

# COLUMBINE LOGGING

Scale: 5" / 100'  
Measured Depth Log

**Well Name** Wolfpack B02-66-1HN VERT

**Location** SEC 2 T5N R64W

**State** COLORADO

**County** WELD

**Country** USA

**Rig Number** H&P 315

**API Number** 05-123-37328

**AFE #** 139195

**Region** DJ BASIN

**Field** WATTENBERG

**Spud Date** 7/16/2013

**Drilling Completed** 7/18/2013

**Surface Coordinates** NWSW SEC 2 T5N R64W  
2115' FSL; 175' FWL

**Bottom Hole Coordinates** SENE SEC2 T5N R64W  
660' FEL; 2350' FNL

**Ground Elevation** 4625'

**K.B. Elevation** 4649'

**Logged Interval** 2000' **To** 5973'

**Total Depth** 5973'

**Formation** NIOBRARA B CHALK

**Type of Drilling Fluid** LSND

## Operator

**Company** Noble Energy Inc

**Address** 1625 Broadway Suite 2200  
Denver, CO 80202

## Geologist

**Name** MARK COLE, NATHAN MURPHY

**Company** COLUMBINE LOGGING, INC

**Address** 2385 S Lipan St  
Denver, CO 80223

## Rock Types

? UNKNOWN  
ANHYDRITE  
BENTONITE  
BRECCIA  
CEMENT  
CHALK  
CHERT  
CLAY CHOKE SAND  
CLAYSTONE

COAL  
CONGLOMERATE  
DOLOMITE  
GRANITE  
GYPSUM  
IGNEOUS  
LIMESTONE  
SIDERITE or LIMONITE  
MARLSTONE

METAMORPHIC  
NO SAMPLE  
SALT  
SALT- PEPPER SAND  
SANDSTONE  
SHALE  
SHALE COLORED  
SHALE GRAY  
SHALY SANDSTONE

SHALY SILTSTONE  
SILTSTONE  
SILTY SHALE  
TILL  
TUFF  
WELDED TUFF

## Accessories

### Fossils

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

F 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

E 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

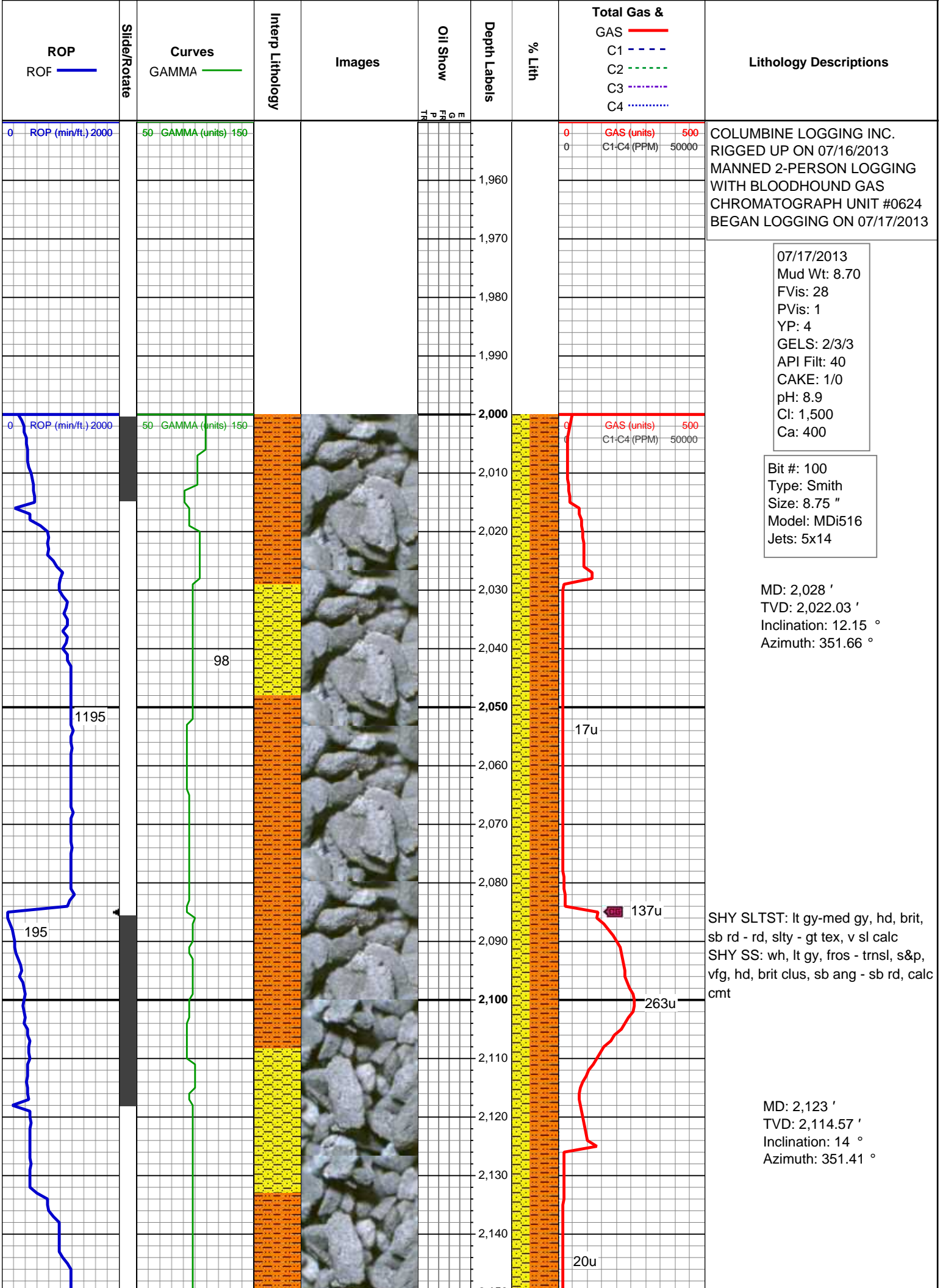
### Textures

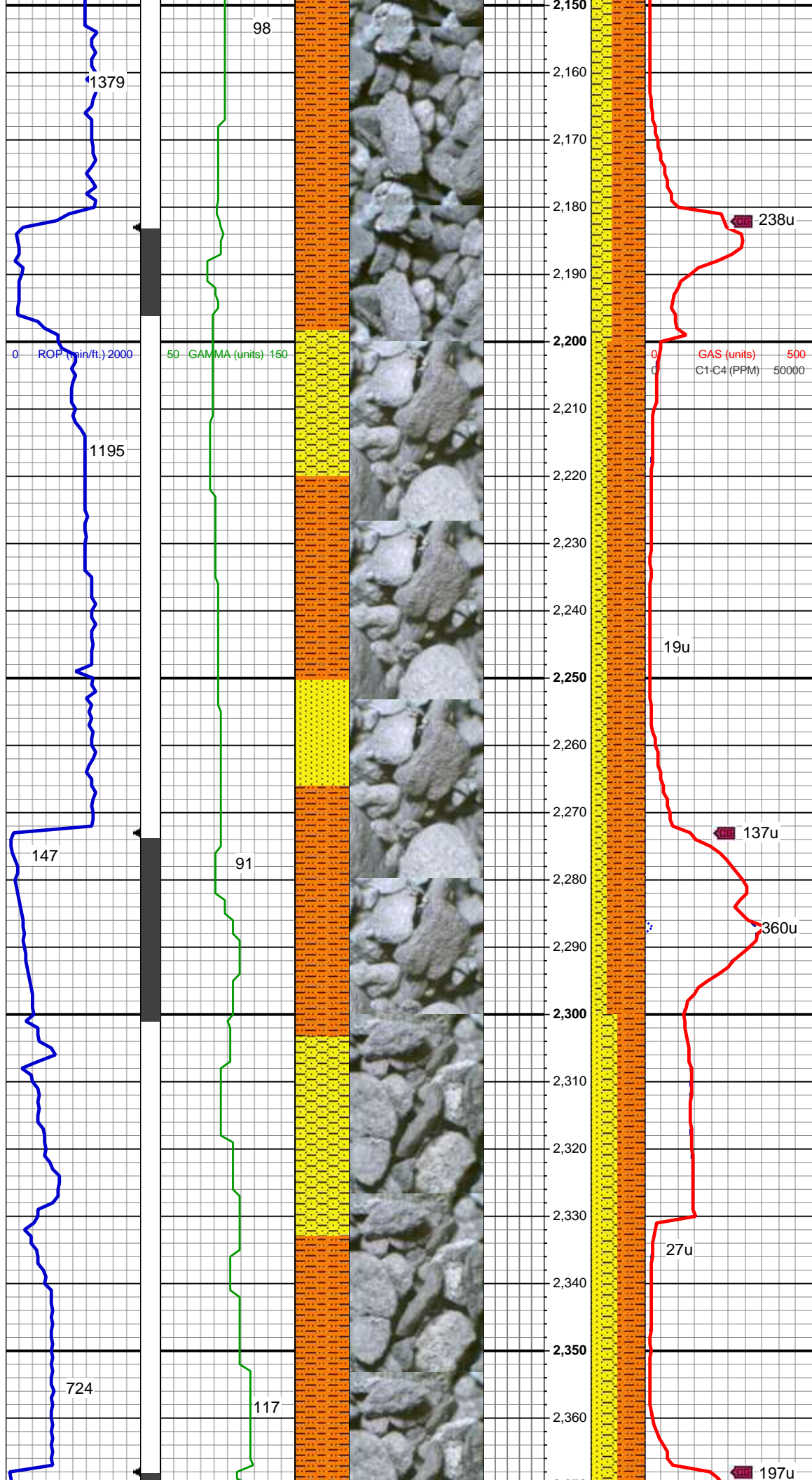
BOUNDSTONE  
CHALKY  
CRYPTOXLN

E EARTHY  
FINELYXLN  
GRAINSTONE  
L LITHOGRAPHIC  
MICROXLN  
MUDSTONE  
PACKSTONE  
WACKESTONE

### Sorting

MODERATE  
POOR  
WELL





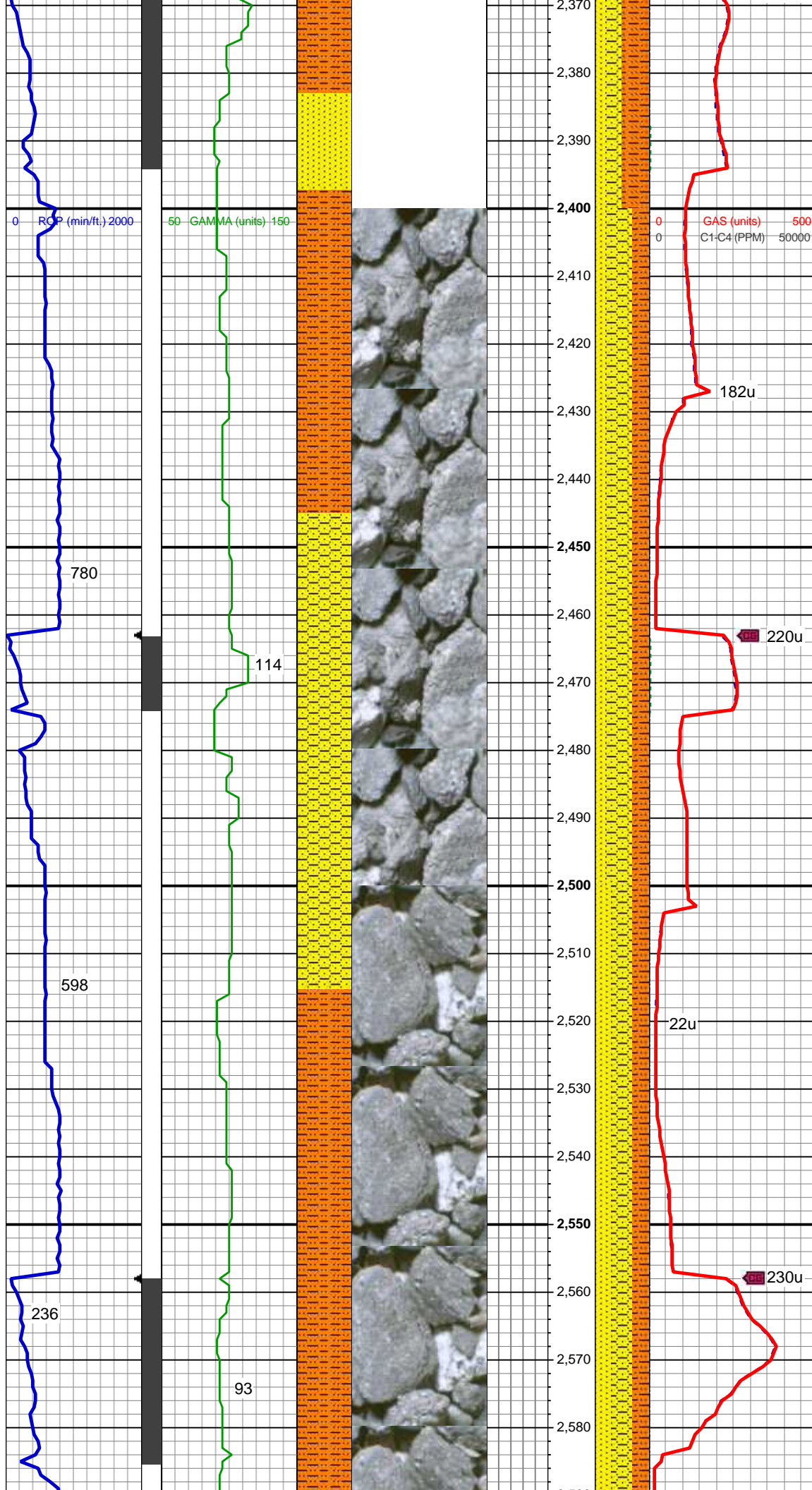
SHY SLTST: lt gy-med gy, hd, brit,  
sb rd - rd, slty - gt tex, v sl calc  
SHY SS: wh, lt gy, fros - trnsl, s&p,  
