Geologic Map of the Kooskia Quadrangle, Idaho County, Idaho

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2006

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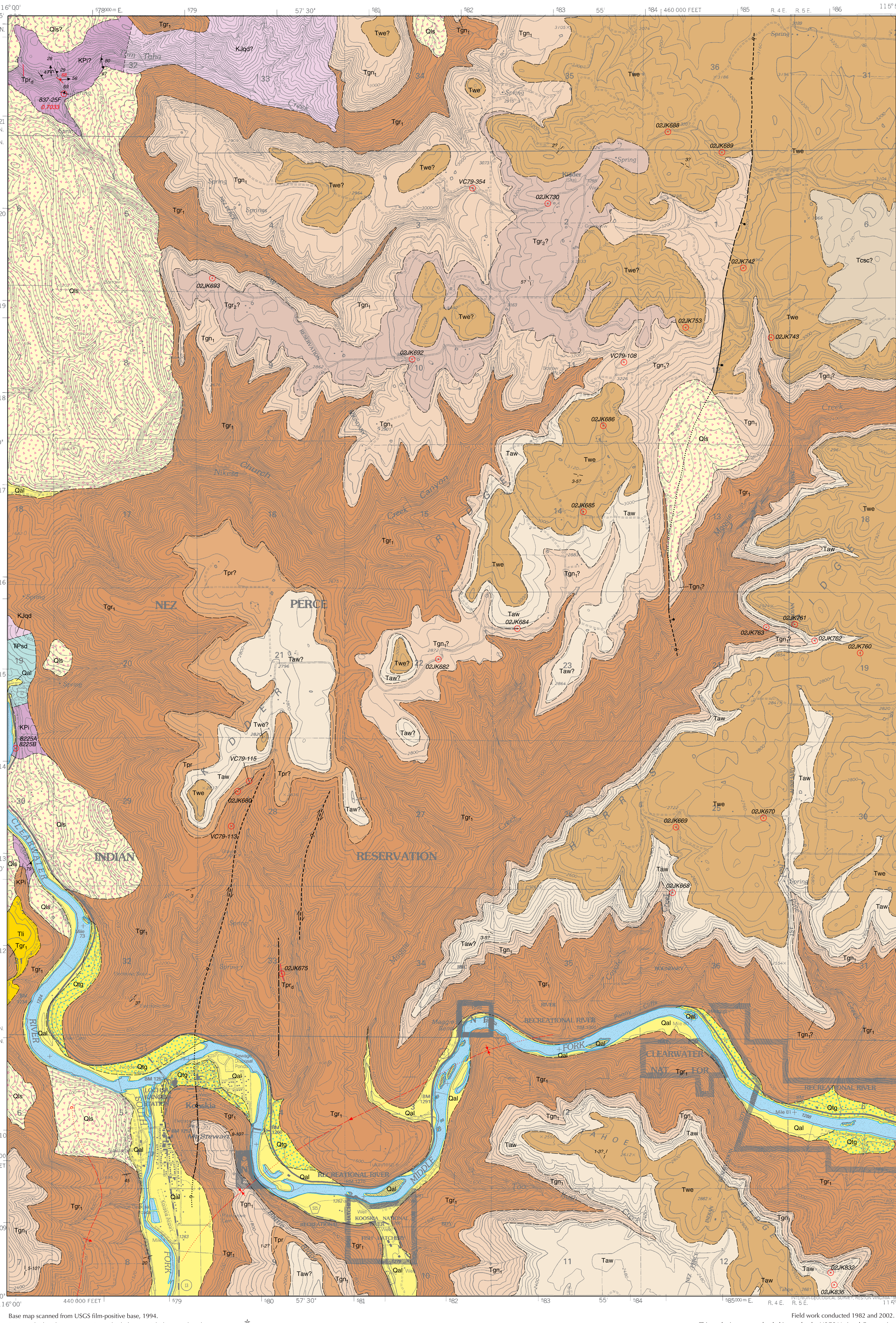


Base map scanned from USGS film-positive base, 1994.

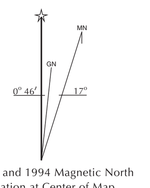
Topography by photogrammetric methods from aerial photographs taken 1963. Revised from aerial photographs taken 1990. Partial field check by US Forest Service 1994.

