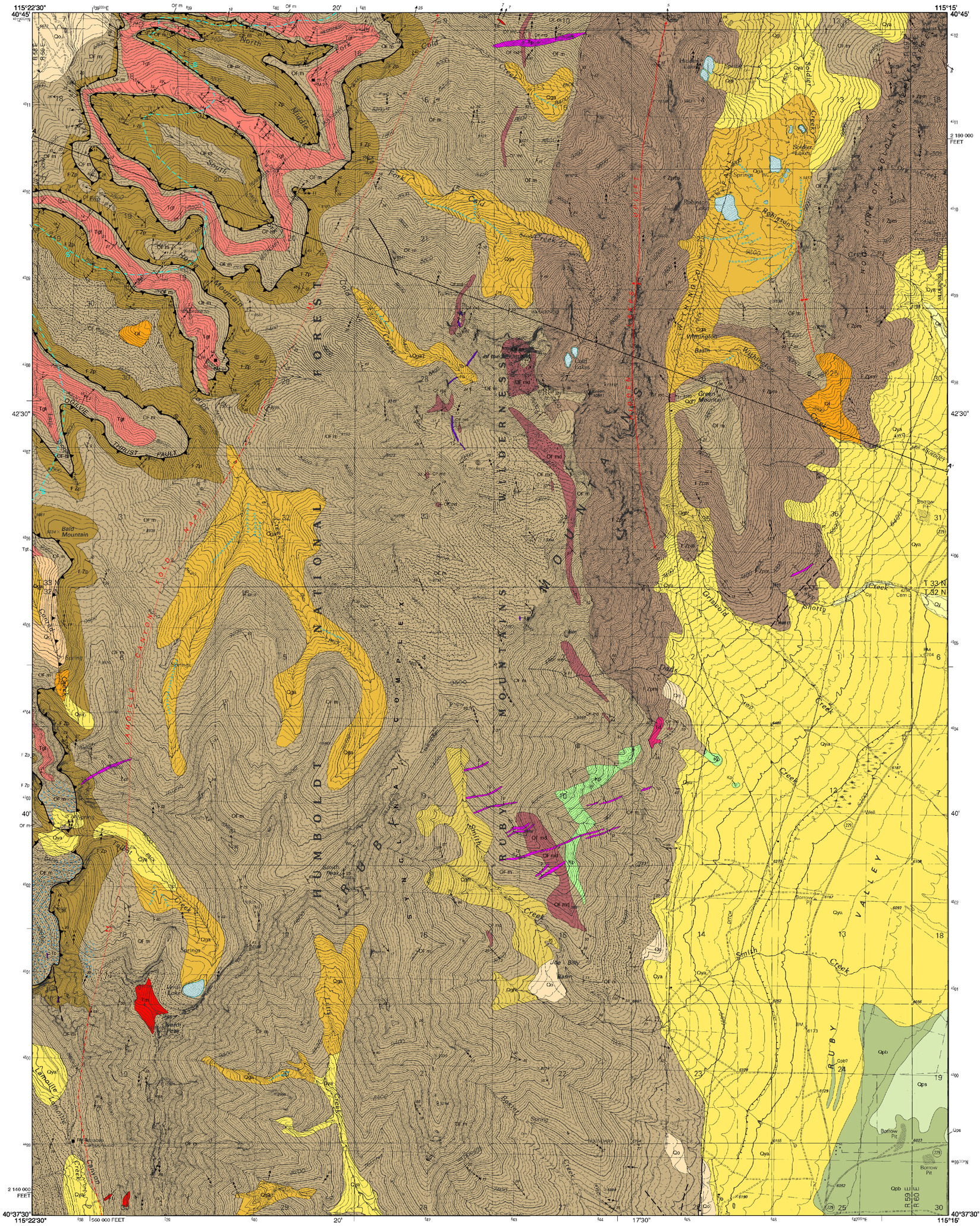
Nevada Bureau of Mines and Geology

USGS Prepared in cooperation with the US Geological Survey

MAP 147 GEOLOGIC MAP OF THE VERDI PEAK QUADRANGLE, ELKO COUNTY, NEVADA



Qy **Youngest alluvium (upper Holocene)** Arkosic gravel, sand, and silt along present streams. Derived from granitic and metamorphic rocks in Ruby Mountains. Thickness a few meters.

