

Text and references to accompany Nevada Bureau of Mines and Geology Open-File Report 14-6

Preliminary Geologic Map of Heath Canyon, Central Grant Range, Nye County, Nevada

by

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DESCRIPTION OF MAP UNITS

Quaternary deposits

Qc – Colluvium – Unconsolidated, locally-derived, angular pebble- to boulder-size clasts deposited on modern hillslopes.

Qal – Alluvium – Unconsolidated, poorly-sorted, conglomeratic sediment deposited in modern drainages.

Qpl – Pluvial lake deposits – Unconsolidated gravel, sand, and mud deposited just below pluvial lake highstand shoreline at ca. 4870 feet elevation.

Qafy – Younger alluvial fans – Unconsolidated gravel and sand deposited by streams on east and west flanks of range. Deposited on top of, and locally incised into, unit Qafo. Cut by east- and west-dipping Holocene fault scarps on west side of range.

Qafo – Older alluvial fans – Unconsolidated to poorly-consolidated gravel and sand deposited by streams on east and west flanks of the range. Isolated remnant exposures are also preserved in Heath Canyon. Deeply-incised by modern drainages. Cut by prominent west-dipping Holocene fault scarp on west side of range.

Tertiary rocks

Tertiary stratigraphic map units

Tu – Tertiary valley fill sediment, undivided – Not exposed in map area; shown in cross-section only. Consists of a section of Late Miocene to Pliocene (Johnson, 1993; Horton and Schmitt, 1998) conglomerate, sandstone, and mudstone deposited in the Railroad Valley structural basin on the west end of the map area. At minimum

thickness of 4000 feet is shown here, but this section is as thick as 9800 feet in other parts of Railroad Valley (Johnson, 1993).

Twb – Windous Butte Formation – Rhyolitic, tan, white, and pink, massive-weathering, structureless, phenocryst-poor, ash-flow tuff. Up to ca. 20% phenocrysts by volume, consisting of about half quartz (1 mm or less) and half plagioclase, with lesser biotite. Distinctly finer-grained and lower phenocryst volume percentage than unit Tsc, and phenocrysts contain less quartz and more plagioclase than Tsc. Exhibits white, un-flattened pumice; locally up to 20% pumice by volume. Contains rare, white, fine-grained, interbedded volcaniclastic rocks. Age is 31.8 Ma (early Oligocene) in the Quinn Canyon Range to the south ($^{40}\text{Ar}/^{39}\text{Ar}$ biotite; Taylor et al., 1989). Upper contact is not exposed in the map area; minimum thickness is 1700 feet.

Tau – Upper andesite flow – Andesite with dark-gray to black, aphanitic, silicic, glassy groundmass with up to ca. 25% volume percentage of ca. 1–2 mm plagioclase phenocrysts, with rare biotite phenocrysts. Forms bluffs and supports steep talus slopes. Flow banding is common. Only present in northeast corner of map area. Thickness is up to 550 feet.

Tsc – Stone Cabin Formation – Rhyolitic ash-flow tuff with orange-, tan-, and white- weathering groundmass, and variable degrees of welding. Massive-weathering, forms bluffs and cliffs. Typically ca. 40–50% phenocrysts by volume, dominated by ca. 2–3 mm quartz, with lesser biotite, plagioclase, sanidine, and hornblende, in order of decreasing abundance. White, flattened pumice fiamme are common and define flow foliation. Also includes rare, interbedded, white, fine-grained volcaniclastic rocks, and rare basal vitrophyre. Age is 34.1 Ma (late Eocene) (K-Ar biotite; Kleinhampl and Ziony, 1985). Thickness is up to 1200 feet.

Tal – Lower andesite flow – Andesite with dark-gray, aphanitic, silicic, glassy groundmass with up to ca. 20% plagioclase phenocrysts, and lesser biotite phenocrysts. Flow banding is common. Only present in northeast corner of map area. Thickness is up to 500 feet.

