$^{40}Ar/^{39}Ar$ Geochronology Results for the Forsyth Reservoir, Hilgard Mountain, and Mount Terrill Quadrangles, Utah

by

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Nevada Isotope Geochronology Laboratory

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INTRODUCTION

This open-file report makes available raw analytical data from laboratory procedures completed to determine the age of rock samples collected during geologic investigations funded or partially supported by the Utah Geological Survey (UGS). The references listed in table 1 generally provide additional information such as sample location, geologic setting, and significance or interpretation of the samples in the context of the area where they were collected. This report was prepared by the Nevada Isotope Geochronology Laboratory (NIGL) under contract to the UGS. These data are highly technical in nature and proper interpretation requires considerable training in the applicable geochronologic techniques.

Table 1. *Sample numbers and locations.*

Sample #	7.5' quadrangle	Latitude (N) NAD27	Longitude (W) NAD27	Reference
FR071708-1	Forsyth Reservoir	38.503767	111.554040	*
FR072108-1	Forsyth Reservoir	38.517638	111.532352	*
HM072308-1	Hilgard Mountain	38.685051	111.543133	*
MT071108-2	Mount Terrill	38.707144	111.646577	*
MT071608-1	Mount Terrill	38.638327	111.717998	*
MT071708-1	Mount Terrill	38.668966	111.640716	*

* *See note in "References"*

DISCLAIMER

This open-file release is intended as a data repository for information gathered in support of various UGS projects. The data are presented as received from the NIGL and do not necessarily conform to UGS technical, editorial, or policy standards; this should be considered by an individual or group planning to take action based on the contents of this report. The Utah Department of Natural Resources, Utah Geological Survey, makes no warranty, expressed or implied, regarding the suitability of this product for a particular use. The Utah Department of Natural Resources, Utah Geological Survey, shall not be liable under any circumstances for any direct, indirect, special, incidental, or consequential damages with respect to claims by users of this product.

REFERENCES

These samples were collected in 2008 during mapping of the Forsyth Reservoir, Hilgard Mountain, and Mount Terrill 7.5' quadrangles in Sevier County, Utah, by Christopher M. Bailey (Geology Department, The College of William and Mary, Williamsburg, VA), David W. Marchetti (Geology Program, Western State College of Colorado), and students. Geologic maps of these 7.5' quadrangles are planned for future publication in the Utah Geological Survey Miscellaneous Publication Series. Also see Bailey and others (2007).

Bailey, C.M., Harris, M.S., and Marchetti, D.W., 2007, Geologic overview of the Fish Lake Plateau, Utah, *in* Willis, G.C., Hylland, M.D., Clark, D.L., and Chidsey, T.C., Jr., Central Utah—diverse geology of a dynamic landscape: Utah Geological Association Publication 36, p. 47–55.

The Nevada Isotope Geochronology Laboratory

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LABORATORY DESCRIPTION AND PROCEDURES

Samples analyzed by the $^{40}Ar/^{39}Ar$ method at the University of Nevada Las Vegas were wrapped in Al foil and stacked in 6 mm inside diameter sealed fused silica tubes. Individual packets averaged 3 mm thick and neutron fluence monitors (FC-2, Fish Canyon Tuff sanidine) were placed every 5-10 mm along the tube. Synthetic K-glass and optical grade CaF_2 were included in the irradiation packages to monitor neutron induced argon interferences from K and Ca. Loaded tubes were packed in an Al container for irradiation. Samples irradiated at the U. S. Geological Survey TRIGA Reactor, Denver, CO were in-core for 7 hours in the In-Core Irradiation Tube (ICIT) of the 1 MW TRIGA type reactor. Correction factors for interfering neutron reactions on K and Ca were determined by repeated analysis of K-glass and CaF_2 fragments. Measured $(^{40}Ar/^{39}Ar)_K$ values were 1.48 (± 79.07%) x 10^{-2}. Ca correction factors were $(^{36}Ar/^{37}Ar)_{Ca}$ = 2.60 (± 3.15%) x 10^{-4} and $(^{39}Ar/^{37}Ar)_{Ca}$ = 6.70 (± 1.70%) x 10^{-4}. J factors were determined by fusion of 4-8 individual crystals of neutron fluence monitors which gave reproducibility's of 0.28% to 0.53 at each standard position. Variation in neutron fluence along the 100 mm length of the irradiation tubes was <4%. Matlab curve fit was used to determine J and uncertainty in J at each standard position. No significant neutron fluence gradients were present within individual packets of crystals as indicated by the excellent reproducibility of the single crystal fluence monitor fusions.

Irradiated FC-2 sanidine standards together with CaF_2 and K-glass fragments were placed in a Cu sample tray in a high vacuum extraction line and were fused using a 20 W CO_2 laser. Sample viewing during laser fusion was by a video camera system and positioning was via a motorized sample stage. Samples analyzed by the furnace step heating method utilized a double vacuum resistance furnace similar to the Staudacher et al. (1978) design. Reactive gases were removed by three GP-50 SAES getters prior to being admitted to a MAP 215-50 mass spectrometer by expansion. The relative volumes of the extraction line and mass spectrometer allow 80% of the gas to be admitted to the mass spectrometer for laser fusion analyses and 76% for furnace heating analyses. Peak intensities were measured using a Balzers electron multiplier by peak hopping through 7 cycles; initial peak heights were determined by linear regression to the time of gas admission. Mass spectrometer discrimination and sensitivity was monitored by repeated analysis of atmospheric argon aliquots from an on-line pipette system. Measured $^{40}Ar/^{36}Ar$ ratios were 282.83± 0.24% during this work, thus a discrimination correction of 1.0448 (4 AMU) was applied to measured isotope ratios. The sensitivity of the mass spectrometer was ~6 x 10^{-17} mol mV^{-1} with the multiplier operated at a gain of 36 over the Faraday. Line blanks averaged 27.94 mV for mass 40 and 0.11 mV for mass 36 for laser fusion analyses and 7.83 mV for mass 40 and 0.03 mV for mass 36 for furnace heating analyses. Discrimination, sensitivity, and blanks were relatively constant over the period of data collection. Computer automated operation of the sample stage, laser, extraction line and mass spectrometer as well as final data reduction and age calculations were done using LabSPEC software written by B. Idleman (Lehigh University). An age of 28.02 Ma (Renne et al., 1988) was used for the Fish Canyon Tuff sanidine fluence monitor in calculating ages for samples.

For $^{40}Ar/^{39}Ar$ analyses a plateau segment consists of 3 or more contiguous gas fractions having analytically indistinguishable ages (i.e. all plateau steps overlap in age at

± 2σ analytical error) and comprising a significant portion of the total gas released (typically >50%). Total gas (integrated) ages are calculated by weighting by the amount of ^{39}Ar released, whereas plateau ages are weighted by the inverse of the variance. For each sample inverse isochron diagrams are examined to check for the effects of excess argon. Reliable isochrons are based on the MSWD criteria of Wendt and Carl (1991) and, as for plateaus, must comprise contiguous steps and a significant fraction of the total gas released. All analytical data are reported at the confidence level of 1σ (standard deviation).

Note: Check your samples data sheets for the discrimination, and fluence monitor values used for each sample.

RESULTS

General Comments

Your samples were run both as conventional furnace step heating analysis on bulk mineral separates, as well as by single crystal laser fusion analysis of sanidine. All data are reported at the 1σ uncertainty level, unless noted otherwise.

Furnace step heating analyses produce what is referred to as an apparent age spectrum. The "apparent" derives from the fact that ages on an age spectrum plot are calculated assuming that the non-radiogenic argon (often referred to as trapped, or initial argon) is atmospheric in isotopic composition (^{40}Ar/^{36}Ar = 295.5). If there is excess argon in the sample (^{40}Ar/^{36}Ar > 295.5) then these apparent ages will be older than the actual age of the sample. U-shaped age spectra are commonly associated with excess argon (the first few and final few steps often have lower radiogenic yields, thus apparent ages calculated for these steps are effected more by any excess argon present). Excess argon can also produce generally discordant age spectra. This is often verified by isochron analysis, which utilizes the analytical data generated during the step heating run, but makes no assumption regarding the composition of the non-radiogenic argon. Thus, isochrons can verify (or rule out) excess argon, and isochron ages are usually preferred if a statistically valid regression is obtained (as evidenced by the MSWD, mean square of weighted deviates, a measure of the coherence of the population). If such a sample yields no reliable isochron, the best estimate of the age is that the minimum on the age spectrum is a maximum age for the sample (it could be affected by excess argon, the extent depending on the radiogenic yield). ^{40}Ar/^{39}Ar total gas ages are equivalent to K/Ar ages. Plateau ages are sometimes found, these are simply a segment of the age spectrum which consists of 3 or more steps, comprising >50% of the total gas released, which overlap in age at the ±2σ analytical error level (not including the J-factor error, which is common to all steps). However, in general an isochron age is the best estimate of the age of a sample, even if a plateau age is obtained.

Laser fusion analyses allow the identification of juvenile phenocryst populations (which should yield the eruption age) as well as any older contaminating xenocrysts, or younger altered crystals. Data sets are screened for anomalous older (or younger) outliers by standard statistical methods. A weighted mean is calculated, and the MSWD is checked. Outliers in the data set which contribute to the MSWD are identified and eliminated sequentially until the MSWD falls below the cutoff value, based on the criteria of Wendt and Carl (1991). Data are also regressed on an isochron plot. As for step heating data, isochrons are generally preferred for age calculation.

FR071708-1 (C63) Biotite

This sample produced a consistent, easily interpreted data set. The age spectrum characterized by a low age first step (~33 Ma) followed by ages which generally decrease slightly from ~38 Ma with increasing gas released. The total gas age (equivalent to a conventional K/Ar age) is 36.93 ± 0.25 Ma. Steps 5-8 (53% of the ^{39}Ar released) define an indistinguishable plateau age of 37.09 ± 0.25 Ma. Steps 4-10 (80% of the ^{39}Ar released) define a statistically valid isochron, which yields an age of 36.53 ± 0.14 Ma and an initial $^{40}Ar/^{36}Ar$ ratio of 411 ± 13, indicating that excess argon is present. Radiogenic yields (%$^{40}Ar^*$) are generally high, indicating the sample is unaltered. Ca/K ratios are low and consistent with outgassing of a homogeneous biotite, with the exception of the final two steps (only ~1% of the total gas released) which may reflect the presence of very minor high-Ca phase impurities (amphibole?). Although all three age calculations overlap within analytical uncertainties the isochron age should be considered the most accurate and reliable.

