# Geologic Map of the Cottonwood Quadrangle, Idaho County, Idaho

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2004

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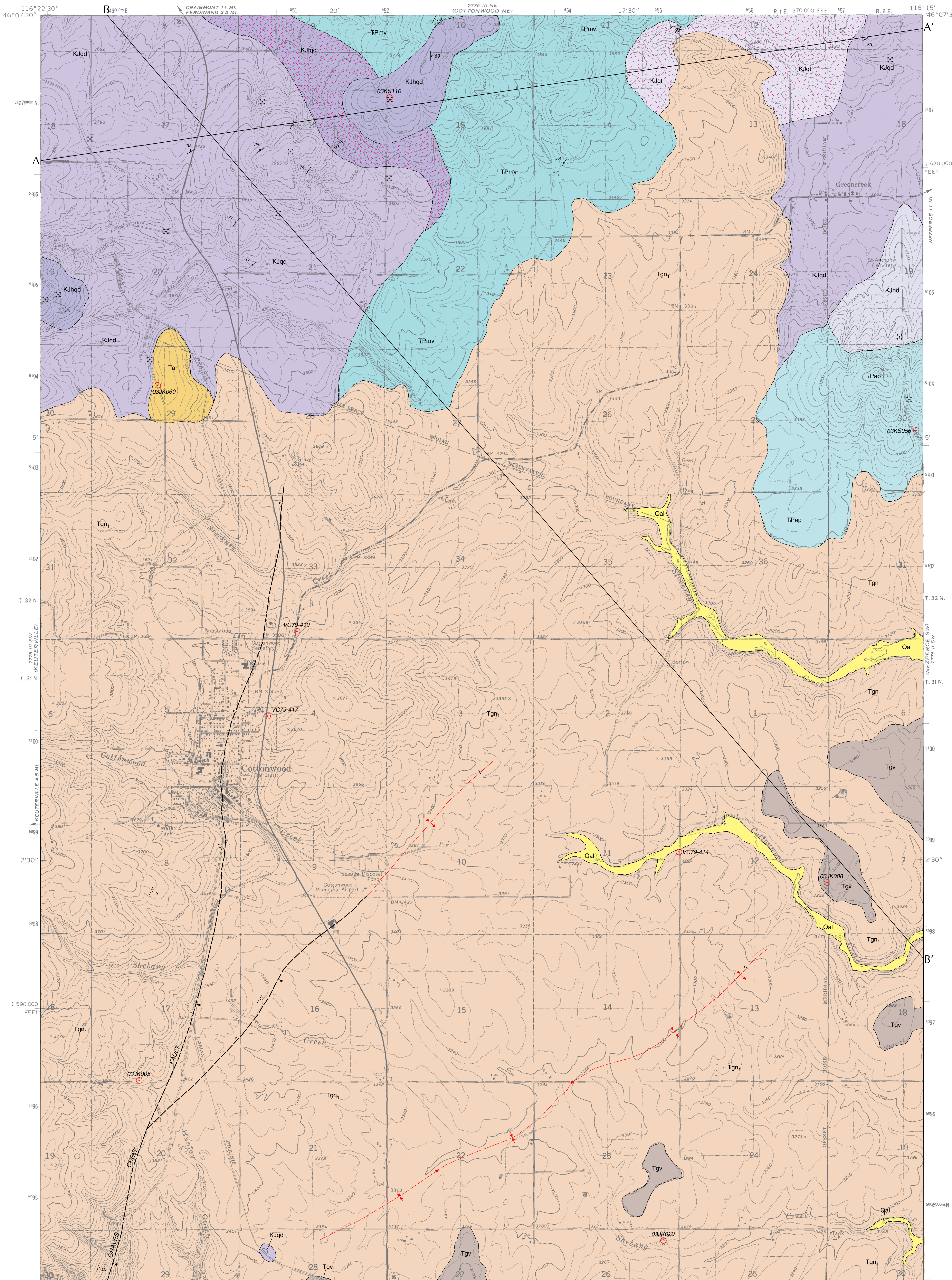
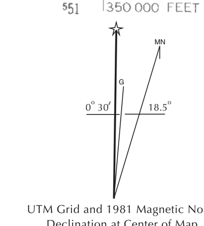
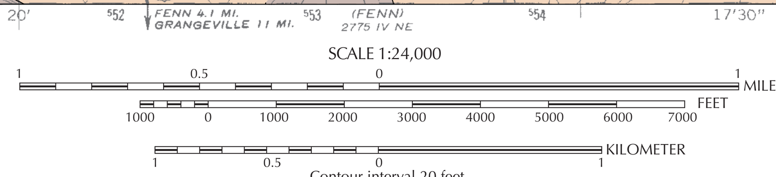


