Geologic Map of the Williams Lake Quadrangle, Lemhi County, Idaho

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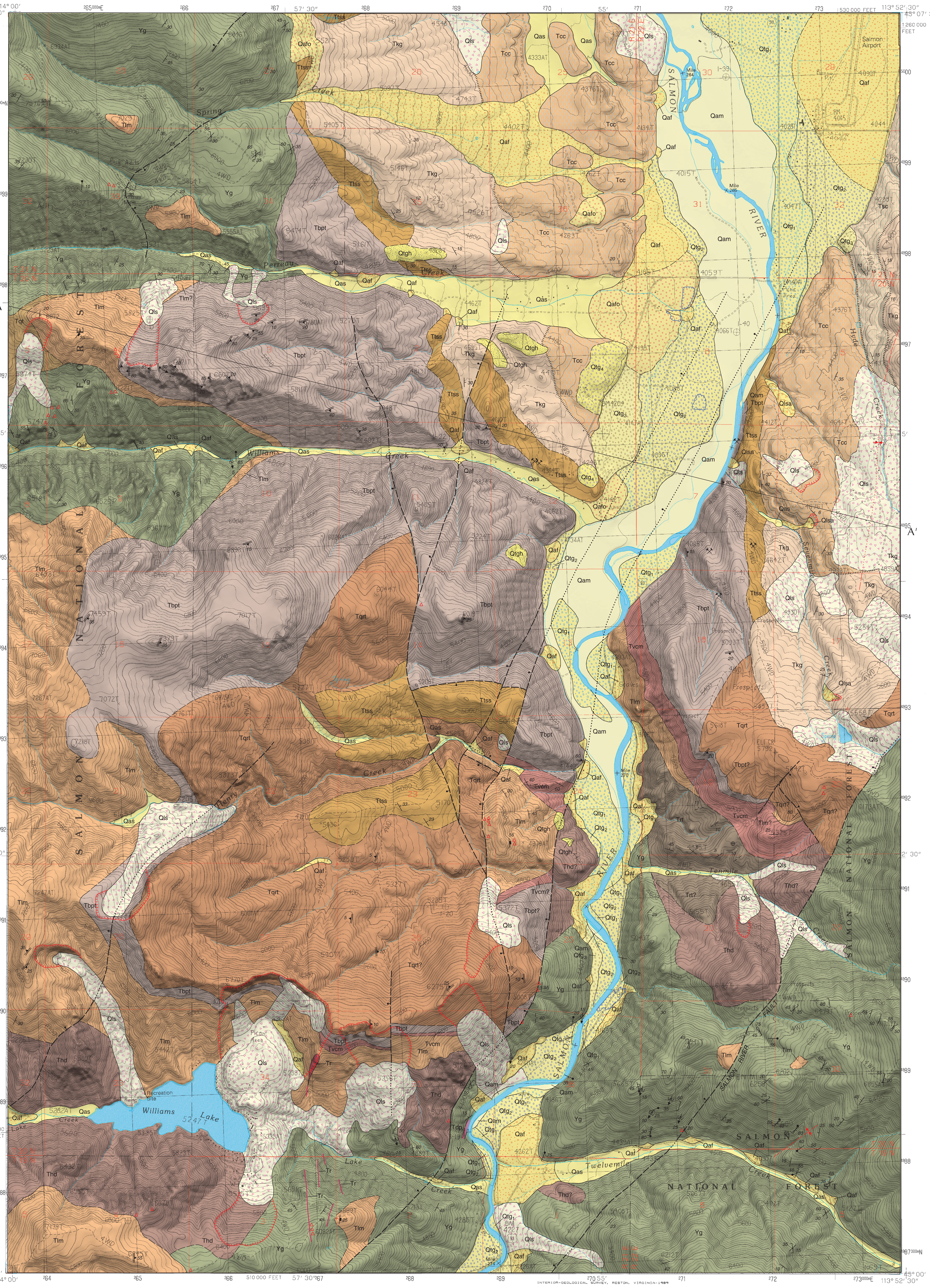
2013



Base Map Credit

Base digitally scanned from 24,000-scale USGS film separates, 1989.

