

# COLUMBINE LOGGING

Scale: 5" / 100'  
Measured Depth Log

**Well Name** Loeffler K1-66-1HN\_VERT

**Location** SEC. 1, T4N, R66W

**State** COLORADO

**County** WELD

**Country** USA

**Rig Number** PRECISION 829

**API Number** 05-123-35834

**Region** DJ BASIN

**Field** WATTENBERG

**Spud Date** 10/18/2013

**Drilling Completed** 10/31/2013

**Surface Coordinates** 1650' FNL x 333' FWL

**Bottom Hole Coordinates** 2310' FNL x 535' FEL

**Ground Elevation** 4666'

**K.B. Elevation** 4682'

**Logged Interval** 639' To 6318'

**Total Depth** 6318'

**Formation** PIERRE SHALE

**Type of Drilling Fluid** LSND

## Operator

**Company** Noble Energy, Inc.

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

## Geologist

**Name** Holly Duncan

**Company** Noble Energy, Inc.

**Address** 1625 BROADWAY, SUITE 2200  
DENVER, COLORADO 80202  
303.389.3600

## Other

## Rock Types

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

## Accessories

## Fossils

ALGAE  
 AMPHIPORA  
 BELEMNITE  
 BIOHERM  
 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  
 CHERT  
 CHERT  
 COAL - THIN BEDS  
 DOLOMITIC  
 FELDSPAR  
 FERRUGINOUS PELLET  
 FERRUGINOUS  
 GLAUCONITE  
 GYPSIFEROUS

HEAVY MINERAL  
 KAOLIN  
 MARLSTONE  
 MICACEOUS  
 MINERAL CRYSTALS  
 NODULES  
 PHOSPHATE PELLETS  
 PYRITE  
 SALT CAST  
 SANDY  
 SILICEOUS  
 SILTY  
 TUFFACEOUS

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

## Stringer

## Other Symbols

## Oil Show

DEAD  
 EVEN  
 QUESTIONABLE  
 SPOTTED STAINING

## Porosity

EARTHY  
 FENESTRAL  
 FRACTURE  
 INTERCRYSTALLINE  
 INTEROOLITIC  
 MOLDIC

ORGANIC  
 PINPOINT  
 VUGGY

## Engineering

BIT CHANGE  
 CONNECTION (LEFT)  
 CONNECTION (RIGHT)  
 CONNECTION GAS  
 TRIP GAS  
 DOWN TIME GAS  
 CORE - LOST  
 CORE - RECOVERED  
 DST INTERVAL

FAULT  
 FORMATION TOP  
 GAS SHOW  
 OIL SHOW  
 MN DEPTH  
 MN DEPTH (RIGHT)  
 NORMAL FAULT  
 OVERTURNED STRATA  
 REVERSE FAULT  
 CASING  
 SIDEWALL CORE (LEFT)  
 SIDEWALL CORE (RIGHT)  
 SLIDE  
 SURVEY

DRILL STEM TEST  
 WIRELINE TESTED - LEFT  
 WIRELINE TESTED - RT

## Rounding

ANGULAR  
 ROUNDED  
 SUBANG  
 SUBRND

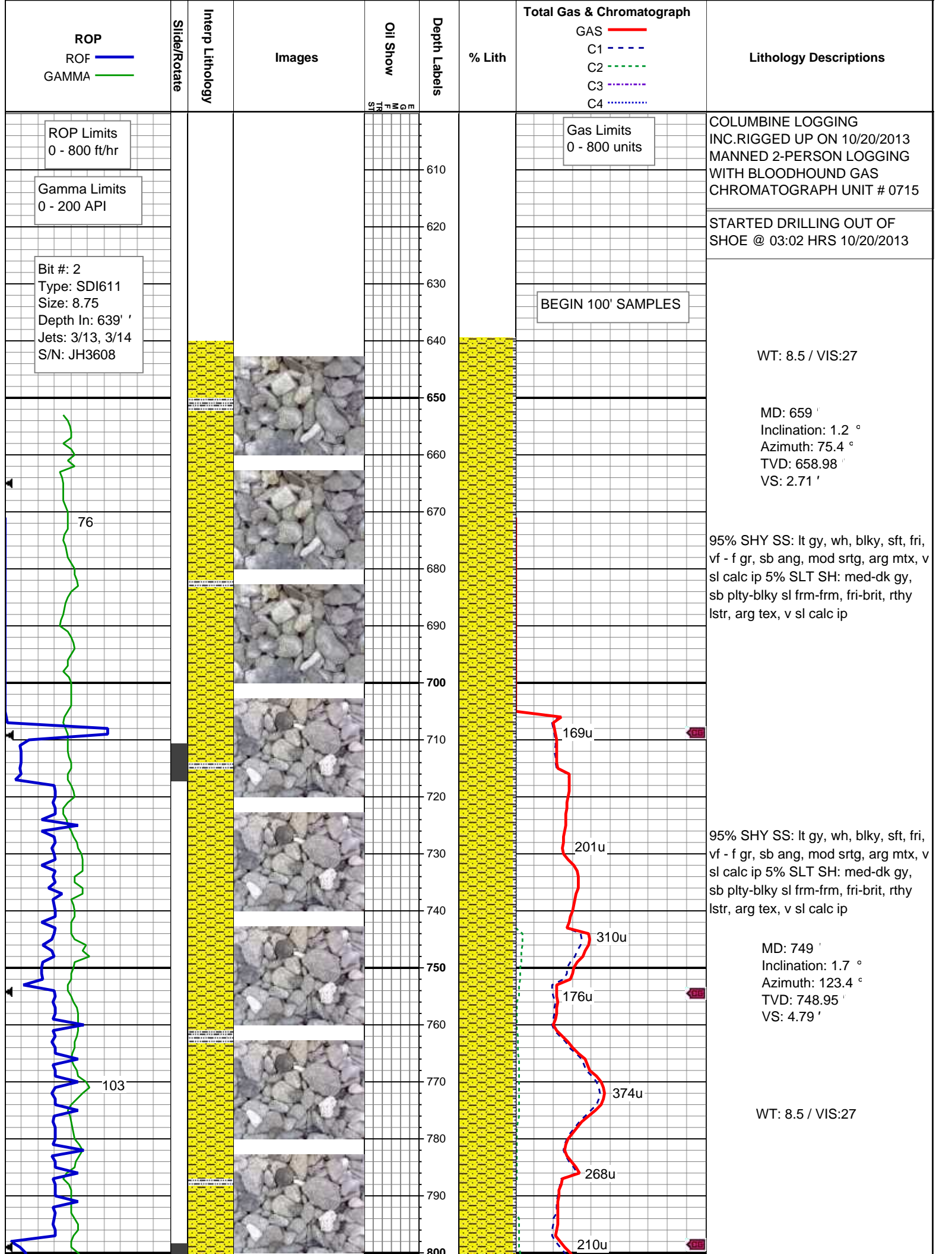
## Textures

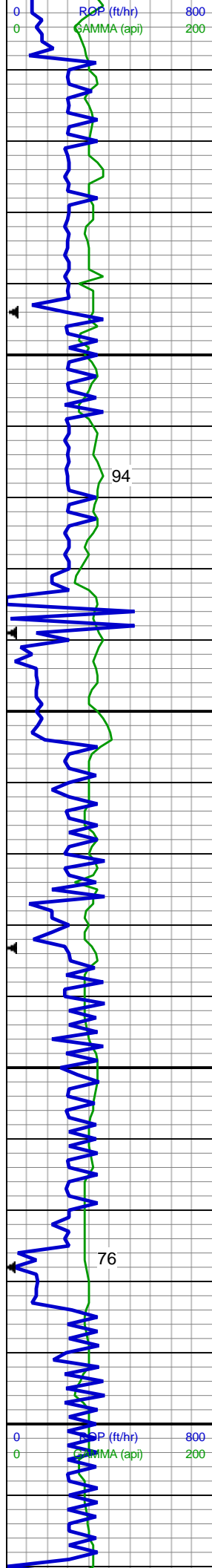
BOUNDSTONE  
 CHALKY  
 CRYPTOXLN

EARTHY  
 FINELYXLN  
 GRAINSTONE  
 LITHOGRAPHIC  
 MICROXLN  
 MUDSTONE  
 PACKSTONE  
 WACKESTONE

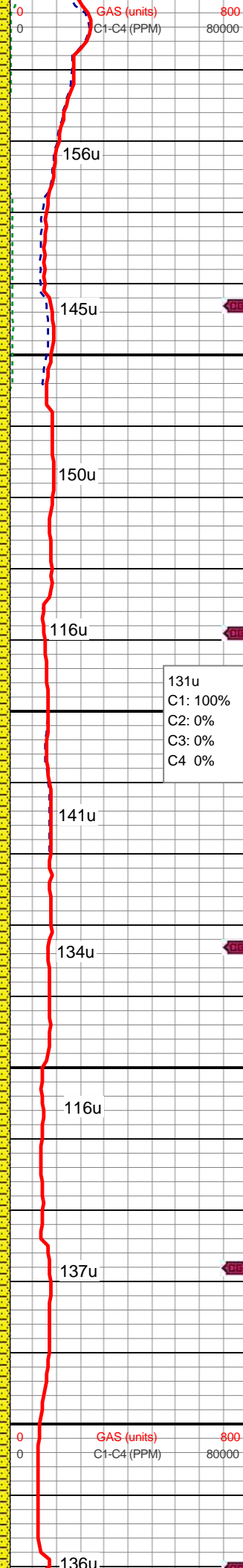
## Sorting

MODERATE  
 POOR  
 WELL





800  
810  
820  
830  
840  
850  
860  
870  
880  
890  
900  
910  
920  
930  
940  
950  
960  
970  
980  
990  
1,000  
1,010  
1,020



MD: 839 '  
Inclination: 2.8 °  
Azimuth: 169.9 °  
TVD: 838.89 '  
VS: 6.66 '

100% SHY SS: wh, lt gy, blk, sft, fri,  
vf - f gr, sb ang, p-mod srtg, arg mtx,  
tr glau, v sl calc ip

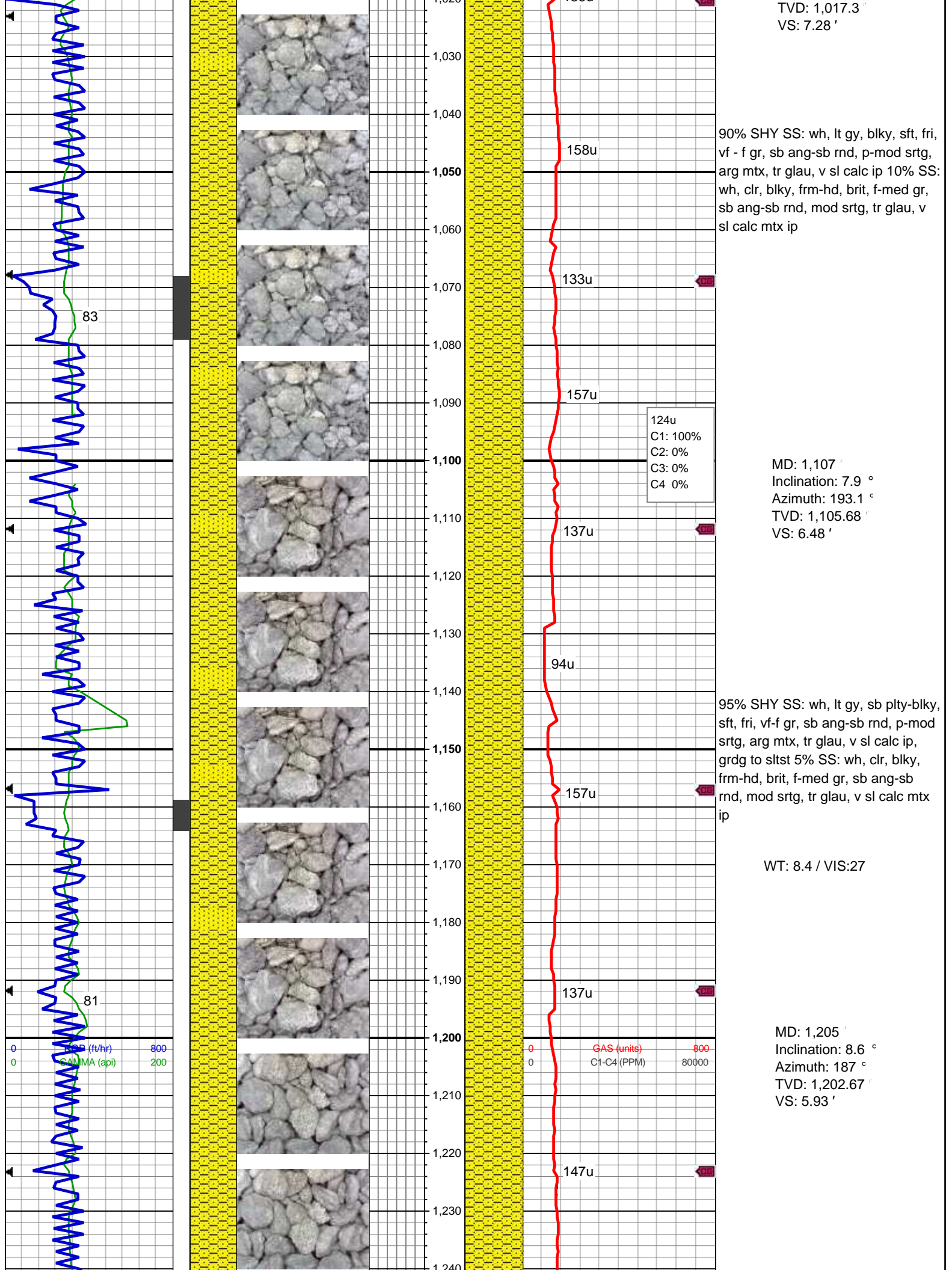
MD: 928 '  
Inclination: 5 °  
Azimuth: 186.3 °  
TVD: 927.68 '  
VS: 7.42 '

