GEOLOGIC MAP OF THE GLASS BUTTES VOLCANIC COMPLEX, OREGON

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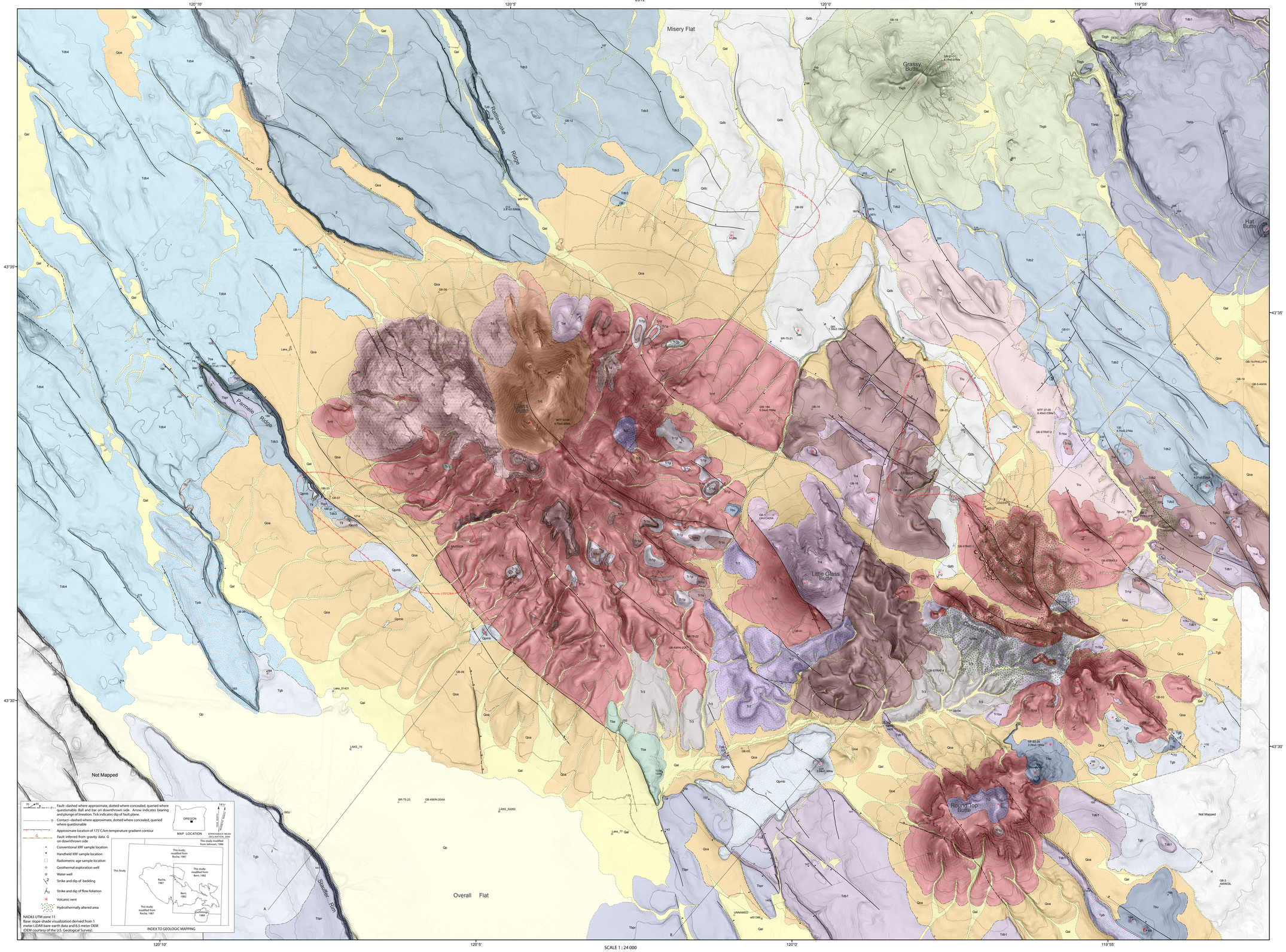

