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# MUDLOG TVD

**COMPANY** ExxonMobil Production  
**WELL** FRU 197-33A9  
**FIELD** FREEDOM RANCH UNIT  
**REGION** ROCKY MOUNTAINS  
**COORDINATES** N39.915656  
W108.285725  
**ELEVATION** KB 6415'  
GL 6388'  
**COUNTY, STATE** RIO BLANCO COUNTY, CO  
**API INDEX** 05-103-11400-00  
**SPUD DATE** 10/02/2009  
**CONTRACTOR** HELMRICH AND PAYNE  
**CO. REP.** RICKY T OWENS  
**RIG/TYPE** 215/FLEX 3  
**LOGGING UNIT** MLU 51  
**GEOLOGISTS** GEORGE BAKER  
BRENDA MARSH  
**ADD. PERSONS** DEVIN CLAAR  
BILL JOHANNING  
**CO. GEOLOGIST** MELISSA SAURBORN

## LOG INTERVAL

## CASING DATA

**DEPTHS:** 3,800' TO 12,281'  
**DATES:** 01/05/2010 TO 01/24/2010  
**SCALE:** 1"=100'

16" AT 131'  
10.75" AT 3,833'  
7.00" AT 8,533'  
AT

## MUD TYPES

## HOLE SIZE

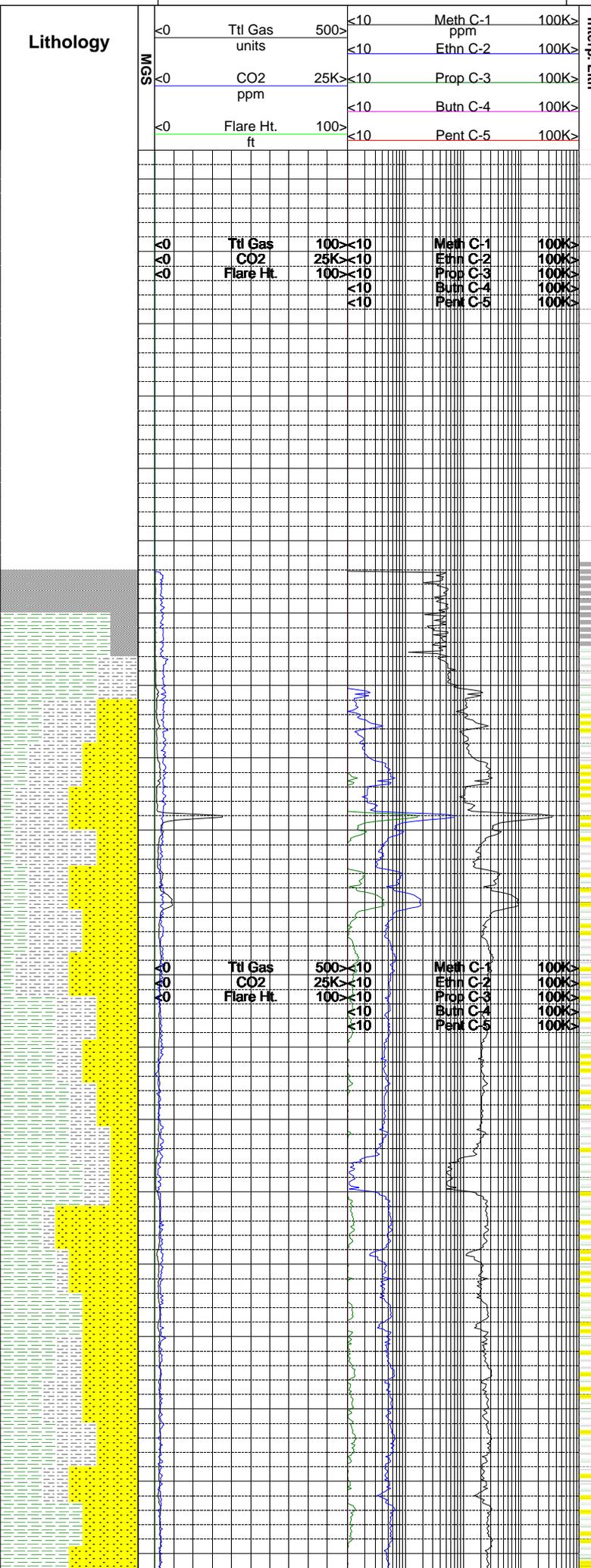
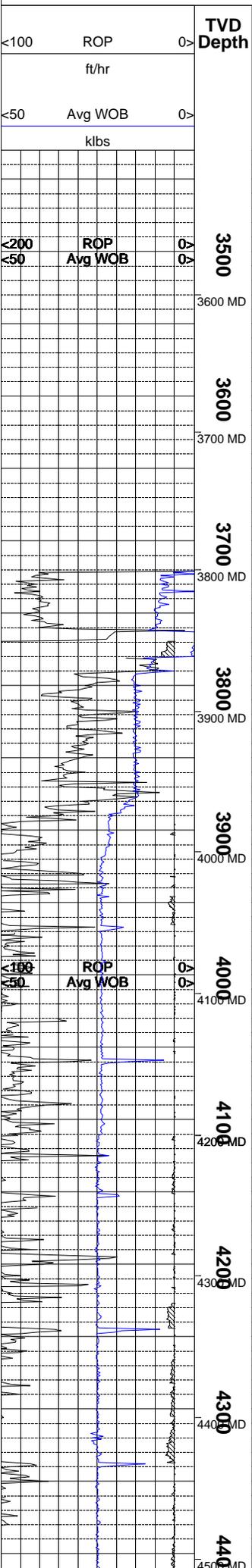
SPUD TO 3,833'  
LSND TO 12,281'  
TO  
TO

9.875' TO 8,533'  
6.125' TO 12,281'  
TO  
TO

## 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               | SERICITIZATION       |
| 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               | KAOLINIC          | RECRYSTALLIZED CALCITE | VOLCANICS            |
| CHALK            | DIATOMITE            | LIMESTONE         | RHYOLITE               |                      |
| CRYSTALLINE TUFF | DIORITE              | LITHIC TUFF       | SALT                   |                      |
| CHERT - ARGILL   | DOLOSTONE            | MARL - DOLO       | SAND                   |                      |



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

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 SAMPLE DEPTHS ARE REFERENCED TO RKB.

CONNECTION GASES AS WELL AS TRIP AND DOWNTIME GASES ARE NOTED ON THE LOG. LARGE CONNECTION GASES WHICH APPEAR ON THE MUD LOG USUALLY REFLECT UPHOLE GAS INTERVALS BLEEDING GAS INTO THE BOREHOLE DURING CONNECTIONS.

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

WHEN THE MUD IS RUN THROUGH THE GAS BUSTER THE INTERVAL IS MARKED ON THE MGS COLUMN AND SIZE OF FLARES NOTED.

EVIDENCE OF FRACTURE FILL IS NOTED ON THE MUD LOG AS METAMORPHICS. KAOLIN PERCENTAGE IN SS INTERVALS IS ALSO NOTED

1 UNIT OF GAS = 200 PPM METHANE

EPOCH WELL SERVICES COMMENCED FULL LOGGING OPERATIONS ON 01/05/2010 AT 3848

SHALE = MEDIUM GRAY; YELLOW GRAY; FIRM TO MOD HARD; MOTTLED IN PART; SLI PLATY TO SLI FLAKY CUTTINGS; IRREGULAR FRACT; MODERATELY CALCAREOUS; SOME VERY SILTY EXAMPLES; SME ISOLATED QUARTZ GRAINS; VERY FINELY MICACEOUS; MINOR PYRITE; INTERBEDDED WITH THIN SILTSTONE.

SILTSTONE = GRAY TO BROWNISH GRAY MOTTLED WITH DARK GRAY TO BLACK SPOTS; TOUGH TO DENSE TENACITY; IRREGULAR TO BLOCKY FRACTURE; TABULAR TO WEDGELIKE CUTTINGS HABIT; SILTY TO GRITTY TEXTURE; THICKLY BEDDED WITH THIN BEDS OF SANDSTONE AND SHALE INBETWEEN.

SANDSTONE = LIGHT GRAY TO WHITE WHITE HUES OF GRAYISH BLUE; SPECKLED WITH DARK LITHICS GIVING A DIRTY SALT AND PEPPERED APPEARANCE; LOWER MEDIUM TO FINE GRAINED; FAIR SORTING; SUB ROUND TO ROUND; CLAY TO CALCAREOUS CEMENTATION; HIGHLY REACTIVE TO DILUTE HCL; TR AMT OF PYRITE IN SAMPLE; LOW GAS.

