

Scale: 5" / 100'  
Measured Depth Log

Well Name	Antelope Federal 44-20-17XRLLNC		
Location	SWSE Sec.20 T5N R62W		
State	Colorado	County	Weld
Country	United States	Rig Number	Atika 19
API Number	05-123-49090-0000	AFE #	19006
Geographic Region	D.J. Basin	Field	Wattenberg
Spud Date	4/25/2019	Drilling Completed	5/5/2019
Surface Coordinates	SWSE Sec.20 T5N R62W 669' FSL 2350' FEL		
Bottom Hole Coordinates	SWSE Sec.20 T5N R62W 470' FNL 523' FEL		
Ground Elevation	4,655	K.B. Elevation	4,672
Logged Interval	6,000 To 17,163	Total Depth	17,163
Formation	Niobrara C Chalk		
Type of Drilling Fluid	Oil Based Mud		

Operator

Company Bonanza Creek  
Address Bonanza Creek Energy  
410 17th Street  
Suite 1400  
Denver, CO 80202

Geologist

Name Ashley Danowski  
Company Bonanza Creek Energy  
Address Bonanza Creek Energy  
410 17th Street  
Suite 1400  
Denver, CO 80202

Other

Dan Kabala Wellsite Geologist  
Ryan Scribner Wellsite Geologist

Color Coding

Oil  
Nole  
Error

Condensate  
Core  
Water

Ga  
Pre  
Se

Rock Types

UNKNOWN	MARLSTONE	SILTSTONE	BENTONITE
GYPSUM	CLAYSTONE	SANDSTONE	TUFF
LIMESTONE	SHALE	CONGLOMERATE	CEMENT
CHERT	SHALE GRAY	BRECCIA	CHALK
COAL	SHALE COLORED	TILL	SILTY SHALE

Accessories

FORAMINIFERA	GLAUCONITE	COAL STRINGER
F FOSSIL	ANHYDRITIC	DOLOMITE STRINGER
ALGAE	GASTROPOD	GYPSUM STRINGER
AMPHIPORA	OOLITE	LIMESTONE STRINGER
BELEMNITE	OSTRACOD	MARLSTONE (CALC) STRG
BIOCLASTIC	PELECYPOD	MARLSTONE (DOL) STRG
BRACHIOPOD	PELLET	SANDSTONE STRINGER
BRYOZOA	PISOLUTE	SHALE STRINGER
CEPHALOPOD	PLANT REMAINS	SILTSTONE STRINGER
CORAL	PLANT SPORES	CHALK STRINGER
CRINOID	SCAPHOPOD	SILTY SHALE STRINGER
ECHINOID	STROMATOPOROID	
FISH	FERRUGINOUS PELLET	
	FERRUGINOUS	

Minerals

Other Symbols

MOLDIC	ORGANIC	OIL
DEAD	PINPOINT	SIDE
EVEN	VUGGY	SIDE
QUESTIONABLE		SLIDE
SPOTTED STAINING		SU
	Engineering	
Porosity		
E EARTHY	CONNECTION (RIGHT)	WIRE
F FENESTRAL	CONNECTION GAS	WIRE
F FRACTURE	CORE - LOST	R ROUND
INTERCRYSTALLINE	CORE - RECOVERED	ANGULAR
INTEROOLITIC	FAULT	

# Symbols

FORMATION TOP      **B** SUBANG      **P** PACKSTONE

SHOW      **P** SUBRND      **W** WACKESTONE

WALL CORE (LEFT)

## Textures      Sorting

WALL CORE (RIGHT)

**B** BOUNDSTONE    **M** MODERATE

**C** CHALKY      **P** POOR

**CX** CRYPTOXLN    **W** WELL


ELINE TESTED - LEFT    **E** EARTHY

ELINE TESTED - RT    **FX** FINELYXLN

## Cut

**ES** GRAINSTONE       No Cut

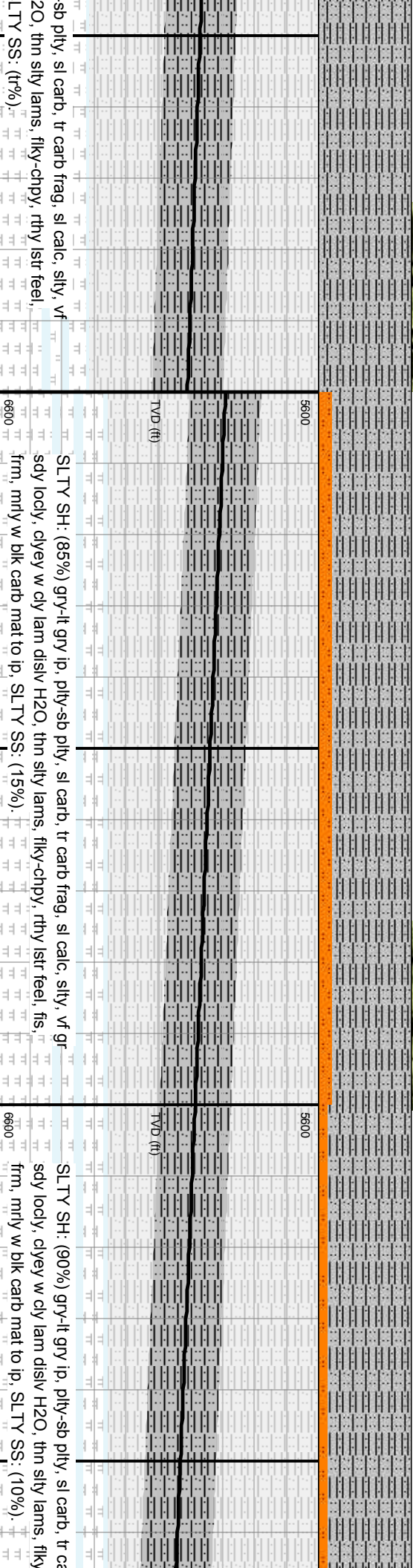
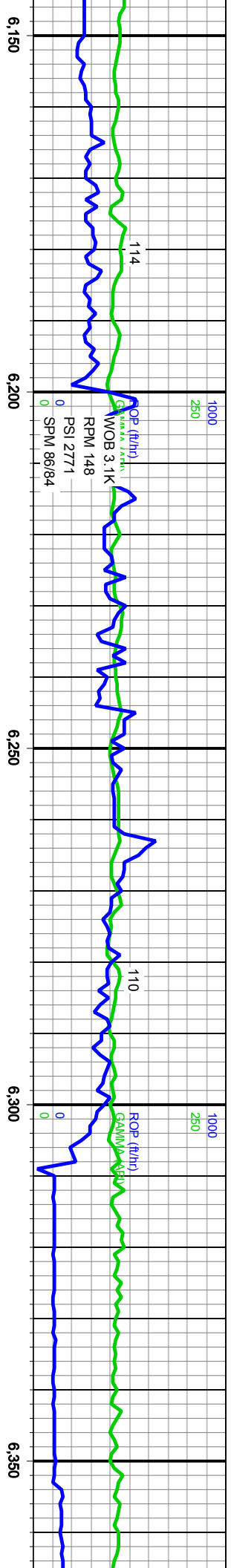
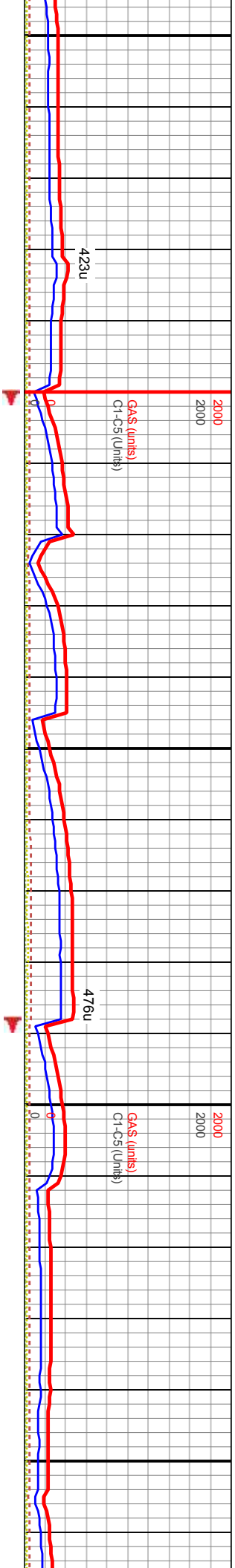
**L** LITHOGRAPHIC       Fair Cut

