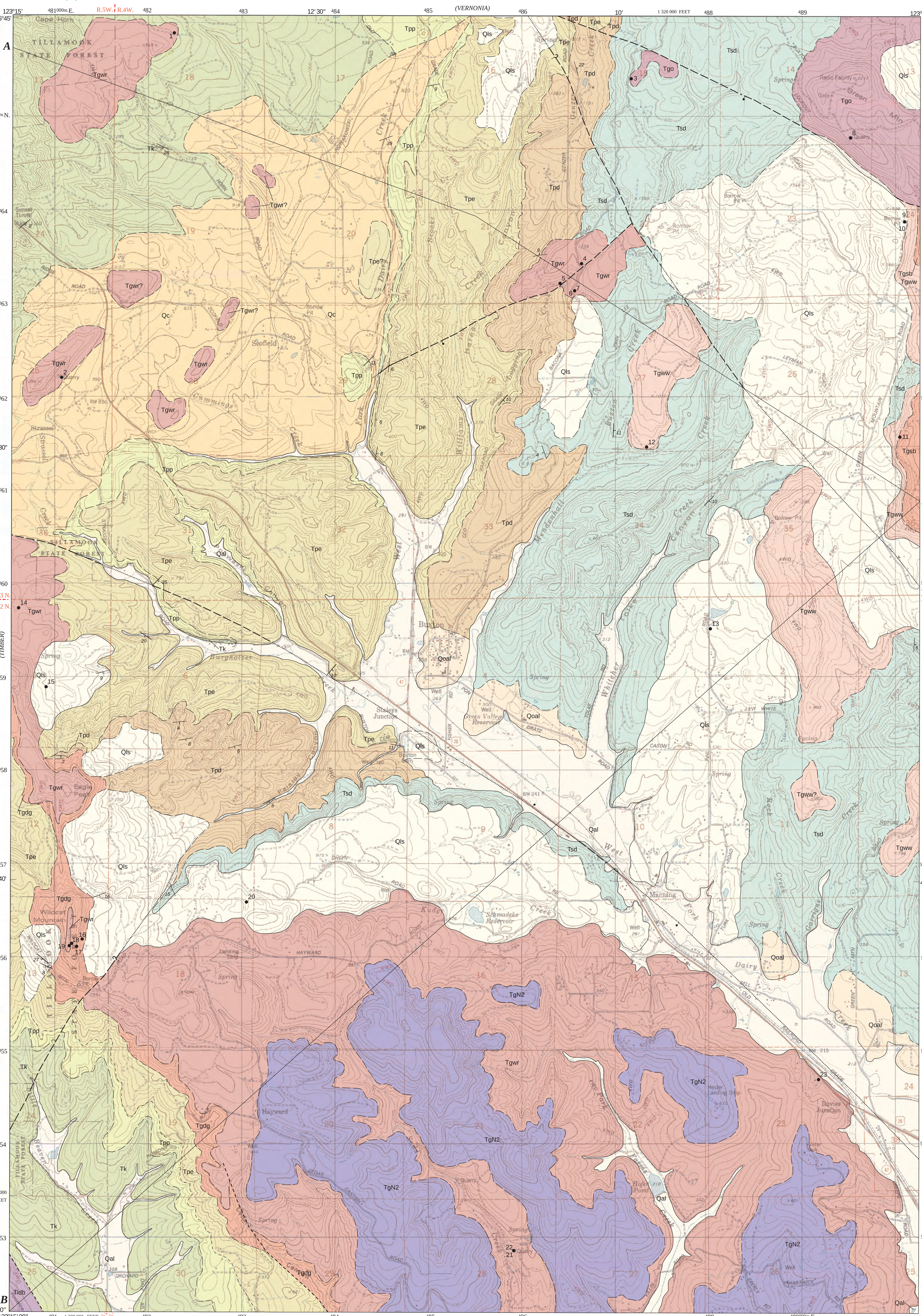

Base from U.S. Geological Survey, Buxton, OR 1992
Universal Transverse Mercator projection, zone 10

