



# FORMATION EVALUATION LOG

Scale: 2" = 100'

**COMPANY:** NORTHWEST NATURAL  
**WELL:** IW 23ach-3-65  
**FIELD:** Bruer Pool Inject/WD Storage  
**COUNTY:** Columbia, OR

**Location:** SE 1/4 Sec. 3, T6N-R5W; WB&M  
**Coordinates:** 2346.8' N 86°26' W and  
 1593.8' N 3°33' E from  
 SE corner. Y: 874129.60 X:1292387.90 FIN

**API No.:** 36-009-00366  
**Spud Date:** 5/11/07  
**Total Depth:** 5/18/07  
**Elevation:** K.B. 1047.3'  
 G.L. 1033.3'

**Company Geologist:** Jack Meyer  
**Company Engineer:** Clayton Roth  
**Company Pusher:** Ed Vader  
**Directional Engineer:** Scientific Drilling  
**Mud Company:** Beaver Drilling Fluids  
**Mud Engineer:** Ed Vader  
**Drilling Contractor:** TD Well Service  
**Rig Pusher:** Jerry Gann  
**Rig No.:** 101  
**Geolog Unit No.:** 19  
**Logging Geologists:** Jim Ferguson  
 Matt Brown

## LOG INTERVAL

**DATES:** 5/11/07 TO 5/25/07  
 TO  
**DEPTHS:** 50' TO 3518'  
 TO

## TOTAL DEPTH

**MEASURED:** 3518'  
**TRUE VERTICAL:** 2599.08' Proj.

## MUD TYPES

Gel Chem TO 3518'  
 TO  
 TO

## HOLE SIZE

17-1/2" TO 590'  
 12-1/4" TO 626'  
 8-3/4" TO 3518'

## MUD PUMPS

**PUMP #1:** EMSCO DB 550 (16" x 5-1/2")  
**PUMP #2:** OILWELL H 560 37 (8" x 5-1/2")

## CASING DATA

20" AT 20'  
 13-3/8" AT 563'  
 AT

## LEGEND

BG - Background Gas	GCW - Gas Cut Water	RMF - Mid-Filtrate Resistivity, Ohm-Meter
CB - Core Bit	G & OCM - Gas and Oil Cut Mud	RPM - Revolutions Per Minute
CG - Connection Gas	GL - Ground Level	RRB - Rerun Bit
CK - Filter Cake	KB - Kelly Bushing	RT - Rotary Table
CKF - Check for Flow	LAT - Logged After Trip	SD - Sand %
CL - Salinity, ppm Cl	NB - New Bit	SO - Show of Oil
CR - Circulate Returns	NCB - New Core Bit	SOL - Solids %
DB - Diamond Bit	NR - No Returns	SPM - Strokes Per Minute
DC - Depth Correction	PDC - Polycrystalline Diamond Compact Bit	STG - Short Trip Gas
DCB - Diamond Core Bit	LC - Lost Circulation	SWG - Swab Gas
DF - Derrick Floor	PPM - Parts Per Million	SVG - Survey Gas
DG - Drilling Gas	PR - Poor Returns	S/T - Suction Temperature
DS - Directional Survey	PP - Pump Pressure	T.D. - Total Depth
DST - Drill Stem Test	PV - Plastic Viscosity	TCL - Trip Chlorides
EL - Electric Log	RM - Mud Resistivity, Ohm-Meter	TG - Trip Gas
E.M.A. - Equivalent Methane in Air, 1% = 50 Units	RMC - Mud Cake Resistivity, Ohm-Meter	TVD - True Vertical Depth
F - Filtrate, API cc's		V - Viscosity, API seconds
F/T - Flowline Temperature		W - Weight of Mud, ppg/pcf
GCM - Gas Cut Mud		WOB - Weight on Bit

