DIGITAL WEB MAP 101 **IDAHO GEOLOGICAL SURVEY** www.ldahoGeology.org GARWOOD AND OTHERS MOSCOW-BOISE-POCATELLO

Geologic Map of the White Bird Quadrangle, Idaho County, Idaho

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Base map scanned from USGS film positive, 1995.

Polyconic projection. 1927 North American Datum.

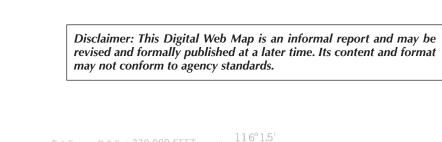
Shaded elevation from 10 meter DEM, vertically exagerated 2x. Topography by photogrammetric methods from aerial

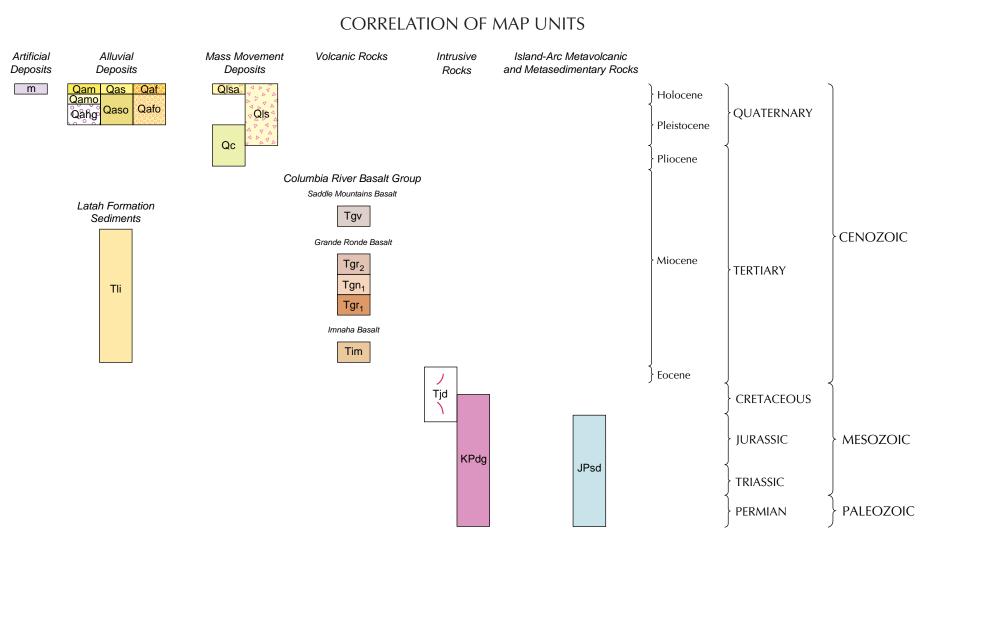
10,000-food grid ticks based on Idaho coordinate system, west

1000-meter Universal Transverse Mercator grid ticks, zone. 11. Declination at Center of Map

photographs taken 1961. Partial field check by U.S. Forest Service 1995.

Contour interval 40 feet





Landslide deposits (Holocene and Pleistocene)—Poorly sorted and poorly

and potentially less stable.

stratified angular basalt cobbles and boulders mixed with silt and clay.

Deposited by slumps, slides, and debris flows. In addition, the unit may

include the landslide scarp and the headwall (steep area adjacent to and

below the landslide scarp) from which material broke away (see Symbols).

