



**Weatherford**

ARRAY INDUCTION  
DUAL NEUTRON  
PHOTO-DENSITY

COMPANY

NGL ENERGY PARTNERS

WELL

SOUTH WELD SWD #1

FIELD

WATTENBERG

PROVINCE/COUNTY

WELD COUNTY

COUNTRY/STATE

USACOLORADO

LOCATION

SHL: SWNE 1615 FNL 1713 FEL

SEC 30

TWP 1N

RGE 66W

Other Services

Latitude

40.025060

Longitude

-104.816540

API Number

05-123-47682

Permanent Datum GL, Elevation 4952 feet

Log Measured From KB, 25.00 feet above Permanent Datum

Drilling Measured From KB

15-FEB-2019

Run Number 2

Service Order 2938-234754042

Depth Driller

11040.00

feet

Depth Logger

11036.00

feet

First Reading

11030.82

feet

Last Reading

9161.00

feet

Casing Driller

9162.00

feet

Casing Logger

9161.00

feet

Bit Size

6.750

inches

Hole Fluid Type

WBM

Density / Viscosity

8.70

lb/USg

37.00

sec/qt

PH / Fluid Loss

8.70

8.30

ml/30Min

Sample Source

FLOWLINE

Rm @ Measured Temp

0.36 @ 75.0

ohm-m

Rmf @ Measured Temp

0.27 @ 75.0

ohm-m

Rmc @ Measured Temp

0.45 @ 75.0

ohm-m

Source Rmf / Rmc

CALC

CALC

Rm @ BHT

0.099 @288.0

ohm-m

Time Since Circulation

12 HRS

Max Recorded Temp

288.00

deg F

Equipment / Base

13173

CASPER

Recorded By

ARBER CUKU

Witnessed By

WILLIAM GACHES

RIG

PATTERSON 346

## BOREHOLE RECORD

Last Edited: 15-FEB-2019 20:40

Bit Size  
inches

9.875

6.750

Depth From  
feet

1235.00

9166.00

Depth To  
feet

9166.00

11040.00

## CASING RECORD

Type

Size  
inches

10.750

7.625

Depth From  
feet

0.00

0.00

Shoe Depth  
feet

1235.00

9162.00

Weight  
pounds/ft

40.50

29.70

## REMARKS

TOOL STRING RUN AS PER THE TOOL STRING DIAGRAM.

TOOLSTRING CONFIGURED FOR VERTICAL AND LOW DEVIATION TRAJECTORY.

PRIMARY SERVICES ACQUIRED:

MCG: GAMMA RAY

MDN: DUAL SPACED NEUTRON

MPD: PHOTO-DENSITY

MAI - MFE: ARRAY INDUCTION

HARDWARE USED:

MPD: 4 inch PROFILE PLATE

MPD: 0.5" STANDOFF OFFSET FOR TOOLS BELOW.

MMR: CALIPER ARM FOR DECENTRALIZATION ABOVE MDN.

MVC: USED FOR DECENTRALIZATION ABOVE MPD

MAI: 0.5" SPRING STANDOFF ASSEMBLY ON BOTTOM

2.68 G/CC MATRIX DENSITY USED TO CALCULATE POROSITY.

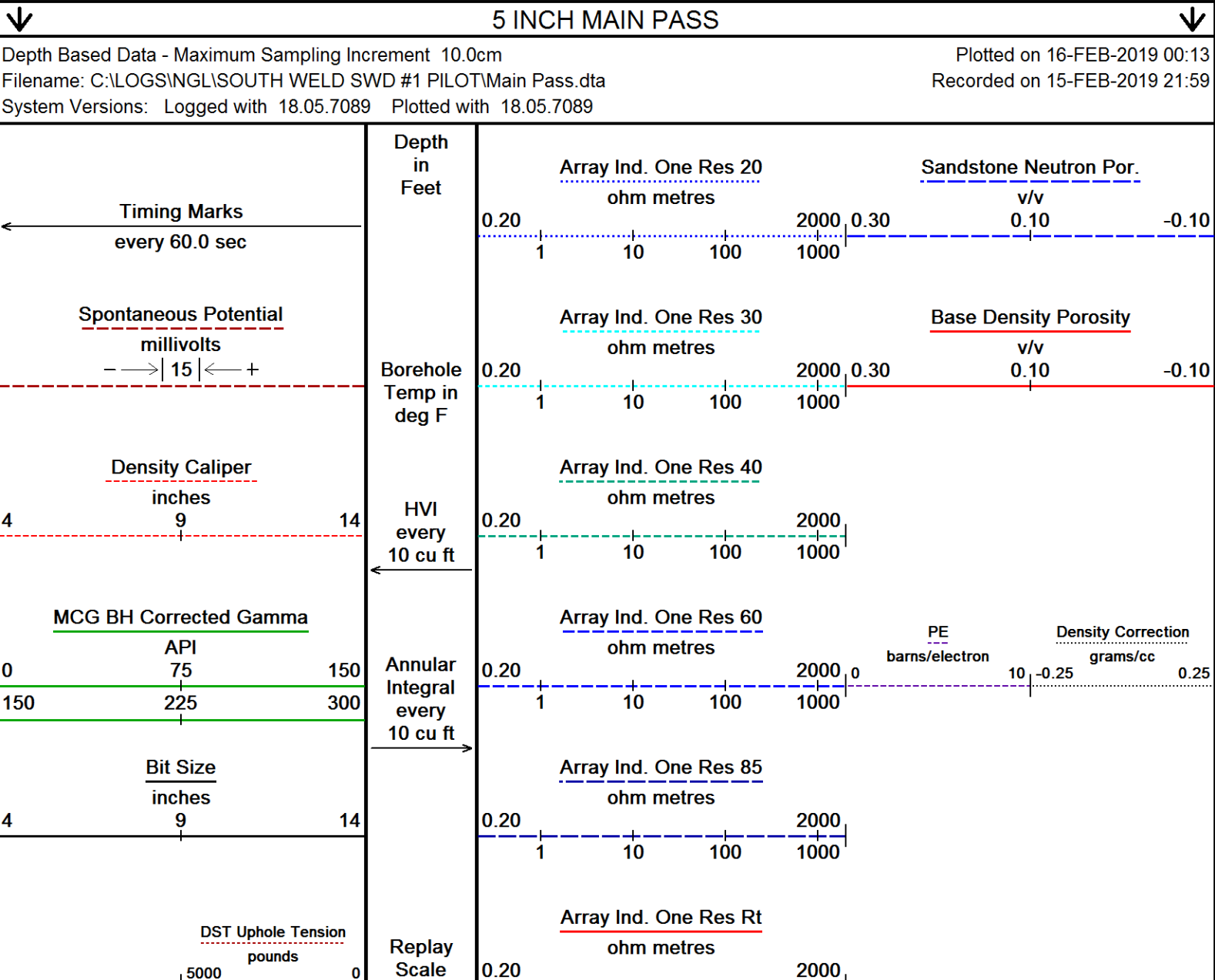
THIS IS THE SECOND RUN IN THIS WELL. LOG CORRELATED WITH THE FIRST "TRIPLE COMBO" LOG ON INTERMEDIATE SECTION LOGGED BY WEATHERFORD ON 04-FEB-2019.

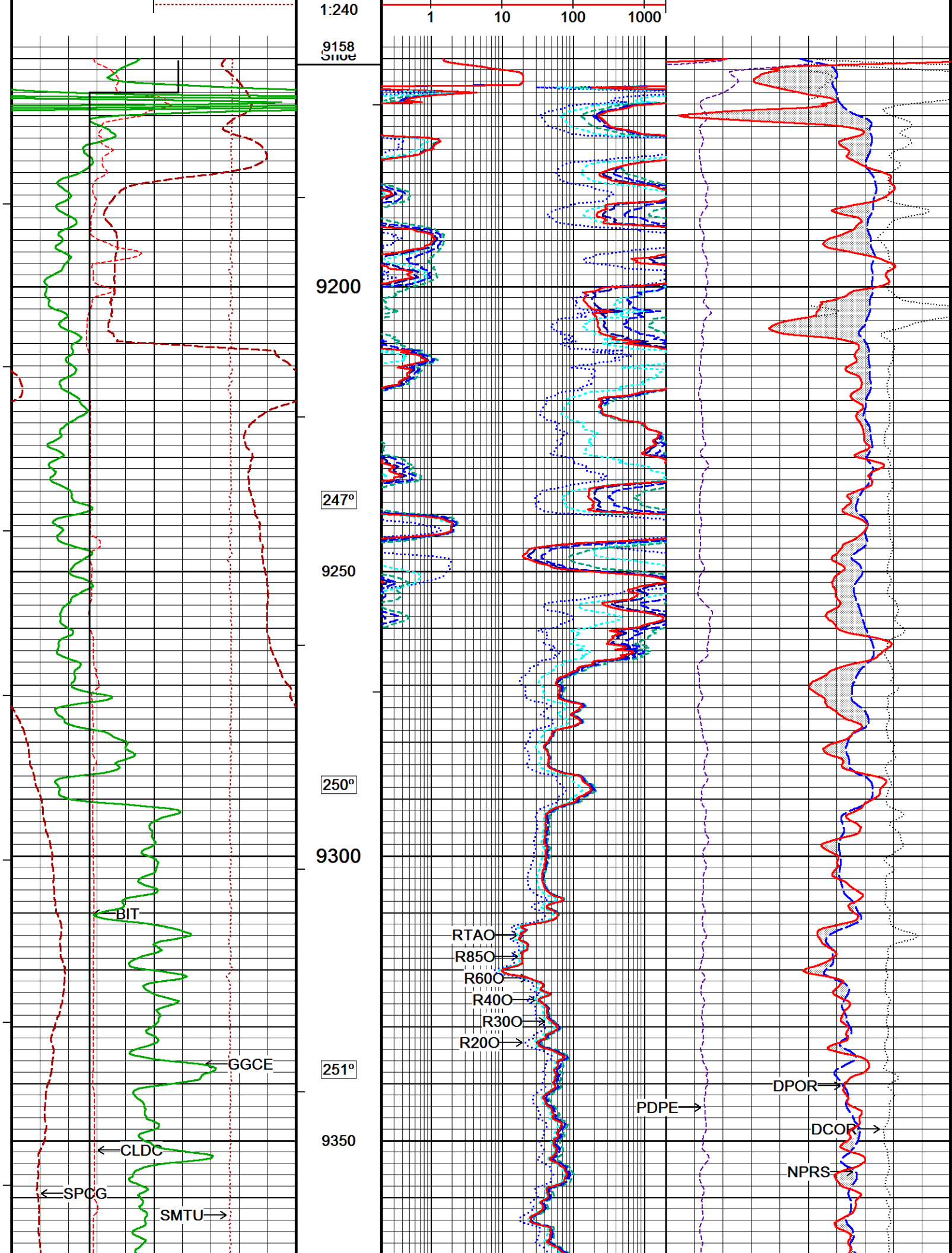
BOREHOLE WASHOUTS AFFECT DENSITY CORRECTION IN INTERVALS: (11036 ft - 10490 ft), (9208 ft - 9161 ft).

