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## Drilling Dynamics MD

**COMPANY** ExxonMobil Oil Corporation  
**WELL** PCU 297-11C5  
**FIELD** Piceance Creek Unit  
**REGION** Rocky Mountians  
**COORDINATES** 39.895944 N  
108.254506 W  
**ELEVATION** GL: 6963'  
RKB: 6993.2'  
**COUNTY, STATE** Rio Blanco, CO  
**API INDEX** 051031146500  
**SPUD DATE** 12/19/2009  
**CONTRACTOR** HP Drilling  
**CO. REP.** M. Sadler / J. Wood  
**RIG/TYPE** #326/ Flex-Rig 4  
**LOGGING UNIT** #36  
**GEOLOGISTS** J. Kokes / D. Thibodeaux  
**ADD. PERSONS** H. Strickland / D. Evans  
**CO. GEOLOGIST** Chris Alba

### LOG INTERVAL

### CASING DATA

**DEPTHS:** 3835' TO 12571'  
**DATES:** 12/26/2009 TO 01/12/2010  
**SCALE:** 1" = 100'

16" AT 150'  
10 3/4" AT 3825'  
7" AT 8673'  
AT

### MUD TYPES

### HOLE SIZE

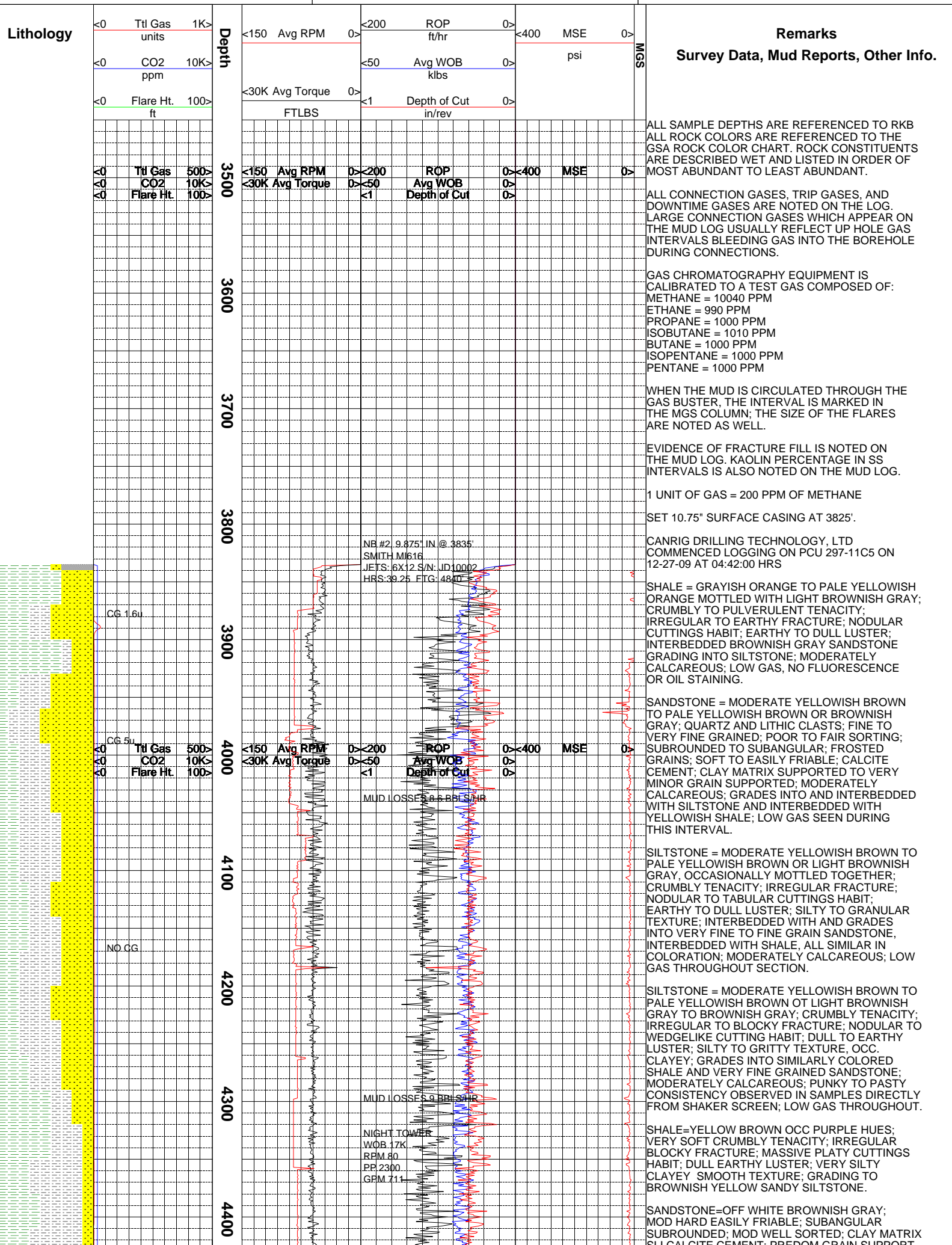
WATER SPUD MUD TO 3846'  
LSND TO 12571'  
TO  
TO

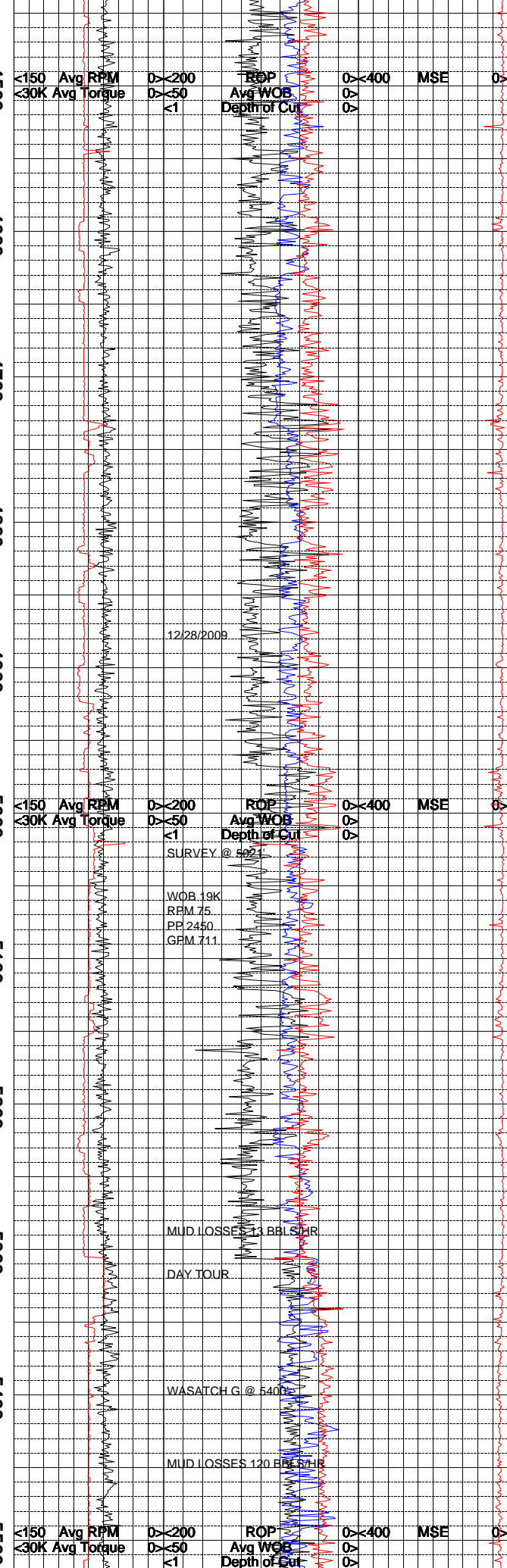
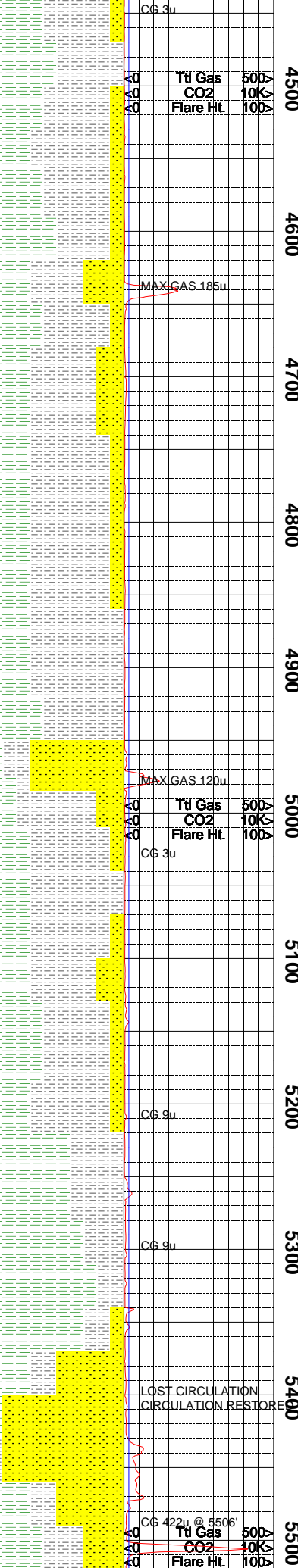
14 3/4" TO 3846'  
9 7/8" TO 8684'  
6 1/8" TO 12571'  
TO

### ABBREVIATIONS

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

ALTERED ZONE	<b>G</b> CHERT - GLASSY	FELSIC SILIC DIKE	MARL - CALC	SANDSTONE
ANDESITE	<b>P</b> CHERT - PORCEL	FOSSIL	METAMORPHICS	SANDSTONE-TUFFACEOUS
ANHYDRITE	<b>T</b> CHERT - TIGER STRIPE	GABBRO	MUDSTONE	SERICITIZATION
BASALT	<b>U</b> 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	KAOLINIC	RECRYSTALLIZED CALCITE	VOLCANICS
CHALK	DIATOMITE	LIMESTONE	RHYOLITE	
CRYSTALLINE TUFF	DIORITE	LITHIC TUFF	SALT	
CHERT - ARGILL	DOLOSTONE	MARL - DOLO	SAND	





MOD TRACE BLACK LITHICS EMBEDDED; VERY SILTY; SLI CALCAREOUS GRADING TO MOD HARD SILTSTONE; VERY LOW GAS READINGS.

