Geologic Map of the Butte City 7.5' Quadrangle, Butte County, Idaho

by
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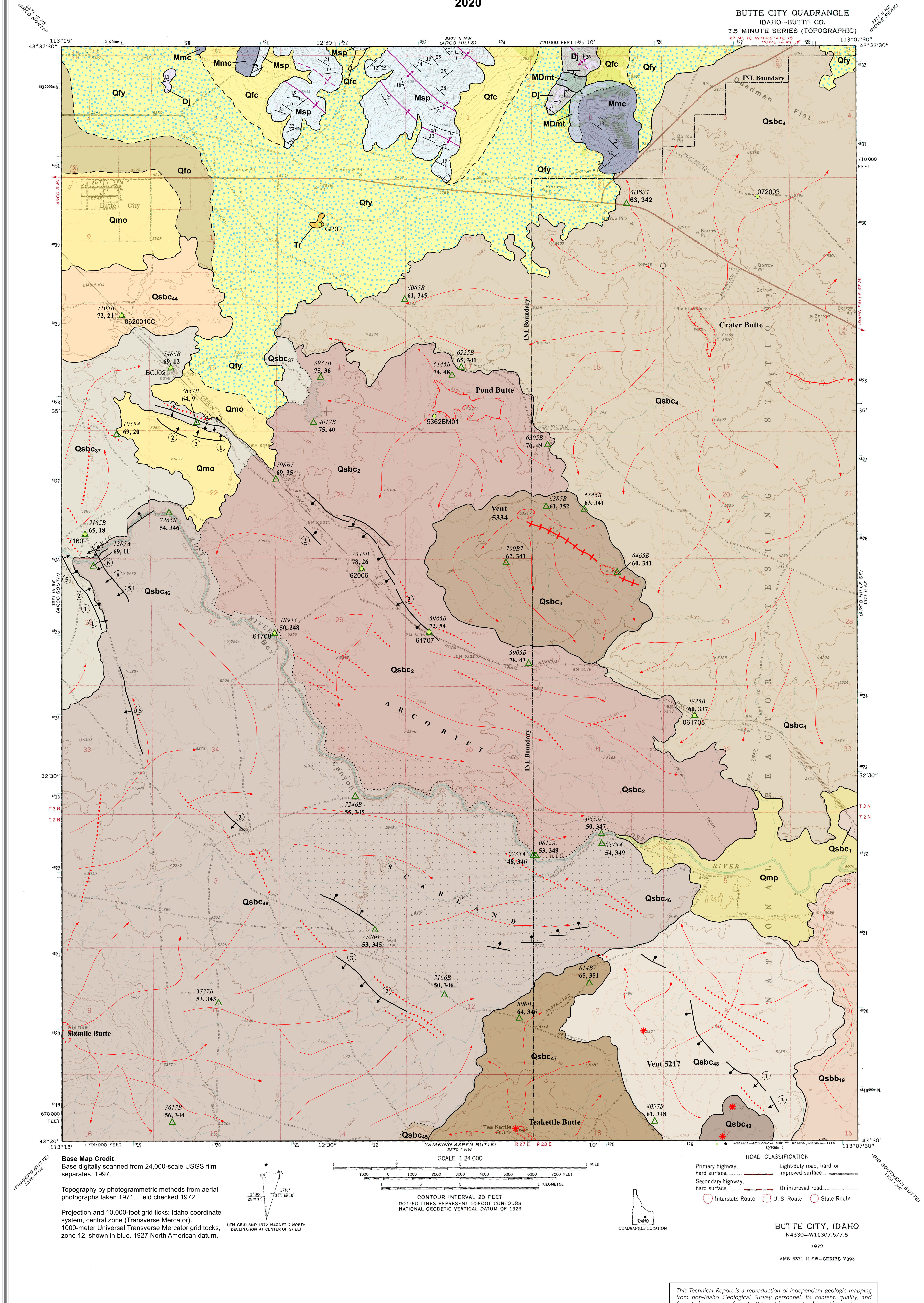
2020



