

# **$^{40}\text{Ar}/^{39}\text{Ar}$ geochronology data from the Big Delta and Circle quadrangles, Alaska**

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## **Raw Data File 2026-14**



DGGS geologist Evan Twelker collects Chena Project outcrop samples.

Raw Data Files provide elevation data, field observations, or analytical data. They are reviewed for clarity and consistency but do not undergo technical peer review.

State of Alaska  
Department of Natural Resource  
Division of Geological & Geophysical Surveys



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3354 College Road | Fairbanks, Alaska 99709-3707

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# **$^{40}\text{Ar}/^{39}\text{Ar}$ geochronology data from the Big Delta and Circle quadrangles, Alaska**

Jamshid A. Moshrefzadeh<sup>1</sup>, Travis J. Naibert<sup>1</sup>, Florian Hofmann<sup>2</sup>, Rainer J. Newberry<sup>1</sup>, Evan Twelker<sup>1</sup>, and J. Wesley Buchanan<sup>1</sup>

## **INTRODUCTION**

During the 2023 field season, geologists from the Alaska Division of Geological & Geophysical Surveys (DGGS) conducted 1:100,000-scale geologic mapping of ~5,750 mi<sup>2</sup> (~15,000 km<sup>2</sup>) within the Big Delta and Circle quadrangles (Buchanan and others, 2025) (fig. 1). Mapping was funded by the U.S. Geological Survey (USGS) Earth Mapping Resource Initiative (Earth MRI) program and the State of Alaska with an aim of producing more detailed and modern geologic maps and supporting datasets to promote mineral resource exploration in Interior Alaska.

The project includes the area around the operating Pogo mine, historical mining areas, exploration projects, and areas with potential for mineral resource development (Buchanan and others, 2025). Mineralization in the project area includes structurally controlled and intrusion-related gold mineralization, including the Pogo Mine placer gold intrusion-related tungsten and molybdenum prospects and syngenetic lead-zinc-silver prospects (e.g., Teuchet Creek) (Gavel and others, 2023). The geochronology results presented here were collected to better understand the geologic history and timing of mineralization in the project area.

The 22  $^{40}\text{Ar}/^{39}\text{Ar}$  ages reported here are from 21 samples collected within the Chena Project boundary (fig. 1). Lithologies analyzed include metagrit, phyllite, gabbro, schist, granofels, amphibolite, quartz veins, lamprophyre, porphyry, paragneiss, orthogneiss, metagabbro, and granite. These data and accompanying discussion are released as a DGGS Raw Data File, and all publication components are available from the DGGS website at <https://doi.org/10.14509/32086>.

## **DATA PRODUCTS**

- Methods report
- Summary data spreadsheet and accompanying data dictionary
- Analytical lab data and accompanying data dictionary

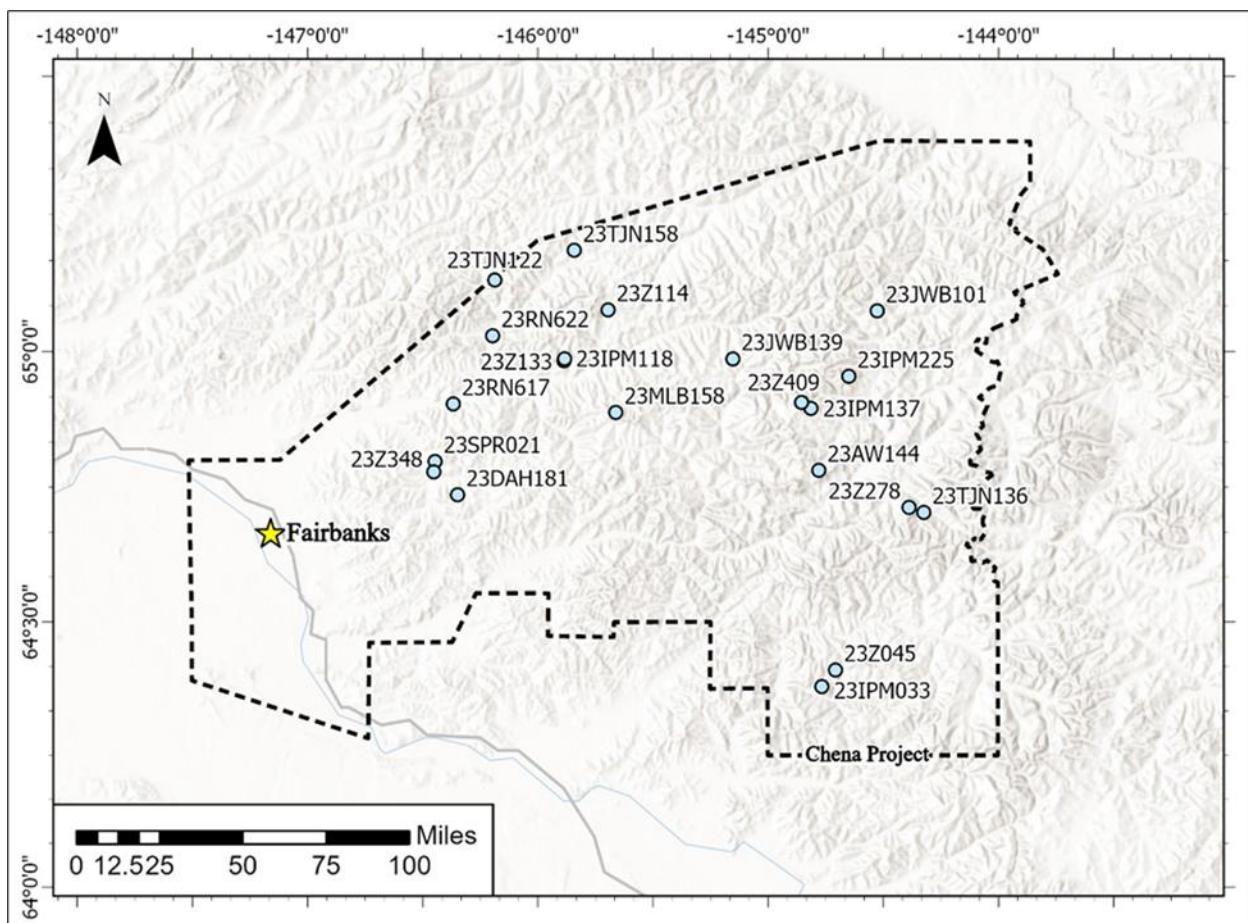
## **METHODS**

### **Sample Collection**

Fresh, unweathered samples were collected from surface outcrops by DGGS field geologists and selected for age dating based on terrane, map unit, and abundance of viable mineral phases for dating. Samples were studied both as hand specimens under a binocular

microscope and as thin sections under a petrographic microscope to target unaltered mineral phases.