SILTSTONE=YELLOWISH BROWN; MOD HARD CRUMBLY DENSE TENACITY; BLOCKY IRREGULAR FRACTURE; MASSIVE CUTTINGS HABIT; DULL EARTHY OCC SPARKLING LUSTER; GRITTY GRANULAR TEXTURE; GRADING TO VFG SILTY SANDSTONE.

SHALE=MULTI COLOR REDDISH BROWN OC LIGHT GRAY; PURPLE HUES; MOD SOFT; CRUMBLY TENACITY; BLOCKY IRREGULAR FRACTURE; MASSIVE OCC WEDGELIKE CUTTINGS HABIT; DULL EARTHY LUSTER; SMOOTH TO SILTY TEXTURE; SLI CALCAREOUS; INTERBEDDED WITH SILTSTONES.

SANDSTONE=WHITE FINE TO MEDIUM GRAIN; SUBANGULAR SUBROUNDED; MOD WELL SORTED; PREDOM GRAIN SUPPORTED; CLAY MATRIX OCC CALCITE CEMENT; VERY SLOW REACTION TO HCL; BLACK LITHICS FRAGS EMBEDDED; MOD SPHERICITY; GRADING SILTY SILTSTONE; HIGH GAS READINGS IN SANDST.

SILTSTONE=BROWNISH YELLOW GRAY; MOD HARD TO OCC SOFT; DENSE CRUMBLY TENACITY IRREGULAR BLOCKY FRACTURE; OCC WEDGELIKE TO TABULAR CUTTINGS HABIT; EARTHY OCC SPARKLING LUSTER; GRITTY OCC SLI GRANULAR TEXTURE; INTERBEDDED WITH VERY SILTY SANDSTONES.

SHALE=MULTI COLOR REDDISH BROWN LIGHT GRAY OCC PURPLE HUES; SOFT MOD HARD; BLOCKY IRREGULAR FRACTURE; MASSIVE PLATY OCC WEDGELIKE CUTTINGS HABIT; DULL EARTHY LUSTER; SMOOTH CLAYEY SILTY TEXTURE; NON FISSILE STRUCTURE; INTERBEDDED WITH YELLOW BROWN MOD HARD SILTSTONE.

SILTSTONE=BROWNISH GRAY YELLOW BROWN OCC LIGHT GRAY; MOD HARD FIRM; DENSE CRUMBLY TENACITY; BLOCKY IRREGULAR FRACTURE; DULL EARTHY OCC SPARKLING LUSTER; GRITTY GRANULAR SLI SMOOTH TEXTURE; MASSIVE THIN STRUCTURE; OCC INTERBEDDED WITH SANDSTONES; LOW GAS READINGS.

SANDSTONE OFF WHITE TO REDDISH BROWN; MOD HARD FRIABLE; SUBANGULAR ANGULAR MOD SORTED; PREDOM GRAIN SUPPORTED; CLAY MATRIX; SLI REACTION TO HCL; MOD HIGH SPHERICITY; TRACE BLACK LITHICS FRAGS EMBEDDED; GRADING TO YELLOWISH BROWN SLI SANDY SILTSTONE.

SILTSTONE=YELLOW REDDISH BROWN; MOD HARD; PLATY IRREGULAR FRACTURE; MASSIVE PLATY OCC WEDGELIKE CUTTINGS HABIT; DULL EARTHY OCC SPARKLING LUSTER; SMOOTH SLI GRITTY TO SANDY TEXTURE; NON CALCAREOUS; MASSIVE THICK STRUCTURE INTERBEDDED WITH REDDISH BROWN WHITE V SILTY SANDSTONES; LOW GAS READINGS OCC TRACE LIGHT GRAY DENSE LIMESTONE.

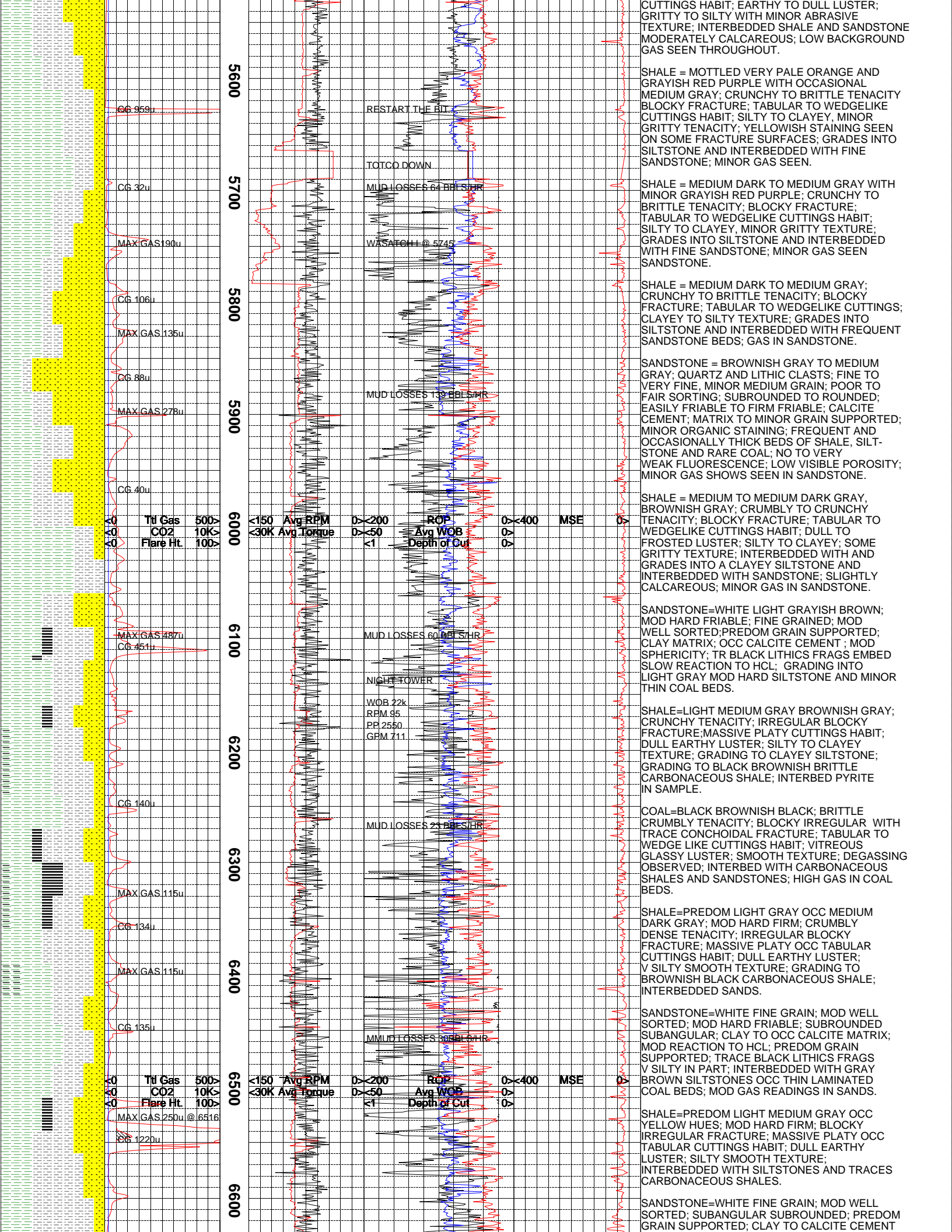
SHALE=MULTI COLOR YELLOW REDDISH BROWN OCC LIGHT GRAY; SOFT MOD HARD; CRUMBLY TENACITY; IRREG BLOCKY FRACTURE; MASSIVE OCC WEDGELIKE CUTTINGS HABIT; DULL EARTHY LUSTER; SMOOTH SILTY TEXTURE GRADING TO MOD HARD YELLOWISH BROWN SILTSTONE WITH INTERBED SILTSTONES FEW SAND STRINGERS; HIGH GAS READING IN SANDS.

SILTSTONE=YELLOW BROWN OCC LIGHT GRAY MOD HARD; DENSE TENACITY; BLOCKY IRREG FRACTURE; MASSIVE PLATY OCC WEDGELIKE CUTTINGS HABIT; DULL EARTHY I SPARKLING LUSTER; SMOOTH SLI GRITTY TEXTURE; TR PYRITE IN SAMPLE; INTERBED WITH LIGHT MEDIUM GRAY SHALE.

SHALE = LIGHT BROWNISH GRAY TO BROWNISH GRAY WITH DARK YELLOWISH ORANGE MOTTLED IN; DENSE TENACITY; BLOCKY FRACTURE; WEDGELIKE TO SCALY CUTTING HABIT; CLAYEY TO SLIGHTLY SILTY TEXTURE; WAXY TO DULL LUSTER.

SANDSTONE = LIGHT TO MEDIUM GRAY, VERY MINOR BROWNISH GRAY; FINE TO MEDIUM, OCCASIONAL VERY FINE GRAIN; 70 TO 90% QUARTZ GRAINS WITH THE REMAINDER LITHIC FRAGMENTS INCLUDING ANGULAR BLACK CLASTS GIVING A SALT AND PEPPER APPEARANCE; WELL TO BIMODAL SORTING; QUARTZ GRAINS SUBROUNDED TO SUBANGULAR; LITHICS ANGULAR; FRIABLE TO EASILY FRIABLE; CALCITE CEMENT; GRAIN SUPPORTED.

