

## Summary of new $^{40}\text{Ar}/^{39}\text{Ar}$ age data, analytical methods, and instrumentation

This supplemental material contains the data tables and corresponding plots for all the new  $^{40}\text{Ar}/^{39}\text{Ar}$  analyses conducted as part of this study. Samples are organized similar to that of Table 1 within the manuscript. Notes at the end contain additional information regarding sample preparation and irradiation, age calculations, instrumentation, and analytical parameters.

### References Cited

Kuiper, K. F., Deino, A., Hilgen, F. J., Krijgsman, W., Renne, P. R., and Wijbrans, J. R., 2008, Synchronizing rock clocks of earth history: *Science*, v. 320, p. 500-504.

Min, K., Mundil, R., Renne, P. L., and Ludwig, K.R., 2000, A test for systematic errors in  $^{40}\text{Ar}/^{39}\text{Ar}$  geochronology through comparison with U/Pb analysis of a 1.1-Ga rhyolite: *Geochimica et Cosmochimica Acta*, v. 64, p. 73-98.

Taylor, J. R., 1982, *An Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements.*, University Science Books, Mills Valley, California, 270 p.

Steiger, R.H., and Jager, E., 1977. Subcommittee on geochronology: convention on the use of decay constants in geo- and cosmochronology: *Earth and Planetary Science Letters*, v. 36, p. 359–362.

York, D., 1969, Least squares fitting of a straight line with correlated errors, *Earth and Planetary Science Letters*, v. 5, p. 320-324.

**Supplemental Table 1.  $^{40}\text{Ar}/^{39}\text{Ar}$  analytical data of the RCVF.**

ID	Power (Watts)	$^{40}\text{Ar}/^{39}\text{Ar}$	$^{37}\text{Ar}/^{39}\text{Ar}$	$^{36}\text{Ar}/^{39}\text{Ar}$ ( $\times 10^{-3}$ )	$^{39}\text{Ar}_k$ ( $\times 10^{-15}$ mol)	K/Ca	$^{40}\text{Ar}^*$ (%)	$^{39}\text{Ar}$ (%)	Age (ka)	$\pm 1\sigma$ (ka)
<b>NMRC-11</b> , GroundmassConcentrate, 32.74 mg, J=0.0002397 $\pm$ 0.05%, IC(O)=1.02493 $\pm$ 0.00056, NM-264E, Lab#=62341-02										
Xi A	0.3	50.82	1.026	174.0	0.481	0.50	-1.0	4.8	-228.8	30.6
Xi B	0.5	20.06	1.464	68.59	0.807	0.35	-0.5	12.9	-46.3	14.3
C	0.8	8.702	1.488	29.52	2.33	0.34	1.0	36.3	38.1	5.6
D	1.0	6.135	1.435	20.77	1.39	0.36	1.6	50.3	44.3	6.1
E	1.3	6.386	1.583	21.72	1.45	0.32	1.3	64.9	36.9	5.9
F	1.6	8.539	1.955	29.11	1.09	0.26	1.0	75.9	35.9	7.8
G	1.9	10.86	2.506	37.28	0.651	0.20	0.3	82.4	12.0	11.9
i H	2.2	12.21	3.119	41.62	0.233	0.16	1.2	84.8	62.3	22.0
I	4.5	21.14	6.124	73.08	0.442	0.083	0.1	89.2	7.2	20.7
J	7.0	29.82	10.00	103.6	0.509	0.051	-0.1	94.3	-8.5	22.5
Xi K	14.0	37.39	11.04	130.0	0.565	0.046	-0.5	100.0	-77.7	22.4
<b>Integrated age <math>\pm 2\sigma</math></b>		n=11			9.95	0.18	K2O=0.49%		7.3	7.0
<b>Plateau <math>\pm 2\sigma</math></b>		steps C-J	n=8	MSWD=1.91	8.10	0.28 $\pm$ 0.23		81.4	36.4	8.1
<b>Isochron<math>\pm 2\sigma</math></b>		steps C-J	n=7	MSWD=0.67	$^{40}\text{Ar}/^{36}\text{Ar} =$		293.9 $\pm$ 1.1	54.8	13.6	
<b>NMRC-11</b> , GroundmassConcentrate, 92.81 mg, J=0.0000844 $\pm$ 0.04%, IC(O)=1.02196 $\pm$ 0.00018, NM-266G, Lab#=62817-02										
Xi A	0.8	135.6	1.380	462.2	0.412	0.37	-0.6	5.0	-133.3	22.0
X B	1.3	48.86	1.700	165.7	0.944	0.30	0.0	16.6	3.6	8.1
C	1.6	31.54	1.664	106.5	0.884	0.31	0.7	27.4	32.0	6.1
D	1.9	25.87	1.688	87.23	0.887	0.30	0.8	38.3	33.6	6.1
E	2.2	25.58	1.780	86.27	0.793	0.29	0.8	48.0	33.2	6.3
F	3.0	29.30	2.260	99.03	1.15	0.23	0.7	62.1	31.9	5.6
G	4.5	34.19	2.705	115.9	1.21	0.19	0.4	77.0	23.4	5.9
H	7.0	40.70	3.576	137.6	0.511	0.14	0.8	83.3	48.7	10.2
I	11.0	37.20	4.224	126.4	0.523	0.12	0.5	89.7	26.6	8.8
J	14.0	44.18	5.430	149.6	0.369	0.094	0.9	94.2	62.1	12.4
X K	20.0	51.40	6.661	174.4	0.474	0.077	0.7	100.0	57.4	12.4
<b>Integrated age <math>\pm 2\sigma</math></b>		n=11			8.16	0.19	K2O=0.40%		22.9	5.0
<b>Plateau <math>\pm 2\sigma</math></b>		steps C-J	n=8	MSWD=1.58	6.33	0.23 $\pm$ 0.17		77.6	32.6	6.1
<b>Isochron<math>\pm 2\sigma</math></b>		steps B-K	n=10	MSWD=3.43	$^{40}\text{Ar}/^{36}\text{Ar} =$		295.2 $\pm$ 1.1	35.6	11.3	
<b>NMRC-11</b> , GroundmassConcentrate, 122.73 mg, J=0.0002547 $\pm$ 0.03%, IC(O)=1.00948 $\pm$ 0.00074, NM-287C, Lab#=65357-01										
X A	0.5	401.9	0.6760	1357.5	0.2	0.75	0.2	0.2	390.1	461.4
Xi B	0.8	81.66	0.8602	278.5	2.3	0.59	-0.7	1.8	-272.7	77.6
Xi C	1.3	26.62	1.689	90.87	11.0	0.30	-0.4	9.6	-50.1	19.9
Xi D	1.6	13.31	1.871	45.58	14.1	0.27	-0.2	19.5	-11.1	12.1
E	1.9	8.383	1.781	28.59	17.8	0.29	0.8	32.0	31.5	8.3
F	2.2	6.753	1.775	23.02	18.7	0.29	1.2	45.2	37.3	7.6
G	3.0	7.924	2.063	26.96	27.2	0.25	1.4	64.4	51.6	6.8
H	5.0	11.02	3.324	37.86	23.1	0.15	0.8	80.6	41.4	8.7
I	7.0	15.65	5.680	54.11	9.9	0.090	0.7	87.6	47.7	15.1
J	10.0	16.63	6.368	57.50	7.7	0.080	0.8	93.0	61.3	17.6
Xi K	15.0	18.79	7.049	65.46	9.9	0.072	-0.1	100.0	-5.9	17.1
<b>Integrated age <math>\pm 2\sigma</math></b>		n=11			141.8	0.17	K2O=1.74%		22.9	7.9
<b>Plateau <math>\pm 2\sigma</math></b>		steps E-J	n=6	MSWD=1.06	104.2	0.21 $\pm$ 0.19		73.5	42.7	7.5
<b>Isochron<math>\pm 2\sigma</math></b>		steps A-J	n=7	MSWD=0.90	$^{40}\text{Ar}/^{36}\text{Ar} =$		296.2 $\pm$ 1.1	33.5	15.4	

**JS-95-48**, GroundmassConcentrate, 10.81 mg, J=0.0002392±0.04%, IC(O)=1.02397±0.00104, NM-264H, Lab#=62355-01

X A	0.3	15.50	1.663	53.00	0.112	0.31	-0.3	3.2	-17.6	42.3
X B	0.5	11.40	1.884	39.25	0.122	0.27	-0.5	6.7	-26.9	37.7
X C	0.8	8.552	1.662	29.39	0.338	0.31	-0.1	16.4	-4.7	16.9
D	1.0	5.392	1.779	18.51	0.193	0.29	1.0	22.0	23.8	20.1
E	1.3	5.042	1.682	17.21	0.489	0.30	1.6	36.1	35.2	10.3
F	1.6	4.658	2.086	16.14	0.237	0.24	0.9	42.9	18.5	16.2
i G	1.9	3.957	2.300	13.54	0.213	0.22	3.2	49.0	55.7	17.1
H	2.2	3.766	2.135	13.13	0.270	0.24	1.2	56.8	19.3	14.4
i I	4.5	5.664	2.898	19.50	0.937	0.18	2.1	83.7	53.0	8.4
J	7.0	6.809	5.230	23.90	0.465	0.098	2.1	97.0	63.7	13.1
K	14.0	5.168	6.465	18.80	0.102	0.079	2.1	100.0	47.7	15.1
i L	25.0	230.7	26.37	807.1	0.001	0.019	-2.5	100.0	-2584.1	#####
<b>Integrated age ± 2σ</b>					n=12	3.48	0.19	K2O=0.52%	33.8	9.5
<b>Plateau ± 2σ</b>					steps D-L n=9 MSWD=1.47	2.91	0.20 ±0.20	83.6	42.6	11.4
<b>Isochron±2σ</b>					steps A-K n=9 MSWD=2.03	<sup>40</sup> Ar/ <sup>36</sup> Ar= 293.1±3.6		49.9	20.3	

**JS-95-48**, GroundmassConcentrate, 101.04 mg, J=0.0002392±0.04%, IC(O)=1.02255±0.00042, NM-264H, Lab#=62355-02

Xi A	0.8	20.87	1.759	71.14	0.879	0.29	-0.1	3.9	-10.5	13.6
B	1.3	7.093	1.543	24.18	2.39	0.33	0.8	14.6	26.1	4.7
C	1.6	5.000	1.469	17.00	2.31	0.35	1.7	25.0	36.4	3.9
D	1.9	4.716	1.488	16.01	2.24	0.34	2.0	35.0	40.7	3.8
E	2.2	4.413	1.581	15.04	1.99	0.32	1.9	43.9	37.3	3.9
F	3.0	4.775	1.826	16.31	3.33	0.28	1.9	58.8	39.6	3.2
H	7.0	4.056	2.967	14.22	2.86	0.17	1.9	71.6	34.0	3.2
I	11.0	3.944	3.305	13.94	2.58	0.15	1.9	83.1	32.5	3.3
J	14.0	4.064	3.539	14.36	2.04	0.14	2.2	92.2	39.0	3.8
K	20.0	4.224	3.820	14.96	1.73	0.13	2.2	100.0	40.5	4.1
<b>Integrated age ± 2σ</b>					n=10	22.4	0.22	K2O=0.36%	34.2	2.6
<b>Plateau ± 2σ</b>					steps B-K n=9 MSWD=1.33	21.5	0.25 ±0.19	96.1	36.4	2.8
<b>Isochron±2σ</b>					steps B-K n=9 MSWD=1.23	<sup>40</sup> Ar/ <sup>36</sup> Ar= 294.0±2.1		46.7	13.0	