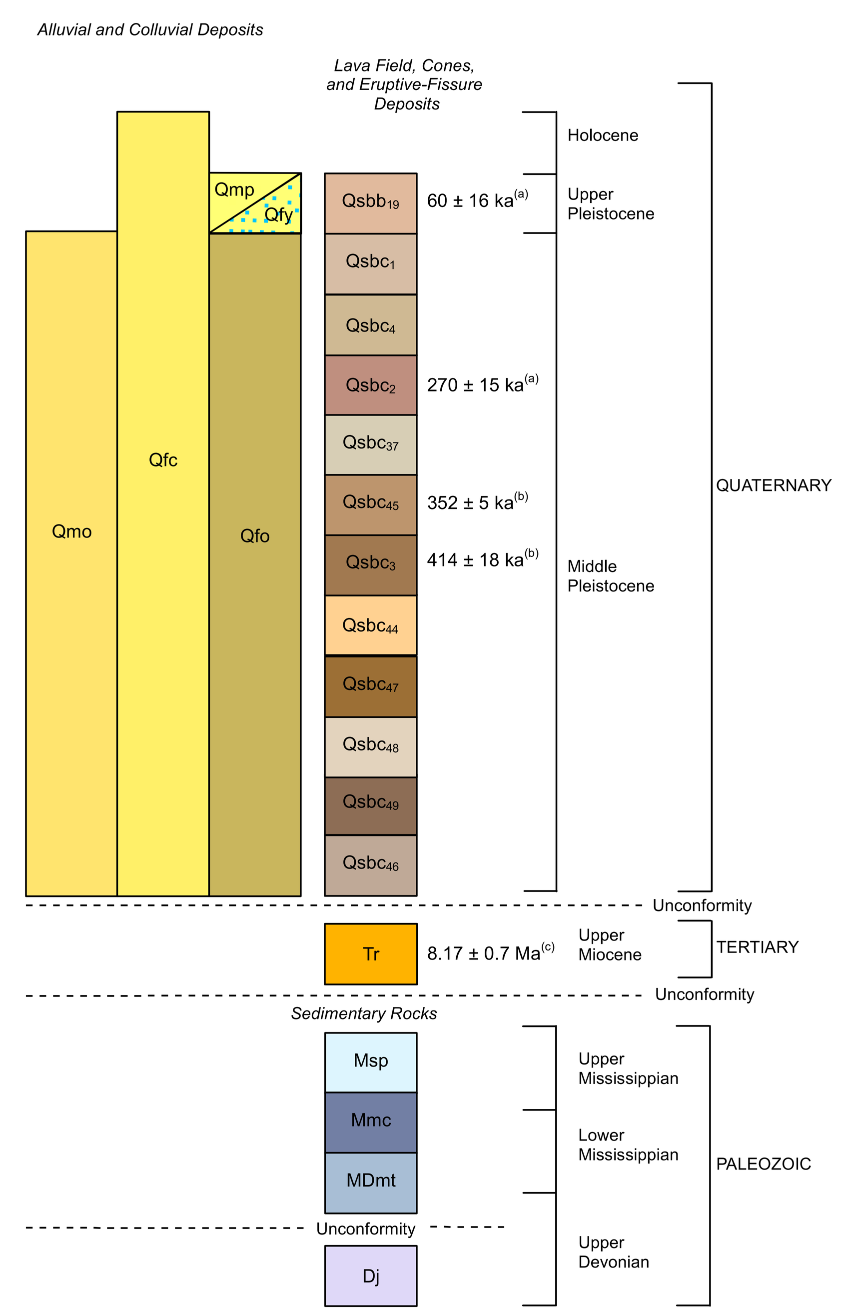
Base Map Credit
Base digitally scanned from 24,000-scale USGS film separates, 1997.

Topography by photogrammetric methods from aerial photographs taken 1971. Field checked 1972.

Projection and 10,000-foot grid ticks: Idaho coordinate system, central zone (Transverse Mercator). 1000-meter Universal Transverse Mercator grid ticks, zone 12, shown in blue. 1927 North American datum.

This Technical Report is a reproduction of independent geologic mapping from non-Idaho Geological Survey personnel. Its content, quality, and format does not conform to IGS publication standards. This preliminary geologic map is published by the IGS to further future scientific studies.

CORRELATION OF MAP UNITS



(a)$^{40}Ar/^{39}Ar$ ages from Hodges and others, 2015.
(b)$^{40}Ar/^{39}Ar$ age from written communication, B. Turrin, 2012, 2017.
(c) U-Pb zircon geochronology from Schusler, 2018.

DESCRIPTION of MAP SYMBOLS

INL Boundary–Indicates the southwestern boundary of the Idaho National Laboratory

Contacts
Solid where certain
Long-dashed where approximated with aerial photography
Short-dash where interpreted based on stratigraphic relations and topography

Faults and Folds
Normal Fault and Monoclinal Flexure–Structures can pass transitionally into one another. Number in circle refers to offset in meters. Dashed where approximately located; ball/arrow and bar on downthrown side

Anticline Axial Trace–Dashed where approximately located.

Syncline Axial Trace–Dashed where approximately located.

25 **Bedding Measurement**–Showing strike and dip direction

6305B
75, 49
Paleomagnetic Sample Site–Site ID with inclination and declination direction rounded to the nearest degree for simplicity; *see* Table 1.