Qya **Younger alluvium and outwash (Holocene and Pleistocene)** Alluvial fan deposits of arkosic gravel and sand derived from granitic and metamorphic rocks in Ruby Mountains. Includes Pleistocene outwash from Angel Lake glacial advance. Thickness more than 5 m.

Ql **Landslide deposits (Holocene and Pleistocene) Locally derived.** Includes lobate rock avalanche deposit or rock glacier(?) in upper Conrad Creek drainage. Deposit near Withington Creek in northeast part of map area possibly includes glacial till. Confined to Ruby Mountains. Maximum thickness about 20 m.

Qc **Colluvium (Holocene and Pleistocene)** Largely slope wash, talus deposits, landslide, debris-flow, and possible solifluction deposits. Locally derived. Confined to Ruby Mountains. Thickness as much as ~10 m.

Glacial till (Pleistocene) Moraine crests indicated. Clasts derived locally from granitic and metamorphic rocks. Moraines of Angel Lake glaciation have bouldery surfaces and weakly developed soil, and are correlated with Tioga and Wisconsin drifts; moraines of Lamoille glaciation correlated with Illinoian drift (Wayne, 1984). Birkeland and others (1991) assumed age of Angel Lake moraines about 20 ka and Lamoille moraines about 140 ka. Confined to Ruby Mountains. Subdivided by Sharp (1938) into:

Qga **Angel Lake moraines** Deposited by the Angel Lake glaciation (Angel Lake substage or stage). Thickness as much as 50 m.

Qgl **Lamoille moraines** Deposited by the Lamoille glaciation (Lamoille substage or stage). Mapped near Hidden Lakes by Sharp (1938); inferred here also along Smith Creek, based on degraded form. Thickness up to perhaps 20 m.

Pluvial lake deposits (Pleistocene) Deposits of Pleistocene Lake Franklin in Ruby Valley. Pluvial lakes discussed by Hubbs and others (1974), Mifflin and Wheat (1979), and Reheis and others (2002).

Qps **Silt and clay** Locally includes sand and pebbles. At least a few meters thick.

Qpb **Beach and delta deposits** Well sorted to very well sorted arkosic pebble gravel and sand. Grains subangular to subrounded; locally imbricated. Calcite-cemented by groundwater below a depth of about 2 m. Surface hummocky in southeast corner of quadrangle, where fine sand occupies surface of swales between gravelly hummocks. Thickness >4 m.

Qo **Old alluvium (Pleistocene)** Underlies dissected terraces 50 to 100 m above present stream grade. Alluvial-fan deposits of arkosic gravel and sand made of subrounded to subangular clasts of granitic and metamorphic rocks derived from the Ruby Mountains. Mostly poorly consolidated. Thickness 0–50 m. Veneers two levels of perched bedrock pediment locally on east side of Ruby Mountains, where higher (outwash?) deposit on terrace surface in Joe Billy Basin along Smith Creek perches higher than and may predate deposit that mantles eastern range-front pediment terrace, itself uplifted by Quaternary fault.

Tb **Basalt dikes (Miocene)** Olivine basalt and diabase. Aphanitic groundmass. Dikes commonly parallel or follow large fractures. Most dikes strike north and dip steeply. Dike thicknesses 0.1 to 5 m. Present west of Verdi Peak, west of Old Man of the Mountains, and 3 km south of Old Man of the Mountains. Similar dikes dated as approximately 16.5 Ma (16.62±0.05 Ma near-plateau) in central Ruby Mountains (whole-rock $^{40}Ar/^{39}Ar$, Hudec, 1990) and about 17 Ma in southern East Humboldt Range (whole rock K-Ar, Snoke and others, 1979).

