3D geologic map of the Four Mound Prairie 7.5-minute quadrangle, Spokane and Stevens Counties, Washington

Disclaimer

Citation and link

WASHINGTON STATE DEPARTMENT OF
Natural Resources
Peter Goldmark - Commissioner of Public Lands

This 3D geologic map is derived from previously published geologic mapping and analysis. Some of the borehole data are considered preliminary and have not been examined for accuracy of either location or lithologic identification. While lithologic identification for all wells was made by the author of the published geologic map, not all of the wells shown in this 3D product were necessarily used to construct the geologic cross section. The map, cross section, and the borehole data within the 3D model are not intended for analytical use. Instead, the published map and (or) pamphlet should be consulted for original data and interpretation.

Click anywhere within this box to dismiss this disclaimer and continue.

3D PDF INSTRUCTIONS

NAVIGATION
(1 of 2)

- Click inside the window to manipulate the 3D view—the compass will rotate to point towards north
- Hold the left mouse button and move the mouse to tilt the view
- Use the mouse wheel to zoom
- Hold both the right and left mouse buttons to pan the view
- Toggle individual layers in the lower left corner
- Change the vertical scaling or layer separation in the lower toolbar
- Selecting an object will display its data below

OBJECT DATA

undefined

undefined

undefined

undefined

Layer001
Layer002

No Separation | 5% | 50% | 100%

5

Probe

1x Z-Scale | 10x Z-Scale | Default Scale | 10

Web tutorial

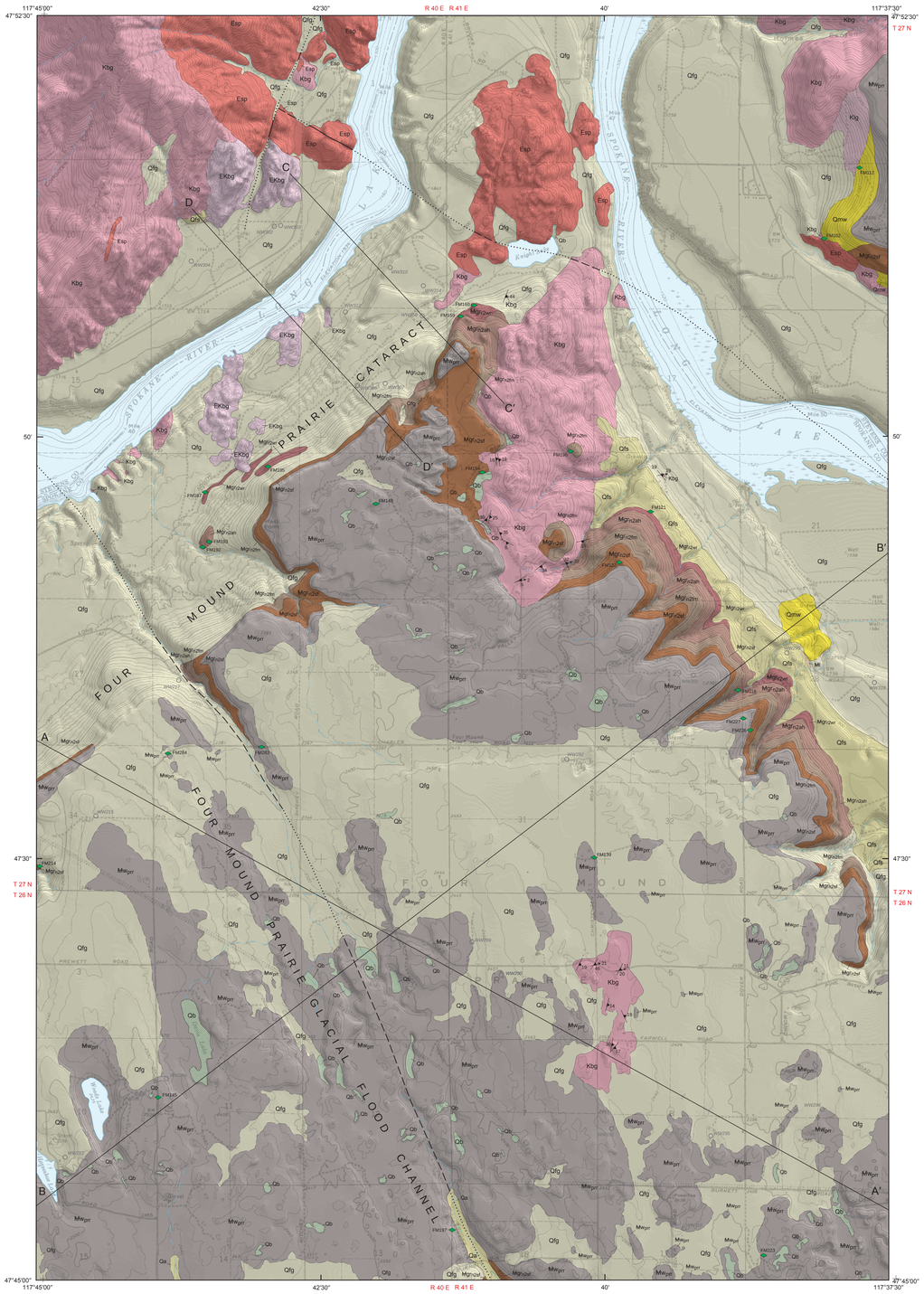
© 2015 Washington Division of Geology and Earth Resources