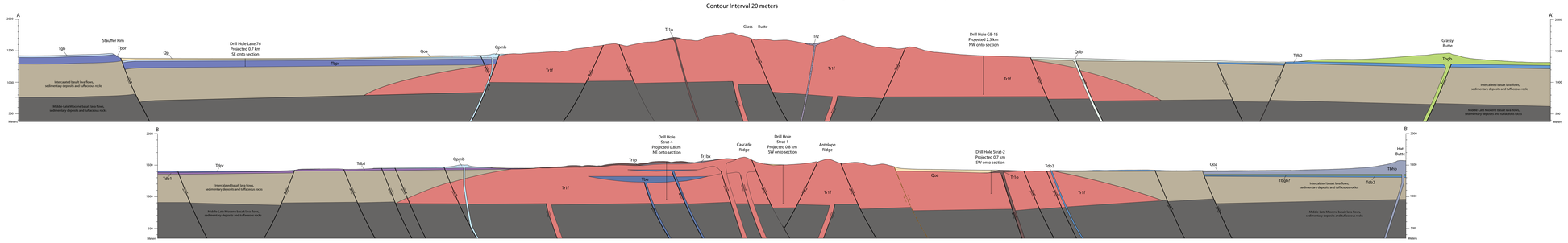

MAP UNIT DESCRIPTIONS

SURFICIAL DEPOSITS

Qal Quaternary alluvium (Holocene)– Unconsolidated gravel, sand and silt deposited along modern alluvial channels. Clasts of rhyolite, obsidian, pumice and locally basalt are subangular to rounded and poorly to moderately sorted.

Qp Playa deposits (Holocene)–Poorly consolidated fine sand, silt, and clay generally restricted to areas of active deposition in the interior of poorly drained basins with flat topography.

Qoa Older alluvium & colluvium (Holocene-Pleistocene)–Unconsolidated to poorly consolidated gravel, sand and silt deposited by slopewash and in abandoned alluvial channels. Typically forms a mantle of debris along flanks and bases of slopes. Clasts of rhyolite, obsidian, pumice, and locally basalt are angular to rounded and generally unsorted. Locally covered by thin, poorly developed soils.

VOLCANIC ROCKS

Pliocene to Pleistocene basalt to basaltic andesite lava flows and tuffs

Diverse basalt to basaltic andesite lava flows flank the Glass Buttes complex in all directions. Source vents located within and around the complex are commonly aligned along northwest striking faults. Flows are exposed along intermittent stream channels and degraded fault scarps, often exhibiting well-developed columnar jointing and locally rare platy jointing. Individual flow units are typically 2-10 meters in thickness, and rarely up to 30 meters where flows ponded into the structural basin to the north. Correlation of basaltic units is based on characteristic mineralogy, texture and whole rock geochemistry.

Fine-grained, dark-gray to black diktytaxitic olivine basalts form most of the surrounding plateau to the north and west of the Glass Buttes complex. These basalts have distinct diktytaxitic texture, with abundant olivine and plagioclase phenocrysts in a groundmass of plagioclase, olivine, clinopyroxene and oxides and 2-5% vesicles. The diktytaxitic olivine basalts (Tdb1, Tdb2, Qdb, Tdb3, Tdb4) have been subdivided into distinct chemical stratigraphic sub-units based on whole rock geochemistry.

Qdb Diktytaxitic olivine basalt (Pleistocene)– (1.39±0.18 Ma) Basalt lava flows of unit Qdb are geochemically characterized by 0.4-0.5 wt.% K2O, and 2.3-2.7 wt.% TiO2. Lava flows of unit Qdb were erupted from fault-aligned vents both within and on the flanks of the main Glass Buttes silicic complex, and were channeled to the northwest along a preexisting fault-controlled structural fabric. A small kipuka of Glass Buttes silicic rocks projects through flows of unit Qdb erupted from a small vent located between Cascade Ridge and Antelope Ridge.

Qpmb Plagioclase megaphyric basalt (Pleistocene?)–(2.04±0.38 Ma) Low volume lava flows of Qpmb erupted from two vents on the south and southeast flanks of Glass Butte. Individual lava flows are 5-10 meters thick. Characterized by 1-3 cm long plagioclase phenocrysts in a fine grained groundmass with abundant plagioclase microlites.

Tgb Plagioclase-Olivine glomerophyric basalt (Pliocene-Pleistocene)– Lava flows of basalt unit Tgb are found in the eastern map area, where flows erupted from several small vents between Round Top Butte and Cascade Ridge. To the west, 10-12 meter thick Tgb lava flows erupted from a nearby vent make up the up-thrown rim rock of Stauffer Rim. This medium to dark gray basalt is characterized by round clusters of olivine and plagioclase up to 1cm in diameter in a fine-grained groundmass.

Tpb Plagioclase intergranular basalt (Pliocene-Pleistocene)– Plagioclase rich (~30%) basalt with intergranular olivine and fine-grained groundmass. Lava flows of Tpib are found banking against the south side of the Parmele Ridge fault scarp and in an uplifted horst block to the south. No source vent is identified for Tpb.

Tb Mafic lapilli tuff (Pliocene-Pleistocene)– 3–5 meter thick unwelded lapili tuff composed of tan and brown pumice and lithics in a dark gray ashy matrix. Highly eroded; only preserved where underlying a cap rock of younger basalt.

