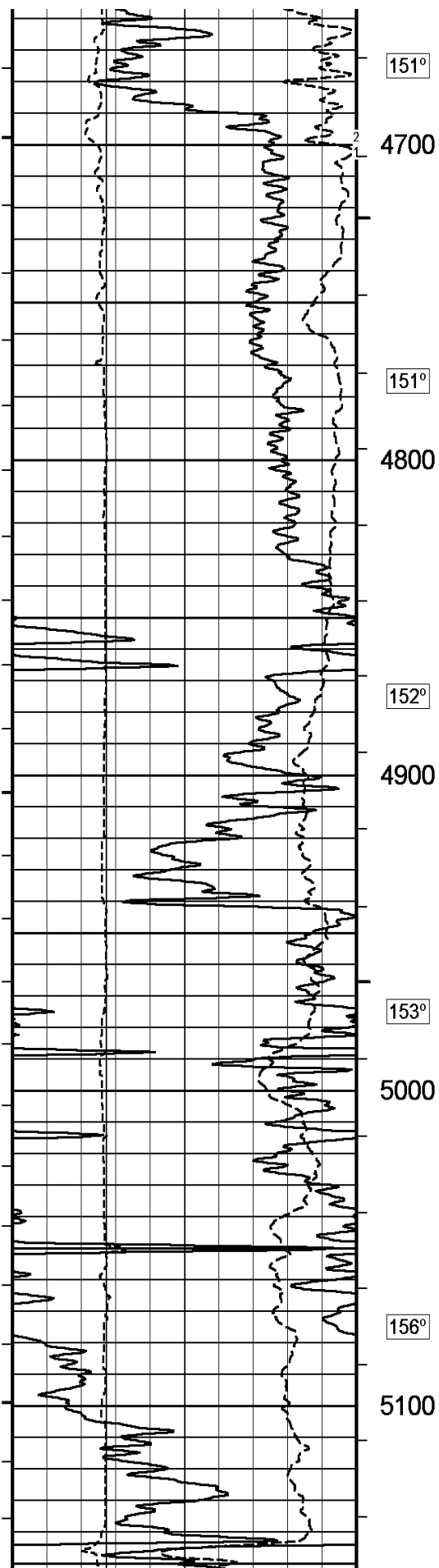


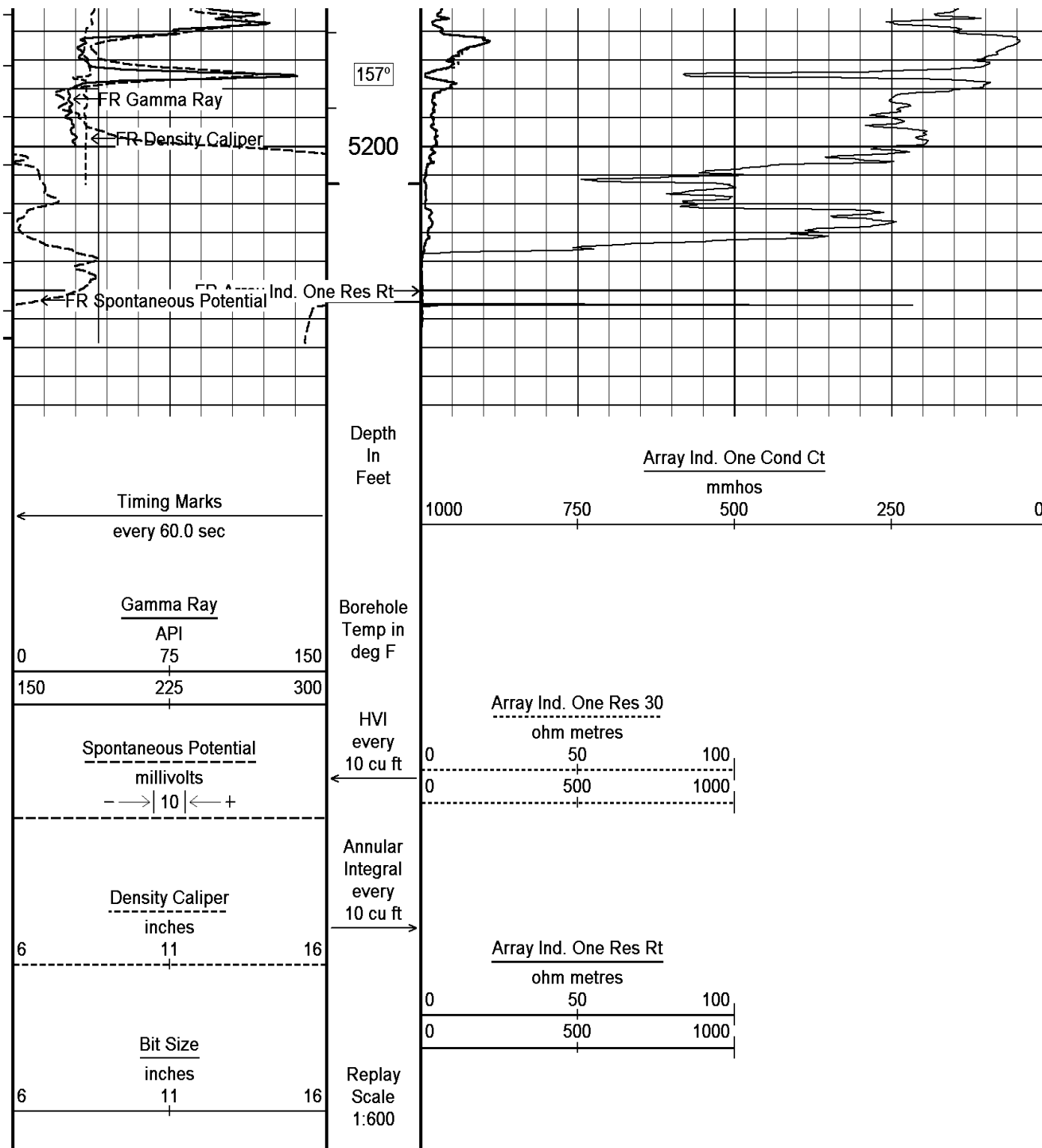












Depth Based Data - Maximum Sampling Increment 10.0cm

Filename: C:\Minimus\Logs\ECGS\ECGS 31-7 WPD005-1\ECGS 31-7 WPD005-1 MainPass.dta

