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(281) 784-5500
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(661) 328-1595
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Anchorage, AK
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Drilling Dynamics MD

COMPANY ExxonMobil Production
WELL FRU197-33B10
FIELD Piceance Creek
REGION Rocky Mountain
COORDINATES 39.921283000
108.282576000
ELEVATION 6460'
COUNTY, STATE Rio Blanco, CO
API INDEX 051031142300
SPUD DATE 4/13/2010
CONTRACTOR HE
CO. REP. C.Curtis
RIG/TYPE 321 / Flex 4
LOGGING UNIT 31
GEOLOGISTS C. Record
M. Franco
ADD. PERSONS M.Piper
R.McCane
CO. GEOLOGIST Nova Roosmawati

LOG INTERVAL

CASING DATA

DEPTHS: 4124' TO 12667'
DATES: 8/05/2010 TO 8/15/2010
SCALE: 1"=100'

16.0" AT 150'
10.75" AT 4114'
4.5" AT 12657'
AT

MUD TYPES

HOLE SIZE

WATERBASED TO 12667'
TO
TO
TO

14.75" TO 4124'
8.75" TO 12667'
TO
TO

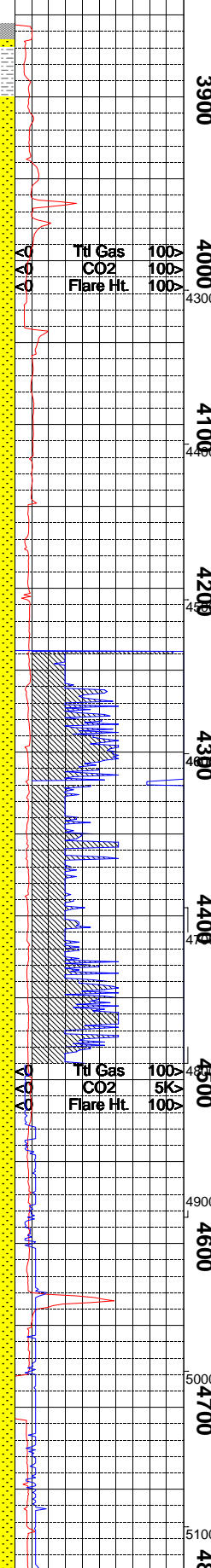
ABBREVIATIONS

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	

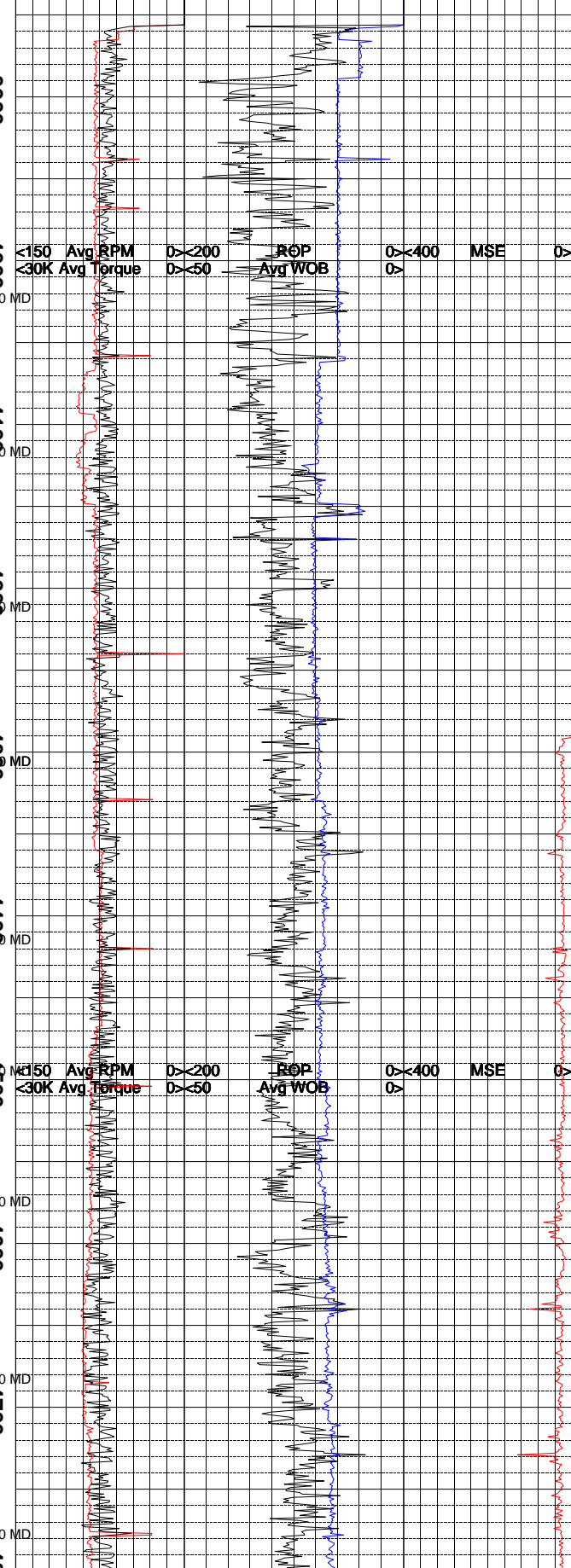
ALTERED ZONE	CHERT - GLASSY	FELSIC SILIC DIKE	MARL - CALC	SANDSTONE
ANDESITE	CHERT - PORCEL	FOSSIL	METAMORPHICS	SANDSTONE-TUFFACEOUS
ANHYDRITE	CHERT - TIGER STRIPE	GABBRO	MUDSTONE	SERICITIZATION
BASALT	CHERT - UNDIFF	GLASSY TUFF	OBSIDIAN	SERPENTINE
BENTONITE	CLAY	GRANITE	PALEOSOL	SHALE
BIOTITIZATION	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	

Lithology

Ttl Gas units
CO2 ppm
Flare Ht. ft



Depth
Avg RPM
ROP
Avg WOB
MSE



Remarks
Survey Data, Mud Reports, Other Info.

EPOCH WELL SERVICES COMMENCED LOGGING THE FRU197-33B10 WELL ON 8/06/2010 @ 4124' MD.

SHALE = VERY LIGHT GRAY TO LIGHT GRAY TO MEDIUM LIGHT GRAY; VERY SLIGHTLY DENSE TO MODERATELY BRITTLE TO MODERATELY CRUMBLY TENACITY; IRREGULAR TO SUB-BLOCKY TO EARTHY FRACTURE; OCCASIONAL MASSIVE TO WEDGE LIKE TO SUB-TABULAR CUTTINGS HABIT; DULL TO EARTHY DULL TO OCCASIONAL SEMI-WAXY TO SEMI-FROSTED LUSTER; MODERATELY SMOOTH TO SLIGHTLY CLAYEY TO VERY SLIGHTLY SILTY TEXTURE; NO VISIBLE LAMINAE OR OTHER DISTINGUISHABLE STRUCTURAL FEATURES PRESENT; NO ACCESSORY MINERALS PRESENT IN SAMPLE.

SANDSTONE = OFF WHITE TO WHITE TO VERY LIGHT GRAY WITH FEW BLACK HUES; QUARTZ DOMINATE FRAME WORK; PREDOMINATELY GRAIN SUPPORTED WITH FEW LOOSE GRAINS; CONSISTS OF CALCITIC CEMENTATION WITH MODERATELY HIGH REACTION TO DILUTE HCL; MATRIX CONTAINS 3 TO 6% DARK LITHIC FRAGMENTS; MEDIUM-COARSE TO COARSE GRAINED; FAIR TO POOR SORTING; SUB-ANGULAR TO ANGULAR TO SUB-ROUNDED ANGULARITY; LOW TO MODERATE SPHERICITY; POOR GRADE SILSTONE VERY POORLY GRADING WITH POOR GRADE SANDSTONE VISIBLE, NO OTHER DISTINGUISHABLE BEDDING OR OTHER SURFACE FEATURES PRESENT IN SAMPLE; NO ACCESSORY MINERALS PRESENT IN SAMPLE.

SILTSTONE = VERY LIGHT GRAY TO LIGHT GRAY; SLIGHTLY BRITTLE TO SLIGHTLY CRUNCHY TO VERY SLIGHTLY DENSE TENACITY; IRREGULAR TO SUB-PLANAR TO EARTHY HACKLY FRACTURE; SUB-TABULAR TO SUB-NODULAR TO SEMI-PLATY CUTTINGS HABIT; DULL TO EARTHY DULL TO OCCASIONAL SEMI-SPARKLING LUSTER; SLIGHTLY CLAYEY TO VERY SLIGHTLY GRITTY TEXTURE; NO VISIBLE STRUCTURAL FEATURES.

