$^{40}Ar/^{39}Ar$ Geochronology Results for the Granite Peak, Granite Peak SE, and Camels Back Ridge NE Quadrangles, Utah

by

Utah Geological Survey and
New Mexico Geochronology Research Laboratory

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This Open-File Report makes available raw analytical data from laboratory procedures completed to determine the age of rock samples collected during geologic mapping funded or partially supported by the Utah Geological Survey (UGS). The references listed in table 1 report the age of the samples and 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 New Mexico Geochronology Research Laboratory (NMGRL) 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)	Longitude (W)	Reference
GP102605-1	Granite Peak	40° 09' 58.2"	113° 15' 56.2"	Clark and others (2008); Clark and others (in press)
GP102605-3	Granite Peak SE	40° 05' 16.2"	113° 16' 45.9"	Clark and others (2008); Clark and others (in press)
FM083105-1	Camels Back Ridge NE	40° 12' 08"	112° 50' 16"	Clark and others (2008)

Location data based on NAD27.

Disclaimer

This Open-File Report is intended as a data repository for technical analytical information gathered in support of various geologic mapping projects. The data are presented as received from the NMGRL and do not necessarily conform to UGS technical or editorial standards. Therefore, it may be premature for an individual or group to take actions based on the contents of this report.

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References to Reports that Cite or Explain Samples Analyzed in this Report

Clark, D.L., Biek, R.F., Willis, G.C., Brown, K.D., Kuehne, P.A., Ehler, J.B., and Ege, C.L., in press, Provisional geologic map of the Granite Peak and Sapphire Mountain area, U.S. Army Dugway Proving Ground, Tooele County, Utah: Utah Geological Survey Miscellaneous Publication, scale 1:24,000.

Clark, D.L., Oviatt, C.G., and Page, D., 2008, Interim geologic map of Dugway Proving Ground and adjacent areas, parts of the Wildcat Mountain, Rush Valley, and Fish Springs 30' x 60' quadrangles, Tooele County, Utah (year 2 of 2): Utah Geological Survey Open-File Report 532, 3 plates, scale 1:75,000.

$^{40}Ar/^{39}Ar$ Geo- & Thermochronology Results For The Granite Peak Area

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Introduction

Donald Clark submitted a hornblende and biotite bearing dacite intrusion sample located about 25 miles E of Granite Peak along with two samples from the granitic intrusion from Granite Peak. From these later samples, muscovite and K-feldspar were extracted from GP102605-1 whereas biotite and K-feldspar were separated from GP102605-3. Based on LA-ICP-MS zircon dating the Granite Peak samples are known to be 149 Ma (Eric Christiansen, pers. com.). Samples dated here by the $^{40}Ar/^{39}Ar$ method are used to estimate the exhumation history of the area as well as to determine the intrusion age of the dacite.

$^{40}Ar/^{39}Ar$ Analytical Methods and Results

All of the minerals were analyzed by the incremental step-heating method and samples were heated within a double vacuum Mo resistance furnace. Additional analytical details specific to this report are provided in Table 1 and details regarding the overall operation and data handling methods employed by the NMGRL can be downloaded from internet site http://geoinfo.nmt.edu/publications/openfile/argon/home.html.

Age spectra for all of the minerals are presented in Figures (1a-1f) and analytical data are summarized in Table 2. The hornblende spectrum from dacite FM083105-1 exhibits initially young ages that climb to a maximum value of 44 Ma before stepping down to ages between 41.5 and 39.7 Ma (Fig. 1a). The initial age complexity occurs in conjunction with overall high K/Ca values whereas the more precise and well behaved higher temperature steps coincide with a constant and lower K/Ca. The variation in K/Ca likely records contamination by a high K (i.e. biotite or alteration phase) that degases at lower temperature compared to the hornblende. The final 4 steps of the spectrum yield a weighted mean age of 40.9±0.3 Ma, however the high MSWD of 18.2 indicates significant geological scatter. The co-existing biotite from FM083105-1 shows a spectrum with significant complexity with an initial age of about 10 Ma followed by climbing ages to a maximum of 47.7 Ma that is followed by decreasing ages for the final 20% of the spectrum (Fig. 1b). The estimated K_2O for the biotite based on the amount of ^{39}Ar is only 2.29% (Table 2) and indicates significant alteration. This alteration is very likely the cause of the age complexity, however the integrated age of 39.56±0.11 Ma is similar to the hornblende result thereby suggesting that K loss is coupled with loss of ^{40}Ar* and that the alteration in concert with ^{39}Ar recoil redistribution (cf. Lo and Onstott, 1989) is the cause of the spectrum complexity. The muscovite from GP102605-1 and biotite from GP102605-3 provide spectra with moderate to low age scatter with ~98.6 % of the total ^{39}Ar from the muscovite yielding a weighted mean age of 13.69±0.12 Ma and the majority of the biotite steps giving a weighted mean age of 15.97±0.04 Ma (Figs. 1c, 1d). The K-feldspars from these samples show considerable complexity with early age oscillations correlating to isothermal duplicate heating steps that are used to resolve the common excess argon behavior of K-feldspars (cf. Harrison et al., 1993). The early age minimum near 10 Ma is followed by quite irregular age patterns characterized by a steep age climb to values significantly older than coexisting micas (Fig. 1e, 1f; Table 2). Ages older than the micas are interpreted to result from excess argon and are not considered to be reliable. The initial youngest apparent ages are thought to provide thermochronologically useful data, but it is difficult to know to what degree the youngest steps are affected by excess argon.

