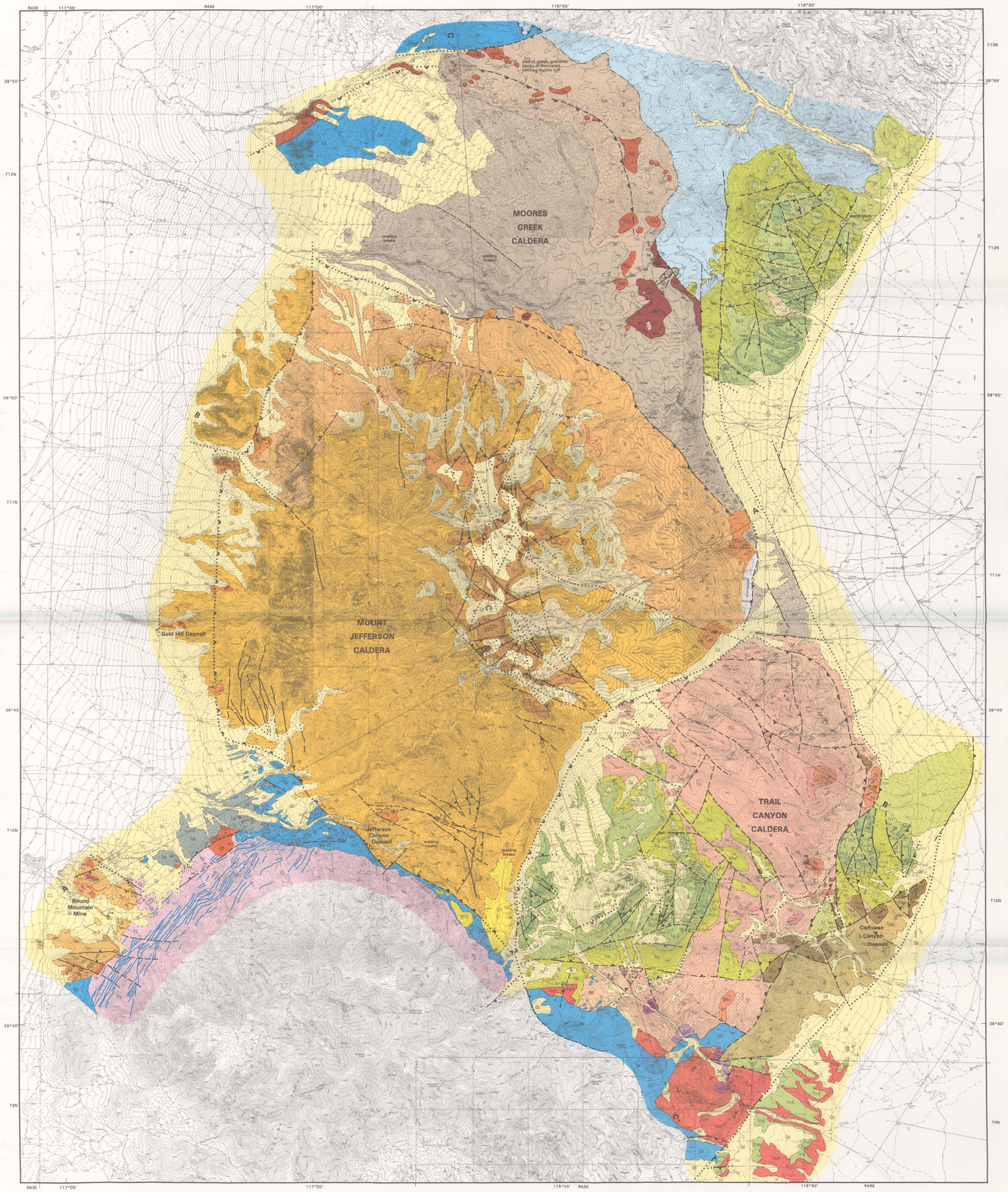


Topographic base is from the following U.S. Geological Survey 7½' quadrangles: Carvers NE, Carvers SE, Corcoran Canyon, Mount Jefferson, Northumberland Pass, Pine Creek Ranch, and Round Mountain, 1971.

GEOLOGIC MAP OF THE TOQUIMA CALDERA COMPLEX, CENTRAL NEVADA

David R. Boden

1992

Scale 1:48,000

0 1 2 3 KILOMETERS

0 1000 2000 3000 METERS

0 1 2 MILES

0 2000 4000 6000 8000 10,000 FEET

CONTOUR INTERVAL IS 10, 20, OR 40 FEET
DATUM IS MEAN SEA LEVEL

Contact Dashed where approximately located, queried where uncertain or speculative, dotted where buried or inferred, and alternating long and short dashed where gradational.

Fault showing dip and lineation Dashed where approximately located, queried where uncertain, and dotted where buried or inferred. Ball on downdropped side. Lineations, where present, are defined by slickenslides or axes of mullions.

Caldera wall unconformity Broken where approximately located and queried where uncertain.

Caldera-bounding fault Solid bars on downdropped side of cauldron block. Solid ball, where present, denotes downdropped side and referenced to late Tertiary-Quaternary basin-range faulting.

