



Weatherford

MICRORESISTIVITY LOG

COMPANY SHAKESPEARE OIL CO., INC			
WELL OTTELEY 2-21			
FIELD CHALK BUTTES			
PROVINCE/COUNTY LOGAN			
COUNTRY/STATE USA / KANSAS			
LOCATION 2050' FNL & 2490' FEL NW-SW-SW-NE			
SEC 21	TWP 14S	RGE 32W	Other Services
Latitude	38.8249133	MAI/MFE	MPD/MDN
Longitude	-100.8817901		
API Number	15-109-21551		
Permanent Datum GL, Elevation 2771 feet			Elevations: feet
Log Measured From KB, 12.00 feet above Permanent Datum			KB 2783.00
Drilling Measured From KB			DF 2781.00
			GL 2771.00
Date	14-JUN-2018		
Run Number	ONE		
Service Order	7055-216229097		
Depth Driller	4511.00	feet	
Depth Logger	4511.00	feet	
First Reading	4476.00	feet	
Last Reading	3511.00	feet	
Casing Driller	267.00	feet	
Casing Logger	266.00	feet	
Bit Size	7.875	inches	
Hole Fluid Type	WBM		
Density / Viscosity	9.40 lb/USg	59.00 sec/qt	
PH / Fluid Loss	9.50	10.00 ml/30Min	
Sample Source	MUD TANK		
Rm @ Measured Temp	0.60 @ 96.0	ohm-m	
Rmf @ Measured Temp	0.48 @ 96.0	ohm-m	
Rmc @ Measured Temp	0.72 @ 96.0	ohm-m	
Source Rmf / Rmc	CALC	CALC	
Rm @ BHT	0.50 @116.0	ohm-m	
Time Since Circulation	5 HOURS		
Max Recorded Temp	116.00	deg F	
Equipment / Base	13096	LIB	
Recorded By	JUSTIN HICKS		
Witnessed By	WES HANSON		

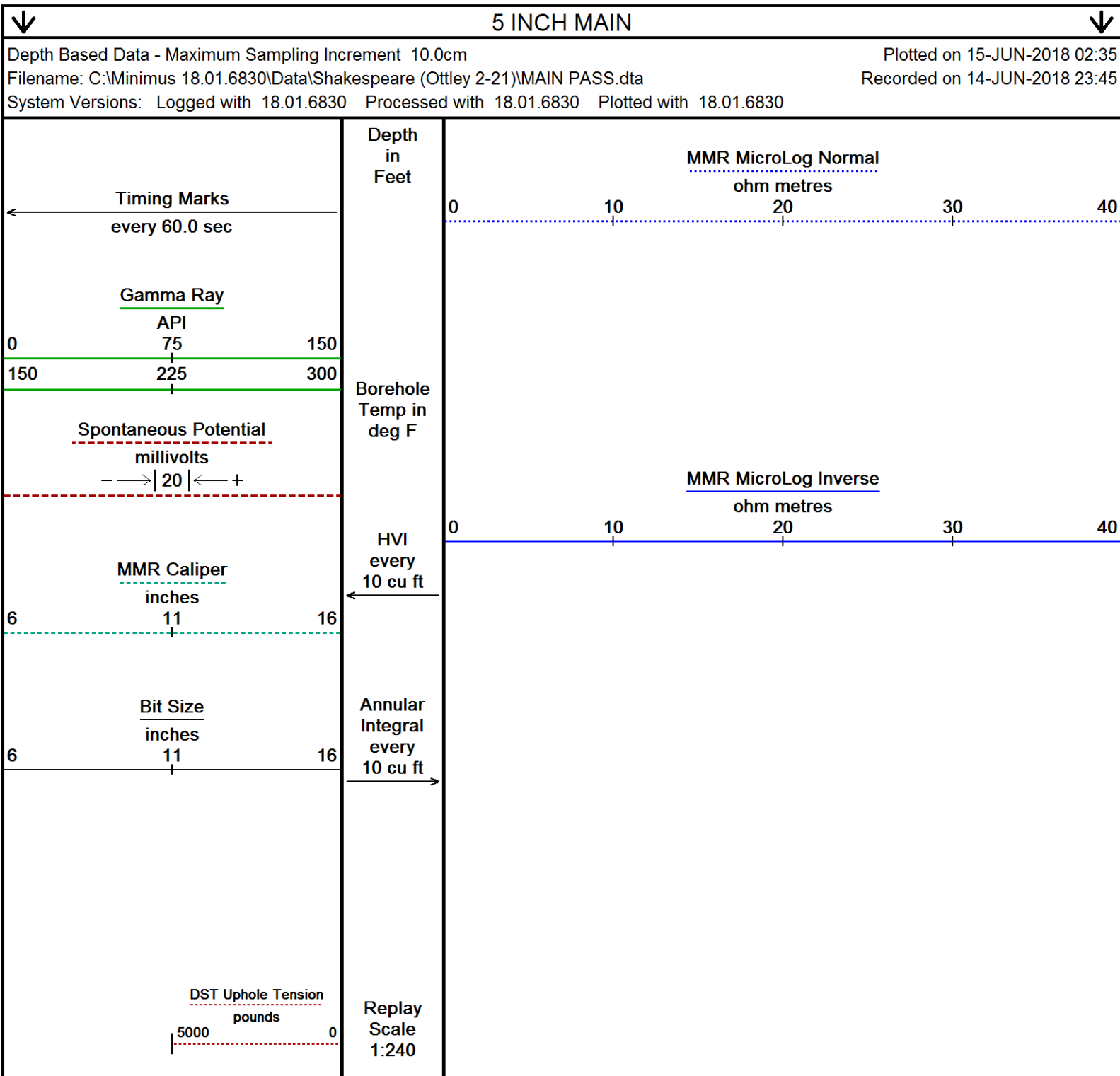
BOREHOLE RECORD				Last Edited: 14-JUN-2018 22:07
Bit Size inches		Depth From feet		Depth To feet
7.875		267.00		4511.00
CASING RECORD				
Type	Size inches	Depth From feet	Shoe Depth feet	Weight pounds/ft
SURFACE	8.625	0.00	267.00	24.00

