STATE OF WASHINGTON
DEPARTMENT OF NATURAL RESOURCES
Brian Boyle, Commissioner of Public Lands
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DIVISION OF GEOLOGY AND EARTH RESOURCES

GEOLOGIC MAP GM-26

GEOLOGY OF THE PULLMAN, MOSCOW WEST, COLTON, AND UNIONTOWN 7 1/2 MINUTE QUADRANGLES, WASHINGTON AND IDAHO

By

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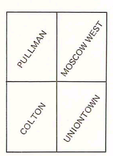
Base maps from U.S. Geological Survey.

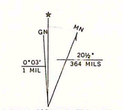


INDEX MAP

QUADRANGLE LOCATION

SCALE 1:62,500

1 1/2 0 1 MILE



UTM GRID AND 1964 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

LEGEND

QUATERNARY

- **Qd** — Landfill sites
- **Qz** — Mazama ash
- **Qf** — Alluvial fans
- **Qa** — Alluvium
- **Ql** — Palouse Formation
- **Qm** — Missoula Flood deposits
- **Qb** — Bonneville Flood deposits

TERTIARY

- **TQc** — Slump blocks of Tertiary basalt and overlying sediments

Middle Miocene — Saddle Mountains Basalt

- **Twl** — Lewiston Orchards flow, Weissenfels Ridge Member
- **Ta** — Asotin Member
- **Tla** — Lapwai flow, Wilbur Creek Member
- **Tw** — Wilbur Creek flow, Wilbur Creek Member
- **Tu** — Umatilla flow, Umatilla Member
- **Tut** — High-Ti Umatilla flow, Umatilla Member
- **Ts** — Interbasalt lake and stream sediments above the Wanapum Basalt

Wanapum Basalt

- **Tpr** — Priest Rapids Member
- **Tr** — Roza Member
- **Tsgpr** — Sedimentary unit separating Grande Ronde Basalt and Priest Rapids Member

Early Miocene — Grande Ronde Basalt

- **Tgn_2 | Tgr_2 | Tgn_1 | Tgr_1** — Grande Ronde Basalt aphyric flows

unconformity

CRETACEOUS

- **Kg** **Kpeg** — Granitic intrusives; Kpeg, pegmatite veins

unconformity

CAMBRIAN

- **€oq** — Orthoquartzites

Contacts
Dashed where approximately located

Tpr dike

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DESCRIPTION OF MAP UNITS

SURFICIAL DEPOSITS

Qd LANDFILL — Includes rubbish disposal sites of variable depths and composition, generally covered with loess, and areas of major movement or leveling of loess deposits for human use

Qz MAZAMA ASH — Small deposits of clean ash 4 to 6 inches thick overlain by variable mixtures of ash and loess up to 5 ft thickness; age 6,600 B.P. These deposits are typically found along roadcuts or stream banks along valley floors

Qf ALLUVIAL FANS — Stream deposits. Composition variable, from nearly pure reworked loess to mixtures of angular to rounded clasts of basalt and loess. Present where tributaries enter major drainage canyons along the Snake, Union Flat Creek, and the South Fork of the Palouse River

Qa ALLUVIUM — Stream sediments. Composition variable, commonly reworked loess or mixtures of loess and basalt. Paradise Creek and the South Fork of the Palouse River contain gravels yielding high percentages of quartz and granitoid rocks derived from steptoes along the eastern part of the map area

Ql PALOUSE FORMATION — Loess, predominantly of quartz and feldspar composition derived from the southwest throughout Pleistocene and Recent. Thickness variable (Ringe, 1970), maximum of 200 to 250 ft in map area. Forms modified dune topography overlying basalt surface and flanks of steptoes

Qm MISSOULA FLOODS BACKWATER DEPOSITS — Rhythmite deposits of cross-bedded, dark-gray, basalt-rich gravels grading upwards into quartz- and feldspar-rich tan sands and silts. Found along some larger tributaries of the Snake River to elevations of approximately 1,000 ft. Equivalent to the Touchet Beds of the Walla Walla area (Waite, 1980) and confined to ages of 17,500 to 13,000 B.P.