FR072108-1 (C89) Basalt Groundmass

This sample also produced a consistent and easily interpreted data set. Aside from some discordance in the initial 3 steps and the final 2 steps (both higher and lower ages than the majority of the steps), the age spectrum is nearly ideally flat. The total gas age is 5.07 ± 0.05 Ma. Steps 4-13 (84% of the ^{39}Ar released) define a nearly identical plateau age of 5.02 ± 0.05 Ma. Steps 5-12 (71% of the ^{39}Ar released) define a well-constrained isochron, which yields an age of 4.98 ± 0.04 Ma and an $^{40}Ar/^{36}Ar$ ratio of 301 ± 5, suggesting that a small amount of excess argon is present. Radiogenic yields are generally high for a low-K sample such as basalt of this age, and Ca/K ratios are typical for degassing of a basalt groundmass sample. As for the sample described above all 3 age calculations overlap within analytical uncertainties, and the isochron should be considered to define the preferred age.

HM072308-1 (C96) Plagioclase

The age spectrum for this sample is discordant, with high ages in the first ~20% gas released, followed by concordant ages from ~20-80% gas released, and ending with high ages with the final gas released. Note that overall the form of the age spectrum is U-shaped, suggesting the presence of excess argon. The total gas age is 26.85 ± 0.07 Ma. Steps 4-8 (56% of the ^{39}Ar released) define a slightly younger plateau age of 26.18 ± 0.09 Ma. Steps 1-9 (81% of the ^{39}Ar released) define a very well-constrained isochron, yielding an age of 26.01 ± 0.04 Ma and an initial $^{40}Ar/^{36}Ar$ ratio of 310 ± 1, indicating that this sample contains excess argon. Radiogenic yields do not suggest alteration, and Ca/K ratios are consistent with outgassing of a homogeneous plagioclase mineral separate. The isochron age should be considered the most accurate and reliable.

MT071108-2 (C9) Single Crystal Sanidine

This sample was analyzed by laser fusion of single sanidine crystals, and produced an ideal data set. Eighteen fusions produced a coherent set of ages, all of which overlap within analytical uncertainty. The mean age is 25.13 ± 0.07 Ma. No analyses were rejected based on MSWD criteria, and a weighted mean age of 25.13 ± 0.02 Ma is calculated. All 18 analyses fit an isochron, which yields an age of 25.13 ± 0.04 Ma, and an initial $^{40}Ar/^{36}Ar$ ratio of 298 ± 6, indicating that no excess argon is present. Radiogenic yields are consistently high, indicating no significant alteration, and Ca/K ratios vary little, demonstrating a single compositional population of sanidine crystals was analyzed. Given the reproducibility of ages calculated by the three different methods, and the isochron which indicates atmospheric initial argon, the weighted mean age can be used as the preferred age in this case.

MT071608-1 (C56) Trachyte Groundmass

The age spectrum for this sample is generally flat and concordant, with the exception of slightly older ages in the first 2 steps (~30% of the total gas released). The total gas age for this sample is 25.96 ± 0.19 Ma. Steps 3-9 (69% of the ^{39}Ar released) define a slightly younger, but statistically indistinguishable, plateau age of 25.68 ± 0.19 Ma. Steps 3-8 (68% of the ^{39}Ar released) define a statistically valid isochron age of 25.76 ± 0.10 Ma. Note, however, that the initial $^{40}Ar/^{36}Ar$ ratio of 229 ± 21 is well below the atmospheric value of 295.5, for which there is no known mechanism. Note also that all the data points that define this isochron are clustered very near the x-axis, thus the line fit, although statistically valid, is poorly constrained. The isochron should be considered unreliable based on these observations. Radiogenic yields are high and do not indicate the sample is altered. Ca/K ratios, with the exception of the last 5 steps which comprise <4% of the total gas released, are low and consistent with outgassing of a homogeneous trachyte groundmass sample. The plateau age should be considered the most reliable for this sample.

MT071708-1 (C61) Plagioclase

This sample produced a consistent, easily interpretable data set. The age spectrum is mildly discordant and U-shaped, with higher initial and final ages, suggesting the presence of excess argon. The total gas age is 26.21 ± 0.19 Ma, and steps 3-9 (71% of the ^{39}Ar released) define a statistically indistinguishable plateau age of 26.03 ± 0.19 Ma. Steps 4-11 (68% of the ^{39}Ar released) define a valid isochron age of 25.93 ± 0.09 Ma, and an initial $^{40}Ar/^{36}Ar$ ratio of 304 ± 2, indicating that a small amount of excess argon is present in this sample. Radiogenic yields are high for a plagioclase of this age, and do not suggest any significant alteration. Ca/K ratios are consistent with outgassing of a homogeneous plagioclase mineral separate. The isochron age should be considered the most accurate and reliable.

These interpretations are based primarily on inspection of the laboratory data. Geologic relationships, which we generally do not know, have not been taken into account in the comments presented above.

REFERENCES

Renne, P.R., Swisher, C.C, Deino, A.L., Karner, D.B., Owens, T.L., DePaolo, D.J., 1998, Intercalibration of standards, absolute ages and uncertainties in $^{40}Ar/^{39}Ar$ dating, *Chemical Geology*, v. 145, p. 117-152.

Staudacher, T.H., Jessberger, E.K., Dorflinger, D., and Kiko, J., A refined ultrahigh-vacuum furnace for rare gas analysis, *J. Phys. E: Sci. Instrum*., *11*, 781-784, 1978.

Wendt, I., and Carl, C., 1991, The statistical distribution of the mean squared weighted deviation, *Chemical Geology*, v. 86, p. 275-285.