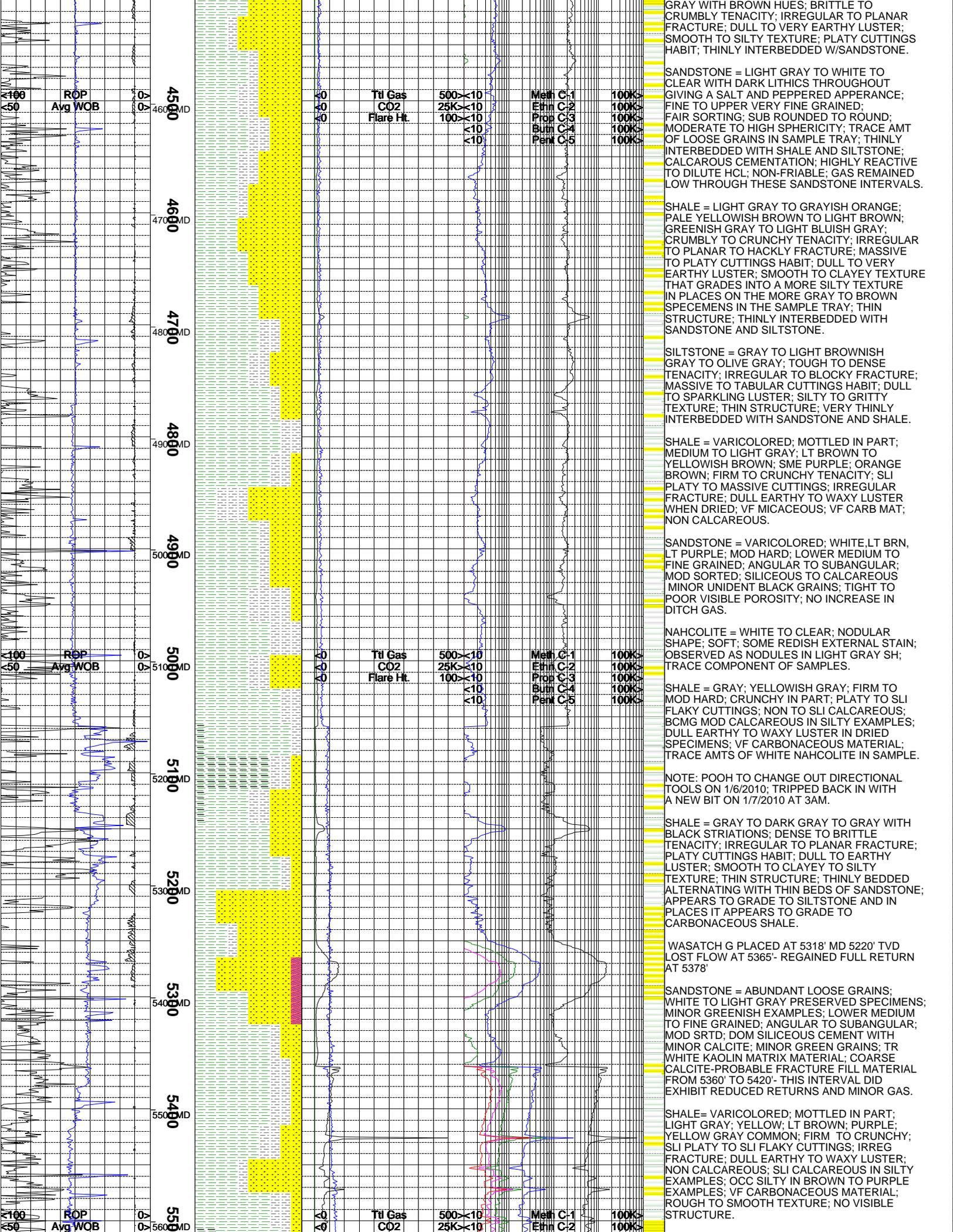
SHALE = LIGHT GRAY TO GRAY WITH HUES OF BLUE AND HUES OF ORANGE-BROWN; BRITTLE TO CRUMBLY TENACITY; IRREGULAR TO PLANAR FRACTURE; PLATY CUTTINGS HABIT; SMOOTH TO CLAYEY TEXTURE; THINLY INTERBEDDED WITH SILTSTONE AND SANDSTONE

SILTSTONE = GRAY TO DARK GRAY WITH HUES OF BROWN; TOUGH TO DENSE TENACITY; IRREGULAR TO HACKLY FRACTURE; TABULAR TO WEDGELIKE CUTTINGS HABIT; EARTHY TO SPARKLING LUSTER; SMOOTH TO SILTY TO GRITTY TEXTURE; THIN STRUCTURE; THINLY INTERBEDDED WITH SHALE AND SANDSTONE.

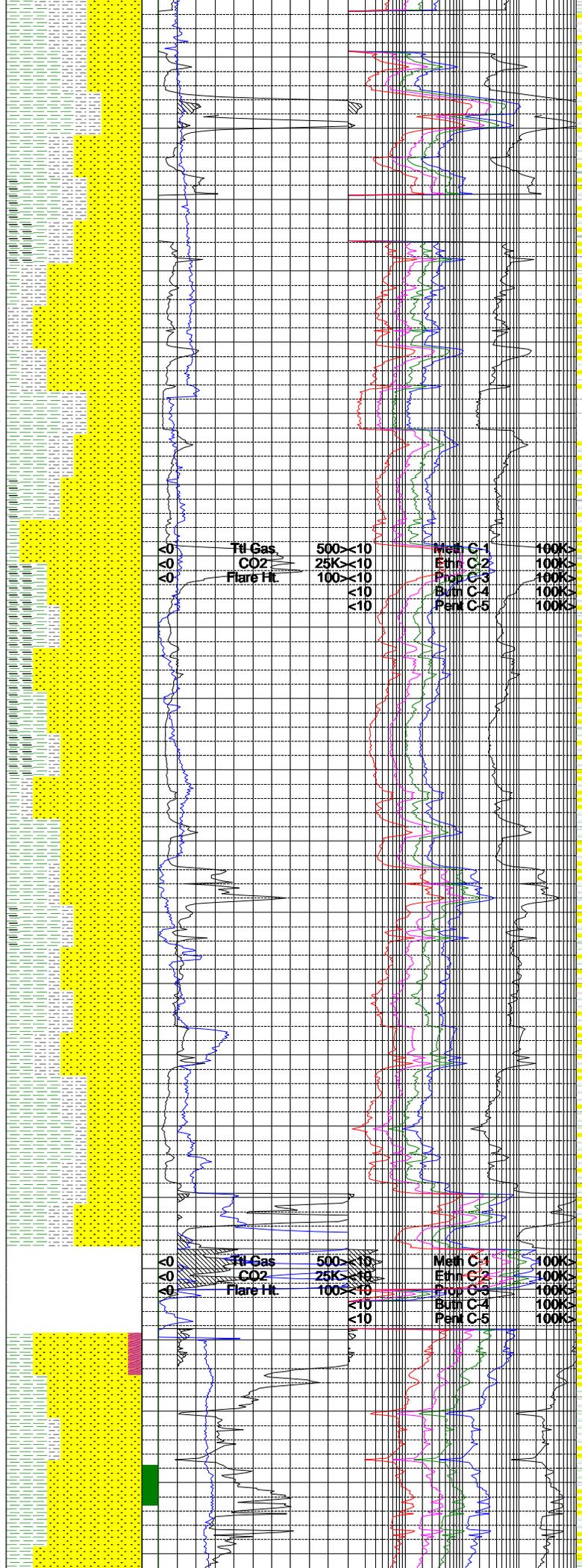
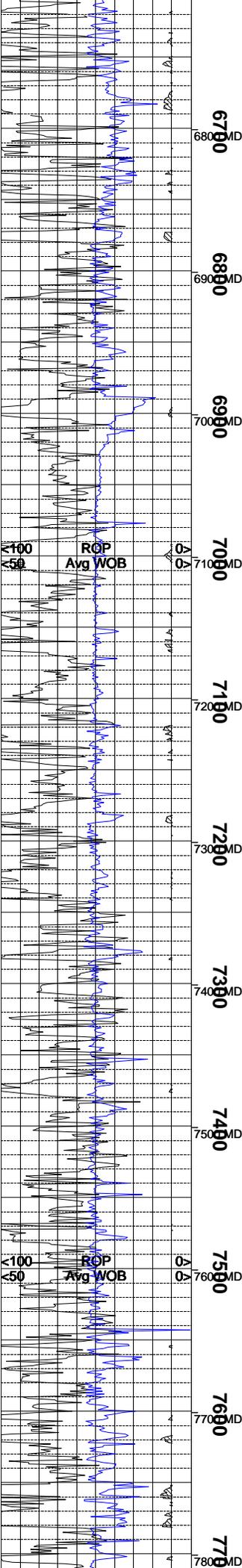
SANDSTONE = LIGHT GRAY TO GRAYISH WHITE TO WHITE WITH HUES OF BROWN; DARK LITHIC MATERIAL THROUGHOUT GIVING A DIRTY SALT AND PEPPERED APPEARANCE; FINE TO UPPER VERY FINE GRAINED; VERY TIGHT NON-POROUS CLUSTERS; NON FRIABLE; FAIR TO WELL SORTED; SUB ANGULAR TO SUB ROUNDED; MODERATE TO LOW SPHERICITY; HIGHLY REACTIVE TO DILUTE HCL; CLAY AND CALCAREOUS CEMENTATION; THINLY INTERBEDDED WITH SHALE AND SILTSTONE.