**MX** MICROXLN       Good Cut

**M** MUDSTONE      Blank

## Grading

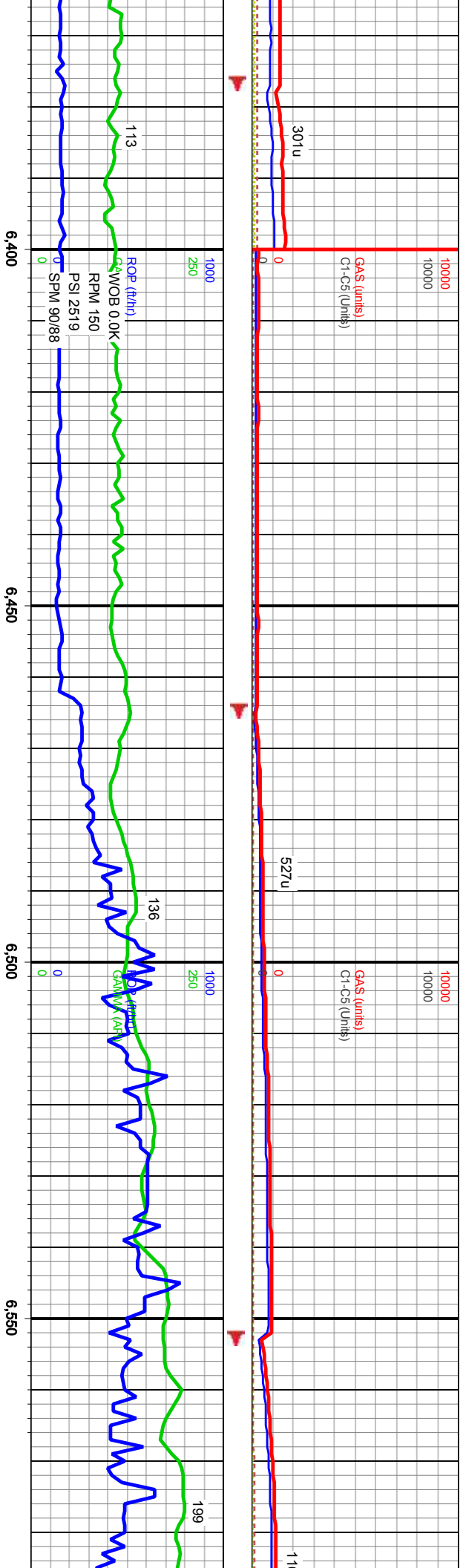




MD: 6,175'  
Inclination: 18°  
Azimuth: 94°  
TVD: 5,865'  
VS: -873'

MD: 6,263'  
Inclination: 19°  
Azimuth: 67°  
TVD: 5,949'  
VS: -863'

MD: 6,351'  
Inclination: 25°  
Azimuth: 67°  
TVD: 6,031'  
VS: -844'



**SHARON SPRINGS TOP @ 6137' TVD 6477' MD**

5600  
6600

SLTY SH: (60%) gry-lt gry lp, pty-sb pty, sl carb, tr carb frag, sl calc, silty, vf gr  
sdy locly, clyey w cly lam dislv H<sub>2</sub>O, thn silty lams, flky-chpy, rthy lstr feel, fts,  
frm, mfly w blk carb mat to lp, CARB SH: (30%), SLTY SS: (10%).

**SHARON SPRINGS "A" TOP @ 6222' TVD 6590' MD**

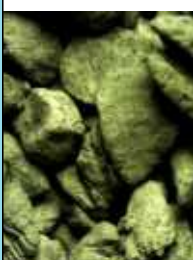
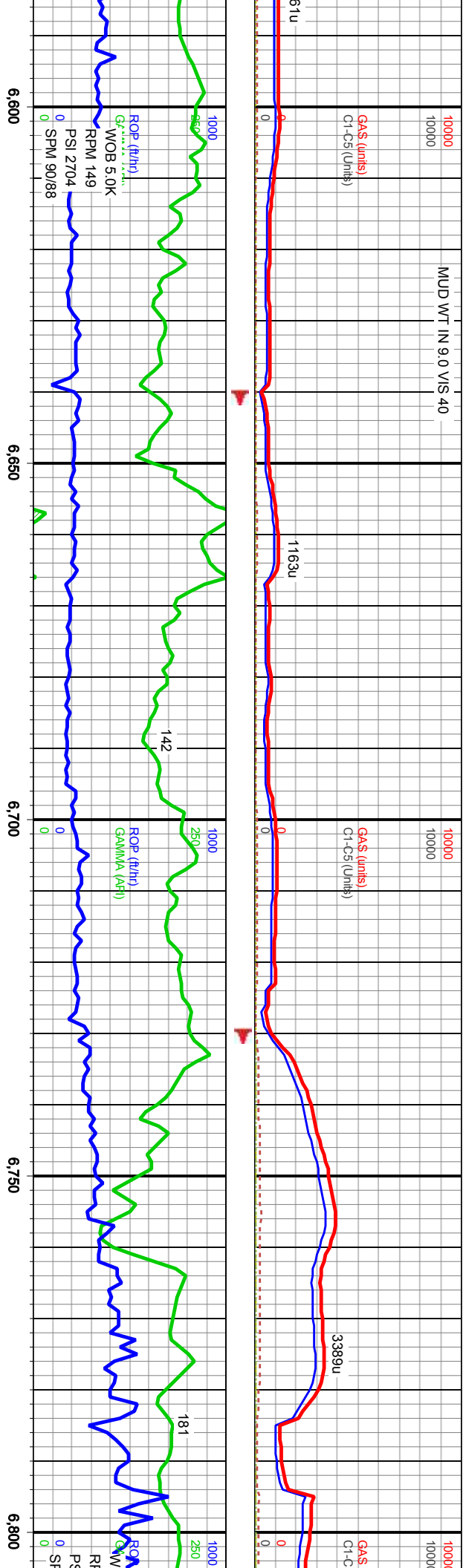
5600  
6600

CARB SH: (70%) med dk gry-gryish brwn, pty-sb pty, shrp/jgdd cting, h  
clyey, HCL sensi, thnly lam slts, sbtrthy-sbwxy, grty-grsy lp, sl calc, sl sft-v-  
sily sn ds, abn blk carb mat to (SH), SLTY SH: (30%), SLTY SH: (tr), tr am  
BENT (phylio) & BENT.

MD: 6,440'  
Inclination: 34°  
Azimuth: 51°  
TVD: 6,108'  
VS: -814'

MD: 6,527'  
Inclination: 41°  
Azimuth: 40°  
TVD: 6,178'  
VS: -770'





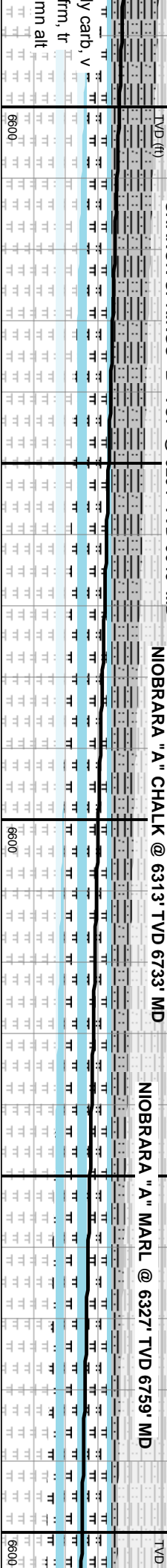
MRLSTN: (70%) med-med drk gry-brwn, rthy, sbchiky, occ sbwxy sprikng ip, frm  
btrtl, sbply, lent chiky lns, no vis perm or por, cmmn blk carb mat (SH) to,  
NSFOC, OBM contin, MRL Y CHLK: (30%) lt brwn-lt gry brwn, sb ply-sb blk, dll  
rthy lstr, dns crmbly ten, v carb, mic xin sug txt, frm, blk carb mat to, est 20-30%  
micrite, ARG CARB CHLK: (tr%), abn alt BENT (phyllo) w pyr nods.

SHARON SPRINGS "B" TOP @ 6264' TVD 6649' MD

NIOBRARA "A" CHALK @ 6313' TVD 6733' MD

NIOBRARA "A" MARL @ 6327' TVD 6759' MD

MRL Y CHLK: (90%) lt brwn-lt gry brwn, sb ply-sb blk, dll  
rthy lstr, dns crmbly ten, v carb, mic xin sug txt, frm, blk carb  
mat to, est 30-40% micrite, MARL: (10%).



