

Text and references to accompany Nevada Bureau of Mines and Geology Map 169

Geologic Map of the Vicksburg Canyon Quadrangle, Humboldt County, Nevada

by

Joseph P. Colgan¹, Sandra J. Wyld², and James E. Wright²

¹ *Stanford University, Stanford, CA*

² *University of Georgia, Athens, GA*

2010

DESCRIPTION OF MAP UNITS

Qal Alluvium (Holocene) Unconsolidated alluvial sand and gravel in modern stream beds.

Qp Playa lake deposits (Pleistocene to Holocene) Surface deposits composed of clay, silt, and sand. Deposited during high stands of late Pleistocene to Holocene glacial lakes.

Qls Landslide deposits (Pliocene? to Holocene) Slope-failure deposits of displaced bedrock blocks and/or chaotically mixed rubble. Larger slide blocks consisting of intact blocks of Ashdown Tuff (Tat) are individually mapped.

Qaf Alluvial fan deposits (Pliocene? to Holocene) Unconsolidated to poorly consolidated deposits of boulders, gravel, and sand that form the modern alluvial fans.

Qol Older alluvium (Pliocene?) Unconsolidated to poorly consolidated deposits of boulders (including Cretaceous granites and Tertiary igneous rocks), gravel, and sand that form the inactive and moderately dissected older alluvial surfaces exposed on the west side of the Pine Forest Range and in Alta Creek Basin.

Ts₂ Tuffaceous sedimentary rocks (Miocene) Thinly bedded, generally fine-grained, poorly exposed tuffaceous sandstones, siltstones, and air-fall tuff interbedded with densely welded ash-flow tuff sheets (Tmt₁ and Tmt₂). Impossible to distinguish from older tuffaceous sediments (Ts₁) in outcrop but generally contains more primary volcanic material and less detritus from older Tertiary rocks and pre-Tertiary basement. Base of unit is arbitrarily located at the top of the underlying Steens Basalt.

Tmt₂ Upper welded ash-flow tuff (Miocene) Thin (<5 m), dark-red-weathering, blue-gray to blue-green, densely welded rhyolite ash-flow tuff. Contains about 20% pumice, 5–10% lithic fragments, and 10–20 % by volume phenocrysts. Phenocrysts are >90% sanidine with the rest quartz and pyroxene.

Tmt₁ Lower welded ash-flow tuff (Miocene) Thin (<5 m) dark-red-weathering, blue-gray to blue-green, densely welded rhyolite ash-flow tuff. Contains about 20% pumice, 5–10% lithic fragments, and 10–20 % by volume phenocrysts. Phenocrysts are >90% sanidine with the rest quartz and pyroxene. Sanidine from this unit (sample JC02-PF46) yielded an ⁴⁰Ar/³⁹Ar laser-fusion age of 16.32 ± 0.15 Ma* (Colgan et al., 2006).

On the basis of age and composition, either of these tuffs (Tmt₁ and Tmt₂) may be equivalent to any of the following units: (1) the Idaho Canyon Tuff of Noble et al. (1970), sourced from the Virgin Valley caldera 15 km to the west (Castor and Henry, 2000); (2) the tuff of Craine Creek of Noble et al. (1970), exposed about 20 km south of the map area; or (3) the tuff of Oregon Canyon of Rytuba and McKee (1984), sourced from the McDermitt caldera 50 km to east.

Tsb Steens Basalt (Miocene) Sequence of reddish-weathering, vesicular olivine basalt flows up to 550 m thick. Distinctive flows near base of unit contain >50% large tabular plagioclase phenocrysts (up to 4 cm in length). Groundmass concentrates from this unit yielded ⁴⁰Ar/³⁹Ar ages of 16.33 ± 0.95 Ma* (inverse isochron age, sample JC02-PF25), and 15.97 ± 0.29 Ma* (plateau age, sample JC02-PF23) (Colgan et al., 2006).

