COLUMBINE LOGGING

Scale: 5" / 100'
Measured Depth Log

Well Name	Crow Creek AA01-766 HORZ		
Location	SEC 1 T6N R63W		
State	COLORADO	**County**	WELD
Country	USA	**Rig Number**	H&P 315
API Number	05-123-40158	**AFE #**	200439
Region	DJ BASIN	**Field**	WATTENBERG
Spud Date	1/16/2015	**Drilling Completed**	1/20/2015
Surface Coordinates	NWNW SEC 1 T6N R63W 290' FNL; 613' FWL LAT/LON: 40.52203/-104.39208		
Bottom Hole Coordinates	SEC 12 T6N R63W 30' FNL; 1610' FWL		
Ground Elevation	4,799'	**K.B. Elevation**	4,823'
Logged Interval	6,012' **To** 11,662'	**Total Depth**	11,662
Formation	NIO C CHALK		
Type of Drilling Fluid	LSND		

Operator

Company Noble Energy Inc

Address 1625 BROADWAY SUITE 2200
DENVER, CO 80202

Geologist

Name NATHAN MURPHY; FLORA SPERBERG

Company COLUMBINE LOGGING, INC

Address 602 S LIPAN ST
DENVER, CO 80223

Zone Color Coding

- Oil
- Note
- Error
- Condensate
- Core
- Water

Rock Types

- CHALK
- MARLSTONE
- SILTY SHALE
- SHALY SANDSTONE
- LIMESTONE
- UNKNOWN
- ANHYDRITE
- BENTONITE
- BRECCIA
- CEMENT
- CHERT
- CLAY CHOKE SANC
- CLAYSTONE
- COAL
- CONGLOMERATE
- DOLOMITE
- GRANITE
- GYPSUM
- IGNEO
- SIDER
- METAM
- NO SAM
- SALT
- SANDS
- SALT-F
- SHALE
- SHALE

Gas
Pressure
Seal

OUS
ITE or LIMONITE
MORPHIC
MPLE
STONE
PEPPER SAND
E
E COLORED

SHALE GRAY
SHALY SILTSTONE
SILTSTONE
TILL
TUFF
WELDED TUFF

Accessories

Fossils

- ALGAE
- AMPHIPORA
- BELEMNITE
- BIOCLASTIC
- BRACHOIPOD
- BRYOZOA
- CEPHALOPOD
- CORAL
- CRINOID
- ECHINOID
- FISH
- FORAMINIFERA
- FOSSIL
- GASTROPOD
- OOLITE
- OSTRACOD
- PELECYPOD
- PELLET
- PISOLITE
- PLANT REMAINS
- PLANT SPORES
- SCAPHOPOD
- STROMATOPOROID

Minerals

- ANHYDRITIC
- ARGILLACEOUS
- ARGILLITE GRAIN
- BENTONITE
- BITUMENOUS SUBSTANCE
- BRECCIA FRAGMENTS
- CALCAREOUS
- CARBONACEOUS FLAKES
- CHTDK
- CHTLT
- COAL - THIN BEDS
- DOLOMITIC
- FELDSPAR
- FERRUGINOUS PELLET
- FERRUGINOUS
- GLAUCONITE
- GYPSIFEROUS
- HEAVY MINERAL
- INOCERAMUS
- KAOLIN
- MARLSTONE
- MINERAL CRYSTALS
- NODULES
- PHOSPHATE PELLETS
- PYRITE
- SALT CAST
- SANDY
- SILICEOUS
- SILTY
- TUFFACEOUS

Stringer

- ANHYDRITE STRINGER
- BENTONITE STRINGER
- COAL STRINGER
- DOLOMITE STRINGER
- GYPSUM STRINGER
- LIMESTONE STRINGER
- MARLSTONE (CALC) STRG
- MARLSTONE (DOL) STRG
- SANDSTONE STRINGER
- SHALE STRINGER
- SILTSTONE STRINGER

Other Symbols

Oil Show

- DEAD
- EVEN
- QUESTIONABLE
- SPOTTED STAINING

Porosity

- EARTHY
- FENESTRAL
- FRACTURE
- INTERCRYSTALLINE
- INTEROOLITIC
- MOLDIC
- ORGANIC
- PINPOINT
- VUGGY

Engineering

- BIT
- CONNECTION (DOWN)
- CONNECTION (LEFT)
- CONNECTION (RIGHT)
- CONNECTION GAS
- CONNECTION GAS UP
- CONNECTION GAS LEFT
- CONNECTION GAS DOWN...
- CORE - LOST
- CORE - RECOVERED
- DST INTERVAL
- FAULT
- FORMATION TOP
- GAS SHOW
- MN DEPTH
- NORMAL FAULT
- OIL SHOW
- OVERTURNED STRATA
- REVERSE FAULT
- SIDEWALL CORE (LEFT)
- SIDEWALL CORE (RIGHT)
- SLIDE
- SURVEY
- TRIP GAS
- WIRELINE TESTED - LEFT
- WIRELINE TESTED - RT

Rounding

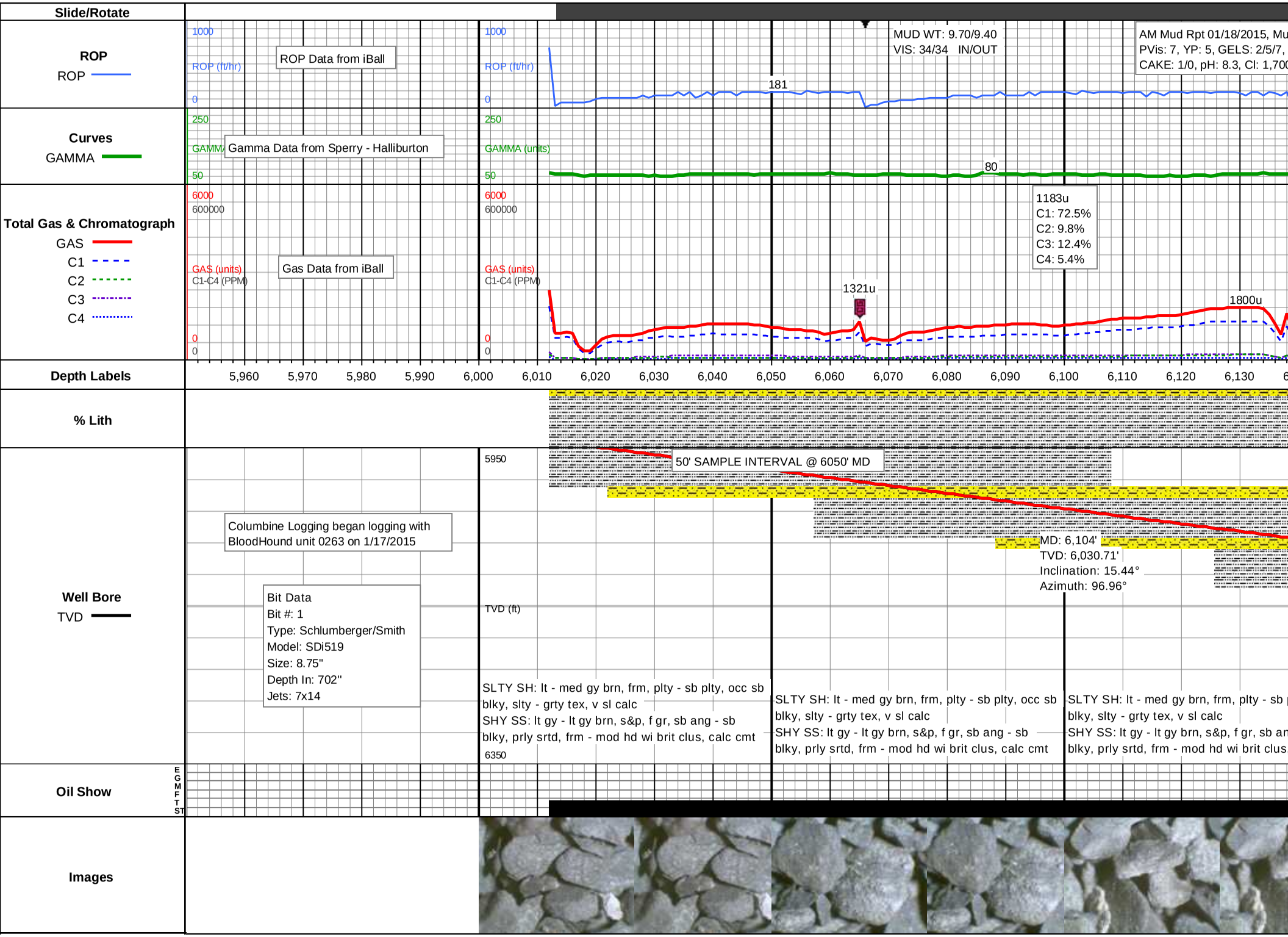
- ANGULAR
- ROUNDED
- SUBANG
- SUBRND

Textures

- BOUNDSTONE
- CHALKY
- CRYPTOXLN
- EARTHY
- FINELYXLN
- GRAINSTONE
- LITHOGRAPHIC
- MICROXLN
- MUDSTONE
- PACKSTONE
- WACKESTONE

Sorting

- MODERATE
- POOR
- WELL


Slide/Rotate
ROP
ROP
1000
ROP (ft/hr)
0
ROP Data from iBall
181
MUD WT: 9.70/9.40
VIS: 34/34 IN/OUT
AM Mud Rpt 01/18/2015, Mu
PVis: 7, YP: 5, GELS: 2/5/7,
CAKE: 1/0, pH: 8.3, Cl: 1,700
Curves
GAMMA
250
GAMMA (units)
50
Gamma Data from Sperry - Halliburton
80
Total Gas & Chromatograph
GAS
C1
C2
C3
C4
6000
600000
GAS (units)
C1-C4 (PPM)
0
Gas Data from iBall
1183u
C1: 72.5%
C2: 9.8%
C3: 12.4%
C4: 5.4%
1321u
1800u
Depth Labels
5,960
5,970
5,980
5,990
6,000
6,010
6,020
6,030
6,040
6,050
6,060
6,070
6,080
6,090
6,100
6,110
6,120
6,130
% Lith
Well Bore
TVD
5950
TVD (ft)
6350
50' SAMPLE INTERVAL @ 6050' MD
Columbine Logging began logging with
BloodHound unit 0263 on 1/17/2015
Bit Data
Bit #: 1
Type: Schlumberger/Smith
Model: SDi519
Size: 8.75"
Depth In: 702"
Jets: 7x14
MD: 6,104'
TVD: 6,030.71'
Inclination: 15.44°
Azimuth: 96.96°
SLTY SH: lt - med gy brn, frm, plty - sb plty, occ sb
blky, slty - grty tex, v sl calc
SHY SS: lt gy - lt gy brn, s&p, f gr, sb ang - sb
blky, prly srtd, frm - mod hd wi brit clus, calc cmt
Oil Show
E
G
M
F
T
ST
Images

d Wt: 9.70, FVis: 34
API Filt: 10.5
0, Ca: 200

MUD WT: 9.95/9.50
VIS: 34/34 IN/OUT

MUD WT: 10.15/9.80
VIS: 34/34 IN/OUT

1000
ROP (ft/hr)
140
90
0
250
GAMMA (units)
50
77
6000
600000
GAS (units)
C1-C4 (PPM)
0
0

1489u
1858u
2935u
2581u
2423u

2175u
C1: 71.9%
C2: 11.2%
C3: 11.4%
C4: 5.5%

6,140 6,150 6,160 6,170 6,180 6,190 6,200 6,210 6,220 6,230 6,240 6,250 6,260 6,270 6,280 6,290 6,300 6,310 6,320 6,330 6,340 6,350

5950
TVD SCALE CHANGE

MD: 6,199'
TVD: 6,120.76'
Inclination: 21.59°
Azimuth: 103.27°

MD: 6,294'
TVD: 6,207.21'
Inclination: 27.5°
Azimuth: 117.06°

TVD (ft)

plty, occ sb
g - sb
, calc cmt

SLTY SH: lt - med gy brn, frm, plty - sb plty, occ sb
blky, slty - grty tex, v sl calc
SHY SS: lt gy - lt gy brn, s&p, f gr, sb ang - sb
blky, prly srtd, frm - mod hd wi brit clus, calc cmt

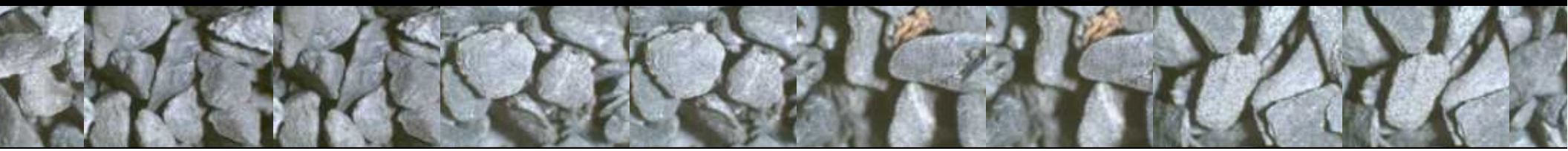
SLTY SH: lt - med gy brn, frm, plty - sb plty, occ sb
blky, slty - grty tex, v sl calc
SHY SS: lt gy - lt gy brn, s&p, f gr, sb ang - sb
blky, prly srtd, frm - mod hd wi brit clus, calc cmt

