Alaska Division of Geological & Geophysical Surveys

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^{40}AR/^{39}AR AGES FROM THE EAST BONNIFIELD GEOLOGIC MAP AREA, FAIRBANKS A-1, FAIRBANKS A-2, HEALY D-1, AND HEALY D-2 QUADRANGLES, ALASKA

by

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Note: This report (including all analytical data and tables) is available in digital format from the DGGS web site (http://dggs.alaska.gov) at no charge. The digital data are available as PDF files and as comma delimited text files

$^{40}AR/^{39}AR$ AGES FROM THE EAST BONNIFIELD GEOLOGIC MAP AREA, FAIRBANKS A-1, FAIRBANKS A-2, HEALY D-1, AND HEALY D-2 QUADRANGLES, ALASKA

by
Jeff A. Benowitz[1], Paul W. Layer[1], and Larry K. Freeman[2]

INTRODUCTION

In 2008, the Alaska Division of Geological & Geophysical Surveys (DGGS) conducted a geologic mapping project in parts of the Fairbanks A-1, Fairbanks A-2, Healy D-1, and Healy D-2 quadrangles. Our purpose was to map the bedrock geology at a scale of 1:50,000 as part of the Alaska Airborne Geophysical/Geological Mineral Inventory (AGGMI) program investigations in the Bonnifield mining district. In 2007, DGGS completed an airborne geophysical survey of the Bonnifield mining district (Burns and others, 2007). In 2009, DGGS published geochemical data resulting from the 2008 work (Freeman and others, 2009a). A brief discussion of the results was given in Freeman and others (2009b, 2010). The purpose of this DGGS Raw Data File is to present the $^{40}Ar/^{39}Ar$ results and make them available for use to others interested in the area.

FIELD AND ANALYTICAL METHODS

Sample locations were determined and recorded by the geologists in the field using Garmin 12XL GPS receivers. Table 1 presents geographic (latitude/longitude) and UTM coordinates. UTM coordinates were downloaded into a relational database from the GPS receivers, and sample numbers were hand entered from geologists' field notes. Geographic coordinates were calculated from the UTM coordinates using the Corpscon v 6.0.1 coordinate conversion utility (U.S. Army Corps of Engineers, 2004). Latitude and longitude coordinates are based on the NAD 27 Alaska datum and the UTM coordinates are based on the Clark 1866 spheroid, NAD 27 datum, UTM zone 6 projection.

DGGS submitted eight rock samples to the Geochronology Laboratory at University of Alaska Fairbanks (UAF) for $^{40}Ar/^{39}Ar$ dating. Samples were selected to be representative of different plutonic suites, dikes, and pluton-related mineralization in the East Bonnifield area. Major oxide and selected trace-element analyses for most of the samples are included in Freeman and others (2009a). Prior to processing, thin sections of the samples were petrographically inspected to ensure that mineral specimens selected for dating were free of alteration. Descriptions of the samples are presented in table 1.

Mineral separates for $^{40}Ar/^{39}Ar$ dating were prepared to greater than 99.5 percent purity (determined by visual inspection) where they were crushed, sieved, washed, and hand-picked for mineral phases or small, phenocryst-free whole-rock chips. The monitor mineral MMhb-1 (Samson and Alexander, 1987) with an age of 513.9 Ma (Lanphere and Dalrymple, 2000) was used to monitor neutron flux (and calculate the irradiation parameter, J). The samples and standards were wrapped in aluminum foil and loaded into aluminum cans 2.5 cm in diameter and 6 cm in height. The samples were irradiated in position 5c of the uranium-enriched research reactor of McMaster University in Hamilton, Ontario, Canada, for 20 megawatt-hours.

Upon their return from the reactor, the samples and monitors were loaded into 2-mm-diameter holes in a copper tray that was then loaded into an ultra-high-vacuum extraction line. The monitors were fused and samples heated using a 6-watt argon–ion laser following the technique described in York and others (1981), Layer and others (1987), and Layer (2000). Argon purification was achieved using a liquid nitrogen cold trap and an SAES Zr–Al getter at 400°C. The samples were analyzed in a VG-3600 mass spec-

[1]Department of Geology and Geophysics, University of Alaska, PO Box 755780, Fairbanks AK, 99775-5780
[2]Alaska Division of Geological & Geophysical Surveys, 3354 College Road, Fairbanks AK, 99709-3707

trometer at the Geophysical Institute, University of Alaska Fairbanks. The argon isotopes measured were corrected for system blank and mass discrimination, as well as calcium, potassium, and chlorine interference reactions following procedures outlined in McDougall and Harrison (1999). System blanks generally were 2×10^{-16}mol ^{40}Ar and 2×10^{-18}mol ^{36}Ar, which are 10 to 50 times smaller than fraction volumes. Mass discrimination was monitored by running both calibrated air shots and a zero-age glass sample. These measurements were made on a weekly to monthly basis to check for changes in mass discrimination.

A summary of all the ^{40}Ar/^{39}Ar results is given in table 2, with all ages quoted to the ±1 sigma level and calculated using the constants of Steiger and Jaeger (1977). The integrated age is the age given by the total gas measured and is equivalent to a potassium–argon (K–Ar) age. The spectrum provides a plateau age if three or more consecutive gas fractions represent at least 50 percent of the total gas release and are within two standard deviations of each other (Mean Square Weighted Deviation less than ~2.5). All samples were run three times to verify sample consistency.

DISCUSSION

Most samples show well-defined plateaus with simple spectra with little or no argon loss (generally this loss is probably Tertiary in age). Potassium feldspar from the two samples show complex histories that might reflect post-emplacement cooling/uplift and might warrant additional study.

One exception to this simple story is the biotite from 08MBW550B. The age spectrum for this sample shows a concave-down "hump-shaped" pattern with young ages at high and low ^{39}Ar release and maximum ages older than those seen from the hornblende from this sample. This pattern is typical for biotite that has been altered. The pattern is caused by argon recoil during irradiation. An indication that this sample is not a good one also comes from the high Ca/K ratio, something not typical for a biotite, but is typically seen in altered biotites. Therefore, the hornblende age is probably most representative of the cooling age of this sample.

For sample 08LF196A, the biotite is slightly older than the hornblende. The ages are not significantly different, however. Again, this biotite shows some evidence of alteration, and so the older age might be influenced by ^{39}Ar recoil.

For sample 08Z205A, only a whole-rock sample could be dated. Two runs of this sample yielded discordant results. Run 1 was completed with a minimum amount of material and so the age is not as precise and the spectrum is not as flat. Run 2 was performed with more material and the age is therefore more precise. Although both ages are included in this report, we feel that the second run is more representative of the true age of this sample.

ACKNOWLEDGMENTS

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Samples used in this report were collected by Larry Freeman, Melanie Werdon, Dave Szumigala, and Joe Andrew of DGGS, and Rainer Newberry of University of Alaska Fairbanks Department of Geology and Geophysics.

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Table 1. Locations and descriptions of samples collected for $^{40}Ar/^{39}Ar$ radiometric ages in this report. Sample locations were recorded with Garmin 12XL GPS receivers; estimated position errors are less than 10 m as calculated by the GPS receivers. Latitude and longitude coordinates are based on the NAD 27 Alaska datum and UTM coordinates are based on the Clark 1866 spheroid, NAD 27 datum, UTM zone 6 projection.

Sample Number	Latitude	Longitude	UTM E	UTM N	Zone	Description
2008LF196A	63.8434	-147.6087	470062	7079508	6	Granodiorite: Medium-grained, equigranular, contains 15% quartz as 2- to 3-mm-diameter grains, 20% plagioclase as subhedral 2- to 3-mm-diameter grains, 15% biotite, minor alteration to chlorite, 5% hornblende altered to chlorite and biotite, 40% fine-grained feldspathic matrix. Kansas Creek pluton.
2008MBW550B	63.8532	-147.5443	473236	7080570	6	Mafic(?) dike (quartz monzodiorite): White and black, medium-grained, approximately equigranular, with biotite (green, up to 4 mm in diameter, 5–7%), feldspar (white, 40%), hornblende (green, up to 1 cm long, 28–35%), sphene (orange, <1%, up to 1.5 mm long), and quartz (~25%). Slight alignment of minerals. Dike strikes 90° (azimuth), dips 90°, and is 0.6 m wide. Dike swarm at head of Dry Creek.
2008MBW415A	64.0660	-147.3248	484148	7104209	6	Porphyritic quartz monzonite: Tan and gray, coarse- to medium-grained, potassium feldspar porphyritic. Potassium–feldspar phenocrysts are sharply euhedral, rectangular, light pink, and up to 3 cm long (average 2 cm long). The matrix grain size ranges from 2 to 5 mm in diameter. Rock contains 33% K-feldspar, 32% plagioclase, 15% quartz (clear, glassy grains), and 20% biotite + hornblende. Hornblende is dark green, rarely with altered cores, and may be mixed with pyroxene(?). Pluton is magnetic. Pluton is located at the north edge of the Alaska Range foothills, near the lower end of Dry Creek canyon.
08RN242A	63.8411	-147.4954	475629	7079208	6	Biotite tonalite: Small stock in Glory Creek, no obvious quartz, plagioclase greater than potassium feldspar, 20% biotite, fine- to medium-grained, equigranular. Glory Creek stock.
2008JOE409	63.9849	-147.8292	459418	7095403	6	Porphyritic quartz monzonite: Contains 10% pale-colored, 1-cm-long potassium feldspar phenocrysts, in a medium-grained matrix containing roughly equal amounts of plagioclase and potassium feldspar, 25% hornblende and biotite, 10% interstitial quartz. Mystic Mountain pluton.
2008Z205A	63.8454	-147.4958	475615	7079689	6	Gabbro: Dark green, blocky outcrop. Broken rock is black to slightly greenish black, fine-grained rock with salt-and-pepper appearance. 1–2-mm-long, lath-shaped hornblende crystals and white feldspar phenocrysts. Rock looks nonfoliated in hand specimen. Moderate HCl reaction (carbonate alteration) throughout rock. Dike swarm at head of Dry Creek.
2008JOE212	63.9840	-147.3817	481345	7095089	6	Felsic dike: Orange-weathering fine-grained rock, tan-weathering siliceous groundmass with 0.5 mm feldspar laths. Dike at head of Slide Creek.
2008RN246B	63.8417	-147.4919	475804	7079268	6	Brecciated quartz vein: Vein is approximately 2 m wide and can be traced for at least 10 m along strike, less than 1% sulfide, approximately 1% white mica. Glory Creek lode prospect area.

Table 2. Summary of $^{40}Ar/^{39}Ar$ radiometric ages of samples in this report. Preferred interpreted ages are underlined. Samples analyzed with standard MMhb-1 with an age of 513.9 Ma.