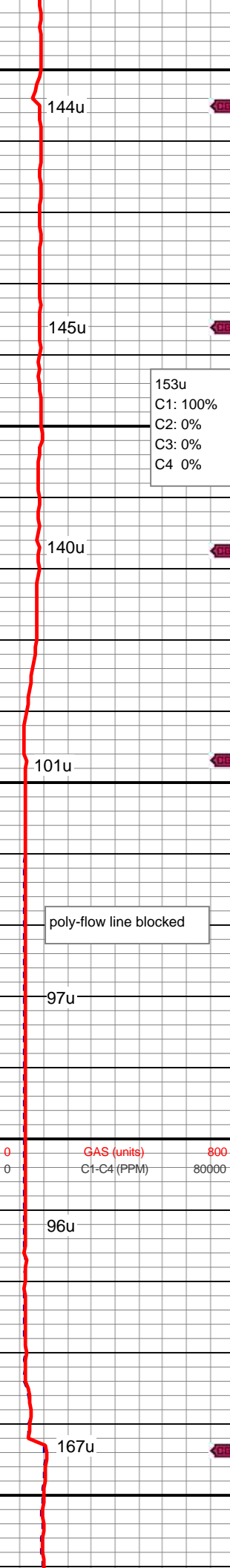
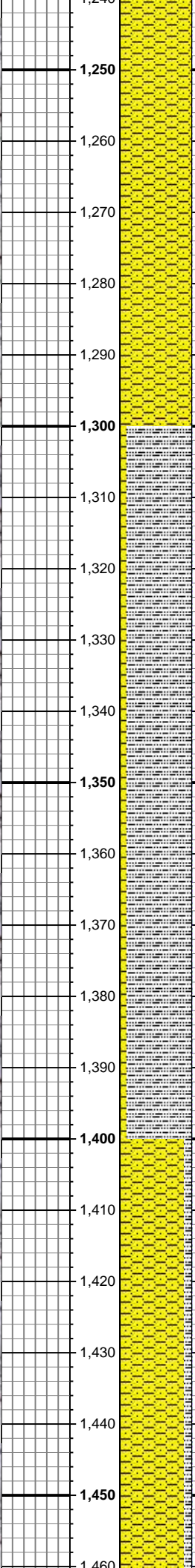
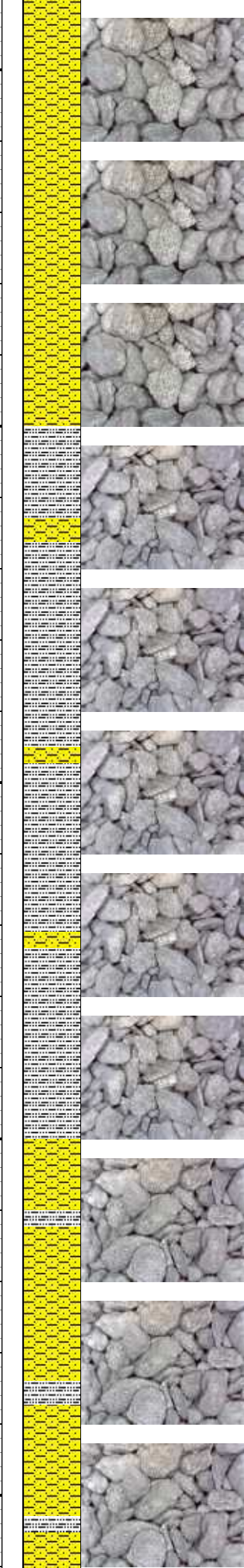
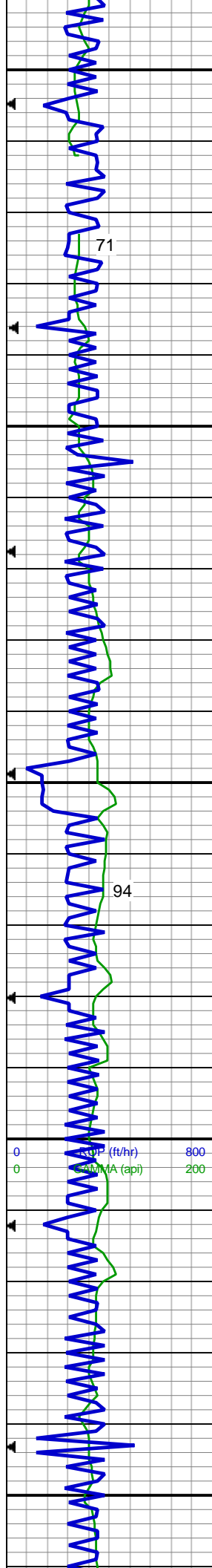
100% SHY SS: wh, lt gy, blk, sft, fri,  
vf - f gr, sb ang-sb rnd, p-mod srtg,  
arg mtx, tr glau, v sl calc ip

WT: 8.4 / VIS:27

MD: 1,018 '  
Inclination: 5.5 °  
Azimuth: 190.7 °







100% SHY SS: wh, lt gy, blkly, sft-sl frm, fri, vf - f gr, sb ang-sb rnd, p-mod srtg, arg mtx, tr glau, v sl calc ip

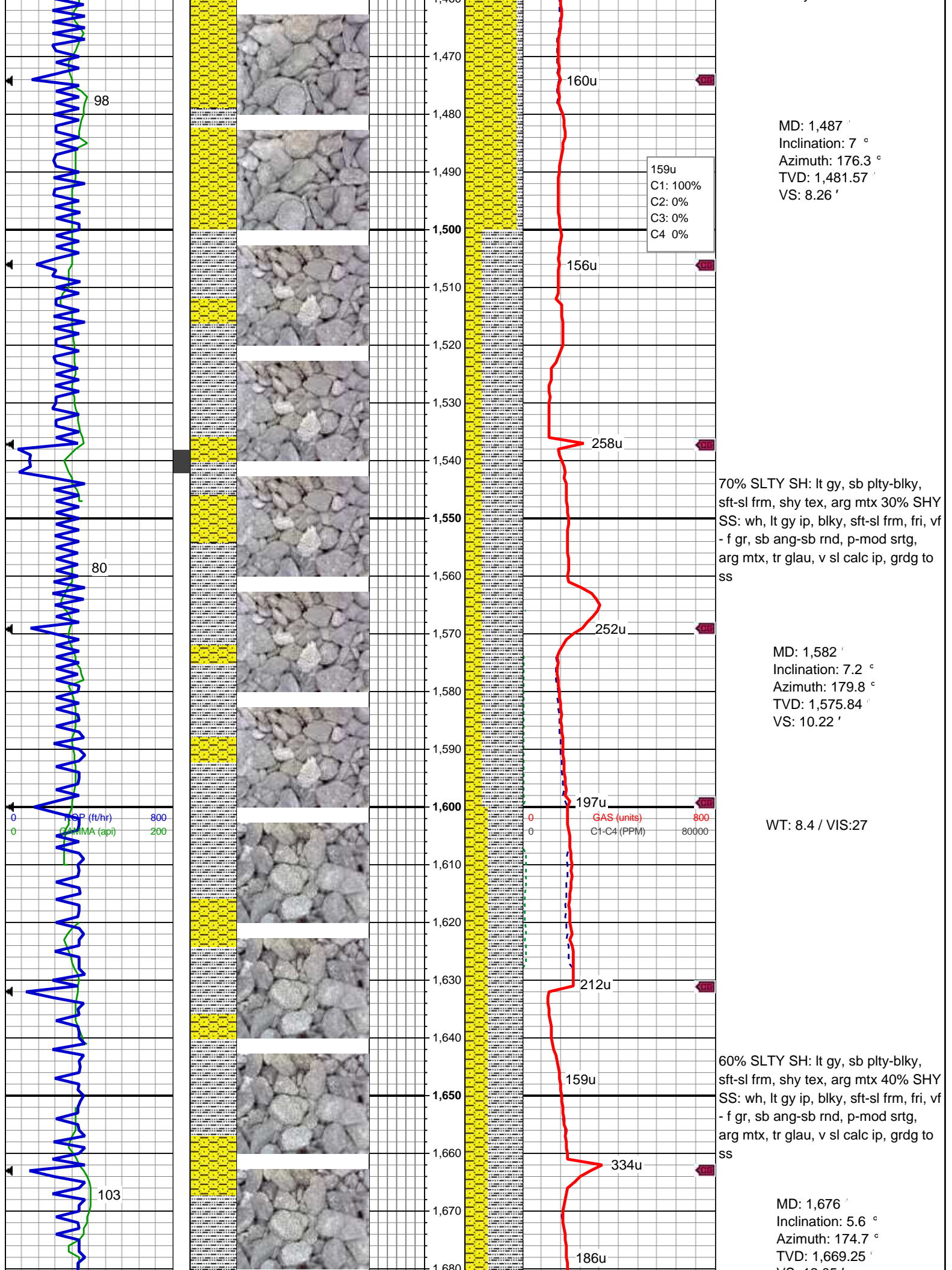
MD: 1,299 '  
Inclination: 9 °  
Azimuth: 190.7 °  
TVD: 1,295.57 '  
VS: 5.62 '

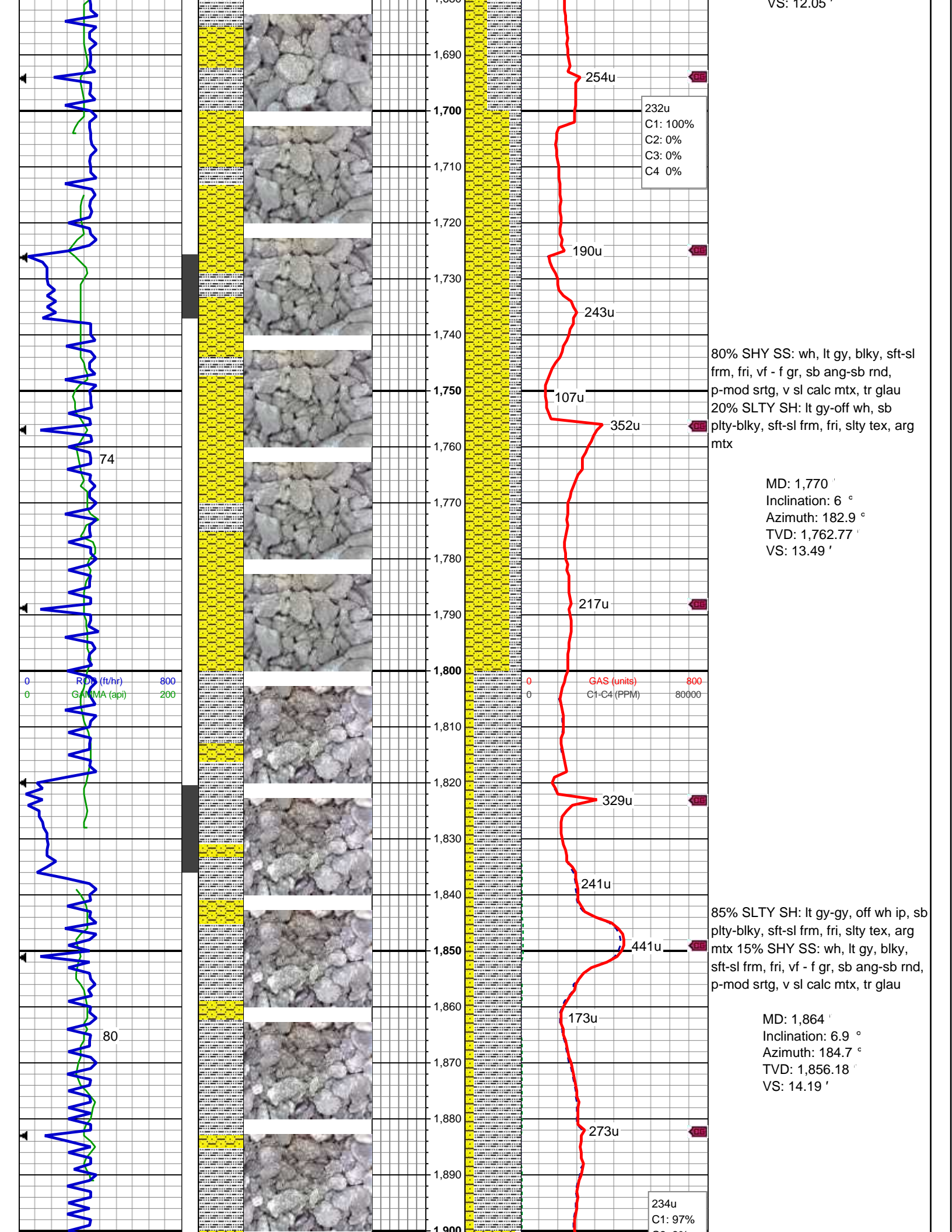
90% SLTY SH: lt gy, sb plty-blky, sft-sl frm, shy tex, arg mtx 10% SHY SS: wh, lt gy, blkly, sft-sl frm, fri, vf - f gr, sb ang-sb rnd, p-mod srtg, arg mtx, tr glau, v sl calc ip, intbdd wi slty sh

MD: 1,393 '  
Inclination: 8.7 °  
Azimuth: 180 °  
TVD: 1,388.45 '  
VS: 6.18 '

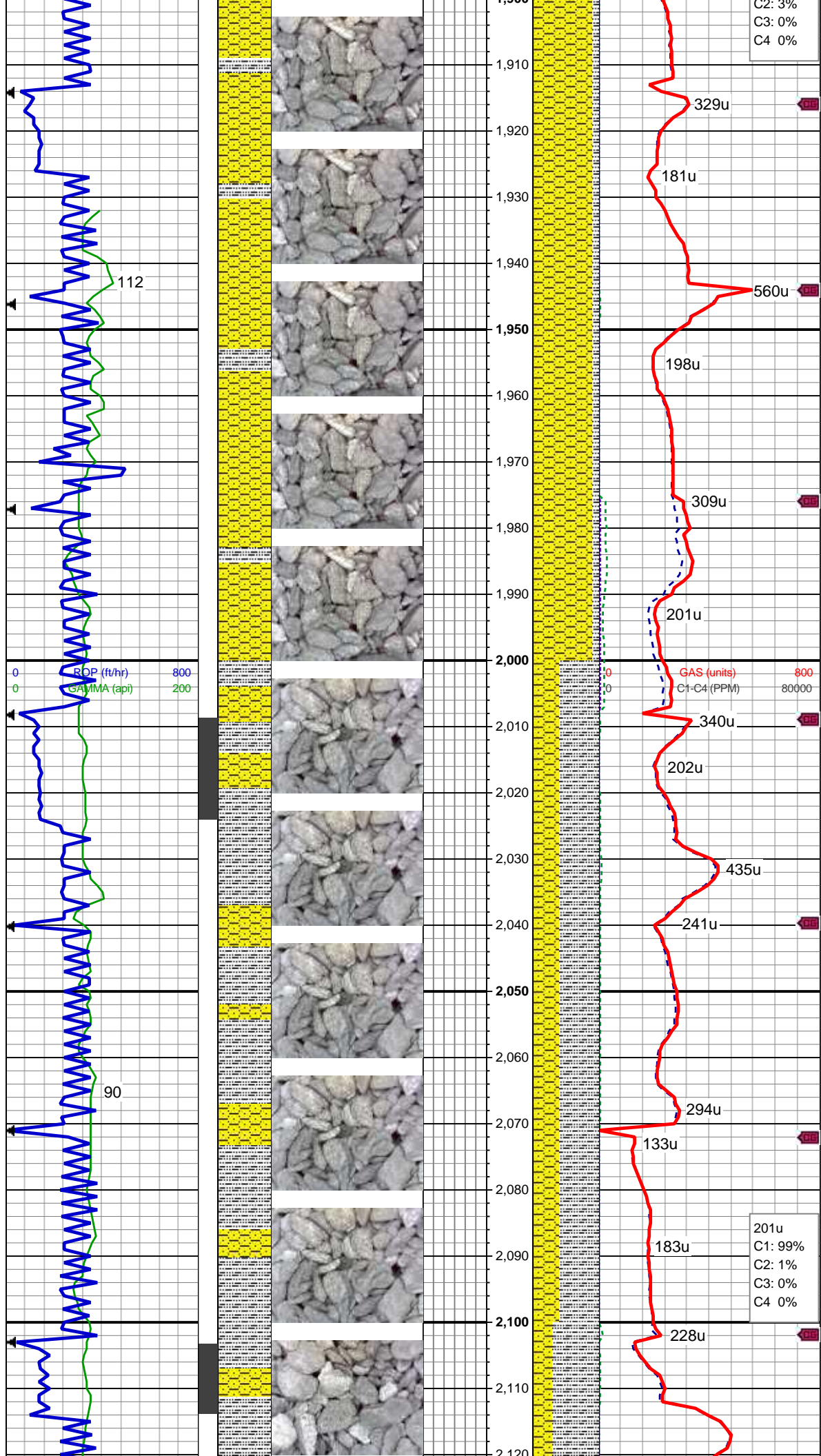
90% SHY SS: wh, lt gy, blkly, sft-sl frm, fri, vf - f gr, sb ang-sb rnd, p-mod srtg, arg mtx, tr glau, v sl calc ip 10% SLTY SH: lt gy, sb plty-blky, sft-sl frm, shy tex, arg mtx, intbdd with shy ss











