**description of map units**

**af Artificial fill**

**ALLUVIAL DEPOSITS**

**Qaya Main-stream alluvium (Holocene)**—Mapped separately from Qay only along Dixie Valley Wash and parts of Bench Creek and Eastgate Wash where the latter are traversed by Highway 50. Forms low terrace where stream is incised. Interstratified coarse to fine sand, silty sand, very fine- to fine-pebbly sand, silt, and sandy pebble to cobble gravel. Sands thinly to thickly bedded, locally cross-bedded. Silts thinly laminated with mud partings. In channel fill, pebble and small cobble gravel overlain by coarse sands that fine upward. Pebbles and cobbles mostly subrounded. Locally contains large amounts of silt and fine sand that probably represent reworked eolian deposits stripped off surrounding terrain. Silty surfaces commonly covered by dark brown to black biological soil crust

**Qay Young alluvial deposits (Holocene)**—Alluvial fan deposits (formed by sheetfloods and debris flows; Harvey, 2005), stream-channel and low-terrace deposits, and sheetwash deposits. Sandy pebble to boulder gravel, gravelly sand, sand, and sandy silt. Locally contains angular blocks as much as 3 meters (m) across. Unconsolidated, poorly to moderately sorted, weakly to moderately bedded. Clasts angular to subrounded. Surface clasts unweathered or minimally weathered with minor spalling of outer surfaces. Original depositional morphology on fan surfaces generally well preserved. Fan surfaces generally undissected to weakly dissected. Desert pavement largely absent but where present, weakly to moderately developed and either unvarnished or lightly varnished. No or minimal soil development characterized by silty vesicular A horizon, thin color B horizon (about 10 centimeters [cm] thick), and locally, very weakly developed stage I pedogenic carbonate horizon (see Schoeneberger and others [2012] for description of stages of pedogenic carbonate development).

Stream-channel deposits locally incised as much as 4–10 m and contain large amounts of light gray to very pale brown silt and very fine to fine sand that probably represent reworked eolian deposits stripped off surrounding terrain. Silty surfaces commonly covered by dark brown to black biological soil crust. In Eastgate Wash stream cuts expose thick section of thinly laminated silts and clayey silts interbedded with poorly to moderately sorted, locally cross-bedded, very fine to coarse sands and locally sandy pebble gravel with subrounded to rounded clasts. AMS 14C dates on organic-rich horizons collected near the base, middle, and top of a 10-m-high exposure just upstream of Eastgate have calibrated radiocarbon ages of 4.16 ± 0.08 cal ka B.P. (3.78 ± 0.02 14C ka B.P., USGS-1157), 3.00 ± 0.08 cal ka B.P. (2.88 ± 0.02 14C ka B.P., USGS-1423), and 1.94 ± 0.05 cal ka B.P. (1.98 ± 0.02 14C ka B.P., USGS-1422), respectively, suggesting that stream aggradation began prior to about 4.2 ka and ended after about 1.9 ka, and that the subsequent 10 m of stream incision occurred within the last 2 ka (Berry and Johnstone, 2019).

Stipple pattern marks areas where young eolian sand overlies and is mixed with uppermost alluvial sediments. Eolian sand fills gullies and forms mounds around brush that acts as sand traps. Mixed with underlying alluvial deposits through bioturbation and surface wash processes. Distribution pattern indicates likely sand source in Dixie Valley is Dixie Valley Wash. In Fairview Valley, sand source likely pluvial Lake Lahontan deposits, with sand transported through a gap in the southern Stillwater Range, and lesser amounts reworked from deposits of pluvial Lake Labou and unit QTs

**Qam Young to Intermediate alluvial deposits (Holocene and late Pleistocene)**—Alluvial fan deposits (formed by sheetfloods and debris flows; Harvey, 2005), stream-terrace deposits, and pediment gravels. Locally includes young stream-channel deposits (unit Qay) too narrow to map separately. Sandy pebble to boulder gravel, gravelly sand, sand, and sandy silt. Unconsolidated, weakly bedded, and poorly to moderately sorted. Clasts mostly subangular or subrounded, locally rounded. Some surface clasts fractured or shattered by post-depositional weathering processes. Minor weathering of biotite-rich surface boulders. Some original depositional morphology preserved. Fan surfaces weakly incised. Desert pavement typically weakly to moderately developed and moderately varnished, but ranges from lightly varnished to well varnished. Where pavement mostly stripped, silty sediments have polygonal fracture pattern with fractures lined by small pebbles. No pavement in areas heavily vegetated by grass. Soil development characterized by silty vesicular A horizon; thin (about 10 cm), reddened clay-enriched B horizon over a less well-developed color B horizon (about 30 cm thick); and weakly developed stage I carbonate horizon. Locally high infiltration of silt into soil profile. Silty surfaces commonly covered by dark brown to black biological soil crust.

Stipple pattern marks areas where young eolian sand overlies and is mixed with uppermost alluvial sediments. Eolian sand fills gullies and forms mounds around brush that acts as sand traps. Mixed with underlying alluvial deposits through bioturbation and surface wash processes. Distribution pattern indicates primary sand source probably Dixie Valley Wash

**Qai Intermediate alluvial deposits (late and middle Pleistocene)**­—Alluvial fan deposits (formed by sheetfloods and debris flows; Harvey, 2005), terrace deposits, and pediment gravels. Locally includes young stream-channel deposits (unit Qay) too narrow to map separately. Sandy pebble to boulder gravel, gravelly sand, sand, and sandy silt. Unconsolidated to weakly consolidated, weakly bedded, and poorly to moderately sorted. Clasts generally angular to subrounded, but locally rounded with some rounded boulders as much as 80 cm in diameter. Weathered and shattered surface clasts common. In subsurface, fractured clasts common and a few clasts are completely disintegrated by weathering processes. Original depositional morphology smoothed. Surfaces moderately incised, but generally planar between gullies. On west side of Stillwater Range, cut by highstand shoreline of pluvial Lake Lahontan (comprising a series of deep lakes that periodically occupied the Lahontan basin during the Quaternary). Desert pavement typically moderately to well developed and moderately to well varnished; locally weakly developed with light varnish. No pavement in areas heavily vegetated by grass. Soil development characterized by silty vesicular A horizon, reddened, clay-enriched B horizon generally 30–40 cm thick, and stage II–III carbonate horizons with common pedogenic silica. Carbonate horizons uncemented to locally well cemented. Silty surfaces commonly covered by dark brown to black biological soil crust

**Qao Old alluvial deposits (middle and early? Pleistocene)**—Alluvial fan deposits (formed by sheetfloods and debris flows; Harvey, 2005), terrace deposits, and pediment gravels. Locally alluvial fan deposits interbedded with rhizolith-rich carbonate-cemented sediment interpreted as marsh deposits that may have formed in wetlands during past pluvial intervals. Also includes young stream-channel deposits (unit Qay) too narrow to map separately. Sandy pebble to boulder gravel, gravelly sand, sand, and sandy silt. Locally contains angular blocks as much as 3 m across. Weakly to moderately consolidated, weakly to moderately bedded, poorly to moderately sorted. Consolidated, fine to coarse sand, medium or thinly bedded, locally cross-bedded. Silts platy, fractured. Clasts generally subangular or subrounded but range from angular to rounded. Many surface clasts shattered by post-depositional weathering processes. At several sites includes rounded meter-sized boulders, typically weathered dark yellowish or reddish brown with fractured and degraded surfaces. In I X L Canyon area, granitic surface boulders deeply pitted and partly altered to grus. Fan surfaces moderately to deeply incised with rounded interfluves (ridge and ravine topography). Cut by highstand shoreline of pluvial Lake Lahontan on west side of Stillwater Range. Desert pavement on fan surfaces typically absent or present only in poorly preserved patches with weak to locally moderate varnish. No pavement in areas heavily vegetated by grass. Terraces preserved in discontinuous remnants with gently undulant surfaces; along Dixie Valley Wash dissecting gullies oriented both perpendicular and parallel to axial drainage. Pavement on terrace and pediment surfaces moderately to locally well developed and moderately to well varnished. Soil development characterized by locally preserved, reddened, clay-enriched B horizons, and moderately to well cemented stage III–IV carbonate horizons. Pedogenic silica common. Laminar caps on horizons with stage IV carbonate morphology typically 2–3 cm-thick. Shattered and weathered clasts in subsurface common. Surfaces covered by variable amounts of unmapped eolian silt. Where silty substrate present, commonly covered by dark brown to black biological soil crust.

Stipple pattern marks areas where young eolian sand overlies and is mixed with uppermost alluvial sediments. Eolian sand forms sand ramps on terrace risers, fills gullies, and forms mounds around brush that acts as sand traps. Mixed with underlying alluvial deposits through bioturbation and surface wash processes. Distribution pattern of eolian sand indicates primary sand source probably Dixie Valley Wash

**QTa Very old alluvial deposits (early Pleistocene and Pliocene?)**—Alluvial fan and stream deposits. Locally includes young stream-channel deposits (unit Qay) too narrow to map separately. Sandy pebble to boulder gravel, gravelly sand, sand, and sandy silt. Weakly to moderately bedded and poorly to moderately sorted. Moderately consolidated, with secondary carbonate and probable silica cement locally visible between grains. Consolidated fine to coarse sands medium or thinly bedded, locally cross-bedded. Clasts generally subangular or subrounded but range from angular to rounded. Surface clasts shattered by post-depositional weathering processes are common. In Bench Creek valley, includes large (1–1.5 m) rounded boulders with fractured and degraded surfaces weathered to dark reddish-brown. Deposits deeply incised and dissected into rounded, segmented ridges or hills and ravines. Many clasts well varnished but pavement mostly absent or present in weakly or moderately developed patches that probably formed relatively recently, subsequent to stabilization of the eroded surfaces. No soil profile observed but thick detached carbonate rinds as much as 5 millimeters (mm) thick present on shoulder of some slopes

**QTs Very old sediments (early Pleistocene and Pliocene?)**—Fluvial deposits of interstratified, weakly to moderately consolidated sand, silt, pebbly sand, and sandy pebble and cobble gravel. Locally contains a few small boulders. Forms near horizontal stacked packets 1–2 m thick of alternating fine and coarse sediment. Fine sediment packets made up of pale brown sands and laminated silts. Coarse sediment packets made up of brownish gray, weakly bedded, poorly sorted, pebbly sand and sandy gravel; some sandy gravel beds pinch out laterally. Sands and pebbly sands locally cross-bedded. Outcrops typically capped by large pebble and cobble gravel. Large pebbles and cobbles mostly rounded or subrounded; small pebbles subrounded or subangular. Capping gravel contains minor amounts of vesicular basalt that crops out to the west/northwest of the deposits, suggesting either that clasts are reworked from older deposits, or that at the time of QTs deposition, drainage flowed out of the west/northwest in contrast to present day drainage. Reheis and Morrison (1997) also suggested that the gravels could predate present-day valleys.

Stipple pattern marks areas where young eolian sand overlies and is mixed with uppermost alluvial sediments. Eolian sand forms sand ramps, fills gullies, and forms mounds around brush that acts as sand traps. Mixed with underlying alluvial deposits through bioturbation and surface wash processes. Distribution pattern indicates eolian sand likely sourced from deposits of pluvial Lake Lahontan, with sand transported through a gap in the southern Stillwater Range, and sand reworked from QTs outcrops and deposits of pluvial Lake Labou

**EOLIAN DEPOSITS**

**Qes Eolian sand (Holocene to middle Pleistocene)**—Forms sand sheets, sand ramps, and sand dunes, including field of mostly transverse dunes in Dixie Valley. Unconsolidated medium sand with scattered granules. Very pale brown. Upper few centimeters of deposits typically silty and vesicular, probably owing to an influx of eolian silt. Stabilized by grass and brush vegetation. Sands likely sourced mostly from pluvial lake deposits (Lake Lahontan, Lake Labou, and Lake Dixie), but may also include sand reworked from deeply weathered Tertiary sedimentary rocks (unit Ts) in the southwestern part of the Stillwater Range

**BASIN-FILL DEPOSITS**

**Qbf Basin-fill deposits (Holocene to middle Pleistocene)**—Undifferentiated alluvial, lacustrine, eolian, and playa deposits filling basins formerly occupied by pluvial lakes. Unconsolidated sand, silt, clayey silt, silty clay, and pebble and small cobble gravel. In Dixie Valley contains Mazama ash (7627±150 calibrated years before present [cal yr B.P.]; Zdanowicz and others, 1999) at about 1-m depth below deposit surface (Bell and Katzer, 1987, 1990)

**COLLUVIAL, ALLUVIAL, AND MASS-WASTING DEPOSITS**

**Qtc Talus, colluvium, and alluvium, undifferentiated (Holocene to middle Pleistocene)**—Includes gravity deposits of angular rock fragments, colluvial mixtures of sand, gravel, silt, and clay derived mostly from weathered residuum and eolian deposits, and alluvium deposited mostly by sheetwash processes. Only large deposits mapped. In Stillwater Range, much of the rubble derived from basalt (unit Tb) and granite porphyry (unit Tgp)

