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# MUDLOG MD

**COMPANY** EXXONMOBIL  
**WELL** PCU-297-11B1ST1  
**FIELD** PICEANCE CREEK  
**REGION** ROCKY MT  
**COORDINATES** LAT.39.879628000  
LON.108.240365000  
**ELEVATION** GL = 7126'  
KB = 7143'  
**COUNTY, STATE** RIO BLANCO CO. CO  
**API INDEX** 051031137801  
**SPUD DATE** 04/10/2009  
**CONTRACTOR** HELMERICH PAYNE  
**CO. REP.** RICKY T. OWENS  
**RIG/TYPE** FLEX 3  
**LOGGING UNIT** MLU038  
**GEOLOGISTS** GEORGE BAKER  
BRENDA MARSH  
**ADD. PERSONS** BILL JOHANNING  
DEVIN CLAAR  
**CO. GEOLOGIST** MICHAEL HOWELL

## LOG INTERVAL

## CASING DATA

**DEPTHS:** 3,960' TO 13,000'  
**DATES:** 09/21/2009 TO 10/10/2009  
**SCALE:** 1" = 100'

16" AT 130'  
10.75" AT 3,953'  
7.00" AT 9,006'  
AT

## MUD TYPES

## HOLE SIZE

LSND TO 13,000'  
TO  
TO  
TO

9.875" TO 8,976'  
6.125" TO 9,006'  
6.125" TO 13,000'  
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	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	KAOLINITIC	RECRYSTALLIZED CALCITE	VOLCANICS
CHALK	DIATOMITE	LIMESTONE	RHYOLITE	
CRYSTALLINE TUFF	DIORITE	LITHIC TUFF	SALT	
CHERT - ARGILL	DOLOSTONE	MARL - DOLO	SAND	

<200 ROP 0>  
 ft/hr  
 <50 Avg WOB 0>  
 klbs

Depth  
 3600  
 3700  
 3800  
 3900  
 4000  
 4100  
 4200  
 4300  
 4400

Lithology

MGS  
 Ttl Gas 100  
 units  
 CO2 50K  
 ppm  
 Flare Ht. 100  
 ft

Meth C-1 100K  
 Ethn C-2 100K  
 Prop C-3 100K  
 Butn C-4 100K  
 Pent C-5 100K

Interp. Lith

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.

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.

1 UNIT OF GAS = 200 PPM C-1 ME

CONNECTION GAS, TRIP GAS AND WIPER GAS ARE NOTED ON THE MUD LOG. FLARE HEIGHTS AND DEPTHS OF GAS BUSTER USEAGE 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.

SURVEY DATA @ 3968'  
 INC. 25.05  
 AZIMUTH: 187.66  
 TVD: 3704.15

EPOCH WELL SERVICES COMMENCED LOGGING OPERATIONS 09/21/2009 AT 14:00 @ 3960'.  
 DRILL TO 3986' AND PERFORM F.I.T.

SHALE = YELLOW; LIGHT GRAY; MOTTLED IN PART; FIRM; PLATY TO SLI FLAKY CUTTINGS; IRREGULAR FRACTURE; DULL EARTHY LUSTER; SMOOTH TO SILTY TEXTURE; MOD CALCAREOUS IN SILTY EXAMPLES; VARIABLE AMOUNTS OF SILT; NO VISIBLE STRUCTURE.

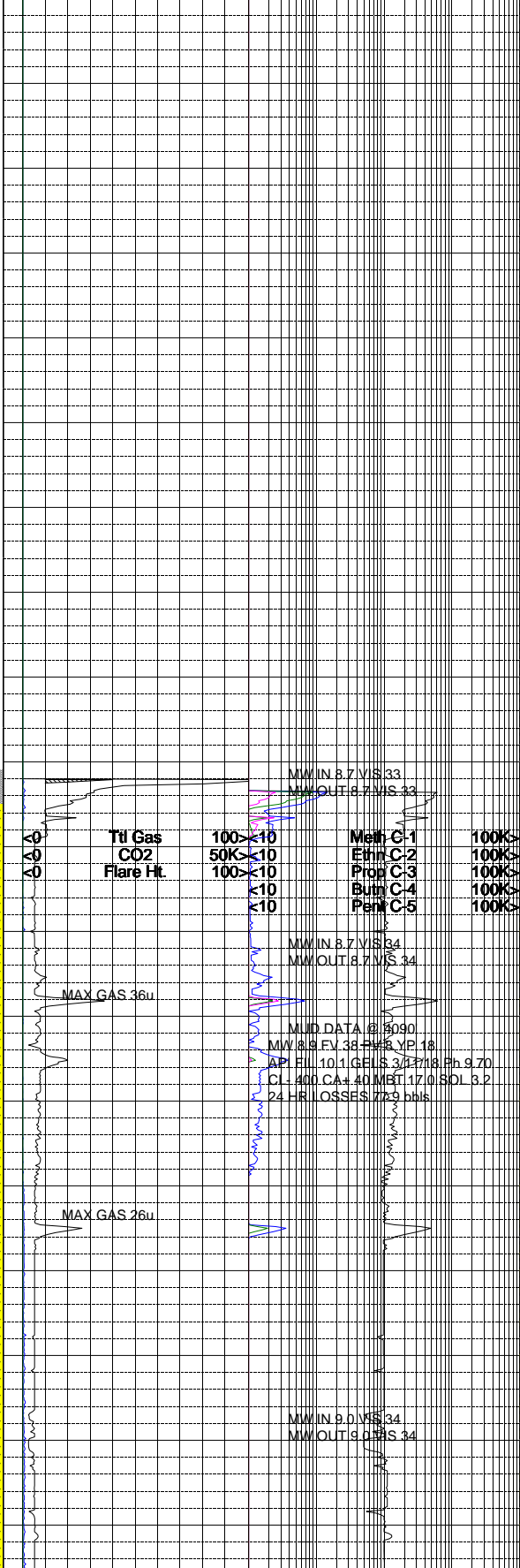
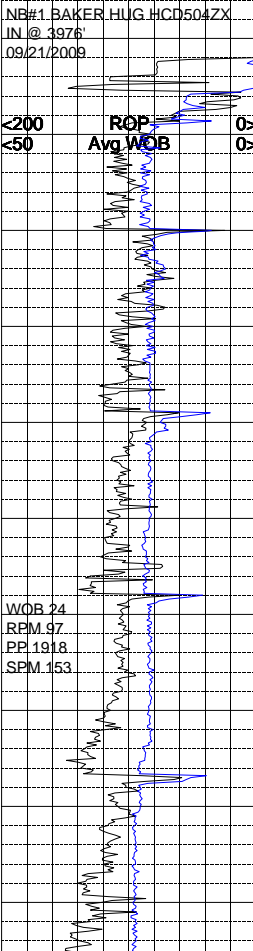
SANDSTONE = LIGHT YELLOWISH BROWN, LIGHT BLUISH GRAY, TRACES TRANSLUCENT QUARTZ GRAINS; UPPER VERY FINE TO UPPER FINE GRAIN; POOR TO FAIR SORTING; PREDOMINATELY SUB ANGULAR TO SUB ROUND ANGULARITY; LOW SHERICITY; TRACE FROSTED SURFACE FEATURES; EASILY FRIABLE TO SLIGHT FIRM; SILICIA MATRIX CEMENT, TRACE CLAY CEMENT; WEAK GRAIN SUPPORT; POOR VISUAL INTER GRANULAR POROSITY; SOME DARK LITHIC AND CARBONACEOUS SHALE IMBEDDED.