90% SHY SS: wh, lt gy, op grs, blkly, sft-sl frm, fri, vf - f gr, sb ang-sb rnd, p-mod srtg, v sl calc mtx, tr glau, grdg to ss 10% SLTY SH: lt gy, off wh, sb plty-blky, sft-sl frm, fri, slty tex, arg mtx

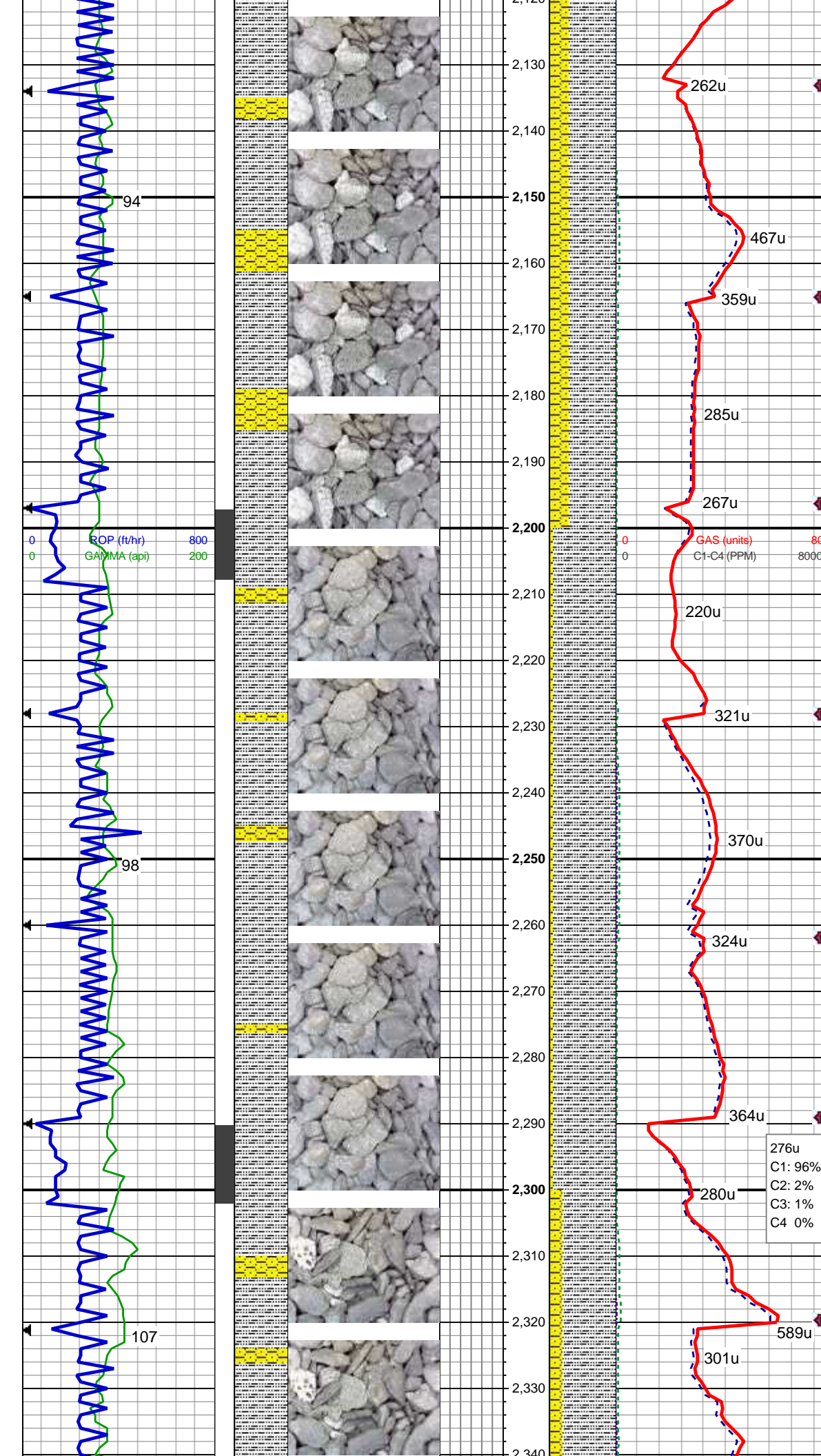
MD: 1,958 '  
Inclination: 7.1 °  
Azimuth: 181.2 °  
TVD: 1,949.48 '  
VS: 15.14 '

60% SLTY SH: lt gy, lt bnshgy, off wh, sb plty-blky, sft-sl frm, fri, slty tex, arg mtx 40% SHY SS: wh, lt gy, op grs ip, blkly, sft-sl frm, fri, vf - f gr, sb ang-sb rnd, p-mod srtg, v sl calc mtx, tr glau, grdg to ss ip

MD: 2,053 '  
Inclination: 8.1 °  
Azimuth: 182.4 °  
TVD: 2,043.64 '  
VS: 16.41 '

WT: 8.4 / VIS:27

70% SLTY SH: lt gy, lt bnshgy, off wh, sb plty-blky, sft-sl frm, fri, slty



tex, arg mtx 30% SHY SS: wh, lt gy,  
op grs ip, blkly, sft-sl frm, fri, vf - f gr,  
sb ang-sb rnd, p-mod srtg, v sl calc  
mtx, tr glau, grdg to ss ip, intbdd wi  
slyt sh

MD: 2,147 '  
Inclination: 8.3 °  
Azimuth: 173.8 °  
TVD: 2,136.68 '  
VS: 18.65 '

WT: 8.4 / VIS:27

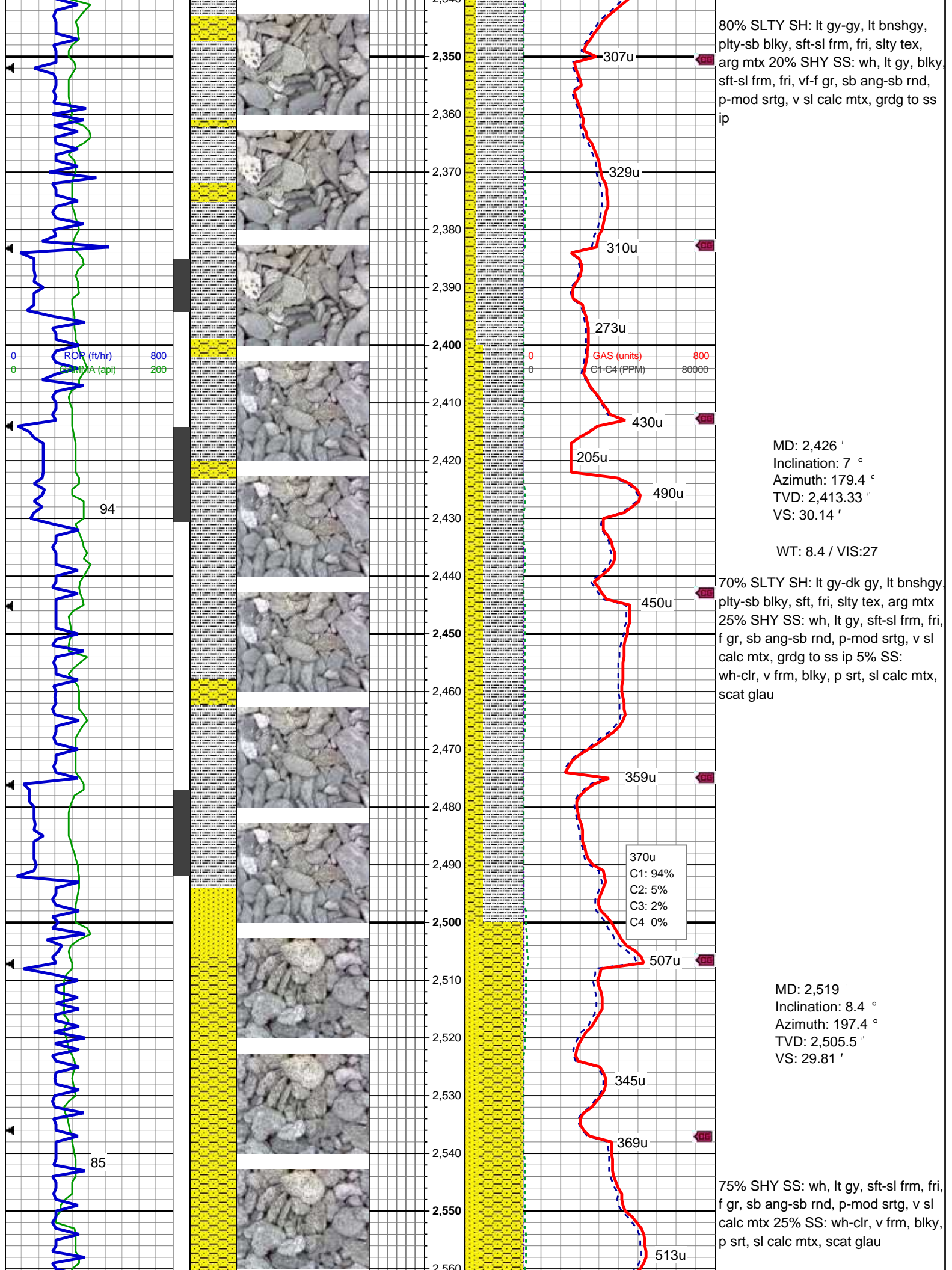
MD: 2,240 '  
Inclination: 7.9 °  
Azimuth: 164.3 °  
TVD: 2,228.76 '  
VS: 22.79 '

95% SLTY SH: lt gy-gy, lt bnshgy,  
sb plty-blky, occ plty, sft-sl frm, fri,  
slyt tex, arg mtx 5% SHY SS: wh, lt  
gy, blkly, sft-sl frm, fri, vf - f gr, sb  
ang-sb rnd, p-mod srtg, v sl calc  
mtx

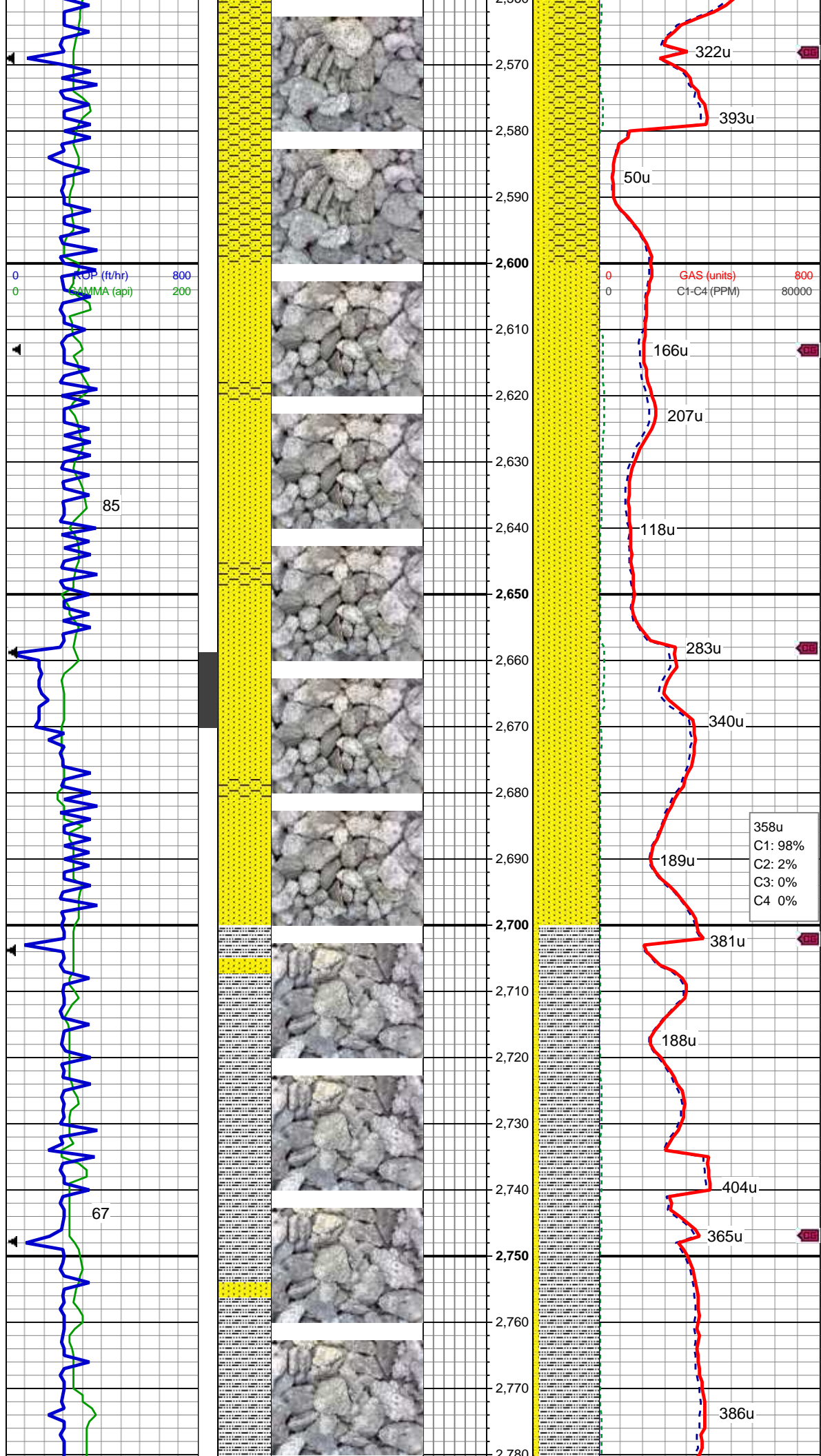
276u  
C1: 96%  
C2: 2%  
C3: 1%  
C4: 0%