**Qls Landslide deposits (Holocene to middle Pleistocene)**—Blocky or hummocky landslide deposits. In northwestern part of map area hummocky deposits made up of basalt (unit Tb) debris

**QTls** **Very old landslide deposits (early Pleistocene or Pliocene?)**—Blocky landslide deposits covering Middlegate Formation along fault-bounded mountain front south of Eastgate. Originally mapped as "marginal tectonic breccia" by Axelrod (1985) but reinterpreted as landslide deposits by Stewart and others (1999)

**LACUSTRINE AND PLAYA DEPOSITS**

**Qp Playa deposits (late Holocene)**­—Silty clay, clayey silt, sand, and precipitated salts in ephemeral lake basins. Mapped in Labou Flat

**Qlb Beach and shoreline deposits of Lake Dixie, Lake Labou, or Lake Edwards (late Pleistocene)**—Sandy pebble and cobble gravel, pebbly sand, sand, and silty sand in remnant shoreline deposits formed during late Pleistocene lacustral cycle of pluvial Lake Dixie in Dixie Valley, pluvial Lake Labou in Fairview Valley, and pluvial Lake Edwards in Edwards Creek Valley (e.g., Mifflin and Wheat, 1979; Bell and Katzer, 1987, 1990; Machette and others, 2005; Koehler and Wesnousky, 2011; Calvin and others, 2012). Locally covered by thin deposits of unmapped alluvial gravel, eolian silt, or eolian sand. Typically forms gravelly beach ridges or locally a thin veneer of beach gravel overlying fine grained lacustrine sediments (unit Qlf). In Dixie Valley, locally contains dendritic tufa heads (based on descriptions of Russell, 1885; Morrison, 1964) or is cemented by dense tufa coatings on pebbles and cobbles (lithoid tufa of Russell [1885] and Morrison [1964]; Benson [2004]). Beach gravels subrounded to rounded, many disc shaped. Desert pavement moderately developed with moderate varnish. Surface clasts shattered by post-depositional weathering processes are common. Remnant beach deposits mark highstand shorelines at about 1097 m in Lake Dixie, about 1274 m in Lake Labou, and about 1609 m in Lake Edwards (Mifflin and Wheat, 1979)

**Qlf Sediments of Lake Dixie (late Pleistocene)**—Sandy silt, silty sand, sand, clayey silt, silty clay, pebbly sand, and pebble gravel deposited during late Pleistocene lacustral cycle of pluvial Lake Dixie in Dixie Valley (e.g., Mifflin and Wheat, 1979; Bell and Katzer, 1987, 1990). Pale brown. Typically has polygonal fracture pattern at surface; fractures lined by small pebbles. Silts at surface typically vesicular. Similar deposits associated with pluvial Lake Labou in Fairview Valley and pluvial Lake Edwards in Edwards Creek Valley exist but are not mapped because they are mostly covered by alluvial and eolian deposits

**Qlbl Beach and shoreline deposits of Lake Lahontan (late Pleistocene)**—Part of the Sehoo Alloformation (Morrison, 1964, 1991). Sandy pebble to small-boulder gravel, pebbly sand, sand, silty sand, and locally large-boulder gravel deposited during the late Pleistocene lacustral cycle (named the Sehoo lacustral cycle [Morrison, 1964, 1991]) of pluvial Lake Lahontan (comprising a series of deep lakes that periodically occupied the Lahontan basin during the Quaternary). Includes deposits associated with wave-formed beach terraces, barrier ridges, and spits, and thin patches of boulder and cobble lag along shorelines cut in hillslopes of mostly basalt bedrock. Highstand shoreline at about 1336–1338 m in map area. Dense tufa coatings on pebbles and cobbles (lithoid tufa of Russell [1885] and Morrison [1964]), slabs of tufa-cemented sand and gravel (beachrock of Benson [2004]), and dendritic tufa heads and colonies (Russell, 1885; Morrison, 1964) locally extensive. Clasts well rounded to subrounded. Many surface and near-surface clasts fractured or shattered by post-depositional weathering processes. Gravels and sands weakly bedded. Sands brownish gray. Distribution of cobbles of basalt (unit Tb) and tuff of Poco Canyon (unit Tpcu) indicates that at high lake levels longshore drift was to the northeast at least part of the time

**Qlfl Sediments of Lake Lahontan (late Pleistocene)**—Part of the Sehoo Alloformation (Morrison, 1964; 1991). Sand, silty sand, sandy silt, silt, pebbly sand, clayey silt, and pebble and cobble gravel deposited during the Sehoo lacustral cycle of pluvial Lake Lahontan. Associated with offshore, beach, and back-barrier lagoon depositional environments. Generally poorly exposed. Surface silts vesicular. Silts light gray to very pale brown. Sands brownish gray. In incised drainages, locally could include buried deposits from older lake cycles (see discussion in John and others, 2024)

**Qlfo Older sediments of Lake Dixie (middle Pleistocene)**—Fine sandy silt, clayey silt, and minor scattered pebbles. Silts light gray. Pebbles angular to subangular. Surface covered by single layer of angular and subangular clasts of alluvial gravel forming desert pavement; pavement moderately developed and moderately varnished. Pavement includes several clasts of tufa. Unit mapped on west side of Dixie Valley at an elevation as much as 12 m above highest late Pleistocene shoreline of pluvial Lake Dixie (1,097 m, Mifflin and Wheat, 1979). Bell and Katzer (1987) estimate Holocene to late Pleistocene offset on adjacent strands of the Dixie Valley Fault to be about 3 m, an amount much less than the elevation difference between Qlfo deposits and the late Pleistocene high shoreline, suggesting that this unit is from an earlier, middle Pleistocene lacustral cycle (Bell and Katzer, 1987; Reheis and others, 2002)

**MIOCENE VOLCANIC AND SEDIMENTARY ROCKS**

**Tb Basalt (Miocene)** — Basalt lava flows and flow breccias. Dark-gray to black, aphyric to sparsely porphyritic rocks containing fine-grained phenocrysts of plagioclase, clinopyroxene, and locally olivine. Locally vesicular. Minor coarse-grained volcaniclastic sandstone locally interbedded with lava flows. Whole-rock K-Ar ages of 13.0±0.4, 13.3±0.4, and 14.4±0.4 Ma from lava flows collected in Table Mountain and Diamond Canyon quadrangles (Stewart and others, 1994). Alm (2016) reported 40Ar/39Ar dates of 15.02±0.0.6 and 14.92±0.35 Ma for lava flows about 8 km southeast of Mountain Well

**Tbi Basalt intrusions (Miocene)** — Plugs and dikes that fed the basalt lava flows (Tb). Intrudes Miocene sedimentary rocks and landslide breccia deposits (units Ts and Tlb, respectively). Whole rock K-Ar age of 13.9±0.5 Ma from dike collected about 1 km north of Mountain Well (John and Silberling, 1994).

**Tya Andesite (Miocene) —** Gray to reddish-brown, fine- to medium-grained to coarsely porphyritic hornblende or pyroxene-plagioclase andesite lava flows (units Tha and Tya of John and others, 2024). Contains about 10 to 15 percent medium-grained hornblende phenocrysts in dark-gray aphanitic groundmass. Mapped in vicinity of Mountain Well, near the mouth of Elevenmile Canyon, and at Drumm Summit along US Highway 50. Hornblende K-Ar age of 15.3±0.5 Ma in southern Stillwater Range (John and Silberling, 1994)

**Td Diabase (Miocene) —** Dikes of dark-reddish-brown to black, fine-grained pyroxene diabase intruding rhyolite of Pirouette Mountain, older dacite and andesite, older tuff, and silicic intrusive rocks units and Freeman Creek pluton on the east front of the Stillwater Range.

**Tddc Dacite of Diamond Canyon (Miocene)** — Dark-gray to black, generally coarsely porphyritic hornblende or pyroxene-plagioclase dacite lava flows, flow breccias, and lahars. Locally includes shallow intrusive rocks. Plagioclase 40Ar/39Ar date of 14.51±0.038 Ma for sample collected near Mountain Well. Alm (2016) reported 40Ar/39Ar dates of 14.92±0.04 and 14.34±0.05 Ma for lava flows about 6 km southeast of Mountain Well.

**Tddci Porphyritic dacite intrusions (Miocene)** — Dark-red, brown, and black, generally coarsely porphyritic, hornblende or pyroxene-plagioclase dacite intrusions. Generally flow banded. Forms several semi-circular plugs intrusive into lava flows and breccias of the dacite of Diamond Canyon (unit **Tddc**) in southwest part of map area.

**Tmr Rhyolite lava flows, breccia, and tuffaceous sedimentary rocks (Miocene?)—**Includes crystal-poor rhyolite lava flows with sparse phenocrysts of sanidine and quartz, and poorly welded, pumice-rich rhyolite tuff with up to 20% phenocrysts of quartz, feldspar, and biotite. Lava flows are locally strongly brecciated and silicified. Corresponds to units Trd, Trdt, and Tstb of Stewart and others (1999). Stewart and others (1999) report a K-Ar age of 16.3 Ma from the rhyolite tuff unit, recalculated from Evernden and James (1964). Concentration of unit along southern margin of Elevenmile Canyon caldera suggests possibility some lavas may be 25 Ma, however.

**Miocene basin fill**

I’m not sure if its worth preserving the split into multiple units for the Miocene sediments or just lumping them. It works in Middlegate and to a lesser extent Eastgate where they were mapped that way originally, but everything in the Stillwater Range is lumped into one unit even though it most likely spans the same full age range as the rest. A lot of the Stillwater Ts is probably Tsl (the oldest unit, older than the young andesite flows), but some of it is as young as 12 Ma. Problem is in most places we don’t know. And TBH I’m not sure how much even Jack Stewart knew outside of the places he had tephra correlations. After reviewing all the recently I’m inclined to just lump everything into a “Ts” unit, but for now I’ve left the polygons divided.

**Ts Sedimentary rocks, undivided (Miocene)** — Clastic sedimentary rocks of units Tsu, Tsm, and Tsl, undivided.

**Tsu Sedimentary rocks, upper unit (Miocene)** —Erosive, lenticular cobble to boulder conglomerate. Includes units Tbc5 of Barrows (1971) in the Eastgate basin, and units Tmmc, Tmmss, Tmmz, Tmmts, Tmmtr, and Tmmcs (upper part of the Monarch Mill Formation of (Stewart and others, 1999) in the Middlegate basin. Corresponds to “Interval 4” of Bristol (2019). Age range of 11.5 to 9.8 Ma; potentially as old as 13 Ma (tephrachronology, Stewart, 1999).

**Tsm Sedimentary rocks, middle unit (Miocene)** — Medium to coarse-grained sandstone with pebble lags and trough cross-bedding, and erosive, lenticular cobble to boulder conglomerate. Includes unit Tbc4 of Barrows (1971) in the Eastgate basin, and units Tmmrb and Tmmr (lower part of the Monarch Mill Formation) of Stewart and others (1999). Corresponds to “Interval 3” of Bristol (2019). Base is ca. 15.6 Ma in the Eastgate basin and ca. 14.4 Ma in the Middlegate basin (U-Pb zircon, Bristol, 2019; tephrachronology, Stewart and others, 1999). Top is between 13 and 10 Ma based on tephrachronology (Stewart and others, 1999)

**Tslb Landslide breccia (Miocene)** —Coarse deposits of unsorted, angular to subangular blocks (up to 10 m) of ash-flow tuff and rhyolite lava in coarse-grained sandstone to pebble conglomerate matrix. In southern Stillwater Range contains blocks of the tuff of Elevenmile Canyon and silicic lava (unit Tlb of John and Silberling, 1994), and grades laterally into sedimentary rocks of unit Tsl. In Middlegate area, includes blocks (up to 10 m) of poorly consolidated sandstone and siltstone in addition to lava and ash-flow tuff (unit brss of Stewart and others, 1999). Suggest deleting some of the very small blobs in the Middlegate area for this map.

**Tbs** **Basaltic sedimentary rocks (Miocene)** — Coarse-grained sandstone and granule and small pebble conglomerate containing abundant clasts of basalt. Locally interbedded with and underlying basalt lava flows. Only mapped in southwest part of map area. Suggest just combing with Ts for this map

**Tsl Sedimentary rocks, lower unit (Miocene)** — Finely interbedded reworked sandstone and tuff with gypsum beds and well-preserved leaf and fish fossils, tuffaceous sandstone and mudstone with trough cross-bedding, and mudstone with abundant plant debris and coalified material. Includes units Tbc2 and Tbc3 of Barrows (1971) in the Eastgate basin, and the Middlegate Formation (units Tmu and Tml) of Stewart and others (1999) in the Middlegate basin. Corresponds in part to unit Ts of John and Silbering (1994) and unit Ts of Alm and Walker (2014) in the southern Stillwater Range, although some of those deposits may be younger. Corresponds to “Interval 1” and “Interval 2” of Bristol (2019). Base slightly older than 16.2 Ma in the Eastgate and Middlegate basins (U-Pb zircon, Bristol, 2019); probably similar to undated deposits in the Stillwater Range. Top is older than 15.6 Ma (U-Pb zircon, Bristol, 2019) in the Eastgate basin, older than ca. 14.4 Ma in the Middlegate basin (tephrachronology, Stewart, 1999; U-Pb zircon, Bristol, 2019), older than 14.7 Ma near Drumm Summit (40Ar/39Ar, this study), and older than ca. 14.4 Ma in the southern Stillwater Range based on 40Ar/39Ar (Alm and Walker, 2014) and K-Ar (John and Silberling, 1994) dates from overlying lava flows.

