DR1: $^{40}Ar/^{39}Ar$ analytical techniques

Mass spectrometer parameters

Argon isotopes were analyzed with a MAP 215-50 mass spectrometer equipped with a Johnston electron multiplier operating in static mode with a Nier source. The multiplier is operated at ~2.2 kV and yields a gain of about 7000 above the Faraday. Analyses were conducted in three intervals between 2001 and 2003 during which time mass spectrometer sensitivity ranged from 1.68e-16 to 1.73e-16 mol/pA (NM-145), 2.47e-16 to 2.50e-16 mol/pA (NM-158), and 2.70e-16 mol/pA (NM-164) for furnace analyses and 9.05e-17 to 9.37e-17 mol/pA (NM-145), 1.35e-16 to 1.36e-16 mol/pA (NM-158), and 1.55e-16 mol/pA (NM-164) for laser analyses. One AMU discrimination values were 1.00535±0.00031, 1.00484±0.00092 and 1.0052±0.00121 in favor of light isotopes for NM-145, NM-157, and NM-164, respectively. Resolution at 5% peak-height at mass 40 was typically 600. Detailed description of analytical methods can be found in the New Mexico Bureau of Geology and Mineral Resources open file report OF-AR-1 at http://geoinfo.nmt.edu/publications/openfile/argon/home.html.

Furnace step-heating

Samples were step heated in a double vacuum molybdenum resistance furnace. K-feldspar separates wrapped in Cu-foil were heated with high resolution (~45 steps) heating schedules, and isothermal steps were conducted to help evaluate excess argon contamination (e.g. Harrison et al., 1993). The gas released reacted with a SAES GP-50 getter operating at ~450°C during heating followed by a second stage of clean up using 2 SAES GP-50 getters (one at 20°C, one at ~450°C) and a tungsten filament operated at ~2000°C. Typically K-feldspar steps were gettered for 2 minutes. The furnace thermocouple was calibrated by melting Cu-foil and true furnace temperature was 35 or 45°C lower than thermocouple temperature. Heating schedules were adjusted by this amount, and corrected sample temperatures are reported in data tables.

Furnace blank and background values were determined by running a 15 minute, 800°C hot blank prior to each analysis. In December 2001 blank and background values were 770, 15, 0.9, 8, and $3.3x10^{-18}$ moles and 590, 7, 0.7, 6, and $2.8x10^{-18}$ moles in October 2002 for masses 40, 39, 38, 37, and 36, respectively.

Laser step-heating

Hornblende, muscovite, and biotite were heated using a defocused Synrad 50 Watt CO_2 laser. Extracted gas was gettered using 2 GP-50 getters operating at 20°C and ~450°C, a tungsten filament at 2000°C, and a cold finger at -140°C.

Blanks and backgrounds were run throughout the step heating experiments. Samples were analyzed in three batches at which times blank and background values were 250, 3.5, 0.4, 1.5, 1.0×10^{-18} moles in December 2001, 592, 0.3, 0.7, 2.2×10^{-18} moles in May 2003, and 500, 4.8, 0.7, 4.8, and 0.90×10^{-18} moles in June 2003 for masses 40, 39, 38, 37, and 36, respectively.

Irradiations, flux monitoring, and age calculations

Samples were irradiated in machined Al disks in the 5C position at the McMaster University reactor, Ontario, for 52.800 MW hours (irradiation NM-145), 41.717 MW hours (irradiation NM-158), and 99.95 MW hours (irradiation NM-164). Fluence gradients were measured using Fish Canyon sanidine placed in holes of known geometry in the Al disks. Typically, 4 single crystals from each position were analyzed to determine the J-value. Mean values for each location were fit with a sine curve and J-values for unknowns were extrapolated based on their geometric relation. J-factor errors are estimated at 0.1 to 0.2% (1σ). Correction factors for interfering reactions were measured using CaF_2 and K-glass included with the samples during irradiation. Four to five grains of each are typically fused to obtain a weighted mean value for each factor and are: NM-145 $(^{39}Ar/^{37}Ar)_{Ca} = 0.0007 \pm 0.00002$; $(^{36}Ar/^{37}Ar)_{Ca} = 0.00027 \pm 0.000005$; $(^{40}Ar/^{39}Ar)_K = 0.031 \pm 0.001$; NM-158 $(^{39}Ar/^{37}Ar)_{Ca} = 0.00075 \pm 0.00003$; $(^{36}Ar/^{37}Ar)_{Ca} = 0.000292 \pm 0.000006$; $(^{40}Ar/^{39}Ar)_K = 0.0296 \pm 0.0005$, and NM-164 $(^{39}Ar/^{37}Ar)_{Ca} = 0.0007 \pm 0.00005$; $(^{36}Ar/^{37}Ar)_{Ca} = 0.00027 \pm 0.00001$; $(^{40}Ar/^{39}Ar)_K = 0.02559 \pm 0.0005$.

Age assignments were handled several ways depending on the complexity of the age spectrum. Ideally, a plateau age is assigned where greater than 50% of the total ^{39}Ar released yields 3 consecutive heating steps with an MSWD of ~1. However, most spectra for this study are complex and weighted means of chosen steps rarely yield MSWD values that fall within the 95% confidence window for n-1 degrees of freedom. Despite this, we still report the weighted mean ages (Taylor, 1982) as plateau ages and increase the weighted mean error by multiplying by the square root of the MSWD. As mentioned in the text, we generally do not attempt to compare data within the cited precision as there are many geological reasons why individual samples will have variable ages and why individual spectra will have internal discordance. Total gas ages and errors are calculated by quadradically summing of all steps and are at times used as our best approximation of the argon closure age.

Monitor age and decay constants

The assigned age of Fish Canyon sanidine is 28.27 Ma and the total ^{40}K decay constant is 5.476e-10/a (Kwon et al., 2002). At present there is no accepted value for the age of FC sanidine (Renne et al., 1998; Lanphere et al., 2001), however there as been considerable recent work towards determining and evaluating the monitor age and ^{40}K decay constants (Min et al., 2000, Kwon, et al., 2002). These recent papers have recognized that $^{40}Ar/^{39}Ar$ ages based on an age of 28.02 Ma for FC sanidine and decay constants recommended by Steiger and Jäger (1977) yield younger results compared to U/Pb ages for samples that should not be discordant. In the near future it is expected that new decay constants for ^{40}K will be recommended based upon the U/Pb system and therefore ages reported here use the values of Kwon et al. (2002) in anticipation of this change. We recognize that these values used here will likely not be the final accepted values, but feel that they best reflect our present knowledge.

Sample preparation

Samples of Proterozoic granite, tonalite, pegmatite, and schist were collected at eight locations along a roughly west to east transect from Santa Fe, NM to Las Vegas, NM. This sampling traverse is perpendicular to the north-striking Picuris-Pecos and Montezuma fault zones and was designed to determine if there are variations in the thermal histories recorded by opposing sides of the faults. Drill cuttings from three basement penetrating petroleum exploration wells east of Las Vegas, NM, approximately 30 kilometers from Hermit Peak, were also obtained from the New Mexico Bureau of Geology and Mineral Resources. Cuttings provide samples of crystalline basement rocks present in the subsurface of the Las Vegas basin. Depth to basement varies and these three samples are from 925, 1300 and 1600 m. Mineral separates were prepared by standard magnetic and heavy liquid techniques. Grain fractions ranging 600 to 180 microns were hand picked to obtain a monomineralic separate. Separates were weighed and wrapped in copper foil before being loaded into machined aluminum disks which in turn were stacked vertically for irradiation.

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DR2. $^{40}Ar/^{39}Ar$ analytical data for samples from the Sangre de Cristo Range and Las Vegas basin, New Mexico.

	ID	Power/Temp (W/°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
	HP02-4 A, E4:157, 1 to 4 xls hornblende, J=0.0188187, D=1.0052±0.00172, NM-157, Lab#=53558-01										
#	A	1.5	278.3	3.325	499.5	0.797	0.15	47.1	0.5	2272	22
#	B	3.0	318.0	5.589	224.9	1.07	0.091	79.2	1.3	3197.4	11.9
#	C	4.0	106.7	4.819	29.62	1.48	0.11	92.2	2.3	1916.2	6.9
#	D	4.5	80.17	5.674	7.142	2.47	0.090	97.9	4.0	1660.6	5.3
#	E	5.0	70.91	5.746	2.908	9.27	0.089	99.4	10.4	1545.9	3.0
#	F	5.5	73.58	5.709	2.552	30.4	0.089	99.6	31.3	1586.5	2.3
	G	6.0	70.20	5.728	2.396	53.1	0.089	99.6	67.9	1537.7	2.3
	H	7.5	70.64	5.742	2.338	34.1	0.089	99.7	91.4	1544.5	2.8
	I	8.5	71.44	7.444	3.501	8.15	0.069	99.4	97.0	1554.5	4.3
#	J	10	66.30	9.437	5.066	3.58	0.054	98.9	99.5	1473.8	7.3
#	K	12	60.46	14.07	7.357	0.798	0.036	98.3	100.0	1380	10
	Total gas age ± 1σ			n=11		145.2				1579.6	2.4
	WMA ± 1s		steps G-I	n=3	MSWD=6.25	95.4	0.087		65.7	1542.6	4.3
	HP02-4 B, E4:157, 1 to 4 xls hornblende, J=0.0188187, D=1.00484±0.00092, NM-157, Lab#=53558-10										
#	A	1.5	351.2	2.082	409.9	0.602	0.25	65.6	0.9	3059	18
#	B	3.0	87.46	5.713	6.687	24.1	0.089	98.3	36.7	1761.2	1.9
	C	4.0	67.77	5.766	2.557	36.6	0.088	99.6	91.0	1500.6	1.8
	D	4.5	68.21	6.007	10.08	1.44	0.085	96.3	93.2	1473.7	7.0
	E	5.0	72.67	6.474	4.604	2.28	0.079	98.8	96.6	1566.0	5.2
	F	5.5	67.79	7.144	3.966	1.89	0.071	99.1	99.4	1497.1	5.1
#	G	6.0	65.43	7.252	27.85	0.157	0.070	88.3	99.6	1348	38
#	H	7.5	67.19	12.28	13.10	0.268	0.042	95.7	100.0	1456	24
	Total gas age ± 1σ			n=8		67.4				1619.8	1.9
	WMA ± 1s		steps C-F	n=4	MSWD=55.98	42.3	0.087		62.7	1505	12
	HP02-4 C, E4:157, 1 to 4 xls hornblende, J=0.0188187, D=1.00484±0.00092, NM-157, Lab#=53558-12										
#	A	1.5	182.5	1.540	316.9	1.60	0.33	48.8	1.9	1798	13
#	B	2.5	73.73	2.954	24.29	3.93	0.17	90.6	6.5	1488.1	4.5
#	C	3.4	70.60	5.679	3.239	30.1	0.090	99.3	41.9	1539.9	1.7
	D	4.5	64.23	5.657	2.492	37.8	0.090	99.6	86.4	1446.0	1.4
#	E	5.0	65.88	6.016	3.542	5.54	0.085	99.1	92.9	1467.6	3.3
#	F	5.5	66.74	7.098	3.586	5.67	0.072	99.3	99.6	1482.7	3.3
#	G	6.0	69.73	7.329	15.77	0.372	0.070	94.2	100.0	1474	17
	Total gas age ± 1σ			n=7		84.9				1492.8	1.7
	WMA ± 1s		steps D-D	n=1	MSWD=0.00	37.8	0.090		44.5	0.0	0.0
	HP02-4 D, E4:157, 1 to 4 xls hornblende, J=0.0188187, D=1.00484±0.00092, NM-157, Lab#=53558-14										
#	A	1.5	363.5	3.841	445.8	0.553	0.13	63.8	1.0	3073	14
#	B	2.5	121.9	5.188	36.31	1.61	0.098	91.5	3.8	2069.8	5.9
#	C	3.5	76.18	5.964	2.814	31.0	0.086	99.5	58.1	1623.2	2.1
	D	4.5	68.13	5.900	2.424	17.9	0.086	99.6	89.4	**1506.8**	**2.2**
#	E	5.0	80.30	7.124	5.389	3.08	0.072	98.7	94.8	1672.3	3.8
#	F	5.5	85.68	7.781	4.538	2.49	0.066	99.2	99.2	1749.8	3.9
#	G	6.0	92.38	10.21	-4.1574	0.162	0.050	102.2	99.5	1873	29
#	H	7.5	109.5	12.10	-0.5330	0.300	0.042	101.0	100.0	2066	19
	Total gas age ± 1σ			n=8		57.0				1635.3	2.0
	Step D										

DR2. $^{40}Ar/^{39}Ar$ analytical data for samples from the Sangre de Cristo Range and Las Vegas basin, New Mexico.

	ID	Power/Temp (W/°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
	HP02-4 E, E4:157, 1 to 4 xls hornblende, J=0.0188187, D=1.00484±0.00092, NM-157, Lab#=53558-16										
#	A	1.5	329.6	3.267	342.5	0.650	0.16	69.4	0.9	3050	14
#	B	2.5	86.96	5.420	14.97	2.37	0.094	95.4	4.2	1721.3	5.9
#	C	3.5	72.21	5.767	2.120	43.5	0.088	99.8	65.3	1568.6	2.2
	D	4.5	65.59	5.819	2.305	22.3	0.088	99.7	96.5	1468.4	2.0
	E	5.0	63.93	7.294	3.238	1.23	0.070	99.4	98.2	1441.2	6.6
#	F	5.5	69.64	9.908	1.740	1.10	0.051	100.4	99.8	1540.2	6.2
#	G	6.0	76.90	13.22	4.460	0.157	0.039	99.7	100.0	1640	35
	Total gas age ± 1σ			n=7		71.3				1561.8	2.0
	WMA ± 1s		steps D-E	n=2	MSWD=15.77	23.5	0.087		33.0	1466.2	7.5
	HP02-4 F, E4:157, 1 to 4 xls hornblende, J=0.0188187, D=1.00484±0.00092, NM-157, Lab#=53558-29										
#	A	1.5	354.2	1.742	341.5	0.869	0.29	71.5	1.1	3202	12
#	B	2.5	107.5	4.417	22.48	2.49	0.12	94.1	4.1	1950.2	5.1
	C	3.5	71.44	5.823	2.774	33.4	0.088	99.5	44.4	**1554.5**	**2.0**
#	D	4.5	74.94	5.692	2.107	39.3	0.090	99.8	92.0	1608.0	2.3
#	E	5.0	69.23	8.239	4.432	4.98	0.062	99.1	98.0	1518.9	3.7
#	F	5.5	71.48	16.94	4.852	1.43	0.030	99.9	99.8	1567.4	6.6
#	G	6.0	84.97	29.80	3.444	0.137	0.017	101.6	99.9	1786	32
#	H	7.5	109.0	29.20	-5.2474	0.068	0.017	103.6	100.0	2106	51
	Total gas age ± 1σ			n=8		82.6				1619.6	2.0
	Step C										
	HP02-4 G, E4:157, 1 to 4 xls hornblende, J=0.0188187, D=1.00484±0.00092, NM-157, Lab#=53558-37										
#	A	1.5	387.8	4.504	387.8	0.578	0.11	70.5	0.7	3321	17
#	B	2.5	101.9	5.183	35.99	1.75	0.098	90.0	2.8	1835.0	5.8
#	C	3.0	77.95	5.935	4.276	6.34	0.086	99.0	10.3	1641.9	3.6
#	D	3.5	68.74	5.926	2.598	31.4	0.086	99.6	47.5	1515.3	1.8
	E	4.0	65.74	5.853	2.416	29.7	0.087	99.6	82.6	**1470.3**	**2.9**
#	F	5.0	70.30	7.065	3.206	14.2	0.072	99.5	99.4	1538.2	2.7
#	G	6.0	69.32	6.208	-14.1360	0.325	0.082	106.7	99.8	1597.2	17.4
#	H	7.5	71.11	4.005	-41.1861	0.084	0.13	117.6	99.9	1729	55
#	I	8.5	88.47	2.704	-14.0368	0.056	0.19	104.9	100.0	1847	83
	Total gas age ± 1σ			n=9		84.3				1542.4	1.9
	Step E										
	HP02-4 H, E4:157, 1 to 4 xls hornblende, J=0.0188187, D=1.00484±0.00092, NM-157, Lab#=53558-39										
#	A	1.5	417.9	3.596	413.5	0.544	0.14	70.8	0.8	3442	15
#	B	2.5	95.86	5.057	25.47	1.76	0.10	92.6	3.3	1797.1	5.4
#	C	3.0	78.76	5.734	2.891	13.5	0.089	99.5	22.9	1658.6	2.4
#	D	3.5	66.18	5.804	2.500	33.6	0.088	99.6	71.8	1476.6	2.4
	E	4.0	64.06	5.889	2.670	11.1	0.087	99.5	88.0	**1443.1**	**2.5**
#	F	5.0	68.22	6.827	3.874	7.62	0.075	99.1	99.1	1503.5	2.4
#	G	6.0	66.35	9.118	6.199	0.356	0.056	98.3	99.6	1469	13
#	H	7.5	67.85	8.218	20.63	0.172	0.062	92.0	99.8	1424	24
#	I	8.5	72.75	7.157	58.17	0.109	0.071	77.1	100.0	1321	41
	Total gas age ± 1σ			n=9		68.7				1546.9	2.0
	Step E									**1443.1**	**2.5**

DR2. $^{40}Ar/^{39}Ar$ analytical data for samples from the Sangre de Cristo Range and Las Vegas basin, New Mexico.

