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Scientific Investigations Map 3382
Sheet 1 of 2
Pamphlet accompanies map

Geologic Map of the Upper Arkansas River Valley Region, North-Central Colorado

By

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View north of tuff bed (white layer ~30 centimeters [cm] thick), about 1 meter (m) below the top of an eroded section of Dry Union Formation, just below the Qgf outwash gravel deposit, on which the person is standing (Qdu). Tuff bed is about 1 m above the base of Qdu and about 3 m left of the photo. The tuff bed in the photo is correlated with dated ash exposed at location B, about 0.9 kilometers (km) southwest of photo. The ash bed at location B has a U-Pb zircon age of 35.22±0.032 Ma (table 2). Figure 9 in text.

Bighorn sheep on a large outcrop of Longhoff Gulch Granite, about 5 km north of the town of Granite, Colo. Photograph by K. S. Kellogg, July 2015.

View to the north of Buffalo Peaks, which are composed mostly of andesite flows, andesite breccias, lahars, and welded tuff adjacent on Mesoproterozoic granite. The peak on the left is Point Buffalo Peak (14,062 meters [m], 13,326 feet [ft]) and the peak on the right is East Buffalo Peak (14,038 m, 13,330 ft). Figure 10 in text.

Table 2. Isotopic ages for rocks in the upper Arkansas Valley region.

[No., list number; —, by symbol on map; Indicates location uncertain or unit too complicated outside of the map area; —, for sample number, indicates no number given; sigma, standard deviation; mp, mean plagioclase; Ma, mega-annum; ppm, parts per million.]

