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Houston, TX (281) 784-5500
Bakersfield, CA (661) 328-1595
New Iberia, LA (337) 364-2322
Anchorage, AK (907) 561-2465

MUDLOG MD

COMPANY ExxonMobil Production
WELL PCU 296-5A01
FIELD Piceance Creek Unit
REGION Rocky Mountain
COORDINATES 39.912053000 108.198567000
ELEVATION 7295.5'
COUNTY, STATE Rio Blanco, CO
API INDEX 051031124800
SPUD DATE 10/21/2009
CONTRACTOR Helmerich and Payne
CO. REP. C.Curtis/ M. Hudon
RIG/TYPE 321 / Flex 4
LOGGING UNIT 031
GEOLOGISTS M. Franco
ADD. PERSONS C. Record/ B.Smelsor M.Piper R.McCane
CO. GEOLOGIST Nova Roosmawati

LOG INTERVAL

CASING DATA

DEPTHS: 4665' TO 14288'
DATES: 09/06/2010 TO 10/05/2010
SCALE: 1" = 100'

16.0" AT 150'
10.75" AT 4633'
7.0" AT 10105'
4.5" AT 14265'

MUD TYPES

HOLE SIZE

WATERBASED TO 14288'
TO
TO
TO

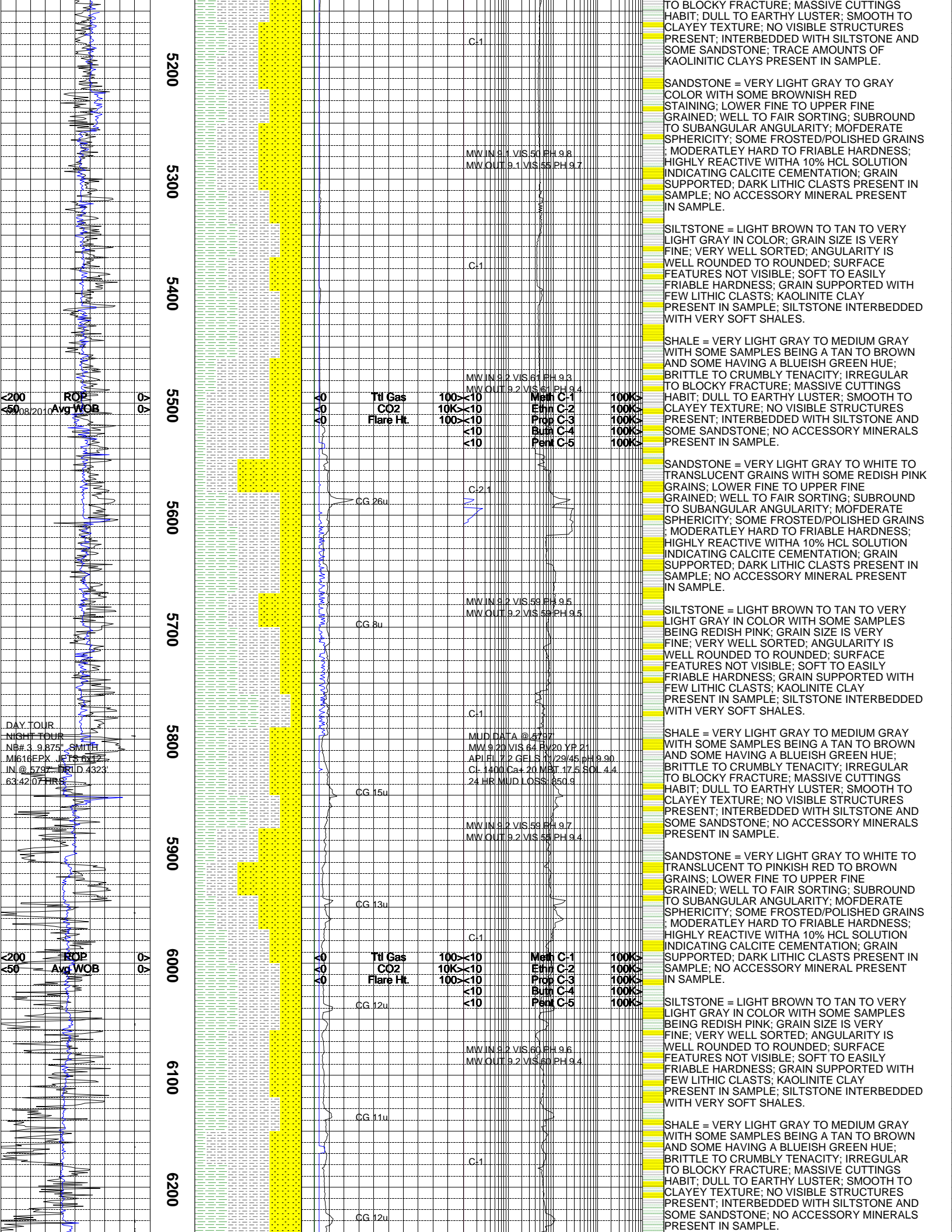
14.75" TO 126'
9.875" TO 10119'
6.125" TO 14288'
TO

ABBREVIATIONS

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

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





5200  
5300  
5400  
5500  
5600  
5700  
5800  
5900  
6000  
6100  
6200

<200 ROP  
<50 Avg WOB

DAY TOUR  
NIGHT TOUR  
NB# 3.9.876 SMITH  
M618EPX JETS 6312  
IN @ 5797 DRID 4323  
63:42:07 HRS

<200 ROP  
<50 Avg WOB

Ttl Gas  
CO2  
Flare Ht

100x<10  
10Kx<10  
100x<10  
<10  
<10

Meth C:1  
Ethn C:2  
Prop C:3  
Butn C:4  
Penk C:5

100Kx  
100Kx  
100Kx  
100Kx  
100Kx

CG 26u

C.2.1

CG 3u

MW IN 9.2 VIS 59 BH 9.5  
MW OUT 9.2 VIS 59 PH 9.5

CG 15u

MUD DATA @ 4797  
MW 9.20 VIS 64 BU 20 YP 21  
API FL 7.2 GEL S 11/29/45 pH 9.90  
Cl- 1400 Ca+ 20 MBT 17.5 SOL 4.4  
24 HR MUD LOSS 850 g

CG 13u

MW IN 9.2 VIS 59 BH 9.7  
MW OUT 9.2 VIS 59 PH 9.4

CG 12u

MW IN 9.2 VIS 60 BH 9.6  
MW OUT 9.2 VIS 60 PH 9.4

CG 11u

CG 12u

TO BLOCKY FRACTURE; MASSIVE CUTTINGS HABIT; DULL TO EARTHY LUSTER; SMOOTH TO CLAYEY TEXTURE; NO VISIBLE STRUCTURES PRESENT; INTERBEDDED WITH SILTSTONE AND SOME SANDSTONE; TRACE AMOUNTS OF KAOLINITIC CLAYS PRESENT IN SAMPLE.

SANDSTONE = VERY LIGHT GRAY TO GRAY COLOR WITH SOME BROWNISH RED STAINING; LOWER FINE TO UPPER FINE GRAINED; WELL TO FAIR SORTING; SUBROUND TO SUBANGULAR ANGULARITY; MODERATE SPHERICITY; SOME FROSTED/POLISHED GRAINS; MODERATLEY HARD TO FRIABLE HARDNESS; HIGHLY REACTIVE WITHA 10% HCL SOLUTION INDICATING CALCITE CEMENTATION; GRAIN SUPPORTED; DARK LITHIC CLASTS PRESENT IN SAMPLE; NO ACCESSORY MINERAL PRESENT IN SAMPLE.