1927 North American Datum.

Projection and 10,000-foot grid ticks based on Idaho coordinate system, west zone.

1000-meter Universal Transverse Mercator grid ticks, zone 11.

National geodetic vertical datum of 1929.



UTM Grid and 1994 Magnetic North Declination at Center of Map

SCALE 1:24,000

Contour interval 40 feet
Supplementary contour interval 20 feet

QUADRANGLE LOCATION

Field work conducted 1982 and 2002.

This geologic map was funded in part by the USGS National Cooperative Geologic Mapping Program.

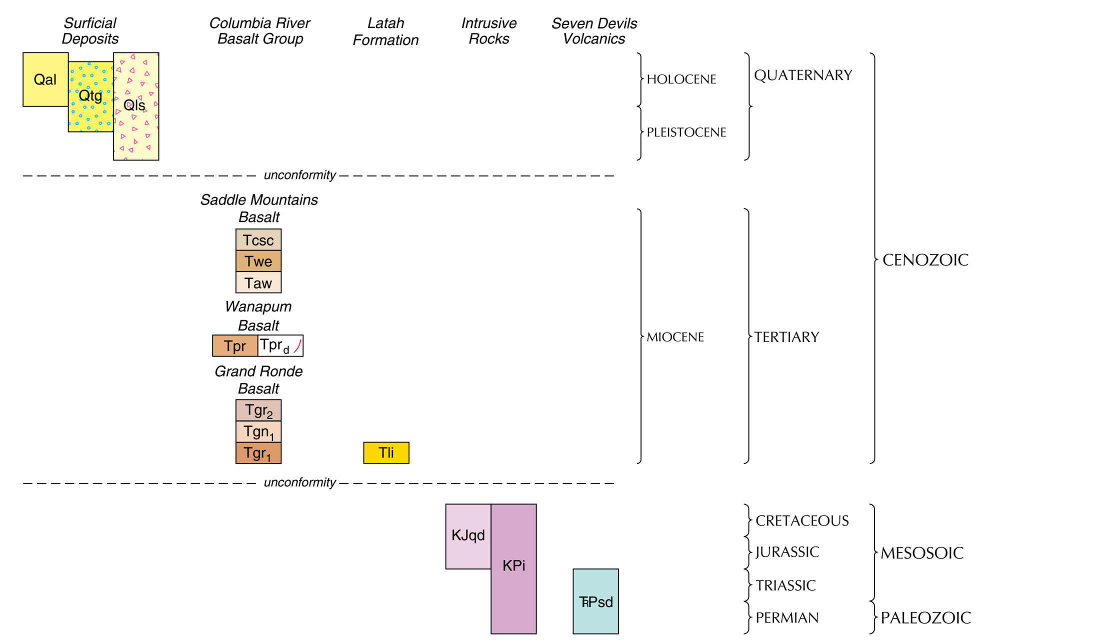
Digital cartography by B. Benjamin E. Studer, Jane S. Freed, and Loudon R. Stanford at the Idaho Geological Survey's Digital Mapping Lab.

Note on printing: The map is reproduced at a high resolution of 600 dots per inch. The inks are resistant to run but not to the fading caused by long-term exposure to light.

PDF map (Acrobat Reader) may be viewed at www.idahogeology.org.

Map version 5-30-2006.

CORRELATION OF MAP UNITS



INTRODUCTION

The geologic map of the Kooskia quadrangle is based largely on field work completed in the summer of 2002, but includes reconnaissance mapping of basement rocks by Paul Myers in 1982 and reconnaissance mapping and sampling of basalt units from 1978 to 1980 by V.E. Camp (Swanson and others, 1979a; Camp, 1981). Alluvial and landslide deposit descriptions were taken in part from Othberg and others (2003).