PDF3D

3D model creation: Daniel W. Eungard

Editing and production: Alexander N. Steely

WASHINGTON STATE DEPARTMENT OF
Natural Resources
Doug Sutherland - Commissioner of Public Lands
Division of Geology and Earth Resources
Ron Teissere - State Geologist



Lambert conformal conic projection
North American Datum of 1927; to place on North American Datum of 1983, move the projection lines approximately 15.3 meters north and 78.9 meters east as shown by crosshair corner ticks
Base map from scanned and rectified U.S. Geological Survey Four Mound Prairie 7.5-minute quadrangle, 1973
Shaded relief generated from U.S. Geological Survey 10-meter digital elevation model; sun azimuth 360°; sun angle 60°; vertical exaggeration 4x
Digital cartography by Anne C. Heinitz, Charles G. Caruthers, and J. Eric Schuster
Editing and production by Jaretta M. Roloff

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 20 feet

16°21'
TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 2007

Disclaimer: This product is provided 'as is' without warranty of any kind, either expressed or implied, including, but not limited to, the implied warranties of merchantability and fitness for a particular use. The Washington Department of Natural Resources and the authors of this product will not be liable to the user of this product for any activity involving the product with respect to the following: (a) lost profits, lost savings, or any other consequential damages; (b) the fitness of the product for a particular purpose; or (c) use of the product or results obtained from use of the product. This product is considered to be exempt from the Geologist Licensing Act [RCW 18.220.190 (4)] because it is geological research conducted by the State of Washington, Department of Natural Resources, Division of Geology and Earth Resources.

Geologic Map of the Four Mound Prairie 7.5-minute Quadrangle, Spokane and Stevens Counties, Washington

by Robert E. Derkey and Michael M. Hamilton

December 2007

MAJOR FINDINGS

New geologic features recognized and interpretations made during the mapping of the Four Mound Prairie quadrangle include:

- The Four Mound Prairie cataract and related glacial flood channel;
- The addition of the Four Mound Prairie compositional type to the Columbia River Basalt Group; and
- The N70–80°E lineation and foliation in the oldest pre-basalt granitic rocks in the quadrangle.

OVERVIEW

Previous geologic mapping of the Spokane area, including the Four Mound Prairie quadrangle, was by Pardee and Bryan (1926), Griggs (1966, 1973), Kiver and others (1979), and Joseph (1990). This mapping was reconnaissance in nature and included overviews of the geologic history of the area that can be summarized as follows: The oldest rocks in the quadrangle are Eocene and Cretaceous granitic rocks. Erosion created an irregular topography, part of which was covered by Miocene basalts of the Columbia River Basalt Group. The oldest of these basalts in the quadrangle is about 16 m.y. old. Catastrophic glacial outburst floods during the Pleistocene eroded channels into the basalt and deposited extensive fluvial sediments, consisting mostly of sand and gravel in this quadrangle, onto the basalt.

The N70–80°E lineation trend in the quadrangle is probably related to the same tectonic process that produced the N70–75°E lineation trend in the Spokane dome of the Priest River metamorphic core complex to the east (Rhodes and others, 1989; Derkey and others, 1999, 2004b,c). The newly mapped lineation and foliation occur in the altered and weathered Cretaceous biotite granite (unit Kbg). The Eocene–Cretaceous biotite granite containing scattered schlieren (unit EKbg) exhibits little alteration or weathering. The term 'granite', as used here, refers to all of the holocrystalline, quartz-bearing igneous rocks in the quadrangle except Silver Point Quartz Monzonite (unit Esp). Silver Point Quartz Monzonite, named by Miller (1969), is the only hornblende-bearing holocrystalline rock in the quadrangle.

Swanson and others (1979) and Reidel (2005) used whole rock geochemistry to identify individual basalt flows and establish the basalt stratigraphy for the region. In the Four Mound Prairie quadrangle, the basalt stratigraphy from oldest to youngest is Grande Ronde Basalt, magnetostratigraphic units R_1 and N_2, overlain by Wanapum Basalt. Grande Ronde Basalt, R_2 magnetostratigraphic unit, is the member of Wapshilla Ridge (Reidel and others, 2002). Grande Ronde Basalt, N_2 magnetostratigraphic unit, is the Sentinel Bluffs Member. In this quadrangle, it is subdivided into three flow units of different compositional types on the basis of geochemistry: the Airway Heights type and Spokane Falls type of Reidel (2005; Wash. State Univ. Tri-Cities, oral commun., 2007) and a new type that we herein name the Four Mound Prairie compositional type. The only sample (FM196, Table 1) of the Four Mound Prairie compositional type in the quadrangle is from an isolated basalt exposure; however, samples with the same chemistry and at a similar elevation (all between 2135 and 2195 ft) from the Nine Mile Falls and Deer Park quadrangles are compositionally similar (Derkey and others, 2003, 2005). The samples from the Nine Mile Falls and Deer Park quadrangles are considered typical of the Grande Ronde Basalt, R_2 magnetostratigraphic unit. In the Four Mound Prairie quadrangle, the stratigraphic position of the Four Mound Prairie compositional type is below the Spokane Falls compositional type and above the Airway Heights compositional type. Wanapum Basalt in the quadrangle is the Priest Rapids Member, Rosalia compositional type. Lava flow boundaries were mapped because they are commonly productive aquifers, due to porosity and permeability. The distribution of aquifers is a major issue for residents of the Four Mound Prairie quadrangle and adjacent West Plains area.