Tp **Pegmatite dikes (Oligocene?)** Dikes of leucogranite composition containing coarse to very coarse books of muscovite and biotite; sparse garnet. Graphic texture common. Plumose or conical muscovite-quartz intergrowths like those described by Orville (1960) common; locally the cones open upward. Largest dike, in north-central part of quadrangle, contains many zones, across its 60-m thickness, distinguished by variations in grain size (medium-grained to very coarse) and mica and garnet content; a border zone contains red-purple garnets whereas a central zone contains red-brown garnets. Pale green beryl in crystals as wide as 30 cm present, and prospected, in an unmapped dike in northeast corner of map area near mouth of Robinson Creek. Most dikes strike east-northeast and dip steeply. Possibly correlative unmapped dikes of this orientation are present at Old Man of the Mountain. Dike thickness 10 to 60 m. Tentatively correlated with muscovite pegmatite dikes described by Lee and Barnes (1997), which intrude the biotite monzogranite unit 2 km south of the southwest corner of the map area.

Tm **Biotite monzogranite (Oligocene and Eocene?)** Medium- to fine-grained, equigranular; massive to moderately foliated biotite monzogranite. Color index (biotite content) 5–10 vol.%. Forms three mapped and numerous unmapped small dikes and irregular-shaped bodies a few meters wide. Similar bodies from several nearby areas in the Ruby Mountains yielded U-Pb zircon ages 29±0.5 Ma (Wright and Snoke, 1993; MacCready and others, 1997). Recent monazite U-Pb dating by J.E. Wright (unpublished) suggests an age no younger than late Eocene for one body near the quadrangle.

Tgt **Granite gneiss of Thorpe Creek (Eocene)** Garnet-biotite-muscovite monzogranite and leucomonzogranite gneiss. Fine- to medium-grained; equigranular; pegmatitic dots present locally. Ubiquitous sparse garnets 1 mm wide. Locally contains sillimanite. Color index (content of mafic minerals biotite and garnet) averages about 5 vol.%. Strongly foliated; present as mylonitic gneiss in most exposures. Locally exhibits either west-trending mineral-elongation lineation or north-trending mineral-alignment lineation. White to very light gray; rust-toned weathering bands common. Commonly weathers as irregular rock towers. Forms a sill as thick as 80 m intruded into marble of Verdi Peak in core of Lamoille Canyon fold nappe. Monazite U-Pb ages 36–39 Ma determined on one sample from the adjacent Lamoille 7.5-minute Quadrangle and two samples from this quadrangle (RM-21 and RM-24) (Wright and Snoke, 1993; MacCready and others, 1997). The two samples dated from this quadrangle exhibit a north-trending lineation, whereas the sample dated from the Lamoille Quadrangle exhibits a west-trending lineation.

Td **Hornblende-biotite diorite (Eocene?)** Medium-grained. On eastern front of Ruby Mountains near Dads Creek. May be late Eocene in age like quartz diorite gneiss (40±3 Ma) and quartz diorite intrusions (38±2 Ma) in East Humboldt Range dated by U-Pb method on zircon by Wright and Snoke (1993).

Kp **Pegmatitic granite (Late Cretaceous)** Well-foliated to nearly massive leucogranite gneiss and leucogranite. Pegmatitic; inequigranular; grain size variable but generally coarse to very coarse. K-feldspar grains containing graphic intergrowths of quartz are common and may be as large as several tens of centimeters across. Contains muscovite, biotite, commonly garnet or sillimanite. Biotite and sillimanite commonly in folia or mats that wrap around feldspar grains. Characterized chemically by Lee and others (2003, their KPG unit). Widespread in quadrangle, but mapped only locally (east-central part of quadrangle) where metasedimentary relics absent. The unmapped pegmatitic granite pervasively and intimately invades host metasedimentary rocks as pods, sills, and dikes; location and igneous proportions of resulting migmatite are indicated by overprint pattern on the metasedimentary map units. Mapped and unmapped pegmatitic granite makes up approximately 50 vol.% of rocks in this part of Ruby Mountains. Preliminary U-Pb age on monazite approximately 84 Ma determined by J.E. Wright (unpub. data referred to by Snoke and others, 1997) from unmapped pegmatitic granite gneiss in roadcut in southwest part of quadrangle (sample locality RM-4). Preliminary Eocene monazite U-Pb age determined for a pegmatitic granite body in the Lamoille Quadrangle (unpublished data of J.F. Wright).