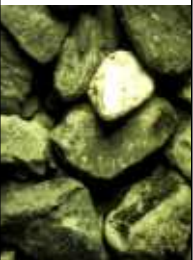
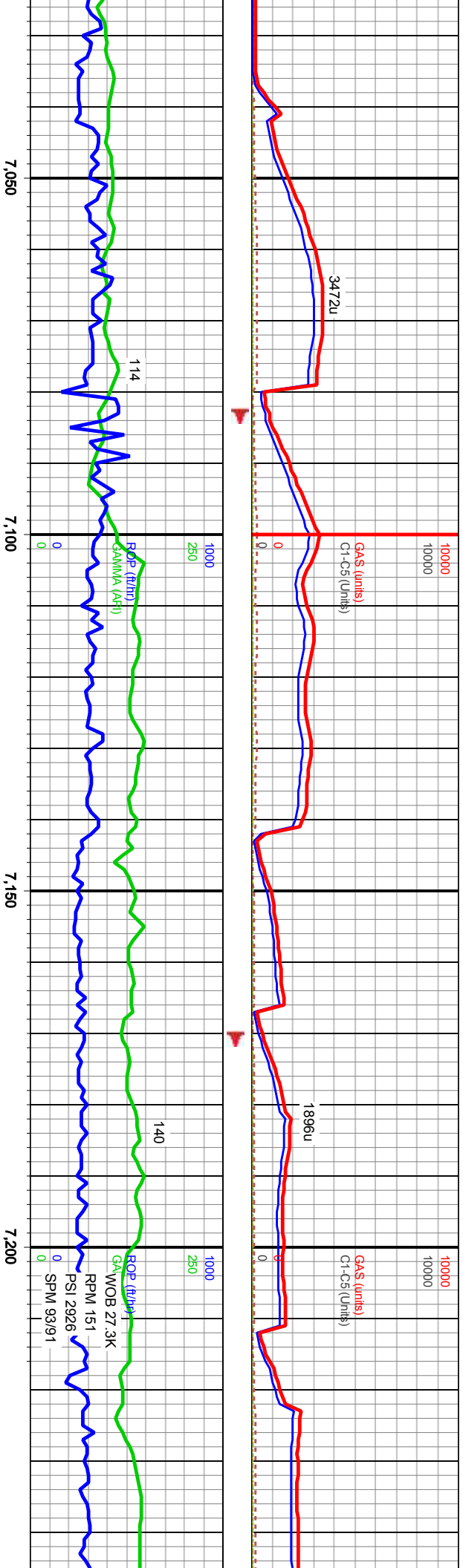
MD: 6,616'  
Inclination: 45°  
Azimuth: 38°  
TVD: 6,243'  
VS: -716'

MD: 6,704'  
Inclination: 55°  
Azimuth: 32°  
TVD: 6,299'  
VS: -654'

MD: 6,792'  
Inclination: 63°  
Azimuth: 26°  
TVD: 6,344'  
VS: -582'

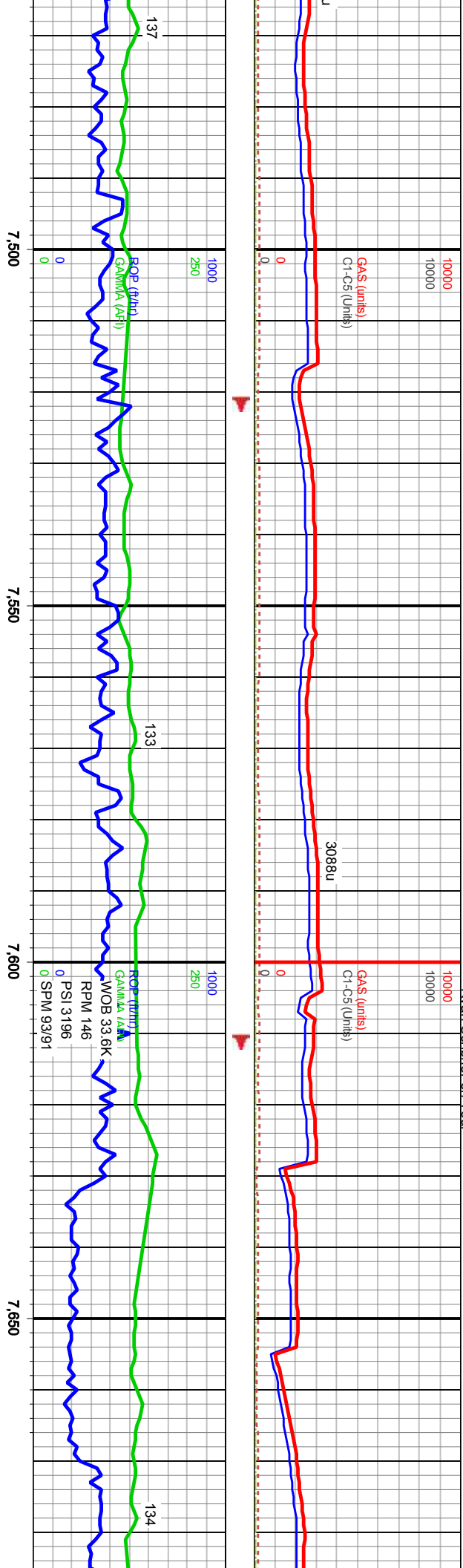






ALK (50%): mtlid med drk-med gry, lt brwn gry, chiky txt, dli sb chiky, mod hrd-frn, mod arg w 20-30% cly mtrx, inf chik is ip, FOSSILIFEROUS MARL (30%), MRLSTN (20%).		5600		Landed Curve @ 7180' MD 6426' TVD on 05/02/2019 (15:04)		5600	
MRLSTN: (60%) med-med drk gry-brwn, rthy, sbchiky, occ sbwxy sprkng ip, frm brtlt, sbply, lent chiky lns, no vis perm or por, cmnn blk carb mat (SH) to, NSFOC, OBM contin, FOSSILIFEROUS MARL: (20%), ARG CARB CHLK: (20%) abn alt BENT (phyllo) w pyr nuds & ls FOSS frags.		TVD (ft)		200 Samples		TVD (ft)	
6600						6600	

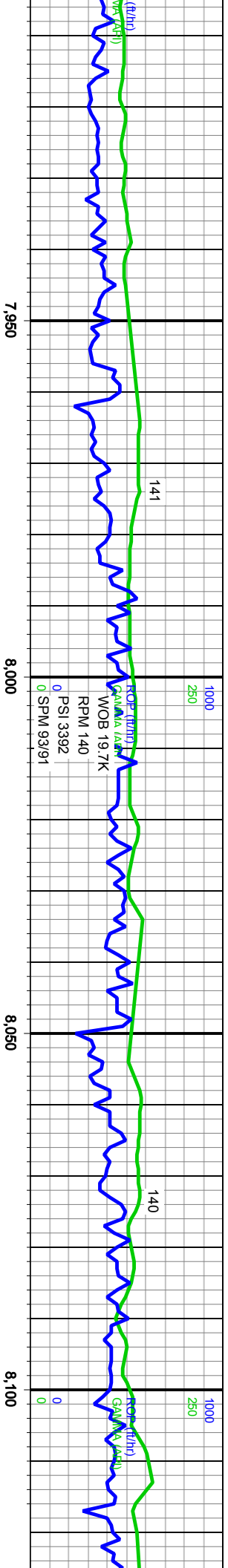
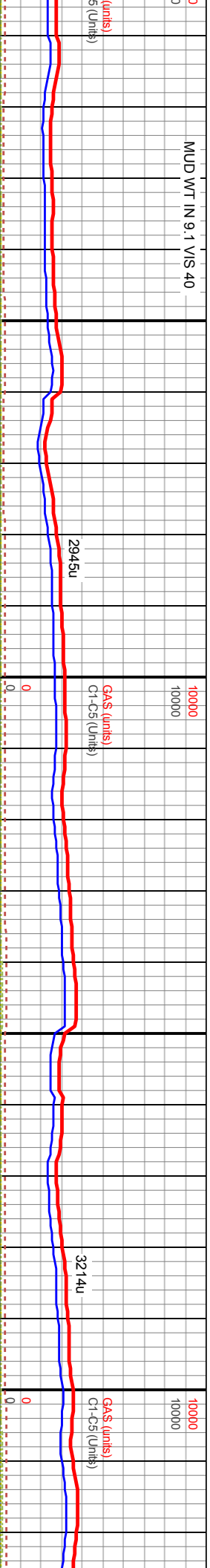




Niobrara C Chalk Target

Niobrara C Chalk Target	5600										5600										5600																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
	ARG CARB CHLK: (50%) mttld drk brwn gry ip, chiky txt, dull rthy lstr, biky-sbchiky, mod hrd-frm, arg w 30-40% cly mtrx, infr chlk por, mny ip, blk carb mat ip, tr alt BENT (phyllo) w pyr nods, MARL: (50%).																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
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ARG CARB CHLK: (55%) mltld dtk brwn gry ip, chlkx bxt, dull rthy lstr,  
blky-sbchlkly, mod hrd-fm, arg w 30% cly mtrx, inf chlk por, mrlly ip, blk  
carb mat ip, tr alt BENT (phyllo) w pyr nodes, MARL: (45%).