CEMENT	COAL & LIGNITE	FINE SAND	KAOLINITE	VOLCANIC
LIMESTONE	CLAY	MEDIUM SAND	TUFF	IGNEOUS
DOLOMITE	SHALE	COARSE SAND	DIATOMITE	METAMORPHIC
GYPSUM	SILTSTONE	CONGLOMERATE	PORCELANITE	
ANHYDRITE	SANDY SILTSTONE	SANDSTONE	CHERT	

DRILL RATE ft/hr	DEPTH	CUTTINGS LITHOLOGY %	OIL TRACE FAIR GOOD	TOTAL GAS	CHROMATOGRAPH C1 C2 C3 C4 C5 ppm	LITHOLOGY DESCRIPTIONS & REMARKS
				Ditch Cuttings units		
Backup Scale - x10					10 100 1K 10K 100K 1M	
Begin Logging at 4:30 PM on 5/11/07						

Ran 20" conductor pipe; set at 20' Drill out with 8-3/4" bit.

Mw 8.7+ Vis 34

Siltst: Medium gray moderately firm, occasionally grading to very fine grain sandst, poorly cemented mostly with clay matrix, some carbonaceous with traces fossil fragments

Sandst: light gray moderately firm friable, very fine to fine with rare medium mostly subanglr clear, white qtz with predom clay matrix

Sandy siltst: medium to dark gray, friable soft, with common very fine grain sandst of clear, white and transul quartz occasionally very clayey, argillaceous

