Table 1. Fort Collins 1:100,000-scale quadrangle isotopic ages.

No. FC-	Unit name	Sample No.	Latitude (N)	Longitude (W)	71/2-minute quadrangle	Method	Mineral	Age in Ma	Analytical uncertainty in Ma	Reference	Comment
001	Metagabbro	BC613-3	40°33'58"[1]	105°18'39"	Buckhorn Mountain	$^{40}Ar/^{39}Ar$	Hornblende	1,534.3	1.8	Cavosie and Selverstone (2003)	Integrated age. 70 pct. of gas yields steps >1,600 Ma with older steps >1,800 Ma
002	Mylonite	BT162	40°34'02"[1]	105°18'37"	Buckhorn Mountain	$^{40}Ar/^{39}Ar$	Hornblende	1,451.6	1.6	Cavosie and Selverstone (2003)	Integrated age. Steps in spectrum suggest Early Proterozoic growth of hornblende followed by partial resetting during ~1.4 Ga mylonitization and (or) heating
003	Sherman Granite	CR-48	40°59'31"[1]	105°14'13"	Table Mountain	Rb/Sr	Whole-rock	1,400[3]	20	Zielinski and others (1981)	Isochron defined by six samples from drill core in Sherman Granite
004	Quartz monzonite	1-0-1R	40°45'42"[1]	105°12'00"	Livermore	Rb/Sr	Whole-rock	1,390[3]	30	Peterman and others (1968)	Isochron based on six samples from Log Cabin pluton
005	Quartz monzonite	C-239R	40°45'48"[1]	105°13'48"	Livermore	Rb/Sr	Whole-rock	1,390[3]	30	Peterman and others (1968)	Isochron based on six samples from Log Cabin pluton
006	Quartz monzonite	W-2-18R	40°46'18"[1]	105°11'48"	Livermore	Rb/Sr	Whole-rock	1,390[3]	30	Peterman and others (1968)	Isochron based on six samples from Log Cabin pluton
007	Quartz monzonite	W-2-20R	40°46'00"[1]	105°11'54"	Livermore	Rb/Sr	Whole-rock	1,390[3]	30	Peterman and others (1968)	Isochron based on six samples from Log Cabin pluton
008	Quartz monzonite	C-211R	40°43'42"[1]	105°17'48"	Poudre Park	Rb/Sr	Whole-rock	1,390[3]	30	Peterman and others (1968)	Isochron based on six samples from Log Cabin pluton

No. FC-	Unit name	Sample No.	Latitude (N)	Longitude (W)	71/2-minute quadrangle	Method	Mineral	Age in Ma	Analytical uncertainty in Ma	Reference	Comment
009	Quartz monzonite	E-30-1R E-30-1Mu E-30-1M E-30-1R	40°52'12"[1]	105°23'06"	Haystack Gulch	Rb/Sr	Whole-rock Muscovite- Microcline- Whole-rock	1,380[3] 1,380[3]	30 40	Peterman and others (1968)	Isochron based on six samples from Log Cabin pluton. Muscovite-microcline-whole-rock isochron
010	Hornblende-biotite quartz monzonite	W-5-15R	40°44'48"[1]	105°13'24"	Laporte	Rb/Sr	Whole-rock	1,380[3]	30	Peterman and others (1968)	10 point isochron for eight rocks and two minerals from Sherman Granite[5]
011	Hornblende-biotite granite	3-0-8R 3-0-8B 3-0-8Hb	40°45'00"[1]	105°12'30"	Livermore/ LaPorte	Rb/Sr K-Ar K-Ar	Whole-rock Biotite Hornblende	1,380[3] 1,263[3] 1,351[3]	30 40 40	Peterman and others (1968)	Whole-rock sample is included in 10 point isochron for eight rocks and two minerals from Sherman Granite
012	Hornblende-biotite quartz monzonite	W-2-7R	40°46'36"[1]	105°12'12"	Livermore	Rb/Sr	Whole-rock	1,380[3]	30	Peterman and others (1968)	10 point isochron for eight rocks and two minerals from Sherman Granite
013	Hornblende-biotite quartz monzonite	C-235.1R	40°46'06"[1]	105°14'36"	Livermore	Rb/Sr	Whole-rock	1,380[3]	30	Peterman and others (1968)	10 point isochron for eight rocks and two minerals from Sherman Granite
014	Biotite quartz monzonite	C-28.1R	40°42'48"[1]	105°17'36"	Poudre Park	Rb/Sr	Whole-rock	1,380[3]	30	Peterman and others (1968)	10 point isochron for eight rocks and two minerals from Sherman Granite
015	Biotite-hornblende granite	81-46R	40°55'00"[1]	105°22'28"	Virginia Dale	Rb/Sr	Whole-rock	1,380[3]	30	Peterman and others (1968)	10 point isochron for eight rocks and two minerals from Sherman Granite
016	Biotite-hornblende granite	31-42aR	40°55'12"[1]	105°29'54"	Cherokee Park	Rb/Sr	Whole-rock	1,380[3]	30	Peterman and others (1968)	10 point isochron for eight rocks and two minerals from Sherman Granite