Niobrara C Chalk Target

TVD (ft)

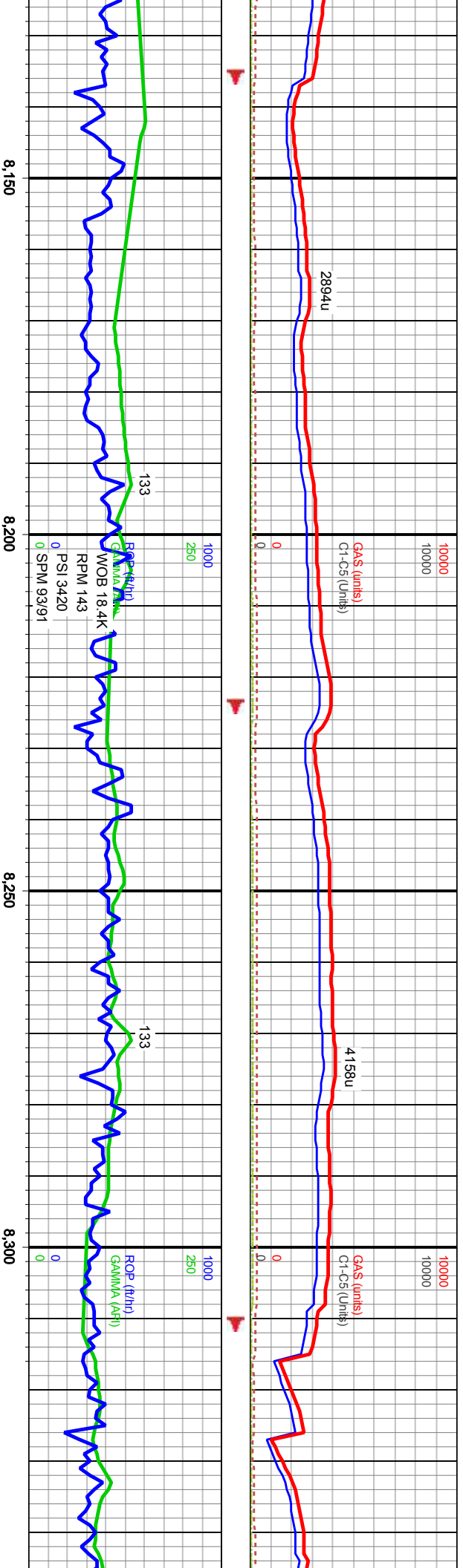
TVD (ft)

MD: 7,936'  
Inclination: 90°  
Azimuth: 1°  
TVD: 6,425'  
VS: 533'

MD: 8,023'  
Inclination: 90°  
Azimuth: 3°  
TVD: 6,425'  
VS: 619'

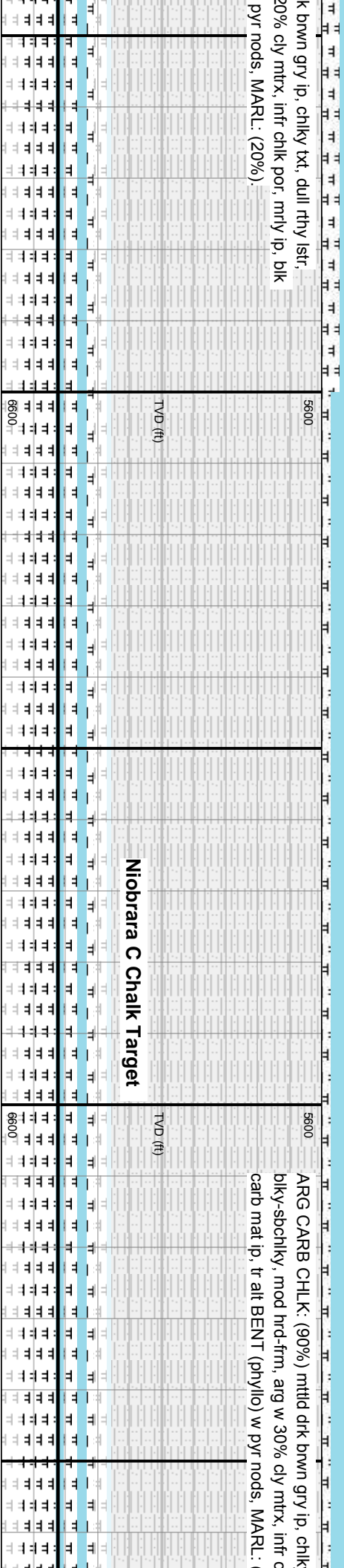
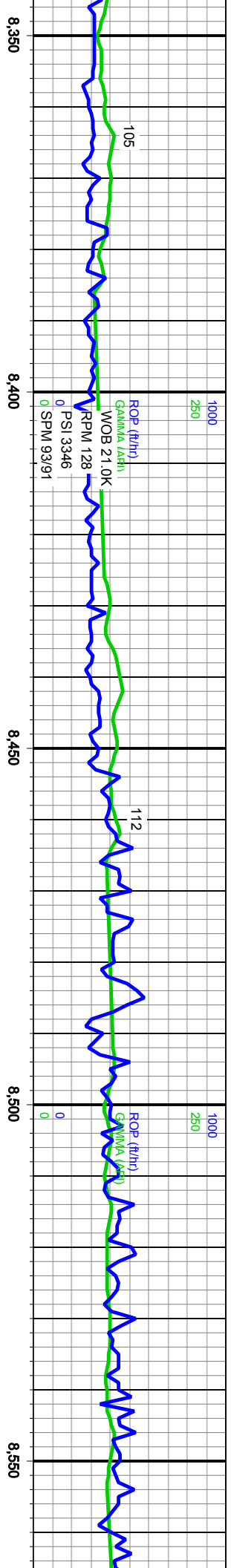
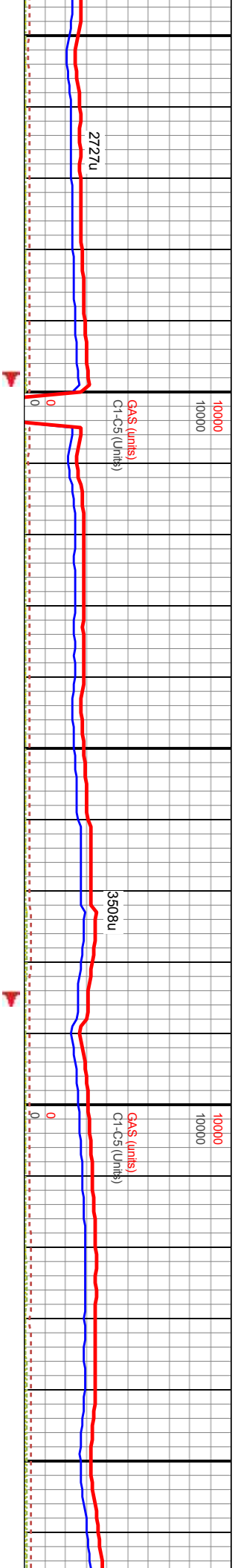
MD: 8,112'  
Inclination: 90°  
Azimuth: 5°  
TVD: 6,425'  
VS: 707'



[illegible]

MD: 8,200'  
Inclination: 90°  
Azimuth: 5°  
TVD: 6,425'  
VS: 794'

MD: 8,287'  
Inclination: 90°  
Azimuth: 359°  
TVD: 6,424'  
VS: 880'



k brwn gry ip, chiky txt, dull rthy lstr,  
20% cly mtrx, infr chlk por, mrlly ip, blk  
pyr nodes, MARL: (20%)

ARG CARB CHLK: (90%) mttld drk brwn gry ip, chlk  
blky-sbchiky, mod hrd-firm, arg w 30% cly mtrx, infr c  
carb mat ip, tr alt BENT (phyllo) w pyr nodes, MARL:

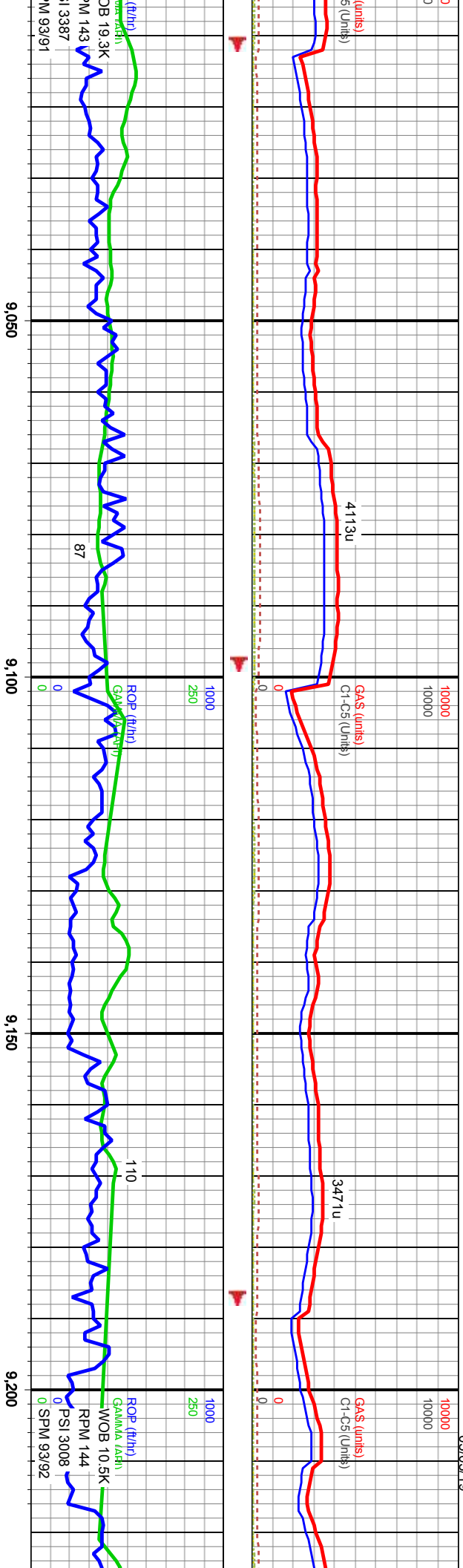
MD: 8,374'  
Inclination: 90°  
Azimuth: 1°  
TVD: 6,424'  
VS: 965'

MD: 8,461'  
Inclination: 90°  
Azimuth: 4°  
TVD: 6,424'  
VS: 1,051'

