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## Gamma Mudlog TVD

**COMPANY** ExxonMobil Production

**WELL** PCU 296-6B1

**FIELD** PICEANCE CREEK UNIT

**REGION** ROCKIES MOUNTAINS

**COORDINATES** LAT 39.905268000  
LON 108.204977000

**ELEVATION** GL = 7364.3'  
KB = 7391.3'

**COUNTY, STATE** RIO BLANCO CO.

**API INDEX** 051031154600

**SPUD DATE** 12-17-2010

**CONTRACTOR** HELMRICH AND PAYNE

**CO. REP.** RICKY T OWENS

**RIG/TYPE** 215 / FLEX 3

**LOGGING UNIT** MLU 51

**GEOLOGISTS** BRENDA MARSH  
GEORGE BAKER

**ADD. PERSONS** DEVIN CLAAR  
BILL JOHANNING

**CO. GEOLOGIST** WILLIAM HOFFMAN

### LOG INTERVAL

### CASING DATA

**DEPTHS:** 144' TO 14,015'

**DATES:** 12-19-2010 TO 01-16-2011

**SCALE:** 1" = 100'

16" AT 144'

10.75" AT 4,528'

7" AT 9,967'

AT

### MUD TYPES

### HOLE SIZE

LSND TO 14,015'

TO

TO

TO

TO

20" TO 144'

14.75" TO 4,528'

9.875" TO 10,067'

6.125" TO 14,015'

### ABBREVIATIONS

<i>NB</i> NEWBIT	<i>PV</i> PLASTIC VISCOSITY	<i>LC</i> LOST CIRCULATION
<i>RRB</i> RERUN BIT	<i>YP</i> YIELD POINT	<i>CO</i> CIRCULATE OUT
<i>CB</i> CORE BIT	<i>FL</i> FLUID LOSS	<i>NR</i> NO RETURNS
<i>WOB</i> WEIGHT ON BIT	<i>CL</i> PPM CLORIDE ION	<i>TG</i> TRIP GAS
<i>RPM</i> ROTARY REV/MIN	<i>Rm</i> MUD RESISTIVITY	<i>SG</i> SURVEY GAS
<i>PP</i> PUMP PRESSURE	<i>Rmf</i> FILTRATE RESISTIVITY	<i>WG</i> WIPER GAS
<i>SPM</i> STROKES/MIN	<i>PR</i> POOR RETURNS	<i>CG</i> CONNECTION GAS
<i>MW</i> MUD WEIGHT	<i>LAT</i> LOGGED AFTER TRIP	
<i>VIS</i> FUNNEL VISCOSITY	<i>LAS</i> LOGGED AFTER SURVEY	

ALTERED ZONE	CHERT - GLASSY	FELSIC SILIC DIKE	MARL - CALC	SANDSTONE
ANDESITE	CHERT - PORCEL	FOSSIL	METAMORPHICS	SANDSTONE-TUFFACEOUS
ANHYDRITE	CHERT - TIGER STRIPE	GABBRO	MUDSTONE	SERICIZATION
BASALT	CHERT - UNDIFF	GLASSY TUFF	OBSIDIAN	SERPENTINE
BENTONITE	CLAY	GRANITE	PALEOSOL	SHALE
BIOTITIZATION	CLAY-MUDSTONE	GRANITE WASH	PHOSPHATE	SHALE TUFFACEOUS
BRECCIA	CLYST-TUFFACEOUS	GRANODIORITE	PORCELANITE	SHELL FRAGMENTS
CALCARENITE	CHLORITIZATION	GYPSUM	PORCELANEOUS CLYST	SIDERITE
CALCAREOUS TUFF	COAL	HALITE	PYRITE	SILICIFICATION
CALCILUTITE	CONGLOMERATE	HORNBL-QTZ-DIO	PYROCLASTICS	SILTSTONE
CARBONATES	CONGL. SAND	IGNEOUS (ACIDIC)	QUARTZ DIORITE	SILTST-TUFFACEOUS
CARBONACEOUS MAT	CONGL. SANDSTONE	IGNEOUS (BASIC)	QUARTZ LATITE	TUFF
CARBONACEOUS SH	COQUINA	INTRUSIVES	QUARTZ MONZONITE	VOLCANICLASTICS SEDS
CEMENT CONTAM.	DACITE	KAOLINITIC	RECRYSTALLIZED CALCITE	VOLCANICS
CHALK	DIATOMITE	LIMESTONE	RHYOLITE	
CRYSTALLINE TUFF	DIORITE	LITHIC TUFF	SALT	
CHERT - ARGILL	DOLOSTONE	MARL - DOLO	SAND	

<300 ROP 0>  
ft/hr  
<50 Avg WOB 0>  
klbs  
<0 Gamma 200>  
API Units

**TVD Depth**

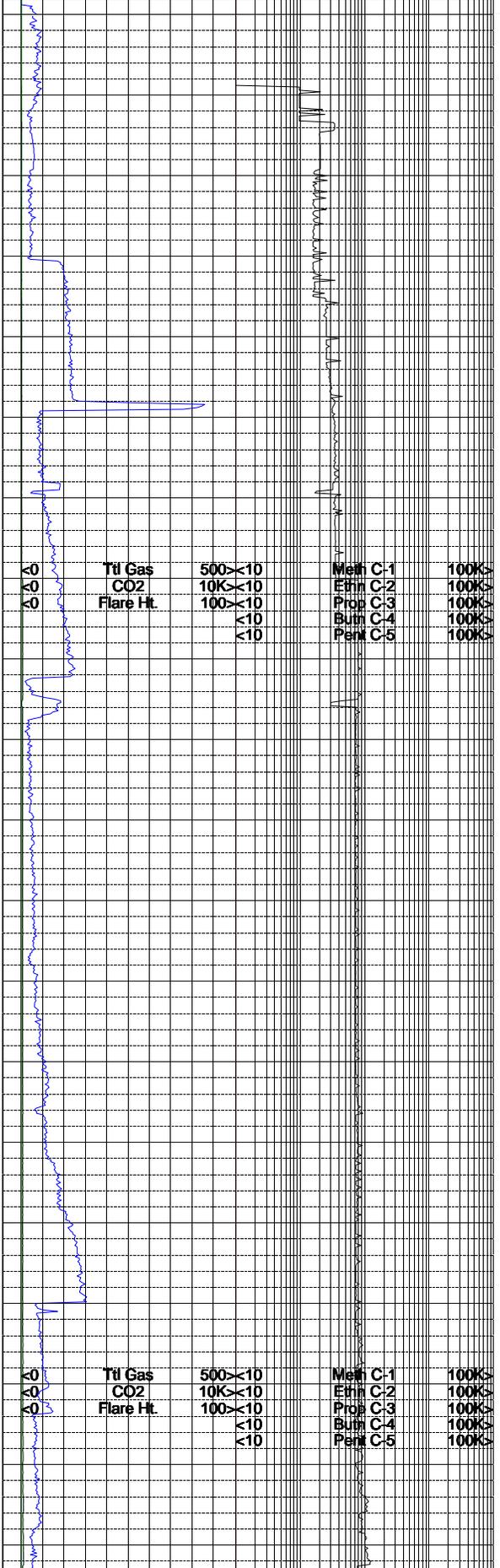
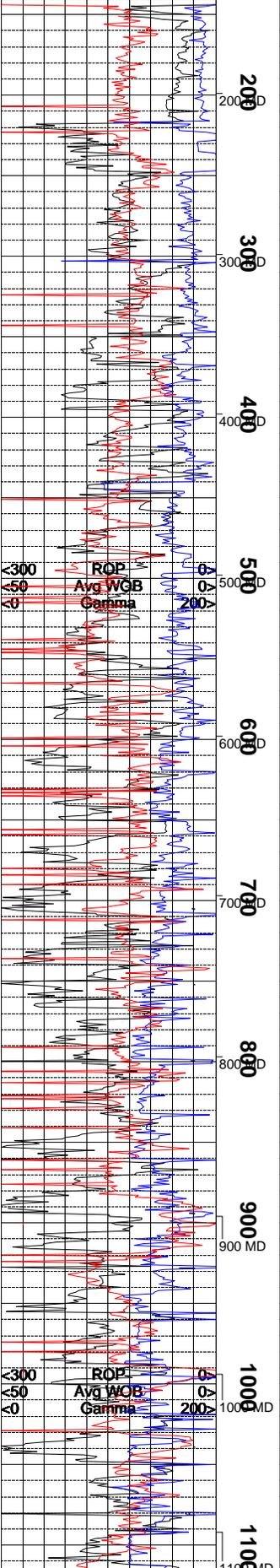
**Lithology**

MGS  
<0 Ttl Gas 500>  
units  
<0 CO2 10K>  
ppm  
<0 Flare Ht. 100>  
ft

Interp. Lith

**Remarks**  
Survey Data, Mud Reports, Other Info.

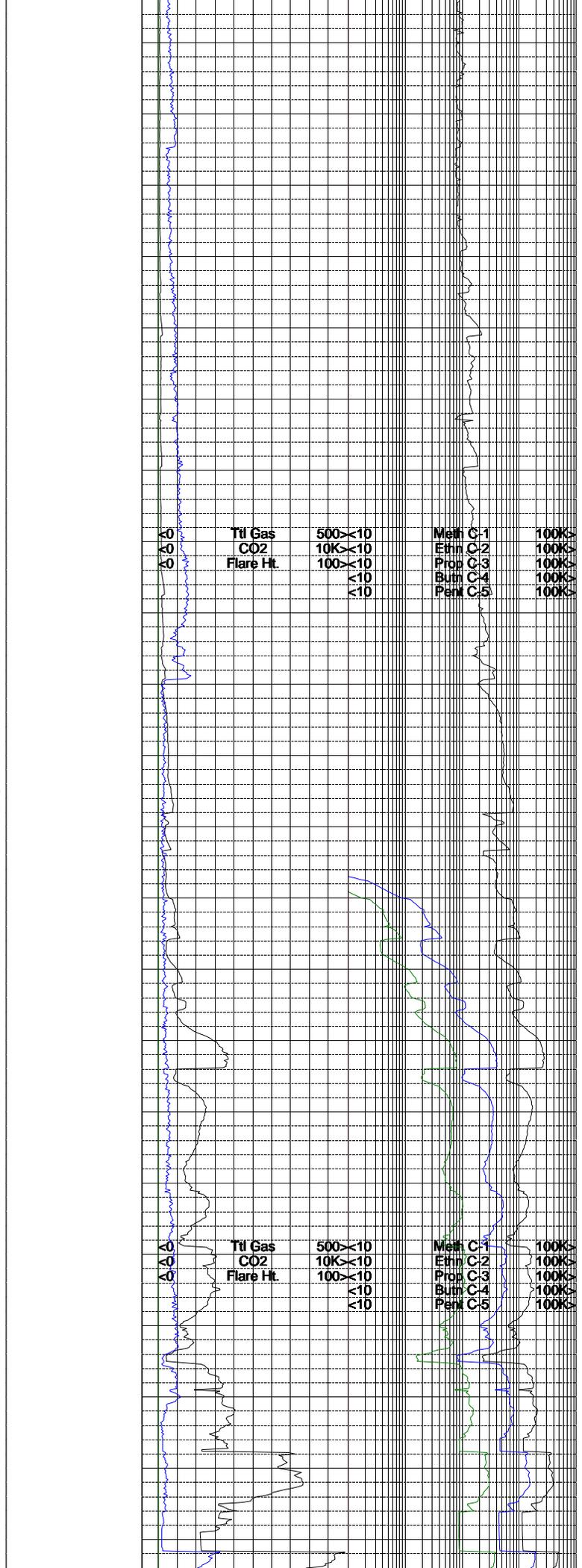
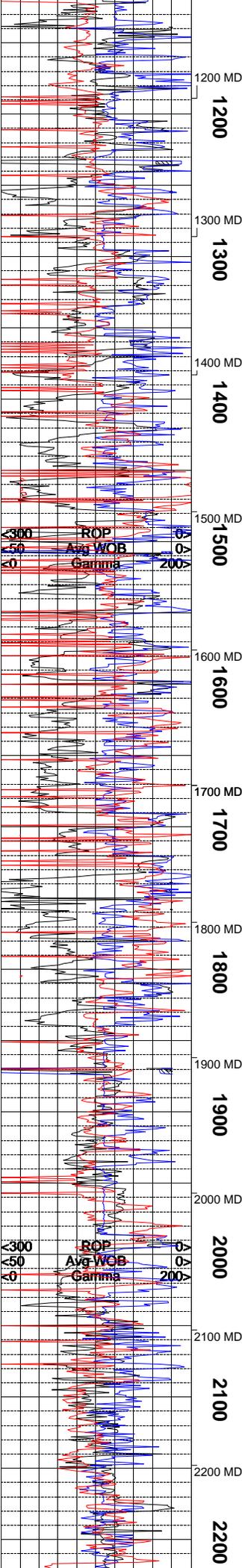
RECORDING FOR THE PCU 296-6B5 SURFACE SECTION ON 12/19/2010 AT 03:52 HRS.