Slump block Broken where approximately located.

Welding breaks

Vein showing dip Broken where approximately located.

Unit query convention Where query precedes map symbol, the unit was not examined in the field, but inferred based on neighboring examined field relations and/or aerial photo interpretation. Where query follows map symbol, the unit was not examined in the field, but stratigraphic affiliation remains uncertain because of limited exposure and/or alteration.

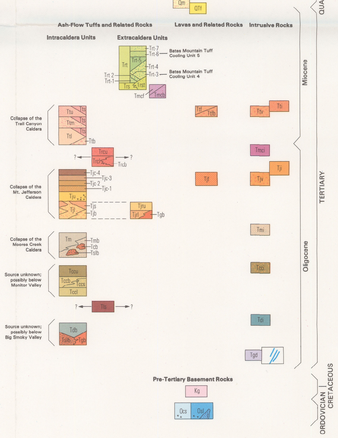
Sample locality of K-Ar determination See table 1 in accompanying text for listing of K-Ar ages and analytical data.

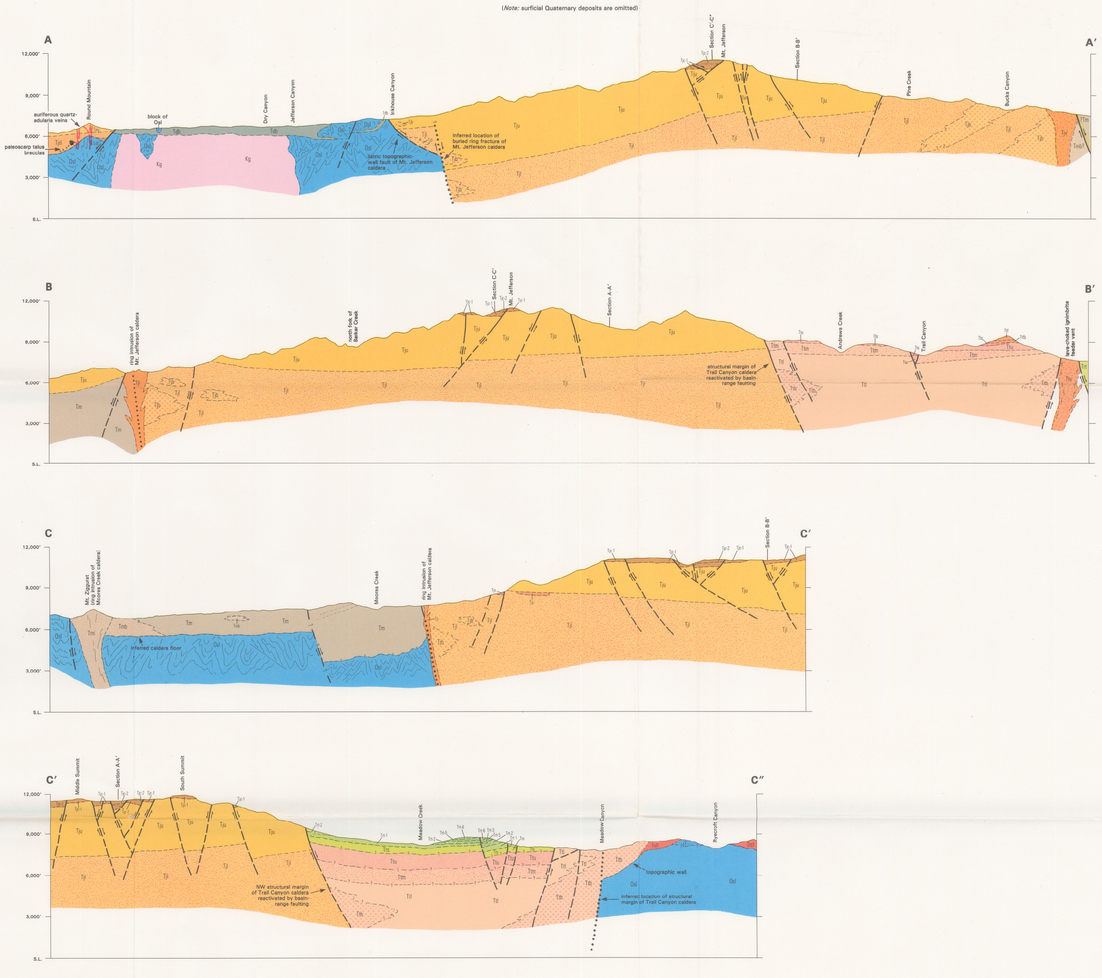
Strike and dip of beds
- Inclined
- Horizontal or within 5° of horizontal
- Vertical

Strike and dip of compaction foliation
- Inclined
- Inclined with lineation defined by stretched pumice lenses oriented parallel to dip
- Horizontal
- Inclined with lineation defined by stretched pumice lenses oriented obliquely to dip direction
- Vertical

Strike and dip of flow layering
- Inclined
- Vertical
- Horizontal
- Undulatory

Joints
- Inclined
- Vertical
- Horizontal





Surficial Deposits

Qd **Quaternary deposits undivided.** Includes alluvium, colluvium, scree, and pediment gravels.

