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Davenport Newberry Geothermal
Well: **TG-16-S**
Field: Newberry Volcano
Date: 17 November 2010
Topic: Lithology Description
TD: 690’ (8” Hole)
Casing: 688’ (5” Pipe)

## SUMMARY

10’ Scoriaceous Basaltic Tuff-Lava
20’ Scoriaceous Basaltic Tuff-Lava
30’ Scoriaceous Basaltic Tuff-Lava
40’ 50% Andesite Crystal Ash Tuff/ 50% Basaltic Tuff-Lava
50’ Crystal Ash Tuff
60’ Basaltic Tuff-Lava
70’ Basaltic Tuff & Tuff Breccia
80’ 70% Dacite Crystal Tuff / 30% Basaltic Tuff & Tuff Breccia
90’ 50% Dacite Crystal Tuff / 50% Basaltic Tuff & Tuff Breccia
100’ 20% Dacite Crystal Ash Tuff/80% Basaltic Tuff
110’ Basaltic Tuff & Tuff Breccia
120’ 80% Basaltic Tuff & Tuff Breccia /20% Debris Flow
130’ 70% Basaltic Tuff & Tuff Breccia/30% Debris Flow
140’ Debris Flow
150’ 20% Pumice / 80% Debris Flow
160’ 30% Pumice / 70% Debris Flow
170’ Debris Flow
180’ Debris Flow
190’ Debris Flow
200’ Lithic Tuff
210’ Basaltic Tuff
220’ Basaltic Tuff
230’ Basaltic Tuff - Tuff Breccia
240’ Basaltic Tuff - Tuff Breccia
250’ Basaltic Andesitic Tuff - Tuff Breccia
268’ Basaltic Andesite Tuff - Tuff Breccia (Depositional Change)
280’ Basaltic Andesite Lava - Crystal Tuff
290’ Basaltic Andesite Lava - Crystal Tuff
300’ Basaltic Andesite Lithic Tuff
310’ Basaltic Andesite Crystal Tuff - Lava
320’ Basaltic Andesite Crystal Tuff - Lava
330’ Basaltic Andesite Crystal Tuff - Lava
340’ Basaltic Andesite Crystal Lithic Tuff - Lava
350’ Basaltic Tuff Breccia
360’ Basaltic Scoriaceous Tuff
370’ Basaltic Scoriaceous Tuff
392’ Basaltic Scoriaceous Tuff

400’ Basaltic Scoriaceous Tuff
410’ Basalt Scoriaceous Tuff
420’ 30% Basalt Scoriaceous Tuff Breccia / 70% Basalt Lava - Crystal Tuff
430’ Basalt Lava
440’ Basalt Lava
450’ Basalt Lava - Crystal Tuff
460’ 50% Basalt Lava / 50% Scoriaceous Basalt Tuff Breccia
470’ Scoriaceous Basalt Tuff Breccia
480’ Basaltic Lithic Tuff
490’ Basalt Tuff Breccia
500’ Scoriaceous Basaltic Lithic Tuff Breccia
510’ Scoriaceous Basaltic Lithic Tuff
520’ Scoriaceous Basaltic Lithic Tuff
530’ Basaltic Lithic Tuff
540’ Basalt Crystal Tuff – Lava
550’ Basalt Lithic Tuff
560’ Scoriaceous Basalt Lithic Tuff
570’ Scoriaceous Basalt Lithic Tuff
580’ Basaltic Lithic Tuff
590’ Basaltic Andesite Lava - Crystal Tuff
600’ Basalt Lava
610’ Basaltic Andesite Lava - Crystal Tuff
620’ Basaltic Andesite Lithic Tuff
630’ Dacite Crystal Tuff
640’ Dacite Crystal Tuff
650’ Lithic Tuff
660’ Dacite Tuff
670’ DaciteTuff
680’ Andesite Crystal Lithic Tuff
690’ Andesite Crystal Lithic Tuff

**LITHOLOGIC NOTES**

10’ Scoriaceous Basaltic Tuff/Lava: 90% Black gray Basalt with 10% to tan white pumiceous lithic fragments with some limonite staining.

20’ Scoriaceous Basaltic Tuff/Lava: Grayish black with minor grayish red on rubbles surfaces. Moderate hematite oxidation on fracture surfaces.

30’ Scoriaceous Basaltic Tuff/Lava: Grayish black to grayish red, hard, very brittle with rough irregular fracture, aphanitic with moderate reddish iron oxide staining from groundwater or post-depositional cooling.

40’ 50% Crystal Ash (Andesite?) Tuff/50% Basaltic Tuff/Lava: Crystal Tuff is medium gray and somewhat glassy with some flow texture and indeterminate composition. Basaltic Tuff is grayish black to grayish red and scoriaceous.

50’ Crystal Ash Tuff: Dark gray, hard, brittle with hackly fracture, composition is estimated to be Andesite to Basaltic Andesite.

60’ Basaltic Tuff/Lava: Dark grayish black with coatings of brownish red iron oxides, moderately vesiculated, some amygdales coated with hematitic material with some whitish gray clay minerals found atop the hematitic material. Lava is porphyritic.

70’ Basaltic Tuff & Tuff Breccia: Grayish black to reddish gray, hard, brittle, rubbly with lapilli-sized fragments with hematite to jarosite staining fracture to vesicle surfaces.

80’ 70% Crystal Tuff / 30% Basaltic Tuff & Tuff Breccia: Crystal Tuff is medium gray possibly Dacitic in composition with slight microscopic salt and pepper texture from micro-opaques set in devitrified glassy ash matrix.