SILTSTONE = LIGHT BROWN TO TAN TO VERY LIGHT GRAY IN COLOR; GRAIN SIZE IS VERY FINE; VERY WELL SORTED; ANGULARITY IS WELL ROUNDED TO ROUNDED; SURFACE FEATURES NOT VISIBLE; SOFT TO EASILY FRIABLE HARDNESS; GRAIN SUPPORTED WITH FEW LITHIC CLASTS; KAOLINITE CLAY PRESENT IN SAMPLE; SILTSTONE INTERBEDDED WITH VERY SOFT SHALES.

SHALE = VERY LIGHT GRAY TO MEDIUM GRAY WITH SOME SAMPLES BEING A TAN TO BROWN AND SOME HAVING A BLUEISH GREEN HUE; BRITTLE TO CRUMBLY TENACITY; IRREGULAR TO BLOCKY FRACTURE; MASSIVE CUTTINGS HABIT; DULL TO EARTHY LUSTER; SMOOTH TO CLAYEY TEXTURE; NO VISIBLE STRUCTURES PRESENT; INTERBEDDED WITH SILTSTONE AND SOME SANDSTONE; NO ACCESSORY MINERALS PRESENT IN SAMPLE.

SANDSTONE = VERY LIGHT GRAY TO WHITE TO TRANSLUCENT GRAINS WITH SOME REDISH PINK GRAINS; LOWER FINE TO UPPER FINE GRAINED; WELL TO FAIR SORTING; SUBROUND TO SUBANGULAR ANGULARITY; MODERATE SPHERICITY; SOME FROSTED/POLISHED GRAINS; MODERATLEY HARD TO FRIABLE HARDNESS; HIGHLY REACTIVE WITHA 10% HCL SOLUTION INDICATING CALCITE CEMENTATION; GRAIN SUPPORTED; DARK LITHIC CLASTS PRESENT IN SAMPLE; NO ACCESSORY MINERAL PRESENT IN SAMPLE.

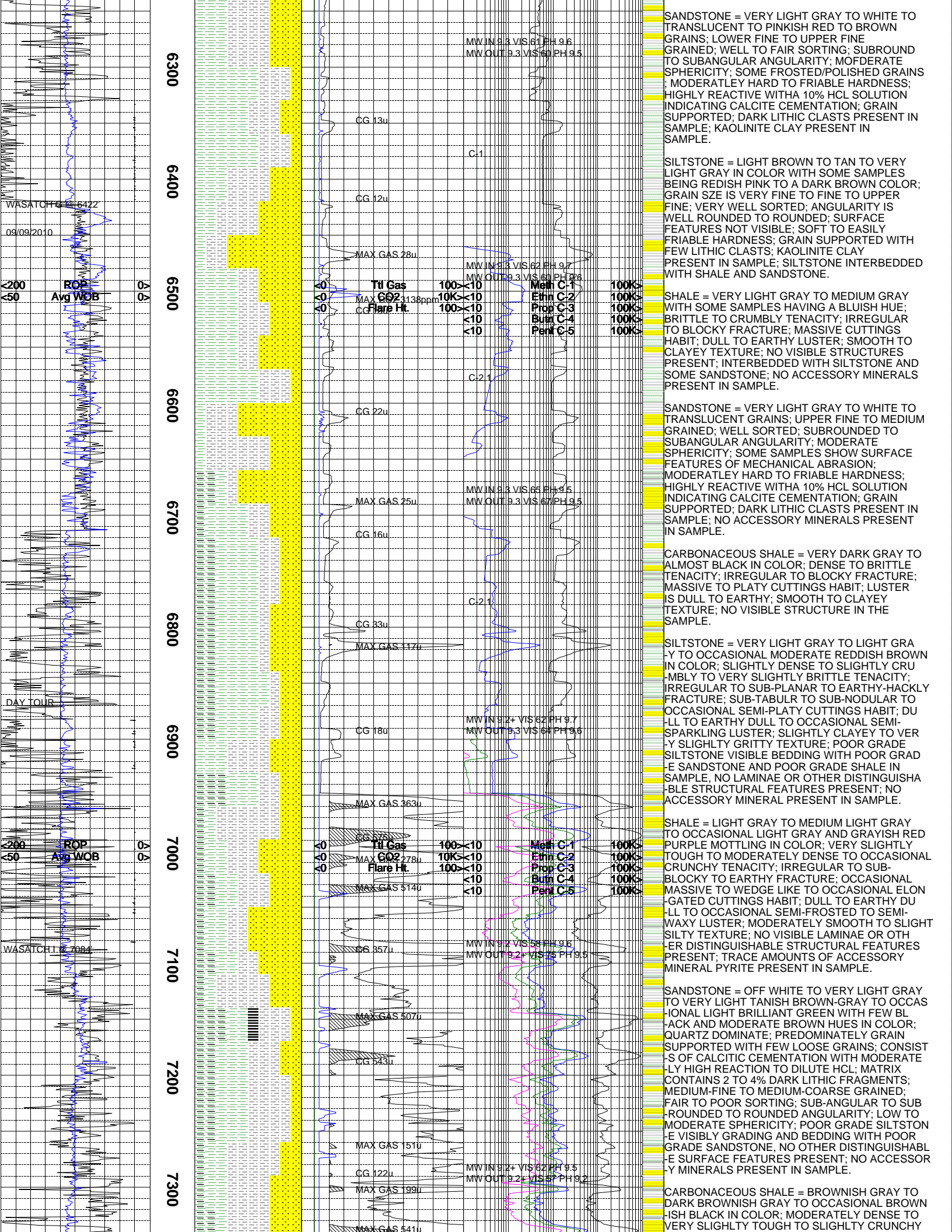
SILTSTONE = LIGHT BROWN TO TAN TO VERY LIGHT GRAY IN COLOR WITH SOME SAMPLES BEING REDISH PINK; GRAIN SIZE IS VERY FINE; VERY WELL SORTED; ANGULARITY IS WELL ROUNDED TO ROUNDED; SURFACE FEATURES NOT VISIBLE; SOFT TO EASILY FRIABLE HARDNESS; GRAIN SUPPORTED WITH FEW LITHIC CLASTS; KAOLINITE CLAY PRESENT IN SAMPLE; SILTSTONE INTERBEDDED WITH VERY SOFT SHALES.

SHALE = VERY LIGHT GRAY TO MEDIUM GRAY WITH SOME SAMPLES BEING A TAN TO BROWN AND SOME HAVING A BLUEISH GREEN HUE; BRITTLE TO CRUMBLY TENACITY; IRREGULAR TO BLOCKY FRACTURE; MASSIVE CUTTINGS HABIT; DULL TO EARTHY LUSTER; SMOOTH TO CLAYEY TEXTURE; NO VISIBLE STRUCTURES PRESENT; INTERBEDDED WITH SILTSTONE AND SOME SANDSTONE; NO ACCESSORY MINERALS PRESENT IN SAMPLE.

SANDSTONE = VERY LIGHT GRAY TO WHITE TO TRANSLUCENT TO PINKISH RED TO BROWN GRAINS; LOWER FINE TO UPPER FINE GRAINED; WELL TO FAIR SORTING; SUBROUND TO SUBANGULAR ANGULARITY; MODERATE SPHERICITY; SOME FROSTED/POLISHED GRAINS; MODERATLEY HARD TO FRIABLE HARDNESS; HIGHLY REACTIVE WITHA 10% HCL SOLUTION INDICATING CALCITE CEMENTATION; GRAIN SUPPORTED; DARK LITHIC CLASTS PRESENT IN SAMPLE; NO ACCESSORY MINERAL PRESENT IN SAMPLE.

