

# COLUMBINE LOGGING

Scale: 5" / 100'  
Measured Depth Log

**Well Name** Cougar B02-67-1HN\_Vert

**Location** SEC 2 T5N R64W

**State** COLORADO

**County** WELD

**Country** USA

**Rig Number** H&P 315

**API Number** 05-123-36406

**AFE #** 136841

**Region** DJ BASIN

**Field** WATTENBERG

**Spud Date** 2/2/2014

**Drilling Completed** 2/9/2014

**Surface Coordinates** NWNW SEC2 T5N R64W  
566' FNL; 680' FWL

LAT/LON 40.43407000/-104.52436000

**Bottom Hole Coordinates** NWNW SEC2 T5N R64W  
1650' FFNLL; 660' FFELL

**Ground Elevation** 4,641'

**K.B. Elevation** 4,665'

**Logged Interval** 2,000' **To** 10,350'

**Total Depth** 10,350'

**Formation** NIOBRARA B CHALK

**Type of Drilling Fluid** LSND

## Operator

**Company** Noble Energy Inc

**Address** 1625 BROADWAY SUITE 2200  
DENVER, CO 80202

## Geologist

**Name** NATHAN MURPHY, JACK WEINERTH

**Company** COLUMBINE LOGGING, INC

**Address** 2385 S LIPAN ST  
DENVER, CO 80223

## Rock Types

	SHALY SILTSTONE		CHALK		IGNEOUS		SHALE COLORED
	SHALY SANDSTONE		CHERT		LIMESTONE		SHALE GRAY
	SANDSTONE		CLAY CHOKE SAND		SIDERITE or LIMONITE		SILTSTONE
	SILTY SHALE		CLAYSTONE		MARLSTONE		TILL
	UNKNOWN		COAL		METAMORPHIC		TUFF
	ANHYDRITE		CONGLOMERATE		NO SAMPLE		WELDED TUFF
	BENTONITE		DOLOMITE		SALT		
	BRECCIA		GRANITE		SALT- PEPPER SAND		
	CEMENT		GYPSUM		SHALE		

## Accessories

### Fossils

ALGAE  
 AMPHIPORA  
 BELEMNITE  
 BIOCLASTIC  
 BRACHIOPOD  
 BRYOZOA  
 CEPHALOPOD  
 CORAL  
 CRINOID  
 ECHINOID  
 FISH  
 FORAMINIFERA

### Fossil

GASTROPOD  
 INOCERAMUS  
 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  
 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 (LEFT)  
 CONNECTION (RIGHT)  
 CONNECTION GAS  
 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

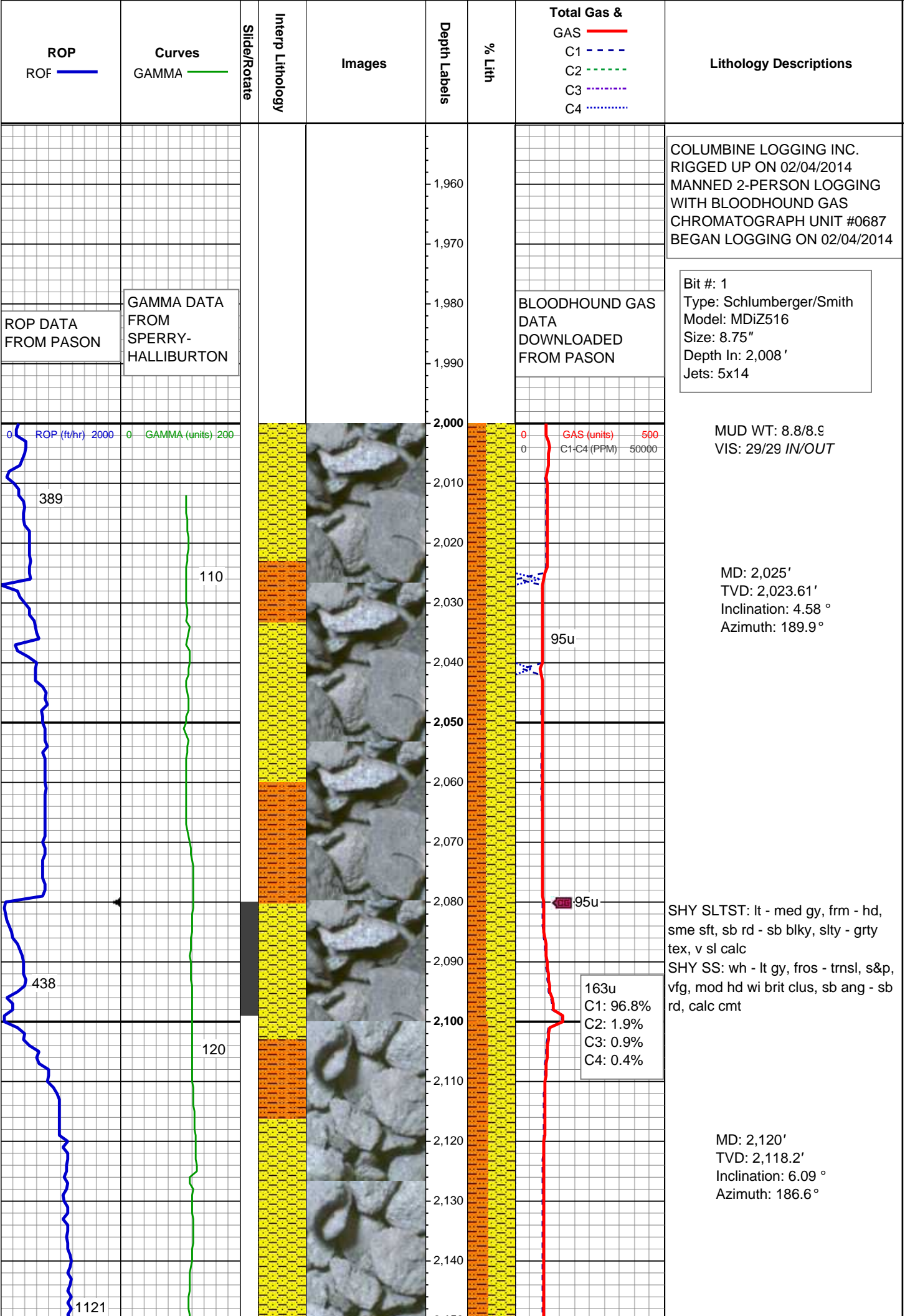
BOUNDSTONE  
 CHALKY  
 CRYPTOXLN

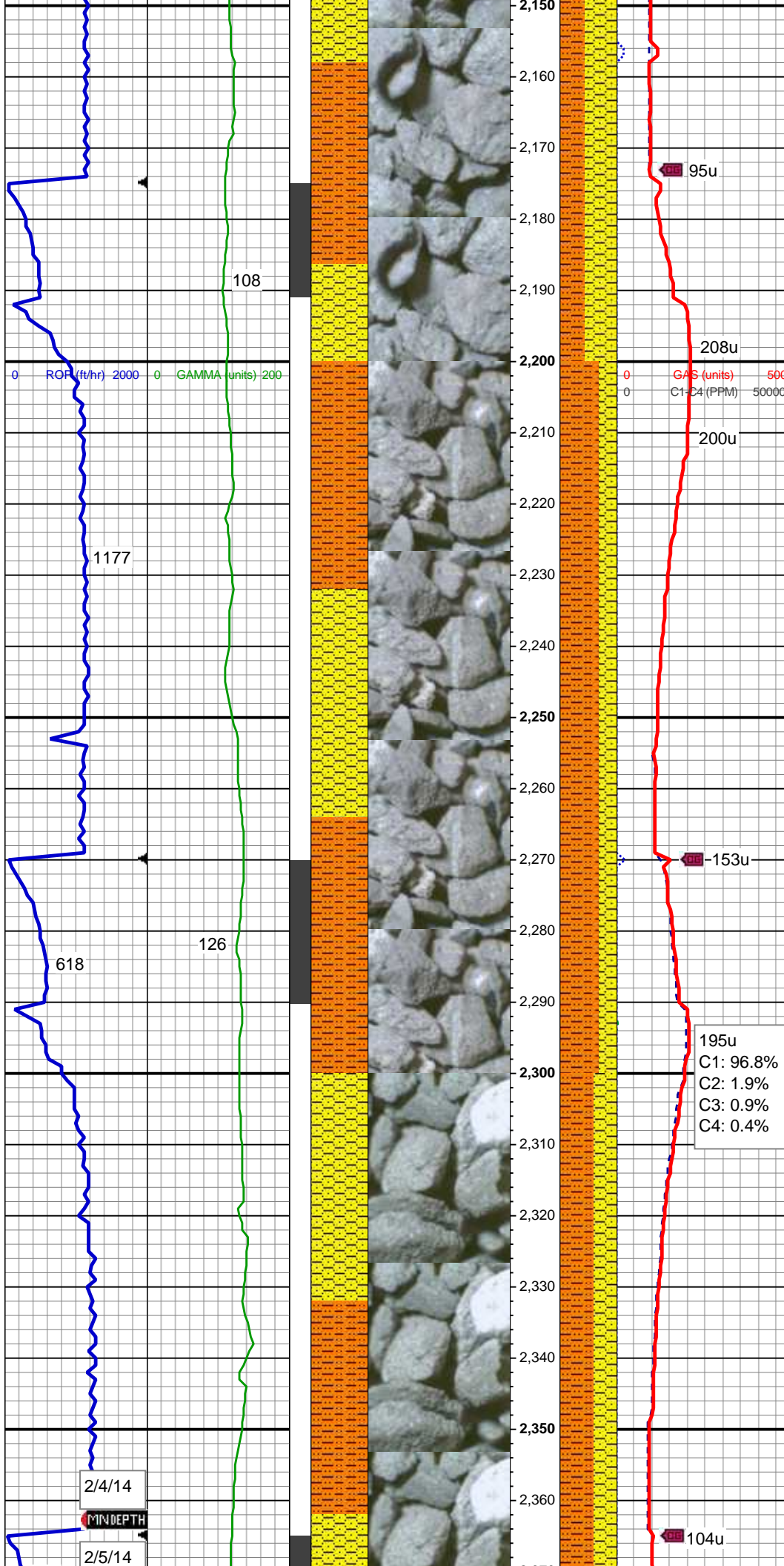
### Earthy

FINELYXLN  
 GRAINSTONE  
 LITHOGRAPHIC  
 MICROXLN  
 MUDSTONE  
 PACKSTONE  
 WACKESTONE

### Sorting

MODERATE  
 POOR  
 WELL





SHY SLTST: lt - med gy, frm - hd,  
sme sft, sb rd - sb blk, slty - grty  
tex, v sl calc  
SHY SS: wh - lt gy, fros - trns, s&p,  
vfg, mod hd wi brit clus, sb ang - sb  
rd, calc cmt

MD: 2,215'  
TVD: 2,212.6'  
Inclination: 6.82 °  
Azimuth: 184.53 °

SHY SLTST: lt - med gy, frm - hd,  
sme sft, sb rd - sb blk, slty - grty  
tex, v sl calc  
SHY SS: wh - lt gy, fros - trns, s&p,  
vfg, mod hd wi brit clus, sb ang - sb  
rd, calc cmt