^{39}Ar Multi-diffusion domain results

The ^{39}Ar released from the K-feldspars can be coupled with the laboratory heating schedules to construct Arrhenius plots and determine the diffusion domain distribution for each sample (Lovera et al., 1989). Arrhenius plots are given in Figures 2b and 3b. These plots are similar in form where an overall initial linear segment is followed by a decrease in slope. The initial Arrhenius points are used to estimate the activation energy (E) and frequency factor-grain size parameter (D_o/r_o^2) for each sample. This initial slope is referred to as the reference line r_o and is assigned an E of 46.0 kcal/mol. In addition to the Arrhenius plots, the diffusion data can be shown on Log (r/r_o) plots (Figs. 2c, 3c). These plots shown the deviation of measured diffusion coefficients from the reference line r_o. By convention r_o is passed through the initial diffusion coefficients such that the log(r/r_o) values begin at zero and as the individual log (D/r^2) values deviate from the reference line the values rise on the log(r/r_o) plot indicating degassing of larger and larger diffusion domains (Richter et al., 1991). The log(r/r_o) values are plotted versus %^{39}Ar as a means for visualizing the amount of gas represented by each individual Arrhenius datum. This plot is mainly a visual tool to help recognize the domain distribution as well as to visually relate the domain distribution to the age spectrum (McDougall and Harrison, 1999).

The diffusion domain distribution for each K-feldspar is obtained by modeling the release of ^{39}Ar relative to the laboratory heating schedule. In all cases, E is assumed to be constant for all diffusion domains of a given sample and seven diffusion domains were imposed on each model (Table 3). The choice of the number of diffusion domains is not important provided that enough are used to adequately allow a good match between measured and modeled data. If too many domains are used, the model simply splits the gas volume housed in one domain into two of equal size thereby slowing the calculations, but not influencing the final model results. The model Arrhenius and $\log(r/r_o)$ plots show that the measured data can be well approximated by seven diffusion domains of varying proportions (Figs 2b, c; 3b, c).

Discussion

The weighted mean plateau ages assigned to the hornblende, biotite and muscovite spectra represent the time that the samples cooled below their respective closure temperatures. Overall, closure temperatures are poorly known and are determined by diffusion parameters that in turn can be influenced by factors such as composition, grain size and cooling rate. A discussion of the state of knowledge for mineral closure temperatures is given in McDougall and Harrison (1999) and here we use the nominal values of 500°C for hornblende and 300°C for biotite. Very recently, the first successful diffusion experiment on muscovite indicates a closure temperature of about 400°C (Harrison et al., in press).

The hornblende age of 40.9±0.3 Ma is considered a close approximation of the intrusion age for sample FM083105-1. Even though the biotite from FM083105-1 is complex, the near concordance of its integrated age with the hornblende age indicates rapid cooling from 500 to 300 °C and provides further support that the hornblende age is approximately equal to the intrusion age.

The mica and K-feldspar data from the Granite Peak samples indicate that significant cooling occurred in the Miocene despite the samples being Jurassic. The biotite is approximately 2.3 Ma older than the muscovite. This age discordance would not be predicted based on closure temperature estimates if the samples shared a common thermal history. Donald Clark (pers. com) indicates that GP102605-3 is structurally higher than GP102605-1 and this crustal positioning would be consistent with GP102605-3 cooling earlier than GP102605-1, which is required by the age data. Thermal histories are calculated from the K-feldspar data using the multi-diffusion domain (MDD) model (Figs. 2d, 3d) and despite being significantly compromised by excess argon contamination, the thermal history results show that GP102605-3 began accelerated cooling at about 10 Ma whereas the structurally lower GP102605-1 begins this same accelerated cooling at about 6 Ma. This cooling pattern is again consistent with the geological relationships.

Conclusions

Hornblende from FM083105-1 suggests dacite intrusion at 40.9±0.3 Ma. Thermochronological analysis of the two GP samples from Granite Peak reveal diachronous cooling likely related to vertical separation. The structurally higher GP102605-3 cools through ~300°C at about 16 Ma and continues cooling below ~225°C by 10 Ma whereas the lower GP102605-1 sample cools through about 400°C by 13.7 Ma and reaches the accelerated cooling interval at about 7 Ma. Uncertainty in the thermal history is dominated by the somewhat ambiguous knowledge of what parts of the K-feldspar age spectra are significantly contaminated with excess ^{40}Ar. To a first order we believe the post 10 Ma thermal histories derived from the K-feldspar MDD analysis are accurate and suggest that significant exhumation likely associated with Basin and Range extension began at about 15 Ma and continued until at least 5 Ma.