Qls **Landslide and slump blocks.** Local semi-coherent blocks of rocks in Round Canyon area that have slid downhill from their in place outcrop positions.

Qm **Glacial morainal deposits.** Includes both lateral and terminal moraines located in the headwaters of drainages on the north and east sides of Mt. Jefferson. Deposits are poorly sorted, unconsolidated, and characterized by hummocky topography.

Qfl **Fanglomerates.** Crudely stratified and indurated deposits mantling bedrock at Jefferson Summit and vicinity. Unit contains cobble- to boulder-size clasts of granitic rock of Shoshone Mountain along with sparse clasts of Paleozoic hornfels.

Tuffs and Sedimentary Rocks of Road Canyon

Tst **Tuffs of Road Canyon.** A sequence of as many as seven separate mappable units of ash-flow tuff. Abrupt, nonsystematic changes in mineralogy and local unconformities indicate that the units probably came from disparate source areas. All units, however, were emplaced between 23.6 and 22 Ma. The sequence takes its name from prominent exposures in Road Canyon in the northeast part of the map. Composite maximum thickness is approximately 300 m.

Tst2 **Member seven.** Grayish-brown, very densely welded, crystal-rich, amphibole-bearing biotite rhyodacitic tuff. Rock has streaky appearance in outcrop due to the strongly collapsed nature of flamme. Unit weathers into lobate, spheroidal outcrops. 0-20 m thick.

Tst6 **Member six.** Purplish-red to gray, moderately to densely welded, in part vapor-phase altered, pumiceous, biotite rhyolitic tuff. Contains 7-10% crystals of plagioclase, sanidine, smoky quartz, and biotite. Characteristic features include sugary-textured, pastel-colored flamme and distinct dark smoky quartz phenocrysts. 0-30 m thick. Unit appears correlative to cooling unit 5 of the Bates Mountain Tuff (Sargent and McKee, 1969), which was renamed the tuff of Clipper Gap by Gromme and others (1972). K-Ar age 22.1 ± 0.3 Ma (Boden, 1988).

Tst5 **Member five.** Brownish-gray to burnt orange, lightly to densely welded, moderately crystal-rich, rhyolitic pumice lapilli tuff. Contains 10-20% crystals of plagioclase, sanidine, quartz, and biotite. Freshly broken surfaces commonly have an opalescent sheen. A distinctive feature of the unit is the occurrence of multiple flamme types: (a) a black, porphyritic, perlitic type (a remnant of the rheomorph), (b) a pale-pink, crystal-poor variety; and (c) a mixed banded type characterized by alternating layers of (a) and (b). 0-60 m thick.

Tst4 **Member four.** Whitish, lightly welded, crystal-poor, biotite-bearing rhyolitic tuff. Contains <5-8% crystals of sanidine, plagioclase, quartz, and biotite. Forms lobate to hoodoo-like outcrops. Tuff is locally punctuated by discontinuous horizons of pebble conglomerate and tuffaceous sandstone. 0-60 m thick.

Tst3 **Member three.** Brick-red, pumiceous, densely welded, crystal-poor, trachytic(?) tuff. Contains <3% crystals consisting pre-dominantly of "glassy" sanidine. Little or no quartz, plagioclase, and mafic minerals present. Highly compressed, sugary-textured, pastel-colored flamme are a characteristic feature. Locally, unit has very irregular lateral distribution. 0-25 m thick. This unit appears correlative to cooling unit 4 of the Bates Mountain Tuff as described by Sargent and McKee (1969).

Tst2 **Member two** ("tuff of Pipe Organ Spring"). Light-tan, moderately to densely welded biotite-bearing rhyolitic tuff. Crystal content increases upward from 5-8% at base to 25-30% at top. Crystals consist of plagioclase, sanidine, quartz, and biotite. Biotite is a conspicuous phase throughout. In upper Meadow Canyon unit weathers into distinct teepee-shaped outcrops (footcrib). 0-75 m thick. K-Ar age 23.6 ± 0.4 Ma (Boden, 1988).

Tst1 **Member one.** Dark-gray to ochre-buff, crystal-poor, moderately to densely welded, amphibole-bearing dacitic tuff. Locally consists of lower and upper units separated by tuffaceous sandstones and conglomerates. Lower unit contains 5-8% crystals of plagioclase, sanidine, plus minor quartz and biotite, whereas the upper unit contains 12-16% crystals of plagioclase, amphibole, biotite, and quartz. Lower unit commonly at least two pumice types. Combined thickness 0-25 m.

Tsu **Tuffaceous sedimentary rocks.** Includes laminated to thinly bedded tuffaceous siltstone to crudely bedded cobble conglomerate. Locally contains interbedded layers of poorly welded, light-colored, crystal-lithic ash-flow tuff. 0-100 m thick.

Tsl **Tuff and local sedimentary rocks.** Consists mainly of poorly to moderately welded, light-colored, biotite-bearing rhyolitic tuff. Tuff locally contains intertonguing lenses of fine- to coarse-grained tuffaceous sedimentary rocks and airfall tuffs. 0-150 m thick.