The arcuate basalt ridge of the Four Mound Prairie cataract (*see* geologic map) is about 8 mi long and extends westward into the adjacent Long Lake quadrangle as far as Long Lake Dam. Bedrock relief from the basalt plain to the granite below is approximately 650 ft (*see* Cross Sections C and D). Flood gravel conceals much of the cataract, which has potential as a multipurpose water storage site. The Four Mound Prairie glacial flood channel (*see* geologic map), a related glacial flood feature, is a broad 0.6- to 2-mi-wide and 16- to 33-ft-deep channel that extends from the south-central border of the quadrangle to the Four Mound Prairie cataract. Boulders and cobbles in the flood gravels of the Four Mound Prairie glacial flood channel are almost exclusively basalt. Giant ripple marks attest to the movement of flood waters through the channel. Several gravel pits (including two county pits in the quadrangle) are in the flood gravel between the Four Mound Prairie cataract and the town of Airway Heights in the Airway Heights quadrangle to the southeast.

The north-northwest-trending Four Mound Prairie glacial flood channel follows a linear trend that we suggest is fault-controlled and was accentuated during glacial flooding. This north-northwest trend appears elsewhere in the Columbia Basin (Schuster and others, 1997). Another proposed fault running through the Spokane River and Knight Lake is an extension of a fault postulated in the Nine Mile Falls quadrangle (Derkey and others, 2003). A third north-northeast-trending fault in the northwest corner of the quadrangle follows a narrow and deep canyon and extends into the Tumtum quadrangle.

DESCRIPTION OF MAP UNITS

Quaternary Sedimentary Deposits

Qa — **Alluvium (Holocene)**—Silt, sand, and gravel deposits in present-day stream channels; consists of reworked glacial flood deposits, basalt, and loess.

Qb — **Bog deposits (Holocene and Pleistocene)**—Peat with lesser amounts of silt, ash, marl (bog lime), and gyttja (freshwater mud with abundant organic matter); located predominantly in Channeled Scabland depressions on basalt bedrock (Milne and others, 1975); numerous deposits were not mapped because they are too small to delineate at the scale of the topographic base map; bog deposits were not included on the cross sections due to their small extent relative to the scale of the cross sections; portions of bog areas may contain seasonal to year-round water-filled ponds.

Qmw — **Mass-wasting deposits (Holocene and late Pleistocene)**—Landslide debris with lesser amounts of debris-flow and rock-fall deposits; consists mostly of a mixture of basalt blocks and Latah Formation sediments; basalt blocks range up to 33 ft; exposures are near the eastern edge of the quadrangle. Most mass wasting occurred during or shortly after Pleistocene catastrophic flood events, but some continues to the present; mass-wasting that occurred during glacial flooding incorporated sand and pebble lenses.

The following units (Qfs and Qfg) were deposited by outburst floods from glacial Lake Missoula. The deposits are the product of numerous flood events and do not represent any single flood event.

Qfs — **Glacial flood deposits, predominantly sand (Pleistocene)**—Medium- to coarse-grained sand and granules with sparse pebbles, cobbles, and boulders; may contain beds and lenses of gravel; composed mainly of granitic and metamorphic detritus from sources to the east; gray, yellowish gray, or light brown; subangular to subrounded; poorly to moderately well sorted; thin bedded to massive; appears speckled in some exposures because of the mixture of light and dark fragments; includes some occurrences of glacial-lake sediments too small to map separately; appears as a deposit south of the Spokane River and adjacent to the basalt highlands in the east part of the quadrangle. The flood gravels in the Four Mound Prairie quadrangle contain a greater proportion of sand and granule gravel than exposures of gravel in the Nine Mile Falls quadrangle adjacent to the east and the Airway Heights quadrangle to the southeast (Derkey and others, 2003, 2004a).

Qfg — **Glacial flood deposits, predominantly gravel (Pleistocene)**—Thick-bedded to massive mixture of boulders, cobbles, pebbles, granules, and sand; contains beds and lenses of sand and silt; gray, yellowish gray, or light brown; poorly to moderately sorted; both matrix and clast supported; locally composed of boulders and cobbles in a matrix of mostly pebbles and coarse sand; large boulder fields in the northern part of the quadrangle are the residuum of reworked glacial drift; boulders and cobbles consist predominantly of local bedrock units and units found to the north and northeast in Idaho.