SCALE 1:24 000

CONTOUR INTERVAL 40 FEET
DOTTED LINES REPRESENT 10-FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

MAP LOCATION

Geology mapped by P.A. Dinterman and A.R. Duvall, 2004-2005; P.A. Dinterman, 2006
Digital database by P.A. Dinterman, A.R. Duvall, and Karen L. Wheeler
Edited by J.L. Zigler
Manuscript approved for publication September 1, 2009

## CORRELATION OF MAP UNITS

SURFICIAL DEPOSITS

Qal, Qls, Qc — Holocene; Qoal — Pleistocene — QUATERNARY

Unconformity

BEDROCK
Sedimentary, Volcanic, and Intrusive Rocks

Tgsb, Tgww, Tgo, Tgwr, Tgdg, TgN2 — Miocene

Unconformity

Tsd — Oligocene

Unconformity

Tpd, Tpe, Tpp — Eocene

Unconformity

Tk, Ttdb — Eocene — TERTIARY

## DESCRIPTION OF MAP UNITS

### SURFICIAL DEPOSITS

**Qal** **Alluvial deposits (Holocene)**—Unconsolidated clay, silt, sand, and gravel deposited in floodplains and channels of rivers and streams. Locally includes colluvium and terrace deposits along valley margin

**Qls** **Landslide deposits (Holocene and Pleistocene)**—Unconsolidated chaotic mixture of weathered angular to subrounded clasts of sandstone, mudstone, and basaltic bedrock, commonly in a yellowish-brown mud-dominated matrix derived from upslope. Forms hummocky topography and may include thick colluvial deposits, and older accumulations with subdued physiographic expression are also included in this unit. Some landslides contain coherent blocks of units indicating large slump and slide blocks

**Qc** **Colluvium Deposits (upper Pleistocene)**—Gently southeast-dipping surface with paleosoils and large-scale blocks of consolidated material including Tgwr and Tpd bedrock. Remnant erosional surface described as "Scofield Surface" by Van Atta (1971) with in-place feeder dikes of basalt flows that have subsequently been removed

**Qoal** **Older Alluvial Deposits (upper Pleistocene)**—Unconsolidated clay, silt, sand, and gravel deposited in floodplains and channels of rivers and streams

### BEDROCK

Sedimentary, Volcanic, and Intrusive Rocks

**Grande Ronde Basalt (lower to middle Miocene)**—Light to dark gray on fresh surface; dark gray to black weathered surface with common thick weathering rinds. Aphyric, microphyric, and sparsely plagioclase-phyric lava flows of tholeiitic basaltic andesite with low $TiO_2$ (<2.4%) contents (Mangan and others, 1986; Beeson and others, 1989; Reidel and others, 1989). $^{40}Ar/^{39}Ar$ ages from the Columbia Plateau indicate emplacement between 16.5 to 15.6 Ma (Reidel and others, 1989). Flows in this quadrangle are assigned on the basis of field, chemical, and paleomagnetic data to informal members recognized on Columbia Plateau (Reidel and others, 1989; Reidel, 1998)

**Tgsb** **Sentinel Bluffs Member (middle Miocene)**—One flow of blocky to columnar-jointed, light- to dark-gray basalt. Fine to medium crystalline, commonly diktytaxitic, sparsely plagioclase microphyric, and rarely plagioclase phyric with small (<0.5 cm in size) tabular plagioclase phenocrysts. The Sentinel Bluffs flow is distinguished from both the younger Frenchman Springs flows and older Grande Ronde units on the combined basis of stratigraphic position, geochemical composition, lithology, and paleomagnetic polarity (see Reidel and others, 1989; Beeson and others, 1989). $TiO_2$ <2%, MgO > 4.5% (table 1). Unit thickness is variable, ranging to 30 m in thickness

