$^{40}Ar/^{39}Ar$ Geochronology Results for Lunar Crater Volcanic Field Basalts, Nevada

By

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Introduction

Greg Valentine from SUNY-Buffalo submitted 8 basalt samples to the NMGRL for $^{40}Ar/^{39}Ar$ dating. The overall goal of the project is to study the Pliocene-Quaternary Lunar Crater Volcanic Field (central Nevada), with focus on linking physical volcanology, local structure, time-volume behavior, and geochemistry to understand the processes associated with intraplate volcanism. Ideally a geochronology-based reference of some units will allow undated units to be dated based on geomorphic characteristics.

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

Groundmass concentrates were prepared from the 8 basaltic samples by crushing and choosing fragments visibly free of phenocrysts. The prepared samples were irradiated for 8 hours at the UGGS TRIGA reactor in Denver, CO along with the standard Fish Canyon tuff sanidine as a neutron flux monitor. Groundmass was analyzed by the step-heating method using a defocused diode laser to heat the samples (Tables 1, 2). A summary of the preferred eruption ages along with a listing of the analytical methods is provided in Table 1 and the general operational details for the NMGRL can be found at internet site http://geoinfo.nmt.edu/publications/openfile/argon/home/html.

The samples were incrementally heated using either 11 or 12 steps (Table 2). The age spectra are variable in form and age with plateau ages falling between about 3.9 and 0.065 Ma (Figures 1, 2; Table 1). The two oldest samples (GVLC-13-50 and 51) have similar spectra with initially old apparent ages the decrease to well defined plateau segments with ages at 3.89±0.01 and 3.16±0.01 Ma, respectively (Figures 1c, d). Samples LC11-48, LC12-79 and GVLC-13-35- have integrated ages between about 900 and 600 ka and their spectra are complex with no statistically rigorous plateau segments (Figures 1b; 2c, d). Weighted mean ages are calculated for the flattest segments and are reported as plateau ages in Table 1. Samples GVLC13-53 and LC12-85 are approximately 200 ka (Figures 1a; 2b). GVLC13-53 has a well-defined plateau age 273±17 ka, however individual steps are very imprecise due to exceptionally low radiogenic yields at about 1% (Figure 1a, Table 2). LV12-85 is more radiogenic and has a saddle-shaped age spectrum with a somewhat noisy saddle segment with a weighted mean age of 220±10 ka

(Figure 2a). Sample LC10-23 is the youngest sample that provides a plateau for the first 6 heating steps at 63±4 ka with the remaining steps climbing to nearly 1 Ma (Figure 2b).

The samples were also evaluated with isochron analysis and are shown in Figure 3. In general isochron data give slightly elevated $^{40}Ar/^{36}Ar$ trapped values between about 298 and 325 (Table 1) and therefore yields younger dates compared to the age spectrum analysis that assumes at trapped initial $^{40}Ar/^{36}Ar$ of 295.5. The isochrons also have variable scatter, but in some instances allow incorporation of more heating steps with normal distributions than the steps defining the plateau ages. For instance, the isochron array for LC10-23 (Figure 3b) incorporates the first 7 heating steps and yields an age of 35±7 ka with an MSWD of 0.87 as compared to the plateau of 6 steps at 63±4 ka. This is also true for the oldest samples where addition of the initial steps of GVLC-13-50 and 51 define a robust isochron with slightly younger ages as compared to the plateau segments (Figures 3g, h; Table 1). Isochron data from the complex ca. 800 ka samples LC11-48 and LC12-79 have very high MSWD values and are essentially averaging the scatter observed in the age spectra (Figures 3e, f) and thus do not appear to offer any insight as to the cause of the complexity.

Discussion

Final choice of preferred age is somewhat subjective, however the basic approach is to incorporate as much of the data as possible that overall yields statistically rigorous populations. By doing so, isochron ages dominate the preferred eruption ages, but it is noted that this procedure is without potential pitfalls. For instance, both GVLC-13-50 and 51 have perfectly defined plateau ages for the majority of the spectra that do not include the initially old apparent ages. Isochron arrays that include these old steps have acceptable MSWD values and suggest that even the plateau segments could have minor excess argon contamination and thus a preferred eruption age based on the isochron is slightly younger than the plateau analysis. It could be argued that the initial heating steps are contaminated with excess argon, however during the plateau steps this excess argon component has been removed leaving only an atmospheric non-radiogenic component. Because there is not a statistical basis to reject the isochron data that incorporate the greatest amount of data, the isochron result is preferred as the eruption age. This choice for these ca. 3.8 and 3.0 Ma samples is only marginally important, however for the youngest sample, LC10-23, the choice of plateau versus isochron results affects the interpreted eruption age by a factor of 2 (Table 1). Because the isochron incorporates the most gas with a lower MSWD value, we prefer to interpret the slightly climbing spectrum to be influenced by excess argon and therefore conclude the most accurate eruption age is 35±7 ka for this sample.

