# MICRO-RESISTIVITY LOG

| | |
|---|---|
| COMPANY | MURFIN DRILLING COMPANY, INC. |
| WELL | DAUNTLESS #15-1 |
| FIELD | WILDCAT |
| PROVINCE/COUNTY | LINCOLN |
| COUNTRY/STATE | U.S.A. / COLORADO |
| LOCATION | 990' FSL & 1650' FEL |

| | | | |
|---|---|---|---|
| SEC 1 | TWP 9S | RGE 56W | Other Services |
| Latitude | 39.290150 | | MAI / MFE MPD / MDN |
| Longitude | -103.608500 | | MSS |
| API Number | 05-073-06732 | | |

Permanent Datum GL, Elevation 5541 feet
Log Measured From KB, 13.00 feet above Permanent Datum
Drilling Measured From KB

| Elevations: | feet |
|---|---|
| KB | 5554.00 |
| DF | 5552.00 |
| GL | 5541.00 |

| | | | | |
|---|---|---|---|---|
| Date | 16-DEC-2017 | | | |
| Run Number | ONE | | | |
| Service Order | 17937-200624549 | | | |
| Depth Driller | 8820.00 | feet | | |
| Depth Logger | 8819.00 | feet | | |
| First Reading | 8770.00 | feet | | |
| Last Reading | 4000.00 | feet | | |
| Casing Driller | 420.00 | feet | | |
| Casing Logger | 478.00 | feet | | |
| Bit Size | 7.875 | inches | | |
| Hole Fluid Type | WBM | | | |
| Density / Viscosity | 9.35 lb/USg | 46.00 sec/qt | | |
| PH / Fluid Loss | 9.00 | 5.20 ml/30Min | | |
| Sample Source | FLOWLINE | | | |
| Rm @ Measured Temp | 0.93 @ 99.0 | ohm-m | | |
| Rmf @ Measured Temp | 0.74 @ 99.0 | ohm-m | | |
| Rmc @ Measured Temp | 1.12 @ 99.0 | ohm-m | | |
| Source Rmf / Rmc | CALC | CALC | | |
| Rm @ BHT | 0.51 @186.0 | ohm-m | | |
| Time Since Circulation | 8 HOURS | | | |
| Max Recorded Temp | 186.00 | deg F | | |
| Equipment / Base | 13057 | OKC | | |
| Recorded By | M. MCGLOTHLIN | | H. LEJEUNE | |
| Witnessed By | WES HANSEN | | SCOTT ROBINSON | |

Last Edited: 16-DEC-2017 16:40

## BOREHOLE RECORD

| Bit Size inches | Depth From feet | Depth To feet |
|---|---|---|
| 7.875 | 420.00 | 8820.00 |

## CASING RECORD

| Type | Size inches | Depth From feet | Shoe Depth feet | Weight pounds/ft |
|---|---|---|---|---|
| SURFACE | 8.625 | 0.00 | 420.00 | 24.00 |

## REMARKS

WLS SOFTWARE VERSION: 17.05.5956

TOOLSTRING: SHA, MCG, MMR, MDN (DUAL BOWSPRING ECCENTRALIZER), MPD (8" PROFILE PLATE), SKJ,
MFE (ONE 0.5" STANDOFF), MSS ( 0.5" STANDOFF), MAI (TWO 0.5" STANDOFFS)

LOG INTERVALS REQUESTED:
MICROLOG / DENSITY / NEUTRON: TD - 4000 FT
GAMMA RAY / INDUCTION / CALIPER / SONIC: TD - CASING

LIMESTONE MATRIX USED FOR POROSITY CALCULATION, 2.71 G/CC.

TOTAL HOLE VOLUME FROM TD TO SURFACE CASING: 4220 CU FT.
ANNULAR HOLE VOLUME FROM TD TO SURFACE CASING WITH 5.5" FUTURE CASING: 2840 CU FT.

MUD PROPERTIES:
CHLORIDES: 720 mg/L
LCM: 9 lb/bbl

CREW: M. MCGLOTHLIN, H. LEJEUNE, D. GILLISPIE.

***LOG RESPONSES EFFECTED BY HOLE RUGOSITY AND WASHOUTS***

***RESISTIVITY ANOMALY OBSERVED FROM 630 FEET TO CASING SHOE AT 478 FEET.***
***ANOMALY REPEATED DURING CASING CHECK AND SUBSEQUENT PASSES.***



## 2 Inch Mud Log 1:600

Depth Based Data - Maximum Sampling Increment 10.0cm
Plotted on 16-DEC-2017 19:34
Filename: C:\Minimus 17.05.5956\Data\MURFIN DRILLING (DAUNTLESS #15-1)\MAIN PASS.dta
Recorded on 16-DEC-2017 13:24
System Versions: Logged with 17.05.5956 Plotted with 17.05.5956

Timing Marks
every 60.0 sec

Spontaneous Potential
millivolts
– → | 20 | ← +

MMR Caliper
inches
6 11 16

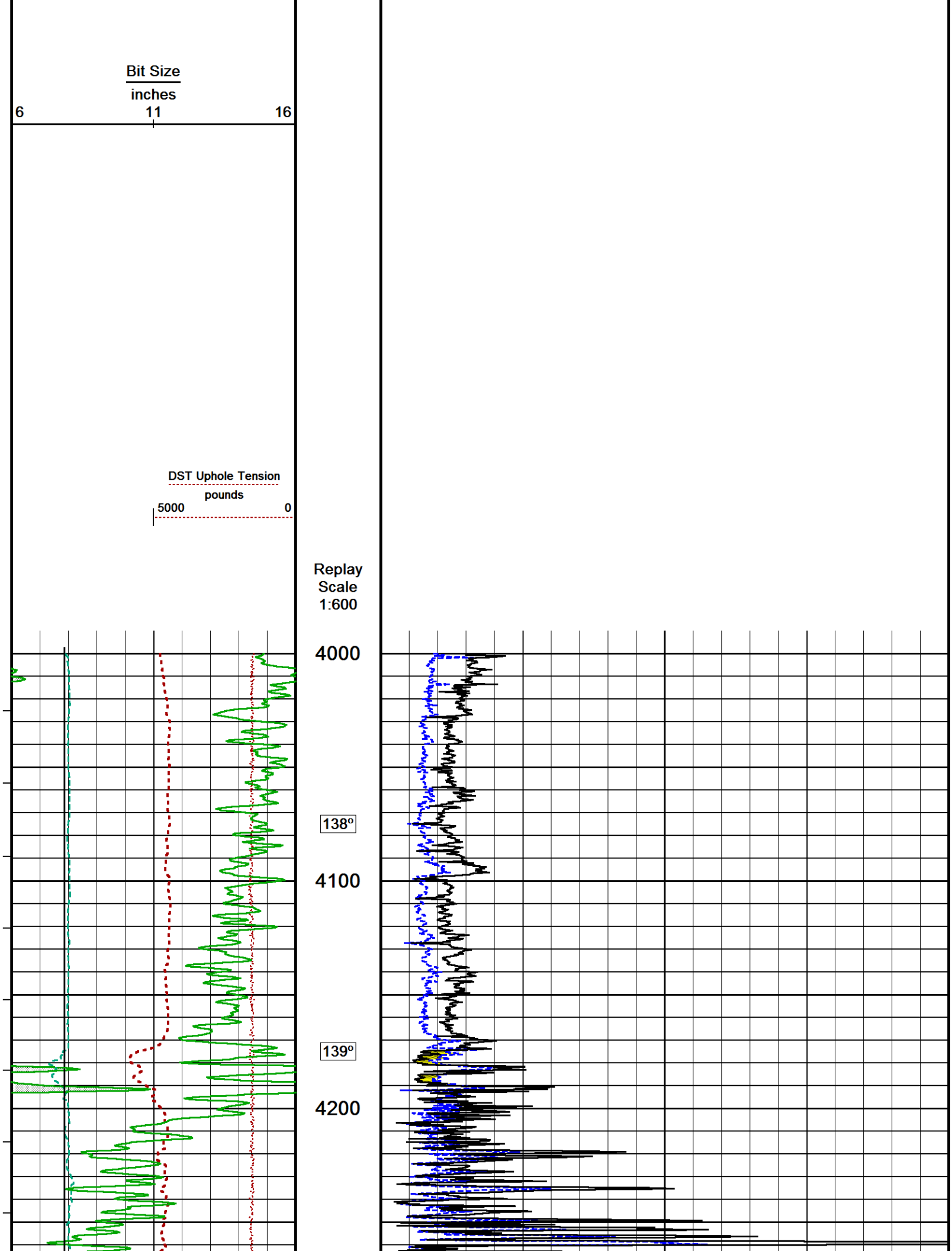
MCG BH Corrected Gamma
API
0 75 150
150 225 300

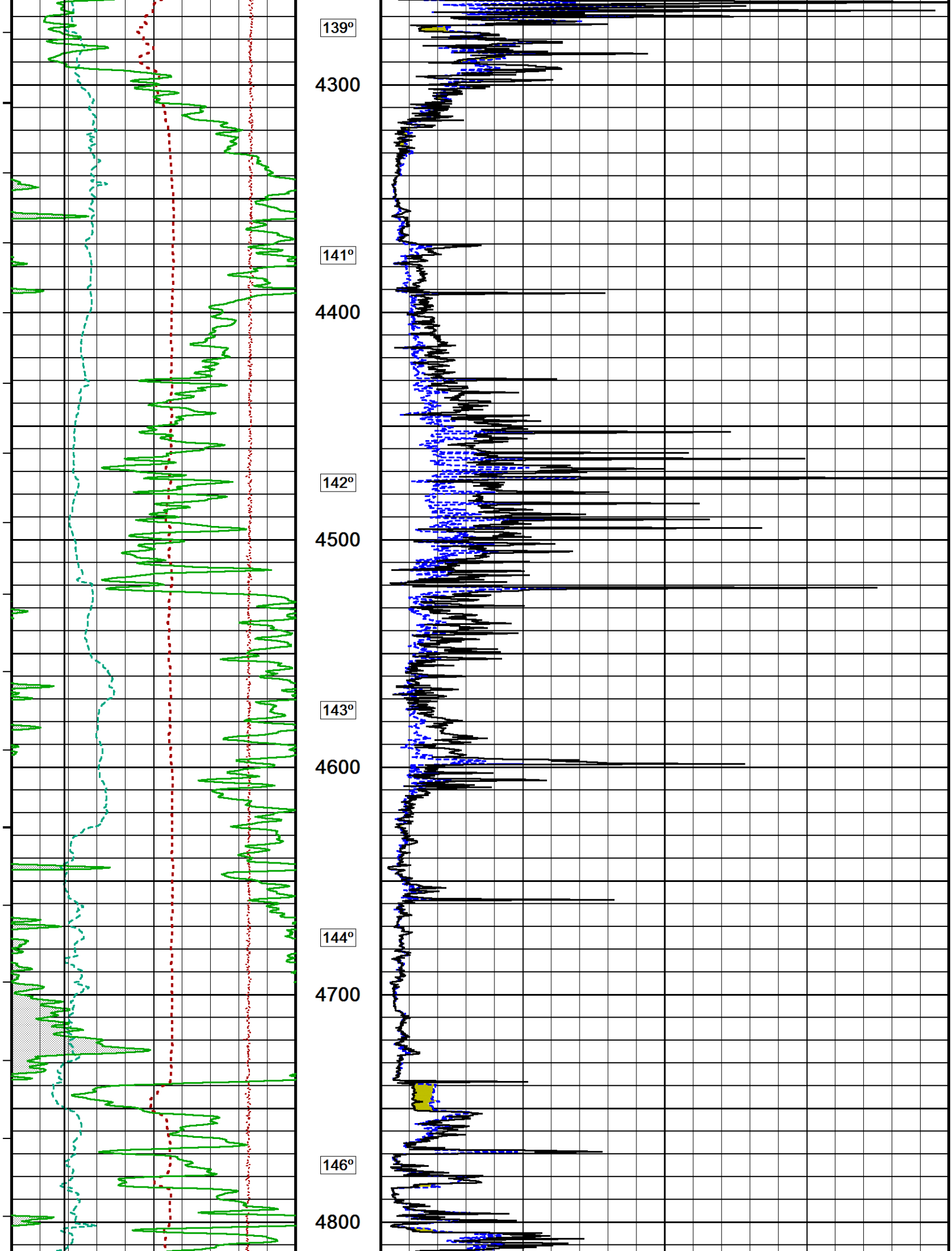
Depth In Feet

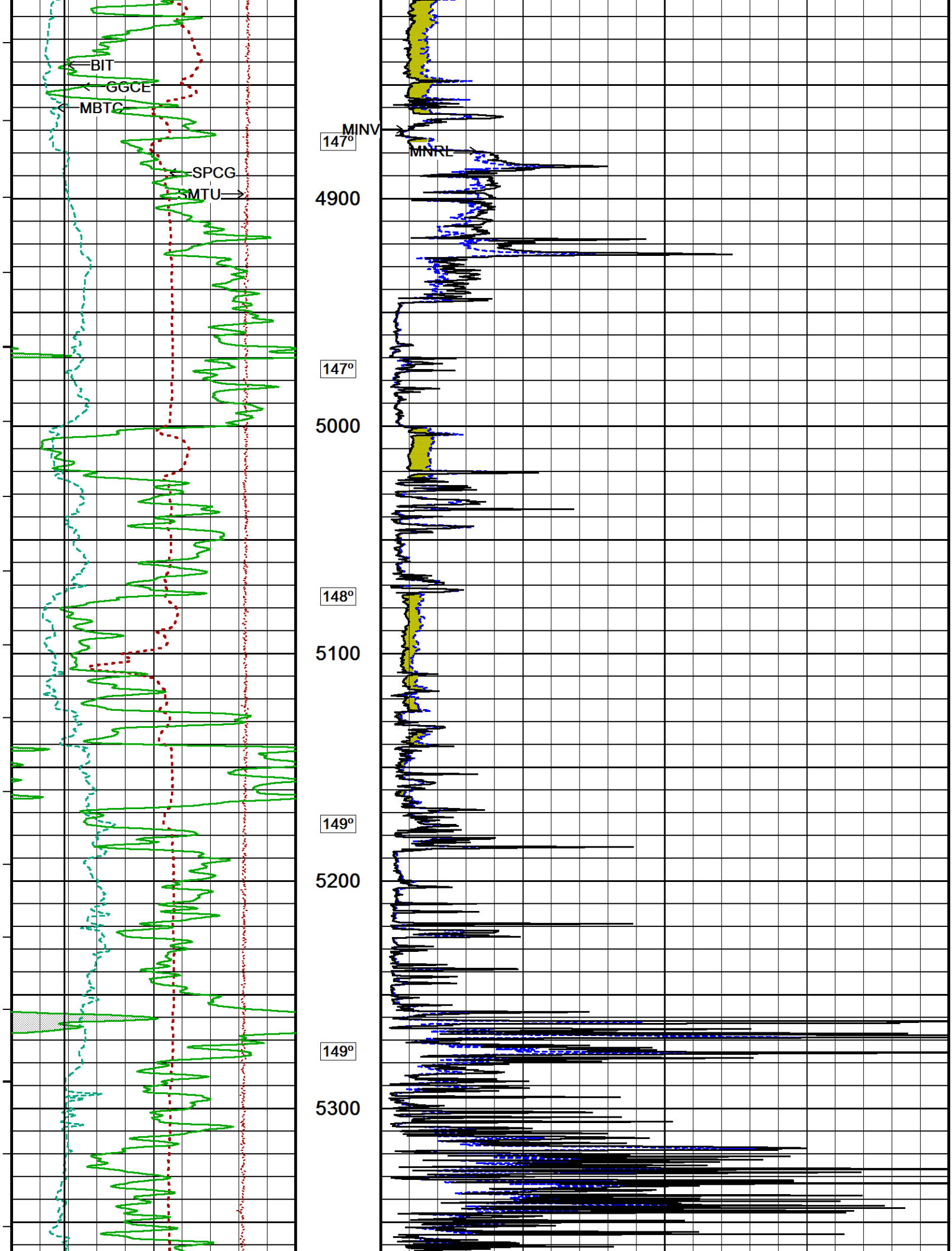
Borehole Temp in deg F

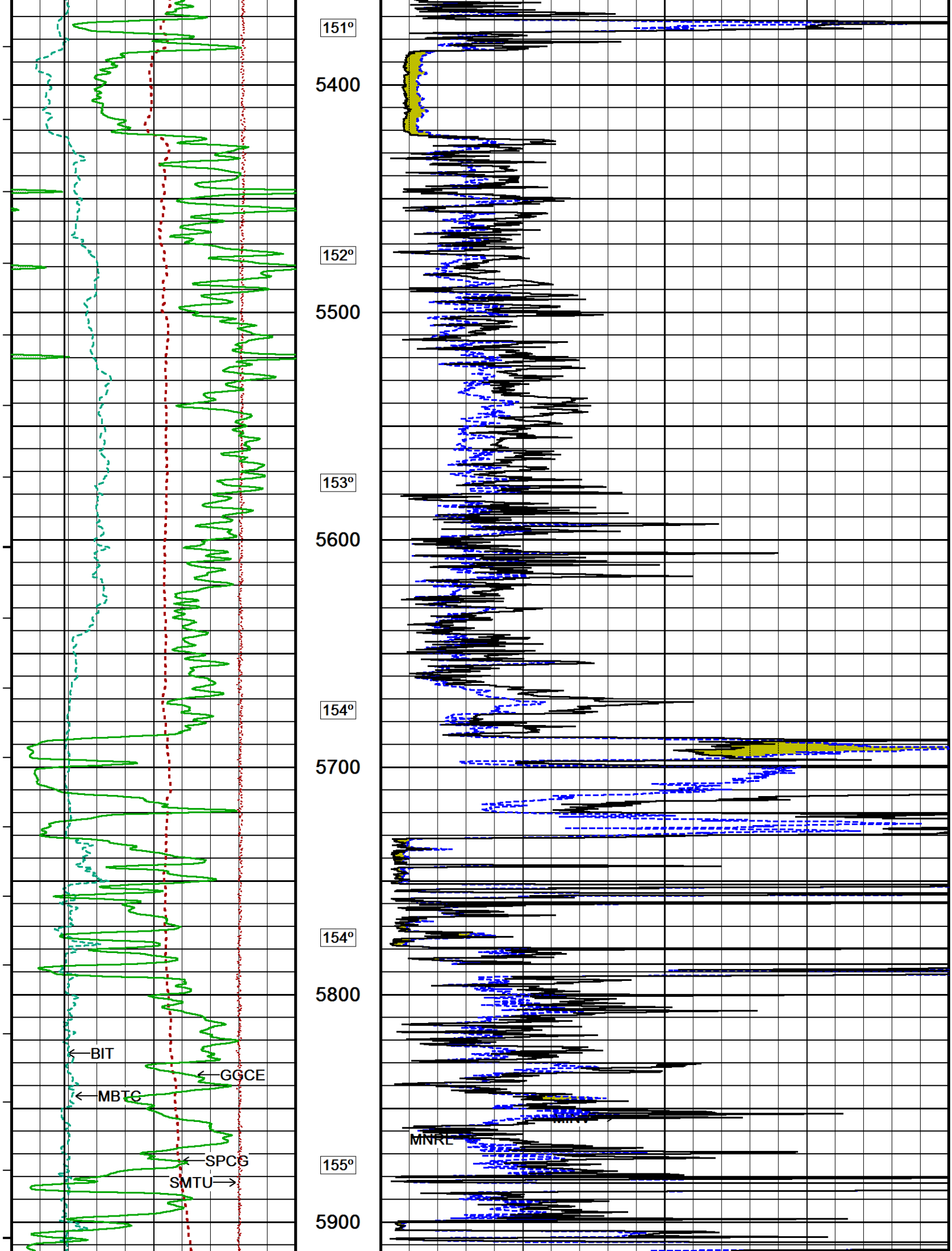
MMR MicroLog Normal
ohm metres
0 10 20 30 40