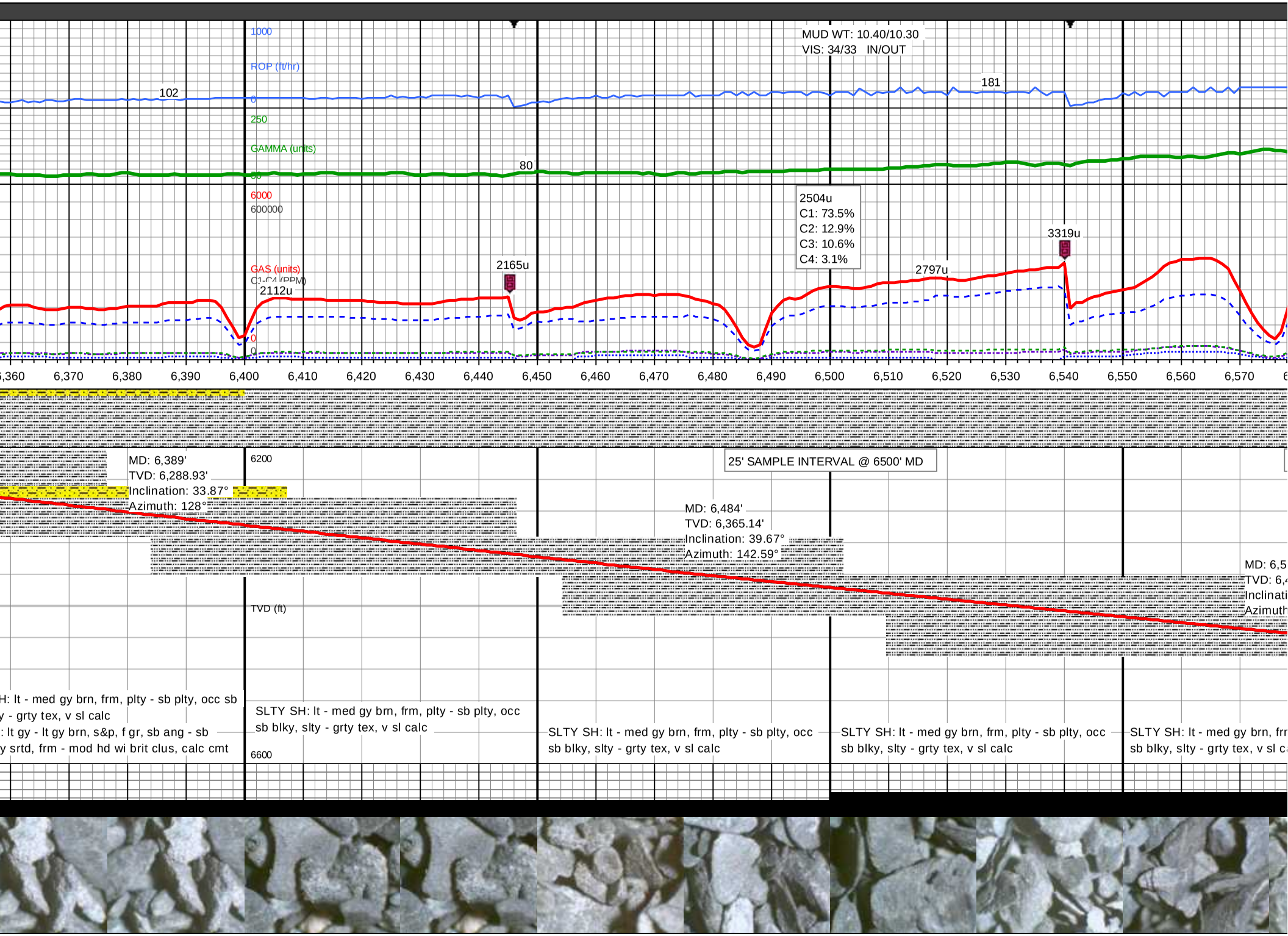
6350

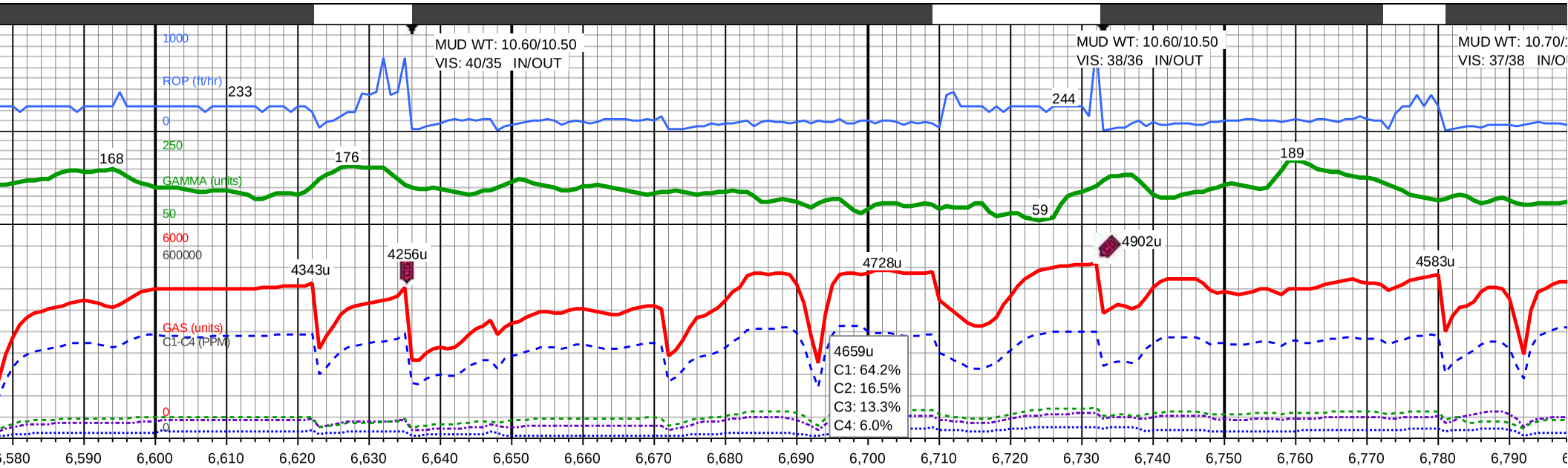
SLTY SH: lt - med gy brn, frm, plty - sb plty, occ sb
blky, slty - grty tex, v sl calc
SHY SS: lt gy - lt gy brn, s&p, f gr, sb ang - sb
blky, prly srtd, frm - mod hd wi brit clus, calc cmt

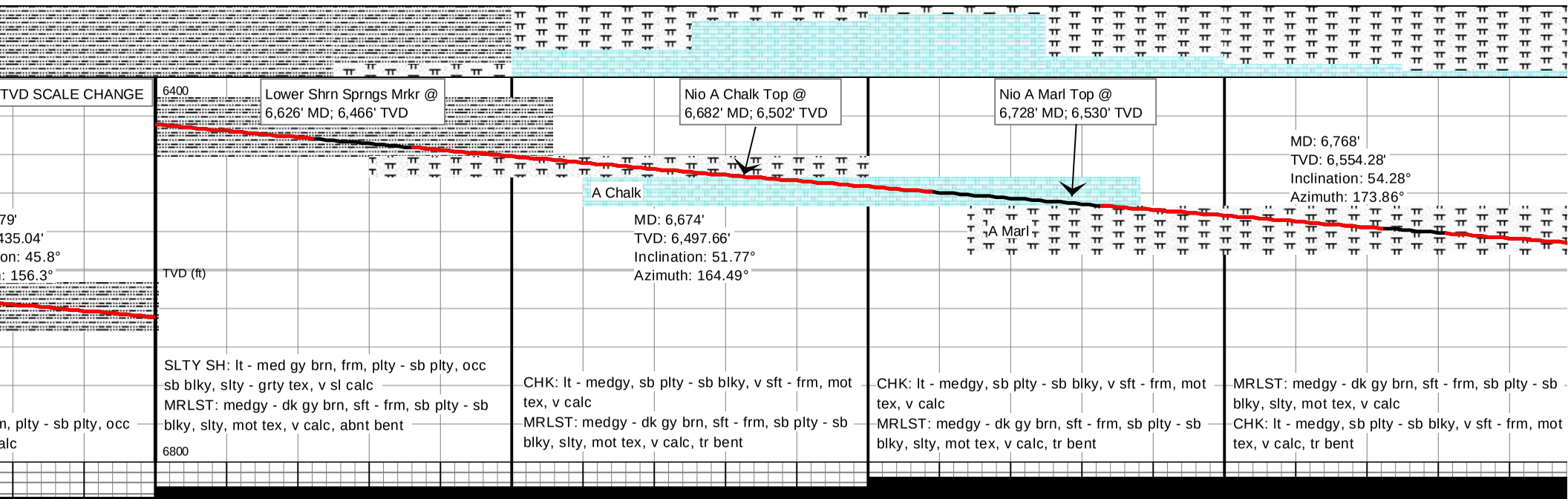
SLTY SH: lt - med gy brn, frm, plty - sb plty, occ sb
blky, slty - grty tex, v sl calc
SHY SS: lt gy - lt gy brn, s&p, f gr, sb ang - sb
blky, prly srtd, frm - mod hd wi brit clus, calc cmt

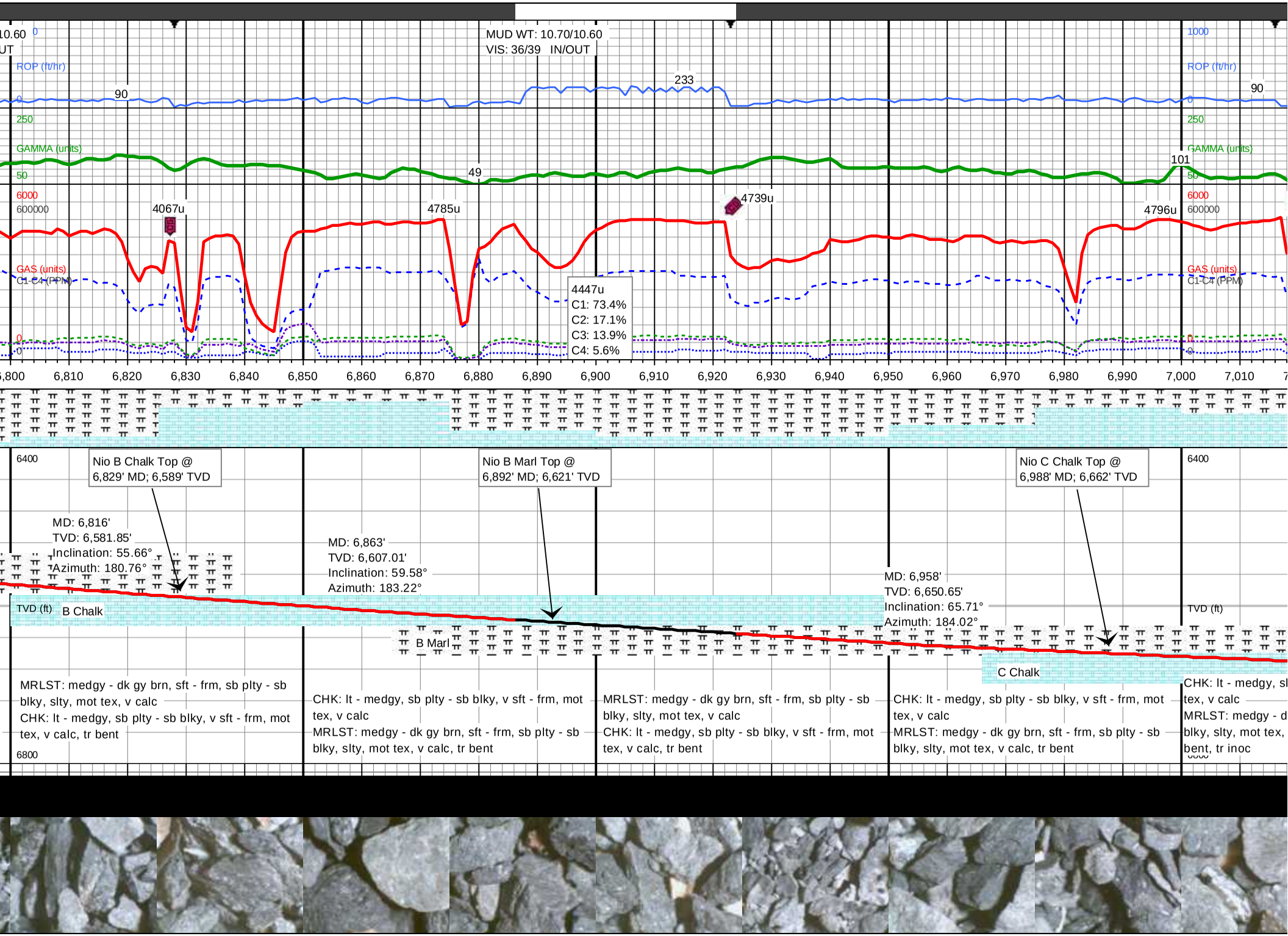
SLTY S
blky, slt
SHY SS
blky, prl




1000
ROP (ft/hr)
102
0
250
GAMMA (units)
80
6000
600000
GAS (units)
C1-C4 (PPM)
2112u
2165u
2504u
C1: 73.5%
C2: 12.9%
C3: 10.6%
C4: 3.1%
2797u
3319u
MUD WT: 10.40/10.30
VIS: 34/33 IN/OUT
181
6,360
6,370
6,380
6,390
6,400
6,410
6,420
6,430
6,440
6,450
6,460
6,470
6,480
6,490
6,500
6,510
6,520
6,530
6,540
6,550
6,560
6,570
MD: 6,389'
TVD: 6,288.93'
Inclination: 33.87°
Azimuth: 128°
6200
25' SAMPLE INTERVAL @ 6500' MD
MD: 6,484'
TVD: 6,365.14'
Inclination: 39.67°
Azimuth: 142.59°
TVD (ft)
6600
SLTY SH: lt - med gy brn, frm, plty - sb plty, occ sb
- grty tex, v sl calc
: lt gy - lt gy brn, s&p, f gr, sb ang - sb
srtd, frm - mod hd wi brit clus, calc cmt
SLTY SH: lt - med gy brn, frm, plty - sb plty, occ
sb blky, slty - grty tex, v sl calc
SLTY SH: lt - med gy brn, frm, plty - sb plty, occ
sb blky, slty - grty tex, v sl calc
SLTY SH: lt - med gy brn, frm, plty - sb plty, occ
sb blky, slty - grty tex, v sl calc
SLTY SH: lt - med gy brn, frm
sb blky, slty - grty tex, v sl


1000
ROP (ft/hr)
0
233
168
176
244
189
59
250
GAMMA (units)
50
MUD WT: 10.60/10.50
VIS: 40/35 IN/OUT
MUD WT: 10.60/10.50
VIS: 38/36 IN/OUT
MUD WT: 10.70/
VIS: 37/38 IN/O
6000
600000
GAS (units)
C1-C4 (PPM)
0
0
4343u
4256u
4728u
4902u
4583u
4659u
C1: 64.2%
C2: 16.5%
C3: 13.3%
C4: 6.0%
6,580
6,590
6,600
6,610
6,620
6,630
6,640
6,650
6,660
6,670
6,680
6,690
6,700
6,710
6,720
6,730
6,740
6,750
6,760
6,770
6,780
6,790