90’ 50% Crystal Tuff/ 50% Basaltic Tuff & Tuff Breccia: Equal mix of medium gray and aphanitic Crystal Ash Tuff as above and grayish black vesiculated mafic material with hematite staining of vesicles and fracture surfaces.

100’ 20% Crystal Ash Tuff/80% Basaltic Tuff: Mix of massive Ash Tuff fragments in predominately basaltic material with scoriaceous, hematite oxidized material with some limonite coating.

110’ Basaltic Tuff & Tuff Breccia: Scoriaceous basaltic material with hematite and other iron oxide coatings.

120’ 80% Basaltic Tuff & Tuff Breccia/20% Debris Flow: Abundant iron oxide staining on mafic material, rare obsidian fragments and some opaline material devitrified from silicic glass.

130’ 70% Basaltic Tuff & Tuff Breccia/30% Debris Flow: Brownish gray, possible lithology boundary common limonite and hematite staining.

(Lithology Change)
140’ Debris Flow: Yellowish brown, subrounded fragments, common Fe-oxides and clay minerals ranging from limonite-jarosite-hematite. Silicic Ash Tuff fragments devitrified or weathered to silica minerals.

150’ 20% Pumice / 80% Debris Flow: Mix of pumiceous Rhyolitic Ash Tuff fragments mixed with grayish black Basalt fragments that are vesiculated and hematite stained.

160’ 30% Pumice / 70% Debris Flow: Mix of pumiceous Rhyolitic Ash Tuff fragments devitrified to clay and silica minerals occurring as subangular cuttings with good sphericity. The dominant lithology in the cutting sample are grayish black mafic fragments with red brown hematitic stains and commonly vesiculated.

170’ Debris Flow: Mostly basaltic material with 5% pumiceous rhyolitic material with common reddish hematite coatings on scoriaceous lapilli-sized fragments.

180’ Debris Flow: Composed of 10% Pumiceous Material; 30% Dacite Crystal Tuff fragments; and 60% basaltic material with limonite stains in places.

190’ Debris Flow: Composed of 10% Pumiceous Material; 30% Dacite Crystal Tuff fragments; and 60% basaltic material with limonite stains in places.

200’ Lithic Tuff Breccia: Mix of scoriaceous hematite stained Basalt fragments and massive medium gray (30%) Dacite Crystal Tuff fragments.

(Lithology Change)
210’ Basaltic Tuff: Reddish gray from strong hematite staining, extremely scoriaceous, trace yellow Fe-oxide clay minerals occurring in vesicle spaces.

220’ Basaltic Tuff / Tuff Breccia: Large black fragments with some reddish gray to dark gray pieces, hard and brittle, hackly fracture; vesiculated; scoriaceous to aphanitic.

230’ Basaltic Tuff / Tuff Breccia: Dark gray to reddish gray from Fe-oxidation of some of the mafic rock matrix; vesiculated; one fragment with coating of yellow brown material within an amygdule or vesicle.

(Lithology Change)
240’ Basaltic Tuff / Tuff Breccia: Dark gray with some grayish purple fragments which are moderately to not vesiculated with some fragment having a ash matrix appearance.

250’ Basaltic Andesitic Tuff/ Tuff Breccia: Reddish gray to medium gray with some purplish hues; scoriaceous and strongly vesiculated; mafic composition with minor felsic components; somewhat agglutinated in places.

268’ Basaltic Andesite Tuff / Tuff Breccia: Reddish gray to brownish gray; scoriaceous; slightly vesiculated.

(Depositional Change)
280’ Basaltic Andesite Lava/ Crystal Tuff: Medium gray; hard; brittle; hackly to somewhat flat fracture; aphanitic; lava-like appearance.

290’ Basaltic Andesite Lava/ Crystal Tuff: Medium gray; hard; crumbly to flaky cutting habit; aphanitic.
300’ Basaltic Andesite Lithic Tuff: Medium gray; large lapilli sized Basaltic Andesite fragments held together by a soft clay matrix probably devitrified ash.

310’ Basaltic Andesite Crystal Tuff/ Lava: Medium gray; hard; blocky cutting habit; hackly fracture; aphanitic.

320’ Basaltic Andesite Crystal Tuff/ Lava: Medium gray; hard; blocky somewhat flat cutting habit with hackly fracture; aphanitic.

330’ Basaltic Andesite Crystal Tuff/ Lava: Medium gray; hard; hackly fracture with some fracture surfaces having a brown mineral-fill; massive appearance; aphanitic.

340’ Basaltic Andesite Crystal Lithic Tuff/ Lava: Mostly medium gray with some red brown vesiculated Debris Flow fragments with slight coating of blue mineral or colloidal material; transitional sample.

(Lithology Change)
350’ Basaltic Tuff Breccia: Grayish red to cinnamon red from hematitic alteration extending deep into the matrix of the rock; some unaltered fragments; rare light orange colloidal-like cuttings occurring as plates.

360’ Basaltic Scoriaceous Tuff: Brownish red with some dark gray fragments; hard; crunchy; brick red under scope.

370’ Basaltic Scoriaceous Tuff: Brick red, hard, sharp edges; crunchy to brittle; aphanitic; strongly vesiculated.

392’ Basaltic Scoriaceous Tuff: Brick red; hard; crunchy to brittle; aphanitic; strongly vesiculated; slight faint colloidal coating in places; matrix devitrified but glassy in places.

400’ Basaltic Scoriaceous Tuff: Brick red; hard; brittle to crunchy; vesiculated with some vesicles flat and stretched in places; devitrified; aphanitic with rare agglutinated fragments.