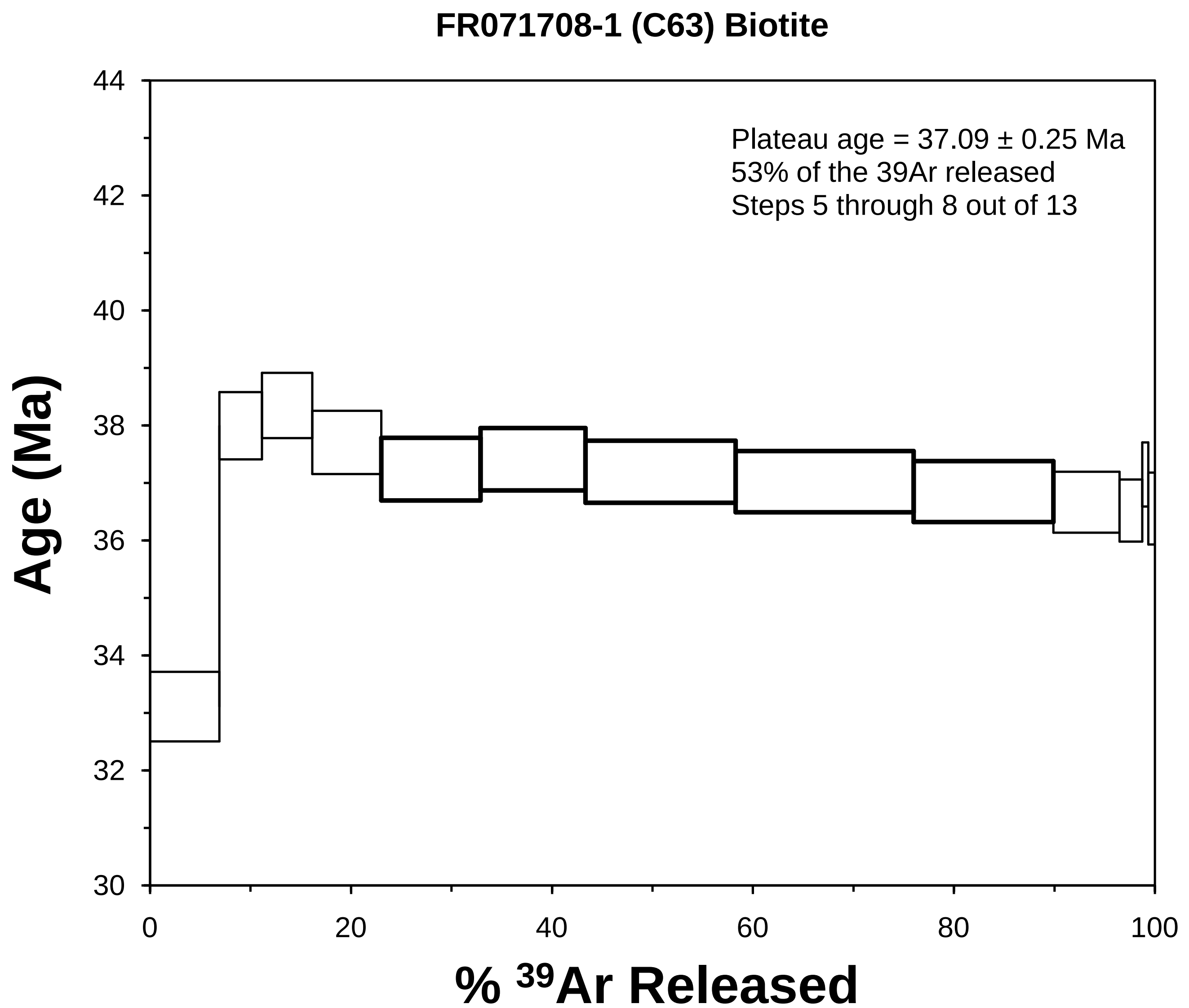
APPENDIX

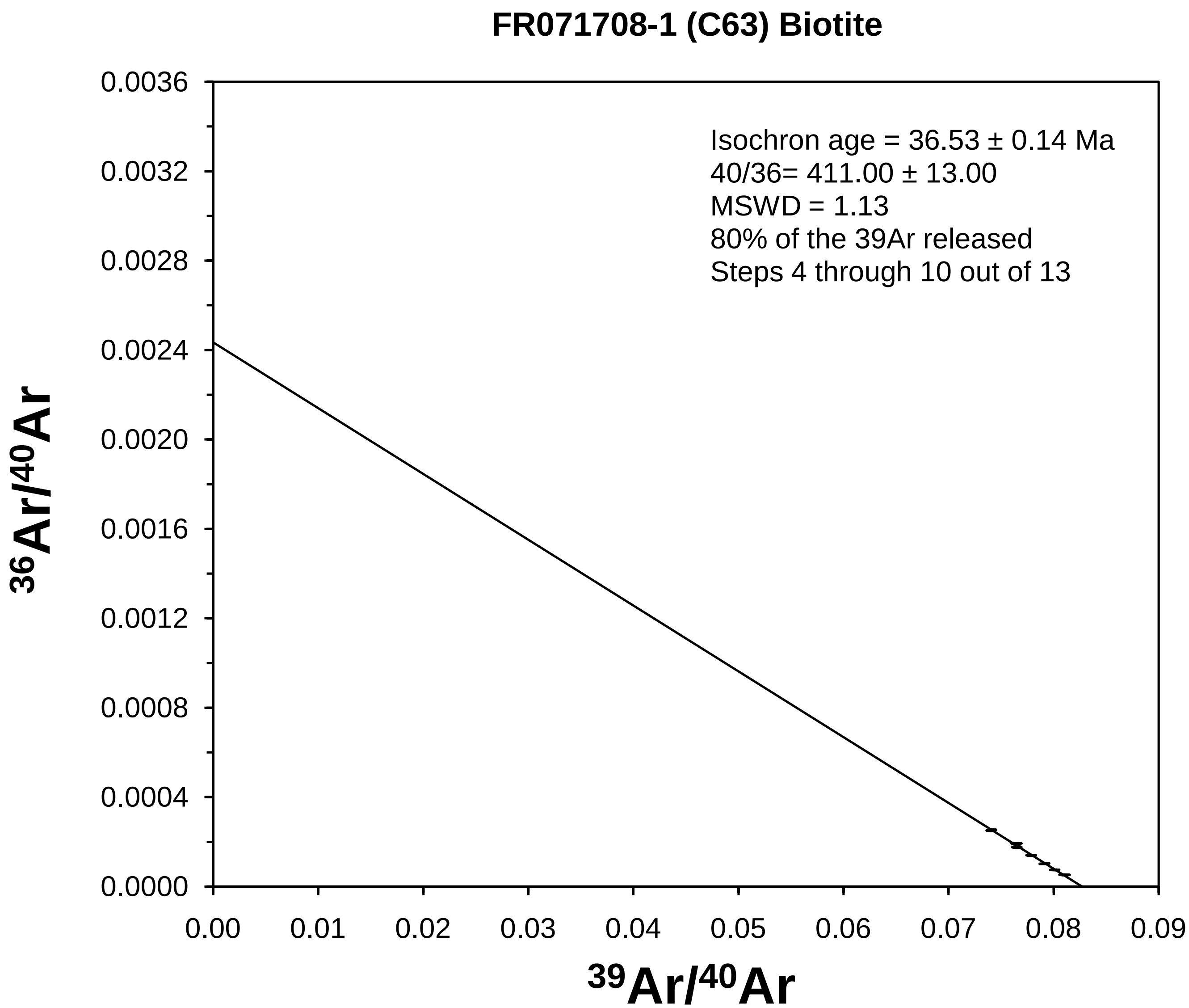
Analytical data for samples FR071708-1 (C63) biotite, FR072108-1 (C89) basalt groundmass, HM072308-1 (C96) plagioclase, MT071108-2 (C9) single crystal sanidine, MT071608-1 (C56) trachyte groundmass, and MT071708-1 (C61) plagioclase.

UT DNR, FR071708-1 (C63), Biotite, 9.80 mg, J = 0.001692 ± 0.65%
4 amu discrimination = 1.0448 ± 0.24%, 40/39K = 0.0148 ± 79.07%, 36/37Ca = 0.00026 ± 3.15%, 39/37Ca = 0.00067 ± 1.70%

step	T (C)	t (min.)	36Ar	37Ar	38Ar	39Ar	40Ar	%40Ar*	% 39Ar rlsd	Ca/K	40Ar*/39ArK	Age (Ma)	1s.d.
1	650	12	5.015	2.362	4.650	84.498	2332.49	39.3	6.9	0.11017638	10.946665	33.11	0.30
2	725	12	1.146	0.699	2.488	52.033	970.557	67.0	4.2	0.05294758	12.578509	37.99	0.29
3	790	12	0.521	0.586	2.792	61.276	918.760	84.4	5.0	0.03769234	12.696959	38.35	0.28
4	850	12	0.318	0.824	3.786	84.182	1131.45	92.4	6.9	0.03857927	12.481156	37.70	0.28
5	905	12	0.338	1.592	5.401	120.660	1569.57	94.2	9.9	0.05200288	12.326628	37.24	0.27
6	945	12	0.340	2.127	5.767	128.241	1668.14	94.6	10.5	0.06537173	12.384153	37.41	0.27
7	980	12	0.371	3.474	8.152	182.853	2333.50	95.8	14.9	0.07488215	12.311244	37.19	0.27
8	1015	12	0.325	6.829	9.686	217.071	2724.93	96.8	17.7	0.12399726	12.253391	37.02	0.27
9	1045	12	0.203	10.124	7.813	170.399	2113.68	97.6	13.9	0.23418324	12.195879	36.85	0.27
10	1080	12	0.090	7.760	3.734	80.300	988.580	98.3	6.6	0.38092148	12.134025	36.66	0.27
11	1125	12	0.058	4.083	1.335	27.904	348.740	98.0	2.3	0.5768023	12.085550	36.52	0.27
12	1180	12	0.036	6.472	0.480	7.334	97.692	99.9	0.6	3.48160054	12.295526	37.15	0.28
13	1400	12	0.120	4.469	0.439	7.953	128.346	81.5	0.6	2.21615815	12.096916	36.55	0.31
							Cumulative %39Ar rlsd =		100.0		Total gas age =	36.93	0.25
											Plateau age = (steps 5-8)	37.09	0.25
											Isochron age = (steps 4-10)	36.53	0.14

note: isotope beams in mV, rlsd = released, error in age includes J error, all errors 1 sigma
(36Ar through 40Ar are measured beam intensities, corrected for decay for the age calculations)


FR071708-1 (C63) Biotite
Plateau age = 37.09 ± 0.25 Ma
53% of the 39Ar released
Steps 5 through 8 out of 13
Age (Ma)
44
42
40
38
36
34
32
30
0
20
40
60
80
100
% 39Ar Released


FR071708-1 (C63) Biotite
Isochron age = 36.53 ± 0.14 Ma
40/36= 411.00 ± 13.00
MSWD = 1.13
80% of the 39Ar released
Steps 4 through 10 out of 13
0.0036
0.0032
0.0028
0.0024
0.0020
0.0016
0.0012
0.0008
0.0004
0.0000
0.00
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
36Ar/40Ar
39Ar/40Ar

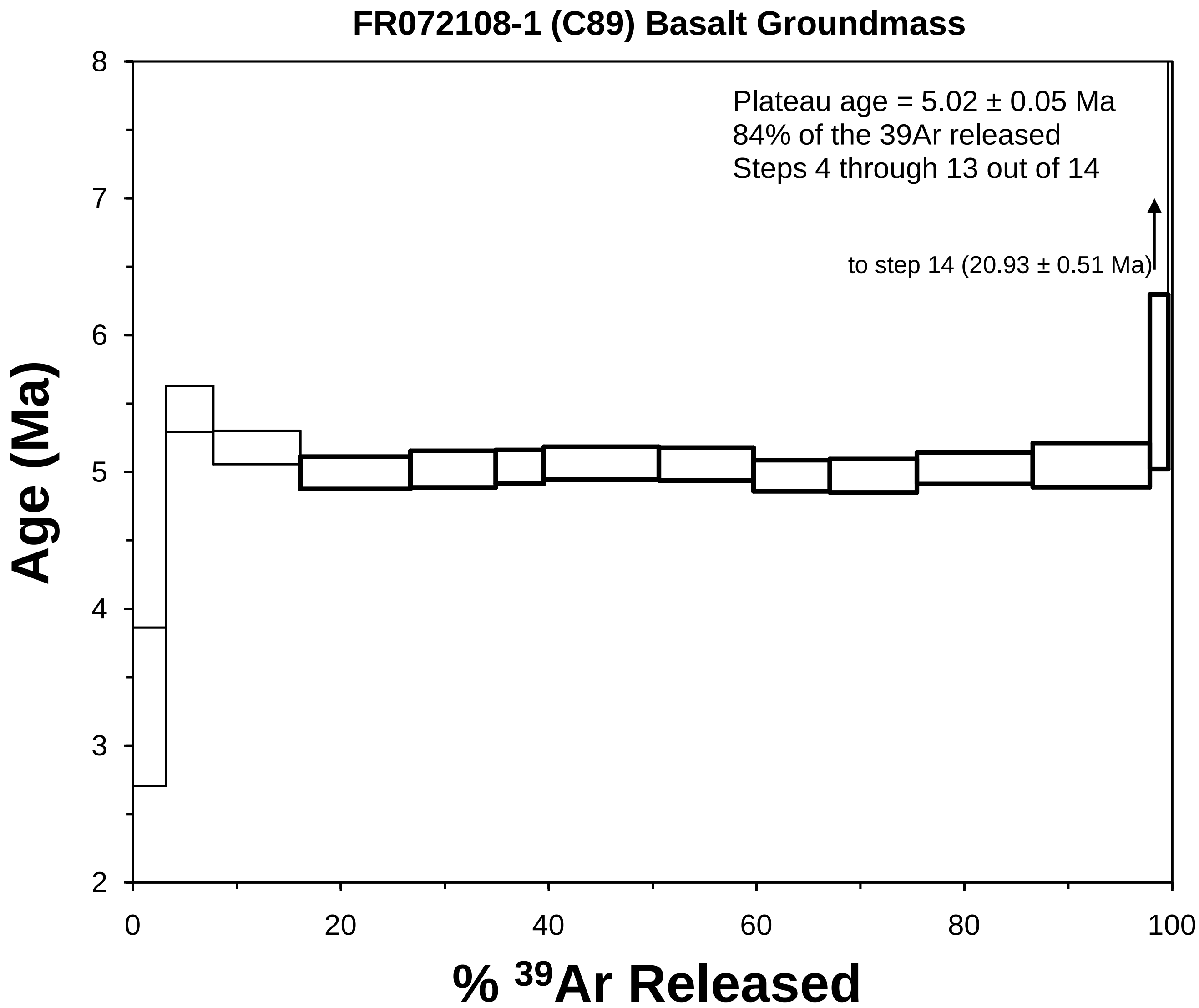
UT DNR, FR072108-1 (C89), Basalt Groundmass, 40.88 mg, J = 0.001705 ± 0.80%

