$^{40}Ar/^{39}Ar$ Data Appendix for

Geology of southern Black Mesa

by

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Table 1. $^{40}Ar/^{39}Ar$ analytical data from incrementally heated groundmass concentrates.

	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)
	V-63-061103-djk, Groundmass Concentrate, 114.61 mg, J=0.0007402±0.15%, D=1.0055±0.001, NM-187J, Lab#=55545-01										
x	B	700	40.93	9.856	129.4	1.532	0.052	8.5	13.6	4.69	0.45
	C	750	18.90	14.60	61.86	0.258	0.035	9.7	15.9	2.47	0.66
	D	800	11.13	21.73	35.43	2.168	0.023	22.1	35.1	3.33	0.21
	E	875	8.656	25.97	27.93	2.127	0.020	29.5	54.0	3.47	0.19
	F	975	8.914	31.04	29.35	2.387	0.016	31.5	75.2	3.83	0.17
	G	1075	15.28	36.71	53.42	1.393	0.014	16.6	87.6	3.47	0.27
	H	1250	40.97	150.2	175.4	0.604	0.003	3.9	92.9	2.4	1.0
x	I	1700	46.28	128.6	178.0	0.799	0.004	9.3	100.0	6.33	0.92
	Integrated age ± 2σ			n=8		11.27	0.013			3.81	0.43
	Plateau ± 2σ	steps C-H		n=6	MSWD=1.64	8.94	0.018±0.021		79.3	3.53	0.25
	Isochron±2σ	steps B-I		n=8	MSWD=4.45		$^{40}Ar/^{36}Ar$=	300.6±4.5		3.44	0.24
	110604c-djk, Groundmass Concentrate, 107.88 mg, J=0.0007506±0.16%, D=1.0055±0.001, NM-187J, Lab#=55547-01										
	B	700	46.87	2.314	150.9	6.49	0.22	5.3	24.6	3.35	0.28
	C	750	36.91	3.185	116.5	0.685	0.16	7.5	27.2	3.73	0.50
	D	800	38.76	7.306	124.0	4.41	0.070	7.0	43.9	3.71	0.29
	E	875	46.93	12.93	155.9	3.43	0.039	4.1	56.9	2.62	0.36
	F	975	59.31	17.83	197.8	3.83	0.029	3.9	71.4	3.18	0.41
	G	1075	132.2	14.38	443.0	3.66	0.035	1.9	85.3	3.36	0.81
	H	1250	152.3	53.76	520.8	3.12	0.009	1.9	97.2	4.1	1.0
x	I	1700	354.9	60.21	1205.1	0.750	0.008	1.1	100.0	5.3	2.4
	Integrated age ± 2σ			n=8		26.37	0.031			3.44	0.90
	Plateau ± 2σ	steps B-H		n=7	MSWD=1.18	25.62	0.088±0.158		97.2	3.34	0.32
	Isochron±2σ	steps B-I		n=8	MSWD=1.24		$^{40}Ar/^{36}Ar$=	296.1±2.1		3.21	0.55
	V-31-041103-djk, Groundmass Concentrate, 107.61 mg, J=0.0007441±0.12%, D=1.0055±0.001, NM-187J, Lab#=55543-02										
x	B	700	68.76	0.8462	222.0	10.12	0.60	4.7	25.1	4.35	0.39
x	C	750	63.28	1.465	203.9	2.660	0.35	5.0	31.7	4.22	0.41
x	D	800	63.35	3.304	201.9	6.65	0.15	6.2	48.2	5.31	0.40
x	E	875	62.92	5.815	199.8	5.45	0.088	6.9	61.7	5.86	0.40
x	F	975	62.05	8.123	195.2	6.18	0.063	8.1	77.0	6.81	0.37
x	G	1075	90.62	10.43	290.4	4.25	0.049	6.3	87.6	7.64	0.56
x	H	1250	170.1	47.54	569.4	3.64	0.011	3.4	96.6	7.9	1.1
x	I	1700	329.8	55.42	1105.8	1.372	0.009	2.3	100.0	10.7	2.1
	Integrated age ± 2σ			n=8		40.3	0.049			5.97	0.92
	No Plateau										
	Isochron±2σ	steps B-I		n=8	MSWD=7.05		$^{40}Ar/^{36}Ar$=	300.5±2.6		4.2	0.7
	110604b-djk, Groundmass Concentrate, 86.6 mg, J=0.0007393±0.17%, D=1.0055±0.001, NM-187J, Lab#=55544-01										
x	B	700	122.6	3.474	407.0	3.29	0.15	2.2	18.6	3.56	0.75
x	C	750	58.82	4.860	194.2	0.715	0.10	3.1	22.6	2.44	0.68
x	D	800	41.45	9.117	136.8	2.884	0.056	4.3	38.8	2.38	0.35
x	E	875	33.43	13.45	108.3	2.634	0.038	7.6	53.7	3.41	0.32
x	F	975	38.75	17.21	131.8	3.07	0.030	3.1	71.0	1.65	0.33
x	G	1075	118.6	15.95	400.2	2.382	0.032	1.4	84.4	2.27	0.80
x	H	1250	272.9	64.97	931.6	2.220	0.008	1.1	96.9	4.2	1.8
x	I	1700	307.2	50.09	1036.7	0.557	0.010	1.6	100.0	6.9	2.5
	Integrated age ± 2σ			n=8		17.76	0.026			3.0	1.2