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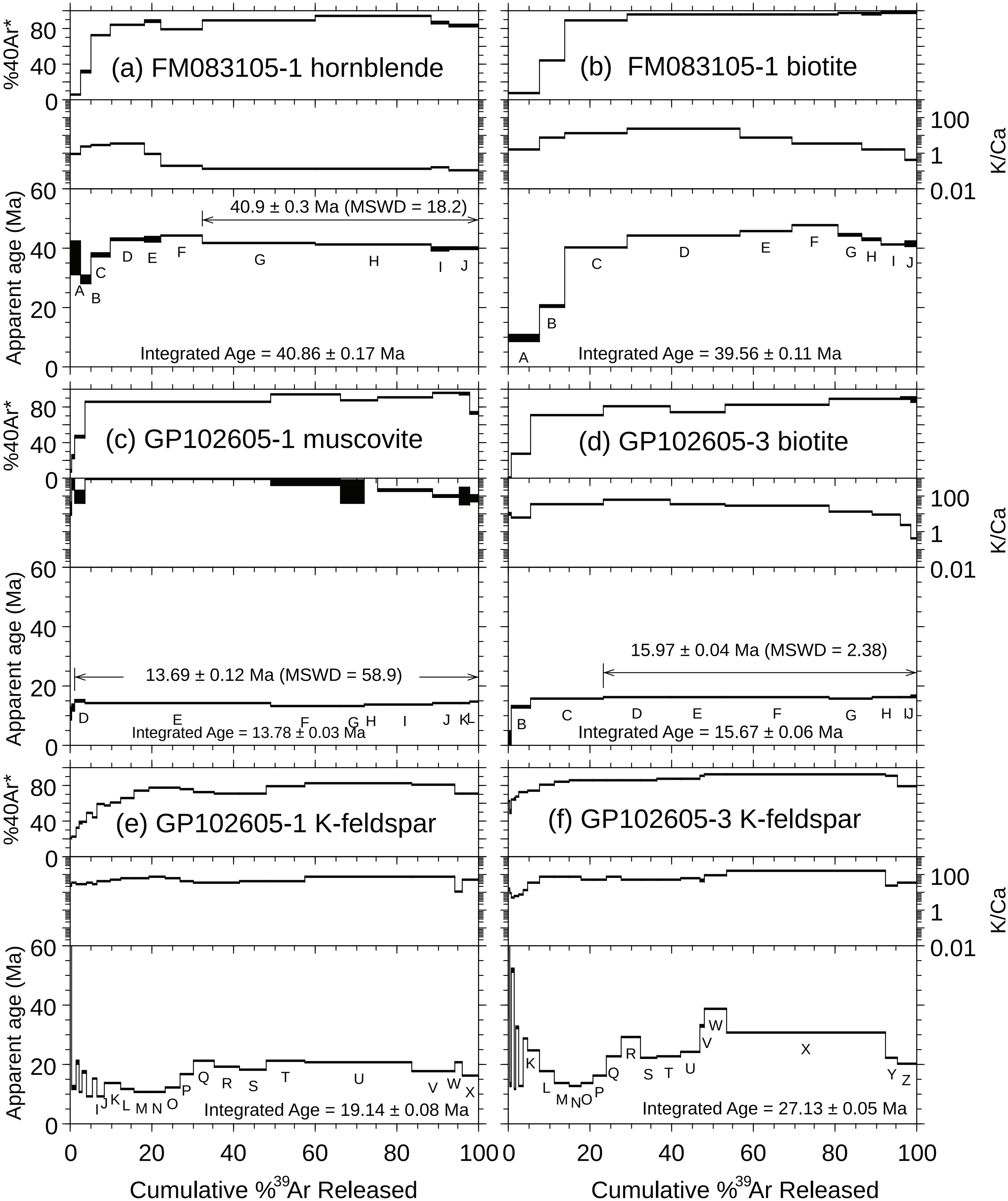

Figure 1. Age spectra, K/Ca and radiogenic yield diagrams. Errors reported at 1σ.

