

## NORTH HALF OF SEARCHLIGHT QUADRANGLE

### ROCK DESCRIPTIONS

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#### Quaternary Deposits

**Qx Manmade deposits** Includes highway fill, graded areas for buildings, and other disturbed areas.

**Qm Mine waste** Waste piles adjacent to generally abandoned mines; only the largest piles were mapped.

#### Alluvial-fan deposits of northern Piute and western Cottonwood Valleys

Alluvial-fan deposits are distinguished by surface morphology, soil development, and inset topographic relations; dominantly coarse-grained alluvium forming a broad fan piedmont in northern Piute Valley; clast lithologies are dominantly volcanic rocks near the Highland Range and a mix of volcanic and granitic rocks near the southern Eldorado, northern Newberry, and McCullough Ranges.

**Qat Alluvial tailings (Holocene)** Modern channel alluvium where eroded tailings form a conspicuous white veneer in active washes directly downstream from mining waste and tailings.

**Qf<sub>4</sub> Young alluvial-fan deposits (Holocene)** Pebble-dominated gravel to gravelly sand in axial washes and forming young alluvial terraces. Deposits are commonly thin (<2 m) veneers overlying older alluvial-fan units; poorly consolidated; generally poorly sorted, poorly to locally moderately stratified. Surfaces are characterized by anastomosing, fresh to subdued, bar-and-swale microtopography. Deposits include modern channel alluvium, and adjacent areas of recent deposition that may be subject to intermittent flooding.

**Qf<sub>3</sub> Alluvial-fan deposits (late Pleistocene)** Fan-piedmont remnants composed predominantly of pebble-cobble to boulder gravel; subangular to subrounded; poorly sorted; generally matrix supported; poorly to moderately stratified. Surfaces are fully smoothed, slightly inset (generally <1 m) below older Qf<sub>2</sub> deposits, and have well-developed desert pavement and dark rock varnish. Soils typically include 5-10 cm platy to unstructured Av, 40-60 cm strongly reddened (7.5 YR) and prismatic argillic Bt, and 50-100 cm cemented stage III Bk horizons. The distinctive red Bt soil horizon commonly crops out in shallow cuts and along road exposures.

**Qf<sub>2</sub> Alluvial-fan deposits (middle Pleistocene)** Fan-piedmont remnants composed mainly of cobble to boulder gravel; subangular to subrounded; poorly sorted; poorly to moderately stratified. Surfaces are generally inset several meters below older Qf<sub>1</sub> remnants; although well dissected, they generally form flat interfluvial surfaces locally with well-developed desert pavement and dark rock varnish. Soils typically include thick (>2 m) strongly cemented stage III to IV Bqkm horizons that underlie remnant surfaces; Bt horizons are locally preserved. Typically

light-toned on aerial photographs due to the presence of abundant white to light-gray calcrete fragments.

**Qf<sub>1</sub> Alluvial-fan deposits (early Pleistocene)** Deeply dissected fan-piedmont remnants disconformably overlying Tertiary rocks. Composed predominantly of sandy cobble-boulder gravel; subangular; poorly to moderately stratified; clast- or matrix-supported; dominantly volcanic lithologies. Surfaces are broadly rounded (ballenas), and typically separated from younger alluvial fan surfaces by a few to tens of meters; generally white to light-gray on aerial photography due to laminar calcrete fragments. Massive carbonate- and silica-cemented horizons (Stage IV-V) are up to several meters thick.

**Qc Colluvial deposits (Holocene to Pleistocene)** Coarse gravel deposits forming thin veneers (generally <1 m) on bedrock hillslopes; poorly sorted; poorly stratified; angular clasts. Commonly grade downslope into alluvial fan surfaces.

### **Late Tertiary Sedimentary Deposits**

**Tgv Gravels, volcanic clasts** (Pliocene to late Miocene) Pale brown to pale reddish-brown poorly sorted gravels dominated by subangular clasts of volcanic rock to ~ 30 cm long.