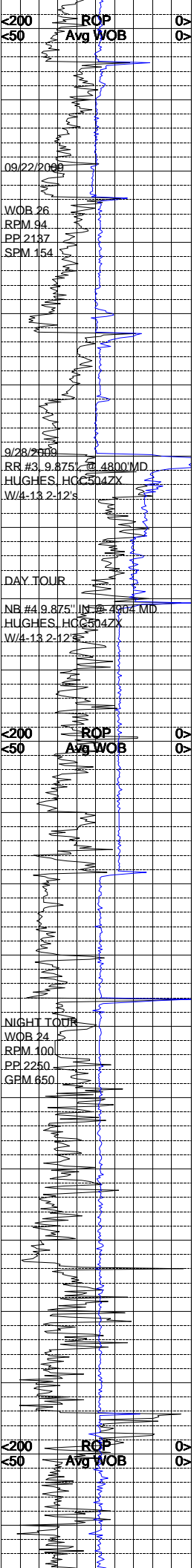
SILTSTONE = BROWN TO DARK BROWN, LIGHT BROWNISH GRAY; PULVERULENT TO CRUMBLY TENACITY; SUB BLOCKY TO BLOCKY FRACTURE; WEDGELIKE, SUB MASSIVE CUTTINGS HABIT; DULL EARTHY SLIGHT WAXY LUSTER; GRITTY TO SMOOTH TEXTURE; SEMI THICK STRUCTURE, GRADING TO SANDSTONE; TRACES BLACK LITHIC IMBEDDED.

SHALE = LIGHT GRAYISH RED, BROWNISH GRAY, LIGHT GRAY; CRUNCHY TO BRITTLE TENACITY; SUB BLOCKY, BLOCKY, IRREGULAR IN PART FRACTURE; TABULAR, SUB MASSIVE CUTTINGS HABIT; DULL, WAXY LUSTER; GRITTY, CLAYEY TEXTURE; SEMI MASSIVE THICK STRUCTURE; GRADING TO SILTSTONE.

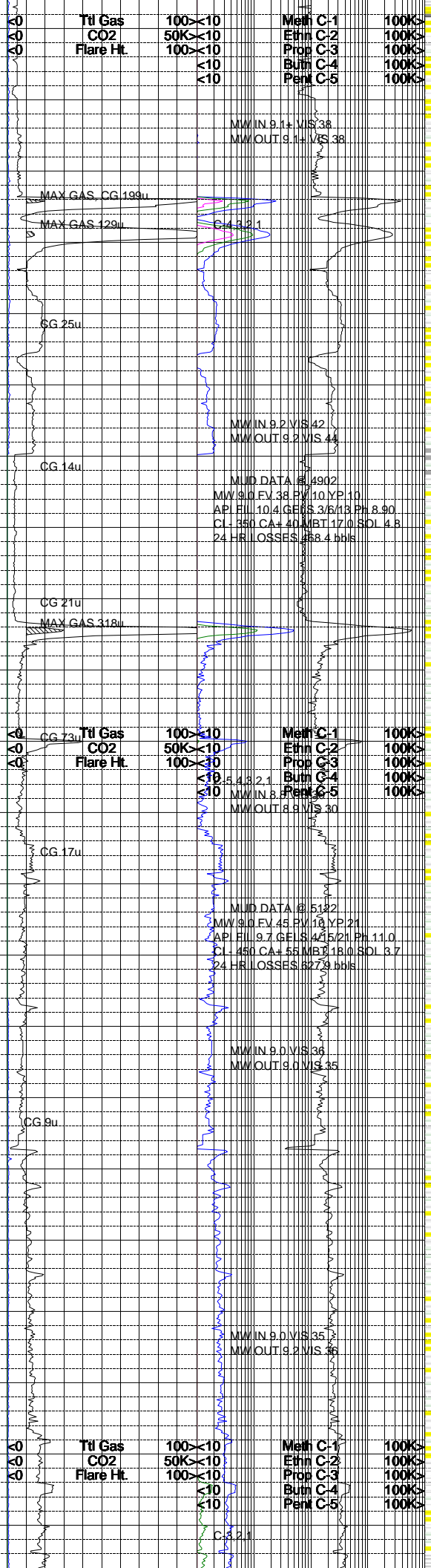
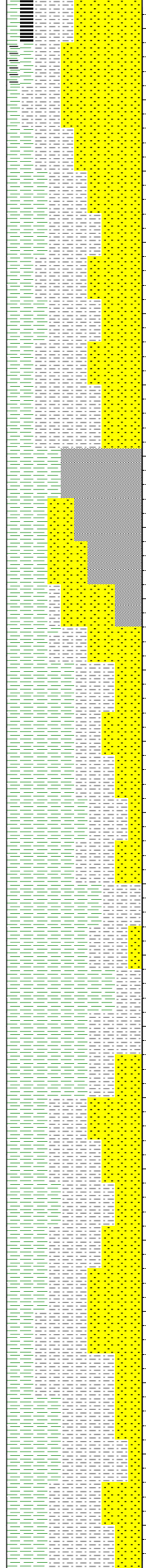
SANDSTONE = TRANSLUCENT, LIGHT YELLOWISH BROWN, PALE GRAYISH ORANGE; LOWER TO UPPER FINE GRAIN; POOR TO FAIR SORTING; PREDOMINATELY SUB ROUNDED TRACE SUB ANGULAR; LOW TO MODERATE SPHERICAL; POLISH TO FROSTED SURFACE FEATURES; EASILY FRIABLE TO FRIABLE; SILICA CEMENT; VERY WEAK GRAIN SUPPORTED; TRACES BLACK COAL IMBEDDED.

SILTSTONE = LIGHT GRAYISH BROWN, PALE YELLOWISH BROWN, LIGHT GRAYISH ORANGE;





4500  
4600  
4700  
4800  
4900  
5000  
5100  
5200  
5300  
5400  
5500



PULVERULENT, CRUNCHY TENACITY; SUB BLOCKY, BLOCKY FRACTURE; ELONGATED, WEDGELIKE, SUB MASSIVE CUTTINGS HABIT; DULL, EARTHY, SLIGHT WAXY LUSTER; GRITTY, SILTY TEXTURE; SEMI MASSIVE, THICK STRUCTURE; GRADING TO SANDSTONE; TRACES BLACK SPECKLED LITHIC IMBEDDED.