Interp. Lith

<0 Ttl Gas 500>  
<0 CO2 10K>  
<0 Flare Ht. 100>  
<0 Meth C-1 100K>  
<0 Ethn C-2 100K>  
<0 Prop C-3 100K>  
<0 Butn C-4 100K>  
<0 Pent C-5 100K>

<0 Ttl Gas 500>  
<0 CO2 10K>  
<0 Flare Ht. 100>  
<0 Meth C-1 100K>  
<0 Ethn C-2 100K>  
<0 Prop C-3 100K>  
<0 Butn C-4 100K>  
<0 Pent C-5 100K>



ROP  
Avg WOB  
Gamma

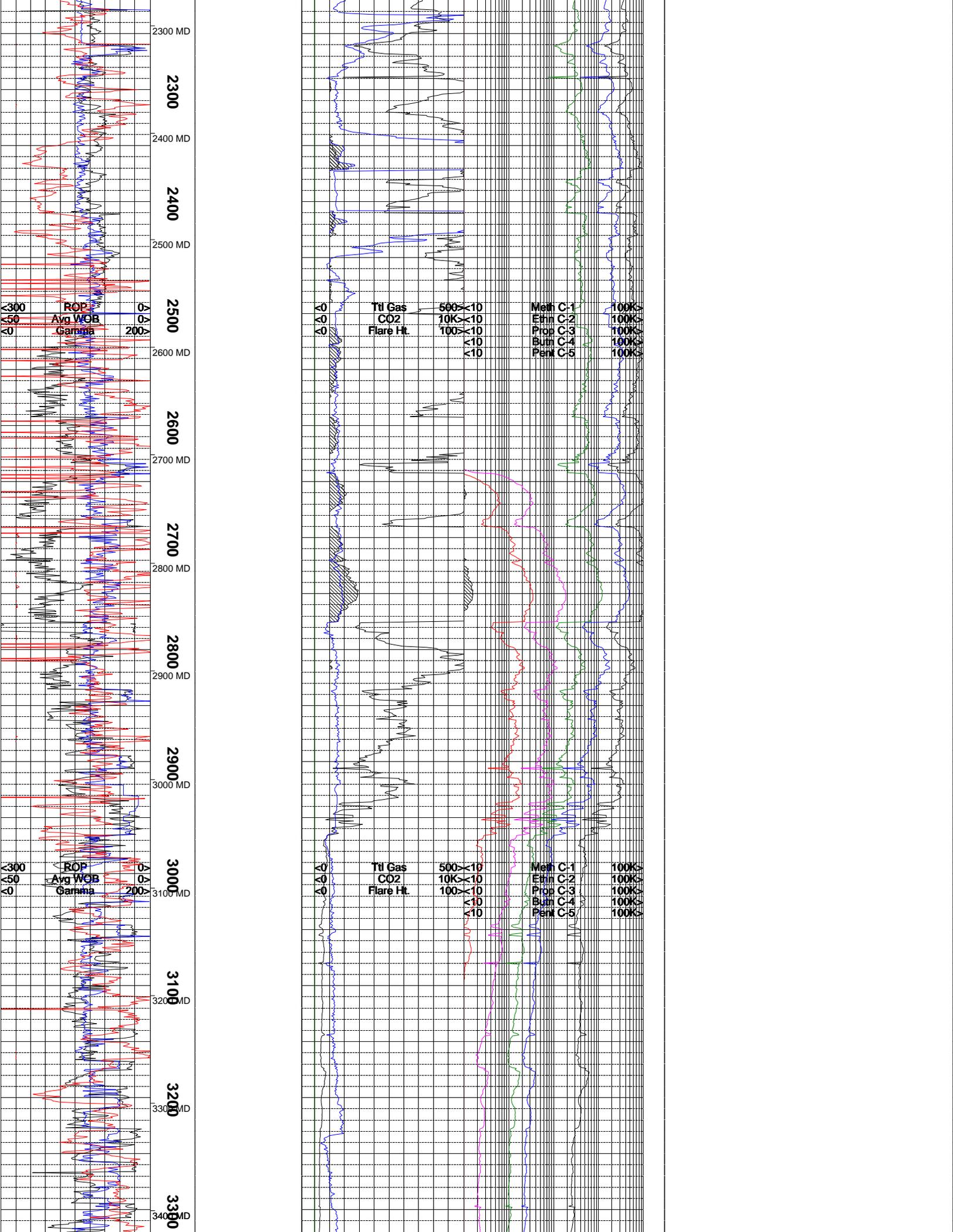
Til Gas  
CO2  
Flare Ht.

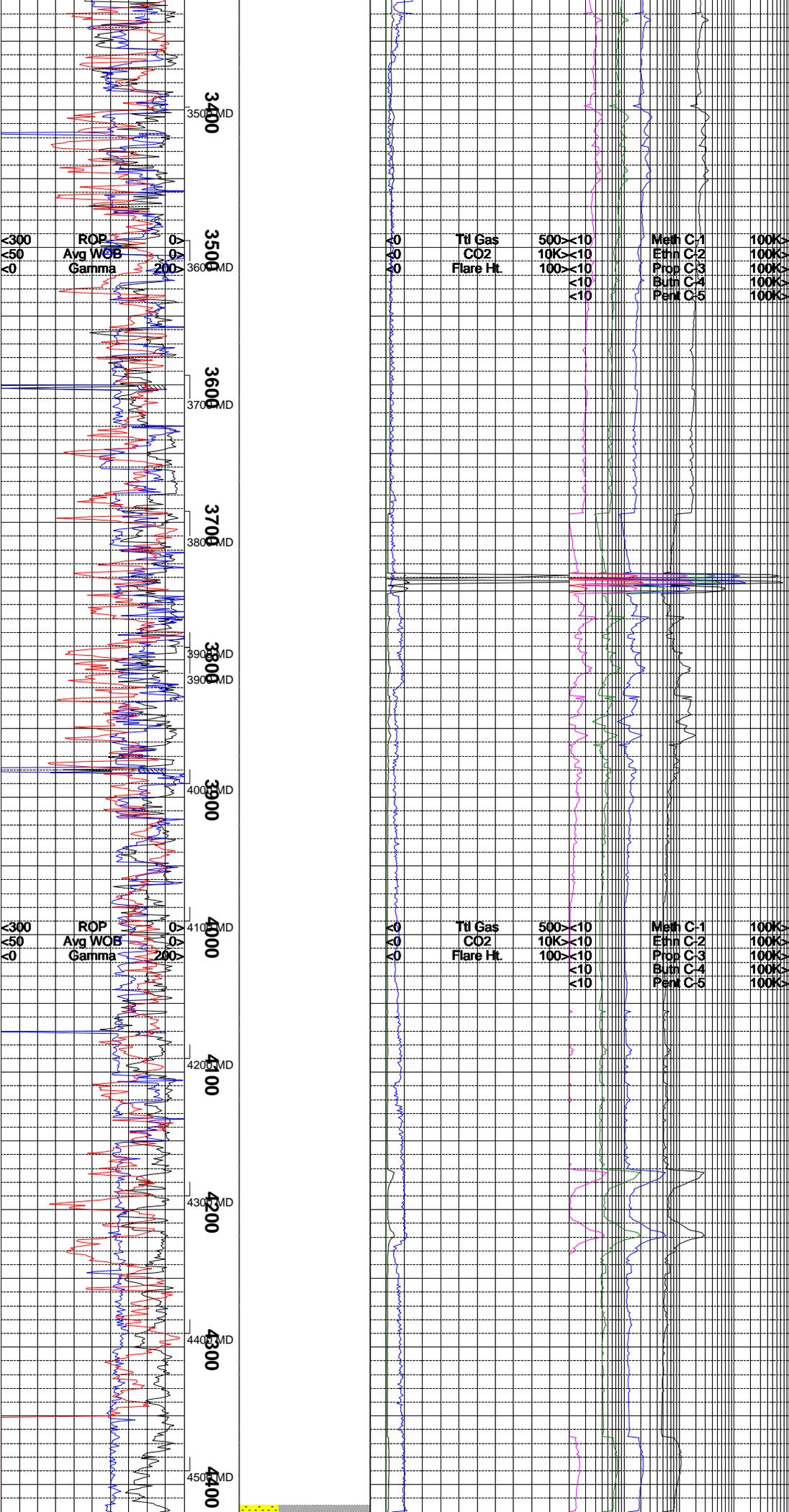
Meth C-1  
Ethn C-2  
Prop C-3  
Butn C-4  
Penl C-5

ROP  
Avg WOB  
Gamma

Til Gas  
CO2  
Flare Ht.

Meth C-1  
Ethn C-2  
Prop C-3  
Butn C-4  
Penl C-5



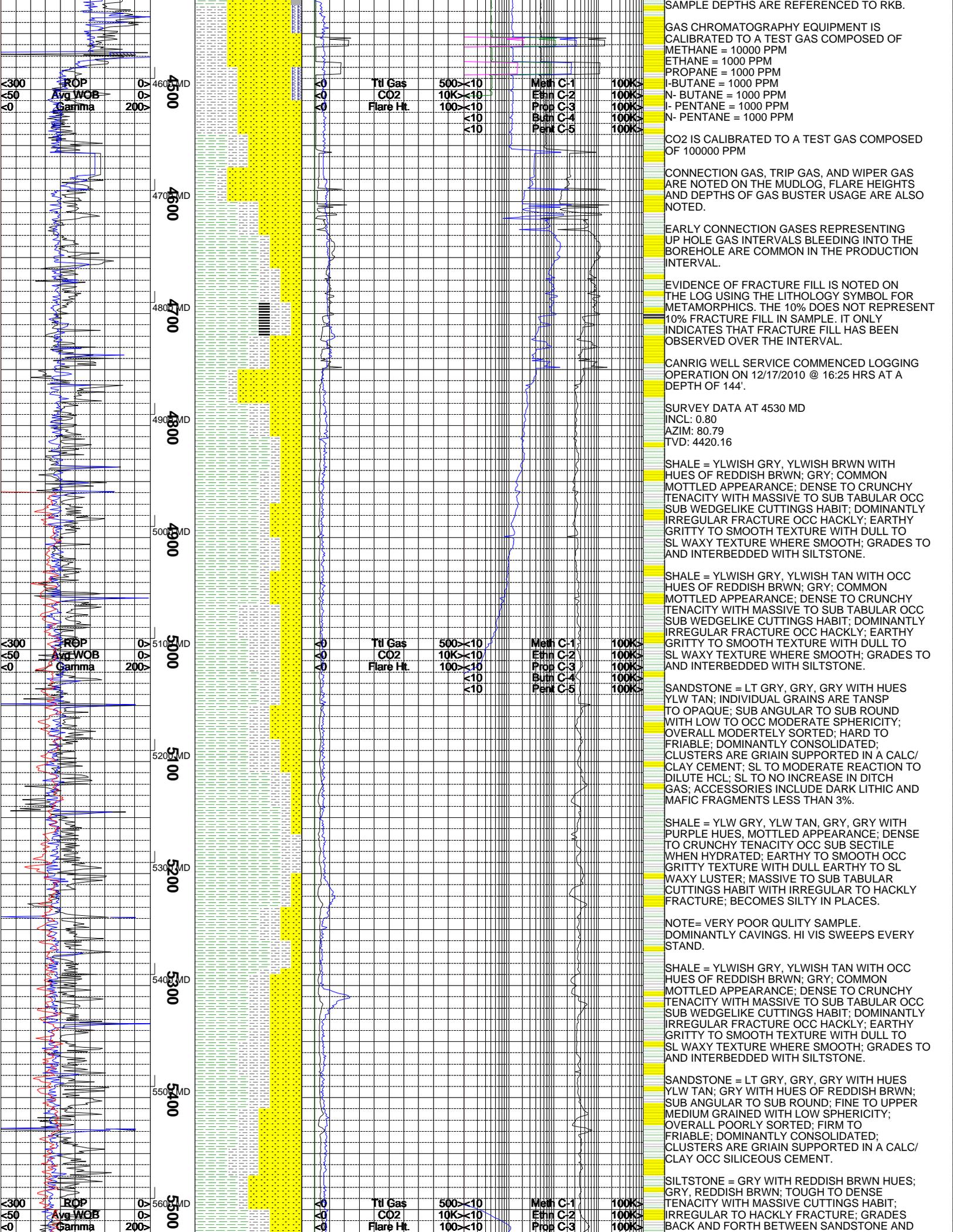


SHOOTING DRAWWORKS MOTOR AND SENSORS.

AHEAD 12/23/2010 05:00 HRS.

