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Geologic Map of the Sacramento Pass Quadrangle, White Pine County, Nevada

by

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ABSTRACT

The Sacramento Pass quadrangle includes Sacramento Pass on U.S Highway 50, located in the southwestern corner of the quadrangle. This is a region of complex normal faulting between the northern Snake Range and southern Snake Range. In the northern Snake Range, the northern Snake Range detachment fault (NSRD) separates faulted and tilted Paleozoic strata in an upper plate position from highly strained, foliated and lineated, mylonitic Precambrian to Cambrian metasedimentary rocks and granites in the lower plate. The NSRD is last exposed in Silver Creek in the northeastern edge of the quadrangle, but is inferred to underlie faulted Paleozoic rocks westward into the bordering South Bastian Spring quadrangle. To the south of Highway 50, Jurassic plutonic rocks and the Precambrian sediments they intrude do not have mylonitic fabrics. The youngest faults in the quadrangle cut and accommodate tilting of Miocene synextensional basin-fill deposits that underlie the southeastern portion of the map. Rock avalanche deposits or sheets of rock breccia derived from Paleozoic strata are intercalated with Miocene lacustrine sediments and are well-exposed in this and surrounding quadrangles. They herald the onset of Basin and Range faulting and differential uplift.

DESCRIPTION OF MAP UNITS

Stratified Rocks

Qal Alluvium (Quaternary) Generally unconsolidated sand and gravel deposited within modern drainage systems and slopes.

Qol_2 Young alluvium (Quaternary) Flat lying consolidated to unconsolidated alluvial-fan sand and gravel deposits. Units are younger than Qol, which is related to an older depositional period and possible faulting on the western side of the southern Snake Range. Clast types and morphology indicate alluvium is derived from the major present-day drainage systems developed in flanking mountain ranges.

Qol Older alluvium (Quaternary) Flat-lying or gently dipping consolidated to unconsolidated, alluvial-fan, sand and gravel deposits that form pediment surfaces, rest in sharp angular discordance on older rocks, and are incised by present day drainages. Clast types and morphology of these deposits reflect derivation from the present-day drainage systems developed in flanking mountain ranges.

Tc Conglomerate (Tertiary) Tilted alluvial-fan conglomerates exposed in low hills in the Sacramento Pass region, mainly in the southeast corner of the quadrangle. Tilted alluvial-fan deposits are well exposed in several drainages in the map area, but elsewhere the unit is poorly exposed, forming red to gray hills and often overlapped or mantled by older alluvium (Qol). Described in detail by Grier (1983, 1984). Alluvial-fan deposits overlie and interfinger laterally with lacustrine deposits (Tl). Clast types and paleocurrent measurements indicate derivation primarily from the southern Snake Range (Grier, 1983). Several large masses of brecciated Paleozoic limestone and quartzite occur within these conglomerates and are interpreted to be rock avalanche deposits. The total thickness of this unit is greater than 2 km, and it accumulated as part of the syntectonic basin fill associated with the normal faults that flank the eastern sides of the northern and southern Snake Range in the early-mid Miocene (Martinez, 1998). The conglomerate ranges from moderately well rounded and clast-supported to angular and matrix-supported with clasts from pebble to boulder sized and bedding 0.05–1.5 m thick.

Tm Marl (Tertiary) Generally poorly exposed, mostly marly lacustrine sediments with lesser limestone and

calcareous sandstones and siltstones. This unit interfingers with Tl (limestone) and Tc (conglomerate).

Tl Limestone (Tertiary) Limestone, marl and calcareous sandstones and siltstones. This unit interfingers laterally with and underlies Tertiary conglomerate (Tc); it was deposited disconformably above underlying Tertiary volcanic rocks. The deposits have been described in detail by Grier (1983, 1984). The section of lacustrine sediments is between 300 and 840 m thick and consists of yellow to tan, ledgy, slope-forming limestone interbedded with white, friable marl. Sandstone and siltstone beds occur sporadically throughout the unit. Biotite from rhyolite tuff layers within the section yielded $^{40}Ar/^{39}Ar$ ages of between 21 to 19 Ma (Martinez, 1998; Miller et al., 1999; Ruksznis, 2015).