SILTSTONE = DUSKY RED TO DARK REDDISH BROWN MOTTLED WITH PALE YELLOWISH BROWN; CRUMBLY TENACITY; WEDGELIKE TO TABULAR



5600  
5700  
5800  
5900  
6000  
6100  
6200  
6300  
6400  
6500  
6600

CG 95u  
CG 32u  
MAX GAS 190u  
CG 106u  
MAX GAS 135u  
CG 88u  
MAX GAS 278u  
CG 40u  
MAX GAS 487u  
CG 451u  
CG 140u  
MAX GAS 115u  
CG 134u  
MAX GAS 115u  
CG 135u  
MAX GAS 250u @ 6516  
CG 122u

RESTART THE BIT  
TOTCO DOWN  
MUD LOSSES 64 BBL/HR  
WASA FCH @ 5745  
MUD LOSSES 139 BBL/HR  
MUD LOSSES 60 BBL/HR  
NIGHT TOWER  
WOB 22k  
RPM 95  
PPI 2550  
GFM 711  
MUD LOSSES 23 BBL/HR

CUTTINGS HABIT; EARTHY TO DULL LUSTER; GRITTY TO SILTY WITH MINOR ABRASIVE TEXTURE; INTERBEDDED SHALE AND SANDSTONE MODERATELY CALCAREOUS; LOW BACKGROUND GAS SEEN THROUGHOUT.

SHALE = MOTTLED VERY PALE ORANGE AND GRAYISH RED PURPLE WITH OCCASIONAL MEDIUM GRAY; CRUNCHY TO BRITTLE TENACITY BLOCKY FRACTURE; TABULAR TO WEDGELIKE CUTTINGS HABIT; SILTY TO CLAYEY, MINOR GRITTY TENACITY; YELLOWISH STAINING SEEN ON SOME FRACTURE SURFACES; GRADES INTO SILTSTONE AND INTERBEDDED WITH FINE SANDSTONE; MINOR GAS SEEN.

SHALE = MEDIUM DARK TO MEDIUM GRAY WITH MINOR GRAYISH RED PURPLE; CRUNCHY TO BRITTLE TENACITY; BLOCKY FRACTURE; TABULAR TO WEDGELIKE CUTTINGS HABIT; SILTY TO CLAYEY, MINOR GRITTY TEXTURE; GRADES INTO SILTSTONE AND INTERBEDDED WITH FINE SANDSTONE; MINOR GAS SEEN SANDSTONE.

SHALE = MEDIUM DARK TO MEDIUM GRAY; CRUNCHY TO BRITTLE TENACITY; BLOCKY FRACTURE; TABULAR TO WEDGELIKE CUTTINGS; CLAYEY TO SILTY TEXTURE; GRADES INTO SILTSTONE AND INTERBEDDED WITH FREQUENT SANDSTONE BEDS; GAS IN SANDSTONE.

SANDSTONE = BROWNISH GRAY TO MEDIUM GRAY; QUARTZ AND LITHIC CLASTS; FINE TO VERY FINE, MINOR MEDIUM GRAIN; POOR TO FAIR SORTING; SUBROUNDED TO ROUNDED; EASILY FRIABLE TO FIRM FRIABLE; CALCITE CEMENT; MATRIX TO MINOR GRAIN SUPPORTED; MINOR ORGANIC STAINING; FREQUENT AND OCCASIONALLY THICK BEDS OF SHALE, SILTSTONE AND RARE COAL; NO TO VERY WEAK FLUORESCENCE; LOW VISIBLE POROSITY; MINOR GAS SHOWS SEEN IN SANDSTONE.

SHALE = MEDIUM TO MEDIUM DARK GRAY, BROWNISH GRAY; CRUMBLY TO CRUNCHY TENACITY; BLOCKY FRACTURE; TABULAR TO WEDGELIKE CUTTINGS HABIT; DULL TO FROSTED LUSTER; SILTY TO CLAYEY; SOME GRITTY TEXTURE; INTERBEDDED WITH AND GRADES INTO A CLAYEY SILTSTONE AND INTERBEDDED WITH SANDSTONE; SLIGHTLY CALCAREOUS; MINOR GAS IN SANDSTONE.

SANDSTONE=WHITE LIGHT GRAYISH BROWN; MOD HARD FRIABLE; FINE GRAINED; MOD WELL SORTED; PREDOM GRAIN SUPPORTED; CLAY MATRIX; OCC CALCITE CEMENT; MOD SPHERICITY; TR BLACK LITHICS FRAGS EMBED SLOW REACTION TO HCL; GRADING INTO LIGHT GRAY MOD HARD SILTSTONE AND MINOR THIN COAL BEDS.

SHALE=LIGHT MEDIUM GRAY BROWNISH GRAY; CRUNCHY TENACITY; IRREGULAR BLOCKY FRACTURE; MASSIVE PLATY CUTTINGS HABIT; DULL EARTHY LUSTER; SILTY TO CLAYEY TEXTURE; GRADING TO CLAYEY SILTSTONE; GRADING TO BLACK BROWNISH BRITTLE CARBONACEOUS SHALE; INTERBED PYRITE IN SAMPLE.

COAL=BLACK BROWNISH BLACK; BRITTLE CRUMBLY TENACITY; BLOCKY IRREGULAR WITH TRACE CONCHOIDAL FRACTURE; TABULAR TO WEDGE LIKE CUTTINGS HABIT; VITREOUS GLASSY LUSTER; SMOOTH TEXTURE; DEGASSING OBSERVED; INTERBED WITH CARBONACEOUS SHALES AND SANDSTONES; HIGH GAS IN COAL BEDS.

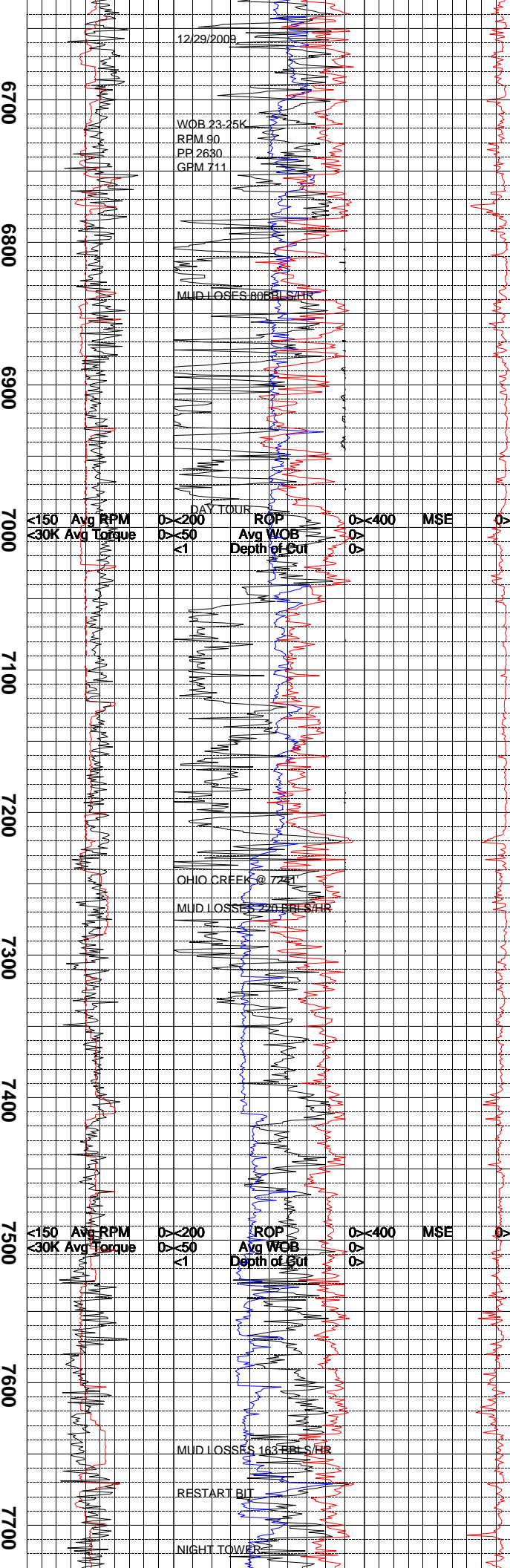
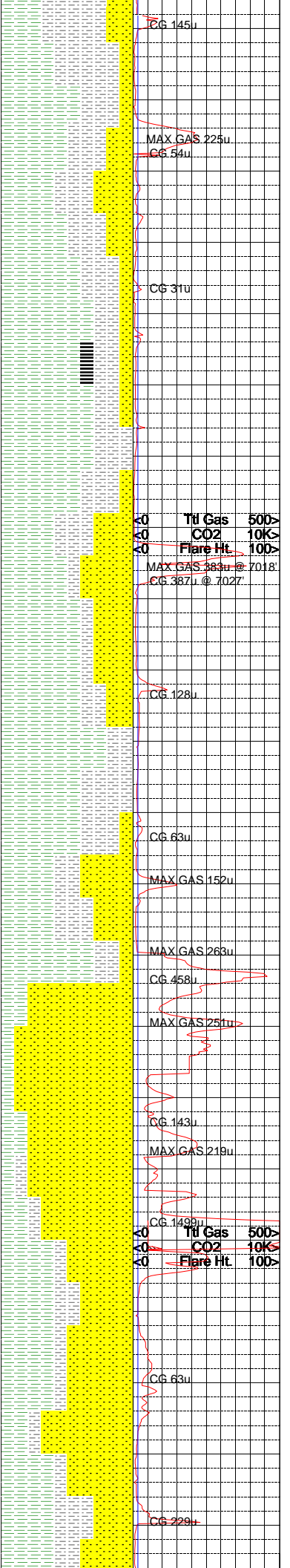
SHALE=PREDOM LIGHT GRAY OCC MEDIUM DARK GRAY; MOD HARD FIRM; CRUMBLY DENSE TENACITY; IRREGULAR BLOCKY FRACTURE; MASSIVE PLATY OCC TABULAR CUTTINGS HABIT; DULL EARTHY LUSTER; V SILTY SMOOTH TEXTURE; GRADING TO BROWNISH BLACK CARBONACEOUS SHALE; INTERBEDDED SANDS.