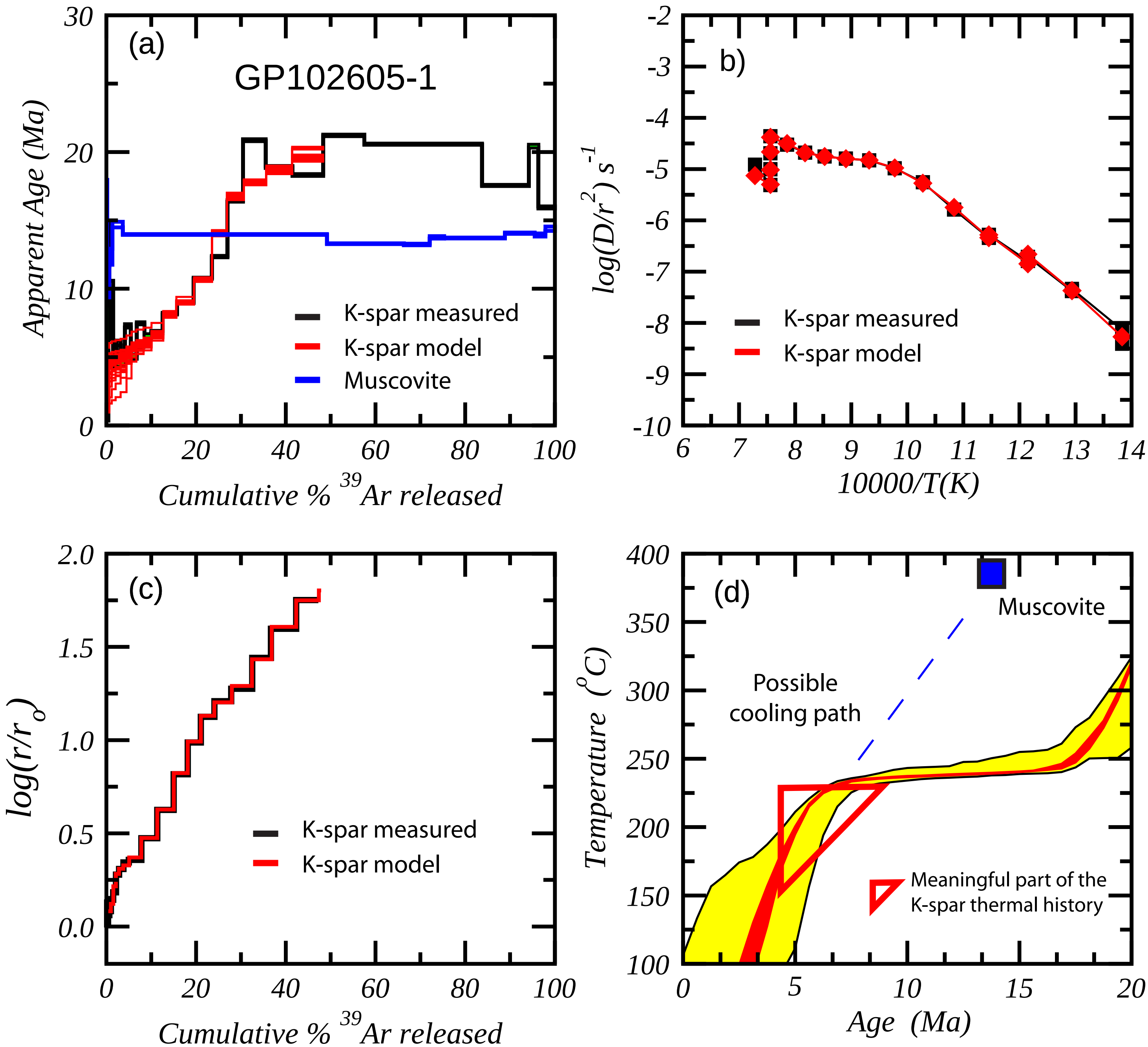

Figure 2. Inferred thermal history for sample GP102605-1 determined from K-feldspar MDD model and estimated closure temperature for muscovite. a) measured age spectra for K-feldspar and muscovite along with model K-feldspar spectra. b) calculated and model kinetic parameters determined from K-feldspar step-heating data. c) Log r/r_o plot for K-feldspar using reference values (ro) of E = 46 kcal/mol and D_o/r_o^2 = 6.0 /sec. d) thermal history returned from MDD modeling of the K-feldspar data along with a data point determined from the muscovite apparent age and estimated closure temperature of 400°C. As the K-feldspar gives apparent ages older than the muscovite it is assumed it contains excess ^{40}Ar and thus the part of the K-feldspar thermal history older than about 10 Ma is not accurate. Data shown in triangle are tentively suggested to be accurate. Dashed line is a possible trajectory for the cooling of the sample.

