Surficial Geologic Map of the Lenore Quadrangle, Nez Perce County, Idaho

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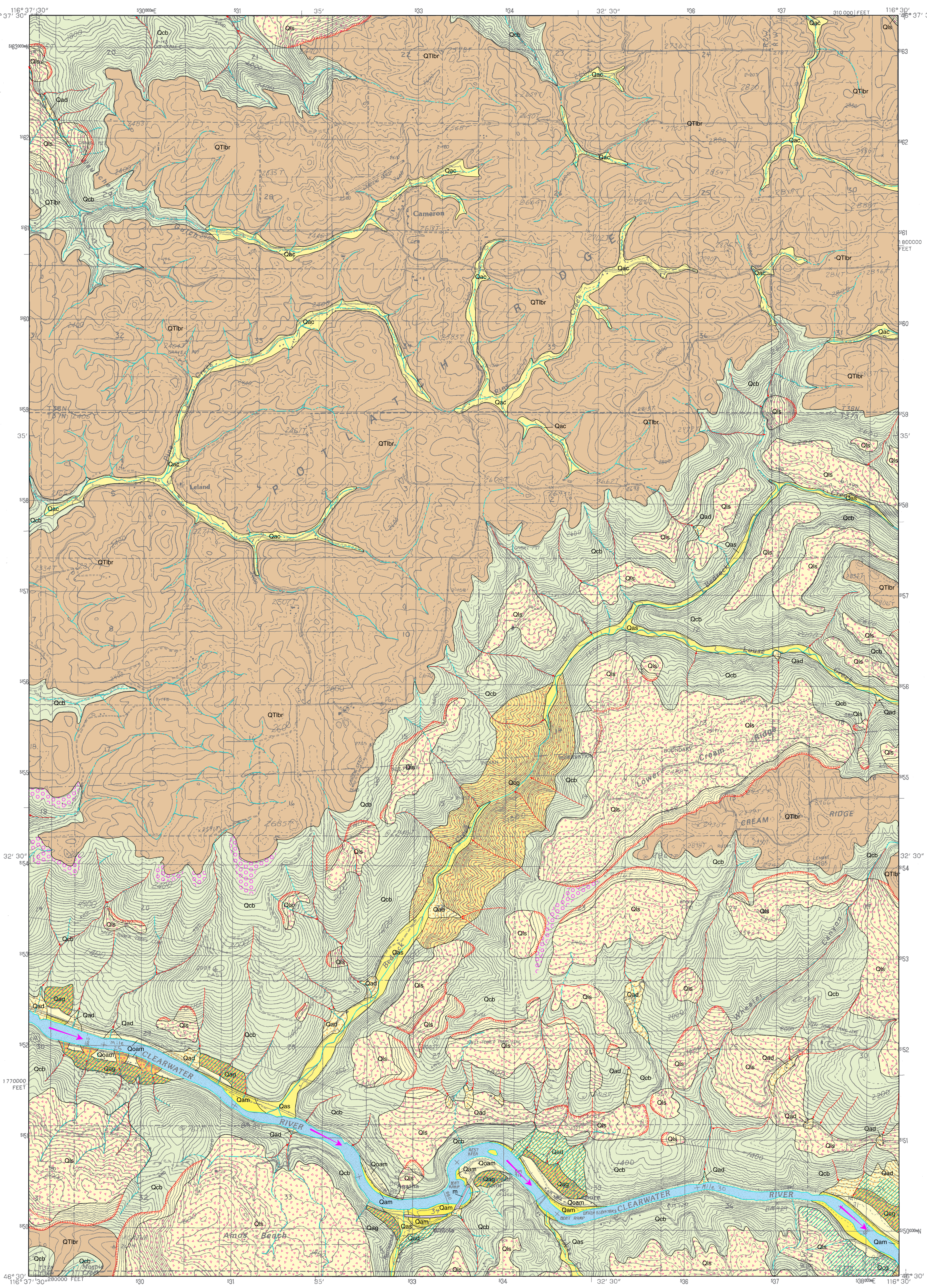
2003



Base map from USGS digital raster graphic 1990.