Miocene Igneous Rocks

COLUMBIA RIVER BASALT GROUP

Wanapum Basalt

Mw_{pr} — **Priest Rapids Member, basalt of Rosalia (middle Miocene)**—Dark gray to black, fine-grained, dense basalt consisting of plagioclase, pyroxene, and olivine in a mostly glass matrix; variable thickness; thinnest where it laps upon pre-Miocene highlands; lies directly on pre-Miocene rocks. Latah Formation, or Grande Ronde Basalt; of the Rosalia compositional type (Table 1), which has higher titanium and lower magnesium and chromium content than other compositional types of the Wanapum Basalt (Swanson and others, 1979); between 14.5 and 15.3 m.y. old; has reversed magnetic polarity (Tolan and others, 1989).

Grande Ronde Basalt

Mgr_{n2sf}, Mgr_{n2ftm}, Mgr_{n2ah} — **Sentinel Bluffs Member, N_2 magnetostratigraphic unit (middle Miocene)**—Dark gray to dark greenish gray, fine-grained basalt consisting of pale green augite and pigeonite grains (10–40%) and plagioclase laths and sparse phenocrysts (10–30%) in a matrix of black to dark brown glass (30–70%) and opaque minerals; locally vesicular with plagioclase laths tangential to vesicle boundaries; some vesicles contain opaline filling and red amorphous secondary minerals; thickness is quite variable due to irregular underlying topography; identified on the basis of chemical analyses (Table 1); between 15.6 and 16.5 m.y. old (Reidel and others, 1989). Based on chemical analysis, we mapped three separate flow units in the Sentinel Bluffs Member. From highest to lowest, they are the Spokane Falls (unit Mgr_{n2sf}), the Four Mound Prairie (unit Mgr_{n2ftm}), and the Airway Heights (unit Mgr_{n2ah}) compositional types. The Airway Heights and Spokane Falls compositional types were described and named by Reidel (2005). The Four Mound Prairie compositional type is herein named and included as part of the Sentinel Bluffs Member.

Mgr_{n2wr} — **Member of Wapshilla Ridge, R_2 magnetostratigraphic unit (middle Miocene)**—Dark gray to dark greenish gray, fine-grained basalt consisting of pale green augite and pigeonite grains (10–40%) and plagioclase laths and sparse phenocrysts (10–30%) in a matrix of black to dark brown glass (30–70%) and opaque minerals; locally vesicular with plagioclase laths tangential to vesicle boundaries; some vesicles contain botryoidal carbonate and red amorphous secondary minerals; thickness quite variable due to irregular underlying topography; between 15.6 and 16.5 m.y. old (Reidel and others, 1989); part of the Wapshilla Ridge unit of Reidel and others (1989), based on whole rock chemistry (Table 1).

Miocene Sedimentary Rocks

Ml — **Latah Formation (middle Miocene)**—Lacustrine and fluvial deposits of finely laminated siltstone, claystone, and minor sandstone; light gray to yellowish gray and light tan; commonly weathers brownish yellow with stains, spots, and seams of limonite; poorly indurated; exposures are limited in the map area; unconformably overlies pre-Miocene rocks or is interbedded with Grande Ronde Basalt; easily eroded and commonly blanketed by colluvium, talus, and residual soils; floral assemblages indicate a Miocene age (Knowlton, 1926; Griggs, 1976); the only map exposure of the unit is in a roadcut in the east-central part of the quadrangle; water well logs confirm its presence between the basalt and the underlying granitic rocks.

Pre-Miocene Intrusive Rocks

Esp — **Silver Point Quartz Monzonite (Eocene)**—Quartz monzonite consisting of distinct microperthitic orthoclase phenocrysts up to 1 in. long accompanied by smaller, zoned-plagioclase, hornblende, biotite, and quartz crystals in a fine- to very fine-grained groundmass; generally light gray with a greenish tinge at contact with host rocks; hornblende has a long dimension of as much as 0.04 in. and is associated with biotite; orthoclase phenocrysts are euhedral; other phenocrysts range from euhedral to anhedral, most are subhedral (Derkey and others, 2003); titanite is the most common accessory mineral, followed by magnetite, apatite, zircon, and rare allanite (Miller and Clark, 1975); as much as 50% of the rock is groundmass; consists of dikes and irregularly shaped intrusive bodies. Two samples from the Chewelah 1:100,000-scale quadrangle to the north gave whole-rock Rb-Sr ages of 39.4 Ma and 46.2 Ma (Armstrong and others, 1987); recalculated K-Ar ages on rocks from the Chewelah 1:100,000-scale quadrangle were 51 Ma on biotite and 62 Ma on hornblende (Miller and Clark, 1975).