61707 **Geochemical Sample Site**–Location of samples and historical sites labeled by site identification number; *see* Table 2.

Scabland–Area affected by cataclysmic flooding of the Big Lost River, *see* Rathburn, 1993. Boundary dotted where interpreted.

SYMBOLS for BASALTIC ROCKS

Small Cone–Vent for small lava cones, cinder cones, and spatter cones

Crater–Outline of crater rim on volcanic vent; hachures point toward central depression

Lava Pond–Basalt-filled topographic depression surrounded by levees; hachures point away from pond

Rootless Vent–Secondary source of lava associated with lava tube openings

Flow Line–Linear flow features and lava tubes; arrows show flow direction; determined from topography, aerial photography, and field mapping

Eruptive Fissure–Fracture in rock through which lava erupted; commonly bordered by spatter ramparts

Noneruptive Fissure–Fractures in rock which lava has not erupted

Lava Channel–Narrow channels; arrow shows direction of flow

INTRODUCTION

The geologic map of the Butte City 7.5' quadrangle is based on mapping summarized in the 1:100,000 scale map of the Idaho National Laboratory, U.S. Geological Survey Miscellaneous Investigations Map I-2330, by Kuntz and others, 1994. New surficial geologic mapping was completed by National Association of Geoscience Teachers (NAGT) interns, Evan Martin (2015) and Samuel Helmuth (2017). Previously published maps and associated data, by various authors, including Kuntz, M.A., Betty Skipp, M.A. Lanphere, W.E. Scott, K.L. Pierce, G.B. Dalrymple, L.A. Morgan, D.E. Champion, G.F. Embree, W.R. Page, R.P. Smith, W.R. Hackett, and D.W. Rodgers from 1994 to 2017, were incorporated into this project. The U. S. Geological Survey (USGS) Idaho National Laboratory Project Office, a field office of the Idaho Water Science Center, conducts subsurface investigations to study the Snake River aquifer at the Idaho National Laboratory. Many subsurface basalts erupted from vents exposed at the surface. Tracing the flows from the surface to the subsurface provides data for numerical models of groundwater flow and contaminant transport.

GEOLOGIC DISCUSSION

The geologic map of the Butte City 7.5' quadrangle contains Paleozoic marine rocks, Miocene to Holocene volcanic rocks, and alluvial sediments of the Pinedale and Bull Lake glaciations (Kuntz and others, 1994; Skipp and others, 2009; Gosse and others, 1995; Pierce and others, 2018). New paleomagnetic data (Table 1) from vents and flows in and near the Butte City quadrangle indicated that certain boundaries between volcanic and alluvial units needed revision.

Paleomagnetic investigations showed that a basalt flow from Pond Butte (Qsbc$_2$) is the top flow of core USGS 142 (lat. 23°38'37.32" N., long. 113°01'09.41" W., NAD27), about 15 km N. 64° E. of the Pond Butte (Qsbc$_2$) vent, in an area that had been previously mapped as Crater Butte (Qsbc$_4$) (Kuntz and others, 1994; Skipp and others, 2009). Further surface and subsurface paleomagnetic investigations revealed that the Pond Butte (Qsbc$_2$) flow was more extensive, while Crater Butte (Qsbc$_4$) was less extensive than described on previously published 1:100,000 scale maps (Kuntz and others,1994; Skipp and others, 2009). Paleomagnetic data was used to make the following changes in interpretation: (1) The unit mapped as Crater Butte (Qsbc$_4$) south of Butte City was now identified as Vent 5337 (Qsbc$_{44}$); (2) The contact between Pond Butte (Qsbc$_2$) and Sixmile Butte (Qsbc$_{46}$) was discovered to be north of the Big Lost River and was adjusted; (3) The extent of Sixmile Butte (Qsbc$_{46}$) along the western map boundary was revised; previously undiscovered Vent 5571 (Qsbc$_{37}$) flows were added; (4) Vent 5571 flows (Qsbc$_{37}$) were revised, and extended eastward into what was previously mapped as Pond Butte (Qsbc$_4$); (5) The northern contact between Teakettle Butte (Qsbc$_{47}$) and Vent 5217 (Qsbc$_{48}$) was revised, with Teakettle Butte flows extended northeast; (6) Field mapping and orthoimagery were used to refine contacts and volcanic flow lines from 1:100,000 scale maps and revealed the rhyolite of Butte Quarry (Tr) in the north-central map area.

Geochemical data (Table 2) shows that all the basalts sampled for this mapping are Snake River olivine tholeiite basalts (Kuntz, 1992). Geochemical and age data also indicate that the rhyolite of Butte Quarry is part of the Starlight Formation (Schusler, 2018), which erupted from the Picabo Caldera from 10.4-6.6 Ma (Bindeman and others, 2013).