System Versions: Logged with 13.02.6600 Plotted with 13.02.6600

Plotted on 16-OCT-2012 16:11

Recorded on 16-OCT-2012 13:54

↑ 2 INCH MAIN LOG ↑

↓

Depth Based Data - Maximum Sampling Increment 10.0cm

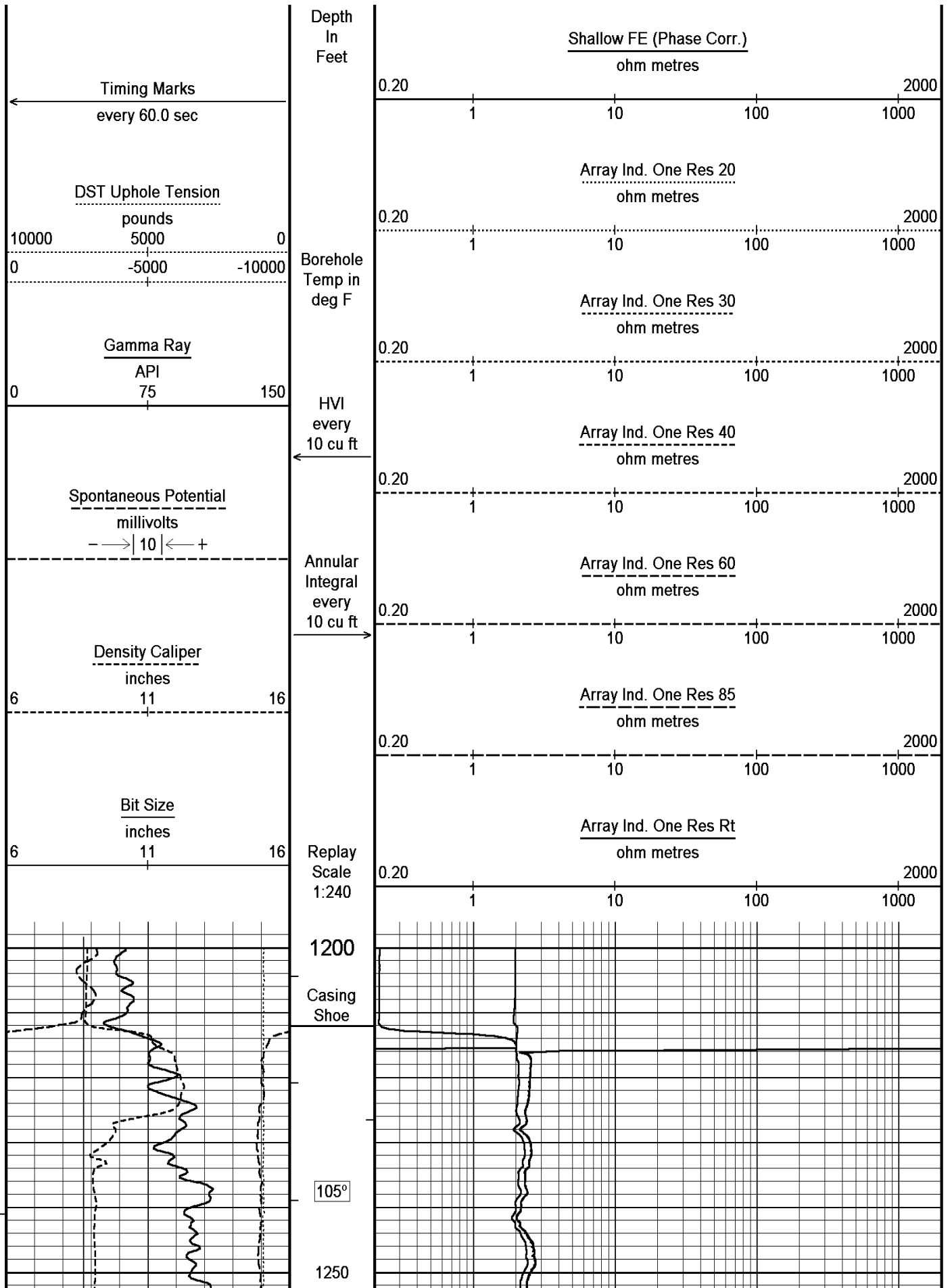
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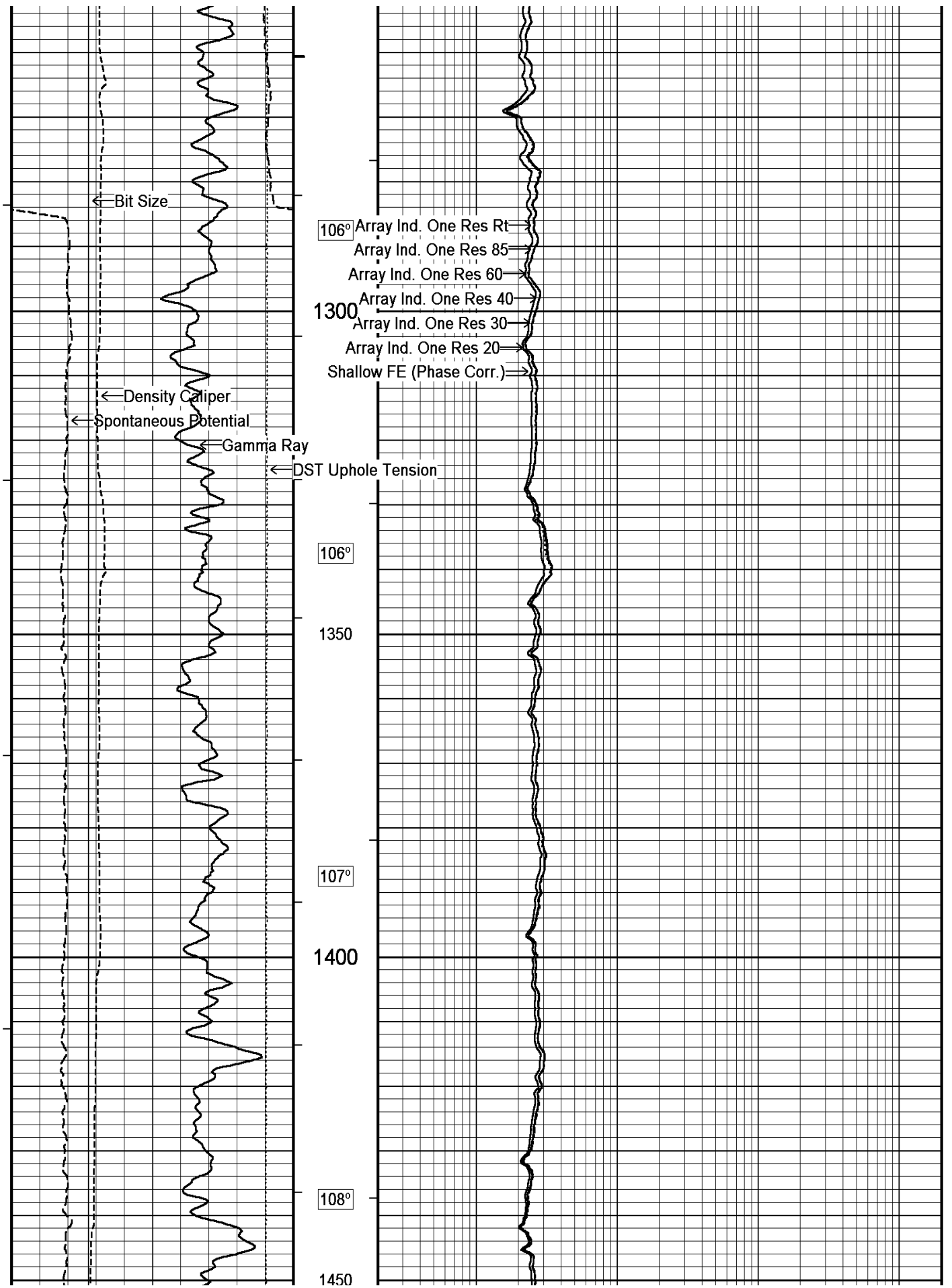
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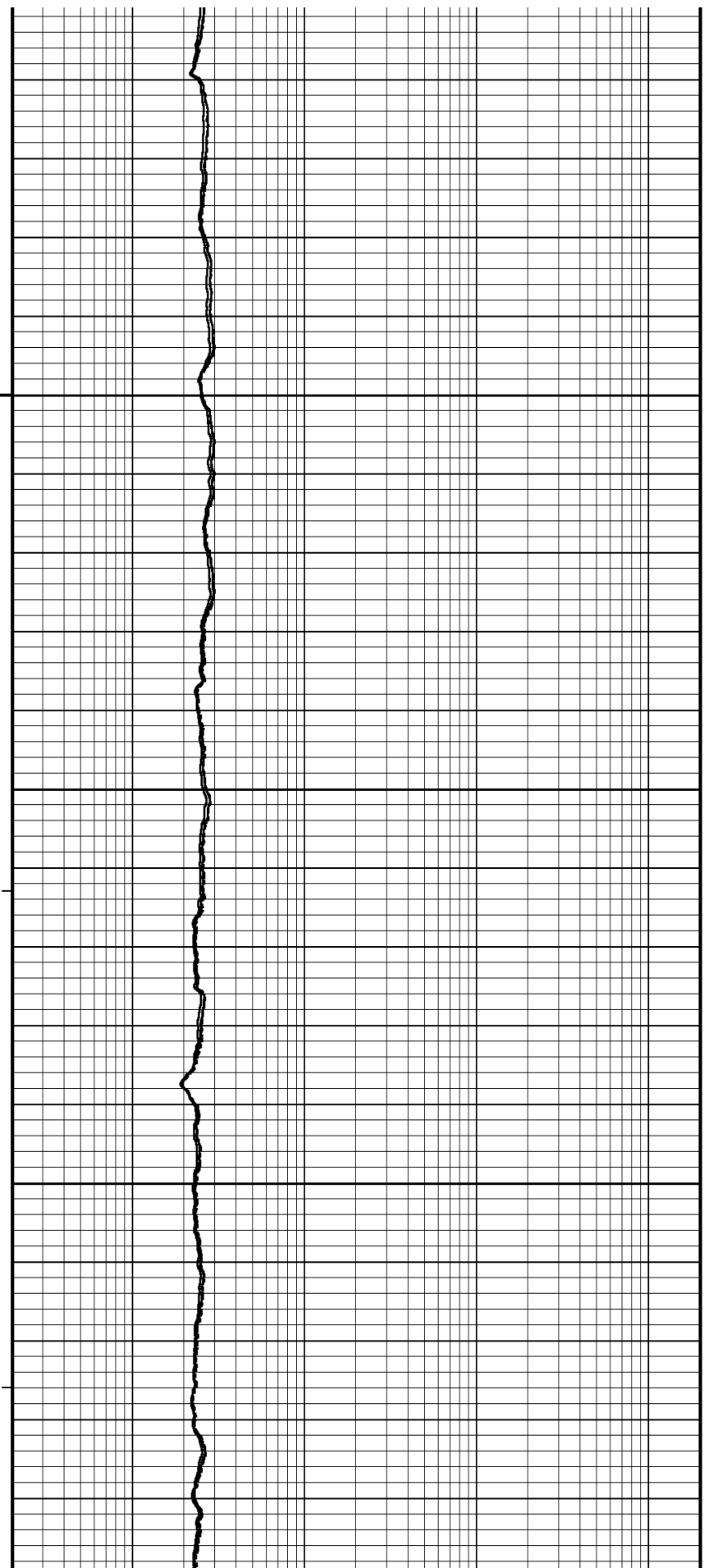
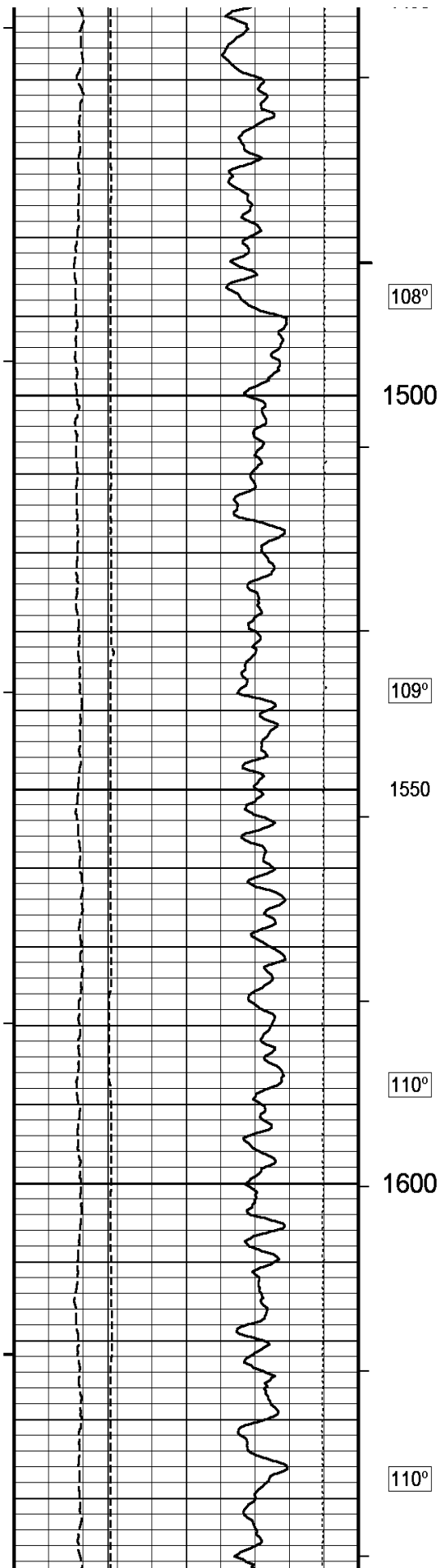
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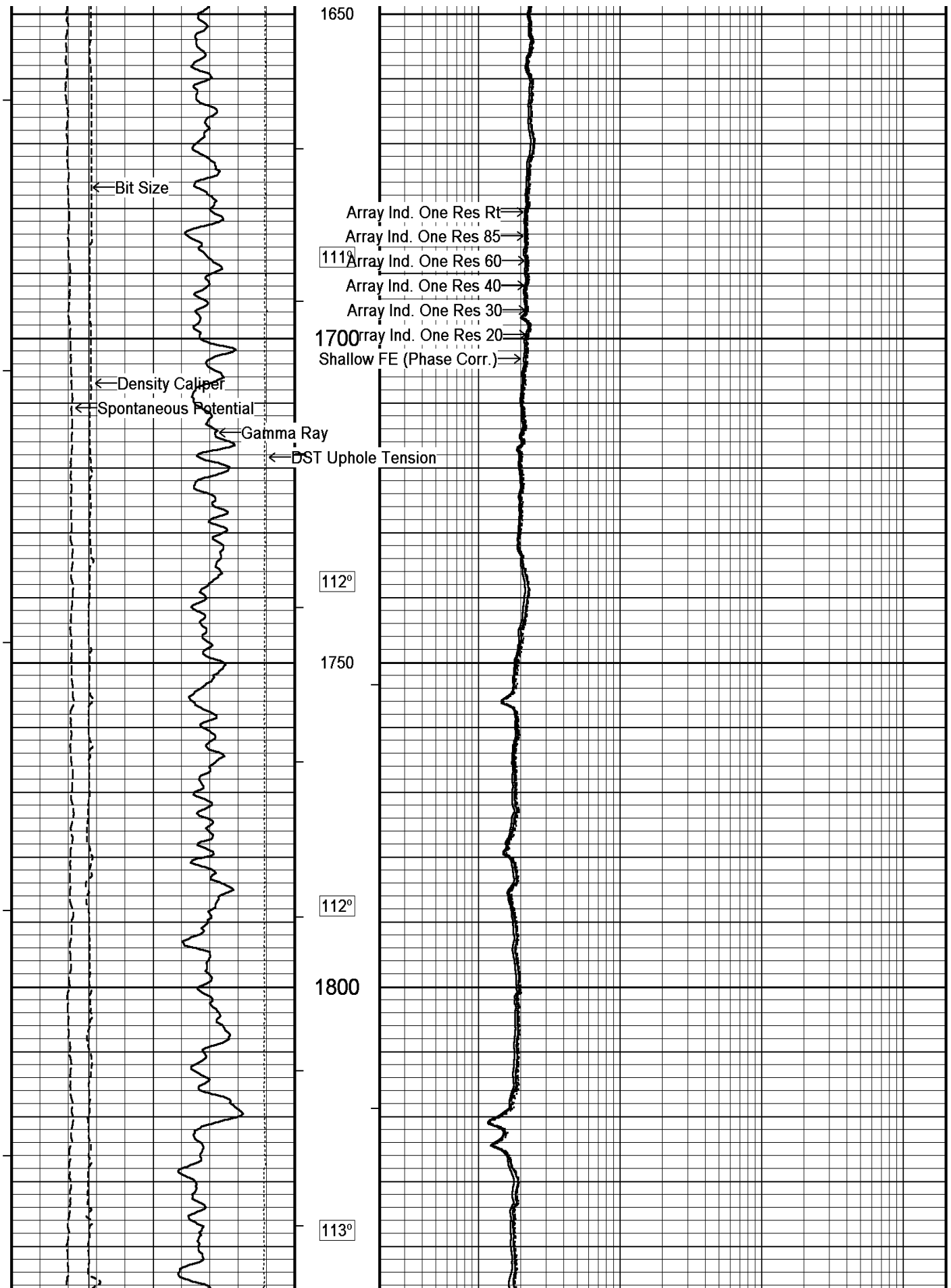
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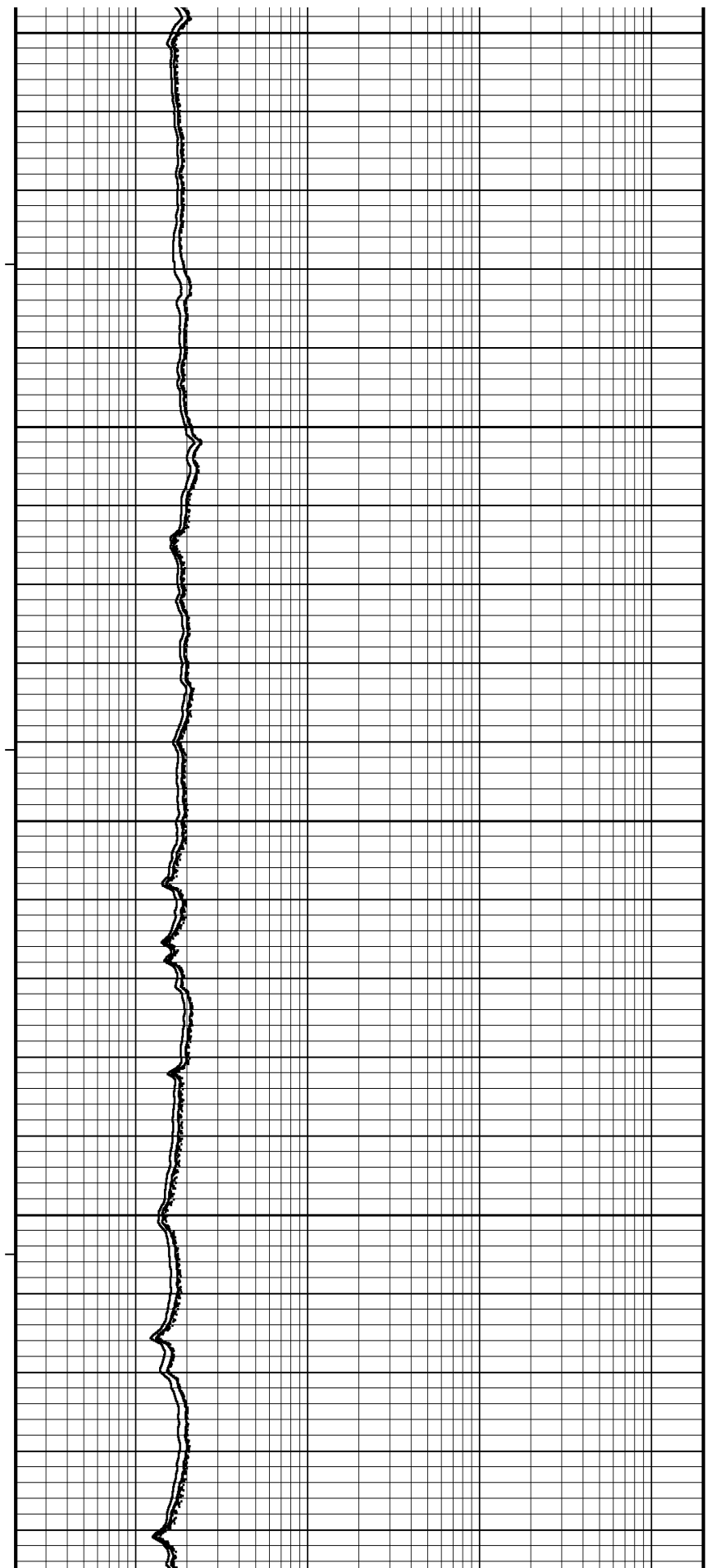
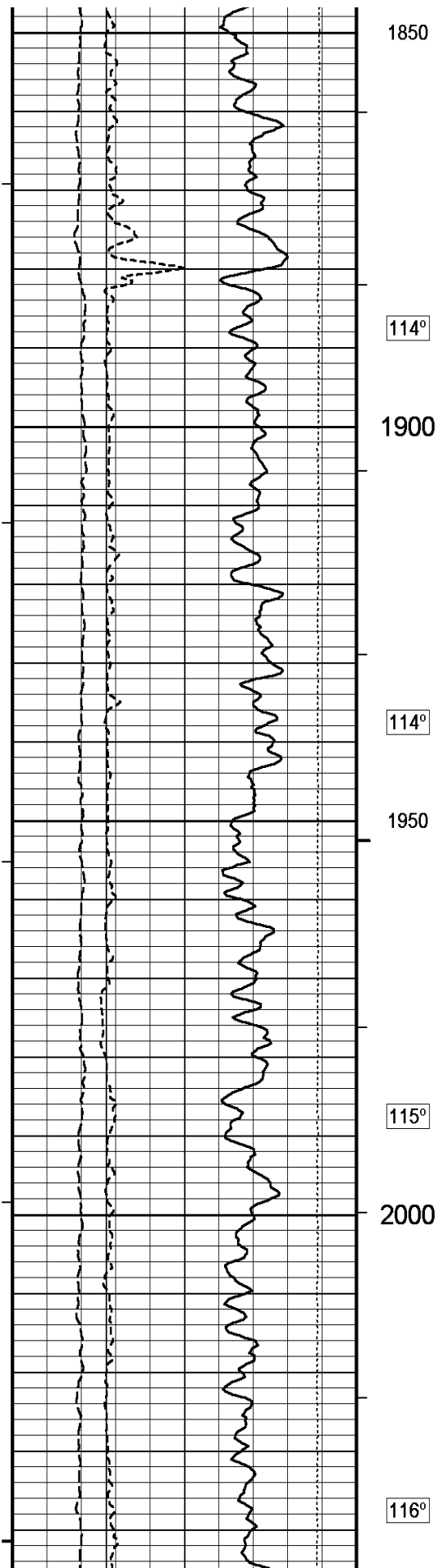
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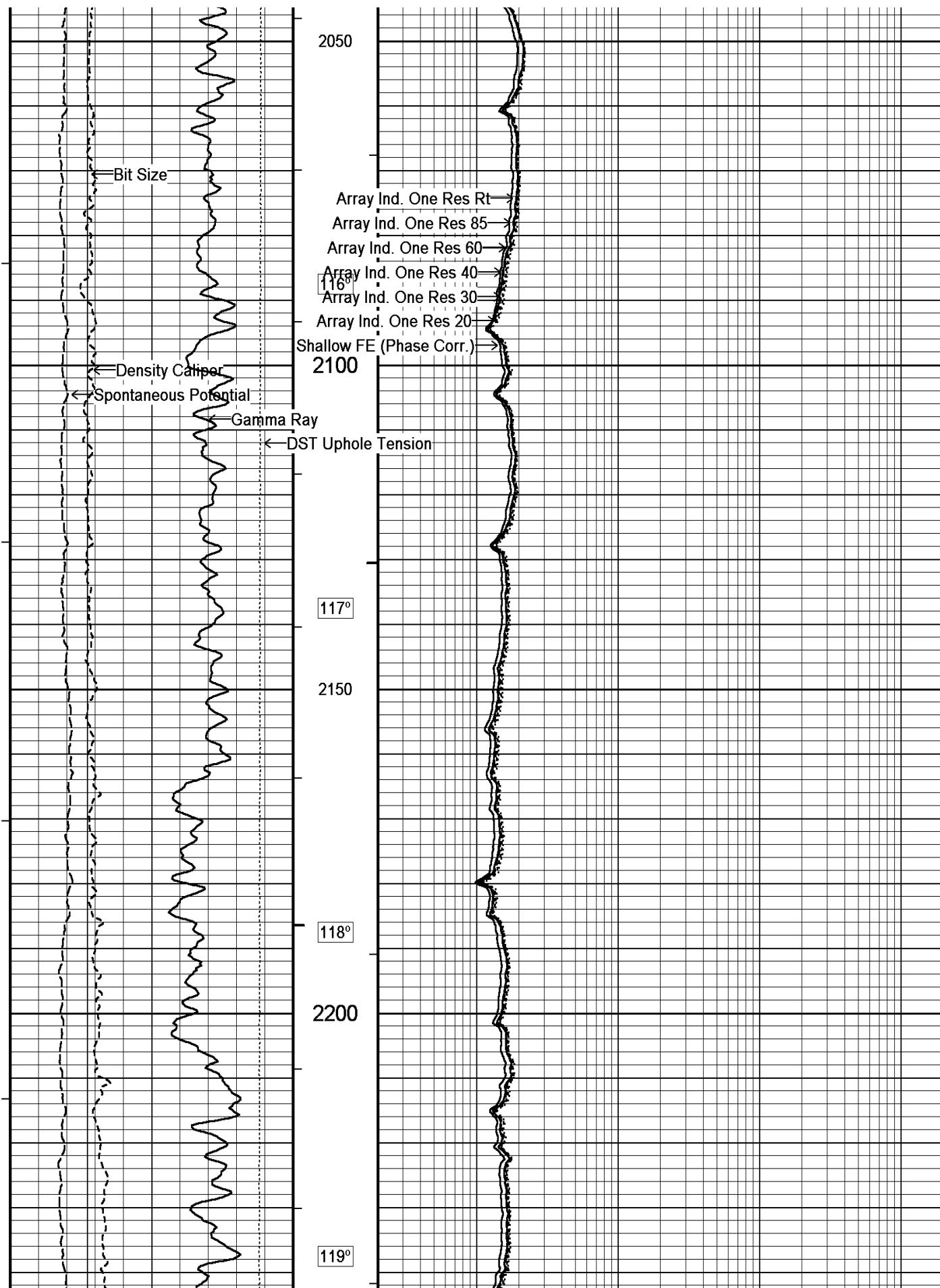