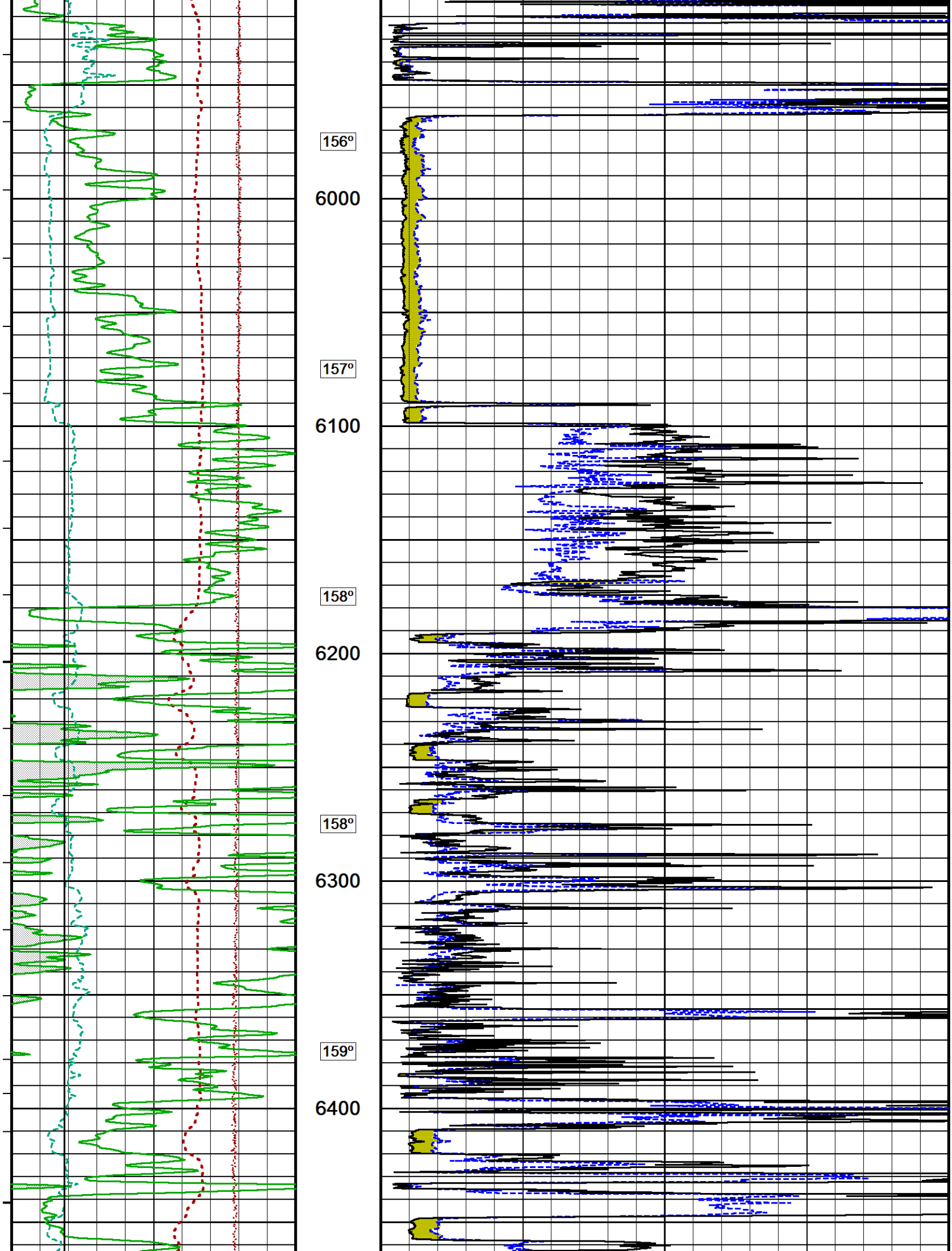
MMR MicroLog Inverse
ohm metres
0 10 20 30 40

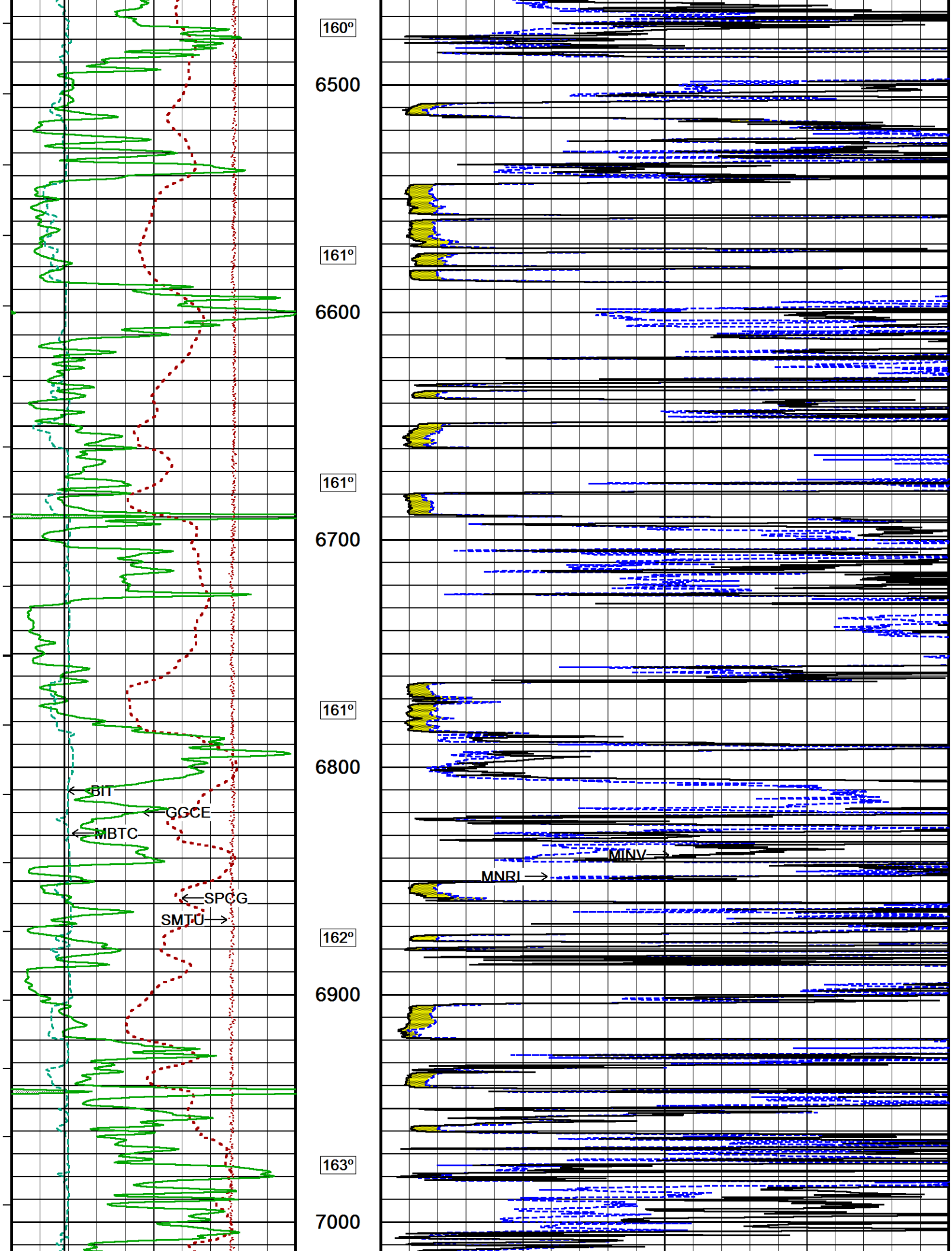

Bit Size
inches
6
11
16
DST Uphole Tension
pounds
5000
0
Replay
Scale
1:600
4000
138°
4100
139°
4200