**Tgww** **Winter Water Member (middle Miocene)**—One or two flows of entablature-jointed, dark-gray to black, commonly porphyritic basalt. Flows are typically microphyric and phyric to abundantly phyric with uncommon small (<0.3 cm) stellate plagioclase glomerocrysts; some contain acicular microphenocrysts. Distribution of plagioclase glomerocrysts is uneven. Winter Water flows are distinguished from other Grande Ronde units on the combined basis of stratigraphic position, lithology, geochemical composition (see table 1), and paleomagnetic polarity (see Reidel and others, 1989; Beeson and others, 1989). Unit thickness within the map area is variable, ranging from 0 to > 40 m-thick

**Tgo** **Ortley Member (lower Miocene)**—At least two flows of entablature-jointed dark-gray basalt. Fresh exposures are dark gray to black; weathered surfaces are greenish gray to dark gray. Ortley flows are commonly glassy to very finely crystalline and aphyric but are commonly microphyric in map area. This unit is distinguished from other Grande Ronde units on the combined basis of stratigraphic position, lithology, geochemical composition (see table 1). Unit thickness is variable, ranging from 0 to >90 m thick

**TgN2** **N2 flows, undifferentiated (lower to middle Miocene)**—One to three flows of normal polarity entablature-jointed, light-gray, commonly microphyric basalt. This unit contains basalt flows from normal polarity (N2) flows in the upper part of the Grande Ronde sequence as described by Reidel and others (1989). This unit includes probable Winter Water and Ortley flows. These flows cannot be differentiated due to extensively weathered outcrops and are, therefore, grouped in this unit

**Tgwr** **Wapshilla Ridge Member (lower Miocene)**—One or two flows that typically display entablature jointing. Fresh exposures are dark gray to black; weathered surfaces are greenish gray to dark gray, commonly glassy to very fine grained with distinctive abundant acicular microphenocrysts of plagioclase. This unit shows an increase in $TiO_2$ upsection with two distinct chemical signatures; an underlying unit with lower $TiO_2$ values and an overlying sequence of flows with higher $TiO_2$ values (table 1). It is likely that Tgwr deposits in this area have filled in remnant topography as intracanyon flows, because basal basalt conglomerates are observed. This unit is distinguished from other Grande Ronde units on the combined basis of stratigraphic position, appearance, and reversed paleomagnetic polarity. Unit thickness is variable, ranging up to 100 m thick. Deeply weathered to deep-darkred, crumbly, altered basalt with spheroidal to ellipsoidal corestones

**Tgdg** **Downey Gulch Member (lower Miocene)**—At least three flows of entablature colonnade jointed basalt. Exposures are dark gray to black, very fine-grained with acicular microphenocrysts of plagioclase. Three normal polarity flows underlie reversed polarity Tgwr flows on Wildcat Mountain. It is likely that Tgdg flows in this area have filled in remnant topography as intracanyon flows. This unit is distinguished from other Grande Ronde units on the combined basis of stratigraphic position and normal paleomagnetic polarity. Unit thickness within the map area is up to 75 m thick

**Tsd** **Scappoose Formation of Warren and others (1945, 1946) (Oligocene)**—Massive to parallel-laminated, light-gray to yellow tuffaceous fine-grained sandstone, siltstone, claystone and some tuffs interbedded with medium- to coarse-grained, micaceous, arkosic-tuffaceous sandstone. Cliff-forming unit. Some tuff beds observed, 1-2 m thick. Tuffaceous siltstone is commonly micaceous, heavily bioturbated (small book-shaped *helminthoidia*), with burrows filled with coarser, darker grains of fecal pellets and carbonized wood fragments. Tuffaceous-arkosic sandstone is commonly orange to buff colored, pumiceous, quartz-rich. Dominantly shallow marine environment. A diverse assemblage of molds and casts of shallow marine mollusks has been correlated to the Blakely Stage (late Oligocene to early Miocene) (Warren and others, 1945; Warren and Norbisrath, 1946)