Tsp – Sheep Pass Formation – Light-gray to cream-colored, fine-crystalline, lacustrine limestone; fetid odor when broken. Varies from thin- to medium-bedded, to massive-weathering, structureless and bluff-forming. A poorly-exposed basal conglomerate consisting of poorly-indurated, well-rounded, pebble to cobble clasts derived from upper Paleozoic carbonate units, is locally present. Precise deposition age in the map area is unknown, but regionally this unit is interpreted as Paleocene to Eocene (Fouch, 1979). Thickness is between 400–700 feet.

Tertiary intrusive igneous map units

Tdd – Dacite dike – Porphyritic dacite, dominated by ~2–4 mm plagioclase phenocrysts, with lesser amphibole, quartz, and biotite, in a medium-gray, very fine-grained phaneritic groundmass. Up to ca. 75% phenocrysts by volume. Consists of a single NNE-trending, ca. 10–30 foot-wide dike on the north side of Heath Canyon that cuts several low-angle normal faults. Undeformed; preserves original magmatic foliation.

Tad – Andesite dikes – Dark-gray, aphanitic to fine-crystalline phaneritic andesitic dikes, typically less than 20 feet wide, and trending N to NNW. Phenocrysts (when visible) dominated by plagioclase, with lesser amphibole and pyroxene, and rare biotite. Undeformed; preserves original magmatic foliation, and cuts low-angle normal faults.

Tgd – Granite dikes – Fine- to coarse-crystalline granite dikes, with muscovite and lesser biotite, typically less than 30 feet wide. Undeformed; preserves magmatic foliation. Consists of several E- to ENE-trending dikes on the south side of Heath Canyon, one of which cuts structurally-lower low-angle normal faults and is cut by a structurally-higher low-angle normal fault.

Paleozoic rocks

Pennsylvanian

Pe – Ely Limestone – Light- to medium-gray, medium- to coarse-crystalline, alternate thin- and thick-bedded, fossiliferous limestone, with common tan-brown chert stringers and nodules, and brown siliceous silty partings. Weathers to distinct light-gray bluffs. Upper contact is not exposed; minimum thickness is 800 feet.

Mississippian

Mc – Chainman Shale – Dark-gray to black, fissile, thinly-laminated, carbonaceous shale, with lesser tan to red siltstone, rare medium- to coarse-grained, thick-bedded, cross-bedded, tan to brown sandstone, and rare silty, medium-gray, medium-bedded limestone. Poorly exposed; float forms characteristic brown and gray slopes. Thickness is up to 1250 feet.

Mj – Joana Limestone – Lower part of section consists of massive-weathering, bluff and cliff-forming, light- to medium-gray limestone, often rich in crinoids, with diagnostic tan to brown bedded chert and chert stringers, which define bedding. Upper part of section consists of poorly-exposed, silt-rich, thin-bedded, gray to pink-weathering, platy-weathering, crinoid-rich limestone, with rare interbeds of chert-rich limestone similar to lower section. Often altered to jasperoid at upper stratigraphic and structural contacts with unit Mc. Thickness is 700 feet.

Devonian

Dg – Guilmette Formation – Thick-bedded, well-bedded, medium- to dark-gray, fine- to medium-crystalline, fossiliferous limestone. Forms characteristic ca. 30–50 foot-high cliffs. *Stringocephalus* corals are common, and are diagnostic to distinguish from unit Mj. Lacks chert, but brown siliceous silt stringers are common. Dark-gray, fossil-rich limestone intervals are often mottled. Full thickness is not exposed in map area, but varies between 1800–2200 feet thick in adjacent parts of the range (Moores et al., 1968; Hyde and Huttner, 1970).

Dsi – Simonson Dolomite – Alternating medium- to dark-gray and gray-brown, medium- to thick-bedded dolostone; regular alternation of these colors is diagnostic. Brown dolostone is typically fine-crystalline, with prevalent compositional lamination and mottling, but medium-dark gray dolostone is often sugary-textured. *Stringocephalus* corals locally present. A minimum thickness of 800 feet is exposed in map area; regionally thickness varies between 700–1000 feet (Moores et al., 1968; Hyde and Huttner, 1970).

Doc – Oxyoke Canyon Sandstone – Brown to tan, cross-bedded, dolomitic, medium- to coarse-grained sandstone, interbedded with medium-gray dolostone similar to unit Dsi. Forms characteristic single brown bluff or cliff. Sandstone is locally altered to quartzite. Thickness is 25–75 feet.