410’ Basalt Scoriaceous Tuff Breccia: Brick red; hard; brittle to crunchy; vesiculated; aphanitic; rarely lava fragments.

(Lithology/Depositional Change)
420’ 30% Basalt Scoriaceous Tuff Breccia / 70% Basalt Lava/ Crystal Tuff: Brownish red; hard; brittle; aphanitic; minor brick red fragments as above; probably a volcanic flow boundary.

430’ Basalt Lava: Medium gray; hard; somewhat flat and roughly splintery fractures; aphanitic; sharp edges; fresh and unaltered appearance.

440’ Basalt Lava: Medium gray; hard; somewhat splintery to blocky cutting habit; aphanitic; 5-10% breccias-like fragments in cutting sample; colloidal-like coatings in on some fragments.

450’ Basalt Lava/ Crystal Tuff: Medium gray with slight brownish gray hue; flaky to blocky cutting habit; breccias-like texture.

(Depositional / Lithology Change)
460’ 50% Basalt Lava / 50% Scoriaceous Basalt Tuff Breccia: Equal part medium gray; hard; aphanitic lava & brick red; scoriaceous; cinder-like; vesiculated Tuff fragments; cutting size for both lithology is large and rubbly.

470’ Scoriaceous Basalt Tuff Breccia: Brick red; subangular, cobble-sized cuttings which are vesiculated; aphanitic with rare agglutinated orange glass sections; some vesicles appears flattened.

480’ Basaltic Lithic Tuff: Equal parts medium gray with blocky to flat cutting habit with aphanitic texture and brick red; subangular somewhat spherical lapilli-sized; vesiculated fragments.

490’ Basalt Tuff Breccia: Brick red and medium gray; hard; brittle; blocky, subangular gravel; aphanitic; gray fragments massive; red fragments are scoriaceous.

500’ Scoriaceous Basaltic Lithic Tuff Breccia: Brick red with 20% dark gray fragments; red cuttings are very vesiculated with some vesicles being flatten and stretched; gray cutting are mafic; massive and aphanitic.

510’ Scoriaceous Basaltic Lithic Tuff: Equal part brick red cinder and medium gray lava; in places obvious breccias texture with red rock adjacent to gray rock.

520’ Scoriaceous Basaltic Lithic Tuff: Brick red to brownish gray lava. Lava fragments are vesiculated in places; some cinder-like fragments have translucent glassy red agglutinate in places.

530’ Basaltic Lithic Tuff: Mostly dark gray with some brick red; moderately vesiculated; aphanitic; trace white clay mineral as vesicle-fill, possible zeolite.

(Depositional Change)
540’ Basalt Crystal Tuff/Lava: Medium gray with minor red brown fragments; flaky to blocky cutting habit with hackly fracture; aphanitic; massive appearance; rare vesiculated fragments.

550’ Basalt Lithic Tuff: Medium gray with 30% brick red fragments; transitional sample from lava to Lithic Tuff; 30% of fragments vesiculated; aphanitic; hematite rimming some vesicle sites.

560’ Scoriaceous Basalt Lithic Tuff: Brick red with 20% medium gray lava-like fragments; red fragments are cinder-like; strongly vesiculated; aphanitic with a devitrified matrix.

(Depositional Change)
570’ Scoriaceous Basalt Lithic Tuff: Equal parts brick red vesiculated fragments and medium gray to grayish brown; aphanitic with fragments having a massive appearance. Breccia fabric visible in cuttings.

580’ Basaltic Lithic Tuff: 60% medium dark gray fragments with massive appearance, aphanitic, and mafic. 40% reddish brown cuttings with rubbly; scoriaceous; and vesiculated fragments.

590’ Basaltic Andesite Lava/Crystal Tuff: Medium gray with 10% orange brown fragments; hard; tough; brittle; flaky to blocky cutting habit; unaltered beyond post depositional hematite and Fe-oxidation of groundmass and vesicle surfaces.

600’ Basalt Lava: Dark gray; mafic; aphanitic; 15% scoriaceous; cinder-like fragments; rough to irregular to hackly fractures; texture mostly crystalline.

610’ Basaltic Andesite Lava/Crystal Tuff: Medium gray; hard; tough; very brittle; blocky to smooth and flat fracture; aphanitic but crystalline at microscopic level; slight salt and pepper texture with pepper appearance from minor opaque minerals in felsic matrix.

620’ Basaltic Andesite Lithic Tuff: 60% medium gray Andesite Crystal Tuff fragments as above. 40% brick red, vesiculated, scoriaceous fragments with some vesicle sites filled with Crystal Tuff material.

(Lithology Change)

630’ Dacite/Andesite Crystal Tuff: Light gray; hard; aphanitic to naked eye, but has crystalline texture at microscopic level with 10% opaque grains, some of which are magnetite and probably the remainder being ilmenite set in devitrified Ash Tuff matrix.

640’ Dacite / Andesite Crystal Tuff: Light medium gray; hard; tough; blocky to somewhat flat cutting habit; aphanitic to naked eye, but has obvious crystalline texture under scope with 10% opaque fragments set in glistening felsic matrix.

(Depositional Change)
650’ Lithic Tuff: 50% Crystal Tuff fragments as above and intermixed with 50% brick red; scoriaceous; hematite oxidized fragments as above.

660’ Dacite Andesite Tuff: 80% fragments light medium gray; hard; tough; blocky cutting habit with somewhat flat fracture; aphanitic to the naked eye but has obvious crystalline texture under the scope with 10% opaque minerals, a few which are magnetite. The remainder of the fragments are mix of scoriaceous fragments and aphanitic, massive, and mafic cuttings as well.