Location of landslide deposits in steep canyons is typically controlled by

the presence of sedimentary interbeds and the interface between basalt

units and underlying basement rocks. In the White Bird basin, landslides

older than Qlsa above are also associated with the Latah Formation

sediments. In other areas, landslides range in age from ancient

movements that are relatively stable features to those that are more recent

Latah Formation Sediments

Sediments of the Latah Formation are stratigraphically equivalent to the

top of the White Bird grade within the Grande Ronde N₁, not far above

basalt of Grangeville, as do the fossiliferous lake sediments in the White

VOLCANIC ROCKS

Columbia River Basalt Group

The stratigraphic nomenclature for the Columbia River Basalt Group

follows that of Swanson and others (1979) and Camp (1981). In Idaho, the

group is divided into four formations. From oldest to youngest, these are

Imnaha Basalt, Grande Ronde Basalt, Wanapum Basalt, and Saddle

Mountains Basalt. Imnaha Basalt is exposed on the slopes of the Salmon

River canyon and along White Bird grade. Grande Ronde Basalt, from

oldest to youngest, has been subdivided into the informal R₁, N₁, R₂, and

N₂ magnetostratigraphic units (Swanson and others, 1979). Of these

units, flows of the R_1 , N_1 , and R_2 are exposed in the quadrangle. No

Wanapum Basalt occurs in the quadrangle. A single flow of Saddle

on the slumped lake sediments and associated sand and pebbles. Basalt

units were identified using hand sample characteristics, paleomagnetic

signatures, geochemical signatures, and compilation of previous data.

Representative samples of most basalt units were collected for chemical

analysis. Sample locations are identified on the map, and analytical

results are listed in Table 1. Samples were analyzed at Washington State

Basalt of Grangeville (Miocene)—Medium to dark gray, fine- to medium-

grained basalt with common plagioclase phenocrysts 1-4 mm in length

and scarce to common olivine phenocrysts generally <1 mm in diameter

that tend to weather pinkish or orangish. Reverse magnetic polarity as

determined in the field and the laboratory. Consists of one flow ranging

from 20-80 feet in thickness. Forms the capping unit on slumped lake

sediments in the National Historical Park and also occurs as thin, isolated

remnants along the lower segment of Free Use Road. Probably flowed into

the basin from the south, capping local stream sediments and at least part

of the lake sediments. Equivalent to the Grangeville Member of Camp

Grande Ronde Basalt, R₂ magnetostratigraphic unit (Miocene)—Medium

to dark gray, fine-grained basalt, commonly with a sugary texture.

Uncommon to common plagioclase phenocrysts 1-2 mm long. Reverse

magnetic polarity, although field magnetometer readings commonly give

weak normal or conflicting results, particularly near the top of the R₂

section. Unit consists of one to three or possibly four flows and thins from

north to south. It likely pinched out against the developing Mt. Idaho

structure. Maximum thickness is about 300 feet at the northwest edge of

Grande Ronde Basalt, N₁ magnetostratigraphic unit (Miocene)—Dark

gray, fine-grained generally aphyric to plagioclase microphyric basalt.

Normal magnetic polarity. Consists of four to six flows (possibly some

with multiple flow units) with a total thickness of about 600 feet. Well

exposed in the Salmon River canyon and along White Bird grade.

Individual flows range from 50 to 150 feet in thickness. Flows near the top

of the sequence are commonly 50-70 feet thick and typically sugary

textured with scarce small plagioclase phenocrysts 1-3 mm long. Flows

lower in the sequence are typically thicker, generally 100-200 feet. The

thick entablature flow at or near the base of Grande Ronde Basalt is

Grande Ronde Basalt, R₁ magnetostratigraphic unit (Miocene)—Mostly

dark gray, fine-grained aphyric to microphyric basalt. Very rare plagioclase

phenocrysts 2-4 mm long in one or more flows. Reverse magnetic

polarity, although flows near the R_1 - N_1 boundary commonly have

inconsistent and weak field magnetometer polarity readings; therefore,

themapped contact is poorly constrained. In general, the contact occurs

between the Johns Creek and Center Creek flows of Bond (1963), both of

which have thick, tiered entablatures and are commonly separated by

oneor two thin flows. Outcrop characteristics of flows are similar to those

in the N₁ Grande Ronde Basalt. Consists of about five to seven flows with

probably equivalent to the Johns Creek flow of Bond (1963).

(1981) and the Amphitheater flow of Bard (1978).

the quadrangle above Center Creek.

University's GeoAnalytical Laboratory.