Preferred eruption ages for the complex ca. 800 ka samples are based on the poorly defined weighted mean ages (Table 1). Both the isochron and plateau methods have highly scattered data and perhaps the scatter is partly related to ^{39}Ar recoil redistribution.

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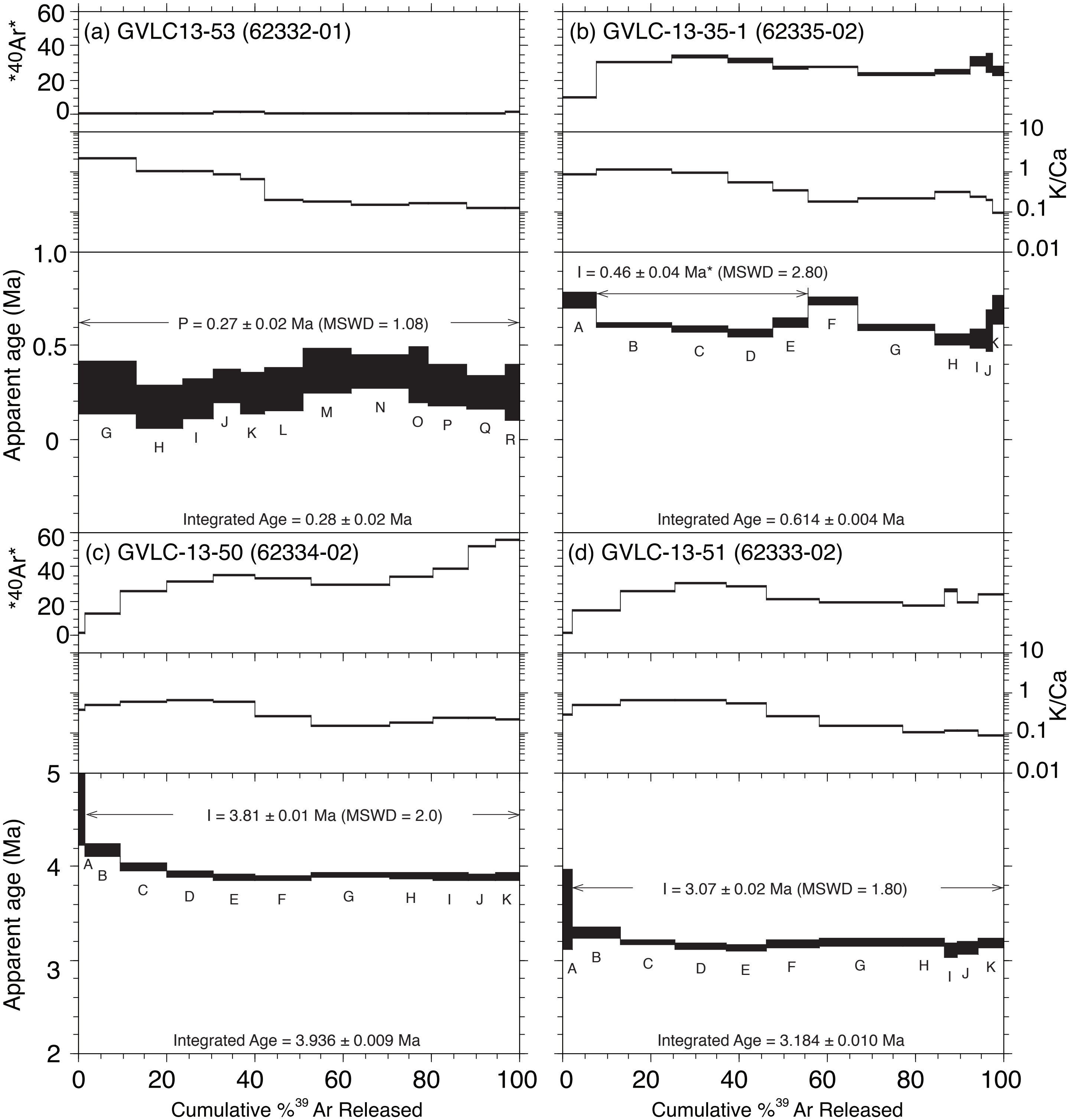

Figure 1. Age, K/Ca and radiogenic yield diagrams for GVL series groundmass samples. Preferred age indicated by steps between the arrows where I = isochron and P = plateau.