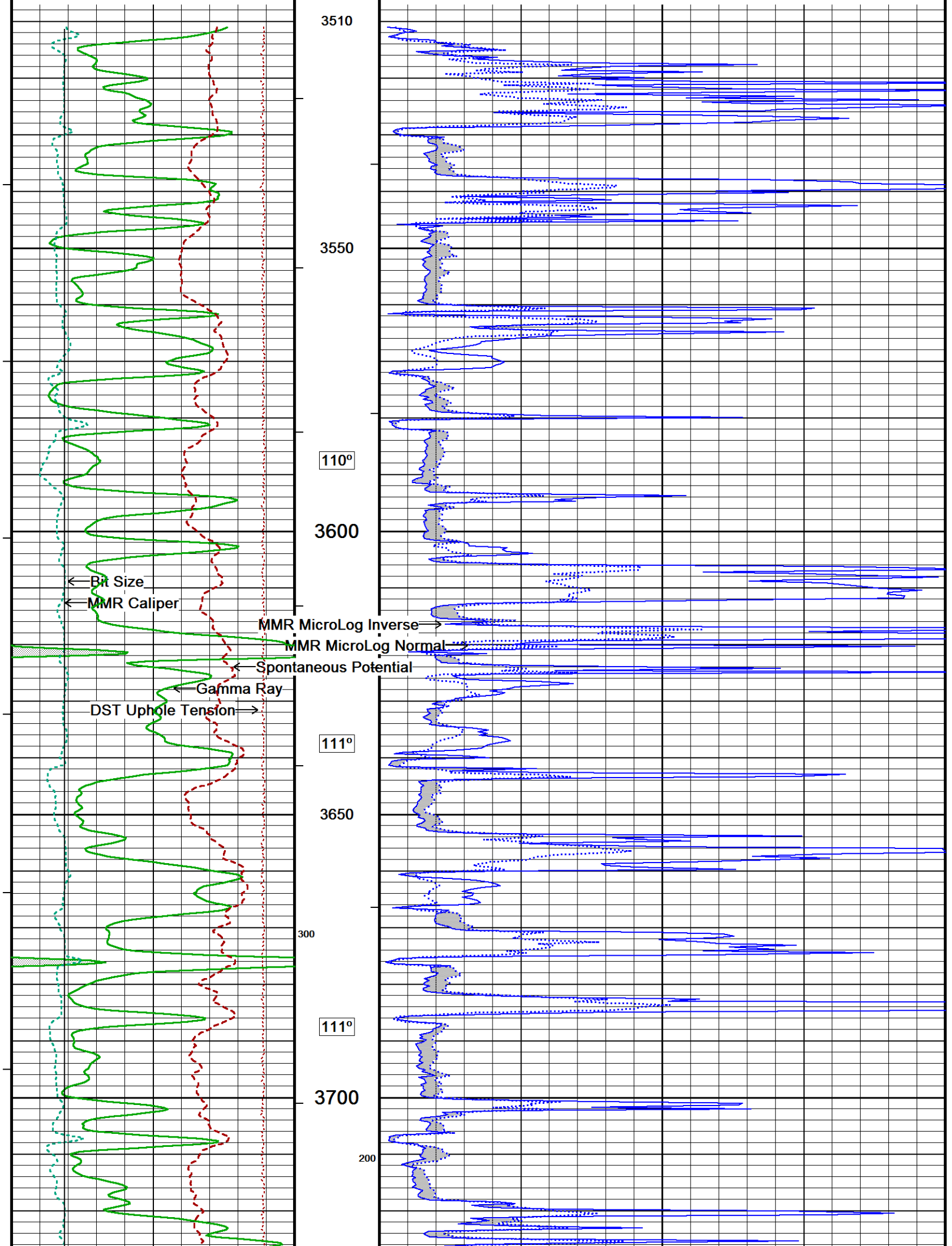
REMARKS
- RUN ONE: MCB, SHA, MCG, MML, MDN, MPD, SKJ, MFE, MSS, MAI RUN IN COMBINATION. - HARDWARE: DUAL BOWSPRING USED ON MDN. 0.5 INCH STANDOFF USED ON MFE. 0.5 INCH STANDOFF USED ON MAI.
- 2.71 G/CC LIMESTONE DENSITY MATRIX USED TO CALCULATE POROSITY.
- BOREHOLE RUGOSITY, TIGHT PULLS, AND WASHOUTS WILL AFFECT DATA QUALITY.
- ALL INTERVALS LOGGED AND SCALED PER CUSTOMER'S REQUEST.
- TOTAL HOLE VOLUME FROM TD TO SURFACE CASING: 1730 CU.FT.
- ANNULAR HOLE VOLUME WITH 4.5 INCH PRODUCTION CASING FROM TD TO SURFACE CASING: 1262 CU.FT.
- RIG: DUKE #1.

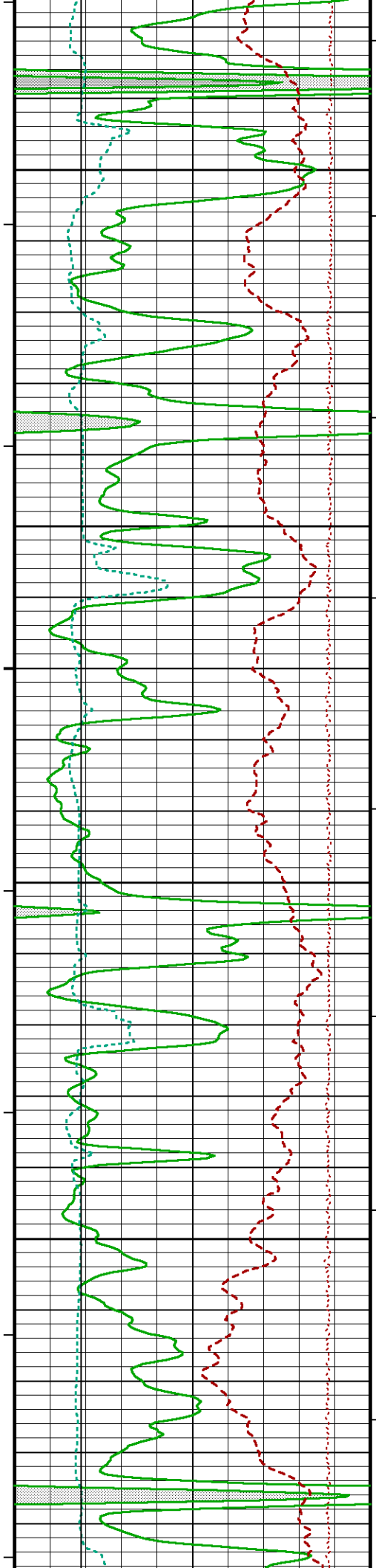
- ENGINEER: J. HICKS.

- OPERATOR: B. TOVAR, B. COPELAND.

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.