670’ Dacite Andesite Tuff: Medium gray; aphanitic to naked eye; microcrystalline; speckled with mafic opaques (ilmenite + magnetite) in felsic matrix; hematite oxidation along minor fracture surfaces; blocky tabular cutting habit.

680’ Andesite Crystal Lithic Tuff: Medium gray intermixed with reddish gray; gray fragments are microcrystalline; red gray fragments are vesiculated and composed of devitrified ash altered to clay minerals in part.

690’ Andesite Crystal Lithic Tuff: Gray to grayish red with some brown hues; crumbly appearance; cutting fragments have somewhat subrounded edges; aphanitic with matrix being made up of devitrified ash with minor vesicles.

Davenport Newberry Geothermal
Well: TG-5-S
Field: Newberry Volcano
Date: 18 November 2010
Topic: Lithology Description
TD: 693’ (8” Hole)
Casing: xxx’ (5” Pipe)
Logger: Mike Krahmer

**SUMMARY**

| | |
|---|---|
| 40’ | Rhyodacite Crystal Tuff |
| 50’ | Rhyodacite Crystal Tuff |
| 60’ | Rhyodacite Crystal Tuff |
| 70’ | Rhyodacite Crystal Tuff |
| 80’ | Rhyodacite Crystal Tuff |
| 90’ | Rhyodacite Crystal Tuff (Pumiceous) |
| 100’ | Rhyodacite Crystal Lithic Tuff |
| 110’ | Basalt Scoria |
| 120’ | Basalt Scoria |
| 130’ | Basalt Scoria |
| 140’ | Basalt Scoria |
| 160’ | Basaltic Andesite Lithic Tuff |
| 170’ | Basaltic Andesite Lithic Tuff |
| 180’ | Basalt Tuff Breccia |
| 200’ | 30% Basalt Scoria / 70% Andesite Crystal Tuff |
| 210’ | Andesite Crystal Tuff |
| 220’ | Basaltic Lithic Tuff |
| 245’ | Basalt Lava |
| 260’ | Dacite Crystal Tuff |
| 270’ | Dacite Crystal Tuff |
| 280’ | Rhyodacite Lithic Tuff |
| 290’ | Rhyodacite Tuff |
| 300’ | 60% Obsidian / 40% Rhyodacite Tuff |
| 310’ | 60% Obsidian / 40% Rhyodacite Tuff |
| 320’ | 60% Obsidian / 40% Rhyodacite Tuff |
| 330’ | Rhyodacite Crystal Tuff |
| 340’ | Rhyodacite Crystal Tuff |
| 350’ | Dacite Crystal Tuff |
| 360’ | Dacite Crystal Tuff |
| 373’ | 30% Obsidian / 70% Rhyodacite |
| 380’ | 30% Obsidian / 70% Rhyodacite |
| 390’ | Lithic Tuff |
| 400’ | Lithic Tuff |
| 408’ | Lithic Tuff |
| 420’ | Andesite Lava/Tuff |
| 430’ | Lithic Tuff/Debris Flow |
| 440’ | Debris Flow |
| 458’ | Lithic Tuff |

470’ Basaltic Andesite Lithic Tuff
480’ Basaltic Andesite Lithic Tuff
490’ Basaltic Andesite Lithic Tuff
500’ Andesitic Crystal Lithic Tuff
510’ Andesitic Crystal Lithic Tuff
520’ Basaltic Andesite Lithic Tuff
530’ Dacite Crystal Tuff
540’ Scoriaceous Ash Tuff
550’ Scoriaceous Ash Tuff
560’ 30% Obsidian / 70% Pumiceous Rhyodacite Tuff
570’ Pumiceous Rhyodacite Tuff
580’ Pumiceous Rhyodacite Tuff
590’ Rhyolite Crystal Tuff
600’ 60% Rhyolite Crystal Tuff / 40% Ash Tuff
610’ 90% Rhyolite Crystal Tuff / 10% Ash Tuff
620’ 80% Rhyolite Crystal Tuff / 20% Ash Tuff
630’ Rhyolite Crystal Lithic Tuff
640’ Rhyolite Crystal Tuff
650’ Rhyolite Crystal Lithic Tuff
660’ Rhyodacite Crystal Tuff
670’ Rhyodacite Crystal Tuff
680’ Rhyolite Crystal Tuff
690’ Rhyolite Crystal Lithic Tuff

## LITHOLOGIC NOTES

40’ Rhyodacite Crystal Tuff: Medium gray; moderately hard; cryptocrystalline and glassy in places; glassy fabric is opaque and dark gray; common to minor grains of fresh to devitrified pumice entrained in matrix; moderately fresh with young appearance.

50’ Rhyodacite Crystal Tuff: Medium gray with interlacing seams of pinkish gray; opaque, glass-like matrix as above; sample shows abundant vesicles/amygdule development with some of the entrained pumice fragments commonly devitrified to cristobalite. Interesting sample. Trace to minor Fe-oxide alteration.

60’ Rhyodacite Crystal Tuff: Medium gray with minor interlaces of pinkish gray; pinkish gray material is assumed to be a silica polymorph derived from devitrified pumice fragments; rough, gritty, crumbly texture; rarely iron clay or oxide minerals.

70’ Rhyodacite Crystal Tuff: Medium gray with minor purple gray hue; moderately hard; crunchy; crumbly cutting habit; aphanitic to rarely microcrystalline in some places; rarely trace iron clay or oxide minerals.

