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

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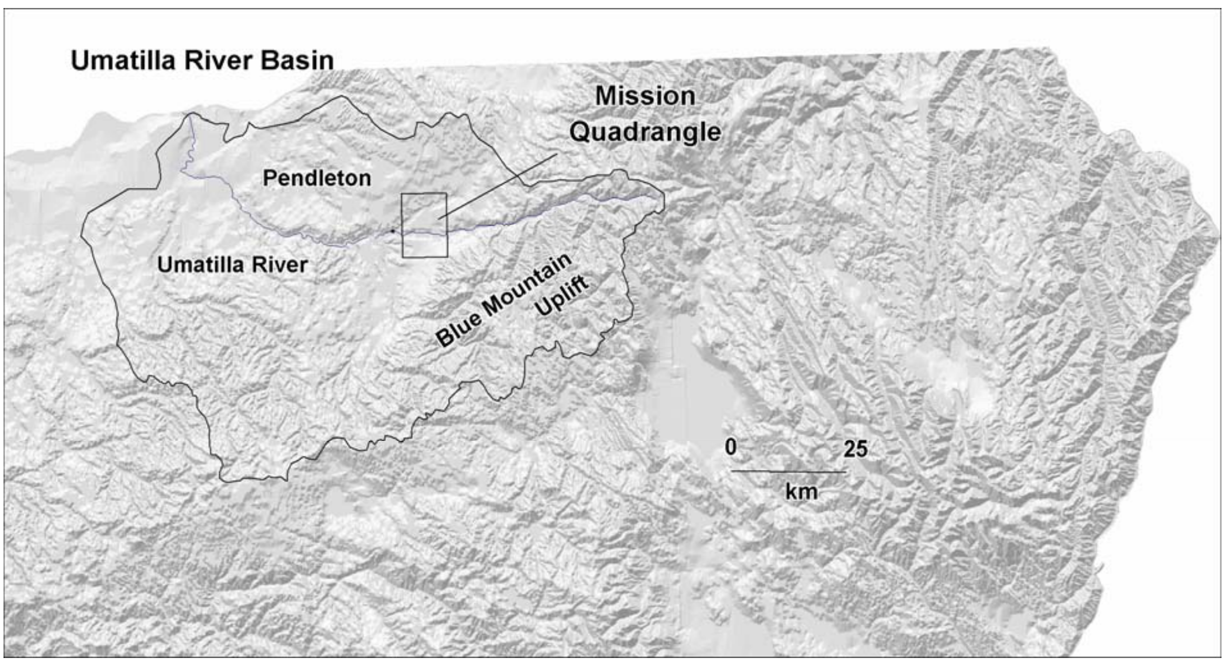
# PRELIMINARY GEOLOGIC MAP OF THE MISSION QUADRANGLE

*By Mark L. Ferns, Oregon Department of Geology and Mineral Industries and
Kate Ely, Confederated Tribes of the Umatilla Indian Reservation.*

## INTRODUCTION

The Mission 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 (CTUIR). 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 Mission 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. These units are recognized in water wells drilled for the Confederated Tribes of the Umatilla Indian Reservation.



## Methodology and Previous Work

The 1:24,000 scale geologic map of the Mission 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 Geologic data were collected at the 1:24,000 scale combining new mapping with published and unpublished data from air photos, orthophotoquads, and digital shaded relief images derived from USGS 30 m DEM (Digital Elevation Model) grids.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. Static water level measurements were collected on 9 October, 2000.

Geologic studies in the Mission 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 – MISSION 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.

**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. Best exposures are 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 northern exposures were previously interpreted as loess deposits (), they are herein interpreted as wind-reworked, fine grained alluvial plain and lacustrine deposits. On basis of stratigraphic position, correlative to the McKay Formation. Unit is disconformable atop the Frenchman Springs basalt, overlying upper Sentinel Gap flows north of the Umatilla River, intermediate high $P_2O_5$ Frenchman Springs flows in the channel of the Umatilla River and directly on lower Sand Hollow flows south of the Umatilla River. In the Pendleton quadrangle to the west, McKay Formation sediments lie directly on Sentinel Gap, Sand Hollow, and upper Grande Ronde Basalt flows (McConnell, in prep.)

