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Geologic Map of Windy Peak 7.5' Quadrangle, White Pine County, Nevada

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INTRODUCTION

The Snake Range is located in White Pine County, east-central Nevada, in the northern Basin and Range Province. Sacramento Pass separates the range into two main parts, the northern and the southern Snake Range (fig. 1). The Windy Peak quadrangle is one of six quadrangles comprising the southern Snake Range and includes part of the northern boundary of the Great Basin National Park (fig. 1).

The Great Basin National Park was established to help preserve the unique geology, human history, and plant and animal communities that are representative of this part of the Great Basin region. The park includes Wheeler Peak, in the adjacent Wheeler Peak quadrangle (fig. 1) which at 3,982 m is the highest peak in the park and the second highest peak in the state of Nevada. In 1964, the world's oldest known living trees, the Great Basin bristlecone pine (*Pinus longaeva*) estimated to be about 4,950 years old, were discover below Wheeler Peak.

GEOLOGIC SETTING

The Windy Peak quadrangle includes the southwestern part of Sacramento Pass, a topographically low region between the greater elevations of the northern and southern Snake Ranges, east-central Nevada (fig. 1). Sacramento Pass is underlain by generally nonresistant Cenozoic strata which were deposited in a fault-bound depression developed between the northern and southern parts of the ranges. The Cenozoic strata are informally referred to here as the Sacramento Pass section. The Sacramento Pass section disconformably overlies Paleozoic and Late Precambrian strata, which were intruded by a variety of plutons (fig. 1). The stratigraphy and sedimentology of the Sacramento Pass section, described in detail by Grier (1983,1984), provides insight into the history of the Basin and Range faulting that led to the uplift of rocks in the surrounding mountains and the development of the present-day topography of the region.

The Tertiary Sacramento Pass section includes volcanic rocks, lacustrine limestone, and alluvial fan deposits. In addition, large coherent blocks of Paleozoic strata occur within the Tertiary sequence and are interpreted as free-sliding blocks carried intact by the tilting and down faulting of portions of the Tertiary section (Grier, 1984). The blocks are comprised of portions of the Ordovician Pogonip Group (Op), Ordovician Eureka Quartzite (Oe), undifferentiated Ordovician-Silurian dolomites (OS), Devonian Guilmette Formation (Dg), and the Pennsylvanian Ely Limestone (lPe). The Late Precambrian and Paleozoic units described below form part of a regionally extensive sequence of Late Precambrian to early Mesozoic shelf facies or miogeoclinal strata described in more detail by Hose and Blake (1976), Whitebread (1969), and Stewart (1980). Some blocks, forming bouldery to craggy exposures of the Ordovician Eureka Quartzite and parts of the Ordovician-Silurian dolomite section are easily visible from Highway 50 which traverses the northeast end of the Windy Peak quadrangle.

The base of the Tertiary section rests disconformably upon upper Paleozoic strata. The best exposures of the basal unconformity and of the lower part of the Sacramento Pass section are found in the adjacent Lehman Caves quadrangle (see fig. 1), just north of Weaver Creek. Here, older conglomerate (Tco) of unknown age and containing clasts derived exclusively from upper Paleozoic strata, rests unconformably on the Pennsylvanian Ely Limestone (lPe). The older basal conglomerate is overlain by volcanic rocks which include latite flows and rhyolite tuff dated by Hose and Blake (1976) as Oligocene. These units, in turn, are conformably overlain by lacustrine limestone (Tl) that grades upwards and interfingers laterally with alluvial fan deposits (Tc) of probable Miocene and younger age (fig. 2).

The alluvial fan deposits of the Sacramento Pass section contain varied clast types attesting to uplift of surrounding ranges (Grier, 1983, 1984). The Tertiary section is now tilted 30-60 degrees to the west and repeated by a series of east-dipping normal faults which have extended the section by a factor of two or more in a WNW-ESE direction (fig. 1). These tilted sections provide excellent three-dimensional control on the stratigraphy and lateral facies variation within the section. Approximately east-west trending faults on the north and south side of Sacramento Pass display normal and strike-slip displacements and separate the Tertiary section from the older bedrock of the southern and northern Snake Range. Near Willow Patch Springs along Highway 50, west-tilted Tertiary conglomerate lies in low-angle fault contact with shattered and brecciated quartzite of the Late Precambrian McCoy Creek Group (Misch and Hazzard, 1962) suggesting that the entire Sacramento Pass Tertiary section may be a thin series of plates on older bedrock.

Older rocks of the southern Snake Range exposed in the Windy Peak quadrangle include the Late Precambrian McCoy Creek Group (Misch and Hazzard, 1962), the Early Cambrian Prospect Mountain Quartzite (Hague, 1892), the Pioche Shale (Wolcott, 1908), and the Middle Cambrian Pole Canyon Limestone (Misch and Hazzard, 1962). Younger Paleozoic rocks are not exposed in the quadrangle except for their occurrence as free sliding blocks incorporated in the Tertiary section. Prior to faulting, Paleozoic strata formed part of a regionally extensive sequence of miogeoclinal strata deposited on the subsiding western continental shelf of North America. Formational designations, thicknesses, and regional facies variations have been described by Drewes and Palmer (1957), Whitebread (1969), Hose and Blake (1976), Stewart (1980), and many others.

Late Precambrian and Cambrian strata in the Windy Peak quadrangle are metamorphosed and possess one or two tectonic fabrics in the form of cleavages. They are intruded by a large Jurassic pluton, informally named the Strawberry Creek Granite and dated as 160 Ma (U-Pb, zircon) (Miller and others, 1988). A pluton of similar composition is present in the Willard Creek drainage to the southwest and may be continuous at depth with granite exposures in Strawberry Creek. The Willard Creek pluton has yielded a K-Ar muscovite age of 151 Ma (Lee and others, 1970), which we interpret as a minimum age for its intrusion. Staurolite is widely developed in the contact aureoles of both of these granite bodies and andalusite and sillimanite are locally present immediately adjacent to their contacts (Miller and others, 1988), attesting to intrusive depths less or equal to those of the Al_2SiO_3 triple point (about 3.8 kb) (Holdaway, 1971). This depth estimate accords well with the inferred depth of intrusion based on the thickness of the overlying stratigraphic section, which is believed to have been about 10-12 km thick (6-7.5 miles) at the beginning of the Mesozoic (Miller and others, 1988). Relevant structural, metamorphic and geochronologic data for the Windy Peak quadrangle are shown on figure 3.