Saddle Mountains Basalt

the N₁-R₁ contact. Sand and pebble deposits mostly occur beneath the

Ellensburg Formation in Washington (Swanson and others, 1979).

Sediments interbedded with basalt flows (Miocene)—Mostly silty sediments.

Table 1. Major oxide and trace element chemistry of samples collected in the White Bird quadrangle

c 1			Major elements in weight percent									Trace elements in parts per million																			
Sample number	Latitude	Longitude	Unit name	Map unit	SiO ₂	TiO ₂	Al_2O_3	FeO*	MnO	MgO	CaO	Na ₂ O	K ₂ O	P_2O_5	Ni	Cr	Sc	V	Ва	Rb S	ir 2	Zr	Y 1	Nb (Ga Cı	ı Zn	Pb	La	Се	Th	No
02RL800	45.78555	-116.27168	Basalt of Grangeville	Tgv	52.20	1.276	15.36	8.90	0.159	7.53	11.30	2.38	0.74	0.161	57	223	25	219	267	14 24	15 1	12	23 1	1.7	20 67	74	3	20	31	4	
06DG003	45.83366	-116.36833	Grande Ronde R_2	Tgr ₂	56.51	2.284	14.12	11.31	0.185	3.15	6.79	3.37	1.84	0.444	5	10	30	326	759	17 36	50 1	89	36 1	1.5	21 12	139	10	29	60	6	32
06DG004	45.83374	-116.36745	Grande Ronde R_2	Tgr ₂	56.52	2.297	14.64	12.12	0.140	2.44	6.33	3.50	1.57	0.441	8	11	33	341	775	39 33	36 1	96	55 1	1.5	22 23	150	8	28	48	6	30
06DG005	45.83207	-116.36594	Grande Ronde N ₁	Tgn ₁	55.68	2.217	14.10	11.93	0.187	3.28	7.00	3.57	1.59	0.438	11	10	34	359	764	38 32	23 1	90	42 1	1.2	21 16	135	7	26	52	4	34
06DG006	45.84318	-116.36347	Grande Ronde R ₂	Tgr ₂	54.15	2.296	13.80	13.02	0.211	3.93	7.71	3.08	1.38	0.426	11	18	35	367 (620	38 33	34 1	67	38 1	0.0	22 22	128	6	21	44	4	28
06DG008	45.84217	-116.36459	Grande Ronde R ₂	Tgr ₂	54.12	2.295	13.76	13.01	0.245	3.68	7.77	3.12	1.56	0.448	11	18	36	371	593	10 33	30 1	68	38 1	0.1	21 22	128	7	21	43	4	28
06DG009	45.84703	-116.36073	Grande Ronde N ₁	Tgn ₁	54.02	2.315	13.70	12.79	0.227	3.99	7.79	3.20	1.53	0.452	14	20	35	374 (602	35 33	32 1	65	37 1	0.9	20 22	130	6	22	45	4	26
07DG106	45.75481	-116.27532	Basalt of Grangeville	Tgv	52.46	1.299	15.52	9.07	0.161	7.32	10.99	2.34	0.68	0.171	62	225	33	231	280	14 24	10 1	17	24 1	0.3	16 67	80	1	19	38	2	20
07DG120	45.84329	-116.35197	Grande Ronde N ₁	Tgn ₁	55.60	2.159	13.73	12.48	0.211	3.41	6.92	3.49	1.57	0.421	12	11	33	357 (688	39 3	0 1	87	42 1	1.4	20 19	132	5	21	48	5	29
07DG121	45.84381	-116.35135	Grande Ronde R_2	Tgr ₂	55.54	2.162	13.72	12.52	0.198	3.38	6.93	3.52	1.60	0.427	12	10	33	359 (697	10 30	9 1	89	41 1	1.1	21 17	130	6	24	58	5	30
07DG127	45.85137	-116.35651	Grande Ronde R_2	Tgr_2	54.98	2.284	13.78	11.80	0.215	3.96	7.77	3.15	1.66	0.409	11	10	36	380 (671	38 33	30 1	73	40 1	1.1	20 19	132	5	21	46	5	20
07DG128	45.85009	-116.35731	Grande Ronde R ₂	Tgr ₂	54.09	2.336	13.75	12.72	0.225	3.93	7.87	3.01	1.61	0.462	14	18	36	377	584	36 33	35 1	67	39 9	9.7	19 23	130	5	21	49	6	27
07JK016	45.75423	-116.27872	Basalt of Grangeville	Tgv	53.16	1.349	15.24	9.01	0.174	6.57	11.12	2.42	0.79	0.165	44	145	33	233	295	16 24	14 1	27	24 1	2.1	17 54	80	3	19	36	4	18
07JK034	45.82903	-116.27606	Grande Ronde N_1	Tgn ₁	55.23	2.065	13.94	11.96	0.199	3.90	7.70	3.08	1.56	0.349	12	10	34	359	594	38 3	8 1	79	38 1	0.4	20 38	123	6	20	46	5	2.5
07JK035	45.82876	-116.27782	Grande Ronde R ₁	Tgr ₁	56.01	2.068	14.25	10.81	0.191	3.97	7.58	3.07	1.74	0.316	11	12	32	347 (667	17 3!	58 1	88	35 1	0.2	20 35	117	7	18	50	6	28
07JK076	45.78057	-116.31659	Imnaha	Tim	51.81	3.053	13.60	13.82	0.234	4.33	8.58	3.23	0.89	0.444	21	22	38	394	415	35 26	55 2	46	48 1	6.8	20 85	138	3	25	54	4	3:
07JK087	45.77493	-116.26951	Basalt of Grangeville	Tgv	52.66	1.290	15.25	10.19	0.285	6.22	10.84	2.39	0.72	0.161	47	145	34	232	490	15 24	17 1	21	23 1	1.6	16 64	79	2	19	35	4	19
07KS018	45.77685	-116.33117	Seven Devils Volcanics lithic tuff	₹Psd	73.08	0.427	13.87	4.18	0.300	0.66	0.61	6.34	0.44	0.105	0	4	14	66	178	6 10	9 9	90	33 1	.5	15 7	100	4	2	14	3	1
07RL518	45.78125	-116.35686	Seven Devils Volcanics basaltic andesite	₹Psd	52.65	1.460	16.30	11.38	0.191	4.76	8.49	3.34	1.24	0.195	18	32	42	407	257	25 23	33 1	00	39 1	.6	18 12	101	0	10	18	1	1.5

