Geologic map of the Secret Pass 7 ½' Quadrangle, Mohave County, Arizona

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Arizona Geological Survey

Digital Geologic Map 130 (DGM-130)

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1:24,000 scale

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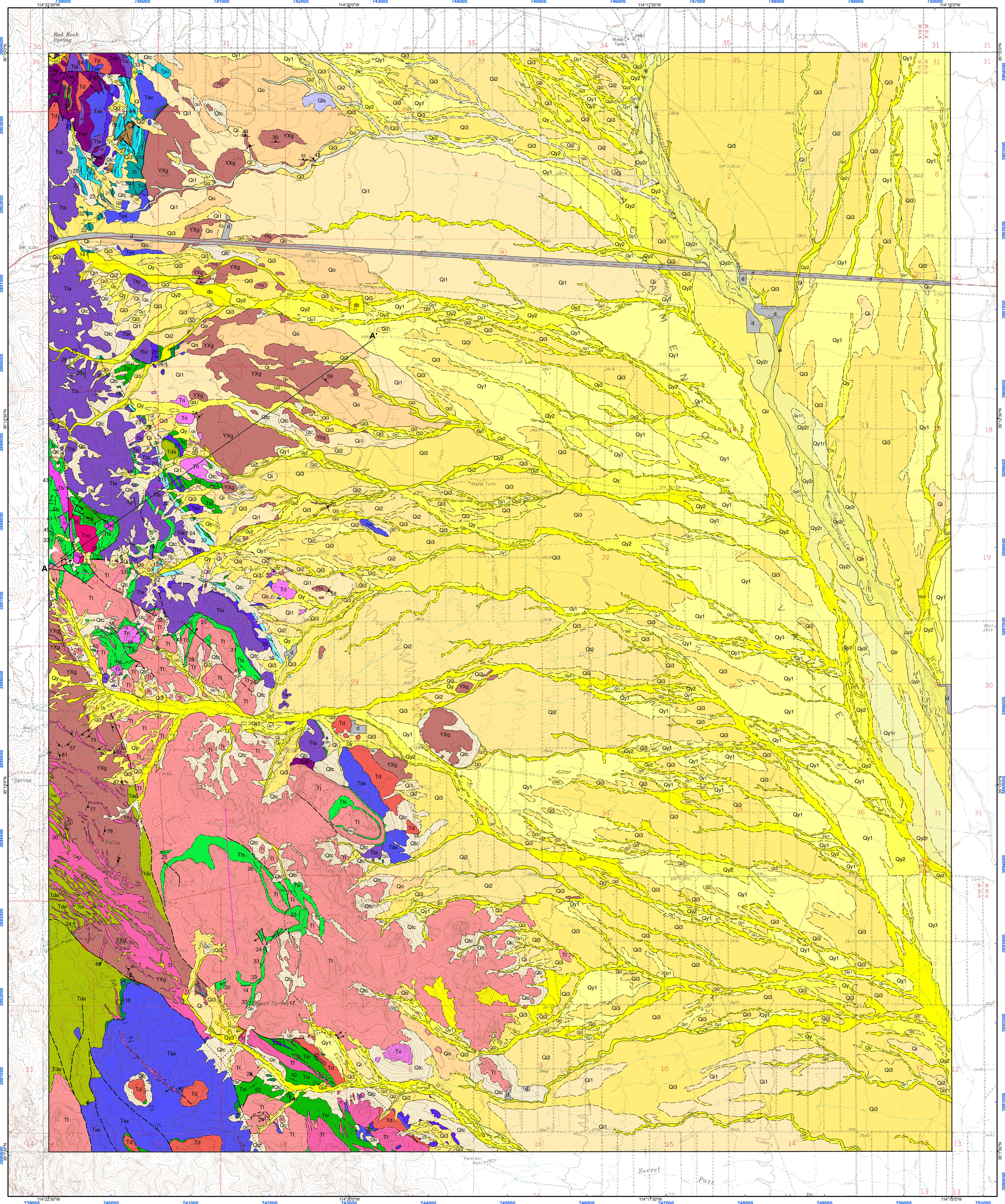
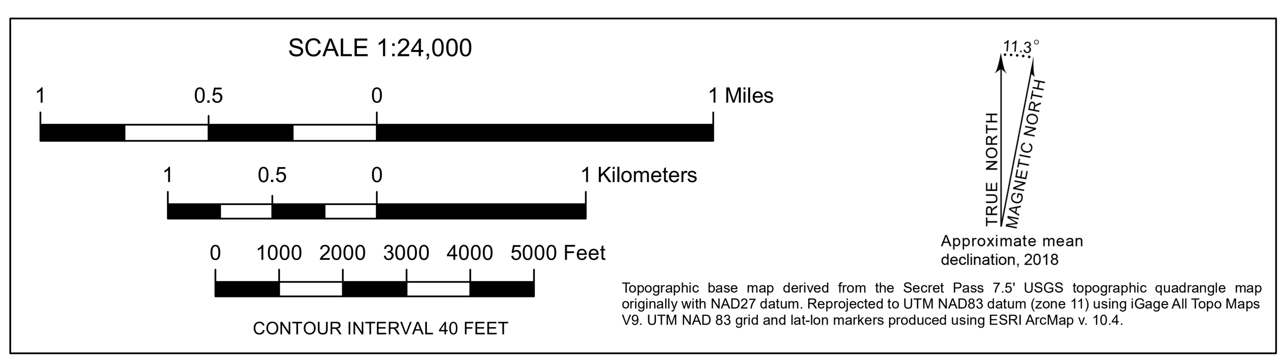
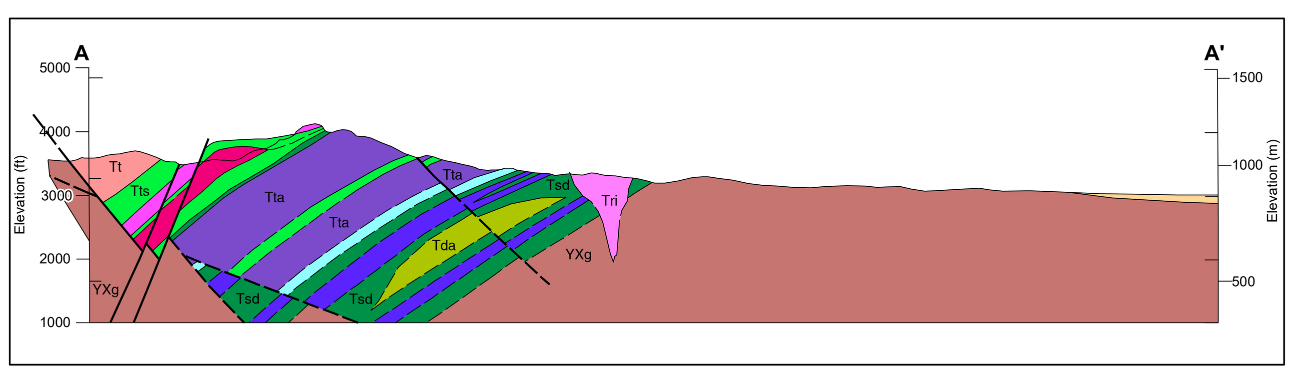
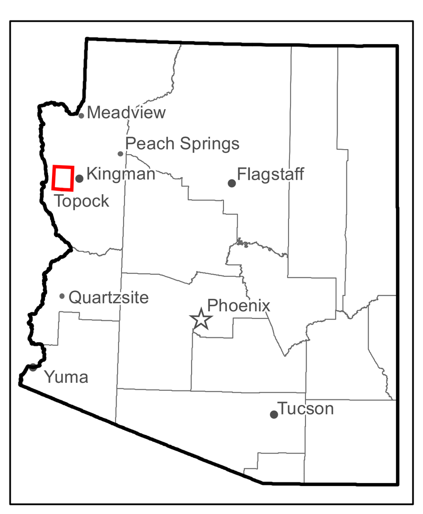
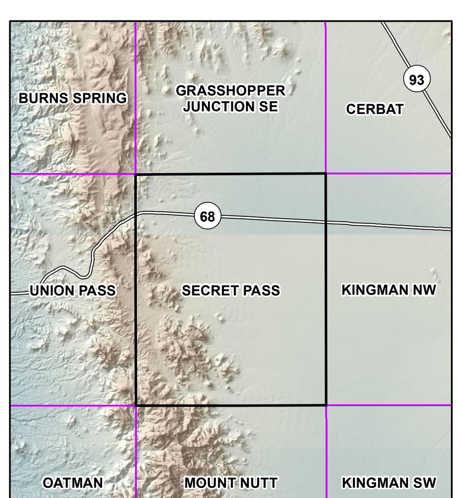