SANDSTONE = CLEAR TO TRANSLUCENT, LIGHT GRAYISH BLUE, OFF WHITE; QUARTZ FRAMEWORK; LOWER TO UPPER FINE GRAIN; FAIR TO WELL SORTED; PREDOMINATELY SUB ROUND TO ROUND ANGULARITY; MODERATE SPHERICITY; FROSTED TO POLISH SURFACE FEATURE; VERY FRIABLE TO FRIABLE; SOME SILICA MATRIX CEMENT, VERY WEAK GRAIN SUPPORT, GOOD VISUAL INTER GRANULAR POROSITY; BLACK SPECKLED COAL IMBEDDED.

SILTSTONE = DUSKY YELLOWISH, PALE YELLOWISH BROWN; PULVERULENT, CRUMBLY, SLIGHT BRITTLE TENACITY; EARTHY, SUB BLOCKY, IRREGULAR IN PART FRACTURE; WEDGELIKE, TABULAR CUTTINGS HABIT; DULL, RESINOUS LUSTER; GRITTY TO GRANULAR TEXTURE; SEMI MASSIVE THICK STRUCTURE; TRACES BLACK LITHIC IMBEDDED.

CEMENT = TIME DRILLING TO KICK OFF THE PCU 297-11B1ST1 FROM 4800' TO 4902' MD, KICK OFF INTO SHALE AND SANDSTONE FORMATIONS, VERY LOW GAS 2-4u.

SHALE = YLWISH GRY TO YLWISH BRWN; DENSE TO CRUNCHY TENACITY WITH SUB MASSIVE TO MASSIVE TO SUB TABULAR CUTTINGS HABIT; IRREGULAR TO HACKLY FRACTURE; DULL EARTHY TO SUB WAXY TEXTURE; BECOMING GRITTY AS GRADING TO DIRTY SILTSTONE; EARTHY TO WAXY LUSTER; COMMONLY INTERBEDDED WITH SILTS AND SANDS.

SILTSTONE = DUSKY YELLOWISH, PALE YELLOWISH BROWN; OCC UPPER FINE GRAINED CRUMBLY, OCC SLIGHTLY BRITTLE TENACITY; BECOMES EARTHY WHERE GRADING TO SHALE WEDGELIKE TO TABULAR SUB TABULAR CUTTINGS HABIT; DULL RESINOUS LUSTER; OCC GRANULAR TEXTURE; TRACE BLACK LITHIC/MAFIC FRAGMENTS.

SANDSTONE = HUES OF YLWISH BRN, OFF WHT VERY LT GRY WITH SL YLW HUE; INDIVIDUAL GRAINS ARE TRANSPARENT TO OPAQUE; SUB ANGULAR TO SUB ROUND SME ROUND, WITH LOW TO MODERATE SPHERICITY; DOMINANTLY LOOSE IN SAMPLE TRAY; CONSOLIDATED CLUSTERS GRAIN SUPPORTED IN A CALC/CLAY CEMENT; MODERATE TO STRONG REACTION TO DILUTE HCL, SOME OCC FROSTING; EASILY FRIABLE; LOOSE GRAINS ARE MOST LIKELY A RESULT OF BIT ACTION; VERY SLIGHT INCREASE IN DITCH GAS; ACCESSORIES INCLUDE DARK LITHIC AND MAFIC FRAGMENTS LESS THEN 5%.

SHALE = DULL YELLOWISH BROWN, LIGHT GRAYISH BROWN, LIGHT GRAY; CRUMBLY IN PART, TRACE SLIGHT BRITTLE TENACITY; EARTHY, SUB BLOCKY, IRREGULAR IN PART FRACTURE; SOME WEDGELIKE, SUB TABULAR TO TABULAR CUTTINGS HABIT; DULL, RESINOUS LUSTER, SILTY GRADING TO GRITTY TEXTURE; SUB THIN STRUCTURE; TRACES IN SAMPLE GRADING TO VERY FINE SILTSTONE.

SANDSTONE = CLEAR TO TRANSLUCENT LOOSE GRAINS, OFF WHITE TO LIGHT BLUISH GRAY CLUSTERS; UPPER VERY FINE TO LOWER FINE GRAIN; FAIR TO WELL SORTED; PREDOMINATELY SUB ROUNDED LOOSE GRAINS, SUB ANGULAR GRAINS IN CLUSTERS; MODERATELY SPHERICITY; FROSTED IN PART; SLIGHTLY MODERATELY FIRM TO FIRM; CALCITE CEMENT, WEAK HCL REACTION; TRACES SILTSTONE AND SHALE INTERBEDDED; FAIR TO GOOD VISUAL INTER GRANULAR POROSITY.

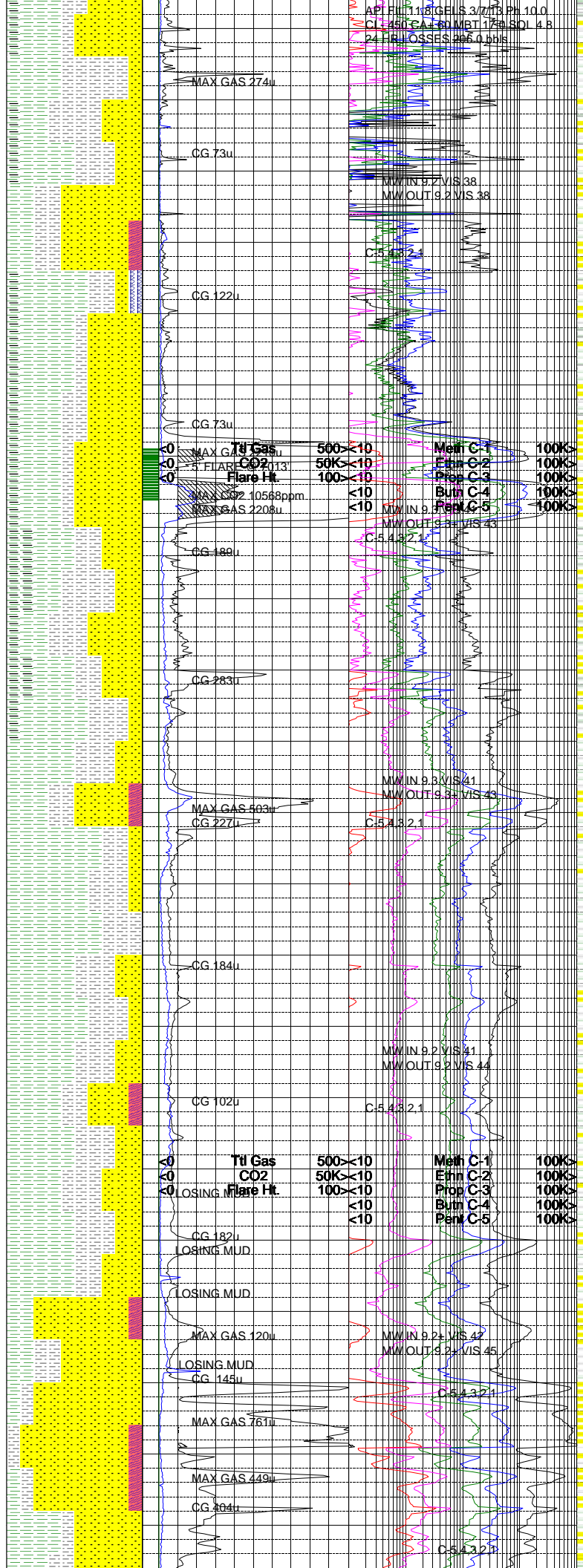
SILTSTONE = LIGHT YELLOWISH BROWN, MODERATED PALE BROWN; CRUNCHY, SOME BRITTLE TENACITY; SUB BLOCKY, BLOCKY IN PART; FRACTURE; WEDGELIKE, SUB TBULAR CUTTINGS HABIT; SLIGHT RESINOUS LUSTER; GRITTY TO SILTY TEXTURE; TRACE SILTSTONE WITH SHALE INTERBEDDED.