Tdb4 Diktytaxitic olivine basalt (Pliocene-Pleistocene)– Basalt unit Tdb4 is geochemically characterized by 74-119 ppm Zr, and 0.17-0.19 wt.% MnO. Lava flows of Tdb4 form much of the low-lying topography west of Parmele Ridge. At Parmele Ridge, Tdb4 is banked against and partially buries the uplifted Tba and Tbpr fault scarp. It is similarly lapped onto the prominent Tib scarp to the north.

Tib Plagioclase trachytic basalt (Pliocene-Pleistocene)– Basalt unit Tib is a dark gray to black, fine-grained basalt with abundant flow aligned plagioclase laths and well-defined platy jointing exposed only along a ~30m high fault scarp east of Rattlesnake Ridge.

Tdb3 Diktytaxitic olivine basalt (Pliocene)– (2.81±0.05 Ma) Basalt unit Tdb3 is geochemically characterized by 0.1-0.2 wt.% K2O, and 0.6-1.0 wt.% TiO2. Lava flows of unit Tdb3 form much of the plateau north of Glass Butte and are well exposed in the prominent fault scarp forming Rattlesnake Ridge. To the south, flows of unit Tdb3 also form the eastern rim of Parmele Ridge. No source vent has been identified for flows of unit Tdb3.

Tpb Pyroxene Basalt (Pliocene)– Basalt unit Tpb is geochemically characterized by 290-298 ppm Sr, and 3.2-3.5 %\Zr with a phenocrysts assemblage of ~20% pyroxene up to 1mm long, and 20% plagioclase 1-3mm long, and rare <1mm size olivine phenocrysts with abundant plagioclase microlites in the groundmass. Exposed in an isolated faulted outcrop just south of Glass Butte and capping a prominent fault scarp southeast of Round Top Butte.

Thbb Basalt of Hat Butte (Pliocene)– Basalt of Hatt Butte is geochemically characterized by 0.8-0.9 wt.% K2O, and 2.6-2.7 wt.% TiO2. Hat Butte is a prominent mafic vent and related lava flows located 8 kilometers southeast of Grassy Butte. Lava flows from Hat Butte are medium to dark gray, with 5% plagioclase (1-3 mm) and rare olivine phenocrysts in a fine-grained groundmass.

Tbgb Basaltic-andesite of Grassy Butte (Pliocene)–(4.18±0.07 Ma) Basaltic-andesite of Grassy Butte is geochemically characterized by 1.1-1.3 wt% K2O, and 2.3-2.7 wt.% TiO2. Grassy Butte is a low, broad basaltic andesite scoria cone and associated lava flows located 10 kilometers north of Little Glass Butte. On the east side of the cone, deposits exposed in several cinder pits consist of mostly unconsolidated, oxidized, fine to coarse, scoriaceous cinders, bombs and agglutinate. Lavas emanating from Grassy Butte consist of very dark gray to black, fine-grained basaltic-andesite with ~2% plagioclase phenocrysts generally <1 mm.

Tdb2 Diktytaxitic olivine basalt (Pliocene)– (4.70±0.27 - 4.31±0.29 Ma) Basalt unit Tdb2 is geochemically characterized by 0.4-0.7 wt.% K2O, and 1.5-1.8 wt.% TiO2. Lava flows of unit Tdb2 were erupted from at least two small, structurally aligned vents located ~3 kilometers northeast of Antelope Ridge and were channeled northwest along preexisting fault-controlled drainages in the silicic rocks of the Glass Buttes complex.

Tbpr Basalt of Parmele Ridge (Pliocene)– (4.51±0.17 Ma) Basalt unit Tpbr is geochemically characterized by 437-482 ppm Sr. This aphyric, light to medium gray basalt caps the west rim of Parmele ridge and is exposed in faulted outcrops south of Glass Butte.

Tbs Basaltic andesite (Pliocene)– basaltic andesite lava flows are geochemically characterized by 634-666 ppm Sr. A ~20m thick section exposed at the NW end of Parmele ridge is light to medium gray, aphyric, and has rare 1-5 cm rhyolite inclusions. Tens km away to the SE, an exposure along a fault scarp is dark gray, and has 20-30% 1-2mm elongate vesicles.

Tdb1 Diktytaxitic olivine basalt (Miocene?-Pliocene)– Basalt lava flows are geochemically characterized by 0.2-0.4 wt.% K2O, and 1.7-2.0 wt.% TiO2. Unit Tdb1 directly overlies silicic rocks of the Glas Buttes complex in 3-8 meter thick faulted exposures directly east of Antelope Ridge and west of Round Top Butte. To the north, a ~30 meter thick exposure lies at the base of the section east of Grassy Butte. No source vent has been identified for lava flows of unit Tdb1. On the basis of available ages, Tdb1 has a bracketed age between 6.49±0.03 and 4.18±0.07 Ma.

