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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 TVD

COMPANY ExxonMobil Production
WELL PCU 197-34A5
FIELD PICEANCE CREEK
REGION ROCKY MOUNTAIN
COORDINATES LAT: 39.918116 LONG: -108.27697
ELEVATION G.L.:6492.9' RKB: 30.2'
COUNTY, STATE RIO BLANCO, CO
API INDEX 051031154000
SPUD DATE 5/27/2010
CONTRACTOR HELMRICH_PAYNE
CO. REP. JOSEPH THOMAS
RIG/TYPE 325/FLEX 4S
LOGGING UNIT MLU 048
GEOLOGISTS MARK GROSS DONNA NEW
ADD. PERSONS JENN SELL
CO. GEOLOGIST MELISSA J. SAURBORN

LOG INTERVAL

CASING DATA

DEPTHS: 3644' TO 12633'
DATES: 05/27/2010 TO 08/24/2010
SCALE: 1" = 100'

10.75" AT 3624'
7" AT 8600'
AT
AT

MUD TYPES

HOLE SIZE

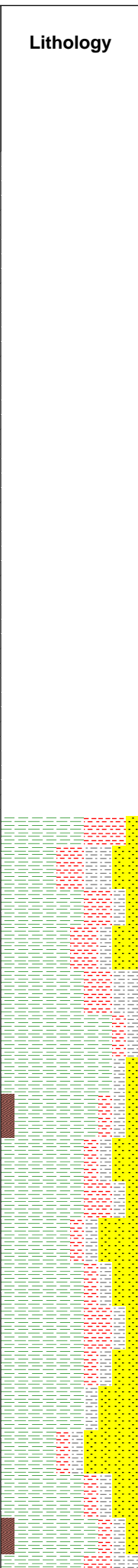
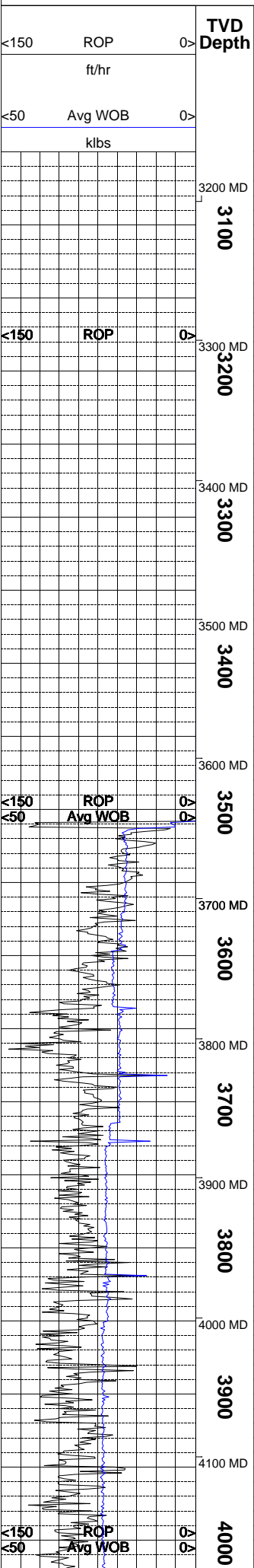
SPUD MUD TO 3644'
LSND TO 12633'
TO
TO

14.75" TO 3644'
9.875" TO 8655'
6.125" TO 12633'
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

Legend of geological symbols and patterns including: 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, KAOLINITIC, 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, SAND, SANDSTONE, SANDSTONE-TUFFACEOUS, SERICITIZATION, SERPENTINE, SHALE, SHALE TUFFACEOUS, SHELL FRAGMENTS, SIDERITE, SILICIFICATION, SILTSTONE, SILTST-TUFFACEOUS, TUFF, VOLCANICLASTICS SEDS, VOLCANICS.



MGS	Ttl Gas		Interp. Lith				
	units	2K	Meth C-1	Ethn C-2	Prop C-3	Butn C-4	Pent C-5
<0	<10	<10	100K	100K	100K	100K	100K
<0	CO2	90K	<10	<10	<10	<10	<10
<0	ppm	<10	100K	100K	100K	100K	100K
<0	Flare Ht.	100	<10	<10	<10	<10	<10
	ft	<10	100K	100K	100K	100K	100K

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 WITH RESPECT TO PERCENTAGE IN SAMPLE. DEPTH IS REFERENCED TO RKB.

CONNECTION GASES AS WELL AS TRIP GASES AND DOWNTIME GASES ARE NOTED ON THE LOG. LARGE CONNECTION GASES WHICH APPEAR ON THE MUDLOG USUALLY REFLECT UPHOLE GAS INTERVALS BLEEDING 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 MGS (MUD GAS SEPERATOR) THE INTERVAL IS MARKED ON THE LOG IN THE SLIDE COLUMN AND NOTED ON THE LOG.

ALL SANDSTONE INTERVALS ARE EXAMINED FOR SAMPLE FLUORESCENCE IN THE UV SCOPE AND FOR HYDROCARBON FLUORESCENCE AND MINOR FLUORESCENCE FROM POSSIBLE FRACTURE FILL. ALL FLUORESCENCE IS NOTED ON THE MUDLOG.

10.75" SURFACE CASING WAS SET AT 3624'. DRILLED 10' OF NEW FORMATION AND PERFORM F.I.T. - GOOD. DRILL AHEAD.

SURVEY @ 3644' MD: INC 17.33 AZI 37.18 TVD 3507.83'

EPOCH WELL SERVICES COMMENCED FULL LOGGING ON 05/30/2010 AT 3645'

SHALE = PALE RED, LIGHT GRAY TO MEDIUM LIGHT GRAY, DARK YELLOWISH ORANGE TO PALE YELLOWISH ORANGE, ALL IN A MOTTLED PATTERN; CRUMBLY TO BRITTLE TENACITY; IRREGULAR TO SEMI PLANAR FRACTURE; PLATY TO FLAKY TO SCALY CUTTINGS HABIT; MATTE TO DULL LUSTER; SMOOTH TO CLAYEY TEXTURE; MASSIVE STRUCTURE.

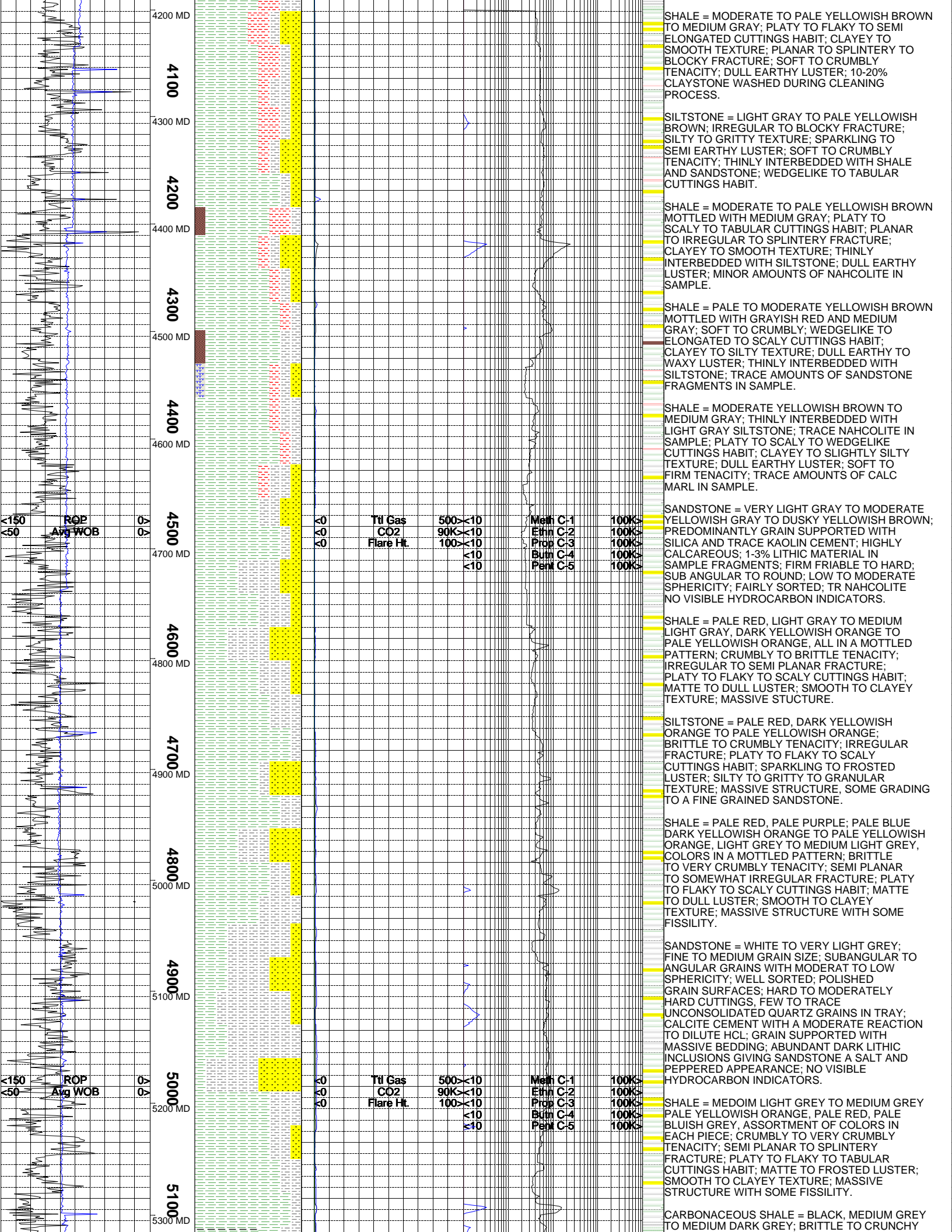
SILTSTONE = LIGHT GRAY TO MEDIUM LIGHT GRAY, PALE YELLOWISH ORANGE TO DARK YELLOWISH ORANGE; BRITTLE TO CRUMBLY TENACITY; BLOCKY TO IRREGULAR FRACUTRE; MASSIVE CUTTINGS HABIT; DULL TO SPARKLING LUSTER; SILTY TO GRITTY TEXTURE; MASSIVE STRUCTURE.