EKbg — **Biotite granite (Eocene–Cretaceous)**—Massive, medium- to coarse-grained, equigranular biotite granitic rock containing chaotically distributed, biotite-rich schlieren; grain size varies from fine- to medium-grained; biotite content varies from 5% to as much as 25%; increased biotite is associated with schlieren; dike- and sill-like bodies as much as 3 ft thick cut this unit and consist of interspersed mafic and felsic igneous rock; less altered and weathered than Cretaceous biotite granite (unit Kbg); weathering and alteration similar to adjacent Silver Point Quartz Monzonite (unit Esp); biotite-rich schlieren may be assimilated inclusions or, alternatively, magma mixing with a more mafic (that is, andesitic) melt.

Klg — **Leucocratic granite (Cretaceous)**—Medium-grained muscovite granite; consists of microcline and albite in microperthitic combination, quartz, and muscovite; microcline and albite content are nearly equal; muscovite can range up to 10% but is generally less than 5%; rarely contains a trace to 2% biotite; pink to cream in color; leucocratic dikes cut biotite granite (unit Kbg) as noted by Derkey and others (2003) in the adjacent Nine Mile Falls quadrangle.

Kbg — **Biotite granite (Cretaceous)**—Massive, medium- to coarse-grained, equigranular biotite granite to quartz monzonite; quartz forms clots or aggregates of crystals and is intergrown with potassium feldspar; potassium feldspar also forms some phenocrysts and clots of phenocrysts; anhedral to subhedral black biotite makes up 2 to 7% of the rock and generally is interstitial to other minerals; due to alteration and weathering, exposures range from punky to grus; leucocratic dikes (unit Klg) intrude biotite granite in the adjacent Nine Mile Falls quadrangle (Derkey and others, 2003); also intruded by mafic dikes.

GEOLOGIC SYMBOLS

Contact—Long dashed where approximately located, short dashed where inferred or indefinite

Fault, unknown offset—Long dashed where approximately located, dotted where concealed; queried where uncertain

Foliation in granitic rock—Showing strike and dip

Mineral lineation—Showing bearing and plunge

WW215 Water well—Numbers correspond to well numbers on cross sections

FM138 Basalt geochemistry sample location—Numbers correspond to sample numbers in Table 1

ACKNOWLEDGMENTS

This map was funded in part by the U.S. Geological Survey National Cooperative Geological Mapping Program (agreement no. 06HQAG0035). Steve Reidel provided extensive insight into basalt geochemistry and stratigraphy in Columbia River Basalt. We are thankful for discussions of Four Mound Prairie geology with Ted Doughty and Jennifer Thomson of the Geology Department at Eastern Washington University. The Washington Department of Ecology provided access to water well logs for the quadrangle and allowed us to copy logs important to our study.

REFERENCES CITED

Armstrong, R. L.; Parrish, R. R.; van der Heyden, Peter; Reynolds, S. J.; Rehrig, W. A., 1987, Rb-Sr and U-Pb geochronometry of the Priest River metamorphic complex—Precambrian X basement and its Mesozoic–Cenozoic plutonic-metamorphic overprint, northeastern Washington and northern Idaho. *In* Schuster, J. E., editor, Selected papers on the geology of Washington: Washington Division of Geology and Earth Resources Bulletin 77, p. 15-40.

Derkey, R. E.; Hamilton, M. M.; Stradling, D. F., 2003, Geologic map of the Nine Mile Falls 7.5-minute quadrangle, Spokane and Stevens Counties, Washington: Washington Division of Geology and Earth Resources Open File Report 2003-8, 1 sheet, scale 1:24,000.

Derkey, R. E.; Hamilton, M. M.; Stradling, D. F., 2004a, Geologic map of the Airway Heights 7.5-minute quadrangle, Spokane County, Washington: Washington Division of Geology and Earth Resources Open File Report 2004-1, 1 sheet, scale 1:24,000.

Derkey, R. E.; Hamilton, M. M.; Stradling, D. F., 2004b, Geologic map of the Greenacres 7.5-minute quadrangle, Spokane County, Washington: Washington Division of Geology and Earth Resources Open File Report 2004-11, 1 sheet, scale 1:24,000.

Derkey, R. E.; Hamilton, M. M.; Stradling, D. F., 2004c, Geologic map of the Washington portions of the Liberty Lake 7.5-minute quadrangle and the south half of the Newman Lake 7.5-minute quadrangle, Spokane County: Washington Division of Geology and Earth Resources Open File Report 2004-12, 1 sheet, scale 1:24,000.

Derkey, R. E.; Hamilton, M. M.; Stradling, D. F., 2005, Geologic map of the Deer Park 7.5-minute quadrangle, Spokane County, Washington: Washington Division of Geology and Earth Resources Geologic Map GM-54, 1 sheet, scale 1:24,000.

Derkey, R. E.; Hamilton, M. M.; Stradling, D. F.; Kiver, E. P., 1999, Preliminary geologic maps of the Spokane NE and SE 7.5-minute quadrangles, Spokane County, Washington: Washington Division of Geology and Earth Resources Open File Report 99-6, 3 sheets, scale 1:24,000.

Griggs, A. B., 1966, Reconnaissance geologic map of the west half of the Spokane quadrangle, Washington and Idaho: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-464, 1 sheet, scale 1:125,000.

Griggs, A. B., 1973, Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana: U.S. Geological Survey Miscellaneous Geologic Investigations Series Map I-768, 1 sheet, scale 1:250,000.