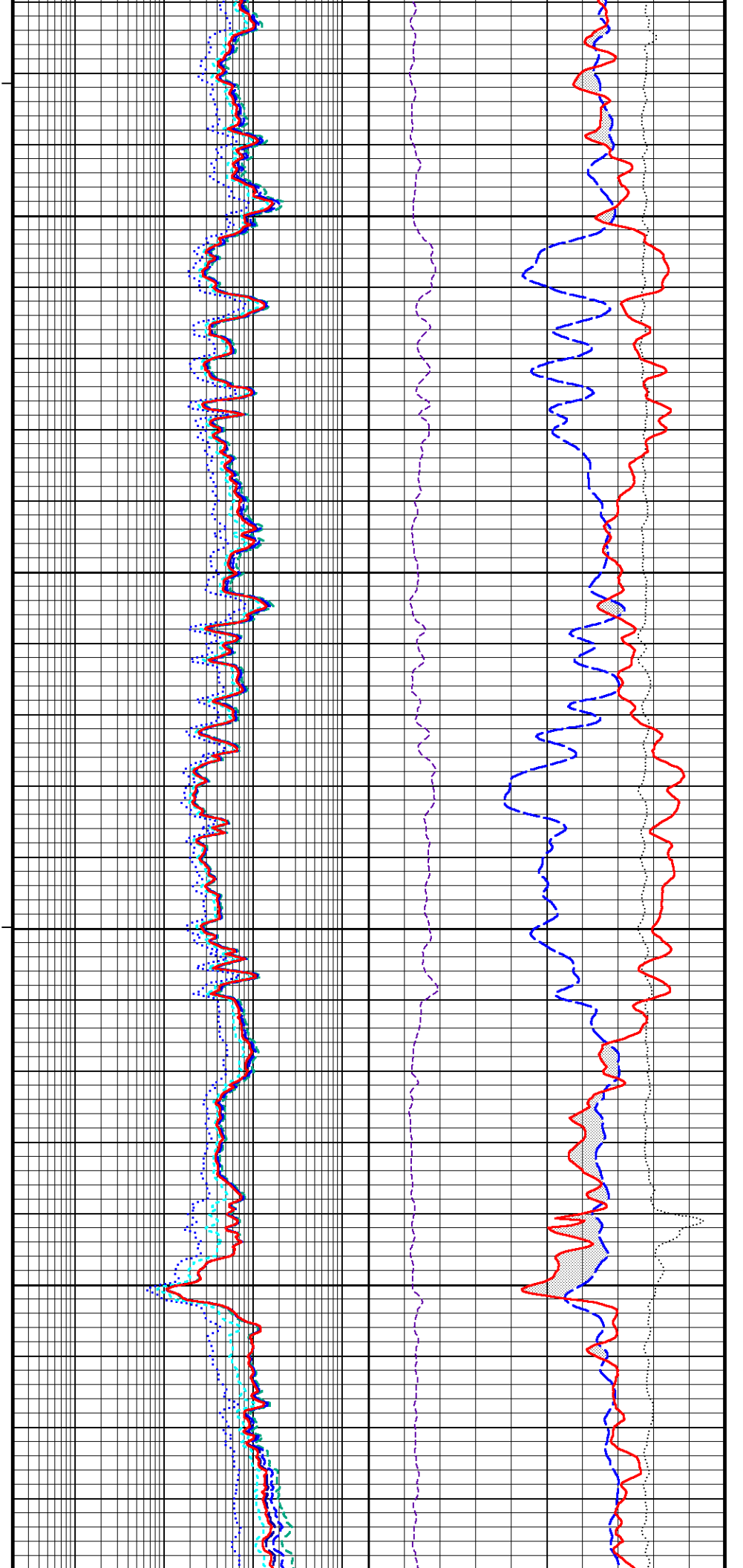
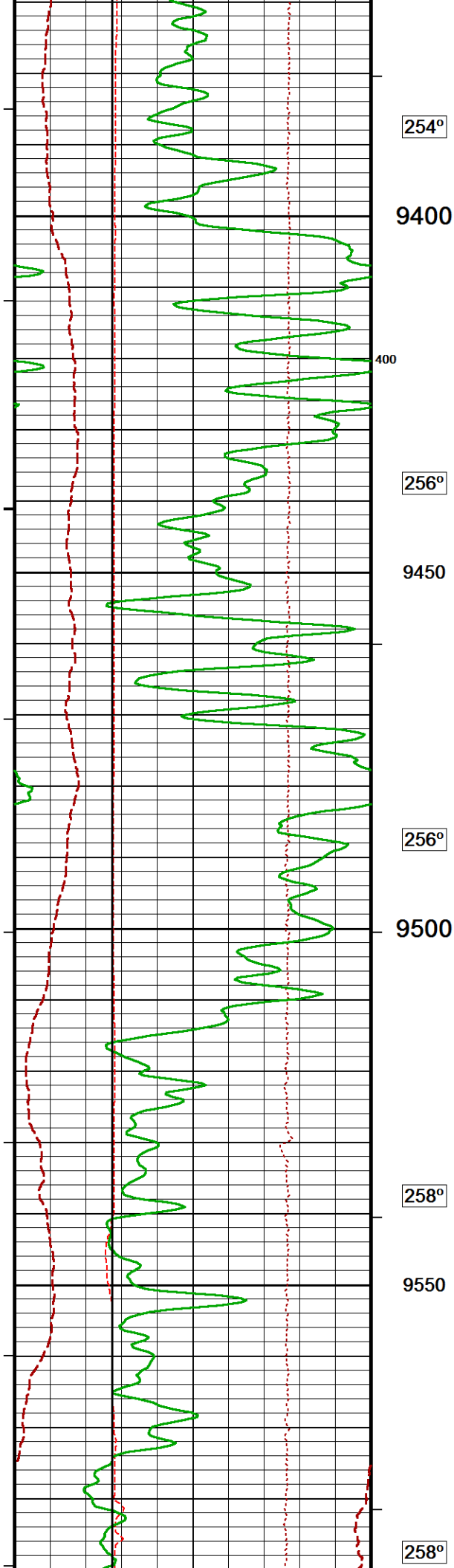
ANNULAR HOLE VOLUME CALCULATED FOR FUTURE CASING SIZE OF 5.5 inches.

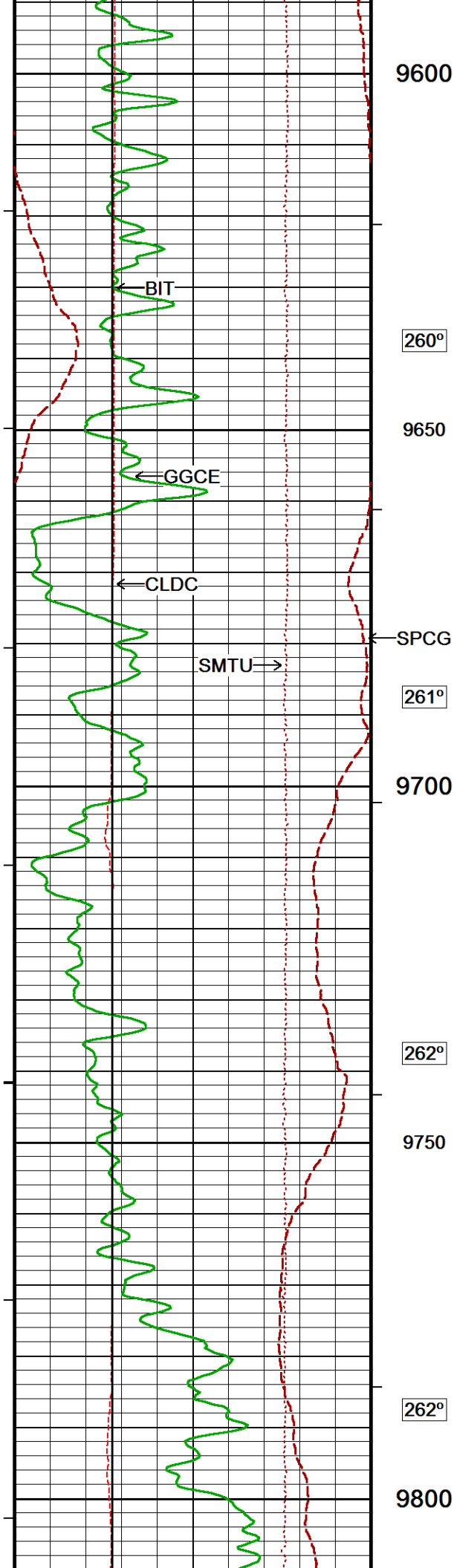
HOLE AND ANNULAR HOLE VOLUME CALCULATED FROM DENSITY CALIPER MEASUREMENTS.

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.