SILTSTONE = LIGHT BROWN TO TAN TO VERY LIGHT GRAY IN COLOR WITH SOME SAMPLES BEING REDISH PINK; GRAIN SIZE IS VERY FINE; VERY WELL SORTED; ANGULARITY IS WELL ROUNDED TO ROUNDED; SURFACE FEATURES NOT VISIBLE; SOFT TO EASILY FRIABLE HARDNESS; GRAIN SUPPORTED WITH FEW LITHIC CLASTS; KAOLINITE CLAY PRESENT IN SAMPLE; SILTSTONE INTERBEDDED WITH VERY SOFT SHALES.

SHALE = VERY LIGHT GRAY TO MEDIUM GRAY WITH SOME SAMPLES BEING A TAN TO BROWN AND SOME HAVING A BLUEISH GREEN HUE; BRITTLE TO CRUMBLY TENACITY; IRREGULAR TO BLOCKY FRACTURE; MASSIVE CUTTINGS HABIT; DULL TO EARTHY LUSTER; SMOOTH TO CLAYEY TEXTURE; NO VISIBLE STRUCTURES PRESENT; INTERBEDDED WITH SILTSTONE AND SOME SANDSTONE; NO ACCESSORY MINERALS PRESENT IN SAMPLE.



**SANDSTONE** = VERY LIGHT GRAY TO WHITE TO TRANSLUCENT TO PINKISH RED TO BROWN GRAINS; LOWER FINE TO UPPER FINE GRAINED; WELL TO FAIR SORTING; SUBROUND TO SUBANGULAR ANGULARITY; MODERATE SPHERICITY; SOME FROSTED/POLISHED GRAINS; MODERATELY HARD TO FRIABLE HARDNESS; HIGHLY REACTIVE WITH 10% HCL SOLUTION INDICATING CALCITE CEMENTATION; GRAIN SUPPORTED; DARK LITHIC CLASTS PRESENT IN SAMPLE; KAOLINITE CLAY PRESENT IN SAMPLE.

**SILTSTONE** = LIGHT BROWN TO TAN TO VERY LIGHT GRAY IN COLOR WITH SOME SAMPLES BEING REDISH PINK TO A DARK BROWN COLOR; GRAIN SIZE IS VERY FINE TO FINE TO UPPER FINE; VERY WELL SORTED; ANGULARITY IS WELL ROUNDED TO ROUNDED; SURFACE FEATURES NOT VISIBLE; SOFT TO EASILY FRIABLE HARDNESS; GRAIN SUPPORTED WITH FEW LITHIC CLASTS; KAOLINITE CLAY PRESENT IN SAMPLE; SILTSTONE INTERBEDDED WITH SHALE AND SANDSTONE.

**SHALE** = VERY LIGHT GRAY TO MEDIUM GRAY WITH SOME SAMPLES HAVING A BLUISH HUE; BRITTLE TO CRUMBLY TENACITY; IRREGULAR TO BLOCKY FRACTURE; MASSIVE CUTTINGS HABIT; DULL TO EARTHY LUSTER; SMOOTH TO CLAYEY TEXTURE; NO VISIBLE STRUCTURES PRESENT; INTERBEDDED WITH SILTSTONE AND SOME SANDSTONE; NO ACCESSORY MINERALS PRESENT IN SAMPLE.

**SANDSTONE** = VERY LIGHT GRAY TO WHITE TO TRANSLUCENT GRAINS; UPPER FINE TO MEDIUM GRAINED; WELL SORTED; SUBROUNDED TO SUBANGULAR ANGULARITY; MODERATE SPHERICITY; SOME SAMPLES SHOW SURFACE FEATURES OF MECHANICAL ABRASION; MODERATELY HARD TO FRIABLE HARDNESS; HIGHLY REACTIVE WITH 10% HCL SOLUTION INDICATING CALCITE CEMENTATION; GRAIN SUPPORTED; DARK LITHIC CLASTS PRESENT IN SAMPLE; NO ACCESSORY MINERALS PRESENT IN SAMPLE.

**CARBONACEOUS SHALE** = VERY DARK GRAY TO ALMOST BLACK IN COLOR; DENSE TO BRITTLE TENACITY; IRREGULAR TO BLOCKY FRACTURE; MASSIVE TO PLATY CUTTINGS HABIT; LUSTER IS DULL TO EARTHY; SMOOTH TO CLAYEY TEXTURE; NO VISIBLE STRUCTURE IN THE SAMPLE.

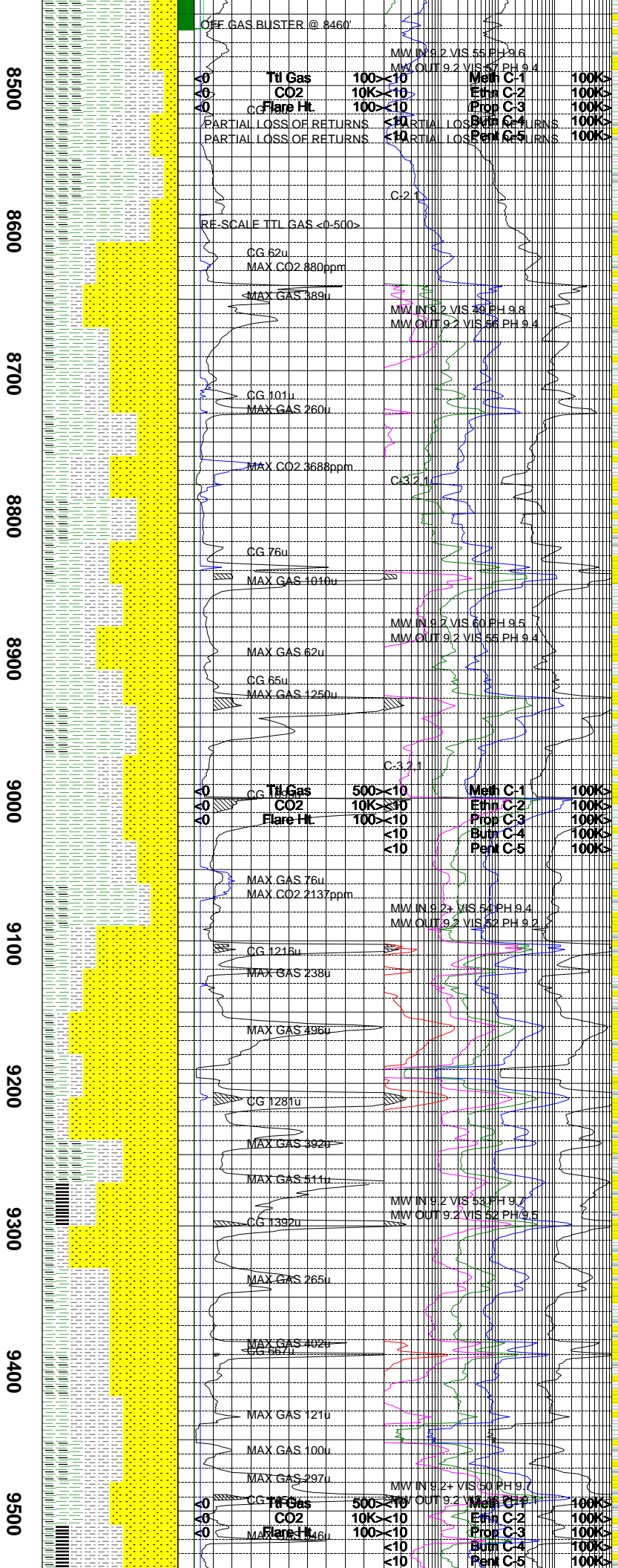
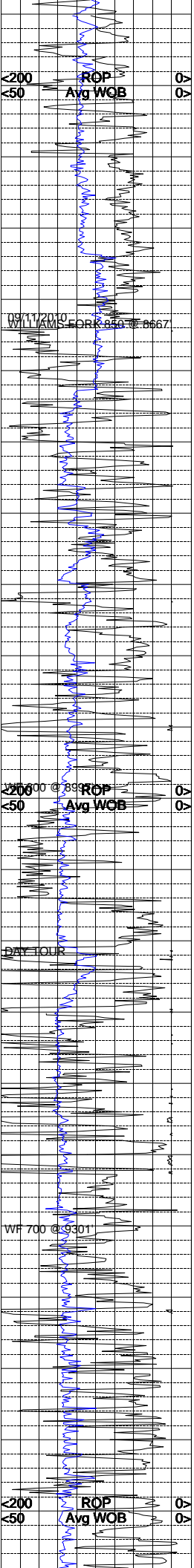
**SILTSTONE** = VERY LIGHT GRAY TO LIGHT GRAY TO OCCASIONAL MODERATE REDDISH BROWN IN COLOR; SLIGHTLY DENSE TO SLIGHTLY CRUMBLY TO VERY SLIGHTLY BRITTLE TENACITY; IRREGULAR TO SUB-PLANAR TO EARTHY-HACKLY FRACTURE; SUB-TABULAR TO SUB-NODULAR TO OCCASIONAL SEMI-PLATY CUTTINGS HABIT; DULL TO EARTHY DULL TO OCCASIONAL SEMI-SPARKLING LUSTER; SLIGHTLY CLAYEY TO VERY SLIGHTLY GRITTY TEXTURE; POOR GRADE SILTSTONE VISIBLE BEDDING WITH POOR GRADE SANDSTONE AND POOR GRADE SHALE IN SAMPLE; NO LAMINAE OR OTHER DISTINGUISHABLE STRUCTURAL FEATURES PRESENT; NO ACCESSORY MINERAL PRESENT IN SAMPLE.