TVD SCALE CHANGE
6400
Lower Shrn Sprngs Mrkr @
6,626' MD; 6,466' TVD
Nio A Chalk Top @
6,682' MD; 6,502' TVD
Nio A Marl Top @
6,728' MD; 6,530' TVD
MD: 6,768'
TVD: 6,554.28'
Inclination: 54.28°
Azimuth: 173.86°
A Chalk
A Marl
MD: 6,674'
TVD: 6,497.66'
Inclination: 51.77°
Azimuth: 164.49°
TVD (ft)
6800
SLTY SH: lt - med gy brn, frm, plty - sb plty, occ sb blky, slty - grty tex, v sl calc
MRLST: medgy - dk gy brn, sft - frm, sb plty - sb blky, slty, mot tex, v calc, abnt bent
CHK: lt - medgy, sb plty - sb blky, v sft - frm, mot tex, v calc
MRLST: medgy - dk gy brn, sft - frm, sb plty - sb blky, slty, mot tex, v calc, tr bent
CHK: lt - medgy, sb plty - sb blky, v sft - frm, mot tex, v calc
MRLST: medgy - dk gy brn, sft - frm, sb plty - sb blky, slty, mot tex, v calc, tr bent
MRLST: medgy - dk gy brn, sft - frm, sb plty - sb blky, slty, mot tex, v calc
CHK: lt - medgy, sb plty - sb blky, v sft - frm, mot tex, v calc, tr bent


10.60
UT
MUD WT: 10.70/10.60
VIS: 36/39 IN/OUT
ROP (ft/hr)
90
233
90
GAMMA (units)
49
101
4067u
4785u
4739u
4796u
GAS (units)
C1-C4 (PPM)
4447u
C1: 73.4%
C2: 17.1%
C3: 13.9%
C4: 5.6%
6,800
6,810
6,820
6,830
6,840
6,850
6,860
6,870
6,880
6,890
6,900
6,910
6,920
6,930
6,940
6,950
6,960
6,970
6,980
6,990
7,000
7,010
6400
Nio B Chalk Top @
6,829' MD; 6,589' TVD
Nio B Marl Top @
6,892' MD; 6,621' TVD
Nio C Chalk Top @
6,988' MD; 6,662' TVD
MD: 6,816'
TVD: 6,581.85'
Inclination: 55.66°
Azimuth: 180.76°
MD: 6,863'
TVD: 6,607.01'
Inclination: 59.58°
Azimuth: 183.22°
MD: 6,958'
TVD: 6,650.65'
Inclination: 65.71°
Azimuth: 184.02°
TVD (ft)
B Chalk
B Marl
C Chalk
MRLST: medgy - dk gy brn, sft - frm, sb plty - sb blky, slty, mot tex, v calc
CHK: lt - medgy, sb plty - sb blky, v sft - frm, mot tex, v calc, tr bent
6800
CHK: lt - medgy, sb plty - sb blky, v sft - frm, mot tex, v calc
MRLST: medgy - dk gy brn, sft - frm, sb plty - sb blky, slty, mot tex, v calc, tr bent
MRLST: medgy - dk gy brn, sft - frm, sb plty - sb blky, slty, mot tex, v calc
CHK: lt - medgy, sb plty - sb blky, v sft - frm, mot tex, v calc, tr bent
CHK: lt - medgy, sb plty - sb blky, v sft - frm, mot tex, v calc
MRLST: medgy - dk gy brn, sft - frm, sb plty - sb blky, slty, mot tex, v calc, tr bent
CHK: lt - medgy, sl
tex, v calc
MRLST: medgy - d
blky, slty, mot tex,
bent, tr inoc

MUD WT: 10.65/10.60
VIS: 36/37 IN/OUT

01/18/15 MINDEPTH 01/19/15

MUD WT: 9.30/9.50
VIS: 32/33 IN/OUT

ROP (ft/hr)
79
147
0
250
GAMMA (units)
63
62
50
6000
600000
4864u
4719u
3680u
GAS (units)
C1-C4 (PPM)
3107u
C1: 58.1%
C2: 18.2%
C3: 15.7%
C4: 8.0%
0

7,020 7,030 7,040 7,050 7,060 7,070 7,080 7,090 7,100 7,110 7,120 7,130 7,140 7,150 7,160 7,170 7,180 7,190 7,200 7,210 7,220 7,230

TVD SCALE CHANGE

6500

TOOH @ 7,108' MD
to run 7" casing

50' Sample Interval @ 7,150' MD

Bit Data
Bit #: 2
Type: Schlumberger / Smith
Model: MDi516
Size: 6.12"
Depth In: 7,108'
Jets: 5x16

MD: 7,108'
TVD: 6,688.5'
Inclination: 85.16°
Azimuth: 183°

6500

MD: 7,216'
TVD: 6,700.1'
Inclination: 88.46°
Azimuth: 182.55°

MD: 7,050'
TVD: 6,679.71'
Inclination: 77.39°
Azimuth: 183.98°

TVD (ft)
C Marl

TVD (ft)

p plty - sb blky, v sft - frm, mot
k gy brn, sft - frm, sb plty - sb
occ thn lam, v calc, fosus, tr

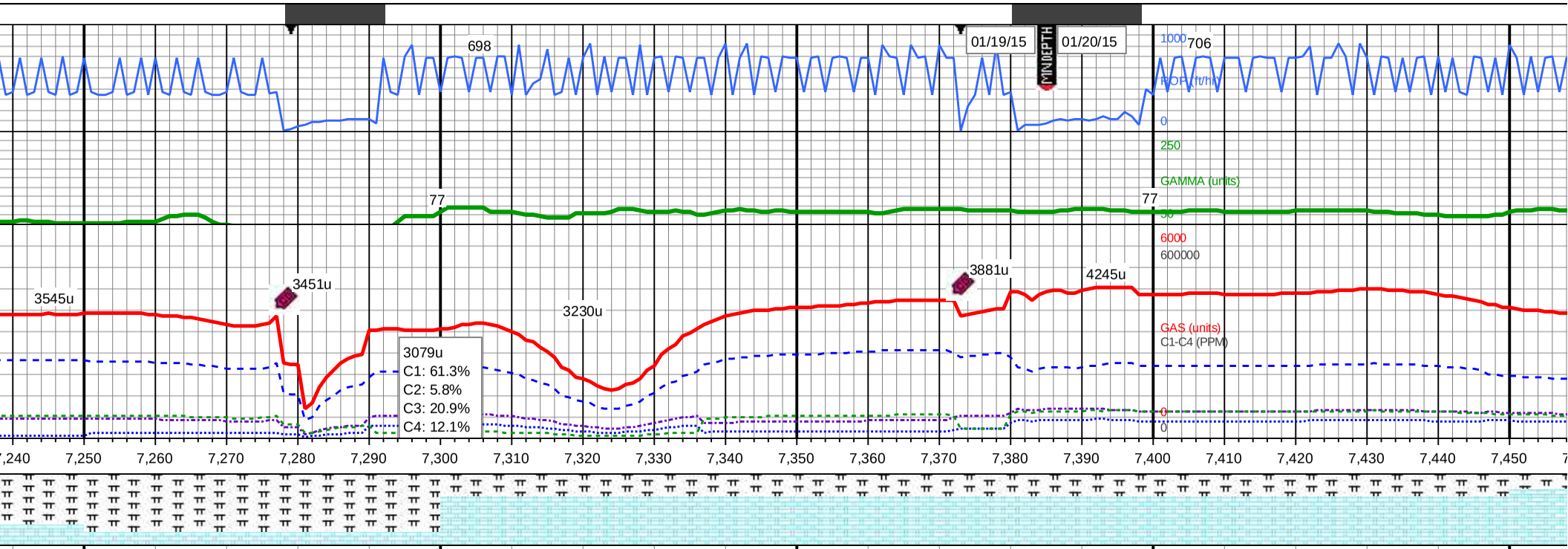
CHK: lt - medgy, sb plty - sb blky, v sft - frm, mot tex, v calc
MRLST: medgy - dk gy brn, sft - frm, sb plty - sb blky, slty, mot tex, occ thn lam, v calc, fosus, tr bent, tr inoc

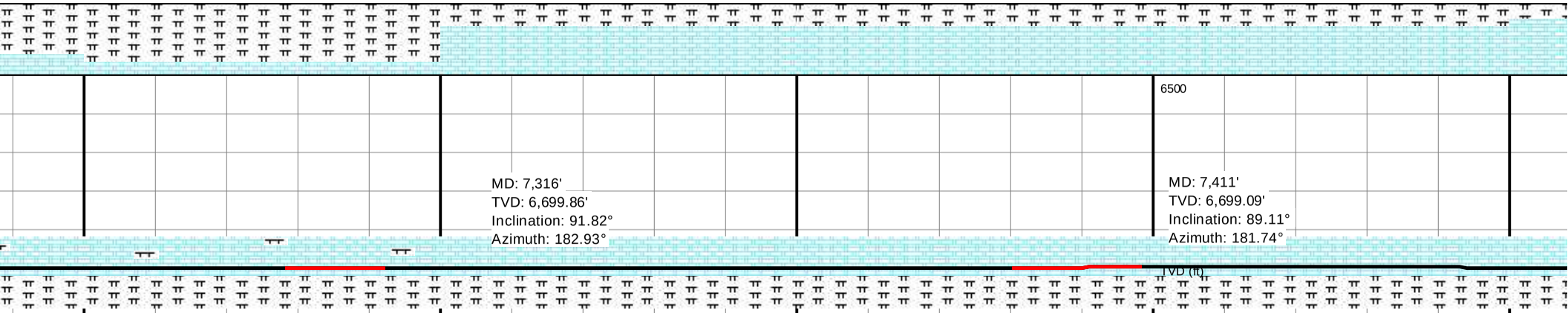
90% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc, rr inoc
10% MRLST: medgy - dk gy brn, sft - frm, sb plty - sb blky, slty, mot tex, v calc, fosus, tr bent

6900

90% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc, rr inoc
10% MRLST: medgy - dk gy brn, sft - frm, sb plty - sb blky, slty, mot tex, v calc, fosus, tr ben

30% CHK: lt - medgy, sb plty - sb blky, s
mot tex, v calc
70% MRLST: medgy - dk gy brn, sft - frm
sb blky, slty, mot-grty tex, v calc, tr ben
inoc frag





sft - frm,
m, sb plty -
, tr ls

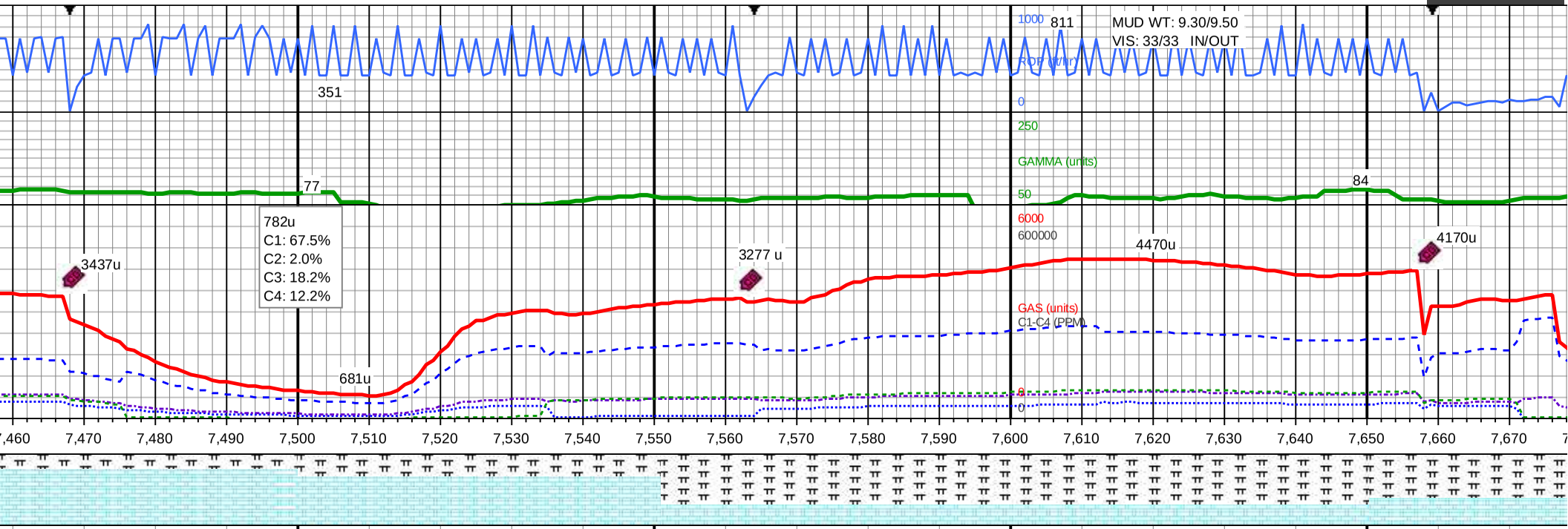
20% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
80% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, pred grty tex, occ mot tex, v calc, tr ben, tr ls inoc frag

70% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, rr xbdd, v calc, tr ls inoc frag
30% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, occ thn lam, v calc, occ ben

70% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, rr xbdd, v calc, tr ls inoc frag
30% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, occ thn lam, v calc, occ ben

70% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc, tr ls inoc frag
30% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, occ thn lam, v calc, tr ben

80% C
mot tex
20% M
sb blky
ben



6500

MD: 7,506'
TVD: 6,699.58'
Inclination: 90.31°
Azimuth: 181.79°

MD: 7,601'
TVD: 6,698.07'
Inclination: 91.51°
Azimuth: 181.82°

TVD (ft)

HK: lt - medgy, sb plty - sb blky, sft - frm,
, v calc, tr ls inoc frag
RLST: medgy - dk gy, v sft - frm, sb plty -
, slty, grty - mot tex, occ thn lam, v calc, tr