Intrusive rocks are classified according to IUGS nomenclature using normalized values of modal quartz (Q), alkali feldspar (A), and plagioclase (P) on a ternary diagram (Streckeisen, 1976). Mineral modifiers are listed in increasing order of abundance for both igneous and metamorphic rocks. Grain sizes of unconsolidated and consolidated sediments are classified on the Wentworth scale (Wentworth, 1922). Basalt units were identified using hand sample characteristics, paleomagnetic and geochemical signatures, and data from previous work (Swanson and others, 1979a; Camp, 1981). Representative samples of the basalt units were collected for chemical analysis. These samples supplemented previous ones collected by V.E. Camp (written commun., 2002). Our sample locations and those of Camp are identified on the map and analyses are listed in Table 1. Table 2 lists analyses of intrusive and metamorphic rocks. Basalt analyses were performed at Washington State University's GeoAnalytical Laboratory. Intrusive and metamorphic rocks were analyzed at Technical Services Laboratories, Mississauga, Ontario, Canada.

DESCRIPTION OF MAP UNITS

SURFICIAL DEPOSITS

Qal **Alluvial deposits (Holocene)**—Mostly stream alluvium but may include some slope-wash and fan deposits. Primarily coarse channel gravels deposited during high-energy stream flow. Subrounded to rounded pebbles, cobbles, and boulders in a sand matrix. Moderately stratified and sorted. Includes intercalated colluvium and debris-flow deposits from steep side slopes.

Qtg **Terrace gravel deposits (Pleistocene-Holocene)**—Mostly stream alluvium but may include some slope wash and fan deposits. Differs from *Qal* only in its location on terraces that are well above river level. Primarily coarse channel gravels deposited during high-energy stream flow. Subrounded to rounded pebbles, cobbles, and boulders in a sand matrix. Includes intercalated colluvium and debris-flow deposits from steep side slopes.

Qls **Landslide and slump deposits (Pleistocene to Holocene)**—Poorly sorted and poorly stratified angular basalt fragments mixed with silt and clay. Landslide deposits include debris slides as well as blocks of basalt and sedimentary interbeds that have been rotated and moved laterally. Commonly form as a result of slumping of Latah Formation sediments.

TERTIARY SEDIMENTS

Latah Formation

The Latah Formation consists of sediments associated with the Columbia River Basalt Group. Exposures were found only along the southwest edge of the quadrangle where coarse to fine arkosic sand is exposed in several embankments. The deposit appears to be an interbed within the R_1 Grande Ronde Basalt sequence. Other thin arkosic interbeds are indicated at several locations by granitic sand in the overburden. Stratigraphically equivalent to the Ellensburg Formation of Washington (Swanson and others, 1979b).

Tli **Latah Formation, sedimentary interbeds (Miocene)**—Sediment interbedded with basalt flows. The few exposures are composed of coarse to fine arkosic sand. On nearby quadrangles, the interbeds contain sediments ranging in size from cobble to silt.

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 oldest to youngest, these are the Imnaha Basalt, Grande Ronde Basalt, Wanapum Basalt, and Saddle Mountains Basalt. No Imnaha Basalt was found on the quadrangle, although a core hole drilled near the Kooskia National Fish Hatchery intersected a basalt with large plagioclase phenocrysts at a depth of about 700 feet, which is interpreted to be Imnaha Basalt (William C. Rember, oral commun., 2002). Grande Ronde Basalt, from oldest to youngest, has been subdivided into the informal R_1, N_1, R_2, and N_2 magnetostratigraphic units (Swanson and others, 1979b). Of these, basalts from the R_1, N_1, and possibly the R_2 units were identified in the map area. Exposures occur along the incised drainages of the Clearwater River, the South Fork Clearwater River, and their tributaries. The only Wanapum Basalt unit in the map area is the Priest Rapids Member on the ridge north of Kooskia and on Battle Ridge to the south. Saddle Mountains Basalt units, from oldest to youngest, are undivided flows of the Asotin Member and Wilbur Creek Member, the basalt of Weippe, and undivided flows of the basalt of Craigmont and basalt of Swamp Creek. Interbedded sediments of the Latah Formation occur at isolated exposures along the southwest edge of the quadrangle. Other interbedded sediments are indicated, generally beneath the *Taw* unit, by sand grains in the overburden, but none are exposed.

Saddle Mountains Basalt

Tcsc **Basalt of Craigmont and basalt of Swamp Creek, undivided (Miocene)**—Undifferentiated on the geologic map because of the similarity in chemical signatures, close physical association, and the scarcity of outcrops. May form a thin cap on *Twe* in northeast part of map. Unit descriptions below are from exposures on the Weippe North and Weippe South quadrangles.

