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PRELIMINARY GEOLOGIC MAP OF THE CAYUSE 7.5′ QUADRANGLE, UMATILLA COUNTY, OREGON

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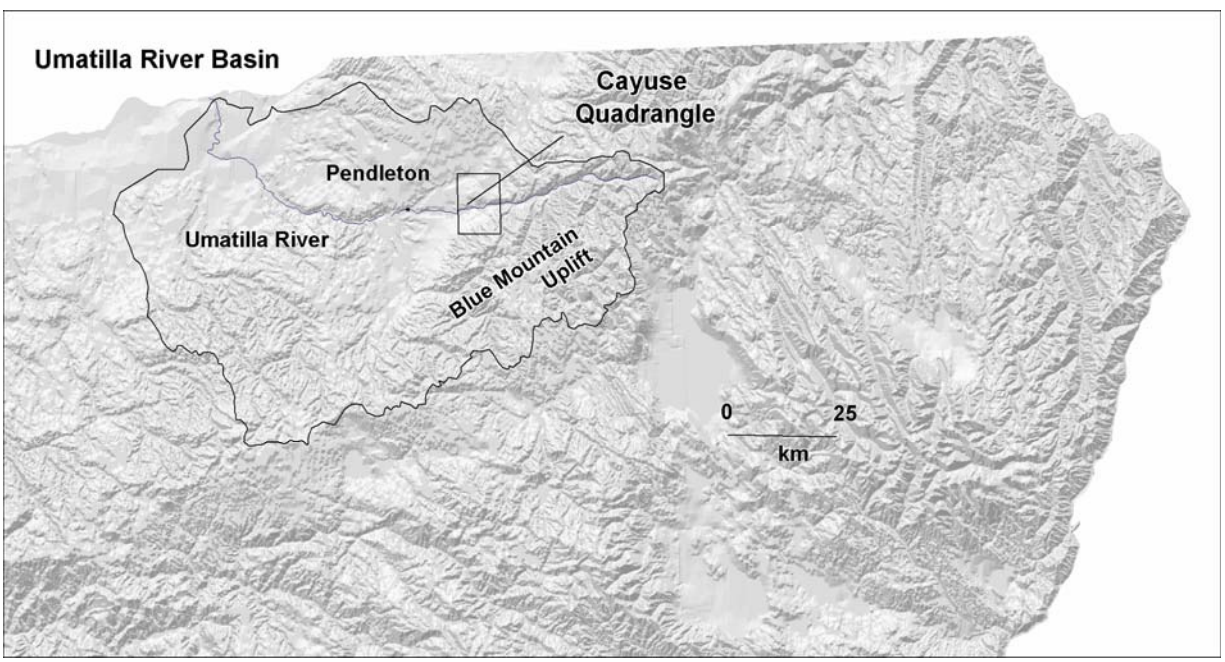
By Mark L. Ferns, Oregon Department of Geology and Mineral Industries.

INTRODUCTION

The Cayuse 7 ½' quadrangle is located along the northwest flank of the Blue Mountains Province of northeastern Oregon, just east of Pendleton, Oregon. The Umatilla River runs through the central part of the quadrangle, most of which lies within the Confederated Tribes of the Umatilla Indian Reservation. Dry land wheat and cattle are the main agricultural products. Primary geologic resource is groundwater, the long term sustainability of which is presently unknown.

The Cayuse quadrangle is underlain by an unknown thickness of Miocene flood basalts (Columbia River Basalt Group). Some individual flow packages in the exposed, upper part of the Columbia River Basalt Group have enough exposure and sufficiently distinctive geochemical signatures to constitute mappable units.



Methodology and Previous Work

The 1:24,000 scale geologic map of the Cayuse quadrangle was partially funded by the U.S. Geological Survey's National Cooperative Geologic Mapping Program under assistance award #03HQAG0070. The map is released as an interim map product as part of a larger mapping project covering the Umatilla River basin (Figure 1). Geologic data were collected at the 1:24,000 scale combining new mapping with published and unpublished data from air photos, orthophotoquads, and digital shaded relief images derived from USGS 30 m DEM (Digital Elevation Model) grids. Mapping was supplemented with x-ray fluourescence (XRF) geochemical analyses. Subsurface geology in cross sections is based on analyses of water-well drill records.