80’ Rhyodacite Crystal Tuff: Medium light gray; moderately hard; crunchy to friable; gritty; pumiceous; aphanitic matrix with cryptocrystalline matrix; some euhedral felsic crystal clusters.

90’ Rhyodacite Crystal Tuff: Light to medium gray; moderately hard; crunchy to rarely friable; gritty; crumbly cutting habit; possible flow banding in places; cryptocrystalline to aphanitic; trace (<1%) very fine opaques; trace (<1%) scoriaceous lithic fragments.

100’ Rhyodacite Crystal Lithic Tuff: Light to medium gray; hard to moderately hard; brittle to crunchy; crumbly to gritty texture; somewhat brecciated appearance with some mafic fragments intermixed with silicic Tuff fragments.

(Lithology / Depositional Change)
110’ Scoriaceous Basalt: Brick red; moderately hard to crunchy, vesiculated cinders with complete devitrification of matrix to iron oxides during cooling process; no vesicle-fill minerals observed.

120’ Scoriaceous Basalt: Brick red; moderately hard to crunchy; rough to abrasive cutting habit; somewhat vesiculated; common splatter accretionary texture; rare Rhyodacite Crystal Tuff lithic fragments.

130’ Scoriaceous Basalt: Brick red to purple reddish gray; moderately hard to crunchy, subangular to angular, roughly spherical cutting habit with abrasive texture; very vesiculated and scoricaceous; rare Basalt fragments as brecciated lithic fragments.

140’ Scoriaceous Basalt: Equal parts brick red and brownish purplish red fragments with no obvious difference in texture or composition between colors; highly vesiculated; scoriaceous; moderately hard to crunchy; abrasive texture; purple hued fragments are possibly slightly glassy.

160’ Basaltic Andesite Lithic Tuff: Mostly dark gray fragments intermixed with reddish brown to brick red scoriaceous fragments; trace lithic fragments altered to limonite; crumbly cutting habit; most likely a Debris Flow.

170’ Basaltic Andesite Lithic Tuff: Brownish gray; hard; crumbly to blocky cutting habit; somewhat granular sample appearance with cuttings having subrounded to subangular edges; cutting fragment surfaces coated with pale gray white clay mineral; probably a Debris Flow.

180’ Basalt Tuff Breccia: Reddish gray to dark gray; hard; brittle to crunchy; moderately scoriaceous and vesiculated; no alteration other than iron oxides of which most are assumed to be immediately formed post-depositional.

200’ 30% Basalt Scoria / 70% Andesite Crystal Tuff: Intermixed medium gray and brick red fragments; gray fragments are hard, blocky cuttings with flat fracture, aphanitic to microcrystalline; red cuttings are scoriaceous with subangular gravel loosely adhered to Tuff fragments.

(Lithology Change)
210’ Andesite Crystal Tuff: Medium to light gray; hard; tabular to flaky cutting habit with subangular edges; microcrystalline; trace to rare magnetite; massive.

220’ Basalt Lithic Tuff: Dark gray fragments are intermixed with brick red scoriaceous fragments; both type of lithic fragments are mixed together in a breccias texture; cinder-like fragments are highly vesiculated; hard to crunchy; rubbly texture overall.

245’ Basalt Lava: Grayish black; hard; very brittle; vesiculated; aphanitic; scoriaceous in part; minor to common hematitic alteration into groundmass.

260’ Dacite Crystal Tuff: Light gray; hard; brittle; tabular to blocky cutting habit; flat to hackly fracture; microcrystalline with sugary micro-texture; trace clear euhedral felsic crystal.

270’ Dacite Crystal Tuff: Light gray; hard; brittle; tabular to blocky cutting habit; flat to hackly fracture; sugary texture more apparent; micro-porphyritic.

280’ Scoriaceous Lithic Tuff: Black, translucent to opaque lithic fragments held and supported in somewhat hematite stained, scoriaceous, crumbly matrix; black fragments are very hard and when fractured with the probe have micro-amygdule line with felsic crystals; rare feldspar phenocrysts.

290’ Rhyodacite Tuff: Medium gray; moderately hard to somewhat crunchy; black glassy fragments glued together with wisps of pumiceous material; gritty and abrasive texture overall.

300’ 60% Obsidian / 40% Rhyodacite Tuff: Dark gray with trace or reddish brown; Obsidian has pumiceous layers and aphanitic, scoriaceous lithic fragments; common vesicles and amygdule-lined with minerals – possibly cristobalite; trace sanidine crystals; hard and brittle; sharp edges.

313’ 60% Obsidian / 40% Rhyodacite Tuff: Abundant fragments with subangular edges which have been coated with a siliceous rime to subrounded fragments which are agglutinated together. When one of the fragments is broken open it reveals shiny black obsidian.

320’ 60% Obsidian / 40% Rhyodacite Tuff: As above with agglutinated texture even more pronounced and obvious.

330’ Rhyodacite Crystal Tuff: Medium gray with some pinkish gray hematitic hues; blocky; tabular cutting habit with flat and hackly surfaces; appears lava-like; aphanitic with some pumiceous material on cutting fragment surfaces.

340’ Rhyodacite Tuff: Medium gray with some pinkish hematitic hues; crumbly; matrix material is aphanitic; some pumice fragments have been incorporated into the lithology and show resorption into the matrix.