Following Gans and Miller (1983), Grier (1984), Miller and others (1983), Miller and others (1988), Miller and others (1989), Miller and others (1990), the geologic history of the region is summarized as follows: (1) Regional deposition of shelf facies strata from the Late Precambrian into the early Mesozoic with cumulative thicknesses possibly greater than 15 km. (2) Intrusion of granitic to dioritic plutons in the Jurassic (about 155-160 Ma) and in the Cretaceous (90-110 Ma) followed by the intrusion of two-mica granites in the Late Cretaceous (90-70 Ma). Deformation and metamorphism of the structurally deeper part of the shelf succession occurred during intrusion of plutons and was intensified in their aureoles. In the Lehman Caves quadrangle (see fig. 1), schist interbeds within the Prospect Mountain Quartzite exhibit two cleavages, one of them inferred to be Jurassic, the other Late Cretaceous in age (Miller and others, 1988). (3) During and after Mesozoic magmatism and deformation, uplift and erosion of the upper 1-2 km of the Paleozoic section. (4) Extrusion of Oligocene volcanic rocks and deposition of basal Tertiary units. (5) Major Basin and Range faulting, tilting and uplift of Paleozoic and Precambrian units in the southern and northern Snake Range synchronous with deposition of the Sacramento Pass section and continuing into the Miocene. (6) Faulting and tilting of the Sacramento Pass section itself in Miocene and younger time in conjunction with the latest stages of uplift of the northern and southern Snake Range. (7) Development of present-day drainage systems and deposition of older alluvium. (8) Incision of older alluvium by modern drainages and development of present day landscape.

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Figure 1. Generalized geologic map of the central Snake Range, Nevada. Map emphasizes the distribution of variably metamorphosed upper Precambrian and Cambrian miogeoclinal strata and the various plutons that intrude these rocks. Geologic map modified after Miller and others (1988). Small index map shows boundary of Great Basin National Park and the six 7.5' topographic quadrangles encompassing the Park, including the Windy Peak quadrangle.

Figure 2. Representative stratigraphic column for the Tertiary Sacramento Pass section (from Grier, 1984). The representative section is located in the Sacramento Pass 7.5' quadrangle adjoining the Windy Peak quadrangle to the north.

Figure 3. Summary of structural, metamorphic and geochronologic data for Jurassic time, Windy Peak quadrangle and surrounding regions (modified after Miller and others, 1988). Numbers in parentheses next to radiometric dates refer to the following references: (1) Lee and others, 1968; (2) Lee and others, 1970; (3) Lee and others, 1980; (4) Lee and others., 1986a,b; (7) J.E. Wright (unpublished data). K-Ar dates have been recalculated using new constants (Dalrymple, 1979) where necessary.

Table 1:

40Ar/39Ar single-grain muscovite ages from Tertiary Muscovite Porphyry (Tmp) in Windy Peak Quadrangle

Grain 1	34.26 ± 0.20 Ma
Grain 2	33.90 ± 0.20 Ma
Grain 3	33.75 ± 0.20 Ma
Grain 4	34.10 ± 0.23 Ma
Grain 5	33.74 ± 0.20 Ma
Grain 6	33.85 ± 0.20 Ma

Mean age: 33.93 ± 0.21 Ma (1 sigma error)

Data collected by Phil Gans at U.S.G.S., Menlo Park, 1983

DESCRIPTION OF MAP UNITS

Qa **Alluvium (Quaternary)**--Generally unconsolidated sand and gravel deposited within modern drainage systems

Qg **Glacial moraine (Quaternary)**--chiefly ground moraine. Includes deposits of two glacial stages. Younger morainal surfaces are hummocky, whereas older morainal surfaces have a more subdued topography

Qao **Older alluvium (Quaternary)**--Flat-lying consolidated to unconsolidated alluvial-fan sand and gravel deposits that rest in sharp angular discordance above older rocks and are incised by present-day drainage systems. Clast types and morphology indicate alluvium is derived from the major present-day drainage systems developed in flanking mountain ranges

Qls **Landslide deposits (Quaternary)**--Chaotic mass of blocks of various sizes deposited on modern slopes

Tc **Conglomerate (Tertiary)**--Alluvial-fan sand, gravel, and conglomerate. Tilted alluvial fan deposits are well exposed in several drainages in the map area; elsewhere unit is poorly exposed, forming red to gray hills often overlapped or mantled by older alluvium (Qao). Unit has been described in detail by Grier (1983, 1984). Alluvial fan deposits overlie and interfinger laterally with lacustrine deposits (Tl). Clast types indicate derivation primarily from the southern Snake Range (Grier, 1983). Tertiary conglomerate overlies sediments containing tuffaceous layers dated at 32.5 Ma. However, conglomerate is mostly or entirely Miocene and younger in age based on apatite fission track ages on granitic and quartzite cobbles reported by Miller and others (1989; 1990). Section is at least 1500 m thick

Tl **Lacustrine deposits (Tertiary)**--Limestone, marl, and calcareous sandstones and siltstones. This unit interfingers laterally with and underlies Tertiary conglomerate (Tc); it was deposited conformably on underlying Tertiary volcanic rocks. These 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. Thin sandstone and siltstone beds occur sporadically throughout the unit. Biotite from a rhyolite tuff within the section yielded a K-Ar age of 32.5 +/- 0.4 Ma (Oligocene)(Grier, 1984).

Trdi **Rhyodacite flows and subvolcanic intrusives (Tertiary Oligocene)**--Exposed in the northeast corner of the Windy Peak quadrangle. Forms large mass of pink-weathering flow-banded rhyolite to dacite lava flows, truncated by a fault on the east, and apparently intrusive into Tertiary conglomerate on the south and west. This unit contains about 20 percent phenocrysts of sanidine, plagioclase, biotite, and minor horneblende and quartz. Mafic minerals are largely replaced by iron oxides. Exact age and stratigraphic position of this unit is not entirely clear. In the Lehman Caves quadrangle, it intrudes or overlies the Tertiary older conglomerate (Tco).

Tmp **Rhyolite porphyry dikes and sills (Tertiary)**--Light-colored, muscovite-bearing rhyolite porphyry dikes and sills of distinctive light-colored rhyolite porphyry in the vicinity of Blue Ridge and Bald Mountain. The rhyolite contains about 20 percent phenocrysts of sanidine, smokey quartz, albite, and conspicuous euhedral muscovite books in an aphanitic white groundmass of quartz and feldspar. Trace microphenocrysts of garnet are often present as well. Oligocene age is indicated by 40 Ar/39 Ar dating of six different muscovite grains which yielded a mean age of 33.9 $^{+}$/- 0.2 Ma (1 sigma error)(table 1). The quenched texture of the porphyry together with the simple argon systematics suggest the dikes and sills were emplaced after the McCoy Creek Group country rocks it intrudes had cooled well below 300^{o} C. This unit is slightly younger than the majority of the volcanic rocks in east-central Nevada and is unusual because of its muscovite and garnet phenocrysts