Base map from USGS digital raster graphic 1981.
Topography by photogrammetric methods from aerial photographs taken 1966. Field check 1967. Photorevised 1981.
1927 North American Datum.
Projection and 10,000-foot grid ticks: Idaho coordinate system, west zone.
1000-meter Universal Transverse Mercator grid ticks, zone 11.
National geodetic vertical datum of 1929.



UTM Grid and 1981 Magnetic North Declination at Center of Map

SCALE 1:24,000

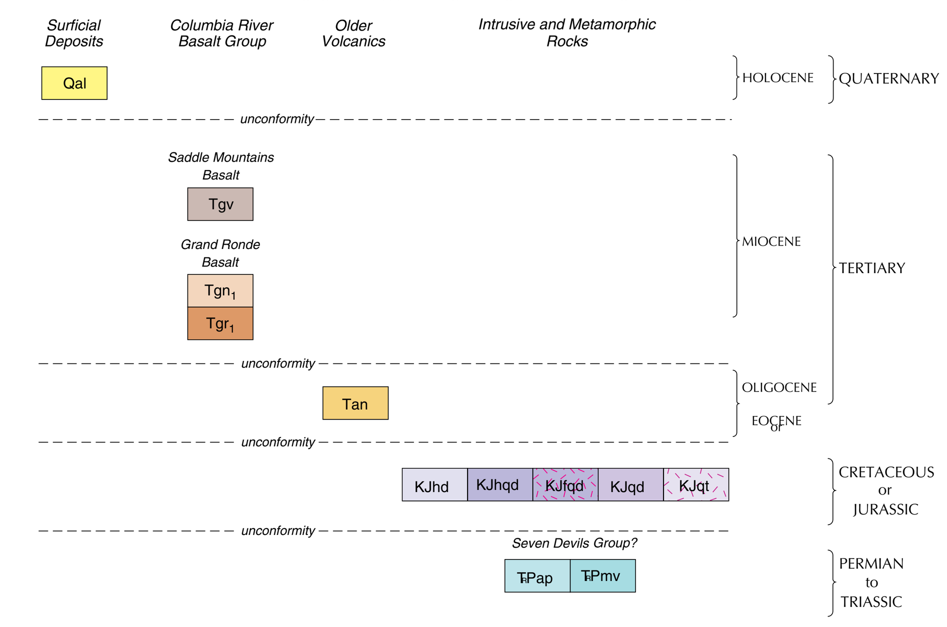


Contour interval 20 feet

QUADRANGLE LOCATION

Field work conducted 2002-2003.
This geologic map was funded in part by the USGS National Cooperative Geologic Mapping Program.
Digital cartography by Jesse S. Bird, Loudon R. Stanford, and Jane S. Freed at the Idaho Geological Survey's Digital Mapping Lab.
Map version 7-19-2004.

## CORRELATION OF MAP UNITS




## INTRODUCTION

The geologic map of the Cottonwood quadrangle depicts rock units exposed at the surface or underlying thin surficial cover of soil and colluvium. Thicker surficial deposits of alluvium and landslide debris are also depicted where they mask the underlying rock units. The map is the result of field work conducted in 2002 and 2003 by the authors. Basalt mapping relied considerably on reconnaissance mapping and sampling in the area from 1978 to 1980 (Camp, 1981; and Swanson and others, 1979a).