**Tog Older gravels (Miocene to Pliocene?)** — At Eastgate, layer of rounded clast a few meters thick overlying Oligocene volcanic rocks on the ridge crest north of US 50. Clasts include (list types from field notes). Check with Margaret – maybe lump into QTs unit?

**Rocks of the Fairview Peak caldera (Henry, 1996a, 1996b)**

**Tfpi Post-caldera dikes (Miocene)** — Rhyolitic to dacitic, mostly east-striking dikes that intrude tuff of Fairview Peak. Contain 20 to 40% phenocrysts of plagioclase, biotite, hornblende, and, rarely, quartz and/or sanidine. 40Ar/39Ar sanidine age on a stock in the Bell Mountain quadrangle is 18.82 ± 0.08 Ma (Henry, 1996b).

**Tfpt Tuff and volcaniclastic sedimentary rocks (Miocene)** — Heterogeneous assemblage of coarse to fine tuff and volcaniclastic sedimentary rock. Includes tuffaceous part of the lavas of Bell Canyon (Tbt; Henry, 1994a), and tuffaceous deposits related to post-caldera rhyolite domes in the Bell Mountain quadrangle (Tdt; Henry, 1994b). Coarse, massive tuff, probably proximal fall deposits, contains blocks of lava up to several meters in diameter in a locally pumiceous matrix. Bedded air-fall tuff is in beds 3 to 20 cm thick, composed of vitric pumice and lava clasts. Sedimentary rocks range from coarse, debris-flow deposits through coarse conglomerate to cross-bedded, pebbly sandstone to massive to finely laminated, tuffaceous sandstone and siltstone. Soft sediment deformation is common.

**Tfpr Sparsely porphyritic rhyolite domes (Miocene)** —Rhyolitic lava domes (unit Td; Henry, 1994b). Contain at most 4% medium-grained (2 mm) phenocrysts of plagioclase, sanidine, and minor biotite and hornblende. 40Ar/ 39Ar ages in the Bell Mountain quadrangle (Henry, 1996b) are 19.05 ± 0.09 Ma (sanidine), 18.86 ± 0.04 Ma (sanidine), and 20.06 ± 1.00 (plagioclase).

**Tfprp Porphyritic rhyolite domes (Miocene)** —Forms series of distinct topographic domes along the northeastern margin of the Fairview Peak caldera. Moderately porphyritic, massive to strongly flow-banded and flow-folded lava domes of high-silica rhyolite. Locally vesicular and vitrophyric along margins. Contain 10 to 20% phenocrysts of plagioclase, sanidine, biotite, and hornblende, and a few mafic inclusions, possibly of contemporaneous basaltic andesite. Sanidine 40Ar/39Ar ages in the Bell Mountain quadrangle (Henry, 1996b) are 18.94 ± 0.06 Ma and 18.87 ± 0.09 Ma.

**Tfpa Andesite (Miocene)** —Moderately thick, massive flows, black, vitrophyric flow breccia of abundantly porphyritic andesite, and abundantly porphyritic dikes (units Tba and Tiba; Henry, 1994a). Crystalline andesites typically have coarse, platy, subhorizontal flow bands. Contains 35 to 40% phenocrysts of plagioclase, clinopyroxene, and oxides.

**Tfp Tuff of Fairview Peak (Miocene)** — Compound cooling unit of light red-brown, devitrified, densely to poorly welded, rhyolitic ash-flow tuff. Mostly deposited within the Fairview Peak caldera except for outflow deposits on the northern flank of Fairview Peak. Minimum intracaldera thickness of 700 m estimated from outcrops in the east face of Fairview Peak. Contains 7 to 10%, and rarely up to 15%, phenocrysts of plagioclase, sanidine, biotite, and quartz. Contains mostly small, sparse lithic fragments except near caldera margins, although scattered fragments of Cretaceous granitic rock up to 40 cm in diameter occur throughout the caldera. Propylitically altered throughout most of the caldera. 40Ar/39Ar sanidine ages from the Bell Mountain quadrangle are 19.25 ± 0.03 Ma and 19.22 ± 0.03 Ma (Henry, 1994b). Outflow deposited as thin (<10 m) layers on top of the tuffs of Campbell Creek and Elevenmile Canyon in the Desatoya Mountains, where it was mapped as the tuff of Milkhouse Creek by McKee and others (1987).

**Rocks of the Fairview Mining district (Henry, 1996)**

**Tfmr – Rhyolite intrusions (Miocene)­** — Bleached, white, flow-banded dikes and small intrusive domes (unit Tir of Henry, 1994). Aphyric to moderately porphyritic; contain phenocrysts of sanidine, plagioclase, quartz, and biotite. Sanidine 40Ar/39Ar age is 19.31 ± 0.06 Ma (Henry, 1996).

**Tfmtr – Rhyolite tuff –** Coarse debris to bedded tuff adjacent to and probably eruptive equivalent of rhyolite intrusions (Tfmr) in Fairview district. Coarsest deposits contain angular, matrix-supported blocks of sparsely porphyritic rhyolite in a matrix of pumice and finer clasts. Bedded tuff is platy to finely laminated and silicified.

**Tfmt – Tuff of the Pyramid** — Coarse, lithic, densely to poorly welded ash-flow tuff that rests depositionally upon andesite intrusion (Tfma) in the eastern part of the district. Contains 15 to 25% phenocrysts, mostly of plagioclase with quartz, sanidine, and biotite. Lithic fragments include spherulitic rhyolite, porphyritic intermediate volcanic rock, and Cretaceous granitic rock up to 40 cm in diameter. Also includes an area of coarse, crudely bedded tuff containing blocks up to 2 m in diameter that crops out along the ridge approximately I .5 km north of Fairview Peak,

**Tfmdy – Younger dacite (Miocene)** — Medium- to dark-gray, massive, porphyritic dacite or andesite that is probably mostly intrusive (including one dike) and possibly some lava (unit Tfdy of Henry, 19994a). Contains 20 to 25% phenocrysts of plagioclase, prominent hornblende, biotite, and Fe-Ti oxides. Biotite is mostly altered to chlorite ± epidote. 40Ar/39Ar hornblende age from the Bell Mountain quadrangle is 20.02 ± 0.10 Ma (Henry, 1996).

**Tfma – Andesite (Miocene)** — Medium-gray, massive to commonly flow banded, porphyritic andesite makes a large, probably intrusive body at least 2 km across (unit Tfa of Henry (1994a). Extends from the eastern part of the Fairview district to northeast of Fairview Peak. Contains 30 to 40% phenocrysts, mostly of trachytic plagioclase and clinopyroxene, with minor biotite, possible altered orthopyroxene, and Fe-Ti oxides.

**Tfmd – Dacite (Miocene)** — Massive, dark-gray, moderately porphyritic dacite that forms most outcrops in the central part of the Fairview district. Includes units Tfd and Tip of Henry (1994a). Intensely propylitically altered and commonly kaolinized. Probably mostly intrusive into tuff of Elevenmile Canyon (**Tec**) but includes some lava and sedimentary breccia. Contains 20 to 25% phenocrysts, mostly of plagioclase with minor quartz and altered biotite, hornblende, and sanidine(?). Unit is the dominant host of precious-metal-bearing quartz veins of the Fairview district. Equivalent to “Lode Andesite” of Schrader (1947). U-Pb zircon age from the Dromedary Hump Mine is 21.15 ± 0.35 Ma.

**Lavas and tuffs of West Gate (Henry, 1996; Henry and others, 2013)**

**Twt Tuff and tuffaceous sedimentary rocks (Miocene)** — Poorly welded rhyolite ash-flow tuff and interbedded poorly indurated, white to light brown sandstone, siltstone, and conglomerate. Tuffs are up to about 20 m thick and contain fine, sparse phenocrysts of sanidine, quartz, and biotite. Common fragments of massive to flow-banded rhyolite with the same phenocryst assemblage suggest the tuffs are explosive equivalents of the rhyolite lavas (**Twr**). Sandstone and siltstone are composed of pumice, mineral, and rock fragments and are generally well-bedded to planar-laminated. They are sufficiently indurated to crop out locally. Conglomerates are poorly indurated and marked mostly by a lag of rounded clasts of porphyritic andesite similar to unit **Twa** and of unidentified rhyolitic ash-flow tuff. Sanidine 40Ar/39Ar age from a poorly welded ash-flow tuff is 22.75±0.06 Ma (Henry, 1996).

**Twa Porphyritic andesite (Miocene)** — Dark-gray to brown, abundantly and coarsely porphyritic, andesitic lavas with massive interiors and poorly exposed, scoriaceous and brecciated tops and bottoms. Contains 30 to 40% phenocrysts mostly of plagioclase with variable proportions of hornblende, biotite, clinopyroxene, Fe-Ti oxides, and sparse xenocrystic(?) quartz. Mafic phenocrysts are commonly altered to aggregates of iron oxides. Several flows contain probable autoliths of fine-grained diorite with similar mineralogy as the host. Includes some interbedded **Twt** too small to show at map scale.

**Twr Rhyolite lava (Miocene)** — Aphyric to sparsely porphyritic, platy, flow-banded and flow-folded, rhyolitic lavas that are mostly bleached white. Contains up to a few percent phenocrysts of small (≤1 mm) sanidine, plagioclase, and biotite.

**Twd Porphyritic dacite (Miocene)** — Abundantly porphyritic dacite containing phenocrysts mostly of plagioclase up to 1 cm long, lesser biotite, and about 1% each of quartz, sanidine, and hornblende that forms thick flows in the southeastern part of the quadrangle. The flows are massive, locally columnar-jointed and planar flow-banded, and have poorly exposed basal and upper flow breccias. Sanidine 40Ar/39Age from a porphyritic dacite lava is 22.82±0.09 Ma (Henry, 1996).

**Early Miocene silicic dikes**

**Tri Rhyolite dikes (Miocene)** – West-northwest-trending dikes in the southern Stillwater Range, Louderback Mountains, and southwestern Clan Alpine Mountains predominantly rhyolite with minor dacite. Mostly consists of sparsely porphyritic, fine-grained biotite rhyolite and coarsely porphyritic hornblende-biotite-quartz-plagioclase-K-feldspar rhyolite porphyry; many dikes are composite. Most dikes are propylitically altered. Rhyolite porphyry dikes near the south wall of the Elevenmile Canyon caldera have zircon U-Pb dates of 24.7±0.3 Ma and 23.36±0.39 Ma (Colgan and others, 2017). Dates in the Wonder Mountain quadrangle are 20.2 ± 0.6 Ma and 19.9 ± 0.6 Ma (K-Ar, biotite) and 21.5 ± 0.2 Ma (40Ar/39Ar, hornblende). Includes unit Tsd of John and others (2024) in the Stillwater Range, unit Tsi of John (1997) in the Wonder Mountain quadrangle, and units Tri and Trd of Henry and others (2013) in the West Gate quadrangle.

**Tdi** **Dacite dikes (Miocene)** – West-northwest-trending dikes and small plugs in the Louderback Mountains and West Gate areas, predominantly dacite with minor andesite. Dark gray to dark blue or green, fine- to medium-grained porphyritic dikes containing 20-30% phenocrysts of plagioclase, less abundant hornblende, and locally biotite and trace quartz. Most dikes are propylitically or argillically altered. Dates in the Wonder quadrangle are 21.3 ± 0.6 Ma (K-Ar) and 20.94 ± 0.13 Ma (40Ar/39Ar). Includes Thp, Tdp, and Tdi of John (1997) in the Wonder Mountain quadrangle, and Tdh of Henry and others (2013) in the West Gate quadrangle.

**Trdi Composite rhyolite and dacite dikes (Miocene)** — Several composite dikes in the West Gate quadrangle, consisting of both rhyolite (Tri) and dacite (Trd), either in parallel bodies along the dike trend or as pods of one type within the other. May either represent zoned intrusions or separate intrusions into the same dike trend. Corresponds to Trd of Henry and others (2013).