vfg, hd, brit clus, sb ang - sb rd, calc  
cmt

MD: 2,218 '  
TVD: 2,206.75 '  
Inclination: 13.99 °  
Azimuth: 349.23 °

SHY SLTST: lt gy-dk gy, hd, brit, sb  
rd - sb plty, slty - gt tex, v sl calc  
SHY SS: wh, lt gy, lt gy brn, fros ip,  
s&p ip, vfg, hd, brit clus, sb ang - sb  
rd, calc cmt  
SS: wh, lt gy, fros - trnsl, spec w/  
mica, tr dk gn xl glau, f-vfg, hd, brit  
clus, sb ang - ang, v calc cmt

MD: 2,313 '  
TVD: 2,298.93 '  
Inclination: 13.98 °  
Azimuth: 353.21 °





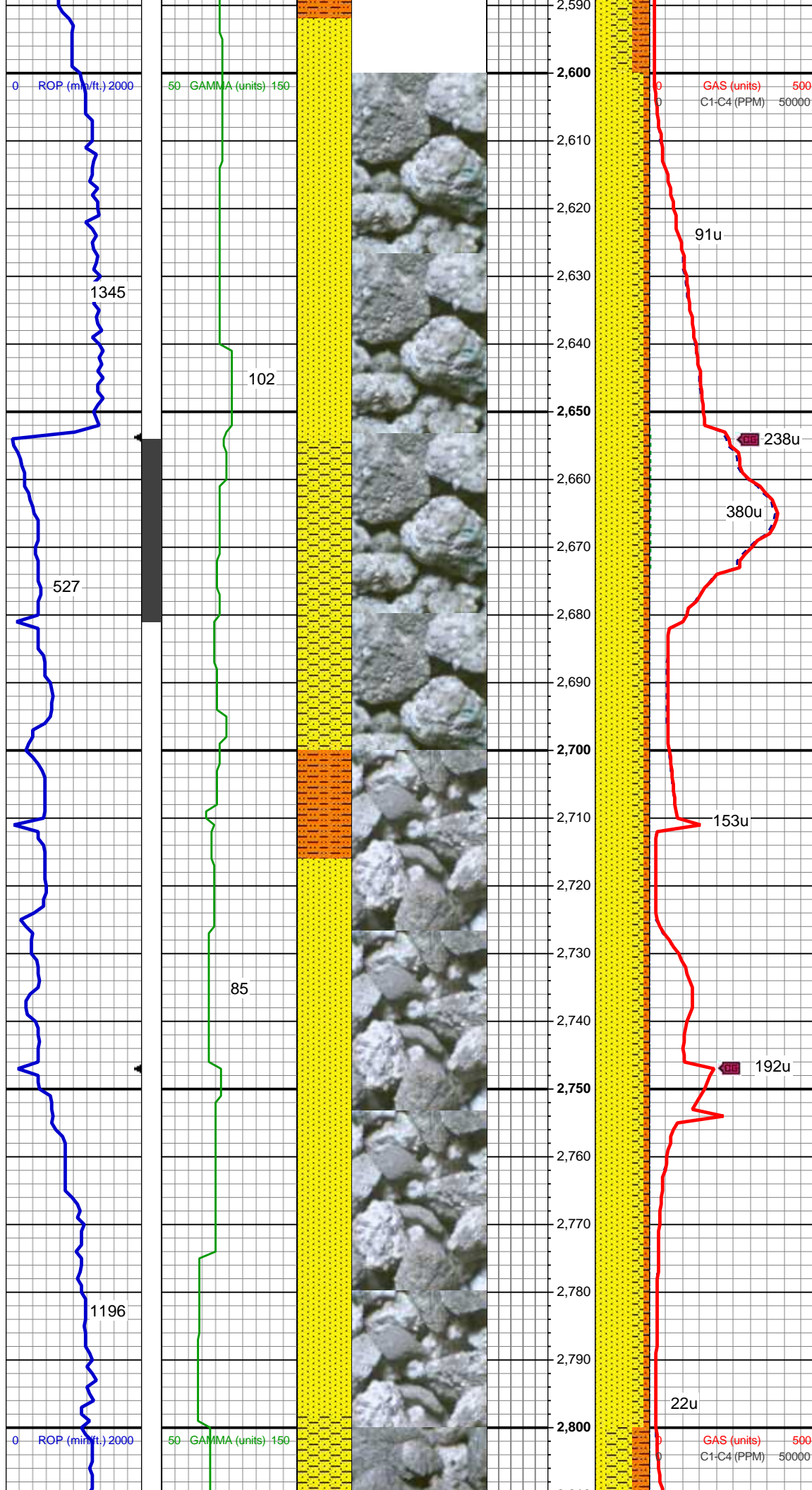
SHY SLTST: lt gy-dk gy, hd, brit, sb  
rd - sb plty, slty - gt tex, v sl calc  
SHY SS: wh, lt gy, lt gy brn, fros ip,  
s&p ip, vfg, hd, brit clus, sb ang - sb  
rd, calc cmt  
SS: wh, lt gy, fros - trnsl, spec w/  
mica, tr dk gn xl glau, f-vfg, hd, brit  
clus, sb ang - ang, v calc cmt

MD: 2,408 '  
TVD: 2,390.95 '  
Inclination: 14.84 °  
Azimuth: 355.98 °

SHY SS: wh, lt gy, lt gy brn, fros ip,  
s&p ip, vfg, hd, brit clus, sb ang - sb  
rd, calc cmt  
SHY SLTST: lt gy-dk gy, hd, brit, sb  
rd - sb plty, slty - gt tex, v sl calc  
SS: wh, lt gy, fros - trnsl, spec w/  
mica, tr dk gn xl glau, f-vfg, hd, brit  
clus, sb ang - ang, v calc cmt, tr fos  
frag

MD: 2,503 '  
TVD: 2,482.74 '  
Inclination: 15.03 °  
Azimuth: 355.23 °

SHY SS: wh, lt gy, lt gy brn, fros ip,  
s&p ip, vfg, hd, brit clus, sb ang - sb  
rd, calc cmt  
SHY SLTST: lt gy-dk gy, hd, brit, sb  
rd - sb plty, slty - gt tex, v sl calc



SS: wh, lt gy, fros - trnsl, spec w/  
mica, tr dk gn xl glau, f-vfg, hd, brit  
clus,sb ang - ang, v calc cmt

MD: 2,597 '  
TVD: 2,573.51 '  
Inclination: 15.08 °  
Azimuth: 357.33 °

SS: wh, lt gy, fros - trnsl, spec w/  
mica, tr dk gn xl glau, f-vfg, hd, brit  
clus,sb ang - ang, v calc cmt  
SHY SS: wh, lt gy, lt gy brn, fros ip,  
s&p ip, vfg, hd, brit clus, sb ang - sb  
rd, calc cmt  
SHY SLTST: lt gy-dk gy, hd, brit, sb  
rd - sb plty, slty - gt tex, v sl calc

