Geologic Map of the Colockum Pass SE 7.5-minute Quadrangle, Kittitas County, Washington

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Geologic Map of the Colockum Pass SE 7.5-minute Quadrangle

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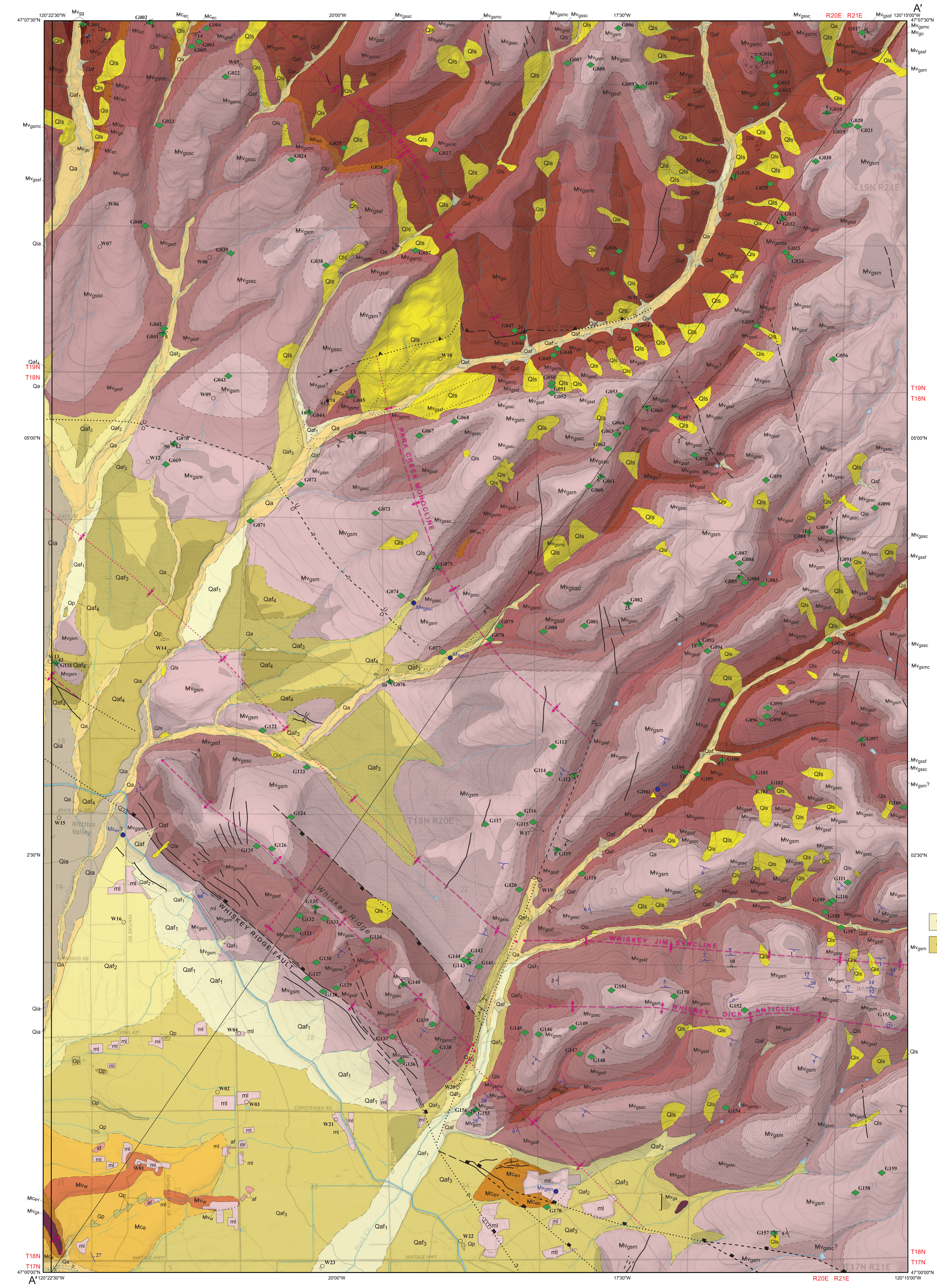