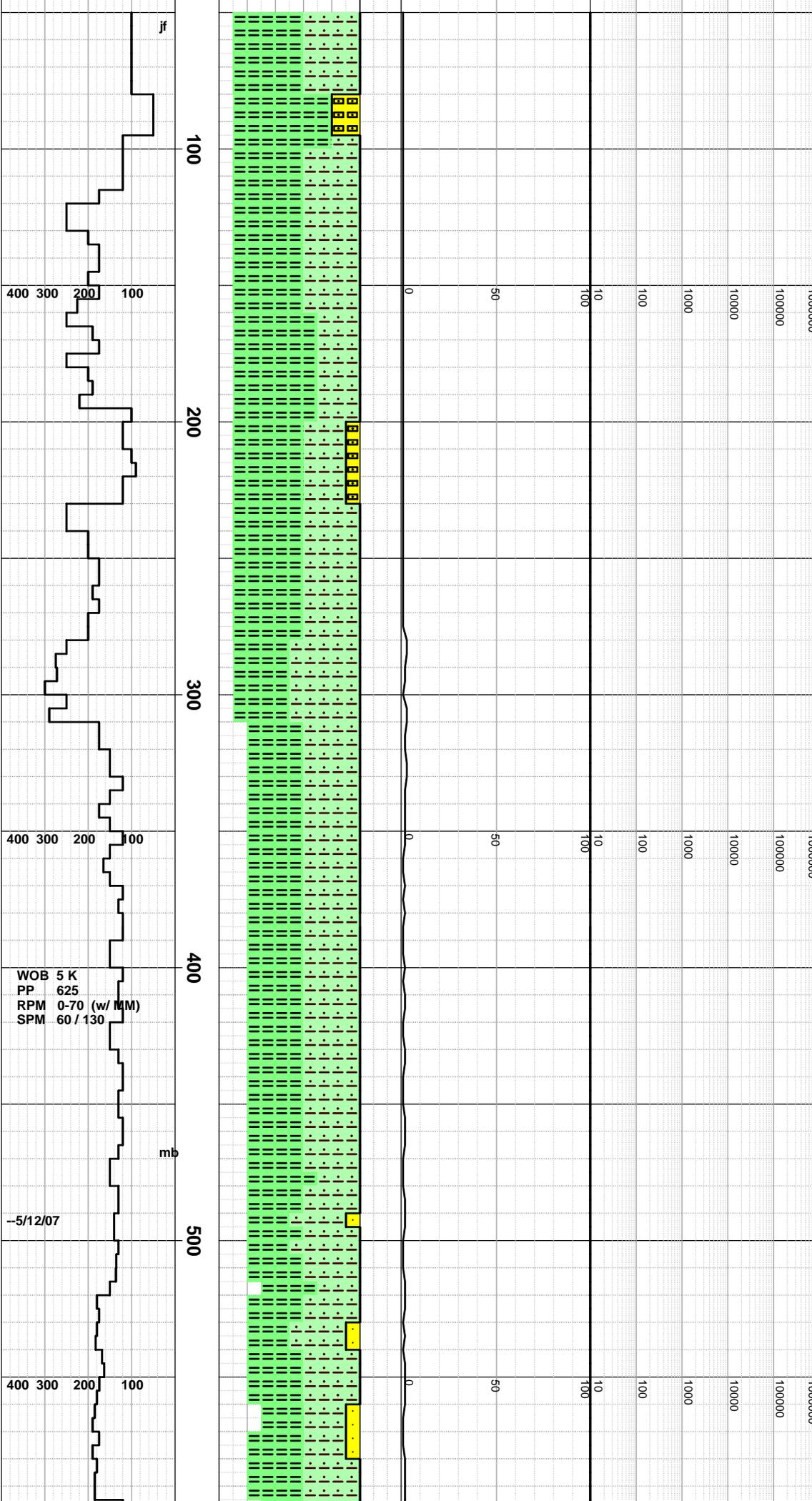
Mw 8.7 Vis 32

Siltst: Medium gray moderately firm, occasionally grading to very fine grain sandst, poorly cemented mostly with clay matrix, some carbonaceous with traces fossil fragments

Siltst: lt-med gry, fn-med grain, subang-subrnd, firm-friable, argillaceous siltstone, lt gry, fn grain subang-subrnd, claystone, clear-milky, fn grain, subrnd, quartz sand

Mw 8.7 Vis 42

Siltst: lt-med gry, fn-med grain, subang-subrnd, firm-friable, argillaceous siltstone, lt gry, fn grain subang-subrnd, claystone, clear-milky, fn grain, subrnd, quartz sand, occ blk, volcanic fragments