MD: 2,692 '  
TVD: 2,664.92 '  
Inclination: 16.54 °  
Azimuth: 355.66 °

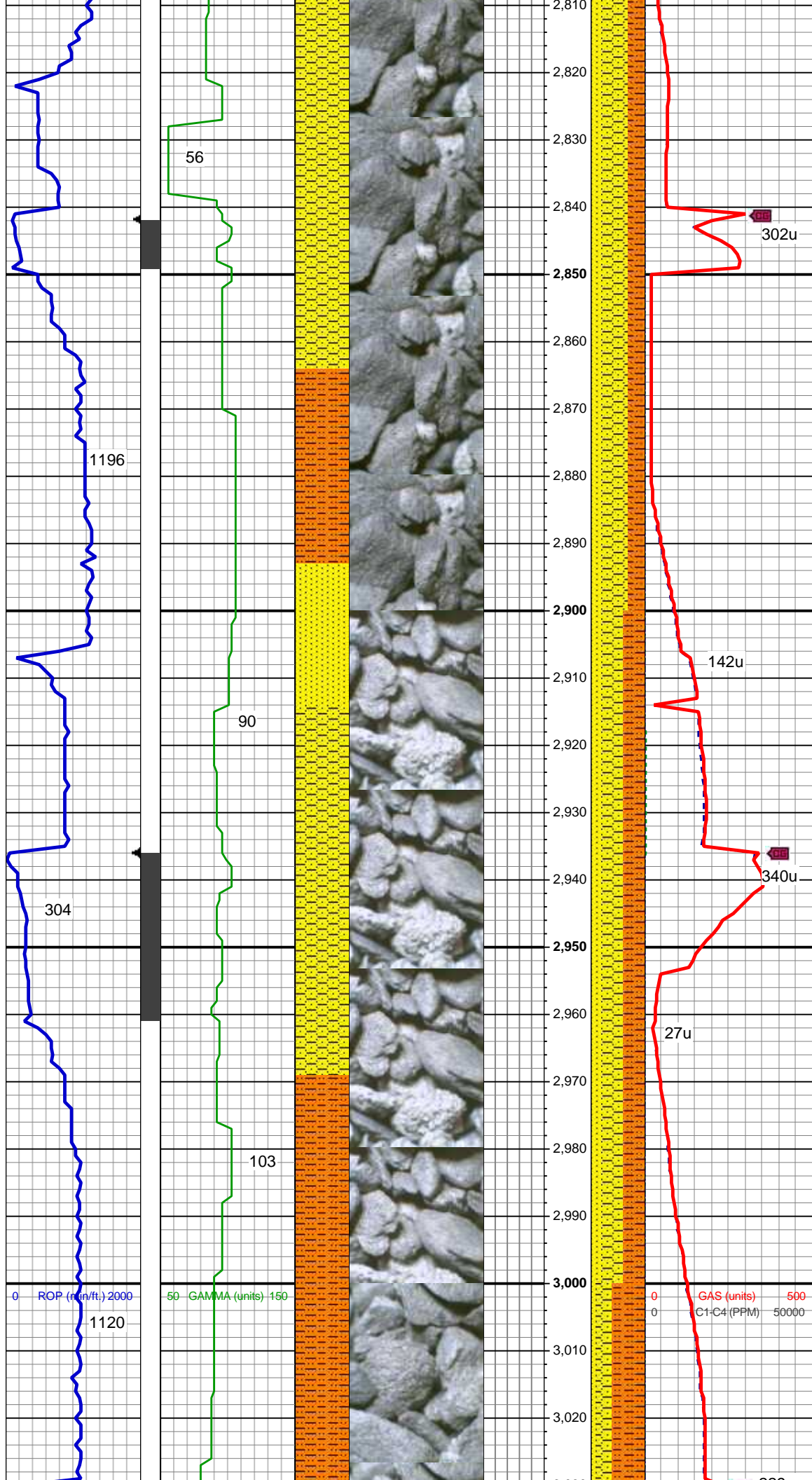
MUD WT: 8.40/9.40  
VIS: 27/27 IN/OUT

SS: wh, lt gy, fros - trnsl, spec w/  
mica, tr dk gn xl glau, f-vfg, hd, brit  
clus,sb ang - ang, v calc cmt,  
SHY SS: wh, lt gy, lt gy brn, fros ip,  
s&p ip, vfg, hd, brit clus, sb ang - sb  
rd, calc cmt  
SHY SLTST: lt gy-dk gy, hd, brit, sb  
rd - sb plty, slty - gt tex, v sl calc

MD: 2,787 '  
TVD: 2,755.83 '  
Inclination: 17.22 °



Inclination: 17.22 °  
Azimuth: 355.4 °



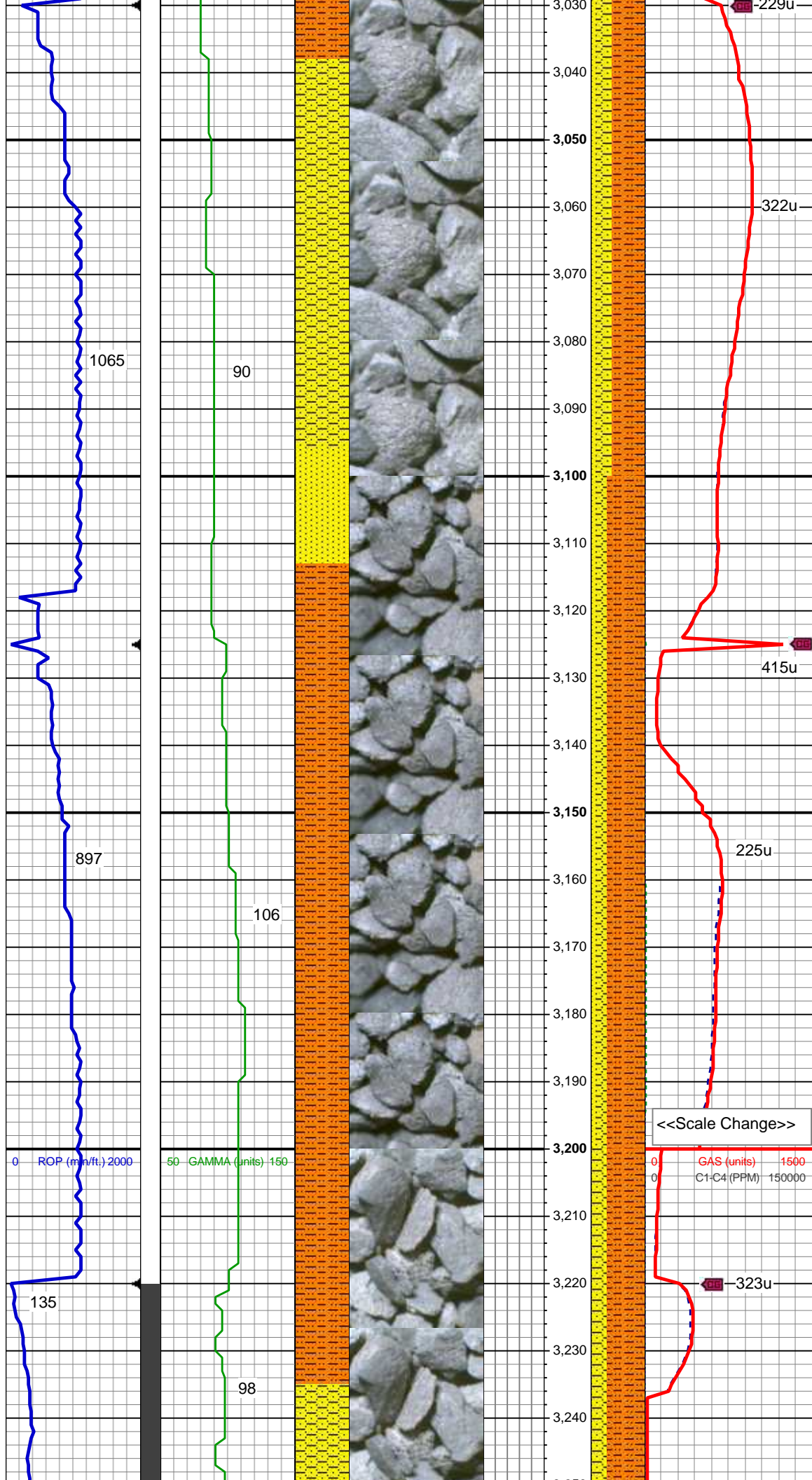
MD: 2,882 '  
TVD: 2,847.1 '  
Inclination: 14.94 °  
Azimuth: 353.87 °

SHY SS: wh, lt gy, lt gy brn, fros ip, s&p ip, vfg, hd, brit clus, sb ang - sb rd, calc cmt  
SHY SLTST: lt gy-dk gy, hd, brit, sb rd - sb plty, slty - gt tex, v sl calc  
SS: wh, lt gy, fros - trnsl, spec w/ mica, tr dk gn xl glau, f-vfg, hd, brit clus, sb ang - ang, v calc cmt

MUD WT: 8.85/9.20  
VIS: 28/28 IN/OUT

MD: 2,977 '  
TVD: 2,938.62 '  
Inclination: 16.18 °  
Azimuth: 354.71 °

SHY SS: wh, lt gy, lt gy brn, fros ip, s&p ip, vfg, hd, brit clus, sb ang - sb rd, calc cmt  
SHY SLTST: lt gy-dk gy, hd, brit, sb rd - sb plty, slty - gt tex, v sl calc  
SS: wh, lt gy, fros - trnsl, spec w/ mica, tr dk gn xl glau, f-vfg, hd, brit clus, sb ang - ang, v calc cmt



MD: 3,072 '  
TVD: 3,029.94 '  
Inclination: 15.83 °  
Azimuth: 353.79 °

SHY SLTST: lt gy-dk gy, hd, brit, sb  
rd - sb plty, slty - gt tex, v sl calc  
SHY SS: wh, lt gy, lt gy brn, fros ip,  
s&p ip, vfg, hd, brit clus, sb ang - sb  
rd, calc cmt  
SS: wh, lt gy, fros - trns, spec w/  
mica, tr dk gn xl glau, f-vfg, hd, brit  
clus, sb ang - ang, v calc cmt

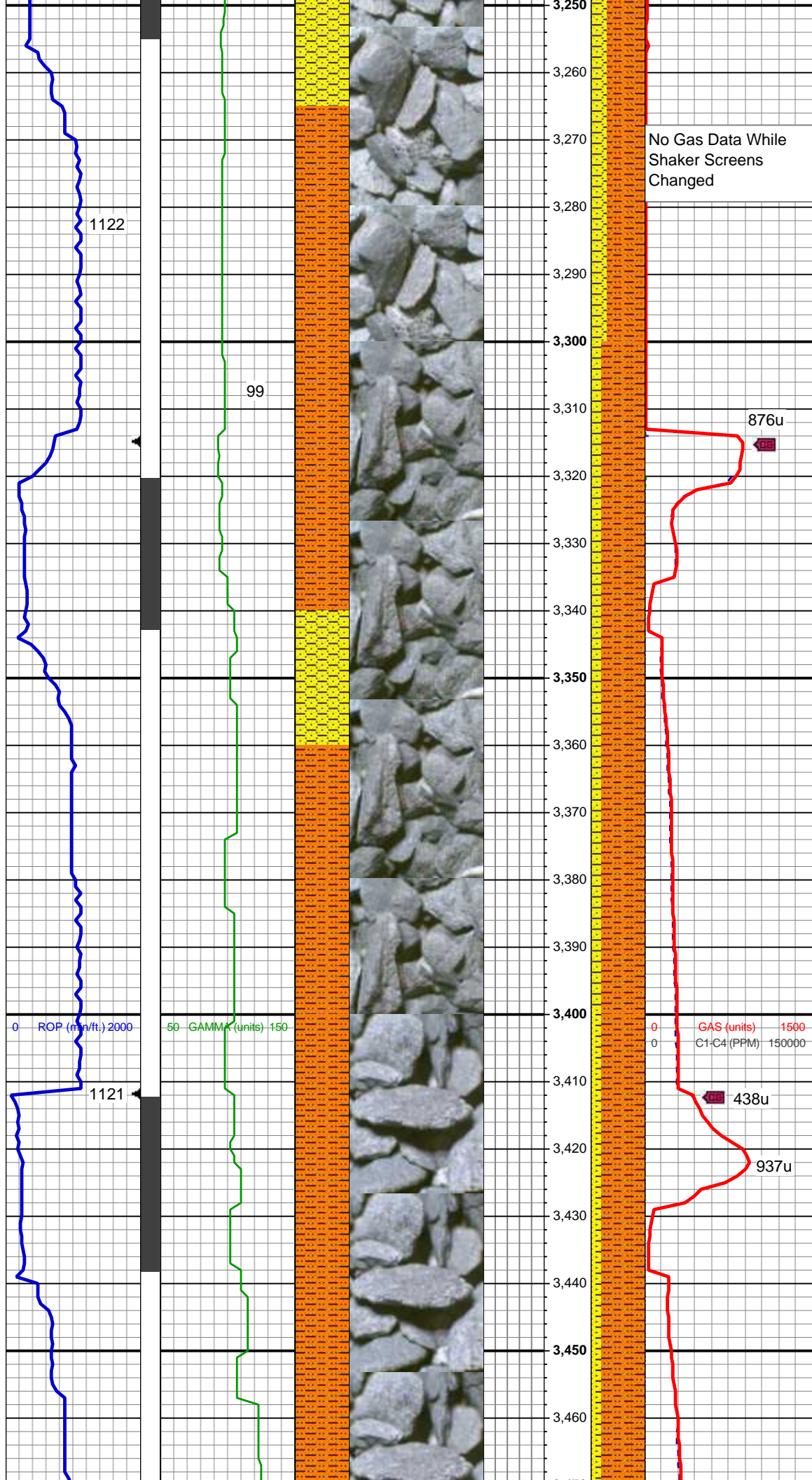
MD: 3,167 '  
TVD: 3,121.97 '  
Inclination: 12.84 °  
Azimuth: 352.61 °