SHALE = MEDIUM LIGHT GRAY TO GRAYISH PURPLE TO LIGHT OLIVE BROWN; BRITTLE TENACITY; FRACTURES FROM PLANAR TO BLOCKY; CUTTINGS ARE TABULAR TO SLIGHTLY PLATY; DULL EARTHY TO SLIGHTLY WAXY LUSTER; SMOOTH TO SILTY TEXTURE WITH OCCASIONAL GRITTY TEXTURE; GRADING FROM SILTSTONE; LIGHT OLIVE BROWN PIECES TEND TO BE MORE SILTY TO SLIGHTLY GRITTY; THIN STRUCTURE.

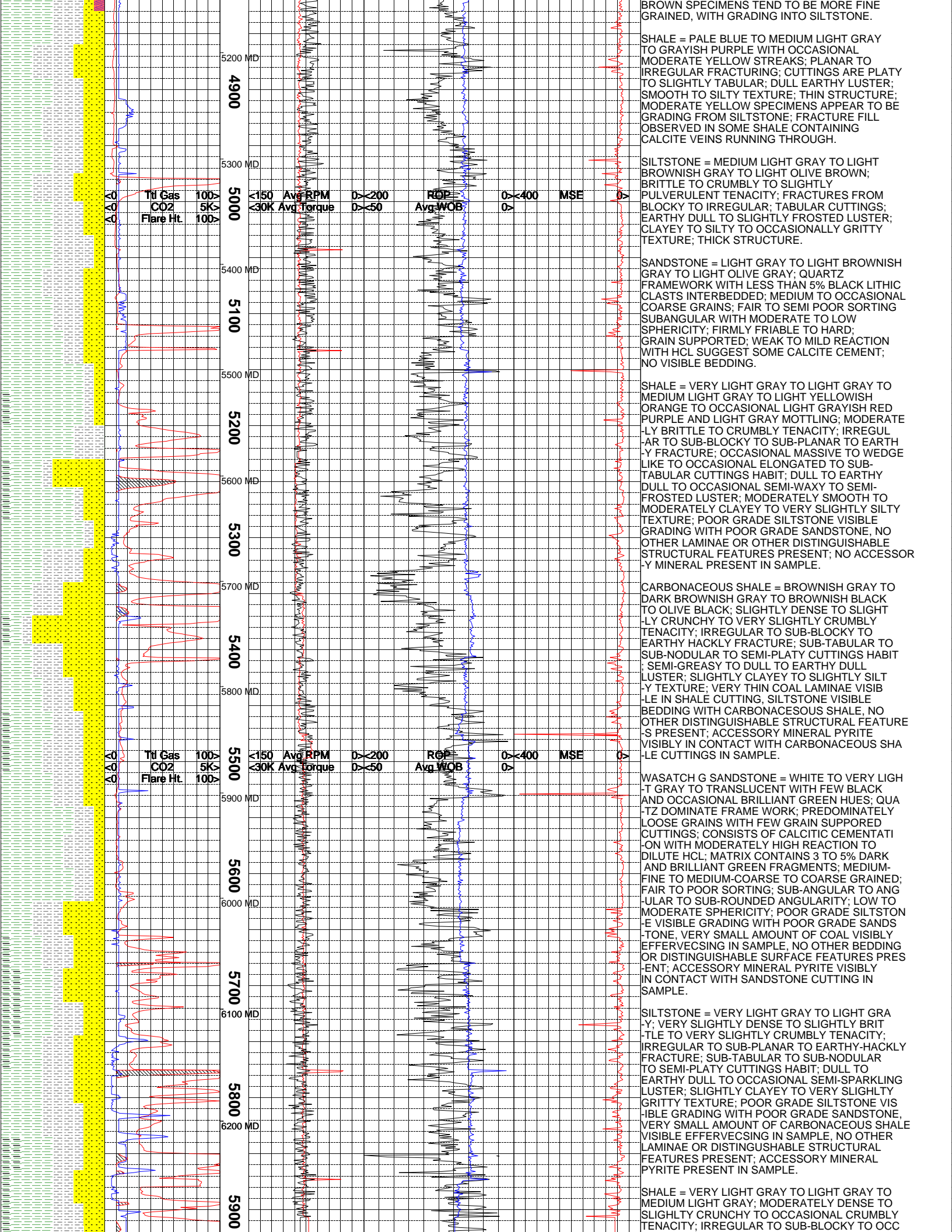
SILTSTONE = MODERATE YELLOWISH BROWN TO MODERATE OLIVE BROWN TO MEDIUM GRAY; BRITTLE TO SLIGHTLY CRUMBLY TENACITY; FRACTURES FROM MOSTLY BLOCKY TO IRREGULAR; CUTTINGS ARE TABULAR TO OCCASIONALLY MASSIVE CUTTINGS; EARTHY LUSTER; TEXTURE IS GRITTY TO SILTY; THICK TO MASSIVE STRUCTURE.

SANDSTONE = WHITE TO VERY LIGHT GRAY; QUARTZ FRAMEWORK; FINE GRAINED WITH WELL SORTING; SUBROUNDED WITH MODERATE SPHERICITY; MODERATE HARDNESS; SLIGHT TO MODERATE REACTION WITH HCL SUGGESTS CALCAREOUS CEMENT; GRAIN SUPPORTED; NO VISIBLE BEDDING; MAY BE GRADING TO SILTSTONE.

SHALE = MEDIUM LIGHT GRAY TO GRAYISH PURPLE TO MODERATE YELLOW; TENACITY IS BRITTLE TO CRUMBLY; PLANAR TO BLOCKY FRACTURING; CUTTINGS ARE PLATY TO TABULAR; WAXY TO DULL LUSTER; SILTY TO SMOOTH TEXTURE; THIN STRUCTURE.

SILTSTONE = MEDIUM GRAY TO MODERATE OLIVE BROWN; TENACITY IS CRUMBLY TO SLIGHTLY BRITTLE; BLOCKY TO IRREGULAR TO SLIGHTLY PLANAR FRACTURING; CUTTINGS ARE TABULAR; LUSTER IS DULL TO EARTHY TO OCCASIONALLY SLIGHTLY SPARKLING; GRITTY TO SILTY TO SLIGHTLY CLAYEY TEXTURE; THICK STRUCTURE.

SANDSTONE = LIGHT GRAY TO LIGHT OLIVE GRAY TO WHITE WITH OCCASIONAL TRANSLUCENCE; FINE TO MEDIUM GRAINED WITH FAIR TO WELL SORTING; SUBANGULAR TO SUBANGULAR WITH MODERATE SPHERICITY; HARD TO FIRMLY FRIABLE; MODERATE REACTION WITH HCL SUGGESTS CALCITIC CEMENT; GRAIN SUPPORTED; LIGHT OLIVE



BROWN SPECIMENS TEND TO BE MORE FINE GRAINED, WITH GRADING INTO SILTSTONE.

SHALE = PALE BLUE TO MEDIUM LIGHT GRAY TO GRAYISH PURPLE WITH OCCASIONAL MODERATE YELLOW STREAKS; PLANAR TO IRREGULAR FRACTURING; CUTTINGS ARE PLATY TO SLIGHTLY TABULAR; DULL EARTHY LUSTER; SMOOTH TO SILTY TEXTURE; THIN STRUCTURE; MODERATE YELLOW SPECIMENS APPEAR TO BE GRADING FROM SILTSTONE; FRACTURE FILL OBSERVED IN SOME SHALE CONTAINING CALCITE VEINS RUNNING THROUGH.

SILTSTONE = MEDIUM LIGHT GRAY TO LIGHT BROWNISH GRAY TO LIGHT OLIVE BROWN; BRITTLE TO CRUMBLY TO SLIGHTLY PULVERULENT TENACITY; FRACTURES FROM BLOCKY TO IRREGULAR; TABULAR CUTTINGS; EARTHY DULL TO SLIGHTLY FROSTED LUSTER; CLAYEY TO SILTY TO OCCASIONALLY GRITTY TEXTURE; THICK STRUCTURE.

SANDSTONE = LIGHT GRAY TO LIGHT BROWNISH GRAY TO LIGHT OLIVE GRAY; QUARTZ FRAMEWORK WITH LESS THAN 5% BLACK LITHIC CLASTS INTERBEDDED; MEDIUM TO OCCASIONAL COARSE GRAINS; FAIR TO SEMI POOR SORTING SUBANGULAR WITH MODERATE TO LOW SPHERICITY; FIRMLY FRIABLE TO HARD; GRAIN SUPPORTED; WEAK TO MILD REACTION WITH HCL SUGGEST SOME CALCITE CEMENT; NO VISIBLE BEDDING.