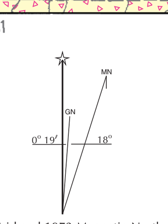
Topography by photogrammetric methods from aerial photographs taken 1957. Revised from photographs taken 1987. Field checked 1988. Map edited 1990.

Polyconic projection. 1927 North American Datum.

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

1000-meter Universal Transverse Mercator grid ticks, zone 11.

National geodetic vertical datum of 1929.



UTM Grid and 1972 Magnetic North Declination at Center of Map

SCALE 1:24,000

1 0.5 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 0.5 0 1 KILOMETER

Contour interval 40 feet
Dotted lines represent 20-foot contours

QUADRANGLE LOCATION

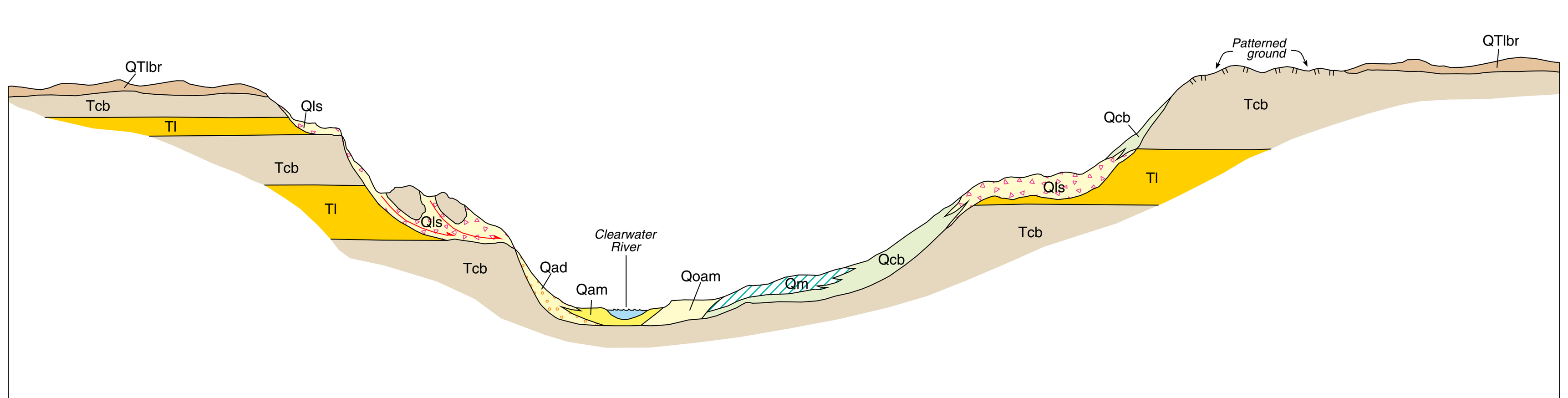
Field work conducted 2000-2001.

Field work and map preparation funded in part by U.S. Geological Survey's STATEMAP Program.

Reviewed by Terry Howard.

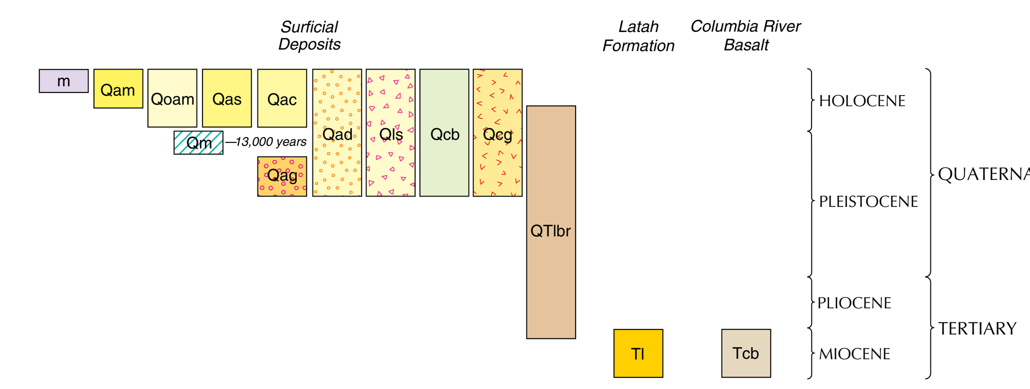
Digital cartography by B. Benjamin E. Studer and Jane S. Freed at the Idaho Geological Survey's Digital Mapping Lab.

