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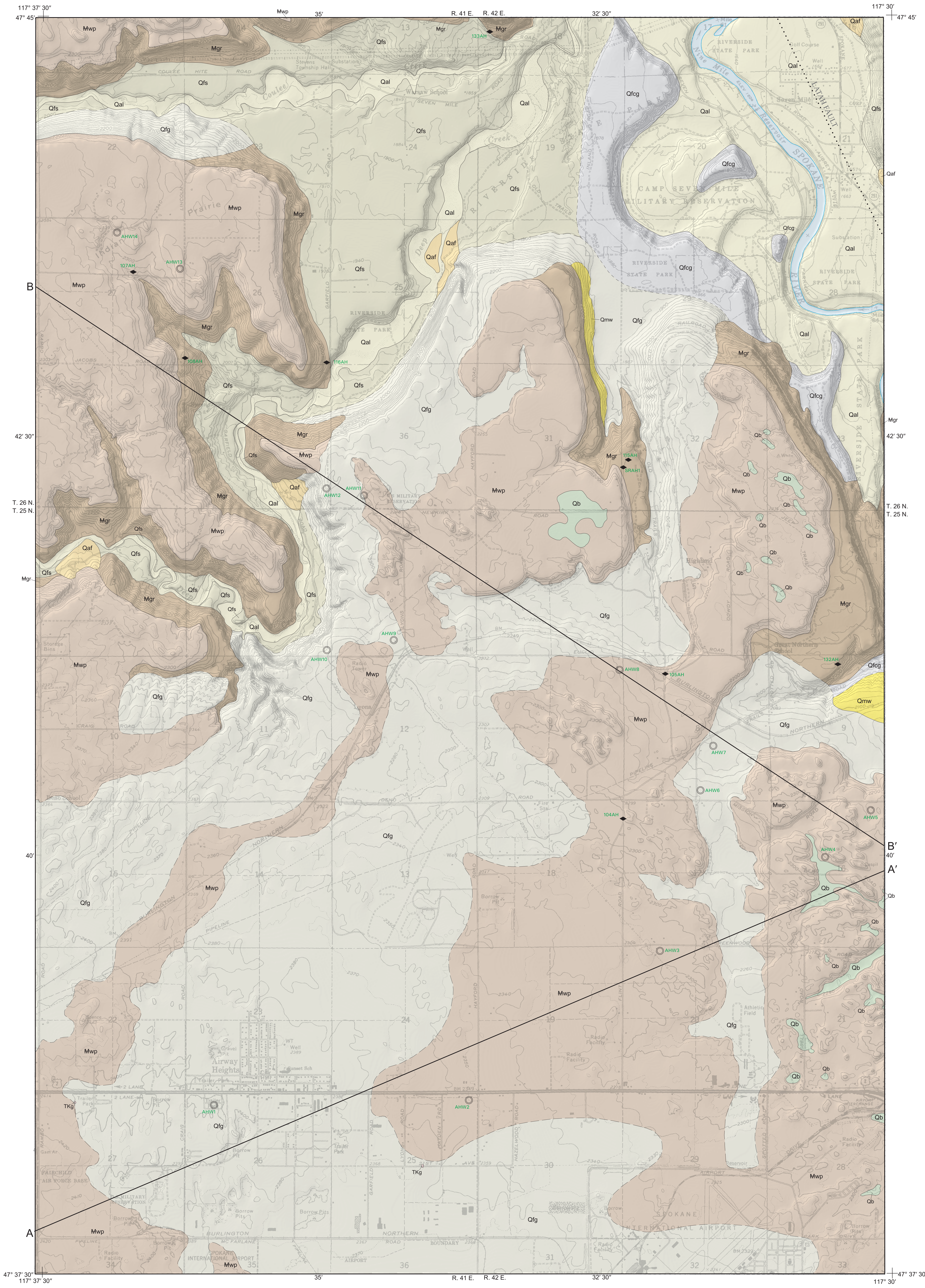
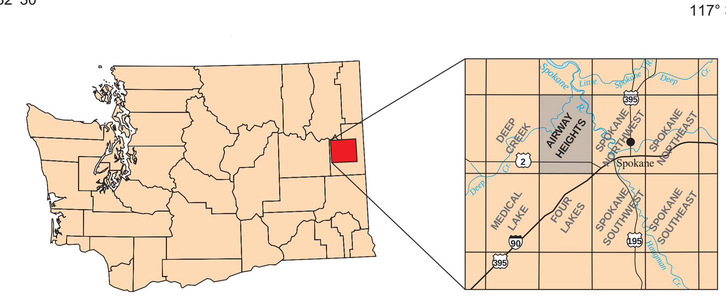


