N A T U R A L R E S O U R C E S

Geologic Maps of the East Half of the Washington Portion of the Goldendale 1:100,000 Quadrangle and the Washington Portion of the Hermiston 1:100,000 Quadrangle

compiled by
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WASHINGTON
DIVISION OF GEOLOGY
AND EARTH RESOURCES

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GEOLOGIC MAPS OF THE EAST HALF OF THE WASHINGTON PORTION OF THE GOLDENDALE 1:100,000 QUADRANGLE AND THE WASHINGTON PORTION OF THE HERMISTON 1:100,000 QUADRANGLE

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INTRODUCTION

These maps of the east half of the Washington portion of the Goldendale 1:100,000-scale quadrangle and the Washington portion of the Hermiston 1:100,000-scale quadrangle show the geology of two of 15 complete or partial 1:100,000-scale quadrangles that cover the southeast quadrant of Washington (Fig. 1). Geologic maps of these quadrangles have been compiled by geologists of the Washington Division of Geology and Earth Resources (DGER), Westinghouse Hanford Co., and Washington State University and are the principal data sources for a new 1:250,000-scale geologic map of the southeast quadrant of Washington, which is in preparation. Eleven of these quadrangles are being released as DGER open-file reports (listed on p. 6). The map of the Wenatchee quadrangle has been published by the U.S. Geological Survey (Tabor and others, 1982),

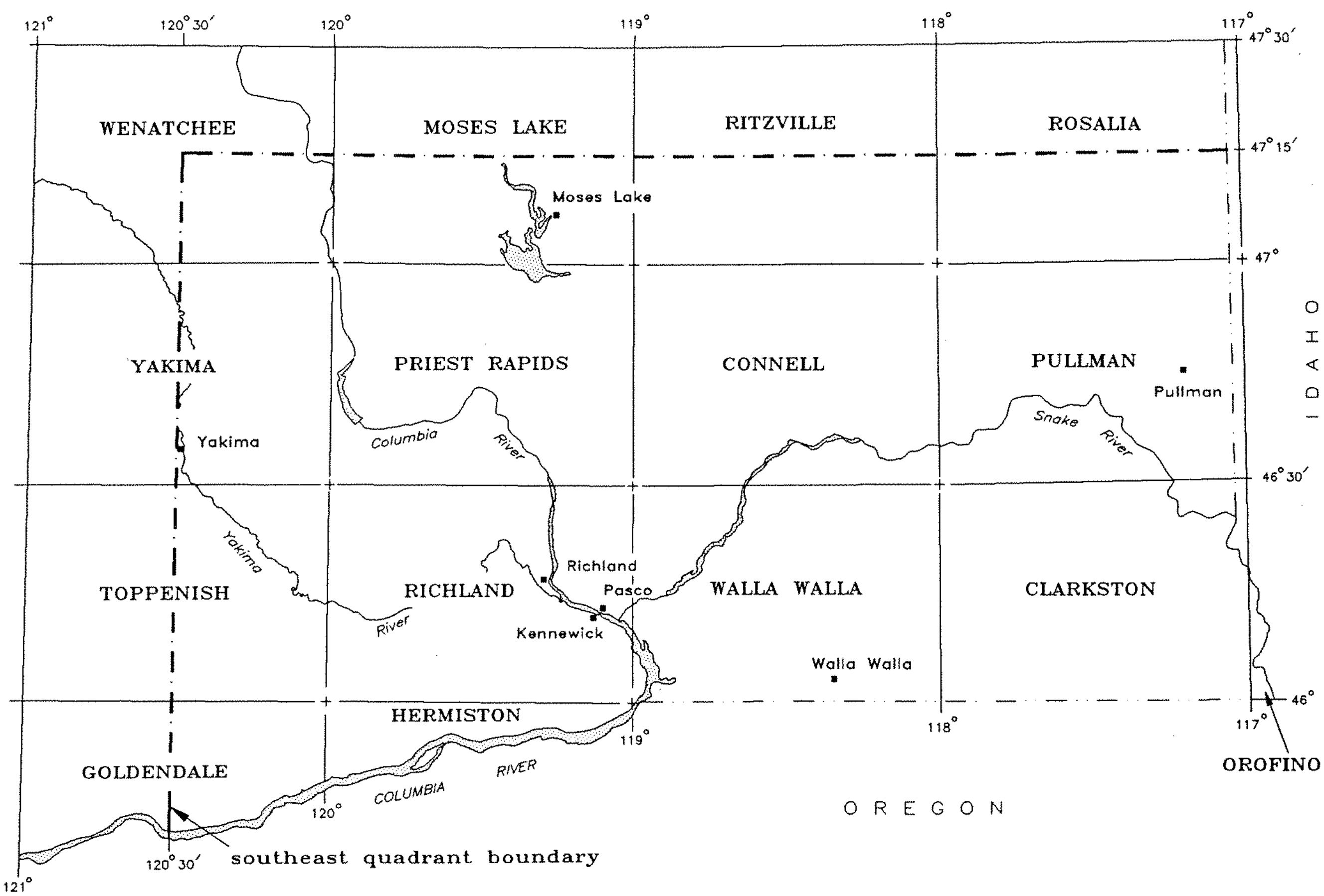

Figure 1. 1:100,000-scale quadrangles in the southeast quadrant of Washington.