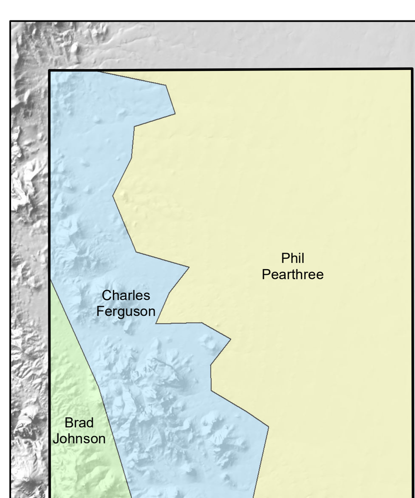






Location of map area





Arizona Geological Survey Digital Geologic Map DGM-130
Geologic map of the Secret Pass 7 1/2' Quadrangle

Introduction

This map depicts the bedrock and surficial geology of the Secret Pass quadrangle in the Black Mountains and Sacramento Valley, Mohave County, northwestern Arizona. The geologic mapping is original but was informed by extensive previous mapping in the lower Colorado River Valley by AZGS geologists. This geologic map complements 11 previous Arizona Geological Survey quadrangle mapping projects in this area.

Bedrock Geology

Miocene volcanic rocks ranging in age between ~19.5 and 16.5 Ma dominate the bedrock geology of the Secret Pass map area which lies along a low, deeply incised, and especially rugged stretch of the 160 km-long Black Mountains, Arizona's longest Basin and Range uplift. The low stretch is the result of the intersection of a prominent, northwesterly striking structural horst with the north-south trending range. The core of the horst exposes recessive, Proterozoic granitic rocks. The volcanics, which nonconformably overlie the granitic rocks in the horst and on both sides of it, are overwhelmingly lava, and range in composition from basaltic andesite to high-silica rhyolite. Since a ~15-14 Ma sequence of basalts, which cap the volcanic sequence throughout the southern Black Mountains, are absent from the map area, it can easily be said that the bulk of the volcanic series becomes strongly felsic up section. The capping basalts are sparsely preserved in the northeast corner of the westerly adjacent Union Pass map area (Murphy and Faulds, 2004), and appear again in the northern part of the southerly adjacent Mt Nutt and southwesterly adjacent Oatman map areas (Ferguson and Cook, 2016; Ferguson et al., 2017).

Three important regional ignimbrites occur within the section; the ~19 Ma Cook Canyon Tuff (Tct), the 18.78 Ma Peach Spring Tuff (Tpl, Tpu), and the 17.77 Ma Bonelli Tuff (Tbt). The two older tuffs are present only in the extreme northwest corner of the map. The correlation is based on a good match between the exposures in this area with the distinctive vertical zonations of phenocryst assemblage and textures documented for both ignimbrite's type sections in the Kingman area, <20km to the east (Ferguson and Cook, 2016; Cook and Ferguson, 2016). The Bonelli Tuff, dated near Thumb Butte in the westerly adjacent Union Pass map area (Lang et al., 2008), is present on both sides of the horst, but was not deposited, or is not preserved in the at least 300m of volcanic section above the Peach Spring Tuff in the northwest corner of this map. In the southern and central parts of the map area, Bonelli Tuff overlies less than 200m of mafic to intermediate lavas and sedimentary rocks (Tda, Tsd, Tax, Tba) that in turn nonconformably overlie Proterozoic granitic rocks (YXg). The upper part of the volcanic section is dominated by a pile of monotonous trachyte and high-silica rhyolite lavas (Tt, Tr) ranging in age from 17.6-16.2 Ma (Murphy and Faulds 2004; Lang et al., 2008).

Structurally, the range crest horst is a prominent tilt-domain boundary, with volcanic strata, regionally, dipping gently to moderately steeply (10-50 degrees) to the west in the hangingwall of the east-dipping, horst-bounding, Union Pass fault. Dips in the north are moderately steep (20-50 degrees), but to the south, dips decrease dramatically, as concomitantly, the Union Pass fault's vertical component of displacement diminishes.

A note on lavas, porphyries, ignimbrites, non-welded tuffs, and volcaniclastic rocks

Lavas display all the typical ranges in flow facies from crystalline-matrix-coherent to vitric-autobreccia (McPhie et al., 1993). Massive, monolithic block and ash-flow deposits are generally included as part of their associated "lava" map unit. Shallow porphyries that in many areas are contiguously connected to lava flows of the same composition are mapped as part of their associated "lava" map unit. In instances where the rock is clearly an intrusion, especially if it isolated from its flow, an "I" suffix may be applied to lava map unit's symbol. Porphyries generally have massive to flow-foliated textures with fine-grained crystalline matrix. Lithic clasts in lavas and porphyries are rare, but are abundant in volcaniclastic and non-welded pyroclastic rocks where they can be used to help define map units. Ignimbrites are welded pyroclastic rocks that represent regionally correlative outflow sheets that can be identified based on distinctive phenocryst assemblages, and zonations (Smith, 1960).