Lambert conformal conic projection
North American Datum of 1927; to place on North American Datum of 1983, move the projection lines 15 meters north and 80 meters east as shown by crosshair corner ticks
Base map from scanned and rectified U.S. Geological Survey 7.5-minute Airway Heights quadrangle, 1973, photorevised 1986
Shaded relief generated from U.S. Geological Survey 10-meter Digital Elevation Model
Digital cartography by Charles G. Caruthers and J. Eric Schuster
Editing and production by Karen D. Meyers

SCALE 1:24 000
contour interval 20 feet



Geologic Map of the Airway Heights 7.5-minute Quadrangle, Spokane County, Washington

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

2004

INTRODUCTION

Previous geologic map coverage of the Airway Heights 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 2001. Our field mapping and air photo interpretation was drawn on a U.S. Geological Survey topographical 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.

The first published geologic map of the area was by Pardee and Bryan (1926). Griggs (1966) completed a 1:125,000-scale geologic 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 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). 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. Deobald (1995) completed a master's thesis on the hydrogeology of the West Plains.

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.

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.

Qgl **Glaciolacustrine deposits of glacial Lake Columbia (Pleistocene) (cross sections only)**—Based on exposures in the adjacent Nine Mile Falls quadrangle (Derkey and others, 2003), consists of silt and fine sand interbedded with clay and silt lakebeds; composed predominantly of quartz, feldspar, and mica grains; very light gray to pinkish or yellowish gray.

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.

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; boulders and cobbles consist predominantly of locally derived basalt; found mainly outside of the principal flood channels, which approximate the present courses of the Spokane and Little Spokane Rivers.

Qfcg **Glacial flood-channel deposits, predominantly gravel (Pleistocene)**—Thick-bedded to massive mixture of boulders, cobbles, pebbles, granules, and sand; may contain 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; derived from granitic and metamorphic rocks similar to those exposed both locally and to the northeast and east in Idaho. This unit differs from flood gravel (unit Qfg) in that it fills deep, ancestral channels of the Spokane and Little Spokane Rivers, which now form the Spokane Valley–Rathdrum Prairie aquifer. The flood deposits filling the channels are known to be several hundred feet thick. Boundaries between this unit and unit Qfg are based on location of these channels rather than clast-size differences.

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%). Exposures in the northern part of the map area are less than 100 ft thick and the contact with the underlying Grande Ronde Basalt occurs between 2,200 and 2,300 ft elevation in most of the quadrangle. However, the contact with the underlying Grande Ronde Basalt or Latah Formation extends below 2,200 ft elevation in the southeast corner of the quadrangle. This suggests that a channel existed and was filled with the Priest Rapids Member prior to the basalt spreading out over the terrain at 2,200 ft elevation and higher. 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) (cross sections only)**—Based on numerous exposures in the Spokane area, consists of 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).

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.; only two small exposures in the quadrangle.

GEOLOGIC SYMBOLS

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

Fault—Concealed

AHW11 Water well—Numbers correspond to well numbers on cross sections

104AH 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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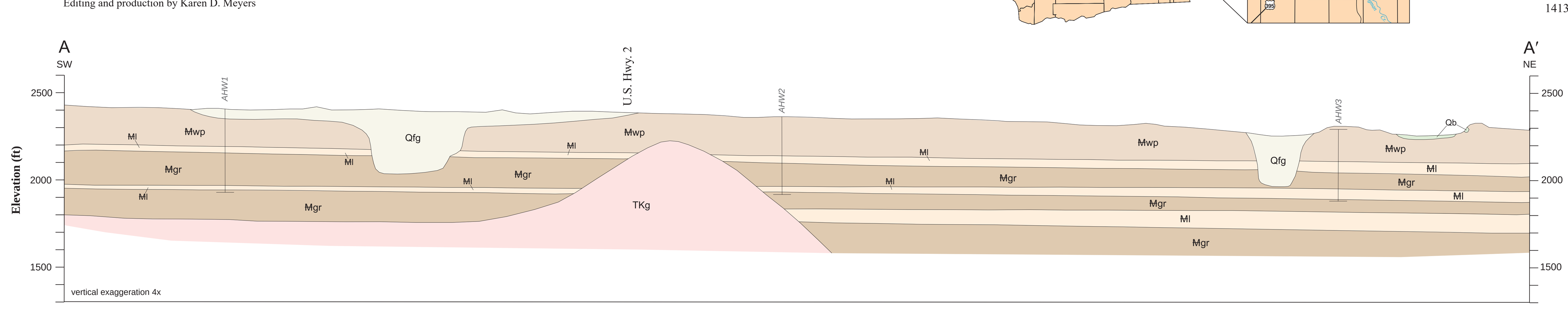