NOTE = REACHED CASING POINT 12/24/2010  
 BEGAN TRIPPING OUT OF HOLE AT 16:30 HRS.  
 RESUMED DRILLING AHEAD IN INTERMEDIATE  
 SECTION 12/28/2010 AT 02:13 HRS

ALL ROCK COLORS ARE REFERENCED TO THE  
 GSA ROCK COLOR CHART, ROCK CONSTITUENTS  
 ARE DESCRIBED WET AND LISTED IN ORDER OF  
 MOST ABUNDANT TO LEAST ABUNDANT, ALL



GAS CHROMATOGRAPHY EQUIPMENT IS CALIBRATED TO A TEST GAS COMPOSED OF  
 METHANE = 10000 PPM  
 ETHANE = 1000 PPM  
 PROPANE = 1000 PPM  
 I-BUTANE = 1000 PPM  
 N- BUTANE = 1000 PPM  
 I- PENTANE = 1000 PPM  
 N- PENTANE = 1000 PPM

CO2 IS CALIBRATED TO A TEST GAS COMPOSED OF 100000 PPM

CONNECTION GAS, TRIP GAS, AND WIPER GAS ARE NOTED ON THE MUDLOG, FLARE HEIGHTS AND DEPTHS OF GAS BUSTER USAGE ARE ALSO NOTED.

EARLY CONNECTION GASES REPRESENTING UP HOLE GAS INTERVALS BLEEDING INTO THE BOREHOLE ARE COMMON IN THE PRODUCTION INTERVAL.

EVIDENCE OF FRACTURE FILL IS NOTED ON THE LOG USING THE LITHOLOGY SYMBOL FOR METAMORPHICS. THE 10% DOES NOT REPRESENT 10% FRACTURE FILL IN SAMPLE. IT ONLY INDICATES THAT FRACTURE FILL HAS BEEN OBSERVED OVER THE INTERVAL.

CANRIG WELL SERVICE COMMENCED LOGGING OPERATION ON 12/17/2010 @ 16:25 HRS AT A DEPTH OF 144'

SURVEY DATA AT 4530 MD  
 INCL: 0.80  
 AZIM: 80.79  
 TVD: 4420.16

SHALE = YLWISH GRY, YLWISH BRWN WITH HUES OF REDDISH BRWN; GRY: COMMON MOTTLED APPEARANCE; DENSE TO CRUNCHY TENACITY WITH MASSIVE TO SUB TABULAR OCC SUB WEDGELIKE CUTTINGS HABIT; DOMINANTLY IRREGULAR FRACTURE OCC HACKLY; EARTHY GRITTY TO SMOOTH TEXTURE WITH DULL TO SL WAXY TEXTURE WHERE SMOOTH; GRADES TO AND INTERBEDDED WITH SILTSTONE.

SHALE = YLWISH GRY, YLWISH TAN WITH OCC HUES OF REDDISH BRWN; GRY: COMMON MOTTLED APPEARANCE; DENSE TO CRUNCHY TENACITY WITH MASSIVE TO SUB TABULAR OCC SUB WEDGELIKE CUTTINGS HABIT; DOMINANTLY IRREGULAR FRACTURE OCC HACKLY; EARTHY GRITTY TO SMOOTH TEXTURE WITH DULL TO SL WAXY TEXTURE WHERE SMOOTH; GRADES TO AND INTERBEDDED WITH SILTSTONE.

SANDSTONE = LT GRY, GRY, GRY WITH HUES YLW TAN; INDIVIDUAL GRAINS ARE TANSF TO OPAQUE; SUB ANGULAR TO SUB ROUND WITH LOW TO OCC MODERATE SPHERICITY; OVERALL MODERATELY SORTED; HARD TO FRIABLE; DOMINANTLY CONSOLIDATED; CLUSTERS ARE GRAIN SUPPORTED IN A CALC/ CLAY CEMENT; SL TO MODERATE REACTION TO DILUTE HCL; SL TO NO INCREASE IN DITCH GAS; ACCESSORIES INCLUDE DARK LITHIC AND MAFIC FRAGMENTS LESS THAN 3%.

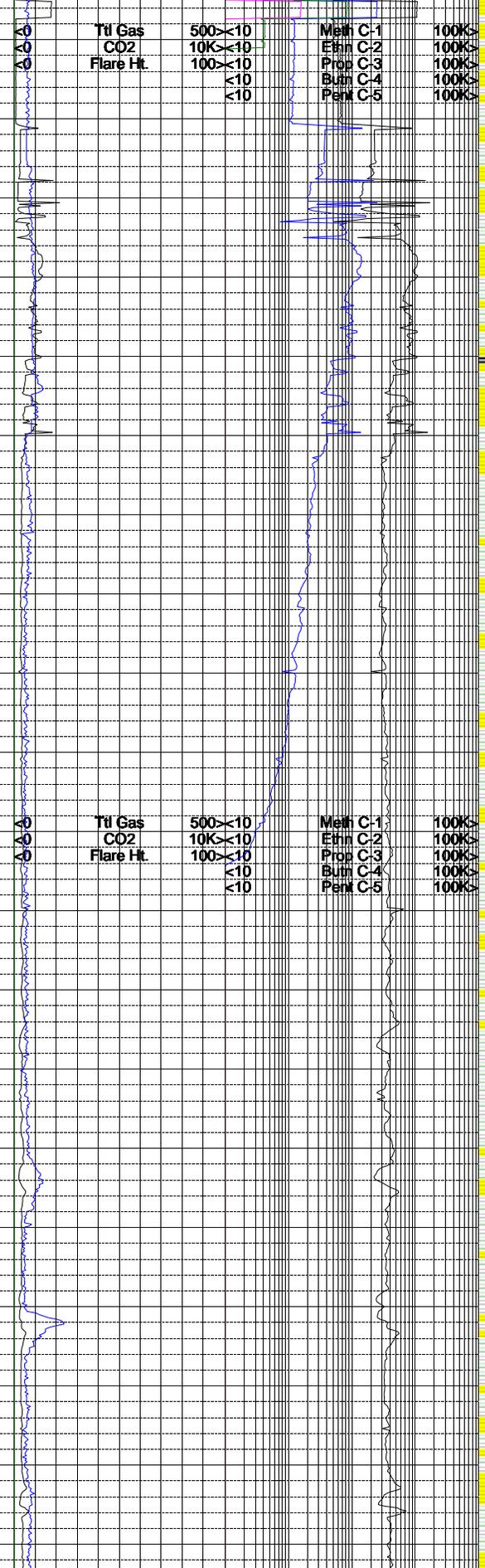
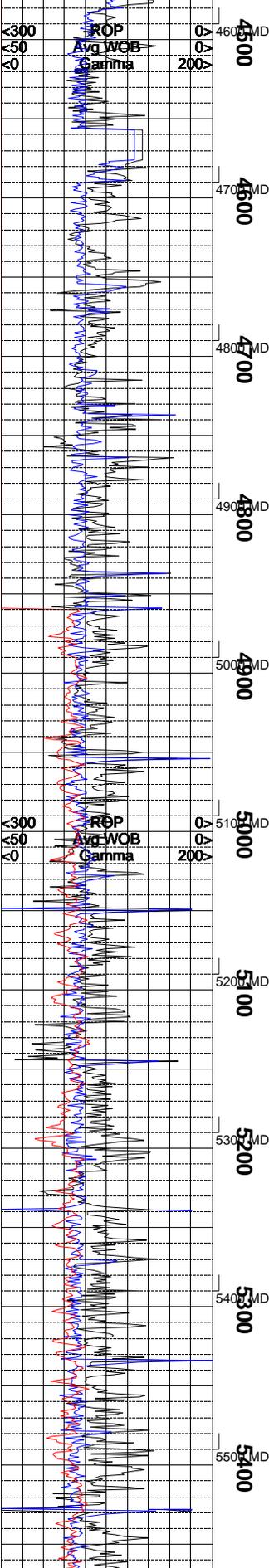
SHALE = YLW GRY, YLW TAN, GRY, GRY WITH PURPLE HUES, MOTTLED APPEARANCE; DENSE TO CRUNCHY TENACITY OCC SUB SECTILE WHEN HYDRATED; EARTHY TO SMOOTH OCC GRITTY TEXTURE WITH DULL EARTHY TO SL WAXY LUSTER; MASSIVE TO SUB TABULAR CUTTINGS HABIT WITH IRREGULAR TO HACKLY FRACTURE; BECOMES SILTY IN PLACES.

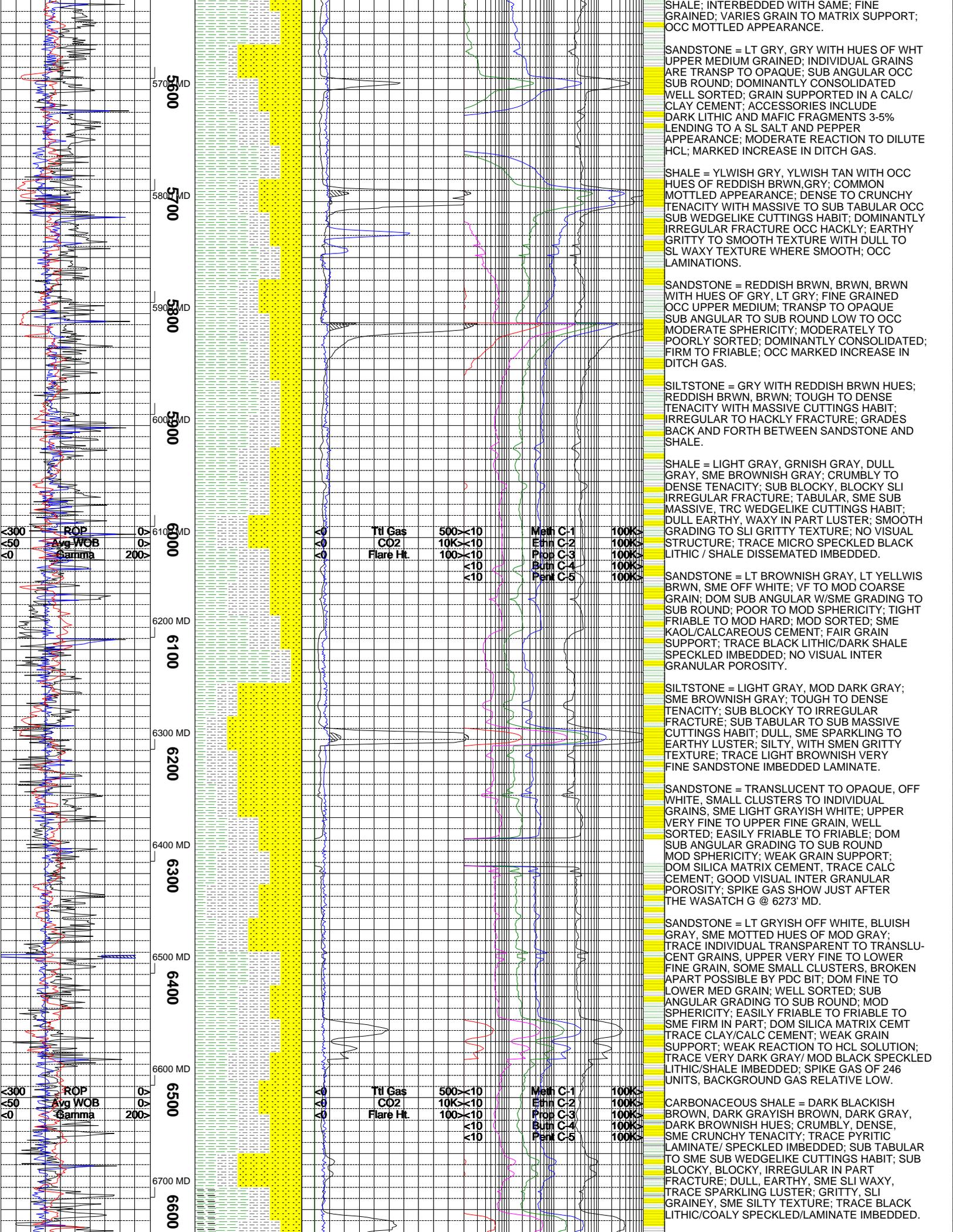
NOTE= VERY POOR QULITY SAMPLE. DOMINANTLY CAVINGS. HI VIS SWEEPS EVERY STAND.

SHALE = YLWISH GRY, YLWISH TAN WITH OCC HUES OF REDDISH BRWN; GRY: COMMON MOTTLED APPEARANCE; DENSE TO CRUNCHY TENACITY WITH MASSIVE TO SUB TABULAR OCC SUB WEDGELIKE CUTTINGS HABIT; DOMINANTLY IRREGULAR FRACTURE OCC HACKLY; EARTHY GRITTY TO SMOOTH TEXTURE WITH DULL TO SL WAXY TEXTURE WHERE SMOOTH; GRADES TO AND INTERBEDDED WITH SILTSTONE.

SANDSTONE = LT GRY, GRY, GRY WITH HUES YLW TAN; GRY WITH HUES OF REDDISH BRWN; SUB ANGULAR TO SUB ROUND; FINE TO UPPER MEDIUM GRAINED WITH LOW SPHERICITY; OVERALL POORLY SORTED; FIRM TO FRIABLE; DOMINANTLY CONSOLIDATED; CLUSTERS ARE GRAIN SUPPORTED IN A CALC/ CLAY OCC SILICEOUS CEMENT.