SILTSTONE = LIGHT GRAY TO GRAY WITH HUES OF DARK BROWN; TOUGH TO DENSE TENACITY; IRREGULAR BLOCKY FRACTURE; MASSIVE TO TABULAR CUTTINGS HABIT; DULL TO SPARKLING LUSTER; SILTY TO GRITTY TO SLIGHTLY GRANULAR TEXTURE; THINLY INTERBEDDED.

SHALE = LIGHT GRAY TO ORANGY BROWN TO







GRAINED TO A FAIR AMOUNT OF TIGHT CLUSTERS THAT HAVE FINE TO UPPER VERY FINE GRAIN SIZES; FAIR TO POOR SORTING; SUB ANGULAR TO SUB ROUNDED; HIGH SPHERICITY WHEN IN CLUSTERS; LOW REACTION TO DILUTE HCL WHEN INDIVIDUAL GRAINS; HIGH REACTION TO DILUTE HCL WHEN IN CLUSTERS INDICATING A CALCAREOUS CEMENT; THINLY INTERBEDDED WITH SHALE AND SILTSTONE; TRACE AMT OF PYRITE IN SAMPLE TRAY.

SHALE = LIGHT GRAY TO GRAY TO BLUISH GRAY; TOUGH TO CRUMBLY TENACITY; IRREGULAR TO PLANAR FRACTURE; MASSIVE TO PLATY CUTTINGS HABIT; DULL TO EARTHY LUSTER; SMOOTH TO SILTY TEXTURE; VISIBLY GRADES TO SILTSTONE WHERE SOME SPECIMENS SHOWED A DEFINITIVE LINE WHERE IT WAS HALF SHALE AND HALF SILTSTONE; THINLY INTERBEDDED.

SILTSTONE = BROWN TO DARK BROWNISH GRAY TO DARK GRAY; TOUGH TENACITY; IRREGULAR TO BLOCKY FRACTURE; TABULAR CUTTINGS HABIT; DULL TO SLIGHTLY SPARKLING LUSTER; THIN STRUCTURE; THINLY INTERBEDDED.

NOTE: SHORT WIPER TRIP AT 6983' MD ON 1/8/2010 6AM; RESUMED DRILLING ON 1/8/2010 AT 6:30PM. FIRST SAMPLE HAD POOR SAMPLE QUALITY DUE TO CAVINGS.

SHALE = BLUISH GRAY TO GRAY WITH DARK LAMINATIONS; TOUGH TO CRUMBLY TENACITY; IRREGULAR TO BLOCKY FRACTURE; PLATY CUTTINGS HABIT; DULL TO EARTHY LUSTER; SMOOTH TO SILTY TEXTURE; APPEARS TO GRADE TO SILTSTONE OR CARB. SHALE IN PLACES; THINLY INTERBEDDED.

OHIO CREEK SANDSTONE = WHITE TO WHITE WITH PALE BLUE HUES TO TRANSLUCENT AND CLEAR; ABUNDANT LOOSE GRAINS; TRACE AMT OF MEDIUM SIZED GRAINS; MAINLY FINE TO UPPER VERY FINE GRAINED; WELL TO FAIR SORTING; SUB ANGULAR TO ANGULAR TO SLIGHTLY SUB ROUNDED; MODERATE TO LOW SPHERICITY; MODERATE REACTION TO DILUTE HCL; SLIGHTLY CALCAREOUS CEMENT; TRACE AMT OF DARK LITHICS 1-3% GIVING A SLIGHT SALT AND PEPPERED APPEARANCE WHEN IN CLUSTERS; CLUSTERS WERE FEW COMPARED TO THE LOOSE GRAINS AND VERY HARD AND NON-FRIABLE; THE SANDSTONE LAYERS AT THE OHIO CREEK BECAME THICKER WITH THIN SHALE, CARB. SHALE, OR SILTSTONE LAYERS ALTERNATING.

SHALE = GREENISH GRAY TO MEDIUM BLUISH GRAY TO SHALE GRAY; TOUGH TO DENSE TENACITY; PLANAR FRACTURE; PLATY TO WEDGELIKE CUTTINGS HABIT; WAXY TO DULL TO EARTHY LUSTER; SMOOTH TEXTURE; THIN STRUCTURE; THINLY BEDDED WITH SANDSTONE.

SANDSTONE = WHITE TO GRAYISH WHITE TO GRAY TO VERY LIGHT BLUISH GRAY, SOME TRANSLUCENT TO TRANSPARENT GRAINS AND SOME DARK LITHICS THROUGHOUT; ABUNDANT LOOSE GRAINS; MEDIUM TO FINE GRAIN SIZES FAIR SORTING; SUB ANGULAR TO ANGULAR; LOW SPHERICITY; MODERATE REACTION TO DILUTE HCL WHEN IN CLUSTERS, NO REACTION ON INDIVIDUAL LOOSE GRAINS; WHEN IN CLUSTERS THEY HAVE SLIGHTLY CALCAREOUS CEMENTATION; ALTERNATES WITH BEDS OF SHALE AND SILTSTONE.

SILTSTONE = GRAY WITH BROWN HUES TO LIGHT BROWNISH GRAY TO LIGHT BROWN; TOUGH TO CRUMBLY TENACITY; IRREGULAR TO MOTTLED FRACTURE; TABULAR TO WEDGELIKE CUTTINGS HABIT; DULL TO SLIGHTLY SPARKLING LUSTER; SILTY TO GRITTY TEXTURE; THINLY INTERBEDDED.

BRIEFLY LOST RETURNS AT 7576' LOST FULL RETURNS AT 7640' IN THE WF800

REPAIR RIG EQUIPMENT

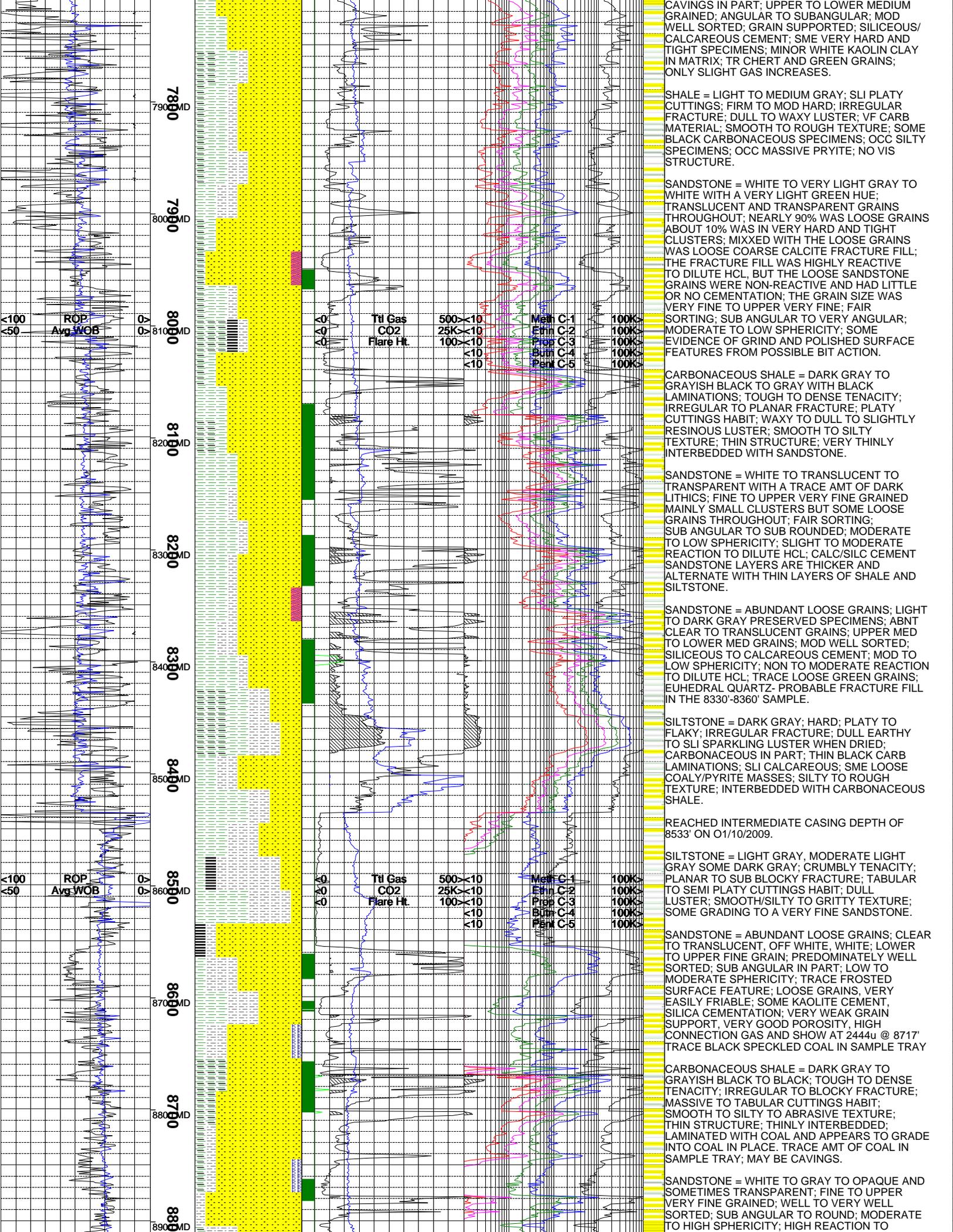
SANDSTONE = ABUNDANT LOOSE GRAINS; UPPER TO LOWER MEDIUM GRAINS; TRACE LIGHT GRAY PRESERVED SPECIMENS; ANGULAR TO SBRNDD; TRACE WHITE KAOLIN CLAY IN MATRIX; DOM CALCITE CEMENT; TRACE LOOSE GREEN AND BLACK GRAINS; SOME BLACK CARBONACEOUS LAMINATIONS; ASSOCIATED WITH GAS SHOWS; WHITE CALCITE-FRACTURE FILL MATERIAL ADHERING TO SANDSTONE CLUSTER IN THE 7640'-7670' SAMPLE.

