Description of Map Units

Nevada Bureau of Mines and Geology

Map 148

GEOLOGIC MAP OF THE DOGSKIN MOUNTAIN QUADRANGLE

WASHOE COUNTY, NEVADA

by

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Qa Active alluvium Alluvium in recently to annually active washes consisting of cobble-pebble gravels and sands, with boulders in proximal reaches. The alluvium occupies channels inset up to 2 m into fan or terrace surfaces. Clasts are generally subrounded to rounded, but subangular clasts are locally common. The main channel that crosses Winnemucca Ranch Road contains pebbly sands with anastomosing braided bars and swales. These deposits are typically 0.5 to more than 3 m thick.

Qaf Fine-grained alluvium (Holocene and late Pleistocene) Unconsolidated silt and very fine sand deposited in a shallow basin formed adjacent to a strand of the Warm Springs Valley fault in Winnemucca Valley.

STREAM CHANNEL DEPOSITS OF WINNEMUCCA VALLEY

Qt_1 Alluvial terrace deposits (late and middle Holocene) Cobbly and pebbly coarse to medium sands, mostly poorly sorted and matrix supported, but locally clast supported; intercalated with well-sorted, medium-grained sand deposits up to 10 cm thick. Clasts are generally subrounded to rounded, with scattered subangular clasts. In Winnemucca Valley, sands and small pebbles are mostly granitic rocks, whereas larger clasts are mostly volcanic rocks. In Dry Valley, clasts are mostly volcanic rocks. Surface is generally smooth with an eolian silt cap as much as a few centimeters thick, but broad, subdued bar and swale topography typically exists. Soils are typically absent or show a weak cambic horizon. Where spring discharge creates a meadow environment on the surface, moderately well developed mollic epipedons exist. Deposits unconformably overlie Qt_2 deposits and are typically 0.60 m thick or less.

Qt_2 Alluvial terrace deposits (earliest Holocene and latest Pleistocene). Pebbly coarse sands, fine sands, and white to pale-brown diatomaceous earth. Some pebble gravels and isolated boulders are also present. Bedding is thin, parallel, wavy with some cross-beds; diatomaceous earth is a thick-bedded unit with parallel, cross-bedded, and convolute sedimentary structures, and some minor very thin beds intercalated with overlying sands. Clasts are well to poorly sorted and subangular to subrounded. In Winnemucca Valley sands are up to 99% derived from granitic rocks, whereas pebbles are mostly volcanic rocks. In Dry Valley, clasts are volcanic. Some iron staining occurs locally in coarser sands, and incorporated twigs are replaced by hematite. Surface is smooth, relatively flat, and locally moderately dissected. Soils range from cambics and weak argillic B horizons to mollic epipedons where the surface is wet from springs and meadow environments. Deposits are as much as 4 m thick.

Qc Undifferentiated Quaternary colluvium and talus Quaternary, small to large colluvial and talus deposits generally developed at the base of steep slopes of resistant Oligocene welded tuffs (e.g., Tnh) and Miocene basaltic andesite lavas (Tp...). Stone stripes are common on talus slopes. Deposits typically consist of poorly sorted, angular to subangular, clast-supported cobbles and boulders. Thickness is generally less than 3 m.

Qls Landslide deposits Coarse, unconsolidated debris composed of local bedrock, particularly basaltic andesite lava of the Pyramid sequence. Clasts range from silt sized to large blocks, as much as 15 m in diameter. Probably as much as 20 m thick. Original headwall scarp is commonly unrecognizable.

Qf, Qfb Undifferentiated Quaternary alluvial fan deposits Small- to medium-size fans that typically form along the base of steep slopes. Bouldery, cobbly, pebbly sand deposits are typically clast-supported and dominated by subangular to angular clasts. Clasts are derived from local sources and, thus, are almost all Tertiary volcanic rock; however, rare clasts of Cretaceous granite or Mesozoic metasedimentary rock occur in some deposits. Surfaces range from smooth to irregular and commonly have active parts. In some cases, well-developed argillic horizons are present, especially near the toe of the fans, but exposures of the deposits are not common. Thickness may locally exceed 20 m. **Qfb** deposits are mostly made up of basaltic andesite.

ALLUVIAL FANS AND OTHER DEPOSITS OF DOGSKIN MOUNTAIN

Qtd_1 Alluvial terrace deposits (late and middle Holocene) Younger alluvium entrenched into the western Dogskin Mountain piedmont. Cobbly, pebbly, coarse sands with isolated boulders in proximal parts; generally non-indurated, poorly to moderately stratified, moderately sorted, matrix-supported deposits with angular to subangular clasts that are mostly granitic. Surfaces commonly have depositional microtopography, including bars and swales, and broadly undulating and pock-marked surface morphology. Soil development ranges from absent to A/Bw/C profiles, where the cambic horizons are weakly developed and as much as 20 cm thick. Deposits are as much as 2 m thick.

Qdf Fine grained deposits (Holocene and late Pleistocene) Silty, very fine sand with some coarse sand grains. Well sorted deposit with mostly angular and subangular grains, but subrounded to well rounded coarse sand grains. Mostly derived from granitic rocks with possible additional eolian quartz and $CaCO_3$. Some parts are cemented with $CaCO_3$.

$Qfdy_1$, $Qfdy_{1b}$ Younger alluvial fan and megabreccia deposits (late and middle Holocene) Cobbly, pebbly, coarse sands with isolated boulders in proximal parts; generally non-indurated, poorly to moderately stratified, moderately sorted, matrix-supported deposits with angular to subangular clasts that are mostly granitic. Surfaces commonly have depositional microtopography, including bars and swales, and broadly undulating and pock-marked surface morphology. Soil development ranges from absent to A/Bw/C profiles, where the cambic horizons are weakly developed and as much as 20 cm thick. Deposits are as much as 3 m thick. **$Qfdy_{1b}$** are monolithic megabreccia deposits made up of subangular and subrounded granitic blocks up to 3 m in diameter; deposits are likely formed from rock and debris avalanches.

$Qfdy_2$, $Qfdy_{2b}$ Alluvial fan and megabreccia deposits (early Holocene and latest Pleistocene) Cobbly, pebbly, silty, coarse sands with isolated boulders in proximal parts; generally non-indurated to weakly indurated, poorly to moderately stratified, moderately sorted, matrix-supported deposits with angular to subangular clasts, that are mostly granitic. Surfaces are commonly smooth with poorly to moderately developed pavements and local

relict cobble or boulder gravel bars that have had the fines winnowed from them. Soil development ranges from A/Bw/C to A/Bt/Bk/C profiles with cambic or weak argillic horizons 20 to 50 cm thick. Calcic horizons (Bk) are absent to weakly developed (up to stage II $CaCO_3$ development). Deposits are as much as 4 m thick. **$Qfdy_{2b}$** are monolithic megabreccia deposits made up of subangular and subrounded granitic blocks up to 3 m in diameter; deposits are likely formed by rock and debris avalanches.

