^{40}AR/^{39}AR DATA FROM THE EASTERN MORAN AREA, TANANA B-6 AND C-6 QUADRANGLES, AND THE RUBY MINING DISTRICT, RUBY B-5 AND B-6 QUADRANGLES, ALASKA

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^{40}AR/^{39}AR DATA FROM THE EASTERN MORAN AREA, TANANA B-6 AND C-6 QUADRANGLES, AND THE RUBY MINING DISTRICT, RUBY B-5 AND B-6 QUADRANGLES, ALASKA

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INTRODUCTION

In 2011, geologists from the Alaska Division of Geological & Geophysical Surveys (DGGS) conducted field studies in the eastern Moran area as part of an integrated geological, geophysical, and geochemical mineral inventory study in the eastern Kokrines Hills near Moran Dome in the Tanana B-6 and C-6 quadrangles. This work was part of the Alaska Airborne Geophysical/Geological Mineral Inventory (AGGMI) program and included geologic mapping under the U.S. Geological Survey National Cooperative Geologic Mapping Program STATEMAP program. Previous geologic work in the area is at a reconnaissance scale, although two localities in the study area have undergone detailed mineral-resource evaluations (Tozimoran Creek Placer: Thomas and Wright, 1948; Chapman and others 1963; Barker and Warner, 1985. Monday Creek: International Tower Hill Mines, Ltd., 2006, 2007). No geochronological data from the area have been published, but limited geochronology has been published from the region. K-Ar ages of Ruby terrane rocks in the Kokrines Hills (Melozitna Quadrangle) indicate peak blueschist metamorphism occurred prior to ~144 Ma with a greenschist overprint at ~133 Ma (Roeske and others, 1995). A subsequent localized cooling age of ~109 Ma was measured from amphibolite in the western Kokrines Hills (Roeske and others, 1995). Orthogneiss in the Ruby terrane in the Kokrines Hills has a zircon U-Pb age indicating crystallization at 380 to 390 Ma (Roeske and others, 2006). Gabbro from the Tozitna Terrane (Rampart Group) has a hornblende K-Ar age of 210 ± 6 Ma (Patton and others, 1977). In the Ruby Mining district, metamorphic rocks have K-Ar cooling ages of 61.9 ± 1.9 from biotite, and 71.3 ± 2.2 from muscovite. The Melozitna Pluton has a K-Ar biotite cooling age of 111 ± 3 Ma (Patton and others, 1978). This report complements geochemical data (Lough and others, 2012) and geophysical data (Burns and others, 2010) from the Moran area.

The data provided in this report add significant detail to the thermal history of the Moran area. These new data indicate that the minimum age of prograde metamorphism of Ruby terrane rocks ranges from 148.5 ± 1.7 to 140.4 ± 1.7 Ma, and retrograde greenschist metamorphism is 122.6 ± 2.3 Ma. The retrograde metamorphism is roughly coeval with the age of fabric development parallel to the Kaltag fault (128.3 ± 1.7) and Tozitna thrust/detachment fault (123.2 ± 1.5 Ma). The new data also indicate that the Melozitna pluton is composite, with a biotite cooling age of 116.5 ± 1.3 from coarse-grained granite, while cooling ages for dikes cutting the granite range from 110.1 ± 1.3 to 102.8 ± 1.2 Ma. The age of mineralized veins in the area are

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variable and include 119.0 ± 1.3 Ma galena veins in the Tozimoran drainage and an interpreted age of 66.5 ± 2.6 for an auriferous vein from the Monday Creek area, which is synchronous with ages of biotite samples from granite and schist from the Ruby Mining district. The analytical data tables associated with this report are available in digital format as comma-separated value (CSV) files. Additional details about the organization of information are noted in the accompanying metadata file. All files can be downloaded from the DGGS website (http://doi.org/10.14509/30117).

Samples collected for this data release are currently housed at the Alaska Geological Materials Center in Anchorage, except for the three samples from the Ruby mining district which are retained by the University of Alaska Fairbanks (UAF) geochronology laboratory archive.

DOCUMENTATION OF METHODS

Sample Collection

Rock samples for this report were collected during the 2011 DGGS field campaign, but also include samples from the Doyon Limited drill core warehouse in Fairbanks, the U.S. Bureau of Mines collection at the Alaska Geologic Materials Center, and the UAF Geochronology Laboratory. The source is noted in the sample descriptions in the data tables and in the discussion of results. Samples for this report were selected for three different purposes: 1) crystallization/cooling age of representative igneous and metaigneous rocks in which the target material (biotite, amphibole, or groundmass) appeared to be free of secondary alteration ; 2) metamorphic age, where white mica was selected from specific foliation planes to obtain an age of the corresponding deformation event; and, 3) alteration age of veins by selecting white mica in the vein selvage or intergrown with other gangue minerals in the vein.

Location data for samples collected during the 2011 DGGS field campaign were derived using Garmin eTrex hand-held GPS units. Waypoints were downloaded from the eTrex units and merged with a hand-transcribed Microsoft Access field notes database on a daily basis, and locations were spot checked to ensure that the data merge was correct. Location error for this process is estimated to range between 3 and 20 m. The North American Datum of 1927 (NAD27) was used consistently for recording and reporting sample locations. Sample 11LF004A used the coordinates for the drill hole collar, which were transformed into NAD27 from World Geodetic System of 1984 coordinates provided by Doyon, Limited. The error for this sample is less than 10 m. Samples from the Ruby mining district were digitized from sample locations depicted on georeferenced images of scanned geologic map sheets (Puchner and others, 1998); these samples were collected prior to the use of GPS, and locations were hand plotted by geologists on USGS 1:63,360 topographic maps. Cumulative error for these locations could be in excess of 100 m. Sample RM 23241-R was collected from sluice box concentrates and the source is at or below the confluence of Ash and Tozimoran creeks. The location provided is for the creek confluence, and a location error of 1,000 m is assigned to this sample.

Sample Preparation

Samples included in this report are from three batches processed for $^{40}Ar/^{39}Ar$ analysis by the Geochronology Laboratory at UAF; each batch was processed using standard procedures outlined below. Sample 11LF004A (lab number prefix 11-004LF-A) was submitted in June 2011, archived samples from the

Ruby mining district were processed starting in May 2012, and the remainder of the samples were submitted in February 2012. Upon submittal to the lab, samples were crushed, sieved, washed, and hand-picked for pure mineral phase separates or phenocryst-free whole rock chips. The monitor mineral MMhb-1 (Samson and Alexander, 1987) with an age of 523.5 Ma (Renne and others, 1994) 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 of 2.5-cm diameter and 6-cm 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.

Analytical Methods

Upon return from the reactor, the samples and monitors were loaded into 2-mm-diameter holes in a copper tray, which 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), and Layer and others (1987). Argon purification was achieved using a liquid nitrogen cold trap and a SAES Zr-Al getter at 400° C. The samples were analyzed in a VG-3600 mass spectrometer at the Geophysical Institute, UAF. 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). Typical full-system 8-minute laser blank values (in moles) were generally 2×10^{-16} mol ^{40}Ar, 3×10^{-18} mol ^{39}Ar, 9×10^{-18} mol ^{38}Ar and 2×10^{-18} mol ^{36}Ar, which are 10–50 times smaller than the sample/standard volume fractions. Correction factors for nucleogenic interferences during irradiation were determined from irradiated CaF_2 and K_2SO_4 as follows: $(^{39}Ar/^{37}Ar)Ca = 7.06 \times 10^{-4}$, $(^{36}Ar/^{37}Ar)Ca = 2.79 \times 10^{-4}$, and $(^{40}Ar/^{39}Ar)K = 0.0297$. Mass discrimination was monitored by running calibrated air shots. The mass discrimination during these experiments was 1.3 percent per mass unit. During sample analysis, calibration measurements were made on a weekly to monthly basis to check for changes in mass discrimination with no significant variation observed during these intervals.

RESULTS AND DISCUSSION

A summary of all the $^{40}Ar/^{39}Ar$ results is provided in the accompanying data tables, with all ages quoted to the ± 1-sigma level and calculated using the constants of Renne and others (2010). The integrated age is the age given by the total gas measured and is equivalent to a potassium-argon (K-Ar) age. Age spectra, Ca/K, and Cl/K plots are included in the appendix. 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 [MSWD] less than 2.5). When a spectrum did not provide a plateau age under the above definition, a weighted-mean age was calculated. Below we provide additional discussion of the results of each age analysis, noting our preferred age determination.

11BAE290A (2011BAE290A BI#2) – Biotite

Sample 11BAE290A is a biotite syenogranite from the Melozitna Pluton. It is coarse-grained, pink to grayish-pink, equigranular, massive, and homogenous. Minerals are equally distributed and include slightly porphyritic potassium feldspar and 10% biotite. This lithology is 90% of the exposed rock at this locality. A biotite separate from sample 11BAE290A was analyzed. The integrated age (116.5 ± 1.3 Ma) and the plateau age (116.5 ± 1.3 Ma) are within error. We prefer the plateau age of 116.5 ± 1.3 Ma because of possible minor alteration in the low-temperature gas release which is reflected in the high atmospheric content of these steps. This age represents the cooling age of the coarse-grained granite at this outcrop.

11BAE290B (2011BAE290B BI#2) – Biotite

Sample 11BAE290B is from a leucocratic syenogranite dike within the Melozitna Pluton. It is fine- to medium-grained, with occasional larger 1- to 5-mm-diameter biotite, 2- to 5-mm-diameter quartz, and 2-mm- to 1-cm-diameter potassium feldspar. Fresh rock is pink but has a white weathering rind. This dike comprises 10% of exposed rock at this locality and intrudes biotite syenogranite (11BAE290A). A biotite separate from sample 11BAE290B was analyzed. The integrated age (110.3 ± 1.3 Ma) and the plateau age (110.1 ± 1.3 Ma) are within error. We prefer the plateau age of 110.1 ± 1.3 Ma because of possible minor alteration in the low-temperature gas release which is reflected in the high atmospheric content of these steps. No isochron age determination was possible due to the generally homogenous radiogenic nature of the steps used in the plateau age determination. The preferred age represents the cooling age of the fine-grained leucocratic granite which occurs as a dike in the coarse-grained granite (11BAE290A).

