

Table DR1. $^{40}\text{Ar}/^{39}\text{Ar}$ analytical data for Grand Canyon basalt groundmass concentrates.

ID	Temp (°C)	$^{40}\text{Ar}/^{39}\text{Ar}$	$^{37}\text{Ar}/^{39}\text{Ar}$	$^{36}\text{Ar}/^{39}\text{Ar}$ ($\times 10^{-3}$)	$^{39}\text{Ar}_K$ ($\times 10^{-10}$ mol)	K/Ca	Cl/K ($\times 10^{-3}$)	$^{40}\text{Ar}^*$ (%)	^{39}Ar (%)	Age (Ma)	$\pm 2s$ (Ma)
188-03, Gray Ledge - upper flow, 94.5 mg groundmass, J=0.0001115±0.10%, D=1.0069±0.001, NM-132, Lab#=51872-01											
A#	625	5374.4		1.527	17778.1	0.167	0.33	37.4	2.3	1.3	24.2
AA#	625	1020.7		0.7951	3380.3	0.814	0.64	3.9	2.1	7.6	4.4
B	700	8.605		0.5329	27.69	3.04	0.96	0.17	5.4	31.3	0.094
C	750	9.366		0.5060	30.92	1.72	1.0	0.77	2.9	44.7	0.054
D	800	12.49		0.5507	40.59	0.763	0.93	0.012	4.3	50.6	0.108
E	875	14.66		0.6996	47.47	1.82	0.73	-0.076	4.7	64.7	0.140
F	975	17.53		1.402	58.55	1.53	0.36	0.12	2.0	76.6	0.069
G	1075	18.42		2.419	60.72	1.32	0.21	0.41	3.7	86.9	0.137
H	1250	62.02		15.29	211.2	1.06	0.033	1.0	1.4	95.1	0.18
I#	1680	98.79		42.28	332.5	0.633	0.012	1.9	4.1	100.0	0.84
total gas age			n=10			12.9	0.63			0.73	0.62
plateau			n=7	steps B-H		11.3	0.67		87.4	0.097	0.032
188-02, Gray Ledge - lower flow, 185.4 mg groundmass, J=0.0001113±0.10%, D=1.0069±0.001, NM-132, Lab#=51873-01											
AA#	625	1041.7		0.4874	3456.9	1.18	1.0	1.7	1.9	7.5	4.1
B	700	15.49		0.4210	48.83	4.80	1.2	0.15	7.1	37.8	0.220
C	750	19.26		0.5165	61.86	1.92	0.99	-0.009	5.3	49.9	0.205
D	800	25.47		0.5567	82.34	0.508	0.92	0.61	4.7	53.1	0.24
E	875	23.69		0.6226	77.46	2.19	0.82	-0.130	3.6	66.9	0.172
F	975	22.71		1.120	75.57	1.50	0.46	0.34	2.1	76.4	0.096
G	1075	21.15		1.684	69.39	1.46	0.30	0.40	3.7	85.6	0.158
H	1250	138.4		12.57	464.1	2.02	0.041	1.6	1.6	98.4	0.46
I#	1680	191.6		38.99	463.5	0.258	0.013	1.8	30.2	100.0	0.56
total gas age			n=9			15.8	0.78			0.7	0.3
plateau			n=7	steps B-H		14.4	0.78		90.9	0.193	0.046
195-01, Massive Diabase flow, 180.83 mg groundmass, J=0.0001118±0.10%, D=1.0069±0.001, NM-132, Lab#=51878-01											
B	700	310.2		2.289	1047.9	0.450	0.22	0.084	0.2	5.1	0.14
D	800	51.19		1.498	164.4	0.301	0.34	0.19	5.4	8.6	0.55
E	875	16.93		1.066	53.19	3.73	0.48	0.26	7.7	51.1	0.262
F	975	11.38		1.329	33.15	2.47	0.38	0.28	14.8	79.2	0.341
G	1075	17.93		2.861	57.54	0.936	0.18	0.53	6.5	89.9	0.235
H#	1250	65.79		14.91	209.5	0.281	0.034	2.4	7.8	93.1	1.04
I#	1680	396.7		36.10	1151.8	0.604	0.014	2.5	15.0	100.0	12.32
total gas age			n=7			8.77	0.36			1.1	0.2
plateau			n=5	steps B-G		7.89	0.39		89.9	0.296	0.057
190-02, Whitmore Canyon flow, 206.0 mg groundmass, J=0.0001116±0.10%, D=1.0069±0.001, NM-132, Lab#=51875-01											
AA	625	4364.7		0.8568	14656.4	0.313	0.60	7.5	0.8	4.5	6.8
B	700	55.31		1.513	181.9	2.23	0.34	0.61	3.0	36.3	0.34
C	750	32.82		2.227	106.9	1.30	0.23	0.42	4.3	54.9	0.285
D	800	34.60		2.544	113.0	0.266	0.20	-0.503	4.1	58.7	0.29
E	875	38.07		4.934	125.5	1.36	0.10	0.19	3.7	78.2	0.28
F	975	55.85		7.978	183.3	0.809	0.064	0.96	4.2	89.7	0.48
G	1075	100.7		8.644	340.1	0.235	0.059	1.2	0.9	93.1	0.19
H	1250	161.4		36.13	540.5	0.214	0.014	2.5	2.9	96.2	0.96
I#	1680	178.8		70.05	522.5	0.269	0.007	0.88	16.9	100.0	0.64
total gas age			n=9			7.00	0.21			0.9	0.8
plateau			n=8	steps AA-H		6.73	0.22		96.2	0.315	0.081
177-02, Mile 177 flow, 97.3 mg groundmass, J=0.0001112±0.10%, D=1.0069±0.001, NM-132, Lab#=51867-01											
B	700	97.72		2.172	320.0	0.132	0.23	-1.698	3.4	1.5	0.67
BB	700	57.47		1.733	187.8	0.451	0.29	0.50	3.7	6.7	0.43

