EPOCH

WELL LOGGING, INC.

COMPANY	ARCO OIL AND GAS CO.
WELL	LF # 24-8-75
FIELD	MIST
LOCATION	1195'N and 93' W from the SE corner of Sec 8, T7N, R5W
COUNTY, STATE	Columbia, Oregon
API WELL INDEX NO.	
ELEVATION	731' G.L. 741' K.B.
DATES	FROM 10-20-88 TO 10-26-88
DEPTHS	FROM 40'K.B. TO 2814'K.B.
SPUD DATE	10-20-88
DRILLING CONTRACTOR	Paul Graham Rig #4
MUD COMPANY	Bariod
LOGGING GEOLOGISTS	John Day Jim Eastes

ABBREVIATIONS

NB	BIT	MW	MUD WEIGHT
RRB	RERUN BIT	VIS	FUNNEL VISCOSITY
RTB	RE-TIP BIT	PV	PLASTIC VISCOSITY
CB	CORE BIT	YP	YIELD POINT
T.G.	TRIP GAS	FL	FLUID LOSS (cc/30 min)
S.G.	SURVEY GAS	CL	PPM CHLORIDE ION
W.G.	WIPER GAS	RM	MUD RESISTIVITY
C.G.	CONNECTION GAS	RMF	FILTRATE RESISTIVITY
WOB	WEIGHT ON BIT	LAT	LOGGED AFTER TRIP
RPM	ROTARY REV/MIN	NR	NO RETURNS
PP	PUMP PRESSURE	PR	POOR RETURNS
SPM	STROKES/MIN	MUD TYPE	E-Z Mud

CASING RECORD

13 3/8" AT 40' K.B.
9 5/8" AT 855' K.B.
AT
AT

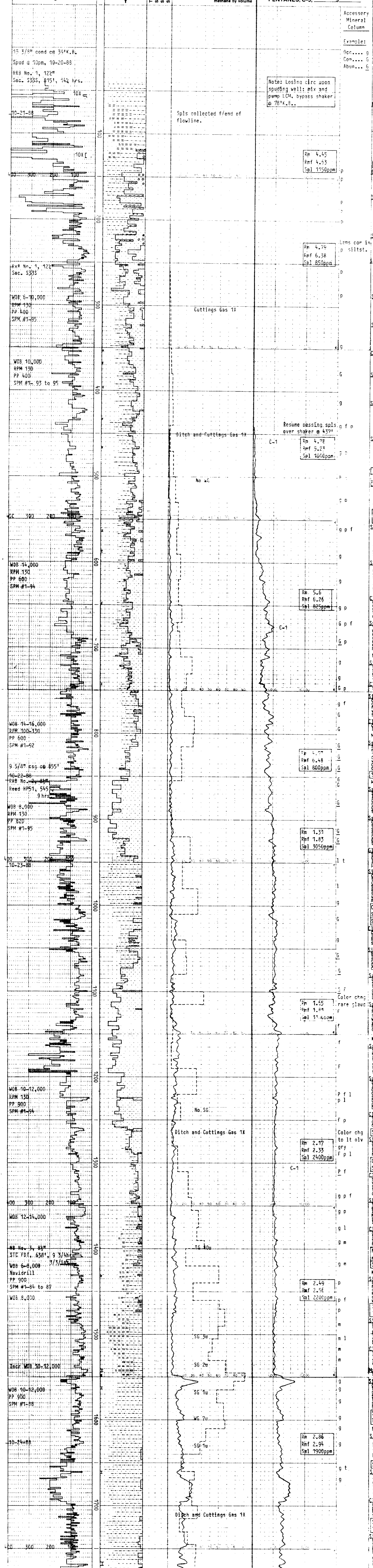
HOLE SIZE

12¼" AT 855' K.B.
8½" AT 2814' K.B.
AT
AT

·▣ SAND/SANDSTONE	☐ CLAY	Ɪ LIMESTONE	T TUFF	▪ LIGNITE
— SHALE	= MUDSTONE	V VOLCANIC	F FOSSIL	G GLAUCONITE
-· SILTSTONE	⊘ CONGLOMERATE	▵ BASALT	M MICA	P PYRITE

OIL: BASED ON LIVE OIL IN UNWASHED CUTTINGS AND PERCENT STAINING AND FLUORESCENCE OF WASHED SAMPLES.

