

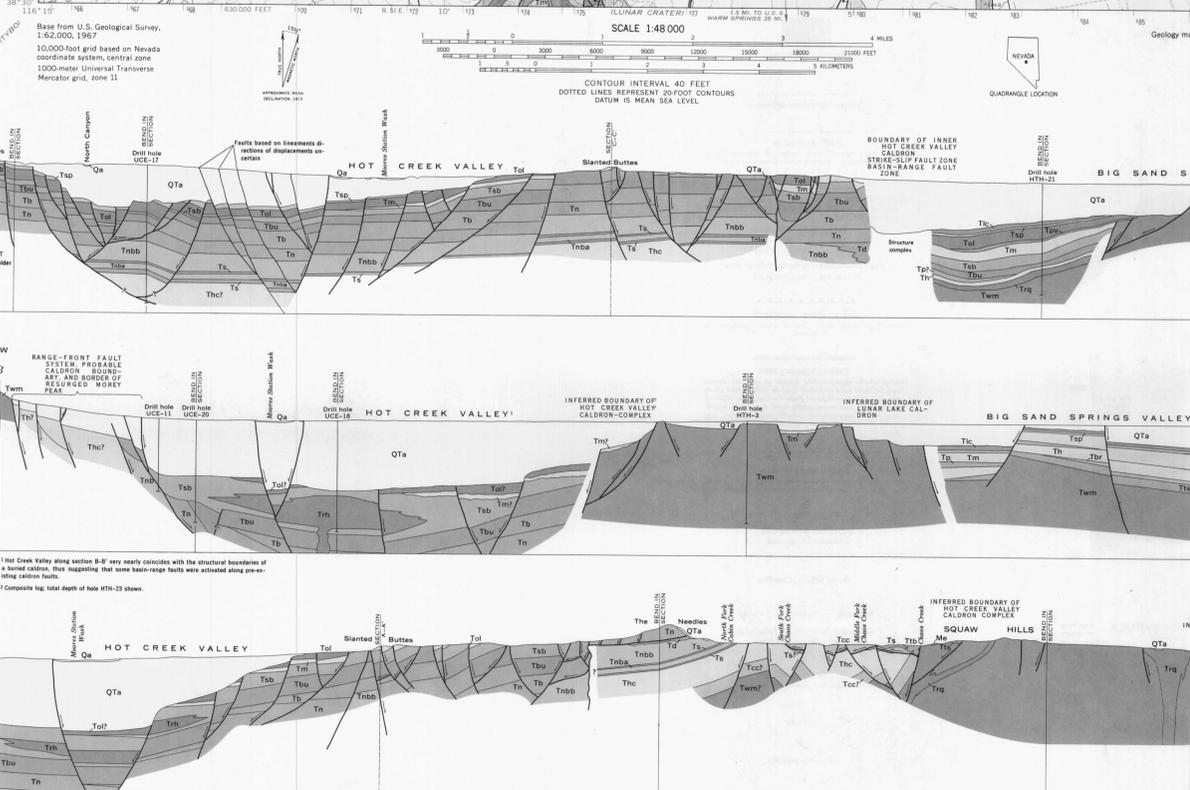
DEPARTMENT OF THE INTERIOR  
UNITED STATES GEOLOGICAL SURVEY

DESCRIPTION OF MAP UNITS

Phenocryst content that is listed in modal range, in percent, of the rock. Phenocryst minerals are listed as percent of total phenocrysts: q, quartz; alk, alkali feldspar; pl, plagioclase; f, feldspar; bi, biotite; ho, hornblende; cpx, clinopyroxene; opx, orthopyroxene; o, opaque minerals.

- Qb BASALT LAVA OF LUNAR CRATER AREA (0-50 ± ft) - Gray and black porphyritic and vesicular and andesite lava; commonly isotaxitic. Phenocrysts of subhedral and anhedral magnesian olivine as long as 8 mm, subhedral labradorite and clinopyroxene as long as 10 mm in an intergranular or subhedral groundmass of labradorite, clinopyroxene, orthopyroxene, opaque minerals, and sparse olivine. Locally diktyritic.