EXPLANATION of MAP UNITS

Names, unit abbreviations, and unit colors have been adopted from the previously published maps, "Geologic map of the Craters of the Moon 30'x60' quadrangle, Idaho": USGS Scientific Investigations Map I-2969, scale 1:100,000, by Kuntz, M.A., Betty Skipp, D.E. Champion, P.B. Gans, and D.P. Van Sistine, 2007, and "Geologic Map of the Arco 30'×60' quadrangle, south-central Idaho", by Skipp, Betty, L.G . Snider, S.U. Janecke, and M.A. Kuntz, 2009, Idaho Geological Survey Geologic Map G M-47, map scale 1:100,000. Names for lava fields are derived from titled vents and buttes on the 1:24,000-scale topographic base map or from named vents on adjacent quadrangles. Where labels for landmarks are absent, spot elevations near the interpreted source are used to name these lava fields. In some instances, names have not been adopted from previous maps and have been replaced by local or base map nomenclature. For example, the vent for Qsbc$_2$ was previously called Vent 5371, and has been renamed with local nomenclature to Pond Butte. The associated unit has also been renamed to Pond Butte lava field.

The unit symbol abbreviation scheme has remained consistent with the earlier publications mentioned. "Q" refers to the age; "s" identifying flows as part of the Snake River Group; "b" indicates basalt; and "b" or "c" refers to subdivisions of Pleistocene time. Final subscript numbers identify lava flows with the lava flow age units from stratigraphic data and interpretation. These numbers are for description, and do not represent relative age relations (Kuntz and others 2007; Skipp and others, 2009).

"Pinedale age" is the Central Rocky Mountain name for the last glacial period, which occurred from roughly 110,000 to 10,000 years B.P. "Bull Lake age" is the Central Rocky Mountain name for the glacial period which preceded the Pinedale glaciation, the maximum advance of which occurred 150,000±4,000 years B.P. (Pierce and others, 2018). Glacial maxima vary considerably depending on local climate and terrain.

MAP UNITS

Alluvial deposits of main streams

Qmp **Alluvial deposits of Pinedale age (upper Pleistocene)–**Pebble and cobble gravel to pebbly sand; poor to moderate sorting; clasts subrounded to rounded; parallel bedding and large-scale crossbedding. Upper 0.5-2 m generally includes sand and silt of eolian origin (Kuntz and others, 1994).

Qmo **Older alluvial deposits (middle Pleistocene)–**Pebble and cobble gravel to pebbly sand and minor sand. Loess cover >1 m thick and contains at least one buried soil. Differentiated from unit Qmp on the basis of higher geomorphic position (Kuntz and others, 1994).

Alluvial-fan deposits

Qfc **Fan deposits of alluvium and colluvium (Holocene to middle Pleistocene)–**Pebble to boulder gravel in a matrix of silty sand to clay and silt; very poorly sorted; crudely bedded (Kuntz and others, 1994; Skipp and others, 2009).

Qfy **Younger fan alluvium (upper Pleistocene)–**Pebble to cobble gravel, locally bouldery near fan heads, generally clast supported; contains varied amounts of sand to silty sand as matrix and small lenses; clasts subangular to subrounded ; parallel bedding and large-scale crossbedding; locally includes alluvium of Holocene age (Kuntz and others, 1994; Skipp and others, 2009).

Qfo **Older fan alluvium (middle Pleistocene)–**Pebble to cobble gravel, locally bouldery near fan heads; matrix contains varied amounts of sand to silty sand; lenses of sand and silty sand also exist; poor to moderate sorting; clasts subangular to rounded; parallel bedding and large-scale crossbedding; locally crudely bedded; medium to thick beds. Forms terraces, small fan remnants, and some fan surfaces. Topographically higher position, better developed soil, and thicker caliche coats on clasts than Qfy; possibly Bull Lake age (Scott, 1982; Skipp and others, 2009).

Pleistocene basaltic vents and associated lava flows of the Snake River Group

Qsbb$_{19}$ **Quaking Aspen Butte lava field (upper Pleistocene)–**Low-lying distal flows of medium to dark-gray pahoehoe basalt, poorly exposed in outcrops along southeastern map boundary. Vent area is approximately 12 km south of the southeastern map boundary. Flows have tumuli, pressure ridges, and pressure plateaus with approximately ≤3 m of relief, and are mantled by ≤1 m of loess and eolian sand (Skipp and others, 2009). $^{40}Ar/^{39}Ar$ age, 60 ± 16 ka (Hodges and others, 2015).

Qsbc$_1$ **Lavatoo Butte lava field (upper middle Pleistocene)–**Dark-gray, surface-fed pahoehoe basalt flows minimally exposed in outcrops along the east-central boundary of the map area. Smooth distal flows have relief of ≤2 m. Main vent approximately 2 km east of boundary (Skipp and others, 2009).

