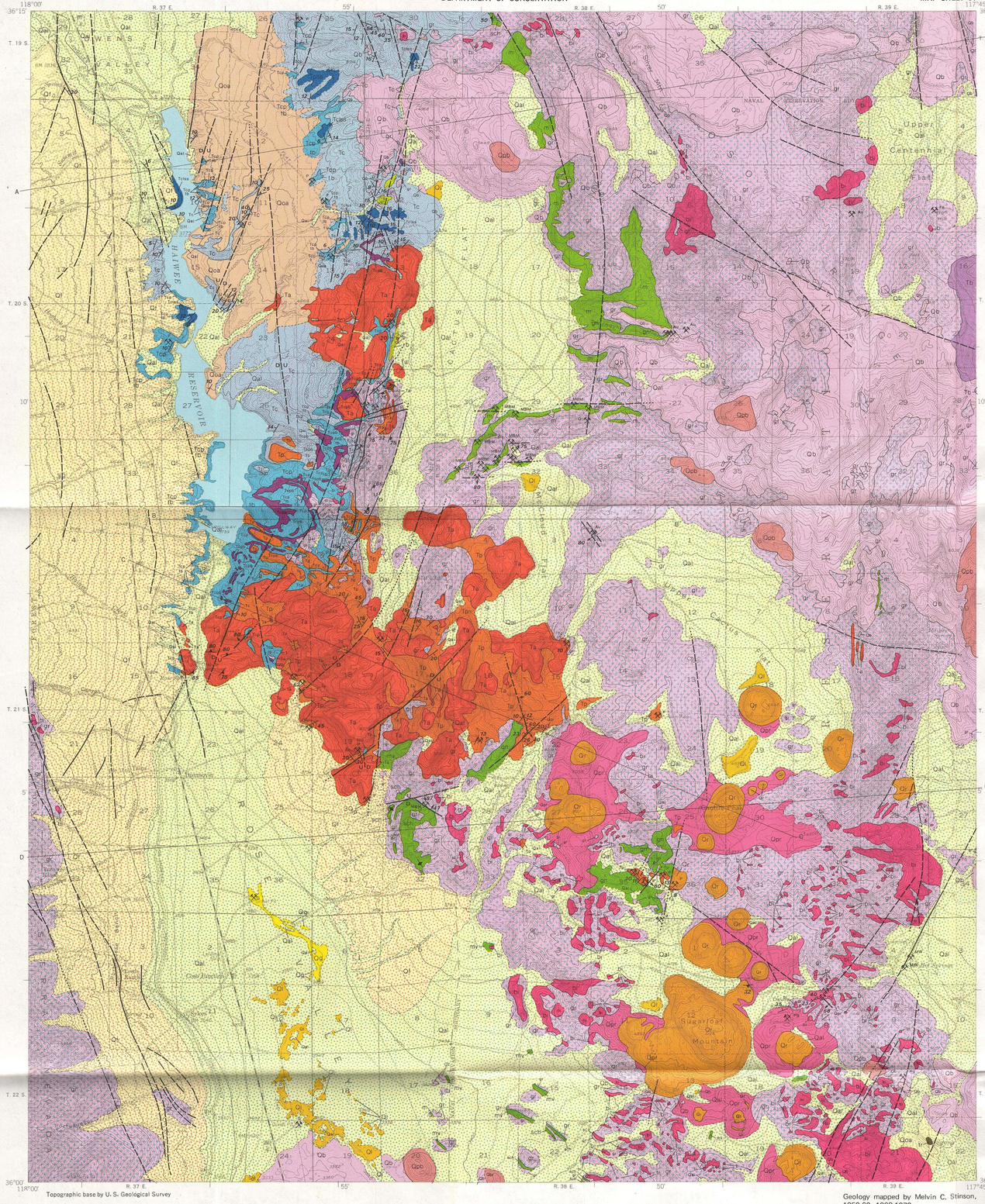
CALIFORNIA DIVISION OF MINES AND GEOLOGY
THOMAS E. GAY JR., STATE GEOLOGIST

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF CONSERVATION

GL03107



Topographic base by U.S. Geological Survey

Geology mapped by Melvin C. Stinson, 1959-60, 1963-1970.