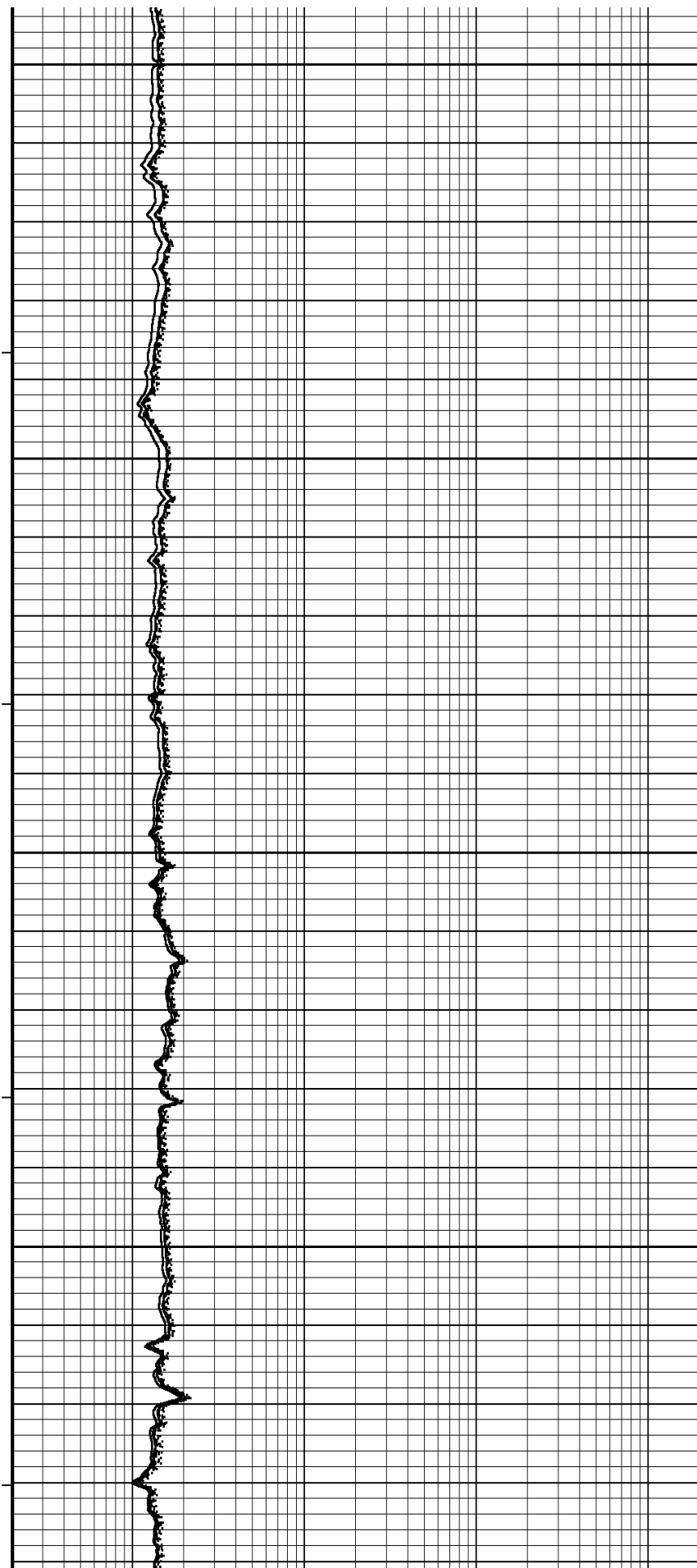
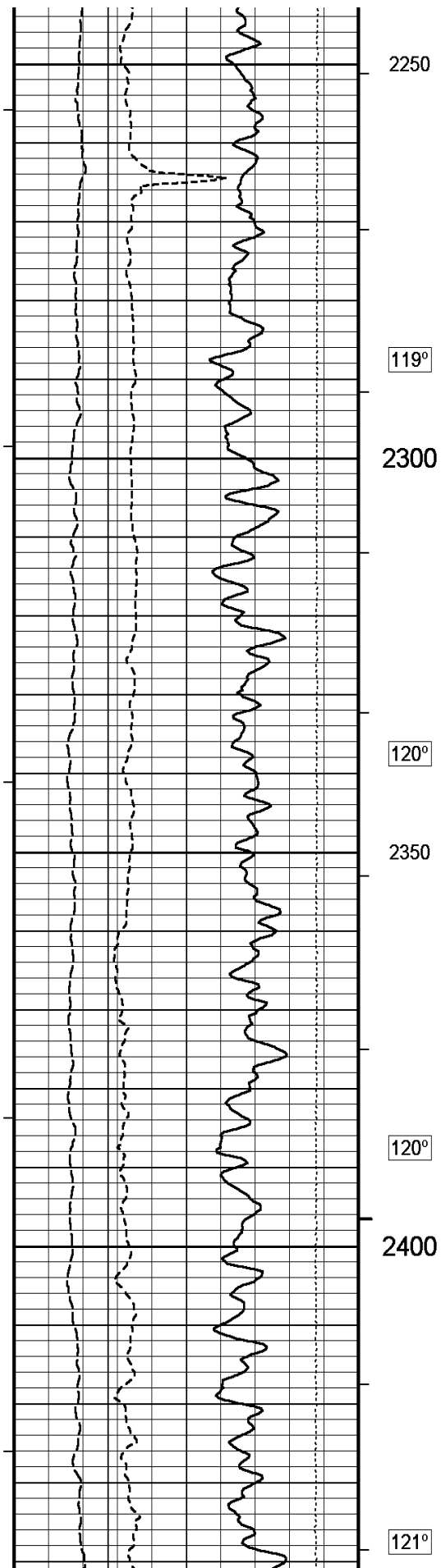


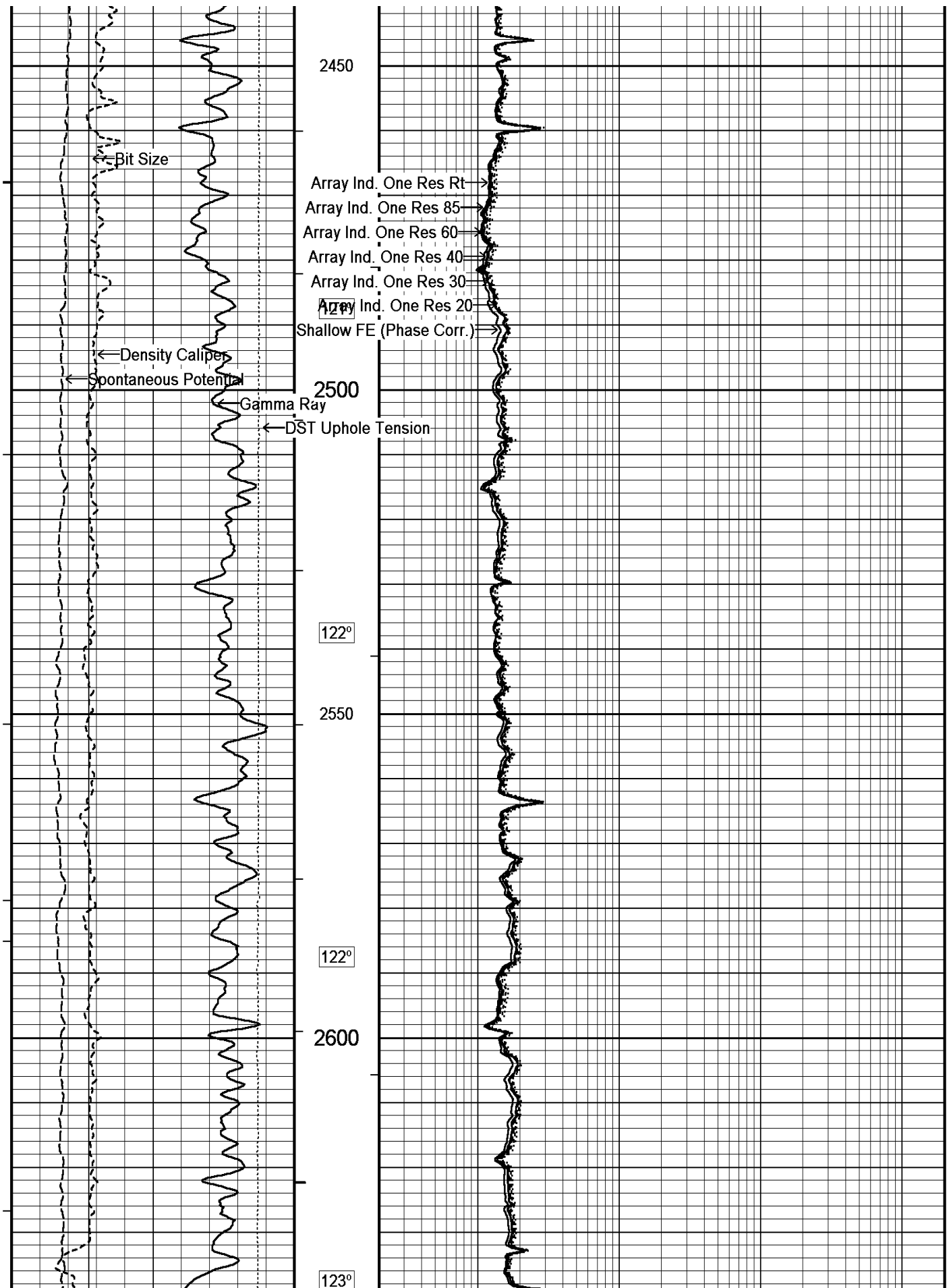


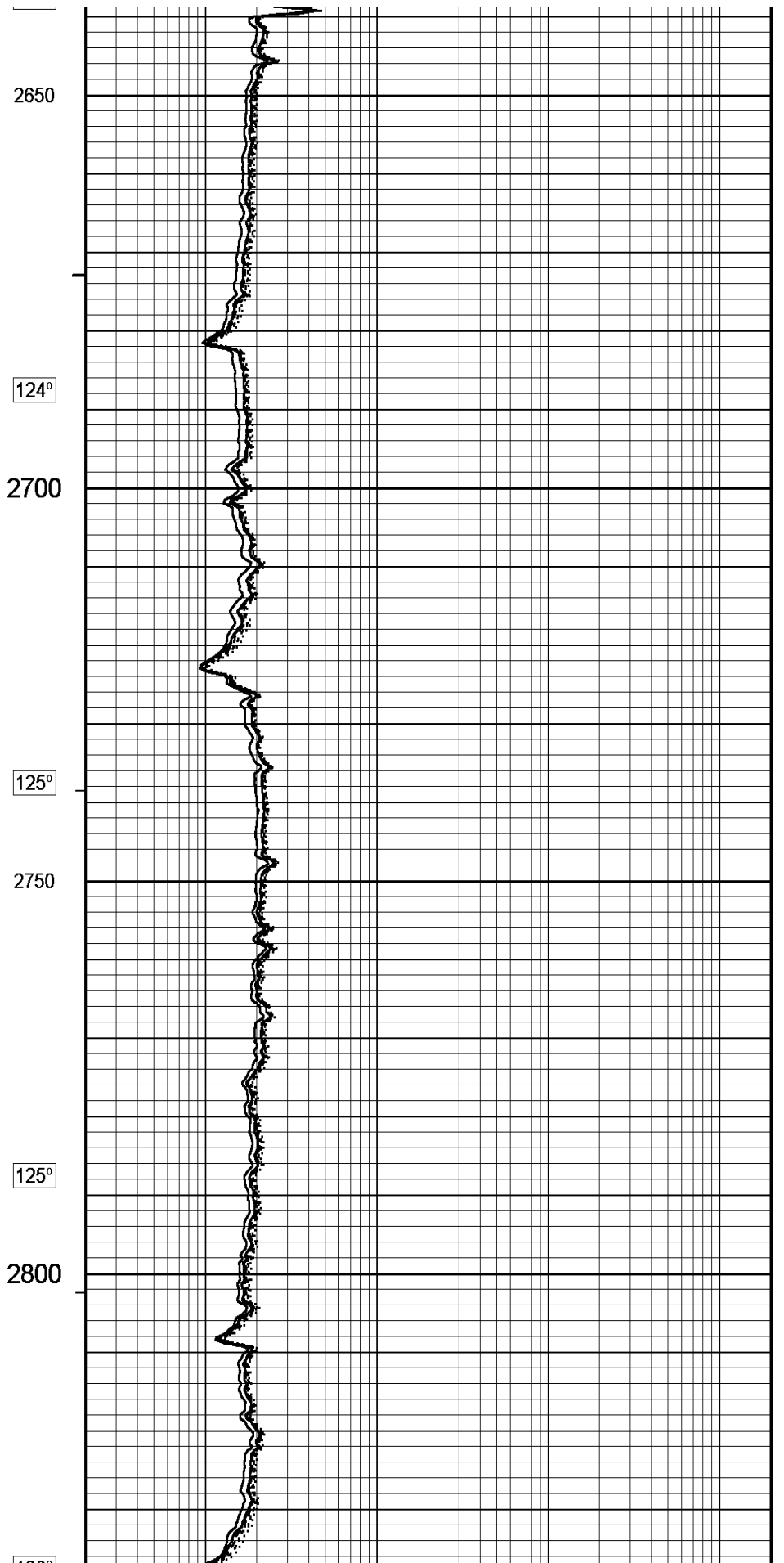
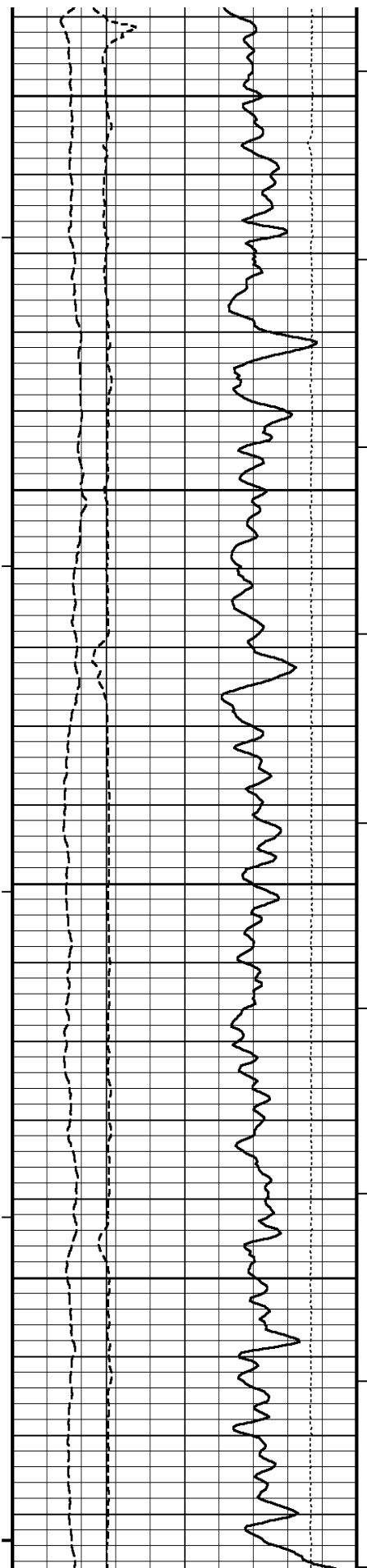