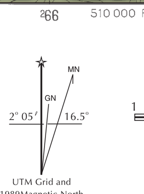
Shaded elevation from 10 m DEM.

Topography by photogrammetric methods from aerial photographs taken 1985. Field checked 1986. Map edited 1989.

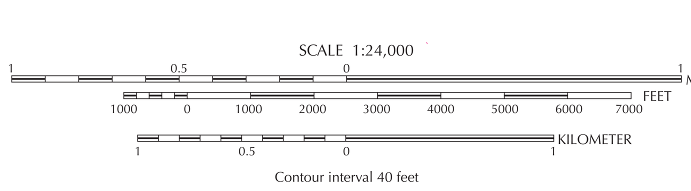
Projection: Idaho coordinate system, central zone (Transverse Mercator). 1927 North American Datum.

10,000-foot grid ticks based on Idaho coordinate system, central zone.

1000-meter Universal Transverse Mercator grid ticks, zone 12.

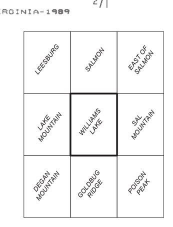


UTM Grid and 1989Magnetic North Declination at Center of Map



Contour interval 40 feet

QUADRANGLE LOCATION



ADJOINING QUADRANGLES

Field work conducted 2012-2013.

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Digital cartography by Jane S. Freed at the Idaho Geological Survey's Digital Mapping Lab.

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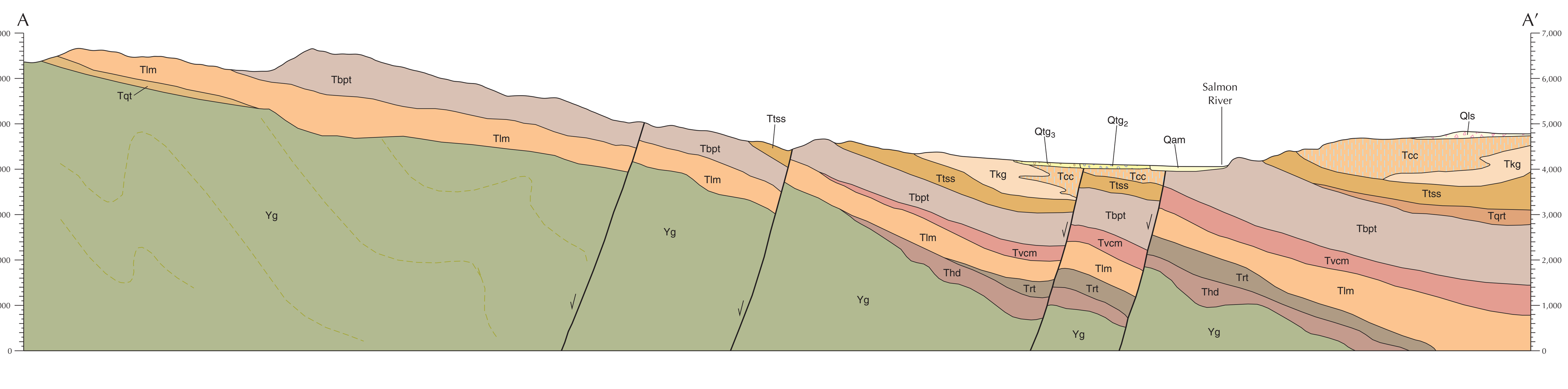
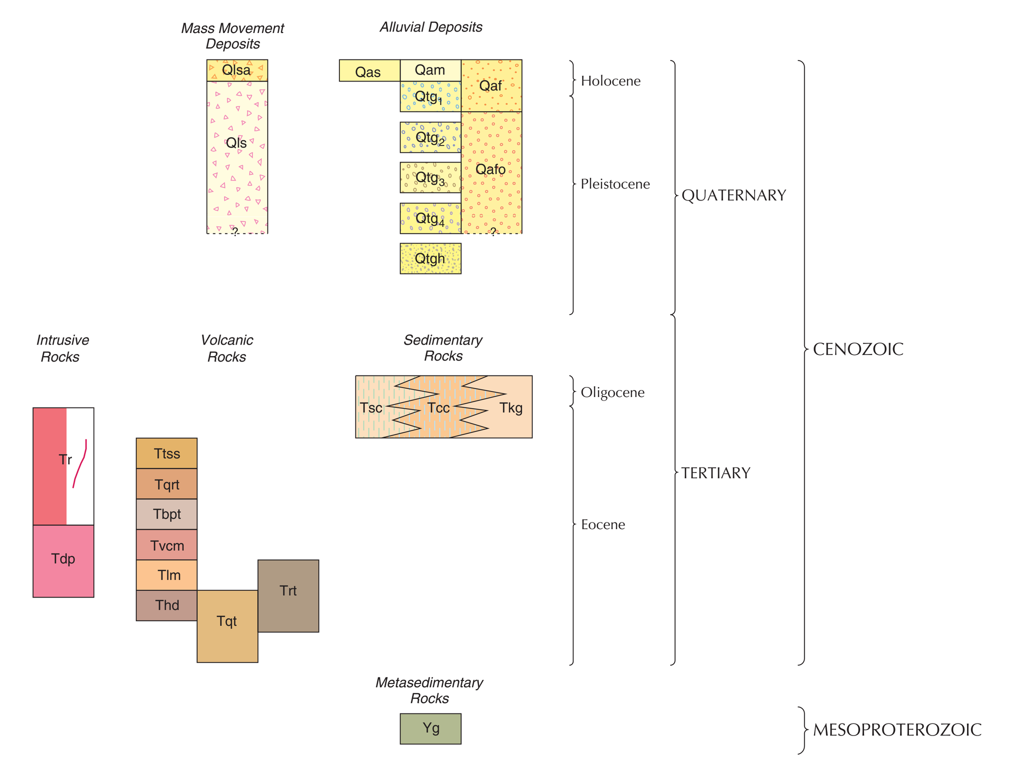
PDF (Acrobat Reader) map may be viewed online at www.idahogeology.org.