Location data for samples were recorded in the WGS84 datum using GPS-enabled field tablets and provided here in the NAD83 datum. Sample location coordinates have a typical reported accuracy of  $\pm 10$  meters. The locations of the 21 samples presented in this report are shown in figure 1.



**Figure 1.** Location of samples analyzed in this report (blue circles) within the Chena Project area (dashed line).

### Sample Preparation

Rock samples were submitted to the Geochronology Laboratory at the University of Alaska Fairbanks Geophysical Institute, where they were processed and prepared for  $^{40}\text{Ar}/^{39}\text{Ar}$  analyses. The rock samples were broken up and crushed to separate individual mineral grains. The samples were then sieved and separated to sort mineral grains. Targeted grains were then manually selected under a microscope for further analysis. The grains selected from each sample were irradiated at the Oregon State University nuclear research reactor along with the FC-2 Fish Canyon Tuff sanidine standard ( $28.201 \pm 0.046$  Ma; Kuiper and others, 2008). The irradiation procedure transforms some  $^{39}\text{K}$  to  $^{39}\text{Ar}$ . The samples were then step-heated with a laser to release

the gases they contained. The argon gas was separated, and the main argon isotopes ( $^{36}\text{Ar}$ ,  $^{37}\text{Ar}$ ,  $^{38}\text{Ar}$ ,  $^{39}\text{Ar}$ , and  $^{40}\text{Ar}$ ) were measured via mass spectrometer at the UAF Geochronology Laboratory. The resulting  $^{40}\text{Ar}/^{39}\text{Ar}$  ratios were compared with those of the FC-standard to determine the ages of the unknown samples. Further details about methodology are available at <https://www.gi.alaska.edu/facilities/geochron-lab>.

## RESULTS AND SAMPLE DESCRIPTIONS

A summary of the  $^{40}\text{Ar}/^{39}\text{Ar}$  results is provided in the accompanying data, with ages quoted at the  $\pm 2\sigma$  level. See the accompanying digital data tables for detailed step-heating results, with ages quoted at the  $\pm 1\sigma$  level. The integrated age is the age given by the total gas measured and is equivalent to a potassium-argon (K-Ar) age. Age spectra plots are included in Appendix A. The spectra provide plateau ages if three or more consecutive gas fractions account for at least 50 percent of the total gas release and are within two standard deviations of each other (Mean Square Weighted Deviation [MSWD] < 2.5). When spectra did not provide a plateau age under the above definition, a weighted mean age was calculated, or the integrated age was used as the preferred age for the sample. Below, we provide sample descriptions, summarized from both field notes reported by Gavel and others (2023) and subsequent thin-section descriptions. Sample descriptions are accompanied by our preferred age determination for each sample.

### 23AW144 – Phyllitic Metagrit

The sample is a phyllitic metagrit. The sample is pale gray with a slight green tinge, is crenulated, and is porphyroclastic. Grain size ranges from 0.1 to 2 mm, with a mineralogy of 60 percent quartz (porphyroclastic), 15 percent albite, 15 percent muscovite, eight percent chlorite, and trace ilmenite, iron oxide, and tourmaline. A muscovite separate was dated, yielding an integrated age of  $127.29 \pm 0.72$  Ma. A plateau age could not be calculated for this sample. A weighted mean age of  $132.61 \pm 1.64$  Ma, based on 2 of 12 heating steps, is preferred and interpreted to record cooling of the sample through the closure temperature of muscovite (fig. A1).

### 23DAH181 - Phyllite

The sample is carbonaceous phyllite. It is black, foliated, phyllitic, and exhibits grain size from 0.05 to 0.5 mm. The mineralogy is 50 percent quartz, 25 percent white mica, 10 percent chlorite, 10 percent apatite, and five percent carbon. A muscovite separate was dated, resulting in an integrated age of  $148.18 \pm 0.37$  Ma. The age spectrum shows a stair-step pattern, and no plateau age could be calculated for the sample. There is no preferred age for this sample. The integrated age is interpreted to record cooling of the sample through the closure temperature of muscovite (fig. A2).

### 23IPM033 - Gabbro

23IPM033 is an amphibole-bearing gabbro. The sample is greenish-black, jointed, seriate, and hypidiomorphic. The grain size ranges from 1 to 30 mm, and the mineralogy consists of 45 percent plagioclase, 45 percent hornblende, four percent biotite, and minor titanite, white mica,

calcite, apatite, and chlorite. A hornblende separate was dated and yielded a stair-stepping down age spectrum with an integrated age of  $127.71 \pm 1.37$  Ma and a weighted mean age of  $122.28 \pm 1.72$  Ma based on 3 of 14 heating steps (fig. A3). The initial  $^{40}\text{Ar}/^{36}\text{Ar}$  ratio calculated from the inverse isochron intercept is significantly different than the presumed atmospheric value of  $298.56 \pm 0.31$  (fig. A4; Lee and others, 2006), indicating excess argon in the sample. The hornblende age spectrum was recalculated by assuming a trapped  $^{40}\text{Ar}/^{36}\text{Ar}$  ratio of  $594.66 \pm 81.18$  as calculated from the inverse isochron intercept. The plateau age of  $104.76 \pm 2.05$  Ma from the recalculated age spectrum is the preferred age and is interpreted as the sample's crystallization age (fig A5).

### **23IPM118 - Schist**

This sample is garnet-bearing schist with grain size ranging from 0.5 to 15 mm. Mineralogy consists of 45 percent quartz, 25 percent muscovite, 20 percent garnet (porphyroblastic), five percent plagioclase, and minor biotite, chlorite, and rutile. A muscovite separate was dated, resulting in an integrated age of  $105.43 \pm 0.58$  Ma and a preferred plateau age of  $104.82 \pm 0.33$  Ma based on 10 of 20 heating steps. The preferred age is interpreted to record cooling of the sample through the closure temperature of muscovite (fig. A6; A7).

