

**Weatherford****ARRAY INDUCTION
SHALLOW FOCUSED
ELECTRIC LOG**

COMPANY

SOUTHERN STAR CENTRAL GAS PIPELINE, INC.

WELL

ALDEN GAS STORAGE #O-27

FIELD

ALDEN

PROVINCE/COUNTY

RICE

COUNTRY/STATE

U.S.A. / KANSAS

LOCATION

330' FNL & 1474' FEL

SEC

TWP
15 21SRGE
9WOther Services
MDN/MPD

MML

API Number

15-159-22730

Permit Number

MSS

Permanent Datum GL, Elevation 1672 feet

Log Measured From KB

Drilling Measured From KB

Date

05-MAY-2013

Elevations:
KB 1685.00
DF 1684.00
GL 1672.00

Run Number

ONE

Service Order

3539046

Depth Driller

3520.00 feet

Depth Logger

3516.00 feet

First Reading

3513.00 feet

Last Reading

578.00 feet

Casing Driller

580.00 feet

Casing Logger

578.00 feet

Bit Size

9.625

inches

Hole Fluid Type

CHEMICAL

Density / Viscosity

9.45 lb/USg 49.00 CP

PH / Fluid Loss

10.50 7.20 ml/30Min

Sample Source

FLOWLINE

Rm @ Measured Temp

1.08 @ 89.0 ohm-m

Rmf @ Measured Temp

0.86 @ 89.0 ohm-m

Rmc @ Measured Temp

1.30 @ 89.0 ohm-m

Source Rmf / Rmc

CALC CALC

Rm @ BHT

0.99 @ 97.0 ohm-m

Time Since Circulation

4 HOURS

Max Recorded Temp

97.00 deg F

Equipment / Base

13057 LIB

Recorded By

ADAM SILL

Witnessed By

MARK ROUSE

JOB #

LB13-124

BOREHOLE RECORD

Last Edited: 05-MAY-2013 15:48

Bit Size
inches

9.625

Depth From
feet

585.00

Depth To
feet

3520.00

CASING RECORD

Type

Size
inches

11.750

Depth From
feet

0.00

Shoe Depth
feet

585.00

Weight
pounds/ft

38.00

SURFACE

REMARKS

- SOFTWARE ISSUE: WLS 13.05.9583.
- RUN 1: MCG, MML, MFE, MSS, MAI RAN IN COMBINATION.
 - HARDWARE: 0.5 INCH STANDOFF USED ON MFE.
TWO 0.5 INCH STANDOFFS USED ON MSS.
0.5 INCH STANDOFF USED ON MAI.
- RUN 2: MCG, MDN, MPD RAN IN COMBINATION.
 - HARDWARE: DUAL BOWSPRING USED ON MDN.
- 2.71 G/CC LIMESTONE DENSITY MATRIX USED TO CALCULATE POROSITY.
- BOREHOLE RUGOSITY, TIGHT PULLS, AND WASHOUTS WILL AFFECT DATA QUALITY.
- ALL INTERVALS LOGGED AND SCALED PER CUSTOMER'S REQUEST.
- TOTAL HOLE VOLUME FROM TD TO GROUND LEVEL: 2290 CU. FT.

- ANNULAR HOLE VOLUME WITH 7 INCH PRODUCTION CASING FROM TD TO 2200 FEET: 390 CU. FT.

- RIG: STERLING #4.

- ENGINEER: A. SILL.

- OPERATOR(S): N. ADAME.

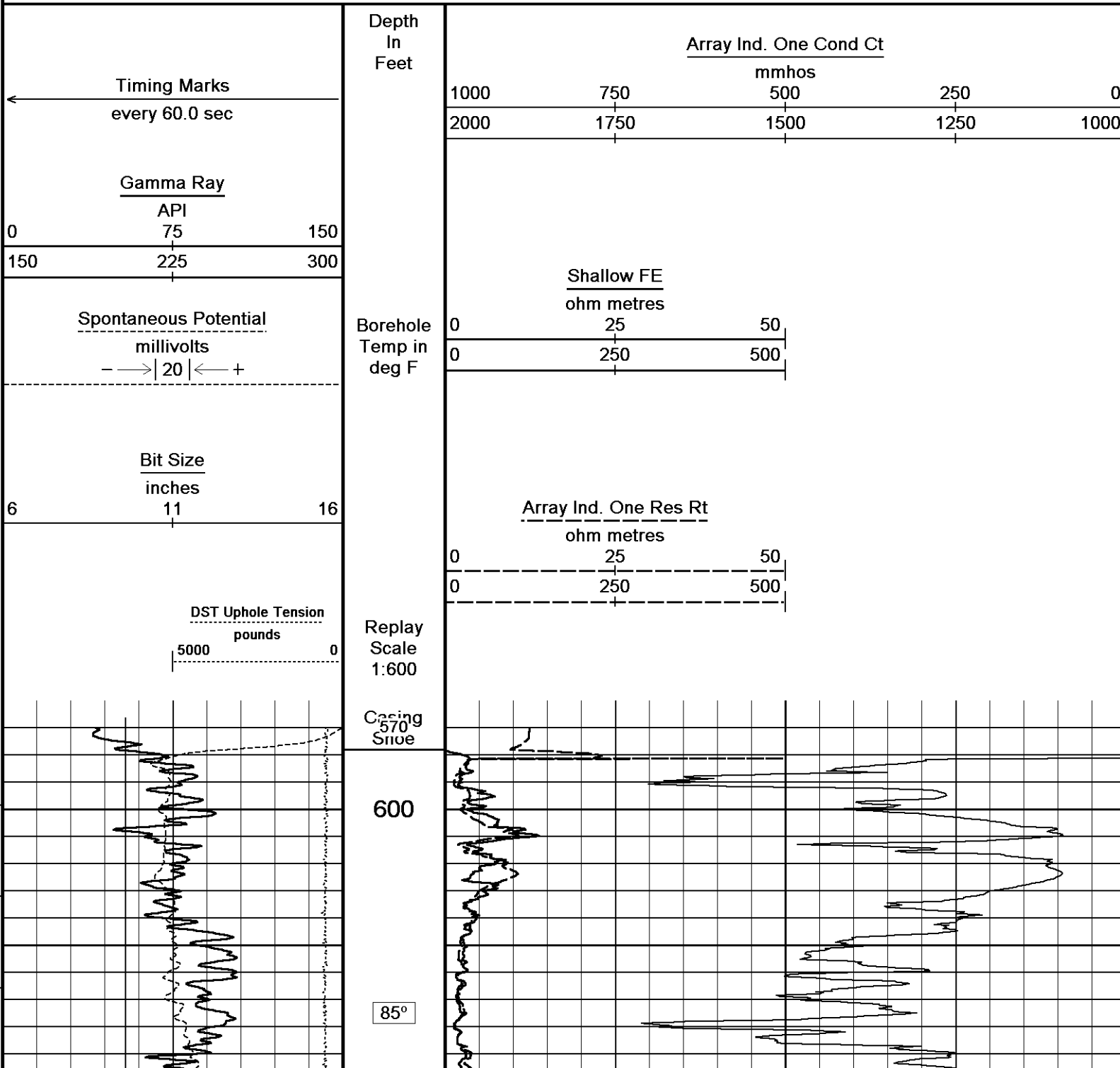
All interpretations are opinions based on inferences from electrical or other measurements and we cannot, and do not, guarantee the accuracy or correctness of any interpretations, and we shall not, except in the case of gross or wilful negligence on our part, be liable or responsible for any loss, costs, 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.

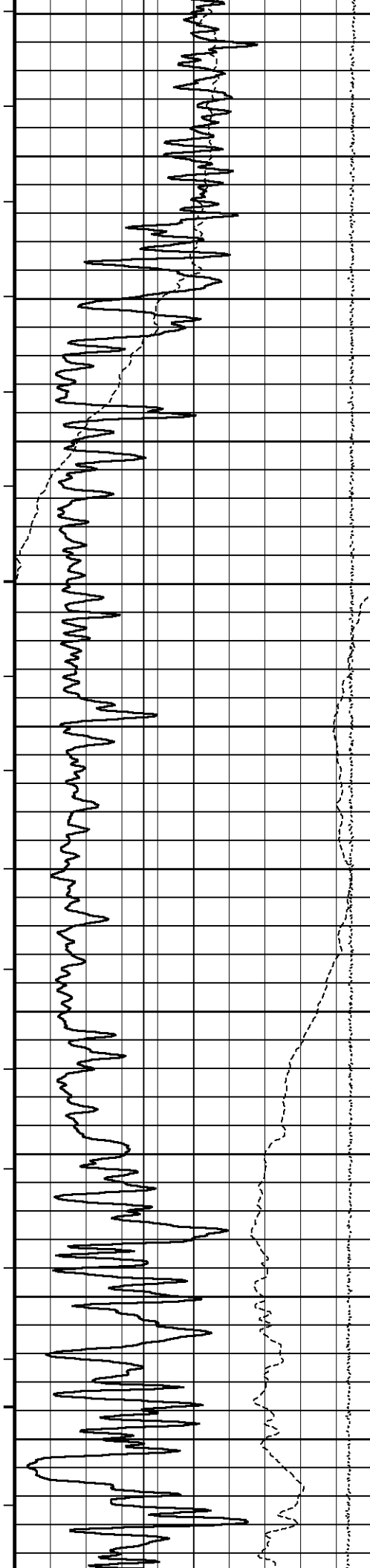
↓ 2 INCH MAIN ↓

Depth Based Data - Maximum Sampling Increment 10.0cm Plotted on 05-MAY-2013 22:39

Filename: C:\Minimus 13.05.9583\Logs\...\Southern Star Alden Gas Storage #0-27 Resistivity2_002.dta Recorded on 05-MAY-2013 16:53

System Versions: Logged with 13.05.9583 Processed with 13.05.9583 Plotted with 13.05.9583