jf

100

200

300

400

500

mb

WOB 5 K  
PP 625  
RPM 0-70 (w/ MM)  
SPM 60 / 130

-5/12/07

400 300 200 100

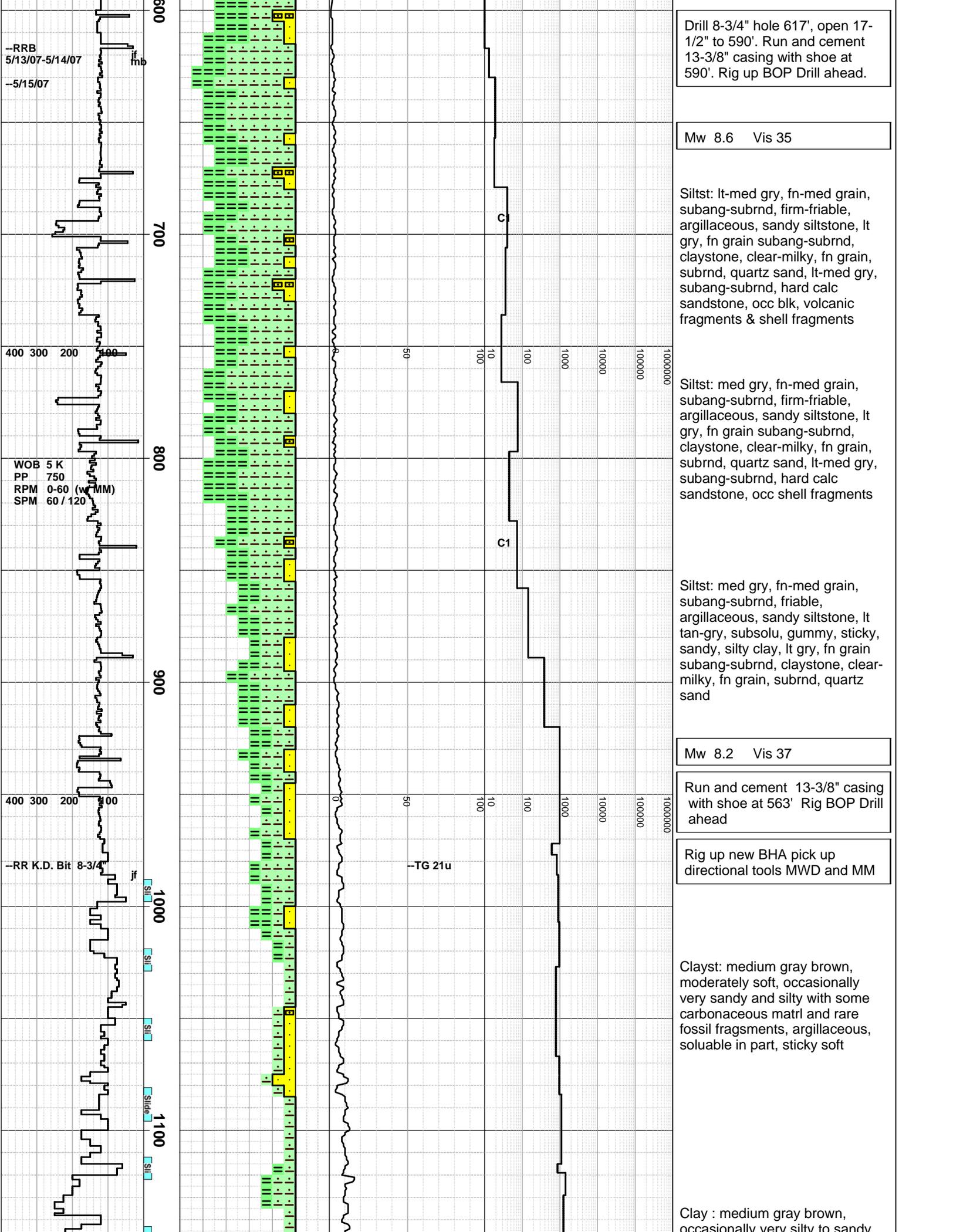
400 300 200 100

400 300 200 100

0 50 100 1000 10000 100000 1000000

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Drill 8-3/4" hole 617', open 17-1/2" to 590'. Run and cement 13-3/8" casing with shoe at 590'. Rig up BOP Drill ahead.

Mw 8.6 Vis 35

Siltst: lt-med gry, fn-med grain, subang-subrnd, firm-friable, argillaceous, sandy siltstone, lt gry, fn grain subang-subrnd, claystone, clear-milky, fn grain, subrnd, quartz sand, lt-med gry, subang-subrnd, hard calc sandstone, occ blk, volcanic fragments & shell fragments

Siltst: med gry, fn-med grain, subang-subrnd, firm-friable, argillaceous, sandy siltstone, lt gry, fn grain subang-subrnd, claystone, clear-milky, fn grain, subrnd, quartz sand, lt-med gry, subang-subrnd, hard calc sandstone, occ shell fragments

Siltst: med gry, fn-med grain, subang-subrnd, friable, argillaceous, sandy siltstone, lt tan-gry, subsolu, gummy, sticky, sandy, silty clay, lt gry, fn grain subang-subrnd, claystone, clear-milky, fn grain, subrnd, quartz sand

Mw 8.2 Vis 37

Run and cement 13-3/8" casing with shoe at 563' Rig BOP Drill ahead

Rig up new BHA pick up directional tools MWD and MM

Clayst: medium gray brown, moderately soft, occasionally very sandy and silty with some carbonaceous matrl and rare fossil fragsments, argillaceous, soluable in part, sticky soft

Clay : medium gray brown, occasionally very silty to sandy

--RRB  
5/13/07-5/14/07  
--5/15/07

400 300 200 100

WOB 5 K  
PP 750  
RPM 0-60 (w/ MM)  
SPM 60 / 120

400 300 200 100

--RR K.D. Bit 8-3/4"