### **23IPM137 - Schist**

This garnet-bearing schist is described as gray, white, and brown, foliated, schistose, and porphyroblastic. The grain size ranges from 0.2 to 1.5 mm with a mineralogy of 35 percent plagioclase, 35 percent muscovite, 30 percent plagioclase, 10 percent quartz, 10 percent biotite, 10 percent staurolite, three percent garnet, and minor ilmenite and sericite. A muscovite separate was dated, yielding an integrated age of  $103.57 \pm 0.52$  Ma and a preferred plateau age of  $103.77 \pm 0.26$  Ma based on 12 of 17 heating steps. This age is interpreted to record cooling of the sample through the closure temperature of muscovite (fig. A8; A9).

### **23IPM225 - Paragneiss**

This sample is a biotite-bearing paragneiss. It is cream, tan, and black, banded, recrystallized, and variegated. Crystal grain size ranges from 0.3 to 1.5 mm, and mineralogy consists of 60 percent quartz, 15 percent biotite (recrystallized), 15 percent plagioclase, four percent muscovite (recrystallized), four percent K-feldspar, and minor chlorite. A muscovite separate was dated, yielding an integrated age of  $105.25 \pm 0.56$  Ma and a weighted mean age of  $100.83 \pm 0.69$  from 3 of 15 heating steps. The age spectrum is saddle-shaped, and the integrated age is preferred. This age is interpreted to record cooling of the sample through the closure temperature of muscovite (fig. A10; A11).

### **23JWB101 - Amphibolite**

23JWB101 is a fine- to medium-grained biotite-bearing amphibolite with slight retrograde chloritization, boudins, and intermixed, dissected layers and pods of calcite and diopside. It is described as light gray and black, with a slightly green tint and a foliated appearance. The grain size spans from 0.2 to 1 mm, and the mineralogy is 65 percent hornblende,

20 percent plagioclase, five percent biotite, five percent titanite, and minor apatite, chlorite, and epidote. A separate hornblende was dated, yielding an integrated age of  $111.37 \pm 0.64$  Ma and a preferred plateau age of  $111.26 \pm 0.49$  Ma based on 6 of 20 heating steps. The preferred age is interpreted to record cooling of the sample through the closure temperature of muscovite (fig. A12; A13).

### **23JWB139 - Phyllite**

This sample is a muscovite-bearing phyllite. It is light gray, foliated, and phyllitic. The grain size range is from 0.1 to 0.2 mm, and the mineralogy consists of 65 percent quartz, 30 percent muscovite, and minor chlorite, sericite, feldspar, and iron oxide. A muscovite separate was dated, resulting in an integrated age of  $106.75 \pm 0.40$  Ma and a preferred plateau age of  $106.80 \pm 0.20$  Ma based on 12 of 19 heating steps. The preferred age is interpreted to record cooling of the sample through the closure temperature of muscovite (fig. A14; A15).

### **23MLB158 - Vein**

This sample is an altered vein, collected from a frost boil that is grayish yellow to gray and interlayered. The crystal grain size ranges from 0.1 to 5 mm. The sample consists of 80 percent quartz (drusy), 18 percent white mica (flakes), one percent molybdenite (flakes), and one percent cassiterite. A muscovite separate was dated, yielding an integrated age of  $91.27 \pm 0.46$  Ma and a preferred plateau age of  $91.12 \pm 0.26$  Ma based on 7 of 13 heating steps. This age is interpreted to record crystallization of muscovite during vein formation (fig. A16; A17).

### **23RN617 - Lamprophyre**

23RN617 is described as a biotite-bearing lamprophyre: dark greenish-black, jointed, diabasic, and hypidiomorphic. The grain size spans 0.1 to 1.5 mm, with a mineralogy of 30 percent plagioclase, 25 percent biotite, 15 percent K-feldspar, 10 percent augite, 10 percent calcite, six percent sericite, and minor apatite, magnetite, and iddingsite. A separate biotite sample was dated, yielding an integrated age of  $65.31 \pm 1.21$  Ma and a preferred plateau age of  $65.69 \pm 1.20$  Ma based on 4 of 13 heating steps. This age is interpreted as the crystallization age of the lamprophyre (fig. A18; A19).

### **23RN622 – Mafic Porphyry**

This sample is a mafic porphyry, green and white, jointed, and porphyritic, with grain sizes ranging from 0.02 to 20 mm. The mineralogy consists of 70 percent aphanitic groundmass, 20 percent plagioclase, five percent potassium feldspar, and five percent calcite (disseminated). A K-feldspar separate was dated, yielding an integrated age of  $53.87 \pm 0.06$  Ma, with the first of 13 heating steps omitted. The integrated age is preferred and interpreted as the sample's crystallization age (fig. A20; A21).

### **23SPR021 - Paragneiss**

This biotite-bearing paragneiss is dark gray, foliated, gneissic, and schistose. The grain size range is from 0.2 to 2 mm, and the mineralogy consists of 60 percent quartz, 20 percent

plagioclase, 14 percent biotite, four percent muscovite, and minor garnet. A muscovite separate was dated, yielding an integrated age of  $114.16 \pm 0.41$  Ma and a preferred weighted mean age of  $113.37 \pm 0.88$  Ma based on 7 of 15 heating steps. The preferred age is interpreted to record cooling of the sample through the closure temperature of muscovite (fig. A22; A23).

### **23TJN122 - Schist**

This sample is a garnet-bearing schist. The average grain size is 2 mm, with a mineralogy of 30 percent muscovite, 25 percent quartz, 15 percent plagioclase, 12 percent biotite, 10 percent garnet, seven percent chlorite, and trace amounts of rutile and tourmaline. A muscovite separate was dated, resulting in an integrated age of  $89.85 \pm 1.22$  Ma and a preferred plateau age of  $90.88 \pm 1.16$  Ma based on 4 of 12 heating steps. The preferred age is interpreted to record cooling of the sample through the closure temperature of muscovite (fig. A24; A25).

### **23TJN136 - Phyllite**

23TJN136 is a phyllite that is tan to pale greenish-gray, foliated, and phyllitic. The average grain size is 0.2 mm, with a mineralogy of 50 percent quartz, 20 percent muscovite, 16 percent chlorite, 12 percent albite, and minor titanite. A muscovite separate was dated, resulting in an integrated age of  $195.15 \pm 0.48$  Ma and a preferred plateau age of  $202.19 \pm 0.61$  Ma based on 6 of 12 heating steps. The preferred age is interpreted to record cooling of the sample through the closure temperature of muscovite (fig. A26).