Map version 6-18-2003.



Scale-less schematic cross section that (1) shows the positions of surficial geologic units in a canyon setting, and (2) depicts typical relationships of the surficial geologic units to the subsurface geology.

CORRELATION OF MAP UNITS



INTRODUCTION

The surficial geologic map of the Lenore quadrangle identifies earth materials on the surface and in the shallow subsurface. It is intended for those interested in the area's natural resources, urban and rural growth, and private and public land development. The information relates to assessing diverse conditions and activities, such as slope stability, construction design, sewage drainage, solid waste disposal, and ground-water use and recharge.

The geology was intensively investigated during a one-year period. Natural and artificial exposures of the geology were examined and selectively sampled. In addition to field investigations, aerial photographs were studied to aid in identifying boundaries between map units through photogeologic mapping of landforms. In most areas map-unit boundaries (contacts) are approximate and were drawn by outlining well-defined landforms. It is rare that contacts between two units can be seen in the field without excavation operations which are beyond the purpose and scope of this map. The contacts are inferred where landforms are poorly defined and where lithologic characteristics grade from one map unit into another. The precision of a contact with respect to actual topography also depends on the accuracy and scale of the topographic base. Details depicted at this scale, therefore, provide an overview of the area's geology. Further intensive analyses at specific locations should be arranged through independent geotechnical specialists.

The canyons of the Clearwater River and its tributary, Bedrock Creek, are the prominent features on the map. The Clearwater River is flowing west from the northern Rocky Mountains and is entrenched into this portion of the Columbia Plateau. The river's canyon exposes the plateau's Miocene basalt flows of the Columbia River Basalt Group and the underlying granitic and metamorphic basement rocks, some of which are exposed in the lower part of Bedrock Creek. During the Miocene, the basalt flows filled ancestral stream valleys eroded into the basement rocks. The flows created volcanic embayments that now form the eastern edge of the Columbia Plateau where the relatively flat region meets the mountains. Sediments of the Latah Formation are interbedded with the basalt flows, and landslide deposits occur where major sedimentary interbeds are exposed along the valley sides. Pleistocene loess forms a thin, discontinuous mantle on the weathered and slightly eroded basalt plateau. In the late Pleistocene, multiple Lake Missoula Floods inundated the Clearwater River valley, locally depositing silt, sand, and ice-rafted pebbles and cobbles in the lower elevations of the canyon.

The bedrock geology of this area is mapped by Lewis and others (2001) and shows details of the basement rocks and the Miocene basalt flows and sediments. The bedrock map's cross sections are especially useful for interpreting subsurface conditions suitable for siting water wells and assessing the extent and limits of ground water.

DESCRIPTION OF MAP UNITS

SURFICIAL DEPOSITS

m **Made ground (Holocene)**—Large-scale artificial fills composed of excavated, transported, and emplaced construction materials of highly varying composition, but typically derived from local sources.

Qam **Alluvium of mainstreams (Holocene)**—Channel and flood-plain deposits of the Clearwater River that are actively being formed on a seasonal or annual basis. Two grain-size suites are typically present: Well-sorted and rounded sandy gravel of river bars and islands, and coarse sand forming thin shoreline deposits. The gravel includes clasts of basaltic, granitic, and metamorphic rocks. Mainstream alluvium is called riverwash-aquents in the soil survey (U.S. Department of Agriculture, Natural Resources Conservation Service, 1999).

Qoam **Older alluvium of mainstreams (Holocene)**—Fine- to coarse-grained bedded sand and silty sand overlying river channel gravel. These alluvial deposits form one or more levels of old point bars and flood plains of the Flood plains that are younger than the Lake Missoula Floods backwater deposits, but older than alluvium of the present river. Surface heights above present mean water level range from 28 to 43 feet. Relative heights and soil characteristics suggest a late Holocene age, and the lower of these surfaces may have been inundated by the highest seasonal flood waters before the stream flows were controlled by Dworshak dam. The sand overlying channel gravel is several feet thick. Soils developed in older mainstream alluvium include the Uhlig series (U.S. Department of Agriculture, Natural Resources Conservation Service, 1999).