SHALE = PALE YELLOWISH BROWN, LIGHT YELLOWISH GRAY, SOME LIGHT GREENISH GRAY; PULVERULENT, SOME CRUMBLY TO BRITLE TENACITY; SUB BLOCKY, BLOCKY FRACTURE; TABULAR, SUB MASSIVE TO MASSIVE CUTTINGS HABIT; DULL EARTHY SLIGHT WAXY LUSTER; CLAYEY TO SMOOTH TEXTURE; SUB MASSIVE STRUCTURE; TRACE SILTSTONE IMBEDDED.



NE# 59-875 IN @ 6702 MD  
 M# 16EPX  
 w/ 5 X12'S  
 NIGHT TOUR  
  
 DACTOUR  
 TROUBLE SHOOT WOB  
 BIT WT NOT SENDING FR TOTCO  
 TOTCO IS REPAIRING  
  
 <200 ROP  
 <50 Avg WOB  
  
 WOB BACK ON LINE  
  
 RE SCALE ROP 20-25G  
  
 <200 ROP  
 <50 Avg WOB  
  
 OHIO CREEK @ 7552  
  
 WE850 @ 7758

6700  
 6800  
 6900  
 7000  
 7100  
 7200  
 7300  
 7400  
 7500  
 7600  
 7700



NOTE: TOH @ 6702 TO CHANGE OUT BHA AND LAY DOWN SHLUMBERGER'S TOOLS. 09-29-09.

CARBONACEOUS SHALE = DARK BRWN, BLACK, OCC DARK GRY; CRUNCHY TO BRITTLE TENACITY; SUB TAB TO SUB WEDGELIKE / ELONGATED CUTTINGS HABIT WITH IRREGULAR TO HACKLY FRACTURE; PLANAR FRACTURE WITH PLATY CUTTINGS; DULL EARTHY TO SUB WAXY OCC SUB VITREOUS LUSTER WITH EARTHY TO SMOOTH TEXTURE; SL PYRITIC IN PLACES; OCC COAL LAMINAE AND LENSES; VISIBLE DEGASSING IN SAMPLE TRAY IN PLACES.

SANDSTONE = WHT, OFF WHT, LT GRY, GRY WITH OCC HUES OF LT BRWN, GRY; DOMINANTLY LOOSE TRANSPARENT TO TRANSLUCENT GRAINS IN TRAY; ROUND TO SUB ROUND; HIGH SPHERICITY; WELL SORTED; UPPER MEDIUM TO LOWER FINE GRAINED IN SIZE; APPEARS BI-MODAL AS CONSOLIDATED CLUSTER ARE FINER GRAINED; MODERATELY SORTED; FINE TO UPPER FINE GRAINED; LOW TO MODERATE SPHERICITY; SUB ANGULAR TO SUB ROUND; CLUSTERS ARE GRAIN SUPPORTED IN A CALC/CLAY MATRIX; ACCESSORIES INCLUDE DARK LITHIC AND MAFIC FRAGMENTS; LOOSE CALCITE GRAINS IN SAMPLE TRAY.

CARBONACEOUS SHALE = DARK BRWN, BLACK, OCC DARK GRY; CRUNCHY TO BRITTLE TENACITY; SUB TAB TO SUB WEDGELIKE / ELONGATED CUTTINGS HABIT WITH IRREGULAR TO HACKLY FRACTURE; PLANAR FRACTURE WITH PLATY CUTTINGS; DULL EARTHY TO SUB WAXY OCC SUB VITREOUS LUSTER WITH EARTHY TO SMOOTH TEXTURE; SL PYRITIC IN PLACES; OCC COAL LAMINAE AND LENSES; VISIBLE DEGASSING IN SAMPLE TRAY IN PLACES.

SANDSTONE = LT GRY, OFF WHT, GRY; INDIVIDUAL GRAINS ARE TRANSPARENT TO OPAQUE; SUB ANGULAR TO SUB ROUND; LOW TO OCC MODERATE SPHERICITY; OVERALL MODERATELY TO WELL SORTED; UPPER FINE TO FINE GRAINED OCC UPPER MEDIUM GRAINED; DOMINANTLY CONSOLIDATED; CLUSTERS ARE GRAIN SUPPORTED IN A CALC/CLAY CEMENT MODERATE TO STRONG REACTION TO DILUTE HCL; SLIGHT TO MODERATE INCREASE IN GAS.

SHALE = GRY, DARK GRY, GRY WITH HUES OF BRWN, BRWNISH YLW IN PLACES; FIRM TO CRUNCHY TENACITY; SUB TABULAR TO TABULAR OCC WEDGELIKE CUTTINGS HABIT; DULL EARTHY TO WAXY LUSTER WITH SMOOTH TO CLAYEY/EARTHY TEXTURE; GRADES TO AND INTERBEDDED WITH SILTSTONE; TRACE CARBONACEOUS SHALE LESS THEN 5% OFTEN PYRITIC AND DEGASSING IN SAMPLE TRAY. OCC LAMINATIONS.