CORRELATION OF MAP UNITS



INTRODUCTION

The map is the result of field work in 2011 and 2012, and previous research in the region by Anderson (1956 and unpublished) and Harrison (1985). Many concepts for geologic units were developed while mapping the nearby Beaverhead Range (e.g. Lewis and others, 2011), part of a 1:24,000-scale collaborative mapping project started in 2007 by the Idaho Geological Survey and the Montana Bureau of Mines and Geology. Attitudes from previous mapping by Anderson (1956 and unpublished) were used to supplement the structural data collected by the authors. Soils information is from Hipple and others (2006).

The oldest rocks in the quadrangle are metasediments of Mesoproterozoic age that form the mountains in the northwest and southeast parts of the quadrangle. Elsewhere, they are overlain by volcanic rocks of the Challis Volcanic Group, which in turn are overlain by sedimentary rocks of the ancestral Salmon basin. Salmon basin sedimentary rocks vary from coarse conglomerate to shale, and record a wide range of depositional environments in the basin as it formed. Much of the basin's sedimentary section has been subsequently eroded through Pleistocene drainage incision. The Quaternary deposits show evidence of terracing, incision, and landsliding. These are characteristic of Quaternary processes that formed the alluvial and mass movement deposits.

SYMBOLS

Contact: dashed where approximately located.

Gradational contact between interfingering units: placed where change in erosional resistance is expressed topographically.

Normal fault: ball and bar on downthrown side; dashed where approximately located; dotted where concealed.

Syncline axial trace: dashed where approximately located; dotted where concealed.

10 Strike and dip of bedding.

Strike of vertical bedding.

27 Strike and dip of bedding where sedimentary structures show bedding to be upright.

45 Strike and dip of bedding where sedimentary structures show bedding to be overturned.

50 Strike and dip of bedding; strike variable.

60 Approximate strike and dip of bedding.

Horizontal bedding.

30 Strike and dip of flow or compaction foliation in volcanic rocks.

35 Strike and dip of joint.

55 Strike and dip of cleavage.

22 Bearing and plunge of lineation, type unknown.

15 Bearing and plunge of small fold axis.

15 Bearing and plunge of asymmetrical small "S" fold showing counterclockwise rotation viewed down plunge.

5 Bearing and plunge of asymmetrical small "Z" fold showing clockwise rotation viewed down plunge.

Uranium prospect.