Tbx Rock-avalanche breccia (Tertiary) Paleozoic slide blocks deposited during large rock-avalanche events in the Miocene. The breccia sheets interfinger with Tc and Tl, and are 10s to 100s meters long and several 10s of meters thick. They consist of Pennsylvanian Ely Limestone (ℙe), Devonian Guilmette Formation (Dg), Ordovician Eureka Quartzite (Oe), Pogonip Group (Op), Ordovician-Silurian Fish Haven and Laketown Dolomite (OSd), and Cambrian Notch Peak Formation (Ꞓn). The breccia was generated during catastrophic emplacement of the rock avalanche. The degree of brecciation varies throughout the exposures, from more highly brecciated, matrix-rich breccia at the base, to crackle breccia near the top (Grier, 1983; 1984; Martinez, 1998).

Tj Jasperite fault breccia (Tertiary?) Formed along Tertiary normal faults.

Tv Rhyodacite flows and subvolcanic intrusive bodies (Tertiary) Exposed in the southeast corner of the Sacramento Pass quadrangle. Forms large mass of pink weathering flow-banded rhyolite to dacite lava flows, truncated by a fault on the east. Lava flows are overlain by the base of the Tertiary sedimentary section. Tertiary conglomerate on the south and west. The rhyodacite contains about 20% phenocrysts of sanidine, plagioclase, biotite and minor hornblende and quartz. Mafic minerals are largely replaced by iron oxides.

Pa Arcturus Formation (Permian) The Arcturus Formation is predominantly tan to white, slope-forming, fine-grained quartzose sandstone with occasional brown-gray, ledge-forming, fossiliferous, medium- to coarse-grained, thin-bedded to massive limestone. The sandstone varies from moderately to well sorted, poorly cemented quartzose sandstone, to poorly sorted, calcite-cemented sandstone and a silica-cemented orthoquartzite. The fraction of limestone increases upsection and contains diagnostic mollusks and hexagonal colonial corals. Black chert nodules are common. Reported regional thickness is about 1,150 m.

ℙe Ely Limestone (Pennsylvanian) Light gray to medium gray, organic detrital limestone. Lenses and bands of chert are common. The Ely Limestone crops out as thick-bedded, ledge-forming limestone. Estimated thickness in the region is 549–823 m.

Mj Joana Limestone (Mississippian) A light gray, medium- to massive-bedded fossiliferous, bioclastic marine limestone. Contains chert nodules in some areas. It is a resistant, cliff-forming unit and is exposed above the slope-forming Pilot Shale.

Mc Chainman Shale (Mississippian) Slope-forming fine-grained shaly to silty, rarely sandy, siliciclastic rocks, poorly exposed. Inferred to be derived from the west, from erosion of the Roberts Mountains allochthon and deposited in its foredeep or foreland basin.

Mdp Pilot Shale (Mississippian and Upper Devonian) A slope-forming, olive-gray to dark gray calcareous shale and siltstone with limestone interbeds at the base of the section. Weathers to a dusky yellow gray and contains a large proportion of silt-sized grains (Hose et al., 1976).

Dg Guilmette Formation (Devonian) The Guilmette Formation consists predominantly of interbedded limestone and dolomite. The base is generally light- to medium-gray, massive cliff-forming, micritic to very finely recrystallized, mottled, somewhat fossiliferous limestone. Fossils include gastropods, crinoids, and brachiopods. This part of the formation may contain solution collapse breccia. The formation becomes better-bedded upwards, where fine-grained gray limestone alternates with medium- to dark-brown, coarser-grained dolomite. Fossils are abundant and include stromatoporoids, brachiopods, crinoids, gastropods, and corals. The top of the formation is more limestone rich, and the uppermost portion is a highly burrowed, platy limestone. The section is incomplete in this quadrangle. Regional thickness reported for the Guilmette Formation is about 750 m (Hose et al., 1976).

Dsi Simonson Dolomite (Devonian) The Simonson Dolomite consists of light- to dark-brown, thin- to medium-bedded, laminated, microcrystalline to coarsely crystalline dolomite. The basal part is thicker-bedded and uniformly light brown. The upper part is strikingly laminated with alternating light-brown and dark-chocolate-brown layers on a centimeter scale. Fossils are rare but include gastropods, crinoids, brachiopods, and coral debris. A typical thickness reported for this unit is about 175 m (Hose et al., 1976).

Dse Sevy Dolomite (Devonian) The Sevy Dolomite is not exposed in the South Bastian Spring quadrangle because it has been faulted out, but it consists of distinctive white-weathering, light-gray, thin- to medium-bedded, very fine-grained, laminated dolomite. Diagnostic dark-brown-weathering stringers of well-rounded coarse- to medium-grained quartz sand occur in the upper part of the formation. The Sevy Dolomite is noted for its lack of fossils and uniform light-gray color. Regionally, the unit has an average thickness of about 250 m (Hose et al., 1976).