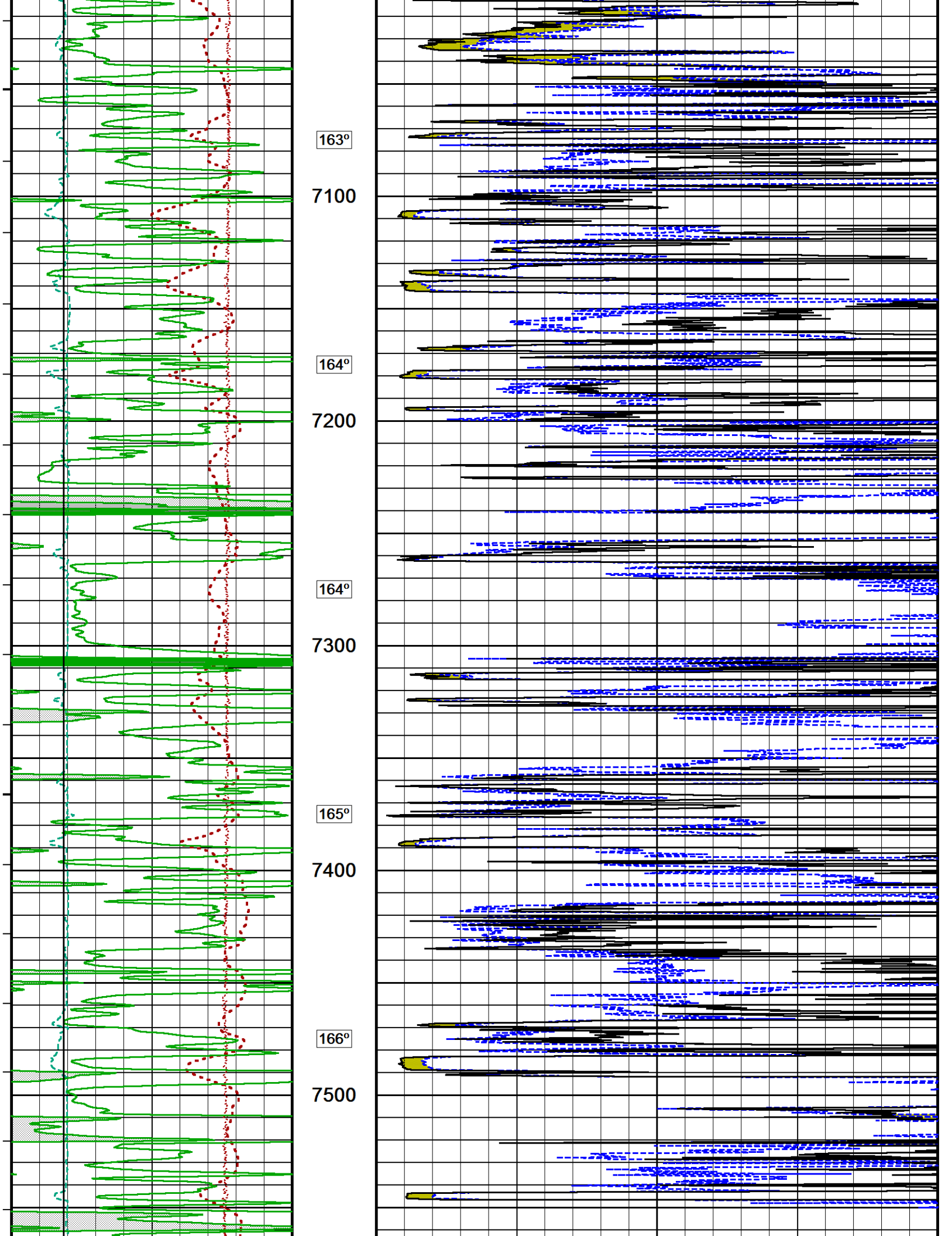

139°
4300
141°
4400
142°
4500
143°
4600
144°
4700
146°
4800

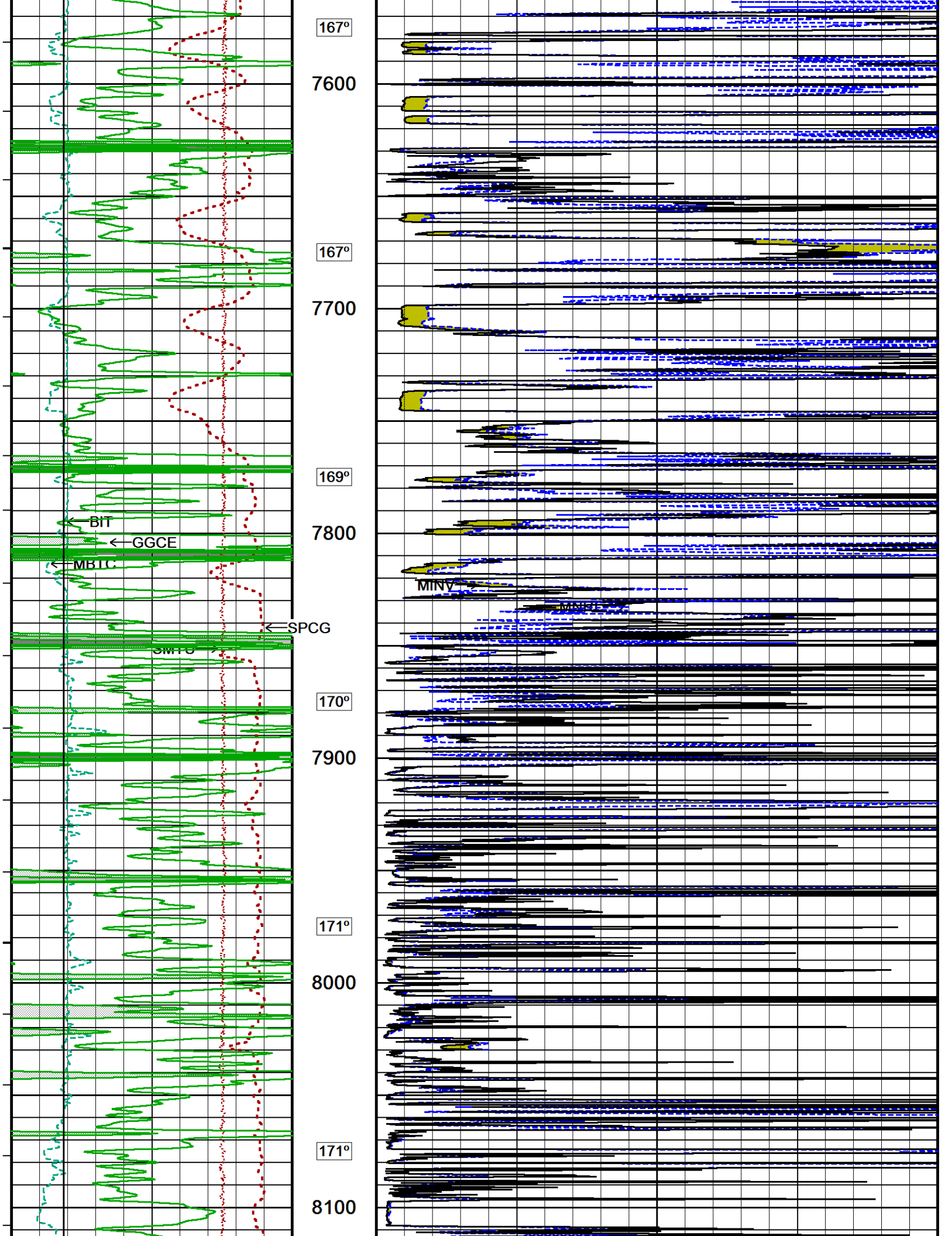

BIT
GGCE
MBTC
SPCG
SMTU
MINV
MNRL
147°
4900
147°
5000
148°
5100
149°
5200
149°
5300

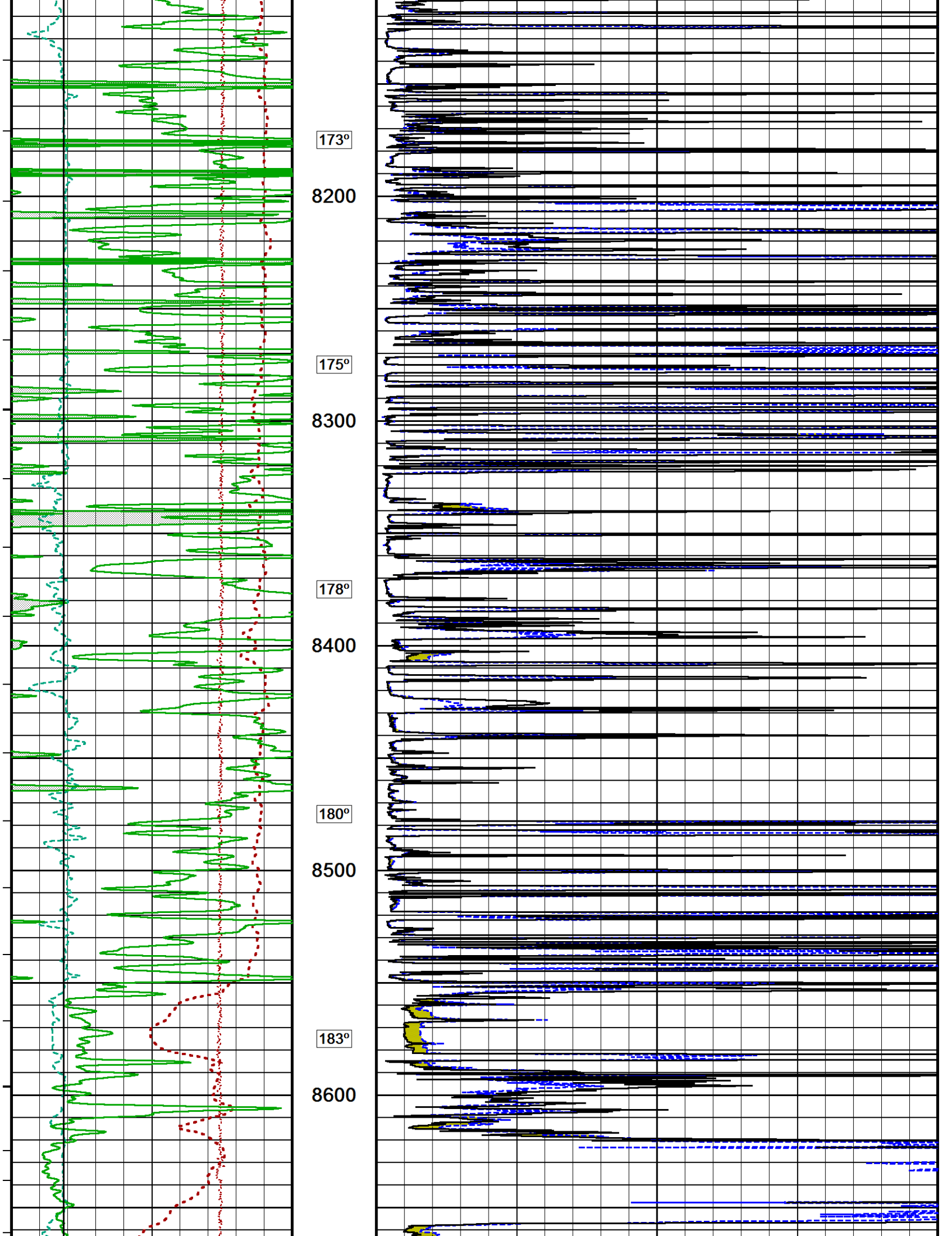

151°
5400
152°
5500
153°
5600
154°
5700
154°
5800
155°
5900
BIT
GGCE
MBTC
SPCG
SMTU
MNRL

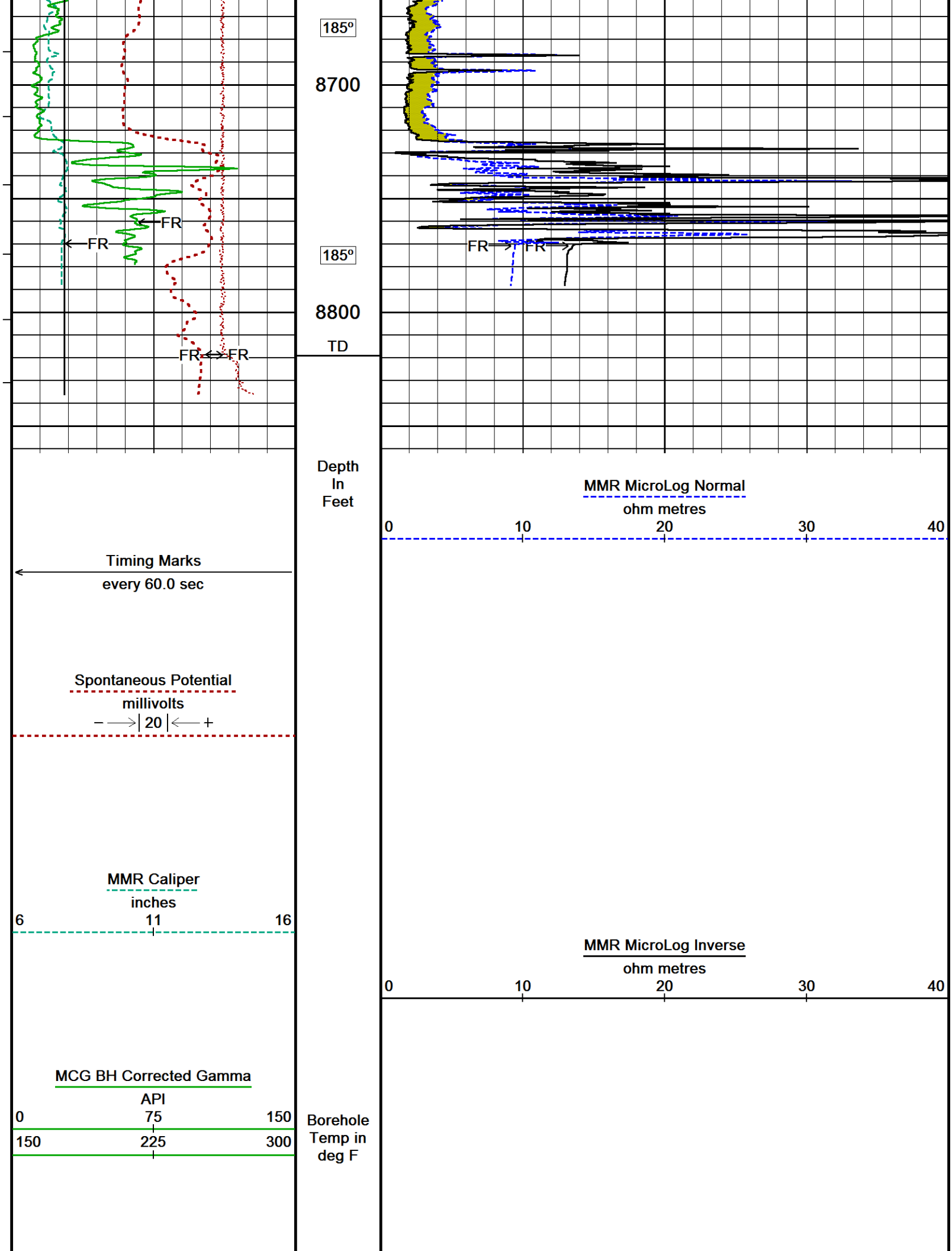

156º
6000
157º
6100
158º
6200
158º
6300
159º
6400


160°
6500
161°
6600
161°
6700
161°
6800
BIT
GGCE
MBTC
MINV
MNRI
SPCG
SMTU
162°
6900
163°
7000


163º
7100
164º
7200
164º
7300
165º
7400
166º
7500


167°
7600
167°
7700
169°
BIT
GGCE
MBTC
7800
MINV
MNRL
SPCG
SMPO
170°
7900
171°
8000
171°
8100


173º
8200
175º
8300
178º
8400
180º
8500
183º
8600


185°
8700
185°
8800
TD
FR
FR
FR
FR
FR
FR
Depth
In
Feet
MMR MicroLog Normal
ohm metres
0
10
20
30
40
Timing Marks
every 60.0 sec
Spontaneous Potential
millivolts
– 20 +
MMR MicroLog Inverse
ohm metres
0
10
20
30
40
MMR Caliper
inches
6
11
16
MCG BH Corrected Gamma
API
0
75
150
150
225
300
Borehole
Temp in
deg F

Bit Size
inches
6 11 16

DST Uphole Tension
pounds
5000 0

Replay
Scale
1:600

Depth Based Data - Maximum Sampling Increment 10.0cm
Plotted on 16-DEC-2017 19:34
Filename: C:\Minimus 17.05.5956\Data\MURFIN DRILLING (DAUNTLESS #15-1)\MAIN PASS.dta
Recorded on 16-DEC-2017 13:24
System Versions: Logged with 17.05.5956 Plotted with 17.05.5956

## 2 Inch Mud Log 1:600

## 5 Inch Main Pass 1:240

Depth Based Data - Maximum Sampling Increment 10.0cm
Plotted on 16-DEC-2017 19:34
Filename: C:\Minimus 17.05.5956\Data\MURFIN DRILLING (DAUNTLESS #15-1)\MAIN PASS.dta
Recorded on 16-DEC-2017 13:24
System Versions: Logged with 17.05.5956 Plotted with 17.05.5956

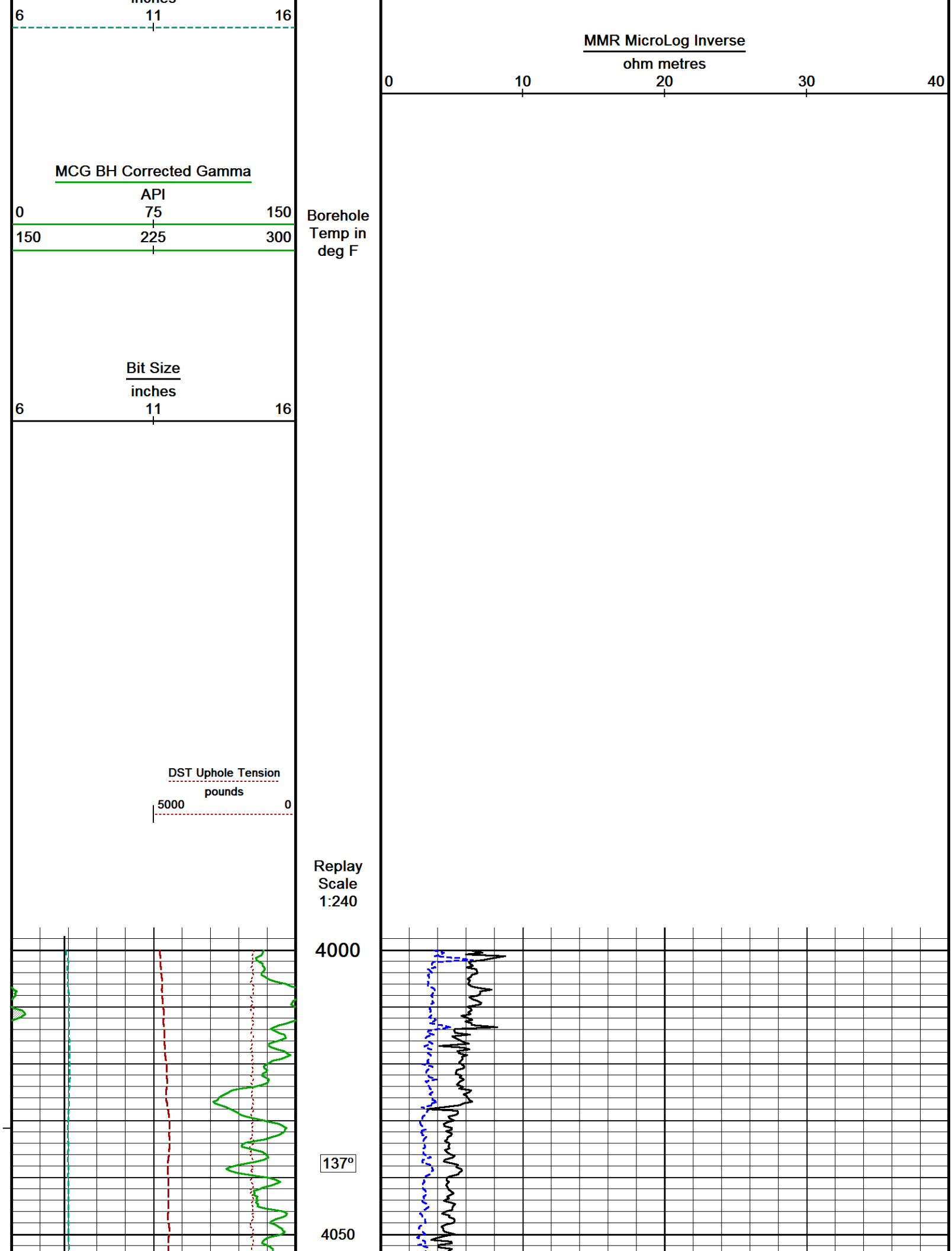
Depth
In
Feet

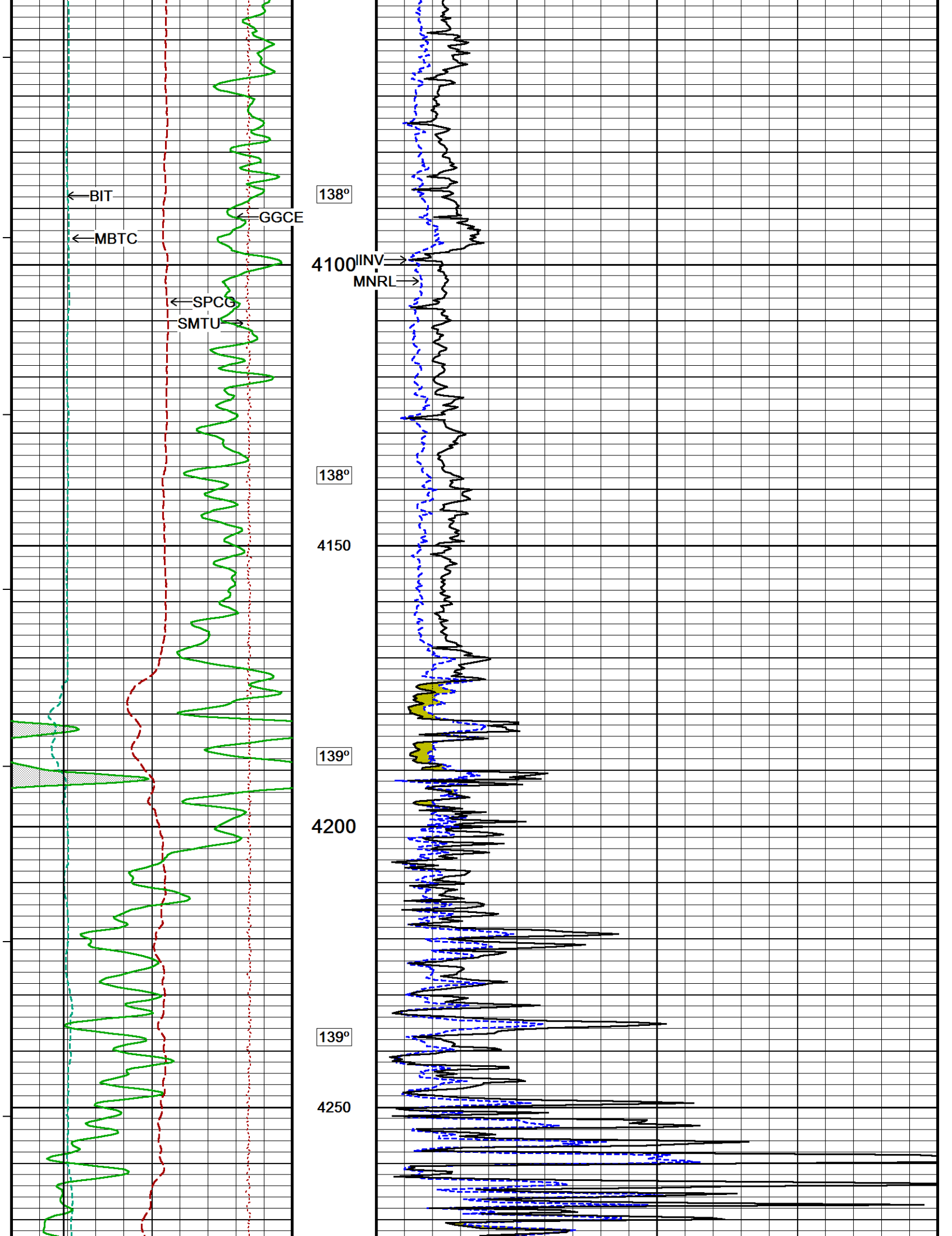
MMR MicroLog Normal
ohm metres
0 10 20 30 40