11BAE359C (2011BAE359C WR#2) – Whole rock

Sample 11BAE359C is from a rhyolite dike within the Melozitna Pluton. It is very fine-grained, light gray, massive, homogenous, and aphanitic. The rock contains small, 1- to 2-mm-diameter brown spots (biotite clots after clinopyroxene?) and occasional small, euhedral quartz or light-colored feldspar. The dike comprises 10% of the exposed rock at this locality and intrudes biotite granite similar to 11BAE290B. A whole rock separate of phenocryst-free groundmass from sample 11BAE359C was analyzed. The integrated age (107.3 ± 1.2 Ma) and the plateau age (102.8 ± 1.2 Ma) are not within error. We prefer the plateau age of 102.8 ± 1.2 Ma because of possible alteration in the low-temperature gas release which is reflected in the high atmospheric content and high Ca/K ratios of these steps. No isochron age determination was possible due to the generally homogenous radiogenic nature of the steps used in the plateau age determination. The preferred age represents a cooling age of a porphyritic dike with an aphanitic groundmass cutting coarse-grained granite.

11BAE364C (2011BAE364C BI#2) – Biotite

Sample 11BAE364C is a granite porphyry dike within the Melozitna pluton. It has a fine- to medium-grained groundmass with large biotite, potassium-feldspar, and quartz phenocrysts, possibly a hypabyssal dike. The dike appears to intrude coarse-grained granite that comprises most of outcrop/subcrop area. A biotite separate from sample 11BAE364C was analyzed. The integrated age (105.5 ± 1.1 Ma) and the plateau age (105.7 ± 1.1 Ma) are within error. We prefer the plateau age of 105.7 ± 1.1 Ma. No isochron age determination was possible due to the generally homogenous radiogenic nature of the steps used in the plateau age determination. The preferred age represents a cooling age of a granite porphyry dike within coarse-grained seriate granite.

11GG044B (2011GG044B WM#2) – White mica

Sample 11GG044B is from a gold-mineralized fault breccia within Ruby terrane albite-quartz schist of probable volcanic arc derivation. Highly oxidized, orangish-brown, welded, and re-silicified fault material with boxwork structures and gossan. Contains sericite and quartz crystals within cavities. A selected breccia-matrix white mica separate from sample 11GG044B was analyzed. The age-stepping up nature of the gas release is indicative of a sample that experienced gas loss/alteration with the higher temperature/more retentive gas release more reflecting the true age of the mineral phase. The integrated age (136.3 ± 1.5 Ma) and the plateau age (140.4 ± 1.7 Ma) are within broad error. We prefer the plateau age of 140.4 ± 1.7 Ma because of the documented loss. No isochron age determination was possible due to the documented loss. The preferred age represents the minimum metamorphic age.

11GG205A (2011GG205A HO#1) – Hornblende

Sample 11GG205A is a metagabbro from the Tozitna terrane. It is granular, metamafic, containing 1-mm-diameter, subhedral epidote, plagioclase, and hornblende. It was collected from the base of a steep cliff of metamafic rocks. A hornblende separate from sample 11GG205A was analyzed. The age-stepping up nature of the gas release is indicative of a sample that experienced gas loss/alteration with the higher temperature/more retentive gas release more reflecting the true age of the mineral phase. The integrated age (231.9 ± 2.0 Ma) and the plateau age (231.5 ± 1.9 Ma) are within broad error. We prefer the plateau age of 231.5 ± 1.9 Ma because of the documented loss and higher precision. No isochron age determination was possible due to the documented loss. The preferred age reflects magmatic cooling age and likely approximates the crystallization age of this gabbro sill within the Tozitna terrane.

11GG463A (2011GG463A WM#1) – White mica

Sample 11GG463A is a meta-conglomerate from Paleozoic(?) quartzite. It is composed of white, elongated, rounded porphyroclasts of cryptocrystalline quartz in dark blueish-gray matrix zones separated by micaceous foliation planes. Clasts are 0.5- to 5-cm long. A selected foliation plane white mica separate from sample 11GG463A was analyzed. The integrated age (134.7 ± 1.6 Ma) and the plateau age (135.4 ± 1.5 Ma) are within error. We prefer the plateau age of 135.4 ± 1.5 Ma because of possible minor alteration in the low-temperature gas release which is reflected in the high atmospheric content of these steps. No isochron age determination was possible due to the generally homogenous radiogenic nature of the steps used in the plateau age determination. The preferred age reflects a minimum metamorphic age.

11LF004A (11-004LF-A MU#1) – Muscovite

Sample 11LF004A was collected from an auriferous quartz vein within schist of the Ruby terrane in drill core from the Monday Creek prospect. The quartz-albite-arsenopyrite-tourmaline vein contains fragments of schist with pale green sericite. Core sample was collected from drill hole WT07-08 at 491-foot depth and retrieved from Doyon Limited core storage in Fairbanks, with permission. We selectively picked pale green sericite and or sericite and albite for mineral separates. Three attempts to date material from the vein and vein wall were made. The first attempt analyzed a muscovite separate from sample 11LF004A. The integrated age (144.3 ± 0.7 Ma) and the average mean age (151.3 ± 2.1 Ma) are not within error. We infer the sample has experienced moderate argon loss (~8 percent) based on the "stepping-up" nature of the age spectra. No isochron age determination was possible because of the homogenous radiogenic content of the release. No plateau age determination was possible because of the discordance between individual steps (mean standard weighted deviation (MSWD) = 4.76, plateau criteria MSWD ≤ 2.5).

11LF004A (11-004LF-A MU#2) – Muscovite

A second muscovite separate from sample 11LF004A was analyzed. The integrated age (140.6. ± 0.8 Ma) and the plateau age (148.5 ± 1.7 Ma) are not within error. We infer the sample has experienced moderate loss (~10 percent) based on the "stepping-up" nature of the age spectra. No isochron age determination was possible because of the homogenous radiogenic content of the release. We prefer the plateau age of 148.5 ± 1.1 Ma for this mineral phase of sample 11-004LF-A, because of the documented loss. The preferred age reflects a minimum metamorphic age of the vein wall rock.

11LF004A (11-004LF-A MU#3) – Muscovite and albite

A third separate (from 11LF004A) composed of a fine-grained mixture of albite and muscovite, was analyzed. The albite content is inferred from the Ca/K ratio (>1). The integrated age (145.5 ± 1.9 Ma) and the plateau age (140.4 ± 2.3 Ma) are not within error. We infer the sample has experienced significant argon loss (~20 percent) based on the "stepping-up" nature of the age spectra. No isochron age determination was possible because of the homogenous radiogenic content of the release. We prefer the weighted average age of 140.4 ± 2.4 Ma for this the albite-muscovite mixture of sample 11-004LF-A because of the documented argon loss. This age for the incorporated muscovite in vein sample 11-004LF-A is within the span of the documented metamorphic ages of other samples in this study.

11LF004A Notes

This sample, 11LF004A, from a gold-bearing vein in drill core from the Monday Creek prospect did not provide an unequivocal age of alteration associated with the gold mineralization. The "see-saw" muscovite age spectra between ~140 Ma and ~151 Ma from both ~pure muscovite runs of sample 11LF004A are indicative of a complex metamorphic and thermal history. Multiple generations of neocrystallization and recrystallization of muscovite are a common phenomenon in complex metamorphic environments. The time of maximum metamorphism of the vein wall rock is most likely at 148.5 ± 1.1 Ma. The plateau age of 11-004LF-A MU#3, 140.4 ± 2. Ma, represents a minimum age of metamorphism. All three analyses produced "stepping-up" age spectra documenting varying degrees of loss. We infer the loss event likely occurred at 66.1 ± 2.6 Ma based on the low-temperature step release (minimum age) of 11-004LF-A MU#2 and the evidence of loss in the other two runs of sample 11LF004A. We interpret this loss event to be a possible age of the gold-bearing veins at Monday Creek.

11LF130C (2011LF130C WM#2) – White mica

Sample 11LF130C is a green-colored, chlorite-muscovite-chloritoid(?)-carbonate(?)-quartz schist from Ruby terrane schist of probable flysch derivation. The outcrop contains lenses of small iron-oxide-filled pits, possibly after carbonate, clots of chlorite, possibly after chloritoid, and has very strong anastomosing foliation. A white mica separate from sample 11LF130C was analyzed. The age-stepping-up nature of the gas release is indicative of a sample that experienced gas loss/alteration, with the higher temperature/more retentive gas release more closely reflecting the true age of the mineral phase. The integrated age (138.3 ± 1.4 Ma) and the plateau age (140.4 ± 1.6 Ma) are within error. We prefer the plateau age of 140.4 ± 1.6 Ma because of the documented loss. No isochron age determination was possible due to the documented loss. The preferred age represents the minimum metamorphic age.

11LF272B (2011LF272B HO#2) – Hornblende

Sample 11LF272B is a metagabbro from Ruby terrane metamafic rocks. The sample is unfoliated, contains 45% 1.5-mm-diameter, blocky, euhedral amphibole and 25% 0.5-mm-diameter feldspar, with speckled, apparently unfoliated groundmass. We selectively sampled amphibole-shaped grains for a mineral separate. A hornblende separate from sample 11LF272B was analyzed. The age-stepping-up nature of the gas release is indicative of a sample that experienced gas loss/alteration, with the higher temperature/more retentive gas release more closely reflecting the true age of the mineral phase. The integrated age (126.3 ± 3.1 Ma) and the plateau age (122.6 ± 2.3 Ma) and the isochron age (122.9 ± 5.6 Ma) are all within error. We prefer the plateau age of 122.6 ± 2.3Ma because of possible minor alteration in the low-temperature gas release which is reflected in the high atmospheric content of these steps and the higher precision over the integrated age. Although amphiboles in this sample are euhedral and appear to be relict igneous amphiboles, the preferred age likely reflects the minimum age of a strong, area-wide, greenschist-facies retrograde metamorphic event.

11Z426A (2011Z426A WM#2) – White mica

Sample 11Z426A is a micaceous quartzite from Paleozoic(?) quartzite. The sample is orange iron-oxide stained, dark gray to black, located within 200 meters of projected location of Tozitna thrust fault. A white mica separate from sample 11Z426A was analyzed. The age-stepping up nature of the gas release is indicative of a sample that experienced gas loss/alteration with the higher temperature/more retentive gas release more reflecting the true age of the mineral phase. The integrated age (123.4 ± 1.3 Ma) and the plateau age (123.2 ± 1.5 Ma) are within error. We prefer the plateau age of 123.2 ± 1.5 Ma because of the documented argon loss. No isochron age determination was possible due to the documented loss. The preferred age reflects the minimum metamorphic age of the micas and is distinctly younger than other white micas in this study; given the proximity of the sample to the trace of the Tozitina thrust fault, this age may represent the most recent deformation on the Tozitna fault.