**Tgg Gravels, granitic clasts** (Pliocene to late Miocene) Pale reddish-brown to light gray, weakly indurated to unconsolidated, poorly sorted, calcareous, matrix-supported conglomerate and gravels; subangular to locally subrounded clasts of the Searchlight pluton (Tsu and lesser Tsuf) dominate, comprising 2/3 or more of the clasts; contains lesser porphyritic dacite clasts (e.g., Tspd) and small amounts (10-20%) of volcanic clasts; clasts of granite range up to ~3 m long.

**Trc Conglomerate** (Pliocene to late Miocene) Dark reddish-brown, weakly indurated to unconsolidated, matrix-supported conglomerate with subangular to subrounded clasts of porphyritic dacite and andesite; granitic clasts are rare.

**Tc Conglomerate and sandstone** (late to middle Miocene) Pale reddish-brown, weakly indurated, noncalcareous, poorly sorted, matrix-supported conglomerate; contains subangular clasts of locally derived volcanic rock.

**Breccia Deposits** (middle Miocene) The upper part of the Miocene section is largely composed of megabreccia deposits. Breccia lithologies include the 15.2 Ma tuff of Bridge Spring (Tbbs), basaltic andesite (Tbba), and andesite-dacite (Tbv). Some megabreccia sheets are monolithologic, but others (especially Tbv) contain many lithologies. The megabreccia sheets probably represent rock avalanche deposits. Fault breccia (Tfbr) was also mapped where particularly thick.

**Tfbr Fault breccia** (middle Miocene) Fault breccia was locally mapped along some of the major faults, where it forms mappable bodies at 1:24,000 scale; largest exposure occurs along the gently dipping normal fault separating crystalline rocks from volcanic strata in the east-central

part of the map area, where the breccia consists almost entirely of porphyritic dacite found in the hanging wall.

**Tbbs Tuff of Bridge Spring megabreccia (middle Miocene)** Poorly exposed megabreccia sheets consisting of angular blocks as large as 4 m long of sanidine-biotite-sphene-bearing ash-flow tuff and lesser basaltic andesite; blocks of tuff probably correlate with 15.2 Ma tuff of Bridge Spring (cf., Faulds and others, 2002a, b). No exposures of the tuff of Bridge Spring have been observed in the Searchlight Quadrangle, but this tuff crops out extensively to the north in the Highland Range and Nelson SW Quadrangle (Faulds and others, 2002a).

**Tbba Basaltic andesite megabreccia (middle Miocene)** Sheets of light gray to grayish-brown monolithologic volcanic breccia composed primarily of basaltic andesite (Thb) and lesser andesite; includes crackle and jigsaw breccia facies with negligible matrix; also includes matrix-supported breccia; matrix consists primarily of subangular sand-size grains of volcanic rock, feldspar, and biotite. Most of Tbba originated as rock avalanches, but matrix-supported deposits probably represent debris flows.

**Tbv Andesite-dacite megabreccia (middle Miocene)** Reddish-brown to grayish-brown megabreccia composed primarily of clasts and blocks of intermediate composition volcanic rock; generally weakly indurated and poorly exposed.

**Volcanics of the Highland Range (middle to early Miocene)** The volcanics of the Highland Range (Th; Faulds and others, 2002a) consist of a thick lower sequence of intermediate composition lavas (e.g., trachydacite and trachyandesite lavas of Thld and Thla, respectively), a middle interval of rhyolite lavas (Thr) intercalated with nonwelded tuffs and tuffaceous sedimentary rocks (Tht), and an upper sequence of basaltic andesite lavas (Thb). Th is bracketed between ~18.5 and 15.7 Ma. The overall thickness of the volcanics of the Highland Range locally exceeds 2,800 m.