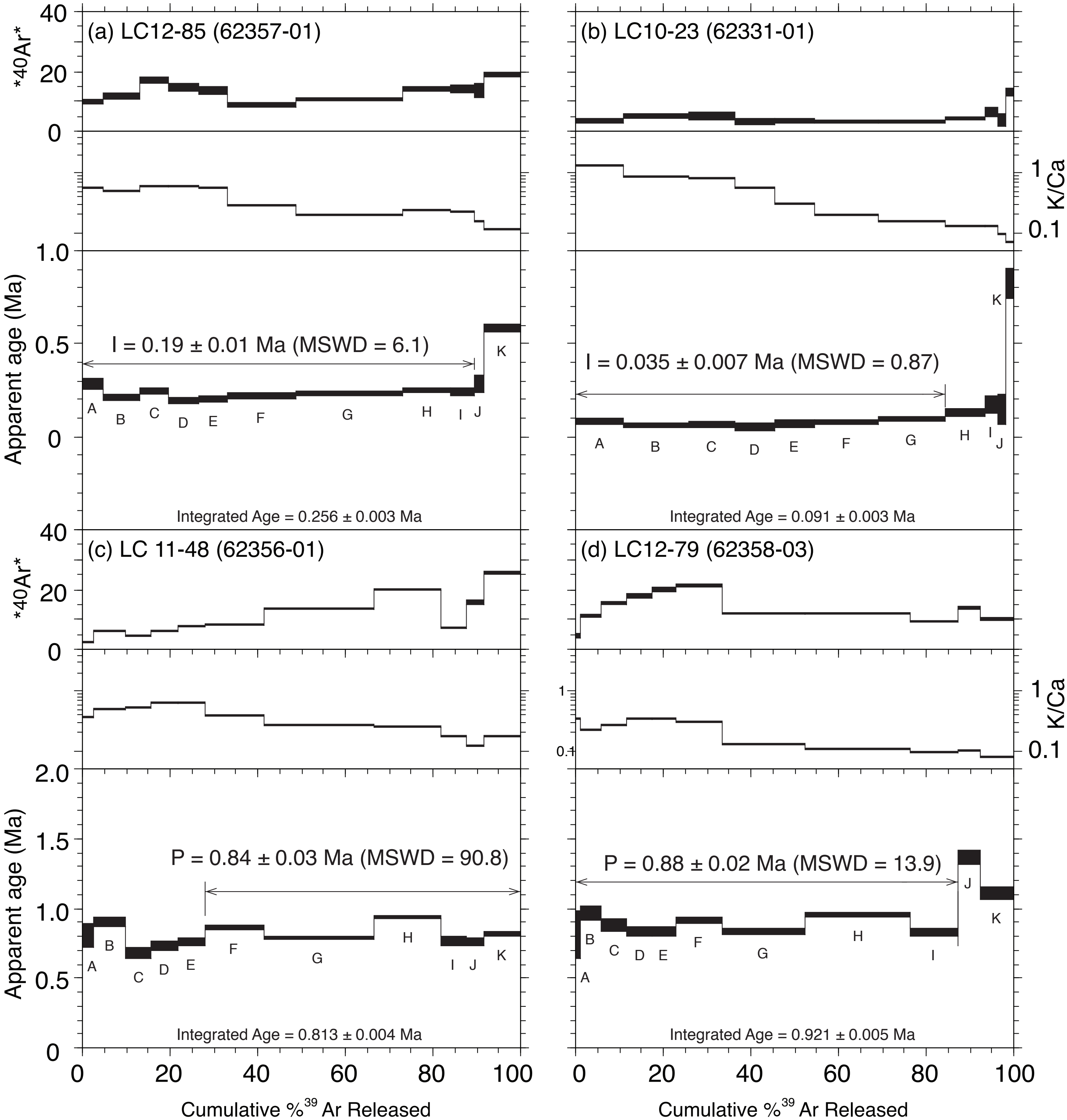

Figure 2. Age, K/Ca and radiogenic yield diagrams for LC series groundmass samples. Preferred age indicated by steps between the arrows where I = isochron and P = plateau.