11Z431A (2011Z431A WM#2) – White mica

Sample 11Z431A is a micaceous quartzite from Ruby terrane schist and quartzite of probable flysch derivation. It is light gray to gray, sugary, foliated, most-recent foliation/cleavage is near vertical and parallel to Yukon River bank and the concealed trace of Kaltag fault. Selectively sampled white mica separate from steep cleavage planes was analyzed. The integrated age (127.0 ± 1.5 Ma) and the plateau age (128.3 ± 1.7 Ma) are within error. We prefer the plateau age of 128.3 ± 1.7 Ma because of possible minor alteration in the low-temperature gas release which is reflected in the high atmospheric content of these steps. No isochron age determination was possible due to the generally homogenous radiogenic nature of the steps used in the plateau age determination. The preferred age represents the metamorphic age of micas on steep foliation planes that parallel the trace of the Kaltag fault and post-dates the main prograde metamorphism of the Ruby terrane.

84-GS-1 (84-GS-1 BI#1) – Biotite

Sample 84-GS-1 is a staurolite-garnet-mica quartz schist from the Ruby terrane schist/gneiss unit. K-Ar Location 3 of Puchner and others (1998) near Cecil Dome, Ruby C-5 Quadrangle. A small, one-inch-diameter sample recovered from the University of Alaska geochronology archive. A biotite separate from sample 84-GS-1 was analyzed. The age-stepping up nature of the gas release is indicative of a sample that experienced gas loss/alteration with the higher temperature/more retentive gas release reflecting the true age of the mineral phase. The integrated age (62.4 ± 0.5 Ma) and the plateau age (64.3 ± 0.6 Ma) are within broad error. We prefer the plateau age of 64.3 ± 0.6 Ma because of the evidence of argon loss. No isochron age determination was possible due to the documented loss. The preferred age reflects a cooling age for the metamorphic rocks and is roughly synchronous with the cooling age for sample 84-RF-23, which was collected from the Birch Creek pluton, more than 12 miles to the south.

84-GS-1 (84-GS-1 MU#1) – Muscovite

A muscovite separate from sample 84-GS-1 was also analyzed. The integrated age (78.6 ± 0.7 Ma), and the plateau age (76.9 ± 0.7 Ma) and the isochron age (76.5 ± 2.1 Ma) are all within error. We prefer the plateau age of 76.9 ± 0.7 Ma because of the higher precision of the plateau and because of the large error in isochron derived initial $^{40}Ar/^{36}Ar$. The preferred age reflects a minimum metamorphic age of the amphibolite-grade metamorphism in this sample of staurolite-garnet mica schist.

84-RF-23 (84-RF-23 BI#1) – Biotite

Sample 84-RF-23 is a Biotite granite from K-Ar location 2 of Puchner and others (1998). Birch Creek pluton outcrop, Ruby B-5 Quadrangle. A small, one-inch-diameter sample recovered from the University of Alaska geochronology archive. A biotite separate from sample 84-RF-23 was analyzed. The integrated age (65.8 ± 0.6 Ma) and the plateau age (64.8 ± 0.6 Ma) and the isochron age (66.2 ± 0.6 Ma) are all within error. We prefer the plateau age of 64.8 ± 0.6 Ma because of the higher precision and because of the large error in isochron derived initial $^{40}Ar/^{36}Ar$. The preferred age reflects a cooling age of the Birch Creek pluton, part of a trend of Late Cretaceous granite plutons in the Ruby-Poorman mining district, and is interpreted to be a cooling age of the pluton.

84-SM-2 (84-SM-2 MU#2) – Muscovite

Sample 84-SM-2 is a gneiss from Ruby terrane schist/gneiss. K-Ar location 4 of Puchner and others (1998), Ruby B-5 Quadrangle near Dominion Creek. Small, one-inch-diameter sample recovered from the University of Alaska geochronology archive. A muscovite separate from sample 84-SM-2 was analyzed. The integrated age (71.6 ± 0.7 Ma) and the plateau age (71.3 ± 0.8 Ma) are within error. We prefer the plateau age of 71.3 ± 0.8 Ma because of possible minor alteration in the low-temperature gas release which is reflected in the high atmospheric content of these steps and high Ca/K ratios. No isochron age determination was possible due to the generally homogenous radiogenic nature of the steps used in the plateau age determination. The preferred age reflects a minimum metamorphic age for the gneiss of the Ruby terrane in the Ruby mining district

RM23241-R (RM23241-R WM#1) – White mica

Sample RM23241 was obtained from galena nuggets collected while sluicing in Ash and Tozimoran creeks below their confluence just east of Moran Dome. Sampled by U.S. Bureau of Mines (USBM) during an assessment of the area's tin placer potential. The sample is a bulk reject recovered from the Alaska Geologic Materials Center. The material consists of galena and pyrite in a quartz-muscovite gangue. Bedrock source for the sample is assumed to be near the confluence of Ash and Tozimoran creeks as described in USBM field notes archived at the Alaska Geologic Material Center. Alaska Resource Data File locality TN021 documents argentiferous galena veins in the Tozimoran headwaters, (U.S.Geological Survey, 2008). A white mica separate from sample RM23241 was analyzed. The age-stepping-up nature of the gas release is indicative of a sample that experienced gas loss/alteration, with the higher temperature/more retentive gas release more closely reflecting the true age of the mineral phase. The integrated age (114.1 ± 1.6 Ma) and the plateau age (119.4 ± 1.3 Ma) are not within error. We prefer the plateau age of 119.0 ± 1.3 Ma because of the documented argon loss. No isochron age determination was possible due to the documented loss. The preferred age of reflects the hydrothermal age of veins containing galena, pyrite, sphalerite, in quartz-mica gangue in the Tozimoran drainage.

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APPENDIX: PLOTS OF $^{40}AR/^{39}AR$ AGE SPECTRA AND CA/K AND CL/K RATIOS

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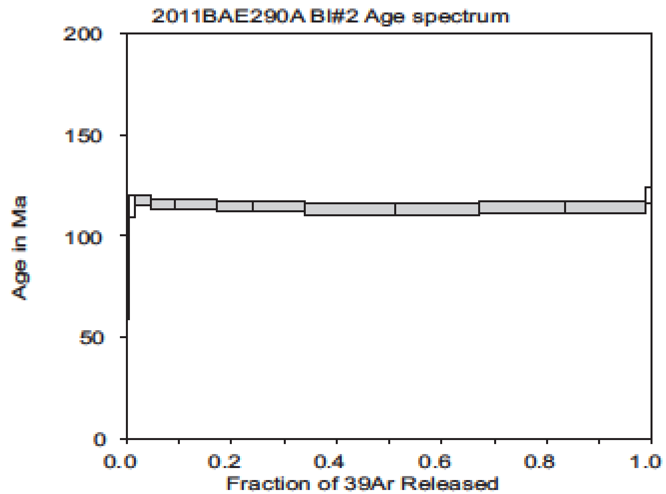

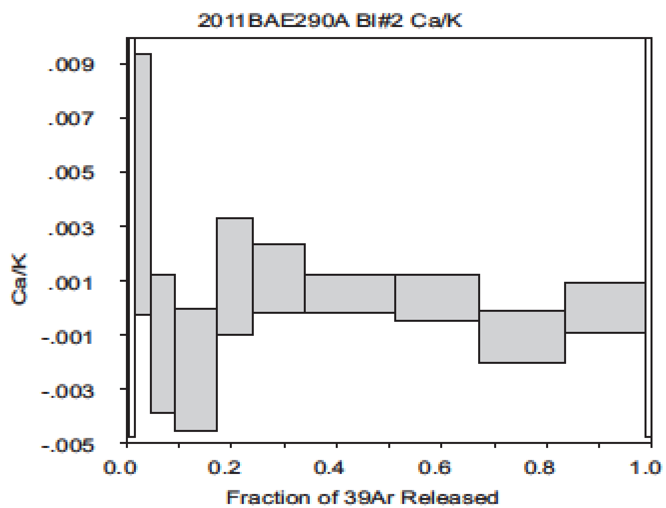

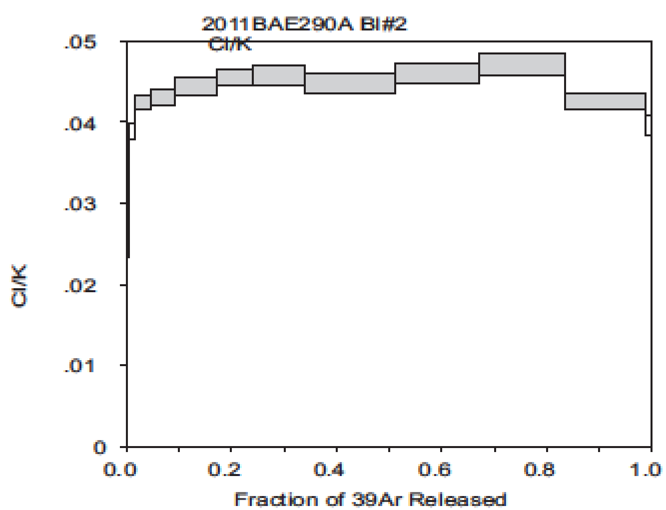

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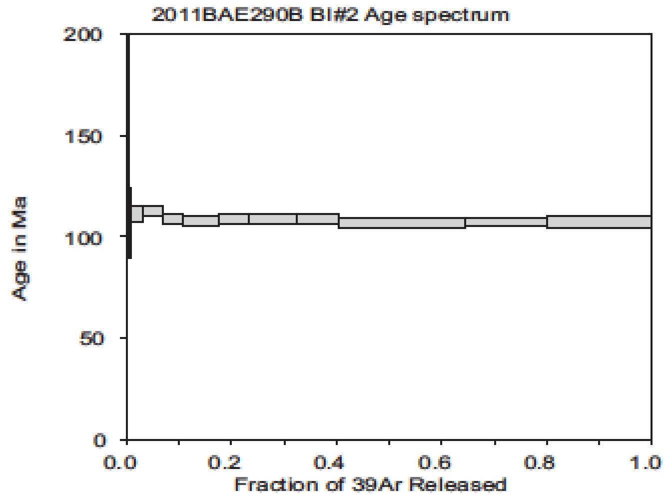