* Major elements are normalized on a volatile-free basis, with total Fe expressed as FeO. All analyses performed at Washington State University GeoAnalytical Laboratory, Pullman, Washington

INTRODUCTION

The geologic map of the White Bird quadrangle depicts rock units exposed at the surface or underlying thin surficial cover of soil and colluvium. Thicker surficial alluvial, colluvial, and landslide deposits are also shown where they mask or modify the underlying rock units or form significant mappable units. The plateau soils include loess parent material (Barker, 1982), but because loess deposits are thin, they are not included on this map. In addition to present channel deposits, the Salmon River alluvial deposits form terrace remnants of at least two older regimes of the river. The map is the result of our field work in 2006 and 2007 and the compilation of previous research, including that of Bond (1963) and reconnaissance mapping from 1978 to 1980 by Camp (1981) and Swanson and others (1981).

Much of the quadrangle is underlain by Miocene basalt flows of the Columbia River Basalt Group. Exposures of prebasalt rocks are restricted to the Salmon River canyon in the central part of the quadrangle and consist of Permian to Triassic island-arc rocks of the Seven Devils Group, which include metamorphosed volcanic flows and sediments, and Jurassic to Cretaceous intrusive rocks. The island-arc rocks were accreted to the North American continent during the Jurassic to Cretaceous. Folds and rocks were emplaced later, probably in the late Jurassic or Cretaceous.

DESCRIPTION OF MAP UNITS

In the following unit descriptions and later discussion of structure, we use the metric system for sizes of mineral or clast constituents of rock units. We use the English system for thickness and distance measurements to conform to those on the base map.