SANDSTONE=WHITE FINE GRAIN; MOD WELL SORTED; MOD HARD FRIABLE; SUBROUNDED SUBANGULAR; CLAY TO OCC CALCITE MATRIX; MOD REACTION TO HCL; PREDOM GRAIN SUPPORTED; TRACE BLACK LITHICS FRAGS V SILTY IN PART; INTERBEDDED WITH GRAY BROWN SILTSTONES OCC THIN LAMINATED COAL BEDS; MOD GAS READINGS IN SANDS.

SHALE=PREDOM LIGHT MEDIUM GRAY OCC YELLOW HUES; MOD HARD FIRM; BLOCKY IRREGULAR FRACTURE; MASSIVE PLATY OCC TABULAR CUTTINGS HABIT; DULL EARTHY LUSTER; SILTY SMOOTH TEXTURE; INTERBEDDED WITH SILTSTONES AND TRACES CARBONACEOUS SHALES.

SANDSTONE=WHITE FINE GRAIN; MOD WELL SORTED; SUBANGULAR SUBROUNDED; PREDOM GRAIN SUPPORTED; CLAY TO CALCITE CEMENT

AC	Tot Gas	500Y	<150	Avg RPM	>200	ROP	>400	MSE	>
AC	CO2	10K	<30K	Avg Torque	>50	Avg WOB	>		>
AC	Flare Hit	100Y	>			Depth of Cut	>		>



MATRIX; SLI REACTION TO HCL; MOD TRACE BLACK LITHICS FRAGS EMBEDDED; MOD SPHERICITY; VERY SILTY INTERBED WITH SILTSTONES MOD GAS READINGS IN SANDS.

SHALE=PREOM LIGHT GRAY WITH YELLOW BROWN TO PURPLE HUES; MOD HARD FIRM; IRREGULAR BLOCKY FRACTURE; MASSIVE PLATY OCC SLI TABULAR CUTTINGS HABIT; DULL EARTHY LUSTER; SMOOTH SLI SILTY TEXTURE; TRACE PYRITE IN SAMPLE; INTERBEDDED WITH LIGHT GRAY GRITTY SILTSTONES AND SANDS.

SILTSTONE=LIGHT MEDIUM GRAY; MOD HARD FIRM; IRREGULAR BLOCKY FRACTURE; PLATY OCC TABULAR CUTTINGS HABIT; DULL EARTHY OCC SPARKLING LUSTER; GRITTY SMOOTH TEXTURE; SLI CALCAREOUS; INTERBEDDED W/ SHALES AND SANDS; LOW GAS READINGS; OCC TRACE FREE PYRITE IN SAMPLE.

SHALE=LIGHT MEDIUM GRAY WITH TRACE YELLOW BROWN; MOD FIRM SOFT; IRREGULAR BLOCKY FRACTURE; PLATY OCC TABULAR CUTTINGS HABIT; DULL EARTHY LUSTER; SMOOTH SILTY TEXTURE; INTERBED SILTSTONE AND OCC TRACE BLACK THIN LAMINATED COAL.

SILTSTONE=LIGHT GRAY YELLOW BROWN; MOD HARD FIRM; BLOCKY IRREGULAR FRACTURE MASSIVE PLATY CUTTINGS HABIT; DULL EARTH SLI SPARKLING LUSTER; GRITTY SLI SMOOTH TEXTURE; INTERBEDDED WITH SHALES.

SANDSTONE = LIGHT TO MEDIUM GRAY, LIGHT BLuish GRAY; 90 TO 80% QUARTZ CLASTS WITH THE REMAINDER LITHIC FRAGMENTS; VERY FINE TO FINE GRAINED, OCCASIONAL MEDIUM GRAINED; FAIR TO POOR SORTING; SUBANGULAR TO SUBROUNDED; FROSTED GRAINS; CALCITE CEMENT; INTERBEDDED GRAY AND REDDISH BROWN SILTSTONE.

SHALE = MEDIUM GRAY TO BLuish GRAY; DENSE TO CRUNCHY TENACITY; BLOCKY FRACTURE; TABULAR, PLATY, AND WEDGELIKE CUTTINGS SEEN; DULL TO SLIGHTLY WAXY LUSTER; CLAYEY TO SMOOTH, OCCASIONALLY SILTY; INTERBEDDED GRAY AND REDDISH BROWN SILTSTONE AND MINOR GRAYISH SANDSTONE.

SHALE = MEDIUM GRAY TO BLuish GRAY; DENSE TO CRUNCHY TENACITY; BLOCKY FRACTURE; TABULAR, PLATY, AND WEDGELIKE CUTTINGS SEEN; DULL TO SLIGHTLY WAXY LUSTER; CLAYEY TO SMOOTH, OCCASIONALLY SILTY TO GRANULAR WITH BLACK AND WHITISH SAND SIZED CLASTS; INTERBEDDED LIGHT SS AND GRAY AND REDDISH BROWN SILTST.

SANDSTONE = MEDIUM TO MEDIUM DARK GRAY; FINE TO VERY FINE GRAINED; WELL TO FAIR SORTING; EASILY FRIABLE TO FRIABLE; CALCITE CEMENT; QUARTZ GRAINS WITH LITHIC FRAGMENTS; INTERBEDDED GRAY SHALE GAS SEEN IN UPPER SANDSTONE UNIT.

SANDSTONE = LIGHT GRAY TO MEDIUM GRAY; SOFT TO EASILY FRIABLE; 90 TO 70% QUARTZ GRAINS WITH THE REMAINDER LITHIC FRAGS, INCLUDING ANGULAR BLACK FRAGMENTS; MEDIUM TO FINE, MINOR VERY FINE GRAINED; WELL SORTED; SUBROUNDED QUARTZ GRAINS WITH ANGULAR TO SUBANGULAR LITHIC FRAGS; MODERATE SPHERICITY; CALCITE CEMENT; GRAIN SUPPORTED; MODERATE VISIBLE POROSITY; INTERBEDDED GRAY SHALE; MINOR GAS SHOW SEEN.

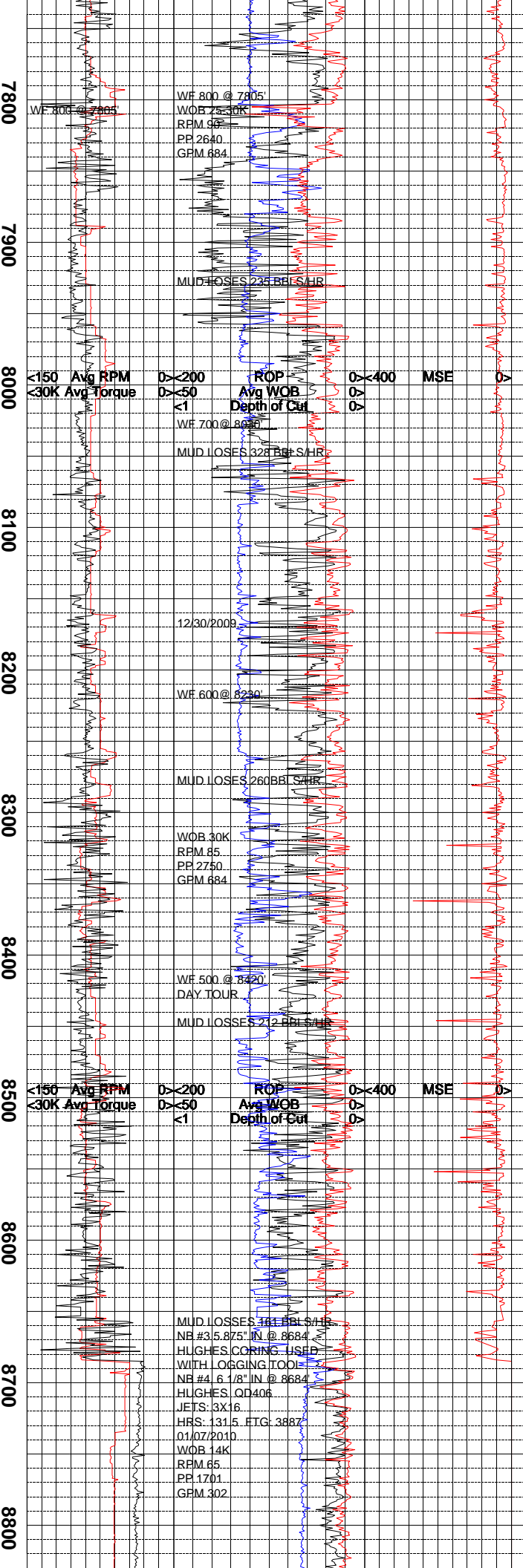
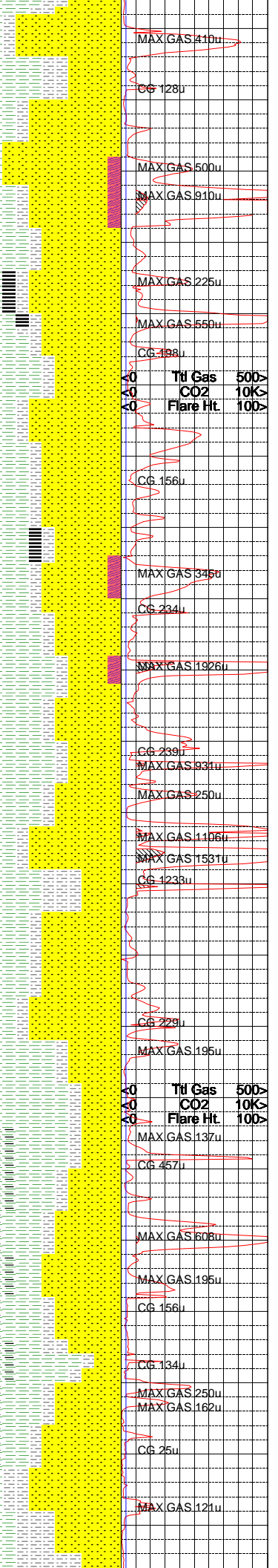
SANDSTONE = LIGHT GRAY, COLORLESS SAND GRAINS; SOFT TO EASILY FRIABLE; PREDOM. QUARTZ GRAINS WITH BLACK LITHIC FRAGS; MEDIUM GRAINED; FAIR TO WELL SORTED; SUBANGULAR TO SUBROUNDED; MODERATE SPHERICITY; FROSTED GRAINS; CALCITE CEMENT; GRAIN SUPPORTED; FREQUENTLY SEEN AS LOOSE GRAINS IN THE SAMPLE; MINOR INTERBEDDED SHALE AND SILTSTONE.