**Tad Lava flows (Oligocene)** — Dark-gray, greenish-gray, and reddish-brown, fine- to coarse-grained lava flows and breccias, including porphyritic andesite with hornblende, pyroxene, and plagioclase, and dacite with biotite, hornblende, and plagioclase. Overlies the tuff of Elevenmile Canyon in the Louderback Mountains and on the crest of the Clan Alpine Mountains. John (1997) reported an 40Ar/39Ar biotite age of 23.7 ± 0.1 Ma from the Wonder Mountain quadrangle. In the eastern Clan Alpine Mountains, two 40Ar/39Ar whole rock ages are 22.359 ± 0.078 and 23.73 ± 0.44 Ma (check with Chris, I believe these are unpublished. At least they were not in the most recent version of the data we released)

**OLIGOCENE VOLCANIC AND INTRUSIVE ROCKS**

**Tyr Younger rhyolite (Oligocene)**—Red, light-purple, green, black, and gray, generally sparsely porphyritic rhyolite lava flows, flow breccia, shallow intrusive rocks and minor welded tuff, accretionary lapilli tuff and epiclastic sandstone. Generally contains 5 to 10 percent fine- to medium-grained phenocrysts of white K-feldspar and minor plagioclase and altered biotite(?) in a devitrified aphanitic groundmass. Locally strongly flow banded. Locally includes thin, interbedded sequences of coarse-grained volcaniclastic sandstone and accretionary lapilli tuff. In the Stillwater Range, intrudes and overlies tuffs of Job Canyon, Poco Canyon and Elevenmile Canyon (John and others, 2024). Outcrops of sparsely porphyritic, brecciated, flow-banded rhyolite that overlie the tuff of Elevenmile Canyon near Eastgate, and outcrops of rhyolite that overlie the tuff of Elevenmile Canyon on the crest of the Clan Alpine Mountains (Hardyman and others, 1988) are included in this unit on the basis of similar composition and their age being younger than the tuff of Elevenmile Canyon. We can make the ones in the Clan Alpine a separate unit if we need to, I just got tired of proliferating rhyolite units.

**Tyrp Porphyritic rhyolite dome (Oligocene)** — Dark gray to brown weathering, gray rhyolite lava with 25 to 30 percent medium-grained phenocrysts of feldspar, 5 to 7 percent biotite and lesser hornblende, and 3 to 5 percent smoky, locally vermicular quartz. Crops out west of lower Edwards Creek in the Desatoya Mountains, where it overlies or intrudes the tuff of Elevenmile Canyon.

**Tsdi Silicic intrusive rocks (Oligocene)**—Numerous texturally and compositionally distinct silicic dikes and domes and minor pyroclastic aprons and lava flows. Includes aphyric felsite, sparsely porphyritic biotite rhyolite and quartz rhyolite, coarsely porphyritic biotite-quartz-plagioclase-K-feldspar rhyolite(?) porphyry, and coarsely porphyritic biotite-hornblende-plagioclase dacite porphyry (units Tsi and Tdi of John and others, 2024). Rhyolitic and dacitic rocks are locally gradational with each other. Most rocks are strongly argillized or propylitized, although glassy domes are locally present along west side of the Stillwater Range in West Lee and Poco Canyons. Sanidine 40Ar/39Ar dates of 25.18±0.03 and 25.17±0.03 Ma on intrusions near the mouth of Poco Canyon and biotite K-Ar date of 24.8±0.6 on glassy dome in West Lee Canyon (Hudson and others, 2000; John and others, 2024).

**Tts Tuffs and sedimentary rocks (Oligocene)**—Mostly argillized, poorly welded, lapilli tuff, fine-grained sedimentary rocks, sedimentary breccia, and lava flows locally associated with rhyolite domes that are part of silicic intrusive rocks and younger rhyolite units (Tsdi and Tyr, respectively). Only mapped in the lower parts of West Lee, Long, and Poco Canyons in the northwest part of map area and at the north end of Elevenmile Canyon

**Trh Hornblende rhyolite (Oligocene)** – Light gray, flow-banded rhyolite lava and shallow intrusions. Fine-grained, holocrystalline, with moderately abundant phenocrysts of small hornblende, plagioclase and locally biotite. Includes lavas intruding and/or overlying the tuff of Elevenmile Canyon in War and Cherry Canyons in the Clan Alpine Mountains (unit Trh of Hardyman and others, 1988), and several small, hornblende-phyric bodies intruding the tuff of Elevenmile Canyon north of Middlegate (unit Ti of Stewart and others, 1999).

**Tse Sedimentary rocks (Oligocene)** — Volcaniclastic sedimentary rocks near mouth of Edwards Creek. Interbedded white to pale green siltstone and/or reworked volcanic ash, coarse sandstone to pebble conglomerate with clasts of flow-banded rhyolite, and coarse conglomerate near base with clasts to ~50 cm of platy, flow-banded rhyolite and possible tuff of Campbell Creek (Tcc) in coarse sandy matrix with grains of quartz, biotite, and altered feldspar. Interpreted to depositionally overlie tuff of Elevenmile Canyon.

**Freeman Creek pluton (Oligocene)**

**Tfcgr** **Granite**—Light- to dark-gray to pinkish-gray, fine- to coarse-grained, equigranular to porphyritic biotite granite containing about 5 to 7 percent fine-gained anhedral biotite that locally replaces hornblende and sparse to abundant white to pink, anhedral to subhedral K-feldspar phenocrysts as long as 1.5 cm medium-grained. Intrudes granodiorite phase and granite porphyry dike. Zircon U-Pb date of 24.93±0.37 Ma from near mouth of Freeman Creek

**Tfcgd** **Granodiorite porphyry**—Dark-gray, fine- to medium-grained biotite-hornblende granodiorite porphyry containing about 10 to 15 percent fine-grained biotite and hornblende and local fine-grained clinopyroxene, small (1-3 mm) dark-gray quartz eyes, scattered 5- to 10-mm white K-feldspar and dark-gray plagioclase phenocrysts set in a fine-grained microgranular groundmass of quartz and feldspar. Hornblende phenocrysts commonly have rusty orange-colored clinopyroxene cores. Intrudes IXL pluton and granite porphyry dike. Zircon U-Pb dates of 25.16±0.23 Ma on granodiorite porphyry block in granite phase collected near mouth of Freeman Creek and 25.71±0.37 Ma on granodiorite porphyry

**Tfcgp** **Granite porphyry (Oligocene)**—Composite dike of white, pink, and orangish-gray biotite granite porphyry. Consists of 40-60 percent, fine- to coarse-grained phenocrysts of subhedral to euhedral K-feldspar, quartz, and plagioclase with about 1-3 percent altered biotite and (or) hornblende. Groundmass varies from microcrystalline (aplitic) to fine-grained allotriomorphic granular. Graphic granite intergrowths of K-feldspar and quartz locally abundant in groundmass. Commonly hydrothermally altered (argillic or propylitic alteration) with abundant clay minerals and pyrite with local epidote and chlorite. Miraolitic cavities present locally. Intrudes older dacite and andesite unit (Tobr and Tolf), older rhyolite (Tor), IXL pluton (Tixl), rhyolite of Pirouette Mountain (Trpm), andesite porphyry (Tap), older tuff unit (Tot), tuffs of Job Peak (Tjp) and Long Canyon (Tlc), and tuff and breccia of Government Trail Canyon (Tpbr). East end intruded by granite phase of Freeman Creek pluton (Tfcgr). Zircon U-Pb date of 25.50±0.46 Ma

**Tfcrp** **Rhyolite porphyry (Oligocene)**—Dike of white, generally orange-weathering biotite rhyolite porphyry. Rock is porphyroaphanitic containing about 20 percent fine- to medium-grained phenocrysts of altered feldspar, clear bipyramidal quartz, and minor chloritized biotite in an aphanitic groundmass. Strongly argillically altered with several percent disseminated pyrite that is mostly oxidized. Intrudes andesite porphyry (Tap), tuff of upper Poco Canyon (Tupc), and tuff and breccia of Government Trail Canyon (Tpbr). Zircon U-Pb date of 25.44±0.63 Ma

**Chalk Mountain intrusions**

**Tcgd Granodiorite of Chalk Mountain (Oligocene)** — Phaneritic rock containing sparse phenocrysts of pink orthoclase and white plagioclase up to 2 cm long in a medium-grained matrix of orthoclase, plagioclase, quartz, and 7–10% combined biotite and hornblende. Granodiorite locally appears quenched against porphyritic rhyolite (Tcrp) but also contains inclusions of sparsely porphyritic, aplitic rhyolite. Dikes of fine-grained granodiorite up to 25 m wide intrude both granodiorite and porphyritic rhyolite, and granodiorite contains common enclaves of fine-grained hornblende or biotite granodiorite. Granodiorite has locally undergone strong argillic and sericitic alteration. Zircon U-Pb age from the eastern flank of Chalk Mountain is 25.05 ± 0.26 Ma.

**Tcrp Rhyolite porphyry of Chalk Mountain (Oligocene)** —High-silica rhyolite porphyry containing moderately abundant medium- to coarse-grained phenocrysts of quartz, K-feldspar, and plagioclase in a microcrystalline groundmass. Overlies and appears to be intruded by granodiorite (Tcgd). Zircon U-Pb age from the eastern flank of Chalk Mountain is 25.04 ± 0.32 Ma.

**Elevenmile Canyon caldera**

**Tsf Silicic lava flows (Oligocene)**—White to light-green, aphyric to sparsely porphyritic silicic lava flows that overlie and interfinger with the sedimentary rocks and tuff (Tst) unit. Rocks are devitrified and commonly argillically altered

**Tst Sedimentary tuff unit (Oligocene)**—White to light-green, crystal-poor, pumice-rich, water-laid(?) rhyolite tuff and fine-grained tuffaceous sedimentary rocks. Tuff contains about 10 percent phenocrysts consisting of K-feldspar, less abundant plagioclase, and minor quartz and biotite. Tuff commonly contains distinctive clasts as long as 50 cm of dark-gray to black, finely bedded siltstone and fine-grained sandstone with wavy soft sediment folds and irregular, flame-textured margins. Locally includes white to light-green, crystal-poor, rhyolite lava flows. Rocks are devitrified and commonly are argillically altered. Zircon U-Pb date of 25.05±0.67 Ma on a tuff sample

**Tec** **Tuff of Elevenmile Canyon (Oligocene)**—Black, greenish-gray, white, reddish-brown, blue-gray, and lavender-gray crystal-rich rhyolite to low-silica dacite ash-flow tuff. Contains 30 to 60 percent phenocrysts consisting of medium-grained plagioclase, less abundant sanidine and quartz, 1 to 5 percent biotite, <1 percent hornblende, and locally trace amounts of clinopyroxene. Generally densely welded. Commonly contains abundant dark-green where altered to orange where unaltered, crystal-rich, flattened pumice clasts as long as 6 cm with abundant, mostly chloritized biotite and abundant fragments of pre-Cenozoic rocks and flow-banded rhyolites and porphyritic andesites. About 30 40Ar/39Ar sanidine dates from intracaldera tuff (on this map) and from outflow elsewhere tuff average ~25.1 Ma (Henry and John, 2013; Colgan and others, 2017; John and others, 2024). Eight zircon U-Pb dates range from 25.90±0.49 to 25.00±0.26 Ma (Colgan and others, 2017).

In the Stillwater Range, corresponds to Tec as mapped by John and others (2024). Megabreccia blocks (Tecx) consisting of internally shattered andesite, marble, and black argillite as large as 100 m are common. Horizons containing coarse blocks of Mesozoic rocks and (or) Oligocene rocks and zones of megabreccia (Tecx) are present near Elevenmile Canyon and in East Lee Canyon. Tuff is devitrified and generally strongly propylitized or argillized.

In the Louderback Mountains and at West Gate includes the tuff of Elevenmile Canyon (Tec) and the tuff of Hercules Canyon (Thc) mapped by John (1997) and Henry and others (2013). Poorly welded upper part mapped separately as Tect corresponds to unit Tpwt of John (1997) in the Wonder Mountain quadrangle. Contains large megabreccia blocks (Tecx) of andesite (Toa?), rhyolite (Trpm), welded ash-flow tuff (Tlm), and minor Mesozoic rocks, particularly close to the southern margin of the Elevenmile Canyon caldera at West Gate and Middlegate. Megabreccia blocks were mapped as Tecj, Teca, Tecr, and Tecm by Henry and others (2013). Lower part is strongly propylitically altered.

In the Clan Alpine Mountains, includes the tuff of Railroad Ridge (Trr) of Hardyman and others (1988). In the Middlegate area, includes the tuff of Clan Alpine Mountains (Tca, Tcat, Tcab, Tcal), tuff of Bench Creek Well (Tbc, Tbct)), and intervening tuffs (Tv, Tbt, Tcr, Tmb) of Stewart and others (1999). On the west side of the Clan Alpine Mountains, overlies rhyolite lava flows and breccia (Trp), tuff of Louderback Mountains (Tlm) and rheomorphically flowed tuff (Trft) and is 3000-4000 m thick; at Middlegate the base is not exposed. Near the southern caldera margin at Middlegate, includes megabreccia blocks (units Tcab and Tmb of Stewart and others, 1999) primarily of welded tuff indistinguishable from Tec, and lesser blocks of tuff strongly resembling Nine Hill Tuff (c.f. Henry and John, 2013).