OF m **Marble of Verdi Peak (Ordovician and Cambrian protolithic age)** Calcite marble, siliceous calcite marble, graphitic marble, calc-silicate rocks; minor mica schist, sillimanite-mica schist, paragneiss, and hornblende-biotite schist. Commonly layered. Mylonitic in northwestern exposures. Diopside and actinolite impart green color to calc-silicate rocks. Rusty-weathering graphitic paragneiss interlayered with graphitic marble common at stratigraphic base of the unit. Upper half of unit mostly marble, locally graphitic or containing metachert, minor schist. Intricately intruded by pegmatitic granite and equigranular granite gneiss in sills, dikes, and irregular bodies, the proportion indicated by overprint pattern. Locally (in original lower plate of Ogilvie thrust fault) intruded by sills and irregular bodies of gabbroic rocks, the proportion indicated by separate overprint pattern. Structural thickness 20 m to about 2 km (including roughly 50 vol.% granite); top not exposed. Correlated lithologically on the basis of stratigraphic position to Cambrian limestones and shales and Ordovician Pogonip Group, having a combined protolith thickness of about 3 km. Includes:

OF md **Brown dolostone** Massive, rust-brown to white, medium-grained (3 mm) dolomite marble and interlayered calcite marble. Coarse tremolite laths and interstitial calcite common. Dolomite marble typically crops out as rounded knobs surrounded by brown or white sand of disintegrated marble. Intruded by pegmatitic granite, the proportion indicated by overprint pattern. Present in stratigraphically low part of marble of Verdi Peak near Hidden Lakes uplift. Thickness a few meters to about 100 m. Similar rock occurs in lowest part of marble of Verdi Peak 12 to 15 km south and southwest of the quadrangle, and in lowest part of the Cambrian limestone section 30 km south of the quadrangle near Green Mountain (Howard, 1971).

F Zp **Metamorphosed Prospect Mountain Quartzite (Cambrian and Neoproterozoic protolithic age)** Tan- to pale brown-weathering, medium-grained micaceous metaquartzite and quartzose schist. Contains 3–10 vol.% K-feldspar, less plagioclase, and 4–8 vol.% biotite plus muscovite. Sillimanite present southeast of mapped sillimanite isograd. Northwestern and structurally high quartzite exposures are fine-grained and flaggy, exhibit conspicuous mylonitic foliation and lineation. Structurally deep, more eastern quartzite exposures are nonmylonitic, medium-grained, and form resistant light-brown cliffs. The two textural types grade into each other. Intricately intruded by pegmatitic granite, the proportion indicated by overprint pattern. Present in Lamoille Canyon fold nappe. Structural thickness 10 to 150 m; base not exposed.

F Zpm **Metamorphosed Prospect Mountain Quartzite (Cambrian and Neoproterozoic protolithic age) and McCoy Creek Group (Neoproterozoic protolithic age), undivided** Tan- to pale brown-weathering, medium-grained micaceous metaquartzite and quartzose schist; local marble and biotite schist. Rarely mylonitic. Forms resistant light-brown cliffs. Dominant quartzite lithotype contains 3–10 vol.% K-feldspar, less plagioclase, 4–8 vol.% biotite plus muscovite, minor sillimanite. Biotite schist locally present. White calcite marble and interlayered quartz-diopside rock and tremolite-calcite rock present locally. Queried exposures north of lower Withington Creek, mostly marble and less schist, may alternatively correlate with marble of Verdi Peak (unit OEm). Uppermost quartzite locally graphitic and rusty-weathering in southern part of Hidden Lakes uplift. Intricately intruded by pegmatitic granite, the proportion indicated by overprint pattern. Present in Hidden Lakes uplift and root zone of Soldier Creek nappe. Presence of upper part of the Neoproterozoic McCoy Creek Group of Misch and Hazzard (1962), stratigraphically below Prospect Mountain Quartzite, indicated by calc-silicate and schist layers similar to those present in upper part of the McCoy Creek Group in the Ruby Mountains 25 km to the south of the quadrangle (Hudec, 1990; Jones, 1959). Structural thickness >700 m. This compares to an approximate undeformed stratigraphic thickness elsewhere in Ruby Mountains of Prospect Mountain Quartzite of about 1,200 m plus at least 75 m (down to the calc-silicate horizon) of upper subunit of the underlying McCoy Creek Group (Hudec, 1990).