Surficial Geology

Most of the quadrangle is covered by surficial deposits derived from the Black Mountains, with a slice of axial deposits of Sacramento Wash that were imported from the north. These surficial deposits record the recent geologic history of this region. Surficial deposits overlie a thick sequence of Cenozoic deposits that fill Sacramento Valley to a depth of ~1000 m. The valley is part of the Sacramento Wash watershed, which is integrated to the Colorado River, but the valley is essentially undissected at this latitude so exposures of basin deposits are very limited and are restricted to a few dissected old alluvial fan complexes on the valley margins. Multiple levels of alluvial fans and terraces preserved across the piedmont record periods of piedmont aggradation and incision through the (possibly) late Pliocene and Quaternary. The oldest deposits exposed are restricted to the upper piedmont / mountain margins; the tops of these coarse alluvial fan deposits are substantially higher than any younger alluvial deposits in the vicinity, and they likely date to the early Pleistocene or late Pliocene. The piedmont areas are dominated by middle to late Pleistocene alluvial fan and terrace deposits, with moderate to strong soil development, but the extent of deposits of different ages varies dramatically in different parts of the map area. These probably range in age from middle to late Pleistocene. In middle and lower piedmont areas, there is little topographic relief between Pleistocene alluvial fan surfaces and active fluvial systems, and active distributary drainage systems transect some Pleistocene fan surfaces. Holocene deposits are locally extensive in the upper piedmont, but generally are more widespread in middle and lower piedmont areas. These deposits record the activity of complex, distributary drainage systems, and include some areas near the mountains that are best categorized as active alluvial fans.

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Map Unit Descriptions

Piedmont Deposits

Qy3 — **Sand and gravel deposits in active channels, bars, low terraces** - Deposits in active channels and adjacent low bars and terraces. Primarily sand, pebbles, and cobbles, with some silt and clay; boulders are rare to common closer to bedrock hills and mountains. Clast lithologies vary with source terrain, but in most of map area they are primarily felsic volcanic rocks, with minor mafic volcanics and crystalline rocks.

Qy2 — **Deposits on low terraces, subsidiary flow paths, and active alluvial fans** - Very poorly sorted sand, pebble, cobble, boulder, and silt deposits in low terraces and flow expansion reaches. Includes some small channels. Topography typically undulates between channels, terraces, and gravel bars. No desert pavement or soil development.

Qy1 — **Deposits on low terraces and alluvial fans** - Very poorly sorted sand, pebble, cobble, boulder, and silt deposits in gravel bars, low terraces, and alluvial fans. Surfaces are typically are undulating, with coarse gravel bars and relict channels. Channels are covered by fine open pebble to cobble lags, gravel bars are somewhat subdued. Soil development is weak, with some carbonate accumulations.

Qy — **Young deposits, undifferentiated** - Holocene deposits of mixed age.

Qi3 — **Young intermediate alluvial fan and terrace deposits** - Poorly sorted mixtures of silt, sand, pebbles, cobbles, with some boulders close to the mountains, forming inactive alluvial fans and terraces. Surface topography varies from gently undulating relict bars and swales to quite smooth. Soil development is weak to moderate, but some reddening of surface soil is evident. Carbonate coatings typically are thin and discontinuous.

Qi2 — **Intermediate alluvial fan and terrace deposits** - Relict alluvial fan and terrace deposits consisting of poorly sorted sand, pebbles, cobbles, and boulders, with minor silt and clay. Soil development is moderate, with soil reddening and moderate clay accumulation on well-preserved surfaces; carbonate accumulation on gravel is obvious. Rock varnish is variable, but locally is dark brown to black. Margins of planar fan surface remnants are well rounded.

Qi — **Intermediate deposits, undifferentiated** - Undivided Pleistocene alluvial fan and terrace deposits, generally including Qi2 or Qi3 deposits,

Qi1 — **Older intermediate alluvial fan and terrace deposits** - Moderately eroded relict alluvial fan and terrace deposits consisting of poorly sorted sand, pebbles, cobbles, and boulders, with minor silt and clay. Surfaces typically are slightly reddened and light in color. Carbonate soil development ist variable, but generally is strong; thin laminar petrocalcic horizons (weak stage IV) are exposed locally on the slopes on the margins of these deposits.

Qo — **Old alluvial fan deposits** - Relatively high, dissected relict alluvial fan deposits consisting of poorly sorted pebbles, cobbles, boulders, and sand with minor silt. Soil development is variable depending on surface preservation, but planar remnants and side slopes typically have cemented petrocalcic with laminar caps (stage IV-V). Qo deposits are only exposed near the mountains, where they are substantially higher in the landscape than any younger deposits.

Qls — **Landslide** - Angular, strongly varnished, closely packed boulders, commonly larger than 3m, of phenocryst-poor basaltic lava. The clasts are crystalline-core and vitirc facies lavas intimately mixed together in a way that would be difficult to achieve through erosion of an in-place outcrop of basaltic lava or lavas. The clasts are similar to many of the basaltic lavas that cap the Black Mountains directly west of here, and are interpreted to represent the remains of an landslide deposit older than or equivalent in age to the Old alluvial fan deposit map unit (Qo) that overlaps the deposit.

Axial Valley Deposits

Qy3r — **Modern channel, floodplain, low terrace deposits** - Sand, pebble, cobble and silt deposits in recently active channels and lightly vegetated in-channel bars and small planar fluvial terraces less than 1 m above active channel. These deposits do not exhibit soil development but commonly have a light vegetation cover of small trees and bushes and grasses due to their relatively frequent inundation. These surfaces are commonly inundated under moderate to extreme flow events and can be subject to deep, high velocity flow and lateral bank erosion.