SILTSTONE = GRY WITH REDDISH BRWN HUES; GRY, REDDISH BRWN; TOUGH TO DENSE TENACITY WITH MASSIVE CUTTINGS HABIT; IRREGULAR TO HACKLY FRACTURE; GRADES BACK AND FORTH BETWEEN SANDSTONE AND





5700 MD  
5800 MD  
5900 MD  
6000 MD  
6100 MD  
6200 MD  
6300 MD  
6400 MD  
6500 MD  
6600 MD

ROP  
Avg WOB  
Gamma

Til Gas  
CO2  
Flare Ht

500 > 10  
100 > 10  
100 > 10  
< 10  
< 10

Meth C-1  
Ethn C-2  
Prop C-3  
Burn C-4  
Perm C-5

100K  
100K  
100K  
100K  
100K

SHALE; INTERBEDDED WITH SAME; FINE GRAINED; VARIES GRAIN TO MATRIX SUPPORT; OCC MOTTLED APPEARANCE.

SANDSTONE = LT GRY, GRY WITH HUES OF WHT UPPER MEDIUM GRAINED; INDIVIDUAL GRAINS ARE TRANSP TO OPAQUE; SUB ANGULAR OCC SUB ROUND; DOMINANTLY CONSOLIDATED WELL SORTED; GRAIN SUPPORTED IN A CALC/CLAY CEMENT; ACCESSORIES INCLUDE DARK LITHIC AND MAFIC FRAGMENTS 3-5% LENDING TO A SL SALT AND PEPPER APPEARANCE; MODERATE REACTION TO DILUTE HCL; MARKED INCREASE IN DITCH GAS.

SHALE = YLWISH GRY, YLWISH TAN WITH OCC HUES OF REDDISH BRWN, GRY; COMMON MOTTLED APPEARANCE; DENSE TO CRUNCHY TENACITY WITH MASSIVE TO SUB TABULAR OCC SUB WEDGELIKE CUTTINGS HABIT; DOMINANTLY IRREGULAR FRACTURE OCC HACKLY; EARTHY GRITTY TO SMOOTH TEXTURE WITH DULL TO SL WAXY TEXTURE WHERE SMOOTH; OCC LAMINATIONS.

SANDSTONE = REDDISH BRWN, BRWN, BRWN WITH HUES OF GRY, LT GRY; FINE GRAINED OCC UPPER MEDIUM; TRANSP TO OPAQUE SUB ANGULAR TO SUB ROUND LOW TO OCC MODERATE SPHERICITY; MODERATELY TO POORLY SORTED; DOMINANTLY CONSOLIDATED; FIRM TO FRIABLE; OCC MARKED INCREASE IN DITCH GAS.

SILTSTONE = GRY WITH REDDISH BRWN HUES; REDDISH BRWN, BRWN; TOUGH TO DENSE TENACITY WITH MASSIVE CUTTINGS HABIT; IRREGULAR TO HACKLY FRACTURE; GRADES BACK AND FORTH BETWEEN SANDSTONE AND SHALE.

SHALE = LIGHT GRAY, GRNISH GRAY, DULL GRAY, SME BROWNISH GRAY; CRUMBLY TO DENSE TENACITY; SUB BLOCKY, BLOCKY SLI IRREGULAR FRACTURE; TABULAR, SME SUB MASSIVE, TRC WEDGELIKE CUTTINGS HABIT; DULL EARTHY, WAXY IN PART LUSTER; SMOOTH GRADING TO SLI GRITTY TEXTURE; NO VISUAL STRUCTURE; TRACE MICRO SPECKLED BLACK LITHIC / SHALE DISSEMINATED IMBEDDED.

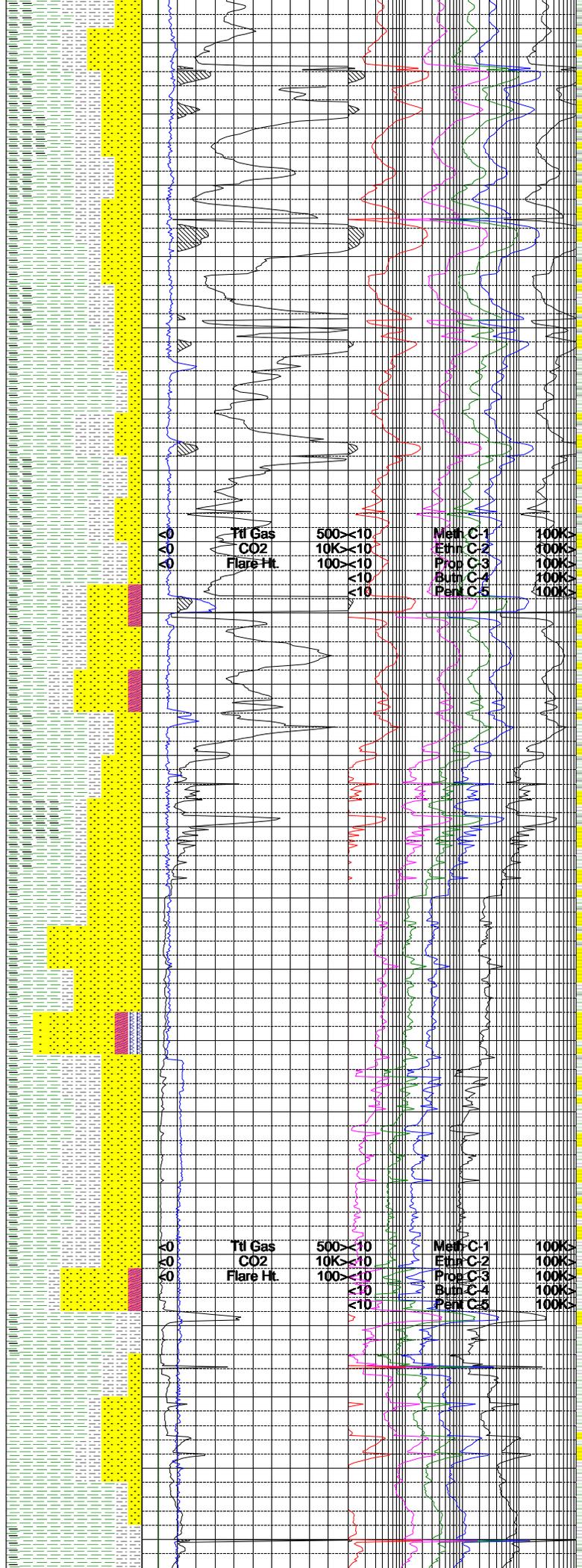
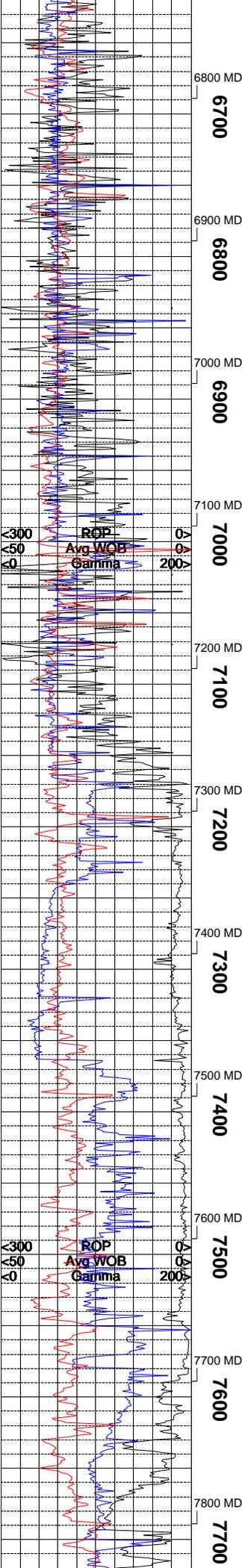
SANDSTONE = LT BROWNISH GRAY, LT YELLWIS BRWN, SME OFF WHITE; VF TO MOD COARSE GRAIN; DOM SUB ANGULAR W/SME GRADING TO SUB ROUND; POOR TO MOD SPHERICITY; TIGHT FRIABLE TO MOD HARD; MOD SORTED; SME KAOL/CALCAREOUS CEMENT; FAIR GRAIN SUPPORT; TRACE BLACK LITHIC/DARK SHALE SPECKLED IMBEDDED; NO VISUAL INTER GRANULAR POROSITY.

SILTSTONE = LIGHT GRAY, MOD DARK GRAY; SME BROWNISH GRAY; TOUGH TO DENSE TENACITY; SUB BLOCKY TO IRREGULAR FRACTURE; SUB TABULAR TO SUB MASSIVE CUTTINGS HABIT; DULL, SME SPARKLING TO EARTHY LUSTER; SILTY, WITH SMEN GRITTY TEXTURE; TRACE LIGHT BROWNISH VERY FINE SANDSTONE IMBEDDED LAMINATE.

SANDSTONE = TRANSLUCENT TO OPAQUE, OFF WHITE, SMALL CLUSTERS TO INDIVIDUAL GRAINS, SME LIGHT GRAYISH WHITE; UPPER VERY FINE TO UPPER FINE GRAIN, WELL SORTED; EASILY FRIABLE TO FRIABLE; DOM SUB ANGULAR GRADING TO SUB ROUND MOD SPHERICITY; WEAK GRAIN SUPPORT; DOM SILICA MATRIX CEMENT, TRACE CALC CEMENT; GOOD VISUAL INTER GRANULAR POROSITY; SPIKE GAS SHOW JUST AFTER THE WASATCH G @ 6273' MD.

SANDSTONE = LT GRYISH OFF WHITE, BLUISH GRAY, SME MOTTLED HUES OF MOD GRAY; TRACE INDIVIDUAL TRANSPARENT TO TRANSLUCENT GRAINS, UPPER VERY FINE TO LOWER FINE GRAIN, SOME SMALL CLUSTERS, BROKEN APART POSSIBLE BY PDC BIT; DOM FINE TO LOWER MED GRAIN; WELL SORTED; SUB ANGULAR GRADING TO SUB ROUND; MOD SPHERICITY; EASILY FRIABLE TO FRIABLE TO SME FIRM IN PART; DOM SILICA MATRIX CEMENT TRACE CLAY/CALC CEMENT; WEAK GRAIN SUPPORT; WEAK REACTION TO HCL SOLUTION; TRACE VERY DARK GRAY/ MOD BLACK SPECKLED LITHIC/SHALE IMBEDDED; SPIKE GAS OF 246 UNITS, BACKGROUND GAS RELATIVE LOW.

CARBONACEOUS SHALE = DARK BLACKISH BROWN, DARK GRAYISH BROWN, DARK GRAY, DARK BROWNISH HUES; CRUMBLY, DENSE, SME CRUNCHY TENACITY; TRACE PYRITIC LAMINATE/ SPECKLED IMBEDDED; SUB TABULAR TO SME SUB WEDGELIKE CUTTINGS HABIT; SUB BLOCKY, BLOCKY, IRREGULAR IN PART FRACTURE; DULL, EARTHY, SME SLI WAXY, TRACE SPARKLING LUSTER; GRITTY, SLI GRAINEY, SME SILTY TEXTURE; TRACE BLACK LITHIC/COALY SPECKLED/LAMINATE IMBEDDED.



SANDSTONE = LIGHT GRAY, LIGHT BROWNISH TAN, TRACE BROWNISH GRAY, SME HUES OF MOD GRAY; DOM LOWER AND UPPER FINE GRAIN SME INDIVIDUAL TRANSLUCENT/OPAQUE SML GRAIN CLUSTERS; FRIABLE GRADING TO FIRM; POOR TO FAIR SORTED; DOM SUB ANGULAR W/ SME SUB ROUNDED; MOD LOW SPHERICITY; BROWNISH CLAYEY/CALC CEMENT, TRACE SILICA MATRIX CEMENT, LOW HCL REACTION; POOR VISUAL INTER GRANULAR POROSITY; TRACE DARK GRAY/BLACKISH LITHIC/CARBONACEOUS SHALE SPECKLED IMBEDDED.

SHALE = GRAY, DARK GRAY, BROWNISH GRAY, HUES OF MOD GRAYISH BROWN, TRACE DARK BROWNISH BLACK CARBONACEOUS SHALE LAMINATE; CRUMBLY, SME DENSE TENACITY; SUB BLOCKY, BLOCKY, TRACE PLANAR, IRREG FRACTURE; WEDGELIKE, PLATY, TABULAR IN PART CUTTINGS HABIT; DULL, EARTHY, SME WAXY, TRACE SPARKLING LUSTER; GRITTY TO SLI GRANULAR TEXTURE; TRACE LIGHT BROWN VERY FINE SANDSTONE IMBEDDED.