No. FC-	Unit name	Sample No.	Latitude (N)	Longitude (W)	71/2-minute quadrangle	Method	Mineral	Age in Ma	Analytical uncertainty in Ma	Reference	Comment
017	Porphyritic biotite quartz monzonite	E-33-4R E-33-4M E-33-4B	40°59'54"[1]	105°28'18"	Cherokee Park	Rb/Sr	Whole-rock Microcline Biotite	1,380[3] 1,380[3] 1,380[3]	30 30 30	Peterman and others (1968)	10 point isochron for eight rocks and two minerals from Sherman Granite
018	Biotite quartz diorite	5-4-1R	40°34'00"[1]	105°11'54"	Horsetooth Reservoir	Rb/Sr	Whole-rock	1,664[3]	40	Peterman and others (1968)	Small concordant body correlated with Boulder Creek
019	Biotite quartz diorite	6-3-21R	40°34'36"[1]	105°17'12"	Buckhorn Mountain	Rb/Sr	Whole-rock	1,664[3]	40	Peterman and others (1968)	Small concordant body correlated with Boulder Creek Granodiorite
020	Biotite quartz diorite	5-4-6R	40°33'42"[1]	105°14'48"	Horsetooth Reservoir	Rb/Sr	Whole-rock	1,664[3]	40	Peterman and others (1968)	Small concordant body correlated with Boulder Creek Granodiorite
021	Biotite quartz diorite	5-4-2R	40°33'00"[1]	105°11'48"	Horsetooth Reservoir	Rb/Sr	Whole-rock	1,664[3]	40	Peterman and others (1968)	Small concordant body correlated with Boulder Creek Granodiorite
022	Biotite quartz diorite	5-4-3R	40°33'00"[1]	105°11'48"	Horsetooth Reservoir	Rb/Sr	Whole-rock	1,664[3]	40	Peterman and others (1968)	Small concordant body correlated with Boulder Creek Granodiorite
023	Biotite quartz diorite	6-3-32R	40°34'30"[1]	105°17'36"	Buckhorn Mountain	Rb/Sr	Whole-rock	1,664[3]	40	Peterman and others (1968)	Small concordant body correlated with Boulder Creek Granodiorite
024	Pegmatite	6-4-98cMu 6-4-98cM 6-4-98cT	40°34'18"[1]	105°19'48"	Buckhorn Mountain	Rb/Sr	Muscovite Microcline Tourmaline	1,458[3] 1,458[3] 1,458[3]	40	Peterman and others (1968)	Mineral isochron for this pegmatite
025	Pegmatite	5-5-8Mi	40°32'24"[1]	105°10'24"	Horsetooth Reservoir	Rb/Sr	Microcline	1,664[3]	40	Peterman and others (1968)	
026	Retrograde muscovite after sillimanite	6-2-49Mu	40°37'06"[1]	105°21'42"	Buckhorn Mountain	Rb/Sr K-Ar	Muscovite Muscovite	1,390[3] 1,388[3]	50 40	Peterman and others (1968)	