SHALE = LT GREENISH GRAY TO GRAY; MINOR LT BROWN; SLI PLATY CUTTINGS; FIRM TO SL HARD; DULL EARTHY LUSTER; ROUGH TEXTURE; VF PYRITE; VERY MICA; VF CARBONACEOUS.

SANDSTONE = ABUNDANT LOOSE GRAINS;

|          |          |          |       |
|----------|----------|----------|-------|
| Ttl Gas  | 500 > 10 | Meth C-1 | 100 > |
| CO2      | 25K > 10 | Ethn C-2 | 100 > |
| Flare Ht | 100 > 10 | Prop C-3 | 100 > |
|          | < 10     | Bum C-4  | 100 > |
|          | < 10     | Pen C-5  | 100 > |

|          |          |          |       |
|----------|----------|----------|-------|
| Ttl Gas  | 500 > 10 | Meth C-1 | 100 > |
| CO2      | 25K > 10 | Ethn C-2 | 100 > |
| Flare Ht | 100 > 10 | Prop C-3 | 100 > |
|          | < 10     | Bum C-4  | 100 > |
|          | < 10     | Pen C-5  | 100 > |



780 MD  
790 MD  
800 MD  
810 MD  
820 MD  
830 MD  
840 MD  
850 MD  
860 MD  
870 MD  
880 MD

ROP  
Avg WOB

Ttl Gas  
CO2  
Flare Ht

500x10  
25Kx10  
100x10

Meth C-1  
Ethn C-2  
Prop C-3  
Bum C-4  
Pen C-5

100K  
100K  
100K  
100K  
100K

CAVINGS IN PART; UPPER TO LOWER MEDIUM GRAINED; ANGULAR TO SUBANGULAR; MOD WELL SORTED; GRAIN SUPPORTED; SILICEOUS/ CALCAREOUS CEMENT; SME VERY HARD AND TIGHT SPECIMENS; MINOR WHITE KAOLIN CLAY IN MATRIX; TR CHERT AND GREEN GRAINS; ONLY SLIGHT GAS INCREASES.

SHALE = LIGHT TO MEDIUM GRAY; SLI PLATY CUTTINGS; FIRM TO MOD HARD; IRREGULAR FRACTURE; DULL TO WAXY LUSTER; VF CARB MATERIAL; SMOOTH TO ROUGH TEXTURE; SOME BLACK CARBONACEOUS SPECIMENS; OCC SILTY SPECIMENS; OCC MASSIVE PRYITE; NO VIS STRUCTURE.

SANDSTONE = WHITE TO VERY LIGHT GRAY TO WHITE WITH A VERY LIGHT GREEN HUE; TRANSLUCENT AND TRANSPARENT GRAINS THROUGHOUT; NEARLY 90% WAS LOOSE GRAINS ABOUT 10% WAS IN VERY HARD AND TIGHT CLUSTERS; MIXED WITH THE LOOSE GRAINS WAS LOOSE COARSE CALCITE FRACTURE FILL; THE FRACTURE FILL WAS HIGHLY REACTIVE TO DILUTE HCL, BUT THE LOOSE SANDSTONE GRAINS WERE NON-REACTIVE AND HAD LITTLE OR NO CEMENTATION; THE GRAIN SIZE WAS VERY FINE TO UPPER VERY FINE; FAIR SORTING; SUB ANGULAR TO VERY ANGULAR; MODERATE TO LOW SPHERICITY; SOME EVIDENCE OF GRIND AND POLISHED SURFACE FEATURES FROM POSSIBLE BIT ACTION.

CARBONACEOUS SHALE = DARK GRAY TO GRAYISH BLACK TO GRAY WITH BLACK LAMINATIONS; TOUGH TO DENSE TENACITY; IRREGULAR TO PLANAR FRACTURE; PLATY CUTTINGS HABIT; WAXY TO DULL TO SLIGHTLY RESINOUS LUSTER; SMOOTH TO SILTY TEXTURE; THIN STRUCTURE; VERY THINLY INTERBEDDED WITH SANDSTONE.

SANDSTONE = WHITE TO TRANSLUCENT TO TRANSPARENT WITH A TRACE AMT OF DARK LITHICS; FINE TO UPPER FINE GRAINED MAINLY SMALL CLUSTERS BUT SOME LOOSE GRAINS THROUGHOUT; FAIR SORTING; SUB ANGULAR TO SUB ROUNDED; MODERATE TO LOW SPHERICITY; SLIGHT TO MODERATE REACTION TO DILUTE HCL; CALC/SILC CEMENT SANDSTONE LAYERS ARE THICKER AND ALTERNATE WITH THIN LAYERS OF SHALE AND SILTSTONE.

SANDSTONE = ABUNDANT LOOSE GRAINS; LIGHT TO DARK GRAY PRESERVED SPECIMENS; ABNT CLEAR TO TRANSLUCENT GRAINS; UPPER MED TO LOWER MED GRAINS; MOD WELL SORTED; SILICEOUS TO CALCAREOUS CEMENT; MOD TO LOW SPHERICITY; NON TO MODERATE REACTION TO DILUTE HCL; TRACE LOOSE GREEN GRAINS; EUHEDRAL QUARTZ- PROBABLE FRACTURE FILL IN THE 8330'-8360' SAMPLE.

SILTSTONE = DARK GRAY; HARD; PLATY TO FLAKY; IRREGULAR FRACTURE; DULL EARTHY TO SLI SPARKLING LUSTER WHEN DRIED; CARBONACEOUS IN PART; THIN BLACK CARB LAMINATIONS; SLI CALCAREOUS; SME LOOSE COALY/PYRITE MASSES; SILTY TO ROUGH TEXTURE; INTERBEDDED WITH CARBONACEOUS SHALE.