Jg **Granite (Jurassic)**--Poorly exposed biotite granite and related aplite and pegmatite underlie the region extending from Strawberry Creek to the headwaters of Weaver Creek. This granitic pluton has been informally named the Strawberry Creek granite and has been dated as 160 Ma by the U-Pb method (Miller and others, 1988). Composition ranges from biotite granite to muscovite-bearing granite. Intrudes the Precambrian McCoy Creek Group, and is inferred to intrude the Cambrian Prospect Mountain Quartzite, Pioche Shale, and Pole Canyon Limestone, all of which may occur as roof pendants in the pluton. The pluton is a coarse-grained hypidiomorphic granite that contains approximately 35 percent K-feldspar, 30 percent plagioclase, 28 percent quartz, 6 percent biotite and less than 1 percent muscovite. Accessory minerals include sphene, epidote and magnetite. The muscovite to biotite ratio appears to increase towards the perimeter of the pluton, and almost no biotite is present in granite adjacent to the contact itself. Quartz veins and muscovite-bearing aplite dikes are found along the perimeter of the pluton and sporadically throughout the pluton as well as in the surrounding country rocks. Autoliths of finer-grained granite having a higher biotite content are found sporadically throughout the pluton. Abundant pendants of Prospect Mountain Quartzite occur in the exposures of the granite on either side of Strawberry Creek. Intrusion of the Strawberry Creek granite caused extensive contact metamorphism of pelitic rocks in the McCoy Creek Group. Within a zone about 200 m wide, phyllites become coarser-grained schists and abundant euhedral staurolite porphyroblasts are developed. Staurolite porphyroblasts are now entirely retrograded to chlorite and white mica. Thin section textural relationships indicate that a more broadly developed cleavage is intensified and formed at higher metamorphic grade adjacent to the Strawberry Creek and Willard Creek granites and thus can be inferred to be Jurassic in age. To the north, the Strawberry Creek granite is in fault contact with Tertiary conglomerate along Weaver Creek. Along this fault, there is evidence for slight mylonitization and brecciation of the granite together with hydrothermal activity as evidenced by extensive chloritization, albitization, and quartz veining within the granite. Slickensided planes of movement are common in the granite along the contact

The Late Precambrian and Paleozoic units described below form part of a regionally extensive sequence of Late Precambrian to early Mesozoic shelf facies or miogeoclinal strata described in more detail by Hose and Blake (1976), Whitebread (1969) and Stewart (1980). Except for slide blocks of Paleozoic strata present in the Cenozoic Sacramento Pass section (which include identifiable portions of the Ordovician Pogonip Group (Op), Ordovician Eureka Quartzite (Oe), undifferentiated Ordovician-Silurian dolomites (OS), Devonian Guilmette Formation (Dg) and the Pennsylvanian Ely Limestone (IPe), no strata younger than the Cambrian Pole Canyon Limestone are exposed in the Windy Peak quadrangle

IPe **Ely Limestone (Pennsylvanian)**--Light-gray to medium light-gray, organic detrital limestone. Chert common; thick-bedded cherty limestone commonly alternates with very thin bedded, ledge-forming limestone units. Exposed as slide blocks in the Tertiary section in northeast part of Windy Peak quadrangle. Estimated thickness in region is 549-823 m

Dg **Guilmette Formation (Upper and Middle Devonian)**--Questionably present in the northeast part of the Windy Peak quadrangle as slide blocks in the Tertiary succession; incomplete sections occur in both the Garrison and Kious Spring quadrangles (see fig. 1). Dark gray, thin-bedded to massive, very fine-grained sublithographic limestone and brown to dark brown dolomite.

Generally more massive at base, better bedded up-section. Fossils include corals, gastropods, brachiopods, crinoids, and stromatoporoids

OS **Fish Haven and Laketown Dolomites undifferentiated (Ordovician and Silurian)**--Exposed in northeast part of Windy Peak quadrangle as slide blocks in the Tertiary section. The most intact section of the Fish Haven and Laketown Dolomites is exposed south of the mouth of Snake Creek in the Kious Spring quadrangle (see fig. 1). In nearby Wheeler Peak and Garrison quadrangles, Whitebread (1969) reported thicknesses for the combined Fish Haven and Laketown Dolomites at about 460 m. Lower part is medium to dark brown dolomite with some stromatolitic, fossiliferous and cherty intervals; upper part is light-brown, coarse-grained dolomite. Fossils include corals and stromatolites

Oe **Eureka Quartzite (Ordovician)**--Exposed in northeast part of Windy Peak quadrangle as slide blocks in the Tertiary section; most complete sections are present in the Kious Spring quadrangle (see fig.1) on either side of the mouth of Snake Creek, where locally, both top and bottom contacts of the formation are exposed. Regional thickness for the Eureka Quartzite is about 135 m. The Eureka Quartzite is a white, cliff-forming, well-sorted, well-rounded, fine- to medium-grained, thick-bedded quartzite. It is a distinctive stratigraphic marker, occurring between dark dolomites above and the yellow-weathering gray slope-forming limestone of the Pogonip Group below

Op **Pogonip Group (Ordovician)**--Exposed in northeast part of Windy Peak quadrangle as slide blocks in the Tertiary section. Most complete section occurs on the north side of Snake Creek in the Kious Spring quadrangle (see fig.1), where it is present immediately above the Southern Snake Range Decollement, where all of its included formations are present, and where it is depositionally overlain by the Eureka Quartzite. Regional thicknesses for the Pogonip are about 460-500 m. The Pogonip Group is a blue-gray, generally quite fossiliferous, thin- to medium-bedded, slope- to ledge-forming silty limestone

Ꞓpc **Pole Canyon Limestone (Middle Cambrian)**--White to dark-gray, massively bedded, burrows or fenestral fabric common; thin but conspicuous orange-weathering thin-bedded silty horizons present throughout section. In the map area, the Pole Canyon is incompletely exposed in the northwestern corner of the quadrangle where it overlies the Pioche Shale and is in fault contact to the north with Tertiary conglomerate. Metamorphic foliation is variably developed, but original bedding and sedimentary structures can still be seen. Estimated thickness in region about 550 m

Ꞓpi **Pioche Shale (Lower Cambrian)**--Greenish-gray to olive-gray, primarily thin-bedded calcareous quartzite and minor dark sandy siltstone. In the southern Snake Range, true shale is subordinate in the section. The Pioche Shale forms an important lithologic transition between dominantly clastic Prospect Mountain Quartzite and the overlying Middle Cambrian Pole Canyon Limestone, which lacks clastics. In the map area, unit is metamorphosed to biotite- and muscovite-bearing psammite, schist, and calc-silicate bearing rocks. Original bedding and sedimentary structures are obscured by metamorphism and deformation. On Pilot Knob Ridge in the Hogum 7.5' quadrangle to the west, an intact, little metamorphosed 120 m thick section is exposed. Here, the basal portion of the Pioche is composed of olive-brown to rust-brown siltstone containing abundant detrital mica and thin interbeds of quartzite. The middle part of the section consists of siltstone, olive-gray shale, and reddish sandstone. The upper part of the Pioche is more calcareous and is composed of interbedded calcareous shale, calcareous sandstone, and silty limestone. The limestone is medium gray or maroon in color, while the silty intervals are olive gray. In general, both metamorphosed and unmetamorphosed Pioche Shale is a conspicuously dark, slope-forming unit characterized by olive, tan, and rust-brown platy talus. Estimated thickness in area about 100-135 m