#### **Upper mafic sequence, volcanics of the Highland Range (middle Miocene)**

**Thb Basaltic andesite lavas (middle Miocene)** Light- to dark-gray basaltic trachyandesite and trachyandesite lavas, flow breccias, and agglomerate containing 15-35% phenocrysts of plagioclase, augite, and sparse hypersthene.

**Tha Andesite lavas (middle Miocene)** Medium- to light- gray and reddish-gray porphyritic andesite lavas containing phenocrysts of plagioclase, oxyhornblende, aegirine-augite, and sparse biotite.

#### **Middle felsic sequence, volcanics of the Highland Range (middle to early Miocene)**

**That Altered tuffaceous rocks (middle to early Miocene)** Light gray, highly silicified breccia exhibiting distinctive cavernous weathering and granular texture; intercalated with or adjacent to Thar and therefore inferred to be altered Tht.

**Thar Altered rhyolite lavas** (middle to early Miocene) Light gray, highly silicified and/or allunitized rhyolite lavas; faint flow-banding recognizable in some exposures; phenocrysts are highly altered and best observed on weathered surfaces.

**Tht Tuffaceous sedimentary rocks and nonwelded tuffs (middle to early Miocene)** White to pale-yellowish-brown ash-fall and nonwelded ash-flow tuffs, surge deposits, and tuffaceous conglomerate and sandstone commonly interfingering with Thr; beds are generally 2 to 3 cm thick but commonly range from 1 to 30 cm thick; nonwelded tuffs contain 3-15% phenocrysts of sanidine and quartz with lesser plagioclase, biotite, and clinopyroxene; nonwelded tuff also contains abundant pumice fragments and lithic fragments of basaltic andesite. Tuffaceous sandstone and conglomerate typically represent reworked tuffs; conglomerate contains varying amounts of subangular to locally angular clasts that usually range from 1 to 20 cm in length.

**Thr Rhyolite lavas** (middle to early Miocene) Pale brownish-gray, light-grayish-white, and pinkish- to reddish-gray commonly flow-banded rhyolite and lesser trachydacite lavas; locally interfingers with the tuffaceous rocks of Tht; includes spherulitic and vitrophyric flows; contains 5-35% phenocrysts of sanidine, plagioclase,  $\pm$ quartz, and biotite; some with sparse sphene, augite, and/or oxyhornblende.

**Tharb Altered rhyolite breccia** (middle to early Miocene) Highly silicified, light gray to reddish- or yellowish-brown, massive matrix-supported volcanic breccia; clasts are generally subangular and average 4-5 cm long, but few clasts as large as 25 cm; most clasts appear to have a felsic protolith, but some are clearly mafic; porphyritic clasts are common; breccia may include subordinate highly altered rhyolite lavas (Thar).

**Thrb Rhyolite breccia** (middle to early Miocene) Light gray to pale brown rhyolite breccia containing clasts of rhyolite (much of which is vitrophyric) that contain 25-30% phenocrysts of sanidine, plagioclase, biotite, and lesser hornblende and sphene.

**Thrd Rhyodacite or dacite lavas** (middle to early Miocene) Pale purplish-gray porphyritic dacite or rhyodacite lavas containing phenocrysts of plagioclase,  $\pm$ sanidine, biotite, hornblende, and sparse vermicular quartz; locally includes inclusions of medium-grained granite.

**Thl Lower intermediate sequence, volcanics of the Highland Range (middle to early Miocene)** The lower intermediate composition sequence of the volcanics of the Highland Range consist primarily of trachydacite, trachyandesite, and rhyodacite lavas. This sequence may correlate with the volcanics of Dixie Queen Mine in the Mount Perkins area of the central Black Mountains in northwestern Arizona (Faulds and others, 1995), ~30 km east of the Searchlight Quadrangle, as evidenced by similarities in stratigraphic position, composition, and age. The age of Thl is bracketed between 18.5 and ~16.2 Ma by the underlying 18.5 Ma Peach Springs Tuff (Tp) and  $^{40}\text{Ar}/^{39}\text{Ar}$  ages on overlying rhyolite lavas in Thr. Biotite from a dacite lava within the quadrangle has yielded an  $^{40}\text{Ar}/^{39}\text{Ar}$  age of  $17.59 \pm 0.06$  Ma. Trachydacite and trachyandesite lavas in the northern Newberry Mountains ~8 km to the southeast of the quadrangle have yielded  $^{40}\text{Ar}/^{39}\text{Ar}$  ages ranging from