SHALE = MEDIUM TO BLuish GRAY; CRUNCHY TO TOUGH; IRREGULAR FRACTURE; TABULAR TO WEDGELIKE, MINOR MASSIVE; DULL TO EARTHY LUSTER; SILTY TO CLAYEY; INTERBEDDED SALT AND PEPPER SANDSTONE AND GRAY SILTSTONE WITH MINOR REDDISH BROWN SILTSTONE THAT GRADES INTO VERY FINE GRAIN SANDSTONE, LOW GAS.

SHALE = MEDIUM TO BLuish GRAY; CRUNCHY TO TOUGH; IRREGULAR FRACTURE; TABULAR TO WEDGELIKE, MINOR MASSIVE; DULL TO EARTHY LUSTER; SILTY TO CLAYEY; INTERBEDDED SALT AND PEPPER SANDSTONE AND GRAY SILTSTONE WITH MINOR REDDISH BROWN SILTSTONE THAT GRADES INTO VERY FINE GRAIN SANDSTONE, LOW GAS.

SANDSTONE=WHITE GRAYISH WHITE; VERY FINE GRAIN; SUBANGULAR SUBROUNDED;

Flare Hit  
500Y  
10K  
100Y  
MSE  
ROP  
Avg WOB  
Depth of Cut  
Avg RPM  
Avg Torque



GRAIN SUPPORTED; CALCITE CEMENT; MOD SPHERICITY; SLI-MOD REACTION TO HCL; 1-3% BLACK LITHICS FRAGS EMBEDDED; MOD HARD FRIABLE; TR KAOLINITE; INTERBEDDED SHALES AND SILTSTONES ; HIGH GAS IN SANDS

SANDSTONE=PREDOM CLEAR UNCONSOLIDATED MEDIUM QUARTZ GRAINS ; EASILY FRIABLE; SUBANGULAR; MOD WELL SORTED; PREDOM QUARTZ SUPPORTED; CALCITE CEMENT; MOD HIGH SPHERICITY; GRADING TO FINE GRAIN SUBANGULAR SUBROUNDED; WELL SORTED MOD HARD EASILY FRIABLE SANDSTONE; TRACE FRACTURE FILL CALCITE CRYSTALS IN SAMPLE HIGH GAS READINGS IN SAND

SHALE=LIGHT MEDIUM GRAY;MOD HARD FIRM IRREGULAR BLOCKY OCC PLANAR FRACTURE; MASSIVE PLATY OCC WEDGE LIKE TO TABULAR CUTTINGS HABIT; DULL EARTHY OCC WAXY LUSTER; SMOOTH SLI SILTY TEXTURE; INTERBEDDED THIN COAL BEDS WITH SANDS SILTSTONES; LOW GAS IN SHALES

SANDSTONE=WHITE;CLEAR OCC FROSTED QUARTZ GRAINS MEDIUM IN SIZE; POORLY CEMENTED MOD HARD FRIABLE; FINE GRAIN SUBANGULAR TO SUBROUNDED; PREDOM GRAIN SUPPORTED; CALCITE CEMENT;MOD REACTION TO HCL; 1-3% BLACK LITHICS FRAG EMBEDDED IN SAND; INTERBEDDED SILTSTONES AND SHALES WITH OCC THIN LAMINATED COAL SEAMS; HIGH GAS READINGS IN SANDS

SHALE=LIGHT MEDIUM GRAY OCC BROWN YELLOW WITH PURPLE HUES; MOD HARD BLOCKY IRREGULAR FRACTURE; PLATY OCC TABULAR CUTTINGS HABIT; DULL EARTHY LUSTER; SILTY SMOOTH TEXTURE; NON FISSILE STRUCTURE; INTERBEDDED WITH LT GRAY SILTSTONES AND WHITE SANDSTONES OCC TRACE PYRITE IN SAMPLE; VERY LOW GAS READINGS IN SHALE; GRADING TO LIGHT GRAYISH BROWN ARENACEOUS SILTSTONE

SANDSTONE=WHITE OCC REDDISH BROWN; MOD HARD FRIABLE; SUBANGULAR MOD WELL SORTED; PREDOM GRAIN SUPPORTED; CALCITE CEMENT TRACE KAOLINITE AND CLAY MATRIX; MOD SPHERICITY; MOD REACTION TO HCL; 1TO3% BLACK LITHICS FRAGS EMBEDDED; INTERBEDDED WITH SHALES AND SILTSTONES HIGH GAS IN SANDS

SHALE=PREDOM DARK MEDIUM GRAY OCC BROWNISH-YELLOW;MOD HARD FIRM; BLOCKY IRREG FRACTURE; PLATY TABULAR CUTTING HABIT; DULL EARTHY LUSTER; SMOOTH SLI SILTY TEXTURE; INTERBEDDED WITH WHITE MOD HARD FRIABLE PREDOM GRAIN SUPPORTED SANDSTONE; VERY HIGH GAS READINGS IN SAND STRINGERS

SANDSTONE=OFF WHITE ; FINE GRAIN MOD WELL SORTED; SUBANGULAR SUBRND; PREDOM GRAIN SUPPORTED; CALCITE CEMENT; FRIABLE TO EASILY FRIABLE; PREDOM QUARTZ WITH BLCK LITHICS; INTERBED SHALE AND SILTSTONE.

SHALE = MEDIUM TO MEDIUM LIGHT GRAY; CRUMBLY TO DENSE TENACITY; BLOCKY FRACTURE; TABULAR TO WEDGELIKE CUTTINGS; DULL TO EARTHY TEXTURE; SILTY TO CLAYEY TEXTURE; INTERBEDDED MEDIUM TO FINE LITHIC SANDSTONE AND MINOR SILTSTONE.

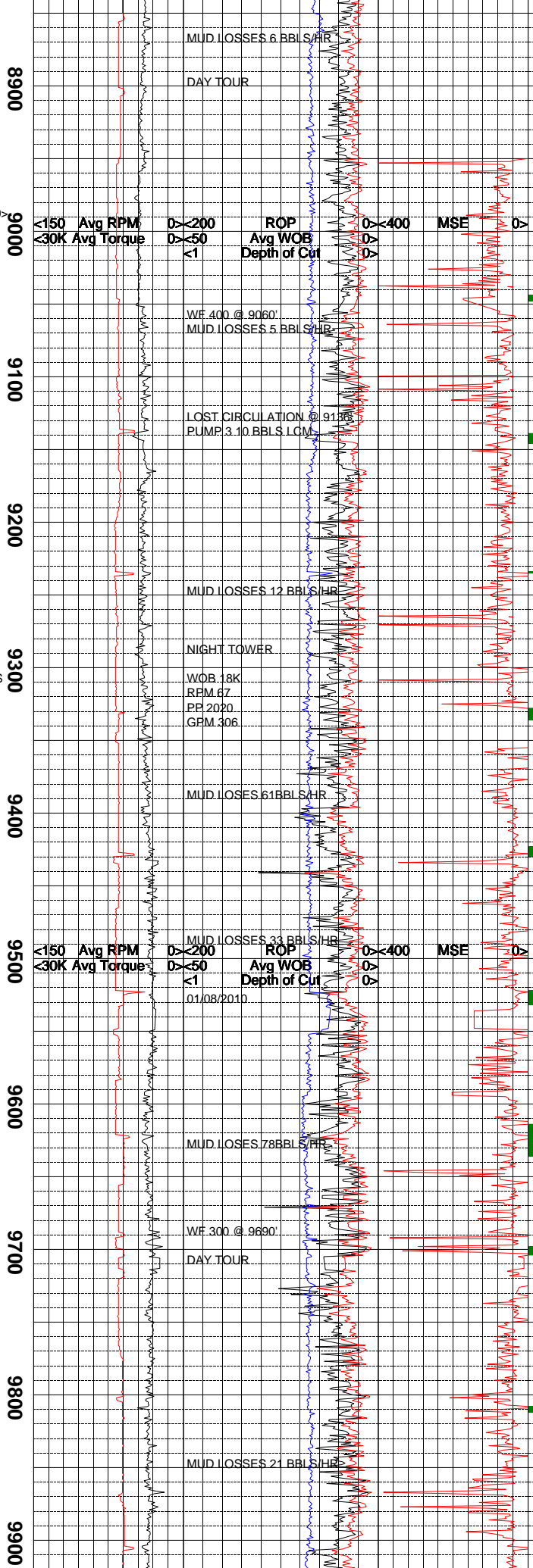
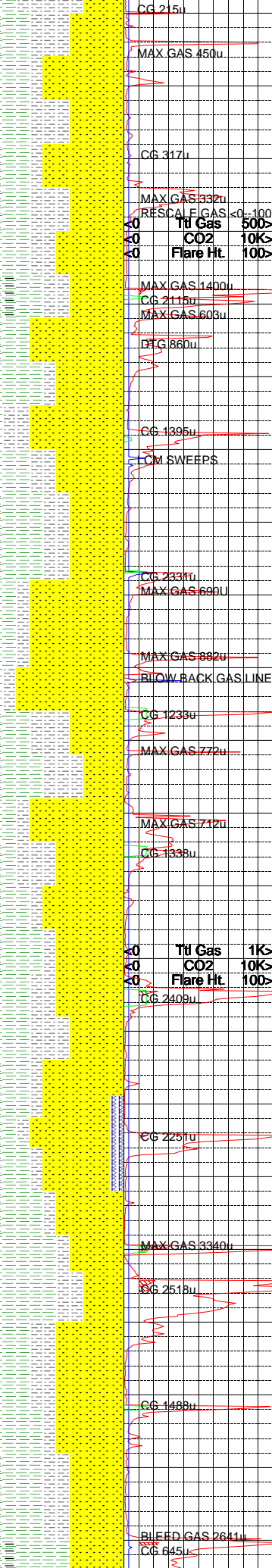
SHALE = MEDIUM TO DARK GRAY, MINOR VERY DARK GRAY TO GRAYISH BLACK; CRUMBLY TO DENSE TENACITY; BLOCKY TO PLANAR FRACTURE; TABULAR TO WEDGELIKE; MINOR MASSIVE CUTTING HABIT; SILTY TO CLAYEY, MINOR GRITTY TEXTURE; DULL TO EARTHY LUSTER; TRACE AMOUNT OF PYRITE SEEN IN MORE ORGANIC RICH SHALE; INTERBEDDED MEDIUM TO FINE GRAIN LITHIC SANDSTONE AND MINOR SILTSTONE; INCREASE IN CARBONACEOUS SHALE WITH DEPTH; GAS SEEN IN THE INTERBEDDED SANDSTONE LAYERS; NO FLUORESCENCE OR OIL STAINING SEEN IN THE SANDSTONE.