### **23TJN158 - Schist**

This sample is a garnet-bearing schist. The sample is foliated and possesses an average grain size of 0.5 mm. The mineralogy consists of 30 percent quartz, 20 percent plagioclase, 20 percent muscovite, 10 percent hornblende, eight percent garnet, seven percent biotite, and minor chlorite and titanite. Both muscovite and hornblende were dated from this sample. Hornblende yielded an integrated age of  $109.60 \pm 2.26$  Ma and a preferred weighted mean age of  $114.60 \pm 3.62$  Ma based on 3 of 12 heating steps, and muscovite yielded an integrated age of  $120.26 \pm 0.91$  Ma and a preferred plateau age of  $120.42 \pm 0.74$  Ma based on 4 of 12 heating steps. The preferred ages are interpreted as recording the cooling of the sample through the closure temperatures of hornblende and muscovite, respectively (fig. A27; A28; A29; A30).

### **23Z045 - Vein**

This sample is a quartz-rich vein, white with brown and greenish-yellow patches. It is massive, vuggy, and granular. The grain size ranges from 0.2 to 1 mm, and the mineralogy consists of 90 percent quartz (vein filling), two percent iron oxide (coating), two percent white mica, and trace pyrite, K-feldspar, and native gold. There is disseminated pyrite and arsenopyrite with limonite and scorodite staining in the white quartz veins and possibly host granitic rock, as well as flakes of white mica on vein margins and in the host rock. The sulfides sometimes occur in fine-grained aggregates with abundant staining. A muscovite separate was dated, resulting in an integrated age of  $102.20 \pm 0.19$  Ma and a preferred plateau age of  $102.87 \pm 0.21$  Ma based on 8

of 14 heating steps. This age is interpreted to record crystallization of muscovite during vein formation (fig. A31; A32).

### **23Z114 - Amphibolite**

This sample is an amphibolite, described as dark green, foliated, and schistose. The outcrop exhibits some fracture-controlled weathering, with some fractures coated in calcite. The grain size ranges from 0.1 to 0.5 mm, and the mineralogy is 70 percent amphibole, 23 percent epidote, four percent titanite, two percent plagioclase, and minor calcite and apatite. A hornblende separate was dated and yielded a stair-stepping down age spectrum with an integrated age of  $304.49 \pm 2.14$  Ma. The initial  $^{40}\text{Ar}/^{36}\text{Ar}$  ratio calculated from the inverse isochron intercept is significantly different than the presumed atmospheric value of  $298.56 \pm 0.31$  (Lee and others, 2006), indicating excess argon in the sample. The hornblende age spectrum was recalculated by assuming a trapped  $^{40}\text{Ar}/^{36}\text{Ar}$  ratio of  $2804.94 \pm 412.05$ , as calculated from the inverse isochron intercept. A plateau age of  $109.78 \pm 14.13$  Ma, based on the recalculated age spectrum from 10 of 19 heating steps, is preferred. This preferred age is interpreted to record cooling of the sample through the closure temperature of hornblende (fig. A33; A34; A35).

### **23Z133 - Amphibolite**

23Z133 is an amphibolite. It is described as dark green to black, fine-grained, foliated, and schistose. The outcrop possesses approximately half a meter-thick interlayers of amphibolite within schist. The mineralogy consists of 75 percent amphibole, 15 percent plagioclase, five percent titanite, four percent epidote, and one percent apatite. A separate hornblende sample was dated, yielding an integrated age of  $206.77 \pm 1.33$  Ma. The initial  $^{40}\text{Ar}/^{36}\text{Ar}$  ratio calculated from the inverse isochron intercept is significantly different than the presumed atmospheric value of  $298.56 \pm 0.31$  (Lee and others, 2006), indicating excess argon in the sample. The hornblende age spectrum was recalculated assuming a trapped  $^{40}\text{Ar}/^{36}\text{Ar}$  ratio of  $714.17 \pm 60.30$ , derived from the inverse isochron intercept. A plateau age of  $139.16 \pm 2.66$  Ma from the recalculated spectrum based on 4 of 19 steps is the preferred age. This preferred age is interpreted to record cooling of the sample through the closure temperature of hornblende (fig. A36; A37; A38).

### **23Z278 - Metamafic**

This melanocratic metagabbro is green to pale green, flaggy, granoblastic, and porphyroblastic. The grain size ranges from 0.2 to 3 mm, with a mineralogy of 45 percent chlorite, 16 percent calcite, 15 percent quartz, 15 percent albite, five percent titanite, and four percent muscovite. A muscovite separate was dated, resulting in an integrated age of  $221.69 \pm 0.92$  Ma and a preferred plateau age of  $222.40 \pm 0.86$  Ma based on 3 of 14 heating steps. This age is interpreted to record cooling of the sample through the closure temperature of muscovite (fig. A39; A40).

### **23Z348 - Amphibolite**

This sample is an amphibolite. It is black and dark green, foliated, gneissic, and granoblastic. Grain size ranges from 0.2 to 1 mm, and the mineralogy is comprised of 45 percent

amphibole, 36 percent plagioclase, 15 percent epidote, three percent titanite, and trace ilmenite and magnetite. A hornblende separate was dated and yielded a stair-stepping down age spectrum with an integrated age of  $161.04 \pm 0.76$  Ma. The initial  $^{40}\text{Ar}/^{36}\text{Ar}$  ratio calculated from the inverse isochron intercept is significantly different than the presumed atmospheric value of  $298.56 \pm 0.31$  (Lee and others., 2006), indicating excess argon in the sample. The hornblende age spectrum was recalculated by assuming a trapped  $^{40}\text{Ar}/^{36}\text{Ar}$  ratio of  $674.93 \pm 105.75$ , as calculated from the inverse isochron intercept. A preferred plateau age of  $143.29 \pm 1.34$  Ma from the recalculated spectrum based on 4 of 18 heating steps. This preferred age is interpreted to record cooling of the sample through the closure temperature of hornblende (fig. A41; A42; A43).

### **23Z409 - Granite**

23Z409 is described as a muscovite-bearing granite. It is light gray, flaggy, and porphyritic. The grain size ranges from 0.2 to 15 mm. The mineralogy consists of 45 percent K-feldspar, 30 percent quartz, 13 percent plagioclase, eight percent tourmaline, and four percent muscovite. A muscovite separate was dated, resulting in an integrated age of  $102.32 \pm 0.32$  Ma and a preferred plateau age of  $102.00 \pm 0.29$  Ma based on 4 of 14 heating steps. The preferred age is interpreted as the sample's crystallization age (fig. A44; A45).