No.	Symbol on map	Sample number	Rock type	USGS 7½′ quadrangle	Age±2σ	Reference
1	—	06-BJH-242	Dry Union Formation, ash layer	Salida West	9.38±0.06 Ma	Morgan and Cosca, 2015
2	B	PP15-07B	Dry Union Formation, ash layer	Salida East	13.6±0.2*	Morgan and Cosca, 2015
3	C	—	Dry Union Formation, ash layer	Nathrop	33.3±0.2*	Hubbard and others, 2005
4	C	—	Dry Union Formation, ash layer	Nathrop	34.4±1.4*	Hubbard and others, 2005
5	—	—	Lava felsite dike (Rhyp–Vaddv dy)	Mount Antero	23±1 ma#	Lindsey, 1975
6	E	GR13-77A	Basaltic andesite porphyry flow	Granite	24.1±0.12 Ma	Kellogg and others, 2014
7	E	GR13-77B	Quartz porphyry stock	Granite	24.3±0.6 Ma	Shroba and others, 2014
8	—	—	High-silica rhyolite dike	Rhyg	26.2±1.0*	Lindsey, 1975
9	—	—	Leucogranite of Mount Antero	Rmag	Mount Antero*	29.97±0.15 Ma#
10	—	—	Rhyolite of Bull Hills, upper flow	Rhyr	Buena Vista East	29.25±0.13 Ma#
11	—	—	Rhyolite of Baby Mtn	Rbm	Buena Vista East	29.25±0.21 Ma#
12	—	—	Rhyolite of Baby Mtn	Rbm	Buena Vista East	30.47±0.08 Ma#
13	—	—	Rhyolite of Baby Mtn lower flow	Rbm	Buena Vista East	30.76±0.08 Ma#
14	—	—	California-Argentine leucogranite	Rcag	Mount Antero	30.7±1.2*
15	—	MP-27	Granite of Vault Park	Rvpr	—	31.57±0.28*
16	—	—	Rhyolite/ash-flow tuff of	Rvpt	Poncha Pass	31.2±1.2 Ma#
17	—	—	Bonanza Tuff	Rbtp	—	33.31±0.08 Ma#
18	—	—	Bonanza Tuff	Rbtp	—	33.42±0.10 Ma#
19	—	—	Bonanza Tuff	Rbtp	—	33.12±0.05 Ma#
20	—	—	Bonanza Tuff	Rbtp	—	33.12±0.05 Ma#
21	—	—	Badger Creek Tuff	Rbtc	—	34.83±0.22*
22	—	—	Mount Aetna ring dike	Rvma	—	34.47±0.16*
23	—	—	Monzogranite of Mount Aetna	Rvma	—	36.31±0.90*
24	—	MP-21	Monzogranite of Mount Aetna	Rvma	—	34.9±0.5*
25	—	NM-2117	Bonilla Seco, Tomichose Hill	Rtuh	Salida East	36.31±0.16*
26	—	NM-2118	Bonilla Seco, Tomichose Hill	Rtuh	Salida East	36.36±0.14*
27	—	NM-2116	Bonilla Seco, Tomichose Hill	Rtuh	Salida East	35.76±1.07*
28	—	—	Late white porphyry	Rlw	Climax	34.9±1.0*
29	—	—	Late white porphyry	Rlw	—	36.0*
30	—	—	Andesite of Triad Ridge	Rtrr	Buena Vista East	36.61±0.16*
31	F	MOR-4	Little Grim Quartz Latite	Rlq	Castle Peak	36.5±0.2*
32	—	NM-2120	Capping andesite, Buffalo Peaks	Rta	Mount Princeton	36.28±0.36*
33	—	1565	Tuff of Buffalo Peaks	Rbu	Mount Princeton	36.66±0.32 Ma#
34	G	HLM-139-3	Lower tuff of Buffalo Peaks	Rbl	Harvard Lakes	37.06±0.12 Ma#
35	—	—	Upper tuff of Triad Ridge	Rtr	Buena Vista East	36.68±0.12 Ma#
36	—	—	Lower tuff of Triad Ridge	Rtr	Buena Vista East	37.0±0.12 Ma#
37	—	—	Tuff of Triad Ridge	Rtr	Buena Vista East	37.68±0.11*
38	—	—	Tuff of Triad Ridge	Rtr	Buena Vista East	38.45±0.38*
39	—	—	Wall Mountain Tuff	Rwm	—	37.15±0.08*
40	—	—	Wall Mountain Tuff	Rwm	—	37.23±0.10*
41	—	—	Mount Princeton batholith	Rmp	—	36.75±0.21*
42	—	—	Mount Princeton batholith	Rmp	—	36.6±0.4*
43	—	—	Mount Princeton batholith	Rmp	—	35.86±0.18*
44	—	—	Mount Princeton batholith	Rmp	—	35.57±0.18*
45	B	MOR-28	Johnson Gulch Porphyry	Rjg	Mount Sherman	39.5±0.6*
46	—	LR31-153	White felsite porphyry	Rwd	Granite	42.25±0.13*
47	—	TL	Twin Lakes Granodiorite pluton	Rtl	Mount Elbert	42.7±1.2 (b)*
48	—	08-J.B-34-A	Twin Lakes Granodiorite pluton	Rtl	Mount Elbert	44.61±1.0 (b)*
49	—	NM-2124	Granite porphyry of Tumble Hill	Rgt	Jones Hill	44.66±0.27*
50	—	NM-2125	Granite porphyry of Tumble Hill	Rgt	Jones Hill	44.57±0.16*
51	—	NM-2126	Granite porphyry of Tumble Hill	Rgt	Jones Hill	45.38±0.17*
52	J	MOR-5	—enriched with Paulo Porphyry	Rrhe	Mount Sherman	44.1±0.8
53	—	—	—enriched with Paulo Porphyry	Rrhe	—	37.4*
54	—	—	Granite porphyry of Black Mtn.	Rggt	Jones Hill	44.47±0.13*
55	K	HLM-44	Monzodiorite dike	Rdyke	Harvard Lakes	45.3±0.5 (b)*
56	L	HLM-89	Hornblende–pyroxenite	Rdyke	Harvard Lakes	45.6±0.8 (b)*
57	M	HLM-136	Hornblende–biotite diorite plug	Rdyke	Harvard Lakes	48.1±0.9 (b)*
58	N	UNKNOWN-4-97	Rhyolite dike	Rdyke	Granite	45.5±2.0*
59	—	—	Whitehorn Granodiorite	Rwg	Salida East*	69.4±2.1 (b)*
60	—	—	Whitehorn Granodiorite	Rwg	Salida East*	70.0±2.1 (b)*
61	—	—	Whitehorn Granodiorite	Rwg	Salida East*	70.4±2.1 (b)*
62	—	V-13-84-1	Browns Pass Granite	Vbp	Mount Yale	1,430±12
63	—	CO-18	Browns Pass Granite	Vbp	Mount Yale*	1,420±0.6 and 1,440±0.6
64	G	R-3, 83-3	Granodiorite of Mount Harvard	Vgdh	Mount Harvard	1,434±20*
65	P	V-8, 83-3	Granodiorite of Mount Elbert	Vgdh	Mount Elbert	1,435±15*
66	Q	MNP-83-4B	Granite of Granite	Vgrg	Granite	1,439±9*
67	R	GR30-313	Granite of Granite	Vgrg	Granite	1,454±6*
68	S	R-33-84-1	Langloff-Gulch Granite	Vgr	Mount Sherman	1,435±20*
69	T	V-1-84-10	St. Kevin Granite	Vgr	Mount Massive	1,425±22*
70	U	HLM-55	Langloff-Gulch Granite	Vgr	Harvard Lakes	1,463±9*
71	V	MNM-103	Langloff-Gulch Granite	Vgr	Mount Massive	1,435±15*
72	W	WRN93-7	Elephant Rock Granite	Vgr	Buena Vista East	1,434±6*
73	X	HLM-125	Elephant Rock Granite	Vgr	Harvard Lakes	1,430±8*
74	—	BBR-10-92-31	Granodiorite	—	Winfield	1,430±12*
75	Z	BJ-17-85 (2)	Granite of Mount Yale	Vgr	Mount Yale	1,695±12*
76	Z	V-11-84-5	Denny Creek Granodiorite	Vdh	Mount Elbert	1,685±12*
77	—	BJ-28-86-5	Denny Creek Granodiorite	Vdh	Mount Harvard	1,710±10*
78	AA	Bickford	Henry Mountains? Granite	Vgd	Cameron Mountain	1,675±5*
79	BB	CN51-756	Henry Mountains? Granite	Vgd	Cameron Mountain	1,700±6*
80	CC	WRN93-8	Metadacite of Salida	Vva	Salida East	1,721±9*
81	DD	Z-1	Metadacite of Salida	Vva	Salida East	1,720±4*