- Qc YOUNGER STREAM ALLUVIUM (0-100 ± ft)
- Qd OLDER ALLUVIUM AND COLLUVIUM (0-4,000 ± ft) - Consolidated and unconsolidated silt, sand, and gravel, and conglomerate and talus; windblown sand and silt on lee slopes along bluffs flanking the east side of Moon Station Wash; lower parts of alluvial section penetrated in all drill holes.
- Ta BASALT (0-100 ± ft) - Black and gray porphyritic lavas and dikes on Basin Butte; phenocrysts of subhedral labradorite as large as 3 mm, and rare phenocrysts of quartz in an intergranular groundmass composed of plagioclase, biotite, and hornblende; opaque minerals, and sparse olivine. Age  $10.2 \pm 0.9$  m.y. (whole rock).
- Tb RHYOLITE OF BIG SAND SPRINGS VALLEY (0-1,000 ± ft) - Medium to purple-gray flow-laminated and laminated lava; 3-4 percent small (1-2 mm) phenocrysts of alkali feldspar, smoky quartz, plagioclase, and biotite. Age  $25.8 \pm 1.3$  m.y. ("Apache tuff").
- Tc TUFF OF LUNAR CUESTA (0-120 ± ft) - Simple cooling unit of nonwelded to partially welded rhyolitic ash-flow tuff, vitric to devitrified, light tan to light gray or pale orange. Contains locally numerous thin inclusions of Shingle Pass Tuff, other Tertiary volcanic rocks, and sparse Paleozoic rock fragments. Phenocrysts: 10-35; pf, 43-66; q, 12-27; af, 3-26; b, 6-18; ho, trace; cpx, trace. Magnetically reversed.
- Td SHINGLE PASS TUFF (0-200 ± ft) - One to three simple cooling units 0.9 to 1.2 m thick of nonwelded and densely welded rhyolitic ash-flow tuff, vitric and devitrified, commonly red and lithophrase where densely welded; light greenish gray where vitric, nonwelded units typically weakly bedded and contain locally old blocks. Phenocrysts - highest unit, 6-8; q, 0-1; af, 19-25; pf, 25-35; b, 0-20; ho, 1-3; cpx, 1-3; Mafic inclusions: q, 25-34; af, 36; pf, 25; b, 3-9; ho, 3. Lowest unit, 9-15; q, 5-15; af, 47-60; pf, 31-37; b, 1-16; ho, trace; cpx and opx, trace; olivine, trace; o, 1-2. Lowest unit is magnetically normal, others are reversed. Mapped to include overlying thin-bedded tuffaceous sediments northeast of Shingle Butte.
- Te TUFF OF ORANGE LICHEN CREEK (0-400 ± ft) - Simple cooling unit of nonwelded to partially welded rhyolitic ash-flow tuff, very light gray to light greenish gray, weathering pale buff and brownish gray. Partially welded, slope-forming and hoodoo-weathering to upper, nonwelded, moderately to completely welded and forming in lower third; outcrops are commonly covered with orange lichens. Phenocrysts: 15-40; q, 22-47; af, 25-44; pf, 29-32; b, 1-10; ho, trace; cpx, trace. Magnetically reversed.
- Tf TUFF OF FORT HOLE VALLEY (0-110 ± ft) - Simple cooling unit of nonwelded to partially welded rhyolitic ash-flow tuff, devitrified with conspicuous upper-phase crystallization; pink with scatter of white pumice latices 1.5 cm across. A few small brown lithic inclusions of rhyolite to quartz latite and andesite. Phenocrysts: 20; af, 45; q, 26; pf, 26; b, 3; ho, 2. Magnetically normal. Unit is present in drill hole HTH-23 and crops out locally in the Heart Hills and Shaded Buttes where it is mapped with the tuff of Orange Lichen Creek (Te).