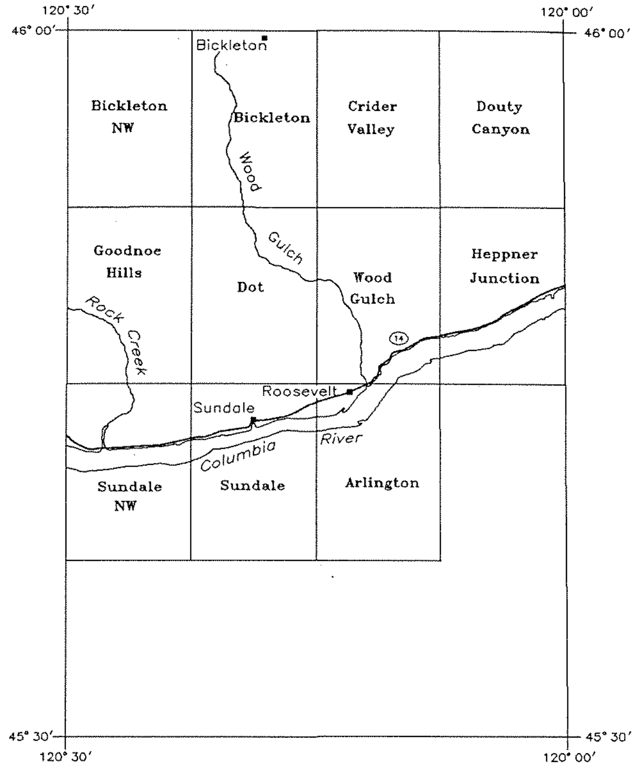

Figure 2. Geographic names and 7.5-minute quadrangle locations in the east half of the Washington portion of the Goldendale 1:100,000 quadrangle.

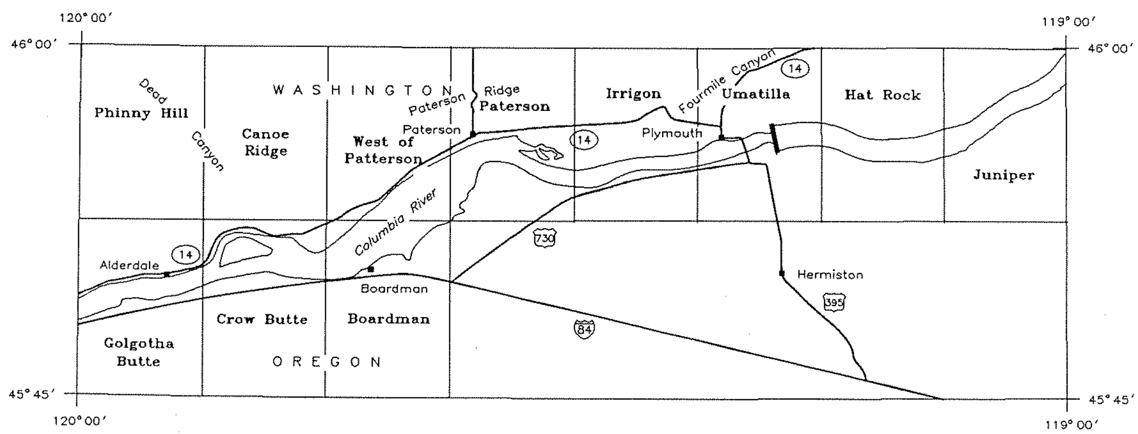

Figure 3. Geographic names and 7.5-minute quadrangle locations in the Washington portion of the Hermiston 1:100,000 quadrangle.

and the Moses Lake (Gulick, 1990a), Ritzville (Gulick, 1990b), and Rosalia (Waggoner, 1990) quadrangles were released in 1990.

The geology of the east half of the Washington portion of the Goldendale and the Washington portion of the Hermiston quadrangles has not previously been compiled at 1:100,000 scale. Furthermore, these are the first 1:100,000 or smaller scale geologic maps of the area to incorporate both bedrock and surficial geology.

Figure 2 shows selected geographic features and the locations of 7.5-minute quadrangles in the east half of the Washington portion of the Goldendale 1:100,000-scale quadrangle, and Figure 3 shows selected geographic features and 7.5-minute quadrangles in the Washington portion of the Hermiston 1:100,000-scale quadrangle.