Tsbi Steens Basalt (intrusive) (Miocene) Gray-black-weathering, medium-grained basaltic dikes and sills; sills display prominent columnar joints (3–5 cm

apart) perpendicular to overlying bedding. Additional unmapped dikes likely intrude the pre-Cenozoic basement rocks in the southeastern part of the map area. A groundmass concentrate from basaltic sills southwest of Fisher Peak (sample JC02-PF24) yielded an $^{40}\text{Ar}/^{39}\text{Ar}$ plateau age of $16.20 \pm 0.56 \text{ Ma}^*$ (Colgan et al., 2006).

Ts₁ Tuffaceous sedimentary rocks (Oligocene and Miocene) Thinly bedded, generally fine-grained, poorly exposed sequence of tuffaceous sandstones and siltstones interbedded with basalt flows (Tob) and densely welded ash-flow tuff sheets (Tac and Tat). Locally contains well-rounded to subrounded clasts from <1 to >50 cm, derived from underlying pre-Cenozoic basement rocks and Tertiary volcanic units. Stratigraphic top of unit is arbitrarily located at the base of the main sequence of overlying Steens Basalt flows (the lowest Steens Basalt flows are interbedded with Ts₁). Sanidine from an unmapped tuff within this unit (sample JC02-PF17) yielded an $^{40}\text{Ar}/^{39}\text{Ar}$ laser-fusion age of $25.27 \pm 0.17 \text{ Ma}$.

Tat Ashdown Tuff (Oligocene) Distinctive, dark-red-weathering, pale-reddish-gray, pumice- and crystal-rich (20–30 vol % crystals) alkali rhyolite ash-flow tuff, named by Noble et al. (1970) for exposures at the Ashdown Mine in the northwestern part of the map area. Contains common lithic fragments up to ~1cm in size, abundant pumice with well-developed eutaxitic texture, sparse biotite, and abundant sanidine phenocrysts that form distinctive, coarse-grained (>5mm) euhedral crystals. Densely welded and forms prominent dark-red cliffs up to 30 m thick. Sanidine from this unit (sample JC02-PF28) yielded an $^{40}\text{Ar}/^{39}\text{Ar}$ laser-fusion age of $26.09 \pm 0.31 \text{ Ma}^*$ (Colgan et al., 2006).

Tac Tuff of Alder Creek (Oligocene) Reddish-brown-weathering, pale-orange-gray, densely welded trachydacitic ash-flow tuff that is relatively crystal and pumice poor (< 10 % by volume crystals) and contains distinctive biotite and anorthoclase phenocrysts, with minor small (< 1 cm) lithic fragments. Informally named for exposures along Alder Creek south of the map area. Laser-fusion analysis of anorthoclase from this unit (JC02-PF3) yielded an $^{40}\text{Ar}/^{39}\text{Ar}$ weighted-mean age of $26.9 \pm 1.1 \text{ Ma}^*$ (Colgan et al., 2006).

Tob Older basalt flows (Oligocene) Dark gray-black-weathering, thin (~1m) basalt flows forming a sequence up to 300m thick that fills a small, roughly east-west-trending paleovalley south of Fisher Peak and pinches out to the north and south. Contains distinctive small (~1 mm) olivine phenocrysts altered to bright reddish iddingsite. Unit also includes similar flows interbedded with overlying tuffaceous sedimentary rocks (Ts₁). A groundmass concentrate from the oldest flows west of Alta Creek Road (sample JC02-PF27) yielded an $^{40}\text{Ar}/^{39}\text{Ar}$ weighted-mean age of $30.07 \pm 0.40 \text{ Ma}^*$. Two

additional groundmass concentrates from flows interbedded with tuffaceous sedimentary rocks (Ts₁) yielded ages of $26.20 \pm 0.39 \text{ Ma}^*$ (plateau age, JC02-PF13) and $23.65 \pm 0.17 \text{ Ma}^*$ (weighted-mean age, JC02-PF21) (Colgan et al., 2006).