Qsbc$_4$ **Crater Butte lava field (upper middle Pleistocene)–**Dark-gray, dominantly surface-fed pahoehoe and shelly pahoehoe basaltic lava flows. Main vent in northwestern map area creating a 20 m deep, steep-walled crater with proximal shelly-pahoehoe flows. Crater is at summit of a large broad shield volcano. Flows have an average relief of ≤4 m and extend from the vent radially. Hand samples are texturally diktytaxitic and weakly porphyritic, with olivine and plagioclase phenocrysts in medium-gray, fine-grained crystalline matrix of plagioclase laths, olivine granules, ± clinopyroxene blades.

Qsbc$_2$ **Pond Butte lava field (upper middle Pleistocene)–**Dark-gray pahoehoe basalt flows dominantely surface-fed, also fed by channels and tubes. Main vent area located in central portion of map area, 2 km northeast of abandoned rail right-of-way. Vent area is a ≤15 m deep, 825 m long, 60-300 m wide lava-lake depression on top of a lava cone. Lava lake overflow created the proximal ridges of smooth pahoehoe flows such as peak 5362. Smooth medial and distal flows create ≤2 m relief, and are inferred to terminate north of the Big Lost River. Flows mantled by ≤2 m of loess and eolian sand (Skipp and others, 2009). Hand samples are texturally diktytaxitic and glomeroporphyritic with clots of olivine and local syntaxial plagioclase. $^{40}Ar/^{39}Ar$ age, 270 ± 15 ka (Hodges and others, 2015).

Qsbc$_{37}$ **Vent 5571 lava field (upper middle Pleistocene)–**Medium-gray, pahoehoe basalt flows outcrop along western edge of map area, inferred to terminate at seasonal pond at approximately lat. N 43° 35' 00" long. W 113° 12' 30". Vent area located approximately 1 km south of map area, and interpreted to be correlated to Wildhorse Butte. Smooth, distal flows with ≤1.5 m relief are mantled by ≤2 m of loess and eolian sand.

Qsbc$_{45}$ **Tin Cup Butte lava field (upper middle Pleistocene)–**Medium-gray, distal basalt flows outcrop along south-central border of map area. Main vent area several kilometers to the south of map area. More information can be found in Kuntz and others, 2007 and Skipp and others, 2009. $^{40}Ar/^{39}Ar$ age, 352 ± 5 ka (written communication, B.Turrin to D. Champion, 2012).

Qsbc$_3$ **Vent 5334 lava field (upper middle Pleistocene)–**Medium-gray to red-brown, surface-, channel-, and tube-fed pahoehoe and shelly pahoehoe basaltic lava flows and pyroclastic deposits proximal to vent. Main vent in east-central portion of map area near INL boundary. Vent area is a low cinder cone with southeast-trending eruptive fissure extending to a rounded vent depression. Shelly pahoehoe flows proximal to main vent, and tephra common in fissure area. Medial and distal flows have ropey textures and relief of ≤2 m. Hand samples are texturally porphyritic with olivine, plagioclase, ± clinopyroxene phenocrysts in dark-gray aphanitic matrix. $^{40}Ar/^{39}Ar$ age, 414 ± 18 ka (written communication, B. Turrin to D. Champion, 2017).

Qsbc$_{44}$ **Vent 5337 lava field (upper middle Pleistocene)–**Medium-gray, surface-fed, distal pahoehoe basalt flows. Poorly exposed weathered outcrop in map area; best exposed at rail right-of-way. Main vent area located south of map area. Paleomagnetic site 7105B provides new insite to area and correlates this with Vent 5337.

Qsbc$_{46}$ **Sixmile Butte lava field (upper middle Pleistocene)–**Medium-gray, surface and tube-fed, pahoehoe basalt flows. Main vent area is in southwest corner of map area, and is a shallow crater at summit of a 150 m high shield volcano. Flows extend from vent and are inferred to terminate north of the Big Lost River. Proximal and medial flows are texturally porphyritic with glomeritic olivine clots and plagioclase phenocrysts in dark-gray aphanitic matrix. Dark-gray, dense, texturally aphanitic flows also exist and are interpreted as stratigraphically older than porphyritic flows. Textural differences and interpreted relationship best observed in outcrop near the Big Lost River.

Qsbc$_{47}$ **Teakettle Butte lava field (upper middle Pleistocene)–**Dark-gray, surface- and channel-fed, pahoehoe and shelly pahoehoe basalt flows. Vent area is a long, round, shallow crater at summit of a 100 m high cinder cone at the southern map boundary. Cinder, and red-brown oxidized pyroclastic deposits are proximal to crater and vent area. Rough, medial flows have a relief of ≤2.5 m (Skipp and others, 2009).