Younger Rocks of Meadow Canyon

Trct **Tuffaceous fanglomerate and breccia.** Chaotic and heterolithic debris breccia and conglomerate containing abundant clasts of porphyritic rhyolite, welded tuff, and Paleozoic sedimentary rocks. Crudely developed stratification occurs locally. 0-75 m thick.

Trb **Tuff breccia.** Light-colored, poorly welded, crystal-lithic tuff containing blocks (<1 m across) of grayish-white, quartz-rich tuff. Blocks of tuff are distinguished by black (perlitic) flamme which are not evident in host tuff. Unit may be a less devitrified equivalent of the monolithic tuff breccia exposed at the mouth of Meadow Canyon (Trcb). Maximum exposed thickness approximately 75 m.

Rocks of the Trail Canyon Caldera

Intrusive Rocks

Tti **Intrusive plugs.** Massive to flow-layered, sparsely to strongly porphyritic, small to medium-size plugs intruded along the southeastern margin of the Trail Canyon caldera. More porphyritic varieties contain 35-40% crystals of plagioclase, sanidine, quartz, biotite, and tabular amphibole. The prominent tooth-shaped peak just north of Corcoran Canyon is concentrically zoned from a sparsely porphyritic rhyolitic margin to a crystal-rich rhyodacitic core. K-Ar age 21.7 ± 0.4 Ma (Boden, 1988).

Tsp **Ash-flow-tuff vent.** Porphyritic, flow-layered and folded, amphibole- and biotite-bearing rhyodacite bordered by steeply dipping, stretched pumice lapilli tuff. Contact relations between intrusive rock and welded rheomorphic fragments rocks are transitional and intragradational. Vent locally contains blocks (septa) of wall rocks.

Post-Collapse Lavas and Flow Breccias

Tlp **Porphyritic lava.** Single flow, approximately 120 m thick, capping prominent knob between lower Waterfall and Trail Canyons near the eastern margin of the Trail Canyon caldera. The lava contains 30-35% medium- to locally coarse-grained phenocrysts of plagioclase, sanidine, quartz, biotite, and minor, but conspicuous, amphibole. Lava is modally similar to underlying upper member of tuff of Trail Canyon. Flow probably erupted from vent (Tlv) near mouth of Waterfall Canyon.

Tlb **Flow breccia.** Monolithic, framework-supported breccia containing angular clasts of porphyritic lava. 0-50 m thick.

Tuff of Trail Canyon

Unit consists of four mappable members: upper, middle, lower, and tuffaceous sandstone. Lower member is a complex breccia having an aggregate exposed thickness of approximately 1,000 m. Discontinuous horizons of tuffaceous sedimentary rocks locally occur between members and indicate that the tuff of Trail Canyon is the product of several eruptive pulses. Despite the pulsatory nature of emplacement, K-Ar ages for the lower, upper, and megabreccia members are analytically indistinguishable having a weighted mean age of 23.6 ± 0.4 Ma (Boden, 1988).

Tsu **Tuffaceous sedimentary rocks.** Discontinuous layers of tuffaceous sandstones and pebbly conglomerates which locally occur between members of the tuff of Trail Canyon. In any one occurrence, thickness of sedimentary unit is generally <5-8 m; lateral extents are generally <1 km and commonly <100 m.

Tsu **Upper member.** Purplish-brown to light-tan, moderately to densely welded, crystal-rich, amphibole-bearing biotite rhyolitic tuff. Contains 35-40% crystals of plagioclase, sanidine, quartz, biotite, amphibole, and minor pyroxene. Distinctive characteristics include: (a) locally coarse-grained crystals (3-6 mm), conspicuous tabular amphibole, and abundant quartz (8-10%). Maximum exposed thickness approximately 300 m. K-Ar age 23.6 ± 0.4 Ma (Boden, 1988).

Tsm **Middle member.** A compositionally zoned tuff grading from a crystal-poor, biotite-bearing rhyolite at the base to a crystal-rich, amphibole and clinopyroxene rhyodacite at its top. Contrasted to prior by discontinuous, grayish-black vitrophyric zones. Maximum exposed thickness is approximately 160-170 m.

Tsl **Lower member.** Light-tan to red-dish-gray-brown, moderately to densely welded, pumiceous, rhyodacitic tuff. Contains 10-15% fine- to medium-grained phenocrysts of plagioclase, sanidine, quartz, and biotite. Light-colored, sparsely porphyritic pumice is conspicuous on foliation surfaces. Maximum exposed thickness 300 m. K-Ar age 23.5 ± 0.4 Ma (Boden, 1988).

Tsb **Megabreccia member.** Moderately to locally densely welded pumiceous tuff breccia containing small (<10 cm) to large (>10 m) blocks of welded tuff and less abundant Paleozoic sedimentary rocks. Clasts are generally matrix supported. Tuff matrix weathers preferentially and forms subdued outcrops and subcrops between more boldly outcropping blocks. Blocks are commonly autobrecciated and monolithic suggesting brecciation occurred prior to incorporation into the tuff. Unit extends from central Meadow Canyon to central Corcoran Canyon and has a maximum exposed thickness of approximately 250 m.