No. FC-	Unit name	Sample No.	Latitude (N)	Longitude (W)	71/2-minute quadrangle	Method	Mineral	Age in Ma	Analytical uncertainty in Ma	Reference	Comment
027	Amphibolite	0C188Hb	40°33'54"[1]	105°18'18"	Buckhorn Mountain	K-Ar	Hornblende	1,546[3]	50	Peterman and others (1968)	
028	Biotite granodiorite	USGS(D)-KC438	40°48'55"[1]	105°56'21"	Glendevey	Rb/Sr	Whole-rock	1,689[3]	[6]	McCallum and Hedge (1976)	Rawah pluton
029	Quartz monzonite	82-17	40°41'00"[1]	105°48'00"	Boston Peak	U-Pb	Zircon	1,720	8	Premo and Van Schmus (1989)	Rawah pluton
030	Carbonatite	USGS(D)-SLOAN-2	40°50'33"	105°27'22"	Haystack Gulch	K-Ar	Biotite	1,350	30	Marvin and Dobson (1979)	From Sloan diatreme
031	Kimberlite[4]	Chicken Park kimberlite	40°52'49"[1]	105°33'00"	Diamond Peak	$^{40}Ar/^{39}Ar$	Phlogopite	616	2	Lester and others (2001)	
032	Kimberlite[4]	Schaffer no. 3 pipe	40°59'41"[1]	105°30'35"	Diamond Peak	Fission-track	Zircon	377	9	Naeser and McCallum (1977)	Six zircon grains from xenoliths
033	Porphyritic rhyodacite	USGS(D)-73N1	40°41'35"	105°31'08"	Rustic	Fission-track Fission-track	Zircon Apatite	57.9 47.5	5.2 5	McCallum and Naeser (1977)	Dike
034	Dacite porphyry	USGS(D)-73N2	40°42'54"	105°35'49"	Rustic	Fission-track Fission-track	Zircon Apatite	60.2 33.6	4.9 6	McCallum and Naeser (1977)	Dike
035	Porphyritic rhyodacite to quartz latite	USGS(D)-73N3	40°43'02"	105°35'22"	Rustic	Fission-track Fission-track	Zircon Apatite	56.4 58	5.0 5	McCallum and Naeser (1977)	Dike
036	Sodic, quartz-rich dacite porphyry	USGS(D)-73N4	40°43'35"	105°34'54"	Rustic	Fission-track Fission-track	Zircon Apatite	54.0 58	5.8 9	McCallum and Naeser (1977)	Dike

No. FC-	Unit name	Sample No.	Latitude (N)	Longitude (W)	71/2-minute quadrangle	Method	Mineral	Age in Ma	Analytical uncertainty in Ma	Reference	Comment
037	Porphyritic hornblende dacite	USGS(D)-73N5	40°44'06"	105°36'11"	Rustic	Fission-track Fission-track	Zircon Apatite	53.6 56.6	5.2 6	McCallum and Naeser (1977)	Dike
038	Quartz-rich dacite porphyry	USGS(D)-5-43	40°43'21"	105°33'59"	Rustic	Fission-track	Zircon	57.2	6.0	McCallum and Naeser (1977)	Dike
039	Quartz-rich dacite porphyry	USGS(D)-5-44	40°43'20"	105°34'15"	Rustic	Fission-track	Zircon	58.7	5.8	McCallum and Naeser (1977)	Dike
040	Flow banded rhyolite	USGS(D)-5-39A	40°43'32"	105°32'21"	Rustic	Fission-track	Zircon	33.3	6.7	McCallum and Naeser (1977)	Plug
041	Rhyolite breccia	USGS(D)-73N6	40°43'27"	105°32'20"	Rustic	Fission-track	Apatite	36	4	McCallum and Naeser (1977)	Pipe
042	Rhyolite ash flow	306S	40°30'00"	105°51'30"	Chambers Lake/Fall River Pass	K-Ar	Sanidine	27.7[3]	3	Marvin and others (1974); Corbett (1968)	
043	Hornblende quartz latite porphyry	D-1	40°43'52"	105°37'18"	Rustic	K-Ar	Hornblende	56.0[3]	1.1	Marvin and others (1974); Bole (1971)	Dike
044	Granite	00LIV02	40°44'19"	105°22'25"	Poudre Park	Fission-track	Apatite	54.0	5.7	Kelley and Chapin (2004)	Laramide annealing zone[2]
045	Granite	00LIV03	40°49'55"	105°18'06"	Livermore Mountain	Fission-track	Apatite	72.3	7.1	Kelley and Chapin (2004)	Laramide annealing zone[2]
046	Granitic gneiss	00LIV04	40°50'10"	105°18'44"	Livermore Mountain	Fission-track	Apatite	50.0	5.1	Kelley and Chapin (2004)	Laramide annealing zone[2]
047	Granite	00LIV05	40°55'40'	105°16'29"	Virginia Dale	Fission-track	Apatite	51.0	5.3	Kelley and Chapin (2004)	Laramide annealing zone[2]

