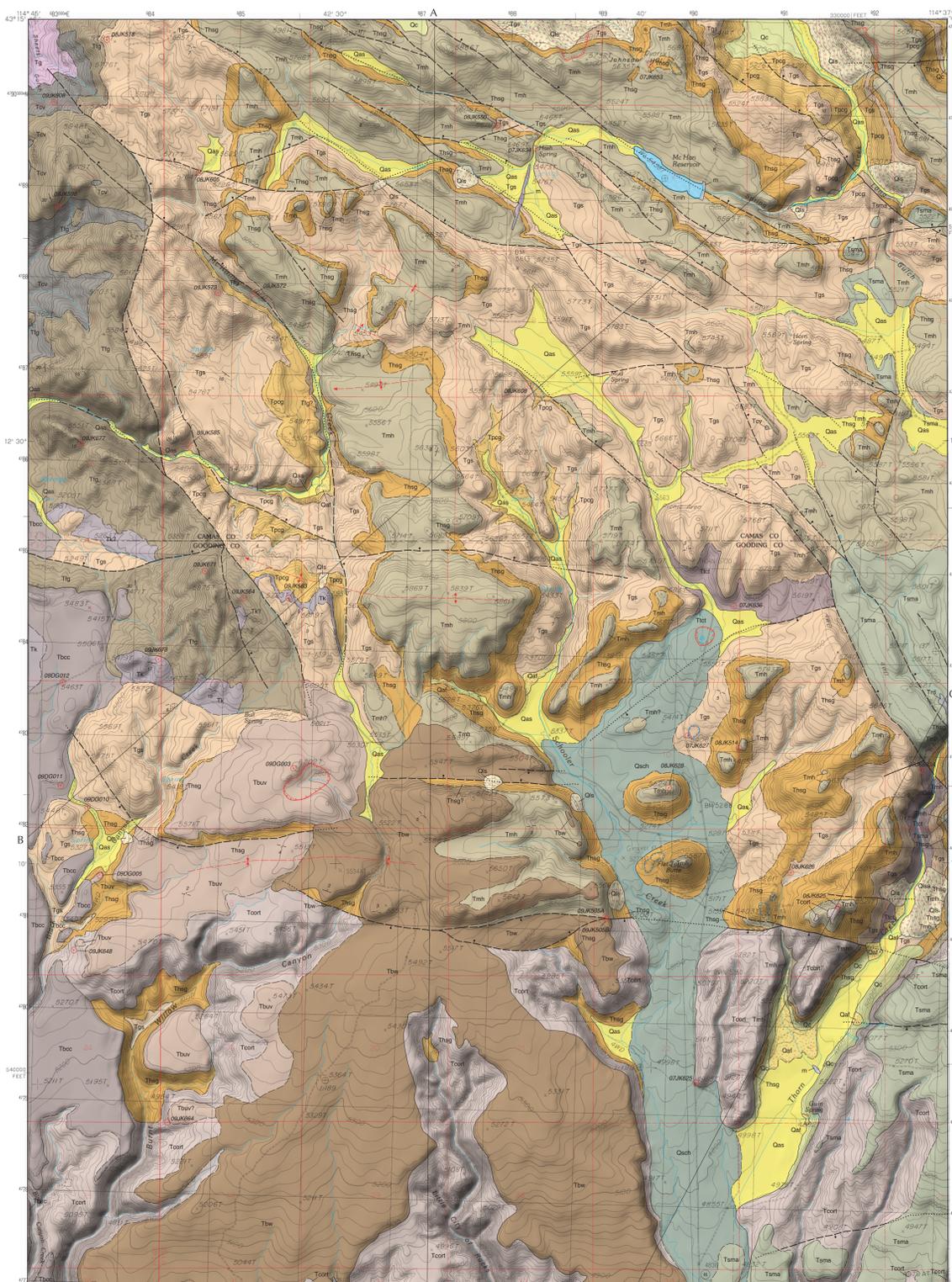
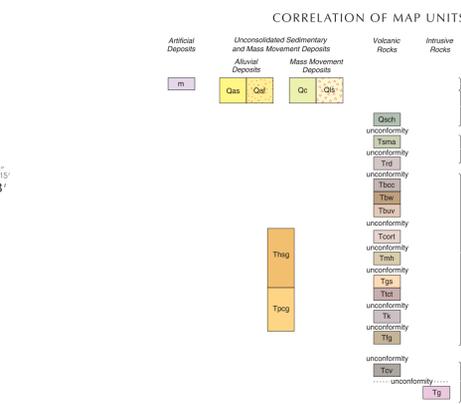
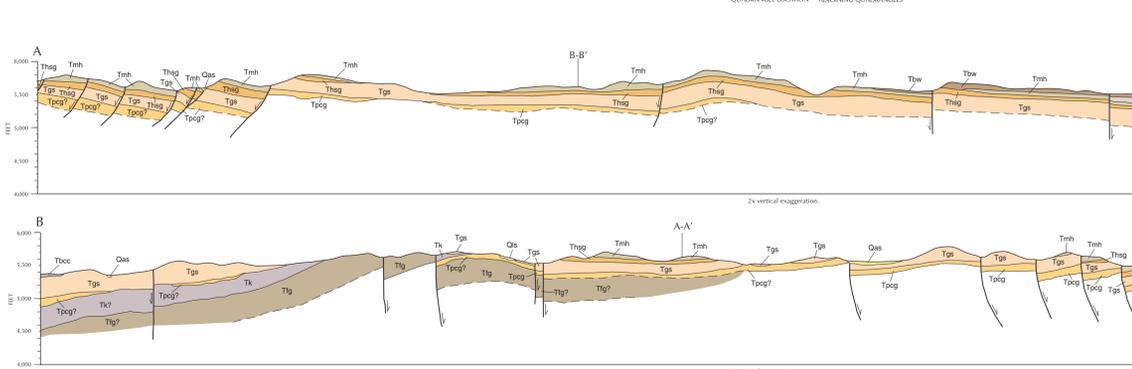