Tbd Undifferentiated basalt

Late Miocene dacite to rhyolite lava flow and dome facies

Silicic rocks of the Glass Buttes complex are the oldest rocks exposed in the field area, and are composed primarily of nearly aphyric rhyolites, including facies that range from interiors of dome-devitrified flow to dense vitrophyre to margins consisting of pumice, brecciated vitrophyre, and pyroclastic ash rocks as well as locally reworked volcaniclastic sedimentary deposits. The silicic rock unit descriptions presented below are taken largely from detailed mapping by Berri (1982), Johnson (1984), and Roche (1987). $^{40}Ar/^{39}Ar$ ages of 6.49 ±0.03Ma, and 5.79 ±0.02Ma, (Ford, 2011) establish a local east to west age progression of silicic eruptive centers in the late Miocene, consistent with the regional westward younging trend of silicic rocks across the High Lava Plains. Hydrothermal alteration of silicic rocks is localized along faults bounding Cascade Ridge and Antelope Ridge, with diffuse zones of alteration extending ~3 kilometers northeast of Antelope Ridge. Hydrothermal opal (silicification) is the dominant alteration type, within irregular zones of rhyolite altered to mixtures of fine-grained kaolinite, alunite and opal and localized cinnabar mineralization (Berri, 1982; Hussey, 2010; Johnson, 1984; Martini, 2010). The opal-kaolinite-alunite alteration is here interpreted to result from near-surface steam-heated advanced argillic alteration characteristic of the uppermost and <100°C parts of epithermal/geothermal fluids (Simeone et al., 2005; Simmons et al., 2005).

Td Dacite lavas (Miocene-Pliocene?)– Voluminous dacite lava flows erupted from the west flank of Glass Butte. Medium to dark gray with ~5% plagioclase phenocrysts and 5-10% elongate vesicles.

Tdc Rhyodacite lavas (Miocene)– Black to gray; pink, often oxidized red rhyodacite lava flows are localized in the western end of the silicic complex and typically have >10% plagioclase and 2-6% hornblende phenocrysts.

Tr4 Rhyolite lavas (Miocene)– Rhyolite lavas occur as black to gray; pink, often oxidized red rhyolite lava flows with common contorted flowbanding, typically with <10% plagioclase phenocrysts.

Tr3 Pyroclastic ryolite (Miocene)– Unit occurs as well indurated ash-flow tuff with clasts of obsidian, pumice, and felsite in a white- to pink-colored rhyolitic ash matrix. Broad cross-bedding of cobble-size clasts occurs locally.

Tr2 Biotite-phyric lava flows & domes (Miocene)– biotite-phyric lava flows contain 1-2% biotite, ± quartz, ± plagioclase, ± sanidine phenocrysts in punriceous, gray to brown, locally perlitically fractured groundmass. Elongate vesicles comprise 25-40% of the volume. Biotite phenocrysts are ~2mm and aligned parralel to flow banding.

Trbx Carapace Breccia (Miocene)– Brecciated pumice zones are found associated with flows and domes and occur as poorly sorted, black, gray & brown pumice clasts within an unaltered gray-brown pumice matrix. Clasts are angular, ranging from pebble to boulder size.

Tr1p Pumice (Miocene)– pumice facies occurs as coarsely vesicular pumice, commonly perlitically fractured that occurs stratigraphically above the obsidian zone. Weathered surfaces are tan and fresh surfaces are light to dark gray. Vesicles, which generally compose more than 50% of the volume, are ovoid to highly elongate, ranging from <1mm to a few cm in diameter.

Tr1f Obsidian (Miocene)– obsidian facies composed of black, red, brown, mahogany, and colorless obsidian flows. Textures are nonvesicular, ranging from massive uniform to strongly flow banded. Obsidian breccia clasts in an obsidian matrix occur locally.

Tr1f Felsite (Miocene-Pliocene)– Devitrified gray glass with weak to moderate vesiculation aligned parallel to moderately-strongly developed flow banding. Lithophysae, spherulitic zones, and perlitic fracturing occur locally.

CORRELATION OF GEOLOGIC UNITS

SURFICIAL DEPOSITS

Qal, Qp, Qoa	Holocene, Pleistocene	QUATERNARY

Unconformity

VOLCANIC ROCKS

Qdb, Qpmb	Pleistocene	QUATERNARY
Tpb, Tpb, Tb, Tdb4, Tib, Tdb3, Tpb, Thbb, Tbgb, Tdb2, Tbpr, Tbs, Tdb1	Pliocene	TERTIARY

Unconformity

Td, Tdc, Tr4, Tr3, Tr2, Trbx, Tr1p, Tr1f, Tr1f	Upper Miocene	Silicic dome & flow facies of the Glass Buttes complex