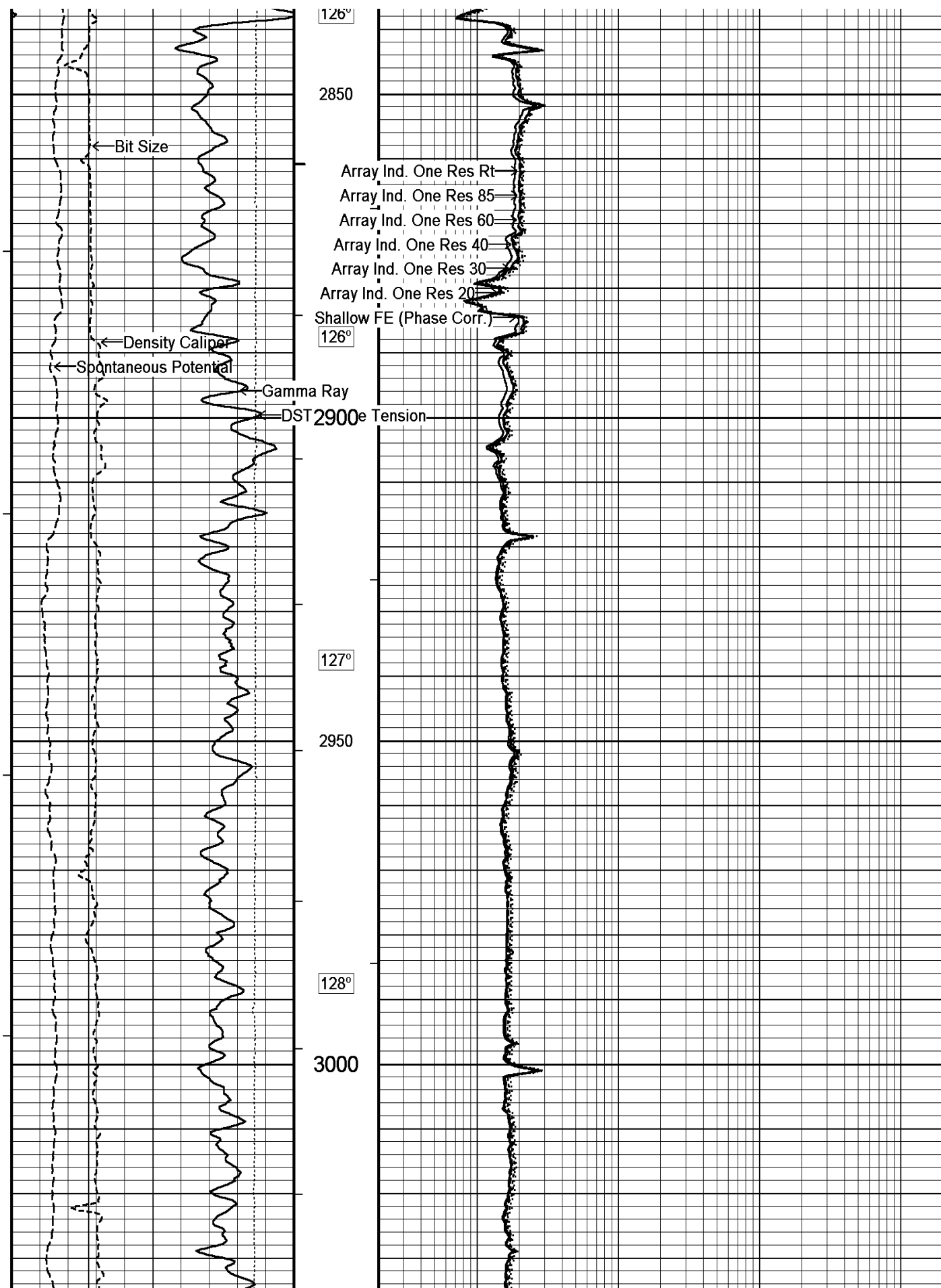


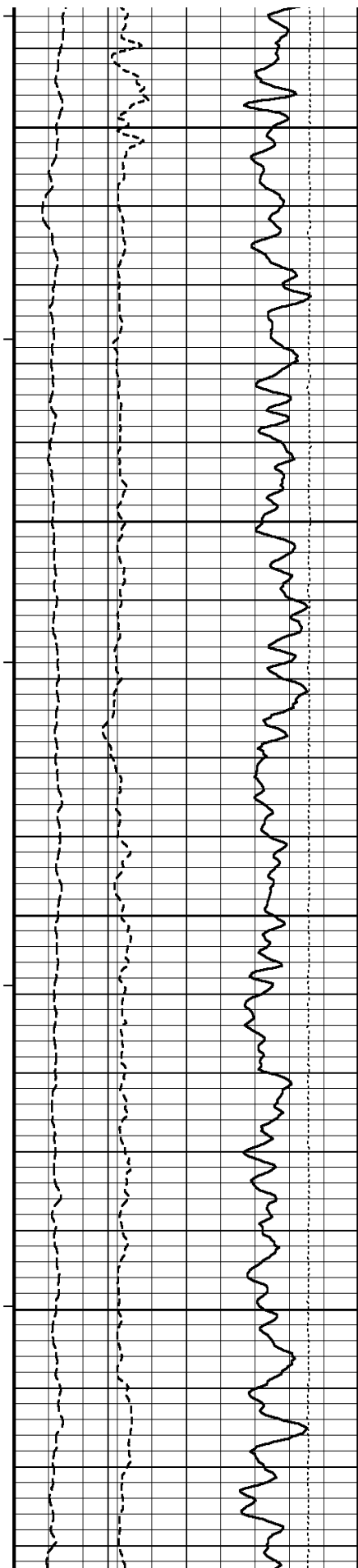












128°

3050

129°

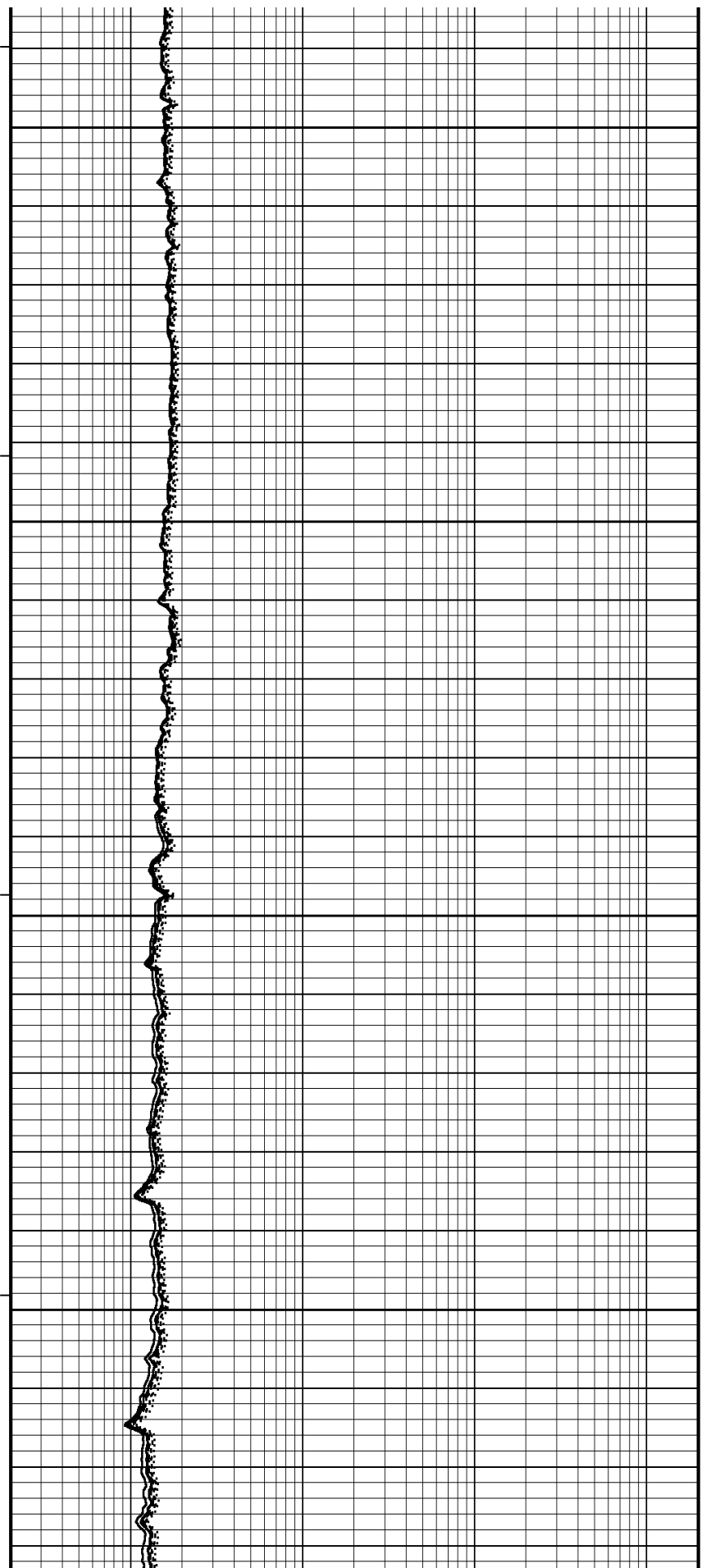
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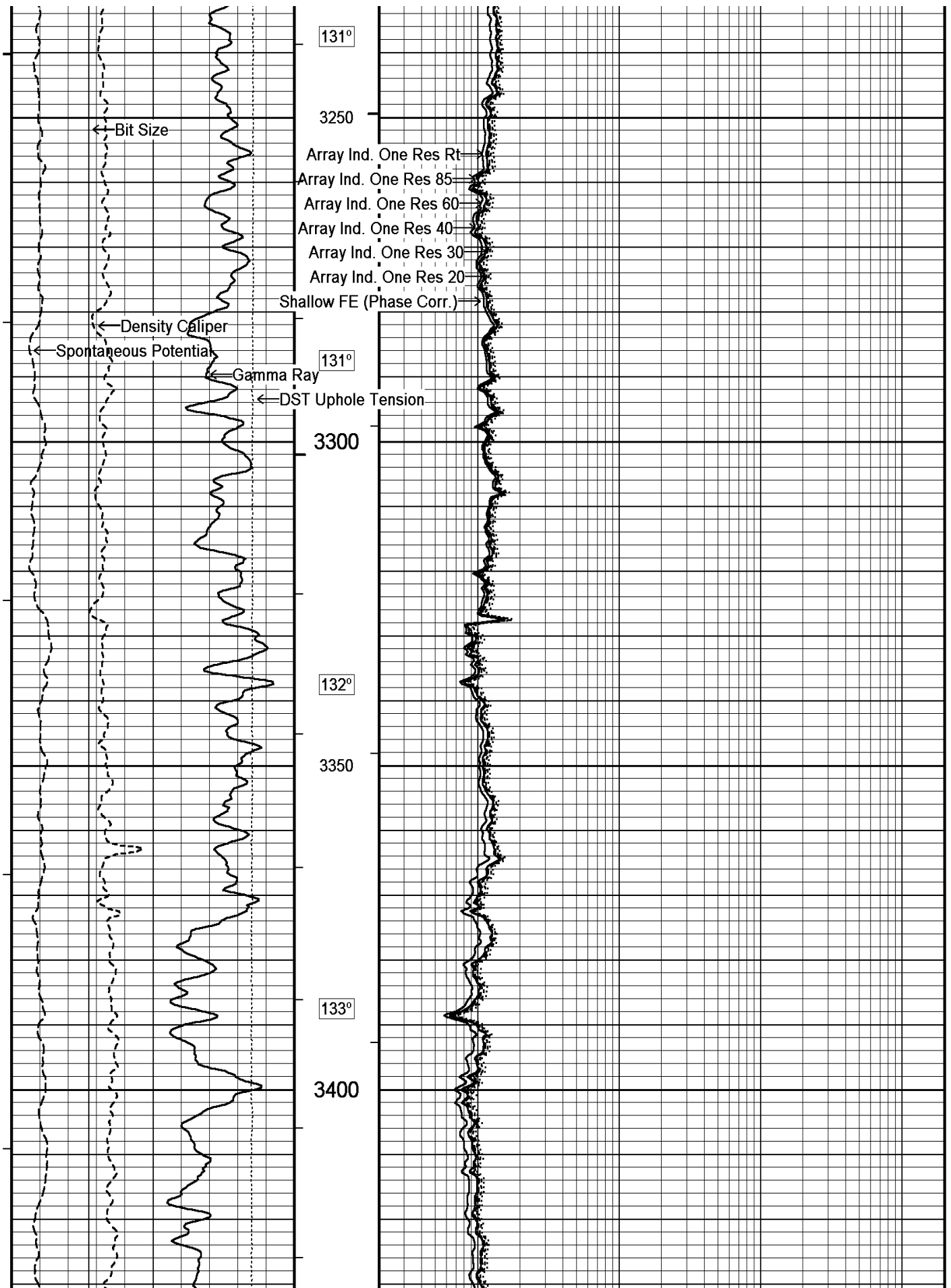
130°