### **ACKNOWLEDGMENTS**

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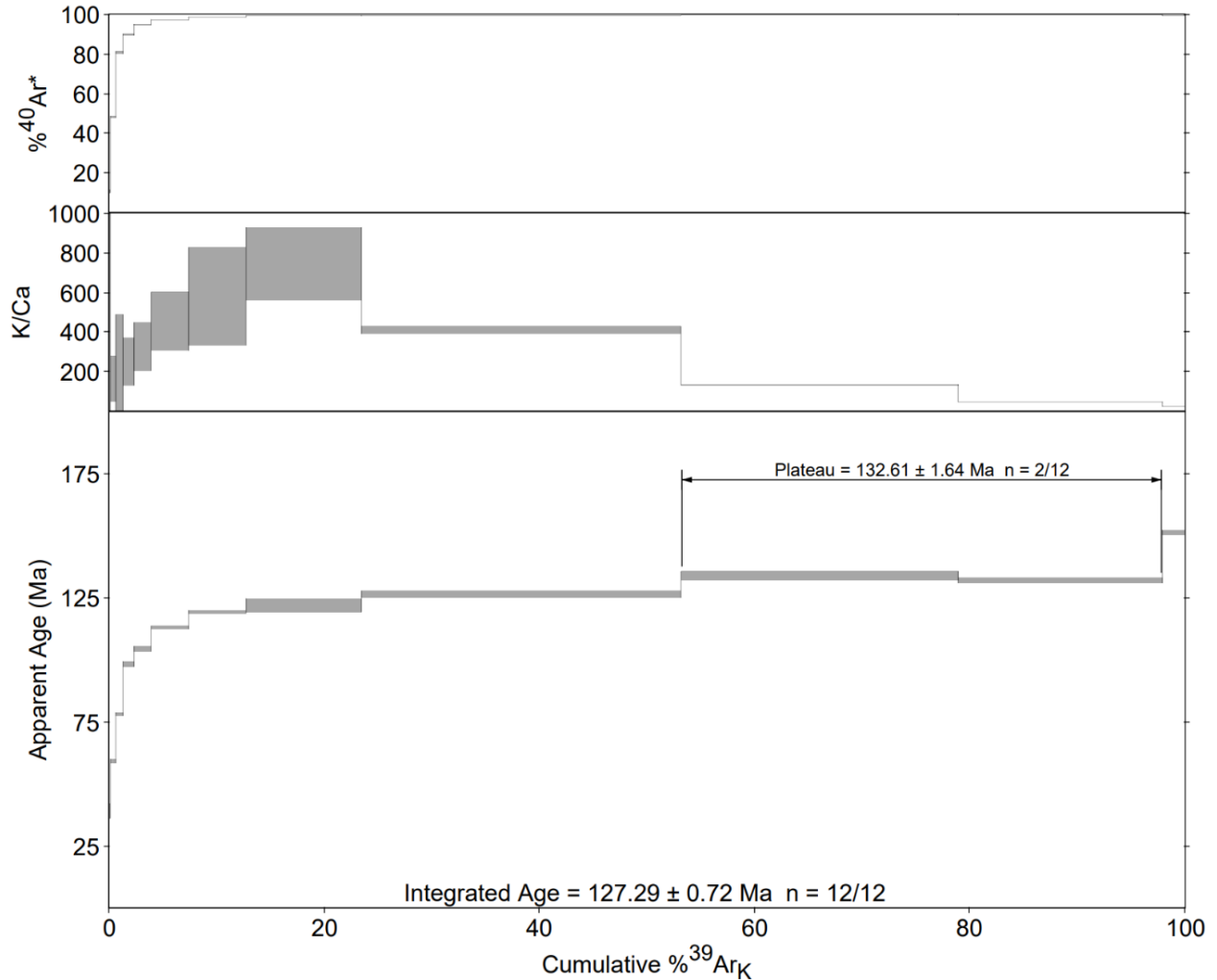
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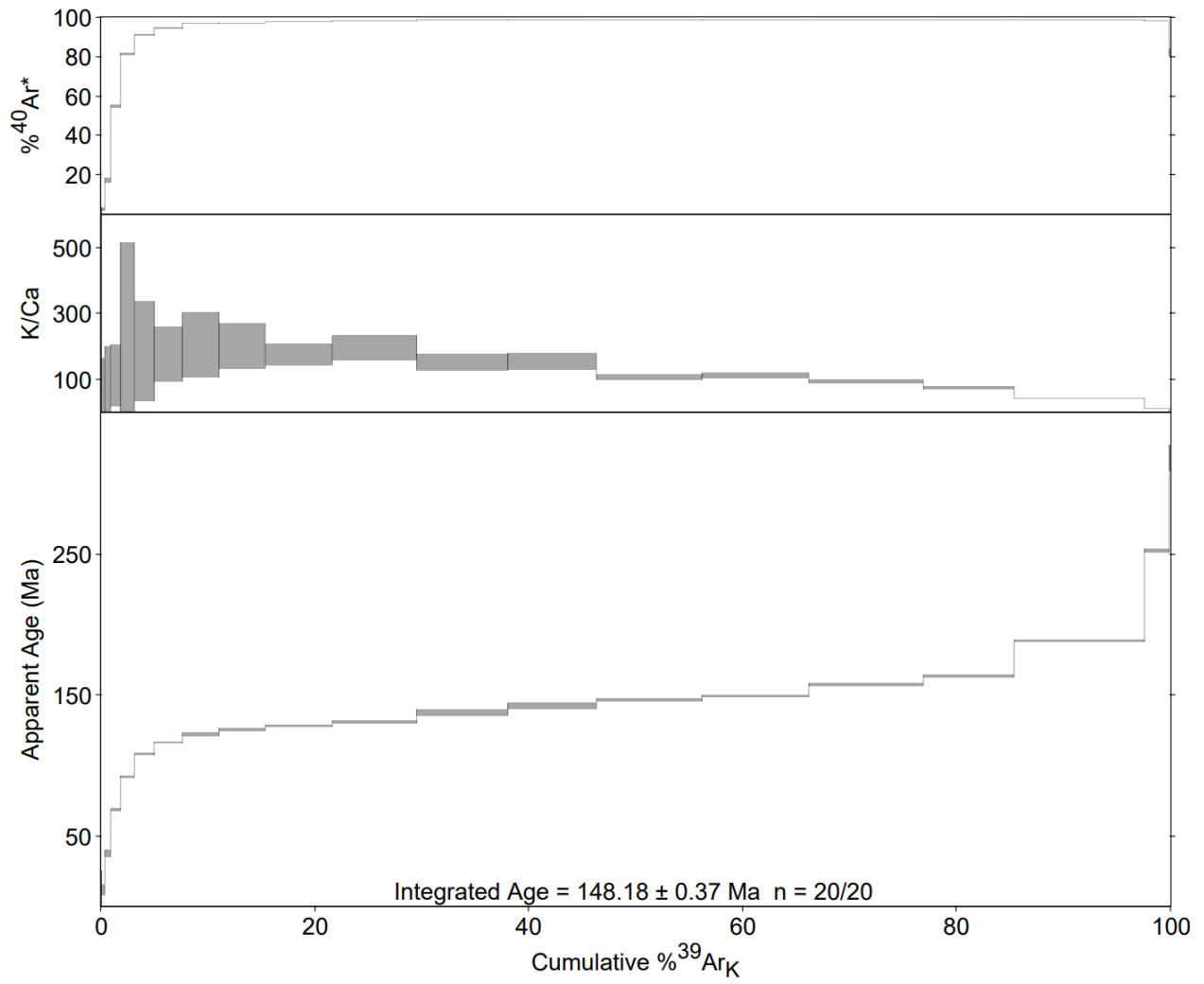
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## APPENDIX A - AGE SPECTRUM AND ISOCHRON PLOTS