1000

1100

C

C1

50

100

1000

10000

100000

1000000

50

100

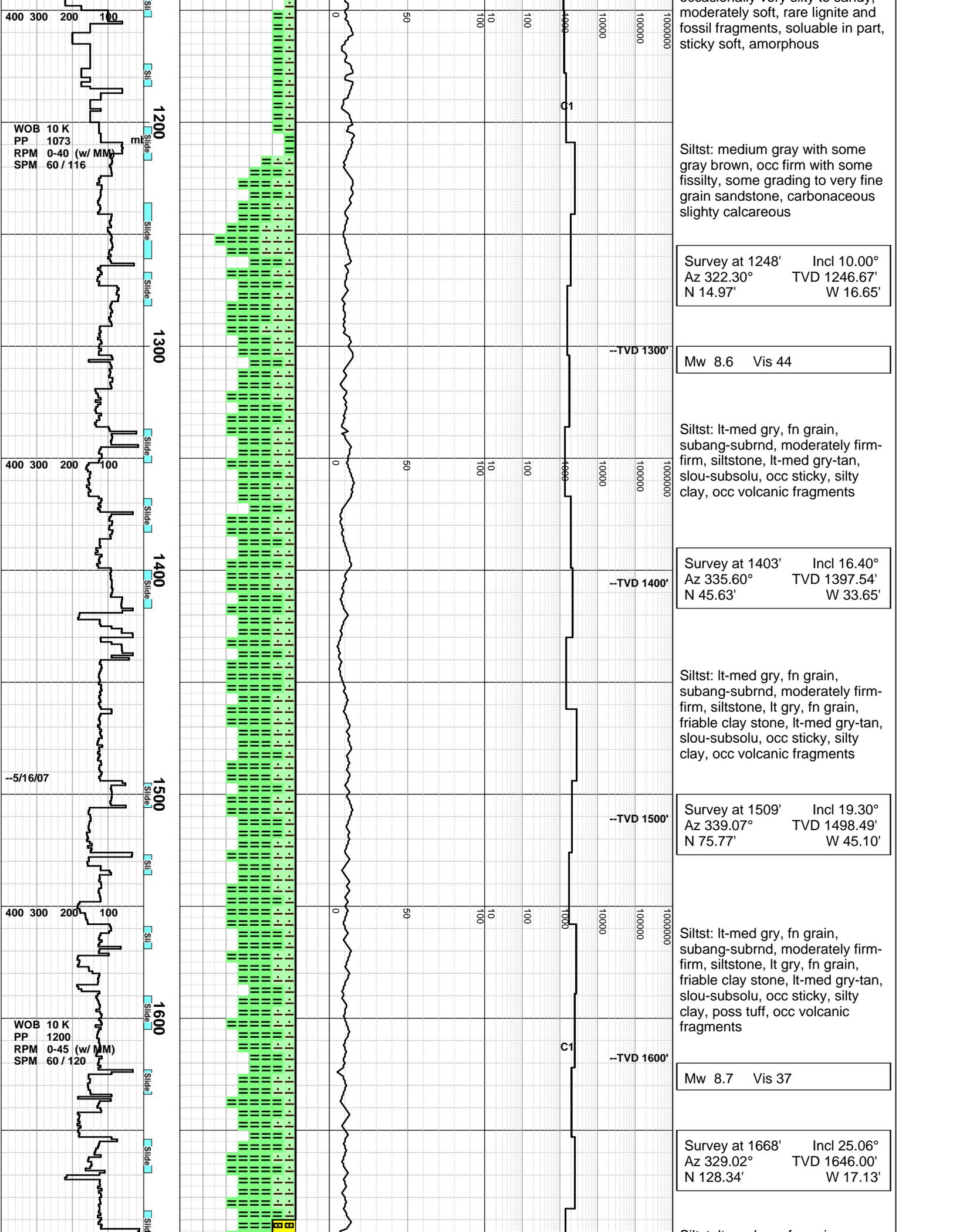
1000

10000

100000

1000000

--TG 21u



WOB 10 K  
 PP 1073  
 RPM 0-40 (w/ MM)  
 SPM 60 / 116

400 300 200 100

--5/16/07

WOB 10 K  
 PP 1200  
 RPM 0-45 (w/ MM)  
 SPM 60 / 120

occasionally very silty to sandy,  
 moderately soft, rare lignite and  
 fossil fragments, soluble in part,  
 sticky soft, amorphous

