Argon Geochronology Data and Analytical Methods

$^{40}Ar/^{39}Ar$ METHODS AND AGE CALCULATIONS

All isotopic data were measured with a MAP-215-50 mass spectrometer equipped with a Johnston electron multiplier. The multiplier is operated at about 2.2 kV and yields a gain above the faraday collector of about 7000. Typical sensitivity values were 2.5e-16 mol/pA and 1.0e-16 mol/pA for the furnace and laser systems, respectively. Resolution at 5% peak-height at mass 40 was typically 600. Details regarding blanks and background, irradiation interference corrections, reactor information and summarized gas-handling procedures are provided in Table 1 within the manuscript. All isotopic data are given here Table 1. Additional information about the New Mexico Geochronology Research Laboratory can be found within New 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: All samples were step-heated in a double vacuum Mo resistance furnace. Heating times varied depending upon mineral composition but typically were 8 to 10 minutes. Sample JM-Coarse K-feldspar had highly variable heating times (10-120 minutes) that were designed to maximize recovery of the diffusion coefficients and to resolve excess argon contamination by performing isothermal replicate-heating steps. All samples were gettered during heating using a SAES GP-50 getter operated at ~450°C. Following heating, gas was expanded to a second-stage of the extraction line were it was reacted with 2 GP-50 getters (one at 20°C, one at ~450°C) and a W filament operated at about 2000°C. Typical K-feldspar gettering time in the second stage was 2-4 minutes, whereas micas and clays were gettered for 4 to 8 minutes. The furnace thermocouple was calibrated by melting copper foil and typically the recorded temperature underestimated the sample temperature by 40-100°C. For the K-feldspar data, correction of thermocouple temperature to the Cu foil melting point was done on a sample-by-sample basis and the reported temperature in the data table is calibrated to the foil melting. Estimated accuracy of the heating temperature is ±15°C for any given step. For the mica and clay data, the thermocouple-recorded temperature is reported.

In vacuo encapsulation: Two clay samples (NB-20, NB-087) were wrapped in copper foil and placed within a quartz vacuum manifold to be sealed under vacuum prior to irradiation. Samples were pumped overnight with a Varian V-70 turbo pump to about 10-7 Torr prior to sealing. The quartz vials were 6 mm OD and 4 mm ID and were sealed while being pumped on by melting and detaching the vial from the manifold with a torch. The final encapsulation vial was about 4 cm long and care was taken not to heat the sample during heating with the torch. The vials were irradiated at the University of Michigan Ford reactor where the sample temperatures were estimated to have not exceed 50°C. Following irradiation, the vials were loaded into the CO_2 laser sample chamber and pumped down overnight without baking. After pump-down the CO_2 laser was used to melt a hole in the encapsulation vial for quantitative measurement of any argon within the vial. Following gettering for 10 minutes, the gas was exposed to a liquid nitrogen cooled activated charcoal finger where heavy noble gases could be collected. After 10 minutes the extraction line was pumped with a turbo pump to remove the ^{4}He that was not trapped on the charcoal finger. This was done because substantial ^{4}He is created during irradiation of the quartz vial and this high ^{4}He pressure compromises the mass spectrometer's ability to accurately measure the argon isotopes. Following pumping the extraction line clean of ^{4}He, the charcoal finger was warmed to room temperature and the argon contained within the encapsulation ampoule was analyzed by our standard mass spectrometry methods. Following this, the encapsulated samples were removed from the vials and loaded into the furnace for step heating. Relative volumes of the furnace system and CO_2 laser systems were determined such that all heating steps and the trapped encapsulation gas could be normalized to a uniform value. Evidence that the encapsulated samples were not heated during sealing or irradiation is the lack on measurable radiogenic argon in the encapsulation vials.

Irradiations, Flux monitoring and age calculations:

All irradiations were preformed at the University of Michigan Ford reactor (position L-67). The irradiations were 24 to 100 hours and all samples were irradiated within an evacuated quartz container. See above for encapsulation experiments.