Qfdi Intermediate-age alluvial fan deposits (late and middle Pleistocene) Cobbly, pebbly, silty, coarse sands with isolated boulders in proximal parts; generally weakly to moderately indurated, poorly to moderately stratified, moderately sorted, matrix-supported deposits with angular to subangular clasts that are mostly granitic. Surfaces are smooth to slightly irregular, and are moderately to well dissected. Notable lack of cobbles on surfaces, even in proximal reaches, indicates they have been weathered and disintegrated. Soils are typically A/Bt/Bk/Cox/C profiles, where argillic horizons (Bt) are well developed, structured, and up to 50 cm thick, calcic horizons (Bk) are intermittent, but with up to stage III $CaCO_3$ development, and oxidized, iron-stained horizons (Cox) are up to 2 m thick. Deposits are up to 4 m thick.

Qfdo Alluvial fan of granite (middle and early Pleistocene) Cobbly, pebbly, silty, coarse sands with local boulders in proximal parts; generally weakly to moderately indurated, poorly to moderately stratified, moderately-sorted, matrix-supported deposits with angular to subangular clasts that are mostly granitic. Surfaces are smoothed to slightly irregular, and are moderately to well dissected. Soils are typically A/Bt/Bk/Cox/C profiles, where argillic horizons (Bt) are well developed, structured, and up to 50-cm-thick calcic horizons (Bk) are intermittent, but with up to stage III carbonate development, and oxidized, iron-stained horizons (Cox) are up to 1- to 2-m thick. The Av horizon is commonly absent due to the vertisolic nature of the argillic horizon. Deposits are as much as 4 m thick.

Qado Older/deformed fan deposits (late? and early Pleistocene) Coarse conglomerate forming low ridges along the Warm Springs fault zone at the toes of alluvial fans emanating from Dogskin Mountain. Clasts consist mostly of Cretaceous quartz monzodiorite (Kqmd) and Jurassic(?) metavolcanic rocks (Jmv) with lesser Oligocene ash-flow tuff. Matrix is not exposed but is inferred to consist of uncemented sand, silt, and fine gravel. Age of this unit is uncertain but may span early Pleistocene to Holocene. Unit Qado is equivalent to units Qfc and Qff, deformed alluvial fan deposits derived from the Virginia Mountains.

ALLUVIAL AND OTHER DEPOSITS OF THE VIRGINIA MOUNTAINS

Qs Spring deposits Fine silt and clay around and down slope from active springs in the northeast part of Winnemucca Valley. The fine material is probably largely eolian material trapped by groundwater discharge and associated grasses and brushy vegetation, but may include some material transported by surface spring waters. The deposits are variably calcareous and locally weakly stratified. Most springs appear to be along faults and form slight topographic highs, especially noticeable where springs are on Quaternary fans.

Qfy_1 Alluvial fan and stream terrace deposits (late and middle Holocene) Bouldery, cobbly, pebbly, coarse to fine sands. Deposits are non-indurated to weakly indurated, moderately stratified, poorly sorted, matrix- and clast-supported with angular to subangular clasts; some clasts are subrounded in distal parts of fans. Clasts are volcanic rocks, mostly felsic and mafic in composition. Surfaces commonly have bars and swales and include active distributive portions of fans. Soils are typically absent, but some A/C profiles exist where thin (<3 cm thick) eolian silts have been deposited on the surface. Deposits are commonly 0.5 to 1 m thick.

Qfy_2 Alluvial fan and stream terrace deposits (early Holocene and latest Pleistocene) Bouldery, cobbly, pebbly, coarse to fine sands. Deposits are non-indurated to weakly indurated, moderately stratified, poorly sorted, matrix- and clast-supported with angular to subangular clasts; some clasts are subrounded in distal parts of fans. Clasts are volcanic rocks. Surfaces are generally smooth with moderately well- to well-developed interlocking pavements. Clasts on surfaces are commonly iron-stained or covered with continuous, thin rock varnish. Soils typically have A/Bw/Bk/C profiles with eolian silt caps (A) up to 10 cm thick, cambic (Bw) horizons with some clay up to 30 cm thick, and discontinuous calcic horizons (Bk) with stage I carbonate development. Deposits are commonly 0.5 to 3 m thick.

Qp Ponded deposits Light-colored, silty, clayey, finely stratified sand with some alkaline salt crusts deposited in closed basins at the toe of the large alluvial fan along the east side of the quadrangle. The basins are located where the distal ends of fans pond against linear ridges produced by the Warm Springs Valley fault zone and apparently resulted from blockage of drainages by displacement along the fault zone. The fault has created a local high water table east of the fault and possibly blocks local drainages during earthquake events. Groundwater dischange traps eolian sediments in addition to distal fan sediments. The deposits appear to overlie or intercalate with Qfy_2 deposits and are locally overlain by Qfy_1 deposits. The ponded deposits are greater than 2 m thick.

Qfi Intermediate-age alluvial fan deposits (late and middle Pleistocene) Bouldery, cobbly, pebbly, coarse to fine sands. Deposits are non-indurated to weakly indurated, moderately stratified, poorly sorted, matrix- and clast-supported deposits with mostly angular to subangular clasts, and some subrounded clasts. Clasts are mostly volcanic rocks, with some granitic rocks near the central stream channel of Winnemucca Valley. Surfaces are generally eroded with moderately developed pavements, littered with weakly to moderately varnished cobbles and boulders. Soils typically have A/Bt/Bk/C profiles. Argillic horizons (Bt) are reddened, commonly well structured, and as much as 50 cm thick. Calcic horizons are discontinuous and variable, but locally have up to stage III carbonate development.

Qfo Alluvial fan deposits (middle? and early Pleistocene?) Bouldery, cobbly, pebbly coarse to fine sands. Similar to Qfi, but where the two deposits occur together Qfo caps a higher, older erosion surface approximately 5 m above Qfi. Qfo along the Warm Springs Valley fault zone in the northwestern part of the quadrangle is marked by a lag of Pyramid sequence boulders and is difficult to distinguish from units Tpc or QTa.