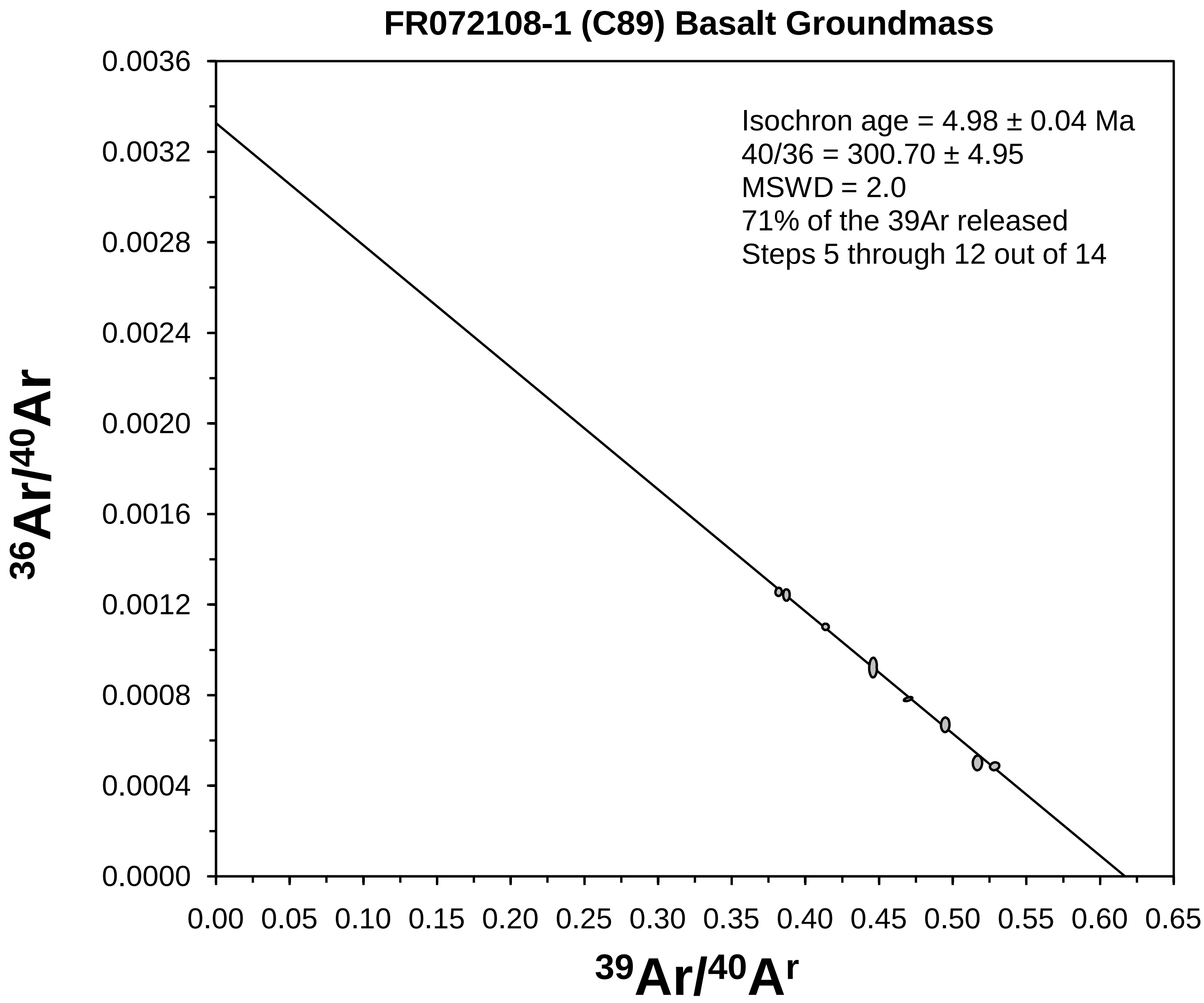
4 amu discrimination = 1.0448 ± 0.24%, 40/39K = 0.0148 ± 79.07%, 36/37Ca = 0.00026 ± 3.15%, 39/37Ca = 0.00067 ± 1.70%

step	T (C)	t (min.)	36Ar	37Ar	38Ar	39Ar	40Ar	%40Ar*	% 39Ar rlsd	Ca/K	40Ar*/39ArK	Age (Ma)	1s.d.
1	550	12	2.836	35.550	1.239	33.719	832.683	4.3	3.2	4.0783483	1.068284	3.28	0.29
2	600	12	0.487	42.348	0.917	47.662	215.085	39.8	4.5	3.43636199	1.778075	5.46	0.08
3	650	12	0.432	48.635	1.421	88.018	262.289	57.0	8.4	2.13624639	1.685800	5.18	0.06
4	700	12	0.341	43.386	1.695	111.413	269.970	67.6	10.6	1.50524736	1.625812	4.99	0.06
5	750	12	0.216	26.753	1.276	86.266	199.140	72.5	8.2	1.19863839	1.634288	5.02	0.07
6	800	12	0.188	15.225	0.751	48.627	131.577	63.2	4.6	1.21014284	1.639830	5.04	0.06
7	870	12	0.440	53.042	1.720	116.541	310.108	62.6	11.1	1.75941148	1.648633	5.06	0.06
8	930	12	0.145	42.479	1.397	95.626	191.625	84.5	9.1	1.71719346	1.646350	5.06	0.06
9	990	12	0.119	34.172	1.158	77.358	153.208	85.0	7.4	1.70759503	1.618640	4.97	0.06
10	1050	12	0.171	39.461	1.353	88.012	184.455	79.6	8.4	1.73320189	1.618640	4.97	0.06
11	1110	12	0.274	94.555	1.910	117.250	255.712	76.4	11.2	3.11867241	1.636570	5.03	0.06
12	1170	12	0.586	518.177	2.327	118.487	291.815	67.7	11.3	16.9806428	1.644068	5.05	0.08
13	1240	12	0.367	443.851	0.432	18.629	79.189	46.7	1.8	94.592469	1.842644	5.66	0.32
14	1400	12	0.094	30.047	0.077	3.841	48.301	70.3	0.4	30.4930773	6.843035	20.93	0.51
								Cumulative %39Ar rlsd =	100.0		Total gas age =	5.07	0.05
											Plateau age = (steps 4-13)	5.02	0.05
											Isochron age = (steps 5-12)	4.98	0.04

note: isotope beams in mV, rlsd = released, error in age includes J error, all errors 1 sigma

(36Ar through 40Ar are measured beam intensities, corrected for decay for the age calculations)

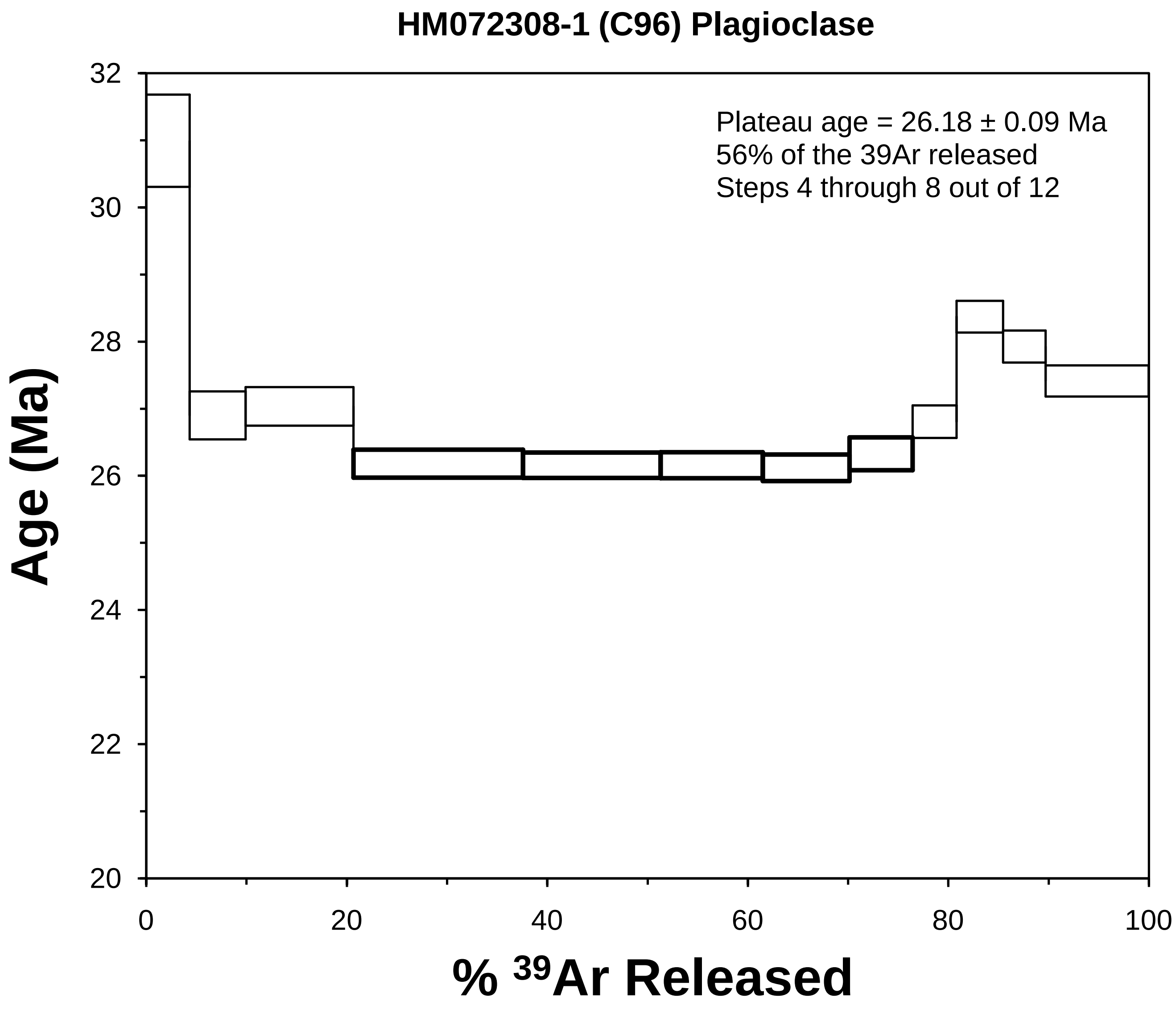

FR072108-1 (C89) Basalt Groundmass
Plateau age = 5.02 ± 0.05 Ma
84% of the 39Ar released
Steps 4 through 13 out of 14
to step 14 (20.93 ± 0.51 Ma)
Age (Ma)
% 39Ar Released
8
7
6
5
4
3
2
0
20
40
60
80
100