111°

3750

111°

3800

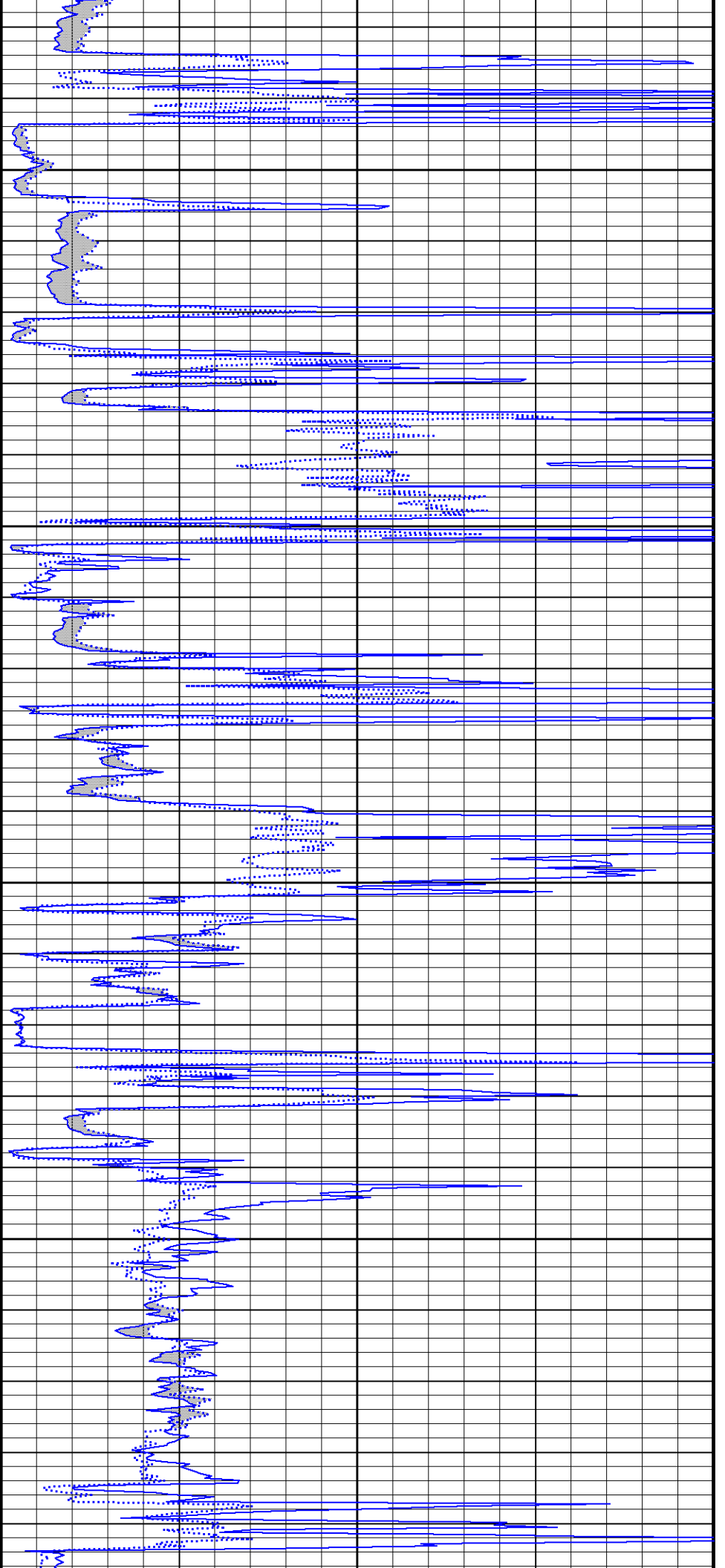
112°

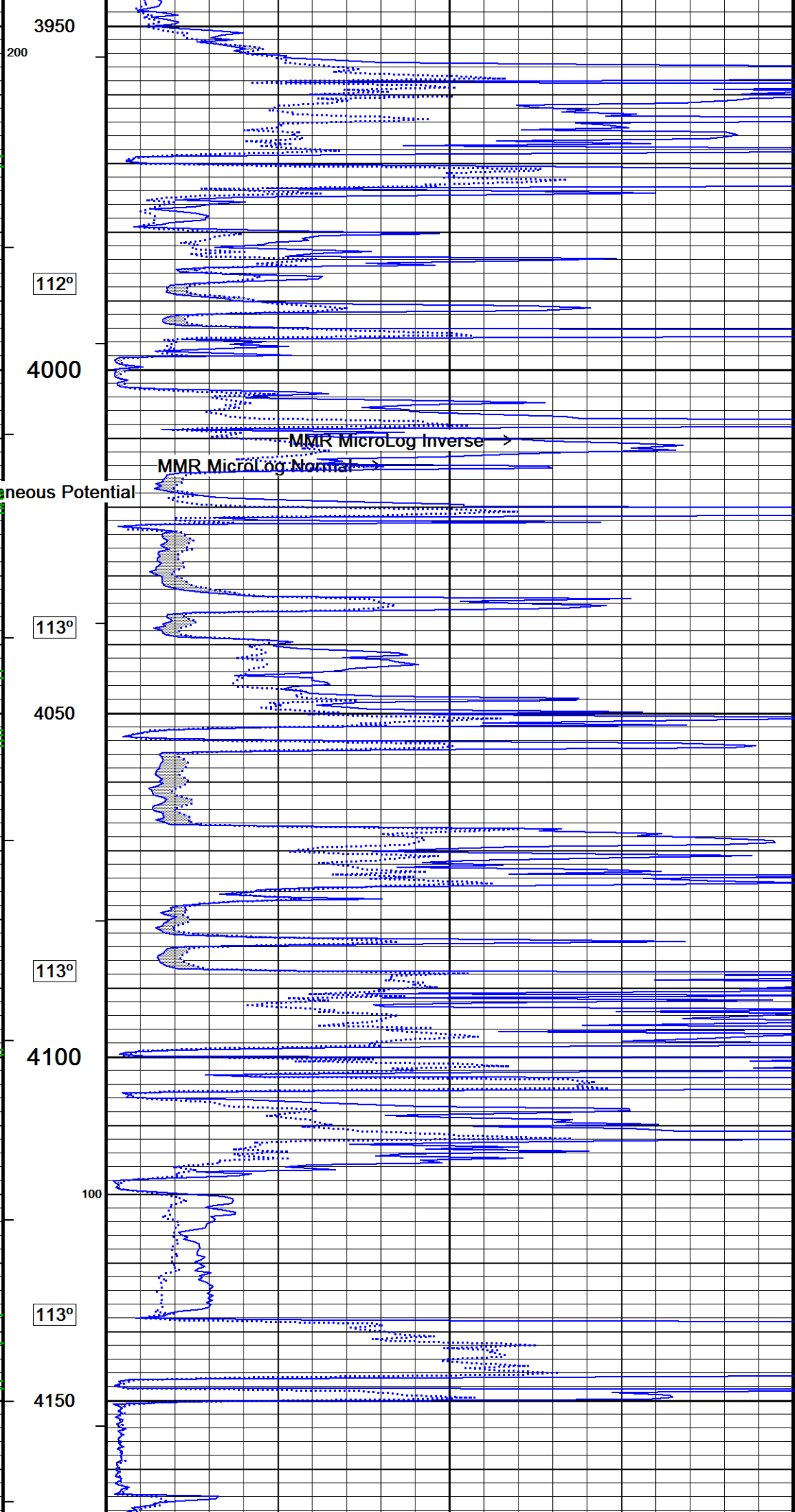
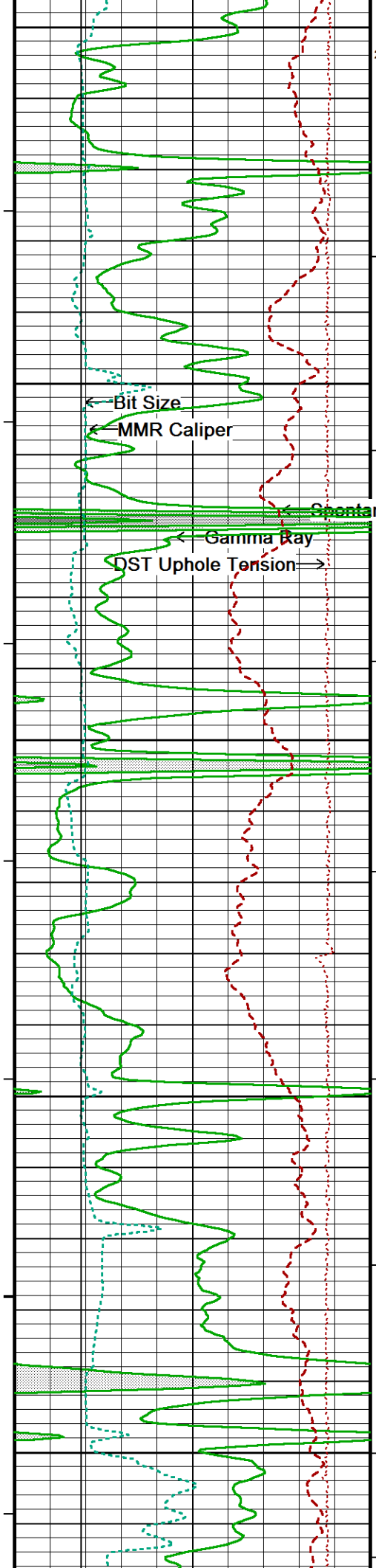
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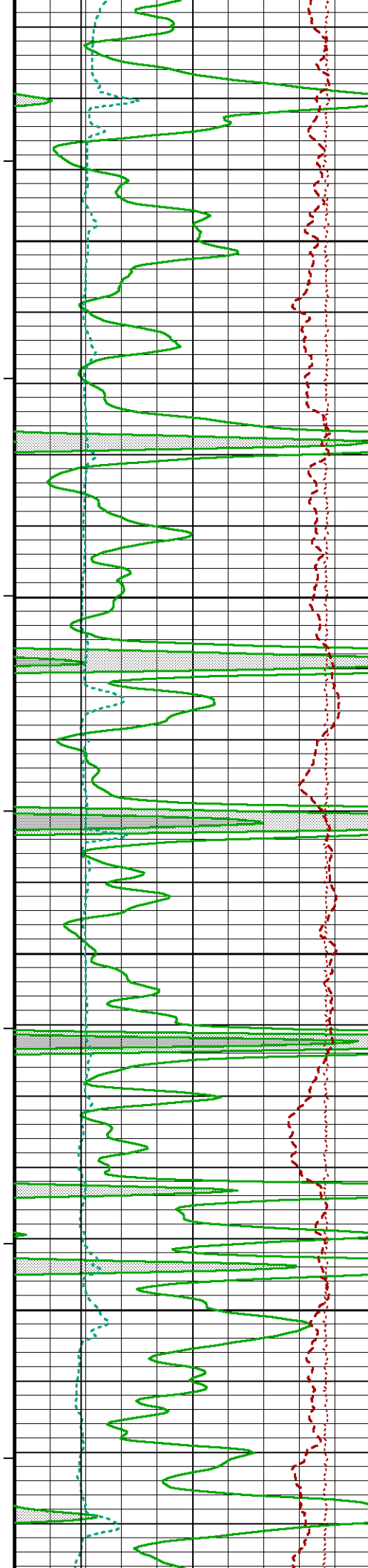
112°