Toc Conglomerate (Eocene to Oligocene) Does not crop out but is exposed in slope wash beneath basalt flows (Tob) just west of Alta Creek Road in the southeastern part of the map area. Contains small (1–4 cm well-rounded pebbles of Paleozoic and Mesozoic rocks, subangular to subrounded 3–10 cm clasts of andesite (Ta), and large (up to 1 m) well-rounded boulders of Mahogany Mountain granodiorite (Kmm).

Ta Andesitic intrusive rocks (Eocene) Reddish-gray-weathering, dark-gray-green, porphyritic trachyandesites containing abundant plagioclase (~30 vol %), hornblende (~10 vol %), and biotite phenocrysts (<5 vol %) in a fine-grained holocrystalline groundmass. Additional small unmapped bodies may exist, particularly in the southeastern part of the map area. Biotite from one small intrusion (JC02-PF42) yielded an $^{40}\text{Ar}/^{39}\text{Ar}$ plateau age of $38.21 \pm 0.29 \text{ Ma}^*$ (Colgan et al., 2006).

* $^{40}\text{Ar}/^{39}\text{Ar}$ ages were calculated relative to sanidine from the Taylor Creek rhyolite (TCR-2) with an assumed age of 27.92 Ma (Duffield and Dalrymple, 1990).

Mahogany Mountain Plutonic Complex (Formerly the Granite Mountain plutonic complex of Wyld and Wright, 2001)

Kmm Mahogany Mountain granodiorite (Cretaceous) Medium- to very coarse-grained, subhedral granular, with sparse phenocrysts of potassium feldspar (up to 4 cm) ± quartz (up to 2.5 cm) ± plagioclase feldspar (up to 1.5 cm). Composition is 30% quartz, 20–25% pale-pink potassium feldspar, 45% plagioclase feldspar, 1–7% biotite and muscovite, and rare accessory garnet. Not foliated. Locally cut by quartz veins and granite pegmatite dikes (not shown on map). Age $104.6 \pm 2.8 \text{ Ma}$ (U-Pb zircon; Wright, J.E., and Wyld, S.J., unpub. data). Dikes of Kmm at Fisher Peak (and unmapped dikes elsewhere) intrude Ktc near the contact.

Krs Rattlesnake Spring Granodiorite (Cretaceous) Medium- to coarse-grained, subhedral granular, generally aphyric quartz monzodiorite to granodiorite (more granodioritic near Ktc boundary). Composition is 10–20% quartz, 45–60% plagioclase feldspar, 5–15% pale-pink to lavender potassium feldspar, 20–25% mafics (hornblende and biotite), and 1–2% sphene (up to 3 mm). Igneous foliation, defined by preferred alignment of mafics, plagioclase and sphene, is prominent along southwest border and variably developed elsewhere. Solid-state foliation superimposed on igneous foliation

along southwest border. Age 106.2 ± 2.2 Ma (U-Pb zircon; Wright, J.E., and Wyld, S.J., unpub. data). Intrudes $\overline{\text{R}}\overline{\text{P}}\overline{\text{Z}}\overline{\text{u}}$.

Ktc Thacker Canyon granodiorite (Cretaceous) Medium- to coarse-grained, subhedral granular, with phenocrysts of potassium feldspar (up to 10 mm), less common hornblende (up to 15 mm), and minor biotite (up to 10 mm). Composition is 20% quartz, 40–50% plagioclase feldspar, 20–25% faintly pink to white potassium feldspar, 10–15% mafics (hornblende typically more common than biotite), and 1–2% sphene (up to 3 mm). Locally has a crude igneous foliation defined by preferred alignment of mafic crystals. Age 107.6 ± 1.0 Ma (U-Pb zircon; Wright, J.E., and Wyld, S.J., unpub. data). Diffuse, gradational border with Krs and Kcs; igneous foliation in each intensifies towards contact. Intrudes Klm northeast of the map area.