Qb BONNEVILLE FLOOD DEPOSITS — Gravels and sandy gravels containing high percentages of basalt with lesser amounts of granitics and greenschist facies volcaniclastics. Formed as back-eddy deposits along tributary canyons to the Snake Canyon. Age of the Bonneville Flood is reported to be 30,000 B.P. (Malde, 1968). Bonneville Flood deposits underlie Missoula floods backwater deposits in quarries in the vicinity of Clarkston, Washington, approximately 16 miles upstream from the map area

TQc Slump blocks of Tertiary basalt and overlying sediments — These blocks are found along the South Fork of the Palouse River northwest of Pullman

COLUMBIA RIVER BASALT GROUP

YAKIMA BASALT SUBGROUP

SADDLE MOUNTAINS BASALT

Twl Lewiston Orchards flow, Weissenfels Ridge Member — Medium-grained basalt flow with microphenocrysts of plagioclase and olivine in an intergranular matrix with some tachylitic glass. Normal magnetic polarity (Camp, 1976; Swanson and others, 1977, 1979). Probably equivalent to Sprague Lake flow (Swanson and others, 1977, 1979). Small outcrops found north of Moscow, and at Colton where it overlies stream sediments as an intravalley flow

Ta Asotin Member — A single flow with microphenocrysts of plagioclase and olivine with subophitic augite in coarser samples. Typically forms small columns. Normal magnetic polarity (Camp, 1976; Swanson and others, 1977, 1979). Intravalley flow overlying the Wilbur Creek Member in the Union Flat drainage southwest to the rim of the Snake River canyon

Tla Lapwai flow, Wilbur Creek Member (Swanson and others, 1977; Camp, 1981) — Medium-grained flow with some plagioclase in a matrix of euhedral ophitic augite, some olivine, feldspar laths, and tachylite. Intermediate in composition between Asotin Member and underlying Wilbur Creek flow. Confined to a small area on the rim of the Snake River canyon west of the western limit of the Asotin flow

Tw Wilbur Creek flow, Wilbur Creek Member (Swanson and others, 1977, 1979; Camp, 1981) — A fine-grained to glassy flow with occasional large, sometimes skeletal plagioclase phenocrysts and scarce olivine microphenocrysts. Normal magnetic polarity. Fills shallow paleovalley in Priest Rapids Member in Union Flat and southwest to the rim of the Snake River canyon

Tu Umatilla flow, Umatilla Member — A very fine-grained, essentially aphyric, flow of dense black appearance. Normal magnetic polarity (Reitman, 1966; Swanson and others, 1977, 1979). Confined to the southwest corner of the map along the rim of the Snake River canyon

Tut High-Ti Umatilla flow, Umatilla Member — A pale fine-grained aphyric flow with an abundance of opaque oxide grains in a matrix of clinopyroxene and feldspar. Locally underlies the Umatilla flow and has distinctly higher TiO_2 and P_2O_5 values (table 1)

Ts Interbasalt lake and stream sediments formed at various stratigraphic levels above the Wanapum Basalt — Quartz-rich sandstones and siltstones, often contain fragmentary plant fossils

WANAPUM BASALT

Tpr Priest Rapids Member (Wright and others, 1973; Swanson and others, 1977, 1979) — Medium-grained basalt with small phenocrysts of plagioclase and olivine in a matrix of intergranular pyroxene, ilmenite blades and some devitrified glass. Reversed magnetic polarity (Reitman, 1966). Two chemical types (Lolo and Rosalia, Wright and others, 1979) occur in the area, small patches of Rosalia type lie both above and below the main flow of the Lolo type which underlies the whole map area with the exception of the pre-basalt steptoes. A third chemical type is represented by dikes in the Pullman area which cut the main Lolo type flow (table 1)

Tr Roza Member (Wright and others, 1973; Reitman, 1966; Swanson and others, 1977, 1979) — A conspicuous flow with large plagioclase phenocrysts and microphenocrysts of olivine and augite in an intergranular matrix. Transitional magnetic polarity (Choiniere and Swanson, 1979). The flow is confined to the southwest corner of the map and can be observed dying out eastwards

Tsgpr A sedimentary unit separating the Grande Ronde Basalt below and the Priest Rapids Member of the Wanapum Basalt above, northwest of Pullman — Siltstones with some fossil plants

GRANDE RONDE BASALT

Fine-grained to very fine-grained aphyric flows of Grande Ronde chemical type (Wright and others, 1973; Swanson and others, 1977, 1979, 1980)

Tgn_2 Second normal magnetic polarity epoch — A single fine-grained aphyric flow of apparent normal polarity (Swanson and others, 1977, 1980) and Grande Ronde chemical type lying immediately beneath the sedimentary unit northwest of Pullman

Tgr_2 Second reverse magnetic polarity epoch — At least six flows of reversed magnetic polarity beneath the Priest Rapids and Roza flows exposed around the rim of the Snake River canyon where Tgn_2 is absent. Approximately 500 ft thick