Fluence gradients were monitored with Fish Canyon (FC-2) sanidine. Typically fusing 4 crystals from each location monitored 3 to 4 locations within individual sample trays. A sine curve was fit to the mean value of each location and J-factors were determined for the unknowns based on their geometry and the calculated curve. J-factor errors are estimated at 0.1% (1σ) for most samples and 2% for the two encapsulated samples. Correction factors for interfering reactions were measured with K-glass and CaF_2. Typically 4 to 5 grains of each were fused with the CO_2 laser to obtain a weighted mean value for each correction factor.

Reported ages for step-heated samples are weighed by the inverse variance for the indicated steps. MSWD values are calculated for each weighted mean and errors are determined using the method of Taylor (1982). If the MSWD value is greater than 1, the error is multiplied by the square root of the MSWD. Most of the igneous micas and K-feldspars yield significant parts of their spectra with several consecutive steps that have normally distributed age populations and thus have “true” plateau ages. Some samples returned slightly elevated MSWD values, however the weighted mean ages are still referred to as plateau ages. The overall climbing clay age spectra precluded determination of plateau ages and therefore only total gas ages are reported. Total gas ages and errors were calculated by quadradically summing isotopic values from each heating step.

Monitor age and decay constants:

The assigned age of Fish Canyon sanidine is 27.84 Ma that is reported by Deino and Potts (1990) relative to Minnesota hornblende (MMhb-1) at 520.4 Ma (Samson and Alexander, 1987). Decay constants and isotopic abundances are those recommended by Steiger and Jäger (1977).

References Cited:

Deino A, Potts R (1990) Single-Crystal $^{40}Ar/^{39}Ar$ dating of the Olorgesailie Formation, Southern Kenya Rift. J. Geophys. Res. 95: 8453-8470.

Samson SD, Alexander EC Jr. (1987) Calibration of the interlaboratory $^{40}Ar/^{39}Ar$ dating standard, Mmhb-1. Chem. Geol. 66: 27-34.

Steiger RH, Jäger E (1977) Subcommission on geochronology: Convention on the use of decay constants in geo- and cosmochronology. Earth and Planet. Sci. Lett. 36: 359-362.

Taylor JR (1982) An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements. Univ. Sci. Books, Mill Valley, Calif., 270 p.

Appendix D, Table 1. Argon isotopic data.

	ID	Temp (°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)
	Cortez Biotite, 0.93 mg, J=0.0034332, D=1.00719±0.00168, nm-64, Lab#=7709-01										
#	A	600	25.89	0.0376	82.27	1.139	13.6	6.0	1.9	9.6	2.9
#	B	750	9.400	0.0166	14.41	5.38	30.8	54.6	10.6	31.42	0.61
	C	850	7.385	0.0097	4.956	8.85	52.4	80.1	25.0	36.16	0.34
	D	920	7.090	0.0081	4.065	7.49	63.3	83.0	37.1	35.96	0.37
	E	1000	7.134	0.0090	4.324	16.90	56.4	82.0	64.6	35.76	0.21
	F	1075	6.454	0.0073	2.126	16.58	70.0	90.2	91.5	35.58	0.19
	G	1110	7.238	0.0279	3.968	2.375	18.3	83.8	95.4	37.0	1.1
	H	1180	9.782	0.3271	11.99	0.901	1.6	64.0	96.8	38.2	2.8
	I	1210	7.338	0.4347	3.830	1.960	1.2	85.0	100.0	38.1	1.3
	TGA ± 1σ			n=9		61.6		K2O=7.41 %		35.10	0.19
	Plateau ± 1σ	steps C-I		n=7	MSWD=1.30	55.1	56.3		89.4	35.80	0.14
	Cortez K-feldspar, 0.88 mg, J=0.0034276, D=1.00719±0.00168, nm-64, Lab#=7705-01										
	C	800	10.63	0.0056	16.45	11.83	90.9	54.2	8.2	35.19	0.45
	E	900	6.960	0.0100	7.218	0.720	51.2	69.3	8.7	29.5	3.8
	F	900	6.975	0.0058	4.620	1.898	88.3	80.4	10.0	34.2	1.4
	G	1000	6.217	0.0044	1.896	3.766	116.3	91.0	12.6	34.50	0.73
	H	1100	6.008	0.0049	1.031	10.44	104.3	94.9	19.9	34.78	0.28
	I	1200	6.028	0.0049	1.113	20.71	104.7	94.5	34.2	34.75	0.17
	J	1250	5.827	0.0045	0.3657	21.86	112.3	98.1	49.4	34.87	0.15
	K	1300	5.869	0.0046	0.4003	21.03	110.3	98.0	63.9	35.06	0.16
	L	1350	6.011	0.0044	0.7786	12.61	115.1	96.2	72.7	35.25	0.24
	M	1400	6.000	0.0045	0.7441	14.03	114.3	96.3	82.4	35.24	0.22
	N	1750	6.391	0.0049	2.338	25.37	104.3	89.2	100.0	34.76	0.16
	TGA ± 1σ			n=11		144.3		K2O=18.37 %		34.91	0.12
	Plateau ± 1σ	steps C-N		n=11	MSWD=1.02	144.3	107.1		100.0	34.932	0.077