SHY SLTST: lt gy-dk gy, hd, brit, sb  
rd - sb plty, slty - gt tex, v sl calc  
SHY SS: wh, lt gy, lt gy brn, fros ip,  
s&p ip, vfg, hd, brit clus, sb ang - sb  
rd, calc cmt  
SS: wh, lt gy, fros - trns, spec w/  
mica, tr dk gn xl glau, f-vfg, hd, brit  
clus, sb ang - ang, v calc cmt

<<Scale Change>>

GAS (units) 1500  
C1-C4 (PPM) 150000





MD: 3,261 '  
TVD: 3,213.71 '  
Inclination: 14.18 °  
Azimuth: 353.01 °

No Gas Data While  
Shaker Screens  
Changed

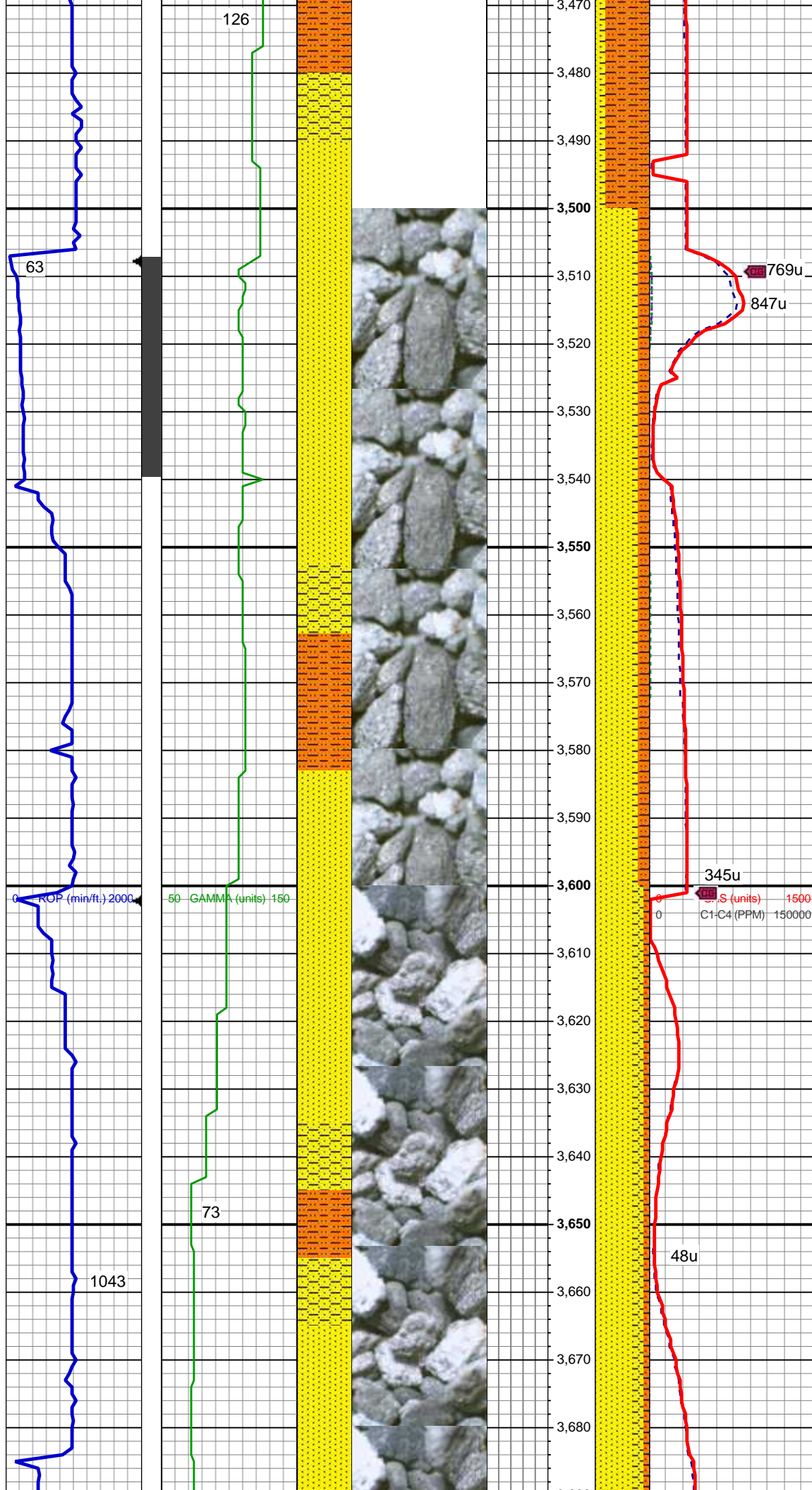
SHY SLTST: pred lt gy, sme medgy,  
hd, brit, sb rd - sb plty - sb blk, slty  
- grty tex, v sl calc  
SHY SS: lt gy, lt gy brn, fros ip, s&p  
ip, vfg, hd, brit clus, sb ang - sb rd,  
calc cmt

MD: 3,357 '  
TVD: 3,306.41 '  
Inclination: 14.34 °  
Azimuth: 358.31 °

SHY SLTST: pred lt gy, sme medgy,  
hd, brit, sb rd - sb plty - sb blk, slty  
- grty tex, v sl calc  
SHY SS: lt gy, lt gy brn, fros ip, s&p  
ip, vfg, hd, brit clus, sb ang - sb rd,  
calc cmt

07/17/2013  
Mud Wt: 8.70  
FVis: 28  
PVis: 2  
YP: 2  
GELS: 3/3/4  
API Filt: 30.0  
CAKE: 1/0  
pH: 9.6  
Cl: 1,500  
Ca: 120

MD: 3,451 '  
TVD: 3,397.63 '  
Inclination: 13.63 °  
Azimuth: 1.4 °



SHY SLTST: pred lt gy, sme medgy, hd, brit, sb rd - sb plty - sb blk, slty - grty tex, v sl calc  
SHY SS: lt gy, lt gy brn, fros ip, s&p ip, vfg, hd, brit clus, sb ang - sb rd, calc cmt  
SS: wh, lt gy, fros - trnsl, speckl wi mica, tr dk gn xl glau, f-vfg, hd, brit clus, sb ang - ang, v calc cmt

MD: 3,546 '  
TVD: 3,489.66 '  
Inclination: 15.06 °  
Azimuth: 359.03 °

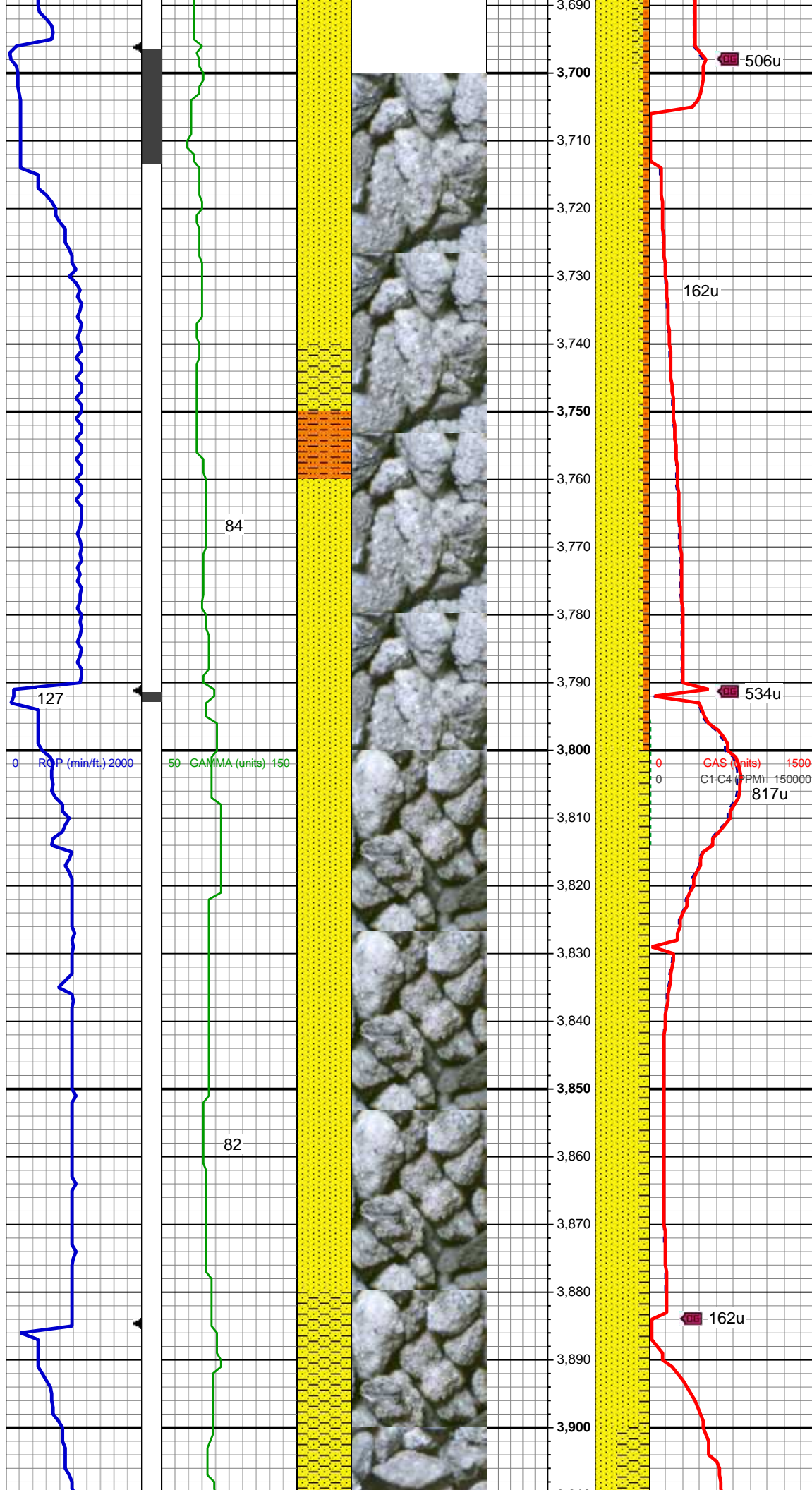
SS: wh, lt gy, fros - trnsl, speckl wi mica, tr dk gn xl glau, f-vfg, hd, brit clus, sb ang - ang, v calc cmt  
SHY SLTST: pred lt gy, sme medgy, hd, brit, sb rd - sb plty - sb blk, slty - grty tex, v sl calc  
SHY SS: lt gy, lt gy brn, fros ip, s&p ip, vfg, hd, brit clus, sb ang - sb rd, calc cmt

Parkman Top @  
3,583' MD; 3,526' TVD

MD: 3,641 '  
TVD: 3,581.18 '  
Inclination: 16.05 °  
Azimuth: 358.57 °

SS: wh, lt gy, fros - trnsl, speckl wi mica, tr dk gn xl glau, f-vfg, hd, brit clus, sb ang - ang, v calc cmt  
SHY SS: lt gy, lt gy brn, fros ip, s&p ip, vfg, hd, brit clus, sb ang - sb rd, calc cmt  
SHY SLTST: pred lt gy, sme medgy, hd, brit, sb rd - sb plty - sb blk, slty - grty tex, v sl calc





SHY SLTST: pred lt gy, sme medgy, hd, brit, sb rd - sb plty - sb blk, slty - grty tex, v sl calc