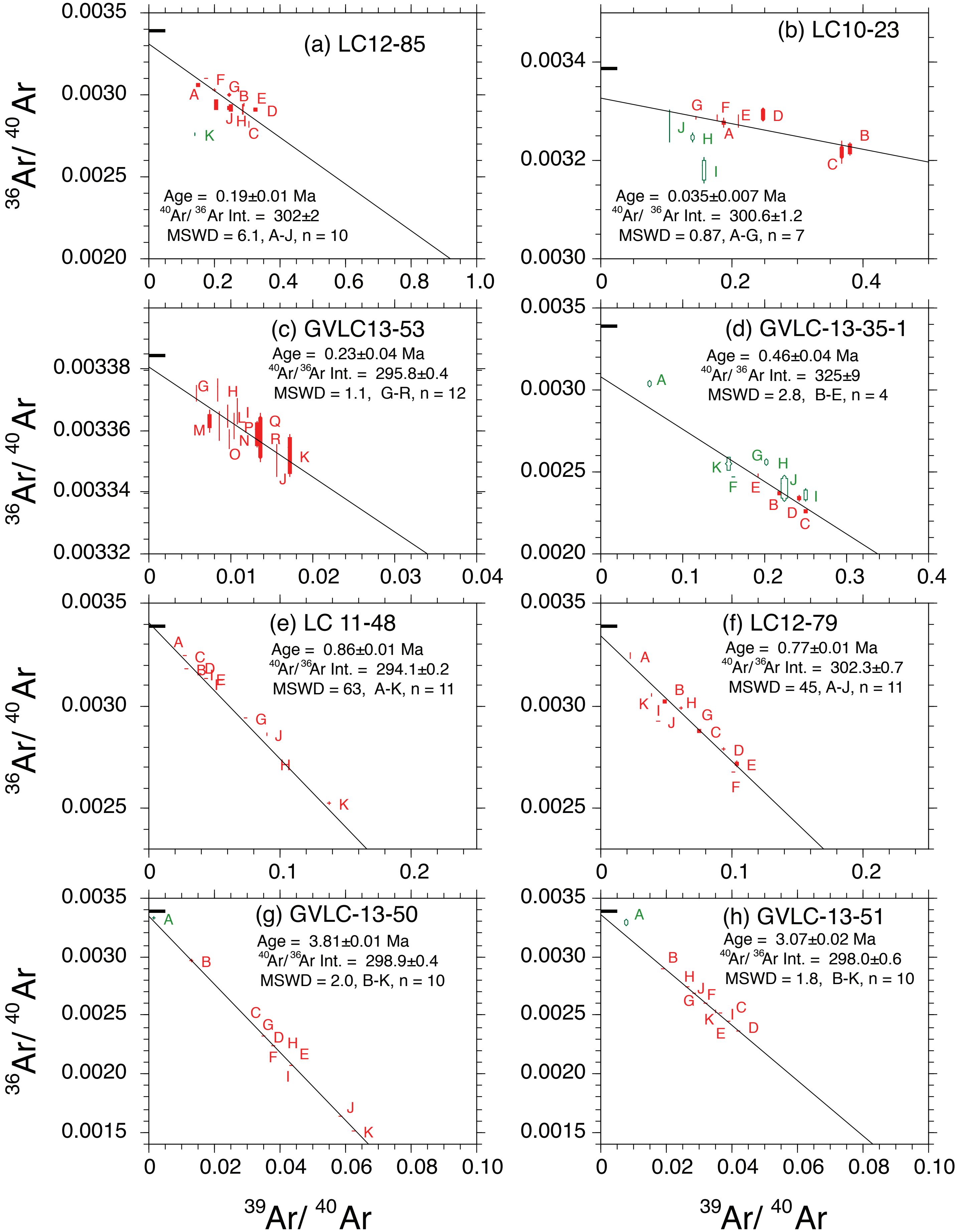

Figure 3. Isochron diagrams for groundmass samples. Data shown in green are omitted from regressions.

Table 1. Summary of analytical methods and instrumentation.

Summary

Sample	L#	Plateau					Isochron						
		Age	±	MSWD	%^{39}Ar	n	Age	±	^{40}Ar/^{36}Ar$_i$	±	MSWD	%^{39}Ar	n
GVLC-13-35-1	62335-02	0.59	0.01	5.9	48.1	4	**0.46**	**0.04**	324.8	9.0	2.8	48.1	4
GVLC-13-50	62334-02	3.89	0.01	0.6	79.8	8	**3.81**	**0.01**	298.9	0.4	2.0	98.3	10
GVLC-13-51	62333-02	3.16	0.01	1.6	86.7	9	**3.07**	**0.02**	298.0	0.6	1.8	97.8	10
GVLC13-53	62332-01	**0.27**	**0.02**	1.1	100.0	12	0.23	0.04	295.8	0.4	1.1	100	12
LC10-23	62331-01	0.063	0.004	1.8	69.4	6	**0.035**	**0.007**	300.6	1.2	0.87	84.5	7
LC 11-48	62356-01	**0.84**	**0.03**	90.8	71.8	6	0.86	0.01	294.1	0.2	63.1	100	11
LC12-79	62358-03	**0.88**	**0.02**	13.9	87.5	9	0.77	0.01	302.3	0.7	45.4	100	11
LC12-85	62357-01	0.22	0.01	5.3	84.4	8	**0.19**	**0.01**	301.9	2.1	6.1	91.7	10