Dse – Sevy Dolomite – Light-gray, white, and cream-colored, porcellanous, fine-crystalline, thin- to medium-bedded, often massive-weathering dolostone. Compositional laminations are prevalent. Rare medium- to dark-gray dolostone interbeds. Thickness is 350–600 feet.

Sl – Laketown Dolomite – Light- to medium-gray, sugary-textured, massive-weathering to very thick-bedded, coarse-crystalline dolostone, with interspersed intervals of dark-gray to black, medium-coarse crystalline dolostone with common silicified shells. Rare gray to tan chert stringers. Often silicified near low-angle normal faults. Forms bluffs and cliffs. Full thickness is not exposed in map area, but varies between 1200–1350 feet in adjacent parts of the range (Moores et al., 1968; Cebull, 1970).

Ordovician (note: Ordovician unit divisions after Camilleri (2013))

Oes – Ely Springs Dolomite – Not exposed in map area; shown on cross-section only. Consists of fossiliferous, dark-gray to black dolostone in adjacent parts of the range (Hyde and Hutterer, 1970; Camilleri, 2013). Thickness in northern Grant Range is 420 feet (Moores et al., 1968).

Oe – Eureka Quartzite - Not exposed in map area; shown in cross-section only. Consists of cliff-forming, white to tan quartzite in adjacent parts of the range (Fryxell, 1988; Camilleri, 2013). Thickness in central Grant Range, north of the map area, is 200 feet (Camilleri, 2013).

Pogonip Group

Opl – Lehman Formation – Not exposed in map area; shown in cross-section only. Consists of light blue-gray limestone with argillaceous partings in adjacent parts of the range (Camilleri, 2013). Thickness is 450 feet in central Grant Range, north of the map area (Camilleri, 2013).

Opp – Kanosh Shale – Not exposed in map area; shown in cross-section only. Consists of laminated argillite interbedded with green-gray argillaceous limestone in adjacent parts of the range (Camilleri, 2013). Thickness is 150 feet in central Grant Range, north of the map area (Camilleri, 2013).

Ops – Shingle Limestone - Medium- to thick-bedded, medium- to dark gray-green limestone, with abundant ca. 1 cm-spaced, tan-brown argillite partings. Limestone has been recrystallized, and white mica porphyroblasts have grown on argillitic partings. Thicker-bedded and has more argillite by volume than unit Opp. A minimum thickness of 1150 feet is exposed in the map area.

Opp – Parker Spring Formation – Thin- to medium-bedded, light green-gray, fine-medium crystalline, argillaceous limestone with <1 cm-thick, gray to brown, micaceous argillite partings, and interbedded gray-green laminated to thin-bedded argillite. Limestone has been recrystallized, and white mica porphyroblasts have grown on argillaceous partings.

Ca. 1–3 cm, lenticular, siliceous and chert nodules are diagnostic, and produce wavy bedforms. Rare intraformational conglomerate. Rare interbeds of thick-bedded, medium-dark gray limestone can form boundins within less competent, argillite-rich limestone. Local outcrop-scale folding, and argillite locally exhibits crenulation cleavage. A minimum thickness of 850 feet is exposed in the map area.

COpG – Goodwin Formation – Upper part of section consists of thin- to medium-bedded, well-bedded, light- to medium-blue-gray limestone with abundant tan-brown chert stringers and nodules. Limestone has been recrystallized and locally has been extensively replaced by white crystalline calcite. White mica porphyroblasts commonly present on argillaceous partings. Limestone in lower part of section is similar to upper part, but is thicker-bedded and more massive-weathering, forming bluffs and cliffs. A minimum thickness of 2000 feet is exposed in the map area.

Cambrian (note: Cambrian unit divisions after Camilleri (2013))

CIm – Little Meadows Formation – Massive-weathering, thick-bedded, white to light blue-gray, coarse-crystalline marble. Forms distinct white cliffs and bluffs. Thickness is 300 feet.