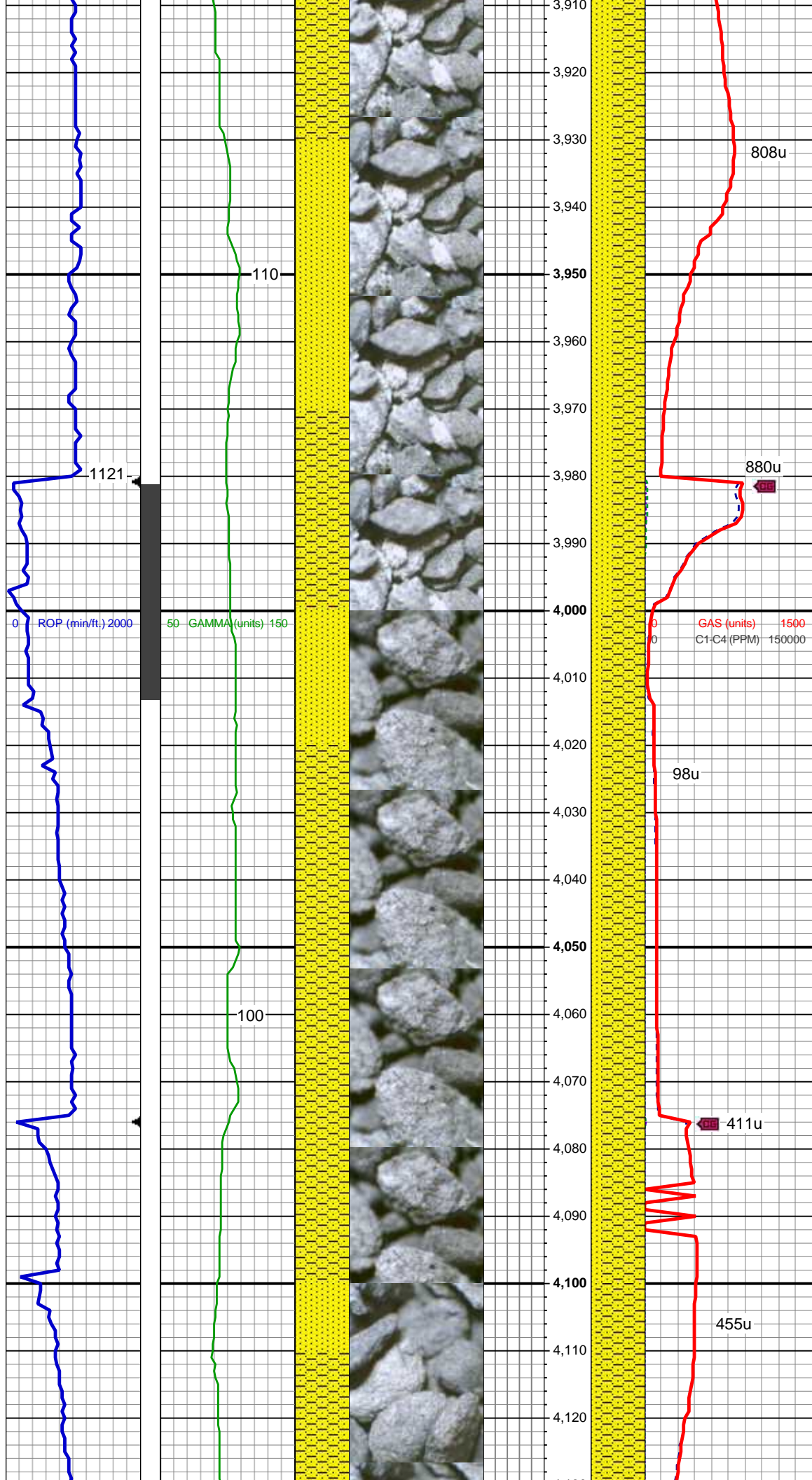
MD: 3,736 '  
TVD: 3,672.59 '  
Inclination: 15.53 °  
Azimuth: 357.96 °

SS: wh, lt gy, fros - trnsl, speckl wi mica, tr dk gn xl glau, f-vfg, hd, brit clus, sb ang - ang, v calc cmt  
SHY SS: lt gy, lt gy brn, fros ip, s&p ip, vfg, hd, brit clus, sb ang - sb rd, calc cmt  
SHY SLTST: pred lt gy, sme medgy, hd, brit, sb rd - sb plty - sb blk, slty - grty tex, v sl calc

MD: 3,831 '  
TVD: 3,763.92 '  
Inclination: 16.45 °  
Azimuth: 357.33 °

SS: wh, lt gy, fros - trnsl, speckl wi mica, tr dk gn xl glau, f-vfg, hd, brit clus, sb ang - ang, v calc cmt  
SHY SS: lt gy, lt gy brn, fros ip, s&p ip, vfg, hd, brit clus, sb ang - sb rd, calc cmt





MD: 3,926 '  
TVD: 3,854.87 '  
Inclination: 17.11 °  
Azimuth: 356.76 °

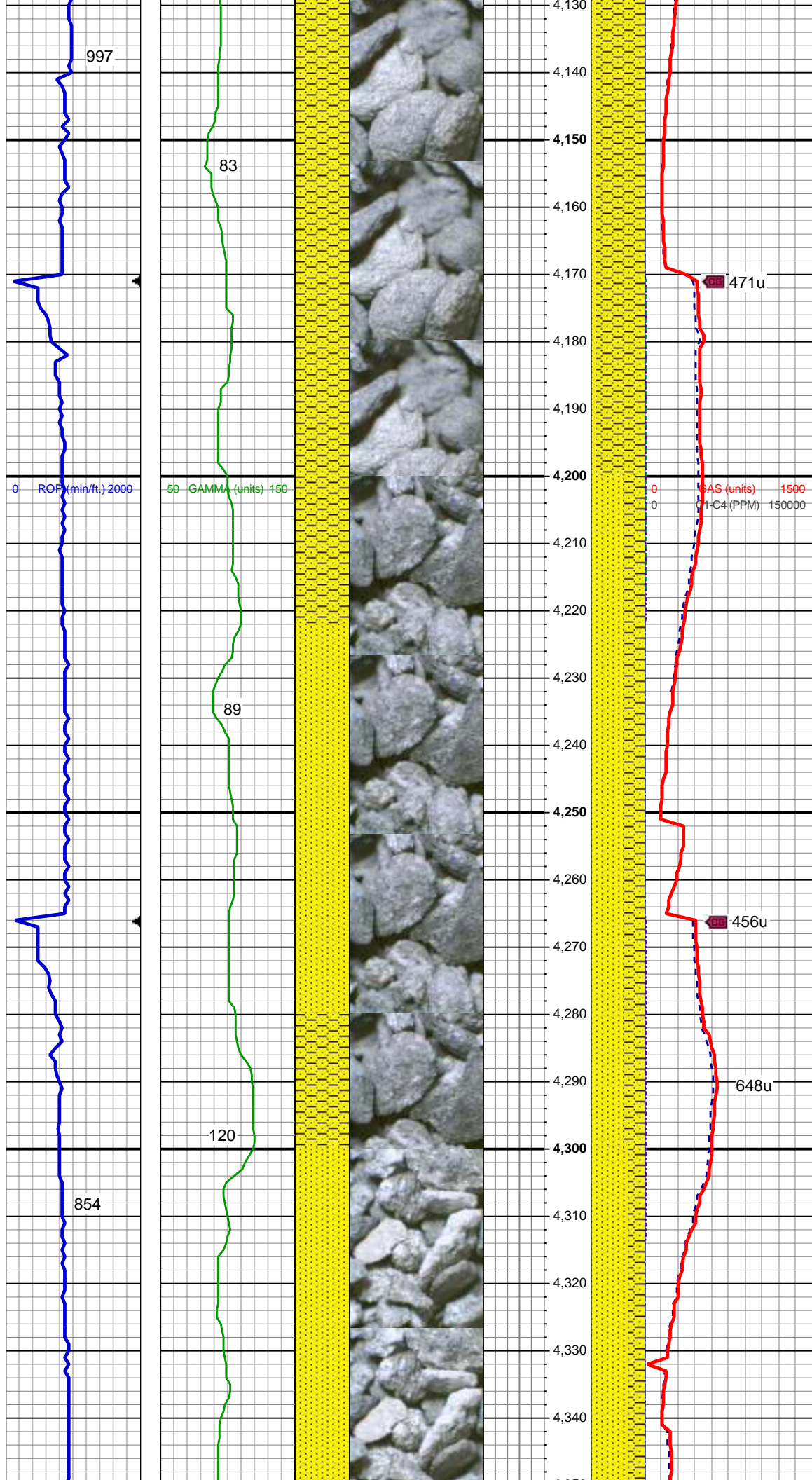
MUD WT: 8.70/9.00  
VIS: 27/27 IN/OUT

SHY SS: lt gy, lt gy brn, fros ip, s&p  
ip, vfg, hd, brit clus, sb ang - sb rd,  
calc cmt  
SS: wh, lt gy, fros - trnsl, speckl wi  
mica, tr dk gn xl glau, f-vfg, hd, brit  
clus, sb ang - ang, v calc cmt

MD: 4,021 '  
TVD: 3,946.31 '  
Inclination: 14.33 °  
Azimuth: 356.51 °

SHY SS: lt gy, lt gy brn, fros ip, s&p  
ip, vfg, hd, brit clus, sb ang - sb rd,  
calc cmt  
SS: wh, lt gy, fros - trnsl, speckl wi  
mica, tr dk gn xl glau, f-vfg, hd, brit  
clus, sb ang - ang, v calc cmt

MD: 4,116 '  
TVD: 4,038.7 '  
Inclination: 12.57 °  
Azimuth: 354.93 °



SHY SS: lt gy, lt gy brn, fros ip, s&p ip, vfg, hd, brit clus, sb ang - sb rd, calc cmt  
SS: wh, lt gy, fros - trnsl, speckl wi mica, tr dk gn xl glau, f-vfg, hd, brit clus, sb ang - ang, v calc cmt