3900

112°







114°

4200

100

114°

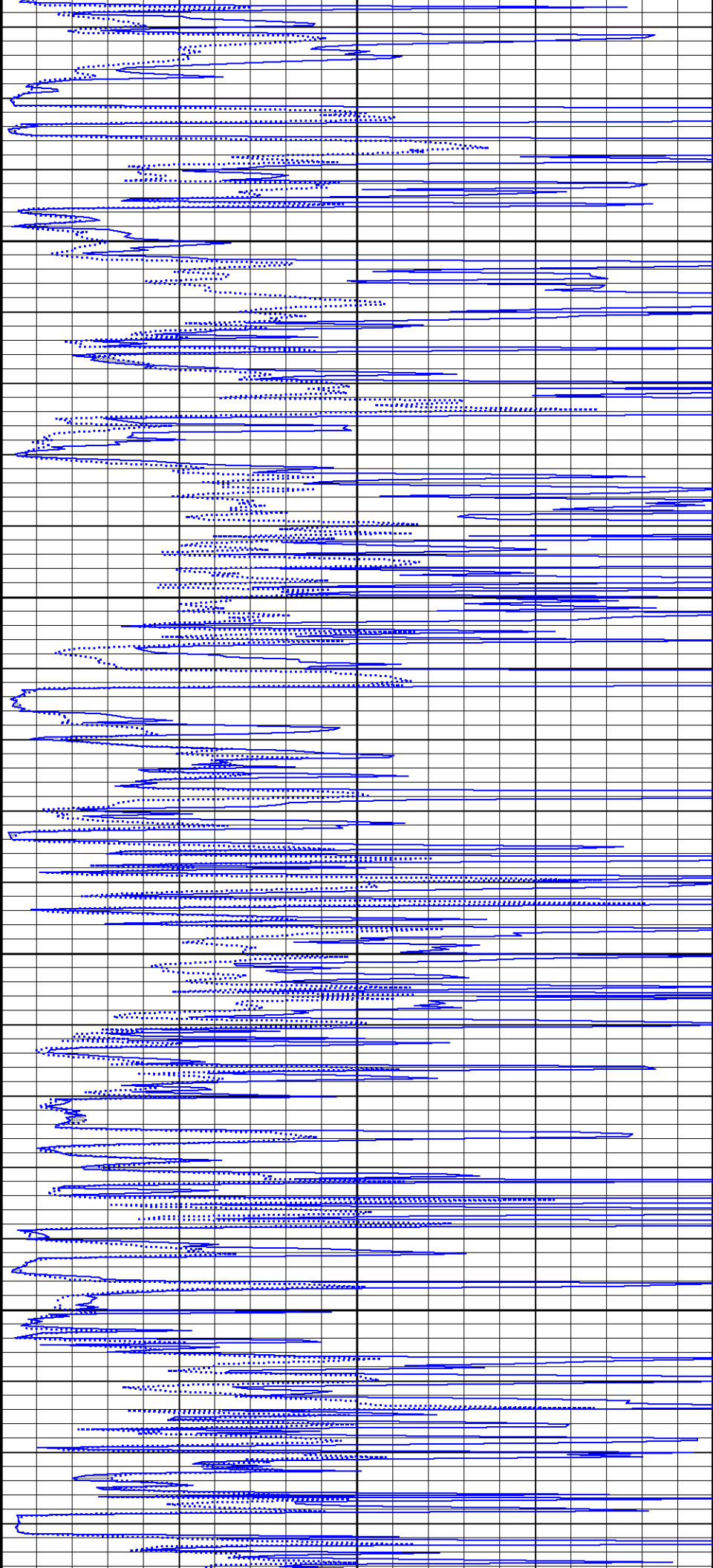
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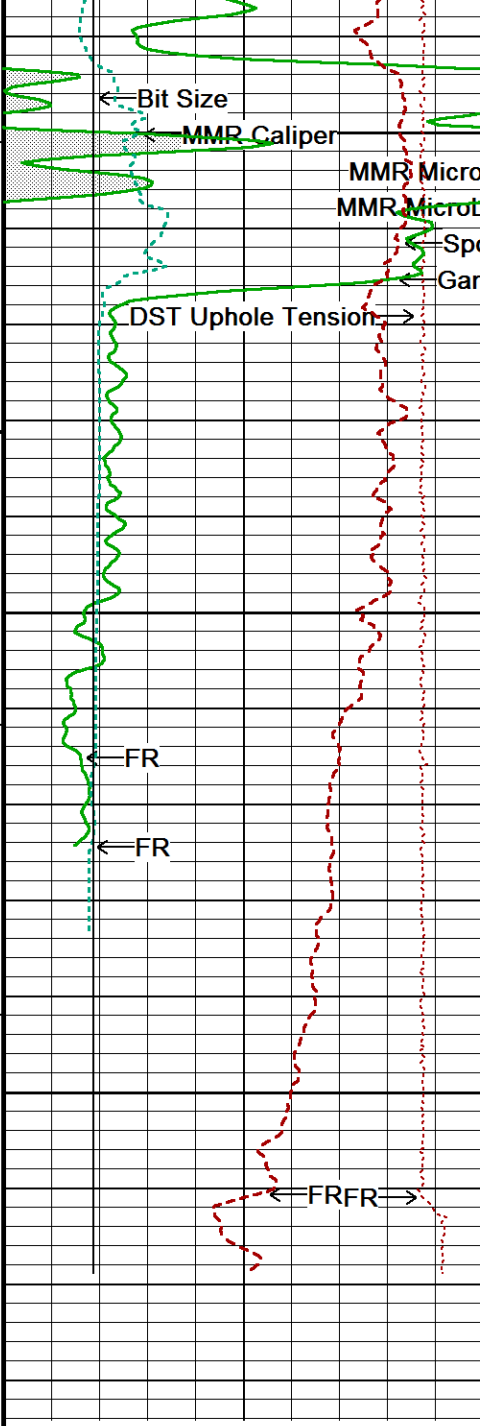
114°

4300

115°

4350





115°

4400

116°

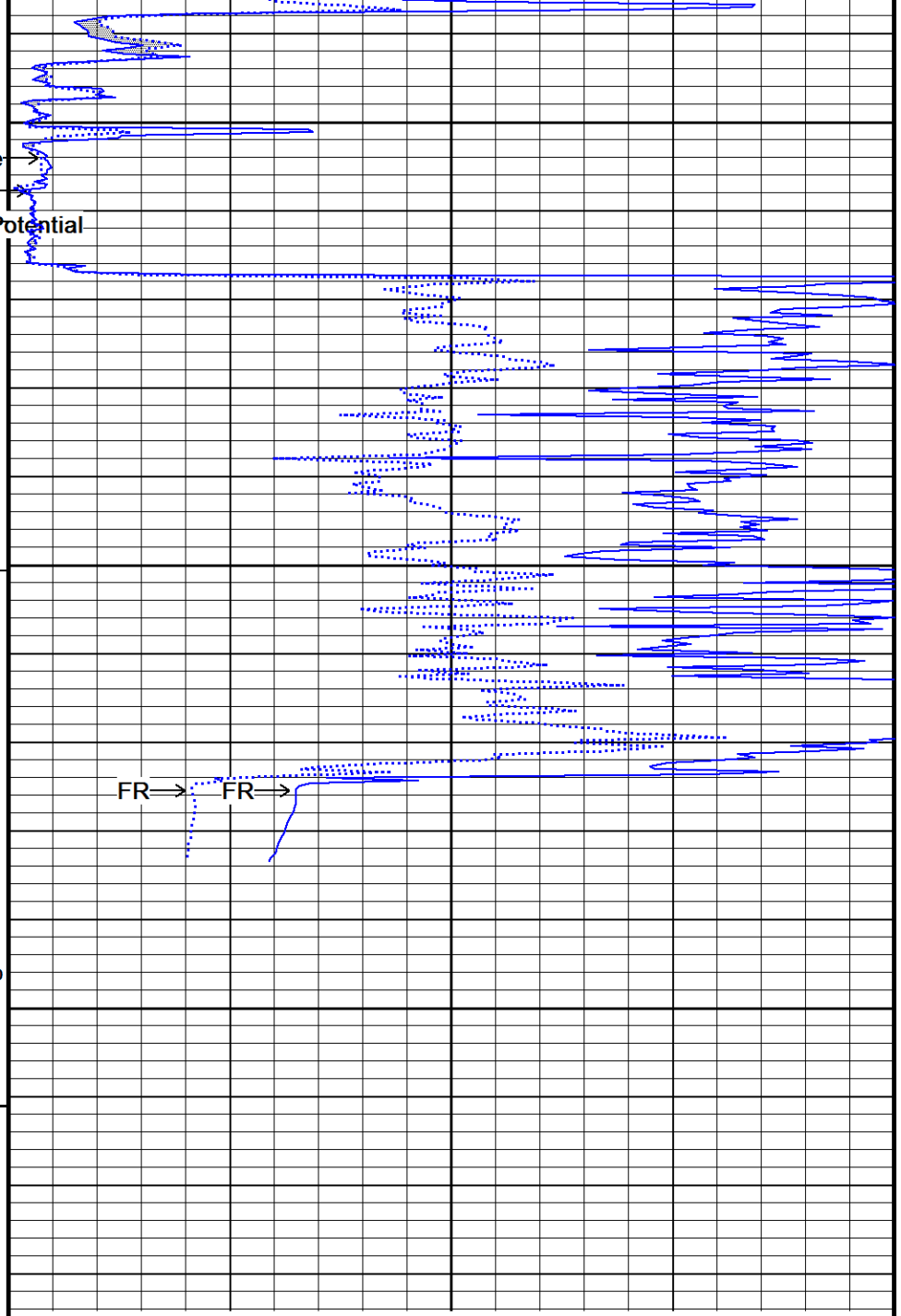
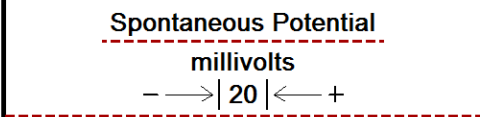
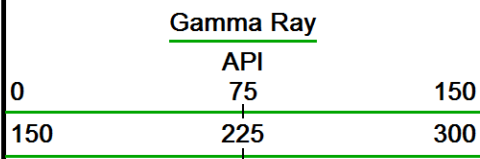
4450