- Tg MONOTONY TUFF (0-1,000 ± ft) - Simple cooling unit of rhyolitic and quartz latite ash-flow tuff; densely welded and devitrified on Basin Butte and in drill holes; partially welded and vitric in the Heart Hills and Shaded Buttes; medium purple-gray, weathering brown and gray brown; mapped to include thin beds of well-sorted pebbles and coarse conglomerate present locally at base. Phenocrysts: 40-55; q, 15-28; af, 5-12; pf, 50-60; b, 10-20; ho, 3; cpx, 1; opx, 1; Age:  $27.9 \pm 0.8$  m.y. (whole rock). Magnetically reversed.
- Th RHYOLITE OF DRILL HOLE UCE-18 (0-1,000 ± ft) - Aphyric light gray flow-laminated and flow-layered devitrified rhyolite lava. The restricted area extent of the rock and the immense thickness encountered in the drill hole suggest very close proximity to the feeder vent at hole UCE-18 (Section B-F). Stratigraphic position of this unit is not known; inferred position is based on similarity of bedded strata above and below the rhyolite with unconsolidated strata of Shaded Buttes (Tsb) exposed northeast of drill hole.
- Ti TUFFACEOUS ROCKS OF SLANTED BUTTES (0-1,000 ± ft) - White to light-gray quartz latite bedded subvolcanic tuffaceous sandstone, siltstone, and conglomerate; locally contains thin beds of well-sorted pebbles and coarse conglomerate of tuffaceous conglomerate composed of fragments of tuff similar to the tuff of Monotony Tuff (Tg) in a matrix of the same material. Contact with the underlying tuff of Moon Station Buttes is gradational in the drill holes and in most surface exposures.
- Tj TUFF OF MOON STATION BUTTES (0-1,000 ± ft) - Compound (T) cooling unit of nonwelded to partially welded quartz latite ash-flow tuff; light gray and white where nonwelded or partially welded, medium brownish gray where welded in moderate to dense; mapped to include at base bedded lithic-rich ash-flow tuff, commonly nonwelded. Phenocrysts: 20-32; q, 10-20; af, 7-24; pf, 45-72; b, 7-14; ho, 1-5; cpx and opx, trace; o, trace; Age:  $30.7 \pm 1.1$  m.y. (biotite);  $30.0 \pm 0.9$  m.y. (sanidine). Magnetically reversed.
- Tk TUFF BETWEEN TUFF OF MOON STATION BUTTES AND TUFF OF THE NEEDLES (0-900 ± ft) - Two cooling units of light gray and pinkish-gray densely welded ash-flow tuff, with conspicuous orange pumice, that crop out only in fault wedges west and northwest of The Needles; occur also at depths of 3,200-3,800 feet in drill hole UCE-17; not present in drill hole UCE-20. Both units are lithologically gradational; the lower tuff of Moon Station Buttes (Tj) and the tuff of The Needles (Tk). Phenocrysts - upper unit, 27-33; q, 33-43; af, 23-30; pf, 30-33; b, 1-5; altered mafics, 1-3; cpx, trace. Lower unit - 24-41; q, 23-33; af, 11-20; pf, 38-52; b, 6-10; altered mafics, 3-7; o, 0.5-1.0.
- Tl TUFF OF THE NEEDLES (0-1,000 ± ft) - Simple cooling unit of partially to densely welded rhyolitic ash-flow tuff; pink, weathering reddish gray, densely welded completely devitrified rock containing very abundant pumice, grading downward to light pinkish gray and partially welded in lower part, containing conspicuous orange (altered) pumice as long as 2 inches. Rich in brown lithic fragments of tuff of Williams Ridge and Morey Peak (Tm) in lower part. Phenocrysts: 28-41; q, 45-41; af, 27-36; pf, 15-25; b, 1-5; ho, trace; cpx, trace. Age:  $30.6 \pm 0.9$  m.y. (biotite);  $30.2 \pm 0.9$  m.y. (sanidine). Magnetically reversed.