Sample	Dated Material	Integrated Age (Ma)	Plateau Age (Ma)	Plateau Information	Isochron or other information
2008LF196A	Mineral separate, hornblende	90.6 ± 0.9	<u>92.0 ± 1.0</u>	9 fractions, 73% ^{39}Ar release, MSWD = 0.5	Isoc. 90.8 ± 1.1, $^{40}Ar/^{36}Ari$=295 ± 4, N=11, MSWD=1.7
2008LF196A	Mineral separate, biotite	92.4 ± 0.6	93.1 ± 0.6	9 fractions, 92% ^{39}Ar release, MSWD = 0.5	
2008LF196A	Mineral separate, potassium feldspar	92.0 ± 0.7	64.2 ±1.0	8 fractions, 45% ^{39}Ar release, MSWD = 2.2	
2008MBW550B	Mineral separate, hornblende	91.8 ± 0.9	<u>92.6 ± 0.9</u>	9 fractions, 92% ^{39}Ar release, MSWD = 1.1	Isoc. 92.5 ± 0.8, $^{40}Ar/^{36}Ari$=295 ± 6, N=10, MSWD = 0.9
2008MBW550B	Mineral separate, biotite	89.4 ± 0.7			Loss spectrum
2008MBW550B	Mineral separate, potassium feldspar	88.1 ± 0.4	82.9 ± 0.4	11 fractions, 95% ^{39}Ar release, MSWD = 1.4	
2008MBW415A	Mineral separate, biotite	92.0 ± 0.5	<u>92.3 ± 0.5</u>	10 fractions, 95% ^{39}Ar release, MSWD = 0.6	
08RN242A	Mineral separate, biotite	93.6 ± 0.6	<u>94.1 ± 0.6</u>	10 fractions, 91% ^{39}Ar release, MSWD = 0.2	
2008JOE409	Mineral separate, biotite	91.2 ± 0.4	<u>91.8 ± 0.4</u>	10 fractions, 95% ^{39}Ar release, MSWD = 0.4	
2008Z205A	Whole rock, run 1	111.1 ± 1.3	102.5 ± 1.5	9 fractions,72% ^{39}Ar release, MSWD = 1.0	Reset
2008Z205A	Whole rock, run 2	97.5 ± 1.1	<u>95.5 ± 1.1</u>	11 fractions, 99% 39Ar release, MSWD = 1.7	Reset/Loss
2008JOE212	Whole rock	84.3 ± 0.5	<u>85.7 ± 0.6</u>	4 fractions, 54% ^{39}Ar release, MSWD = 0.7	
2008RN246B	Mineral separate, white mica, run 1	90.3 ± 0.7	<u>90.9 ± 0.7</u>	9 fractions, 94% ^{39}Ar release, MSWD = 0.04	
2008RN246B	Mineral separate, white mica, run 2	90.0 ± 0.7	91.4 ± 0.7	9 fractions, 91% ^{39}Ar release, MSWD = 0.4	

Table 3. Step heating data for $^{40}Ar/^{39}Ar$ radiometric ages for samples.

08LF196A Hornblende								Weighted average of J from standards = 3.600e-03 ± 1.153e-05								
Laser (mW)	Cum. ^{39}Ar	$^{40}Ar/^{39}Ar$ measured	±	$^{37}Ar/^{39}Ar$ measured	±	$^{36}Ar/^{39}Ar$ measured	±	% Atm. ^{40}Ar	Ca/K	±	Cl/K	±	$^{40}Ar^*/^{39}Ar_K$	±	Age (Ma)	± (Ma)
500	0.0239	202.8487	2.2315	2.9322	0.0343	0.6338	0.0087	92.2	5.3914	0.0632	0.01768	0.00134	15.792	2.298	99.8	14.1
750	0.0617	51.8837	0.9578	1.5281	0.0281	0.1321	0.0023	75.0	2.8069	0.0517	0.00577	0.00048	12.970	0.881	82.3	5.5
1000	0.1394	21.7240	0.3908	0.6697	0.0129	0.0290	0.0010	39.2	1.2293	0.0237	0.00467	0.00023	13.199	0.421	83.7	2.6
1250	0.2200	17.3231	0.3320	2.7673	0.0575	0.0112	0.0014	17.8	5.0875	0.1059	0.01421	0.00041	14.246	0.513	90.2	3.2
1500	0.2934	23.0831	0.4583	4.5282	0.0906	0.0292	0.0014	35.8	8.3353	0.1673	0.02349	0.00054	14.842	0.549	93.9	3.4
1750	0.3697	18.8872	0.3520	6.6122	0.1200	0.0152	0.0009	20.9	12.1894	0.2222	0.03281	0.00093	14.993	0.412	94.8	2.5
2000	0.4899	16.4167	0.3029	7.8792	0.1460	0.0080	0.0007	10.5	14.5381	0.2710	0.04631	0.00095	14.748	0.348	93.3	2.2
2300	0.6475	16.1822	0.2883	6.5754	0.1153	0.0081	0.0005	11.4	12.1212	0.2136	0.03835	0.00084	14.379	0.314	91.0	1.9
2600	0.7905	15.3259	0.2826	6.5597	0.1240	0.0052	0.0004	6.5	12.0921	0.2297	0.04529	0.00096	14.369	0.302	91.0	1.9
3000	0.8664	15.6269	0.2916	4.6539	0.0950	0.0058	0.0011	8.5	8.5675	0.1755	0.02326	0.00064	14.311	0.431	90.6	2.7
5000	0.9816	15.7644	0.3220	5.5753	0.1202	0.0077	0.0005	11.5	10.2703	0.2224	0.02723	0.00060	13.981	0.336	88.6	2.1
9000	1.0000	17.3904	0.3720	9.5937	0.2181	0.0172	0.0031	24.7	17.7232	0.4057	0.04520	0.00182	13.156	0.980	83.5	6.1
Integrated		23.0531	0.1298	5.3364	0.0347	0.0312	0.0003	38.1	9.8285	0.0642	0.03020	0.00025	14.307	0.136	90.6	0.9

08LF196A Biotite								Weighted average of J from standards = 3.600e-03 ± 1.153e-05								
Laser (mW)	Cum. ^{39}Ar	$^{40}Ar/^{39}Ar$ measured	±	$^{37}Ar/^{39}Ar$ measured	±	$^{36}Ar/^{39}Ar$ measured	±	% Atm. ^{40}Ar	Ca/K	±	Cl/K	±	$^{40}Ar^*/^{39}Ar_K$	±	Age (Ma)	± (Ma)
500	0.0512	16.1882	0.3108	0.0442	0.0019	0.0127	0.0011	23.2	0.0811	0.0034	0.00421	0.00018	12.408	0.416	78.8	2.6
750	0.2192	14.8286	0.2277	0.0048	0.0003	0.0008	0.0002	1.7	0.0089	0.0006	0.00456	0.00009	14.551	0.231	92.1	1.4
1000	0.3520	14.9121	0.2737	0.0045	0.0005	0.0001	0.0003	0.2	0.0083	0.0010	0.00449	0.00014	14.850	0.284	94.0	1.8
1250	0.4691	14.9982	0.2739	0.0112	0.0007	0.0001	0.0002	0.2	0.0206	0.0013	0.00443	0.00014	14.938	0.280	94.5	1.7
1500	0.5924	14.8723	0.2655	0.0184	0.0006	0.0002	0.0002	0.4	0.0338	0.0011	0.00438	0.00011	14.787	0.273	93.6	1.7
1750	0.6813	14.7225	0.2633	0.0338	0.0010	0.0001	0.0004	0.2	0.0621	0.0018	0.00456	0.00016	14.664	0.288	92.8	1.8
2000	0.7434	14.6795	0.0780	0.0665	0.0009	0.0005	0.0004	0.9	0.1220	0.0017	0.00476	0.00009	14.522	0.138	91.9	0.9
2300	0.8679	14.7354	0.2097	0.0807	0.0020	0.0003	0.0002	0.5	0.1481	0.0037	0.00476	0.00016	14.640	0.217	92.7	1.3
2600	0.9447	14.7822	0.0795	0.1256	0.0017	0.0002	0.0003	0.3	0.2304	0.0032	0.00505	0.00007	14.713	0.128	93.1	0.8
3000	0.9687	14.9021	0.1545	0.0950	0.0047	0.0013	0.0010	2.5	0.1742	0.0087	0.00571	0.00029	14.503	0.326	91.8	2.0
5000	0.9960	14.9467	0.1613	0.0544	0.0018	-0.0005	0.0009	-0.9	0.0998	0.0032	0.00524	0.00019	15.059	0.307	95.2	1.9
9000	1.0000	14.6685	0.3598	0.0351	0.0118	0.0032	0.0046	6.3	0.0643	0.0217	0.00565	0.00116	13.710	1.393	86.9	8.6
Integrated		14.9050	0.0804	0.0380	0.0004	0.0010	0.0001	1.9	0.0697	0.0007	0.00462	0.00004	14.597	0.085	92.4	0.6

Table 3 (continued). Step heating data for $^{40}Ar/^{39}Ar$ radiometric ages for samples.

08LF196A Feldspar								Weighted average of J from standards = 3.600e-03 ± 1.153e-05								
Laser (mW)	Cum. ^{39}Ar	$^{40}Ar/^{39}Ar$ measured	±	$^{37}Ar/^{39}Ar$ measured	±	$^{36}Ar/^{39}Ar$ measured	±	% Atm. ^{40}Ar	Ca/K	±	Cl/K	±	$^{40}Ar^*/^{39}Ar_K$	±	Age (Ma)	± (Ma)
500	0.0022	887.4823	38.3715	0.0324	0.0971	0.3506	0.0400	11.7	0.0594	0.1782	0.03839	0.00704	783.876	35.643	2418.7	60.6
750	0.0114	128.9778	1.8740	0.0269	0.0225	0.0263	0.0064	6.0	0.0494	0.0412	0.00792	0.00191	121.186	2.590	653.1	11.7
1000	0.0483	18.7057	0.2611	0.0145	0.0052	0.0069	0.0018	10.9	0.0265	0.0095	0.00183	0.00059	16.647	0.571	105.0	3.5
1250	0.1284	12.1401	0.1394	0.0149	0.0030	0.0039	0.0010	9.6	0.0273	0.0055	0.00082	0.00019	10.948	0.312	69.7	2.0
1500	0.2088	9.6751	0.1114	0.0109	0.0026	0.0003	0.0005	0.8	0.0200	0.0048	0.00059	0.00021	9.572	0.186	61.1	1.2
1750	0.2691	9.3571	0.1413	0.0055	0.0042	-0.0018	0.0021	-5.6	0.0100	0.0078	0.00043	0.00038	9.850	0.628	62.9	3.9
2000	0.3068	9.9717	0.1579	0.0084	0.0035	0.0012	0.0016	3.4	0.0153	0.0065	0.00055	0.00024	9.602	0.483	61.3	3.0
2500	0.3575	9.9963	0.1250	0.0099	0.0035	-0.0003	0.0015	-0.8	0.0181	0.0063	0.00035	0.00027	10.042	0.463	64.1	2.9
3000	0.4066	10.2710	0.1576	0.0109	0.0027	0.0017	0.0013	4.9	0.0201	0.0049	0.00068	0.00022	9.735	0.411	62.1	2.6
4000	0.4851	11.0054	0.0860	0.0054	0.0015	0.0007	0.0011	1.9	0.0100	0.0027	0.00059	0.00014	10.770	0.320	68.6	2.0
6000	0.5446	10.8698	0.1325	0.0040	0.0032	0.0023	0.0014	6.2	0.0074	0.0058	0.00030	0.00021	10.169	0.428	64.9	2.7
9000	0.5733	11.0506	0.1898	-0.0024	0.0059	0.0003	0.0022	0.8	-0.0045	0.0108	0.00042	0.00044	10.928	0.671	69.6	4.2
Fuse	1.0000	13.7915	0.1011	0.0040	0.0004	0.0012	0.0002	2.6	0.0074	0.0008	0.00066	0.00006	13.410	0.113	85.1	0.7
Integrated		15.2415	0.0565	0.0069	0.0007	0.0023	0.0003	4.5	0.0127	0.0013	0.00079	0.00006	14.528	0.097	92.0	0.7

