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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

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View north of soft bed (white layer ~20 centimeters [cm] thick, about 1 meter [m] below the top of an exposed section of Dry Union Formation, just below the Qgd) beneath gravel deposit, on which the person is standing (Qg). Soft bed is a bed of fine-grained ash that is near the base of the person. The ash bed in the photo is correlated with dated ash exposed at location B, about 0.5 kilometers (km) southwest of photo. The ash bed at location B has a 15.98 zircon age of 19.23±0.02 Ma (table 2). Figure 9 in text.

View to the north of Buffalo Peaks, which are composed mostly of andesite flows, andesite breccias, lahars, and welded tuff deposited on Mesoproterozoic granite. The peak on the left is Mount Buffalo Peak (14,962 meters [m]; 13,326 feet [ft]) and the peak on the right is East Buffalo Peak (14,854 m; 13,330 ft). Figure 10 in text.

Bighorn sheep on a large outcrop of Longhoff Gulch Granite, about 3 km north of the town of Granite, Colo. Photograph by A.S. Kellogg, July 2013.

Table 2. Isotopic ages for rocks in the upper Arkansas Valley region.
[Dec., late number; c., for symbol or map, indicates uncertain assessment or unit not completely studied of the map area; —, for sample number, indicates no number given; e, sigma, standard deviation; map., map(ped); Alt., Alt.ritic; plate, pamphlet.]