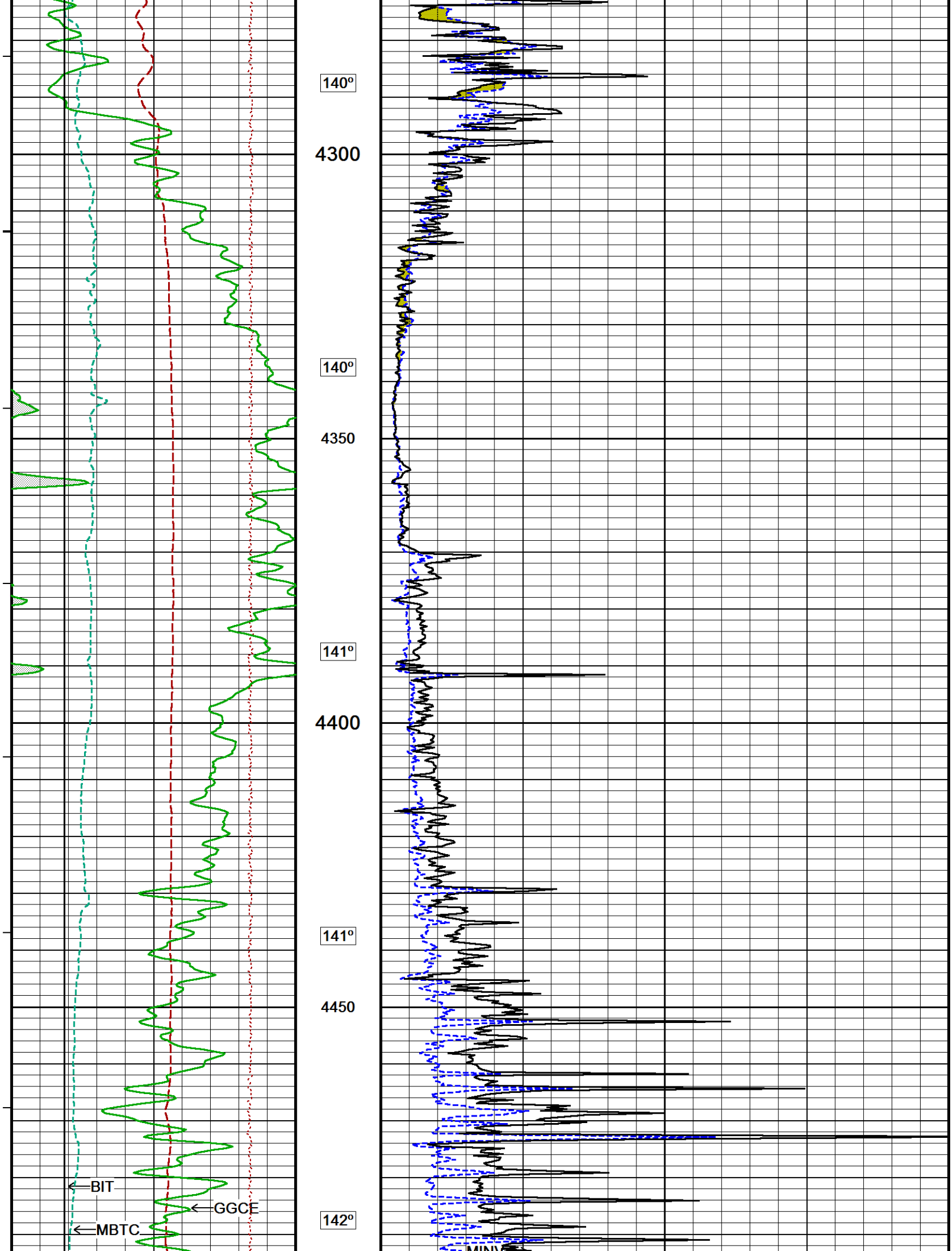
Timing Marks
every 60.0 sec

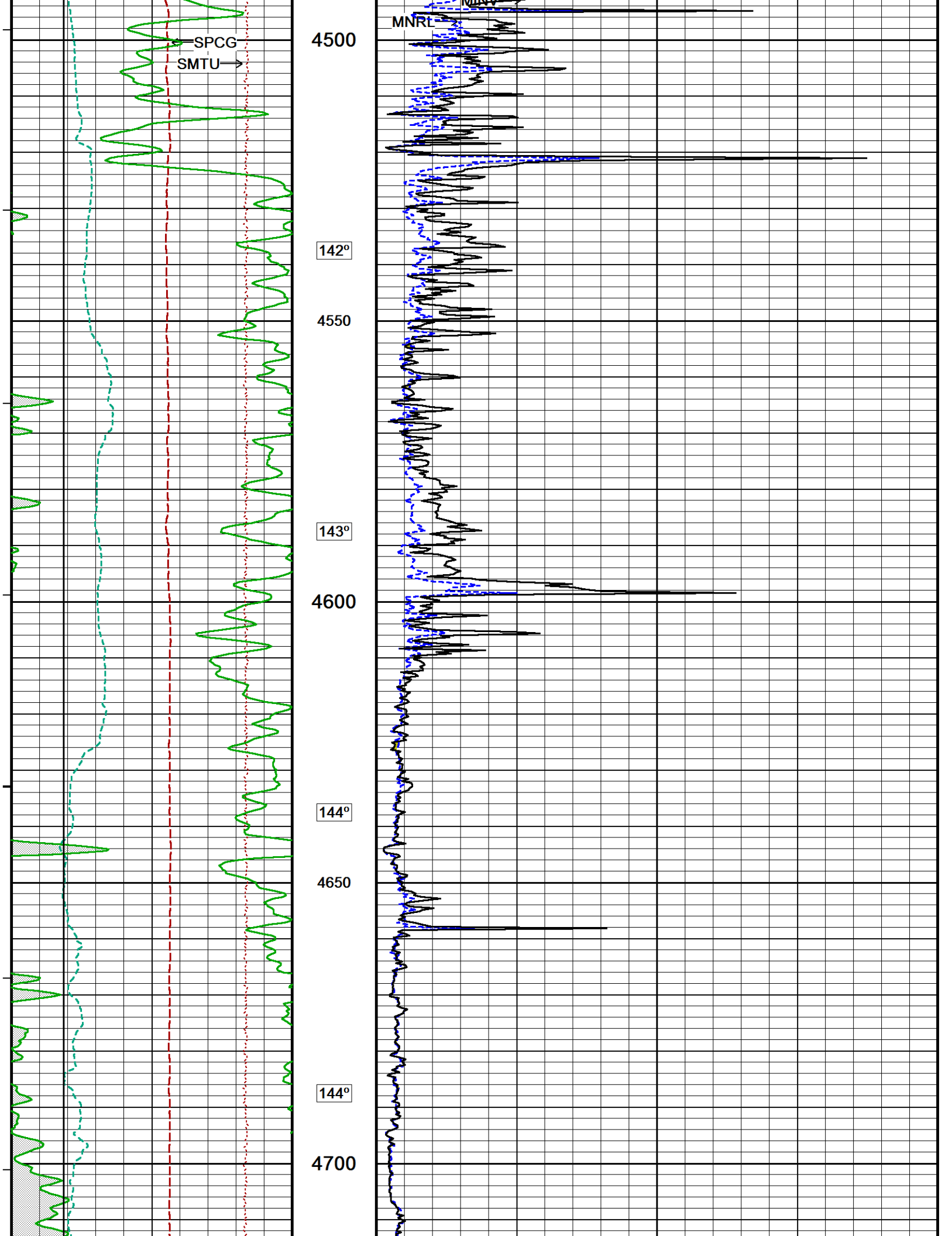
Spontaneous Potential
millivolts
− 20 +

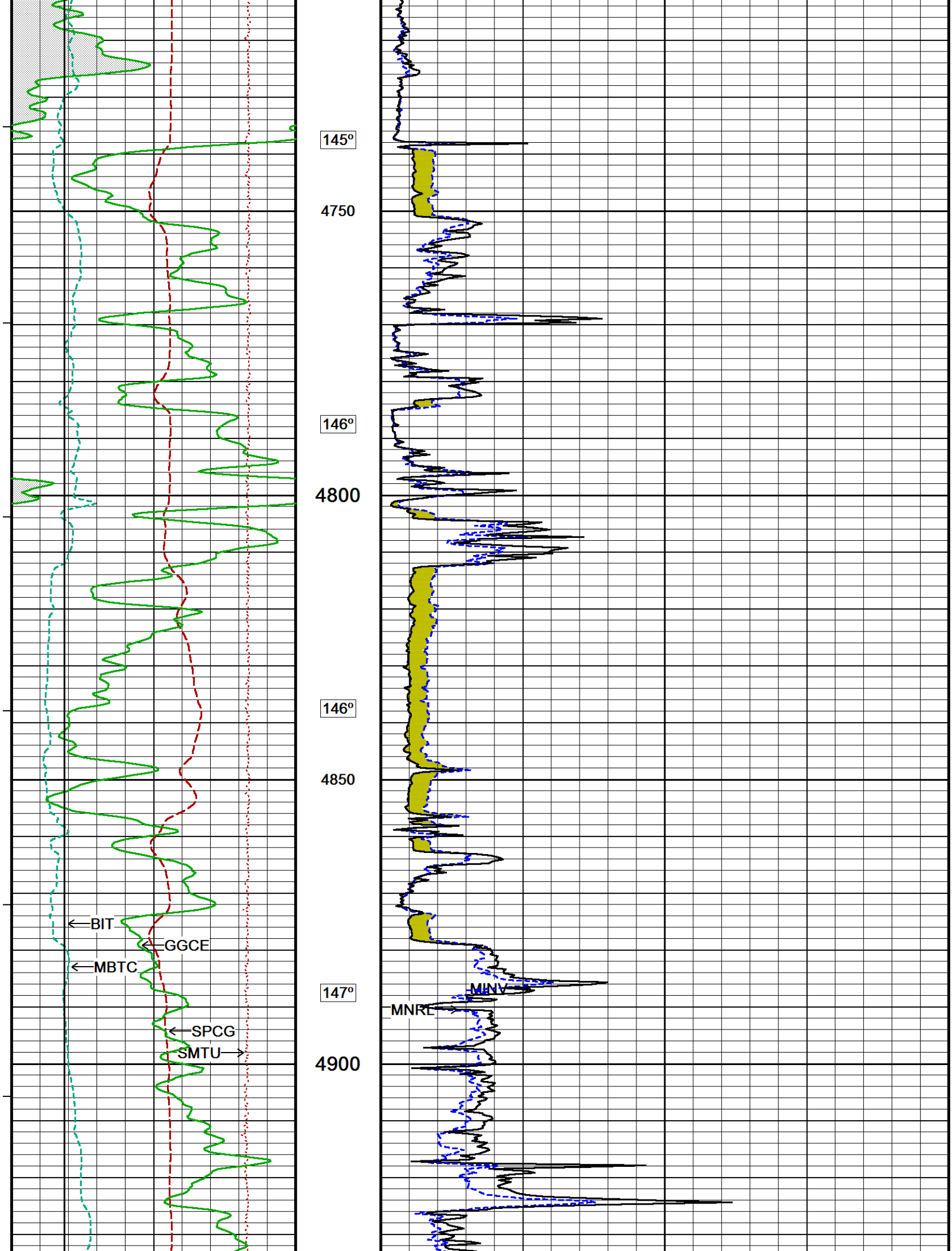
MMR Caliper
inches

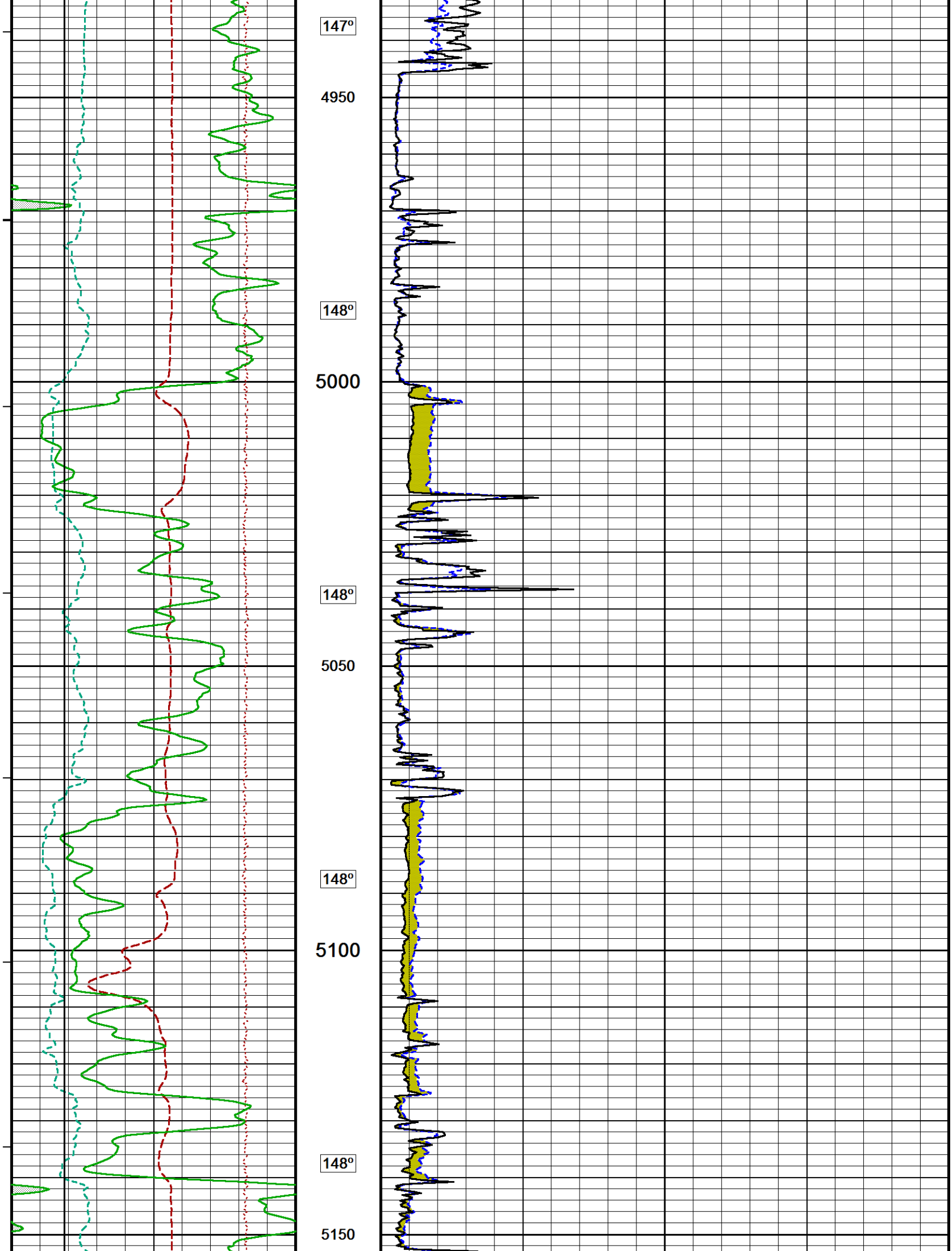

6
11
16
MCG BH Corrected Gamma
API
0
75
150
150
225
300
Bit Size
inches
6
11
16
DST Uphole Tension
pounds
5000
0
Borehole Temp in deg F
MMR MicroLog Inverse
ohm metres
0
10
20
30
40
Replay Scale 1:240
4000
137°
4050