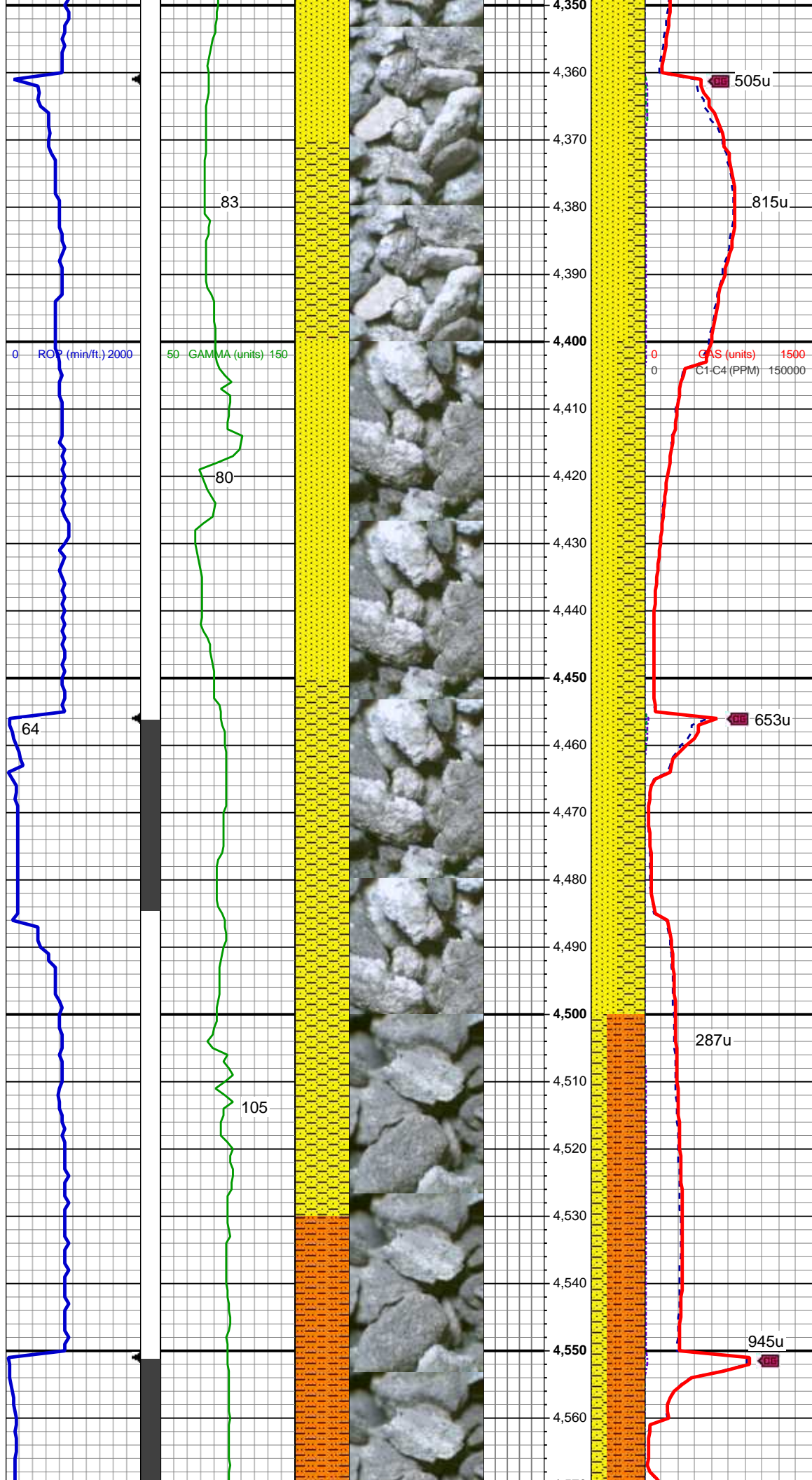
MD: 4,211 '  
TVD: 4,131.69 '  
Inclination: 11.04 °  
Azimuth: 353.79 °

Sussex Top @  
4,222' MD; 4,143' TVD

SS: wh, lt gy, fros - trnsl, speckl wi mica, tr dk gn xl glau, f-vfg, hd, brit clus, sb ang - ang, v calc cmt  
SHY SS: lt gy, lt gy brn, fros ip, s&p ip, vfg, hd, brit clus, sb ang - sb rd, calc cmt

MD: 4,306 '  
TVD: 4,225.26 '  
Inclination: 8.83 °  
Azimuth: 350.82 °





SS: wh, lt gy, fros - trnsl, speckl wi mica, tr dk gn xl glau, f-vfg, hd, brit clus, sb ang - ang, v calc cmt  
SHY SS: lt gy, lt gy brn, fros ip, s&p ip, vfg, hd, brit clus, sb ang - sb rd, calc cmt

MD: 4,400 '  
TVD: 4,318.3 '  
Inclination: 7.54 °  
Azimuth: 352.2 °

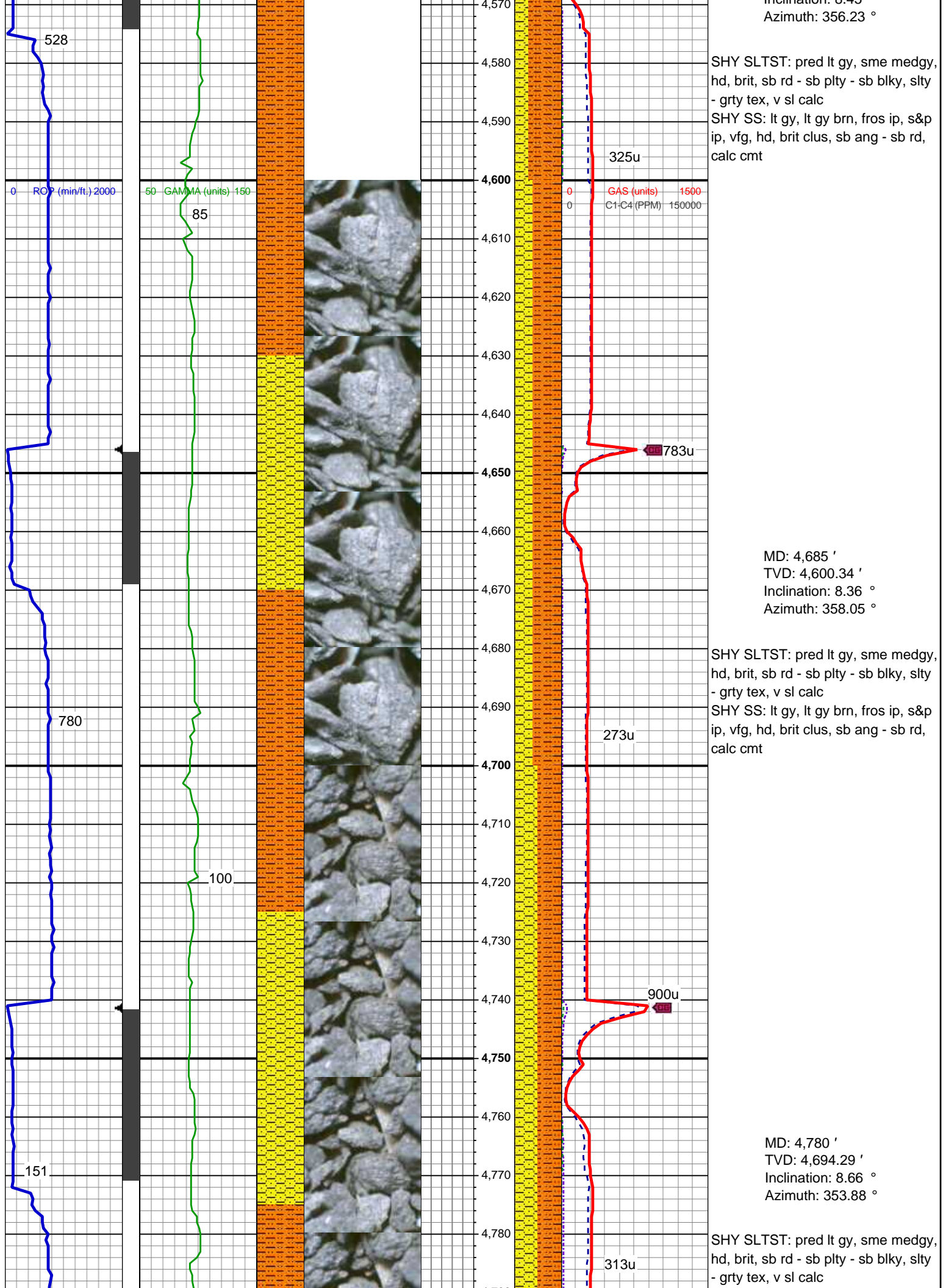
SS: wh, lt gy, fros - trnsl, speckl wi mica, tr dk gn xl glau, f-vfg, hd, brit clus, sb ang - ang, v calc cmt  
SHY SS: lt gy, lt gy brn, fros ip, s&p ip, vfg, hd, brit clus, sb ang - sb rd, calc cmt

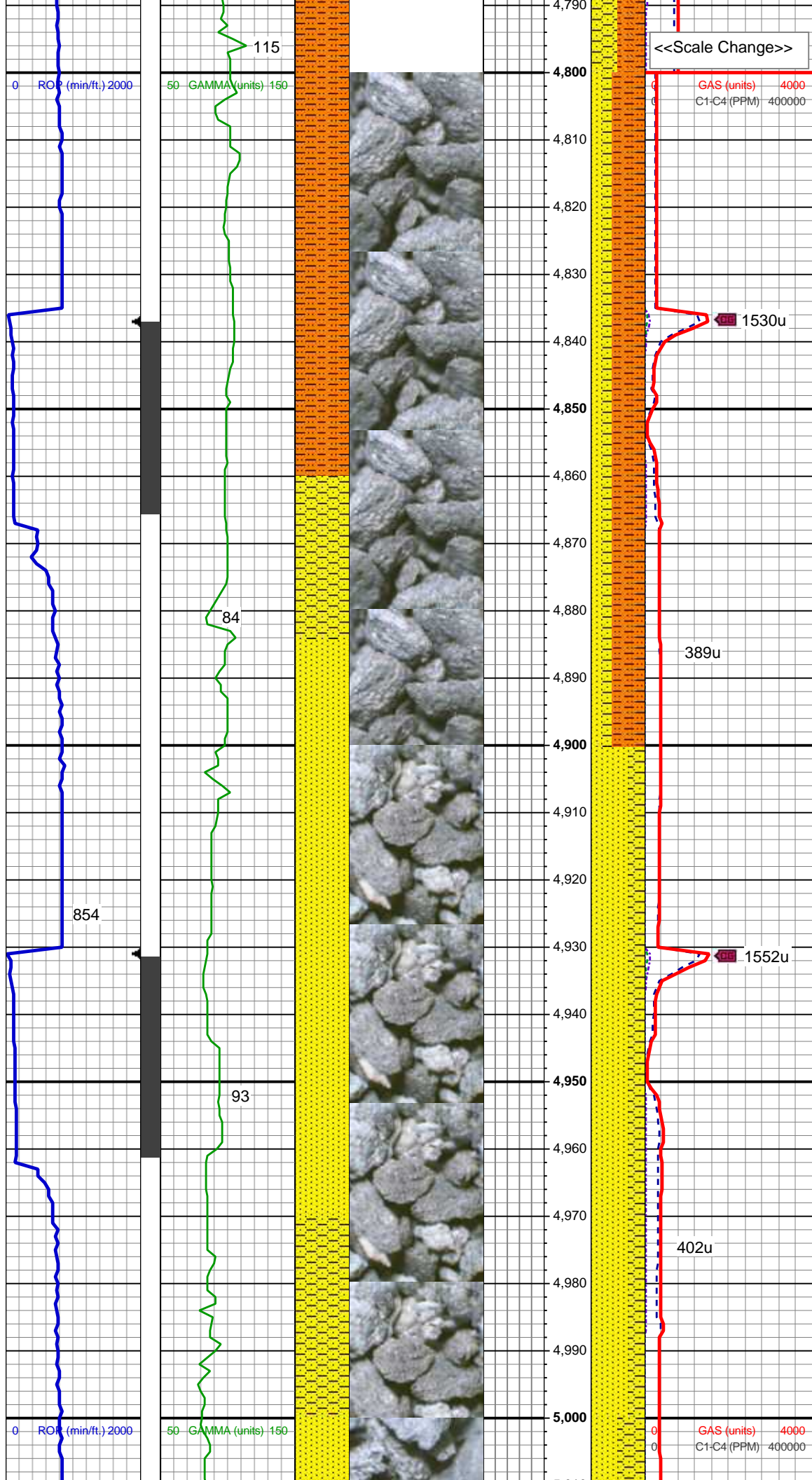
MD: 4,495 '  
TVD: 4,412.38 '  
Inclination: 8.39 °  
Azimuth: 354.26 °

MUD WT: 8.70/9.00  
VIS: 27/27 IN/OUT

MD: 4,590 '  
TVD: 4,506.36 '  
Inclination: 8.45 °







SHY SS: lt gy, lt gy brn, fros ip, s&p ip, vfg, hd, brit clus, sb ang - sb rd, calc cmt