PENETRATION		ANALYSIS OF RETURNS				REMARKS
EPOCH WELL LOGGING, INC. DRILL RATE (FT/HR) drilling data	DEPTH	LITHOLOGY	OIL TRACE STRONG TRACE SHOW STRONG SHOW	GAS — UNITS DITCH — TOTAL GAS CUTTINGS GAS CALIBRATION 100 units = 2% methane by volume	CHROMATOGRAPH — PPM METHANE, C-1, ETHANE, C-2, PROPANE, C-3, BUTANES, C-4, 4 PENTANES, C-5, 5	LITHOLOGIC DESCRIPTION MUD PROPERTIES SURVEYS, OTHER TEST DATA



Note: All carbides 500gm unless otherwise noted.

Note: All lith colors referenced to the GSA Rock Color Chart.

Note: Modifiers in Accessory Mineral Column are referenced to the number of cuttings present in a standard sample tray:

Rare..............1-5 cuttings
Occasional........5-10 cuttings
Common............10+ cuttings
Abundant..........present thru entire sample.

Weathered Soil: siltstone/mudstone ol yel-org; soft; crumbly to sli musky like soft waxy; lo density; fnly abrasive tex; no vis sand or dist indiv grains; tr organic mat/root.

Mudstone: ol yel-org; firm; lo nodular ctgs; easily broken; dull earthy lstr w/tr micaceous sparkle; silty w/fnly abrasive tex; com dk brnish-blk min stain w/ lesser hematite stn; no dist bed lineation.

MW 8.6 VIS 45

Note: Dist color chng [illegible]

Conglomerate: dk gry w/... com grn-blk clasts; fn to granule; sbang to rnd; mod spher; pr sort; qtz w/lgr polished basaltic clasts; spotty mica; decr lithics, incr clr qtz w/depth; tr pyr, glauc.

Siltstone: med to dk gry w/dist grnish hue; v firm; tough; blocky; earthy lstr; gritty tex, com sandy, interbed w/thin mod well sorted grain-[illegible] ss, [illegible] com fn anhedral pyr nods assoc w/ sandy fraction.

MW 8.8 VIS 68

Sand: med to dk gry; fn to occ granule, dom fn to med; sbang to rnd lo to mod sphericity; mod soft; unconsol to friable; qtz and fldsp w/v com dk grn to blk lithic frags com fn anhed pyr; occ mica.

Sandstone: dk gry; fn to crse; sbang to rnd; mod sort; mod well indur; tight; calc cmt; qtz w/sme ang fldsp; com dk grn and occ rd-org volc lithics; spotty pyr.

Survey @ 248', 0°30', S16E

Note: POOH @ 257', unplug jets.

Siltstone: becoming dom gry-brn w olv gry to gry stringers; soft to infreq firm; varies from v clayey to v sandy; dull lstr; sli to noncalc; occ to com thin cabonaceous lams; disseminated ppt mica incls.

Sandstone: oly gry; v fn to med; dom fn; ang to sbrndd; mod well sorted; mod to low spher; gr to matrix supp, tr calc cmtd; qtz, flds, tr to occ glauc, occ mica and carbonaceous mat; com grds to sandy sltstn.

Clay: olive gry to brnsh gry; mod thick, sli pasty consis; firm, occ plastic nature; mod high solubility; fr to pr cohesion; sli to non calc.

Siltstone: lt to med olive gry; overall incr ind to dom firm; gritty to grainy tex; dull to sli rsns lstr; no vis structures; com incld sand, occ glauc, relict micro fossils; dissem pyrite; tr free shelll frags.

Sandstone: med olv gry; v fn to fn, rare med; ang to subrndd; well sorted; low to mod spher, where vis; friable to mod well ind where calc cmtd; glassy to frosted qtz, flds, scat glauconite, occ mafic lithic frags, calcite, com free mollusk frags; sndstn com grds to sltstn.