ARTIFICIAL DEPOSITS

Made ground (Holocene)-Artificial fills composed of excavated, transported, and emplaced construction materials of highly varying composition, but typically derived from local sources. Mostly fill along the U.S. 95 White

SEDIMENTARY AND MASS MOVEMENT DEPOSITS

Alluvial Deposits

inundated during flood discharge as recently as 1974 (Davis, 2001). The

low terraces were disrupted almost beyond recognition by hydraulic

Alluvium of the Salmon River (late Holocene)—Channel and flood-plain deposits that are part of the present river system. Two grain-size suites are typically present: coarse sand in thin shoreline deposits, and well-sorted and rounded pebble to boulder gravel in river bars and islands. Gravel includes clasts of basaltic, granitic, and metamorphic rocks. Low-terrace deposits occur as much as 20 feet above the river channel and were

Qamo Older alluvium of the Salmon River (early Holocene)—Primarily stratified sand and well-rounded pebble to boulder gravel of point-bar and terrace remnants above modern levels of the Salmon River. Gravel clast lithology similar to Qam. May be capped by thin loess and eolian sand. Height above present mean water level is about 40 feet. Interfingers with colluvium and alluvial-fan deposits at toe of canyon slope. Davis (2001) and Davis and others (2002) describe the alluvial deposits and eolian caps seen in pits dug for the research. Deposits of Mazama ash and

placer mining in the nineteenth century (see Symbols).

်လူ့ango Gravel of high terraces in the Salmon River canyon (late Pleistocene)—Stratified sand and well-rounded pebble to boulder gravel that form terrace remnants from 100 feet to 250 feet above present mean water level. Gravel clast lithology similar to Qam. Commonly capped by local colluvium, alluvial-fan deposits, or thin loess. Shown on map as

radiocarbon dating suggest an early Holocene age.

Qas Channel and flood-plain deposits of Salmon River tributaries (Holocene)—Primarily stratified and rounded pebble to boulder gravel in

White Bird Creek. Gravel clasts predominantly basalt. Qaso Older channel and flood-plain deposits of tributary streams (early Holocene to late Pleistocene)—Stratified and rounded pebble to boulder gravel in terrace remnants in the White Bird Creek valley. May be graded to older alluvium of the Salmon River (Qamo).

Qaf Alluvial-fan deposits (Holocene)—Crudely bedded, poorly sorted brown muddy gravel derived from basalt colluvium on steep canyon slopes. Gravel is composed of subangular and angular pebbles, cobbles, and boulders of basalt in a matrix of granules, sand, silt, and clay. May include beds of silt and sand reworked from loess and Mazama ash. Qafo Older alluvial-fan deposits (late Pleistocene to early Holocene)—Poorly

Mass Movement Deposits

lithology similar to Qaf.

This geologic map was funded in part by the National Park Service,

Digital cartography by Theresa A. Taylor and Jane S. Freed at the

on printing: The map is reproduced at a high resolution of 600

dots per inch. The inks are resistant to run and fading but will deteriorate with long-term exposure to light.

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Map version 9-5-2008.

www.idahogeology.org.

Idaho Geological Survey's Digital Mapping Lab.

PDF (Acrobat Reader) map may be viewed online at

Qc Colluvial deposits, undifferentiated (Pleistocene-Pliocene)—Poorly sorted and poorly stratified angular basalt cobbles and boulders mixed with silt and clay. Deposited by gravity movements of various sources, including ancient alluvial-fans and landslides. Surface weathered forming high clay content within a few feet in depth.

a maximum thickness of 800-900 feet. Deposits of active landslides (Holocene)—Slumps, slides, and debris flows of Miocene Latah Formation sediments in the White Bird basin, active as recently as the 1970s and potentially still active.

sorted gravel deposits of incised alluvial fan remnants. Texture and

Imnaha Basalt (Miocene)—Medium- to coarse-grained, sparsely to abundantly plagioclase-phyric basalt; olivine common; plagioclase phenocrysts generally 0.5-2 cm long but some as large as 3 cm. Normal magnetic polarity. Weathers to a sooty brown granular detritus. Commonly has well-developed fanning or irregular columns 1-2 feet in diameter. Maximum exposed thickness is about 600 feet on the ridge north of the confluence of the Salmon River and White Bird Creek.