SHALE = LIGHT GRAY TO MOD YELLOWISH BROWN MOTTLED WITH BROWNISH GRAY; PLATY TO SCALY TO FLAKY CUTTINGS HABIT; CLAYEY TO SMOOTH TEXTURE; DULL EARTHY LUSTER; THINLY INTERBEDDED WITH PALE YELLOWISH GRAY SILTSTONE; PLANAR TO HACKLY FRACTURE.

SANDSTONE = VERY LIGHT GRAY TO PALE YELLOWISH BROWN OT OFF WHITE; FRAIBLE TO MODERATE HARD; VERY FINE TO FINE GRAIN; FAIRLY SORTED; SUBANGULAR TO SUBROUND; LOW TO MODERATE SPHERICITY; PREDOMINANTLY GRAIN SUPPORTED WITH SILICA AND SOME KAOLIN CEMENT; THINLY INTERBEDDED WITH SILTSTONE; TRACE ACC MINERALS OF NAHCOLITE AND CHLORITE; TR CARBONACEOUS MATERIAL IN SAMPLE FRAGS.

SHALE = LIGHT GRAY MOTTLED WITH MODERATE YELLOWISH BROWN AND TRACE GRAYISH RED; PLATY TO SCALY TO WEDGELIKE CUTTINGS HABIT; CLAYEY TO SLIGHTLY SILTY TEXTURE; EARTHY LUSTER; THINLY INTERBEDDED WITH LIGHT GRAY SILTSTONE; ANGULAR TO PLANAR TO HACKLY FRACTURE.

SILTSTONE = LIGHT GRAY TO MODERATE YELLOWISH GRAY; IRREGULAR TO BLOCKY TO SPLINTERY FRACTURE; PLATY TO TABULAR CUTTINGS HABIT; SILTY TO CLAYEY TEXTURE; GRADES TO LIGHT GRAY SANDSTONE; TRACE LOOSE FINE GRAIN SAND; SPARKLING TO EARTHY LUSTER; THINLY INTERBEDDED WITH SANDSTONE AND SHALE.



4200 MD
4100
4300 MD
4200
4400 MD
4300
4500 MD
4400
4600 MD
4500
4700 MD
4600
4800 MD
4700
4900 MD
4800
5000 MD
4900
5100 MD
5000
5200 MD
5100
5300 MD

ROP
A1g WOB

Til Gas
CO2
Flare Ht

500x10
90Kx10
100x10
x10
x10

Meth C-1
Ethn C-2
Prop C-3
Butn C-4
Perm C-5

100Kx
100Kx
100Kx
100Kx
100Kx

SHALE = MODERATE TO PALE YELLOWISH BROWN TO MEDIUM GRAY; PLATY TO FLAKY TO SEMI ELONGATED CUTTINGS HABIT; CLAYEY TO SMOOTH TEXTURE; PLANAR TO SPLINTERY TO BLOCKY FRACTURE; SOFT TO CRUMBLY TENACITY; DULL EARTHY LUSTER; 10-20% CLAYSTONE WASHED DURING CLEANING PROCESS.

SILTSTONE = LIGHT GRAY TO PALE YELLOWISH BROWN; IRREGULAR TO BLOCKY FRACTURE; SILTY TO GRITTY TEXTURE; SPARKLING TO SEMI EARTHY LUSTER; SOFT TO CRUMBLY TENACITY; THINLY INTERBEDDED WITH SHALE AND SANDSTONE; WEDGELIKE TO TABULAR CUTTINGS HABIT.

SHALE = MODERATE TO PALE YELLOWISH BROWN MOTTLED WITH MEDIUM GRAY; PLATY TO SCALY TO TABULAR CUTTINGS HABIT; PLANAR TO IRREGULAR TO SPLINTERY FRACTURE; CLAYEY TO SMOOTH TEXTURE; THINLY INTERBEDDED WITH SILTSTONE; DULL EARTHY LUSTER; MINOR AMOUNTS OF NAHCOLITE IN SAMPLE.

SHALE = PALE TO MODERATE YELLOWISH BROWN MOTTLED WITH GRAYISH RED AND MEDIUM GRAY; SOFT TO CRUMBLY; WEDGELIKE TO ELONGATED TO SCALY CUTTINGS HABIT; CLAYEY TO SILTY TEXTURE; DULL EARTHY TO WAXY LUSTER; THINLY INTERBEDDED WITH SILTSTONE; TRACE AMOUNTS OF SANDSTONE FRAGMENTS IN SAMPLE.

SHALE = MODERATE YELLOWISH BROWN TO MEDIUM GRAY; THINLY INTERBEDDED WITH LIGHT GRAY SILTSTONE; TRACE NAHCOLITE IN SAMPLE; PLATY TO SCALY TO WEDGELIKE CUTTINGS HABIT; CLAYEY TO SLIGHTLY SILTY TEXTURE; DULL EARTHY LUSTER; SOFT TO FIRM TENACITY; TRACE AMOUNTS OF CALC MARL IN SAMPLE.

SANDSTONE = VERY LIGHT GRAY TO MODERATE YELLOWISH GRAY TO DUSKY YELLOWISH BROWN; PREDOMINANTLY GRAIN SUPPORTED WITH SILICA AND TRACE KAOLIN CEMENT; HIGHLY CALCAREOUS; 1-3% LITHIC MATERIAL IN SAMPLE FRAGMENTS; FIRM FRIABLE TO HARD; SUB ANGULAR TO ROUND; LOW TO MODERATE SPHERICITY; FAIRLY SORTED; TR NAHCOLITE NO VISIBLE HYDROCARBON INDICATORS.

SHALE = PALE RED, LIGHT GRAY TO MEDIUM LIGHT GRAY, DARK YELLOWISH ORANGE TO PALE YELLOWISH ORANGE, ALL IN A MOTTLED PATTERN; CRUMBLY TO BRITTLE TENACITY; IRREGULAR TO SEMI PLANAR FRACTURE; PLATY TO FLAKY TO SCALY CUTTINGS HABIT; MATTE TO DULL LUSTER; SMOOTH TO CLAYEY TEXTURE; MASSIVE STRUCTURE.