Tectonic breccia.

Gravel pit or rock quarry that exposes a map unit.

Landslide scarp and headwall: Steep area adjacent to and below the landslide scarp from which material broke away.

DESCRIPTION OF MAP UNITS

The geologic map of the Williams Lake quadrangle shows rock units exposed at the surface or underlying a thin surficial cover of soil and colluvium. Surficial alluvial and landslide deposits are shown where they are thick and extensive enough to be mapped. Mineral modifiers are listed in order of increasing abundance. Grain size classification of unconsolidated and consolidated sediment is based on the Wentworth scale (Lane, 1947). Bed thicknesses are given in abbreviation of metric units (e.g. cm=centimeter). Formation thickness, distances, and elevation are listed in both metric and English units. Multiple lithologies within a rock unit description are listed in order of decreasing abundance.

ALLUVIAL DEPOSITS

Qam **Main-stream alluvium (Holocene)**—Well-rounded, moderately sorted and stratified pebble to boulder sandy gravel of the Salmon River. Gravel clasts mostly quartzite, siltite, granite, and volcanic rocks. Includes floodplain areas of sand, silt, and clay. Deposits are 3-12 m (10-40 ft) thick. Soils not developed to weakly developed.

Qas **Side-stream alluvium (Holocene)**—Subangular to rounded, moderately sorted and stratified pebble to boulder sandy gravel. Gravel clasts primarily quartzite, siltite, and volcanic rocks. Includes pebbly to cobbly sandy silt in local lower-energy drainages, minor colluvium, and fan deposits. Deposits are 3-18 m (10-60 ft) thick. Soils not developed to weakly developed.

Qaf **Alluvial-fan and debris-flow deposits (Holocene to late Pleistocene)**—Angular to subrounded, poorly sorted, matrix-supported pebble to boulder gravel in a sand, silt, and clay matrix. Commonly grades into, interfingers with, and caps side-stream alluvium (*Qas*). Thickness of deposits varies greatly, ranging from 1 to 24 m (3 to 80 ft). Soils vary from weakly developed to moderately developed.

Qafo **Older alluvial-fan deposits (Pleistocene)**—Angular to subrounded, poorly sorted, matrix-supported pebble to boulder gravel in a matrix of sand, silt, and clay. Locally caps and interfingers with terrace gravel. Includes prominent fan of Perreau Creek from which sand and gravel aggregate is excavated for the area. Thickness of deposits varies greatly, ranging from 1 to 15 m (3 to 50 ft). Soils moderately developed to well developed.

GRAVEL TERRACE DEPOSITS

Gravel deposits of Pleistocene alluvial terraces are composed of moderately sorted and clast-supported sandy gravel. Clasts are subrounded to rounded pebbles, cobbles, and boulders. Clast lithologies are quartzite, siltite, and volcanic rocks from the adjacent mountains, and may include granite from outside the Salmon basin. Terrace deposits form a relatively thin (9 m; 30 ft) cap over a streamcut bedrock surface. Several levels of terraces and terrace remnants are preserved 3-150 m (10-500 ft) above present-day streams. The terrace sequence records long-term episodic incision of the Salmon basin, which was probably driven by glacial climate during the Pleistocene. Terrace gravels commonly are capped by, and interfinger with, alluvial-fan deposits (*Qaf* and *Qafo*), which are included in the terrace unit locally. Higher terraces are mined for gravel.

Qtg_1 **Gravel of first terrace (Holocene to Late Pleistocene)**—Forms terrace 3-6 m (10-20 ft) above modern streams. Weakly developed soils.

Qtg_2 **Gravel of second terrace (Late? Pleistocene)**—Forms terrace 9-18 m (30-60 ft) above modern streams. Moderately developed soils.

Qtg_3 **Gravel of third terrace (Middle? Pleistocene)**—Forms terrace 18-40 m (60-130 ft) above modern streams. Well developed soils.

Qtg_4 **Gravel of fourth terrace (Middle? Pleistocene)**—Forms terrace 61-91 m (200-300 ft) above modern streams. Well developed soils.

Qtgh **Gravel of high terraces (Early? Pleistocene)**—Forms terrace remnants at least 150 m (500 ft) above modern streams. Soils of original terrace surface eroded away.