Qas **Alluvium of side streams (Holocene)**—Channel and flood-plain deposits of Bedrock Creek and Louse Creek. Primarily coarse channel gravel deposited during high-energy stream flows. Subrounded to rounded pebbles, cobbles, and boulders of basalt in a sand matrix. Moderately stratified and sorted. Includes intercalated colluvium and debris-flow deposits from steep side slopes. Soils developed in side-stream alluvium include the Bridgewater and Joseph series and riverwash-aquents (U.S. Department of Agriculture, Natural Resources Conservation Service, 1999).

Qac **Alluvium and colluvium (Holocene)**—Stream, slope-wash, and gravity deposits. Predominantly beds of silt, clay, and sand derived from erosion of adjacent units. Stream deposits typically are thin and interfinger with laterally thickening deposits of slope wash and colluvium derived from local loess deposits and weathered basalt. Soils developed in these deposits include the Latahco Wilkins, and Westlake series (U.S. Department of Agriculture, Natural Resources Conservation Service, 1999

Qad **Alluvial-fan and debris-flow deposits (Holocene and Pleistocene)**—Primarily crudely bedded, poorly sorted brown muddy gravel shed from canyon slopes of basalt colluvium. Gravel is composed of subangular and angular pebbles, cobbles, and boulders of basalt in a matrix of granules, sand, silt, and clay. May include beds of silt and sand derived from reworked loess, Mazama ash, and Lake Missoula Flood backwater deposits. Thickness varies, but typically ranges from 6-50 feet. Fans composed of alluvium and debris-flow deposits commonly occur in canyon bottoms below steep debris-flow chutes (see Symbols).

Qls **Landslide deposits (Holocene and Pleistocene)**—Poorly sorted and poorly stratified angular basalt cobbles and boulders mixed with silt and clay. Landslide deposits include debris slides as well as blocks of basalt, sedimentary interbeds, and pre-Miocene rocks that have been rotated and moved laterally. Debris slides mainly composed of unstratified, unsorted gravel rubble in a clayey matrix. In addition to the landslide deposit, the unit may include the landslide scarp and the headwall (steep area adjacent to and below the landslide scarp) from which material broke away (see Symbols). The headwall area may include talus formed after landslide movement. Location of landslide deposits in canyons is controlled by the presence of sedimentary interbeds, the hydrogeologic regime, and the occurrence of basalt overlying clay-rich weathered basement rocks. The largest landslides occur where canyon-cutting has exposed landslide-prone sediments to steep topography. Slope failures have occurred where the fine-grained sedimentary interbeds and weathered basement rocks are saturated by ground water moving toward the valleys. This relationship is so prevalent that the major sedimentary interbeds may be traced by locating landslide deposits along the valley sides. The landslides range in age from ancient, relatively stable features, to those that have been active within the past few years. The factors that cause landslides have been prevalent in the region for thousands of years. The frequency of landsliding may have been greater in the Pleistocene. Today, initiation and reactivation of landslides is closely tied to unusual climatic events and land-use changes. Even small landslide activity on the upper parts of canyon slopes can transform into high-energy debris flows that endanger roads, buildings, and people below (see *Debris-flow chute* under Symbols). Landslide debris is highly unstable when modified through natural variations in precipitation, artificial cuts, fills, and changes to surface drainage and ground water.

Qcb **Colluvium from basalt (Holocene and Pleistocene)**—Primarily poorly sorted brown muddy gravel composed of angular and subangular pebbles, cobbles, and boulders of basalt in a matrix of silt and clay. Emplaced by gravity movements on steep-sided canyons and gullies cut into Columbia River basalt. Includes outcrops of basalt that are common on steep, dry, southerly aspects where colluvium is thinner and the more erosion-resistant basalt flows form laterally traceable ledges. More gently sloping areas are mantled with thin loess (typically 1-5 feet thick), especially near boundaries with loess (*QTlbr*). Distribution and thickness of colluvium is dependent on slope aspect, upper and lower slope position, basalt and sediment stratigraphy, and association with landslides. Colluvium is thin and associated with many basalt outcrops on dry, southerly facing slopes, and may exhibit patterned-ground features (see Symbols). Colluvium is thicker on north- and east-facing slopes, and is associated with landslides (*Qls*) and debris-flow chutes (see Symbols), especially where more moisture is retained and where sedimentary interbeds are present. Areas of thicker colluvium have fewer outcrops of basalt, and the surface may have a patterned ground of crescent-shaped lobes of colluvium, probably relicts of Pleistocene solifluction. Unit includes landslides too small to map separately, and talus below cliffs and ledges of basalt. Colluvium typically increases in thickness toward the base of slopes where it interfingers with alluvium in valley bottoms. May include all of valley-bottom sediment where streams have little discharge or are ephemeral. Soils developed in basalt colluvium include the Gwin, Kettenback, Keuterville, Klickson, Linville, and Waha series (U.S. Department of Agriculture, Natural Resources Conservation Service, 1999).