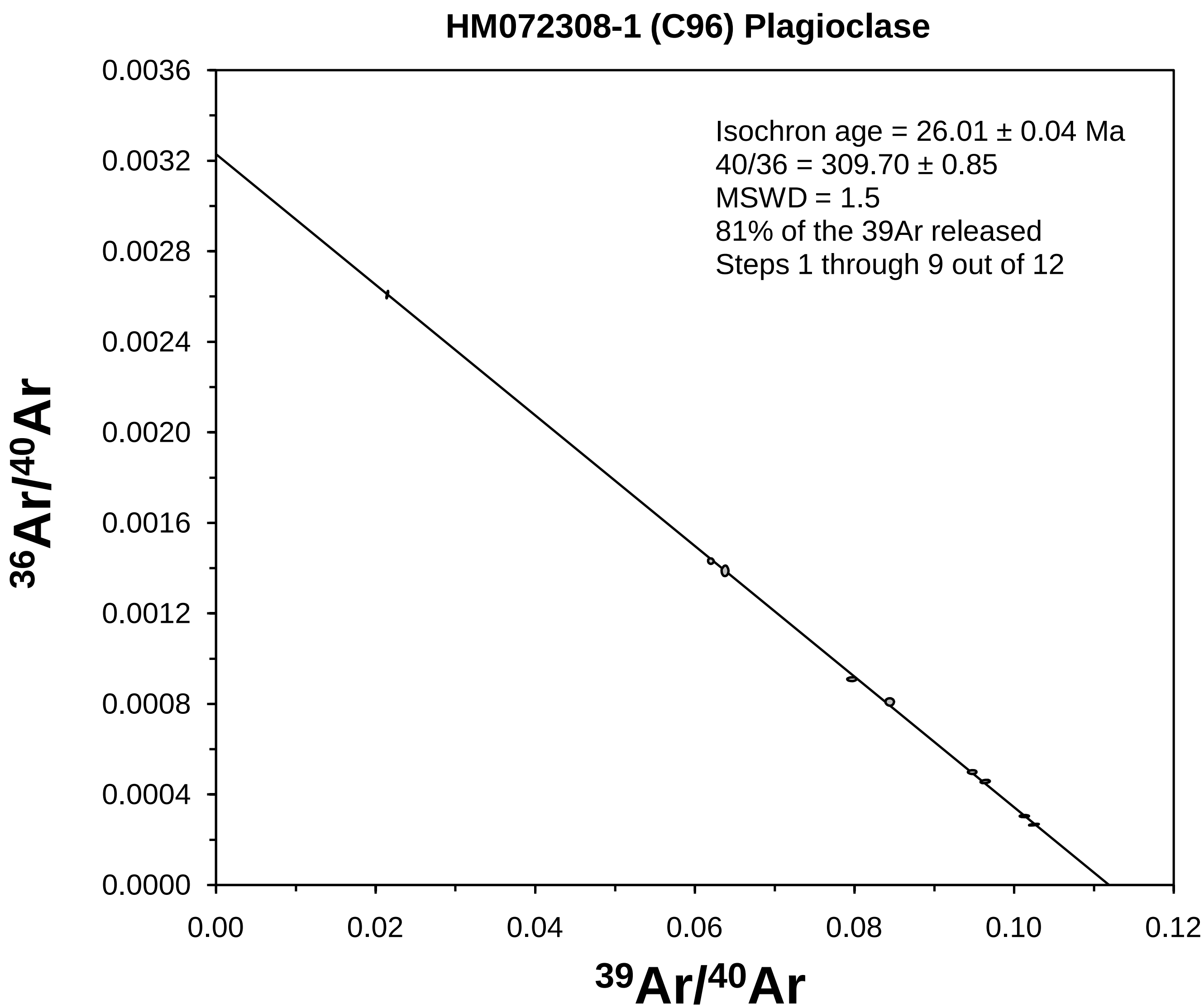

FR072108-1 (C89) Basalt Groundmass
Isochron age = 4.98 ± 0.04 Ma
40/36 = 300.70 ± 4.95
MSWD = 2.0
71% of the 39Ar released
Steps 5 through 12 out of 14
0.0036
0.0032
0.0028
0.0024
0.0020
0.0016
0.0012
0.0008
0.0004
0.0000
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
0.45
0.50
0.55
0.60
0.65
$^{36}Ar/^{40}Ar$
$^{39}Ar/^{40}Ar$

UT DNR, HM072308-1 (C96), Plagioclase, 29.10 mg, J = 0.001625 ± 0.09%
4 amu discrimination = 1.0448 ± 0.24%, 40/39K = 0.0148 ± 79.07%, 36/37Ca = 0.00026 ± 3.15%, 39/37Ca = 0.00067 ± 1.70%

step	T (C)	t (min.)	36Ar	37Ar	38Ar	39Ar	40Ar	%40Ar*	% 39Ar rlsd	Ca/K	40Ar*/39ArK	Age (Ma)	1s.d.
1	650	12	2.611	28.803	0.810	20.640	950.756	23.0	4.3	5.2176131	10.663283	30.99	0.34
2	730	12	0.632	38.748	0.491	26.511	417.208	59.0	5.6	5.46510215	9.244547	26.90	0.18
3	810	12	1.274	79.555	0.978	51.197	821.83	57.6	10.8	5.8108778	9.291290	27.04	0.14
4	890	12	0.514	129.488	1.296	80.363	845.276	85.1	16.9	6.02586377	8.994963	26.18	0.10
5	960	12	0.253	108.018	1.096	65.282	637.566	92.0	13.7	6.18826805	8.987003	26.16	0.10
6	1020	12	0.213	75.612	0.881	48.470	480.838	90.9	10.2	5.83363639	8.987349	26.16	0.10
7	1070	12	0.263	70.524	0.752	41.237	430.714	86.4	8.7	6.39650298	8.974544	26.12	0.10
8	1120	12	0.349	54.068	0.583	29.907	358.724	76.3	6.3	6.76248632	9.046534	26.33	0.12
9	1170	12	0.293	41.001	0.417	20.804	266.415	73.3	4.4	7.37332996	9.212002	26.81	0.12
10	1220	12	0.213	44.254	0.401	22.146	267.46	82.3	4.7	7.47629276	9.754062	28.37	0.12
11	1270	12	0.181	41.781	0.388	20.216	237.004	83.8	4.2	7.73294752	9.599535	27.93	0.12
12	1400	12	0.513	99.351	0.987	48.902	588.656	78.8	10.3	7.60134546	9.422189	27.41	0.12
							Cumulative %39Ar rlsd =		100.0		Total gas age =	26.85	0.07
											Plateau age = (steps 4-8)	26.18	0.09
											Isochron age = (steps 1-9)	26.01	0.04

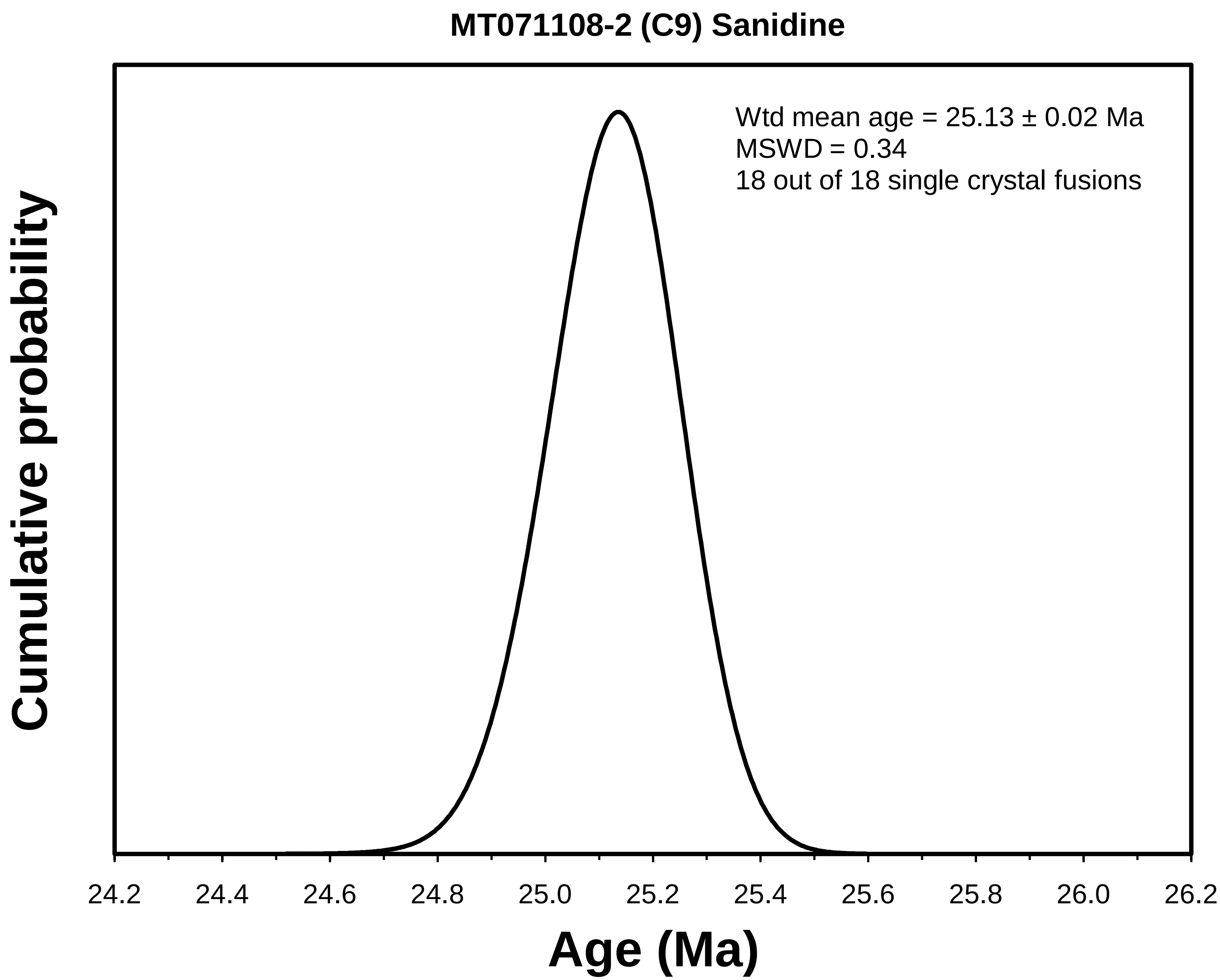
note: isotope beams in mV, rlsd = released, error in age includes J error, all errors 1 sigma
(36Ar through 40Ar are measured beam intensities, corrected for decay for the age calculations)