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	JM-fine Biotite, 3.41 mg, J=0.0076919, D=1.00361±0.00157, NM-100, Lab#=9914-01										
#	A	650	9.180	0.0171	21.72	14.76	29.9	29.9	2.5	37.56	0.97
#	B	730	4.965	0.0071	6.569	17.92	72.2	60.7	5.6	41.12	0.62
#	C	800	3.351	0.0017	1.463	45.7	293.6	87.0	13.3	39.69	0.24
#	D	870	2.872	0.0011	0.3869	63.0	482.9	96.0	24.1	37.50	0.17
	E	950	2.724	0.0009	0.2206	79.5	551.0	97.6	37.6	36.15	0.15
	F	1000	2.766	0.0009	0.2928	51.3	553.2	96.8	46.3	36.44	0.19
	G	1075	2.749	0.0010	0.2833	107.0	494.6	96.9	64.5	36.24	0.12
	H	1250	2.753	0.0030	0.2893	180.7	168.0	96.9	95.3	36.273	0.093
	I	1350	3.207	0.0119	1.668	27.87	42.9	84.5	100.0	36.91	0.36
	TGA ± 1σ			n=9		587.8		K2O=8.61 %		36.87	0.11
	Plateau ± 1σ		steps E-I	n=5	MSWD=1.12	446.4	351.0		75.9	36.28	0.07
	JM-fine K-feldspar, 9.73 mg, J=0.0076364, D=1.00361±0.00157, nm-100, Lab#=9915-01										
	F	800	2.672	0.0163	0.3439	19.95	31.2	96.2	1.1	34.72	0.13
	G	900	2.611	0.0067	0.1484	58.6	75.7	98.3	4.4	34.654	0.084
	H	1000	2.597	0.0058	0.0558	121.2	87.7	99.4	11.1	34.840	0.070
	I	1075	2.584	0.0057	0.0497	146.1	90.2	99.4	19.3	34.686	0.085
	J	1150	2.586	0.0054	0.0454	197.5	94.1	99.5	30.3	34.727	0.078
	K	1200	2.586	0.0054	0.0981	127.4	94.9	98.9	37.4	34.519	0.071
	L	1250	2.578	0.0054	0.0587	158.5	95.0	99.3	46.2	34.571	0.066
	M	1300	2.584	0.0052	0.0381	244.3	97.3	99.6	59.8	34.738	0.074
#	N	1400	2.600	0.0052	0.0218	520.4	98.8	99.8	88.8	35.011	0.072
#	O	1650	2.676	0.0056	0.1642	201.6	91.4	98.2	100.0	35.471	0.079
	TGA ± 1σ			n=10		1795.6		K2O=9.28 %		34.869	0.067
	Plateau ± 1σ		steps F-M	n=8	MSWD=2.01	1073.5	91.6		59.8	34.67	0.05
	JM-coarse Biotite, 2.77 mg, J=0.0078027, D=1.00361±0.00157, NM-100, Lab#=9912-01										
#	B	730	13.54	0.1101	10.63	9.49	4.6	76.8	2.2	140.5	1.2
	C	800	11.86	0.0140	1.863	35.82	36.5	95.4	10.6	152.17	0.48
	D	870	11.43	0.0033	0.3904	94.8	153.9	99.0	32.7	152.31	0.46
	E	950	11.40	0.0048	0.2238	76.7	107.4	99.4	50.6	152.59	0.38
	F	1000	11.43	0.0169	0.3452	29.50	30.2	99.1	57.5	152.44	0.42
	G	1075	11.35	0.0286	0.3961	46.8	17.8	99.0	68.4	151.19	0.37
	H	1250	11.43	0.0557	0.3363	119.7	9.2	99.2	96.4	152.56	0.38
	I	1350	12.89	0.6914	5.296	15.56	0.74	88.3	100.0	153.26	0.74
	TGA ± 1σ			n=8		428.4		K2O=7.61 %		152.08	0.32
	Plateau ± 1σ		steps C-I	n=7	MSWD=1.99	418.9	64.4		97.8	152.24	0.26