**SHALE** = LIGHT GRAY TO MEDIUM LIGHT GRAY TO OCCASIONAL LIGHT GRAY AND GRAYISH RED PURPLE MOTTLING IN COLOR; VERY SLIGHTLY TOUGH TO MODERATELY DENSE TO OCCASIONAL CRUNCHY TENACITY; IRREGULAR TO SUB-BLOCKY TO EARTHY FRACTURE; OCCASIONAL MASSIVE TO WEDGE LIKE TO OCCASIONAL ELONGATED CUTTINGS HABIT; DULL TO EARTHY DULL TO OCCASIONAL SEMI-FROSTED TO SEMI-WAXY LUSTER; MODERATELY SMOOTH TO SLIGHT SILTY TEXTURE; NO VISIBLE LAMINAE OR OTHER DISTINGUISHABLE STRUCTURAL FEATURES PRESENT; TRACE AMOUNTS OF ACCESSORY MINERAL PYRITE PRESENT IN SAMPLE.

**SANDSTONE** = OFF WHITE TO VERY LIGHT GRAY TO VERY LIGHT TANISH BROWN-GRAY TO OCCASIONAL LIGHT BRILLIANT GREEN WITH FEW BLACK AND MODERATE BROWN HUES IN COLOR; QUARTZ DOMINATE; PREDOMINATELY GRAIN SUPPORTED WITH FEW LOOSE GRAINS; CONSISTENT OF CALCITIC CEMENTATION WITH MODERATELY HIGH REACTION TO DILUTE HCL; MATRIX CONTAINS 2 TO 4% DARK LITHIC FRAGMENTS; MEDIUM-FINE TO MEDIUM-COARSE GRAINED; FAIR TO POOR SORTING; SUB-ANGULAR TO SUB-ROUNDED TO ROUNDED ANGULARITY; LOW TO MODERATE SPHERICITY; POOR GRADE SILTSTONE VISIBLE GRADING AND BEDDING WITH POOR GRADE SANDSTONE. NO OTHER DISTINGUISHABLE SURFACE FEATURES PRESENT; NO ACCESSORY MINERALS PRESENT IN SAMPLE.

**CARBONACEOUS SHALE** = BROWNISH GRAY TO DARK BROWNISH GRAY TO OCCASIONAL BROWNISH BLACK IN COLOR; MODERATELY DENSE TO VERY SLIGHTLY TOUGH TO SLIGHTLY CRUNCHY





SMOOTH TO CLAYEY TO SILTY TEXTURE; SOME SAMPLES SHOW LAMINAE TO VERY THIN STRUCTURE WITH THE MAJORITY OF THE SAMPLE HAVING NO STRUCTURE.

CARBONACEOUS SHALE = BLACK TO A VERY DARK BROWN COLOR; DENSE TO BRITTLE TENACITY; IRREGULAR TO PLANAR FRACTURE; CUTTINGS HABIT IS PLATY TO WEDGELIKE TO BLADED; DULL TO EARTHY LUSTER; SMOOTH TO CLAYEY TO SILTY TEXTURE; NO VISIBLE STRUCTURE IN THE SAMPLE.

SILTSTONE = LIGHT BROWN TO TAN TO A REDISH BROWN COLOR; CRUMBLY TO CRUNCHY TENACITY; SOME SAMPLE IS NOT VERY WELL CONSOLIDATED; IRREGULAR TO BLOCKY FRACTURE; MASSIVE CUTTINGS HABIT; DULL EARTHY LUSTER WITH SOME HAVING A GREASY LUSTER; SILTY TO GRITTY TEXTURE; NO VISIBLE STRUCTURE OR ACCESSORY MINERALS.

SANDSTONE = TRANSLUCENT TO WHITE GRAINS; QUARTZ FRAMEWORK; UPPER FINE TO LOWER MEDIUM GRAIN SIZE; VERY WELL TO WELL SORTING; ROUND TO SUBROUND TO SUB ANGULAR GRAINS; SPERICITY IS HIGH TO MODERATE; SOME FROSTED GRAINS; FIRMLY FRIABLE TO HARD; CALCITE CEMENTATION; GRAIN SUPPORTED; FEW LITHIC CLASTS; HIGHLY REACTIVE WITH A 10% HCL SOLUTION; NO VISIBLE FLOURECENSE.

SHALE = VERY LIGHT GRAY TO DARK GRAY TO A VERY LIGHT BLUEISH GRAY; BRITTLE TO CRUNCHY TENACITY; PLANAR TO IRREGULAR FRACTURE; PLATY TO WEDGELIKE TO BLADED CUTTINGS HABIT; DULL TO EARTHY LUSTER; SMOOTH TO CLAYEY TEXTURE; LAMINAE TO THIN STRUCTURE; INTERBEDDED WITH SILTSTONE AND SANDSTONE.

SILTSTONE = LIGHT BROWN TO TAN TO A REDISH BROWN COLOR; CRUMBLY TO CRUNCHY TENACITY; SOME SAMPLE IS NOT VERY WELL CONSOLIDATED; IRREGULAR TO BLOCKY FRACTURE; MASSIVE CUTTINGS HABIT; DULL EARTHY LUSTER WITH SOME HAVING A GREASY LUSTER; SILTY TO GRITTY TEXTURE; NO VISIBLE STRUCTURE OR ACCESSORY MINERALS.