Tgn_1 First normal magnetic polarity epoch — More than 800 ft of aphyric flows with normal magnetic polarity beneath Tgr_2 in the Snake River Canyon

Tgr_1 First reverse magnetic polarity epoch — Two or three aphyric flows of reversed magnetic polarity form the base of the basalt flow succession along the bottom of the Snake River canyon. Approximately 200 ft thick

CRETACEOUS INTRUSIONS

Kg Two varieties of coarse-grained intrusion come under this heading: a quartz-rich tonalite devoid of alkali feldspar forms Bald Butte and smaller outcrops at Chamber Road junction and the ridge east of Bald Butte to Highway 95 in Idaho. The second is a quartz-free hornblende monzodiorite of much darker color that forms the eastern extremity of the map southeast of Moscow and east of Highway 95. The Bald Butte tonalite (Hoffman, 1932) is a slightly foliated inequigranular rock composed of quartz, unzoned andesine ($An_{38\pm2}$) and muscovite and biotite partly altered to chlorite. Apatite, zircon, and a carbonate are present as accessories. The steep foliation is irregular but trends approximately E-W parallel to the ridge (Hooper and Rosenberg, 1970). A sample from Chambers Road-Highway 195 junction gives a date of 69.8 ± 2.6 m.y. (Geochron B-4992). The monzodiorite is a dark medium-grained rock with a strong foliation and inequigranular texture. The principal mineral phases are oligoclase (An_{27}) with slight normal zoning, microcline, and a dark-green hornblende. The hornblende occurs in clots, the cores of which appear to be pseudomorphs after pyroxene, associated with numerous small crystals of sphene, apatite, and opaque oxides. Quartz is only present as small areas of myrmekitic intergrowth

Kpeg Pegmatite veins associated with the tonalite (Kg) but occurring outside the main intrusive bodies

CAMBRIAN(?) ORTHOQUARTZITES

€oq Orthoquartzites of Kamiak Butte type — Coarse recrystallized quartzites almost 100 percent quartz with occasional small crystals of muscovite, biotite, and zircon. It is similar to the quartzites of Kamiak Butte, 15 miles due north of Pullman (Luis Nunez, personal communications, 1981) and tentatively correlated with similar Cambrian quartzites of northeast Washington. It is distinct from the impure laminated quartzites of the Belt Supergroup found farther east in Idaho. The orthoquartzite is found as outcrops all around and over the top of Bald Butte and Paradise Ridge. One example of a well-bedded diopside hornfels is included within this group

TABLE 1.—*Major element analyses of basalt units*

Flow	No. of analyses	SiO_2	Al_2O_3	TiO_2	Fe[1/]	MnO	CaO	MgO	K_2O	Na_2O	P_2O_5
Lewiston Orchards (Twl)	3	50.64	15.87	2.71	10.81	0.19	11.15	5.89	0.36	1.84	0.53
Asotin (Ta)	21	50.96(.47)[2/]	16.86(.24)	1.42(.04)	9.61(.38)	0.17(.01)	10.99(.20)	7.79(.33)	0.36(.05)	1.61(.24)	0.19(.01)
Lapwai (Tla)	5	52.67	16.21	1.69	10.65	0.17	9.53	6.13	1.04	1.56	0.34
Wilbur Creek (Tw)	22	54.36(.79)[2/]	15.92(.38)	1.93(.07)	10.97(.84)	0.17(.02)	8.41(.19)	4.28(.56)	1.64(.10)	1.78(.20)	0.46(.01)
High-Ti Umatilla (Tut)	5	57.99	17.05	3.21	7.47	0.13	6.26	1.52	2.89	2.53	0.95
Umatilla (Tu)	8	54.56	15.03	2.71	12.98	0.24	6.17	2.78	2.71	2.02	0.82
Lolo[3/] (Tprl)	51	50.17(.43)[2/]	14.69(.25)	3.17(.07)	13.85(.59)	0.23(.02)	9.09(.19)	5.16(.35)	1.00(.11)	1.96(.33)	0.67(.02)
Rosalia[3/] (Tprr)	8	50.63	15.78	3.54	12.84	0.20	9.35	4.11	0.83	2/01	0.73
Dikes[3/] (Tprd)	3	50.10	14.55	2.99	13.53	0.21	9.56	5.36	0.84	2.30	0.58
Grande Ronde Flows (Tg)	13	54.52	15.36	2.04	11.91	0.20	7.91	4.37	1.34	2.03	0.34

[1/] Total iron expressed as 2.00 percent Fe_2O_3, remainder as FeO.

[2/] Number in parentheses is the standard deviation.

[3/] Priest Rapids Member.

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