These maps were compiled in 1993, using published and unpublished geologic maps as sources of data. The areas covered by these sources are shown on Figures 4 and 5. Maps produced before 1979 were not used as sources of data for the Columbia River Basalt Group because prior to that year mappers generally did not use geochemistry or magnetic polarity to confirm assignment of basalt flows to stratigraphic units, nor did they employ the stratigraphy that was proposed by Swanson and others (1979b) and, with subsequent modifications, is universally used today. The lack of consistent, reliable identification procedures and standardized nomenclature makes it difficult to use the older maps unless one is personally familiar with the geology.

Figures 4 and 5 identify some of the sources of data as primary. These are discussed further below. Some maps that were not used in compiling the geology of this report are shown on Figures 4 and 5 in an attempt to make the sources-of-data listings exhaustive and to inform the reader that these sources were not overlooked.

One unpublished source of geologic data was used: N. P. Campbell's 1978 1:24,000-scale surficial geologic maps for the entire area (N. P. Campbell, Yakima Valley Comm. Coll., written commun., 1978a, b).

As noted above, Figures 4 and 5 identify some of the sources of data as primary. These were the main sources of geologic map data used to compile this report, but they were used in different ways. For the entire area N. P. Campbell's unpublished reconnaissance 7.5-minute surficial geologic maps (N. P. Campbell, Yakima Valley Comm. Coll., written commun., 1978a, b) were the sources for the surficial geology and for the outlines of areas of exposure of the bedrock units, mostly Columbia River Basalt Group. For bedrock areas of both quadrangles details were taken from Swanson and others (1979a). Geologic structure also came from Swanson and others (1979a), with strikes and dips in the Goldendale quadrangle from Shannon & Wilson, Inc. (1973).

In a review of late Cenozoic structure and stratigraphy of south-central Washington Reidel and others (1994, table 5) report suspected late Pleistocene(?) movement on an unnamed fault along the Service anticline in the SE1/4SW1/4 sec. 28, T. 6 N., R. 28 E., Hermiston quadrangle. For further information refer to Foundation Sciences, Inc. (1980, p. 48-49).

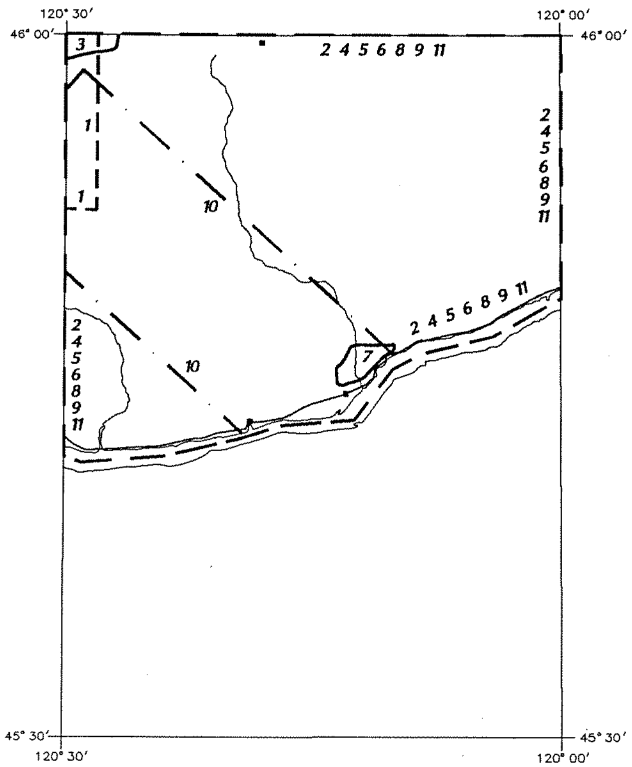

Figure 4. Sources of geologic mapping for the east half of the Washington portion of the Goldendale 1:100,000 quadrangle. The primary sources of geologic data used in this compilation are marked with asterisks.

1. Anderson, 1987 (plate 3, scale 1:84,480)
2. Bela, 1982 (scale 1:250,000)
3. Bentley and others, 1980 (scale 1:84,480)
4. Brown, 1979 (plate V, scale 1:94,000)
5.* Campbell, 1978a (unpublished mapping, scale 1:24,000)
6. Campbell, 1979 (scale 1:250,000)
7. Kent, 1978 (scale 1:31,680)
8. Myers, Price, and others, 1979 (plates II-9 and II-18, scale 1:250,000)
9. Rigby and others, 1979 (plate 6, scale 1:250,000)
10. Shannon & Wilson, Inc., 1973 (figure 6, scale 1:250,000)
11.* Swanson and others, 1979a (sheet 11, scale 1:250,000)