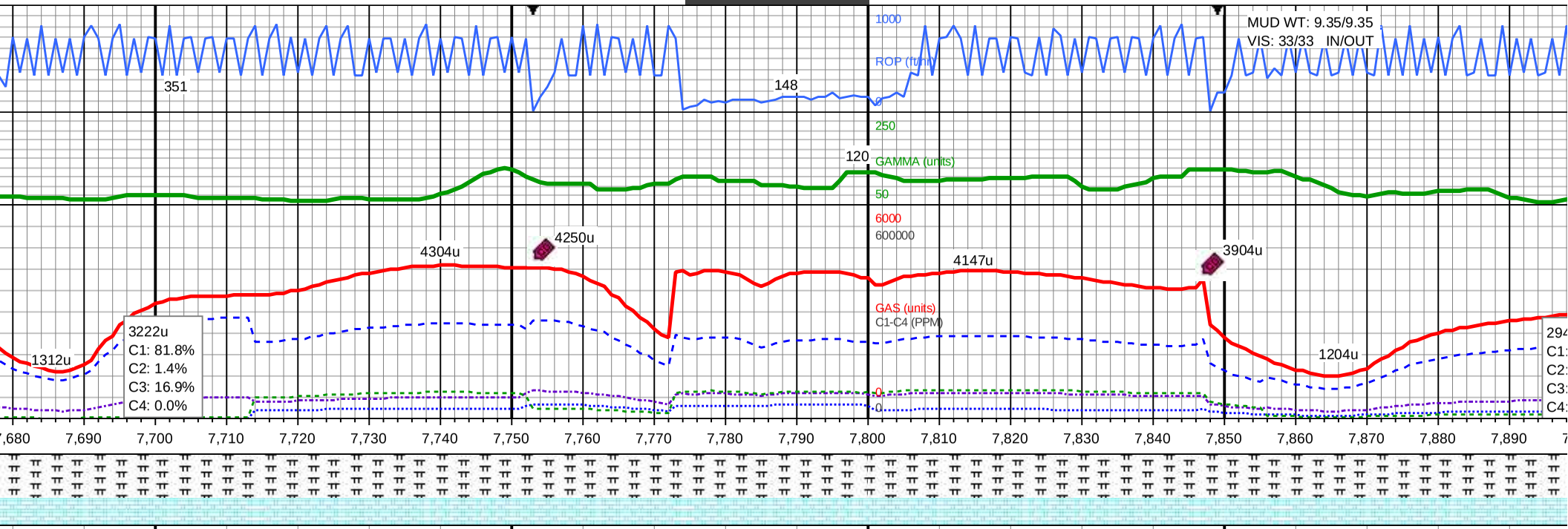
70% CHK: lt - medgy, sb plty - sb blky, sft - frm,
mot tex, v calc, tr ls inoc frag
30% MRLST: medgy - dk gy, v sft - frm, sb plty -
sb blky, slty, grty - mot tex, occ thn lam, occ
fosus, v calc, tr ben

20% CHK: lt - medgy, sb plty - sb blky, sft - frm,
mot tex, v calc
80% MRLST: medgy - dk gy, v sft - frm, sb plty -
sb blky, slty, grty - mot tex, occ thn lam, occ
fosus, v calc, tr ben, tr ls inoc frag

30% CHK: lt - medgy, sb plty - sb blky, sft - frm,
mot tex, v calc
70% MRLST: medgy - dk gy, v sft - frm, sb plty -
sb blky, slty, grty - mot tex, abnt thn lam, occ
fosus, v calc, tr ben, tr ls inoc frag

6900

40% CHK: lt - medgy, sb plty
mot tex, v calc
60% MRLST: medgy - dk gy,
sb blky, slty, grty - mot tex, a
fosus, v calc, tr ben, tr ls inoc



6500

MD: 7,695'
TVD: 6,696.02'
Inclination: 90.99°
Azimuth: 181.59°

MD: 7,791'
TVD: 6,695.22'
Inclination: 89.97°
Azimuth: 181.5°

MD: 7,885'
TVD: 6,696.25'
Inclination: 89.57°
Azimuth: 181.35°

TVD (ft)

- sb blky, sft - frm,
v sft - frm, sb plty -
bnt thn lam, occ
c frag

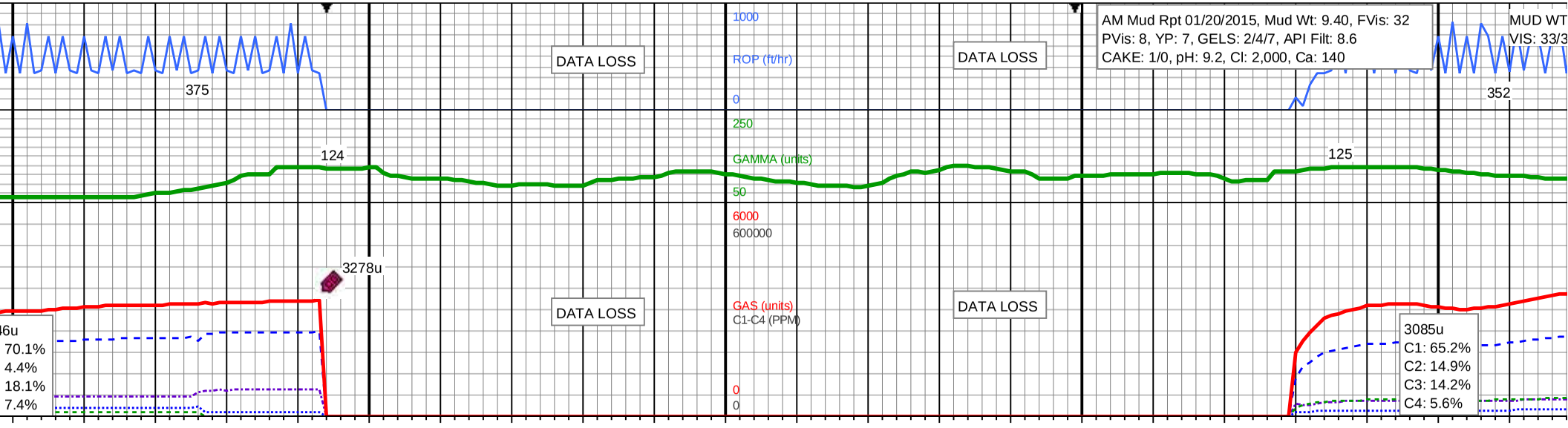
40% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
60% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr ben, tr ls inoc frag

40% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
60% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr ben, tr ls inoc frag

40% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
60% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr ben, tr ls inoc frag

6900

40% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
60% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr ben, tr ls inoc frag



6500

MD: 7,980'
TVD: 6,695.51'
Inclination: 91.33°
Azimuth: 181.48°

MD: 8,075'
TVD: 6,694.44'
Inclination: 89.97°
Azimuth: 182.59°

TVD (ft)

30% CHK: pred tan wi wh, sme ltgy, mot, lam, sft - mod hd, sb plty - sb blky, rthy tex, v calc
70% MRLST: lt - med gy, occ blk speckl wi wh, sft - mod hd, plty - sb plty, occ sb blky, slty - grty tex, tr Inoc

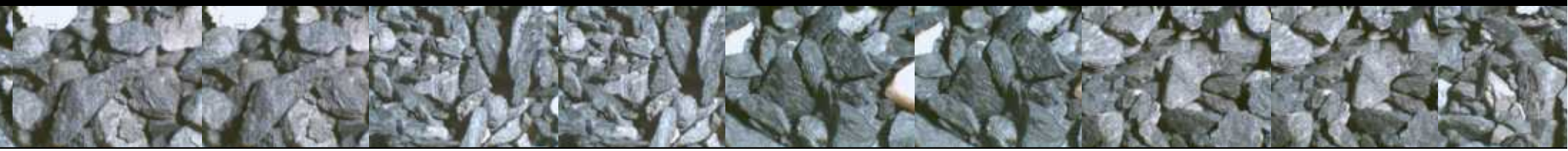
10% CHK: pred tan wi wh, sme ltgy, mot, lam, sft - mod hd, sb plty - sb blky, rthy tex, v calc
90% MRLST: lt - med gy, occ blk speckl wi wh, sft - mod hd, plty - sb plty, occ sb blky, slty - grty tex, tr Inoc

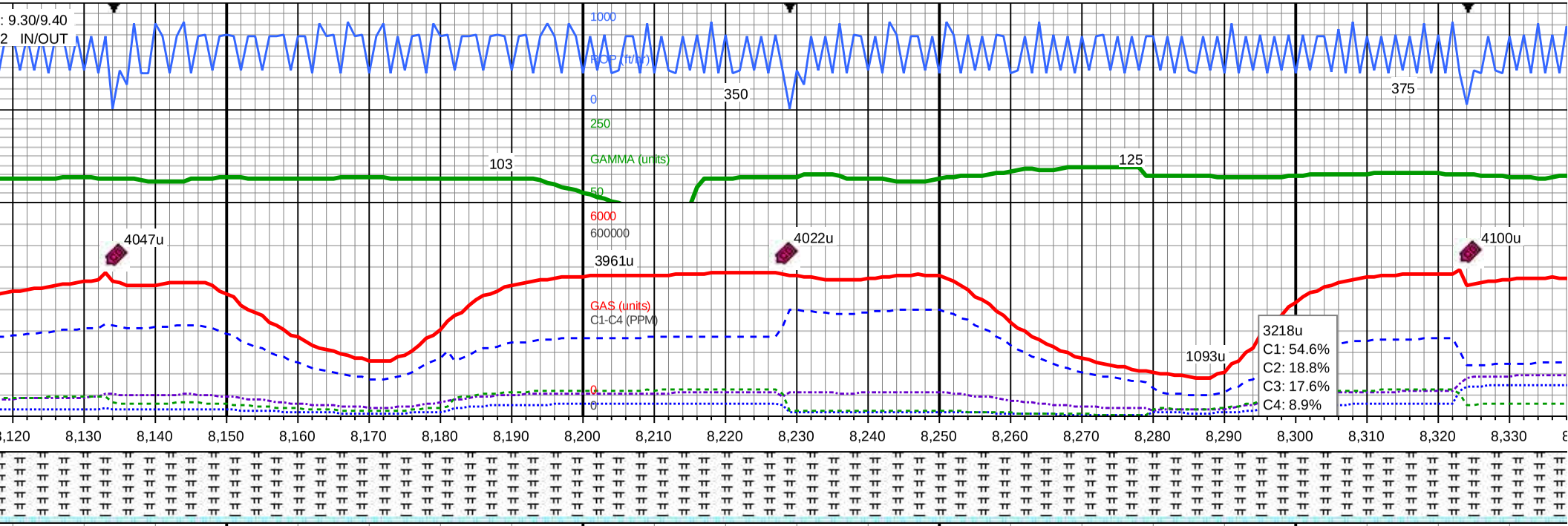
10% CHK: pred tan wi wh, sme ltgy, mot, lam, sft - mod hd, sb plty - sb blky, rthy tex, v calc
90% MRLST: lt - med gy, occ blk speckl wi wh, sft - mod hd, plty - sb plty, occ sb blky, slty - grty tex, tr Inoc

6900

10% CHK: pred tan wi wh, sme ltgy, mot, lam, sft - mod hd, sb plty - sb blky, rthy tex, v calc
90% MRLST: lt - med gy, occ blk speckl wi wh, sft - mod hd, plty - sb plty, occ sb blky, slty - grty tex, tr Inoc

10% CHK: pred ta
- mod hd, sb plty -
90% MRLST: lt - m
sft - mod hd, plty -
tex, tr Inoc





6500

MD: 8,170'
TVD: 6,694'
Inclination: 90.55°
Azimuth: 183.48°

MD: 8,265'
TVD: 6,694.54'
Inclination: 88.8°
Azimuth: 181.41°

TVD (ft)

n wi wh, sme ltgy, mot, lam, sft
sb blky, rthy tex, v calc
med gy, occ blk speckl wi wh,
sb plty, occ sb blky, slty - grty

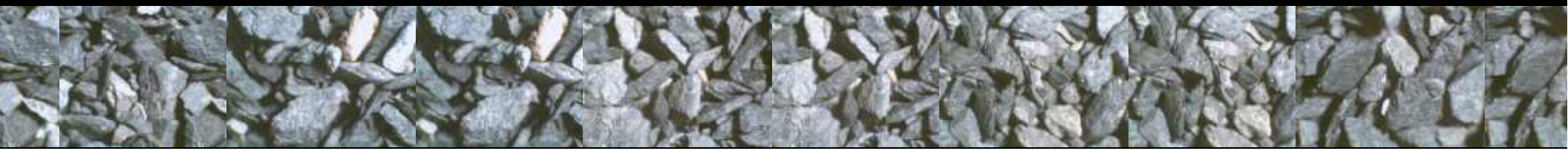
10% CHK: pred tan wi wh, sme ltgy, mot, lam, sft
- mod hd, sb plty - sb blky, rthy tex, v calc
90% MRLST: lt - med gy, occ blk speckl wi wh,
sft - mod hd, plty - sb plty, occ sb blky, slty - grty
tex, tr Inoc