SHALE = VERY LIGHT GRAY TO LIGHT GRAY TO MEDIUM LIGHT GRAY TO LIGHT YELLOWISH ORANGE TO OCCASIONAL LIGHT GRAYISH RED PURPLE AND LIGHT GRAY MOTTLING; MODERATELY BRITTLE TO CRUMBLY TENACITY; IRREGULAR TO SUB-BLOCKY TO SUB-PLANAR TO EARTHLY FRACTURE; OCCASIONAL MASSIVE TO WEDGE LIKE TO OCCASIONAL ELONGATED TO SUB-TABULAR CUTTINGS HABIT; DULL TO EARTHY DULL TO OCCASIONAL SEMI-WAXY TO SEMI-FROSTED LUSTER; MODERATELY SMOOTH TO MODERATELY CLAYEY TO VERY SLIGHTLY SILTY TEXTURE; POOR GRADE SILTSTONE VISIBLE GRADING WITH POOR GRADE SANDSTONE. NO OTHER LAMINAE OR OTHER DISTINGUISHABLE STRUCTURAL FEATURES PRESENT; NO ACCESSORY MINERAL PRESENT IN SAMPLE.

CARBONACEOUS SHALE = BROWNISH GRAY TO DARK BROWNISH GRAY TO BROWNISH BLACK TO OLIVE BLACK; SLIGHTLY DENSE TO SLIGHTLY CRUNCHY TO VERY SLIGHTLY CRUMBLY TENACITY; IRREGULAR TO SUB-BLOCKY TO EARTHY HACKLY FRACTURE; SUB-TABULAR TO SUB-NODULAR TO SEMI-PLATY CUTTINGS HABIT; SEMI-GREASY TO DULL TO EARTHY DULL LUSTER; SLIGHTLY CLAYEY TO SLIGHTLY SILTY TEXTURE; VERY THIN COAL LAMINAE VISIBLE IN SHALE CUTTING, SILTSTONE VISIBLE BEDDING WITH CARBONACEOUS SHALE, NO OTHER DISTINGUISHABLE STRUCTURAL FEATURES PRESENT; ACCESSORY MINERAL PYRITE VISIBLY IN CONTACT WITH CARBONACEOUS SHALE CUTTINGS IN SAMPLE.

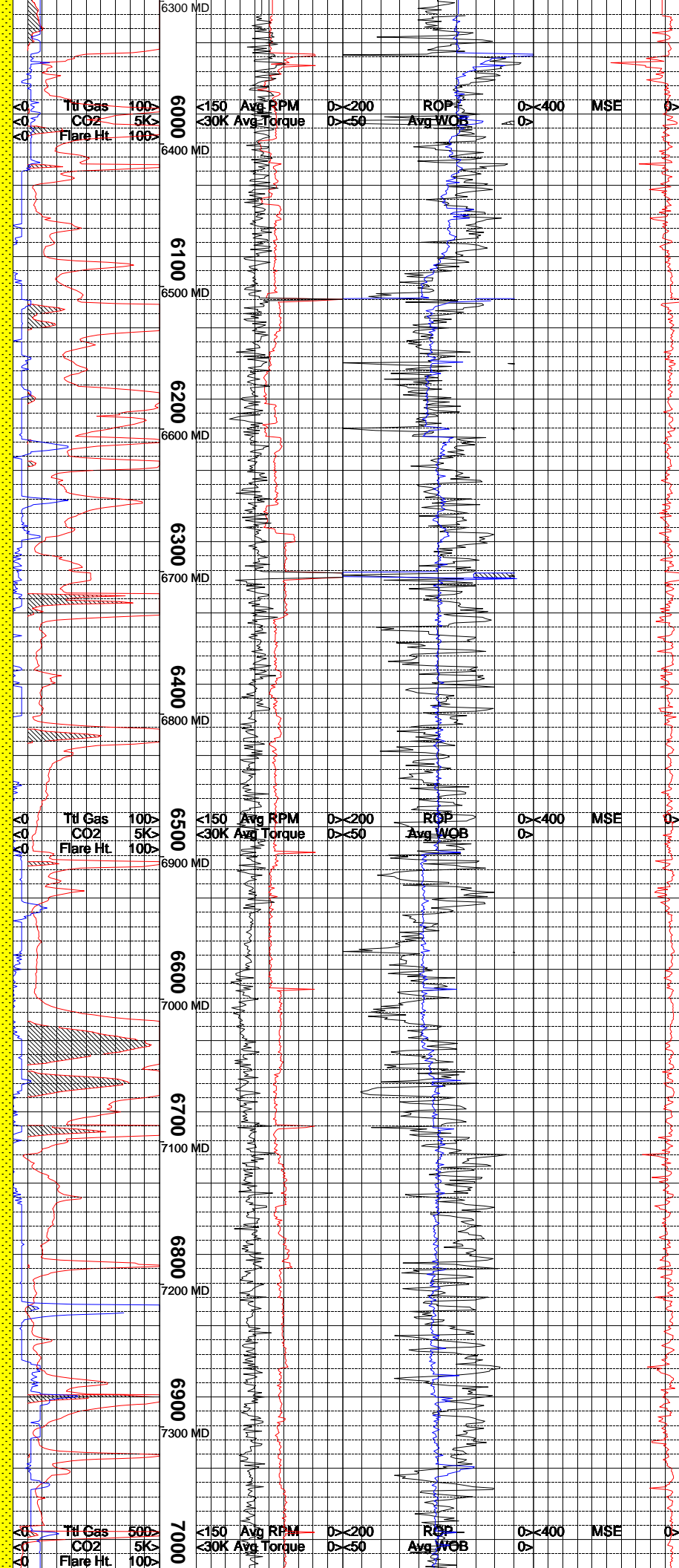
WASATCH G SANDSTONE = WHITE TO VERY LIGHT GRAY TO TRANSLUCENT WITH FEW BLACK AND OCCASIONAL BRILLIANT GREEN HUES; QUARTZ DOMINATE FRAMEWORK; PREDOMINATELY LOOSE GRAINS WITH FEW GRAIN SUPPORTED CUTTINGS; CONSISTS OF CALCITIC CEMENTATION WITH MODERATELY HIGH REACTION TO DILUTE HCL; MATRIX CONTAINS 3 TO 5% DARK AND BRILLIANT GREEN FRAGMENTS; MEDIUM-FINE TO MEDIUM-COARSE TO COARSE GRAINED; FAIR TO POOR SORTING; SUB-ANGULAR TO ANGULAR TO SUB-ROUNDED ANGULARITY; LOW TO MODERATE SPHERICITY; POOR GRADE SILTSTONE VISIBLE GRADING WITH POOR GRADE SANDSTONE. VERY SMALL AMOUNT OF COAL VISIBLY EFFERVESCING IN SAMPLE, NO OTHER BEDDING OR DISTINGUISHABLE SURFACE FEATURES PRESENT; ACCESSORY MINERAL PYRITE VISIBLY IN CONTACT WITH SANDSTONE CUTTING IN SAMPLE.

SILTSTONE = VERY LIGHT GRAY TO LIGHT GRAY; VERY SLIGHTLY DENSE TO SLIGHTLY BRITTLE TO VERY SLIGHTLY CRUMBLY TENACITY; IRREGULAR TO SUB-PLANAR TO EARTHY-HACKLY FRACTURE; SUB-TABULAR TO SUB-NODULAR TO SEMI-PLATY CUTTINGS HABIT; DULL TO EARTHY DULL TO OCCASIONAL SEMI-SPARKLING LUSTER; SLIGHTLY CLAYEY TO VERY SLIGHTLY GRITTY TEXTURE; POOR GRADE SILTSTONE VISIBLE GRADING WITH POOR GRADE SANDSTONE, VERY SMALL AMOUNT OF CARBONACEOUS SHALE VISIBLY EFFERVESCING IN SAMPLE, NO OTHER LAMINAE OR DISTINGUISHABLE STRUCTURAL FEATURES PRESENT; ACCESSORY MINERAL PYRITE PRESENT IN SAMPLE.

SHALE = VERY LIGHT GRAY TO LIGHT GRAY TO MEDIUM LIGHT GRAY; MODERATELY DENSE TO SLIGHTLY CRUNCHY TO OCCASIONAL CRUMBLY TENACITY; IRREGULAR TO SUB-BLOCKY TO OCCASIONAL

100% Td Gas
 5K CO2
 100% Flare Ht
 <150 Avg RPM
 <30K Avg Torque
 >200 >50
 ROF Avg WOB
 >400 >

100% Td Gas
 5K CO2
 100% Flare Ht
 <150 Avg RPM
 <30K Avg Torque
 >200 >50
 ROF Avg WOB
 >400 >



ASIONAL SUB-PLANAR FRACTURE; MASSIVE TO WEDGE LIKE TO OCCASIONAL ELONGATED CUTTINGS HABIT; DULL TO EARTHY DULL TO OCCASIONAL SEMI-FROSTED TO SEMI-WAXY LUSTER; MODERATELY SMOOTH TO SLIGHTLY CLAYEY TO VERY SLIGHTLY SILTY TEXTURE; VERY SMALL AMOUNT OF COAL BEDDING CONTACT VISIBLE WITH SHALE CUTTING, VERY SMALL AMOUNT OF CARBONACEOUS SHALE VISIBLE EFFERVESCING IN SAMPLE, NO OTHER DISTINGUISHABLE STRUCTURAL FEATURES PRESENT.