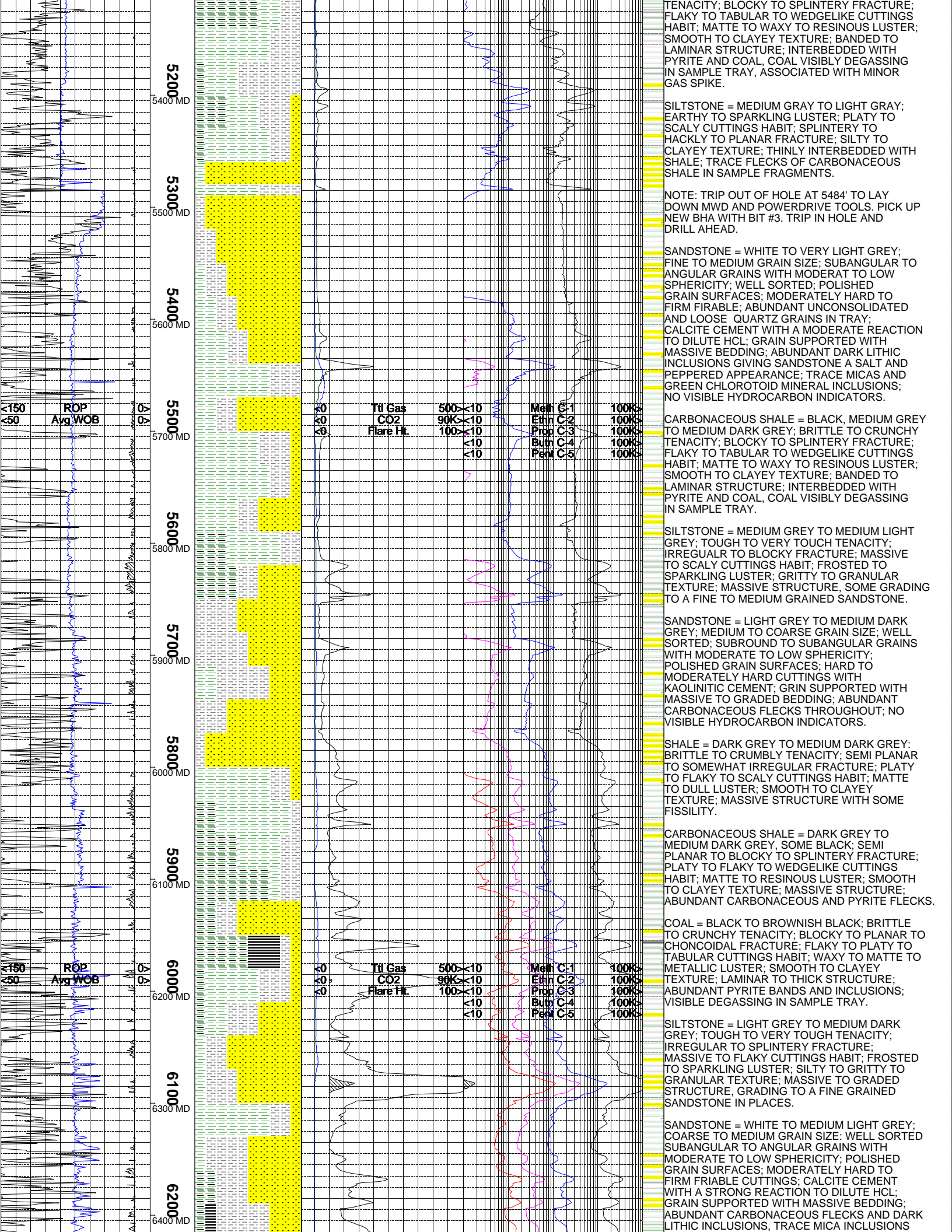
SILTSTONE = PALE RED, DARK YELLOWISH ORANGE TO PALE YELLOWISH ORANGE; BRITTLE TO CRUMBLY TENACITY; IRREGULAR FRACTURE; PLATY TO FLAKY TO SCALY CUTTINGS HABIT; SPARKLING TO FROSTED LUSTER; SILTY TO GRITTY TO GRANULAR TEXTURE; MASSIVE STRUCTURE, SOME GRADING TO A FINE GRAINED SANDSTONE.

SHALE = PALE RED, PALE PURPLE; PALE BLUE DARK YELLOWISH ORANGE TO PALE YELLOWISH ORANGE, LIGHT GREY TO MEDIUM LIGHT GREY, COLORS IN A MOTTLED PATTERN; BRITTLE TO VERY CRUMBLY TENACITY; SEMI PLANAR TO SOMEWHAT IRREGULAR FRACTURE; PLATY TO FLAKY TO SCALY CUTTINGS HABIT; MATTE TO DULL LUSTER; SMOOTH TO CLAYEY TEXTURE; MASSIVE STRUCTURE WITH SOME FISSILITY.

SANDSTONE = WHITE TO VERY LIGHT GREY; FINE TO MEDIUM GRAIN SIZE; SUBANGULAR TO ANGULAR GRAINS WITH MODERATE TO LOW SPHERICITY; WELL SORTED; POLISHED GRAIN SURFACES; HARD TO MODERATELY HARD CUTTINGS, FEW TO TRACE UNCONSOLIDATED QUARTZ GRAINS IN TRAY; CALCITE CEMENT WITH A MODERATE REACTION TO DILUTE HCL; GRAIN SUPPORTED WITH MASSIVE BEDDING; ABUNDANT DARK LITHIC INCLUSIONS GIVING SANDSTONE A SALT AND PEPPERED APPEARANCE; NO VISIBLE HYDROCARBON INDICATORS.

SHALE = MEDIUM LIGHT GREY TO MEDIUM GREY PALE YELLOWISH ORANGE, PALE RED, PALE BLuish GREY, ASSORTMENT OF COLORS IN EACH PIECE; CRUMBLY TO VERY CRUMBLY TENACITY; SEMI PLANAR TO SPLINTERY FRACTURE; PLATY TO FLAKY TO TABULAR CUTTINGS HABIT; MATTE TO FROSTED LUSTER; SMOOTH TO CLAYEY TEXTURE; MASSIVE STRUCTURE WITH SOME FISSILITY.

CARBONACEOUS SHALE = BLACK, MEDIUM GREY TO MEDIUM DARK GREY; BRITTLE TO CRUNCHY



5200 MD
5300 MD
5400 MD
5500 MD
5600 MD
5700 MD
5800 MD
5900 MD
6000 MD
6100 MD
6200 MD

Til Gas	500 $\times 10$	Meth C-1	100K >
CO2	90K $\times 10$	Ethin C-2	100K >
Flare Ht	100 $\times 10$	Prop C-3	100K >
	<math>< 10</math>	Butn C-4	100K >
	<math>< 10</math>	Perh C-5	100K >

Til Gas	500 $\times 10$	Meth C-1	100K >
CO2	90K $\times 10$	Ethin C-2	100K >
Flare Ht	100 $\times 10$	Prop C-3	100K >
	<math>< 10</math>	Butn C-4	100K >
	<math>< 10</math>	Perh C-5	100K >

TENACITY; BLOCKY TO SPLINTERY FRACTURE; FLAKY TO TABULAR TO WEDGELIKE CUTTINGS HABIT; MATTE TO WAXY TO RESINOUS LUSTER; SMOOTH TO CLAYEY TEXTURE; BANDED TO LAMINAR STRUCTURE; INTERBEDDED WITH PYRITE AND COAL, COAL VISIBLY DEGASSING IN SAMPLE TRAY, ASSOCIATED WITH MINOR GAS SPIKE.

SILTSTONE = MEDIUM GRAY TO LIGHT GRAY; EARTHY TO SPARKLING LUSTER; PLATY TO SCALY CUTTINGS HABIT; SPLINTERY TO HACKLY TO PLANAR FRACTURE; SILTY TO CLAYEY TEXTURE; THINLY INTERBEDDED WITH SHALE; TRACE FLECKS OF CARBONACEOUS SHALE IN SAMPLE FRAGMENTS.

NOTE: TRIP OUT OF HOLE AT 5484' TO LAY DOWN MWD AND POWERDRIVE TOOLS. PICK UP NEW BHA WITH BIT #3. TRIP IN HOLE AND DRILL AHEAD.

SANDSTONE = WHITE TO VERY LIGHT GRAY; FINE TO MEDIUM GRAIN SIZE; SUBANGULAR TO ANGULAR GRAINS WITH MODERATE TO LOW SPHERICITY; WELL SORTED; POLISHED GRAIN SURFACES; MODERATELY HARD TO FIRM FIRABLE; ABUNDANT UNCONSOLIDATED AND LOOSE QUARTZ GRAINS IN TRAY; CALCITE CEMENT WITH A MODERATE REACTION TO DILUTE HCL; GRAIN SUPPORTED WITH MASSIVE BEDDING; ABUNDANT DARK LITHIC INCLUSIONS GIVING SANDSTONE A SALT AND PEPPERED APPEARANCE; TRACE MICAS AND GREEN CHLOROTOID MINERAL INCLUSIONS; NO VISIBLE HYDROCARBON INDICATORS.

CARBONACEOUS SHALE = BLACK, MEDIUM GREY TO MEDIUM DARK GREY; BRITTLE TO CRUNCHY TENACITY; BLOCKY TO SPLINTERY FRACTURE; FLAKY TO TABULAR TO WEDGELIKE CUTTINGS HABIT; MATTE TO WAXY TO RESINOUS LUSTER; SMOOTH TO CLAYEY TEXTURE; BANDED TO LAMINAR STRUCTURE; INTERBEDDED WITH PYRITE AND COAL, COAL VISIBLY DEGASSING IN SAMPLE TRAY.

SILTSTONE = MEDIUM GRAY TO MEDIUM LIGHT GRAY; TOUGH TO VERY TOUCH TENACITY; IRREGULAR TO BLOCKY FRACTURE; MASSIVE TO SCALY CUTTINGS HABIT; FROSTED TO SPARKLING LUSTER; GRITTY TO GRANULAR TEXTURE; MASSIVE STRUCTURE, SOME GRADING TO A FINE TO MEDIUM GRAINED SANDSTONE.

SANDSTONE = LIGHT GRAY TO MEDIUM DARK GRAY; MEDIUM TO COARSE GRAIN SIZE; WELL SORTED; SUBROUND TO SUBANGULAR GRAINS WITH MODERATE TO LOW SPHERICITY; POLISHED GRAIN SURFACES; HARD TO MODERATELY HARD CUTTINGS WITH KAOLINIC CEMENT; GRIN SUPPORTED WITH MASSIVE TO GRADED BEDDING; ABUNDANT CARBONACEOUS FLECKS THROUGHOUT; NO VISIBLE HYDROCARBON INDICATORS.