08MBW550B Hornblende								Weighted average of J from standards = 3.600e-03 ± 1.153e-05								
Laser (mW)	Cum. ^{39}Ar	$^{40}Ar/^{39}Ar$ measured	±	$^{37}Ar/^{39}Ar$ measured	±	$^{36}Ar/^{39}Ar$ measured	±	% Atm. ^{40}Ar	Ca/K	±	Cl/K	±	$^{40}Ar^*/^{39}Ar_K$	±	Age (Ma)	± (Ma)
500	0.0070	187.7282	4.4928	2.4426	0.0670	0.5854	0.0156	92.0	4.4896	0.1233	0.04808	0.00262	14.951	3.738	94.6	23.0
750	0.0149	47.9850	1.1691	1.7322	0.0584	0.1326	0.0073	81.4	3.1823	0.1074	0.00962	0.00188	8.915	2.080	57.0	13.1
1000	0.0255	26.1147	0.5594	1.2144	0.0437	0.0557	0.0077	62.7	2.2301	0.0804	0.00828	0.00116	9.739	2.283	62.2	14.3
1250	0.0389	18.9613	0.4232	1.6225	0.0427	0.0201	0.0051	30.7	2.9805	0.0786	0.01394	0.00105	13.135	1.541	83.3	9.6
1500	0.0534	17.2409	0.3130	3.1211	0.0757	0.0116	0.0037	18.5	5.7395	0.1394	0.04301	0.00136	14.063	1.126	89.1	7.0
1750	0.0777	17.5270	0.2174	5.3679	0.0784	0.0129	0.0022	19.3	9.8868	0.1450	0.08731	0.00129	14.170	0.679	89.8	4.2
2000	0.1443	17.3429	0.3317	6.7225	0.1394	0.0108	0.0011	15.2	12.3938	0.2583	0.12042	0.00243	14.748	0.440	93.3	2.7
2300	0.2577	16.2980	0.3120	6.7302	0.1263	0.0064	0.0004	8.2	12.4079	0.2339	0.11878	0.00240	15.005	0.328	94.9	2.0
2600	0.4328	15.7599	0.2861	6.7700	0.1259	0.0054	0.0003	6.5	12.4816	0.2333	0.11729	0.00228	14.773	0.294	93.5	1.8
3000	0.6442	15.4176	0.2694	6.6402	0.1189	0.0040	0.0005	4.2	12.2412	0.2203	0.11744	0.00224	14.812	0.299	93.7	1.9
5000	0.9002	15.3825	0.2601	6.3553	0.1057	0.0050	0.0003	6.3	11.7136	0.1957	0.09270	0.00154	14.455	0.266	91.5	1.6
9000	1.0000	15.7824	0.3163	6.7369	0.1275	0.0079	0.0006	11.4	12.4204	0.2362	0.09564	0.00203	14.031	0.342	88.9	2.1
Integrated		17.4274	0.1218	6.3412	0.0473	0.0118	0.0002	17.0	11.6875	0.0875	0.10356	0.00081	14.505	0.131	91.8	0.9

Table 3 (continued). Step heating data for $^{40}Ar/^{39}Ar$ radiometric ages for samples.

08MBW550B Biotite								Weighted average of J from standards = 3.600e-03 ± 1.153e-05								
Laser (mW)	Cum. ^{39}Ar	$^{40}Ar/^{39}Ar$ measured	±	$^{37}Ar/^{39}Ar$ measured	±	$^{36}Ar/^{39}Ar$ measured	±	% Atm. ^{40}Ar	Ca/K	±	Cl/K	±	$^{40}Ar^*/^{39}Ar_K$	±	Age (Ma)	± (Ma)
300	0.0340	12.0514	0.2253	0.4280	0.0097	0.0219	0.0011	53.5	0.7856	0.0178	0.00665	0.00026	5.596	0.355	36.0	2.3
500	0.1005	13.3484	0.2230	0.3097	0.0064	0.0122	0.0006	27.0	0.5684	0.0117	0.00650	0.00020	9.730	0.268	62.1	1.7
750	0.2130	14.9267	0.3059	0.1486	0.0027	0.0064	0.0003	12.6	0.2727	0.0050	0.00630	0.00025	13.014	0.296	82.6	1.8
1000	0.3653	15.3454	0.2993	0.1204	0.0027	0.0024	0.0002	4.5	0.2210	0.0050	0.00650	0.00016	14.631	0.298	92.6	1.8
1250	0.5132	15.8162	0.3265	0.0809	0.0016	0.0016	0.0002	3.0	0.1484	0.0030	0.00659	0.00021	15.317	0.326	96.8	2.0
1500	0.6292	16.1001	0.2817	0.0905	0.0020	0.0013	0.0002	2.3	0.1660	0.0036	0.00654	0.00016	15.703	0.286	99.2	1.8
1750	0.7130	15.7570	0.3249	0.1543	0.0039	0.0002	0.0004	0.3	0.2832	0.0071	0.00619	0.00024	15.685	0.341	99.1	2.1
2000	0.7927	15.4849	0.3109	0.2719	0.0054	-0.0002	0.0004	-0.5	0.4990	0.0098	0.00643	0.00023	15.540	0.331	98.2	2.0
2500	0.8960	15.1346	0.2829	0.5216	0.0102	0.0001	0.0003	-0.1	0.9575	0.0188	0.00649	0.00022	15.120	0.295	95.6	1.8
3000	0.9333	13.8770	0.2363	0.3837	0.0070	-0.0011	0.0008	-2.6	0.7043	0.0129	0.00593	0.00023	14.206	0.329	90.0	2.0
4000	0.9679	13.0112	0.1667	0.2675	0.0057	-0.0011	0.0009	-2.8	0.4909	0.0104	0.00545	0.00024	13.343	0.307	84.6	1.9
6000	0.9987	11.3121	0.1302	0.1043	0.0037	-0.0007	0.0015	-1.9	0.1915	0.0068	0.00439	0.00024	11.499	0.455	73.2	2.8
9000	1.0000	12.6168	1.0336	0.3560	0.0737	-0.0458	0.0227	-107.8	0.6534	0.1353	0.01241	0.00435	26.160	6.836	162.4	40.6
Integrated		14.9713	0.0951	0.2084	0.0015	0.0029	0.0001	5.6	0.3825	0.0027	0.00635	0.00007	14.112	0.099	89.4	0.7

08MBW550B Feldspar								Weighted average of J from standards = 3.600e-03 ± 1.153e-05								
Laser (mW)	Cum. ^{39}Ar	$^{40}Ar/^{39}Ar$ measured	±	$^{37}Ar/^{39}Ar$ measured	±	$^{36}Ar/^{39}Ar$ measured	±	% Atm. ^{40}Ar	Ca/K	±	Cl/K	±	$^{40}Ar^*/^{39}Ar_K$	±	Age (Ma)	± (Ma)
500	0.0186	73.0933	0.3895	0.0029	0.0036	0.0411	0.0024	16.6	0.0054	0.0066	0.01368	0.00058	60.919	0.776	357.7	4.1
750	0.0501	12.5900	0.1639	0.0121	0.0027	0.0042	0.0014	9.9	0.0222	0.0049	0.00047	0.00026	11.323	0.448	72.1	2.8
1000	0.0669	12.8338	0.1810	0.0082	0.0052	-0.0011	0.0024	-2.6	0.0151	0.0095	0.00001	0.00049	13.137	0.732	83.4	4.5
1250	0.0911	12.9897	0.2313	0.0039	0.0045	-0.0012	0.0016	-2.7	0.0072	0.0083	0.00036	0.00036	13.314	0.522	84.5	3.2
1500	0.1087	13.3446	0.2277	0.0030	0.0044	-0.0017	0.0030	-3.9	0.0055	0.0080	0.00002	0.00046	13.829	0.910	87.6	5.6
1750	0.1257	12.9726	0.2430	-0.0026	0.0048	0.0002	0.0027	0.3	-0.0047	0.0088	-0.00024	0.00042	12.898	0.824	81.9	5.1
2000	0.1345	12.1473	0.2464	0.0257	0.0123	0.0033	0.0043	8.0	0.0471	0.0226	0.00108	0.00111	11.152	1.283	71.0	8.0
2500	0.1499	12.7432	0.2063	0.0096	0.0061	0.0003	0.0019	0.8	0.0176	0.0111	0.00056	0.00043	12.618	0.607	80.1	3.8
3000	0.1654	12.5346	0.1937	0.0160	0.0110	-0.0004	0.0024	-0.9	0.0293	0.0202	0.00083	0.00056	12.616	0.724	80.1	4.5
4000	0.1856	12.6981	0.1907	0.0072	0.0046	0.0008	0.0018	1.8	0.0132	0.0085	0.00072	0.00039	12.441	0.574	79.0	3.6
6000	0.2167	12.7380	0.1942	0.0040	0.0025	-0.0004	0.0009	-0.9	0.0074	0.0045	0.00075	0.00029	12.820	0.329	81.4	2.0
9000	0.2367	12.7946	0.1931	0.0052	0.0048	0.0031	0.0017	7.2	0.0095	0.0088	0.00094	0.00034	11.850	0.543	75.4	3.4
Fuse	1.0000	13.5167	0.0375	0.0013	0.0002	0.0012	0.0001	2.6	0.0023	0.0003	0.00102	0.00003	13.140	0.040	83.4	0.3
Integrated		14.4649	0.0332	0.0026	0.0004	0.0018	0.0001	3.7	0.0048	0.0007	0.00114	0.00004	13.900	0.053	88.1	0.4

Table 3 (continued). Step heating data for $^{40}Ar/^{39}Ar$ radiometric ages for samples.