NOTE = TRIPPED OUT OF THE HOLE AT 6335' MD TO LAY DOWN DIRECTIONAL TOOLS.

CARBONACEOUS SHALE = BROWNISH GRAY TO DARK BROWNISH GRAY TO BROWNISH BLACK TO OLIVE BLACK; MODERATELY DENSE TO SLIGHTLY CRUNCHY TO VERY SLIGHTLY BRITTLE TENACITY; IRREGULAR TO SUB-BLOCKY TO SUB-PLANAR TO EARTHY-HACKLY FRACTURE; OCCASIONAL MASSIVE TO WEDGE LIKE TO OCCASIONAL ELONGATED TO SUB-TABULAR TO SUB-NODULAR CUTTINGS HABIT; DULL TO EARTHY DULL TO OCCASIONAL SEMI-SPARKLING LUSTER; SLIGHTLY CLAYEY TO VERY SLIGHTLY GRITTY TEXTURE; VERY THIN COAL LAMINAE VISIBLE IN SHALE CUTTING, CARBONACEOUS SHALE VISIBLE BEDDING WITH SANDSTONE, NO OTHER STRUCTURAL FEATURES PRESENT IN SAMPLE; ACCESSORY MINERAL PYRITE PRESENT IN SAMPLE.

SANDSTONE = OFF WHITE TO WHITE TO VERY LIGHT YELLOWISH GRAY WITH FEW BLACK HUES; QUARTZ DOMINATE FRAME WORK; PREDOMINANTLY GRAIN SUPPORTED WITH FEW LOOSE GRAINS; CONSISTS OF CALCITIC CEMENTATION WITH MODERATELY HIGH REACTION TO DILUTE HCL; MATRIX CONTAINS 1 TO 3% DARK LITHIC FRAGMENTS; MEDIUM-COARSE TO VERY COARSE GRAINED; FAIR TO POOR SORTING; SUB-ANGULAR TO ANGULAR TO SUB-ROUNDED ANGULARITY; LOW TO MODERATE SPHERICITY; POOR GRADE SILTSTONE VISIBLE SPHERING WITH POOR GRADE SANDSTONE, CARBONACEOUS SHALE CUTTING VISIBLE BEDDING WITH POOR GRADE SANDSTONE, NO OTHER BEDDING OR OTHER DISTINGUISHABLE SURFACE FEATURES PRESENT IN SAMPLE; ACCESSORY MINERAL PYRITE PRESENT IN SAMPLE.

SILTSTONE = VERY LIGHT GRAY TO LIGHT GRAY TO OCCASIONAL MEDIUM LIGHT GRAY; 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; VERY SLIGHTLY CLAYEY TO VERY SLIGHTLY GRITTY TO VERY SLIGHTLY GRANULAR TEXTURE; POOR GRADE SANDSTONE VISIBLE GRADING WITH POOR GRADE SILTSTONE, POOR GRADE SANDSTONE VISIBLE BEDDING WITH POOR GRADE CARBONACEOUS SHALE, NO OTHER LAMINAE OR OTHER DISTINGUISHABLE STRUCTURAL FEATURES PRESENT; ACCESSORY MINERAL PYRITE PRESENT IN SAMPLE.

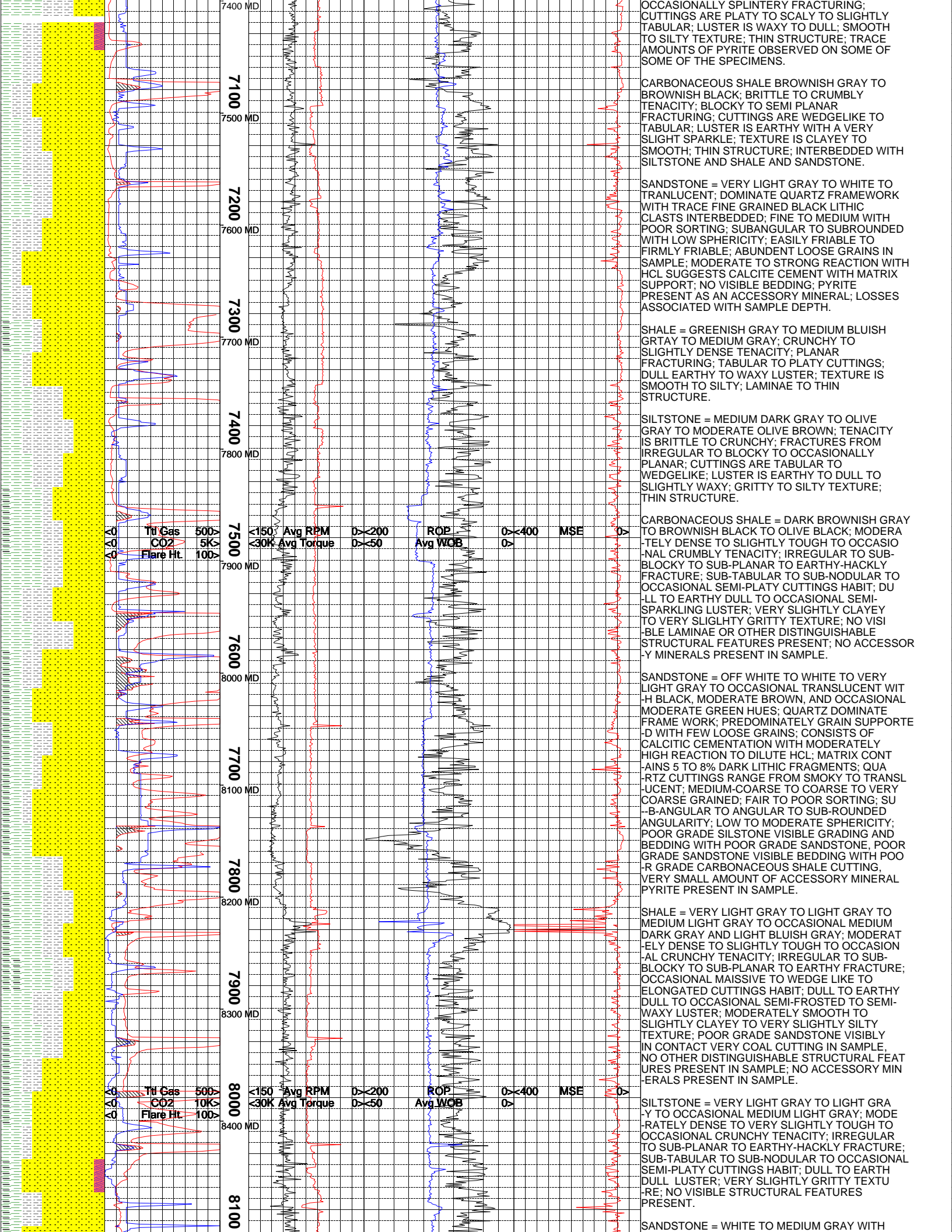
CARBONACEOUS SHALE = BROWNISH BLACK TO GRAYISH BLACK TO BROWNISH GRAY; BRITTLE TO SLIGHTLY CRUMBLY TENACITY; PLANAR TO SLIGHTLY BLOCKY FRACTURING; CUTTINGS ARE WEDGE LIKE TO TABULAR; EARTHY TO DULL TO SLIGHTLY GREASY LUSTER; SILTY TO CLAYEY TEXTURE; THIN STRUCTURE.

SHALE = MEDIUM GRAY TO MEDIUM BLUISH GRAY TO GREENISH GRAY; BRITTLE TO CRUNCHY TENACITY; FRACTURES FROM PLANAR TO SLIGHTLY SPLINTERY; CUTTINGS RANGE FROM PLATY TO TABULAR; WAXY DULL LUSTER; TEXTURE IS SMOOTH TO SILTY; LAMINAE TO THIN STRUCTURE.

SANDSTONE = VERY LIGHT GRAY TO MEDIUM GRAY WITH OCCASIONAL LIGHT BROWNISH GRAY HUES; QUARTZ FRAMEWORK; FINE TO MEDIUM FINE GRAINED WITH FAIR TO SEMI WELL SORTING; SUB-ROUNDED TO SUBANGULAR WITH MODERATE SPHERICITY; MODERATE HARDNESS; GRAIN SUPPORTED; MILD REACTION WITH HCL SUGGESTS SOME CALCAREOUS CEMENT; NO VISIBLE BEDDING; TRACE AMOUNTS OF PYRITE IN SAMPLE AS AN ACCESSORY.

SILTSTONE = BROWNISH GRAY TO MEDIUM DARK GRAY WITH OCCASIONAL GREENISH GRAY HUES; TENACITY IS DENSE TO BRITTLE; FRACTURES FROM IRREGULAR TO SLIGHTLY BLOCKY; CUTTINGS ARE TABULAR TO SLIGHTLY MASSIVE EARTHY TO FROSTED LUSTER; TEXTURE IS GRITTY TO SILTY TO OCCASIONALLY CLAYEY; THICK STRUCTURE; CAN BE SEEN GRADING TO SHALE.