Geologic studies in the Cayuse quadrangle first began in the1960’s when Hogenson (1964) released a report on the geology and groundwater of the Umatilla River basin. Reconnaissance mapping in the late 1970’s by the U.S. Geological Survey, resulting in the 1:250,000 scale map of the Pendleton quadrangle (Walker, 1973). Columbia River Basalt Group units were later mapped in detail by Swanson and others, 1980; who also collected a considerable amount of geochemical data (Wright and others, 1979; 1980; 1982).

PRELIMINARY DESCRIPTION OF GEOLOGIC UNITS – CAYUSE QUADRANGLE, UMATILLA COUNTY, OREGON

Surficial Deposits

Qa Stream alluvium (Holocene and late Pleistocene) Gravel, sand, and silt deposited in active stream channels and on adjoining flood plains. Includes gravel and channel sand deposited in active or recently channels and overbank silt and mud deposited along the modern flood plain. North of the Umatilla River, includes loess and ash deposited along Wildhorse Creek and its tributaries.

Qf Alluvial fan deposits (Holocene? and Pleistocene) Unconsolidated, poorly sorted deposits of brown to orangish brown boulder gravel. Series of coalescing alluvial fans extending east from Mission Creek. Fan surface is dissected by modern stream system. Extent mapped on basis of rounded fan morphology.

Qls Landslide deposits (Holocene and Pleistocene?) Unconsolidated mass of rock and soil. Characterized by hummocky topography.

Qts Terrace deposits. (Pleistocene) Unconsolidated to weakly consolidated, brown to orangish brown deposits of coarse boulder gravel and pebbly sand. Unit forms benches along the Umatilla River and is comprised of rounded clasts of volcanic rocks. Generally no more than 10 m thick. Locally mantled by reworked ash and loess.

TERTIARY VOLCANIC AND SEDIMENTARY UNITS

Tms Sedimentary rocks (late Miocene) Unconsolidated to poorly consolidated deposits of clay, silt, and sand. Includes volcanic-clast pebble gravels that are exposed only in road cuts and bar ditches. Unit is mapped largely on the basis of rounded land forms. South of the Umatilla River, includes medium-grained cobble gravels. North of the Umatilla River, consists mostly of fine-grained silt and clay, weathering to form deep silty soils. Although previously interpreted as loess deposits (), herein interpreted as wind-reworked, fine grained alluvial plain and lacustrine deposits. On basis of stratigraphic position, correlative to the McKay Formation.

COLUMBIA RIVER BASALT GROUP

Two major Columbia River Basalt Group units are exposed in the Thorn Hollow quadrangle. Flows in the quadrangle include the basal Umatilla member of the Saddle Mountain Basalt; the Frenchman Springs member of the Wanapum Basalt, and four mappable units in the upper part of the Grande Ronde Basalt.

WANAPUM BASALT Multiple flow-on-flow lava flows. The Frenchman Springs basalt(Swanson and others, 1981; Hooper and Swanson,1990) is the only member of the Wanapum Basalt that has been identified in the Thorn Hollow quadrangle. A high alumina basalt similar to the Dodge member, which crop out below the Frenchman Springs member in areas to the east, has been identified from water well drill cuttings from adjoining Mission quadrangle to the west.

Tcwf **Frenchman Springs basalt (middle Miocene)** Flow-on-flow sequence of black to grayish-black, generally medium- to coarse-grained, iron-rich basalt and basaltic andesite flows. Flows weather to shades of brownish gray, brown, and bright orangish-brown. Fresh samples are generally dark grayish black in color and marked by distinct crystal faces. Generally microphorphyritic or porphyritic, with distinct plagioclase phenocrysts. Porphyritic flows contain sparse, pale yellow, blocky plagioclase phenocrysts as much as 1 cm in length. Individual eruptions apparently produced chemically discrete flows that form packages as much as 40 m thick wherein stacked flow lobes are separated by thin vesiculated flow tops and basal flow breccias. Cores to individual lobes pinch and swell laterally, forming discontinuous outcrops. Coarser-grained flows commonly weather to form grussy slopes marked by spheroidal-weathering core stones. Distinguished on basis of geochemistry from other Columbia River Basalt Group units by high titanium (~3.00 wt percent TiO_2). Based on slight differences in TiO_2, MgO, P_2O_5, unit includes at least 3 separate flows. Stratigraphic section based in part on analyzed water well cuttings from water well (OWRD ref numbers UMAT-5331 and UMAT-5930) that are located 1.8 km north and 1.5 km west of the quadrangle boundary respetively. Includes flows correlative to the Sand Hollow and Sentinel Gap units of McConnell (in prep). In the UMAT-5331 well, unit is 210 m thick. Basal UMAT-5331 flow is a low titanium – high magnesium flow (2.57 wt percent TiO_2 and 4.21 wt percent MgO) that appears to be transitional between the Frenchman