## COLUMBIA RIVER BASALT GROUP

Two major Columbia River Basalt Group units are exposed in the Mission quadrangle. Flows in the quadrangle include the Frenchman Springs member of the Wanapum Basalt and the Sentinel Bluffs and Winter Water units at the top 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 Mission quadrangle outcrops. A high-alumina basalt, possibly equivalent to the Dodge member, occurs between the Frenchman Springs basalt and underlying Grande Ronde Basalt in the UMAT-53456 well.

**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 wells (CTUIR well designation-OWRD well numbers CTUIR well # 3 – UMAT-5930; CTUIR well # 4 – UMAT-5929; and CTUIR well # 5 - UMAT-53456). Includes flows correlative to the Sand Hollow and Sentinel Gap units of McConnell (in prep). In the UMAT-5929 well, unit is about 140 m thick and capped by a Sentinel Gap flow. The Sentinel Gap flow is separated from the Sand Hollow by about 30 m of high phosphorus lavas (> 0.64 wt percent $P_2O_5$). Underlying Sand Hollow section, marked by low phosphorus lavas (< 0.60 wt percent $P_2O_5$) is about 80 m thick in the UMAT-5929 well. A single Sentinel Gap flow also caps the southern section. In the UMAT-5930 well, the Frenchman Springs basalt is about 150 m thick. 100 m of Sand Hollow type flows are capped by a high phosphorus flows that separates the Sentinel Gap from the Sand Hollow. The Frenchman Springs basalt thins to the south; where about 110 m of flows are penetrated by the UMAT-53456 well. The section is capped by about 35 m of high phosphorus flows. The Sand Hollow here is about 70 m thick and overlies a peculiar high alumina, very low phosphorus flow (17.12 wt percent $Al_2O_3$ and 0.14 wt percent P2O5) that is situated in the same stratigraphic position as the high alumina Dodge and Robinette members (Hooper and Swanson, 1989).

## 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. Only the uppermost two flow packages of Grande Ronde Basalt are exposed in the Mission Quadrangle.

**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. Based on water well stratigraphy, unit is 90 m thick in the Mission quadrangle. 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). Unit locally includes intercalated lava flows whose geochemistry appears transitional between upper Grande Ronde Basalt (Sentinel Bluff) and basal Frenchman Springs basalt flows (Sand Hollow). Two flows intercalated with Sentinel Bluffs lavas in the UMAT-53456 well have titanium and phosphorus abundances more typical of Frenchman Springs (~ 2.6 wt percent $TiO_2$ and ~0.48 wt percent $P_2O_5$). Equivalent to the Sentinel Bluffs unit of Reidel and others (1989) and the high MgO flows of Wright and others (1973) at the top of the Grande Ronde Basalt N2 magnetostratigraphic unit.

**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. Where exposed in the southeast corner of the quadrangle, 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. Aphyric to sparsely plagioclase phyric and often glassy. In the Mission quadrangle, easily distinguished from overlying Sentinel Bluffs unit by lower magnesium (< 3.5 wt percent MgO) and higher potassium ($\geq$ 1.5 wt percent $K_2O$). Thickness in quadrangle is not known, over 90 m of Winter Water flows are penetrated in the UMAT-5930 and UMAT-53456 wells. Correlative with the Winter Water unit of Reidel and others (1987).