700

87°

800

88°

900

88°

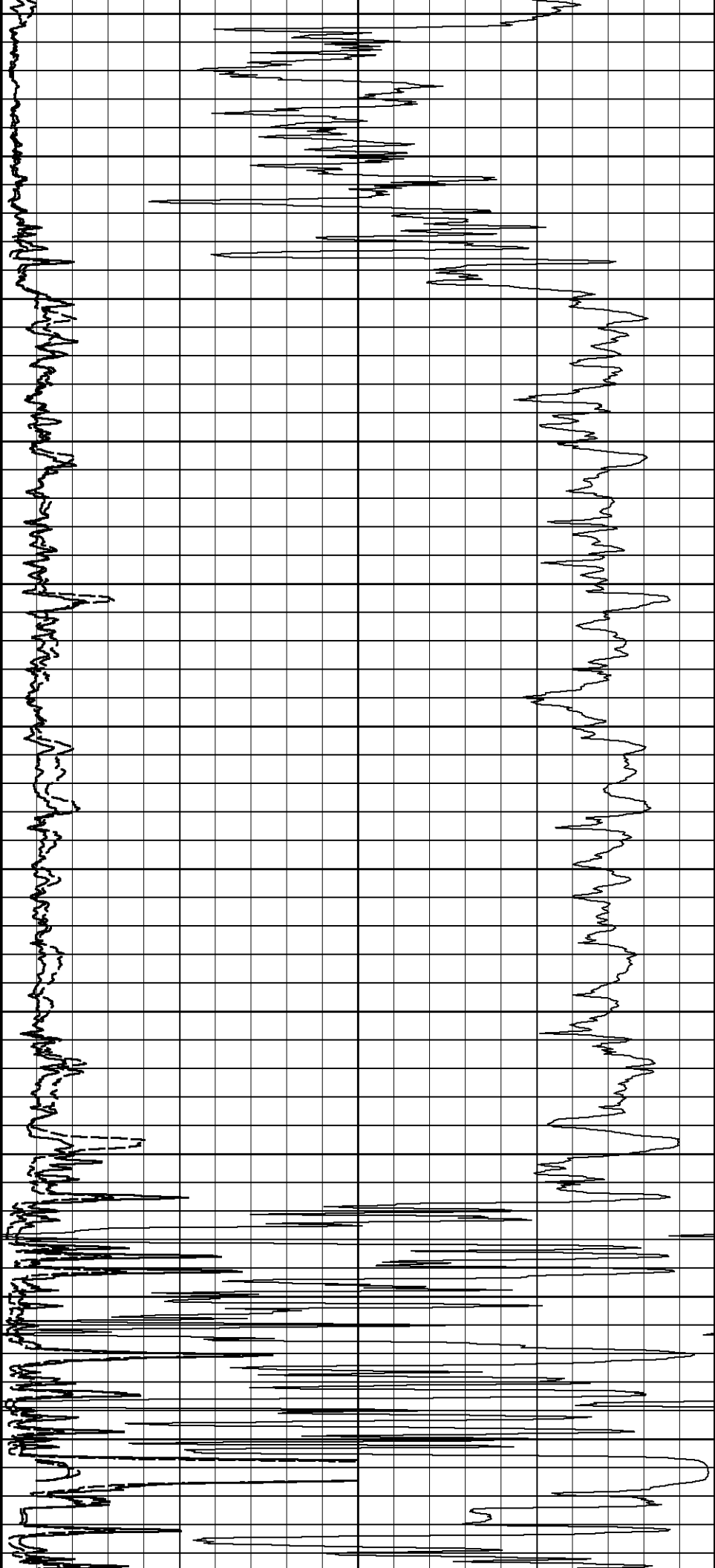
1000

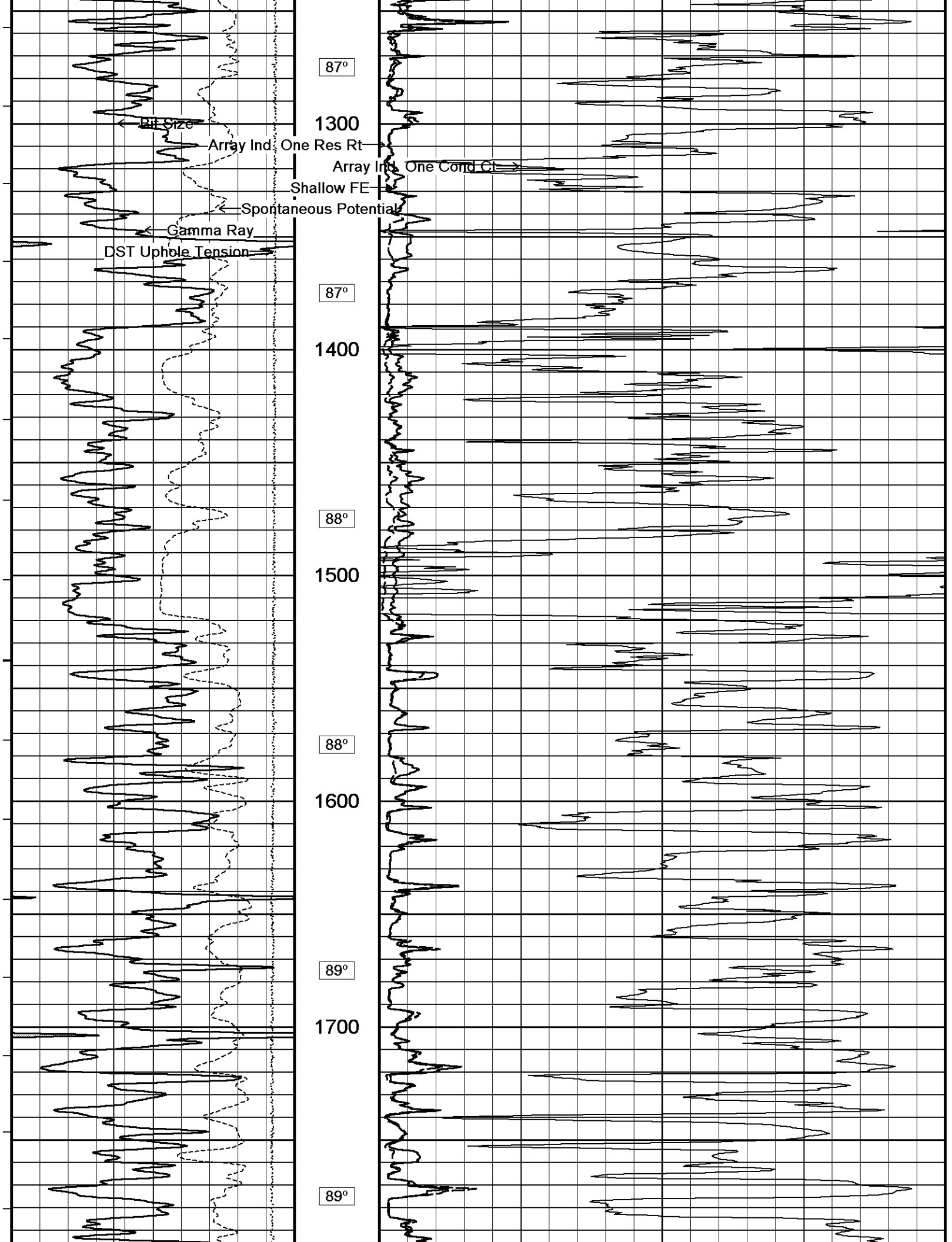
86°

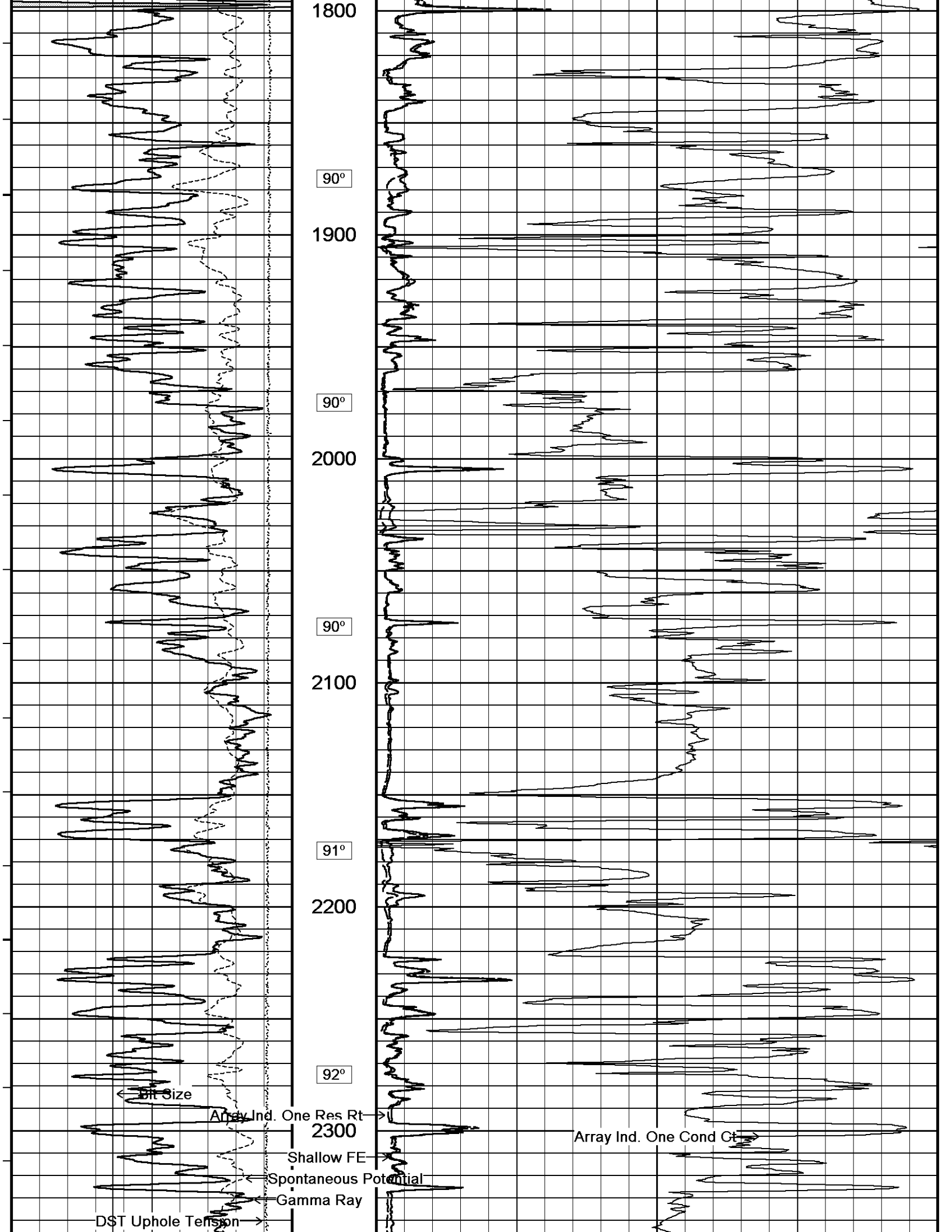
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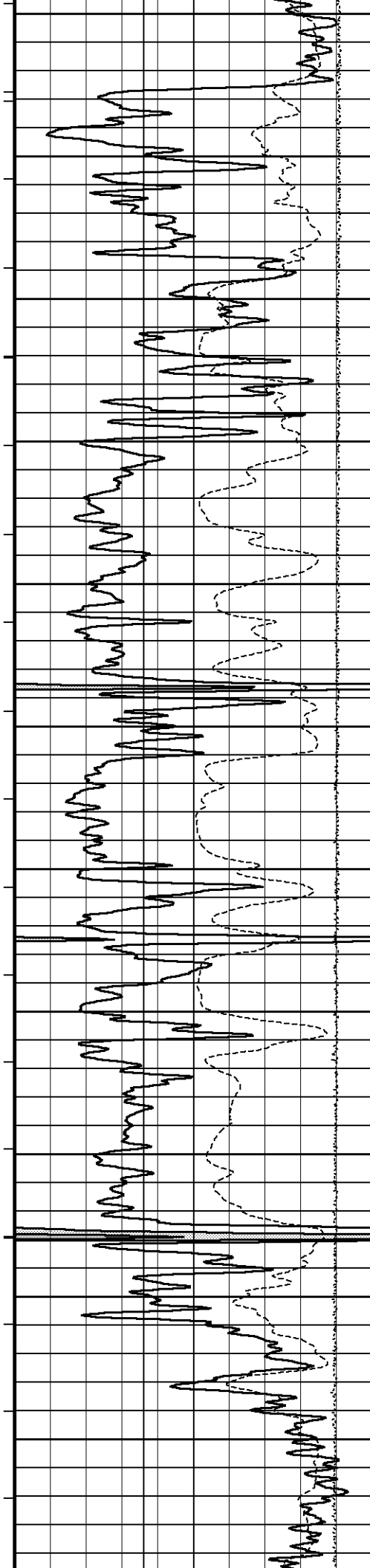
86°

1200









92°

2400

92°

2500

93°

2600

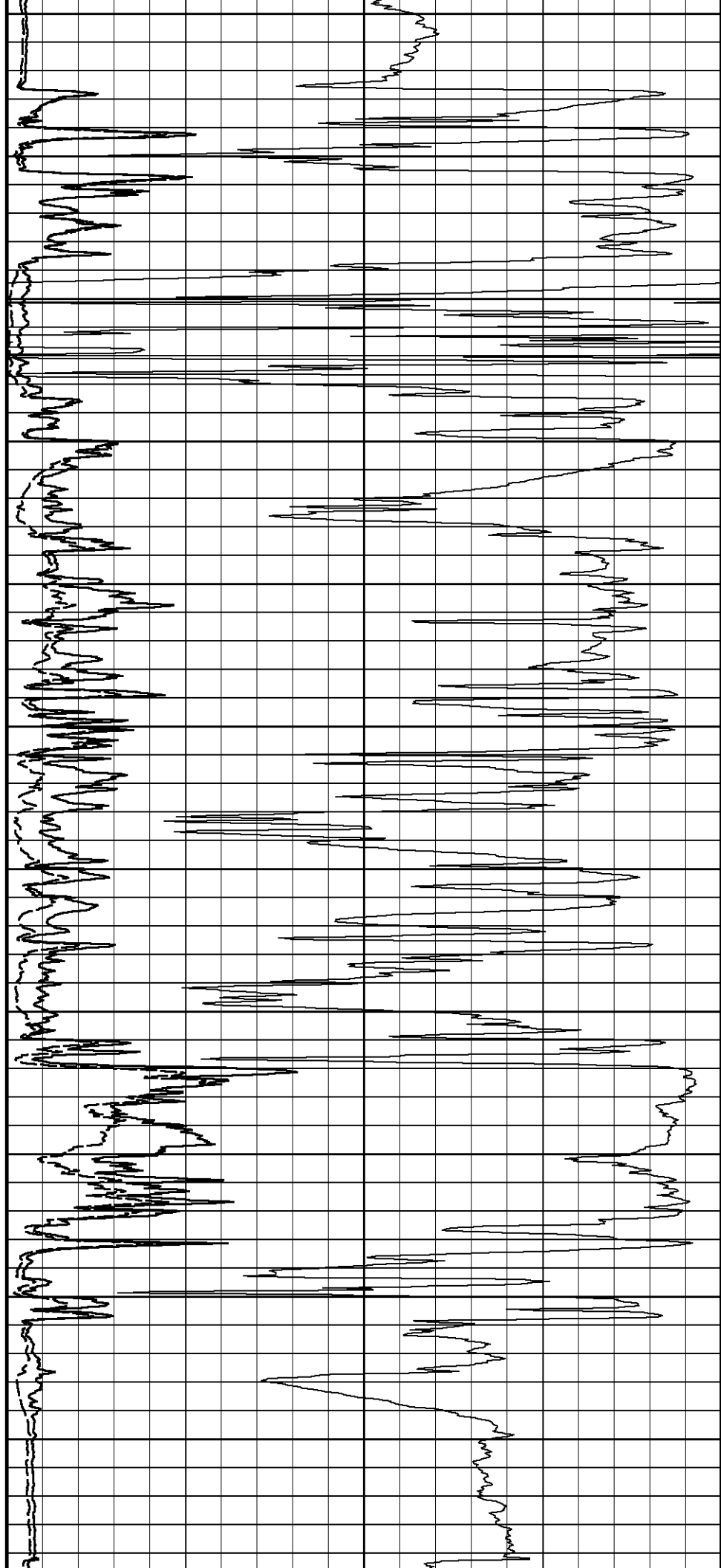
94°

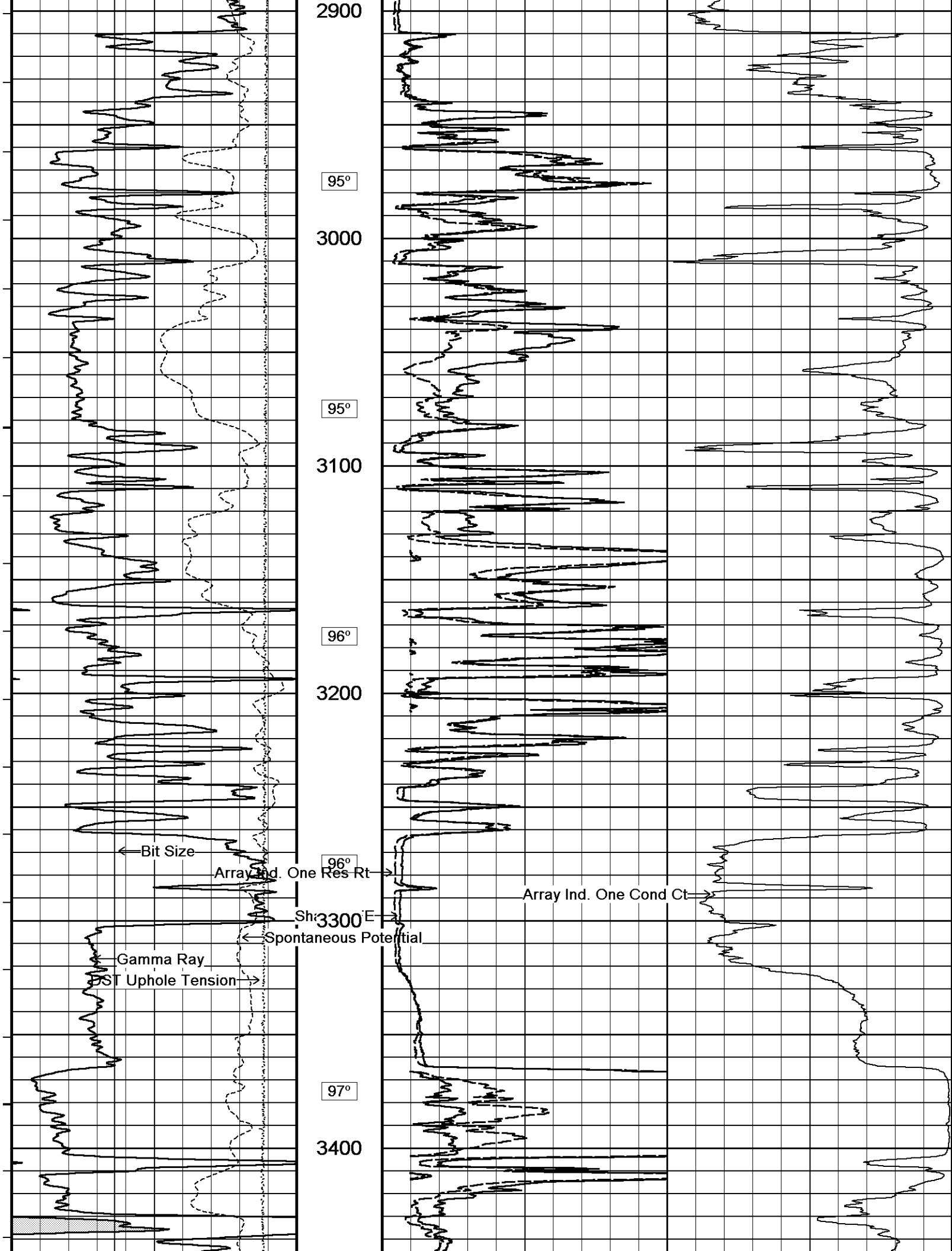
2700

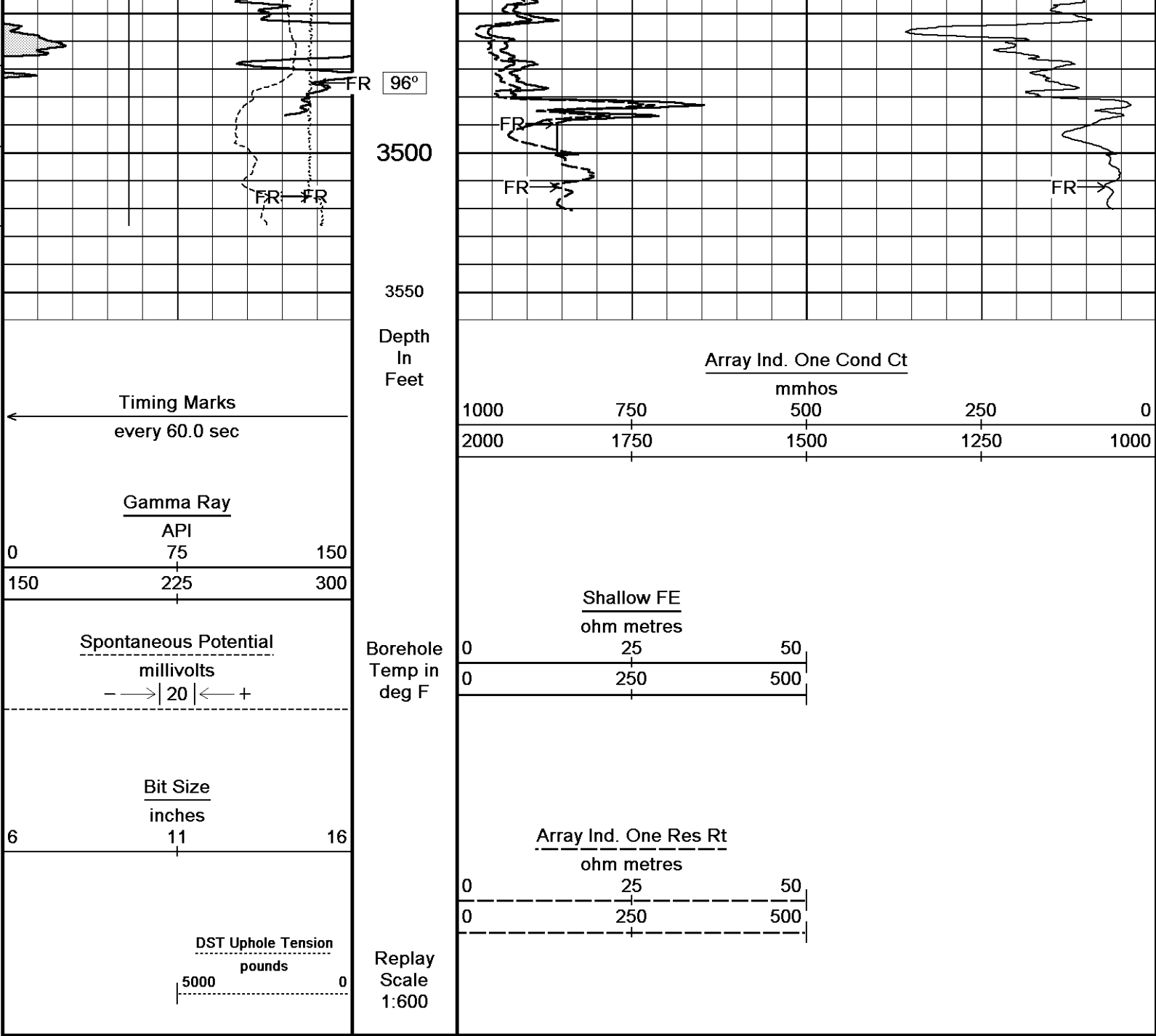
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2800

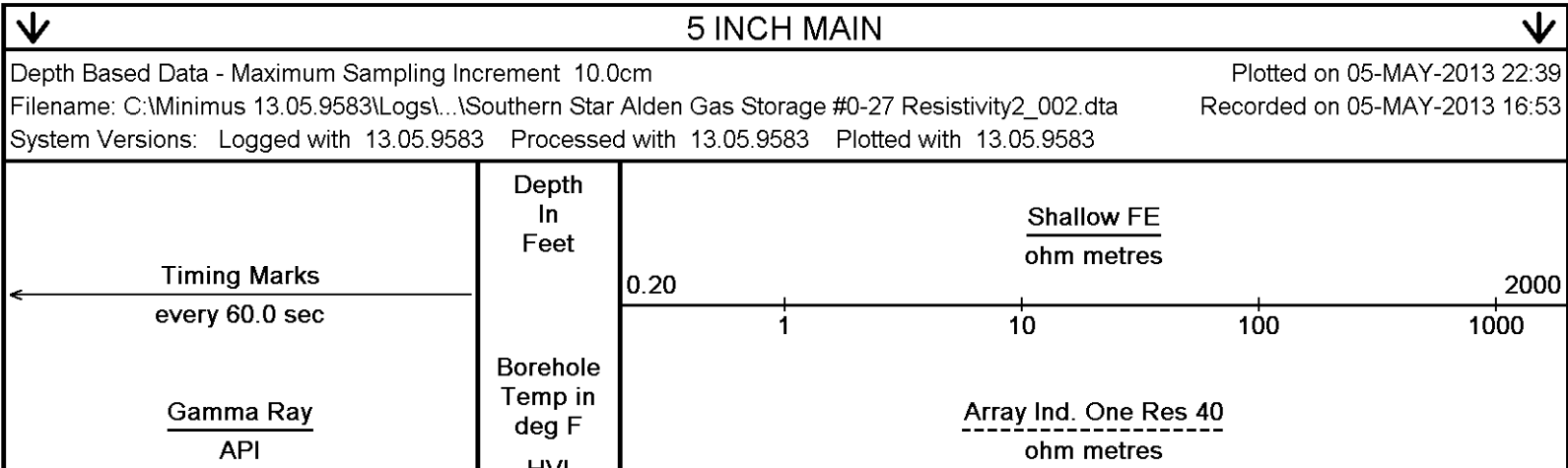
95°

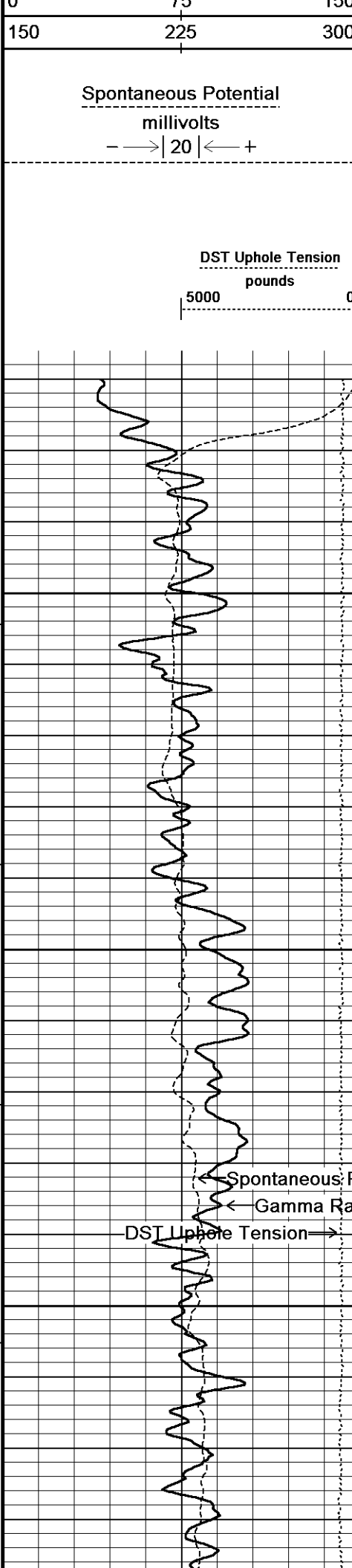






Depth Based Data - Maximum Sampling Increment 10.0cm
Filename: C:\Minimus 13.05.9583\Logs\...\Southern Star Alden Gas Storage #0-27 Resistivity2_002.dta
System Versions: Logged with 13.05.9583 Processed with 13.05.9583 Plotted with 13.05.9583
Plotted on 05-MAY-2013 22:39
Recorded on 05-MAY-2013 16:53





