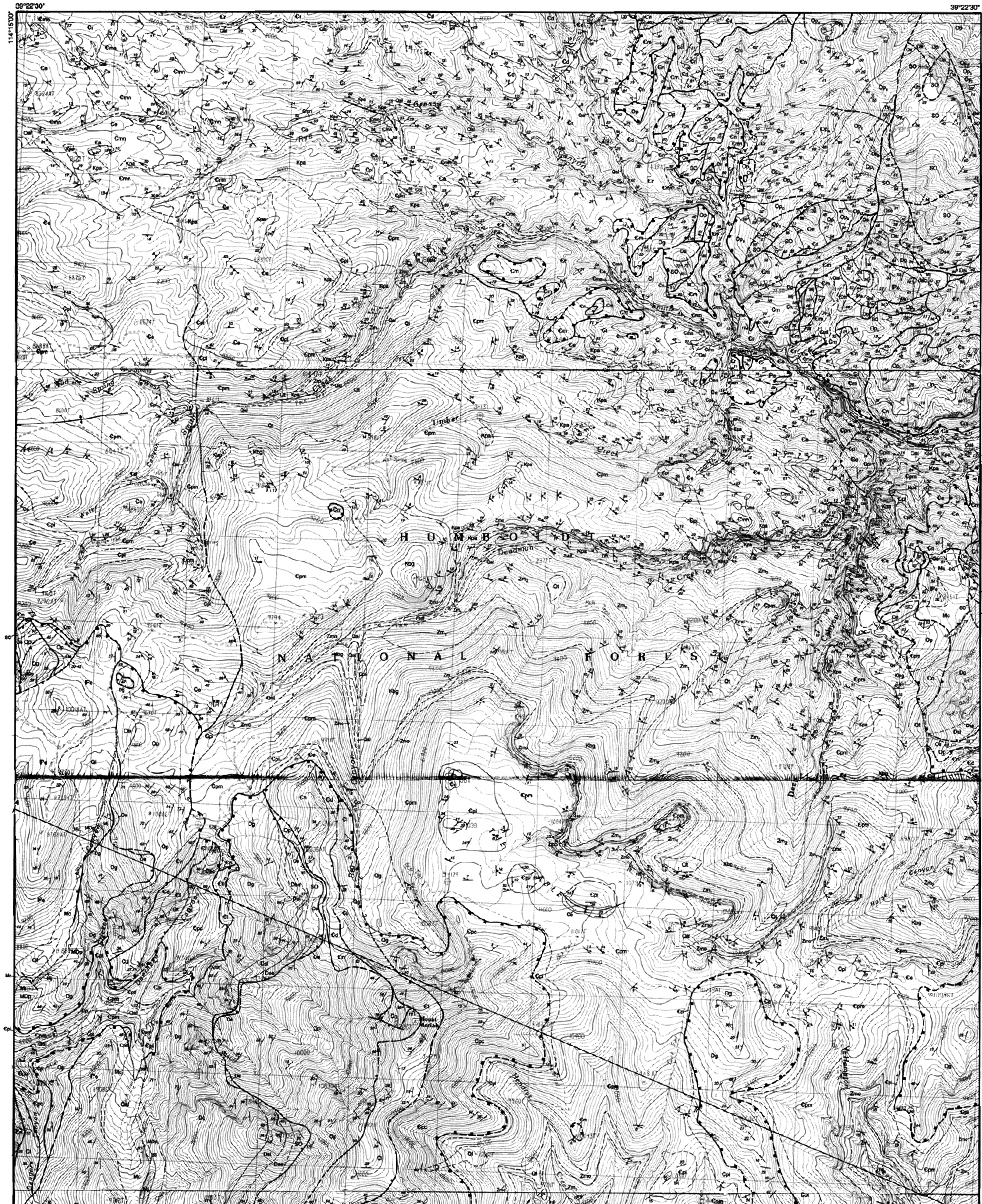


GEOLOGIC MAP OF THE MOUNT MORIAH QUADRANGLE, NEVADA

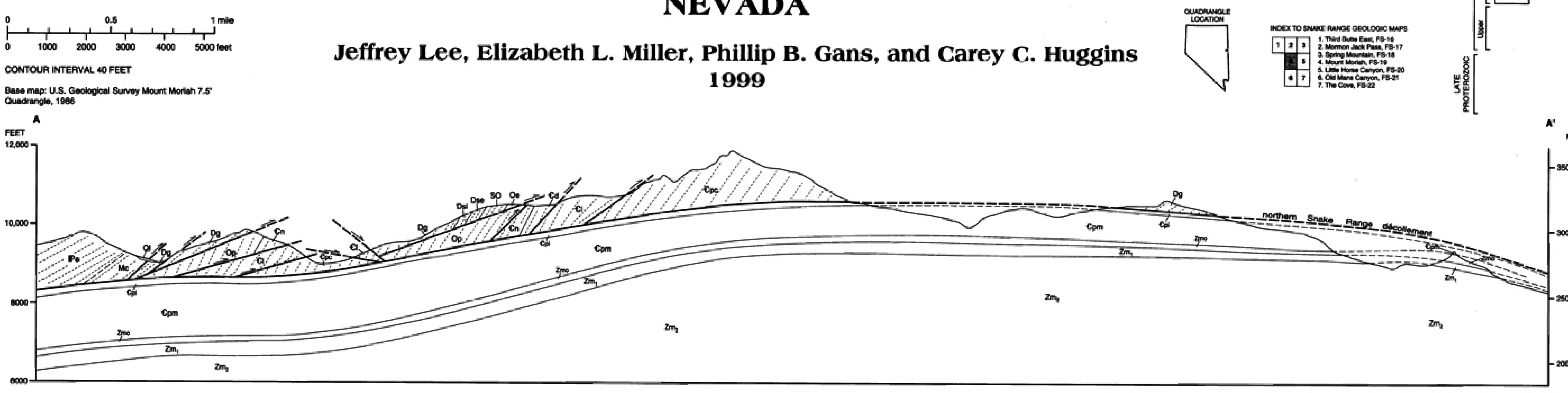
Jeffrey Lee, Elizabeth L. Miller, Phillip B. Gans, and Carey C. Huggins

1999

Scale 1:24,000

CONTOUR INTERVAL 40 FEET

Base map: U.S. Geological Survey Mount Moriah 7.5' Quadrangle, 1986



Stratified Rock Units

Qal **Quaternary alluvium** Generally unconsolidated sands and gravels deposited within modern drainage systems.

Qt **Quaternary talus** Locally derived, generally monolithologic, unconsolidated, matrix-free, angular and poorly sorted, boulder and smaller-size rock debris.

Ql **Quaternary landslides(?)** Locally derived, unconsolidated, commonly matrix supported, angular and poorly sorted clasts of all sizes. Typically exhibit hummocky topography and chaotic structure.

Qg **Quaternary glacial deposits** Unconsolidated glacial moraine and glacial outwash deposits.

Qol **Quaternary older alluvium** Flat-lying 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 major present-day drainage systems developed in flanking mountain ranges.

Tc_1 **Tertiary conglomerate** A conspicuous orange-red, ledge- to slope-forming, moderately well-bedded, clast-supported, limestone cobble conglomerate. Small exposures of this unit occur in the northeastern corner of the quadrangle. This unit contains rounded, coarse sand- to cobble-sized clasts derived strictly from the Permian Arcturus Formation and the Pennsylvanian Ely Limestone. It contains a series of fining-upward sequences