9600

260°

9650

261°

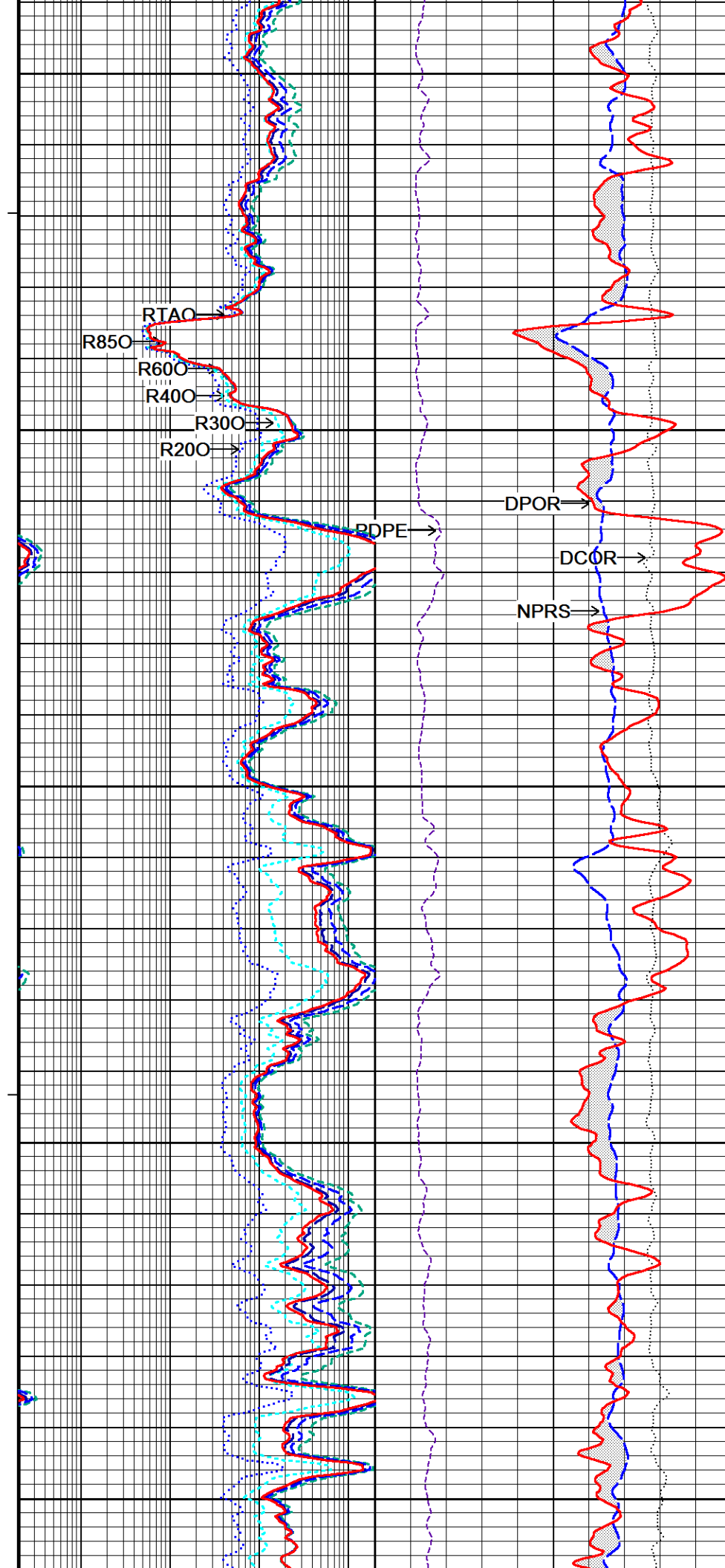
9700

262°

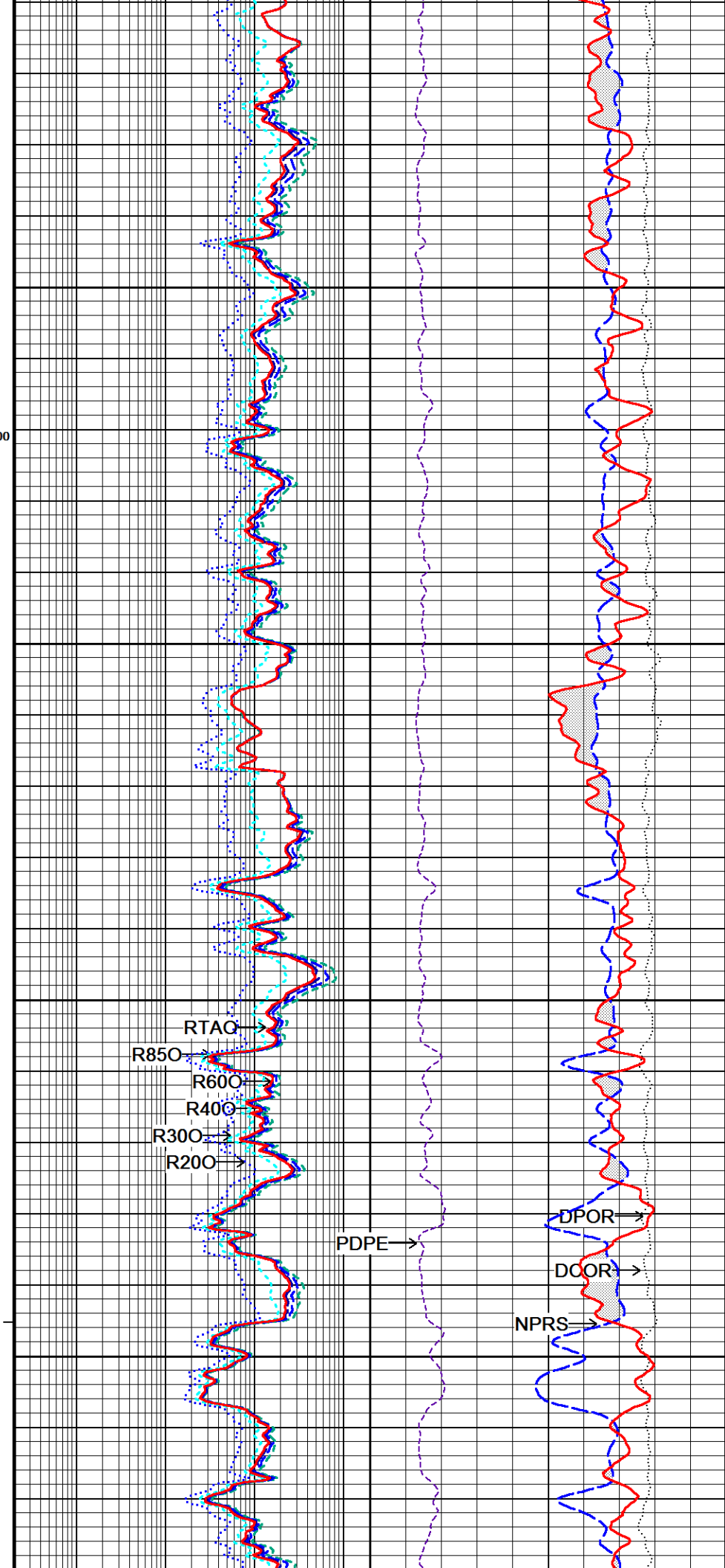
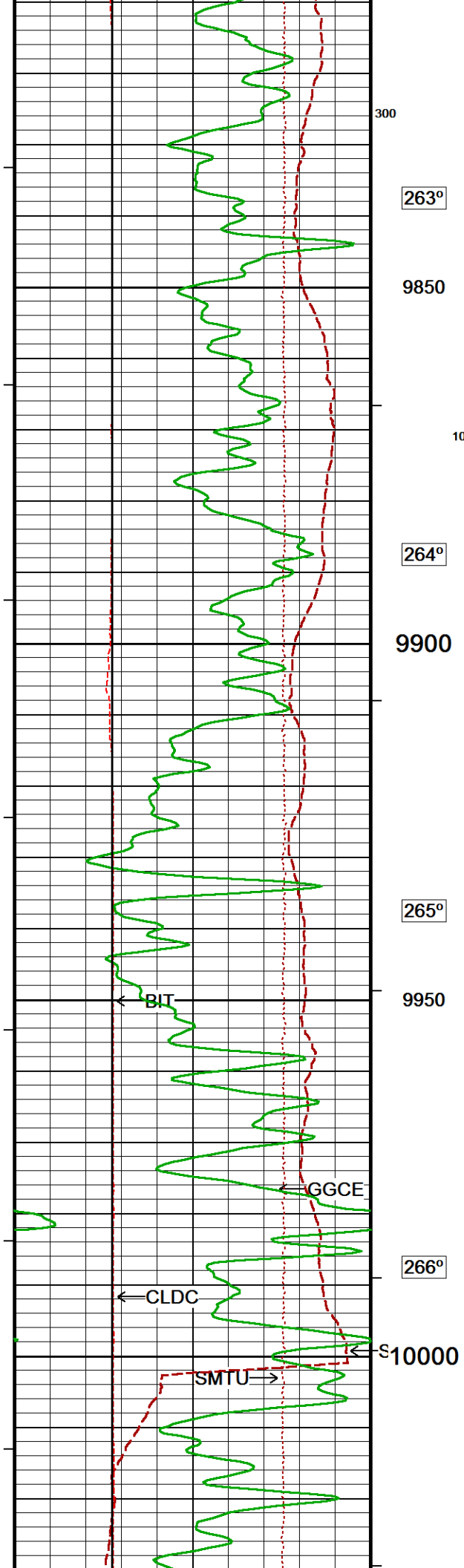
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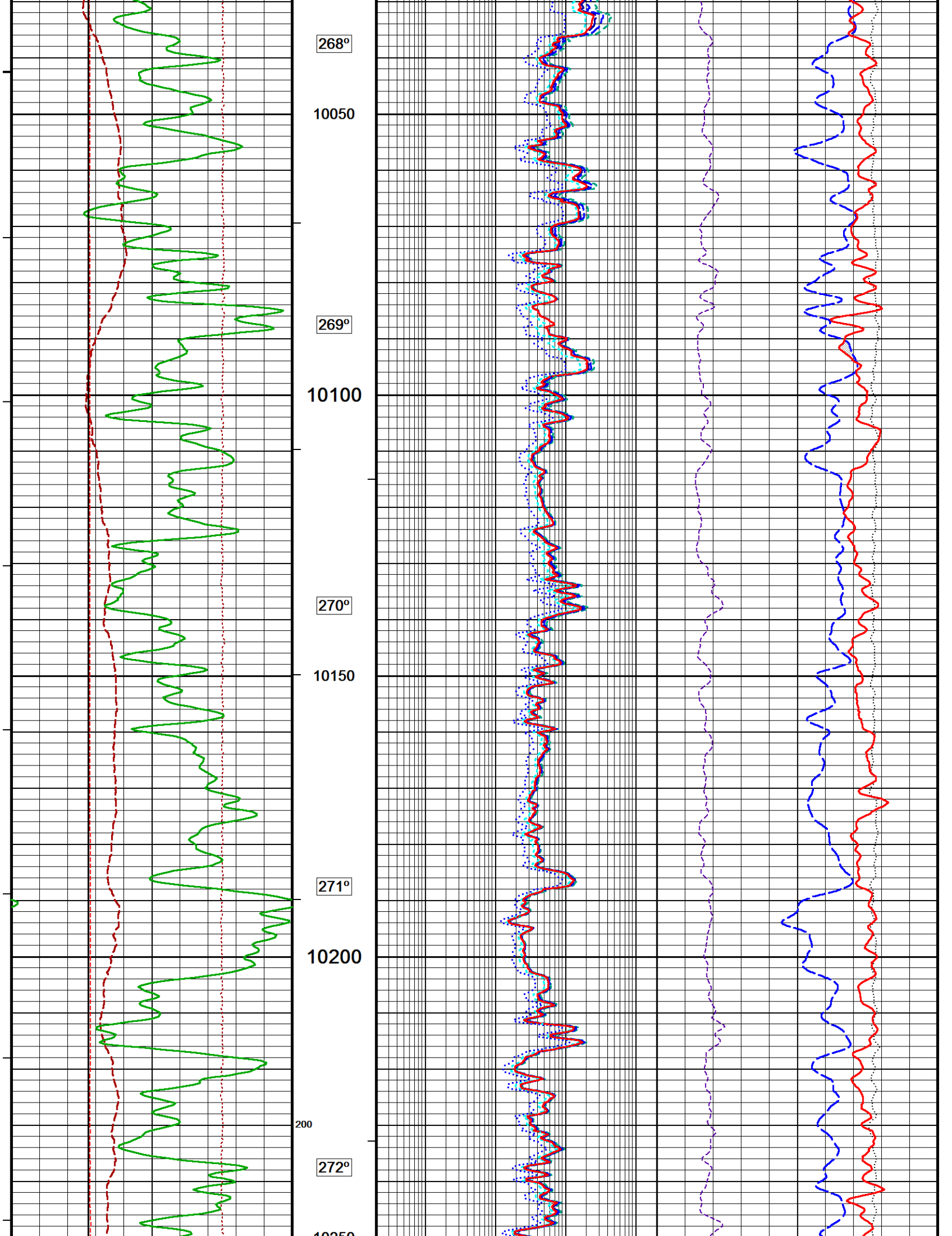
262°