every
10 cu ft

Annular
Integral
every
10 cu ft

Replay
Scale
1:240

568
Casing
Shoe

600

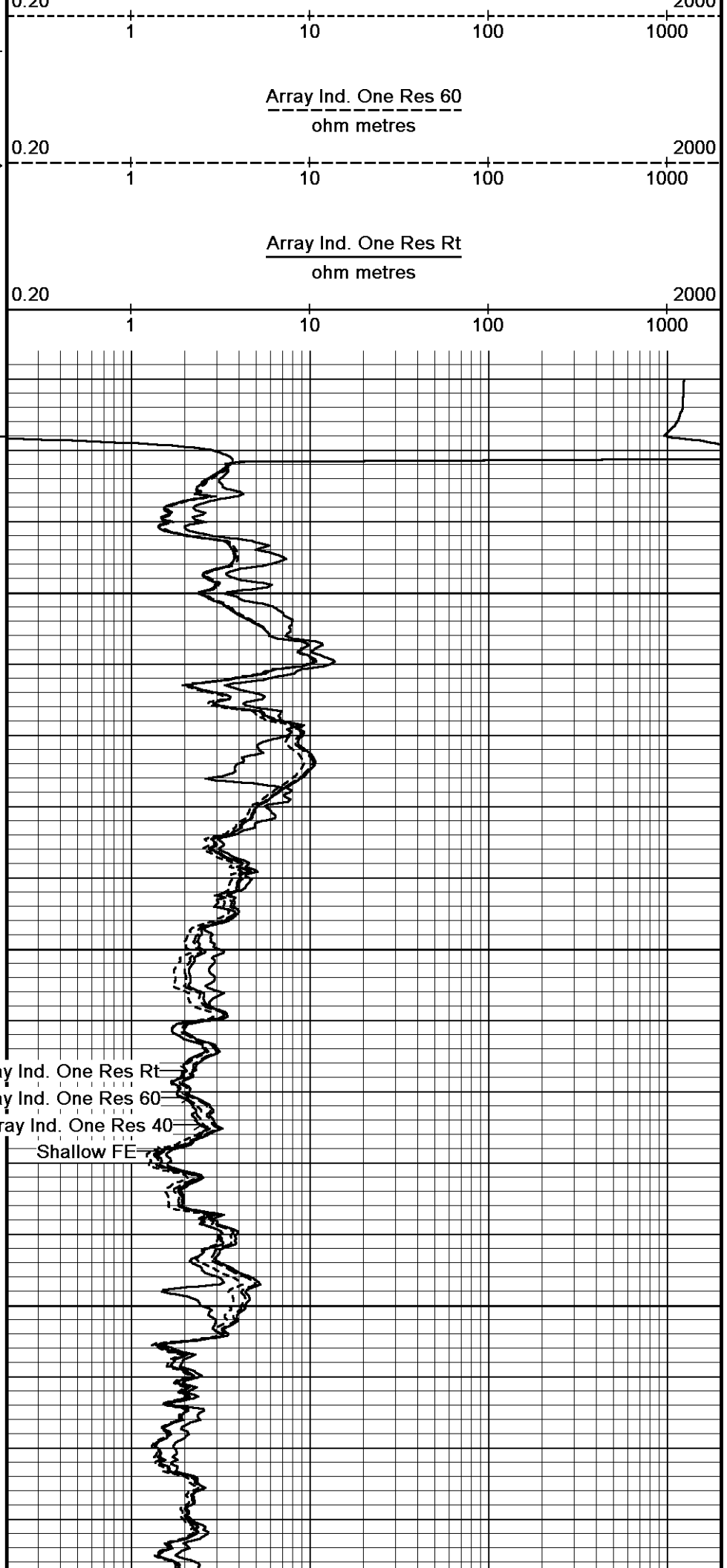
85°

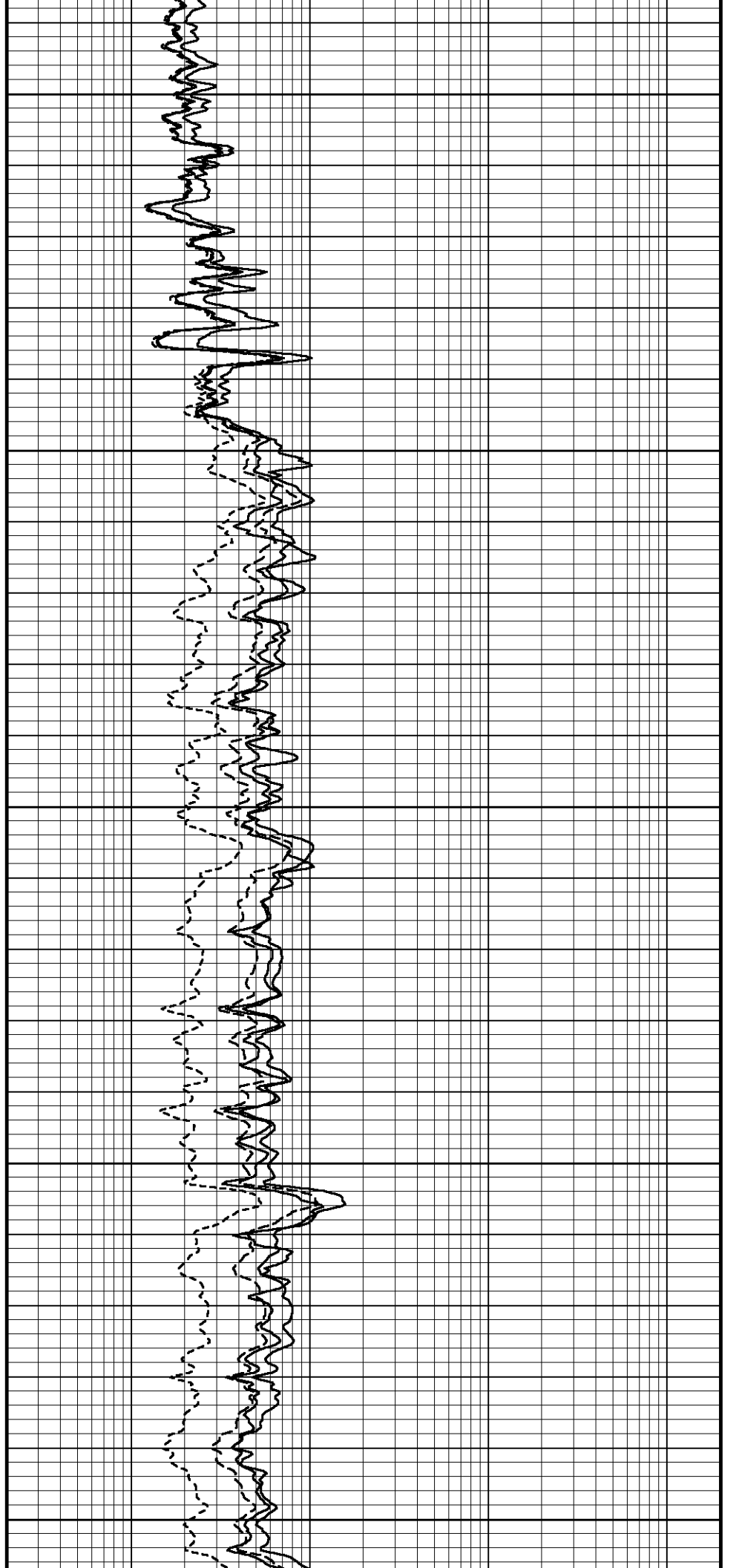
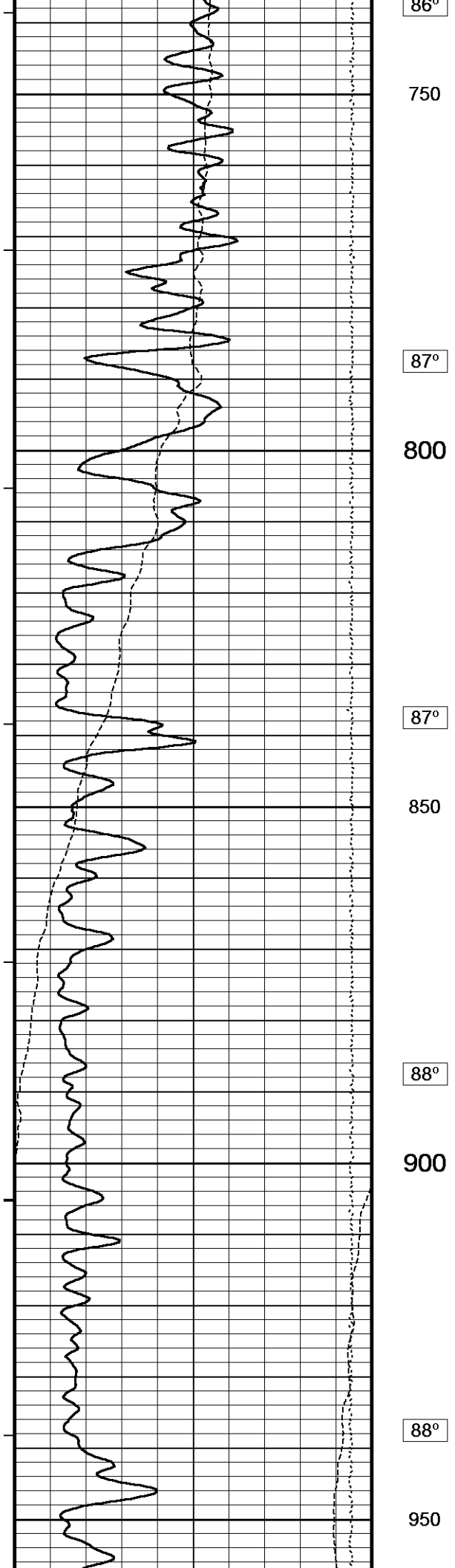
650

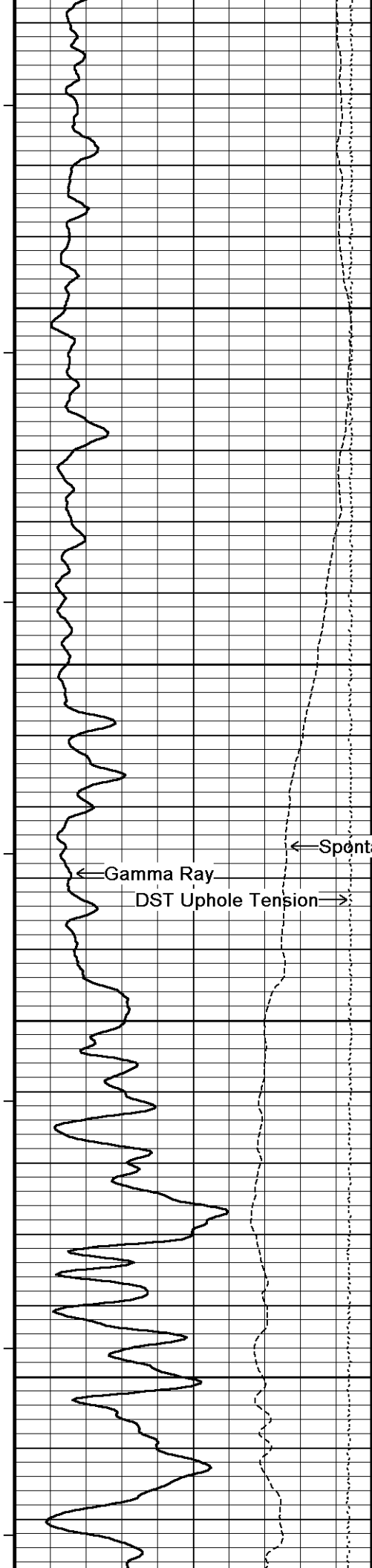
85°

700

800





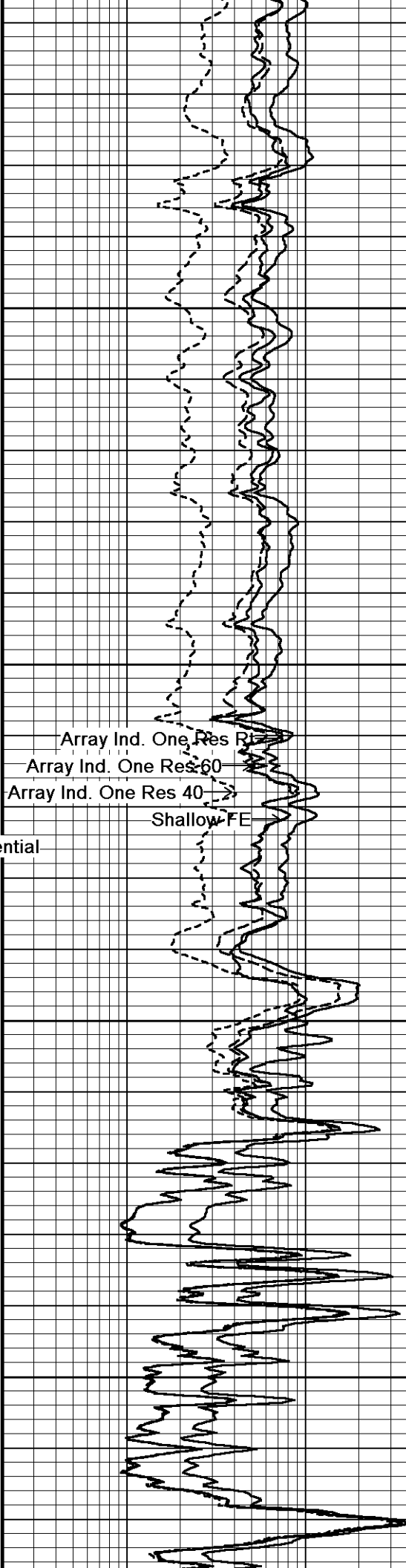


88°

1000

87°

1050



Array Ind. One Res R

Array Ind. One Res 60

Array Ind. One Res 40

Shallow FE

← Spontaneous Potential

Gamma Ray

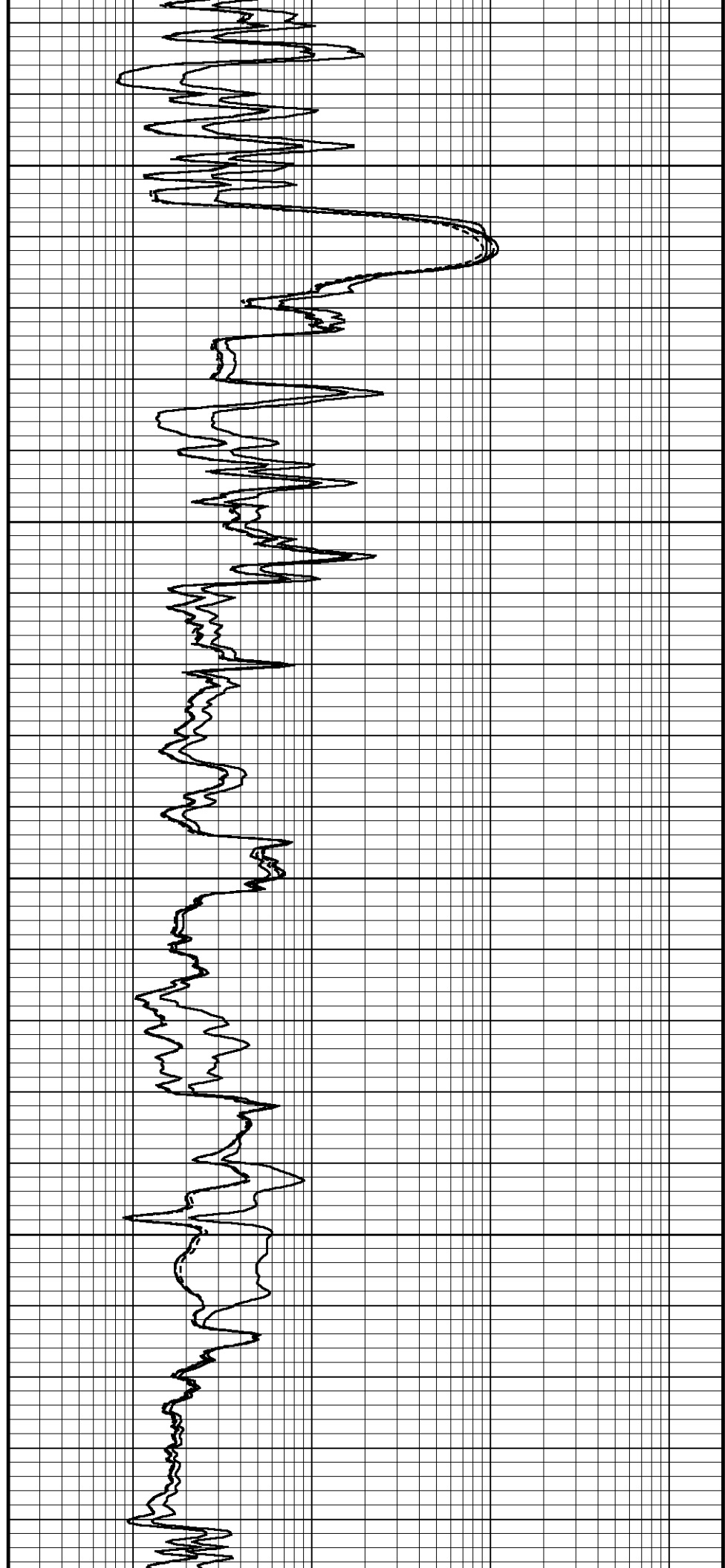
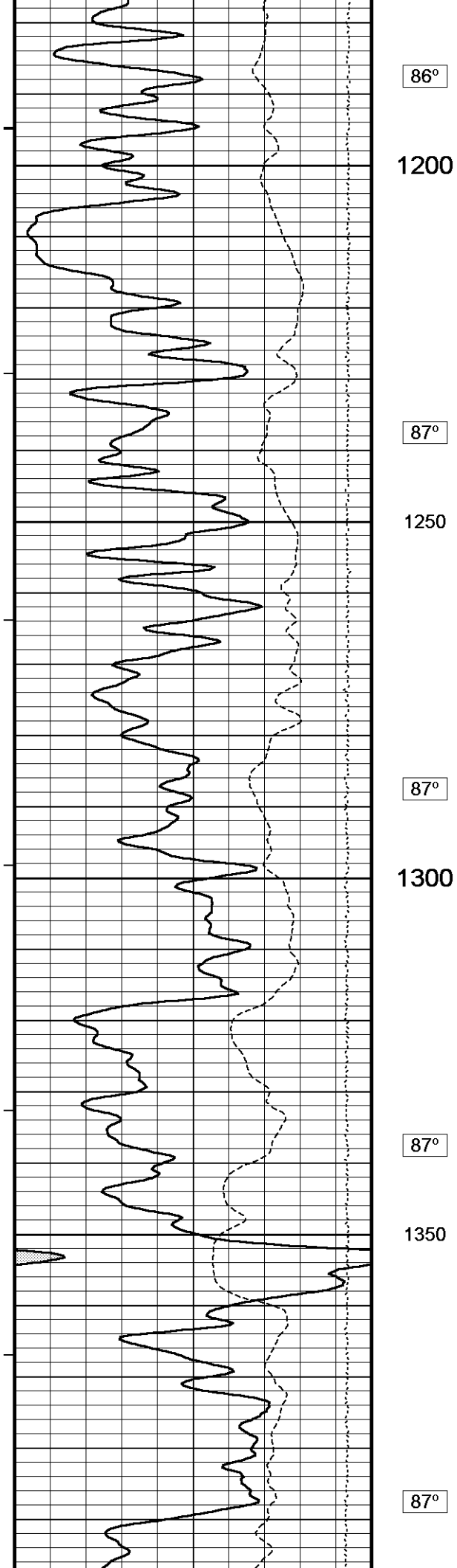
DST Uphole Tension →