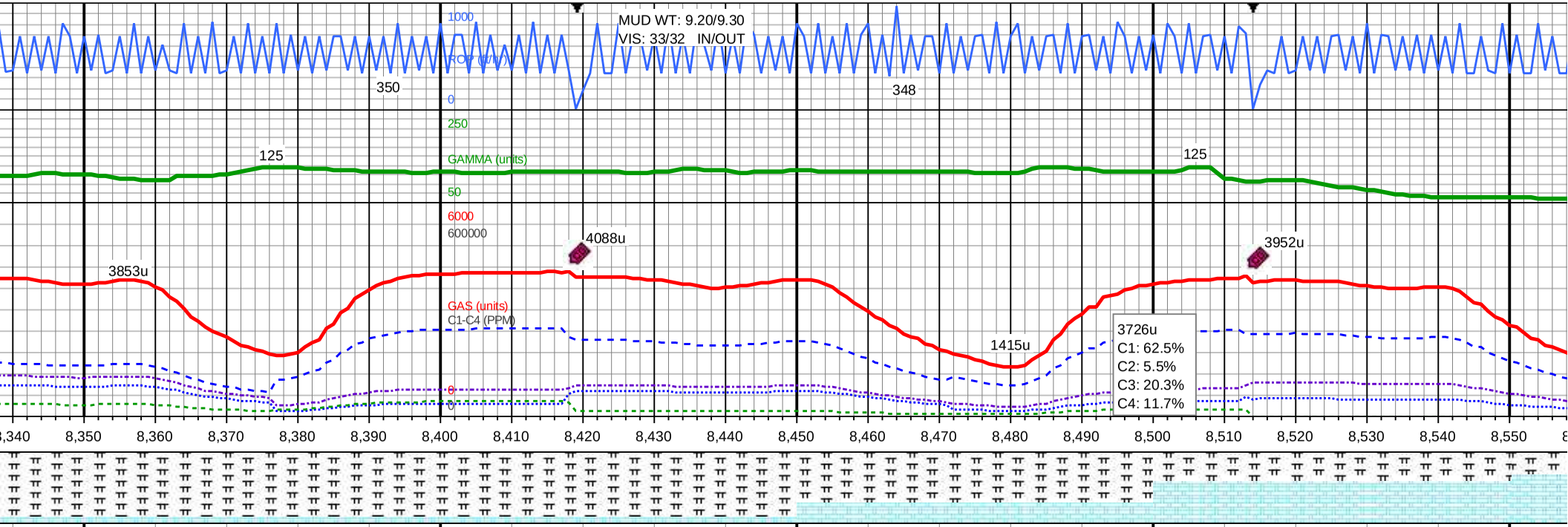
10% CHK: pred tan wi wh, sme ltgy, mot, lam, sft
- mod hd, sb plty - sb blky, rthy tex, v calc
90% MRLST: lt - med gy, occ blk speckl wi wh,
sft - mod hd, plty - sb plty, occ sb blky, slty - grty
tex, tr Inoc

6900

10% CHK: pred tan wi wh, sme ltgy, mot, lam, sft
- mod hd, sb plty - sb blky, rthy tex, v calc
90% MRLST: lt - med gy, occ blk speckl wi wh,
sft - mod hd, plty - sb plty, occ sb blky, slty - grty
tex, tr Inoc

10% CHK: pred tan wi wh, sme ltgy, mo
- mod hd, sb plty - sb blky, rthy tex, v ca
90% MRLST: lt - med gy, occ blk speckl
sft - mod hd, plty - sb plty, occ sb blky,
tex, tr Inoc





6500

MD: 8,360'
TVD: 6,696.15'
Inclination: 89.26°
Azimuth: 181.54°

MD: 8,455'
TVD: 6,696.46'
Inclination: 90.37°
Azimuth: 182.81°

MD: 8,550'
TVD: 6,696.15'
Inclination: 90°
Azimuth: 181.99°

TVD (ft)

t, lam, sft
alc
wi wh,
slty - grty

10% CHK: pred tan wi wh, sme ltgy, mot, lam, sft - mod hd, sb plty - sb blky, rthy tex, v calc
90% MRLST: lt - med gy, occ blk speckl wi wh, sft - mod hd, plty - sb plty, occ sb blky, slty - grty tex, tr Inoc

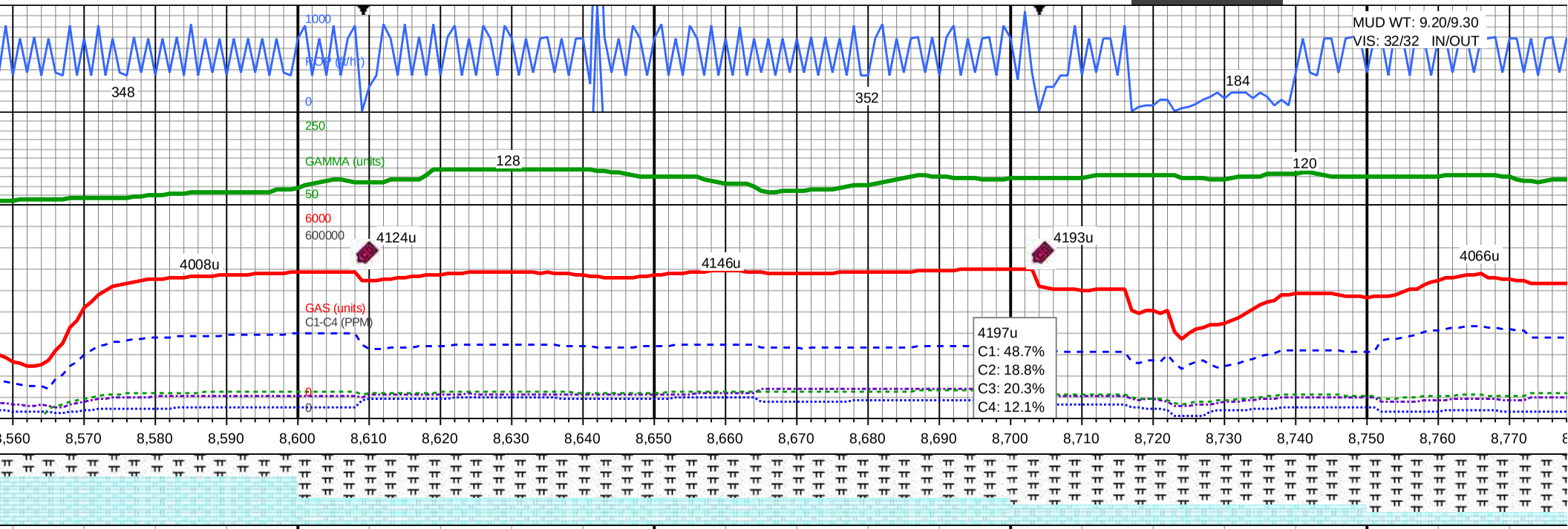
10% CHK: pred tan wi wh, sme ltgy, mot, lam, sft - mod hd, sb plty - sb blky, rthy tex, v calc
90% MRLST: lt - med gy, occ blk speckl wi wh, sft - mod hd, plty - sb plty, occ sb blky, slty - grty tex, tr Inoc

6900

30% CHK: pred tan wi wh, sme ltgy, mot, lam, sft - mod hd, sb plty - sb blky, rthy tex, v calc
70% MRLST: lt - med gy, occ blk speckl wi wh, sft - mod hd, plty - sb plty, occ sb blky, slty - grty tex, tr Inoc

60% CHK: pred tan wi wh, sme ltgy, mot, lam, sft - mod hd, sb plty - sb blky, rthy tex, v calc
40% MRLST: lt - med gy, occ blk speckl wi wh, sft - mod hd, plty - sb plty, occ sb blky, slty - grty tex, tr Inoc

70% CH
- mod h
30% MR
sft - mo
tex, tr In



6500

MD: 8,645'
TVD: 6,695.82'
Inclination: 90.4°
Azimuth: 181.7°

MD: 8,740'
TVD: 6,694.95'
Inclination: 90.65°
Azimuth: 181.67°

TVD (ft)

IK: pred tan wi wh, sme ltgy, mot, lam, sft
d, sb plty - sb blky, rthy tex, v calc
RLST: lt - med gy, occ blk speckl wi wh,
d hd, plty - sb plty, occ sb blky, slty - grty
noc

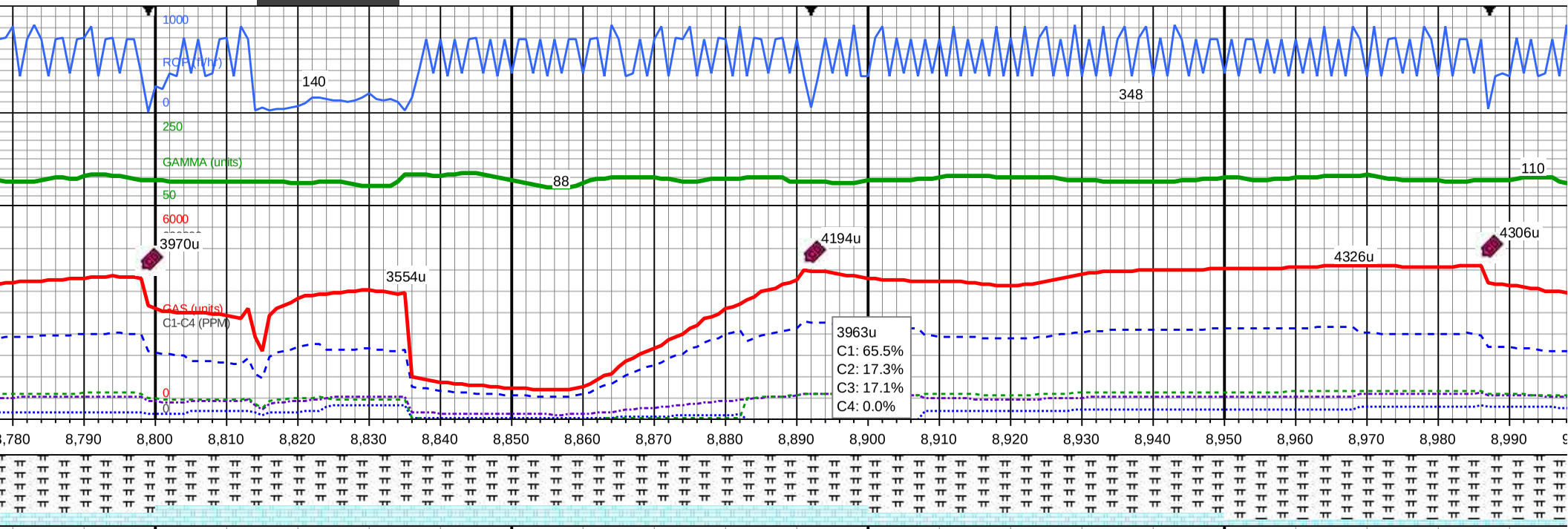
40% CHK: pred tan wi wh, sme ltgy, mot, lam, sft - mod hd, sb plty - sb blky, rthy tex, v calc
60% MRLST: lt - med gy, occ blk speckl wi wh, sft - mod hd, plty - sb plty, occ sb blky, slty - grty tex, tr Inoc

6900

40% CHK: pred tan wi wh, sme ltgy, mot, lam, sft - mod hd, sb plty - sb blky, rthy tex, v calc
60% MRLST: lt - med gy, occ blk speckl wi wh, sft - mod hd, plty - sb plty, occ sb blky, slty - grty tex, tr Inoc

30% CHK: pred tan wi wh, sme ltgy, mot, lam, sft - mod hd, sb plty - sb blky, rthy tex, v calc
70% MRLST: lt - med gy, occ blk speckl wi wh, sft - mod hd, plty - sb plty, occ sb blky, slty - grty tex, tr Inoc

20% CHK: pred tan wi wh, sm
- mod hd, sb plty - sb blky, rt
80% MRLST: lt - med gy, occ
sft - mod hd, plty - sb plty, oc
tex, tr Inoc



6500

MD: 8,835'
TVD: 6,694.87'
Inclination: 89.45°
Azimuth: 179.97°

MD: 8,929'
TVD: 6,694.77'
Inclination: 90.68°
Azimuth: 180.55°

TVD (ft)

he ltgy, mot, lam, sft
hy tex, v calc
blk speckl wi wh,
c sb blky, slty - grty

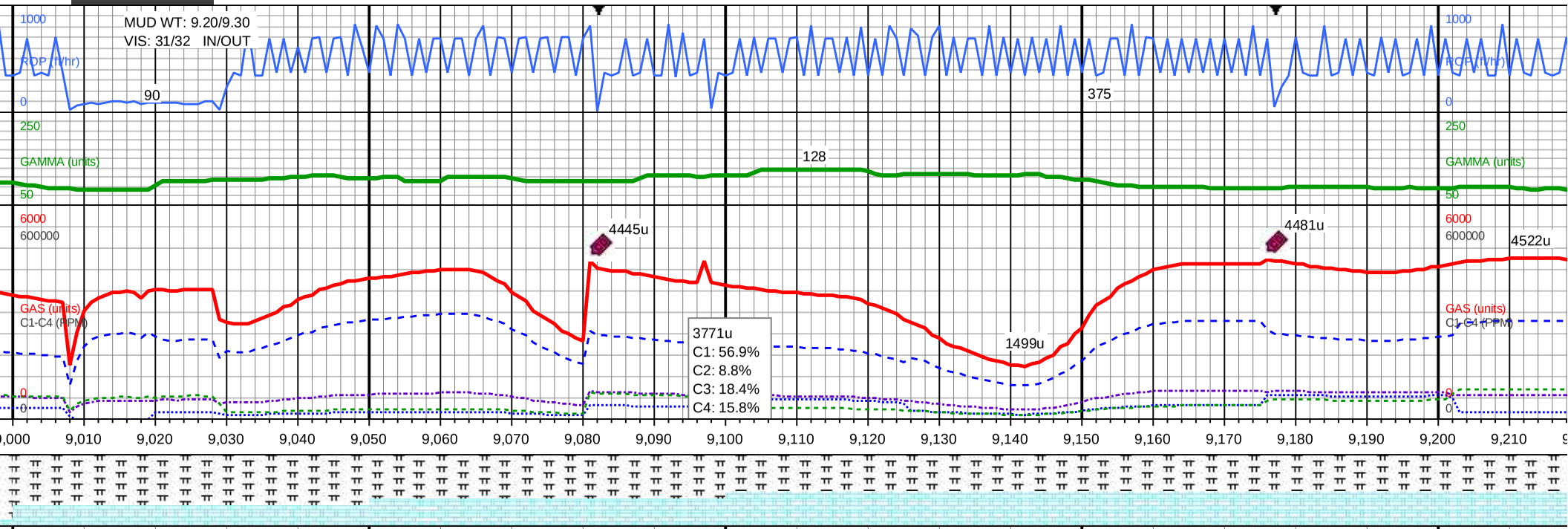
30% CHK: pred tan wi wh, sme ltgy, mot, lam, sft - mod hd, sb plty - sb blky, rthy tex, v calc
70% MRLST: lt - med gy, occ blk speckl wi wh, sft - mod hd, plty - sb plty, occ sb blky, slty - grty tex, tr Inoc

6900

30% CHK: pred tan wi wh, sme ltgy, mot, lam, sft - mod hd, sb plty - sb blky, rthy tex, v calc
70% MRLST: lt - med gy, occ blk speckl wi wh, sft - mod hd, plty - sb plty, occ sb blky, slty - grty tex, tr Inoc

20% CHK: pred tan wi wh, sme ltgy, mot, lam, sft - mod hd, sb plty - sb blky, rthy tex, v calc
80% MRLST: lt - med gy, occ blk speckl wi wh, sft - mod hd, plty - sb plty, occ sb blky, slty - grty tex, tr Inoc

10% CHK: pred tan wi wh, sme ltgy, mot, lam, sft - mod hd, sb plty - sb blky, rthy tex, v calc
90% MRLST: lt - med gy, occ blk speckl wi wh, sft - mod hd, plty - sb plty, occ sb blky, slty - grty tex, tr Inoc



6500

MD: 9,024'
TVD: 6,695.36'
Inclination: 88.61°
Azimuth: 179.95°

MD: 9,119'
TVD: 6,697.28'
Inclination: 89.08°
Azimuth: 179.59°

MD: 9,214'
TVD: 6,697.61
Inclination: 90
Azimuth: 179.