L# = Lab number
n = number of steps for plateau or isochron used for age calculation.
%^{39}Ar = percentage of total ^{39}Ar comprising the plateau or isochron steps.
All errors at 1σ
Age in box is preferred eruption age.

Analytical Methods and Instrumentation

Sample preparation and irradiation:
Groundmass prepared by crushing and hand-picking fragments devoid of phenocrysts.
Samples were loaded into machined Al discs and irradiated for 10 hours, USGS TRIGA Reactor, Denver, CO
Neutron flux monitor Fish Canyon Tuff sanidine (FC-2). Assigned age = 28.201 Ma (Kuiper et al., 2008)

Instrumentation:
Thermo-Fisher Scientific ARGUS VI mass spectrometer on line with automated all-metal extraction system.
System = Obama
Multi-collector configuration: 40Ar-H1, 39Ar-Ax, 38Ar-L1, 37Ar-L2, 36Ar-L3
Amplification: H1, L1, L2 all 1E12 Ohm Faraday, AX 1E13 Ohm Faraday, L3 - CDD ion counter, deadtime 14 nS.
Laser Step-heating:
Samples step-heated (40 second heating) with 55W Photon-Machines diode laser
Reactive gases removed by 4 min reaction with 1 SAES GP-50 getter operated at 450°C.
Gas also exposed to cold finger operated at -140°C and a W filament operated at ~2000°C.

Analytical parameters:
Mass spectrometer sensitivity = 1E-16 mol/fA
Total system blank and background: 20±12%, 0.18±25%, 0.10±150%, 0.20±150%, 0.08±15%, x 10^{-17} moles for masses 40, 39, 38, 37, 36, respectively.
J-factors determined to a precision of ~± 0.02% by CO_2 laser-fusion of 6 single crystals from each radial positions around the irradiation tray.
Correction factors for interfering nuclear reactions were determined using K-glass and CaF_2 and are as follows:
$(^{40}Ar/^{39}Ar)_K = 0.0072\pm0.00016$; $(^{36}Ar/^{37}Ar)_{Ca} = 0.000273\pm0.0000002$; and $(^{39}Ar/^{37}Ar)_{Ca} = 0.000698\pm0.0000078$.

Table 2. Argon isotopic data.