MD: 8,548'  
Inclination: 90°  
Azimuth: 2°  
TVD: 6,424'  
VS: 1,137'





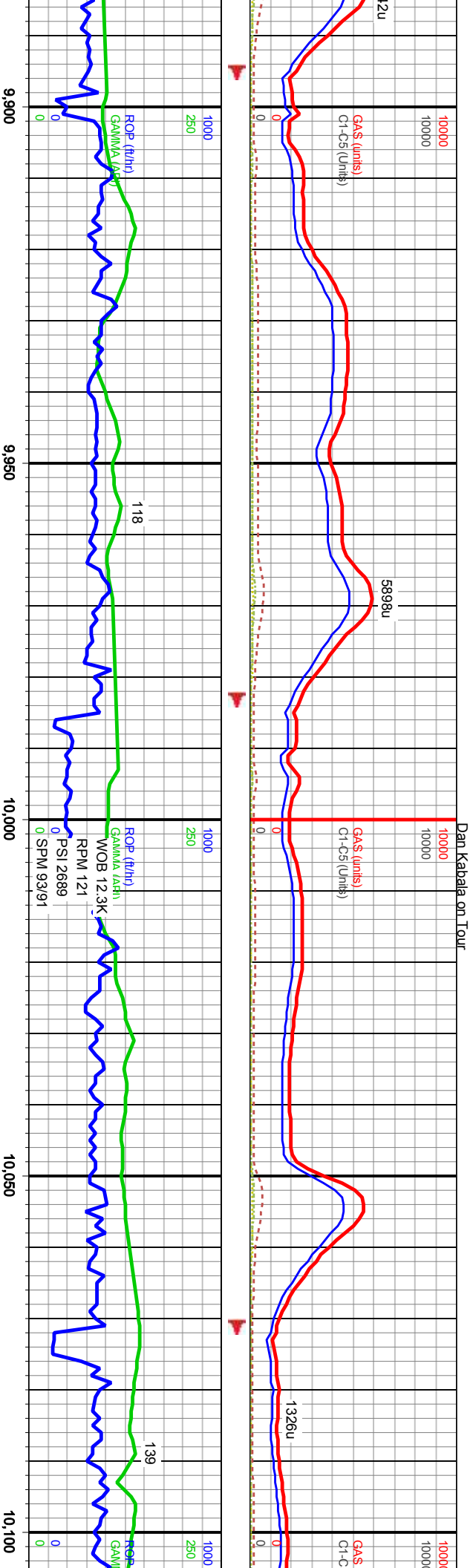










5600	5600	5600
ARG CARB CHLK: (85%) mttld drk brwn gry ip, chiky txt, dull rthy lstr, blkly-sbchiky, mod hrd-fm, arg w 35% cly mtr, inf chlk por, mrly ip, blk carb mat ip, tr alt BENT (phyllo), MARL: (15%)	Niobrara C Chalk Target	
TVD (ft)	TVD (ft)	TVD
6600	6600	6600

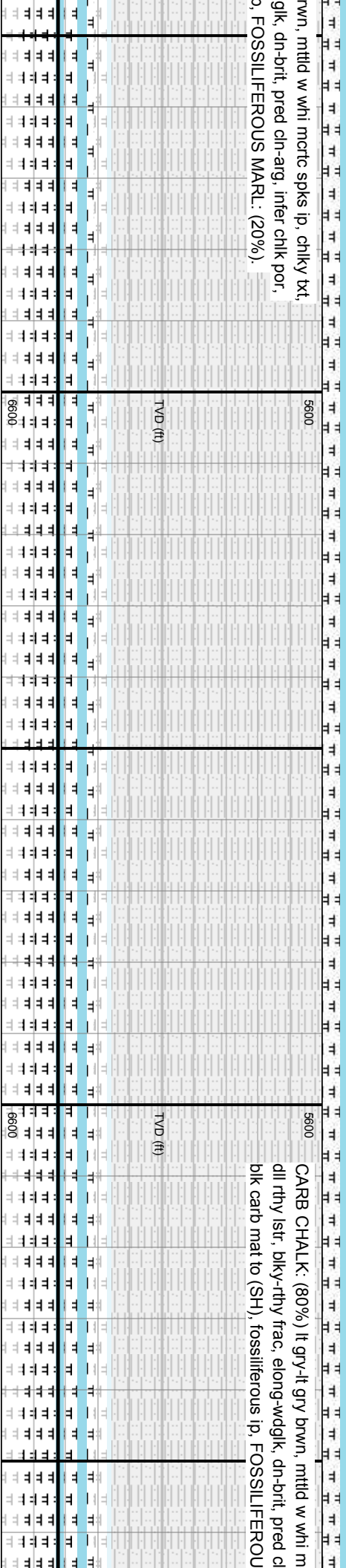
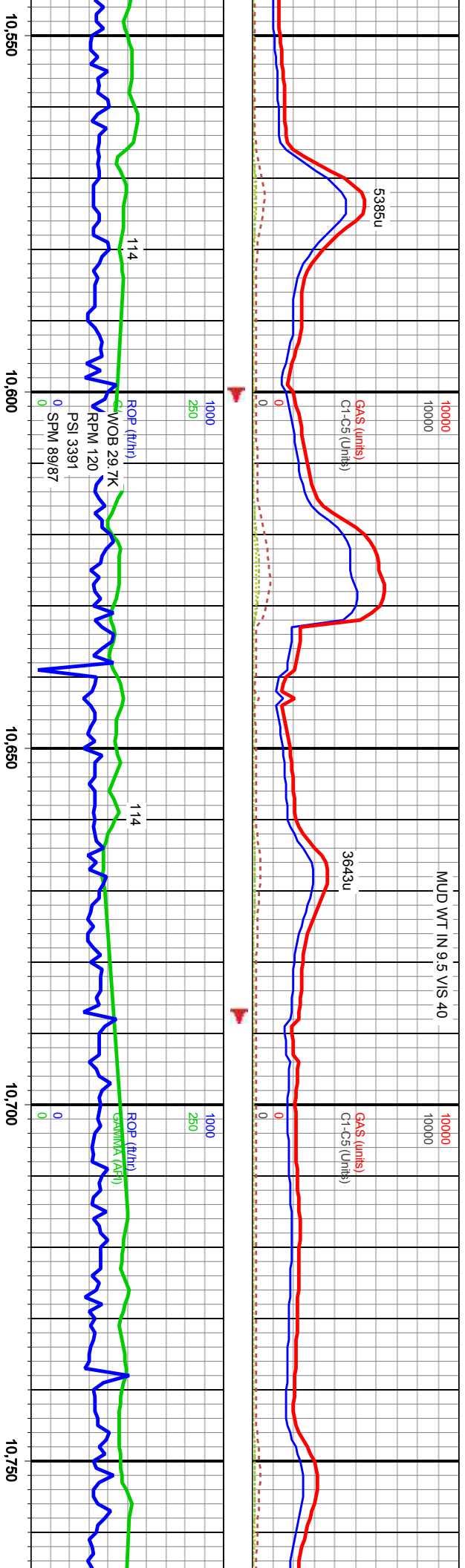
MD: 9,959'  
Inclination: 90°  
Azimuth: 2°  
TVD: 6,419'  
VS: 2,520'

MD: 10,047'  
Inclination: 90°  
Azimuth: 1°  
TVD: 6,418'  
VS: 2,606'







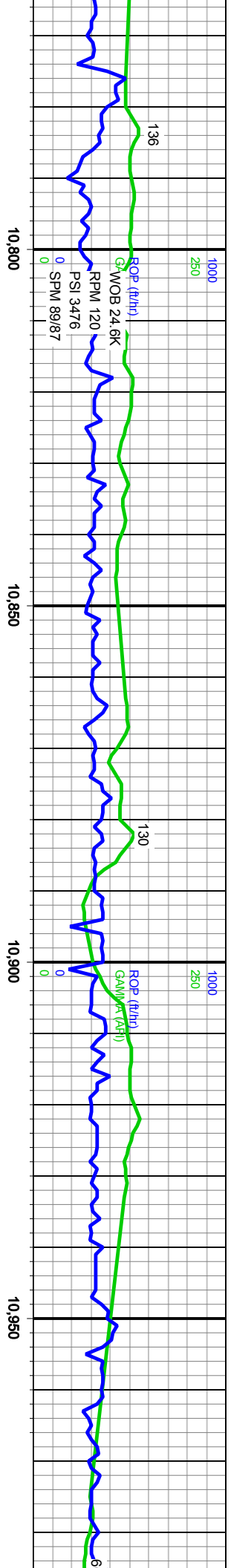
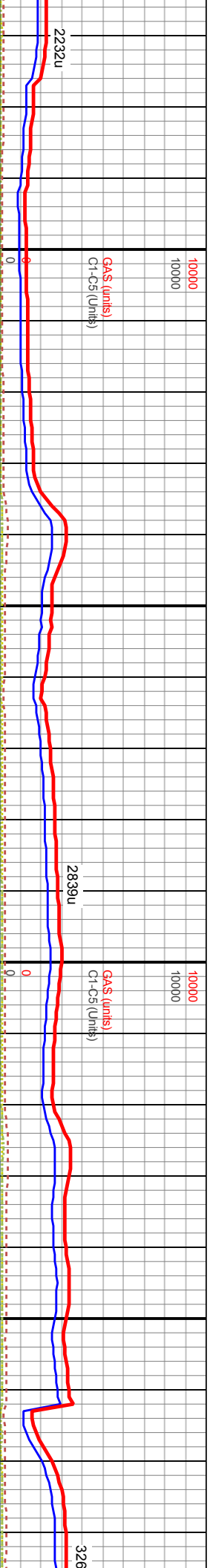


3, FOSSILIFEROUS MARL: (20%).