- Tm TUFF AND DEBRIS BEDS - Principally boulders of brown welded tuff as much as 10 feet in diameter are presumed to be derived from tuff of Williams Ridge and Morey Peak (Tm); locally includes (1) welded lithic-rich ash-flow tuff containing the same welded tuff fragments as in a boulder below and below; (2) nonwelded yellow weakly welded tuff; (3) white to light-gray bedded tuff; and (4) rare blocks of Paleozoic rock. As much as 100 feet of unit is preserved.
- Tn BOTTE TUFF, SEDIMENTARY ROCKS, AND BRECCIATED TUFF OF THE NEEDLES AREA - Quartz latite ash-flow tuff. Dike (T) 200 ± ft - Simple cooling unit of densely welded ash-flow tuff with vitrophyre at top and base. Phenocrysts: 20-40; q, 17-22; af, 4-30; pf, 42-54; b, 3-10; ho, trace; o, trace. Dike (D) (0-300 ft) - Nonwelded white unit B (TnB) but phenocryst content is not known to exceed 25 percent and phenocrysts are slightly smaller (c. 3 mm) interspersed with lacustrine sedimentary rocks and tuff (T). Lacustrine sedimentary rocks and tuff (0-300 ± ft) - Thinly laminated yellow, yellow, and white siltstone, gray limestone, and gray concretionary bedded ash-flow tuff. Brecciated tuff (0-300 ± ft) - Principally faulted and brecciated blocks of ash-flow tuff; several welded tuffs occur in the brecciated masses, but the most abundant are tuff of Chain Creek (Tc) and tuff of Williams Ridge and Morey Peak (Tm).

- Tp TUFF OF HOT CREEK CANYON (0-1,500 ± ft) - Compound cooling unit of partially and densely welded quartz latite and rhyolitic ash-flow tuff; light gray, weathering light gray where weakly welded, weathering brown and rusty brown where welded in moderate to dense; several zones from top to base are rich in small lithic fragments of rhyolitic ash-flow tuff, black chert lenses with fibrous phenocrysts larger than those in enclosing matrix. Vitrophyre occur at top, within 200 feet of top, and at base. Phenocrysts: 30-50; q, 17-41; af, 15-39; pf, 30-55; b, 3-10; ho, 1-7; cpx and opx, trace; o, 1. Age:  $30.3 \pm 0.9$  m.y. (biotite);  $29.7 \pm 0.9$  m.y. (sanidine). Magnetically reversed.
- Tq TUFF OF PALSADE MESA (0-400 ft) - Multiple-flow simple cooling unit of mostly densely welded rhyolitic ash-flow tuff, devitrified except for a thin partial vitrophyre near the base that contains conspicuous black fumes as long as 4 inches. Upper part light buff and pink and contains very few mafic phenocrysts; lower part purplish brown, weathering same, and contains conspicuous biotite which makes up as much as 10 percent of the phenocrysts. Unit mostly free of lithic fragments. Phenocrysts: 21-41; q, 21-45; af, 26-32; pf, 22-41; b, 1-10; ho, 0-2; cpx, trace; o, trace. Age:  $30.3 \pm 0.9$  m.y. (biotite). Magnetically reversed.
- Tr TUFF OF HALLAM MESA (0-400 ft) - Multiple-flow simple cooling unit of nonwelded to densely welded rhyolitic ash-flow tuff, devitrified except for a thin partial vitrophyre near the base that contains conspicuous black fumes as long as 4 inches. Upper part light buff and pink and contains very few mafic phenocrysts; lower part purplish brown, weathering same, and contains conspicuous biotite which makes up as much as 10 percent of the phenocrysts. Unit mostly free of lithic fragments. Phenocrysts: 21-41; q, 21-45; af, 26-32; pf, 22-41; b, 1-10; ho, 0-2; cpx, trace; o, trace. Age:  $30.3 \pm 0.9$  m.y. (biotite). Magnetically reversed.