Siltst: medium gray with some  
 gray brown, occ firm with some  
 fissility, some grading to very fine  
 grain sandstone, carbonaceous  
 slightly calcareous

Survey at 1248' Incl 10.00°  
 Az 322.30° TVD 1246.67'  
 N 14.97' W 16.65'

Mw 8.6 Vis 44

Siltst: lt-med gry, fn grain,  
 subang-subrnd, moderately firm-  
 firm, siltstone, lt-med gry-tan,  
 slou-subsolu, occ sticky, silty  
 clay, occ volcanic fragments

Survey at 1403' Incl 16.40°  
 Az 335.60° TVD 1397.54'  
 N 45.63' W 33.65'

Siltst: lt-med gry, fn grain,  
 subang-subrnd, moderately firm-  
 firm, siltstone, lt gry, fn grain,  
 friable clay stone, lt-med gry-tan,  
 slou-subsolu, occ sticky, silty  
 clay, occ volcanic fragments

Survey at 1509' Incl 19.30°  
 Az 339.07° TVD 1498.49'  
 N 75.77' W 45.10'

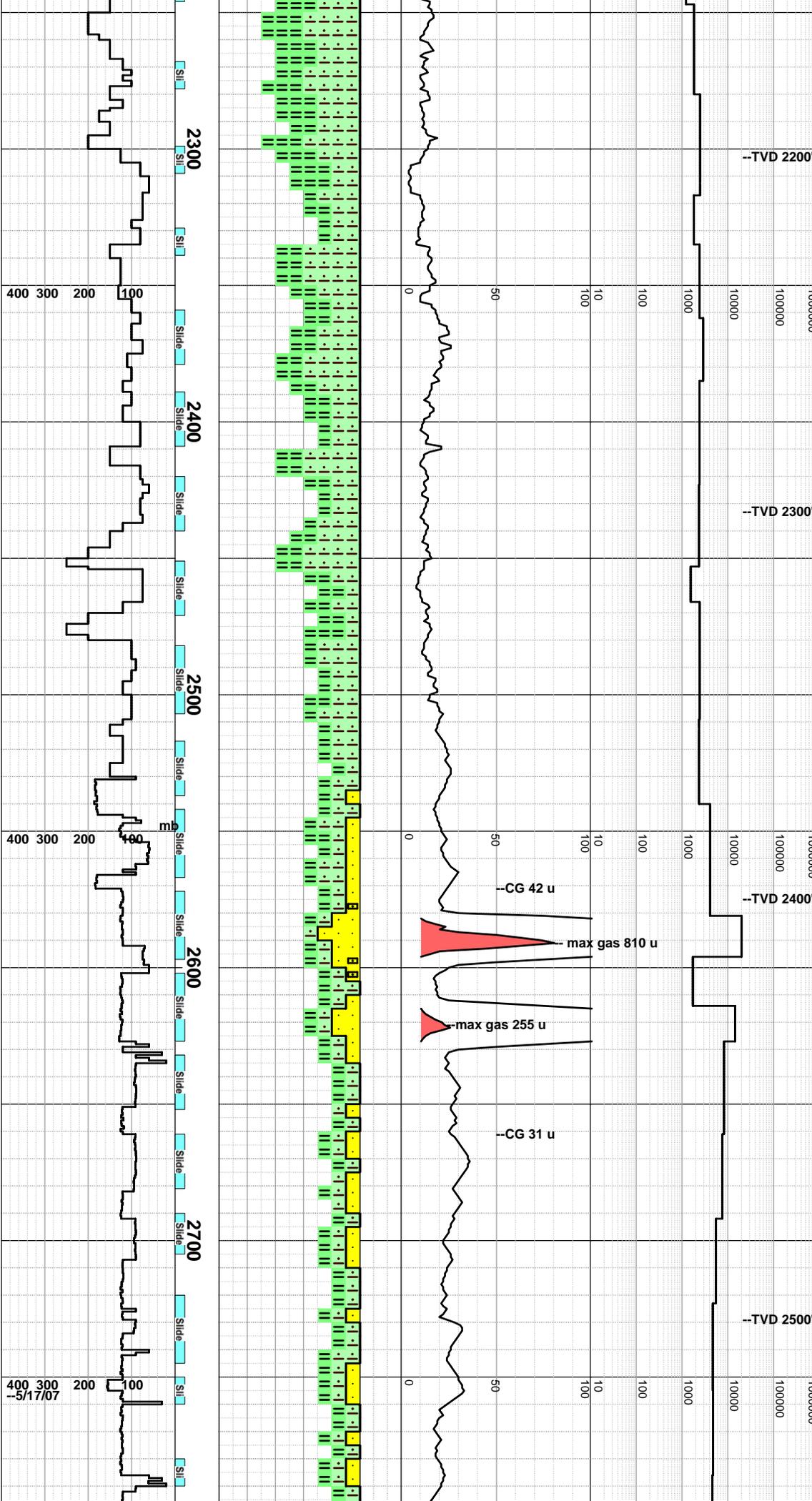
Siltst: lt-med gry, fn grain,  
 subang-subrnd, moderately firm-  
 firm, siltstone, lt gry, fn grain,  
 friable clay stone, lt-med gry-tan,  
 slou-subsolu, occ sticky, silty  
 clay, poss tuff, occ volcanic  
 fragments