Notes: 1Ma=106 years ago or 1 Ph (mega) (microbe) ago.
Ages: *, by U-Pb zircon; #, by U-Pb titanite; (b), by U-Pb baddeleyite; a, by Ar/Ar; s, by Ar/Ar; m, by hornblende.
Sr, by ages. Mineral dated: h, hornblende; w, whole rock; no letter, not specified.
Weighted means of the 206Pb/238U ages is complete.
Ma, Mount Aetna; Mm, Mount Mercer; Mp, Mount Princeton; Mt, Mount Tenmile; Mv, Mount Vernon.
Recalculated by Shroba, 1996.
Recalculated by Cosca, 2016.
Weighted mean of 206Pb/238U ages is complete.
Recalculated using revised standards for Fish Canyon Tuff sanidine (Kuiper and others, 2008).

Extent of lidar coverage and sources of geologic mapping. Per U.S. Geological Survey (USGS) publications, the publication number, author(s) and year of publication are shown. For non-USGS publications, the State agency or institution, author(s) and year of publication are shown. CGS, Colorado Geological Survey; SM4, Summit-Arkansas-Saguache Map; PP, Professional Paper.







Selected boundaries. Generalized selected Federal boundaries in the map area. FCW, Fossil Creek Wilderness; LNWR, Leadville National Fish Hatchery; RGNP, Rio Grande National Forest; SDCW, Sangre de Cristo Wilderness; WRNP, White River National Forest.

Topical maps downloaded and obtained from the U.S. Geological Survey, The National Map, May 29–31 at https://viewer.nationalmap.gov/launch/ and Colorado Forest Atlas at http://www.coloradoforestatlas.org/. Data accessed on May 31, 2017, at https://www.fs.fed.us/r2/gis/data.shtml and http://www.fs.fed.us/r2/gis/publications.shtml.

Conversion Factors

International System of Units to Inch-Pound

Multiply	By	To obtain
	LENGTH	
millimeter (mm)	0.03937	inch (in)
centimeter (cm)	0.3937	inch (in)
meter (m)	3.281	foot (ft)
kilometer (km)	0.6214	mile (mi)
	AREA	
square kilometer (km²)	0.3861	square mile (mi²)
	Flow rate	
cubic meter per second (m³/s)	0.1383	cubic foot per second (ft³/s)
	Mass	
metric ton (t)	1.102	ton, short (2,000 lb)

U.S. customary units to International System of Units

Multiply	By	To obtain
	Mass	
ounce, avoirdupois (oz)	28.35	gram (g)
pound (lb)	0.4536	kilogram (kg)

Altitude as used in this report refers to distance above the vertical datum.

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Kellogg completed and reviewed the geology of the map area and wrote the map-unit descriptions and other text during 2009–2015. Shroba mapped many of the Quaternary deposits and the age of lidar. Eight detection and ranging) imagery during 2014–2016. He revised the map units descriptions and other text describing Quaternary deposits with the aid of the lidar imagery. Bohannon mapped the bedrock geology and structure in the Quaternary deposits with the aid of the lidar imagery. Bohannon mapped the bedrock geology and structure in the southern part of Pleistocene and Tertiary bedrock units in the map area. Brandt assisted in interpretation of bedrock ages of Proterozoic and Tertiary bedrock units in the map area. Brandt assisted in interpretation of geologic structures and wrote the structure section of the text. Ruleman compiled the geologic map, prepared the digital compilation of the geologic map, GIS database and digital cartography for T.R. Brandt.

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