Basalt of Craigmont—Fine- to medium-grained phyric basalt, common plagioclase phenocrysts 2-5 mm in length, rarely 7-10 mm long; scattered to uncommon olivine about 1 mm in diameter; some manganese(?) oxide cavity filling. Normal magnetic polarity, although some field magnetometer readings are inconsistent. Outcrops uncommon and generally poorly exposed. Probably consists of one flow 50-150 feet thick, possibly thicker locally. Commonly weathers to red-brown saprolite.

Basalt of Swamp Creek—Medium- to coarse-grained basalt with common plagioclase phenocrysts as long 10 mm and olivine phenocrysts a few millimeters in diameter. Normal magnetic polarity, although some field magnetometer readings are inconsistent. Probably fills structural and erosional depressions on older units. Thickness not determined, but probably less than 75 feet. Commonly weathers to red-orange or red-brown saprolite

Twe **Basalt of Weippe (Miocene)**—Medium- to coarse-grained plagioclase-phyric basalt. Abundant olivine crystals and clots, generally visible to the naked eye. Reverse magnetic polarity, although field magnetometer readings are commonly conflicting and weak. Chemically similar in both major oxide and trace elements to Pomona Member near Lewiston (Swanson and others, 1979a) and included in the Pomona Member by Camp (1981). Kauffman (2004) suggests the two units may not be coeval based on paleomagnetic directions, although a K/Ar age for the Weippe unit of 12.9 ± 0.8 Ma (Kauffman, 2004) is not significantly different from the 12 Ma K/Ar age reported for the Pomona Member by McKee and others (1977). Consists of one flow typically 100-150 feet thick, although may locally thicken to 200 feet or more. Commonly weathers to saprolite. Typically overlies *Taw* unit but may lie directly on Grande Ronde Basalt. Forms capping unit over much of the northern and eastern part of the quadrangle.

Taw **Asotin Member and Wilbur Creek Member, undivided (Miocene)**—Fine-grained basalt with scattered plagioclase phenocrysts 1-5 mm in length and a few olivine phenocrysts about 1 mm in diameter. Upper parts of flows commonly have abundant small spherical vesicles, many with a pale bluish coating. Both members have normal magnetic polarity. Consists of one to two flows with a total thickness of about 200 feet. Locally underlain by arkosic sediment too thin or too poorly exposed to depict at the map scale.

Wanapum Basalt

Tpr **Priest Rapids Member (Miocene)**—Dark gray, fine- to medium-grained basalt, dense to diktytaxitic, phyric with scattered equant crystals and laths of plagioclase as long as 5 mm and scattered to common olivine crystals 1-3 mm in diameter. Reverse magnetic polarity. Appears to fill a broad, shallow north-south- or northwest-trending trough developed on the Grande Ronde Basalt in the Kooskia-Stites area. One flow with a thickness of about 100 feet.

Tpr$_d$ **Basalt dikes of the Priest Rapids Member (Miocene)**—Fine-grained basalt dikes. Dike sampled 1 mile northeast of Kooskia in sec. 33 is chemically similar, though not identical, to Priest Rapids Member. The dike has higher SiO_2 and TiO_2 values and a lower FeO value (sample 02JK675, Table 1) than Camp's Priest Rapids sample (sample VC79-115, Table 1) taken about 1 mile north of the dike.

Grande Ronde Basalt

In the Kooskia area, separating the Grande Ronde Basalt into magnetostratigraphic units has proven difficult. Field magnetometer readings are commonly contradictory, inconclusive, or weak and inconsistent. Several locations on adjacent quadrangles, which were thought to be the N_1 unit because of consistent normal fluxgate magnetometer readings, have been determined to be reverse by laboratory analysis. Although Camp previously divided the Grande Ronde Basalt in this area into R_1, N_1, and R_2 units (Swanson and others, 1979a; Camp, 1981), his field notes commonly record inconsistent magnetic readings at many locations (Camp, written commun., 2001). Chemical signatures, while helpful in separating some Grande Ronde Basalt units, also tend to overlap between R_1, N_1 and R_2 units, all of which may be present in the area. Without detailed sampling of stratigraphic sections, in conjunction with laboratory paleomagnetic analysis of oriented samples, accurately determining Grande Ronde Basalt stratigraphy will remain questionable at best. We have attempted to separate magnetostratigraphic units by extrapolating from areas where we feel reasonably certain of the magnetic polarity or where chemistry supports our unit separation, but the contact between units is poorly constrained.