MASS MOVEMENT DEPOSITS

Qlsa **Deposits of active landslides (late Holocene)**—Unstratified, poorly sorted silty clay, and gravelly silty clay. Deposited by slumps, slides, and debris flows from slope failures in Tertiary sediments.

Qls **Landslide deposits (Holocene to Pleistocene)**—Unstratified, poorly sorted silty clay, gravelly silty clay, and boulders. Deposited by slumps, slides, slide blocks, earth flows, debris flows, debris avalanches, and rockfalls. Landslides are common in areas of Tertiary sediments. Large, complex landslide masses occur in Challis volcanics. Slump and slide blocks fill the valley bottom of Lake Creek forming Williams Lake. More recently, high-energy rock slides emplaced boulders near the USFS picnic area there.

TERTIARY SEDIMENTARY DEPOSITS OF THE SALMON BASIN

In her study of the sedimentology of the basin filling sediments, Harrison (1985) identified a series of gradational facies and lithostratigraphic units that are adopted here. The units are conformable and were deposited in alluvial-fan, braided-stream, mixed-channel and floodplain, and lake environments in a downfaulted subsiding basin. Most units are semi-consolidated; cementation is restricted to thin beds of sandstone and conglomerate, which are not laterally extensive. As a result, outcrops are rare and many slopes are covered with thin sheet wash and colluvium. Conglomerate beds weather to a gravelly soil mantle.

Tsc **Salmon City formation (Oligocene and Eocene)**—Fine- to coarse-grained, moderate- to well-sorted vitric quartz arenites interbedded with vitric siltstone, shale, and minor conglomerate. Outcrops generally buff colored. Bed thicknesses range from 50 cm to 3 m. Depositional environments predominantly distal sandy stream and distal shallow braided stream in basin-axis longitudinal stream system (Harrison, 1985). Grades into, and interfingers with, the Kriley Gulch and Carmen Creek formations (*Tkg* and *Tcc*).

Tcc **Carmen Creek formation (Oligocene and Eocene)**—Trough cross-stratified sandstone beds that vary from well-sorted quartz arenites to vitric and lithic wackes. Resistant beds cemented with silica and hematite. Buff colored in outcrop. Common interbeds of massive and trough cross-stratified conglomerate; conglomerate beds similar to those in the Kriley Gulch formation (*Tkg*) into which it grades and interfingers. Exposures include conglomerate with light gray quartzite clasts that are probably sourced north or northeast of the quadrangle. Dark gray quartzite, typical of *Yg*, is a minor component.

Tkg **Kriley Gulch formation (Oligocene and Eocene)**—Matrix-supported conglomerate, sandstone, and minor claystone. Clasts commonly cobbles and boulders that cover surfaces as lag deposits from weathered and eroded beds. Boulders and cobbles include quartzite and Challis volcanics. Forms steep slopes with coarse gravelly soils and resistant ridges capped with common lag pebbles, cobbles, and boulders. Exposures between Perreau Creek and Spring Creek show common cemented conglomerate beds rich in volcanic clasts. Similar cemented beds occur in the upper part of Sevenmile Creek. These appear low in the unit near the contact with Challis volcanics. Higher in the unit volcanic clasts are uncommon and Mesoproterozoic quartzite clasts predominate.

CHALLIS VOLCANIC GROUP

Rocks of the Challis Volcanic Group formed from eruptions, intrusions, erosion and deposition in the Eocene (about 51-44 Ma). They are widespread southwest of the Williams Lake quadrangle where they were mapped in the Challis 1° x 2° quadrangle (Fisher and others, 1992). Blankenau (1999) established a stratigraphic section about 36 km (22 mi) east of Williams Lake, northwest of Lemhi Pass, which is also useful for mapping in this part of the volcanic field.

Ttss **Tuff, sandstone, and siltstone, undivided (Eocene)**—Volcanic and sedimentary rocks overlying the quartz-rich tuff (*Tqrt*) in Henry Creek drainage and overlying the biotite-plagioclase tuff north and northeast of there. Includes pink welded tuff both north and south of Henry Creek with euhedral chatoyant sanidine and smoky quartz in a fine to glassy groundmass. Locally prospected for uranium (see Mineralization section below). The pink welded tuff is correlated here with upper quartz-sanidine tuff (Tqs_2) of Othberg and others (2011) and Blankenau (1999) in the Baker and Lemhi Pass areas to the southeast. Multiple eruptive events marked by basal zones rich in lithic fragments in exposures along Sevenmile Creek.