Lambert conformal conic projection
North American Datum of 1983
Base map from U.S. Geological Survey Colockum Pass SE 7.5-minute quadrangle, 2020; a portion of the Colockum Pass SW quadrangle is also included along the left side of the map to account for datum shifts since previous mapping
Shaded relief generated from a lidar bare-earth digital elevation model (available from the Washington Geological Survey, https://lidarportal.dnr.wa.gov/)
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Editing and production by Susan R. Schnur and Maria A. Furtney

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SCALE 1:24,000

1 MILE — 1,000 FEET to 7,000 FEET — 1 KILOMETER

contour interval 40 feet

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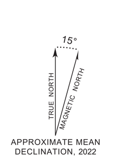
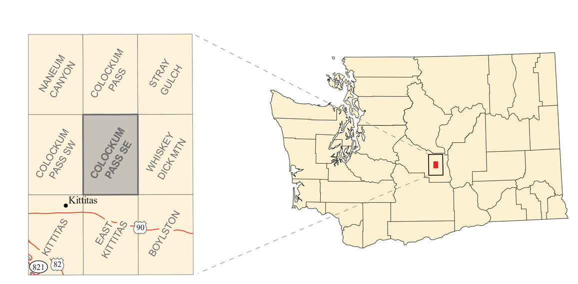




ABSTRACT

New geological and geophysical investigations of the Colockum Pass SE quadrangle refine Columbia River Basalt Group stratigraphy and characterize geologic structures in northeastern Kittitas Valley. New whole rock geochemistry from 169 locations builds upon existing magnetostratigraphy and locally refines the chemostratigraphic framework of the Grande Ronde Basalt of the Columbia River Basalt Group, particularly for the Sentinel Bluffs Member. Flat-lying stratigraphy in the north—mostly composed of subunits of Sentinel Bluffs—becomes progressively tilted southward toward the range front as a result of faulting and folding. Interbeds of the sedimentary Coleman member are less common in the map area compared to quadrangles farther west, which suggests the unit's depositional center was farther west.

We identify oblique-slip and reverse faults and fault-related folds, including several northwest- through west-trending anticlines, synclines, and monoclines. We map a long, northwest-striking fault with an associated linear magnetic anomaly located southwest of a feature informally named "Whiskey ridge." The Whiskey ridge fault continues beyond the western and southern edges of the map area. We also identify fault scarps in Quaternary deposits related to this structure that have various lengths and amounts of offset. Lastly, we map several short, northerly striking faults with small offsets that exhibit conspicuous scarps through Miocene bedrock.

Geophysical modeling of gravity and aeromagnetic data suggests laterally abrupt thickness changes in basaltic units. These thickness changes may be related to a period of syn-eruptive development of local accommodation space perhaps adjacent to growing folds.

DESCRIPTION OF MAP UNITS

Holocene to Pliocene Nonglacial Deposits

af — **Artificial fill (Holocene)**—Cobbles, pebbles, sand, and boulders; poorly sorted and unconsolidated; placed to elevate home sites, highways, or other infrastructure.

ml — **Modified land (Holocene)**—Sand- through boulder-sized material, redistributed to modify topography for industrial, agricultural, and residential uses, including but not limited to gravel pits, rock quarries, aggregate mines, excavator training locations, and home sites.

Qp — **Peat (Holocene to Pleistocene)**—Organic and organic-rich sediment; includes peat, gyttja, muck, silt, and clay; typically in closed depressions; mapped in natural or man-made wetlands, bog areas, and ephemeral water bodies; also mapped from assessing black-and-white aerial photos where black to dark gray ephemeral ponds and water bodies were not mapped in the published base map. Man-made water bodies likely contain smaller (or no) peat deposits than older natural features. The thickness of most peat deposits is largely unassessed but presumed to be less than 10 m. Small peat deposits are scattered throughout the map area, typically within alluvium, and are related to ponding of stagnant water or agricultural activities.