OSd Fish Haven and Laketown Dolomites, undivided (Silurian and Ordovician) The OSd dolomite is a light-gray to dark-chocolate-brown, slope- to cliff-forming

dolomite. Regionally it averages approximately 600 m thick and is often divided into Ordovician Fish Haven Dolomite and Silurian Laketown Dolomite. The OSd dolomite varies from poorly bedded, dark-brown dolomite with rust- to black-colored nodular chert beds 1 to 3 cm thick and spaced about 4 to 6 cm apart, to uniformly chocolate-brown to a light-rust-gray, poorly bedded, fossiliferous dolomite with lesser, variable amounts of chert nodules, to massive, light brown-gray dolomite similar in appearance to the Sevy Dolomite. Fossils include colonial, rugose, and tabulata corals as well as crinoids, brachiopods, and gastropods. A distinctive feature of the OSd dolomite is a several-meter-thick zone of algal stromatolite beds found about two-thirds of the way up through the unit. The upper part of the OSd dolomite that underlies the Sevy Dolomite is light-gray, cliff-forming, poorly bedded sugary dolomite.

Oe Eureka Quartzite (Ordovician) The Eureka Quartzite is white, cliff- to ledge-forming, thick-bedded orthoquartzite consisting of nearly 100% fine-grained (0.3–0.5 mm), extremely well-sorted and well-rounded, silica-cemented quartz grains. It is a distinctive stratigraphic marker, occurring as it does between dark dolomites above and the yellow weathering, blue-gray limestone below. Complete sections in surrounding areas range from 40 to 150 m thick (Hose et al., 1976). Fresh surfaces are white and vitreous, weathered surfaces are rust-brown and pitted. The Eureka Quartzite commonly occurs as thin, brecciated, fault-bounded slivers and is often smeared out along fault planes.

Op Pogonip Group (Ordovician) The Pogonip Group is yellow-weathering, ledgy-slope-to slope-forming, well-bedded, fossiliferous, medium-blue-gray to light-blue-gray, silty limestone. A number of fossil types occur in the Pogonip Group, including brachiopods, gastropods, crinoids, ostracods, coiled nautiloids, and tabulate corals. Due to areal variations within the group, various authors have divided it differently into formations. In the northern Snake Range, it is most convenient to follow the nomenclature of Fritz (1968), who divided the Pogonip Group into six units: A, B, C, D, Kanosh Shale and Lehman Limestone. In this quadrangle, complete sections are present of some of these subunits, but in most areas, faulting and poor exposure precluded our subdividing the unit. In surrounding areas the Pogonip Group is approximately 600 to 900 m thick.

Ꞓn Notch Peak Formation (Upper Cambrian) The Notch Peak Formation is medium-gray, fine- to medium-grained, cliff- to ledge-forming, thin-bedded, cherty limestone. Complete sections of the formation are locally exposed. Typically, the limestone contains 1- to 2-cm-thick, rust- to brown-colored chert nodules in layers 2 to 4 cm apart. In some intervals, the chert occurs as isolated nodules that are sporadically distributed in thin-bedded to massive limestone or is entirely absent. Bedding, defined by silty limestone interlayers, can be irregular to well developed. The lowest 5 to 10 m of the Notch Peak Formation typically consists of a resistant interval of light-gray, fine- to medium-grained limestone, designated the Barton Canyon Member of Young (1960). Medium- to dark-brown coarse-grained, chert-poor dolomitic intervals are common in the middle part of the unit. The upper part of the Notch Peak Formation contains a variety of rock types. These include intervals of silty, chert-poor, well-bedded (1- to 3-cm-thick) limestone, dark-gray limestone beds with mauve mottling 2 to 4 cm thick, and tan, buff and gray blocky limestone beds containing well-preserved trilobite spines. Within more massive intervals are lenses and beds of dark-gray, bioclastic limestone. The uppermost section is light-gray, massive to poorly defined bedding, cliff-forming, sparse chert, and fossiliferous, including brachiopods, gastropods, trilobites, and crinoids. Meter-scale stromatolites are often well developed in the upper portion and occur within repeated shoaling upward sequences.