The quadrangle is underlain by Miocene basalt flows of the Columbia River Basalt Group, Eocene or Oligocene andesite of the Kamiah volcanics(?), Cretaceous(?) intrusive rocks, and Permian to Triassic(?) metavolcanics of the Seven Devils Group. The basalt flows flooded much the preexisting topography and filled ancestral drainages, leaving islands of older rocks protruding above the basalt surface. Structural warping of the basalt occurred both during and after emplacement, controlling the distribution of younger basalt units and the development of major streams. Basalt units were identified using hand sample characteristics, paleomagnetic signature, geochemical signature, and compilation of previous data.

Representative samples of most Columbia River basalt units and some older units were collected for analysis. These samples supplemented a previous sample set collected by V.E. Camp (written commun., 2002). Our sample locations and those of Camp are identified on the map. Analytical results of all samples are included in Table 1. All analyses were performed at Washington State University's GeoAnalytical Laboratory.

## DESCRIPTION OF MAP UNITS

### SURFICIAL DEPOSITS

Qal **Alluvial deposits (Holocene)**–Mostly stream alluvium but may include some slope-wash and fan deposits. Consists of sand and silt in low-gradient areas and contains cobbles in areas with higher gradients.

### COLUMBIA RIVER BASALT GROUP

The stratigraphic nomenclature for the Columbia River Basalt Group follows that of Swanson and others (1979b) and used in Reidel and Hooper (1989). In Idaho, the group is divided into four formations. From base upward, these are the Imnaha Basalt, Grande Ronde Basalt, Wanapum Basalt, and Saddle Mountains Basalt. Imnaha Basalt is not exposed on the quadrangle. Grande Ronde Basalt, from base upward, has been subdivided into the informal R1, N1, R2, and N2 magnetostratigraphic units (Swanson and others, 1979b). Of these, only basalt from the N1 unit is exposed in the map area, although some inconsistent fluxgate magnetometer readings on units near Cottonwood may indicate the presence of thin R2 basalt. Grande Ronde R1 is not exposed but is interpreted to underlie *Tgn1* throughout much of the quadrangle as shown in the cross sections. No Wanapum Basalt was found in the map area. The only Saddle Mountains Basalt unit identified in the map area is the Grangeville Member of Camp (1981). Interbedded sediments of the Latah Formation were found at a few isolated exposures too small to show at the map scale.

**Saddle Mountains Basalt**

Tgv **Grangeville Member (Miocene)**—Fine- to medium-grained, medium to dark gray basalt with common to abundant olivine grains 0.5-1 mm in diameter, and common to abundant plagioclase phenocrysts 1-2 mm long. Olivine is commonly weathered pale greenish to rusty tan or pink. Reverse magnetic polarity. One flow forms a thin cap on *Tgn1* in the southeast part of the quadrangle. Thickness probably does not exceed 50 feet.

**Grande Ronde Basalt**

$Tgn_1$ **Grande Ronde, N1 magnetostratigraphic unit (Miocene)**—Typically dense, dark gray to black, fine- to very fine-grained aphyric to microphyric basalt. Less commonly medium grained with scattered small plagioclase phenocrysts. Normal magnetic polarity. Inconsistent fluxgate magnetometer readings near Cottonwood may indicate the presence of thin R2 unit. Outcrops occur mainly in roadcuts, quarries, or along streams. Chemical analyses indicate several flows. Base of the sequence is not exposed. Invasive into sand and silt poorly exposed in an embankment near a playground at the southeast edge of Cottonwood (NE¼, NW¼, sec. 8, T31N, R1E).

$Tgr_1$ **Grande Ronde, R1 magnetostratigraphic unit (Miocene)**—Not exposed on the Cottonwood quadrangle but interpreted to underlie *Tgn1*. Shown only in cross section.

### OLDER VOLCANIC ROCKS

Tan **Andesite (Eocene or Oligocene)**—Poorly exposed in a roadcut north of Cottonwood. Rock is vesicular, suggesting origin as a volcanic flow rather than an intrusive unit. A sample from the outcrop (03JK060) has chemistry similar to andesite of the Kamiah volcanics found east of the Cottonwood quadrangle and southeast of Nezperce, although correlation over that distance is highly speculative.