MD: 2,333 '  
Inclination: 6.8 °  
Azimuth: 166.4 °  
TVD: 2,321 '  
VS: 27.33 '









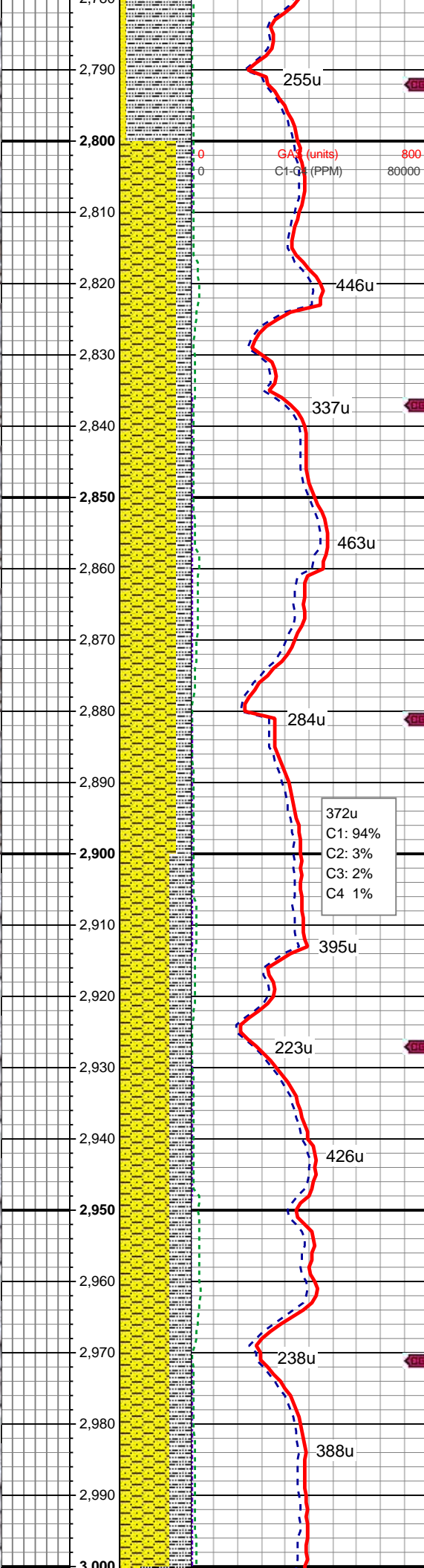
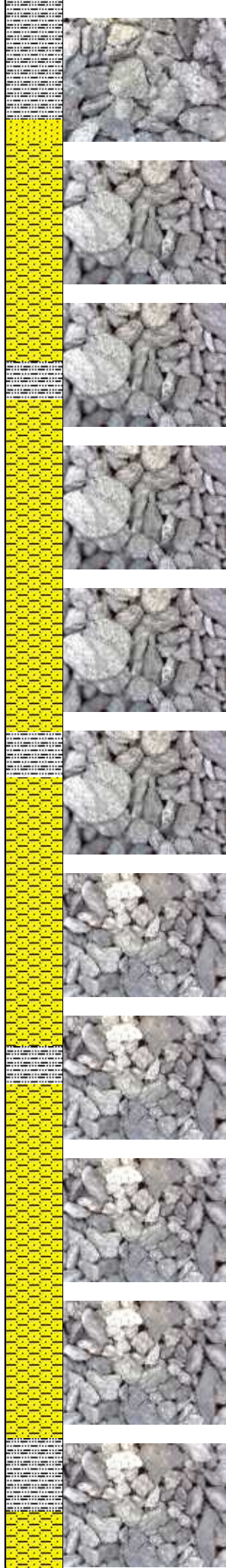
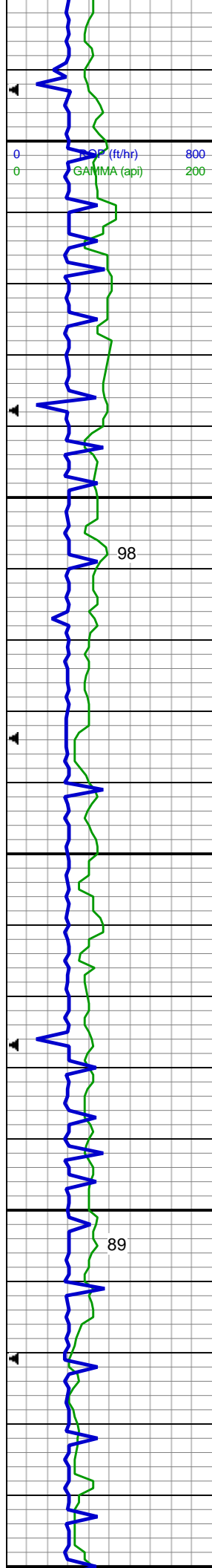
WT: 8.4 / VIS:27

MD: 2,608 '  
Inclination: 8.9 °  
Azimuth: 197.2 °  
TVD: 2,593.49 '  
VS: 27.57 '

90% SS: wh-clr,lt gy, v frm, blk, p  
srt, sl calc mtx, scat glau 10% SHY  
SS: wh, lt gy, sft-sl frm, fri, f gr, sb  
ang-sb rnd, p-mod srtg, v sl calc  
mtx

MD: 2,698 '  
Inclination: 10.4 °  
Azimuth: 195.4 °  
TVD: 2,682.21 '  
VS: 25.32 '

90% SLTY SH: med-dk gy, sft,  
sbply, arg mtx 10% SS: wh-clr,lt gy,  
v frm, blk, p srt, sl calc mtx, scat  
glau



MD: 2,787 '  
Inclination: 10.4 °  
Azimuth: 194.9 °  
TVD: 2,769.75 '  
VS: 23.23 '

80% SHY SS: lt gy, sft, sb blkly-sb  
ang, p srt, sl calc mtx, scat glau  
20% SLTY SH: med-dk gy, sft, sb  
plty, arg mtx

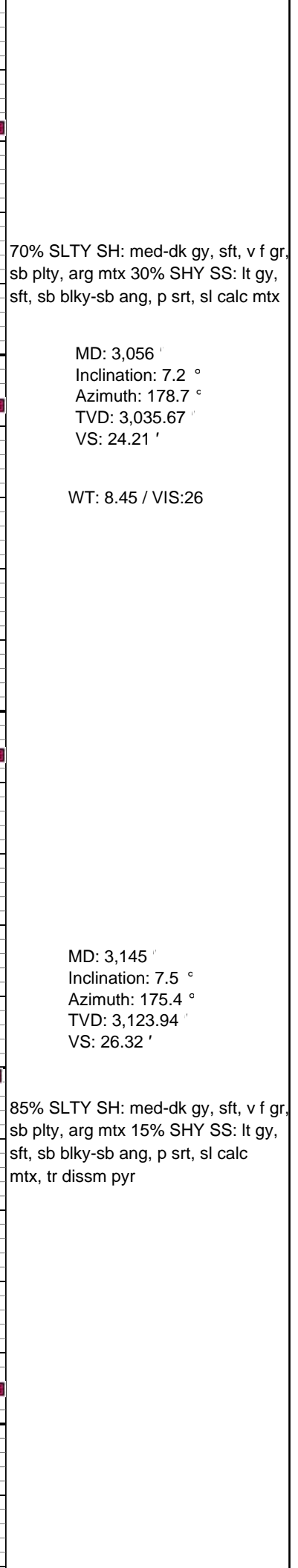
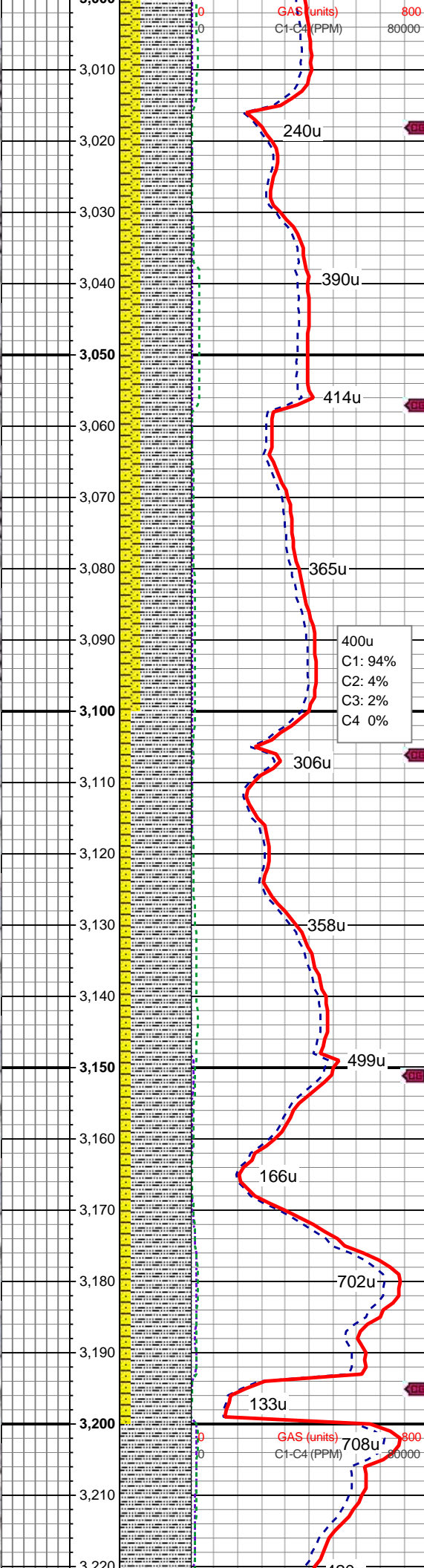
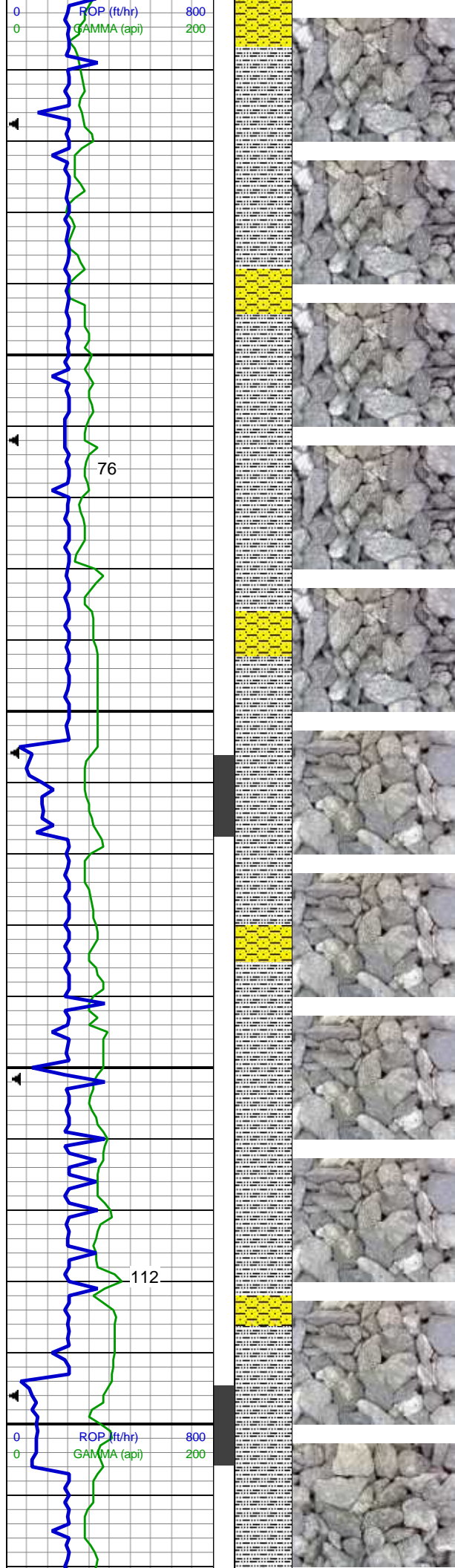
MD: 2,877 '  
Inclination: 9 °  
Azimuth: 187 °  
TVD: 2,858.46 '  
VS: 22.29 '