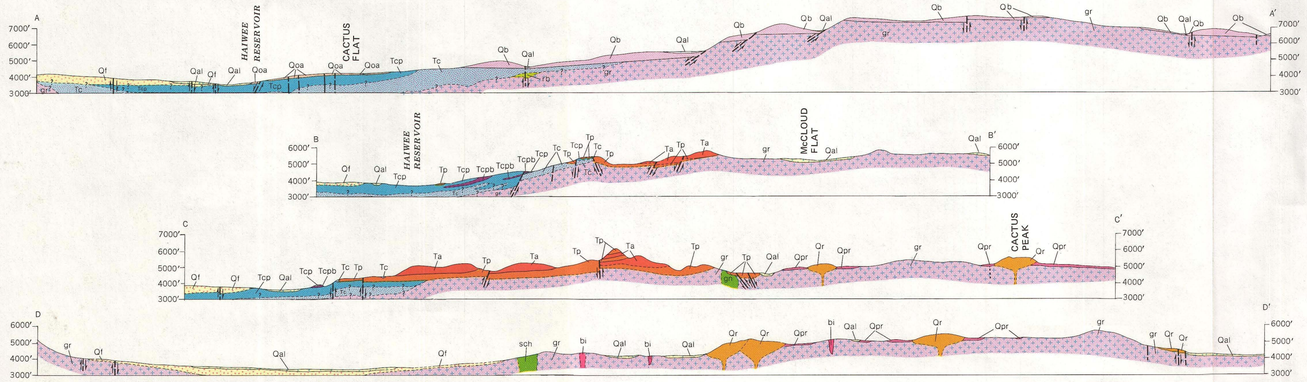
SCALE 1:62500

1 0 1 2 3 4 MILES
3000 0 3000 6000 9000 12000 15000 18000 21000 FEET
0 1 2 3 4 5 KILOMETERS

GN MN 16° 284 MILS 0°31' 9 MILS

UTM GRID AND 1955 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

CONTOUR INTERVAL 40 FEET
DOTTED LINES REPRESENT 10 FOOT AND 20 FOOT CONTOURS
DATUM IS MEAN SEA LEVEL



EXPLANATION

SEDIMENTARY AND VOLCANIC ROCKS

CENOZOIC — QUATERNARY — Holocene

Qal | Qf | Qg | Ql

Surficial sediments
Qal - alluvium, windblown sand, stream wash.
Qf - fan deposits, Owens and Rose Valleys.
Qg - gravel deposits, Rose Valley.
Ql - lacustrine deposits.

UNCONFORMITY

CENOZOIC — QUATERNARY — Pleistocene and Holocene

Qoa | tr

Older alluvium
tr - travertine

UNCONFORMITY

Qb | Qr | Qpb | Qpr

Volcanic rocks
Qb - basalt and basaltic andesite flows.
Qpb - basalt cinder cones.
Qr - rhyolite flows, perlite domes, obsidian.
Qpr - rhyolite lapilli tuff.

LOCAL UNCONFORMITY

CENOZOIC — Pliocene and Pleistocene(?)

Tp | Ta

Andesite
Ta - lava flows, sills, plugs.
Tp - vitric lapilli tuff, tuff breccia, mudflow breccia.

UNCONFORMITY

Tcls | Tc | Tcpb | Tcfg | Tcp | tb

Coso Formation
Tc - undifferentiated sedimentary rocks, includes fanglomerate consisting of massive indurated arkosoic sandstone and conglomerate (Tcfg) and limy sandstone, often ferruginous (Tclss).
Tcp - undifferentiated rhyolitic pyroclastic rocks, includes tuff (t) and tuff breccia (tb).
Tcpb - silicified ferruginous rhyolite tuff and tuff-breccia

rb

Red beds

UNCONFORMITY

CENOZOIC — (?)