Older Rocks of Meadow Canyon

Tlb **Intrusive plugs.** Porphyritic, flow-layered rhyolitic plugs containing 15-20% medium- to coarse-grained phenocrysts of sanidine, quartz, plagioclase, and biotite. Groundmass is aphanitic and locally vesicular. Plug closest to the mouth of Meadow Canyon has gradational contact relations with intruded tuff of Ryecroft Canyon (Trcl) suggesting a possible feeder relationship.

Tuff of Ryecroft Canyon

Mapped as consisting of lower, upper, and monolithic tuff breccia members. Aggregate thickness about 1,000 m.

Trcu **Upper member.** Light-tan, densely welded and locally rheomorphosed, crystal-quartz-rich rhyolitic tuff. Unit characterized by abundant (10-12%) dark smoky quartz commonly showing pyramidal terminations. Maximum thickness 120-140 m. K-Ar age 25.0 ± 0.5 Ma (Boden, 1988).

Trcl **Lower member.** Purplish-brown, densely welded, crystal-rich, biotite-bearing rhyodacitic tuff. Containing 30-35% phenocrysts of plagioclase, sanidine, quartz, biotite, and minor amphibole. Quartz is much less abundant and mafic minerals more abundant than in upper member. Contact between lower and upper members is not exposed. Near contact with Paleozoic sedimentary rocks, flamme are stretched parallel to dip suggesting minor secondary flowage after deposition. Maximum thickness approximately 750 m.

Trcb **Monolithic tuff breccia.** Forms bold castellated outcrops at mouth of Meadow Canyon and contains clasts (<5 m across) of lower member. Clasts are generally supported in a structureless matrix that appears derived by abrasion of the clasts during deposition. Maximum exposed thickness 75 m.

Rocks of the Mt. Jefferson Caldera

Intrusive Rocks

Tji **Porphyritic to aphanitic plugs.** Local flow-layered to massive, porphyritic to nearly aphyric plugs intruded along or near ring fracture of the Mt. Jefferson caldera. Plugs along southwest margin are generally characterized by more silicic mineral assemblage than intruded tuff. Phenocryst content ranges from <1 to 30%. Plagioclase, sanidine, quartz, biotite, and minor amphibole comprise principal phenocrysts. Y-shaped plug north of Barker Creek has a weighted mean K-Ar age of 24.5 ± 0.5 Ma (Boden, 1988).

Tjv **Ash-flow-tuff feeder vents.** Intrusive plugs characterized by gradational contacts with intruded tuff. Some vents consist of flow-layered porphyritic lava compositionally similar to or more mafic than surrounding tuff. Margins of vents are a complex mixture of fragmental rocks and stretched clots of lava. Vents occur at lower Willow Creek, Barker Creek, and possibly near mouth of Pine Creek.

Tjl **Lava.** Purplish-brown, flow-layered, porphyritic lava which issued from vent in lower Willow Creek. Flow is modally similar to underlying ash-flow tuff of Mt. Jefferson but distinguished by conspicuous flow layering and generally unbroken phenocrysts. 25-30 m thick.

Tuff of Mt. Jefferson

Compositionally zoned ash-flow tuff consisting of lower, upper, and capping intracaldera members and an outflow Round Mountain member correlative to the intracaldera member. Discontinuous tongues of caldera-collapse breccia occur within the lower member and tuffaceous sedimentary rocks locally intervene between the lower and upper members. The upper member is capped by a series of thin cooling units and tuffaceous sedimentary rocks exposed in grabens atop Mt. Jefferson. Combined thickness of intracaldera tuff is >2 km and the outflow Round Mountain ranges from 0 to 500 m thick at the Round Mountain mine.

Tjcp **Capping member, unit four.** A heterogeneous sequence of fine- to medium-grained tuffaceous sedimentary rocks (both fluviatile and lacustrine deposits), crudely stratified, loosely consolidated whitish airfall tuff, and pumiceous, lithic-rich rhyolitic ash-flow tuff. Unit as a whole forms poor outcrops and is exposed mainly as float and rubbly subcrops. Maximum thickness approximately 30 m. K-Ar age of interstratified tuff 25.8 ± 0.5 Ma (Boden, 1988).

Tjc-3 **Capping member, unit three.** Simple cooling unit consisting of moderately welded pumiceous, moderately crystal-rich, amphibole-bearing biotite rhyolitic ash-flow tuff. Contains 20-25% oxidized porphyritic flamme <5 cm long and 25% crystals of plagioclase, sanidine, smoky quartz, and minor amphibole. Unit grades down into a poorly exposed lightly welded zone. Maximum thickness 40 m.

Tjc-2 **Capping member, unit two.** Compound cooling unit consisting of lower grayish-white, lightly to moderately welded, smoky quartz-rich, amphibole-bearing biotite rhyolitic ash-flow tuff and upper gray to tan, densely welded, crystal-rich, amphibole-biotite rhyodacitic pumice lapilli tuff. Upper part contains at least two populations of flamme in outcrop: (a) abundant, large (as much as 25-35 cm long), gray to black, porphyritic flamme; and (b) less conspicuous, small (typically <5 cm long), pinkish-white, sparsely porphyritic flamme. Total maximum thickness 45 m.