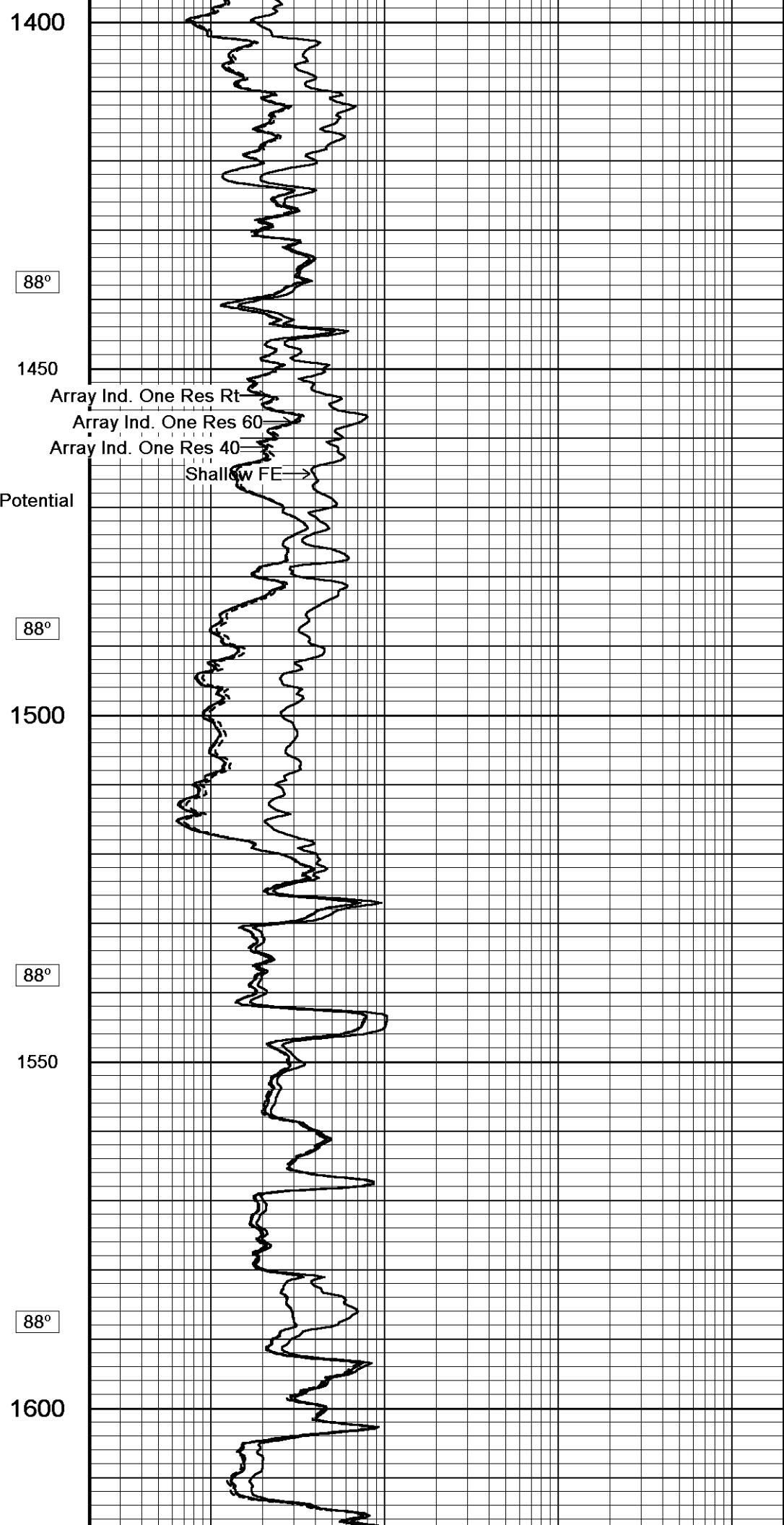
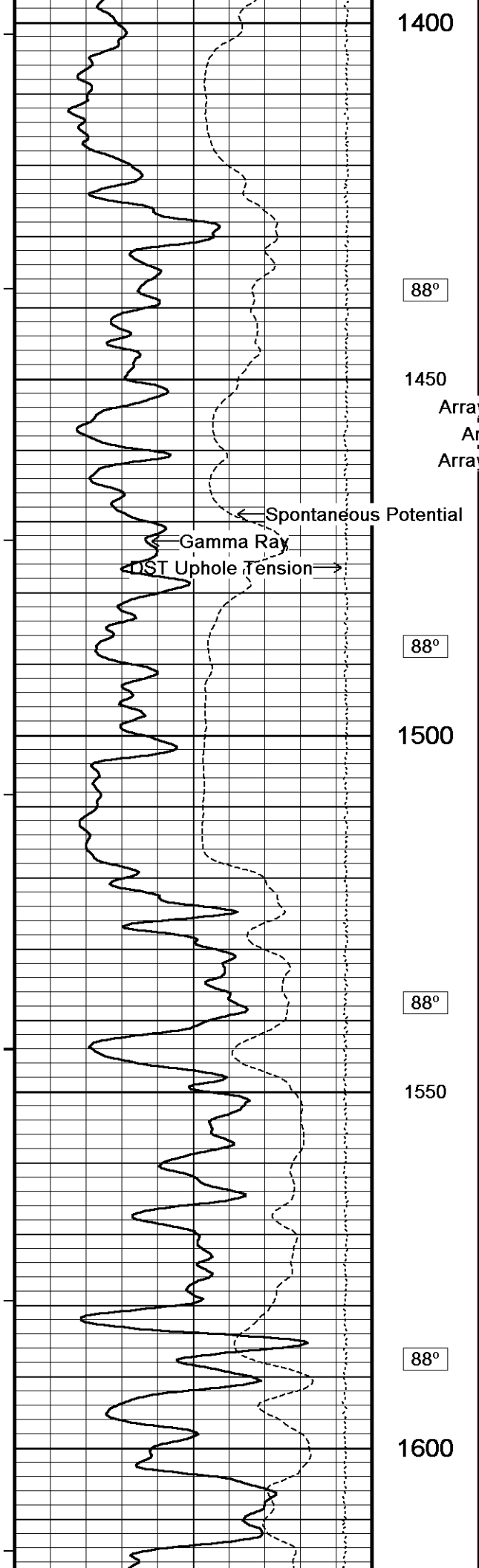
86°

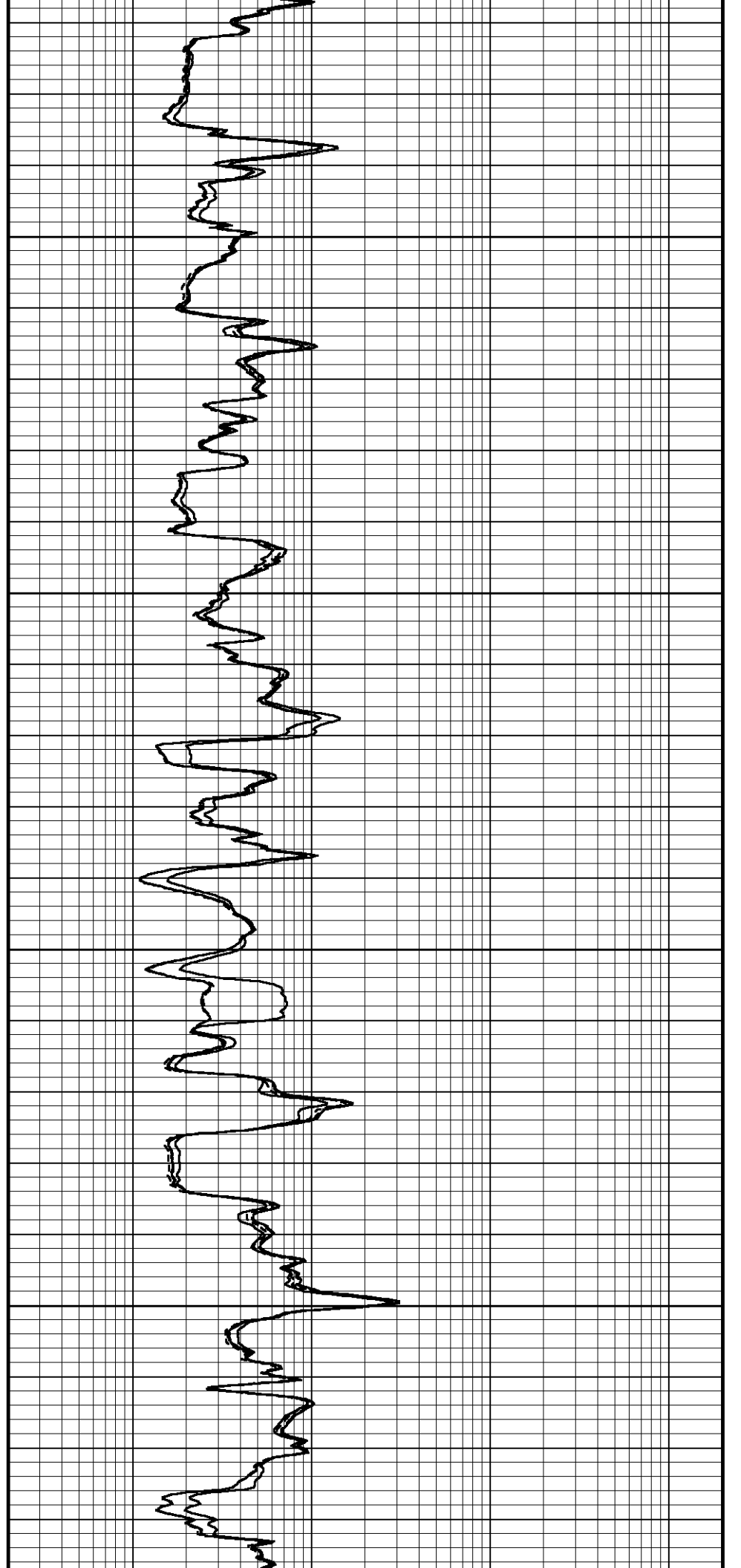
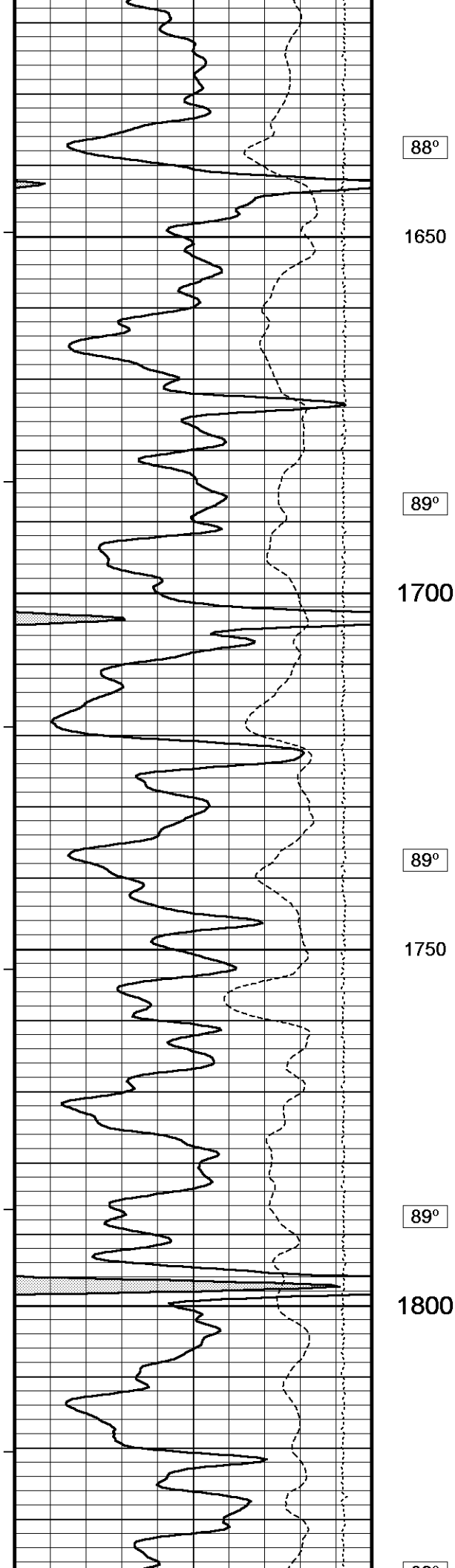
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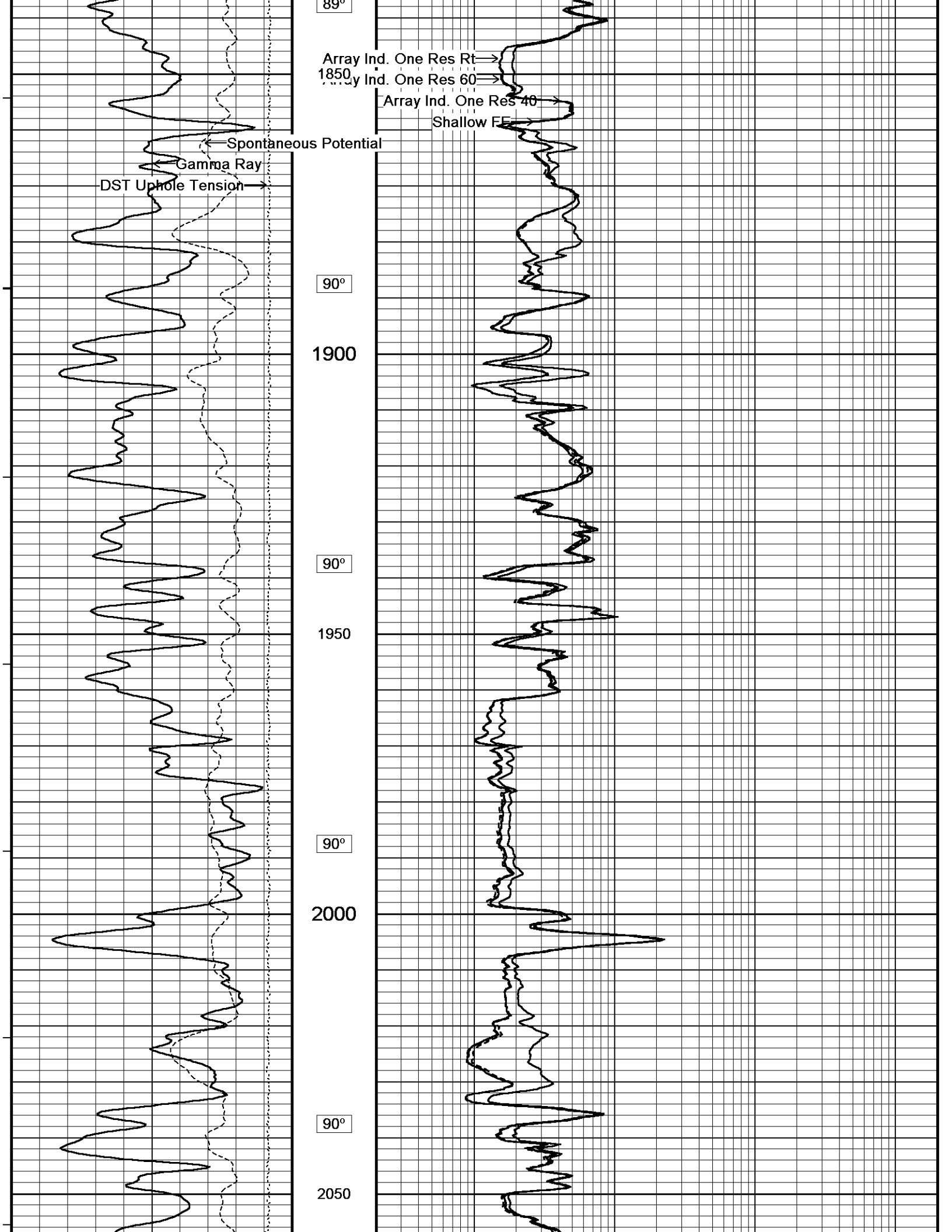
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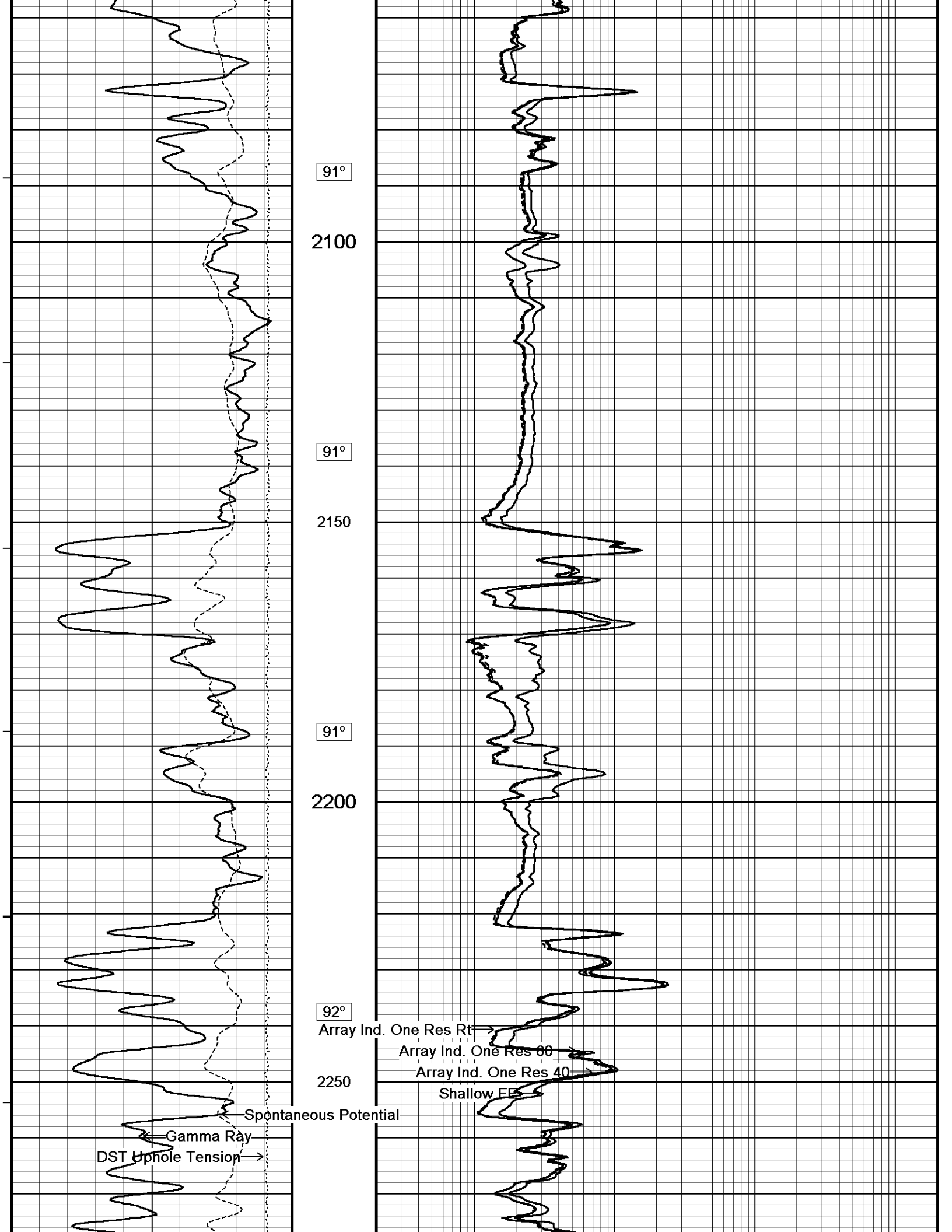
1150