Ꞓd Dunderberg Shale (Upper Cambrian) The Dunderberg Shale is a platy, well-bedded, slope- and saddle-forming khaki-colored shale interbedded with dark-gray, fine- to medium-grained, fossiliferous, silty limestone. Bedding in the limestone is typically 0.5 to 1.0 cm thick. Generally, the khaki-colored shale is very poorly exposed, and is only observed in float. The limestone float typically has distinctive brown- to rust-colored siltstone coating. The limestone contains abundant phosphatic inarticulate brachiopods and trilobite debris.

Ꞓl Lincoln Peak Formation (Upper Cambrian) The Lincoln Peak limestone is a slope-forming, platy, medium- to dark-gray, very thinly bedded limestone. Silty intervals and chert stringers weather distinctly brown. The limestone contains sparse trilobite hash and oncolites. The unit is estimated to be 1200–1400 meters thick in the southern Snake Range, but complete sections are not exposed in this quadrangle.

Ꞓpc Pole Canyon Limestone (Middle Cambrian) The Pole Canyon Limestone consists of thick alternating layers of light- to bluish-gray limestone and darker cliff-forming limestone. The limestone exhibits fenestral fabrics and contains abundant Girvanella and oolitic layers, especially at its base. Members A and C as described by Whitebread, (1969) are dark gray and contain discontinuous silty partings. Members A and C as described by Whitebread are light-gray massive cliff formers and E is light gray with argillaceous partings and varicolored shale near its top. In the Sacramento Pass quadrangle, the Pole Canyon Limestone occurs in both lower and upper plate positions with respect to the northern Snake Range detachment. Where present beneath it, the Pole Canyon Limestone is a marble mylonite.

Ꞓpi Pioche Shale (Lower Cambrian) The Pioche Shale forms an important lithologic transition between dominantly clastic Early Cambrian and older strata and the overlying clastic-absent Middle Cambrian limestone section. The Pioche Shale is a slope-forming unit of dark, sandy siltstone and shale that is greenish-gray to khaki-colored, mostly thin bedded, and includes some cross-bedded sandstone at the base. In the upper plate rocks of the Snake Range

detachment fault, the Pioche Shale is affected by weak metamorphism.

Ꞓpm Prospect Mountain Quartzite (Lower Cambrian) The regional reported thickness of the Prospect Mountain Quartzite is approximately 1200 m. The unit is a cliff-forming quartzite that weathers rust-brown, tan or purple with consistent bedding thicknesses (.3–1 m). Beds have cross-beds defined by dark laminations. In hand specimen, the quartzite is white to gray, well sorted, fine- to medium-grained, and consists of 90–95% quartz, 5% feldspar and lesser muscovite, chlorite, and opaque oxides. The abundance of cross-beds and the regular bedding help to distinguish the Prospect Mountain Quartzite from the underlying McCoy Creek Group. The Prospect Mountain Quartzite was metamorphosed in the Mesozoic and Cenozoic and highly deformed during the Cenozoic beneath the northern Snake Range detachment fault (e.g., Lee et al., 1987; Lee and Sutter, 1991; Miller et al., 1999). Bedding has been thinned during development of a bedding-parallel foliation, and stretching lineations are well developed. In the Sacramento Pass quadrangle, Ꞓpm occurs in both lower plate and upper plate positions, as indicated by the presence or absence of mylonitic foliation and stretching lineations.

Neoproterozoic McCoy Creek Group

p€mu McCoy Creek Group (Proterozoic) (Misch and Hazzard, 1962) Formal designation given throughout east central Nevada to a thick interval of alternating quartzite and shale that underlies the Lower Cambrian Prospect Mountain Quartzite. It is generally assumed to be Neoproterozoic. Detrital zircon studies confirm its Neoproterozoic age (Hoiland et al., 2022).

In adjacent ranges, this interval has been divided into 6 to10 informal quartzite and shale members, but the regional correlation of these members is not clear. The stratigraphically highest pelite within the McCoy Creek Group rock is the Osceola Argillite ($p€m_0$) (following the nomenclature of Misch and Hazzard, 1962), and lower quartzite and pelite intervals are divided into informal units 2 ($p€m_2$) to 5 ($p€m_5$) in descending order.