In the Desatoya Mountains, mapped as the Desatoya Formation by Barrows (1971), and as the tuff of Desatoya Peak by McKee et al. (1987). Massive, mostly densely welded intracaldera tuff forms prominent cliff bands along the entire west face of the Desatoya Mountains, separated by a conspicuous, light-colored, poorly welded zone above Big Den Canyon mapped separately as Tect (this zone was mapped as sedimentary rocks by McKee and others, 1987). Underlies the northern part of Eastgate Ridge, and crops out prominently along Nevada State Route 722 in Eastgate Canyon, where it contains distinct flattened orange pumice up to a meter long. Southern caldera margin approximately coincident with Eastgate Canyon along Nevada SR 722, and with Park Canyon in the Desatoya Mountains. At Eastgate, abundant large megabreccia blocks (Tecx) consist mostly of the tuff of Eastgate and a crystal-rich rhyolite tuff (Tecxr), with occasional blocks of probable Nine Hill Tuff (Tnh) and pre-Tertiary basement clasts. At Park Canyon, coarse megabreccia consists of blocks of dacite probably derived from dacite domes (Tsd) along on the caldera margin.

**Tect Poorly welded tuff of Elevenmile Canyon (Oligocene)**—Pale brown to white weathering, cream colored, poorly welded rhyolite ash-flow tuff. Crystal content similar to more densely welded Tec, especially the hornblende-bearing upper part. Generally lithic rich, with large breccia blocks mostly of intermediate lavas. Contact with more densely welded tuff approximate in most places. In Wonder Mountain quadrangle corresponds to the “poorly welded tuff” unit (Tpwt) of John (1997). In Desatoya Mountains forms prominent light-colored zone halfway up the west side of the range above Big Den canyon, mapped as tuffaceous sediments by McKee and others (1987).

**Tecx Megabreccia in tuff of Elevenmile Canyon (Oligocene)**—As a map unit, corresponds to zones of abundant breccia blocks or to single very large blocks. Blocks range in size from a few meters to over 100 meters across and are generally internally shattered and strongly brecciated. Block lithology varies depending on the nearby wallrocks, with pre-caldera lavas and Mesozoic basement rocks predominating.

**Tecxr Rhyolite tuff megabreccia (Oligocene)**—Crystal-rich rhyolite tuff with ~30 percent phenocrysts quartz, plagioclase, and k-feldspar. Contains sparse lithics and little or no pumice. Occurs as massive breccia block or group of blocks over 1 km long in the tuff of Elevenmile Canyon north of Eastgate. Superficially resembles tuff of Poco Canyon. Mapped as silicic intrusions (Ti) by Barrows (1971). U-Pb zircon age is 25.7 + 0.39 Ma

**Trft Rheomorphically flowed tuff (Oligocene)**—White, greenish-gray, black, and brown, densely welded, rhyolite tuff. Locally vitrophyric. Commonly rheomorphically folded. Contains about 5% medium-grained phenocrysts consisting of subequal amounts of clear quartz, sanidine, and plagioclase. Forms discontinuous erosional remnants between the tuff of Elevenmile Canyon and tuff of Louderback Mountains. Sanidine 40Ar/39Ar age of 25.109 ± 0.018 Ma (reference? This hasn’t been published as part of one of our data releases).

**Volcanic rocks underlying the Elevenmile Canyon caldera**

**Tasc Andesite of Sheep Canyon (Oligocene)**—Dark-green, dark-gray, and dark-lavender-gray, aphyric to medium-grained, porphyritic andesite and dacite lava flows. Phenocrysts consist of medium-grained tabular plagioclase, hornblende, and local biotite. Locally flow banded. Generally altered to a propylitic mineral assemblage containing abundant epidote, chlorite, calcite, and illite or an argillic assemblage. Cut by numerous quartz±calcite veins east of Mountain Well. Forms outcrops in Sheep Canyon, near Mountain Well, and between La Plata and Elevenmile Canyons and occurs as megabreccia blocks enclosed within tuff of Elevenmile Canyon. Zircon U-Pb date of 25.07±0.41 Ma

**Trelc Rhyolite of East Lee Canyon (Oligocene)**—White, gray and pale lavender gray, sparsely porphyritic fine- medium-grained rhyolite lava flows locally overlain by sandstone and pebbly conglomerate mostly derived from underlying rhyolite lava flows and lower cooling unit of tuff of Poco Canyon. Overlies lower cooling unit of tuff of Poco Canyon and underlies tuff of Elevenmile Canyon. Petrographically similar to rhyolite of Pirouette Mountain (Trpm) and younger rhyolite (Tyr).

**Trp Rhyolite lava flows and breccia (Oligocene)**—Dark reddish-brown to gray weathering, gray, purple, and reddish-pink rhyolite. Locally strongly flow-banded, forms dark, massive outcrops with prominent coarse columnar jointing. Aphanitic to porphyritic with phenocrysts of plagioclase up to 1 cm, pyroxene, and trace sanidine and quartz. Phenocrysts often concentrated along bands parallel to glassy flow banding. Includes pale gray to white bedded sedimentary breccias with clasts of dark crystal-poor and porphyritic rhyolite, predominantly near base of unit. On west side of Cow Canyon, base consists of black vitrophyre of densely welded tuff with abundant streaky pumice and sparse lithics. Mostly corresponds to Trp unit of Hardyman and others (1988). U-Pb zircon age from Dummy Canyon is 25.25 ± 0.24 Ma. Overlies tuff of Poco Canyon and underlies tuff of Elevenmile Canyon, occupying the same stratigraphic position as the rhyolite of East Lee Canyon (Trelc) in the Stillwater Range.

**Trpt** **Tuffaceous sedimentary rocks (Oligocene)** —underlie Trp domes between Deep Canyon and Grover Canyon, probably related to domes. Chris had descriptions of these in his notes.

**Tsd Rhyolite and dacite lava flows (Oligocene)**—Check notes for color and field description. Devitrified to glassy, locally flow-banded and strongly brecciated. Sparsely porphyritic with small phenocrysts of sanidine and plagioclase. Two samples yielded a sanidine 40Ar/39Ar age of 25.279 ± 0.039 Ma, and a plagioclase 40Ar/39Ar age of 25.173 ± 0.018 Ma (believe these are Chris’ unpublished dates so we would either need to publish those or say something more general). Intrudes tuff of Campbell Creek and forms south wall of Elevenmile Canyon caldera along Park Canyon in the Desatoya Mountains, where it forms large (≥10 m) breccia blocks in the tuff of Elevenmile Canyon. Mapped as Skull Formation by Barrows (1971).

**Tuff of Poco Canyon (Oligocene)**—Multiple cooling units of rhyolite and high-silica rhyolite ash-flow tuff

**Tpcu** **Upper cooling unit**—Reddish-brown, white, and greenish-gray, medium-grained, crystal-rich rhyolite and high-silica rhyolite ash-flow tuff. Tuff is mostly devitrified, densely welded, locally vuggy due to leached pumice, and commonly contains abundant, small (generally less than 2 cm) fragments of intermediate lava flows and less common Mesozoic rocks. Locally contains coarse fragments (as large as 20 cm) of intermediate to silicic lava flows. In Poco Canyon, contains large megabreccia blocks of underlying tuff and breccia of Government Trail Canyon and rhyolite of Pirouette Mountain (mapped as **Tpcx**). Generally contains 30 to 50 percent phenocrysts of sanidine, quartz, lesser plagioclase, and trace amounts of biotite. Sanidine locally is iridescent and quartz commonly is smoky. Basal part of unit in Poco Canyon locally contains black glassy fiamme as much as 6 cm long. Sanidine 40Ar/39Ar dates of 25.16±0.08 and 25.26±0.07 Ma, and zircon U-Pb dates of 25.60±0.25 and 25.66±0.51 Ma in the Stillwater Range.

**Tpbr** **Tuff and breccia of Government Trail Canyon**—Heterolithic megabreccia consisting of unsorted blocks of older Oligocene igneous units in a moderately welded rhyolite ash-flow tuff matrix. Breccia matrix consists of pale green, moderately pumiceous, crystal-poor tuff containing about 2 to 4 percent phenocrysts of quartz and altered feldspar. Pumice fragments are dark-green, crystal-poor, and generally less than 4 cm in maximum dimension. Breccia fragments range from millimeters to hundreds of meters in diameter and include rhyolite of Pirouette Mountain (Trpm), tuff of Job Peak (Tjp), and lower cooling unit of tuff of Poco Canyon (Tpcl). Breccia horizons commonly are clast supported. Unit locally contains thin beds of sandstone and accretionary lapilli. Zircon U-Pb date of 25.99±0.20 Ma

**Tpsb** **Sandstone and breccia**—Dark-red, reddish-brown and lavender-gray, medium-bedded to massive, quartz-rich sandstone and sedimentary breccia and minor quartz-rich ash-flow tuff. Breccia layers contain abundant pebble- to cobble-size, subangular to subrounded clasts of rhyolite of Pirouette Mountain (Trpm) and lower cooling unit of tuff of Poco Canyon in a quartz-rich sandy matrix derived in large part from the underlying tuff of Poco Canyon. Present locally west of Coyote Canyon where it overlies the lower cooling unit of tuff of Poco Canyon

**Tpcl** **Lower cooling unit**—White, gray, reddish-brown, lavender-gray, and greenish-gray, crystal-rich rhyolite and high-silica rhyolite ash-flow tuff. Contains 30 to 55 percent medium-grained phenocrysts comprised of K-feldspar and smoky quartz, less abundant plagioclase, minor biotite, and locally trace hornblende. Generally lithic- and pumice-poor and densely welded. Commonly hydrothermally altered and recrystallized. Zircon U-Pb date of 25.74±0.19 Ma

**Tpc Outflow tuff**—Reddish-brown weathering, white to gray, crystal-rich rhyolite and high-silica rhyolite ash-flow tuff. Contains 30 to 55 percent medium-grained phenocrysts comprised of K-feldspar and smoky quartz, less abundant plagioclase, minor biotite, and locally trace hornblende. Generally lithic-poor with moderate to sparse pumice, and densely welded. Zircon U-Pb date from Dummy Canyon is 25.97 ± 0.86 Ma. Sanidine 40Ar/39Ar date from Grover Canyon is 25.244 ± 0.041 Ma. Forms thick exposures on the west side of the Clan Alpine Mountains, where it is inferred to have ponded in the older Grover Canyon caldera. Unclear if outflow tuff correlates with upper or lower cooling unit in the Stillwater Range

**Tbt Biotite-rich tuff (Oligocene)** ­- Crystal-rich, abundantly porphyritic, pumice rich tuff with sparse lithics 269 21 N dip. Fresh plag, sanidine, biotite, some qtz but not as much as Poco usually has, or as smoky. 17-JC-21, lone outcrop south of the mouth of Grover Canyon (field notes, will update)

**Tupc Tuff of Upper Poco Canyon (Oligocene)**—Light gray-green to dark-green, crystal- and lithic-rich rhyolite ash-flow tuff. Contains about 20-30 percent fine- to medium-grained phenocrysts of clear quartz and altered K-feldspar and plagioclase with 1-2 percent chloritized biotite. Pervasive strong propylitic alteration with abundant clay minerals, calcite, and chlorite. Blocks of intermediate and silicic lavas as much as 5 m across are abundant. Zircon U-Pb date of 25.90±0.49 Ma

**Tjp Tuff of Job Peak (Oligocene)**—White to light green-gray, densely welded, moderately crystal-rich, lithic-rich rhyolite ash-flow tuff. Contains 10-20 percent, fine-grained phenocrysts of altered plagioclase and K-feldspar and locally trace quartz and biotite. Small (<6 cm) lithic fragments of Mesozoic metamorphic rocks, flow-banded rhyolite, and andesite are abundant, and much of tuff contains 30 to 50 volume percent lithic fragments. Locally includes coarse blocks of propylitized andesite derived from andesite porphyry (Tap). Zircon U-Pb date of 25.78±0.49 Ma

**Tap Andesite porphyry (Oligocene)**—Dark-green to black, coarse-grained, strongly porphyritic andesite and dacite. Mostly consists of hornblende plagioclase andesite porphyry containing about 30 percent, medium- to coarse-grained phenocrysts of plagioclase, hornblende, and minor resorbed quartz in a microcrystalline groundmass. Generally strongly propylitically altered and(or) thermally metamorphosed with formation of abundant epidote, illite, calcite, and chlorite. Intrudes and overlies the rhyolite of Pirouette Mountain (Trpm) and older tuff (Tot) units south of the IXL pluton. Zircon U-Pb date of 26.36±0.42 Ma

**Tlm Tuff of Louderback Mountains (Oligocene)**—Multiple cooling units of white, dark gray, greenish gray, and dark brown, densely welded rhyolite ash-flow tuff. Contains about 20 to 30% phenocrysts consisting of fine-grained plagioclase and less abundant K-feldspar. Minor hornblende locally present. Devitrified and generally propylitically or argillically altered. Locally lithic-rich, containing abundant clasts of andesite and flow-banded rhyolite (Toa and Trpm, respectively) that form 30-40% or more of the unit. U-Pb zircon age from West Gate quadrangle is 25.48 ± 0.49 Ma. Mostly too altered for 40Ar/39Ar dating, but Colgan et al. (2018) report 40Ar/39Ar sanidine ages of 25.227 ± 0.017 Ma and 25.173 ± 0.018 M from breccia blocks of Tlm in the tuff of Elevenmile Canyon in the West Gate area. se