**JS-95-48**, GroundmassConcentrate, 79.39 mg, J=0.0002391±0.04%, IC(O)=1.2443±0.00059, NM-264H, Lab#=62354-02

Xi A	0.8	2.733	0.7111	8.442	0.024	0.72	10.5	0.1	125.0	97.2
X B	1.3	3.177	1.340	10.79	0.271	0.38	2.7	1.8	37.2	11.6
Xi C	1.6	3.586	1.412	12.07	0.837	0.36	3.4	7.0	52.7	5.9
Xi D	1.9	3.993	1.490	13.48	1.46	0.34	3.0	15.9	52.0	4.3
i E	2.2	4.362	1.636	14.82	1.51	0.31	2.4	25.2	45.0	4.4
F	3.0	5.470	2.059	18.77	2.48	0.25	1.4	40.5	33.5	4.1
G	4.5	5.213	2.547	18.03	3.13	0.20	1.4	59.8	32.6	3.5
H	7.0	4.152	3.272	14.60	1.88	0.16	2.0	71.3	36.6	3.8
I	11.0	4.094	3.534	14.48	1.77	0.14	2.0	82.2	36.6	4.0
i J	14.0	3.785	3.724	13.40	1.37	0.14	2.9	90.6	47.9	4.7
K	20.0	4.157	3.834	14.79	1.53	0.13	1.9	100.0	34.6	4.6
<b>Integrated age ± 2σ</b>					n=11	16.3	0.19	K2O=0.33%	39.2	2.9
<b>Plateau ± 2σ</b>					steps E-K n=7 MSWD=1.88	13.7	0.19 ±0.14	84.1	37.4	4.2
<b>Isochron±2σ</b>					steps B-K n=6 MSWD=0.05	<sup>40</sup> Ar/ <sup>36</sup> Ar= 293.9±3.7		45.4	25.0	

**NMRC-10**, GroundmassConcentrate, 91.09 mg, J=0.0002396±0.04%, IC(O)=1.02395±0.00037, NM-264B, Lab#=62313-02

Xi A	0.8	116.6	1.109	393.2	1.16	0.46	0.4	3.8	206.2	36.0
X B	1.3	29.49	1.284	99.21	2.71	0.40	0.9	12.6	117.3	12.9
X C	1.6	18.16	1.240	61.03	2.77	0.41	1.2	21.7	93.6	9.6
Xi D	1.9	13.09	1.224	43.81	2.78	0.42	1.8	30.7	103.9	7.2

X E	2.2	10.81	1.306	36.26	2.53	0.39	1.7	39.0	82.1	7.1
X F	3.0	8.662	1.835	29.18	4.01	0.28	2.0	52.1	77.5	5.6
X G	4.5	7.573	2.557	25.75	6.08	0.20	2.0	71.9	67.7	3.7
Xi H	7.0	6.179	2.804	21.28	2.93	0.18	1.7	81.5	45.2	4.9
X I	11.0	6.216	2.818	21.26	2.28	0.18	2.4	89.0	64.4	5.6
X J	14.0	5.772	2.767	19.76	1.45	0.18	2.5	93.7	62.5	7.4
Xi K	20.0	5.651	2.980	19.14	1.93	0.17	3.9	100.0	96.8	6.3
<b>Integrated age ± 2σ</b>			n=11		30.6	0.25	K2O=0.54%		84.6	5.1
<b>Plateau ± 2σ</b>	no plateau		n=0	MSWD=0.00	0.0	0.00 ±0.00	0.0		0.0	0.0
<b>Isochron±2σ</b>	steps B-J		n=7	MSWD=0.41		<sup>40</sup> Ar/ <sup>36</sup> Ar=	297.1±0.7		51.7	9.9

**NMRC-17a**, GroundmassConcentrate, 44.04 mg, J=0.0002397±0.04%, IC(O)=1.02443±0.00059, NM-264B, Lab#=62314-03

A	0.8	19.16	0.8988	64.70	2.39	0.57	0.5	16.0	46.1	8.5
B	1.3	7.756	1.172	26.14	2.98	0.44	1.5	35.9	51.0	4.3
C	1.6	6.904	1.429	23.43	1.71	0.36	1.2	47.3	37.6	5.4
D	1.9	7.484	1.845	25.34	1.16	0.28	1.8	55.1	58.8	6.7
Xi E	2.2	8.033	2.195	27.57	0.900	0.23	0.6	61.1	21.9	7.9
X F	3.0	7.829	2.694	26.88	1.33	0.19	1.1	70.0	38.6	6.5
X G	4.5	8.082	3.253	27.93	1.32	0.16	0.9	78.8	32.4	6.5
X H	7.0	6.685	3.178	23.06	0.695	0.16	1.7	83.5	49.3	8.1
Xi I	11.0	6.943	3.684	23.86	0.816	0.14	2.5	88.9	75.9	7.7
Xi J	14.0	6.696	4.323	23.09	0.648	0.12	3.0	93.3	88.4	8.4
X K	20.0	6.773	4.522	23.65	1.01	0.11	1.9	100.0	57.5	6.9
<b>Integrated age ± 2σ</b>			n=11		15.0	0.23	K2O=0.54%		48.1	4.4
<b>Plateau ± 2σ</b>	steps A-D		n=4	MSWD=2.25	8.2	0.44 ±0.25	55.1		48.2	8.5
<b>Isochron±2σ</b>	steps A-K		n=8	MSWD=2.65		<sup>40</sup> Ar/ <sup>36</sup> Ar=	295.4±1.0		47.6	11.3

**NMRC-17b**, GroundmassConcentrate, 99.19 mg, J=0.0002399±0.04%, IC(O)=1.02309±0.00122, NM-264B, Lab#=62315-01

A	0.8	6.659	0.4142	22.24	3.51	1.2	1.7	9.6	49.5	4.7
B	1.3	2.344	0.7200	7.738	5.86	0.71	4.5	25.6	46.6	2.0
C	1.6	2.346	1.022	7.832	4.43	0.50	4.4	37.7	45.5	2.1
D	1.9	2.498	1.207	8.407	3.42	0.42	4.0	47.1	43.9	2.5
E	2.2	2.604	1.291	8.822	2.77	0.40	3.5	54.6	39.8	2.6
F	3.0	2.803	1.577	9.578	3.62	0.32	3.2	64.5	38.7	2.7
G	4.5	2.966	1.879	10.21	5.09	0.27	2.9	78.4	38.1	2.5
Xi H	7.0	3.743	3.165	13.26	3.65	0.16	1.7	88.4	28.0	3.3
X I	11.0	4.973	4.885	17.80	1.67	0.10	1.7	93.0	37.6	5.3
X J	14.0	6.141	6.130	22.14	1.27	0.083	1.1	96.4	30.0	6.8
X K	20.0	6.804	7.008	24.47	1.30	0.073	1.7	100.0	49.7	6.9
<b>Integrated age ± 2σ</b>			n=11		36.6	0.27	K2O=0.59%		41.3	2.0
<b>Plateau ± 2σ</b>	steps A-G		n=7	MSWD=2.39	28.7	0.55 ±0.66	78.4		43.1	2.9
<b>Isochron±2σ</b>	steps A-K		n=10	MSWD=2.48		<sup>40</sup> Ar/ <sup>36</sup> Ar=	295.3±1.1		43.5	4.8

**NMRC-17b**, GroundmassConcentrate, 48.56 mg, J=0.0002399±0.04%, IC(O)=1.02443±0.00059, NM-264B, Lab#=62315-02

A	0.8	4.145	0.5550	13.78	4.19	0.92	2.7	23.3	48.2	2.6
B	1.3	2.440	1.062	8.176	3.78	0.48	4.1	44.2	43.5	2.1
C	1.6	2.595	1.364	8.743	1.81	0.37	4.3	54.3	48.5	3.1
D	1.9	2.893	1.561	9.844	1.19	0.33	3.4	60.9	43.3	4.2
E	2.2	2.898	1.773	9.875	0.974	0.29	3.8	66.3	48.5	4.8
Xi F	3.0	3.029	1.985	10.51	1.39	0.26	2.3	74.0	31.0	4.0
X G	4.5	3.453	2.590	12.06	1.17	0.20	2.5	80.5	37.5	4.9
X H	7.0	3.842	3.478	13.53	1.09	0.15	2.8	86.6	46.8	5.1
X I	11.0	5.130	4.864	18.32	1.05	0.10	1.7	92.4	38.9	6.2
X J	14.0	5.826	6.017	20.96	0.719	0.085	1.6	96.4	41.6	8.0
X K	20.0	6.360	6.570	22.76	0.642	0.078	2.2	100.0	61.3	8.8

<b>Integrated age ± 2σ</b>	n=11			18.0	0.26	K2O=0.59%	44.4	2.4
<b>Plateau ± 2σ</b>	steps A-E	n=5	MSWD=0.87	11.9	0.59 ±0.51	66.3	45.9	2.6
<b>Isochron±2σ</b>	steps A-K	n=10	MSWD=1.30		<sup>40</sup> Ar/ <sup>36</sup> Ar=	296.2±1.7	42.3	7.7

**NMRC-13**, GroundmassConcentrate, 97.2 mg, J=0.0002397±0.03%, IC(O)=1.02255±0.00043, NM-264G, Lab#=62348-01

X A	0.3	303.3	2.252	1025.7	0.072	0.23	0.1	0.2	164.7	175.2
X B	0.5	79.36	1.659	267.5	0.321	0.31	0.5	1.1	186.0	42.1
Xi C	0.8	21.01	1.169	70.42	1.93	0.44	1.3	6.7	123.9	9.1
Xi D	1.0	14.18	0.9996	47.48	1.97	0.51	1.6	12.4	96.6	7.3
X E	1.3	10.69	0.9635	35.85	2.66	0.53	1.5	20.1	71.9	5.6
X F	1.6	8.895	0.9663	29.74	2.83	0.53	2.0	28.3	76.5	4.5
G	1.9	7.549	1.024	25.27	2.69	0.50	2.1	36.1	68.0	4.4
H	2.2	6.769	1.172	22.77	2.44	0.44	1.8	43.2	54.6	4.3
I	4.5	4.726	2.252	16.13	9.71	0.23	2.7	71.3	56.4	2.0
i J	6.5	3.628	2.853	12.64	4.68	0.18	3.0	84.8	47.2	2.3
K	9.0	3.742	3.765	13.21	1.73	0.14	3.3	89.8	54.9	4.0
L	11.0	3.863	3.909	13.60	1.01	0.13	3.7	92.8	61.9	5.6
M	14.0	3.952	4.114	14.06	0.988	0.12	2.8	95.6	48.1	6.0
X N	20.0	4.191	4.066	14.81	1.51	0.13	3.0	100.0	54.3	4.4
<b>Integrated age ± 2σ</b>			n=14		34.5	0.25	K2O=0.57%		66.0	2.7
<b>Plateau ± 2σ</b>	steps G-M	n=7	MSWD=3.89	23.2	0.26 ±0.31	67.3			54.2	4.8
<b>Isochron±2σ</b>	steps A-N	n=11	MSWD=2.22		<sup>40</sup> Ar/ <sup>36</sup> Ar=	296.6±0.5			50.3	4.5