TVD (ft)

30% CHK: pred tan wi wh, sme ltgy, mot, lam, sft - mod hd, sb plty - sb blky, rthy tex, v calc
70% MRLST: lt - med gy, occ blk speckl wi wh, sft - mod hd, plty - sb plty, occ sb blky, slty - grty tex, tr bent, tr Inoc

6900

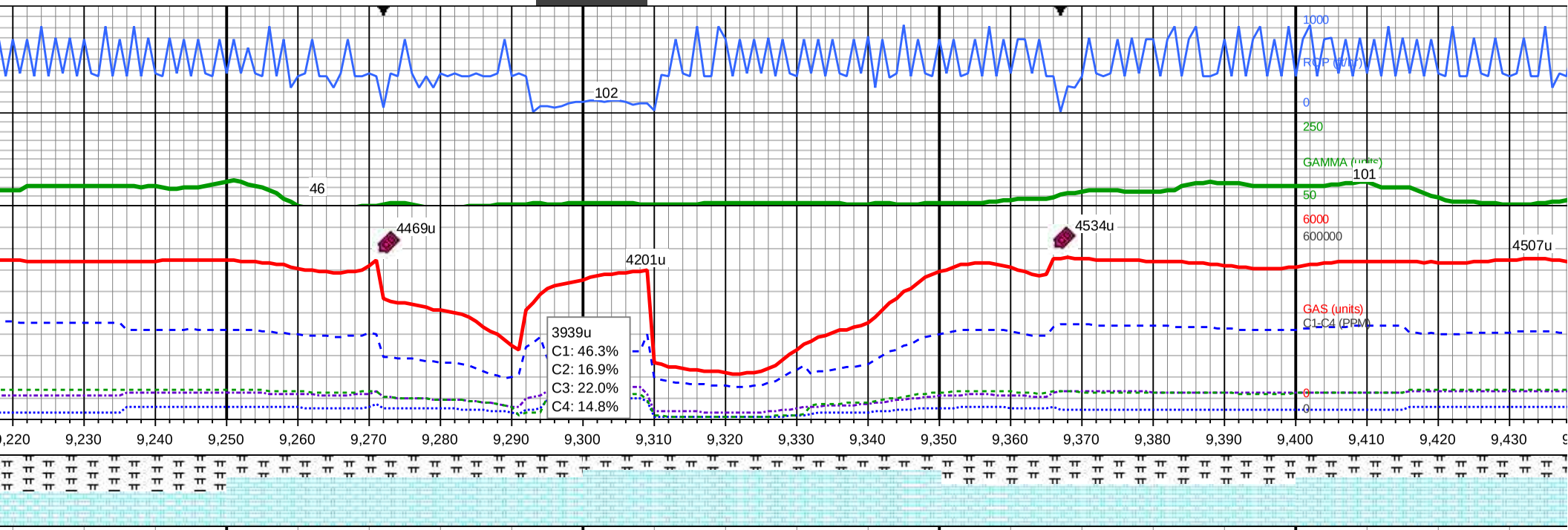
40% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
60% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, v tr ben, tr ls inoc frag

50% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
50% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr ben, tr ls inoc frag

50% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
50% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr ben, tr ls inoc frag

50% CHK: lt - med
mot tex, v calc
50% MRLST: med
sb blky, slty, grty -
fosus, v calc, tr be

6900



6500

MD: 9,309'
TVD: 6,697.13'
Inclination: 90.06°
Azimuth: 180.79°

MD: 9,404'
TVD: 6,693.27'
Inclination: 94.59°
Azimuth: 182.48°

TVD (ft)

gy, sb plty - sb blky, sft - frm,
gy - dk gy, v sft - frm, sb plty -
mot tex, abnt thn lam, occ
n, tr ls inoc frag

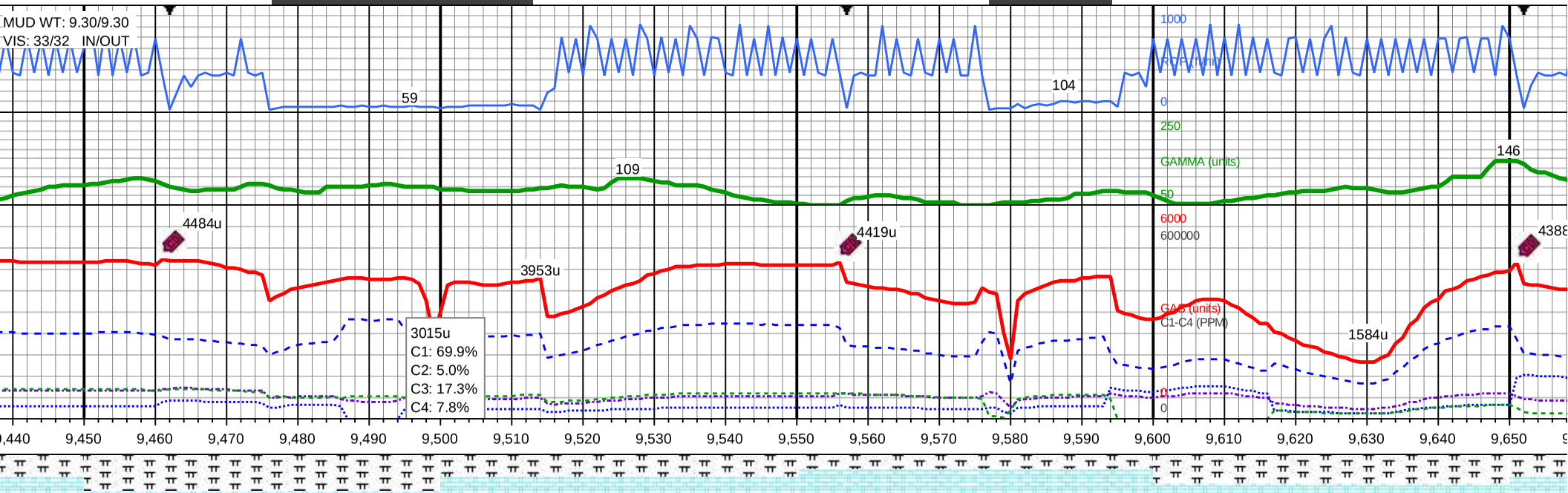
70% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
30% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr ben, tr ls inoc frag

80% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
20% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr ls inoc frag

60% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
40% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr ls inoc frag

70% CHK: lt - medgy, sb plty - sb blky, s
mot tex, v calc
30% MRLST: medgy - dk gy, v sft - frm,
sb blky, slty, grty - mot tex, abnt thn lam
fosus, v calc, tr ls inoc frag

6900



6500

MD: 9,499'
TVD: 6,688.11'
Inclination: 91.63°
Azimuth: 181.88°

MD: 9,594'
TVD: 6,687.72'
Inclination: 88.83°
Azimuth: 180.63°

TVD (ft)

sft - frm,
sb plty -
n, occ

50% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
50% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr ben, tr ls inoc frag

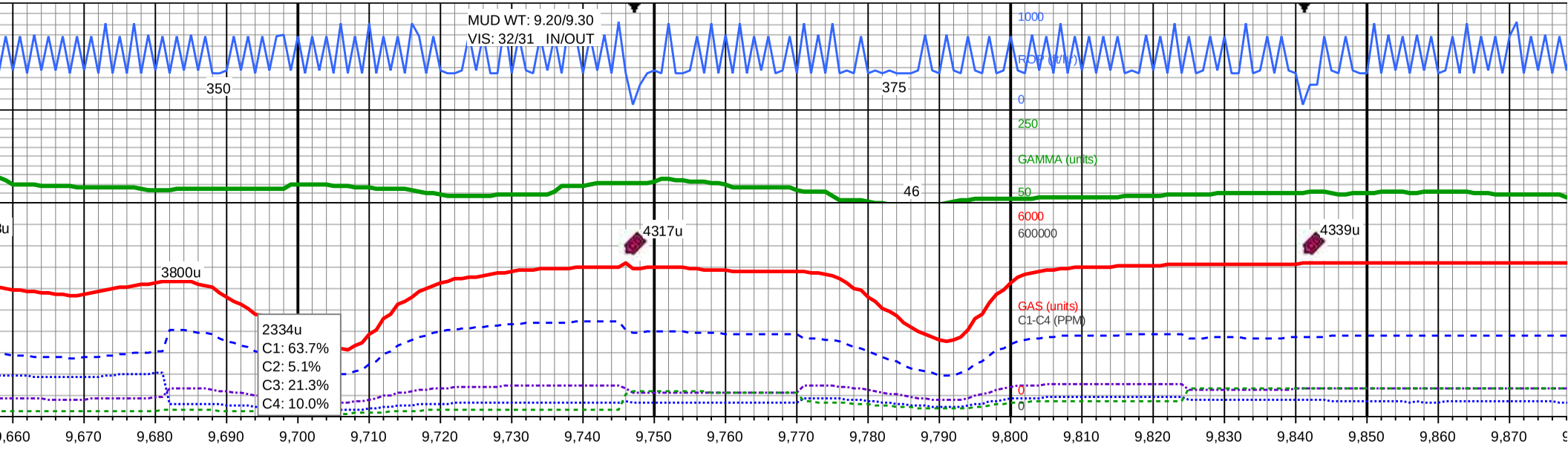
70% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
30% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr ls inoc frag

80% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
20% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr ls inoc frag

60% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
40% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr ls inoc frag

6900

70% CH
mot tex
30% MR
sb blky,
fosus, v



6500

MD: 9,688'
TVD: 6,689.47'
Inclination: 89.04°
Azimuth: 179.57°

MD: 9,783'
TVD: 6,690.57'
Inclination: 89.63°
Azimuth: 179.2°

MD: 9,878
TVD: 6,68
Inclinatio
Azimuth:

TVD (ft)

K: lt - medgy, sb plty - sb blky, sft - frm,
, v calc
RLST: medgy - dk gy, v sft - frm, sb plty -
slty, grty - mot tex, abnt thn lam, occ
calc, tr ls inoc frag

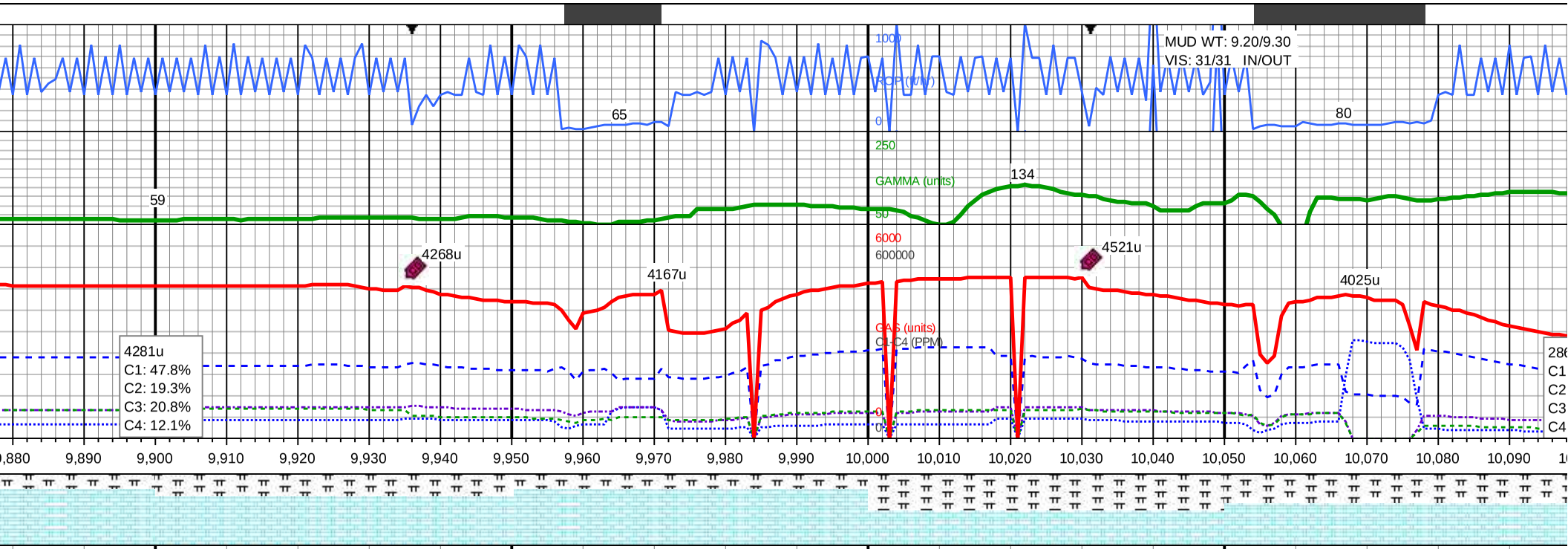
70% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
30% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr ls inoc frag

90% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
10% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr ls inoc frag

90% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
10% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr ls inoc frag

6900

80% CHK: lt - medgy, sb plty
mot tex, v calc
20% MRLST: medgy - dk gy,
sb blky, slty, grty - mot tex, a
fosus, v calc, tr ls inoc frag



6500

MD: 9,973'
TVD: 6,688.19'
Inclination: 90.4°
Azimuth: 178.83°

MD: 10,068'
TVD: 6,688.58'
Inclination: 89.14°
Azimuth: 179.66°

TVD (ft)