and imbricate pebbles that indicate a northerly paleocurrent. This evidence, along with the well-rounded, clast-supported pebbles, suggests a fluvial origin for this unit. The age of this unit is poorly constrained; it postdates the Permian and probably predates the Tertiary extension, as it only contains clasts of Permian and Pennsylvanian rocks, and is cut by normal faults in the northeastern corner of the quadrangle.

Pa **Permian Arcturus Formation** 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.

ℙe **Pennsylvanian Ely Limestone** The Ely Limestone is tan-gray to brown-gray, ledge- to cliff-forming, bioclastic to fossiliferous, medium- to coarse-grained limestone that can be massive, thickly bedded (~1 m) or well bedded (1.0-4.0 cm), with bedding defined by silty partings. Some of the lower sections contain up to 50% well-bedded, generally black, but also white and reddish-brown, chert stringers and nodules. Chert also occurs in large irregular shaped patches with no apparent relationship with bedding. Fossils within the Ely Limestone include large, well-preserved brachiopods, crinoids, bryozoa, rugosan cup corals, and pelecypods. Silty limestone, silt interbeds, and sandstone lenses increase in abundance upsection. Sandstone lenses are composed of fine-grained quartzose sand and are discontinuous laterally on the order of meters to tens of meters. These lenses only form a small proportion (~15%) of the limestone and silty limestone section that is characteristic of the bulk of the Ely Limestone.