SHALE = MEDIUM GRAY TO PALE BLUE TO GREENISH GRAY; TENACITY IS CRUNCHY TO BRITTLE; IRREGULAR TO PLANAR TO



OCCASIONALLY SPLINTERY FRACTURING; CUTTINGS ARE PLATY TO SCALY TO SLIGHTLY TABULAR; LUSTER IS WAXY TO DULL; SMOOTH TO SILTY TEXTURE; THIN STRUCTURE; TRACE AMOUNTS OF PYRITE OBSERVED ON SOME OF SOME OF THE SPECIMENS.

CARBONACEOUS SHALE BROWNISH GRAY TO BROWNISH BLACK; BRITTLE TO CRUMBLY TENACITY; BLOCKY TO SEMI PLANAR FRACTURING; CUTTINGS ARE WEDGELIKE TO TABULAR; LUSTER IS EARTHY WITH A VERY SLIGHT SPARKLE; TEXTURE IS CLAYEY TO SMOOTH; THIN STRUCTURE; INTERBEDDED WITH SILTSTONE AND SHALE AND SANDSTONE.

SANDSTONE = VERY LIGHT GRAY TO WHITE TO TRANLUCENT; DOMINATE QUARTZ FRAMEWORK WITH TRACE FINE GRAINED BLACK LITHIC CLASTS INTERBEDDED; FINE TO MEDIUM WITH POOR SORTING; SUBANGULAR TO SUBROUNDED WITH LOW SPHERICITY; EASILY FRIABLE TO FIRMLY FRIABLE; ABUNDENT LOOSE GRAINS IN SAMPLE; MODERATE TO STRONG REACTION WITH HCL SUGGESTS CALCITE CEMENT WITH MATRIX SUPPORT; NO VISIBLE BEDDING; PYRITE PRESENT AS AN ACCESSORY MINERAL; LOSSES ASSOCIATED WITH SAMPLE DEPTH.

SHALE = GREENISH GRAY TO MEDIUM BLUISH GRAY TO MEDIUM GRAY; CRUNCHY TO SLIGHTLY DENSE TENACITY; PLANAR FRACTURING; TABULAR TO PLATY CUTTINGS; DULL EARTHY TO WAXY LUSTER; TEXTURE IS SMOOTH TO SILTY; LAMINAE TO THIN STRUCTURE.

SILTSTONE = MEDIUM DARK GRAY TO OLIVE GRAY TO MODERATE OLIVE BROWN; TENACITY IS BRITTLE TO CRUNCHY; FRACTURES FROM IRREGULAR TO BLOCKY TO OCCASIONALLY PLANAR; CUTTINGS ARE TABULAR TO WEDGELIKE; LUSTER IS EARTHY TO DULL TO SLIGHTLY WAXY; GRITTY TO SILTY TEXTURE; THIN STRUCTURE.

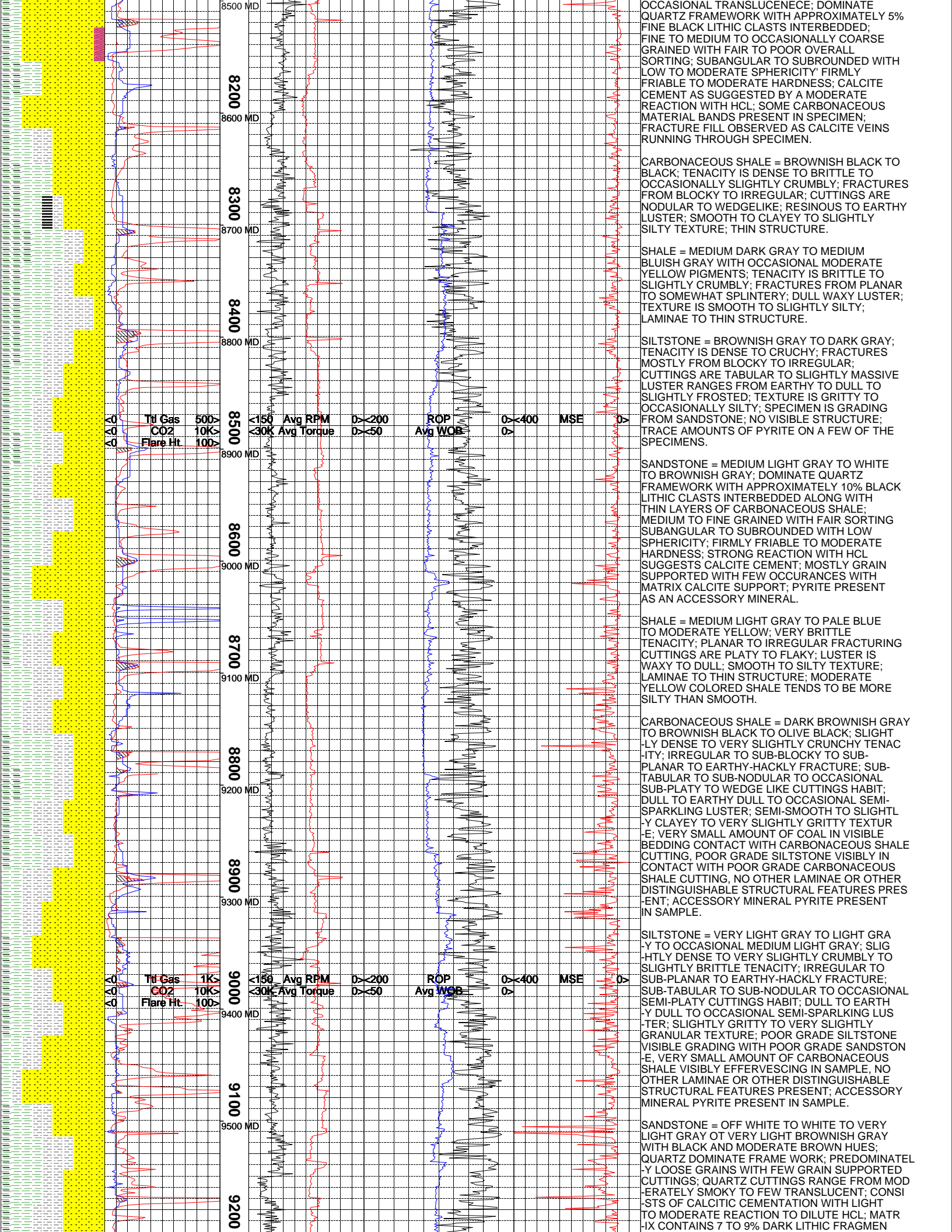
CARBONACEOUS SHALE = DARK BROWNISH GRAY TO BROWNISH BLACK TO OLIVE BLACK; MODERATELY DENSE TO SLIGHTLY TOUGH TO OCCASIONAL CRUMBLY TENACITY; IRREGULAR TO SUB-BLOCKY TO SUB-PLANAR TO EARTHY-HACKLY FRACTURE; SUB-TABULAR TO SUB-NODULAR TO OCCASIONAL SEMI-PLATY CUTTINGS HABIT; DULL TO EARTHY DULL TO OCCASIONAL SEMI-SPARKLING LUSTER; VERY SLIGHTLY CLAYEY TO VERY SLIGHTLY GRITTY TEXTURE; NO VISIBLE LAMINAE OR OTHER DISTINGUISHABLE STRUCTURAL FEATURES PRESENT; NO ACCESSORY MINERALS PRESENT IN SAMPLE.

SANDSTONE = OFF WHITE TO WHITE TO VERY LIGHT GRAY TO OCCASIONAL TRANSLUCENT WITH BLACK, MODERATE BROWN, AND OCCASIONAL MODERATE GREEN HUES; QUARTZ DOMINATE FRAMEWORK; PREDOMINATELY GRAIN SUPPORTED WITH FEW LOOSE GRAINS; CONSISTS OF CALCITIC CEMENTATION WITH MODERATELY HIGH REACTION TO DILUTE HCL; MATRIX CONTAINS 5 TO 8% DARK LITHIC FRAGMENTS; QUARTZ CUTTINGS RANGE FROM SMOKY TO TRANSLUCENT; MEDIUM-COARSE TO COARSE TO VERY COARSE GRAINED; FAIR TO POOR SORTING; SUB-ANGULAR TO ANGULAR TO SUB-ROUNDED ANGULARITY; LOW TO MODERATE SPHERICITY; POOR GRADE SILTSTONE VISIBLE GRADING AND BEDDING WITH POOR GRADE SANDSTONE, POOR GRADE SANDSTONE VISIBLE BEDDING WITH POOR GRADE CARBONACEOUS SHALE CUTTING, VERY SMALL AMOUNT OF ACCESSORY MINERAL PYRITE PRESENT IN SAMPLE.