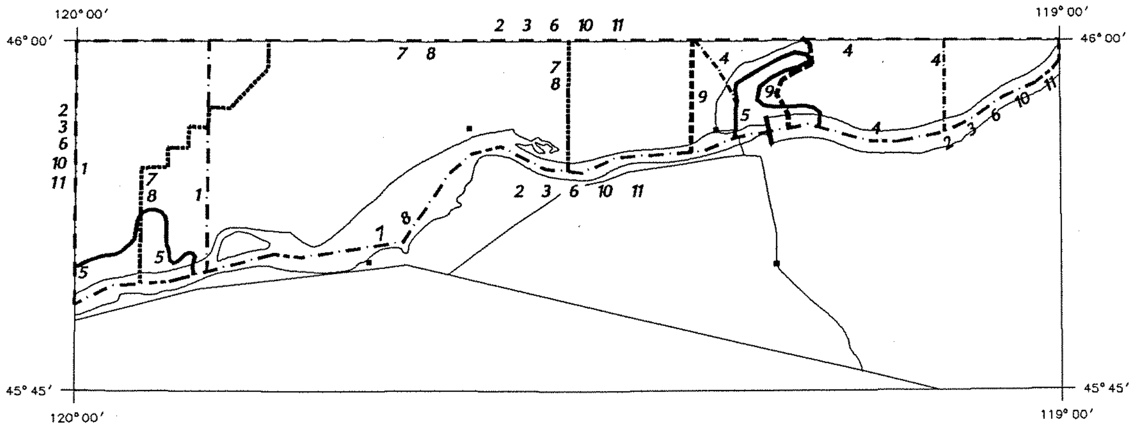

Figure 5. Sources of geologic mapping for the Washington portion of the Hermiston 1:100,000 quadrangle. The primary sources of geologic data used in this compilation are marked with asterisks.

1. Brown, 1979 (plate V, scale 1:94,000)
2.* Campbell, 1978b (unpublished mapping, scale 1:24,000)
3. Campbell, 1979 (scale 1:250,000)
4. Foundation Sciences, Inc., 1980 (scale 1:125,000)
5. Laval, 1956 (plates XXVIII and XXX, scale 1:62,500)
6. Myers, Price, and others, 1979 (plates II-8 and II-17, scale 1:250,000)
7. Newcomb, 1969 (scale 1:31,680)
8. Newcomb, 1971 (scale 1:31,680)
9. Shannon & Wilson, Inc., 1973 (figure 7, scale 1:63,360)
10.* Swanson and others, 1979a (sheet 12, scale 1:250,000)
11. Walker, 1973 (scale 1:250,000)

Age assignments of geologic units were made following the flow chart in Figure 6. Because all potassium-argon (K-Ar) ages cited herein (Baksi, 1989; Tolan and others, 1989; McKee and others, 1977; Reidel and Fecht, 1987) were published after 1976, they are assumed to have been calculated using the decay and abundance constants adopted by the International Union of Geological Sciences in 1976 (Dalrymple, 1979). The actual constants used were not reported.

The geologic time scale devised for the "Correlation of Stratigraphic Units of North America (COSUNA)" project of the American Association of Petroleum Geologists (Salvador, 1985) is used in this report, with slight modifications: the Oligocene-Eocene boundary is set at 35.7 Ma (Montanari and others, 1985), and the Pleistocene-Pliocene boundary is set at 1.6 Ma (Aguirre and Pasini, 1985).

The current nomenclature and stratigraphic relations of the Columbia River Basalt Group are shown in Figure 7.