- sb blky, sft - frm,
v sft - frm, sb plty -
bnt thn lam, occ

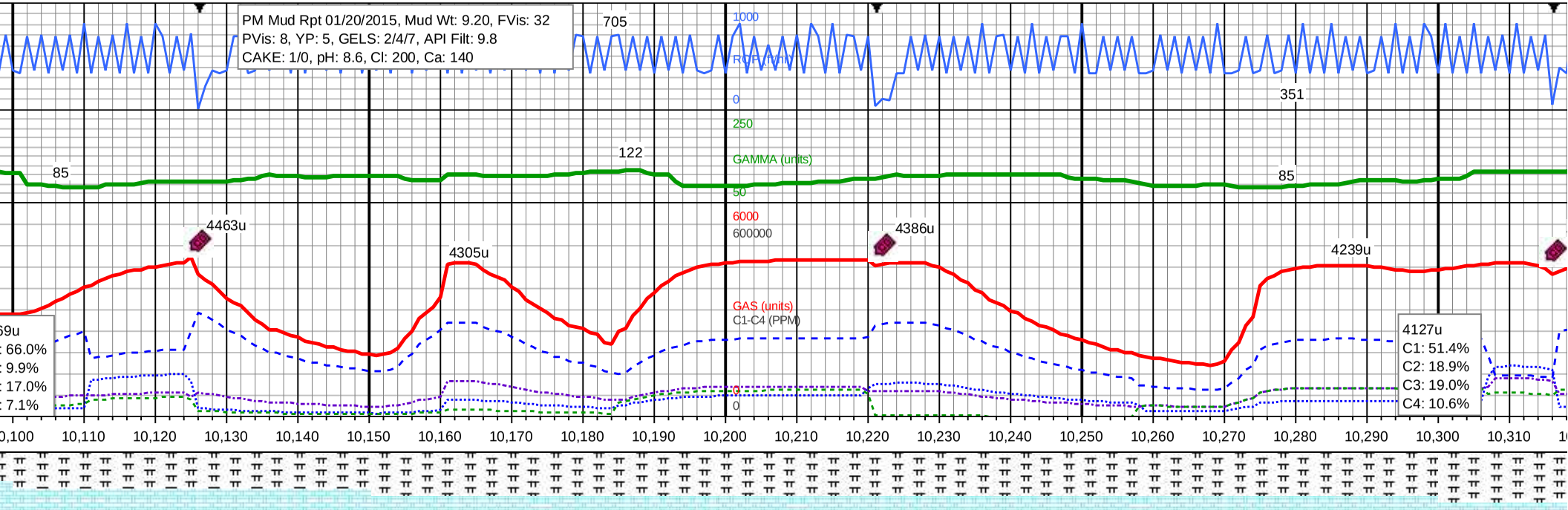
70% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
30% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr ls inoc frag

80% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
20% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr ls inoc frag

50% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
50% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr ls inoc frag

6900

60% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
40% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr ls inoc frag



6500

MD: 10,163'
TVD: 6,690.36'
Inclination: 88.71°
Azimuth: 179.58°

MD: 10,258'
TVD: 6,692.43'
Inclination: 88.8°
Azimuth: 178.93°

TVD (ft)

50% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
50% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr inoc frag

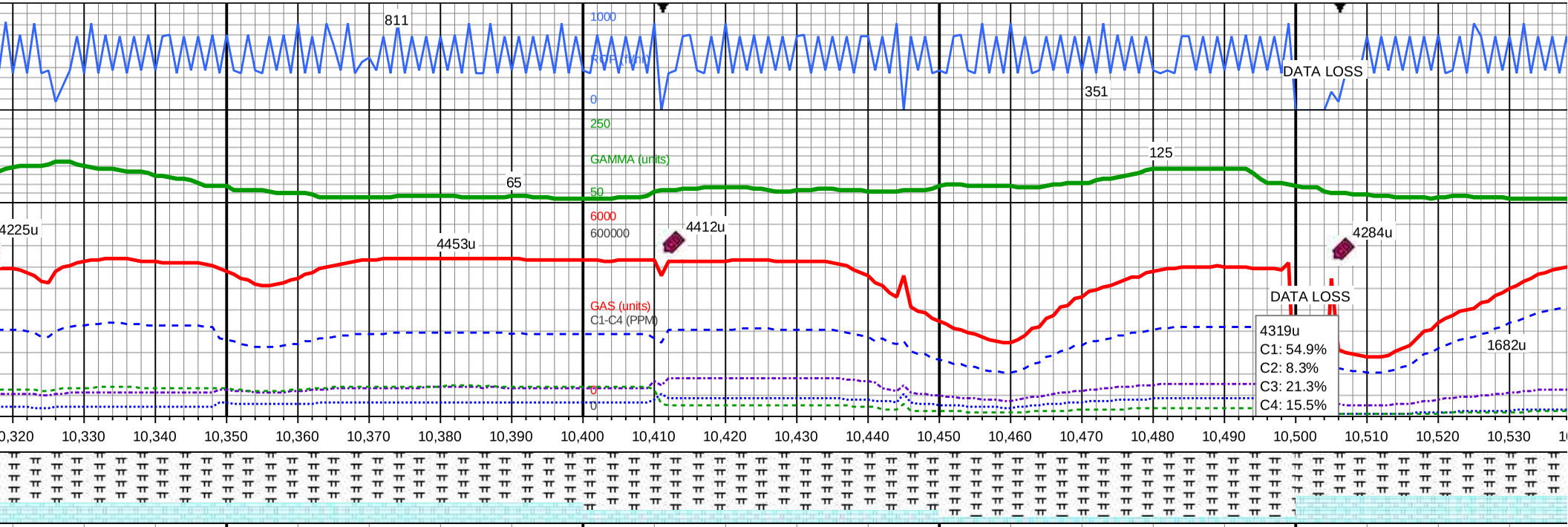
40% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
60% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr inoc frag

40% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
60% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr inoc frag

6900

40% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
60% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr inoc frag

30% CHK: lt - med
mot tex, v calc, oc
70% MRLST: med
sb blky, slty, grty -
fosus, v calc, tr in



6500

MD: 10,353'
TVD: 6,694.25'
Inclination: 89.01°
Azimuth: 178.64°

MD: 10,447'
TVD: 6,695.79'
Inclination: 89.11°
Azimuth: 178.22°

MD: 1
TVD:
Inclin
Azimu

TVD (ft)

dgy, sb plty - sb blky, sft - frm,
c lam, occ fosus
gy - dk gy, v sft - frm, sb plty -
mot tex, abnt thn lam, occ
oc frag

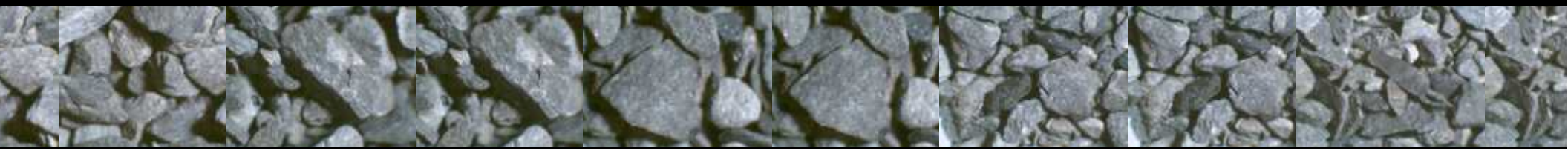
30% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc, occ lam, occ fosus
70% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr inoc frag

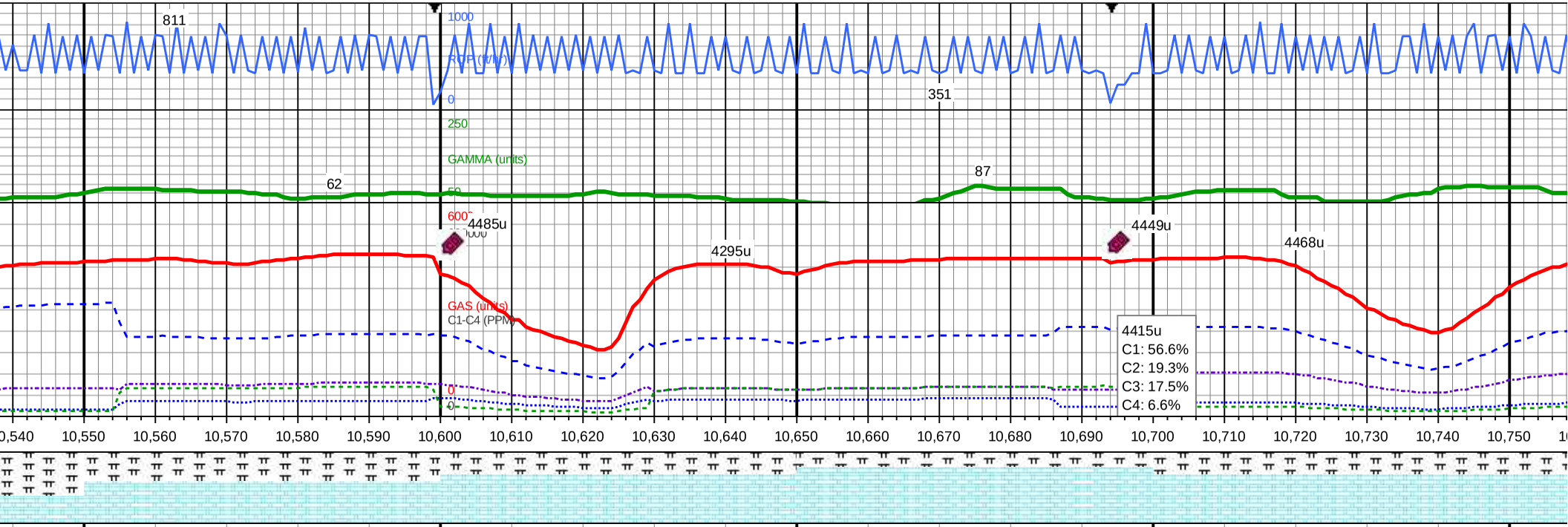
20% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc, occ lam, occ fosus
80% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr inoc frag

6900

10% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc, occ lam, occ fosus
90% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr inoc frag

40% CHK: lt - medgy, sb plty - sb blky,
mot tex, v calc
60% MRLST: medgy - dk gy, v sft - frm,
sb blky, slty, grty - mot tex, abnt thn la
fosus, v calc, abnt inoc frag





6500

0,542'
6,697.22'
ation: 89.17°
uth: 178.31°

MD: 10,637'
TVD: 6,698.65'
Inclination: 89.11°
Azimuth: 177.9°

MD: 10,732'
TVD: 6,700.2'
Inclination: 89.01°
Azimuth: 177.51°

TVD (ft)

sft - frm,
sb plty -
m, occ

60% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
40% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr inoc frag

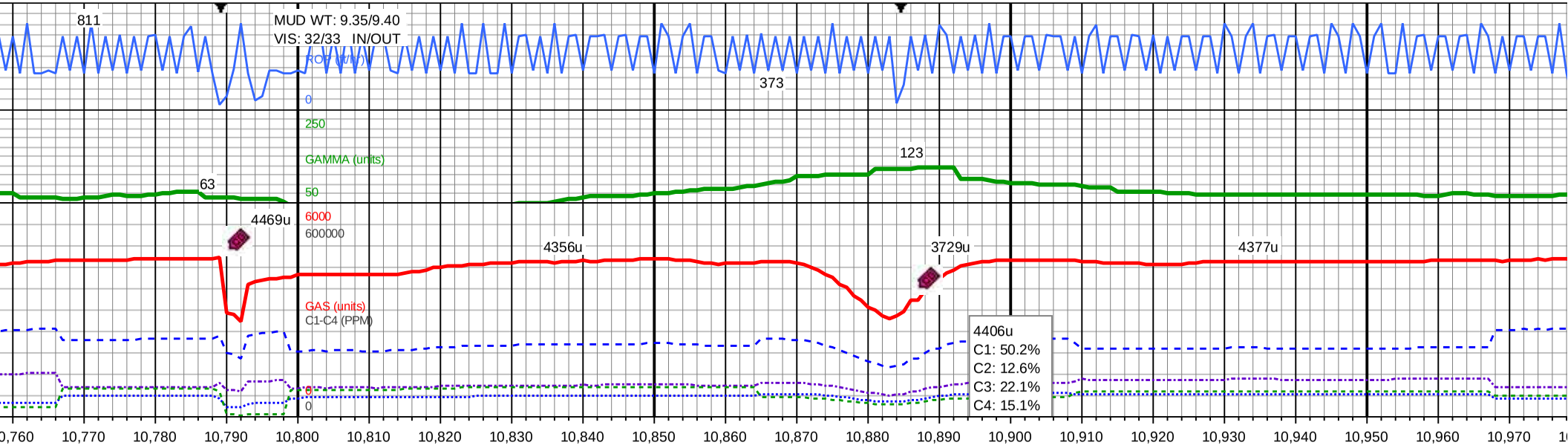
70% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
30% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr inoc frag

6900

80% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
20% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr inoc frag

70% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc, fosus, occ lam
30% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr inoc frag

70% CH
mot tex
30% MR
sb blky,
fosus, v



6500

MD: 10,827'
TVD: 6,701.35'
Inclination: 89.6°
Azimuth: 177.49°

MD: 10,922'
TVD: 6,702.38'
Inclination: 89.17°
Azimuth: 176.29°

TVD (ft)

HK: lt - medgy, sb plty - sb blky, sft - frm, , v calc, fosus, occ lam
RLST: medgy - dk gy, v sft - frm, sb plty - slty, grty - mot tex, abnt thn lam, occ v calc, tr inoc frag

