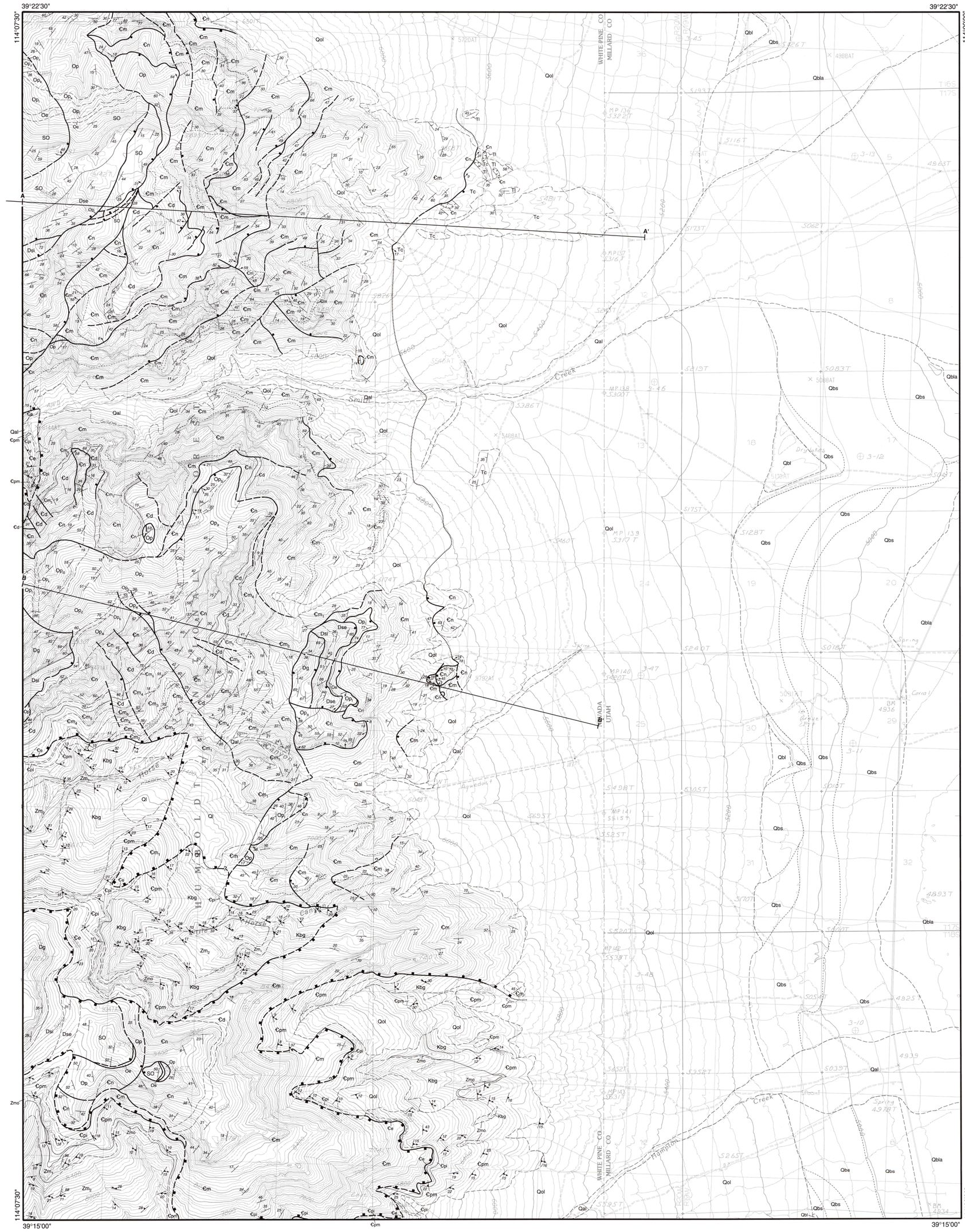

Scale 1:24,000

0 0.5 1 kilometer

0 0.5 1 mile

0 1000 2000 3000 4000 5000 feet

CONTOUR INTERVAL 40 FEET

Base map: U.S. Geological Survey Little Horse Canyon 7.5' Quadrangle, 1986

GEOLOGIC MAP OF THE LITTLE HORSE CANYON QUADRANGLE, NEVADA AND UTAH

Phillip B. Gans, Elizabeth L. Miller, Carey C. Huggins, and Jeffrey Lee
1999

QUADRANGLE LOCATION

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Stratified Rock Units

Qal **Quaternary alluvium** Generally unconsolidated sand and gravel deposited within modern drainage systems.