### INTRUSIVE ROCKS

KJhd **Hornblende diorite (Jurassic or Cretaceous?)**—Strongly heterogeneous unit consisting of fine- to coarse-grained, equigranular to porphyritic, hornblende ± pyroxene diorite, gabbro, anorthositic gabbro, and gabbroic anorthosite. Hornblende and plagioclase typically 0.5-3.0 mm in length. Magnetite is common oxide mineral. Samples commonly contain up to 10 percent biotite and minor pyroxene(?). Fabrics are mostly massive with uncommon, weak igneous foliation.

KJhqd **Hornblende quartz diorite (Jurassic or Cretaceous?)**—Moderately heterogeneous unit consisting of mostly medium-grained, slightly plagioclase porphyritic, hornblende quartz diorite. Also occurs in both fine- and coarse-grained varieties, and ranges into tonalite compositions. Generally contains no observable fabric. Consists of 30-40 percent hornblende that occurs in clots up to 1 cm in size and approximately 55 percent plagioclase that occurs in subhedral to euhedral grains up to 6 mm in length. Quartz ranges from 15-25 percent and forms grains that are 0.5-4.0 mm in size. No potassium feldspar was observed. Small body on western map margin is notably leucocratic and consists of <10 percent hornblende and 30-35 percent quartz.

KJfqd **Fine-grained hornblende quartz diorite (Jurassic or Cretaceous?)**—Fine- to medium-grained, equigranular biotite-hornblende quartz diorite. Displays weak magmatic foliation. Contains 10-15 percent biotite ranging from 0.1-2.0 mm in length, 8-13 percent hornblende that reaches 2 mm in length, and 15-20 percent quartz occurring in grains 0.1- 1.0 mm in size. Plagioclase comprises approximately 60 percent of the rock and attains sizes of up to 4 mm. A few percent potassium feldspar and anhedral epidote occur in anhedral grains up to 2 mm in size.

KJqd **Biotite-hornblende quartz diorite (Jurassic or Cretaceous?)**—Medium-grained, equigranular, moderately foliated (both solid state and magmatic fabrics) biotite-hornblende quartz diorite. Contains 15-20 percent biotite that occurs in clots up to 8 mm in diameter, 10-15 percent hornblende that ranges from 1-5 mm in length, and 10-25 percent quartz 2 mm in size. Potassium feldspar is typically 2-3 percent, but is as much as percent in some samples. At one location north of Greencreek, a gradational margin was observed in which mafic quartz diorite containing approximately 40 percent hornblende and 5 percent quartz transitioned into normal quartz diorite across a distance of 200 m. Similar to quartz diorite farther north along the Clearwater River that has been dated by U/Pb SHRIMP zircon means at ~157 Ma (W.C. McClelland, written commun., 2002).

KJqt **Quartz-rich tonalite (Jurassic or Cretaceous?)**—Medium-grained, leucocratic, hornblende-bearing quartz-rich tonalite. No penetrative fabrics were observed. Consists of 1-8 percent anhedral hornblende less than 0.5 mm in size. Contains 40-45 percent quartz and 50-55 percent plagioclase that form a distinctive texture consisting of larger, irregularly shaped domains on the order of 5-10 mm in diameter that contain either quartz or feldspar and an interstitial subordinate domain that forms blebs and stringers of very fine-grained quartz + plagioclase intergrowths. Individual quartz and plagioclase crystals in the larger domains attain sizes of 0.5-1.5 mm; those in the interstitial domain are generally on the order of 0.2 mm or less in size. Selvages of fine-grained quartz commonly form around the larger plagioclase domains. Outcrops of this unit are generally very altered.

### SEVEN DEVILS GROUP(?)

TrPap **Plagioclase porphyritic andesite (Permian to Triassic?)**—Plagioclase, amphibole andesite porphyry occurring in dikes and other intrusive units as well as probable volcanic flows. Typically contains 10-40 percent phenocrysts of mostly plagioclase ranging from 0.5 mm to 2 cm in size with subordinate amphibole, which is less than 2 mm in length and is commonly replaced by actinolite. Groundmass is dark to medium gray and felty to trachytic. Unit commonly weathers greenish gray due to abundant chlorite and epidote as greenschist grade metamorphic minerals.