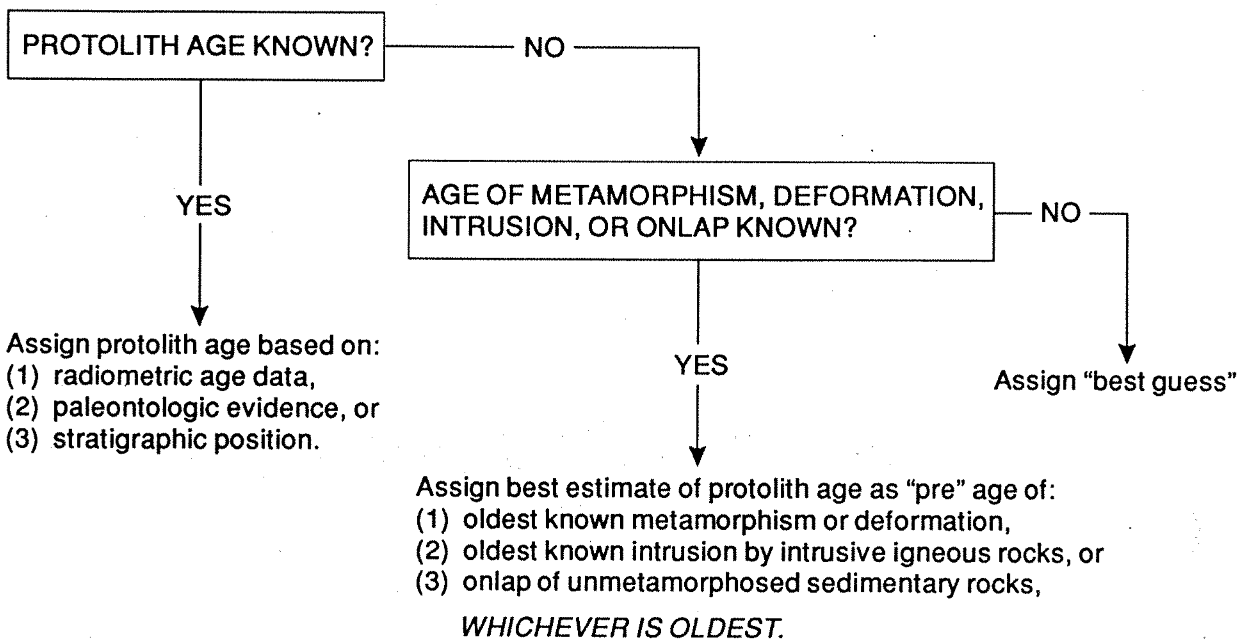

Figure 6. Flow chart for age assignment of geological units. Protolith age or estimated protolith age may be assigned by correlation with other geologic units. The unit description includes information about how the age of the unit was determined.

DGER Southeast Quadrant Open-File Reports

Gulick, C. W., compiler, 1990a, Geologic map of the Moses Lake 1:100,000 quadrangle, Washington: Washington Division of Geology and Earth Resources Open File Report 90-1, 9 p., 1 plate.

Gulick, C. W., compiler, 1990b, Geologic map of the Ritzville 1:100,000 quadrangle, Washington: Washington Division of Geology and Earth Resources Open File Report 90-2, 7 p., 1 plate.

Gulick, C. W., compiler, in press, Geologic map of the Connell 1:100,000 quadrangle, Washington: Washington Division of Geology and Earth Resources Open File Report.

Gulick, C. W., compiler, 1994, Geologic map of the Pullman 1:100,000 quadrangle, Washington-Idaho: Washington Division of Geology and Earth Resources Open File Report 94-6, 22 p., 1 plate.

Reidel, S. P.; Fecht, K. R., compilers, in press, Geologic map of the Priest Rapids 1:100,000 quadrangle, Washington: Washington Division of Geology and Earth Resources Open File Report.

Reidel, S. P.; Fecht, K. R., compilers, in press, Geologic map of the Richland 1:100,000 quadrangle, Washington: Washington Division of Geology and Earth Resources Open File Report 94-8, 21 p., 1 plate.

SERIES		GROUP	FORMATION	MEMBER	ISOTOPIC AGE (Ma)	MAGNETIC POLARITY
MIOCENE	upper	COLUMBIA RIVER BASALT GROUP	SADDLE MOUNTAINS BASALT	LOWER MONUMENTAL MEMBER	6	N
				ICE HARBOR MEMBER	8.5	
				basalt of Goose Island		N
				basalt of Martindale		R
				basalt of Basin City		N
				BUFORD MEMBER		
	middle			ELEPHANT MOUNTAIN MEMBER	10.5	N,T
				POMONA MEMBER	12	R
				ESQUATZEL MEMBER		N
				WEISSENFELS RIDGE MEMBER		
				basalt of Slippery Creek		N
				basalt of Tenmile Creek		N
				basalt of Lewiston Orchards		N
				basalt of Cloverland		N
				ASOTIN MEMBER	13	
				basalt of Huntzinger		N
				WILBUR CREEK MEMBER		
				basalt of Lapwai		N
				basalt of Wahluke		N
				UMATILLA MEMBER		
				basalt of Sillusi		N
				basalt of Umatilla		N
			WANAPUM BASALT	PRIEST RAPIDS MEMBER	14.5	
				basalt of Lolo		R
				basalt of Rosalia		R
				ROZA MEMBER		T,R
				FRENCHMAN SPRINGS MEMBER		
				basalt of Lyons Ferry		N
				basalt of Sentinel Gap		N
				basalt of Sand Hollow	15.3	N
				basalt of Silver Falls		N,E
				basalt of Ginkgo		E
				basalt of Palouse Falls		E
				ECKLER MOUNTAIN MEMBER		
				basalt of Shumaker Creek		N
				basalt of Dodge		N
				basalt of Robinette Mountain		N
			GRANDE RONDE BASALT (PRINEVILLE BASALT)	Sentinel Bluffs unit	15.6	N_2
				Slack Canyon unit		
				Fields Spring unit		
				Winter Water unit		
				Umtanum unit		
				Ortley unit		
				Armstrong Canyon unit		
				Meyer Ridge unit		R_2
				Grouse Creek unit		
				Wapshilla Ridge unit		
				Mt. Horrible unit		
			GRANDE RONDE BASALT (PICTURE GORGE BASALT)	China Creek unit		N_1
				Downey Gulch unit		
				Center Creek unit		R_1
				Rogersburg unit		
				Teepee Butte unit		
				Buckhorn Springs unit	16.9	
	lower		IMNAHA BASALT	See Hooper and others (1984) for Imnaha units	17.0	R_1
						T
						N_0
					17.3	R_0

Figure 7. Generalized nomenclature and stratigraphic relations of the Columbia River Basalt Group. Jagged lines mark the positions of local or regional erosional unconformities and/or sedimentary interbeds. Modified from Reidel and others (1989). This figure includes units that do not occur in the map areas of this report.