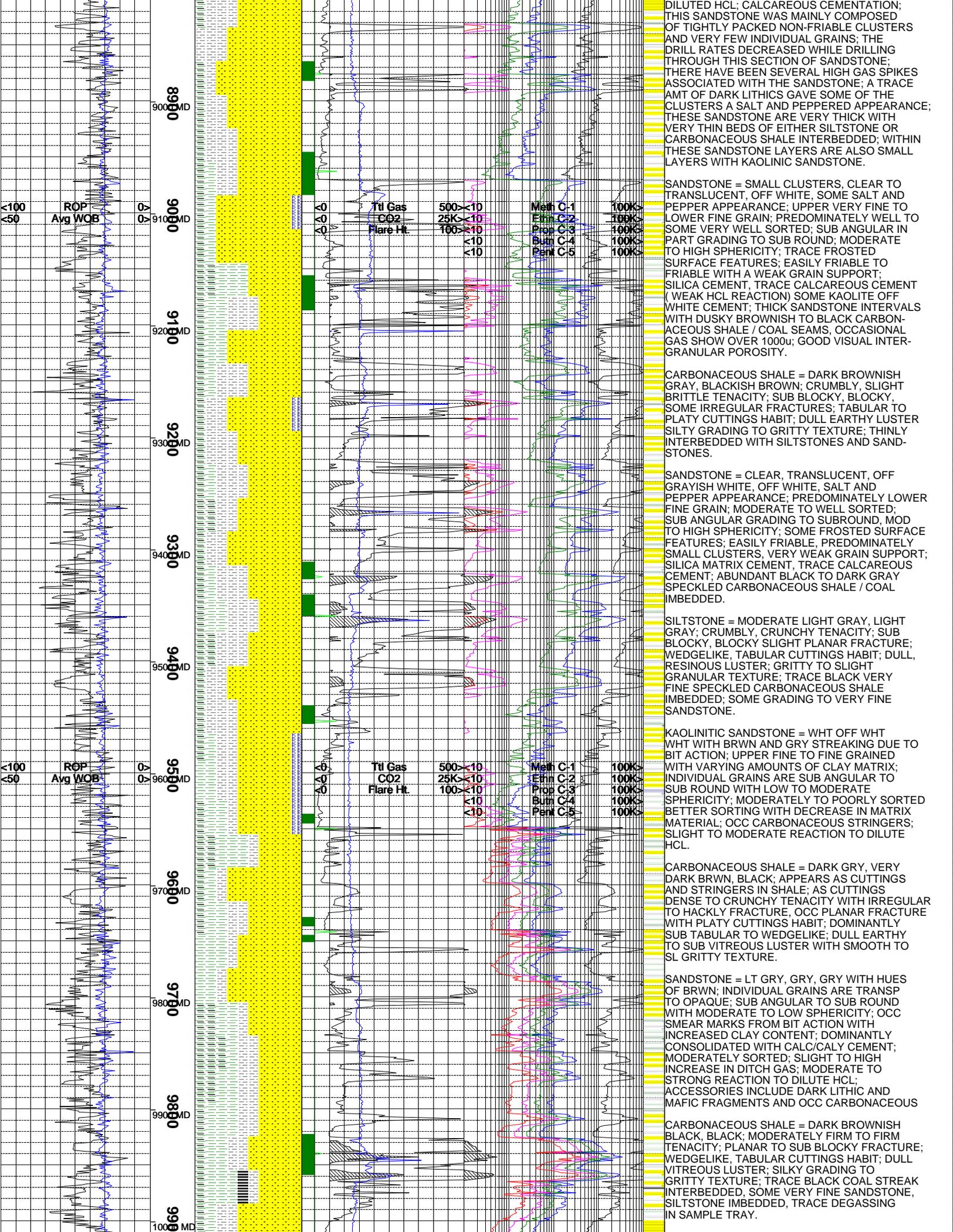
REACHED INTERMEDIATE CASING DEPTH OF 8533' ON 01/10/2009.

SILTSTONE = LIGHT GRAY, MODERATE LIGHT GRAY SOME DARK GRAY; CRUMBLY TENACITY; PLANAR TO SUB BLOCKY FRACTURE; TABULAR TO SEMI PLATY CUTTINGS HABIT; DULL LUSTER; SMOOTH/SILTY TO GRITTY TEXTURE; SOME GRADING TO A VERY FINE SANDSTONE.

SANDSTONE = ABUNDANT LOOSE GRAINS; CLEAR TO TRANSLUCENT, OFF WHITE, WHITE; LOWER TO UPPER FINE GRAIN; PREDOMINATELY WELL SORTED; SUB ANGULAR IN PART; LOW TO MODERATE SPHERICITY; TRACE FROSTED SURFACE FEATURE; LOOSE GRAINS, VERY EASILY FRIABLE; SOME KAOLITE CEMENT, SILICA CEMENTATION; VERY WEAK GRAIN SUPPORT, VERY GOOD POROSITY, HIGH CONNECTION GAS AND SHOW AT 244u @ 8717' TRACE BLACK SPECKLED COAL IN SAMPLE TRAY

CARBONACEOUS SHALE = DARK GRAY TO GRAYISH BLACK TO BLACK; TOUGH TO DENSE TENACITY; IRREGULAR TO BLOCKY FRACTURE; MASSIVE TO TABULAR CUTTINGS HABIT; SMOOTH TO SILTY TO ABRASIVE TEXTURE; THIN STRUCTURE; THINLY INTERBEDDED; LAMINATED WITH COAL AND APPEARS TO GRADE INTO COAL IN PLACE, TRACE AMT OF COAL IN SAMPLE TRAY; MAY BE CAVINGS.

SANDSTONE = WHITE TO GRAY TO OPAQUE AND SOMETIMES TRANSPARENT; FINE TO UPPER VERY FINE GRAINED; WELL TO VERY WELL SORTED; SUB ANGULAR TO ROUND; MODERATE TO HIGH SPHERICITY; HIGH REACTION TO



890 MD  
900 MD  
910 MD  
920 MD  
930 MD  
940 MD  
950 MD  
960 MD  
970 MD  
980 MD  
990 MD

ROP  
Avg WOB

|          |          |          |      |
|----------|----------|----------|------|
| Ttl Gas  | 500 < 10 | Meth C-1 | 100% |
| CO2      | 25K < 10 | Ethn C-2 | 100% |
| Flare Ht | 100 > 10 | Prop C-3 | 100% |
|          | < 10     | Burn C-4 | 100% |
|          | < 10     | Pen C-5  | 100% |

DILUTE HCL: CALCAREOUS CEMENTATION; THIS SANDSTONE WAS MAINLY COMPOSED OF TIGHTLY PACKED NON-FRIABLE CLUSTERS AND VERY FEW INDIVIDUAL GRAINS; THE DRILL RATES DECREASED WHILE DRILLING THROUGH THIS SECTION OF SANDSTONE; THERE HAVE BEEN SEVERAL HIGH GAS SPIKES ASSOCIATED WITH THE SANDSTONE; A TRACE AMT OF DARK LITHICS GAVE SOME OF THE CLUSTERS A SALT AND PEPPERED APPEARANCE; THESE SANDSTONE ARE VERY THICK WITH VERY THIN BEDS OF EITHER SILTSTONE OR CARBONACEOUS SHALE INTERBEDDED; WITHIN THESE SANDSTONE LAYERS ARE ALSO SMALL LAYERS WITH KAOLINIC SANDSTONE.

SANDSTONE = SMALL CLUSTERS, CLEAR TO TRANSLUCENT, OFF WHITE, SOME SALT AND PEPPER APPEARANCE; UPPER VERY FINE TO LOWER FINE GRAIN; PREDOMINATELY WELL TO SOME VERY WELL SORTED; SUB ANGULAR IN PART GRADING TO SUB ROUND; MODERATE TO HIGH SPHERICITY; TRACE FROSTED SURFACE FEATURES; EASILY FRIABLE TO FRIABLE WITH A WEAK GRAIN SUPPORT; SILICA CEMENT, TRACE CALCAREOUS CEMENT (WEAK HCL REACTION) SOME KAOLITE OFF WHITE CEMENT; THICK SANDSTONE INTERVALS WITH DUSKY BROWNISH TO BLACK CARBONACEOUS SHALE / COAL SEAMS, OCCASIONAL GAS SHOW OVER 1000u; GOOD VISUAL INTERGRANULAR POROSITY.

CARBONACEOUS SHALE = DARK BROWNISH GRAY, BLACKISH BROWN; CRUMBLY, SLIGHT BRITTLE TENACITY; SUB BLOCKY, BLOCKY, SOME IRREGULAR FRACTURES; TABULAR TO PLATY CUTTINGS HABIT; DULL EARTHY LUSTER SILTY GRADING TO GRITTY TEXTURE; THINLY INTERBEDDED WITH SILTSTONES AND SANDSTONES.

SANDSTONE = CLEAR, TRANSLUCENT, OFF GRAYISH WHITE, OFF WHITE, SALT AND PEPPER APPEARANCE; PREDOMINATELY LOWER FINE GRAIN; MODERATE TO WELL SORTED; SUB ANGULAR GRADING TO SUBROUND, MOD TO HIGH SPHERICITY; SOME FROSTED SURFACE FEATURES; EASILY FRIABLE, PREDOMINATELY SMALL CLUSTERS, VERY WEAK GRAIN SUPPORT; SILICA MATRIX CEMENT, TRACE CALCAREOUS CEMENT; ABUNDANT BLACK TO DARK GRAY SPECKLED CARBONACEOUS SHALE / COAL IMBEDDED.