Intrusive Rocks

Jgr Granite (Jurassic) Biotite- and muscovite-bearing granite. Exposed in the northeastern edge of the quadrangle, in the Silver Creek drainage, where it has been dated as ca. 160 Ma (Miller et al., 1988). At this location it lies in the lower plate of the northern Snake Range detachment (NSRD) and is highly deformed, with a mylonitic fabric. Jurassic granite is also present in the southwestern corner of the quadrangle, where it intrudes the McCoy Creek Group south of Sacramento Pass. At this location neither the granite nor its country rocks have mylonitic fabrics. Here, biotite granite and related aplite and pegmatite underlie a region extending westward into the adjacent Hogum quadrangle. This granitic pluton has been informally named the Strawberry Creek granite and has also been dated as ca.160 Ma (Miller et al., 1988).

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REFERENCES

Fritz, W.H., 1968, Geologic map and sections of the southern Cherry Creek and northern Egan ranges, White Pine County, Nevada: Nevada Bureau of Mines and Geology Map 35, scale 1:62,500.

Grier, S.P., 1983, Tertiary stratigraphy and structural history of Sacramento Pass in the Snake Range, Nevada: Geological Society of America Abstracts with Programs, v. 15, p. 403.

Grier, S.P., 1984, Alluvial fan and lacustrine carbonate deposits in the Snake Range—a study of Tertiary sedimentation and associated tectonism: Stanford, California, Stanford University, M.S thesis, 55 p.

Hoiland, C., Hourigan, J., and Miller, E., 2022, Evidence for large departures from lithostatic pressure during Late Cretaceous metamorphism in the northern Snake Range metamorphic core complex, Nevada, *in* Craddock, J.P., Malone, D.H., Foreman, B.Z., and Konstantinou, A., editors, Tectonic evolution of the Sevier-Laramide hinterland, thrust belt, and foreland, and postorogenic slab rollback (180–20 Ma): Geological Society of America Special Paper 555, 27 p.

Hose, R.K., Blake, M.C., Jr., and Smith, R.M., 1976, Geology and mineral resources of White Pine County, Nevada: Nevada Bureau of Mines and Geology Bulletin 85, 105 p., 2 plates, scale 1:250,000.

Johnston, S.M., 2000, Normal faulting in the upper plate of a metamorphic core complex, northern Snake Range, Nevada: Stanford, California, Stanford University, M.S. thesis.

Lee, J., Miller, E.L., and Sutter, J.F., 1987, Ductile strain and metamorphism in an extensional tectonic setting—a case study from the northern Snake Range, Nevada, USA—*in* Coward, M.P., Dewey, J.F., and Hancock, P.L., editors, Continental extensional tectonics: Geological Society of London Special Publication No. 28, p. 267–298.

Lee, J., and Sutter, J.F., 1991, Incremental $^{40}Ar/^{39}Ar$ thermochronology of mylonitic rocks from the northern Snake Range, Nevada: Tectonics, v. 10, p. 77–100.

Martinez, C.M., Miller, E.L., and Stockli, D.F., 1998, Miocene age rock avalanche deposits of the Sacramento Pass basin, Basin and Range Province, Nevada: Geological Society of America Abstracts with Programs, v. 30, no. 5, p. 53.

Miller, E.L., Dumitru, T.A., Brown, R.W., Gans, P.B., 1999, Rapid Miocene slip on the Snake Range–Deep Creek Range fault system, east-central Nevada: Geological Society of America Bulletin, v. 111, p. 886–905.

Miller, E.L., Gans, P.B., Wright, J.E., and Sutter, J.F., 1988, Metamorphic history of the east-central Basin and Range Province—tectonic setting and relationship to magmatism, *in* Ernst, W.G., editors, Metamorphism and crustal evolution of the western United States (Rubey Volume VII): Englewood Cliffs, New Jersey, Prentice-Hall, p. 649–682.

Misch, P., and Hazzard, J.C., 1962, Stratigraphy and metamorphism of late Precambrian rocks in central northeastern Nevada and adjacent Utah, American Association of Petroleum Geologists Bulletin 46, p. 289–343.

Ruksznis, A., 2015, Geology and geochronology of Cenozoic sedimentary basins, east-central Nevada: Stanford, California, Stanford University, M.S thesis.

Whitebread, D.H., 1969, Geologic map of the Wheeler Peak and Garrison quadrangles, Nevada and Utah: U.S Geological Survey Miscellaneous Geologic Investigations Map, 1–578, scale 1:48,000, 7 p.

Young, J.C., 1960, Structure and stratigraphy in north central Schell Creek Range: Intermountain Association of Petroleum Geologists 11th Annual Field Conference, Guidebook, p. 158–172.

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