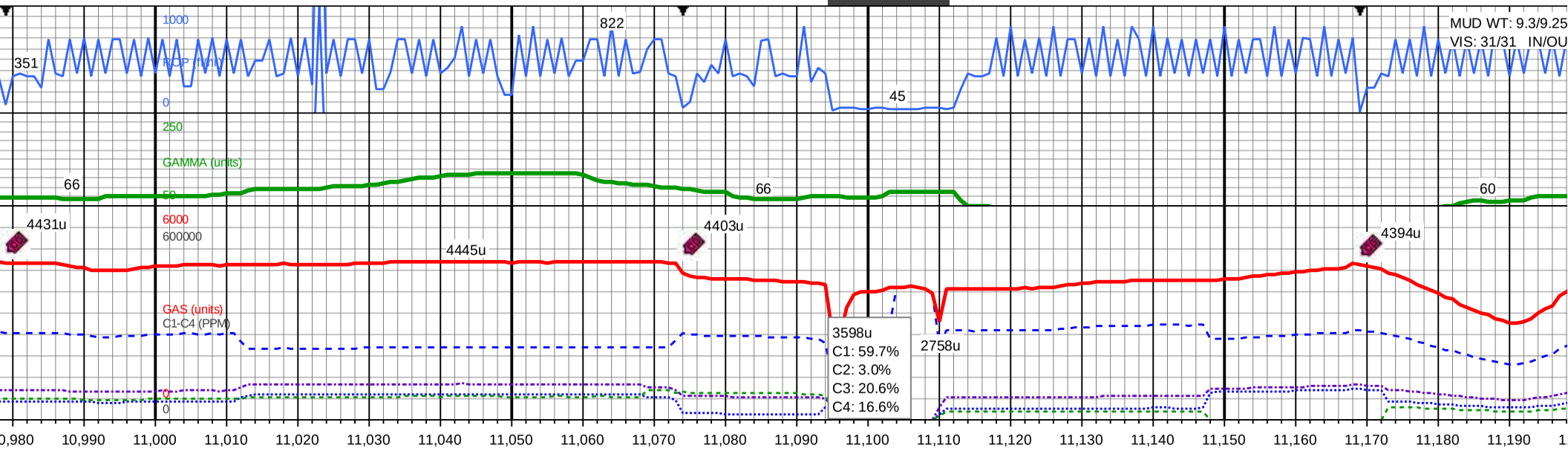
80% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc, fosus, occ lam
20% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, occ inoc frag, tr pyr

6900

40% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc, fosus, occ lam
60% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr inoc frag

40% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc, fosus, occ lam
60% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr inoc frag

50% CHK: lt - medgy, sb plty mot tex, v calc, fosus, occ la
50% MRLST: medgy - dk gy, blky, slty, grty - mot tex, abn v calc, tr inoc frag



6500

MD: 11,017'
TVD: 6,703.47'
Inclination: 89.51°
Azimuth: 176.06°

MD: 11,111'
TVD: 6,704.15'
Inclination: 89.66°
Azimuth: 176.47°

TVD (ft)

- sb blky, sft - frm,
m
v sft - frm, sb plty - sb
t thn lam, occ fosus,

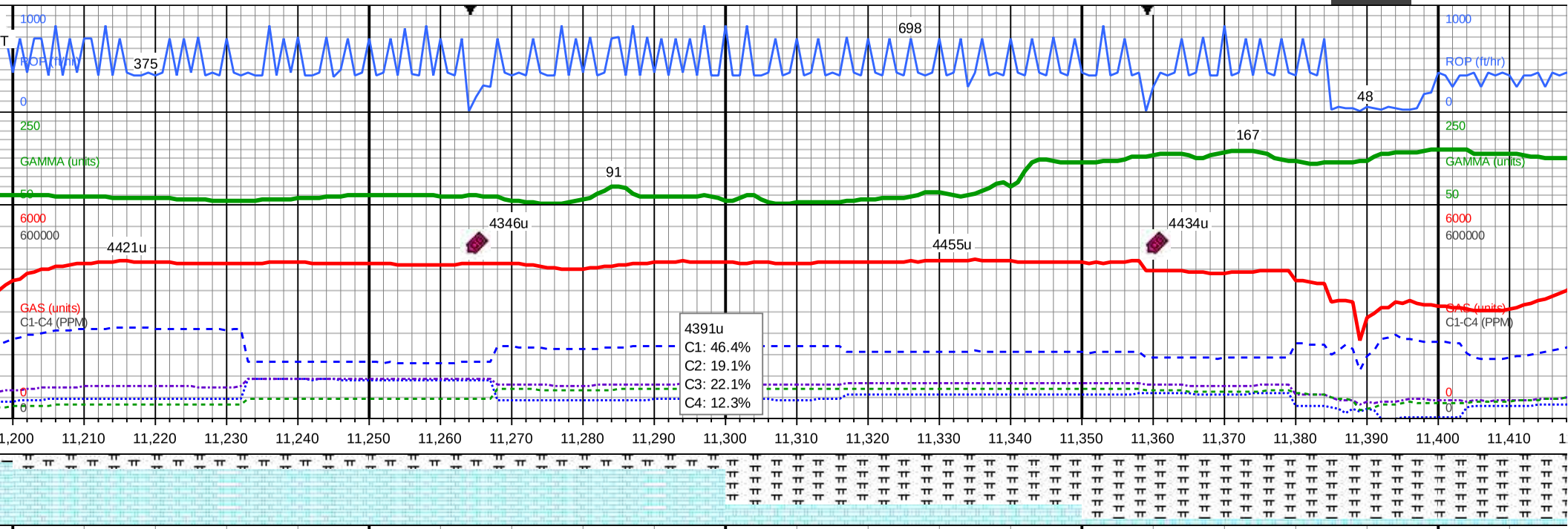
40% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
60% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr inoc frag

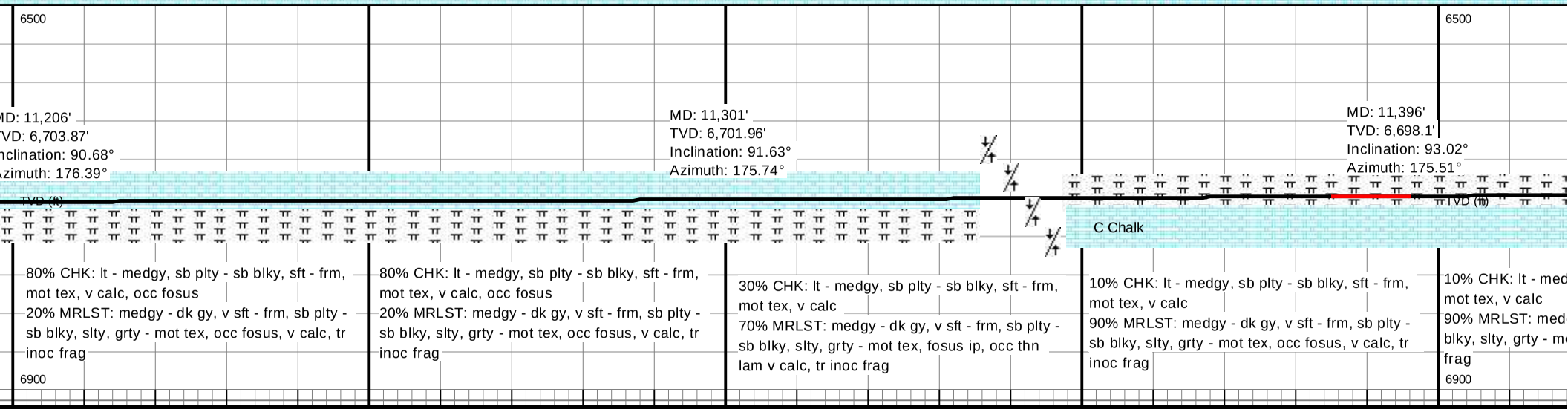
6900

70% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
30% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr inoc frag

90% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
10% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr inoc frag

90% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
10% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, abnt thn lam, occ fosus, v calc, tr inoc frag





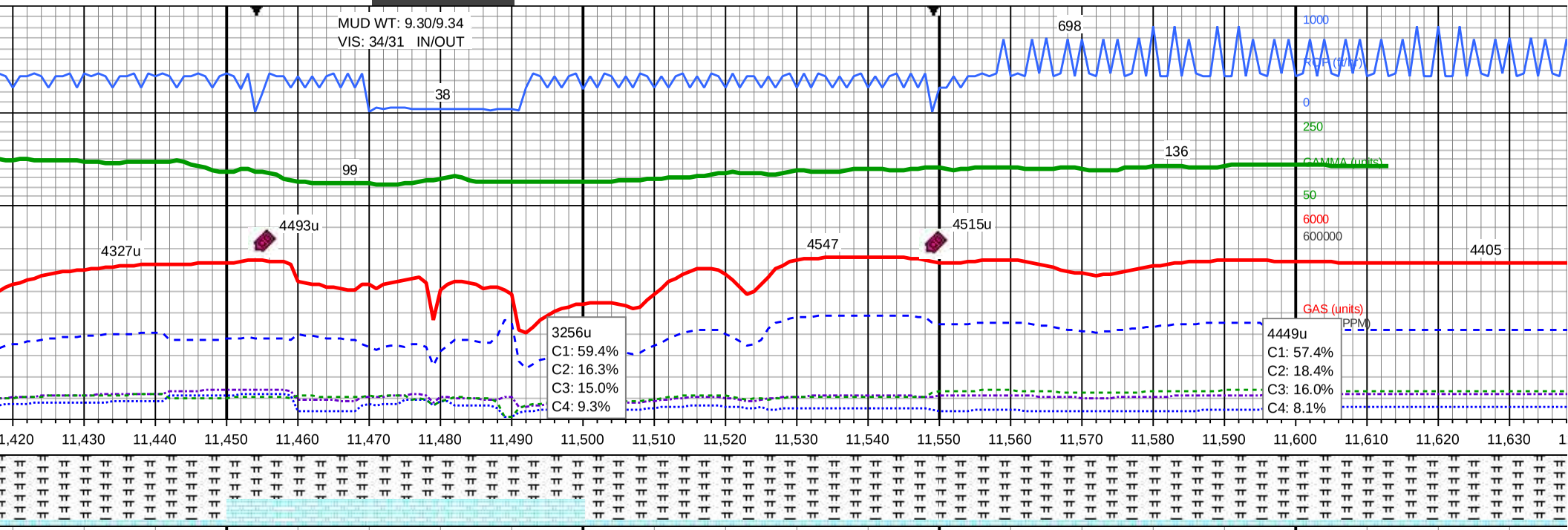
80% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc, occ fosus
20% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, occ fosus, v calc, tr inoc frag

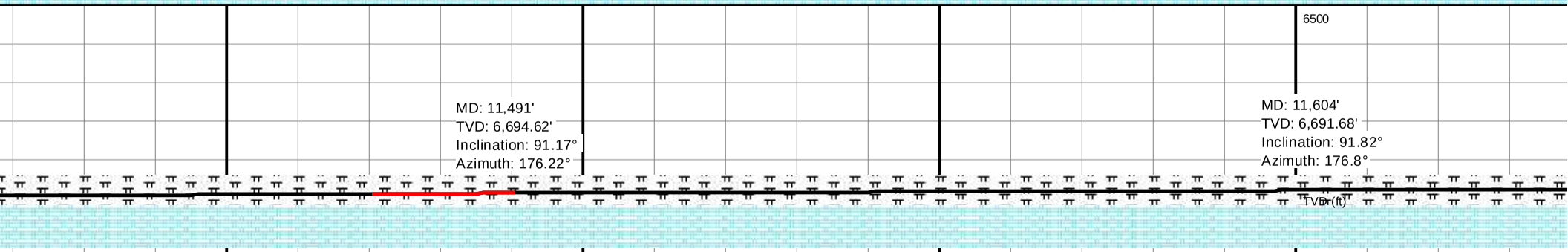
80% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc, occ fosus
20% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, occ fosus, v calc, tr inoc frag

30% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
70% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, fosus ip, occ thn lam v calc, tr inoc frag

10% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
90% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, occ fosus, v calc, tr inoc frag

10% CHK: lt - med
mot tex, v calc
90% MRLST: med
blky, slty, grty - m
frag





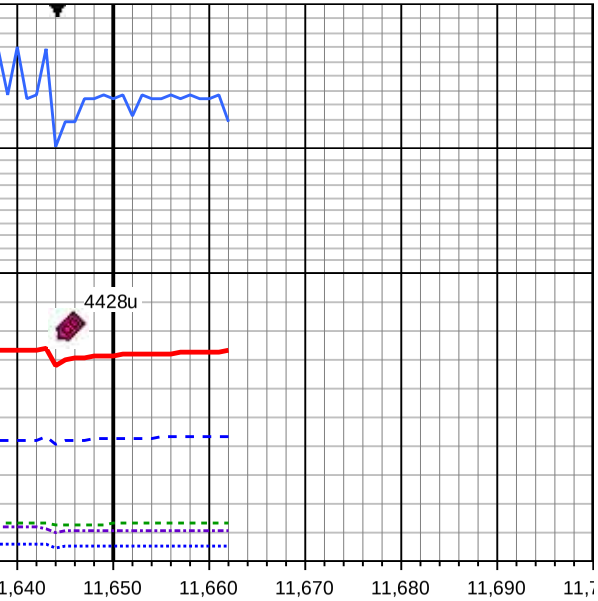
gy, sb plty - sb blky, sft - frm,
gy - dk gy, v sft - frm, sb plty - sb
ot tex, occ fosus, v calc, tr inoc

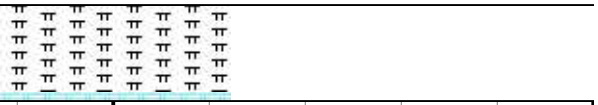
40% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
60% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, occ fosus, v calc, tr inoc frag

10% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
90% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, occ fosus, v calc, tr inoc frag

10% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
90% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, occ fosus, v calc, tr inoc frag

10% CHK: lt - medgy, sb plty - sb blky, mot tex, v calc
90% MRLST: medgy - dk gy, v sft - frm, sb blky, slty, grty - mot tex, occ fosus, v inoc frag

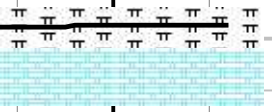




TD @ 11,662' MD
@ 21:47 hrs MST
on 1/20/2015

MD: 11,662'
TVD: 6,689.83'
Inclination: 91.82°
Azimuth: 176.8°

See Corresponding
Vertical Log Crow Creek
AA01-766 VERT



Wellsite Geological
Services Provided By
Columbine Logging

sft - frm,
sb plty -
v calc, tr

10% CHK: lt - medgy, sb plty - sb blky, sft - frm, mot tex, v calc
90% MRLST: medgy - dk gy, v sft - frm, sb plty - sb blky, slty, grty - mot tex, occ fosus, v calc, tr inoc frag

[redacted]