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JM-Coarse K-feldspar, 14.24 mg, J=0.007788, D=1.00361±0.00157, NM-100, Lab#=9913-01										
A	450	312.0	0.0331	28.99	4.21	15.4	97.3	0.2	2188.1	3.7
B	450	7.912	0.0089	2.521	1.101	57.4	90.6	0.3	97.6	2.2
C	500	18.30	0.0148	1.543	5.02	34.4	97.5	0.6	234.49	0.73
D	500	5.459	0.0143	1.099	3.34	35.6	94.0	0.7	70.38	0.81
E	550	34.39	0.0154	1.996	15.41	33.1	98.3	1.6	421.31	0.82
F	550	4.466	0.0336	1.236	6.96	15.2	91.8	1.9	56.37	0.28
G	600	16.01	0.0399	1.356	19.3	12.8	97.5	3.0	206.66	0.41
H	600	4.047	0.0591	1.058	9.80	8.6	92.3	3.5	51.41	0.26
I	650	9.282	0.0605	0.8432	20.0	8.4	97.4	4.5	122.36	0.26
J	650	4.077	0.0709	0.9930	12.22	7.2	92.9	5.2	52.09	0.22
K	700	6.622	0.0695	0.6828	20.8	7.3	97.0	6.3	87.73	0.21
L	700	4.281	0.0678	0.8728	13.99	7.5	94.1	7.0	55.36	0.20
M	750	6.240	0.0644	0.9879	8.90	7.9	95.4	7.5	81.40	0.29
N	800	6.905	0.0676	0.5824	24.26	7.5	97.6	8.8	91.91	0.22
O	850	5.730	0.0590	0.3675	35.98	8.6	98.2	10.7	77.00	0.17
P	900	5.242	0.0649	0.3073	45.5	7.9	98.4	13.2	70.67	0.16
Q	950	6.134	0.0738	2.920	49.6	6.9	86.0	15.8	72.30	0.25
R	1000	6.161	0.0674	0.7217	51.9	7.6	96.6	18.6	81.39	0.19
S	1050	7.148	0.0474	0.3319	58.5	10.8	98.7	21.7	96.11	0.22
T	1100	8.676	0.0270	0.3747	73.7	18.9	98.7	25.6	116.17	0.26
U	1100	8.951	0.0165	0.4027	120.3	30.9	98.7	32.0	119.67	0.25
V	1100	9.257	0.0138	0.4799	139.7	36.9	98.5	39.5	123.39	0.25
W	1100	9.638	0.0141	0.7734	153.0	36.3	97.6	47.7	127.24	0.26
X	1100	10.40	0.0152	0.9366	148.8	33.7	97.3	55.6	136.61	0.36
Y	1100	11.44	0.0168	1.469	147.4	30.3	96.2	63.5	148.01	0.29
Z	1230	11.90	0.0237	0.4127	52.7	21.6	99.0	66.3	158.00	0.31
ZA	1280	11.49	0.0183	0.2172	159.8	27.9	99.5	74.8	153.50	0.50
ZB	1330	11.42	0.0111	0.1393	360.4	45.9	99.6	94.0	152.86	0.35
ZC	1430	10.58	0.1594	0.4387	70.7	3.2	98.9	97.8	140.97	0.29
ZD	1530	10.43	0.1401	0.7143	36.45	3.6	98.1	99.7	137.93	0.32
ZE	1650	14.11	0.1679	9.826	5.16	3.0	79.5	100.0	150.83	0.74
TGA ± 1σ			n=31		1874.9		K2O=6.49 %		140.78	0.27
NB20 Fine Illite, 3.95 mg, J=0.0034782, D=1.00719±0.00168, nm-64, Lab#=7672-01										
B	500	5.426	0.0222	3.388	4.31	23.0	81.5	1.8	27.41	0.61
C	550	13.93	0.0214	1.964	10.03	23.8	95.8	6.1	81.73	0.31
E	625	14.49	0.1002	0.6720	27.19	5.1	98.7	17.8	87.41	0.21
F	650	15.32	0.0832	0.3579	25.67	6.1	99.4	28.8	92.90	0.22
G	675	16.15	0.0757	0.2538	43.7	6.7	99.6	47.4	98.03	0.23
H	700	16.95	0.0893	0.2286	53.9	5.7	99.6	70.5	102.87	0.21
I	730	17.33	0.0949	0.2807	48.2	5.4	99.6	91.2	104.99	0.22
J	760	18.12	0.0573	0.4635	7.99	8.9	99.3	94.6	109.36	0.39
K	800	22.15	0.0459	0.9291	8.42	11.1	98.8	98.2	132.16	0.40
L	850	37.14	0.1219	3.260	2.030	4.2	97.4	99.1	213.8	1.2
M	950	42.56	0.2346	7.093	1.172	2.2	95.1	99.6	237.6	2.1
N	1250	23.39	0.3898	14.46	1.015	1.3	81.8	100.0	116.2	2.4
TGA ± 1σ			n=12		233.6		K2O=6.53 %		100.30	0.21