INTRUSIVE ROCKS

TJd / Dacite dikes (Jurassic to Tertiary)—Aplitic and porphyritic dikes that intrude the diorite complex and the Seven Devils Group rocks. The porphyritic dikes are light to medium gray with conspicuous phenocrysts of white plagioclase laths as large as 4 mm set in a fine-grained groundmass. Biotite is present and locally pseudohexagonal. The dikes are resistant to

weathering and form light-colored talus.

Diorite complex (Permian to Cretaceous)—This composite intrusive body consists primarily of textural variations of diorite, but also includes small bodies of gabbro, quartz diorite, and felsic aplite dikes not shown on the map. The diorite is dark gray with light-colored plagioclase 1-3 mm long and black hornblende 2-5 mm long, giving the rock a mottled appearance. Samples typically contain a few percent quartz. Texture ranges from mostly medium grained to very fine grained in places, and the rock is locally mylonitized adjacent to the Hammer Creek thrust. The diorite weathers readily to a fine, dark brown soil. At several localities, including the area along the east side of the lower Salmon River between Soards Gulch and Owens Gulch, this complex contains notable migmatite textures in rocks that vary in composition from diorite to biotitehornblende quartz diorite, biotite tonalite, and trondhjemite. The migmatite is strongly banded at millimeter to centimeter scale and

ISLAND-ARC METASEDIMENTARY AND METAVOLCANIC ROCKS

Seven Devils Group

typically contains very weak solid-state fabric or no fabric.

Mountains Basalt, the basalt of Grangeville, occurs as thin remnants Seven Devils Group and younger rocks (Permian to Jurassic)—Red to gray within the White Bird basin, resting either on the Grande Ronde Basalt, or volcaniclastic, volcanic flow, and sedimentary rocks locally metamorphosed to greenschist facies. Composition ranges from basaltic andesite to rhyolite with as much as 15 percent quartz phenocrysts. The original nature of these rocks can be difficult to determine in the field. We suspect that the section exposed along the lower Salmon River between Hammer Creek and Pine Bar (north of the quadrangle) consists of two distinct packages of rocks: a lower package of porphyritic to phyric volcanic flow and intrusive (mostly sill) rocks and uncommon volcaniclastic rocks with clast size ranging from 2 to 10 mm. Compositions range from basaltic to andesitic. This sequence is commonly strongly metamorphosed to chlorite-rich greenstone. The lower package occurs in the northern part of the map near Shorts Bar and farther downstream, and it is lithologically similar to parts of the Triassic Wild

Sheep Creek Formation of Vallier (1977).

and contains the following lithologies: (1) Red to gray weathering, thickly bedded plagioclase ± amphibole ± quartz lithic tuffs and lava flow rocks of rhyolitic to basaltic andesite composition. At some localities, these rocks contain flattened pumice that clearly indicates a pyroclastic flow origin. Most outcrops of lithic volcanics, however, do not show clear textures indicating that clasts were pumice. Either these textures have been destroyed by diagenesis and mild metamorphism, or the volcanic part of the section is mostly lava flow in origin. (2) Medium- to thickbedded volcanic breccias and very immature epiclastic conglomerates with subangular to subrounded clasts, and graywackes, siltstones, and argillites with uncommon interbedded thin recrystallized limestone layers. One limestone was fossiliferous. Epiclastic conglomerates are mostly matrix supported and uncommonly clast supported. The clasts contain a mix of mostly porphyritic rock of volcanic or shallow intrusive origin that reach sizes of about 50 cm and coarse sand-size plagioclase and quartz crystals in a mud- to fine sand-sized matrix. Most of the exposures of the JPsd unit in the quadrangle belong to this upper package. The quartzbearing volcanics and epiclastic rocks of the upper stratigraphic package are similar in lithology to parts of the Permian Windy Ridge or Hunsaker Creek formations, or possibly to the Red tuff unit of White and Vallier (1994) at Pittsburgh Landing. Some or all of the rocks may not fit the described stratigraphy of the Wallowa Terrane in Hells Canyon and the Wallowa Mountains west of the White Bird quadrangle. South of the White Bird quadrangle, on the Slate Creek and Graves Point quadrangles, other lithologies appear in the section, including black argillites,