MD: 2,310'  
TVD: 2,306.94'  
Inclination: 6.74 °  
Azimuth: 175.66 °

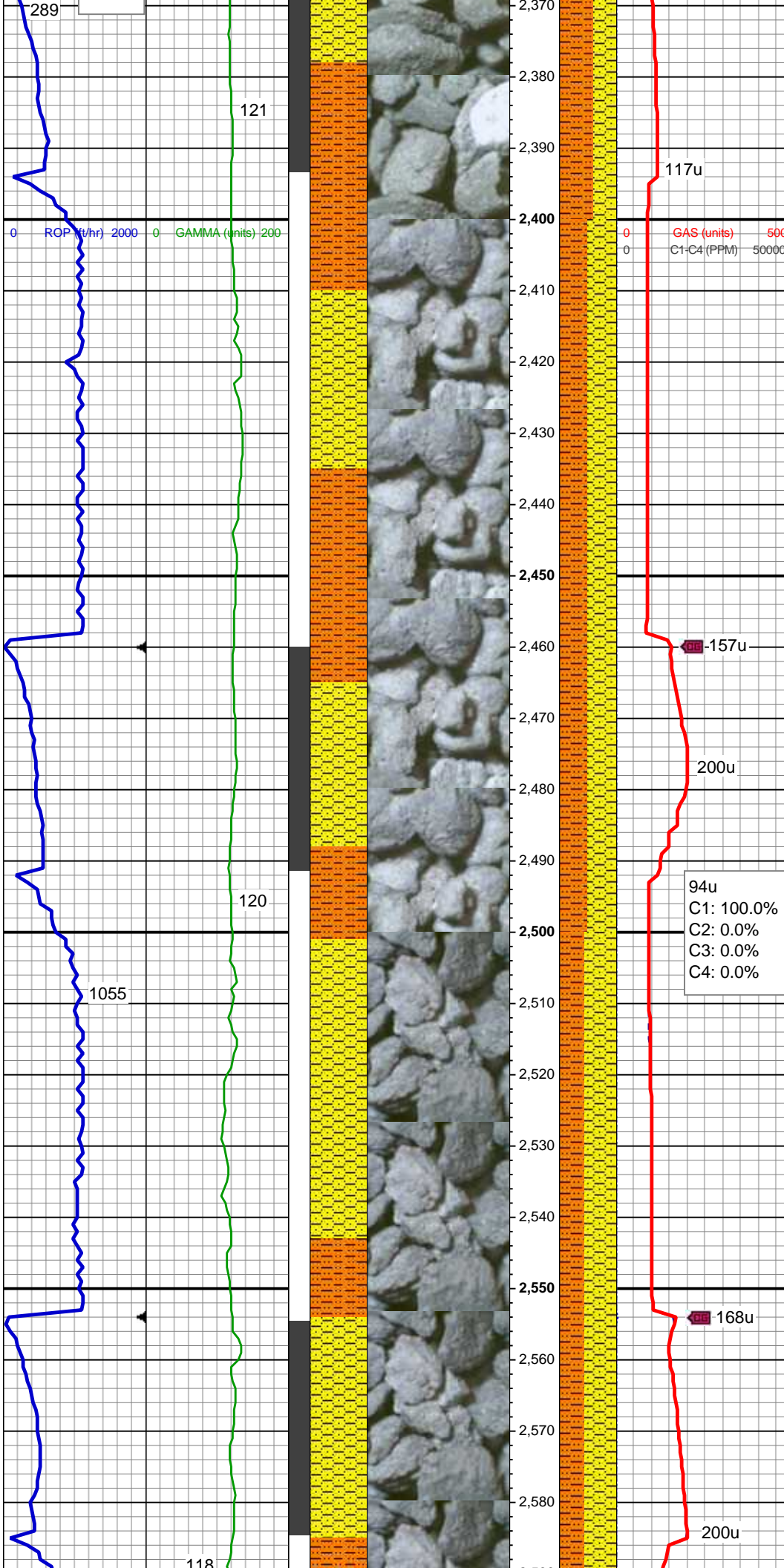
195u
C1: 96.8%
C2: 1.9%
C3: 0.9%
C4: 0.4%

2/4/14

MINDEPTH

2/5/14





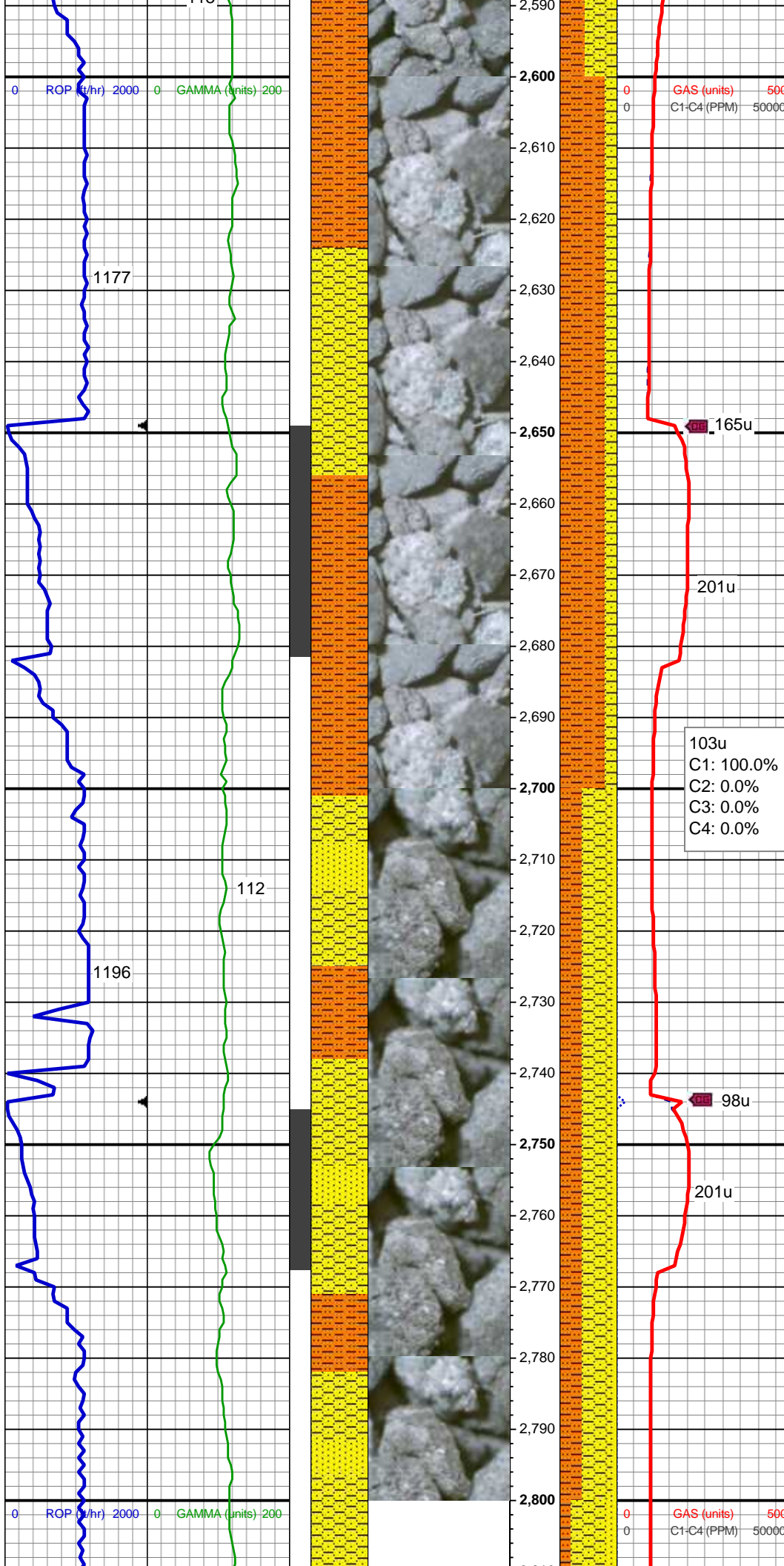
SHY SLTST: lt - med gy, frm - hd,  
sme sft, sb rd - sb blk, slty - grty  
tex, v sl calc  
SHY SS: wh - lt gy, fros - trns, s&p,  
vfg, mod hd wi brit clus, sb ang - sb  
rd, calc cmt

MD: 2,405'  
TVD: 2,401.11'  
Inclination: 8.33 °  
Azimuth: 172.29 °

SHY SLTST: lt - med gy, frm - hd,  
sme sft, sb rd - sb blk, slty - grty  
tex, v sl calc  
SHY SS: wh - lt gy, fros - trns, s&p,  
vfg, mod hd wi brit clus, sb ang - sb  
rd, calc cmt

MD: 2,500'  
TVD: 2,494.85'  
Inclination: 10.32 °  
Azimuth: 178.42 °

SHY SLTST: lt - med gy, frm - hd,  
sme sft, sb rd - sb blk, slty - grty  
tex, v sl calc



tex, v sl calc  
SHY SS: wh - lt gy, fros - trns, s&p,  
vfg, mod hd wi brit clus, sb ang - sb  
rd, calc cmt