4500

TD

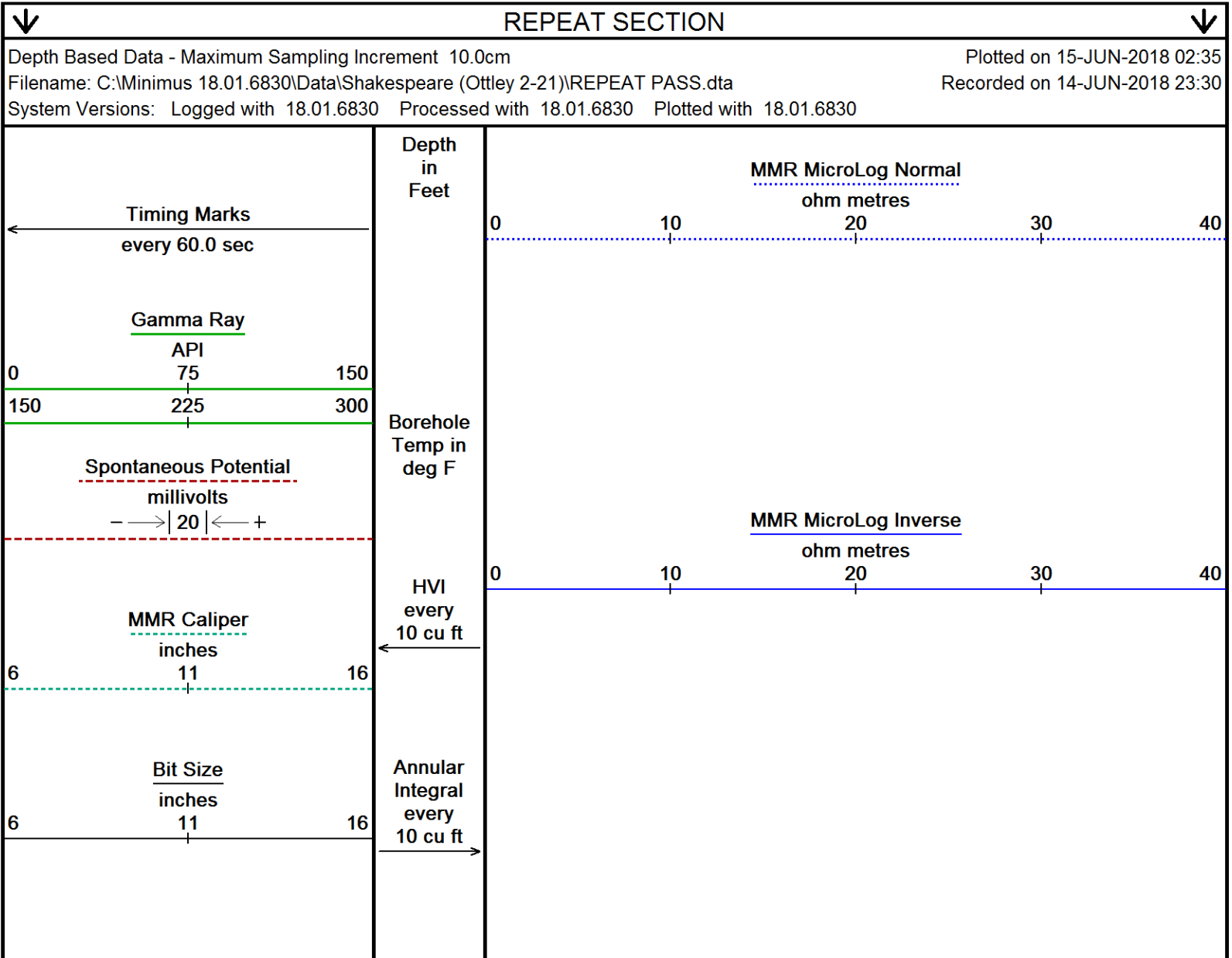
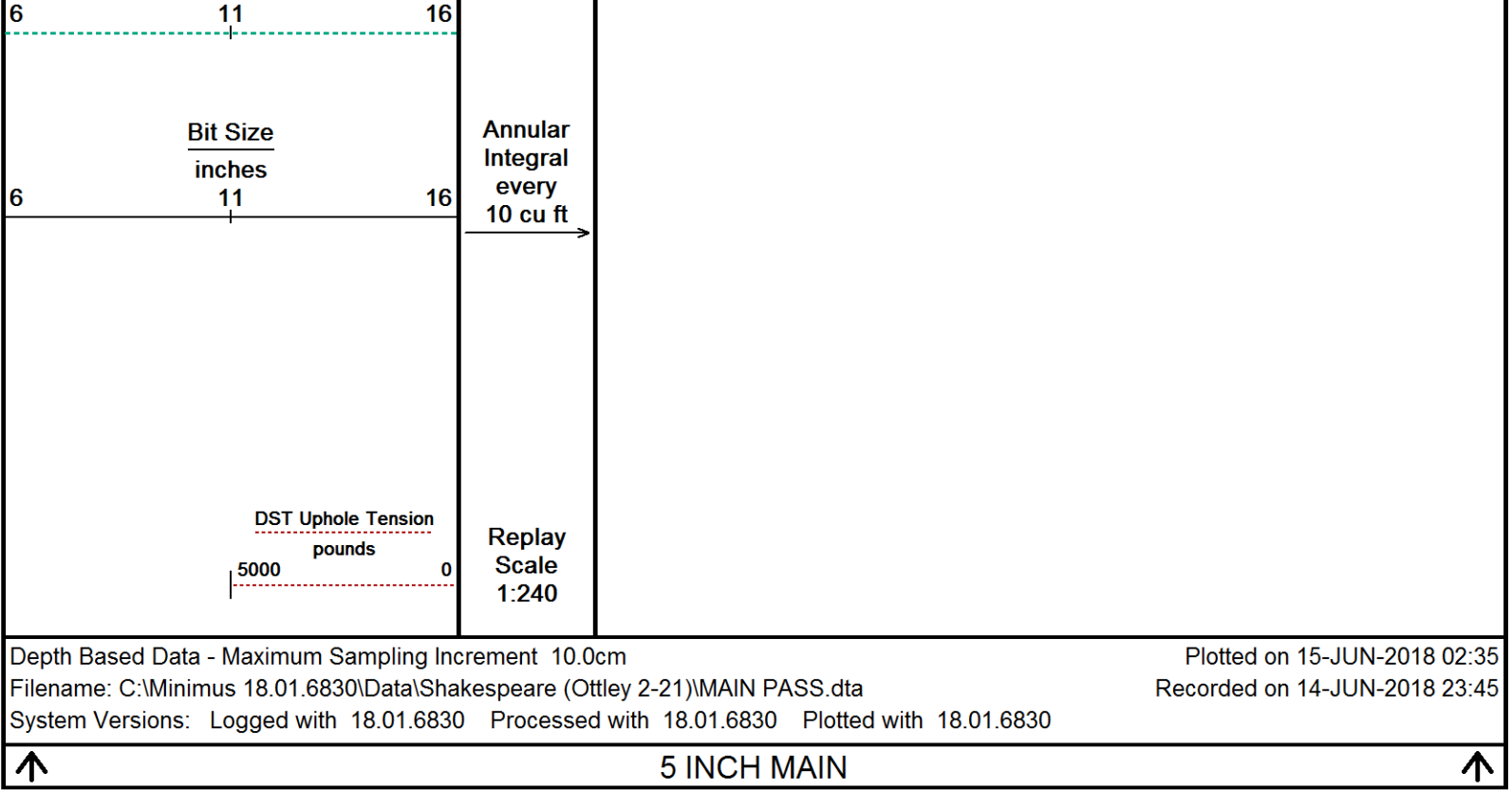
Depth
in
Feet