Schuster, J. E., compiler, 1993, Geologic map of the Clarkston 1:100,000 quadrangle, Washington-Idaho, and the Washington portion of the Orofino 1:100,000 quadrangle: Washington Division of Geology and Earth Resources Open File Report 93-4, 43 p., 1 plate.

Schuster, J. E., compiler, in press, Geologic map of the east half of the Toppenish 1:100,000 quadrangle, Washington: Washington Division of Geology and Earth Resources Open File Report.

Schuster, J. E., compiler, 1994, Geologic map of the east half of the Washington portion of the Goldendale 1:100,000 quadrangle, and the Washington portion of the Hermiston 1:100,000 quadrangle: Washington Division of Geology and Earth Resources Open File Report 94-9, 17 p., 2 plates.

Schuster, J. E., compiler, in press, Geologic map of the east half of the Yakima 1:100,000 quadrangle, Washington: Washington Division of Geology and Earth Resources Open File Report.

Schuster, J. E., compiler, 1994, Geologic map of the Walla Walla 1:100,000 quadrangle, Washington: Washington Division of Geology and Earth Resources Open File Report 94-3, 18 p., 1 plate.

Waggoner, S. Z., compiler, 1990, Geologic map of the Rosalia 1:100,000 quadrangle, Washington-Idaho: Washington Division of Geology and Earth Resources Open File Report 90-7, 20 p., 1 plate.

Acknowledgments

N. P. Campbell of Yakima Valley Community College and D. A. Swanson of the U.S. Geological Survey reviewed the map and text and provided many helpful suggestions. Swanson also supplied unpublished mapping for several areas in the Hermiston quadrangle. K. G. Ikerd and C. F. T. Harris of the DGER cartographic staff, Jari Roloff, and K. M. Reed of the DGER editorial staff prepared final copy and provided editorial support.

DESCRIPTIONS OF MAP UNITS

Sedimentary Deposits

Quaternary Sedimentary Deposits

Qd

Dune sand (Holocene)—Eolian medium to fine sand; grains composed mostly of quartz and basalt reworked from older sedimentary deposits; active and stabilized dunes; near the Columbia River in the Goldendale quadrangle and are scattered over a wide area in the Hermiston quadrangle; age inferred from geomorphology and ages of parent materials. Description from Rigby and others (1979, p. 46-47).

Qa

Alluvium (Holocene)—Silt, sand, and gravel deposits of diverse composition; locally includes fine fluvial, paludal, lacustrine, and/or eolian sediments in meadows or depressions; largely confined to valley floors; age inferred from geomorphology and ages of parent materials. Description from Rigby and others (1979, p. 45).

Qls

Mass-wasting deposits (Holocene to Pleistocene)—Mass-movement deposits from bedrock and overburden sources; unstratified and poorly sorted; surface commonly hummocky and blanketed with loess; includes talus; found at the base of slopes and on lower slopes; age inferred from stratigraphic position, age of parent materials, and geomorphology. Description from Rigby and others (1979, p. 44).

Ql

Loess (Holocene to Pleistocene)—Eolian silt and fine sand; locally includes multiple caliche layers and tephra beds; pale orange to brown; occurs in patches throughout the area of the maps, with more continuous deposits in the eastern part of the Hermiston quadrangle; uppermost loess locally contains Mazama tephra (Foley, 1982, p. 90), about 7 ka (Kittleman, 1973, p. 2958; Bacon, 1983, p. 105); paleomagnetic measurements show that the oldest loess was deposited during the Matuyama reversed polarity epoch and is at least 790 ka and probably 1 Ma or older (McDonald and Busacca, 1989, p. 338). Includes Palouse Formation. Description from Rigby and others (1979, p. 23-25).

Qaf

Alluvial fans (Holocene to Pleistocene)—Unconsolidated sand and gravel of various lithologies; generally cone shaped; surface only moderately dissected; little or no caliche development; formed where streams from basalt ridges and other elevated terrain enter surrounding lowlands; locally overlain by loess; age inferred from geomorphology, absence of caliche, and ages of parent materials. Description compiled from Bentley and others (1988a, b, c) and Rigby and others (1979, p. 45).

Qfs

Outburst flood deposits, silt and sand (Pleistocene)—Silt, sand, and minor gravel; rhythmically bedded and graded; locally contains clastic dikes, tephra beds, and ice-rafted clasts; occurs in patches along the Columbia River in the Goldendale quadrangle and at the east edge of the Goldendale map area and is extensively distributed in the central and western parts of the Hermiston quadrangle; thought to be younger than about 19 ka and older than about 11 ka on the basis of ^{14}C determinations that constrain the ages of advance and retreat of the Columbia ice lobe in southernmost British Columbia (Waitt, 1980, p. 675); additionally, Mount St. Helens set S tephra, with an isotopic age estimate of 13 ka (Mullineaux and others, 1978, p. 178), occurs below the top of the Touchet Beds (Waitt, 1980, p. 667). Deposited by outburst floods from glacial Lake Missoula. Consists of the Touchet Beds. Description from Rigby and others (1979, p. 37).