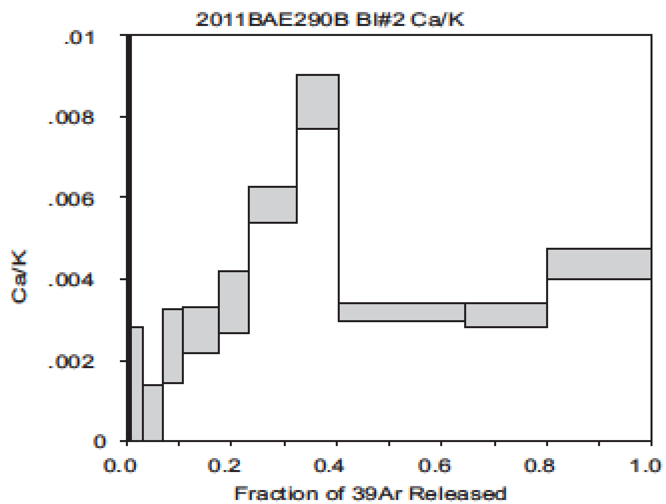

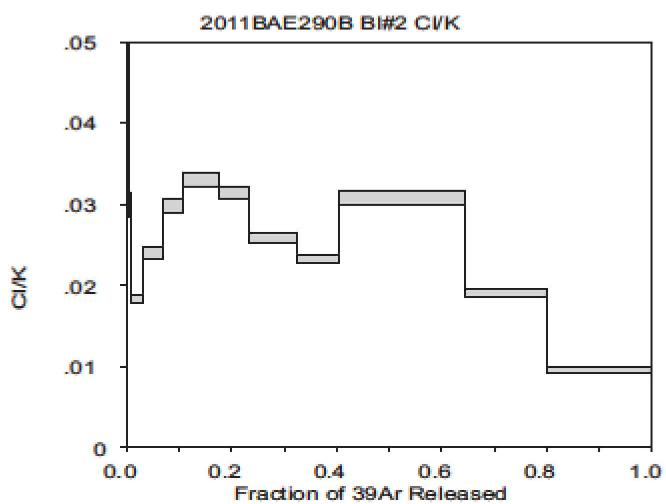

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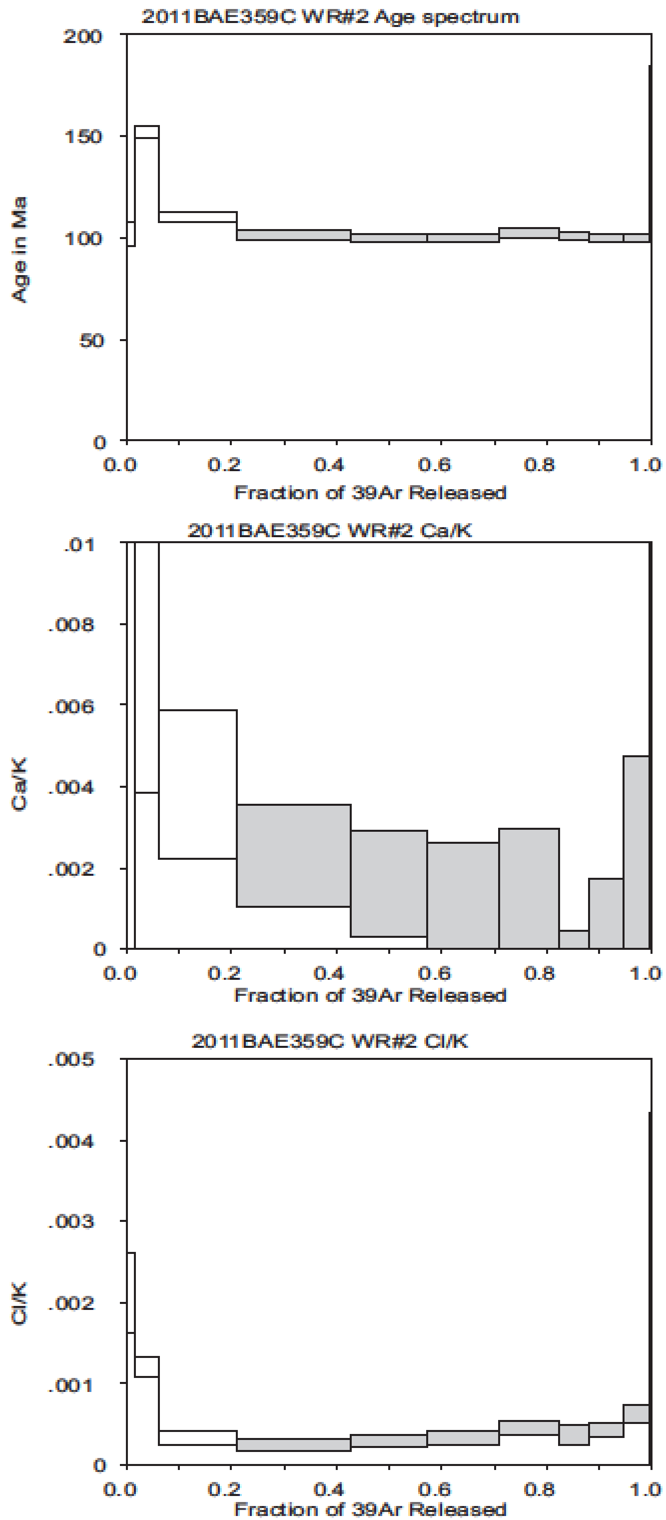

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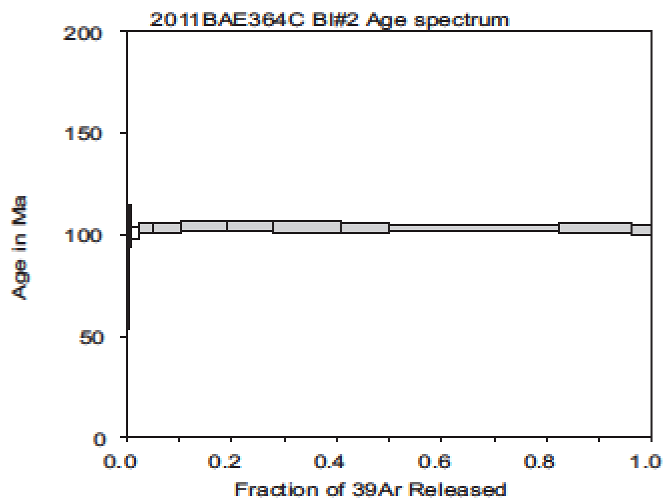

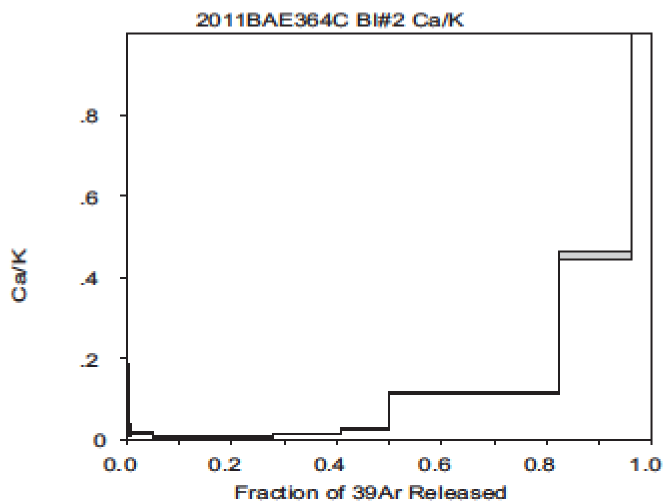

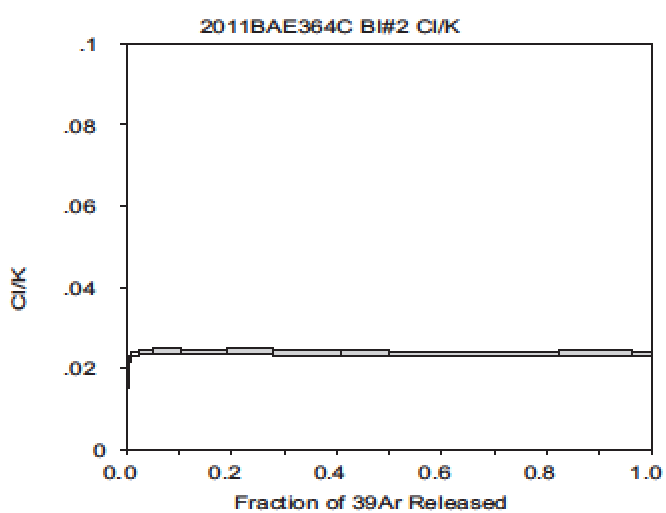

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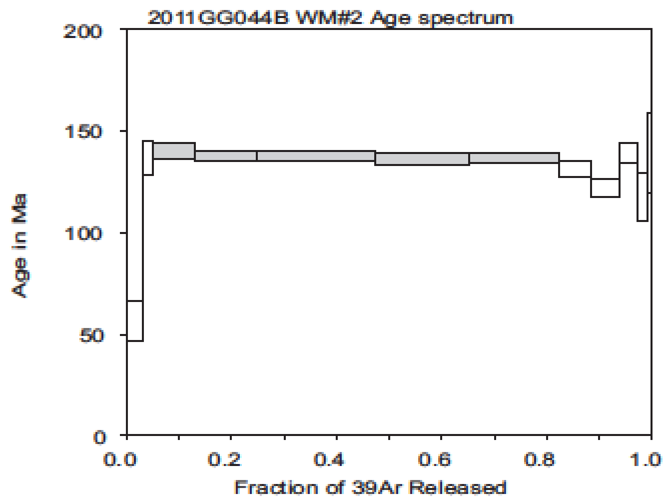