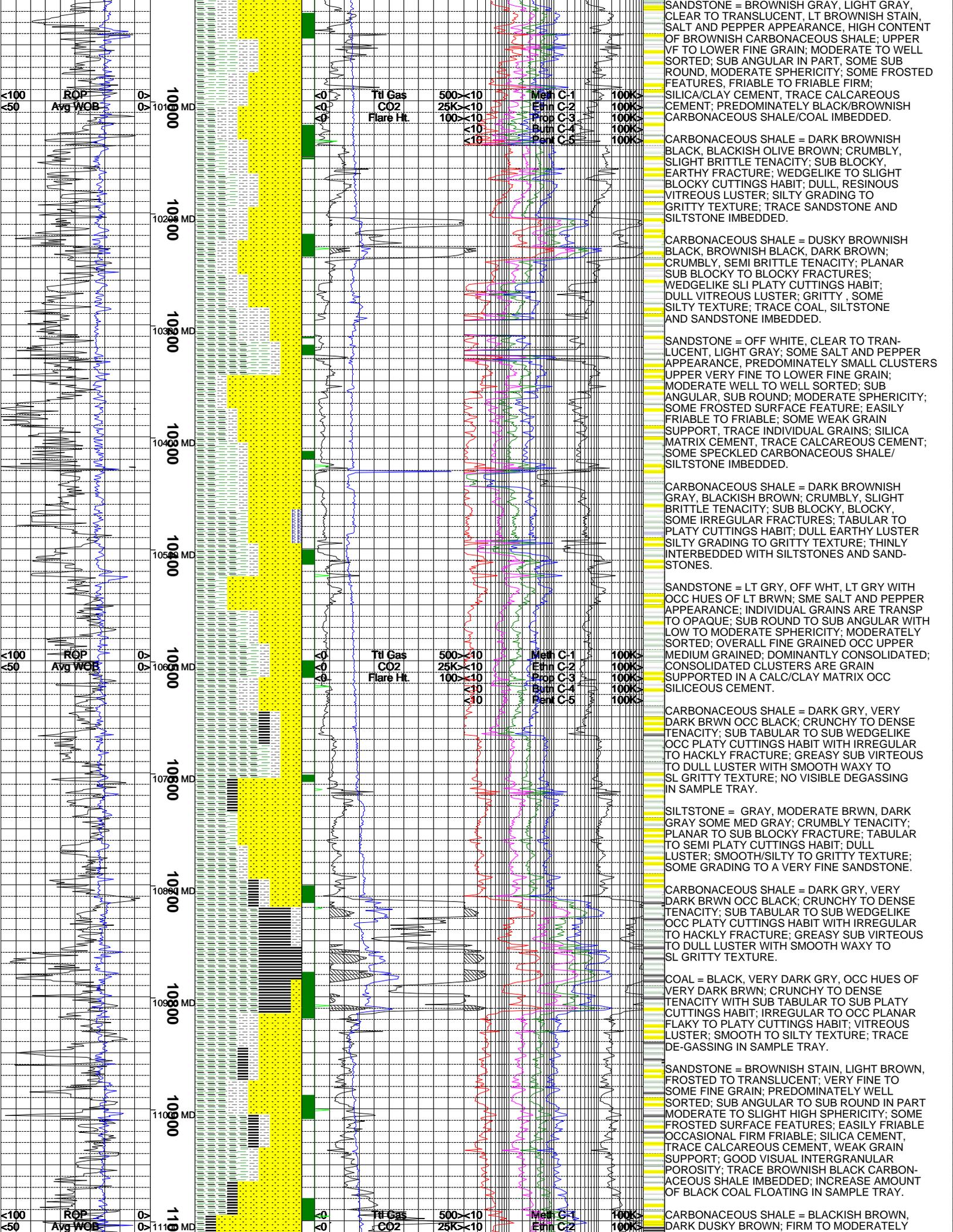
SILTSTONE = MODERATE LIGHT GRAY, LIGHT GRAY; CRUMBLY, CRUNCHY TENACITY; SUB BLOCKY, BLOCKY SLIGHT PLANAR FRACTURE; WEDGELIKE, TABULAR CUTTINGS HABIT; DULL, RESINOUS LUSTER; GRITTY TO SLIGHT GRANULAR TEXTURE; TRACE BLACK VERY FINE SPECKLED CARBONACEOUS SHALE IMBEDDED; SOME GRADING TO VERY FINE SANDSTONE.

KAOLINIC SANDSTONE = WHT OFF WHT WHT WITH BRWN AND GRAY STREAKING DUE TO BIT ACTION; UPPER FINE TO FINE GRAINED WITH VARYING AMOUNTS OF CLAY MATRIX; INDIVIDUAL GRAINS ARE SUB ANGULAR TO SUB ROUND WITH LOW TO MODERATE SPHERICITY; MODERATELY TO POORLY SORTED BETTER SORTING WITH DECREASE IN MATRIX MATERIAL; OCC CARBONACEOUS STRINGERS; SLIGHT TO MODERATE REACTION TO DILUTE HCL.

CARBONACEOUS SHALE = DARK GRAY, VERY DARK BRWN, BLACK; APPEARS AS CUTTINGS AND STRINGERS IN SHALE; AS CUTTINGS DENSE TO CRUNCHY TENACITY WITH IRREGULAR TO HACKLY FRACTURE, OCC PLANAR FRACTURE WITH PLATY CUTTINGS HABIT; DOMINANTLY SUB TABULAR TO WEDGELIKE; DULL EARTHY TO SUB VITREOUS LUSTER WITH SMOOTH TO SL GRITTY TEXTURE.

SANDSTONE = LT GRAY, GRAY, GRAY WITH HUES OF BRWN; INDIVIDUAL GRAINS ARE TRANSP TO OPAQUE; SUB ANGULAR TO SUB ROUND WITH MODERATE TO LOW SPHERICITY; OCC SMEAR MARKS FROM BIT ACTION WITH INCREASED CLAY CONTENT; DOMINANTLY CONSOLIDATED WITH CALC/CALY CEMENT; MODERATELY SORTED; SLIGHT TO HIGH INCREASE IN DITCH GAS; MODERATE TO STRONG REACTION TO DILUTE HCL; ACCESSORIES INCLUDE DARK LITHIC AND MAFIC FRAGMENTS AND OCC CARBONACEOUS

CARBONACEOUS SHALE = DARK BROWNISH BLACK, BLACK; MODERATELY FIRM TO FIRM TENACITY; PLANAR TO SUB BLOCKY FRACTURE; WEDGELIKE, TABULAR CUTTINGS HABIT; DULL VITREOUS LUSTER; SILKY GRADING TO GRITTY TEXTURE; TRACE BLACK COAL STREAK INTERBEDDED, SOME VERY FINE SANDSTONE, SILTSTONE IMBEDDED, TRACE DEGASSING IN SAMPLE TRAY.



SANDSTONE = BROWNISH GRAY, LIGHT GRAY, CLEAR TO TRANSLUCENT, LT BROWNISH STAIN, SALT AND PEPPER APPEARANCE, HIGH CONTENT OF BROWNISH CARBONACEOUS SHALE; UPPER VF TO LOWER FINE GRAIN; MODERATE TO WELL SORTED; SUB ANGULAR IN PART, SOME SUB ROUND, MODERATE SPHERICITY; SOME FROSTED FEATURES, FRIABLE TO FRIABLE FIRM; SILICA/CLAY CEMENT, TRACE CALCAREOUS CEMENT; PREDOMINATELY BLACK/BROWNISH CARBONACEOUS SHALE/COAL IMBEDDED.

CARBONACEOUS SHALE = DARK BROWNISH BLACK, BLACKISH OLIVE BROWN; CRUMBLY, SLIGHT BRITTLE TENACITY; SUB BLOCKY, EARTHY FRACTURE; WEDGELIKE TO SLIGHT BLOCKY CUTTINGS HABIT; DULL, RESINOUS VITREOUS LUSTER; SILTY GRADING TO GRITTY TEXTURE; TRACE SANDSTONE AND SILTSTONE IMBEDDED.

CARBONACEOUS SHALE = DUSKY BROWNISH BLACK, BROWNISH BLACK, DARK BROWN; CRUMBLY, SEMI BRITTLE TENACITY; PLANAR SUB BLOCKY TO BLOCKY FRACTURES; WEDGELIKE SLI PLATY CUTTINGS HABIT; DULL VITREOUS LUSTER; GRITTY, SOME SILTY TEXTURE; TRACE COAL, SILTSTONE AND SANDSTONE IMBEDDED.

SANDSTONE = OFF WHITE, CLEAR TO TRANSLUCENT, LIGHT GRAY; SOME SALT AND PEPPER APPEARANCE, PREDOMINATELY SMALL CLUSTERS UPPER VERY FINE TO LOWER FINE GRAIN; MODERATE WELL TO WELL SORTED; SUB ANGULAR, SUB ROUND; MODERATE SPHERICITY; SOME FROSTED SURFACE FEATURE; EASILY FRIABLE TO FRIABLE; SOME WEAK GRAIN SUPPORT, TRACE INDIVIDUAL GRAINS; SILICA MATRIX CEMENT, TRACE CALCAREOUS CEMENT; SOME SPECKLED CARBONACEOUS SHALE/ SILTSTONE IMBEDDED.