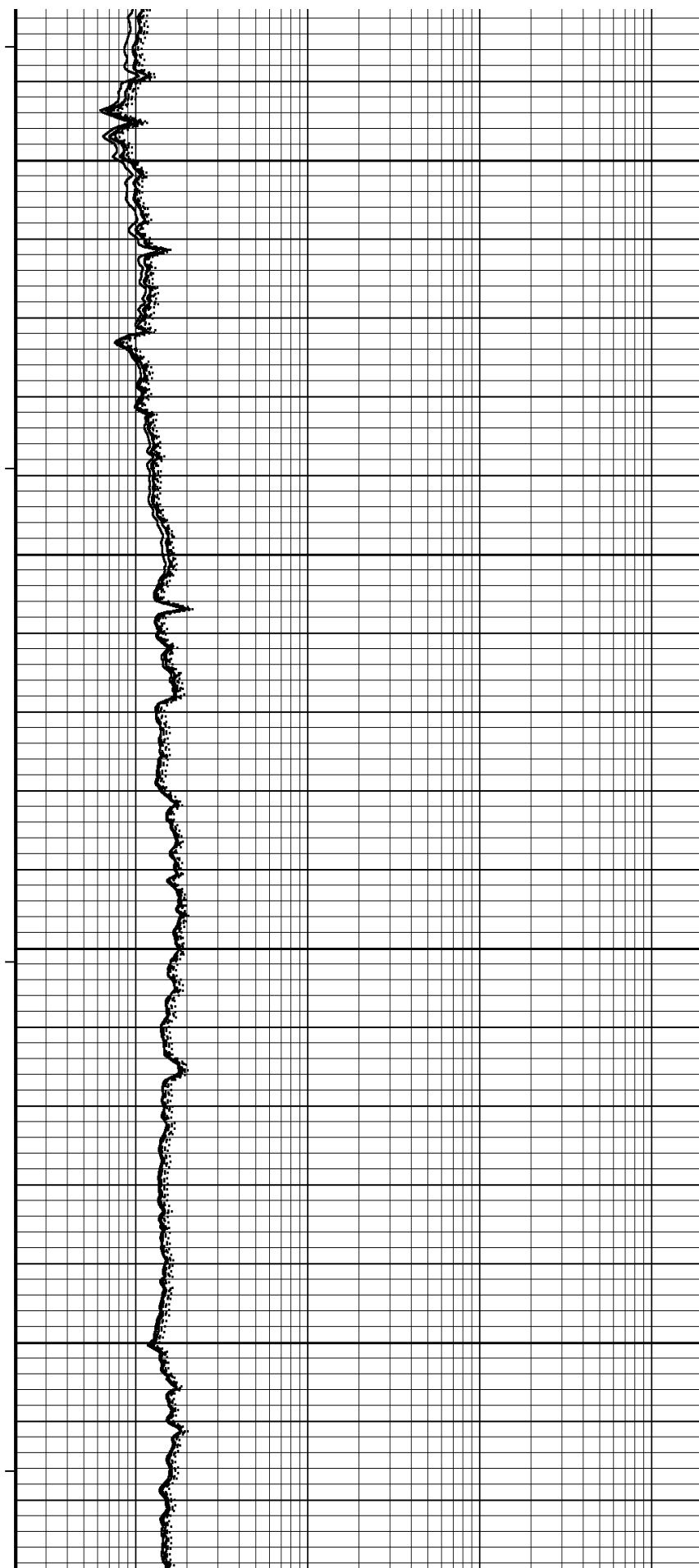
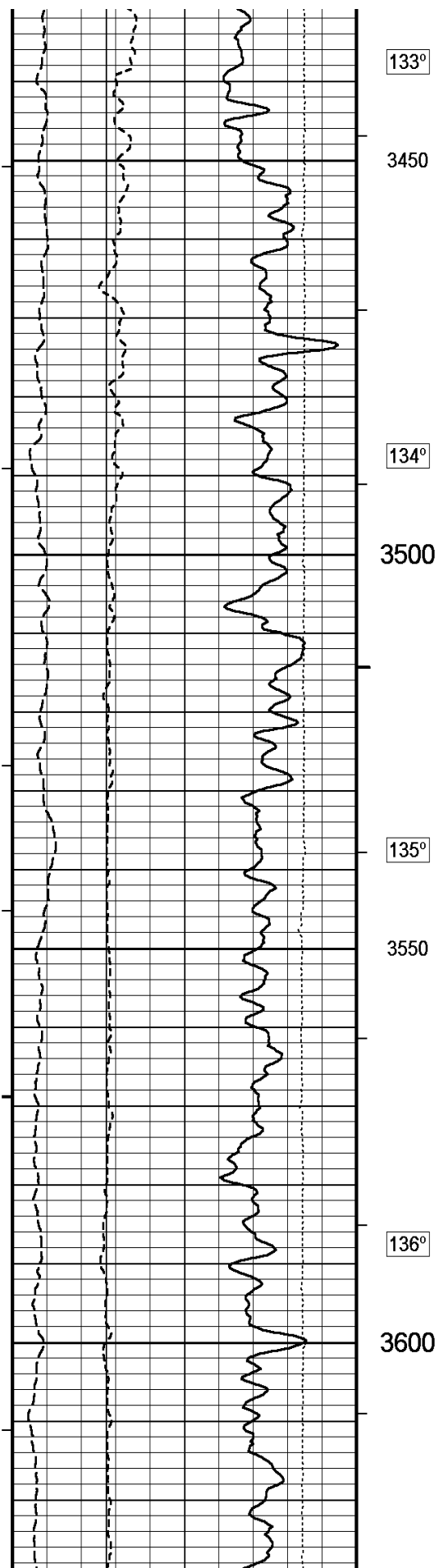
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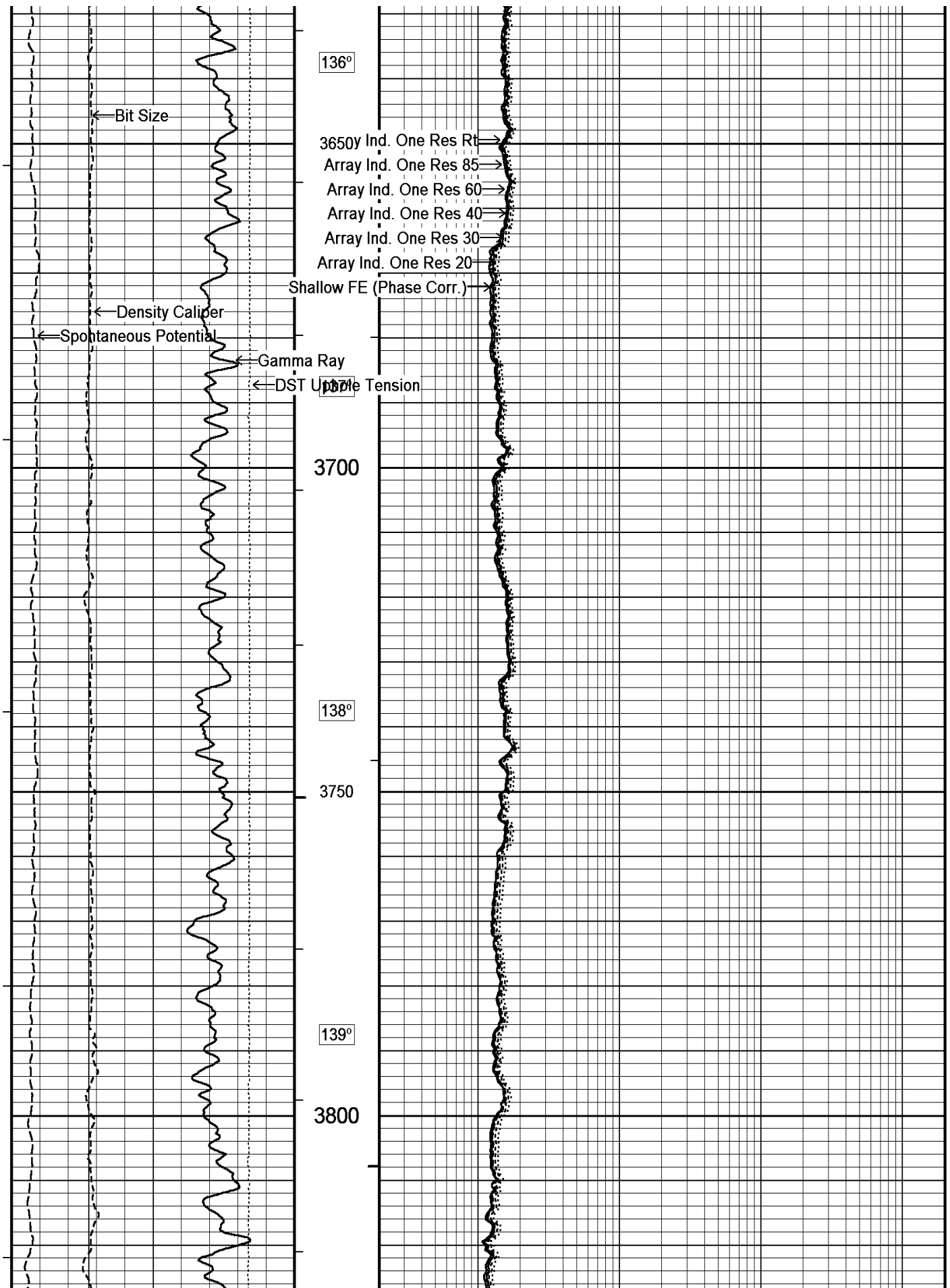
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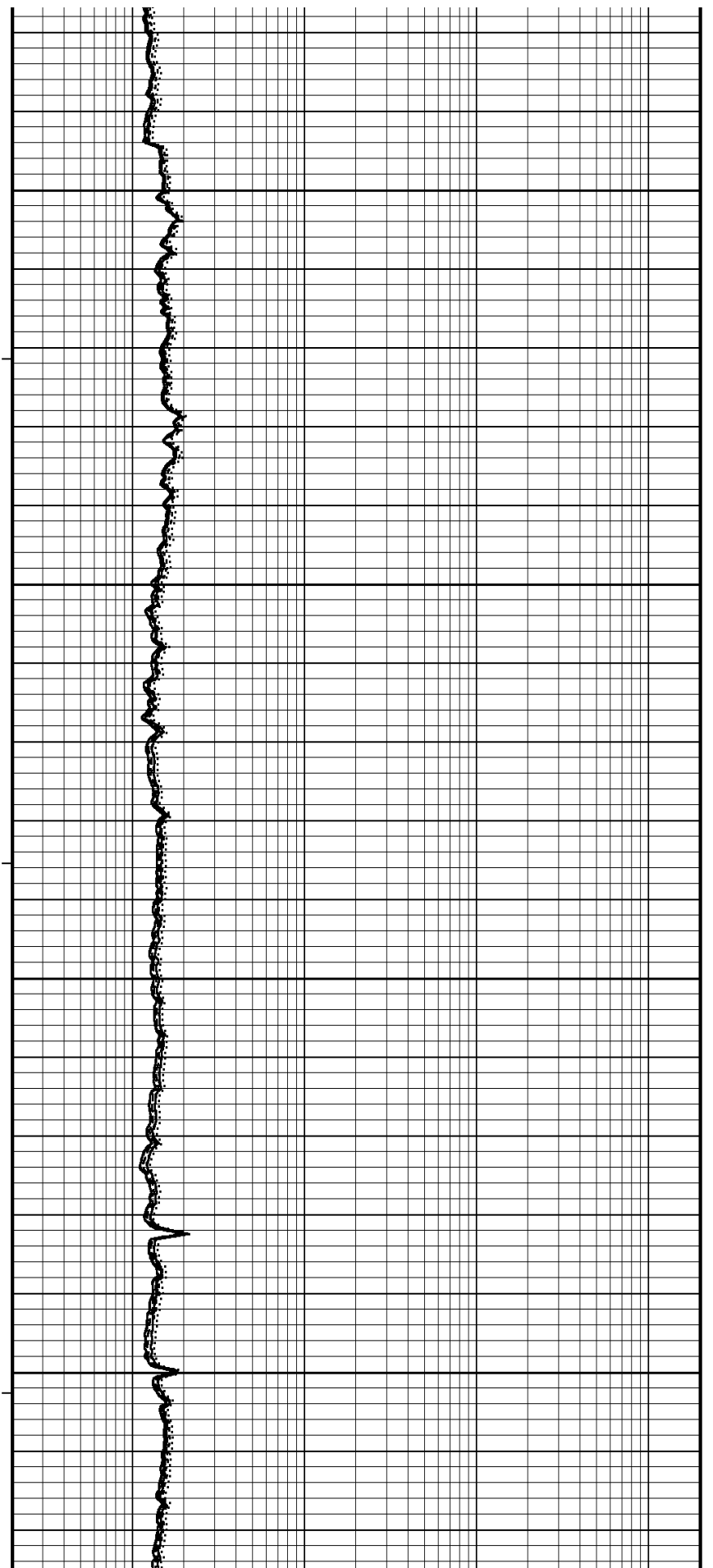
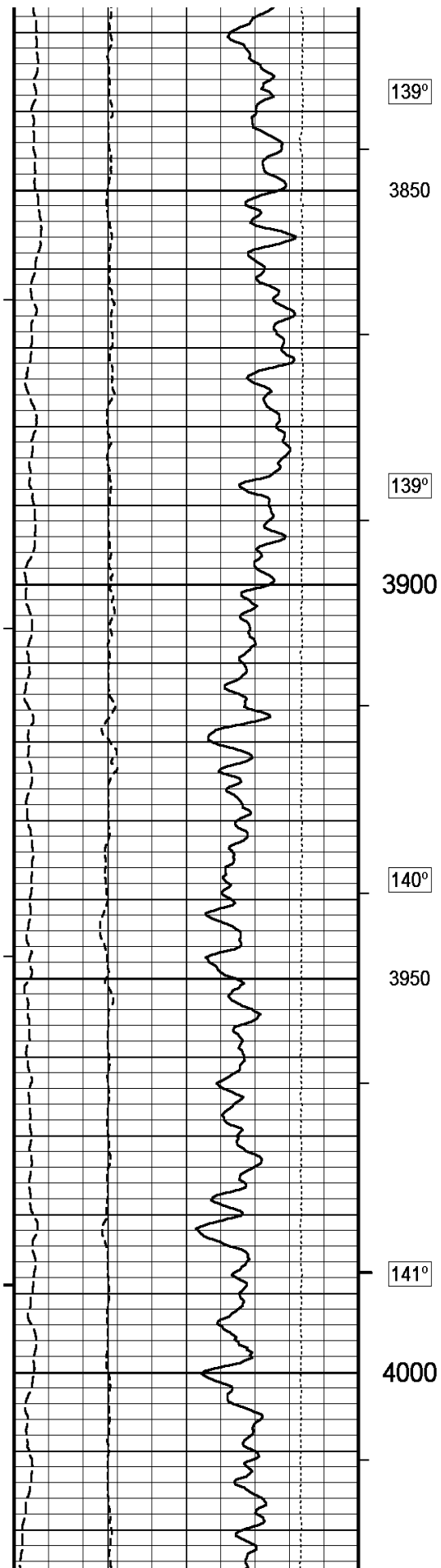
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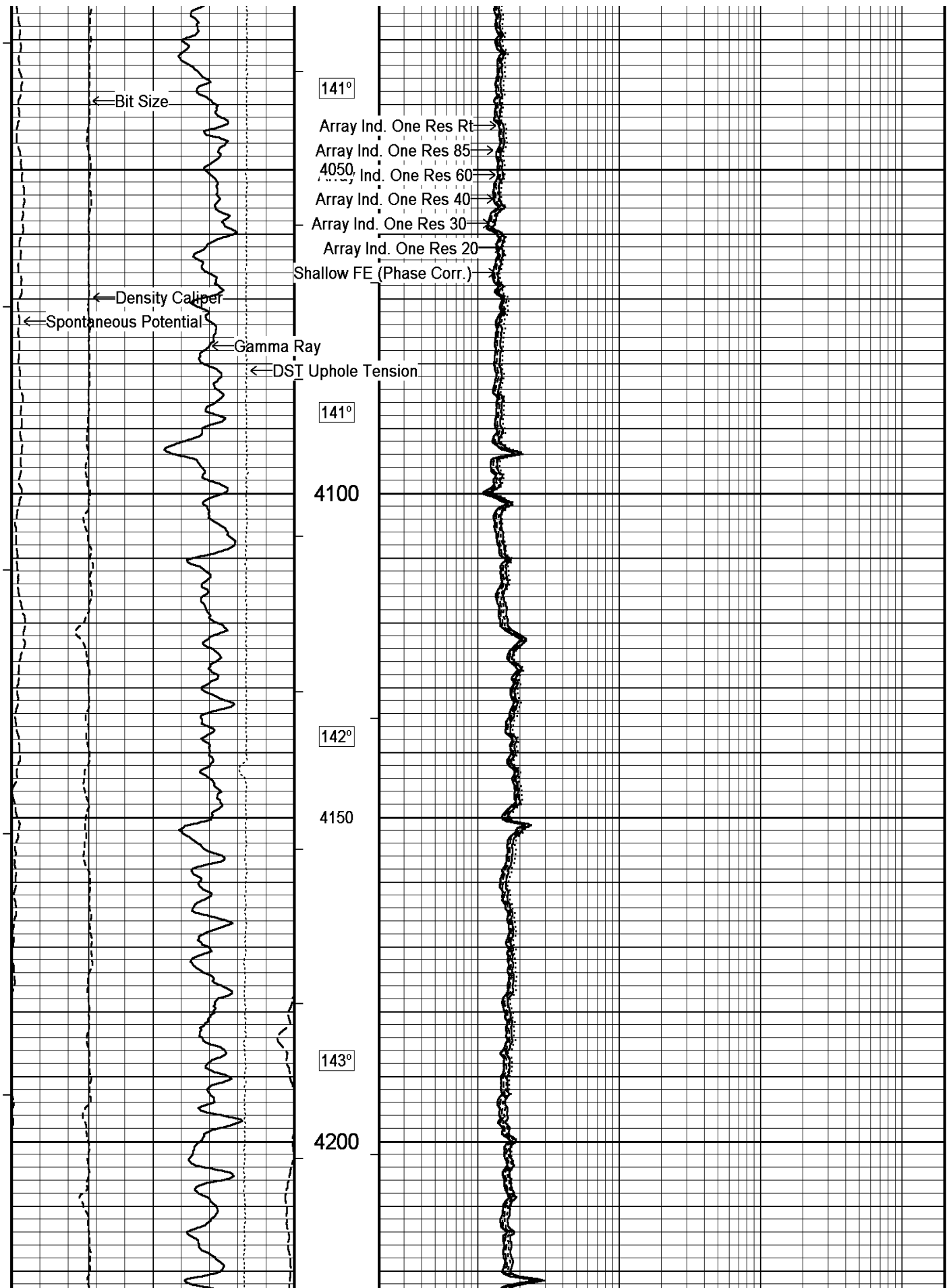


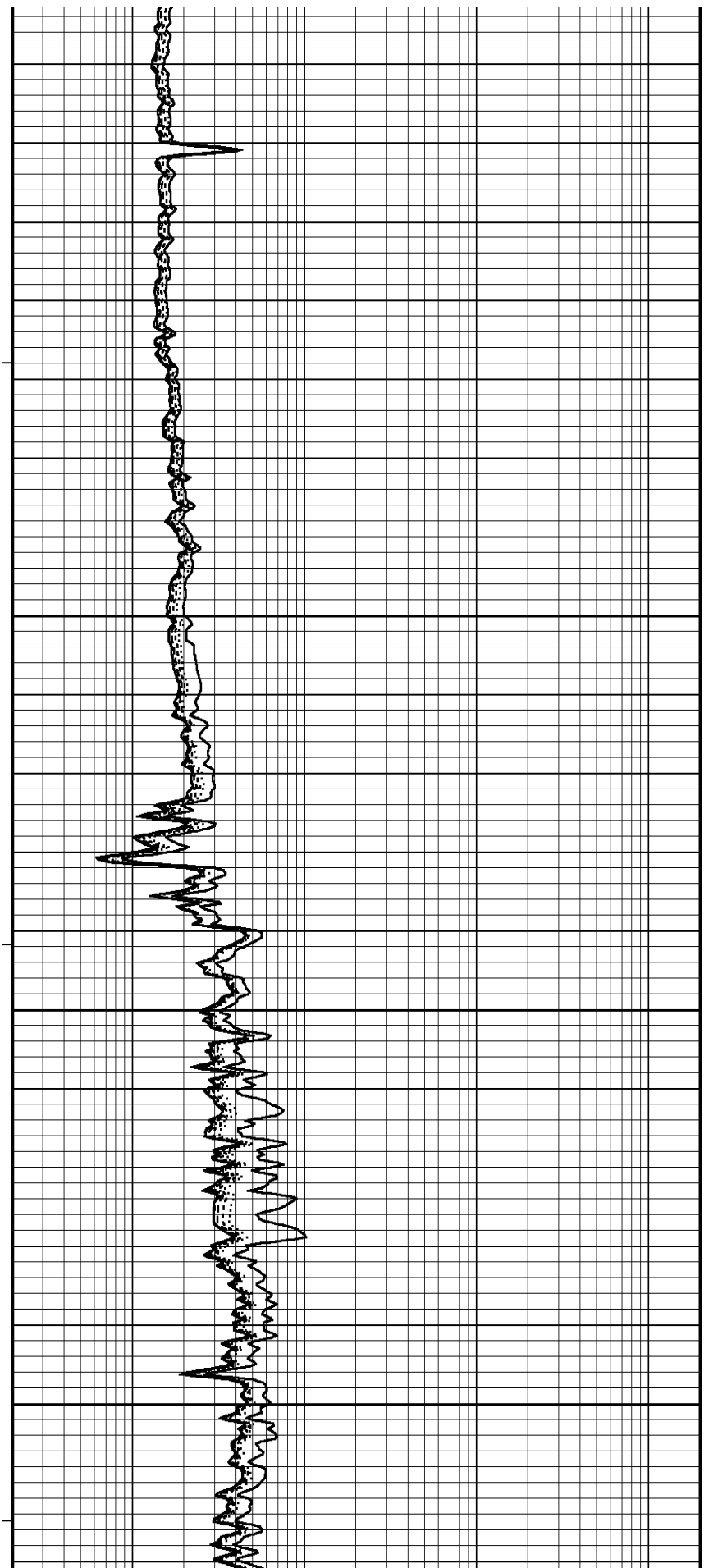
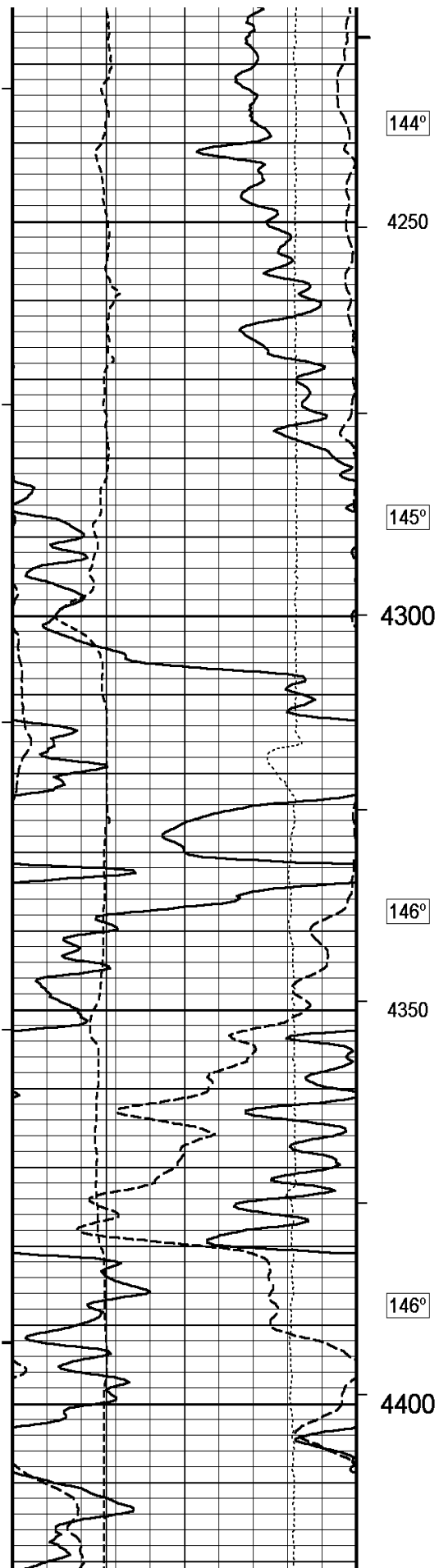