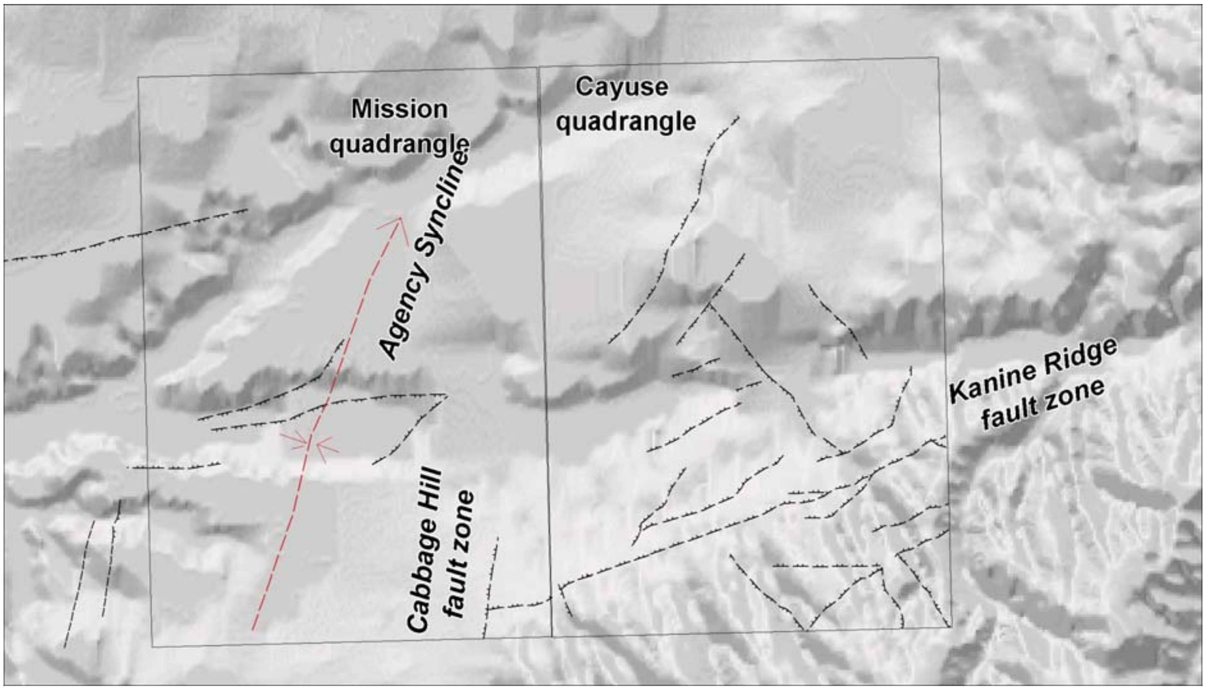
## STRUCTURE

Flow packages in the southeast corner of the Mission quadrangle display a pronounced, northwest tilt. Apparent dips, marked by interflow contacts, steepen to the northwest, into the Kanine Ridge fault zone, which in the Cayuse quadrangle, which 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 Cayuse quadrangle.

Abrupt changes in depths to bedrock evident in water wells logs indicate that a moderate displacement, northerly-trending normal fault, herein referred to as the Cabbage Hill fault, truncates the west end of the Kanine Ridge fault zone and continues northward, toward the Umatilla River. The Cabbage Hill fault parallels the projected trend of the Agency Syncline (Hogenson, 1964), a north plunging downwarp whose axis is marked by the thickest accumulation of Miocene sediments. The syncline is cut by several small displacement, eastwardly-trending faults that apparently act as aquatards.

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, uplifting surface upon which successive flow packages formed an offlap sequence. Similar active northeast trending flexures have been described along the Limekiln fault further to the east (Hooper and Swanson, 1990).

The Cabbage Hill fault and Agency Syncline are younger structures that did not effect the distribution of CRB units. Although the thickest section of middle Miocene sediments (Tms) help define the trough of the syncline/downwarp, scattered erosional remnants of middle Miocene sediments to the west (McConnell, mapping in 2002) indicates that middle Miocene sedimentation was not confined to the present-day downwarp as defined by the Agency Syncline and other north-trending structures.



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