CARBONACEOUS SHALE = DARK BROWNISH GRAY, BLACKISH BROWN; CRUMBLY, SLIGHT BRITTLE TENACITY; SUB BLOCKY, BLOCKY, SOME IRREGULAR FRACTURES; TABULAR TO PLATY CUTTINGS HABIT; DULL EARTHY LUSTER SILTY GRADING TO GRITTY TEXTURE; THINLY INTERBEDDED WITH SILTSTONES AND SANDSTONES.

SANDSTONE = LT GRY, OFF WHT, LT GRY WITH OCC HUES OF LT BRWN; SME SALT AND PEPPER APPEARANCE; INDIVIDUAL GRAINS ARE TRANSP TO OPAQUE; SUB ROUND TO SUB ANGULAR WITH LOW TO MODERATE SPHERICITY; MODERATELY SORTED; OVERALL FINE GRAINED OCC UPPER MEDIUM GRAINED; DOMINANTLY CONSOLIDATED; CONSOLIDATED CLUSTERS ARE GRAIN SUPPORTED IN A CALC/CLAY MATRIX OCC SILICEOUS CEMENT.

CARBONACEOUS SHALE = DARK GRAY, VERY DARK BRWN OCC BLACK; CRUNCHY TO DENSE TENACITY; SUB TABULAR TO SUB WEDGELIKE OCC PLATY CUTTINGS HABIT WITH IRREGULAR TO HACKLY FRACTURE; GREASY SUB VIRTEOUS TO DULL LUSTER WITH SMOOTH WAXY TO SL GRITTY TEXTURE; NO VISIBLE DEGASSING IN SAMPLE TRAY.

SILTSTONE = GRAY, MODERATE BRWN, DARK GRAY SOME MED GRAY; CRUMBLY TENACITY; PLANAR TO SUB BLOCKY FRACTURE; TABULAR TO SEMI PLATY CUTTINGS HABIT; DULL LUSTER; SMOOTH/SILTY TO GRITTY TEXTURE; SOME GRADING TO A VERY FINE SANDSTONE.

CARBONACEOUS SHALE = DARK GRAY, VERY DARK BRWN OCC BLACK; CRUNCHY TO DENSE TENACITY; SUB TABULAR TO SUB WEDGELIKE OCC PLATY CUTTINGS HABIT WITH IRREGULAR TO HACKLY FRACTURE; GREASY SUB VIRTEOUS TO DULL LUSTER WITH SMOOTH WAXY TO SL GRITTY TEXTURE.

COAL = BLACK, VERY DARK GRAY, OCC HUES OF VERY DARK BRWN; CRUNCHY TO DENSE TENACITY WITH SUB TABULAR TO SUB PLATY CUTTINGS HABIT; IRREGULAR TO OCC PLANAR FLAKY TO PLATY CUTTINGS HABIT; VITREOUS LUSTER; SMOOTH TO SILTY TEXTURE; TRACE DE-GASSING IN SAMPLE TRAY.

SANDSTONE = BROWNISH STAIN, LIGHT BROWN, FROSTED TO TRANSLUCENT; VERY FINE TO SOME FINE GRAIN; PREDOMINATELY WELL SORTED; SUB ANGULAR TO SUB ROUND IN PART MODERATE TO SLIGHT HIGH SPHERICITY; SOME FROSTED SURFACE FEATURES; EASILY FRIABLE OCCASIONAL FIRM FRIABLE; SILICA CEMENT, TRACE CALCAREOUS CEMENT, WEAK GRAIN SUPPORT; GOOD VISUAL INTERGRANULAR POROSITY; TRACE BROWNISH BLACK CARBONACEOUS SHALE IMBEDDED; INCREASE AMOUNT OF BLACK COAL FLOATING IN SAMPLE TRAY.

CARBONACEOUS SHALE = BLACKISH BROWN, DARK DUSKY BROWN; FIRM TO MODERATELY

ROP >100  
Avg WOB >50

ROP >100  
Avg WOB >50

ROP >100  
Avg WOB >50

Ttl Gas 500x<10  
CO2 25Kx<10  
Flare Ht 100x<10

Ttl Gas 500x<10  
CO2 25Kx<10  
Flare Ht 100x<10

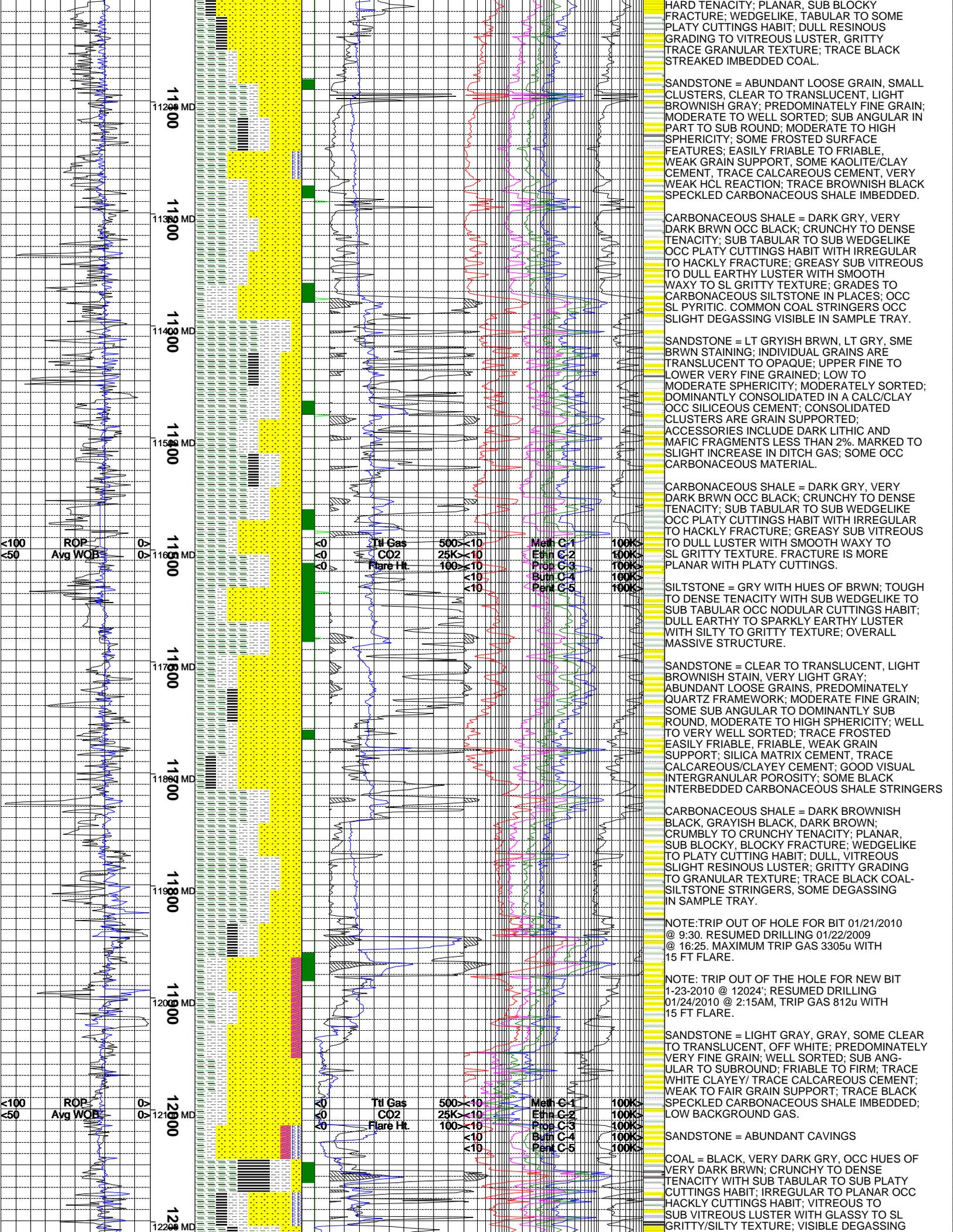
Ttl Gas 500x<10  
CO2 25Kx<10  
Flare Ht 100x<10

Meth C-1 100K  
Ethn C-2 100K  
Prop C-3 100K  
Bum C-4 100K  
Pen C-5 100K

Meth C-1 100K  
Ethn C-2 100K  
Prop C-3 100K  
Bum C-4 100K  
Pen C-5 100K

Meth C-1 100K  
Ethn C-2 100K  
Prop C-3 100K  
Bum C-4 100K  
Pen C-5 100K

10100 MD  
10200 MD  
10300 MD  
10400 MD  
10500 MD  
10600 MD  
10700 MD  
10800 MD  
10900 MD  
11000 MD  
11100 MD



HARD TENACITY; PLANAR, SUB BLOCKY FRACTURE; WEDGELIKE, TABULAR TO SOME PLATY CUTTINGS HABIT; DULL RESINOUS GRADING TO VITREOUS LUSTER, GRITTY TRACE GRANULAR TEXTURE; TRACE BLACK STREAKED IMBEDDED COAL.