CARB CHALK: (80%) lt gry-lt gry brwn, mttld w whi m  
dll rthy lstr, blyk-rthy frac, elong-wdgk, dn-brit, pred cl  
blk carb mat to (SH), fossiliferous ip, FOSSILIFEROUS

MD: 10,575'  
Inclination: 90°  
Azimuth: 359°  
TVD: 6,421'  
VS: 3,126'

MD: 10,750'  
Inclination: 90°  
Azimuth: 356°  
TVD: 6,422'  
VS: 3,296'



crtc spks ip, chiky bxl, n-ag, infer chlk por, S MARL: (20%).		5600	6600	5600	6600
TVD (ft)		5600	6600	5600	6600
Niobrara C Cha		5600	6600	5600	6600

MD: 10,836'  
Inclination: 90°  
Azimuth: 356°  
TVD: 6,423'  
VS: 3,378'

MD: 10,924'  
Inclination: 90°  
Azimuth: 357°  
TVD: 6,423'  
VS: 3,463'









## Niobrara C Chalk Target

TVD (ft)

Inclination:  $89^\circ$

TVĐ: 6,428

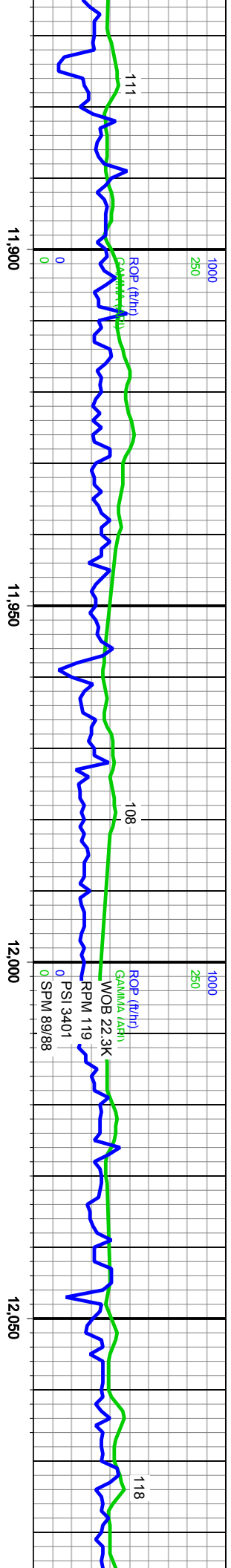
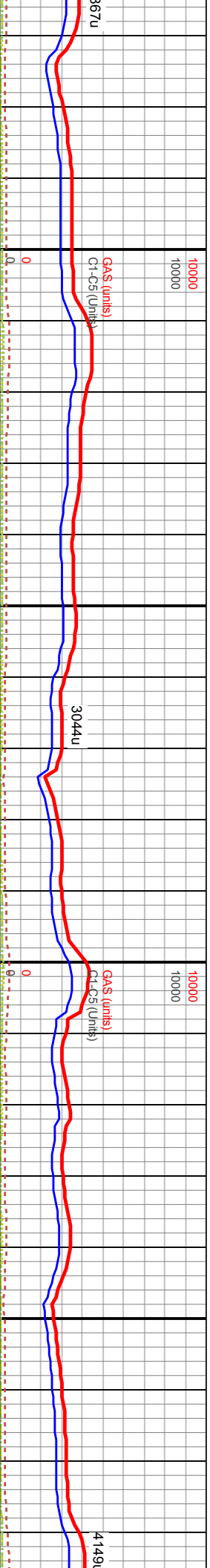
VS: 4,022'

Inclination:  $90^\circ$ 

TVĐ: 6,428

VS: 4,108





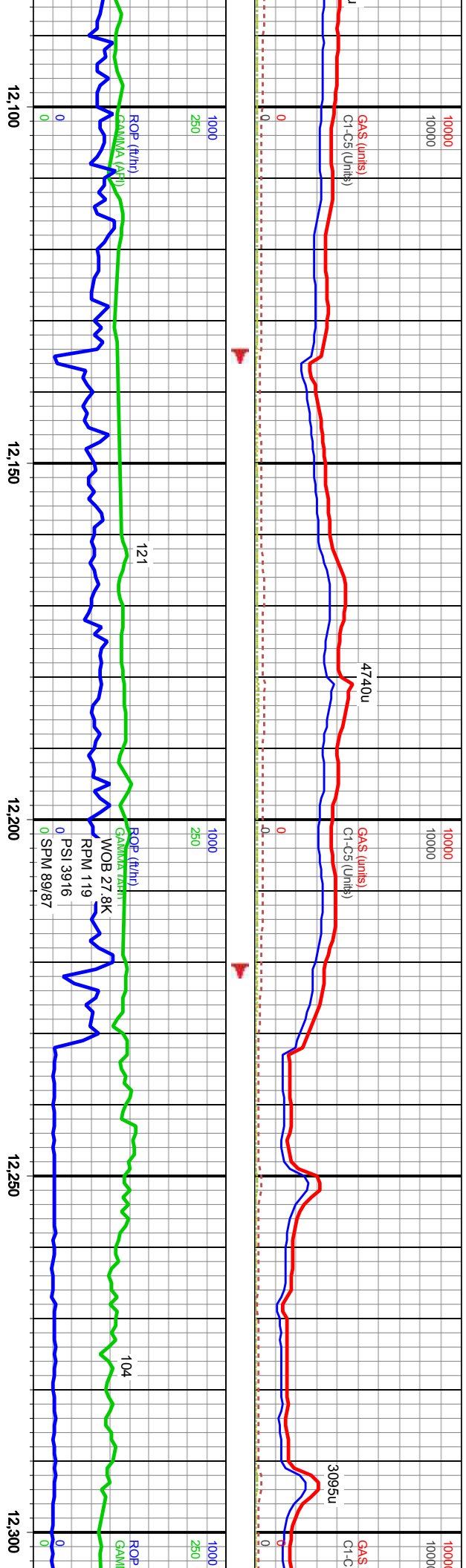
CARB CHALK: (90%) lt gry-lt gry brwn, mttld w whi merte spks ip, chlkv txt.  
dll rthy lstr, blkv-rthy frac, elong-wdglik, dn-bit, pred cin, infer chlk por, blk  
carb mat to (SH), fossiliferous ip, FOSSILIFEROUS MARL: (10%).

### Niobrara C Chalk Target

Depth (ft)	ROP (ft/hr)	Gamma (API)	WOB (22.3K)	RPM (119)	PSI (3401)	SPM (89/88)
11,900	111					
11,950	108					
12,000		118				
12,050						

MD: 11,934'  
Inclination: 89°  
Azimuth: 357°  
TVD: 6,431'  
VS: 4,455'

MD: 12,023'  
Inclination: 90°  
Azimuth: 358°  
TVD: 6,432'  
VS: 4,541'



5600		5600		5600	
CARB CHALK: (80%) lt gry-lt gry brwn, mttld w whi mcrct spks ip, chiky txt, dli rthy lst, blk-rthy frac, elong-wdglk, dn-brt, pred cin, infer chlk por, blk carb mat to (SH), fossiliferous ip, FOSSILIFEROUS MARL. (20%).					
TVD (ft)		TVD (ft)		TVD	
6600		6600		6600	

MD: 12,111'  
Inclination: 90°  
Azimuth: 1°  
TVD: 6,432'  
VS: 4,627'

MD: 12,197'  
Inclination: 90°  
Azimuth: 8°  
TVD: 6,431'  
VS: 4,712'

MD: 12,286'  
Inclination: 90°  
Azimuth: 5°  
TVD: 6,431'  
VS: 4,801'





Figure 1 consists of two panels, each showing the evolution of GAs (units) and C1-C5 (units) over time (0 to 100,000). The top panel shows the evolution for a 348u mutation, and the bottom panel shows the evolution for a 3918u mutation. In both panels, the red line represents GAs (units) and the blue line represents C1-C5 (units). The y-axis for both panels ranges from 0 to 10,000 units. The x-axis represents time from 0 to 100,000. A vertical dashed line indicates the time of the mutation event. In the top panel, the mutation occurs at approximately 34,800 units, and in the bottom panel, it occurs at approximately 39,180 units. After the mutation event, the GAs (red line) show a sharp increase, while the C1-C5 (blue line) shows a sharp decrease.