Tqrt **Quartz-rich tuff (Eocene)**—Pink tuff with conspicuous quartz phenocrysts, most but not all of which are smoky. Also contains sanidine, plagioclase, and biotite phenocrysts. Well exposed in cliffs north of Williams Lake; there the lowermost part of the unit is densely welded and contains flattened pumice (fiame). Also underlies benches west of the Salmon River fault. Lithic fragments common and are typically of similar composition to the tuff itself. Unit is apparently absent north of Williams Creek.

Tbpt **Biotite-plagioclase tuff (Eocene)**—Pink tuff containing plagioclase and biotite, and minor hornblende and quartz phenocrysts. Characterized by extensive vapor-phase alteration resulting in devitrification, formation of spherulites, and formation of drusy quartz as vug fillings. Locally prospected for uranium (see Mineralization section below).

Tvcm **Mafic volcaniclastic rocks (Eocene)**—Green quartz-poor volcaniclastic rocks locally present above the mafic lava flows (*Tlm)*.

Trt **Rhyolite tuff (Eocene)**—White rhyolite tuff with small phenocrysts of sanidine and quartz exposed north of Tenmile Creek. Well bedded and possibly water lain. Stratigraphic position uncertain, but may be at the same level as the mafic lava flows (*Tlm*) or perhaps the hornblende dacite (*Thd*). Northwest part of exposure is massive vitrophyre with quartz, biotite, and feldspar phenocrysts.

Tlm **Mafic lava flows (Eocene)**—Dark gray latite and andesite flows, subordinate amounts of poorly exposed biotite-quartz tuff, and flow breccia. Locally vesicular; secondary chalcedony and calcite are common in vesicular intervals. Forms extensive talus north of Williams Lake. Latite and andesite contain sparse 0.5-1 mm phenocrysts of clinopyroxene and altered olivine in a very fine grained groundmass containing abundant plagioclase. Locally contains xenocrystic quartz and plagioclase, particularly in the upper part of unit. Quartz is highly embayed and has reaction rims; plagioclase is less embayed but is turbid and shows disequilibrium textures. Likely correlative with the latite (Tl) unit mapped by Blankenau (1999), and mafic lava flows mapped by Lewis and others (2011) and Othberg and others (2011) northwest of Lemhi Pass. Also correlative with Tl unit of potassium-rich andesite, latite, and basalt lava in the Challis 1° x 2° quadrangle to the southwest (Fisher and others, 1992).

Thd **Hornblende dacite (Eocene)**—Gray to pink dacite containing phenocrysts of euhedral hornblende and plagioclase, minor biotite, and rare quartz in a fine groundmass. Interpreted here to be lava flows, but a pyroclastic origin permissive. Underlies *Tlm* unit in Williams Lake area. Possibly equivalent to Tdf unit of Fisher and others (1992) and Tldac unit of Blankenau (1999), both of which were thought to be lava flow units. Includes vitrophyre opposite the mouth of Tenmile Creek that contains more quartz and biotite than the unit does elsewhere, and which may be a different unit (possibly Ellis tuff that is exposed southwest of the quadrangle; Fisher and others, 1992).

Tqt **Quartzite-bearing ash-flow tuff (Eocene)**—White, white-gray, or pink-gray tuff containing abundant angular very dark gray to black quartzite lithic fragments and less abundant quartz and plagioclase. Poorly welded. Depositional on *Ysq* and overlain by mafic volcanic breccia and vesicular lava (*Tlm)*. Preserved only locally, probably as erosional remnants below *Tlm* north of Williams Creek. Correlated here with Tqt unit on the Baker quadrangle to the southeast (Othberg and others, 2011; and Tqt unit of Blankenau, 1999).

INTRUSIVE ROCKS

Tr **Rhyolite dikes (Eocene)**—Porphyritic rhyolite dikes near Williams Lake. Phenocrysts of quartz, plagioclase, sanidine, and biotite.