C	750	12.31	1.093	36.09	0.935	0.47	0.33	14.1	17.5	0.348	0.064
D	800	10.15	0.8696	26.54	0.260	0.59	-0.230	23.4	20.5	0.48	0.12
E	875	12.83	0.9098	37.83	3.17	0.56	0.050	13.5	57.0	0.346	0.033
F	975	12.87	1.378	38.31	1.91	0.37	0.42	12.9	79.0	0.334	0.037
G	1075	17.12	3.470	53.42	0.911	0.15	0.36	9.5	89.5	0.327	0.078
H	1250	58.38	22.25	200.7	0.304	0.023	-0.091	1.6	93.0	0.19	0.29
I#	1680	112.0	30.52	336.0	0.604	0.017	1.4	13.6	100.0	3.14	0.28
total gas age			n=9		8.68	0.39				0.544	0.087
plateau			n=8	steps B-H	8.07	0.42			93.0	0.346	0.033

180-05, upper Prospect flow, 189.0 mg groundmass, J=0.0001094±0.10%, D=1.00535±0.00031, NM-139, Lab#=52408-01

A#	625	217.7	1.692	720.9	0.616	0.30	2.0	2.2	6.3	0.96	0.24
B	700	16.70	1.257	48.04	0.842	0.41	0.47	15.6	15.0	0.515	0.035
C	750	11.58	1.007	30.94	1.43	0.51	0.56	21.8	29.7	0.499	0.022
D	800	10.62	0.8883	27.68	0.922	0.57	0.52	23.6	39.2	0.496	0.029
E	875	10.61	1.121	28.23	2.15	0.46	0.91	22.3	61.3	0.467	0.016
F	975	17.10	1.576	50.03	1.64	0.32	0.98	14.3	78.1	0.483	0.026
G	1075	59.68	2.284	196.3	0.791	0.22	0.94	3.1	86.2	0.366	0.076
H	1250	131.3	24.23	441.1	1.23	0.021	2.3	2.2	98.8	0.59	0.13
I#	1650	282.5	14.45	903.2	0.115	0.035	2.6	6.0	100.0	3.35	0.82
total gas age			n=9		9.73	0.36				0.554	0.064
plateau			n=7	steps B-H	9.00	0.37			92.5	0.483	0.022

180-03, upper Prospect flow, 179.5 mg groundmass, J=0.0001094±0.10%, D=1.00535±0.00031, NM-139, Lab#=52406-01