No Plateau

Isochron±2σ	steps B-I	n=8	MSWD=3.12	$^{40}Ar/^{36}Ar$=	297.1±2.0	2.24	0.49

Notes:
x symbol preceding sample ID denotes analyses excluded from plateau age calculations.
Isotopic ratios corrected for blank, radioactive decay, and mass discrimination, not corrected for interfering reactions.
Errors quoted for individual analyses include analytical error only, without interfering reaction or J uncertainties.

Age calculations:
Ages calculated relative to FC-2 Fish Canyon Tuff sanidine interlaboratory standard (28.02 Ma, Renne et al, 1998).
Integrated age calculated by summing isotopic measurements of all steps.
Integrated age error calculated by quadratically combining errors of isotopic measurements of all steps.
Plateau age or preferred age calculated for the indicated steps by weighting each step by the inverse of the variance.
Plateau age error is inverse-variance-weighted mean error (Taylor, 1982) times root MSWD where MSWD>1.
MSWD values are calculated for n-1 degrees of freedom for plateau age.
Isochron ages, $^{40}Ar/^{36}Ar_i$ and MSWD values calculated from regression results obtained by the methods of York (1969).
Decay constants and isotopic abundances after Steiger and Jäger (1977).
All errors reported at ±2σ, unless otherwise noted.

Sample preparation and irradiation:
Croundmass concentrates separates prepared using crushing, dilute HCl acid treatment, Franz magnetic separator,
Samples were loaded into machined Al discs and irradiated in one batch (NM-187)
for 7 hours in the D-3 position, Nuclear Science Center, College Station, TX.
Neutron flux monitor Fish Canyon Tuff sanidine (FC-1).

Instrumentation:
Mass Analyzer Products 215-50 mass spectrometer on line with automated all-metal extraction system.
Samples were step-heated using a Mo double-vacuum resistance furnace (heating duration 10 minutes).
Reactive gases removed during furnace (laser) analysis by reaction with 3 (2) SAES GP-50 getters, 2 (1) operated at ~450°C and 1 at 20°C.

Analytical parameters:
Electron multiplier sensitivity averaged 2.9 x 10-16 moles /pA.
Total system blank and background for the furnce averaged 1963, 9, 2, 7, 5 x 10^{-18} moles.
at masses 40, 39, 38, 37 and 36, respectively.
J-factors determined to a precision of ± 0.1% by CO_2 laser-fusion of 6 single crystals from each of 6 radial positions around the irradiation tray.
Correction factors for interfering nuclear reactions were determined using K-glass and CaF_2 and are as follows:
$(^{39}Ar/^{37}Ar)_{Ca}$ = 0.0007 ± 5e-05
$(^{36}Ar/^{37}Ar)_{Ca}$ = 0.00028 ± 1e-05
$(^{38}Ar/^{39}Ar)_{K}$ = 0.013
$(^{40}Ar/^{39}Ar)_{K}$ = 0 ± 0.0004

Table 2. $^{40}Ar/^{39}Ar$ analytical data from laser-heated biotite.