The upper package is considerably less metamorphosed, well-bedded,

STRUCTURE

conglomerates, and sandstones.

The structural history of this area is complex and long-lived. Rocks of the Seven Devils Group and associated intrusive units were modified by folding, faulting, and erosion before the eruption of the Miocene Columbia River Basalt Group. Postbasalt and synbasalt modification of all units by folding, faulting, and erosion adds to the complexity of the area.

PRE-MIOCENE STRUCTURES The main prebasalt structure is a north-northeast-trending zone of thrust faulting, which we name the Hammer Creek thrust, that extends across the quadrangle from southwest to northeast. Along the trace of the thrust, deeper and partially migmatized rocks of the diorite basement complex (KPdg) have been thrust west-northwest over footwall rocks of the Seven Devils Group. The upper package of the Seven Devils Group in the

plunging folds with amplitudes of hundreds of meters. Splays of the Hammer Creek thrust occur in rocks of the footwall both north and south of Hammer Creek Bar. Near Shorts Bar, this fault thrusts the lower package of island arc rocks westward over rocks of the upper package. The Hammer Creek thrust appears to be part of a major thrust fault system that

Cougar Creek basement intrusive complex northwestward over rocks assigned to the Jurassic Coon Hollow Formation. To the northeast near Grangeville, this structure is interpreted to merge with the Mt. Idaho fault zone, a mylonite shear zone that shows evidence for dextral-reverse oblique kinematics (Schmidt and others, 2007). North and south of the White Bird quadrangle, the Hammer Creek thrust splays disappear beneath tilted but unfaulted Columbia River Basalt Group units.

MIOCENE AND LATER STRUCTURES

Synbasalt and postbasalt structures reflect tilting, folding, and faulting.

The main fault that offsets basalt units is the White Bird fault, although it is

footwall has been deformed into open, shallowly south-southeast-

continues southwest of the map to Pittsburg Landing, where it is mapped

as the Klopton Creek thrust (White and Vallier, 1994), which places the

basin and to uplift of the Mt. Idaho structure northeast of the quadrangle (Schmidt and others, 2007). Major faults in the area may be in part related to reactivation along the Hammer Creek thrust system that started during the Miocene and likely continues to the present. Minor faults are interpreted as localized adjustments related to the major faults.

buried beneath landslide deposits for much of its length in the quadrangle. It extends from the head of Magpie Gulch on the northeast to the roadcut south of White Bird on Banner Ridge. Vertical displacement on the fault is estimated to be as much as 1,000 feet in White Bird basin; the relative sense of displacement is down-to-the-east. To the northeast, on the White Bird Hill quadrangle, the fault continues through Poe Saddle, bends to the northeast, and can be traced along the west slope of Chapman Creek and across White Bird Hill where the amount of displacement decreases and the relative sense of displacement changes. Farther northeast, the fault can be traced to the Grangeville area and is mapped as the Mt. Idaho fault (Schmidt and others, 2007). Preliminary reconnaissance indicates the White Bird fault probably continues to the south in the Slate Creek

Subsidiary to but closely associated with the White Bird fault is the White Bird Hill fault, which is aligned along the highway grade and exposed as sheared, brecciated basalt in several roadcuts. The White Bird Hill fault is likely a splay off the White Bird fault, beginning at about Poe Saddle on the north (just east of the quadrangle boundary) and probably merging with it again just south of the town of White Bird. Displacement on the White Bird Hill fault is also down-to-the-east, although the amount of

vertical displacement is probably less than 300 feet. We also propose an unnamed fault approximately parallel to and west of the Salmon River on the basis of the elevation of Grande Ronde-Imnaha contact east of the river and on the ridge west of the river in the south part of the quadrangle. East of the river near Giants Nose, the contact is at approximately 2,000 feet elevation, whereas on the ridge west of the river it is at approximately 3,800 feet elevation. To the north, this offset diminishes, and the elevation of the contact is about the same.