A#	625	1067.3	2.299	3573.1	0.466	0.22	6.4	1.1	5.1	2.3	2.2
B	700	52.16	1.471	167.1	1.30	0.35	0.85	5.6	19.4	0.574	0.060
C	750	26.26	1.125	79.48	1.02	0.45	1.2	10.9	30.6	0.566	0.056
D	800	24.12	1.038	72.71	1.05	0.49	0.88	11.3	42.1	0.538	0.053
E	875	17.98	1.281	52.41	2.15	0.40	0.40	14.5	65.7	0.514	0.050
F	975	14.62	1.740	41.30	1.63	0.29	0.75	17.5	83.6	0.505	0.029
G	1075	42.61	2.023	136.0	0.499	0.25	0.56	6.1	89.0	0.510	0.092
H#	1250	131.9	32.83	443.3	0.808	0.016	2.4	2.7	97.9	0.73	0.17
I#	1650	449.9	15.48	1491.7	0.193	0.033	3.2	2.3	100.0	2.1	1.0
total gas age			n=9		9.12	0.33				0.673	0.194
plateau			n=6	steps B-G	7.65	0.38			83.9	0.526	0.030

180-06, upper Prospect flow, 190.0 mg groundmass, J=0.0001094±0.10%, D=1.00535±0.00031, NM-139, Lab#=52409-01

A#	625	1366.3	2.388	4557.5	0.674	0.21	4.9	1.4	7.4	3.9	2.7
B	700	105.4	1.776	346.9	1.05	0.29	0.86	2.9	18.8	0.599	0.098
C	750	74.23	1.270	240.3	0.758	0.40	1.1	4.5	27.0	0.658	0.092
D	800	76.50	1.052	247.9	0.823	0.48	1.2	4.4	36.0	0.660	0.081
E	875	38.47	1.199	121.2	1.89	0.43	0.67	7.2	56.7	0.545	0.036
F	975	46.35	1.676	150.2	1.45	0.30	0.97	4.5	72.5	0.415	0.050
G	1075	141.9	1.945	475.1	1.04	0.26	0.98	1.2	83.9	0.34	0.13
H#	1250	294.4	26.65	967.6	1.33	0.019	2.2	3.6	98.4	2.15	0.96
I#	1650	245.5	28.58	778.3	0.144	0.018	3.2	7.3	100.0	3.61	0.98
total gas age			n=9		9.16	0.29				1.055	0.413
plateau			n=6	steps B-G	7.01	0.36			76.5	0.528	0.083

180-10, upper Prospect flow, 191.0 mg groundmass, J=0.0001094±0.10%, D=1.00535±0.00031, NM-139, Lab#=52410-01

A#	625	2595.0	2.906	8696.0	0.421	0.18	7.0	1.0	4.2	5.0	10.5
B	700	115.0	2.001	379.7	0.973	0.25	0.47	2.6	13.9	0.60	0.19
C	750	63.47	1.441	206.0	0.849	0.35	0.49	4.3	22.4	0.535	0.073
D	800	52.97	1.184	170.2	0.719	0.43	0.67	5.3	29.6	0.551	0.073
E	875	32.51	1.248	101.1	1.81	0.41	0.79	8.5	47.7	0.544	0.034
F	975	32.32	1.485	101.2	1.73	0.34	0.51	7.9	65.0	0.505	0.036
G	1075	114.9	1.933	381.3	1.20	0.26	1.4	2.1	77.1	0.48	0.16
H	1250	231.8	17.59	778.8	2.11	0.029	2.0	1.4	98.2	0.63	0.24
I#	1725	241.9	23.20	793.8	0.181	0.022	3.7	3.8	100.0	1.85	0.92

total gas age	n=9	10.0	0.27	0.765	0.570
plateau	n=7 steps B-H	9.4	0.27	94.0	0.529

180-04, upper Prospect flow, 184.8 mg groundmass, J=0.0001094±0.10%, D=1.00535±0.00031, NM-139, Lab#=52407-01

A#	625	1387.5	1.500	4644.9	0.838	0.34	4.5	1.1	7.3	3.0	2.8
B	700	88.64	1.072	290.4	1.63	0.48	1.1	3.3	21.7	0.578	0.098
C	750	78.75	0.8882	255.6	1.29	0.57	0.81	4.2	33.0	0.650	0.082
D	800	85.50	0.9368	278.7	1.17	0.54	1.1	3.8	43.3	0.639	0.084
E	875	34.65	1.160	108.1	1.90	0.44	0.75	8.1	59.9	0.553	0.039
F	975	23.10	1.359	70.45	1.41	0.38	1.0	10.4	72.2	0.473	0.043
G	1075	39.01	1.353	124.4	0.987	0.38	1.3	6.0	80.9	0.465	0.060
H	1250	109.3	15.91	364.6	1.54	0.032	2.0	2.7	94.4	0.58	0.17
I#	1650	213.9	11.94	711.6	0.639	0.043	1.3	2.1	100.0	0.91	0.38
total gas age		n=9			11.4	0.37				0.760	0.301
plateau		n=7 steps B-H			9.9	0.40				87.0	0.534
											0.056