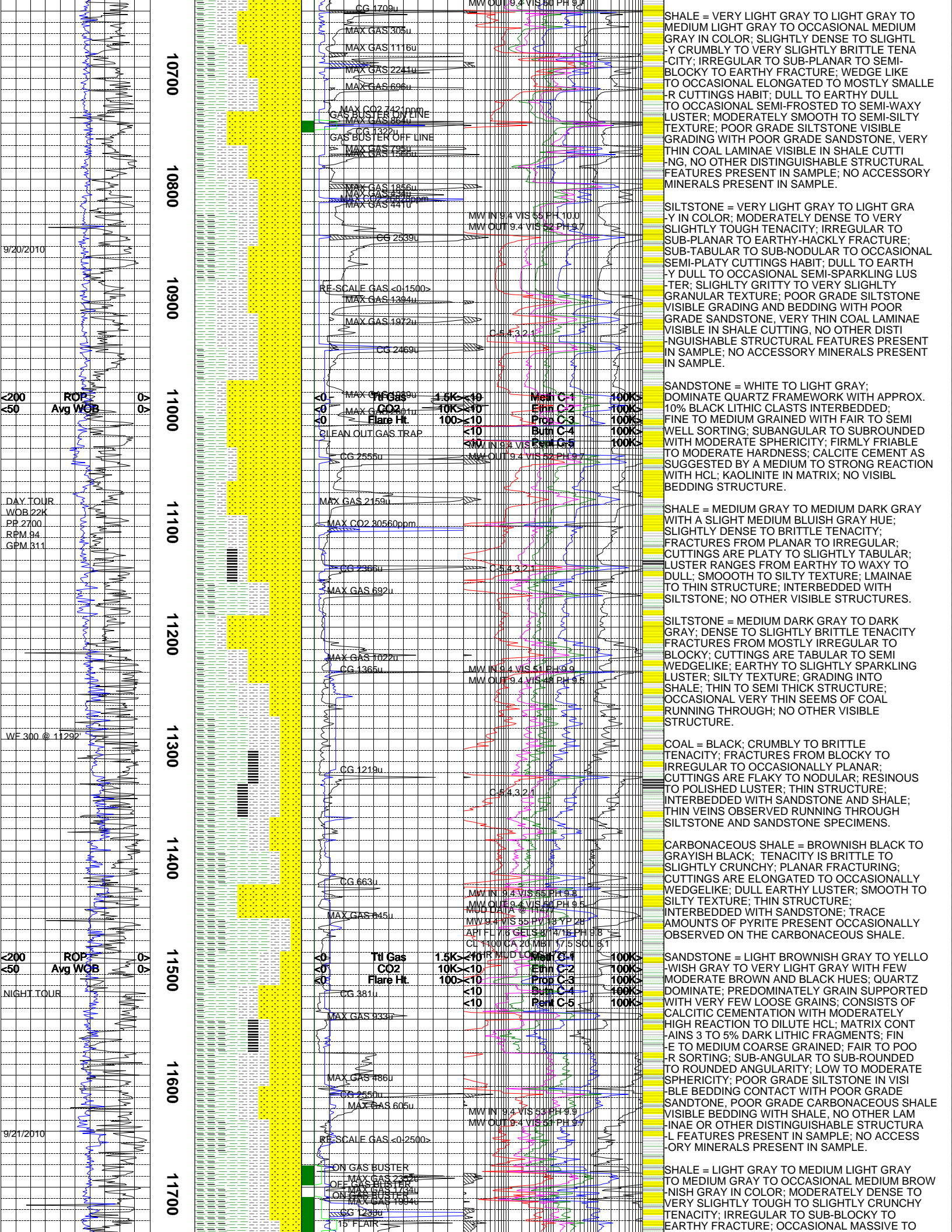
SANDSTONE = TRANSLUCENT TO WHITE GRAINS; QUARTZ FRAMEWORK; UPPER FINE TO LOWER MEDIUM GRAIN SIZE; VERY WELL TO WELL SORTING; ROUND TO SUBROUND TO SUB ANGULAR GRAINS; SPERICITY IS HIGH TO MODERATE; SOME FROSTED GRAINS; FIRMLY FRIABLE TO HARD; CALCITE CEMENTATION; GRAIN SUPPORTED; FEW LITHIC CLASTS; HIGHLY REACTIVE WITH A 10% HCL SOLUTION; NO VISIBLE FLOURECENSE.

CARBONACEOUS SHALE = BROWNISH GRAY TO DARK BROWNISH GRAY TO BROWNISH BLACK TO OCCASIONAL OLIVE BLACK IN COLOR; MODERATELY DENSE TO SLIGHTLY TOUGH TENACITY; IRREGULAR TO SUB-BLOCKY TO SUB-PLANAR TO EARTHY FRACTURE; MOSTLY SMALLER CUTTINGS TO WEDGE LIKE TO SUB-TABULAR CUTTING HABIT; DULL TO EARTHY DULL TO OCCASIONAL SEMI-SPARKLING LUSTER; SEMI-SMOOTH TO VERY SLIGHTLY GRITTY TEXTURE; POOR GRADE SILTSTONE VISIBLE GRADING WITH POOR GRADE SANDSTONE, VERY THIN COAL LAMINAE VISIBLE IN SHALE CUTTING, VERY SMALL AMOUNT OF CARBONACEOUS SHALE VISIBLE EFFERVESCING IN SAMPLE, NO OTHER DISTINGUISHABLE STRUCTURAL FEATURES PRESENT IN SAMPLE; NO VISIBLE ACCESSORY MINERALS PRESENT IN SAMPLE.

SHALE = VERY LIGHT GRAY TO LIGHT GRAY TO OCCASIONAL MEDIUM LIGHT GRAY IN COLOR; MODERATELY DENSE TO VERY SLIGHTLY TOUGH TO OCCASIONAL CRUNCHY TENACITY; IRREGULAR TO SEMI-BLOCKY TO SEMI-PLANAR TO EARTHY FRACTURE; OCCASIONAL MASSIVE TO SUB-PLANAR TO WEDGE LIKE TO OCCASIONAL ELONGATED CUTTINGS HABIT; DULL TO EARTHY DULL TO OCCASIONAL SEMI-FROSTED TO SEMI-WAXY LUSTER; MODERATELY SMOOTH TO SEMI-SILTY TEXTURE; POOR GRADE SANDSTONE VISIBLE IN CONTACT WITH COAL, SMALL AMOUNT OF CARBONACEOUS SHALE AND COAL VISIBLE EFFERVESCING IN SAMPLE, NO OTHER DISTINGUISHABLE STRUCTURAL FEATURES PRESENT IN SAMPLE; TRACE AMOUNTS OF ACCESSORY MINERAL PYRITE PRESENT IN SAMPLE.

SILTSTONE = LIGHT GRAY TO MEDIUM LIGHT GRAY WITH FEW BLACK HUES IN COLOR; MODERATELY DENSE TO OCCASIONAL BRITTLE TENACITY; IRREGULAR TO SUB-PLANAR TO EARTHY-FACKLY FRACTURE; SUB-TABULAR TO SUB-NODULAR CUTTINGS HABIT; DULL TO EARTHY DULL TO OCCASIONAL SEMI-SPARKLING LUSTER; SLIGHTLY GRITTY TO VERY SLIGHTLY GRANULAR TEXTURE; POOR GRADE SANDSTONE VISIBLE GRADING WITH POOR GRADE SILTSTONE, NO LAMINAE OR OTHER DISTINGUISHABLE STRU