**Tpd** **Pittsburg Bluff Formation, Divide member of Niem and others (1992) (lower to middle Oligocene)**—Fine to coarse-grained, yellow to orange-brown arkosic sandstone, commonly trough to planar crossbedded, contains some mudstone rip-up clasts, channelized deposits. Sandstone is micaceous, quartz and feldspar rich, and rarely pebbly

**Tpe** **Pittsburg Bluff Formation, East Fork member of Niem and others (1992) (lower Oligocene and upper Eocene)**—Massive to rarely laminated, light gray tuffaceous siltstone and very fine grained sandstone with minor fine-grained arkosic sandstone, thin burrowed, white to very light gray tuff beds and calcareous concretions. Thick, cliff-forming unit. Some mottled rippled horizons indicating wave action. Commonly thoroughly bioturbated, including large *Thalassinoides* and *zinconela* burrows. Contains wood fragments and disseminated organic matter, carbonaceous and pumiceous. Locally fossiliferous beds include mollusks and gastropods. Fossils indicate shallow marine environment (Moore, 1976). Unit is up to 200 m thick

**Tpp** **Pittsburg Bluff Formation, Pebble Creek member of Niem and others (1992) (upper Eocene)**—Fine- to coarse-grained, yellow to orange-brown, micaceous, arkosic sandstone, commonly trough to planar crossbedded, contains common mud rip-up clasts, channelized deposits. Sandstone is micaceous, quartz and feldspar rich, and locally pebbly. Unit is 0 to 40 m thick

**Tk** **Keasey Formation (upper Eocene)**—Massive to rarely laminated, bioturbated, light gray to white tuffaceous siltstone, claystone, and fine-grained sandstone with minor thin (<10 cm) arkosic beds and white tuff beds, commonly bioturbated with some burrows filled with coarser-grained sandstone, common spheroidal calcareous concretions. Locally fossiliferous containing dominantly mollusks (usually in the form of casts and molds), gastropods, scaphopods. Dominantly deep marine environment based on fossils (McDougall, 1975)

**Ttdb** **Diabase (middle Eocene)**—Aphyric to plagioclase-phyric, amygdaloidal diabase with smectite clays and zeolite vesicle fillings; locally pillowform with radial columnar joints, more commonly tabular bodies with well-developed columnar joints and a layered appearance. Sills are cut by the regional dike swarm that fed overlying Tillamook Volcanics but intrude strata as young as Yamhill Formation, suggesting a minimum age of about 43 Ma; unit may include some basalt and diabase correlative with the Tillamook Volcanics (unit description from Wells and others, 1995). Inferred from adjacent mapping

**Contact**—Dashed where approximately located; short-dashed where inferred; dotted where concealed

**Fault**—Dashed where inferred; dotted where concealed. Ball and bar on downthrown side

**Strike and dip of inclined beds**

**Scappoose megafossil locality**—From Warren and Norbisrath; 1945

**Chemical analysis**—see table 1

## ACKNOWLEDGMENTS

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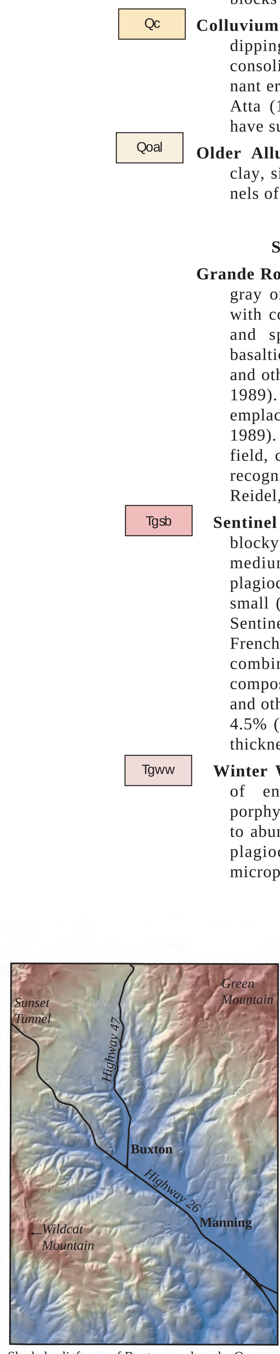