18.58±0.05 to 16.75±0.26 Ma (Ruppert and Faulds, 1998). Thl locally interfingers with the lower part of the felsic sequence in the volcanics of the Highland Range and is temporally correlative with the lower part of the Patsy Mine volcanics of Anderson (1971). Within the Searchlight Quadrangle, Thl is divided into 1) basaltic trachyandesite lavas (Thlba), 2) porphyritic dacite lavas (Thlpd), 3) trachydacite lavas, 4) trachyandesite lavas (Thla), 5) porphyritic trachyandesite flows (Thlpa), 6) transitional trachyandesite-trachydacite lavas (Thlda), 7) sparse rhyodacite lavas (Thlrd), and 8) volcanic breccia and conglomerate (Thlbr). The overall thickness of Thl approaches and possibly exceeds 1,500 m.

**Thlba Basaltic trachyandesite lavas** (middle to early Miocene) Generally finely porphyritic basaltic trachyandesite lavas containing 5-20% phenocrysts of clinopyroxene and plagioclase.

**Thlrd Rhyodacite lavas** (middle to early Miocene) Porphyritic rhyodacite or rhyolite lavas intercalated in Thld; contain ~35% phenocrysts of plagioclase, biotite, and hornblende; accessory minerals include titanomagnetite and apatite.

**Thlada Altered trachyandesite-trachydacite lavas** (middle to early Miocene) Weakly to strongly altered, pale reddish to yellowish brown Thlda, containing moderate to abundant amounts of smectite clays, illite, and jarosite.

**Thlda Transitional trachyandesite-trachydacite lavas** (middle to early Miocene) Light to dark gray porphyritic trachyandesite to trachydacite flows containing ~20% phenocrysts of plagioclase, clinopyroxene, and biotite; relative abundance of clinopyroxene and biotite varies; phenocryst assemblage and color suggest a transitional composition between trachydacite and trachyandesite; only larger sequences of such flows were mapped.

**Thlapds Strongly altered porphyritic trachydacite lavas** (middle to early Miocene) Moderately to strongly altered pale red to yellowish brown Thlpd, containing abundant smectite clays, illite, and jarosite; locally includes veinlets of alunite; original phenocrysts are difficult to identify, with ghosts of feldspar best observed on weathered surfaces.

**Thlpd Altered porphyritic trachydacite lavas** (middle to early Miocene) Weakly altered, pale yellowish brown Thlpd, containing moderate amounts of smectite clays, illite, and jarosite; locally includes veinlets of alunite; feldspars are altered to clays and sericite; mafic constituents are altered to iron oxides.

**Thlpd Porphyritic trachydacite lavas** (middle to early Miocene) Purplish- to reddish-gray, light-gray, reddish-brown, or greenish-gray porphyritic trachydacite lavas containing 15-35% phenocrysts of plagioclase, hornblende, biotite, ±augite or aegirine-augite, and traces of hypersthene and apatite (in typical order of decreasing abundance); plagioclase is commonly partly to largely altered to clays or sericite; mafic constituents are commonly altered to chlorite and iron oxides; degree of alteration generally increases eastward toward the Searchlight pluton; plagioclase phenocrysts commonly exceed 5 mm in length; commonly interfingers with Thla; locally includes minor trachyandesite lavas (Thla) and rhyodacite lavas (Thlrd).