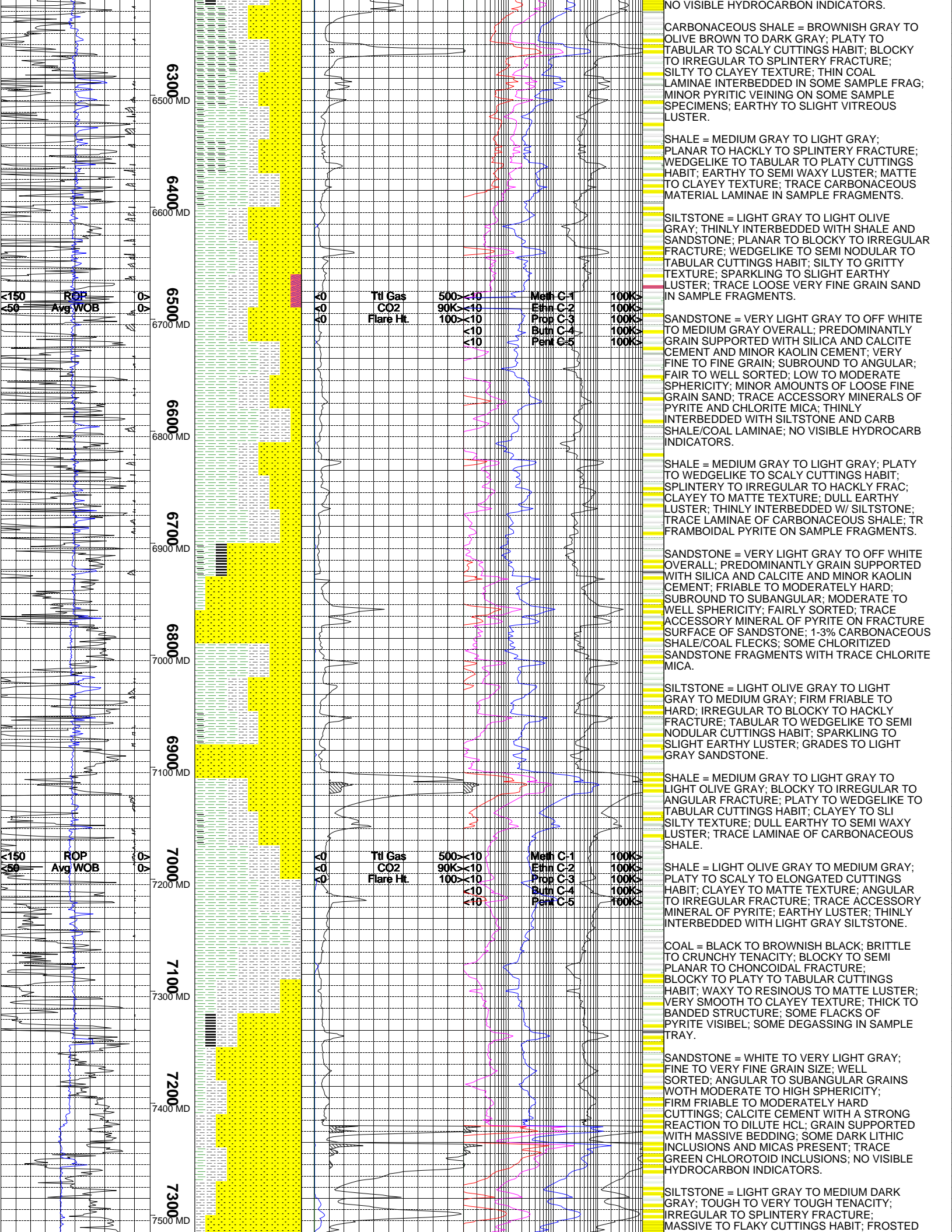
SHALE = DARK GRAY TO MEDIUM DARK GRAY; BRITTLE TO CRUMBLY TENACITY; SEMI PLANAR TO SOMEWHAT IRREGULAR FRACTURE; PLATY TO FLAKY TO SCALY CUTTINGS HABIT; MATTE TO DULL LUSTER; SMOOTH TO CLAYEY TEXTURE; MASSIVE STRUCTURE WITH SOME FISSILITY.

CARBONACEOUS SHALE = DARK GRAY TO MEDIUM DARK GRAY, SOME BLACK; SEMI PLANAR TO BLOCKY TO SPLINTERY FRACTURE; PLATY TO FLAKY TO WEDGELIKE CUTTINGS HABIT; MATTE TO RESINOUS LUSTER; SMOOTH TO CLAYEY TEXTURE; MASSIVE STRUCTURE; ABUNDANT CARBONACEOUS AND PYRITE FLECKS.

COAL = BLACK TO BROWNISH BLACK; BRITTLE TO CRUNCHY TENACITY; BLOCKY TO PLANAR TO CHONCOIDAL FRACTURE; FLAKY TO PLATY TO TABULAR CUTTINGS HABIT; WAXY TO MATTE TO METALLIC LUSTER; SMOOTH TO CLAYEY TEXTURE; LAMINAR TO THICK STRUCTURE; ABUNDANT PYRITE BANDS AND INCLUSIONS; VISIBLE DEGASSING IN SAMPLE TRAY.

SILTSTONE = LIGHT GRAY TO MEDIUM DARK GRAY; TOUGH TO VERY TOUGH TENACITY; IRREGULAR TO SPLINTERY FRACTURE; MASSIVE TO FLAKY CUTTINGS HABIT; FROSTED TO SPARKLING LUSTER; SILTY TO GRITTY TO GRANULAR TEXTURE; MASSIVE TO GRADED STRUCTURE, GRADING TO A FINE GRAINED SANDSTONE IN PLACES.

SANDSTONE = WHITE TO MEDIUM LIGHT GRAY; COARSE TO MEDIUM GRAIN SIZE; WELL SORTED SUBANGULAR TO ANGULAR GRAINS WITH MODERATE TO LOW SPHERICITY; POLISHED GRAIN SURFACES; MODERATELY HARD TO FIRM FRIABLE CUTTINGS; CALCITE CEMENT WITH A STRONG REACTION TO DILUTE HCL; GRAIN SUPPORTED WITH MASSIVE BEDDING; ABUNDANT CARBONACEOUS FLECKS AND DARK LITHIC INCLUSIONS, TRACE MICA INCLUSIONS



6300
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7000 MD
6900
7100 MD
7000
7200 MD
7100
7300 MD
7200
7400 MD
7300
7500 MD

ROP
Avg WOB

ROP
Avg WOB

Til Gas
CO2
Flare Ht

500 < 10
90K < 10
100 < 10
< 10

Meth C-1
Eth C-2
Prop C-3
Butn C-4
Pent C-5

100K <
100K <
100K <
100K <
100K <

CARBONACEOUS SHALE = BROWNISH GRAY TO OLIVE BROWN TO DARK GRAY; PLATY TO TABULAR TO SCALY CUTTINGS HABIT; BLOCKY TO IRREGULAR TO SPLINTERY FRACTURE; SILTY TO CLAYEY TEXTURE; THIN COAL LAMINAE INTERBEDDED IN SOME SAMPLE FRAG; MINOR PYRITIC VEINING ON SOME SAMPLE SPECIMENS; EARTHY TO SLIGHT VITREOUS LUSTER.

SHALE = MEDIUM GRAY TO LIGHT GRAY; PLANAR TO HACKLY TO SPLINTERY FRACTURE; WEDGELIKE TO TABULAR TO PLATY CUTTINGS HABIT; EARTHY TO SEMI WAXY LUSTER; MATTE TO CLAYEY TEXTURE; TRACE CARBONACEOUS MATERIAL LAMINAE IN SAMPLE FRAGMENTS.

SILTSTONE = LIGHT GRAY TO LIGHT OLIVE GRAY; THINLY INTERBEDDED WITH SHALE AND SANDSTONE; PLANAR TO BLOCKY TO IRREGULAR FRACTURE; WEDGELIKE TO SEMI NODULAR TO TABULAR CUTTINGS HABIT; SILTY TO GRITTY TEXTURE; SPARKLING TO SLIGHT EARTHY LUSTER; TRACE LOOSE VERY FINE GRAIN SAND IN SAMPLE FRAGMENTS.

SANDSTONE = VERY LIGHT GRAY TO OFF WHITE TO MEDIUM GRAY OVERALL; PREDOMINANTLY GRAIN SUPPORTED WITH SILICA AND CALCITE CEMENT AND MINOR KAOLIN CEMENT; VERY FINE TO FINE GRAIN; SUBROUND TO ANGULAR; FAIR TO WELL SORTED; LOW TO MODERATE SPHERICITY; MINOR AMOUNTS OF LOOSE FINE GRAIN SAND; TRACE ACCESSORY MINERALS OF PYRITE AND CHLORITE MICA; THINLY INTERBEDDED WITH SILTSTONE AND CARB SHALE/COAL LAMINAE; NO VISIBLE HYDROCARB INDICATORS.