**NMRC-15**, GroundmassConcentrate, 92.38 mg, J=0.0002391±0.04%, IC(O)=1.02255±0.00043, NM-264G, Lab#=62350-01

X A	0.5	1161.3	2.206	3949.1	0.215	0.23	-0.5	0.7	-2428.6	282.0
X B	0.8	255.9	1.397	873.3	1.05	0.37	-0.8	4.2	-878.9	62.4
X C	1.0	174.1	1.099	592.8	1.09	0.46	-0.6	7.8	-432.7	43.6
X D	1.3	128.5	0.9485	436.5	1.67	0.54	-0.3	13.3	-167.6	32.1
X E	1.6	105.6	0.8891	356.7	1.90	0.57	0.2	19.5	107.2	27.2
X F	1.9	91.98	0.9475	310.7	1.88	0.54	0.3	25.7	108.9	24.1
X G	2.2	83.93	1.104	282.9	1.72	0.46	0.5	31.4	178.4	23.7
X H	3.0	63.97	1.699	215.9	3.11	0.30	0.5	41.6	126.3	16.1
X I	4.5	52.95	2.311	178.7	5.75	0.22	0.6	60.6	137.6	12.1
X J	7.0	34.39	2.668	115.6	3.35	0.19	1.2	71.7	181.7	10.2
X K	11.0	29.33	3.094	97.94	2.61	0.16	2.1	80.2	273.8	10.2
X L	13.0	26.48	3.294	88.19	2.00	0.15	2.5	86.8	294.7	10.2
X M	16.0	26.84	3.306	89.54	1.58	0.15	2.3	92.1	276.2	11.2
X N	20.0	25.46	3.167	85.38	2.40	0.16	1.9	100.0	207.2	9.3
<b>Integrated age ± 2σ</b>			n=14		30.3	0.24	K2O=0.53%		84.0	11.4
<b>Plateau ± 2σ</b>	no plateau	n=0	MSWD=0.00	0.000	0.000±0.000	0.0			0.0	0.0
<b>Isochron±2σ</b>	steps A-N	n=14	MSWD=17.63		<sup>40</sup> Ar/ <sup>36</sup> Ar=	293.3±0.2			338.8	12.0

**NMRC-16**, GroundmassConcentrate, 79.85 mg, J=0.0002393±0.04%, IC(O)=1.02255±0.00043, NM-264G, Lab#=62351-01

A	0.5	13.87	2.290	47.03	0.295	0.22	1.0	1.0	63.3	18.8
B	0.8	2.886	1.314	9.647	1.71	0.39	4.5	7.0	56.9	3.5
C	1.0	1.811	1.044	5.977	1.75	0.49	6.6	13.2	51.9	5.4
D	1.3	1.614	0.9395	5.273	2.59	0.54	7.5	22.2	53.0	2.2
E	1.6	1.550	0.8974	5.051	2.70	0.57	7.8	31.7	52.5	2.0
F	1.9	1.716	0.9434	5.598	2.41	0.54	7.5	40.1	56.2	2.3
G	2.2	1.961	1.125	6.490	2.01	0.45	6.3	47.2	53.9	2.7
H	3.0	2.527	1.744	8.558	3.20	0.29	5.0	58.4	55.3	2.4
Xi I	4.5	2.838	2.316	9.694	4.73	0.22	5.2	75.0	64.1	2.1
X J	7.0	3.027	2.792	10.50	2.27	0.18	4.4	82.9	58.4	3.1
Xi K	11.0	4.454	4.218	15.26	2.07	0.12	6.0	90.2	116.6	4.0
Xi L	14.0	6.782	4.684	16.45	1.14	0.11	33.6	94.2	1001.0	5.6

Xi M	20.0	4.228	4.384	14.76	1.67	0.12	4.8	100.0	88.3	4.2
<b>Integrated age ± 2σ</b>			n=13		28.5	0.25	K2O=0.57%		100.5	1.8
<b>Plateau ± 2σ</b>	steps A-H		n=8	MSWD=0.44	16.7	0.46 ±0.25	58.4		54.2	1.9
<b>Isochron±2σ</b>	steps A-J		n=9	MSWD=0.37		<sup>40</sup> Ar/ <sup>36</sup> Ar=	296.7±1.6		51.3	4.9

**NMRC-21**, GroundmassConcentrate, 96.05 mg, J=0.0002399±0.03%, IC(O)=1.02052±0.00058, NM-264G, Lab#=62353-01

Xi A	0.8	27.78	0.2863	95.00	3.96	1.8	-1.0	7.7	-120.9	10.0
Xi B	1.3	14.55	0.4474	49.55	6.43	1.1	-0.5	20.2	-30.5	5.3
Xi C	1.6	11.97	0.5566	40.70	5.57	0.92	-0.2	31.0	-10.6	4.8
Xi D	1.9	11.10	0.6563	37.71	4.90	0.78	0.0	40.6	0.5	4.7
Xi E	2.2	11.05	0.7441	37.56	4.09	0.69	0.0	48.5	-1.5	4.8
Xi F	3.0	10.90	0.9109	37.09	5.56	0.56	0.0	59.3	0.1	4.4
Xi G	4.5	10.81	1.054	36.85	7.93	0.48	0.0	74.8	-0.6	4.1
Xi H	7.0	10.93	1.531	36.97	5.27	0.33	1.1	85.0	53.5	4.6
Xi I	11.0	10.46	1.710	35.32	2.09	0.30	1.4	89.1	64.9	6.3
Xi J	14.0	11.09	2.037	37.42	1.98	0.25	1.6	92.9	79.5	6.7
Xi K	20.0	10.79	2.043	36.21	3.63	0.25	2.2	100.0	104.6	5.4
<b>Integrated age ± 2σ</b>			n=11		51.4	0.53	K2O=0.86%		4.1	3.3
<b>Plateau ± 2σ</b>	steps C-G		n=5	MSWD=0.95	28.0	0.67 ±0.34	54.6		0.0	0.0
<b>Isochron±2σ</b>	steps C-G		n=5	MSWD=0.12		<sup>40</sup> Ar/ <sup>36</sup> Ar=	289.3±6.5		0.0	0.0

**NMRC-21**, GroundmassConcentrate, 126.8 mg, J=0.0002548±0.04%, IC(F)=1.00200±0.00109, NM-287C, Lab#=65361-01

Xi A	0.5	156.0	1.419	533.0	0.2	0.36	-0.9	0.2	-631.6	202.8
Xi B	0.8	60.56	0.3028	206.8	1.1	1.7	-0.9	1.4	-245.5	57.5
Xi C	1.3	27.03	0.2723	92.61	4.4	1.9	-1.2	6.4	-148.1	19.7
Xi D	1.6	18.23	0.3595	62.30	6.7	1.4	-0.9	14.0	-76.0	13.1
Xi E	1.9	13.35	0.4512	45.67	9.0	1.1	-0.9	24.1	-55.7	9.6
Xi F	2.2	10.73	0.5465	36.62	11.0	0.93	-0.6	36.6	-27.6	8.3
Xi G	3.0	8.205	0.7237	27.81	20.2	0.70	0.5	59.5	17.6	5.5
Xi H	5.0	7.752	1.186	26.31	22.7	0.43	0.8	85.2	29.7	5.3
Xi I	7.0	11.75	2.880	39.83	7.9	0.18	1.7	94.1	92.4	9.6
Xi J	10.0	13.24	3.181	44.91	2.4	0.16	1.6	96.8	98.5	15.2
Xi K	15.0	12.58	2.836	42.07	2.9	0.18	2.9	100.0	170.4	13.3
<b>Integrated age ± 2σ</b>			n=11		88.3	0.48	K2O=1.05%		1.5	6.0
<b>Plateau ± 2σ</b>	no plateau		n=0	MSWD=0.00	0.000	0.000±0.000	0.0		0.0	0.0
<b>Isochron±2σ</b>	no isochron		n=0	MSWD=1.95		<sup>40</sup> Ar/ <sup>36</sup> Ar=	0.0±0.0		0.0	0.0

**NMRC-22**, GroundmassConcentrate, 69.16 mg, J=0.0002398±0.05%, IC(O)=1.02281±0.00207, NM-264F, Lab#=62347-01

Xi A	0.8	10.68	1.351	36.40	1.92	0.38	0.2	5.6	11.7	11.3
Xi B	1.3	3.129	1.033	10.52	4.93	0.49	3.0	19.9	40.8	3.5
Xi C	1.6	2.123	0.8225	7.060	4.46	0.62	4.4	32.9	41.2	2.6
Xi D	1.9	1.952	0.7472	6.345	4.05	0.68	6.6	44.6	56.1	2.4
Xi E	2.2	2.069	0.8232	6.752	3.38	0.62	6.4	54.5	57.5	2.7
Xi F	3.0	2.541	1.452	8.435	4.58	0.35	6.1	67.8	68.0	3.0
Xi G	4.5	2.859	2.063	9.486	4.20	0.25	7.3	80.0	92.1	3.3
Xi H	7.0	2.774	2.326	9.172	1.96	0.22	8.6	85.7	104.6	4.1
Xi I	11.0	3.049	2.692	9.749	2.04	0.19	12.2	91.6	162.8	4.1
Xi J	14.0	2.665	2.394	8.771	1.23	0.21	9.5	95.2	110.9	4.8
Xi K	20.0	3.039	2.341	9.686	1.65	0.22	11.6	100.0	154.6	4.5
<b>Integrated age ± 2σ</b>			n=11		34.4	0.36	K2O=0.80%		71.3	2.4
<b>Plateau ± 2σ</b>	no plateau		n=0	MSWD=0.00	0.000	0.000±0.000	0.0		0.0	0.0
<b>Isochron±2σ</b>	no isochron		n=0	MSWD=1.95		<sup>40</sup> Ar/ <sup>36</sup> Ar=	0.0±0.0		0.0	0.0

**NMRC-23**, GroundmassConcentrate, 109.55 mg, J=0.0000641±0.05%, IC(O)=1.02345±0.00031, NM-274D, Lab#=63449-01

X A	0.5	349.1	0.7124	1182.1	0.014	0.72	0.0	0.1	-12.7	300.6
Xi B	0.8	108.3	0.2394	362.2	0.063	2.1	1.2	0.5	157.7	36.2
Xi C	1.3	44.36	0.2088	146.1	0.188	2.4	2.7	1.7	141.2	12.2
Xi D	1.6	23.02	0.2685	74.61	0.238	1.9	4.3	3.3	115.7	8.2
Xi E	1.9	15.47	0.2714	49.40	0.297	1.9	5.7	5.2	103.9	6.1
Xi F	2.2	11.05	0.3229	35.14	0.357	1.6	6.2	7.6	80.8	4.8
G	3.0	8.499	0.3821	26.86	0.742	1.3	6.9	12.4	69.0	2.7
H	5.0	5.164	0.4869	15.81	1.75	1.0	10.2	23.8	61.8	1.4
I	7.0	2.442	0.5426	6.550	2.44	0.94	22.4	39.8	64.0	0.7
J	10.0	25.94	0.5877	85.94	4.59	0.87	2.3	69.8	68.7	2.1
X K	13.0	0.9861	0.6034	1.680	3.56	0.85	54.5	93.1	62.6	0.3
X L	17.0	1.039	0.5839	1.893	1.06	0.87	50.5	100.0	61.2	0.8
<b>Integrated age ± 2σ</b>			n=12		15.3	0.95	K2O=0.84%		68.2	1.6
<b>Plateau ± 2σ</b>	steps G-J		n=4	MSWD=3.65	9.52	0.96 ±0.41		62.2	64.2	2.3
<b>Isochron±2σ</b>	steps A-L		n=7	MSWD=1.95		<sup>40</sup> Ar/ <sup>36</sup> Ar=	296.2±0.4		62.4	0.6