Qls — **Landslide deposits (Holocene to Pleistocene)**—Clastic aggregate and scree; medium brown to light yellowish brown; weathering is typically mild or moderate; generally loose and poorly consolidated; clay to boulder-sized clasts; angular to subangular; unsorted, typically matrix supported, and less commonly clast supported near talus piles; unstratified and structureless; unit contains rubble of sand, silt, clay, cobbles, pebbles, boulders, and diamicton of mostly basalt clasts and sometimes fine sand derived from nearby sedimentary units or soils; deposit thicknesses are less than 30 m and typically less than 15 m.

Holocene to Pliocene(?) Alluvial Deposits

Stream channel and stream flood (overbank) deposits and terraces. Deposits include pebbles, cobbles, sand, silt, clay, peat, and boulders, all in varying amounts and thicknesses. Colors range from light tannish gray to medium brown. The deposits are fresh to mildly weathered and are not compacted or cemented. The clasts are typically cobbles with sand and gravel, well rounded, moderately to well sorted, and mostly composed of basalt.

Qa — **Alluvium (Holocene)**—Stream channel deposits on active flood plain; depositional environment is the active flood plain; unit is narrowly distributed throughout the low elevations of the map area and these deposits commonly flank creeks.

Qia — **Intermediate-aged alluvium (Holocene to Pleistocene)**—Stream flood (overbank) and old channel deposits near active flood plains, where ongoing alluvial deposition from overland flow is possible but less clear compared to unit Qa; surfaces of unit Qia are slightly elevated relative to surfaces of unit Qa. Unit Qia is commonly indistinguishable from alluvial fan unit Qaf_1 based on lithology and height relative to unit Qa. However, unit Qia tends to be found (1) closer to unit Qa than unit Qaf_1, and (2) at slightly lower elevations than unit Qaf_1.

Qaf, Qaf_1, Qaf_2, Qaf_3, Qaf_4 — **Alluvial fan deposits (Holocene to Pliocene?)**—Sand and gravel deposited in alluvial fans and other relict debris flow deposits; generally brown; uncompacted to poorly consolidated; silt- to boulder-sized clasts; angular to subrounded; unsorted; clast composition is generally basalt of the CRBG; unit thickness is generally less than 15 m but varies with age, where older units tend to be thicker. Unit is subdivided and numbered from 1 (lowest and youngest) to 4 (highest and oldest) based on relative elevation above the modern stream level and differences in surface morphologies.

Tertiary Sedimentary and Volcanic Bedrock

SEDIMENTARY ROCKS OF THE ELLENSBURG FORMATION

Mc_e — **Ellensburg Formation, undivided (Miocene)**—Feldsarenite of volcaniclastic to lacustrine or fluvial origin underlying, intercalated with, and overlying rocks of the CRBG; light to medium brown to light to medium gray; mildly to strongly weathered; moderately indurated; where interbedded in the CRBG, unit is generally fine to coarse grained sandstone, where unconformably overlying the CRBG—upper Ellensburg Formation—unit may be locally conglomeratic or partly laharic in the southwestern part of the map area; subrounded or subangular; well to moderately sorted; grain supported; generally less than 90 m thick; interbed exposures are thin, discontinuous, poorly exposed interbeds in the GRB along cliffs, topographic saddles, and benches, whereas exposures of upper Ellensburg Formation rocks that unconformably overlie the CRBG can form well-exposed roadcuts with lighter color tones. The upper Ellensburg Formation commonly lacks white mica, whereas older members interbedded with basalts commonly have white mica in varying amounts. Locally subdivided into:

Mc_{ev} — **Vantage Member of the Ellensburg Formation (Miocene)**—Micaceous sandstone and siltstone; light brownish gray to light gray or white, moderately to strongly weathered; mildly to moderately indurated, mildly cemented; subangular; fine to coarse grained; commonly well sorted, grain supported. Unit thickness is greater than 30 m. The unit unconformably overlies the GRB in and around Kittitas Valley and resides between the underlying GRB—where the top of the GRB is the basalt of Museum of the Sentinel Bluffs Member, unit Mv_{gsm}—and the overlying Wanapum Basalt.

Mc_{ec} — **Coleman member of the Ellensburg Formation, undivided (Miocene)**—Sandstone and siltstone underlying the Sentinel Bluffs Member of the CRBG; medium brown to light gray; generally fine-to-medium grained micaceous sandstone; inferred to be less than 60 m thick.