	ID	Power/Temp (W/°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
	HP02-2 I, C11:157, 1 to 4 xls hornblende, J=0.0192598, D=1.0052±0.00172, NM-157, Lab#=53555-01										
#	A	1.5	149.6	1.989	477.4	0.220	0.26	5.8	1.3	283	97
#	B	3.0	73.36	2.322	140.5	0.409	0.22	43.6	3.6	878	34
#	C	4.0	45.37	1.267	26.81	0.411	0.40	82.7	6.0	994	17
#	D	4.5	50.97	2.540	18.67	0.332	0.20	89.6	7.9	1153	16
#	E	5.0	54.42	3.731	10.19	0.610	0.14	95.0	11.5	1264	12
	F	5.5	58.18	5.016	4.335	3.80	0.10	98.5	33.5	1360.8	4.7
	G	6.0	58.23	5.068	3.294	5.01	0.10	99.0	62.5	1366.9	3.8
#	H	7.5	56.37	4.903	2.794	5.24	0.10	99.2	92.8	1337.8	3.8
#	I	8.5	51.79	6.592	6.486	0.585	0.077	97.3	96.2	1242	11
#	J	10	53.06	11.44	2.524	0.506	0.045	100.3	99.1	1296	12
#	K	12	53.24	22.55	18.11	0.158	0.023	93.3	100.0	1240	34
	Total gas age ± 1σ			n=11		17.3				1312.7	3.1
	WMA ± 1s		steps F-G	n=2	MSWD=1.02	8.8	0.10		51.0	1364.5	3.1
	HP02-2 J, C11:157, 1 to 4 xls hornblende, J=0.0192598, D=1.00484±0.00092, NM-157, Lab#=53555-14										
#	A	1.5	125.3	2.385	344.7	2.20	0.21	18.8	2.0	685	23
#	B	2.5	53.53	3.423	31.30	4.95	0.15	83.2	6.4	1132.8	4.2
	C	3.0	59.55	4.595	3.489	18.9	0.11	98.9	23.3	1387.0	1.9
	D	3.2	59.44	4.733	2.625	12.9	0.11	99.3	34.8	1389.7	2.0
	E	3.5	59.24	4.627	2.194	12.7	0.11	99.5	46.2	1388.1	2.1
	F	4.0	59.02	4.686	2.069	30.0	0.11	99.6	73.0	1385.4	1.9
	G	5.0	59.05	5.407	2.795	24.9	0.094	99.3	95.3	1383.7	3.1
	H	5.5	58.82	13.05	6.034	4.45	0.039	98.7	99.3	1379.3	3.4
#	I	7.5	64.19	45.38	23.60	0.480	0.011	94.8	99.7	1448	16
#	J	10	243.7	49.19	515.7	0.259	0.010	39.1	99.9	1944	38
#	K	12	518.0	78.24	1565.8	0.090	0.007	11.9	100.0	1484	112
	Total gas age ± 1σ			n=11		111.9				1365.7	1.8
	WMA ± 1s		steps C-H	n=6	MSWD=1.78	103.9	0.10		92.9	1386.5	1.5
	HP02-2 K, C11:157, 1 to 4 xls hornblende, J=0.0192598, D=1.00484±0.00092, NM-157, Lab#=53555-16										
#	A	1.5	144.2	2.091	421.1	2.00	0.24	13.8	1.8	593	21
#	B	2.5	50.16	1.893	63.58	3.10	0.27	62.8	4.5	866.6	7.1
#	C	3.0	57.12	3.540	8.821	4.39	0.14	95.9	8.3	1317.5	3.4
#	D	3.2	58.02	4.242	1.845	6.35	0.12	99.6	13.9	1368.9	3.3
	E	3.5	59.56	4.669	1.629	20.4	0.11	99.8	31.7	1396.3	2.0
	F	4.0	59.54	4.610	2.020	46.3	0.11	99.6	72.2	1393.9	1.6
#	G	5.0	58.20	4.978	2.757	21.2	0.10	99.3	90.8	1368.8	2.2
#	H	5.5	54.62	5.930	3.963	9.12	0.086	98.7	98.8	1303.9	2.2
#	I	7.5	52.29	9.216	3.577	0.944	0.055	99.4	99.6	1272.0	8.0
#	J	10	97.40	19.13	140.1	0.403	0.027	59.0	99.9	1374	22
#	K	12	296.9	92.03	800.5	0.064	0.006	22.8	100.0	1593	122
	Total gas age ± 1σ			n=11		114.3				1353.3	1.7
	WMA ± 1s		steps E-F	n=2	MSWD=0.82	66.7	0.11		58.3	1394.8	1.6

DR2. $^{40}Ar/^{39}Ar$ analytical data for samples from the Sangre de Cristo Range and Las Vegas basin, New Mexico.

	ID	Power/Temp (W/°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
	HP02-2 L, C11:157, 1 to 4 xls hornblende, J=0.0192598, D=1.00484±0.00092, NM-157, Lab#=53555-30										
#	A	1.5	62.97	2.809	131.7	0.637	0.18	38.5	1.6	701	24
#	B	2.5	47.29	3.579	26.99	0.986	0.14	83.7	4.0	1036.4	9.7
	C	3.0	59.46	4.537	3.637	6.92	0.11	98.8	21.2	1384.6	2.9
	D	3.2	59.21	4.617	1.602	6.58	0.11	99.8	37.5	1390.6	2.9
	E	3.5	58.88	4.699	1.840	7.63	0.11	99.7	56.4	1384.2	3.3
	F	4.0	59.42	4.789	2.504	14.1	0.11	99.4	91.3	1389.9	2.2
#	G	5.0	55.96	6.454	5.679	1.83	0.079	97.9	95.8	1319.3	6.0
#	H	5.5	57.76	9.751	8.354	0.457	0.052	97.1	96.9	1343	15
#	I	7.5	59.23	17.46	13.48	0.643	0.029	95.6	98.5	1358	11
#	J	10	97.87	25.51	142.6	0.564	0.020	59.0	99.9	1383	20
#	K	12	317.9	99.77	1083.5	0.025	0.005	1.8	100.0	203	497
	Total gas age ± 1σ			n=11		40.3				1366.1	1.9
	WMA ± 1s		steps C-F	n=4	MSWD=1.41	35.2	0.11		87.3	1387.9	1.9
	HP02-2 A, E7:157, 1 to 4 xls biotite, J=0.0193994, D=1.0052±0.00172, NM-157, Lab#=53560-01										
#	A	1.0	582.2	0.1682	1915.2	2.49	3.0	2.8	2.6	501	122
#	B	1.4	74.53	0.0299	86.69	5.44	17.1	65.6	8.2	1218.0	6.6
	C	1.7	60.91	0.0124	27.58	7.11	41.1	86.6	15.5	1286.5	3.9
	D	2.0	56.94	0.0086	11.21	13.7	59.6	94.2	29.6	1301.8	3.1
	E	2.4	55.28	0.0099	4.654	19.6	51.3	97.5	49.8	1306.5	2.3
	F	2.7	55.51	0.0075	2.946	13.9	68.0	98.4	64.1	1319.2	2.6
	G	3.0	54.86	0.0097	1.607	8.63	52.7	99.1	73.0	1314.8	2.8
	H	3.5	55.01	0.0287	3.042	7.65	17.8	98.4	80.9	1310.1	3.1
	I	3.8	54.70	0.0514	5.150	3.23	9.9	97.2	84.3	1294.0	4.8
	J	4.2	54.83	0.0847	4.904	2.15	6.0	97.4	86.5	1297.5	4.8
	K	5.0	54.04	0.1376	2.543	4.96	3.7	98.6	91.6	1296.1	3.0
	L	6.0	54.20	0.3291	4.554	3.51	1.6	97.6	95.2	1288.9	4.1
	M	8.0	53.53	1.198	5.475	4.45	0.43	97.2	99.8	1274.2	4.0
	N	10	54.88	0.2650	13.68	0.185	1.9	92.7	100.0	1253	30
	Total gas age ± 1σ			n=14		96.9				1282.1	4.0
	WMA ± 1s		steps C-N	n=12	MSWD=14.41	89.0	41.8		91.8	1303.0	3.8
	HP02-2 B, E7:157, 1-4 xls biotite, J=0.0193994, D=1.00484±0.00092, NM-157, Lab#=53560-10										
#	A	1	298.0	0.0484	874.8	24.8	10.5	13.2	6.2	1038	22
	B	1.4	60.61	0.0047	25.10	55.2	107.9	87.8	20.0	1294.1	2.0
	C	1.7	55.46	0.0028	5.259	85.1	179.7	97.2	41.3	1306.6	1.7
	D	2.0	55.39	0.0030	2.663	63.7	171.8	98.6	57.2	1318.5	1.7
	E	2.4	55.14	0.0053	2.066	54.2	96.2	98.9	70.7	1317.3	1.8
	F	2.7	55.88	0.0144	2.247	24.3	35.5	98.8	76.8	1329.1	1.8
	G	3.0	55.53	0.0116	2.675	19.1	43.9	98.6	81.6	1321.0	1.8
	H	3.5	55.30	0.0482	2.499	21.7	10.6	98.7	87.0	1318.0	2.6
	I	3.8	55.30	0.0330	2.512	13.9	15.5	98.7	90.4	1317.9	2.1
	J	4.2	55.09	0.0716	3.025	8.05	7.1	98.4	92.5	1311.7	2.6
	K	5.0	55.32	0.2525	3.901	9.80	2.0	98.0	94.9	1311.5	2.8
	L	6.0	54.85	0.5949	3.946	15.8	0.86	98.0	98.8	1303.9	2.6
	M	8.0	55.02	0.9436	4.636	1.02	0.54	97.6	99.1	1304.1	9.0
	N	10	55.38	0.6542	3.873	3.63	0.78	98.0	100.0	1313.6	4.2
	Total gas age ± 1σ			n=14		400.4				1296.0	2.3
	WMA ± 1s		steps B-N	n=13	MSWD=20.01	375.5	105.6		93.8	1314.4	2.9

DR2. $^{40}Ar/^{39}Ar$ analytical data for samples from the Sangre de Cristo Range and Las Vegas basin, New Mexico.

	ID	Power/Temp (W/°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
	HP02-2 C, E7:157, 1-4 xls biotite, J=0.0193994, D=1.00484±0.00092, NM-157, Lab#=53560-34										
#	A	1.0	105.6	0.0251	188.2	53.3	20.3	47.3	29.4	1237.6	6.1
	B	1.4	54.44	0.0124	3.199	55.1	41.1	98.3	59.8	1299.4	1.9
	C	1.7	54.65	0.0348	1.607	29.6	14.7	99.1	76.1	1311.3	1.7
	D	2.0	54.91	0.0102	2.099	11.4	50.0	98.9	82.4	1313.2	2.4
	E	2.4	54.29	0.0544	1.821	10.2	9.4	99.0	88.0	1304.0	2.6
	F	2.7	53.99	0.0597	3.162	5.55	8.6	98.3	91.1	1291.9	3.2
	G	3.0	53.31	0.0701	3.604	3.25	7.3	98.0	92.9	1277.7	3.7
	H	3.5	53.51	0.3676	2.857	2.84	1.4	98.5	94.4	1285.7	4.8
	I	3.8	53.89	0.2722	3.740	1.91	1.9	98.0	95.5	1287.5	4.8
	J	4.2	53.61	0.5515	3.814	2.04	0.93	98.0	96.6	1282.9	4.9
	K	5.0	52.38	1.087	3.579	2.01	0.47	98.1	97.7	1263.4	5.6
	L	6.0	53.72	0.8449	1.543	1.86	0.60	99.3	98.7	1297.1	4.8
	M	8.0	53.48	1.302	4.899	2.28	0.39	97.5	100.0	1276.4	6.2
	Total gas age ± 1σ			n=13		181.3				1282.7	2.5
	WMA ± 1s		steps B-M	n=12	MSWD=18.47	127.9	26.9		70.6	1300.2	3.8
	HP02-2 D, E7:157, 1-4 xls biotite, J=0.0193994, D=1.00484±0.00092, NM-157, Lab#=53560-36										
#	A	1.0	123.3	0.0267	255.5	81.8	19.1	38.7	23.2	1196.5	7.6
	B	1.4	54.39	0.0114	6.364	100.8	44.9	96.5	51.8	1282.3	2.0
	C	1.7	53.84	0.0170	2.192	54.9	30.0	98.8	67.4	1294.1	2.0
	D	2.0	53.94	0.0192	1.957	34.5	26.6	98.9	77.2	1297.2	1.7
	E	2.4	53.42	0.0513	2.518	23.6	10.0	98.6	83.9	1285.3	2.0
	F	2.7	52.62	0.0849	2.261	14.6	6.0	98.7	88.1	1272.5	1.9
	G	3.0	52.76	0.1239	2.756	9.99	4.1	98.5	90.9	1272.4	2.4
	H	3.5	52.42	0.0440	2.797	8.40	11.6	98.4	93.3	1266.1	3.1
	I	3.8	52.31	0.1309	3.751	7.31	3.9	97.9	95.4	1259.3	2.7
	J	4.2	52.45	0.1288	3.082	3.33	4.0	98.3	96.3	1265.4	3.6
	K	5.0	52.56	0.5652	3.110	4.19	0.90	98.3	97.5	1268.0	3.3
	L	6.0	53.16	0.5080	3.319	7.36	1.0	98.2	99.6	1277.5	2.3
	M	8.0	55.25	-0.0074	5.501	1.43	-	97.1	100.0	1301.6	5.4
	Total gas age ± 1σ			n=13		352.1				1264.4	2.6
	WMA ± 1s		steps B-M	n=12	MSWD=28.29	270.3	28.1		76.8	1280.8	3.7
	HP02-2 E, E7:157, 1-4 xls biotite, J=0.0193994, D=1.00484±0.00092, NM-157, Lab#=53560-38										
#	A	1.0	111.7	0.0310	229.2	57.4	16.4	39.3	14.2	1124.9	7.0
	B	1.4	54.41	-0.0040	7.414	95.1	-	96.0	37.8	1277.1	1.7
	C	1.7	53.64	0.0064	2.611	75.8	79.8	98.6	56.5	1288.5	1.9
	D	2.0	53.47	0.0064	1.697	33.5	79.8	99.1	64.8	1290.3	1.8
	E	2.4	53.56	0.0165	1.859	41.2	31.0	99.0	75.0	1291.0	1.9
	F	2.7	52.74	0.0731	2.406	24.3	7.0	98.7	81.0	1273.9	2.7
	G	3.0	53.20	0.0918	2.579	16.2	5.6	98.6	85.1	1281.2	2.3
	H	3.5	52.88	0.1207	1.805	16.4	4.2	99.0	89.1	1279.5	2.3
	I	3.8	52.50	0.0829	2.372	7.11	6.2	98.7	90.9	1269.8	2.7
	J	4.2	52.63	0.1689	2.431	8.24	3.0	98.7	92.9	1272.1	2.3
	K	5.0	53.57	0.3573	2.845	8.37	1.4	98.5	95.0	1286.7	2.6
	L	6.0	52.90	0.8103	2.580	19.2	0.63	98.7	99.7	1277.3	2.6
	M	8.0	51.50	1.098	-2.5780	0.427	0.46	101.7	99.8	1280	15
	N	10	54.07	0.8178	4.789	0.614	0.62	97.5	100.0	1286	11
	Total gas age ± 1σ			n=14		403.9				1261.0	1.9
	WMA ± 1s		steps B-N	n=13	MSWD=10.06	346.5	41.5		85.8	1282.0	2.2

DR2. $^{40}Ar/^{39}Ar$ analytical data for samples from the Sangre de Cristo Range and Las Vegas basin, New Mexico.

	ID	Power/Temp (W/°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
	HP02-2 F, E7:157, 1-4 xls biotite, J=0.0193994, D=1.00484±0.00092, NM-157, Lab#=53560-40										
#	A	1.0	99.99	0.0493	187.2	29.8	10.4	44.7	11.6	1139.3	5.7
	B	1.4	56.55	0.0121	11.88	70.2	42.2	93.8	38.9	1291.5	1.8
	C	1.7	54.68	0.0094	4.607	57.4	54.4	97.5	61.2	1296.3	2.0
	D	2.0	54.31	0.0136	3.497	29.8	37.6	98.1	72.8	1295.7	1.8
	E	2.4	54.18	0.0538	2.789	22.0	9.5	98.5	81.4	1297.1	2.7
	F	2.7	53.61	0.0574	3.284	12.5	8.9	98.2	86.2	1284.6	2.4
	G	3.0	53.89	0.1612	4.011	5.38	3.2	97.8	88.3	1286.0	2.9
	H	3.5	52.53	0.1668	4.343	7.45	3.1	97.6	91.2	1260.2	3.9
	I	3.8	52.37	0.0244	3.821	4.30	20.9	97.8	92.9	1259.8	3.1
	J	4.2	51.62	0.1917	4.886	7.36	2.7	97.2	95.8	1241.1	2.8
	K	5.0	50.97	0.1996	4.326	2.25	2.6	97.5	96.7	1232.4	5.1
	L	6.0	49.79	0.5525	5.238	2.86	0.92	97.0	97.8	1206.8	3.8
	M	8.0	51.70	0.4084	4.301	4.90	1.2	97.6	99.7	1246.2	3.1
	N	10	44.97	0.3331	7.408	0.848	1.5	95.2	100.0	1103.6	8.9
	Total gas age ± 1σ			n=14		257.0				1270.3	1.8
	WMA ± 1s		steps B-N	n=13	MSWD=119.72	227.2	33.8		88.4	1277.5	8.2
	HP02-8 A, E5:157, single xl muscovite, J=0.0190109, D=1.0052±0.00172, NM-157, Lab#=53559-01										
#	A	1.0	38.96	0.0245	17.82	1.99	20.8	86.5	0.4	903.3	6.0
#	B	1.4	47.74	0.0058	4.045	2.98	88.0	97.5	1.0	1157.0	3.7
#	C	1.7	49.64	0.0033	0.8343	4.66	152.9	99.5	1.9	1208.7	3.0
#	D	2.0	64.68	0.0006	0.1433	21.4	879.7	99.9	6.2	1463.2	2.4
#	E	2.4	58.52	0.0004	0.1017	52.5	1176	99.9	16.7	1364.7	2.1
#	F	2.7	55.06	0.0004	0.1180	58.3	1183	99.9	28.4	1306.9	2.2
	G	3.0	52.16	0.0003	0.0704	64.0	1466	100.0	41.2	1257.1	1.9
	H	3.5	50.17	0.0004	0.1145	60.2	1323	99.9	53.2	1221.9	1.8
	I	3.8	51.29	0.0003	0.1146	57.3	1589	99.9	64.7	1241.8	2.0
	J	4.2	52.84	0.0003	0.0476	22.8	2026	100.0	69.3	1269.2	2.6
	K	5.0	53.86	0.0004	0.0731	58.0	1162	100.0	80.9	1286.5	2.1
	L	6.0	53.17	0.0004	0.1299	38.6	1412	99.9	88.6	1274.5	2.1
	M	8.0	54.45	0.0001	0.0693	47.6	7096	100.0	98.1	1296.6	2.2
	N	10	54.52	0.0000	0.2088	9.31	14619	99.9	100.0	1297.1	2.5
	Total gas age ± 1σ			n=14		499.6				1285.4	1.9
	WMA ± 1s		steps G-N	n=8	MSWD=172.1C	357.8	######		71.6	1264.3	9.8

DR2. $^{40}Ar/^{39}Ar$ analytical data for samples from the Sangre de Cristo Range and Las Vegas basin, New Mexico.