**NMRC-23**, GroundmassConcentrate, 99.58 mg, J=0.0000641±0.05%, IC(O)=1.02493±0.00028, NM-274D, Lab#=63449-02

X A	0.5	406.6	0.6296	1379.2	0.013	0.81	-0.2	0.1	-100.6	159.6
X B	0.8	131.5	0.2922	446.4	0.069	1.7	-0.3	0.6	-43.3	35.6
Xi C	1.3	45.39	0.2620	150.8	0.203	1.9	1.8	2.0	97.9	12.5
Xi D	1.6	21.25	0.2689	68.43	0.247	1.9	4.9	3.7	122.8	7.8
Xi E	1.9	14.30	0.3082	45.72	0.302	1.7	5.6	5.8	94.6	5.7
Xi F	2.2	9.995	0.3531	31.67	0.359	1.4	6.6	8.3	77.4	4.3
X G	3.0	7.441	0.3772	23.36	0.751	1.4	7.5	13.5	65.8	2.6
Xi H	5.0	86.15	0.5038	285.5	1.72	1.0	2.1	25.4	214.6	6.2
X I	7.0	2.036	0.5543	5.333	2.46	0.92	24.6	42.5	58.6	0.7
J	10.0	1.171	0.6084	2.332	4.36	0.84	45.2	72.7	61.6	0.3
K	15.0	0.8990	0.6314	1.419	2.89	0.81	58.9	92.8	61.6	0.4
L	16.0	0.6716	0.5740	0.7048	0.673	0.89	75.9	97.4	59.2	1.0
M	18.0	0.5483	0.6843	0.2757	0.372	0.75	95.6	100.0	60.7	1.7
<b>Integrated age ± 2σ</b>			n=13		14.4	0.92	K2O=0.87%		81.5	1.7
<b>Plateau ± 2σ</b>	steps J-M		n=4	MSWD=1.94	8.30	0.83 ±0.12		57.5	61.5	0.7
<b>Isochron±2σ</b>	steps A-M		n=8	MSWD=4.55		<sup>40</sup> Ar/ <sup>36</sup> Ar=	294.3±0.9		61.5	0.5

**NMRC-24**, GroundmassConcentrate, 106.1 mg, J=0.0000639±0.05%, IC(O)=1.02345±0.00031, NM-274D, Lab#=63450-01

X A	0.5	18722.4	0.4635	63068.1	0.019	1.1	0.5	0.2	10008.6	#####
X B	0.6	9154.0	0.4328	30899.2	0.040	1.2	0.3	0.7	2728.7	513.7
X C	0.7	8320.0	0.2835	28043.9	0.045	1.8	0.4	1.2	3862.9	437.8
X D	0.8	5600.4	0.2862	18877.7	0.066	1.8	0.4	1.9	2583.0	311.6
X E	1.3	2925.9	0.4471	9859.0	0.249	1.1	0.4	4.7	1469.7	135.1
Xi F	1.6	1605.9	0.6037	5398.7	0.396	0.85	0.7	9.1	1238.4	76.3
Xi G	1.9	1029.2	0.7835	3484.5	0.484	0.65	0.0	14.5	-46.6	53.6
X H	2.2	697.9	0.9407	2351.6	0.542	0.54	0.4	20.5	357.2	36.8
X I	3.0	401.2	1.030	1349.2	1.02	0.50	0.6	32.0	301.1	21.3
X J	5.0	244.5	1.076	823.4	2.34	0.47	0.5	58.0	148.1	12.8
Xi K	7.0	279.7	1.624	935.8	1.63	0.31	1.2	76.2	385.9	14.3
Xi L	8.5	258.6	4.002	861.9	1.02	0.13	1.6	87.6	496.1	15.0
Xi M	10.0	224.3	5.155	744.0	0.612	0.099	2.2	94.4	568.3	17.1
Xi N	13.0	200.6	4.953	662.2	0.323	0.10	2.6	98.0	623.6	20.8
Xi O	17.0	223.3	4.122	735.8	0.179	0.12	2.8	100.0	725.6	29.5
<b>Integrated age ± 2σ</b>			n=15		8.97	0.27	K2O=0.51%		462.3	20.0
<b>Plateau ± 2σ</b>	no plateau		n=0	MSWD=0.00	0.000	0.000±0.000		0.0	0.0	0.0
<b>Isochron±2σ</b>	steps A-J		n=8	MSWD=3.40		<sup>40</sup> Ar/ <sup>36</sup> Ar=	296.6±0.1		60.6	19.2

**NMRC-04**, GroundmassConcentrate, 44.06 mg, J=0.0002391±0.04%, IC(O)=1.02493±0.00056, NM-264F, Lab#=62343-02

A	0.3	37.44	1.355	126.1	0.956	0.38	0.7	5.9	116.7	17.8
B	0.5	8.283	1.046	27.39	1.91	0.49	3.2	17.7	114.8	5.6
C	0.8	4.493	0.8846	14.61	4.29	0.58	5.3	44.2	103.2	2.7
D	1.0	4.242	0.8842	13.82	1.95	0.58	5.2	56.3	96.4	4.0
E	1.3	4.163	1.137	13.54	1.83	0.45	5.9	67.6	106.8	4.2
F	1.6	5.387	2.631	18.20	0.722	0.19	3.8	72.1	89.9	7.7
G	1.9	5.135	2.755	17.43	0.297	0.19	3.7	73.9	83.5	12.3
H	2.2	5.064	2.384	17.07	0.273	0.21	3.9	75.6	87.1	13.4
I	4.5	6.537	4.358	22.52	1.55	0.12	3.3	85.2	94.5	5.5
Xi J	7.0	7.076	6.857	25.19	1.47	0.074	2.3	94.3	69.9	6.2
Xi K	14.0	14.86	8.458	52.25	0.917	0.060	0.5	100.0	33.0	11.6
<b>Integrated age ± 2σ</b>			n=11		16.2	0.21	K2O=0.59%		95.9	3.9
<b>Plateau ± 2σ</b>	steps A-I		n=9	MSWD=2.14	13.8	0.45 ±0.36	85.2		101.6	4.9
<b>Isochron±2σ</b>	steps A-I		n=9	MSWD=2.25		<sup>40</sup> Ar/ <sup>36</sup> Ar=	295.9±0.7		98.5	6.1

**NMRC-05**, GroundmassConcentrate, 52.24 mg, J=0.000239±0.04%, IC(O)=1.02493±0.00056, NM-264F, Lab#=62344-02

Xi A	0.3	50.56	0.4054	173.5	1.14	1.3	-1.4	3.8	-299.0	20.5
Xi B	0.5	29.30	0.5256	100.2	2.05	0.97	-0.9	10.7	-114.6	12.0
Xi C	0.8	13.08	0.6756	44.05	6.40	0.76	0.8	32.1	46.0	4.8
D	1.0	6.305	0.7344	20.81	4.85	0.69	3.3	48.4	89.9	3.1
E	1.3	4.194	0.7672	13.62	5.20	0.67	5.3	65.8	97.1	2.4
F	1.6	3.878	0.8986	12.58	4.34	0.57	5.8	80.3	97.9	2.6
G	1.9	4.380	1.231	14.37	2.93	0.41	5.1	90.1	96.8	3.2
H	2.2	5.933	1.616	19.68	0.903	0.32	4.0	93.2	103.4	7.1
X I	4.5	10.79	4.486	36.79	1.19	0.11	2.4	97.1	115.1	7.9
Xi J	7.0	23.15	8.830	78.54	0.482	0.058	2.7	98.8	271.4	19.1
Xi K	10.0	17.79	8.455	60.72	0.370	0.060	2.8	100.0	217.4	19.0
<b>Integrated age ± 2σ</b>			n=11		29.9	0.43	K2O=0.92%		60.7	3.7
<b>Plateau ± 2σ</b>	steps D-H		n=5	MSWD=1.41	18.2	0.59 ±0.33	61.1		96.1	3.2
<b>Isochron±2σ</b>	steps D-I		n=6	MSWD=2.71		<sup>40</sup> Ar/ <sup>36</sup> Ar=	295.9±1.3		93.6	9.2

**NMRC-09**, GroundmassConcentrate, 51.01 mg, J=0.0002393±0.05%, IC(O)=1.02493±0.00058, NM-264F, Lab#=62345-01

X A	0.3	8.544	0.1206	27.94	4.09	4.2	3.4	21.7	127.2	4.2
X B	0.5	8.670	0.1558	28.44	3.00	3.3	3.1	37.7	118.2	4.7
X C	0.8	12.21	0.2551	40.58	3.26	2.0	1.9	55.0	100.0	5.5
X D	1.0	15.79	0.3583	52.78	1.42	1.4	1.4	62.6	93.7	8.5
X E	1.3	17.80	0.5791	59.74	1.46	0.88	1.0	70.4	81.3	10.1
X F	1.6	22.70	1.812	76.29	1.41	0.28	1.3	77.9	127.7	11.7
Xi G	1.9	28.21	5.765	96.47	1.22	0.089	0.5	84.4	64.1	13.9
Xi H	2.2	26.39	7.748	90.98	0.403	0.066	0.4	86.5	45.1	22.8
X I	4.5	36.06	15.41	125.0	2.10	0.033	0.9	97.6	144.6	13.8
Xi J	7.0	41.44	23.13	140.7	0.444	0.022	4.0	100.0	743.5	26.3
<b>Integrated age ± 2σ</b>			n=10		18.8	0.16	K2O=0.59%		125.6	5.6
<b>Plateau ± 2σ</b>	no plateau		n=0	MSWD=0.00	0.000	0.000±0.000	0.0		0.0	0.0
<b>Isochron±2σ</b>	steps A-I		n=7	MSWD=7.80		<sup>40</sup> Ar/ <sup>36</sup> Ar=	295.4±0.6		117.1	10.5

**NMRC-09**, GroundmassConcentrate, 58.69 mg, J=0.0002393±0.05%, IC(O)=1.02100±0.00000, NM-264F, Lab#=62345-02

Xi A	0.8	9.944	0.1320	32.66	7.47	3.9	3.0	31.9	129.2	2.7
B	1.3	13.05	0.2257	43.35	3.73	2.3	1.9	47.8	110.4	4.5
C	1.6	15.28	0.3014	51.01	2.06	1.7	1.5	56.6	99.3	6.8
D	1.9	18.54	0.6462	61.95	1.57	0.79	1.5	63.3	124.1	8.1
E	2.2	22.89	1.684	77.02	1.26	0.30	1.1	68.6	112.8	11.1
F	3.0	26.40	4.395	89.51	1.70	0.12	1.1	75.9	124.1	9.8
G	4.5	29.71	9.236	102.1	1.95	0.055	0.8	84.2	108.6	9.9
H	7.0	27.53	9.458	94.84	1.51	0.054	0.8	90.7	102.4	10.2



Xi H	11.0	29.61	11.22	102.0	1.36	0.045	1.2	96.5	153.1	11.8
X I	14.0	26.88	12.32	93.27	0.479	0.041	1.0	98.5	120.9	19.7
Xi J	20.0	31.65	15.05	109.9	0.353	0.034	1.1	100.0	151.3	250.1
<b>Integrated age ± 2σ</b>			n=11		23.4	0.17	K2O=0.64%		120.0	8.6
<b>Plateau ± 2σ</b>	steps B-H		n=7	MSWD=1.36	13.8	1.0 ±1.8		58.8	110.7	6.6
<b>Isochron±2σ</b>	steps B-I		n=8	MSWD=1.34		<sup>40</sup> Ar/ <sup>36</sup> Ar=		295.7±0.6	106.0	17.0