WT: 8.45 / VIS:26

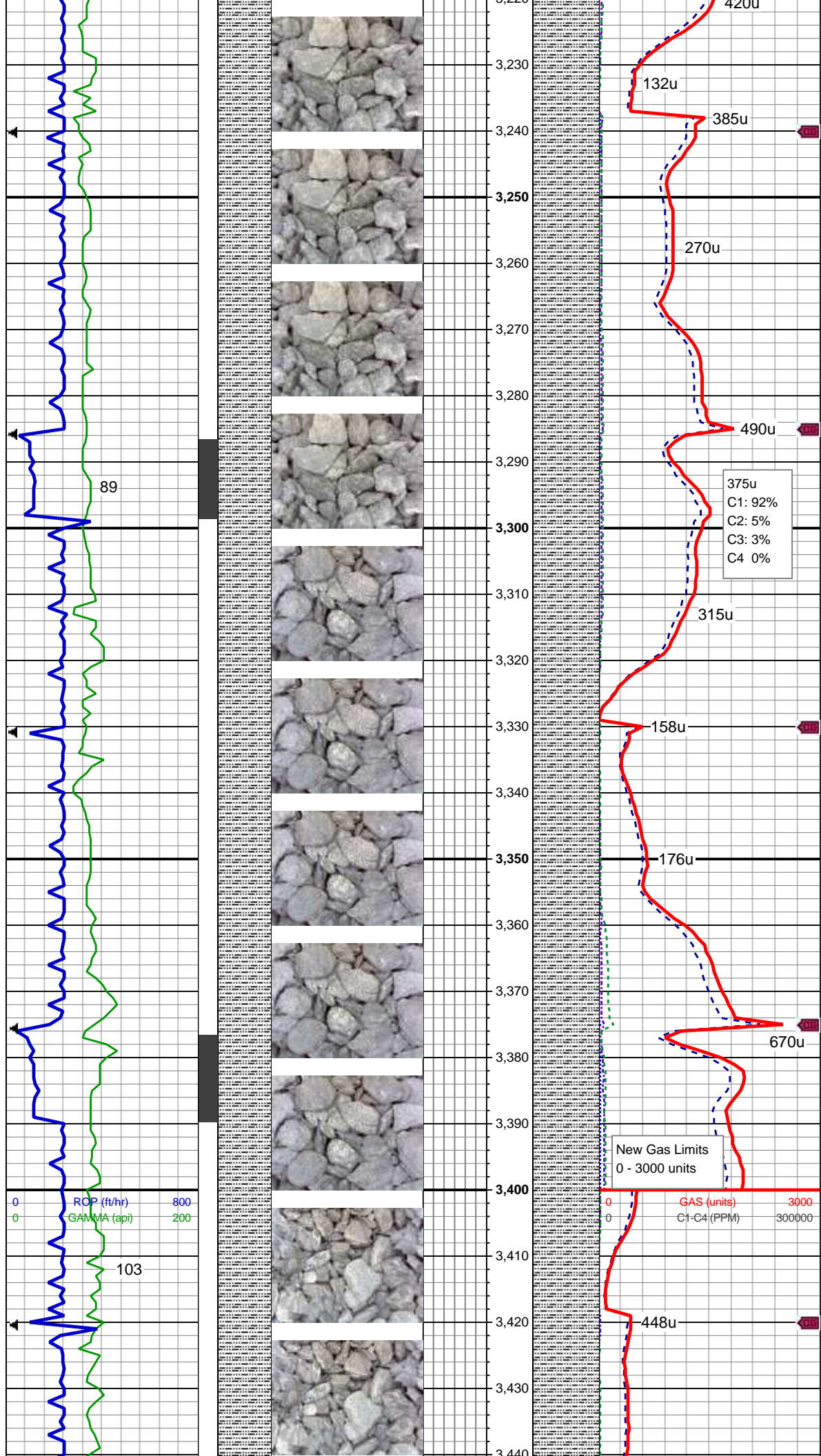
70% SHY SS: lt gy, sft, sb blkly-sb  
ang, p srt, sl calc mtx, scat glau  
30% SLTY SH: med-dk gy, sft, sb  
plty, arg mtx

MD: 2,966 '  
Inclination: 8.1 °  
Azimuth: 183.3 °  
TVD: 2,946.47 '  
VS: 22.85 '









MD: 3,235 '  
Inclination: 7.1 °  
Azimuth: 184.5 °  
TVD: 3,213.22 '  
VS: 27.87 '

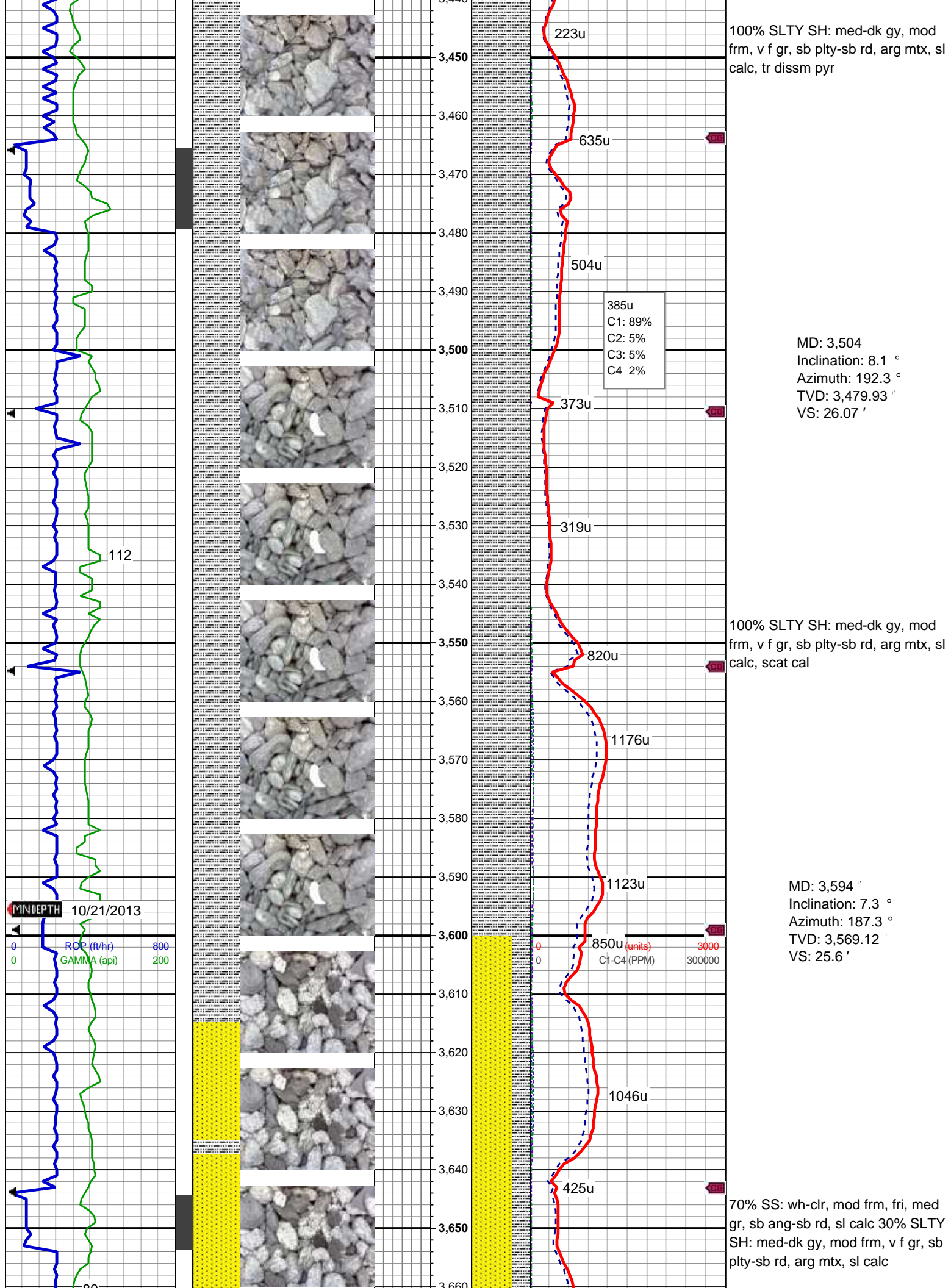
100% SLTY SH: med-dk gy, mod  
frm, v f gr, sb plty-plty, arg mtx, sl  
calc

WT: 8.45 / VIS:26

MD: 3,325 '  
Inclination: 7.3 °  
Azimuth: 188 °  
TVD: 3,302.51 '  
VS: 28.15 '

100% SLTY SH: med-dk gy, mod  
frm, v f gr, sb plty-plty, arg mtx, sl  
calc, tr diss m pyr

MD: 3,414 '  
Inclination: 7.5 °  
Azimuth: 195.2 °  
TVD: 3,390.77 '  
VS: 27.35 '



100% SLTY SH: med-dk gy, mod frm, v f gr, sb plty-sb rd, arg mtx, sl calc, tr dissim pyr

385u  
C1: 89%  
C2: 5%  
C3: 5%  
C4: 2%

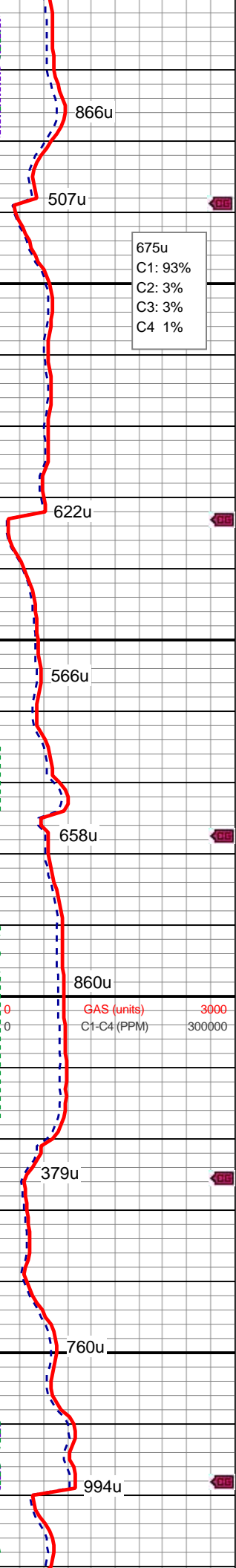
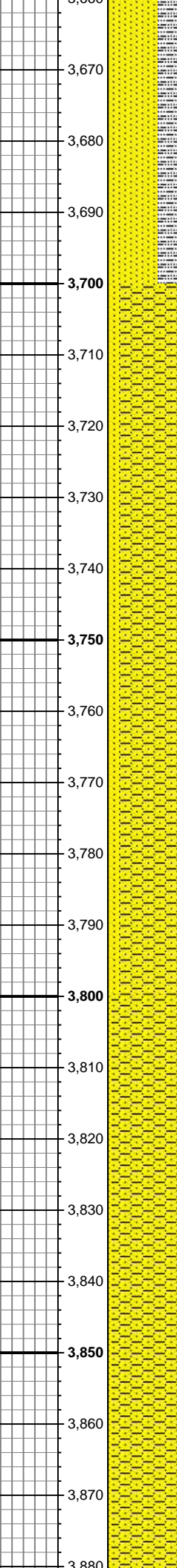
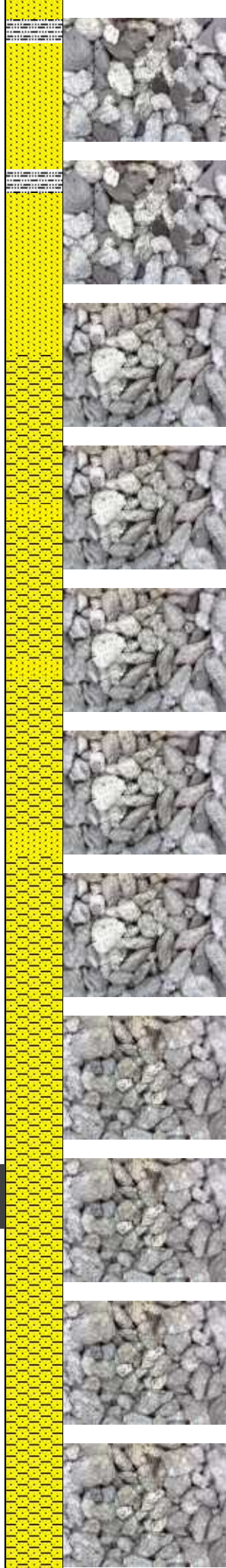
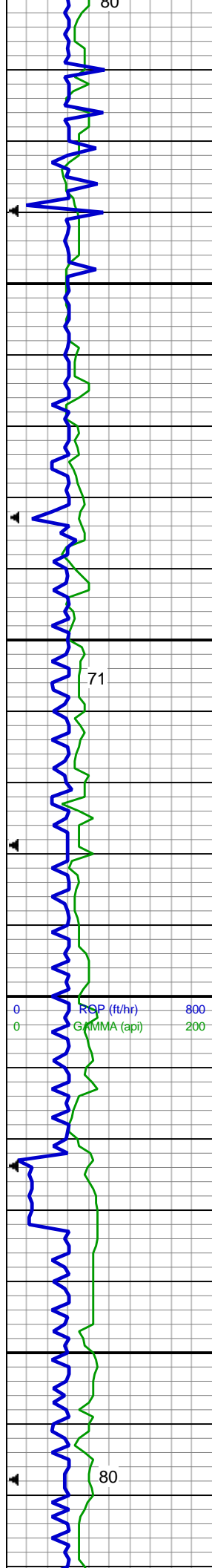
MD: 3,504 '  
Inclination: 8.1 °  
Azimuth: 192.3 °  
TVD: 3,479.93 '  
VS: 26.07 '

100% SLTY SH: med-dk gy, mod frm, v f gr, sb plty-sb rd, arg mtx, sl calc, scat cal

MD: 3,594 '  
Inclination: 7.3 °  
Azimuth: 187.3 °  
TVD: 3,569.12 '  
VS: 25.6 '

70% SS: wh-clr, mod frm, fri, med gr, sb ang-sb rd, sl calc 30% SLTY SH: med-dk gy, mod frm, v f gr, sb plty-sb rd, arg mtx, sl calc





MD: 3,683 '  
Inclination: 9 °  
Azimuth: 186.8 °  
TVD: 3,657.22 '  
VS: 25.74 '

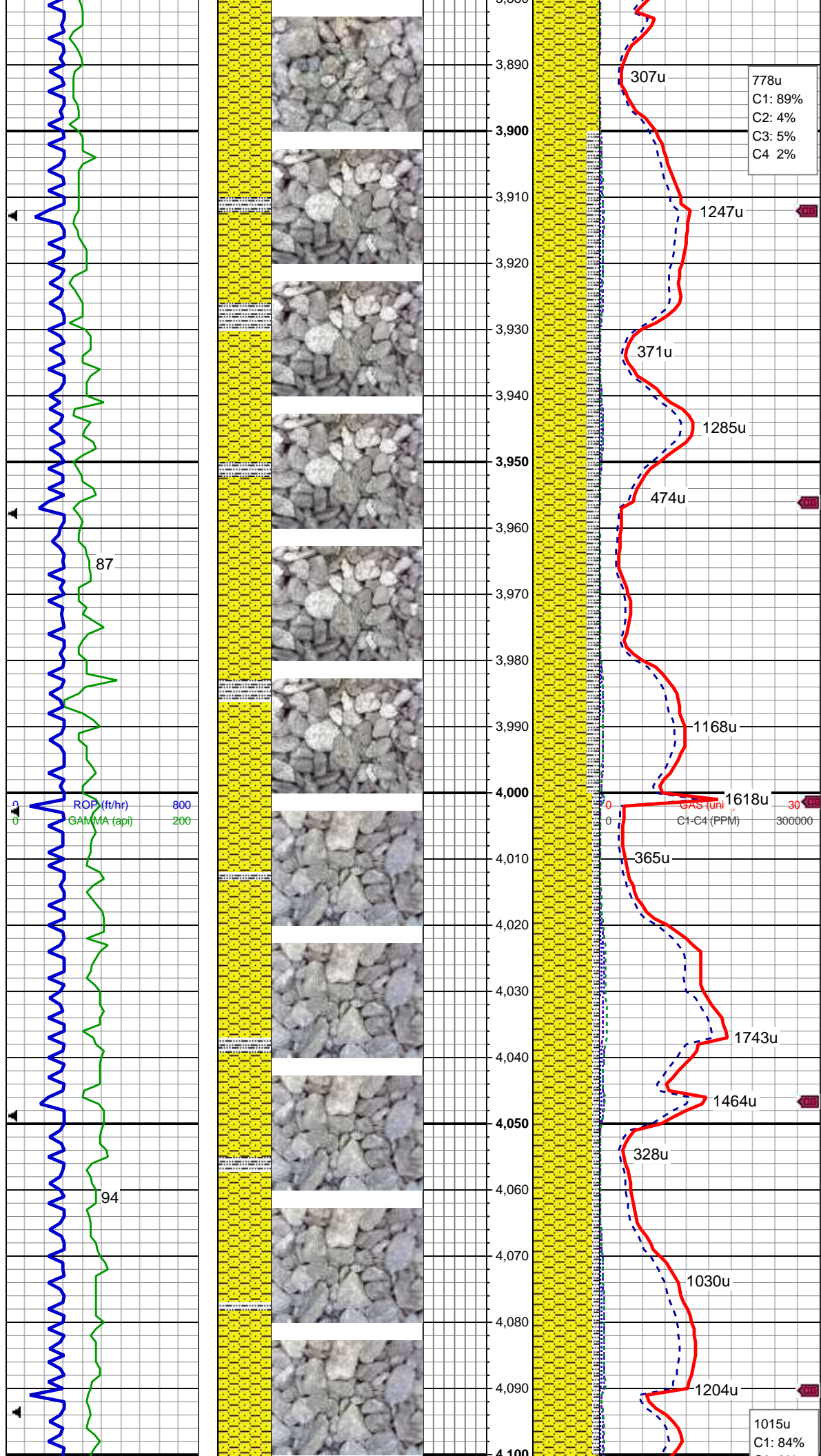
85% SHY SS: lt-med gy, frm, fri, f gr,  
sb blk-y-sb ang, sl calc 15% SS:  
wh-clr, mod frm, fri, med gr, sb  
ang-sb rd, sl calc