	ID	Power (Watts)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
	GVLC-13-35-1, gm, 21.1 mg, J=0.0002408±0.02%, IC=1.02251±0.00064, NM-264D, Lab#=62335-02										
Xi	A	0.8	17.82	0.6040	54.76	1.161	0.84	9.4	7.8	0.740	0.022
	B	1.3	4.555	0.4703	10.89	2.55	1.1	30.1	24.8	0.603	0.007
	C	1.6	3.979	0.5323	9.117	1.911	0.96	33.3	37.6	0.582	0.009
	D	1.9	4.116	0.9050	9.859	1.527	0.56	30.9	47.8	0.560	0.010
	E	2.2	5.209	1.463	13.25	1.212	0.35	27.0	55.9	0.619	0.013
Xi	F	3.0	6.119	2.736	15.78	1.694	0.19	27.3	67.2	0.737	0.011
Xi	G	4.5	5.807	2.280	15.72	2.61	0.22	23.1	84.7	0.591	0.008
Xi	H	7.0	4.914	1.591	12.98	1.186	0.32	24.4	92.6	0.529	0.013
Xi	I	11.0	3.999	2.148	9.981	0.521	0.24	30.5	96.1	0.537	0.026
Xi	J	14.0	4.449	2.698	11.36	0.233	0.19	29.3	97.6	0.576	0.055
Xi	K	20.0	6.322	5.425	17.58	0.355	0.094	24.7	100.0	0.689	0.038
	Integrated age ± 1σ			n=11		14.96	0.34	K2O=1.13%		0.614	0.004
	Plateau ± 1σ		steps B-E	n=4	MSWD=5.94	7.204			48.1	0.591	0.011
	Isochron±1σ		steps B-E	n=4	MSWD=2.80		$^{40}Ar/^{36}Ar$=	324.8±9.0		0.458	0.040
	GVLC-13-50, gm, 23.28 mg, J=0.0002405±0.01%, IC=1.02251±0.00064, NM-264D, Lab#=62334-02										
Xi	A	0.8	569.1	1.359	1889.7	0.254	0.38	1.9	1.7	4.74	0.26
X	B	1.3	75.06	1.055	222.2	1.224	0.48	12.6	9.7	4.170	0.037
X	C	1.6	35.68	0.8356	90.28	1.597	0.61	25.4	20.2	3.985	0.022
	D	1.9	28.35	0.7885	66.07	1.621	0.65	31.3	30.9	3.908	0.020
	E	2.2	25.24	0.8475	55.81	1.414	0.60	34.9	40.2	3.876	0.019
	F	3.0	26.51	1.935	60.51	1.942	0.26	33.1	53.0	3.867	0.016
	G	4.5	30.16	3.259	72.98	2.72	0.16	29.3	70.8	3.899	0.015
	H	7.0	26.08	2.901	59.09	1.474	0.18	33.9	80.5	3.898	0.019
	I	11.0	22.75	2.084	47.64	1.201	0.24	38.8	88.4	3.888	0.020
	J	14.0	17.00	2.229	28.33	0.961	0.23	51.8	94.7	3.877	0.019
	K	20.0	15.92	2.255	24.61	0.798	0.23	55.4	100.0	3.886	0.021
	Integrated age ± 1σ			n=11		15.20	0.27	K2O=1.04%		3.936	0.008
	Plateau ± 1σ		steps D-K	n=8	MSWD=0.62	12.13			79.8	3.887	0.006
	Isochron±1σ		steps B-K	n=10	MSWD=1.97		$^{40}Ar/^{36}Ar$=	298.9±0.4		3.812	0.013
	GVLC-13-51, gm, 26.57 mg, J=0.0002400±0.02%, IC=1.02251±0.00064, NM-264D, Lab#=62333-02										
Xi	A	0.8	472.7	1.794	1572.7	0.352	0.28	1.7	2.2	3.54	0.21
X	B	1.3	51.49	1.033	149.2	1.765	0.49	14.5	13.3	3.285	0.027
	C	1.6	28.46	0.8105	71.98	1.978	0.63	25.5	25.8	3.182	0.016
	D	1.9	23.61	0.8104	55.88	1.809	0.63	30.3	37.2	3.145	0.016
	E	2.2	25.46	0.8982	62.29	1.425	0.57	28.0	46.2	3.126	0.019
	F	3.0	34.75	2.002	93.75	1.949	0.25	20.7	58.5	3.166	0.018
	G	4.5	38.23	3.445	105.8	2.96	0.15	18.9	77.2	3.182	0.018
	H	7.0	42.15	5.092	119.6	1.489	0.10	17.1	86.5	3.181	0.024
	I	11.0	27.19	4.353	69.37	0.494	0.12	25.9	89.7	3.099	0.038
	J	14.0	37.14	4.662	103.0	0.722	0.11	19.1	94.2	3.117	0.035
	K	20.0	30.83	5.682	81.51	0.919	0.090	23.3	100.0	3.171	0.027
	Integrated age ± 1σ			n=11		15.87	0.21	K2O=0.96%		3.184	0.008
	Plateau ± 1σ		steps C-K	n=9	MSWD=1.62	13.75			86.7	3.160	0.009
	Isochron±1σ		steps B-K	n=10	MSWD=1.83		$^{40}Ar/^{36}Ar$=	298.0±0.6		3.073	0.023

Table 2. Argon isotopic data.