Mc **Mississippian Chainman Shale** The Chainman Shale is a dark-brown to black, slope-forming shale containing thin beds (0.5-1.5 cm thick) of tan limestone and limestone concretions around fossil shells. Outcrop is scarce, and the shale is identified by the distinctive chocolate-brown to black soil that forms as the shale weathers. Within the Chainman Shale, four lithologies can be distinguished: a) the dominant rust-brown to black, platy (0.5-1.5 cm thick), calcareous shale; b) occasional sandstone lenses of well-sorted, fine- to medium-grained, light-gray sandstone; c) a thinly bedded (0.5-1.0 cm), platy sandstone that locally contains carbonaceous plant debris; and d) moderately abundant, dark-gray to black, fine-grained nonfossiliferous limestone beds.

Mj **Mississippian Joana Limestone** The Joana Limestone is medium-brown-gray, fine-grained, massive to poorly bedded, prominent, narrow cliff-forming, bioclastic limestone. Bedding, in the uppermost section, is thick (0.5-1.5 m) to platy (2-8 cm). Well-sorted, coarse- to medium-grained fossil debris gives the limestone a distinctive granular texture. Occasional intact fossils include large corals, crinoids, pelecypods, and brachiopods. Black, red, and cream-colored chert nodules and bands are locally found and usually define bedding. The contact with the underlying Pilot Shale is abrupt.

MDp **Mississippian-Devonian Pilot Shale** The Pilot Shale is dark gray-green to black, slope-forming, thin-bedded (2 mm to 2 cm thick) calcareous shale and siltstone. The shale contains occasional interbeds of platy, generally nonfossiliferous, fine-grained gray limestone. Locally, trace fossils and fossil hash can be found. Limestone interbeds occur at the base of the unit.

Dg **Devonian Guilmette Formation** The Guilmette Formation consists predominantly of interbedded limestones and dolomites and can be divided into four general members, although there is considerable lateral variability.

The lowermost member is a light- to medium-gray, massive cliff-forming, micritic to very finely recrystallized, mottled, somewhat fossiliferous limestone. Fresh surfaces exhibit the dark brown-gray color that is characteristic of most of the Guilmette Formation. Mottled patches are light yellow tan or pink. Fossils include gastropods, crinoids, and brachiopods. This member contains abundant solution collapse breccias that form extensive bodies of carbonate clasts (<1 mm to > 8 m across; average 8 to 10 cm in their largest dimension) surrounded by a limestone matrix. The matrix is typically lighter in color than the dark-gray breccia fragments and commonly is light pink or red. Other common features in this member include abundant small veins of white calcite, irregular seams of orange-weathering silt, and small degrees of irregular dolomitization.

Overlying this unit is medium-blue-gray or medium-gray, ledge/slope- to saddle-forming, micritic or very fine-grained recrystallized, locally fossiliferous, well-bedded (4-20 cm thick) to well-laminated (0.1-1.0 cm thick), silty limestone. Limestone beds are typically separated by orange-weathering silt layers. Fossils include gastropods, crinoids, and brachiopods. Dolomitization is rare at the base of this member but gradually increases in abundance upsection.

Guilmette Formation (continued)

The third member is a ledge/slope-former consisting of well-bedded (1-30 cm thick) and finely laminated (0.1-1.0 cm thick), fossiliferous, alternating dark-gray, fine-grained limestone and medium- to dark-brown, coarser-grained dolomite. Intervals of dolomite and limestone vary from 2 to 10 cm thick. Locally, regularly spaced, 2- to 8-cm-thick, alternating layers of dark-gray to nearly black limestone and brown dolomite form a distinctive striped pattern. Fossils are abundant and include stromatoporoids, brachiopods, crinoids, gastropods, and corals.

The uppermost member is medium-gray, blue-gray or brown-gray, ledge/slope- to cliff-forming, thick-bedded (15 to 100 cm thick) to massive, chert-bearing limestone. Irregular-shaped dolomite blocks are found in the lower portion of this unit; dolomite decreases in abundance upsection. The amount of evenly spaced lenses or irregular masses of blue to nearly black chert in this unit is variable but appears to increase upsection. Chert may constitute up to 50% of small outcrops. The uppermost portion of this unit is highly burrowed, platy limestone that forms a gradational contact with the overlying Pilot Shale.

