$^{40}Ar/^{39}Ar$ Geochronology Results for the Cotton Thomas Basin, Dairy Valley, Dry Canyon Mountain, Goshen, Judd Mountain, Peplin Flats, Pole Creek, and Toms Cabin Spring 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) NAD83**	**Longitude (W) NAD83**	**Reference**
F11_205GC	Toms Cabin Spring	41.57786	113.987216	Miller and others, in prep.
F11_248GC	Dairy Valley	41.547909	114.006306	Miller and others, in prep.
		Latitude (N) NAD27	**Longitude (W) NAD27**	
SI-13	Judd Mountain	41.781418	114.038048	Miller and others, in prep.
		UTM27-12 E	**UTM27-12 N**	
GCDC-1	Dry Canyon Mountain	252727	4638383	Miller and others, in prep.
GCDC-14	Pole Creek	255239	4640527	Miller and others, in prep.
GCDC-17	Pole Creek	258423	4644669	Miller and others, in prep.
		UTM83-12 E	**UTM83-12N**	
GN2011-393	Goshen	421818	4415807	McKean and Solomon, in prep.
		Latitude (N) NAD83	**Longitude (W) NAD83**	
F10_293GC	Peplin Flats	41.700731	113.157779	Miller and others, in prep.
MW11VM-3	Cotton Thomas Basin	41.95072353	113.8733586	Miller and others, in prep.
MW99GC-8T	Cotton Thomas Basin	41.931078	113.859794	Miller and others, in prep.

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

McKean, A.P., and Solomon, B.J., 2012, Interim geologic map of the Goshen quadrangle, Utah and Juab Counties, Utah: Utah Geological Survey Open-File Report 604, 1 plate, 31 p., scale 1:24,000.

McKean, A.P., and Solomon, B.J., in preparation, Geologic map of the Goshen quadrangle, Utah and Juab Counties, Utah: Utah Geological Survey Map, scale 1:24,000.

Miller, D.M., Clark, D.L., Wells, M.L., Oviatt, C.G., Felger, T.J., and Todd, V.R., 2012, Progress report geologic map of the Grouse Creek 30´ x 60´ quadrangle and Utah part of the Jackpot 30´ x 60´ quadrangle, Box Elder County, Utah, and Cassia County, Idaho (Year 3 of 4): Utah Geological Survey Open-File Report 598, 1 plate, 31 p., scale 1:62,500.

Miller, D.M., Clark, D.L., Wells, M.L., Oviatt, C.G., Felger, T.J., and Todd, V.R., in preparation, Geologic map of the Grouse Creek and east part of the Jackpot 30´ x 60´ quadrangles, Box Elder County, Utah, and Cassia County, Idaho: Utah Geological Survey Map, scale 1:62,500.

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Project No. 350

LABORATORY DESCRIPTION AND PROCEDURES

These procedures cover all the samples except MW99GC-8T.

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 3.13 (± 27.39%) x 10^{-2}. Ca correction factors were $(^{36}Ar/^{37}Ar)_{Ca}$ = 2.78 (± 2.43%) x 10^{-4} and $(^{39}Ar/^{37}Ar)_{Ca}$ = 6.67 (± 0.99%) x 10^{-4}. J factors were determined by fusion of 4-8 individual crystals of neutron fluence monitors which gave reproducibility's of 0.07% to 0.27 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 279.78 ± 0.28% during this work, thus a discrimination correction of 1.056 (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 3.45 mV for mass 40 and 0.01 mV for mass 36 for laser fusion analyses and 27.19 mV for mass 40 and 0.06 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., 1998) 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).

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.

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

LABORATORY DESCRIPTION AND PROCEDURES

Different procedures were used for sample MW99GC-8T analyzed in 2002.

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 Pyrex 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 Nuclear Science Center at Texas A&M University were in-core for 14 hours in the D3 position on the core edge (fuel rods on three sides, moderator on the fourth side) of the 1MW TRIGA type reactor. Irradiations are performed in a dry tube device, shielded against thermal neutrons by a 5 mm thick jacket of B_4C powder, which rotates about its axis at a rate of 0.7 revolutions per minute to mitigate horizontal flux gradients. 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 2.0 (± 150%) x 10^{-4}. Ca correction factors were $(^{36}Ar/^{37}Ar)Ca$ = 2.68 (± 2.52) x 10^{-4} and $(^{39}Ar/^{37}Ar)Ca$ = 7.17 (± 4.77) x 10^{-4}. J factors were determined by fusion of 4-5 individual crystals of neutron fluence monitors which gave reproducibility's of 0.1% to 0.4% at each standard position. Variation in neutron flux along the 100 mm length of the irradiation tubes was <4%. An error in J of 0.50% was used in age calculations. No significant neutron flux gradients were present within individual packets of crystals as indicated by the excellent reproducibility of the single crystal flux monitor fusions.

Irradiated crystals together with CaF_2 and K-glass fragments were placed in a Cu sample tray in an 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 289.81 ± 0.08% during this work, thus a discrimination correction of 1.0196 (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 52 over the Faraday. Line blanks averaged 1.96 mV for mass 40 and 0.01 mV for mass 36 for laser fusion analyses and 10.20 mV for mass 40 and 0.02 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 27.9 Ma (Steven et al., 1967; Cebula et al., 1986) was used for the Fish Canyon Tuff sanidine flux 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).

Cebula, G.T., M.J. Kunk, H.H. Mehnert, C.W. Naeser, J.D. Obradovich, and J.F. Sutter, The Fish Canyon Tuff, a potential standard for the ^{40}Ar-^{39}Ar and fission-track dating methods (abstract), *Terra Cognita (6th Int. Conf. on Geochronology, Cosmochronology and Isotope Geology), 6*, 139, 1986.

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.

Steven, T.A., H.H. Mehnert, and J.D. Obradovich, Age of volcanic activity in the San Juan Mountains, Colorado, *U.S. Geol. Surv. Prof. Pap., 575-D*, 47-55, 1967.
Wendt, I., and Carl, C., 1991, The statistical distribution of the mean squared weighted deviation, *Chemical Geology*, v. 86, p. 275-285.

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

RESULTS

General Comments

Your samples were run as conventional furnace step heating analyses on bulk groundmass or amphibole mineral separates, as well as single crystal laser fusion analyses on 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.

F11_205GC Sanidine

This sample yielded a set of 20 indistinguishable laser fusion ages, with no statistical outliers. The mean age of these analyses is 12.36 ± 0.17 Ma (n=20) and the corresponding weighted mean on these same analyses is identical at 12.36 ± 0.04 Ma. A statistically valid isochron is defined by 19 of 20 analyses and yields an slightly older, but indistinguishable, age of 12.42 ± 0.04 Ma. Note that the data are all clustered near the x-axis, and the y-intercept (initial $^{40}Ar/^{36}Ar$ ratio) is poorly defined at 271 ± 24 (although indistinguishable from atmospheric argon at $^{40}Ar/^{36}Ar$ = 295.5). Thus, this isochron should be treated with some caution. All of these analyses have consistently low Ca/K ratios and high radiogenic yields (%$^{40}Ar^*$), indicating analysis of a chemically homogeneous population of sanidine crystals that are unaltered. The weighted mean age should be considered the most reliable for this sample.

F11_248GC Sanidine

This sample yielded a set of 11 indistinguishable laser fusion ages, with no statistical outliers. The mean age of these analyses is 11.93 ± 0.04 Ma (n=11) and the corresponding weighted mean on these same analyses is identical at 11.93 ± 0.02 Ma. There was no isochron defined by these data. All analyses have consistent and low Ca/K ratios and high radiogenic yields, thus indicating analysis of a chemically homogeneous population of sanidine crystals that are unaltered. The weighted mean age should be considered the most reliable for this sample.

SI-13 Sanidine

This is another example of a textbook-perfect data set. This sample yielded a set of 19 concordant laser fusion ages, with no statistical outliers. Mean, weighted mean and isochron ages are identical. The mean age of these analyses is 13.68 ± 0.13 Ma (n=19) and the corresponding weighted mean on these same analyses is 13.68 ± 0.04 Ma. A statistically valid isochron is defined by all 19 analyses and yields an age of 13.68 ± 0.04 Ma, with an initial $^{40}Ar/^{36}Ar$ ratio of 301 ± 10. Ca/K ratios are consistent with analysis of a homogeneous population of sanidine crystals and radiogenic yields are high and do not suggest recent alteration and argon loss. The isochron age should be considered the most reliable for this sample.

GCDC-1 Groundmass

This sample produced a generally flat and concordant step heating age spectrum, characterized by ages which range between 11.9 Ma and 12.3 Ma for the first ~87% of the ^{39}Ar released, followed by ages which are slightly higher and then lower. The total gas age (equivalent to a conventional K/Ar age) for this sample is 12.09 ± 0.05 Ma. Steps 3-8 (54% of the ^{39}Ar released) define an indistinguishable plateau age of 12.08 ± 0.07 Ma. The same steps define a statistically valid isochron which yields a younger age of 11.35 ± 0.22 Ma, with an initial $^{40}Ar/^{36}Ar$ isotopic composition of 321 ± 8, suggesting that a small amount of excess argon is present in this sample. However, note that the data defining this isochron are rather tightly clustered (due to similar radiogenic yields) and thus the x- and y-intercepts are not precisely defined, making this isochron age less reliable. Ca/K ratios are low (for a basalt, which is typically >>1), with values <1 for the first 6 steps and only rising to ~3 with later steps. Radiogenic yields are reasonable for a volcanic rock groundmass sample of this age, and thus do not necessarily indicate alteration (although inspection of a thin section would clarify this). Although the isochron is statistically valid I would suggest using the plateau age for this sample, for the reason described above.

GCDC-14 Sanidine

This sample yielded a set of 18 concordant laser fusion ages, with no statistical outliers. The mean age of these analyses is 12.92 ± 0.09 Ma (n=18) and the corresponding weighted mean on these same analyses is indistinguishable at 12.91 ± 0.04 Ma. A statistically valid isochron is defined by all 18 analyses and yields an identical age of 12.91 ± 0.04 Ma, with an initial $^{40}Ar/^{36}Ar$ ratio of 302 ± 4. As this overlaps at the 2σ uncertainty level with the atmospheric argon value there is no indication of excess argon. All analyses have consistent and low Ca/K ratios indicating analysis of a homogeneous population of sanidine crystals. Radiogenic yields are generally high, and there is no correlation of younger ages with younger radiogenic yields, thus no indication of alteration and recent argon loss. The isochron age should be considered the most reliable for this sample. This is an example of a textbook-perfect data set.

GCDC-17 Sanidine

This sample yielded a set of 12 concordant laser fusion ages, with no statistical outliers. The mean age of these analyses is 12.92 ± 0.08 Ma (n=12) and the corresponding weighted mean on these same analyses is identical at 12.92 ± 0.03 Ma. There is no isochron defined by these data. Ca/K ratios are somewhat variable, with a few that are higher than would be expected for sanidine (analyses 1 and 2), but there are no significant correlations between Ca/K and age. Radiogenic yields are high and do not suggest any recent alteration has occurred. The weighted mean age should be considered the most reliable for this sample.

GN2011-393 Amphibole

This sample produced a generally flat and concordant step heating age spectrum, characterized by ages which range between 35.6 Ma and 36.6 Ma for the first ~78% of the ^{39}Ar released, followed by younger and then higher ages. The total gas age for this sample is 35.65 ± 0.13 Ma. There are no plateau or isochron ages defined by these data. Ca/K ratios are consistent with analysis of a homogeneous amphibole mineral separate and radiogenic yields are reasonably high for this mineral and thus do not indicate recent alteration. For a sample such as this the most simple and conservative interpretation is to use the total gas age. Alternatively one could use the mean and standard deviation of the more concordant part of the age spectrum (steps 1-7, ~78% of the ^{39}Ar released) which is 36.2 ± 0.4 Ma.

F10_293GC Sanidine

This sample yielded a set of 14 single crystal analyses with a mean age of 39.10 ± 1.05 Ma. Nine of these analyses define a statistically coherent population with an indistinguishable weighted mean age of 39.60 ± 0.05 Ma. Note that the two youngest rejected outliers (analyses 9 and 10) have the lowest radiogenic yields, suggesting some minor alteration and loss of radiogenic argon may have occurred. There is no statistically valid isochron defined by these data. Ca/K ratios and radiogenic yields are (with a few exceptions as mentioned) consistent with analysis of a single population of unaltered sanidine crystals. The weighted mean age should be considered the most reliable for this sample.

MW11VM-3 Sanidine

This sample yielded a set of 24 single crystal analyses with a mean age of 12.89 ± 0.43 Ma. Fifteen of these analyses define a statistically coherent population with an indistinguishable weighted mean age of 12.86 ± 0.04 Ma. A statistically valid isochron is defined by 13 analyses, yielding another indistinguishable age of 12.81 ± 0.05 Ma, with an initial $^{40}Ar/^{36}Ar$ ratio of 312 ± 25. Note that due to the highly radiogenic nature of the individual analyses all data cluster tightly near the x-axis (age) and thus the initial argon isotopic composition (y-axis) is imprecisely defined. Ca/K ratios and radiogenic yields are generally consistent with analysis of a single population of unaltered sanidine crystals. Either the weighted mean or isochron ages are suitable for constraining a reliable age for this sample.