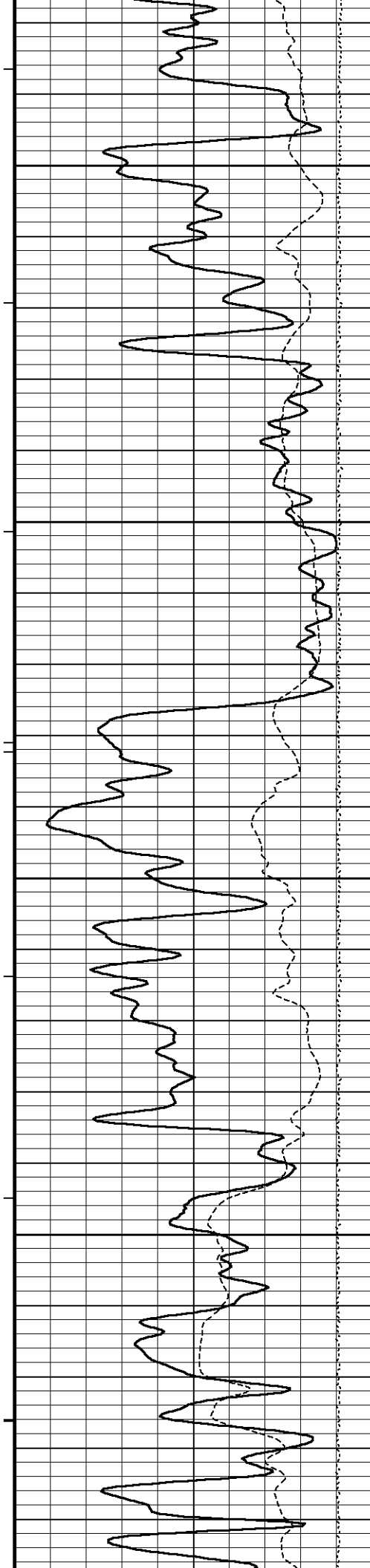












92°

2300

92°

2350

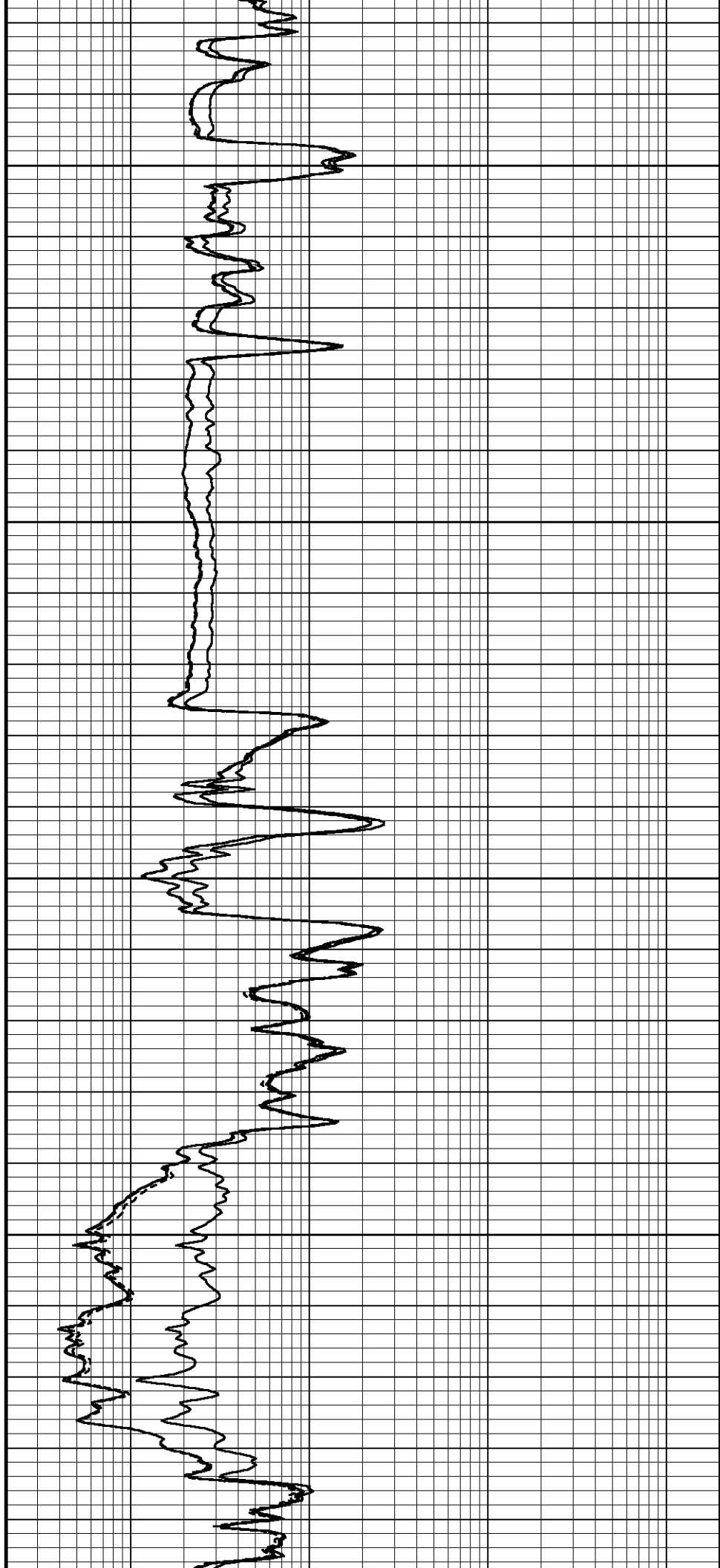
92°

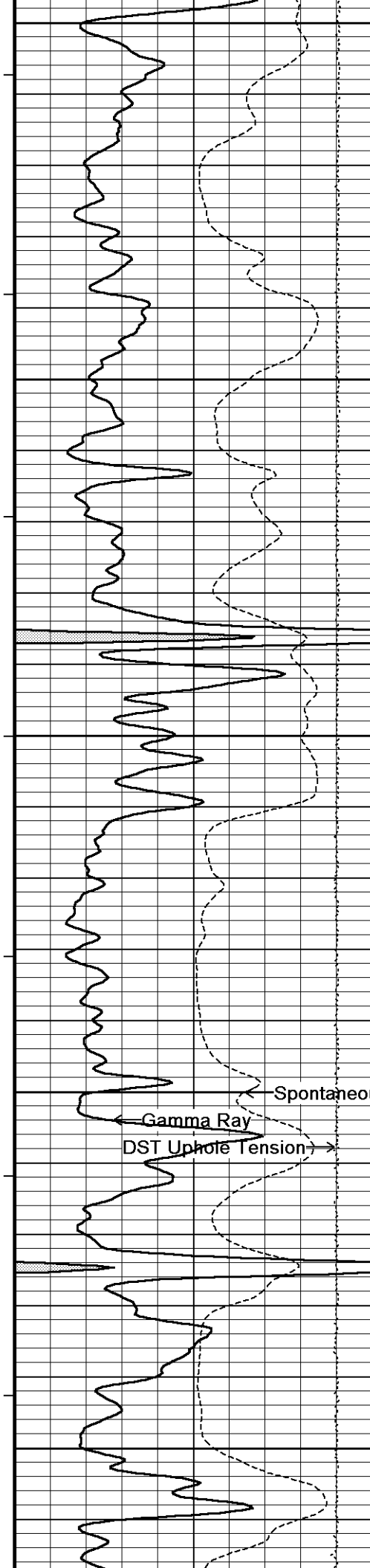
2400

92°

2450

93°





2500

93°

2550

93°

2600

Array Ind. One Res Rt

93° Array Ind. One Res 60

Array Ind. One Res 40

Shallow FE

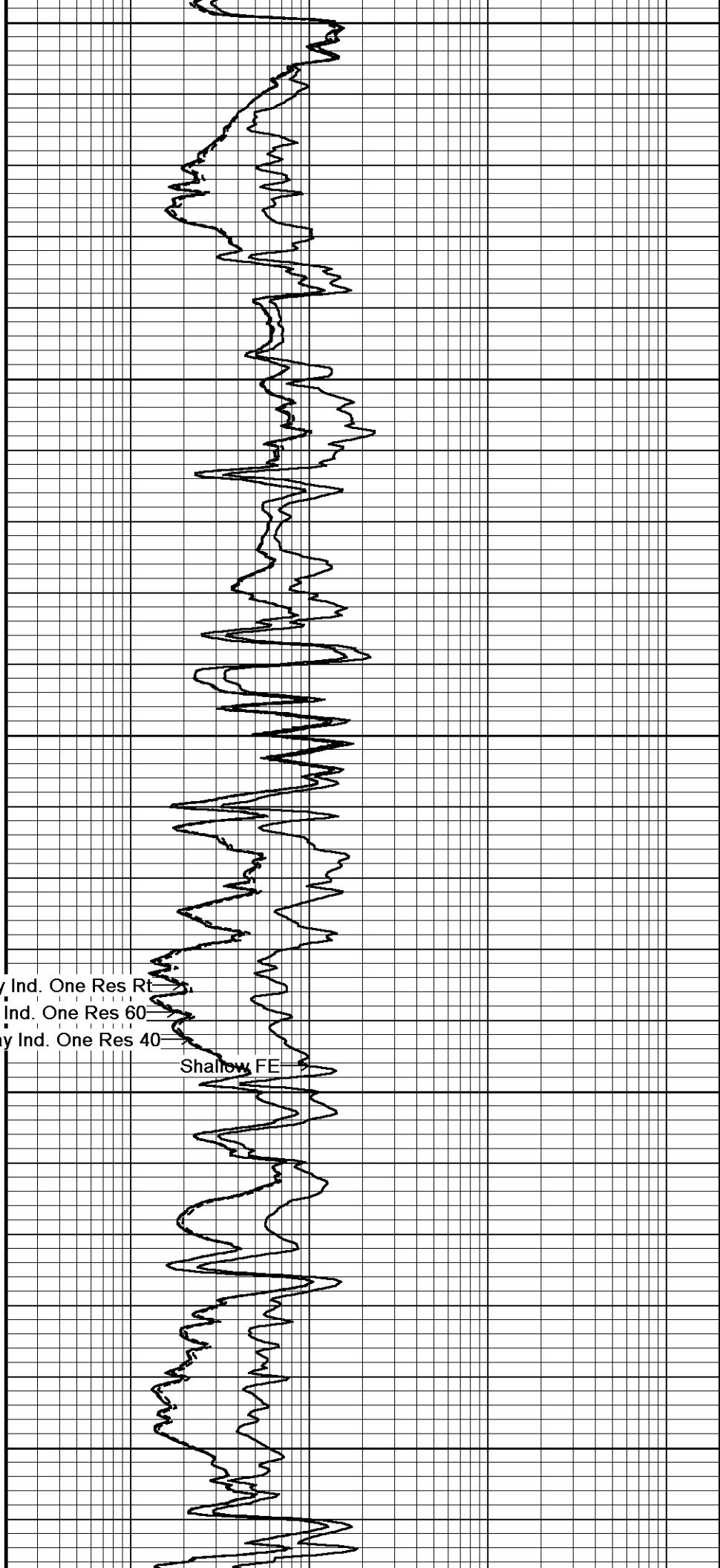
Spontaneous F2650

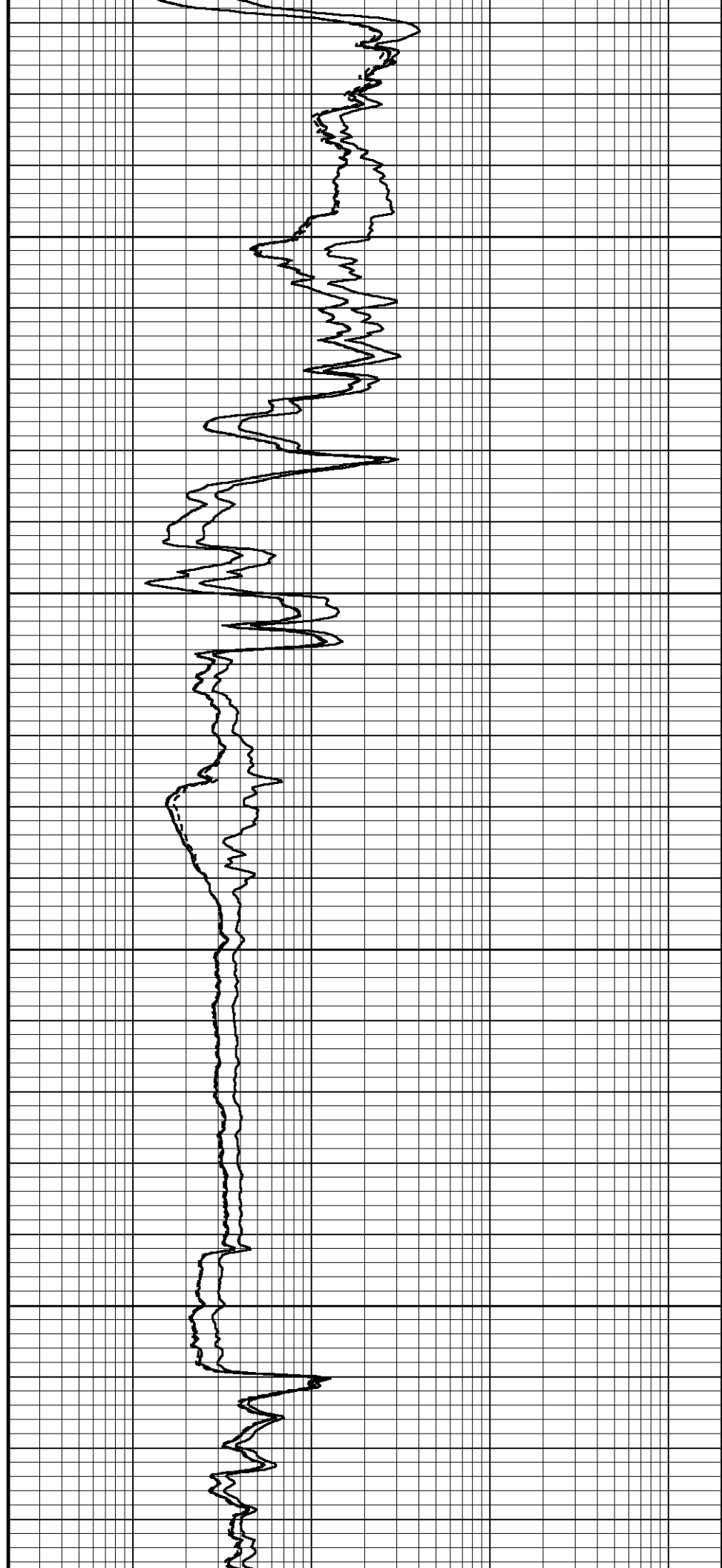
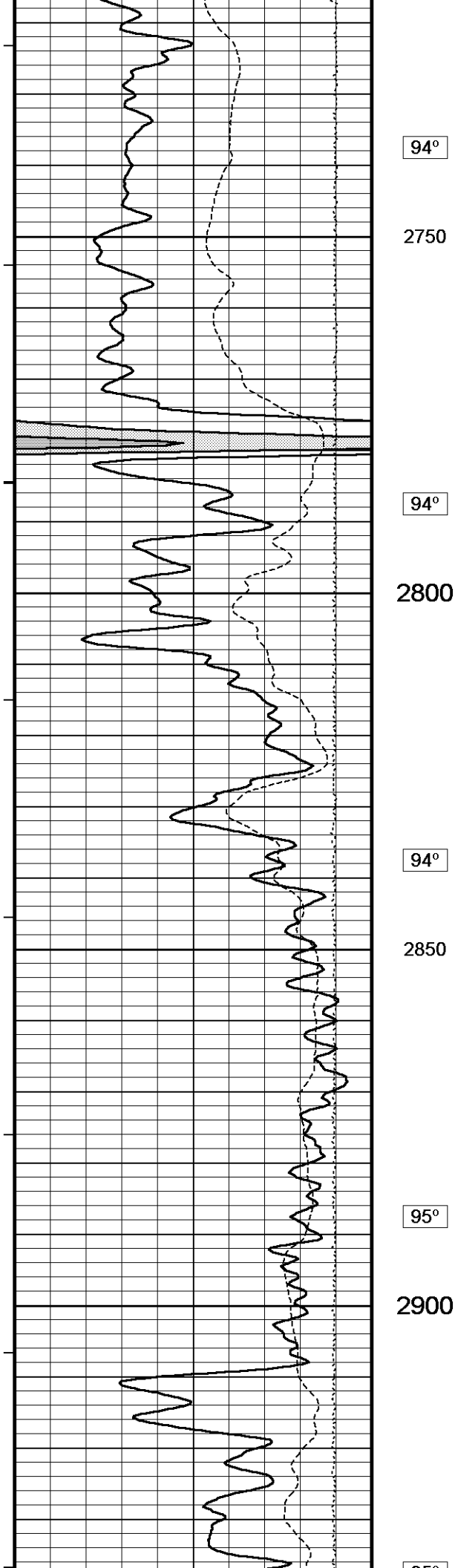
Gamma Ray