PLEISTOCENE (?) AND LATE PLIOCENE ALLUVIAL DEPOSITS

QTa Pleistocene and late Pliocene(?) alluvial deposits Coarse conglomerate consisting of a boulder lag composed mostly of Pyramid sequence rocks up to 2 m in diameter and minor clasts of ash-flow tuff and rhyolite up to 50 cm in diameter forms a series of ridges along the Warm Springs Valley fault zone. Matrix consists of very poorly indurated sand, silt, and fine gravel but is rarely exposed. A trench in unit QTa across one strand of the fault zone in the Tule Peak Quadrangle exposed weakly silica-cemented, pebbly sandstone and boulder conglomerate in a muddy matrix. Age is uncertain but younger than 3.58 Ma, the age of underlying unit QTk. The alluvial deposits are similar to, and probably are in part, Quaternary fan deposits, possibly older, deformed fan deposits related to the large alluvial fan complex along the east edge of the quadrangle. Pyramid sequence rocks and ash-flow tuff are exposed in The Cove, a large canyon just east of the quadrangle that is the headwaters for the fan complex. The Cove is a likely source for these clasts in both unit QTa and the fan complex.

QTaf Finer grained alluvial deposits Conglomerate similar to unit QTa but in which most clasts are less than 20 cm in diameter, and maximum clast size is about 40 cm. Matrix is better exposed than in unit QTa and consists of poorly indurated and poorly bedded, brown sandstone and mudstone containing scattered cobbles and boulders.

QTk Pleistocene(?) and late Pliocene sandstone Poorly exposed sandstone and pebble conglomerate crop out beneath late Pliocene (?) to Pleistocene alluvial deposits in one ridge along the Warm Springs fault. Pebbles are exclusively well-rounded Cretaceous quartz monzodiorite (Kqmd) up to 2 cm in diameter. Most exposures consist of a lag of granitic pebbles. A small quarry in similar deposits in the Tule Peak Quadrangle shows steeply southwest-dipping pebble conglomerate, sandstone, and tephra. The tephra gives an age of 3.58±0.45 Ma (plagioclase).

PYRAMID SEQUENCE

Tpc Conglomerate, sandstone, and breccia Massive to moderately well stratified, matrix supported, poorly to moderately sorted, pale brown to light gray pebble to boulder conglomerate, breccia, and sandstone occur throughout the Pyramid sequence. The conglomerate is complexly interbedded with Pyramid lavas and diatomite and, in areas of poor exposure, may include thin lavas or diatomite. Clasts are subangular to subrounded and mostly Pyramid lavas with rare ash-flow tuff or Cretaceous granitic rocks. Conglomerate commonly includes lenses of fine- to coarse-grained, pebbly sandstone; sand grains are subangular to subrounded and consist mainly of volcanic lithics and feldspar. The deposit is weakly to highly indurated and noncalcareous. Thicker, up to 10 m, more massive beds are generally unsorted and probably originated as debris flows. Finer deposits include planar bedded, more moderately sorted, matrix- to locally clast-supported conglomerate with clasts up to 25 cm in diameter interbedded with pebbly, planar to rarely cross-bedded, commonly ferruginous sandstone. Conglomerate of unit Tpc that fills a deep (100 m) channel cut into early parts of the Pyramid sequence is spectacularly well exposed in the Tule Peak Quadrangle immediately east of the Dogskin Mountain Quadrangle; similar channels probably occur in the Dogskin Mountain Quadrangle but are not as well exposed. Unit Tpc rock types indicate deposition as a fanglomerate derived from the Pyramid sequence.

Tpbi Basaltic andesite dike Two small, west-northwest-striking basaltic andesite dikes, probably equivalent to the finely porphyritic basaltic andesite lavas (Tpp′), crop out in the quadrangle. One dike, approximately 2 m wide and possibly 200 m long, cuts Cretaceous quartz monzondiorite (Kqmd) along the east face of Dogskin Mountain. Olivine is largely altered to iddingsite. Another dike, approximately 2 m wide and no more than 50 m long, cuts tuff of Chimney Spring (Tcs) and porphyritic dacite (Tdi) in the northwestern part of the quadrangle. The tuff of Chimney Spring is strongly baked along the contact; heating by the dike commonly converted tuff matrix to glass.

Tpp Porphyritic basaltic andesite lava Coarsely porphyritic flows distinguished by prominent, tabular plagioclase phenocrysts 5 to 20 mm long. Massive, resistant interiors make rounded, rubbly outcrops, whereas scoriaceous upper and lower breccias rarely crop out. Individual flows are mostly 10 to 30 m thick and can terminate abruptly, suggesting steep flow margins or that they locally filled paleovalleys. Flows generally occur as complexes of several flows totalling as much as 100 m thick. Matrix consists of plagioclase, olivine, clinopyroxene, opaques, and variably altered, interstitial glass.

Tpb′ Sparsely porphyritic basaltic andesite lava A variant of the basalt to basaltic andesite lavas (Tpb) that contains 3 to 8% large, tabular plagioclase phenocrysts. These flows commonly overlie basalt (Tpb) and underlie porphyritic basaltic andesite (Tpp) flows, which suggests the sparsely porphyritc basalts are transitional. They weather much like the aphyric basaltic lavas (Tpb).

Tpp′ Finely porphyritic basaltic andesite lava A variant of the porphyritic basaltic andesite lavas (Tpp) is characterized by abundant plagioclase phenocrysts less than 5 mm long and by abundant pyroxene phenocrysts up to 5 mm in diameter. Plagioclase varies from tabular to more equant. These lavas occur as individual flows about 20 m thick or as groups of flows totalling about 75 m thick.

Tpp″ Bimodal porphyritic basaltic andesite lava What is probably a single, thick flow in the northeastern part of the quadrangle is distinguished by a bimodal population of plagioclase phenocrysts, both large, tabular and small, more equant grains. The highly resistant flow is 20 to 40 m thick, holds up prominent ridges, and commonly weathers to 10 to 20 cm thick slabs.

Tpr Porphyritic rhyolite lava A horizon of probable breccia of coarsely porphyritic rhyolite lava crops out in Black Canyon at the northern edge of the quadrangle, where it is about 25 m thick. The "outcrop" is marked by abundant boulders of strongly flow-banded and commonly brecciated lava; similar but highly weathered rock is very poorly exposed beneath soil and talus. Most boulders are devitrified but a few are glassy. The rhyolites $^{40}Ar/^{39}Ar$ age, combined with the contradictory ages of Pyramid sequence, allows the rhyolite to be either in place or reworked.