08MBW415A Biotite									Weighted average of J from standards = 3.600e-03 ± 1.153e-05							
Laser (mW)	Cum. ^{39}Ar	$^{40}Ar/^{39}Ar$ measured	±	$^{37}Ar/^{39}Ar$ measured	±	$^{36}Ar/^{39}Ar$ measured	±	% Atm. ^{40}Ar	Ca/K	±	Cl/K	±	$^{40}Ar^*/^{39}Ar_K$	±	Age (Ma)	± (Ma)
500	0.0280	18.1868	0.1938	0.0193	0.0028	0.0179	0.0010	29.1	0.0355	0.0051	0.05068	0.00074	12.870	0.327	81.7	2.0
750	0.1133	15.4735	0.0686	0.0035	0.0008	0.0034	0.0003	6.4	0.0063	0.0015	0.05128	0.00037	14.451	0.111	91.5	0.7
1000	0.2249	14.8014	0.1278	0.0010	0.0007	0.0004	0.0002	0.9	0.0019	0.0012	0.05107	0.00058	14.642	0.143	92.7	0.9
1250	0.3194	14.7871	0.2035	0.0032	0.0010	0.0001	0.0002	0.1	0.0059	0.0017	0.05118	0.00087	14.736	0.214	93.3	1.3
1500	0.4068	14.8158	0.1790	0.0037	0.0010	0.0002	0.0003	0.3	0.0069	0.0018	0.05172	0.00096	14.735	0.197	93.2	1.2
1750	0.5068	14.7107	0.1818	0.0057	0.0007	-0.0001	0.0002	-0.2	0.0104	0.0012	0.05162	0.00081	14.714	0.196	93.1	1.2
2000	0.5854	14.6710	0.0562	0.0143	0.0011	0.0002	0.0005	0.5	0.0262	0.0020	0.05092	0.00051	14.574	0.159	92.2	1.0
2300	0.7259	14.6227	0.1730	0.0190	0.0005	0.0003	0.0003	0.6	0.0349	0.0009	0.05059	0.00073	14.500	0.192	91.8	1.2
2600	0.8098	14.7227	0.0603	0.0303	0.0009	0.0002	0.0004	0.5	0.0555	0.0016	0.05128	0.00037	14.626	0.140	92.6	0.9
3000	0.8607	14.7199	0.0903	0.0086	0.0015	0.0010	0.0008	1.9	0.0158	0.0028	0.05073	0.00054	14.408	0.245	91.2	1.5
5000	0.9737	14.7072	0.0840	0.0033	0.0006	0.0008	0.0004	1.5	0.0060	0.0010	0.05098	0.00038	14.453	0.132	91.5	0.8
9000	1.0000	14.6918	0.1834	0.0031	0.0022	0.0002	0.0019	0.5	0.0057	0.0041	0.04944	0.00068	14.594	0.577	92.4	3.6
Integrated		14.8848	0.0447	0.0094	0.0003	0.0011	0.0001	2.1	0.0172	0.0005	0.05107	0.00020	14.539	0.056	92.0	0.5

08RN242A Biotite									Weighted average of J from standards = 3.600e-03 ± 1.153e-05							
Laser (mW)	Cum. ^{39}Ar	$^{40}Ar/^{39}Ar$ measured	±	$^{37}Ar/^{39}Ar$ measured	±	$^{36}Ar/^{39}Ar$ measured	±	% Atm. ^{40}Ar	Ca/K	±	Cl/K	±	$^{40}Ar^*/^{39}Ar_K$	±	Age (Ma)	± (Ma)
500	0.0885	16.0480	0.2613	0.1337	0.0024	0.0070	0.0004	12.8	0.2453	0.0045	0.00769	0.00018	13.964	0.271	88.5	1.7
750	0.2555	15.1245	0.2455	0.0015	0.0005	0.0007	0.0001	1.3	0.0028	0.0008	0.00879	0.00020	14.902	0.246	94.3	1.5
1000	0.3745	15.0170	0.2768	0.0020	0.0011	-0.0001	0.0004	-0.2	0.0037	0.0020	0.00875	0.00020	15.024	0.303	95.0	1.9
1250	0.4780	15.0423	0.2677	0.0025	0.0005	0.0006	0.0002	1.2	0.0046	0.0010	0.00841	0.00019	14.837	0.273	93.9	1.7
1500	0.5886	14.9792	0.2964	0.0028	0.0006	0.0001	0.0004	0.2	0.0052	0.0011	0.00838	0.00021	14.922	0.313	94.4	1.9
1750	0.6768	15.0239	0.2661	0.0065	0.0006	0.0005	0.0002	0.9	0.0119	0.0012	0.00850	0.00023	14.861	0.272	94.0	1.7
2000	0.7489	14.9793	0.0903	0.0136	0.0008	0.0004	0.0003	0.7	0.0249	0.0015	0.00821	0.00024	14.849	0.130	93.9	0.8
2300	0.8503	14.8665	0.1785	0.0222	0.0006	0.0003	0.0002	0.5	0.0408	0.0012	0.00897	0.00019	14.760	0.189	93.4	1.2
2600	0.9179	14.9091	0.0712	0.0330	0.0013	-0.0002	0.0003	-0.5	0.0606	0.0023	0.00889	0.00015	14.949	0.115	94.6	0.7
3000	0.9558	14.9798	0.0991	0.0190	0.0020	0.0008	0.0009	1.6	0.0349	0.0037	0.00915	0.00024	14.707	0.270	93.1	1.7
5000	0.9948	15.0276	0.0880	0.0351	0.0019	0.0007	0.0005	1.3	0.0644	0.0035	0.00944	0.00029	14.810	0.174	93.7	1.1
9000	1.0000	15.1119	0.3174	0.0324	0.0133	0.0035	0.0052	6.9	0.0594	0.0245	0.00636	0.00111	14.039	1.554	88.9	9.6
Integrated		15.0995	0.0782	0.0212	0.0003	0.0009	0.0001	1.8	0.0389	0.0006	0.00859	0.00007	14.795	0.083	93.6	0.6

Table 3 (continued). Step heating data for $^{40}Ar/^{39}Ar$ radiometric ages for samples.

08JOE409 Biotite								Weighted average of J from standards = 3.600e-03 ± 1.153e-05									
Laser (mW)	Cum. ^{39}Ar	$^{40}Ar/^{39}Ar$ measured	±	$^{37}Ar/^{39}Ar$ measured	±	$^{36}Ar/^{39}Ar$ measured	±	% Atm. ^{40}Ar	Ca/K	±	Cl/K	±	$^{40}Ar^*/^{39}Ar_K$	±	Age (Ma)	± (Ma)
500	0.0492	17.1032	0.1073	0.0267	0.0006	0.0154	0.0004	26.6	0.0489	0.0011	0.04438	0.00037	12.524	0.155	79.6	1.0
750	0.1714	15.1021	0.0928	0.0072	0.0003	0.0024	0.0002	4.6	0.0132	0.0005	0.04355	0.00030	14.379	0.102	91.0	0.6
1000	0.3026	14.7648	0.0875	0.0074	0.0003	0.0007	0.0001	1.5	0.0136	0.0005	0.04298	0.00025	14.518	0.096	91.9	0.6
1250	0.4154	14.7904	0.1282	0.0105	0.0002	0.0005	0.0002	0.9	0.0193	0.0004	0.04276	0.00044	14.628	0.137	92.6	0.8
1500	0.5059	14.7358	0.1880	0.0193	0.0004	0.0006	0.0002	1.1	0.0355	0.0007	0.04259	0.00061	14.538	0.197	92.0	1.2
1750	0.6233	14.7743	0.1212	0.0604	0.0007	0.0006	0.0002	1.2	0.1108	0.0012	0.04320	0.00034	14.561	0.128	92.2	0.8
2000	0.7334	14.6722	0.1245	0.1062	0.0015	0.0003	0.0001	0.5	0.1949	0.0028	0.04386	0.00039	14.567	0.130	92.2	0.8
2300	0.8032	14.6156	0.2348	0.0765	0.0013	0.0005	0.0002	0.9	0.1404	0.0024	0.04255	0.00073	14.452	0.243	91.5	1.5
2600	0.8593	14.6356	0.2003	0.0507	0.0012	0.0007	0.0003	1.4	0.0930	0.0022	0.04208	0.00070	14.406	0.213	91.2	1.3
3000	0.9011	14.7125	0.0938	0.0992	0.0014	0.0008	0.0004	1.5	0.1820	0.0026	0.04227	0.00043	14.471	0.139	91.6	0.9
5000	0.9949	14.5652	0.2038	0.0963	0.0016	0.0003	0.0002	0.5	0.1768	0.0029	0.03982	0.00058	14.457	0.208	91.5	1.3
9000	1.0000	14.9962	0.1998	0.0389	0.0064	0.0029	0.0025	5.7	0.0713	0.0117	0.03459	0.00091	14.115	0.772	89.4	4.8
Integrated		14.8749	0.0444	0.0464	0.0003	0.0015	0.0001	3.0	0.0852	0.0005	0.04273	0.00014	14.407	0.047	91.2	0.4

08Z205A Whole Rock run #1								Weighted average of J from standards = 3.600e-03 ± 1.153e-05									
Laser (mW)	Cum. ^{39}Ar	$^{40}Ar/^{39}Ar$ measured	±	$^{37}Ar/^{39}Ar$ measured	±	$^{36}Ar/^{39}Ar$ measured	±	% Atm. ^{40}Ar	Ca/K	±	Cl/K	±	$^{40}Ar^*/^{39}Ar_K$	±	Age (Ma)	± (Ma)
500	0.0836	66.5321	0.5105	6.3205	0.0600	0.1287	0.0025	56.4	11.6493	0.1112	0.01521	0.00044	29.119	0.743	179.8	4.4
750	0.1751	20.1888	0.3239	7.2607	0.1114	0.0168	0.0022	21.7	13.3911	0.2066	0.00220	0.00030	15.874	0.721	100.3	4.4
1000	0.2489	18.9712	0.2710	2.9867	0.0413	0.0097	0.0025	13.8	5.4918	0.0762	0.00193	0.00042	16.368	0.794	103.3	4.9
1250	0.3324	19.6097	0.3585	10.2285	0.1977	0.0108	0.0021	12.0	18.9044	0.3680	0.00369	0.00031	17.361	0.708	109.4	4.3
1500	0.4400	18.5970	0.3342	11.0482	0.1972	0.0081	0.0018	8.0	20.4314	0.3676	0.00787	0.00037	17.209	0.629	108.4	3.9
1750	0.5392	17.2226	0.2985	5.2438	0.0973	0.0070	0.0023	9.5	9.6574	0.1798	0.01172	0.00040	15.611	0.729	98.6	4.5
2000	0.6216	16.9300	0.2784	3.9498	0.0748	0.0054	0.0019	7.5	7.2676	0.1380	0.02230	0.00078	15.683	0.613	99.1	3.8
2300	0.7025	16.6166	0.2971	3.9133	0.0731	0.0027	0.0021	2.9	7.2002	0.1348	0.02430	0.00080	16.152	0.685	102.0	4.2
2600	0.7561	16.6628	0.2707	3.7404	0.0609	0.0042	0.0026	5.6	6.8813	0.1123	0.02057	0.00066	15.751	0.825	99.5	5.1
3000	0.8010	16.9274	0.2485	4.4974	0.0801	0.0062	0.0028	8.7	8.2784	0.1480	0.02469	0.00102	15.484	0.867	97.9	5.3
5000	0.9463	18.6689	0.2552	8.1747	0.1319	0.0061	0.0010	6.1	15.0865	0.2449	0.03860	0.00061	17.601	0.378	110.8	2.3
9000	1.0000	21.9184	0.1983	10.4200	0.1430	0.0146	0.0028	15.8	19.2610	0.2664	0.04099	0.00117	18.569	0.845	116.7	5.1
Integrated		22.4371	0.0985	6.7732	0.0367	0.0183	0.0006	21.7	12.4877	0.0680	0.01776	0.00017	17.637	0.198	111.1	1.3

Table 3 (continued). Step heating data for $^{40}Ar/^{39}Ar$ radiometric ages for samples.