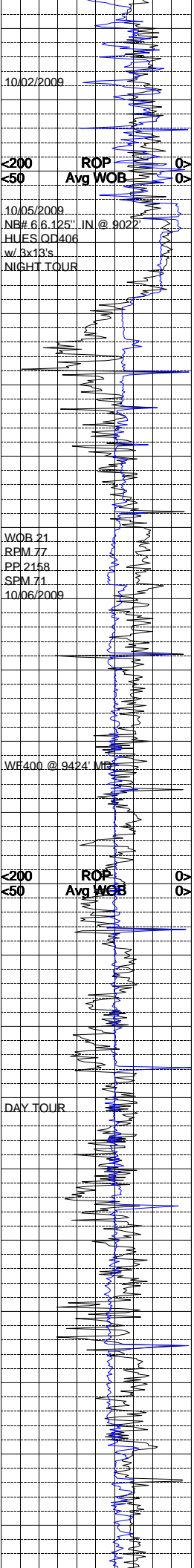
SHALE = GRY, DARK GRY, GRY WITH HUES OF GRN, BRWNISH YLW IN PLACES; FIRM TO CRUNCHY TENACITY; SUB TABULAR TO TABULAR OCC WEDGELIKE CUTTINGS HABIT; DULL EARTHY TO WAXY LUSTER WITH SMOOTH TO CLAYEY/EARTHY TEXTURE; GRADES TO AND INTERBEDDED WITH SILTSTONE; TRACE CARBONACEOUS SHALE LESS THEN 5% OFTEN PYRITIC AND DEGASSING IN SAMPLE TRAY; OCC LAMINATIONS.

SILTSTONE = LT GRY, MED GRY OCC REDDISH BRWN; FIRM TO CRUMBLY TENACITY WITH SL PLATY TO SUB TABULAR OCC FLAKY CTNGS HABIT; SL SPARKLING LUSTER WITH SILTY TO SUB GRITTY TEXTURE; SL TO MODERATELY MICACEOUS; OCC GRADES TO SANDSTONE.

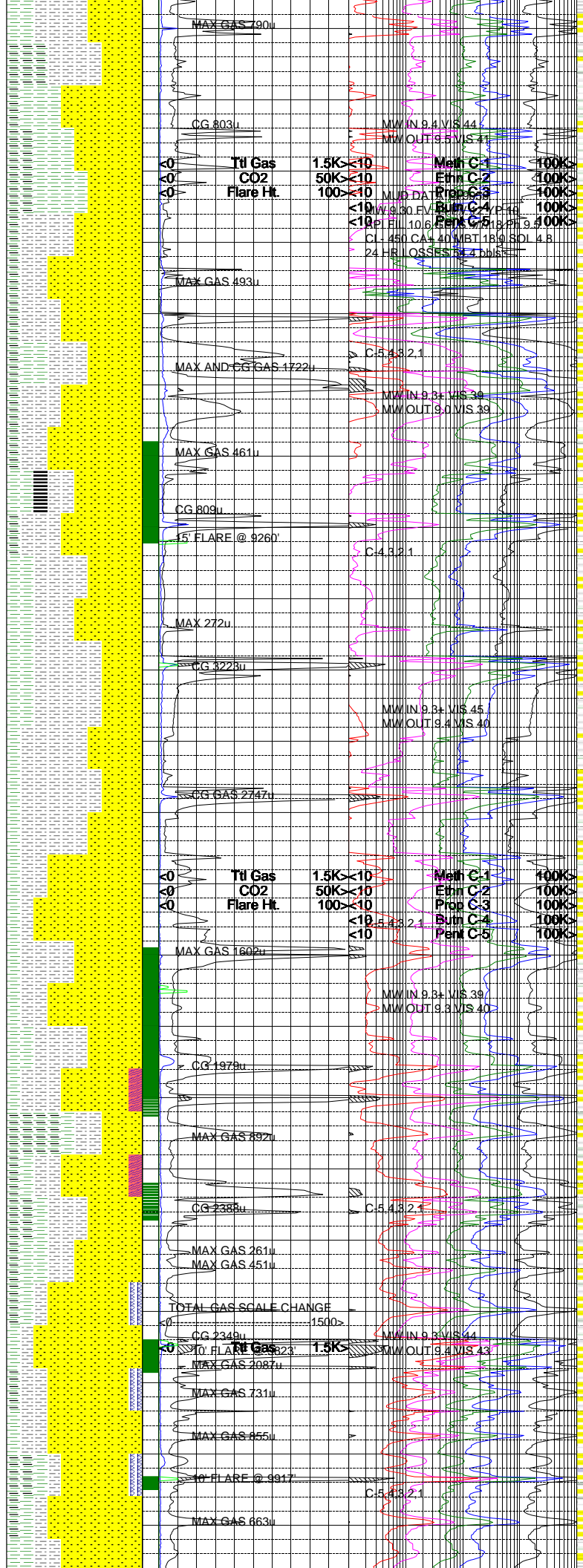
SANDSTONE = VERY LT GRY, OFF WHT, SME GRNISH GRY; INDIVID GRAINS ARE TRANSP TO OPAQUE; LOWER FINE TO FINE GRAINED; SUB ANGULAR TO SUB ROUND WITH LOW TO MODERATE SPHERICITY; OVERALL MODERATELY WELL TO WELL SORTED; OCCASSIONAL GREEN GRAINS INDICATING POSS CHLORITIZATION; OVERALL DOMINANTLY CONSOLIDATED; CLUSTERS ARE GRAIN SUPPORTED IN A CALC/CLAY MATRIX OCC SL SILICEOUS; STRONG REACTION TO DILUTE HCL; ACCESSORIES INCL DARK LITHIC AND MAFIC FRAGMENTS LESS THAN 5%. SLIGHT TO HIGH INCREASE IN DITCH GAS.

SANDSTONE = VERY LT GRY, OFF WHT, SME GRNISH GRY; INDIVID GRAINS ARE TRANSP TO OPAQUE; FINE TO UPPER FINE GRAINED; SUB ANGULAR TO SUB ROUND WITH LOW TO MODERATE SPHERICITY; OVERALL MODERATELY WELL TO WELL SORTED; OCCASSIONAL GREEN GRAINS INDICATING POSS CHLORITIZATION; OVERALL DOMINANTLY CONSOLIDATED; CLUSTERS ARE GRAIN SUPPORTED IN A CALC/CLAY MATRIX OCC SL SILICEOUS; STRONG REACTION TO DILUTE HCL; ACCESSORIES INCL DARK LITHIC AND MAFIC FRAGMENTS 5-10% MODERATE TO HIGH INCREASE IN DITCH GAS.





8900  
9000  
9100  
9200  
9300  
9400  
9500  
9600  
9700  
9800  
9900



CONSOLIDATED IN PART, FRIABLE TO MODERATE FIRM; FIRM; PREDOMINATELY SILICEOUS MATRIX CEMENT, TRACE CALCAREOUS CEMENT; WEAK HCL REACTION; DISSEMINATED BLACK CARBONACEOUS SHALE IMBEDDED.