MD: 4,875 '  
TVD: 4,788.25 '  
Inclination: 8.34 °  
Azimuth: 345.02 °

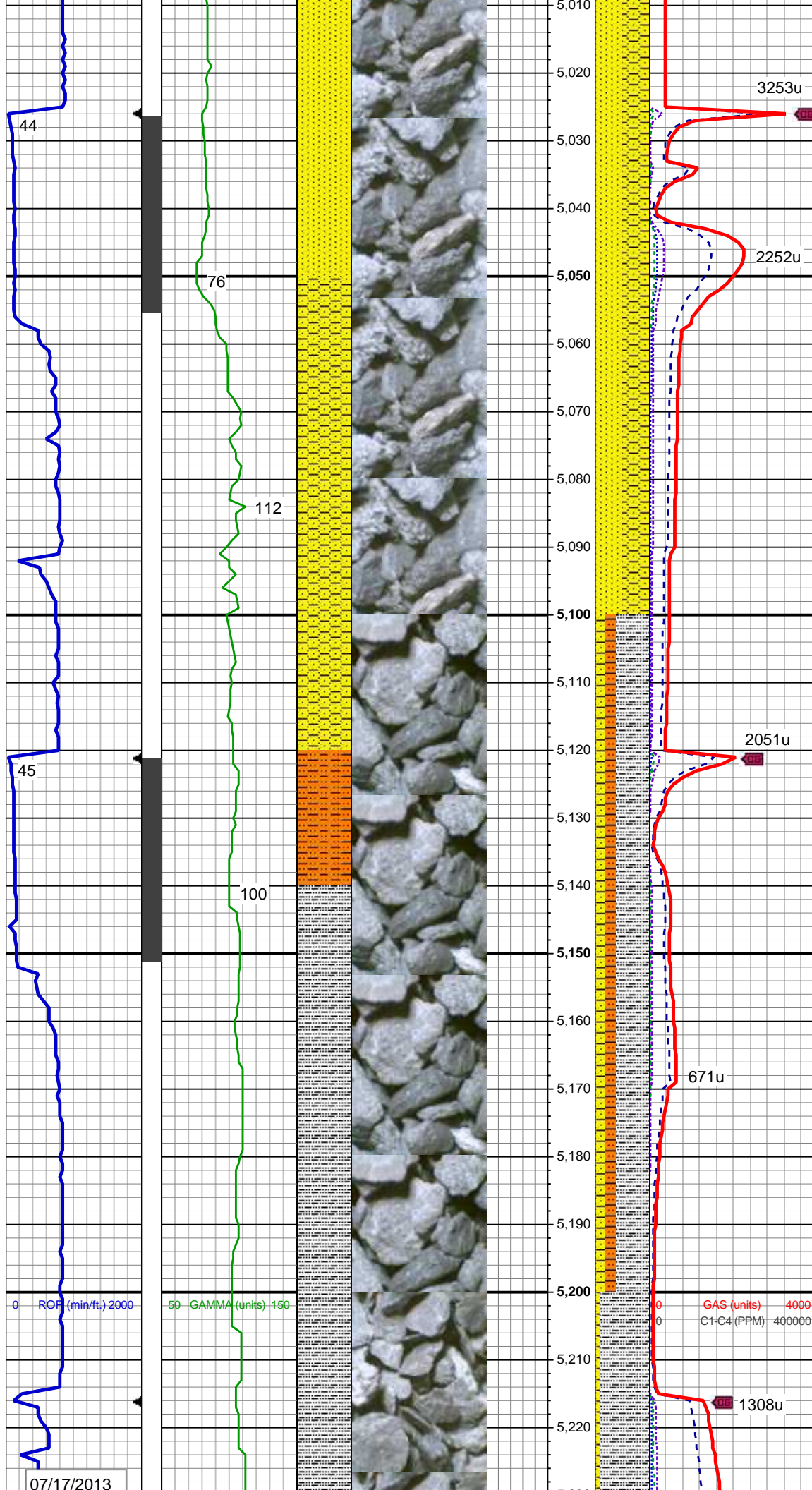
SHY SLTST: pred lt gy, sme medgy, hd, brit, sb rd - sb plty - sb blkly, slty - grty tex, v sl calc  
SHY SS: lt gy, lt gy brn, fros ip, s&p ip, vfg, hd, brit clus, sb ang - sb rd, calc cmt

Shannon Top @  
4,884' MD; 4,797' TVD

MD: 4,970 '  
TVD: 4,882.17 '  
Inclination: 8.97 °  
Azimuth: 346.62 °

SS: wh, lt gy, fros - trnsl, speckl wi mica, tr dk gn xl glau, f-vfg, hd, brit clus, sb ang - ang, v calc cmt  
SHY SS: lt gy, lt gy brn, fros ip, s&p ip, vfg, hd, brit clus, sb ang - sb rd, calc cmt





MUD WT: 8.90/8.80  
VIS: 27/27 IN/OUT

MD: 5,065 '  
TVD: 4,975.9 '  
Inclination: 9.79 °  
Azimuth: 345.85 °

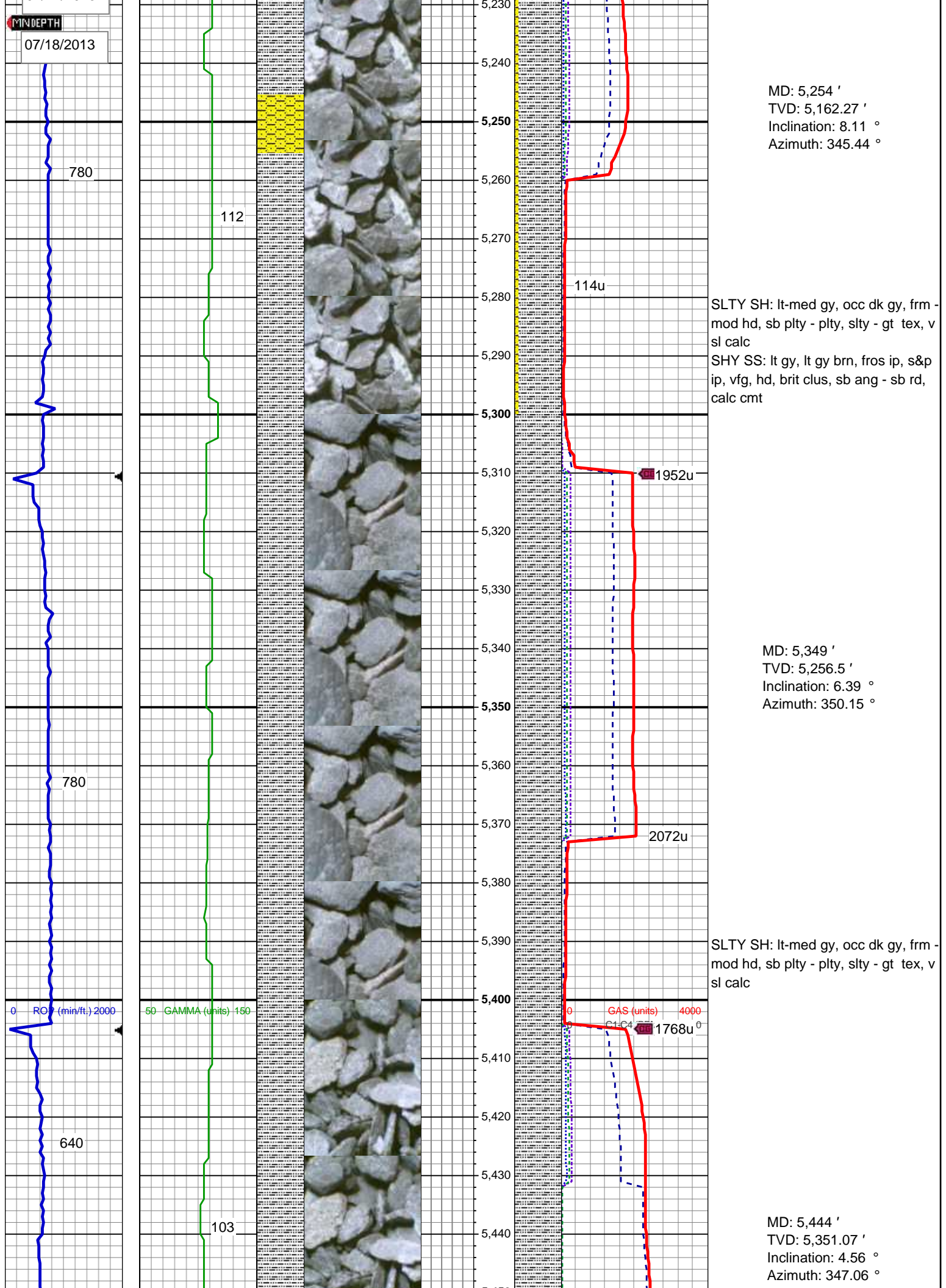
SS: wh, lt gy, fros - trnsl, speckl wi mica, tr dk gn xl glau, f-vfg, hd, brit clus, sb ang - ang, v calc cmt  
SHY SS: lt gy, lt gy brn, fros ip, s&p ip, vfg, hd, brit clus, sb ang - sb rd, calc cmt

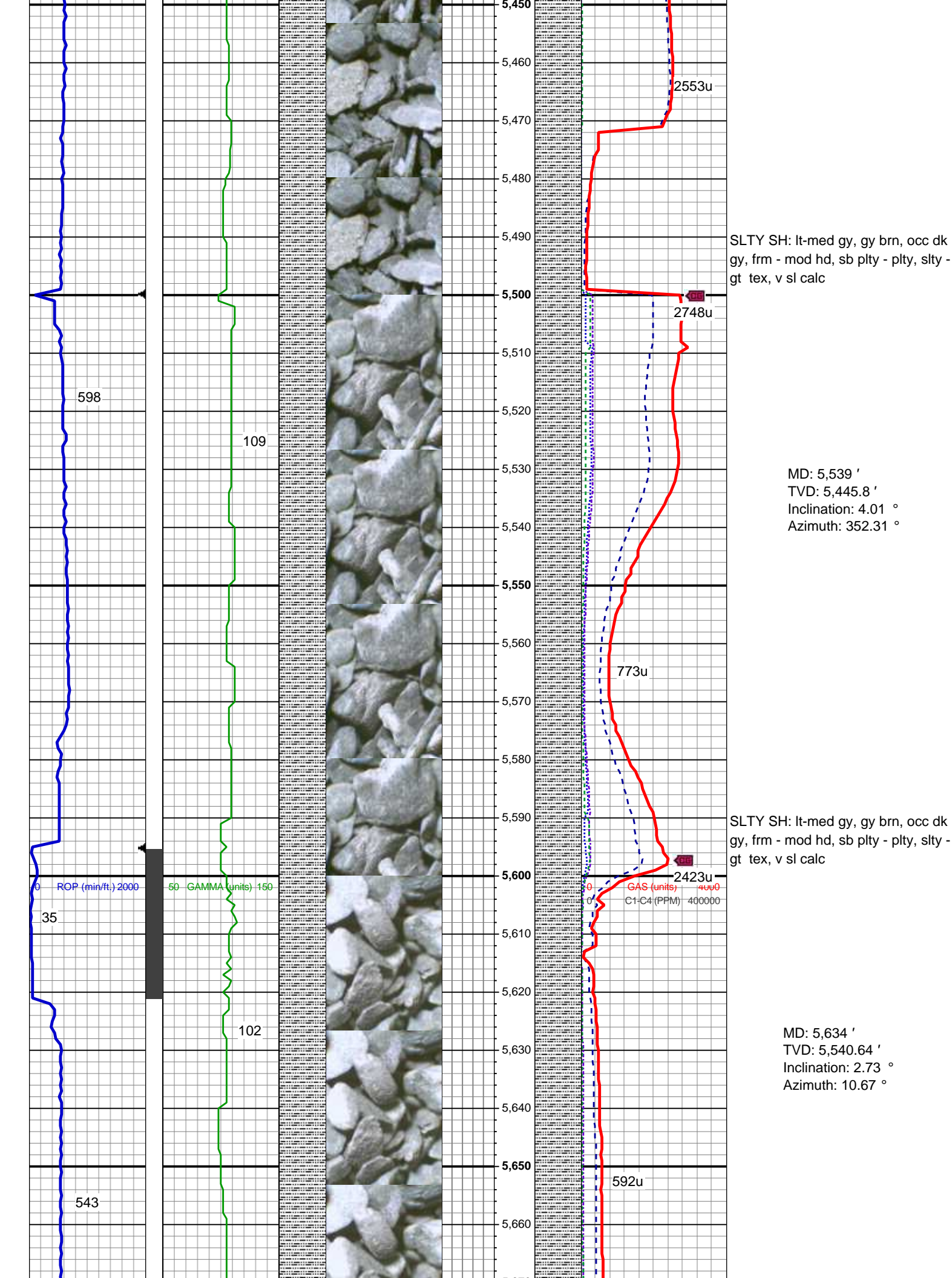
MD: 5,159 '  
TVD: 5,068.48 '  
Inclination: 10.17 °  
Azimuth: 345.68 °