SHALE = MEDIUM GRAY TO LIGHT GRAY; PLATY TO WEDGELIKE TO SCALY CUTTINGS HABIT; SPLINTERY TO IRREGULAR TO HACKLY FRAC; CLAYEY TO MATTE TEXTURE; DULL EARTHY LUSTER; THINLY INTERBEDDED W/ SILTSTONE; TRACE LAMINAE OF CARBONACEOUS SHALE; TR FRAMBOIDAL PYRITE ON SAMPLE FRAGMENTS.

SANDSTONE = VERY LIGHT GRAY TO OFF WHITE OVERALL; PREDOMINANTLY GRAIN SUPPORTED WITH SILICA AND CALCITE AND MINOR KAOLIN CEMENT; FRIABLE TO MODERATELY HARD; SUBROUND TO SUBANGULAR; MODERATE TO WELL SPHERICITY; FAIRLY SORTED; TRACE ACCESSORY MINERAL OF PYRITE ON FRACTURE SURFACE OF SANDSTONE; 1-3% CARBONACEOUS SHALE/COAL FLECKS; SOME CHLORITIZED SANDSTONE FRAGMENTS WITH TRACE CHLORITE MICA.

SILTSTONE = LIGHT OLIVE GRAY TO LIGHT GRAY TO MEDIUM GRAY; FIRM FRIABLE TO HARD; IRREGULAR TO BLOCKY TO HACKLY FRACTURE; TABULAR TO WEDGELIKE TO SEMI NODULAR CUTTINGS HABIT; SPARKLING TO SLIGHT EARTHY LUSTER; GRADES TO LIGHT GRAY SANDSTONE.

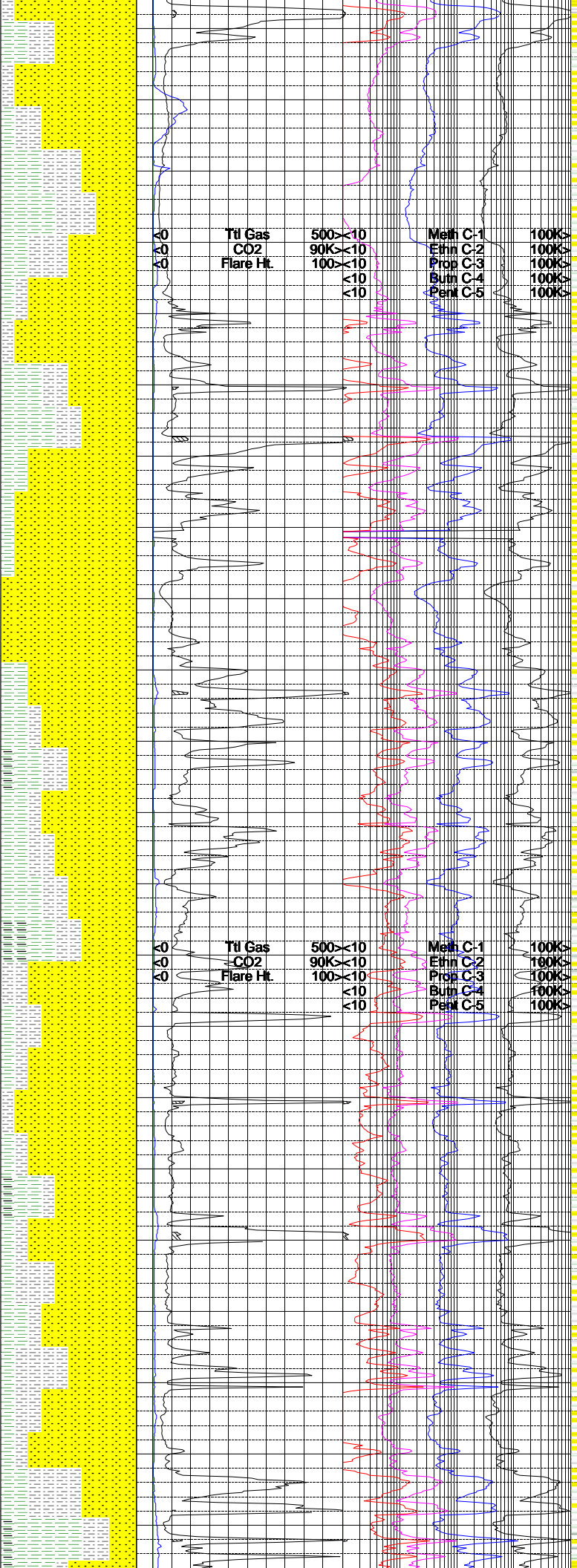
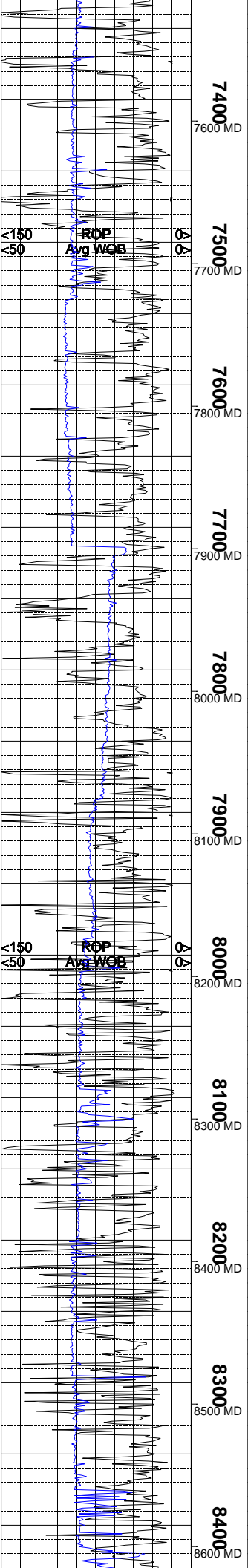
SHALE = MEDIUM GRAY TO LIGHT GRAY TO LIGHT OLIVE GRAY; BLOCKY TO IRREGULAR TO ANGULAR FRACTURE; PLATY TO WEDGELIKE TO TABULAR CUTTINGS HABIT; CLAYEY TO SILTY TEXTURE; DULL EARTHY TO SEMI WAXY LUSTER; TRACE LAMINAE OF CARBONACEOUS SHALE.

SHALE = LIGHT OLIVE GRAY TO MEDIUM GRAY; PLATY TO SCALY TO ELONGATED CUTTINGS HABIT; CLAYEY TO MATTE TEXTURE; ANGULAR TO IRREGULAR FRACTURE; TRACE ACCESSORY MINERAL OF PYRITE; EARTHY LUSTER; THINLY INTERBEDDED WITH LIGHT GRAY SILTSTONE.

COAL = BLACK TO BROWNISH BLACK; BRITTLE TO CRUNCHY TENACITY; BLOCKY TO SEMI PLANAR TO CHONCOIDAL FRACTURE; BLOCKY TO PLATY TO TABULAR CUTTINGS HABIT; WAXY TO RESINOUS TO MATTE LUSTER; VERY SMOOTH TO CLAYEY TEXTURE; THICK TO BANDED STRUCTURE; SOME FLACKS OF PYRITE VISIBEL; SOME DEGASSING IN SAMPLE TRAY.

SANDSTONE = WHITE TO VERY LIGHT GRAY; FINE TO VERY FINE GRAIN SIZE; WELL SORTED; ANGULAR TO SUBANGULAR GRAINS WOTH MODERATE TO HIGH SPHERICITY; FIRM FRIABLE TO MODERATELY HARD CUTTINGS; CALCITE CEMENT WITH A STRONG REACTION TO DILUTE HCL; GRAIN SUPPORTED WITH MASSIVE BEDDING; SOME DARK LITHIC INCLUSIONS AND MICAS PRESENT; TRACE GREEN CHLOROTOID INCLUSIONS; NO VISIBLE HYDROCARBON INDICATORS.

SILTSTONE = LIGHT GRAY TO MEDIUM DARK GRAY; TOUGH TO VERY TOUGH TENACITY; IRREGULAR TO SPLINTERY FRACTURE; MASSIVE TO FLAKY CUTTINGS HABIT; FROSTED



TO SPARKLING LUSTER; SILTY TO GRITTY TO GRANULAR TEXTURE; MASSIVE TO GRADED STRUCTURE, GRADING TO A FINE GRAINED SANDSTONE IN PLACES.

SHALE = MODERATE TO PALE YELLOWISH BROWN TO MEDIUM GRAY; PLATY TO FLAKY TO SEMI ELONGATED CUTTINGS HABIT; CLAYEY TO SMOOTH TEXTURE; PLANAR TO SPLINTERY TO BLOCKY FRACTURE; SOFT TO CRUMBLY TENACITY; DULL MATTE LUSTER; MASSIVE STRUCTURE.