CARBONACEOUS SHALE = DARK GRAYISH BROWN, DUSKY BROWN; CRUMBLY TO BRITTLE TENACITY; SUB BLOCKY, SLIGHTLY IRREGULAR FRACTURES; SUB TABULAR CUTTINGS HABIT; DULL, EARTHY LUSTER; GRITTY TEXTURE; SUB SANDSTONE STRUCTURE.

TD INTERMEDIATE @ 9022' MD 10-02-2009 RESUMED DRILLING 10-05-2009 @ 17:35.

SANDSTONE = LIGHT GRAY, OFF WHITE, GRAYISH WHITE; LOWER FINE TO MEDIUM GRAIN; PREDOMINATELY FAIR SORTING; SUBANGULAR TO SUBROUND ANGULARITY; LOW SPHERICITY; EASILY FRIABLE TO FRIABLE; PREDOMINATELY CALCITE CEMENT; TRACES CALCITE CRYSTALS IN FRACTURES; BLACK LITHIC AND CARBONACEOUS SHALE IMBEDDED; HIGHER GASES ASSOCIATED WITH SANDSTONE.

SILTSTONE = MODERATE LIGHT GRAY, LIGHT GRAY, TRACE DARK GREENISH GRAY; FIRM, HARD TO OCCASIONAL VERY HARD; SUB BLOCKY, BLOCKY IN PART, SOME IRREGULAR FRACTURE; TABULAR, PLATY CUTTINGS HABIT; DULL WAXY LUSTER; GRITTY, TO SLIGHTLY SMOOTH TEXTURE; TRACE SANDSTONE AND SHALE IMBEDDED; LOWER GASES OBSERVED IN SILTSTONE.

SANDSTONE = OFF WHITE, LIGHT BLUISH GRAY, LIGHT GRAYISH WHITE; SPECKLED WITH BLACK LITHIC AND CARBONACEOUS SHALE; LOWER TO MEDIUM FINE GRAIN; SOME POOR TO PREDOMINATE FAIR SORTING; SUB ANGULAR TO SUBROUND, LOW SPHERICITY; TRACE FOSTED SURFACE FEATURE FIRM FRIABLE TO MODERATELY HARD; PREDOMINATELY CALCAREOUS CEMENT, SOME SILICA MATRIX CEMENT; TRACE BLACK COAL LAMINATION; HIGH LEVELS OF GAS SHOWS.

SILTSTONE = MODERATE DARK GRAY, LIGHT GRAY, MEDIUM BLUISH GRAY; BRITTLE TO DENSE; SUB BLOCKY, BLOCKY SLIGHT IRREGULAR FRACTURES; TRACE CALCAREOUS CEMENT; PLATY TO WEDGELIKE CUTTINGS HABIT; DULL, RESINOUS LUSTER, TRACE MICA IMBEDDED; GRITTY TO SILTY TEXTURE; TRACES VERY FINE SANDSTONE IMBEDDED.

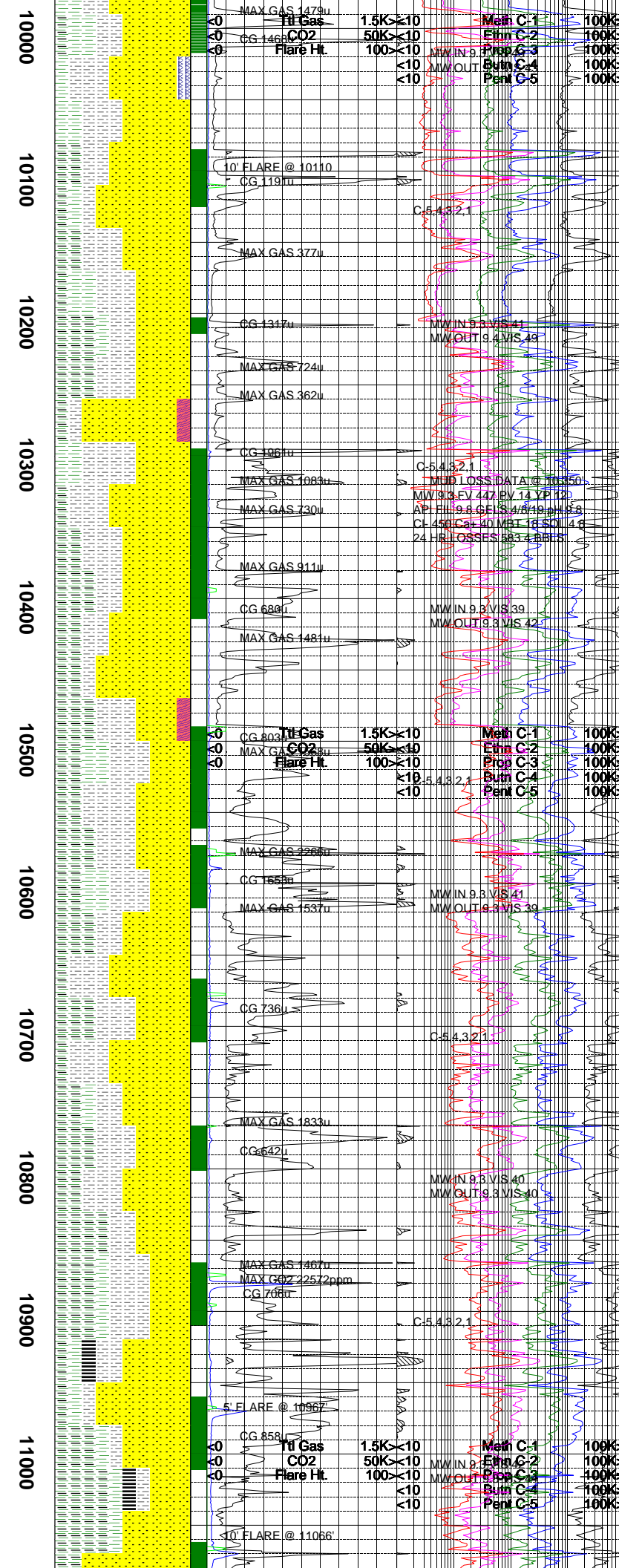
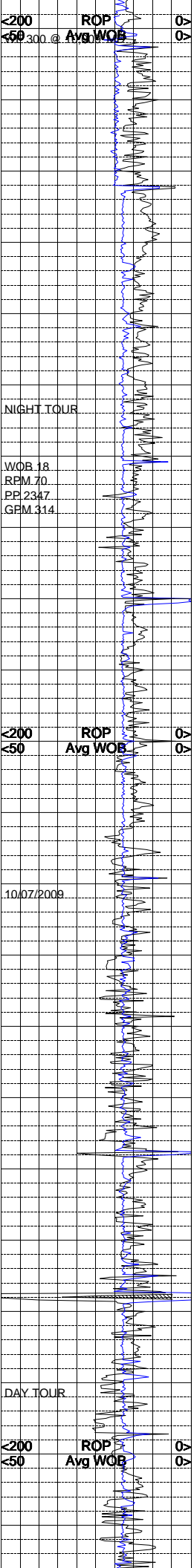
SANDSTONE = ABUNDANT LOOSE GRAINS, OFF GRAYISH WHITE, UPPER VERY FINE TO LOWER FINE GRAIN; POOR TO FAIR SORTING; PREDOMINATELY SUBANGULAR, SOME SUB ROUND, VERY LOW SPHERICITY; FROSTED IN PART SURFACE FEATURES; EASILY FRIABLE TO FRIABLE POSSIBLE DUE TO PDC BIT; PREDOMINATELY SILICA CEMENT, TRACE KAOLIN AND CALCAREOUS CEMENT; DISSEMINATED BLACK LITHIC AND CARBONACEOUS SHALE IMBEDDED.