Griggs, A. B., 1976, The Columbia River Basalt Group in the Spokane quadrangle, Washington, Idaho, and Montana; with a section on Petrography, by D. A. Swanson: U.S. Geological Survey Bulletin 1413, 39 p., 1 plate.

Johnson, D. M.; Hooper, P. R.; Conrey, R. M., 1998, XRF analysis of rocks and minerals for major and trace elements on a single low dilution Li-tetraborate fused bead: Washington State University GeoAnalytical Laboratory, 25 p.

Joseph, N. L., compiler, 1990, Geologic map of the Spokane 1:100,000 quadrangle, Washington–Idaho: Washington Division of Geology and Earth Resources Open File Report 90-17, 29 p., 1 plate.

Kiver, E. P.; Rigby, J. G.; Stradling, D. F., 1979, Surficial geologic map of the Spokane quad, Washington: Washington Division of Geology and Earth Resources Open File Report 79-11, 1 sheet, scale 1:250,000.

Knowlton, F. H., 1926, Flora of the Latah Formation of Spokane, Washington, and Coeur d'Alene, Idaho. *In* Shorter contributions to general geology, 1925: U.S. Geological Survey Professional Paper 140-A, p. 17-81.

Miller, F. K., 1969, Preliminary geologic map of the Loon Lake quadrangle, Stevens and Spokane Counties, Washington: Washington Division of Mines and Geology Geologic Map GM-6, 1 sheet, scale 1:62,500, with 7 p. text.

Miller, F. K.; Clark, L. D., 1975, Geology of the Chewelah–Loon Lake area, Stevens and Spokane Counties, Washington, with a section on potassium-argon ages of the plutonic rocks, by J. C. Engels: U.S. Geological Survey Professional Paper 806, 74 p., 2 plates.

Milne, S. S.; Hayashi, S. K.; Gese, D. D., 1975, Stratigraphy of scabland meadows in southeast Spokane County [abstract]: Northwest Scientific Association, 48th Annual Meeting, Program and Abstracts, abstract no. 81.

Pardee, J. T.; Bryan, Kirk, 1926, Geology of the Latah Formation in relation to the lavas of the Columbia Plateau near Spokane, Washington. *In* Shorter contributions to general geology 1925: U.S. Geological Survey Professional Paper 140, p. 1-16.

Reidel, S. P., 2005, A lava flow without a source—The Cohassett flow and its compositional components, Sentinel Bluff Member, Columbia River Basalt Group: Journal of Geology, v. 113, no. 1, p. 1-21.

Reidel, S. P.; Johnson, V. G.; Spane, F. A., 2002, Natural gas storage in basalt aquifers of the Columbia Basin, Pacific Northwest USA—A guide to site characterization: Pacific Northwest National Laboratory PNNL-13962, 1 v.

Reidel, S. P.; Tolan, T. L.; Hooper, P. R.; Beeson, M. H.; Fecht, K. R.; Bentley, R. D.; Anderson, J. L., 1989, The Grande Ronde Basalt, Columbia River Basalt Group; Stratigraphic descriptions and correlations in Washington, Oregon, and Idaho. *In* Reidel, S. P.; Hooper, P. R., editors, Volcanism and tectonism in the Columbia River flood-basalt province: Geological Society of America Special Paper 239, p. 21-53.

Rhodes, B. P.; Harms, T. A.; Hyndman, D. W., 1989, Geology of the southern Priest River Complex and the Newport fault. *In* Joseph, N. L.; and others, editors, Geologic guidebook for Washington and adjacent areas: Washington Division of Geology and Earth Resources Information Circular 86, p. 163-186.

Schuster, J. E.; Gulick, C. W.; Reidel, S. P.; Fecht, K. R.; Zurenko, S. E., 1997, Geologic map of Washington—Southeast quadrant: Washington Division of Geology and Earth Resources Geologic Map GM-45, 2 sheets, scale 1:250,000, with 20 p. text.

Swanson, D. A.; Wright, T. L.; Hooper, P. R.; Bentley, R. D., 1979, Revisions in stratigraphic nomenclature of the Columbia River Basalt Group: U.S. Geological Survey Bulletin 1457-G, 59 p., 1 plate.

Tolan, T. L.; Reidel, S. P.; Beeson, M. H.; Anderson, J. L.; Fecht, K. R.; Swanson, D. A., 1989, Revisions to the estimates of the areal extent and volume of the Columbia River Basalt Group. *In* Reidel, S. P.; Hooper, P. R., editors, Volcanism and tectonism in the Columbia River flood-basalt province: Geological Society of America Special Paper 239, p. 1-20. ■

Suggested citation: Derkey, Robert E.; Hamilton, Michael M., 2007, Geologic map of the Four Mound Prairie 7.5-minute quadrangle, Spokane and Stevens Counties, Washington: Washington Division of Geology and Earth Resources Geologic Map GM-66, 1 sheet, scale 1:24,000.