VOLCANIC ROCKS OF THE COLUMBIA RIVER BASALT GROUP

Mv_w — **Wanapum Basalt, undivided (Miocene)**—Basalt; dark gray to grayish brown; well indurated; mostly microporphyritic to weakly glomerocrystic, commonly with groundmass crystals larger than 1.0 mm and less commonly aphyric than GRB units; euhedral; groundmass textures are microcrystalline, equigranular to seriate, and plagioclase microlite laths are unoriented (pilotaxitic more than trachytic); in the map area we infer the presence of the unit where moderate-relief landforms are found stratigraphically above unit Mc_{ev}. Unit thickness is less than 60 m. The unit unconformably overlies the Vantage member (unit Mc_{ev}) and unit Mc_e unconformably onlaps onto unit Mv_w.

Mv_g — **Grande Ronde Basalt (GRB), undivided (Miocene) (cross section only)**—Basaltic andesite, described in detail in the following units. Unit Mv_g is inferred where geochemistry was unavailable, outcrops were absent, inference for a subunit was overly speculative, or units were grouped at depth in cross section. Locally subdivided into:

Mv_{gs} — **Sentinel Bluffs Member, undivided (Miocene)**—Basaltic andesite; aphyric; the map area contains four subunits, from oldest to youngest: basalts of McCoy Canyon, Spokane Falls, Stember Creek, and Museum. Cumulatively, the Sentinel Bluffs Member is at least ~150 m thick. Unit Mv_{gs} is mapped as undivided ("grouped") where geochemical results are unavailable to divide exposures into subunits and where reasonable interpolations are made using nearby stratigraphic relationships. With available whole-rock geochemistry, the Sentinel Bluffs Member is subdivided into:

Mv_{gsm} — **Basalt of Museum (Miocene)**—Fine-grained basaltic andesite with groundmass crystals ranging in size from 0.05 to 0.6 mm and very rare phenocrysts of plagioclase up to 3.5 mm in size; most commonly aphyric; groundmass textures are microcrystalline, mostly equigranular (rarely seriate), and pilotaxitic (unoriented). Unit thickness is greater than 30 m and contains at least two flows. Unpublished mapping by Bentley and Powell in the early 1980s labels this unit as Tmz (Museum), Tor (Ortley Rocky Coulee), or Trc (Rocky Coulee).

Mv_{gssc} — **Basalt of Stember Creek (Miocene)**—Fine-grained basaltic andesite with groundmass crystals ranging in size from 0.05 to 0.4 mm and very rare phenocrysts of plagioclase as large as 1.6 mm; most commonly aphyric; groundmass textures are microcrystalline, seriate more than equigranular, and pilotaxitic (unoriented). Unit thickness is less than ~60 m and it contains at least two flows. Unit thins and pinches out to the northeast, and it consistently overlies flows with Spokane Falls-type compositions in the map area. Unpublished mapping by Bentley and Powell in the early 1980s labels this unit as Toc (Ortley Cohassett?) or Tch (Chinahat/Cohassett?).

Mv_{gssf} — **Basalt of Spokane Falls (Miocene)**—Fine-grained basaltic andesite with groundmass crystals ranging in size from 0.1 to 0.4 mm and very rare phenocrysts of plagioclase as large as 1.2 mm; most commonly aphyric; groundmass textures are microcrystalline, range from seriate to equigranular, and pilotaxitic (unoriented). Unit thickness is less than 60 m and contains at least two flows. Unit may pinch out to the north-northeast and may interfinger with rocks with Stember Creek-type compositions. Unpublished mapping by Bentley and Powell in the early 1980s labels this unit as Toj (Ortley Jim?) or Tbt (Bingen unknown designation?).

Mv_{gsmc} — **Basalt of McCoy Canyon (Miocene)**—Fine-grained basaltic andesite with groundmass crystals ranging in size from ~0.1 to 0.5 mm and very rare phenocrysts of plagioclase as large as 1.2 mm; most commonly aphyric; groundmass texture is microcrystalline, equigranular, pilotaxitic (unoriented), and uncommonly microvesicular. Unit thickness is a least 60 m and contains two or three flows. Unpublished mapping by Bentley and Powell in the early 1980s labels this unit as Tbb (Bingen Bumping Hollow?) or Tmc (McCoy).