SILTSTONE = MEDIUM GRAY TO MEDIUM LIGHT GRAY; TOUGH TO VERY TOUCH TENACITY; IRREGULAR TO BLOCKY FRACTURE; MASSIVE TO SCALY CUTTINGS HABIT; FROSTED TO SPARKLING LUSTER; GRITTY TO GRANULAR TEXTURE; MASSIVE STRUCTURE, SOME GRADING TO A FINE TO MEDIUM GRAINED SANDSTONE.

SANDSTONE = VERY LIGHT GRAY TO OFF WHITE OVERALL; PREDOMINANTLY GRAIN SUPPORTED WITH SILICA AND CALCITE CEMENT AND TRACE KAOLIN; 1-3% CARBONACEOUS SHALE/COAL FLECKS INTERSPERSED IN SAMPLE FRAGMENTS; ROUND TO SUBANGULAR; VERY FINE TO UPPER FINE GRAIN; WELL SORTED; MODERATE TO WELL SPHERICITY; TRACE ACCESSORY MINERALS OF PYRITE AGGREGATE AND CHLORITE MICAS; SOME LOOSE GRAINS; TRANSLUCENT TO CLEAR; FRIABLE TO MODERATE HARD; TRACE LITHICS IN SAMPLE SPECIMENS.

SANDSTONE = OFF WHITE TO TRANSPARENT TO VERY LIGHT GRAY; PREDOMINANTLY LOOSE GRAIN; TRACE ACCESSORY MINERALS OF MICRO PYRITE AND CHLORITE MICA; SUBANGULAR TO ROUND; WELL SORTED; MODERATE TO HIGH SPHERICITY; CLEAR TO OPAQUE; MINOR ABRASIONS TO GRAINS POSSIBLE DUE TO PDC BIT ACTION; SOME PRESERVED SANDSTONE SPECIMENS; 1-2% CARBONACEOUS MATERIAL IN SAMPLE FRAGMENTS; THINLY INTERBEDDED WITH SILTSTONE LAMINAE; SOFT TO FIRM FRIABLE; SILICA AND CALCITE CEMENT; NO VISIBLE HYDROCARBON INDICATORS.

NOTE: UPHOLE FORMATION GASES BLEEDING INTO WELLBORE DURING CONNECTIONS. EARLY GASES SHOWING ON MUDLOG AT CONNECTION DEPTHS.

SHALE = MEDIUM GRAY TO LIGHT GRAY; HACKLY TO BLOCKY TO PLANAR FRACTURE; PLATY TO ELONGATED TO WEDGELIKE CUTTINGS HABIT; CLAYEY TO MATTE TEXTURE; DULL EARTHY TO SEMI WAXY LUSTER; GRADES TO LIGHT GRAY SILTSTONE; MINOR AMOUNTS OF LOOSE SAND IN SAMPLE FRAGMENTS.

SILTSTONE = LIGHT GRAY TO LIGHT OLIVE GRAY; IRREGULAR TO HACKLY TO BLOCKY FRACTURE; FLAKY TO WEDGELIKE TO TABULAR CUTTINGS HABIT; SPARKLING TO SLI EARTHY LUSTER; SILTY TO GRITTY TEXTURE; THINLY INTERBEDDED WITH SHALE AND SANDSTONE.

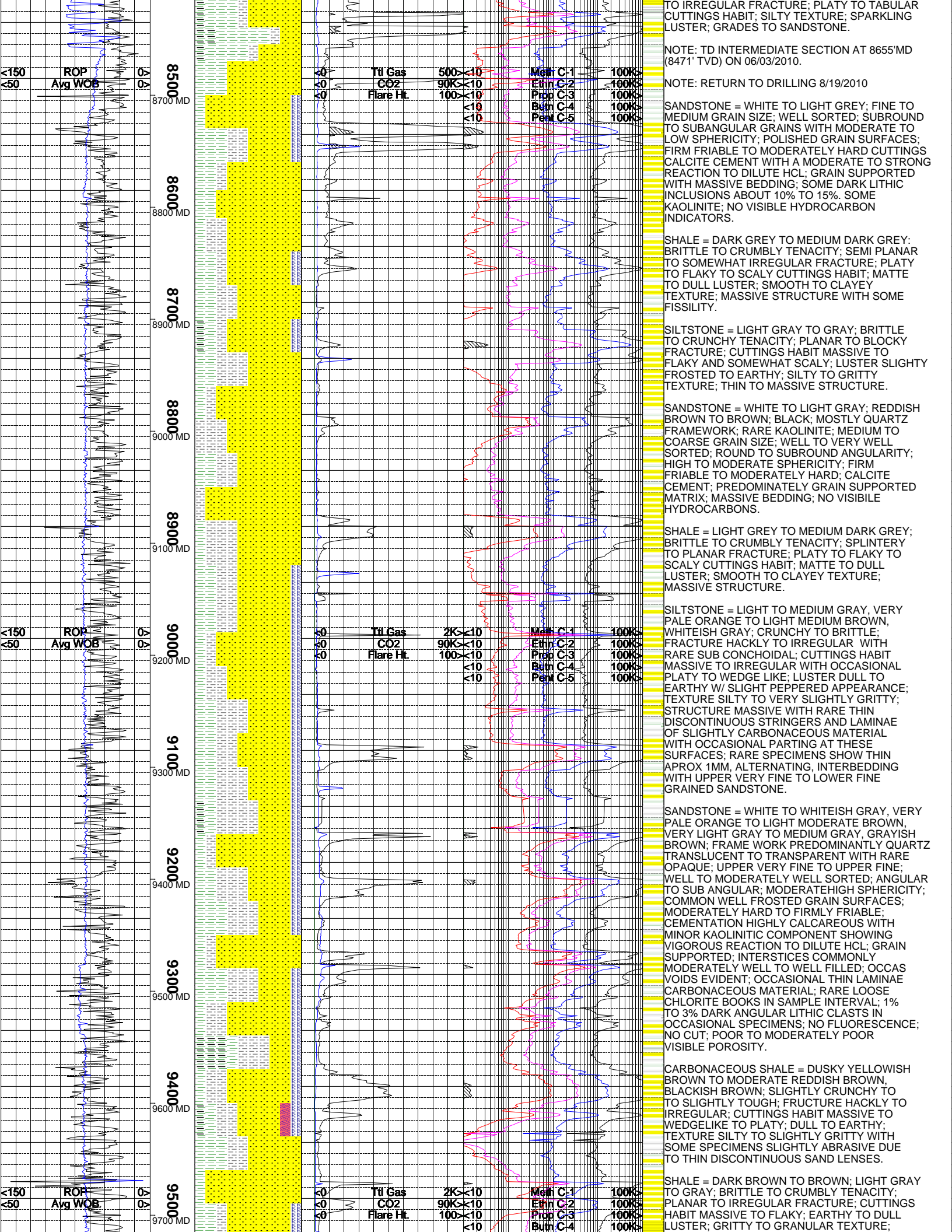
SANDSTONE = WHITE TO MEDIUM LIGHT GREY; COARSE TO MEDIUM GRAIN SIZE; WELL SORTED SUBANGULAR TO ANGULAR GRAINS WITH MODERATE TO LOW SPHERICITY; POLISHED GRAIN SURFACES; MAINLY UNCONSOLIDATED QUARTZ GRAINS WITH FEW EASILY FRIABLE CUTTINGS; GRAIN SUPPORTED AND MASSIVELY BEDDED WHERE CONSOLIDATED; ABUNDANT DARK LITHIC INCLUSIONS IN SANDSTONE; INTERBEDDED WITH A LIGHT GREY SILTSTONE; NO VISIBLE HYDROCARBON INDICATORS.