MW99GC-8T K-feldspar

Note that this sample was analyzed in 2002 using different laboratory procedures than the other samples described above. The sample produced a discordant step heating age spectrum, characterized by ages which decrease from a first step at ~28 Ma to 13.1-13.6 Ma for steps 5-11, followed by increasing ages for the remaining gas released. The total gas age for this sample is 13.57 ± 0.07 Ma. Note that the age spectrum has a distinct U-shape, suggesting the presence of excess argon. There is no plateau age defined by these data. A statistically valid isochron is defined by steps 5-14 (~91% of the ^{39}Ar released) and yields an age of 12.98 ± 0.08 Ma, with an initial $^{40}Ar/^{36}Ar$ ratio of 308 ± 3, indicating a small amount of excess argon. Ca/K ratios and radiogenic yields are generally consistent with analysis is a pure, unaltered K-feldspar mineral separate. The isochron age should be considered the most accurate and reliable for this sample.

The interpretations given above are based simply on inspection of the laboratory data. Geologic relationships, which are unknown to us, are not considered.

APPENDIX

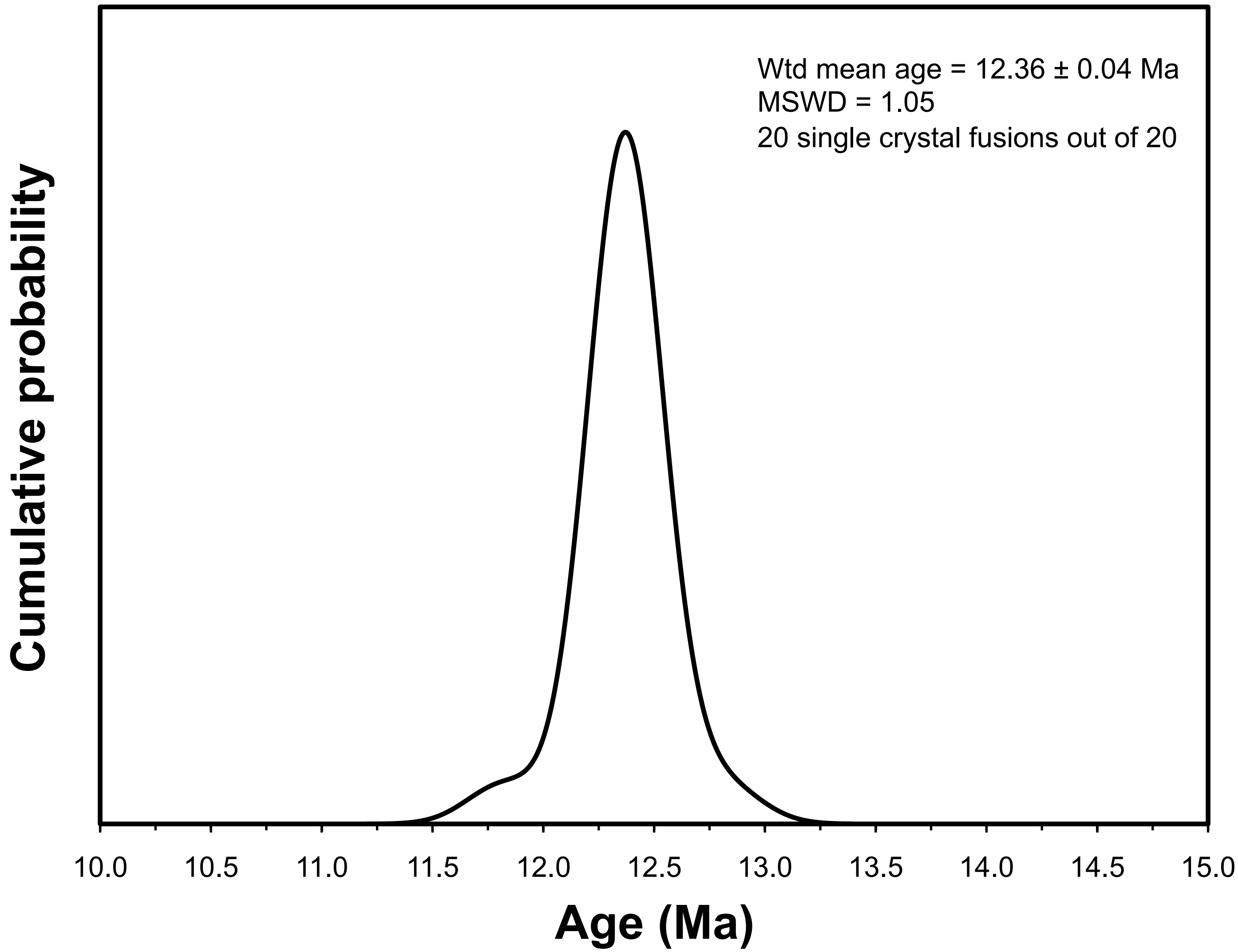
Analytical data for samples F11_205GC sanidine, F11_248GC sanidine, SI-13 sanidine, GCDC-1 groundmass, GCDC-14 sanidine, GCDC-17 sanidine, GN2011-393 amphibole, F10_293GC sanidine, MW11VM-3 sanidine, and MW99GC-8T K-feldspar.

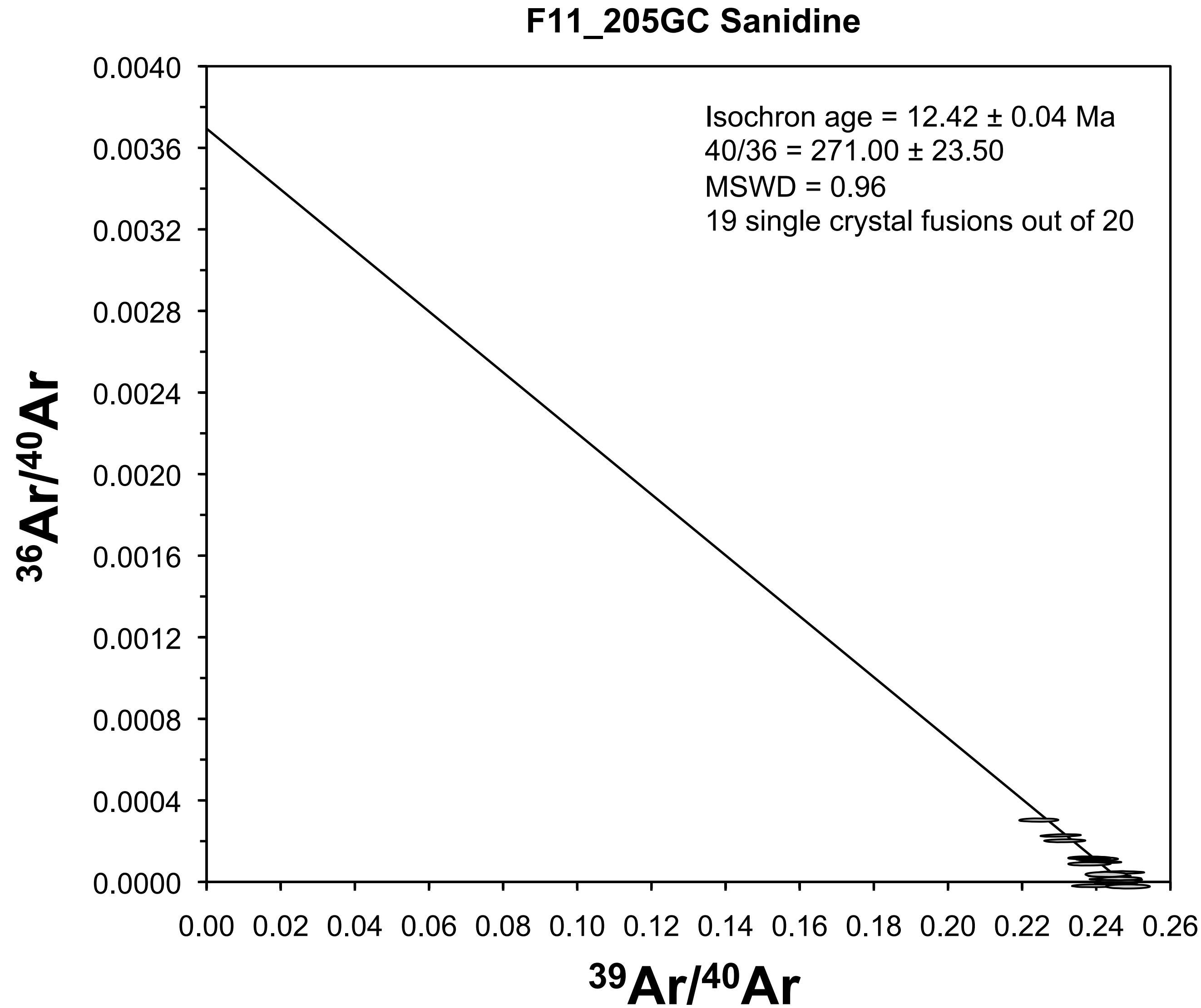
Clark-UT DNR, F11_205GC, Sanidine, single crystal fusion, J = 0.001708 ± 0.30%
4 amu discrimination = 1.056 ± 0.97%, 40/39K = 0.0313 ± 27.39%, 36/37Ca = 0.000278 ± 2.43%, 39/37Ca = 0.000667 ± 0.99%

Crystal	T (°C)	t (min.)	36Ar	37Ar	38Ar	39Ar	40Ar	%40Ar*	Ca/K	40Ar*/39ArK	Age (Ma)	1s.d.
1	1600	2	0.065	1.532	1.149	88.652	369.823	95.2	0.09534	3.99394	12.27	0.16
2	1600	2	0.039	1.220	2.291	175.692	711.831	98.2	0.03831	4.01355	12.33	0.16
3	1600	2	0.177	0.963	2.185	162.364	700.757	92.6	0.03272	4.03511	12.39	0.17
4	1600	2	0.088	0.785	1.588	121.925	512.054	95.1	0.03552	4.02270	12.35	0.16
5	1600	2	0.028	0.629	1.374	105.068	431.355	98.2	0.03303	4.05668	12.46	0.16
6	1600	2	0.080	0.775	1.705	128.437	532.769	95.6	0.03329	3.99819	12.28	0.16
7	1600	2	0.039	0.739	1.570	119.273	489.899	97.7	0.03418	4.04099	12.41	0.16
8	1600	2	0.050	0.482	1.011	77.378	325.954	95.9	0.03437	4.05864	12.46	0.16
9	1600	2	0.013	0.351	0.856	64.838	272.276	99.0	0.02987	4.17237	12.81	0.17
10	1600	2	0.157	0.757	1.686	127.582	553.566	91.9	0.03273	4.01910	12.34	0.17
11	1600	2	0.042	0.555	1.333	102.567	416.399	98.4	0.02985	4.01943	12.34	0.16
12	1600	2	0.029	0.710	1.554	118.551	482.834	98.2	0.03304	4.02923	12.37	0.16
13	1600	2	0.021	0.433	1.022	77.748	317.624	98.4	0.03073	4.03609	12.39	0.16
14	1600	2	0.030	0.451	0.939	70.521	292.038	97.4	0.03528	4.04916	12.43	0.16
15	1600	2	0.029	0.578	1.331	101.153	411.380	98.0	0.03152	4.01191	12.32	0.16
16	1600	2	0.189	0.782	1.575	117.167	521.706	89.7	0.03682	4.02629	12.36	0.17
17	1600	2	0.140	1.561	2.695	205.640	861.498	95.1	0.04188	4.02302	12.35	0.16
18	1600	2	0.003	0.316	0.686	52.477	212.871	99.2	0.03322	4.02564	12.36	0.16
19	1600	2	0.021	0.526	1.282	96.888	395.822	98.5	0.02995	4.05047	12.44	0.16
20	1600	2	0.066	0.477	1.045	77.359	314.363	94.3	0.03402	3.84921	11.82	0.17
										Mean ± s.d. =	12.36	0.17
										Wtd mean age = (20 fusions)	12.36	0.04
										Isochron age = (19 fusions)	12.42	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 in age calculations)