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

Qbla **Quaternary Lake Bonneville lacustrine and alluvial deposits** Undifferentiated sand, gravel, and marl and older rocks reworked by Lake Bonneville during its existence 10,000 to 32,000 years ago.

Qbs **Quaternary Lake Bonneville sand and gravel** Shoreline beach and bar deposits related to Lake Bonneville, including sand and gravel spits formed during the high stand of the lake by wind, current, and wave activity.

Qbl **Quaternary Lake Bonneville lagoonal deposits** Fine-grained marly rocks deposited in lagoons behind gravel and sand beaches and bars related to Lake Bonneville.

Qol **Quaternary older alluvium** 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 **Tertiary conglomerate** Well exposed outcrops of conglomerate and subordinate lacustrine limestone and marl that occur along the eastern flank of the range and as low hills rising above the older alluvium pediment surface. Exposures north of Smith Creek contain clasts derived only from the upper plate and have an aggregate thickness in excess of several hundred meters. Several large masses of brecciated Cambrian limestone occur within these conglomerates and are interpreted to be slide blocks. Exposures south of the mouth of Smith Creek contain abundant clasts derived from the lower plate, including cobble- to boulder-size clasts of mylonitic Prospect Mountain Quartzite, marble tectonite, and Cretaceous orthogneiss and pegmatite. These lower plate clasts yield apatite fission track ages of 15 to 20 Ma and record the rapid cooling and exhumation of the lower plate at that time. These ages thus provide a maximum depositional age for the conglomerate. The total thickness and age span of this unit are poorly known, but it apparently accumulated as part of the syntectonic basin fill to the youngest system of normal faults that bound the eastern side of the Snake Range. These rocks are generally tilted 15 to 30° westward and overlain by older alluvium along a prominent angular unconformity. Bedding thickness ranges from 5 to 50 cm, and the conglomerate ranges from moderately well rounded and clast-supported to angular and matrix-supported.

Tl **Tertiary limestone** Poorly exposed intervals of white, thin- to medium-bedded lacustrine limestone and marl that occur along the eastern flank of the range interbedded with Tertiary conglomerate. Only the thicker intervals of lacustrine limestone are mapped separately.

Dg **Devonian Guilmette Formation** 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 and Blake, 1976).

Dsi **Devonian Simonson Dolomite** 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 and Blake, 1976).

Dse **Devonian Sevy Dolomite** The Sevy Dolomite 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 and Blake, 1976).

SO **Silurian and Ordovician Fish Haven and Laketown Dolomites, undifferentiated (SO dolomite)** The SO dolomite is a light-gray to dark-chocolate-brown, slope- to cliff-forming dolomite. It occurs in the northwest and southwest portion of the quadrangle, with an apparently complete section on the high ridge north of Smith Creek. Regionally it averages approximately 600 m thick and is often divided into Ordovician Fish Haven Dolomite and Silurian Laketown Dolomite. The SO 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 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.

Oe **Ordovician Eureka Quartzite** 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. A complete section is preserved in the northwest part of the quadrangle on the high ridge north of Smith Creek. Complete sections in surrounding areas range from 40 to 150 m thick (Hose and Blake, 1967). 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 **Ordovician Pogonip Group** 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 most of these subunits, but in some areas, faulting and poor exposure precluded our subdividing the unit. Complete or nearly complete sections of various formations within the Pogonip are preserved on the ridges north and south of Smith Creek in the northwestern portion of the quadrangle. In surrounding areas the Pogonip Group is approximately 600 to 900 m thick. Maximum exposed thickness in the quadrangle is about 700 m.

Op_l **Lehman Formation** The Lehman Limestone is medium blue-gray, ledge and slope-forming, thinly bedded (2 to 5 cm), fossiliferous, mottled limestone with yellow silty partings. This unit contains some fossiliferous (trilobite debris) flat-pebble conglomerate beds, some beds with abundant horizontal trace fossil burrows, and occasional beds with death assemblages of generally one type of organism: brachiopods, trilobites, 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 yellowish-brown, slope- or saddle-forming, thinly bedded, shaly to silty limestone with beds of dark-brown, coarsely bioclastic limestone containing phosphatic brachiopods, ostracods, 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 or ostracods. The siltstone-shale beds are almost never seen in outcrop, but form a distinctive brown soil with abundant dark-khaki-colored shale chips.