Qsbc$_{48}$ **Vent 5217 lava field (upper middle Pleistocene)–**Dark-gray, surface- and channel-fed, pahoehoe basalt flows. Vent is a small cinder cone at peak 5201, with a ridge extending to the southeast, in southwestern map area. Red to brown pyroclastic deposits located proximal to vent area. Smooth proximal and medial flows have ≤3 m of relief, and are mantled by ≤2.5 m of loess and eolian sand (Skipp and others, 2009). Hand samples are texturally diktytaxitic and porphyritic with phenocrysts of olivine and plagioclase in fine-grained, gray matrix.

Qsbc$_{49}$ **Vent 5153 lava field (middle Pleistocene)–**Dark-gray, surface-, and channel-fed pahoehoe basalt flows. Vent area is a small cinder cone with red, oxidized pyroclastic deposits, in the southwest map area. Rough proximal flows with relief of ≤2 m and mantled by ≤2 m of loess and eolian sand (Kuntz and others, 2007).

Miocene Rhyolitic rocks

Tr **Rhyolite of Butte Quarry (upper Miocene)–**Dark-gray to maroon, fine-grained, moderately vesicular, rhyolite and associated vitrophyre outcrops 10 m north of main rhyolite exposure. Rhyolite has sub-parallel vesicles elongated east-west; hand samples are weakly-porphyritic with subhedral plagioclase and vitreous quartz, sparse to rare sanidine phenocrysts in dense, aphanitic matrix. Dark-gray to charcoal gray vitrophyre with quartz and plagioclase phenocrysts in dark gray, dense, glassy ground mass. U-Pb zircon age, 8.17 ± 0.7 Ma (Schusler, 2018).

Table 2. Geochemical data for selected volcanic rocks in the Butte City 7.5' quadrangle, Butte County, Idaho. Analyzed by by Stanley A. Mertzman, Department of Earth and Environment, Franklin and Marshall College, Lancaster, PA. LOI: loss on ignition.

Site ID	Unit Sampled	Easting	Northing	LOI	Na_2O + K_2O	Major elements in weight percent										Trace elements in parts per million																	
						SiO_2	TiO_2	Al_2O_3	FeO*	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	Ni	Cr	Sc	V	Ba	Rb	Sr	Zr	Y	Nb	Ga	Cu	Zn	Co	Pb	La	Ce	Th
71602	Qsbc$_{37}$	318601	4826269	-0.58	2.74	46.18	2.11	15.36	13.80	0.20	9.10	10.45	2.40	0.34	0.38	124	257	31	280	243	6.4	254	170	31.1	15.7	15.6	61	96	54	<1	15	25	4.4
061703	Qsbc$_4$	326273	4823759	-0.69	3.02	47.14	2.25	15.46	13.57	0.20	8.19	10.19	2.55	0.47	0.37	106	209	26	284	325	13.6	297	209	35.2	24.6	17.4	53	100	50	<1	18	33	2.5
061707	Qsbc$_2$	322933	4824907	-0.33	3.04	46.75	2.25	15.36	13.75	0.20	8.20	10.20	2.57	0.47	0.37	116	238	29	294	309	7.7	277	171	31.2	15.3	17.1	47	94	54	<1	14	25	1.8
0620010C	Qsbc$_{44}$	319144	4829027	-0.56	2.95	45.92	2.31	15.17	13.51	0.20	8.37	10.07	2.51	0.44	0.33	104	230	30	289	294	7	249	178	34.3	15.8	16.5	64	95	52	<1	15	28	2.4
072003	Qsbc$_4$	327252	4830315	-0.21	3.08	46.11	2.67	15.18	14.78	0.21	7.46	10.09	2.63	0.45	0.62	93	218	32	311	315	6.2	313	231	34.7	21.2	16.9	45	116	55	<1	13	34	4.0
5362BM01	Qsbc$_2$	323077	4827644	-0.39	2.92	46.18	2.35	15.05	14.25	0.21	8.11	10.09	2.49	0.43	0.39	115	228	29	295	308	6.7	323	181	31.8	17.5	16.4	56	102	52	<1	12	29	4.6
61708	Qsbc$_{46}$	320975	4824948	-0.25	2.79	45.30	2.20	15.51	14.35	0.21	8.94	10.45	2.48	0.31	0.45	117	287	31	296	364	4.9	270	182	35.6	17.3	15.9	53	103	61	<1	14	32	2.5
62006	Qsbc$_2$	322098	4825734	-0.54	2.9	46.89	2.21	15.49	13.74	0.23	8.34	10.10	2.49	0.41	0.33	111	309	31	301	272	8.3	279	166	31.1	13.7	16.9	69	97	52	<1	12	25	1.7
BCJ02	Qsbc$_{37}$	319748	4828349	-0.57	2.83	46.48	2.14	15.48	13.77	0.20	8.59	10.49	2.47	0.36	0.38	122	245	31	290	299	6.6	252	170	32.5	14.3	16.3	62	98	57	<1	12	29	<0.5
GP02	Tr	321688	4830116	2.26	8.05	73.33	0.45	12.15	2.87	0.07	0.50	2.20	3.30	4.75	0.13	5	12	4	23	1189	168.2	98	604	72.1	63.8	19.9	3	72	1	40	83	169	46