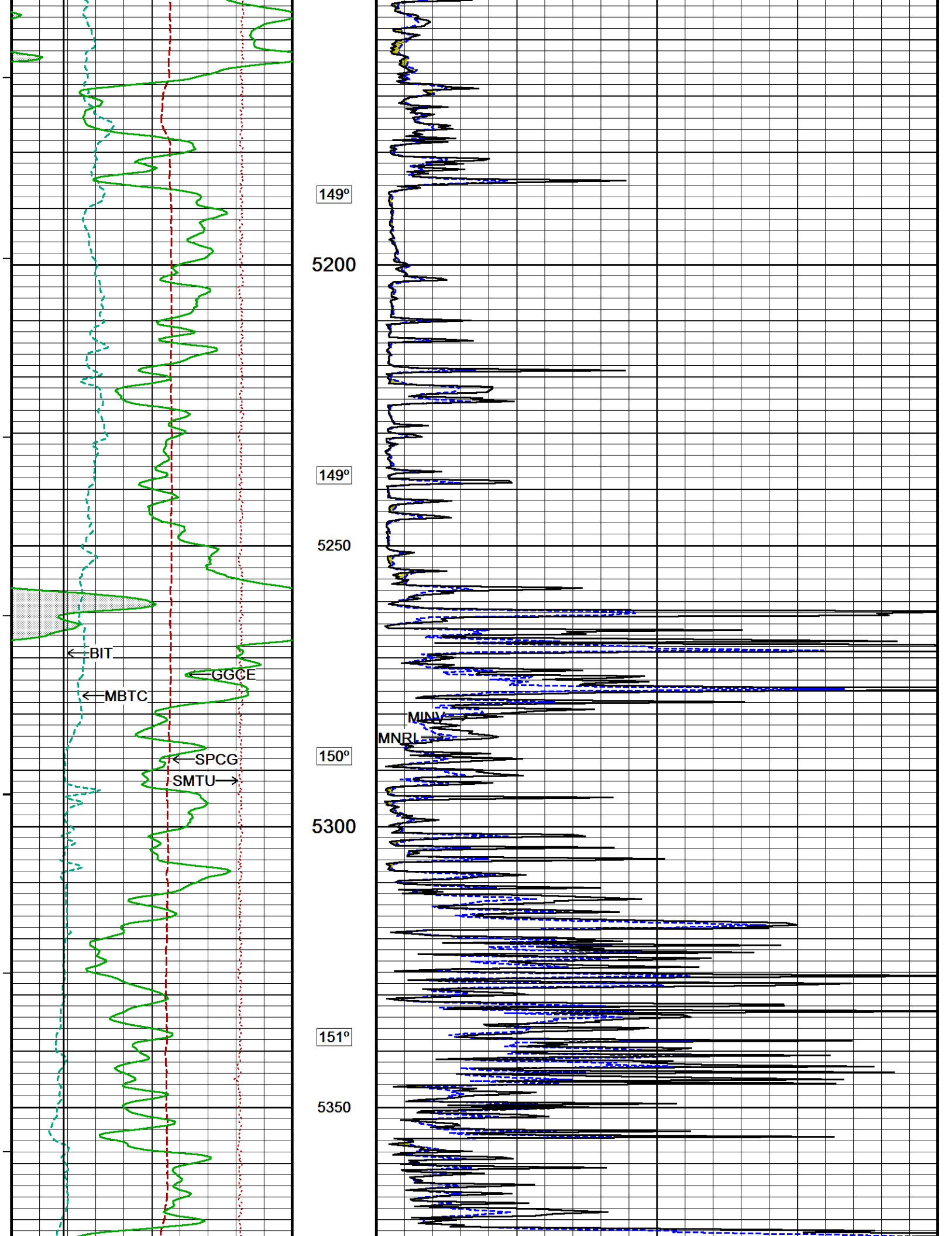

BIT
MBTC
GGCE
SPCG
SMTU
IINV
MNRL
138°
138°
139°
139°
4100
4150
4200
4250

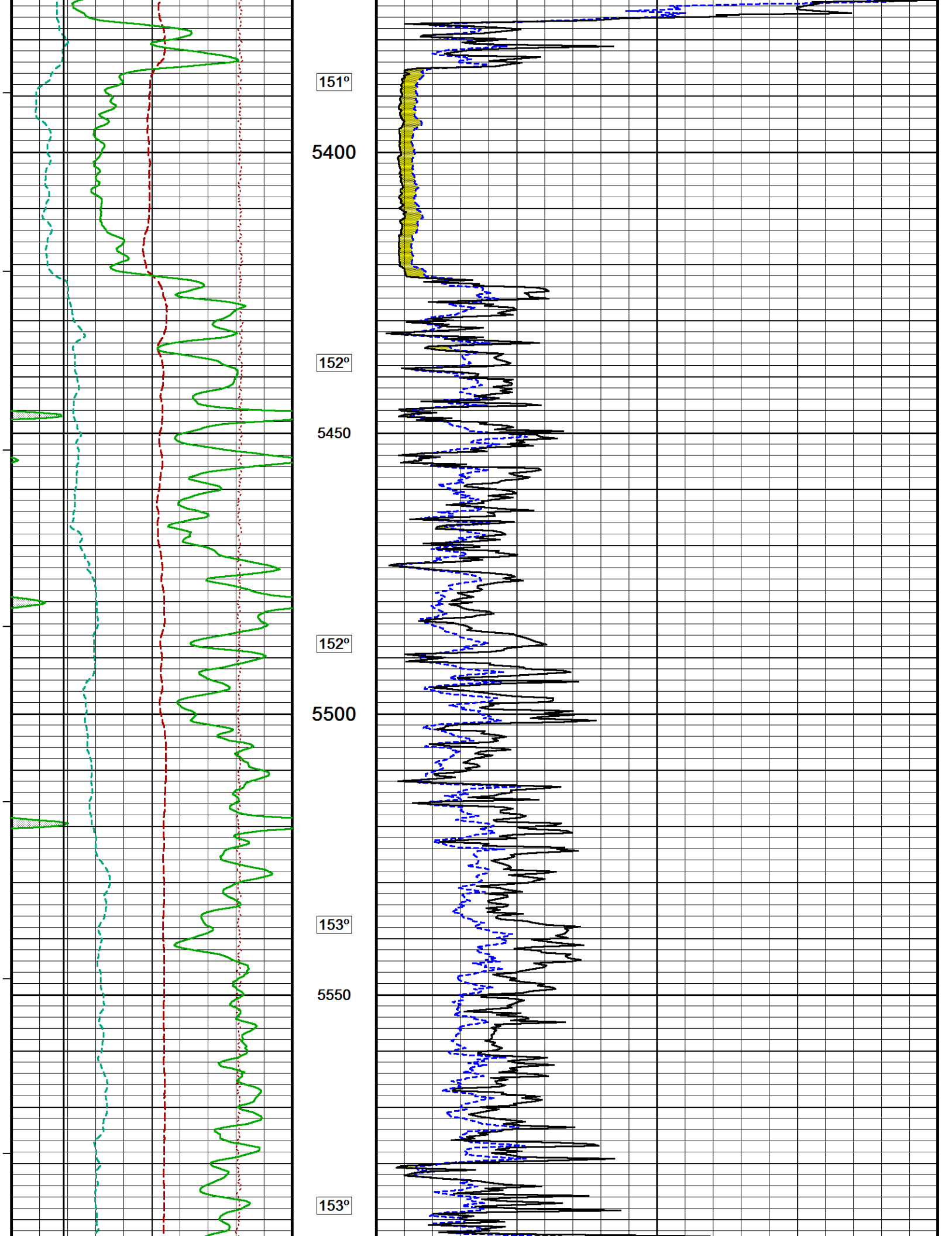

140°
4300
140°
4350
141°
4400
141°
4450
142°
BIT
GGCE
MBTC

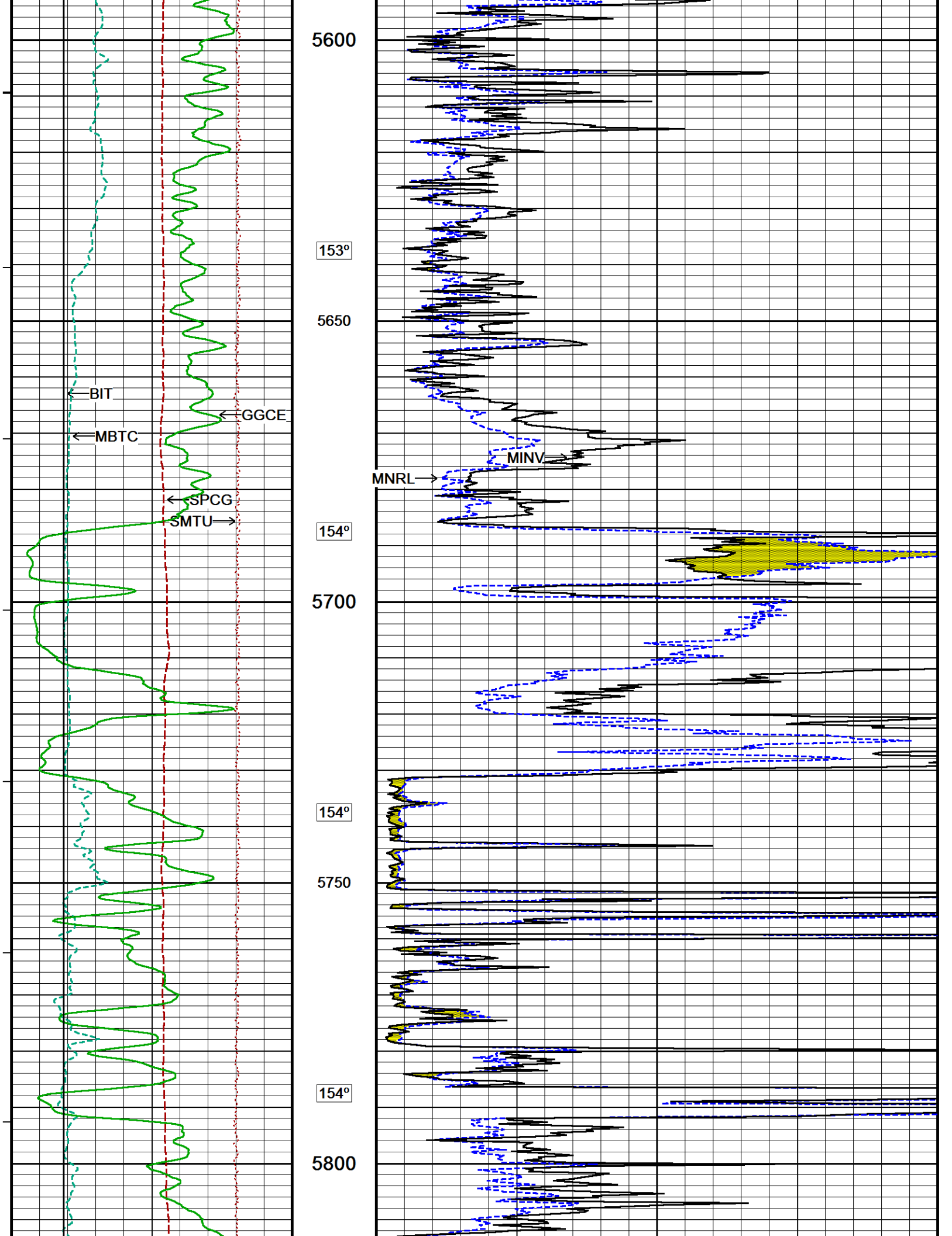

SPCG
SMTU
MNRL
4500
142°
4550
143°
4600
144°
4650
144°
4700

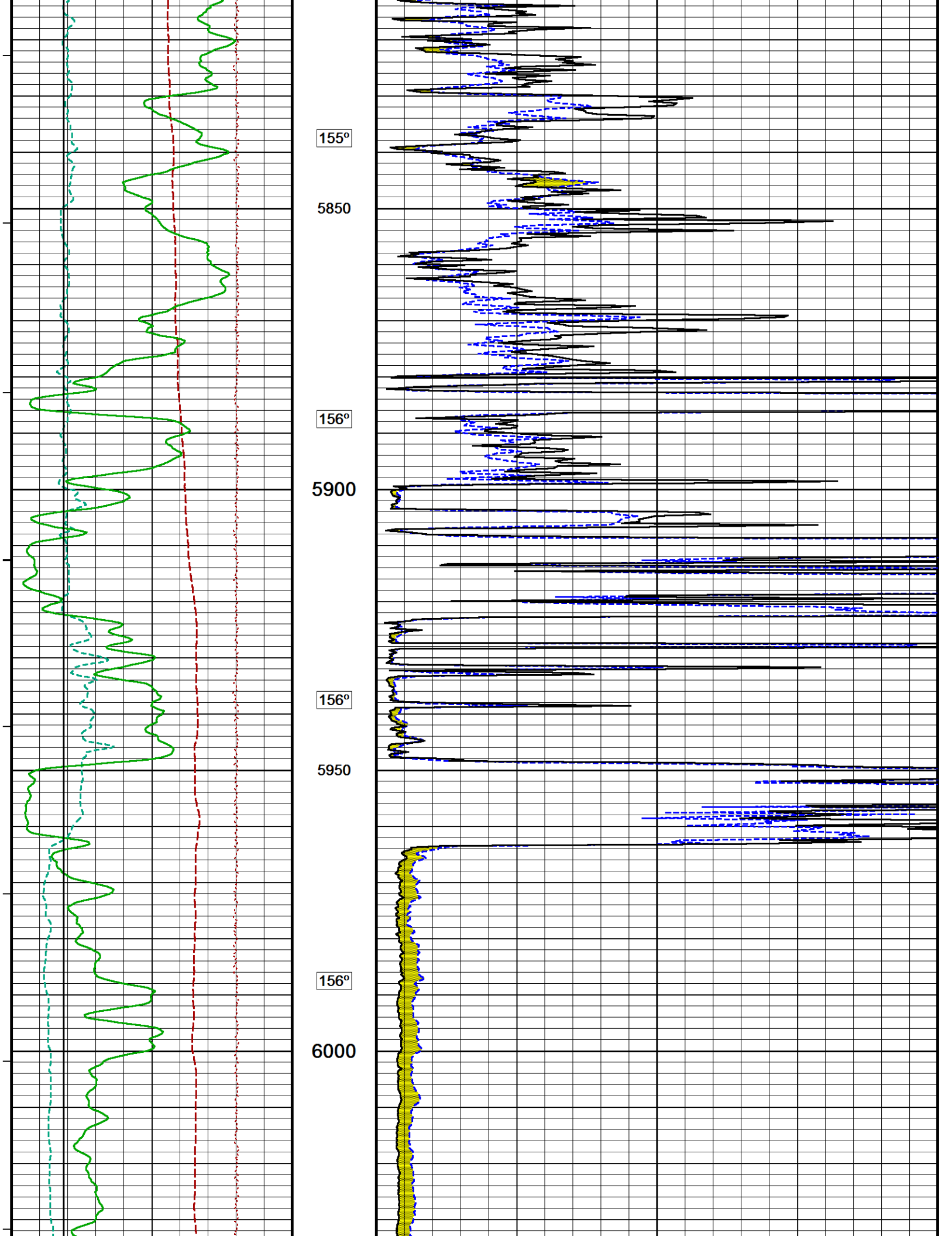

145°
4750
146°
4800
146°
4850
147°
4900
BIT
GGCE
MBTC
SPCG
SMTU
MNRL
MINV

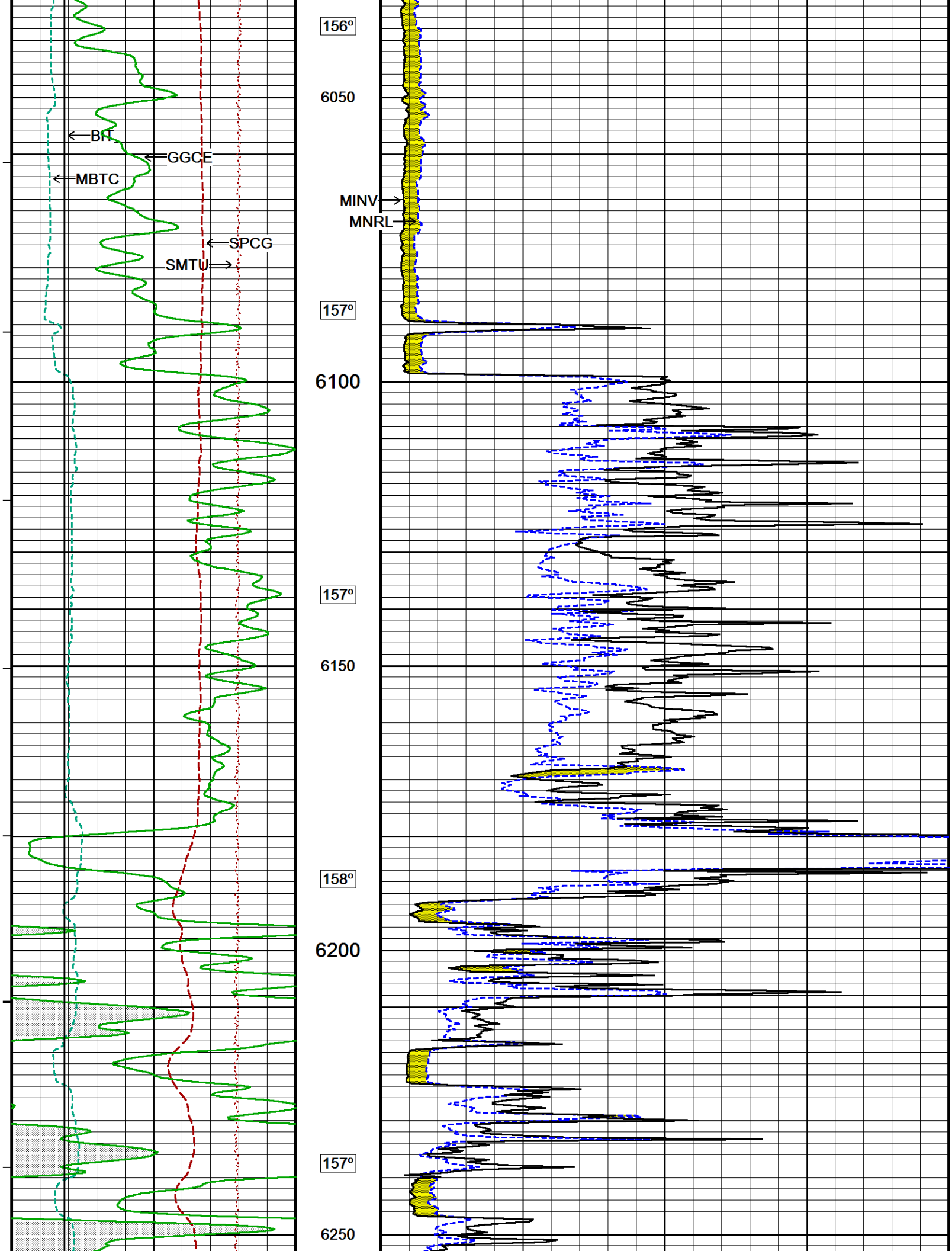

147°
4950
148°
5000
148°
5050
148°
5100
148°
5150

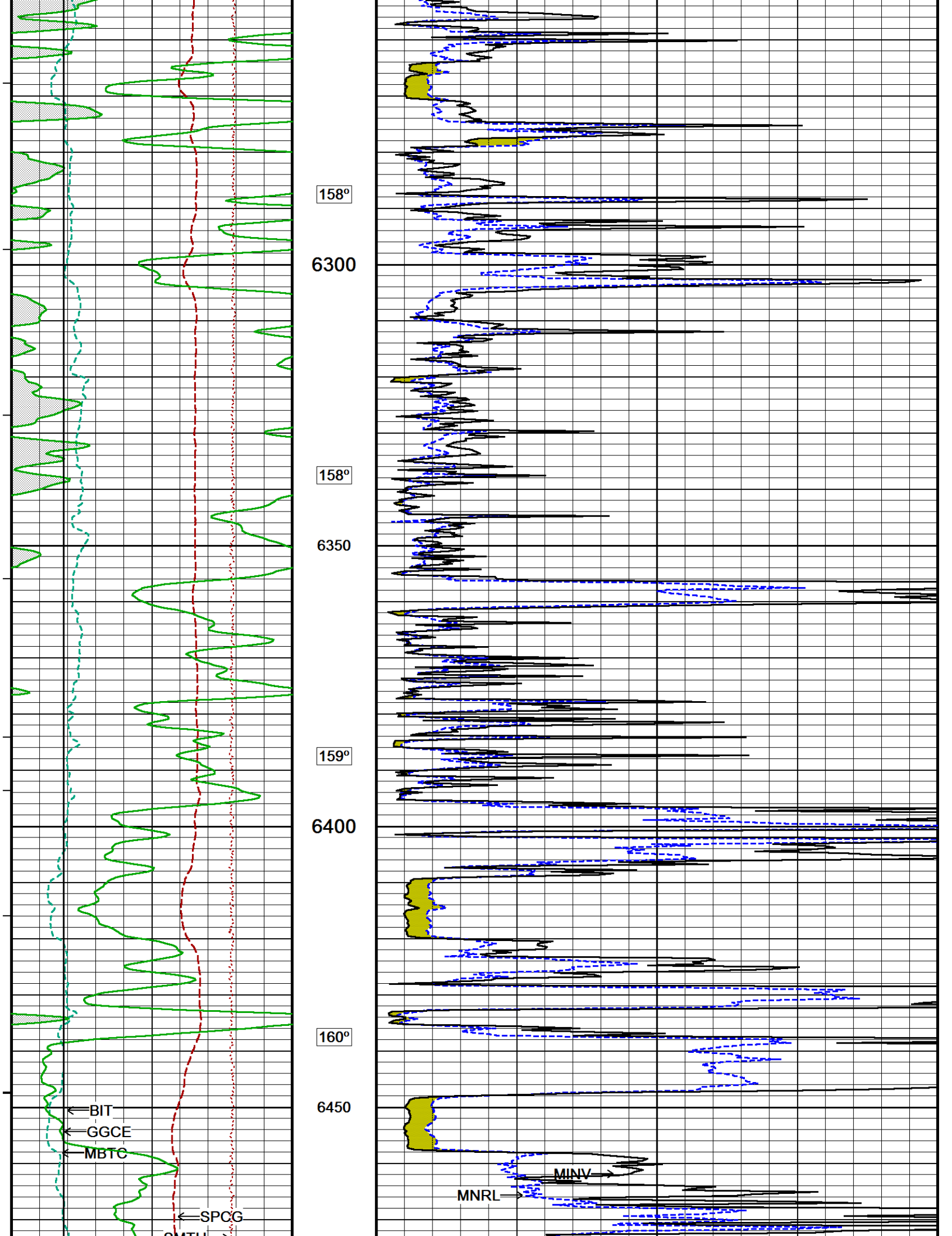

149°
5200
149°
5250
BIT
GGCE
MBTC
MINV
MNRL
150°
SPCG
SMTU
5300
151°
5350

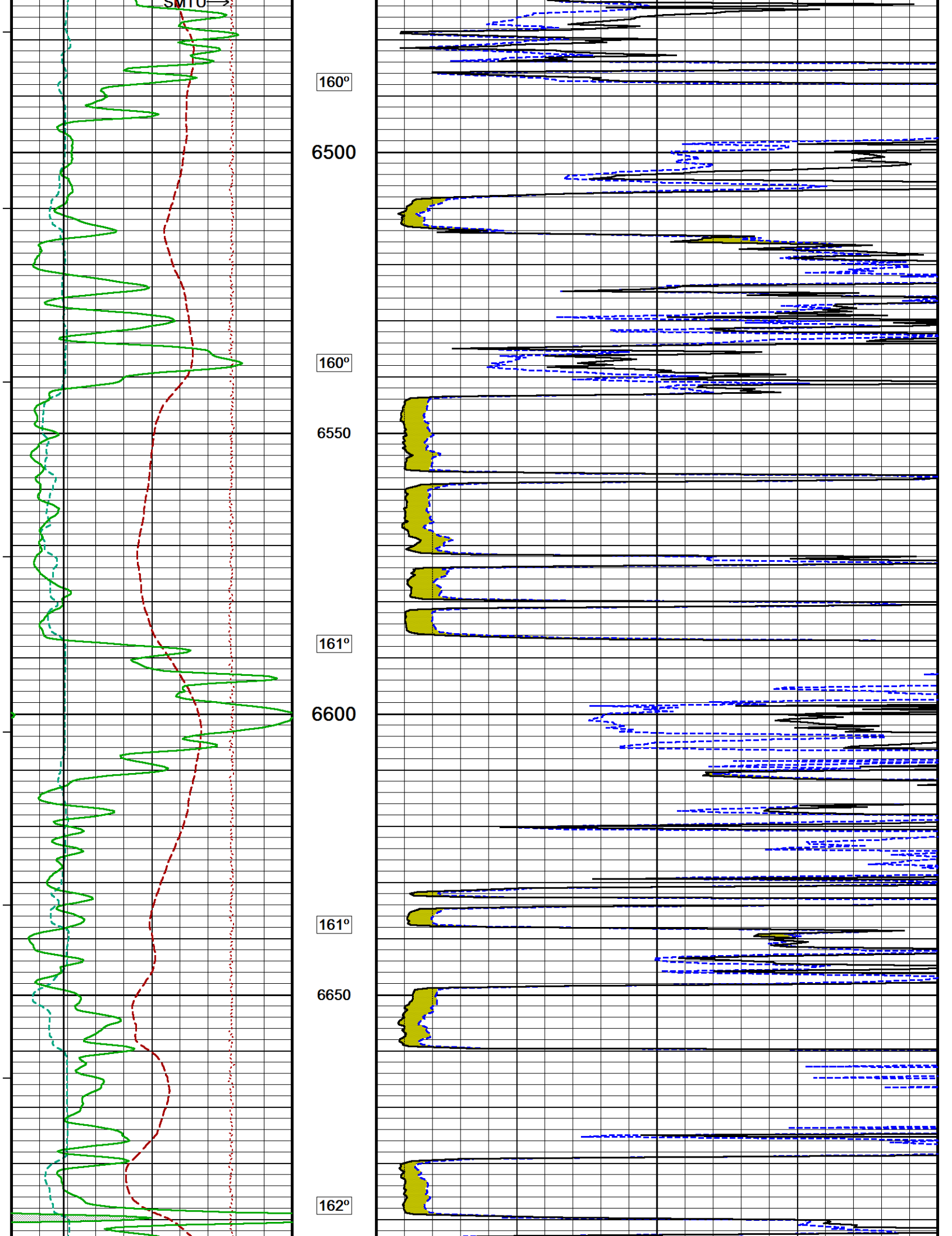

151º
5400
152º
5450
152º
5500
153º
5550
153º