350’ Dacite Crystal Tuff / Lava: Medium gray; hard and brittle; platy with hackly fracture; porphyritic with medium grain feldspar phenocrysts set in a matrix with a somewhat sugary appearance; pinkish gray mineral-fill of joints and seams; the fracture-fill appears to be siliceous with rare to minor garnet-like mineral (apatite?); trace euhedral tarnished sulfide.

360’ Dacite Crystal Tuff: Medium gray with some pinkish gray minerals on fractures, joints, bedding seams; hard to very hard; brittle; crumbly along pumiceous filled areas or mottled layers.

373’ 30% Obsidian / 70% Rhyodacite Tuff: Dark gray with streaks and fracture surfaces of reddish gray; hard and brittle; moderate to strong fragmental texture; obsidian fragments are dull glassy with a abundant amygdule and vesicles sites filled with hematite altered material, pumice material and some post-depositional crystals.

380’ 30% Obsidian / 70% Rhyodacite Tuff: Medium gray; very hard and very brittle; glassy fragments cemented with crunchy and crumbly pumiceous material; obvious fragmental texture.

(Lithology/Depositional Change)
390’ Lithic Tuff: Dusky brown with slight red brown to yellowish brown hues; rubble-sized fragments; half of fragments are vesiculated; fresh lithic fragments surfaces appear mafic; trace pumice lithic fragments; overall composition is possibly Basaltic Andesite.

400’ Lithic Tuff: Yellowish brown gray; subangular cutting habit with rubbly fragmental texture; larger fragments all have a slight yellow brown limonite-like coating; possibly Debris Flow.

408’ Lithic Tuff: Multicolored with olive gray mixed with reddish gray; fragmental texture; hematite scoriaceous fragments mixed with Basaltic Andesite, Obsidian, and Crystal Ash Tuff.

420’ Andesite Lava/Tuff: Olive gray; hard; very brittle; tabular cutting habit with hackly fracture; microcrystalline matrix to aphanitic; flecked with micro-opaques which probably ilmenite and a trace of magnetite.

430’ Lithic Tuff/Debris Flow: Multicolored; red, dusky yellow brown, red brown; and med gray; commonly scoriaceous; rubbly, fragmental texture; no groundwater related minerals noted on vesicle or amygdule surfaces.

440’ Debris Flow: Yellowish brown with some dark gray; fragments are hard to moderate hard and set in a crumbly and rubbly matrix; fragments with subround to subangular edge; a minor amount of scoriaceous fragments with Jasper-like color.

458’ Lithic Tuff: Dusky yellowish brown to brownish gray; fragments are hard with tough texture; appears fragmental with a tendency to be more gravelly than crumbly; lithic fragments have subangular to angular edges and fragments appear fused together; composition is estimated to Basaltic Andesite.

470’ Basasltic Andesite Lithic Tuff: Dusky yellowish brown to dark brownish gray with some minor reddish fragments; the lithic fragments are hard; fragmental and brecciated texture with some limonite-like alteration.

480’ Basaltic Andesite Lithic Tuff: Dusky yellowish brown to brownish gray; with trace yellow orange fragments; blocky and gravelly fragments with subangular edges; fragmental texture; brecciated; minor grains altered to yellow brown to tan limonite-like clay minerals; trace scoriaceous vesiculated with jasper-like color.

490’ Basaltic Andesite Lithic Tuff: Brownish gray with brownish red coatings on fracture surfaces; matrix material is becoming more well define and is light gray and aphanitic; composition is indeterminate, but appears mafic.

500’ Andesite Crystal Lithic Tuff: Light gray; crumbly with hard fragments; aphanitic; possibly glassy in places; cuttings have angular to subangular edges.

510’ Andesite Crystal Lithic Tuff: Dusky yellowish brown to brownish gray; fragments are hard and brittle set in crumbly, fragmental texture; fragments are aphanitic with slight abrasive texture.

520’ Basaltic Andesite Lithic Tuff: Brownish gray; gray; some yellowish brown; hard; lithic fragments with a crumbly appearance; trace scoriaceous cinders.

530’ Dacite Crystal Tuff: Light gray to pinkish gray; hard; brittle to crunchy; aphanitic matrix with brecciate areas in places.

540’ Scoriaceous Ash Tuff: Light pinkish gray; hard; brittle; aphanitic matrix derived from devitrified ash; somewhat brecciated texture; estimated to have a Dacitic composition.

550’ Scoriaceous Ash Tuff: As above with some reddish gray; hard; brittle to crunchy; trace rounded quartz grain; common lithic fragments; somewhat brecciated.

(Lithology Depositional Change)
560’ 30% Obsidian / 70% Rhyodacite: Pinkish gray with blackish gray fragments; crumbly and fragmental texture with mix of rounded obsidian and pumice fragments fused into a Rhyodacite Crystal Tuff Matrix.

570’ Pumiceous Rhyodacite Tuff: Light gray to light pinkish gray; moderately hard; crunchy to crumbly fragments with subrounded edges; matrix somewhat devitrified; fragmental texture.

580’ Pumiceous Rhyolite Tuff: Light gray with slight pink hue; moderately hard; crumbly to crunchy; fragmental texture that is slightly fused; ~3% opaques; appears somewhat porphyritic in places.

590’ Rhyolite Crystal Tuff: Light gray; mottled; moderately hard and crunchy; slightly brittle; 3% to 5% opaque minerals; texture grades between fragmental and crystalline.

600’ 60% Rhyolite Crystal Tuff / 40% Ash Tuff: Rhyolite fragments are very light gray and somewhat speckled; moderately hard; crunchy; slightly pumiceous; microcrystalline with entrained lithic fragments and opaques; somewhat porphyritic. Lithic fragments are light brown to reddish brown; very slightly scoriaceous; moderately hard; ash matrix is devitrified.