Tjc-1 **Capping member, unit one.** Boldly outcropping compound cooling unit consisting of densely welded, crystal-rich, amphibole-bearing biotite rhyodacitic coarse pumice lapilli tuff. Similar to capping member unit two, coarse porphyritic collapsed bombs of dacite (as much as 30 cm across) are a conspicuous component. Unit grades down to recessive, lightly welded, crystal-poor rhyolitic ash-flow tuff at its base. Middle of unit is locally punctuated by a welding reversal and recurrence of less crystal-rich, more silicic tuff (lacking large, porphyritic dacitic flamme) lithologically similar to the base of the unit. Central less welded tuff in turn grades upward to crystal-rich, densely welded coarse pumice lapilli tuff. Maximum total thickness 60 m. K-Ar age 26.5 ± 0.5 Ma (Boden, 1988).

Tjc **Upper member.** Boldly outcropping, gray to purplish brown, densely welded, crystal-rich, amphibole- and biotite-bearing rhyolitic to rhyodacitic ash-flow tuff. Compositionally zoned with crystal-, plagioclase-, and mafic mineral contents increasing upwards. Clinopyroxene is absent in the lower part and present in the upper part. Interfingering landslide breccia zones occur locally in lower part of member in Jefferson Canyon. Maximum thickness 1,000 m. Weighted mean K-Ar age of 26.3 ± 0.6 Ma (Boden, 1988).

Tjs **Tuffaceous sedimentary rocks.** Local interfingering horizons of tuffaceous sandstones, conglomerates, and breccias in the upper part of lower member. Interlayered ash-flow-tuff and sedimentary layers are characterized by complex depositional contacts including slump folding, flame structures, and interpenetrating dikes of tuff and sedimentary rocks. Sedimentary layers generally <10 m thick and pinch out laterally.

Tjl **Lower member.** Light-tan to reddish-brown where oxidized, lightly to moderately welded, biotite-bearing rhyolitic ash-flow tuff. Unlike the upper member, the lower member forms subdued exposures on rounded, featureless hills. Crystal content increases upward from 15% to 30%—the assemblage consisting of plagioclase, sanidine, quartz, and biotite. Plagioclase and biotite increase upward and amphibole occurs near the top. Maximum exposed thickness 1,300 m. K-Ar age 26.3 ± 1.0 Ma (Boden, 1988).

Tjb **Megabreccia member.** Discontinuous tongues of chaotic masses of large clasts of precaldera rocks in lightly to moderately welded ash-flow-tuff matrix of the lower member. Breccia clasts are most abundant and largest (as much as several tens of meters across) in lower Pine Creek. Many clasts are internally brecciated.

Outflow Round Mountain Member

Tjru **Upper Round Mountain member.** Densely welded, purplish-brown (unaltered), crystal-rich, biotite-bearing rhyolitic ash-flow tuff. Contains 35-40% crystals of plagioclase, sanidine, quartz, biotite, and minor amphibole. Prior to mining unit graded upward to lightly welded tuff and overlying tuffaceous sedimentary rocks. 0-200 m thick. Weighted mean K-Ar age 26.7 ± 0.6 Ma (Boden, 1988).

Tjrl **Lower Round Mountain member.** Off-white, lightly welded, crystal-poor, biotite-bearing rhyolitic ash-flow tuff. Contains 5-15% crystals (increasing upwards) of sanidine, plagioclase, quartz, and biotite. Abundant dime-size, ovoid, aphyric pumice fragments are characteristic. Base of unit contains local lithic-rich landslide or talus deposits. Clasts in basal lithic-rich zones are generally <1 m across and consist of Paleozoic sedimentary rocks or granitic rocks (see description of Kgb below). 0-300 m thick.

Breccia Deposits

Tbl **Granitic breccia.** Framework- to locally matrix-supported breccia consisting of granitic clasts. Matrix of breccia is generally recessive and consists of tuff affiliated with either the Round Mountain member or megabreccia of Dry Canyon (see Tdb below). In the former, clasts are generally <1 m across, whereas in the latter, clasts are as much as several meters across.

Tbsh **Shale and limestone breccia.** Strongly brecciated shale and limestone (and their metamorphosed equivalents) containing local salvages, dikes, and matrix of ash-flow tuff related to either the tuff of Moores Creek (see Tm below) or to the megabreccia of Dry Canyon (Tdb). This unit occurs as either disrupted caldera floor or as relatively homolithic lenses of caldera-collapse breccia. Where symbol is enclosed by parentheses, the unit is interpreted as large blocks enclosed in tuff rather than rooted brecciated basement rocks. Unit occurs in area of roof pendant with exposed thickness <30 m.

Tbch **Chert breccia.** Similar mode of occurrence as Ordb, but rock consists of dark chert. Unit forms shattered and brecciated wall rocks along northeast side of Moores Creek caldera or large autobrecciated clasts, as denoted by parentheses about map symbol, in tuff of Moores Creek. Intensely brecciated nature of blocks or wall rocks suggests formation in vicinity of structural margin of Moores Creek caldera.