MD: 2,595'  
TVD: 2,588.13'  
Inclination: 11.52 °  
Azimuth: 173.92 °

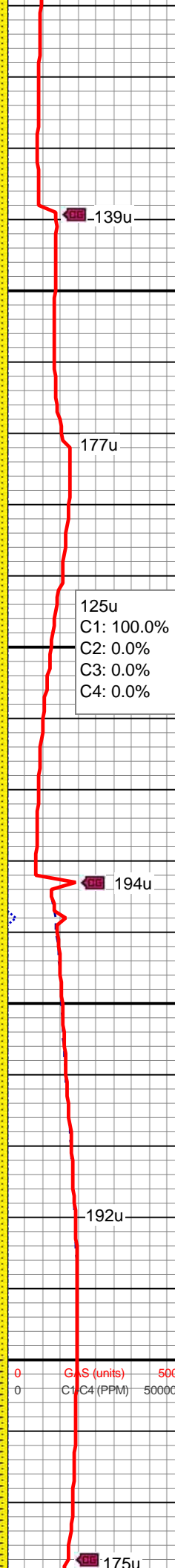
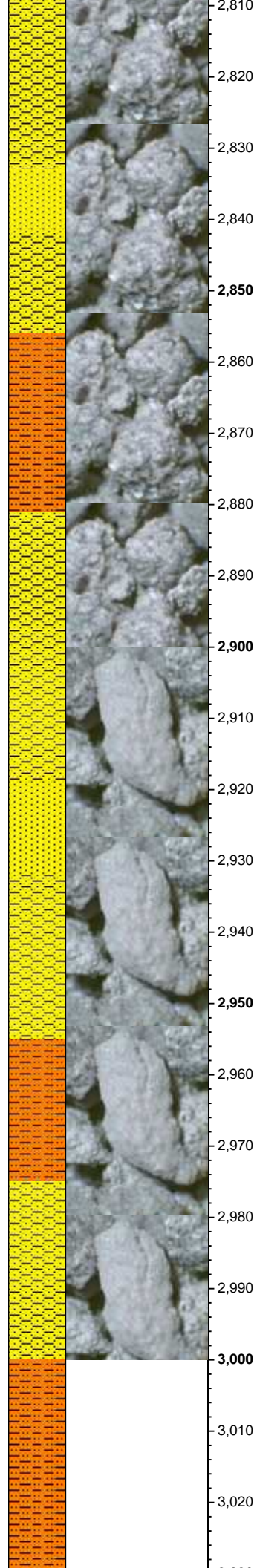
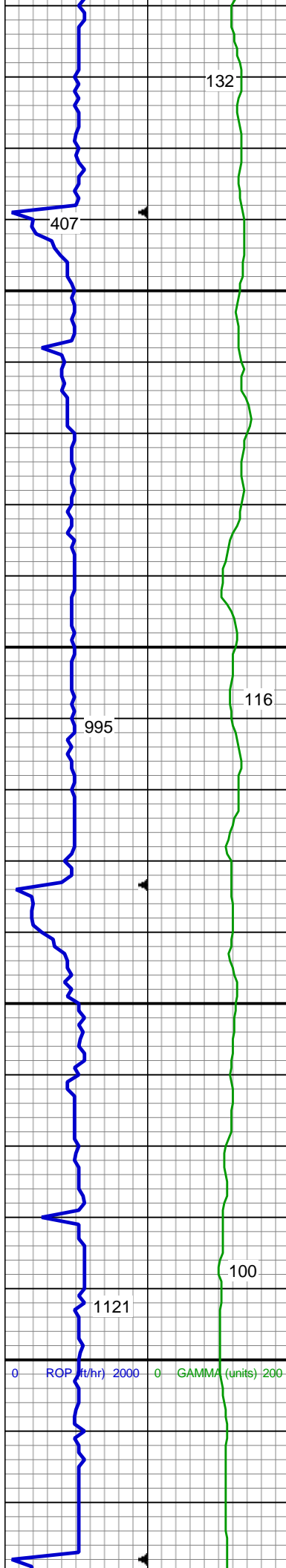
SHY SLTST: lt - med gy, frm - hd,  
sme sft, sb rd - sb blk, slty - grty  
tex, v sl calc  
SHY SS: wh - lt gy, fros - trns, s&p,  
vfg, mod hd wi brit clus, sb ang - sb  
rd, calc cmt

MD: 2,690'  
TVD: 2,680.98'  
Inclination: 12.93 °  
Azimuth: 173.29 °

SHY SS: wh - lt gy, fros - trns, s&p,  
vfg, mod hd wi brit clus, sb ang - sb  
rd, calc cmt  
SHY SLTST: lt - med gy, frm - hd,  
sme sft, sb rd - sb blk, slty - grty  
tex, v sl calc  
SS: wh, fros - trns, speckl wi mica,  
f gr, hd brit clus, ang - sb ang, glau,  
v calc cmt

MD: 2,784'  
TVD: 2,772.31'  
Inclination: 14.44 °





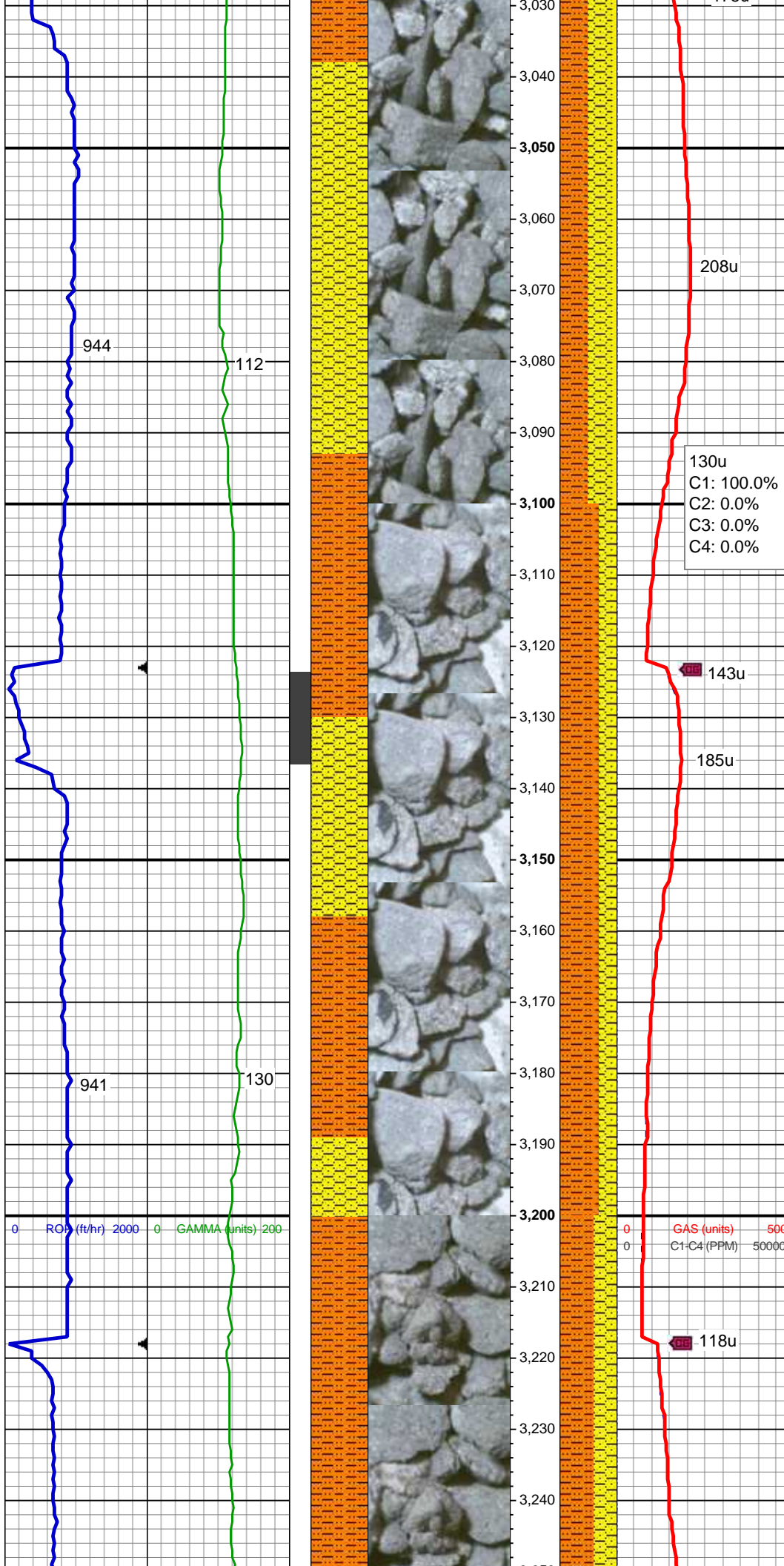
Azimuth: 175.02°

MD: 2,879'  
TVD: 2,864.48'  
Inclination: 13.58 °  
Azimuth: 175.53°

SHY SS: wh - lt gy, fros - trns, s&p, vfg, mod hd wi brit clus, sb ang - sb rd, calc cmt  
SHY SLTST: lt - med gy, frm - hd, sme sft, sb rd - sb blk, slty - grty tex, v sl calc  
SS: wh, fros - trns, speckl wi mica, f gr, hd brit clus, ang - sb ang, glau, v calc cmt

SHY SS: wh - lt gy, fros - trns, s&p, vfg, mod hd wi brit clus, sb ang - sb rd, calc cmt  
SHY SLTST: lt - med gy, frm - hd, sme sft, sb rd - sb blk, slty - grty tex, v sl calc  
SS: wh, fros - trns, speckl wi mica, f gr, hd brit clus, ang - sb ang, glau, v calc cmt

MD: 2,974'  
TVD: 2,956.84'  
Inclination: 13.48 °  
Azimuth: 175.8°



MD: 3,069'  
TVD: 3,049.33'  
Inclination: 12.95 °  
Azimuth: 175.84 °

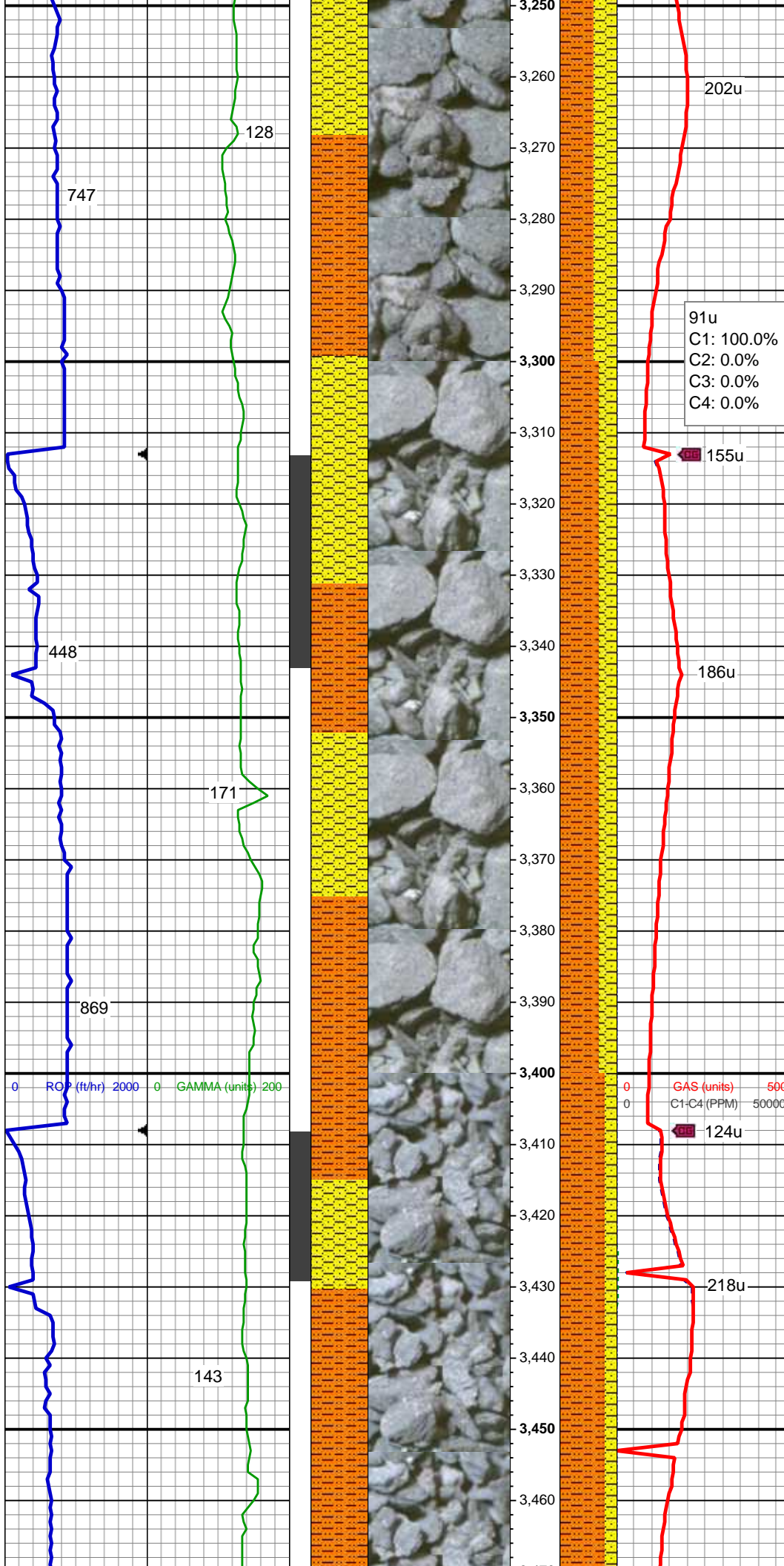
SHY SLTST: lt - med gy, frm - hd,  
sme sft, sb rd - sb blkly, slty - grty  
tex, v sl calc  
SHY SS: wh - lt gy, fros - trnsl, s&p,  
vfg, mod hd wi brit clus, sb ang - sb  
rd, calc cmt  
SS: wh, fros - trnsl, speckl wi mica,  
f gr, hd brit clus, ang - sb ang, glau,  
v calc cmt