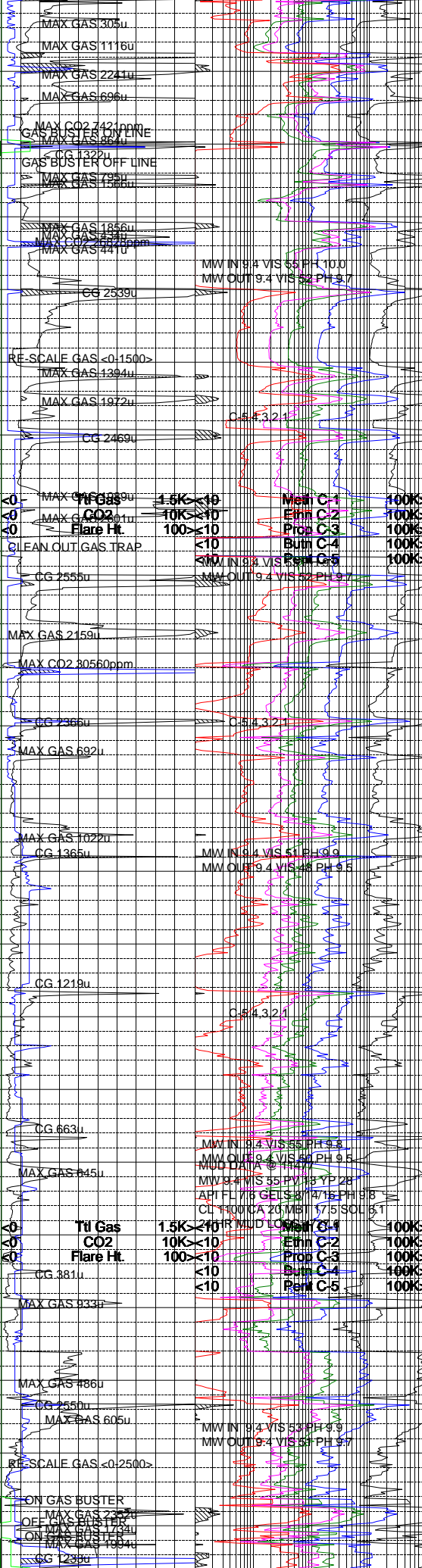
10700  
10800  
10900  
11000  
11100  
11200  
11300  
11400  
11500  
11600  
11700

ROP  
Avg WOB

DAY TOUR  
WOB 22K  
PP 2700  
RPM 94  
GPM 311

ROP  
Avg WOB

NIGHT TOUR



SHALE = VERY LIGHT GRAY TO LIGHT GRAY TO MEDIUM LIGHT GRAY TO OCCASIONAL MEDIUM GRAY IN COLOR; SLIGHTLY DENSE TO SLIGHTLY CRUMBLY TO VERY SLIGHTLY BRITTLE TENACITY; IRREGULAR TO SUB-PLANAR TO SEMI-BLOCKY TO EARTHY FRACTURE; WEDGE LIKE TO OCCASIONAL ELONGATED TO MOSTLY SMALLER CUTTINGS HABIT; DULL TO EARTHY DULL TO OCCASIONAL SEMI-FROSTED TO SEMI-WAXY LUSTER; MODERATELY SMOOTH TO SEMI-SILTY TEXTURE; POOR GRADE SILTSTONE VISIBLE GRADING WITH POOR GRADE SANDSTONE, VERY THIN COAL LAMINAE VISIBLE IN SHALE CUTTING, NO OTHER DISTINGUISHABLE STRUCTURAL FEATURES PRESENT IN SAMPLE; NO ACCESSORY MINERALS PRESENT IN SAMPLE.

SILTSTONE = VERY LIGHT GRAY TO LIGHT GRAY IN COLOR; MODERATELY DENSE TO VERY SLIGHTLY TOUGH TENACITY; IRREGULAR TO SUB-PLANAR TO EARTHY-HACKLY FRACTURE; SUB-TABULAR TO SUB-NODULAR TO OCCASIONAL SEMI-PLATY CUTTINGS HABIT; DULL TO EARTHY DULL TO OCCASIONAL SEMI-SPARKLING LUSTER; SLIGHTLY GRITTY TO VERY SLIGHTLY GRANULAR TEXTURE; POOR GRADE SILTSTONE VISIBLE GRADING AND BEDDING WITH POOR GRADE SANDSTONE, VERY THIN COAL LAMINAE VISIBLE IN SHALE CUTTING, NO OTHER DISTINGUISHABLE STRUCTURAL FEATURES PRESENT IN SAMPLE; NO ACCESSORY MINERALS PRESENT IN SAMPLE.

SANDSTONE = WHITE TO LIGHT GRAY; DOMINATE QUARTZ FRAMEWORK WITH APPROX. 10% BLACK LITHIC CLASTS INTERBEDDED; FINE TO MEDIUM GRAINED WITH FAIR TO SEMI WELL SORTING; SUBANGULAR TO SUBROUNDED WITH MODERATE SPHERICITY; FIRMLY FRIABLE TO MODERATE HARDNESS; CALCITE CEMENT AS SUGGESTED BY A MEDIUM TO STRONG REACTION WITH HCL; KAOLINITE IN MATRIX; NO VISIBL BEDDING STRUCTURE.

SHALE = MEDIUM GRAY TO MEDIUM DARK GRAY WITH A SLIGHT MEDIUM BLUISH GRAY HUE; SLIGHTLY DENSE TO BRITTLE TENACITY; FRACTURES FROM PLANAR TO IRREGULAR; CUTTINGS ARE PLATY TO SLIGHTLY TABULAR; LUSTER RANGES FROM EARTHY TO WAXY TO DULL; SMOOTH TO SILTY TEXTURE; LAMINAE TO THIN STRUCTURE; INTERBEDDED WITH SILTSTONE; NO OTHER VISIBLE STRUCTURES.

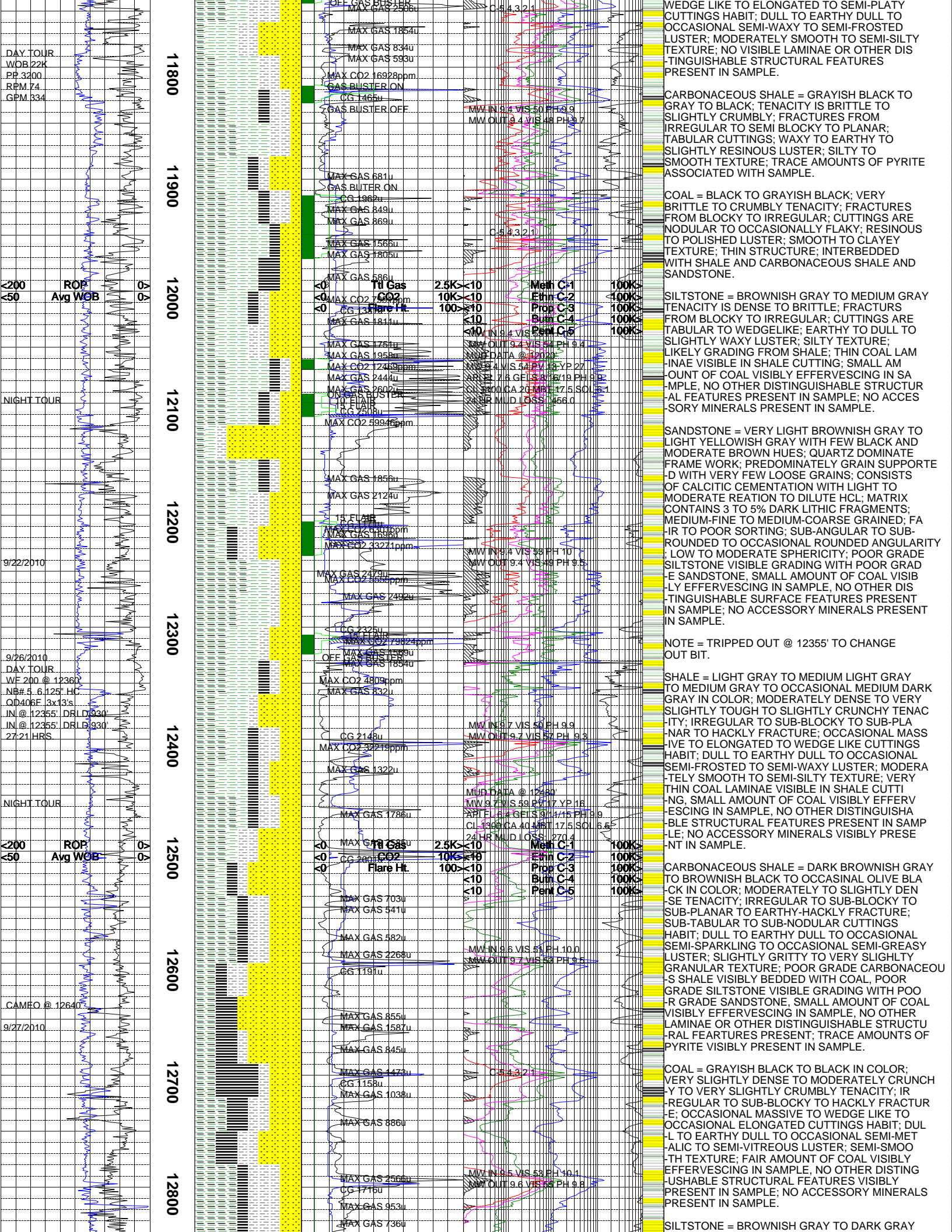
SILTSTONE = MEDIUM DARK GRAY TO DARK GRAY; DENSE TO SLIGHTLY BRITTLE TENACITY FRACTURES FROM MOSTLY IRREGULAR TO BLOCKY; CUTTINGS ARE TABULAR TO SEMI WEDGELIKE; EARTHY TO SLIGHTLY SPARKLING LUSTER; SILTY TEXTURE; GRADING INTO SHALE; THIN TO SEMI THICK STRUCTURE; OCCASIONAL VERY THIN SEEMS OF COAL RUNNING THROUGH; NO OTHER VISIBLE STRUCTURE.