Tgr$_2$ **Grande Ronde Basalt, R_2 magnetostratigraphic unit (Miocene)**—Several samples collected in the quadrangle have chemistry indicative of the Grande Ronde R_2 unit (Table 1) and a small area of R_2 has previously been mapped north of Kooskia (Swanson and others, 1979a). Typically fine-grained, medium to dark gray sugary-textured basalt with a few scattered plagioclase phenocrysts 2-4 mm in length. Outcrops occur as large stubby columns 3-5 feet in diameter, or as smaller, blocky to hackly columns. Probably one or two flows with a total thickness of 100 feet or less. Sample 02JK693 is chemically comparable to the Wapshilla Ridge unit of Reidel and others (1989).

Tgn$_1$ **Grande Ronde Basalt, N_1 magnetostratigraphic unit (Miocene)**—Mostly fine-grained, dark gray to black, aphyric to plagioclase-microphyric basalt, although uppermost flows in some areas are medium gray and medium grained with a few plagioclase phenocrysts 2-5 mm in length, or fine grained but sugary textured and diktytaxitic in places. Normal magnetic polarity. Entablatures commonly form cliffs and colonnades form less pronounced ledges on canyon slopes. Interpreted to thin and thicken locally, possibly as a result of structural warping or, less likely, erosion on R_1. Mapped contacts with the overlying R_2 and underlying R_1 units are interpretative. Appears to be very thin or absent north of Kooskia, yet possibly as much as 400 feet thick in the Clear Creek drainage southeast of Kooskia on the adjacent Stites quadrangle. Consists of one to three flows with a maximum thickness on the Kooskia quadrangle about 200 feet.

Tgr$_1$ **Grande Ronde Basalt, R_1 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. Reverse magnetic polarity, although field magnetometer readings commonly inconsistent and weak, or contradictory. Consists of numerous flows ranging from about 50 feet to several hundred feet thick. Entablatures of thick flows or sequence of flows form cliffs several hundred feet high along canyon walls. Forms irregular contact with pre-Tertiary rocks in the west and northwest part of the quadrangle. Base of complete sequence not exposed. Appears to be 1,000-1,200 feet thick north of Kooskia.

INTRUSIVE ROCKS

KJqd **Quartz diorite (Jurassic or Cretaceous)**—Medium- to coarse-grained biotite-hornblende quartz diorite. May include some hornblende diorite or hornblende quartz diorite. Unit was mapped and sampled immediately north of the quadrangle and projected south to the upper part of Tom Taha Creek. Also includes a small area of quartz diorite on the west-central map boundary projected into the quadrangle from mapping in the adjacent Kamiah quadrangle.

KPi **Intrusive rocks, undivided (Permian? to Cretaceous?)**—Foliated intrusive complex consisting of a wide variety of rock types. Includes biotite tonalite, biotite-hornblende quartz diorite or diorite, and hornblende diorite. Overall more deformed than *KJqd*. Initial $^{87}Sr/^{86}Sr$ values are low (0.7033, sample 837-25F; Criss and Fleck, 1987). Also includes gneissic rocks that may be metasedimentary or metavolcanic units. Exposure along Highway 12 near the western map boundary is primarily biotite tonalite with abundant secondary epidote, but includes mafic schlieren or septa that may be deformed and metamorphosed mafic dikes. The tonalite has lenticular plagioclase and quartz grains that no longer reflect original igneous textures. A sample of this tonalite and an associated mafic schlieren were analyzed for major elements (Table 2).

SEVEN DEVILS GROUP(?)

TRPsd **Seven Devils Group (Permian to Triassic)**—Poorly exposed metavolcanic or metasedimentary rocks projected into the western part of the map from the adjoining Kamiah quadrangle (Kauffman and others, 2006).

SYMBOLS

Contact: dashed where approximately located.

Normal fault: dashed where approximately located; dotted where concealed; ball and bar on downthrown side.

Strike-slip fault: dashed where approximately located; dotted where concealed.

Fold axis: dashed where approximately located, dotted where concealed; arrow indicates plunge direction.