130u  
C1: 100.0%  
C2: 0.0%  
C3: 0.0%  
C4: 0.0%

MD: 3,164'  
TVD: 3,141.93'  
Inclination: 12.82 °  
Azimuth: 174.55 °

SHY SLTST: lt - med gy, frm - hd,  
sme sft, sb rd - sb blkly, slty - grty  
tex, v sl calc  
SHY SS: wh - lt gy, fros - trnsl, s&p,  
vfg, mod hd wi brit clus, sb ang - sb  
rd, calc cmt





MD: 3,259'  
TVD: 3,234.81'  
Inclination: 11.44 °  
Azimuth: 175.66 °

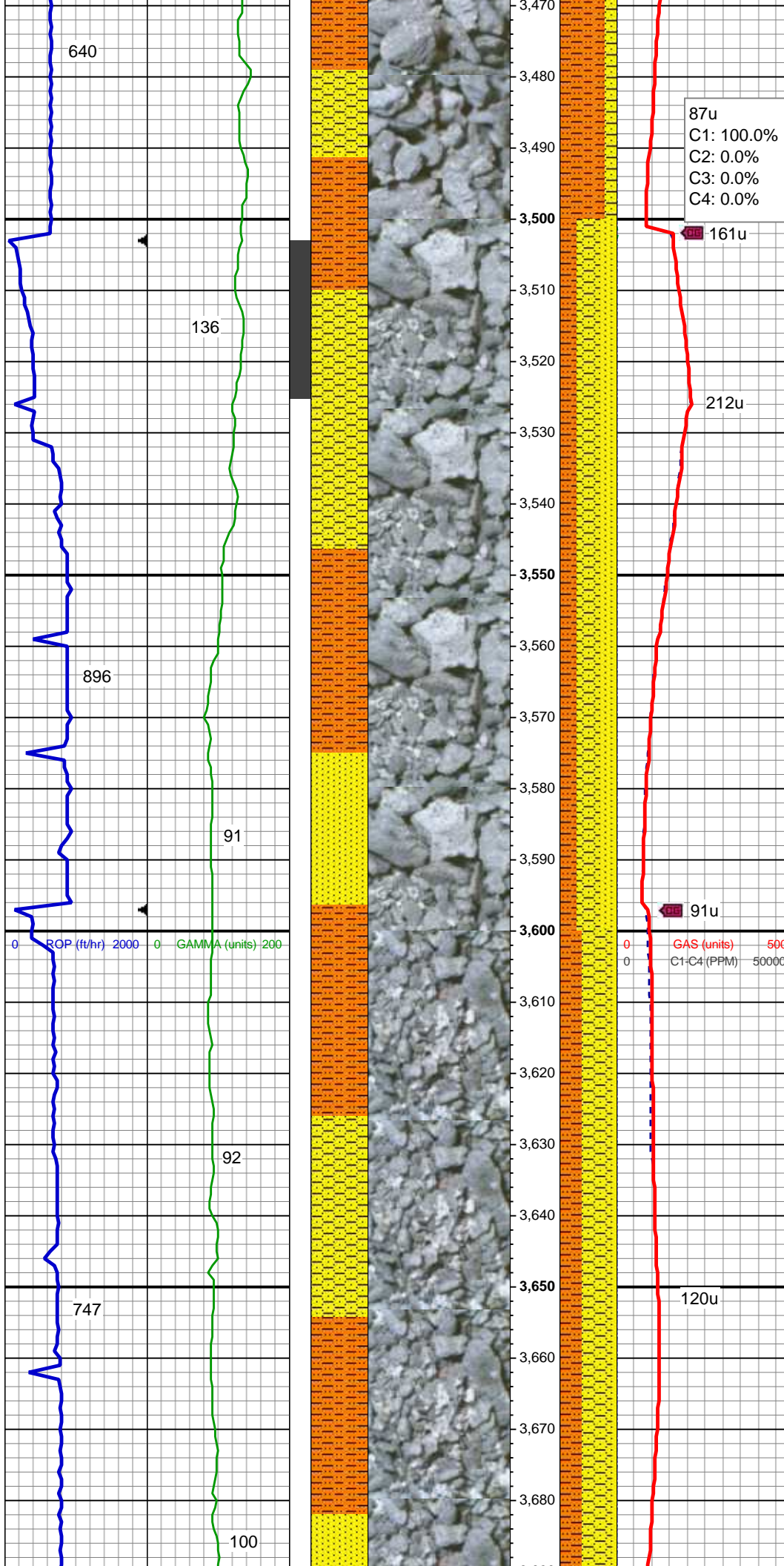
SHY SLTST: lt - med gy, frm - hd,  
sme sft, sb rd - sb blkly, slty - grty  
tex, v sl calc  
SHY SS: wh - lt gy, fros - trnsl, s&p,  
vfg, mod hd wi brit clus, sb ang - sb  
rd, calc cmt

02/05/2014  
Mud Wt: 8.95  
FVis: 29  
PVis: 4  
YP: 3  
GELS: N/A  
API Filt: N/A  
CAKE: 1/0  
pH: 11.7  
Cl: 1,500  
Ca: 1

MD: 3,354'  
TVD: 3,327.72'  
Inclination: 12.65 °  
Azimuth: 177.03 °

SHY SLTST: lt - med gy, frm - hd,  
sme sft, sb rd - sb blkly, slty - grty  
tex, v sl calc  
SHY SS: wh - lt gy, fros - trnsl, s&p,  
vfg, mod hd wi brit clus, sb ang - sb  
rd, calc cmt

MD: 3,449'  
TVD: 3,420.36'  
Inclination: 12.96 °  
Azimuth: 175.57 °



SHY SLTST: lt - med gy, frm - hd,  
sme sft, sb rd - sb blk, slty - grty  
tex, v sl calc  
SHY SS: wh - lt gy, fros - trns, s&p,  
vfg, mod hd wi brit clus, sb ang - sb  
rd, calc cmt

MD: 3,544'  
TVD: 3,512.66'  
Inclination: 14.42 °  
Azimuth: 178.32 °

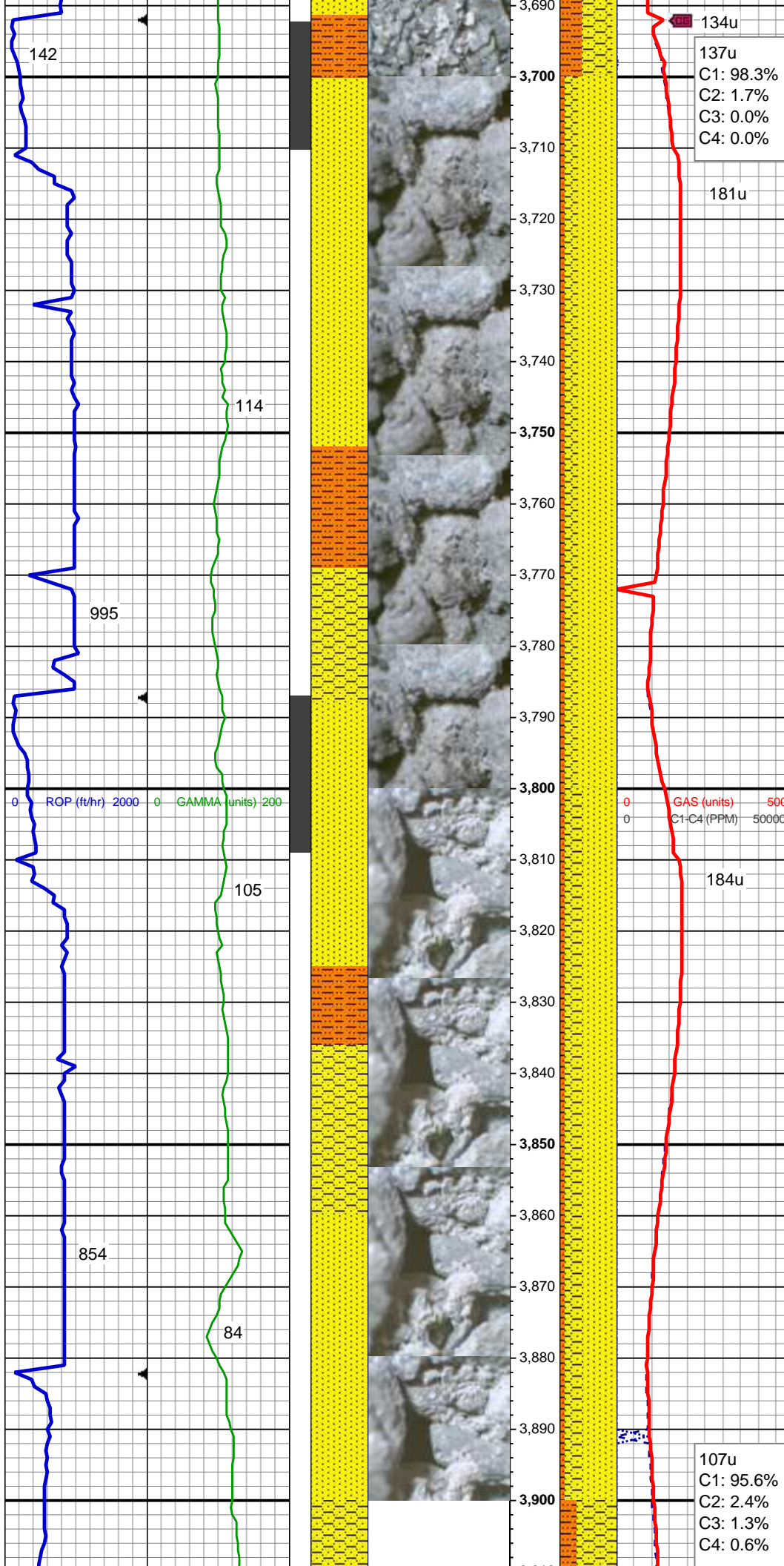
Parkman Top @  
3,550' MD; 3,518' TVD

SHY SS: wh - lt gy, fros - trns, s&p,  
vfg, mod hd wi brit clus, sb ang - sb  
rd, calc cmt  
SS: wh, fros - trns, s&p, speckl wi  
mica, f gr, hd brit clus, sb ang - sb  
rd - sb blk, v calc cmt  
SHY SLTST: lt - med gy, frm - hd,  
sme sft, sb rd - sb blk, slty - grty  
tex, v sl calc