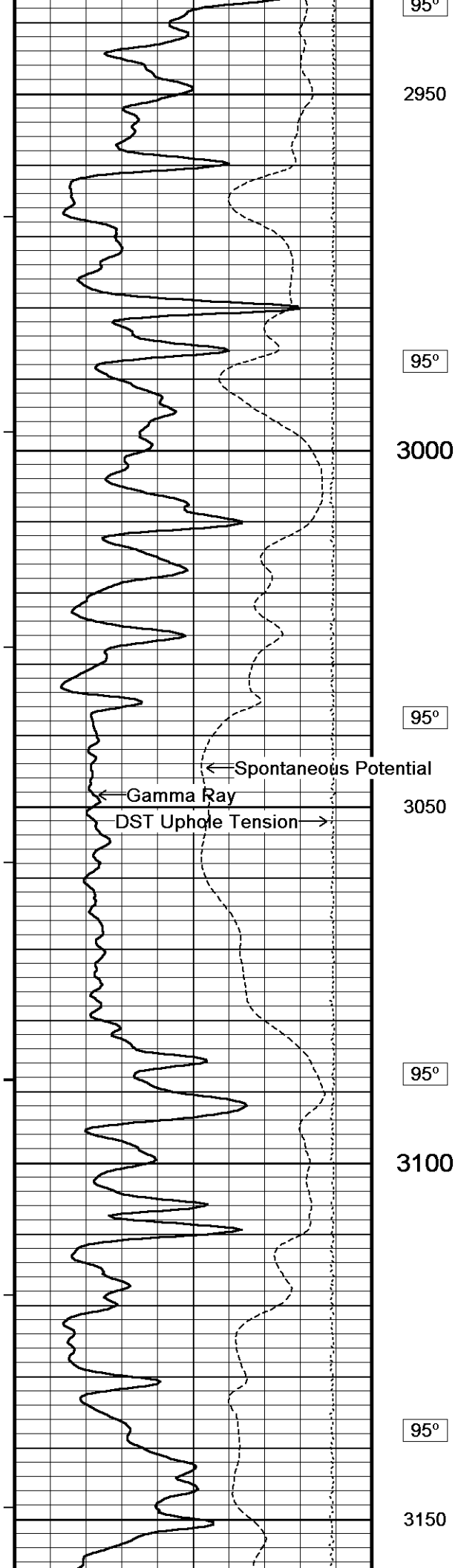
DST Uphole Tension

94°

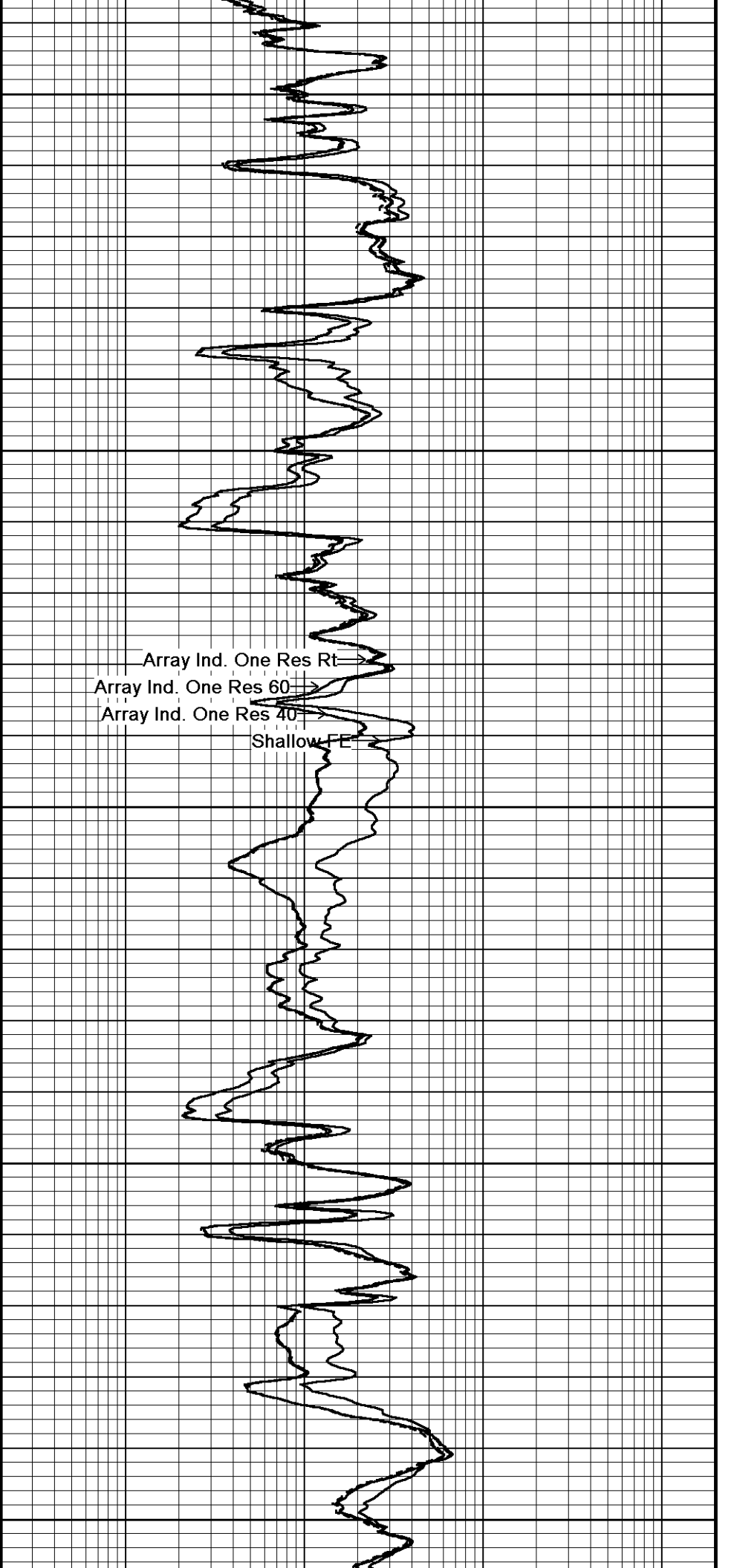
2700



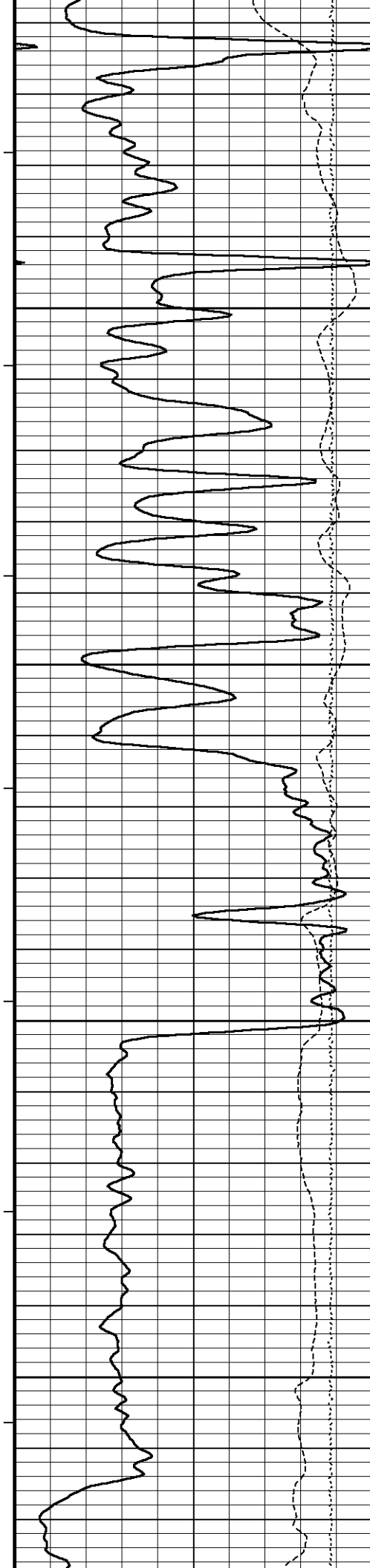




95°
2950
95°
3000
95°
3050
95°
3100
95°
3150



Array Ind. One Res Rt
Array Ind. One Res 60
Array Ind. One Res 40
Shallow Fm



96°

3200

96°

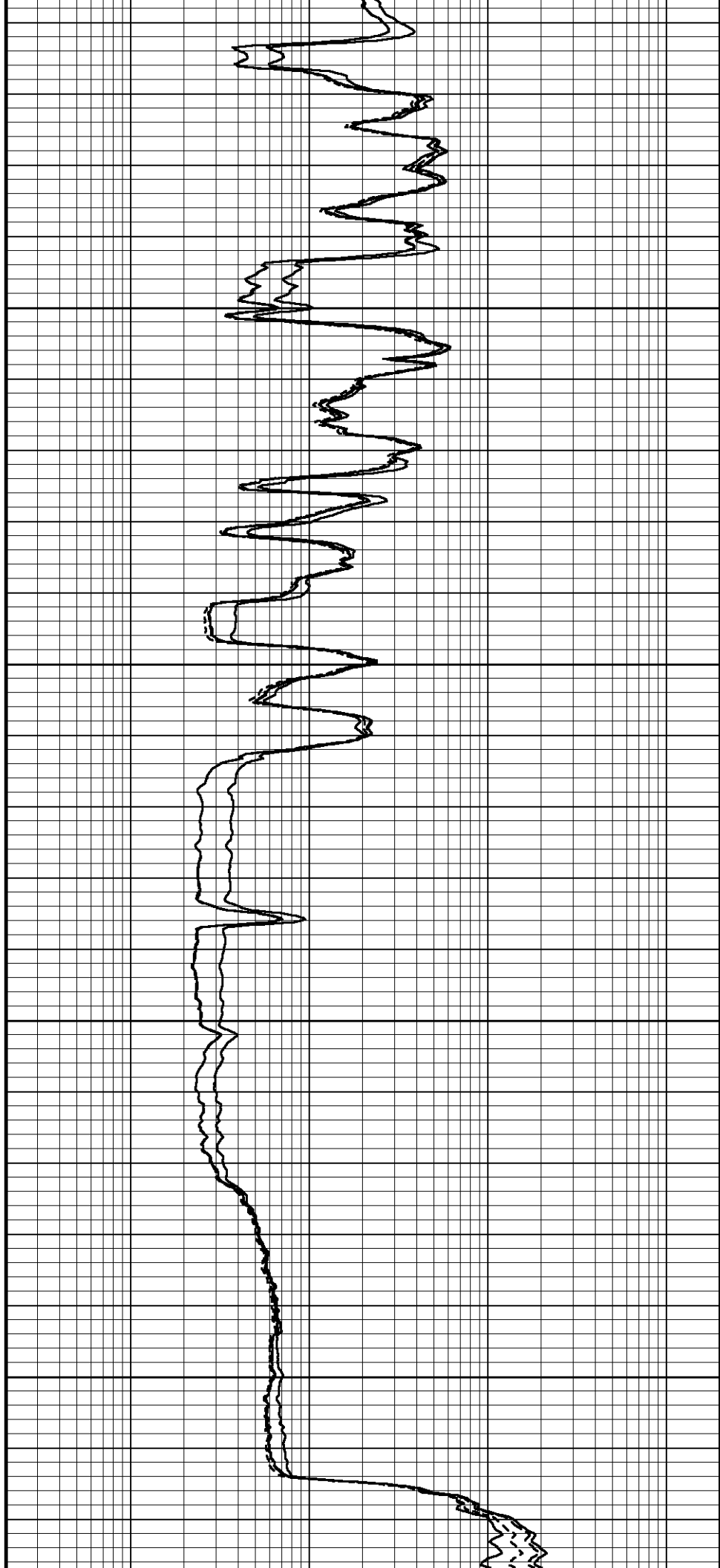
3250

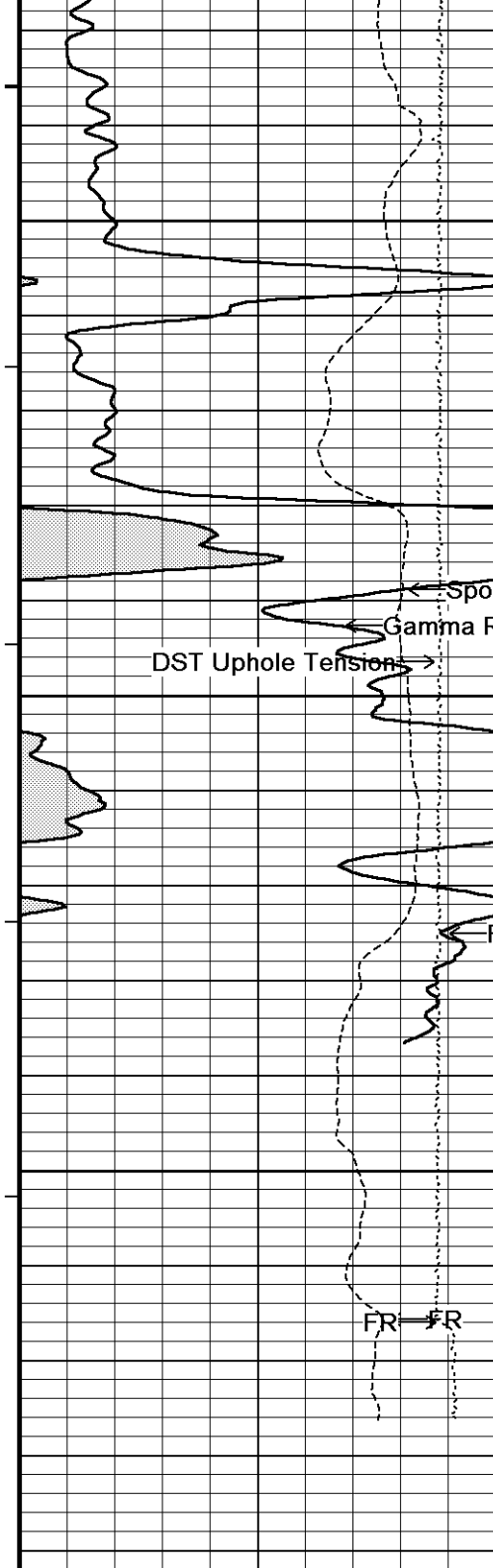
96°

3300

97°

3350





97°

3400

97°

3450

96°

3500

3540

Depth
In
Feet

Borehole
Temp in
deg F

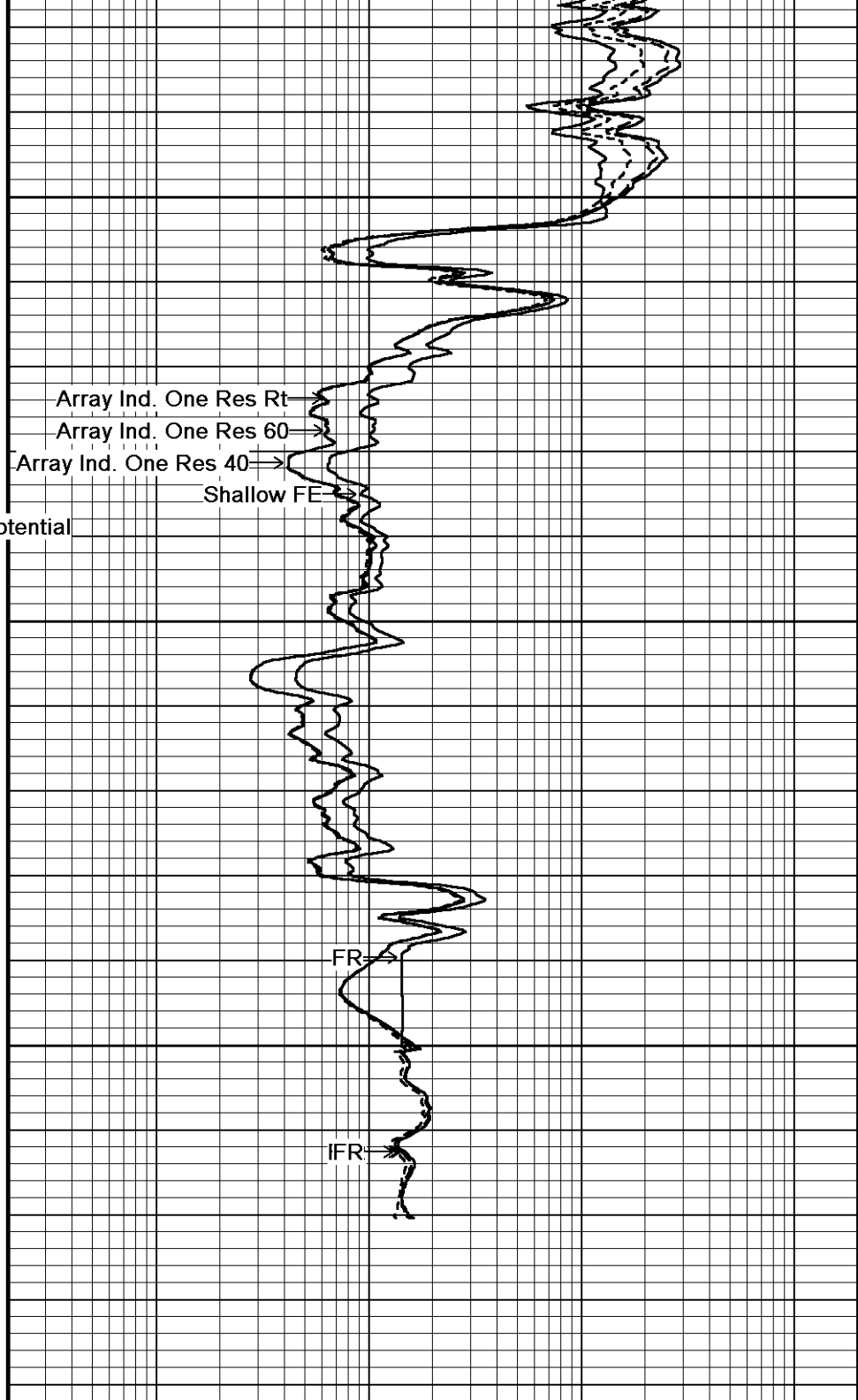
HVI
every
10 cu ft

Annular
Integral
every
10 cu ft

Timing Marks
every 60.0 sec

Gamma Ray
API
0 75 150
150 225 300

Spontaneous Potential
millivolts
--> 20 |<-- +