€Zpm Prospect Mountain Quartzite (Lower Cambrian and Late Proterozoic)--Very light gray to white to red-purplish-gray, fine- to coarse-grained quartzite; conglomeratic to sometimes gritty; commonly crossbedded throughout unit. The best exposures are present on the northeastern flanks of the southern Snake Range between Strawberry Creek and Lehman Creek in the Windy Peak quadrangle. The base of the Prospect Mountain Quartzite and its contact with the underlying Osceola Argillite is exposed in the cliffs above Stella Lake and the saddle between Buck Mountain and Bald Mountain. Its upper contact with the Pioche Shale is exposed in the adjacent Lehman Caves quadrangle to the east. The Prospect Mountain Quartzite is little metamorphosed as exposed on the headwall of the Wheeler Peak cirque, but is much more metamorphosed where it is in contact with Jurassic plutons and Cretaceous (?) to Tertiary intrusives nearby. In general, the Prospect Mountain Quartzite forms cliffs and talus slopes that weather rust brown, tan, or purple. Beds range from 0.3 to 1 m in thickness, are commonly cross-bedded, and have foresets 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 Prospect Mountain Quartzite is distinguished from quartzite beds in the underlying McCoy Creek Group by its general lack of pebble conglomerates (thin layers are, however, occasionally present), lack of pelitic intervals, abundance of cross-beds, and by the more regular bedding thickness. The basal and upper sections of the Prospect Mountain Quartzite contain intervals of siltstone and shale and are clearly in conformable and gradational contact with the underlying Osceola Argillite and the overlying Pioche Shale. Total thickness is approximately 1200 m

McCoy Creek Group of Misch and Hazzard(1962) (Precambrian)--Alternating light-gray quartzite and medium-gray to dark-gray pelitic units which are variably metamorphosed. The McCoy Creek Group is informally subdivided into four units, from oldest to youngest: Zmwq, white quartzite (Pre-Willard Creek and Willard Creek quartzite of Misch and Hazzard, 1962); Zmga, green argillite (Strawberry Creek Formation of Misch and Hazzard, 1962); Zmbq, brown quartzite (Shingle Creek Conglomeratic Quartzite of Misch and Hazzard, 1962); and Zmoa, Osceola Argillite (Osceola Argillite of Misch and Hazzard, 1962). Rocks of this age comprise a large part of the Windy Peak quadrangle. On the north-facing slopes leading up towards Wheeler Peak, they form an intact, gently dipping, apparently conformable section. Our unit nomenclature is based on color and dominant lithology. The McCoy Creek Group has been assigned a Late Precambrian age based on its position beneath the Prospect Mountain Quartzite which is generally assigned to the Early Cambrian (Hose and Blake, 1976). Hose and Blake (1976) described the depositional environment of the entire McCoy Creek Group as representing marine environments. We support their interpretation and suggest deposition in a tidally influenced shallow marine system. Exposed thickness in the southern Snake Range is estimated at about 1100 m

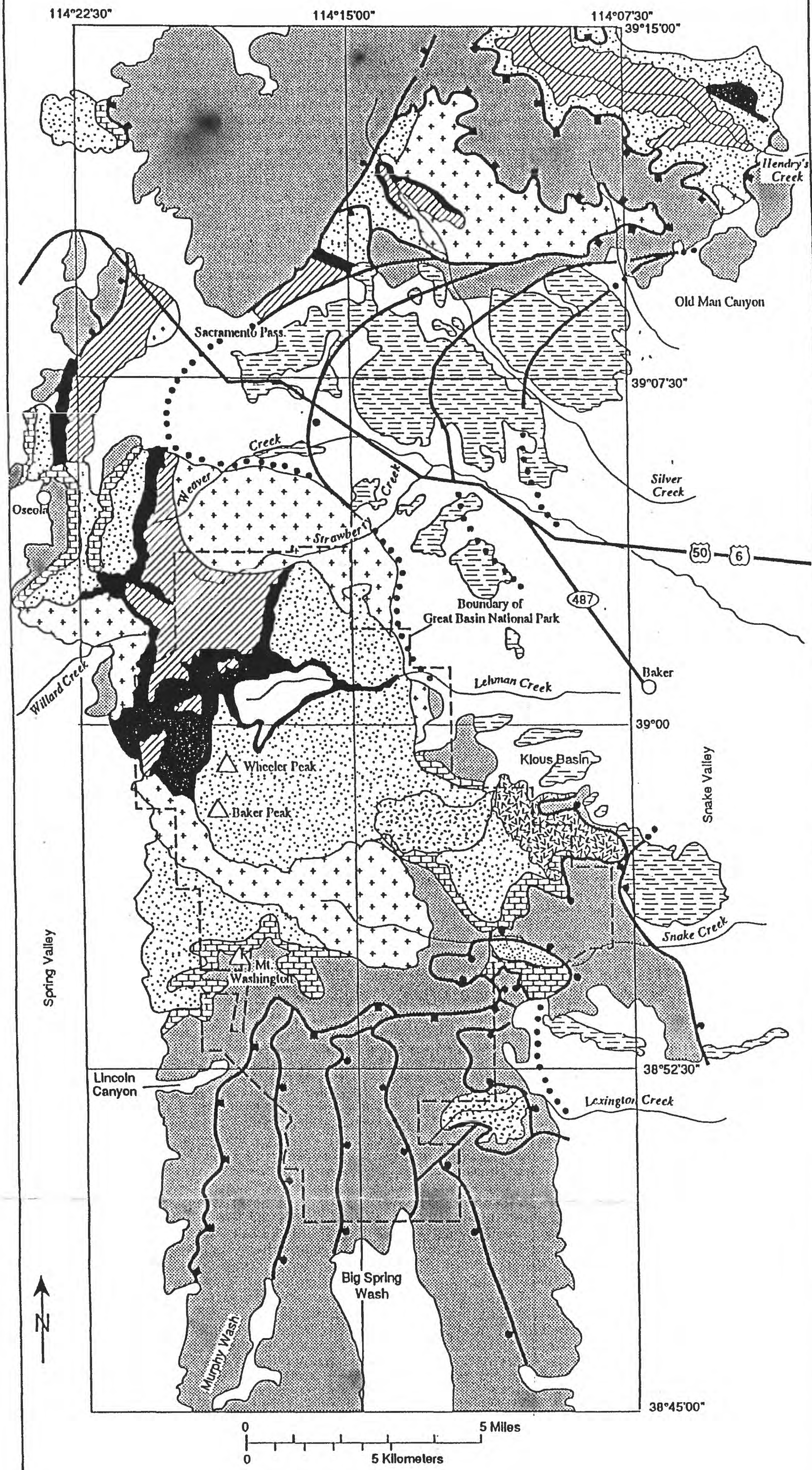
Zm McCoy Creek Group undivided (Precambrian) -- Present only in two small fault-bounded outcrops near the north boundary of the quadrangle. Stratigraphic position unknown