	6500	6600	6700	6800	6900	7000	7100	7200	7300	7400	7500	7600	7700	7800	7900	8000	8100	8200	8300	8400	8500	8600	8700	8800	8900	9000	9100	9200	9300	9400	9500	9600	9700	9800	9900	10000
(70%) lt gry-tt gry brwn, mttld w whi mortc spks ip, chlky txt, dlt rthy frac, elong-wdglk, dn-bit, pred cin, infer chlck por, blk fossiliferous ip, FOSSILIFEROUS MARL: (30%).	5600	TVD (ft)	5600	CARB CHALK: (70%) lt gry-tt gry c dlt rthy lsrt, blkly-rthy frac, elong-w carb mat to (SH), fossiliferous ip, F	5600	TVD (ft)																														

MD: 12,727'  
Inclination: 90°  
Azimuth: 2°  
TVD: 6,430'  
VS: 5,234'



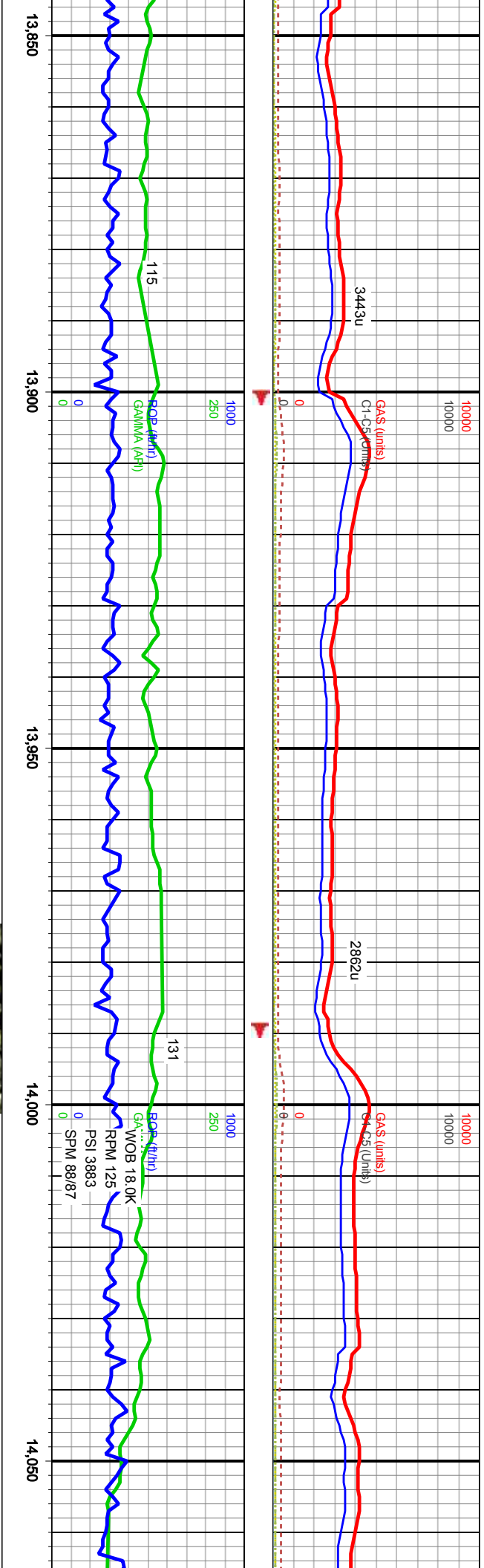












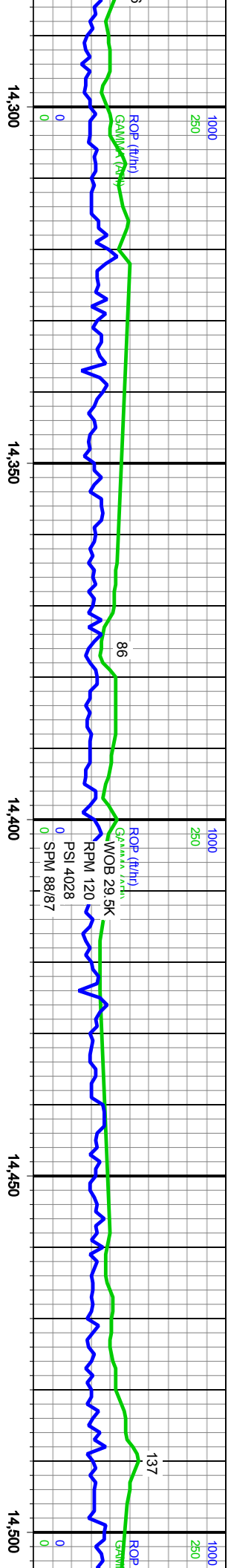
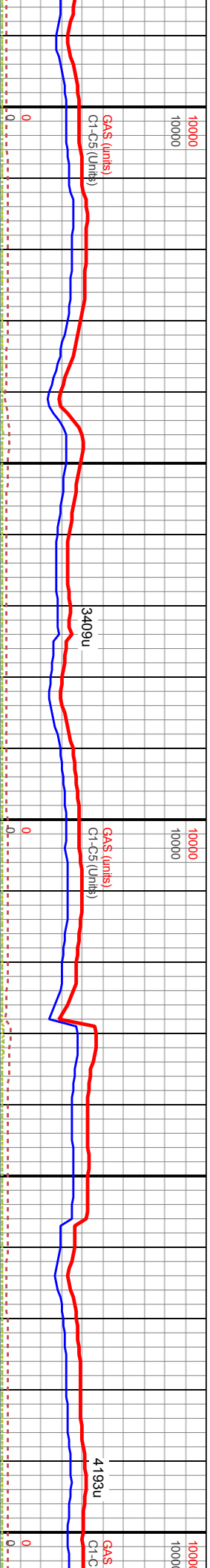
5600		5600	
CARB CHALK: (90%) lt gry-lt gry brwn, mtlld w whi mrtc spks ip, chiky txt, dill rthy lstr, blkly-rthy frac, elong-wdglk, dn-brit, pred cin, infer chlk por, blk carb mat to (SH), fossiliferous ip, FOSSILIFEROUS MARL: (10%).		5600	
TVD (ft)		TVD (ft)	
6600		6600	
Niobrara C Chalk Target		Niobrara C Chalk Target	
6600		6600	

MD: 13,874'  
Inclination: 91°  
Azimuth: 359°  
TVD: 6,426'  
VS: 6,362'

MD: 13,962'  
Inclination: 91°  
Azimuth: 0°  
TVD: 6,425'  
VS: 6,448'

MD: 14,050'  
Inclination: 91°  
Azimuth: 0°  
TVD: 6,423'  
VS: 6,534'



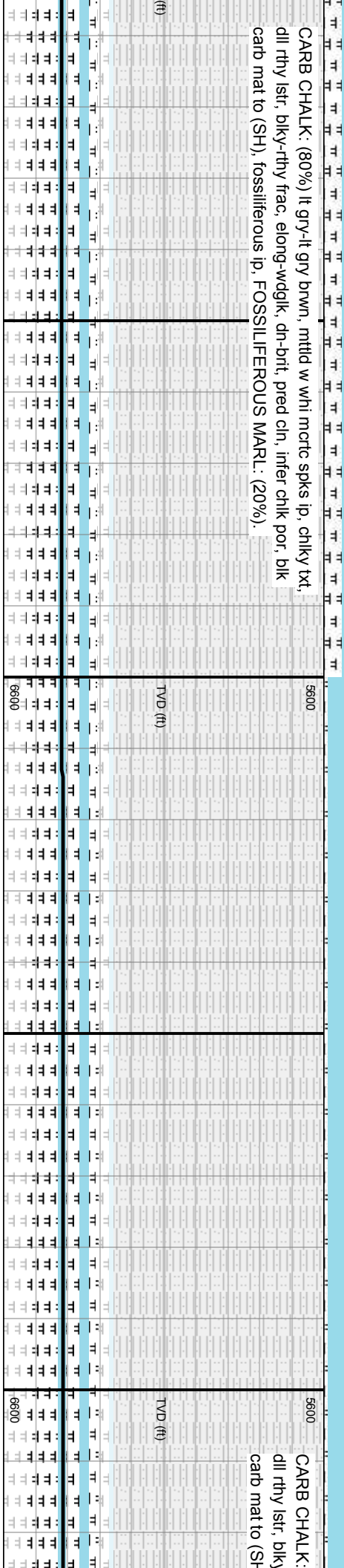
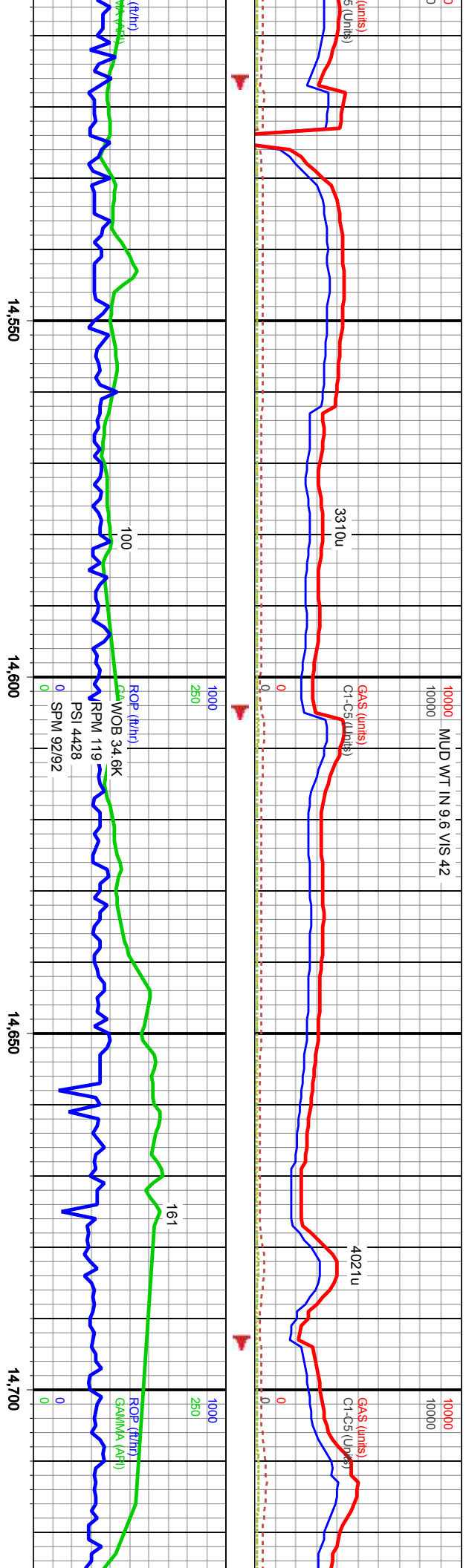