Sidehill Spring Formation

Csb – Blue Eagle member – Light blue-gray, thin- to medium-bedded, massive-weathering, recrystallized limestone with characteristic dark- to blue-gray, micaceous compositional laminations. White mica porphyroblasts are dispersed within limestone and are prevalent on compositional partings. Rare intraformational conglomerate. A minimum thickness of 350 feet is exposed in the map area.

Csgu – Grant Canyon member, upper unit – Laminated to very thin-bedded, dark blue-gray, recrystallized limestone, with prevalent, closely-spaced, rust-brown argillite partings, and less common cm-thick phyllite interbeds. Phyllite and argillite partings contain white mica porphyroblasts. Outcrop-scale folding is common. A minimum thickness of 4050 feet is exposed in the southwest part of the map area.

Csgl – Grant Canyon member, lower unit – Dark-gray, green, and brown, laminated phyllite alternating with very thin-bedded, dark blue-gray, brown-weathering limestone interbeds. Contains much more phyllite than unit Csgu. Phyllite contains white mica porphyroblasts, and some phyllite is black and graphitic. Shows signs of penetrative ductile

deformation, including prevalent outcrop-scale folding, common development of crenulation cleavage in phyllitic intervals, local boudinage of limestone interbeds within phyllite, and local development of overprinting tectonic foliation over original compositional lamination (i.e., bedding). Measurements of tectonic foliation shown on map represent orientation of original compositional lamination. A minimum thickness of 2950 feet is exposed in the map area.

Csw – Willow Springs member - Thin-bedded, green-gray to green-brown, recrystallized limestone and marble with prevalent orange-brown, locally graphitic, phyllitic partings. Marble contains dispersed white mica porphyroblasts, and phyllitic partings often exhibit white mica, phlogopite, and amphibole porphyroblasts (Camilleri, 2013). Exhibits signs of penetrative ductile strain, including prevalent outcrop-scale folding, development of crenulation cleavage on phyllitic partings, folded and boudinaged calcite veins, and occasionally two planar fabrics, consisting of original composition lamination (bedding) overprinted by a younger tectonic foliation, often at an acute angle. Measurements of tectonic foliation shown on map represent orientation of original compositional lamination. A minimum thickness of 2000 feet is exposed in the map area.

Cpc – Pole Canyon limestone – Dark blue-gray, thin-bedded, recrystallized limestone and marble with regularly-spaced (2–4 cm) red-brown phyllitic partings up to 1 cm-thick, and local thin-bedded phyllite interbeds. Limestone contains dispersed white mica and phlogopite porphyroblasts (Camilleri, 2013), which are often parallel to original compositional lamination. Phyllitic partings exhibit biotite and white mica porphyroblasts (Camilleri, 2013). Exhibits signs of penetrative ductile strain, including outcrop-scale folding, development of crenulation cleavage on phyllitic partings, and local development of younger tectonic foliation that overprints original compositional lamination. Measurements of tectonic foliation shown on map represent orientation of original compositional lamination. A minimum thickness of 500 feet is exposed in the map area. A full thickness of 1400 feet is reported in the southern Grant Range (Fryxell, 1988).

Cp – Pioche Shale – Not exposed in map area; shown in cross-section only. Consists of red to brown, micaceous quartzite and mudstone (mudstone is often metamorphosed to phyllite and schist), and black limestone in southern Grant Range (Fryxell, 1988). Thickness is 600–800 feet in adjacent parts of range (Cebull, 1970; Fryxell, 1988).

Cpm – Prospect Mountain Quartzite – Not exposed in map area; shown in cross-section only. Consists of white, yellow, gray, and red quartzite in southern Grant Range

(Fryxell, 1988). A minimum thickness of 3000 feet is exposed in the southern Grant Range (Fryxell, 1988), but full thicknesses up to 4500 feet are reported regionally (Hyde and Huttner, 1970).

Precambrian

Zu – Neoproterozoic rocks, undivided – Not exposed in map area; shown in cross-section only. Though not exposed in the Grant Range or adjacent ranges, clastic rocks of the Neoproterozoic McCoy Creek Group (e.g., Stewart, 1980) are inferred to underlie unit Cpm in cross-section.

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