3D geologic map of the Spokane Southwest 7.5-minute quadrangle, Spokane County, Washington

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Citation and link

WASHINGTON STATE DEPARTMENT OF
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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.

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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

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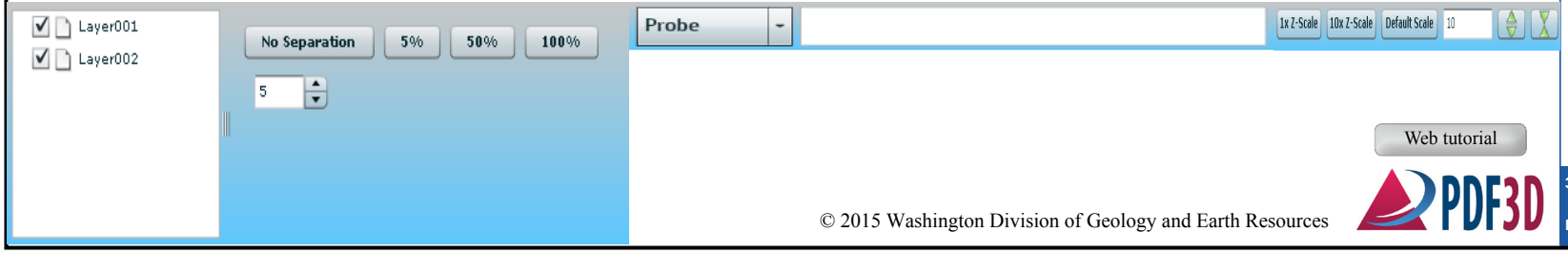

Web tutorial

PDF3D

3D model creation: Ashley A. Cabibbo

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

WASHINGTON DIVISION OF GEOLOGY AND EARTH RESOURCES
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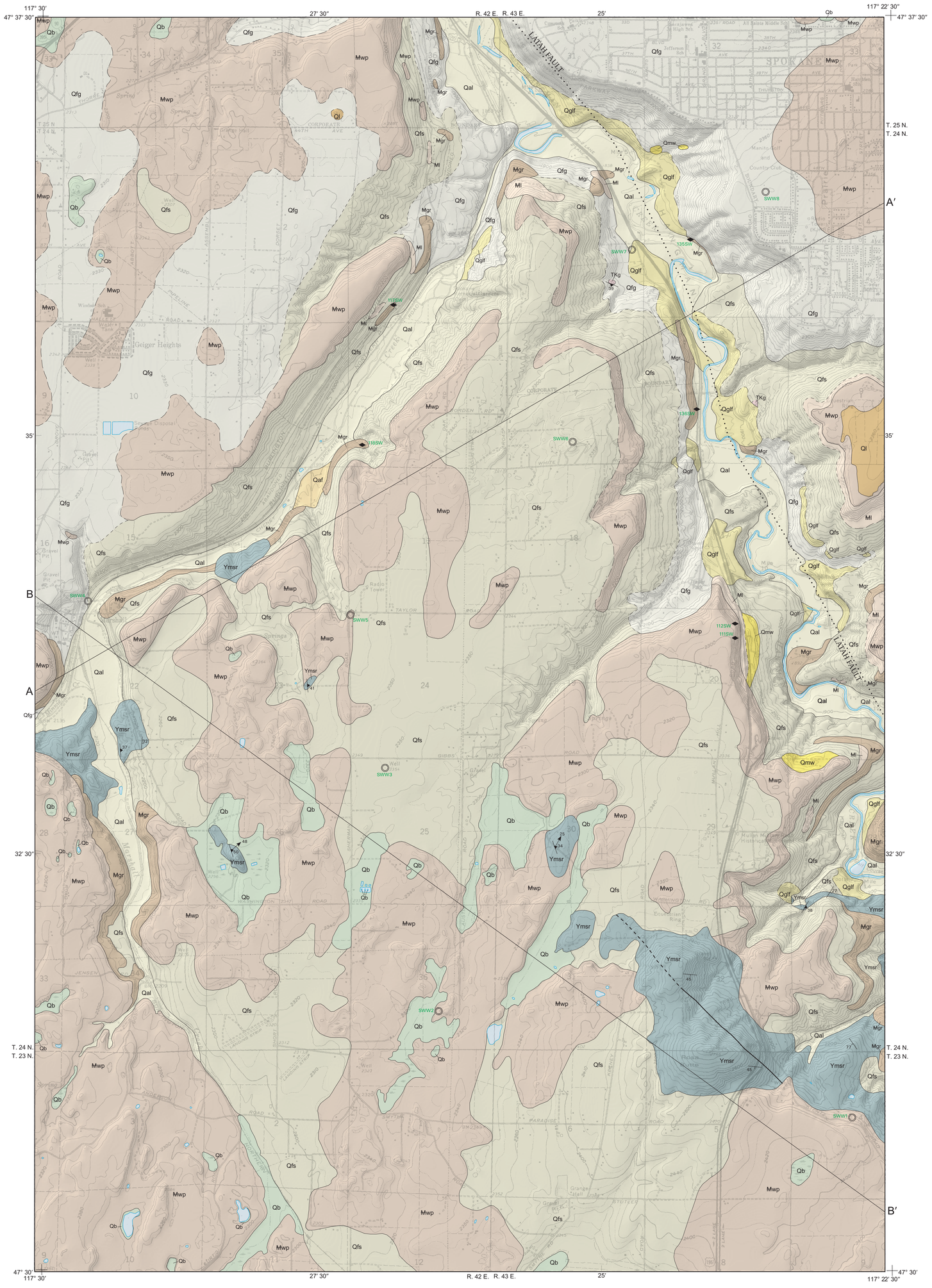
Geologic Map of the Spokane Southwest 7.5-minute Quadrangle, Spokane County, Washington