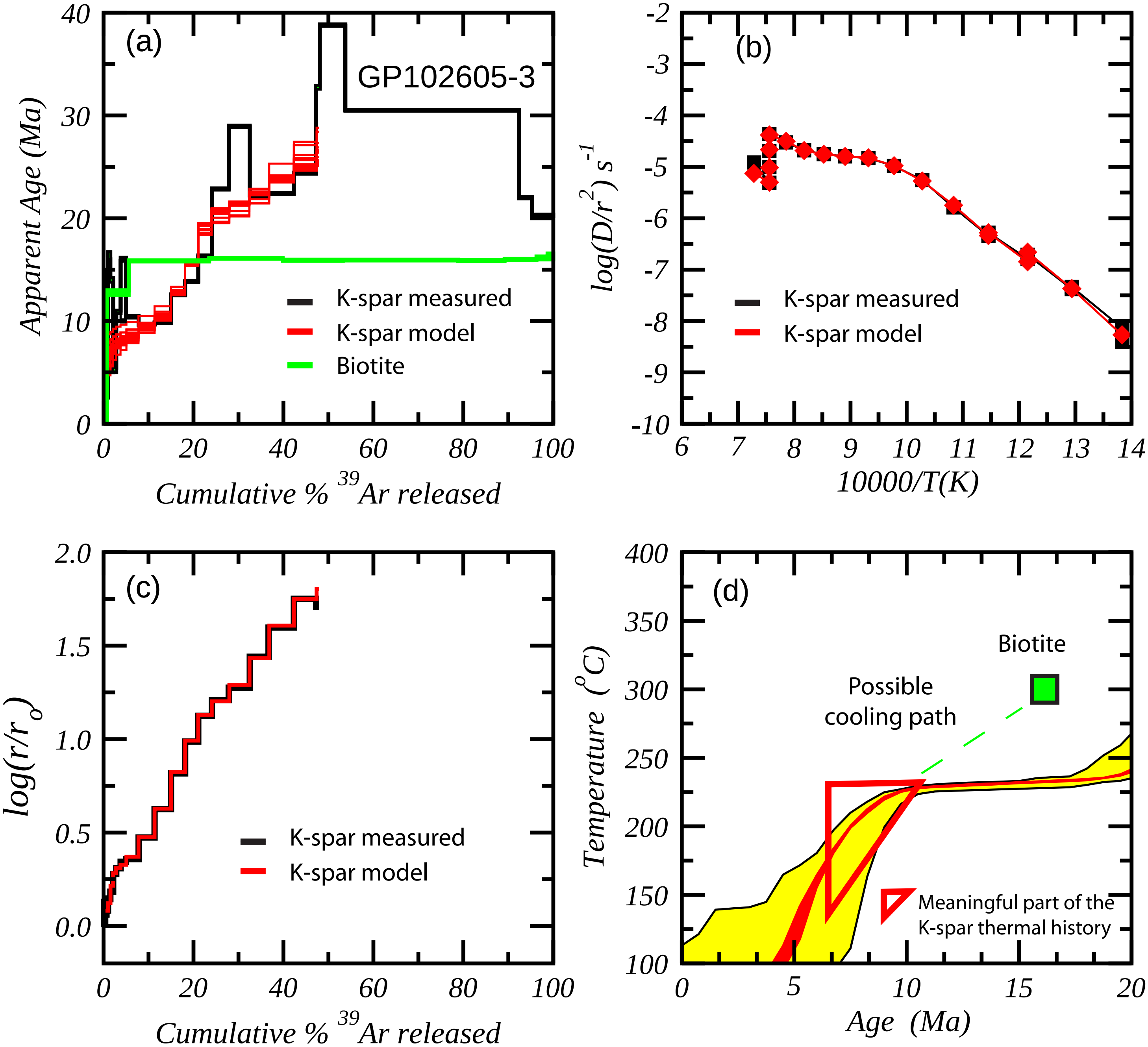

Figure 3. Inferred thermal history for sample GP102605-3 determined from K-feldspar MDD model and estimated closure temperature for biotite. a) measured age spectra for K-feldspar and biotite along with model K-feldspar spectra. b) calculated and model kinetic parameters determined from K-feldspar step-heating data. c) Log r/r_o plot for K-feldspar using reference values (ro) of E = 46 kcal/mol and D_o/r_o^2 = 5.8 /sec. d) thermal history returned from MDD modeling of the K-feldspar data along with a data point determined from the biotite apparent age and estimated closure temperature of 300 °C. As the K-feldspar gives apparent ages older than the biotite it is assumed it contains excess ^{40}Ar and thus the part of the K-feldspar thermal history older than about 10 Ma is not accurate. Data shown in triangle are tentively suggested to be accurate. Dashed line is a possible trajectory for the cooling of the sample.

Table 1. Summary of age data and analytical methods.

Sample	L#	Plateau Age	±	MSWD	%^{39}Ar	n	Int. Age	±
FM083105-1 Hornblende	56746	40.9	0.3	18.2	67.3	4/10	40.9	0.2
FM083105-1 Biotite	56747	np	np	np	np	np	39.6	0.1
GP102605-1 Muscovite	56750	13.69	0.12	58.9	98.6	9/12	13.78	0.03
GP102605-1 K-feldspar	56751	np	np	np	np	np	19.14	0.08
GP102605-3 Biotite	56749	16.00	0.04	2.38	76.5	7/10	15.67	0.06
GP102605-3 K-feldspar	56748	np	np	np	np	np	27.13	0.05

L# = Lab number
n = number of steps for plateau.
%^{39}Ar = percentage of total ^{39}Ar comprising the plateau.
Int. = Integrated age
All errors at 1σ
np = No plateau age assigned

Methods

Sample preparation and irradiation:
Mineral separates made with standard heavy liquid and magnetic separation methods.
Separates were loaded into machined Al discs and irradiated for 6 hours at the USGS TRIGA reactor in Denver, CO.
Neutron flux monitor Fish Canyon Tuff sanidine (FC-2). Assigned age = 28.02 Ma (Renne et al., 1998).

Instrumentation:
Mass Analyzer Products 215-50 mass spectrometer on line with automated all-metal extraction system.
Hornblende, biotite and muscovite step heated in a Mo resistance furnace. Heating time 5 minutes.
K-feldspar step heated in a Mo resistance furnace. Heating times ranged from 10 to 120 minutes.
Reactive gases removed during heating with a SAES GP-50 getter operated at ~450°C.
Additional cleanup (3-5 minutes hornblende and micas; 1 minute K-feldspar) following heating with 2 SAES GP-50 getters, 1 operated at ~450°C and 1 at 20°C. Gas also exposed to a W filament operated at ~2000°C.