08Z205A Whole Rock run #2								Weighted average of J from standards = 3.600e-03 ± 1.153e-05								
Laser (mW)	Cum. ^{39}Ar	$^{40}Ar/^{39}Ar$ measured	±	$^{37}Ar/^{39}Ar$ measured	±	$^{36}Ar/^{39}Ar$ measured	±	% Atm. ^{40}Ar	Ca/K	±	Cl/K	±	$^{40}Ar^*/^{39}Ar_K$	±	Age (Ma)	± (Ma)
500	0.0104	134.1856	2.3365	2.4208	0.0418	0.2975	0.0069	65.4	4.4494	0.0770	0.02682	0.00098	46.529	1.762	279.4	9.8
750	0.0225	32.4863	1.2002	2.2496	0.0638	0.0664	0.0046	59.9	4.1343	0.1175	0.00607	0.00065	13.031	1.566	82.7	9.7
1000	0.0410	25.9793	0.8338	3.8522	0.0821	0.0450	0.0030	50.0	7.0875	0.1514	0.00505	0.00051	13.021	1.109	82.6	6.9
1250	0.0630	22.8456	0.7807	5.5063	0.1213	0.0329	0.0019	40.6	10.1428	0.2243	0.00443	0.00048	13.612	0.863	86.3	5.3
1500	0.0881	24.2549	0.7582	7.6417	0.1690	0.0362	0.0023	41.5	14.0976	0.3135	0.00384	0.00030	14.243	0.912	90.2	5.6
1750	0.1206	22.8586	0.5933	7.8477	0.1269	0.0292	0.0016	35.0	14.4797	0.2354	0.00341	0.00037	14.925	0.692	94.4	4.3
2000	0.1580	20.6782	0.5783	4.8848	0.0936	0.0239	0.0015	32.3	8.9940	0.1729	0.00335	0.00033	14.031	0.669	88.9	4.1
2300	0.2045	19.2814	0.4868	5.4220	0.0943	0.0180	0.0012	25.2	9.9868	0.1744	0.00309	0.00026	14.447	0.562	91.5	3.5
2600	0.2642	18.8752	0.4192	4.8069	0.0732	0.0152	0.0008	21.8	8.8500	0.1352	0.00486	0.00023	14.791	0.454	93.6	2.8
3000	0.3463	17.9283	0.3528	4.1161	0.0567	0.0116	0.0008	17.2	7.5745	0.1047	0.00611	0.00015	14.857	0.408	94.0	2.5
5000	0.5968	18.1995	0.5315	5.5114	0.1532	0.0108	0.0005	15.1	10.1522	0.2833	0.01165	0.00041	15.484	0.512	97.9	3.2
9000	1.0000	17.2364	0.2100	4.5435	0.0674	0.0074	0.0002	10.5	8.3636	0.1244	0.01690	0.00031	15.446	0.201	97.6	1.2
Integrated		19.9029	0.1799	4.9644	0.0475	0.0166	0.0002	22.6	9.1411	0.0877	0.01154	0.00016	15.431	0.169	97.5	1.1

08JOE212 Whole Rock								Weighted average of J from standards = 3.600e-03 ± 1.153e-05								
Laser (mW)	Cum. ^{39}Ar	$^{40}Ar/^{39}Ar$ measured	±	$^{37}Ar/^{39}Ar$ measured	±	$^{36}Ar/^{39}Ar$ measured	±	% Atm. ^{40}Ar	Ca/K	±	Cl/K	±	$^{40}Ar^*/^{39}Ar_K$	±	Age (Ma)	± (Ma)
500	0.0112	33.3788	0.6180	0.7023	0.0138	0.0930	0.0018	82.3	1.2893	0.0253	0.00469	0.00017	5.916	0.597	38.0	3.8
750	0.0297	14.3011	0.2002	0.6083	0.0083	0.0188	0.0003	38.5	1.1166	0.0152	0.00429	0.00010	8.775	0.184	56.1	1.2
1000	0.0620	14.0656	0.2839	0.6305	0.0119	0.0127	0.0003	26.4	1.1574	0.0219	0.00387	0.00013	10.341	0.261	65.9	1.6
1250	0.1080	14.8425	0.5048	0.9249	0.0312	0.0079	0.0004	15.2	1.6981	0.0573	0.00162	0.00015	12.566	0.476	79.8	3.0
1500	0.1545	14.6960	0.4817	1.0816	0.0409	0.0059	0.0002	11.3	1.9861	0.0752	0.00167	0.00014	13.022	0.454	82.7	2.8
1750	0.2228	14.6883	0.2824	0.7153	0.0186	0.0038	0.0001	7.3	1.3132	0.0341	0.00162	0.00009	13.592	0.264	86.2	1.6
2000	0.3018	14.6159	0.3104	0.4138	0.0118	0.0021	0.0001	3.9	0.7594	0.0216	0.00232	0.00013	14.015	0.301	88.8	1.9
2300	0.4648	14.6215	0.2240	0.0646	0.0012	0.0021	0.0001	4.1	0.1185	0.0022	0.00302	0.00011	13.992	0.216	88.7	1.3
2600	0.6418	14.4495	0.2083	0.0650	0.0013	0.0033	0.0001	6.7	0.1193	0.0024	0.00270	0.00010	13.458	0.197	85.4	1.2
3000	0.7620	14.8551	0.2318	0.0694	0.0017	0.0046	0.0002	9.2	0.1273	0.0031	0.00269	0.00011	13.462	0.216	85.4	1.3
5000	0.9594	15.6194	0.1272	0.0758	0.0007	0.0069	0.0001	13.0	0.1391	0.0014	0.00280	0.00005	13.562	0.118	86.0	0.7
9000	1.0000	15.5607	0.1001	0.0494	0.0007	0.0063	0.0002	12.0	0.0906	0.0013	0.00212	0.00007	13.668	0.112	86.7	0.7
Integrated		15.0575	0.0807	0.2613	0.0025	0.0060	0.0001	11.5	0.4795	0.0045	0.00263	0.00003	13.295	0.074	84.3	0.5

Table 3 (continued). Step heating data for $^{40}Ar/^{39}Ar$ radiometric ages for samples.

08RN246B Sericite run #1								Weighted average of J from standards = 3.600e-03 ± 1.153e-05								
Laser (mW)	Cum. ^{39}Ar	$^{40}Ar/^{39}Ar$ measured	±	$^{37}Ar/^{39}Ar$ measured	±	$^{36}Ar/^{39}Ar$ measured	±	% Atm. ^{40}Ar	Ca/K	±	Cl/K	±	$^{40}Ar^*/^{39}Ar_K$	±	Age (Ma)	± (Ma)
500	0.0114	14.0148	0.0664	0.0049	0.0016	0.0167	0.0007	35.3	0.0091	0.0029	0.00190	0.00022	9.044	0.203	57.8	1.3
750	0.0307	14.0626	0.2070	0.0028	0.0011	0.0039	0.0003	8.1	0.0051	0.0020	0.00022	0.00013	12.896	0.221	81.9	1.4
1000	0.0558	14.7044	0.2613	0.0017	0.0007	0.0023	0.0003	4.7	0.0030	0.0012	0.00034	0.00010	13.991	0.265	88.6	1.6
1250	0.0914	14.8832	0.2653	-0.0001	0.0005	0.0014	0.0002	2.7	-0.0002	0.0010	0.00033	0.00010	14.446	0.267	91.5	1.7
1500	0.1680	14.6150	0.3297	0.0001	0.0003	0.0004	0.0001	0.9	0.0002	0.0006	0.00034	0.00007	14.457	0.330	91.5	2.0
1750	0.2759	14.5035	0.3103	0.0001	0.0002	0.0004	0.0001	0.8	0.0003	0.0003	0.00038	0.00007	14.352	0.308	90.9	1.9
2000	0.3797	14.6132	0.2862	-0.0001	0.0002	0.0006	0.0001	1.3	-0.0001	0.0003	0.00039	0.00007	14.398	0.283	91.2	1.8
2300	0.5249	14.4986	0.3128	0.0000	0.0001	0.0005	0.0001	1.0	0.0000	0.0002	0.00037	0.00008	14.331	0.310	90.8	1.9
2600	0.6612	14.5409	0.3135	0.0001	0.0001	0.0007	0.0001	1.4	0.0001	0.0002	0.00043	0.00007	14.305	0.310	90.6	1.9
3000	0.7022	14.7983	0.1570	0.0001	0.0004	0.0013	0.0001	2.6	0.0002	0.0006	0.00035	0.00005	14.382	0.159	91.1	1.0
5000	0.8465	14.5919	0.3285	-0.0001	0.0001	0.0008	0.0001	1.5	-0.0002	0.0002	0.00037	0.00008	14.338	0.325	90.8	2.0
9000	1.0000	14.5209	0.3080	0.0001	0.0001	0.0006	0.0001	1.2	0.0001	0.0002	0.00032	0.00006	14.324	0.305	90.7	1.9
Integrated		14.5598	0.1059	0.0002	0.0001	0.0009	0.0000	1.9	0.0003	0.0001	0.00038	0.00002	14.256	0.104	90.3	0.7

08RN246B Sericite run #2								Weighted average of J from standards = 3.600e-03 ± 1.153e-05								
Laser (mW)	Cum. ^{39}Ar	$^{40}Ar/^{39}Ar$ measured	±	$^{37}Ar/^{39}Ar$ measured	±	$^{36}Ar/^{39}Ar$ measured	±	% Atm. ^{40}Ar	Ca/K	±	Cl/K	±	$^{40}Ar^*/^{39}Ar_K$	±	Age (Ma)	± (Ma)
300	0.0128	17.3105	0.3581	0.0162	0.0109	0.0329	0.0037	56.3	0.0298	0.0201	0.00198	0.00079	7.548	1.105	48.4	7.0
500	0.0444	14.3875	0.2515	0.0070	0.0042	0.0085	0.0014	17.5	0.0129	0.0078	0.00042	0.00032	11.847	0.481	75.3	3.0
750	0.0931	16.4702	0.2731	0.0056	0.0030	0.0102	0.0010	18.3	0.0102	0.0055	0.00041	0.00019	13.435	0.395	85.2	2.5
1000	0.2472	14.7936	0.2684	0.0002	0.0008	0.0017	0.0003	3.4	0.0003	0.0015	0.00042	0.00008	14.268	0.274	90.4	1.7
1250	0.3780	14.9651	0.2896	0.0004	0.0016	0.0017	0.0003	3.4	0.0008	0.0029	0.00033	0.00010	14.429	0.299	91.4	1.9
1500	0.4345	15.2772	0.2900	0.0024	0.0025	0.0032	0.0008	6.3	0.0044	0.0046	0.00024	0.00022	14.291	0.357	90.5	2.2
1750	0.5475	14.9361	0.2878	0.0011	0.0013	0.0018	0.0004	3.6	0.0021	0.0024	0.00041	0.00011	14.364	0.306	91.0	1.9
2000	0.7294	14.6008	0.2546	0.0008	0.0007	0.0006	0.0002	1.3	0.0015	0.0012	0.00038	0.00006	14.388	0.259	91.1	1.6
2500	0.8364	14.7861	0.2950	-0.0004	0.0017	0.0009	0.0003	1.7	-0.0007	0.0031	0.00045	0.00009	14.501	0.303	91.8	1.9
3000	0.8628	15.0856	0.1903	0.0027	0.0045	0.0010	0.0007	1.9	0.0049	0.0083	0.00049	0.00043	14.775	0.289	93.5	1.8
4000	0.9104	14.8994	0.2582	0.0001	0.0021	0.0009	0.0006	1.8	0.0001	0.0038	0.00019	0.00012	14.605	0.305	92.4	1.9
6000	1.0001	14.8519	0.2667	-0.0018	0.0014	0.0005	0.0003	1.0	-0.0034	0.0025	0.00031	0.00013	14.673	0.283	92.9	1.7
9000	1.0000	-87.3886	122.5255	1.4429	2.7043	-0.4268	0.7423	144.4	2.6503	4.9721	0.01834	0.09641	38.855	147.708	236.2	841.5
Integrated		14.9489	0.0933	0.0010	0.0005	0.0024	0.0001	4.8	0.0018	0.0009	0.00039	0.00004	14.209	0.099	90.0	0.7