TD INTERMEDIATE @ 8684' MD ON 12/30/2009 AT 11:05; SET CASING AT 8669'.

SANDSTONE=WHITE FINE GRAIN; SUBANGULAR SUBROUNDED; MOD WELL SORTED; PREDOM GRAIN SUPPORTED; CALCITE CEMENT OCC TR KAOLINITE; MOD SPHERICITY; 1-3% BLACK LITHICS FRAGS EMBEDDED; INTERBEDDED WITH LIGHT GRAY SILTSTONES AND DARK SHALES HIGH GAS READINGS IN SANDS

SILTSTONE=LIGHT GRAY; MOD HARD VERY HARD TOUGH DENSE TENACITY; IRREGULAR BLOCKY FRACTURE; MASSIVE PLATY CUTTINGS HABIT; DULL OCC SPARKLING LUSTER; SMOOTH SLI GRITTY TEXTURE; GRADING TO FINE GRAIN MOD HARD SANDSTONE; INTERBEDDED WITH

MOD GRAY DARK GRAY SHALES; LOW GAS.



SANDSTONE = LIGHT GRAY WITH BLACK LITHIC FRAGMENTS; QUARTZ GRAINS WITH 10 TO 5% LITHIC FRAGMENTS; FRIABLE TO EASILY FRIABLE; FINE TO VERY FINE, GRADING INTO SILTSTONE; FAIR TO WELL SORTED; SUB-ANGULAR TO SUBROUNDED; MATRIX SUPPORTED TO MINOR GRAIN SUPPORTED; CALCITE CEMENT LOW VISIBLE POROSITY; FREQUENTLY INTER-BEDDED WITH SILTSTONE AND SHALE, VERY MINOR CARBONACEOUS SHALE; NO FLUORESCENCE OR STAINING; GAS SEEN IN THE SANDSTONE BEDS.

SILTSTONE = LIGHT TO MEDIUM DARK GRAY; INTERBEDDED SANDSTONE AND SHALE; LOW GAS SEEN DURING SECTION.

SANDSTONE = LIGHT GRAY TO WHITISH; FRIABLE TO MODERATELY HARD; FINE TO MEDIUM GRAIN; QUARTZ WITH BLACK LITHIC FRAGMENTS; FAIR TO POOR SORTING; SUB-ANGULAR TO SUBROUNDED; MATRIX WHITE CLAY; MATRIX SUPPORTED IN FINE GRAIN TO GRAIN SUPPORTED MEDIUM GRAIN; MODERATE VISIBLE POROSITY IN MEDIUM GRAIN; INTER-BEDDED SHALE AND OCCASIONALLY GRADES INTO SILTSTONE; GAS SEEN IN THE MORE POROUS SANDSTONE; NO FLUORESCENCE OR STAINING OBSERVED.

SANDSTONE = LIGHT TO MEDIUM GRAY; FRIABLE TO MODERATELY HARD; FINE TO MEDIUM GRAIN, GRADES INTO VERY FINE TO SILTSTONE; QUARTZ WITH BLACK LITHIC FRAGMENTS; CALCITE CEMENT; MATRIX SUPPORTED TO SUB GRAIN SUPPORTED MEDIUM GRAINED SANDSTONE; WHITE MATRIX OF QUARTZ AND CLAY; VERY MINOR CARBONACEOUS MATERIAL SEEN ALONG BEDDING PLANES; INTERBEDDED GRAY SHALE AND VERY MINOR CARBONACEOUS SHALE.

SHALE=LIGHT MEDIUM OCC DARK GRAY; MOD HARD FIRM; CRUMBLY BRITTLE TENACITY; SLI TABULAR TO MASSIVE PLATY CUTTINGS HABIT; DULL EARTHY LUSTER; SMOOTH SLI SILTY TEXTURE; INTERBEDDED WITH SANDS AND LIGHT GRAY SANDY SILTSTONES WITH VERY RARE TRACE LIGHT BROWN DENSE VERY HARD LIMESTONE

SANDSTONE=WHITE CLEAR; FINE MEDIUM GRAIN SUBANGULAR SUBROUNDED; MOD WELL SORTED; MOD HARD FRIABLE; PREDOM GRAIN SUPPORTED ABUD CLEAR MEDIUM QUARTZ GRAINS; SLI CALCITE CEMENT WITH 1-3% BLACK LITHICS FRAGS EMBEDDED; MOD HIGH SPHERICITY; INTERBEDDED GRAY WHITE SILTSTONES AND GRAY OCC CARBONACEOUS SHALES LOW GAS READINGS

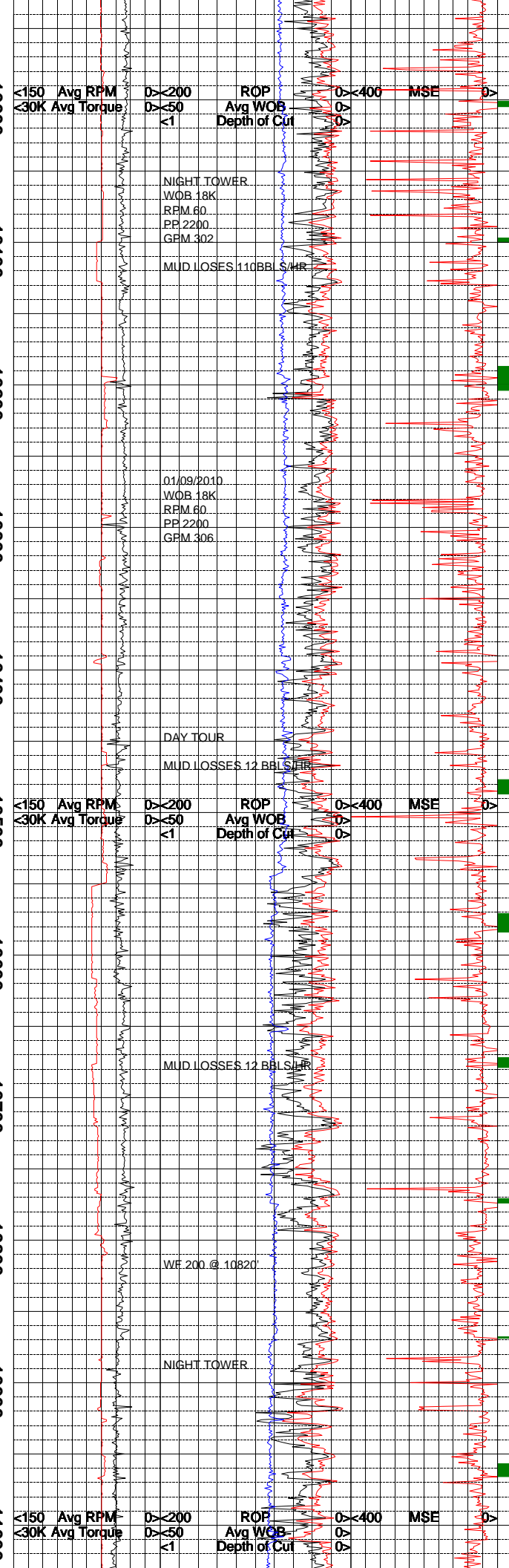
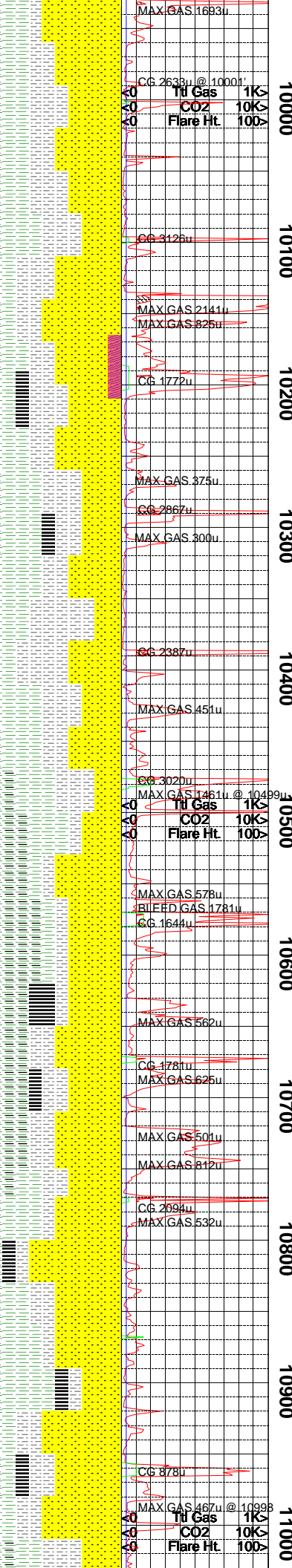
SHALE=YELLOW BROWN LIGHT GRAY OCC DARK GRAY; BRITTLE TENACITY; IRREGULAR BLOCKY PLANAR FRACTURE; TABULAR PLATY CUTTINGS HABIT; DULL EARTHY LUSTER; SMOOTH SLI SILT TO CLAYEY TEXTURE; SLI CALCAREOUS; INTERBEDDED WITH DARK BROWN BLACK CARBONACEOUS SHALES AND LIGHT GRAY WHITE SANDY SILTSTONES; LOW GAS READINGS