SANDSTONE = ABUNDANT LOOSE GRAIN, SMALL CLUSTERS, CLEAR TO TRANSLUCENT, LIGHT BROWNISH GRAY; PREDOMINATELY FINE GRAIN; MODERATE TO WELL SORTED; SUB ANGULAR IN PART TO SUB ROUND; MODERATE TO HIGH SPHERICITY; SOME FROSTED SURFACE FEATURES; EASILY FRIABLE TO FRIABLE, WEAK GRAIN SUPPORT, SOME KAOLITE/CLAY CEMENT, TRACE CALCAREOUS CEMENT, VERY WEAK HCL REACTION; TRACE BROWNISH BLACK SPECKLED CARBONACEOUS SHALE IMBEDDED.

CARBONACEOUS SHALE = DARK GRAY, VERY DARK BRWN OCC BLACK; CRUNCHY TO DENSE TENACITY; SUB TABULAR TO SUB WEDGELIKE OCC PLATY CUTTINGS HABIT WITH IRREGULAR TO HACKLY FRACTURE; GREASY SUB VITREOUS TO DULL EARTHY LUSTER WITH SMOOTH WAXY TO SL GRITTY TEXTURE; GRADES TO CARBONACEOUS SILTSTONE IN PLACES; OCC SL PYRITIC, COMMON COAL STRINGERS OCC SLIGHT DEGASSING VISIBLE IN SAMPLE TRAY.

SANDSTONE = LT GRAYISH BRWN, LT GRAY, SME BRWN STAINING; INDIVIDUAL GRAINS ARE TRANSLUCENT TO OPAQUE; UPPER FINE TO LOWER VERY FINE GRAINED; LOW TO MODERATE SPHERICITY; MODERATELY SORTED; DOMINANTLY CONSOLIDATED IN A CALC/CLAY OCC SILICEOUS CEMENT; CONSOLIDATED CLUSTERS ARE GRAIN SUPPORTED; ACCESSORIES INCLUDE DARK LITHIC AND MAFIC FRAGMENTS LESS THAN 2%. MARKED TO SLIGHT INCREASE IN DITCH GAS; SOME OCC CARBONACEOUS MATERIAL.

CARBONACEOUS SHALE = DARK GRAY, VERY DARK BRWN OCC BLACK; CRUNCHY TO DENSE TENACITY; SUB TABULAR TO SUB WEDGELIKE OCC PLATY CUTTINGS HABIT WITH IRREGULAR TO HACKLY FRACTURE; GREASY SUB VITREOUS TO DULL LUSTER WITH SMOOTH WAXY TO SL GRITTY TEXTURE. FRACTURE IS MORE PLANAR WITH PLATY CUTTINGS.

SILTSTONE = GRAY WITH HUES OF BRWN; TOUGH TO DENSE TENACITY WITH SUB WEDGELIKE TO SUB TABULAR OCC NODULAR CUTTINGS HABIT; DULL EARTHY TO SPARKLY EARTHY LUSTER WITH SILTY TO GRITTY TEXTURE; OVERALL MASSIVE STRUCTURE.

SANDSTONE = CLEAR TO TRANSLUCENT, LIGHT BROWNISH STAIN, VERY LIGHT GRAY; ABUNDANT LOOSE GRAINS, PREDOMINATELY QUARTZ FRAMEWORK; MODERATE FINE GRAIN; SOME SUB ANGULAR TO DOMINANTLY SUB ROUND, MODERATE TO HIGH SPHERICITY; WELL TO VERY WELL SORTED; TRACE FROSTED EASILY FRIABLE, FRIABLE, WEAK GRAIN SUPPORT; SILICA MATRIX CEMENT, TRACE CALCAREOUS/CLAYEY CEMENT; GOOD VISUAL INTERGRANULAR POROSITY; SOME BLACK INTERBEDDED CARBONACEOUS SHALE STRINGERS

CARBONACEOUS SHALE = DARK BROWNISH BLACK, GRAYISH BLACK, DARK BROWN; CRUMBLY TO CRUNCHY TENACITY; PLANAR, SUB BLOCKY, BLOCKY FRACTURE; WEDGELIKE TO PLATY CUTTING HABIT; DULL, VITREOUS SLIGHT RESINOUS LUSTER; GRITTY GRADING TO GRANULAR TEXTURE; TRACE BLACK COAL-SILTSTONE STRINGERS, SOME DEGASSING IN SAMPLE TRAY.

NOTE: TRIP OUT OF HOLE FOR BIT 01/21/2010 @ 9:30. RESUMED DRILLING 01/22/2009 @ 16:25. MAXIMUM TRIP GAS 3305u WITH 15 FT FLARE.

NOTE: TRIP OUT OF THE HOLE FOR NEW BIT 1-23-2010 @ 12024'; RESUMED DRILLING 01/24/2010 @ 2:15AM, TRIP GAS 812u WITH 15 FT FLARE.

SANDSTONE = LIGHT GRAY, GRAY, SOME CLEAR TO TRANSLUCENT, OFF WHITE; PREDOMINATELY VERY FINE GRAIN; WELL SORTED; SUB ANGULAR TO SUBROUND; FRIABLE TO FIRM; TRACE WHITE CLAYEY/TRACE CALCAREOUS CEMENT; WEAK TO FAIR GRAIN SUPPORT; TRACE BLACK SPECKLED CARBONACEOUS SHALE IMBEDDED; LOW BACKGROUND GAS.

SANDSTONE = ABUNDANT CAVINGS

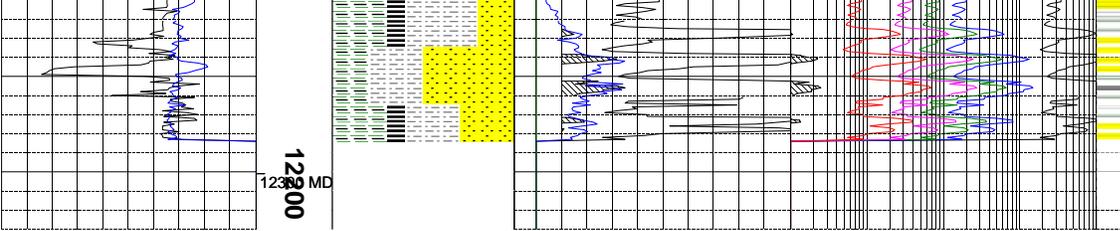
COAL = BLACK, VERY DARK GRAY, OCC HUES OF VERY DARK BRWN; CRUNCHY TO DENSE TENACITY WITH SUB TABULAR TO SUB PLATY CUTTINGS HABIT; IRREGULAR TO PLANAR OCC HACKLY CUTTINGS HABIT; VITREOUS TO SUB VITREOUS LUSTER WITH GLASSY TO SL GRITTY/SILTY TEXTURE; VISIBLE DEGASSING

|          |                            |          |                     |
|----------|----------------------------|----------|---------------------|
| Ttl Gas  | 500 <math>\times 10</math> | Meth C-1 | 100K <math>></math> |
| CO2      | 25K <math>\times 10</math> | Ethn C-2 | 100K <math>></math> |
| Flare Ht | 100 <math>\times 10</math> | Prop C-3 | 100K <math>></math> |
|          | <math>< 10</math>          | Bum C-4  | 100K <math>></math> |
|          | <math>< 10</math>          | Pen C-5  | 100K <math>></math> |

|          |                            |          |                     |
|----------|----------------------------|----------|---------------------|
| Ttl Gas  | 500 <math>\times 10</math> | Meth C-1 | 100K <math>></math> |
| CO2      | 25K <math>\times 10</math> | Ethn C-2 | 100K <math>></math> |
| Flare Ht | 100 <math>\times 10</math> | Prop C-3 | 100K <math>></math> |
|          | <math>< 10</math>          | Bum C-4  | 100K <math>></math> |
|          | <math>< 10</math>          | Pen C-5  | 100K <math>></math> |

ROP <math>> 100</math>  
Avg WOB <math>> 50</math>

ROP <math>> 100</math>  
Avg WOB <math>> 50</math>



IN SAMPLE TRAY IN PLACES.  
 CARBONACEOUS SHALE = DARK GRAY, VERY  
 DARK BRWN OCC BLACK; CRUNCHY TO DENSE  
 TENACITY; SUB TABULAR TO SUB WEDGELIKE  
 OCC PLATY CUTTINGS HABIT WITH IRREGULAR  
 TO HACKLY FRACTURE; GREASY SUB VITREOUS  
 TO DULL LUSTER WITH SMOOTH WAXY TO  
 SL GRITTY TEXTURE. GRADES TO AND INTER  
 BEDDED WITH MARINE SILTSTONES.

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