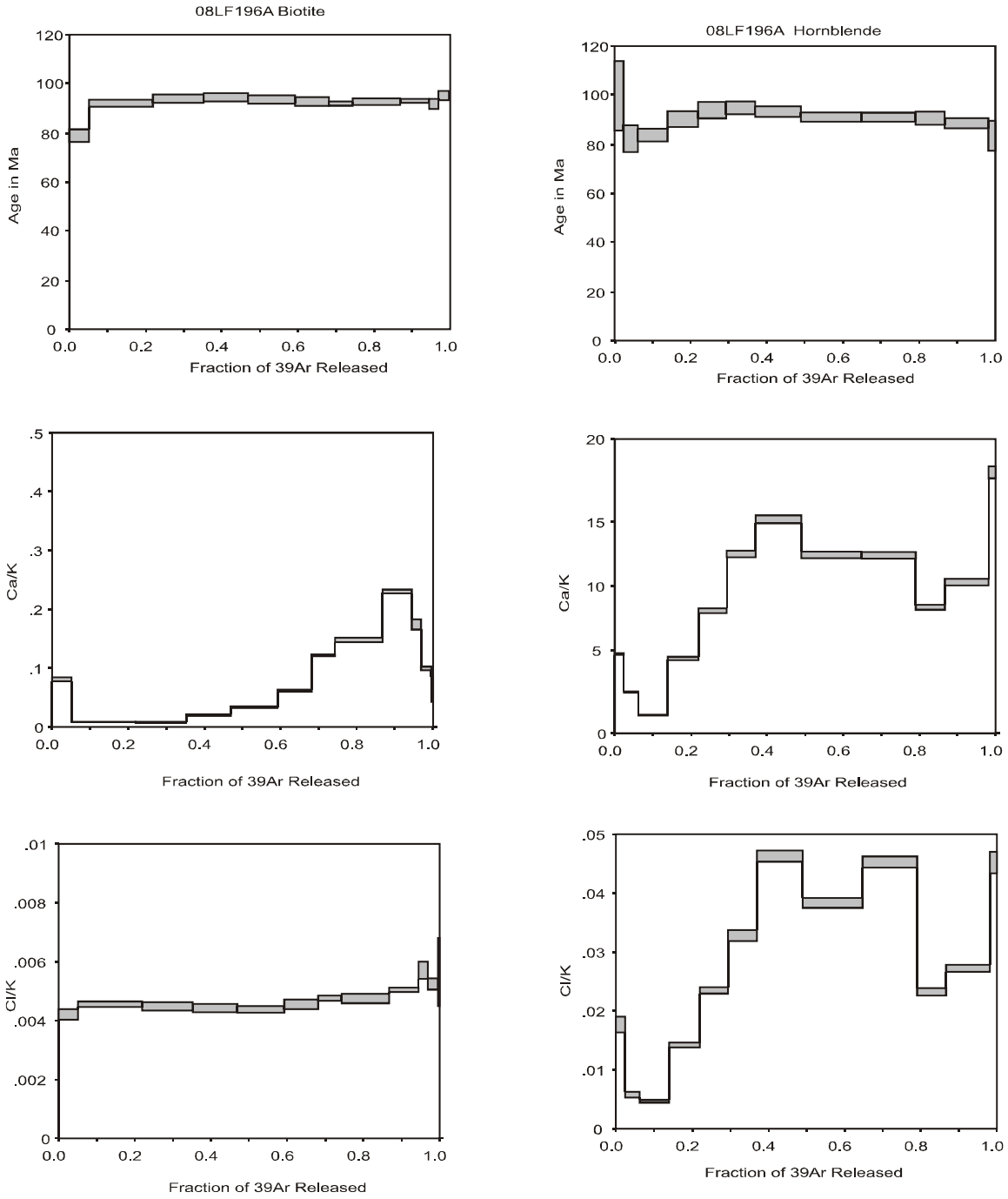

Figure 1. Spectra plots of Age, Ca/K, and Cl/K step heating data for samples from the East Bonnifield geologic map area.

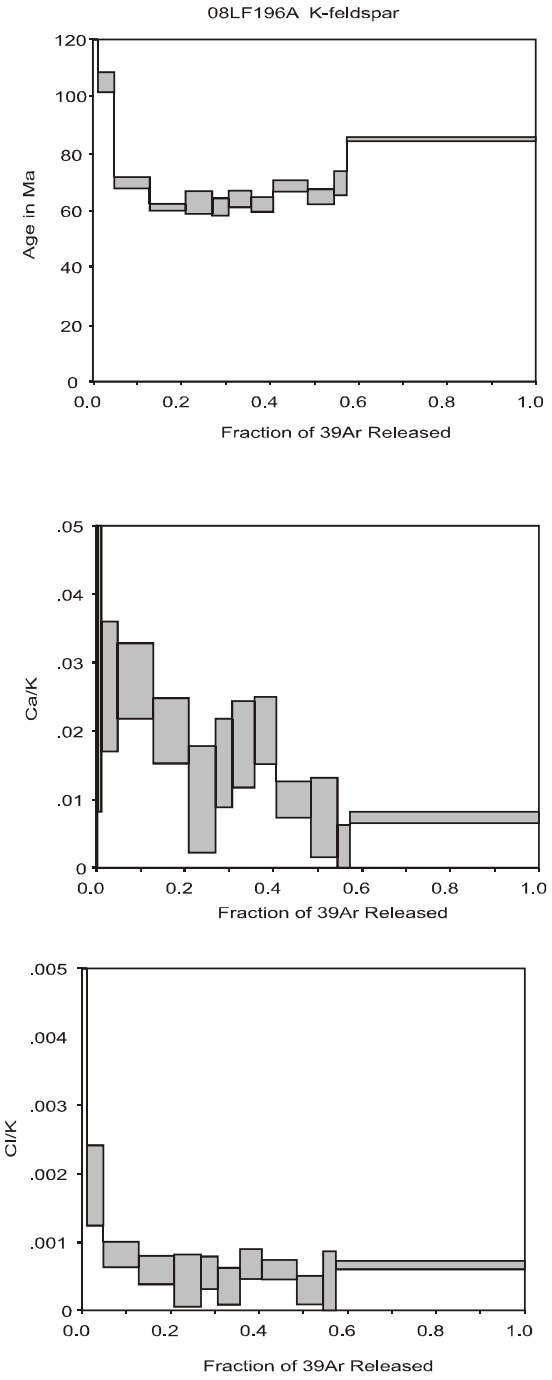

Figure 1 (continued). Spectra plots of Age, Ca/K, and Cl/K step heating data for samples from the East Bonnifield geologic map area.

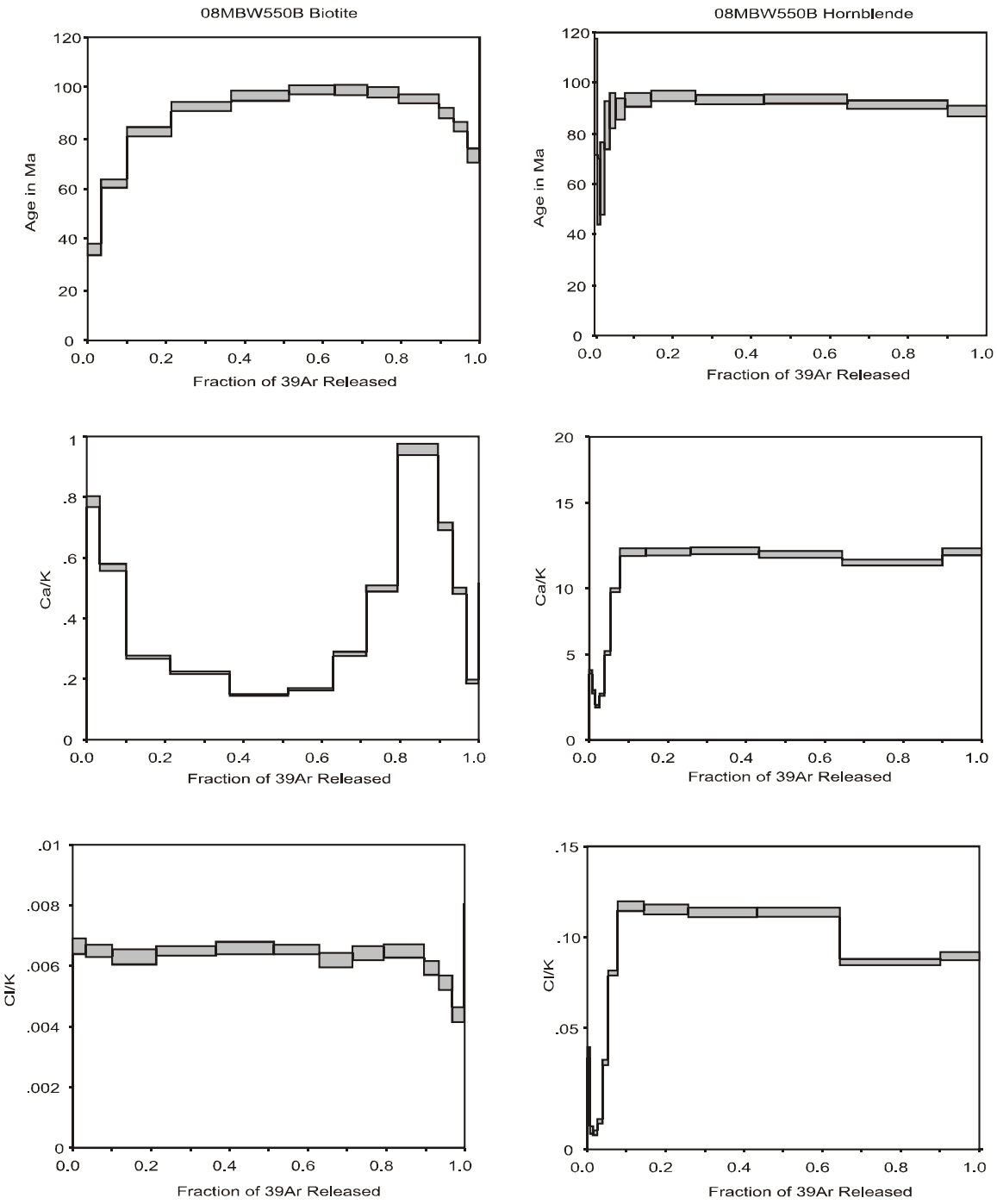

Figure 1 (continued). Spectra plots of Age, Ca/K, and Cl/K step heating data for samples from the East Bonnifield geologic map area.