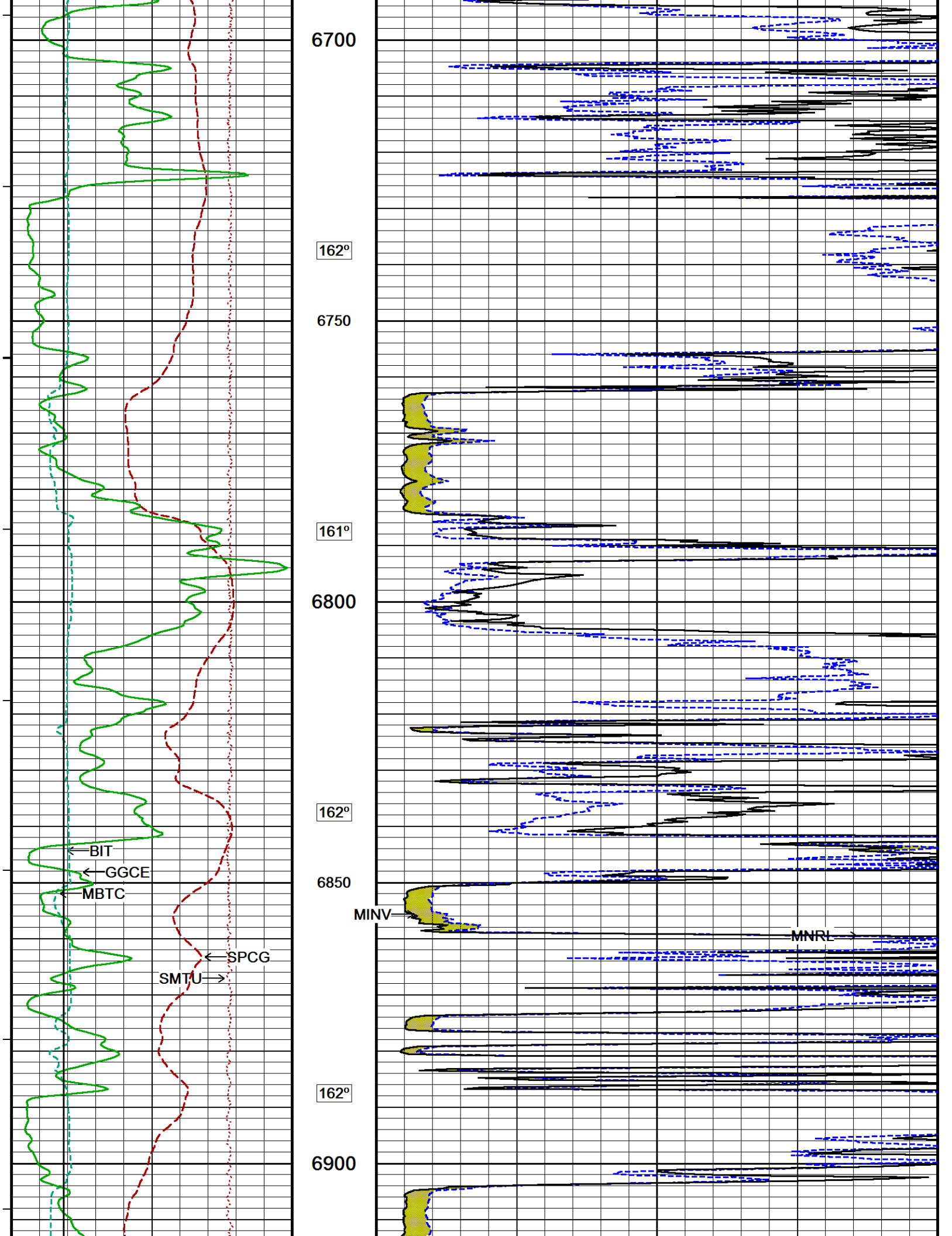

5600
153°
5650
BIT
GGCE
MBTC
MINV
MNRL
SPCG
SMTU
154°
5700
154°
5750
154°
5800

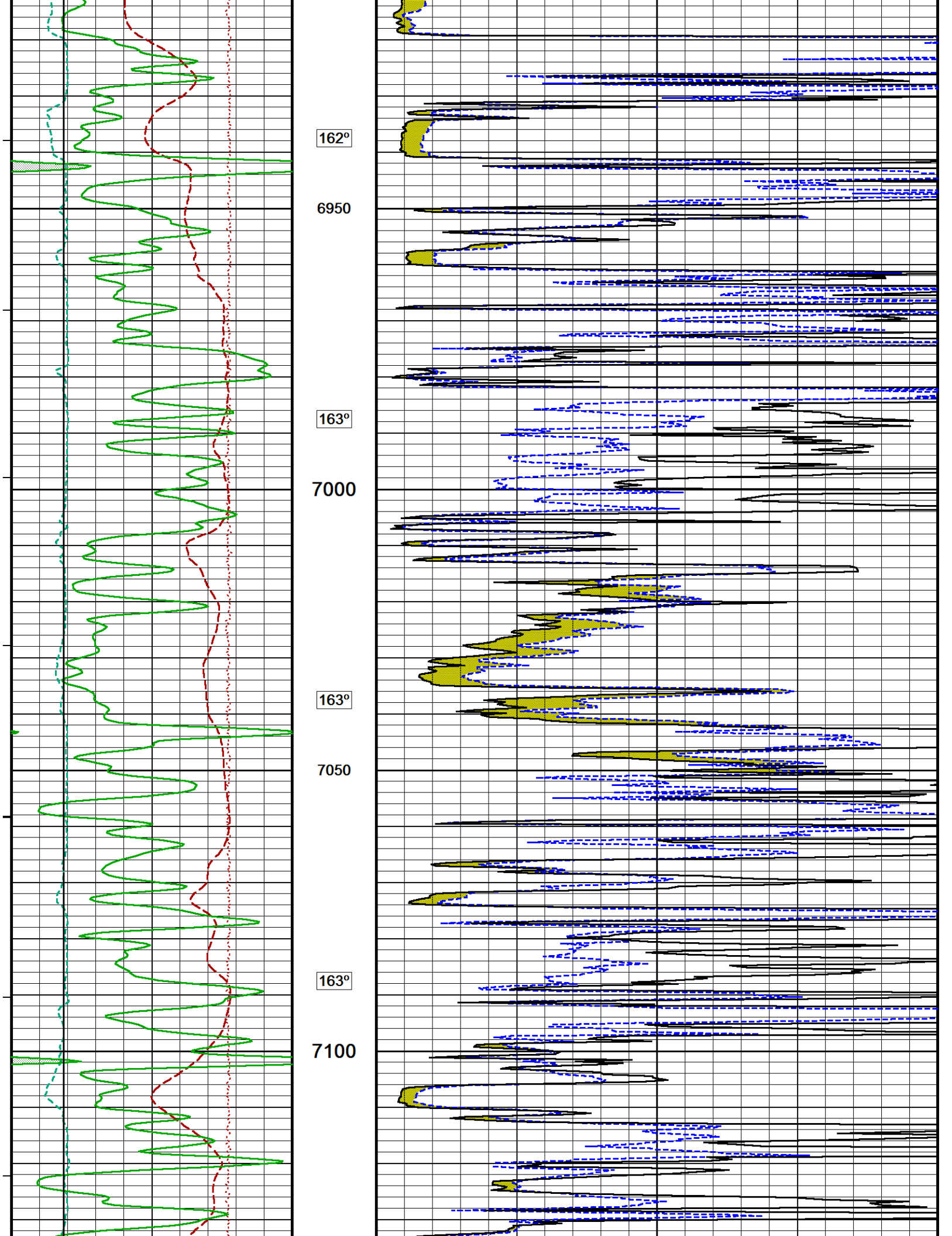

155°
5850
156°
5900
156°
5950
156°
6000

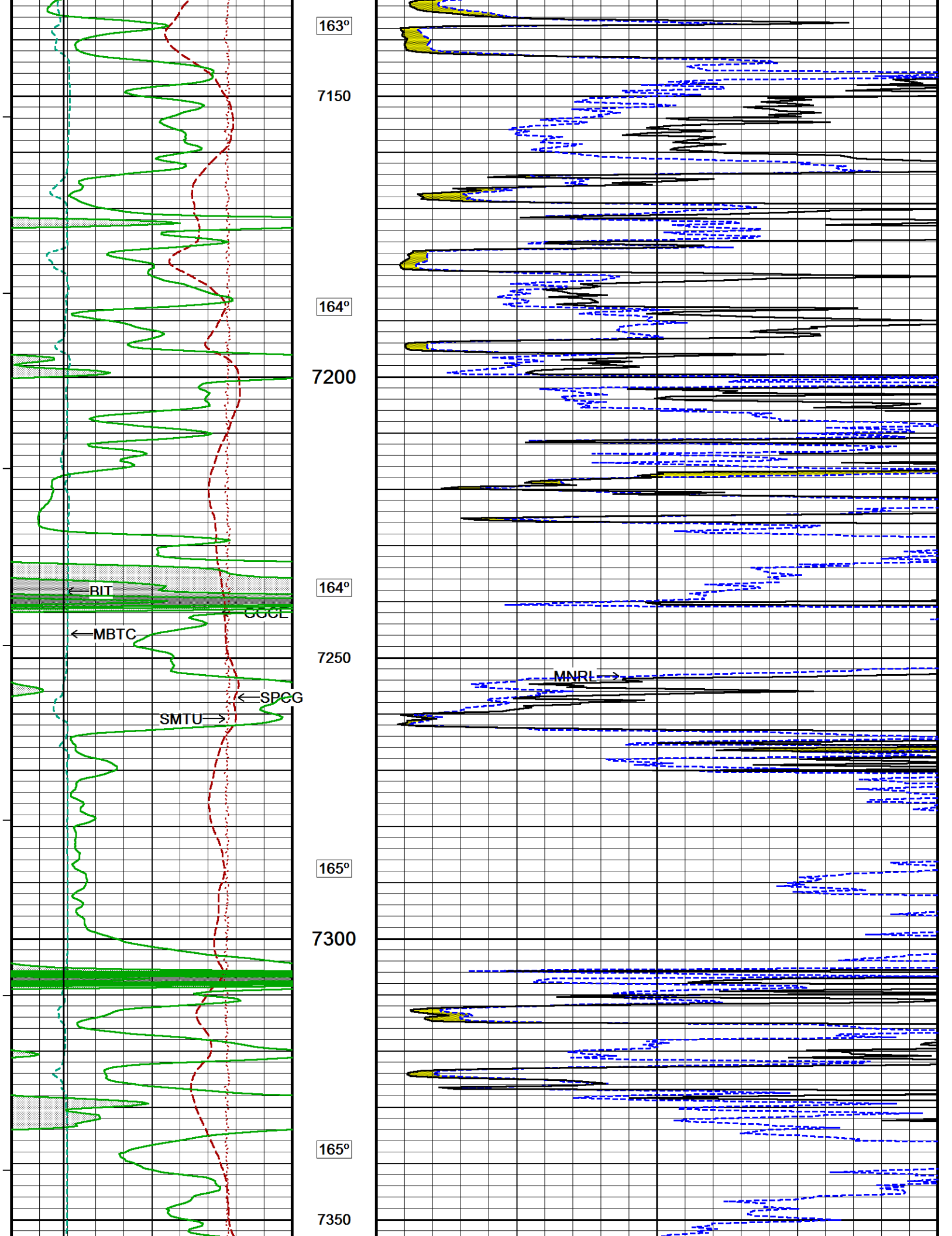

156°
6050
BIT
GGCE
MBTC
MINV
MNRL
SPCG
SMTU
157°
6100
157°
6150
158°
6200
157°
6250

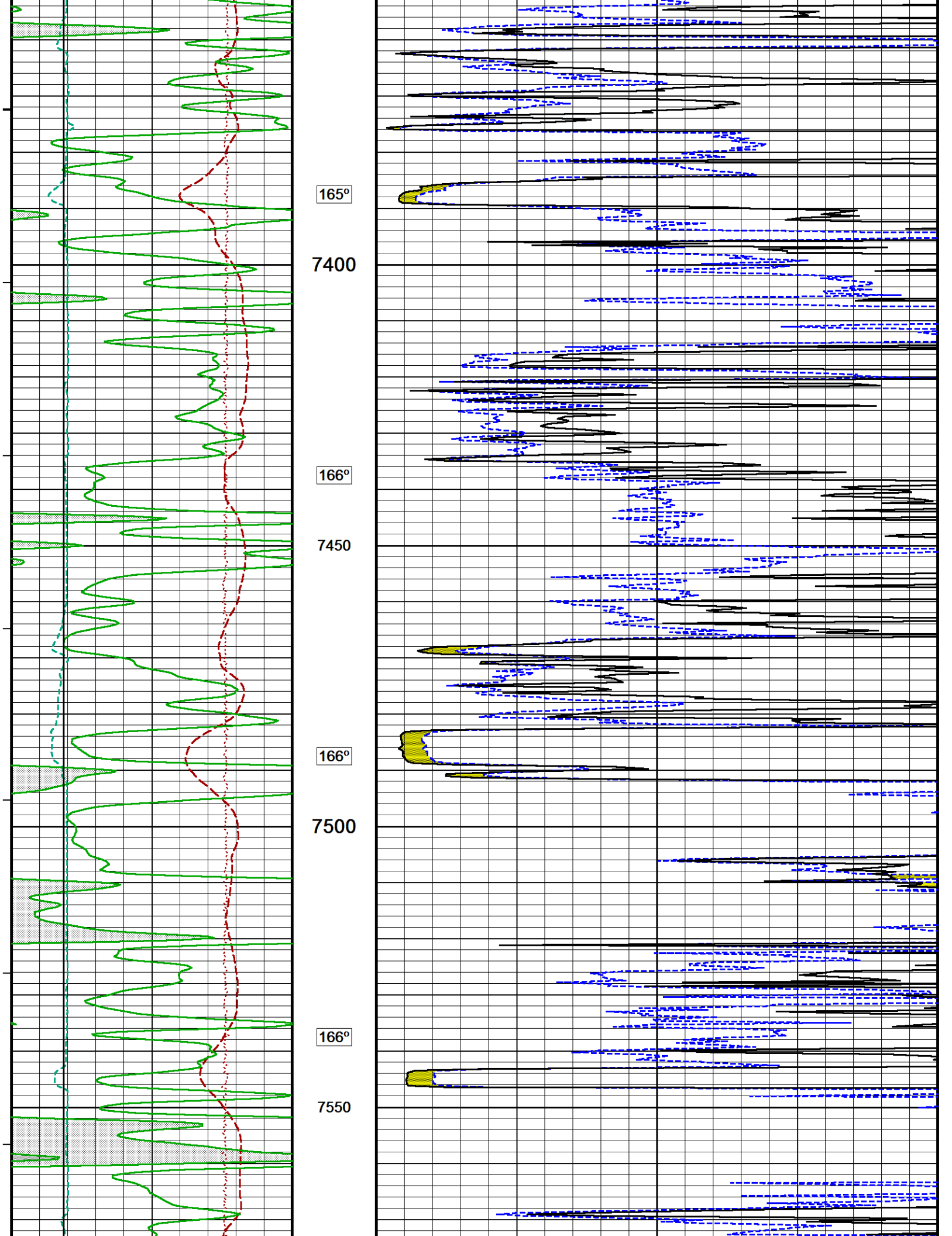

158°
6300
158°
6350
159°
6400
160°
6450
BIT
GGCE
MBTC
SPCG
MINV
MNRL

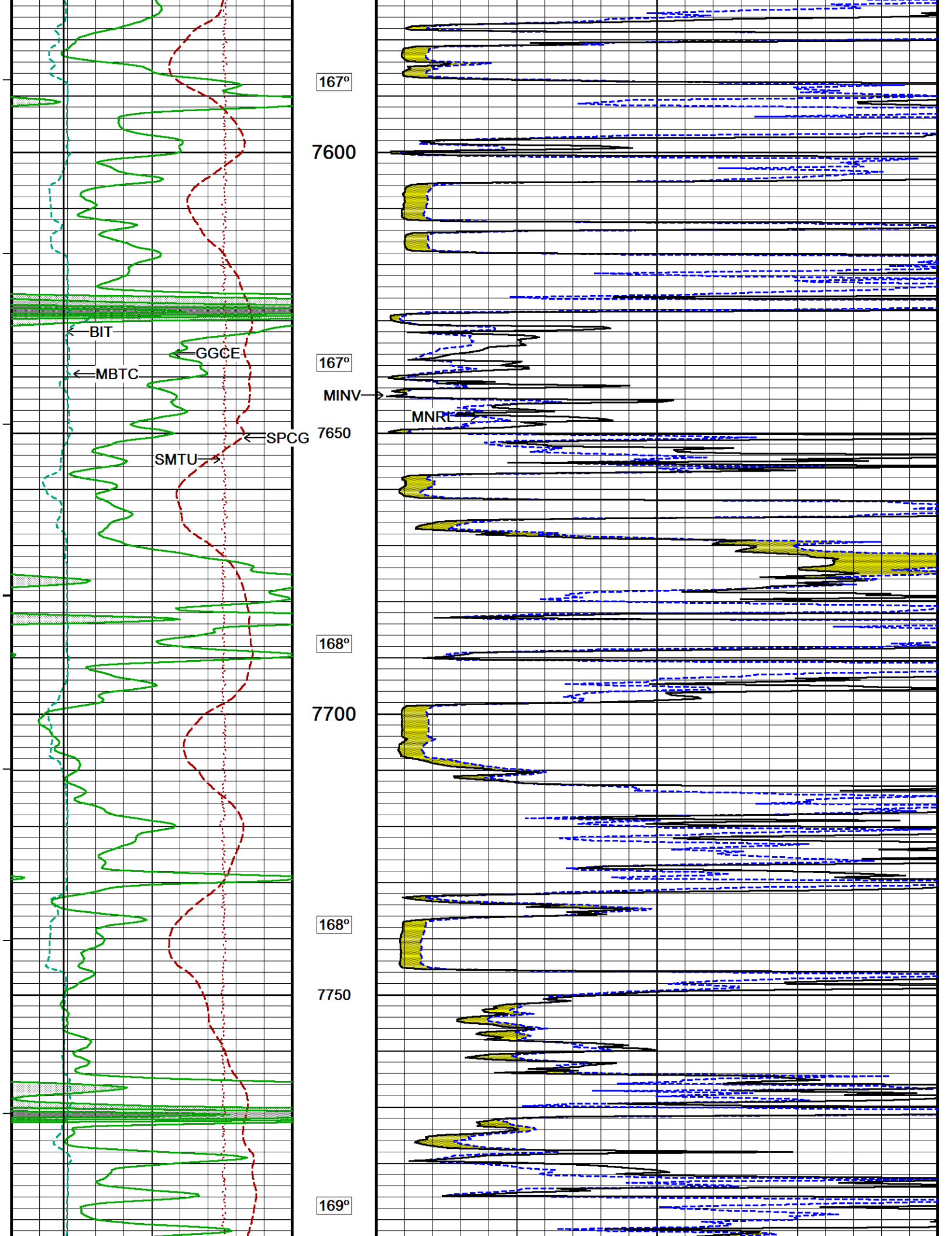

SMTU→
160°
6500
160°
6550
161°
6600
161°
6650
162°

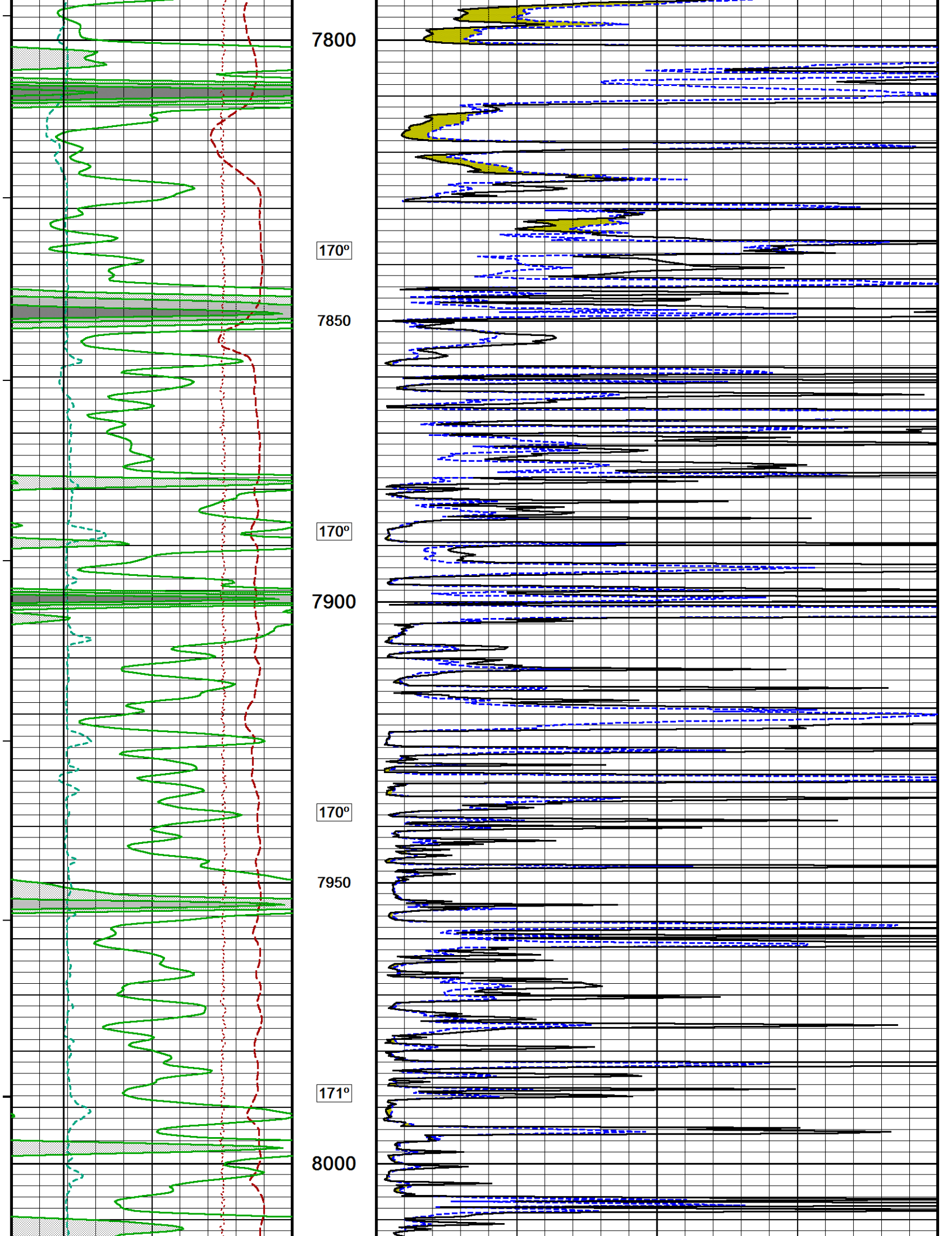

6700
162°
6750
161°
6800
162°
6850
6900
BIT
GGCE
MBTC
SPCG
SMTU
MINV
MNRL

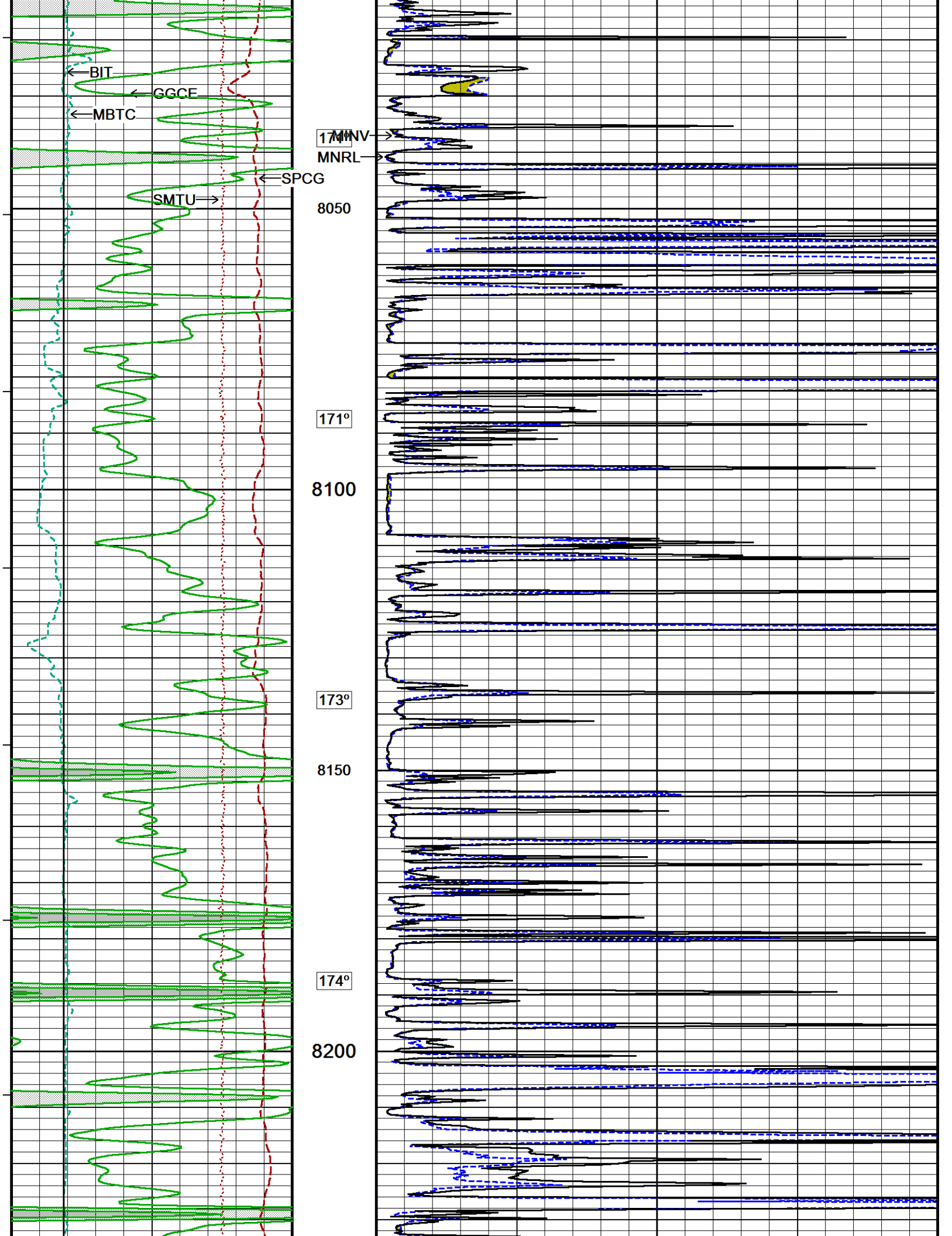

162º
6950
163º
7000
163º
7050
163º
7100