Klm-Kcs Lone Mountain-Cold Spring quartz monzodiorite (Cretaceous) Mostly medium- to coarse-grained and subhedral granular quartz monzodiorite, with local dikes (not mapped) of fine-grained quartz monzodiorite, bearing phenocrysts of plagioclase and hornblende. Ductilely deformed within Antelope Valley shear zone. Complex mixed zone of dikes and selvages of wall rock along highly strained western side.

Lone Mountain phase (Klm) is located north of Cold Spring fault and extends to the northeast into the Wilder Creek Ranch quadrangle. Composition is 10–15% quartz, 40–50% plagioclase feldspar, 15–25% faintly pink potassium feldspar, 20–30% mafics (hornblende more common than biotite; clinopyroxene occurs as cores in hornblende), and trace sphene. Local fine- to medium-grained dikes of leucocratic granite with 2–8% biotite. Age 109.6 ± 0.8 Ma (U-Pb zircon; Wright, J.E., and Wyld, S.J., unpub. data).

Cold Spring phase (Kcs) is located south of Cold Spring fault. Composition is 5–15% quartz, 50–70% plagioclase feldspar, 5–20% distinctly colored potassium feldspar (lavender to reddish to pink), and 15–25% mafics (hornblende somewhat more abundant than biotite, clinopyroxene occurs as cores in hornblende), local accessory sphene (up to 3 mm). Becomes more mafic (up to 40%) towards western contact with Kgb, where it locally contains fine-grained mafic dikes (not mapped). Igneous foliation, defined by preferred alignment of plagioclase and mafic crystals, is common and particularly well developed in eastern part of pluton. Age 110.9 ± 1.3 Ma (U-Pb zircon; Wright, J.E., and Wyld, S.J., unpub. data). Gradational contact with Kgb.

Kgb Gabbro (Cretaceous) Mostly medium-grained, subhedral to euhedral granular hornblende gabbro. Less common varieties are fine grained or coarse grained to pegmatitic, and locally contain up to 10% hornblende oikocrysts. Minor hornblende diorite and rare hornblendite. Becomes texturally more heterogeneous towards contact with Kcs. East side ductilely deformed within Antelope Valley shear zone. Age 106.0 ± 1.6 Ma ($^{40}\text{Ar}/^{39}\text{Ar}$ hornblende; Wyld, S.J., and Iriondo, A., unpub. data). Gradational contact with Kcs. Intrudes $\overline{\text{R}}\overline{\text{P}}\overline{\text{Z}}\overline{\text{bas}}$.

Jurassic Intrusive Rocks

Jep Emigrant Pass granite (Jurassic) Mostly coarse- to very coarse-grained, subhedral granular granite with phenocrysts of potassium feldspar (up to 5 cm) and less common quartz (up to 1.5 cm). Composition is 25–45% quartz, 15–25% plagioclase feldspar, 30–45% white to faintly pink potassium feldspar, 1–5% biotite, up to 2% garnet, and up to 2% amphibole \pm muscovite \pm sphene. Also includes fine- to medium-grained dikes (not mapped) of similar (but leucocratic) composition and phenocryst assemblage. Ductilely deformed within Antelope Valley shear zone. Age ~ 162 Ma (U-Pb zircon; Wright, J.E., and Wyld, S.J., unpub. data). Intrudes $\overline{\text{R}}\overline{\text{P}}\overline{\text{Z}}\overline{\text{bas}}$ and $\overline{\text{R}}\overline{\text{og}}$ here and north of map area in the Denio quadrangle.

Jtp Theodore Quartz Diorite (Jurassic) Medium-grained, subhedral granular quartz diorite. Forms dark-reddish-brown outcrops. Composition is 3–10% quartz, 55–60% plagioclase feldspar, 0–4% potassium feldspar, and 30–40% mafics (including 10–20% biotite, 5–20% clinopyroxene, and 0–16% hornblende). Variably developed igneous foliation defined by mafics and plagioclase feldspar, present mostly near the contact with wall rocks. No tectonic foliation. Age 184 ± 1 Ma (U-Pb zircon; Wyld, 1996). Intrudes $\overline{\text{R}}\overline{\text{P}}\overline{\text{Z}}\overline{\text{u}}$.