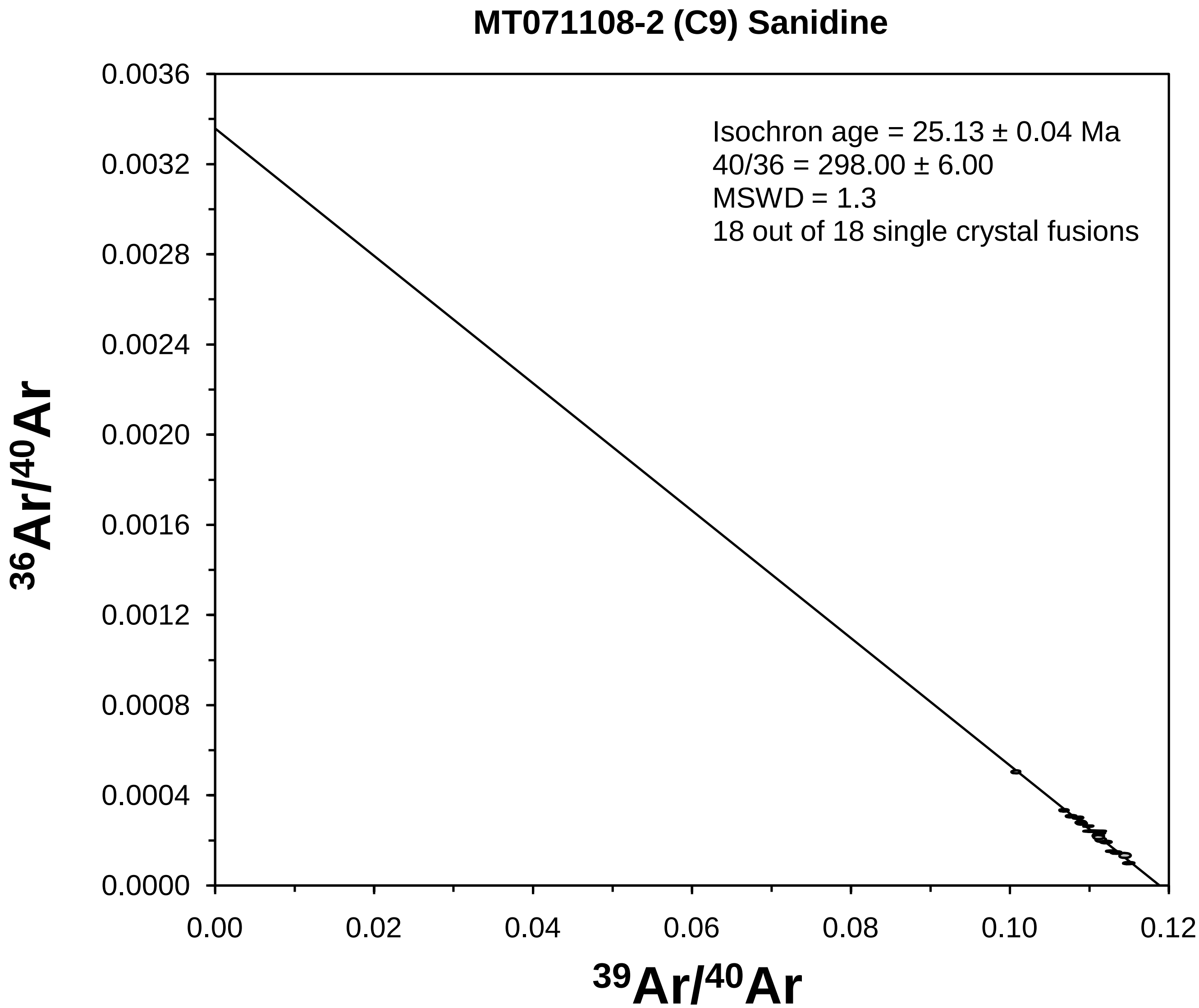

HM072308-1 (C96) Plagioclase
Plateau age = 26.18 ± 0.09 Ma
56% of the 39Ar released
Steps 4 through 8 out of 12
Age (Ma)
32
30
28
26
24
22
20
0
20
40
60
80
100
% 39Ar Released


HM072308-1 (C96) Plagioclase
Isochron age = 26.01 ± 0.04 Ma
40/36 = 309.70 ± 0.85
MSWD = 1.5
81% of the 39Ar released
Steps 1 through 9 out of 12
0.0036
0.0032
0.0028
0.0024
0.0020
0.0016
0.0012
0.0008
0.0004
0.0000
0.00
0.02
0.04
0.06
0.08
0.10
0.12
$^{36}Ar/^{40}Ar$
$^{39}Ar/^{40}Ar$

UT DNR, MT071108-2 (C9), Single Crystal Sanidine, J = 0.001667 ± 0.10%
4 amu discrimination = 1.0448 ± 0.24%, 40/39K = 0.0148 ± 79.07%, 36/37Ca = 0.00026 ± 3.15%, 39/37Ca = 0.00067 ± 1.70%

Crystal	T (C)	t (min.)	36Ar	37Ar	38Ar	39Ar	40Ar	%40Ar*	Ca/K	40Ar*/39ArK	Age (Ma)	1s.d.
1	1600	1	0.458	4.006	1.847	133.060	1237.07	91.6	0.12375673	8.4152	25.13	0.09
2	1600	1	0.346	2.422	1.181	83.666	791.58	91.0	0.11899535	8.3906	25.06	0.09
3	1600	1	0.325	2.763	1.525	106.119	973.995	93.3	0.1070265	8.4064	25.11	0.10
4	1600	1	0.433	3.586	1.846	130.305	1203.17	92.0	0.11312366	8.3849	25.04	0.09
5	1600	1	0.213	2.445	1.224	87.962	789.069	95.9	0.1142584	8.3835	25.04	0.10
6	1600	1	0.189	2.356	1.258	90.211	805.596	96.8	0.10735429	8.4351	25.19	0.09
7	1600	1	0.283	2.301	1.146	81.121	750.095	92.9	0.11659715	8.3592	24.97	0.09
8	1600	1	0.355	2.377	1.211	83.797	798.604	90.7	0.11660182	8.4317	25.18	0.10
9	1600	1	0.226	2.420	1.242	88.493	801.46	95.4	0.11241147	8.4327	25.18	0.09
10	1600	1	0.268	2.301	1.200	85.508	788.272	93.8	0.11061495	8.4311	25.18	0.09
11	1600	1	0.265	3.251	1.592	112.706	1018.13	95.3	0.11856998	8.4628	25.27	0.09
12	1600	1	0.301	2.017	1.037	72.858	690.333	91.5	0.11379756	8.4091	25.11	0.10
13	1600	1	0.291	2.417	1.296	91.938	847.334	93.5	0.10806506	8.4182	25.14	0.09
14	1600	1	0.477	3.046	1.625	113.848	1083.82	89.9	0.10997865	8.4287	25.17	0.09
15	1600	1	0.325	2.574	1.357	96.340	890.256	92.7	0.10982616	8.3825	25.04	0.15
16	1600	1	0.234	1.902	1.027	71.869	663.185	94.1	0.10878592	8.4095	25.12	0.09
17	1600	1	0.341	2.454	1.236	87.867	826.981	91.5	0.11480298	8.4125	25.12	0.09
18	1600	1	0.471	1.982	1.053	70.591	722.069	85.0	0.11541408	8.4456	25.22	0.10
note: isotope beams in mV rlsd = released, error in age includes J error, all errors 1 sigma										Mean ± s.d. =	25.13	0.07
(36Ar through 40Ar are measured beam intensities, corrected for decay in age calculations)										Wtd mean age = (18 fusions)	25.13	0.02
										Isochron age = (18 fusions)	25.13	0.04