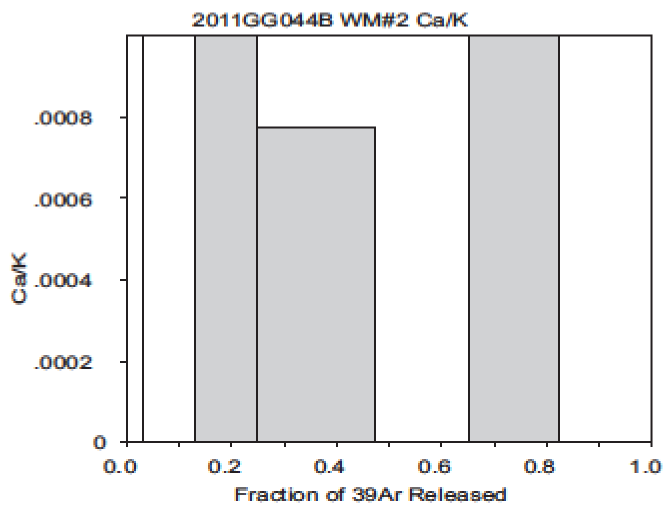

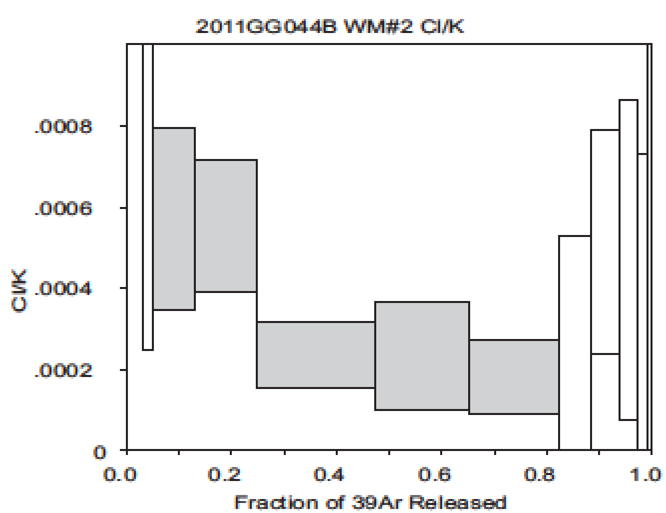

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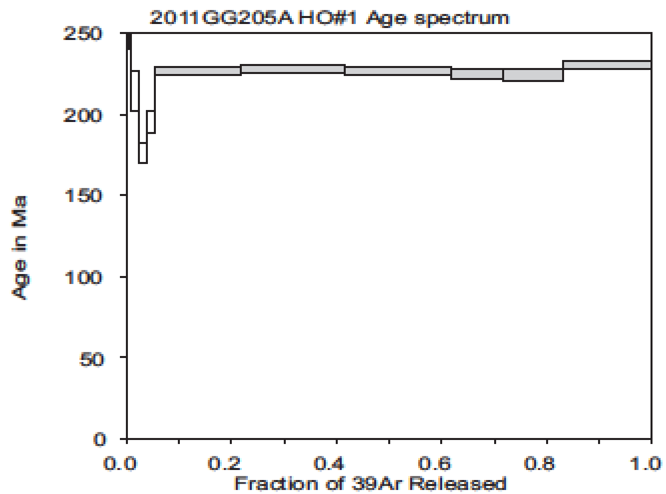

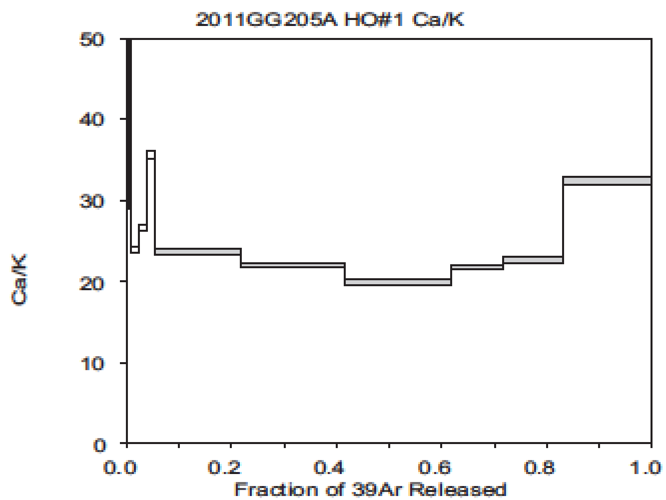

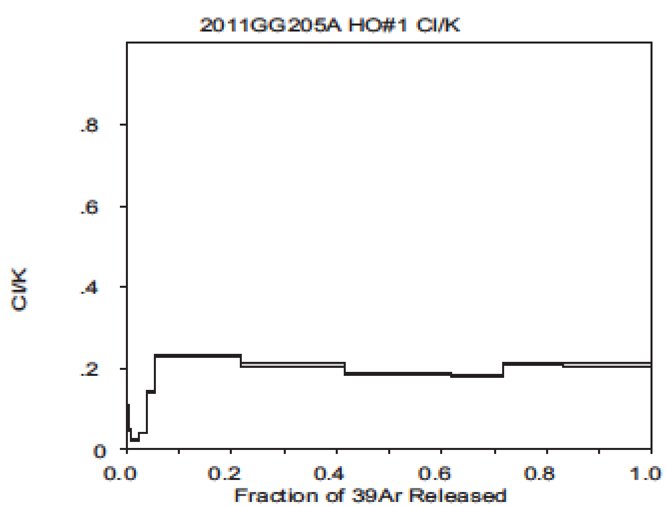

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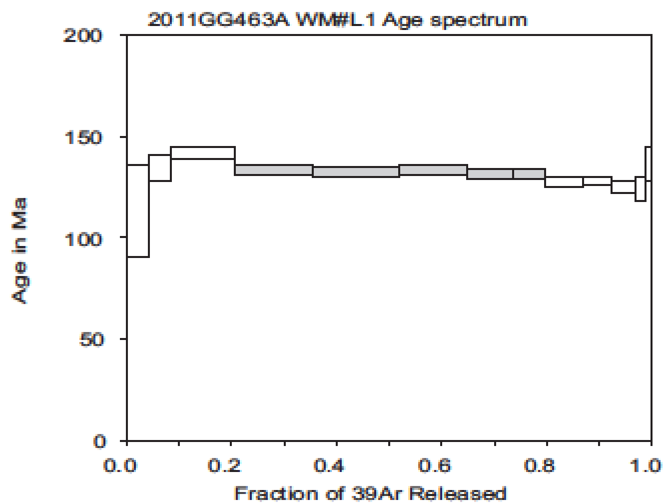

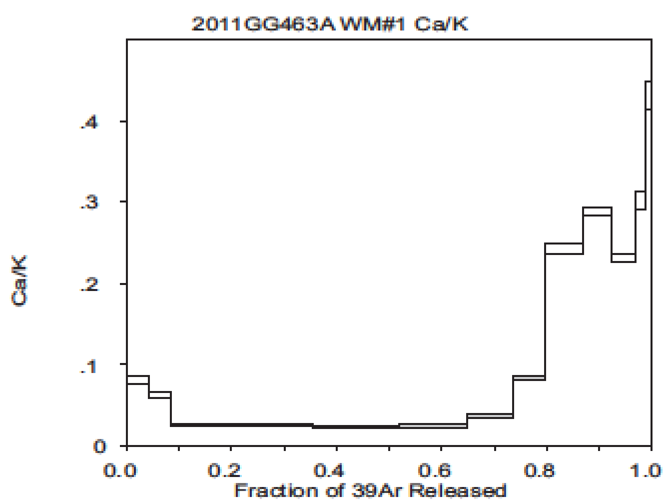

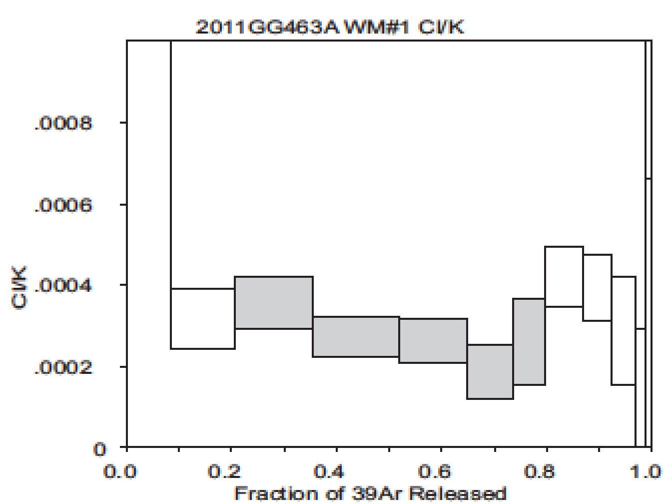

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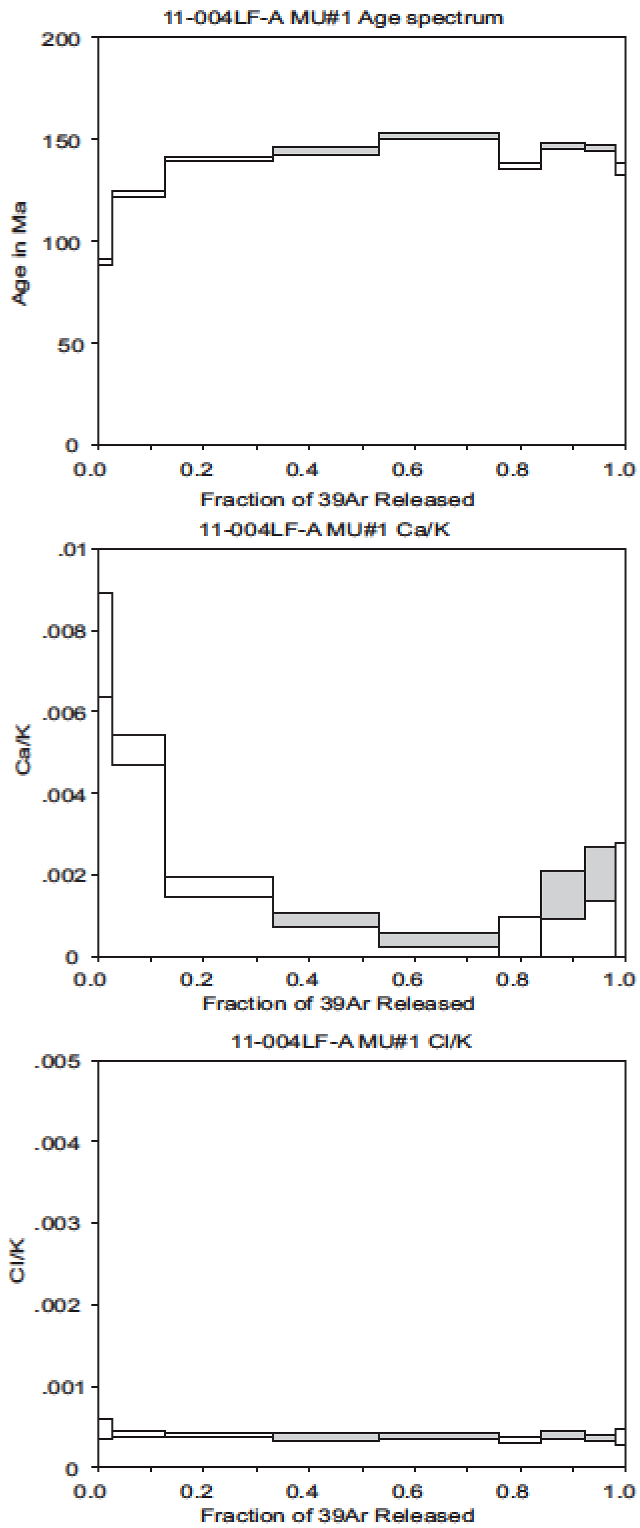