CARBONACEOUS SHALE = DARK BROWNISH GRAY, BLACKISH BROWN, DARK HUES GRAYISH BROWN; TRACE PYRITIC SPECKLED OCC LAMINATE; CRUNCHY, DENSE IN PART TENACITY; SUB BLOCKY, IRREGULAR SME PLANAR FRACTURE; WEDGELIKE, TABULAR, SME PLATY CUTTINGS HABIT; DULL, SLI WAXY EARTHY, SME SPARKLING LUSTER; SILTY, GRADING TO GRITTY, TRACE SANDSTONE GRANULAR TEXTURE; TRACE BLACK COALY/ LITHIC DISSEMATED IMBEDDED.

SANDSTONE = LIGHT YELLOWISH BROWN, LIGHT BROWNISH GRAY, LIGHT GRAY; DOM UPPER FINE, SME UPPER VERY FINE/LOWER FINE GRAIN; FAIR TO GOOD SORTED; SUB ANGULAR GRADING TO SUB ROUND, MOD SPHERICITY; FRIABLE TO FIRM TO SME HARD; DOM LT BROWNISH CLAYEY/ WEAK CALC CEMENT, TRACE SILICA MATRIX CEMENT; LOW HCL REACTION; FAIR GRAIN SUPPORTED; TRAC BLACKISH/BROWN CARBONACEOUS SHALE/ LITHIC LAMINATE, SOME DISSEMATED IMBEDDED; TRACE YELLOW BROWN SILTY SILTSTONE LAMIATED.

CARBONACEOUS SHALE = DARK BROWN, BLACK, DENSE TO CRUNCHY TENACITY WITH SUB TABULAR TO SUB PLATY CUTTINGS HABIT OCC WEDGELIKE; IRREGULAR TO HACKLY FRACTURE WITH PLANAR FRACTURE WHERE PLATY; OCC OCCURS AS LAMINATIONS; MODERATELY TO STRONGLY PYRITIC; SMOOTH TO SL EARTHY TEXTURE WITH EARTHY TO WAXY TO OCC SUB VITREOUS LUSTER; GRADES TO AND INTER BEDDED WITH SHALES. SL TO MODERATE INCREASE IN DITCH GAS; NO REACTION TO DILUTE HCL.

SHALE = GRAY, DARK GRAY, BROWNISH GRAY, HUES OF LT GRAYISH BROWN, OCCASIONAL DARK BRWNISH BLACK CARBONACEOUS MATERIAL LAMINAE; DENSE TO CRUMBLY TENACITY WITH MASSIVE TO SUB TABULAR CUTTINGS HABIT; IRREGULAR FRACTURE OCC PLANAR WHEN LAMINATED OR PLATY. OCC SL PYRITIC IN PLACES. EARTHY TO WAXY TEXTURE OCC GRANULAR IN PLACES; DULL TO WAXY LUSTER OCC SL SPARKLY WHEN BECOMING SILTY.

NOTE=TOH FOR NEW BIT @ 7473' MD 12-29-10 RESUMED DRILLING AHEAD 01-01-11 @ 13:02 HRS.

SANDSTONE = LT BLUISH GRY, OFF WHITE, LT GRAY, TRACE SALT AND PEPPER APPEARANACE, DOM W SORTED; SUB ANGULAR GRADING TO LOW SUB ROUNDED; MOD SPHERICITY; FRIABLE TO FIRM AND HARD; SILICA MATRIX CEMENT; TRACE CLAYEY/CALC CEMENT, WEAK HCL REACT FAIR TO POOR VISUAL INTER GRANULAR PORO; TRCE BLACK SPECKLED CARBONACEOUS SHALE/ LITHIC IMBEDDED; VERY LOW BACKGROUND GAS

NOTE = TRIP OUT OF HOLE FOR NEW BIT DUE TO SLOW ROP 01-02-2010 AT 14:00 HRS RESUMED DRILLING AHEAD 01-03-2011AT 09:30 HRS WITH BIT # 4.

SANDSTONE = LT GRY, GRY WITH HUES OF WHT UPPER MEDIUM GRAINED; INDIVIDUAL GRAINS ARE TRANSP TO OPAQUE; SUB ANGULAR OCC SUB ROUND; DOMINANTLY CONSOLIDATED WELL SORTED; GRAIN SUPPORTED IN A CALC/ CLAY CEMENT; ACCESSORIES INCLUDE DARK LITHIC AND MAFIC FRAGMENTS 3-5% SALT AND PEPPER APPEARANCE; SL TO MOD REACTION TO DILUTE HCL; SL INCREASE IN DITCH GAS.

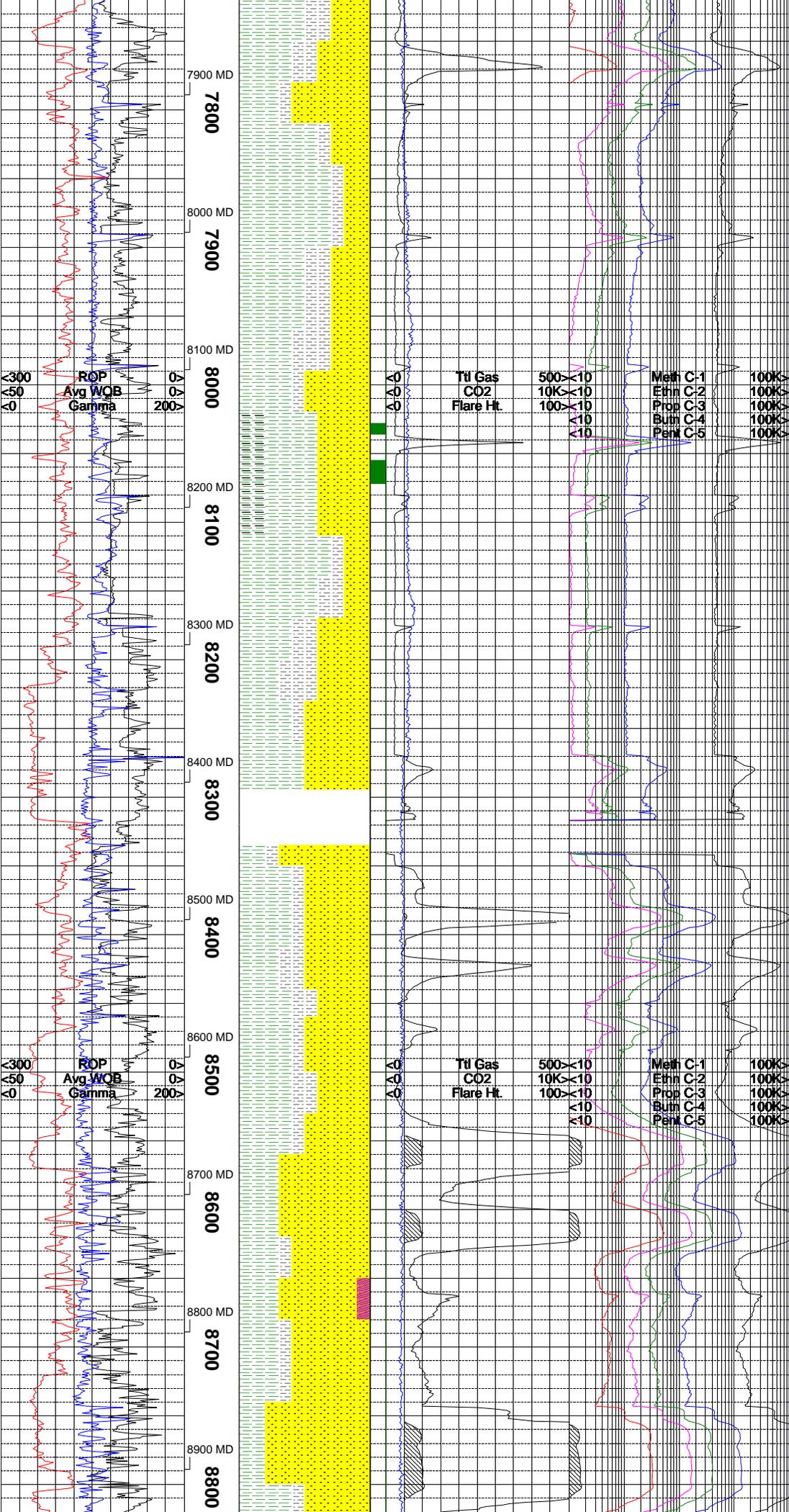
SHALE = LT GRY, GRY, GRYISH BLUE, SL MOTTLED IN PLACES; DENSE TO STIFF TENACITY WITH SUB MASSIVE TO WEDGELIKE SUB BLADED CUTTINGS HABIT; IRREGULAR FRACTURE; SMOOTH TO CLAYEY TEXTURE WITH DULL TO WAXY LUSTER.

300  
150  
0  
ROP  
Avg WOB  
Gamma  
200

Ti Gas 500x10  
CO2 100x10  
Flare Ht <10  
Meth C-1 100K  
Ethn C-2 100K  
Prop C-3 100K  
Bum C-4 100K  
Perm C-5 100K

300  
150  
0  
ROP  
Avg WOB  
Gamma  
200

Ti Gas 500x10  
CO2 100x10  
Flare Ht <10  
Meth C-1 100K  
Ethn C-2 100K  
Prop C-3 100K  
Bum C-4 100K  
Perm C-5 100K



SANDSTONE = WHITE TO SPECKLED BROWN WH; LOWER MEDIUM TO FINE GRAINED; ANGULAR TO SUBANGULAR; MOD SORTED; TAN/BROWN LITHIC FRAGMENTS; SCATTERED BLACK TO DARK GRAY MATERIAL; DOM CALCITE CEMENT; MINOR WH CLAY IN MATRIX; LOW TO MOD SPERICITY; MINOR GAS INCREASES.

SHALE = LIGHT GRAY; LIGHT GREENISH GRAY; SME REDDISH BROWN; FIRM TO SLI HARD; PLATY TO WEDGELIKE CUTTINGS; IRREGULAR FRACTURE; SOME MOTTLED EXAMPLES; SLI TO MOD CALCAREOUS; COMMONLY SILTY TO SANDY WITH ISOLATED QUARTZ GRAINS; SME CARB LAYERS; NO VISIBLE STRUCTURE.

SANDSTONE = WHITE; LIGHT GREENISH GRAY; FINE TO VERY FINE GRAINED; ANGULAR TO SUBANGULAR; MOD WELL SORTED; SME MOTTLED TAN SPECIMENS; DOM GRAIN SUPPORTED; VARIABLE AMOUNT OF CALCITE CEMENTATION; LOW TO MOD SPHERICITY; MINOR CARBON MATERIAL; MINOR GAS INCREASES.

SHALE = LIGHT GRAY TO LIGHT GREENISH GRAY; IRREGULAR FRACTURE; SLI PLATY TO MASSIVE IN SILTY EXAMPLES; FIRM TO VERY HARD IN SILTY SPECIMENS; SLI CALCAREOUS; SILTY TO SANDY IN PART; THIN CARBON LAYERS; SME TAN TO REDDISH BROWN SILTST; SOME VERY SILTY SPECIMENS; SOME BLACK TO DARK GRAY CARBONACEOUS SPECIMENS; TR COAL IN SAMPLES.

SILTSTONE = LT GREENISH GRAY; RED TAN; MOD TO VERY HARD; PLATY TO FLAKY CTGS IRREGULAR FRACTURE; NON TO SLI CALC; DULL TO SLI SPARKLING LUSTER WHEN DRIED; SILTY TO SLI GRITTY TEXTURE; OCC CARB.

OHIO CREEK SANDSTONE = WHITE TO VERY LIGHT GRAY WITH SOME FLAKES OF KAOLINIC CLAY THROUGHOUT; FINE TO UPPER VERY FINE GRAINED; MAINLY SMALL TIGHT MODERATELY TO NON-FRIABLE CLUSTERS; FAIR SORTING; SUB ANGULAR TO ROUND; MODERATE SPHERICITY; HIGHLY REACTIVE TO DILUTE HCL; CALCAREOUS CEMENTATION;

SHALE = LIGHT GRAY TO GRAY; BRITTLE TO CRUMBLY; PLANAR; VERY FLAKY TO SCALY; DULL TO EARTHY LUSTER; SMOOTH TO SILTY TEXTURE; GRADES TO SILTSTONE IN PLACES; THIN STRUCTURE; THINLY INTER-BEDDED.

NOTE: LOST CIRC. @ 8375' (WORKED PIPE); NO RETURNS @ 8430'; LOST CIRC. AGAIN @ 8470'.

SANDSTONE = POOR SAMPLE QUALITY IN LOST CIRCULATION ZONE; ABUNDANT LOOSE GRAINS; UPPER MEDIUM TO UPPER FINE GRAINED; MOD SORTED; ANGULAR TO SUBROUNDED; SILICEOUS TO CALCAREOUS CEMENT; GRAIN SUPPORTED; SCATTERED DARK BROWN CARBONACEOUS MAT; TRACE GREEN GRAINS; ASSOCIATED WITH MINOR GAS INCREASES.