Dsi **Devonian Simonson Dolomite** The Simonson Dolomite is light-gray to chocolate brown, ledge- to slope-forming, medium- to coarse-grained recrystallized dolomite with occasional limestone beds near the top of the section. Locally, this unit has been divided into four members.

The basal member is light-brown, ledge-forming, weakly bedded (10-200 cm thick) dolomite with a distinctive medium- to coarse-grained sugary texture. The base of this lower member is interbedded with light-gray, aphanitic dolomites like those of the Sevy Dolomite. Quartz sand stringers and lenses, like those found in the Sevy Dolomite, may extend up to 15 m into the basal portion of the Simonson Dolomite.

The second member is well-laminated, ledge/slope-forming dolomite consisting of alternating dark-brown, medium- to coarse-grained and light-gray, fine-grained to micritic dolomites. The light-gray dolomite forms approximately one-third of this unit and is typically 3 to 6 m thick. At the base of this unit are occasional interbeds of light brown sugary dolomite.

The third member is uniformly chocolate-brown, ledge- to cliff-forming, generally massive, rarely laminated, fine- to medium-grained, locally fossiliferous dolomite. Fossils, including gastropods, brachiopods, corals, and crinoids, are locally abundant and have been dolomitized but are much lighter in color than the dolomite matrix that surrounds them. This unit may be laterally discontinuous and difficult to identify.

The uppermost member is dark-brown, slope-forming, well-bedded (0.5-30 cm thick), mottled, fossiliferous dolomite with nearly black, fine-grained, thinly bedded (0.5-3 cm thick) limestone interbeds. Fossils include corals, brachiopods, gastropods, and crinoids.

Dse **Devonian Sevy Dolomite** The Sevy Dolomite is light-gray, micritic to fine-grained recrystallized, ledge/slope-forming, well-bedded (10 cm to 1.5 m thick), well-laminated (spaced at 0.5-4.0 cm) dolomite. Occasional small bands (0.3-1.0 m thick) of darker-blue-gray, fine- to medium-grained recrystallized dolomite may be interbedded with the lighter dolomite. These darker intervals are more abundant in the lower portion of the Sevy Dolomite.

The upper one-third of this unit is characterized by the presence of lenses and stringers of fine- to medium-grained, very well-rounded, well-sorted quartz sand. These stringers weather light-orange-brown or rust. Near the upper contact of this unit, the quartz sand becomes concentrated forming 3 to 4 cm thick sandstone lenses. Scattered clear dolomite rhombs, 0.5 to 1.0 mm in size, also occur in the Sevy Dolomite.

SO **Silurian Laketown and Ordovician Fish Haven dolomites, undifferentiated (SO dolomite)** The SO dolomite is a light-gray to dark-chocolate-brown, fine- to medium-grained recrystallized, knobby slope- to massive cliff-forming, poorly bedded to well laminated, cherty, fossiliferous dolomite. Typically it varies from poorly bedded dark-brown dolomite with rust-colored to black nodular chert beds 1 to 3 cm thick and spaced about 4 to 6 cm apart to uniformly chocolate-brown to light-rust-gray, poorly bedded, fossiliferous dolomite with lesser, variable amounts of chert nodules to massive, light-brown-gray dolomite. A distinctive feature of the SO 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 SO dolomite that underlies the Sevy Dolomite is light-gray, cliff-forming, poorly bedded, sugary dolomite. The SO dolomite commonly contains silicified zones up to 25 m thick and can be brecciated, having secondary calcite veins. The basal contact with the underlying Eureka Quartzite is gradational over several meters. The lowest 1 to 2 m of the SO dolomite consists of dolomite cemented, well-rounded, closely packed, very well-sorted, fine- to medium-grained quartz sandstone.

Oe **Ordovician Eureka Quartzite** The Eureka Quartzite is white to orange-brown, cliff- to ledge-forming, poorly but thick bedded (30-90 cm thick), texturally and compositionally mature orthoquartzite consisting of nearly 100% fine-grained (0.3-0.5 mm), extremely well-sorted and well-rounded, silica-cemented quartz grains. Fresh surfaces are white to vitreous, and weathered surfaces are irregular and pitted forming orange-brown, rounded outcrops. The Eureka Quartzite commonly occurs as thin, brecciated, fault-bounded slivers and is often smeared out along fault planes. Large boulders of quartzite characterize slopes below these outcrops.