MD: 3,638'  
TVD: 3,603.52'  
Inclination: 15.26 °  
Azimuth: 178.97 °

SHY SS: wh - lt gy, fros - trns, s&p,  
vfg, mod hd wi brit clus, sb ang - sb  
rd, calc cmt  
SHY SLTST: lt - med gy, frm - hd,  
sme sft, sb rd - sb blk, slty - grty  
tex, v sl calc





SS: wh, fros - trnsl, s&p, speckl wi mica, f gr, hd brit clus, sb ang - sb rd - sb blkly, v calc cmt

MUD WT: 8.65/8.90  
VIS: 29/29 IN/OUT

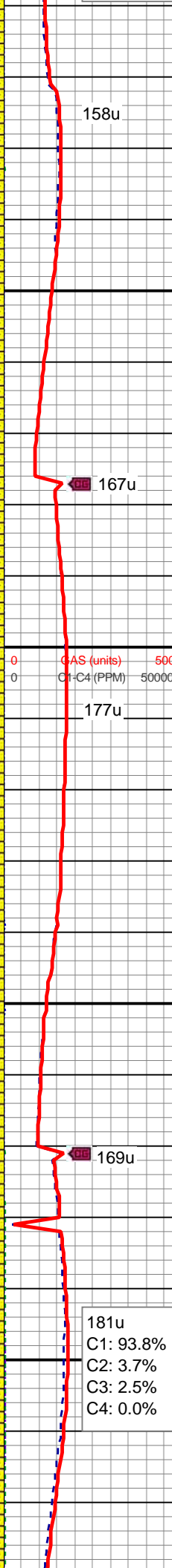
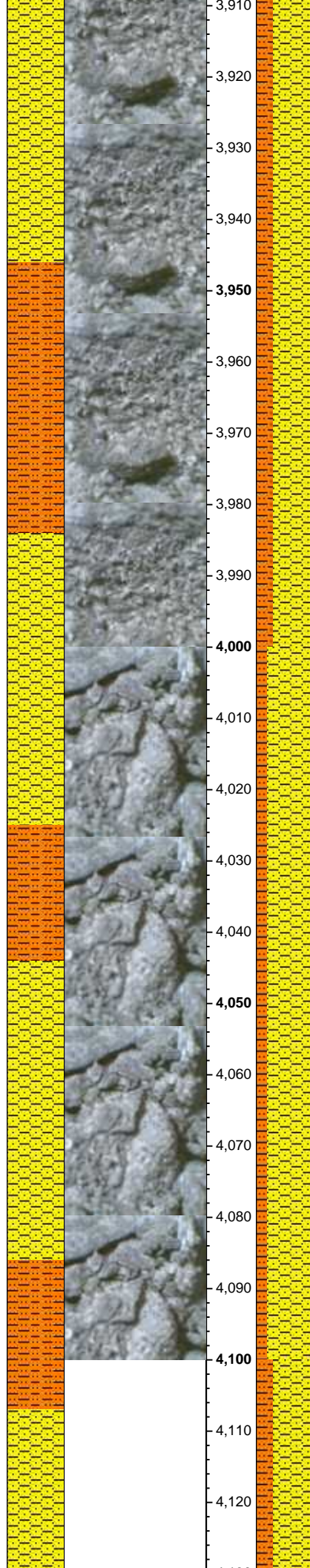
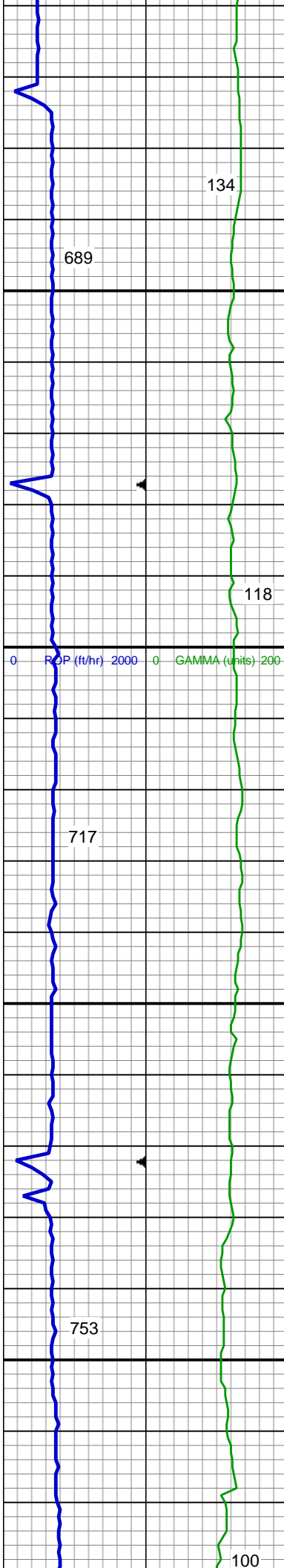
MD: 3,733'  
TVD: 3,695.23'  
Inclination: 15 °  
Azimuth: 175.93 °

SS: wh, fros - trnsl, s&p, speckl wi mica, f gr, hd brit clus, sb ang - sb rd - sb blkly, v calc cmt  
SHY SS: wh - lt gy, fros - trnsl, s&p, vfg, mod hd wi brit clus, sb ang - sb rd, calc cmt  
SHY SLTST: lt - med gy, frm - hd, sme sft, sb rd - sb blkly, slty - grty tex, v sl calc

MD: 3,828'  
TVD: 3,787.24'  
Inclination: 13.81 °  
Azimuth: 177.24 °

SS: wh, fros - trnsl, s&p, speckl wi mica, f gr, hd brit clus, sb ang - sb rd - sb blkly, v calc cmt  
SHY SS: wh - lt gy, fros - trnsl, s&p, vfg, mod hd wi brit clus, sb ang - sb rd, calc cmt  
SHY SLTST: lt - med gy, frm - hd, sme sft, sb rd - sb blkly, slty - grty tex, v sl calc





MD: 3,923'  
TVD: 3,879.47'  
Inclination: 13.91 °  
Azimuth: 177.7 °

Sussex Top @  
3,958' MD; 3,913' TVD

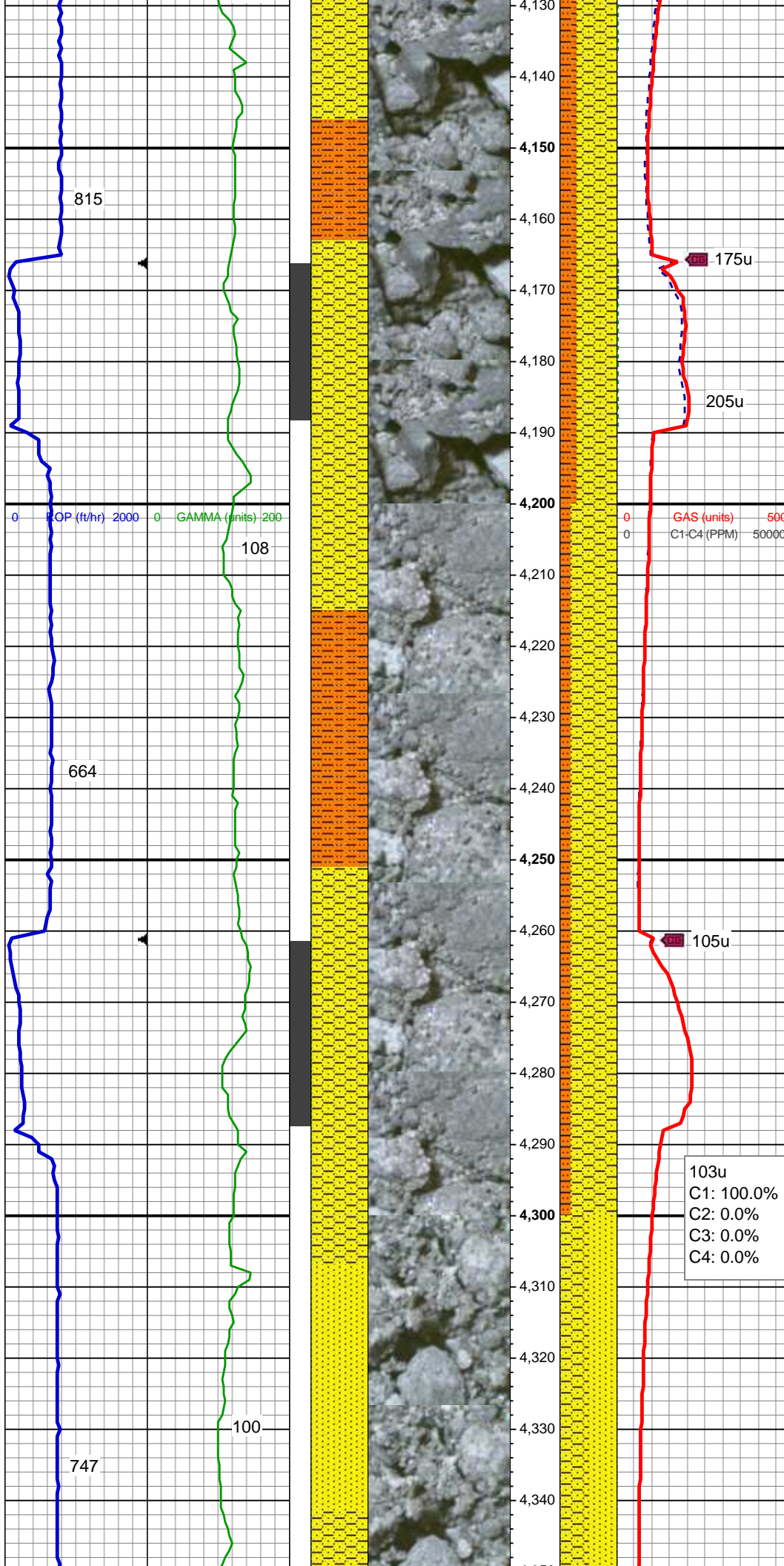
SHY SS: wh - lt gy, fros - trnsl, s&p,  
vfg, mod hd wi brit clus, sb ang - sb  
rd, calc cmt, grdg to SS  
SHY SLTST: lt - med gy, frm - hd,  
sme sft, sb rd - sb blkly, slty - grty  
tex, v sl calc

MD: 4,018'  
TVD: 3,971.84'  
Inclination: 13.11 °  
Azimuth: 179.55 °

SHY SS: wh - lt gy, fros - trnsl, s&p,  
vfg, mod hd wi brit clus, sb ang - sb  
rd, calc cmt, grdg to SS  
SHY SLTST: lt - med gy, frm - hd,  
sme sft, sb rd - sb blkly, slty - grty  
tex, v sl calc