Springs basalt and the underlying Grande Ronde Basalt flows. Sampled flows from the upper 130 m of the unit in the UMAT-5331 well all appear to be of Sentinel Gap chemical type. The Frenchman Springs thins to the south where, on Kanine Ridge, thin basal flows are exposed that belong to the Sand Hollow geochemical unit, with 0.51 - 0.65 wt percent P_2O_5 and 3.057 - 3.113 wt percent TiO_2. Overlying flows are comparatively richer in phosphorus (0.69 – 0.72 wt percent P_2O_5) and poorer in titanium (2.937 – 2.965 wt percent TiO_2). A single Sentinel Gap flow locally caps the southern section. In the UMAT-5930 well, the Frenchman Springs basalt is about 150 m thick. A 100 m of Sand Hollow type flows are capped by a high phosphorus flows that separates the Sentinel Gap from the Sand Hollow.

GRANDE RONDE BASALT

Flow-on-flow sequence of bluish-black aphyric to sparsely plagioclase phyric lava flows. Includes both medium grained crystalline and fine-grained glassy lava flows. Two uppermost flow packages mapped separately on basis of geochemistry and petrology.

Tcgs Sentinel Bluffs unit (middle Miocene) Flow-on-flow sequence of dark grayish black, iron-rich basaltic andesite lava flows. Unit is made up of thin flows and flow lobes, generally < 5m thick, that are marked by vesicular flow tops and basal flow breccias. Weathered surfaces are shades of brownish gray and reddish brown. Central parts of individual flows form laterally discontinuous outcrops. Thickest flows, which are as much as 20 m thick, are platy jointed. Coarser grained flows commonly form reddish- and yellowish-brown punky subcrop from which spheroidal-weathering corestones erode. Based on strong geochemical similarities, unit is made up of chemically discrete lava flows that form individual flow packages as much as 30 m thick wherein overlapping flow lobes are separated by vesiculated flow tops and basal flow breccias. Generally holocrystalline. Brownish gray, weathered surfaces to coarse grained flows sometimes display diktytaxitic textures defined by a groundmass of randomly oriented, lathe-shaped plagioclase crystals. Flows generally contain olivine microphenocrysts. Unit thickens to the northwest, where it is as much as 70 m thick. In places, separated from overlying

Frenchman Springs flows by a thin red soil zone. Readily distinguished from overlying Frenchman Springs flows on the basis of geochemistry, notably low titanium (<2.0 wt percent TiO_2) and phosphorous (<0.35 wt percent P_2O_5). Distinguished from underlying Winter Water unit by high magnesium contents (> 4.35 wt % MgO). Equivalent to the Sentinel Bluffs unit of Reidel and others (1989) and the high MgO flows Wright and others (1973) at the top of the Grande Ronde Basalt N2 magnetostratigraphic unit. 70 m apparent in both wells