Tpm Tuff of Mullen Pass Gray to dark gray, glassy to devitrified, dacitic ash-flow tuff with prominent dark gray, glassy, flattened pumice. The soft tuff is locally preserved in the lower part of the Pyramid sequence but was eroded or poorly exposed in most areas. The tuff is a single cooling unit, composed of several individual ash flows, that is mostly moderately welded. Maximum preserved thickness is about 10 m. The pumice is up to 40 cm long and 5 cm thick and makes up 10% to as much as 50% of the whole rock. Small (1cm) fragments of basaltic andesite (Tpb?) are common. Age:13.86±0.15 Ma, hornblende; C98-246; Sutcliffe Quadrangle (Faulds and others, 2003a; Garside and others, 2003). 13.93±0.15 Ma; plagioclase, KA1244, probably from this tuff (Swisher, 1992).

Tpb Basalt to basaltic andesite lava Aphyric to very finely and sparsely porphyritic basalt or basaltic andesite makes up numerous flows throughout the Pyramid sequence. Flow interiors, which make the most prominent outcrops, are typically black or dark gray, massive to platy and faintly flow banded. The platy foliation distinguishes aphyric from most porphyritic lavas, which generally make rounded, rubbly outcrops. Basal and upper breccias are generally scoriaceous and oxidized and rarely crop out. Individual flows are 10 to 30 m thick and appear to have greater lateral continuity than do porphyritic flows. Matrix consists of pilotaxitic, subophitic to intergranular plagioclase, pyroxene, olivine, and opaque minerals. Age: 13.62±0.12 Ma, matrix; H00-14, Tule Peak Quadrangle.

MISCELLANEOUS INTRUSIONS

Tdi Porphyritic dacite intrusions Two coarsely porphyritic dacite or andesite(?) intrusions cut ash-flow tuff in the northwestern part of the quadrangle. A dacitic dike crops out discontinuously over about 2.5 km, with a western, west-striking, steeply north-dipping segment approximately 1 km long and 5 to 100 m wide separated by a gap of ~300 m from an eastern, west-northwest-striking, steeply south-dipping segment that is about 1.5 km long and ~100 m wide. A dark gray, sparsely porphyritic andesite(?) sill as much as 15 m thick and about 500 m long intrudes platy tuffaceous rocks of unit Tts along the north canyon wall of Dry Valley Creek. The lack of basal breccia, presence of vesicles at both top and bottom contacts, and strong baking and compaction of both over- and underlying tuff demonstrates an intrusive origin. The coarse phenocryst assemblage, especially presence of quartz, suggests a relation to the rhyolite to dacite domes (Tri) in the Tule Peak Quadrangle. However, imprecise $^{40}Ar/^{39}Ar$ data allow an age of either 13 or 15

Ma, much younger than the rhyolites and probably related to the Pyramid sequence. The dated dike is cut by one of the basaltic andesite dikes, which suggests the 15 Ma date is more likely. Phenocrysts dacite (~20–25%): plagioclase (15–20%, 1–15 mm), biotite (1–4%, 1-5 mm), hornblende (1–3%, 1–7 mm), quartz (≤1%, 1–4 mm). andesite (~6%): plagioclase (5%, 1–7mm), biotite (1%, 1–2mm), and minor quartz (trace, ≤2mm). Hornblende is commonly altered to iron oxides.

Tih Hornblende andesite dike Several short dikes or plugs of andesite(?), distinguished by sparse to moderately abundant, large hornblende rods in a fine-grained, felty groundmass, are present in the western part of the quadrangle. Dikes strike northwest and are up to 50 m long and 4 to 10 m wide. Dikes intrude Oligocene ash-flow tuffs; age relative to Pyramid sequence or rhyolite group unknown. Tuffs are baked and reddened along contacts. Phenocrysts (2–10%): hornblende (2–10%, prisms to 1 cm long); plagioclase (0–1%,≤1.5mm).

RHYOLITE GROUP

Trds Rhyolite-clast conglomerate Poorly exposed and probably poorly indurated, coarse conglomerate marked by lag of well-rounded clasts. Clasts are up to 1 m in diameter and consist mostly of rhyolite-dacite tuff (Trt) or equivalent rhyolite intrusion (Tri) and minor older tuffs and porphyritic andesite. The unit is similar to the tuff and rhyolite breccias (Tbt and Tbd) except that clasts are well-rounded, indicating stream transport. The conglomerate is younger than rhyolite and, given the absence of Pyramid sequence rocks, probably older than the Pyramid sequence. It probably represents erosion immediately following formation of the domes and related tuffs. Preserved thickness is about 20 m.

Trt Rhyolite-dacite ash-flow tuff Densely to moderately welded, light to medium gray, abundantly and coarsely porphyritic ash-flow tuff crops out discontinuously above the Oligocene ash-flow tuffs and below rocks of the Pyramid sequence. The presence of common flattened pumice to 10 cm long and sparse lithic fragments of biotite-hornblende dacite distinguish the tuff from rhyolite or dacite lava or intrusions, which contain the same phenocryst assemblage. The tuff is as much as 50 m thick. Many outcrops consist of boulders up to 5 m in diameter in which the compaction foliation is irregularly oriented, which suggests some outcrops mapped as tuff may be rhyolite-dacite breccia (Tbd) containing only blocks of unit Trt. The tuff is petrographically similar to and probably the same age (~23.7 Ma) as the porphyritic rhyolite domes (Tri) in the Fraser Flat and Sutcliffe Quadrangles (Table 3; Garside and others, 2003; Faulds and others, 2003a).

Tbt Tuff breccia Purplish- to reddish-brown, brick red, or mustardy yellow megabreccia composed primarily of blocks of ash-flow tuff and minor rhyolite or dacite. Blocks of tuff of Chimney Spring (Tcs) are most common, but clasts of Nine Hill Tuff (Tnh), the lower and upper tuffs of Painted Hills (Tpl, Tpu), and a few older tuffs are also present. Megablocks (>20 m) of tuff of Chimney Spring and Nine Hill Tuff present in unit Tbt are separately identified. Many of the blocks appear to be slightly silicified. Matrix, which is rarely exposed, consists of still finer and variably silicified breccia. Tuff breccia probably originated as rock avalanches induced by slumping and catastrophic failure of steeply dipping strata around the flanks of rhyolite domes. Thickness is as much as 70 m.