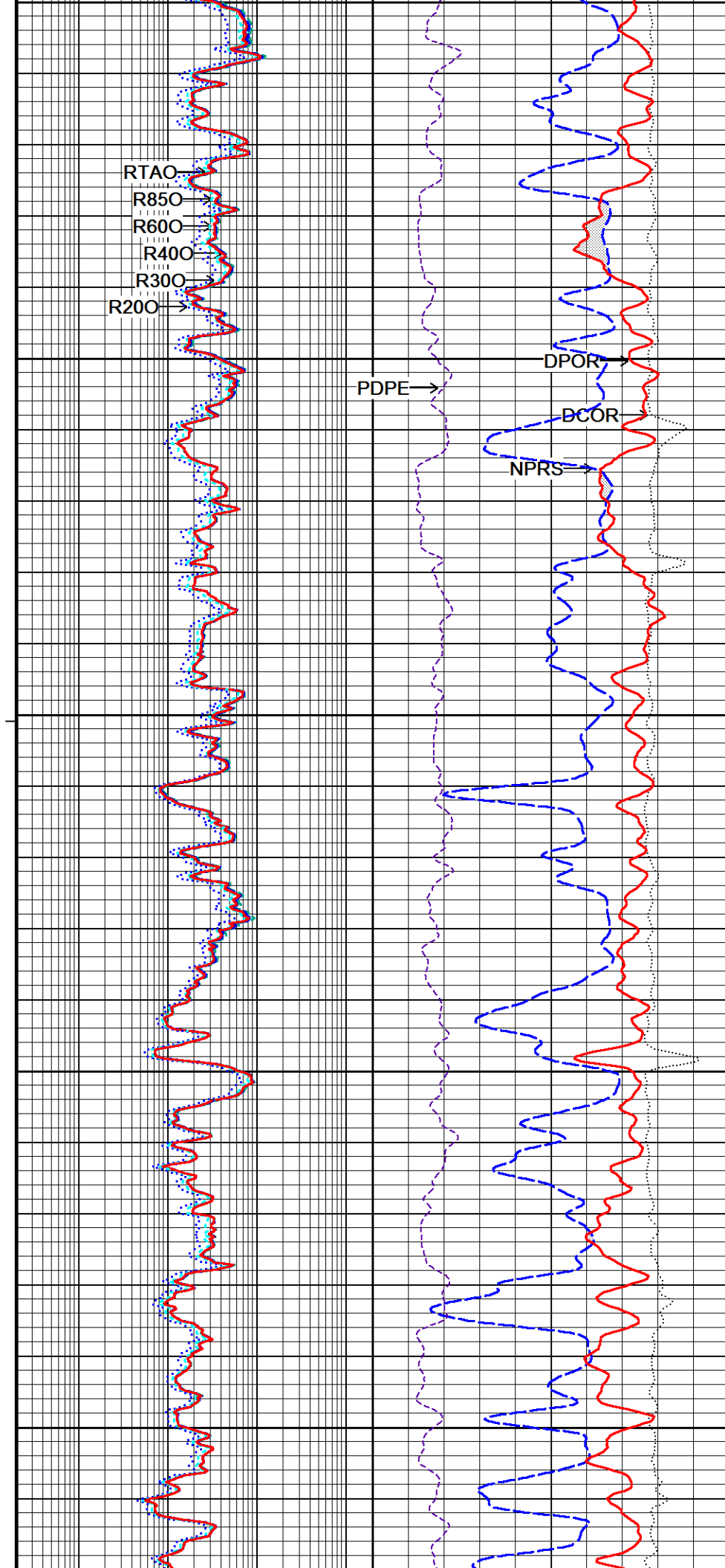
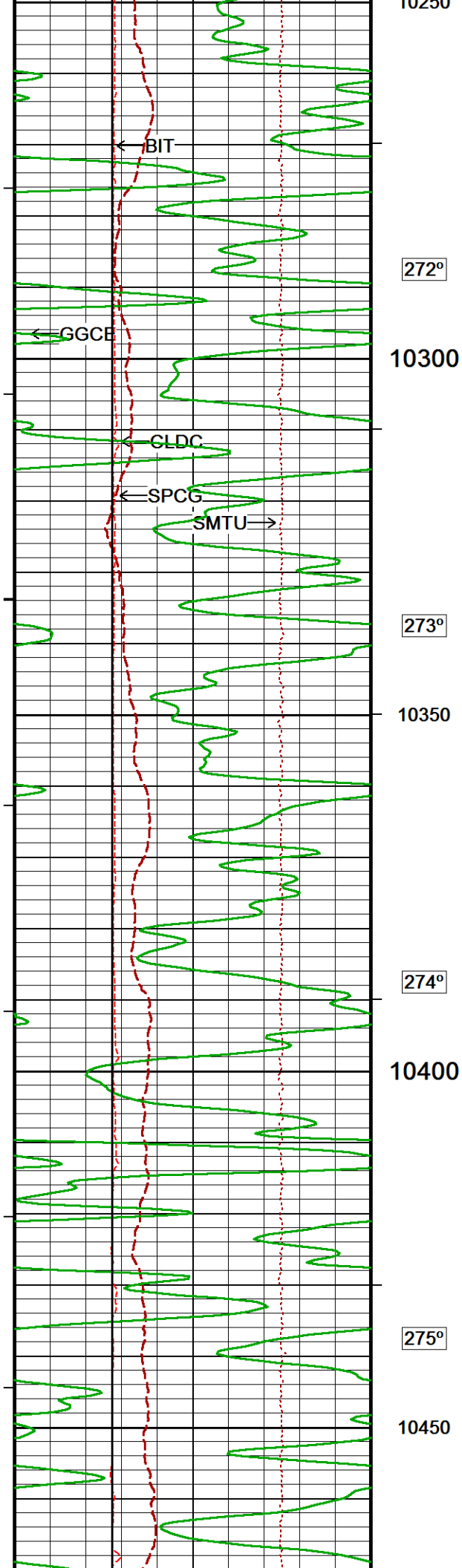
9800



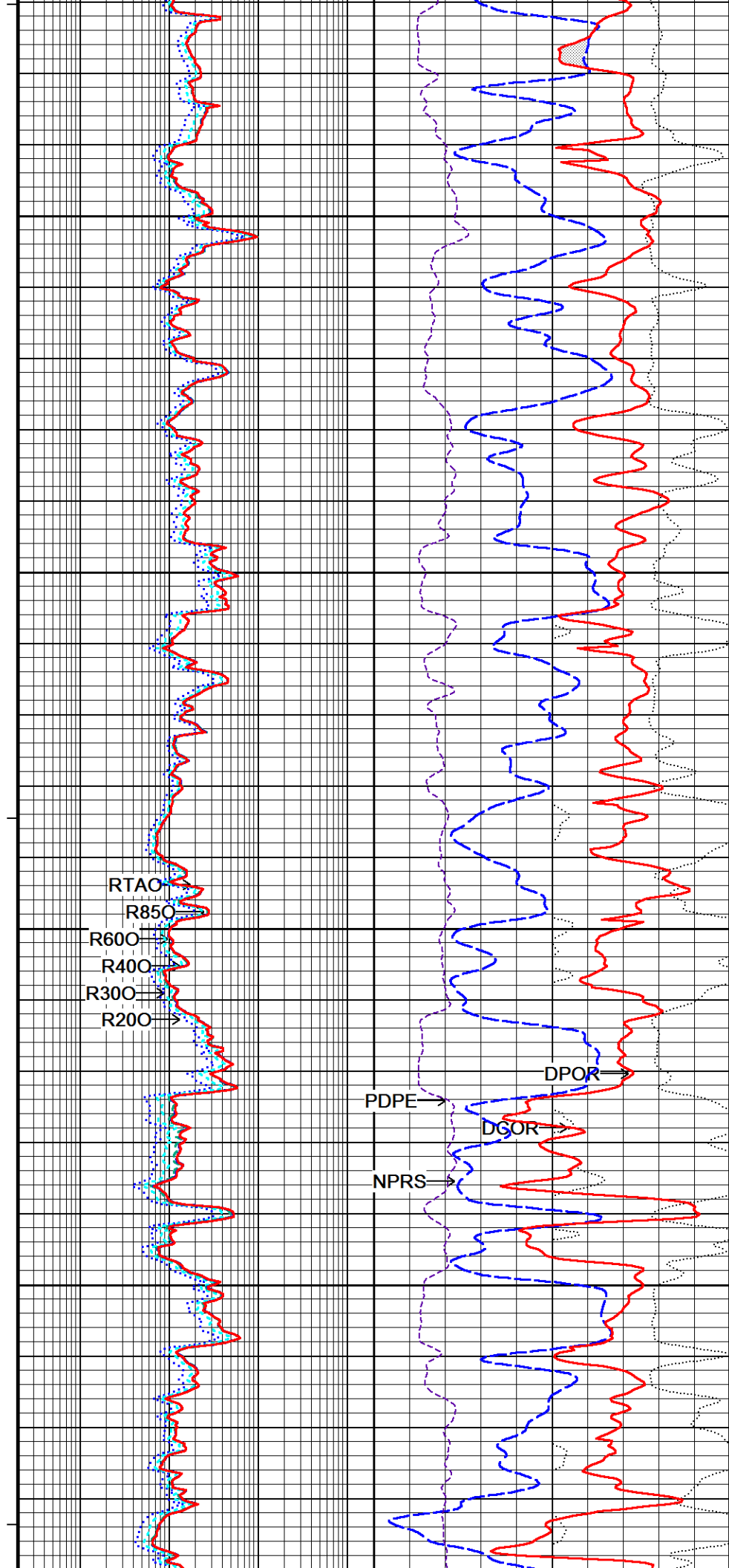
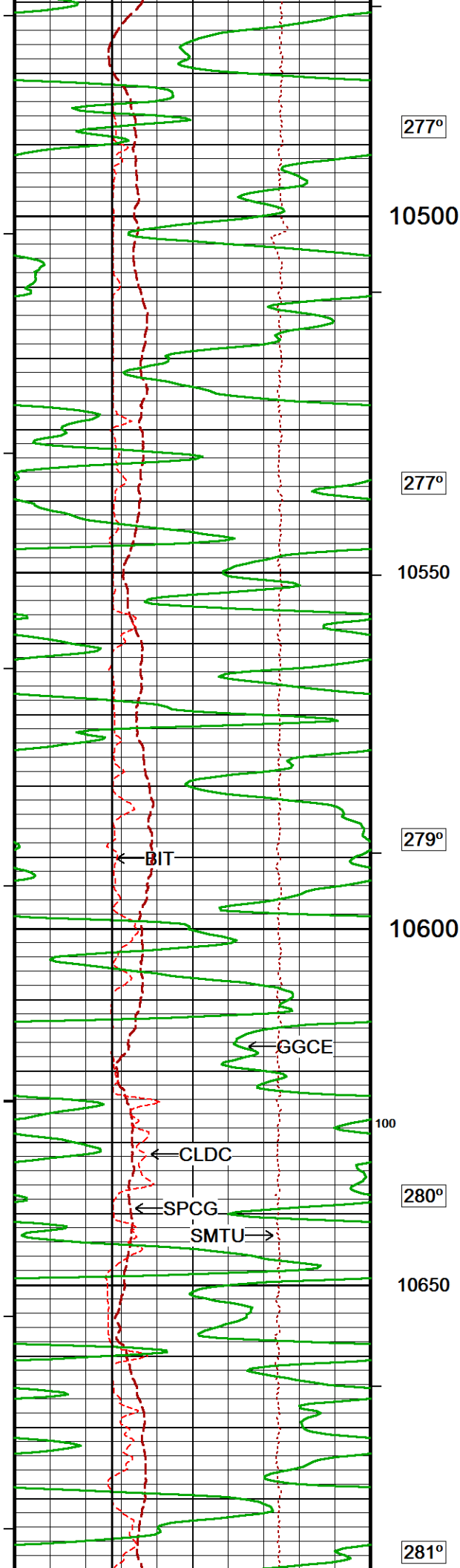