**Trpm Rhyolite of Pirouette Mountain (Oligocene)**—Red, light-purple, green, black, and gray, generally sparsely porphyritic rhyolite lava flows and shallow intrusive rocks, with less abundant welded tuff and volcaniclastic sedimentary rocks. Rocks generally contain 0 to 10 percent fine- to medium-grained phenocrysts composed of altered plagioclase and K-feldspar, minor strongly resorbed quartz, and trace amounts of altered mafic minerals (hornblende and (or) pyroxene) in a microfelsite groundmass. Commonly strongly flow banded and locally flow folded. Locally includes thin interbedded sequences of moderately to densely welded, pumice-rich, crystal-poor ash-flow tuff and coarse-grained volcaniclastic sandstone and conglomerate. Tuffs locally show rheomorphic flow textures, and contain locally abundant, small lithic fragments consisting mostly of flow banded rhyolite. In Stillwater Range locally overlain by poorly exposed fine-grained sandstone and shale. Zircon U-Pb dates of 25.24±0.25 and 24.97±0.66 Ma from near top of unit in the Stillwater Range, and 25.52 ± 0.25 and 25.53 ± 0.39 Ma from the Louderback Mountains

**Tot Older tuffs (Oligocene)**—In Stillwater Range, includes at least three separate units of densely welded, lithic- and crystal-rich, pumice-poor rhyolite to dacite ash-flow tuff: (1) dark-green dacite tuff containing about 30 to 35 percent phenocrysts comprised mostly of fine- to medium-grained plagioclase, (2) light-greenish-gray, quartz-rich rhyolite tuff containing about 15 to 20 percent fine-grained phenocrysts, and (3) dark-green to black, biotite-hornblende dacite tuff containing about 30 percent medium-grained phenocrysts consisting mostly of plagioclase with 4 to 5 percent biotite + hornblende. All units are weakly to strongly propylitically altered and thermally metamorphosed with development of abundant hydrothermal epidote and fine-grained biotite. Relative ages of three units uncertain. Zircon U-Pb date of 26.10±0.54 Ma on unit 3. In Louderback Mountains, includes white, light-green-gray, and orange-brown, crystal-rich ash-flow tuff with 35 to 55 percent fine- to medium-grained phenocrysts of K-feldspar, plagioclase, clear to smoky quartz, and trace biotite. Devitrified, mostly densely welded, and commonly argillically altered. Zircon U-Pb date of 26.0 ± 0.63 Ma.

**Grover Canyon caldera**

**Trgc Rhyolite of Grover Canyon (Oligocene)** —Purple, gray, and reddish weathering, gray to grayish purple rhyolite lava with sparse small feldspar phenocrysts. Very strongly flow banded. Forms large masses (domes?) between Grover and Deep Canyons on the west side of the Clan Alpine Mountains. Overlies and (or) intrudes tuff of Grover Canyon (**Ttgc**) with a U-Pb age of ca. 25.6 Ma and is overlain by rhyolite lava and breccia unit **Trp** with a U-Pb zircon age of ca. 25.3 Ma. Chris has a bunch of argon dates that can come out in his Nine Hill paper later, for the purpose of this map the stratigraphy dates it well enough

**Trgct Tuffaceous rocks in rhyolite of Grover Canyon –** that band of pale tuffaceous stuff north of the mouth of Deep Canyon, can’t remember who all saw it but I need to dig up a description.

**Ttgcs** Sedimentary breccia between **Ttgc/Ttgcx** and tuff of Poco Canyon on north side of Grover Canyon. I called it this to distinguish from the main mass of Tnhx farther south, but Chris and Dave spent the most time here.

**Ttgc Tuff of Grover Canyon (Oligocene)** — Dark reddish orange to reddish brown weathering, crystal poor, pumice and lithic rich, densely welded rhyolite ash-flow tuff. Contains 10-15% phenocrysts predominantly of sanidine, with anorthoclase, lesser plagioclase, and trace quartz and biotite. Abundant, strongly flattened “wispy” pumice fiamme weather darker than matrix and give the rock a distinctive appearance in outcrop; mapped as “delicate fiamme tuffs” by Hardyman and others (1988). Densely welded tuff occurs as discrete lenses a few meters to several hundred meters thick, intercalated with massive, very coarse breccia. Breccia contains clasts and giant blocks predominantly of brecciated andesite and rhyolite lava in an altered matrix probably composed mostly of more finely crushed breccia and is interpreted as megabreccia (**Ttgcx**) in intracaldera tuff. Coarsest blocks occur on north side of Dummy Canyon. Total exposed thickness of Ttgc and Ttgcx is at least 420 [check this more carefully] meters; base is not exposed. U-Pb zircon ages are 25.82 ± 0.26 and 25.60 ± 0.41 Ma from Dummy Canyon, and 25.66 ± 0.45 Ma from Dry Canyon. On the basis of outcrop appearance, unusual three-feldspar phenocryst assemblage, composition, and age, this tuff is very similar to---and potentially correlative with---the widespread Nine Hill Tuff (Henry and John, 2013). Chris will write a whole paper about this someday and pronounce it Real Nine Hill

**Tcx Breccia in Cow Canyon (Oligocene)**—White to pale brown, greenish, and gray, poorly welded tuff, tuffaceous sediments, and coarse breccia with a tuffaceous matrix. Poorly welded tuff contains abundant small white pumice, abundant lithics predominantly of flow-banded rhyolite, and phenocrysts of quartz, feldspar, and biotite. Well bedded fine= to medium=grained sandstones contain abundant quartz crystals and other volcanic detritus. Coarse breccias have tuffaceous matrix with large (up to 30 m), variably brecciated blocks including flow-banded rhyolite lava, crystal and lithic-rich tuff with smoky quartz, pale orange to cream colored tuff with small phenocrysts of feldspar and quartz (possibly **Tcc**). Dark-weathering, resistant breccia blocks stand out prominently against background of white tuffaceous matrix. Makes up entire slope on west side of Cow Canyon, where it is ~300 m thick and capped by **Trp** on the ridgetop. On west side of ridge overlies tuff of Poco Canyon (**Tpcl**); overlies tuff of Deep Canyon (**Tdc)** near intersection of Cow and Deep Canyons. Age probably close to ca. 25 Ma based on cross-cutting relationships. Chris has unpublished argon dates that can either appear here or in the paper about the Grover Canyon caldear and Nine Hill Tuff.

**Eastgate caldera**

**Tteu Ash flow tuff and sedimentary rocks (Oligocene) —** Contains thin layers of tuff identical to tuff of Eastgate, poorly exposed sedimentary breccias, and thin lenses of tuff resembling outflow Nine Hill Tuff or tuff of Grover Canyon. Interpreted to be deposited in the depression formed by collapse of the Eastgate caldera following eruption of the tuff of Eastgate. Appears to be host unit for most of the mineralization in the Eastgate district.

We called the thin tuffs Nine Hill in the field but they can’t be if the tuff of Eastgate is what Chris argon dated in the Desatoya because its too young.

**Tte Tuff of Eastgate (Oligocene)**—Gray to greenish-brown weathering, gray welded ash-flow tuff. Contains 30-40% phenocrysts mainly of fine-grained plagioclase, with lesser K-feldspar, minor quartz, and 3-5% altered biotite and hornblende. Exposed on Eastgate ridge south of US Highway 50, where it was mapped as the “Eastgate volcanics” by Barrows (1971). About 300 m thick where it rests on older dacite lava flows and sedimentary rocks (Tde) and is interpreted as intracaldera tuff. Extensively propylitically and locally argillically altered. Zircon U-Pb zircon date south of US 50 is 25.11 ± 0.34 Ma. North of US 50, it occurs as large megabreccia blocks (**Tecx**) in intracaldera tuff of Elevenmile Canyon. In the Desatoya Mountains, inferred outflow overlies the tuff of Campbell Creek. Chris has unpublished argon dates on this unit, originally we thought it was Dogskin but it turned out to be 25 Ma. We can include those here if you want since they aren’t really part of the Nine Hill story

**Tde Porphyritic dacite lava (Oligocene)**—Brownish-green weathering, brown and gray porphyritic lava and minor bedded volcanoclastic sandstone. Coarsely porphyritic lava contains about 40 percent phenocrysts consisting large square plagioclase, lesser biotite and hornblende. Plagioclase is illite-calcite altered and biotite and hornblende are altered to reddish iron oxides or chlorite. Underlies tuff of Eastgate at base of east side of Eastgate ridge south of US 50; base is not exposed. Precise age unknown, older than 25.2 Ma and probably no older than 33 Ma. Absence of tuff of Campbell Creek between Tde and overlying Tte may suggest an age between ca. 25 and 29 Ma

**Tcc Tuff of Campbell Creek (Oligocene)**—Orange to tan weathering, pale orange to gray densely welded ash flow tuff. Contains about 8 percent phenocrysts of subequal plagioclase, K-feldspar, quartz (often distinctly wormy), with trace biotite and locally hornblende. Outflow has sparse lithics, moderately abundant pumice, and ranges from densely to poorly welded. In the Desatoya Mountains, intracaldera Tcc forms a single massive, densely welded cooling unit >600 m thick (Henry et al., 2012); the base is not exposed. Outflow in the Clan Alpine Mountains occurs as ledges ~10 m thick, often with a densely welded, distinctly orange upper part and a gray, poorly welded, sometimes glassy base. Sanidine 40Ar/39Ar ages from outflow and intracaldera tuff are ca. 28.9 Ma (Henry et al., 2012)

**Tots Older tuffs and sedimentary rocks (Oligocene)**—Pale orange to tan weathering, pale orange, cream, and light gray welded ash-flow tuff. Multiple distinct cooling units, locally with poorly exposed sandstone in between. Sparsely to moderately porphyritic tuffs have generally fine-grained phenocrysts of feldspar, quartz, and distinctive biotite. As mapped, overlies the tuff of Dogskin Mountain (**Tdm**) along the east side of lower Edwards Creek, but may be interbedded with multiple cooling units of **Tdm** or an identical tuff. Henry and John (2013) report a sanidine 40Ar/39 age of 29.07 + 0.018 Ma (sample H13-55D) from Bassie Canyon about 200m east of the map boundary near Edwards Creek.

**Tdm Tuff of Dogskin Mountain (Oligocene)**—Dark gray weathering, gray densely welded ash-flow tuff. Contains (25% ??) phenocrysts of plagioclase, sanidine, biotite, and trace quartz. Outflow along Edwards Creek has sparse lithics and abundant pumice. Deposited on older rhyolite lava (Trdm) near the mouth of Edwards Creek, where it is clearly welded against paleotopography and dips steeply but variably to the east and north. Henry and John (2013) report a plagioclase 40Ar/39 age of 29.819 + 0.033 Ma (sample H11-186) near the mouth of Edwards Creek.

**Trdm Rhyolite lava, breccia, and tuff (Oligocene)** — Gray, reddish, and greenish weathering, gray to gray-green rhyolite breccias, lava flows, and poorly welded tuff along the west side of lower Edwards Creek in the Desatoya Mountains. Lava flows and domes(?) are a massive, reddish-weathering, gray cliff-forming rhyolite with prominent flow banding and sparse phenocrysts of sanidine and quartz; locally intensely brecciated. Tuff is pale green, ranges from sparsely to moderately porphyritic with 5-20% quartz and sanidine, locally with minor biotite and/or altered hornblende; contains abundant small greenish pumice; lithics range from sparse small clasts to large (10s of meters) breccia blocks of crystal-poor flow-banded rhyolite. Undated but overlain by tuff of Dogskin Mountain (Tdm) at the mouth Edwards Creek and therefore older than ca. 29 Ma.

**Tor Older rhyolite (Oligocene)**—Light-gray, sparsely porphyritic, locally vesicular, flow banded rhyolite exposed along south margin of Job Canyon caldera. Contains 5-10 percent phenocrysts of fine- to medium-grained altered plagioclase and K-feldspar and trace to 1 percent clear quartz in microcrystalline quartz-feldspar groundmass. Intrudes(?) or overlies older dacite and andesite (units Tolf, Tobr, and Todt) and intruded by IXL pluton (Tixl). Western outcrop is propylitically altered with clots of epidote, quartz and hematite filling vesicles and in groundmass. Other outcrops are hornfelsed by IXL pluton

**Job Canyon caldera**

**Tixl IXL pluton (Oligocene)**—Dark-gray, fine- to medium-grained, equigranular to porphyritic granodiorite and quartz monzodiorite. North and west margins of the pluton have a conspicuous porphyry texture consisting of medium-grained feldspar and scattered biotite and hornblende phenocrysts set in a small amount of fine-grained groundmass composed of quartz, feldspar and biotite. The color index is about 12 to 15. The lowest exposed part of the pluton along the Dixie Valley Fault is a medium-grained, equigranular rock with a color index of about 25 including hornblende crystals containing clinopyroxene cores. Irregular, spongy, hornblende-rich mafic enclaves as much as 1 m long with chilled margins are common near the roof (west margin) of the pluton; smaller mafic enclaves are scattered elsewhere in the pluton. Zircon U-Pb dates of 28.45±0.35 and 28.07±0.33 Ma.