SLTY SH: lt-med gy, occ dk gy, frm - mod hd, sb plty - plty, slty - gt tex, v sl calc  
SHY SS: lt gy, lt gy brn, fros ip, s&p ip, vfg, hd, brit clus, sb ang - sb rd, calc cmt  
SHY SLTST: pred lt gy, sme medgy, hd, brit, sb rd - sb plty - sb blk, slty - grty tex, v sl calc

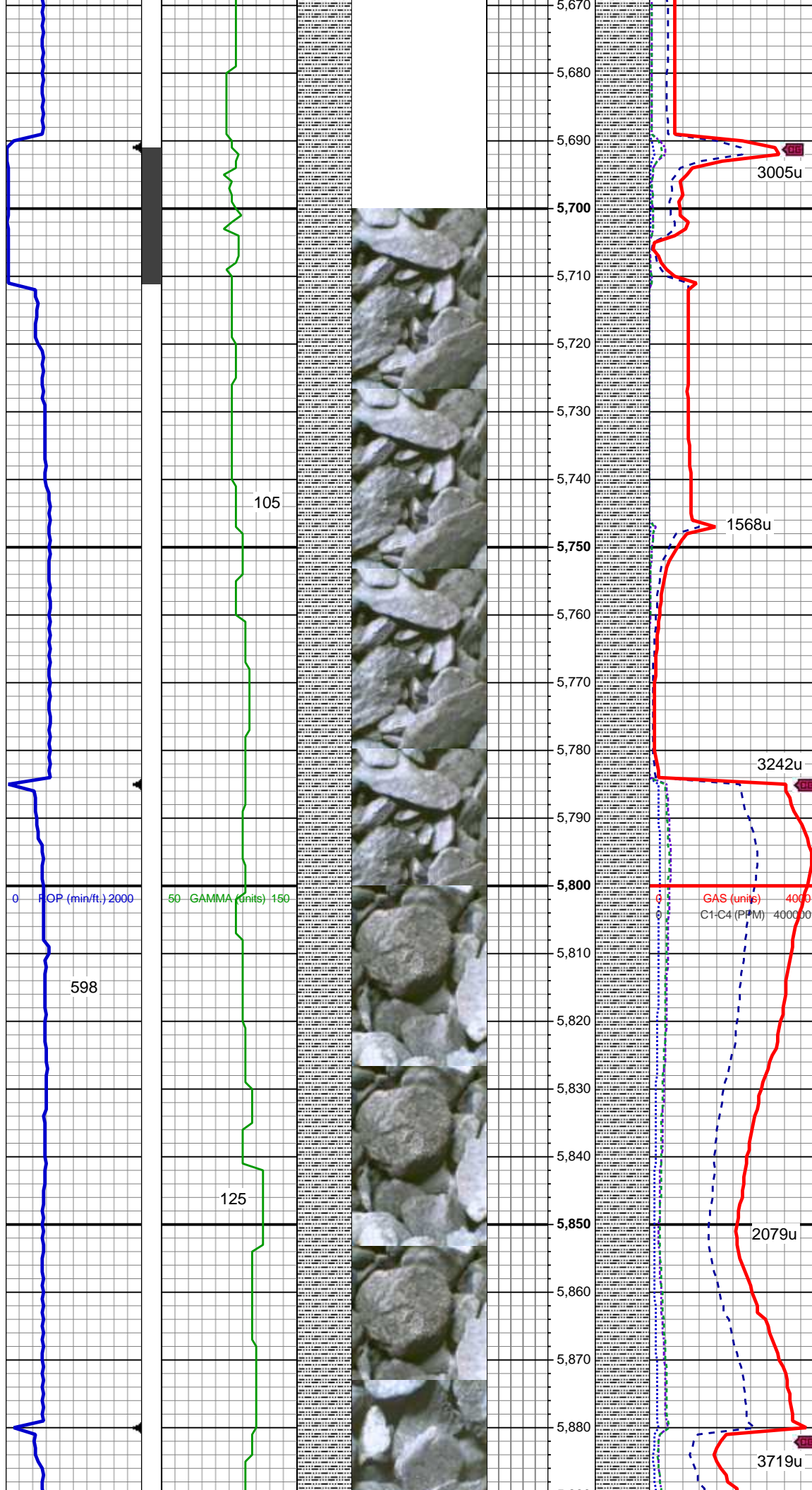
GAS (units) 4000  
C1-C4 (PPM) 400000









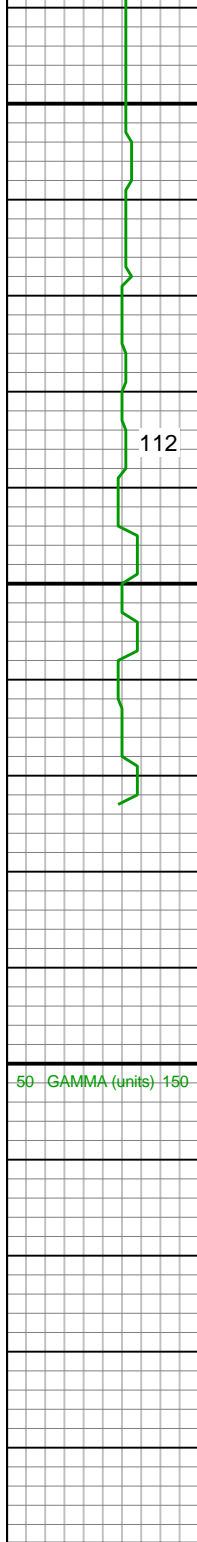
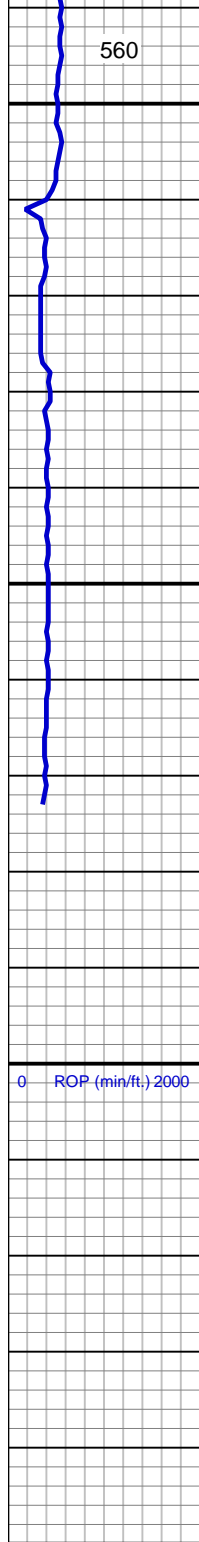


SLTY SH: lt-med gy, gy brn, occ dk  
gy, frm - mod hd, sb plty - plty, slty -  
gt tex, v sl calc

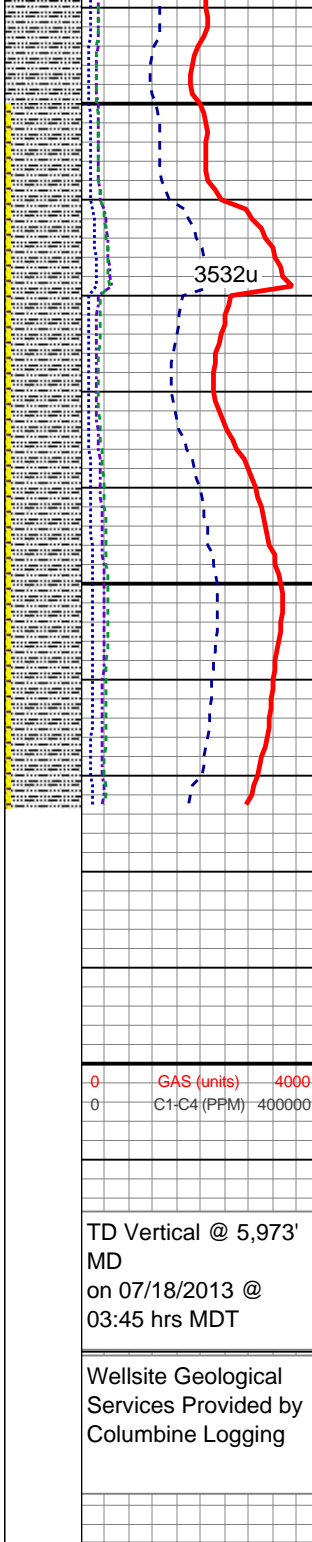
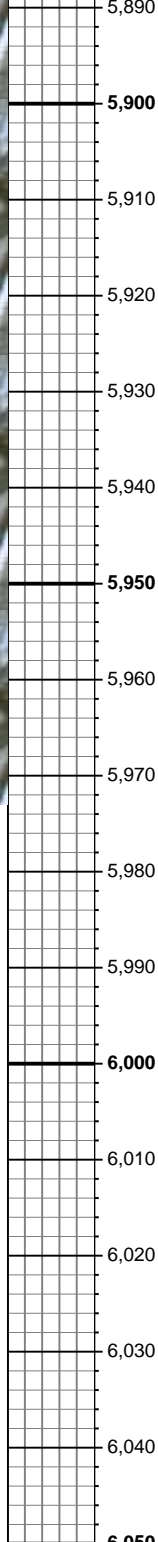
MD: 5,728 '  
TVD: 5,634.59 '  
Inclination: 1.02 °  
Azimuth: 32.26 °

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

07/18/2013  
Mud Wt: 9.3  
FVis: 33  
PVis: 6  
YP: 3  
GELS: 4/6/10  
API Filt: 16.0  
CAKE: 1/0  
pH: 9.2  
Cl: 2,000  
Ca: 120



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



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

MUD WT: 9.20/9.10  
VIS: 34/32 IN/OUT

MD: 5,918 '  
TVD: 5,824.57 '  
Inclination: 0.85 °  
Azimuth: 324.16 °

Teepee Buttes @  
5,919' MD; 5,825' TVD

MD: 5,973 '  
TVD: 5,881.56 '  
Inclination: 0.85 °  
Azimuth: 324.16 °

SLTY SH: lt-med gy, occ dk gy, frm - mod hd, sb plty - plty, slty - gt tex, v sl calc

SHY SS: lt gy, lt gy brn, fros ip, s&p ip, vfg, hd, brit clus, sb ang - sb rd, calc cmt

0 GAS (units) 4000  
0 C1-C4 (PPM) 400000

TD Vertical @ 5,973'  
MD  
on 07/18/2013 @  
03:45 hrs MDT

Wellsite Geological  
Services Provided by  
Columbine Logging

See Corresponding Horizontal Log  
Wolfpack B02-66-1HN HORZ