Tbd Rhyolite-dacite breccia Grayish brown to pale brown megabreccia composed mostly of rhyolite and dacite blocks and minor blocks of tuff. Clasts range from a few centimeters to ~6 m in diameter. Outcrops typically consist of bouldery rubble. Matrix, which is rarely exposed, consists of still finer and commonly silicified breccia. Unit Tbd probably originated as rock avalanches induced by slumping and catastrophic failure of the steep-sided rhyolite domes. Thickness is as much as 50 m.

Tri Porphyritic rhyolite dome Coarsely and abundantly porphyritic, low-silica rhyolite to high-silica dacite intrusion. Interpreted to underlie tuff breccia (Tbt) along section B–B′.

OLIGOCENE ASH-FLOW TUFFS

Tphu Upper tuff of Painted Hills Medium gray, poorly to moderately welded, relatively pumice poor, moderately porphyritic ash-flow tuff. It typically forms a ledge or low cliff above the white, slope-forming but petrographically similar lower tuff of Painted Hills (Tphl) and beneath megabreccia (Tbt). However, it was eroded before deposition of megabreccia or Pyramid sequence in most of the quadrangle. Darker color, greater welding, and lesser abundance of pumice distinguish the upper tuff from the lower tuff. Also, local presence of red soil zone on top of the lower tuff and of rounded cobbles of older tuffs between the two tuffs indicate they are separate ash-flow tuffs. The upper tuff correlates with the orange tuff of the Tule Peak Quadrangle (Faulds and others, 2003b). All these tuffs may correlate with the tuff of Eleven Mile Canyon of the Stillwater Range (John, 1995), which is petrographically similar and has an indistinguishable age. Named for exposures in the Painted Hills in the Tule Peak Quadrangle (Faulds and others, 2003b).

Tphl Lower tuff of Painted Hills White to light gray, nonwelded to poorly welded, nonresistant, pumiceous, moderately porphyritic ash-flow tuff. The lower tuff of Painted Hills makes rounded hills or slopes beneath the more resistant upper tuff of Painted Hills (Tphu) or megabreccia (Tbt). The lower tuff contains up to 20% white pumice up to 10 cm long and 3% fragments of porphyritic andesite up to 8 cm in diameter. The lower tuff is petrographically similar to and, as mapped, may locally include the upper poorly welded part of the tuff of Chimney Springs. However, the lower tuff is distinguished by fewer phenocrysts, more abundant biotite, less abundant quartz, and relatively sparse smoky quartz. Also, common presence of a red soil zone on top of the tuff of Chimney Springs and a white, platy, fine tuffaceous sandstone between the two tuffs indicate they are separate ash flows with some erosion and weathering between them. Nevertheless, stratigraphic position and phenocryst assemblage suggest that both the lower and upper tuffs of Painted Hills are related to the tuff of Chimney Springs; all may have erupted from calderas in the Stillwater Range (John, 1995). Named for exposures in the Painted Hills in the Tule Peak Quadrangle (Faulds and others, 2003b).

Tcp Sedimentary rocks below the tuff of Painted Hills A sequence of platy, tuffaceous sandstone to siltstone containing quartz and sanidine grains probably reworked from tuff of Chimney Spring and thick bedded, pebble to cobble conglomerate, largely composed of clasts of older ash-flow tuffs. Unit Tcp crops out only in the western part of the quadrangle, but sedimentary deposits too thin to map lie between the tuffs of Painted Hills and the tuff of Chimney Spring throughout the quadrangle.

Tcs/Tcsl Tuff of Chimney Spring Red-brown weathering, pinkish gray, densely to poorly welded, abundantly porphyritic ash-flow tuff characterized by smoky quartz and adularescent sanidine. Most of the tuff is densely welded and devitrified and has undergone vapor phase crystallization. A basal, white, poorly welded part (**Tcsl**) capped by a black vitrophyre is locally present in deeper parts of paleovalleys. An upper white, poorly welded tuff is rarely preserved. Greater abundance of biotite and plagioclase in the lower and upper, poorly welded parts than in the densely welded part suggests compositional zoning; however, intense devitrification and vapor phase crystallization in the welded part has destroyed most mafic minerals. The massive, densely welded part mostly contains little pumice, so eutaxitic texture is poorly developed, whereas upper and lower parts contain as much as 20% white pumice to 15 cm long. Lithic fragments, most abundant in the lower part, consist of porphyritic, silicic to intermediate volcanic rocks, and lesser quartzite and indurated shale. The tuff of Chimney Spring is as much as 50 m thick in an intratuff paleovalley southwest of the Winnemucca Ranch, but it thins, becomes less welded, and pinches out over thick deposits

of Nine Hill Tuff. Based on its age and distinctive phenocrysts, the tuff of Chimney Spring correlates with the tuff of Poco Canyon in the Stillwater Range and with the New Pass Tuff east of Austin, Nevada (John, 1995; Hudson and others, 2000). The Poco Canyon caldera in the Stillwater Range was the source (John, 1995; Hudson and others, 2000).

Tnh/Tnhl Nine Hill Tuff Sparsely porphyritic, commonly highly pumiceous ash-flow tuff that consists mostly of dark red-brown, densely welded tuff containing 12–15% phenocrysts. This passes downward into a light brown, poorly welded (**Tnhl**) base that contains ~5% phenocrysts. Thickness and welding are highly variable because the tuff filled paleovalleys. Maximum thickness is about 100 m where it forms a syncline within the Warm Springs fault zone. The tuff is at most about 40 m thick in the intratuff paleovalley southwest of the Winnemucca Ranch and thins and locally pinches out over paleoridges. Prominent pumice fragments make flattened lenses up to 40 cm long in welded tuff and ellipsoids up to 20 cm long in poorly welded tuff. The tuff contains sparse lithic fragments of porphyritic to aphyric silicic volcanic rocks up to a few centimeters in diameter. The Nine Hill Tuff is widely distributed through western Nevada and the Sierra Nevada (Bingler, 1978; Deino, 1985). Deino (1985, 1989) demonstrated that it also correlates with the "D" unit of the Bates Mountain Tuff in central and eastern Nevada and suggested a source beneath the Carson Sink.