ID	Power/Temp (W/°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
HP02-8 B, E5:157, single xl muscovite, J=0.0190109, D=1.00484±0.00092, NM-157, Lab#=53559-10										
B	1.4	57.95	0.0034	0.0598	143.4	147.9	100.0	12.2	1355.6	1.9
C	1.7	58.76	0.0068	0.1264	104.9	75.2	99.9	21.1	1368.5	2.5
D	2.0	55.89	0.0141	0.1185	139.1	36.1	99.9	32.9	1320.8	1.9
E	2.4	53.91	0.0043	0.0871	201.2	119.2	100.0	50.0	1287.4	2.2
F	2.7	53.35	-0.0018	0.1262	162.2	-	99.9	63.8	1277.6	2.2
G	3.0	54.80	0.0180	0.2757	61.1	28.3	99.9	69.0	1301.6	2.2
H	3.5	54.88	0.0051	0.0861	65.5	100.2	100.0	74.5	1304.0	2.2
I	3.8	54.90	0.0037	0.1464	50.1	136.5	99.9	78.8	1304.0	1.8
J	4.2	54.77	0.0078	0.2762	34.4	65.3	99.9	81.7	1301.2	1.9
K	5.0	54.84	0.0029	-0.0361	58.6	177.4	100.0	86.7	1303.9	1.9
L	6.0	55.83	0.0002	0.0466	87.3	2227	100.0	94.1	1320.3	1.8
M	8.0	55.87	-0.0210	1.514	6.41	-	99.2	94.7	1313.5	3.0
N	10	55.78	0.0022	0.2431	62.9	227.4	99.9	100.0	1318.5	1.5
Total gas age ± 1σ			n=13		1177.1				1313.6	1.4
WMA ± 1s		steps B-N	n=13	MSWD=134.49	1177.1	282.4		100.0	1314.0	6.4
HP02-8 C, E5:157, single xl muscovite, J=0.0190109, D=1.00484±0.00092, NM-157, Lab#=53559-14										
A	1.0	62.22	0.0034	1.037	62.5	148.4	99.5	5.4	1420.1	1.7
B	1.4	56.57	0.0019	0.0943	102.3	274.4	100.0	14.2	1332.5	2.0
C	1.7	57.55	0.0019	0.1476	81.6	273.7	99.9	21.2	1348.4	2.1
D	2.0	56.30	0.0082	0.0402	85.7	62.5	100.0	28.6	1328.1	2.1
E	2.4	55.68	0.0033	0.0876	137.1	156.3	100.0	40.5	1317.5	2.6
F	2.7	54.97	0.0025	0.0816	143.4	206.8	100.0	52.8	1305.6	1.7
G	3.0	52.77	0.0031	0.0510	109.1	162.7	100.0	62.2	1268.0	1.9
H	3.5	53.31	0.0021	0.0005	111.5	245.2	100.0	71.8	1277.5	1.8
I	3.8	54.35	-0.0023	0.0563	61.9	-	100.0	77.2	1295.1	3.3
J	4.2	54.35	-0.0097	0.0955	40.0	-	99.9	80.6	1294.9	1.5
K	5.0	54.64	-0.0012	0.0109	132.3	-	100.0	92.0	1300.2	2.4
L	6.0	54.05	-0.0630	0.1273	12.6	-	99.9	93.1	1289.4	2.5
M	8.0	54.95	-0.0076	0.2663	20.8	-	99.9	94.9	1304.2	1.9
N	10	54.59	-0.0038	-0.0592	58.9	-	100.0	100.0	1299.7	1.4
Total gas age ± 1σ			n=14		1159.6				1312.2	1.4
WMA ± 1s		steps A-N	n=14	MSWD=435.63	1159.6	139.0		100.0	1314	11
LV02-3895 D, Q2:157, single xl muscovite, J=0.0186725, D=1.0052±0.00172, NM-157, Lab#=53565-01										
# A	1.0	57.45	0.0191	15.01	2.77	26.7	92.3	2.5	1256.1	4.3
B	1.4	55.16	0.0023	2.345	6.49	220.0	98.7	8.3	1280.7	3.0
C	1.7	55.03	0.0012	0.2713	12.3	409.4	99.9	19.2	1288.8	2.2
D	2.0	54.59	0.0010	0.3387	19.4	492.6	99.8	36.5	1281.2	2.7
E	2.4	54.53	0.0011	0.0734	24.7	446.2	100.0	58.6	1281.5	2.3
F	2.7	54.87	0.0017	0.3295	12.6	305.3	99.8	69.8	1285.9	2.2
G	3.0	54.47	0.0002	0.2847	15.8	2171	99.8	83.9	1279.3	2.4
H	3.5	54.57	0.0002	0.1430	10.9	2327	99.9	93.6	1281.9	2.2
I	3.8	55.05	-0.0009	0.0968	4.14	-	99.9	97.3	1290.2	3.6
J	4.2	55.17	-0.0031	-1.6419	2.06	-	100.9	99.2	1300.8	5.6
K	5.0	55.75	-0.0103	-3.5731	0.796	-	101.9	99.9	1320	10
N	10	57.69	-0.0799	-33.1316	0.130	-	117.0	100.0	1488	41
Total gas age ± 1σ			n=12		112.0				1283.0	2.0
WMA ± 1s		steps B-N	n=11	MSWD=6.30	109.3	828.6		97.5	1284.2	2.4

DR2. $^{40}Ar/^{39}Ar$ analytical data for samples from the Sangre de Cristo Range and Las Vegas basin, New Mexico.

	ID	Power/Temp (W/°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
	LV02-3895 E, Q2:157, single xl muscovite, J=0.0186725, D=1.00484±0.00092, NM-157, Lab#=53565-12										
#	A	1.0	63.74	-0.0619	63.40	3.59	-	70.6	0.1	1113.2	5.3
	B	1.4	54.90	-0.0014	5.733	16.3	-	96.9	0.7	1259.3	2.1
	C	1.7	53.79	0.0066	0.9161	35.5	77.4	99.5	1.9	1264.6	1.8
	D	2.0	54.32	0.0075	1.187	97.7	67.7	99.4	5.3	1272.4	2.9
	E	2.4	54.28	-0.0008	0.8927	122.0	-	99.5	9.6	1273.0	1.7
	F	2.7	53.55	-0.0015	0.7785	113.6	-	99.6	13.5	1261.3	1.8
	G	3.0	53.60	0.0044	0.1205	54.9	116.7	99.9	15.4	1265.4	1.4
	H	3.5	53.69	0.0022	0.1356	65.9	232.3	99.9	17.7	1266.9	2.2
	I	3.8	53.43	0.0083	0.3409	98.3	61.5	99.8	21.1	1261.4	3.0
	J	4.2	54.48	0.0045	0.2654	162.9	113.5	99.9	26.8	1279.6	1.9
	K	5.0	54.73	0.0022	0.1362	428.3	228.5	99.9	41.7	1284.6	2.6
	L	6.0	53.84	0.0019	0.0855	687.6	263.0	100.0	65.6	1269.7	3.9
	M	8.0	54.38	0.0012	0.0556	986.5	422.3	100.0	99.9	1278.9	6.1
	N	10	52.99	-0.3217	-0.0581	1.81	-	100.0	100.0	1255.2	6.3
	Total gas age ± 1σ			n=14		2874.9				1274.8	2.6
	WMA ± 1s		steps B-N	n=13	MSWD=11.58	2871.3	286.4		99.9	1268.2	2.3
	LV02-3895 F, Q2:157, single xl muscovite, J=0.0186725, D=1.00484±0.00092, NM-157, Lab#=53565-16										
#	A	1.0	55.95	0.0321	12.37	39.0	15.9	93.5	3.9	1243.7	3.1
	B	1.4	54.83	0.0025	0.5565	71.8	204.8	99.7	11.1	1284.1	1.6
	C	1.7	55.06	0.0032	0.2948	101.9	160.0	99.8	21.3	1289.3	1.6
	D	2.0	55.06	0.0034	0.2477	115.5	151.5	99.9	32.9	1289.6	1.8
	E	2.4	55.08	0.0003	0.1649	153.4	1829	99.9	48.2	1290.3	2.4
	F	2.7	54.54	0.0043	0.1577	129.4	119.0	99.9	61.2	1281.1	1.7
	G	3.0	54.23	-0.0016	0.1766	102.0	-	99.9	71.4	1275.8	2.3
	H	3.5	54.04	0.0100	0.0513	132.0	50.8	100.0	84.7	1273.3	1.4
	I	3.8	54.79	0.0084	0.0494	49.5	60.6	100.0	89.6	1286.0	1.8
	J	4.2	55.05	0.0126	0.0284	29.0	40.3	100.0	92.5	1290.4	2.0
	K	5.0	55.03	0.0122	-0.0443	16.4	41.8	100.0	94.2	1290.4	2.1
	L	6.0	55.18	-0.0006	-0.0232	21.5	-	100.0	96.3	1292.9	2.3
	M	8.0	55.68	0.0083	-0.1275	35.8	61.7	100.1	99.9	1301.8	2.0
#	N	10	56.87	-0.0733	-5.3066	1.04	-	102.7	100.0	1346.5	9.8
	Total gas age ± 1σ			n=14		998.2				1283.3	1.4
	WMA ± 1s		steps B-M	n=12	MSWD=18.05	958.2	375.7		96.0	1285.9	2.5

DR2. $^{40}Ar/^{39}Ar$ analytical data for samples from the Sangre de Cristo Range and Las Vegas basin, New Mexico.

	ID	Power/Temp (W/°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
	EM02-1 G, Q1:157, single xl muscovite, J=0.0187679, D=1.0052±0.00172, NM-157, Lab#=53564-01										
#	A	1.0	62.70	0.0003	17.88	7.67	1506	91.6	2.5	1334.8	3.5
#	B	1.4	60.02	-0.0003	0.9172	13.7	-	99.5	7.1	1372.9	2.6
	C	1.7	59.14	0.0001	0.3967	35.0	8546	99.8	18.7	1361.1	2.7
	D	2.0	58.89	0.0004	0.0443	46.9	1272	100.0	34.3	1358.7	2.2
	E	2.4	58.79	0.0002	0.1464	67.4	2283	99.9	56.7	1356.6	1.9
	F	2.7	58.56	0.0001	0.1329	59.7	3464	99.9	76.6	1352.9	2.2
	G	3.0	58.71	0.0006	0.2180	13.4	865.2	99.9	81.0	1355.0	2.8
	H	3.5	58.46	0.0012	0.2939	8.55	439.3	99.9	83.9	1350.5	3.2
	I	3.8	59.48	0.0007	-0.0385	4.56	684.2	100.0	85.4	1368.6	4.0
	J	4.2	58.91	0.0002	-0.4671	5.22	3008	100.2	87.1	1361.6	3.0
	K	5.0	59.27	0.0016	0.0917	5.10	312.7	100.0	88.8	1364.7	3.0
	L	6.0	59.74	0.0007	-0.2220	5.67	698.2	100.1	90.7	1373.8	3.2
	M	8.0	59.47	0.0001	0.0816	25.6	5052	100.0	99.2	1368.0	2.4
	N	10	59.47	-0.0006	1.067	2.41	-	99.5	100.0	1363.3	4.7
	Total gas age ± 1σ			n=14		300.9				1358.4	2.0
	WMA ± 1s		steps C-N	n=12	MSWD=5.77	279.6	3178		92.9	1360.0	2.1
	EM02-1 H, Q1:157, single xl muscovite, J=0.0187679, D=1.00484±0.00092, NM-157, Lab#=53564-14										
	A	1.0	61.48	0.0090	5.509	63.1	56.7	97.4	28.4	1374.6	2.3
	B	1.4	59.82	0.0110	0.2948	46.3	46.5	99.9	49.2	1372.6	1.8
	C	1.7	59.36	-0.0022	0.0991	75.2	-	100.0	83.0	1366.1	2.9
	D	2.0	60.44	0.0508	-0.1205	7.13	10.0	100.1	86.2	1384.7	2.9
	E	2.4	60.23	0.1006	0.3178	8.86	5.1	99.9	90.2	1379.4	2.8
	F	2.7	60.29	0.0850	0.2776	5.30	6.0	99.9	92.6	1380.4	2.9
	G	3.0	60.16	0.0740	0.9242	3.45	6.9	99.6	94.1	1375.3	3.2
	H	3.5	60.32	0.0052	0.0321	2.52	98.5	100.0	95.3	1382.0	4.4
	I	3.8	59.85	-0.3961	2.389	1.01	-	98.8	95.7	1362.2	7.3
	J	4.2	60.57	-0.2160	-2.3810	0.748	-	101.1	96.1	1396.9	8.4
	K	5.0	59.93	0.0111	1.914	1.14	46.1	99.1	96.6	1366.7	6.6
	L	6.0	60.25	0.0197	1.825	1.68	25.9	99.1	97.3	1372.2	6.0
	M	8.0	60.29	0.0235	0.9328	4.39	21.7	99.5	99.3	1377.2	3.1
	N	10	60.72	0.1674	2.603	1.56	3.0	98.8	100.0	1376.4	5.4
	Total gas age ± 1σ			n=14		222.4				1372	2
	WMA ± 1s		steps A-N	n=14	MSWD=3.27	222.4	30.0		100.0	1376	2

DR2. $^{40}Ar/^{39}Ar$ analytical data for samples from the Sangre de Cristo Range and Las Vegas basin, New Mexico.

	ID	Power/Temp (W/°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
	EM02-1 I, Q1:157, single xl muscovite, J=0.0187679, D=1.00484±0.00092, NM-157, Lab#=53564-16										
	A	1.0	64.60	0.0030	17.21	86.4	170.0	92.1	21.0	1369.1	2.3
	B	1.4	59.54	0.0064	0.5765	110.8	80.1	99.7	48.0	1366.7	1.9
	C	1.7	59.49	0.0094	0.4920	65.7	54.3	99.8	64.0	1366.4	1.9
	D	2.0	59.65	0.0109	0.2901	51.4	46.7	99.9	76.5	1369.9	1.9
	E	2.4	59.59	0.0031	0.2440	48.1	166.0	99.9	88.2	1369.1	1.8
	F	2.7	59.83	0.0259	0.5211	25.9	19.7	99.7	94.5	1371.8	2.3
	G	3.0	60.25	0.1168	0.5685	5.74	4.4	99.7	95.9	1378.5	3.3
	H	3.5	59.81	0.0115	-0.0042	12.5	44.2	100.0	98.9	1373.9	2.2
	I	3.8	60.25	-0.0613	1.743	1.10	-	99.1	99.2	1372.5	7.3
	J	4.2	60.12	-0.2271	-0.1790	0.568	-	100.1	99.3	1379	12
	K	5.0	60.65	-0.7171	-1.5807	0.663	-	100.7	99.5	1393	10
	L	6.0	59.75	-0.3774	-1.3318	0.971	-	100.6	99.7	1378.5	8.2
	M	8.0	60.14	-0.2325	3.849	0.574	-	98.1	99.9	1360	12
#	N	10	60.51	-0.4035	4.584	0.536	-	97.7	100.0	1363	12
	Total gas age ± 1σ			n=14		410.9				1368.6	1.6
	WMA ± 1s	steps A-M		n=13	MSWD=2.10	410.3	94.1		99.9	1369.9	1.4
	DCBZ-3a J, G3:145, muscovite, J=0.0097154, D=1.00535±0.00031, NM-145, Lab#=52784-01										
#	A	1.0	78.04	0.0296	38.29	0.534	17.3	85.5	0.8	912.2	2.4
#	B	1.4	97.96	0.0142	13.20	0.588	35.9	96.0	1.7	1185.1	2.3
#	C	1.7	104.2	0.0068	3.719	0.753	75.5	98.9	2.9	1267.4	2.5
#	D	2.0	105.7	0.0052	2.410	0.960	97.7	99.3	4.4	1283.4	1.9
#	E	2.3	107.4	0.0048	1.676	1.28	106.0	99.5	6.4	1300.8	1.6
#	F	2.7	110.5	0.0037	1.631	2.45	137.8	99.6	10.2	1326.9	1.5
#	G	3.0	110.0	0.0030	1.253	2.97	168.7	99.7	14.8	1324.0	1.3
#	H	3.3	110.0	0.0026	1.195	3.34	198.5	99.7	20.0	1324.2	1.6
#	I	3.6	110.9	0.0022	0.7990	3.96	232.5	99.8	26.2	1332.7	1.2
#	J	4.0	111.4	0.0015	0.6152	11.8	330.0	99.8	44.4	1337.7	1.5
#	K	4.5	111.5	0.0015	0.6673	8.78	332.5	99.8	58.1	1338.7	1.8
#	L	5.0	112.5	0.0015	0.6419	7.40	337.1	99.8	69.6	1346.9	1.8
#	M	5.5	114.0	0.0015	0.6068	6.74	329.8	99.8	80.0	1359.3	1.3
	N	6.0	114.9	0.0015	0.7865	5.91	333.6	99.8	89.2	1366.9	1.2
	O	8.0	114.7	0.0039	1.802	5.77	131.6	99.5	98.2	1363.0	1.6
#	P	9.0	115.7	0.0118	11.12	1.16	43.1	97.2	100.0	1348.1	2.4
	Total gas age ± 1σ			n=16		64.4				1337.5	1.1
	WMA ± 1s	steps N-O		n=2	MSWD=3.66	11.7	233.8		18.2	1365.4	2.1

DR2. $^{40}Ar/^{39}Ar$ analytical data for samples from the Sangre de Cristo Range and Las Vegas basin, New Mexico.