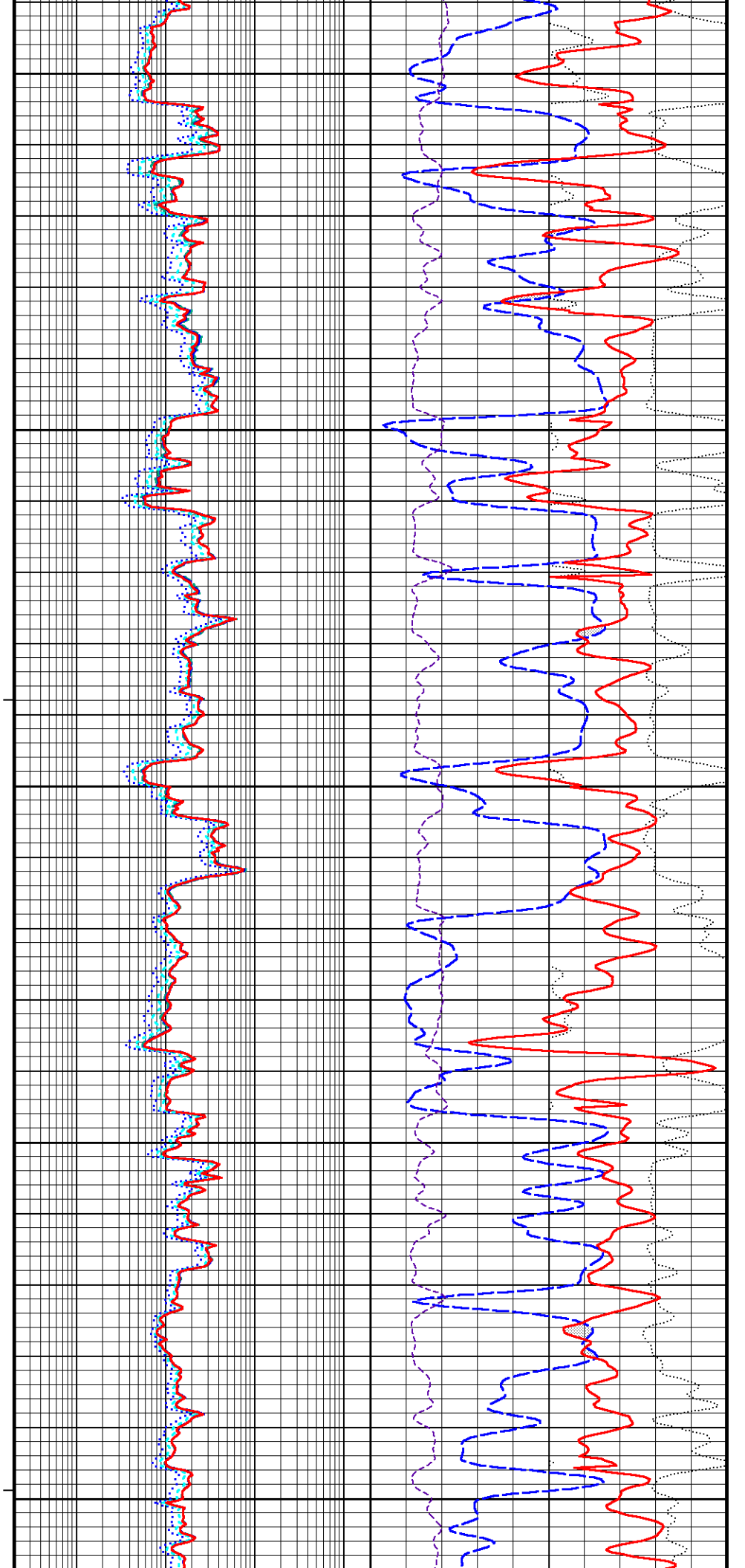
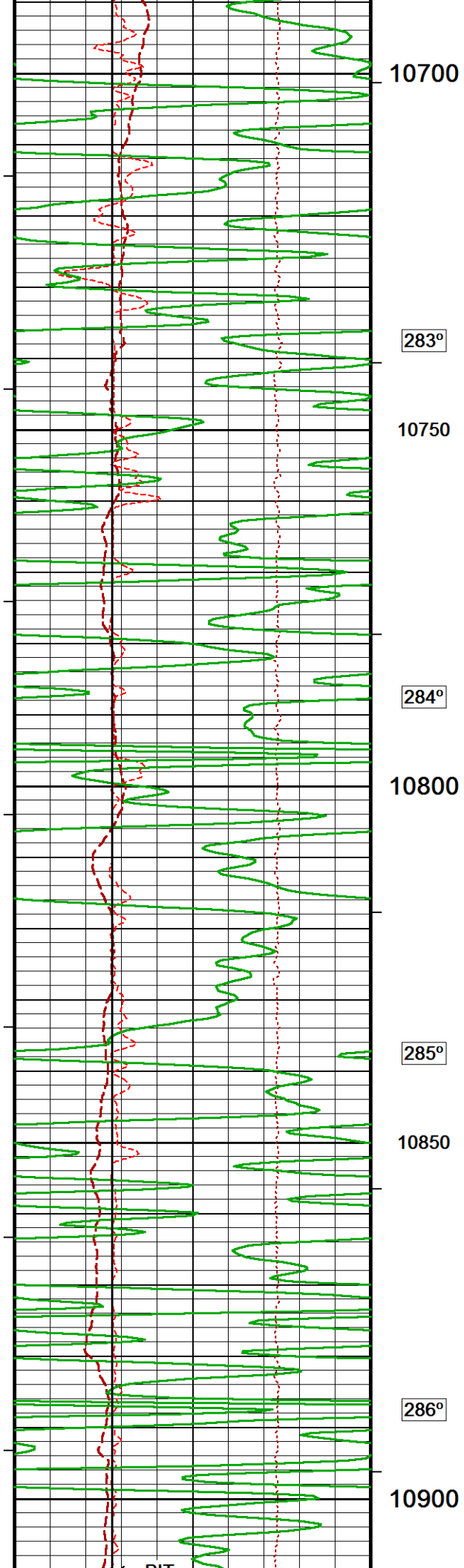


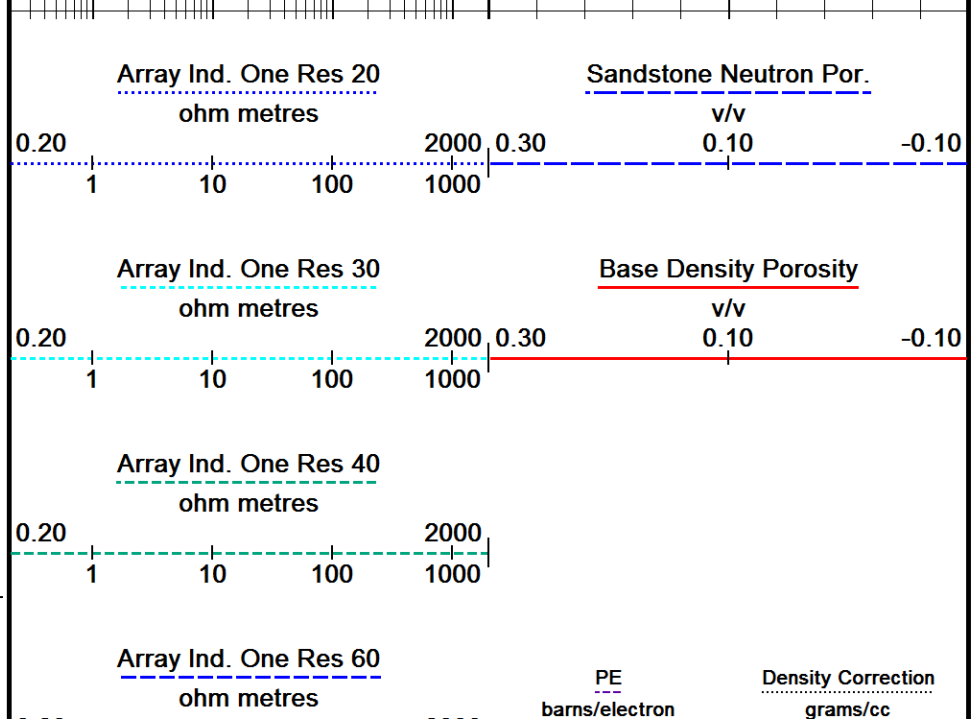
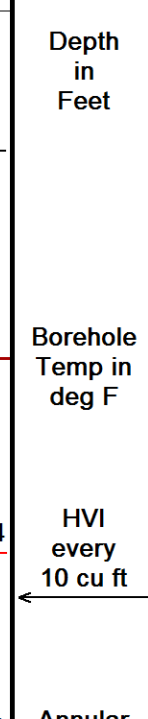
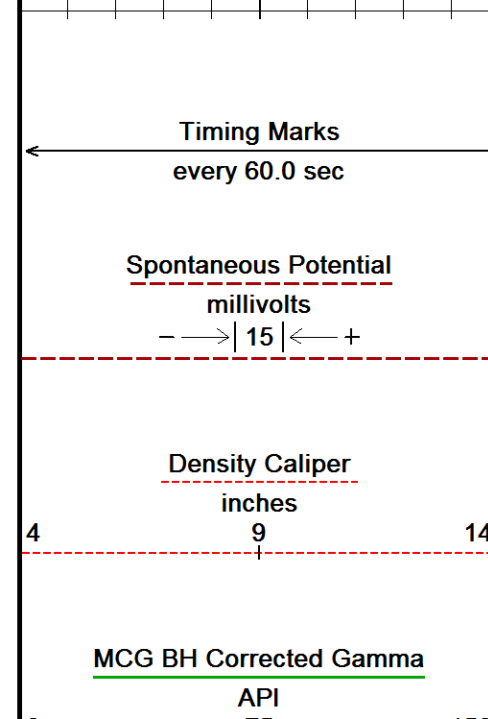
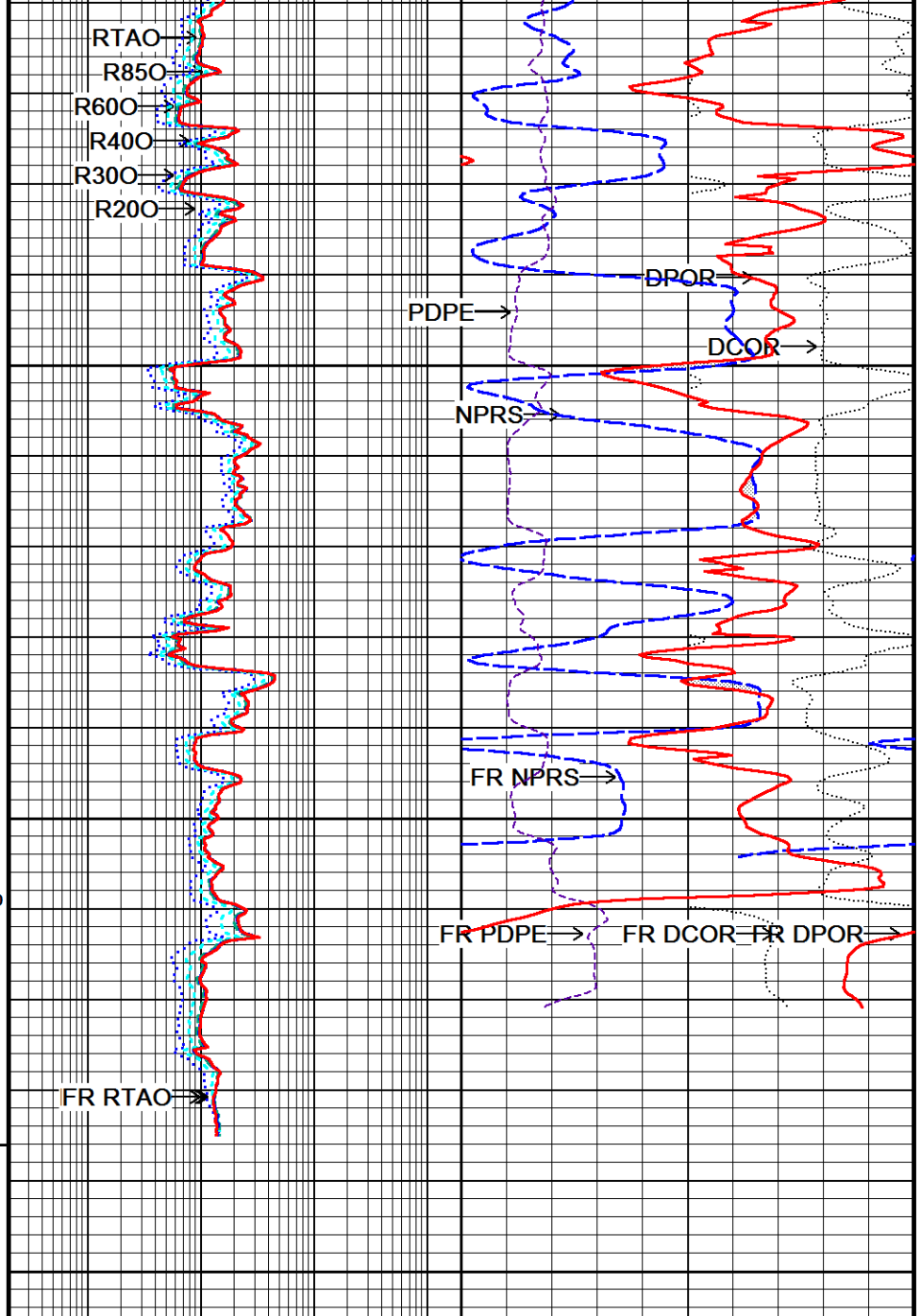
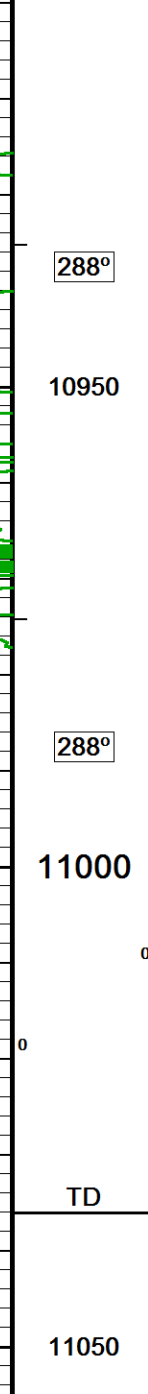
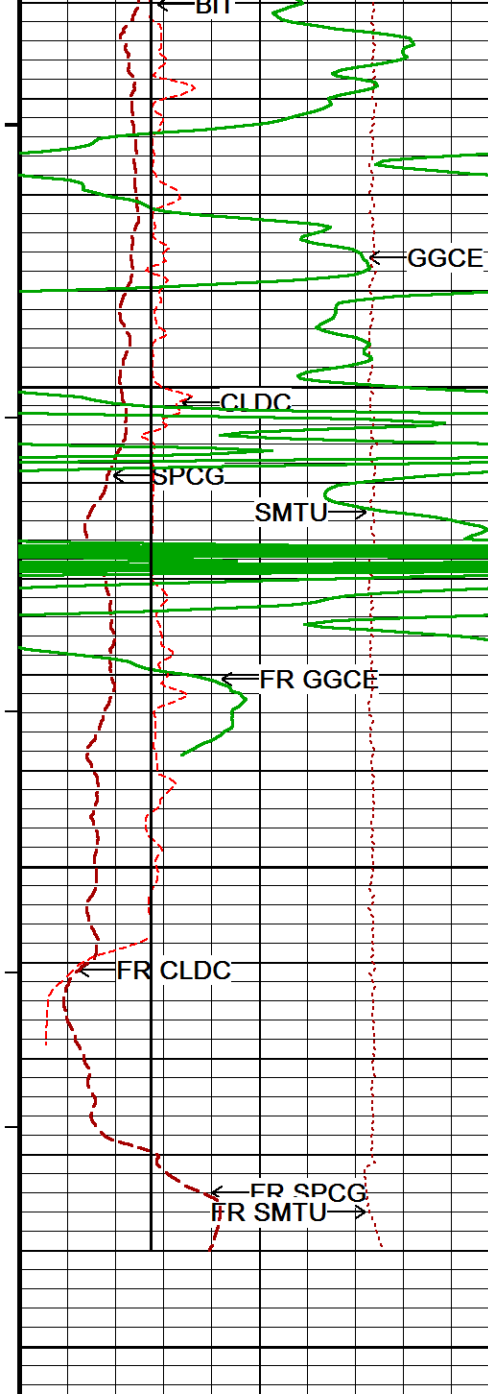