Qy2r — **Low terrace deposits** - Sand, silt, clay, pebbles and cobbles associated with low terraces and islands of Sacramento Wash. Qy2r deposits are associated with broadly planar surfaces that locally retain the shape of the historical valley bottom. Qy2r surfaces are 1-2 m above modern river channels and are the fairly extensivey. These surfaces are predominantly fine grained at the surface due episodic shallow flood inundation, but include interfingering coarse sandy to pebbly braided channel deposits. Qy2r deposits are likely subject to inundation by river floods. Qy2r deposits are subject to catastrophic bank failure due to undercutting and lateral erosion during flow events.

Qy1r — **Older low terrace deposits** - Sand, silt, pebble, clay and cobble deposits associated with higher terraces that represent remnants of older Holocene aggradation periods. Soil development is weak and surface color typically is gray to light brown. Incipient stage I calcium carbonate accumulation is evident on the undersides of some buried clasts. Qy1r surfaces are up to 3 meters above the channels of Sacramento Wash and are slightly inset below adjacent Qir surfaces.

Qir — **Intermediate terrace deposits** - Sand, silt, clay, pebble, and minor cobble deposits associated with the late Pleistocene axial valley floor. Surfaces are slightly dissected by tributary drainages that head on the surfaces and through-going channels. Sacramento Wash is incised 2-4 m below Qir surfaces. Soil development is moderate, with some clay accumulation and soil reddening and stage II calcic horizon development with soft nodule development.

Bedrock Units

Tr — **Rhyolitic rocks** - Phenocryst-poor to moderately phenocryst-rich (0.5% - 15%) rhyolitic lavas (Tr) and porphyries (Tri) containing feldspar (<8mm) and quartz (<5mm) phenocrysts in ratios ranging between 1:1 and 3:1, and sparse (<2mm) biotite. Feldspars are generally dominated by K-feldspar. Intrusive varieties (Tri) mapped separately where known.

Tri — **Rhyolite intrusions** - Phenocryst-poor to moderately phenocryst-rich (0.5% - 15%) rhyolitic porphyries containing feldspar (<8mm) and quartz (<5mm) phenocrysts in ratios ranging between 1:1 and 3:1, and sparse (<2mm) biotite. Feldspars are generally dominated by K-feldspar.

Tk — **K-feldspar porphyritic dikes** - Porphyritic dikes containing 20% K-feldspar phenocrysts 1-10 mm, 1% anhedral quartz 2-4 mm, and trace-1% biotite 1-2 mm, in light-gray aphanitic groundmass.

Tf — **Felsic intrusions** - Felsic dikes, mostly phenocryst-poor, containing trace to 5% feldspar phenocrysts (mostly 1-2 mm, up to 4 mm) in a white to pink aphanitic groundmass. Most of the phenocrysts are plagioclase (euhedral, elongate prisms, white to pink). Some dikes also contain phenocrysts of clear K-feldspar (probably sanidine), 2-3% quartz, and trace biotite. The rocks of this unit exhibit weak to intense quartz-sericite-pyrite alteration, are weathered yellow-brown to red-brown, and form resistant outcrops.

Tt — **Trachytic rocks** - Glassy to fine-grained crystalline matrix lavas and related shallow porphyries containing 0. 5% – 12% phenocrysts of <2mm feldspar >> biotite (<1mm). Feldspar phenocrysts are dominantly plagioclase. Associated pyroclastic rocks, ranging from clast-supported block and ash-flows to thin-bedded fallout tephras are locally included within this map unit.

Tsi — **Intermediate volcaniclastic rocks** - A fairly thick and heterogenous sequence of volcaniclastic dominated strata consisting of conglomerate, breccia, and pebbly sandstone containing clasts of dacitic, andesitiic, and trachytic lavas, locally with abundant granite and gneiss. The unit also contains, locally, fairly abundant, yet always subordinate felsic (trachytic) pyroclastic rocks. The strata occur above a thick pile of phenocryst-rich andesite lavas (Tax) in the southwest corner of the map area where they envelope a distinctive, inclusion-rich dacitic lava (Td). The upper part of the sequence in this area becomes increasingly trachytic pyroclastic up-section where it is overlain by a thick pile of fairly monotonous trachytic lavas (Tt).

Ttv — **Trachytic lava of "Window Peak"** - Moderately phenocryst-rich (7-12%) trachytic lava with a distinctive, fairly thick, vitric to spherulitic-lithophysal, strongly flow-foliated, coherent-facies core. Feldspars (plagioclase and sanidine) are up to 5mm and biotite up to 3mm. This lava overlies the older rhyolite lava at "Window Peak" along the north-central edge of section 24, R 20 W, T 21N.