No. FC-	Unit name	Sample No.	Latitude (N)	Longitude (W)	71/2-minute quadrangle	Method	Mineral	Age in Ma	Analytical uncertainty in Ma	Reference	Comment
048	Biotite schist	00LIV06	40°55'46"	105°20'20"	Virginia Dale	Fission-track	Apatite	81.2	4.6	Kelley and Chapin (2004)	Laramide annealing or partial annealing zone[2]
049	Schist	94PR01	40°39'53"	105°12'53"	Laporte	Fission-track	Apatite	56.4	3.9	Kelley and Chapin (2004)	Laramide annealing zone
050	Schist	94PR02	40°41'58"	105°14'55"	Laporte	Fission-track	Apatite	75.8	4.6	Kelley and Chapin (2004)	Laramide annealing zone[2]
051	Gneiss	94PR03	40°41'31"	105°15'19"	Poudre Park	Fission-track	Apatite	57.6	3.9	Kelley and Chapin (2004)	Laramide annealing zone[2]
052	Schist/ gneiss	94PR04	40°41'18"	105°17'42"	Poudre Park	Fission-track	Apatite	70.5	5.0	Kelley and Chapin (2004)	Laramide annealing zone[2]
053	Gneiss	94PR05	40°41'23"	105°19'29"	Poudre Park	Fission-track	Apatite	68.7	5.1	Kelley and Chapin (2004)	Laramide annealing zone
054	Schist	94PR06	40°41'30"	105°22'14"	Poudre Park	Fission-track	Apatite	74.4	4.6	Kelley and Chapin (2004)	Laramide annealing zone
055	Schist	94PR07	40°40'37"	105°25'44"	Big Narrows	Fission-track	Apatite	61.9	5.1	Kelley and Chapin (2004)	Laramide annealing zone[2]
056	Gneiss	94PR08	40°41'46"	105°26'14"	Big Narrows	Fission-track	Apatite	63.4	4.9	Kelley and Chapin (2004)	Laramide annealing zone[2]
057	Granite breccia	94PR09	40°41'21"	105°25'43"	Big Narrows	Fission-track	Apatite	44.4	5.2	Kelley and Chapin (2004)	Laramide annealing zone(?)
058	Granodiorite	94PR10	40°41'53"	105°35'29"	Rustic	Fission-track	Apatite	52.5	3.7	Kelley and Chapin (2004)	Laramide annealing zone[2]
059	Granodiorite	94PR11	40°41'04"	105°46'21"	Boston Peak	Fission-track	Apatite	47.1	7.1	Kelley and Chapin (2004)	Laramide annealing zone(?)

No. FC-	Unit name	Sample No.	Latitude (N)	Longitude (W)	71/2-minute quadrangle	Method	Mineral	Age in Ma	Analytical uncertainty in Ma	Reference	Comment
060	Granodiorite	94PR12	40°37'58"	105°48'20"	Boston Peak	Fission-track	Apatite	57.3	4.9	Kelley and Chapin (2004)	Laramide annealing zone[2]
061	Gneiss	94PR13	40°33'22"	105°46'42"	Chambers Lake	Fission-track	Apatite	47.8	4.7	Kelley and Chapin (2004)	Laramide annealing zone[2]

[1] Location approximate.
[2] Track lengths determined.
[3] Age recalculated using currently accepted decay and abundance constants recommended by the IUGS Subcommission on Geochronology (Steiger and Jäger, 1977). For Rb/Sr ages based on the ^{87}Rb decay constant ($\lambda=1.39x10^{-11}$/yr) used for the earlier determinations were converted to ages based on the currently accepted decay constant ($\lambda=1.42x10^{-11}$/yr) by multiplying the earlier age by 0.9788. The K-Ar ages based on the previously used decay constant ($^{40}K/K=1.19x10^{-4}$ mol/mol) were recalculated to ages using the presently accepted decay constant ($^{40}K/K=1.167x10^{-4}$ mol/mol) with the tables of Dalrymple (1979).
[4] Ages in kimberlites can be confusing. C. Naeser (USGS, oral commun.) suggests that some dated phlogopites from kimberlites are much older than their time of emplacement as shown by the age of the rocks they intruded. Detailed $^{40}Ar/^{39}Ar$ ages on mantle xenolith phlogopites show that only the rims of the phlogopite crystals indicate eruption age (Wartho and Kelley, 2003).
[5] U-Pb zircon date on Sherman Granite just north of 41° is 1,412±13 Ma based on concordia upper intercept from 15 samples of drill core (Aleinikoff, 1983).
[6] No data.