Paleozoic strata of the southern Arco Hills

Msp **Scot Peak Formation (upper Mississippian)–**Medium gray, silty, sandy, with gray to orange chert, thin- to thick-bedded, ledge- to cliff-forming limestone; weathers light gray with scalloped texture. Abundant fossils include crinoids and rugose corals among fossil hash. Gradationally underlain by the Middle Canyon Formation; estimated thickness of 150 m in the southern Arco Hills (Skipp and others, 2009).

MDmt **McGowan Creek and Three Forks Formations undivided (lower Mississippian and upper Devonian)–**Undivided due to limited exposure in mapping area. Medium gray, fine- to medium-grained, thinly-bedded, slope-forming limestone; locally brecciated.

Mmc **Middle Canyon Formation (Mississippian)–**Dark gray, fine-grained, thin- to medium-bedded, slope- to ledge-forming silty limestone; thin light gray rind on weathered surfaces. Locally interbedded limestone and calcareous siltstone with tan to black discontinuous chert stringers and nodules. Gradational contacts with Scott Peak Formation above and McGowan Creek Formation below; estimated thickness of 180 m in the southern Arco Hills (Skipp and others, 2009).

Dj **Jefferson Formation (upper Devonian)–**Medium gray, fine-grained, medium-bedded, slope- to ledge-forming dolostone; locally dolostone-limestone breccia or siltstone. Estimated thickness of 80 m in the southern Arco Hills (Skipp and other, 2009).

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ACKNOWLEDGMENTS

The USGS/NAGT Cooperative Field Training Program is the longest continuously running internship program in the earth sciences and the opportunities this program provides to young, aspiring scientists is greatly appreciated. Thanks are due to the U.S. Geological Survey and the Idaho Geological Survey for making the publication of this map possible, to Kyle Schusler for his help and knowledge in the southern Arco Hills, and also to Michael Clynee, Paul Link, and Jan Zigler for their constructive peer reviews.

Table 1. Paleomagnetic data for samples of selected basaltic lava fields in the Butte City 7.5' quadrangle, Butte County, Idaho. Analytical data acquired from sampling during 2015-2017 field seasons, and from the previous publication Kuntz and others, 1994. Recent field samples were acquired and analyzed by Duane E. Champion, U.S. Geological Survey, Volcano Hazards Program, Alaska Volcano Center, Menlo Park, California, using standard protocols and sampling equipment.

Definition of table headings:
Site ID - site-alphanumeric identifier
Unit Sampled - alphanumeric abbreviation associated with geologic unit
East and North - Easting/Northing in UTM Zone 12N, NAD27
N/No - number of cores used to calculate mean site direction compared with number of cores collected at site
Exp. - strength of the peak alternating field (AF) demagnetization field in mT
Li - indicates that a vector component lines analysis was used
Pl - indicates that a planes analysis was used
Mx - indicates that a mixture of lines and planes was used to define the mean remanent direction
I - remanent inclination in degrees
D - remanent declination in degrees
α95 - radius of the 95% confidence limit about the mean direction
k - estimate of the Fisher precision parameter
R - length of the resultant vector
Plat and Plong - location in degrees north and east of virtual geomagnetic pole (VGP) calculated from the mean direction of the site
Source - publication for paleomagnetic data