**NMRC-06**, GroundmassConcentrate, 21.21 mg, J=0.0002395±0.05%, IC(O)=1.02493±0.00056, NM-264E, Lab#=62339-03

X A	0.3	31.07	0.6722	103.5	0.396	0.76	1.7	4.5	232.8	23.4
X B	0.5	12.53	0.6199	40.46	0.613	0.82	4.9	11.3	268.3	11.6
X C	0.8	5.254	0.5947	15.92	1.94	0.86	11.2	33.1	258.4	4.0
X D	1.0	3.771	0.5630	11.07	1.38	0.91	14.3	48.6	235.6	4.5
X E	1.3	3.632	0.9953	10.67	1.34	0.51	15.2	63.7	241.2	4.2
Xi F	1.6	3.731	0.8575	9.798	1.23	0.59	24.0	77.5	392.7	4.1
X G	1.9	4.444	1.786	13.59	0.772	0.29	12.6	86.2	245.4	6.4
Xi H	2.2	5.438	2.913	17.43	0.449	0.18	9.3	91.3	222.0	9.9
Xi I	4.5	6.265	4.200	19.58	0.480	0.12	12.7	96.7	350.5	10.0
Xi J	7.0	7.680	4.871	22.37	0.298	0.10	18.8	100.0	634.0	14.0
<b>Integrated age ± 2σ</b>			n=10		8.90	0.41	K2O=0.67%		285.0	4.4
<b>Plateau ± 2σ</b>	no plateau		n=0	MSWD=0.00	0.000	0.000±0.000	0.0		0.0	0.0
<b>Isochron±2σ</b>	steps A-G		n=6	MSWD=4.56		<sup>40</sup> Ar/ <sup>36</sup> Ar=		296.2±1.0	242.2	7.7

**NMRC-06**, GroundmassConcentrate, 114.39 mg, J=0.0002548±0.04%, IC(F)=1.00948±0.00074, NM-287C, Lab#=65356-01

X A	0.5	195.8	0.9747	661.1	0.1	0.52	0.3	0.1	231.4	343.1
X B	0.8	84.05	0.9610	285.0	0.5	0.53	-0.1	0.9	-41.4	81.3
X C	1.3	21.74	0.8339	72.40	2.9	0.61	1.9	5.9	191.1	16.6
X D	1.6	11.31	0.7214	36.89	4.5	0.71	4.0	13.7	212.4	9.3
X E	1.9	8.561	0.6648	27.56	5.3	0.77	5.4	23.0	215.4	7.4
X F	2.2	7.439	0.6638	23.69	5.2	0.77	6.5	32.0	225.3	7.2
Xi G	3.0	5.762	0.9244	17.88	9.1	0.55	9.4	47.8	253.1	5.0
Xi H	5.0	5.777	2.607	18.21	16.9	0.20	10.2	77.0	276.2	3.6
Xi I	7.0	8.282	3.744	25.91	9.3	0.14	11.0	93.2	425.4	5.5
Xi J	10.0	11.08	4.123	35.45	1.9	0.12	8.3	96.5	429.5	14.2
Xi K	15.0	11.41	4.214	34.50	2.0	0.12	13.5	100.0	720.4	13.8
<b>Integrated age ± 2σ</b>			n=11		57.7	0.25	K2O=0.76%		295.2	4.8
<b>Plateau ± 2σ</b>	no plateau		n=0	MSWD=0.00	0.000	0.000±0.000	0.0		0.0	0.0
<b>Isochron±2σ</b>	steps A-F		n=6	MSWD=0.83		<sup>40</sup> Ar/ <sup>36</sup> Ar=		294.0±0.9	238.9	16.4

**NMRC-07**, GroundmassConcentrate, 27.92 mg, J=0.0002397±0.04%, IC(O)=1.02493±0.00056, NM-264E, Lab#=62340-03

Xi A	0.3	23.86	0.8353	78.53	0.594	0.61	3.0	4.6	312.0	16.9
X B	0.5	7.208	0.6530	22.03	1.17	0.78	10.3	13.6	325.1	6.6
X C	0.8	3.177	0.6368	8.800	3.12	0.80	19.5	37.7	271.7	2.5
Xi D	1.0	2.568	0.6856	6.938	1.79	0.74	22.0	51.5	247.3	3.0
X E	1.3	2.432	0.8308	6.444	1.76	0.61	24.1	65.1	256.9	2.8
Xi F	1.6	2.916	1.315	7.788	1.51	0.39	24.4	76.8	311.5	3.4
X G	1.9	3.465	2.440	10.19	0.910	0.21	18.4	83.8	279.8	5.0
X H	2.2	3.033	3.121	8.848	0.283	0.16	21.6	86.0	287.4	11.1
X I	4.5	3.892	5.189	12.11	0.362	0.098	18.3	88.8	312.6	9.6
Xi J	7.0	6.613	6.001	12.10	0.619	0.085	52.9	93.6	1539.3	6.8
Xi K	10.0	10.30	8.036	17.18	0.828	0.063	56.7	100.0	2572.7	6.9
<b>Integrated age ± 2σ</b>			n=11		12.9	0.28	K2O=0.74%		487.7	3.1
<b>Plateau ± 2σ</b>	no plateau		n=0	MSWD=0.00	0.000	0.000±0.000	0.0		0.0	0.0
<b>Isochron±2σ</b>	steps B-I		n=6	MSWD=3.90		<sup>40</sup> Ar/ <sup>36</sup> Ar=		305.9±2.2	232.5	9.0

**NMRC-02**, GroundmassConcentrate, 20.81 mg, J=0.0002392±0.04%, IC(O)=1.02493±0.00056, NM-264E, Lab#=62337-03

X A	0.3	160.7	0.1621	539.8	0.512	3.1	0.7	3.1	519.0	60.4
X B	0.5	58.98	0.2167	196.3	0.722	2.4	1.7	7.5	435.6	27.0
Xi C	0.8	26.20	0.2938	86.45	1.70	1.7	2.6	17.9	294.8	11.5
Xi D	1.0	16.85	0.3598	54.68	1.26	1.4	4.3	25.5	314.1	9.9
Xi E	1.3	14.14	0.4166	45.25	1.59	1.2	5.6	35.2	345.6	7.9
X F	1.6	11.60	0.4707	36.64	1.56	1.1	6.9	44.7	349.7	7.0
X G	1.9	11.64	0.5325	36.71	1.71	0.96	7.1	55.2	359.7	6.8
X H	2.2	11.90	0.6150	37.39	1.31	0.83	7.5	63.1	390.2	7.2
X I	4.5	9.943	0.6637	30.76	4.29	0.77	9.0	89.3	393.8	4.3
Xi J	7.0	7.936	0.7193	23.60	1.45	0.71	12.7	98.1	442.7	5.9
Xi K	10.0	12.14	0.7772	35.20	0.316	0.66	14.8	100.0	785.4	16.8
<b>Integrated age ± 2σ</b>			n=11		16.4	0.99	K2O=1.27%		382.3	6.5
<b>Plateau ± 2σ</b>	no plateau		n=0	MSWD=0.00	0.000	0.000±0.000	0.0		0.0	0.0
<b>Isochron±2σ</b>	steps A-I		n=6	MSWD=10.67		<sup>40</sup> Ar/ <sup>36</sup> Ar=	296.1±0.4		370.3	9.3

**NMRC-02**, GroundmassConcentrate, 11.15 mg, J=0.0002392±0.04%, IC(O)=1.02000±0.0000, NM-264E, Lab#=62337-04

A	0.8	48.06	0.2043	159.9	1.33	2.5	1.7	15.2	354.5	14.5
B	1.3	24.65	0.3769	80.60	1.20	1.4	3.5	28.9	375.6	11.7
i C	1.6	25.19	0.4944	82.37	0.624	1.0	3.5	36.0	388.2	15.2
i D	1.9	18.64	0.5829	60.34	0.530	0.88	4.5	42.1	370.7	15.4
i E	2.2	17.01	0.5285	54.85	0.488	0.97	4.9	47.7	367.1	16.8
X F	3.0	15.48	0.5022	49.32	1.00	1.0	6.1	59.1	412.7	10.1
X G	4.5	12.18	0.5620	38.05	1.19	0.91	8.0	72.7	425.3	8.0
X H	7.0	12.88	0.6380	40.41	0.708	0.80	7.6	80.8	429.9	10.7
X I	11.0	9.830	0.6258	30.15	0.641	0.82	9.8	88.1	421.0	9.8
X J	14.0	8.859	0.7301	26.82	0.607	0.70	11.1	95.0	431.3	10.0
X K	20.0	7.380	0.8225	21.78	0.434	0.62	13.6	100.0	438.5	11.0
<b>Integrated age ± 2σ</b>			n=11		8.75	1.0	K2O=1.26%		398.1	7.7
<b>Plateau ± 2σ</b>	steps A-E		n=5	MSWD=0.69	4.17	1.56 ±1.34	47.7		371.6	12.9
<b>Isochron±2σ</b>	steps A-K		n=8	MSWD=0.82		<sup>40</sup> Ar/ <sup>36</sup> Ar=	294.0±0.5		447.1	12.6

**NMRC-03**, GroundmassConcentrate, J=0.0002392±0.06%, IC(O)=0.00128±0.2163, NM-264E, Lab#=62338-02

A	0.5	23.58	0.3187	77.21	0.180	1.6	3.3	2.1	341.9	34.3
B	0.7	22.13	0.4363	72.31	0.487	1.2	3.5	7.9	343.6	20.3
C	0.9	21.77	0.5324	71.04	0.687	0.96	3.7	16.0	357.0	17.8
D	1.0	21.91	0.5971	71.58	0.721	0.85	3.6	24.5	349.7	18.1
E	1.2	22.56	0.6556	73.83	0.828	0.78	3.5	34.3	343.5	18.2
F	1.7	25.56	0.7980	83.83	1.30	0.64	3.3	49.6	367.7	17.3
G	1.9	29.16	0.8153	95.78	0.740	0.63	3.1	58.4	400.7	22.4
X H	2.2	34.85	0.9440	114.5	0.666	0.54	3.1	66.2	479.8	25.2
X I	4.0	42.12	0.9940	137.6	1.77	0.51	3.6	87.1	665.3	25.6
Xi J	7.0	38.55	1.023	124.9	0.679	0.50	4.5	95.1	754.6	27.5
Xi K	21.0	35.18	1.285	112.5	0.383	0.40	5.8	99.7	891.1	30.5
X L	25.0	60.66	1.532	199.7	0.029	0.33	2.9	100.0	774.8	135.5
<b>Integrated age ± 2σ</b>			n=12		8.47	0.63			491.0	15.5
<b>Plateau ± 2σ</b>	steps A-G		n=7	MSWD=0.92	4.95	0.82 ±0.69	58.4		357.8	15.0
<b>Isochron±2σ</b>	steps A-L		n=10	MSWD=1.55		<sup>40</sup> Ar/ <sup>36</sup> Ar=	305.0±1.6		38.0	20.3