Siltstone: olive gry; firm, brit to rarely tough; sandy texture; dull lstr, w occ pkly ppt and larger mica flakes; no vis fissility; occ sand rich layers; loc com glauconite and carbonaceous material; occ to com pyrite, dissem and tr in clusters.

Survey @ 498', 0°15', S12E

Wipe Hole @ 498'

Clay: olive gry; less thick, pasty consistency; soft to occ firm, gritty to abrasive tex; sli sticky in places; sli to noncalc; gen pr cohes.

MW 9.1 VIS 55

Carbide Lag 11.3 min @ 528', 46u
SPM #1-94, 113% theor, 4 min dur

Sandstone: olv gry, v fn to more com med; ang to sbrndd; dom subang; fr to gd srtg; more ind w incr calc cmtg, dom gr and matrix supported; qtz, com to occ glauc, occ pyrite, layered organics, few shell frags, tr lt gry to gry-brn volcanic rich clast.; persis grds to sltstn.

Siltstone: lt to med olive gry; firm to occ v soft and sli solubie; sli gritty to v grainy tex; dull earthy lstr; no visible structures; common incld qtz, glauc, occ to com framboidal to disseminated v fn pyrite, some carbonaceous material; wk tr forams; more com grds to v fn ss.

Clay: olive gry; sli to mod thick consistency; soft to sli firm, gritty texture; pr to fr cohesion; good solubility, occ tr sli plastic, v prly sold nodules grdg to clystn; non to sli calc.

Sandstone: lt to med olive gry; v fn to med; ang to well rndd; mod well sorted; dom easily friable, occ v well ind w abun calc cmtd; grdg to sandy limestone; qtz, occ to loc abundant fn glauconite, occ pyrite, dom dissem, flds, mafic lithic frags, some mica.

MW 9.2 VIS 54

Siltstone: med to lt olv gry; firm, sli sticky in places; gritty to sandy tex; non fissile; noncalc; com qtz, glauc, mafics; v clayey in places.

Clay: olv gry; soft, gritty, sli sticky tex; pr cohes; gd solu.

Siltstone: med to dk olv gry; firm; crumbly to sli tough; earthy lstr; grainy/gritty tex; sandy in part; noncalc; tr mica; occ to com bivalve frags; tr glauc assoc w/ fn ss interbeds.

Clay: olv gry; soft; thin pasty consistency; easily to mod soluble lo plasticity; lo adhesion; silty.

MW 9.2+ VIS 58

Sand: olv gry; v fn to med, dom fn; ang to sbrnd, dom sbang; lo to mod spher; mod sort; silty matrix; grain packed; com friable ss; non calc; com clr qtz, fldsp; tr lith v com to abund fn rndd glauconite clasts; occ to locally com foram; occ shell frags; tr pyr.

Survey @ 855', 0°30', S51E

MW 9.0 VIS 40

Sand: dk gryish grn, grn-blk; v fn to med, com fn; sbang to sbrnd; lo to mod sphericity; unconsolidated; clr qtz w/ang fldsp; com grn stained grs; abund fn rndd glauconite; tr org volc frags; occ shell frags.

Sand: dk gry-grn, grn-blk; v fn to occ crse, dom fn to med; sbang to sbrnd; lo to mod sphericity; mod sorted; unconsol w/tr pr-mod indur ss; clr qtz and fldsp; com'l abund glauconite; v com grn staining on transluc grains; tr shell frag tr pyrite as fn anhedral grs.

Glauconite: dk grn, grnish blk; soft to firm; com sli brittle; fn rndd to pellet shaped grains; dl lstr, waxy when broken; tr dissem pyr assoc w/glauc.

Siltstone: lt to med olv gry; firm; crumbly to sli tough; blocky; earthy lstr, waxy when scored; fine grainy to occ gritty tex; occ sandy; dist lack of glauc - glauc assoc w/thin sand stringers; spotty carb mat; occ to com bivalve frags; tr tuff; tr yel-gry marl.

Carbide Lag 9 min @ 987', 90u
SPM #1-95, 100% theor; 4 min dur.