**Tdg Diorite and granodiorite (Oligocene)**—Light-grayish-green, fine-grained, sparsely porphyritic clinopyroxene diorite and medium-grained, sparsely porphyritic, biotite-hornblende granodiorite and granodiorite porphyry exposed in northwest part of map. Diorite contains small (2–4 mm) plagioclase phenocrysts and about 15 percent clinopyroxene partially altered to chlorite. Granodiorite contains about 15 percent mafic minerals. Both rock types are weakly to strongly propylitically altered or locally strongly argillically altered. Intrudes tuff of Job Canyon. Age relation to younger dacite and andesite unit (Tyda) uncertain due to strong alteration of both units

**Tyda Younger dacite and andesite (Oligocene)**—Generally dark- to pale-green to black, aphyric to coarsely porphyritic dacite and andesite lava flows, flow breccias, minor air-fall and ash-flow tuff and epiclastic sedimentary rocks (units Tyda, Tydas, and Tydat of John and others, 2024). Porphyritic units contain plagioclase, less abundant hornblende, biotite, and clinopyroxene, and rare quartz phenocrysts. Generally weakly to strongly altered to propylitic and intermediate argillic assemblages with development of chlorite, illite or smectite, and (or) calcite. Quartz commonly fills vesicles. Dacitic ash-flow tuff beds locally present near base of unit. Siltstone and fine-grained sandstone beds common in upper part of unit. Plagioclase and biotite 40Ar/39Ar ages 28.89 ± 0.40 and 28.81 ± 0.01 Ma, respectively, on glassy lava flows near top of unit, and zircon U-Pb age of 28.54 ± 0.51 Ma on propylitized lava flow in middle of unit

**Tydai Dacite and andesite intrusions (Oligocene)**—Dark-green to dark-gray, fine- to medium-grained, moderately to abundantly porphyritic biotite-hornblende(?)-plagioclase dacite and andesite intrusions. Generally strongly propylitized with abundant epidote and chlorite. Plagioclase phenocrysts commonly white to pale pink colored. Forms narrow dikes and small irregular intrusions in the tuff of Job Canyon and older dacite and andesite unit and likely fed overlying lava flows in the younger dacite and andesite unit (Tyda)

**Tjc Tuff of Job Canyon (Oligocene)**—White, light-gray, and green-gray, densely welded, generally lithic-rich and crystal-poor rhyolite ash-flow tuff. Tuff is devitrified and commonly strongly altered to propylitic, argillic, and local advanced argillic assemblages. Locally contains abundant disseminated pyrite. Generally contains less than 10 to 15 percent fine-grained phenocrysts of altered plagioclase and K-feldspar with local trace amounts of quartz and biotite. Highly variable pumice contents. Small (<6 cm) lithic fragments of Mesozoic metamorphic rocks and Cenozoic volcanic rocks are common. Zircon U-Pb ages of 29.25 ± 0.47 and 29.30 ± 0.45 Ma. Locally contains coarse megabreccia blocks (**Tjcx**) of andesitic metavolcanic rocks, marble, argillite, siltstone, quartzite and the older dacite and andesite unit as much as 50 m across

**Tjcxr Jurassic rhyolite megabreccia (Oligocene)**—White, commonly orange-weathering, locally flow banded, nearly aphyric rhyolite. Commonly strongly kaolinite or illite altered and locally strongly brecciated. Zircon U-Pb ages of 155.2 ± 2.4 and 156.33 ± 0.37 Ma. Forms massive outcrops along northwest edge of the Job Canyon caldera, where it is interpreted as megabreccia deposited near the top of the caldera following eruption of caldera-filling tuff of Job Canyon (**Tjc**) or during eruption of the overlying younger dacite and andesite unit (**Tyda**)

**Dacite and andesite underlying the Job Canyon caldera**

**Todt Dacite tuff (Oligocene)**—Dark-gray to green, densely welded, lithic- and crystal-rich dacite tuff. Contains about 15–30 percent, fine- to medium-grained phenocrysts of altered sanidine and plagioclase with prominent strongly resorbed quartz and fine-grained biotite, and minor strongly altered hornblende(?). Contains abundant lithic fragments of Cenozoic intermediate and silicic lava flows and less abundant Mesozoic quartzite and granite. Tuff is pervasively propylitically altered with abundant illite, epidote, chlorite, calcite and disseminated pyrite. Zircon U-Pb date of 29.32±0.97 Ma and biotite 40Ar/39Ar age of 29.17±0.09 Ma. Only mapped where tuff forms top of older dacite and andesite unit

**Tolf Lava flows (Oligocene)**—Heterogeneous sequence of aphyric to coarsely porphyritic dacite and andesite lava flows and flow breccias, hypabyssal intrusions, and minor pyroclastic rocks and conglomerate. Porphyritic rocks contain fine- to coarse-grained phenocrysts of plagioclase, hornblende, biotite, and clinopyroxene. Pyroclastic rocks are lithic-rich welded tuffs. Generally strongly propylitically altered with abundant calcite, chlorite, epidote, illite and local specular hematite. Zircon U-Pb date of 29.38±0.38 on a lava flow near top of unit

**Tobr Breccia, conglomerate, and tuffs (Oligocene)** — Dark-green, gray-green, and reddish-brown lithic-rich tuff breccia, flow breccia, and conglomerate. Lithic fragments consist of small (<10 cm), subangular to subrounded clasts of Cenozoic andesitic to rhyolitic lavas and less common Mesozoic quartzite and granitic rocks. Locally contains blocks as much as 10 m across of andesite breccia in tuffaceous matrix composed of fine- to medium-grained, moderately porphyritic dacite(?) similar to tuff in dacite tuff unit (Todt). Generally strongly propylitically altered with abundant clots and fracture coatings of epidote and specular hematite. Zircon U-Pb dates of 29.27±0.49 Ma on lithic-rich tuff breccia near top of unit and 29.65±0.52 Ma on densely welded tuff in lower part of unit

**Trwc Rhyolite of War Canyon (Oligocene)**—Reddish-orange to gray weathering, gray, purple, and pinkish rhyolite lava exposed on the east flank of the Clan Alpine Mountains between War and Byers Canyons. Aphyric to very sparsely porphyritic with small feldspar phenocrysts. Very strongly flow-banded with prominent devitrification texture along flow bands. Include flows, domes, and shallow intrusions(?) that overlie and intrude Tdc but are otherwise undated. Tentatively interpreted as ca. 30 Ma post-caldera domes along north margin of Deep Canyon caldera, but may correlate with other rhyolites as young as ca. 25 Ma. I was worn out by crystal poor rhyolite at this point. Dave, if you want to take a look at the chemistry maybe that says something, otherwise it can stay partly mysterious.

**Tdai Intrusive rocks in Deep Canyon (Oligocene)**—Andesite and dacite intrusive complex intruding tuff of Deep Canyon. Porphyritic with phenocrysts of plagioclase, hornblende, biotite, and ferromagnesian minerals. Spherulitic and increasingly mafic towards margins. Tentatively interpreted as post-caldera intrusion associated with Deep Canyon caldera, but could be as young as Miocene, possibly correlative with **Tdi** on west side of range. Exposed in one remote canyon and not examined as part of this study. Includes units Tdi and Ta of Hardyman and others (1987). It would take a full day to get to this and look at it, not sure if that’s worth it although I am curious. Some of the mapped bodies look suspiciously like they could be megabreccia, but Hardyman recognized that elsewhere so who knows.

**Deep Canyon caldera**

**Tdts Tuffaceous sediments and breccias (Oligocene)**—White to pale gray layers of fine-grained, well-bedded tuff, very fine-grained, laminated, platy-weathering tuffaceous sediments, and pebble conglomerate containing clasts of rhyolite and intermediate lava (possibly Tao). Overlies Tdc along the northern margin of the Deep Canyon caldera south of Byers Canyon. Undated but inferred to be deposited in a topographic “moat” along the northern caldera margin, suggesting an age of ca. 30 Ma.

**Tdc Tuff of Deep Canyon (Oligocene)**—Tan to brown weathering, gray rhyolite ash-flow tuff. Contains about 20% (do we have a thin section?) phenocrysts of plagioclase, potassium feldspar, biotite, quartz, and sparse hornblende. Moderately welded to nonwelded. Pumice and lithic rich, with abundant clasts of dark Triassic siltstone (probably TRbc) and less common mafic lava (probably Tao). Contains megabreccia blocks (unit Tdcx) of lava and Triassic sedimentary rocks along north caldera margin near Deep Canyon and Byers Canyon. In study area filling the Deep Canyon caldera in the Clan Alpine Mountains. At least 400 m thick; base not exposed. Sanidine 40Ar/39Ar ages are 30.374 ± 0.011 and 30.52 ± 0.168 Ma from Deep Canyon, and 30.351 ± 0.018 Ma from Byers Canyon. – I think these are Chris’ unpublished dates, include here or in the eventual Nine Hill paper? Was there a date in Henry and John 2013?

**Older intermediate lavas**

**Tao Andesite lava flows (Oligocene)** — in Byers Canyon, overlies Triassic metasedimentary rocks and partly forms north wall of Deep Canyon caldera. Need description from Chris. Within the map area, 40Ar39Ar ages of 31.736 +/- 0.186 Ma north of Deep Canyon, and 32.37 +/- 0.06 Ma in upper Byers Canyon. An outcrop in the central Clan Alpine Mountains ~10 km northeast of the map area yielded an 40Ar/39Ar age of 32.33 +/- 0.3 Ma (H14-113), and an isolated outcrop in Edwards Creek Valley ~6 km east of the map area yielded an 40Ar/39Ar age of 32.461 +/- 0.05 Ma. I think these dates are unpublished, Chris up to you to include them here or save for another paper.

**Toa Andesite lava and conglomerate (Oligocene to Eocene?)**—Dark-green, dark-gray, and dark-lavender-gray, aphyric to medium-grained to rarely coarsely plagioclase-phyric, porphyritic andesite, dacite, and basaltic andesite lava flows. Phenocrysts consist of tabular plagioclase, mostly ≤1 to 3 mm long but up to 1 x 10 mm in basaltic andesite, hornblende, and pyroxene, although mafic phenocrysts are mostly altered. Generally altered to propylitic mineral assemblages containing abundant epidote, chlorite, and sericite. Locally flow banded and finely to coarsely vesicular. Crops out mainly south of the large area of Jurassic rocks along the west side of the Clan Alpine Mountains where it overlies coarse sedimentary breccia/conglomerate (Toax) and both filled a deep canyon cut into Jurassic rocks. Smaller outcrop areas are along the eastern and southern flank of Chalk Mountain (Corvalan, 1962; Willden and Speed, 1974), and overlying Cretaceous granite (Kg) on the northwest flank of Fairview Peak (Henry, 1994a).

**Toai Andesite intrusion** **(Oligocene to Eocene?)**—Finely porphyritic andesite with plagioclase, pyroxene, and sparse quartz forming an irregular west-striking intrusion between lower Jurassic rocks (**Jl**) and coarse conglomerate–sedimentary breccia (**Toax**) in the West Gate area. Probably intrusive equivalent of older andesite lava (**Toa**).

**Toax Coarse conglomerate and sedimentary breccia (Oligocene to Eocene?)**—Coarse conglomerate/sedimentary breccia composed of various mixes of andesite (**Toa**), limestone, shale or phyllite, and chert (probably mostly Jurassic (**Jl**), and Cretaceous(?) granodiorite up to 10 m long. Clast proportions vary from exclusively andesite clasts (where it is difficult to distinguish from andesite lava (**Toa**) to almost entirely Jurassic limestone, to locally abundant granodiorite. Even largest clasts are mostly rounded but can vary to subangular. Matrix mostly consists of moderately to poorly bedded, sandy to pebbly to cobbly andesite grit but is rarely exposed. Crops out in two areas north and south of large area of Jurassic rocks along west side of Clan Alpine Mountains, where it probably filled major paleocanyons cut into Jurassic rocks. A hornblende andesite clast from low in this section yielded an 40Ar/39Ar age of 33.93 + 0.24 Ma. Chris’ unpublished date, include here?