F11_205GC Sanidine



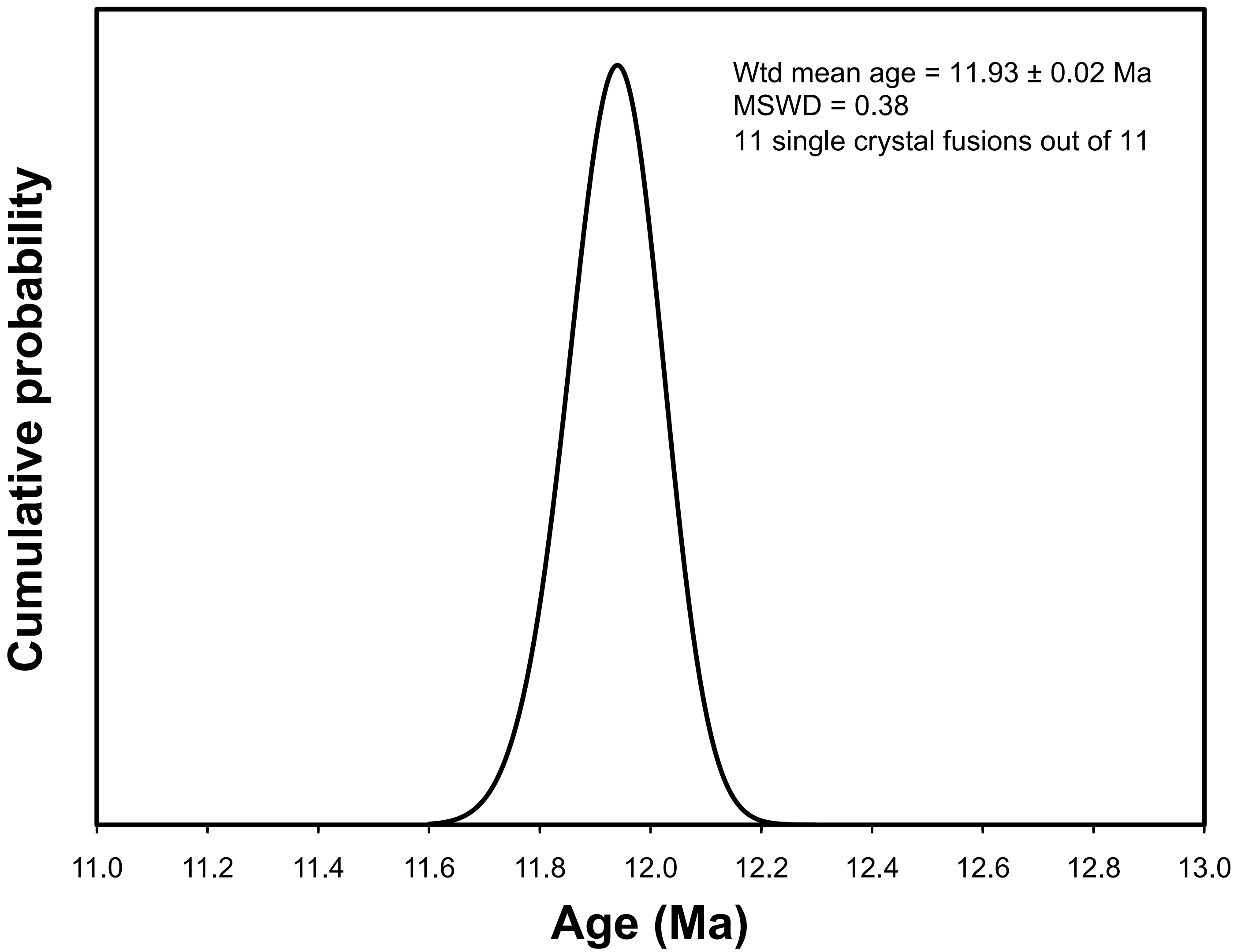

F11_205GC Sanidine
Isochron age = 12.42 ± 0.04 Ma
40/36 = 271.00 ± 23.50
MSWD = 0.96
19 single crystal fusions out of 20
0.0040
0.0036
0.0032
0.0028
0.0024
0.0020
0.0016
0.0012
0.0008
0.0004
0.0000
0.00 0.02 0.04 0.06 0.08 0.10 0.12 0.14 0.16 0.18 0.20 0.22 0.24 0.26
$^{36}Ar/^{40}Ar$
$^{39}Ar/^{40}Ar$

Clark-UT DNR, F11_248GC, Sanidine, single crystal fusion, J = 0.00168 ± 0.44%

4 amu discrimination = 1.0562 ± 0.28%, 40/39K = 0.0313 ± 27.39%, 36/37Ca = 0.000278 ± 2.43%, 39/37Ca = 0.000667 ± 0.99%

Crystal	T (°C)	t (min.)	36Ar	37Ar	38Ar	39Ar	40Ar	%40Ar*	Ca/K	40Ar*/39ArK	Age (Ma)	1s.d.
1	1600	2	0.046	0.140	1.831	138.805	556.420	98.6	0.02708	3.94624	11.92	0.08
2	1600	2	0.073	0.129	1.362	103.094	420.672	96.5	0.03360	3.91469	11.83	0.08
3	1600	2	0.056	0.214	2.415	180.732	726.993	98.3	0.03179	3.96484	11.98	0.07
4	1600	2	0.044	0.110	1.342	99.337	400.412	98.4	0.02973	3.93993	11.90	0.07
5	1600	2	0.594	0.197	2.485	180.996	878.172	81.3	0.02922	3.96252	11.97	0.08
6	1600	2	0.046	0.122	1.824	138.219	554.391	98.6	0.02370	3.94824	11.93	0.07
7	1600	2	0.041	0.115	1.626	124.672	499.030	98.8	0.02477	3.94159	11.91	0.07
8	1600	2	0.069	0.169	1.605	121.036	495.302	97.2	0.03749	3.96451	11.98	0.07
9	1600	2	0.045	0.103	1.305	98.894	401.215	98.4	0.02797	3.96318	11.97	0.07
10	1600	2	0.139	0.084	1.342	99.635	430.393	92.2	0.02264	3.96252	11.97	0.08
11	1600	2	0.072	0.106	1.588	120.875	493.506	97.0	0.02355	3.94724	11.92	0.08
note: isotope beams in mV rlsd = released, error in age includes J error, all errors 1 sigma										Mean ± s.d. =	11.93	0.04
(36Ar through 40Ar are measured beam intensities, corrected for decay in age calculations)										Wtd mean age =	11.93	0.02
										(11 fusions)		
										No isochron		

F11_248GC Sanidine

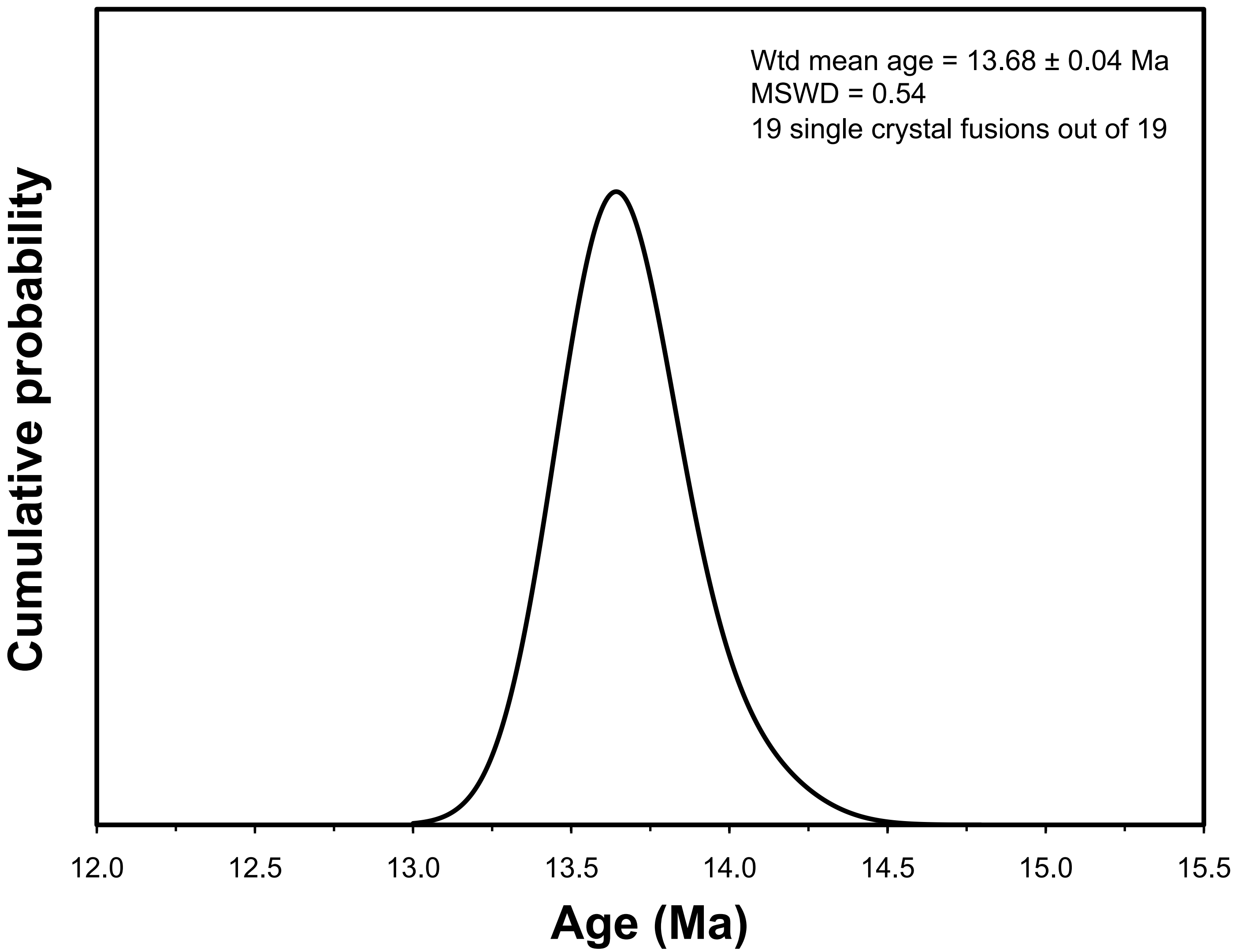


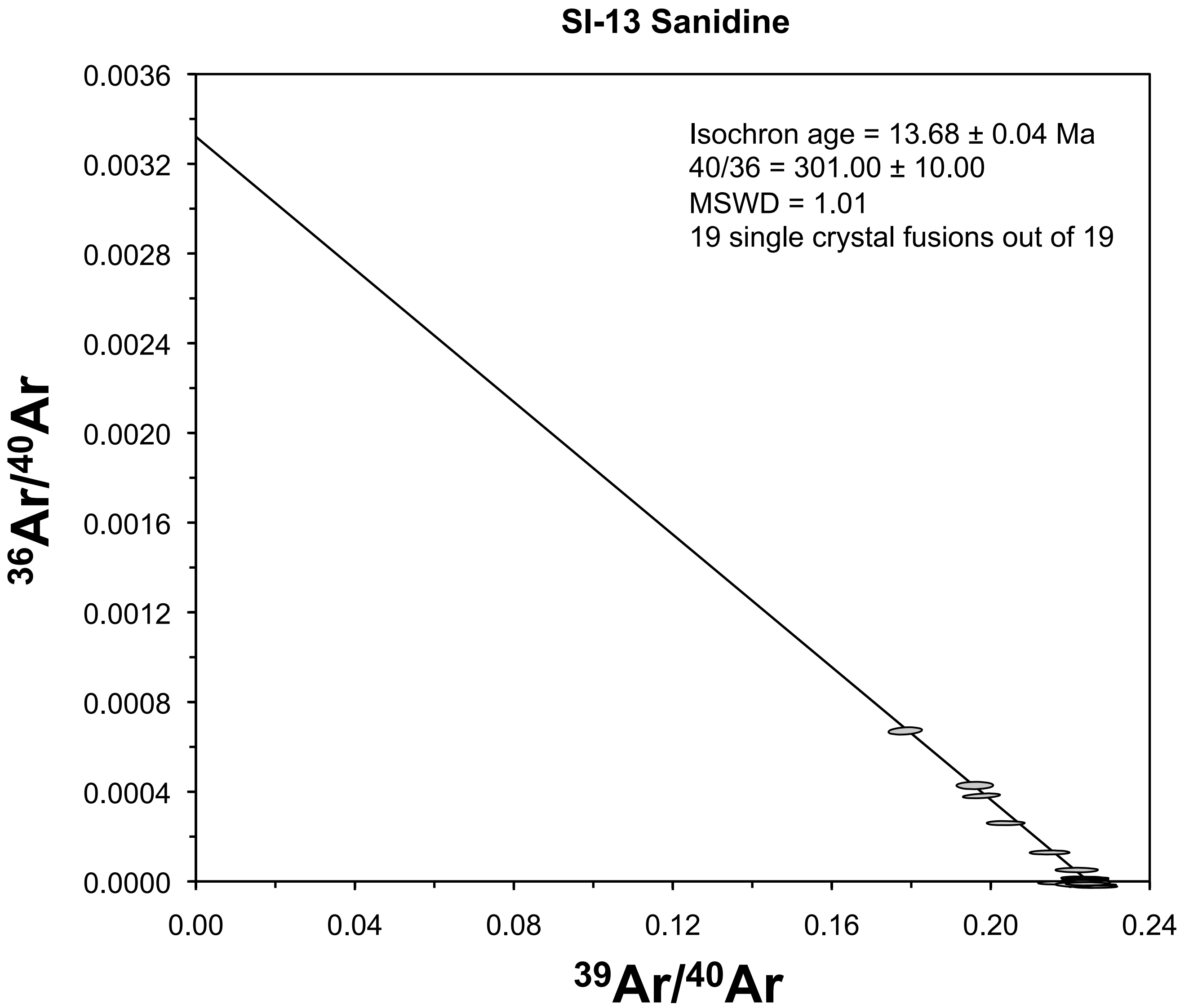
Clark-UT DNR, SI-13, Sanidine, single crystal fusion, J = 0.00171 ± 0.30%
4 amu discrimination = 1.056 ± 0.97%, 40/39K = 0.0313 ± 27.39%, 36/37Ca = 0.000278 ± 2.43%, 39/37Ca = 0.000667 ± 0.99%