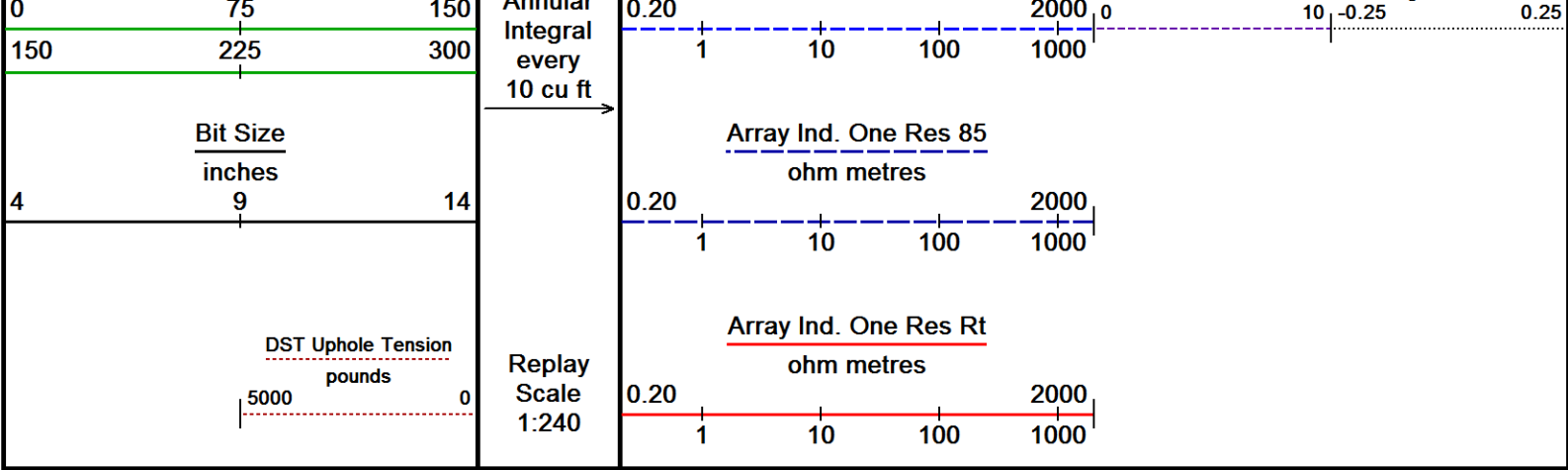










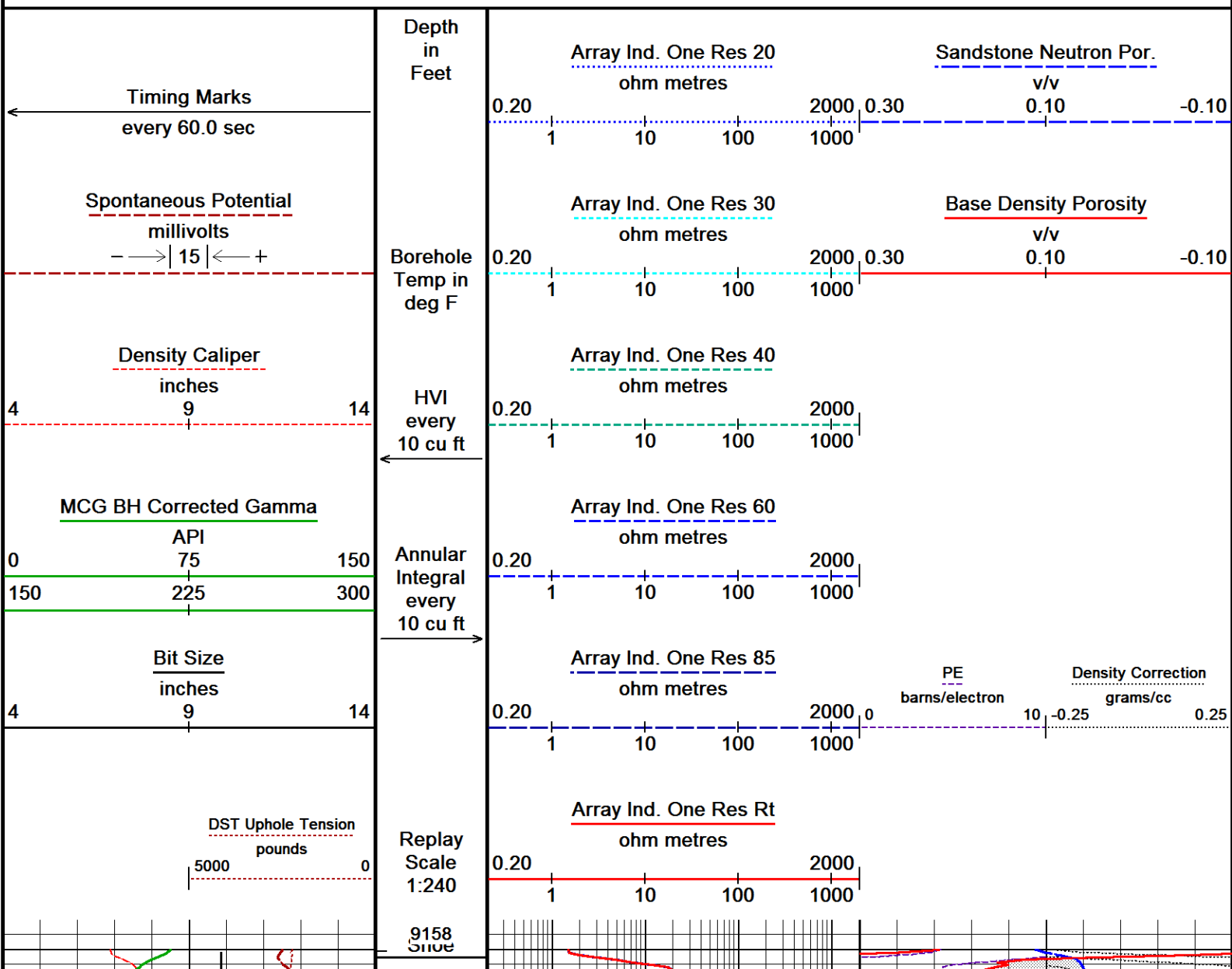


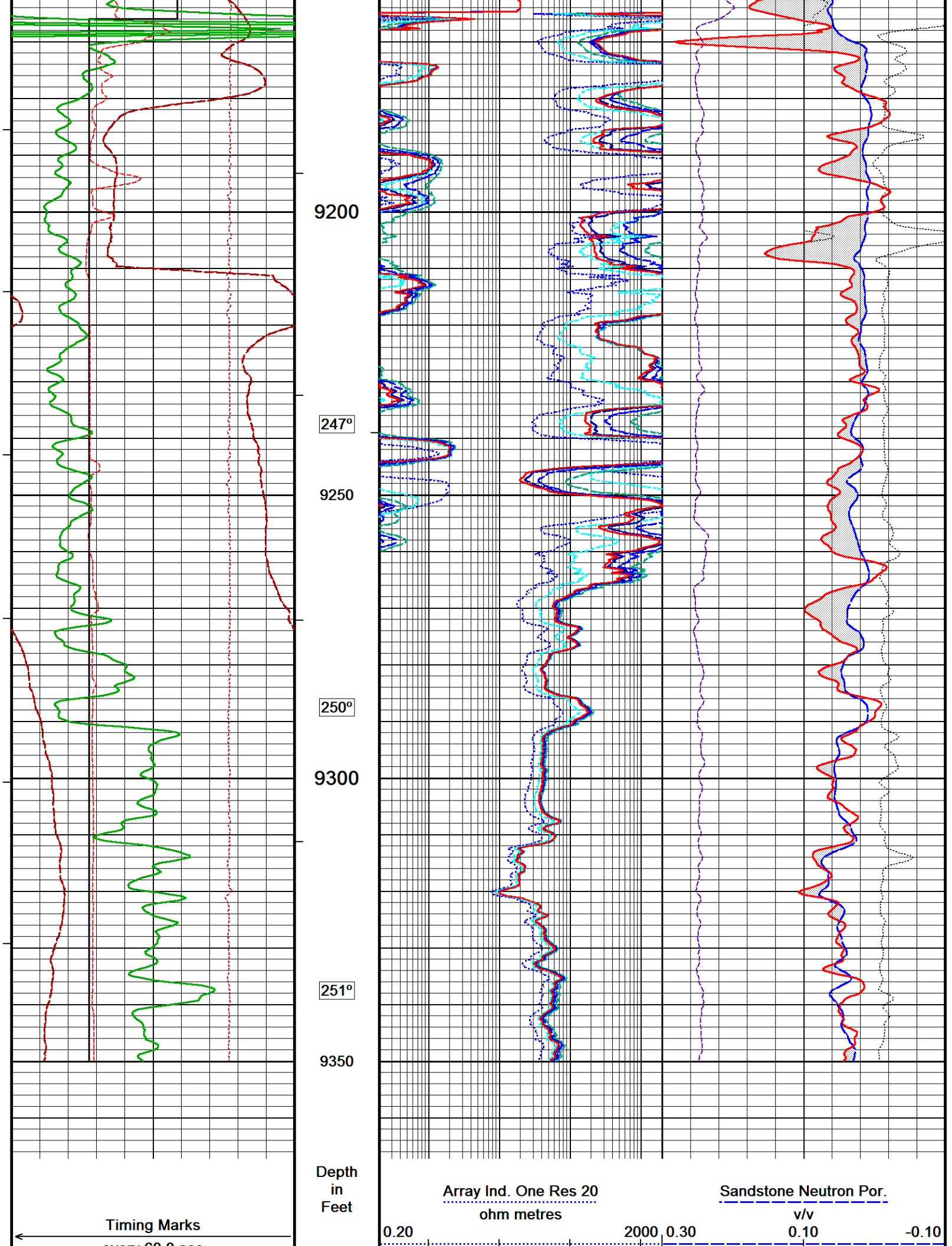
Depth Based Data - Maximum Sampling Increment 10.0cm Plotted on 16-FEB-2019 00:13  
Filename: C:\LOGS\INGL\SOUTH WELD SWD #1 PILOT\Main Pass.dta Recorded on 15-FEB-2019 21:59  
System Versions: Logged with 18.05.7089 Plotted with 18.05.7089

5 INCH MAIN PASS

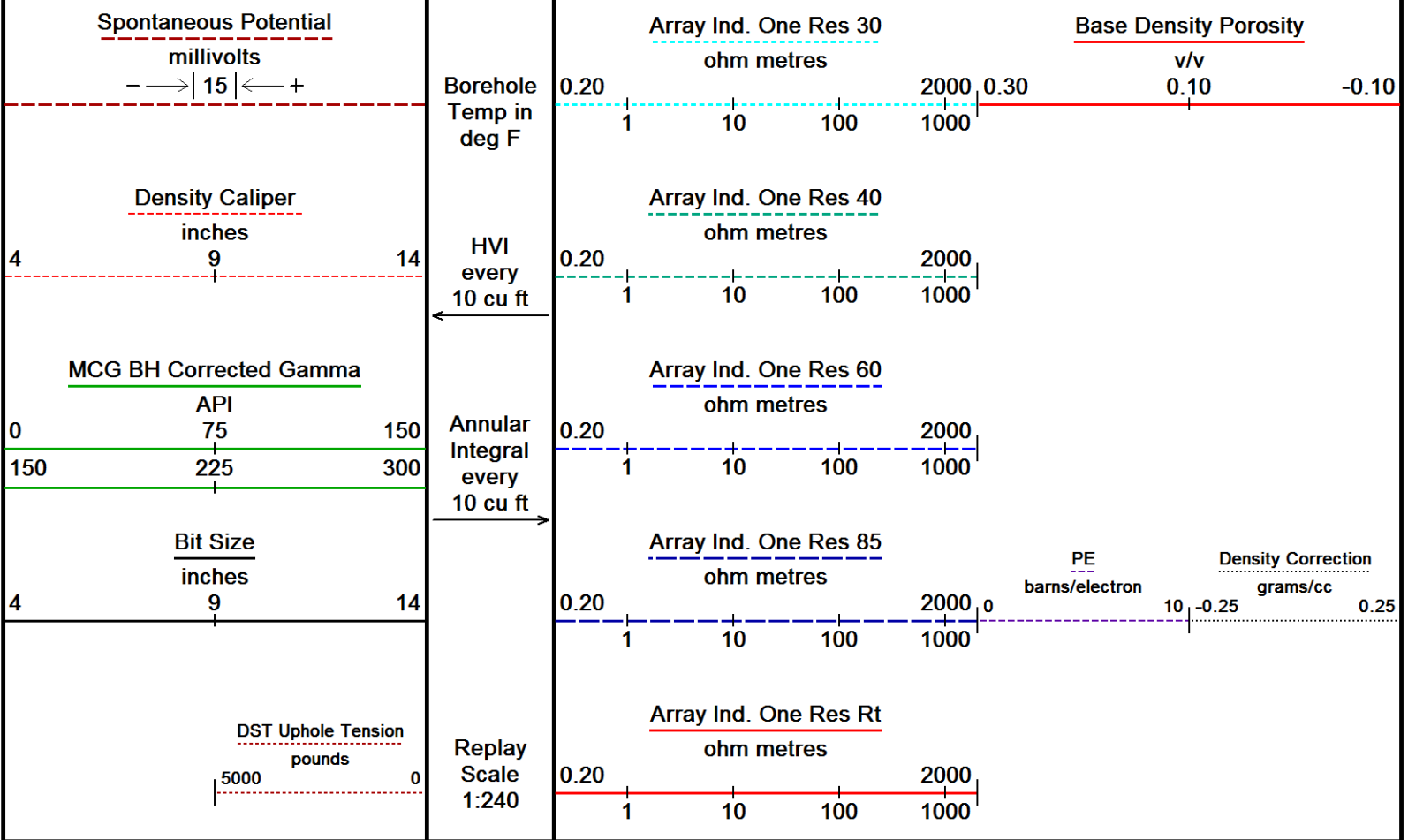
5 INCH OVERLAY REPEAT PASS

Depth Based Data - Maximum Sampling Increment 10.0cm Plotted on 16-FEB-2019 00:13  
Filename: C:\LOGS\INGL\SOUTH WELD SWD #1 PILOT\Main Pass.dta Recorded on 15-FEB-2019 21:59  
Filename: C:\LOGS\INGL\SOUTH WELD SWD #1 PILOT\Main Pass.dta Recorded on 15-FEB-2019 21:59  
System Versions: Logged with 18.05.7089 Plotted with 18.05.7089





every 60.0 sec



Depth Based Data - Maximum Sampling Increment 10.0cm  
Filename: C:\LOGS\INGL\SOUTH WELD SWD #1 PILOT\Main Pass.dta  
Filename: C:\LOGS\INGL\SOUTH WELD SWD #1 PILOT\Main Pass.dta  
System Versions: Logged with 18.05.7089 Plotted with 18.05.7089

Plotted on 16-FEB-2019 00:13  
Recorded on 15-FEB-2019 21:59  
Recorded on 15-FEB-2019 21:59

5 INCH OVERLAY REPEAT PASS

BEFORE SURVEY CALIBRATION		
C:\LOGS\INGL\SOUTH WELD SWD #1 PILOT\Main Pass.dta		
General Constants All 000		Last Edited on 15-FEB-2019,20:26
General Parameters		
Mud Resistivity	0.360	ohm-metres
Mud Resistivity Temperature	75.000	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	Density Caliper	
HVOL Caliper 2	N/A	
Annular Volume Diameter	5.500	inches
Caliper for Differential Caliper	Density Caliper	
Rwa Parameters		
Porosity used	Base Density Porosity	