**Thld Trachydacite lavas** (middle to early Miocene) Finely to sparsely porphyritic trachydacite lavas containing up to 20% phenocrysts of plagioclase, biotite, and hornblende; plagioclase phenocrysts are generally less than 3 mm long.

**Thlbr Volcanic breccia** (middle to early Miocene) Moderately indurated, purplish-gray to gray clast- and matrix-supported breccia containing angular to subangular cobbles and boulders up to 1.5 m long; locally includes subordinate medium-grained, poorly sorted litharenite.

**Thlaas Strongly altered trachyandesite lavas** (middle to early Miocene) Moderately to strongly altered pale red to yellowish brown Thla, containing abundant smectite clays, illite, and jarosite; locally includes veinlets of alunite; original phenocrysts are difficult to identify, with ghosts of feldspar best observed on weathered surfaces.

**Thlaa Altered trachyandesite lavas** (middle to early Miocene) Weakly altered, greenish-gray to pale yellowish brown Thla, containing moderate amounts of smectite clays, illite, and jarosite; locally includes veinlets of alunite; feldspars are altered to clays and sericite; mafic constituents are altered to iron oxides.

**Thla Trachyandesite lavas** (middle to early Miocene) Finely porphyritic to aphanitic trachyandesite lavas containing 5-15% phenocrysts of plagioclase, hornblende, clinopyroxene, and lesser biotite; plagioclase phenocrysts are less than 3 mm long.

**Thlapa Altered porphyritic trachyandesite lavas** (middle to early Miocene) Weakly altered, pale yellowish brown Thlapa, containing moderate amounts of smectite clays, illite, and jarosite; locally includes veinlets of alunite; feldspars are altered to clays and sericite; mafic constituents are altered to iron oxides.

**Thlpa Porphyritic trachyandesite lavas** (middle to early Miocene) Light- to dark-gray porphyritic trachyandesite lavas containing 20-30% phenocrysts of plagioclase, oxyhornblende, augite or aegirine-augite, biotite, and trace hypersthene and apatite; the relative abundance of oxyhornblende, clinopyroxene, and biotite varies, but clinopyroxene is generally most abundant and biotite least abundant; plagioclase phenocrysts range up to ~7 mm long; plagioclase and the mafic constituents are commonly partly to largely altered to sericite and chlorite-iron oxides, respectively; degree of alteration increases southward and southeastward toward the Searchlight pluton; commonly interfingers with Thlpd.

**Thlu Trachydacite and trachyandesite flows – Undivided** (middle to early Miocene) Trachydacite and trachyandesite flows and lesser volcanic breccia; locally includes capping rhyolite lavas and tuffaceous rocks.

## SEARCHLIGHT VOLCANIC COMPLEX

The Searchlight volcanic complex includes a section of generally massive trachydacite and trachyandesite situated directly above and west of the exposed roof of the Searchlight pluton. A

lack of layering within individual units and typically irregular contacts between units suggest that this sequence represents a series of intermediate composition domes. This dome complex is interpreted as the surficial volcanic edifice that once stood above the Searchlight pluton.

**Tsaps Strongly altered porphyritic trachydacite-trachyandesite** (middle to early Miocene) Strongly altered greenish-gray to reddish- or yellowish-brown porphyritic lavas; protolith cannot be determined due to alteration; contains abundant smectite clays, illite, hematite, and jarosite; locally includes veinlets of alunite and quartz.

**Tsap Altered porphyritic trachydacite-trachyandesite** (middle to early Miocene) Altered greenish-gray to reddish or yellowish brown porphyritic lavas containing 20-40% phenocrysts; original trachydacite vs. trachyandesite composition cannot be determined due to alteration; contains moderate amounts of smectite clays, illite, hematite, and jarosite; locally includes veinlets of alunite and quartz.

**Tsapsd Strongly altered porphyritic trachydacite** (middle to early Miocene) Strongly altered greenish-gray to yellowish-brown Tspd; contains abundant smectite clays, illite, hematite, and jarosite; locally includes veinlets of alunite and quartz; phenocrysts are entirely altered to clays and iron oxides; relict phenocrysts best observed on weathered surfaces.