610’ 90% Rhyolite Crystal Tuff/ 10% Ash Tuff: Light gray to off white and partially flecked with darker grays; moderately hard; crunchy; porphyritic; mottled with some evidence of resorbed crystals; subangular, blocky, spherical cutting habit; 3% opaques. Ash Tuff is brown and moderately hard; composed of devitrified ash; vesiculated in places; commonly incorporated into Crystal Tuff.

620’ 80% Rhyolite Crystal Tuff /20% Ash Tuff: Generally as above, but with less siliceous appearance; increase in amount of groundmass and that groundmass appears denser and pinker; felsic phenocrysts are better developed. Ash Tuff shows better devitrification to various minerals and is porphyritic in places.

630’ Rhyolite Crystal Lithic Tuff: Not much change in from 610’ and 620’ samples with 80% off white to light gray with pinkish hued Rhyolite Tuff that is somewhat mottled and intermingled with 20% reddish brown aphanitic Ash Tuff.

640’ Rhyolite Crystal Tuff: Off white to very light gray with slight pinkish hue; moderately hard and crunchy; porphyritic with pinkish cryptocrystalline groundmass and common white phenocryst sites showing resorption back into groundmass; overall composition maybe be Rhyodacite; 1% opaque minerals scattered through rock.

650’ Rhyolite Crystal Lithic Tuff: Mostly as above, with Rhyolite or Rhyodacite material being consistent over the last 50’. Lithic Tuff component continues to be brown devitrified Ash Tuff fragments incorporated and fused into rock.

660’ Rhyodacite Crystal Tuff: Very light gray with purplish brown hue; moderately hard and crunchy; porphyritic with resorbed felsic phenocrysts; groundmass is cryptocrystalline, dense, and siliceous; minor brown Ash Tuff lithic fragments; mottled; 1% - 2% opaques. Label change from Rhyolite to Rhyodacite represents no significant compositional change for the lithology.

670’ Rhyodacite Crystal Tuff: Same as 660’ sample. No secondary minerals noted in either sample or lithology section.

680’ Rhyolite Crystal Tuff: Very light gray to off white; moderately hard to tough, but friable in places; crumbly to crunchy; microgranular to microcrystalline texture; 2-3% opaques; 5% lithic fragments

690’ Rhyolite Crystal Lithic Tuff: Very light gray to off white with purplish hue; moderately hard to crunchy; porphyritic; groundmass is microcrystalline to cryptocrystalline and somewhat mottled. 20% lithic fragments appear to be mafic lava, possibly Basaltic Andesite.

| Well | TG 17 N |
|---|---|
| Depth (ft) | Description |
| 10 | Vesicular basalt |
| 20 | Vesicular basalt |
| 30 | Vesicular basalt with plag pheno, limonite filling vescules |
| 40 | Vesicular basalt |
| 70 | Vesicular basalt, some rounded fragments |
| 75 | Vesicular basalt, very rough and angular |
| 90 | Vesicular basalt |
| 100 | Vesicular basalt with plag pheno |
| 110 | Vesicular basalt with limonite |
| 120 | Basalt and Red cinders, a lot of oxidized powder coating everything |
| 130 | Basalt with limonite |
| 140 | basalt and vesicular basalt, olivine and plag phenos, found one 3-4mm inclusion of pure white quartz? It is hard, tried scratching it with office sissors left a faint mark |
| 150 | Basalt with oxidized phenocrysts |
| 160 | Basalt |
| 170 | Vesicular to scoria basalt |
| 180 | Basalt, Olivine pheno |
| 190 | Basalt/Andesite with plag phenos and biotite? |
| 200 | Vesicular basalt |
| 210 | Vesicular basalt with limonite |
| 220 | Vesicular basalt and red cinders |
| 230 | andesite/dacite? Some red cinders |
| 240 | Basalt/andesite |
| 250 | Weathered Basalt |
| 260 | Vesicular basalt, basalt, some red cinders |
| 270 | Basalt/andesite |
| 280 | basalt, some vesicular basalt and red cinders |
| 291 | basalt and vesicular basalt |
| 300 | Vesicular basalt and red cinders |
| 309 | Vesicular basalt with limonite, some oxidizied surfaces |
| 320 | Vesicular basalt with limonite |
| 330 | basalt and vesicular basalt |
| 340 | Basalt, inclusions on obsidian? |
| 350 | Vesicular basalt and red cinders |
| 360 | Vesicular basalt with limonite |
| 370 | Vesicular basalt, basalt, and some red cinders |
| 392 | Vesicular basalt with limonite |
| 400 | Vesicular basalt some calcite filling vugs, some red cinders |
| 435 | Vesicular to scoria basalt |
| 445 | Black and red cinders |
| 450 | Black cinders, some red cinders |
| 460 | Andesite, vesicular basalt, some red cinders |
| 470 | Vesicular basalt |
| 480 | Black Cinders |
| 489 | Black cinders and basalt |