Timing Marks
every 60.0 sec



Borehole
Temp in
deg F

HVI
every
10 cu ft



DST Uphole Tension
pounds
5000 0

Replay
Scale
1:240

4300

114°

4350

115°

4400

116°

4450

← Bit Size

← MMR Caliper

MMR MicroLog Inverse →

MMR MicroLog Normal →

← Spontaneous Potential

← Gamma Ray

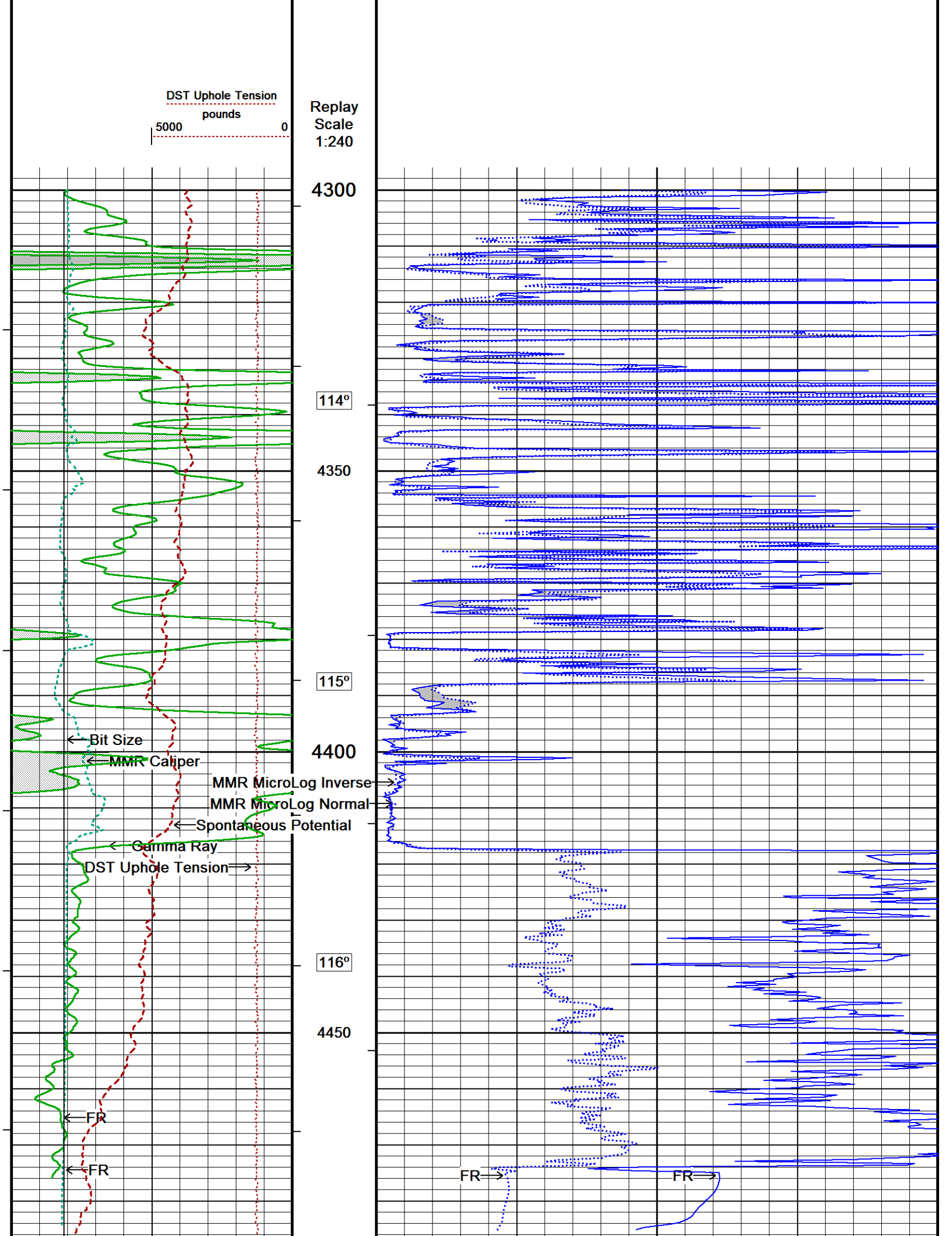
DST Uphole Tension →

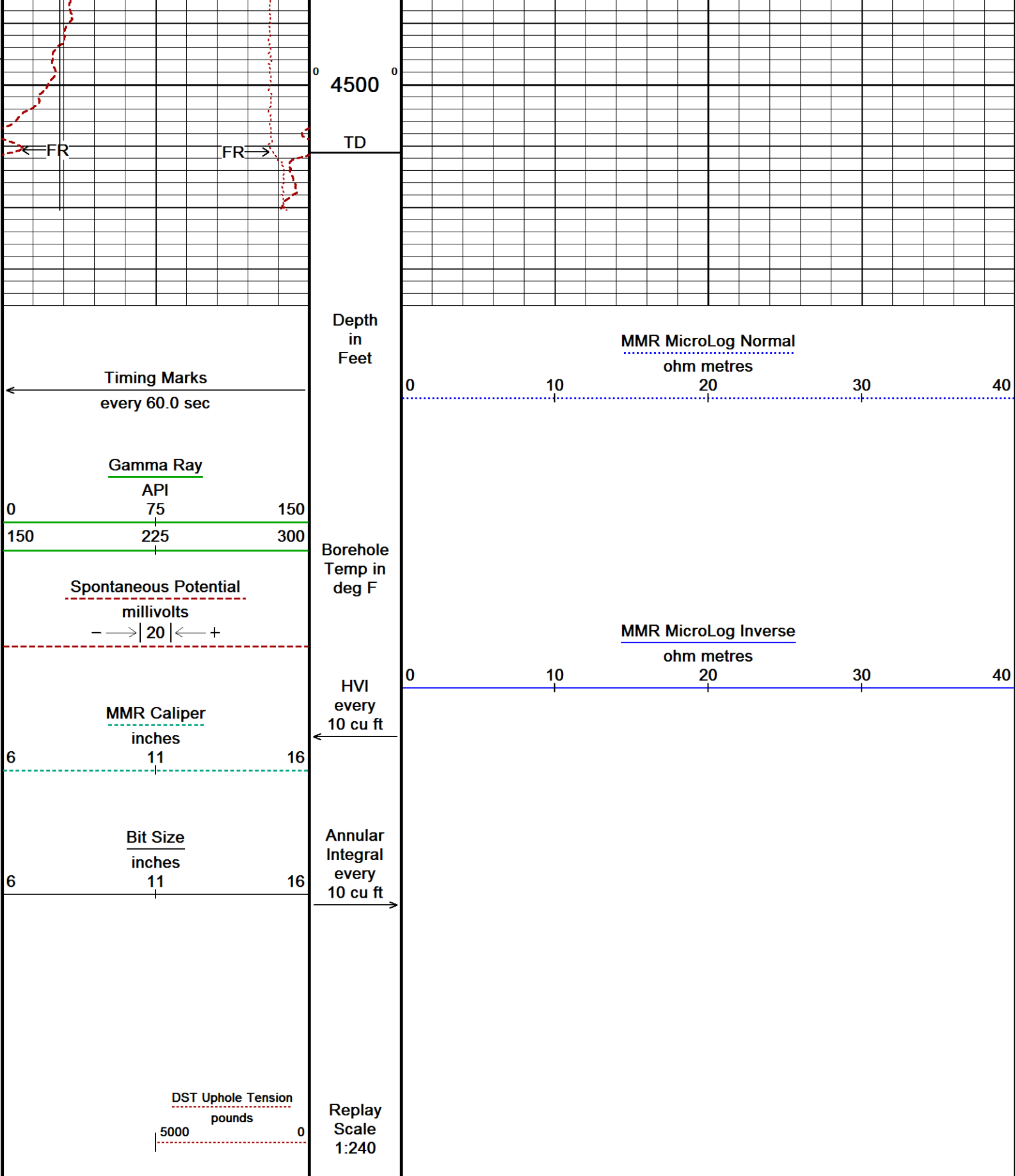
← FR

← FR

FR →

FR →





General Constants All 000

Last Edited on 15-JUN-2018,01:35

General Parameters

Mud Resistivity	0.600	ohm-metres
Mud Resistivity Temperature	96.000	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	4.500	inches
Caliper for Differential Caliper	Density Caliper	