**Tsapd Altered porphyritic trachydacite** (middle to early Miocene) Weakly to moderately altered greenish-gray to yellowish-brown Tspd; contains moderate amounts of smectite clays, illite, hematite, and jarosite; locally includes veinlets of alunite and quartz; feldspars are altered to clays and sericite; mafic constituents are altered to iron oxides.

**Tspd Porphyritic trachydacite** (middle to early Miocene) Generally massive, light purplish-gray porphyritic trachydacite containing ~35% phenocrysts of plagioclase, hornblende, lesser biotite, and  $\pm$ trace sphene; plagioclase is generally altered to clays; hornblende and biotite are typically altered to iron oxides.

**Tscpd Trachydacite porphyry** (middle to early Miocene) Massive light gray to greenish-gray trachydacite porphyry containing ~50% phenocrysts of plagioclase, hornblende, lesser biotite, and  $\pm$ quartz; plagioclase and hornblende to 8 mm long; similar to Tspd but generally coarser grained.

**Tsaas Strongly altered trachyandesite** (middle to early Miocene) Strongly altered greenish-gray to yellowish white Tsa; contains abundant smectite clays, illite, hematite, and jarosite; locally includes veinlets of alunite and quartz.

**Tsaa Altered trachyandesite** (middle to early Miocene) Weakly to moderately altered, greenish-gray to yellowish brown Tsa; contains moderate amounts of smectite clays, illite, hematite, and jarosite; locally includes veinlets of alunite and quartz; locally has a salt-and-pepper appearance.

**Tsa Trachyandesite** (middle to early Miocene) Generally massive, sparsely and finely porphyritic, medium to dark gray and greenish-gray trachyandesite containing sparse phenocrysts of plagioclase, hornblende, and lesser biotite in a fine-grained groundmass.

**Tspa Porphyritic trachyandesite** (middle to early Miocene) Medium gray, coarsely porphyritic trachyandesite containing 25-40% phenocrysts of plagioclase (to 1.4 cm long), hornblende, and clinopyroxene.

**Tsdi Diorite intrusions** (middle to early Miocene) Generally massive, sparsely porphyritic, relatively equigranular, medium- to coarse-grained, medium gray to greenish-gray diorite or granodiorite containing plagioclase, hornblende, and biotite; hornblende and biotite are commonly altered to chlorite; locally has a salt-and-pepper appearance, especially where slightly altered; similar to Tsa but coarse grained; locally appears to grade into Tsa.

**Tsagd Altered granodiorite** (middle to early Miocene) Moderately altered generally porphyritic, greenish-gray to yellowish-brown granodiorite (Tspgd), containing moderate amounts of smectite clays, illite, hematite, and jarosite.

**Tspgd Porphyritic granodiorite** (middle to early Miocene) Grayish-green porphyritic, massive granodiorite containing ~20-30% phenocrysts of plagioclase (to 7 mm long), hornblende, and biotite; relative proportions of hornblende and biotite vary; commonly weakly altered, with feldspars altered to clays and mafic constituents altered to iron oxides and chlorite.

**Tsvu Searchlight volcanic complex – Undivided** (middle to early Miocene) Generally massive trachydacite and trachyandesite situated directly above and west of the exposed roof of the Searchlight pluton.

**Tp Peach Springs Tuff** (early Miocene, 18.5 Ma) Moderately altered light grayish-white to pale brown ash-flow tuff containing ~20% phenocrysts of feldspar and lesser biotite; feldspars are altered to clays; biotite is altered to iron oxides; exhibits an apparent relict compaction foliation; includes apparent lithic fragments of mafic to intermediate volcanic rock; stratigraphic position (directly overlying Proterozoic gneiss) of exposure ~1.5 km south of Quartette Mine indicates a correlation with the 18.5 Ma Peach Springs Tuff (cf., Glazner and others, 1986; Nielson and others, 1990); correlation of altered tuff in NW ¼ of Section 28 (T28S, R63E) to Peach Springs Tuff is less certain.