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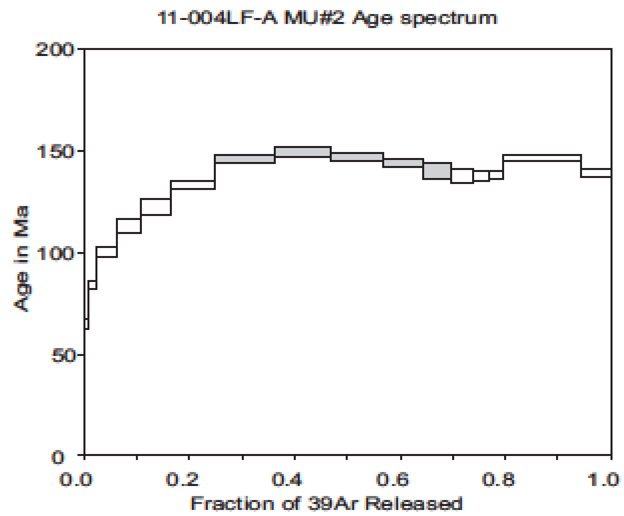

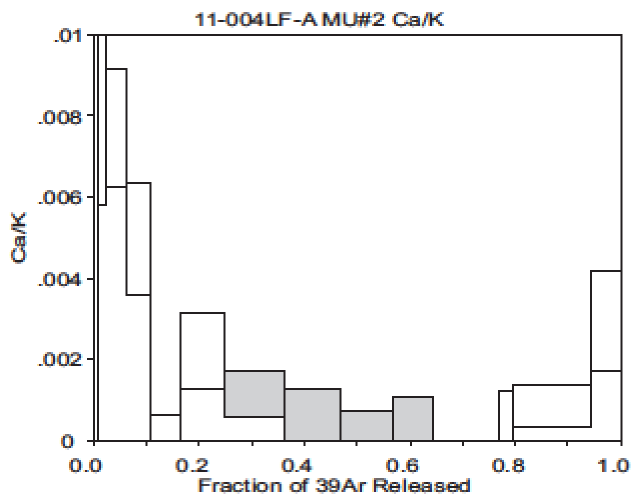

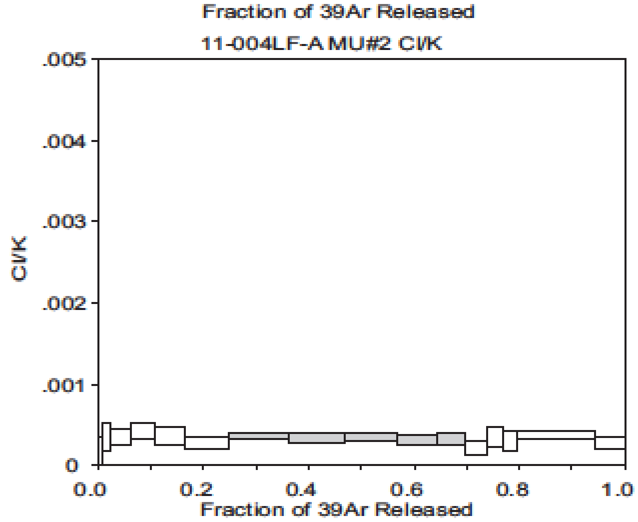

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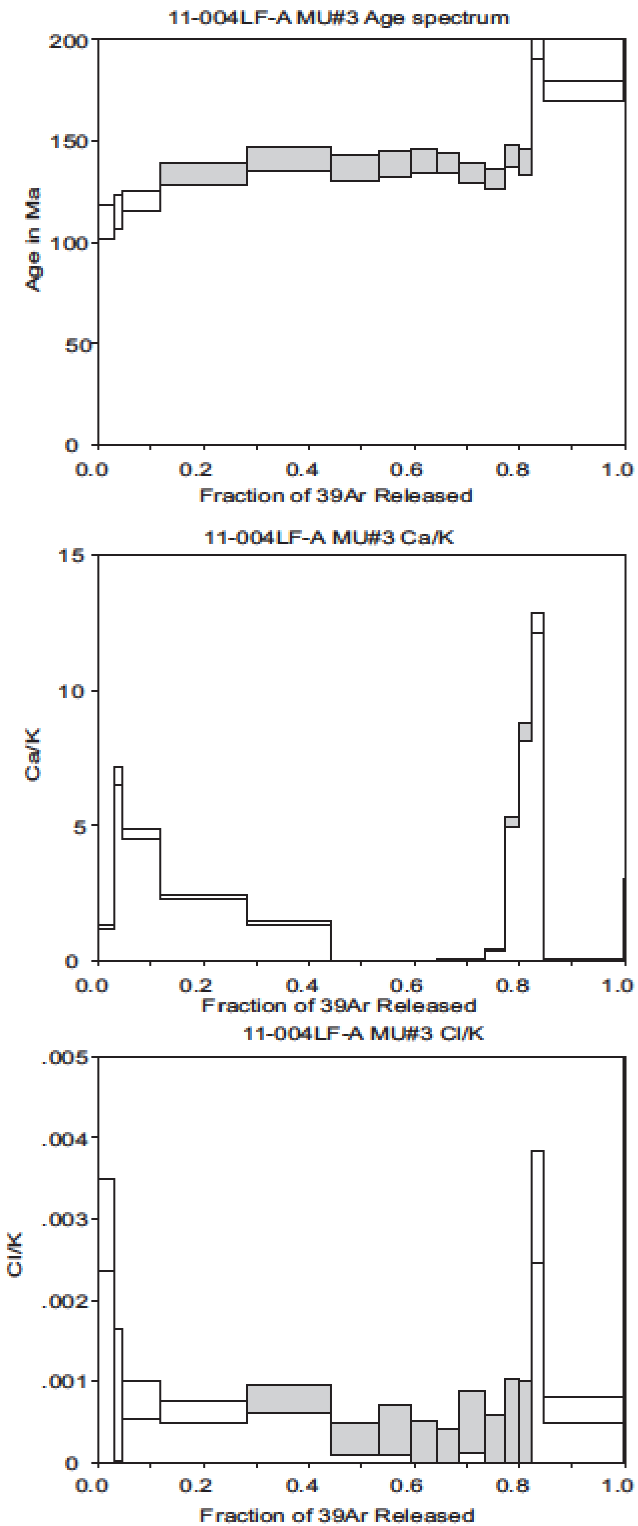

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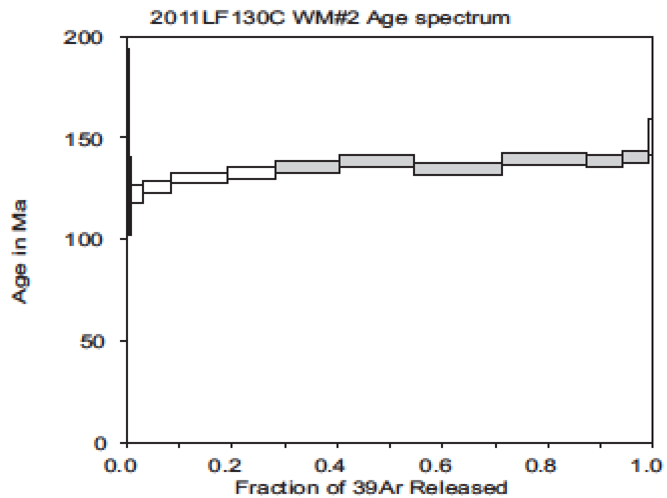