Survey @ 1018', 0°15', N1E

Clay: med olv gry; soft; thin pasty consistency; easily to mod soluble lo to occ mod plasticity; lo adhesion; pr cohesion; occ becomes sli firmer, forming pasty nodules.

Siltstone: med olv gry, sli brnish hue; soft to firm; crumbly; earthy lstr; fn grainy tex; com sandy, grdg to matrix supported ss; com qtz, clr fldsp and abund glauc as clasts in silty matrix; com foram.

Sand/Sandstone: olv gry; v fn to occ crse, dom fn; ang to sbrnd; lo spher; mod sort; dom friable; qtz fldsp, occ org volc lithics; v com glauc; com foram; occ to local abund bivalve frags; calc cmtd ss assoc w/abund shell frags.

Sand: med gry; v fn to crse, dom fn to med; sbang to sbrnd; lo sphericity; mod sort; dom loose, sme friable ss; clr to milky qtz w/occ fldsp; incr to com fn org volc frags; dist decr glauc; com bivalve frags; occ mica; decr clr w/less colored grains.

MW 9.1 VIS 42

Sand: med gry; v fn to med; ang to sbrnd, dom sbang; lo to mod spher; mod sorted; dom loose w/occ friable ss; clr to milky qtz w/occ fldsp; dist decr grn stained grs; spotty biotite; tr epidote; occ to com fn bivalve shell frags; spotty org volc frags.

Sand: lt to med gry; v fn to crse; ang to well rndd; fr to pr srtg; low to mod spher; unconsol w occ calc cmtd ctgs as drlg bodes; qtz occ gry to wht, flds, occ to com subhed pyrite in clusters, carbonaceous mat, occ shell frags, glauconite, mafic lithics, inclg basalt, red-org welded tuff.

Clay: dk gry; thick, pasty consis; firm, greasy to abrasive tex; gd cohes; noncalc; nonexpansive, com incld sand.

Survey @ 1238', 0°30', N21W

Siltstone: lt olv gry w brn hue; soft, crumbly; gritty tex; dull lstr; occ organic incls; sli calc in places; non fissle; occ pyrite.

Carbide Lag 12.9 min @ 1299', 49u
SPM #1-95, 114% theor, 5 min dur

Clay: lt olv gry; mod thick consis; soft, greasy tex; fr solu, com v prly solu nodules w com incld sand; gd cohes; v sli calc; occ to abun fn euhedral pyrite in clusters.

Siltstone: gry-brn to dk yel-brn; firm, com brit; sli gritty tex; earthy; dom structureless w occ incipient fissility; com ppt mica spkls, occ glauc, pyrite; sli to noncalc; persis tr well ind calc cmtd sndstn.

Clay: varies btwn olv gry and lt gry-brn; thick, pasty consis; incr firm, v greasy tex; com insolu silty nodles; v sli xpnsv; non to sli calc; plastic.

Note: POOH @ 1400' to pick up mud motor.

Survey @ 1400', 0°30', S28E

MW 9.2 VIS 38

Siltstone: dk yelsh brn to rr olv gry; sft to firm; com prly solu; more ind ctgs are grayer; sli girtty tex; dull lstr; com incld mica, occ sand, organics; tr to com blk lithics, pyrite; sli calc where incld calcite is present.

Survey @ 1424', 1°30', S12E
TVD 1423.97', 5.33'S, 5.71'E

Siltstone/Mudstone: yel-brn to olv gry w/dist brn hue; soft; pasty to crumbly; dom nodular ctgs; v clayey w/plastic quality; grainy tex; micaceous; sli calc f/ppt sources; tr carb mat poss delin bedding; occ foram.

Clay: olv gry, sli brnish hue; sft thick pasty consistency; gd plasticity; pr solubility; mod adhesion; silty; com nodular ctgs grdg to mudstone.

Marl: dk yel-org; v firm; tough; abrasive; silty; small ang chips.

Siltstone: olv gry, gry-grn; firm; crumbly to tough; tab w/incipient fiss; dl to occ sli resinous lstr; gritty abrasive tex; dist lack solu clay matrix; dissem glauc; forams; occ thin wavy marl streaks sli-mod calc; rare fn sand; wkly siliceous appearance.