Resistivity used	Array Ind. Two Res Rt	
RWA Constant A	0.620	
RWA Constant M	2.150	
SW/APOR Tool Source	0.000	

Gamma Calibration MCG-E.A 588

Measured Calibrated (API)

Field Calibration on 15-FEB-2019 18:20



Background	96	62
Calibrator (Gross)	1058	688
Calibrator (Net)	963	626

Gamma Calibration Tolerances MCG-E.A 588		
Ratio	1.538	<div> <div>1.40</div> <div>1.475</div> <div>1.55</div> </div> <div>Counts/API</div>

Gamma Constants MCG-E.A 588		Last Edited on 15-FEB-2019,20:26	
Gamma Calibrator Number	GRC051		
GRC-M Calibrator Jig in Use?	NO		
Inactive Background Jig in Use?	NO		
Mud Density	1.04	gm/cc	
Caliper Source for Processing	Density Caliper		
Tool Position	Eccentred		
Potassium Equivalence	Chloride		
K Mud Concentration	0.00	%	

High Resolution Temperature Calibration MCG-E.A 588		Field Calibration on 13-JAN-2019 22:00	
	Measured	Calibrated(Deg F)	
Lower	33.00	33.00	
Upper	212.00	212.00	

High Resolution Temperature Constants MCG-E.A 588		Last Edited on 26-DEC-2018 01:52	
Pre-filter Length	11		

Neutron Calibration MDN-C.A 514				Base Calibration on 01-FEB-2019 16:14	
				Field Check on 15-FEB-2019 18:35	
Base Calibration					
		Measured		Calibrated (cps)	
	Near	Far		Near	Far
	2907	89		3714	110
Ratio	32.744			33.764	
Field Calibrator at Base					
				Calibrated (cps)	
				1302	1939
Ratio				0.672	
Field Check					
				Calibrated (cps)	
				1499	2197
Ratio				0.682	

Neutron Calibration Tolerances MDN-C.A 514		
Ratio	32.744	<div> <div>-5%</div> <div>33</div> <div>+5%</div> </div>
Base Check	0.672	<div> <div>0.65</div> <div>0.7</div> <div>0.75</div> </div>
Field Check	0.682	<div> <div>0.652</div> <div>0.672</div> <div>0.692</div> </div>