SHALE = VERY LIGHT GRAY TO LIGHT GRAY TO MEDIUM LIGHT GRAY TO OCCASIONAL MEDIUM DARK GRAY AND LIGHT BLUISH GRAY; MODERATELY DENSE TO SLIGHTLY TOUGH TO OCCASIONAL CRUNCHY TENACITY; IRREGULAR TO SUB-BLOCKY TO SUB-PLANAR TO EARTHY FRACTURE; OCCASIONAL MAISSIVE TO WEDGE LIKE TO ELONGATED CUTTINGS HABIT; DULL TO EARTHY DULL TO OCCASIONAL SEMI-FROSTED TO SEMI-WAXY LUSTER; MODERATELY SMOOTH TO SLIGHTLY CLAYEY TO VERY SLIGHTLY SILTY TEXTURE; POOR GRADE SANDSTONE VISIBLY IN CONTACT VERY COAL CUTTING IN SAMPLE, NO OTHER DISTINGUISHABLE STRUCTURAL FEATURES PRESENT IN SAMPLE; NO ACCESSORY MINERALS PRESENT IN SAMPLE.

SILTSTONE = VERY LIGHT GRAY TO LIGHT GRAY TO OCCASIONAL MEDIUM LIGHT GRAY; MODERATELY DENSE TO VERY SLIGHTLY TOUGH TO OCCASIONAL CRUNCHY 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 EARTHY DULL TO EARTHY DULL LUSTER; VERY SLIGHTLY GRITTY TEXTURE; NO VISIBLE STRUCTURAL FEATURES PRESENT.

SANDSTONE = WHITE TO MEDIUM GRAY WITH



OCCASIONAL TRANSLUCENCE; DOMINATE QUARTZ FRAMEWORK WITH APPROXIMATELY 5% FINE BLACK LITHIC CLASTS INTERBEDDED; FINE TO MEDIUM TO OCCASIONALLY COARSE GRAINED WITH FAIR TO POOR OVERALL SORTING; SUBANGULAR TO SUBROUNDED WITH LOW TO MODERATE SPHERICITY; FIRMLY FRIABLE TO MODERATE HARDNESS; CALCITE CEMENT AS SUGGESTED BY A MODERATE REACTION WITH HCL; SOME CARBONACEOUS MATERIAL BANDS PRESENT IN SPECIMEN; FRACTURE FILL OBSERVED AS CALCITE VEINS RUNNING THROUGH SPECIMEN.

CARBONACEOUS SHALE = BROWNISH BLACK TO BLACK; TENACITY IS DENSE TO BRITTLE TO OCCASIONALLY SLIGHTLY CRUMBLY; FRACTURES FROM BLOCKY TO IRREGULAR; CUTTINGS ARE NODULAR TO WEDGELIKE; RESINOUS TO EARTHY LUSTER; SMOOTH TO CLAYEY TO SLIGHTLY SILTY TEXTURE; THIN STRUCTURE.

SHALE = MEDIUM DARK GRAY TO MEDIUM BLuish GRAY WITH OCCASIONAL MODERATE YELLOW PIGMENTS; TENACITY IS BRITTLE TO SLIGHTLY CRUMBLY; FRACTURES FROM PLANAR TO SOMEWHAT SPLINTERY; DULL WAXY LUSTER; TEXTURE IS SMOOTH TO SLIGHTLY SILTY; LAMINAE TO THIN STRUCTURE.

SILTSTONE = BROWNISH GRAY TO DARK GRAY; TENACITY IS DENSE TO CRUCHY; FRACTURES MOSTLY FROM BLOCKY TO IRREGULAR; CUTTINGS ARE TABULAR TO SLIGHTLY MASSIVE LUSTER RANGES FROM EARTHY TO DULL TO SLIGHTLY FROSTED; TEXTURE IS GRITTY TO OCCASIONALLY SILTY; SPECIMEN IS GRADING FROM SANDSTONE; NO VISIBLE STRUCTURE; TRACE AMOUNTS OF PYRITE ON A FEW OF THE SPECIMENS.

SANDSTONE = MEDIUM LIGHT GRAY TO WHITE TO BROWNISH GRAY; DOMINATE QUARTZ FRAMEWORK WITH APPROXIMATELY 10% BLACK LITHIC CLASTS INTERBEDDED ALONG WITH THIN LAYERS OF CARBONACEOUS SHALE; MEDIUM TO FINE GRAINED WITH FAIR SORTING SUBANGULAR TO SUBROUNDED WITH LOW SPHERICITY; FIRMLY FRIABLE TO MODERATE HARDNESS; STRONG REACTION WITH HCL SUGGESTS CALCITE CEMENT; MOSTLY GRAIN SUPPORTED WITH FEW OCCURANCES WITH MATRIX CALCITE SUPPORT; PYRITE PRESENT AS AN ACCESSORY MINERAL.

SHALE = MEDIUM LIGHT GRAY TO PALE BLUE TO MODERATE YELLOW; VERY BRITTLE TENACITY; PLANAR TO IRREGULAR FRACTURING CUTTINGS ARE PLATY TO FLAKY; LUSTER IS WAXY TO DULL; SMOOTH TO SILTY TEXTURE; LAMINAE TO THIN STRUCTURE; MODERATE YELLOW COLORED SHALE TENDS TO BE MORE SILTY THAN SMOOTH.

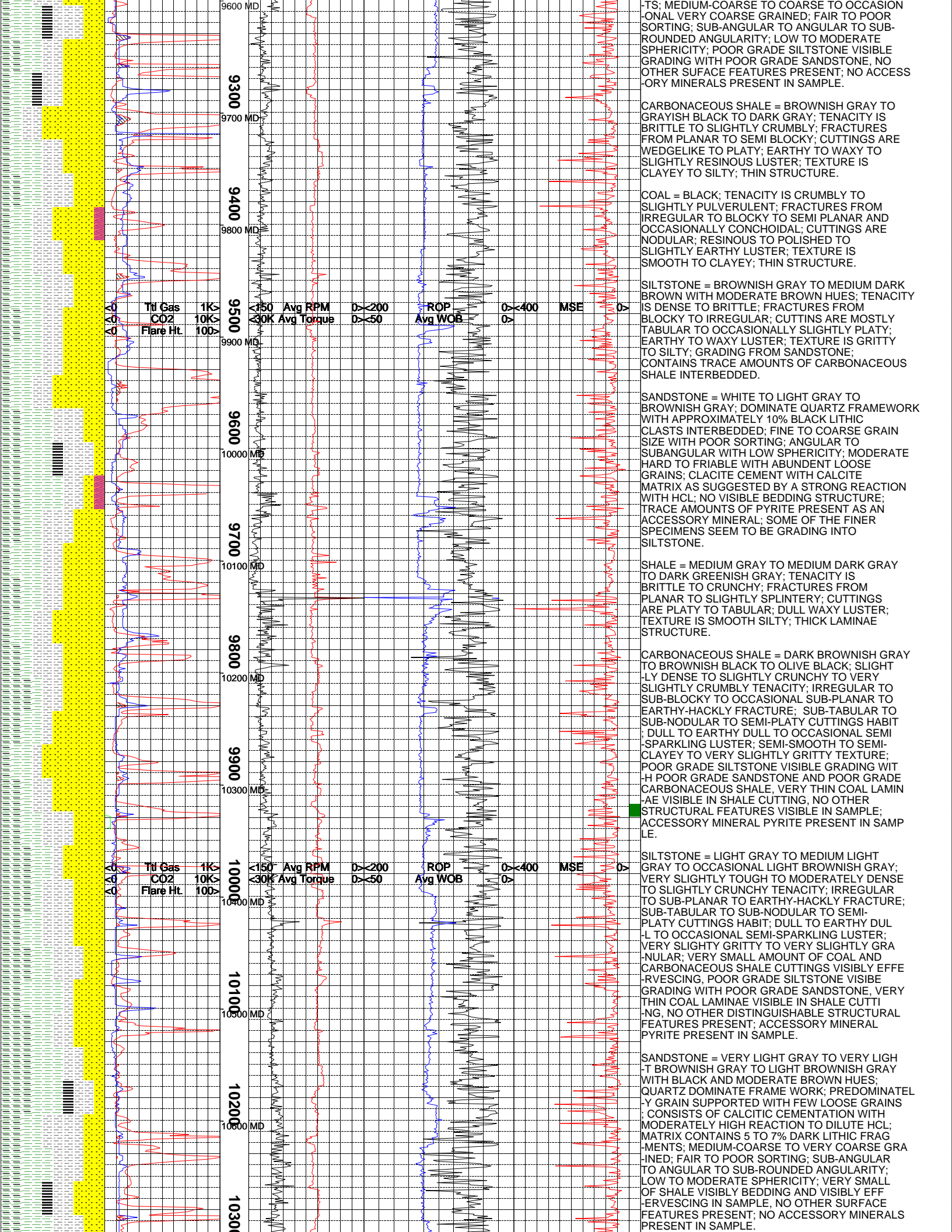
CARBONACEOUS SHALE = DARK BROWNISH GRAY TO BROWNISH BLACK TO OLIVE BLACK; SLIGHTLY DENSE TO VERY SLIGHTLY CRUNCHY TENACITY; IRREGULAR TO SUB-BLOCKY TO SUB-PLANAR TO EARTHY-HACKLY FRACTURE; SUB-TABULAR TO SUB-NODULAR TO OCCASIONAL SUB-PLATY TO WEDGE LIKE CUTTINGS HABIT; DULL TO EARTHY DULL TO OCCASIONAL SEMI-SPARKLING LUSTER; SEMI-SMOOTH TO SLIGHTLY CLAYEY TO VERY SLIGHTLY GRITTY TEXTURE; VERY SMALL AMOUNT OF COAL IN VISIBLE BEDDING CONTACT WITH CARBONACEOUS SHALE CUTTING, POOR GRADE SILTSTONE VISIBLY IN CONTACT WITH POOR GRADE CARBONACEOUS SHALE CUTTING, NO OTHER LAMINAE OR OTHER DISTINGUISHABLE STRUCTURAL FEATURES PRESENT; ACCESSORY MINERAL PYRITE PRESENT IN SAMPLE.