**Figure A1.** Age spectrum plot for sample 23AW144



**Figure A2.** Age spectrum plot for sample 23DAH181

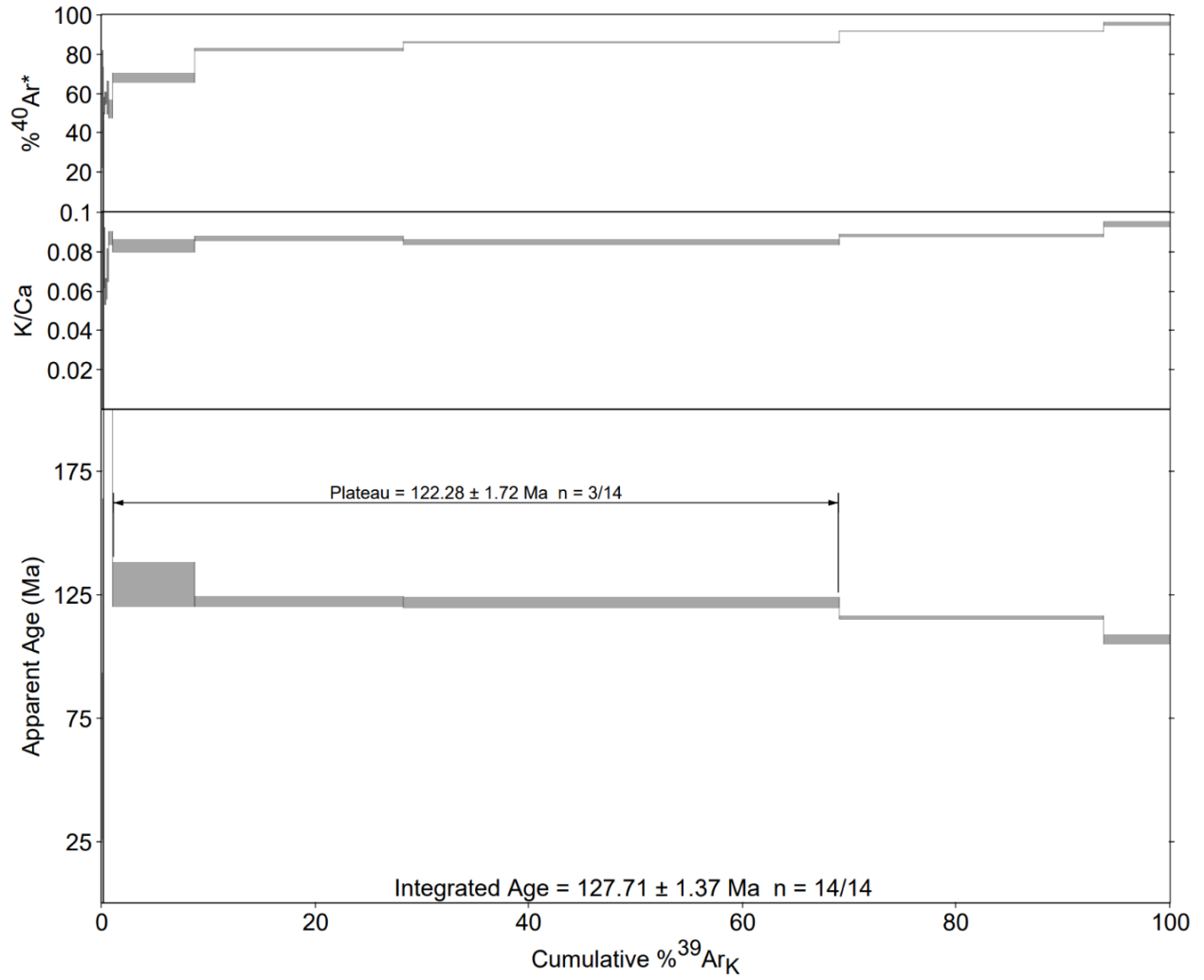
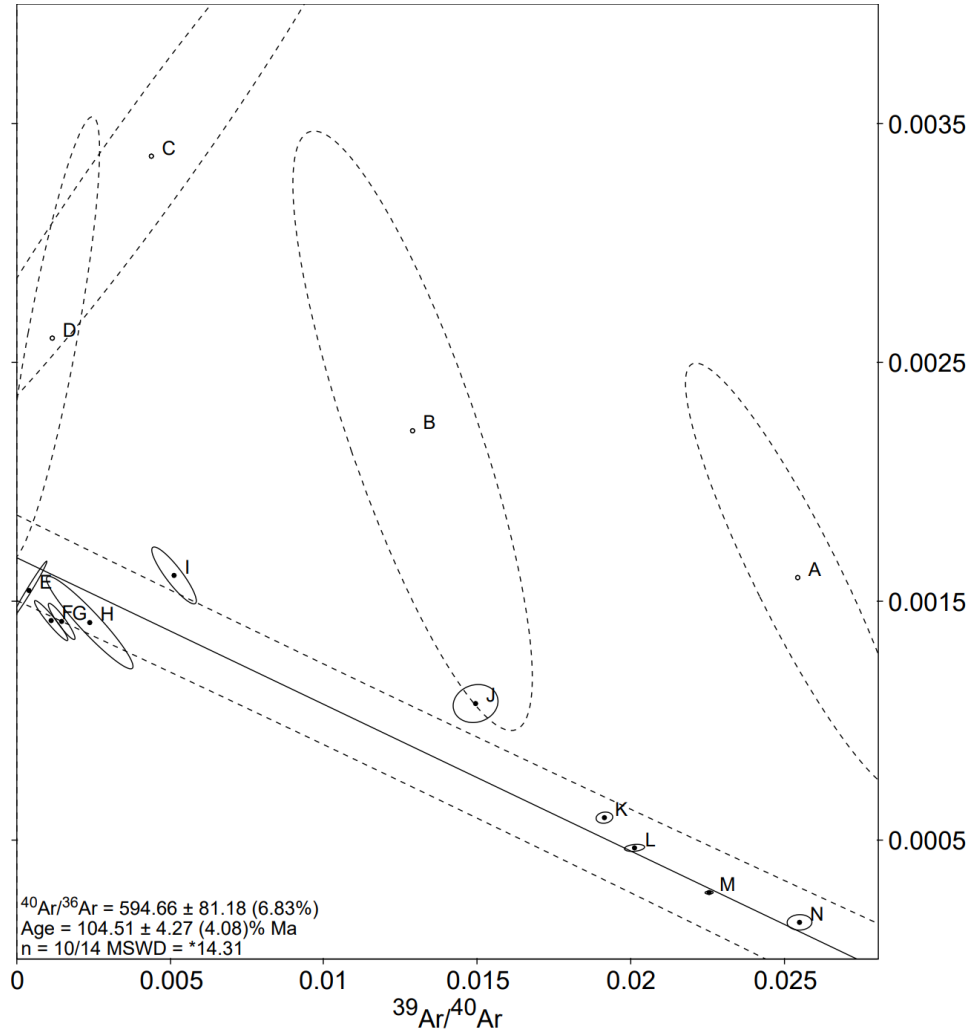
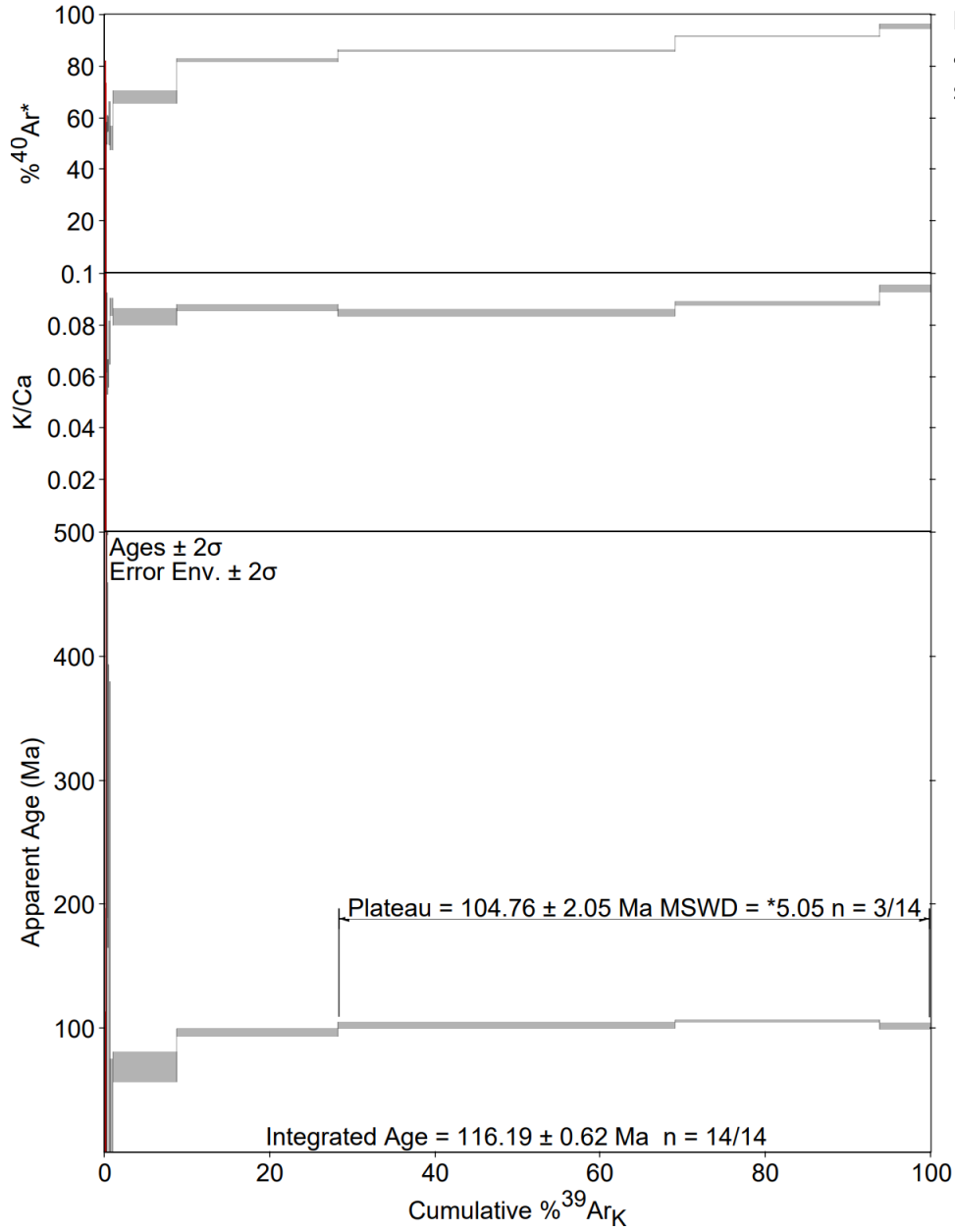