Tro — **Older Rhyolite lava** - Moderately phenocryst-rich rhyolitic lava containing ~10% phenocrysts of feldspar <4mm 2:1 to 3:1 over quartz <3mm, and sparse biotite <2mm. Recognized only in the Window Peak area (sec. 24, R 20 W, T 21N).

Tts — **Non-welded tuff and volcaniclastic rocks:** - Sequences of non-welded felsic, pyroclastic rock (ash-fall, ash-flow, and surge), and volcaniclastic sedimentary rocks with variable amounts of volcanic, plutonic, metamorphic, and sedimentary clasts. Generally phenocryst-poor with feldsapar and minor biotite, +/ quartz, Bedding ranges from massive to thin-bedded. A tuff breccia containing abundant, dark, phenocryst-poor trachyandesitic lava clasts in the Thumb Butte area was mapped separately (Ttta).

Td — **Dacitic rocks** - Moderately phenocryst-rich to phenocryst-rich (10-30%) dacitic lavas/porphyries containing <10mm plagioclase and 1-5% mafics of pyroxene and biotite in proportions ranging between 1:3 and 3:1. Hornblende may also be present. The lavas contain up to 10% sparsely plagioclase porphyritic, fine-grained crystalline matrix inclusions.

Tta — **Trachyandesitic rocks** - Dark, very fine-grained to fine-grained crystalline matrix, aphyric to phenocryst-poor lavas/porphyries containing <5mm mafic phenocrysts (biotite, hornblende, and/or pyroxene) in equal or greater abundance than <2mm plagioclase. Phenocryst content generally <<2% and rarely up to 5%

Tap — **Phenocryst-poor andesitic rocks** - Phenocryst-poor (1-10%) andesitic lavas/porphyries containing <5mm plagioclase and pyroxene in proportions ranging between 1:3 and 3:1.

Ta — **Moderately phenocryst-rich andesitic rocks** - Moderately phenocryst-rich (7-15%) andesitic lavas/porphyries containing <5mm plagioclase and pyroxene (<3mm) in proportions greater than 1:1.

Tbt — **Bonelli Tuff** - Tbt□ Phenocryst-poor rhyolite ignimbrite containing 1-5% <4mm feldspar (mostly or all sanidine) with sparse biotite and/or other mafics. Pumice lapilli (fiamme) range between 1 and 15%. Dark gray, finely crystalline matrix grades into semi-vitric near the base of the flow overlying a thin, poorly to non-welded base. The nonwelded base and the semi-vitric zone are not always present.

Tsa — **Sandstone and argillite** - Gray to red weathering, fine- to medium-grained volcaniclastic, mostly clay-cemented, sandstone, siltstone, and argillite. The sedimentary rocks are commonly poorly indurated and recessive, but parts of the sequence are silica-cemented and resistant. Light green, fine-grained ash beds constitute up to 25% of the sequence. The map unit is only recognized in the northeast corner of the map area where it directly overlies the capping vitrophyre of the Peach Spring Tuff (Tpu).

Peach Spring Tuff

Tpu — **Upper Peach Spring Tuff** - Red, phenocryst-rich ignimbrite containing 20-35% phenocrysts of sanidine (<6mm) > plagioclase (<3mm), and <0.5% mafics and opaque minerals, mostly <2mm biotite, with sparse to trace amounts of hornblende, pyroxene and sphene. The map unit has a distinctive black vitrophyre cap <5m that correlates with the Warm Springs zone of the Peach Spring Tuff. The base is a gradational change over a few meters into light colored moderately phenocryst-rich to phenocryst-poor ignimbrite of the lower Peach Spring Tuff map unit (Tpl).

Tpl — **Lower Peach Spring Tuff** - Light gray, phenocryst-poor to moderately phenocryst-rich ignimbrite containing 5-18% phenocrysts of sanidine (<6mm) > plagioclase (<3mm), and <0.5% mafics and opaque minerals, mostly <2mm biotite, with sparse to trace amounts of hornblende, pyroxene and sphene. The base is poorly exposed and nonwelded to poorly welded, and the top is a gradational, yet rapid (<5m interval), change upwards into red densely welded ignimbrite of the upper Peach Spring Tuff map unit (Tpu).

Tct — **Cook Canyon Tuff** - Phenocryst-rich trachydacitic ignimbrite containing 15-25% phenocrysts of plagioclase (4mm) and 2-5% biotite (<4mm) in a dark reddish matrix. <5cm lithic lapilli are sparse, and pumice lapilli (<15cm) range between 5-15%.

Tax — **Phenocryst-rich andesitic rocks** - Andesitic lavas containing 10-30% plagioclase phenocrysts (euhedral, clear vitreous, 2-8 mm) and 2-4% green clinopyroxene phenocrysts (2-4 mm). Some flows contain < 1% biotite 1-2 mm. Coherent facies are hard, platy, and weathered dark brown.