Tcn Conglomerate/breccia An extremely coarse, variably indurated conglomerate and/or rock avalanche deposit consisting of subangular to rounded boulders of ash-flow tuff up to 12 m in diameter, porphyritic andesite up to 8 m in diameter, and quartz monzodiorite up to 2.5 m in diameter. Tuff clasts are mostly tuff of Dogskin Mountain (Tdm). Some andesite clasts are from the Mesozoic metavolcanic unit (Jmv), as indicated by chloritized mafic phenocrysts and albitized plagioclase. Phenocrysts in other andesite clasts are unaltered, which suggests they may be Cenozoic. The rarely exposed matrix of the deposit shows angular to well-rounded, matrix-supported clasts, including rounded pebbles of probably Paleozoic quartzite and chert that were derived from outcrop at least as far east as the Nightingale Range. The outermost margin of large clasts is brecciated, with angular fragments in a silicified(?) matrix. This deposit fills a deep, narrow, intratuff channel that crops out in a semi-continuous, east-northeast-striking belt across the northern part of Dogskin Mountain. The mapped unit is mostly overlain by the tuff of Chimney Spring or the Nine Hill Tuff. It is possible but not certain that some conglomerate is younger than Nine Hill Tuff. The conglomerate is as much as 50 m thick within this paleovalley.

Tw Tuff of Winnemucca Ranch Light brown- or tan-weathering, finely porphyritic, densely to poorly welded, rhyolitic ash-flow tuff. It is found only in two areas, immediately south of Dry Valley Creek, where it forms low ridges, and about 2 km west of Winnemucca Ranch. A thin but continuous, medium gray, moderately welded vitrophyre containing glass lumps up to 2 cm in diameter occurs near the base of the unit. The vitrophyre is overlain by a thick devitrified zone in which the glass lumps form spherulitic clots. Much of the upper part is highly pumiceous, with fragments to 4 cm, and has undergone vapor phase crystallization. Unit Tw is at least 50 m thick and the top is faulted in the deeper part of the paleovalley. It thins to only about 5 m and is poorly welded but silicified southward along one strand of the Warm Springs fault.

Tcc Tuff of Campbell Creek A dark to light gray to cream-colored, sparsely porphyritic, pumiceous, densely to mostly moderately or poorly welded ash-flow tuff characterized by common, smoky, vermicular quartz phenocrysts and minor plagioclase. The tuff grades upward from a relatively sparsely and finely porphyritic, poorly welded and glassy base, which is commonly silicified, to more abundantly and coarsely porphyritic, densely welded, devitrified, nubbly weathering main part, to moderately or poorly welded top. Widespread in the intratuff paleovalley west of the Winnemucca Ranch, where it is as much as 160 m thick. Quartz and total phenocryst abundance decreases abruptly upward from the densely to moderately welded parts; biotite and plagioclase abundance increases. All parts have abundant pumice up to 40 cm long, which makes the tuff platy in the densely and moderately welded parts. Shards are easily visible with a hand lens. The age and petrographic character indicate correlation with the rhyolite of Campbell Creek (McKee and Conrad, 1987), which is an intracaldera tuff in the Desatoya Mountains approximately 190 km to the east-southeast.

Tcy Conglomerate below tuff of Campbell Creek The tuff of Campbell Creek is locally underlain by a coarse conglomerate marked by a lag of well-rounded boulders. Boulders are mostly tuff of Dogskin Mountain (Tdm) but include a few pre-Cenzoic rocks.

Tdm Tuff of Dogskin Mountain A thick, complex sequence of at least three cooling units of similar, plagioclase- and biotite-rich ash-flow tuff interbedded with platy, compacted, probably mostly reworked tuff and definite tuffaceous sedimentary rocks. The ash-flow tuffs are dark red-brown to medium gray, moderately pumiceous, and densely to poorly welded. Poorly welded parts form slopes, whereas dense parts locally form resistant ledges. Moderately to densely welded vitrophyres are common. White pumice that weathers to form ellipsoidal cavities up to 25 cm long is common in dense parts of the tuffs; darker, crystal-rich pumice up to 25 cm long that resembles porphyritic andesite is abundant in upper, densely to moderately welded parts. The ash-flow tuffs are laterally discontinuous, probably reflecting both nondeposition and erosion. Individual cooling units are 8 to 30 m thick. The composite unit, including reworked tuff, is as much as 120 m thick. The tuff of Dogskin Mountain correlates with the tuff of Coyote Spring of Garside and Bonham (1992) and is widely distributed through the region.

A light gray, generally poorly welded, nonresistant, sparsely and finely porphyritic ash-flow tuff overlies Mesozoic rocks along the Dogskin Mountain range front and probably lies within the lower part of the unit. Locally contains carbonaceous fragments near the base.

Thick-bedded, dense but nonresistant, greenish gray to gray, plagioclase- and biotite-rich tuff dominates the lower part of the unit and locally separates cooling units. The thick bedding is most apparent from a distance; close up, the tuffs are platy. This platy tuff is relatively dense throughout and shows no evidence of welding zonation. Pumice is present mostly as thin seems. Lithic fragments up to ~10 cm in diameter are scattered randomly through the unit. Based on these characteristics and local presence of thin (≤50 cm) lenses of pebble to cobble conglomerate and conglomeratic sandstone, most and possibly all of the platy tuff is reworked. The dense character may result from sedimentary compaction rather than welding. The platy tuff forms easily eroded and commonly bare slopes. The massive, pumice-rich, variably welded character of ash-flow tuffs distinguish them from the bedded, platy, reworked tuff.

Tcd Debris-flow deposit and conglomerate within the tuff of Dogskin Mountain Coarse, probable debris-flow deposit, conglomerate, and sandstone. Includes channel-filling debris-flow deposit, conglomerate, and sandstone about 25 m thick exposed on the north side of the south fork of Dry Valley Creek in the western part of the quadrangle. Debris-flow deposit there contains blocks of older tuffs, especially the tuff of Cove Spring (Twc, and some granitic rock (Kqmd) in a muddy matrix. Also includes conglomerate that fills an intratuff paleovalley cut into the tuff of Mine Canyon (Tmc) within the Warm Springs fault system south of Dry Valley Creek. Conglomerate consists of large, rounded boulders, commonly more than 1 m and up to 2.5 m in diameter, almost entirely of tuff of Mine Canyon. Boulders form a surficial lag and no matrix is exposed. This same paleovalley was apparently reeroded and subsequently filled with later tuffs.

Tw3 Tuff 30 Moderately and finely porphyritic, densely welded, white to light pink or gray and weathering to brown, rhyolitic ash-

flow tuff. It is a resistant, ridge-forming unit in its only occurrence in the intratuff paleovalley south of Dry Valley Creek. Although resistant, it was partly eroded before deposition of unit Tdm. Unit Tw3 is similar to unit Tw but distinguished by abundant, aligned biotite and generally sparse pumice or lithic fragments. Unit Tw3 is about 30 m thick and has not been found elsewhere in the region.