**TKas Aplite dikes and sills (age uncertain)**—White to cream-colored, fine-grained aplite or aphyric felsite makes dikes, sills, and irregular intrusions into Jurassic rocks. In southern Clan Alpine Mountains may be aphyric equivalents of Oligocene porphyritic rhyolite dikes. Age and affinity of aplites south of US 50, which only intrude lower Jurassic rocks (Jl) and are not spatially associated with porphyritic rhyolite, are uncertain

MESOZOIC INTRUSIVE ROCKS

**Kg Granite (Late Cretaceous)**—Medium- to coarse-grained, equigranular to coarsely porphyritic biotite-hornblende granodiorite with megacrysts of potassium feldspar up to 5 mm long. Sphene up to 1 mm long is a ubiquitous accessory. Includes small body exposed west of the Fairview district (Kg of Henry, 1994a) and small outcrop underlying Miocene sedimentary rocks on the west edge of Dixie Valley in the southwest part of the map area. U-Pb zircon age on the Dixie Valley outcrop is 85.7 ± 0.82 Ma. Probably correlative with the Sand Springs pluton, from which Watts and others (2019) reported a U-Pb zircon age of 88.6 ± 3.1 Ma

**Klp La Plata Canyon pluton (Cretaceous)**—Composite, light-colored granitic intrusion consisting of fine- to medium-grained, equigranular biotite granite, quartz monzonite, and associated leucocratic dikes (Butler, 1979). Commonly altered with formation of abundant fine- to coarse-grained muscovite and pyrite with local fluorite and milky white quartz veins. Between Elevenmile and La Plata Canyons contains small bodies of propylitized, coarsely porphyritic biotite-hornblende dacite or rhyolite porphyry that probably are early Miocene intrusions. Zircon U-Pb date of 87.25±0.50 Ma on biotite granite in La Plata Canyon, and K-Ar alteration age of 84.4±0.8 Ma from muscovite in vein within Mesozoic wall rocks at fluorite prospect near mouth of La Plata Canyon (Garside and others, 1981)

**Kf Felsite (Cretaceous)**—Light-colored felsite containing sparse, 1-2 mm phenocrysts of resorbed quartz and altered feldspar in a fine-grained, allotriomorphic granular groundmass of quartz, altered plagioclase and K-feldspar(?), illite, minor pyrite, and ghosts of tabular mafic minerals outlined by ragged aggregates of epidote. In La Plata Canyon, contacts between felsite dikes and leucocratic parts of the La Plata Canyon pluton are gradational and arbitrarily drawn. Zircon U-Pb date of 104.8±1.4 Ma

MESOZOIC METASEDIMENTARY AND METAVOLCANIC rocks

**Mountain Well sequence (Early Cretaceous?)**—Poorly dated, metamorphosed volcanic and sedimentary rocks in the southern Stillwater Range; provisional age assignment based on preliminary zircon U-Pb date of meta-andesite lava flow (Kmv) and association with Cretaceous felsite unit (Kf). Divided into:

**Kmv** **Andesitic metavolcanic rocks** --Foliated metamorphosed andesite, andesite breccia containing stretched clasts, and dacitic welded tuff and tuff breccia. Zircon U-Pb date of 103.9±1.5 Ma

**Kms** **Metasedimentary rocks** --Heterogeneous, interstratified and intergradational, subaqueous gravity-flow sequence mainly of gray to black (1) slaty siliceous argillite, (2) massive fine- to medium-grained orthoquartzite, (3) turbiditic quartz siltstone or fine-grained sandstone in well-bedded, thin- to medium-thick, Tb A(B)C(E) Bouma sequences, (4) calcareous quartz siltstone, (5) fine-grained mud-chip or lime mudstone chip sedimentary breccia, and (6) lithic sandstone of dense felsitic or plagioclase-lath volcanic rocks along with minor quartzite and quartz grains. Also included are minor amounts of foliated marble and tuffaceous(?) greenstone. Less competent rock types strongly flattened on foliation and with grain-stretch lineation. Discontinuous channel(?) deposits of tectonically flattened limestone- and orthoquartzite-clast sedimentary breccia crop out in two places near stratigraphic base of unit,andat one of these localities the breccia forms coarse-grained base of a Tb AB(C) Bouma sequence of black orthoquartzite

**Kmd** **Dacitic volcanic-felsite flows and sedimentary breccia**--White to dark gray, mostly weathered light brown. Massive felsite completely aphyric and featureless in hand specimen; in thin section, composed entirely of more or less flow-aligned laths of altered plagioclase in altered, probably originally glassy, groundmass. Tectonically flattened, crudely bedded sedimentary breccia of felsite clasts interstratified in upper part of unit, and upper part of unit interfingers with unit Kms. Stratigraphic base of unit Kmd everywhere faulted

**Jq Quartzite (Jurassic?)**—Massive, fine-grained white quartzite north of the Job Canyon caldera in the Stillwater Range. Age assignment inferred based on regional distribution of quartzite (Page, 1965; Willden and Speed, 1974)

**Jm Calcareous quartz arenite and limestone (Middle Jurassic)**—Calcareous quartz arenite about 60 m thick overlain by at least 100 m of thick-bedded to massive, dark gray limestone that is sandy in its lower part. Corvalan (1962) reported a Bajocian fauna that demonstrates the unit is Middle Jurassic. Exposed in overturned syncline north of West Gate. Contact with underlying Lower Jurassic shale and limestone (Jl) is conformable and gradational

**Jl Shale and limestone (Lower Jurassic)**—Thin- to medium-bedded, light to dark gray limestone and sandy (quartzitic) limestone with thick interbeds of dark gray to black, calcareous shale and silstone that is variably metamorphosed to phyllite. North of US 50, Corvalan (1962) divided the unit into seven lithologic members that totaled 360 m thick but are not separated here. South of US 50, unit consists of a thick, lower shale overlain by thin- to medium-bedded limestone that conformably overlies Upper Triassic dolomite (TRd) along a gradational contact. Corvalan (1962) found numerous fossils, especially ammonites, that demonstrate the unit is Lower Jurassic.

**JTRm Undifferentiated metasedimentary rocks (Jurassic and Triassic)**—West of Fairview Peak, includes JTRm unit of Henry (1994), consisting of dark gray quartzite and phyllitic sandstone and shale. Sandstone and shale form fining upward sequences up to 1 m thick. Metamorphic minerals include muscovite, epidote, and chlorite. On the west edge of the Louderback Mountains, includes Mzmp unit of John (1997), consisting of dark gray marble, garnet-pyroxene skarn, and black phyllite, possibly correlative with the Clan Alpine sequence.

**TRd Dolomite (Triassic)**—Thin-to thick-bedded, mostly light gray to almost black, strongly recrystallized dolomite and dolomitic limestone, commonly with secondary muscovite. Locally has minor argillaceous material, commonly recrystallized to muscovite or chlorite, and a layer of black, calcitic shale about 10 m thick lies within the unit south of US 50. Skarn consisting mostly of serpentine with coarse magnetite and finer grained epidote, garnet, and phlogopite is developed along the contact with Oligocene rhyolite porphyry (Tcrp). About 150 m thick; base is not exposed (Corvalan, 1962). Corvalan (1962) found late Norian fossils, especially in the black shale layer, that demonstrate that the unit is Upper Triassic.

**Clan Alpine sequence (Lower Jurassic and Upper Triassic)**—Limestone and argillite provisionally correlated with units assigned to the Clan Alpine sequence of Speed (1978). Exposed in three main outcrop areas, divided into:

**Clan Alpine sequence in the southern Stillwater Range (upper plate of La Plata fault)**

**JTRcl** **Limestone (Lower Jurassic** **and (or) Upper Triassic)**—Massive, gray-weathering, lime mudstone; bedding mostly obscure, commonly veined with calcite, and locally foliated; in places abundantly oncolitic. Interpreted as a carbonate-platform deposit. Exposures of contact with unit TRcl are limited in extent and difficult to interpret. Believed to depositionally overlie unit TRcl and thus be laterally equivalent to the Mud Springs Canyon Formation of Speed (1978) in the Clan Alpine sequence of the Clan Alpine Mountains

**TRcl** **Limestone (Upper Triassic)**—Regularly thin-bedded to medium-bedded black lime mudstone. Weakly metamorphosed except where conspicuously flattened, foliated, and lineated near La Plata Fault and where thermally metamorphosed to marble near contact with La Plata Canyon pluton. Turbiditic interbeds as thick as 20 cm formed of crinoid ossicles (and more rarely of molluscan shell fragments) exhibit TbA and AB Bouma sequences; in southwesternmost exposures, crinoidal turbidites form as much as 50 percent of section through stratigraphic thicknesses of several tens of meters and are associated with rare units of limestone sedimentary breccia containing clasts as large as several centimeters. Lime mudstone beds commonly have internal planar lamination and locally have laminae of quartz silt or subordinate interbeds of black argillite. Interpreted as slope, and possibly partly basinal, deposit. Conspicuous white alteration lenses, several millimeters thick and as long as 20 cm, and composed of neomorphosed calcite, are locally abundant within lime mudstone beds. Age-diagnostic fossils scarce but include ammonite Choristoceras, spherical hydrozoan Heterastridium, and pelagic bivalve Monotis subcircularis, all of late Norian age and in southwestern part of outcrop area (John and Silberling, 1994). Similar in lithic character, age, and depositional setting to, and is regarded as a lateral equivalent of the Hoyt Canyon Formation of Speed (1978), which forms part of the Clan Alpine sequence of the Clan Alpine Mountains.

**TRca** **Argillite (Upper Triassic)**—Predominantly planar laminated argillite with subordinate quartzose siltstone and fine-grained sandstone that occurs as laminae or in thin, locally graded beds. Light brown, olive gray, or gray but black where hornfelsed near La Plata Canyon pluton. Weakly developed slaty foliation away from areas of thermal metamorphism. Minor intercalations of limestone. Interpreted as laterally equivalent to the slope or basinal siliciclastic rocks that are either interstratified with limestone strata of the Hoyt Canyon Formation of Speed (1978) or form the underlying Bernice Formation of Speed (1978) in the typical Clan Alpine sequence of the Clan Alpine Mountains. In southwesternmost part of outcrop area, rocks of unitTRca are clearly overlain stratigraphically by generally overturned, fossiliferous, turbiditic limestone of unit TRcl; elsewhere in map area, stratigraphic superpositon of rocks assigned to these two units is ambiguous

**Clan Alpine sequence north of the Job Canyon caldera**

**TRcs** **Calcareous siltstone and sandstone (Triassic)**—Pale red-purple and yellow-brown calcareous siltstone and sandstone with some intercalated bedded gray limestone. Matrix-supported chert grit and fine-grained pebbles in some beds. Small, glogose ammonites of indeterminate species suggest Triassic rather than Early Jurassic age

**TRs** **Siltstone and argillite (Triassic)**—Mostly dark olive-gray siltstone and argillite, with intercalated beds and units of fine- to medium-grained brownish sandstone and partly bioclastic limestone. Some sandstone and limestone beds have Bouma layering, and flute casts locally well developed. Unit characteristic of basinal part of Auld Lang Syne Group or Clan Alpine sequence of Speed (1978)

**Clan Alpine sequence in the Clan Alpine Mountains**

**TRdc Dyer Canyon Formation (Upper Triassic)**—Sandstone (about 70%) and subordinate pelitic rocks (about 30%). Sandstone composed of medium-grained quartz sand, 1-5% detrital white mica, and a few percent or less of plagioclase and chert sand, typically with calcite cement; bed thickness varies from 0.08 to 15 m; thin and medium beds are commonly graded and richer in fine-grained sand and mica; thicker beds are typically more uniform except for concentrations of coarse, angular quartz at the base and a few cm of rippled fine-grained sand at the top. Pelitic rocks chiefly laminate, which varies from 85-50% black mudstone and the rest very fine-grained to fine-grained sandstone, sandstone and mudstone chiefly in graded sets between 2 m and 10 cm thick. Upper Triassic on the basis of Norian fauna in the Clan Alpine Mountains (Speed, 1978).

**TRbc Byers Canyon Formation (Upper Triassic)**—Chiefly pelitic rocks, with 10% limestone, 5% sandstone, and minor conglomerate. Pelitic rocks include laminated mudstone to very fine-grained sandstone in graded sets, with discontinuous cross-laminated to ungraded sandstone laminae, and massive dark mudstone. Limestone is chiefly dark gray to black, crystalline or aphanitic, massive or laminated; occurs in beds up to 3 m thick that are commonly clustered in zones 6 to 60 m thick where limestone is as much as half the succession. Sandstone includes fine- to medium-grained quartz-mica arenite in discrete thin to thick beds (.03 to 1 m, mostly .06 to .3 m thick) within pelitic successions, and calcareous quartz arenite; sandstones are commonly massive, flat bottomed, without sole marks, and with ripple marks on tops. Conglomerates commonly graded and transitional to pebbly and plane-laminated chert arenite; pebbles constitute bed framework, have strong preferred alignment but no evident imbrication; base of conglomerate beds planar; conglomerates interbedded with limy mudstone, calcarinite, pebbly mudstone, and chert arenite. Upper Triassic on the basis of Norian fauna in the Clan Alpine Mountains (Speed, 1978).

**Mesozoic rocks in the lower plate of the La Plata fault, southern Stillwater Range**

**Mzp Phyllite (lower Mesozoic?)**—Strongly foliated phyllite, commonly containing intrafoliation andalusite porphyroblasts (chiastolites) that are locally aligned, forming a pronounced lineation. In contact zone of La Plata Canyon pluton, younger generation of andalusite porphyroblasts is superimposed upon and crosscuts foliation and lineation. Locally, phyllite grades into foliated, medium- to coarse-grained, impure, volcanic sandstone having only a small percentage of quartz grains; volcanic-lithic and feldspar (?) grains generally strongly stretched on foliation. No direct evidence for age, but its lithology and metamorphic and structural history resembles rocks included in the Sand Springs "lithotectonic assemblage" of Oldow (1984) (Oldow and others, 1993), which lies to the south of the La Plata Canyon area, and from which fossils of probable Triassic and Jurassic ages are known (Satterfield, 2002)

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