Array Ind. One Res Rt

Array Ind. One Res 60

Array Ind. One Res 40

Shallow FE

FR

IFR

Shallow FE
ohm metres

Array Ind. One Res 40
ohm metres

Array Ind. One Res 60
ohm metres

0.20

1

10

100

1000

2000

0.20

1

10

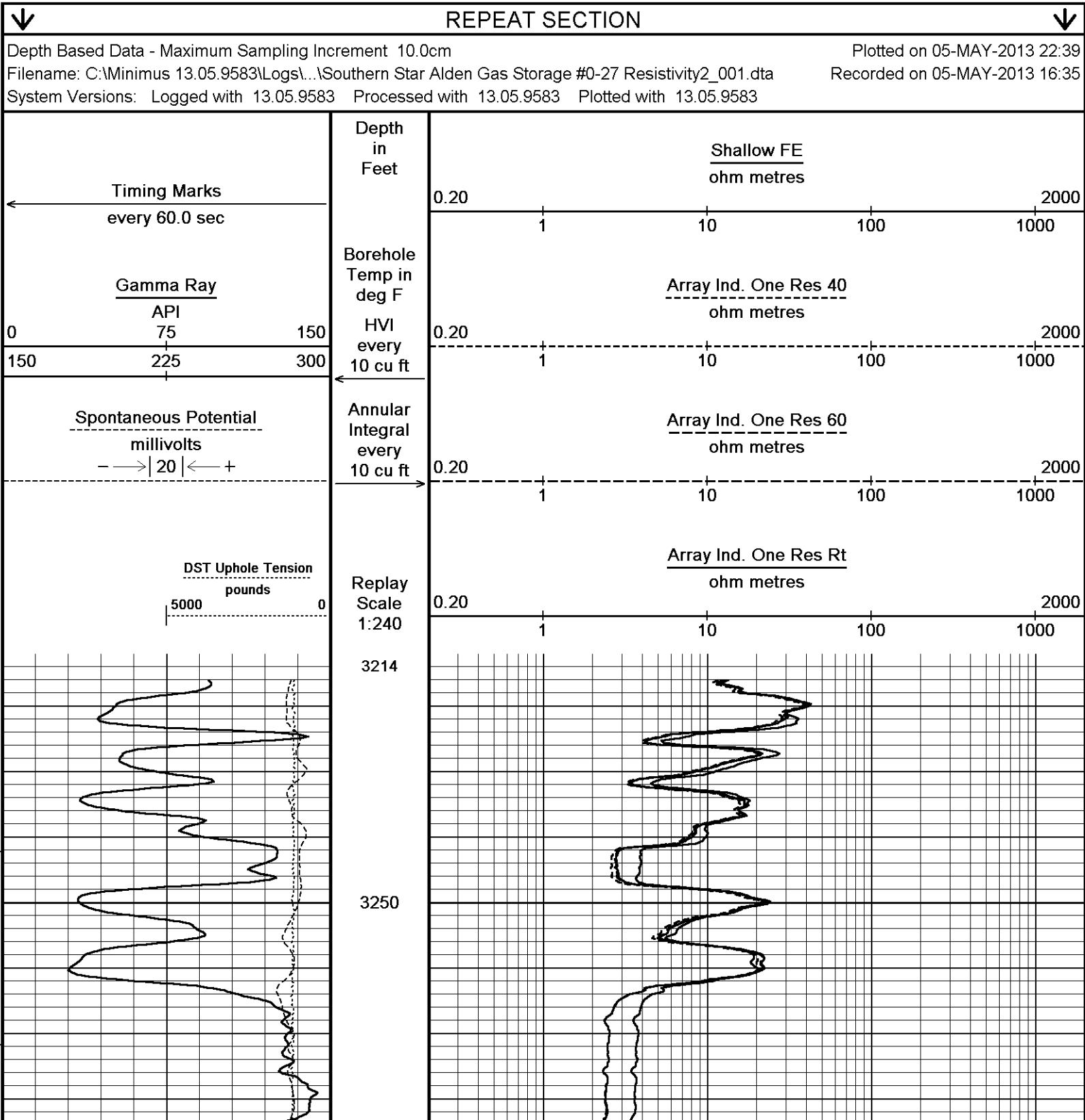
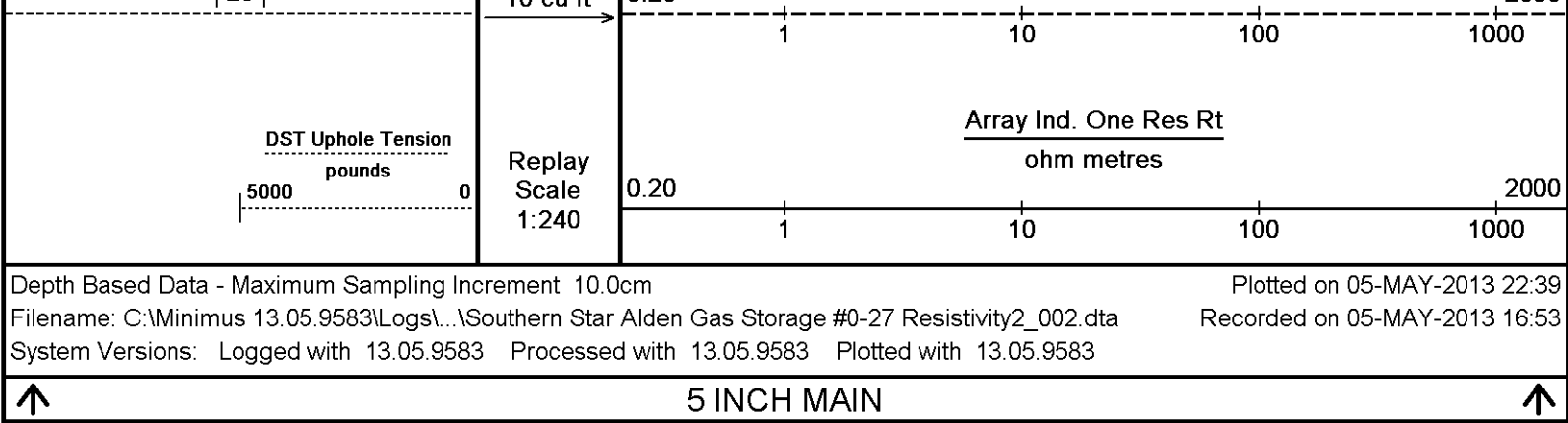
100

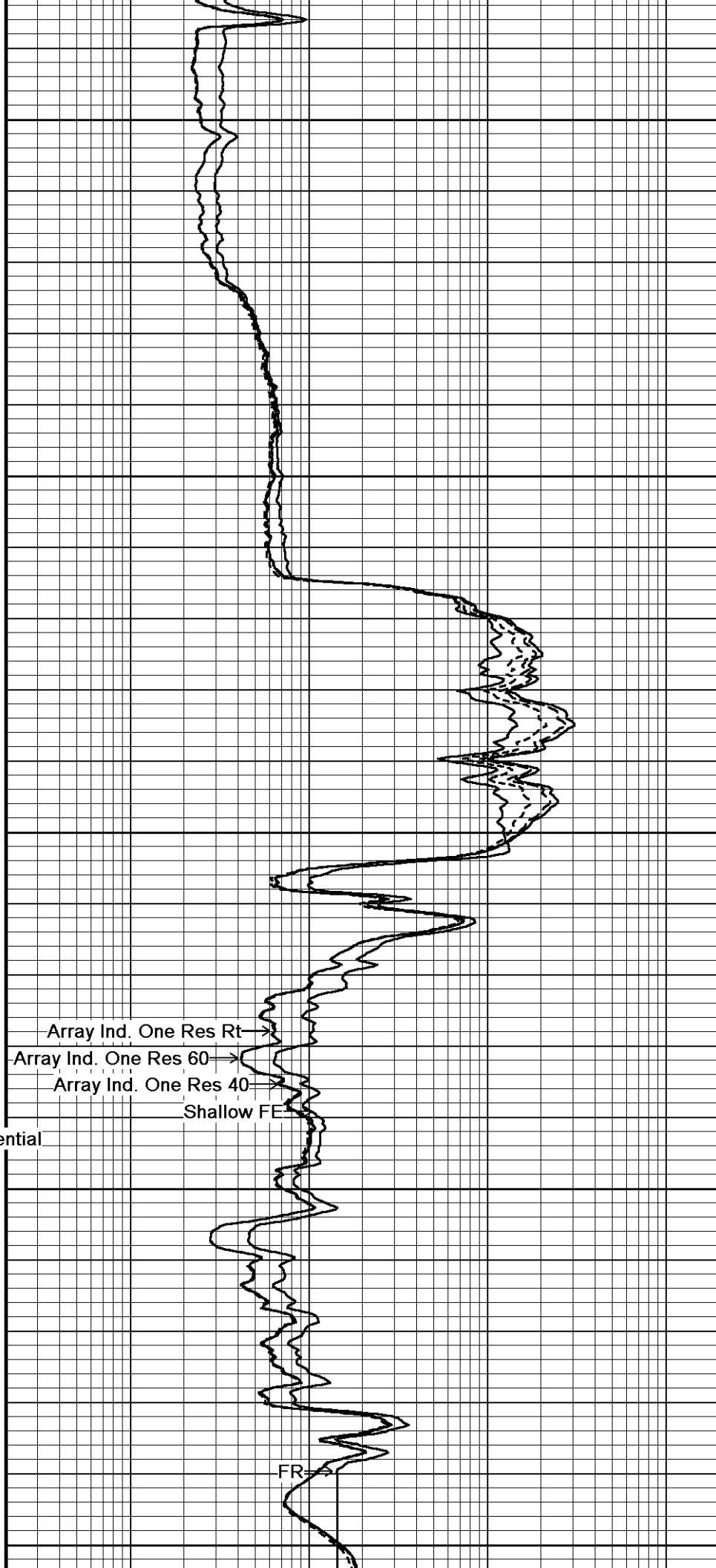
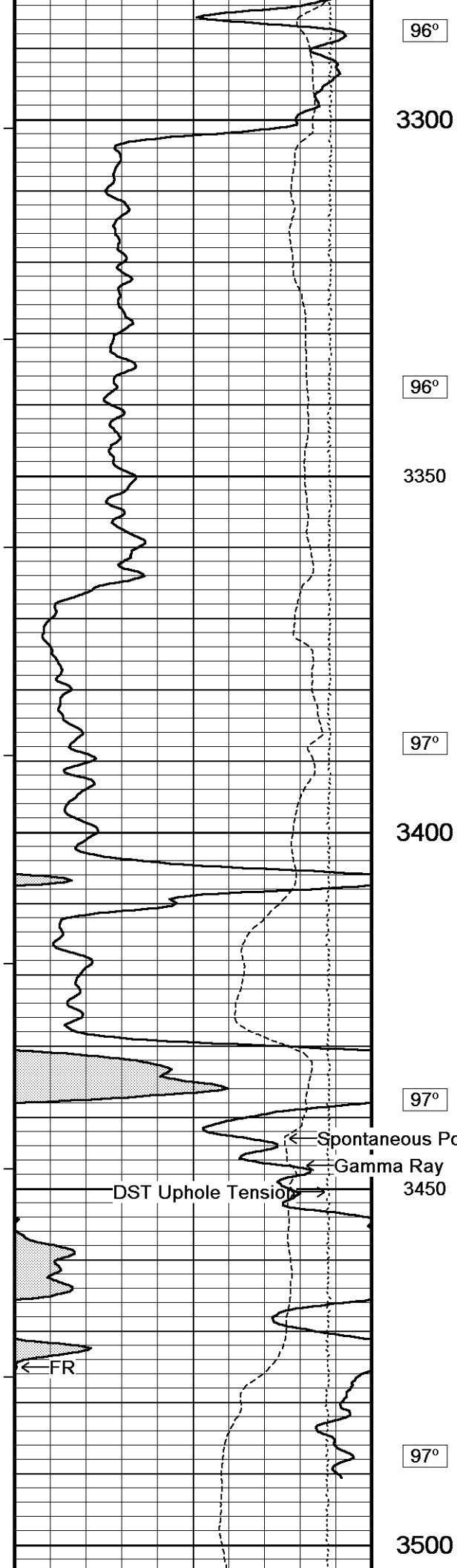
1000

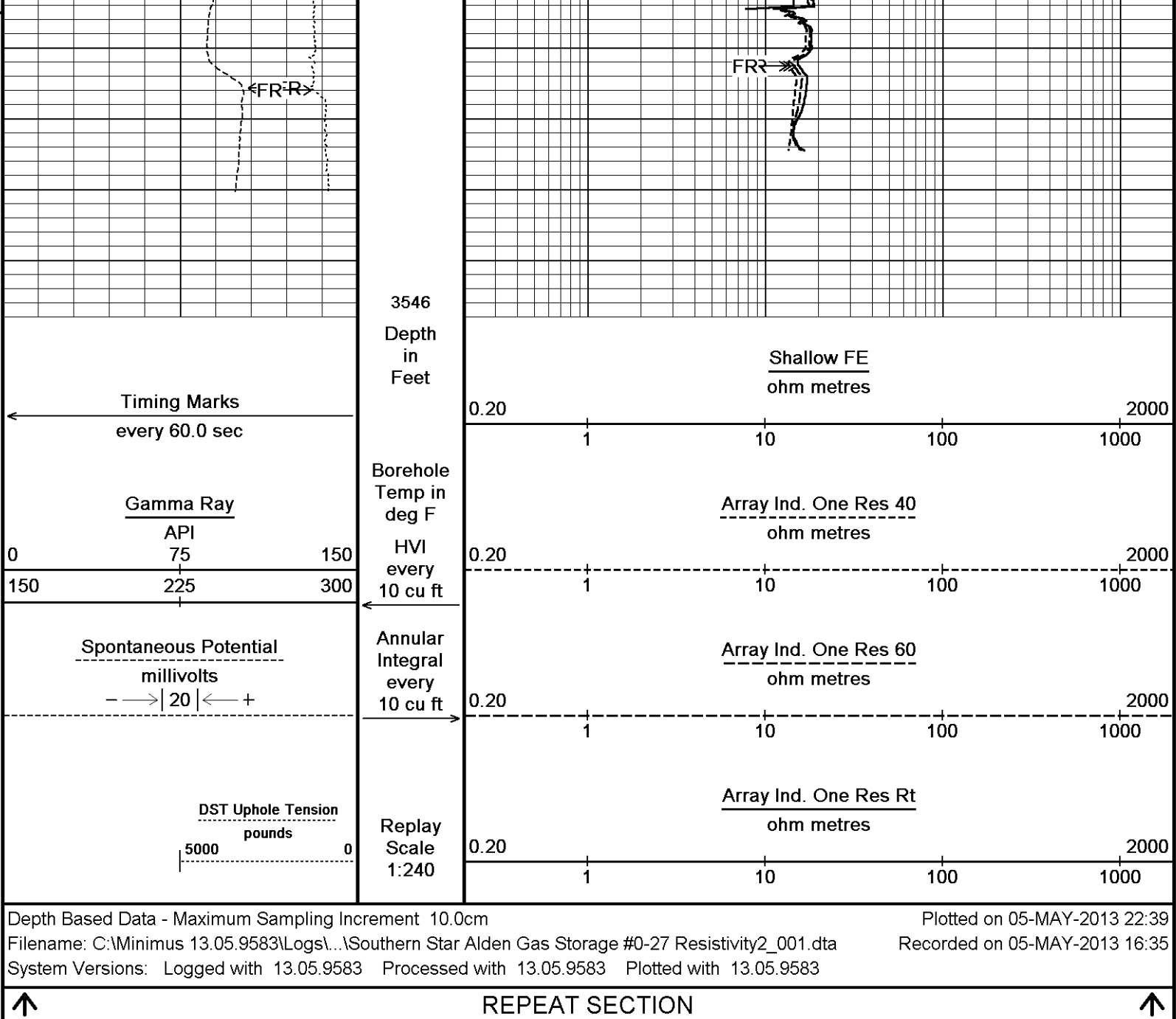
2000

0.20

2000







Depth Based Data - Maximum Sampling Increment 10.0cm
Filename: C:\Minimus 13.05.9583\Logs\Southern Star Alden Gas Storage #0-27 Resistivity2_001.dta
System Versions: Logged with 13.05.9583 Processed with 13.05.9583 Plotted with 13.05.9583