- Ts TUFFS OF CHAIN CREEK (0-600 ft) - Two or three simple cooling units of densely welded ash-flow tuff; mostly light gray with conspicuous orange or red well-laminated matrix, and thin clasts two conspicuous homogeneous black vitrophyres each about 20 feet thick; elliptical (1-2 cm long) lithophrase are conspicuous above the vitrophyres in zones 10-20 feet thick locally, the tuffs are siliceous or argillaceous and weather dark brown, orange, or red. Phenocrysts: 25-45; q, 25-45; af, 15-30; pf, 30-40; b, 1-5; ho, trace; cpx, trace; opx, trace; olivine, trace; o, trace. Age:  $30.3 \pm 0.9$  m.y. (biotite). Magnetically reversed.
- Tt TUFF OF BLACK ROCK SUMMIT (0-200 ± ft) - Simple cooling unit of partially welded ash-flow tuff; in drill hole UCE-23 unit is white and light purple mottled. Phenocrysts: 14; q, 19; af, 6; pf, 57; b, 17; c, 1. Magnetically reversed.
- Tu LANDSLIPPED DEBRIS (0-50 ± ft) - Chaotic blocks of Paleozoic carbonate and Tertiary tuffs intercalated with tuffaceous siltstone, tuff, and sandstone.
- Tv GILMORE GULLY FORMATION (0-200 ± ft) - Thin-bedded dark gray siltstone, yellowish-brown finely laminated siltstone claystone, thin-bedded limestone, and fine-grained sandstone.
- Tw RHYOLITE, QUARTZ LATITE, AND TUFFACEOUS SEDIMENTARY ROCKS - Rhyolite and quartz latite lavas and dikes (0-200 ± ft) - Includes (1) coarsely flow-layered quartz latite with large and abundant phenocrysts that make up 50 percent of the rock (this rock is nearly identical macroscopically and microscopically to the tuff of Williams Ridge and Morey Peak (Tm) flow-layered pink and gray lava containing 30 percent phenocrysts, which rarely exceed 3 mm, of quartz, alkali feldspar, plagioclase, and biotite; and (2) finely flow-laminated rhyolite containing only 5-10 percent phenocrysts of quartz, alkali feldspar, and biotite. The laminated rock was apparently extruded simultaneously with the quartz latite, and locally the two contrasting lithologies are intimately intermixed. Rhyolite dike of Morey Peak area - Light-gray to white finely flow-laminated aphyric rhyolite. Less than 5 percent tiny phenocrysts of quartz and alkali feldspar. Tuffaceous sedimentary rocks and bedded tuff (0-400 ± ft) - Claystone, mudstone, siltstone, bedded tuff, and conglomerate; sandstone, and minor amounts of light gray to white lacustrine limestone; bedded tuff has nearly the same mineralogy as tuff of Williams Ridge and Morey Peak (Tm), and contains most of the stratigraphic interval between the tuff of Williams Ridge and Morey Peak (Tm) and the tuff of Black Rock Summit (Tb) in drill holes UCE-23 and HTH-23.
- Txm TUFF OF WILLIAMS RIDGE AND MOREY PEAK (0-6,500 ± ft) - Three or more compound cooling units of gray, weathering dark gray, brown, and purple, rhyolitic and quartz latite welded tuff; characterized by abundant large books of biotite (as thick as 1.5 mm) and large phenocrysts of quartz (as long as 6 mm). Uppermost part at Williams Ridge includes vent breccia that also characterizes the upper part north of Square Wells Spring; it contains unusually large crystals - plagioclase as long as 1 cm, hornblende as long as 1.5 cm, and sparse quartz > 1 cm. Phenocrysts: 48-55; q, 22-27; af, 25; pf, 48-54; b, 1-5; ho, trace; cpx, trace; opx, trace; o, 1-2. Age: at Williams Ridge 31.6 ± 0.9 m.y. (biotite); 31.4 ± 1.4 m.y. (sanidine); at Square Wells Spring area 31.4 ± 1.0 m.y. (biotite). Most outcrops and drill cores are magnetically reversed. The tuff of Williams Ridge and Morey Peak fills an enormous depression or caldera which probably formed as a result of the extrusion of the Windows Butte Formation.