Neutron Constants MDN-C.A 514		Last Edited on 15-FEB-2019,20:27	
Neutron Source Id	P31131B		
Neutron Jig Number	6532NK		
Air Hole Processing	Modified Ratio		
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	

Formation Fluid Salinity	N/A	kppm
Barite Mud Correction	Not Applied	

Induction Calibration MAI-C.A 494	Factory Loop Calibration 07-FEB-2019 14:28
	Field Check on 15-FEB-2019 18:43

### Factory Loop Calibration

High Conductivity Reference Resistor	3.3	ohm
Low Conductivity Reference Resistor	333.3	ohm

Array	Measured Signal (unitless)		Reference Conductivity (mmho/m)		Calibration	
	Low	High	Low	High	Gain	Offset
1 (near)	16.0	455.1	9.3	966.2	2.179	-25.5
2	6.0	369.3	7.6	821.4	2.240	-5.8
3	3.0	251.1	5.2	566.0	2.261	-1.6
4 (far)	0.1	128.5	2.6	279.2	2.155	2.3
Array Temperature	73.9		Deg F			

### Tool Checks

Array	Factory Reference (mmho/m)		Before Survey (mmho/m)		Deg F
	Low	High	Low	High	
1 (near)	-3.8	2116.7	-3.8	2117.5	
2	13.9	1946.0	13.9	1946.6	
3	15.3	1678.7	15.4	1679.3	
4 (far)	13.8	1135.7	13.8	1136.2	
Array Temperature	23.5		55.1		

### Induction Check Tolerances MAI-C.A 494

Low Array 1	-3.8	<div><div></div><div></div><div></div><div></div></div>	mmho/m	High Array 1	2117.5	<div><div></div><div></div><div></div><div></div></div>	mmho/m
Low Array 2	13.9	<div><div></div><div></div><div></div><div></div></div>	mmho/m	High Array 2	1946.6	<div><div></div><div></div><div></div><div></div></div>	mmho/m
Low Array 3	15.4	<div><div></div><div></div><div></div><div></div></div>	mmho/m	High Array 3	1679.3	<div><div></div><div></div><div></div><div></div></div>	mmho/m
Low Array 4	13.8	<div><div></div><div></div><div></div><div></div></div>	mmho/m	High Array 4	1136.2	<div><div></div><div></div><div></div><div></div></div>	mmho/m

### Induction Constants MAI-C.A 494

Last Edited on 15-FEB-2019,20:31

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
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	
Borehole Correction Method	Default	

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
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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	1.00	v/v
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	

Photo Density Calibration MPD-D.A 472

Base Calibration on 01-FEB-2019 15:17  
Field Check on 15-FEB-2019 18:31

Density Calibration				
Base Calibration		Measured	Calibrated (sdu)	
	Near	Far	Near	Far
Background	1042	1267		
Reference 1	51098	25098	59898	31131
Reference 2	20296	2381	24540	2525
Field Check at Base				
	1042.0	1266.6		
Field Check				
	1042.4	1280.6		

PE Calibration				
Base Calibration		Measured	Calibrated	
	WS	WH	Ratio	Ratio
Background	204	940		
Reference 1	23014	50933	0.456	0.369
Reference 2	6484	20185	0.326	0.271
Field Check at Base				
	204.1	940.3		
Field Check				
	203.8	941.1		

Photo Density Calibration Tolerances MPD-D.A 472

Near Density Ratio	2.60	<div><div>-5%2.52+5%</div></div>	Far Density Ratio	21.39	<div><div>-5%21.00+5%</div></div>
PE Calibration	0.123	<div><div>0.0890.1100.131</div></div>			
Near Den. Field Check	1042.4	<div><div>-3%1042.0+3%</div></div>	Far Den. Field Check	1280.6	<div><div>-3%1266.6+3%</div></div>
PE WS Field Check	203.8	<div><div>-6%204.1+6%</div></div>	PE WH Field Check	941.1	<div><div>-6%940.3+6%</div></div>

Density Constants MPD-D.A 472

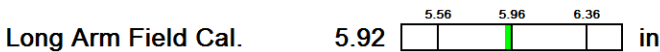
Last Edited on 15-FEB-2019,20:27

Density Source Id	20720B	
Nylon Calibrator Number	DNCE 631	
Aluminium Calibrator Number	DACD 631	
Density Shoe Profile	4 inch	
Caliper Source for Processing	Density Caliper	
PE Correction to Density	Not Applied	
Mud Density	1.04	gm/cc
Mud Density Type		
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	
Precision Enhanced Density Processing	Applied	
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

Caliper Calibration MPD-D.A 472			Base Calibration on 01-FEB-2019 15:43
			Field Calibration on 15-FEB-2019 18:25
Base Calibration			
Reading No	Measured	Calibrator Size (in)	
1	16640	4.00	
2	24832	5.96	
3	33503	7.98	
4	41667	9.86	
5	50976	11.91	
6	N/A	N/A	
Field Calibration			
	Measured Caliper (in)	Actual Caliper (in)	
	5.92	5.96	

Caliper Calibration Tolerances MPD-D.A 472



DOWNHOLE EQUIPMENT

C:\LOGS\INGL\SOUTH WELD SWD #1 PILOT\Main Pass.dta

Cablehead, 11 pin  
CBH-DB 202 LG: 2.40 ft WT: 24.3 lb OD: 2.240 in

Compact Swivel Head Adaptor  
SHA-J.B 504 LG: 2.30 ft WT: 22.0 lb OD: 2.244 in

Compact Knuckle Joint  
SKJ-E.B 614 LG: 2.17 ft WT: 24.3 lb OD: 2.244 in

Compact Comms Gamma  
MCG-E.A 588 LG: 8.70 ft WT: 63.9 lb OD: 2.244 in

Compact Micro-Resistivity  
MMR-C.A 242 LG: 8.59 ft WT: 81.6 lb OD: 2.244 in

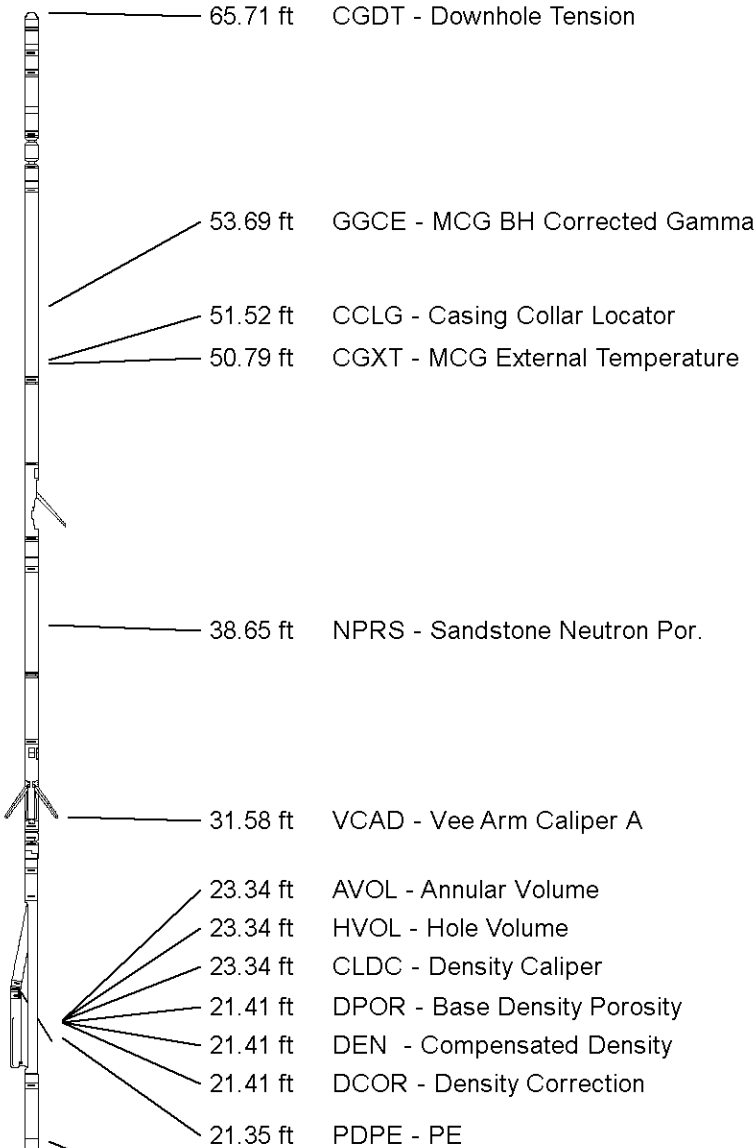
Compact Neutron  
MDN-C.A 514 LG: 5.04 ft WT: 50.7 lb OD: 2.244 in

Compact Vee Arm Caliper  
MVC-A.A 141 LG: 8.06 ft WT: 61.7 lb OD: 2.244 in

Compact Density/Caliper  
MPD-D.A 472 LG: 9.59 ft WT: 90.4 lb OD: 2.244 in

Compact Focussed Electric  
MFE-C.A 381 LG: 6.05 ft WT: 48.5 lb OD: 2.244 in

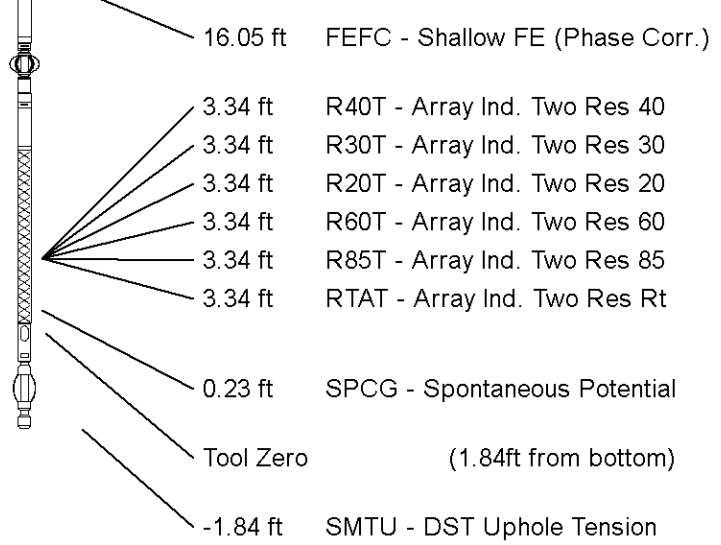
Compact Inline Standoff sub



Compact inline Standoff sub  
MIS-E.B 784 LG: 2.14 ft WT: 15.4 lb OD: 2.244 in

Compact Induction  
MAI-C.A 494 LG: 12.52 ft WT: 48.5 lb OD: 2.240 in

Total Length: 67.55 ft Weight: 531.3 lb



All measurements relative to tool zero.

COMPANY	NGL ENERGY PARTNERS
WELL	SOUTH WELD SWD #1
FIELD	WATTENBERG
PROVINCE/COUNTY	WELD COUNTY
COUNTRY/STATE	USA/COLORADO

Elevation Kelly Bushing	4977	feet	First Reading	11030.82	feet
Elevation Drill Floor	4977	feet	Depth Driller	11040.00	feet
Elevation Ground Level	4952	feet	Depth Logger	11036.00	feet



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DUAL NEUTRON  
PHOTO-DENSITY