by Michael M. Hamilton, Robert E. Derkey, and Dale F. Stradling

2004



INTRODUCTION

Previous geologic mapping of the Spokane Southwest 7.5-minute quadrangle was reconnaissance and lacked sufficient detail to be of service to developers and planners in the area. We undertook detailed field mapping of the quadrangle in 1999 and completed it in 2000. Our field mapping and air photo interpretation was drawn on a U.S. Geological Survey topographic map of the quadrangle and then digitized and overlaid on digital orthophotos from the Washington State Department of Natural Resources (1995 edition). Digital contours furnished by the Spokane County geographic information system (GIS) and the orthophotos were then used as supplemental base maps to add to and refine geologic unit contacts on the final version of the map. Additional details of the geology were added through mapping of the Hangman Creek Flood Hazard Management Area in 2000 (Hamilton and others, 2001).

The first published geologic map of the area was by Pardee and Bryan (1926). Griggs (1966) completed a 1:125,000-scale map of the western half of the Spokane 1- by 2-degree quadrangle. He later extended his mapping eastward to complete a 1:250,000-scale geologic map of the entire Spokane 1- by 2-degree quadrangle (Griggs, 1973). Joseph (1990) compiled a 1:100,000-scale map of the Spokane quadrangle that incorporated more detailed interpretations of Pleistocene glacial features based on Kiver and others (1979) and basalt stratigraphy based on Swanson and others (1979). Rigby (1982) and Meyer (1999) completed master's thesis studies on selected portions of glacial flood deposits exposed on Hangman Creek. In 1993 and 1994, Wendy Gerstel and others of the Washington State Department of Natural Resources mapped the Quaternary deposits related to the Spokane aquifer recharge and aquifer sensitive areas at 1:24,000 scale; this unpublished mapping has been available to Spokane County officials since 1996 through the county's GIS.

DESCRIPTION OF MAP UNITS

Quaternary Sedimentary Deposits

Qal **Alluvium (Holocene)**—Silt, sand, and gravel deposits in present-day stream channels, on flood plains, and on terraces; consists of reworked glacial flood deposits (units Qfcg, Qfg, and Qfs) and reworked loess; may include small alluvial fans and minor mass-wasting deposits that extend onto the flood plain from tributaries.