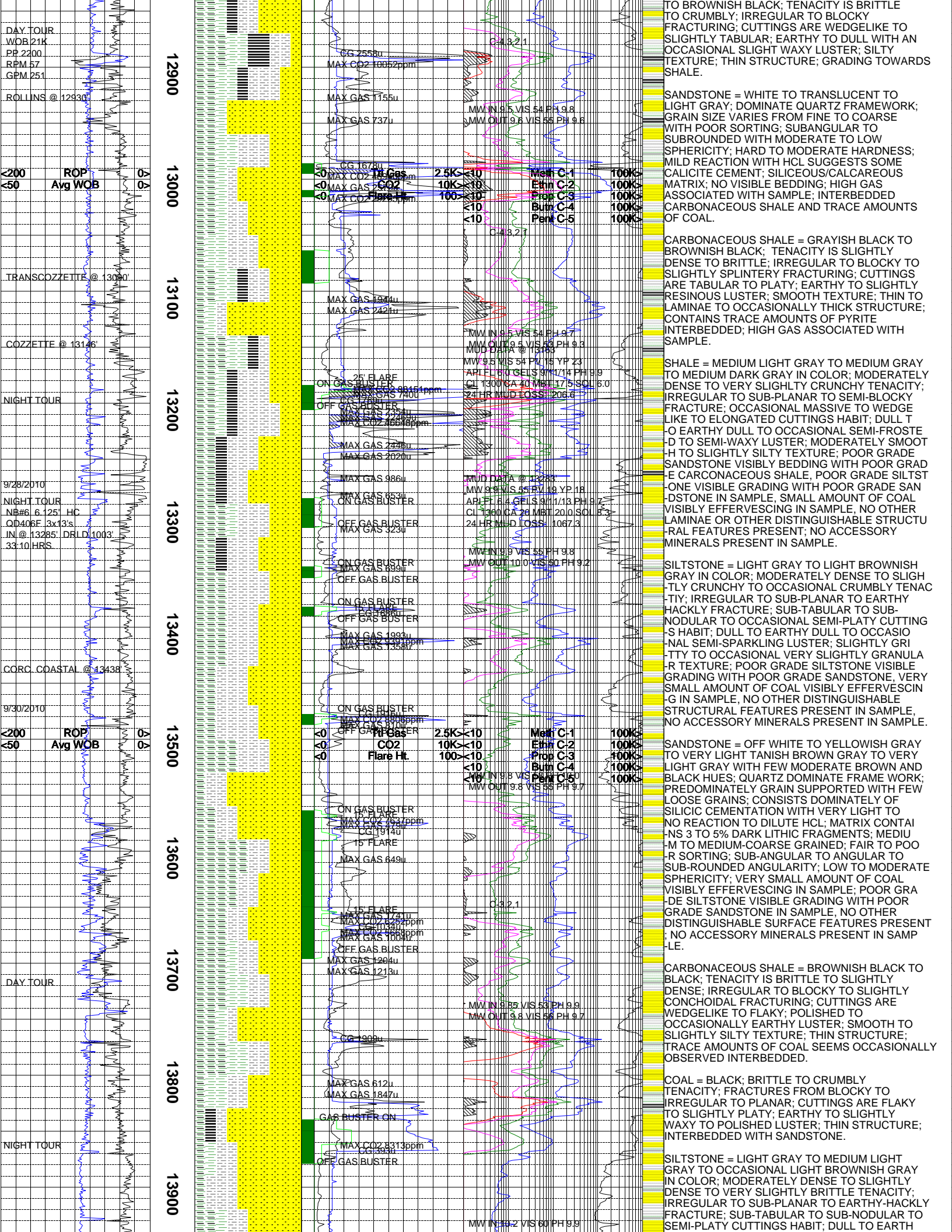
COAL = BLACK; CRUMBLY TO BRITTLE TENACITY; FRACTURES FROM BLOCKY TO IRREGULAR TO OCCASIONALLY PLANAR; CUTTINGS ARE FLAKY TO NODULAR; RESINOUS TO POLISHED LUSTER; THIN STRUCTURE; INTERBEDDED WITH SANDSTONE AND SHALE; THIN VEINS OBSERVED RUNNING THROUGH SILTSTONE AND SANDSTONE SPECIMENS.

CARBONACEOUS SHALE = BROWNISH BLACK TO GRAYISH BLACK; TENACITY IS BRITTLE TO SLIGHTLY CRUNCHY; PLANAR FRACTURING; CUTTINGS ARE ELONGATED TO OCCASIONALLY WEDGELIKE; DULL EARTHY LUSTER; SMOOTH TO SILTY TEXTURE; THIN STRUCTURE; INTERBEDDED WITH SANDSTONE; TRACE AMOUNTS OF PYRITE PRESENT OCCASIONALLY OBSERVED ON THE CARBONACEOUS SHALE.

SANDSTONE = LIGHT BROWNISH GRAY TO YELLOWISH GRAY TO VERY LIGHT GRAY WITH FEW MODERATE BROWN AND BLACK HUES; QUARTZ DOMINATE; PREDOMINATELY GRAIN SUPPORTED WITH VERY FEW LOOSE GRAINS; CONSISTS OF CALCITIC CEMENTATION WITH MODERATELY HIGH REACTION TO DILUTE HCL; MATRIX CONTAINS 3 TO 5% DARK LITHIC FRAGMENTS; FINE TO MEDIUM COARSE GRAINED; FAIR TO POOR SORTING; SUB-ANGULAR TO SUB-ROUNDED TO ROUNDED ANGULARITY; LOW TO MODERATE SPHERICITY; POOR GRADE SILTSTONE IN VISIBL BEDDING CONTACT WITH POOR GRADE SANDSTONE, POOR GRADE CARBONACEOUS SHALE VISIBLE BEDDING WITH SHALE, NO OTHER LAMINAE OR OTHER DISTINGUISHABLE STRUCTURAL FEATURES PRESENT IN SAMPLE; NO ACCESSORY MINERALS PRESENT IN SAMPLE.