Analytical parameters:
Electron multiplier sensitivity averaged 8x10^{-17} moles/pA.
Total system blank and background: Hornblende, micas = 200 1.8, 0.3, 0.8, 1.3 x 10^{-17} moles for masses 40, 39, 38, 37, 36, respectively.
Total system blank and background: K-feldspar = 175 1.0, 0.2, 0.9, 0.5 x 10^{-17} moles for masses 40, 39, 38, 37, 36, respectively.
J-factors determined to ± 0.1% by CO_2 laser-fusion of 6 single crystals from each of 4 radial positions around the irradiation tray.
Correction factors for interfering nuclear reactions were determined using K-glass and CaF_2 and are as follows:
NM-202: $(^{40}Ar/^{39}Ar)_K$ = 0.010±0.002; $(^{36}Ar/^{37}Ar)_{Ca}$ = 0.00028±0.00002; $(^{39}Ar/^{37}Ar)_{Ca}$ = 0.00070±0.00005; $(^{38}Ar/^{39}Ar)_K$ = 0.013±0.001.

Table 2. Argon isotopic data.

	ID	Temp (°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ ($\times 10^{-3}$)	$^{39}Ar_K$ ($\times 10^{-15}$ mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	$\pm 1\sigma$ (Ma)
	FM083105-1, Hornblende, 6.44 mg, J=0.0013621±0.07%, D=1.002±0.001, NM-202H, Lab#=56746-01										
X	A	650	261.5	0.5350	834.3	1.021	0.95	5.7	2.9	36.4	2.8
X	B	750	38.12	0.2186	88.62	0.908	2.3	31.3	5.4	29.11	0.79
X	C	850	21.63	0.2011	20.75	1.67	2.5	71.7	10.1	37.71	0.39
X	D	920	21.24	0.1383	12.34	2.94	3.7	82.9	18.3	42.73	0.23
X	E	1000	19.98	0.5520	8.226	1.44	0.92	88.1	22.3	42.72	0.41
X	F	1075	23.19	2.745	18.07	3.73	0.19	78.0	32.7	43.96	0.21
	G	1110	19.08	3.865	7.998	9.80	0.13	89.3	60.1	41.48	0.12
	H	1180	17.84	4.007	4.805	10.17	0.13	93.9	88.6	40.80	0.11
	I	1210	19.03	3.316	10.13	1.58	0.15	85.7	93.0	39.73	0.38
	J	1250	19.71	4.384	12.77	2.50	0.12	82.7	100.0	39.74	0.26
	Integrated age ± 1σ			n=10		35.8	0.17	K2O=1.57%		40.87	0.16
	Plateau ± 1σ		steps G-J	n=4	MSWD=18.2	24.061			67.3	40.95	0.321
	FM083105-1, Biotite, 6.47 mg, J=0.0013619±0.07%, D=1.002±0.001, NM-202H, Lab#=56747-01										
X	A	650	52.47	0.3352	164.5	4.01	1.5	7.4	7.6	9.54	0.59
X	B	750	18.77	0.0714	35.62	3.36	7.1	43.9	14.0	20.14	0.26
X	C	850	18.61	0.0386	7.497	7.98	13.2	88.1	29.2	39.82	0.13
X	D	920	18.93	0.0241	2.694	14.5	21.2	95.8	56.9	43.991	0.076
X	E	1000	19.74	0.0755	3.150	6.59	6.8	95.3	69.5	45.62	0.13
X	F	1075	20.48	0.1627	2.710	5.99	3.1	96.2	80.9	47.74	0.12
X	G	1110	18.99	0.1648	2.538	3.03	3.1	96.1	86.7	44.28	0.22
X	H	1180	18.36	0.3142	2.745	2.57	1.6	95.7	91.6	42.66	0.24
X	I	1210	17.28	0.3257	1.559	3.00	1.6	97.5	97.3	40.91	0.20
X	J	1250	17.34	1.193	1.596	1.42	0.43	97.9	100.0	41.23	0.39
	Integrated age ± 1σ			n=10		52.5		K2O=2.29%		39.56	0.10
	Plateau ± 1σ		no plateau								
	GP102605-1, Muscovite, 7.18 mg, J=0.0013611±0.06%, D=1.002±0.001, NM-202H, Lab#=56750-01										
X	A	700	98.68	0.0337	312.4	0.475	15.1	6.5	0.2	15.6	2.4
X	B	750	54.07	0.0201	168.4	1.073	25.4	7.9	0.6	10.5	1.1
X	C	800	21.72	0.0064	56.42	1.70	80.3	23.2	1.4	12.34	0.58
	D	850	13.10	0.0043	23.98	5.56	118.9	45.9	3.7	14.69	0.21
	E	950	6.623	0.0005	3.060	109.3	1016	86.3	49.2	13.965	0.028
	F	1000	5.771	0.0006	1.106	41.1	912.1	94.3	66.3	13.295	0.028
	G	1050	6.241	0.0012	2.773	13.89	414.1	86.9	72.1	13.240	0.056
	H	1100	6.532	0.0012	3.040	7.78	434.1	86.2	75.3	13.758	0.092
	I	1200	6.154	0.0026	1.821	32.5	197.5	91.2	88.8	13.713	0.034
	J	1300	6.044	0.0055	0.9695	15.9	92.2	95.3	95.5	14.060	0.046
	K	1350	6.081	0.0031	1.272	5.75	163.2	93.8	97.9	13.93	0.11
	L	1650	8.048	0.0073	7.291	5.11	70.0	73.2	100.0	14.39	0.16
	Integrated age ± 1σ			n=12		240.2	303.6	K2O=9.44%		13.775	0.032
	Plateau ± 1σ		steps D-L	n=9	MSWD=58.9	236.921			98.6	13.69	0.115

Table 2. Argon isotopic data.