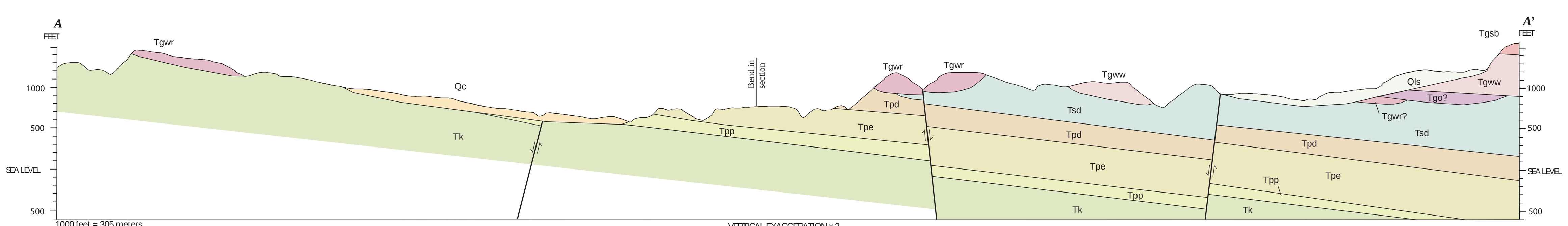
Shaded-relief map of Buxton quadrangle. Orange colors show high elevations and blue colors show low elevations.

**Table 1.** Major and trace element chemistry for Grande Ronde Basalt of the Columbia River Basalt Group samples in the Buxton, Oregon quadrangle.