Tmc Tuff of Mine Canyon Red-brown to pinkish gray, moderately porphyritic, densely welded tuff containing large, glassy sanidine and smaller, cloudy white plagioclase phenocrysts. Biotite phenocrysts are distinctly more abundant than in the similar tuff of Cove Spring (Twc). The tuff contains sparse pumice fragments up to 2 cm long and lithic fragments of porphyritic andesite and metasedimentary rock (greenish-gray siltstone). An upper poorly welded zone present in the Tule Peak Quadrangle is absent here. The tuff of Mine Canyon is as much as 30 m thick and crops out intermittently in the westcentral part of the quadrangle and within the Warm Springs Valley fault zone in the north-central part. This distribution and obvious erosion in the fault zone suggest it was removed by erosion through much of the area. In contrast, it is widely distributed through the Virginia and Pah Rah Mountains. Named for exposures in Mine Canyon in the Tule Peak Quadrangle (Faulds and others, 2003b).

Tcm Conglomerate below the tuff of Mine Canyon Exposed only in one location in the northwest part of the quadrangle, immediately north of Dry Valley Creek. Consists of lag of rounded boulders up to 1 m in diameter.

Twc/Twcu Tuff of Cove Spring A sparsely to moderately porphyritic ash-flow tuff with a thick, red-brown to tan, densely welded lower part that passes upward into a light gray, poorly welded upper part (**Twcu**), which is mapped separately where it can be easily delineated. The densely welded part commonly makes prominent, columnar-jointed cliffs. The tuff is characterized by large, abundant sanidine, fine, mostly altered plagioclase, and sparse biotite: much less than 1% in the densely welded tuff to ~1% in the upper, poorly welded part. The lesser biotite content distinguishes unit Twc from unit Tmc, which is otherwise similar. Ellipsoidal cavities marking eroded pumice fragments are common in the densely welded part. A lithophysal zone a few meters thick is locally present a few meters above the base. Unit Twc is mostly 15 to 30 m thick but reaches 50 m in the intratuff paleovalley just south of Dry Valley Creek. Named for exposures near Cove Spring in the Tule Peak Quadrangle (Faulds and others, 2003b).

Tts Bedded tuff and tuffaceous sedimentary rock A sequence of thick bedded, dense but nonresistant, greenish gray to gray, plagioclase- and particularly biotite-rich tuff, similar to the platy, reworked tuff within unit Tdm. Unit Tts forms easily eroded and commonly well exposed slopes. The thick bedding is most apparent at a distance; close up, the tuffs are platy. Rocks of unit Tts are relatively dense throughout and show no evidence of welding zonation. Pumice is absent through much of the deposits; where present, it occurs only as thin, shaly seams. Lithic fragments up to ~10 cm in diameter are scattered randomly through the unit. Based on these characteristics and local presence of definite sedimentary interbeds, most and possibly all of unit Tts is reworked, probably from the tuff of Sutcliffe (Ts) and other older ash-flow tuffs.

Ts Tuff of Sutcliffe Light red, dark red-weathering, densely welded, mostly abundantly porphyritic and commonly columnar jointed ash-flow tuff. Zoned upward from moderately porphyritic, plagioclase-sanidine tuff with ~1% biotite to abundantly porphyritic, plagioclase-biotite rich tuff with lesser sanidine. Similar appearance to the plagioclase-biotite-rich welded tuffs in the tuff of Dogskin Mountain (Tdm) but distinguished by the presence of common, large sanidine. Pumice content is highly variable from ~1% in most of the tuff to 10–15% in a lithophysal zone in the middle of the tuff where pumice is up to 40 cm long. Small fragments of porphyritic andesite and shale are common. Thickness averages about 50 m but is highly variable from >100 m where it fills a probable intratuff paleovalley just northeast of Jackass Spring to less than about 10 m where it rests on quartz monzodiorite (Kqmd) in the south fork of Dry Valley Creek. Named for exposures near Sutcliffe in the Sutcliffe Quadrangle (Faulds and others, 2003a).

Tcu Sedimentary rocks below tuff of Sutcliffe Poorly exposed sequence of sedimentary rocks consisting mostly of platy tuffaceous sandstone interbedded with thin pebble to cobble conglomerate lenses similar to rocks of unit Tts. One outcrop just east of Jackass Spring consists of conglomerate marked by lag of rounded cobbles of metavolcanic rock (Jmv) in dark red soil, presumably weathered matrix.

Trc Tuff of Rattlesnake Canyon Light red, densely grading upward to poorly welded ash-flow tuff characterized by large and abundant sanidine. Dense part is commonly columnar jointed and shows nubbly weathering. Upper, poorly welded part is more finely porphyritic and contains ~10% pumice up to 15 cm long. Fragments of porphyritic andesite and quartzite up to 1 cm across are common near the base. Named for exposures in Rattlesnake Canyon in the Fraser Flat Quadrangle.

Tcr Sedimentary rocks below tuff of Rattlesnake Canyon Poorly exposed sequence of platy, poorly bedded tuffaceous rocks interbedded with thin lenses of coarse sandstone and pebble to cobble conglomerate similar to those in unit Tts and Tcs. Mostly covered by colluvium. May also include some tuff of Hardscrabble Canyon (Thc).

Thc Tuff of Hardscrabble Canyon Poorly exposed, moderately to poorly welded, sparsely and finely porphyritic, light gray ash-flow tuff distinguished by the presence of about 5%, small, angular, smoky quartz phenocrysts. The tuff contains a few small (<1 cm long) pumice fragments and few if any lithic fragments. The tuff is exposed only in two areas: in the northwestern part of the quadrangle on the north side of Dry Valley Creek and in the western part near Carls Spring north of the south fork of Dry Valley Creek. It is about 20 m thick in both areas. However, it may be more widely distributed in the largely colluvium-covered interval between the tuffs of Rattlesnake Canyon (Trc) and Axehandle Canyon (Tac). Named for exposures in Hardscrabble Canyon in the Tule Peak Quadrangle.