	ID	Temp (°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
	GP102605-3, Biotite, 7.2 mg, J=0.0013615±0.06%, D=1.002±0.001, NM-202H, Lab#=56749-01										
X	A	650	156.7	0.0583	529.7	1.52	8.8	0.1	0.8	0.4	2.1
X	B	750	19.72	0.0780	49.08	9.07	6.5	26.5	5.6	12.77	0.23
X	C	850	9.107	0.0154	8.864	33.8	33.2	71.2	23.5	15.845	0.063
	D	920	8.142	0.0087	5.250	30.9	58.6	80.9	39.8	16.094	0.048
	E	1000	8.785	0.0166	7.681	25.2	30.6	74.2	53.2	15.913	0.059
	F	1075	7.970	0.0187	4.900	48.5	27.3	81.8	78.8	15.929	0.041
	G	1110	7.306	0.0387	2.729	19.5	13.2	89.0	89.2	15.878	0.051
	H	1180	7.442	0.0616	3.056	13.41	8.3	87.9	96.3	15.980	0.067
	I	1210	7.417	0.2045	2.798	4.64	2.5	89.1	98.7	16.14	0.15
	J	1250	7.643	1.266	3.672	2.42	0.40	87.2	100.0	16.28	0.29
	Integrated age ± 1σ			n=10		189.0	11.3	K2O=7.41%		15.671	0.055
	Plateau ± 1σ		steps D-J	n=7	MSWD=2.38	144.6			76.5	15.966	0.036
	GP102605-1, K-Feldspar, 15.6 mg, J=0.0013609±0.07%, D=1.002±0.001, NM-202H, Lab#=56751-01										
X	B	600	552.4	0.0199	1492.6	4.09	25.6	20.2	0.6	254.6	4.2
X	C	600	22.11	0.0156	58.28	5.47	32.7	22.1	1.5	11.94	0.33
X	D	650	26.42	0.0188	61.05	4.71	27.1	31.7	2.3	20.43	0.36
X	E	650	11.37	0.0186	24.07	5.96	27.4	37.4	3.2	10.39	0.17
X	F	700	18.67	0.0206	39.27	5.94	24.8	37.8	4.1	17.24	0.23
X	G	700	7.606	0.0150	13.36	8.38	34.0	48.0	5.5	8.94	0.12
X	H	750	14.49	0.0187	28.03	8.31	27.2	42.8	6.8	15.14	0.15
X	I	750	6.417	0.0125	9.047	10.78	40.7	58.3	8.5	9.146	0.077
X	J	800	9.960	0.0131	14.74	9.64	39.1	56.2	10.0	13.69	0.12
X	K	850	9.447	0.0115	12.91	16.0	44.4	59.6	12.5	13.751	0.096
X	L	900	7.368	0.0094	8.639	20.4	54.4	65.3	15.8	11.762	0.059
X	M	950	5.860	0.0082	5.319	23.4	62.5	73.1	19.5	10.476	0.055
X	N	1000	5.705	0.0075	4.388	25.7	68.0	77.2	23.5	10.768	0.039
X	O	1050	6.595	0.0093	5.204	22.0	54.8	76.7	27.0	12.351	0.053
X	P	1100	8.990	0.0133	7.641	21.9	38.5	74.9	30.5	16.431	0.062
X	Q	1150	11.74	0.0142	10.78	31.9	36.1	72.9	35.5	20.866	0.069
X	R	1200	11.09	0.0158	11.30	37.9	32.3	69.9	41.5	18.906	0.069
X	S	1200	10.69	0.0137	10.75	43.4	37.2	70.3	48.3	18.322	0.065
X	T	1250	11.04	0.0117	7.911	58.1	43.5	78.8	57.5	21.213	0.056
X	U	1300	10.23	0.0066	6.058	165.9	76.9	82.5	83.8	20.570	0.042
X	V	1350	8.942	0.0075	5.912	66.0	68.1	80.4	94.2	17.555	0.045
X	W	1450	12.06	0.0466	12.48	13.41	11.0	69.4	96.3	20.42	0.10
X	X	1750	9.348	0.0104	9.526	23.4	48.9	69.9	100.0	15.947	0.077
	Integrated age ± 1σ			n=23		632.7		K2O=11.45%		19.139	0.076
	Plateau ± 1σ		no plateau								

Table 2. Argon isotopic data.