	ID	Power (Watts)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
	GVLC13-53, gm, 13.27 mg, J=0.0002397±0.03%, IC=1.02251±0.00064, NM-264D, Lab#=62332-01										
	G	0.8	172.2	0.2401	580.7	1.278	2.1	0.4	13.3	0.273	0.071
	H	1.3	117.9	0.4957	397.8	1.004	1.0	0.3	23.8	0.166	0.058
	I	1.6	92.39	0.5067	311.2	0.673	1.0	0.5	30.8	0.212	0.053
	J	1.9	63.96	0.5906	214.5	0.595	0.86	1.0	37.0	0.279	0.046
	K	2.2	57.53	0.8080	193.1	0.504	0.63	1.0	42.3	0.243	0.055
	L	3.0	103.9	2.476	350.2	0.852	0.21	0.6	51.2	0.264	0.057
	M	4.0	132.8	2.899	447.2	1.042	0.18	0.6	62.1	0.362	0.061
	N	6.0	101.0	3.454	340.1	1.241	0.15	0.8	75.0	0.357	0.046
	O	7.0	115.2	3.095	387.9	0.436	0.16	0.7	79.6	0.343	0.075
	P	11.0	95.39	3.162	321.5	0.810	0.16	0.7	88.0	0.282	0.056
	Q	14.0	74.49	3.893	251.2	0.862	0.13	0.8	97.0	0.248	0.045
	R	20.0	72.69	4.048	245.2	0.287	0.13	0.8	100.0	0.248	0.076
	Integrated age ± 1σ			n=12		9.58	0.25	K2O=1.16%		0.277	0.018
	Plateau ± 1σ	steps G-R		n=12	MSWD=1.08	9.58			100.0	0.273	0.017
	Isochron±1σ	steps G-R		n=12	MSWD=1.12		$^{40}Ar/^{36}Ar$=	295.8±0.4		0.231	0.044
	LC10-23, gm, 39.24 mg, J=0.0002400±0.03%, IC=1.02241±0.00039, NM-264D, Lab#=62331-01										
	A	0.8	5.309	0.3778	17.48	3.32	1.4	3.3	11.0	0.076	0.008
	B	1.3	2.631	0.5789	8.618	4.53	0.88	4.8	26.1	0.056	0.006
	C	1.6	2.725	0.6253	8.924	3.10	0.82	5.0	36.4	0.059	0.008
	D	1.9	4.018	0.9253	13.46	2.80	0.55	2.8	45.7	0.049	0.009
	E	2.2	4.746	1.690	16.01	2.78	0.30	3.1	54.9	0.065	0.009
	F	3.0	5.629	2.601	19.18	4.36	0.20	3.0	69.4	0.073	0.007
X	G	4.5	6.874	3.296	23.46	4.54	0.15	3.0	84.5	0.090	0.007
Xi	H	7.0	7.062	3.895	23.97	2.73	0.13	4.1	93.6	0.128	0.010
Xi	I	11.0	6.287	3.978	21.04	0.887	0.13	6.1	96.5	0.169	0.025
Xi	J	14.0	9.489	5.333	32.46	0.509	0.096	3.4	98.2	0.142	0.041
Xi	K	20.0	14.42	7.539	44.56	0.544	0.068	12.9	100.0	0.818	0.041
	Integrated age ± 1σ			n=11		30.1	0.25	K2O=1.23%		0.091	0.003
	Plateau ± 1σ	steps A-F		n=6	MSWD=1.84	20.9			69.4	0.063	0.004
	Isochron±1σ	steps A-G		n=7	MSWD=0.87		$^{40}Ar/^{36}Ar$=	300.6±1.2		0.035	0.007
	LC 11-48, gm, 64.08 mg, J=0.0002399±0.04%, IC=1.02241±0.00039, NM-264H, Lab#=62356-01										
X	A	0.8	84.73	1.391	280.9	1.145	0.37	2.2	2.6	0.802	0.044
X	B	1.3	33.32	1.016	106.1	3.19	0.50	6.1	9.9	0.898	0.016
X	C	1.6	35.31	0.9492	114.5	2.65	0.54	4.4	15.9	0.676	0.019
X	D	1.9	28.20	0.8290	90.04	2.73	0.62	5.9	22.1	0.729	0.017
X	E	2.2	22.36	0.8217	70.08	2.68	0.62	7.7	28.2	0.752	0.015
	F	3.0	23.46	1.297	73.13	5.94	0.39	8.3	41.7	0.858	0.010
	G	4.5	13.43	1.921	39.96	11.05	0.27	13.2	66.8	0.781	0.005
	H	7.0	10.74	2.004	29.69	6.70	0.25	19.8	82.0	0.934	0.006
	I	11.0	24.97	2.866	79.38	2.50	0.18	6.9	87.7	0.763	0.016
	J	14.0	11.08	4.129	32.78	1.739	0.12	15.5	91.7	0.758	0.015
	K	20.0	7.224	2.985	19.01	3.66	0.17	25.5	100.0	0.810	0.008
	Integrated age ± 1σ			n=11		44.0	0.28	K2O=1.10%		0.813	0.003
	Plateau ± 1σ	steps F-K		n=6	MSWD=90.8	31.592			71.8	0.836	0.030
	Isochron±1σ	steps A-K		n=11	MSWD=63.1		$^{40}Ar/^{36}Ar$=	294.1±0.2		0.856	0.005

Table 2. Argon isotopic data.