Op **Ordovician Pogonip Group, undifferentiated** The Pogonip Group in the upper plate is yellow-weathering, ledge/slope- to slope-forming, well-bedded, fossiliferous, medium-blue-gray to light-blue-gray, silty limestone. A number of fossil types are abundant in the Pogonip Group, including brachiopods, ostracods, coiled nautiloids, and tabulate corals. Due to areal variations within the group, various authors have divided the Pogonip Group into different 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 Formation. Where exposure and sedimentary sequence permitted, the Pogonip was subdivided according to the map units below. Otherwise it was mapped simply as Op.

Op_l **Lehman Formation** The Lehman Formation is medium blue-gray, ledge/slope-forming, thinly bedded (2-5 cm thick), fossiliferous, often mottled limestone with silty partings. This subunit contains some fossiliferous [illegible] horizontal trace fossil burrows and numerous death assemblages containing generally one type of organism: brachiopods, trilobites, bryozoa, ostracods, or coiled nautiloids. This unit seems to have the highest faunal diversity of the Pogonip Group.

Op_k **Kanosh Shale** The Kanosh Shale is a subunit of yellowish-brown, slope-forming, thinly bedded, shaly to silty limestone containing beds of dark-brown, coarsely bioclastic limestone composed of phosphatic brachiopods and echinoderm spines, as well as the characteristic fauna of the Pogonip Group cited above. Near the top of the section are blue or brown-gray, micritic limestones that contain beds that consist almost entirely of brachiopods, ostracods, coiled nautiloids, or other fossil types. The siltstone/shale beds are almost never seen in outcrop and instead form a distinctive brown, coarse primitive soil that can contain well-preserved brachiopods, a distinctive species of tabulate coral and other fossils.

Op_d **Pogonip Group Unit D** Unit D is a medium-blue-gray, ledge- to cliff-forming, non-cherty, bioclastic, bioturbated, micritic limestone with silty interbeds. The thickness of bedding ranges from 2 to 40 cm. About 50% of the beds are fossiliferous, containing crinoids, gastropods, brachiopods, trilobite hash, and straight and coiled nautiloids.

Op_c **Pogonip Group Unit C** Unit C is yellow to gray, slope-forming, well-bedded, poorly exposed heterogeneous limestone containing several intervals similar to other units in the Pogonip Group. Intervals vary from tan, sandy, yellow-weathering cross-bedded limestones, to silty, flat-pebble conglomerates, to more resistant silty/cherty beds, to cliff-forming, well-bedded (2-4 cm thick) limestone and dark-brown, intensely fossiliferous silty limestones. This unit becomes more fossiliferous upsection, as does the Pogonip Group as a whole.

Op_b **Pogonip Group Unit B** Unit A grades upwards into Unit B, a yellow-weathering, ledge/slope- to cliff-forming, well-bedded, silty/cherty light-gray limestone. The distinctive rust-colored silicified silty zones vary from silty laminations to massive, irregular, poorly bedded blobs 1 m or more across to nodular, silty chert similar to those of the Notch Peak Limestone. Beds range from 2 to 100 cm thick to massive intervals. Rare flat-pebble conglomerates are present, as well as some bioclastic beds containing brachiopods, trilobite hash, and nautiloids, and some beds containing ichnofossils of unorganized, horizontal burrowing or castings.

Op_a **Pogonip Group Unit A** Unit A is yellow-weathering, slope-forming, well-bedded (5-15 cm thick), flat-pebble limestone conglomerate interbedded with easily eroded silty intervals. Well-rounded, gray, tan and brown, oblate rip-up clasts (2-3 cm in diameter) are set within the yellow silty interbeds. This unit is generally poorly fossiliferous.

Ꞓn **Upper Cambrian Notch Peak Limestone** In the upper plate, the Notch Peak Limestone is medium-gray, fine- to medium-grained, cliff- to ledge-forming, bedded (typically 1-6 cm, and as much as 30 cm thick) cherty limestone. Typically the limestone contains 1- to 2-cm-thick, rust- colored to brown chert nodules in beds 2 to 4 cm apart, but variations include sporadic chert nodules in massive limestone and massive to thinly bedded limestone without chert. Bedding, defined by silty interlayers, can be irregular to well developed. Locally, the lowest 5 m of the Notch Peak Limestone consist of buff, fine- to medium-grained limestone, designated the Barton Canyon Member of Young (1960). Medium- to dark-brown, ledge-forming, medium-grained, chert-poor dolomitic intervals are common in the middle part of the unit. The upper part of the Notch Peak Limestone contains several variations in lithology.