Tpd **Porphyritic dacite dike (Eocene)**—Single dike exposed immediately west of the Salmon River near the southern map boundary. Phenocrysts of plagioclase and hornblende.

MESOPROTEROZOIC STRATA

Low metamorphic grade metasedimentary rocks of Mesoproterozoic age are exposed in the southeast and northwest parts of the quadrangle. They differ visually from Lemhi Group strata in the Lemhi Range and correlative strata along and east of the Beaverhead Divide in that all the rocks are much darker here. This is attributed to different metamorphic conditions, with the darker rocks containing magnetite and biotite. All metasedimentary rocks were assigned to the Gunsight Formation by Evans and Green (2003). This is likely correct as they seem to stratigraphically underlie Swauger Formation mapped farther south and west. They contain some characteristics of the Gunsight Formation mapped in the Lemhi Range farther south (McBean, 1983; Othberg and others, 2011) or rocks correlated with the Gunsight Formation in the Beaverhead Mountains to the northeast (e.g. Burmester and others, 2011).

Yg **Gunsight Formation (Mesoproterozoic)**—Gray quartzite, darker siltite, and both black and light gray argillite. Quartzite is very fine to fine grained and feldspathic in 1-5 dm beds; rare, generally thicker beds have rounded fine quartz grains. Potassium feldspar equal to plagioclase feldspar in coarsest sample; less abundant or absent in others. Sharp bases locally loaded into siltite; rare tops have argillite in ripple troughs or muscovite flakes. Internal cross lamination and truncated lamination rarely observed, probably due to common medium to dark brown weathering, iron staining, and extensive cleavage development. Siltite as separate, even parallel laminated beds 4 cm to 4 dm thick, and as graded tops, or less commonly bases, of 1-3 dm thick quartzite beds. Argillite as graded or discrete tops of quartzite or siltite beds rarely as 1-3 cm separate layers. Correlated with Gunsight Formation based on presence of quartzite and proximity to Swauger Formation mapped to the south and west (Evans and Green, 2003) despite paucity of soft-sediment features, darker color, and lower feldspar concentration than in the type section. Presence of faults and extensive folding within the area preclude estimation of thickness or even stratigraphic relationships between exposures.

STRUCTURE

FAULTS

Several down-to-the-west normal faults traverse the quadrangle. The most prominent fault crosses the upper part of Tenmile Creek and forms the range front from there north into the adjoining Sal Mountain quadrangle. Not shown by Anderson (1956), but present on a later, unpublished map of his, this fault extends north to Salmon Hot Springs; to the south it apparently connects with a north-south structure termed the Salmon River fault (Tysdal, 2002) or the Allison Creek fault (Link and Janecke, 1999).

FOLDS

The Mesoproterozoic strata in the southeast corner of the map are folded along northeast axes that plunge gently southwest. One fold, whose axis trends north-northeast, has affected the Tertiary strata near the east edge of the map. It may have resulted from movement on the Salmon River fault. Mesoproterozoic strata in the northwest corner appear to define an antiform with similar trend but less well-defined plunge.

MINERALIZATION

Anderson (1956) described the mineralization present in the Salmon region, including the Tormey mine located north of Perreau Creek in the northwest part of the map. The U.S. Geological Survey base map spelling is "Tormay." According to Anderson (1956), the Tormey mine was located by John Tormey and produced copper, gold, and silver during the period 1918-1925. Most of the production came from a northwest-striking, northeast-dipping shear zone in Mesoproterozoic rocks.

Exploration for uranium commenced in the area shortly after Anderson released his report, and several localities within the quadrangle were found by prospectors to contain anomalous concentrations. All are in the uppermost part of the Challis Volcanic Group, either in the Sevenmile Creek area or northwest of the mouth of Williams Creek. Three Defense Minerals Exploration Administration (DMEA) reports discuss these exploration efforts. These DMEA reports (Dockets 4308, 4754, and 4899) are available for download (U.S. Geological Survey, 2012). Reconnaissance sampling in the 1970s during the National Uranium Resource Evaluation (NURE) Program also yielded anomalous uranium concentrations in the Sevenmile Creek area (Wodzicki and Krason, 1981).

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