181u  
C1: 93.8%  
C2: 3.7%  
C3: 2.5%  
C4: 0.0%

MD: 4,112'  
TVD: 4,063.58'  
Inclination: 12.1 °  
Azimuth: 180.05 °



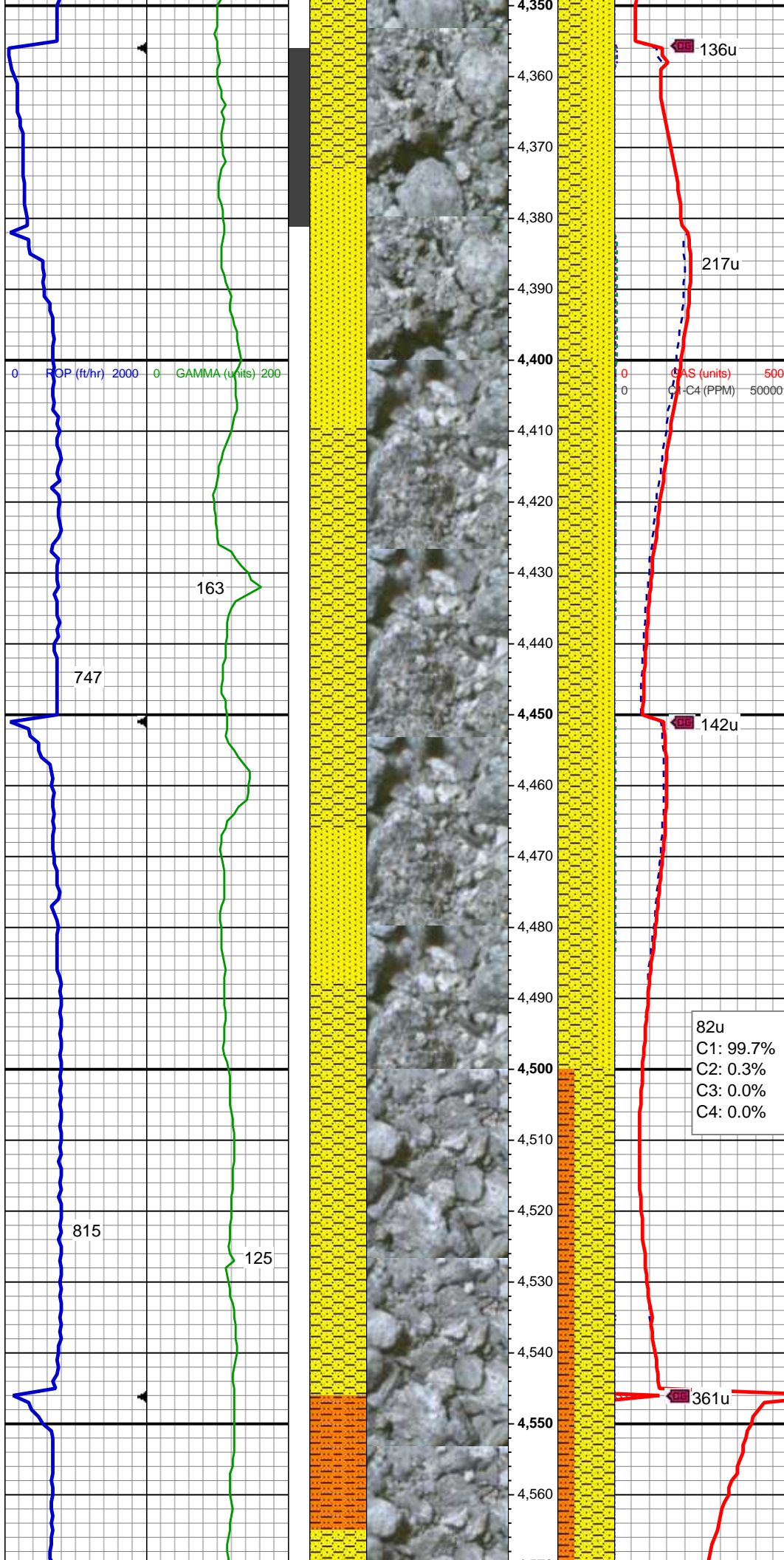
SHY SS: wh - lt gy, fros - trnsl, s&p,  
vfg, mod hd wi brit clus, sb ang - sb  
rd, calc cmt, grdg to SS  
SHY SLTST: lt - med gy, frm - hd,  
sme sft, sb rd - sb blk, slty - grty  
tex, v sl calc

MD: 4,207'  
TVD: 4,156.39'  
Inclination: 12.52 °  
Azimuth: 180.63 °

SHY SS: wh - lt gy, fros - trnsl, s&p,  
vfg, mod hd wi brit clus, sb ang - sb  
rd, calc cmt, grdg to SS  
SHY SLTST: lt - med gy, frm - hd,  
sme sft, sb rd - sb blk, slty - grty  
tex, v sl calc

MD: 4,302'  
TVD: 4,249.03'  
Inclination: 13.1 °  
Azimuth: 179.25 °





SS: wh, fros - trnsl, s&p, speckl wi mica, f gr, hd brit clus, sb ang - sb rd - sb blkly, v calc cmt  
SHY SS: wh - lt gy, fros - trnsl, s&p, vfg, mod hd wi brit clus, sb ang - sb rd, calc cmt

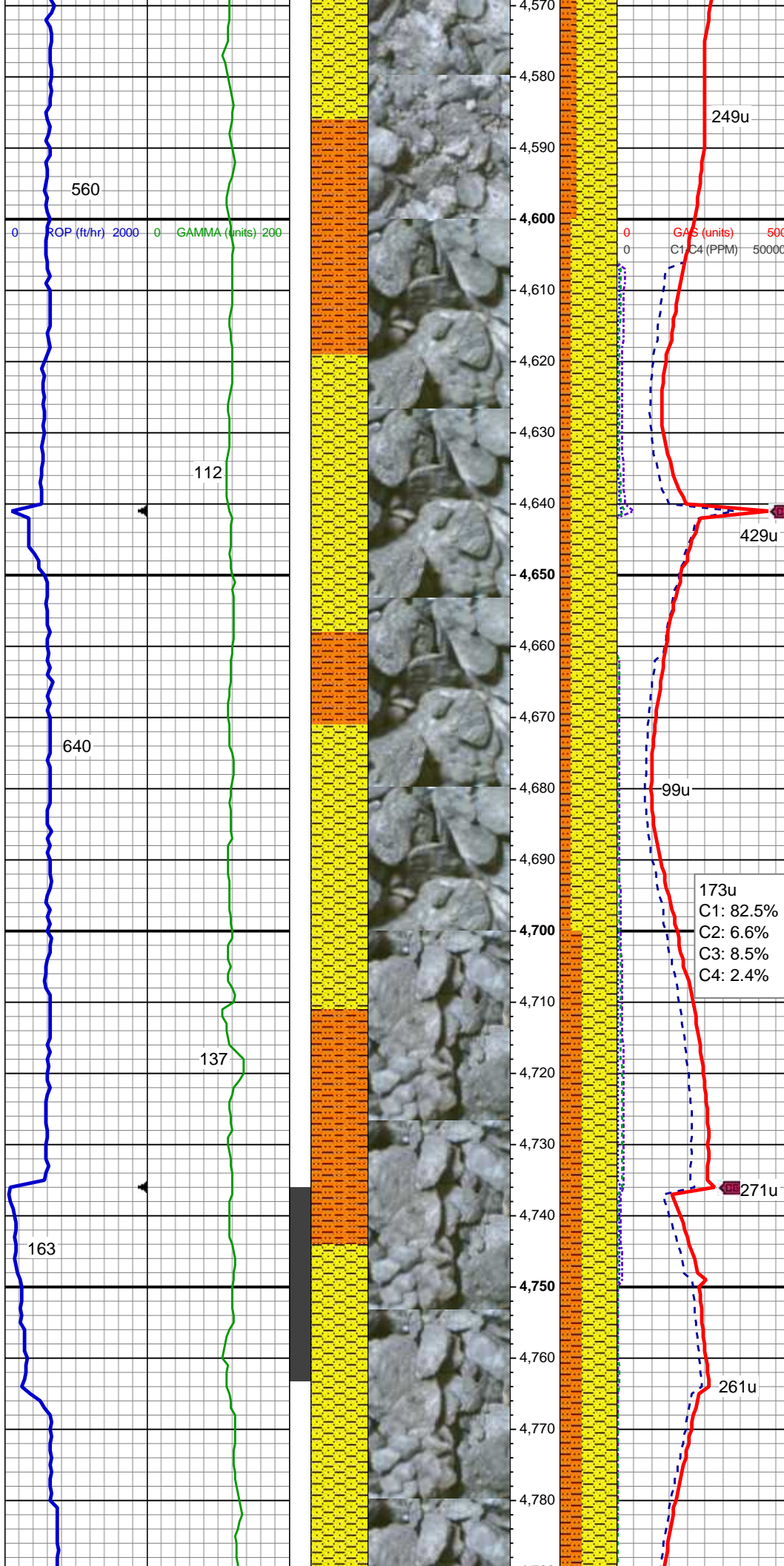
MD: 4,397'  
TVD: 4,341.28'  
Inclination: 14.54 °  
Azimuth: 178.02 °

SHY SS: wh - lt gy, fros - trnsl, s&p, vfg, mod hd wi brit clus, sb ang - sb rd, calc cmt  
SS: wh, fros - trnsl, s&p, speckl wi mica, f gr, hd brit clus, sb ang - sb rd - sb blkly, v calc cmt

MD: 4,492'  
TVD: 4,433.23'  
Inclination: 14.57 °  
Azimuth: 178.44 °

MD: 4,587'