Mv_{go} — **Ortley member (Miocene)**—Fine- to medium-grained basaltic andesite with groundmass crystals up to 1 mm in size; most commonly aphyric; groundmass texture is weakly microporphyritic, pilotaxitic (unoriented), and mildly microvesicular (diktytaxitic). Unit thickness is ~150 m thick and contains at least two to four flows. Unit is part of the N2 MSU and represents the base of N2 MSU in the map area. Unpublished mapping by Bentley and Powell in the early 1980s labels this unit as Tbp (Bingen unknown designation?) or Tbw (Bingen unknown designation?).

Mv_{gg} — **Grouse Creek member (Miocene)**—Medium- to fine-grained basaltic andesite with groundmass crystals less than 1.5 mm in size; aphyric; groundmass texture is generally pilotaxitic (unoriented) with groundmass crystal sizes slightly greater than those of unit Mv(gs). Base of unit is not observed. Unit thickness is greater than 45 m in the map area but may be considerably thicker as suggested by a 180+ m section west of the map area (Sadowski and others, 2021). Unit contains at least one flow. Unit is found in the map area on in Cooke Canyon. Unit was mapped as the Howard Creek invasive flow by Rosenmeier (1968), and (or) GRB MSU R2 by Tabor and others (1982), and (or) the Meeks Table flow by Swanson (1976, 1978), Bentley (1977), and Hammond (2013). Unit represents the top of the R2 MSU in the map area.

GEOLOGIC SYMBOLS

Mass-wasting (overlay pattern) (Holocene to Pleistocene)—Mapped where landforms suggest mass movement on unstable slopes, but where evidence for landslide deposits is inconclusive.

Loess (overlay pattern) (earliest Holocene to Late Pleistocene)—Light brown to medium brown eolian loess; moderately weathered; low density, poorly compacted; silt to very fine-grained sand; angular; moderate sorting, matrix-supported; internally structureless; forms 1 meter-tall, irregularly spaced mounds most common in the central to northern map area with patchy mounds at higher elevations between Naneum and Coleman Canyons. Generally, but not always, conceals fault traces. We do not observe tectonically folded loess.

Hyaloclastite (overlay pattern) (Miocene)—Volcaniclastic aggregate, pillow breccia; light yellowish brown to orange brown or tan, strongly weathered; moderately dense, moderately well consolidated; generally sand-to-boulder sized clasts in a very fine-grained matrix; angular to subangular; poorly sorted, matrix-supported; generally convoluted and structureless; may contain basalt pillows that are matrix-supported; clastic aggregates characteristically include basaltic glass, palagonite, and plagioclase crystals with varied amounts of vesicular rock fragments; thickness varies from several feet up to about 30 m; unit is associated with many basaltic and sedimentary exposures and is most commonly found near the contact between the Grouse Creek and Ortley members (units Mv_{gg} and Mv_{go}) and between the lower basalts of the Sentinel Bluffs Member; interpreted as resulting from quenching of GRB lavas as they entered a water body.

Contact—Solid where location accurate; long-dashed where approximate; short-dashed where inferred; dotted where concealed; queried where identity or existence questionable

Geologic boundary—Identity and existence certain; solid where location accurate; long-dashed where approximate; short-dashed where inferred; In this map, symbol shows internal contacts between lava flows of the same unit, or boundaries between alluvial fans of similar ages

Fault—Solid where location accurate; long-dashed where approximate; short-dashed where inferred; dotted where concealed; queried where identity or existence questionable

Thrust fault—Solid where location accurate; long-dashed where approximate; short-dashed where inferred; dotted where concealed; queried where identity or existence questionable; Sawteeth on upper plate

Reverse fault—Solid where location accurate; long-dashed where approximate; short-dashed where inferred; dotted where concealed; rectangles on upthrown block

Oblique-slip fault, reverse right lateral offset—Solid where location accurate; long-dashed where approximate; short-dashed where inferred; dotted where concealed; queried where identity or existence questionable; arrows show relative motion; rectangles on upthrown block