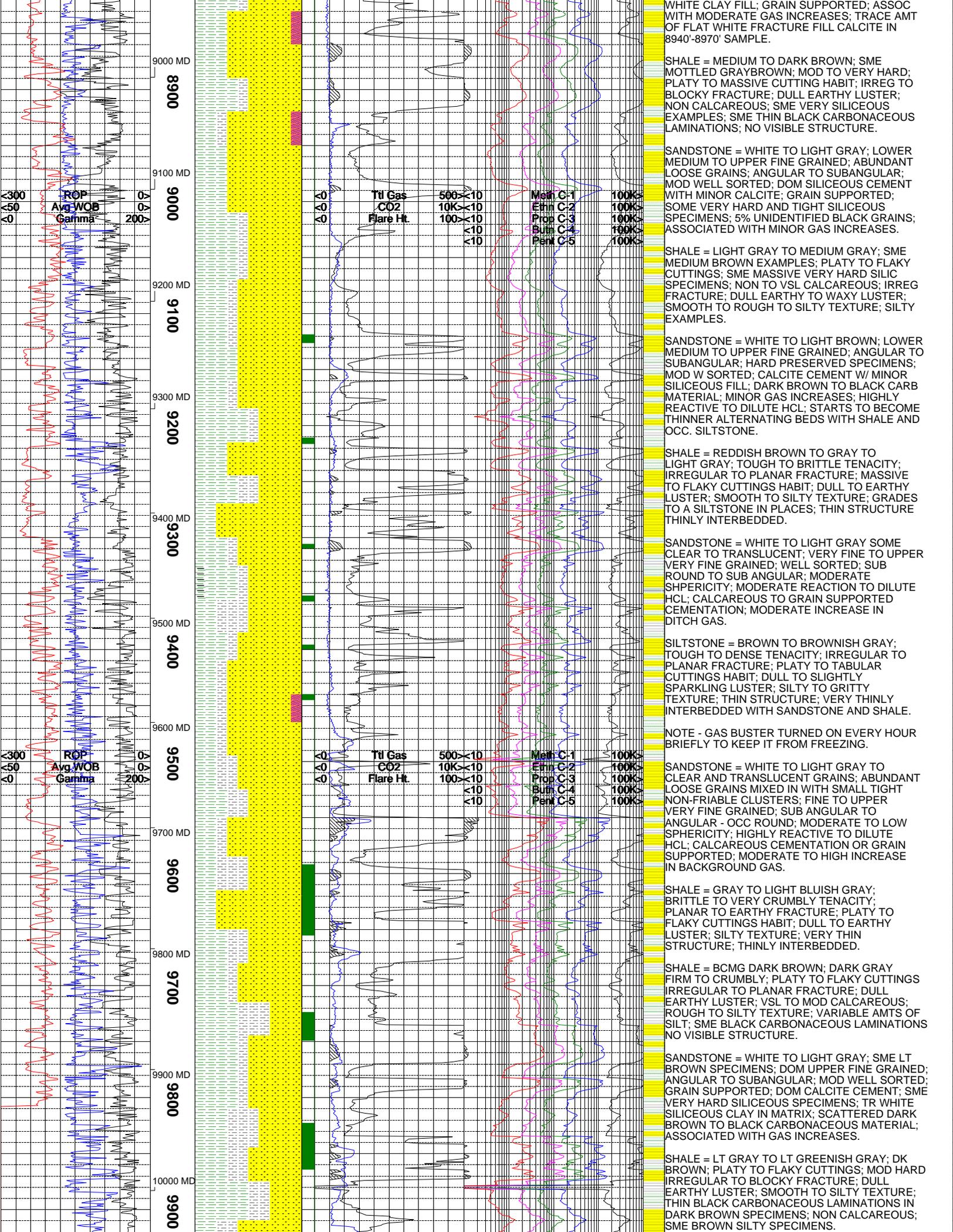
SHALE = LT REDDISH BROWN; LIGHT GRAY TO LT GREENISH GRAY; MOTTLED IN PART; FIRM TO OCC HARD; PLATY TO FLAKY CUTTINGS; IRREGULAR TO BLOCKY FRACTURE; DULL EARTHY LUSTER; SMOOTH TO SILTY TEXTURE; SOME SANDY TO SILTY EXAMPLE; VSL CALC; OCC BLACK CARBONACEOUS MATERIAL; NO VIS STRUCTURE.

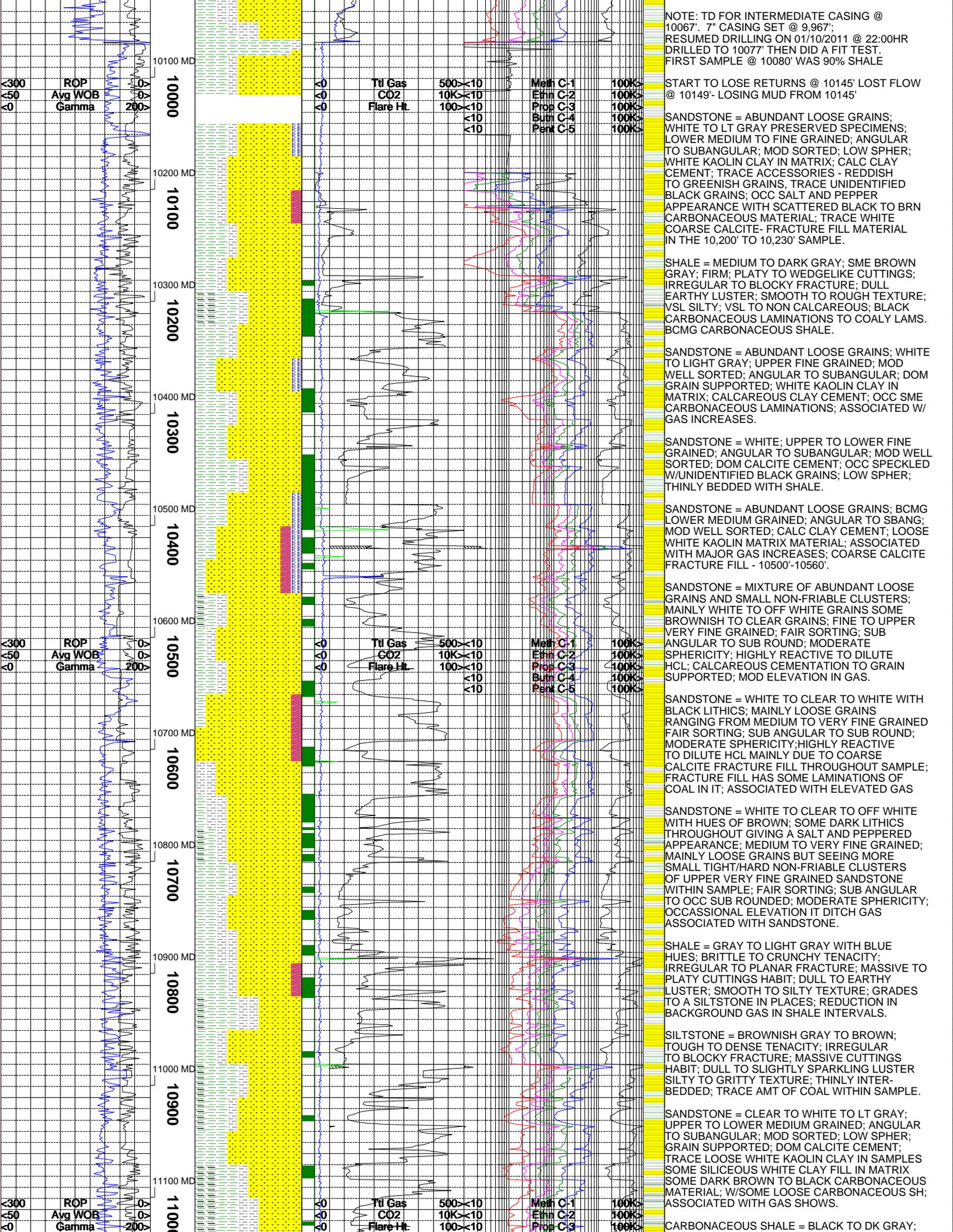
NOTE: POOR SAMPLE AND GAS QUALITY IN HIGH MUD LOSS INTERVALS AFTER WORKING ON LOST CIRCULATION.

SANDSTONE = LIGHT GRAY TO WHITE; MINOR LT GREENISH GRAY; ABUNDANT LOOSE GRAINS; UPPER MEDIUM TO LOWER MEDIUM GRAINED; SILICEOUS CALCAREOUS CEMENT; ANGULAR TO SUBROUNDED; MOD WELL SORTED; GRAIN SUPPORTED; LOW TO MOD SPHERICITY; SCATT BLACK MAFIC AND CARBONACEOUS GRAINS; TR GREEN GRAINS; SOME SILICEOUS WHITE CLAY IN MATRIX; TRACE MICA; RARE BLACK COALY LAMINATIONS; ASSOCIATED WITH MODERATE GAS INCREASES; THIN WHITE CALCITE LAYERS FRACTURE FILL MATERIAL IN THE 8760-8790' SAMPLE.

SHALE = LT GRAY; SOME GREENISH GRAY; FIRM TO MOD HARD; PLATY TO FLAKY TO WEDGELIKE CUTTINGS; IRREGULAR FRACTURE; VSL CALCAREOUS; GRADING TO SILTSTONE; DULL EARTHY TO WAXY WHEN DRIED; SMOOTH TO ROUGH TEXTURE; NO VISIBLE STRUCTURE.

SANDSTONE = WHITE TO LIGHT GRAY; UPPER TO LOWER MEDIUM GRAINED; ANGULAR TO SUBROUNDED; MOD SORTED; OCC SALT AND PEPPER APPEARANCE WITH SCATTERED BLACK MAFIC FRAGMENTS AND CARBONACEOUS MAT; SILICEOUS/CALC CEMENT WITH SME SILICEOUS





NOTE: TD FOR INTERMEDIATE CASING @ 10067'. 7" CASING SET @ 9.967'; RESUMED DRILLING ON 01/10/2011 @ 22:00HR DRILLED TO 10077' THEN DID A FIT TEST. FIRST SAMPLE @ 10080' WAS 90% SHALE

START TO LOSE RETURNS @ 10145' LOST FLOW @ 10149'- LOSING MUD FROM 10145'

SANDSTONE = ABUNDANT LOOSE GRAINS; WHITE TO LT GRAY PRESERVED SPECIMENS; LOWER MEDIUM TO FINE GRAINED; ANGULAR TO SUBANGULAR; MOD SORTED; LOW SPHER; WHITE KAOLIN CLAY IN MATRIX; CALC CLAY CEMENT; TRACE ACCESSORIES - REDDISH TO GREENISH GRAINS, TRACE UNIDENTIFIED BLACK GRAINS; OCC SALT AND PEPPER APPEARANCE WITH SCATTERED BLACK TO BRN CARBONACEOUS MATERIAL; TRACE WHITE COARSE CALCITE- FRACTURE FILL MATERIAL IN THE 10,200' TO 10,230' SAMPLE.

SHALE = MEDIUM TO DARK GRAY; SME BROWN GRAY; FIRM; PLATY TO WEDGELIKE CUTTINGS; IRREGULAR TO BLOCKY FRACTURE; DULL EARTHY LUSTER; SMOOTH TO ROUGH TEXTURE; VSL SILTY; VSL TO NON CALCAREOUS; BLACK CARBONACEOUS LAMINATIONS TO COALY LAMS. BCMG CARBONACEOUS SHALE.

SANDSTONE = ABUNDANT LOOSE GRAINS; WHITE TO LIGHT GRAY; UPPER FINE GRAINED; MOD WELL SORTED; ANGULAR TO SUBANGULAR; DOM GRAIN SUPPORTED; WHITE KAOLIN CLAY IN MATRIX; CALCAREOUS CLAY CEMENT; OCC SME CARBONACEOUS LAMINATIONS; ASSOCIATED W/ GAS INCREASES.

SANDSTONE = WHITE; UPPER TO LOWER FINE GRAINED; ANGULAR TO SUBANGULAR; MOD WELL SORTED; DOM CALCITE CEMENT; OCC SPECKLED W/UNIDENTIFIED BLACK GRAINS; LOW SPHER; THINLY BEDDED WITH SHALE.

SANDSTONE = ABUNDANT LOOSE GRAINS; BCMG LOWER MEDIUM GRAINED; ANGULAR TO SBANG; MOD WELL SORTED; CALC CLAY CEMENT; LOOSE WHITE KAOLIN MATRIX MATERIAL; ASSOCIATED WITH MAJOR GAS INCREASES; COARSE CALCITE FRACTURE FILL - 10500'-10560'.

SANDSTONE = MIXTURE OF ABUNDANT LOOSE GRAINS AND SMALL NON-FRIABLE CLUSTERS; MAINLY WHITE TO OFF WHITE GRAINS SOME BROWNISH TO CLEAR GRAINS; FINE TO UPPER VERY FINE GRAINED; FAIR SORTING; SUB ANGULAR TO SUB ROUND; MODERATE SPHERICITY; HIGHLY REACTIVE TO DILUTE HCL; CALCAREOUS CEMENTATION TO GRAIN SUPPORTED; MOD ELEVATION IN GAS.