Zmoa Osceola Argillite McCoy Creek Group (Upper Precambrian)--The Osceola Argillite is the uppermost unit of the Late Precambrian McCoy Creek Group. Although the unit is described in earlier reports, it was first named by Misch and Hazzard (1962) , after the town of Osceola in the Hogum quadrangle to the west. A complete well-exposed section of the Osceola Argillite occurs on the north flank of Bald Mountain where it is conformably overlain by the Prospect Mountain Quartzite (€Zpm) and underlain by quartzite of McCoy Creek Group, Zmbq, of this report. The Osceola Argillite consists mostly of well-bedded to laminated slates and siltstone which are distinctively green to gray blue, although in the Stella Lake area near Wheeler Peak, maroon colors are common (Misch and Hazzard, 1962). On the north slope of Bald Mountain, the complete section is about 200 m thick and consists of alternating slate-blue, light-green, or gray slate interbedded with laminated siltstone. Abundant sedimentary structures are present and include small-scale cross beds (maximum height 6 cm), ripple marks, fluid-escape structures, rip-up clasts, and soft-sediment deformation features such as complex folds and slumps. Quartz-rich sandy to gritty layers and lenses also occur, and some of these exhibit cross-bedding and more rarely, graded beds. Rare limestone interbeds occur near the base of the unit. The contact with the overlying Prospect Mountain Quartzite is gradational over 10-15 m as the upper part of the Osceola contains interbeds of cross-bedded pure quartz sandstone. The bottom 10-15m of the Prospect Mountain Quartzite contains many thin argillaceous intervals similar to those present in the Osceola. Euhedral magnetite is abundant in this part of the section. Although Misch and Hazzard (1962) identified a separate unit between the Osceola Argillite and the Prospect Mountain Quartzite which they called the Stella Lake Quartzite, we have followed Hose and Blake (1976) and treated it as part of the Prospect Mountain Quartzite. Metamorphic grade and degree of deformation varies from very little metamorphism and deformation near Stella Lake to amphibolite facies (biotite, muscovite, staurolite, garnet, andalusite, and sillimanite) adjacent to Jurassic plutons in the quadrangle (Miller and others, 1988). Where little deformed, shales exhibit an incipient penetrative cleavage that dips east with respect to more gently dipping bedding. This cleavage can be followed into the contact aureoles of Jurassic plutons where it is more intensely developed and can be shown to have formed synchronous with the intrusion of plutons (Miller and others, 1988). It is locally cut by a younger, west-dipping cleavage inferred to be Cretaceous in age (Miller and others, 1988). Maximum thickness of the Osceola Argillite in the southern Snake Range is about 240 m

Zmbq **McCoy Greek Group brown quartzite (Upper Precambrian)**--Medium to dark-gray and brownish-gray quartzite which varies considerably in thickness and grain size from north to south across the Windy Peak quadrangle. To the north it consists of a thin conglomeratic quartzite, no more than 30 m thick; clasts are predominantly of rounded quartz pebbles 1-3 cm in diameter. South of Willard Creek, the upper 50 m or more consists of ledge and cliff-forming, well-bedded, conglomeratic quartzite. The lower part of the unit is relatively dark colored, blocky to slabby weathering, thinly laminated, nonconglomeratic, vitreous quartzite and fine-grained metasediments. The unit was first described by Misch and Hazzard (1962) and named the Shingle Creek Conglomeratic Quartzite. We have assigned a more generic unit name because it is not notably conglomeratic in the Deep Creek and Egan Ranges to the north and west, respectively. Instead, it consists of a regionally persistent fine- to coarse-grained quartzite. Thickness in the southern Snake Range is about 150 m

Zmga **McCoy Creek Group green argillite (Upper Precambrian)**--Olive-drab, greenish-gray schist and light- to medium-gray quartzite. This unit corresponds to the Pre-Willard Creek quartzite of Misch and Hazzard, 1962. As a whole, quartzites are more common in the lower part than in the upper part. Where the unit is more pelitic, it forms brown-weathering slopes containing ledge to cliff-forming exposures of more feldspathic or quartzitic sandstone. In the Windy Peak quadrangle, exposure of this unit is quite variable. Good exposures of the more metamorphosed equivalents of this unit occur in the Windy Pass area and along the western contact of the Strawberry Creek Granite pluton. Exposures of the less metamorphosed equivalents on the heavily forested north side of Bald Moutain are poor. The unit is distinguished from the Osceola Argillite by wider variation in composition and grain size and having abundant unsorted, quartzo-feldspathic grit-bearing layers. It is a distinctive slope or ledge- to slope-former and lies in sharp and abrupt contact above the underlying massive, white, cliff-forming quartzite (Zmwq). Thickness in the southern Snake Range is about 230 m

Zmwq McCoy Creek Group white quartzite (Upper Precambrian)--Light-gray to nearly white quartzite. This unit is a massive, thick, cliff-forming quartzite, and is the oldest of the McCoy Creek Group units exposed in the Windy Peak quadrangle; its base is not exposed. It corresponds to the Pre-Willard Creek quartzite of Misch and Hazzard, 1962. The sharp top of the unit is well-exposed along the pack trail in Windy Canyon. Bedding is thicker (about 0.5 to 1 m) and cross beds less common than in the Prospect Mountain Quartzite. Occasional well rounded quartz-pebble stringers and layers occur. Regionally, this unit is generally a massive, conspicuous, cliff former, and its sharp, upper, probably conformable, contact with the dark brown slope-forming shales or schists of Zmgq is one of its main distinguishing features. Thickness in the southern Snake Range is about 245 m



114°22'30"
114°15'00"
114°07'30"
39°15'00"
Hendry's Creek
Old Man Canyon
Sacramento Pass
39°07'30"
Weaver Creek
Silver Creek
Osceola
Strawberry Creek
50
6
487
Boundary of Great Basin National Park
Baker
Willard Creek
Lehman Creek
39°00
Wheeler Peak
Klous Basin
Snake Valley
Baker Peak
Snake Creek
Spring Valley
Mt. Washington
Lincoln Canyon
38°52'30"
Lexington Creek
Big Spring Wash
N
Murphy Wash
38°45'00"
0
5 Miles
0
5 Kilometers