TrPmv **Metavolcanic rocks (Permian to Triassic?)**—Strongly heterogeneous unit of mostly volcanic protolith consisting of quartzo-feldspathic phyllite and schist, and uncommon amphibolite. The two most common lithologies of recognizable protolith include medium to light gray quartz plagioclase crystal lithic dacite(?) tuff and lava flows and medium to dark gray plagioclase porphyritic andesite(?). Dacite(?) includes 10-40 percent phenocrysts of quartz and plagioclase that vary in length from 0.5-8 mm in a medium to light gray groundmass. Uncommonly contains angular lithic fragments of mostly volcanic origin. Andesite(?) porphyry contains 10-30 percent plagioclase phenocrysts varying in length from 0.5 mm to 2 cm in dark gray, commonly felty groundmass. Unit commonly weathers greenish gray due to abundant chlorite and epidote as greenschist grade metamorphic minerals. Fabrics vary from schistose to mylonite. Tentatively correlated with similar rocks of the Seven Devils Group exposed in Hells Canyon (Vallier, 1977).

## SYMBOLS

Contact: Approximately located

Fault: Dashed where inferred or approximately located; bar and ball on downthrown side.

Fold axis.

Syncline.

Monocline: shorter arrow indicates steeper dip.

20 Approximate strike and dip of basalt flow.

85 Strike and dip of igneous foliation.

Strike of vertical igneous foliation.

65 Strike and dip of solid state foliation.

80 Strike and dip of mylonite foliation.

03JK005 Sample location and number.

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## ACKNOWLEDGMENTS

We thank the landowners who allowed access on their property. Will Oakley assisted with mapping of the basement-basalt contact. V.E. Camp kindly provided copies of his field maps and notebooks of the area, and gave permission to publish his sample analyses.

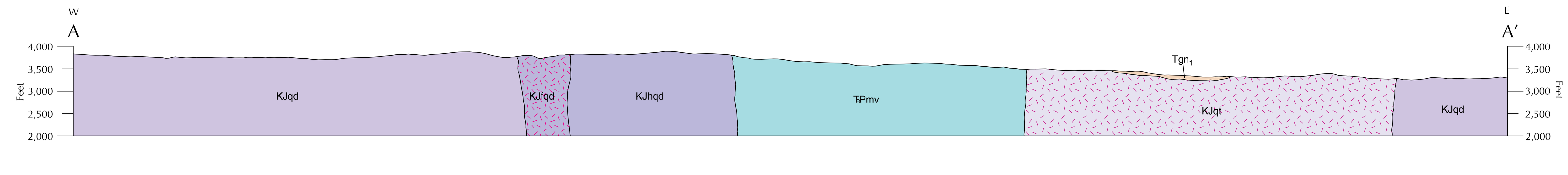
Table 1. Major oxide and trace element chemistry of basalt samples collected on the Cottonwood quadrangle.