5600		5600		5600		5600	
CARB CHALK: (80%) lt gry-lt gry brwn, mtlld w whi mcrtc spks ip, chiky txt, dli rthy lstr, blk-y-rthy frac, elong-wdgk, dn-brit, pred cln, infer chlk por, blk carb mat to (SH), fossiliferous ip, FOSSILIFEROUS MARL: (20%).		TVD (ft)		TVD (ft)		Niobrara C Chalk Target	
6600		6600		6600		6600	

MD: 14,314'  
Inclination: 90°  
Azimuth: 6°  
TVD: 6,421'  
VS: 6,793'

MD: 14,403'  
Inclination: 91°  
Azimuth: 5°  
TVD: 6,420'  
VS: 6,862'

MD: 14,491'  
Inclination: 91°  
Azimuth: 5°  
TVD: 6,418'  
VS: 6,969'

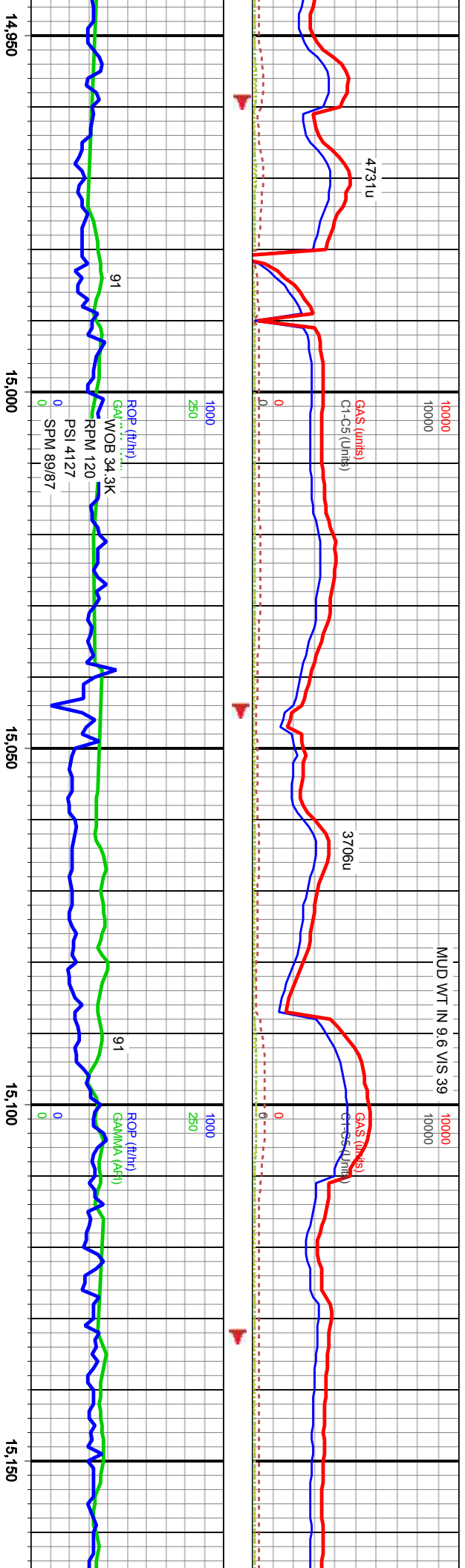


MD: 14,579'  
Inclination: 91°  
Azimuth: 4°  
TVD: 6,416'  
VS: 7.056'

MD: 14,667'  
Inclination: 91°  
Azimuth: 4°  
TVD: 6,414'  
VS: 7.143'





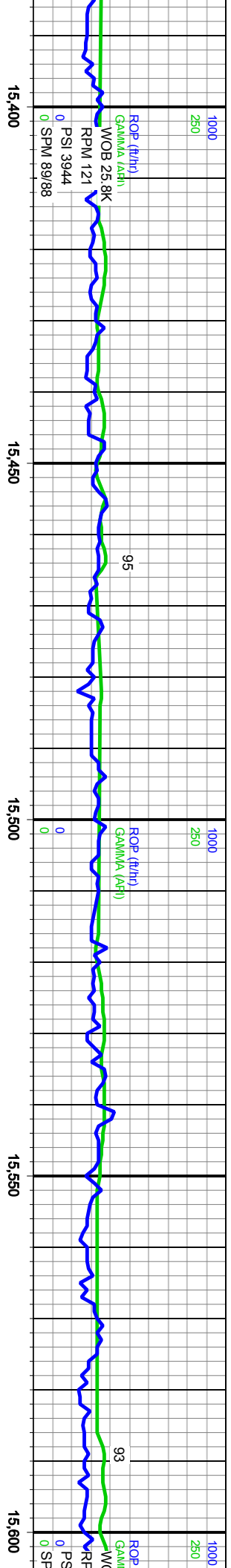
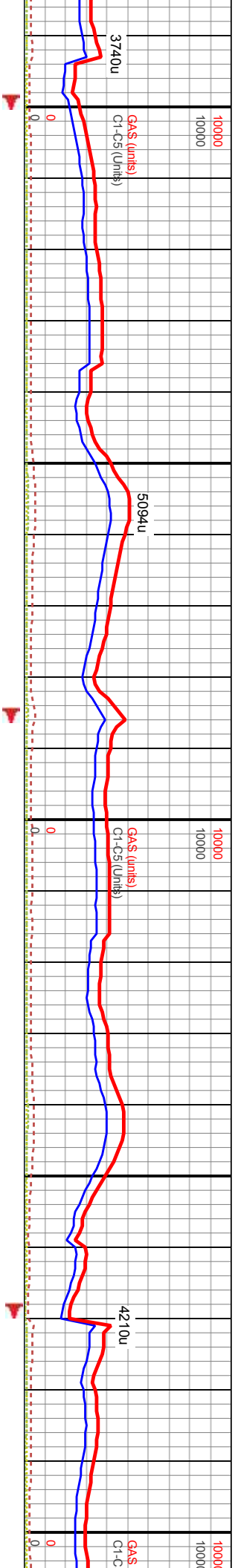


	bwn, mttld w whi mcrtc spks ip, chiky txt, wdgk, dn-brt, pred cln, infer chk por, blk FOSSILIFEROUS MARL: (2%).	5600	TVD (ft)	6600		5600	CARB CHALK: (90%) lt gry-lt gry bwn, mttld w whi dll rthy lstr, bkly-rthy frac, along-wdgk, dn-brt, pred carb mat to (SH), fossiliferous ip, FOSSILIFEROUS	6600
Niobrara C Chalk Target								

MD: 15,020'  
Inclination: 90°  
Azimuth: 355°  
TVD: 6,411'  
VS: 7,488'

MD: 15,107'  
Inclination: 90°  
Azimuth: 357°  
TVD: 6,411'  
VS: 7,572'





txt. lk	5600	TVD (ft)	6600	5600	TVD (ft)	6600	5600	TVD	6600
Niobrara C Chalk Target									
CARB CHALK: (95%) lt gry-lt gry brwn, mttld w whi merte spks ip, chlky txt, dill rthy lstr, blkly-rthy frac, elong-wdglk, dn-brit, pred clin, infer chlk por, blk carb mat to (SH), fossiliferous ip, FOSSILIFEROUS MARL: (5%).									

MD: 15,459'  
Inclination: 90°  
Azimuth: 4°  
TVD: 6,412'  
VS: 7,919'

MD: 15,543'  
Inclination: 90°  
Azimuth: 2°  
TVD: 6,411'  
VS: 8,002'

















[illegible]

TVD (ft)

TV/D (ft)

MD: 17,124' MD: 17,138'  
Inclination: 90° Inclination: 90°  
Azimuth: 11° Azimuth: 11°  
TVD: 6,408' TVD: 6,408'  
VS: 9,561' VS: 9,575'