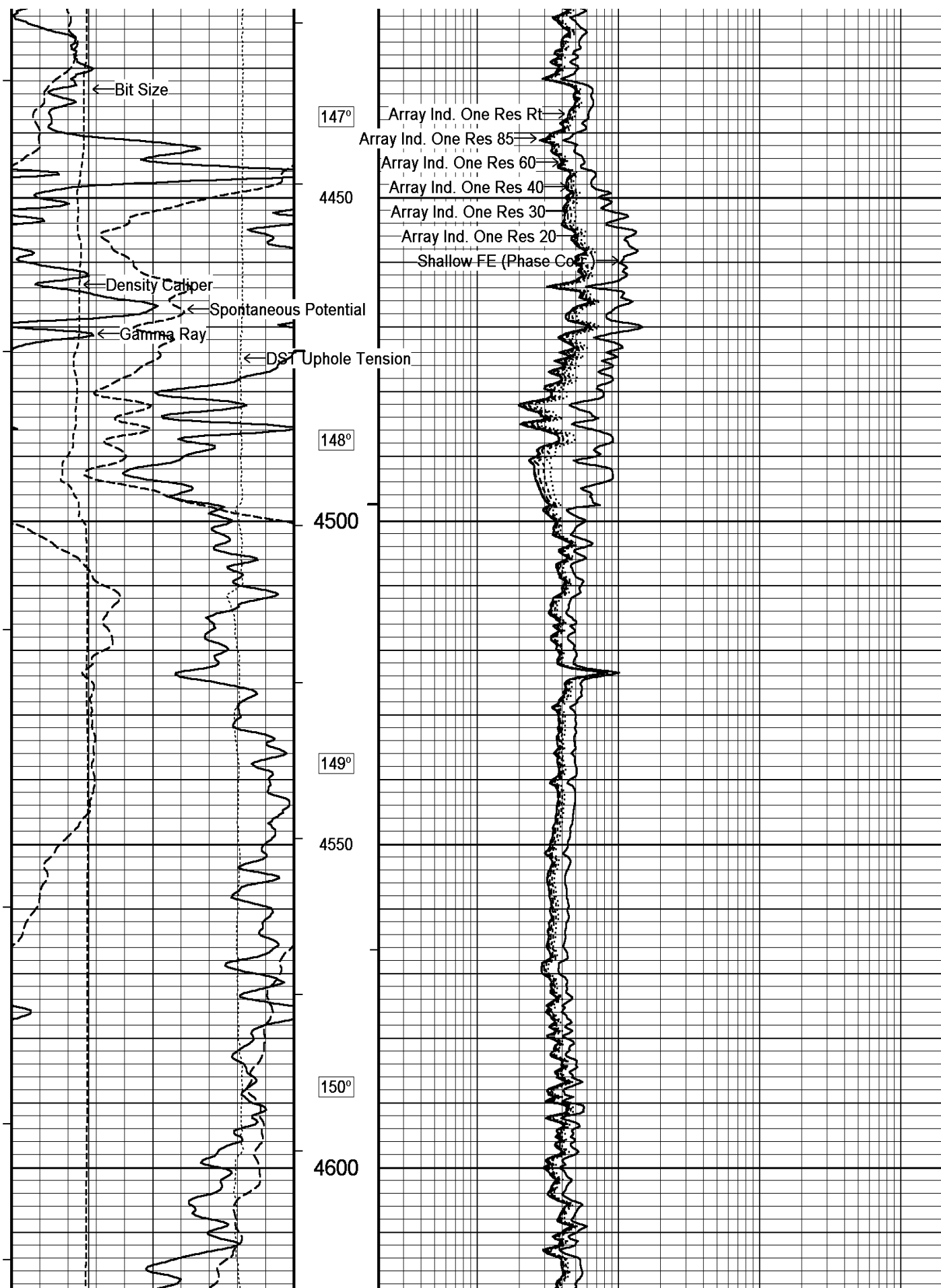


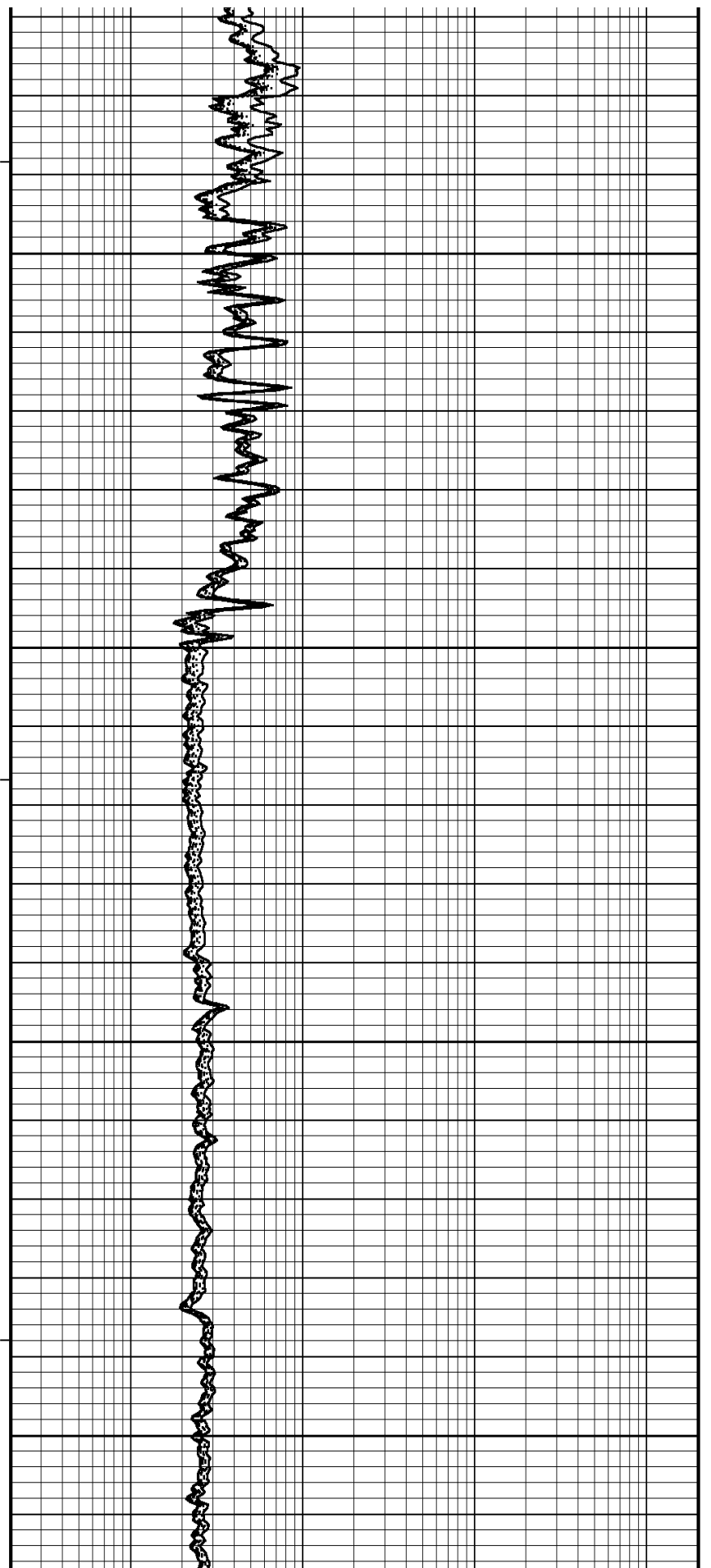
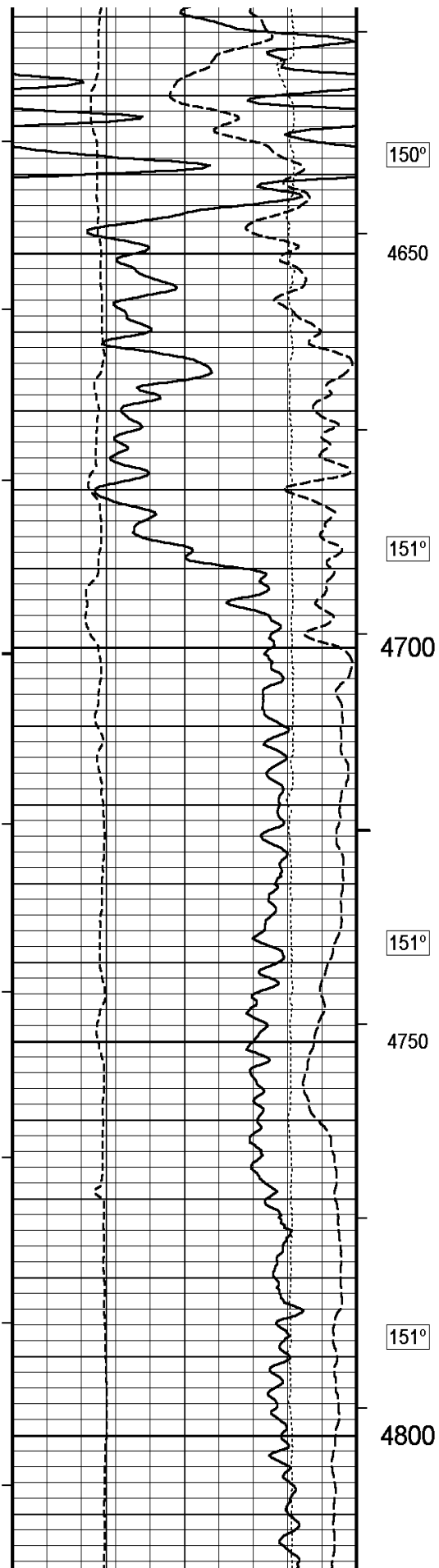


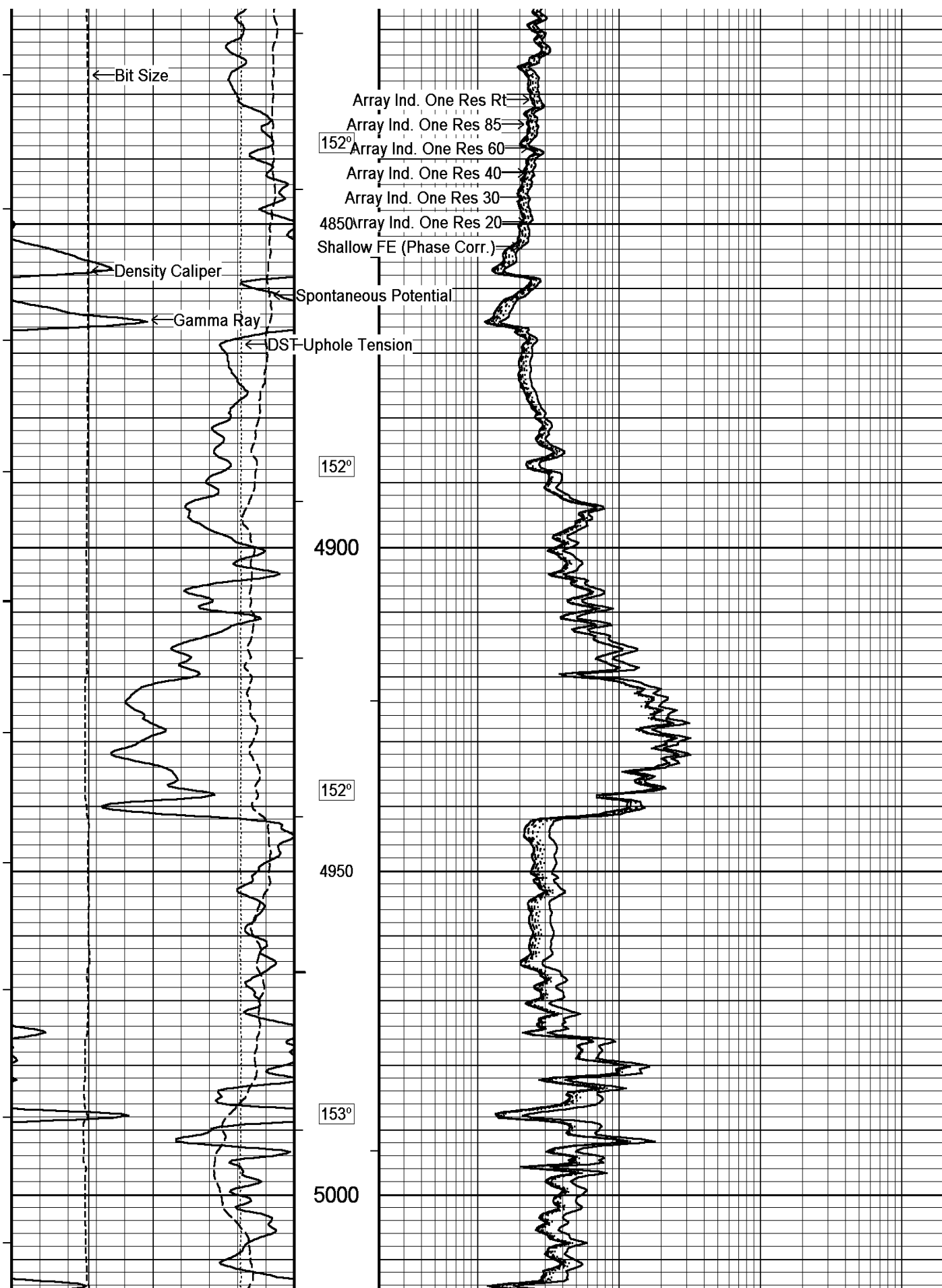


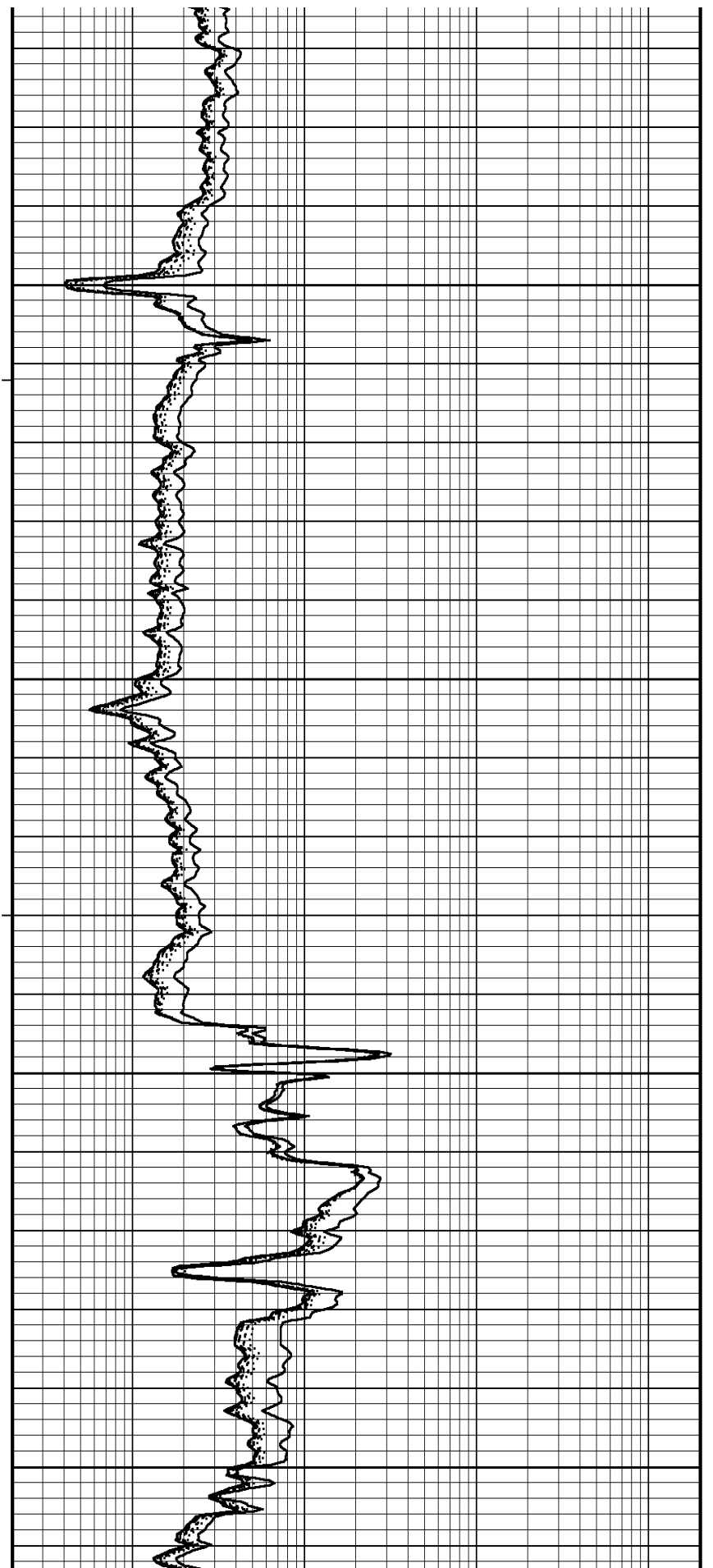
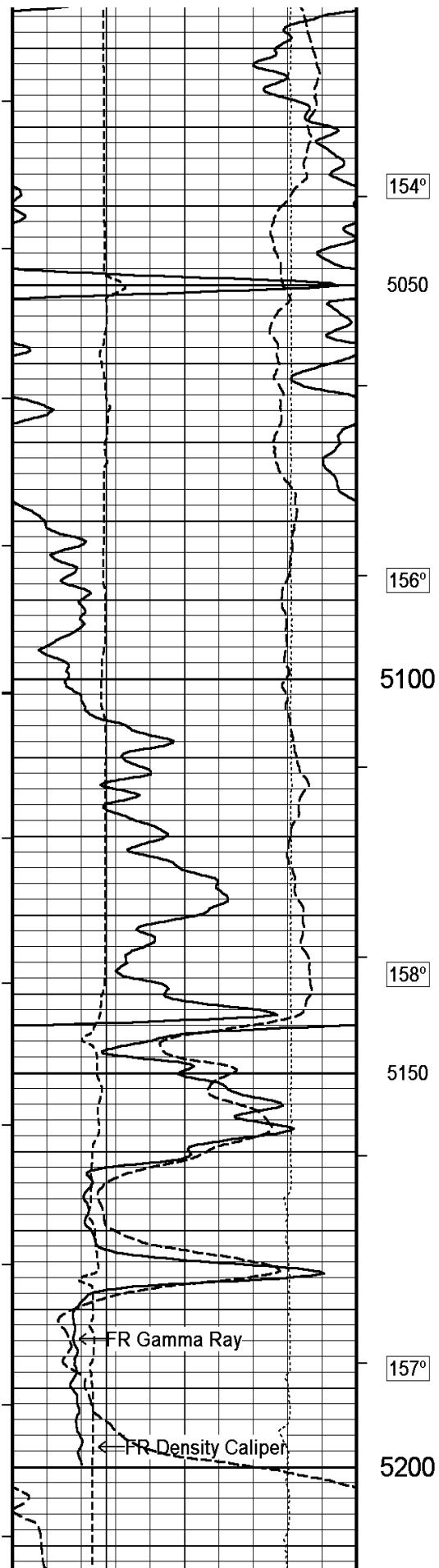