GEOLOGIC MAP OF THE McHAN RESERVOIR QUADRANGLE, CAMAS AND GOODING COUNTIES, IDAHO

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2010



Field work conducted 2007-2009. This geologic map was funded in part by the U.S. Geological Survey's National Cooperative Geologic Mapping Program, USGS Award No. G299AC0163. Digital cartography by Collette Catechis and Lisa S. Freed at the Idaho Geological Survey's Digital Mapping Lab. Map version 8.5-2010. PDF (Acrobat Reader) map may be viewed online at www.idahogeology.org.



INTRODUCTION

The geologic map of the McHan Reservoir quadrangle identifies rock units exposed at the surface or underlying thin surficial cover of soil and colluvium. Thicker surficial deposits are also shown where they modify the underlying rock units or form significant mappable units. The map is the result of field work conducted in 2007 to 2009 by the authors. Mapping by previous workers, noted below, was field checked and incorporated where appropriate. Soils information is from Case (1981) and Johnson (2002). Major oxide and trace element analyses of samples in the quadrangle were done at Washington State University's Geoanalytical Laboratory in Pullman, Washington; analytical results are listed in Table 1.

Previous work in the area includes that of Middle and others (1963), Smith (1966), Wolf and others (1991), Oakley (2006), Kauffman and Othberg (2008a), and Othberg and Kauffman (2009). Middle and others conducted regional reconnaissance mapping and established a regional stratigraphy. Smith mapped part of the eastern Mount Bennett Hills, which includes the quadrangle. Wolf and others mapped and compiled the geology of the Hasley 1.2 quadrangle, which also includes the quadrangle. To the south, Oakley mapped the Davis Mountain quadrangle, which has some of the same map units that occur in this quadrangle. Othberg and Kauffman mapped the adjacent Spring Creek Reservoir quadrangle to the north and Kauffman and Othberg mapped the Macon quadrangle to the northeast.

The quadrangle is in the Mt. Bennett Hills just south of the Camas Prairie, an extensional basin that is probably related to formation of the Snake River Plain (Kirkham, 1931; Cluer and Cluer, 1986). Tertiary granite and Eocene Chalk Volcanics diatitic rocks occur in the northwest corner of the map and underlie Miocene volcanic and sedimentary rock units, which cover most of the quadrangle. The volcanic rocks consist of rhyolite tuff, basalt, and andesitic sedimentary sand and gravel units are locally interbedded with the volcanic rocks. Northwest-trending faults in the northern half of the quadrangle have mostly down-to-the-north displacement and form southerly dipping fault blocks related to development of the Camas Prairie graben. West-trending faults in the south part of the map have down-to-the-south displacement and are likely related to development of the Snake River Plain. Quaternary basalt erupted from a vent in the east-central part of the quadrangle and flowed south down the Schoolee Creek drainage. Quaternary surficial deposits consist of alluvium in a few stream valleys, colluvium on slopes, and landslide deposits commonly related to the Miocene sedimentary units.