Tba — **Basaltic andesitic rocks** - Phenocryst-poor to moderately phenocryst-rich (1-15%) basaltic andesitic lavas/porphyries containing pyroxene and/or iddingsite (after olivine or pyroxene) = or > plagioclase. Up to three distinct flows of basaltic andesite containing black and green pyroxene (ortho and clino) are present interbedded with the Tds map unit between Thumb Butte and the southern edge of the map area. These flows are similar to a distinctive suite of basaltic trachyandesite lava recognized immediately underlying the Peach Spring Tuff south of Oatman (Spencer et al., 2006). The mafic flows continue sparsely along the western base of the rugged spine of the Black Mountains between Oatman and this area but without any associated Peach Spring Tuff, and so are tentatively used as a stratigraphic marker, potentially of that age in this area.

Tsd — **Dark volcaniclastic rocks** - Green, propylitically altered sandstone, argillite, conglomerate and breccia with clasts dominantly of mafic to intermediate volcanics, but also locally, clasts of Proterozoic granitoid and gneiss. Sandstone ranges from arkosic to lithic-feldspathic (plagioclase). Sections of argillite are locally very thick and dominate the map unit, but are always poorly exposed. Breccia and conglomerate are subordinate where the unit overlies the Alcyone Dacite (Tda). Pebble-cobble conglomerates are commonly associated with sandstone dominated sections. A clay-sandy matrix-supported breccia with clast of andesite and dacite up to 5m is present in the SW/4 of section 18, R 19 W, T 21N. Mafic to intermediate lavas (Ta, Tba, Tda) are closely associated with this unit, which may include some unmapped flows of those compositions in some areas. In the southwest corner of the map area a sequence of medium- to fine-grained volcaniclastic sandstone is interbedded with tuff in between the Alcyone trachydacite (Tda) and phenocryst-rich andesite (Tax). The basal part of this succession consists of several meters of pale-green tuff containing biotite flakes and lithic lapilli. This is overlain by a thin- to medium-bedded sandstone interval that is well-exposed for <2 m thickness. The sandstone is light gray-green, medium-grained, moderately sorted litharenite or lithic wacke with subrounded to subangular grains. Some beds contain light-green pumice. The upper part of the unit is poorly exposed and contains massive or thick-bedded intervals of homogeneous sandstone.

Tda — **Alcyone trachydacite** - Trachydacite lava flows, subordinate ignimbrite, and sedimentary rocks, cheifly at the base of the map unit. Dacite lava flows contain 20-30% 1-7-mm plagioclase phenocrysts and 5-10% 1-3-mm biotite phenocrysts in an aphanitic groundmass, typically purple or dark olive green. The contact between this unit and underlying Proterozoic rocks is a nonconformity. A discontinuous interval at the base of the unit consists of up to at least 5 m of conglomerate or breccia interbedded with pebbly sandstone. The basal unit is texturally variable. Breccia contains pebbles and cobbles of granitoid rocks, angular to subangular pebbles and granules of K-feldspar, and granules of plagioclase. Clast-supported conglomerate contains subrounded pebbles, cobbles, and a few boulders of crystalline rocks. Pebbly sandstone contains very coarse-grained, angular to subrounded, sand- and granule-sized grains of lithics and plagioclase, plutonic quartz granules, granitoid and other pebbles, in an unsorted (sand to clay) green matrix. Throughout most of the map area, a dacitic ignimbrite unit up to several tens of meters thick overlies either the basal conglomerate or lies directly on Proterozoic rocks. This unit contains 35-50% plagioclase phenocrysts (crystals and fragments, <1-2 mm), 10-20% biotite phenocrysts (chloritized in some intervals), 15% altered flattened pumice (purple to green or yellow with plagioclase and biotite phenocrysts), and 5-10% lithic lapilli (mostly <2 cm, up to 5 cm), in a light-colored matrix.

YXg — **Granitic rocks and gneiss** - Proterozoic rocks form the core of an upthrown block bounded by high-angle extensional faults along the southwestern edge of the map area, and underlying volcanic rocks along the eastern edge of the range. The most abundant rock type in this unit is medium- to coarse-grained biotite monzogranite containing >20-25% K-feldspar megacrysts, at least 30% medium- to coarse-grained plagioclase, 20-25% medium-grained quartz, and at least 10% biotite. Most of the megacrysts are 2-3 cm (ranging up to 5 cm) and are Carlsbad-twinned. On the southwest slope of the ridge that extends from Secret Pass to west of Union Pass, megacrystic granite is nearly the only Proterozoic rock exposed. Some zones within the granite contain at least 10% 1-cm red garnet, probably reflecting alumina enrichment in zones of assimilated country rock. On the crest of the ridge, the granite contains xenoliths of country rock 5-20 cm long. Northeast of the ridge crest, granite encloses large xenoliths of gneiss several meters long. Sparse hummocky outcrops of granitoid and intervening low areas with sparse outcrops of gneiss are exposed on the northeast slope of the ridge. The granitoid on the northeast slope locally contains up to 10% 15-20-mm megacrysts, but typically most of the K-feldspar is 5 mm, with sparse megacrysts in the 10-15-mm size range. Much of the granitoid on the northeast slope is medium- to coarse-grained quartz monzonite to quartz monzodiorite containing 15-20% biotite and weathered dark gray. Locally it appears that domains of this more-mafic granitoid are engulfed by granitoid that contains less biotite and more megacrysts, more like the monzogranite on the southwest slope of the ridge.