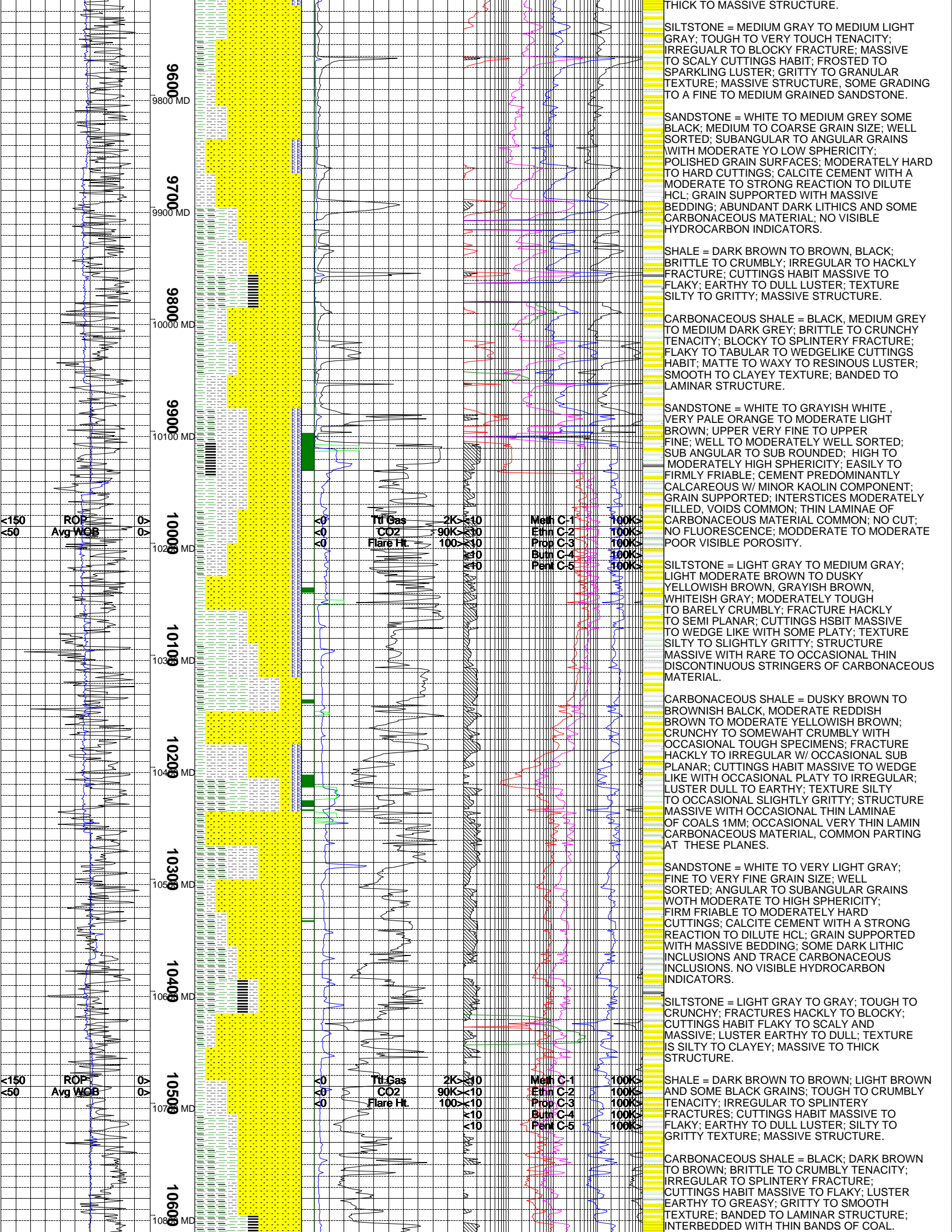
SILTSTONE = LIGHT GREY TO MEDIUM LIGHT GREY; TOUGH TO VERY TOUCH TENACITY; IRREGULAR TO SPLINTERY FRACTURE; MASSIVE TO FLAKY CUTTINGS HABIT; FROSTED TO SPARKLING LUSTER; SILTY TO GRITTY TO GRANULAR TEXTURE; MASSIVE TO GRADED STRUCTURE, GRADING TO A FINE GRAINED WHITE TO LIGHT GREY SANDSTONE.

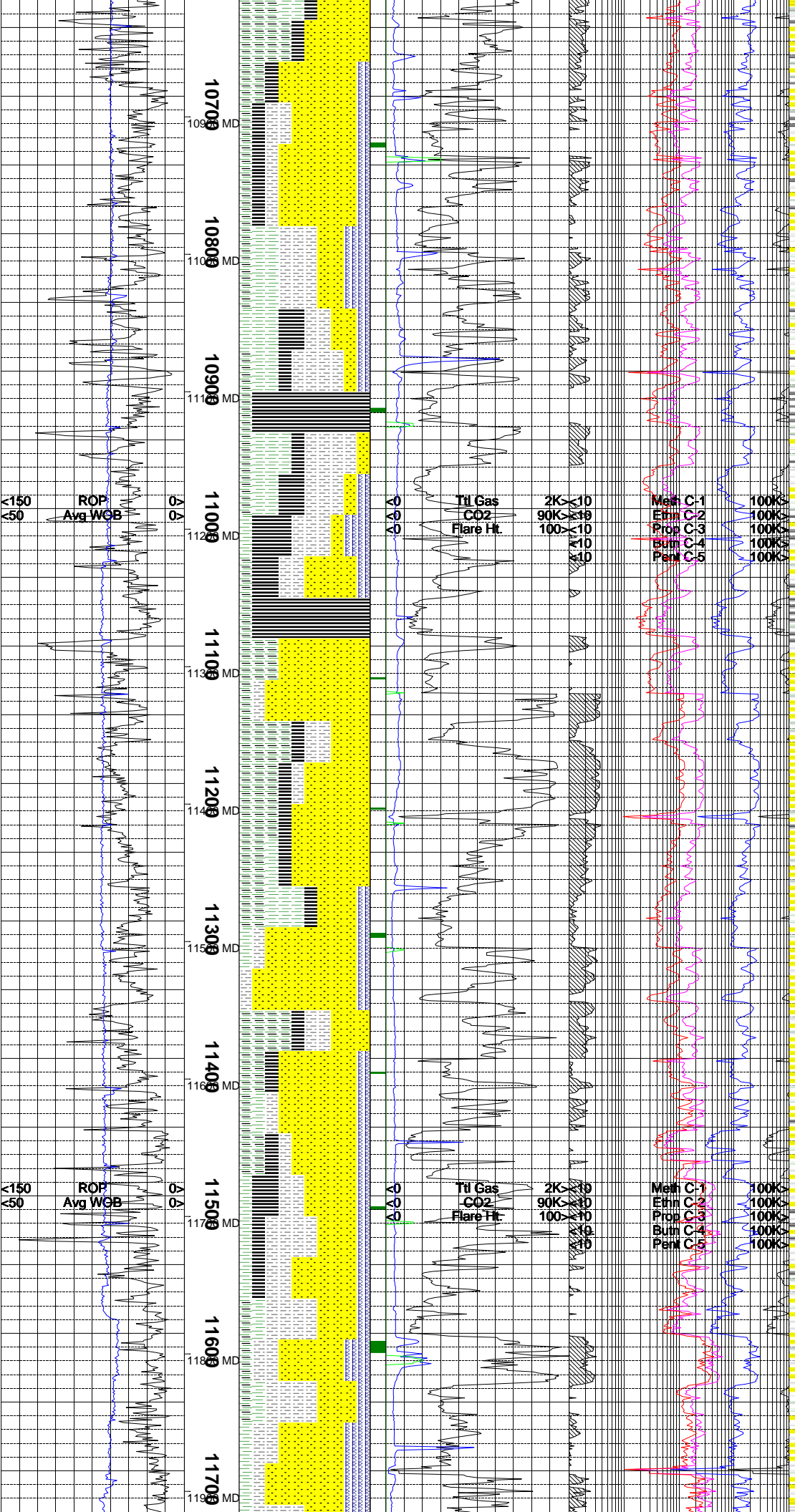
SHALE = PALE RED, DARK YELLOWISH ORANGE TO PALE YELLOWISH ORANGE; BRITTLE TO CRUMBLY TENACITY; SEMI PLANAR TO SPLINTERY FRACTURE; PLATY TO FLAKY TO SCALY CUTTINGS HABIT; DULL TO MATTE LUSTER; SMOOTH TO CLAYEY TEXTURE; MASSIVE STRUCTURE WITH FISSILITY.

SANDSTONE = WHITE TO VERY LIGHT GREY; FINE TO MEDIUM GRAIN SIZE; SUBANGULAR TO ANGULAR GRAINS WITH MODERATE TO LOW SPHERICITY; WELL SORTED; POLISHED GRAIN SURFACES; MODERATELY HARD TO FIRM FRIABLE; ABUNDANT UNCONSOLIDATED AND LOOSE QUARTZ GRAINS IN TRAY; CALCITE CEMENT WITH A STRONG REACTION TO DILUTE HCL; GRAIN SUPPORTED WITH MASSIVE BEDDING; SOME DARK LITHICS; NO VISIBLE HYDROCARBON INDICATORS.

SILTSTONE = LIGHT TO MEDIUM GRAY; BLOCKY







COAL = BLACK, BLACKISH BROWN, OLIVE BLACK; BRITTLE TO CRUNCHY TENACITY; FRACTURE CONCHOIDAL, PLANAR, ANGULAR; CUT HABIT BLOCKY, TABULAR, SPLINTERTY AND ELONGATED, MASSIVE; LUSTER VITREOUS TO SUB METALLIC LUSTER; TEXTURE SMOOTH HOMOGENOUS; STRUCTURE VERY THINLY LAMINATED TO 1MM LAMINAE; VIGOROUS TO MODERATE OUT GASSING IN MOST SAMPLES.

SANDSTONE = WHITE TO WHITEISH GRAY, VERY PALE ORANGE TO LIGHT BROWN, LIGHT GRAY TO GRAYISH BROWN; FRAMEWORK MOSTLY TRANSPARENT TO TRANSLUCENT COLORLESS QUARTZ; UPPER TO LOWER VERY FINE GRAINED; VERY WELL TO WELL SORTED; SUB ROUNDED TO WELL ROUNDED; HIGH TO VERY HIGH SPHERICITY; SOFT TO EASILY FRIABLE; CEMENTATION SPARSE KAOLIN WITH MINOR CALACAREOUS COMPONENT SHOWING POOR TO MODERATE RECTION TO DILUTE HCL; INTERSTICES WELL TO MOD WELL FILLED WITH OCCASIONAL VOIDS, MASSIVE BEDDING; NO LITHIC CLASTS; NO CUT; NO FLUORESCENCE.