Other faults displacing the basalts are the northeast-trending Soards Gulch fault, three northwest-trending faults near Giants Nose on the ridge west of White Bird, and some minor faults east of White Bird. The Soards Gulch fault has approximately 300 feet of offset with down-to-the-southeast displacement. The three faults near Giants Nose have down-to-thenortheast displacement; maximum offset is about 100 feet. Soards Gulch fault appears to merge with either the unnamed fault described above or the Hammer Creek thrust. The Giants Nose faults appear to terminate against the Soards Gulch fault.

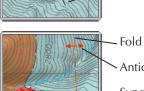
At least three stages of deformation have occurred in the area. In stage 1 deformation reverse movement on the Hammer Creek thrust and associated folding occurred in the Mesozoic before the eruption of the Columbia River Basalt Group. During this stage, rocks of the diorite basement complex (KPdg) were thrust west-northwest over footwall island arc rocks. Stage 2 deformation involved north-south compression that included folding and faulting of the Imnaha and Grande Ronde formations. This stage marks the onset of the Mt. Idaho uplift to the east and downwarping of the White Bird basin. The White Bird and White Bird Hill faults probably formed as oblique or strike-slip faults associated with the compressional activity during this period. These faults probably accommodated reverse movement on the Mt. Idaho structure to the east. After this stage, the White Bird Basin had started to form and began to fill with Latah Formation sediments. The basalt of Grangeville then flowed into the basin, capping local stream sediments and at least part of the lake sediments. In stage three deformation, east-west oriented extension was accommodated by north-south striking normal faults. These structures are part of the Neogene Basin and Range extensional province that continues well to the south into southeastern Oregon and Nevada. The White Bird and White Bird Hill faults were reactivated during this stage of deformation as normal faults rather than oblique or strike-slip faults.

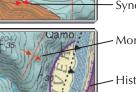
High-angle fractures on the White Bird Hill fault record left lateral strikeslip, whereas intermediate angle fractures record oblique normal and reverse slip (Jones, 2003). We interpret the strike-slip and reverse movement to be part of stage 2 deformation and the normal movement to be part of stage 3. Normal faults that cross into the footwall of the thrust fault in the map terminate rapidly to the north. Most of the normal deformation is restricted to the hanging wall of the Hammer Creek thrust. These relationships appear to indicate that the Hammer Creek thrust fault has been reactivated at depth during Neogene time and serves as a major detachment surface for extensional deformation to the south.

SYMBOLS

Contact: dashed where approximately located. Fault: bar and ball on downthrown side; dashed where approximately located; dotted where concealed. rust fault: dashed were approximately located; dotted where concealed; teeth on upper plate.

Strike and dip of volcanic flows. stimated strike and dip of volcanic flows.





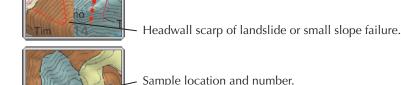
- Monocline; synclinal flexure; shorter arrow on steeper Historic hydraulic placer mining: Low-terrace placers of the Salmon River were extensively mined in the late 19th century using hydraulic methods. The line symbol is the upper limit of a mining disturbance zone that extends to the river shore. Although mostly removed, remnants of terraces mined are present as a subtle break in slope between the valley wall and the modern flood plain.



Strike and dip of foliation. Strike and dip of mylonitic foliation. Strike and dip of cleavage.



Bearing and plunge of lineation, type unknown Bearing and plunge of mylonitic lineation.



mple location and number.

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