See accompanying text for references and a discussion of the geology of the Verdi Peak Quadrangle.

Lithologic contact Dashed where inferred (cross section only)

Fault Dashed where inferred, dotted where concealed. Ball on downthrown side of normal fault.

Premetamorphic thrust fault Dotted where concealed. Metamorphosed; concordant to foliation; lacks cataclastic structures. Identified as contact that repeats mapped stratigraphic sequence.

Right-side up Sawteeth on upper plate. Places older over younger rocks.

Overturned Sawteeth point into older rocks, into originally higher plate.

S **Sillimanite isograd** Delineates presence of sillimanite in muscovite-biotite-K-feldspar-bearing metaquartzite. S on sillimanite side; the metaquartzite lacks aluminosilicate minerals on the opposing side of the isograd. Host-rock-specific isograd; sillimanite locally occurs in schists outside this host-rock-defined sillimanite zone.

Upright syncline

Upright anticline Showing plunge direction.

Projected recumbent anticline axis Hinge line along fold nose defined by stratigraphic top of metamorphosed Prospect Mountain Quartzite. Drawn and projected based on where the hinge line pierces successive valley walls. Arrow shows plunge direction. Dash-dotted where projected above ground. Dotted where concealed.

Strike and dip of foliation

32 Inclined ⊕ Horizontal —◇— Vertical

54 **Bearing and plunge of lineation in mylonitic zone** Mineral elongation and streaking; local rodding in marble. May be combined with foliation symbol. Tail of arrow located at measurement site.

10 **Bearing and plunge of lineation in infrastructure and in rock fabrics transitional between mylonitic zone and infrastructure** Mineral alignment, corrugations, rodding, and (where oriented minerals intersect folded lithologic layering) intersection lineation. Tail of arrow located at measurement site. May be combined with foliation symbol.

10 **Bearing and plunge of mesoscopic fold** Folded layering. Tail of arrow located at measurement site.

Moraine crest

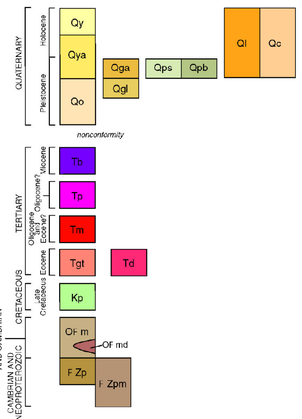
Groundwater discharge zone and subtle scarp Concentration of lush vegetation and springs on bajada surface on younger alluvium in Ruby Valley. Tracks contour around coalescing alluvial fans at about 6,250-foot elevation. Southern part straddles a subtle scarp or steepened zone approximately 3 m high and tens of meters wide where the bajada slopes as steeply as 5 degrees, 2 degrees steeper than adjacent parts of bajada. Boulders as wide as 2–3 m concentrate on the sloping bajada surface below scarp. On air photos, resembles other constant-elevation groundwater discharge zones on alluvial fans in Nevada (cf., Mifflin and Wheat, 1979, figs. 12, 19). Scarp morphology suggests possible fault origin. Boulder concentration would be compatible with origin as lag at a wavecut pluvial shoreline, but a wave-cut origin here rejected because the scarp rises ~54 m in elevation above clear shoreline features of pluvial Lake Franklin, and 16–43 m above three possible outlet passes where pluvial lakes could have spilled from Ruby Valley northeastward into Clover Valley and the Humboldt River drainage.