Op_d **Pogonip Group Unit D** Unit D is medium blue-gray, ledge- to cliff-forming, non-cherty, bioclastic, bioturbated, micritic limestone with silty interbeds. Bedding ranges from 2 to 40 cm thick. 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 heterogeneous limestone containing a mixture of all the different rock types that are more characteristic of other units in the Pogonip Group. The unit consists of alternating thin intervals of tan, sandy, cross-bedded limestone, yellow-weathering, silty, flat-pebble conglomerate, resistant silty and cherty limestone, cliff-forming, well-bedded pure gray limestone, and dark-brown, intensely fossiliferous silty limestone. This unit becomes more fossiliferous upsection, as the does the Pogonip Group as a whole.

Op_b **Pogonip Group Unit B** Unit B is yellow-weathering, ledge/slope to cliff-forming, well-bedded, silty and cherty light-gray limestone. The distinctive rust- to cream-colored chert ranges from persistent layers that appear to preferentially replace silty laminations to massive, irregular nodules up to 1 m across. Beds range from 2 to 100 cm thick. Scarce flat-pebble conglomerate beds are present, as well as some bioclastic beds containing brachiopods, trilobite hash, and ichnofossils of unorganized, horizontal burrows.

Op_a **Pogonip Group Unit A** Unit A is yellow-weathering, slope-forming, well-bedded (5 to 15 cm thick) silty and cherty limestone that includes abundant flat-pebble conglomerate interbedded with easily eroded silty limestone intervals. Disk-shaped gray, tan and brown, limestone rip-up clasts, 2 to 3 cm in diameter, are set within the yellow silty limestone matrices. This unit is poorly fossiliferous and contains moderately abundant chert nodules.

Ꞓn **Upper Cambrian Notch Peak Limestone** The Notch Peak Limestone is medium-gray, fine- to medium-grained, cliff- to ledge-forming, thin-bedded, cherty limestone. Complete sections of the formation are well exposed on the ridge immediately north of Horse Canyon. 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 Limestone 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 Limestone contains a variety of rock types. 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 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. 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-bearing 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** 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 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. Complete sections approximately 50 m thick are well exposed on the ridge north of Horse Canyon.

Ꞓm **Middle Cambrian limestone, undifferentiated** In the upper plate, the Middle Cambrian limestone is a thick, medium- to light-gray, massive to thickly bedded cliff former. It underlies much of the eastern flank of the range in the central part of the quadrangle, including the precipitous cliff walls of Smith Creek Canyon. In the northern Snake Range, this unit lacks a depositional base due to truncation by the northern Snake Range decollement. In the southern part of the range, this unit is divided into the Pole Canyon Limestone and the Lincoln Peak Formation, following the nomenclature of Whitebread (1969) in the southern Snake Range. In the Little Horse Canyon Quadrangle and in quadrangles to the north, this division was not practical due to abrupt changes in middle Cambrian facies. We have used the designation Ꞓm for Middle Cambrian carbonates in the upper plate where identification and unit designation were not possible (fig. 5). We locally divided the 1,250-m thick exposed section into five informal subunits: $Ꞓm_1$ to $Ꞓm_5$. The general lack of distinguishing lithological characteristics along with patchy secondary dolomitization, commonly makes assignment of a particular member difficult. If assignment is impossible, the Middle Cambrian limestone is left undifferentiated (Ꞓm).

In the lower plate, marbles and calc-schists correlative with Middle Cambrian strata in the upper plate were divided into the Ralf Limestone, the Monte Neva Formation, and the Eldorado Limestone of Young (1960) (see fig. 5 in the accompanying pamphlet). Only the lowest of these, the Eldorado Limestone, is exposed in the Little Horse Canyon Quadrangle.

$Ꞓm_5$ $Ꞓm_5$ is the uppermost subunit of the Middle Cambrian limestone and typically forms prominent white cliffs beneath the Dunderberg Shale. It is cliff-forming, light-gray, thickly bedded (1 to 2 m), nearly micritic limestone about 90 m thick. It is distinguished from $Ꞓm_3$ by the nearly vitreous appearance on fresh surfaces, a pink tinge in other areas, by it being the whitest of all the units, by it having thinner beds than $Ꞓm_3$ and by the bedding planes having irregular undulating surfaces (on the scale of 10 cm).