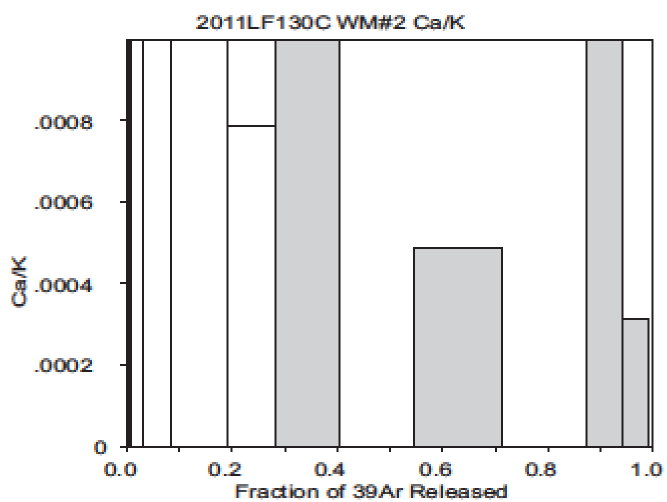

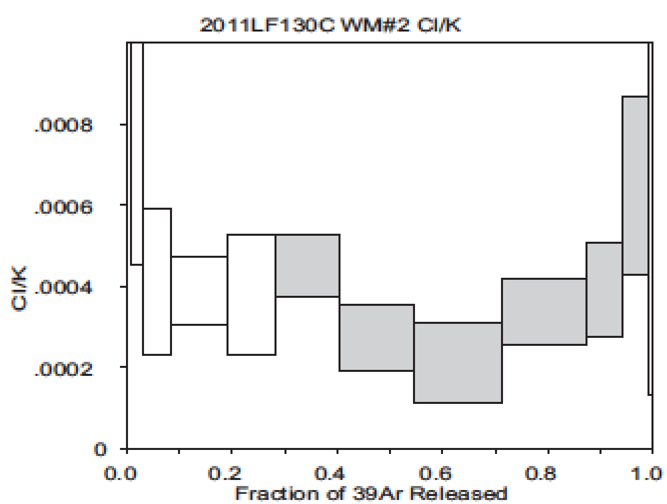

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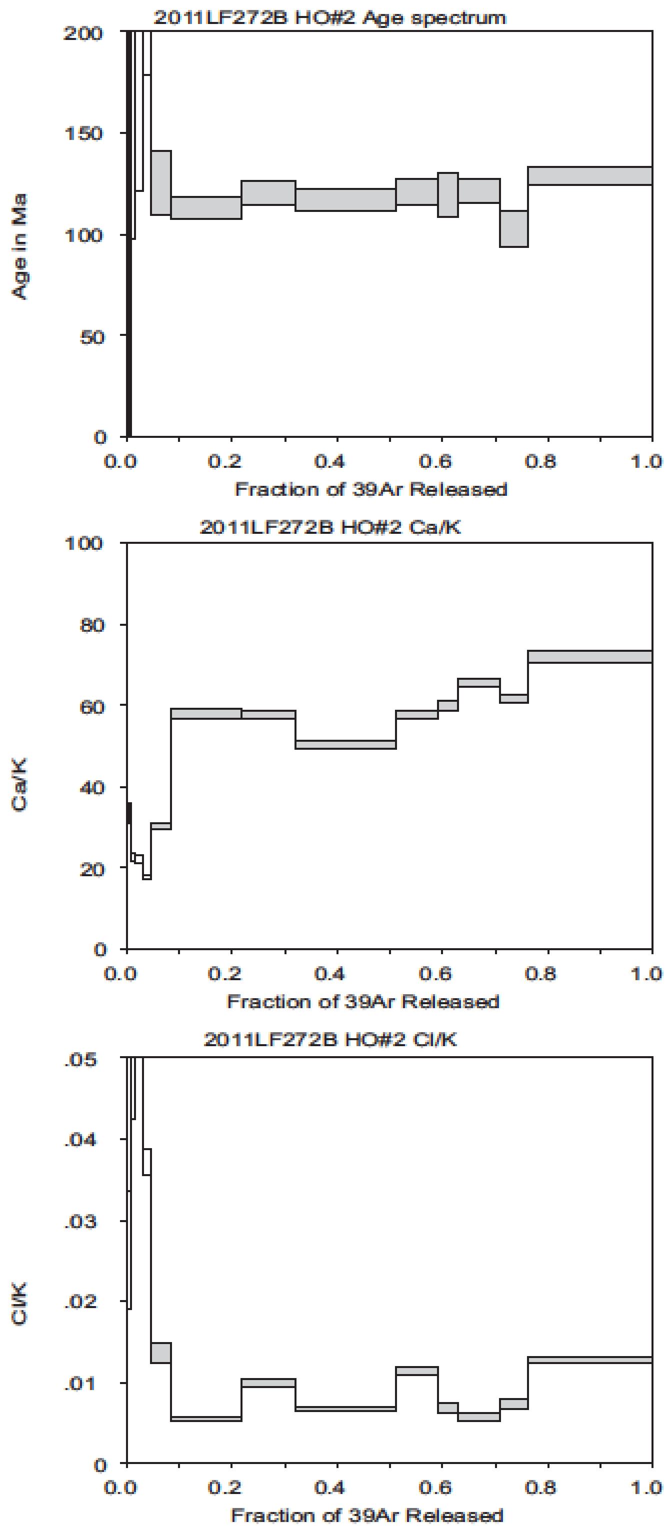

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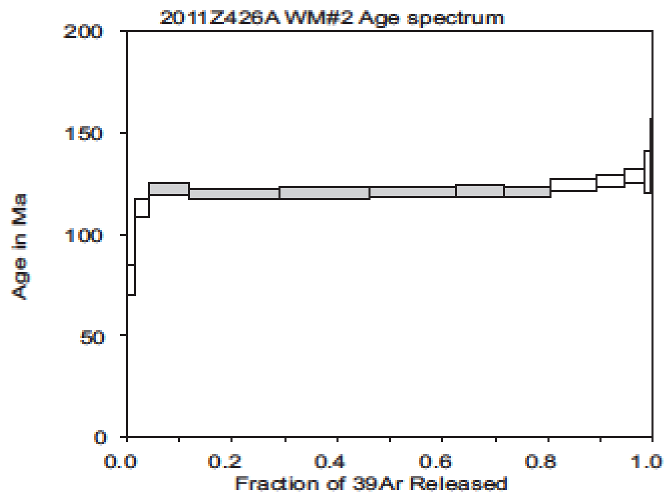

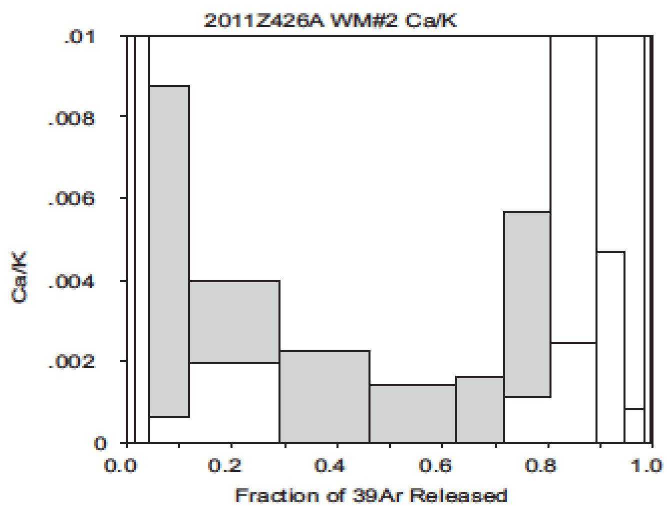

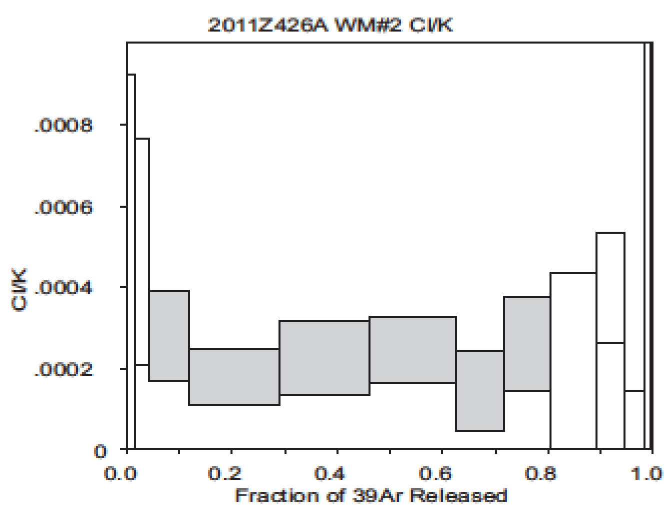

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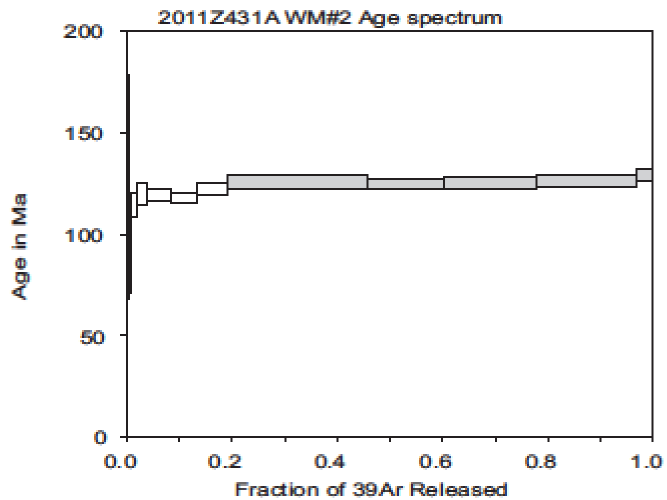

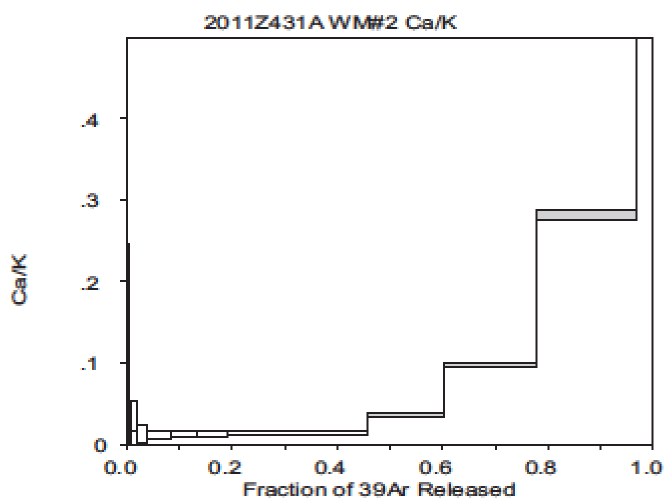

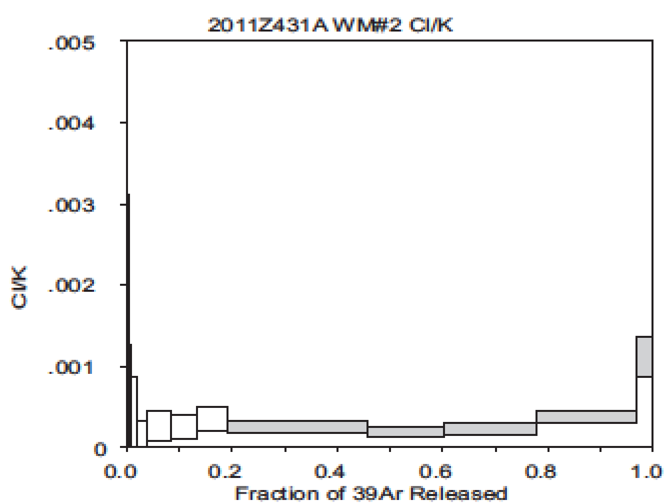

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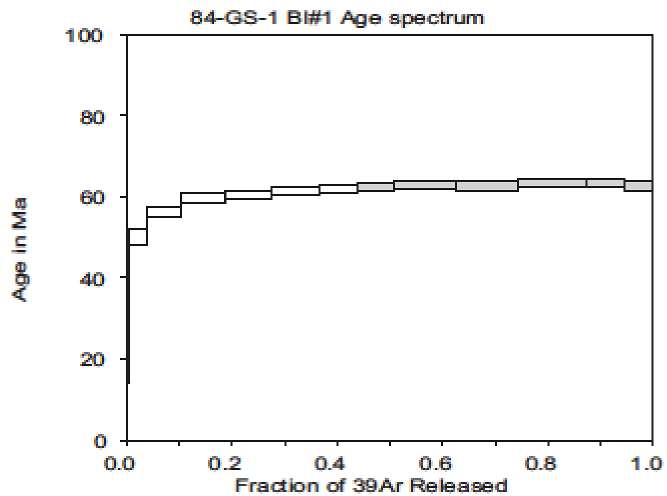