Metamorphic Rocks

$\overline{\text{R}}\overline{\text{og}}$ Orthogneiss (Triassic) Orthogneiss protolith was medium- to coarse-grained, equigranular granite. Now extensively recrystallized, and consists of 30–50% quartz, 10–20% plagioclase feldspar, 30–40% potassium feldspar, up to 3% biotite, up to 3% muscovite, and trace sphene. Also includes very fine- to medium-grained, equigranular dikes (not mapped) of similar composition but generally leucocratic. Orthogneiss and dikes have a strong metamorphic foliation (S1) defined by preferred alignment of biotite and stretched quartz grains that is complexly folded by tight to isoclinal (D2) and open (D3) folds; D3 folds have moderately NE-dipping axial surfaces and moderately NE-plunging fold hinges. Igneous crystallization age of 239.0 ± 5.7 Ma from medium- to coarse-grained phase, and 236.1 ± 0.9 Ma

from fine-grained leucocratic dike (U-Pb zircon; Wright, J.E., and Wyld, S.J., unpub. data). Orthogneiss and dikes both intrude $\overline{\text{R}}\text{Pzbas}$; in places (e.g., west of Klm) the schist is pervasively intruded and the contact between the two is difficult to pinpoint. The three phases of deformation in $\overline{\text{R}}\text{og}$ are correlative with those in $\overline{\text{R}}\text{Pzbas}$.

$\overline{\text{R}}\text{Pzbas}$ Biotite and amphibolite schist (Paleozoic or Triassic?) Consists mostly of biotite (\pm sillimanite \pm kyanite) schist, with less common amphibolite schist. Biotite schist is fine grained and characterized by mm-scale compositional layering between biotite-rich versus quartz and feldspar-rich layers. Layering is parallel to biotite-defined schistose foliation. Locally contains thin, irregular felsic layers, parallel to foliation, that appear to reflect partial melting. Amphibolite schist consists of 80–95% hornblende and 5–20% plagioclase feldspar; foliation is defined by preferred alignment of hornblende. Schistose foliation (S1) in $\overline{\text{R}}\text{Pzbas}$ is complexly deformed by tight to isoclinal (D2) and open to tight (D3) folds. D3 folds have moderately NE-dipping axial surfaces and moderately NE-plunging fold hinges. The three phases of deformation in $\overline{\text{R}}\text{Pzbas}$ are correlative with those in $\overline{\text{R}}\text{og}$. Predates intrusion of middle Triassic $\overline{\text{R}}\text{og}$, but is otherwise undated.

$\overline{\text{R}}\text{Pzu}$ Schist and gneiss, undivided (Paleozoic or Triassic?) Unit consists mostly of fine- to medium-grained mafic to felsic schists, with lesser orthogneiss. Schists have highly variable compositions and are interlayered on a scale from mm to several m. Most common are hornblende-bearing schists with prominent compositional layering between hornblende-rich (40–90%) and hornblende-poor (5–10%) layers; other minerals are pyroxene (up to 50%), epidote (up to 10%), quartz (from 10–70%), and plagioclase feldspar (from 10–40%). Less common are biotite-bearing schists that contain 5–25% biotite, 0–30% hornblende, 10–40% quartz, and 10–60% plagioclase feldspar. Quartzite schist (up to 97% quartz), and calc-silicate schist are uncommon to rare. Orthogneiss was medium- to coarse-grained, equigranular granodiorite to tonalite with 5–10% biotite. All rocks in this unit are strongly foliated; foliation is generally steeply dipping to the NE or SW but complex folding of foliation is locally seen. Foliation is composite; it initially developed in the earliest Jurassic but was later intensified (and locally folded) in the mid-Cretaceous during intrusion of Krs (Wyld, 1996). Similar orthogneiss located southeast of the map area yields a U-Pb zircon crystallization age of about 230–235 Ma (Wyld and Wright, 1997, and references therein). Schists are apparently intruded by Triassic orthogneiss but are otherwise undated and do not appear similar to $\overline{\text{R}}\text{Pzbas}$.