	ID	Power/Temp (W/°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
	ASF01-9 K, H5:145, muscovite, J=0.0097408, D=1.00535±0.00031, NM-145, Lab#=52788-01										
#	A	1.0	103.7	0.0654	43.21	0.204	7.8	87.7	0.6	1157.9	4.2
#	B	1.4	109.6	0.0156	5.598	0.210	32.8	98.5	1.2	1311.9	4.1
#	C	1.7	113.9	0.0082	4.108	0.316	62.3	98.9	2.2	1352.9	4.4
#	D	2.0	113.9	0.0038	4.097	0.492	134.5	98.9	3.6	1352.2	2.1
	E	2.3	116.8	0.0023	3.630	1.79	225.7	99.1	9.0	1377.9	1.4
	F	2.7	116.5	0.0015	1.768	3.43	330.0	99.6	19.2	1380.0	2.0
	G	3.0	115.4	0.0010	2.537	2.19	493.0	99.4	25.7	1369.4	1.6
	H	3.3	114.9	0.0008	1.190	1.39	650.5	99.7	29.9	1368.4	1.8
	I	3.6	115.1	0.0006	1.805	1.68	808.8	99.5	34.9	1368.2	1.4
	J	4.0	114.9	0.0006	1.133	3.63	893.8	99.7	45.7	1368.1	1.1
	K	4.5	115.4	0.0005	0.8374	5.45	974.6	99.8	62.0	1373.1	1.0
	L	5.0	114.7	0.0003	0.9670	3.05	1960	99.8	71.1	1367.5	1.4
	M	5.5	115.2	0.0010	1.182	1.80	516.1	99.7	76.5	1371.1	1.6
	N	6.0	115.6	0.0008	1.329	1.48	677.4	99.7	80.9	1373.5	1.5
	O	8.0	115.2	0.0004	0.7571	5.62	1250	99.8	97.6	1372.2	1.5
	P	9.0	116.3	0.0010	1.639	0.791	508.0	99.6	100.0	1379.0	2.7
	Total gas age ± 1σ			n=16		33.5				1370.1	1.1
	WMA ± 1s		steps E-P	n=12	MSWD=7.12	32.3	890.9		96.4	1371.6	1.5
	PV03-01 L, L5:164, 0.21 mg biotite, J=0.015, D=1.0052±0.00121, NM-164, Lab#=54026-01										
#	A	1.0	7.055	0.2876	2.059	5.81	1.8	91.7	7.4	168.5	1.3
#	B	1.4	40.49	0.0688	3.346	4.99	7.4	97.6	13.7	849.5	2.3
#	C	1.7	66.46	0.0368	2.116	4.73	13.9	99.1	19.8	1254.1	2.9
	D	2.0	70.69	0.0442	0.9630	4.26	11.5	99.6	25.2	1316.0	3.5
	E	2.4	73.30	0.0385	1.282	11.2	13.3	99.5	39.4	1349.3	2.4
	F	2.7	75.31	0.0216	0.9546	6.62	23.6	99.6	47.8	1376.5	2.9
	G	3.0	78.82	0.0376	0.7211	5.36	13.6	99.7	54.6	1422.1	3.2
	H	3.5	83.05	0.0634	0.8293	6.38	8.0	99.7	62.8	1474.2	3.5
	I	3.8	81.52	0.0857	0.6219	6.89	6.0	99.8	71.5	1456.3	2.5
	J	4.2	75.66	0.1291	0.4897	6.26	4.0	99.8	79.5	1383.0	3.4
	K	5.0	77.23	0.3545	0.3179	3.63	1.4	99.9	84.1	1404.1	4.4
	L	6.0	74.23	0.1284	0.4510	5.24	4.0	99.8	90.8	1364.6	3.0
	M	8.0	73.65	0.0630	0.0157	6.27	8.1	100.0	98.8	1358.7	3.4
	N	10	71.65	0.0411	-0.1255	0.972	12.4	100.1	100.0	1333.1	5.0
	Total gas age ± 1σ			n=14		78.6	K2O=9.58 %			1283.1	1.6
	WMA ± 1s		steps D-N	n=11	MSWD=244.69	63.0	10.0		80.2	1389	15

DR2. $^{40}Ar/^{39}Ar$ analytical data for samples from the Sangre de Cristo Range and Las Vegas basin, New Mexico.

ID	Power/Temp (W/°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
PVBR-3, H:2:144, 2.95 mg K-feldspar, J=0.0094167, D=1.00535±0.00031, NM-144, Lab#=52786-01										
BA	450	58.16	-0.0063	9.657	0.378	-	95.1	0.0	765.6	5.9
C	450	50.17	0.0078	8.670	0.870	65.5	94.9	0.1	676.5	3.2
D	500	151.8	0.0089	7.905	1.243	57.3	98.5	0.3	1604.6	3.5
E	500	46.59	0.0098	4.557	2.111	51.9	97.1	0.5	648.1	1.9
F	500	47.11	0.0106	3.568	2.127	48.3	97.8	0.7	657.8	1.9
G	550	91.50	0.0129	3.208	3.437	39.6	99.0	1.0	1126.1	1.2
H	550	53.14	0.0109	1.892	4.67	46.7	98.9	1.5	734.5	1.5
I	550	53.86	0.0066	1.639	4.65	77.5	99.1	2.0	743.3	1.5
J	600	73.47	0.0079	1.856	6.11	64.6	99.3	2.6	954.4	1.4
K	600	58.15	0.0071	0.9753	9.04	71.7	99.5	3.6	793.98	0.91
L	600	59.97	0.0064	0.8733	9.13	79.5	99.6	4.5	814.4	1.3
M	650	67.95	0.0079	0.6680	10.39	64.8	99.7	5.6	900.89	0.93
N	650	63.74	0.0066	0.5042	15.28	77.3	99.8	7.2	856.6	1.0
O	650	65.77	0.0064	0.3838	14.95	79.2	99.8	8.7	878.72	0.85
P	700	68.50	0.0082	0.5831	15.26	62.0	99.7	10.3	906.90	0.84
Q	700	67.54	0.0075	0.3213	20.70	68.4	99.9	12.4	897.6	1.2
R	700	68.06	0.0070	0.2606	19.79	72.5	99.9	14.5	903.3	1.1
S	750	70.43	0.0088	0.3064	16.98	58.1	99.9	16.2	927.8	1.2
T	750	69.29	0.0083	0.2156	23.30	61.2	99.9	18.6	916.2	1.0
U	750	69.64	0.0083	0.2495	21.46	61.5	99.9	20.8	919.8	1.2
V	800	70.40	0.0097	0.2587	15.62	52.8	99.9	22.4	927.7	1.2
W	800	70.36	0.0090	0.2381	20.65	56.6	99.9	24.6	927.26	0.91
X	850	71.00	0.0105	0.2146	21.99	48.6	99.9	26.8	934.0	1.0
Y	850	71.06	0.0095	0.2975	24.18	54.0	99.9	29.3	934.3	1.1
Z	900	71.71	0.0113	0.3019	21.13	45.3	99.9	31.5	941.07	0.97
ZA	900	71.84	0.0099	0.3516	24.52	51.3	99.9	34.0	942.23	0.81
ZB	950	72.21	0.0104	0.4192	19.38	49.1	99.8	36.0	945.8	1.3
ZC	950	72.15	0.0089	0.5468	19.91	57.2	99.8	38.1	944.76	0.96
ZD	1000	73.81	0.0109	0.6639	16.98	46.9	99.7	39.8	961.4	1.1
ZE	1000	73.43	0.0097	0.5369	18.93	52.6	99.8	41.8	957.92	0.98
ZF	1050	75.55	0.0153	0.9329	19.52	33.4	99.6	43.8	978.2	1.2
ZG	1050	75.53	0.0147	0.8686	22.84	34.7	99.7	46.2	978.2	1.1
ZH	1100	77.92	0.0215	1.287	20.77	23.8	99.5	48.3	1000.85	0.99
ZI	1100	77.61	0.0178	1.120	25.31	28.7	99.6	50.9	998.22	0.83
ZJ	1100	80.18	0.0129	0.8400	97.9	39.5	99.7	61.0	1024.5	1.8
ZK	1100	82.29	0.0084	0.8865	48.3	61.1	99.7	66.0	1044.9	1.3
ZL	1100	83.72	0.0079	1.160	60.6	64.8	99.6	72.3	1057.9	1.5
ZM	1200	83.57	0.0052	0.7320	47.8	98.7	99.7	77.2	1057.7	1.2
ZN	1300	84.10	0.0047	0.9083	134.3	108.8	99.7	91.0	1062.3	2.1
ZO	1400	87.43	0.0112	1.075	26.03	45.8	99.6	93.7	1093.6	1.1
ZP	1660	87.36	0.0025	0.8614	12.81	204.7	99.7	95.1	1093.5	1.2
ZQ	1660	85.78	0.0123	1.111	48.0	41.5	99.6	100.0	1077.8	1.2
Total gas age ± 1σ			n=42		969.3		K2O=13.40 %		993.20	0.46

DR2. $^{40}Ar/^{39}Ar$ analytical data for samples from the Sangre de Cristo Range and Las Vegas basin, New Mexico.

ID	Power/Temp (W/°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
ASF01-9, H:4:145, 2.98 mg K-feldspar, J=0.0096403, D=1.00535±0.00031, NM-145, Lab#=52787-01										
A	450	311.7	0.0703	547.8	1.225	7.3	48.1	0.9	1632.0	8.4
B	450	73.35	0.0523	164.9	0.649	9.8	33.5	1.3	388.6	10.7
C	450	55.46	0.0524	104.7	0.439	9.7	44.2	1.6	387.2	9.4
D	500	56.79	0.0559	75.35	0.329	9.1	60.8	1.8	524.4	10.3
E	500	31.51	0.0666	31.70	0.804	7.7	70.3	2.4	353.0	4.0
F	500	29.55	0.0789	27.72	0.754	6.5	72.3	2.9	341.5	4.3
G	550	59.59	0.1118	68.19	1.204	4.6	66.2	3.8	588.1	4.6
H	550	29.03	0.1218	14.15	1.458	4.2	85.6	4.8	391.9	2.6
I	550	30.28	0.1376	13.13	1.250	3.7	87.2	5.6	413.8	2.8
J	600	56.32	0.1715	65.91	1.464	3.0	65.4	6.7	554.9	4.0
K	600	35.00	0.1641	15.75	1.713	3.1	86.7	7.8	468.4	2.2
L	600	35.60	0.1583	7.055	1.389	3.2	94.2	8.8	511.1	2.4
M	650	51.57	0.1931	45.84	1.646	2.6	73.8	10.0	570.2	3.0
N	650	40.08	0.2055	6.046	1.819	2.5	95.6	11.2	573.7	2.2
O	650	44.03	0.2127	3.750	1.506	2.4	97.5	12.3	632.3	2.3
P	700	55.92	0.3079	24.90	1.480	1.7	86.9	13.3	701.3	2.9
Q	700	54.40	0.3147	8.778	2.232	1.6	95.3	14.9	739.8	2.1
R	700	59.53	0.3004	5.788	1.729	1.7	97.2	16.1	809.1	2.2
S	750	65.61	0.3811	18.80	1.385	1.3	91.6	17.0	834.3	3.2
T	750	64.67	0.3202	3.505	1.840	1.6	98.4	18.3	873.7	2.7
U	750	66.07	0.2780	4.171	1.644	1.8	98.2	19.4	886.7	2.8
V	800	68.81	0.3291	16.48	1.367	1.6	93.0	20.4	877.0	3.2
W	800	68.89	0.2918	4.504	2.119	1.7	98.1	21.9	916.0	2.2
X	850	68.99	0.3125	15.59	2.688	1.6	93.4	23.7	881.8	2.1
Y	850	69.32	0.2195	6.297	4.102	2.3	97.3	26.6	914.8	1.5
Z	900	73.13	0.1857	7.155	6.72	2.7	97.1	31.3	952.4	1.4
ZA	900	71.81	0.1375	3.663	6.68	3.7	98.5	35.9	949.2	1.2
ZB	950	69.80	0.1376	4.558	4.97	3.7	98.1	39.4	925.3	1.6
ZC	950	70.01	0.1251	5.100	5.30	4.1	97.9	43.0	925.8	1.6
ZD	1000	70.27	0.1335	5.761	5.03	3.8	97.6	46.5	926.5	1.2
ZE	1000	70.58	0.1362	6.819	5.45	3.7	97.2	50.3	926.5	1.6
ZF	1050	71.40	0.1679	8.377	5.41	3.0	96.6	54.1	930.3	1.4
ZG	1050	72.28	0.1920	10.67	5.50	2.7	95.7	57.9	932.5	1.6
ZH	1100	75.48	0.3036	18.31	6.18	1.7	92.9	62.2	942.5	1.7
ZI	1100	73.51	0.4160	27.94	8.09	1.2	88.8	67.8	891.4	1.5
ZJ	1100	73.59	0.5342	28.46	11.47	0.96	88.6	75.8	890.7	1.3
ZK	1100	77.29	0.5478	22.65	10.73	0.93	91.4	83.3	948.5	1.4
ZL	1100	81.70	0.4049	16.21	12.33	1.3	94.2	91.8	1013.2	1.2
ZM	1200	86.71	0.7832	16.98	3.092	0.65	94.3	94.0	1061.5	2.4
ZN	1300	85.17	1.589	38.48	2.980	0.32	86.8	96.1	983.2	2.4
ZO	1400	81.04	0.9190	30.37	1.069	0.56	89.0	96.8	964.3	3.8
ZP	1660	84.26	0.7342	16.40	4.59	0.69	94.3	100.0	1038.8	1.6
Total gas age ± 1σ			n=42		143.8	K2O=1.92 %			896.11	0.86

DR2. $^{40}Ar/^{39}Ar$ analytical data for samples from the Sangre de Cristo Range and Las Vegas basin, New Mexico.

ID	Power/Temp (W/°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
TP02-4, A:1:157 , 2.36 mg K-feldspar, J=0.0186268, D=1.0052±0.00172, NM-157, Lab#=53525-01										
A	430	404.4	0.0047	32.22	4.11	108.0	97.6	0.2	3876.8	5.5
B	430	33.38	0.0021	5.475	1.94	239.6	95.1	0.3	848.1	4.5
C	430	37.97	0.0021	3.258	1.63	244.7	97.5	0.4	956.8	4.4
D	430	20.54	0.0031	3.229	1.56	165.4	95.3	0.5	567.1	4.5
E	480	27.43	0.0018	2.161	2.30	286.0	97.7	0.6	738.5	3.4
F	480	19.98	0.0001	0.9064	2.52	4887	98.7	0.7	570.2	2.8
G	480	15.71	0.0018	0.0360	2.34	286.2	99.9	0.9	467.8	2.9
H	480	17.89	0.0032	4.801	2.55	159.2	92.1	1.0	487.8	3.5
I	530	27.54	0.0011	0.8174	3.05	457.5	99.1	1.2	750.1	2.7
J	530	18.13	0.0043	-0.0796	3.68	118.4	100.1	1.3	531.2	2.1
K	530	19.11	0.0027	0.2127	3.46	187.7	99.7	1.5	553.8	2.1
L	530	20.83	0.0015	0.1313	3.99	331.9	99.8	1.7	597.0	2.3
M	580	31.57	0.0011	0.7721	6.10	480.0	99.3	2.1	839.0	2.3
N	580	25.15	0.0009	0.0493	6.9	599.0	99.9	2.4	700.6	2.0
O	580	27.35	0.0010	-0.0499	6.40	515.1	100.1	2.7	751.5	2.0
P	580	27.95	0.0002	0.6191	5.71	3294	99.3	3.0	760.6	2.3
Q	630	33.33	0.0013	0.2902	7.1	378.9	99.7	3.4	879.5	2.0
R	630	32.28	0.0007	0.0325	8.9	688.8	100.0	3.9	858.9	1.7
S	630	33.60	0.0003	0.1353	8.0	1588	99.9	4.3	886.1	2.1
T	680	35.91	0.0019	0.6296	9.8	265.8	99.5	4.8	930.8	2.0
U	680	35.01	-0.0002	0.0976	10.8	-	99.9	5.4	915.6	2.0
V	680	35.69	0.0008	0.0307	8.5	672.9	100.0	5.8	929.9	2.1
W	730	38.00	0.0009	0.4051	10.8	555.2	99.7	6.4	974.4	1.8
X	730	37.16	0.0009	0.1016	12.5	598.9	99.9	7.0	959.3	1.8
Y	730	38.04	0.0006	0.3002	11.7	833.4	99.8	7.7	975.8	1.9
Z	780	38.93	0.0010	0.1803	12.2	520.9	99.9	8.3	994.1	1.8
ZA	780	39.53	0.0009	0.2081	15.5	588.7	99.8	9.1	1005.9	2.0
ZB	830	41.15	0.0016	0.1622	19.8	327.8	99.9	10.1	1037.5	1.8
ZC	830	41.91	0.0001	0.2145	22.5	7615	99.8	11.3	1051.8	1.9
ZD	880	43.35	0.0020	0.2776	26.3	261.0	99.8	12.7	1078.8	1.9
ZE	880	44.46	0.0008	0.1257	28.7	627.6	99.9	14.2	1100.4	1.9
ZF	930	45.39	0.0015	0.3340	28.6	342.7	99.8	15.7	1116.6	2.1
ZG	930	45.85	0.0003	0.2803	32.5	1661	99.8	17.4	1125.4	2.3
ZH	980	46.83	0.0016	0.4900	34.1	326.4	99.7	19.2	1142.1	1.9
ZI	980	46.88	0.0007	0.2732	37.7	703.5	99.8	21.2	1144.2	1.7
ZJ	1030	47.59	0.0014	0.5516	47.2	364.5	99.7	23.6	1155.5	2.0
ZK	1030	47.95	0.0006	0.3113	43.8	855.6	99.8	25.9	1163.3	2.0
ZL	1100	46.03	0.0012	0.6700	63.5	429.9	99.6	29.2	1126.4	2.2
ZM	1100	46.80	0.0007	0.5228	61.9	703.1	99.7	32.5	1141.4	2.2
ZN	1100	47.76	0.0007	0.6161	106.4	755.0	99.6	38.1	1158.3	2.0
ZO	1100	48.77	0.0008	0.6938	149.0	642.9	99.6	45.9	1176.0	2.5
ZP	1100	51.65	0.0006	0.6313	215.4	785.3	99.6	57.1	1227.1	3.1
ZQ	1180	54.37	0.0005	0.6656	55.7	1022	99.6	60.0	1273.5	2.2
ZR	1280	53.99	0.0007	0.7014	449.7	750.5	99.6	83.6	1266.9	4.3
ZS	1380	50.23	0.0007	0.6953	144.4	759.8	99.6	91.1	1202.0	2.3
ZT	1670	51.23	0.0008	0.7010	169.5	616.8	99.6	100.0	1219.3	2.6
Total gas age ± 1σ			n=46		1910.9		K2O=16.70 %		1188.0	2.0

DR2. $^{40}Ar/^{39}Ar$ analytical data for samples from the Sangre de Cristo Range and Las Vegas basin, New Mexico.