$Ꞓm_4$ $Ꞓm_4$ is about 180 m thick, dark-brown-gray, slope- to ledge-forming, thinly bedded (2 to 4 cm), sparsely fossiliferous, bioturbated limestone with yellow silty intervals and partings overlain by slope-forming, well-bedded light- to medium-gray dolomites. This subunit contains an approximately 1-to 3-m-thick distinctive interval of 200- to 700-cm-thick beds of yellow-tan, ledge-forming, massive, silty limestone beds. The upper contact is marked by an abrupt change in slope between the slope-forming dolomites and the cliff-forming $Ꞓm_5$.

$Ꞓm_3$ The middle subunit, is medium-gray, cliff-forming, massive, evenly banded, 230-m-thick recrystallized micrite limestone. The laterally continuous banding (about 1 m thick) is formed by the same dark resistant silty/dolomitic laminations as above. It may be distinguished from $Ꞓm_1$ by thinner, more abundant and continuous silty bandings and the lack of the massive dark-gray fenestral/well-bedded, brown silty limestone units.

$Ꞓm_2$ $Ꞓm_2$ forms light-gray, thick-bedded (2-4 m thick), nearly vertical cliffs of recrystallized micrite limestone. This 330 m-thick subunit shows some interval variation that includes some beds containing thin zones (< 1 m thick) of laterally continuous, dark-brown resistant silty/dolomitic laminae (spaced 5-10 m apart); other beds contain evenly distributed, filmentous silty/dolomitic stringers (1 mm x 1 mm x 10-60 mm); and others contain sporadic silty/cherty nodules. The remaining beds are relatively featureless. The contact between $Ꞓm_2$ and $Ꞓm_3$ is at the point where the dark-brown, lamina-containing zones go from being spaced 5 to 10 m apart to 1 to 2 m apart.

$Ꞓm_1$ $Ꞓm_1$ is the lowest of the exposed units and consists of medium-gray to yellow-buff, cliff-forming, massive, fenestral, recrystallized micritic limestone with irregular zones (0.5-1.5 m thick) containing resistant dark-brownish-gray silty/dolomitic laminations. This subunit tends to weather to buff- gray on southerly exposures and medium-gray on north-facing outcrops. This subunit contains two darker-gray, massive units with well-bedded dark-brown silty intervals. The upper two of these two units defines the top of $Ꞓm_1$ and bears further description. The bottom of this 45-m-thick (minimum) subunit is a less resistant, dark-brown silty interval containing dark-gray, sparsely fossiliferous (trilobites and crinoids) limestone with dark-brown silty interbeds defining 2- to 4-cm-thick beds. This section grades into a several tens of meters of dark-gray massive limestone containing fenestra, occasional cross-bedding and oolitic intervals, sparse *girvanella*, and increasing amounts of silty/dolomitic laminae (about 1 cm thick and 1-3 cm apart) going upsection. The subunit lightens gradually approaching the top until finally there is a dolomitic(?) 30-m-thick slope-former between $Ꞓm_1$ and $Ꞓm_2$.

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. It is exposed in the lower plate in the headwaters of Little Horse Canyon and Smith Creek. The base of the unit is gradational with the underlying Pioche Shale and 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 the predominant pure blue- and white-striped marble. The upper third of the unit contains meter-scale, irregular-shaped boudins of coarse-grained, white to light-gray to blue, massive dolomite. 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.

Ꞓpi **Lower Cambrian Pioche Shale** Regionally, 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. In the map area, the Pioche occurs only in the lower plate where it is highly deformed and metamorphosed to biotite- and muscovite-bearing psammite schist and calc-silicate-bearing rocks, obscuring original bedding and sedimentary structures. Its thickness is variable, but generally less than 20 m. Gradational contacts with the overlying Middle Cambrian marbles and underlying Prospect Mountain Quartzite can be demonstrated in many places. In the Little Horse Canyon Quadrangle, the Pioche Shale is a slope-forming unit that includes three members. The basal member is garnet-bearing, medium- to coarse-grained biotite + muscovite + quartz schist that grades upwards into the middle member, a fine-grained biotite + muscovite + chlorite phyllite. The highest member contains thin interlayers of gray to gray-blue marble and 5 to 15 cm thick layers of fine- to medium-grained calc-silicate rock containing amphibole, diopside, epidote, calcite, quartz, and plagioclase.