TVD: 4,525.41'  
Inclination: 13.4 °  
Azimuth: 180.51 °

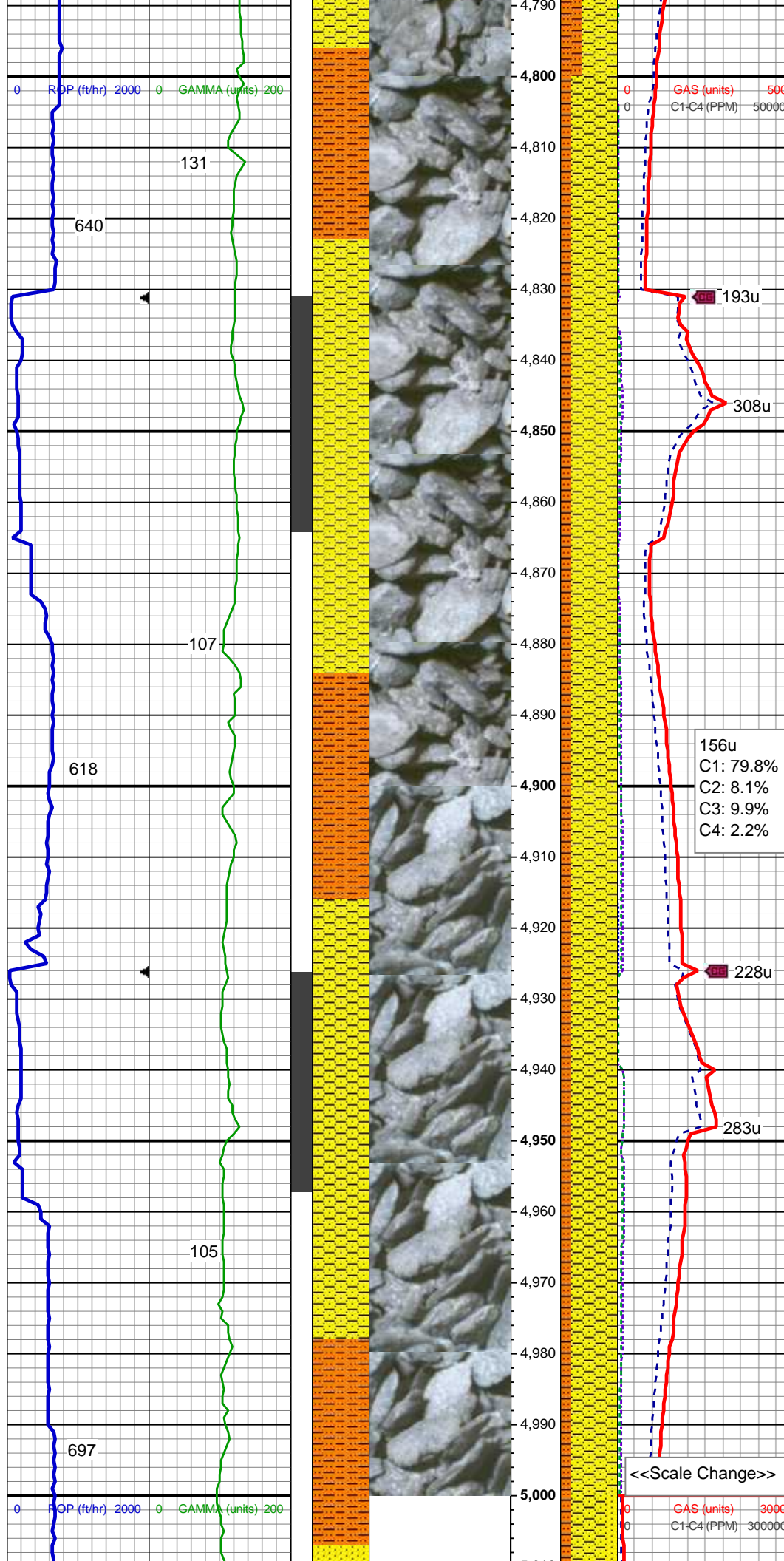
SHY SS: wh - lt gy, fros - trns, s&p,  
vfg, mod hd wi brit clus, sb ang - sb  
rd, calc cmt, grdg to SS  
SHY SLTST: lt - med gy, frm - hd,  
sme sft, sb rd - sb blk, slty - grty  
tex, v sl calc

MD: 4,682'  
TVD: 4,618.06'  
Inclination: 12.13 °  
Azimuth: 182.83 °

SHY SS: wh - lt gy, fros - trns, s&p,  
vfg, mod hd wi brit clus, sb ang - sb  
rd, calc cmt, grdg to SS  
SHY SLTST: lt - med gy, frm - hd,  
sme sft, sb rd - sb blk, slty - grty  
tex, v sl calc

MD: 4,777'  
TVD: 4,710.93'  
Inclination: 12.18 °  
Azimuth: 178.92 °

SHY SS: wh - lt gy, fros - trns, s&p,  
vfg, mod hd wi brit clus, sb ang - sb  
rd, calc cmt, grdg to SS



rd, calc cmt, grdg to SS  
SHY SLTST: lt - med gy, frm - hd,  
sme sft, sb rd - sb blkly, slty - grty  
tex, v sl calc

Shannon Top @  
4,848' MD; 4,780' TVD

SHY SS: wh - lt gy, fros - trnsl, s&p,  
vfg, mod hd wi brit clus, sb ang - sb  
rd, calc cmt, grdg to SS  
SHY SLTST: lt - med gy, frm - hd,  
sme sft, sb rd - sb blkly, slty - grty  
tex, v sl calc

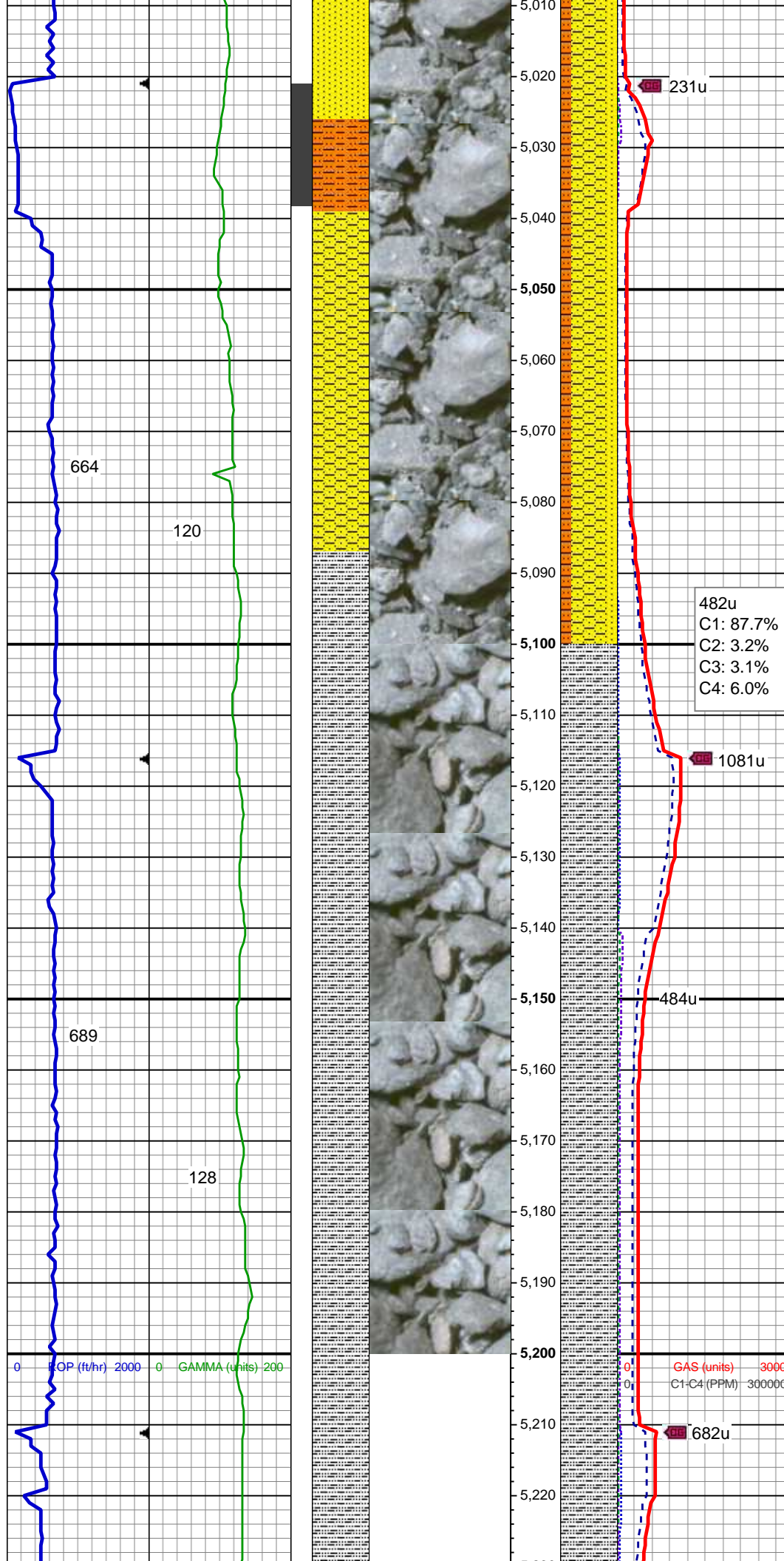
MUD WT: 8.7/8.7  
VIS: 29/29 IN/OUT

MD: 4,967'  
TVD: 4,896.14'  
Inclination: 13.62 °  
Azimuth: 172.12 °

SHY SS: wh - lt gy, fros - trnsl, s&p,  
vfg, mod hd wi brit clus, sb ang - sb  
rd, calc cmt, grdg to SS  
SHY SLTST: lt - med gy, frm - hd,  
sme sft, sb rd - sb blkly, slty - grty  
tex, v sl calc

<<Scale Change>>





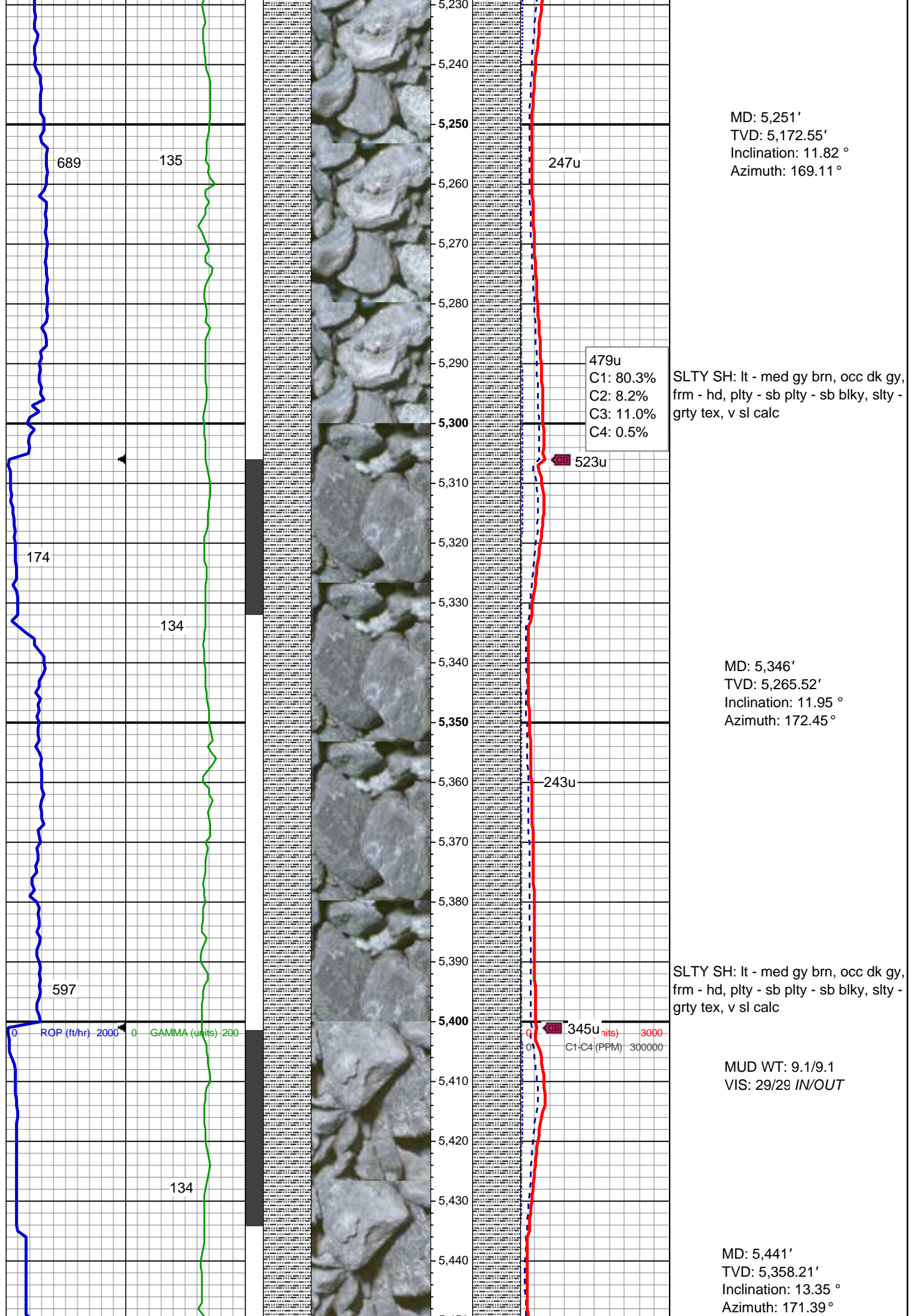
MD: 5,061'  
TVD: 4,987.4'  
Inclination: 14.11 °  
Azimuth: 170.73 °