ID	Power/Temp (W/°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
LV02-4800, A:4:157, 2.76 mg K-feldspar, J=0.0184739, D=1.0052±0.00172, NM-157, Lab#=53527-01										
A	430	417.5	0.0111	35.46	3.90	46.2	97.5	0.2	3912.0	5.5
B	430	36.75	0.0066	2.655	1.55	77.8	97.9	0.3	929.8	6.2
C	430	32.44	0.0066	3.223	1.33	77.6	97.1	0.4	836.5	7.0
D	430	26.84	0.0062	3.257	1.49	82.5	96.4	0.4	712.8	6.3
E	480	29.50	0.0073	1.422	2.35	70.0	98.6	0.6	784.6	4.1
F	480	16.51	0.0116	0.3067	2.64	43.9	99.5	0.7	482.9	3.6
G	480	15.11	0.0107	1.526	2.69	47.8	97.0	0.9	436.9	3.7
H	480	13.59	0.0103	0.5228	3.05	49.7	98.9	1.0	404.0	3.0
I	530	56.85	0.0126	0.9709	6.54	40.4	99.5	1.4	1305.9	2.7
J	530	10.99	0.0121	-0.1876	5.16	42.0	100.5	1.7	338.2	2.0
K	530	11.03	0.0092	-0.0479	4.91	55.7	100.1	1.9	338.2	2.1
L	530	10.00	0.0083	0.1190	5.37	61.7	99.7	2.2	307.8	2.0
M	580	50.46	0.0082	0.8546	11.6	62.6	99.5	2.8	1197.9	2.5
N	580	12.82	0.0074	0.3280	7.9	68.5	99.2	3.3	384.8	1.6
O	580	14.07	0.0042	0.1531	7.5	120.8	99.7	3.7	419.9	1.7
P	580	14.24	0.0029	0.1260	7.6	176.7	99.7	4.1	424.6	1.6
Q	630	26.31	0.0043	0.7479	9.2	119.1	99.2	4.6	717.5	1.8
R	630	17.22	0.0043	0.0903	9.1	118.6	99.8	5.1	503.0	1.5
S	630	18.31	0.0033	0.1317	8.2	156.3	99.8	5.5	530.3	1.7
T	680	21.56	0.0055	0.5448	10.7	92.9	99.3	6.1	607.5	1.7
U	680	20.91	0.0040	0.0416	12.1	128.4	99.9	6.7	595.4	1.4
V	680	21.57	0.0039	0.0123	10.7	131.8	100.0	7.3	611.7	1.5
W	730	22.89	0.0046	0.1096	12.7	111.6	99.9	8.0	642.4	1.5
X	730	22.20	0.0044	-0.0563	14.6	116.9	100.1	8.8	627.2	1.5
Y	730	22.12	0.0040	-0.0309	13.3	127.9	100.0	9.5	625.1	1.3
Z	780	22.25	0.0032	0.0668	14.2	157.7	99.9	10.3	627.6	1.5
ZA	780	22.06	0.0045	0.0183	17.0	114.1	100.0	11.2	623.3	1.3
ZB	830	22.70	0.0061	0.1750	20.7	83.3	99.8	12.3	637.5	1.3
ZC	830	23.20	0.0049	0.0618	21.9	104.0	99.9	13.5	650.1	1.6
ZD	880	24.23	0.0074	0.3307	24.6	68.6	99.6	14.8	672.4	1.4
ZE	880	25.24	0.0055	0.2781	26.1	93.6	99.7	16.2	696.2	1.6
ZF	930	25.90	0.0070	0.4630	29.0	72.9	99.5	17.8	710.3	1.3
ZG	930	27.06	0.0055	0.3459	32.0	93.1	99.6	19.5	737.3	1.5
ZH	980	26.82	0.0074	0.3724	36.8	69.4	99.6	21.5	731.8	1.3
ZI	980	28.02	0.0055	0.3951	41.4	92.2	99.6	23.7	758.5	1.4
ZJ	1030	27.56	0.0059	0.5747	51.2	85.8	99.4	26.5	747.0	1.4
ZK	1030	29.17	0.0054	0.5149	56.4	94.4	99.5	29.5	783.2	1.5
ZL	1100	30.85	0.0055	0.5971	110.3	93.6	99.4	35.4	819.1	1.6
ZM	1100	32.62	0.0056	0.4407	104.9	91.1	99.6	41.1	857.9	1.8
ZN	1100	34.57	0.0061	0.4526	169.8	84.0	99.6	50.2	898.5	2.1
ZO	1100	35.60	0.0057	0.4567	182.2	88.9	99.6	60.1	919.5	2.2
ZP	1100	36.76	0.0044	0.3423	259.3	116.8	99.7	74.0	943.7	1.8
ZQ	1180	37.76	0.0020	0.1442	93.3	255.4	99.9	79.1	964.9	1.8
ZR	1280	37.75	0.0017	0.1721	197.8	308.8	99.9	89.7	964.5	1.7
ZS	1380	37.47	0.0041	0.1782	54.9	125.4	99.9	92.7	958.9	1.8
ZT	1670	38.06	0.0019	0.2852	135.8	269.5	99.8	100.0	970.1	1.7
Total gas age ± 1σ			n=46		1855.7		K2O=13.98 %		877.2	1.5

DR2. $^{40}Ar/^{39}Ar$ analytical data for samples from the Sangre de Cristo Range and Las Vegas basin, New Mexico.

ID	Power/Temp (W/°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
LV02-3895, A:5:157, 2.15 mg K-feldspar, J=0.0187113, D=1.0052±0.00172, NM-157, Lab#=53528-01										
A	430	1019.7	0.0177	83.58	2.37	28.8	97.6	0.2	5435.4	5.9
B	430	70.76	0.0055	13.10	0.84	92.0	94.5	0.2	1481.7	7.4
C	430	51.94	-0.0089	7.331	0.680	-	95.8	0.3	1201.3	7.9
D	430	39.14	0.0087	8.148	0.77	58.9	93.8	0.3	954.7	7.6
E	480	58.75	0.0129	6.705	1.23	39.6	96.6	0.4	1321.2	5.2
F	480	30.31	0.0062	4.110	1.55	82.8	96.0	0.5	793.0	4.4
G	480	23.44	0.0089	2.890	1.50	57.2	96.4	0.6	642.9	4.4
H	480	27.06	0.0087	5.500	1.77	58.6	94.0	0.7	710.3	3.9
I	530	56.75	0.0120	6.593	2.98	42.5	96.6	0.9	1288.3	3.3
J	530	22.03	0.0136	3.540	2.91	37.4	95.2	1.1	604.1	2.8
K	530	18.79	0.0125	3.598	2.77	40.9	94.3	1.3	522.4	2.3
L	530	21.46	0.0117	3.053	3.14	43.5	95.8	1.6	593.6	2.2
M	580	37.85	0.0193	5.189	3.70	26.5	95.9	1.8	946.2	3.1
N	580	15.80	0.0190	1.648	4.18	26.9	96.9	2.1	459.4	1.9
O	580	16.75	0.0200	1.375	3.84	25.5	97.6	2.4	486.4	1.7
P	580	17.09	0.0202	1.474	3.72	25.3	97.5	2.6	494.5	2.2
Q	630	30.78	0.0174	3.342	3.19	29.4	96.8	2.8	808.4	2.9
R	630	18.44	0.0101	1.362	3.38	50.6	97.8	3.1	530.2	1.8
S	630	20.78	0.0082	1.439	2.95	62.5	98.0	3.3	588.7	2.4
T	680	39.77	0.0132	3.320	4.46	38.7	97.5	3.6	995.9	3.0
U	680	27.64	0.0115	1.372	4.22	44.4	98.5	3.9	751.3	2.3
V	680	29.87	0.0091	1.047	3.66	56.3	99.0	4.1	803.4	2.9
W	730	38.36	0.0107	1.558	4.67	47.7	98.8	4.5	978.2	2.8
X	730	36.41	0.0092	0.7784	5.67	55.5	99.4	4.8	943.5	2.4
Y	730	38.13	0.0076	0.5742	5.91	66.9	99.6	5.3	979.4	2.3
Z	780	44.14	0.0066	1.416	8.5	77.2	99.1	5.8	1091.1	2.1
ZA	780	37.47	0.0063	0.3395	10.6	81.3	99.7	6.6	967.5	1.9
ZB	830	37.62	0.0058	0.5854	16.6	88.0	99.5	7.7	969.1	1.9
ZC	830	34.94	0.0049	0.1361	21.1	105.0	99.9	9.2	917.1	1.5
ZD	880	34.54	0.0049	0.3822	27.8	103.3	99.7	11.1	907.4	1.7
ZE	880	33.14	0.0041	0.2036	34.0	123.7	99.8	13.4	879.2	1.5
ZF	930	33.11	0.0045	0.4644	40.1	113.4	99.6	16.2	876.8	1.5
ZG	930	32.73	0.0037	0.2868	48.0	138.9	99.7	19.5	870.0	1.5
ZH	980	32.45	0.0040	0.3172	52.6	127.0	99.7	23.1	863.8	1.5
ZI	980	32.49	0.0036	0.2659	62.9	141.0	99.8	27.5	865.0	1.7
ZJ	1030	32.37	0.0043	0.3894	68.2	119.2	99.6	32.2	861.8	1.5
ZK	1030	33.00	0.0038	0.2558	81.5	133.5	99.8	37.8	875.8	1.7
ZL	1100	33.42	0.0066	0.3705	119.6	76.9	99.7	46.1	884.1	1.5
ZM	1100	35.59	0.0074	0.3241	116.3	68.7	99.7	54.1	929.4	1.7
ZN	1100	37.08	0.0094	0.3307	132.8	54.2	99.7	63.3	959.8	1.7
ZO	1100	39.52	0.0108	0.4600	124.1	47.1	99.7	71.8	1007.6	1.8
ZP	1100	41.74	0.0069	0.4278	141.8	74.0	99.7	81.6	1051.0	2.1
ZQ	1180	42.19	0.0028	0.4118	37.0	180.1	99.7	84.2	1059.7	2.0
ZR	1280	43.04	0.0032	0.2544	100.5	158.3	99.8	91.1	1076.8	2.1
ZS	1380	43.40	0.0028	0.4346	18.0	180.4	99.7	92.4	1082.7	2.2
ZT	1670	44.30	0.0057	0.4221	110.6	90.2	99.7	100.0	1099.6	1.9
Total gas age ± 1σ			n=46		1448.6	K2O=13.83 %			988.0	1.6

DR2. $^{40}Ar/^{39}Ar$ analytical data for samples from the Sangre de Cristo Range and Las Vegas basin, New Mexico.

ID	Power/Temp (W/°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
EM02-1, A:8:157, 1.97 mg K-feldspar, J=0.0195129, D=1.0052±0.00172, NM-157, Lab#=53530-01										
A	430	490.4	0.0027	44.66	2.85	188.8	97.3	0.2	4260.7	6.0
B	430	32.83	0.0021	11.54	1.50	240.0	89.6	0.3	827.7	6.1
C	430	27.27	0.0006	7.321	1.34	785.8	92.1	0.4	727.4	5.7
D	430	23.83	-0.0012	4.822	1.59	-	94.0	0.5	661.6	4.9
E	480	30.81	0.0005	1.895	2.51	1017	98.2	0.7	846.5	3.6
F	480	19.20	0.0004	2.169	3.37	1421	96.7	0.9	563.7	2.5
G	480	18.73	-0.0003	1.975	3.60	-	96.9	1.2	552.8	2.5
H	480	18.03	0.0006	2.036	4.55	839.6	96.7	1.5	533.8	2.3
I	530	22.73	0.0008	0.9003	5.86	623.5	98.8	1.9	662.9	1.9
J	530	20.02	0.0005	0.4559	7.9	1055	99.3	2.5	597.9	1.7
K	530	20.57	0.0009	0.3976	8.3	581.4	99.4	3.0	612.4	1.6
L	530	21.81	0.0002	0.2704	10.0	2299	99.6	3.7	644.6	1.4
M	580	25.31	0.0007	0.3232	10.4	695.0	99.6	4.5	729.9	1.5
N	580	23.98	0.0000	0.2523	14.0	-	99.7	5.4	698.5	1.3
O	580	25.10	0.0004	0.0146	14.0	1149	100.0	6.4	727.2	1.4
P	580	25.93	0.0001	0.1882	16.1	9431	99.8	7.5	745.5	1.6
Q	630	28.15	0.0002	0.2109	15.0	2642	99.8	8.6	797.4	1.5
R	630	27.54	0.0000	0.1038	19.4	10607	99.9	9.9	784.0	1.8
S	630	28.01	0.0000	0.2421	19.2	10328	99.7	11.3	794.0	1.6
T	680	29.56	0.0003	0.1190	23.1	1723	99.9	12.9	830.0	1.6
U	680	29.22	0.0002	0.0832	26.8	2953	99.9	14.8	822.6	1.5
V	680	29.54	0.0003	0.0464	24.1	1488	100.0	16.5	830.2	1.8
W	730	30.48	0.0002	0.0017	24.3	2132	100.0	18.2	851.6	1.7
X	730	30.16	0.0002	0.1216	26.5	2061	99.9	20.0	843.7	1.6
Y	730	30.09	0.0000	0.0788	21.8	1322	99.9	21.5	842.3	1.6
Z	780	30.45	0.0006	0.1222	19.3	865.2	99.9	22.9	850.0	1.6
ZA	780	30.17	0.0001	0.0673	20.6	7057	99.9	24.3	844.3	2.0
ZB	830	30.12	0.0006	0.0959	21.6	836.4	99.9	25.8	843.0	1.4
ZC	830	29.96	0.0000	0.0421	21.2	24412	100.0	27.3	839.7	1.5
ZD	880	30.29	0.0004	0.0853	20.6	1220	99.9	28.8	846.8	1.8
ZE	880	30.05	0.0004	0.2008	21.1	1234	99.8	30.2	840.7	1.7
ZF	930	30.35	0.0010	0.0862	19.6	534.5	99.9	31.6	848.1	1.8
ZG	930	30.36	0.0004	0.4798	20.1	1294	99.5	33.0	845.7	2.0
ZH	980	30.78	0.0008	0.1457	19.6	605.1	99.9	34.4	857.3	1.8
ZI	980	30.84	0.0006	0.3072	21.3	879.8	99.7	35.9	857.7	1.8
ZJ	1030	32.16	0.0016	0.5088	22.3	310.2	99.5	37.4	885.4	1.7
ZK	1030	32.61	0.0007	0.3933	26.1	698.0	99.6	39.3	896.1	1.5
ZL	1100	35.15	0.0012	0.4759	46.4	421.2	99.6	42.5	950.2	1.5
ZM	1100	36.00	0.0005	0.5474	49.8	1092	99.6	46.0	967.5	1.9
ZN	1100	36.06	0.0007	0.4352	61.7	761.5	99.6	50.3	969.5	1.8
ZO	1100	36.85	0.0006	0.5096	54.4	854.6	99.6	54.1	985.5	1.9
ZP	1100	38.42	0.0005	0.7523	78.5	1069	99.4	59.6	1016.4	1.7
ZQ	1180	41.40	0.0008	0.6445	19.2	637.0	99.5	60.9	1076.9	2.3
ZR	1280	41.83	0.0003	0.5927	389.3	1814	99.6	88.2	1085.6	2.6
ZS	1380	42.07	0.0003	0.6795	139.1	1721	99.5	97.9	1089.9	1.9
ZT	1670	42.13	0.0005	1.313	30.2	977.0	99.1	100.0	1087.4	1.9
Total gas age ± 1σ			n=46		1429.8	K2O=14.29 %			980.6	1.6

DR2. $^{40}Ar/^{39}Ar$ analytical data for samples from the Sangre de Cristo Range and Las Vegas basin, New Mexico.