Crystal	T (°C)	t (min.)	36Ar	37Ar	38Ar	39Ar	40Ar	%40Ar*	Ca/K	40Ar*/39ArK	Age (Ma)	1s.d.
1	1600	2	0.250	1.586	1.348	98.586	503.041	86.3	0.08700	4.43492	13.63	0.19
2	1600	2	0.028	2.693	1.651	123.732	550.239	98.7	0.11770	4.42382	13.60	0.18
3	1600	2	0.020	1.463	1.494	114.766	508.046	99.1	0.06894	4.41761	13.58	0.17
4	1600	2	0.043	1.632	1.024	77.160	349.033	97.1	0.11438	4.41370	13.57	0.18
5	1600	2	0.069	1.492	0.934	71.832	335.309	94.9	0.11233	4.44701	13.67	0.18
6	1600	2	0.023	1.278	1.296	94.668	436.492	98.9	0.07301	4.58682	14.10	0.18
7	1600	2	0.034	1.780	1.776	135.244	602.904	98.5	0.07118	4.42545	13.60	0.18
8	1600	2	0.330	1.441	1.117	78.263	438.391	79.3	0.09957	4.46791	13.73	0.20
9	1600	2	0.042	3.796	1.910	142.265	637.350	98.2	0.14430	4.43721	13.64	0.18
10	1600	2	0.262	1.993	1.638	115.623	585.133	87.6	0.09322	4.46726	13.73	0.19
11	1600	2	0.021	2.584	1.532	114.766	510.519	99.1	0.12176	4.43852	13.64	0.17
12	1600	2	0.019	1.823	1.536	115.458	513.027	99.1	0.08539	4.43754	13.64	0.17
13	1600	2	0.014	1.151	1.347	104.940	464.205	99.4	0.05932	4.42643	13.60	0.18
14	1600	2	0.143	1.956	1.187	87.609	430.617	91.1	0.12074	4.50417	13.84	0.19
15	1600	2	0.034	3.530	1.847	140.200	628.057	98.5	0.13617	4.45191	13.68	0.18
16	1600	2	0.020	1.495	1.367	100.946	456.573	99.1	0.08009	4.51005	13.86	0.18
17	1600	2	0.022	1.754	1.184	89.365	399.223	98.9	0.10615	4.44244	13.65	0.17
18	1600	2	0.039	2.816	1.662	128.272	572.175	98.2	0.11872	4.41533	13.57	0.18
19	1600	2	0.034	1.846	1.672	124.757	555.991	98.4	0.08002	4.41925	13.58	0.17
										Mean ± s.d. =	13.68	0.13
										Wtd mean age = (19 fusions)	13.68	0.04
										Isochron age = (19 fusions)	13.68	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 in age calculations)

SI-13 Sanidine

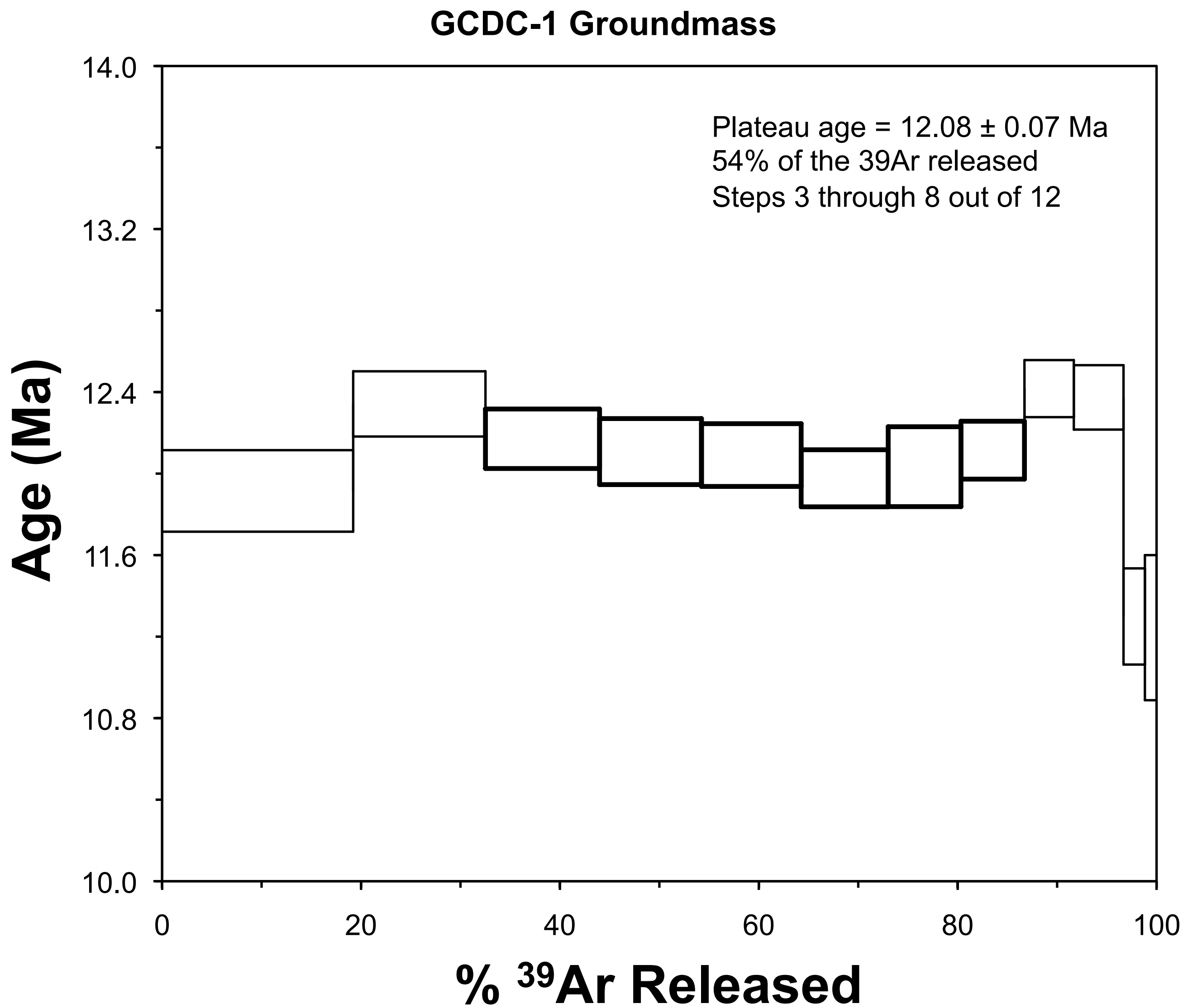


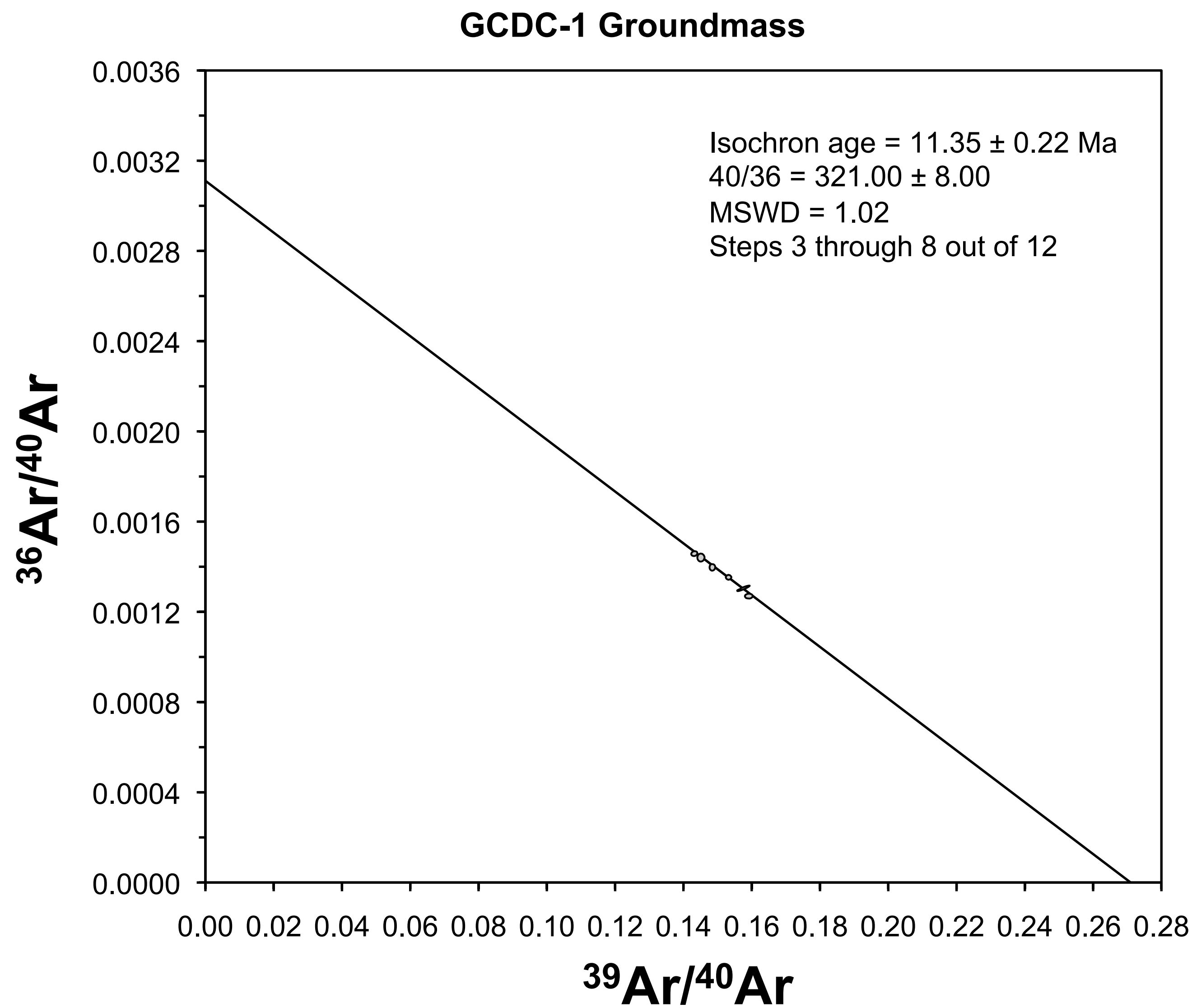

SI-13 Sanidine
Isochron age = 13.68 ± 0.04 Ma
40/36 = 301.00 ± 10.00
MSWD = 1.01
19 single crystal fusions out of 19
0.0036
0.0032
0.0028
0.0024
0.0020
0.0016
0.0012
0.0008
0.0004
0.0000
0.00
0.04
0.08
0.12
0.16
0.20
0.24
36Ar/40Ar
39Ar/40Ar

Clark-UT DNR, GCDC-1, Groundmass, 24.13 mg, J = 0.00171 ± 0.27%
4 amu discrimination = 1.0420 ± 0.25%, 40/39K = 0.0313 ± 27.39%, 36/37Ca = 0.000278 ± 2.43%, 39/37Ca = 0.000667 ± 0.99%

step	T (C)	t (min.)	36Ar	37Ar	38Ar	39Ar	40Ar	%40Ar*	% 39Ar rlsd	Ca/K	40Ar*/39ArK	Age (Ma)	1s.d.
1	500	12	3.291	5.123	10.579	274.280	1993.30	53.2	19.2	0.332430809	3.875054	11.92	0.10
2	530	12	2.094	3.265	7.114	189.903	1354.73	56.4	13.3	0.305998349	4.014401	12.34	0.08
3	560	12	1.791	3.178	5.997	163.808	1155.25	56.3	11.5	0.345295928	3.958593	12.17	0.07
4	590	12	1.567	3.587	5.137	146.305	1019.26	56.8	10.2	0.43637147	3.938033	12.11	0.08
5	620	12	1.460	4.773	4.812	143.108	974.827	58.1	10.0	0.593651362	3.932486	12.09	0.08
6	650	12	1.210	5.860	4.021	124.934	827.271	59.3	8.8	0.834932371	3.895285	11.98	0.07
7	680	12	0.965	6.887	3.194	104.437	676.174	62.9	7.3	1.173958405	3.913885	12.03	0.10
8	720	12	0.826	8.646	2.641	91.196	586.234	64.2	6.4	1.688033941	3.940318	12.12	0.07
9	760	12	0.664	9.010	1.998	70.868	467.004	65.2	5.0	2.26406481	4.038879	12.42	0.07
10	850	12	0.742	11.586	2.043	71.342	488.364	62.3	5.0	2.8925547	4.024845	12.37	0.08
11	1000	12	0.455	4.853	1.052	30.703	237.398	54.4	2.2	2.815224827	3.674087	11.30	0.12
12	1400	12	0.597	2.704	0.639	16.769	227.620	31.0	1.2	2.872038632	3.656147	11.24	0.18
							Cumulative %39Ar rlsd =		100.0		Total gas age =	12.09	0.05
											Plateau age = (steps 3-8)	12.08	0.07
											Isochron age = (steps 3-8)	11.35	0.22

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)


GCDC-1 Groundmass
Plateau age = 12.08 ± 0.07 Ma
54% of the 39Ar released
Steps 3 through 8 out of 12
Age (Ma)
14.0
13.2
12.4
11.6
10.8
10.0
0
20
40
60
80
100
% 39Ar Released