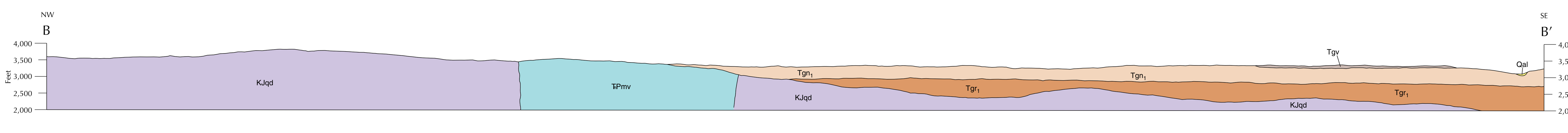
| | | | | | Normalized major elements in weight percent | | | | | | | | | | Unnormalized trace elements in parts per million | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample number | Latitude | Longitude | Unit name | Map unit | $SiO_2$ | $Al_2O_3$ | $TiO_3$ | FeO* | MnO | MgO | CaO | $K_2O$ | $Na_2O$ | $P_2O_5$ | Ni | Cr | Sc | V | Ba | Rb | Sr | Zr | Y | Nb | Ga | Cu | Zn | Pb | La | Ce | Th |
| 03JK005 | 46.01996 | -116.36101 | Grande Ronde $N_1$ | $Tgn_1$ | 54.68 | 14.43 | 2.073 | 11.21 | 0.197 | 4.46 | 8.22 | 1.22 | 3.19 | 0.315 | 9 | 25 | 37 | 373 | 528 | 27 | 337 | 158 | 34 | 11.5 | 25 | 22 | 119 | 7 | 22 | 27 | 0 |
| 03JK008 | 46.03947 | -116.26364 | Grangeville | Tgv | 53.51 | 15.53 | 1.382 | 8.90 | 0.149 | 6.26 | 10.87 | 0.68 | 2.55 | 0.168 | 31 | 130 | 37 | 225 | 350 | 16 | 254 | 131 | 28 | 14.3 | 16 | 57 | 77 | 5 | 25 | 51 | 3 |
| 03JK020 | 46.00418 | -116.28682 | Grande Ronde $N_1$ | $Tgn_1$ | 56.10 | 13.91 | 2.422 | 11.38 | 0.184 | 3.32 | 7.00 | 1.92 | 3.29 | 0.455 | 9 | 7 | 37 | 371 | 743 | 51 | 340 | 193 | 39 | 14.5 | 22 | 20 | 133 | 9 | 27 | 65 | 9 |
| 03JK060 | 46.08849 | -116.35844 | andesite, Kamiah volcanics ? | Tan | 60.42 | 16.58 | 2.938 | 5.92 | 0.067 | 1.43 | 6.07 | 2.33 | 3.68 | 0.555 | 10 | 0 | 38 | 395 | 1633 | 61 | 427 | 233 | 58 | 15.8 | 27 | 23 | 207 | 9 | 43 | 60 | 6 |
| 03KS056 | 46.08404 | -116.25098 | andesite porphyry | TrPap | 53.95 | 20.63 | 0.661 | 9.25 | 0.197 | 1.73 | 10.42 | 0.31 | 2.77 | 0.082 | 9 | 5 | 34 | 276 | 122 | 6 | 236 | 48 | 19 | 1.5 | 19 | 11 | 77 | 2 | 3 | 11 | 2 |
| 03KS110 | 46.11688 | -116.3256 | quartz diorite | KJhqd | 58.59 | 19.03 | 0.538 | 4.39 | 0.115 | 3.46 | 10.81 | 0.08 | 2.92 | 0.074 | 8 | 19 | 31 | 194 | 86 | 2 | 326 | 48 | 17 | 1.9 | 16 | 8 | 61 | 2 | 3 | 14 | 1 |
| **VC79-414 | 46.0425 | -116.2846 | Grande Ronde $N_1$ | $Tgn_1$ | 54.77 | 14.71 | 2.33 | 12.28 | 0.19 | 3.48 | 6.94 | 1.76 | 2.94 | 0.39 | | | | | | | | | | | | | | | | | |
| **VC79-417 | 46.05589 | -116.34298 | Grande Ronde $N_1$ | $Tgn_1$? | 57.34 | 15.34 | 2.51 | 9.17 | 0.16 | 3.06 | 6.63 | 1.94 | 3.22 | 0.41 | | | | | | | | | | | | | | | | | |
| **VC79-419 | 46.06424 | -116.33869 | Grande Ronde $N_1$ | $Tgn_1$? | 57.38 | 15.60 | 2.49 | 8.77 | 0.16 | 3.30 | 6.63 | 1.80 | 3.26 | 0.41 | | | | | | | | | | | | | | | | | |

* Major elements are normalized on a volatile-free basis, with total Fe expressed as FeO.

** Samples collected by V. Camp, 1978. Analytical results used with permission (Camp, written communication 2002).

Analyses performed at Washington State University GeoAnalytical Laboratory, Pullman, WA.

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