Tr — Quartz monzonite porphyry
Tb — Basalt flows of Coso Peak

UNCONFORMITY

BASEMENT ROCKS

MESOZOIC

gr

Granitic rocks
Include biotite quartz monzonite, alaskite, quartz diorite, aplite dikes.

bi

Basic intrusive rocks
Gabbro, hornblende gabbro, diorite

m | mv | gn | sch

Metamorphic rocks
m - metamorphic rocks undifferentiated
mv - metavolcanic rocks
gn - gneiss
sch - quartz biotite schist

SYMBOLS

Contact
(dashed where gradational or approximately located; queried where inferred)

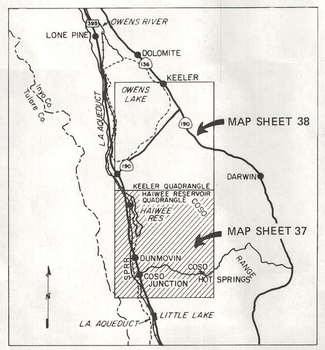
40
(dashed where approximately located; dotted where concealed, U upthrown side, D downthrown side)

15 — Strike and dip of beds

30 — Strike and dip of foliation or flow banding

60 — Inclined; Vertical — Strike and dip of joints

Mine, prospect, or quarry
(Showing principal metal or non-metallic commodity mined or quarried: Gold, Au; iron, Fe; uranium, U; mercury, Hg; miscellaneous base metal, MBM, pumice or pumicite, P; quartz, Q; clay, C; mineral water (Spa) MW; sand and gravel, G; dimension stone, S.)



LOCATION MAP

GEOLOGIC MAP AND SECTIONS OF THE HAIWEE RESERVOIR 15-MINUTE QUADRANGLE, INYO COUNTY, CALIFORNIA

By Melvin C. Stinson
1977

DESCRIPTION OF MAP UNITS

SURFICIAL DEPOSITS

Alluvium (Qal): Poorly consolidated silt and sand on valley floors; unsorted cobbles, pebbles, and coarse sand on slopes surrounding valley floors; thin windblown sand and silt accumulations on west slope of Haiwee Ridge.

Fan deposits (Qf): Slightly dissected, poorly sorted accumulations of boulders, cobbles, and gravel in sandy and silty matrix. Upper 5 to 10 feet locally cemented by caliche. Material derived from Sierra Nevada or Haiwee Ridge; grades downslope into alluvium.

Gravel (Qg): Moderately sorted stream gravel deposits derived from erosion and weathering of alluvial fans and deposited by intermittent streams in lowest part of Rose Valley. Larger deposits are used as source of gravel for road building.

Lacustrine deposits (Ql): Deposits of well-sorted fine sand, silt, and clay deposited by intermittent streams in Rose Valley and in shallow depressions (playas) primarily in high valleys of Coso Mountains.

Unconformity

Older alluvium (Qoa): Light gray, poorly to moderately well bedded, locally dissected fanglomerate consisting of poorly to moderately well sorted boulders, cobbles, and pebbles in weakly to moderately consolidated clayey silty matrix. Locally upper 5 to 10 feet of surface is cemented by caliche. Derived from formations exposed on western slope of Coso Range. Basaltic and andesitic debris common but not found in Coso Formation, which locally unconformably underlies older alluvium; maximum thickness approximately 200 feet. In southeastern corner of quadrangle, older alluvium includes conglomerate consisting of boulders, cobbles, and pebbles of metamorphic and granitic rocks cemented by silica and veinlets of limestone and a small area of well-bedded white and tan travertine (tr) deposited directly on irregular surface of conglomerate. Conglomerate has maximum thickness of approximately 100 feet. May be older than Pleistocene because of absence of andesitic or basaltic debris of Pleistocene age.