SILTSTONE=LIGHT GRAY WHITE;MOD HARD FIRM DENSE TOUGH TENACITY; BLOCKY IRREGULAR FRACTURE; MASSIVE PLATY CUTTINGS HABIT; DULL EARTHY OCC SPARKLING LUSTER; SMOOTH GRITTY TEXTURE; GRADING TO VERY FINE WHITE MOD HARD FRIABLE SANDSTONE; WITH MOD AMOUNTS OF KAOLINITE; LOW GAS READINGS

SANDSTONE = LIGHT TO MEDIUM GRAY; MOD HARD TO FIRM FRIABLE; QUARTZ CLASTS WITH LITHIC FRAGMENTS, OFTEN BLACK; FINE TO VERY FINE, OCCASIONAL MEDIUM GRAINED; FAIR TO WELL SORTED; ROUNDED TO SUB-ROUNDED, LITHIC SUBANGULAR; MODERATE SPHERICITY; INTERBEDDED SHALE AND SILTSTONE; CALCITE CEMENT WITH PROBABLE MINOR SILICA CEMENT; MATRIX SUPPORTED TO VERY OCCASIONAL GRAIN SUPPORT; LOW TO VERY LOW VISIBLE POROSITY; LOW BACKGROUND GAS, HIGH CONNECTION GAS.

SHALE = MEDIUM TO LIGHT MEDIUM GRAY; DENSE TO BRITTLE, OCCASIONAL CRUMBLY; BLOCKY TO PLANAR FRACTURE; TABULAR TO WEDGELIKE CUTTING HABIT, MASSIVE ALSO SEEN; DULL TO EARTHY LUSTER; SILTY TO CLAYEY TEXTURE; SLIGHTLY CALCAREOUS; INTERBEDDED ANDS GRADES INTO SILTSTONE AND INTERBEDDED LITHIC SANDSTONE; LOW BACKGROUND GAS, HIGH CONNECTION GAS.

SANDSTONE = BROWNISH GRAY TO LIGHT GRAY; MODERATELY HARD TO FRIABLE; GRADES FROM FINE UP TO MEDIUM AND DOW TO VERY FINE EQUALLY; 90 TO 70% QUARTZ FRAGMENTS WITH THE REMAINDER LITHIC FRAGMENTS; FAIR TO



POOR SORTING; SUBANGULAR TO SUBROUNDED; CALCITE CEMENT WITH POSSIBLE MINOR SILICA; SOME ORGANIC STAINING; INTERBED SHALE AND OCCASIONALLY GRADES INTO A SILTSTONE; GAS SEEN IN SAND.

SILTSTONE = LIGHT GRAY TO LIGHT YELLOWISH BROWN; BRITTLE TO DENSE TENACITY; GRADES INTO VERY TO FINE MOD HARD LITHIC SANDSTONE; GAS SEEN IN SANDSTONE.

SHALE=LIGHT MEDIUM GRAY OCC DARK GRAY; MOD HARD FIRM; CRUMBLY DENSE TENACITY; BLOCKY IRREGULAR OCC PLANAR FRACTURE; TABULAR TO ELONGATED CUTTINGS HABIT; DULL EARTHY LUSTER; SMOOTH SILTY TEXTURE INTERBEDDED WITH WHITE BROWNISH RED VERY FINE GRAIN SANDSTONE AND OCC CARBONACEOUS SHALES; HIGH GAS IN SANDS

SANDSTONE=WHITE BROWNISH RED HUE; VERY FINE GRAIN TO SLI MEDIUM GRAIN; MOD WELL SORTED; SUBANGULAR SUBROUNDED; PREDOM GRAIN SUPPORTED; SLI CALCITE 1-2% BLACK LITHIC FRAGS; MOD SPHERICITY; VIS TRACE OF FREE FRACTURE FILL CLEAR WHITE CALCITE EMBEDDED; INTERBEDDED WITH GRAY SANDY SILTST CARBONACEOUS SHALES OCC TRACE THIN LAMINATED COAL BEDS; HIGH GAS IN SANDS

SHALE=LIGHT MEDIUM GRAY OCC DARK GRAY; MOD HARD FIRM; BRITTLE TOUGH TENACITY; IRREGULAR BLOCKY OCC SPLINTERY FRACTURE TABULAR ELONGATED CUTTINGS HABIT; SMOOTH SLI SILTY TEXTURE; DULL EARTHY LUSTER; INTERBED WITH CARBONACEOUS SHALE THIN COAL BEDS AND VERY HARD FRIABLE WHITE REDDISH BROWN SANDSTONES; LOW GAS READINGS IN SHALES AND SILTSTONES

SILTSTONE=LIGHT GRAY BROWNISH GRAY; MOD HARD; BRITTLE TENACITY; PLANAR IRREGULAR FRACTURE; MASSIVE PLATY CUTTINGS HABIT; DULL TO OCC SPARKLING LUSTER; SLI GRITTY SMOOTH TEXTURE; INTERBEDDED SHALE, CARBONACEOUS SHALE, AND SANDSTONE.

SHALE = MEDIUM TO DARK GRAY; CRUNCHY TO PULVERULENT TENACITY; BLOCKY TO PLANAR FRACTURE; TABULAR TO WEDGELIKE CUTTINGS; EARTHY TO DULL LUSTER; INTERBEDDED LITHIC SANDSTONE WITH ORGANIC STAINING, SILTSTONE, AND CARBONACEOUS SHALE; LOW BACKGROUND GAS.

SANDSTONE = BROWNISH GRAY, MEDIUM TO LIGHT GRAY; MODERATELY HARD TO FRIABLE; QUARTZ CLASTS WITH BLACK AND BROWN LITHIC FRAGMENTS; MINOR REACTION TO HCL, CALCITE AND POSSIBLE SILICA CEMENT; BROWNISH STAIN, NO FLUORESCENCE OR CUT; ABUNDANT INTERBEDDED CARBONACEOUS SHALE AND MINOR GRAY SHALE, VERY MINOR SILTST; GAS IN SANDSTONE.

SANDSTONE = BROWNISH GRAY TO LIGHT GRAY; MODERATELY HARD TO FRIABLE; GRADES FROM FINE UP TO MEDIUM AND DOW TO VERY FINE EQUALLY; 90 TO 70% QUARTZ FRAGMENTS WITH THE REMAINDER LITHIC FRAGMENTS; FAIR TO POOR SORTING; SUBANGULAR TO SUBROUNDED; CALCITE CEMENT WITH POSSIBLE MINOR SILICA; ORGANIC STAINING, NO FLUORESCENC SHALE AND OCCASIONALLY GRADES INTO A SILTSTONE. ORGANIC RICH SILTSTONE ALSO SEEN; MODERATE TO POOR VISIBLE POROSITY; GAS SEEN IN SANDSTONE BEDS.

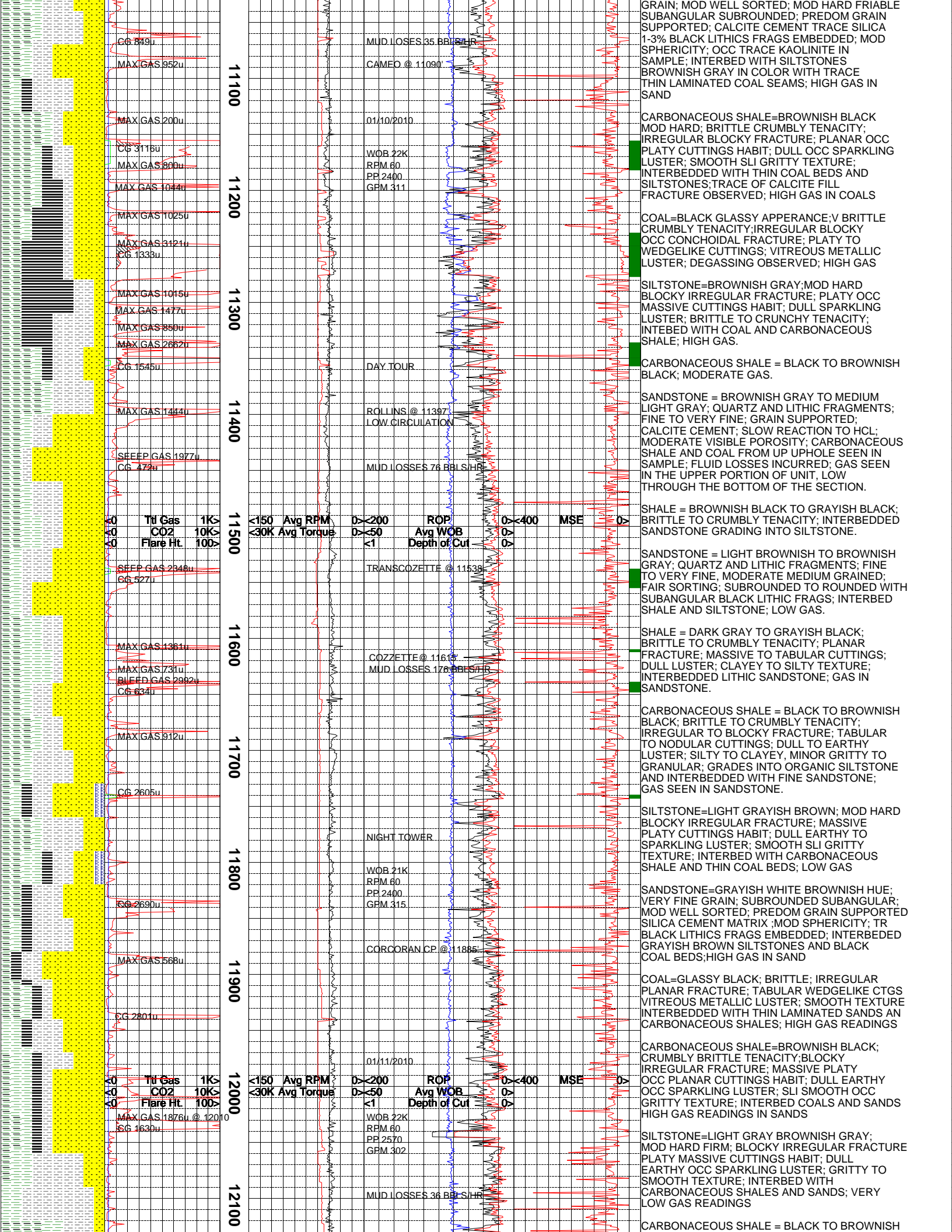
SHALE = DARK GRAY TO BLACK; CRUNCHY TO CRUMBLY; INTERBEDDED SANDSTONE AND COAL.