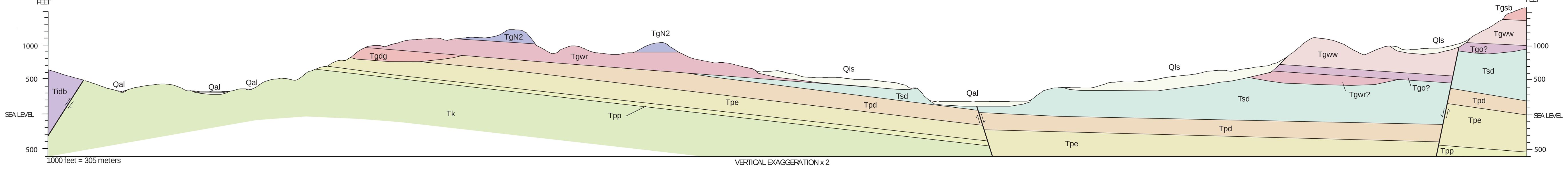
| Map Number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SampleID | PD0508261150a | 04AD3 | 04AD7 | 04PD10 | PD0508251213a | 04PD11 | 04PD12 | 04PD8 | PD0508251744a | PD0508251744b | 06_0831_1325P04b | 06_0821_1643PDa |
| StationID | PD0508261150 | PD0409191004 | AD0409211646 | PD0409221537 | PD0508251213 | PD0409221734 | PD0409221734 | PD0409211315 | PD0508251744 | PD0508251744 | 06_0831_1325P04 | 06_0821_1643PD |
| FlowUnit | Wapshilla Ridge | Wapshilla Ridge | Ortley | Wapshilla Ridge? | Wapshilla Ridge? | Wapshilla Ridge | Wapshilla Ridge | Ortley | Ortley | Winter Water | Sentinel Bluffs | Winter Water |
| SampleYear | 2005 | 2004 | 2005 | 2005 | 2005 | 2004 | 2004 | 2004 | 2005 | 2005 | 2006 | 2006 |
| Major element oxides in percent (%) | | | | | | | | | | | | |
| SiO2 | 54.24 | 53.37 | 55.40 | 54.92 | 55.14 | 55.04 | 55.25 | 56.27 | 56.41 | 56.23 | 53.47 | 55.28 |
| TiO2 | 2.28 | 2.33 | 1.94 | 2.16 | 2.11 | 2.14 | 2.34 | 1.82 | 1.97 | 2.32 | 1.98 | 2.10 |
| Al2O3 | 13.68 | 14.05 | 13.64 | 14.56 | 13.52 | 13.75 | 13.50 | 13.91 | 14.03 | 13.64 | 13.95 | 13.41 |
| FeO* | 11.18 | 12.70 | 10.40 | 9.78 | 11.79 | 12.21 | 11.57 | 11.08 | 10.00 | 10.01 | 11.62 | 11.94 |
| MnO | 0.20 | 0.19 | 0.19 | 0.20 | 0.19 | 0.19 | 0.20 | 0.18 | 0.17 | 0.21 | 0.21 | 0.19 |
| MgO | 3.45 | 3.42 | 3.48 | 3.72 | 3.34 | 3.29 | 3.34 | 3.42 | 3.52 | 3.27 | 4.75 | 3.31 |
| CaO | 7.10 | 7.28 | 6.95 | 7.27 | 6.86 | 6.86 | 6.98 | 7.04 | 7.15 | 6.92 | 8.53 | 6.77 |
| Na2O | 3.16 | 2.95 | 3.18 | 3.18 | 3.09 | 3.06 | 3.16 | 3.01 | 3.16 | 3.35 | 2.94 | 3.18 |
| K2O | 1.87 | 1.47 | 1.78 | 1.57 | 1.88 | 1.65 | 1.91 | 1.71 | 1.73 | 1.82 | 1.24 | 1.85 |
| P2O5 | 0.36 | 0.36 | 0.33 | 0.37 | 0.36 | 0.36 | 0.41 | 0.30 | 0.33 | 0.37 | 0.33 | 0.35 |