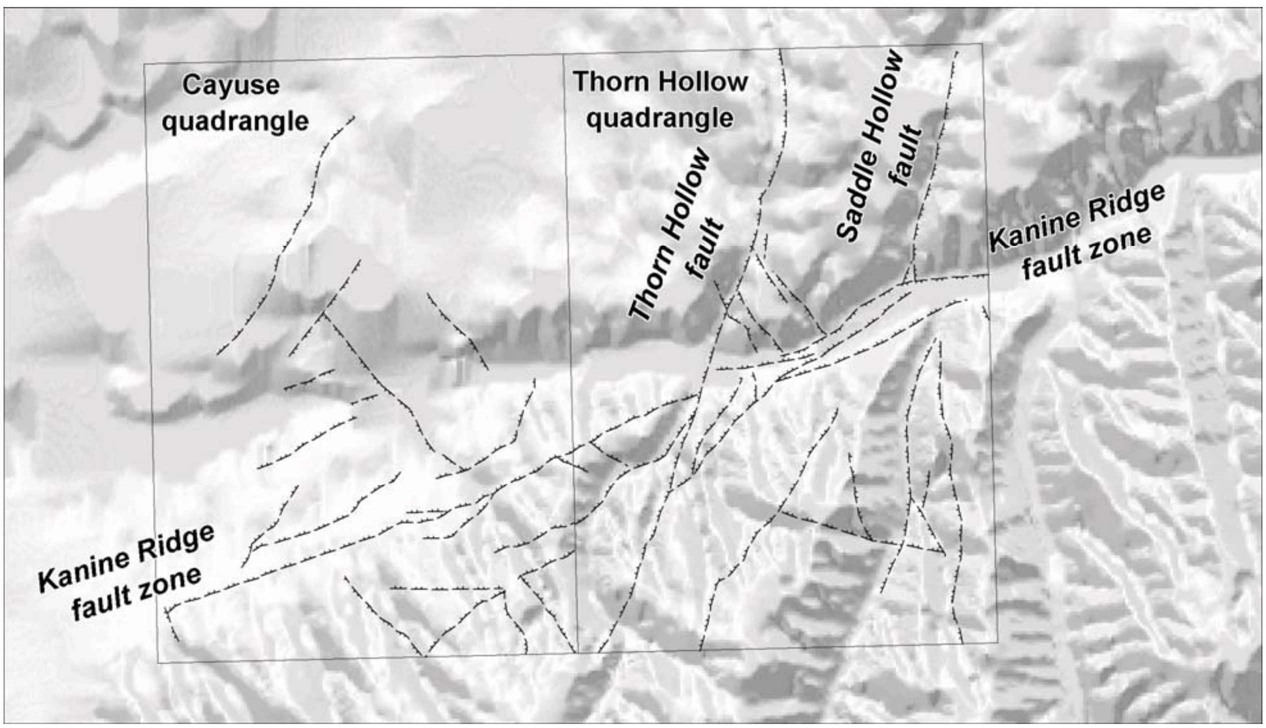
Tcgw Winter Water unit (middle Miocene) Hackly jointed, fine-grained iron-rich basaltic andesite and andesite lava flows. Unit is made up of one or more flows that have coalesced to form thick, hackly jointed cooling units as much as 50 m thick. Typically forms ridge crests marked by gray and grayish-brown, angular blocks 10 cm in diameter. The angular, equidimensional blocks weather from a thick entabulature that forms a marker horizon that can be traced laterally across canyons. Aphyric to sparsely plagioclase phyric and often glassy. In the Thorn Hollow quadrangle, easily distinguished from overlying Sentinel Bluffs unit by lower magnesium (< 3.5 wt percent MgO) and higher potassium ($\geq$ 1.5 wt percent K_2O). In the southern part of the quadrangle, thick hackly jointed, glassy flows are locally separated by thin holocrystalline flows with markedly higher magnesium (3.77 wt percent MgO) content. Unit is between 70 and 80 m thick throughout the quadrangle. May thicken to the west, where at least 90 m is found in the UMAT-5930 well. Correlative with the Winter Water unit of Reidel and others (1987).

Tcgn$_2$ N$_2$ magnetostratigraphic unit (middle Miocene) Flow-on-flow sequence of fine-grained, generally holocrystalline lava flows. In the Cayuse quadrangle, includes all normally polarized lava flows below the Winter Water unit. Includes iron-rich basaltic andesite and andesite lava flows and flow breccias. Individual flows are sometimes marked by red weathering basal flow breccias. Outcrops are discontinuous and individual flow lobes or cooling units cannot be traced laterally across canyons with any certainty. Base of unit is not exposed in the Cayuse quadrangle, about 90 m of unit is exposed in the adjoining Thorn Hollow quadrangle. Age of the N_2 unit lies between 15.5 and 15.7 +/- 0.3 Ma (Baksi, 1989).

STRUCTURE

Flow packages south of the Umatilla River show a pronounced, northwest tilt Apparent dips, marked by interflow contacts, steepen to the northwest, into a compex flexure zone, referred to as the Kanine Ridge fault zone, which in the Cayuse quadrangle, is defined by a northeast-trending, high angle reverse fault. Flow package dips to the south of the Kanine Ridge fault zone are steeper than tributary stream gradients. The Kanine Ridge fault zone parallels to the Umatilla River and can be traced easttward into the adjacent Thorn Hollow quadrangle

Relative timing of structural development is conjectural. Northward thickening of younging flow packages away from the Kanine Ridge fault zone may indicate that the Kanine Ridge fault zone was an active flexure during the middle Miocene. Similar active northeast trending flexures have been described along the Limekiln fault further to the east (Hooper and Swanson, 1990).



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