	ID	Temp (°C)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
	GP102605-3, K-Feldspar, 14.21 mg, J=0.0013617±0.06%, D=1.002±0.001, NM-202H, Lab#=56748-01										
X	B	550	616.7	0.0570	1087.9	1.027	9.0	47.9	0.2	609.7	3.9
X	C	550	31.00	0.0250	57.92	1.284	20.4	44.8	0.4	33.77	0.67
X	D	600	65.37	0.0386	83.67	1.90	13.2	62.2	0.7	97.17	0.65
X	E	600	10.41	0.0619	17.38	2.29	8.2	50.7	1.0	12.90	0.32
X	F	650	33.08	0.1053	40.10	3.23	4.8	64.2	1.5	51.42	0.34
X	G	650	7.373	0.0931	9.028	4.03	5.5	63.9	2.1	11.52	0.17
X	H	700	20.15	0.0861	23.14	4.42	5.9	66.1	2.8	32.42	0.22
X	I	700	7.035	0.0690	6.789	6.26	7.4	71.5	3.8	12.30	0.12
X	J	750	16.26	0.0411	15.56	7.74	12.4	71.7	5.0	28.40	0.15
X	K	800	13.85	0.0149	12.49	18.1	34.2	73.4	7.8	24.777	0.095
X	L	850	8.925	0.0080	5.772	22.7	64.1	80.9	11.3	17.626	0.056
X	M	900	6.684	0.0073	3.835	23.5	69.8	83.0	15.0	13.563	0.047
X	N	950	6.073	0.0070	3.171	20.3	72.6	84.6	18.1	12.550	0.045
X	O	1000	6.602	0.0104	3.141	18.8	49.0	85.9	21.1	13.862	0.053
X	P	1050	7.792	0.0110	3.740	19.5	46.2	85.8	24.1	16.331	0.052
X	Q	1100	11.04	0.0080	5.639	24.1	64.0	84.9	27.8	22.847	0.064
X	R	1150	14.00	0.0106	7.165	30.3	48.1	84.9	32.5	28.939	0.073
X	S	1150	10.68	0.0104	5.352	26.8	48.9	85.2	36.7	22.183	0.062
X	T	1150	10.55	0.0097	4.633	36.2	52.7	87.0	42.3	22.399	0.051
X	U	1150	11.49	0.0090	5.044	31.9	56.6	87.0	47.3	24.382	0.059
X	V	1200	15.08	0.0122	5.472	5.35	41.8	89.3	48.1	32.74	0.15
X	W	1250	17.39	0.0065	4.798	36.6	78.8	91.8	53.8	38.787	0.071
X	X	1350	13.53	0.0031	3.392	248.8	166.6	92.6	92.4	30.492	0.047
X	Y	1450	10.06	0.0217	3.535	18.6	23.5	89.6	95.3	21.988	0.061
X	Z	1750	10.63	0.0156	7.828	30.3	32.8	78.2	100.0	20.289	0.059
	Integrated age ± 1σ			n=25		644.2		K2O=12.79%		27.132	0.052
	Plateau ± 1σ	no plateau									

Notes:

Isotopic ratios corrected for blank, radioactive decay, and mass discrimination, not corrected for interfering reactions.
Errors quoted for individual analyses include analytical error only, without interfering reaction or J uncertainties.
Integrated age calculated by summing isotopic measurements of all steps.
Integrated age error calculated by quadratically combining errors of isotopic measurements of all steps.
Plateau age is inverse-variance-weighted mean of selected steps.
Plateau age error is inverse-variance-weighted mean error (Taylor, 1982) times root MSWD where MSWD>1.
Plateau error is weighted error of Taylor (1982).
Decay constants and isotopic abundances after Steiger and Jäger (1977).
X symbol preceding sample ID denotes analyses excluded from plateau age calculations.
Weight percent K_2O calculated from ^{39}Ar signal, sample weight, and instrument sensitivity.
Ages calculated relative to FC-2 Fish Canyon Tuff sanidine interlaboratory standard at 28.02 Ma
Decay Constant (LambdaK (total)) = 5.543e-10/a
Correction factors:

$(^{39}Ar/^{37}Ar)_{Ca} = 0.0007 \pm 0.00005$
$(^{36}Ar/^{37}Ar)_{Ca} = 0.00028 \pm 0.00002$
$(^{38}Ar/^{39}Ar)_K = 0.013 \pm 0.001$
$(^{40}Ar/^{39}Ar)_K = 0.010 \pm 0.002$

Table 3. Arrhenius data for feldspar samples. Data shown in bold used for r0 determination.

GP102605-1			GP102605-3		
E=46.0 kcal/mol			E=46.0 kcal/mol		
$Log(D_0/r_0^2)$ = 6.0 /sec			$Log(D_0/r_0^2)$ = 3.2 /sec		
Domain	$Log(D_0/r^2)$	Volume fraction	Domain	$Log(D_0/r^2)$	Volume fraction
1	8.495	0.0317	1	9.194	0.0081
2	6.994	0.0556	2	7.303	0.0301
3	5.820	0.0593	3	6.573	0.0663
4	5.528	0.0445	4	5.811	0.0533
5	4.237	0.0898	5	4.466	0.1162
6	2.800	0.0845	6	3.788	0.0674
7	2.800	0.6347	7	2.000	0.6587