References for isotopic ages in the Fort Collins 1:100,000-scale quadrangle

Aleinikoff, J.N., 1983, U-Th-Pb systematics of zircon inclusions in rock-forming minerals—A study of armoring against isotopic loss using the Sherman Granite of Colorado-Wyoming, USA: Contributions to Mineralogy and Petrology, v. 83, p. 259–269.

Bole, C.E., 1971, Potassium-argon ages, argon diffusion studies, and petrography in the northern Front Range, Manhattan, Colorado: Ohio State University M.S. thesis.

Corbett, M.K., 1968, Tertiary volcanism of the Specimen-Lulu-Iron Mountain area, north-central Colorado, *in* Epis, R.C., ed., Cenozoic volcanism in the southern Rocky Mountains: Colorado School of Mines Quarterly, v. 63, no. 3, p. 1–7.

Cavosie, Aaron, and Selverstone, Jane, 2003, Early Proterozoic oceanic crust in the northern Colorado Front Range—Implications for crustal growth and the initiation of basement faults: Tectonics, v. 22, no. 2, doi:10.1029/2001TC001325, 23 p.

Dalrymple, G.B., 1979, Critical tables for conversion of K-Ar ages from old to new constants: Geology, v. 7, p. 558–560.

Kelley, S.A., and Chapin, C.E., 2004, Denudation history and internal structure of the Front Range and Wet Mountains, Colorado, based on apatite fission-track thermochronology, *in* Cather, S.M., McIntosh, W.A., and Kelley, S.A., eds., Tectonics, geochronology, and volcanism in the southern Rocky Mountains and Rio Grande rift: New Mexico Bureau of Geology and Mineral Resources Bulletin 160, p. 41–77

Lester, A.P., Larson, E.E., Farmer, G.L., Stern, C.R., and Funk, J.A., 2001, Neoproterozoic kimberlite emplacement in the Front Range, Colorado: Rocky Mountain Geology, v. 36, no. 1, p. 1–12.

Marvin, R.F., and Dobson, S.W., 1979, Radiometric ages—Compilation B, U.S. Geological Survey: Isochron/West, no. 26, 32 p.

Marvin, R.F., Young, E.J., Mehnert, H.H., and Naeser, C.W., 1974, Summary of radiometric age determinations on Mesozoic and Cenozoic igneous rocks and uranium and base metal deposits in Colorado: Isochron/West, no. 11, 41 p.

McCallum, M.E., and Hedge, C.E., 1976, Rb-Sr ages of granitic rocks in the Rawah batholith, Medicine Bow Mountains, northern Colorado: Isochron/West, no. 17, p. 33–37.

McCallum, M.E., and Naeser, C.W., 1977, Fission-track ages of Tertiary intrusive rocks in the Manhattan mining district, northern Front Range, Colorado: Isochron/West, no. 18, p. 1–4.

Naeser, C.W., and McCallum, M.E., 1977, Fission-track determinations of kimberlite zircons: Santa Fe, New Mexico, Second International kimberlite conference, extended abstracts.

Peterman, Z.E., Hedge, C.E., and Braddock, W.A., 1968, Age of Precambrian events in the northeastern Front Range, Colorado: Journal of Geophysical Research, v. 73, no. 6, p. 2277–2296.

Premo, W.R., and Van Schmus, W.R., 1989, Zircon geochronology of Precambrian rocks in southeastern Wyoming and northern Colorado, *in* Grambling, J.A., and Tewksbury, B.J., eds., Proterozoic geology of the southern Rocky Mountains: Geological Society of America Special Paper 235, p. 13–32.

Steiger, R.H., and Jäger, E., 1977, Subcommission on geochronology: Convention on use of decay constants in geo- and cosmochronology: Earth and Planetary Science Letters, v. 36, p. 359–362.

Wartho, Jo-Anne, and Kelley, S.P., 2003, $^{40}Ar/^{39}Ar$ ages in mantle phlogopites—Determining the ages of multiple lithospheric mantle events and diatreme ascent rates in southern Africa and Malaita, Solomon Islands, *in* Vance, D., Muller, W., and Villa, I.M., eds., Geochronology-linking the isotopic record with petrology and textures: Geological Society of London Special Publication no. 220, p. 231–248.

Zielinski, R.A., Peterman, Z.E., Stuckless, J.S., Rosholt, J.N., and Nkomo, I.T., 1981, The chemical and isotopic record of rock-water interaction in the Sherman Granite, Wyoming and Colorado: Contributions to Mineralogy and Petrology, v. 78, p. 209–219.