Rocks of the Moores Creek Caldera

Tm **Porphyritic plug.** Prominent intrusion of flow-layered porphyritic rhyolite exposed at Mt. Ziggurat along the northern margin of the caldera. Contains 10-15% phenocrysts of sanidine, quartz, plagioclase, and biotite. Some sanidine crystals are as much as 2 cm long. Groundmass is aphanitic to vesicular and ovoid lithophysal cavities are locally well expressed. K-Ar age 26.5 ± 0.7 Ma (Boden, 1988).

Tm **Tuff of Moores Creek.** Light-tan to grayish, moderately to densely welded, crystal-rich, biotite rhyolitic ash-flow and pumice-lapilli tuff. Contains 20-25% crystals of sanidine, quartz, plagioclase, and biotite. Phenocryst content and proportions change little with stratigraphic height. Units is characterized by conspicuous, light-colored, porphyritic flamme as much as 30 cm long locally. Maximum exposed thickness 800 m. Weighted mean K-Ar age 27.2 ± 0.6 Ma (Boden, 1988).

Tmb **Lithic-rich and megabreccia member.** Lightly to moderately welded, lithic-rich tuff breccia and coarse collapse breccia. Clasts consist predominately of Paleozoic sedimentary rocks but also include porphyritic volcanic rocks. Some of the clasts are sufficiently large to be mapped separately (see Tdb and Tob above). The abundance and size of clasts increase toward margin of the Moores Creek caldera. Near mouth of Pine Creek, unit contains local exotic megablocks of welded tuff.

Pre-Toquima Ash-Flow Tuffs and Related Rocks

Corcoran Canyon Assemblage

A heterogeneous assemblage of welded ash-flow tuff, tuffaceous sedimentary rocks, lithic-lapilli tuff and tuff breccia, and porphyritic plugs.

Tcp **Porphyritic plugs.** A series of three porphyritic, flow-layered, biotite-bearing rhyolitic plugs intruded along a major ENE-trending fault. The plugs contain 10-20% phenocrysts of sanidine, plagioclase, quartz, and biotite. All plugs affected by variable degrees of quartz-sericite alteration in which plagioclase is altered to punky clay and biotite to silvery sericite. Anastomosing fine-grained breccia veinlets of silica and ilmonite are common and most strongly pronounced in the southwestern-most intrusion. Northeasternmost plug has gradational contacts with the intruded tuff of Corcoran Canyon suggesting a possible feeder relationship.

Tcu **Upper tuff of Corcoran Canyon.** Dark grayish-brown, densely welded, amphibole-bearing, biotite-rich dacitic ash-flow tuff. Contains 35-40% plagioclase, biotite, sanidine, quartz, and chlorite-altered amphibole. Biotite flakes, as much as 5-6 mm across, are a distinctive feature of the unit. Commonly occurs as clasts in megabreccia member of the tuff of Trail Canyon. Maximum exposed thickness 200 m. K-Ar age 27.7 ± 0.7 Ma (Boden, 1988).

Tcb **Monolithic agglomerate and tuff breccia.** Lithic-rich facies of upper member containing subrounded to subangular clasts of flamme-rich lower tuff of Corcoran Canyon (Tcrl) in a welded biotite-rich, welded tuff matrix. Clasts are generally <1 m across. Maximum exposed thickness 75 m.

Tcss **Tuffaceous sedimentary rocks.** Finely laminated to medium-bedded, tuffaceous siltstone and sandstone which coarsen upward to tuffaceous conglomerate and pebbly sandstone, reworked(?), lightly welded, biotite-bearing ash-flow tuff. Conglomerate contains clasts resembling lower tuff of Corcoran Canyon. Sequence variably affected by hydrothermal alteration including silicification and formation of clay, sericite, and limonite. Maximum exposed thickness 300 m.

Tcl **Lower tuff of Corcoran Canyon.** Light-gray to tan, moderately to densely welded, crystal-rich, biotite-bearing rhyolitic pumice-lapilli tuff. Gray-white, porphyritic flamme, as low Canyon unit, is a distinctive feature of the unit. Contains 18-20% crystals of plagioclase, sanidine, quartz, and biotite. Locally, unit is strongly brecciated, silicified, and mineralized. Maximum exposed thickness 2,000 m. (Thickness may be exaggerated due to repetition of section by unrecognized intraformational faults.) Triangular symbols denote isolated zones of silicified breccia. Where map symbol enclosed by parentheses denotes uncertainty as to whether exposure is a large rootless megablock or an inplace erosional window.

Tcrl **Tuff of Lupin Spring.** Gray to purplish-brown, densely welded, crystal-rich, biotite rhyodacitic ash-flow tuff. Contains 25-30% crystals of plagioclase sanidine, quartz, biotite, and minor fresh to altered amphibole and pyroxene. Basal vitrophyre characterized by abundant shiny biotite. Unit forms, in part, wall of the Moores Creek caldera and possibly occurs as very large blocks (several hundred meters across) in tuff of Moores Creek. Source of unit is unclear, but probably represents an outflow from unrecognized or concealed caldera. Maximum exposed thickness 100 m. K-Ar age 28.8 ± 0.6 Ma (Boden, 1986). Where symbol enclosed by parentheses denotes uncertainty as to whether exposure is in place or detached megablock.