Antelope Valley Shear Zone (Cretaceous)

Zone of mylonitic rocks with northwest-side-up shear sense that extends northeast from the Vicksburg Canyon quadrangle to the north end of Lone Mountain in the Wilder Creek Ranch quadrangle (Wyld and Wright, 2001). Deforms Klm, Kcs, Kgb, and $\overline{\text{R}}\text{Pzbas}$. Intruded by Ktc north of map area. Age constrained to 109–108 Ma based on cross-cutting relations with Klm and Ktc. From the Cold Spring fault through the north end of Lone Mountain, shear zone foliation everywhere dips to the northwest at approximately 65°. Steep east dip of shear zone south of the Cold Spring fault reflects differential amounts of Tertiary tilting and extension across the fault.

REFERENCES

- Castor, S.B., and Henry, C.D., 2000, Geology, geochemistry, and origin of volcanic rock-hosted uranium deposits in northwestern Nevada and southeastern Oregon, USA: *Ore Geology Reviews*, v. 16, p. 1–40.
- Colgan, J.P., Dumitru, T.A., McWilliams, M.O., and Miller, E.L., 2006, Timing of Cenozoic volcanism and Basin and Range extension in northwestern Nevada—new constraints from the northern Pine Forest Range: *Geological Society of America Bulletin*, v. 118, p. 126–139.
- Duffield, W.A., and Dalrymple, G.B., 1990, The Taylor Creek Rhyolite of New Mexico—a rapidly emplaced field of lava domes and flows: *Bulletin of Volcanology*, v. 52, p. 475–487.
- Noble, D.C., McKee, E.H., Smith, J.G., and Korrington, M.K., 1970, Stratigraphy and geochronology of Miocene volcanic rocks in northwestern Nevada: U.S. Geological Survey Professional Paper 700D, p. 23–32.
- Perssonius, S.F., Crone, A.J., Machette, M.N., Mahan, S.A., Kyung, J.B., Cisneros, H., and Lidke, D.J., 2007, Late Quaternary paleoseismology of the southern Steens fault zone, northern Nevada: *Bulletin of the Seismological Society of America*, v. 97, p. 1662–1678.
- Rytuba, J.J. and McKee, E.H., 1984, Peralkaline ash-flow tuff and calderas of the McDermitt volcanic field, southeast Oregon and north-central Nevada: *Journal of Geophysical Research*, v. 89, no. B10, p. 8,616–8,628.
- Wyld, S.J., 1996, Early Jurassic deformation in the Pine Forest Range, northwest Nevada, and implications for Cordilleran tectonics: *Tectonics*, v. 15, p. 566–583.
- Wyld, S.J., and Wright, J.E., 1997, Triassic-Jurassic tectonism and magmatism in the Mesozoic continental arc of Nevada—classic relations and new developments: *Geological Society of America Field Trip Guidebook*, in Link, P.K., and Kowallis, B.J., eds., *Proterozoic to Recent stratigraphy, tectonics, and volcanology, Utah, Nevada, southern Idaho and central Mexico*: Brigham Young University Geology Studies v. 42, pt. 1, p.197–224.
- Wyld, S.J., and Wright, J.E., 2001, New evidence for Cretaceous strike-slip faulting in the United States Cordillera and implications for terrane displacement,

deformation patterns, and plutonism: *American Journal of Science*, v. 301, p. 150–181.

Author contact information:

Joseph P. Colgan, U.S. Geological Survey
345 Middlefield Rd., MS 973, Menlo Park, CA 94025
jcolgan@usgs.gov, (650) 329-5461