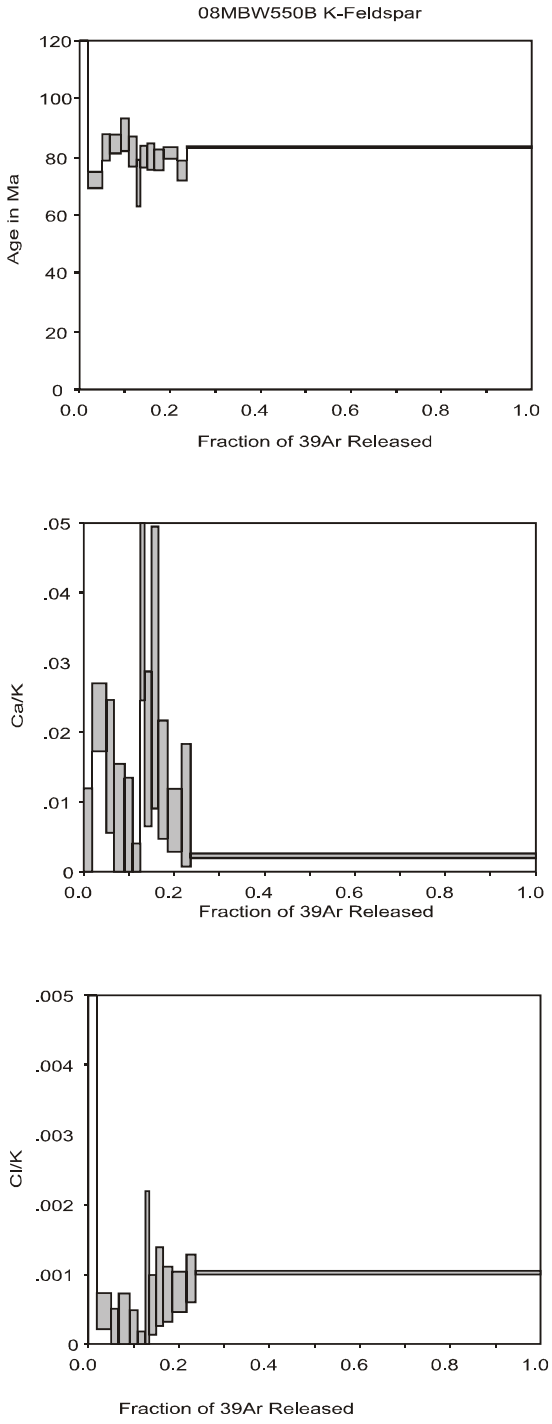

Figure 1 (continued). Spectra plots of Age, Ca/K, and Cl/K step heating data for samples from the East Bonnifield geologic map area.

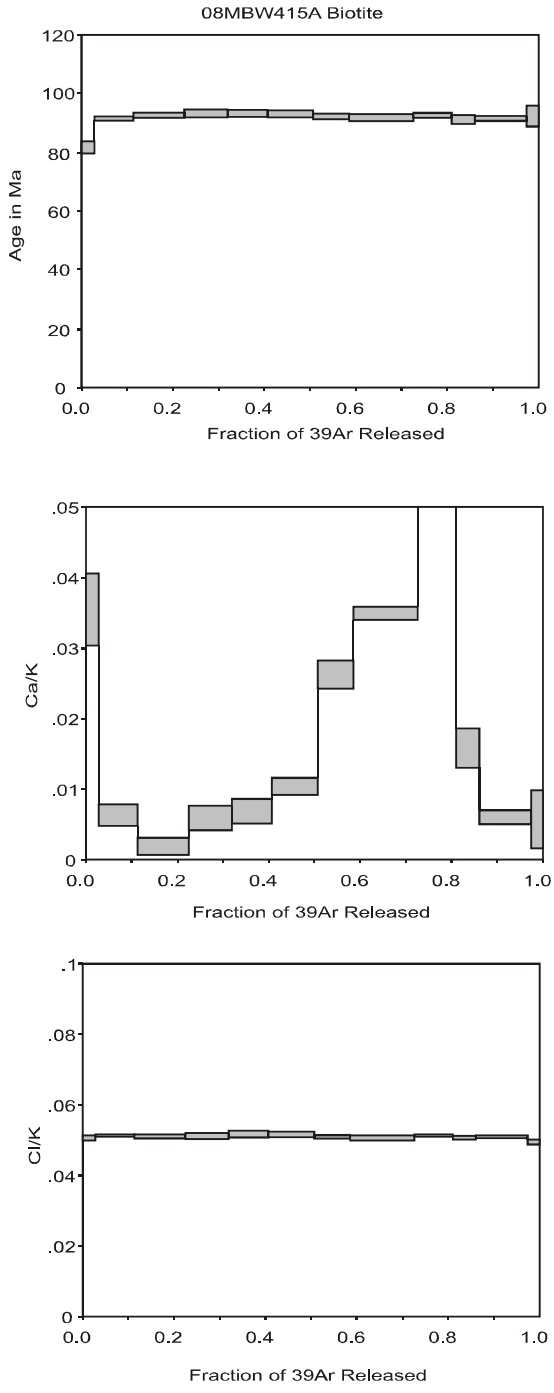

Figure 1 (continued). Spectra plots of Age, Ca/K, and Cl/K step heating data for samples from the East Bonnifield geologic map area.

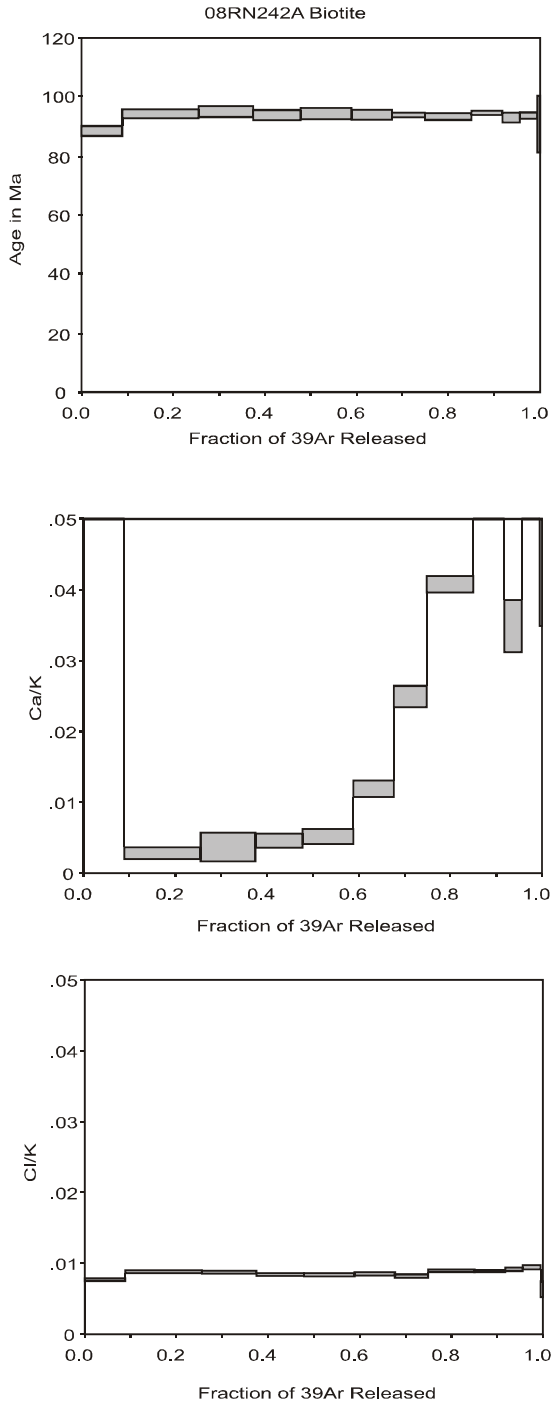

Figure 1 (continued). Spectra plots of Age, Ca/K, and Cl/K step heating data for samples from the East Bonnifield geologic map area.

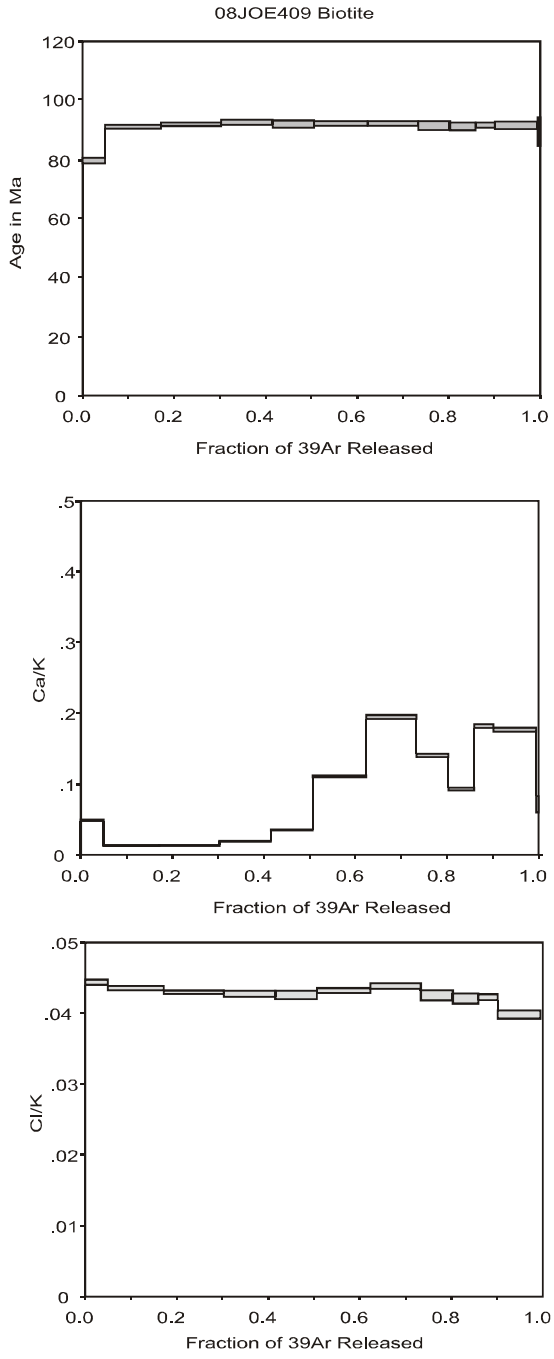

Figure 1 (continued). Spectra plots of Age, Ca/K, and Cl/K step heating data for samples from the East Bonnifield geologic map area.