Rwa Parameters

Porosity used	Crossplot Porosity
Resistivity used	Array Ind. Two Res Rt
RWA Constant A	0.620
RWA Constant M	2.150
SW/APOR Tool Source	0.000

Down-hole Tension Calibration SMS 0

Field Calibration on 14-JUN-2018 22:36

Reading No	Measured	Calibrated (lbs)
1	15468.14	0.00
2	16556.59	454.20

Gamma Calibration MCG-D.A 246

Field Calibration on 11-JUN-2018 15:07

	Measured	Calibrated (API)
Background	75	51
Calibrator (Gross)	743	507
Calibrator (Net)	668	456

Gamma Calibration Tolerances MCG-D.A 246

Ratio	1.465		Counts/API
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Gamma Constants MCG-D.A 246

Last Edited on 14-JUN-2018,22:06

Gamma Calibrator Number	MCGGRCC141	
GRC-M Calibrator Jig in Use?	NO	
Inactive Background Jig in Use?	NO	
Mud Density	1.13	gm/cc
Caliper Source for Processing	Density Caliper	
Tool Position	Eccentred	
Potassium Equivalence	Chloride	
K Mud Concentration	0.00	%

High Resolution Temperature Calibration MCG-D.A 246

Field Calibration on 07-JUN-2018,10:42

	Measured	Calibrated(Deg F)
Lower	50.00	50.00
Upper	212.00	212.00

High Resolution Temperature Constants MCG-D.A 246

Last Edited on 07-JUN-2018,10:42

Pre-filter Length	11
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SP Calibration MCG-D.A 246

Field Calibration on 07-JUN-2018 11:07

	Measured	Calibrated (mV)
Reference 1	103.5	100.0
Reference 2	-96.9	-100.1

Micro Normal and Micro Inverse Calibration MMR-B.A 91

Base Calibration on 07-JUN-2018 13:43

Field Check on 11-JUN-2018 15:37

	Resistor 1 (ohm)	Resistor 2 (ohm)
Base Calibration	10.0	50.0

Measured	Calibrated (ohm-m)
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Micro Normal	10.2	49.8	5.1	25.6
Micro Inverse	9.9	49.4	3.4	16.9

Channel	Base Check (ohm-m)	Field Check (ohm-m)
Micro Normal	93.9	93.9
Micro Inverse	62.3	62.3

Micro Normal & Micro Inverse Calibration Tolerance MMR-B.A 91

Micro Normal Res. 1	10.2		ohm	Micro Normal Res. 2	49.8		ohm
Micro Inverse Res. 1	9.9		ohm	Micro Inverse Res. 2	49.4		ohm
Micro Normal Base Check	93.9		ohm-m				
Micro Inverse Base Check	62.3		ohm-m				
Micro Normal Field Check	93.9		ohm-m				
Micro Inverse Field Check	62.3		ohm-m				

Micro Normal and Micro Inverse Constants MMR-B.A 91

Last Edited on 13-APR-2018,05:04

Pad Type	8-12 in Soft Rubber Inflatable 006-9011-159
Micro Normal K Factor	0.5110
Micro Inverse K Factor	0.3380
Standoff Offset	0.0000 inches

Caliper Calibration MMR-B.A 91

Base Calibration on 07-JUN-2018 13:30
Field Calibration on 11-JUN-2018 15:36

Base Calibration		
Reading No	Measured	Calibrator Size (in)
1	13946	5.98
2	17303	7.97
3	20607	9.86
4	24616	11.92
5	0	0.00
6	N/A	N/A
Field Calibration		
	Measured Caliper (in)	Actual Caliper (in)
	8.00	7.97

Caliper Calibration Tolerances MMR-B.A 91

Short Arm Field Cal.	8.00		in
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Micro-Resistivity Caliper Constants MMR-B.A 91

Sonde Configuration	Resistivity Mode
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Micro Laterolog Calibration MMR-B.A 91

Base Calibration on 31-DEC-1999 00:00
Field Check on 31-DEC-1999 00:00

	Resistor 1 (ohm)	Resistor 2 (ohm)
	0.0	0.0
Base Calibration		
	Measured	Calibrated (ohm-m)
	Ref 1 Ref 2	Ref 1 Ref 2
	0.0 0.0	0.0 0.0
	Base Check (ohm-m)	Field Check (ohm-m)
	0.0	0.0

Micro Laterolog Constants MMR-B.A 91

Pad Type	6 in Solid Nylon B23059
Standoff Offset	0.0000 inches
Micro Laterolog K Factor	0.0128
Micro Laterolog Rm K Factor	N/A
Mudcake Thickness Correction Constants	
Mud Cake Source	Constant Value
Mud Cake Thickness	0.4000 inches

Mud Cake Thickness Caliper	0.1500	ohm-m
Mud Cake Resistivity	20.00	Degrees C
Mud Cake Resistivity Temp.	Constant Value	
Mud Cake Resistivity Source	MCG External Temperature	
Temp. for Rmc Corr.		

Neutron Calibration MDN-B.A 292

Base Calibration on 15-MAY-2018 10:16
Field Check on 11-JUN-2018 15:13

Base Calibration

	Measured		Calibrated (cps)	
	Near	Far	Near	Far
	2945	91	3714	110
Ratio	32.304		33.764	

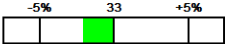
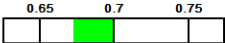
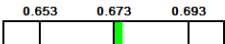
Field Calibrator at Base

	Calibrated (cps)
	2179 3239
Ratio	0.673

Field Check

	Calibrated (cps)
	2170 3215
Ratio	0.675

Neutron Calibration Tolerances MDN-B.A 292

Ratio	32.304	
Base Check	0.673	
Field Check	0.675	

Neutron Constants MDN-B.A 292

Last Edited on 14-JUN-2018,22:08

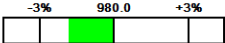
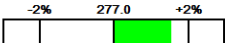
Neutron Source Id	P0204NN	
Neutron Jig Number	NJ5736	
Air Hole Processing	Modified Ratio	
Caliper Source for Processing	Density Caliper	
Stand-off	0.00	inches
Mud Density	1.00	gm/cc
Limestone Sigma	7.10	cu
Sandstone Sigma	4.26	cu
Dolomite Sigma	4.70	cu
Formation Pressure Source	None	
Formation Pressure	N/A	kpsi
Temperature Source	Constant Value	
Temperature	68.00	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	

FE Calibration MFE-A.A 135

Base Calibration on 07-JUN-2018 13:53
Field Check on 11-JUN-2018 15:20

	Resistor 1 (ohm)	Resistor 2 (ohm)
	0.0	1000.0
Base Calibration		
	Measured	Calibrated (ohm-m)
Reference 1	0.0	0.0
Reference 2	962.0	126.8
Base Check		281.3
Field Check		281.2

FE Calibration Tolerances MFE-A.A 135

Reference 2	962.0		ohm
Base Check	281.3		ohm-m

Field Check	281.2		ohm-m
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FE Constants MFE-A.A 135 Last Edited on 11-JUN-2018,15:18

Running Mode	No Sleeve
MFE K Factor	0.1268
Borehole Correction Constants	
Sonde Position	0.5 inches
Hole Size Source	Density Caliper
Hole Size Constant Value	N/A inches
Rm Source	Global Value: Temperature Corrected
Temp. for Rm Corr.	MCG External Temperature

High Resolution Temperature Calibration MAI-A.A 111	Field Calibration on 23-FEB-2018,11:15
	Measured Calibrated(Deg F)
Lower	10.00 10.00
Upper	100.00 100.00

High Resolution Temperature Constants MAI-A.A 111	Last Edited on 26-JUN-2014,15:06
Pre-filter Length	11

Induction Calibration MAI-A.A 111 Factory Loop Calibration 07-JUN-2018 14:52
Field Check on 11-JUN-2018 16:21