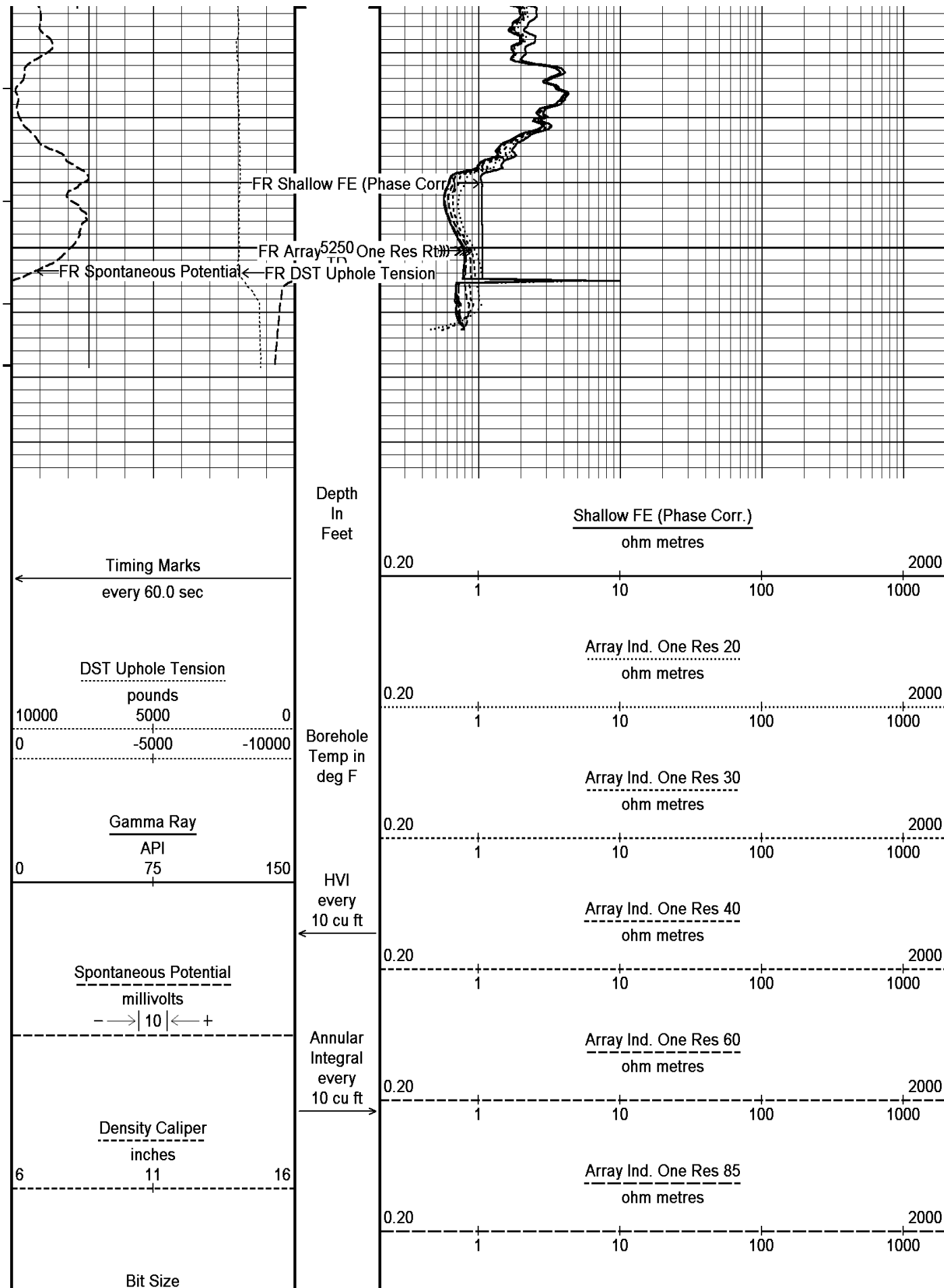


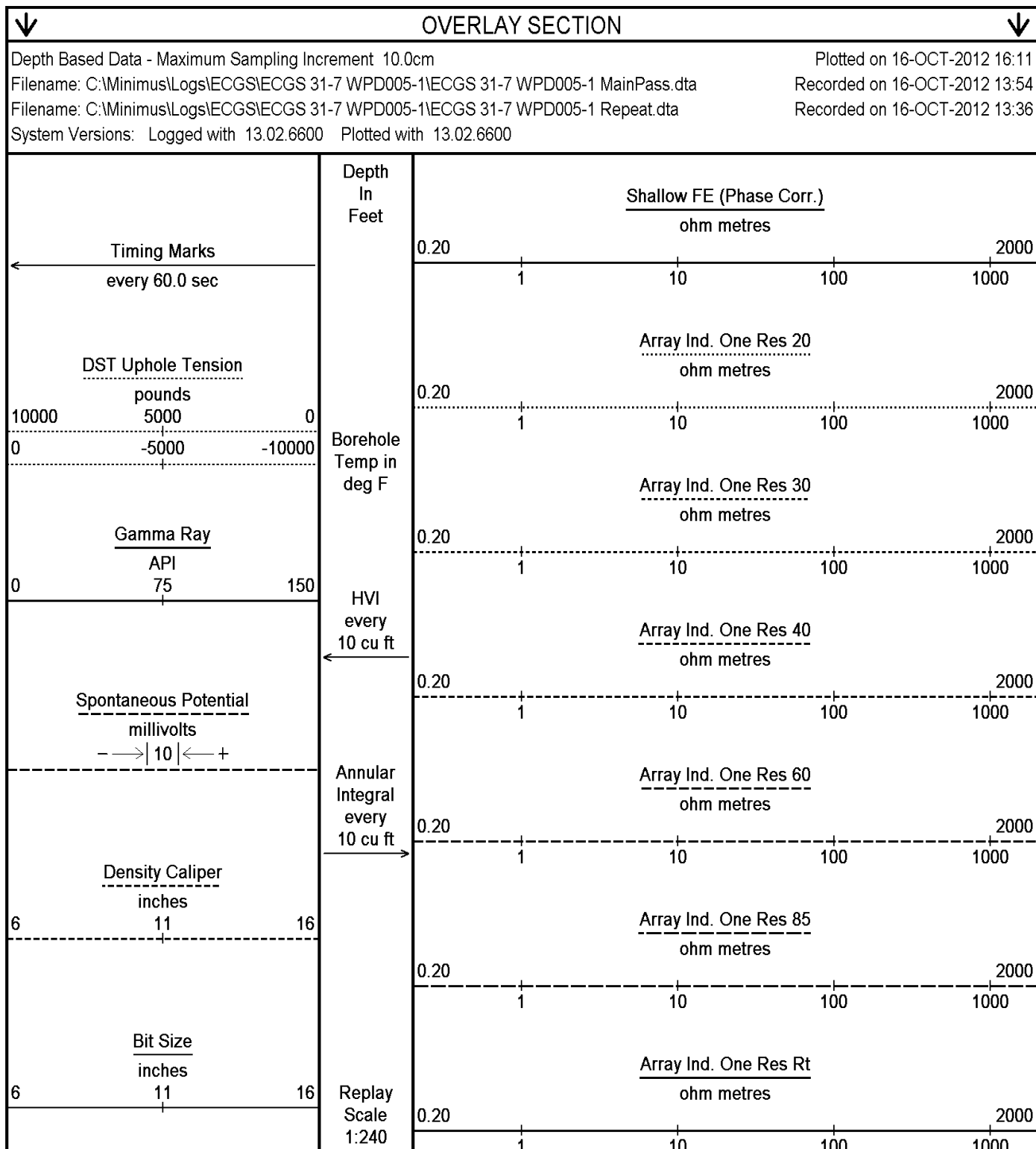
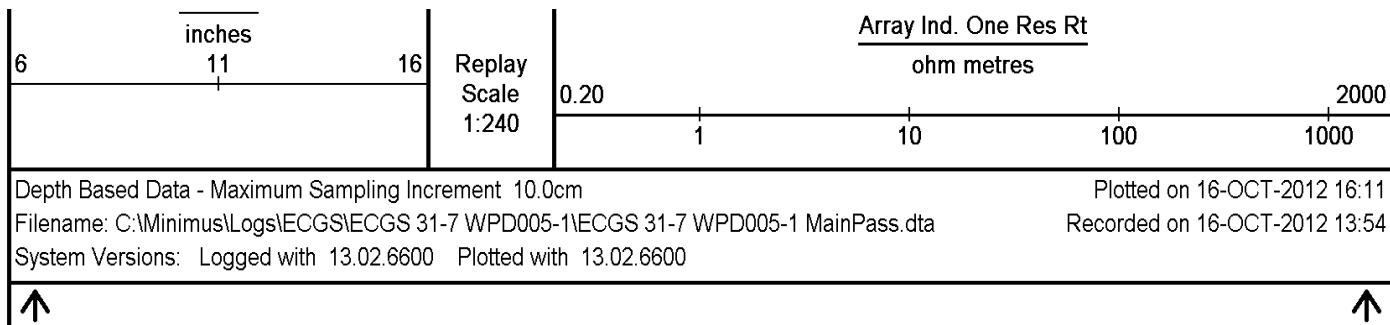


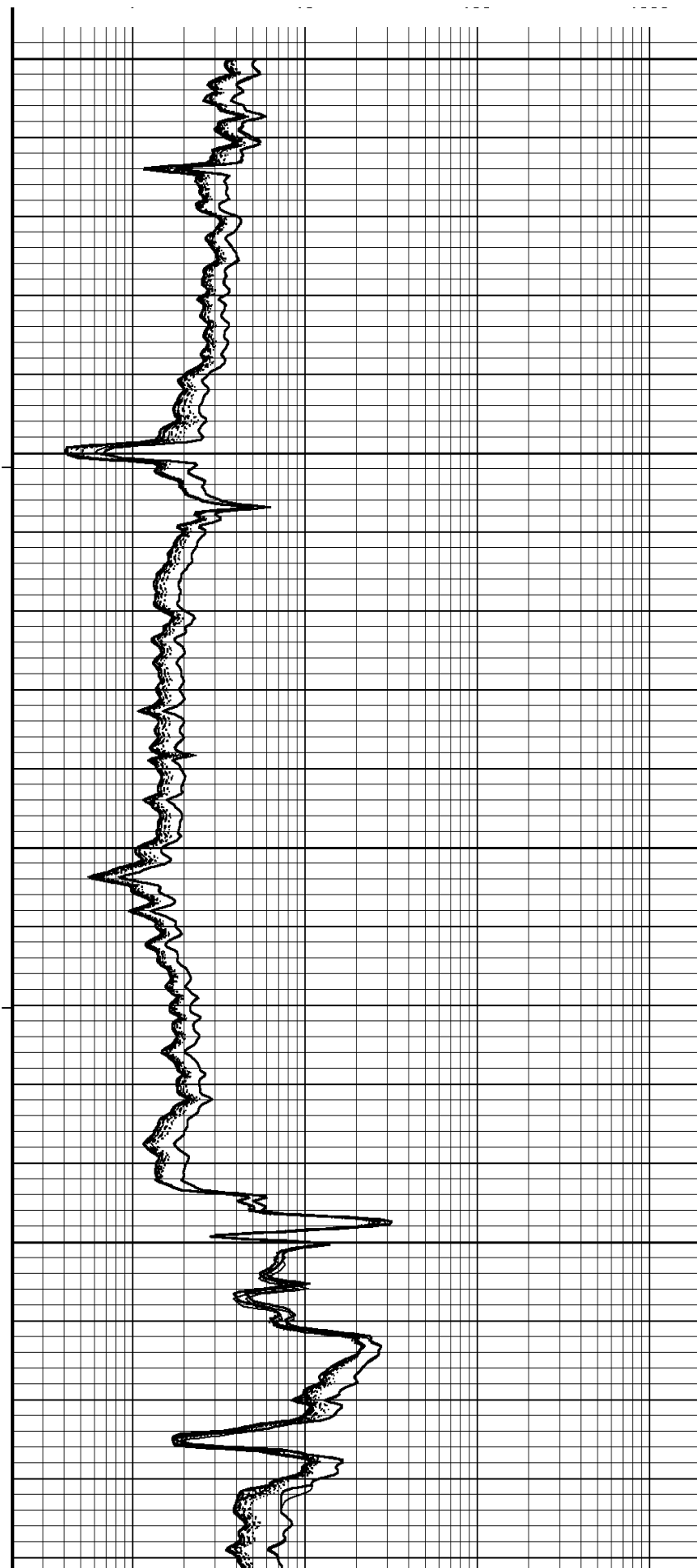
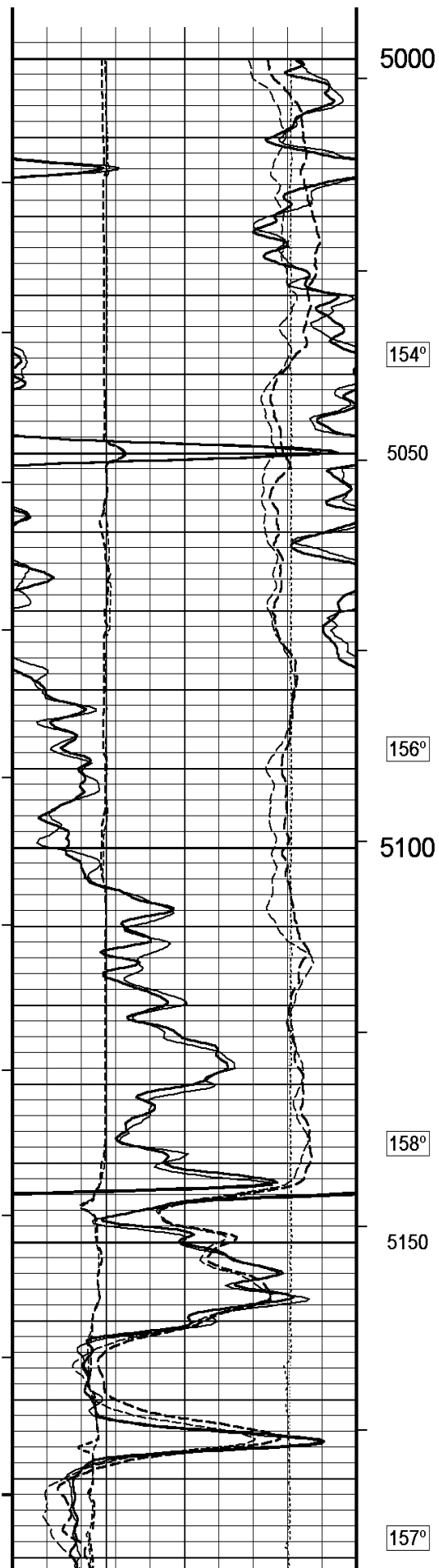












Down-hole Tension Calibration All 000

Field Calibration on 24-OCT-2010 03:34

Reading No	Measured	
1	15659.85	0.00
2	15734.68	370.00

General Constants All 000

Last Edited on 16-OCT-2012,09:44

General Parameters

Mud Resistivity	6.420	ohm-metres
Mud Resistivity Temperature	54.200	degrees F
Water Level	0.000	feet
Density/Neutron 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