208-01, Black Ledge Flow, 185.36 mg groundmass, J=0.00011±0.10%, D=1.00712±0.00131, NM-147, Lab#=52861-01

AA#	400	4694.5	0.6783	15603.3	0.011	0.75	-13.478	1.6	0.1	15.1	13.9
B#	725	77.91	0.3672	255.9	0.066	1.4	-0.540	2.8	0.9	0.43	0.62
BB	725	154.7	0.5132	514.8	2.08	0.99	0.53	1.5	24.4	0.46	0.35
C	800	46.78	0.4746	149.0	0.802	1.1	0.86	5.8	33.4	0.538	0.149
D	850	37.07	0.5655	116.5	2.19	0.90	0.37	7.1	58.2	0.523	0.087
E	900	30.86	0.7719	94.99	1.04	0.66	0.68	9.1	69.9	0.557	0.093
F	975	36.28	1.298	115.0	0.587	0.39	1.5	6.5	76.5	0.467	0.145
G	1075	37.35	1.668	119.4	0.634	0.31	0.21	5.7	83.7	0.427	0.142
H	1175	115.7	7.871	386.8	1.02	0.065	1.8	1.7	95.3	0.38	0.29
I#	1350	1343.9	78.54	4386.6	0.410	0.006	27.7	3.9	99.9	10.9	3.1
J#	1750	7002.5	26.76	23186.2	0.010	0.019	79.3	2.0	100.0	28.5	21.7
total gas age		n=11			8.85	0.70				1.015	0.368
plateau		n=7 steps BB-H			8.36	0.73				94.4	0.511
											0.063

Notes:

Isotopic ratios corrected for blank, radioactive decay, and mass discrimination, not corrected for interfering reactions.

Individual analyses show analytical error only; mean age errors also include error in J and irradiation parameters.

Analyses denoted by # are excluded from plateau age calculations.

Sample preparation and irradiation:

Groundmass concentrate separated using standard techniques (crushing, sieving, magnetics, and hand-picking).

Samples were packaged and irradiated in machined Al discs for 7 hours in D-3 position, Texas A&M University Research Reactor.

Neutron flux monitor Fish Canyon Tuff sanidine (FC-1). Assigned age = 27.84 Ma (Deino and Potts, 1990)

relative to Mmhb-1 at 520.4 Ma (Samson and Alexander, 1987).

Instrumentation:

Mass Analyzer Products 215-50 mass spectrometer on line with automated all-metal extraction system.

Groundmass concentrate samples were step-heated by a double-vacuum resistance furnace.

Reactive gases from the groundmass concentrate were removed during a 15 minute reaction with 3 SAES GP-50 getters,

2 operated at ~450°C and 1 at 20°C. Gas also exposed to a W filament operated at ~2000°C and a cold finger operated at -140°C.

Analytical parameters:

Electron multiplier sensitivity averaged 1.33×10^{-16} moles/pA for those samples analyzed by the furnace.

Total system blank and background for the incrementally heated samples averaged 1730, 37.4, 1.6, 6.3, 9.4×10^{-18} moles

J-factors determined to a precision of ± 0.1% by CO₂ laser-fusion of 4 single crystals from each of 4 or 6 radial positions around tray.

Correction factors for interfering nuclear reactions were determined using K-glass and CaF₂ and are as follows:

NM-132: (⁴⁰Ar/³⁹Ar)_K = 0.0002±0.0003; (³⁶Ar/³⁷Ar)_{Ca} = 0.00028±0.000011; and (³⁹Ar/³⁷Ar)_{Ca} = 0.00089±0.00003.

NM-139: (⁴⁰Ar/³⁹Ar)_K = 0.0002±0.0003; (³⁶Ar/³⁷Ar)_{Ca} = 0.00028±0.000011; and (³⁹Ar/³⁷Ar)_{Ca} = 0.00070±0.00002.

Age calculations:

Plateau steps selected using criteria of Fleck et al. (1977).

Plateau age calculated by weighting each age analysis by the inverse of the variance.

Total gas ages and errors calculated by weighting individual steps by the fraction of ^{39}Ar released.

Isochrons for plateau segments of all analyses have atmospheric intercepts and agree with plateau ages within error.

Decay constants and isotopic abundances following Steiger and Jäger (1977).

All errors reported at $\pm 2\text{s}$.