ID	Power/Temp (W/°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
LV02-2773, A:7:157, 2.02 mg K-feldspar, J=0.0193112, D=1.0052±0.00172, NM-157, Lab#=53529-01										
A	430	548.1	0.0401	37.42	3.80	12.7	98.0	0.3	4439.5	6.5
B	430	30.76	0.0382	2.138	1.20	13.3	98.0	0.4	836.8	6.6
C	430	25.07	0.0435	2.551	1.04	11.7	97.0	0.5	702.3	6.7
D	430	23.33	0.0498	1.716	1.18	10.2	97.8	0.6	666.2	5.6
E	480	42.52	0.0534	2.774	1.95	9.5	98.1	0.7	1078.3	4.2
F	480	20.08	0.0767	1.126	2.29	6.6	98.4	0.9	589.3	3.4
G	480	20.77	0.1004	2.325	2.22	5.1	96.7	1.1	597.9	3.8
H	480	18.68	0.1087	1.631	2.57	4.7	97.5	1.3	549.5	3.3
I	530	37.10	0.1055	1.858	5.00	4.8	98.5	1.6	974.8	2.8
J	530	17.33	0.1511	1.051	4.50	3.4	98.3	2.0	518.5	2.0
K	530	16.42	0.1671	0.9393	4.62	3.1	98.4	2.3	495.1	2.1
L	530	13.92	0.1821	0.4009	5.03	2.8	99.3	2.7	431.1	1.7
M	580	31.49	0.1750	1.889	8.7	2.9	98.3	3.4	855.0	2.1
N	580	14.37	0.2689	0.6612	6.9	1.9	98.8	3.9	441.5	1.7
O	580	14.76	0.2383	0.5168	6.21	2.1	99.1	4.4	453.6	1.6
P	580	15.87	0.1224	0.3367	6.40	4.2	99.4	4.9	484.8	1.9
Q	630	35.27	0.0428	1.263	11.8	11.9	99.0	5.8	940.1	2.1
R	630	18.90	0.0321	0.4060	7.8	15.9	99.4	6.4	564.3	1.7
S	630	19.67	0.0205	0.2525	7.1	24.9	99.6	7.0	585.3	1.9
T	680	26.27	0.0161	0.6688	10.7	31.6	99.3	7.8	744.1	1.8
U	680	22.17	0.0097	0.2050	10.7	52.8	99.7	8.6	648.5	1.6
V	680	22.08	0.0080	0.2309	9.5	63.6	99.7	9.3	646.2	1.7
W	730	24.40	0.0127	0.3045	12.0	40.2	99.6	10.3	702.1	1.4
X	730	22.89	0.0082	0.1269	13.0	62.3	99.8	11.3	666.9	1.3
Y	730	23.24	0.0067	0.1297	12.0	76.3	99.8	12.2	675.3	1.5
Z	780	24.67	0.0087	0.1680	13.5	58.6	99.8	13.2	709.6	1.3
ZA	780	24.09	0.0072	0.1378	15.5	70.7	99.8	14.4	696.0	2.1
ZB	830	25.34	0.0112	0.1486	20.6	45.6	99.8	16.0	725.6	1.7
ZC	830	25.41	0.0081	0.0953	22.4	63.4	99.9	17.7	727.7	1.4
ZD	880	26.37	0.0097	0.2526	28.4	52.8	99.7	19.9	749.2	1.5
ZE	880	26.33	0.0078	0.2306	30.2	65.2	99.7	22.2	748.4	1.3
ZF	930	27.01	0.0097	0.3390	38.8	52.4	99.6	25.2	763.4	1.4
ZG	930	26.15	0.0086	0.3034	41.8	59.1	99.7	28.5	743.6	1.6
ZH	980	25.69	0.0111	0.4275	58.9	45.8	99.5	33.0	732.1	1.3
ZI	980	25.71	0.0099	0.3989	72.2	51.4	99.5	38.6	732.7	1.5
ZJ	1030	25.77	0.0145	0.4743	104.0	35.3	99.5	46.6	733.7	1.4
ZK	1030	27.29	0.0133	0.4081	85.9	38.4	99.6	53.2	769.6	1.4
ZL	1100	28.95	0.0154	0.4055	102.9	33.2	99.6	61.1	807.7	1.4
ZM	1100	31.80	0.0112	0.2819	72.4	45.5	99.7	66.7	871.9	1.7
ZN	1100	33.45	0.0075	0.2630	96.6	68.0	99.8	74.2	907.7	1.7
ZO	1100	35.13	0.0048	0.2069	137.3	106.0	99.8	84.7	943.8	1.7
ZP	1100	36.24	0.0035	0.3143	129.1	147.0	99.7	94.7	966.4	1.8
ZQ	1180	37.25	0.0025	0.2334	10.8	205.6	99.8	95.5	987.6	2.0
ZR	1280	37.46	0.0048	0.2390	10.1	105.3	99.8	96.3	992.0	2.0
ZS	1380	37.98	0.0058	0.0723	16.6	88.2	99.9	97.6	1003.5	1.9
ZT	1670	38.15	0.0071	0.5690	31.5	71.9	99.6	100.0	1004.0	1.6
Total gas age ± 1σ			n=46		1297.6	K2O=12.78 %			852.1	1.4

DR2. $^{40}Ar/^{39}Ar$ analytical data for samples from the Sangre de Cristo Range and Las Vegas basin, New Mexico.

ID	Power/Temp (W/°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
HP02-1, B:8:157, 1.71 mg K-feldspar, J=0.0193992, D=1.0052±0.00172, NM-157, Lab#=53545-01										
A	430	637.5	-0.0027	66.03	1.54	-	96.9	0.1	4682.4	8.9
B	430	47.01	-0.0068	9.436	0.655	-	94.1	0.2	1130.5	9.1
C	430	36.28	-0.0046	11.82	0.546	-	90.4	0.2	898.4	9.7
D	430	27.02	-0.0121	12.24	0.560	-	86.6	0.3	682.8	9.4
E	480	35.15	-0.0029	8.216	0.74	-	93.1	0.4	896.8	6.7
F	480	23.77	-0.0022	4.834	1.19	-	94.0	0.5	656.8	4.5
G	480	18.71	0.0010	3.294	1.26	510.1	94.8	0.6	539.2	4.7
H	480	20.88	-0.0012	2.602	1.21	-	96.3	0.7	600.7	4.8
I	530	28.03	0.0019	2.415	1.52	271.2	97.5	0.8	775.8	3.7
J	530	18.96	-0.0034	2.058	1.93	-	96.8	1.0	555.2	3.5
K	530	18.37	0.0008	1.273	2.23	609.1	97.9	1.2	545.9	2.7
L	530	19.05	0.0021	1.468	2.92	247.5	97.7	1.5	562.3	2.3
M	580	26.52	0.0091	1.143	3.19	56.0	98.7	1.8	749.3	2.6
N	580	20.68	0.0023	0.9702	3.73	217.7	98.6	2.1	607.9	2.1
O	580	21.37	0.0006	0.7075	4.15	850.9	99.0	2.5	627.4	1.9
P	580	22.36	0.0009	0.2792	4.99	538.5	99.6	2.9	655.1	1.8
Q	630	28.16	0.0026	0.7073	5.29	196.1	99.3	3.4	790.5	2.3
R	630	25.04	0.0016	0.4322	5.75	327.0	99.5	3.9	719.1	1.9
S	630	26.34	0.0012	0.4619	6.18	408.9	99.5	4.5	749.8	1.9
T	680	31.44	0.0024	0.4010	8.5	217.0	99.6	5.3	866.2	2.2
U	680	30.76	0.0020	0.4944	10.1	254.5	99.5	6.2	850.6	1.7
V	680	32.69	0.0023	0.2066	8.4	226.3	99.8	6.9	894.9	1.9
W	730	35.54	0.0031	0.3562	10.9	165.9	99.7	7.9	954.8	1.7
X	730	35.03	0.0016	0.2050	13.6	310.4	99.8	9.2	945.0	2.0
Y	730	35.21	0.0013	0.2843	13.4	383.8	99.8	10.4	948.3	1.9
Z	780	36.11	0.0016	0.1001	12.3	312.9	99.9	11.5	968.3	1.8
ZA	780	34.54	0.0014	0.1888	18.3	372.4	99.8	13.2	934.7	1.8
ZB	830	34.78	0.0027	0.2126	18.1	187.6	99.8	14.8	939.7	1.7
ZC	830	33.65	0.0021	0.3589	24.2	241.5	99.7	17.0	914.6	1.7
ZD	880	33.88	0.0024	0.1789	20.2	210.1	99.8	18.8	920.6	1.7
ZE	880	33.40	0.0022	0.1793	26.8	231.2	99.8	21.3	910.4	1.8
ZF	930	34.09	0.0027	0.2869	22.9	187.1	99.8	23.3	924.4	1.6
ZG	930	33.53	0.0025	0.1479	24.6	201.6	99.9	25.6	913.3	1.7
ZH	980	34.65	0.0033	0.2499	27.5	152.9	99.8	28.1	936.7	1.7
ZI	980	33.70	0.0024	0.2434	30.0	208.4	99.8	30.8	916.5	1.8
ZJ	1030	35.97	0.0038	0.3726	25.9	134.3	99.7	33.1	963.7	1.7
ZK	1030	34.70	0.0028	0.4085	34.8	183.7	99.7	36.3	936.7	1.6
ZL	1100	37.10	0.0050	0.5012	40.3	102.9	99.6	39.9	986.3	1.7
ZM	1100	36.63	0.0045	0.4610	30.9	114.3	99.6	42.7	976.9	1.8
ZN	1100	38.31	0.0050	0.3935	58.3	101.8	99.7	48.0	1011.9	1.8
ZO	1100	39.80	0.0055	0.4951	56.1	92.1	99.6	53.1	1041.2	1.9
ZP	1100	40.83	0.0040	0.5158	67.8	128.2	99.6	59.3	1061.8	2.2
ZQ	1180	40.23	0.0014	0.3270	19.8	353.3	99.8	61.1	1050.8	2.0
ZR	1280	40.82	0.0004	0.2800	299.2	1308	99.8	88.2	1062.9	3.1
ZS	1380	40.75	0.0011	0.3862	60.8	481.2	99.7	93.7	1060.8	2.0
ZT	1670	39.43	0.0007	0.4590	68.9	707.3	99.7	100.0	1034.1	2.0
Total gas age ± 1σ			n=46		1101.9		K2O=12.76 %		1010.9	1.7

DR2. $^{40}Ar/^{39}Ar$ analytical data for samples from the Sangre de Cristo Range and Las Vegas basin, New Mexico.

ID	Power/Temp (W/°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
HP02-10, E:1:157, 2.38 mg K-feldspar, J=0.0187144, D=1.0052±0.00172, NM-157, Lab#=53556-01										
A	430	531.1	0.0114	46.62	2.39	44.6	97.4	0.2	4325.1	6.5
B	430	30.04	0.0038	6.706	0.98	136.0	93.4	0.2	770.0	6.8
C	430	23.10	0.0062	7.986	0.620	81.9	89.8	0.3	598.2	8.0
D	430	18.09	0.0033	3.312	0.82	152.9	94.6	0.3	506.6	6.3
E	480	18.94	0.0105	1.157	0.88	48.8	98.2	0.4	544.6	5.8
F	480	12.91	0.0085	2.268	1.10	60.0	94.8	0.5	375.7	4.4
G	480	12.20	0.0032	2.378	1.34	161.4	94.2	0.6	355.0	4.1
H	480	12.60	0.0039	1.961	1.27	130.5	95.4	0.7	369.7	4.2
I	530	18.89	0.0077	1.931	1.86	66.4	97.0	0.8	537.4	3.3
J	530	14.40	0.0083	2.989	2.03	61.6	93.9	1.0	411.0	3.4
K	530	13.56	0.0098	0.6281	2.42	52.0	98.6	1.1	407.1	2.7
L	530	14.10	0.0057	0.9663	2.80	90.2	98.0	1.3	419.0	2.2
M	580	19.38	0.0044	0.5978	3.03	116.7	99.1	1.6	559.9	2.2
N	580	15.60	0.0048	0.3262	3.36	105.7	99.4	1.8	464.4	1.9
O	580	17.13	0.0054	0.6478	3.64	93.8	98.9	2.1	501.9	1.7
P	580	19.19	0.0061	0.6711	3.76	83.4	99.0	2.3	554.5	1.9
Q	630	22.52	0.0032	-0.0087	3.24	160.1	100.0	2.6	641.4	2.1
R	630	23.29	0.0061	0.5881	2.98	83.3	99.3	2.8	655.7	2.2
S	630	25.43	0.0054	0.7565	2.80	94.5	99.1	3.0	704.9	2.5
T	680	32.97	0.0056	0.7297	3.77	90.8	99.3	3.3	872.3	2.4
U	680	32.01	0.0055	0.7312	3.51	93.5	99.3	3.5	851.9	2.3
V	680	34.50	0.0055	0.7759	3.64	92.4	99.3	3.8	904.2	2.4
W	730	39.75	0.0064	0.5775	3.64	80.1	99.6	4.0	1011.6	2.4
X	730	39.11	0.0048	0.3840	4.93	106.6	99.7	4.4	1000.2	2.4
Y	730	40.23	0.0041	0.2576	5.80	124.2	99.8	4.8	1022.8	2.4
Z	780	41.95	0.0049	0.3515	6.39	103.6	99.8	5.3	1055.5	2.2
ZA	780	40.16	0.0032	0.2885	10.5	158.8	99.8	6.0	1021.3	1.9
ZB	830	39.74	0.0045	0.3816	12.1	113.4	99.7	6.9	1012.5	1.9
ZC	830	38.13	0.0027	0.1295	14.6	188.8	99.9	8.0	982.1	1.9
ZD	880	37.90	0.0027	0.2894	16.8	187.0	99.8	9.2	976.5	2.0
ZE	880	36.82	0.0024	0.1268	23.6	214.8	99.9	10.9	955.8	1.9
ZF	930	37.56	0.0030	0.3734	31.7	170.2	99.7	13.2	969.2	1.9
ZG	930	36.83	0.0020	0.1127	34.2	259.2	99.9	15.7	956.0	1.6
ZH	980	38.06	0.0027	0.3002	47.1	188.6	99.8	19.1	979.7	1.7
ZI	980	37.16	0.0015	0.2412	50.6	347.8	99.8	22.8	962.1	1.9
ZJ	1030	38.01	0.0025	0.3543	76.6	206.3	99.7	28.3	978.4	1.8
ZK	1030	37.26	0.0017	0.2293	74.7	295.7	99.8	33.7	964.0	1.9
ZL	1100	38.23	0.0028	0.2707	119.3	181.8	99.8	42.4	983.3	1.8
ZM	1100	38.10	0.0026	0.1935	124.9	193.6	99.9	51.4	981.2	1.9
ZN	1100	38.55	0.0023	0.1756	166.0	221.6	99.9	63.4	990.3	2.1
ZO	1100	39.37	0.0020	0.1824	152.2	255.0	99.9	74.4	1006.4	1.7
ZP	1100	39.44	0.0015	0.2265	133.5	346.6	99.8	84.1	1007.5	1.6
ZQ	1180	40.29	0.0010	0.2572	20.3	534.2	99.8	85.6	1024.0	1.6
ZR	1280	40.26	0.0006	0.2113	113.8	864.5	99.8	93.8	1023.6	2.1
ZS	1380	40.26	0.0008	0.3587	24.8	601.2	99.7	95.6	1022.8	1.7
ZT	1670	40.07	0.0011	0.3994	60.4	446.5	99.7	100.0	1018.9	1.8
Total gas age ± 1σ			n=46		1380.8		K2O=11.91 %		996.9	1.6

DR2. $^{40}Ar/^{39}Ar$ analytical data for samples from the Sangre de Cristo Range and Las Vegas basin, New Mexico.

ID	Power/Temp (W/°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
LAMY02-1, A:11:157, 2.04 mg K-feldspar, J=0.0192267, D=1.0052±0.00172, NM-157, Lab#=53532-02										
A	430	59.88	0.0056	15.01	3.57	90.7	92.6	0.3	1324.6	3.7
B	430	18.85	-0.0038	2.763	1.66	-	95.7	0.4	542.8	3.4
C	430	16.75	-0.0003	2.966	1.49	-	94.8	0.5	485.6	3.9
D	430	16.76	0.0009	2.788	1.48	575.4	95.1	0.7	487.3	3.1
E	480	17.32	0.0010	1.873	1.92	486.4	96.8	0.8	509.4	3.5
F	480	17.26	0.0026	1.184	2.53	193.4	98.0	1.0	513.3	2.0
G	480	18.23	0.0025	0.7187	2.11	208.1	98.8	1.2	542.5	3.3
H	480	18.72	0.0013	2.233	2.41	406.9	96.5	1.4	543.6	2.7
I	530	20.66	0.0023	1.642	3.18	222.5	97.6	1.7	597.9	1.9
J	530	20.43	0.0023	0.6471	4.21	219.0	99.1	2.0	599.5	1.9
K	530	21.79	0.0032	0.6265	3.21	159.9	99.2	2.3	633.6	2.1
L	530	23.09	0.0010	0.6049	3.87	528.6	99.2	2.6	665.8	2.0
M	580	26.18	0.0020	1.189	3.93	254.5	98.7	2.9	735.5	2.1
N	580	27.13	0.0016	0.6077	4.65	312.0	99.3	3.3	761.8	1.9
O	580	29.92	0.0008	0.5609	4.22	626.8	99.4	3.6	825.3	2.4
P	580	32.73	0.0046	0.4802	4.66	111.8	99.6	4.0	887.7	2.1
Q	630	35.74	0.0032	0.7181	4.04	158.9	99.4	4.3	950.1	2.7
R	630	37.12	0.0012	0.6184	5.25	442.4	99.5	4.8	979.3	2.2
S	630	38.33	0.0015	0.3232	5.30	345.3	99.8	5.2	1005.7	2.8
T	680	39.46	0.0014	0.4881	5.32	364.6	99.6	5.6	1027.5	2.3
U	680	39.01	0.0010	0.3421	7.4	504.9	99.7	6.2	1019.4	2.2
V	680	38.82	0.0007	0.2290	7.1	682.2	99.8	6.8	1016.1	2.6
W	730	38.71	0.0018	0.3650	9.2	277.2	99.7	7.6	1013.2	2.2
X	730	37.92	0.0021	0.3908	10.5	245.9	99.7	8.4	997.1	2.1
Y	730	37.42	0.0016	0.4446	11.5	320.1	99.6	9.4	986.4	2.0
Z	780	37.11	0.0030	0.3868	10.5	167.7	99.7	10.2	980.4	2.0
ZA	780	36.77	0.0033	0.2381	15.2	153.1	99.8	11.4	974.3	2.1
ZB	830	36.49	0.0054	0.1485	19.3	94.2	99.9	13.0	969.1	1.7
ZC	830	36.58	0.0023	0.2763	23.6	217.3	99.8	14.9	970.1	2.2
ZD	880	36.80	0.0062	0.1823	20.8	82.0	99.9	16.6	975.4	1.9
ZE	880	36.75	0.0041	0.2219	28.1	125.7	99.8	18.9	974.1	1.7
ZF	930	37.18	0.0085	0.3603	21.4	60.2	99.7	20.7	982.1	1.8
ZG	930	36.97	0.0047	0.1691	28.7	109.4	99.9	23.0	979.0	2.3
ZH	980	36.76	0.0041	0.3342	26.9	123.1	99.7	25.2	973.6	1.7
ZI	980	36.99	0.0021	0.2655	29.2	243.4	99.8	27.6	978.8	1.8
ZJ	1030	36.61	0.0051	0.4780	34.1	99.1	99.6	30.4	969.7	1.7
ZK	1030	37.34	0.0036	0.4097	31.4	140.9	99.7	32.9	985.0	2.1
ZL	1100	36.89	0.0113	0.6211	44.3	45.0	99.5	36.5	974.4	1.5
ZM	1100	37.68	0.0074	0.4953	47.7	69.3	99.6	40.4	991.5	1.7
ZN	1100	37.99	0.0063	0.3885	70.4	80.4	99.7	46.2	998.4	2.2
ZO	1100	38.26	0.0039	0.4765	127.9	132.3	99.6	56.6	1003.4	1.9
ZP	1100	38.67	0.0019	0.4799	133.0	265.4	99.6	67.4	1011.7	2.2
ZQ	1180	38.46	0.0008	0.2615	57.9	622.8	99.8	72.1	1008.7	1.9
ZR	1280	39.79	0.0009	0.2485	295.6	565.2	99.8	96.2	1035.5	2.8
ZS	1380	40.21	0.0032	0.5150	26.0	158.1	99.6	98.3	1042.2	1.8
ZT	1670	40.31	0.0041	1.194	20.3	123.7	99.1	100.0	1040.2	2.3
Total gas age ± 1σ			n=46		1227.0		K2O=12.02 %		995.0	1.7

DR2. $^{40}Ar/^{39}Ar$ analytical data for samples from the Sangre de Cristo Range and Las Vegas basin, New Mexico.

