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Data Repository Item

Geochronology Sample Preparation and Analysis

Volcanic matrix from three basalts and one dacite sample from the Black Mountains and Black Hills, respectively, were separated to perform $^{40}Ar/^{39}Ar$ geochronology (Fig. A1 and Table A1). Matrix separates (250-180 μm size fraction) were produced using magnetic separation, heavy liquids and hand picking techniques to a purity of >99%. The separates were then washed in acetone, alcohol, and deionized water in an ultrasonic cleaner to remove dust and then re-sieved by hand using a 180-μm sieve.

Sample aliquots of approximately 1000 mg (4x250 mg) were packaged in copper capsules and sealed under vacuum in quartz tubes. The samples were irradiated for 10 hours (irradiation package KD27) in the central thimble facility at the TRIGA reactor (GSTR) at the U.S. Geological Survey, Denver, Colorado. The monitor mineral used in the package was Fish Canyon Tuff sanidine (FCT-3) with an age of 27.79 Ma (Kunk et al. 1985; Cebula et al. 1986) relative to MMhb-1 with an age of 519.4 ± 2.5 Ma (Alexander, et al. 1978; Dalrymple et al. 1981). The type of container and the geometry of samples and standards are similar to that described by (Snee et al. 1988).

Samples were analyzed at the U.S. Geological Survey Thermochronology Laboratory in Denver, Colorado on a VG Isotopes Ltd., Model 1200 B Mass Spectrometer fitted with an electron multiplier using the $^{40}Ar/^{39}Ar$ step heating method of dating. For additional information on the analytical procedure see Kunk et al. (2001).

The argon isotopic data was reduced using an updated version of the computer program ArAr* (Haugerud and Kunk, 1988). We used the decay constants recommended by (Steiger and Jäeger, 1977). Table A1 shows $^{40}Ar/^{39}Ar$ step-heating data for the basalts and dacite and includes the identification of individual steps, existence of plateau, and total gas ages. Total gas ages represent the age calculated from the addition of all of the measured argon peaks for all steps in a single sample. The total gas ages are roughly equivalent to conventional K/Ar ages. No analytical precision is calculated for total gas

ages. Plateau ages (not present) are identified when three or more contiguous steps in the age spectrum agree in age, within the limits of analytical precision, and contain more than 50% of the ^{39}Ar released from the sample.

References

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Figure Caption

Figure A1

Age spectra and inverse isochron ages from $^{40}Ar/^{39}Ar$ geochronology of glass matrix separates from basalt and dacite lava flows offset by the Blackwater fault. All ages in the plots are 2-sigma uncertainty. Vertical extent of boxes represents age uncertainty for individual heat steps. Black mountains basalt field shows stratigraphically consistent

series of Pliocene ages, ca. 3.6 to 3.8 Ma. Dacite of the Black Hills is not younger than Late Miocene.