Survey @ 1550', 3°55', S38W
TVD 1549.82', 11.50'S, 4.54'E

MW 9.3 VIS 40

Siltstone: olv gry to gry-grn; firm; crumbly to sli brittle; tab; sli waxy lstr; occ transluc on v thin edges; abrasive tex w/tr v fn sand; incip fiss; tr dissem pyr; tr pl blu and brt org lith frags; scat foram; rare pyr.

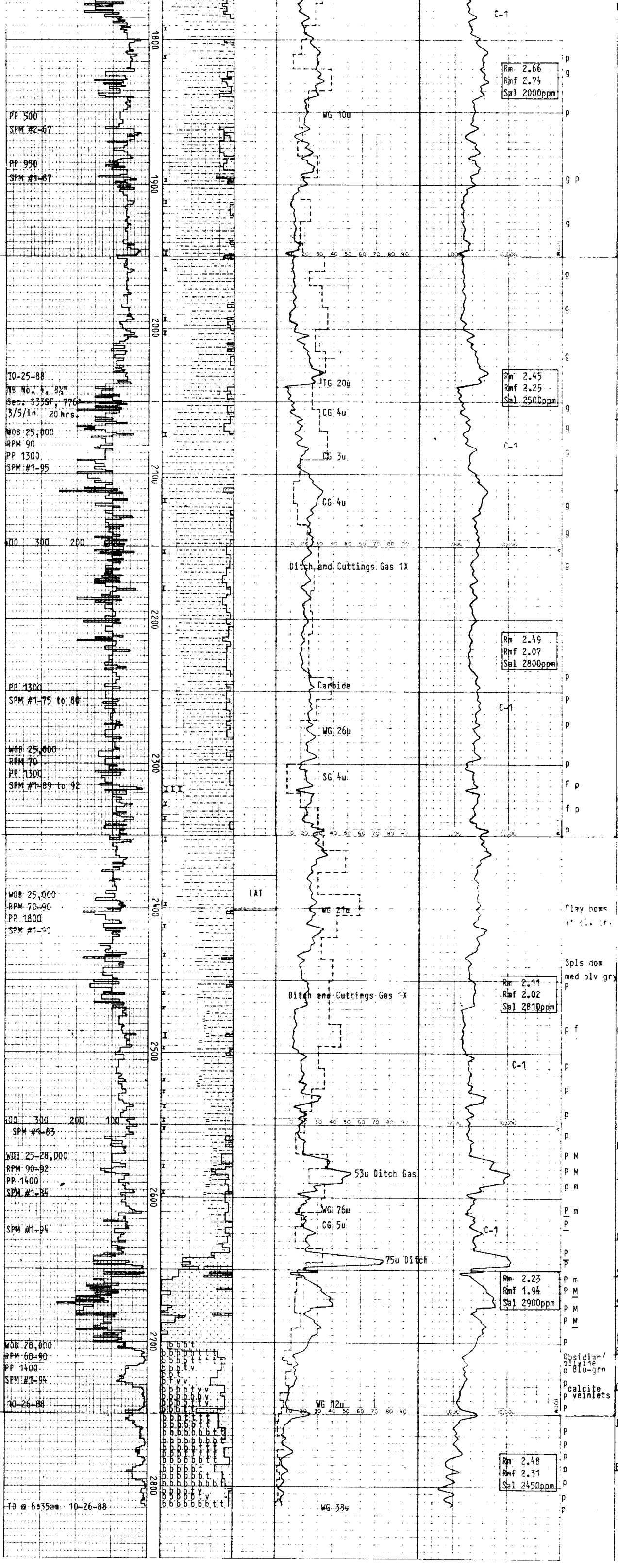
Survey @ 1644', 7°, S48W

Siltstone: olv gry, gry-grn, sli yelish hue; firm; crumbly to occ tough; tab - blky; dl lstr, less waxy; con't abrasive w/sli incr v fn sand; sli calc; dissem glauc tr organics; tr fiss; homogeneous appear; infreq lt brn siltst lam.