- Ty WINDOW BUTTE FORMATION - Large landlipped or thrust faulted mass along the northern edge of the quadrangle; it is presumed to be deeply buried beneath thousands of feet of intracanyon rocks in the Moon Station quadrangle. Petrographic studies by W. D. Ostroff and F. M. Byrne, Jr. (oral communication, 1971), suggest that the rock core at the bottom of drill hole HTH-23 is rhyolitic Windows Butte. Compound cooling unit moderately to densely welded, devitrified, light to medium brownish gray; quartz latite in upper approximately one-half and interbedded with quartz latite as large as 6 mm; lower half is rhyolitic with smaller crystals. Phenocrysts - upper part, 35-40 (3-6 mm); q, 20-30; af, 8-20; pf, 48-55; b, 7-12; ho, 3-10; cpx, 0-2; opx, 0-1. Lower part, 25-30 (2 mm); q, 20-40; af, 25-45; pf, 25-30; b, 1-10; ho, 0-4; cpx, trace; opx, trace; o, 0-2. Magnetically reversed.
- Tz LATTICE LAVA AND TUFF - Lava (0-100 ± ft) - Dark gray where fresh, reddish brown where altered, flow-layered lattice lava. Phenocrysts: 10-20; q, 0-5; af, 0-5; pf, 52-90; b, 0-9; cpx, 5; altered mafic and opaque minerals, 9-17. Ash-flow tuff (0-50 ± ft) - Compound (T) cooling unit of gray, black, and brown densely welded latite ash-flow tuff, vitrophyre, locally flow layered. Phenocrysts: 5-16; q, 0-1; af, 0; ho, 85-94; b, 0-1; op, 1-2; altered mafic and opaque minerals, 3-5.
- Ta RHYOLITE LAVA AND BEDDED TUFF (0-500 ± ft) - Pale-gray flow-layered and laminated rhyolite lava, gray and red-brown near top. A few small phenocrysts of quartz and alkali feldspar; locally biotite is moderately abundant. Age:  $37.2 \pm 1.3$  m.y. (biotite).
- Tb BEDDED TUFF AND TUFFACEOUS SANDSTONE (0-300 ± ft) - Pale-gray, yellow, and pink bedded tuff and tuffaceous sandstone; highly fractured, mostly intensely iron stained and siliceified. Near base contains clasts of Paleozoic rock.
- Tc ELEANA FORMATION, UPPER PART (1,000 ± ft) - Quartzite (40 percent), conglomerate (20 percent), argillite (20 percent), shale (10 percent), and limestone (10 percent). Quartzite and conglomerate, medium to dark gray, weathering dark brown; cross laminated and ripple marked, poorly to moderately sorted; in places as thick as 5 feet. Argillite, gray and yellow, weathering yellowish brown, platy and blocky weathering; contains sparse plant fossils. Shale, black, blocky, weathers medium to dark gray; contains weathering clay, encloses thin interbeds of gray fossiliferous limestone. Top and base not exposed.
- Td NEVADA FORMATION - Dolomite (80 percent) and limestone (20 percent). Dolomite, pale to dark gray; beds 2-8 feet thick; medium and coarse grained; common "quartzite beds". Limestone, pale and medium gray; beds less than 2 feet thick; fine grained; very fossiliferous. Top and base not exposed.
- Te DOLOMITIC LIMESTONE (0-900 ± ft) - Pale-gray dolomitic fine-grained massive-weathering limestone. Beds are thick and poorly defined.



GEOLOGIC MAP OF THE MOORS STATION QUADRANGLE, NYE COUNTY, NEVADA

By  
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