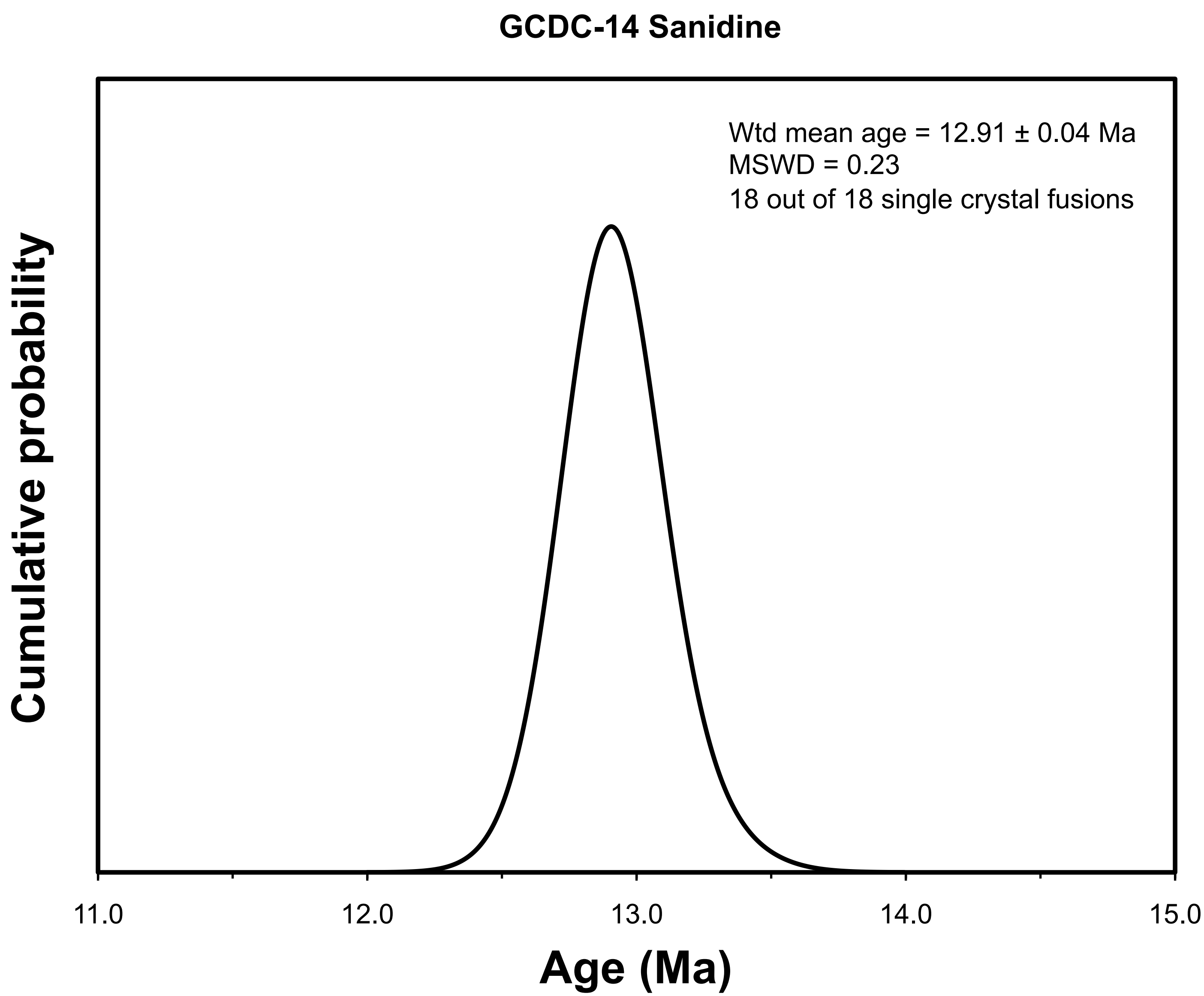


GCDC-1 Groundmass
Isochron age = 11.35 ± 0.22 Ma
40/36 = 321.00 ± 8.00
MSWD = 1.02
Steps 3 through 8 out of 12
0.0036
0.0032
0.0028
0.0024
0.0020
0.0016
0.0012
0.0008
0.0004
0.0000
0.00 0.02 0.04 0.06 0.08 0.10 0.12 0.14 0.16 0.18 0.20 0.22 0.24 0.26 0.28
$^{36}Ar/^{40}Ar$
$^{39}Ar/^{40}Ar$

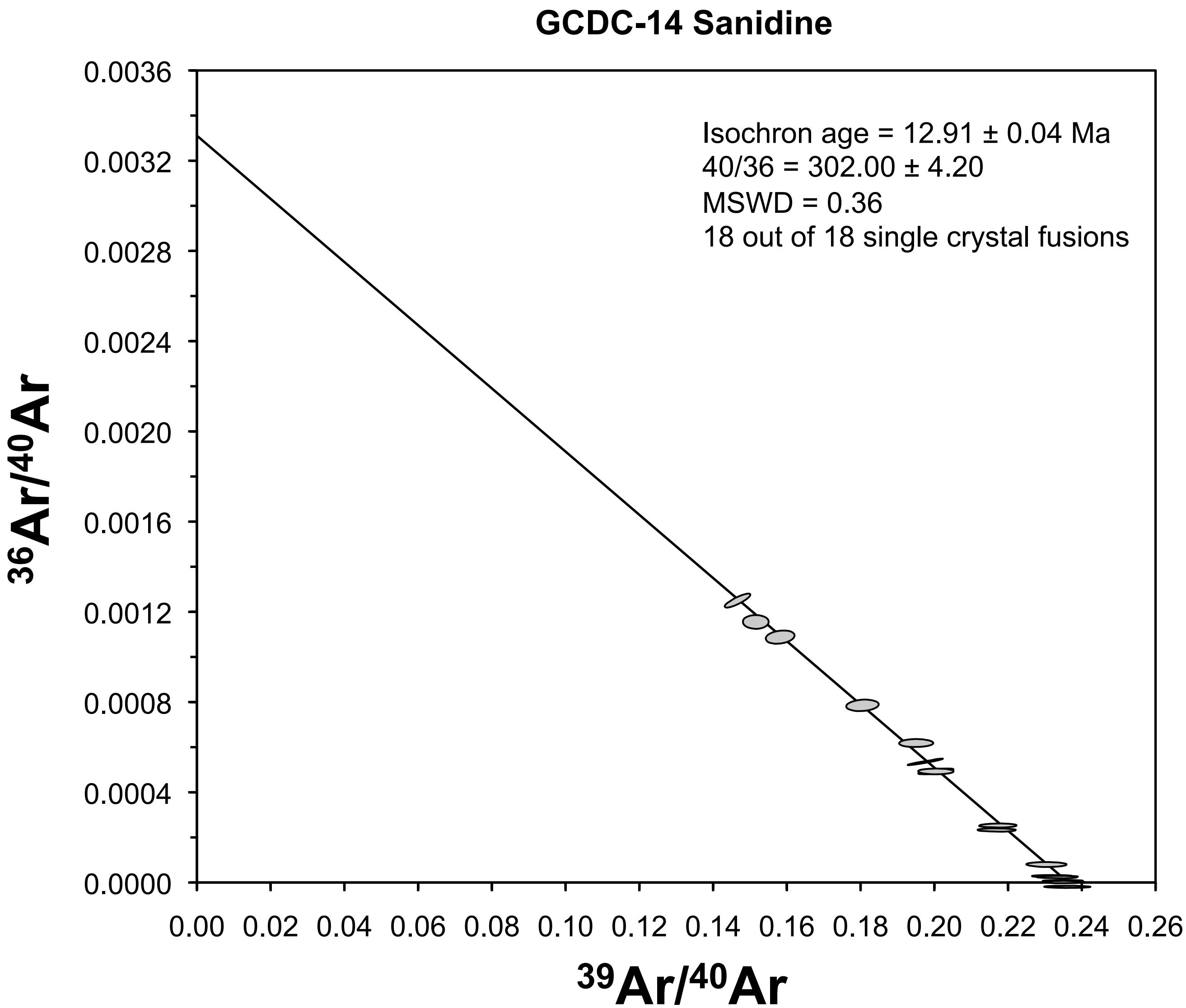
Clark-UT DNR, GCDC-14, Sanidine, single crystal fusion, J = 0.001697 ± 0.31%
4 amu discrimination = 1.056 ± 0.97%, 40/39K = 0.0313 ± 27.39%, 36/37Ca = 0.000278 ± 2.43%, 39/37Ca = 0.000667 ± 0.99%

Crystal	T (°C)	t (min.)	36Ar	37Ar	38Ar	39Ar	40Ar	%40Ar*	Ca/K	40Ar*/39ArK	Age (Ma)	1s.d.
1	1600	2	0.043	0.676	1.438	112.002	480.906	97.5	0.03201	4.21850	12.87	0.17
2	1600	2	0.032	0.647	1.306	99.483	425.201	98.0	0.03449	4.22409	12.89	0.17
3	1600	2	0.254	0.519	0.963	69.289	356.964	80.4	0.03972	4.16257	12.70	0.19
4	1600	2	0.131	0.560	1.161	85.647	395.522	90.9	0.03467	4.22475	12.89	0.17
5	1600	2	0.053	1.038	2.047	154.128	664.820	97.6	0.03571	4.24811	12.96	0.17
6	1600	2	0.060	0.602	1.187	90.472	394.730	96.0	0.03529	4.21159	12.85	0.17
7	1600	2	0.747	0.875	1.318	90.599	597.095	65.0	0.05121	4.31917	13.18	0.23
8	1600	2	0.293	0.764	1.299	94.174	477.444	82.9	0.04302	4.23363	12.92	0.18
9	1600	2	0.020	0.515	1.072	81.421	347.629	98.7	0.03354	4.23626	12.92	0.17
10	1600	2	0.020	0.587	1.084	83.532	354.845	98.7	0.03726	4.21619	12.86	0.17
11	1600	2	0.115	0.484	1.050	79.723	368.940	91.6	0.03219	4.25995	13.00	0.17
12	1600	2	0.034	0.574	1.015	77.233	333.063	97.5	0.03941	4.22541	12.89	0.17
13	1600	2	0.285	0.780	1.367	99.930	499.029	84.1	0.04139	4.22935	12.90	0.18
14	1600	2	0.030	0.712	1.409	106.398	454.219	98.2	0.03549	4.22310	12.88	0.17
15	1600	2	0.935	0.630	1.532	102.107	694.794	62.3	0.03272	4.27607	13.04	0.23
16	1600	2	0.686	0.914	1.996	144.299	798.257	75.8	0.03359	4.23264	12.91	0.20
17	1600	2	0.613	0.514	1.221	81.877	517.956	66.9	0.03329	4.26686	13.02	0.22
18	1600	2	0.343	0.718	1.682	122.004	608.636	84.2	0.03121	4.23396	12.92	0.18
										Mean ± s.d. =	12.92	0.09
										Wtd mean age = (18 fusions)	12.91	0.04
										Isochron age = (18 fusions)	12.91	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 in age calculations)



GCDC-14 Sanidine
Wtd mean age = 12.91 ± 0.04 Ma
MSWD = 0.23
18 out of 18 single crystal fusions
Cumulative probability
11.0
12.0
13.0
14.0
15.0
Age (Ma)


GCDC-14 Sanidine
Isochron age = 12.91 ± 0.04 Ma
40/36 = 302.00 ± 4.20
MSWD = 0.36
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 0.14 0.16 0.18 0.20 0.22 0.24 0.26
36Ar/40Ar
39Ar/40Ar