Factory Loop Calibration	
High Conductivity Reference Resistor	3.3 ohm
Low Conductivity Reference Resistor	333.3 ohm
	Measured Signal (unitless) Reference Conductivity (mmho/m) Calibration
Array	Low High Low High Gain Offset
1 (near)	17.6 473.6 9.3 966.2 0.000 0.0
2	6.4 385.9 7.6 821.4 0.000 0.0
3	3.2 264.0 5.2 566.0 0.000 0.0
4 (far)	2.1 135.5 2.6 279.2 0.000 0.0
Array Temperature	23.0 Deg F

Tool Checks	
	Factory Reference (mmho/m) Before Survey (mmho/m)
Array	Low High Low High
1 (near)	11.4 3841.4 11.4 3842.9
2	29.4 3499.6 29.4 3500.4
3	28.8 2996.9 28.7 2997.4
4 (far)	18.9 2041.5 18.9 2041.9
Array Temperature	83.6 99.3 Deg F

Induction Check Tolerances MAI-A.A 111									
Low Array 1	11.4	9.911.412.9	mmho/m	High Array 1	3842.9	-0.5%3841.4+0.5%	mmho/m		
Low Array 2	29.4	27.929.430.9	mmho/m	High Array 2	3500.4	-0.5%3499.6+0.5%	mmho/m		
Low Array 3	28.7	27.328.830.3	mmho/m	High Array 3	2997.4	-0.5%2996.9+0.5%	mmho/m		
Low Array 4	18.9	17.418.920.4	mmho/m	High Array 4	2041.9	-0.5%2041.5+0.5%	mmho/m		

Induction Constants MAI-A.A 111 Last Edited on 14-JUN-2018,22:05

Induction Model	RtAP-WBM
Borehole Correction Constants	
Tool Centred	No
Hole Size Source	Density Caliper
Hole Size Constant Value	2.500 inches
Stand-off Type	Fins
Stand-off	0.50 inches
Number of Fins on Stand-off	8.0000
Stand-off Fin Angle	45.00 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	
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-C.A 216			Base Calibration on 07-JUN-2018 14:09	
			Field Calibration on 11-JUN-2018 15:33	
Base Calibration				
Reading No	Measured		Calibrator Size (in)	
1	14245		3.99	
2	22960		5.98	
3	31650		7.97	
4	39952		9.86	
5	49231		11.92	
6	N/A		N/A	
Field Calibration				
	Measured Caliper (in)		Actual Caliper (in)	
	7.93		7.97	

Caliper Calibration Tolerances MPD-C.A 216				
Long Arm Field Cal.	7.93	7.57 7.97 8.37	in	

Photo Density Calibration MPD-C.A 216			Base Calibration on 07-JUN-2018 14:35	
			Field Check on 11-JUN-2018 15:18	
Density Calibration				
Base Calibration		Measured	Calibrated (sdu)	
	Near	Far	Near	Far
Background	1007	1198		
Reference 1	50088	24364	59556	30836
Reference 2	19851	2273	24941	2541
Field Check at Base				
	1006.9	1197.8		
Field Check				
	1004.3	1191.6		
PE Calibration				
Base Calibration		Measured	Calibrated	

	WS	WH	Ratio	Ratio
Background	184	903		
Reference 1	21030	49928	0.425	0.371
Reference 2	5765	19740	0.296	0.272

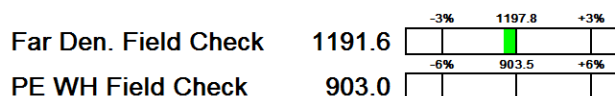
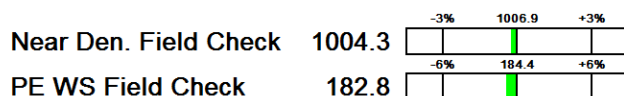
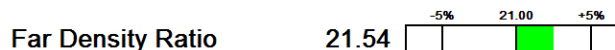
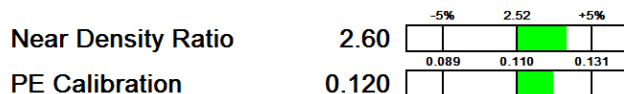
Field Check at Base

184.4 903.5

Field Check

182.8 903.0

Photo Density Calibration Tolerances MPD-C.A 216



Density Constants MPD-C.A 216

Last Edited on 14-JUN-2018,22:06

Density Source Id	P50557B	
Nylon Calibrator Number	DNCE695	
Aluminium Calibrator Number	DACD698	
Density Shoe Profile	8 inch	
Caliper Source for Processing	Density Caliper	
PE Correction to Density	Not Applied	
Mud Density	1.13	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	Not Applied	
Matrix Density (gm/cc)	Depth (ft)	
2.71	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:\Minimus 18.01.6830\Data\Shakespeare (Ottley 2-21)\MAIN PASS.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 724 LG: 2.30 ft WT: 22.0 lb OD: 2.244 in

Compact Comms Gamma
MCG-D.A 246 LG: 8.70 ft WT: 63.9 lb OD: 2.244 in

Compact Micro-Resistivity
MMR-B.A 91 LG: 8.59 ft WT: 81.6 lb OD: 4.882 in



45.66 ft GRGC - MCG Gamma Ray

42.76 ft CGXT - MCG External Temperature

36.40 ft MBTC - MMR Caliper

35.41 ft MINV - Micro-inverse

35.41 ft MNRL - Micro-normal

Compact Neutron
MDN-B.A 202 LG: 5.04 ft WT: 50.7 lb OD: 2.244 in

MDN-B.A 292 LG: 5.04 ft WT: 50.7 lb OD: 2.244 in

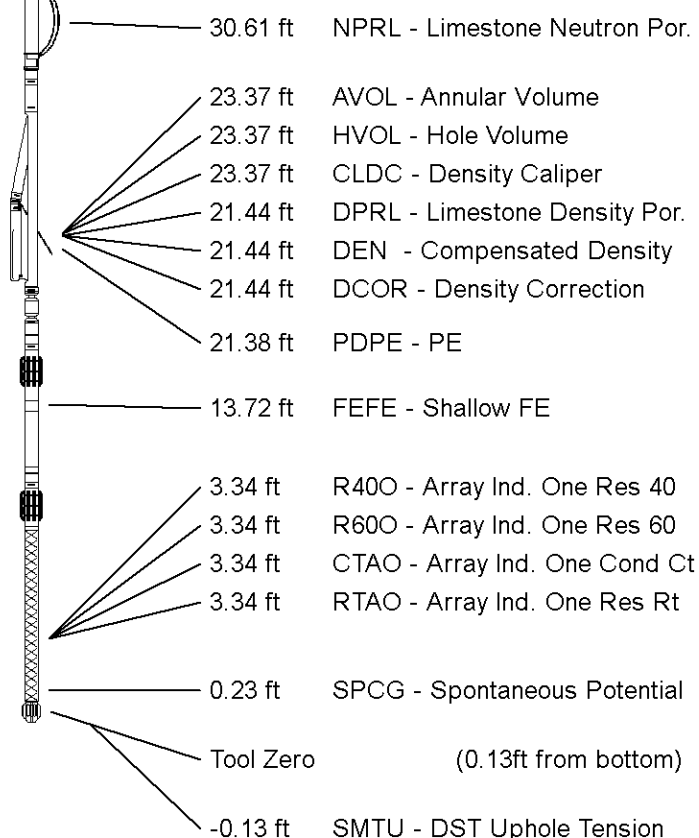
Compact Density/Caliper
MPD-C.A 216 LG: 9.59 ft WT: 90.4 lb OD: 2.913 in

Compact Knuckle Joint
SKJ-D.A 167 LG: 2.17 ft WT: 24.3 lb OD: 2.244 in

Compact Focussed Electric
MFE-A.A 135 LG: 6.05 ft WT: 48.5 lb OD: 2.244 in

Compact Induction
MAI-A.A 111 LG: 10.81 ft WT: 48.5 lb OD: 2.244 in

Total Length: 55.64 ft Weight: 454.2 lb



All measurements relative to tool zero.

COMPANY	SHAKESPEARE OIL CO., INC
WELL	OTTLEY 2-21
FIELD	CHALK BUTTES
PROVINCE/COUNTY	LOGAN
COUNTRY/STATE	USA / KANSAS

Elevation Kelly Bushing	2783	feet	First Reading	4476.00	feet
Elevation Drill Floor	2781	feet	Depth Driller	4511.00	feet
Elevation Ground Level	2771	feet	Depth Logger	4511.00	feet



Weatherford®

MICRORESISTIVITY LOG