SANDSTONE = VERY LT GRAY TO OFF WHT; INDIVIDUAL GRAINS ARE TRANSL TO OPAQUE; UPPER FINE TO VERY FINE GRAINED WITH LOW TO OCC MODERATE SPHERICITY; DOMINANTLY CONSOLIDATED CLUSTERS; FIRM AND MODERATELY FRIABLE; OVERALL GRAIN SUPPORTED IN A CAL/CLAY MATRIX; MODERATE TO STRONG REACTION TO DILUTE HCL; ACCESSORIES INCLUDE DARK LITHIC AND MAFIC FRAGMENTS 3-5%; SLIGHT TO HIGH INCREASE IN DITCH GAS.

SHALE = GRY, BRWNISH GRY, OCC DARK GRY; DENSE TO STIFF TENACITY WITH SUB WEDGELIKE TO SUB TABULAR CUTTINGS HABIT; DARK CARBONACEOUS FOSSILIZED IMPRINTS OF PLANT MATERIAL; IRREGULAR TO SUB PLANAR FRACTURE; DULL TO SUB WAXY LUSTER WITH EARTHY TO SMOOTH TEXTURE; CARBONACEOUS LAMINATIONS AND LENSES; SL PYRITIC IN PLACES; GRADES TO CARBONACEOUS SHALE IN PLACES; NO REACTION TO DILUTE HCL.

CARBONACEOUS SHALE = DARK BRWN, BLACK, OCC DARK GRY; CRUNCHY TO BRITTLE TENACITY; SUB TAB TO SUB WEDGELIKE / ELONGATED CUTTINGS HABIT WITH IRREGULAR TO HACKLY FRACTURE; PLANAR FRACTURE WITH PLATY CUTTINGS; DULL EARTHY TO SUB WAXY OCC SUB VITREOUS LUSTER WITH EARTHY TO SMOOTH TEXTURE; SL PYRITIC IN PLACES; OCC COAL LAMINAE AND LENSES; GRADES TO AND INTERBEDDED WITH SHALE AND SILTSTONE.

SANDSTONE = TRANSLUCENT TO TRANSPARENT OFF WHT; DOMINANTLY LOOSE GRAINS IN SAMPLE TRAY; MOST LIKELY A RESULT OF BIT ACTION; INDIVIDUAL GRAINS ARE SUB ANGULAR TO SUB ROUND WITH MODERATE



SPHERICITY; MODERATELY TO WELL SORTED FINE TO UPPER FINE GRAINED; OCC CONSOLIDATED CLUSTER ARE GRAIN SUPPORTED IN A CALC/CLAY CEMENT. SLIGHT TO HIGH INCREASE IN DITCH GAS; SL TO STRONG REACTION TO DILUTE HCL; VERY CLEAN; LESS THEN 1% ACCESSORY MINERALS.

SILTSTONE = DARK GRAY; GRAY; GRAY WITH HUES OF BRWN; HARD TO DENSE TENACITY WITH MASSIVE TO TABULAR/SUB TABULAR CUTTINGS HABIT; IRREGULAR TO HACKLY FRACTURE; SPARKLY TO DULL LUSTER WITH GRITTY TO SILTY TEXTURE; COMMON CARBONACEOUS LAMINAE OCC APPEARS SLICKENSIDAL; COMMONLY INTERBEDDED WITH SANDSTONE.

CARBONACEOUS SHALE = DARK BRWN, BLACK, OCC DARK GRAY; CRUNCHY TO BRITTLE TENACITY; SUB TAB TO SUB WEDGELIKE / ELONGATED CUTTINGS HABIT WITH IRREGULAR TO HACKLY FRACTURE; DULL EARTHY TO SUB VITREOUS LUSTER OCC GREASY; EARTHY TO WAXY SMOOTH TEXTURE.

SANDSTONE = CLEAR TO WHITE WITH A TRACE AMOUNT OF DARK LITHICS GIVING A SALT AND PEPPERED APPEARANCE; MIXTURE OF SMALL CLUSTERS AND LOOSE INDIVIDUAL GRAINS; ALSO PRESENT WERE LOOSE CALCITE AND HEXAHEDRON QUARTZ CRYSTALS AS POSSIBLE FRACTURE FILL; CLUSTERS WERE HIGHLY REACTIVE TO DILUTE HCL AND HAD A CALCITE CEMENTATION; FINE TO UPPER FINE GRAINED WHEN IN CLUSTERS; MEDIUM TO FINE GRAINED WHEN LOOSE; FAIR TO WELL SORTING; SUB-ANGULAR TO ANGULAR; MODERATE SPHERICITY; TRACE AMT OF COAL IN SAMPLE TRAY MAY BE CAVINGS.

SILTSTONE = DARK GRAY TO BROWNISH GRAY TO BROWNISH BLACK; TOUGH TO DENSE TENACITY; IRREGULAR TO BLOCKY FRACTURE; MASSIVE TO TABULAR CUTTINGS HABIT; DULL TO SPARKLING LUSTER; SILTY TO GRITTY TEXTURE; THINLY INTERBEDDED WITH SANDSTONE AND CARBONACEOUS SHALE.

CARBONACEOUS SHALE = GRAY TO DARK GRAY TO GRAYISH BLACK; DENSE TO BRITTLE TENACITY; IRREGULAR TO PLANAR FRACTURE; PLATY TO FLAKY CUTTINGS HABIT; DULL TO WAXY LUSTER; SMOOTH TO SILTY TEXTURE; THIN STRUCTURE; INTERBEDDED WITH SANDSTONE AND SILTSTONE.