Notch Peak Limestone (continued)

These include intervals of silty, chert-poor, well-bedded (1-3 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 genal spines and pygidia. Within more massive intervals are lenses and beds of dark-gray, bioclastic limestone. The uppermost section is light-gray, massive to poorly bedded, chert-poor, cliff-forming, fossiliferous limestone. Fossils include commonly observed brachiopods, gastropods, trilobites, crinoids, stromatolites, and rare echinoids.

In the lower plate, the Notch Peak Limestone is light- to dark-gray and white banded, ledge- to cliff-forming, cherty, well foliated marble. The base of this unit typically consists of a distinctive 1.5- to 6-m-thick, generally coarse-grained, pure white marble that corresponds to the Barton Canyon Member of Young (1960) in unmetamorphosed sections. Above this member is platy to non-platy, fine-grained marble containing laterally discontinuous beige and light-gray to brown and rust-colored chert stringers and nodules that have been thinned and stretched parallel to the foliation. The uppermost part of the unit is light-gray to light-yellow, coarse-grained, non-chert-bearing, slightly micaceous marble. This unit contains a well-developed, shallow-dipping mylonitic foliation, defined by color banding, and a moderately developed stretching lineation, defined by elongate calcite grains and strung-out chert nodules.

Ꞓd **Upper Cambrian Dunderberg Shale** In the upper plate, the Dunderberg Shale is platy, well-bedded, poorly exposed, slope-forming interbedded khaki/olive-green, somewhat bioclastic shale and dark-gray, fine- to medium-grained, fossiliferous limestone with dark-red-brown interbeds and mottlings. Bedding in the limestone is typically 0.5 to 1.0 cm thick. Generally, all that is seen of this unit is limestone float, with a brown to rust-colored siltstone coating. The limestone contains phosphatic inarticulate brachiopods and trilobite debris.

In the lower plate, the Dunderberg Shale is a light- to dark-brown, slope-forming, thinly laminated to platy calc-schist/calc-silicate rock. Small (<2 mm across) white mica/phlogopite flakes are commonly found on parting surfaces. The middle part of the unit is a calc-schist containing large (up to 0.5 cm across) brown magnesium-rich biotite porphyroblasts (Ann$_{40}$) (Lee, 1990) and includes the mineral assemblage clinozoisite + muscovite + quartz ± plagioclase ± calcite ± sphene. The uppermost part of the unit is fine-grained, finely laminated, yellow-tan and gray marble with brown chert stringers and nodules that grades into the overlying Notch Peak Limestone.

Ꞓl **Middle Cambrian Lincoln Peak Formation** The Lincoln Peak Formation is a dark to medium-gray, poorly to well-exposed, slope- to cliff-forming, platy silty limestone and massive to thin bedded limestone. The darker limestone beds may contain girvanella, minor brown chert nodules, trilobite hash, pisolith and oolite horizons, and abundant trace fossils. In the silty limestone, bedding is defined by yellow, silty partings. These layers are occasionally interbedded with thin, platy, shaly limestone beds. The cliff-forming section is laterally discontinuous and commonly includes blotchy-shaped sections of blue-gray dolomite. A distinguishing characteristic of the basal Lincoln Peak Formation is the presence of white, tiger-like stripes that appear as continuous, evenly spaced, rippled bands (0.5-1.0 cm thick) and represent desiccation features.

Ꞓpc **Middle Cambrian Pole Canyon Limestone** The Pole Canyon Limestone is a light- to dark-gray, massive to banded, cliff-forming limestone. Typically, this unit is characterized by alternating bands of light- and dark-gray limestone punctuated by oolitic, pisolitic, and girvanella-rich horizons and occasional intervals of fenestral fabric and collapse-breccias. The lowermost section of this unit is a thin- to medium-bedded, ledge-forming interbedded medium-gray limestone and tan to khaki siltstone layers. Abundant, subspheroidal girvanella and occasional sandstone interbeds are also present. The uppermost portion of this unit contains a conspicuous dark-gray to black, very fine-grained, medium-bedded to massive limestone interval that is rich in girvanella, worm tubes, mud chips, and occasionally a fenestral fabric.

Ꞓm **Middle Cambrian limestone, undifferentiated** Across the Mount Moriah Quadrangle (south to north), the above formational designations for the Middle Cambrian break down and other formational names are used. We have used the designation Ꞓm for Middle Cambrian carbonates in the upper plate where identification and unit designation were not possible (fig. 6).