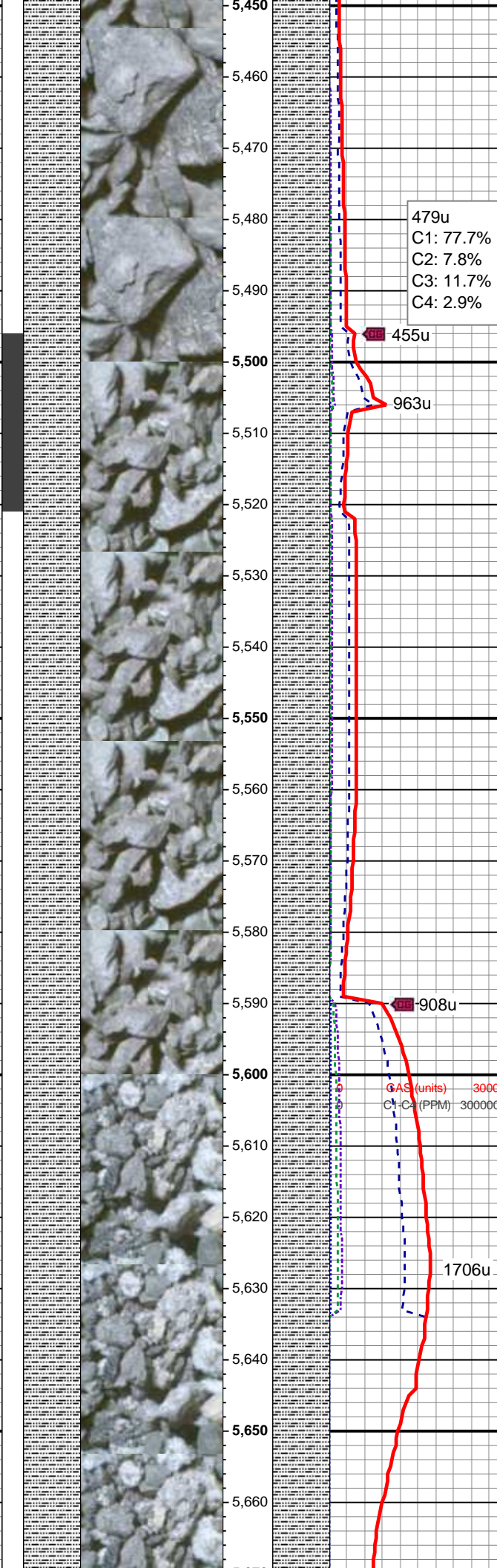
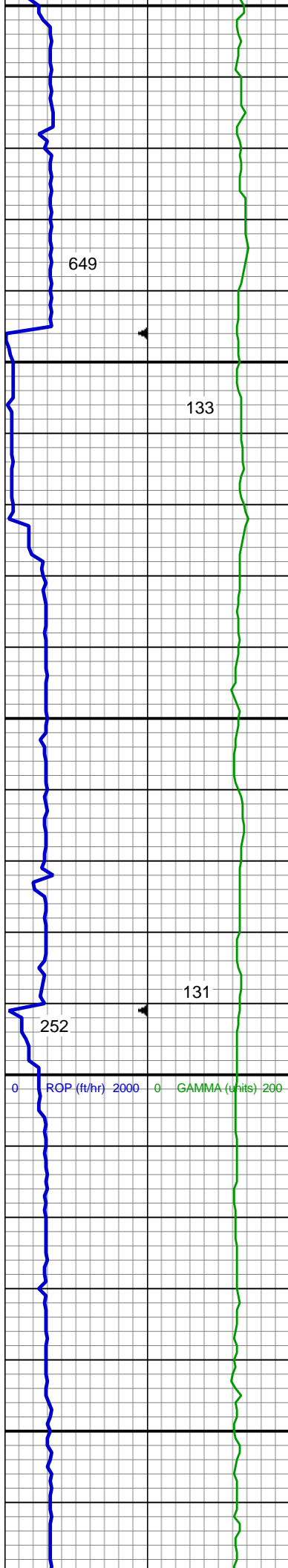
SHY SS: wh - lt gy, fros - trnsl, s&p, vfg, mod hd wi brit clus, sb ang - sb rd, calc cmt  
SHY SLTST: lt - med gy, frm - hd, sme sft, sb rd - sb blk, slty - grty tex, v sl calc  
SS: wh, fros - trnsl, s&p, speckl wi mica, f gr, hd brit clus, sb ang - sb rd - sb blk, v calc cmt

MD: 5,156'  
TVD: 5,079.76'  
Inclination: 12.96 °  
Azimuth: 171.83 °

SLTY SH: lt - med gy brn, occ dk gy, frm - hd, plty - sb plty - sb blk, slty - grty tex, v sl calc







479u  
C1: 77.7%  
C2: 7.8%  
C3: 11.7%  
C4: 2.9%

455u

963u

908u

1706u

SLTY SH: lt - med gy brn, occ dk gy,  
frm - hd, plty - sb plty - sb blk, slty -  
grty tex, v sl calc

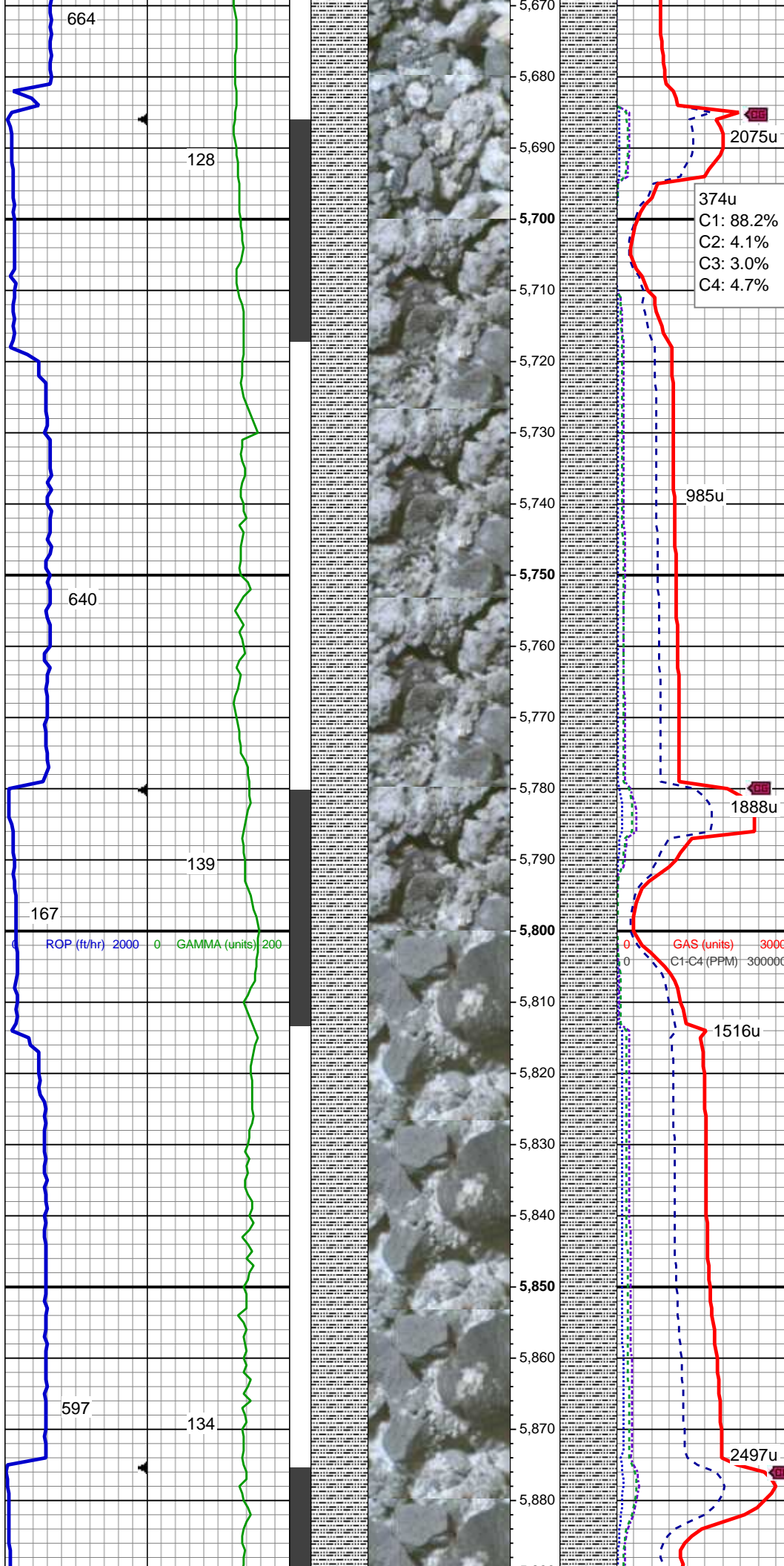
MUD WT: 9.2/9.2  
VIS: 32/32 IN/OUT

MD: 5,536'  
TVD: 5,450.56'  
Inclination: 13.78 °  
Azimuth: 171.15 °

SLTY SH: lt - med gy brn, occ dk gy,  
frm - hd, plty - sb plty - sb blk, slty -  
grty tex, v sl calc

MD: 5,631'  
TVD: 5,543.09'  
Inclination: 12.36 °  
Azimuth: 171.46 °





SLTY SH: lt - med gy brn, occ dk gy,  
frm - hd, plty - sb plty - sb blk, slty -  
grty tex, v sl calc

MUD WT: 9.4/9.4  
VIS: 31/31 IN/OUT

SLTY SH: lt - med gy brn, occ dk gy,  
frm - hd, plty - sb plty - sb blk, slty -  
grty tex, v sl calc

MD: 5,820'  
TVD: 5,727.35'  
Inclination: 13.39 °  
Azimuth: 177.46 °

Teepee Buttes Top @  
5,868' MD; 5,864' TVD

MUD WT: 9.55/9.45  
VIS: 36/36 IN/OUT