DESCRIPTION OF MAP UNITS

Made ground (Holocene)—Artificial fill composed of excavated, transported, and compacted construction materials typically derived locally. Primarily reservoir dam fills.

SEDIMENTARY AND MASS MOVEMENT DEPOSITS

Alluvial Deposits
Alluvium of side streams (Holocene and Pleistocene)—Moderate- to well-sorted stratified silty sand, coarse sand, and pebbly sand. Includes pebble-cobble gravel in stream channels, and surface clay 0.6-1.5 m thick in flat, poorly drained areas. Gravel clasts include subangular to subrounded tuff and basalt from local sources, and rounded granitic clasts reworked from Tertiary gravel. Thickness 1.5-10 m (3-30 feet) except in Thom Creek valley (Covin Spring Ranch) indicate 42 m (137 feet) of clay, sand, and gravel. Shaker valley fill formed after basalt of Schoolee Creek entered the drainage.

Alluvial-fan deposits (Holocene and Pleistocene)—Moderate- to well-sorted, crudely bedded, sand and pebble to boulder gravel.

Gravel of Hash Spring (Miocene)—Mostly unconsolidated, silty sand, and gravel irregularly covering Covin Spring tuff and unconformably overlain by McHan basalt. Thickens and thins, possibly on irregular surface of the tuff and also possibly partly eroded prior to emplacement of the basalt. Maximum thickness is about 60 m (200 feet). Gravel is subangular to well rounded and include Chalk Volcanics, granitic, Covin Spring tuff, and Pliocene sedimentary rock clasts in a sand and silt matrix. Deposits are typically poorly to moderately sorted. Many of the mapped landforms originate in these deposits or the Pole Coral gravel deposits described below. Equivalent to Hash Spring formation of Smith (1966) and upper Black Canyon and Burnt Willow Canyon, which include reworked sediments younger than the City of Rocks tuff eroded from nearby Hash Spring gravel deposits.

Gravel of Pole Coral (Miocene)—Mostly unconsolidated, poorly sorted, angular to subrounded pebbles and cobbles in a mostly coarse granitic sand matrix. Underlies the tuff of Covin Spring in the northeast and central part of the quadrangle; base and underlying units are not exposed. Pebble to cobble clasts are composed mostly of granitic rock and subordinate Chalk Volcanics fragments. Equivalent to Pole Coral gravel of Smith (1966).

Landslide deposits (Holocene and Pleistocene)—Poorly sorted and poorly stratified angular basalt cobbles and boulders mixed with silt and clay. Deposited by slumps, slides, and debris flows. Map may also show the landslide scarp and the headwall steep area adjacent to and below the landslide scarp from which material broke away (see Symbols).

Colluvium (Holocene and Pleistocene)—Primarily unsorted and unstratified silt to clayey sand and sandy pebble gravel; cobbles and boulders common in Thom Creek valley where unit includes talus. Forms foot slopes of steep escarpments mostly stabilized by vegetation. Deposited by sheet wash, creep, and rock fall.

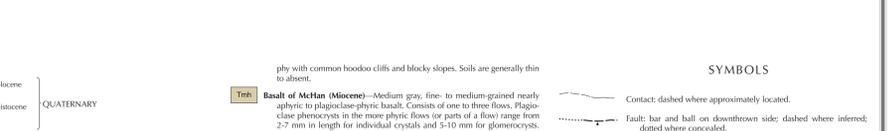
VOLCANIC ROCKS

Basalt of Schoolee Creek (Pliocene)—Fine-grained dark gray, vesicular to scoriaceous basalt with a microcline texture of small plagioclase crystals and scattered abundant fresh grains <1.4 mm. Remnant magnetic polarity normal, as determined in the field. Shallow circular depression near the junction of Highway 46 and Thom Creek Reservoir 46 is likely source. Flowed south down Schoolee Creek drainage and extended well beyond the south edge of the quadrangle. Stream drainage is moderately well developed. Remnants of pressure ridges and variations in soil characteristics form a pattern of mounds visible on air photos. The mounds are composed of silty clay 1.2-1.8 m (4-6 feet) thick that buries a well-developed soil caliche (durpan). Between mounds, the basalt is at or near the surface.