<1/3 1/3–2/3 >2/3

Proportion of granite within mapped metasedimentary rock units Dominantly gneissic pegmatitic leucogranite gneiss and pegmatitic leucogranite of the pegmatitic granite map unit (Kp); lesser medium-grained two-mica granite gneiss and biotite granite gneiss; local medium-grained biotite-hornblende quartz diorite gneiss. Dominantly Cretaceous; may include Tertiary rocks.

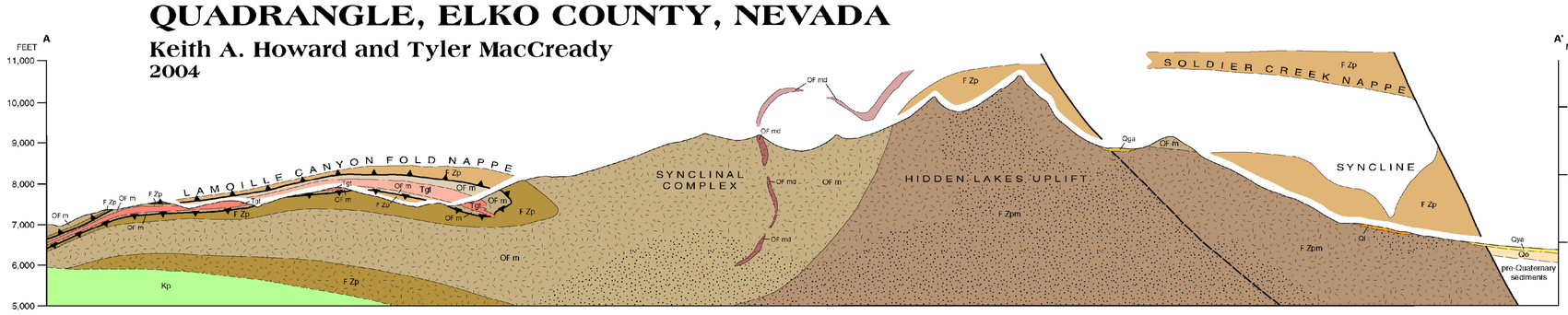
Areas where small bodies of metamorphosed gabbro occur within mapped marble of Verdi Peak In southwest part of quadrangle. Sills and dikes of metamorphosed gabbro. Mineral assemblages include various combinations of clinopyroxene, hornblende, cummingtonite, biotite-phlogopite, olivine, plagioclase. Intruded by small sills and agmatite veins of leucogranite gneiss. Gabbro may be of Tertiary or Mesozoic age.

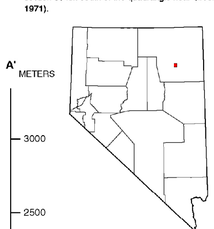
RM-4 Sample dated by U-Pb method (MacCready and others, 1997). RM-4 dated by J.E. Wright, unpub., cited in Snoke and others (1997).



GEOLOGIC MAP OF THE VERDI PEAK QUADRANGLE, ELKO COUNTY, NEVADA

Keith A. Howard and Tyler MacCready
2004





Adjoining 7.5' quadrangle names

1	2	3
4		5
6	7	8

1 Halleck SW
2 Soldier Peak
3 Secret Valley
4 Lamoille
5 Ruby City Creek
6 Ruby Dome
7 Ruby Valley School
8 Smith Well

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
Verdi Peak 7.5' Quadrangle, 1990

Field work performed from 1963–1967, 1973, 1993. Mapping largely by Howard (1966). Compiled and revised by Howard, incorporating revisions to northern third of area after MacCready and others (1997) and unpublished field map of Horse Mountain provided by George Dunne (California State University at Northridge) from work by his 1973 field class.

Office Review: Christopher Henry, NBMG; Jeffrey Lee (Central Washington University); David Miller (USGS) and Ted Theodore (USGS).

Field Review: Christopher Henry, NBMG, Connie Nutt (USGS) and Charles Thurman (LBSS, retired).

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