SILTSTONE = VERY LIGHT GRAY TO LIGHT GRAY TO OCCASIONAL MEDIUM LIGHT GRAY; SLIGHTLY DENSE TO VERY SLIGHTLY CRUMBLY TO 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 GRITTY TO VERY SLIGHTLY GRANULAR TEXTURE; POOR GRADE SILTSTONE VISIBLY GRADING WITH POOR GRADE SANDSTONE; VERY SMALL AMOUNT OF CARBONACEOUS SHALE VISIBLY EFFERVESCING IN SAMPLE, NO OTHER LAMINAE OR OTHER DISTINGUISHABLE STRUCTURAL FEATURES PRESENT; ACCESSORY MINERAL PYRITE PRESENT IN SAMPLE.

SANDSTONE = OFF WHITE TO WHITE TO VERY LIGHT GRAY TO VERY LIGHT BROWNISH GRAY WITH BLACK AND MODERATE BROWN HUES; QUARTZ DOMINATE FRAME WORK; PREDOMINATELY LOOSE GRAINS WITH FEW GRAIN SUPPORTED CUTTINGS; QUARTZ CUTTINGS RANGE FROM MODERATELY SMOKY TO FEW TRANSLUCENT; CONSISTS OF CALCITIC CEMENTATION WITH LIGHT TO MODERATE REACTION TO DILUTE HCL; MATRIX CONTAINS 7 TO 9% DARK LITHIC FRAGMENT

Ttl Gas 500K
 CO2 10K
 Flare Ht 100K
 Avg RPM ≤ 150 ≥ 200
 Avg Torque $\le 30K$ ≥ 50
 ROP ≤ 200 ≥ 50
 Avg WOB ≤ 400 ≥ 0
 MSE ≤ 0 ≥ 0

Ttl Gas 1K
 CO2 10K
 Flare Ht 100K
 Avg RPM ≤ 150 ≥ 200
 Avg Torque $\le 30K$ ≥ 50
 ROP ≤ 200 ≥ 50
 Avg WOB ≤ 400 ≥ 0
 MSE ≤ 0 ≥ 0



-TS: MEDIUM-COARSE TO COARSE TO OCCASION-
ONAL VERY COARSE GRAINED; FAIR TO POOR
SORTING; SUB-ANGULAR TO ANGULAR TO SUB-
ROUNDED ANGULARITY; LOW TO MODERATE
SPHERICITY; POOR GRADE SILTSTONE VISIBLE
GRADING WITH POOR GRADE SANDSTONE, NO
OTHER SUFACE FEATURES PRESENT; NO ACCESS-
ORY MINERALS PRESENT IN SAMPLE.

CARBONACEOUS SHALE = BROWNISH GRAY TO
GRAYISH BLACK TO DARK GRAY; TENACITY IS
BRITTLE TO SLIGHTLY CRUMBLY; FRACTURES
FROM PLANAR TO SEMI BLOCKY; CUTTINGS ARE
WEDGELIKE TO PLATY; EARTHY TO WAXY TO
SLIGHTLY RESINOUS LUSTER; TEXTURE IS
CLAYEY TO SILTY; THIN STRUCTURE.

COAL = BLACK; TENACITY IS CRUMBLY TO
SLIGHTLY PULVERULENT; FRACTURES FROM
IRREGULAR TO BLOCKY TO SEMI PLANAR AND
OCCASIONALLY CONCHOIDAL; CUTTINGS ARE
NODULAR; RESINOUS TO POLISHED TO
SLIGHTLY EARTHY LUSTER; TEXTURE IS
SMOOTH TO CLAYEY; THIN STRUCTURE.

SILTSTONE = BROWNISH GRAY TO MEDIUM DARK
BROWN WITH MODERATE BROWN HUES; TENACITY
IS DENSE TO BRITTLE; FRACTURES FROM
BLOCKY TO IRREGULAR; CUTTINGS ARE MOSTLY
TABULAR TO OCCASIONALLY SLIGHTLY PLATY;
EARTHY TO WAXY LUSTER; TEXTURE IS GRITTY
TO SILTY; GRADING FROM SANDSTONE;
CONTAINS TRACE AMOUNTS OF CARBONACEOUS
SHALE INTERBEDDED.

SANDSTONE = WHITE TO LIGHT GRAY TO
BROWNISH GRAY; DOMINATE QUARTZ FRAMEWORK
WITH APPROXIMATELY 10% BLACK LITHIC
CLASTS INTERBEDDED; FINE TO COARSE GRAIN
SIZE WITH POOR SORTING; ANGULAR TO
SUBANGULAR WITH LOW SPHERICITY; MODERATE
HARD TO FRIABLE WITH ABUNDENT LOOSE
GRAINS; CLACITE CEMENT WITH CALCITE
MATRIX AS SUGGESTED BY A STRONG REACTION
WITH HCL; NO VISIBLE BEDDING STRUCTURE;
TRACE AMOUNTS OF PYRITE PRESENT AS AN
ACCESSORY MINERAL; SOME OF THE FINER
SPECIMENS SEEM TO BE GRADING INTO
SILTSTONE.

SHALE = MEDIUM GRAY TO MEDIUM DARK GRAY
TO DARK GREENISH GRAY; TENACITY IS
BRITTLE TO CRUNCHY; FRACTURES FROM
PLANAR TO SLIGHTLY SPLINTERY; CUTTINGS
ARE PLATY TO TABULAR; DULL WAXY LUSTER;
TEXTURE IS SMOOTH SILTY; THICK LAMINAE
STRUCTURE.

CARBONACEOUS SHALE = DARK BROWNISH GRAY
TO BROWNISH BLACK TO OLIVE BLACK; SLIGHT-
LY DENSE TO SLIGHTLY CRUNCHY TO VERY
SLIGHTLY CRUMBLY TENACITY; IRREGULAR TO
SUB-BLOCKY TO OCCASIONAL SUB-PLANAR TO
EARTHY-HACKLY FRACTURE; SUB-TABULAR TO
SUB-NODULAR TO SEMI-PLATY CUTTINGS HABIT
; DULL TO EARTHY DULL TO OCCASIONAL SEMI-
SPARKLING LUSTER; SEMI-SMOOTH TO SEMI-
CLAYEY TO VERY SLIGHTLY GRITTY TEXTURE;
POOR GRADE SILTSTONE VISIBLE GRADING WIT-
H POOR GRADE SANDSTONE AND POOR GRADE
CARBONACEOUS SHALE, VERY THIN COAL LAMIN-
AE VISIBLE IN SHALE CUTTING, NO OTHER
STRUCTURAL FEATURES VISIBLE IN SAMPLE;
ACCESSORY MINERAL PYRITE PRESENT IN SAMP-
LE.

SILTSTONE = LIGHT GRAY TO MEDIUM LIGHT
GRAY TO OCCASIONAL LIGHT BROWNISH GRAY;
VERY SLIGHTLY TOUGH TO MODERATELY DENSE
TO SLIGHTLY CRUNCHY TENACITY; IRREGULAR
TO SUB-PLANAR TO EARTHY-HACKLY FRACTURE;
SUB-TABULAR TO SUB-NODULAR TO SEMI-
PLATY CUTTINGS HABIT; DULL TO EARTHY DUL-
L TO OCCASIONAL SEMI-SPARKLING LUSTER;
VERY SLIGHTY GRITTY TO VERY SLIGHTLY GRA-
NULAR; VERY SMALL AMOUNT OF COAL AND
CARBONACEOUS SHALE CUTTINGS VISIBLY EFFE-
RVERSCING, POOR GRADE SILTSTONE VISIBE
GRADING WITH POOR GRADE SANDSTONE, VERY
THIN COAL LAMINAE VISIBLE IN SHALE CUTTI-
NG, NO OTHER DISTINGUISHABLE STRUCTURAL
FEATURES PRESENT; ACCESSORY MINERAL
PYRITE PRESENT IN SAMPLE.