MD: 3,773 '  
Inclination: 9.6 °  
Azimuth: 188.4 °  
TVD: 3,746.04 '  
VS: 25.75 '

95% SHY SS: lt-med gy, frm, fri, f gr,  
sb blk-y-sb ang, sl calc 5% SS:  
wh-clr, mod frm, fri, med gr, sb  
ang-sb rd, sl calc

MD: 3,863 '  
Inclination: 8.8 °  
Azimuth: 182.9 °  
TVD: 3,834.88 '  
VS: 26.23 '





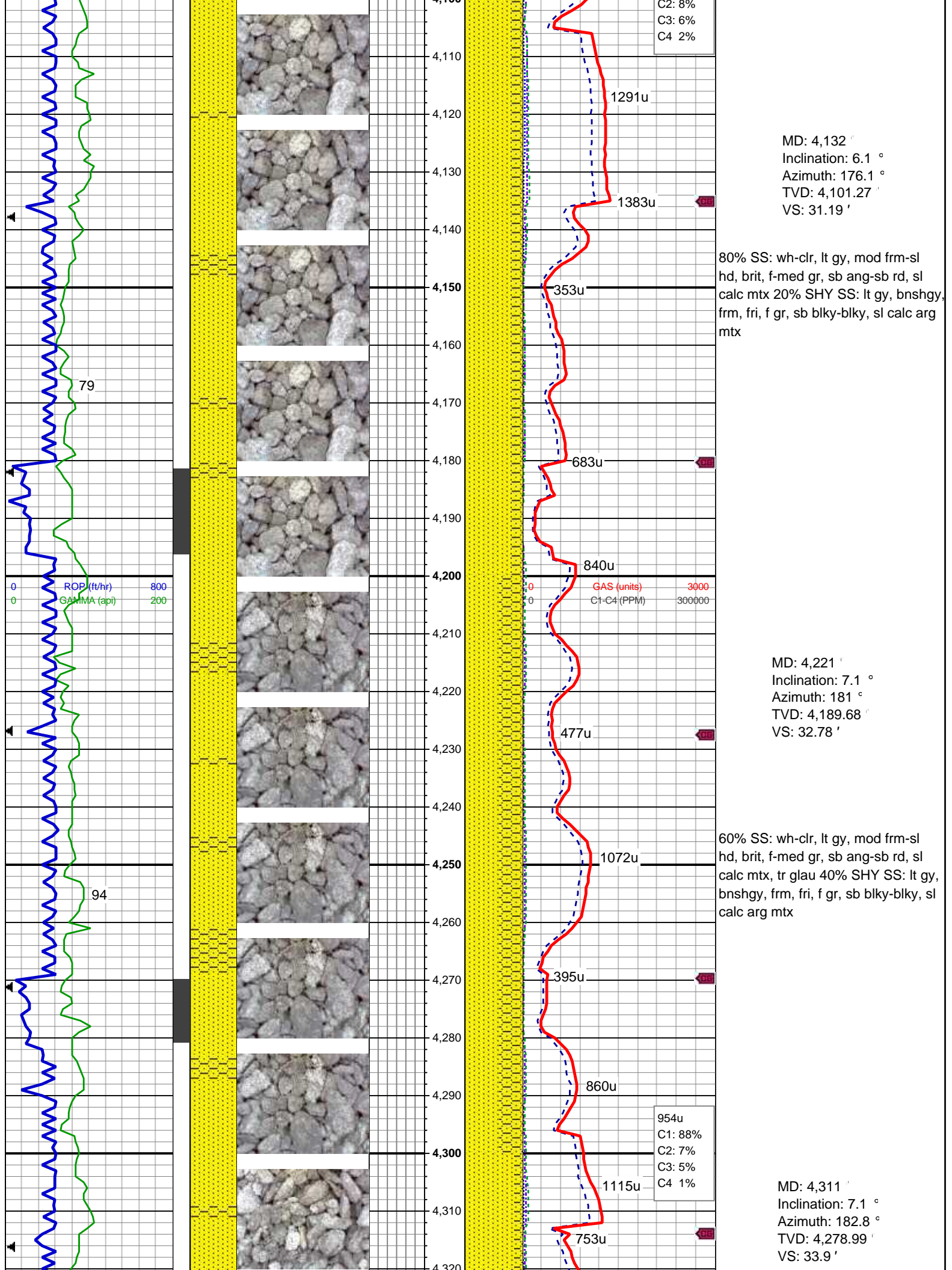
WT: 8.35 / VIS:26

75% SHY SS: lt-med gy, frm, fri, f gr, sb blkgy-sb ang, sl calc 20% SLTY SH: med-dk gy, mod frm, v f gr, sb plty-plty, arg mtx, sl calc 5% SS: wh-clr, mod frm, fri, med gr, sb ang-sb rd, sl calc

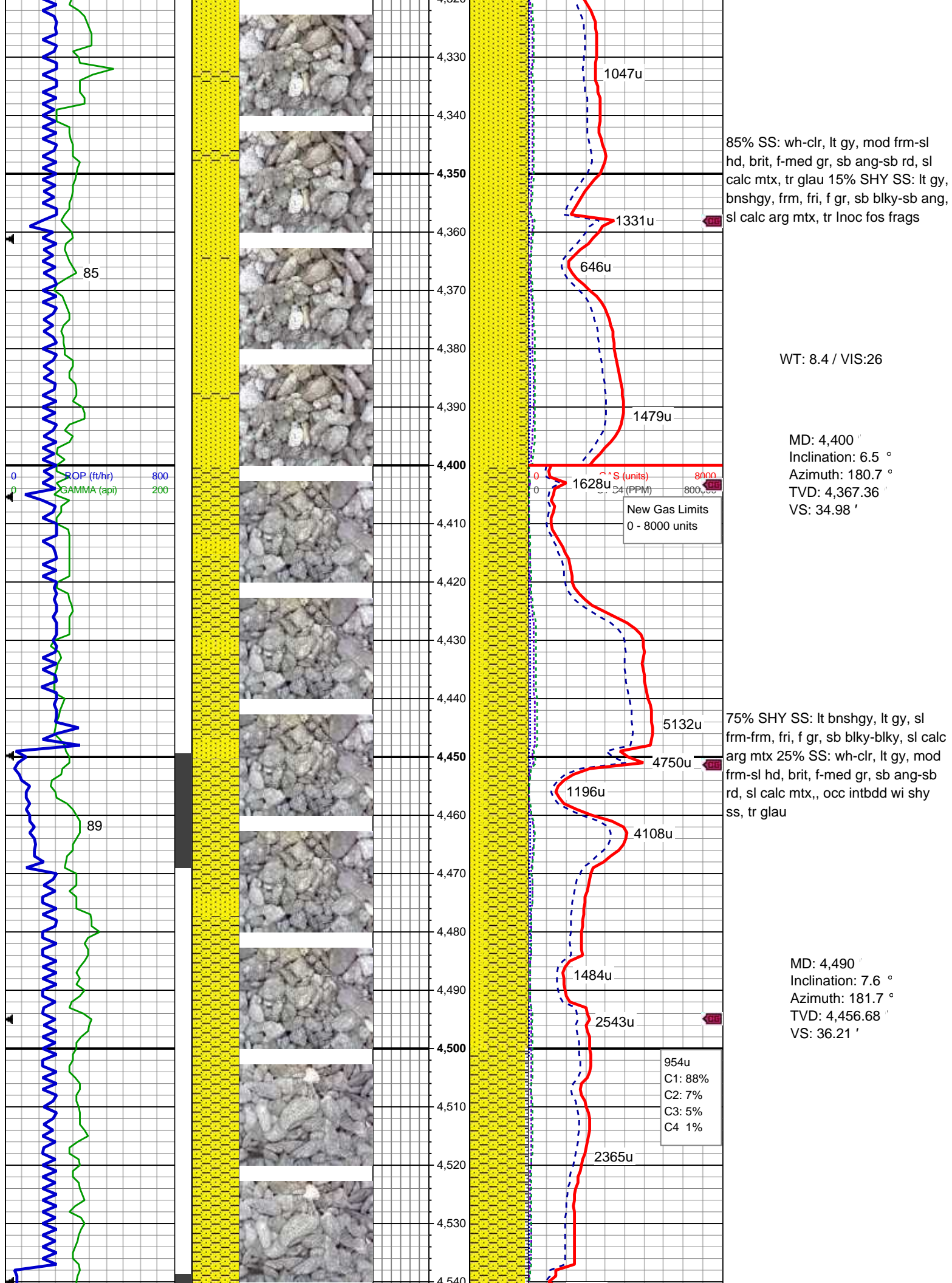
MD: 3,952 '  
Inclination: 8.8 °  
Azimuth: 181.2 °  
TVD: 3,922.83 '  
VS: 27.56 '

MD: 4,042 '  
Inclination: 7.6 °  
Azimuth: 178.5 °  
TVD: 4,011.91 '  
VS: 29.28 '

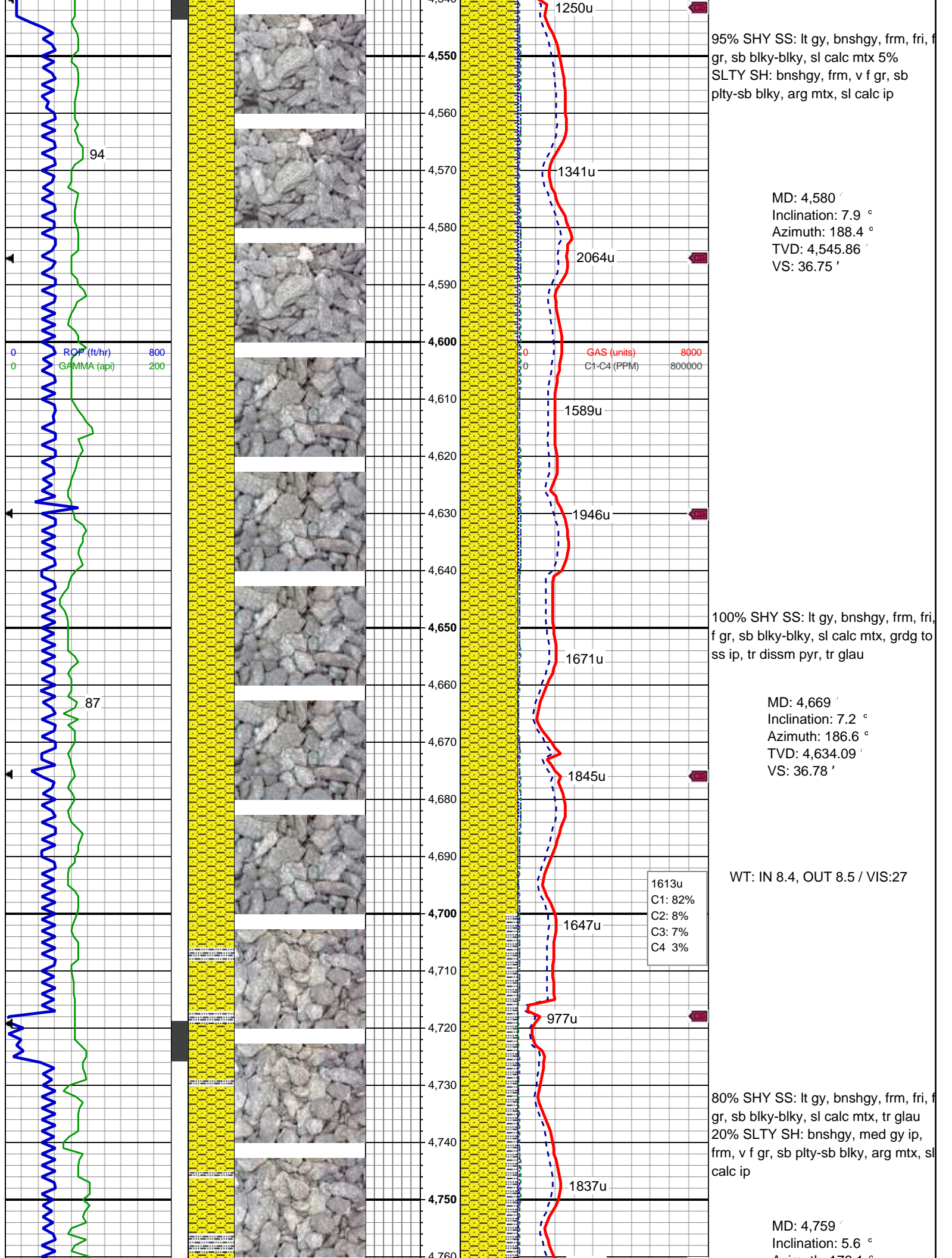
90% SHY SS: lt gy, bnshgy, frm, fri, f gr, sb blkgy-blky, sl calc 10% SLTY SH: med gy, mod frm, v f gr, sb plty-sb blkgy, arg mtx, sl calc