Qfg

Outburst flood deposits, gravel (Pleistocene)—Predominantly coarse gravel and sand deposits of diverse composition; poorly sorted; clasts angular to subrounded; local foreset bedding; deposited by outburst floods from glacial Lake Missoula; locally contains tephra and locally overlain by loess; found along the Columbia River and in the lower parts of tributary valleys; same age as outburst flood deposits, silt and sand (unit Qfs) and correlative with Touchet Beds. Description from Rigby and others (1979, p. 37).

Qt

Terrace deposits (Pleistocene)—Alluvial deposits of silt, sand, and gravel; clasts of diverse compositions; deposited by the Columbia River and confined to its valley; age inferred from geomorphology. Description from Rigby and others (1979, p. 42).

Tertiary Sedimentary Deposits

Mcg

Continental sedimentary deposits, conglomerate (upper Miocene)—Fluvial gravel, silt, and sand; light yellow-tan to reddish-orange; weakly to strongly indurated; dominated by well-rounded quartzite pebbles, with significant numbers of granitic, gneissic, metavolcanic, and andesitic clasts; deposited by the ancestral Columbia River; interfingers with fluvial and laharic deposits of the upper Ellensburg Formation; outside the map area, unit is underlain by the Elephant Mountain Member of the Saddle Mountains Basalt and overlain by the Pliocene Thorp Gravel; occurs in the northwest part of the east half of the Goldendale quadrangle, where it overlies the Pomona Member of the Saddle Mountains

Basalt. Consists of the conglomerate of Snipes Mountain of Swanson and others (1979a) and the Snipes conglomerate (informal) of Bentley and others (1988a, b, c) of the upper Ellensburg Formation. Description compiled from Bentley and others (1988a, b, c) and Swanson and others (1979a).

Mc

Continental sedimentary deposits (upper and middle Miocene)—Fluvial sand, silt, and clay; local gravel lenses, diatomite, and diamictons interpreted as lahars; white to reddish-brown; derived from basaltic, andesitic, and pumiceous rocks; weakly to moderately indurated; occurs stratigraphically above, and as interbeds between units of the Columbia River Basalt Group; age determined by radiometric age estimates of interbedded basalt flows; in the Goldendale quadrangle overlies the Priest Rapids Member of the Wanapum Basalt (14.5 Ma, Tolan and others, 1989) and/or units of the Saddle Mountains Basalt and underlies various Quaternary units and/or upper members of the Saddle Mountains Basalt; the unit is not present in the Hermiston quadrangle. Consists of the finer grained facies of the Ellensburg Formation. Description compiled from Bentley and others (1988a, b, c) and Swanson and others (1979a).

Tertiary Volcanic Rocks

Columbia River Basalt Group

The Columbia River Basalt Group in Washington is composed of four formations. From top to bottom they are the Saddle Mountains Basalt, the Wanapum Basalt, the Grande Ronde Basalt, and the Imnaha Basalt. The upper two formations crop out in the Washington portion of the Hermiston 1:100,000-scale quadrangle, and the upper three crop out in the Washington portion of the east half of the Goldendale 1:100,000-scale quadrangle. Generalized formal and informal stratigraphic units currently recognized in the Columbia River Basalt Group are shown on Figure 7.

The volcanic units of the Columbia River Basalt Group are described as fine, medium, or coarse grained. These terms are rarely quantified in the literature, but it is possible to do so on the basis of average length of plagioclase laths in the matrix. These categories generally correspond with the following plagioclase lengths: fine, ≤0.25 mm; medium, 0.25-0.5 mm; coarse, ≥0.5 mm (V. E. Camp, San Diego State Univ., written commun., 1992).

Saddle Mountains Basalt

Mv_{sem}

Elephant Mountain Member (upper Miocene)—Single flow; black to blue-black; gray-weathering; fine-grained; aphyric to sparsely plagioclase-phyric; normal to transitional magnetic polarity (Rietman, 1966; Choiniere and Swanson, 1979); occurs widely in the eastern part of the Goldendale map area and in the central and western parts of the Hermiston map area; isotopically dated at 10.5 Ma by McKee and others (1977) and at

9.4 ± 0.7 Ma and 10.7 ± 0.8 Ma by Stoffel (1984). Description compiled from Bentley and others (1988a, b, c) and Swanson and others (1979a).