Andesite of Square Mountain (Pliocene)—Fine-grained andesite with abundant plagioclase phenocrysts and common quartz and plagioclase xenocrysts. Dark gray to black glassy groundmass in upper part of unit; greenish gray groundmass in phly zones. Remnant magnetic polarity inconclusive, but probably reverse; both normal and reverse readings were obtained in the field. Occurs along the east edge of the quadrangle where it overlies McHan basalt. Hash Spring sediments, rhyolite-diatite unit, or City of Rocks tuff. Probably flowed into the area from the northeast onto an eroded surface. Samples just in the upper part of the andesite form the total alkali-silica diagram of Le Maitre (1984). Equivalent to the Square Mountain ferratite of Honjo (1986) and Honjo and Leeman (1987), the

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Basalt of McHan (Miocene)—Medium gray, fine- to medium-grained finely platy to plagioclase-phyric basalt. Consists of one to three flows. Nearly all phenocrysts are euhedral prisms or plates of a few grains ranging 2.7 mm in length for individual crystals and 5-10 mm for glomerocrysts. Olivine uncommon and typically <1 mm. Remnant magnetic polarity is probably reverse, although both normal, reverse, inconclusive, or inclination sensitive readings were obtained in the field. Thickness ranges from 10 to 50 feet to as much as 100 to 100 feet. Unconformably overlies Hash Spring sediments or Covin Spring tuff where the sediments are absent. Underlies a thin vitrophyric cap of City of Rocks tuff north of the Thom Creek fault and underlies City of Rocks tuff basal vitrophyric cap to the south. Equivalent to McHan basalt of Smith (1966). Pinches out to the southwest. Oakley (2006) mapped "basalt of McHan" as equivalent to Smith's McHan basalt; however the chemical composition of samples we collected near the McHan Reservoir (see which Smith named the unit) are somewhat different than that reported by Oakley. We were unable to trace the basalt farther west than McKinney Creek, also indicating Oakley's McHan basalt may be a separate unit. Honjo and others (1986) report a K-Ar age of 6.4 ± 0.1 Ma. Forms the capping unit on much of the fault-block ridge and valley topography in the northeast part of the map.

Tuff of Covin Spring (Miocene)—Light purplish to pinkish gray to tan crystalline rhyolite tuff. Lithophysical cavities present at one or more horizons and platy partings common. Folded flow layering locally common. Underlies Hash Spring sediments or McHan basalt and overlies Pole Coral gravel in the northeast corner and central part of the map. In Thom Creek canyon, it underlies Hash Spring sediments and directly overlies tuff of Thom Creek. Oakley (2006) reports normal polarity for this tuff of Covin Spring, although our tests produced both normal and reverse magnetometer readings in the field. Thickness varies from less than 15 m (50 feet) to as much as 100 m (300 feet) as the result of either original emplacement characteristics, deposition on an irregular surface, erosion after deposition, or a combination thereof. Gray to black vitrophyric at top; unit is typically poorly exposed and commonly absent or eroded. According to Oakley (2006), age is based on 10 overlying 9.4 Ma McHan basalt and underlying 10.1 Ma tuff of Thom Creek in the Davis Mountain quadrangle to the southwest. Equivalent to Covin Spring formation of Smith (1966), who named it a spring near the mouth of Thom Creek canyon, although the exposures of the tuff are north of the spring; the spring actually issues from the base of the City of Rocks tuff. Chemical composition of our samples (Table 1) closely matches composition reported by Smith (1966). As noted below, the tuff of Fir Grove description, the Covin Spring tuff and Fir Grove tuff are nearly identical in appearance and stratigraphic position. We use the term "Covin Spring" stratigraphic marker units. Forms fault-block ridge and valley topography with common ledges and rhyolite slopes. Soils are generally thin to absent.