95% SHY SS: lt gy, bnshgy, frm, fri, f  
gr, sb blkly-blky, sl calc mtx 5%  
SLTY SH: bnshgy, frm, v f gr, sb  
plty-sb blkly, arg mtx, sl calc ip

MD: 4,580 '  
Inclination: 7.9 °  
Azimuth: 188.4 °  
TVD: 4,545.86 '  
VS: 36.75 '

100% SHY SS: lt gy, bnshgy, frm, fri,  
f gr, sb blkly-blky, sl calc mtx, grdg to  
ss ip, tr dissim pyr, tr glau

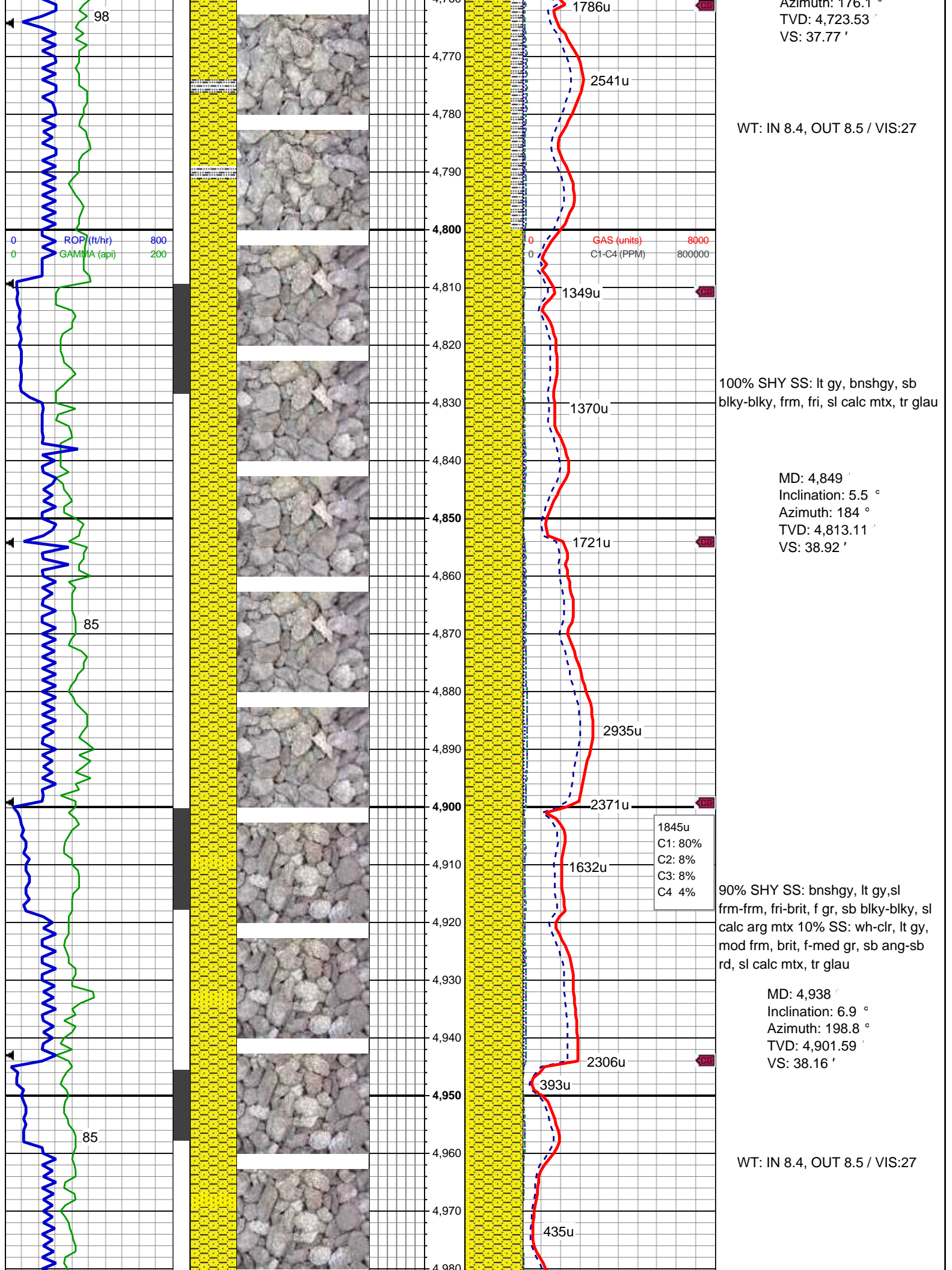
MD: 4,669 '  
Inclination: 7.2 °  
Azimuth: 186.6 °  
TVD: 4,634.09 '  
VS: 36.78 '

WT: IN 8.4, OUT 8.5 / VIS:27

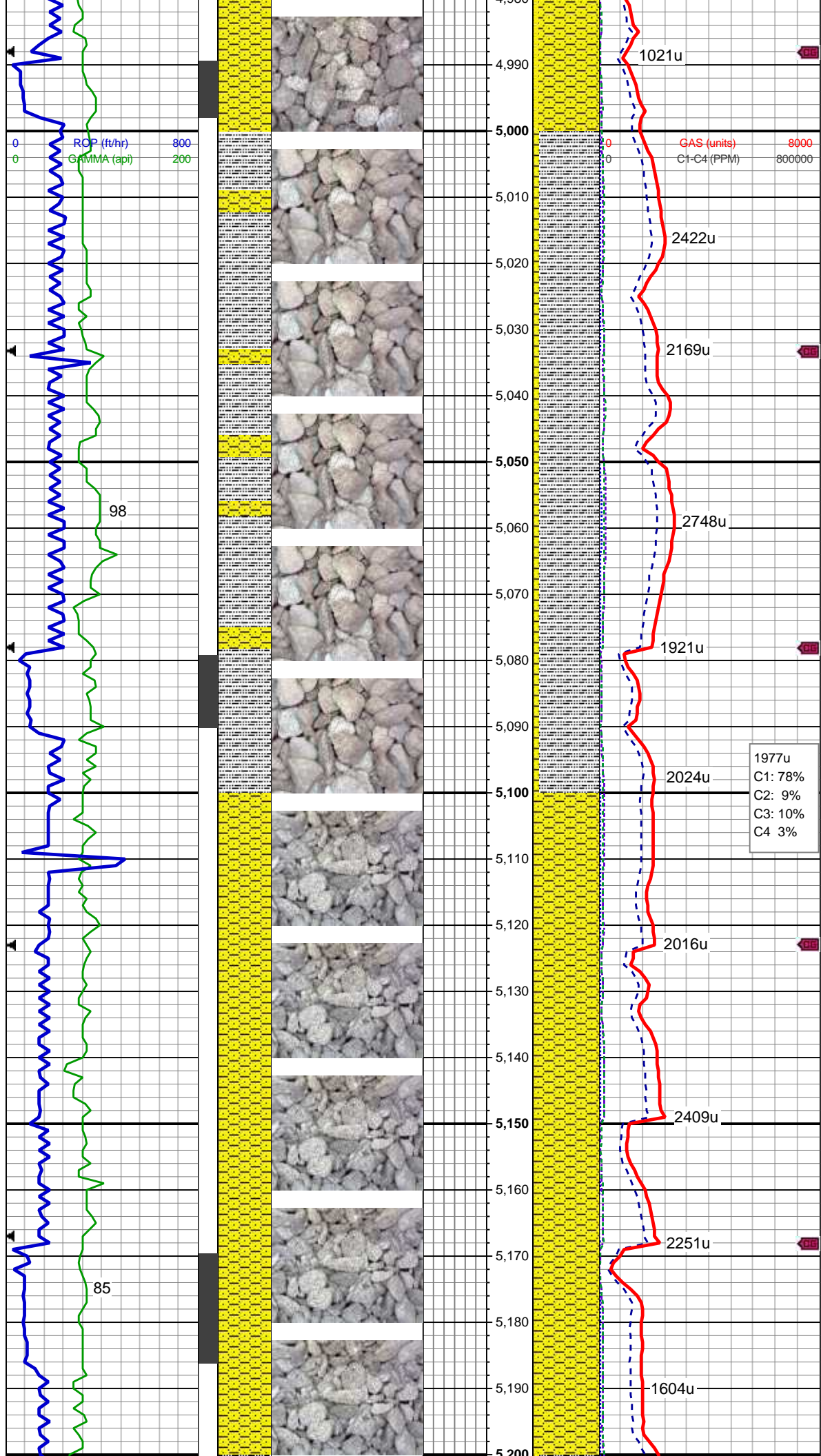
1613u  
C1: 82%  
C2: 8%  
C3: 7%  
C4 3%

80% SHY SS: lt gy, bnshgy, frm, fri, f  
gr, sb blkly-blky, sl calc mtx, tr glau  
20% SLTY SH: bnshgy, med gy ip,  
frm, v f gr, sb plty-sb blkly, arg mtx, sl  
calc ip

MD: 4,759 '  
Inclination: 5.6 °  
Azimuth: 179.1 °





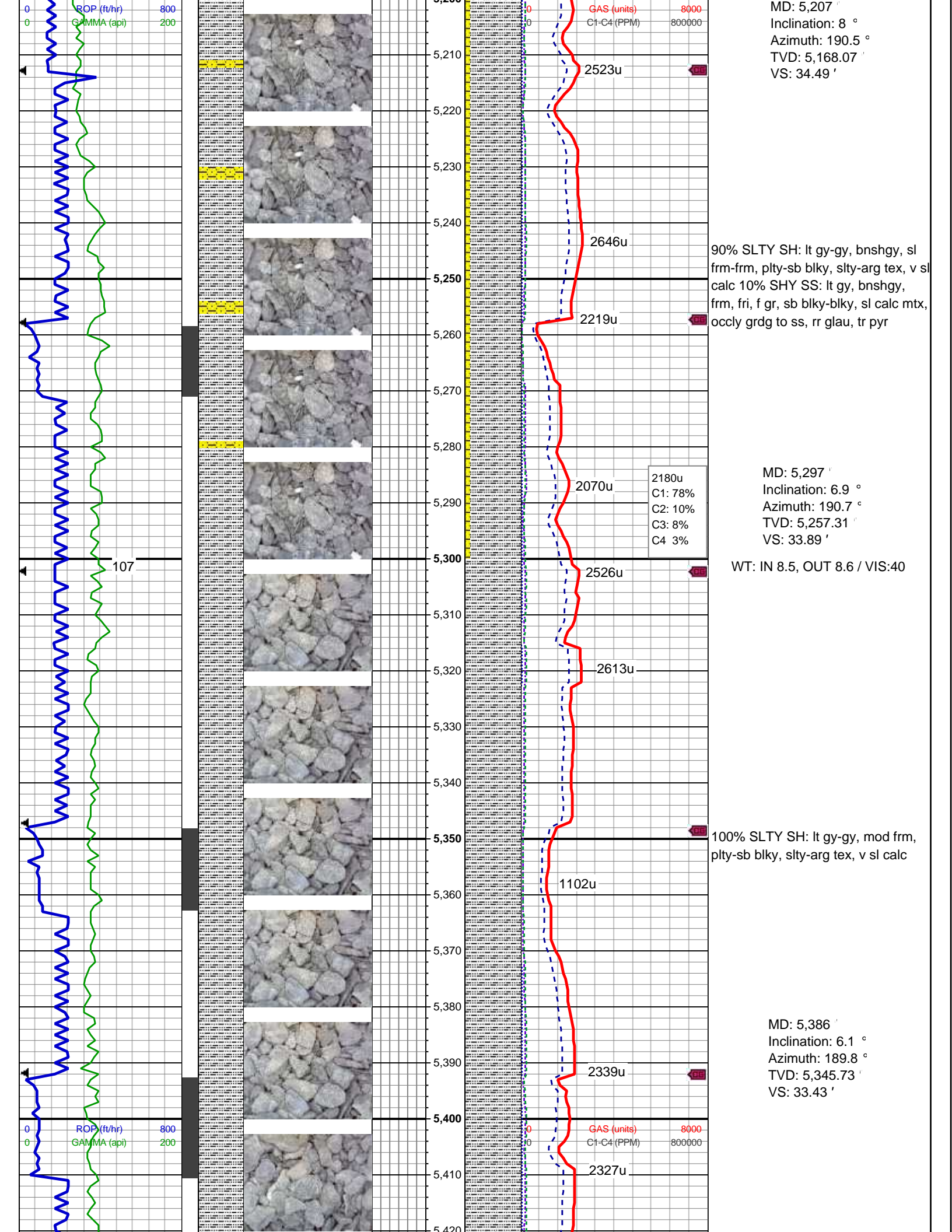


MD: 5,028 '  
Inclination: 8.4 °  
Azimuth: 196.3 °  
TVD: 4,990.79 '  
VS: 36.13 '

90% SLTY SH: lt gy -gy, bnshgy, sl  
frm-frm, sb plty-sb blkly, occ plty,  
slty-arg tex, v sl calc 10% SHY SS: lt  
gy, bnshgy, frm, fri, f gr, sb blkly-blky,  
sl calc mtx, occly grd to ss, rr glau,  
tr pyr

MD: 5,117 '  
Inclination: 7.7 °  
Azimuth: 189.4 °  
TVD: 5,078.91 '  
VS: 34.98 '

100% SHY SS: lt gy, bnshgy, sb  
blkly-blky, frm, fri, f gr, sl calc mtx, tr  
glau, occly grd to ss





112

94

ROP (ft/hr)  
GAMMA (api)800  
2005,420  
5,430  
5,440  
5,450  
5,460  
5,470  
5,480  
5,490  
5,500  
5,510  
5,520  
5,530  
5,540  
5,550  
5,560  
5,570  
5,580  
5,590  
5,600  
5,610  
5,620  
5,630  
5,640