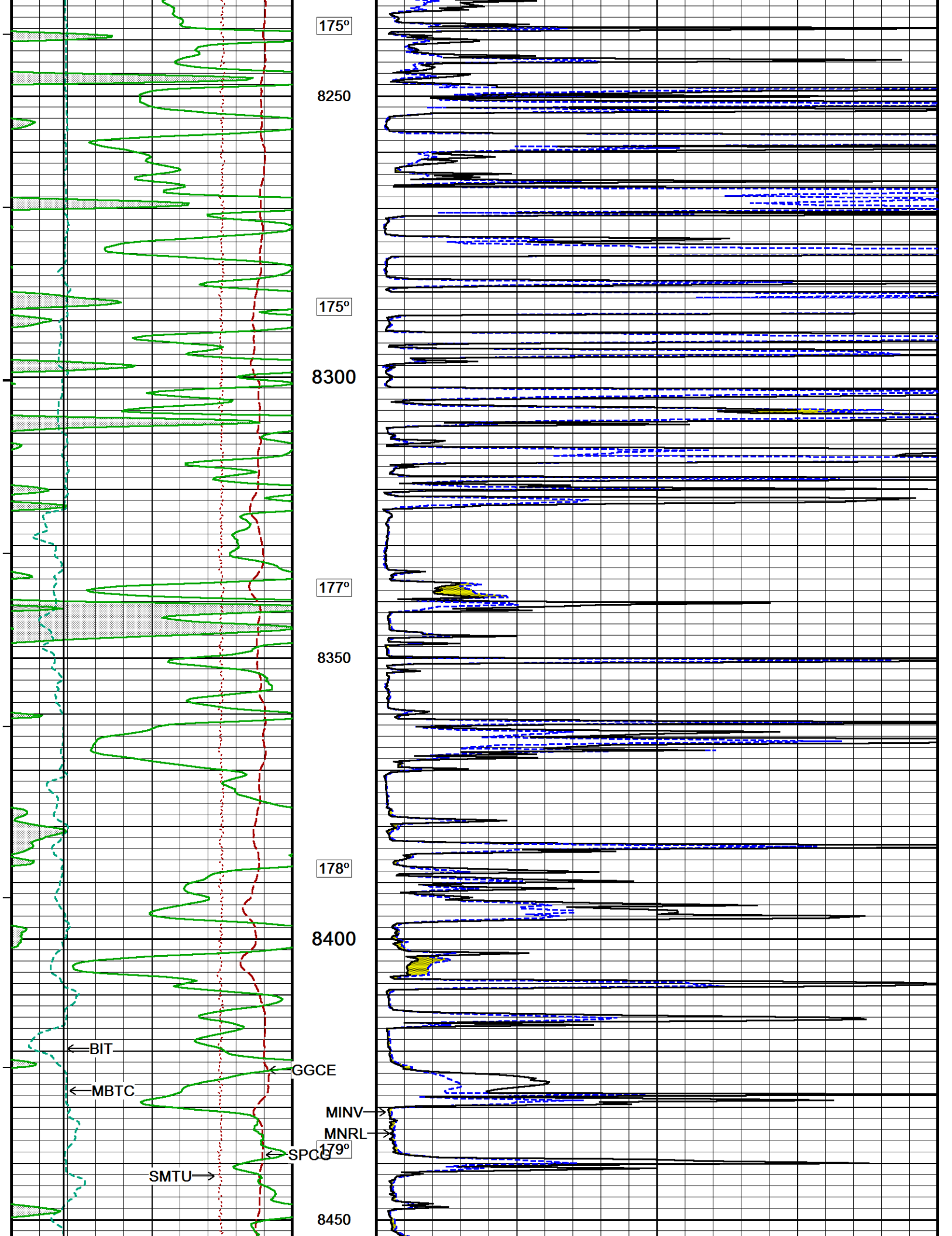

163º
7150
164º
7200
164º
RIT
CGCL
MBTC
7250
MNRL
SPCG
SMTU
165º
7300
165º
7350

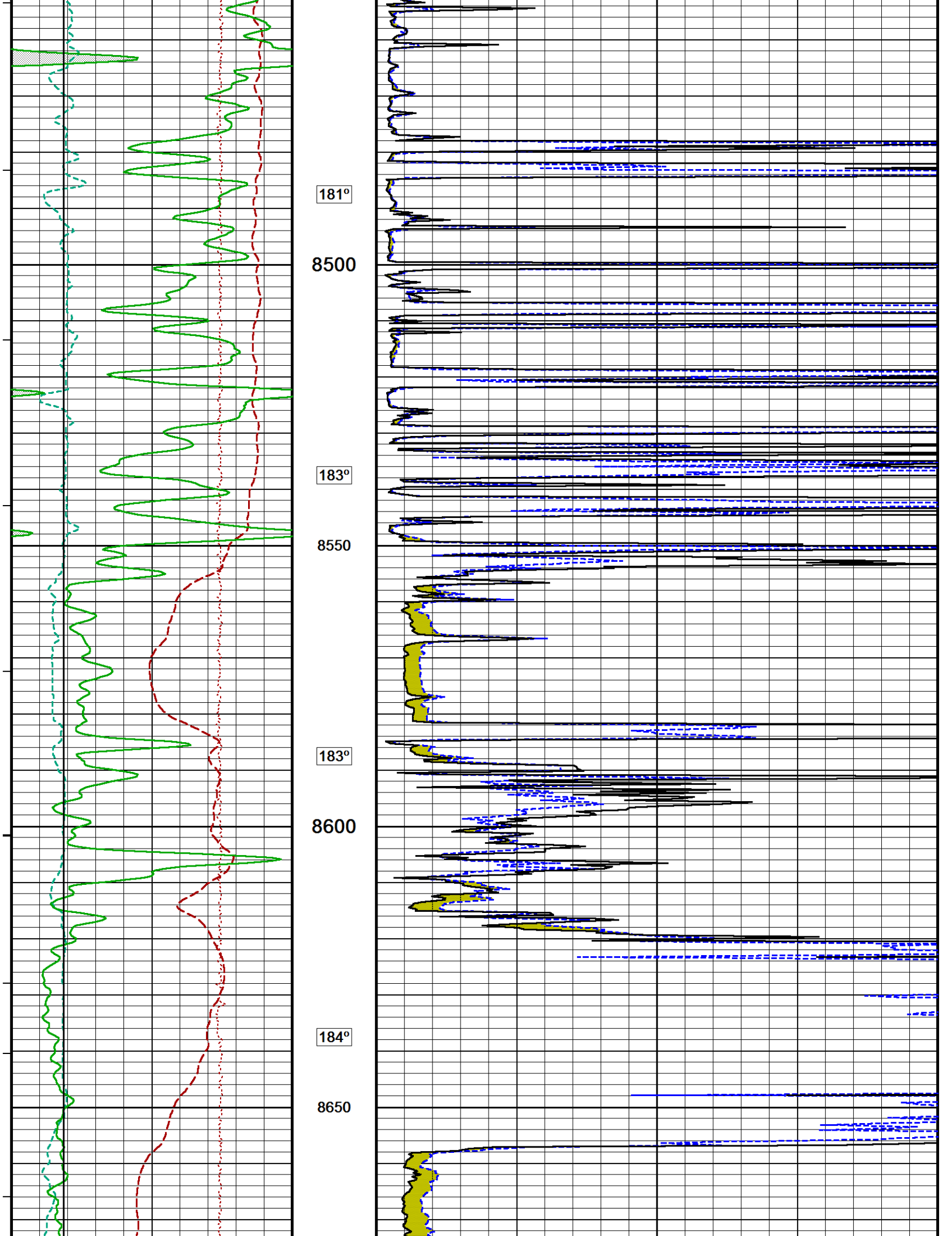

165º
7400
166º
7450
166º
7500
166º
7550

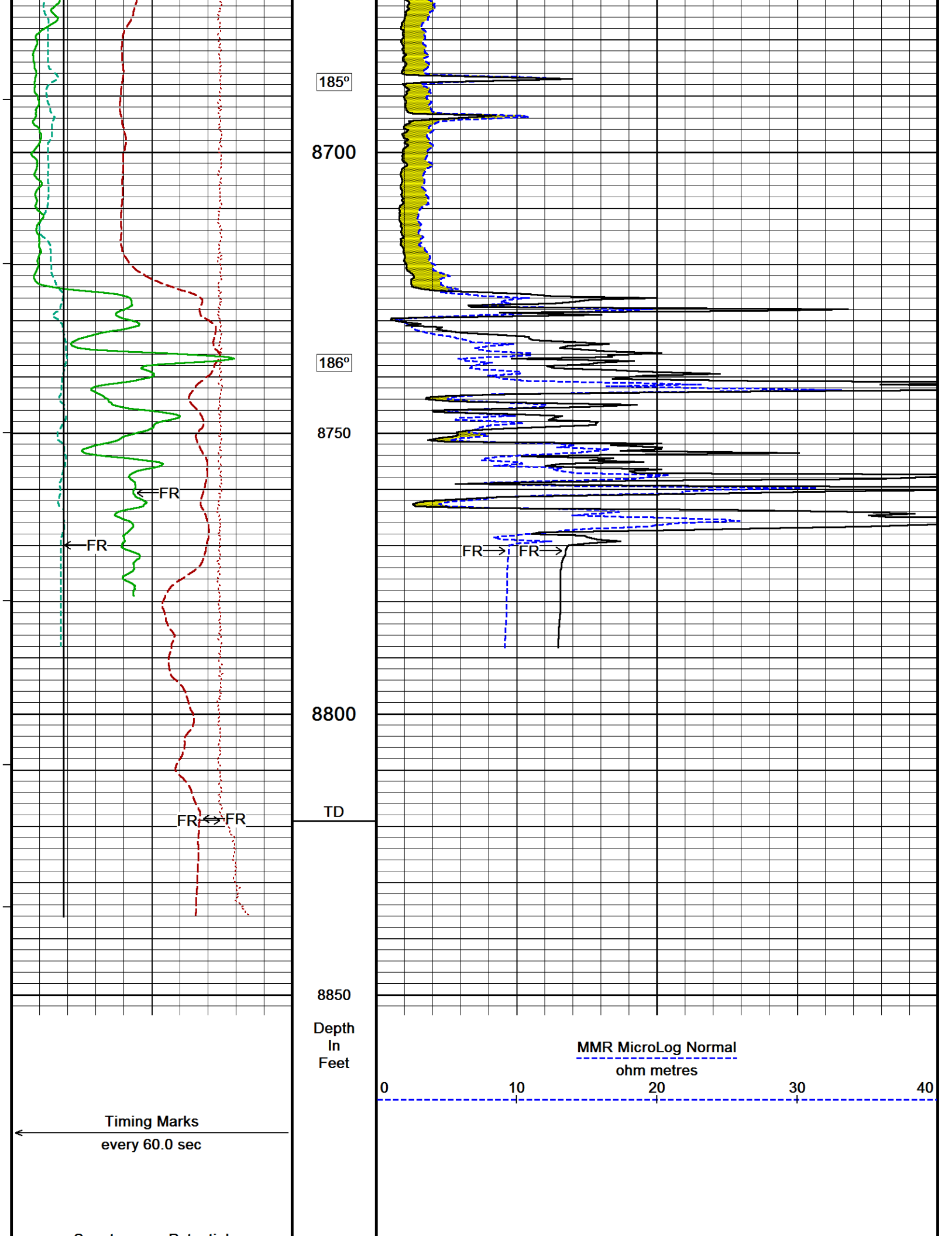

167º
7600
BIT
GGCE
MBTC
167º
MINV
MNRL
SPCG
7650
SMTU
168º
7700
168º
7750
169º

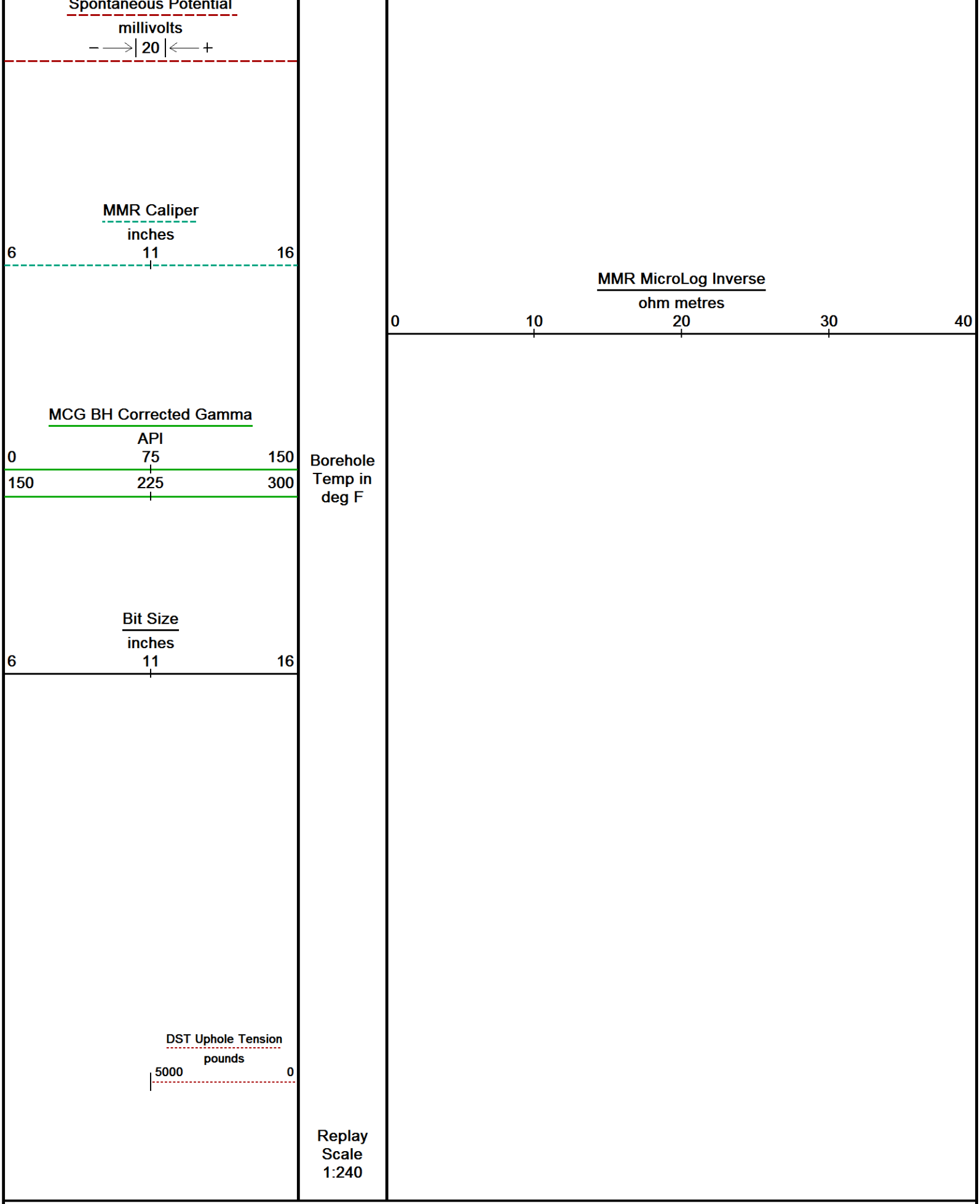

7800
170°
7850
170°
7900
170°
7950
171°
8000


BIT
GGCE
MBTC
MNV
MNRL
SPCG
SMTU
8050
171°
8100
173°
8150
174°
8200


175°
8250
175°
8300
177°
8350
178°
8400
179°
8450
BIT
MBTC
GGCE
MINV
MNRL
SPCG
SMTU


181°
8500
183°
8550
183°
8600
184°
8650


185°
8700
186°
8750
FR
FR
FR
FR
8800
TD
8850
Depth
In
Feet
MMR MicroLog Normal
ohm metres
0
10
20
30
40
Timing Marks
every 60.0 sec