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NB20 Coarse Illite, 3.52 mg, J=0.0035, D=1.00719±0.00168, nm-64, Lab#=7674-01										
B	500	9.379	0.0117	3.018	6.17	43.7	90.5	2.8	52.66	0.43
C	550	15.46	0.0106	1.554	7.81	48.0	97.0	6.3	92.15	0.36
D	600	14.75	0.0101	0.4704	14.65	50.5	99.1	12.9	89.85	0.26
E	625	15.62	0.0104	0.4446	20.73	48.8	99.2	22.3	95.10	0.25
F	650	16.04	0.0101	0.2153	29.23	50.5	99.6	35.4	98.01	0.21
G	675	16.36	0.0097	0.1624	38.30	52.8	99.7	52.7	100.05	0.24
H	700	16.84	0.0090	0.2020	41.46	56.4	99.6	71.4	102.83	0.23
I	730	17.59	0.0087	0.1848	39.01	58.4	99.7	89.0	107.31	0.23
J	760	20.85	0.0091	0.4129	15.85	56.1	99.4	96.1	126.21	0.31
K	800	29.05	0.0091	0.5130	3.560	56.3	99.5	97.8	173.67	0.74
L	850	49.10	0.0134	2.013	3.673	38.2	98.8	99.4	282.75	0.94
M	950	86.03	0.0263	8.198	0.866	19.4	97.2	99.8	463.0	3.1
N	1250	24.53	0.0714	43.72	0.450	7.1	47.3	100.0	71.8	5.5
TGA ± 1σ			n=13		221.8		K2O=6.91 %		106.65	0.22
NB-20 Illite, In Vacuo irradiation, 3.75 mg, J=0.015, D=1.00535±0.00031, NM-140, Lab#=52520-02										
AA	In Vacuo	2.026	0.0121	6.719	76.1	42.3	1.0	6.6	0.57	0.23
A	550	3.406	0.0122	0.3542	265.5	41.8	96.9	29.8	86.677	0.091
B	600	3.867	0.0112	0.0490	312.6	45.6	99.6	57.2	100.85	0.11
C	650	4.081	0.0100	0.0581	310.0	50.9	99.6	84.2	106.23	0.13
D	675	4.567	0.0100	0.0741	117.2	51.2	99.5	94.5	118.47	0.15
E	700	6.109	0.0100	0.1315	43.0	51.0	99.4	98.2	156.72	0.25
F	730	9.327	0.0109	0.2394	14.29	46.9	99.2	99.5	234.08	0.50
G	760	13.93	0.0134	0.5688	5.98	38.1	98.8	100.0	338.09	0.88
TGA ± 1σ			n=8		1144.7		K2O=7.82 %		99.55	0.12
NB19 Illite 4.07 mg, J=0.0034297, D=1.00719±0.00168, nm-64, Lab#=7676-01										
B	500	8.202	0.0317	8.626	6.03	16.1	68.9	3.8	34.50	0.48
C	550	12.70	0.0283	3.831	10.09	18.0	91.1	10.1	70.04	0.32
D	600	13.59	0.0188	-4.4524	0.392	27.1	109.7	10.4	89.8	5.8
E	625	17.95	0.0269	0.8412	33.69	19.0	98.6	31.6	106.21	0.23
F	650	19.99	0.0265	0.4759	21.44	19.3	99.3	45.0	118.71	0.27
G	675	21.61	0.0259	0.4778	23.22	19.7	99.4	59.6	128.05	0.29
H	700	24.71	0.0250	0.5383	20.12	20.4	99.4	72.3	145.73	0.34
I	730	30.20	0.0243	0.6925	16.68	21.0	99.3	82.8	176.54	0.48
J	760	37.36	0.0244	0.9965	10.31	20.9	99.2	89.2	215.75	0.48
K	800	42.99	0.0254	1.366	4.34	20.1	99.1	92.0	245.84	0.76
L	850	52.59	0.0283	1.424	5.97	18.0	99.2	95.7	296.85	0.75
M	950	53.42	0.0435	5.091	2.679	11.7	97.2	97.4	295.5	1.1
N	1250	5.126	0.0681	3.327	4.139	7.5	80.8	100.0	25.34	0.61
TGA ± 1σ			n=13		159.1		K2O=4.38 %		138.54	0.28