High-angle dip-slip fault—Solid where location accurate; short-dashed where inferred; dotted where concealed; queried where identity or existence questionable; relative motion shown by U and D

Anticline—Long-dashed where approximate; dotted where concealed; arrow on line indicates plunge direction

Syncline—Long-dashed where approximate; short-dashed where inferred; dotted where concealed; arrow on line indicates plunge direction

Monocline, anticlinal bend—Long-dashed where approximate; short-dashed where inferred; dotted where concealed; queried where identity or existence questionable; arrows show direction of dip; shorter arrow on steeper limb; arrow on line indicates plunge direction

A —— A' Cross section line

Perennial stream

Intermittent stream

Scarp of unknown origin—Hachures point down slope

Black structural symbols indicate surface data collected by Washington Geological Survey; **blue symbols** indicate surface data compiled from R. Bentley and J. Powell (written commun., 2013)

12, 27 — Inclined bedding—showing strike and dip

Horizontal bedding

37 — Small, minor inclined joint—showing strike and dip

7 — Inclined bedding in unconsolidated sedimentary deposits or unconsolidated fragmental deposits of volcanic origin—showing strike and dip

15, 9 — Inclined flow banding, lamination, layering, or foliation in igneous rock—showing strike and dip

62 — Shear—showing strike and dip

GD01 — Age site, U-Pb, uranium-lead

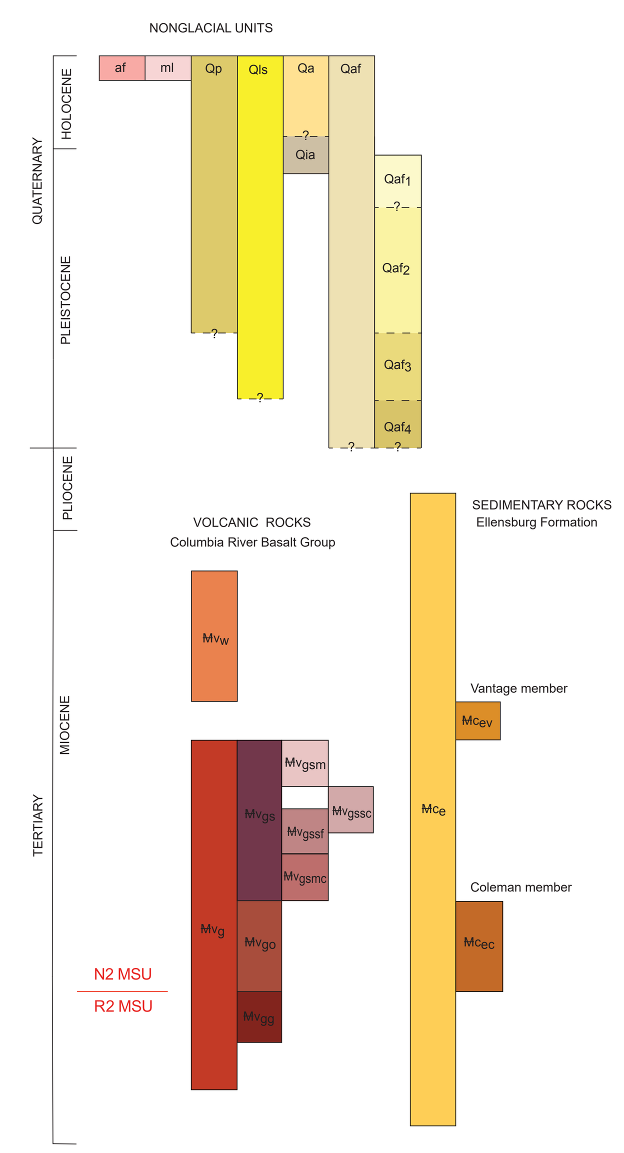
G158 — Geochemistry sample location

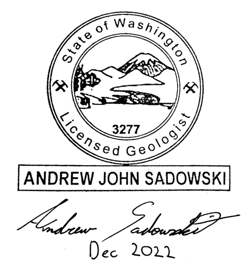
W09 — Water well

Mc_{ev}? — Geologic unit too small to show as a polygon at map scale

CORRELATION OF MAP UNITS

PERIODS AND EPOCHS BASED ON USGS FACT SHEET 2010-3059





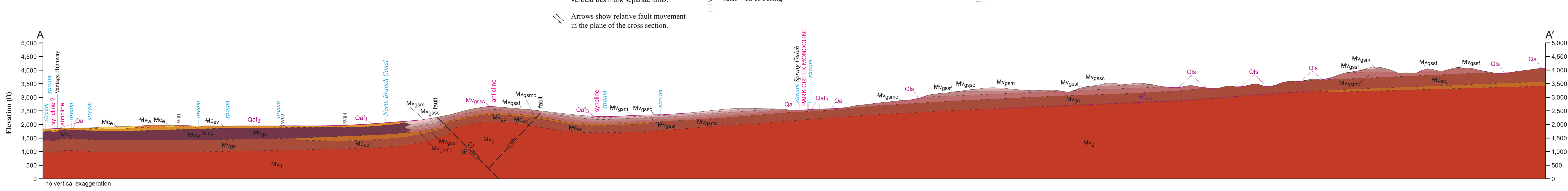
CROSS SECTION EXPLANATION

Qaf_3, Qa, Mc_{ec} — Geologic units too thin to show as polygons at the scale of the cross section—Solid where location accurate; short-dashed where inferred; vertical tics mark separate units.

Arrows show relative fault movement in the plane of the cross section.

⊗ ⊙ Arrow point shows fault movement toward the viewer; arrow feathers show fault movement away from the viewer.

W04 — Water well or boring



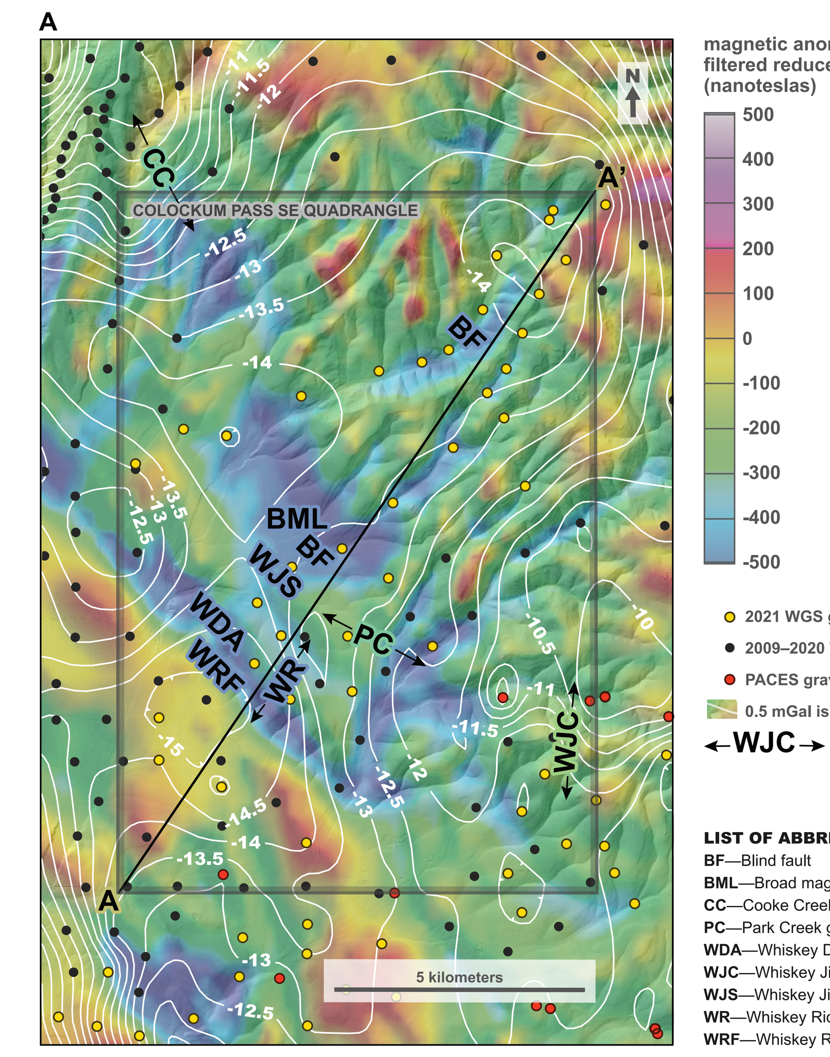


Figure M1A: Combined isostatic gravity and aeromagnetic map. Gravity contours are 0.5 mGal and hachures indicate closed lows. Hillshade topography aids geographic orientation in the background.