Unconformity

VOLCANIC ROCKS

Basalt and basaltic andesite flows (Qb): Dark-brown or gray, finely porphyritic with phenocrysts of plagioclase (andesine-labradorite) and augite in aphanitic groundmass, usually slightly porous with minute interstitial vugs often partially filled with chalcedony. Some flows are of olivine basalt, which contain phenocrysts of olivine in addition to plagioclase and augite. Basaltic andesite is gray, porphyritic with phenocrysts of plagioclase, occasionally some quartz and olivine, rare hornblende, and biotite in aphanitic groundmass. Basaltic andesite is confined primarily to southeast corner of quadrangle. Individual flows to 100 feet thick, with maximum accumulated thickness of over 500 feet; thick flows show columnar jointing where cut by canyons. Weathered surfaces are dark yellowish-brown. Age probably varies from late Pleistocene to late Pliocene or early Pleistocene; basalt and basaltic andesite flows of southern part of quadrangle are fresher and less weathered and may be younger than those farther north.

Basalt cinder cones (Qpb): Deep red-brown or nearly purple, loosely consolidated, cone-shaped masses of basaltic cinders and fragments of scoriaceous basalt usually less than 1 inch in diameter. Cinder cones are slightly older than associated lava flows and usually mark site of vent.

Rhyolite flows, perlite domes, obsidian (Qr): Light-gray, pinkish-gray, and dark-gray flow-banded perlite vitrophyre with a few scattered quartz and sanidine phenocrysts occurs as mushroom-shaped domes. Bands of black obsidian and zones of vesiculated perlite locally occur in vitrophyre. Obsidian on south and southeast slope of Sugarloaf Mountain contains lithophysae, consisting of orthoclase and cristobalite with tridymite and fayalite, to 2 inches in diameter. Reddish-brown-weathering, gray and pinkish-tan rhyolite flows with total thickness about 200 feet.

Rhyolite lapilli tuff (Qpr): Light-gray, dark-gray-weathering, poorly bedded, loosely consolidated rhyolite lapilli tuff associated with rhyolite domes in southeastern quarter of quadrangle. Locally silicified and mineralized with sulfur and cinnabar. Maximum thickness 200 feet. Age unknown, but older than rhyolite domes or basalt flows near Sugarloaf Mountain.

Local Unconformity

ANDESITIC VOLCANIC ROCKS

Lava flows, sills, plugs (Ta): Light- to dark-gray, light- to dark-brown, flow banded, extremely compact and resistant to weathering, locally perlitic, porphyritic andesite as flows and sills primarily in south half of quadrangle. Andesite usually contains phenocrysts of white plagioclase (andesine) up to 15 mm long; locally less common phenocrysts of dark greenish black hornblende, biotite, with minor magnetite, quartz, and pyroxene in aphanitic groundmass. Locally, badly fractured with fractures filled with hyaline opal. Columnar jointing present in thicker flows. Total exposed thickness of flows over 500 feet.

Pyroclastic deposits (Tp): Massive, poorly sorted, gray pumice tuff with fragments of red granitic rock and metamorphic rock and mineral grains. Locally contains gray, buff, or red tuff breccia and gray, brown-weathering mudflow breccia. Overlain by, or interbedded in, andesite flows or deposited directly on granitic bedrock, older sedimentary rocks, or locally in water (these deposits are well sorted and stratified). Red granitic rock fragments are often coated with rind of powdery pumicite or welded lapilli tuff suggesting glowing-avalanche or nuée ardente origin of tuff. Maximum thickness of tuff varies from a few feet at north end of Haiwee Ridge to at least 400 feet a few miles southeast of Haiwee Ridge. Locally used as source of pumice.

Unconformity

COSO FORMATION

Named by Schultz (1937, p. 78) for about 300 feet of rhyolite tuff, buff-colored arkose and clay with a vertebrate fossil locality near the base, and red shaly and arkosic material. A Plio-Pleistocene age was given the formation based on the age of the fossil vertebrate fauna. In this quadrangle, the Coso Formation consists of fanglomerate, rhyolitic pyroclastic rocks, and lacustrine deposits with thin-bedded limestone lenses. The informal units listed below are locally interfingered and stratigraphically repeated and are not necessarily listed in stratigraphic order. Maximum thickness probably over 1000 feet.