Depth Based Data - Maximum Sampling Increment 10.0cm

Plotted on 16-DEC-2017 19:34

Filename: C:\Minimus 17.05.5956\Data\MURFIN DRILLING (DAUNTLESS #15-1)\MAIN PASS.dta

Recorded on 16-DEC-2017 13:24

System Versions: Logged with 17.05.5956 Plotted with 17.05.5956

# 5 Inch Repeat Pass 1:240

Depth Based Data - Maximum Sampling Increment 10.0cm
Plotted on 16-DEC-2017 19:34
Filename: C:\Minimus 17.05.5956\Data\MURFIN DRILLING (DAUNTLESS #15-1)\REPEAT PASS.dta
Recorded on 16-DEC-2017 12:47
System Versions: Logged with 17.05.5956 Plotted with 17.05.5956

Timing Marks
every 60.0 sec

Spontaneous Potential
millivolts
− → | 20 | ← +

MMR Caliper
inches
6 11 16

MCG BH Corrected Gamma
API
0 75 150
150 225 300

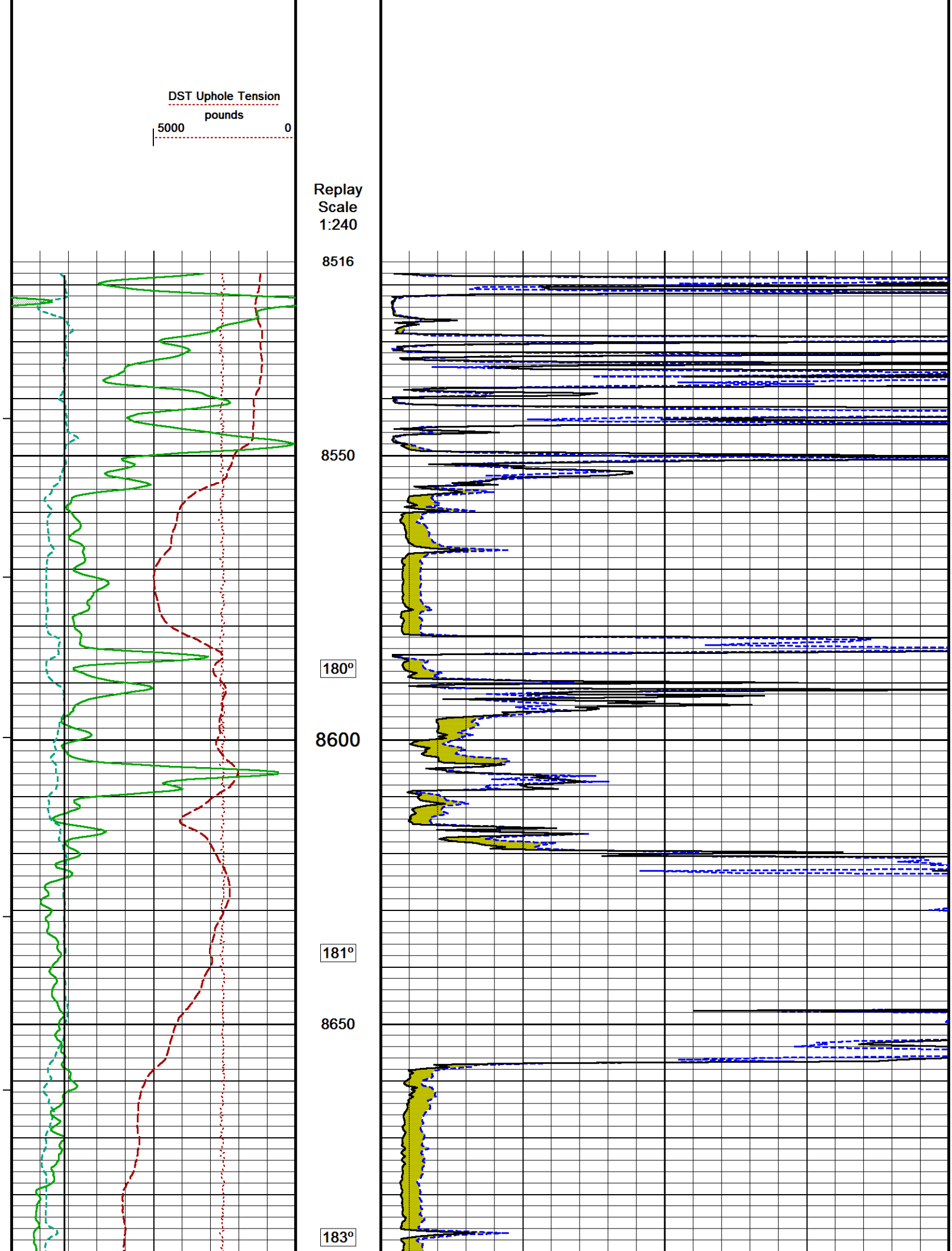
Bit Size
inches
6 11 16

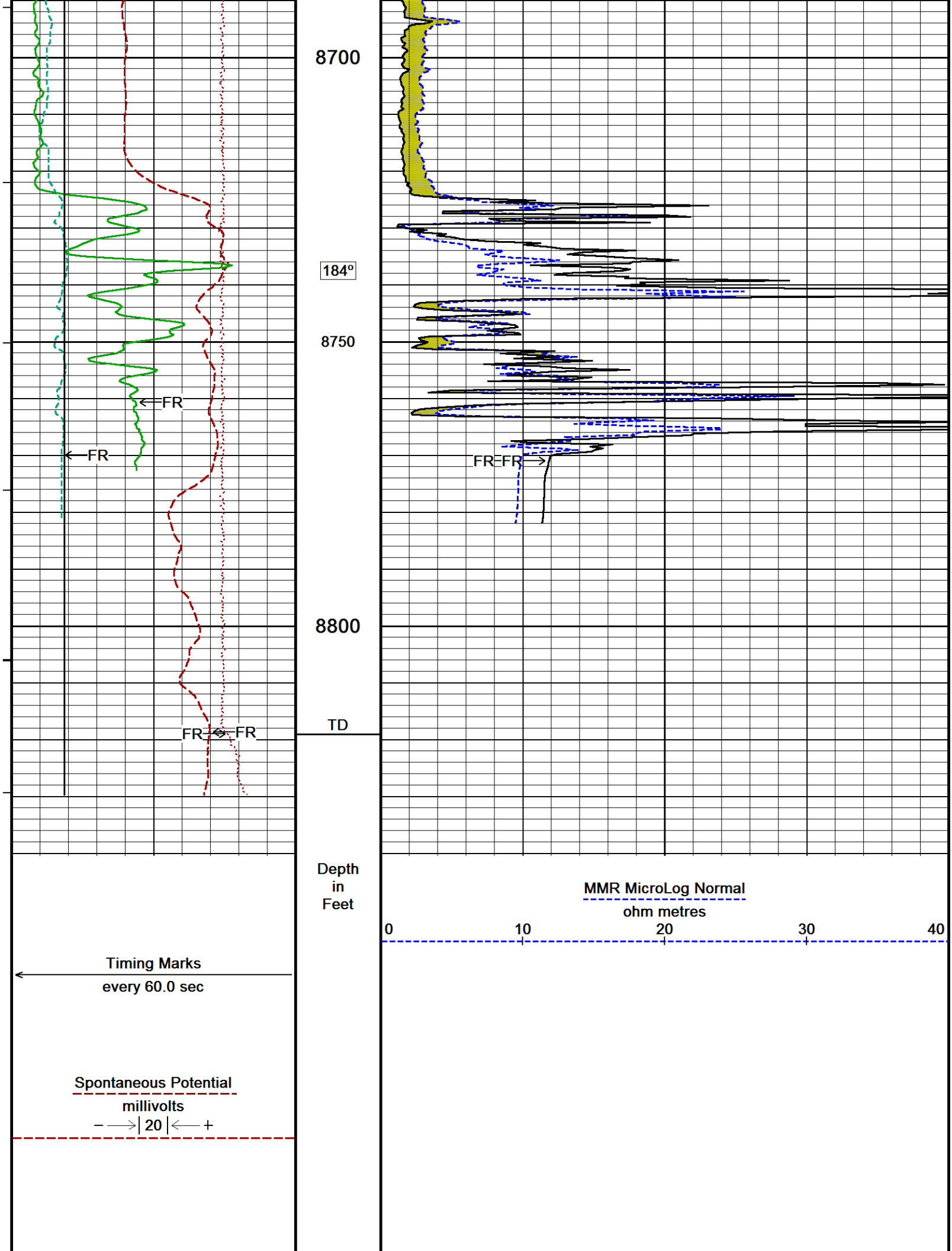
Depth
in
Feet

Borehole
Temp in
deg F

MMR MicroLog Normal
ohm metres
0 10 20 30 40

MMR MicroLog Inverse
ohm metres
0 10 20 30 40


DST Uphole Tension
pounds
5000
0
Replay
Scale
1:240
8516
8550
180°
8600
181°
8650
183°


8700
184°
8750
8800
TD
FR
FR
FR
FR
FR
Depth
in
Feet
MMR MicroLog Normal
ohm metres
0
10
20
30
40
Timing Marks
every 60.0 sec
Spontaneous Potential
millivolts
– 20 +

MMR Caliper
inches
6 11 16

MMR MicroLog Inverse
ohm metres
0 10 20 30 40

MCG BH Corrected Gamma
API
0 75 150
150 225 300

Borehole Temp in deg F

Bit Size
inches
6 11 16

DST Uphole Tension
pounds
5000 0

Replay Scale 1:240

Depth Based Data - Maximum Sampling Increment 10.0cm
Plotted on 16-DEC-2017 19:34
Filename: C:\Minimus 17.05.5956\Data\MURFIN DRILLING (DAUNTLESS #15-1)\REPEAT PASS.dta
Recorded on 16-DEC-2017 12:47
System Versions: Logged with 17.05.5956 Plotted with 17.05.5956

5 Inch Repeat Pass 1:240

## BEFORE SURVEY CALIBRATION

C:\Minimus 17.05.5956\Data\MURFIN DRILLING (DAUNTLESS #15-1)\MAIN PASS.dta

General Constants All 000
Last Edited on 16-DEC-2017,11:58

General Parameters

| | | |
|---|---|---|
| Mud Resistivity | 0.930 | ohm-metres |
| Mud Resistivity Temperature | 99.000 | 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 | Crossplot Porosity |
| Resistivity used | Array Ind. One Res Rt |
| RWA Constant A | 0.620 |
| RWA Constant M | 2.150 |
| SW/APOR Tool Source | 0.000 |

## High Resolution Temperature Calibration MCG-D.K 475

Field Calibration on 15-DEC-2017,10:22

| | Measured | Calibrated(Deg F) |
|---|---|---|
| Lower | 50.00 | 50.00 |
| Upper | 200.00 | 200.00 |

## High Resolution Temperature Constants MCG-D.K 475

Last Edited on 11-MAY-2016 11:23

| | |
|---|---|
| Pre-filter Length | 11 |

## Gamma Calibration MCG-D.K 475

Field Calibration on 14-DEC-2017 14:26

| | Measured | Calibrated (API) |
|---|---|---|
| Background | 46 | 31 |
| Calibrator (Gross) | 1905 | 1292 |
| Calibrator (Net) | 1859 | 1261 |

## Gamma Calibration Tolerances MCG-D.K 475

| | | | | |
|---|---|---|---|---|
| | | 1.40 | 1.475 | 1.55 |
| Ratio | 1.474 | | | Counts/API |

## Gamma Constants MCG-D.K 475

Last Edited on 16-DEC-2017,09:16

| | | |
|---|---|---|
| Gamma Calibrator Number | GRC.C 46 | |
| GRC-M Calibrator Jig in Use? | NO | |
| Inactive Background Jig in Use? | NO | |
| Mud Density | 1.12 | gm/cc |
| Caliper Source for Processing | Density Caliper | |
| Tool Position | Eccentred | |
| Potassium Equivalence | Chloride | |
| K Mud Concentration | 0.00 | % |

## Caliper Calibration MMR-A 11

Base Calibration on 01-DEC-2017 14:28
Field Calibration on 14-DEC-2017 14:09

Base Calibration

| Reading No | Measured | Calibrator Size (in) |
|---|---|---|
| 1 | 14815 | 5.96 |
| 2 | 18126 | 7.96 |
| 3 | 21509 | 9.86 |
| 4 | 25443 | 11.88 |
| 5 | 0 | 0.00 |
| 6 | N/A | N/A |

Field Calibration

| Measured Caliper (in) | Actual Caliper (in) |
|---|---|
| 7.99 | 7.96 |

## Caliper Calibration Tolerances MMR-A 11

| | | | | | |
|---|---|---|---|---|---|
| | | 7.76 | 7.96 | 8.16 | |
| Short Arm Field Cal. | 7.99 | | | | in |

## Micro Normal and Micro Inverse Calibration MMR-A 11

Base Calibration on 01-DEC-2017 14:15
Field Check on 14-DEC-2017 14:06

| | Resistor 1 (ohm) | Resistor 2 (ohm) |
|---|---|---|
| | 10.0 | 50.0 |

Base Calibration

Base Calibration

| | Measured | | Calibrated (ohm-m) | |
|---|---|---|---|---|
| Micro Normal | 9.9 | 49.2 | 5.1 | 25.6 |
| Micro Inverse | 9.9 | 49.2 | 3.4 | 16.9 |

| Channel | Base Check (ohm-m) | Field Check (ohm-m) |
|---|---|---|
| Micro Normal | 94.6 | 94.6 |
| Micro Inverse | 62.7 | 62.7 |

## Micro Normal & Micro Inverse Calibration Tolerance MMR-A 11

| | | | | | |
|---|---|---|---|---|---|
| Micro Normal Res. 1 | 9.9 | -5% 10.0 +5% | ohm | Micro Normal Res. 2 | 49.2 -5% 50.0 +5% ohm |
| Micro Inverse Res. 1 | 9.9 | -5% 10.0 +5% | ohm | Micro Inverse Res. 2 | 49.2 -5% 50.0 +5% ohm |
| Micro Normal Base Check | 94.6 | -2% 94.46 +2% | ohm-m | | |
| Micro Inverse Base Check | 62.7 | -2% 62.58 +2% | ohm-m | | |
| Micro Normal Field Check | 94.6 | -2% 94.6 +2% | ohm-m | | |
| Micro Inverse Field Check | 62.7 | -2% 62.7 +2% | ohm-m | | |

## Micro Normal and Micro Inverse Constants MMR-A 11

Last Edited on 28-AUG-2017,14:27

| | | |
|---|---|---|
| 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 |

## DOWNHOLE EQUIPMENT

C:\Minimus 17.05.5956\Data\MURFIN DRILLING (DAUNTLESS #15-1)\MAIN PASS.dta

11B Tension Cablehead
MCB-A.A 2 LG: 2.40 ft WT: 19.8 lb OD: 2.244 in

Compact Swivel Head Adaptor
SHA-J.A 438 LG: 2.30 ft WT: 22.0 lb OD: 2.244 in

Compact Comms Gamma
MCG-D.K 475 LG: 8.70 ft WT: 63.9 lb OD: 2.244 in

Compact Micro-Resistivity
MMR-A 11 LG: 8.59 ft WT: 81.6 lb OD: 4.882 in

Compact Neutron
MDN-B.J 388 LG: 5.04 ft WT: 50.7 lb OD: 2.244 in

Compact Density/Caliper
MPD-B 120 LG: 9.59 ft WT: 90.4 lb OD: 2.449 in

Compact Knuckle Joint
SKJ-E.A 166 LG: 2.17 ft WT: 24.3 lb OD: 2.244 in

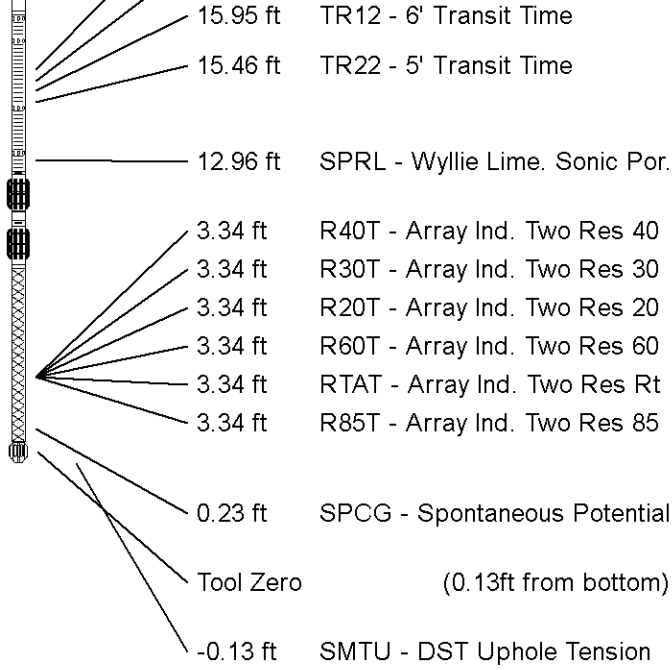
Compact Focussed Electric
MFE-B.A 261 LG: 6.05 ft WT: 48.5 lb OD: 2.244 in

Compact Sonic
MSS-C.A 147 LG: 12.52 ft WT: 72.8 lb OD: 2.240 in

| | |
|---|---|
| 58.18 ft | GGCE - MCG BH Corrected Gamma |
| 55.28 ft | CGXT - MCG External Temperature |
| 48.92 ft | MBTC - MMR Caliper |
| 47.93 ft | MINV - Micro-inverse |
| 47.93 ft | MNRL - Micro-normal |
| 43.13 ft | NPRL - Limestone Neutron Por. |
| 35.89 ft | AVOL - Annular Volume |
| 35.89 ft | HVOL - Hole Volume |
| 35.89 ft | CLDC - Density Caliper |
| 33.96 ft | DPRL - Limestone Density Por. |
| 33.96 ft | DCOR - Density Correction |
| 33.90 ft | PDPE - PE |
| 26.24 ft | FEFC - Shallow FE (Phase Corr.) |
| 16.96 ft | TR11 - 4' Transit Time |
| 16.46 ft | TR21 - 3' Transit Time |

Compact Induction
MAI-B.J 426 LG: 10.81 ft WT: 48.5 lb OD: 2.244 in

Total Length: 68.16 ft Weight: 522.5 lb




All measurements relative to tool zero.

| | |
|---|---|
| COMPANY | MURFIN DRILLING COMPANY, INC. |
| WELL | DAUNTLESS #15-1 |
| FIELD | WILDCAT |
| PROVINCE/COUNTY | LINCOLN |
| COUNTRY/STATE | U.S.A. / COLORADO |

| | | | | | |
|---|---|---|---|---|---|
| Elevation Kelly Bushing | 5554 | feet | First Reading | 8770.00 | feet |
| Elevation Drill Floor | 5552 | feet | Depth Driller | 8820.00 | feet |
| Elevation Ground Level | 5541 | feet | Depth Logger | 8819.00 | feet |

Weatherford®

# MICRO-RESISTIVITY LOG