SANDSTONE = WHITE TO CLEAR TO WHITE WITH BLACK LITHICS; MAINLY LOOSE GRAINS RANGING FROM MEDIUM TO VERY FINE GRAINED FAIR SORTING; SUB ANGULAR TO SUB ROUND; MODERATE SPHERICITY; HIGHLY REACTIVE TO DILUTE HCL MAINLY DUE TO COARSE CALCITE FRACTURE FILL THROUGHOUT SAMPLE; FRACTURE FILL HAS SOME LAMINATIONS OF COAL IN IT; ASSOCIATED WITH ELEVATED GAS

SANDSTONE = WHITE TO CLEAR TO OFF WHITE WITH HUES OF BROWN; SOME DARK LITHICS THROUGHOUT GIVING A SALT AND PEPPERED APPEARANCE; MEDIUM TO VERY FINE GRAINED; MAINLY LOOSE GRAINS BUT SEEING MORE SMALL TIGHT/HARD NON-FRIABLE CLUSTERS OF UPPER VERY FINE GRAINED SANDSTONE WITHIN SAMPLE; FAIR SORTING; SUB ANGULAR TO OCC SUB ROUNDED; MODERATE SPHERICITY; OCCASIONAL ELEVATION IT DITCH GAS ASSOCIATED WITH SANDSTONE.

SHALE = GRAY TO LIGHT GRAY WITH BLUE HUES; BRITTLE TO CRUNCHY TENACITY; IRREGULAR TO PLANAR FRACTURE; MASSIVE TO PLATY CUTTINGS HABIT; DULL TO EARTHY LUSTER; SMOOTH TO SILTY TEXTURE; GRADES TO A SILTSTONE IN PLACES; REDUCTION IN BACKGROUND GAS IN SHALE INTERVALS.

SILTSTONE = BROWNISH GRAY TO BROWN; TOUGH TO DENSE TENACITY; IRREGULAR TO BLOCKY FRACTURE; MASSIVE CUTTINGS HABIT; DULL TO SLIGHTLY SPARKLING LUSTER SILTY TO GRITTY TEXTURE; THINLY INTER-BEDDED; TRACE AMT OF COAL WITHIN SAMPLE.

SANDSTONE = CLEAR TO WHITE TO LT GRAY; UPPER TO LOWER MEDIUM GRAINED; ANGULAR TO SUBANGULAR; MOD SORTED; LOW SPHER; GRAIN SUPPORTED; DOM CALCITE CEMENT; TRACE LOOSE WHITE KAOLIN CLAY IN SAMPLES SOME SILICEOUS WHITE CLAY FILL IN MATRIX SOME DARK BROWN TO BLACK CARBONACEOUS MATERIAL; W/SOME LOOSE CARBONACEOUS SH; ASSOCIATED WITH GAS SHOWS.

CARBONACEOUS SHALE = BLACK TO DK GRAY;

300  
50  
0

ROP  
Avg WOB  
Gamma

10500  
10550  
10600

Til Gas  
CO2  
Flare Ht

500 > 10  
10K < 10  
100 < 10  
< 10  
< 10

Meth C-1  
Ethn C-2  
Prop C-3  
But C-4  
Penl C-5

100K  
100K  
100K  
100K  
100K

300  
50  
0

ROP  
Avg WOB  
Gamma

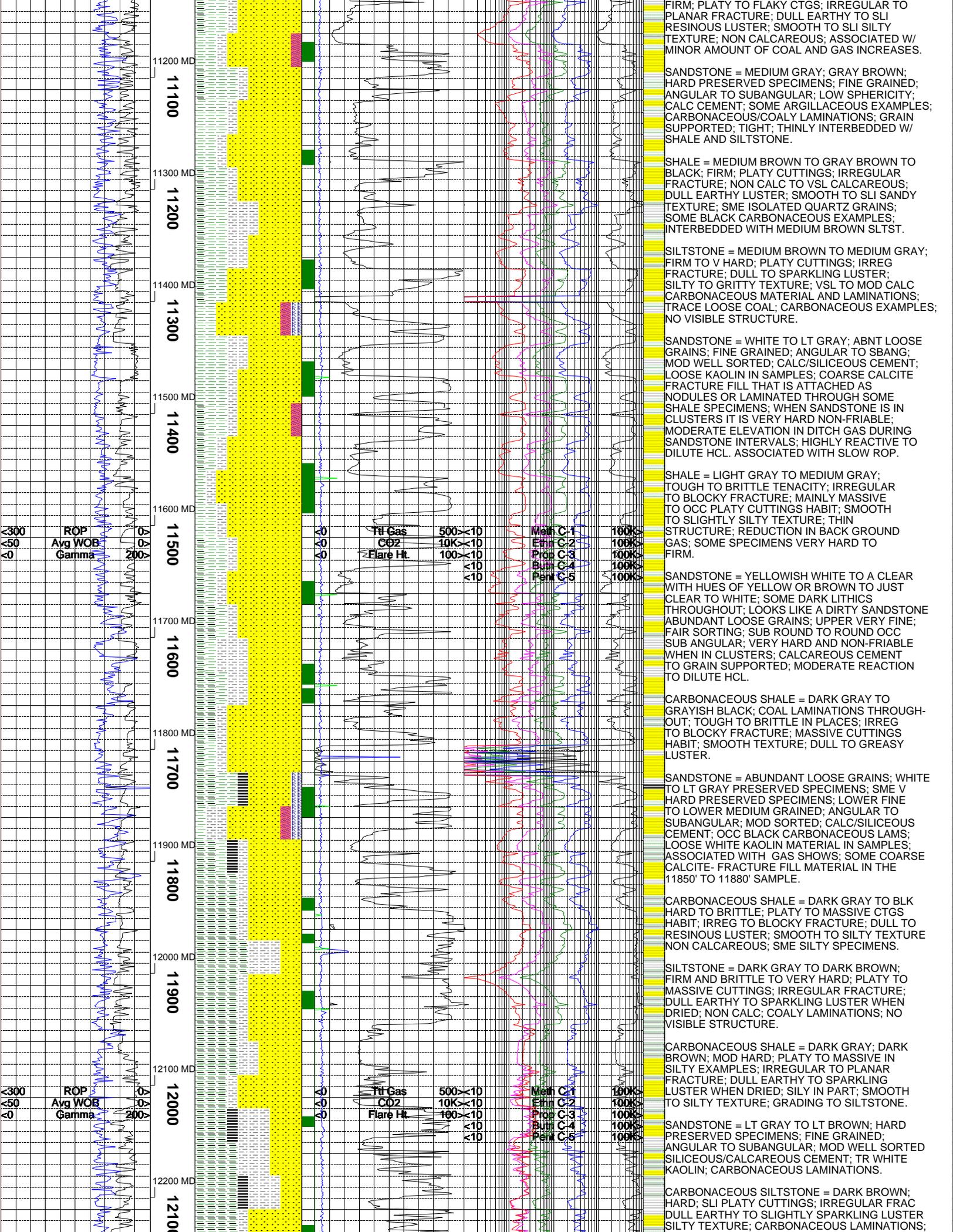
11000  
11050  
11100

Til Gas  
CO2  
Flare Ht

500 > 10  
10K < 10  
100 < 10  
< 10  
< 10

Meth C-1  
Ethn C-2  
Prop C-3

100K  
100K  
100K



11200 MD  
11100  
11300 MD  
11200  
11400 MD  
11300  
11500 MD  
11400  
11600 MD  
11500  
11700 MD  
11600  
11800 MD  
11700  
11900 MD  
11800  
12000 MD  
11900  
12100 MD  
12000  
12200 MD  
12100

300  
50  
0

ROP  
Avg WOB  
Gamma

300  
50  
0

ROP  
Avg WOB  
Gamma

Ti Gas	500	<10	Meth C 1	100K
CO2	10K	<10	Ethn C 2	100K
Flare Ht	100	<10	Prop C 3	100K
		<10	Burn C 4	100K
		<10	Perm C 5	100K

Ti Gas	500	<10	Meth C 1	100K
CO2	10K	<10	Ethn C 2	100K
Flare Ht	100	<10	Prop C 3	100K
		<10	Burn C 4	100K
		<10	Perm C 5	100K

FIRM; PLATY TO FLAKY CTGS; IRREGULAR TO PLANAR FRACTURE; DULL EARTHY TO SLI RESINOUS LUSTER; SMOOTH TO SLI SILTY TEXTURE; NON CALCAREOUS; ASSOCIATED W/ MINOR AMOUNT OF COAL AND GAS INCREASES.

SANDSTONE = MEDIUM GRAY; GRAY BROWN; HARD PRESERVED SPECIMENS; FINE GRAINED; ANGULAR TO SUBANGULAR; LOW SPHERICITY; CALC CEMENT; SOME ARGILLACEOUS EXAMPLES; CARBONACEOUS/COALY LAMINATIONS; GRAIN SUPPORTED; TIGHT; THINLY INTERBEDDED W/ SHALE AND SILTSTONE.

SHALE = MEDIUM BROWN TO GRAY BROWN TO BLACK; FIRM; PLATY CUTTINGS; IRREGULAR FRACTURE; NON CALC TO VSL CALCAREOUS; DULL EARTHY LUSTER; SMOOTH TO SLI SANDY TEXTURE; SME ISOLATED QUARTZ GRAINS; SOME BLACK CARBONACEOUS EXAMPLES; INTERBEDDED WITH MEDIUM BROWN SLTST.

SILTSTONE = MEDIUM BROWN TO MEDIUM GRAY; FIRM TO V HARD; PLATY CUTTINGS; IRREG FRACTURE; DULL TO SPARKLING LUSTER; SILTY TO GRITTY TEXTURE; VSL TO MOD CALC CARBONACEOUS MATERIAL AND LAMINATIONS; TRACE LOOSE COAL; CARBONACEOUS EXAMPLES; NO VISIBLE STRUCTURE.

SANDSTONE = WHITE TO LT GRAY; ABNT LOOSE GRAINS; FINE GRAINED; ANGULAR TO SBANG; MOD WELL SORTED; CALC/SILICEOUS CEMENT; LOOSE KAOLIN IN SAMPLES; COARSE CALCITE FRACTURE FILL THAT IS ATTACHED AS NODULES OR LAMINATED THROUGH SOME SHALE SPECIMENS; WHEN SANDSTONE IS IN CLUSTERS IT IS VERY HARD NON-FRIABLE; MODERATE ELEVATION IN DITCH GAS DURING SANDSTONE INTERVALS; HIGHLY REACTIVE TO DILUTE HCL. ASSOCIATED WITH SLOW ROP.

SHALE = LIGHT GRAY TO MEDIUM GRAY; TOUGH TO BRITTLE TENACITY; IRREGULAR TO BLOCKY FRACTURE; MAINLY MASSIVE TO OCC PLATY CUTTINGS HABIT; SMOOTH TO SLIGHTLY SILTY TEXTURE; THIN STRUCTURE; REDUCTION IN BACK GROUND GAS; SOME SPECIMENS VERY HARD TO FIRM.

SANDSTONE = YELLOWISH WHITE TO A CLEAR WITH HUES OF YELLOW OR BROWN TO JUST CLEAR TO WHITE; SOME DARK LITHICS THROUGHOUT; LOOKS LIKE A DIRTY SANDSTONE ABUNDANT LOOSE GRAINS; UPPER VERY FINE; FAIR SORTING; SUB ROUND TO ROUND OCC SUB ANGULAR; VERY HARD AND NON-FRIABLE WHEN IN CLUSTERS; CALCAREOUS CEMENT TO GRAIN SUPPORTED; MODERATE REACTION TO DILUTE HCL.

CARBONACEOUS SHALE = DARK GRAY TO GRAYISH BLACK; COAL LAMINATIONS THROUGHOUT; TOUGH TO BRITTLE IN PLACES; IRREG TO BLOCKY FRACTURE; MASSIVE CUTTINGS HABIT; SMOOTH TEXTURE; DULL TO GREASY LUSTER.

SANDSTONE = ABUNDANT LOOSE GRAINS; WHITE TO LT GRAY PRESERVED SPECIMENS; SME V HARD PRESERVED SPECIMENS; LOWER FINE TO LOWER MEDIUM GRAINED; ANGULAR TO SUBANGULAR; MOD SORTED; CALC/SILICEOUS CEMENT; OCC BLACK CARBONACEOUS LAMS; LOOSE WHITE KAOLIN MATERIAL IN SAMPLES; ASSOCIATED WITH GAS SHOWS; SOME COARSE CALCITE- FRACTURE FILL MATERIAL IN THE 11850' TO 11880' SAMPLE.