SHALE = LIGHT GRAY TO MEDIUM LIGHT GRAY TO MEDIUM GRAY TO OCCASIONAL MEDIUM BROWNISH GRAY IN COLOR; MODERATELY DENSE TO VERY SLIGHTLY TOUGH TO SLIGHTLY CRUNCHY TENACITY; IRREGULAR TO SUB-BLOCKY TO EARTHY FRACTURE; OCCASIONAL MASSIVE TO





TO BROWNISH BLACK; TENACITY IS BRITTLE TO CRUMBLY; IRREGULAR TO BLOCKY FRACTURING; CUTTINGS ARE WEDGELIKE TO SLIGHTLY TABULAR; EARTHY TO DULL WITH AN OCCASIONAL SLIGHT WAXY LUSTER; SILTY TEXTURE; THIN STRUCTURE; GRADING TOWARDS SHALE.

SANDSTONE = WHITE TO TRANSLUCENT TO LIGHT GRAY; DOMINATE QUARTZ FRAMEWORK; GRAIN SIZE VARIES FROM FINE TO COARSE WITH POOR SORTING; SUBANGULAR TO SUBROUNDED WITH MODERATE TO LOW SPHERICITY; HARD TO MODERATE HARDNESS; MILD REACTION WITH HCL SUGGESTS SOME CALCITIC CEMENT; SILICEOUS/CALCAREOUS MATRIX; NO VISIBLE BEDDING; HIGH GAS ASSOCIATED WITH SAMPLE; INTERBEDDED CARBONACEOUS SHALE AND TRACE AMOUNTS OF COAL.

CARBONACEOUS SHALE = GRAYISH BLACK TO BROWNISH BLACK; TENACITY IS SLIGHTLY DENSE TO BRITTLE; IRREGULAR TO BLOCKY TO SLIGHTLY SPLINTERY FRACTURING; CUTTINGS ARE TABULAR TO PLATY; EARTHY TO SLIGHTLY RESINOUS LUSTER; SMOOTH TEXTURE; THIN TO LAMINAE TO OCCASIONALLY THICK STRUCTURE; CONTAINS TRACE AMOUNTS OF PYRITE INTERBEDDED; HIGH GAS ASSOCIATED WITH SAMPLE.

SHALE = MEDIUM LIGHT GRAY TO MEDIUM GRAY TO MEDIUM DARK GRAY IN COLOR; MODERATELY DENSE TO VERY SLIGHTLY CRUNCHY TENACITY; IRREGULAR TO SUB-PLANAR TO SEMI-BLOCKY FRACTURE; OCCASIONAL MASSIVE TO WEDGE LIKE TO ELONGATED CUTTINGS HABIT; DULL TO EARTHY DULL TO OCCASIONAL SEMI-FROSTED TO SEMI-WAXY LUSTER; MODERATELY SMOOTH TO SLIGHTLY SILTY TEXTURE; POOR GRADE SANDSTONE VISIBLY BEDDING WITH POOR GRADE CARBONACEOUS SHALE, POOR GRADE SILTSTONE VISIBLE GRADING WITH POOR GRADE SANDSTONE IN SAMPLE, SMALL AMOUNT OF COAL VISIBLY EFFERVESCING IN SAMPLE, NO OTHER LAMINAE OR OTHER DISTINGUISHABLE STRUCTURAL FEATURES PRESENT; NO ACCESSORY MINERALS PRESENT IN SAMPLE.

SILTSTONE = LIGHT GRAY TO LIGHT BROWNISH GRAY IN COLOR; MODERATELY DENSE TO SLIGHTLY CRUNCHY TO OCCASIONAL CRUMBLY TENACITY; IRREGULAR TO SUB-PLANAR TO EARTHY HACKLY FRACTURE; SUB-TABULAR TO SUB-NODULAR TO OCCASIONAL SEMI-PLATY CUTTING HABIT; DULL TO EARTHY DULL TO OCCASIONAL SEMI-SPARKLING LUSTER; SLIGHTLY GRITTY TO OCCASIONAL VERY SLIGHTLY GRANULAR TEXTURE; POOR GRADE SILTSTONE VISIBLE GRADING WITH POOR GRADE SANDSTONE, VERY SMALL AMOUNT OF COAL VISIBLY EFFERVESCING IN SAMPLE, NO OTHER DISTINGUISHABLE STRUCTURAL FEATURES PRESENT IN SAMPLE, NO ACCESSORY MINERALS PRESENT IN SAMPLE.

SANDSTONE = OFF WHITE TO YELLOWISH GRAY TO VERY LIGHT TANISH BROWN GRAY TO VERY LIGHT GRAY WITH FEW MODERATE BROWN AND BLACK HUES; QUARTZ DOMINATE FRAMEWORK; PREDOMINATELY GRAIN SUPPORTED WITH FEW LOOSE GRAINS; CONSISTS DOMINATEDLY OF SILICIC CEMENTATION WITH VERY LIGHT TO NO REACTION TO DILUTE HCL; MATRIX CONTAINS 3 TO 5% DARK LITHIC FRAGMENTS; MEDIUM TO MEDIUM-COARSE GRAINED; FAIR TO POOR SORTING; SUB-ANGULAR TO ANGULAR TO SUB-ROUNDED ANGULARITY; LOW TO MODERATE SPHERICITY; VERY SMALL AMOUNT OF COAL VISIBLY EFFERVESCING IN SAMPLE; POOR GRADE SILTSTONE VISIBLE GRADING WITH POOR GRADE SANDSTONE IN SAMPLE, NO OTHER DISTINGUISHABLE SURFACE FEATURES PRESENT; NO ACCESSORY MINERALS PRESENT IN SAMPLE.

CARBONACEOUS SHALE = BROWNISH BLACK TO BLACK; TENACITY IS BRITTLE TO SLIGHTLY DENSE; IRREGULAR TO BLOCKY TO SLIGHTLY CONCHOIDAL FRACTURING; CUTTINGS ARE WEDGELIKE TO FLAKY; POLISHED TO OCCASIONALLY EARTHY LUSTER; SMOOTH TO SLIGHTLY SILTY TEXTURE; THIN STRUCTURE; TRACE AMOUNTS OF COAL SEEMS OCCASIONALLY OBSERVED INTERBEDDED.

COAL = BLACK; BRITTLE TO CRUMBLY TENACITY; FRACTURES FROM BLOCKY TO IRREGULAR TO PLANAR; CUTTINGS ARE FLAKY TO SLIGHTLY PLATY; EARTHY TO SLIGHTLY WAXY TO POLISHED LUSTER; THIN STRUCTURE; INTERBEDDED WITH SANDSTONE.

SILTSTONE = LIGHT GRAY TO MEDIUM LIGHT GRAY TO OCCASIONAL LIGHT BROWNISH GRAY IN COLOR; MODERATELY DENSE TO SLIGHTLY DENSE TO VERY SLIGHTLY BRITTLE TENACITY; IRREGULAR TO SUB-PLANAR TO EARTHY-HACKLY FRACTURE; SUB-TABULAR TO SUB-NODULAR TO SEMI-PLATY CUTTINGS HABIT; DULL TO EARTH