No.	Symbol on map	Sample number	Rock type	USGS 'E' quadrangle	Age (Ma	Reference
1	—	84JB1242	Dry Union Formation, ash layer	Salida West	9.30±0.04ma	Morgan and Cosca, 2017
2	B	PP15478	Dry Union Formation, ash layer	Salida East	13.6±0.2	Morgan and Cosca, 2017
3	C	--	Dry Union Formation, ash layer	Maysville	13.5±0.2	Hubbard and others, 2001
4	C	--	Dry Union Formation, ash layer	Maysville	14.4±0.4	Hubbard and others, 2001
5	--	--	Late felsic dike (Ruby Gulch dyke)	Mount Antero	32±1 to 0	Limbach, 1975
6	D	GR11-771	Rhyolite ashfall tuff(?)	Granite	24.12±0.12 (Ar/Ar)	Thorpe and others, 2014
7	E	GR13-756	Quartz porphyry sack	Granite	24.1±0.6 (c)(Ar/Ar)	Shroba and others, 2014
8	--	--	High-silica rhyolite dike	Mount Antero	29.1±1.0	Limbach, 1975
9	--	--	Leucogranite of Mount Antero	Mount Antero	29.97±0.15 (Ar/Ar)[1]	McIntosh and Chapin, 2004
10	--	--	Rhyolite of Bald Mtn, upper flow	Buena Vista East	29.25±0.17 (Ar)[1]	McIntosh and Chapin, 2004
11	--	--	Rhyolite of Baby Mtn	Buena Vista East	29.22±0.21 (Ar)[1]	McIntosh and Chapin, 2004
12	--	--	Rhyolite of Baby Mtn	Buena Vista East	30.47±0.08 (Ar)[1]	McIntosh and Chapin, 2004
13	--	--	Rhyolite of Baby Mtn lower flow	Buena Vista East	30.74±0.08 (Ar)[1]	McIntosh and Chapin, 2004
14	--	--	Carbonate-bearing monzogranite	Mount Antero	30.7±1.2	Cunningham, 1987
15	--	--	Granite of North Fork	Mount Antero	31.37±0.18	Zimmerer and McIntosh, 2012
16	--	MP-27	Rhyolite(?) ash-flow tuff	Poncha Pass	33.2±1.3 (Ar)	Van Alstine, 1974
17	--	--	Bonanza Tuff	--	33.3±0.08 (Ar)[1]	McIntosh and Chapin, 2004
18	--	--	Bonanza Tuff	--	33.42±0.10 (Ar)[1]	McIntosh and Chapin, 2004
19	--	--	Bonanza Tuff	--	33.52±0.03 (Ar)[1]	McIntosh and Chapin, 2004
20	--	--	Bonanza Tuff	--	33.52±0.03 (Ar)	Lipman and others, 2012
21	--	--	Badger Creek Tuff	--	34.03±0.22	Zimmerer and McIntosh, 2012
22	--	--	Mount Aetna ring dike	--	34.37±0.07	McIntosh and Chapin, 2004
23	--	--	Monzogranite of Mount Aetna	--	34.51±0.06	McIntosh and Chapin, 2004
24	--	MP-21	Monzogranite of Mount Aetna	--	34.9±0.5	Zimmerer and McIntosh, 2012
25	--	NM-2317	Rosetta lava, Tenderfoot Hill	Salida East	34.35±0.14	Kellogg and others, 2017
26	--	NM-2138	Rosetta lava, Tenderfoot Hill	Salida East	34.34±0.14	Kellogg and others, 2017
27	--	NM-2136	Rosetta lava, Tenderfoot Hill	Salida East	34.79±1.0	Kellogg and others, 2017
28	--	--	Late white porphyry	Climax	34.9±3.0	Bookstrom, 1989
29	--	--	Late white porphyry	--	36(?)	Pearson and others, 1982
30	--	--	Andesite of Trail Ridge	Buena Vista East	36.41±0.10	McIntosh and Chapin, 2004
31	F	MNR-4	Lake Creek basalt, plate	Castello Nook	36.5±1.2	Kellogg and others, 2017
32	--	NM-2120	Calpeng andesite, Buffalo Peaks	Mt. Princeton	36.28±0.36	Kellogg and others, 2017
33	--	1303	Tuff of Buffalo Peaks	Mount Princeton	36.66±0.31 (Ar)[1]	McIntosh and Chapin, 2004
34	G	BLdb-170-1	Lower tuff of Buffalo Peaks	Harvard Lakes	36.7±0.3 (Ar)	Kellogg and others, 2013
35	--	--	Upper tuff of Trail Ridge	Buena Vista East	36.68±0.32 (Ar)[1]	McIntosh and Chapin, 2004
36	--	--	Lower tuff of Trail Ridge	Buena Vista East	37.06±0.23 (Ar)[1]	McIntosh and Chapin, 2004
37	--	--	Tuff of Trail Ridge	Buena Vista East	37.68±0.13 (Ar)	Wallace and Keller, 2003
38	--	--	Tuff of Trail Ridge	Buena Vista East	38.45±0.30 (Ar)	Wallace and Keller, 2003
39	--	--	Wall Mountain Tuff	Buena Vista	37.17±0.08 (Ar)[1]	McIntosh and Chapin, 2004
40	--	--	Wall Mountain Tuff	Buena Vista	37.35±0.10 (Ar)	Zimmerer and McIntosh, 2012
41	--	--	Mount Princeton batholith	Buena Vista	34.75±0.2 (Ar)	McIntosh and Chapin, 2004
42	--	--	Mount Princeton batholith	Buena Vista	36.6±0.4	McCalpin and Shannon, 2005
43	--	--	Mount Princeton batholith	Buena Vista	35.08±0.10 (Ar)	Mills and Coleman, 2012
44	--	--	Mount Princeton batholith	Buena Vista	35.37±0.10 (Ar)	Mills and Coleman, 2012
45	H	MOS-28	Johnson Gulch Porphyry	Mount Shavano	38.1±0.6	Kellogg and others, 2017
46	I	GR11-735	White Mtns porphyry	Granite	42.25±0.23	Shroba and others, 2014
47	--	TL	Twin Lakes Granodiorite pluton	Mount Elbert	42.7±1.2 (Rb)	Obradovich and others, 1969
48	--	88-28-84a	Twin Lakes Granodiorite pluton	Mt. Elbert	44.0±1.4 (Rb)[1]	Tilling and others, 1990
49	--	NM-2134	Granite porphyry of Tumble Hill	Jones Hill	44.04±0.17	Kellogg and others, 2017
50	--	NM-2125	Granite porphyry of Tumble Hill	Jones Hill	44.17±0.16	Kellogg and others, 2017
51	--	NM-2126	Granite porphyry of Tumble Hill	Jones Hill	44.20±0.12	Kellogg and others, 2017
52	J	MOS-1	correlated with Panda Porphyry	Mount Shavano	44.1±0.8	Kellogg and others, 2017
53	--	--	correlated with Panda Porphyry	--	71.8	Cunningham and others, 1994
54	--	--	Granite porphyry of Black Mtn.	Jones Hill	44.47±0.15	Williams and others, 2013
55	K	88-89-4d	Monzodiorite dike	Harvard Lakes	45.3±0.3 (Ar)	Kellogg and others, 2013
56	L	88-89-3f	Hornblende monzodiorite	Harvard Lakes	45.4±0.3 (Ar)	Kellogg and others, 2013
57	M	88-89-12k	Hornblende-biotite diorite plug	Harvard Lakes	46.1±0.3 (Ar)	Kellogg and others, 2013
58	N	UNCHDG-6.82	Rhyolite dike	Granite	46.2±1.4	Marvin and others, 1989
59	--	--	Whitehorn Granodiorite	Salida East?	69.4±1.1 (Rb)[1]	McDowell, 1971
60	--	--	Whitehorn Granodiorite	Salida East?	70.0±2.1 (Rb)[1]	Wrucke, 1974
61	--	--	Whitehorn Granodiorite	Salida East?	71.0±2.2 (Rb)[1]	McDowell, 1971
62	--	Y-13-58-1	Browns Pass Granite	Mount Yale	1.430±11	Mercer and others, 2012
63	--	CG-38	Browns Pass Granite	Mount Yale	1.430±0.014 (c)	Mercer and others, 2012
64	O	S-1-83-1	Granodiorite of Mount Harvard	Mount Elbert	1,454±20	Mercer and others, 2012
65	P	S-4-83-1	Granodiorite of Mount Elbert	Mount Elbert	1,453±33	Mercer and others, 2017
66	Q	MNF-93-08	Granite of Granite	Granite	1,429±9	Mercer and others, 2017
67	R	GR10-321	Granite of Granite	Granite	1,430±8	Mercer and others, 2017
68	S	S-13-98-3	Langloff Gulch Granite	Mount Sherman	1,432±26	Mercer and others, 2017
69	T	Y-1-84-10	St. Kevin Granite	Mount Massive	1,425±12	Mercer and others, 2017
70	U	88-89-10	Langloff Gulch Granite	Harvard Lakes	1,441±14	Mercer and others, 2017
71	V	MNM-191	Langloff Gulch Granite	Mount Princeton	1,441±14	Mercer and others, 2017
72	W	WMNO-7	Elephant Rock Granite	Buena Vista East	1,434±8	Mercer and others, 2017
73	X	88-89-12U	Elephant Rock Granite	Harvard Lakes	1,439±8	Mercer and others, 2017
74	--	RBR-10-02-1	Granodiorite	--	Wetherill	Mercer and others, 2017
75	Y	88-87-8E-2A	Granite of Mount Yale	Mount Yale	1,430±11	Mercer and others, 2017
76	Z	S-11-84-2	Denny Creek Granodiorite	Mount Elbert	1,430±12	Mercer and others, 2017
77	--	88-89-8k-1	Denny Creek Granodiorite	Mount Harvard	1,710±10	Mercer and others, 2017
78	AA	Hedrick	Henry Mountain? Granite	Cameron Mountain	1,437±21	Hedrick and others, 1989
79	BB	CM11-756	Henry Mountain? Granite	Cameron Mountain	1,700±0	Mercer and others, 2017
80	CC	WMNO-4	Metadacite of Salida	Salida East	1,721±9	Kellogg and others, 2017
81	DD	Z-1	Metadacite of Salida	Salida East	1,720±0	Hedrick and others, 1989