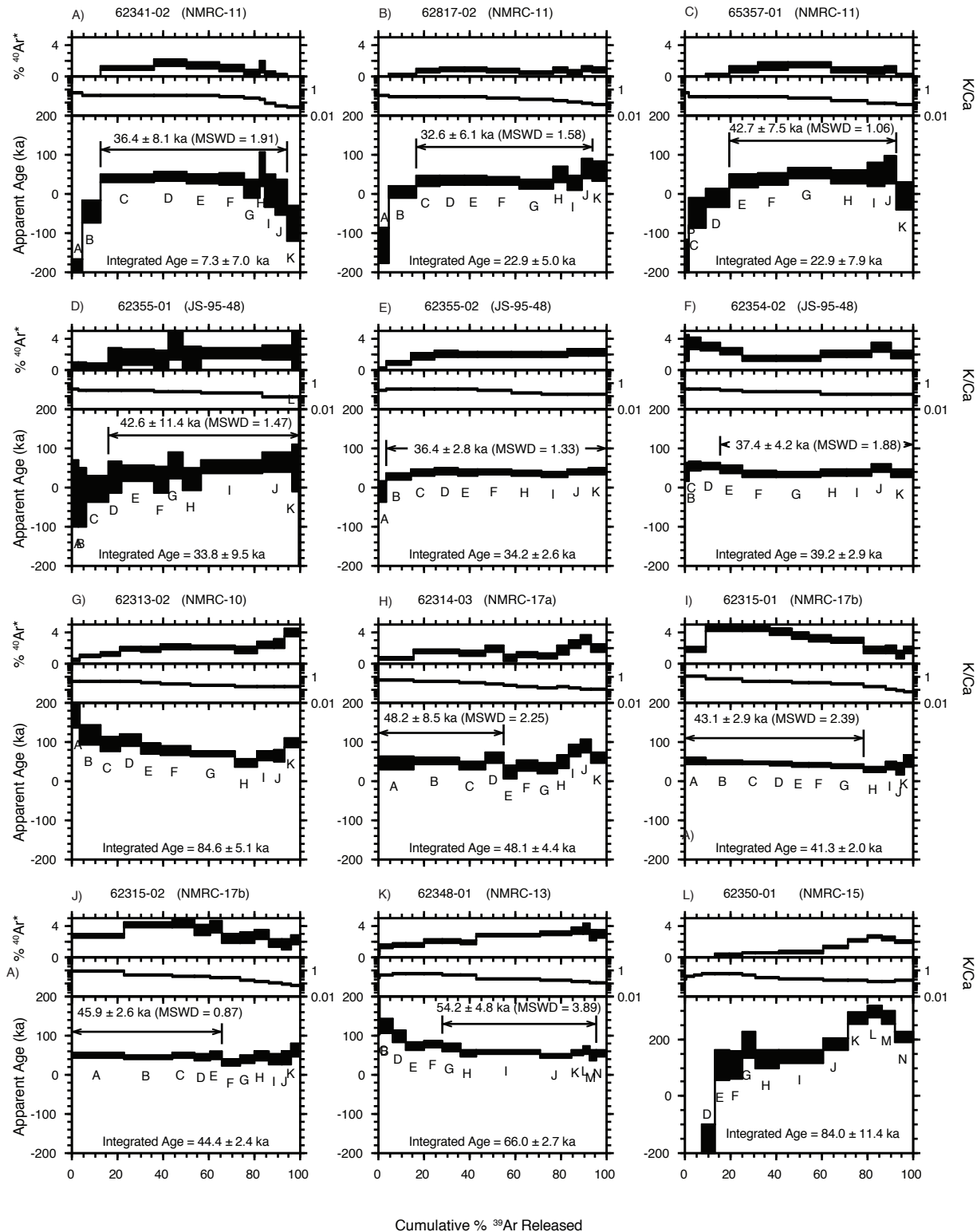
**NMRC-03**, GroundmassConcentrate, 20.91 mg, J=0.0002392±0.06%, IC(O)=1.02493±0.00056, NM-264E, Lab#=62338-03

X A	0.3	60.37	0.1675	202.6	0.782	3.0	0.8	4.9	215.1	26.4
X B	0.5	51.09	0.2247	170.2	1.23	2.3	1.6	12.5	353.3	20.2
X C	0.8	23.90	0.2895	78.91	2.61	1.8	2.5	28.7	263.7	9.7
X D	1.0	20.87	0.3641	68.32	2.04	1.4	3.4	41.4	307.8	9.2
X E	1.3	22.38	0.5043	73.33	1.98	1.0	3.3	53.7	326.4	9.6

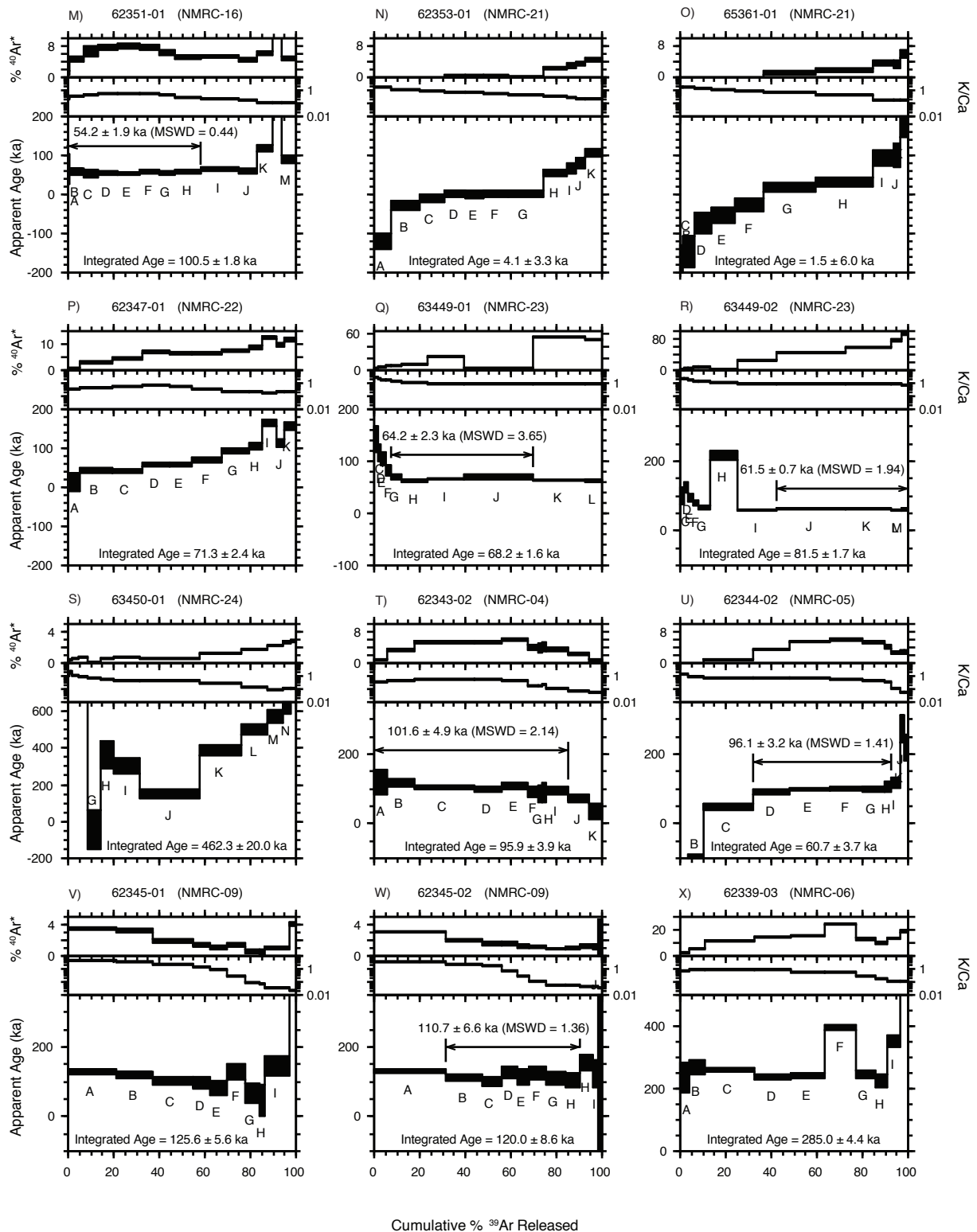
X F	1.6	23.74	0.5891	77.53	1.73	0.87	3.7	64.4	379.7	11.1
X G	1.9	26.32	0.7113	85.94	1.17	0.72	3.7	71.7	426.0	13.5
X H	2.2	29.37	0.7712	96.32	0.803	0.66	3.3	76.7	419.7	16.5
X I	4.5	41.26	0.8838	135.4	2.95	0.58	3.2	95.0	572.0	13.0
X J	7.0	38.59	1.028	125.2	0.582	0.50	4.3	98.6	726.8	21.5
X K	10.0	38.19	1.124	123.4	0.222	0.45	4.7	100.0	786.5	34.7
<b>Integrated age ± 2σ</b>			n=11		16.1	0.93	K2O=1.24%		394.0	8.7
<b>Plateau ± 2σ</b>	no plateau		n=0	MSWD=0.00	0.000	0.000±0.000	0.0		0.0	0.0
<b>Isochron±2σ</b>	steps A-K		n=11	MSWD=80.95		<sup>40</sup> Ar/ <sup>36</sup> Ar=	299.4±0.6		217.5	13.4