Qaf **Alluvial fan deposits (Holocene)**—Gravel, sand, and silt deposited in fans at the base of steep drainages; very poorly sorted; most lack a large drainage source; minimal soil development.

Ql **Loess (Holocene and Pleistocene)**—Silt with lesser amounts of clay; locally includes small amounts of fine sand and volcanic ash; light to medium brown; unstratified; clay mostly montmorillonite and illite in a ratio of 3:1, with minor kaolinite (Hosterman, 1969); sand and silt composed of angular quartz with lesser amounts of feldspar and mica; except where eroded, caps most deposits to a thickness of 1 or 2 ft; thickness increases to the south in the map area, where flood erosion was less effective.

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).

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 in size from several feet to hundreds of feet in diameter. Most mass-wasting events occurred during or shortly after Pleistocene catastrophic flood events, but some mass wasting continued to the present; mass-wasting events that occurred during glacial flooding incorporated flood materials as scattered sand and pebble lenses interspersed with the mass-wasting deposits.

The following units are deposits from outburst floods of glacial Lake Missoula. They are a composite of numerous flood events and do not represent deposits from any single flood event.

Qglf **Glacial lake and glacial flood deposits, undifferentiated (Pleistocene)**—Fine-grained, massive and thin-bedded lake deposits of sand and silt interbedded with irregularly distributed glacial-flood sand and gravel; tan to gray; locally exposed in the bed of Hangman Creek but mostly occurs on valley walls; probably filled most of the valley before being dissected by later floods and post-flood stream action.

Qfs **Glacial flood deposits, predominantly sand (Pleistocene)**—Medium-fine- 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 and of local basalt; gray, yellowish gray, or light brown; subangular to subrounded; poorly to moderately well sorted; medium bedded to massive; appears speckled in some exposures because of the mixture of light and dark fragments; distribution uneven and thickness variable due to irregular underlying topography and varying degrees of erosion; appears to have been deposited when glacial Lake Missoula outburst floods flowed into a high stand of glacial Lake Columbia.

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 in a matrix of mostly pebbles and coarse sand; derived from granitic and metamorphic rocks similar to those exposed both locally and to the northeast and east in Idaho; found mainly outside of the principal flood channels, which are north of the quadrangle.

Pre-Quaternary Igneous and Sedimentary Rocks

Mwp **Priest Rapids Member of the Wanapum Basalt, Columbia River Basalt Group (middle Miocene)**—Dark gray to black, fine-grained, dense basalt consisting of plagioclase (20–30%), pyroxene (10–20%), and olivine (1–2%) in a mostly glass matrix (40–60%); variable thickness; very thin where it laps upon pre-Miocene highlands; lies directly on pre-Miocene rocks, Latah Formation, or Grande Ronde Basalt; contact with the underlying Grande Ronde Basalt occurs between 2,200 and 2,300 ft elevation in this quadrangle. Basalt is of the Rosalia chemical type (Table 1), which has higher titanium and lower magnesium and chromium than other flows of Wanapum Basalt (Steve Reidel, Pacific Northwest National Laboratory, oral commun., 1998). This unit is between 14.5 and 15.3 m.y. old and has reversed magnetic polarity (Reidel and others, 1989).

Mgr **Grande Ronde Basalt, magnetostratigraphic units R_2 and N_2, Columbia River Basalt Group (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 is quite variable due to irregular underlying topography, variable thickness of water-saturated Latah Formation (unit Ml) interbeds, and the invasive nature of at least some of the Grande Ronde Basalt flows in the area; identified in the map area on the basis of chemical analyses (Table 1); between 15.6 and 16.5 m.y. old (Reidel and others, 1989).

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; unconformably overlies pre-Miocene rocks or is interbedded with Grande Ronde Basalt (unit Mgr); easily eroded and commonly blanketed by colluvium, talus, and residual soils; floral assemblages indicate a Miocene age (Knowlton, 1926; Griggs, 1976); exposures are of limited extent with most occurring in the walls of Hangman Creek valley.