Mw 8.7 Vis 37

Survey at 1668' Incl 25.06°  
 Az 329.02° TVD 1646.00'  
 N 128.34' W 17.13'

Siltst: lt-med gry, fn grain,





Brown, moderately to calcareous, occasionally grading to very fine grain sandstone, some argillaceous with rare fossil fragments

Survey at 2303' Incl 39.0°  
 Az 304.40° TVD 2196.72'  
 N 372.77' W 258.41'

Siltst: medium gray to gray brown with some green olive tint, occasionally grading to very fine grain sandst with abundant clay with some clay matrix, argillaceous, poor fissility with rare fossil fragments

Survey at 2462' Incl 45.00°  
 Az 296.50° TVD 2314.67'  
 N 428.55' W 349.01'

Siltst: medium gray to gray brown with some green olive tint, occasionally grading to very fine grain sandst with abundant clay with some clay matrix, argillaceous, poor fissility with rare fossil fragments

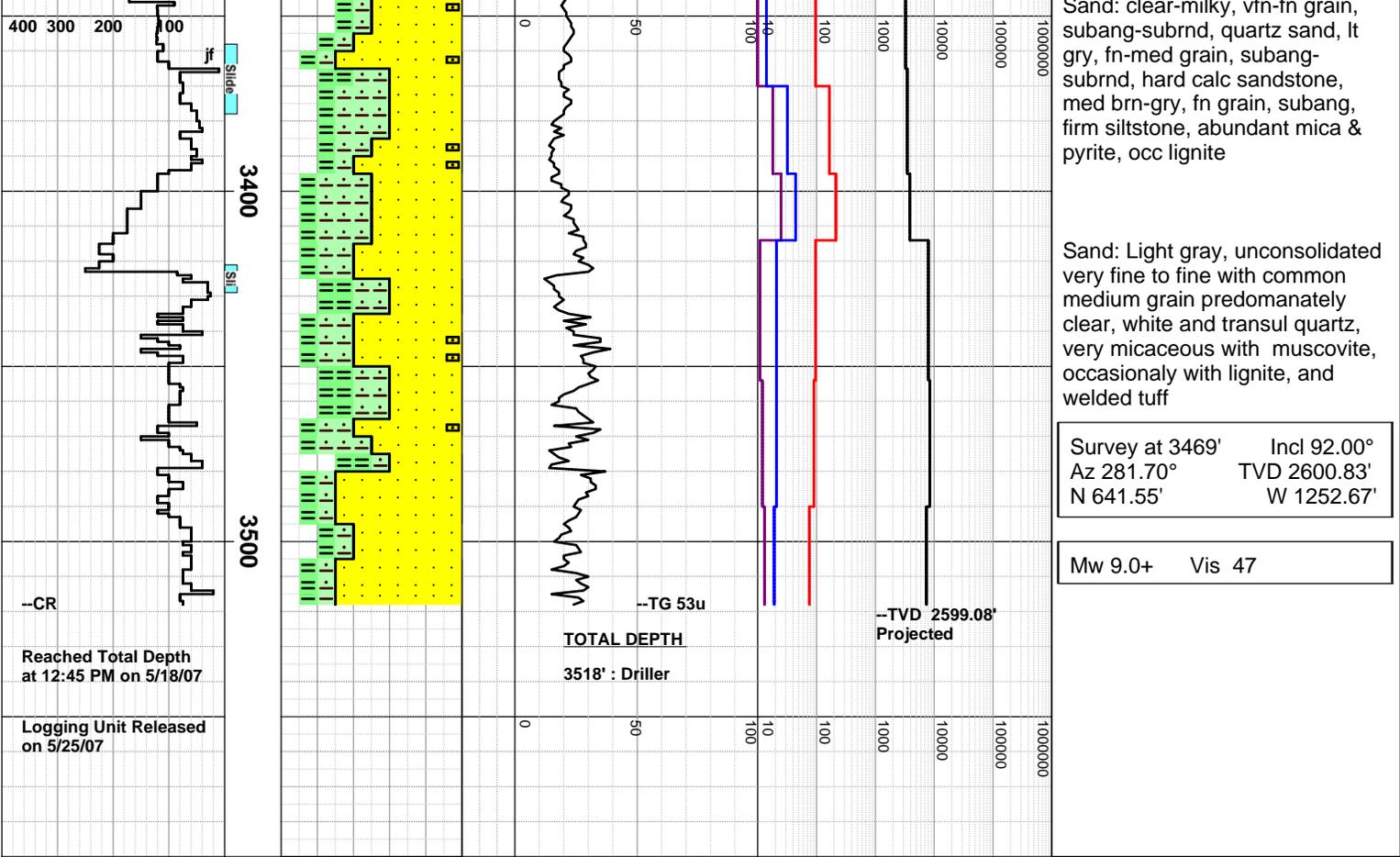
Sand: clear-milky, vfn-fn grain, subang-subrnd, quartz sand, lt gry, fn-med grain, subang-subrnd, hard calc sandstone, lt-med gry, subsolu, gummy, sticky, sandy clay, med gry, subang, argillaceous siltstone, occ fossil fragments & pyrite

Survey at 2670' Incl 59.40°  
 Az 286.90° TVD 2442.39'  
 N 488.74' W 500.78'

Clay: lt-med gry, subsolu, gummy, sticky, sandy clay, med gry, subang, argillaceous siltstone, clear-milky, vfn-fn grain, subang-subrnd, quartz sand, occ fossil fragments & pyrite

Clay: lt-med gry, subsolu, gummy, sticky, sandy clay, med gry, subang, argillaceous siltstone, clear-milky, vfn-fn grain, subang-subrnd, quartz sand, occ





Comments:

NORTHWEST NATURAL    IW 23ach-3-65    Bruer Pool Inject/WD Storage    SE 1/4 Sec. 3, T6N-R5W; WB&M



## FORMATION EVALUATION LOG

Scale: 2" = 100'