Southwestern Area

Tp **Porphyritic plugs.** Light-tan to gray, sparsely porphyritic, massive to locally flow-layered dacitic(?) plugs. Contains 5-15% phenocrysts of quartz and altered lath-shaped minerals that were probably feldspar; no mafic minerals preserved. Margin of plug has transitional intrusive and fragmental textures characterized by scattered lithics and alternating flow layers and stretched pumice(?) fragments. Crystals are smaller and more commonly broken along margin than in core of the intrusions.

Tgb **Megabreccia tuff of Dry Canyon.** Tan to gray-black (where vitrophyric), crystal-lithic, biotite-bearing, densely welded ash-flow tuff. Contains 20-25% crystals of sanidine, quartz, plagioclase, and biotite. Phenocryst content and proportions change little with stratigraphic height. Units is characterized by conspicuous, light-colored, porphyritic flamme as much as 30 cm long locally. Maximum exposed thickness 800 m. Weighted mean K-Ar age 27.2 ± 0.6 Ma (Boden, 1988).

Tmb **Lithic-rich and megabreccia member.** Lightly to moderately welded, lithic-rich tuff breccia and coarse collapse breccia. Clasts consist predominately of Paleozoic sedimentary rocks but also include porphyritic volcanic rocks. Some of the clasts are sufficiently large to be mapped separately (see Tdb and Tob above). The abundance and size of clasts increase toward margin of the Moores Creek caldera. Near mouth of Pine Creek, unit contains local exotic megablocks of welded tuff.

Pre-Ash-Flow Tuff Intrusive Rocks

Dike swarm. Northeast-trending dike swarm characterized by an anastomosing system of rhyolitic and andesitic to dacitic dikes. Dikes are generally 1-5 m wide, but some are several tens of meters wide. Rhyolitic dikes vary from sparsely porphyritic and flow-layered to porphyro-aphanitic and massive. Rhyolitic dikes contain 2-20% quartz, feldspar, and biotite. Andesitic and dacitic dikes are dark greenish-gray, porphyro-aphanitic, and contain 10-20% phenocrysts of plagioclase, amphibole, biotite, augite, and local rounded quartz. Unlike the rhyolitic dikes, which have undergone quartz-sericite-pyrite and local tourmaline alteration, the andesitic-dacitic dikes are relatively unaltered. Field relations indicate that the andesitic dikes postdate the rhyolitic dikes. A portion of the mapped dike swarm was compiled from Shawe (1981). K-Ar and fission track ages on the dikes range from 37 to 34 Ma (Shawe and others, 1986).

Tgd **Granodiorite stock.** Fine- to medium-grained, hypidiomorphic-granular, amphibole-bearing, biotite granodiorite. Stock intruded along the northwest margin of the Cretaceous granite of Shoshone Mountain (see Kg below). Rock contains 60% plagioclase, 20% alkali feldspar, 10% biotite, 5% amphibole, and 5% quartz. Sphene is a characteristic accessory phase. Intrusion locally weathers into subdued, lobate to spheroidal outcrops. In better exposures, a prominent northeast-trending joint set is developed. Stock is locally cut by northeast-trending quartz veins having 1- to 2-cm-wide halos of alkali feldspar. Granodiorite cuts off rhyolitic dikes, but is in turn cut by the andesitic dikes. Fission track age of 37-36 Ma (Shawe and others, 1986).

Pre-Tertiary Basement Rocks

Kg **Granitic rock.** Medium- to coarse-grained, hypidiomorphic-granular granite to adamellite pluton. Contains 30-40% quartz, 40-50% plagioclase and alkali feldspar, 10-15% biotite, 0-5% muscovite, and accessory zircon, sphene, and garnet. A pronounced northeast-trending mineral foliation is developed along the northwestern margin of pluton east of Round Mountain. K-Ar ages on muscovite and biotite range from 83 to 75 Ma (Shawe and others, 1986).

Shale and limestone. Interbedded shale and limestone and their metamorphosed equivalents including phyllite, knotty schist, marble, and local calc-silicates. Sequence is complexly folded and faulted; limestone beds are often characterized by contorted folding and clastic beds are typically isoclinally folded. Triangular symbols denote local areas of silicified breccia. The symbol j denotes local irregular zones of cryptocrystalline to granular, dark-gray to light-tan, commonly brecciated silicified rock in limestone. Where field relations are lacking, determining whether the rock is a silicified recrystallized limestone or a metamorphosed quartzite whose detrital grains are all recrystallized is difficult.

Ordc **Chert and shale.** Crops out mainly in the northern part of the map, where it forms the wall rock of the Moores Creek caldera. The chert is typically dark gray and commonly brecciated in vicinity of the caldera. Elsewhere the chert is complexly folded. Unit is believed correlative to the Vinini Formation as exposed further north in the Range (McKee, 1976). Solid triangles denote local areas of strongly brecciated rock.

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