Table 1. Geochemical analyses of basalt samples from the Four Mound Prairie quadrangle were performed at the Washington State University GeoAnalytical Laboratory. Instrumental precision is described in Johnson and others (1998). Total Fe is expressed as FeO.

WANAPUM BASALT, PRIEST RAPIDS MEMBER, BASALT OF ROSALIA

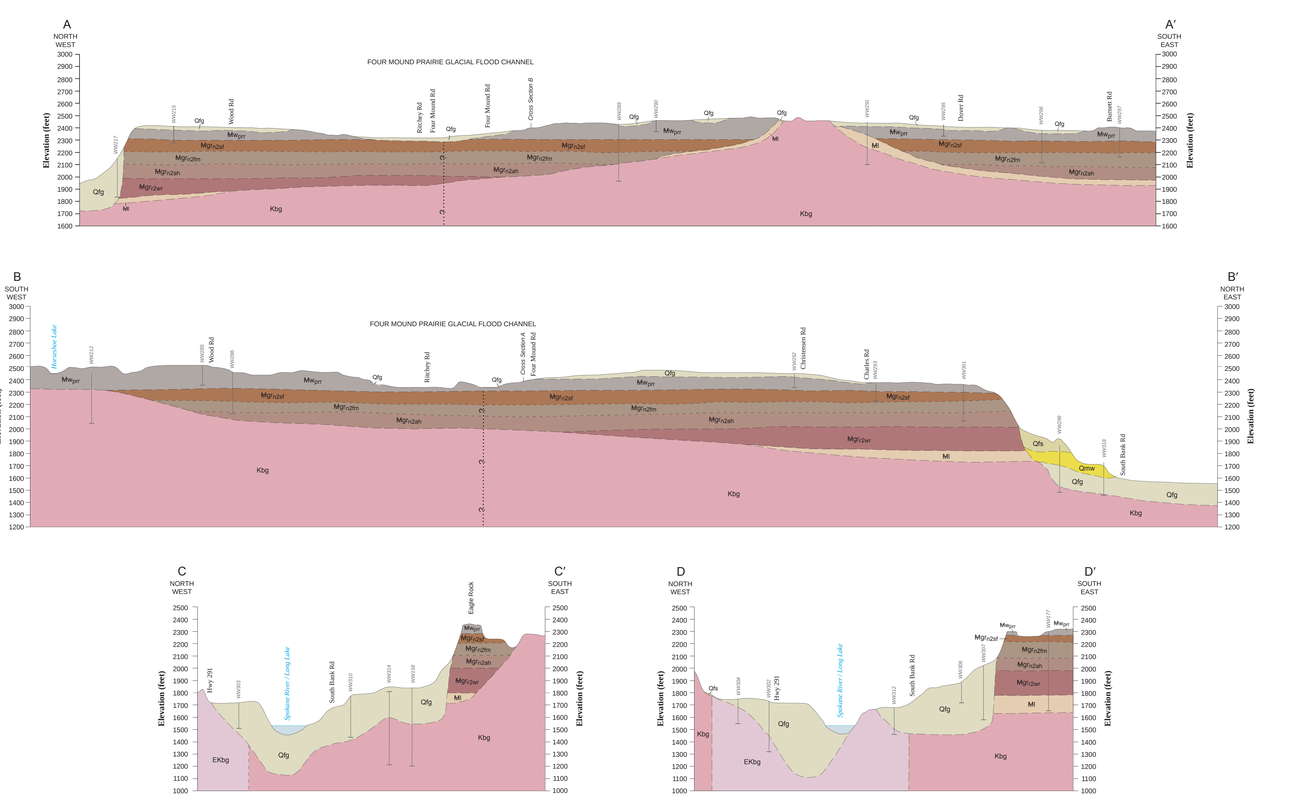
Sample no.	SiO_2	Al_2O_3	TiO_2	FeO	MnO	CaO	MgO	K_2O	Na_2O	P_2O_5	Total	Ni	Cr	Sc	V	Ba	Rb	Sr	Zr	Y	Nb	Ga	Cu	Zn	Pb	La	Ce	Th	Nd
FM102	49.36	12.76	3.626	14.78	0.247	8.46	4.50	1.36	2.67	0.779	98.54	19	16	39	420	594	30	293	224	50	17.3	23	19	158	6	32	64	5	37
FM112	49.17	12.72	3.576	14.75	0.244	8.47	4.56	1.23	2.72	0.760	98.21	21	18	39	421	563	30	292	219	48	15.9	21	22	153	7	30	62	6	39
FM138	49.74	12.79	3.642	14.21	0.238	8.55	4.26	1.18	2.71	0.793	98.10	20	13	38	421	603	31	304	227	51	16.9	24	22	163	7	34	68	5	39
FM145	49.05	12.60	3.613	14.54	0.243	8.23	4.14	1.24	2.82	0.786	97.26	17	12	39	423	585	30	286	227	51	16.3	22	20	160	5	27	70	5	41
FM148	49.36	12.73	3.684	14.38	0.245	8.55	4.42	1.33	2.68	0.802	98.18	19	14	39	441	597	30	293	226	50	17.1	22	20	155	7	30	67	5	39
FM197	49.08	12.58	3.575	14.59	0.241	8.33	4.40	1.28	2.69	0.778	97.55	19	13	38	414	575	33	289	223	49	16.6	20	21	156	5	27	66	6	38
FM223	49.34	12.79	3.643	14.51	0.245	8.57	4.46	1.21	2.70	0.764	98.23	19	13	40	424	583	30	298	222	50	16.5	24	20	155	6	29	68	5	40
FM227	48.98	12.77	3.622	14.18	0.231	8.52	3.99	1.26	2.53	0.805	96.88	19	14	39	427	576	30	296	226	51	17.0	21	21	153	7	30	67	5	40
FM283	48.25	12.89	3.624	14.65	0.254	8.63	3.95	1.33	2.61	0.808	96.99	20	15	39	430	591	31	299	223	50	17.6	23	21	154	7	27	63	5	38
FM284	48.95	12.72	3.648	14.42	0.229	8.61	4.27	1.31	2.59	0.801	97.54	20	14	39	428	577	29	301	229	50	16.7	21	21	156	6	29	65	4	39