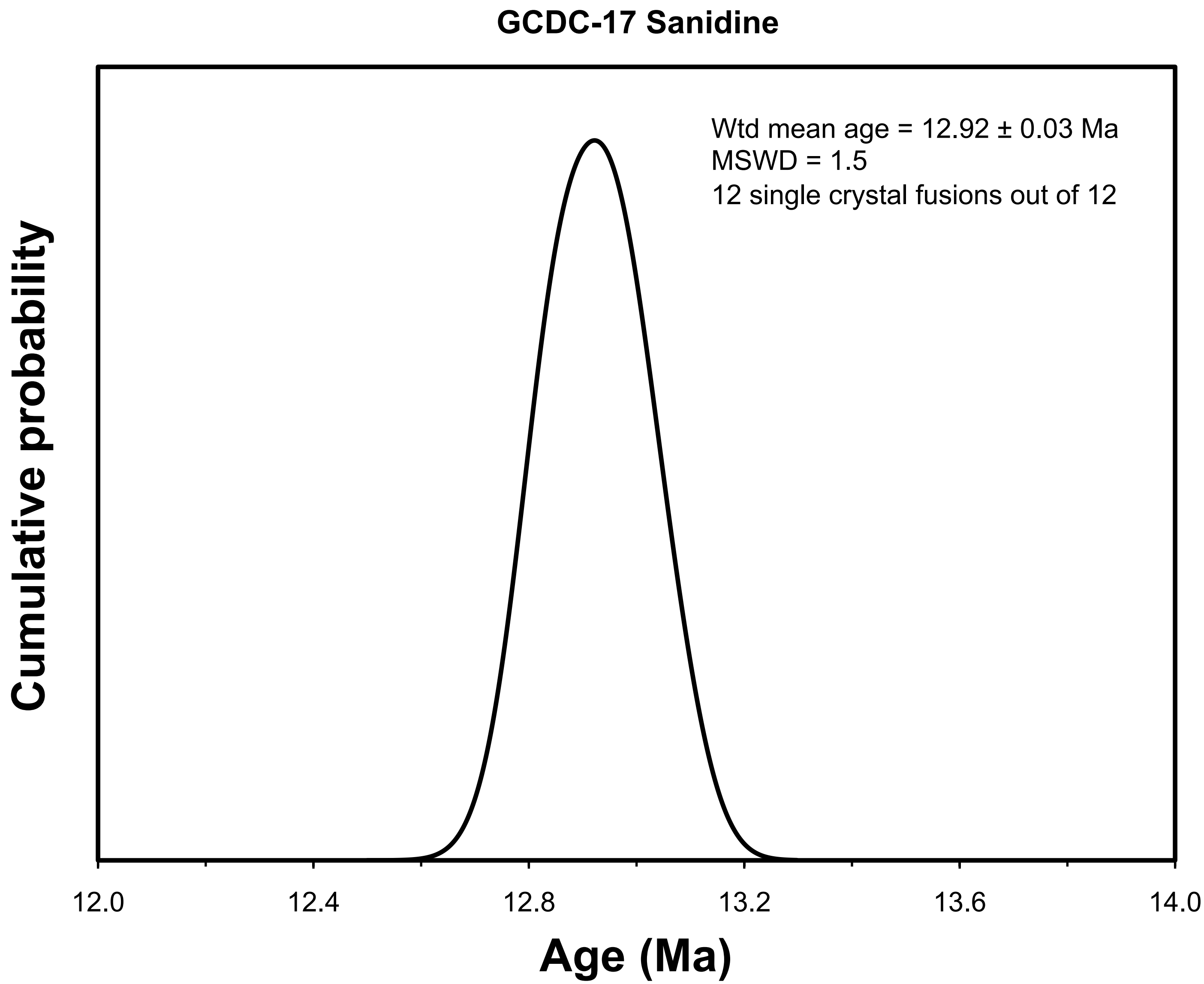
Clark-UT DNR, GCDC-17, Sanidine, single crystal fusion, J = 0.001708 ± 0.26%

4 amu discrimination = 1.0562 ± 0.28%, 40/39K = 0.0313 ± 27.39%, 36/37Ca = 0.000278 ± 2.43%, 39/37Ca = 0.000667 ± 0.99%

Crystal	T (°C)	t (min.)	36Ar	37Ar	38Ar	39Ar	40Ar	%40Ar*	Ca/K	40Ar*/39ArK	Age (Ma)	1s.d.
1	1600	2	0.250	3.100	2.100	156.650	716.545	91.0	0.53012	4.16747	12.80	0.07
2	1600	2	0.288	1.437	1.346	97.616	488.659	84.7	0.39433	4.21846	12.95	0.07
3	1600	2	0.054	0.185	1.710	129.767	558.947	98.2	0.03819	4.21682	12.95	0.07
4	1600	2	0.085	0.342	1.541	117.396	518.891	96.4	0.07803	4.24526	13.03	0.07
5	1600	2	0.041	0.206	1.930	144.420	612.375	98.9	0.03821	4.18610	12.85	0.06
6	1600	2	0.044	0.141	1.368	103.966	445.214	98.5	0.03633	4.19035	12.87	0.07
7	1600	2	0.190	0.166	1.540	112.469	525.391	90.8	0.03953	4.22532	12.97	0.07
8	1600	2	0.044	0.151	1.237	93.287	400.239	98.4	0.04336	4.18545	12.85	0.07
9	1600	2	0.059	0.181	1.668	127.640	551.424	97.9	0.03798	4.21682	12.95	0.07
10	1600	2	0.068	0.141	1.330	100.404	436.580	96.9	0.03761	4.18512	12.85	0.07
11	1600	2	0.402	0.136	1.343	102.946	443.594	98.6	0.03539	4.22173	12.96	0.07
12	1600	2	0.047	0.233	1.527	114.865	498.710	98.5	0.05433	4.25441	13.06	0.06
										Mean ± s.d. =	12.92	0.08
										Wtd mean age =	12.92	0.03
										(12 fusions)		
										No isochron		

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 in age calculations)

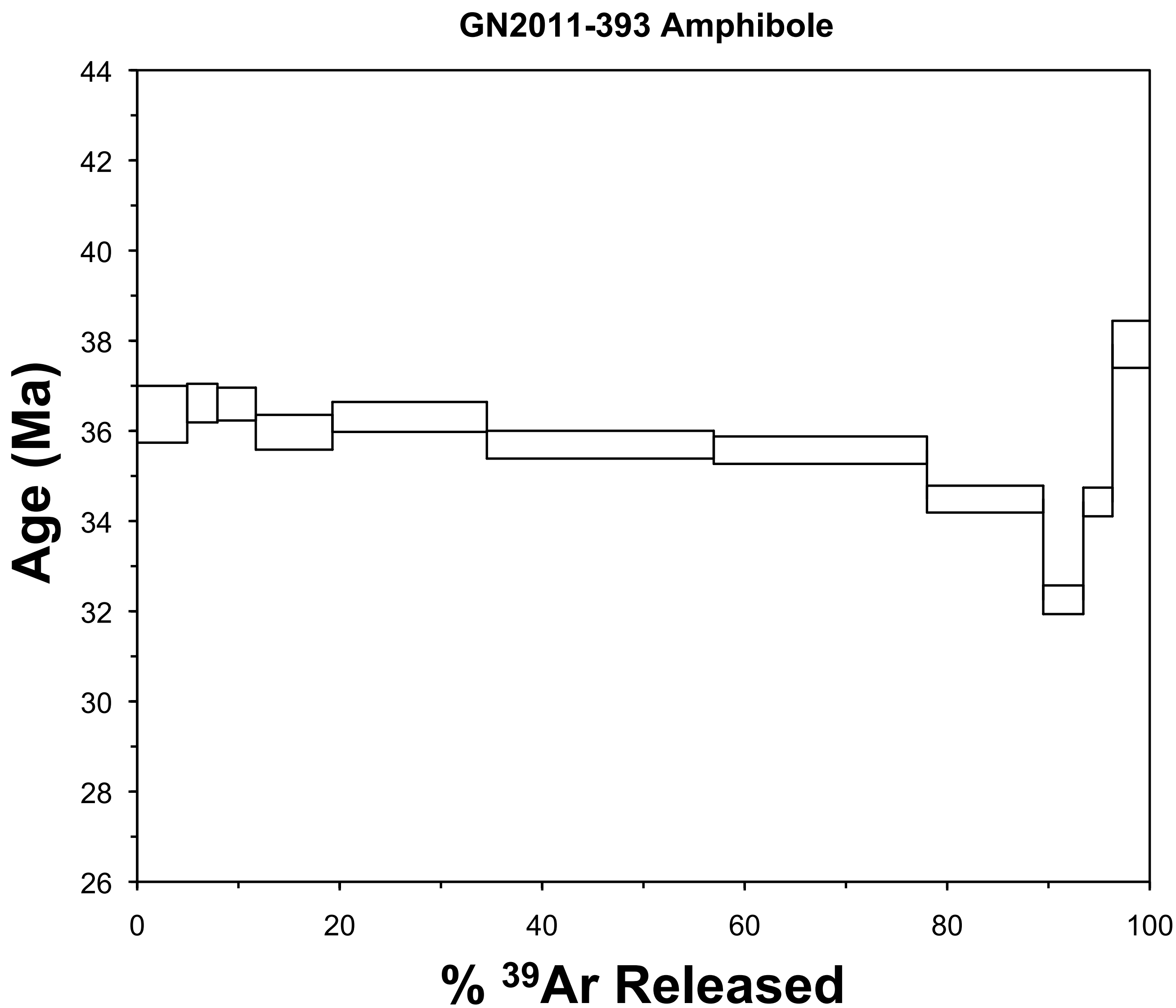

GCDC-17 Sanidine
Wtd mean age = 12.92 ± 0.03 Ma
MSWD = 1.5
12 single crystal fusions out of 12
Cumulative probability
12.0
12.4
12.8
13.2
13.6
14.0
Age (Ma)

Clark-UT DNR, GN2011-393, Amphibole, 23.77 mg, J = 0.001699 ± 0.25%
4 amu discrimination = 1.0420 ± 0.25%, 40/39K = 0.0313 ± 27.39%, 36/37Ca = 0.000278 ± 2.43%, 39/37Ca = 0.000667 ± 0.99%

step	T (C)	t (min.)	36Ar	37Ar	38Ar	39Ar	40Ar	%40Ar*	% 39Ar rlsd	Ca/K	40Ar*/39ArK	Age (Ma)	1s.d.
1	950	12	1.902	3.066	0.698	19.346	765.943	31.2	4.9	2.877418335	11.985820	36.37	0.32
2	1060	12	0.415	6.438	0.978	11.672	251.465	63.3	3.0	10.0352349	12.068384	36.62	0.21
3	1080	12	0.298	10.118	1.232	14.825	253.388	79.6	3.8	12.42573012	12.061059	36.60	0.18
4	1090	12	0.363	21.029	2.410	29.625	435.380	85.9	7.6	12.92542731	11.853010	35.97	0.19
5	1100	12	0.448	42.528	4.942	59.687	804.991	91.2	15.3	12.97436155	11.966180	36.31	0.17
6	1110	12	0.359	63.699	6.903	87.690	1079.96	97.1	22.4	13.2283354	11.761158	35.69	0.15
7	1120	12	0.310	60.171	6.045	82.414	1003.61	98.1	21.1	13.29588851	11.720895	35.57	0.15
8	1130	12	0.153	33.802	3.247	44.948	535.578	100.0	11.5	13.69662066	11.359639	34.49	0.15
9	1140	12	0.092	12.266	1.226	15.493	194.200	100.0	4.0	14.42247813	10.617853	32.26	0.16
10	1180	12	0.121	10.547	1.539	11.259	157.842	99.9	2.9	17.0779011	11.338689	34.42	0.16
11	1400	12	0.554	16.326	2.700	14.397	321.307	71.7	3.7	20.69503833	12.502362	37.92	0.26
							Cumulative %39Ar rlsd =		100.0		Total gas age =	35.65	0.13

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)

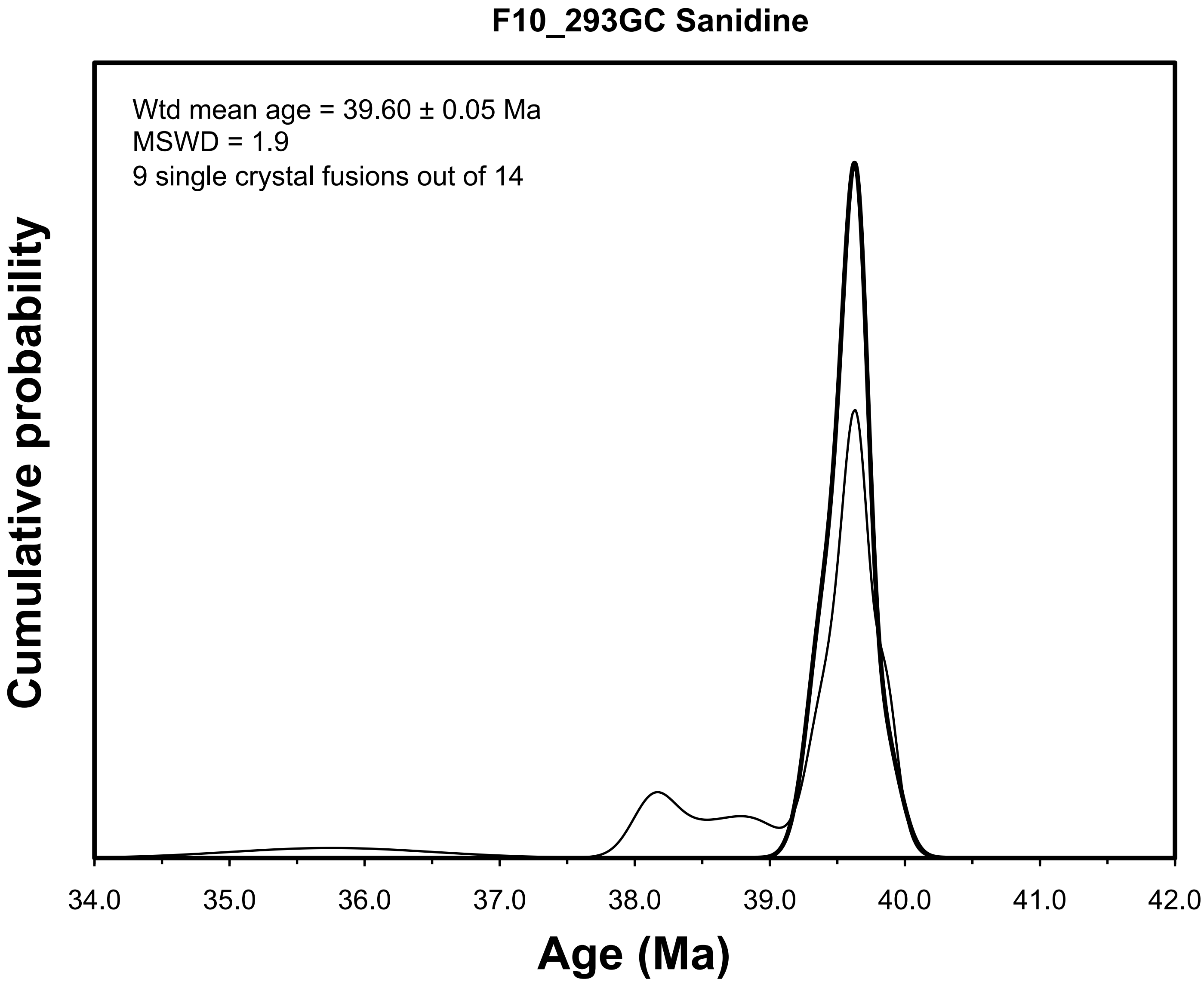
No plataeu
No isochron


GN2011-393 Amphibole
Age (Ma)
44
42
40
38
36
34
32
30
28
26
0
20
40
60
80
100
% ³⁹Ar Released