ID	Power/Temp (W/°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
MG01-1a, J:1:145, 3.25 mg K-feldspar(?), J=0.0095489, D=1.00535±0.00031, NM-145, Lab#=52790-01										
A	450	79.79	2.143	186.8	1.515	0.24	31.0	0.8	387.5	8.3
B	450	27.95	0.7130	17.64	0.887	0.72	81.5	1.3	359.4	4.3
C	450	25.92	0.4026	11.90	0.782	1.3	86.5	1.7	354.2	4.2
D	500	25.23	0.7817	9.002	0.463	0.65	89.7	2.0	357.1	8.3
E	500	25.04	1.039	7.270	1.451	0.49	91.7	2.8	362.0	2.3
F	500	26.95	0.4165	6.449	1.312	1.2	93.0	3.5	391.7	2.7
G	550	28.98	0.1446	4.301	1.579	3.5	95.6	4.3	428.5	2.1
H	550	31.07	0.0636	3.806	2.278	8.0	96.4	5.5	458.9	1.8
I	550	34.32	0.0427	2.658	2.027	11.9	97.7	6.6	506.9	2.1
J	600	37.67	0.0496	3.191	2.033	10.3	97.5	7.7	548.6	2.0
K	600	39.71	0.0309	1.920	3.195	16.5	98.6	9.5	579.5	1.6
L	600	42.84	0.0238	1.444	2.937	21.4	99.0	11.0	620.6	1.8
M	650	44.64	0.0262	0.9979	2.920	19.5	99.3	12.6	644.5	2.2
N	650	47.05	0.0218	0.7057	4.67	23.4	99.6	15.1	674.8	1.3
O	650	49.09	0.0188	0.6965	4.411	27.1	99.6	17.5	699.2	1.3
P	700	50.70	0.0233	1.051	3.981	21.9	99.4	19.7	717.0	1.2
Q	700	52.27	0.0211	1.008	5.88	24.2	99.4	22.8	735.6	1.1
R	700	53.94	0.0212	0.8825	5.06	24.1	99.5	25.6	755.4	1.2
S	750	55.24	0.0264	0.9916	4.215	19.3	99.5	27.8	769.9	1.5
T	750	56.52	0.0266	0.7326	6.05	19.2	99.6	31.1	785.3	1.1
U	750	58.02	0.0288	1.346	4.64	17.7	99.3	33.6	800.3	1.3
V	800	59.53	0.0654	1.698	3.093	7.8	99.2	35.3	816.1	1.8
W	800	59.75	0.0508	1.978	4.396	10.0	99.0	37.6	817.6	1.4
X	850	61.62	0.0668	1.318	5.92	7.6	99.4	40.8	840.5	1.2
Y	850	63.61	0.0472	1.170	6.21	10.8	99.5	44.2	862.7	1.4
Z	900	65.19	0.0472	1.320	6.95	10.8	99.4	47.9	879.3	1.2
ZA	900	66.75	0.0343	0.9894	7.09	14.9	99.6	51.8	897.0	1.2
ZB	950	66.48	0.0593	1.170	6.78	8.6	99.5	55.4	893.7	1.2
ZC	950	67.96	0.0373	1.034	7.04	13.7	99.6	59.2	909.8	1.1
ZD	1000	67.02	0.0522	1.625	7.75	9.8	99.3	63.4	898.0	1.4
ZE	1000	70.63	0.0395	1.220	7.20	12.9	99.5	67.3	937.3	1.1
ZF	1050	72.81	0.0599	2.383	10.26	8.5	99.0	72.8	956.37	0.90
ZG	1050	77.02	0.0582	1.992	10.27	8.8	99.2	78.4	1000.6	1.2
ZH	1100	82.99	0.0710	3.220	12.43	7.2	98.9	85.1	1056.3	1.6
ZI	1100	87.14	0.0621	1.937	10.03	8.2	99.3	90.5	1100.0	1.2
ZJ	1100	90.06	0.0813	3.379	7.10	6.3	98.9	94.3	1123.6	1.6
ZK	1100	93.82	0.1447	12.34	2.180	3.5	96.1	95.5	1134.2	3.4
ZL	1100	99.91	0.2024	30.47	1.012	2.5	91.0	96.0	1141.1	4.2
ZN	1300	84.82	0.3499	7.490	0.537	1.5	97.4	96.3	1062.2	6.0
ZO	1400	87.55	0.0860	5.506	1.146	5.9	98.1	96.9	1093.9	3.2
ZP	1660	89.99	0.0932	7.135	5.69	5.5	97.7	100.0	1112.5	1.4
Total gas age ± 1σ			n=41		185.3		K2O=2.29 %		871.65	0.80

DR2. $^{40}Ar/^{39}Ar$ analytical data for samples from the Sangre de Cristo Range and Las Vegas basin, New Mexico.

ID	Power/Temp (W/°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)

Isotopic ratios corrected for blank, radioactive decay, and mass discrimination, not corrected for interferring reactions.
Ages calculated relative to FC-2 Fish Canyon Tuff sanidine interlaboratory standard at 28.27 Ma.
Errors quoted for individual analyses include analytical error only, without interferring reaction or J uncertainties.
Total gas age calculated by recombining isotopic measurements of all steps.
Total gas age error calculated by recombining errors of isotopic measurements of all steps.
WMA (weighted mean age) is inverse-variance-weighted mean of selected steps.
WMA age error is inverse-variance-weighted mean error (Taylor, 1982) times root MSWD where MSWD>1.
WMA and total gas ages incorporate uncertainties in interferring reaction corrections and J factors.
Isotopic abundances after Steiger and Jager (1977). Decay constant for ^{40}K is 5.476e-10/a after Kwon et al. (2002).
# symbol preceding sample ID denotes analyses excluded from WMA age calculations.
Discrimination = 1.00535±0.00031, 1.00484±0.00092, and 1.0052±0.00121 for NM-145, NM-157, and NM-164, respectively.
Correction factors:
$(^{39}Ar/^{37}Ar)_{Ca}$ = 0.0007±0.00003(NM-145); 0.00075±0.00003(NM-158); 0.0007±0.00005(NM-164)
$(^{36}Ar/^{37}Ar)_{Ca}$ = 0.00027±0.000005(NM-145); 0.000292±0.000006(NM-158); 0.00027±0.00001(NM-164)
$(^{38}Ar/^{39}Ar)_{K}$ = 0.01077
$(^{40}Ar/^{39}Ar)_{K}$ = 0.031± 0.001(NM-145); 0.0296±0.0005(NM-158); 0.02559±0.001487(NM-164)

DR3 Data repository: Methods for obtaining thermal histories from $^{40}Ar/^{39}Ar$ K-feldspar step heating data

K-feldspar $^{40}Ar/^{39}Ar$ data and plots

Age spectrum diagrams

We employ the Multiple Diffusion Domain (MDD) model of Lovera et al. (1989) to extract thermal histories from $^{40}Ar/^{39}Ar$ step heating data. The thermal history recorded by a K-feldspar can be determined by combining the age spectrum data and the laboratory degassing behavior of ^{39}Ar. The age spectrum is a measurement of the natural radiogenic ^{40}Ar ($^{40}Ar^*$) concentration distribution within the sample; whereas the degassing of the reactor-produced ^{39}Ar during step heating is a measure of the K-feldspar closure temperatures. Below we demonstrate the steps used to recover thermal histories from $^{40}Ar/^{39}Ar$ K-feldspar step heating data. The first step is to create the age spectrum by high-resolution (~45 steps) step heating (Fig. 1a). Heating schedules typically begin at 400°C and include three to four isothermal steps for many of the lower temperature settings (Fig. 1b). The isothermal steps serve two primary purposes. The first is to resolve excess ^{40}Ar that is common in most K-feldspars. The excess ^{40}Ar appears to be cited in thermally distinct reservoirs as the first isothermal step commonly records an anomalously old apparent age relative to the next isothermal steps at a given temperature (Figs 1a, b). When the next higher isothermal temperature group is carried out the 1st step is once again anomalously old and is followed by younger apparent ages (Fig. 1b). This behavior is thought to be caused by decrepitation of fluid inclusions that contain excess ^{40}Ar (Harrison et al., 1993, 1994). After initial decrepitation caused by the first of the isothermal replicate steps, the age typically decreases and then rises more uniformally as the true distribution of $^{40}Ar^*$ is less disturbed by the fluid-inclusion hosted excess argon. Moving to the next highest temperature of isothermal replicates causes decrepitation of new fluid inclusions that again causes the apparent age to increase significantly (Fig. 1a, b).

Because MDD theory does not allow for excess argon contamination, the anomalously old steps need correction prior to modeling the age spectrum. Harrison et al. (1993) developed a method to correct for fluid inclusion hosted excess argon though the recognition that the old apparent ages were correlated to Cl that is monitored by measuring $^{38}Ar_{Cl}$. Using the Harrison et al. (1993) approach for many of the Precambrian samples analyzed at the NMGRL, yields Cl-corrected ages that are negative indicating that the Cl cannot all be correlated to excess argon and thus the method of Harrison et al. (1993) is not employed. Rather, it is assumed that when the apparent age reaches a minimum for a given set of isothermal heating steps the measured age accurately records the true $^{40}Ar^*$ distribution. To correct the anomalously old apparent ages that are given by the 1st isothermal step they are decreased to the mean value of the previous and following steps (Fig. 1b, c). This procedure results in a corrected age spectrum that only records an overall increasing spectrum and is the spectrum used for thermal history modeling.

Arrhenius diagrams

The second purpose of the isothermal steps is to evaluate whether the calculated diffusion coefficients for the initial heating steps on the Arrhenius diagram are approximately the same. An Arrhenius diagram is a plot of inverse temperature (1/T) and frequency-factor length scale parameter (D/r^2) for each heating step (Fig. 2a). The frequency-factor length scale ratio is determined from the fraction of ^{39}Ar released and the duration of each heating step assuming a plane-sheet geometry (eqs. 1 and 2).

$$f=1-(8/\pi^2)\exp(-\pi^2 Dt/4r^2) \qquad \text{for } 0.45\leq f\leq 1 \qquad \text{eq. 1}$$

$$f=(2/((\pi^{1/2}))(Dt/r^2)^{1/2} \qquad \text{for } 0\leq f\leq 0.60 \qquad \text{eq. 2}$$

where D = diffusion coefficient; f = fraction ^{39}Ar released; r = diffusion half width; t = time at temperature.

The slope of the Arrhenius data is a function of the activation energy (E) of a sample, however with multiple diffusion domains contributing gas to each temperature step the true slope can be difficult to determine. Lovera et al. (1989) demonstrated that the initial heating steps could yield diffusion coefficients with a slope that accurately records the true E if the gas released is dominated by only one of the diffusion domains. Subequal diffusion coefficients for isothermal replicate heating steps indicates gas release that is dominated by a single domain (Fig. 2b – data segment 1), whereas significant decreases of the diffusion coefficient during replicate temperature steps indicates gas evolution from a mixture of different domain sizes (Fig. 2b – data segment 2). Because up to 4 replicate isothermal steps are typically used for these samples the overall slope of the initial segment of the Arrhenius plot is generally underestimated by linear regression of all of the diffusion coefficients (Fig. 2b – data segment 3). Therefore, we calculate the slope of line segments between the last isothermal step of a temperature group and the 1st isothermal step of the next highest temperature group (Fig 2b – data segment 4). The individual line segments that yield similar values are averaged to estimate the E for each sample. Typically, the first 3 to 5 line segments yield similar slopes that are averaged to estimate the E of the sample. For an Arrhenius diagram with Y-axis of $\log(D/r^2)$ and X-axis of 10000/T the E is given in kcal/mol via equation 3.

$$E = m*2.303*19.87 \qquad \text{eq. 3}$$

where m is slope, 2.303 is a log versus natural log conversion and 19.87 is the gas constant.

Once the E is determined, a reference Arrhenius law (r_o) with this E is projected through the initial heating steps (Fig. 2a – data segment 5). Another characteristic of the Arrhenius plot is the several isothermal heating steps conducted at 1100°C (Fig. 2a – data segment 6). Typically a K-feldspar is heated at 1100°C for several steps that total about 8 hours to facilitate substantial degassing prior to incongruent melting. Stepping above 1100°C, where the sample begins to degas via melting, is readily recognized on the Arrhenius plot by a calculated diffusion coefficient that is anomalously high relative to the projection of the lower temperature diffusion coefficients (Fig. 2a – data segment 7).

Log(r/r_o) diagrams

Recall, as small diffusion domains are exhausted of argon during initial heating steps, the slope of the Arrhenius data decrease as larger domains begin to contribute more ^{39}Ar. This, coupled with the fact that each diffusion coefficient datum on the Arrhenius plot is graphically displayed with a symbol of equal size makes it difficult to visualize the domain distribution of the sample. Also, the Arrhenius plot varies with heating schedule, thus making it somewhat ineffective in representing the diffusion domain distribution. Therefore, Lovera et al. (1991) devised the log(r/r_o) plot as an alternative method of portraying the Arrhenius data (Fig. 3). This is a plot of the log of the deviation of the measured data from r_o versus cumulative %^{39}Ar released. Dividing the deviation by 2 yields the parameter log(r/r_o) that represents the change in domain size (r) necessary to depart from r_o. For a single domain sample there would be no variation between r_o and the measured data and thus the log(r/r_0) plot would be a horizontal line with value equal to zero. Log(r/r_o) values increase as the measured frequency factors fall below r_o on the Arrhenius diagram. A log(r/r_o) value of 1 indicates a relative increase in diffusion domain size of 10 whereas a value of 2 means a domain size that is 100 times larger than r_0. For the example given in Fig. 3, the log(r/r_o) values climb almost immediately from zero indicating that there is very little gas in the smallest diffusion domain and the overall flat part near a value of 2 indicates that the largest diffusion domain is about 100 times larger than the reference value. The nondiffusive loss of ^{39}Ar that stems from sample melting is quite apparent on the log(r/r_o) plot as noted by a sudden drop of the log(r/r_o) value near 75% cumulative %^{39}Ar released.

Modeling kinetic parameters and thermal histories

Once the activation energy and the maximum value on the log(r/r_o) plot are determined, the domain distribution (i.e. volume fraction, number of domains, relative sizes) can be obtained by modeling the fraction of ^{39}Ar released relative to the heating schedule (Lovera et al., 1989; 1991). Lovera developed a set of automated routines for modeling both the ^{39}Ar fraction released and age spectrum data. We generally use these programs in a semi-automated manner by inputting our determined E and restricting the number of diffusion domains. The programs are modified from routines given in Press et al. (1992) and use a variational method to calculate a nonlinear-square fit approximation of the $\log(r/r_0)$ and age spectrum diagrams. For the case of the age spectrum modeling, the thermal histories are approximated with the Chebyshev polynomials with the best-fit Chebyshev coefficients being found with the Levenberg-Marquard methods. After the kinetic parameters are determined, the measured age spectrum is forward modeled by inputting thermal histories that yield calculated spectra that match the measured ages. There are two types of thermal histories calculated by the Lovera programs. For monotonic thermal histories, the sample is only allowed to cool from an initially high temperature, whereas for the unconstrained thermal histories the sample is allowed to undergo reheating (Figs. 4, 5a, b). Individual thermal histories are accepted when they yield a model spectrum that meets the fitting criteria relative to the measured spectrum (Quidelleur et al., 1997). The individual models are contoured and displayed in two separate fashions. For the monotonic thermal histories, 90% confidence intervals are calculated for the mean as well as the overall distribution and are shown as black and grey bans, respectively (Fig. 4). For the unconstrained models, bins of time-temperature space are assigned and then the number of thermal histories that pass through an individual bin is calculated. The contour shading represents various percentages of the number of time-temperature paths that pass through individual bins relative to the total number of solutions. The background region represents a density of acceptable solutions that is less then 2% of the total number of solutions.