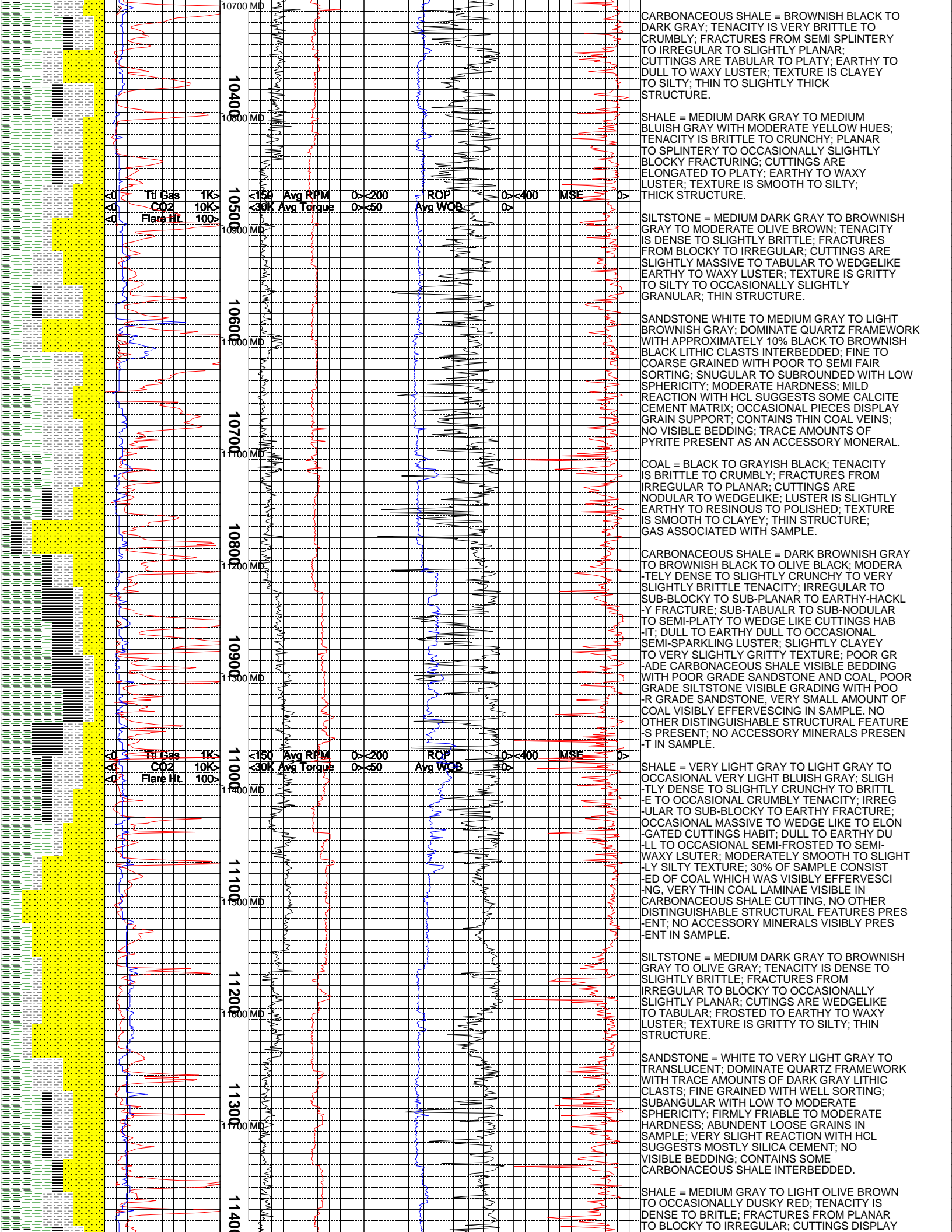
SANDSTONE = VERY LIGHT GRAY TO VERY LIGH-
T BROWNISH GRAY TO LIGHT BROWNISH GRAY
WITH BLACK AND MODERATE BROWN HUES;
QUARTZ DOMINATE FRAME WORK; PREDOMINATEL
-Y GRAIN SUPPORTED WITH FEW LOOSE GRAINS
; CONSISTS OF CALCITIC CEMENTATION WITH
MODERATELY HIGH REACTION TO DILUTE HCL;
MATRIX CONTAINS 5 TO 7% DARK LITHIC FRAG-
-MENTS; MEDIUM-COARSE TO VERY COARSE GRA-
-INED; FAIR TO POOR SORTING; SUB-ANGULAR
TO ANGULAR TO SUB-ROUNDED ANGULARITY;
LOW TO MODERATE SPHERICITY; VERY SMALL
OF SHALE VISIBLY BEDDING AND VISIBLY EFF-
-VERSCING IN SAMPLE; NO OTHER SURFACE
FEATURES PRESENT; NO ACCESSORY MINERALS
PRESENT IN SAMPLE.

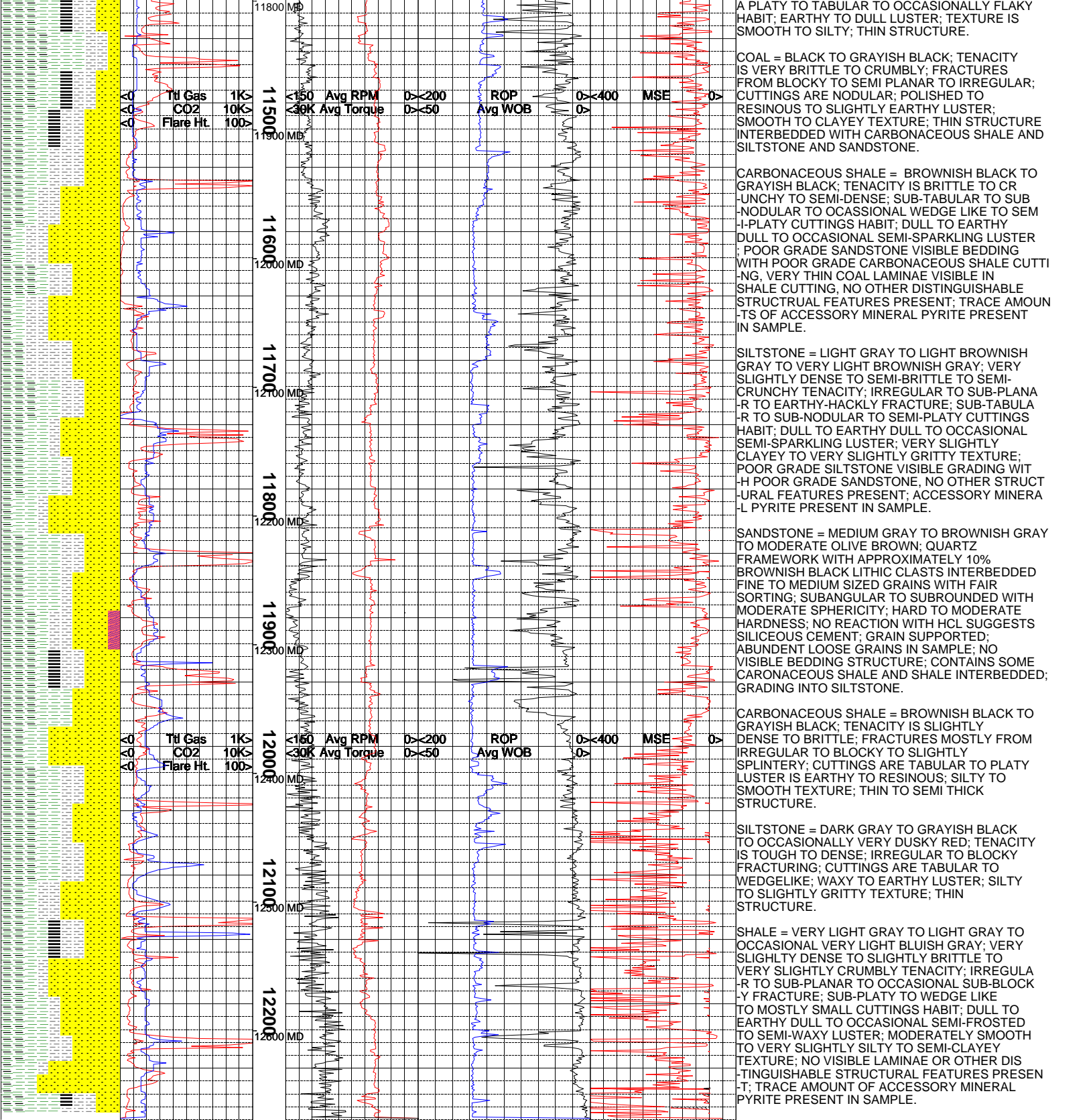
Ttl Gas 1K
CO2 10K
Flare Ht 100

150 Avg RPM
30K Avg Torque
ROP Avg WOB
MSE

Ttl Gas 1K
CO2 10K
Flare Ht 100

150 Avg RPM
30K Avg Torque
ROP Avg WOB
MSE





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