Syncline.

52 Strike and dip of foliation.

45 Strike and dip of basalt flows.

20 Strike and dip of basalt flows visually estimated from slope of upland surfaces or from flow boundaries on canyon walls.

65 Bearing and plunge of lineation, type unknown.

50 Bearing and plunge of small fold axis.

02RL802 Sample location and number.

0.7033 Initial $^{87}Sr/^{86}Sr$ ratio (from Criss and Fleck, 1987).

REFERENCES

Camp, V.E., 1981, Geologic studies of the Columbia Plateau: Part II: Upper Miocene basalt distribution, reflecting source locations, tectonism, and drainage history in the Clearwater embayment, Idaho: Geological Society of America Bulletin, Part I, v. 92, p. 669-678.

Criss, R.E., and R.J. Fleck, 1987, Petrogenesis, geochronology, and hydrothermal alteration systems of the northern Idaho batholith and adjacent areas based on $^{18}O/^{16}O$, D/H, $^{87}Sr/^{86}Sr$, and $^{40}Ar/^{39}Ar$ studies, *in* T.L. Vallier and H.C. Brooks, eds., Geology of the Blue Mountains Region of Oregon, Idaho, and Washington: U.S. Geological Survey Professional Paper 1436, p. 95-138.

Kauffman, J.D., 2004, Geologic map of the Gifford quadrangle, Nez Perce County, Idaho: Idaho Geological Survey Geologic Map 36, scale 1:24,000.

Kauffman, J.D., R.S. Lewis, and P.E. Myers 2006, Geologic map of the Kamiah quadrangle, Lewis and Idaho counties, Idaho: Idaho Geological Survey Geologic Map 42, scale 1:24,000.

McKee, E.H., D.A. Swanson, and T.L. Wright, 1977, Duration and volume of Columbia River Basalt volcanism, Washington, Oregon and Idaho [abs.]: Geological Society of America Abstracts with Programs, v. 9, no. 4, p. 463-464.

Othberg, K.L., D.W. Weisz, and R.M. Breckenridge, 2003, Surficial geologic map of the Kooskia quadrangle, Idaho County, Idaho: Idaho Geological Survey Digital Web Map 16, scale 1:24,000.

Reidel, S.P., and P.R. Hooper, eds., 1989, Volcanism and tectonism in the Columbia River flood-basalt province: Geological Society of America Special Paper 239, 386 p.

Reidel, S.P., T.L. Tolan, P.R. Hooper, M.H. Beeson, K.R. Fecht, R.D. Bentley, and J.L. Anderson, 1989, The Grande Ronde Basalt, Columbia River Basalt Group; stratigraphic descriptions and correlations in Washington, Oregon, and Idaho, *in* S.P. Reidel and P.R. Hooper, eds., Volcanism and Tectonism in the Columbia River Flood-Basalt Province: Geological Society of America Special Paper 239, p. 21-53.

Streckeisen, A., 1976, To each plutonic rock its proper name: Earth Science Reviews, v. 12, p. 1-33.

Swanson, D.A., J.L. Anderson, R.D. Bentley, G.R. Byerly, V.E. Camp, J.N. Gardner, and T.L. Wright, 1979a, Reconnaissance geologic map of the Columbia River Basalt Group in eastern Washington and northern Idaho: U.S. Geological Survey Open-File Report 79-1363, 26 p., sheet 9 of 12.

Swanson, D.A., T.L. Wright, P.R. Hooper, and R.D. Bentley, 1979b, Revisions in stratigraphic nomenclature of the Columbia River Basalt Group: U.S. Geological Survey Bulletin 1457-G, 59 p.

Wentworth, C.K., 1922, A scale of grade class terms for clastic sediments: Journal of Geology, v. 30, no. 5, p. 377-392.

ACKNOWLEDGMENTS

We thank the many landowners in the area for access to their property, and the Nez Perce Tribe for access to its land. We thank V.E. Camp for providing copies of his field notes and maps of the area, and for permission to publish his sample analyses. Review and comments by Stephen P. Reidel and William C. McClelland are greatly appreciated.