Clay: olv grn; soft; thin pasty consistency; easily soluble; lo plasticity; mod adhesion; poss derived f/crushed siltstone as sltst matrix becms more clay rich.

Survey @ 1706', 9°30', S50W
TVD 1704.80', 23.57'S, 8.43'W

Siltstone: gry-grn to olv gry; firm crumbly to tough, breaking w/dull snap; tab to incr blocky; dull to con't sli waxy lstr; abrasive tex becmg sli sandy; sli to mod calc f/ppt sources; occ v thin wavy calc streaks; tr dissem glauc; spty pl blu, blu-grn and org grst tr carb mat; infreq pr fiss.



Marl: @ 1763'; pl yel-gry; firm; brittle; flaky; assoc w/pasty ash wht chalky clay - sli expansive, pos volc origin.

Survey @ 1769', 11°30', S48W

Siltstone: olv gry to brnsh gry; soft to firm, dom brit; gritty to abrasive tex; earthy to sli rsns lstr; com organic debris; more com incld v fn to fn sand; occ v fn pyrite, glauc; occ to com basalt + volcaniclastic frags.

Survey @ 1832', 13°45', S51W
TVD 1828.24', 40.06'S, 27.64'W

MW 9.2 VIS 40

Sandstone: olv gry; v fg to fn; ang to subrndd; mod well srtd; mod to low spher; friable, gr supp to well ind, calc cmtd; qtz, com dk lithics, basalt, tuff, flds, occ pyrite and glauc; tr w incld shell frag; micaceous.

Survey @ 1894', 16°, S51W

Clay: olv gry; thin to sli thick, pasty consis; v sli sticky, abrasive tex due to incr ind of incl ctgs; gd solu; app predom derived from sli solu and crushed siltstn.

Siltstone: olv gry, occ sli grnsh tint; more firm, & brit; gritty; earthy to sli waxy lstr; non-calc; com incld sand, organics.

MW 9.4 VIS 40

Survey @ 1957', 17°15', S48W
TVD 1948.53', 61.59/S, 54.02'W

Siltstone: olv gry to dk grnsh gry; firm, brit to tough; gritty to sandy tex; dull lstr; occ subtrnsl on broken edges; less sand; occ glauc and organics; tr lineated poss microfoss relicts; few lt olv gry lams; tr pyrite, volcs.

Clay: olive gry; becoming more thin, less pasty consis; v sli sticky tex; decr cohes; gd solu; sli calc; occ lt olv gry prly solu nodules; persis tr pl yel-brn marl w organic, sulfide incls.

Survey @ 1988', 18°45', S49W
POOH @ 2038', drop mudmotor.

Siltstone: dk grnish gry; firm; crumbly to occ tough; tab w/fairly dist edges; dull to sli waxy lstr; fn grainy to occ gritty tex; sandy in part; non to sli calc; occ flaky partings; spotty glauc; tr framboidal to v fn anhedral pyr nods; occ-com loose calcite/shell frag.

MW 9.5 VIS 42

Siltstone: dk grnish gry; firm; crumbly to sli brittle; tab to blky ctgs; occ flaky w/tr fissility; dull to sli waxy lstr; gritty tex; sli sandy in places; sandy ctgs exhib subtle transluc quality; spotty fn glauc and framboid pyrite; tr org flecks; tr organic mat; com fn bivalve frags.

Note: Subtle improv quality pyr.

Survey @ 2152', 19°15', S47W
TVD 2132.85', 104.90'S, 100.72'W

Clay: gry-grn; soft; pasty; easily to mod soluble; mod plasticity; lo adhesion; silty.

Siltstone: dk grnish gry; firm; crumbly to occ sli tough; tab to blocky; sli waxy lstr; gritty tex com sli sandy w/occ lter gry streaks of silty ss; sli calc; tr fissility; spotty fn glauc; occ - com framb pyr; occ loose bivalve frags; fairly homogeneous.