16

EXPLANATION

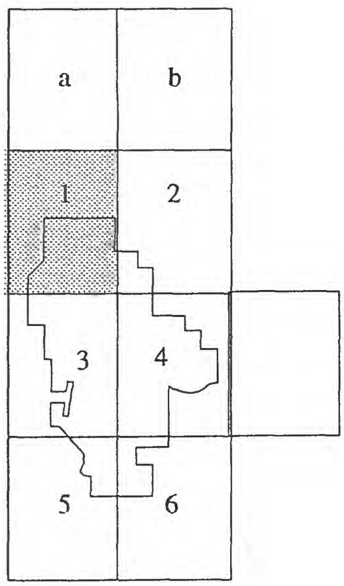
- Alluvial deposits (quaternary)
- Continental deposits, undivided (Tertiary)
- Granitic deposits (Tertiary)
- Granitic deposits (Cretaceous)
- Granitic deposits (Jurassic)
- Miogeoclinal strata (Paleozoic)
- Pioche Shale (Middle and Lower Cambrian)
- Prospect Mountain Quartzite (Lower Cambrian and Late Paleozoic)

McCoy Creek Group of Misch and Hazzard, 1962, late Precambrian

- McCoy Creek Group, undivided
- Osceola Argillite
- Major Cenozoic faults--Ball on downthrown side
- Snake Range decollément--Squares on upper plate

1. Windy Peak
2. Lehman Caves
3. Wheeler Peak
4. Kious Spring
5. Minerva Canyon
6. Arch Canyon

a Sacramento Pass
b Old Man's Canyon
c Garrison



Index map showing numbered 7.5' topographic quadrangles that include Great Basin National Park

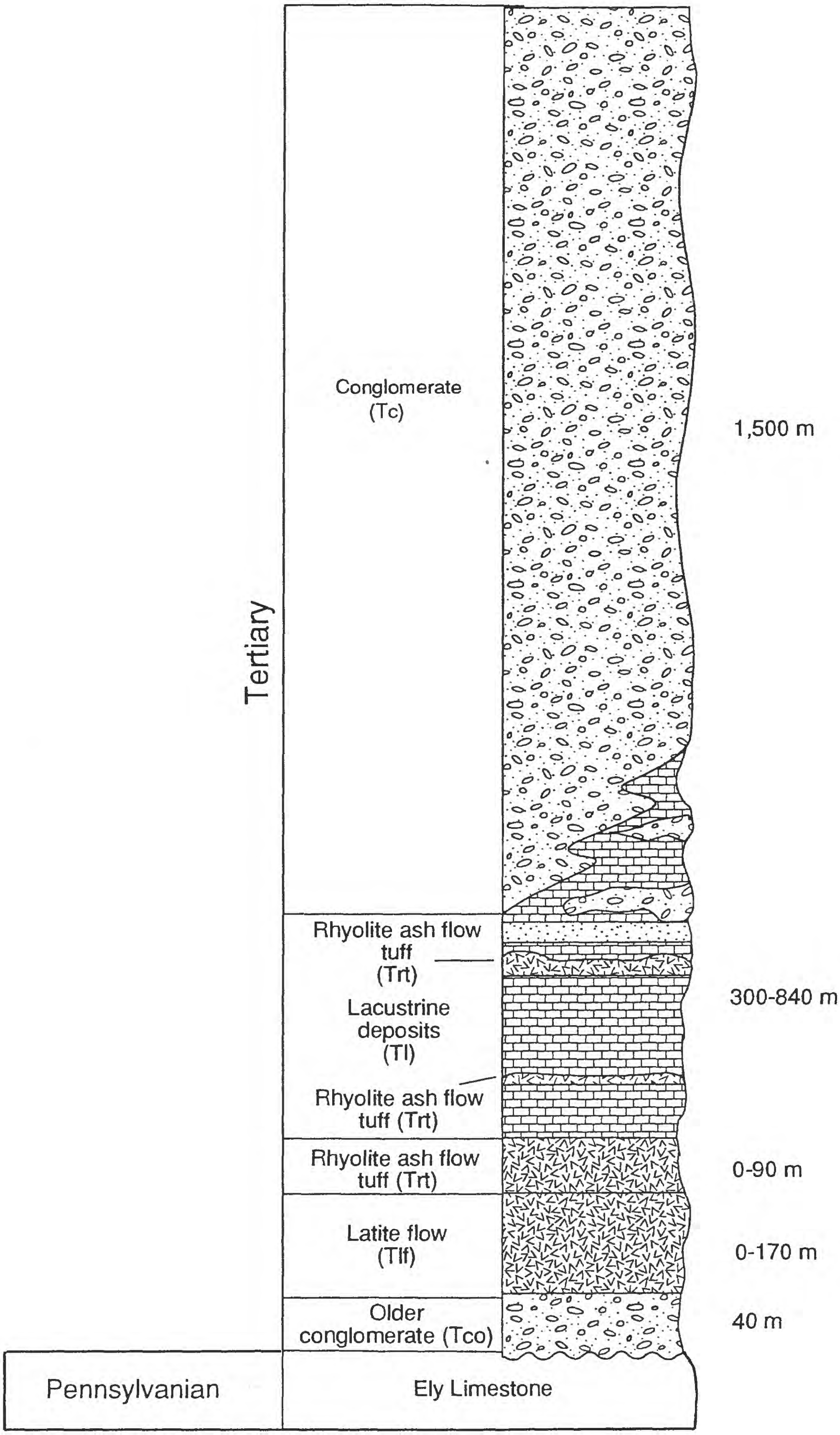

Conglomerate
(Tc)
1,500 m
Tertiary
Rhyolite ash flow
tuff
(Trt)
Lacustrine
deposits
(Tl)
Rhyolite ash flow
tuff (Trt)
300-840 m
Rhyolite ash flow
tuff (Trt)
0-90 m
Latite flow
(Tlf)
0-170 m
Older
conglomerate (Tco)
40 m
Pennsylvanian
Ely Limestone

Figure 2.