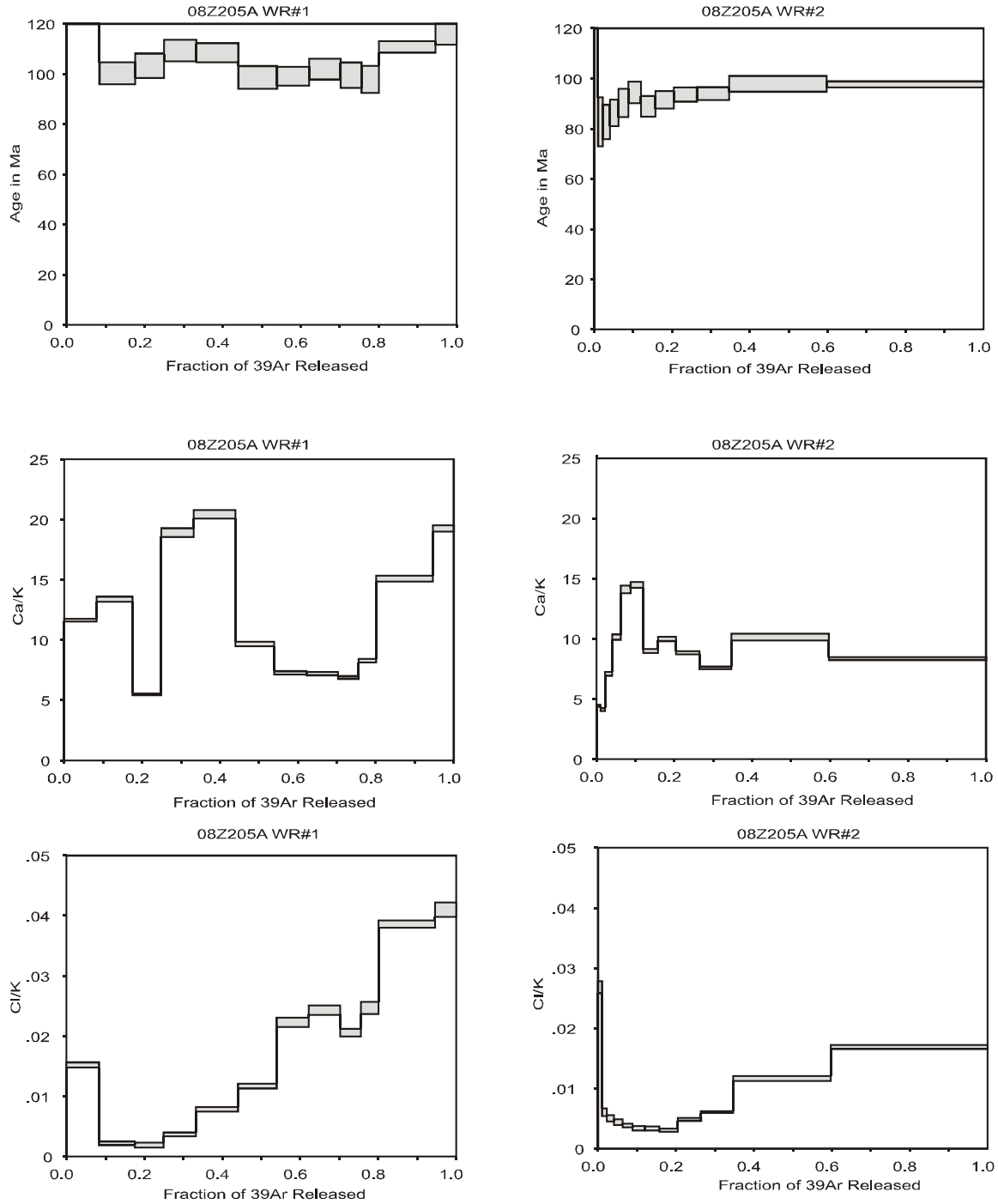

Figure 1 (continued). Spectra plots of Age, Ca/K, and Cl/K step heating data for samples from the East Bonnifield geologic map area.

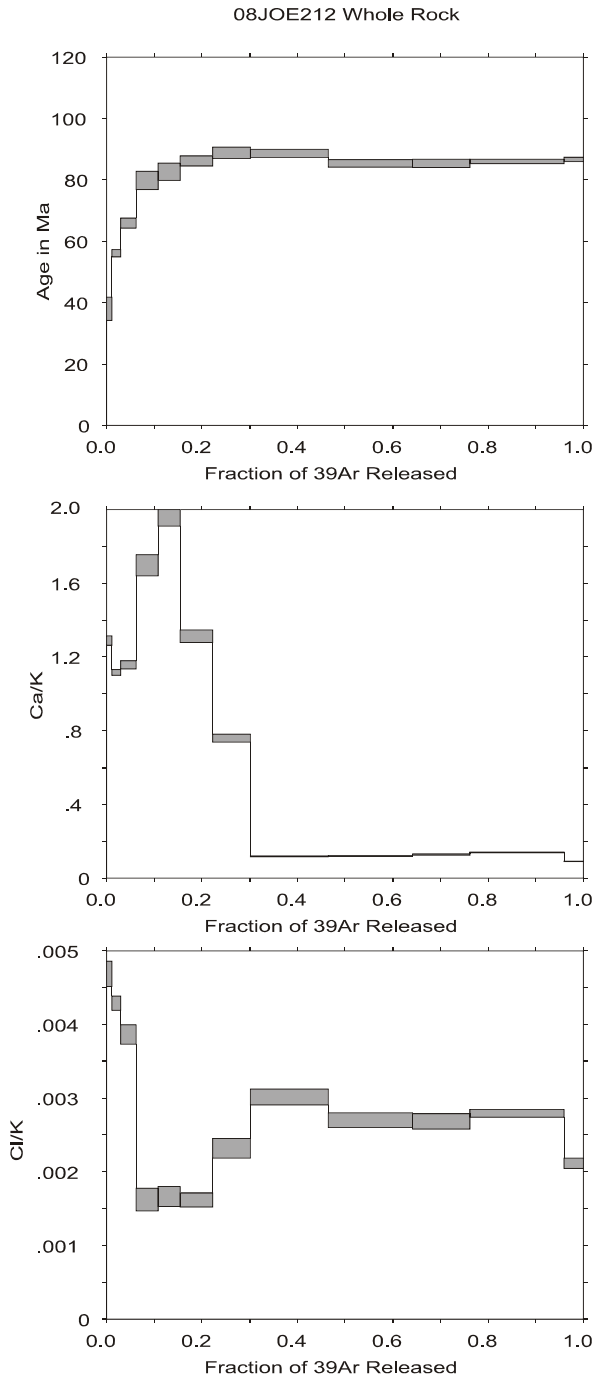

Figure 1 (continued). Spectra plots of Age, Ca/K, and Cl/K step heating data for samples from the East Bonnifield geologic map area.

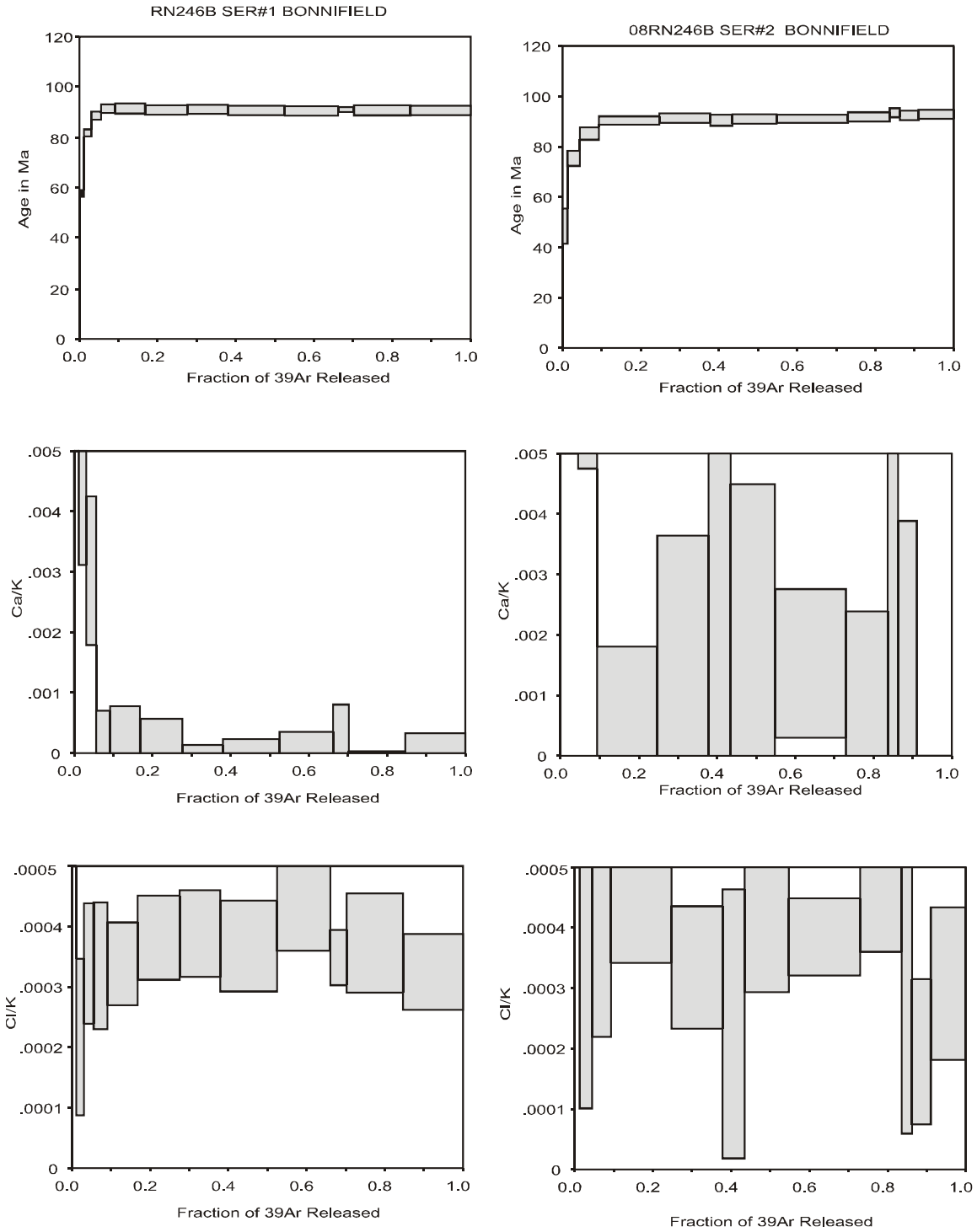

Figure 1 (continued). Spectra plots of Age, Ca/K, and Cl/K step heating data for samples from the East Bonnifield geologic map area.