Down-hole Tension Calibration SMS 0

Field Calibration on 16-OCT-2012 12:47

Reading No	Measured	Calibrated (lbs)
1	15175.17	0.00
2	16394.83	500.00

High Resolution Temperature Calibration MCG-D.K 483

Field Calibration on 06-JUL-2012 14:06

	Measured	Calibrated(Deg F)
Lower	0.00	0.00
Upper	0.00	0.00

High Resolution Temperature Constants MCG-D.K 483

Last Edited on

Pre-filter Length 11

SP Calibration MCG-D.K 483

Field Calibration on 06-JUL-2012 14:06

	Measured	Calibrated (mV)
Reference 1	100.6	100.1
Reference 2	-98.9	-100.1

Gamma Calibration MCG-D.K 483

Field Calibration on 15-OCT-2012 14:49

	Measured	Calibrated (API)
Background	60	40
Calibrator (Gross)	788	520
Calibrator (Net)	728	480

Gamma Constants MCG-D.K 483

Last Edited on 16-OCT-2012,09:37

Gamma Calibrator Number	GRCC-112	
Mud Density	1.00	gm/cc
Caliper Source for Processing	Density Caliper	
Tool Position	Eccentred	
Concentration of KCl	0.00	kppm

Neutron Calibration MDN-B.A 227

Base Calibration on 15-OCT-2012 15:48

Base Calibration

	Measured		Calibrated (cps)	
	Near	Far	Near	Far
	2896	90	3714	110
Ratio	32.069		33.764	

Field Calibrator at Base

	Calibrated (cps)	
	1658	2365
Ratio	0.701	

Field Check

	Calibrated (cps)	
	1664	2383
Ratio	0.698	

Neutron Constants MDN-B.A 227

Last Edited on 16-OCT-2012,13:17

Neutron Source Id	P44382B
Neutron Jig Number	NEC43
Epithermal Neutron	No
Caliper Source for Processing	Density Caliper
Stand-off	0.00 inches
Mud Density	1.00 gm/cc
Limestone Sigma	7.10 cu
Sandstone Sigma	7.00 cu
Dolomite Sigma	4.70 cu
Formation Pressure Source	None
Formation Pressure	N/A kpsi
Temperature Source	None
Temperature	N/A degrees F
Mud Salinity	0.00 kppm
Salinity Correction	Not Applied
Formation Fluid Salinity Source	None
Formation Fluid Salinity	N/A kppm
Barite Mud Correction	Not Applied

Caliper Calibration MIE-A.J 244

Base Calibration on 15-OCT-2012 14:34

Field Calibration on 15-OCT-2012 14:37

Base Calibration

Reading No	Pads 1-5 Meas.	Pads 3-7 Meas.	Calibrator Size (in)
1	26843	27657	5.96
2	37134	38542	7.99
3	46830	48303	9.86
4	58657	60137	11.93
5	0	0	0.00

Reading No	Pad 2 Meas.	Pad 4 Meas.	Pad 6 Meas.	Pad 8 Meas.	Calibrator Size (in)
1	25364	25860	23860	25685	5.96
2	34515	34810	32509	34263	7.99
3	42698	43019	40815	42625	9.86
4	52715	53061	50670	52203	11.93
5	0	0	0	0	0.00

Field Calibration

Measured		Measured		Actual	
Pads 1-5 Caliper(in)		Pads 3-7 Caliper(in)		Caliper(in)	
7.99		8.00		7.99	
Measured		Measured		Measured	
Pad 2 Caliper(in)		Pad 4 Caliper(in)		Pad 6 Caliper(in)	
4.00		4.00		4.00	
Measured		Measured		Actual	
Pad 8 Caliper(in)		Pad 8 Caliper(in)		Caliper(in)	
4.00		4.00		7.99	

Caliper Constants MIE-A.J 244

Last Edited on 15-OCT-2012,14:26

Caliper Difference for BRKT	0.120 inches
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Accelerometer Parameters MIE-A.J 244

Date Of Last Accelerometer Calibration	8-FEB-2012,10:33		
	X Accelerometer	Y Accelerometer	Z Accelerometer
Slope	-1.101858	-1.105662	-1.102074
Offset	-0.006691	0.007176	-0.004341

Accelerometer Constants MIE-A.J 244

Last Edited on 15-OCT-2012,14:38

Accelerometer Calibrator Number		000			
Accelerometer Temperature Characterisation					
X Accelerometer					
Serial Number	1016				
Calibration Date	12-Apr-2011				
	B0	B1	B2	B3	
Bias(g)	0.00000e+000	1.93698e-005	-7.60293e-010	6.54727e-011	
	SF0	SF1	SF2	SF3	
Scale Factor(mA/g)	3.00000e+000	2.59257e-004	6.13375e-007	-3.90888e-010	
Y Accelerometer					
Serial Number	973				
Calibration Date	19-Jan-2011				
	B0	B1	B2	B3	
Bias(g)	0.00000e+000	1.95276e-005	-1.88058e-008	2.74122e-010	
	SF0	SF1	SF2	SF3	
Scale Factor(mA/g)	3.00000e+000	2.75268e-004	3.53140e-007	7.52116e-010	
Z Accelerometer					
Serial Number	1032				
Calibration Date	18-Apr-2011				
	B0	B1	B2	B3	
Bias(g)	0.00000e+000	-1.14960e-005	3.94288e-009	8.97135e-011	
	SF0	SF1	SF2	SF3	
Scale Factor(mA/g)	3.00000e+000	2.88058e-004	2.44833e-007	8.38007e-010	

Magnetometer Parameters MIE-A.J 244

Date Of Last Magnetometer Calibration	16-FEB-2012,10:58		
	X Magnetometer	Y Magnetometer	Z Magnetometer
Slope	-1.000000	-1.002948	-0.976095
Offset	-0.005483	-0.018155	-0.000073

Magnetometer Constants MIE-A.J 244

Last Edited on 15-OCT-2012,14:39

Magnetometer Calibrator Number	000
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Navigation Constants MIE-A.J 244

Last Edited on 15-OCT-2012,14:39

Magnetic Declination	0.00	degrees	East
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Imager Pad Check MIE-A.J 244

Field Check on

Pad 1	Pad Not Tested	Pad 5	Pad Not Tested
Pad 2	Pad Not Tested	Pad 6	Pad Not Tested
Pad 3	Pad Not Tested	Pad 7	Pad Not Tested
Pad 4	Pad Not Tested	Pad 8	Pad Not Tested

Compact Micro Imager Constants MIE-A.J 244

Last Edited on 15-OCT-2012,14:39

Sonde Configuration	Imager Mode	degrees
Arm-Pad Kit	Normal Pads (12.25 in)	
Centre Pad 1 Rotational Offset	0.00	
Image/Borehole Ovality Reference	Azimuth of Pad 1	degrees
Non Active Buttons	Omit	feet

Search Angle	0.00	feet
Correlation Interval	3.28	mAmp
Correlation Step	1.64	mAmp
Current Offset	0.0000	
Squasher Start	N/A	
Image Processing	Enabled	
FE Calibration MFE-A.A 66		Base Calibration on 15-OCT-2012 13:42 Field Check on 15-OCT-2012 13:46
Base Calibration		
	Measured	Calibrated (ohm-m)
Reference 1	0.0	0.0
Reference 2	997.0	126.8
Base Check		272.6
Field Check		272.7
FE Constants MFE-A.A 66		Last Edited on 16-OCT-2012,09:34
Running Mode	No Sleeve	
MFE K Factor	0.1268	
Caliper Source for FE correction	Density Caliper	
Caliper Value for FE correction	N/A	inches
Rm Source for FE correction	Temperature Corr	
Temp. for Rm Corr.	MCG External Temperature	
Stand-off	1.0	inches
FE Calibration MAI-A.A 165		Base Calibration on 12-FEB-2009 10:30 Field Check on 04-APR-2009 14:52
Base Calibration		
	Measured	Calibrated (ohm-m)
Reference 1	0.0	0.0
Reference 2	976.9	126.8
Base Check		277.9
Field Check		278.3
FE Constants MAI-A.A 165		Last Edited on 04-APR-2009,15:12
Running Mode	0	
MFE K Factor	0.0000	
Caliper Source for FE correction	Density Caliper	
Caliper Value for FE correction	N/A	inches
Rm Source for FE correction	Temperature Corr	
Temp. for Rm Corr.	MCG External Temperature	
Stand-off	1.0	inches
High Resolution Temperature Calibration MAI-A.A 165		Field Calibration on 10-OCT-2011,15:43
	Measured	Calibrated(Deg F)
Lower	50.00	50.00
Upper	75.00	75.00
High Resolution Temperature Constants MAI-A.A 165		Last Edited on 15-OCT-2012,13:33
Pre-filter Length	11	
Induction Calibration MAI-A.A 165		Base Calibration on 15-OCT-2012,13:08 Field Check on 15-OCT-2012 13:32
Base Calibration		
Test Loop Calibration	Measured	Calibrated (mmho/m)
Channel	Low High	Low High
1	17.2 469.6	9.3 966.2
2	6.7 392.8	7.6 821.4
-	- -	- -

3	4.2	262.3	5.2	566.0
4	1.6	136.6	2.6	279.2
Array Temperature		75.0	Deg F	
Channel	Base Check (mmho/m)		Field Check (mmho/m)	
	Low	High	Low	High
1	12.9	3869.0	13.0	3868.3
2	28.4	3433.8	28.4	3433.0
3	26.7	3021.4	26.7	3021.3
4	19.7	2016.0	19.7	2016.1
Deep	17.3	2011.3	17.3	2011.8
Medium	37.6	3970.8	37.6	3970.3
Shallow	41.2	5011.9	41.3	5010.0
Array Temperature		69.2	70.6	Deg F

Induction Constants MAI-A.A 165

Last Edited on 16-OCT-2012,09:33

Induction Model	RtAP-WBM		
Caliper for Borehole Corr.	Density Caliper		
Hole Size for Borehole Correction	N/A	inches	
Tool Centred	No		
Stand-off Type	Fins		
Stand-off	1.00	inches	
Number of Fins on Stand-off	6.0000		
Stand-off Fin Angle	60.00	degrees	
Stand-off Fin Width	0.0500	inches	
Borehole Corr. Rm Source	Temperature Corr		
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	
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-C.A 195

Base Calibration on 15-OCT-2012 13:53

Field Calibration on 15-OCT-2012 13:54

Base Calibration		
Reading No	Measured	Calibrator Size (in)
1	15007	4.00
2	23645	5.96
3	32400	7.99
4	40161	9.86

5	49760	11.93
6	N/A	N/A
Field Calibration		
	Measured Caliper (in)	Actual Caliper (in)
	7.95	7.99
Photo Density Calibration MPD-C.A 195		Base Calibration on 15-OCT-2012 14:12 Field Check on 15-OCT-2012 14:18
Density Calibration		
Base Calibration	Measured	Calibrated (sdu)
	Near Far	Near Far
Reference 1	38135 13267	52994 19128
Reference 2	18092 1824	25188 2558
Field Check at Base		
	670.1 775.1	
Field Check		
	667.4 773.4	
PE Calibration		
Base Calibration	Measured	Calibrated
	WS WH Ratio	Ratio
Background	122 602	
Reference 1	13157 38045	0.348 0.309
Reference 2	5216 18018	0.292 0.274
Field Check at Base		
	122.4 602.2	
Field Check		
	122.5 598.0	
Density Constants MPD-C.A 195		Last Edited on 16-OCT-2012,13:16
Density Source Id	2859GW	
Nylon Calibrator Number	535	
Aluminium Calibrator Number	535	
Density Shoe Profile	8 inch	
Caliper Source for Processing	Density Caliper	
PE Correction to Density	Not Applied	
Mud Density	1.17	gm/cc
Mud Density Z/A Multiplier	1.11	
Mud Filtrate Density	1.00	gm/cc
Dry Hole Mud Filtrate Density	1.00	gm/cc
DNCT	0.00	gm/cc
CRCT	0.00	gm/cc
Density Z/A Correction	Hybrid	
Matrix Density (gm/cc)	Depth (ft)	
2.68	0.00	
0.00	0.00	
0.00	0.00	
0.00	0.00	
0.00	0.00	
0.00	0.00	
0.00	0.00	
0.00	0.00	

DOWNHOLE EQUIPMENT

C:\Minimum\ccc\EGGS\EGGS 31.7.WPD005 1\EGGS 31.7.WPD005 1 Report.doc

CBH-C, Cablehead, 11 pin

CBH-C 102 LG: 2.40 ft WT: 24.3 lb OD: 2.24 in

SHA-H Compact Swivel Head Adaptor

SHA-H 142 LG: 2.30 ft WT: 22.0 lb OD: 2.24 in

Compact Comms Gamma

MCG-D.K 483 LG: 8.70 ft WT: 63.9 lb OD: 2.24 in

Compact Neutron

MDN-B.A 227 LG: 5.04 ft WT: 50.7 lb OD: 2.24 in

Compact Density/Caliper

MPD-C.A 195 LG: 9.59 ft WT: 90.4 lb OD: 2.45 in

MIS-D.B Compact Inline Bowspring sub

MIS-D.B 658 LG: 5.70 ft WT: 33.1 lb OD: 2.24 in

SKJ-E.B Compact Knuckle Joint

SKJ-E.B 536 LG: 2.17 ft WT: 24.3 lb OD: 2.24 in

MIS-E.A Compact Inline Standoff sub

MIS-E.A 199 LG: 2.14 ft WT: 15.4 lb OD: 2.24 in

SKJ-D.A Compact Knuckle Joint

SKJ-D.A 66 LG: 2.17 ft WT: 24.3 lb OD: 2.24 in

SHA-J.B Compact Swivel Head Adaptor

SHA-J.B 511 LG: 2.30 ft WT: 22.0 lb OD: 2.24 in

Compact MMI Memory Section

MMI-A.J 244 LG: 4.65 ft WT: 26.5 lb OD: 2.24 in

Compact MMI Electrode Section

MIE-A.J 244 LG: 13.96 ft WT: 99.2 lb OD: 4.09 in

SKJ-E.B Compact Knuckle Joint

SKJ-E.B 589 LG: 2.17 ft WT: 24.3 lb OD: 2.24 in

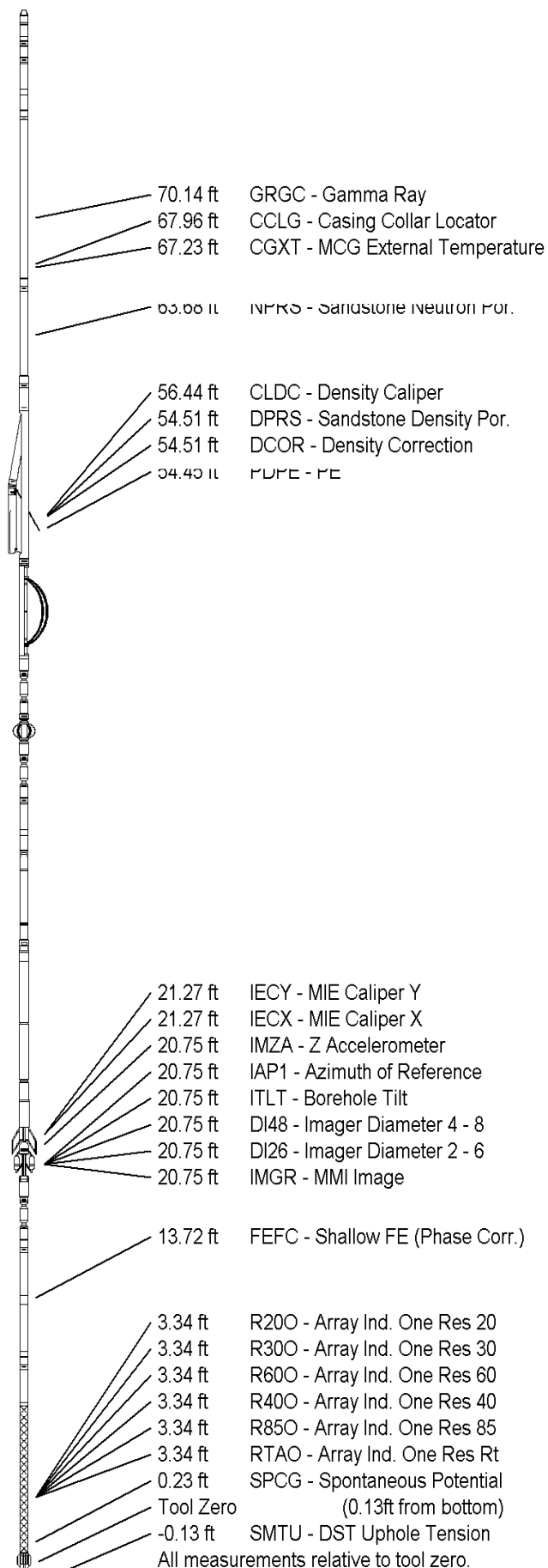
Compact Focussed Electric

MFE-A.A 66 LG: 6.05 ft WT: 48.5 lb OD: 2.24 in

Compact Induction

MAI-A.A 165 LG: 10.81 ft WT: 48.5 lb OD: 2.24 in

Total Length: 80.12 ft Weight: 617.3 lb



COMPANY	EAST CHEYENNE GAS STORAGE LLC
WELL	ECGS No 31-7 WPD005-1
FIELD	PEETZ WEST
PROVINCE/COUNTY	LOGAN
COUNTRY/STATE	USA/COLORADO

Elevation Kelly Bushing	4557.00	feet	First Reading	5251.00	feet
Elevation Drill Floor	4556.00	feet	Depth Driller	5260.00	feet
Elevation Ground Level	4543.00	feet	Depth Logger	5254.00	feet



Weatherford®

ARRAY INDUCTION
LOGS