The coarse-grained granitoid rocks intrude a suite of country rocks that includes biotite-quartz-feldspar and garnet-biotite-quartz-feldspar gneiss, fine- to medium-grained biotite granite (<10% biotite), and fine- to medium-grained garnet leucogranite with garnet up to 1 cm. The gneiss is composed of fine- to medium-grained quartz and feldspar, fine-grained biotite, and up to 15% garnet that is mostly 2-5 mm but up to >1 cm in some layers. Gneissic layering is on few-mm to few-cm scale, and some of the thinner layers are quartz-rich paragneiss.

The granitoid rocks and gneiss are intruded locally by fine-grained diabase that forms northwest-striking dike swarms.

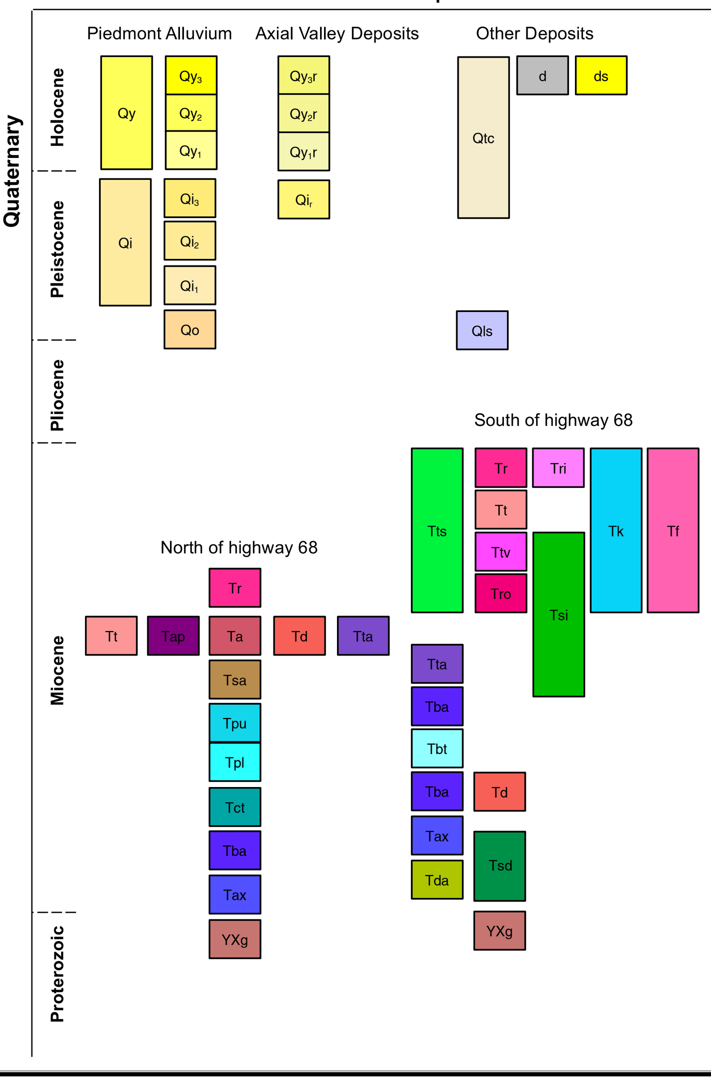
Other units

Qtc — **Colluvium, Regolith, and Talus** - Very poorly sorted, angular to subangular, locally derived gravel, sand, silt and clay deposits derived from immediately adjacent bedrock.Material at and near the surface is derived from underlying or adjacent bedrock outcrops. Locally includes some bouldery talus deposits with minimal fine matrix, and some areas of weathered bedrock where there are no outcrops.

d — **disturbed areas** - Areas substantially altered by human activities, primarily maor roadways and mining areas

ds — **Stocktanks** - Areas of stocktanks formed by earthen dams

Correlation of map units



Symbols and Lines

Contact, accurate
Contact, approximate
Contact, gradational
Fault, accurate
Fault, approximate
Fault, concealed
Anticline
Syncline
Cross-section location
Bedding
Eutaxitic foliation (in welded tuff)
Flow-foliation (in lava and hypabyssal rocks)
Foliation (in granitic gneissic rocks)
Slickenline lineation
Dip of contact

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