Qcg **Colluvium from granitic and metamorphic rocks (Holocene and Pleistocene)**—Primarily poorly sorted muddy gravel composed of angular and subangular pebbles, cobbles, and boulders in a matrix of sand, silt, and clay. Emplaced by gravity movements in Bedrock Creek canyon where there are outcrops of pre-Tertiary granitic rocks and quartzite. Includes local debris-flow deposits and isolated rock outcrops. Includes colluvium and debris-flow deposits from the upslope basalt section, and areas of thin loess (typically less than 5 feet). Grades laterally, as slope gradients decrease, into areas where thin loess and clayey saprolite mantle bedrock. Distribution and thickness of colluvium depend on slope, aspect, upper and lower slope position, and association with landslide deposits. Colluvium typically increases in thickness toward the base of slopes and may interfinger with alluvium in valley bottoms. Soils developed in the colluvium include the Keuterville and Klickson series (U.S. Department of Agriculture, Natural Resources Conservation Service, 1999).

Qm **Lake Missoula Floods backwater deposits (Pleistocene)**—Rhythmites deposited when backwaters from Lake Missoula Floods inundated the Clearwater River valley. Primarily alternating thin beds of gray sand and pale brown silt. Cross-bedded, dark-gray, basalt-rich granule gravel and coarse sand may be present at the base. Includes cut and fill structures and sandy clastic dikes. Similar depositional environment, sedimentology, and age as Lake Missoula Floods rhythmites of eastern Washington (Smith, 1993; Waitt, 1980, 1985). Commonly reworked into sandy, silty colluvium. Found locally up to 1,200 feet in elevation, the approximate maximum flood level. Mapped as a pattern where sandy, silty rhythmites mantle deposits of debris flows and alluvial fans (*Qad*), landslide deposits (*Qls*), and Pleistocene alluvial gravel (*Qag*). Downstream at Lewiston in the Snake River valley, Lake Missoula Floods backwater deposits overlie Bonneville Flood gravel. In the Clearwater River drainage, Bonneville Flood deposits have not been recognized. Lake Missoula Floods temporarily reversed the course of the Clearwater River within the area of backwater inundation (see *Flow direction* in Symbols). Soils developed in Lake Missoula Floods deposits include the Uhlig series (U.S. Department of Agriculture, Natural Resources Conservation Service, 1999).

Qag **Alluvial gravel (Pleistocene)**—Well-rounded pebble and cobble gravel of remnant point bars that range 58 to 78 feet above the Clearwater River. Gravel poorly exposed owing to mantle of Lake Missoula Floods backwater sediments (*Qm*). Interfingers with colluvium and debris-flow deposits at toe of canyon slope. The gravel was deposited by the ancestral Clearwater River prior to the latest Lake Missoula Floods and may have formed during periodic greater discharges of the river during the Wisconsin glaciation. Soils mapped in areas of Pleistocene alluvial gravel include the Uhlig series (U.S. Department of Agriculture, Natural Resources Conservation Service, 1999).

QTlbr **Loess mantling basalt residuum (Quaternary and Tertiary)**—Thin Quaternary loess mantling Tertiary residuum on remnant surfaces of the basalt plateau. Loess 1-6 feet thick mantles basalt that is spheroidally weathered and locally forms a zone of thoroughly decomposed clayey saprolite. Most weathered spheroids have indurated cores of basalt that grade outward into yellowish and reddish sand, silt, and clay. The basalt residuum is laterally discontinuous, probably as a result of erosion of the Miocene land surface, so that near drainages and canyon rims fresh basalt is often near or at the present surface. The weathering of the basalt probably can be attributed to the eastward increase in precipitation and to the Miocene age of this remnant basalt surface. Includes gravelly basalt colluvium on local steeper slopes where stream incision has occurred and local deposits of thin alluvium too small in area to show at this scale. Soils in this unit include the Cavendish, Driscoll, Joel, Larkin, Naff, Palouse, Southwick, and Taney series (U.S. Department of Agriculture, Natural Resources Conservation Service, 1999).