Site ID	Unit Sampled	East	North	N/No	Exp	I	D	α95	k	R	Plat	Plong	Source
0575A	Qsbc$_{46}$	325047	4822182	8/8	Li	53.9	348.6	2.5	494	7.9858	77.3	114.8	This Report
0655A	Qsbc$_{46}$	325048	4822305	8/8	Mx	49.9	346.7	1.4	1735	7.9960	73.4	110.6	
0735A	Qsbc$_{46}$	324175	4822054	8/8	Li	48.3	346.4	3.1	319	7.9781	72.1	108.7	
0815A	Qsbc$_{46}$	324210	4822049	7/8	Li	52.5	348.5	2.2	723	6.9917	76.2	111.4	
1055A	Qsbc$_{37}$	319061	4827554	8/8	Mx	68.8	19.7	1.1	2769	7.9975	74.3	296.6	
1385A	Qsbc$_{37}$	318700	4826119	8/8	Mx	69.3	11.1	1.4	1780	7.9961	78.1	281.0	
3617B	Qsbc$_{46}$	319503	4818793	8/8	Mx	55.6	344.2	2.7	491	7.9857	75.8	130.8	
3777B	Qsbc$_{46}$	320130	4820290	8/8	Mx	53.0	343.1	1.9	1125	7.9938	73.5	125.4	
3857B	Qsbc$_{37}$	320058	4827661	8/8	Mx	63.8	8.9	1.0	3343	7.9979	83.4	317.2	
3937B	Qsbc$_2$	321644	4828190	8/8	Li	75.2	36.5	2.2	647	7.9892	61.8	282.9	
4017B	Qsbc$_2$	321537	4827620	7/8	Li	74.8	40.0	1.9	1040	6.9942	60.5	285.4	
4097B	Qsbc$_{48}$	325624	4818640	8/8	Mx	61.4	348.4	1.7	1113	7.9937	81.5	154.2	
4B631	Qsbc$_4$	331319	4827141	12/12	30+	63.1	342.1	1.6	784	11.98597	77.1	167.4	Kuntz, 1994
4B943	Qsbc$_{46}$	321000	4824963	10/12	20	50.4	348.2	1.2	1541	9.99416	74.5	107.6	Kuntz, 1994
5825B	Qsbc$_4$	326384	4823810	8/8	Mx	59.8	337.4	2.7	469	7.9851	73.0	154.9	This Report
5905B	Qsbc$_2$	324222	4824545	8/8	Mx	78.0	42.5	1.1	2643	7.9974	57.5	276.3	
5985B	Qsbc$_2$	323019	4824910	8/8	Mx	71.6	53.7	2.0	855	7.9918	54.2	296.6	
6065B	Qsbc$_4$	322807	4829139	8/8	Mx	60.6	344.9	2.2	674	7.9896	78.7	151.7	
6145B	Qsbc$_2$	323346	4828124	8/8	Li	73.7	48.3	3.7	231	7.96964	57.0	290.5	
6225B	Qsbc$_4$	323511	4828231	8/8	Mx	64.7	340.9	1.7	1176	7.9941	76.2	176.1	
6305B	Qsbc$_2$	324537	4827315	8/8	Mx	76.0	48.7	1.4	1520	7.9954	56.1	283.8	
6385B	Qsbc$_3$	324516	4826538	7/8	Pl	61.2	352.4	5.9	80	6.8541	84.3	146.4	
6465B	Qsbc$_3$	325382	4825626	8/8	Li	61.4	341.4	1.8	907	7.9923	76.4	158.9	
6545B	Qsbc$_4$	324998	4826414	8/8	Li	63.1	341.2	1.4	1489	7.9953	76.5	167.8	
7105B	Qsbc$_{44}$	319250	4829011	8/8	Li	71.8	21.2	4.0	194	7.96398	71.3	285.0	
7166B	Qsbc$_{46}$	323001	4820316	8/8	Mx	49.7	346.4	4.4	162	7.9569	73.1	111.0	
7185B	Qsbc$_{37}$	318610	4826250	8/8	n/a	64.4	17.8	1.0	2910	7.99759	77.1	318.8	
7246B	Qsbc$_{46}$	321939	4822864	8/8	Li	54.6	344.9	1.5	1369	7.9949	75.6	126.0	
7265B	Qsbc$_{46}$	319749	4826553	8/8	Li	54.3	346.0	0.8	4364	7.9984	76.1	122.7	
7345B	Qsbc$_2$	322151	4825711	8/8	Mx	78.4	26.4	3.5	255	7.9726	62.1	268.0	
7486B	Qsbc$_{37}$	319815	4828534	8/8	Li	68.6	11.8	1.4	1552	7.9955	78.5	286.1	
7726B	Qsbc$_{46}$	322140	4821163	8/8	Mx	53.3	345.4	3.6	251	7.9721	75.1	121.3	
790B7	Qsbc$_3$	323931	4825775	8/8	Mx	61.8	340.8	2.3	678	7.9891	76.0	161.1	
798B7	Qsbc$_2$	321134	4826960	8/8	Mx	68.8	35.2	2.5	518	7.9865	65.2	304.1	
806B7	Qsbc$_{47}$	323941	4819995	8/8	Mx	64.3	346.1	1.0	3236	7.9978	79.8	176.3	
814B7	Qsbc$_{47}$	324842	4820416	8/8	Mx	64.7	350.9	1.8	970	7.9928	82.9	185.7	

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University of Idaho, Moscow, Idaho 83844-3014