Table 1. Major oxide and trace element chemistry for basalt samples collected in the Kooskia quadrangle

Sample number	Latitude	Longitude	Unit name	Map unit	Major elements in weight percent: SiO_2	Al_2O_3	TiO_2	FeO*	MnO	CaO	MgO	K_2O	Na_2O	P_2O_5	Trace elements in parts per million: Ni	Cr	Sc	V	Ba	Rb	Sr	Zr	Y	Nb	Ga	Cu	Zn	Pb	La	Ce	Th
02JK668	46.1644	-115.9065	Asotin	Taw	49.86	16.30	1.459	10.27	0.157	11.09	7.95	0.40	2.32	0.187	121	268	31	235	258	4	249	111	26	9.7	18	84	80	4	19	37	3
02JK669	46.1708	-115.906	Weippe	Twe	50.21	15.19	1.776	11.60	0.199	11.07	7.08	0.25	2.42	0.208	39	79	38	288	233	2	248	125	31	13.6	19	70	94	2	28	29	2
02JK670	46.1717	-115.8937	Weippe	Twe	51.75	14.86	1.777	10.68	0.174	11.19	6.27	0.49	2.59	0.219	29	73	37	303	244	9	244	125	28	12.7	22	60	91	4	20	44	2
02JK675	46.1565	-115.9614	Priest Rapids dike?	Tpr?	52.17	13.65	4.162	12.13	0.195	9.37	3.34	1.37	2.72	0.890	8	40	45	466	660	33	320	238	57	20.9	24	23	177	8	30	62	5
02JK680	46.1743	-115.9676	Grande Ronde R1?	Tgr$_1$?	53.95	13.84	2.236	12.59	0.211	8.02	4.35	1.55	2.87	0.376	8	25	38	370	589	35	327	166	37	12.0	23	19	128	6	26	37	5
02JK682	46.1872	-115.9394	Grande Ronde N1?	Tgn$_1$?	55.60	14.35	2.294	10.69	0.185	8.07	3.86	1.57	3.02	0.373	8	28	44	374	756	35	344	170	60	13.0	22	18	142	5	27	43	8
02JK684	46.1902	-115.9283	Asotin	Taw	49.80	16.00	1.459	10.09	0.160	11.27	8.22	0.52	2.29	0.184	125	277	42	233	232	8	249	111	26	10.2	15	89	83	3	17	34	3
02JK685	46.2016	-115.919	Weippe	Twe	51.43	14.75	1.738	11.24	0.183	11.06	6.46	0.46	2.47	0.200	32	67	37	278	248	8	238	123	29	14.4	17	61	92	0	22	20	1
02JK686	46.21	-115.9162	Weippe	Twe	51.68	15.54	1.803	9.41	0.175	11.70	6.42	0.39	2.67	0.208	37	80	42	284	237	5	254	126	33	14.0	21	61	95	6	22	33	1
02JK688	46.2387	-115.9071	Weippe	Twe	51.02	15.12	1.802	11.22	0.190	10.87	6.76	0.40	2.39	0.219	37	72	42	279	255	7	237	126	28	12.2	18	62	95	3	13	33	5
02JK689	46.2367	-115.8995	Weippe	Twe	51.64	14.89	1.701	10.74	0.189	11.09	6.61	0.49	2.45	0.206	37	69	42	271	204	9	236	120	27	12.8	21	63	92	1	31	58	3
02JK692	46.2165	-115.9431	Grande Ronde R2?	Tgr$_2$?	55.41	14.83	2.386	10.33	0.165	7.92	3.83	1.58	3.15	0.394	9	31	45	377	681	32	358	178	42	13.2	24	19	134	9	17	46	1
02JK693	46.2244	-115.9712	Grande Ronde R2?	Tgr$_2$?	59.03	15.13	2.477	8.13	0.124	6.11	2.71	2.31	3.62	0.362	7	24	32	389	1069	62	360	229	47	16.5	27	15	131	10	30	70	5
02JK730	46.2317	-115.924	Grande Ronde R2?	Tgr$_2$?	56.91	14.34	2.396	10.81	0.170	6.72	3.01	1.99	3.30	0.349	6	21	34	372	852	47	336	216	41	16.8	22	14	134	12	12	54	7
02JK742	46.2254	-115.8965	Weippe	Twe	51.42	14.92	1.745	10.98	0.195	10.92	6.76	0.47	2.38	0.211	35	69	36	286	262	6	234	120	29	12.3	19	59	93	4	3	37	5
02JK743	46.2186	-115.8926	Weippe	Twe	51.46	14.67	1.679	10.82	0.192	11.00	6.95	0.51	2.52	0.200	37	69	40	273	205	9	230	117	27	13.5	16	67	95	2	17	35	3
02JK753	46.2196	-115.9046	Weippe	Twe	52.29	15.39	1.778	9.39	0.182	11.36	6.30	0.48	2.62	0.213	39	75	44	283	275	7	247	124	32	12.7	19	66	95	0	13	48	0
02JK760	46.1878	-115.8801	Weippe	Twe	52.20	15.10	1.790	10.63	0.174	10.83	6.18	0.47	2.40	0.222	34	71	42	294	246	8	237	123	33	12.7	16	65	98	3	13	26	3
02JK761	46.1906	-115.8893	Weippe	Twe	51.54	15.14	1.673	10.75	0.195	10.74	6.85	0.48	2.44	0.200	35	75	36	277	240	8	230	124	27	13.2	21	60	96	2	15	27	2
02JK762	46.189	-115.8865	Asotin	Taw	50.38	16.22	1.430	9.87	0.154	11.39	7.71	0.50	2.19	0.166	121	282	34	243	207	10	246	104	25	9.0	17	87	80	0	19	28	0
02JK763	46.1903	-115.8933	Grande Ronde N1?	Tgn$_1$	55.03	14.11	2.228	11.29	0.236	8.01	4.11	1.55	3.06	0.367	19	33	42	382	653	31	306	159	36	31.6	21	23	121	7	31	42	3
02JK832	46.1273	-115.8843	Asotin	Taw	50.85	16.42	1.466	9.81	0.153	11.34	7.15	0.46	2.18	0.176	125	282	35	249	232	9	252	108	30	9.2	15	78	83	1	21	38	2
02JK836	46.1261	-115.8838	Asotin	Taw	50.02	16.38	1.443	9.75	0.161	11.17	8.17	0.51	2.22	0.181	133	269	28	248	232	7	245	107	26	8.7	21	84	84	3	11	20	3
**VC79-108	46.2162	-115.9133	Grande Ronde R1?	Tgr$_1$?	53.76	14.93	2.19	12.62	0.21	7.80	3.93	1.50	2.51	0.34																	
**VC79-113	46.1709	-115.9685	Grande Ronde R1?	Tgr$_1$?	53.59	14.63	2.18	12.51	0.23	7.96	4.03	1.60	2.73	0.34																	
**VC79-115	46.1753	-115.966	Priest Rapids	Tpr	49.60	13.76	3.49	15.15	0.26	8.45	4.36	1.35	2.72	0.66																	
**VC79-354	46.2332	-115.9346	Grande Ronde N1?	Tgn$_1$?	53.87	14.86	2.15	12.52	0.27	7.70	4.11	1.54	2.43	0.34																	