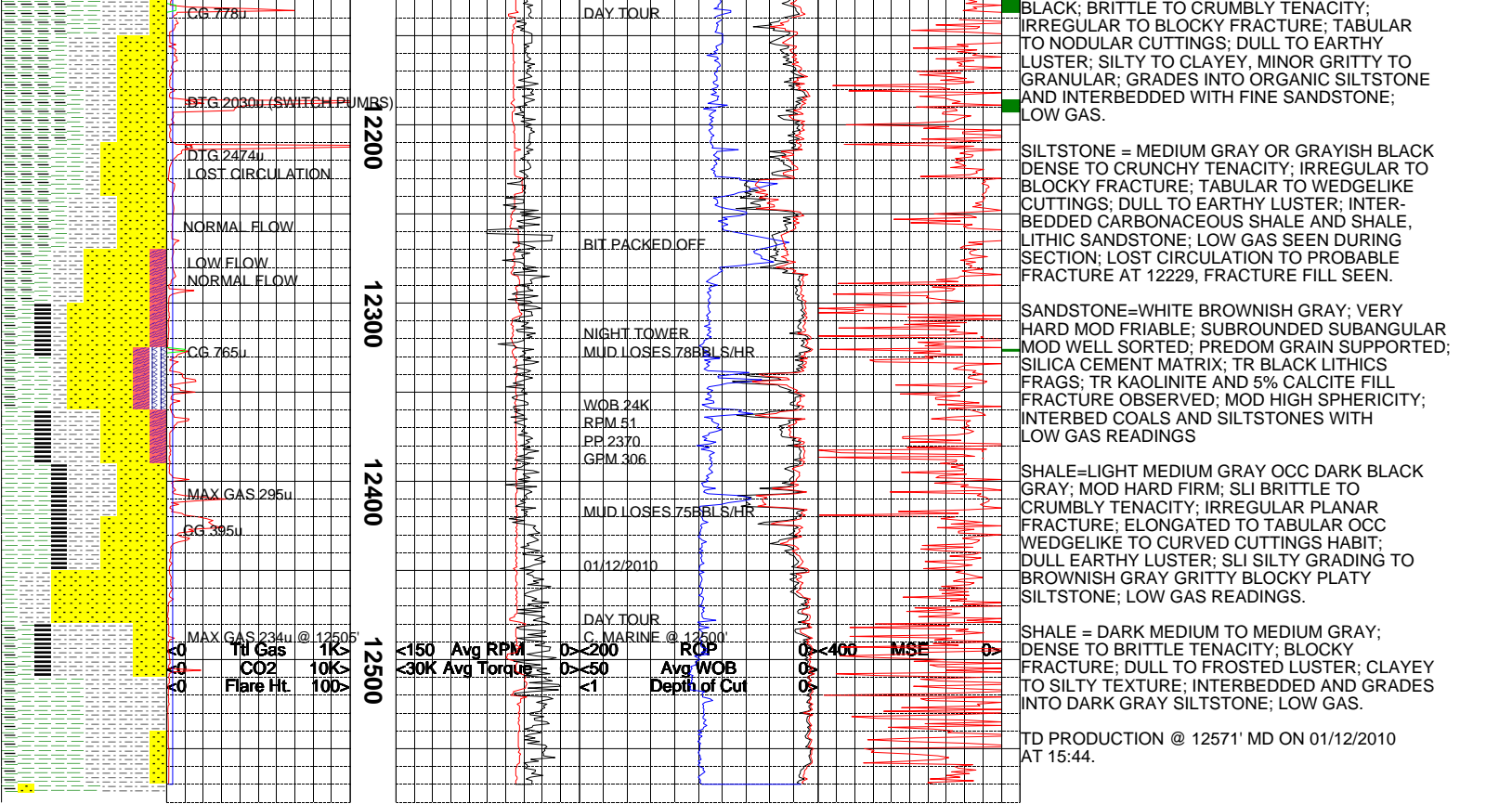
SANDSTONE = BROWNISH GRAY TO LIGHT GRAY; PREDOMINATELY QUARTZ WITH LITHIC FRAGS; MODERATELY HARD TO FRIABLE; FINE TO VERY FINE, MINOR MEDIUM; LOW VISIBLE POROSITY INTERBEDDED CARBONACEOUS SHALE AND SHALE ORGANIC SILTSTONE, MINOR COAL; LOW GAS SEEN, HIGH CONNECTION GAS.

SHALE=DARK GRAY BLACK GRAY; CRUMBLY CRUNCHY TENACITY; BLOCKY IRREGULAR PLANAR FRACTURE; TABULAR ELONGATED CUTTINGS HABIT; DULL EARTHY LUSTER; SLI SILTY SMOOTH TEXTURE; INTERBED WITH THIN COAL BEDS AND CARBONACEOUS SHALES WITH SAND STRINGERS GIVING MOD AMOUNTS OF GAS

COAL=BLACK; BRITTLE CRUMBLY TENACITY; IRREGULAR BLOCKY FRACTURE; WEDGELIKE CUTTINGS HABIT; GLASSY METALLIC LUSTER; SMOOTH TEXTURE; INTERBED WITH SLI CARBONACEOUS SHALES AND SANDSTONES MOD GAS READINGS IN COALS

SANDSTONE=LIGHT GRAY WHITE; VERY FINE





The log data, interpretations and recommendation provided by Epoch are inferences and assumptions based on measurements of drilling fluids. Such inferences and assumptions are not infallible and reasonable professionals may differ. Epoch does not represent or warrant the accuracy, correctness or completeness of any log data, interpretations, recommendations or information provided by Epoch, its officers, agents or employees. Epoch does not and cannot guarantee the accuracy of any such interpretation of the log data, interpretations or recommendations and Company is fully responsible for all decisions and actions it takes based on such log data, interpretations and recommendations.

BLACK; BRITTLE TO CRUMBLY TENACITY; IRREGULAR TO BLOCKY FRACTURE; TABULAR TO NODULAR CUTTINGS; DULL TO EARTHY LUSTER; SILTY TO CLAYEY, MINOR GRITTY TO GRANULAR; GRADES INTO ORGANIC SILTSTONE AND INTERBEDDED WITH FINE SANDSTONE; LOW GAS.

SILTSTONE = MEDIUM GRAY OR GRAYISH BLACK DENSE TO CRUNCHY TENACITY; IRREGULAR TO BLOCKY FRACTURE; TABULAR TO WEDGELIKE CUTTINGS; DULL TO EARTHY LUSTER; INTERBEDDED CARBONACEOUS SHALE AND SHALE, LITHIC SANDSTONE; LOW GAS SEEN DURING SECTION; LOST CIRCULATION TO PROBABLE FRACTURE AT 12229, FRACTURE FILL SEEN.

SANDSTONE=WHITE BROWNISH GRAY; VERY HARD MOD FRIABLE; SUBROUNDED SUBANGULAR MOD WELL SORTED; PREDOM GRAIN SUPPORTED; SILICA CEMENT MATRIX; TR BLACK LITHICS FRAGS; TR KAOLINITE AND 5% CALCITE FILL FRACTURE OBSERVED; MOD HIGH SPHERICITY; INTERBED COALS AND SILTSTONES WITH LOW GAS READINGS

SHALE=LIGHT MEDIUM GRAY OCC DARK BLACK GRAY; MOD HARD FIRM; SLI BRITTLE TO CRUMBLY TENACITY; IRREGULAR PLANAR FRACTURE; ELONGATED TO TABULAR OCC WEDGELIKE TO CURVED CUTTINGS HABIT; DULL EARTHY LUSTER; SLI SILTY GRADING TO BROWNISH GRAY GRITTY BLOCKY PLATY SILTSTONE; LOW GAS READINGS.

SHALE = DARK MEDIUM TO MEDIUM GRAY; DENSE TO BRITTLE TENACITY; BLOCKY FRACTURE; DULL TO FROSTED LUSTER; CLAYEY TO SILTY TEXTURE; INTERBEDDED AND GRADES INTO DARK GRAY SILTSTONE; LOW GAS.

TD PRODUCTION @ 12571' MD ON 01/12/2010 AT 15:44.