| | |
|---|---|
| 500 | Black cinders to vesicular basalt |
| 510 | Black and red cinders to vesicular basalt |
| 520 | vesicular basalt, red and black cinders |
| 530 | Vesicular basalt with limonite, red cinders, and weathered basalt |
| 540 | Red cinders, vesicular basalt with plag pheno and limonite |
| 550 | oxidizied Vesicular basalt with liminite, red cinders or tuff |
| 560 | basalt and vesicular basalt w/ limonite |
| 570 | Basalt |
| 581 | Vesicular basalt and basalt |
| 590 | Vesicular basalt with limonite |
| 600 | basalt and vesicular basalt |
| 610 | Basalt |
| 620 | basalt and vesicular basalt w/ limonite |
| 630 | Vesicular basalt with limonite |
| 640 | Vesicular basalt with limonite |
| 650 | Vesicular basalt |
| 660 | Black cinders to vesicular basalt |
| 670 | Black cinders to vesicular basalt, some pale yellow alteration |
| 690 | Black and red cinders |
| 705 | Red Cinders |
| 710 | red cinders |
| 720 | Red cinders some basalt |
| 730 | Red cinders some basalt |
| 740 | Red Cinders |
| 750 | Vesicular basalt and red cinders |
| 760 | Basalt and Red cinders |
| 770 | Basalt and Red cinders |
| 780 | Basalt and Red cinders |
| 790 | Vesicular basalt with limonite and red cinders |
| 800 | Vesicular basalt and red cinders |
| 810 | Basalt, Vesicular Basalt and red cinders |
| 820 | Vesicular basalt and red cinders |
| 830 | Basalt some yellow to green alteration |
| 840 | Vesicular basalt with limonite |
| 850 | Vesicular basalt with limonite, some pale yellow alteration |
| 860 | Fresh basalt, vesicular to cinder basalt, yellow altered cinders and light grey pumice |
| 870 | Black cinders, vesicular basalt with calcite filled vugs, some pale yellow cinders |
| 880 | Basalt |
| 890 | Basalt |
| 900 | Basalt |
| 910 | Basalt with pale pink mineralization |
| 920 | fresh basalt, black cinders |
| 930 | fresh basalt, black and red cinders |
| 940 | fresh basalt (plag lathes), vesicular basalt, calcite filling vugs |
| 950 | fresh basalt (plag lathes), vesicular basalt, calcite filling vugs |

| Well | **TG 19 N** |
|---|---|
| Depth (ft) | Description |
| 10 | dirt |
| 20 | Basalt |
| 30 | red cinders |
| 40 | Vesicular Basalt and Red Cinders |
| 50 | Cinders |
| 62 | red cinders |
| 75 | red cinders |
| 90 | Red Cinders and Basalt |
| 100 | Basalt |
| 110 | Basalt |
| 120 | Basalt |
| 130 | Basalt, Plag lathes |
| 140 | Basalt |
| 150 | Basalt |
| 160 | Basalt |
| 170 | Basalt/Andesite |
| 180 | Basalt/Andesite |
| 190 | Basalt |
| 200 | Basalt |
| 210 | Basalt |
| 220 | Basalt |
| 230 | Basalt, red streaks on some grains |
| 240 | Basalt |
| 250 | Basalt and red cinders |
| 260 | red cinders |
| 270 | red cinders |
| 280 | Red cinders and some basalt |
| 290 | red cinders |
| 300 | red cinders |
| 310 | red cinders |
| 320 | red cinders |
| 330 | red cinders |
| 340 | red cinders |
| 350 | red cinders |
| 360 | Red Cinders and Basalt |
| 370 | Red Cinders and Basalt |
| 380 | Basalt and some red cinders |
| 390 | Red Cinders and Basalt |
| 400 | Basalt |
| 410 | Basalt/Andesite |
| 420 | Basalt/Andesite |
| 430 | Basalt/Andesite |
| 440 | Andesite and red Cinders |
| 450 | Basaltic Andesite |
| 460 | Andesite |
| 470 | Andesite and red Cinders |
| 480 | red and rust brown cinders w/ some andesite |

| | |
|---|---|
| 490 | Andesite |
| 500 | Basalt and red cinders |
| 510 | Basalt |
| 520 | Andesite/Dacite |
| 534 | Andesite |
| 552 | Basalt and red cinders |
| 560 | Red to Black Cinders, Basalt |
| 574 | Red cinders and some basalt |
| 582 | Red cinders and some basalt |
| 590 | Vesicular Basalt and Red Cinders |
| 590 | Red Cinders and Basalt |
| 616 | Red to black cinders |
| 620 | red cinders |
| 630 | Red Cinders and Vesicular Basalt w/ Limonite |
| 640 | Vesicular Basalt w/Limonite |
| 650 | Basalt and red cinders |
| 660 | Basalt, red cinders, and some white tuff |
| 670 | Red Cinders and Basalt |
| 670 | Red Cinders and Basalt  bag labeled 670 about 50/50 bag labeled 670-675 70/30 basalt to cinders |
| 680 | Red to Black Cinders some Basalt |
| 690 | Red to Black Cinders some pale yellow alteration, traces of Basalt |
| 700 | Red to Black Cinders some pale yellow alteration, traces of Basalt |
| 710 | Red to Black Cinders some Basalt |
| 720 | Red Cinders and andesite |
| 730 | Red Cinders with some lt grey tuff |
| 750 | Red to Black Cinders some pale yellow alteration |
| 760 | Red to Black Cinders some pale yellow alteration, traces of Basalt |
| 780 | Basalt and some red cinders |
| 790 | Basalt with calcite filling vugs, Traces of lt grey tuff |
| 800 | Basalt and red cinders |
| 810 | Vesicular Basalt w/ Limonite |
| 820 | Vesicular Basalt w/ Limonite |
| 830 | Basalt olive phenocrysts?(only saw one), calcite filling vugs |
| 840 | Basalt, calcite filling vugs |
| 850 | Basalt with rust and white colored mineralization filling vugs |
| 860 | Basalt with rust and white colored mineralization filling vugs, red cinders |