* 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 commun., 2002). Analyses performed in 1978 at Washington State University GeoAnalytical Laboratory, Pullman, Washington.

All other analyses performed in 2002 at Washington State University GeoAnalytical Laboratory, Pullman, Washington.

Table 2. Major element chemistry for intrusive rock samples collected in the Kooskia quadrangle

Sample number	Latitude	Longitude	Map unit	Rock name	Major elements in weight percent: SiO_2	Al_2O_3	TiO_2	$FeTO_3$*	FeO	Fe_2O_3	MnO	CaO	MgO	K_2O	Na_2O	P_2O_5	LOI	Total
82025A	46.1784	-115.9988	KPi	Biotite tonalite	75.69	12.72	0.30	2.16	1.30	0.71	0.04	2.42	0.44	1.00	4.00	0.04	0.59	99.73
82025B	46.1784	-115.9988	KPi	Amphibolite inclusion	51.76	16.77	1.14	9.93	6.63	2.56	0.16	8.61	6.23	0.77	3.35	0.21	0.78	99.71

*Total Fe expressed as Fe_2O_3.

**LOI is loss on ignition.

Analyses performed at Technical Services Laboratories, Mississauga, Ontario, Canada.

Published and sold by the Idaho Geological Survey
University of Idaho, Moscow, Idaho 83844-3014