TKg **Hornblende biotite granitic rock (Tertiary to Cretaceous)**—Medium-grained granitic rock; contains biotite crystals up to 0.2 in., hornblende, and minor zircon; light gray with some light-pink feldspars; porphyritic in part, with feldspar crystals up to 0.5 in.

Ymsr **Ravalli Group (Precambrian Y)**—White, light gray, gray-green, or pale yellowish orange feldspathic sandstone and siltstone; fine to medium grained; thin to medium bedded with some massive sections; feldspathic sandstone typically contains 30 to 70 percent quartz, 20 to 30 percent feldspar, and 1 to 5 percent biotite; siltstone contains more feldspar and less quartz; contains some quartz-biotite gneiss and numerous small leucogranite and granite sills and dikes that are too small to map separately at this map scale.

GEOLOGIC SYMBOLS

- Contact—Long dashed where approximately located; short dashed where inferred or indefinite
- Fault—Short dashed where inferred or indefinite; dotted where concealed
- 45 Inclined bedding—Showing strike and dip
- 39 Inclined foliation—Showing strike and dip
- 48 Lineation—Showing bearing and plunge
- SWW8 Water well—Numbers correspond to well numbers on cross sections
- 112SW Basalt geochemistry sample location—Numbers correspond to sample numbers in Table 1

ACKNOWLEDGMENTS

Eugene Kiver of Eastern Washington University, Geology Department, accompanied us on numerous trips to examine Quaternary deposits in the area. Bea Lackaff of the Spokane County Water Quality Management Program digitized the unpublished geologic mapping of Wendy Gerstel and others into Spokane County's GIS. Steve Reidel of Pacific Northwest National Laboratory (Richland, Wash.) provided assistance during a two-day visit in the field to examine Columbia River Basalt Group stratigraphy and reviewed an earlier version of the map.

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Table 1. Geochemical analyses of Columbia River Basalt Group basalt performed by x-ray fluorescence at the Washington State University GeoAnalytical Lab. Instrumental precision is described in detail in Johnson and others (1999). Total Fe is expressed as FeO

MAJOR ELEMENTS—UNNORMALIZED (in weight percent)

Sample no.	SiO_2	Al_2O_3	TiO_2	FeO	MnO	CaO	MgO	K_2O	Na_2O	P_2O_5	Total
Priest Rapids Member of the Wanapum Basalt (unit Mwp)											
111SW	49.99	12.65	3.677	15.24	0.250	8.56	4.51	1.14	2.77	0.773	99.56
112SW	50.26	13.04	3.732	13.88	0.236	8.85	4.10	1.29	2.69	0.807	98.89
Grande Ronde Basalt (unit Mgr)											
117SW	54.15	14.22	1.867	10.65	0.195	8.97	4.89	1.23	2.88	0.305	99.36
118SW	54.28	14.39	1.889	10.96	0.192	8.94	4.14	1.19	2.82	0.298	99.10
135SW	49.24	12.54	3.634	15.05	0.246	8.53	4.50	1.34	2.61	0.794	98.49
136SW	55.92	13.44	2.150	11.72	0.178	6.67	3.10	1.75	3.33	0.385	98.64

TRACE ELEMENTS (in parts per million)

Sample no.	Ni	Cr	Sc	V	Ba	Rb	Sr	Zr	Y	Nb	Ga	Cu	Zn	Pb	La	Ce	Th
Priest Rapids Member of the Wanapum Basalt (unit Mwp)																	
111SW	10	31	42	427	549	23	285	209	50	16.5	23	19	155	5	34	85	4
112SW	13	33	34	440	576	27	294	219	54	18.8	26	24	149	5	35	71	0
Grande Ronde Basalt (unit Mgr)																	
117SW	13	49	36	319	484	29	309	154	33	11.6	20	29	114	8	12	26	3
118SW	8	56	38	312	522	29	315	157	35	12.1	20	35	118	7	17	30	2
135SW	15	34	39	441	584	29	286	216	50	18.6	23	10	148	3	10	61	7
136SW	5	17	35	293	732	47	323	184	38	13.5	22	2	117	11	23	64	8