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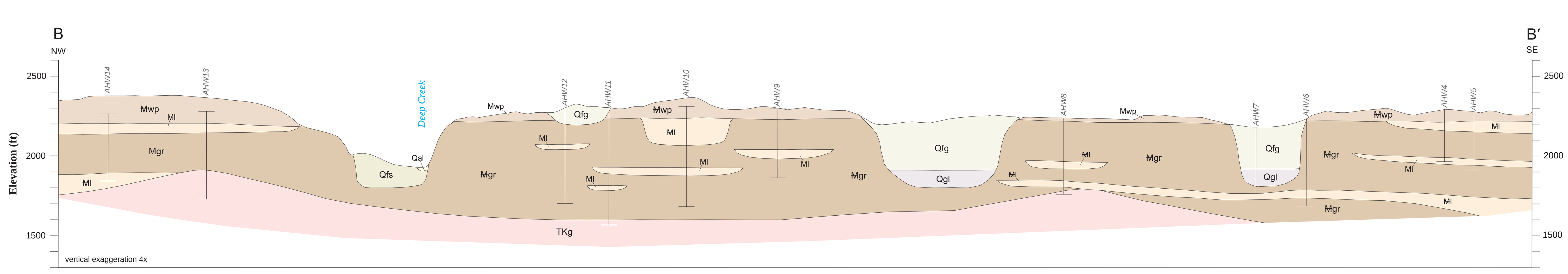

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Table 1. Geochemical analyses of Columbia River Basalt Group basalt performed by x-ray fluorescence at the Washington State University GeoAnalytical Lab. Instrumental precision is described in detail in Johnson and others (1999). Total Fe is expressed 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)											
104AH	50.96	14.01	3.976	12.57	0.225	9.17	3.29	1.30	3.04	0.886	99.42
105AH	50.24	12.82	3.637	14.89	0.248	8.57	4.61	1.32	2.76	0.798	99.89
107AH	50.60	12.92	3.663	14.39	0.228	8.71	4.29	1.28	2.75	0.802	99.63
Grande Ronde Basalt (unit Mgr)											
108AH	54.23	14.22	1.850	10.89	0.193	8.86	4.78	1.29	2.83	0.304	99.45
115AH	53.85	13.91	1.890	11.47	0.210	8.65	4.75	1.26	2.97	0.374	99.34
116AH	54.11	14.04	1.875	11.33	0.206	8.75	4.77	1.30	2.91	0.372	99.66
132AH	53.58	14.22	1.840	10.82	0.194	8.90	4.79	1.27	2.72	0.301	98.64
133AH	54.05	13.16	2.429	13.10	0.214	7.09	3.33	1.84	3.09	0.424	98.73
SRAH1	53.8	14.17	1.842	11.19	0.193	8.92	4.69	1.29	3.12	0.299	99.52

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)																	
104AH	14	35	48	460	641	28	317	231	56	20.2	24	26	165	9	28	68	3
105AH	16	30	34	429	558	30	282	215	50	18.2	21	25	151	5	25	54	2
107AH	17	34	45	430	571	31	294	214	51	19.3	26	25	156	6	35	67	5
Grande Ronde Basalt (unit Mgr)																	
108AH	12	50	35	322	502	29	309	152	34	11.1	18	34	108	11	23	34	2
115AH	12	47	36	283	488	29	304	160	35	11.9	22	34	119	7	11	44	2
116AH	13	47	34	303	510	30	309	158	36	11.2	21	33	117	8	3	27	4
132AH	14	57	41	332	547	29	313	154	35	12.4	21	24	107	7	14	42	5
133AH	4	20	42	365	718	44	324	186	39	13.2	19	0	128	11	28	48	6
SRAH1	22	57	39	324	509	31	318	160	35	13	18	35	112	5	14	39	5