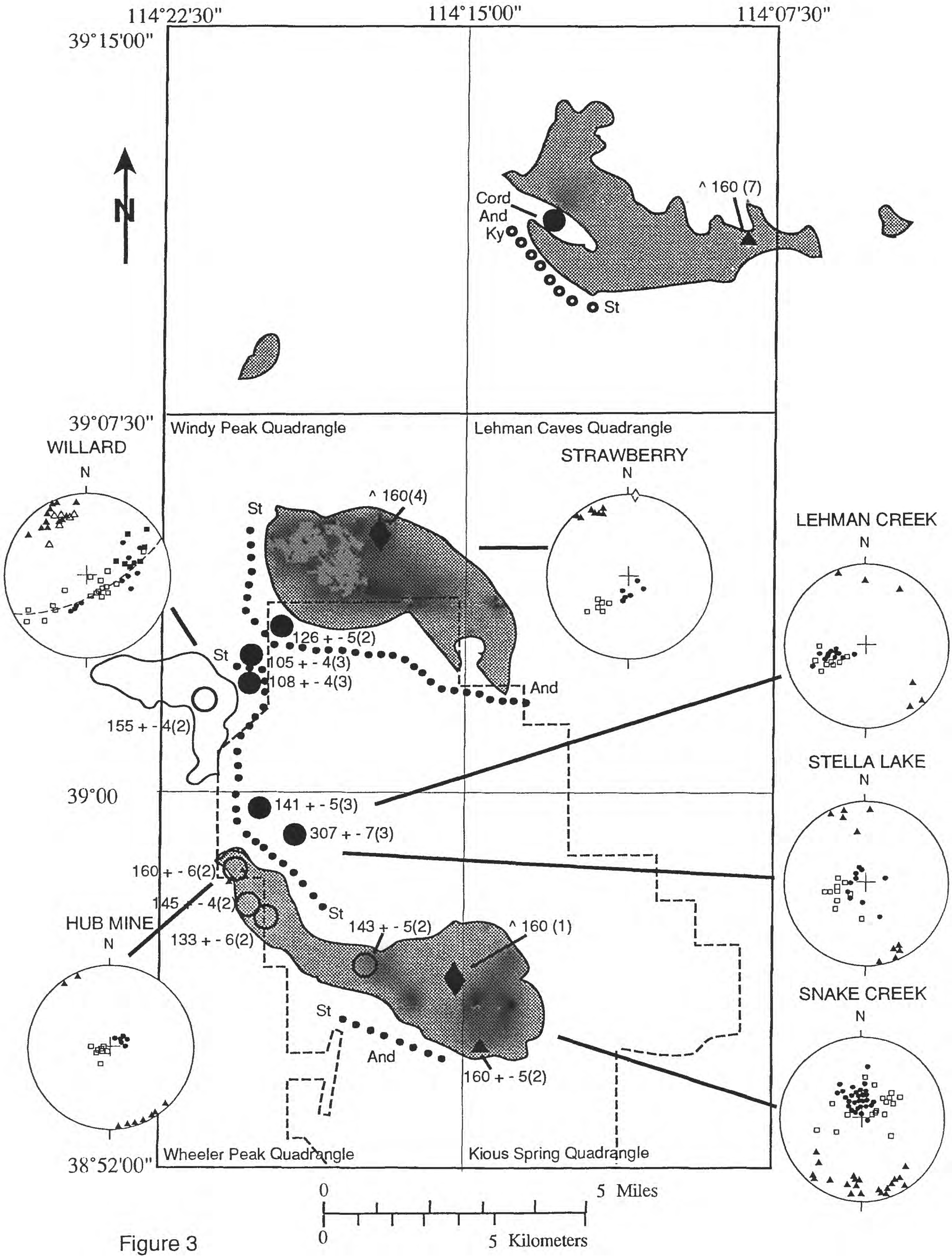

114°22'30"
114°15'00"
114°07'30"
39°15'00"
N
Cord
And
Ky
^ 160 (7)
St
39°07'30"
Windy Peak Quadrangle
Lehman Caves Quadrangle
WILLARD
N
STRAWBERRY
N
St
^ 160(4)
LEHMAN CREEK
N
126 + - 5(2)
St
105 + - 4(3)
108 + - 4(3)
And
155 + - 4(2)
STELLA LAKE
N
39°00
141 + - 5(3)
307 + - 7(3)
160 + - 6(2)
145 + - 4(2)
St
HUB MINE
N
133 + - 6(2)
143 + - 5(2)
^ 160 (1)
SNAKE CREEK
N
St
And
160 + - 5(2)
38°52'00"
Wheeler Peak Quadrangle
Kious Spring Quadrangle
0
5 Miles
0
5 Kilometers

Figure 3

Legend

Jurassic Plutons

Symbols for Selected Radiometric Ages

- ◆ U-Pb zircon
- ● K-Ar muscovite
- ▲ K-Ar hornblende

Symbols for Metamorphic Data

- ••••••• Approximate location of mineral isograds
- O Diagnostic mineral assemblages

St Staurolite

And Andalusite

Sill Sillimanite

Cord Cordierite

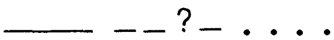
Ky Kyanite

Symbols for Structural Data on Lower Hemisphere Stereographic Projections

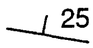
- ● Poles to bedding (So)
- □ Poles to S1 cleavage
- ■ Poles to S2 cleavage
- ▲ S0 to S1 intersection lineations
- △ S0 to S2 intersection lineations

Figure 3

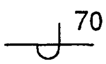
EXPLANATION OF MAP SYMBOLS
Windy Peak 7.5 Quadrangle



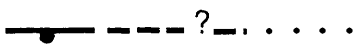
CONTACT --Solid line continuous, dashed where inferred, queried where uncertain, dotted where concealed



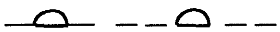
STRIKE AND DIP OF BEDDING



STRIKE AND DIP OF OVERTURNED BEDS



FAULT -- Solid line continuous, dashed where inferred, queried where uncertain; dotted where concealed; ball on downthrown side