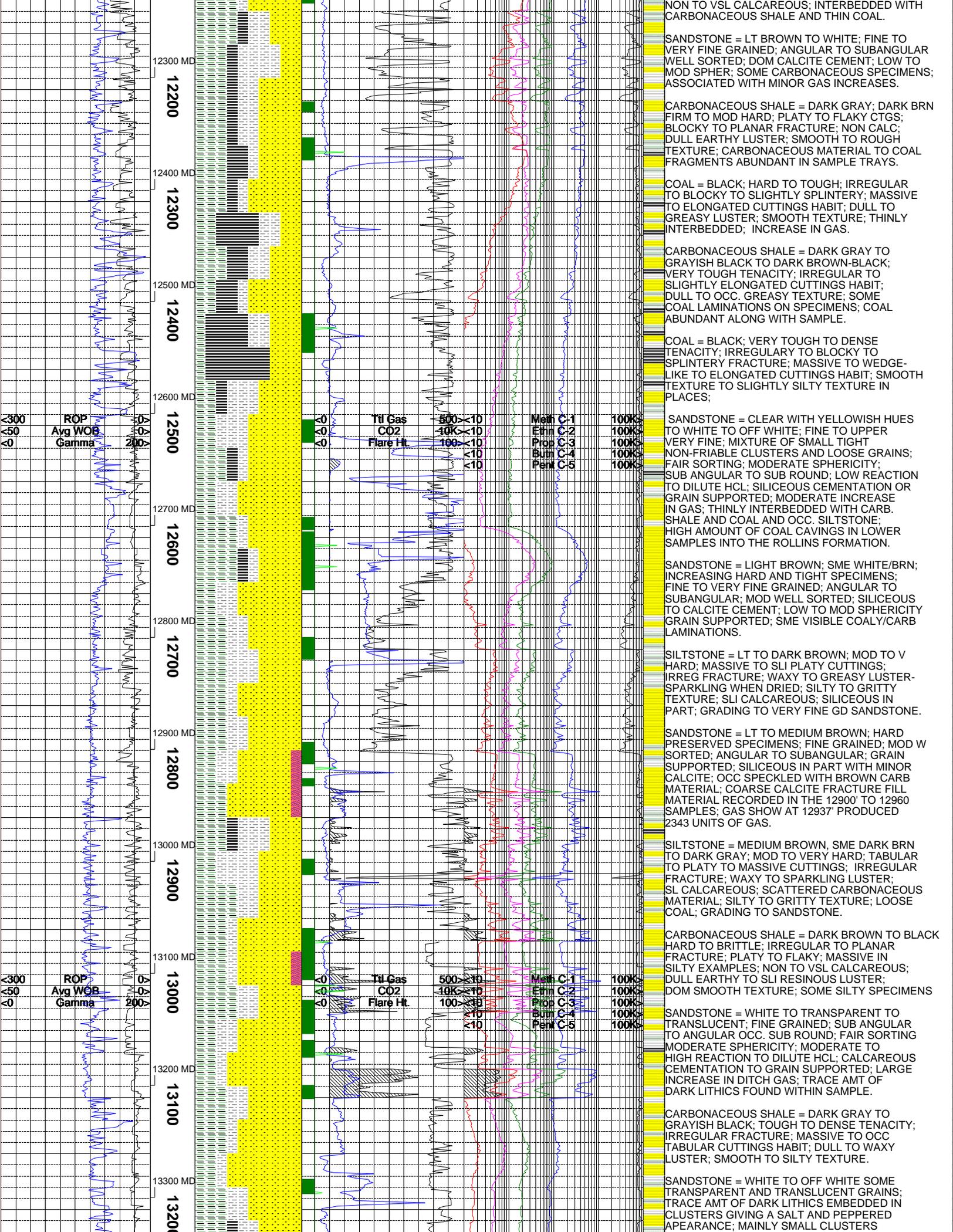
CARBONACEOUS SHALE = DARK GRAY TO BLK HARD TO BRITTLE; PLATY TO MASSIVE CTGS HABIT; IRREG TO BLOCKY FRACTURE; DULL TO RESINOUS LUSTER; SMOOTH TO SILTY TEXTURE NON CALCAREOUS; SME SILTY SPECIMENS.

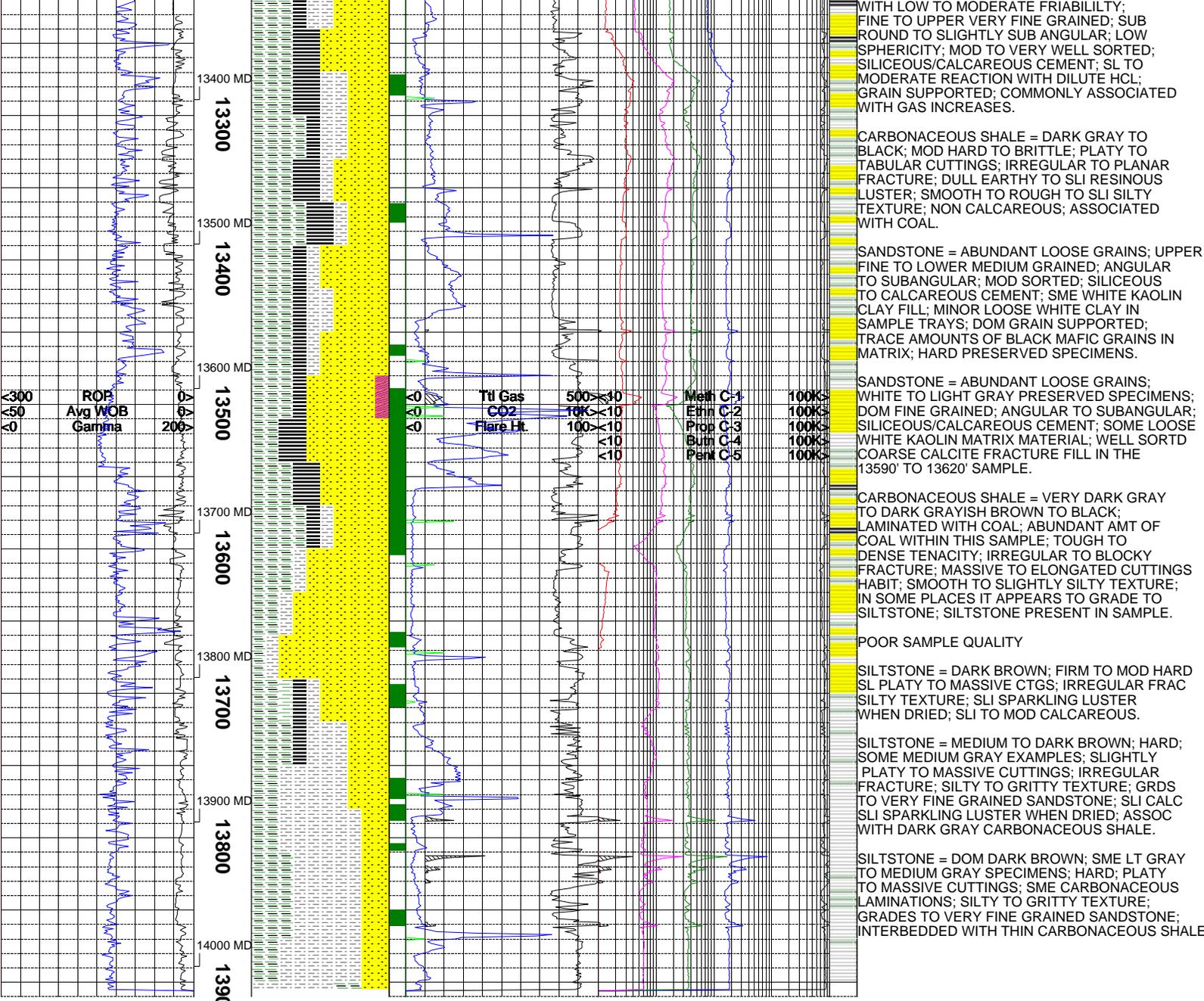
SILTSTONE = DARK GRAY TO DARK BROWN; FIRM AND BRITTLE TO VERY HARD; PLATY TO MASSIVE CUTTINGS; IRREGULAR FRACTURE; DULL EARTHY TO SPARKLING LUSTER WHEN DRIED; NON CALC; COALY LAMINATIONS; NO VISIBLE STRUCTURE.

CARBONACEOUS SHALE = DARK GRAY; DARK BROWN; MOD HARD; PLATY TO MASSIVE IN SILTY EXAMPLES; IRREGULAR TO PLANAR FRACTURE; DULL EARTHY TO SPARKLING LUSTER WHEN DRIED; SILTY IN PART; SMOOTH TO SILTY TEXTURE; GRADING TO SILTSTONE.

SANDSTONE = LT GRAY TO LT BROWN; HARD PRESERVED SPECIMENS; FINE GRAINED; ANGULAR TO SUBANGULAR; MOD WELL SORTED SILICEOUS/CALCAREOUS CEMENT; TR WHITE KAOLIN; CARBONACEOUS LAMINATIONS.

CARBONACEOUS SILTSTONE = DARK BROWN; HARD; SLI PLATY CUTTINGS; IRREGULAR FRAC DULL EARTHY TO SLIGHTLY SPARKLING LUSTER SILTY TEXTURE; CARBONACEOUS LAMINATIONS;





WITH LOW TO MODERATE FRIABILITY;  
 FINE TO UPPER VERY FINE GRAINED; SUB  
 ROUND TO SLIGHTLY SUB ANGULAR; LOW  
 SPHERICITY; MOD TO VERY WELL SORTED;  
 SILICEOUS/CALCAREOUS CEMENT; SL TO  
 MODERATE REACTION WITH DILUTE HCL;  
 GRAIN SUPPORTED; COMMONLY ASSOCIATED  
 WITH GAS INCREASES.

CARBONACEOUS SHALE = DARK GRAY TO  
 BLACK; MOD HARD TO BRITTLE; PLATY TO  
 TABULAR CUTTINGS; IRREGULAR TO PLANAR  
 FRACTURE; DULL EARTHY TO SLI RESINOUS  
 LUSTER; SMOOTH TO ROUGH TO SLI SILTY  
 TEXTURE; NON CALCAREOUS; ASSOCIATED  
 WITH COAL.

SANDSTONE = ABUNDANT LOOSE GRAINS; UPPER  
 FINE TO LOWER MEDIUM GRAINED; ANGULAR  
 TO SUBANGULAR; MOD SORTED; SILICEOUS  
 TO CALCAREOUS CEMENT; SME WHITE KAOLIN  
 CLAY FILL; MINOR LOOSE WHITE CLAY IN  
 SAMPLE TRAYS; DOM GRAIN SUPPORTED;  
 TRACE AMOUNTS OF BLACK MAFIC GRAINS IN  
 MATRIX; HARD PRESERVED SPECIMENS.

SANDSTONE = ABUNDANT LOOSE GRAINS;  
 WHITE TO LIGHT GRAY PRESERVED SPECIMENS;  
 DOM FINE GRAINED; ANGULAR TO SUBANGULAR;  
 SILICEOUS/CALCAREOUS CEMENT; SOME LOOSE  
 WHITE KAOLIN MATRIX MATERIAL; WELL SORTD  
 COARSE CALCITE FRACTURE FILL IN THE  
 13590' TO 13620' SAMPLE.

CARBONACEOUS SHALE = VERY DARK GRAY  
 TO DARK GRAYISH BROWN TO BLACK;  
 LAMINATED WITH COAL; ABUNDANT AMT OF  
 COAL WITHIN THIS SAMPLE; TOUGH TO  
 DENSE TENACITY; IRREGULAR TO BLOCKY  
 FRACTURE; MASSIVE TO ELONGATED CUTTINGS  
 HABIT; SMOOTH TO SLIGHTLY SILTY TEXTURE;  
 IN SOME PLACES IT APPEARS TO GRADE TO  
 SILTSTONE; SILTSTONE PRESENT IN SAMPLE.

POOR SAMPLE QUALITY

SILTSTONE = DARK BROWN; FIRM TO MOD HARD  
 SL PLATY TO MASSIVE CTGS; IRREGULAR FRAC  
 SILTY TEXTURE; SLI SPARKLING LUSTER  
 WHEN DRIED; SLI TO MOD CALCAREOUS.

SILTSTONE = MEDIUM TO DARK BROWN; HARD;  
 SOME MEDIUM GRAY EXAMPLES; SLIGHTLY  
 PLATY TO MASSIVE CUTTINGS; IRREGULAR  
 FRACTURE; SILTY TO GRITTY TEXTURE; GRDS  
 TO VERY FINE GRAINED SANDSTONE; SLI CALC  
 SLI SPARKLING LUSTER WHEN DRIED; ASSOC  
 WITH DARK GRAY CARBONACEOUS SHALE.

SILTSTONE = DOM DARK BROWN; SME LT GRAY  
 TO MEDIUM GRAY SPECIMENS; HARD; PLATY  
 TO MASSIVE CUTTINGS; SME CARBONACEOUS  
 LAMINATIONS; SILTY TO GRITTY TEXTURE;  
 GRADES TO VERY FINE GRAINED SANDSTONE;  
 INTERBEDDED WITH THIN CARBONACEOUS SHALE

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