GRANDE RONDE BASALT, SENTINEL BLUFFS MEMBER, N_2 MAGNETOSTRATIGRAPHIC UNIT

Sample no.	SiO_2	Al_2O_3	TiO_2	FeO	MnO	CaO	MgO	K_2O	Na_2O	P_2O_5	Total	Ni	Cr	Sc	V	Ba	Rb	Sr	Zr	Y	Nb	Ga	Cu	Zn	Pb	La	Ce	Th	Nd
Spokane Falls compositional unit																													
FM214	54.07	14.84	1.896	10.00	0.187	9.10	4.12	1.29	2.84	0.310	98.64	14	45	38	346	514	28	335	164	35	10.0	22	33	118	6	19	42	4	23
FM226	53.18	14.24	1.826	10.47	0.190	8.78	4.52	1.19	2.75	0.296	97.44	17	44	36	327	574	29	329	157	34	10.1	20	34	115	6	20	39	4	22
FM122	53.57	14.04	1.849	11.11	0.202	8.65	4.85	1.32	2.80	0.297	98.69	17	45	36	335	503	29	314	161	34	10.4	19	35	116	6	17	43	5	26
Four Mound Prairie compositional unit																													
FM196	55.44	13.58	2.212	11.00	0.189	6.79	3.23	1.80	3.11	0.382	97.74	7	4	33	305	766	49	339	196	38	12.1	22	12	132	8	27	55	7	30
Airway Heights compositional unit																													
FM118	53.20	13.94	1.895	11.05	0.206	8.55	4.71	1.17	2.89	0.367	97.98	16	42	37	302	514	28	315	164	36	10.2	19	30	122	6	21	52	4	27
FM154	53.32	14.09	1.897	10.89	0.205	8.66	4.53	1.33	2.88	0.376	98.17	16	41	36	300	536	29	318	165	35	11.1	20	31	120	6	20	45	5	28
FM192	53.01	13.85	1.865	11.26	0.206	8.52	4.78	1.19	2.85	0.364	97.89	16	42	36	295	496	28	313	162	35	9.8	20	32	122	7	22	44	5	28
FM193	53.42	14.03	1.886	11.21	0.208	8.70	4.71	1.20	2.90	0.364	98.62	16	41	36	302	512	29	316	164	35	11.2	20	31	122	6	22	44	4	25

GRANDE RONDE BASALT, MEMBER OF WAPSHILLA RIDGE, R_2 MAGNETOSTRATIGRAPHIC UNIT

Sample no.	SiO_2	Al_2O_3	TiO_2	FeO	MnO	CaO	MgO	K_2O	Na_2O	P_2O_5	Total	Ni	Cr	Sc	V	Ba	Rb	Sr	Zr	Y	Nb	Ga	Cu	Zn	Pb	La	Ce	Th	Nd
FM121	55.57	13.66	2.176	11.05	0.188	6.80	3.27	1.77	3.17	0.372	98.03	7	7	32	299	756	50	341	194	37	12.4	22	12	130	9	27	59	7	32
FM119	55.37	13.52	2.146	10.92	0.195	6.80	3.27	1.93	3.08	0.382	97.61	8	4	31	300	733	51	334	195	37	12.7	20	11	129	10	25	60	7	30
FM160	55.59	13.68	2.104	11.04	0.190	6.83	3.28	1.79	3.19	0.367	98.05	6	5	32	302	762	49	339	195	36	13.3	22	12	129	10	27	58	8	31
FM187	55.50	13.58	2.060	11.18	0.192	6.84	3.28	1.87	3.16	0.362	98.03	8	5	31	301	739	51	334	193	36	13.0	20	11	126	8	27	61	6	32
FM195	55.36	13.52	2.056	10.91	0.192	6.82	3.28	1.80	3.18	0.361	97.49	7	6	30	300	713	49	333	192	37	11.8	22	12	125	10	31	54	7	30



© 2007 Washington Division of Geology and Earth Resources