	ID	Power (Watts)	$^{40}Ar/^{39}Ar$	$^{37}Ar/^{39}Ar$	$^{36}Ar/^{39}Ar$ (x 10^{-3})	$^{39}Ar_K$ (x 10^{-15} mol)	K/Ca	$^{40}Ar^*$ (%)	^{39}Ar (%)	Age (Ma)	±1σ (Ma)
	LC12-79, gm, 66.82 mg, J=0.0002401±0.03%, IC=1.02251±0.00064, NM-264H, Lab#=62358-03										
	A	0.8	44.34	1.509	144.2	0.287	0.34	4.2	1.4	0.809	0.086
	B	1.3	20.10	2.338	61.26	0.979	0.22	10.9	6.1	0.962	0.027
	C	1.6	13.13	1.863	38.23	1.171	0.27	15.2	11.7	0.875	0.021
	D	1.9	10.60	1.534	29.92	1.221	0.33	17.8	17.5	0.829	0.020
	E	2.2	9.536	1.485	26.29	1.188	0.34	19.8	23.2	0.830	0.019
	F	3.0	9.768	1.641	26.52	2.14	0.31	21.1	33.5	0.907	0.012
	G	4.5	16.09	3.867	49.11	3.96	0.13	11.7	52.4	0.830	0.010
	H	7.0	18.52	4.860	56.71	5.07	0.10	11.6	76.7	0.949	0.010
	I	11.0	20.89	5.263	65.79	2.26	0.097	8.9	87.5	0.823	0.016
X	J	14.0	22.38	5.215	66.71	1.047	0.098	13.8	92.6	1.359	0.027
X	K	20.0	25.40	6.608	79.27	1.552	0.077	9.9	100.0	1.105	0.022
	Integrated age ± 1σ			n=11		20.9	0.13	K2O=0.50%		0.921	0.005
	Plateau ± 1σ		steps A-I	n=9	MSWD=13.9	18.274			87.5	0.880	0.019
	Isochron±1σ		steps A-K	n=11	MSWD=45.4		$^{40}Ar/^{36}Ar$=	302.3±0.7		0.766	0.014
	LC12-85, gm, 25.44 mg, J=0.0002402±0.04%, IC=1.02251±0.00064, NM-264H, Lab#=62357-01										
X	A	0.8	6.556	0.9315	20.28	0.626	0.55	9.7	5.1	0.279	0.014
	B	1.3	4.039	1.012	12.34	1.033	0.50	11.6	13.4	0.206	0.009
	C	1.6	3.273	0.8698	9.439	0.798	0.59	16.8	19.9	0.241	0.009
	D	1.9	3.037	0.8484	9.023	0.850	0.60	14.3	26.7	0.190	0.009
	E	2.2	3.448	0.9248	10.35	0.800	0.55	13.3	33.2	0.202	0.009
	F	3.0	5.631	1.794	17.88	1.944	0.28	8.6	48.9	0.214	0.008
	G	4.5	4.926	2.505	15.58	3.03	0.20	10.6	73.4	0.229	0.006
	H	7.0	4.029	2.153	12.32	1.329	0.24	13.8	84.1	0.245	0.008
	I	11.0	3.934	2.273	12.08	0.665	0.22	13.8	89.5	0.239	0.011
X	J	14.0	4.784	3.401	14.95	0.272	0.15	13.3	91.7	0.280	0.023
Xi	K	20.0	7.090	4.451	20.75	1.030	0.11	18.5	100.0	0.578	0.011
	Integrated age ± 1σ			n=11		12.38	0.26	K2O=0.78%		0.256	0.003
	Plateau ± 1σ		steps B-I	n=8	MSWD=5.33	10.45			84.4	0.222	0.007
	Isochron±1σ		steps A-J	n=10	MSWD=6.14		$^{40}Ar/^{36}Ar$=	301.9±2.1		0.189	0.011

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).
Isochron data calculated using methods of York (1969).
Decay constants and isotopic abundances after Steiger and Jäger (1977).
Isotopic abundances after Steiger and Jäger (1977).
x preceding sample ID denotes analyses excluded from plateau age calculations.
i preceding sample ID denotes analyses excluded from isochron age calculations.
IC = measured 40Ar/36Ar of air standard divided by 295.5.
Ages relative to FC-2 Fish Canyon Tuff sanidine interlaboratory standard at 28.201 Ma (Kuiper et al., 2008).
Decay Constant (LambdaK (total)) = 5.463e-10/a (Min et al., 2000).
Correction factors:
$(^{39}Ar/^{37}Ar)_{Ca}$ = 0.00069 ± 2e-06
$(^{36}Ar/^{37}Ar)_{Ca}$ = 0.0002724 ± 2e-07
$(^{40}Ar/^{39}Ar)_K$ = 0.0072 ± 2e-05