SILTSTONE = DUSKY YELLOWISH BROWN TO MODERATE YELLOWISH BROWN, LIGHT MOD BROWN TO BROWNISH GRAY; CRUNCHY TO SOMEWHAT TOUGH THENACITY; FRACTURE HACKLY TO SUB PLANAR; CUTTINGS HABIT MASSIVE TO COMMON WEDGE LIKE; LUSTER DULL TO EARTHY; TEXTURE SILTY TO SLIGHT GRITTIENESS; STRUCTURE MASSIVE.

COAL = BLACK, BLACKISH BROWN, GRAYISH BROWN; CRUNCHY TO BRITTLE TENACITY; FRACTURE CONCHOIDAL, SEMI BLOCKY, ANGLR; CUT HABIT BLOCKY, TABULAR, PLATY W/ RARE MASSIVE; LUSTER VITREOUS TO METALLIC; TEXTURE SMOOTH AND HOMOGENOUS; THINLY LAMINATED STRUCTURE W/ SOME THICKER LAMINAE APROX 1MM; VIGOROUS OUTGASSING IN MOST SPECIMENS.

CARBONACEOUS SHALE = DARK GREY TO MEDIUM DARK GREY, SOME BLACK; SEMI PLANAR TO BLOCKY TO SPLINTERY FRACTURE; PLATY TO FLAKY TO WEDGELIKE CUTTINGS HABIT; MATTE TO RESINOUS LUSTER; SMOOTH TO CLAYEY TEXTURE; BANDED TO LAMINAR STRUCTURE, INTERBEDDED WITH THIN TO MEDIUM BANDS OF COAL WITH SOME VISIBLE DEGASSING.

SHALE = MEDIUM GRAY TO LIGHT GRAY; PLATY TO WEDGELIKE TO SCALY CUTTINGS HABIT; SPLINTERY TO IRREGULAR TO HACKLY FRAC; CLAYEY TO MATTE TEXTURE; DULL EARTHY LUSTER; THINLY INTERBEDDED WITH CARBONACEOUS SHALE AND SANDSTONE.

COAL = BLACK TO BROWNISH BLACK; BRITTLE TO CRUNCHY TENACITY; BLOCKY TO SEMI PLANAR TO CHONCOIDAL FRACTURE; BLOCKY TO PLATY TO TABULAR CUTTINGS HABIT; WAXY TO RESINOUS TO MATTE LUSTER; VERY SMOOTH TO CLAYEY TEXTURE; THICK TO BANDED STRUCTURE; VISIBLE DEGASSING IN SAMPLE TRAY.

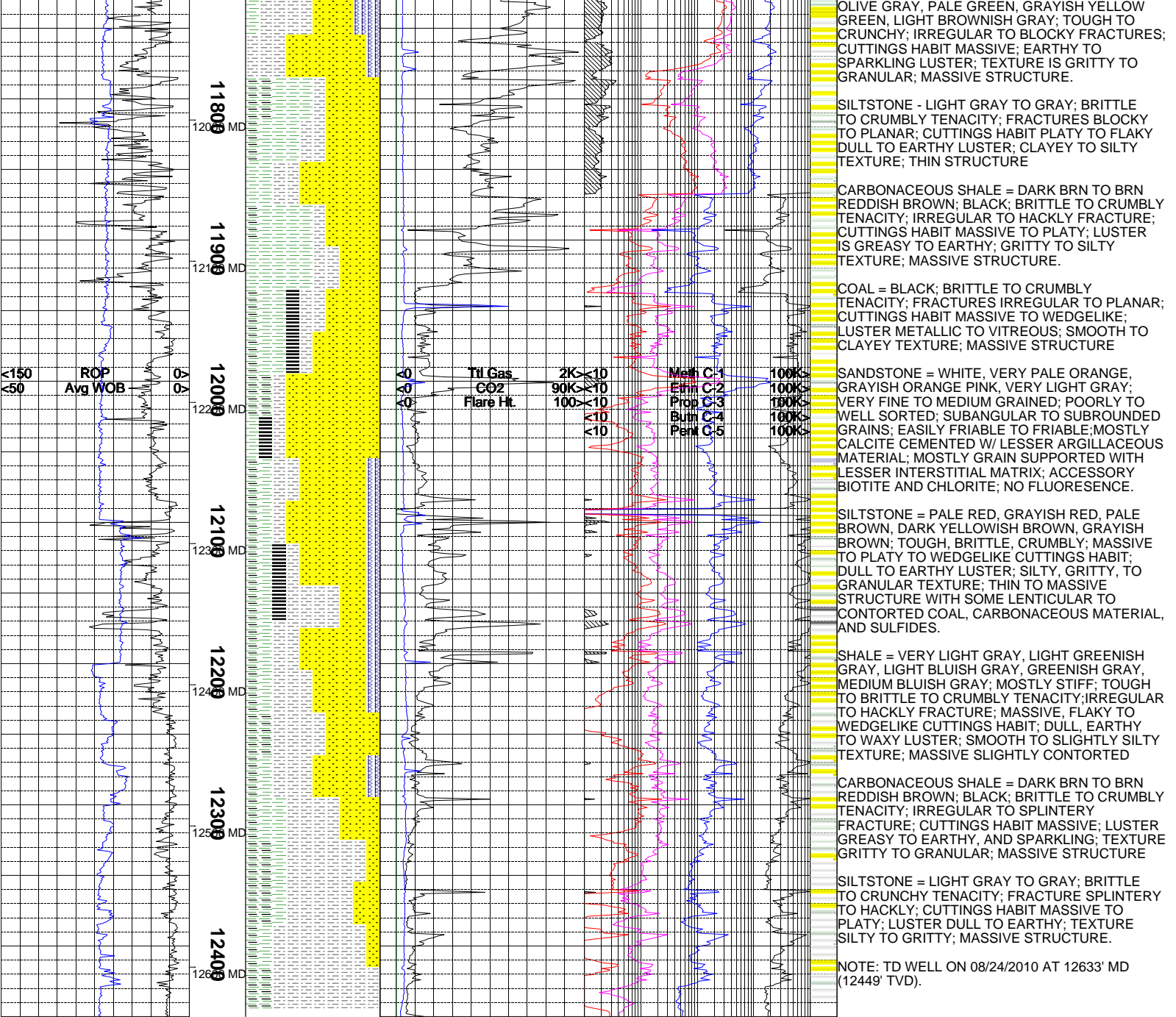
SANDSTONE = WHITE TO TRANSPARENT TO TRANSLUCENT; GRAYISH BROWN TO LIGHT BROWN; FRAMEWORK IS MOSTLY QUARTZ; WITH FINE TO MEDIUM GRAIN SIZE; WELL TO VERY WELL SORTED; ROUND TO SUBROUNDED ANGULARITY; MODERATE TO HIGH SPHERICITY; SOFT TO EASILY FRIABLE; SOME KAOLINIC CEMENT; GRAIN SUPPORTED MATRIX; MASSIVE BEDDING; NO VISIBLE HYDROCARBONS.

CARBONACEOUS SHALE = DUSKY YELLOWISH BROWN TO MODERATE BROWN, DARK GRAYISH BROWN TO BLACKISH BROWN; BARELY CRUNCHY TO CRUMBLY; FRACTURE HACKLY TO IRREGULAR; CUTTINGS HABIT MASSIVE TO WEDGELIKE; TEXTURE SMOOTH TO SLIGHTLY SILTY; STRUCTURE MASSIVE; THIN LAMINAE OF CARBONACEOUS MATERIAL; VISIBLE OUTGASSING FROM LAMINAE.

COAL = BLACK, BLACKISH GRAY, OLIVE BLACK, GRAYISH BLACK; CRUNCHY TO BRITTLE TENACITY; FRACTURE CONCHOIDAL, BLOCKY, ANGULAR; CUTTINGS HABIT BLOCKY TO TABULAR TO FLAKY; METALLIC TO VITREOUS TO RESINOUS LUSTER; SMOOTH HOMOGENOUS TEXTURE; MASSIVE, SOMEWHAT CONTORTED STRUCTURE; NO VISIBLE OUTGASSING.

SANDSTONE = WHITE, PALE RED, PALEREDDISH BROWN; VERY FINE TO MEDIUM GRAINED; QUARTZ FRAMEWORK; FAIRLY WELL SORTED TO WELL SORTED; SUBANGULAR TO ROUNDED GRAINS; SOFT TO FIRMLY FRIABLE; CALCITE CEMENT W/ LESSER ARGILLACEOUS MATERIAL; NO FLUORESCENCE.

SHALE = LIGHT GRAY, PALE OLIVE, LIGHT



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