**NMRC-20**, GroundmassConcentrate, J=0.0002403±0.04%, IC(O)=1.02396±0.00104, NM-264B, Lab#=62317-02

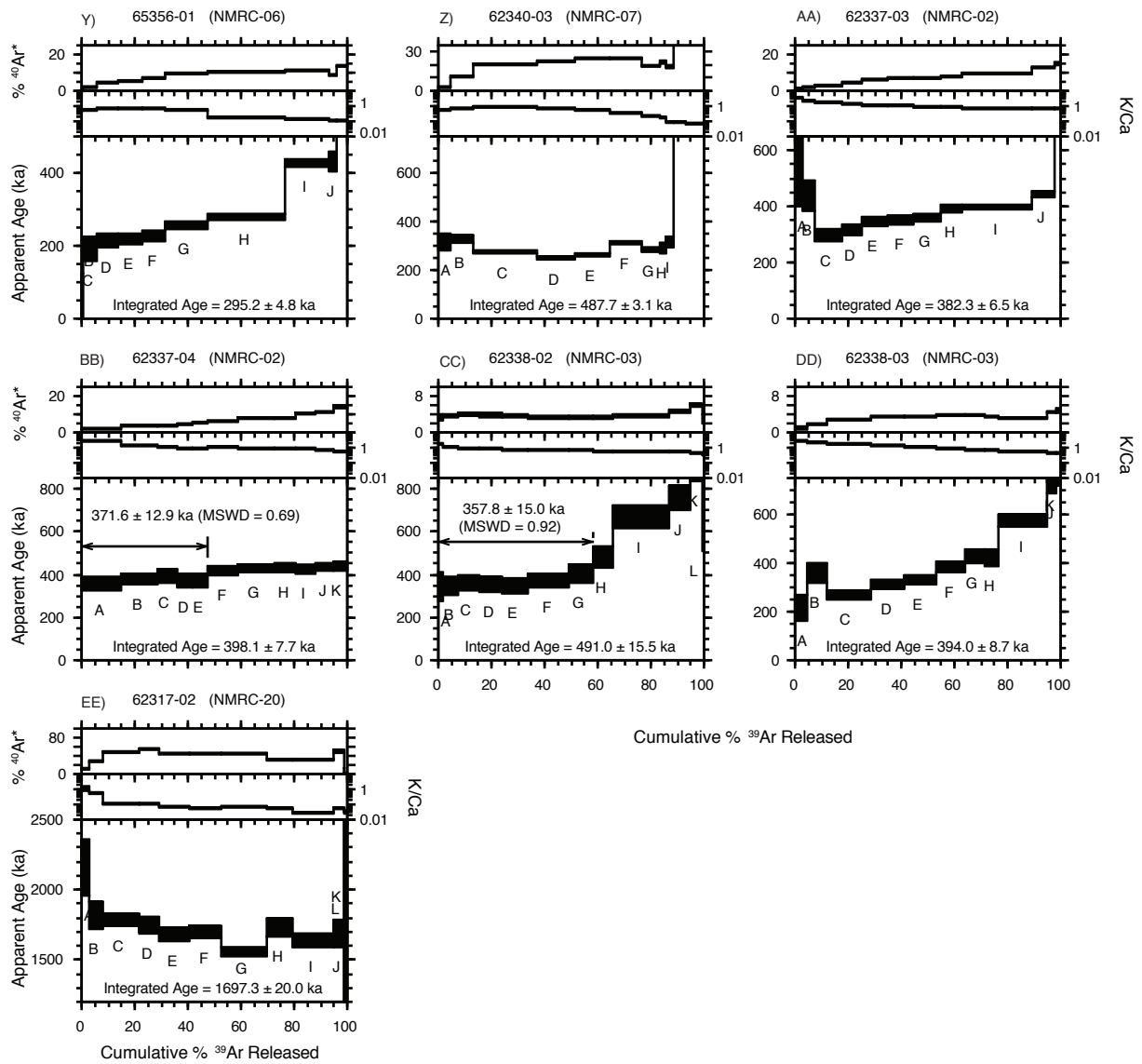
Xi A	0.3	41.59	0.4598	124.3	0.045	1.1	11.8	3.2	2157.3	100.1
X B	0.5	14.53	0.9717	35.46	0.076	0.53	28.4	8.5	1812.7	47.5
Xi C	0.8	8.755	4.430	17.13	0.191	0.12	46.1	21.9	1778.8	21.7
X D	1.0	7.615	5.022	13.71	0.112	0.10	51.9	29.8	1742.0	28.9
X E	1.3	8.620	7.793	18.37	0.156	0.065	44.1	40.7	1676.9	24.4
X F	1.6	8.418	8.576	17.80	0.172	0.059	45.4	52.8	1688.5	21.9
Xi G	1.9	8.066	7.094	17.24	0.245	0.072	43.6	70.0	1553.5	16.3
X H	2.2	13.25	8.865	33.95	0.141	0.058	29.5	79.9	1726.1	30.2
X I	4.5	11.81	19.08	32.56	0.213	0.027	31.1	94.9	1632.1	24.5
X J	7.0	7.719	8.855	15.57	0.058	0.058	49.3	98.9	1681.9	51.1
X K	14.0	61.61	14.23	198.6	0.005	0.036	6.6	99.3	1793.5	565.1
X L	25.0	282.0	17.78	946.1	0.010	0.029	1.3	100.0	1676.7	593.3
<b>Integrated age ± 2σ</b>			n=12		1.43	0.060			1697.3	20.0
<b>Plateau ± 2σ</b>	no plateau		n=0	MSWD=0.00	0.00	0.000±0.000	0.0		0.0	0.0
<b>Isochron±2σ</b>	steps B-L		n=9	MSWD=2.46		<sup>40</sup> Ar/ <sup>36</sup> Ar=	295.7±2.6		1692.2	32.4



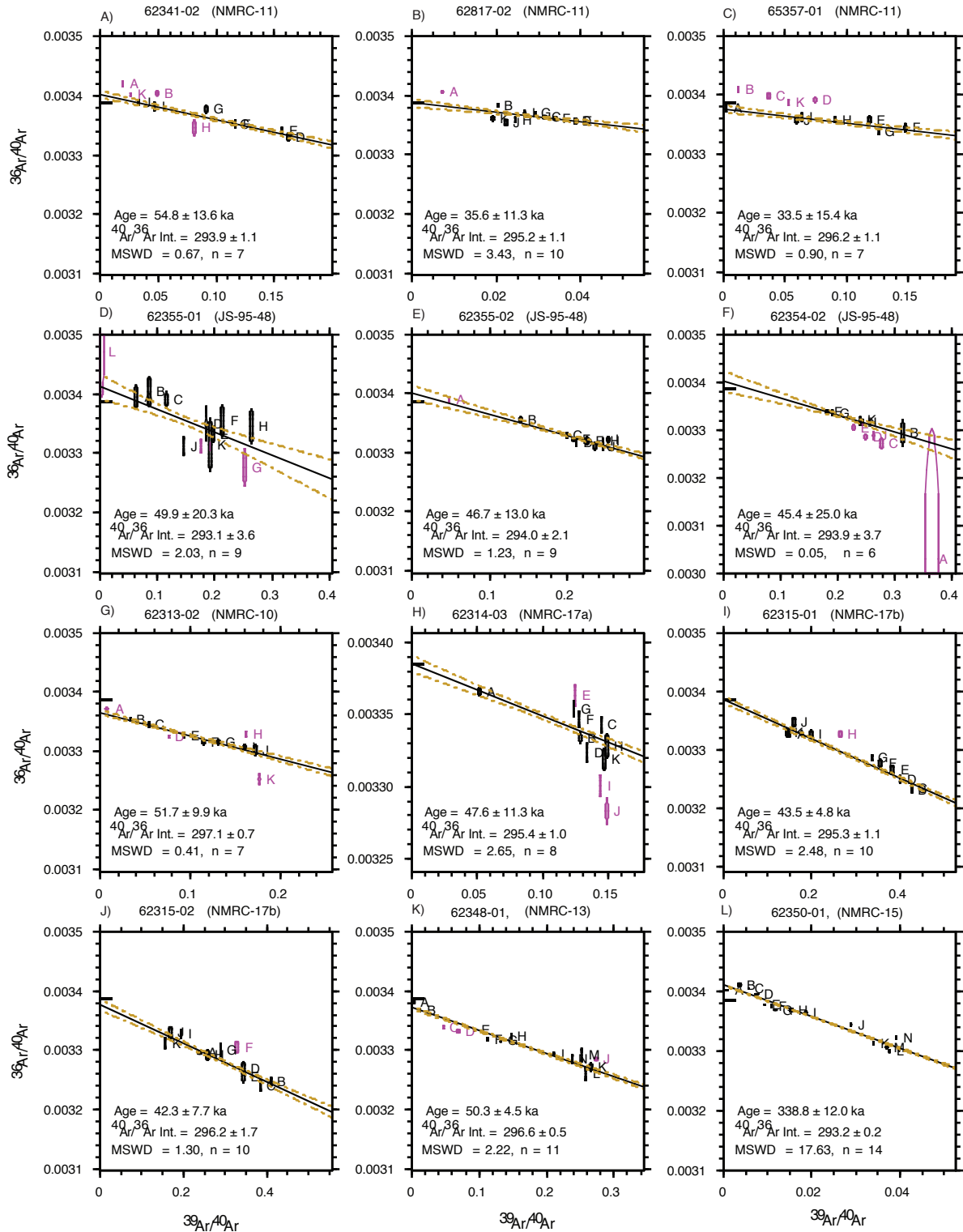
Supplemental Figure 1a. Age Spectra for samples of the Raton Clayton volcanic field. Data at 2-sigma. Results at 2-sigma.



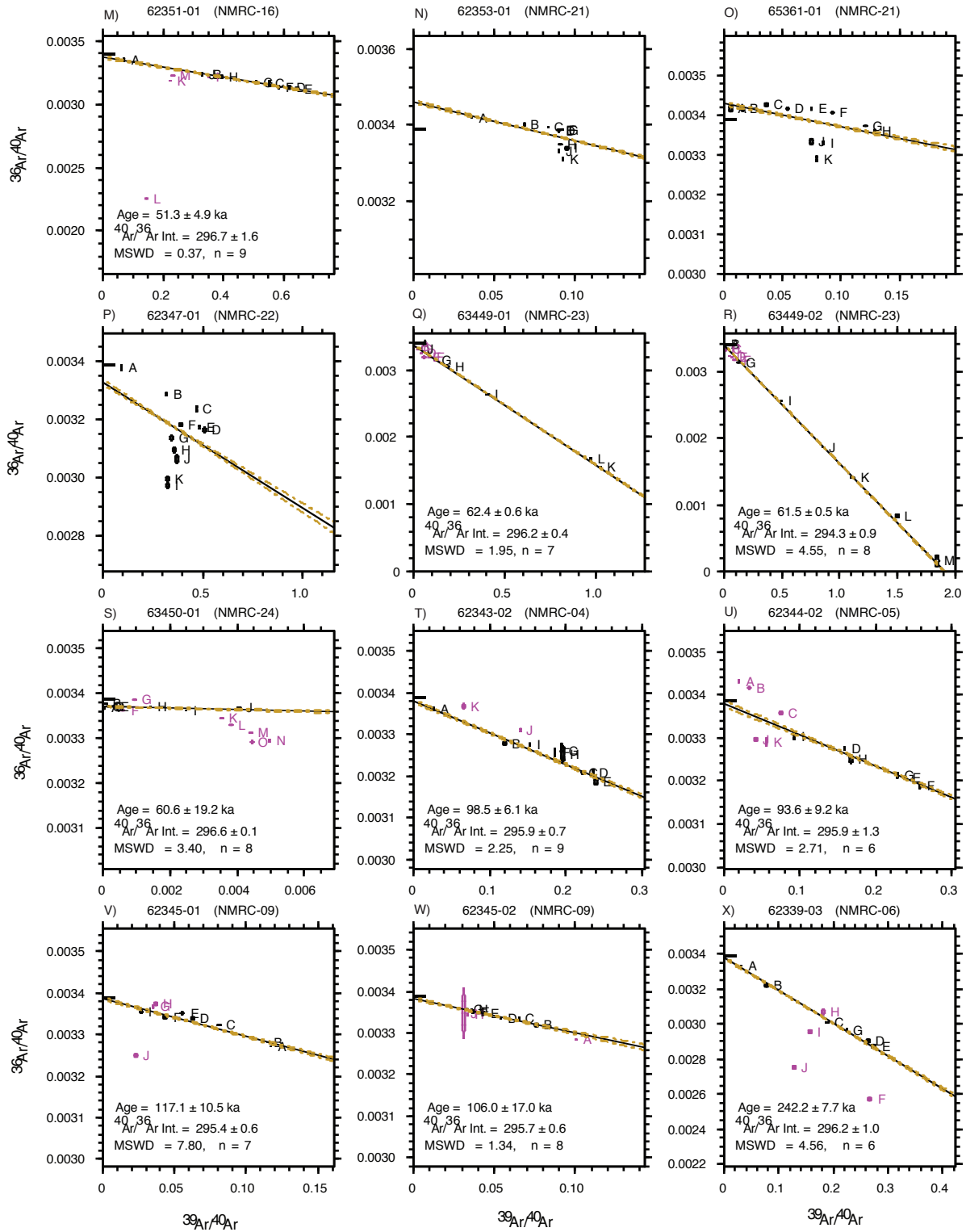
Supplemental Figure 1b. Age Spectra for samples of the Raton Clayton volcanic field. Data at 2-sigma. Results at 2-sigma.



Supplemental Figure 1c. Age Spectra for samples of the Raton Clayton volcanic field. Data at 2-sigma. Results at 2-sigma.