## MIOCENE INTRUSIONS

**Searchlight pluton (middle to early Miocene)** The Searchlight pluton is a 10-km-thick quartz monzonite to granite pluton exposed in a large, steeply west-tilted fault block in the southern Eldorado and northern Newberry Mountains (Bachl and others, 2001). The upper part of this fault block extends into the Searchlight Quadrangle. Paleomagnetic data indicate that the pluton is tilted at least 55° to the west (Faulds and others, 1998). The pluton is compositionally stratified with quartz monzonite (61-70 weight % SiO<sub>2</sub>) in the shallow western part, granite (69-75 weight % SiO<sub>2</sub>) in the middle unit, and more mafic quartz monzonite (59-64 weight % SiO<sub>2</sub>)



in the deeper eastern part (Bachl and others, 2001). U/Pb and  $^{40}\text{Ar}/^{39}\text{Ar}$  data indicate that the pluton was emplaced from ~15.8 to 16.7 Ma (J. Miller and C. Miller, unpublished data). The roof of the pluton and upper quartz monzonite unit crop out in the Searchlight Quadrangle. Here, the upper Searchlight pluton invades Early Proterozoic gneiss and the lower part of the Miocene volcanic section. Just north of the town of Searchlight, the roof of the pluton appears to be intruded into porphyritic intermediate composition domes associated with the lower volcanics of the Highland Range. The upper Searchlight pluton within the quadrangle is divided into three units: (1) a porphyritic to phaneritic quartz monzonite near the northern margin (Tsuf), (2) a medium-grained equigranular quartz monzonite (Tsu), and (3) a diorite to monzodiorite phase (Tsud).

**Tsud Upper Searchlight pluton, diorite to monzodiorite phase** (middle to early Miocene)

Light to medium gray, medium-grained equigranular quartz monzodiorite consisting of plagioclase, potassium feldspar (mainly orthoclase), interstitial quartz, hornblende, biotite, and accessory apatite and titanomagnetite; in contrast to Tsu, Tsud has a darker color, more hornblende, and less plagioclase.

**Tsu Upper Searchlight pluton, equigranular quartz monzonite** (middle to early Miocene)

Light-gray to pinkish-gray, medium-grained equigranular quartz monzonite typically consisting of laths of plagioclase, potassium feldspar (generally orthoclase), hornblende, interstitial quartz, biotite, and accessory zircon, apatite, and sphene (rare); locally contains small pods and dikes of porphyritic granite consisting of potassium feldspar, plagioclase, and lesser biotite and hornblende; feldspars and mafic constituents in these pods and dikes are largely altered to sericite and chlorite-iron oxides, respectively.

**Tsuf Upper Searchlight pluton, porphyritic phase** (middle to early Miocene) Pale-reddish-brown to pale-greenish-gray porphyritic to locally phaneritic quartz monzonite consisting of potassium feldspar, plagioclase, and lesser quartz, hornblende, and biotite; accessory minerals include apatite, titanomagnetite,  $\pm$ sphene,  $\pm$ epidote, and  $\pm$ clinopyroxene; the relative abundance of plagioclase and potassium feldspar, as well as hornblende and biotite, varies; phenocrysts commonly constitute 30-40% of the rock; feldspar phenocrysts commonly reach 4-6 mm in length; feldspars and mafic constituents are generally partly to largely altered to sericite and chlorite-iron oxides, respectively; Tsuf essentially represents the northern margin of the Searchlight pluton.

## **DIKES AND VEINS**

**Tbai Basaltic andesite dikes** (middle Miocene) Dikes of basaltic andesite, which contain 10-25% phenocrysts of plagioclase, augite, and subordinate iddingsitized olivine. Groundmass consists of intergrown plagioclase and pyroxene laths.