Fanglomerate (Tcfg): Boulder and pebble conglomerate and coarse-grained sandstone, extensively silicified, crossbedded; forms large, massive, lens-like masses up to 50 feet thick on west slope of Haiwee Ridge. Deposited on irregular erosional surface of underlying granitic rock. Locally underlain or interbedded in buff-colored silicified rhyolite tuff. Thins toward west and overlain by arkosic sandstone and rhyolitic pyroclastic rocks.

Rhyolitic pyroclastic rocks (Tcp): White to buff rhyolite vitric tuff, pumice lapilli tuff, and tuff breccia consisting of white pumice fragments and phenocrysts of quartz, sanidine, and rare biotite in fine-grained ashy matrix. Pumice chunks up to 6 inches found in tuff breccia, which is locally silicified. Maximum thickness about 500 feet near south end of Haiwee Ridge; thins toward north. Locally used as source of pumice and pumicite. Includes brown, ferruginous, silicified tuff unit 10 to 30 feet thick (Tcpb).

Lacustrine deposits (Tc): White to buff sandstone, siltstone, clay, and thin-bedded limestone. Reworked rhyolitic volcanic debris present in varying amounts; ripple marks common; some beds of finer-grained tuffaceous sediments have been subject to subaqueous slumping. Limy, pale-gray sandstone and siltstone, resistant to weathering, often forms cap rock over less-resistant tuffaceous sediments; locally ferruginous and associated with uranium mineralization (Tclss).

Local Unconformity

Red beds (rb): Deep-red arkosic sandstone and interbedded red clay, with fragments of metavolcanic rock and locally large boulders of granitic rock in upper 50 feet. Unit has poorly developed bedding and tendency to form badland topography. Base of unit not exposed in quadrangle; exposed thickness approximately 200 feet. Age unknown, but at least as old as fanglomerates of Coso Formation.

HAIWEE RESERVOIR QUADRANGLE
CALIFORNIA DIVISION OF MINES & GEOLOGY
MAP SHEET 37
1977

Unconformity

Quartz monzonite porphyry (Ti): Light pinkish to greenish gray or light greenish tan massive porphyritic rock composed of scattered phenocrysts of subhedral pale pink orthoclase up to 2 cm long, biotite, and phenocrysts of anhedral quartz, in fine-grained groundmass composed of nearly equal quantities of orthoclase and oligoclase, biotite, and hornblende. Large orthoclase phenocrysts are microperthitic and generally poikilitically enclose all other minerals. Accessory minerals include a green amphibole, apatite, zircon, and sphene. Quartz monzonite porphyry is well fractured and forms prominent ridge of large blocks with brown weathered surfaces. The porphyry intrudes quartz diorite and biotite schist and may be Tertiary in age.

Basalt flows of Coso Peak (Tb): Greenish-gray, massive to thickly layered flows of basalt occur on southwestern and southeastern slopes of Coso Peak. Westernmost edge of flow extends west into quadrangle. Basalt consists of phenocrysts of euhedral to subhedral green augite and iron-stained colorless to yellow-white olivine as large as 5 mm in intergranular matrix composed of laths of labradorite and interstitial grains of augite, apatite, and magnetite. Rock is extremely hard and resistant to weathering. Weathered surfaces are deep red. Maximum thickness of flows probably not more than 100 feet. Basalt overlies quartz monzonite of Coso Peak and is overlapped by Quaternary basalt on southwestern edge of flow. Tertiary, possibly Pliocene-Miocene.

Unconformity

BASEMENT ROCKS

Basement rocks in the Haiwee Reservoir quadrangle consist of (1) coarse-grained granitic rocks, aplite and pegmatite dikes; (2) basic intrusive rocks including hornblende gabbro, gabbro, and diorite; and (3) metamorphic rocks consisting of metavolcanic rocks, andesine-quartz-biotite-schist, and gneiss. The granitic rocks—which crop out in about half of the western two-thirds of the quadrangle and probably underlie most of the quadrangle—consist of biotite quartz monzonite locally grading into quartz diorite and alaskite. Associated with the granitic rocks are small aplite and pegmatite dikes of quartz monzonite composition. The granitic rocks are Mesozoic, possible Cretaceous.