In the lower plate, marbles and calc-schists correlative with Middle Cambrian strata in the upper plate are the Raiff Limestone, the Monte Neva Formation, and the Eldorado Limestone of Young (1960) (fig. 6).

Ꞓr **Middle Cambrian Raiff Limestone** The Raiff Limestone is predominantly dark-gray and light-gray, coarse-grained, platy, slope- and ledge-forming, well-foliated marble alternating with white to light-gray, massive, coarse-grained dolomite. The dolomite is quite distinctive in that it is not foliated. The middle portion of the unit contains a thin interval of gray to light-brown, biotite porphyroblast (up to 0.5 cm across) bearing calc-schist/calc-silicate. The unit is typically capped by white to light-gray, massive to laminated pure marble.

Ꞓmn **Middle Cambrian Monte Neva Formation** The Monte Neva Formation is a medium- to dark-brown, slope-forming, medium- to coarse-grained, platy calcareous schist. The base is typically characterized by an approximately 2.5-m-thick, laterally discontinuous dark-brown, fine-grained muscovite and biotite graphitic phyllite/schist. The predominant calcareous schist contains a variable mineral assemblage of large brown magnesium-rich biotite books (up to 0.5 cm across), smaller tabular clinozoisite porphyroblasts on parting surfaces as well as quartz + calcite ± plagioclase ± tremolite ± sphene. The unit is typically capped by a thin platy, less silty section that contains light- to medium-gray limestone interlayered with light-brown calcareous schist layers that contain small (<2 mm across) muscovite/phlogopite grains.

Ꞓe **Middle Cambrian Eldorado Limestone** The Eldorado Limestone is predominantly white- and blue-striped, slope- to ledge-forming, fine- to coarse grained, massive to finely foliated pure marble. The base of the unit is characterized by dirty-white to light-tan silty marble interlayered with thin (1-5 cm) white mica-bearing schist layers and calcareous-schists. This basal silty section grades upwards into [illegible] third of the unit contains meter-scale, irregular-shaped blocks of coarse-grained, white to light-gray to blue, massive dolomite. This unit has nearly the same characteristics as the Raiff Limestone; the most distinguishing feature of the Eldorado Limestone is that it contains fewer dolomite intervals. Foliation is defined by silty layers in the basal section and by alternating blue and white (millimeter to centimeter scale) bands in the marble. Minor constituents minerals in the marble are biotite, phlogopite, sphene, and tremolite.

Ꞓpl **Lower Cambrian Pioche Shale** The Pioche Shale is a slope-forming unit that can be subdivided into three subunits. The basal unit is garnet-bearing, medium- to coarse-grained biotite + muscovite + quartz schist that grades upwards into subunit 2, a fine-grained biotite + muscovite + chlorite phyllite. Subunit 3 may contain thin interlayers of gray to gray-blue marble, which is gradational with the overlying Eldorado Limestone, or it may contain 5- to 15-cm-thick layers of fine- to medium-grained calc-silicate rock containing amphibole, diopside, epidote, calcite, quartz, and plagioclase. The amphibole is commonly coarse-grained (up to 5 cm in length), forming radiating grains on parting surfaces.

Ꞓpm **Lower Cambrian Prospect Mountain Quartzite** The Prospect Mountain Quartzite is a rust-brown to tan, cliff- to talus-forming quartzite. The quartzite contains minor amounts of muscovite (both dispersed and found on micaceous partings), feldspar, and opaque minerals. Contacts above and below are gradational. The quartzite is increasingly schistose at the top, with thin (1-5 cm thick), medium- to coarse-grained, garnet-bearing, muscovite, biotite, chlorite, quartz schistose layers becoming more common as the unit grades upward into the overlying Pioche Shale. The foliation is defined by micaceous minerals and flattened quartz grains, and the stretching lineation is defined by elongate quartz grains.

Late Proterozoic McCoy Creek Group

Zmo **Osceola Argillite** The Osceola Argillite, the youngest unit of the McCoy Creek Group, is usually a distinctive bluish color, but color can vary to red-brown or gray-silver. It is slope-forming, coarse-grained muscovite + biotite schist. The schist is typically 30% fine-grained quartz and thin quartz-rich layers are common near both the upper and lower contacts of this unit, marking gradational contacts with the overlying and underlying quartzite units. Feldspar content is usually less than 3%, but may be as high as 10% locally. Mineral assemblage includes muscovite + biotite ± garnet ± staurolite ± chlorite ± tourmaline ± kyanite ± ilmenite and rare zircon and epidote.