**Tcv Calcite veins** (middle to early Miocene) Generally easterly striking grayish-white veins composed primarily of coarse-grained calcite and lesser quartz; some veins also include minor amounts of barite; veins are typically 1 to 4 m thick and commonly exhibit margin-parallel layering; some veins were clearly emplaced along faults; also includes one sizable travertine deposit in the eastern part of the map area.

**Tqv Quartz veins** (middle to early Miocene) Veins of fine-grained quartz ranging from 30 cm to several meters thick; locally vuggy; abundant thin veinlets are locally found proximal to major veins; thin (5-30 cm thick) discontinuous and unmapped quartz veins locally occur along fault zones throughout the quadrangle.

**Tql Quartz ledges and bodies** (middle to early Miocene) Isolated lenses of massive fine-grained to cryptocrystalline quartz and highly silicified zones without discrete veins.

**Tari Altered rhyolite intrusions** (middle to early Miocene) Weakly to strongly altered, pale reddish to white Tri, containing moderate to abundant amounts of smectite clays, illite, and jarosite.

**Tri Rhyolite intrusions** (middle to early Miocene) Grayish-white to pinkish-white rhyolite dikes and plugs; flow-banding characterizes some intrusions; generally contain 2-10% phenocrysts of sanidine, quartz, and sparse biotite and plagioclase; sanidine and quartz commonly occur in subequal amounts, but sanidine dominates in some intrusions; some bodies lack quartz, biotite, or plagioclase.

**Tqmi Quartz monzonite porphyry dikes** (middle to early Miocene) Dikes of quartz monzonite porphyry containing ~50% phenocrysts of k-spar (to 2 cm long) plagioclase, quartz, biotite, lesser hornblende, and trace sphene.

**Tgdi Granodiorite dikes** (middle to early Miocene) Fine porphyritic pinkish to greenish-gray granodiorite dikes containing as much as 15% phenocrysts of plagioclase, K-spar, hornblende, and biotite

**Tpgdi Porphyritic granodiorite dikes** (middle to early Miocene) Light gray to pinkish-gray porphyritic granodiorite dikes containing 15-30% phenocrysts of plagioclase (to ~7 mm long), biotite, generally lesser hornblende,  $\pm$ minor clinopyroxene, and  $\pm$ traces of sphene.

**Tai Andesite and diorite dikes** (middle to early Miocene) Light gray to medium gray finely porphyritic andesite or diorite dikes containing ~5-15% phenocrysts of plagioclase, hornblende, and locally clinopyroxene.

**Tdi Diorite intrusions** (middle to early Miocene) Light to medium gray diorite intrusions consisting of plagioclase, hornblende, and lesser biotite.

**Tapdi Altered porphyritic dacite intrusions** (middle to early Miocene) Moderately to highly altered light gray to grayish-white Tpd, containing moderate to abundant smectite clays, illite, and jarosite.

**Tpdi Porphyritic dacite intrusions** (middle to early Miocene) Purplish-gray porphyritic dacite intrusions containing phenocrysts of plagioclase, hornblende, and biotite.

## PROTEROZOIC BASEMENT

**Xq Quartzite (?)** (Early Proterozoic?) Highly altered, light gray to pale reddish-brown quartz-rich rock that resembles a medium-grained quartzite; observed only in a few isolated exposures on east flank of high ridge in NW ¼ of section 28 (T28S, R63E).

**Xms Mica schist** (Early Proterozoic?) Highly altered, reddish-brown biotite or phlogopite apparent schist observed only in a few isolated exposures on east flank of high ridge in NW ¼ of section 28 (T28S, R63E).

**XgTi Early Proterozoic orthogneiss and Miocene dikes (undifferentiated)** Complex assemblage of poorly exposed orthogneiss laced with abundant dikes of generally porphyritic dacite and andesite and lesser granite.

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