Wells-UNLV, F10_293GC, Single Crystal Sanidine, J = 0.001789 ± 0.05%
4 amu discrimination = 1.0574 ± 0.11%, 40/39K = 0.022 ± 69.30%, 36/37Ca = 0.000264 ± 3.44%, 39/37Ca = 0.000672 ± 0.94%

Crystal	T (C)	t (min.)	36Ar	37Ar	38Ar	39Ar	40Ar	%40Ar*	Ca/K	40Ar*/39ArK	Age (Ma)	1s.d.
1	1600	2	0.252	0.925	3.073	233.012	2921.73	97.6	0.02106	12.38750	39.54	0.08
2	1600	2	0.184	0.851	2.742	210.585	2633.16	98.0	0.02144	12.41188	39.62	0.09
3	1600	2	0.141	0.705	2.276	171.404	2141.56	98.2	0.02182	12.41853	39.64	0.08
4	1600	2	0.065	0.284	0.824	61.959	753.340	98.0	0.02432	12.03385	38.43	0.26
5	1600	2	0.048	0.293	0.841	63.644	786.761	98.7	0.02443	12.32258	39.34	0.12
6	1600	2	0.037	0.475	1.555	118.080	1460.50	99.4	0.02134	12.43089	39.68	0.08
7	1600	2	0.048	0.125	0.449	33.632	416.421	97.7	0.01972	12.17819	38.88	0.23
8	1600	2	0.041	0.521	1.661	128.126	1592.38	99.3	0.02158	12.48663	39.86	0.08
9	1600	2	0.161	0.478	1.397	101.205	1237.81	96.5	0.02506	11.94143	38.14	0.15
10	1600	2	0.149	0.480	0.773	54.533	642.996	94.0	0.04670	11.18845	35.75	0.75
11	1600	2	0.046	0.205	0.582	43.479	541.483	98.3	0.02502	12.34348	39.41	0.10
12	1600	2	0.039	0.259	0.774	59.609	744.754	99.0	0.02305	12.48663	39.86	0.12
13	1600	2	0.084	0.279	0.741	56.717	716.504	97.2	0.02610	12.39510	39.57	0.12
14	1600	2	0.033	0.255	0.777	58.655	727.774	99.2	0.02307	12.42582	39.67	0.13
										Mean ± s.d. =	39.10	1.05
										Wtd mean age =	39.60	0.05
										(9 crystals)		
										No isochron		

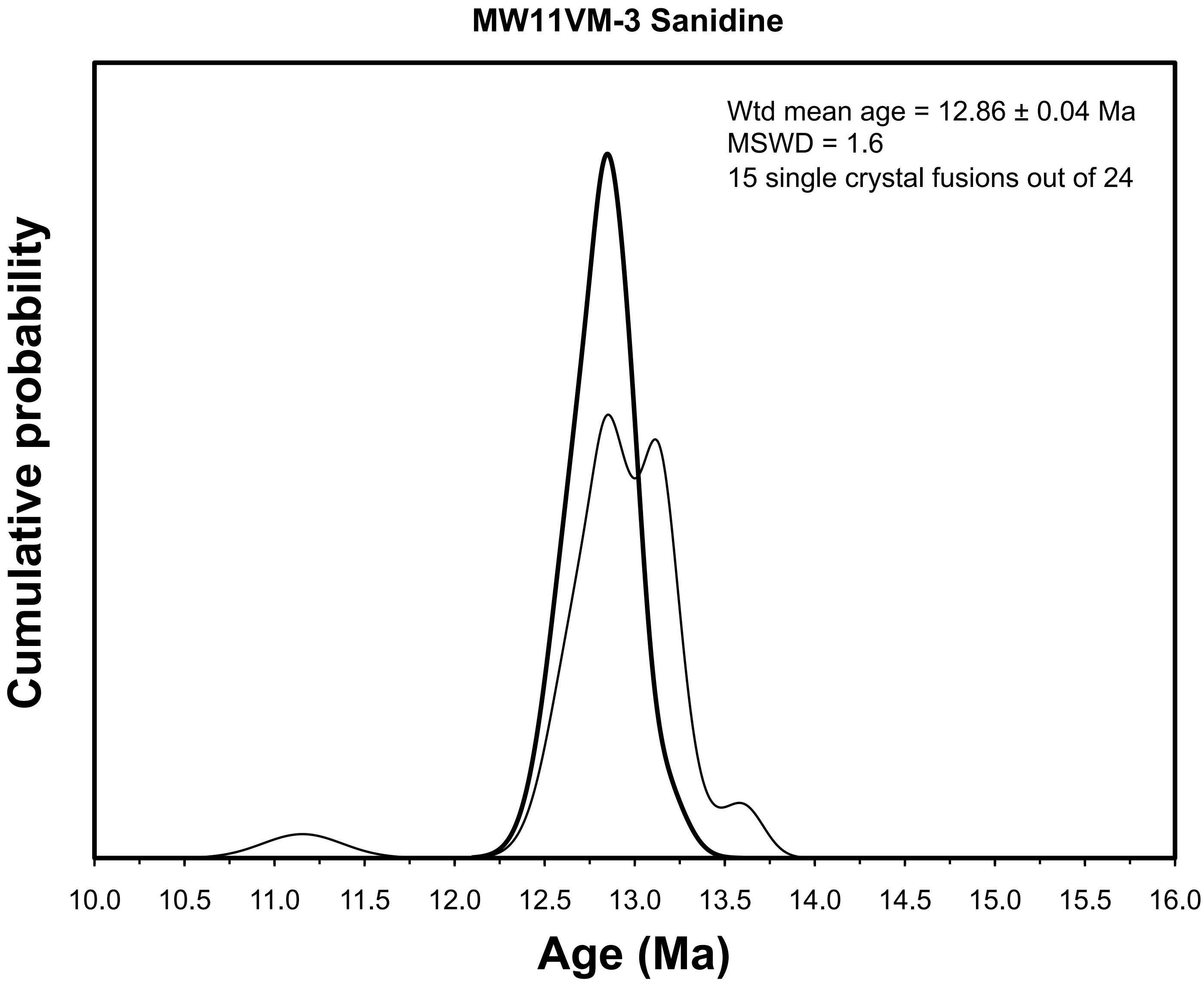
note: isotope beams in mV rlsd = released, error in age includes J error, all errors 1 sigma
(36Ar through 40Ar are measured beam intensities, corrected for decay in age calculations)


F10_293GC Sanidine
Wtd mean age = 39.60 ± 0.05 Ma
MSWD = 1.9
9 single crystal fusions out of 14
Cumulative probability
34.0
35.0
36.0
37.0
38.0
39.0
40.0
41.0
42.0
Age (Ma)

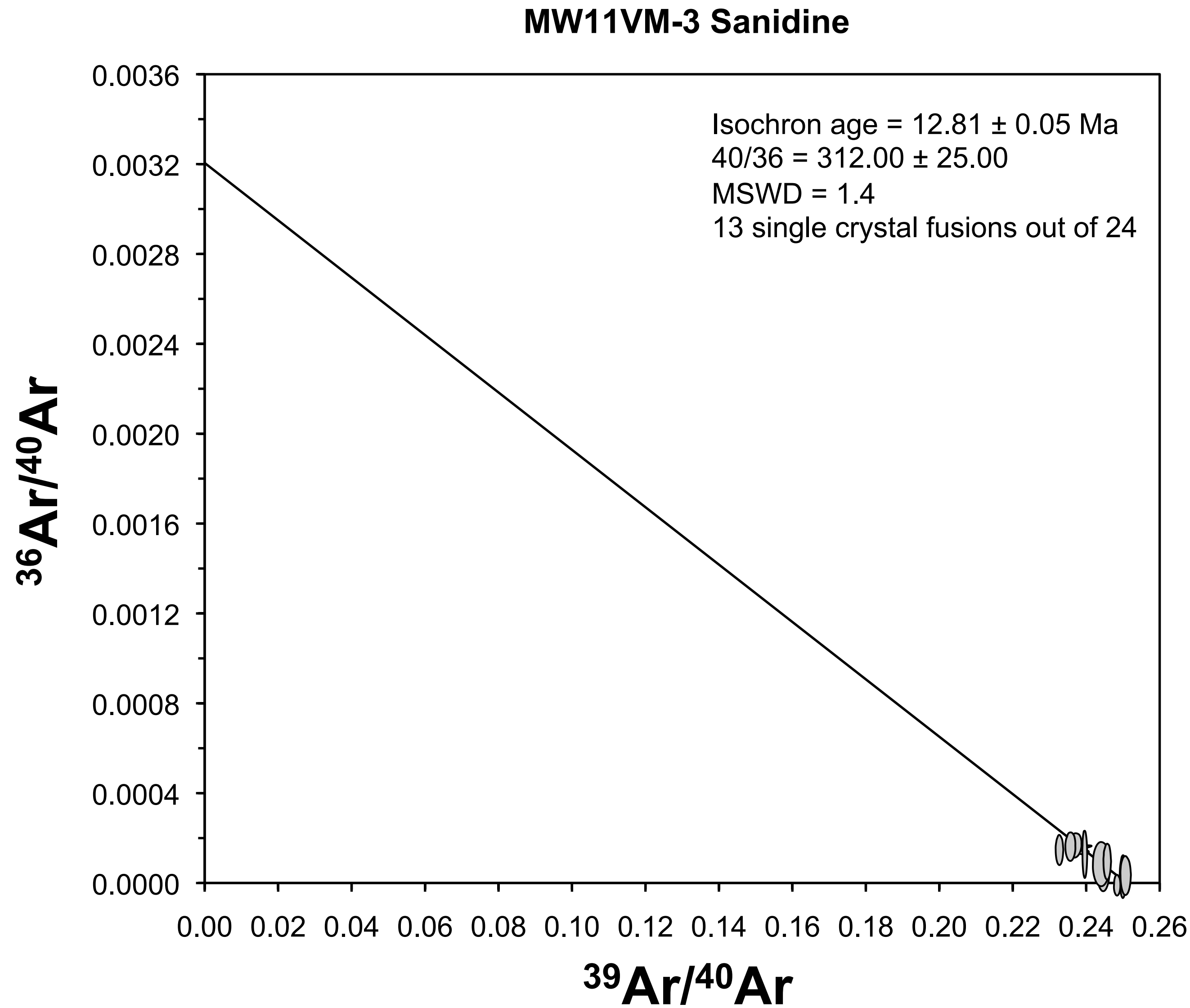
Wells-UNLV, MW11VM-3, Single Crystal Sanidine, J = 0.001788 ± 0.06%
4 amu discrimination = 1.0574 ± 0.11%, 40/39K = 0.022 ± 69.30%, 36/37Ca = 0.000264 ± 3.44%, 39/37Ca = 0.000672 ± 0.94%