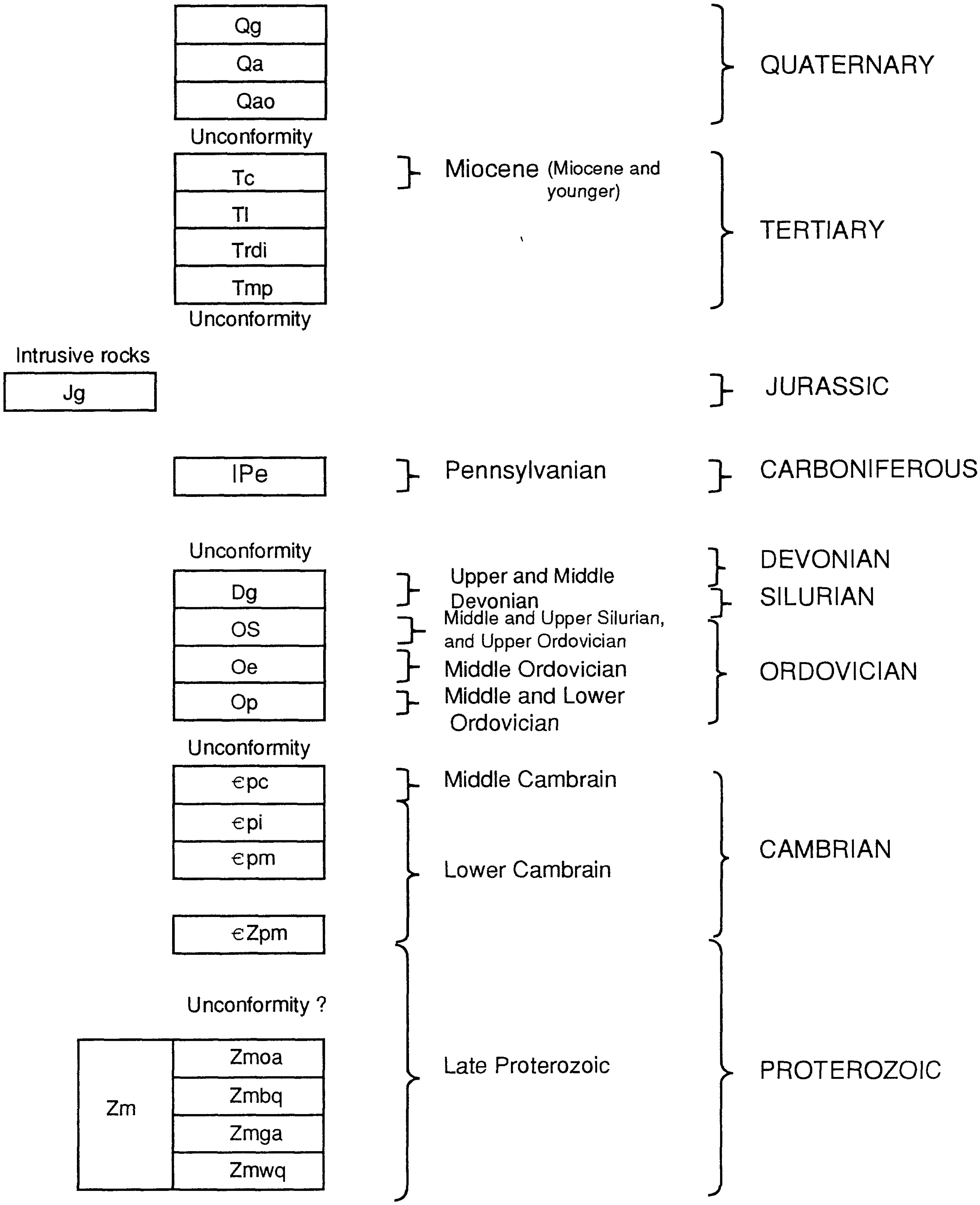

BASAL CONTACT OF TERTIARY SLIDE BLOCKS -- Solid line continuous, dashed where inferred, open crescents on upper side

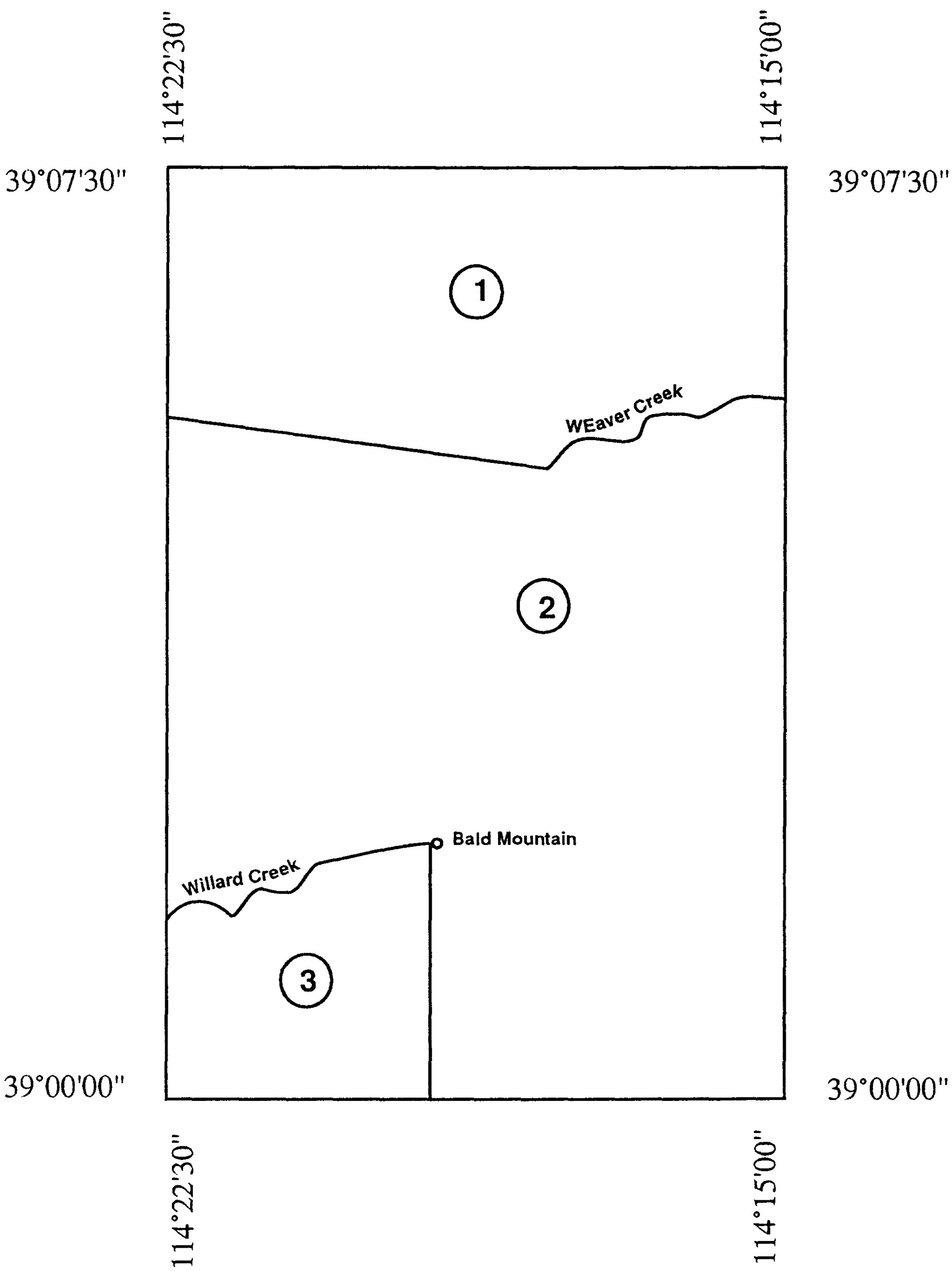
METRIC CONVERSION FACTORS

Inch-pound unit	Metric equivalent
1 inch (in)	2.54 centimeters (cm)
1 foot (ft.)	0.305 meters (m)
1 mile (mi)	1.609 kilometers (km)

CORRELATION OF MAP UNITS

Windy Peak 7.5 Quadrangle





MAP CREDITS WINDY PEAK QUADRANGLE

1. Susan P. Grier, Philip B. Gans, Elizabeth L. Miller
2. Elizabeth L. Miller
3. Elizabeth L. Miller, Philip B. Gans