Plotted on 05-MAY-2013 22:39
Recorded on 05-MAY-2013 16:35

BEFORE SURVEY CALIBRATION		
C:\Minimus 13.05.9583\Logs\Southern Star Alden Gas Storage #0-27\Southern Star Alden Gas Storage #0-27 Resistivity2_002.dta		
General Constants All 000		Last Edited on 05-MAY-2013,08:29
General Parameters		
Mud Resistivity	1.080	ohm-metres
Mud Resistivity Temperature	89.000	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	MMR Caliper	
HVOL Caliper 2	N/A	
Annular Volume Diameter	7.000	inches
Caliper for Differential Caliper	MMR Caliper	
Rwa Parameters		
Porosity used	Wyllie Lime. Sonic Por.	
Resistivity used	Array Ind. Six Res Rt	
RWA Constant A	0.610	

RWA Constant M		2.150		
SW/APOR Tool Source		0.000		
High Resolution Temperature Calibration MCG-D.K 442			Field Calibration on 24-APR-2013,09:31	
	Measured	Calibrated(Deg F)		
Lower	50.00	50.00		
Upper	75.00	75.00		
High Resolution Temperature Constants MCG-D.K 442			Last Edited on 05-MAY-2013,08:10	
Pre-filter Length	11			
Gamma Calibration MCG-D.K 442			Field Calibration on 05-MAY-2013 01:40	
	Measured	Calibrated (API)		
Background	72	49		
Calibrator (Gross)	1134	774		
Calibrator (Net)	1061	725		
Gamma Constants MCG-D.K 442			Last Edited on 05-MAY-2013,08:10	
Gamma Calibrator Number	GRC38			
Mud Density	1.13	gm/cc		
Caliper Source for Processing	MMR Caliper			
Tool Position	Eccentred			
Concentration of KCl		kppm		
K Mud Type	Chloride			
K Mud Concentration	0.00	%		
Caliper Calibration MML-A 16			Base Calibration on 17-APR-2013 18:35 Field Calibration on 05-MAY-2013 01:28	
Base Calibration				
Reading No	Measured	Calibrator Size (in)		
1	14233	5.98		
2	17427	7.97		
3	20674	9.86		
4	24554	11.92		
5	0	0.00		
6	N/A	N/A		
Field Calibration				
	Measured Caliper (in)	Actual Caliper (in)		
	6.00	5.98		
FE Calibration MFE-B.J 352			Base Calibration on 17-APR-2013 13:24 Field Check on 05-MAY-2013 01:19	
Base Calibration				
	Measured	Calibrated (ohm-m)		
Reference 1	0.0	0.0		
Reference 2	963.6	126.8		
Base Check		281.5		
Field Check		281.6		
FE Constants MFE-B.J 352			Last Edited on 05-MAY-2013,16:06	
Running Mode	No Sleeve			
MFE K Factor	0.1268			
Caliper Source for FE correction	Bit Size			
Caliper Value for FE correction	N/A	inches		
Rm Source for FE correction	Temperature Corr			
Temp. for Rm Corr.	MCG External Temperature			
Stand-off	0.5	inches		
Induction Calibration MAI-A.A 45			Base Calibration on 26-APR-2013,08:48 Field Check on 05-MAY-2013 01:17	
Base Calibration				
Test Loop Calibration	Measured	Calibrated (mmho/m)		
Channel	Low	High	Low	High
1	14.4	472.6	9.3	966.2
2	5.7	374.0	7.6	821.4
3	3.4	261.2	5.2	566.0

4	2.5	133.9	2.6	279.2
Array Temperature		0.0	Deg F	
Channel	Base Check (mmho/m)		Field Check (mmho/m)	
	Low	High	Low	High
1			18.4	3851.0
2			31.6	3628.9
3			28.6	3049.0
4			18.3	2078.9
Deep			16.1	1910.9
Medium			42.5	4060.1
Shallow			49.4	5482.5
Array Temperature			60.7	Deg F

Induction Constants MAI-A.A 45

Last Edited on 05-MAY-2013,16:06

Induction Model		RtAP-WBM	
Caliper for Borehole Corr.		Bit Size	
Hole Size for Borehole Correction		N/A	inches
Tool Centred		No	
Stand-off Type		Fins	
Stand-off		0.50	inches
Number of Fins on Stand-off		8.0000	
Stand-off Fin Angle		60.00	degrees
Stand-off Fin Width		0.5000	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	

DOWNHOLE EQUIPMENT

C:\Minimus 13.05.9583\Logs\Southern Star Alden Gas Storage #0-27\Southern Star Alden Gas Storage #0-27 Resistivity2_002.dta

3/8" Triple Cone Cable Head (MCB C A)
MCB-C.A 5 LG: 1.58 ft WT: 15.4 lb OD: 2.24 in

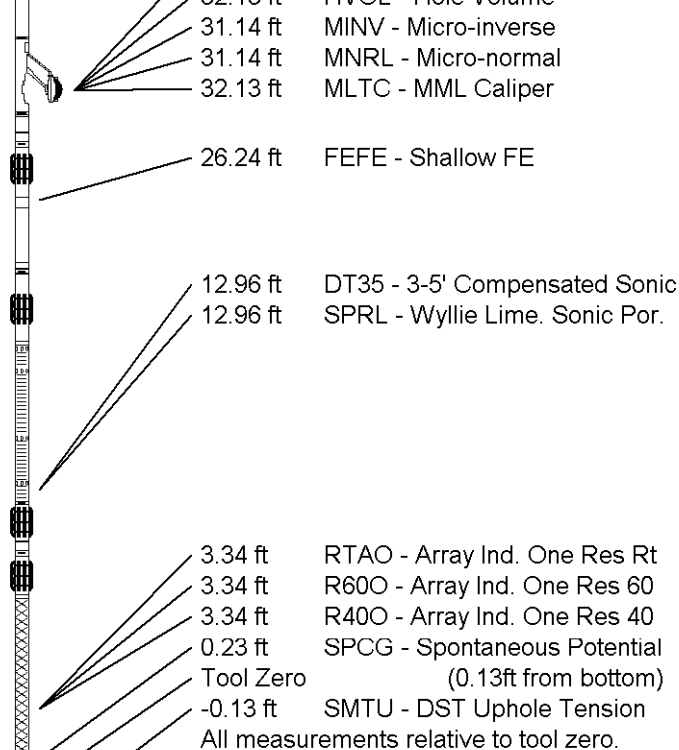
Compact Comms Gamma
MCG-D.K 442 LG: 8.70 ft WT: 63.9 lb OD: 2.24 in

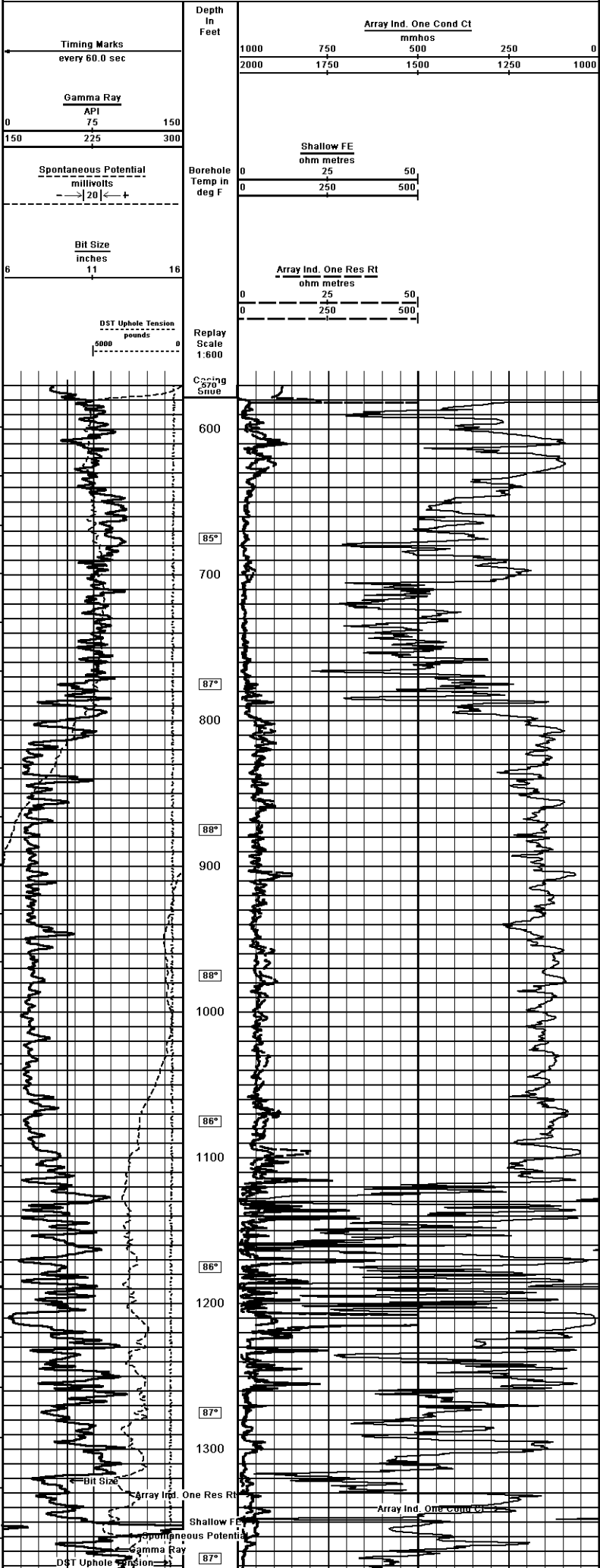
Compact Micro-log
MMI-A 16 LG: 7.97 ft WT: 81.6 lb OD: 2.24 in

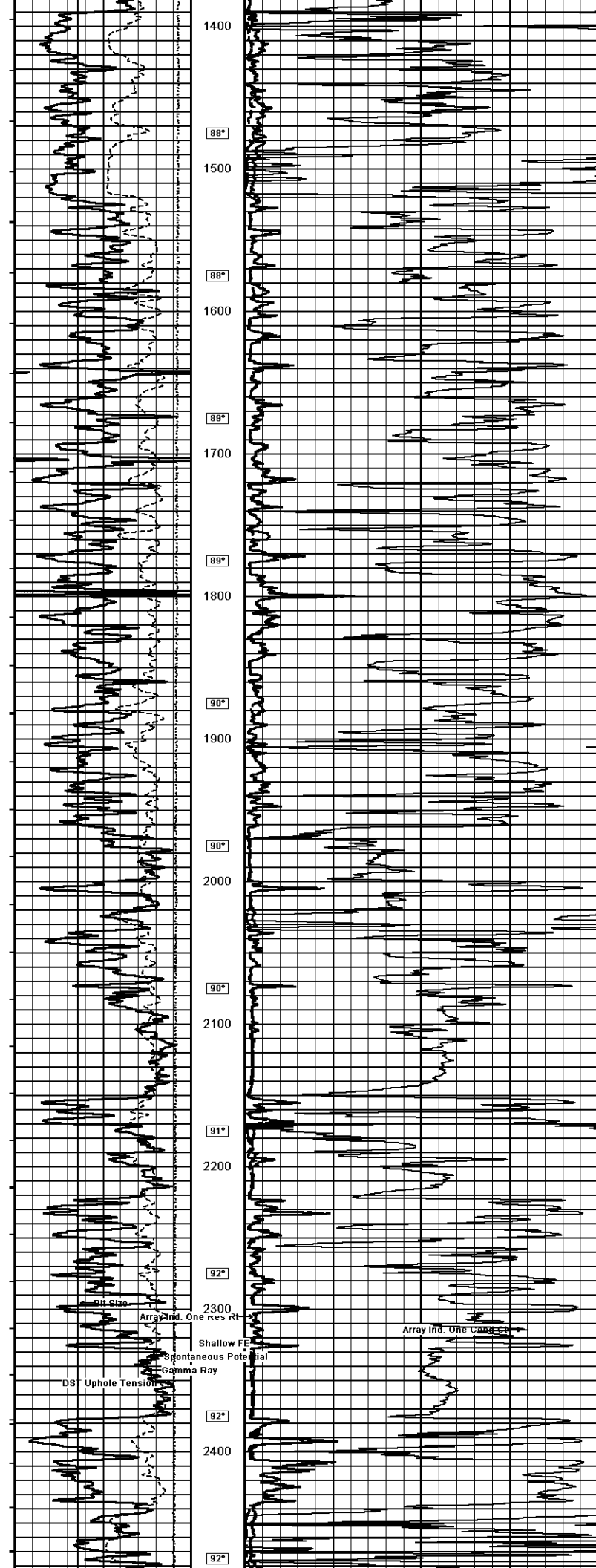


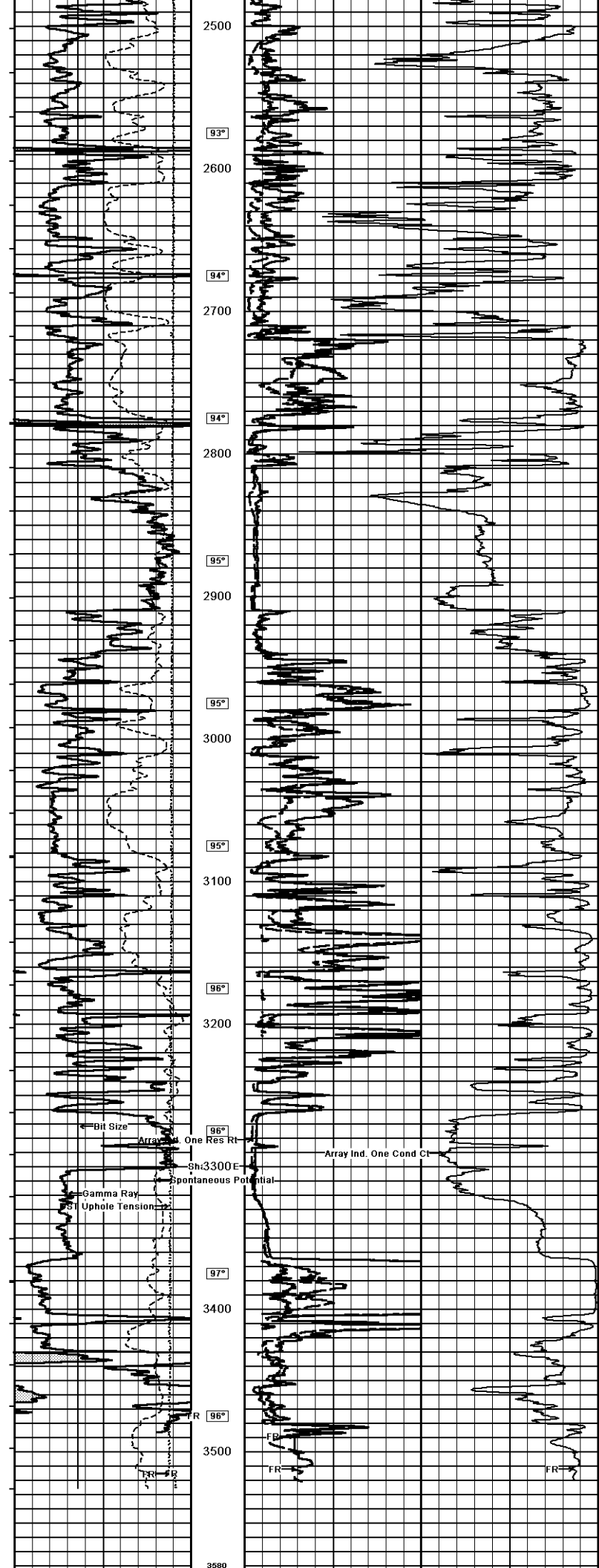
40.76 ft GRGC - Gamma Ray
37.85 ft CGXT - MCG External Temperature

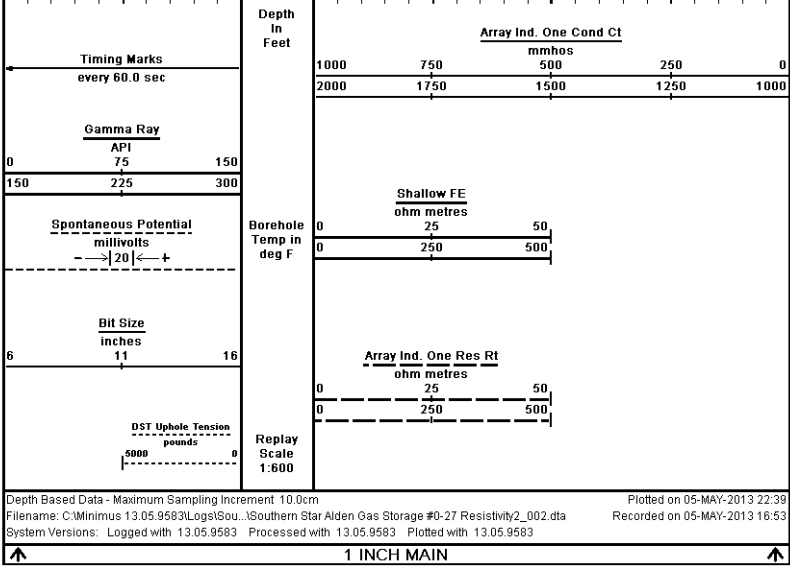
32.13 ft AVOL - Annular Volume
32.13 ft HVOL - Hole Volume











COMPANY		SOUTHERN STAR CENTRAL GAS PIPELINE, INC.			
WELL		ALDEN GAS STORAGE #O-27			
FIELD		ALDEN			
PROVINCE/COUNTY		RICE			
COUNTRY/STATE		U.S.A. / KANSAS			
Elevation Kelly Bushing	1685.00	feet	First Reading	3513.00	feet
Elevation Drill Floor	1684.00	feet	Depth Driller	3520.00	feet
Elevation Ground Level	1672.00	feet	Depth Logger	3516.00	feet
		ARRAY INDUCTION			
Weatherford		SHALLOW FOCUSED			
		ELECTRIC LOG			