LIST OF ABBREVIATIONS
BF—Blind fault
BML—Broad magnetic low
CC—Cooke Creek gradient
PC—Park Creek gradient
WDA—Whiskey Dick anticline
WJC—Whiskey Jim Creek gradient
WJS—Whiskey Jim syncline
WR—Whiskey Ridge
WRF—Whiskey Ridge fault

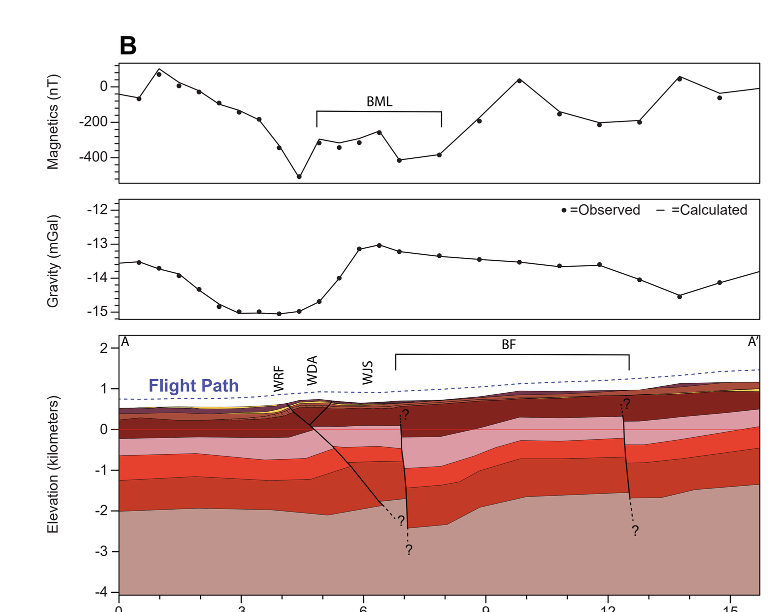


Figure M1B. Geophysical model along profile A–A'. Table shows geophysical properties used in the modeling process. Units for density (ρ) are kg/m³, magnetic susceptibility (χ) are SI units multiplied by 10³, magnetic remanence (Mr) is A/m, inclination (Incl) and declination (Decl) are in degrees. R1, N1, R2, and N2 are locally defined magnetostratigraphic units (MSU) that represent periods of the Earth's magnetic field orientation. R indicates reversed remanent magnetization and N indicates normal. Note: Hyaloclastite is less dense than the more slowly cooled parent lava and may retain some magnetic properties.

LIST OF ABBREVIATIONS
BF—blind faults
BML—broad magnetic low
N—normal magnetic polarity
R—reverse magnetic polarity
WDA—Whiskey Dick Anticline
WJS—Whiskey Jim syncline
WRF—Whiskey Ridge fault

	ρ	χ	Magnetic Remanence Mr	Incl	Decl
Quaternary or Miocene sedimentary rocks	1900-2010	0	0		
Sentinel Bluffs member (N2) hyaloclastite	2310	1	0.25	58	16
Sentinel Bluffs member (N2)	2610	8.3	2.5	58	16
Ortley member (N2) hyaloclastite	2200	4.0	0.25	58	16
Ortley member (N2)	2500	8.3	2.5	58	16
Grouse Creek member (R2)	2550	11.1	4.0	-58	196
Wapshilla Ridge & Mt. Horrible members (R2)	2590	15.4	4.0	-72	219
Grande Ronde (N1)	2770	6.3	2.5	58	355
Grande Ronde (R1)	2780	6.3	2.5	-66	171
Eocene/Oligocene sediment	2450	0	0		