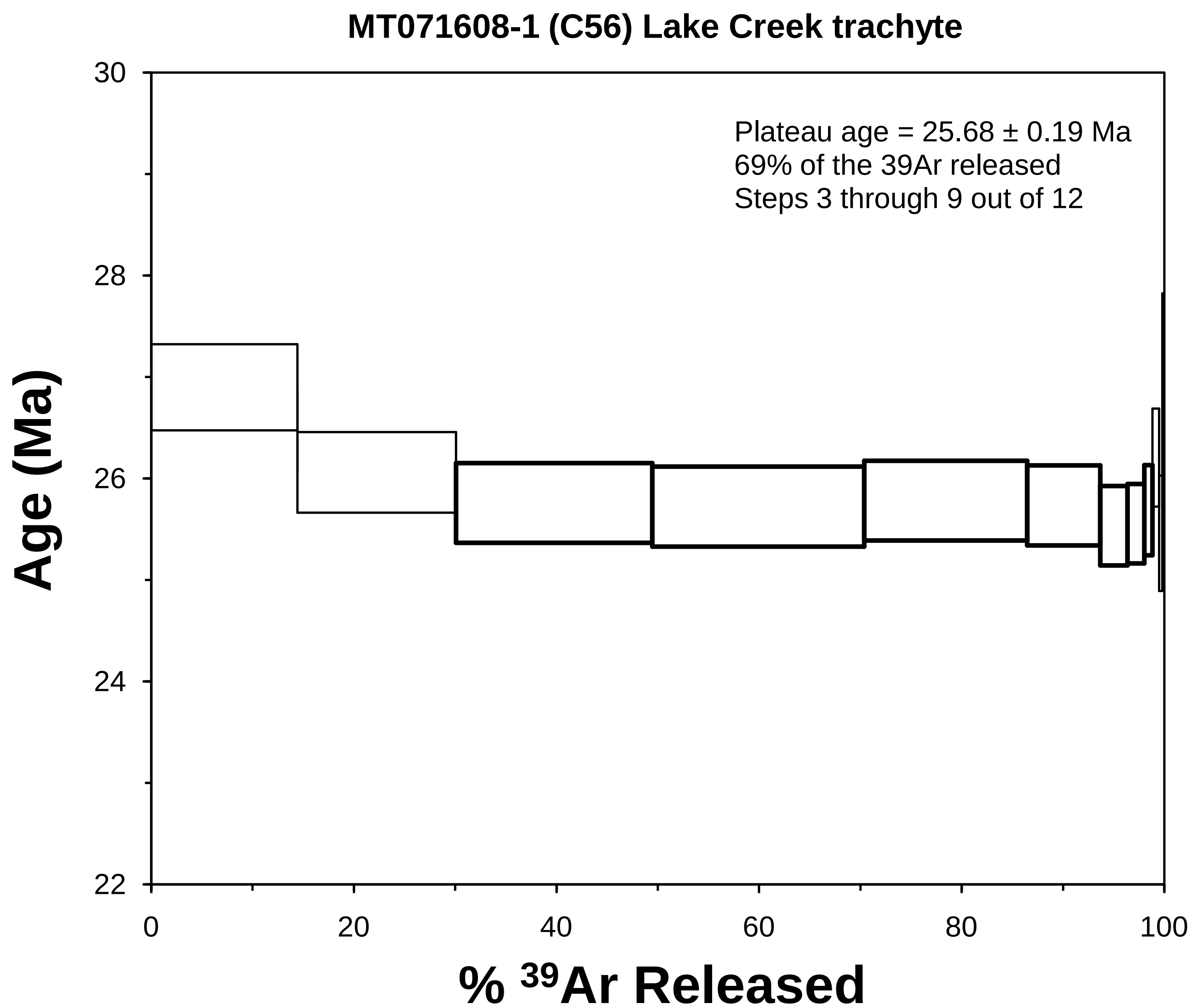

MT071108-2 (C9) Sanidine
Wtd mean age = 25.13 ± 0.02 Ma
MSWD = 0.34
18 out of 18 single crystal fusions
Cumulative probability
24.2
24.4
24.6
24.8
25.0
25.2
25.4
25.6
25.8
26.0
26.2
Age (Ma)

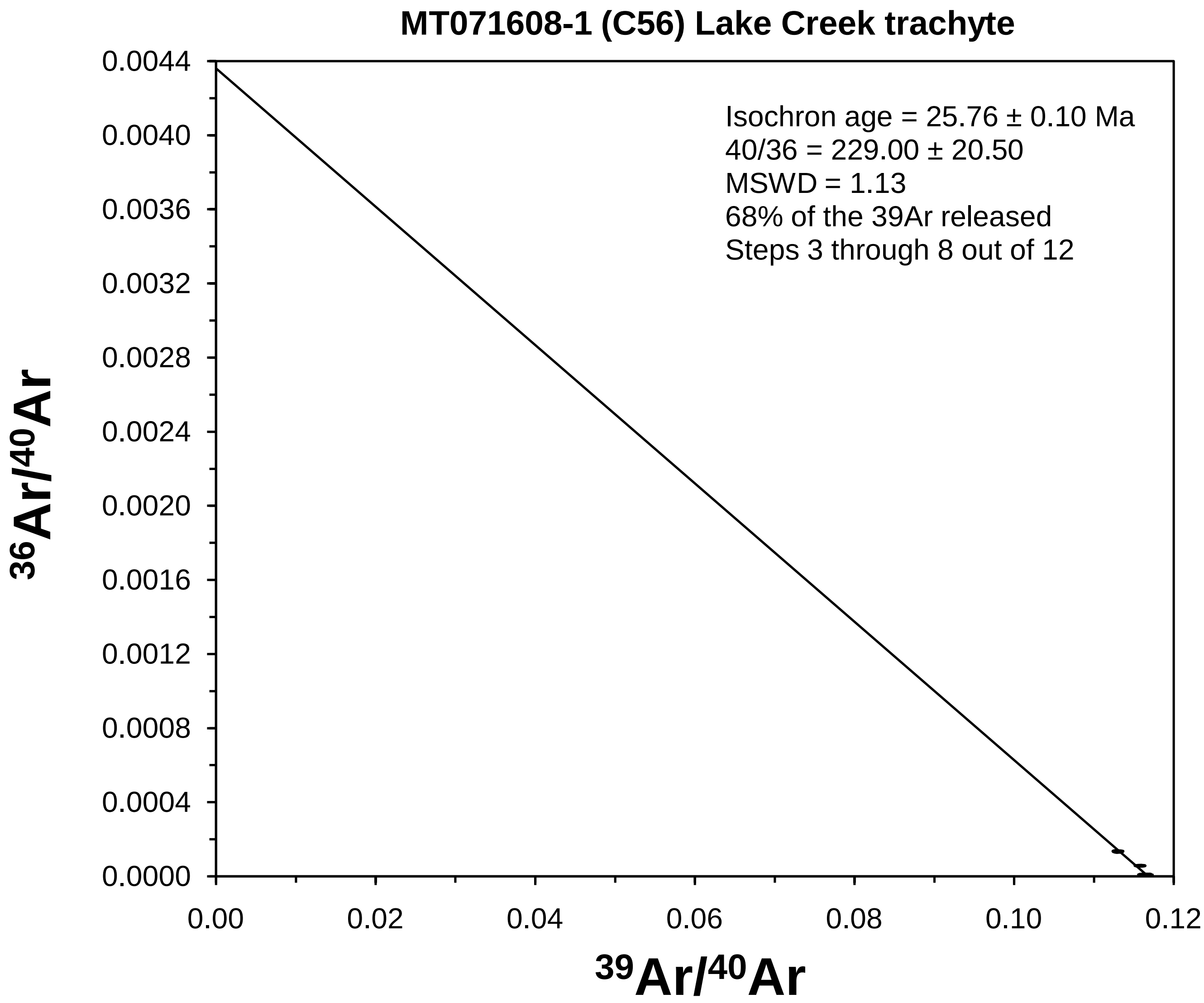

MT071108-2 (C9) Sanidine
Isochron age = 25.13 ± 0.04 Ma
40/36 = 298.00 ± 6.00
MSWD = 1.3
18 out of 18 single crystal fusions
0.0036
0.0032
0.0028
0.0024
0.0020
0.0016
0.0012
0.0008
0.0004
0.0000
0.00
0.02
0.04
0.06
0.08
0.10
0.12
$^{36}Ar/^{40}Ar$
$^{39}Ar/^{40}Ar$

UT DNR, MT071608-1 (C56), Lake Creek trachyte, 26.35 mg, J = 0.001680 ± 0.69%
4 amu discrimination = 1.0448 ± 0.24%, 40/39K = 0.0148 ± 79.07%, 36/37Ca = 0.00026 ± 3.15%, 39/37Ca = 0.00067 ± 1.70%

step	T (C)	t (min.)	36Ar	37Ar	38Ar	39Ar	40Ar	%40Ar*	% 39Ar rlsd	Ca/K	40Ar*/39ArK	Age (Ma)	1s.d.
1	660	12	3.321	16.980	5.736	376.069	4267.69	78.0	14.4	0.17547587	8.941563	26.90	0.21
2	710	12	0.079	15.683	5.509	409.019	3529.30	99.4	15.7	0.14901485	8.660315	26.06	0.20
3	760	12	0.070	17.253	6.910	505.029	4302.89	99.6	19.4	0.132767	8.559567	25.76	0.20
4	810	12	0.066	16.884	7.495	546.046	4643.49	99.6	20.9	0.12016732	8.547853	25.72	0.20
5	870	12	0.070	12.413	5.812	419.406	3580.32	99.5	16.1	0.11502221	8.567264	25.78	0.20
6	930	12	0.056	6.645	2.788	188.066	1607.97	99.4	7.2	0.13731789	8.551534	25.73	0.20
7	990	12	0.069	4.995	1.532	70.272	608.768	98.1	2.7	0.27625693	8.484602	25.53	0.20
8	1050	12	0.088	7.476	1.663	43.707	390.672	95.8	1.7	0.66485578	8.490960	25.55	0.20
9	1110	12	0.125	4.987	0.713	20.933	210.885	87.3	0.8	0.92608338	8.535804	25.69	0.22
10	1170	12	0.145	4.813	0.578	16.928	185.582	82.3	0.6	1.10528703	8.709189	26.21	0.24
11	1240	12	0.093	2.939	0.343	8.047	92.490	80.1	0.3	1.4199408	8.459504	25.46	0.28
12	1400	12	0.079	2.194	0.236	5.120	67.211	81.6	0.2	1.66610529	8.952280	26.93	0.45
							Cumulative %39Ar rlsd =		100.0		Total gas age =	25.96	0.19
											Plateau age = (steps 3-9)	25.68	0.19
											Isochron age = (steps 3-8)	25.76	0.10

note: isotope beams in mV, rlsd = released, error in age includes J error, all errors 1 sigma
(36Ar through 40Ar are measured beam intensities, corrected for decay for the age calculations)


MT071608-1 (C56) Lake Creek trachyte
Plateau age = 25.68 ± 0.19 Ma
69% of the 39Ar released
Steps 3 through 9 out of 12
Age (Ma)
30
28
26
24
22
0
20
40
60
80
100
% 39Ar Released