| Total | 97.52 | 98.11 | 97.37 | 97.73 | 98.34 | 98.58 | 98.56 | 98.73 | 98.47 | 97.94 | 99.03 | 98.38 |
| Trace elements, parts per million (ppm) | | | | | | | | | | | | |
| Ni | 16.0 | 5.0 | 12.0 | 13.0 | 13.0 | 7.0 | 6.0 | 2.0 | 10.0 | 6.0 | 10.4 | 14.2 |
| Cr | 13.0 | 11.0 | 13.0 | 14.0 | 8.0 | 8.0 | 8.0 | 7.0 | 9.0 | 7.0 | 35.9 | 6.4 |
| Sc | 33.0 | 34.0 | 31.0 | 34.0 | 31.0 | 33.0 | 32.0 | 31.0 | 31.0 | 33.0 | 39.3 | 32.3 |
| V | 411.0 | 425.0 | 326.0 | 360.0 | 358.0 | 363.0 | 386.0 | 301.0 | 322.0 | 347.0 | 327.6 | 355.7 |
| Ba | 703.0 | 739.0 | 715.0 | 772.0 | 750.0 | 782.0 | 792.0 | 710.0 | 809.0 | 683.0 | 518.3 | 746.4 |
| Rb | 40.0 | 41.0 | 49.0 | 38.0 | 48.0 | 40.0 | 50.0 | 48.0 | 50.0 | 50.0 | 27.2 | 51.1 |
| Sr | 331.0 | 337.0 | 311.0 | 337.0 | 310.0 | 307.0 | 324.0 | 302.0 | 335.0 | 325.0 | 304.8 | 303.7 |
| Zr | 181.0 | 174.0 | 180.0 | 194.0 | 188.0 | 179.0 | 177.0 | 172.0 | 183.0 | 192.0 | 159.7 | 184.7 |
| Y | 36.0 | 40.0 | 36.0 | 42.0 | 43.0 | 49.0 | 37.0 | 40.0 | 45.0 | 41.0 | 41.3 | 40.0 |
| Nb | 11.7 | 10.6 | 11.9 | 12.8 | 12.3 | 11.1 | 11.1 | 11.1 | 12.8 | 12.7 | 10.4 | 12.1 |
| Ga | 23.0 | 21.0 | 21.0 | 21.0 | 22.0 | 23.0 | 21.0 | 22.0 | 22.0 | 24.0 | 21.2 | 20.3 |
| Cu | 15.0 | 14.0 | 15.0 | 22.0 | 23.0 | 20.0 | 21.0 | 9.0 | 14.0 | 6.0 | 25.0 | 22.6 |
| Zn | 131.0 | 135.0 | 123.0 | 140.0 | 129.0 | 127.0 | 127.0 | 119.0 | 146.0 | 136.0 | 119.7 | 126.7 |
| Pb | 8.0 | 9.0 | 8.0 | 9.0 | 8.0 | 9.0 | 8.0 | 13.0 | 9.0 | 9.0 | 6.5 | 10.2 |
| La | 28.0 | 30.0 | 28.0 | 28.0 | 30.0 | 31.0 | 26.0 | 29.0 | 31.0 | 29.0 | 28.3 | 26.6 |
| Ce | 53.0 | 57.0 | 49.0 | 58.0 | 55.0 | 62.0 | 57.0 | 56.0 | 57.0 | 53.0 | 51.1 | 54.9 |
| Th | 5.0 | 6.0 | 4.0 | 5.0 | 4.0 | 6.0 | 6.0 | 5.0 | 4.0 | 5.0 | 5.5 | 6.9 |