Ꞓpm **Lower Cambrian Prospect Mountain Quartzite** A complete section of the Prospect Mountain Quartzite is present along the northern wall of Hampton Creek and in Little Horse Canyon in the southern part of the quadrangle, where it lies in gradational contact below the Pioche Shale and above the McCoy Creek Group. The regional reported thickness of the Prospect Mountain Quartzite is approximately 1200 m, but in this quadrangle, the formation has been ductilely attenuated and is about 100 m thick or less, less than 1/10th of its original thickness. The mylonitic foliation is defined by micaceous minerals and flattened quartz grains, and the stretching lineation is defined by elongate quartz grains. In general, the flaggy, resistant quartzite beds of the Prospect Mountain Quartzite form impressive buff to reddish-brown cliffs. Sets of vertical joints are conspicuous. In hand specimen, the quartzite is white to gray to light brown, fine to medium-grained, and consists of 90 to 95% quartz, 5% feldspar, and lesser muscovite, chlorite and opaque oxides. Coarse mica-rich partings occur between the flaggy quartzite layers. In thin section, the Prospect Mountain Quartzite is a quartzose mylonite; its quartz fabrics have been studied in some detail (Lee and others, 1987). The Prospect Mountain Quartzite is distinguished from similar quartzite units in the underlying McCoy Creek Group by its general lack of pebble conglomerates, and pelitic intervals, and by its thinner and more uniform flaggy bedding.

Late Proterozoic McCoy Creek Group

The McCoy Creek Group (Misch and Hazzard, 1962) is the 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 Late Proterozoic, though no definitive fossils or radiometric ages have been obtained from the sequence. 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. In the Little Horse Canyon Quadrangle, we designate the stratigraphically highest pelite within the McCoy Creek Group rock as the Osceola Argillite (following the nomenclature of Misch and Hazzard, 1962), and divide lower quartzite and pelite intervals into informal units 1 (Zm_1) and 2 (Zm_2) in descending order.

Zmo **Osceola Argillite** The Osceola Argillite is well exposed in the Hampton and Little Horse drainage, where its attenuated thickness is about 10 to 30 m. Upper and lower contacts with the Prospect Mountain Quartzite is concordant and the McCoy Creek Group unit 1, is gradational. The Osceola Argillite is typically muscovite-rich, silvery-gray to gray-blue schist, which, depending on metamorphic grade, can contain chlorite, biotite, kyanite, garnet, and/or staurolite. Accessory minerals include ilmenite, hematite, tourmaline, apatite, epidote, zircon, and monazite (Huggins, 1990). It is distinguished from other schist units lower in the succession by its general absence of coarser clastic horizons and by its highly aluminous composition. The Osceola Argillite in less metamorphosed and deformed sections in the southern Snake Range are about 200 m thick and consist of well-bedded to laminated slates and siltstones that are distinctively green to gray-blue, although locally, maroon colors are common (Miller and others, 1993).

Zm_1 **Unit 1, quartzite** Lower plate exposures of McCoy Creek Group unit 1 in the Little Horse Canyon Quadrangle are 30 to 60 m thick, and form resistant cliffs of grayish-white to buff, slightly feldspathic quartzite that weathers buff to orange. Thin conglomeratic horizons are present only at the top of the unit.

Zm_2 **Unit 2, quartzite and schist** Quartzite and schist assigned to McCoy Creek Group unit 2 occurs in the lower plate and consists of a thick succession (about 300 m) of alternating meter-thick intervals of light-gray to buff, feldspathic quartzite and grit and coarse muscovite ± biotite ± garnet ± staurolite schist. It rests in gradational but sharp contact with the overlying McCoy Creek Group unit 1 in Hampton Creek and beneath the Cretaceous orthogneiss in the Little Horse Canyon Quadrangle. Within the unit, a more quartzite-rich section is a conspicuous cliff former. Its position within the section, its variable and more feldspathic composition and its abundant horizons of grit make correlation with the unmetamorphosed successions in surrounding ranges straightforward. In less metamorphosed sections, such as those in the southern Snake Range, this unit is a brown-weathering slope former with ledge to cliff exposures of more feldspathic or quartz sand-rich intervals. The unit is distinguished from the Osceola Argillite in that it is more variable in composition and grain size and has abundant unsorted, quartzo-feldspathic grit-bearing horizons. It is a distinctive slope- or ledge-former and lies in sharp and abrupt contact above the underlying massive cliff-forming quartzite of McCoy Creek Group unit 3 observed in nearby quadrangles.