Oskin and Iriondo Figure A1

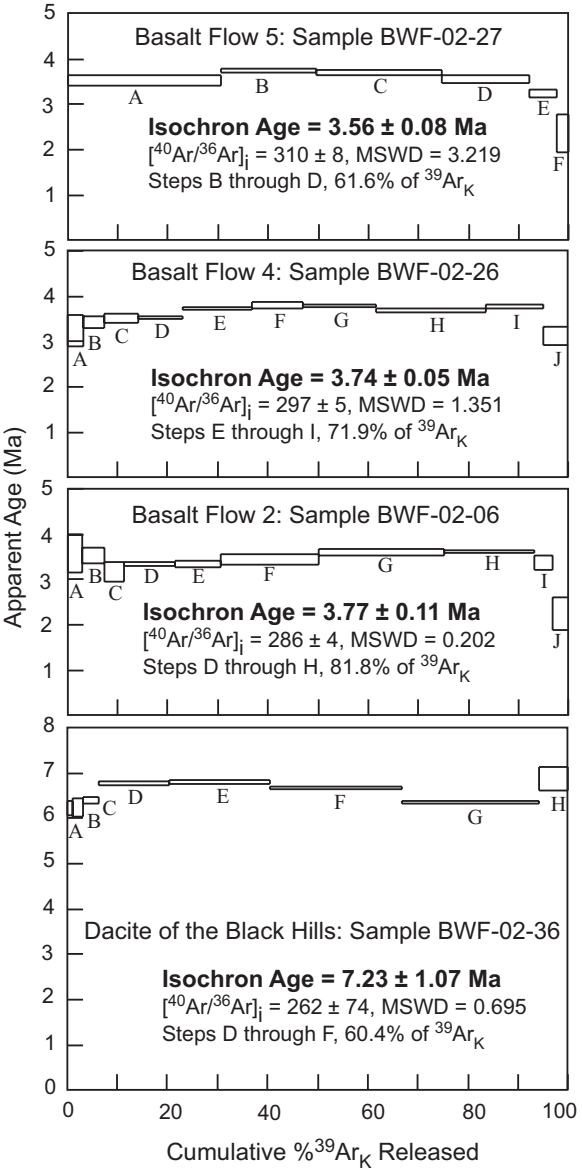

Table A1. $^{40}Ar/^{39}Ar$ step-heating data

Step	Temp. °C	%^{39}Ar of total	Radiogenic Yield (%)	$^{39}Ar_k$ (Moles x 10^{-12})	$^{40}Ar^*/^{39}Ar_k$	Apparent K/Ca	Apparent K/Cl	Apparent Age (Ma)		Error (Ma)
BWF-02-27 ***basalt matrix*** *J = 0.002545 ± 0.50% wt = 751.4 mg #1, 3 & 4KD27*										
A	700	30.5	28.6	0.941226	0.768	2.24	42	3.53	±	0.06
B	800	19.0	47.9	0.587705	0.819	0.85	53	3.76	±	0.02
C	900	25.1	65.6	0.775511	0.809	0.32	129	3.71	±	0.03
D	1000	17.4	67.6	0.538759	0.777	0.21	366	3.56	±	0.04
E	1100	5.4	47.1	0.165909	0.707	0.17	167	3.24	±	0.05
F	1250	2.6	21.2	0.078829	0.514	0.06	31	2.36	±	0.21
Total Gas		100	49.2	3.087939	0.780	0.97	129	3.58		
BWF-02-26 ***basalt matrix*** *J = 0.002563 ± 0.50% wt = 999.3 mg #9, 10, 11 & 12KD27*										
A	500	3.3	6.5	0.140083	0.702	2.63	28	3.24	±	0.17
B	600	4.1	16.2	0.174520	0.741	3.47	33	3.42	±	0.06
C	650	6.8	25.4	0.287824	0.760	3.03	35	3.51	±	0.05
D	700	8.9	32.9	0.377067	0.767	2.06	36	3.54	±	0.02
E	750	13.6	42.8	0.578647	0.807	1.13	46	3.73	±	0.02
F	800	10.3	54.3	0.438836	0.825	0.70	60	3.81	±	0.04
G	900	14.5	67.3	0.614999	0.820	0.37	109	3.79	±	0.02
H	1000	21.9	77.5	0.930677	0.797	0.25	291	3.68	±	0.03
I	1100	11.4	71.1	0.483961	0.818	0.21	271	3.78	±	0.02
J	1450	5.0	31.2	0.213888	0.674	0.02	44	3.12	±	0.10
Total Gas		100	53.4	4.240502	0.790	0.98	133	3.65		
BWF-02-6 ***basalt matrix*** *J = 0.002554 ± 0.50% wt = 1002.7 mg #5, 6, 7 & 8KD27*										
A	500	3.0	5.2	0.106533	0.777	2.19	35	3.58	±	0.21
B	600	4.5	12.0	0.162480	0.767	2.99	47	3.53	±	0.09
C	650	3.9	15.8	0.138130	0.688	3.24	52	3.17	±	0.11
D	700	10.1	20.0	0.360318	0.728	2.15	54	3.35	±	0.02
E	750	9.1	21.9	0.326614	0.727	1.78	55	3.35	±	0.04
F	800	19.7	25.7	0.703562	0.748	0.89	59	3.44	±	0.06
G	900	25.0	33.0	0.894284	0.782	0.38	70	3.60	±	0.04
H	1000	17.9	45.6	0.641938	0.786	0.14	119	3.62	±	0.02
I	1100	3.6	33.7	0.127388	0.732	0.09	190	3.37	±	0.08
J	1450	3.3	10.5	0.117381	0.487	0.02	29	2.24	±	0.18
Total Gas		100	28.3	3.578628	0.750	1.00	74	3.45		
BWF-02-36 ***dacite matrix*** *J = 0.002573 ± 0.50% wt = 1000.7 mg #13, 14, 15 & 16KD27*										
A	700	1.2	29.7	0.083202	1.347	3.55	39	6.24	±	0.08
B	750	2.0	43.6	0.140676	1.349	3.46	38	6.25	±	0.10
C	800	3.3	52.1	0.230703	1.381	2.93	35	6.40	±	0.04
D	900	14.0	60.2	0.985934	1.461	1.64	115	6.77	±	0.02
E	1000	19.9	63.0	1.396434	1.470	0.96	246	6.81	±	0.02
F	1100	26.4	60.5	1.856385	1.443	0.71	223	6.69	±	0.01
G	1450	27.2	53.7	1.908899	1.374	0.47	150	6.36	±	0.02
H	1650	6.0	53.4	0.418319	1.487	0.50	194	6.89	±	0.13
Total Gas		100	57.7	7.020552	1.430	0.98	179	6.62		

Ages calculated assuming an initial $^{40}Ar/^{36}Ar = 295.5 \pm 0$.
All precision estimates are at the one sigma level of precision.
Ages of individual steps do not include error in the irradiation parameter J.
No error is calculated for the total gas age.