Tuff of Thom Creek (Miocene)—Pinkish gray, brownish gray to gray crystalline rhyolite tuff. In Thom Creek, black vitrophyric at top; unit directly underlies and appears to be conformable, or nearly so, with the Covin Spring tuff. Thickness is at least 60 m (200 feet); base is not exposed. Equivalent to tuff of knob of Smith (1966). Rhyolite in the northeast corner of Thom Creek canyon at the east margin of the quadrangle; but extends east to Magic Reservoir. Included in the Moonstone rhyolite by Schmidt (1961) and Leeman (1982). Equivalent to rhyolite of Magic Reservoir (Tm unit) of Honjo (1986) and quartz latite of Magic Reservoir (Tm unit) of Wolf and others (1991). Samples just near the diatitic rhyolite boundary of total alkali versus silica classification (Le Maitre, 1984). Honjo (1986) reports a K-Ar age of 2.2 Ma for the Tm unit. Stübenacker and others (1982) report a K-Ar age of 5.8 Ma for their "older rhyolite" at the north end of Magic Reservoir, which we believe is equivalent to the Tm unit. Kauffman and Othberg (2008b) report a low confidence "A₀A₁" age of about 4.22 Ma. As noted in the Square Mountain andesite description above, Tm is overlain by a 4.84 Ma tuff of Nason Creek. Therefore, we believe the 5.8 Ma age for Tm is the more reasonable.

Basalt of Black Canyon Creek (Miocene)—Moderate to abundantly plagioclase-phyric basalt. Covin Spring tuff in the upper part of black Canyon Creek and City of Rocks tuff in the lower part. Characterized by high TiO₂ (>3.0 wt. %) and FeO (>13 wt. %). Remnant magnetic polarity is probably reverse, although both normal, reverse, and inconclusive readings were obtained in the field. Thickness varies from less than 10 m (30 feet) to about 30 m (100 feet) at the west edge of the quadrangle where it likely fills a channel eroded in the City of Rocks tuff. Equivalent to Black Canyon Creek basalt (Tbc) of Kauffman and Othberg (2008b). This basalt is also very similar to that reported for the Ficalco tuff in the Magic Reservoir East quadrangle (Kauffman and Othberg, 2007). Oakley (2006) reports reverse magnetic polarity; however, we had normal, reverse, and inconclusive polarity readings in the field. Honjo (2006) reports an "A₀A₁" age from the Davis Mountain quadrangle of 11.7 ± 0.08 Ma. However, Smith (1966) mapped this unit as younger than the tuff of Covin Spring. Oakley (2006) concurred from stratigraphic evidence that it was older. We concur with Oakley's stratigraphy on the basis of the chemical composition and our present mapping, but noted relationship with the Covin Spring tuff is locally ambiguous, as noted below.

Basalt of Burnt Willow Canyon (Miocene)—Moderate to abundantly olivine-phyric basalt. Olivine is typically aligned to amber in matrix and commonly occurs as irregular 3.8 mm clasts. Physically and chemically distinct (Table 1) from plagioclase-rich basalt of unnamed vent (Tbv) and Black Canyon Creek basalt (Tbc). Characterized by low TiO₂ (<1.1 wt. %), FeO (<10 wt. %), and Fe₂O₃ (<0.7 wt. %), and high MgO (>8.5 wt. %), CaO (>12 wt. %), and Cr (<150 ppm). Remnant magnetic polarity is reverse, as determined in the field. Samples checked gave consistent moderate to strong reverse polarity readings. Source uncertain, but may have erupted along an east-trending fault west of Schoolee Creek. Caps McHan basalt and City of Rocks tuff. Thickness varies but typically less than 15 m (50 feet). Thickens and thins locally on City of Rocks tuff, where it forms thin rock from Schoolee Creek to Burnt Willow Canyon. Age uncertain but probably younger than Fir Grove unit. Previously included in Burnt Willow basalt by Smith (1966). Stream drainage is moderately well developed. Clay-rich cobble soils bury a well-developed soil caliche (durpan) formed on basalt. Variations in soil characteristics form a pattern of mounds visible on air photos, but the patterned ground is less well developed compared to that formed on tuff.