	ID	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	Age (Ma)	±1σ (Ma)
	unit-5c-NWchili-sect-djk, Biotite, J=0.0007974±0.06%, D=1.004±0.001, NM-217L, Lab#=57850								
x	13B	174.9	0.0770	576.8	1.155	6.6	2.5	6.4	1.3
x	09B	275.2	0.0911	910.4	0.597	5.6	2.2	8.8	2.2
	26B	56.50	0.1199	168.4	1.449	4.3	12.0	9.69	0.57
	11B	200.0	0.1073	653.4	1.141	4.8	3.4	9.9	1.5
x	07B	264.6	0.1056	871.8	0.554	4.8	2.7	10.1	2.3
	18B	57.77	0.1551	171.2	5.168	3.3	12.4	10.30	0.37
	20B	54.35	0.0833	159.0	1.602	6.1	13.6	10.59	0.51
	28B	54.45	0.4726	158.1	6.991	1.1	14.3	11.15	0.34
	15B	86.04	0.0803	264.8	2.807	6.4	9.1	11.18	0.63
	59B	61.01	0.0590	179.7	2.527	8.6	13.0	11.35	0.46
	57B	53.01	0.0769	152.2	5.236	6.6	15.2	11.52	0.35
	17B	160.7	0.1273	516.6	2.553	4.0	5.0	11.6	1.0
	22B	52.99	0.1055	150.8	2.998	4.8	15.9	12.10	0.42
x	24B	167.1	0.0817	536.0	0.574	6.2	5.2	12.5	1.6
	Mean age ± 2σ	n=10	MSWD=2.25			5.0 ±4.2		11.08	0.44

Notes:

x (or i) symbol preceding sample ID denotes analyses excluded from weighted-mean age calculations.
Isotopic ratios corrected for blank, radioactive decay, and mass discrimination, not corrected for interfering reactions.
Errors quoted for individual analyses include analytical error only, without interfering reaction or J uncertainties.

Age calculations:

Ages calculated relative to FC-2 Fish Canyon Tuff sanidine interlaboratory standard (28.02 Ma, Renne et al, 1998).
Mean age is weighted mean age of Taylor (1982). Mean age error is weighted error
of the mean (Taylor, 1982), multiplied by the root of the MSWD where MSWD>1, and also
incorporates uncertainty in J factors and irradiation correction uncertainties.
MSWD values are calculated for n-1 degrees of freedom for plateau age.
Decay constants and isotopic abundances after Steiger and Jäger (1977).
All errors reported at ±2σ, unless otherwise noted.

Sample preparation and irradiation:

Biotite separates prepared using crushing, dilute HCl acid treatment, Franz magnetic separator, and hand-picking techniques.
Samples were loaded into machined Al discs and irradiated in one batch (NM-217)
for 7 hours in the D-3 position, Nuclear Science Center, College Station, TX.
Neutron flux monitor Fish Canyon Tuff sanidine (FC-1).

Instrumentation:

Mass Analyzer Products 215-50 mass spectrometer on line with automated all-metal extraction system.
Samples were step-heated using a Mo double-vacuum resistance furnace (heating duration 10 minutes),
or CO2 laser (heating duration 2 minutes).
Reactive gases removed during furnace (laser) analysis by reaction with 3 (2) SAES GP-50 getters, 2 (1) operated
at ~450°C and 1 at 20°C. Gas also exposed to a W filament operated at ~2000°C.

Analytical parameters:

Electron multiplier sensitivity averaged 2.9 x 10-16 moles /pA.
Total system blank and background for the laser averaged 4467, 25, 10, 19,42 x 10^{-18} moles.
at masses 40, 39, 38, 37 and 36, respectively.
J-factors determined to a precision of ± 0.1% by CO_2 laser-fusion of 6 single crystals from each of 6 radial positions
around the irradiation tray.
Correction factors for interfering nuclear reactions were determined using K-glass and CaF_2 and are as follows:
$(^{39}Ar/^{37}Ar)_{Ca}$ = 0.00068 ± 5e-05
$(^{36}Ar/^{37}Ar)_{Ca}$ = 0.00028 ± 2e-05
$(^{38}Ar/^{39}Ar)_K$ = 0.0125
$(^{40}Ar/^{39}Ar)_K$ = 0 ± 0.0004