Appendix D, Table 1. Argon isotopic data.

ID	Temp (°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)
NB-59 Illite, 10.64 mg, J=0.0037063, D=1.0019±0.001, NM-80, Lab#=8602-01										
B	500	6.986	0.0054	3.780	14.45	95.2	84.0	1.8	38.69	0.17
C	550	17.14	0.0061	2.270	14.11	83.8	96.1	3.6	106.77	0.19
D	600	14.43	0.0072	1.240	5.60	70.7	97.5	4.3	91.51	0.28
E	625	15.41	0.0048	0.7376	49.7	106.5	98.6	10.5	98.71	0.18
F	650	16.01	0.0062	0.6135	66.0	82.8	98.9	18.7	102.75	0.17
G	675	16.36	0.0059	0.5560	89.9	86.5	99.0	30.0	105.05	0.17
H	700	16.71	0.0046	0.5890	109.8	111.6	99.0	43.7	107.21	0.27
I	740	17.21	0.0041	0.6749	160.1	123.2	98.8	63.7	110.20	0.20
J	780	19.88	0.0039	0.8429	142.1	131.2	98.7	81.4	126.56	0.28
K	800	28.88	0.0041	1.836	58.3	124.8	98.1	88.7	180.03	0.31
L	850	47.04	0.0042	2.302	39.1	121.7	98.6	93.6	285.95	0.55
M	900	72.48	0.0064	3.489	16.31	80.2	98.6	95.6	423.73	0.76
N	1000	64.71	0.0473	4.012	13.00	10.8	98.2	97.3	381.35	0.69
O	1650	5.729	0.0186	4.769	21.9	27.4	75.3	100.0	28.53	0.16
TGA ± 1σ			n=14		800.4		K2O=7.80 %		132.94	0.20
NB-087 Illite, In Vacuo irradiation, 3.73 mg, J=0.015, D=1.00535±0.00031, NM-140, Lab#=52524-02										
AA	In Vacuo	3.419	0.0083	11.37	48.4	61.3	1.1	6.8	1.01	0.34
A	550	3.525	0.0061	0.5107	114.7	83.8	95.7	23.0	88.55	0.12
B	600	3.942	0.0056	0.0522	132.8	91.0	99.6	41.8	102.73	0.13
C	650	4.187	0.0055	0.0514	143.1	92.5	99.6	62.0	108.97	0.16
D	675	4.824	0.0049	0.0778	84.0	105.1	99.5	73.9	124.93	0.18
E	700	6.277	0.0048	0.1662	43.1	105.5	99.2	79.9	160.61	0.23
F	730	8.560	0.0047	0.2159	33.82	107.9	99.3	84.7	215.90	0.35
G	760	11.44	0.0050	0.2158	21.62	102.9	99.4	87.8	283.68	0.40
H	800	14.78	0.0053	0.2841	18.83	96.1	99.4	90.4	359.02	0.56
I	840	17.12	0.0063	0.2560	11.51	81.4	99.6	92.0	410.23	0.59
J	860	17.57	0.0077	0.3640	6.98	66.3	99.4	93.0	419.30	0.86
K	900	16.39	0.0102	0.2638	6.58	49.8	99.5	94.0	394.53	0.90
L	1000	14.30	0.0146	0.3891	12.69	35.1	99.2	95.8	347.48	0.56
M	1200	6.850	0.0179	0.7659	18.86	28.4	96.7	98.4	170.41	0.36
N	1750	3.722	0.0292	3.624	11.20	17.5	71.1	100.0	69.86	0.65
TGA ± 1σ			n=15		708.2		K2O=4.86 %		137.37	0.16