Basalt of Burnt Willow Canyon (Miocene)—Moderate to abundantly olivine-phyric basalt. Olivine is typically aligned to amber in matrix and commonly occurs as irregular 3.8 mm clasts. Physically and chemically distinct (Table 1) from plagioclase-rich basalt of unnamed vent (Tbv) and Black Canyon Creek basalt (Tbc). Characterized by low TiO₂ (<1.1 wt. %), FeO (<10 wt. %), and Fe₂O₃ (<0.7 wt. %), and high MgO (>8.5 wt. %), CaO (>12 wt. %), and Cr (<150 ppm). Remnant magnetic polarity is reverse, as determined in the field. Samples checked gave consistent moderate to strong reverse polarity readings. Source uncertain, but may have erupted along an east-trending fault west of Schoolee Creek. Caps McHan basalt and City of Rocks tuff. Thickness varies but typically less than 15 m (50 feet). Thickens and thins locally on City of Rocks tuff, where it forms thin rock from Schoolee Creek to Burnt Willow Canyon. Age uncertain but probably younger than Fir Grove unit. Previously included in Burnt Willow basalt by Smith (1966). Stream drainage is moderately well developed. Clay-rich cobble soils bury a well-developed soil caliche (durpan) formed on basalt. Variations in soil characteristics form a pattern of mounds visible on air photos, but the patterned ground is less well developed compared to that formed on tuff.

Basalt of unpaired vent (Miocene)—Moderate to abundantly plagioclase-phyric basalt. Similar in appearance to Black Canyon Creek basalt and Black Canyon Creek basalt, but chemically distinct (Table 1). Characterized by high FeO (>18 wt. %) and low SiO₂ (<45 wt. %). Remnant magnetic polarity is reverse, although many polarity tests were inconclusive in the field. Strongly magnetic, and commonly deflects a compass needle. Overlies City of Rocks tuff, Hash Spring sediments, or Covin Spring tuff north of Burnt Willow Canyon. Source is an unnamed vent in zones 7 and 8, T. 3 S., R. 15 E. Previously included in Burnt Willow basalt by Smith (1966).

Tuff of City of Rocks (Miocene)—Pinkish gray to brownish gray crystalline rhyolite tuff, typically with black vitrophyric at base and top. Remnant magnetic polarity normal, as determined in the field. Oakley (2006) also reports normal polarity. Base exposed in Thom Creek canyon, where the basalt vitrophyric overlies McHan basalt (Tm) and Hash Spring gravel (Tsg), and in Burnt Willow Canyon, where a cobble basalt vitrophyric overlies sediments (possibly equivalent to Hash Spring gravel). Play subhorizontal flow foliation is typically several millimeters to several centimeters thick, although some massive zones are present. Isoclinal folding of the foliation occurs locally. Forms eroded, channelled cliffs and pillars that form the City of Rocks and Little City of Rocks north of Gooding. Abruptly thin and mostly terminates against the Thom Creek fault, although thin remnants occur at a few locations north of the fault. Offset of the underlying McHan basalt in Thom Creek is about 106 m (350 feet), down to the south. Honjo and others (1986) report a K-Ar age of 9.1 ± 0.13 Ma. Equivalent to City of Rocks tuff of Smith (1966) and Oakley's (2006) tuff of City of Rocks. Forms eroded and dissected irregular topography with common hoodoo cliffs and blocky slopes. Soils are generally thin to absent.

Chalks Volcanics, undivided (Eocene)—Light gray, tan, green, or pale purplish gray hornblende diatite porphyry. Phenocrysts are mostly plagioclase and initial hornblende laths, commonly with altered rims. Play partings (lofted) are common. Probably several faults, but insufficiently exposed in this area to be separated. Exposed along the northwest edge of the map where it unconformably overlies granitic (Tg) and/or unconformably overlain by Fir Grove tuff (Tg). One small outcrop mapped in the NW1/4, sec. 35, T. 2 S., R. 15 E., is likely a later xenolith incorporated in the Covin Spring tuff.

INTRUSIVE ROCKS

Biotite granite (Eocene)—Light colored, pinkish-tan coarse-grained, equigranular to porphyritic biotite granite. Phenocrysts consist of equant dark gray to black quartz 2-7 mm and tabular pale pink orthoclase crystals 10-20 mm long. Biotite composes about 5 percent of the rock. Easily weathered and typically poorly exposed. Smith (1966) mapped this granite as Cretaceous, but Wolf and others (1991) considered it a later Eocene. Quanted for road material at several locations.