Note: The following units are shown only in cross section:

LATAH FORMATION

The Latah Formation sedimentary rocks were deposited along the margins of and within the Columbia basin during middle- to late-Miocene time. The Latah Formation comprises the sedimentary interbeds within the Columbia River Basalt Group. Their presence represents time intervals between eruptions of lava when sediments accumulated in lakes, streams, and local basins.

Tl **Latah Formation sedimentary interbeds (Miocene)**—Bedded silt, clay, and minor sand. The distribution of sedimentary interbeds controls the location of most landslides in the area (*Qls*). Ground water moving into and within the basalt and interbed sections can saturate the silts and clays and cause landsliding. Unstable slopes commonly occur where valley incision has exposed interbeds in steep-sided canyons.

COLUMBIA RIVER BASALT GROUP

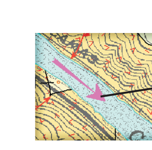
Tcb **Columbia River Basalt, Undifferentiated (Miocene)**—Comprises flows of the Saddle Mountains, Wanapum, Grande Ronde, and Imnaha Basalts of the Columbia River Basalt Group.

SYMBOLS

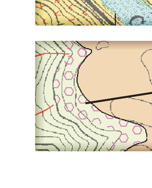
Contact: Line showing the approximate boundary between one map unit and another. The apparent ground width of the line representing the contact is about 80 feet at this scale (1:24,000).

Landslide scarp and headwall: Ticks show top of scarp.

Debris-flow chute in canyons. High-energy, short duration floods and debris flows may occur in these chutes in response to severe climatic conditions, such as thunderstorms and rain-on-snow events. Debris flows can also be triggered by landslides. These events are historically infrequent, dependent on weather, with a recurrence cycle on the order of years to decades. The most prominent debris-flow chutes are shown on the map, but any steep-gradient valley sides and canyon bottoms have the potential for these catastrophic events. Thin and discontinuous alluvial-fan and debris-flow deposits (*Qad*) may be present, but are not mappable at this scale.



Flow direction of Lake Missoula Floods backwater inundation.



Patterned ground associated with the weathered, differentially eroded surface of basalt. Pattern consists of regularly spaced, subround fracture system in basalt with silty mounds between fractures. Silty mounds give way to fractured basalt downslope, but thicken upslope where they gradually obscure the fracture pattern and merge with loess deposits or weathered basalt. Probably formed by stripping of loess from the basalt surface through Pleistocene periglacial processes. Original patterned-ground features destroyed by field plowing in many locations.

REFERENCES

Lewis, R.S, J.H. Bush, R.F. Burmester, J.D. Kauffman, D.L. Garwood, P.E. Meyers, K.L. Othberg, and W.C. McClelland, 2001, Geologic map of the Potlatch 30' x 60' quadrangle, Idaho: Idaho Geological Survey Special Report, 1:100,000 scale.

Smith, G.A., 1993, Missoula flood dynamics and magnitudes inferred from sedimentology of slackwater deposits on the Columbia Plateau, Washington: Geological Society of America Bulletin. v. 105, p. 77-100.

U.S. Department of Agriculture, Natural Resources Conservation Service, 1999, Soil survey geographic (SSURGO) database for Lewis and Nez Perce counties: USDA-NRCS Soil Survey Division, National SSURGO Database Data Access, ID611, http://www.ftw.nrcs.usda.gov/ssur_data.html.

Waitt, R.B., Jr., 1985, Case for periodic, colossal jökulhaups from Pleistocene glacial Lake Missoula: Geological Society of America Bulletin, v. 95, p. 1271-1286.

Waitt, R.B., Jr., 1980, About 40 last-glacial Lake Missoula jökulhaups through southern Washington: Journal of Geology, v. 88, p. 653-679.

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