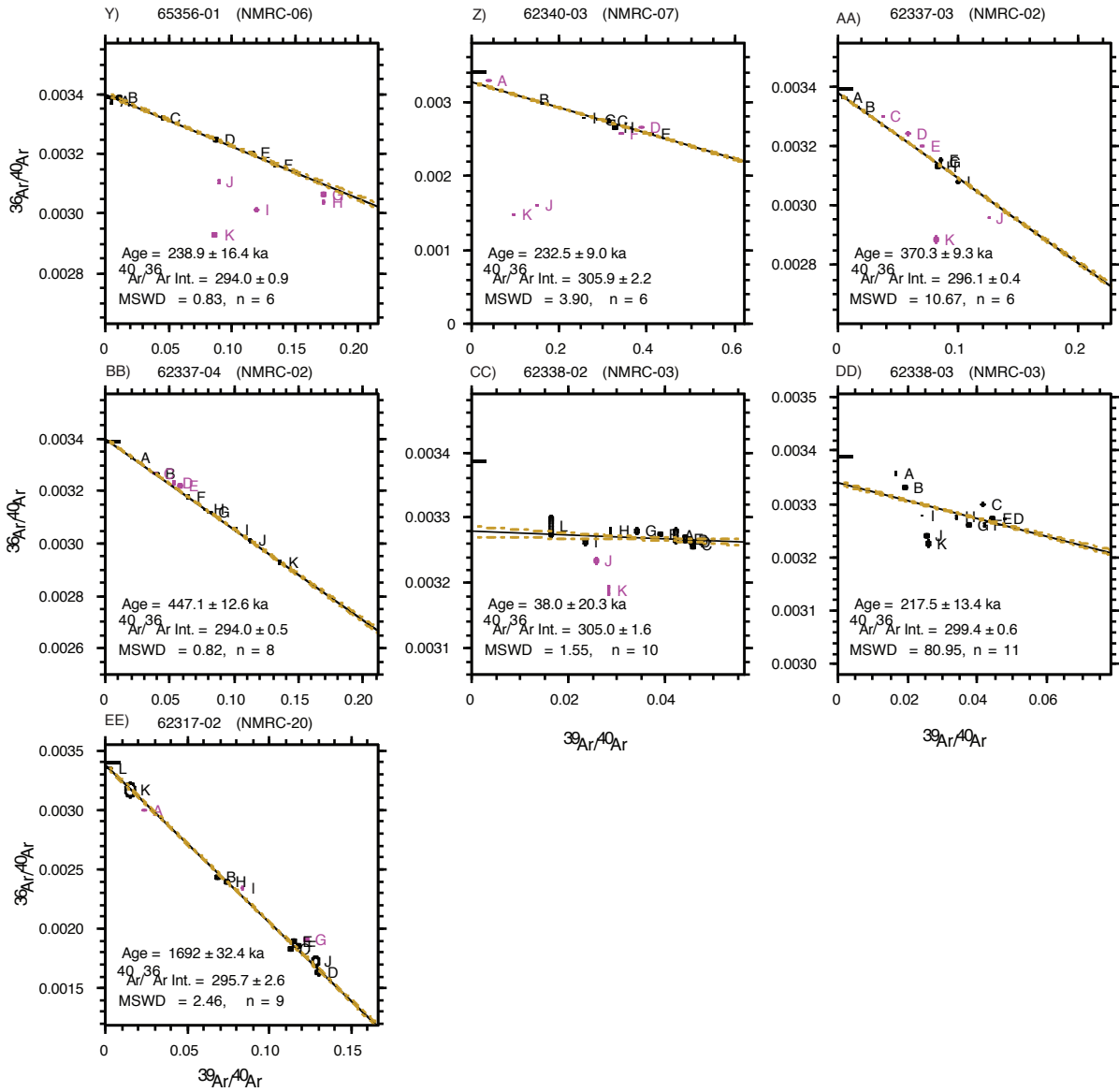


Supplemental Figure 2a. Inverse isochron for samples of the Raton Clayton volcanic field. Data at 1-sigma. Results at 2-sigma. Points in purple were excluded from the regression calculation.



Supplemental Figure 2b. Inverse isochron for samples of the Raton Clayton volcanic field. Data at 1-sigma. Results at 2-sigma. Points in purple were excluded from the regression calculation.





Supplemental Figure 2c. Inverse isochron for samples of the Raton Clayton volcanic field. Data at 1-sigma. Results at 2-sigma. Points in purple were excluded from the regression calculation.

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**Notes:**

X preceding sample ID denotes analyses excluded from plateau or weighted mean age calculations.

i preceding sample ID denotes analyses excluded from isochron age calculations.

Isotopic ratios corrected for blank, radioactive decay, and detector intercalibration data (ARGUS VI and Helix data).

Errors quoted for individual analyses includes analytical errors, interfering reactions, and J uncertainties.

**Age calculations:**

Ages calculated relative to neutron flux monitor Fish Canyon Tuff Sanidine (FC-2). Assigned age = 28.201 Ma (Kuiper et al., 2008)

$^{40}\text{K}$  Decay Constant (LambdaK total) =  $5.463\text{e-}10/\text{a}$  (Min et al., 2000)

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) and also incorporates uncertainty in J factors and irradiation correction uncertainties.

MSWD values are calculated for n-1 degrees of freedom for plateau age.

Isochron ages,  $^{40}\text{Ar}/^{36}\text{Ar}$  and MSWD values calculated from regression results obtained by the methods of York (1969).

Isotopic abundances after Steiger and Jäger (1977).

Weight percent  $\text{K}_2\text{O}$  calculated from  $^{39}\text{Ar}$  signal, sample weight, and instrument sensitivity.

Mean age errors reported at 2-sigma. All other errors at 1-sigma.

Detector intercalibration (IC = measured  $^{40}\text{Ar}/^{36}\text{Ar}$  divided by 295.5) determined using atmospheric air.

$^{1}\text{C}(\text{O})$  is IC for spectrometer Obama (Argus VI).  $^{1}\text{C}(\text{F})$  is IC for spectrometer Felix (Helix MC Plus).

**Sample preparation and irradiation:**

Concentrated groundmass and mineral separates prepared from bulk samples using crushing, grinding, Frantz magnetic separation, acid washing (7% HCl to remove  $\text{CaCO}_3$ ), heavy density liquid techniques, and hand-picking.

Samples were loaded into machined Al discs and irradiated in the NM-264, 266, 274, and 287

positions at the Triga Reactor along with the neutron flux monitor Fish Canyon Tuff sanidine FC-2.

**Instrumentation:**

Isotopic ratios of gmc determined using an ARGUS VI (Obama) or Helix MC Plus (Felix) mass spectrometer.

Isotopic ratios of FC-2 sanidine (not reported) determined with the ARGUS VI (Jan).

Single crystals of sanidine were fused using a focused  $\text{CO}_2$  laser.

Groundmass concentrate heated (one minute per step) with a 75 W Photon Machines 810 nm diode laser.

All mass spectrometers were on line with an automated all-metal extraction system

Reactive gases removed by reaction with 1 SAES GP-50, D-50, and/or NP-10 getter(s).

Gas (except from sanidine) also exposed to cold finger operated at  $-140^\circ\text{C}$ .

Thermo-Fisher Scientific Helix MC Plus mass spectrometer

System = Felix

Multi-collector configuration:  $^{40}\text{Ar}$ -H2,  $^{39}\text{Ar}$ -H1,  $^{38}\text{Ar}$ -AX,  $^{37}\text{Ar}$ -L1,  $^{36}\text{Ar}$ -L2

Amplification (all irradiations): H2 and L1  $1\text{E}12$  Ohm Faraday, H1 and Ax  $1\text{E}13$  Ohm Faraday, L2 CDD ion counter, deadtime 20ns

Thermo-Fisher Scientific ARGUS VI mass spectrometer

System = Obama

Multi-collector configuration:  $^{40}\text{Ar}$ -H1,  $^{39}\text{Ar}$ -Ax,  $^{38}\text{Ar}$ -L1,  $^{37}\text{Ar}$ -L2,  $^{36}\text{Ar}$ -L3

Amplification (all irradiations): H1, L1, L2 1E12 Ohm Faraday, AX 1E13 ohm Faraday, L3 - CDD ion counter, dead time 14 nS.

**Analytical Parameters:**

Obama (ARGUS VI) Mass Spectrometer sensitivity =  $1\text{E-}16$  mol/fA

Total system blank and background: 13.8, 0.37, 0.253, 0.46, and  $0.057 \times 10^{-17}$  moles

for masses 40,39, 38, 37, and 36, respectively.

Felix (Helix MC Plus) Mass Spectrometer sensitivity =  $4\text{E-}16$  mol/fA

Total system blank and background: 199, 0.34, 0.50, 0.95, and  $0.31 \times 10^{-17}$  moles

for masses 40,39, 38, 37, and 36, respectively.

J-factors determined to a precision of 0.01 to 0.03% by  $\text{CO}_2$  laser fusion of typically 6 FC-2 crystals from multiple radial positions

Correction factors for interfering nuclear reactions were determined using K-glass and  $\text{CaF}_2$ .

See following compilation table for a summary of irradiation times and correction factors.

Correction Factors for Irradiations used in the Raton-Clayton volcanic field study

<b>Irradiation</b>	<b>Hours</b>	<b>(<sup>39</sup>Ar/<sup>37</sup>Ar)Ca</b>	<b>(<sup>36</sup>Ar/<sup>37</sup>Ar)Ca</b>	<b>(<sup>38</sup>Ar/<sup>39</sup>Ar)K</b>	<b>(<sup>40</sup>Ar/<sup>39</sup>Ar)K</b>
NM-264	1	6.530e-4 ± 3.6e-7	2.633e-4 ± 3.4e-7	1.077e-2 ± 0e0	7.529e-3 ± 2.37e-4
NM-266	0.33	6.530e-4 ± 3.6e-7	2.633e-4 ± 3.4e-7	1.077e-2 ± 0e0	7.529e-3 ± 2.37e-4
NM-274	0.25	6.600e-4 ± 1.0e-6	2.640e-4 ± 1.0e-6	1.300e-2 ± 2e-5	7.614e-3 ± 1.05e-4
NM-287	1	6.600e-4 ± 1.0e-6	2.640e-4 ± 1.0e-6	1.300e-2 ± 2e-5	7.614e-3 ± 1.05e-4

Supplemental Table 2 – Location of dated samples. All locations in section 13S. Datum is NAD 27

Sample	Unit/Vent	Easting	Northing
NMRC-02	Las Maetas Southern Vent	583869	4034430
NMRC-03	Las Maetas flow toe	584034	4033783
NMRC-04	Capping lava flow of "The Crater"	573664	4046877
NMRC-05	Lava flow of "The Crater"	574132	4046336
NMRC-06	Horseshow Crater lava flow	588075	4058819
NMRC-07	Horseshoe Crater lava flow	588718	4060073
NMRC-09	Trinchera Pass lava flow	582302	4092804
NMRC-10	Baby Capulin lava flow at Folsom Falls	599790	4081166
NMRC-11	Purvine Hills agglutinated lava	601173	4074920
NMRC-13	Capulin volcano crater lava	591889	4071017
NMRC-16	Lava lake remant in Capulin volcano Boca	591049	4071312
NMRC-17	Baby Capulin lava flow toe	598021	4077146
NMRC-20	Basalt flow of Mud Hill	594458	4073217
NMRC-21	Capulin volcano 2nd lava flow	592681	4066955
NMRC-22	Capulin volcano 3rd lava flow	590235	4070327
NMRC-23	Malpai lava flow	592195	4051540
NMRC-24	Malpai lava flow	592195	4051540