Table 1. Major oxide and trace element chemistry for representative samples of units collected in the McHan Reservoir quadrangle.

Sample number	Latitude	Longitude	Unit name	Major elements in weight percent											Trace elements in parts per million														
				SiO ₂	TiO ₂	FeO*	Fe ₂ O ₃	MnO	MgO	CaO	Na ₂ O	K ₂ O	P ₂ O ₅	Al ₂ O ₃	Cr	Ni	V	Ba	Rb	Sr	Zr	Y	Nb	Co	Zn	Pb	Cu	Th	U
9809008	43.9320	-114.6714	basalt of Burnt Willow Canyon	48.0	12.09	16.30	0.67	0.74	8.63	12.82	23.1	0.19	0.23	49	40	18	248	207	2.01	70	23	4.4	15	42	77	5	12	2	
9809011	43.9319	-114.6712	basalt of Burnt Willow Canyon	48.03	12.05	15.23	1.02	0.68	8.29	14.67	24.8	0.18	0.21	47	39	18	250	210	2.07	70	23	4.4	15	42	77	5	12	2	
9809012	43.9402	-114.6237	basalt of Burnt Willow Canyon	46.6	13.03	15.22	1.04	0.27	8.39	14.82	27.5	0.84	0.89	24	48	29	652	186	2.13	49	16	14.2	18	44	43	31	3	38	
9809013	43.9392	-114.6719	basalt of unnamed vent	44.07	13.01	15.17	1.62	0.26	4.59	8.73	3.29	0.62	0.514	31	40	32	188	109	2.14	209	67	15.5	23	17.1	4.28	3.0	3.0		
9809015	43.9392	-114.7803	basalt of unnamed vent	44.01	13.28	14.74	1.17	0.26	6.07	8.91	3.33	0.56	0.434	31	41	34	148	114	2.16	219	50	14.7	24	17.2	4.13	3.16	4.26		
9809016	43.9279	-114.6809	basalt of McHan	38.48	10.89	16.55	12.21	0.196	5.33	8.13	3.77	1.40	0.460	28	8	26	232	174	2.16	139	30	16.7	28	12.9	4.19	3.1	2.26		
9809017	43.9438	-114.6841	basalt of McHan	38.99	10.89	16.28	12.38	0.198	4.49	8.96	3.92	1.48	0.602	30	28	24	229	163	2.18	140	30	16.2	25.4	20	12.9	4.1	2.6	2.33	
9809018	43.9398	-114.6841	basalt of McHan	40.8	12.55	16.29	11.27	0.198	4.43	8.69	3.29	0.83	0.828	29	28	25	225	165	2.18	140	30	16.2	22	12.2	17.1	4.1	2.6	2.33	
9809019	43.9763	-114.6420	basalt of McHan	31.75	10.87	16.24	11.69	0.197	4.43	7.93	3.92	1.93	0.523	27	22	22	189	118	2.18	140	30	16.2	25.4	20	12.9	4.1	2.6	2.33	
9809015A	43.9443	-114.6715	basalt of McHan	36.41	10.82	16.48	12.40	0.200	5.01	7.48	3.66	1.47	0.457	27	25	25	218	158	2.18	140	30	16.2	25.4	20	12.9	4.1	2.6	2.33	
9809015	43.9409	-114.6806	tuff of City of Rocks	38.01	8.75	13.54	4.20	0.665	2.04	3.35	4.54	0.23	0.6	13	8	37	103	155	2.21	575	108	40.8	20	9	76	23	17	139	25
9809015	43.9423	-114.6806	tuff of City of Rocks	38.20	8.789	13.54	4.40	0.667	2.74	3.23	4.50	0.177	0.4	13	7	39	102	148	2.21	575	108	40.8	20	9	76	23	17	139	25
9809016	43.9391	-114.6707	tuff of City of Rocks	38.46	8.885	13.59	4.48	0.668	0.53	3.75	3.29	4.33	0.199	1	15	8	102	152	2.21	575	108	40.8	20	9	76	23	17	139	25
9809016	43.9391																												