Many (**Rb**)-(**Sr**) ages are 2–3% precise (uncertain age).
Rock type: Ash, ash-flow tuff; Gr, granite; Gd, granodiorite; Q, Quartz; Sy, syenite; Sy, monzonite; Sy, Syenitoids.
Ar/Ar ages: Mineral dated: S, Sanidine; B, biotite; W, whole rock; no letter, not specified.
[1]Weighted mean of the 206Pb/238U ages is reported.
[2]Recalculated by Wallace and Keller (2003).
[3]Recalculated by Shroba, 1980.
[4]Recalculated by Hedrick, 1989.
[5]Recalculated using revised standards for Fish Canyon Tuff sanidine (Kuiper and others, 2008).

Salida
Buena Vista
Leadville
Fairplay
Hartsel
Poncha Springs
Cañon City
Pueblo
Colorado Springs
Denver
Aspen
Glenwood Springs
Grand Junction
Taylor Park
Tincup
Tungsten
Lake Ellen Galbraith Campground
Twin Lakes
Twin Lakes Reservoir
Cooper Creek
Clear Creek Res.
Turquoise Lake
Mount Elbert
Mount Massive
Mount Sherman
Mount Antero
Mount Princeton
Mount Yale
Mount Harvard
Mount Oxford
Mount Columbia
Mount Shavano
Tabeguache Peak
Mount Aetna
Mount Buffalo
Mount Hope
Mount Ouray
Wall Mountain
Trail Ridge
Browns Pass
Cameron Mountain
Granite
Castello Nook
Harvard Lakes
Jones Hill
Whitehorn
Salida East
Salida West
Mount Shavano
Mount Princeton
Mount Yale
Mount Harvard
Mount Elbert
Granite
Harvard Lakes
Mount Princeton
Buena Vista East
Cameron Mountain
Salida East