Intrusive Rock Units

Kbg **Cretaceous biotite granodiorite (orthogneiss of Little Horse Canyon)** Sill-like body of mylonitic orthogneiss that ranges in composition from tonalite to granodiorite or granite. U-Pb dating of zircons yielded data that is highly discordant but lie on a chord with a lower intercept of approximately 110 Ma, which is interpreted to be the intrusive age (Miller and others, 1988). Strongly foliated and lineated gneiss with 10 to 30% quartz, 40 to 50% plagioclase, 5 to 10% K-feldspar, 5 to 10% biotite, and up to several percent muscovite, garnet, and epidote. The rock was probably initially fairly equigranular medium-grained granodiorite. Both muscovite and garnet are inferred to be of metamorphic origin, as the rock has clearly undergone amphibolite-facies, Late Cretaceous metamorphism. Locally euhedral epidote is also interpreted to be of metamorphic origin.

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

		Upper Plate	Intrusive Rocks	Lower Plate
QUATERNARY		Qal, Ql, Qbla, Qbs, Qbl, Qol		
TERTIARY		Tc, Tl		
CRETACEOUS			Kbg	
DEVONIAN		Dg, Dsi, Dse		
SILURIAN		SO, Oe		
ORDOVICIAN		Op, Op_l, Op_k, Op_d, Op_c, Op_b, Op_a		Op
CAMBRIAN		Ꞓn, Ꞓd, Ꞓm, $Ꞓm_5$, $Ꞓm_4$, $Ꞓm_3$, $Ꞓm_2$, $Ꞓm_1$		Ꞓn, Ꞓd, Ꞓe, Ꞓpi, Ꞓpm
LATE PROTEROZOIC				Zmo, Zm_1, Zm_2

Contact Dashed where approximately located, queried where uncertain; short dashes indicate internal contact and bedding in cross section and marker beds in Ꞓm and Qbs units, 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.

Slide block

Strike and dip of bedding

Inclined — Vertical — Overturned

Strike and dip of compaction foliation in ash-flow tuff

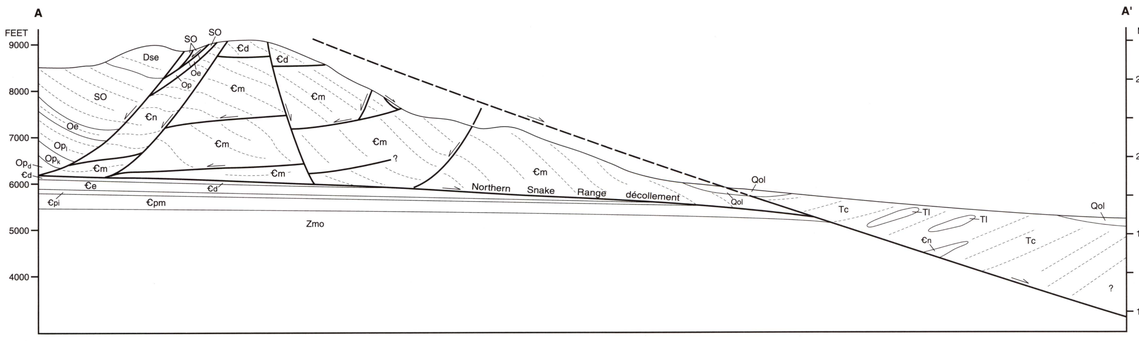
Inclined

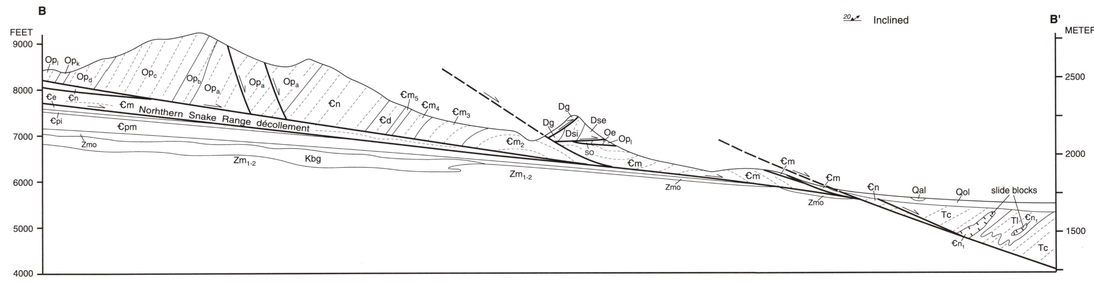
Strike and dip of metamorphic foliation

Inclined

Showing trend and plunge of intersection/elongation lineation.

Inclined





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