Mv_{sp}

Pomona Member (middle Miocene)—Single flow; gray to blue-black; gray-weathering; fine-grained; slightly to moderately phyric with white to colorless plagioclase microphenocrysts; sparse plagioclase glomerocrysts; sparse olivine phenocrysts; small clinopyroxene phenocrysts; well-developed entablature and fanning columns; where more than 50 m thick, well-developed 0.5- to 1-m-diameter columns dominant; reversed magnetic polarity (Choiniere and Swanson, 1979); occurs widely in both the Goldendale and Hermiston map areas; isotopically dated at 12 Ma (K-Ar method) by McKee and others (1977) and 12 Ma (^{40}Ar-^{39}Ar method) by S. P. Reidel (Wash. State Univ., unpub. data, 1991). Description compiled from Bentley and others (1988a, b, c) and Swanson and others (1979a).

Mv_{su}

Umatilla Member (middle Miocene)—Single flow; black to blue-black; gray- to red-orange-weathering; fine-grained to very fine grained; aphyric to very sparsely plagioclase-phyric; normal magnetic polarity (Rietman, 1966); occurs in uplands and canyons in the northern and eastern parts of the Goldendale map area and in canyons in the Hermiston map area. Description compiled from Bentley and others (1988a, b, c) and Swanson and others (1979a).

Wanapum Basalt

Mv_{wpr}

Priest Rapids Member (middle Miocene)—Gray-black flows; rusty brown-weathering; medium- to coarse-grained; locally finely diktytaxitic; aphyric, with rare plagioclase phenocrysts; well-developed colonnade with 0.5-to 1.5-m-diameter columns; reversed magnetic polarity (Rietman, 1966); occurs in canyons in the central and eastern parts and in canyons and upland areas in the western part of the Goldendale map area; isotopic age 14.5 Ma (Tolan and others, 1989). Upper flow is designated the basalt of Lolo and the lower flows the basalt of Rosalia; the Lolo has higher MgO and lower TiO_2 contents than the Rosalia (Swanson and others, 1979b, p. G11, G37). Description from Bentley and others (1988a, b, c) and Swanson and others (1979a).

Mv_{wr}

Roza Member (middle Miocene)—One or two flows; gray-black; reddish brown-weathering; fine- to medium-grained; locally finely diktytaxitic; 0.5- to 1-cm plagioclase phenocrysts and glomerocrysts, commonly several hundred phenocrysts per square meter of flow surface; well-developed colonnade with columns as much as 1 m in diameter; transitional to reversed magnetic polarity (Choiniere and Swanson, 1979); Swanson and others (1979a, p. 8) report that magnetic polarity is an unreliable criterion for field identification because of common overprint of present magnetic field; occurs in the western part of the

Goldendale map area; older than Priest Rapids Member (14.5 Ma; Tolan and others, 1989) and younger than Frenchman Springs Member (15.3 Ma; Tolan and others, 1989). The Roza Member, because of its large and persistent plagioclase phenocrysts and wide distribution, is a key marker unit across much of the Columbia Basin. Description compiled from Bentley and others (1988a, b, c) and Swanson and others (1979a).

Mv_{wfs}

Frenchman Springs Member (middle Miocene)—Several flows; generally dark gray to black; fine- to medium-grained; distinguished from flows of the Grande Ronde Basalt chiefly because they are commonly plagioclase phyric, especially the lower flows (Swanson and others, 1979a, 1979b); normal to excursional magnetic polarity (Fig. 7); occurs in the western part of the Goldendale map area, where it rests on Grande Ronde Basalt, in many places with an intervening sedimentary interbed, and in the eastern part of the Hermiston map area; overlain by the Roza Member; isotopic age of 15.3 Ma for basalt of Sand Hollow, a flow in the middle of the member (Tolan and others, 1989); Beeson and others (1985) defined the informal Frenchman Springs subunits shown on Figure 7. Description compiled from Bentley and others (1988a, b, c) and Swanson and others (1979a).

Grande Ronde Basalt

Grande Ronde Basalt (middle Miocene)—Generally aphyric flows; black to gray-black; reddish-brown, gray, reddish-gray, to grayish-black-weathering; fine- to medium-grained; exposed only in the canyon of Rock Creek in the western part of the Goldendale map area; base not exposed in map area; overlain by Frenchman Springs Member of the Wanapum Basalt, commonly with an intervening sedimentary interbed; isotopically dated at about 16.9 Ma to 15.6 Ma (Baksi, 1989, p. 109; age information summarized by Reidel and others, 1989, p. 24-25). Divided into four magnetostratigraphic units; only the upper one is exposed in the map area:

Mv_{gN2} — Upper flows of normal magnetic polarity: Upper four or five flows of this unit are high-Mg Grande Ronde chemical type (Swanson and others, 1979b); commonly microphyric with 1- to 3-mm-long equant plagioclase phenocrysts. Lower flows of this unit are low-Mg Grande Ronde chemical type (Swanson and others, 1979b); fine-grained; aphyric; thick, massive, hackly entablatures over colonnades. Discontinuous, invaded sedimentary interbeds common near top and bottom of this sequence of flows.

Description compiled from Bentley and others (1988c) and Swanson and others (1979a).

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