| Map Number | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SampleID | 04PD6 | PD0508161557a | PD0508161457a | AD0508111855a | AD0508231132a | AD0508231225a | PD0508111721a | 04PD5 | T1009a | T1009b | 04PD9 |
| StationID | PD0409201901 | PD0508161557a | PD0508161457 | AD0508111855 | AD0508231132 | AD0508231225 | PD0508111721 | PD0409201226 | T1009 | T1009 | PD0409221220 |
| FlowUnit | Wapshilla Ridge | Wapshilla Ridge | Ortley | Downey Gulch | Downey Gulch | Downey Gulch | Wapshilla Ridge | Winter Water? | Wapshilla Ridge | Wapshilla Ridge | Wapshilla Ridge |
| SampleYear | 2005 | 2005 | 2005 | 2005 | 2005 | 2005 | 2005 | 2004 | 2001 | 2001 | 2004 |
| Major element oxides in percent (%) | | | | | | | | | | | |
| SiO2 | 54.90 | 56.22 | 54.81 | 54.71 | 54.80 | 55.32 | 55.39 | 55.36 | 55.20 | 55.24 | 54.20 |
| TiO2 | 2.34 | 2.41 | 2.04 | 2.20 | 2.16 | 2.20 | 2.39 | 2.04 | 2.15 | 2.16 | 2.32 |
| Al2O3 | 14.07 | 14.25 | 13.81 | 13.64 | 13.50 | 13.68 | 13.98 | 13.25 | 13.31 | 13.37 | 15.08 |
| FeO* | 10.50 | 8.82 | 10.61 | 11.33 | 11.88 | 10.86 | 10.31 | 12.11 | 12.74 | | 10.87 |
| MnO | 0.19 | 0.18 | 0.20 | 0.20 | 0.20 | 0.20 | 0.19 | 0.23 | 0.21 | 0.21 | 0.21 |
| MgO | 3.04 | 3.51 | 3.77 | 3.39 | 3.36 | 3.49 | 3.39 | 3.23 | 3.29 | | 3.39 |
| CaO | 7.27 | 7.22 | 7.68 | 7.21 | 7.00 | 7.09 | 7.04 | 6.90 | 7.03 | 7.06 | 7.31 |
| Na2O | 3.14 | 3.07 | 3.22 | 3.10 | 3.09 | 3.06 | 3.10 | 3.13 | 3.17 | 3.22 | 3.13 |
| K2O | 1.83 | 2.17 | 1.50 | 1.76 | 1.72 | 1.85 | 1.98 | 1.69 | 1.75 | 1.71 | 1.18 |
| P2O5 | 0.38 | 0.38 | 0.32 | 0.37 | 0.37 | 0.37 | 0.37 | 0.36 | 0.36 | 0.36 | 0.41 |
| Total | 97.66 | 98.22 | 97.95 | 97.92 | 98.08 | 98.12 | 98.15 | 98.29 | 99.21 | 99.29 | 98.11 |
| Trace elements, parts per million (ppm) | | | | | | | | | | | |
| Ni | 13.0 | 11.0 | 8.0 | 10.0 | 8.0 | 7.0 | 12.0 | 1.0 | 2.0 | 3.0 | 1.0 |
| Cr | 10.0 | 11.0 | 10.0 | 13.0 | 9.0 | 9.0 | 10.0 | 7.0 | 18.0 | 22.0 | 7.0 |
| Sc | 33.0 | 34.0 | 36.0 | 37.0 | 34.0 | 34.0 | 33.0 | 33.0 | 42.0 | 41.0 | 37.0 |
| V | 420.0 | 385.0 | 380.0 | 396.0 | 370.0 | 370.0 | 380.0 | 339.0 | 386.0 | 391.0 | 370.0 |
| Ba | 805.0 | 810.0 | 636.0 | 663.0 | 650.0 | 711.0 | 810.0 | 639.0 | 611.0 | 625.0 | 1296.0 |
| Rb | 46.0 | 56.0 | 39.0 | 50.0 | 50.0 | 50.0 | 55.0 | 47.0 | 49.0 | 48.0 | 27.0 |
| Sr | 347.0 | 344.0 | 317.0 | 312.0 | 307.0 | 323.0 | 328.0 | 298.0 | 295.0 | 297.0 | 338.0 |
| Zr | 186.0 | 202.0 | 175.0 | 176.0 | 178.0 | 181.0 | 199.0 | 175.0 | 180.0 | 177.0 | 201.0 |
| Y | 39.0 | 41.0 | 38.0 | 37.0 | 38.0 | 40.0 | 41.0 | 38.0 | 37.0 | 37.0 | 56.0 |
| Nb | 12.4 | 12.5 | 12.1 | 11.2 | 11.4 | 12.1 | 12.3 | 11.6 | 11.7 | 12.0 | 13.5 |
| Ga | 24.0 | 23.0 | 24.0 | 23.0 | 24.0 | 22.0 | 22.0 | 20.0 | 19.0 | 22.0 | 25.0 |
| Cu | 15.0 | 19.0 | 8.0 | 18.0 | 11.0 | 10.0 | 20.0 | 5.0 | 0.0 | 0.0 | 6.0 |
| Zn | 136.0 | 132.0 | 131.0 | 130.0 | 128.0 | 136.0 | 131.0 | 124.0 | 116.0 | 117.0 | 218.0 |
| Pb | 9.0 | 10.0 | 8.0 | 8.0 | 10.0 | 9.0 | 10.0 | 8.0 | 9.0 | 8.0 | 11.0 |
| La | 27.0 | 25.0 | 25.0 | 23.0 | 24.0 | 29.0 | 29.0 | 26.0 | 21.0 | 30.0 | 36.0 |
| Ce | 53.0 | 54.0 | 47.0 | 46.0 | 50.0 | 53.0 | 60.0 | 55.0 | 56.0 | 49.0 | 68.0 |
| Th | 5.0 | 7.0 | 4.0 | 4.0 | 5.0 | 4.0 | 6.0 | 6.0 | 8.0 | 9.0 | 7.0 |

* FeO less than 11% are likely weathered









# Preliminary Geologic Map of the Buxton 7.5' Quadrangle, Washington County, Oregon

By

Philip A. Dinterman and Alison R. Duvall

2009

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