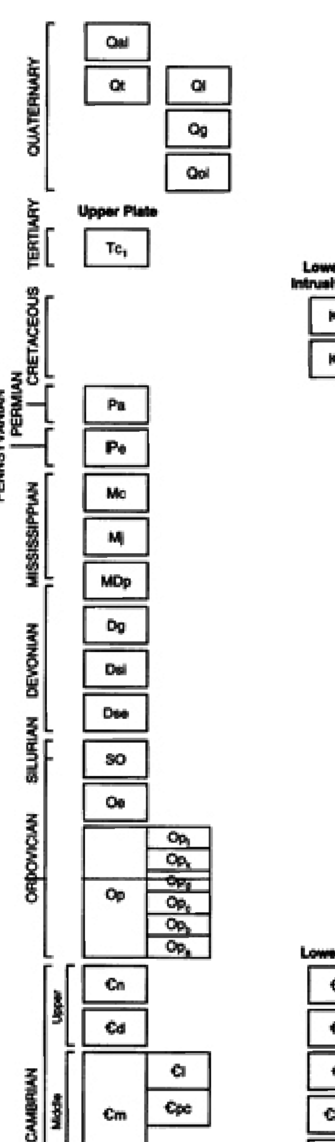
Zm_1 **Unit 1, quartzite** Unit 1 of the McCoy Creek Group is massive white to gray, cliff-forming quartzite. Cross-beds are uncommon. These quartzites contain less than 10% feldspar and up to 5% muscovite on 3 to 20 cm thick parting surfaces. The upper few meters of this quartzite are interbedded with thin, brown, coarse-grained schists, marking the gradational contact with the overlying Osceola Argillite.

Zm_2 **Unit 2, quartzite and schist** Unit 2 of the McCoy Creek Group consists of alternating broken cliffs of white to brown, feldspathic (up to 10-15%) quartzite containing 10% dispersed muscovite and garnets on micaceous parting surfaces (spaced 5-40 cm apart), with slopes of brown, 1 to 15 m thick, feldspathic (up to 15%) quartz + biotite + muscovite + garnet + chlorite ± staurolite ± kyanite schist layers. Staurolite occurs as medium- to coarse-grained poikiloblasts with inclusions of quartz + biotite ± garnet, and is commonly retrogressed to muscovite and chlorite.

Intrusive Rock Units

Kpa **Cretaceous pegmatites and aplites** These dikes and sills contain coarse-grained muscovite, potassium feldspar, quartz, and plagioclase, with minor amounts of garnet and biotite. They crosscut the 100-Ma tonalite orthogneiss. These pegmatites and aplites in detail generally crosscut lower plate units, but have been deformed into sheet-like or sill-like bodies. U-Pb analysis of monazite yielded an age of 82 Ma, interpreted as an intrusive age (Huggins and Wright, 1989; Huggins, 1990).

Kbg **Cretaceous biotite orthogneiss** The metamorphosed and deformed medium- to coarse-grained, tonalite orthogneiss sill contains plagioclase, quartz, biotite, minor garnet, muscovite, and epidote. This pluton is crosscut by east-trending mineral-in isograds associated with peak metamorphism of Late Cretaceous age (Huggins, 1990) and is penetratively deformed by the high-strain Tertiary ductile extensional deformation. U-Pb geochronology on zircons indicates an intrusive age of 100±8 Ma (Miller and others, 1988); thus this pluton provides a maximum age limit for the Cretaceous metamorphism.



Contact Dashed where approximately located, queried where uncertain; short dashes represent marker beds in Ꞓm unit and bedding in cross section, dotted where concealed.

Normal fault Dashed where approximately located, dotted where concealed, queried where uncertain; ball on downthrown side; full arrow indicates dip and dip direction of fault plane, half arrow indicates trend and plunge of fault striation.

Northern Snake Range décollement Dashed where approximately located, dotted where concealed, queried where uncertain; squares on upper plate.

Surface trace of axial surface

Synform — Overturned

Antiform — Overturned

Strike and dip of bedding

Inclined — Vertical

Horizontal — Overturned

Showing trend and plunge of lineation

Inclined

Strike and dip of metamorphic foliation

Inclined

Showing trend and plunge of intersection/elongation lineation.

Inclined — Horizontal

See accompanying text for figures, references, and a discussion of the geologic setting, previous work, geology, and structural history of this quadrangle.

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