Carbide Lag 24 min @ 2245', 56u
SPM #1-75, 100% theor, 5 min dur

Siltstone: bcmng olive gry; firm; gritty to grainy tex; dom rsns to waxy lstr, occ earthy where clayey; some v crude fiss, grdg to shale; com sandy w dissem and framboidal pyrite; tr fn glauc, dk lithics, few lineated organics.

Note: Pull tight during wiper trip @ 2276', 45' fill following trip, raise MW to 9.7

Survey @ 2277', 19°15', S46W
TVD 2250.86', 133.27'S, 130.61'W

Limestone/Marl: lt gry, pl yelsh brn; mod to v well ind; hackly to subrndd ctgs; microxln to grainy tex; rsns to earthy lstr; ranges from cln to v argill; occ calcite healings and pyrite lams.

MW 9.8 VIS 41

Siltstone: lt to med olv gry; firm, incr brit, occ tough; v sli to v gritty tex; rsns lstr when wet, earthy when dry; some incipient fiss and poss bedding planes; incld sand decr to occ trc, scat carbonaceous mat; tr forams, macroshell frags, poss phosphatic mat, dissem pyrite, and mica.

Wipe hole @ 2401'

Clay: lt olv gry; incr thick, mod pasty consis; more firm, sli sticky tex; improved cohes; solu remains high; nonplstic; sli calc.

Survey @ 2402', 20°, S46W

MW 9.9 VIS 43

Siltstone: med to dk olv gry; decr ind, firm, more crumbly; occ brit; more gritty texture; dull earthy lstr; few marl and sand laminations; calcareous; tr to loc com pyrite clusters; occ mollusk frags; tr fissility.

Marl: pl yel-gry, off wht; firm to hard; dom well ind; grainy tex; dull lstr; ang to subrndd ctgs; occ carbonaceous and sulfide incls; dom v argillaceous.

Clay: lt to med olv gry; thick, pasty consistency; soft to firm often silty tex; improved cohes and adhes; decr solubility to fr; sli calc; plastic; occ v prly solu noddles grdg to mudstn.

Survey @ 2529', 19°30', S46W
TVD 2488.12', 192.24'S, 191.68'W

MW 9.9 VIS 48

Mudstone: lt to med olv gry; firm; dom lg rndd ctgs; occ lams; sli gritty tex; dull lstr; v silty, grds to sltstn, often prly sold.

Sand: clr, wht, gry, blk; v fn to crse; dom fn to med; ang to rndd; fr srtg; lo to mod spher; unconsol; tr cmtd; frosted to glassy qtz, flds, com app volcanics, euhed pyrite, muschvite; tr poss glauc, some forams, shell frags.

Wipe Hole @ 2610'

Clay: olv gry, sli whtish bue f/ intermix ash wht chalky clay lams; soft; thin pasty consistency; easily soluble; lo plasticity; abund euhedral pyrite.

Sand: med gry, clr, milky; fn to crse; sbang to rnd; lo spher; mod sort; loose w/occ ss beds; qtz w/ scat org tuff frags; com sbhed pyr

Sand: incr clr f/2655'; fn to crse sbang to rnd; mod sort; loose; sli calc; dom qtz w/dist decr lithics; v com mica; com small sbhed to euhedral pyr.

Survey @ 2683', 19°45', S46W

Basalt: blk, grn-blk; firm-hd; crumbly to tough; fresh to weathered appears tuffaceous w/glassy grnd mass; spotty obsidian; waxy when scored; rndd to ang ctgs; rd tuff.

Clay: assoc w/incr ROP; pl bl-grn soft to firm; mottled; calc; f/ weathered volc; com euhedral chalcopyrite; incr rd tuff @ 2750'

Lithic Tuff: dk org-rd, com mottled w/brnish blk; soft to firm; com crumbly, occ sli brittle; com clr calc zeolite; occ pyrite inclusions; occ porphory tex; incr tuff assoc w/incr weathering in basalt.

Basalt: blk, gryish blk; v firm to hd; com brittle; tab and ang when fresh; dl to sparkling lstr; occ vis mafic xtls; com calcite vein fill; com pyr inclu in wthrd ctgs infreq vescicular.

Survey @ 2784', 20°, S46W
TVD 2728.12', 252.11'S, 253.68'W