Tac Tuff of Axehandle Canyon Densely welded, moderately pumice-rich, pink to light brown, dark red-brown-weathering ashflow tuff, the oldest exposed tuff in the quadrangle. Grades upward from sparsely porphyritic base with sanidine more abundant than plagioclase and 1% biotite to upper part with plagioclase much more abundant than sanidine and 2–3% biotite. This upper part is similar in appearance to the tuff of Sutcliffe (Ts). Both parts contain common white pumice up to 10 cm long. Exposed in three areas: along Dry Valley Creek, near Carls Spring just north of the south fork of Dry Valley Creek (where it overlies meta-andesite (Jmv)), and in the canyon just north of Jackson Spring (where it reaches its maximum thickness of ~60 m, and the base is not exposed). Named for exposures in Axehandle Canyon in the Griffith Canyon Quadrangle. Our unpublished petrographic, stratigraphic, and age data indicate correlation 225 km eastward to a tuff at Reese River Narrows in the Toiyabe Range. M.G. Best (personal commun., 2001) correlates the tuff at Reese River Narrows with part of the Windous Butte Formation, but further work is needed to test possible correlation between the tuff of Axehandle Canyon and the Windous Butte Formation.

Tck Basal Tertiary conglomerate Conglomerate composed exclusively of pre-Cenozoic clasts. Crops out only in Dry Valley Creek where it overlies the meta-andesite (Jmv). Exposed as a lag of rounded boulders of meta-andesite and a few granitic rock up to 50 cm in diameter.

MESOZOIC ROCKS

Cretaceous granitic rocks

Kgg Granite of Granite Peak Massive, medium grained, speckled light gray to white, mostly deeply weathered granite in the Sand Hills at the southwest corner of the quadrangle. Area within the quadrangle is almost entirely weathered to a deep sand, so that

the division between granite and alluvial fan derived from granite is approximate. Mineralogy: orthoclase (30%, to 1 cm, commonly enclosing plagioclase, biotite, and hornblende), plagioclase (40%, to 5 mm), quartz (25%, to 4 mm), biotite (5%, to 3 mm), and hornblende (2%, to 5 mm). Same as quartz monzonite of Granite Peak in the northeastern part of the Granite Peak Quadrangle (Garside, 1987).

Kgb Granodiorite of Black Canyon Massive, coarse grained, speckled light gray to light pink, mostly deeply weathered quartz monzonite crops out in Black Canyon at the north edge of the quadrangle. Outcrop consists of deep grus with scattered knobs of moderately rounded boulders. The rock contains, in decreasing order of abundance, plagioclase, perthitic orthoclase as poikilitic grains up to 1 cm in diameter, quartz, biotite, minor hornblende, which can form elongate grains up to 1.5 cm long, magnetite, and euhedral sphene. Lighter color, greater abundance and large size of potassium feldspar, preponderance of biotite over hornblende, and lack of foliation distinguish unit Kgb from unit Kqmd. Cut by minor pegmatitic and aplitic dikes.

Kf Aplitic to pegmatitic dikes and irregular intrusions Dikes and irregular shaped intrusions of aplite and pegmatite in quartz monzodiorite (Kqmd). All rocks consist of orthoclase, quartz, lesser plagioclase, and minor biotite; black tourmaline is present in rare vugs. Grain size in aplites is generally less than 2 mm. Pegmatites can contain orthoclase up to 6 cm in diameter and quartz up to 10 cm long. Aplite dikes zone to or contain irregular pods of pegmatite. Larger intrusions commonly show parallel, gradational bands of aplite and pegmatite.

Kdd Diorite dikes Dikes, small stocks, and large inclusions of fine- to medium-grained, medium gray diorite and lesser quartz diorite consisting of mostly anhedral to subhedral plagioclase (60–75%, locally less than 50%), potassium feldspar (1–5%), quartz (1–10%), hornblende and biotite (25–30%, locally up to 50%), and minor magnetite, hematite, limonite, chlorite, sericite, and epidote. Hornblende is mostly 4 to 5 times more abundant than biotite, but locally they occur in subequal amounts. Crystals are generally 0.1 to 2 mm long, but subhedral to euhedral plagioclase up to 7 mm long can constitute 1–2% of the rock. The diorite dikes are petrographically similar to the small lens-shaped diorite inclusions common to Kqmd.

Kqw Weathered quartz monzodiorite Distinct, discontinuous paleoweathering zone as much as 15 m thick developed in quartz monzodiorite (Kqmd) along the unconformity with Cenozoic rocks. Distinguished by its bright red appearance on the ground and air photos. Biotite, which is probably altering to mixed layer clay, and a dark red stain on all minerals are particularly prominent and give the appearance of a mafic rock unlike the quartz monzodiorite.

Kqv Quartz vein A single, massive quartz vein cuts quartz monzodiorite near the southeastern corner of the map.

Kqmd Quartz monzodiorite Coarse-grained, light to medium gray quartz monzodiorite and granodiorite consisting of, in decreasing order of abundance, plagioclase, microcline, quartz, hornblende, biotite, and accessory titanomagnetite, anhedral sphene, and zircon, make up most of the southern part of the Dogskin Mountain. A weak foliation defined by the preferred orientation of hornblende is common. Enclaves of diorite similar to and probably comagmatic with diorite dikes range up to 20 cm long. Local veinlets of black tourmaline. Generally weathers to large angular blocks or rounded boulders surrounded by grus. Much greater abundance of plagioclase relative to potassium feldspar and quartz, weak foliation, and occurrence of potassium feldspar as microcline distinguish this from granodiorite of Black Canyon (Kgb). This unit is identical to, and in continuous outcrop with, unit Kqmd in the Fraser Flat (Garside and others, 2003) and Tule Peak Quadrangles (Faulds and others, 2003b).

JURASSIC(?) METAMORPHIC ROCKS

Jmv/Jms Jurassic(?) metavolcanic and metasedimentary rocks Metamorphosed porphyritic andesite, ash-flow tuff(?), volcanic conglomerate, and sandstone to shale (schist) form roof pendants in granitic rocks along the northeast flank of Dogskin Mountain, in Black Canyon, and in deeper canyons along the west side of the quadrangle. Andesite is petrographically variable but contains 20–40% aligned plagioclase phenocrysts (1–4 mm long) and 3–6% chloritized hornblende or pyroxene to 4 mm long in a biotitized and slightly schistose matrix. Volcanic conglomerate contains clasts of andesite up to 25 cm in diameter in a fine, biotitic matrix. Metamorphosed ash-flow tuff(?) contains 25% feldspar phenocrysts in a very felsic matrix containing abundant, white, disk-shaped lenses (pumice?) up to 20 cm long. Siltstone and shale are metamorphosed to platy biotite schist in which foliation parallels variably preserved sedimentary layering. Contains many thin granitic and pegmatitic dikes near contacts with granitic rocks.