1887u

772u

3161u

2162u

2780u

2406u

3116

2882u

1916u

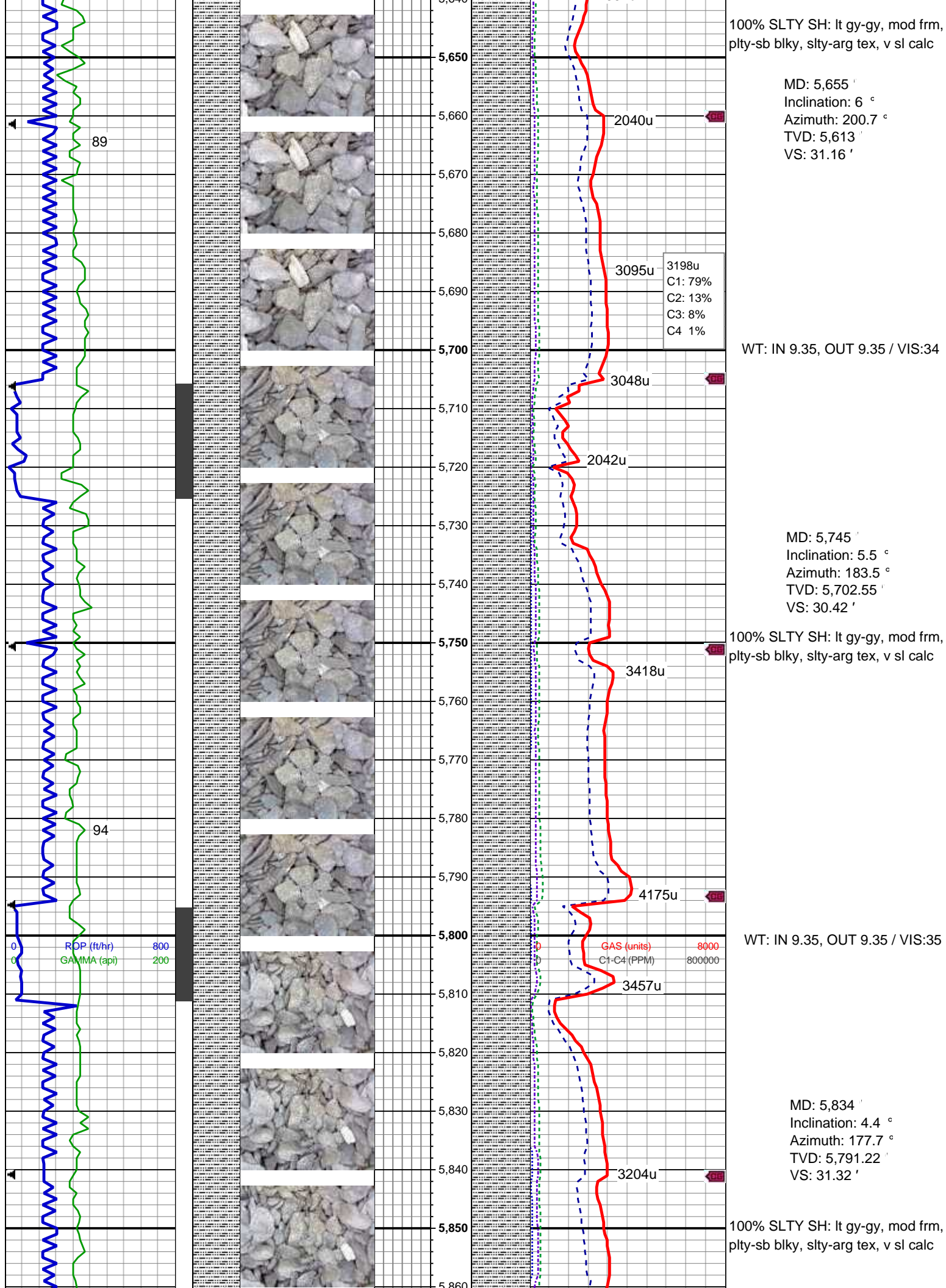
2351u

WT: IN 8.65, OUT 8.7 / VIS:34

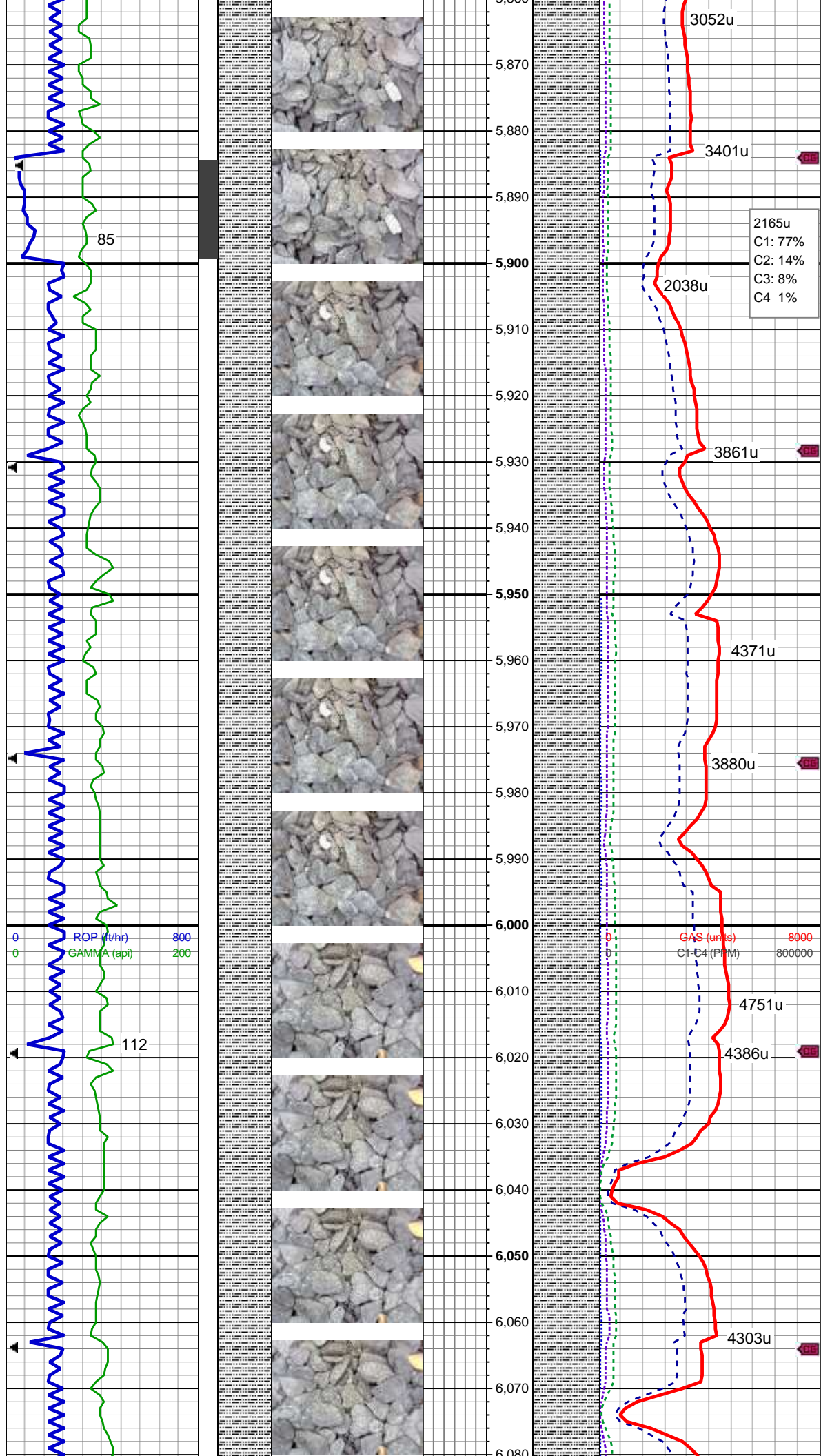
100% SLTY SH: lt gy-gy, mod frm,  
plty-sb blkly, slty-arg tex, v sl calcMD: 5,476 '  
Inclination: 6.9 °  
Azimuth: 185.6 °  
TVD: 5,435.15 '  
VS: 33.45 '1821u  
C1: 75%  
C2: 13%  
C3: 8%  
C4 3%100% SLTY SH: lt gy-gy, mod frm,  
plty-sb blkly, slty-arg tex, v sl calcMD: 5,565 '  
Inclination: 6.6 °  
Azimuth: 195.6 °  
TVD: 5,523.54 '  
VS: 32.94 '

WT: IN 9.2, OUT 9.2 / VIS:34

GAS (units)  
C1-C4 (PPM)8000  
800000







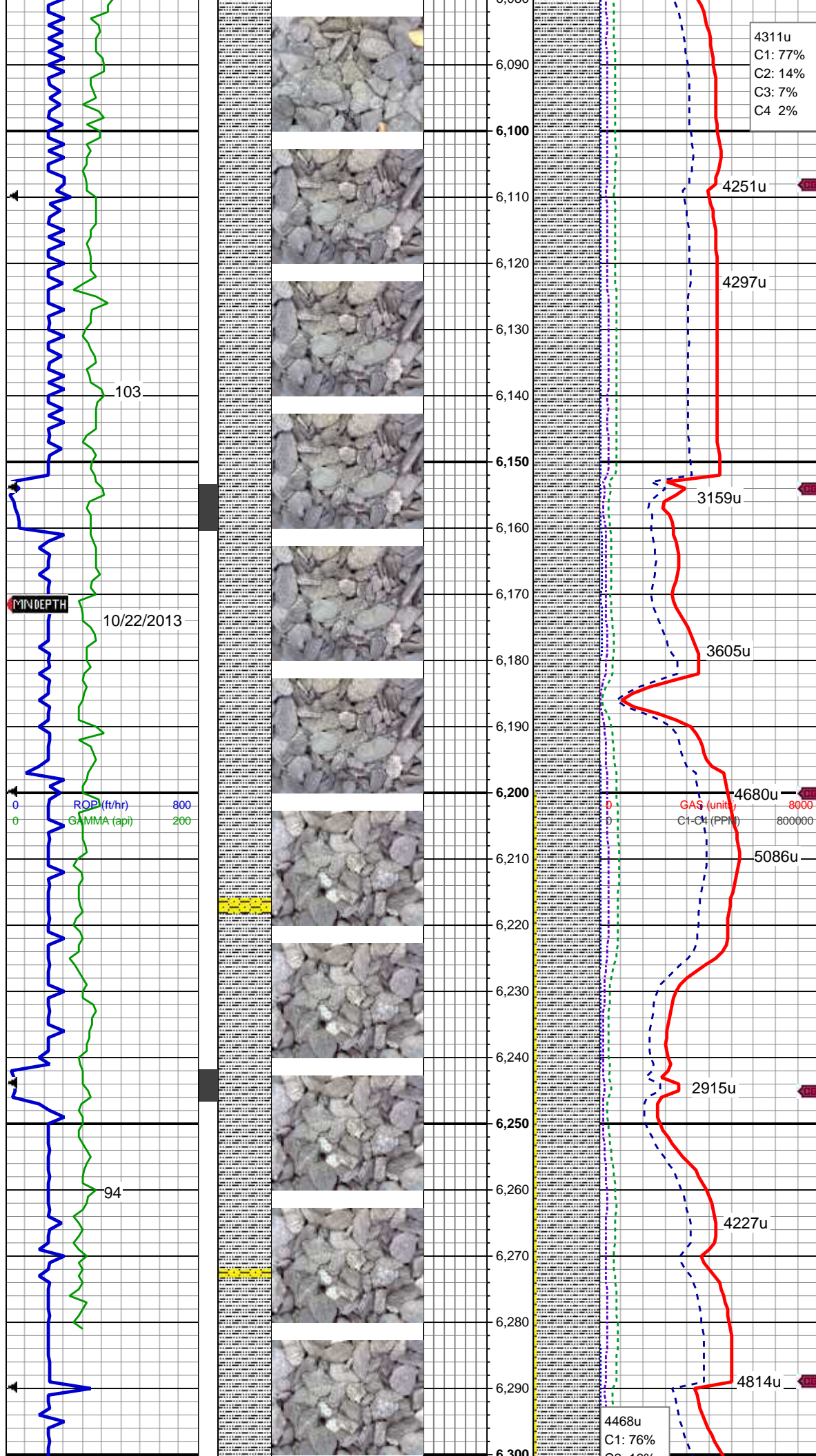
MD: 5,924 '  
Inclination: 4 °  
Azimuth: 177.7 °  
TVD: 5,880.98 '  
VS: 32.46 '

100% SLTY SH: lt gy-gy, mod frm,  
plty-sb blk, silky tex

WT: IN 9.4, OUT 9.4 / VIS:36

MD: 6,014 '  
Inclination: 2.9 °  
Azimuth: 182.8 °  
TVD: 5,970.81 '  
VS: 33.2 '

100% SLTY SH: lt gy-gy, mod frm,  
plty-sb blk, silky tex



MD: 6,103 '  
Inclination: 1.8 °  
Azimuth: 187.9 °  
TVD: 6,059.74 '  
VS: 33.38 '

100% SLTY SH: lt gy-gy, mod frm, plty-sb blk, slty tex

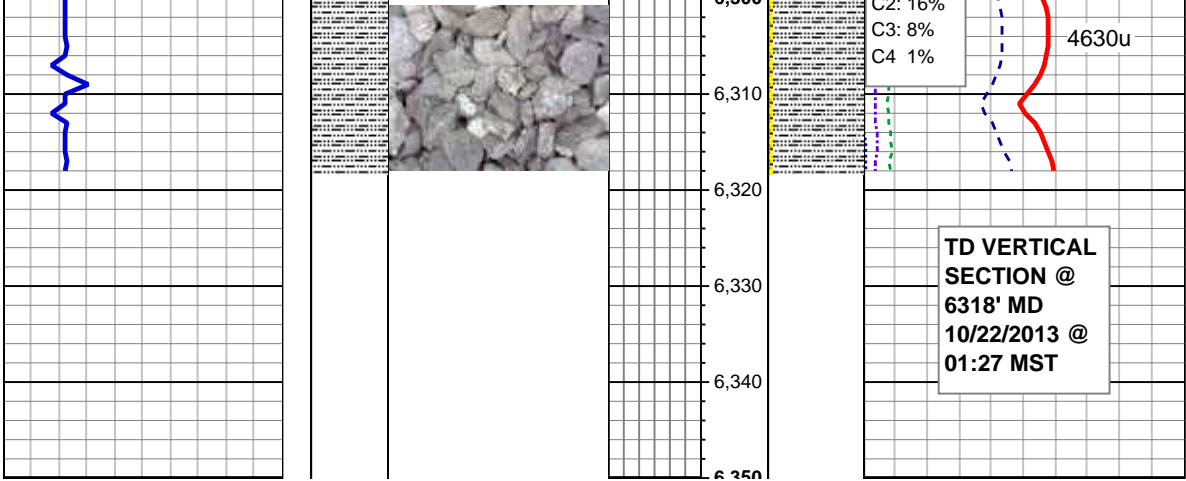
MD: 6,193 '  
Inclination: 1.1 °  
Azimuth: 186.3 °  
TVD: 6,149.71 '  
VS: 33.4 '

95% SLTY SH: lt gy-gy, mod frm, plty-sb blk, slty tex 5% SHY  
SS:wh-lt gy, s&p, frm, fri, f gr, sb plty-sb blk, sl calc

WT: IN 9.7, OUT 9.7 / VIS:38

MD: 6,283 '  
Inclination: 0.8 °  
Azimuth: 183.6 °  
TVD: 6,239.69 '  
VS: 33.46 '





LOG CONTINUES ON FILE:  
Loeffler K1-66-1HN\_Horiz.mplot

THANK YOU FOR CHOOSING  
COLUMBINE LOGGING, INC.