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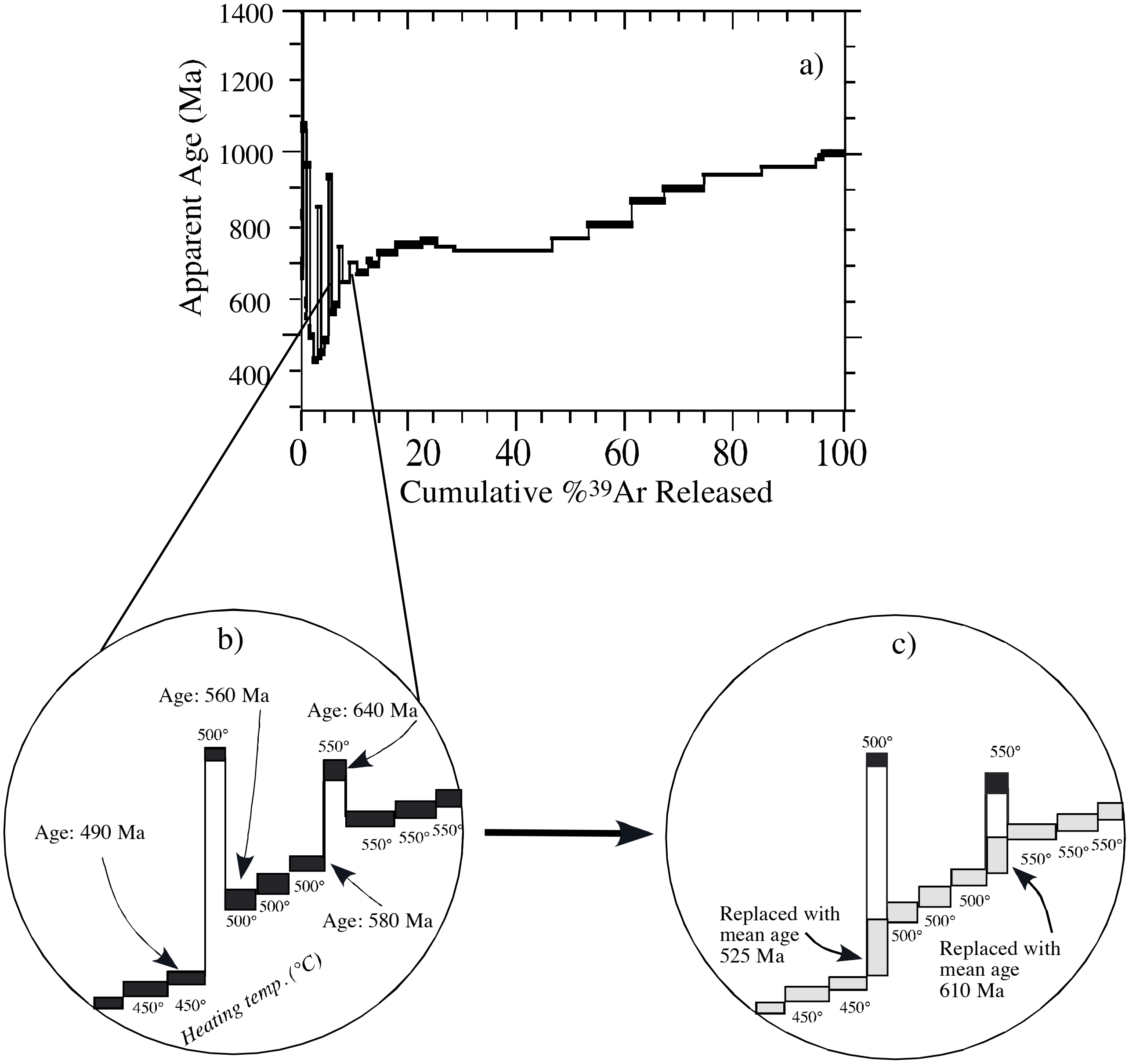

<u>Fig. 1. Age spectrum diagram and excess argon corrections.</u> 1a. Common age spectrum for many K-feldspars with initially old ages indicating excess ^{40}Ar contamination followed by an overall increasing age gradient revealing the non-uniform $^{40}Ar^*$ concentration profile developed by argon loss associated with slow-cooling and/or reheating events. 1b. Isothermal replicate heating steps demonstrate a characteristic behavior with the first step yielding an anomalously old age caused by degassing of fluid inclusions that host excess ^{40}Ar. 1c. Method of correcting anomalous ages involves substituting old ages with the mean age of the preceding and following steps. The error bar is expanded to fill the age space between the preceding and following steps.

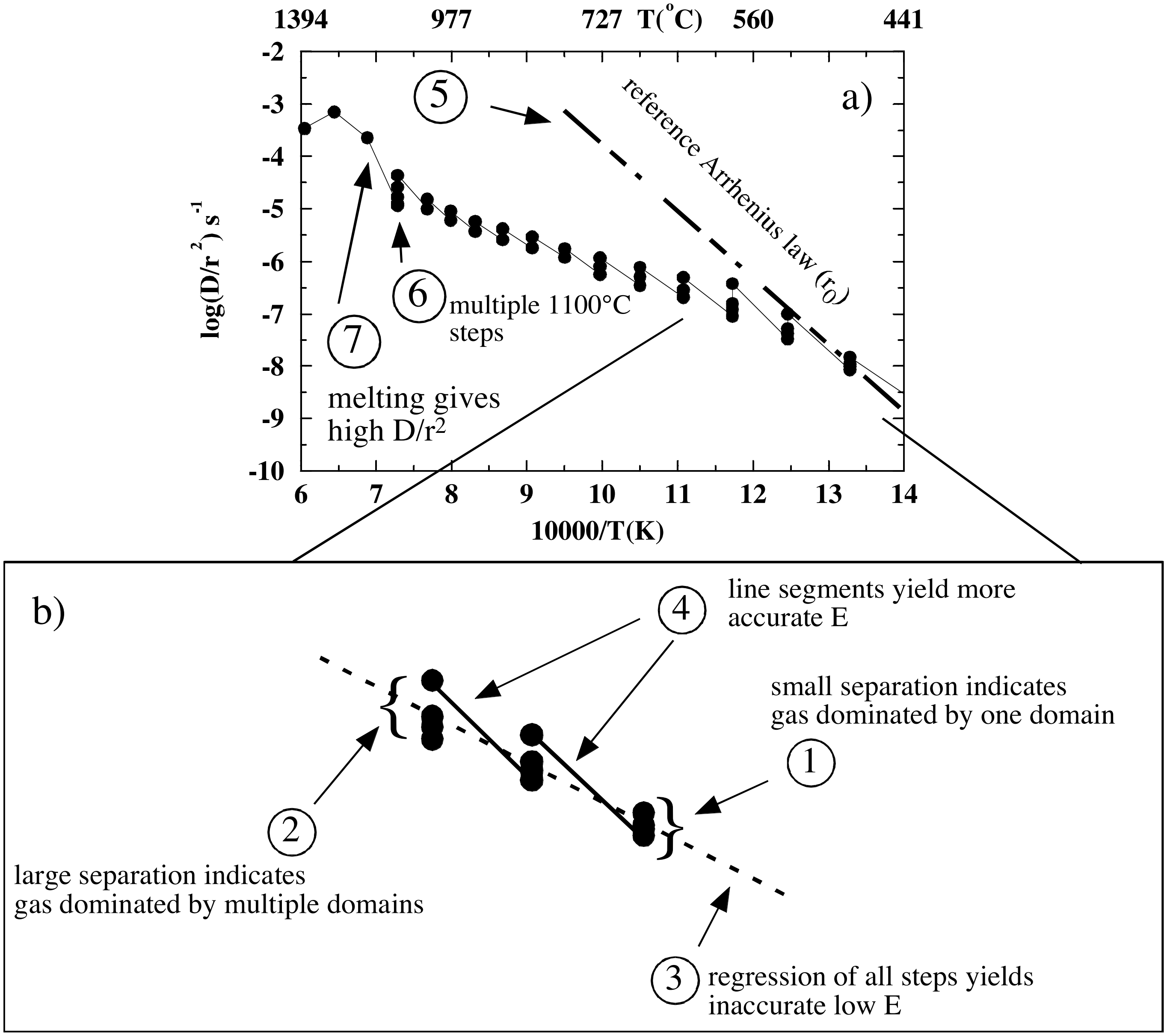

Fig. 2 Arrhenius diagram. 1a. Typical K-feldspar Arrhenius diagram for samples containing multiple diffusion domains. 1b. Expansion of initial part of the Arrhenius diagram to demonstrate characteristic data and choice of best E. 1, when isothermal steps yield similar $\log(D/r_2)$ values it is inferred that gas released is dominated by a single domain, whereas 2, shows significant decrease of $\log(D/r_2)$ values for isothermal steps that indicate a transition to degassing of larger diffusion domains. 3, regression of all initial data would provide an E that is underestimated due to ^{39}Ar derived from multiple domains. 4, line segments connecting last step of isothermal group with 1st step of next highest temperature isothermal group can be used to better determine the slope (E) of r_o. 5, by convention the reference Arrhenius law is projected through initial heating steps such that the initial steps on $\log(r/r_o)$ are zero. 6, several steps at 1100°C are carried out to degas the sample prior to the onset of melting. 7, once the temperature is raised above 1100°C high apparent $\log(D/r^2)$ values are calculated due to enhanced argon loss via melting compared to diffusive argon loss. Data collected above 1100°C are not used for modeling since the argon loss from the sample is not occurring by the same mechanism that occurred in nature.

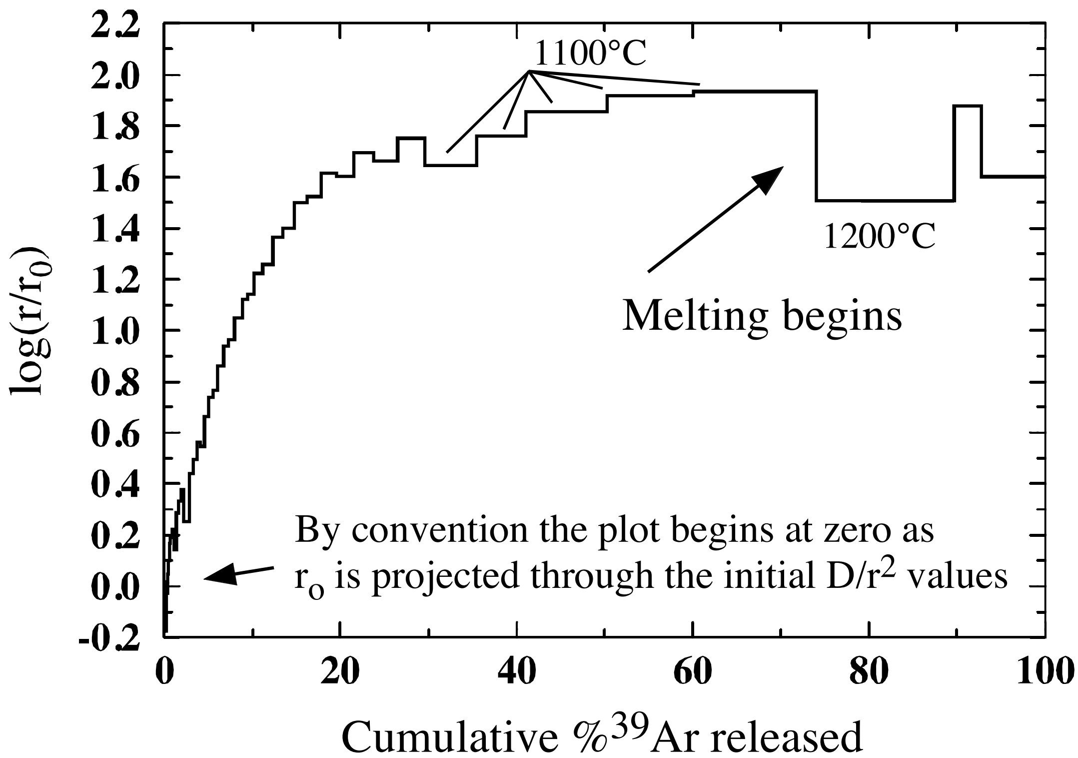

Fig. 3. Log(r/r_o) diagram. This plot is intended to provide a method to show how much ^{39}Ar is contained in an individual point on the Arrhenius plot. The log(r/r_o) value represents the relative domain size compared to r_o that has caused deviation from the reference Arrhenius law. A value of 1 indicates that r is 10 times larger than r_0 whereas a value of 2 indicates that r is 100 times larger than r_o.

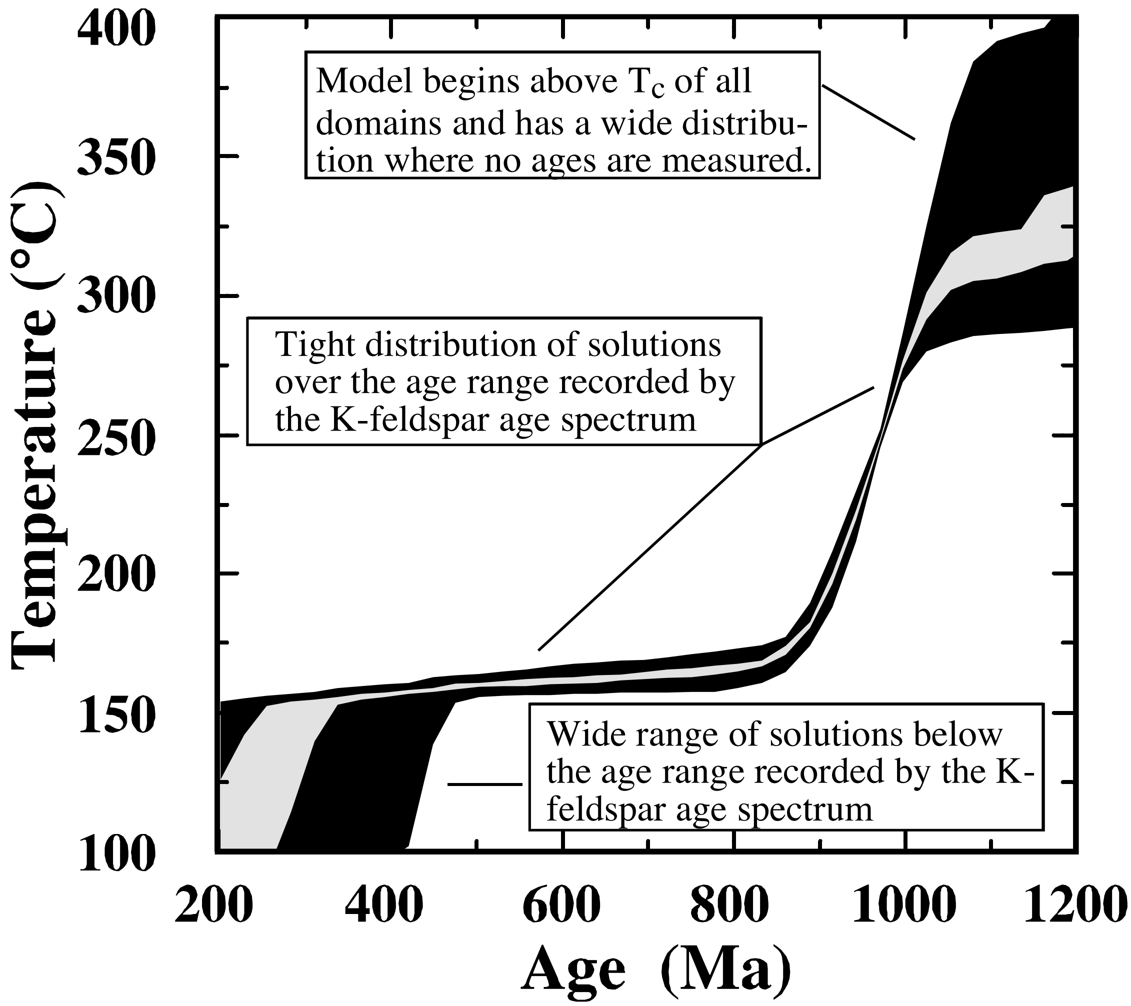

Fig. 4. Thermal histories from monotonic models. Diagram represents contoured results of thermal histories that yield calculated age spectra that match a measured age spectrum. This model only allows the sample to cool from an initially high temperature. The grey band is the 90% confidence interval of the mean, whereas the black band is the 90% confidence of the entire distribution. Large uncertainties in time-temperature space occur where there is either poor agreement between the model and measured data, or more commonly in the age regions that are younger or older than the measured data.

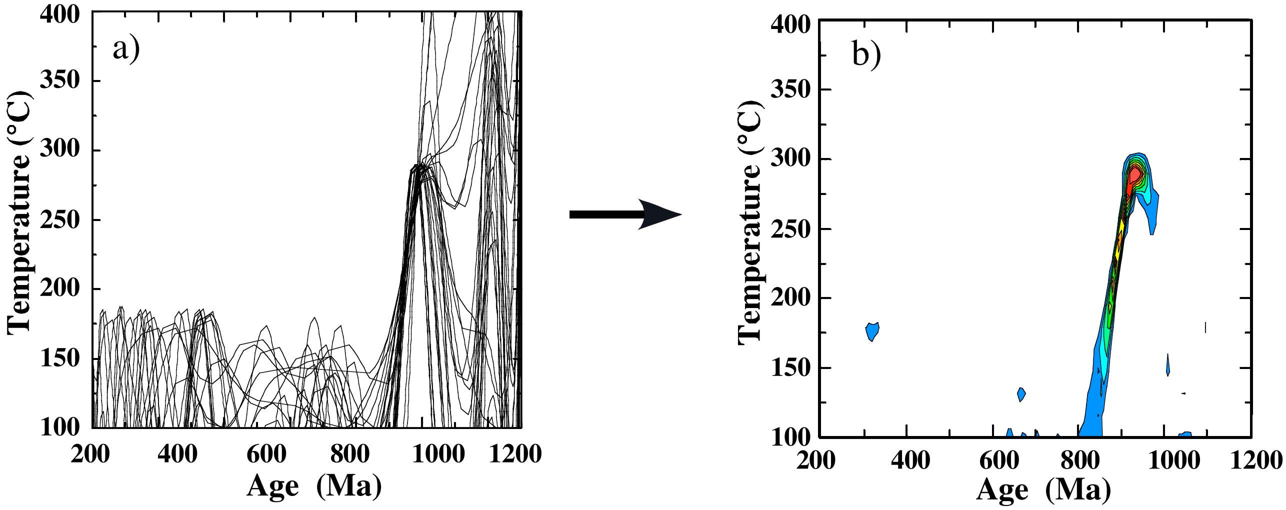

Fig. 5. Thermal histories from unconstrained models. Unconstrained thermal histories incorporate models allowed to accommodate possible reheating events. 5a, Essentially all acceptable models require the sample to be near 275°C at about 950 Ma followed by cooling soon after. Later thermal perturbations cause minor argon loss. 5b, Contoured data of all individual solutions constructed by determining the percentage of solutions that fall within discrete time-temperature bins. Warm colors reflect the highest density of solutions.