Basic intrusive rocks occur as elongate or irregular masses, commonly trending northwest-southeast. They are exposed principally in deep canyons or on fault surfaces in the northern and central parts of the quadrangle; the individual bodies of basic igneous rock become more numerous but smaller than those to the north. However, the overall proportion of basic igneous rock to quartz monzonite is higher in the south half of the quadrangle. The contact between the basic igneous rock and the surrounding monzonitic (acid granitic) rock is quite often sharp but usually with the addition of epidote at the contact and alteration of the basic intrusive rocks. The basic intrusive rock, which is therefore probably older than the quartz monzonite, is possibly pre-Mesozoic in age.

Metamorphic rocks consisting of metavolcanics, schist, and gneiss crop out in a number of areas in the quadrangle. The metavolcanic rock is similar in appearance to the Triassic volcanic rocks exposed in adjacent areas and may be Triassic in age. The age of the schist and gneiss is unknown. The units listed below are not necessarily in stratigraphic sequence.

Granitic rocks (gr): Light gray biotite quartz monzonite grading locally to darker gray quartz diorite. Fresh-appearing speckled rock with equigranular to porphyritic texture. Essential minerals are microcline, quartz, oligoclase-andesine, and varying amounts of biotite. Hornblende locally present. Quartz diorite contains more femic minerals and a larger percentage of soda-plagioclase. Accessory minerals include sphene, magnetite, zircon, and apatite. Gray-white to tan coarse-grained alaskite granite underlies southern part of Haiwee Ridge. Essential minerals in alaskite are quartz, microcline, microperthite, and oligoclase. Trace of biotite is sometimes present. Small irregularly shaped aplite and pegmatite dikes of quartz monzonite composition are associated with plutonic rocks.

Basic intrusive rock (bi): Dark green to dark greenish gray fine- to coarse-grained gabbro and hornblende gabbro composed of labradorite, pale green diopside-augite, albite, and varying amounts of biotite and hornblende. Apatite and magnetite also present. Locally, hornblende gabbro is porphyritic with subhedral phenocrysts of dark-green hornblende to 1½ inches long, poikilitically enclosing diopside, clinozoisite, and epidote. Occasionally uralitized. Black and white, nearly equigranular diorite composed of andesine, hornblende, biotite; sometimes trace of quartz and orthoclase occurs as small inclusions a few inches in diameter in the granitic rocks to large masses nearly a square mile in area. Alluvium surrounding bodies of basic intrusive rocks is commonly dark gray because of high biotite and hornblende content.

Metamorphic rocks: In addition to undifferentiated metamorphic rocks (m), the following informal units are present.

Metavolcanic rocks (mv): Grayish-white metarhyolite composed of phenocrysts of frosty-white dipyramidal quartz and glassy sanidine in matrix of devitrified glass. Gray-green meta-andesite with phenocrysts of light-gray plagioclase in matrix of plagioclase, pale-green diopside epidote, magnetite, and apatite. The plagioclase poikilitically encloses epidote. Light-greenish tan metatuff, locally showing flow banding and folding, composed of corroded plagioclase phenocrysts, quartz, epidote, rare garnet, and opaque minerals. Metavolcanic rocks are more resistant to weathering than surrounding rocks and often form prominent ridges.

Schist (sch): Dark-gray and white, fine-grained, often iron-stained, easily decomposed, andesine-quartz-biotite schist composed of about equal proportions of dark green biotite partially altered to chlorite, and white to pale-greenish andesine, and colorless quartz. Locally, apatite, hornblende, and clinozoisite are present.

Gneiss (gn): Dark greenish-gray, brownish-gray-weathering gneiss composed of plagioclase, quartz, and varying amounts of biotite and hornblende. Locally banded with black or dark-green laminae rich in biotite or hornblende alternating with white laminae of quartz and plagioclase. Biotite schist and quartzite locally interbedded in gneiss.

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