Appendix D, Table 1. Argon isotopic data.

ID	Temp (°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)
NB-102 Sericite, 5.71 mg, J=0.0039223, D=1.00362±0.00105, NM-95, Lab#=9574-01										
A	600	25.59	0.0279	33.45	5.50	18.3	61.3	11.9	107.71	0.84
B	630	16.64	0.0183	2.594	6.05	27.8	95.4	25.0	108.79	0.52
C	660	15.96	0.0126	0.8573	4.77	40.3	98.4	35.4	107.68	0.62
D	690	15.47	0.0092	0.8151	3.078	55.4	98.4	42.0	104.50	0.92
E	720	15.05	0.0104	0.8741	5.58	49.0	98.3	54.1	101.56	0.54
F	750	14.64	0.0164	1.100	5.00	31.1	97.8	65.0	98.38	0.61
G	780	14.15	0.0247	0.8151	4.51	20.6	98.3	74.7	95.70	0.67
H	810	13.77	0.0338	0.8174	2.947	15.1	98.3	81.1	93.14	0.99
I	840	13.28	0.0401	0.9154	1.207	12.7	98.0	83.7	89.7	2.4
J	870	12.92	0.0528	0.0123	0.806	9.7	100.0	85.5	89.0	3.7
K	900	11.90	0.0559	0.4717	0.460	9.1	98.9	86.5	81.2	6.4
L	1000	9.373	0.0739	3.602	0.844	6.9	88.7	88.3	57.7	3.6
M	1100	6.075	0.0901	5.187	1.129	5.7	74.8	90.7	31.7	2.8
N	1200	4.227	0.0828	6.170	0.941	6.2	56.8	92.8	16.8	3.4
O	1300	4.426	0.0922	10.26	1.096	5.5	31.3	95.2	9.7	3.0
P	1650	11.76	0.1576	25.52	2.233	3.2	35.9	100.0	29.5	1.6
TGA ± 1σ			n=16		46.2	K2O=0.79 %			92.17	0.32

Isotopic ratios corrected for blank, radioactive decay, and mass discrimination, not corrected for interfering reactions.
Ages calculated relative to FC-2 Fish Canyon Tuff sanidine interlaboratory standard at 27.84 Ma.
Errors quoted for individual analyses include analytical error only, without interfering reaction or J uncertainties.
TGA=Total gas age: Calculated by summing isotopic measurements of all steps.
TGA error calculated by by quadratically combining errors of isotopic measurements of all steps.
Plateau age is inverse-variance-weighted mean of selected steps.
Plateau age error is inverse-variance-weighted mean error (Taylor, 1982) times square root MSWD where MSWD>1.
Plateau and TGAs incorporate uncertainties in interfering reaction corrections and J factors.
Decay constants and isotopic abundances after Steiger and Jäger (1977).
symbol preceding sample ID denotes analyses excluded from plateau age calculations.
K_2O estimated from sample weight, ^{39}Ar signal, J-factor and mass spectrometer sensitivity.
D= Discrimination (1 AMU) in favor of light isotopes.