SANDSTONE = WHITE TO VERY LIGHT GRAY TO TRANSLUCENT TO CLEAR; SOME DARK LITHICS WHEN IN CLUSTERS GIVING A SALT AND PEPPERED APPEARANCE; FINE GRAINED; WELL TO FAIR SORTING; SUB ANGULAR TO SUB ROUNDED; MODERATE SPHERICITY; MODERATE REACTION TO DILUTE HCL; CALC/ SILICA CEMENTATION; ABUNDANT LOOSE GRNS; THICKER SANDSTONE BEDS WITH THIN LAYERS OF CARB. SHALE AND SILTSTONE IN-BETWEEN.

SILTSTONE = BROWN TO GRAYISH BROWN TO BROWNISH BLACK; TOUGH TO DENSE TENACITY; IRREGULAR TO TABULAR CUTTINGS HABIT; DULL TO SPARKLING LUSTER; SILTY TO GRITTY TEXTURE; THINLY INTERBEDDED WITH SANDSTONE AND SILTSTONE.

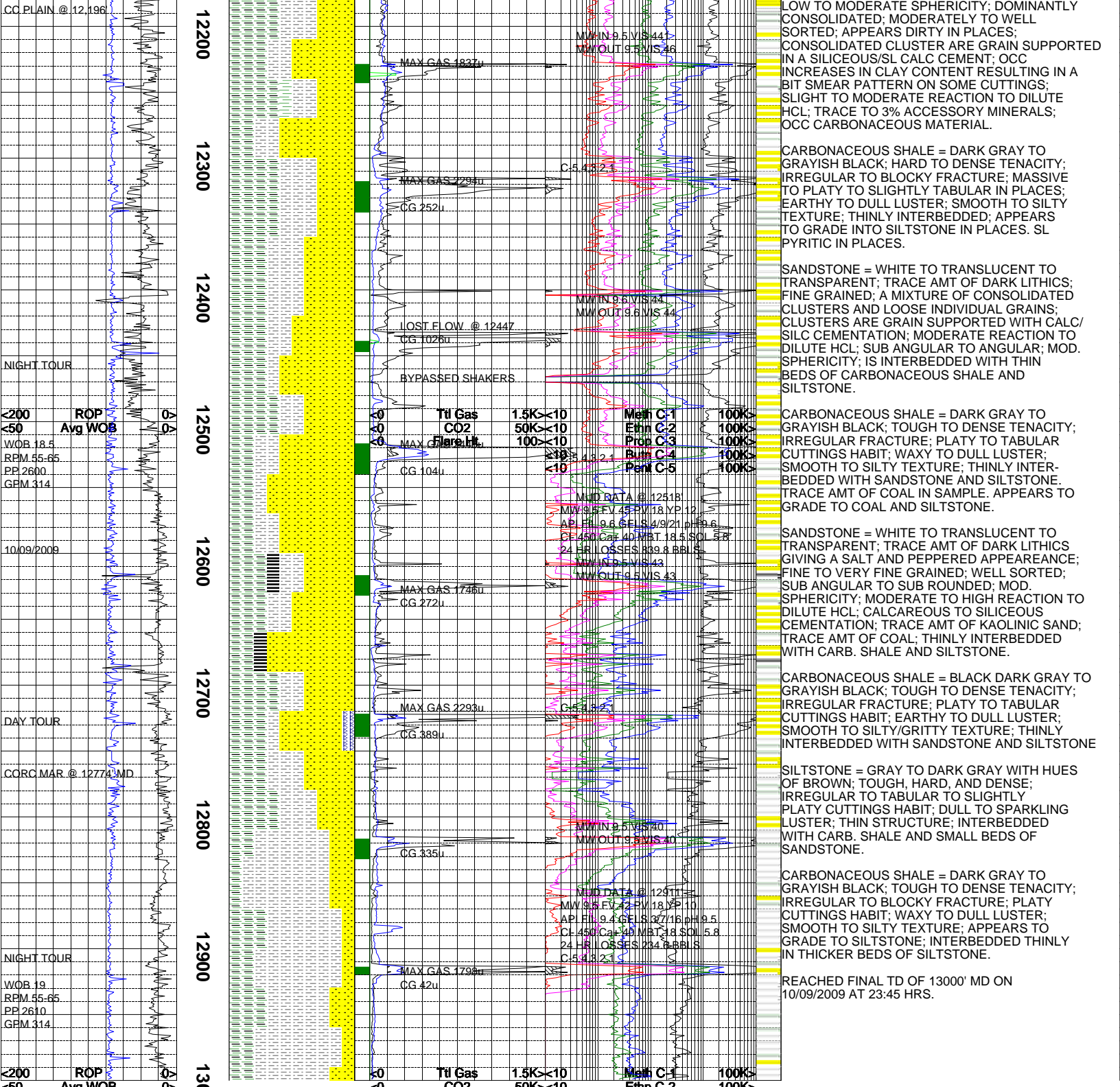
CARBONACEOUS SHALE = DARK GRAY TO GRAYISH BLACK; TOUGH TO FIRM TO BRITTLE TENACITY; IRREGULAR TO PLANAR FRACTURE; MASSIVE TO PLATY CUTTINGS HABIT; DULL TO EARTHY LUSTER; SMOOTH TO SILTY TEXTURE; THINLY INTERBEDDED WITH SANDSTONE AND SILTSTONE.

SANDSTONE = CLEAR TO TRANSLUCENT TO OPAQUE WITH SOME WHITE TO YELLOWISH WHITE GRAINS; TRACE AMOUNT OF DARK LITHICS THROUGHOUT; FINE TO VERY FINE GRAINED; FAIR TO WELL SORTED; SUB-ANGULAR TO SUB ROUND; MODERATE SPHERICITY; SLIGHT TO MODERATE REACTION TO DILUTE HCL; CALC/SILC CEMENTATION; TRACE AMT OF COAL IN SAMPLE; THINLY INTERBEDDED. ASSOCIATED WITH ELEV. GAS.

COAL = BLACK, VERY DARK GRAY; DARK GRAY WITH HUES OF BROWN; CRUNCHY TO BRITTLE TENACITY WITH IRREGULAR TO HACKLY FRACTURE IS PLANAR WITH PLATY CUTTINGS; EARTHY/GREASY TO SUB VITREOUS LUSTER WITH EARTHY TO SMOOTH/GREASY TEXTURE; SUB TABULAR TO SUB WEDGELIKE CUTTINGS HABIT OCC PLATY; OCC SLIGHTLY PYRITIC IN PLACES; VISIBLE DEGASSING IN SAMPLE TRAY

CARBONACEOUS SHALE = DARK GRAY, BLACK, GRAY WITH BWN HUES; CRUNCHY TO BRITTLE TENACITY; SUB TAB TO SUB WEDGELIKE / ELONGATED CUTTINGS HABIT WITH IRREGULAR TO HACKLY FRACTURE; PLANAR FRACTURE





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