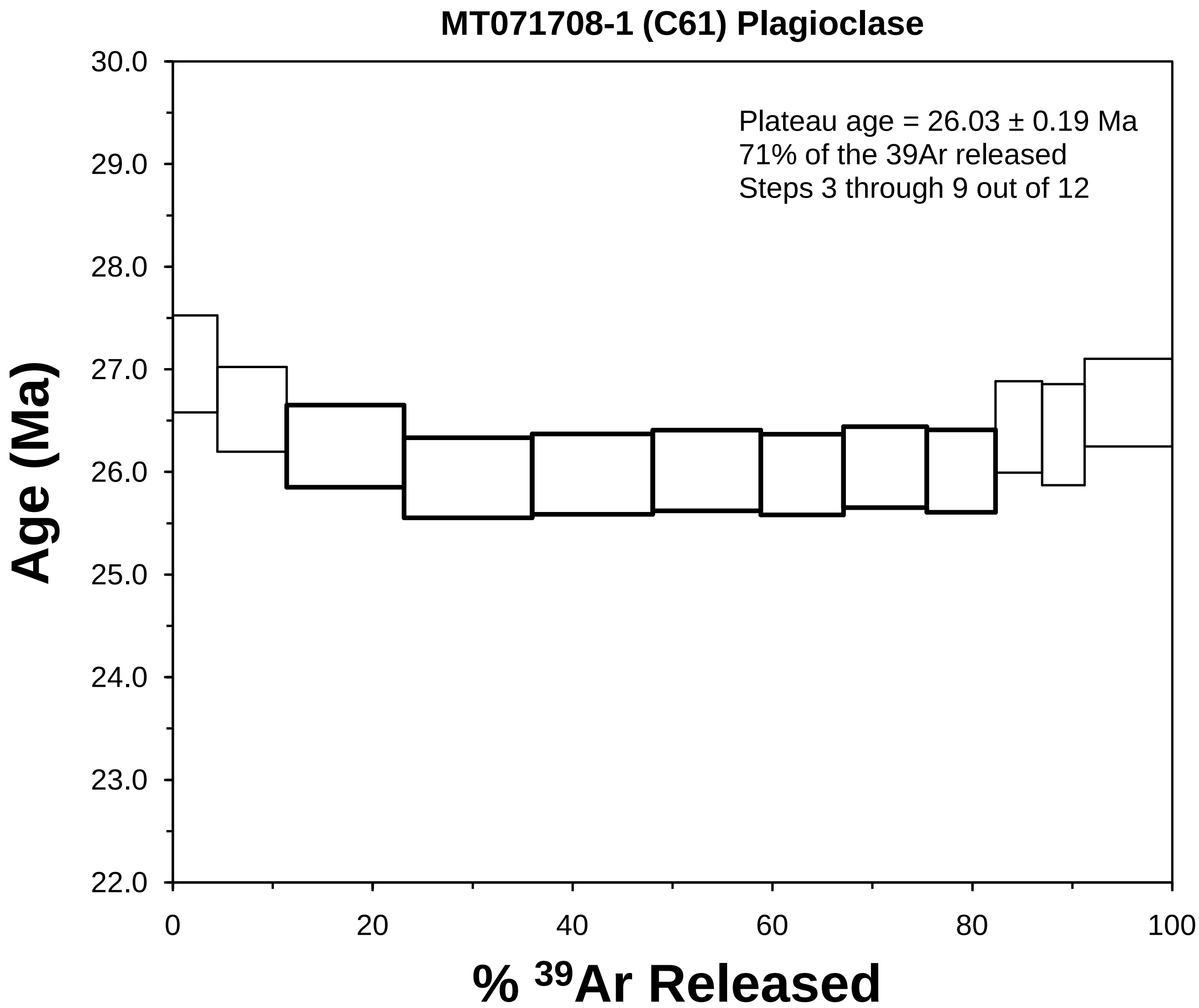

MT071608-1 (C56) Lake Creek trachyte
Isochron age = 25.76 ± 0.10 Ma
40/36 = 229.00 ± 20.50
MSWD = 1.13
68% of the 39Ar released
Steps 3 through 8 out of 12
0.0044
0.0040
0.0036
0.0032
0.0028
0.0024
0.0020
0.0016
0.0012
0.0008
0.0004
0.0000
0.00
0.02
0.04
0.06
0.08
0.10
0.12
36Ar/40Ar
39Ar/40Ar

UT DNR, MT071708-1 (C61), Plagioclase, 40.00 mg, J = 0.001702 ± 0.67%

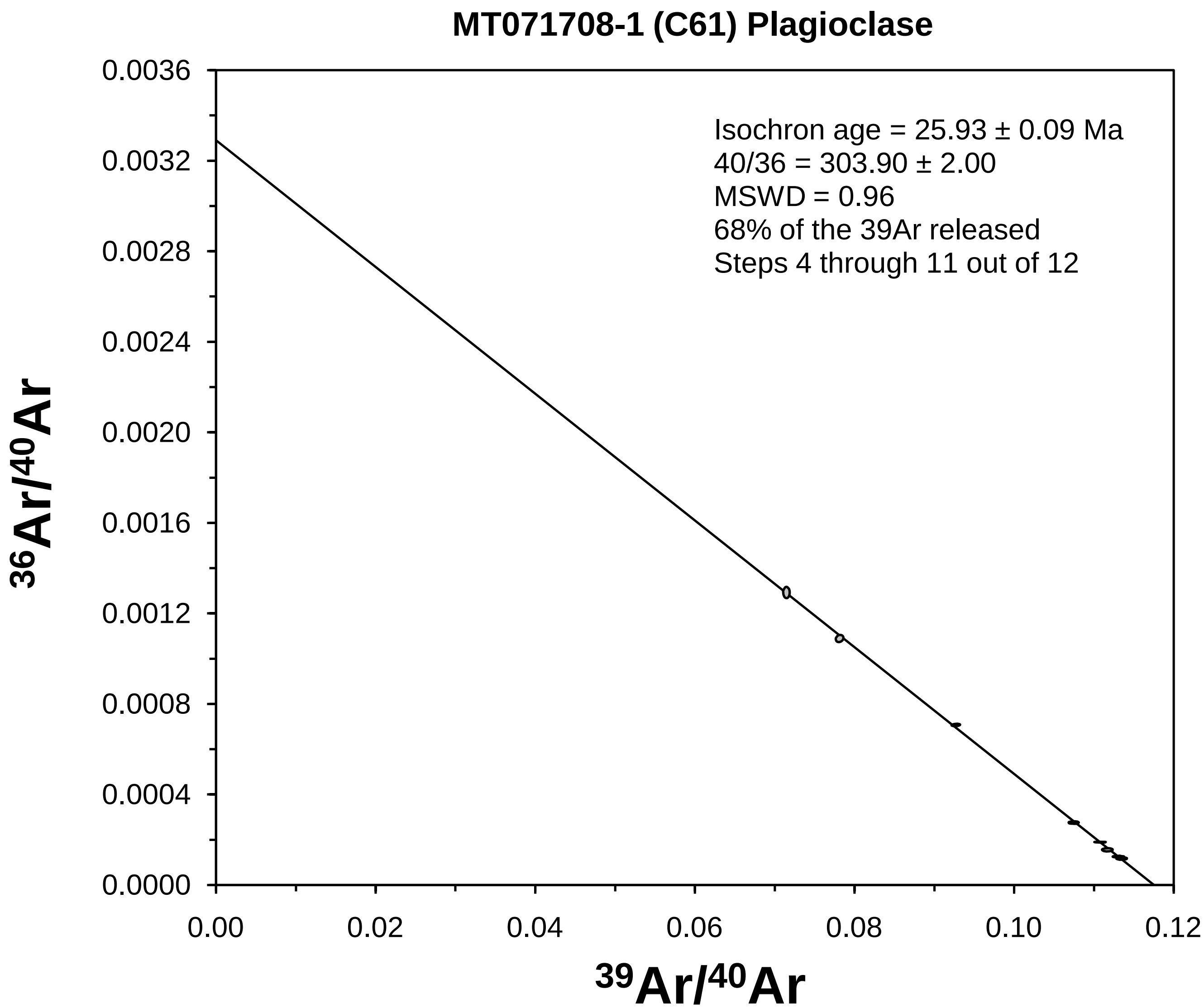
4 amu discrimination = 1.0448 ± 0.24%, 40/39K = 0.0148 ± 79.07%, 36/37Ca = 0.00026 ± 3.15%, 39/37Ca = 0.00067 ± 1.70%

step	T (C)	t (min.)	36Ar	37Ar	38Ar	39Ar	40Ar	%40Ar*	% 39Ar rlsd	Ca/K	40Ar*/39ArK	Age (Ma)	1s.d.
1	650	12	1.428	50.841	0.890	40.919	756.027	47.8	4.4	4.73021399	8.876894	27.05	0.24
2	730	12	0.710	79.550	1.012	63.743	742.644	74.7	6.9	4.7511862	8.730458	26.61	0.21
3	810	12	0.292	137.137	1.548	108.188	988.566	93.8	11.8	4.82591156	8.612146	26.25	0.20
4	860	12	0.227	157.226	1.671	117.821	1037.82	96.1	12.8	5.08086523	8.510376	25.94	0.20
5	910	12	0.207	152.949	1.612	111.028	974.571	96.7	12.1	5.245307	8.521609	25.98	0.20
6	960	12	0.237	141.086	1.502	99.431	887.895	95.2	10.8	5.403048	8.533504	26.01	0.20
7	1010	12	0.208	97.593	1.246	76.173	687.851	94.2	8.3	4.87784477	8.520288	25.97	0.20
8	1070	12	0.270	82.419	1.334	76.697	713.398	91.7	8.3	4.09034399	8.544407	26.05	0.20
9	1130	12	0.565	81.465	1.202	63.207	683.194	79.0	6.9	4.90704386	8.531852	26.01	0.20
10	1190	12	0.681	75.826	0.902	42.847	550.590	67.7	4.7	6.74129674	8.673612	26.44	0.22
11	1260	12	0.797	80.781	0.897	39.186	550.283	61.7	4.3	7.85533387	8.648827	26.36	0.25
12	1400	12	1.262	158.608	1.930	80.521	1033.49	68.1	8.8	7.5051276	8.751942	26.68	0.21
							Cumulative %39Ar rlsd =		100.0		Total gas age =	26.21	0.19
											Plateau age = (steps 3-9)	26.03	0.19
											Isochron age = (steps 4-11)	25.93	0.09

note: isotope beams in mV, rlsd = released, error in age includes J error, all errors 1 sigma
(36Ar through 40Ar are measured beam intensities, corrected for decay for the age calculations)



MT071708-1 (C61) Plagioclase
Plateau age = 26.03 ± 0.19 Ma
71% of the 39Ar released
Steps 3 through 9 out of 12
Age (Ma)
30.0
29.0
28.0
27.0
26.0
25.0
24.0
23.0
22.0
0
20
40
60
80
100
% 39Ar Released


MT071708-1 (C61) Plagioclase
Isochron age = 25.93 ± 0.09 Ma
40/36 = 303.90 ± 2.00
MSWD = 0.96
68% of the 39Ar released
Steps 4 through 11 out of 12
0.0036
0.0032
0.0028
0.0024
0.0020
0.0016
0.0012
0.0008
0.0004
0.0000
0.00
0.02
0.04
0.06
0.08
0.10
0.12
$^{36}Ar/^{40}Ar$
$^{39}Ar/^{40}Ar$