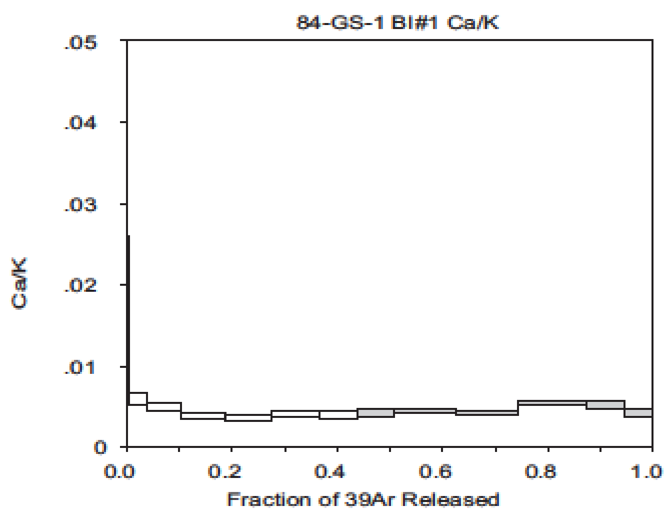

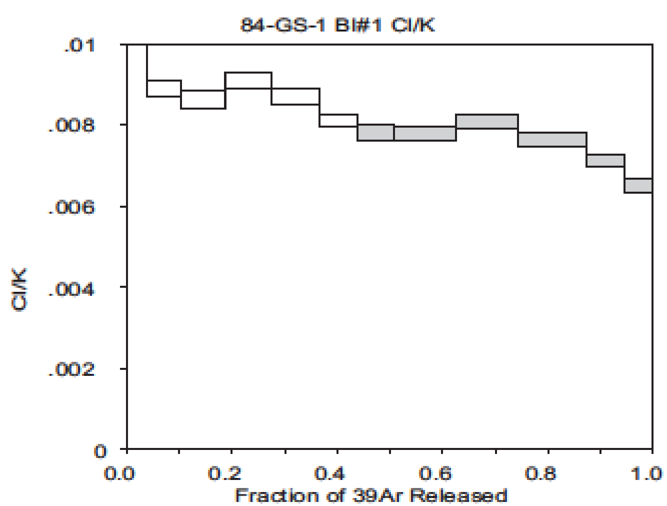

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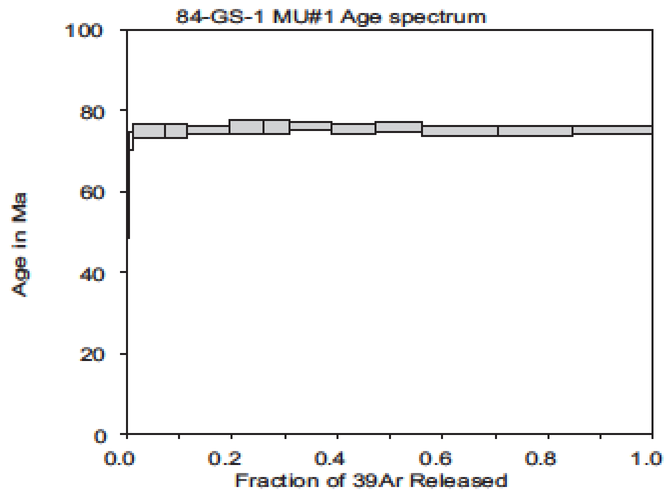

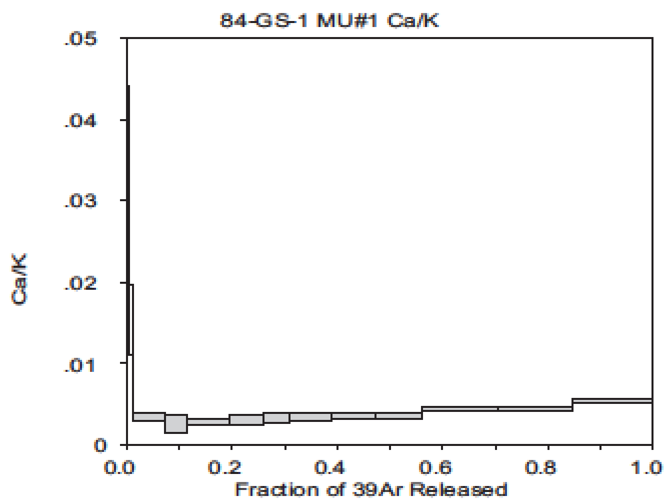

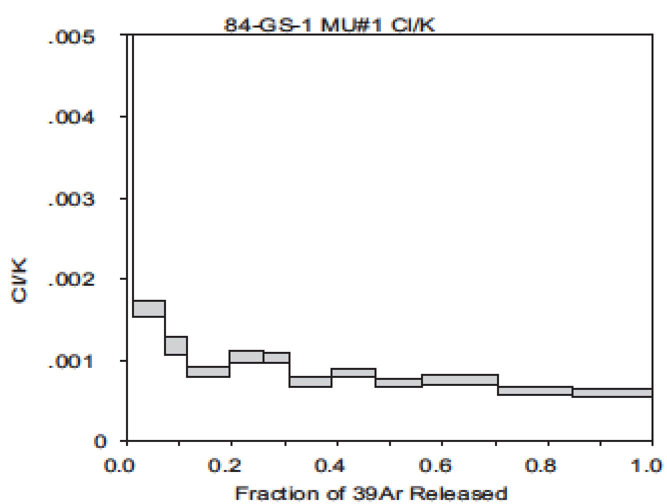

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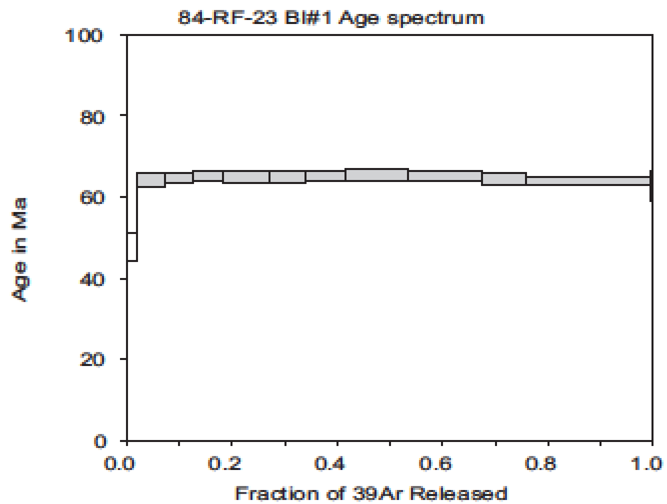

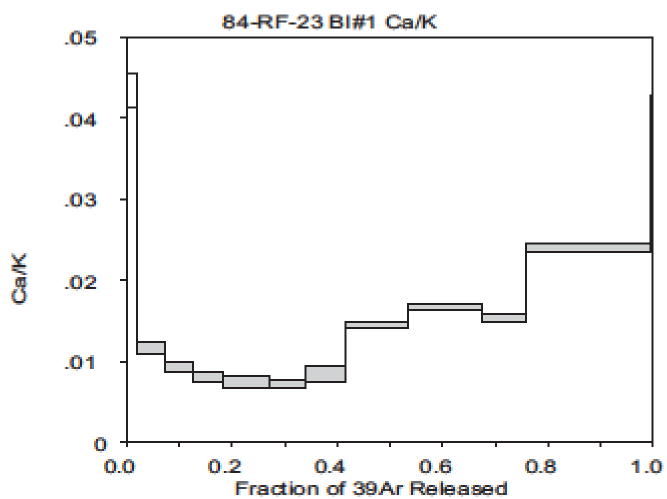

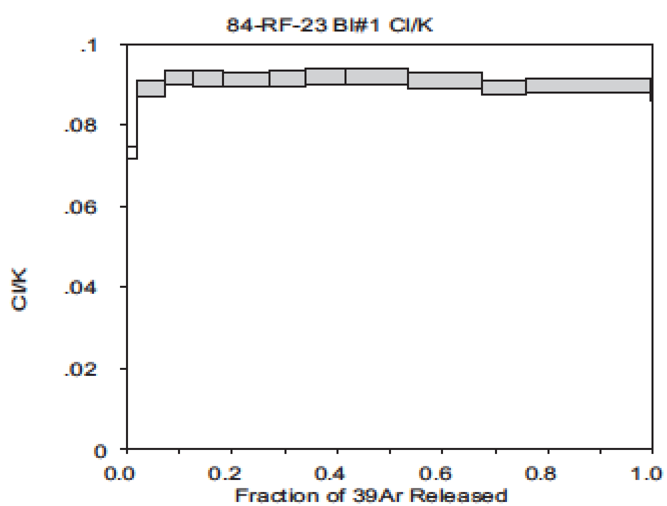

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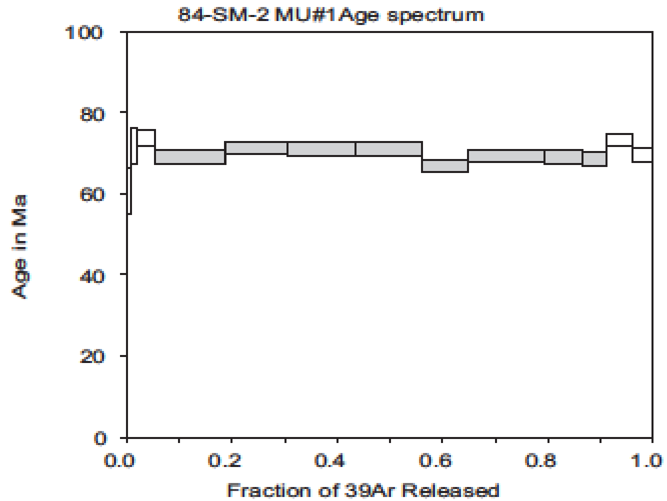

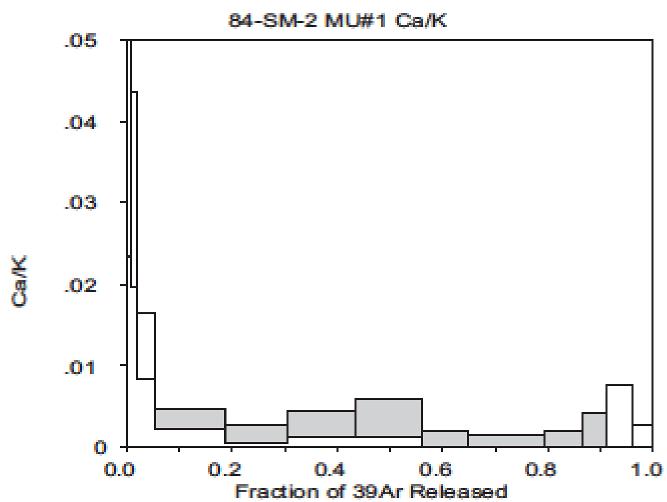

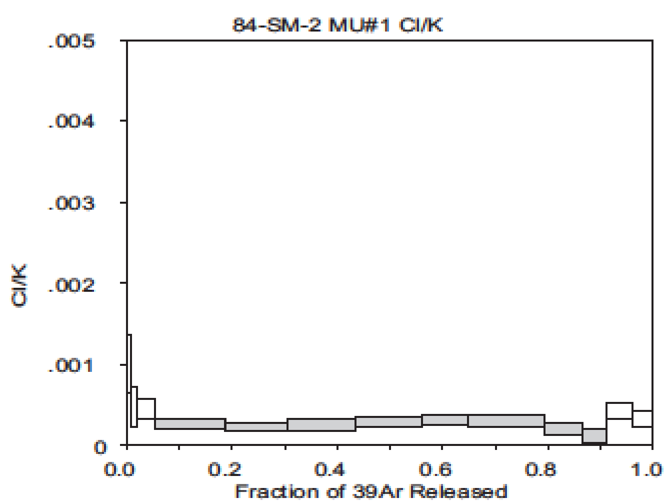

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