Crystal	T (C)	t (min.)	36Ar	37Ar	38Ar	39Ar	40Ar	%40Ar*	Ca/K	40Ar*/39ArK	Age (Ma)	1s.d.
1	1600	2	0.154	2.191	2.325	172.381	720.436	94.2	0.06933	3.97195	12.77	0.08
2	1600	2	0.088	1.422	1.371	102.817	430.254	94.8	0.07544	3.99287	12.83	0.06
3	1600	2	0.040	0.115	0.138	10.177	44.962	98.8	0.06164	4.10591	13.20	0.14
4	1600	2	0.022	0.141	0.117	9.105	41.025	95.1	0.08447	3.99818	12.85	0.18
5	1600	2	0.014	0.232	0.217	15.839	70.006	99.1	0.07989	4.23490	13.61	0.11
6	1600	2	0.021	0.177	0.170	12.748	55.046	95.2	0.07573	3.92044	12.60	0.16
7	1600	2	0.023	0.189	0.191	14.459	61.247	96.2	0.07130	3.94354	12.68	0.12
8	1600	2	0.023	0.194	0.200	15.160	64.981	96.4	0.06980	3.97663	12.78	0.17
9	1600	2	0.027	0.245	0.188	14.317	64.388	94.5	0.09334	4.09154	13.15	0.12
10	1600	2	0.025	0.248	0.275	19.575	73.144	95.9	0.06910	3.46889	11.16	0.22
11	1600	2	0.031	0.239	0.248	17.840	78.080	93.9	0.07307	3.99381	12.84	0.11
12	1600	2	0.031	0.370	0.247	18.261	80.224	94.1	0.11052	4.02159	12.93	0.12
13	1600	2	0.015	0.198	0.227	17.440	72.731	99.9	0.06193	4.04127	12.99	0.08
14	1600	2	0.016	0.208	0.179	13.313	57.301	99.5	0.08522	4.10434	13.19	0.09
15	1600	2	0.019	0.156	0.217	16.001	68.658	98.2	0.05318	4.07718	13.10	0.08
16	1600	2	0.019	0.158	0.187	13.908	58.453	98.0	0.06196	3.95010	12.70	0.16
17	1600	2	0.020	0.210	0.226	17.090	70.890	97.9	0.06702	3.93230	12.64	0.15
18	1600	2	0.017	0.171	0.128	9.673	43.145	98.8	0.09643	4.14307	13.32	0.16
19	1600	2	0.022	0.251	0.313	24.281	103.058	97.8	0.05638	4.08155	13.12	0.08
20	1600	2	0.013	0.211	0.214	16.609	69.570	99.5	0.06929	4.03284	12.96	0.09
21	1600	2	0.017	0.169	0.259	19.362	81.355	98.0	0.04761	4.01441	12.90	0.07
22	1600	2	0.017	0.234	0.382	27.670	116.153	98.5	0.04613	4.07811	13.11	0.08
23	1600	2	0.024	0.236	0.223	15.987	67.799	96.1	0.08052	3.93823	12.66	0.14
24	1600	2	0.030	0.306	0.307	22.693	99.521	95.5	0.07355	4.11121	13.21	0.09
										Mean ± s.d. =	12.89	0.43
										Wtd mean age = (15 crystals)	12.86	0.04
										Isochron age = (13 crystals)	12.81	0.05

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 in age calculations)



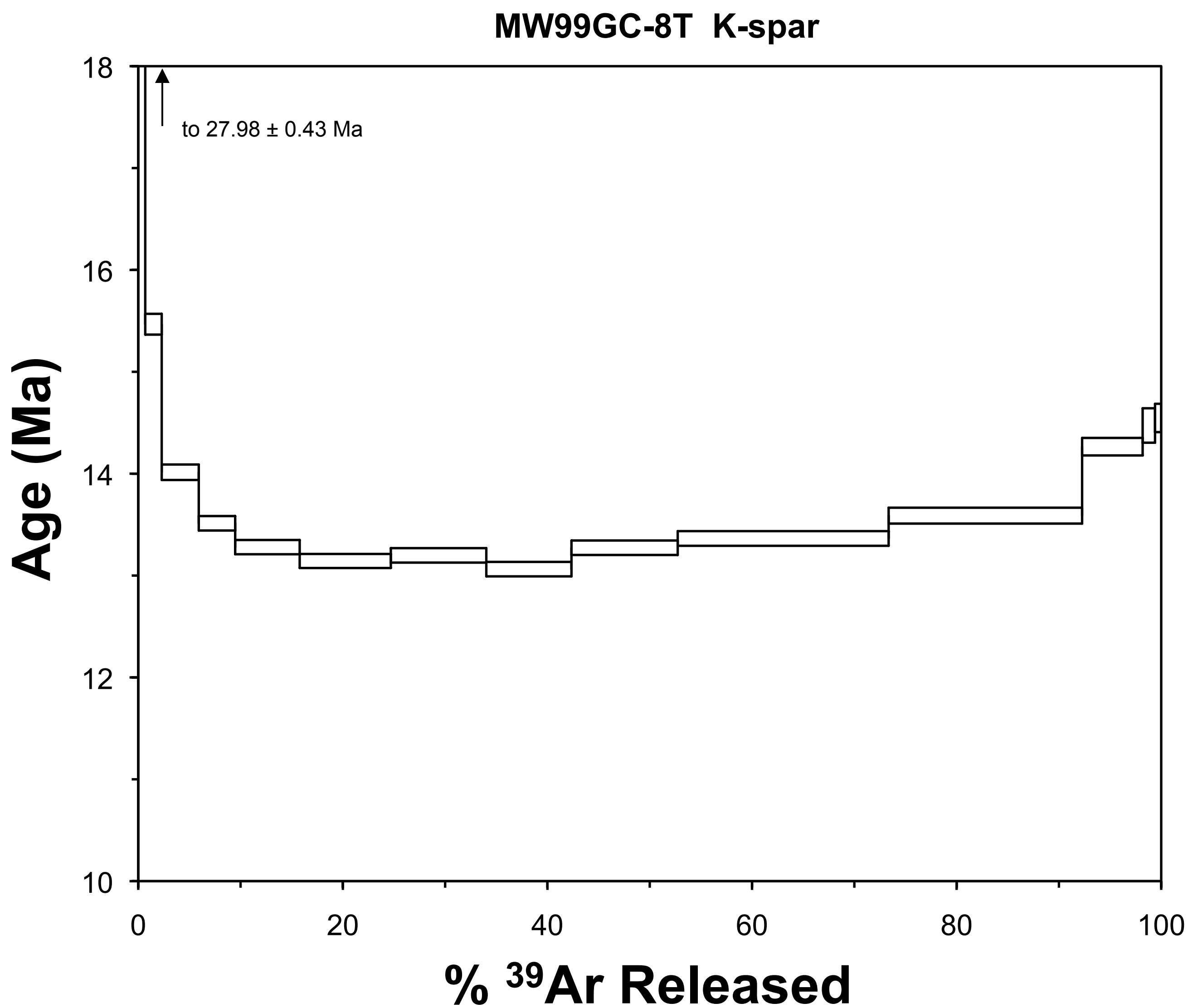
MW11VM-3 Sanidine
Wtd mean age = 12.86 ± 0.04 Ma
MSWD = 1.6
15 single crystal fusions out of 24
Cumulative probability
10.0
10.5
11.0
11.5
12.0
12.5
13.0
13.5
14.0
14.5
15.0
15.5
16.0
Age (Ma)

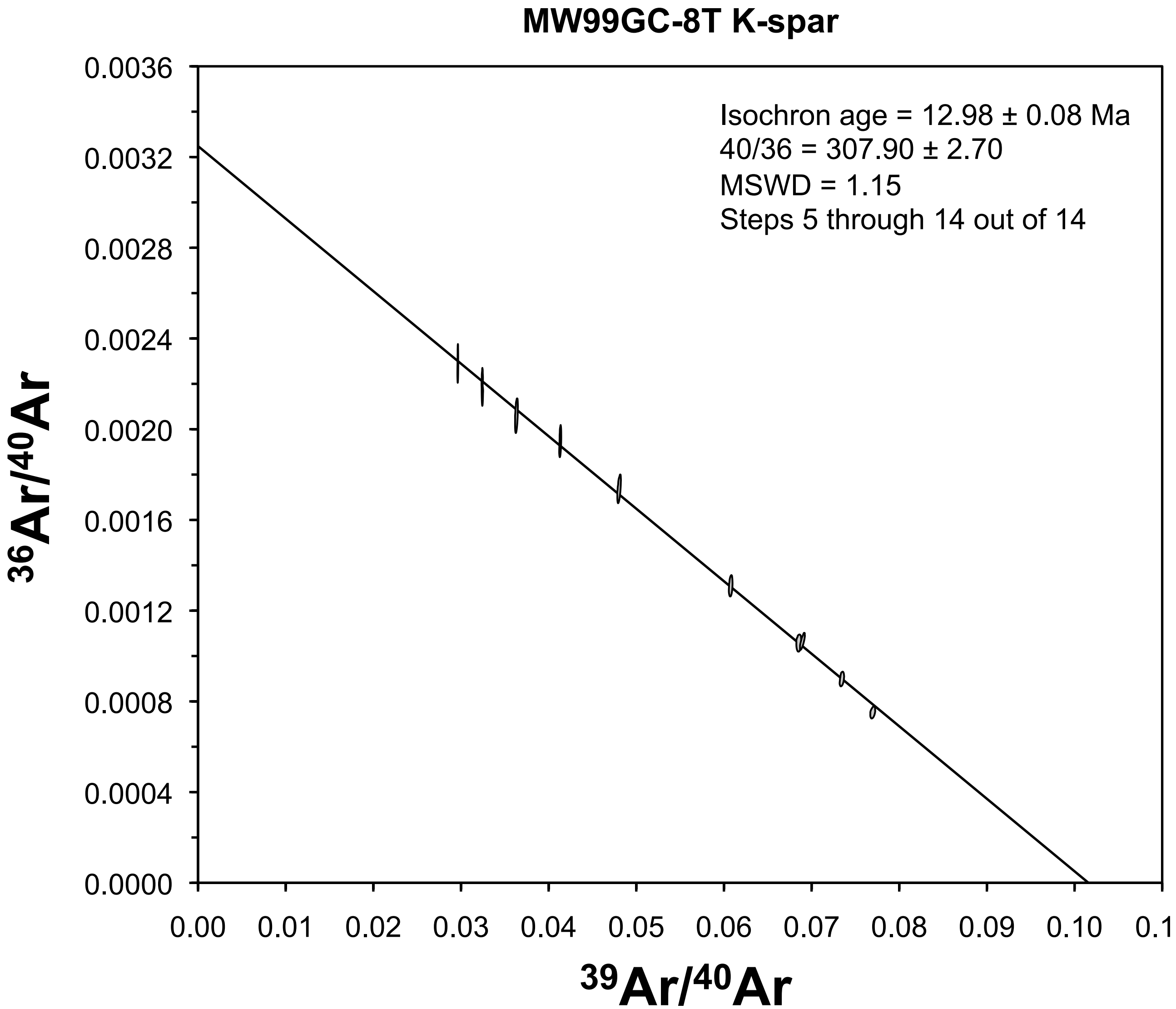

MW11VM-3 Sanidine
Isochron age = 12.81 ± 0.05 Ma
40/36 = 312.00 ± 25.00
MSWD = 1.4
13 single crystal fusions out of 24
0.0036
0.0032
0.0028
0.0024
0.0020
0.0016
0.0012
0.0008
0.0004
0.0000
0.00 0.02 0.04 0.06 0.08 0.10 0.12 0.14 0.16 0.18 0.20 0.22 0.24 0.26
36Ar/40Ar
39Ar/40Ar

Wells-UNLV, MW99GC-8T, K-spar, 8.27 mg, J = 0.000734 ± 0.5%
4 amu discrimination = 1.0196 ± 0.08%, 40/39K = 0.0002 ± 150.0%, 36/37Ca = 0.000268 ± 2.52%, 39/37Ca = 0.000717 ± 4.77%

step	T (C)	t (min.)	36Ar	37Ar	38Ar	39Ar	40Ar	%40Ar*	% 39Ar rlsd	Ca/K	40Ar*/39ArK	Age (Ma)	1s.d.
1	600	12	4.994	0.069	1.037	6.442	1583.31	8.7	0.7	0.137243346	21.31061	27.98	0.43
2	700	12	0.980	0.104	0.376	15.201	461.490	39.0	1.6	0.087663263	11.73853	15.47	0.10
3	800	12	1.185	0.144	0.660	34.200	705.234	51.7	3.6	0.053949625	10.63151	14.01	0.08
4	850	12	0.260	0.139	0.477	33.641	418.580	83.2	3.6	0.052941692	10.25000	13.51	0.07
5	925	12	0.624	0.201	0.917	59.546	777.850	77.3	6.3	0.043250797	10.07185	13.28	0.07
6	1000	12	1.082	0.249	1.276	84.137	1148.46	73.1	8.9	0.037919471	9.96832	13.14	0.07
7	1060	12	1.419	0.262	1.398	88.154	1289.61	68.4	9.3	0.038081079	10.01019	13.20	0.07
8	1100	12	1.270	0.230	1.259	78.630	1144.15	68.2	8.3	0.037479126	9.90743	13.06	0.07
9	1150	12	2.204	0.288	1.702	98.080	1619.96	61.1	10.4	0.037623738	10.06729	13.27	0.07
10	1200	12	7.235	0.517	3.932	194.738	4059.73	48.5	20.6	0.034016473	10.13656	13.36	0.07
11	1240	12	8.638	0.490	3.946	178.629	4334.02	42.4	18.9	0.03514744	10.30711	13.59	0.08
12	1280	12	3.273	0.169	1.303	55.879	1548.73	39.1	5.9	0.038751466	10.82268	14.27	0.09
13	1320	12	0.837	0.060	0.306	11.434	368.701	35.3	1.2	0.06723677	10.98112	14.47	0.17
14	1400	12	0.502	0.049	0.169	5.718	209.470	32.3	0.6	0.109802258	11.03749	14.55	0.14
							Cumulative %39Ar rlsd =		100.0		Total gas age =	13.57	0.07
											No plateau		
											Isochron age =	12.98	0.08
											(steps 5-14)		

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)


MW99GC-8T K-spar
to 27.98 ± 0.43 Ma
Age (Ma)
18
16
14
12
10
0
20
40
60
80
100
% ^{39}Ar Released


MW99GC-8T K-spar
Isochron age = 12.98 ± 0.08 Ma
40/36 = 307.90 ± 2.70
MSWD = 1.15
Steps 5 through 14 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
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.10
0.11
36Ar/40Ar
39Ar/40Ar