Figure A3. Age spectrum plot for sample 23IPM033





**Figure A5.** Recalculated age spectrum plot for sample 23IPM033

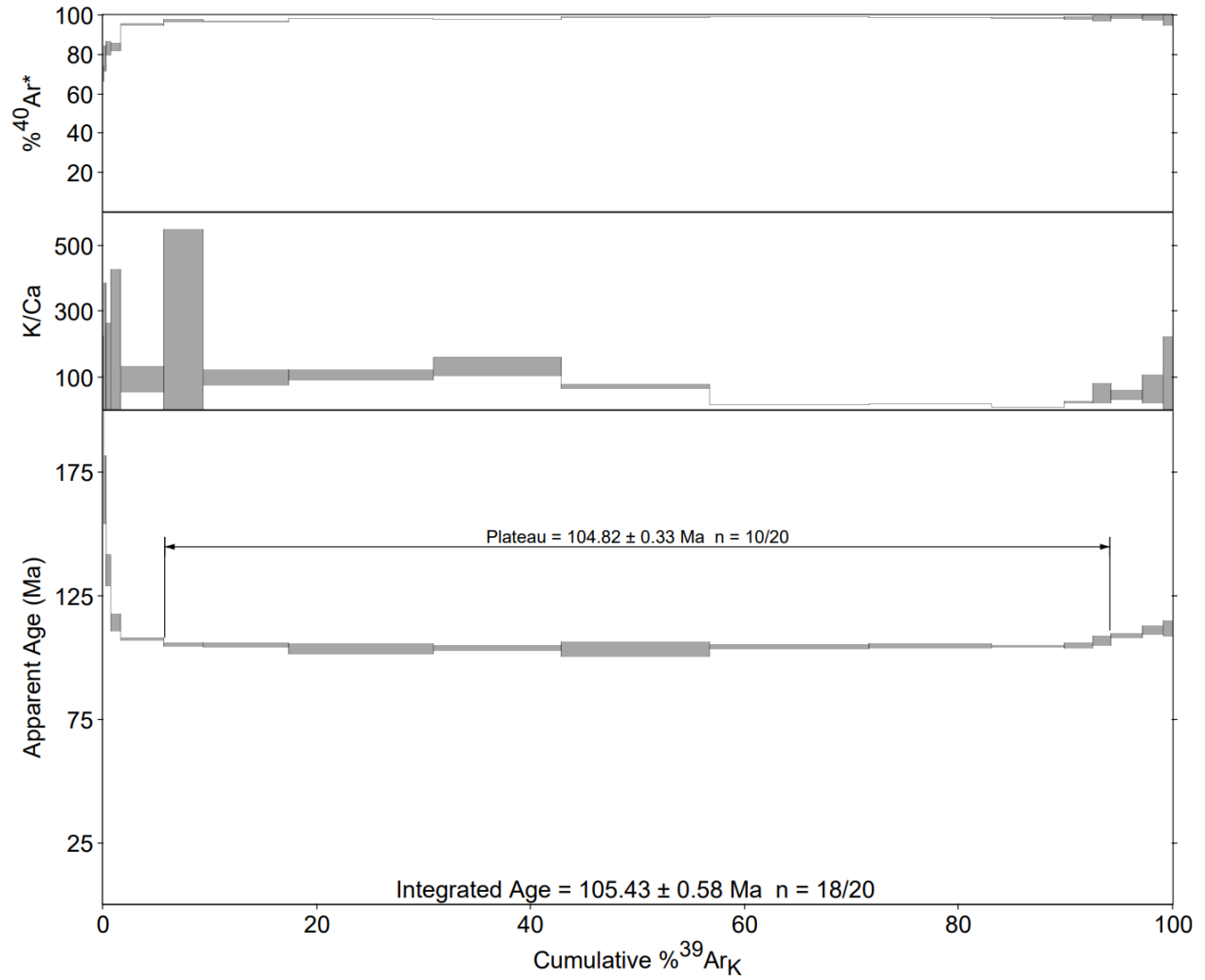
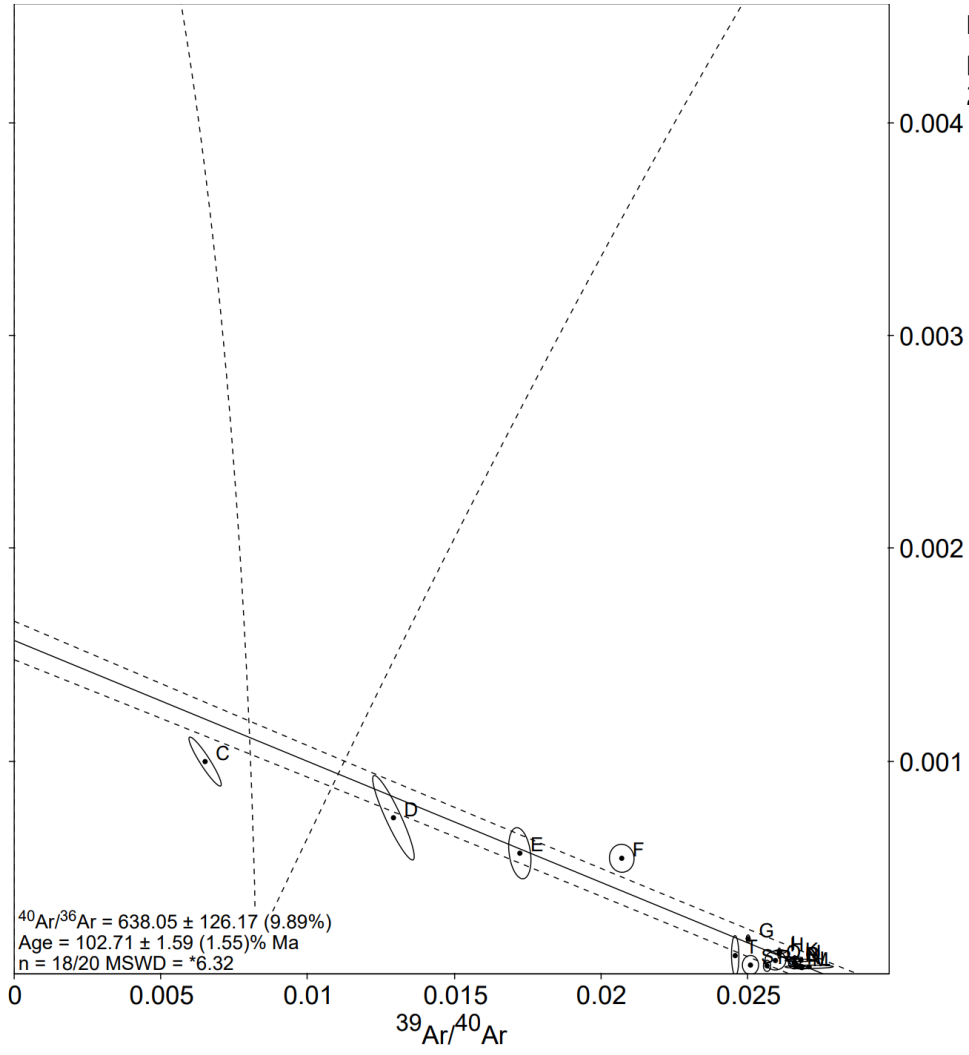
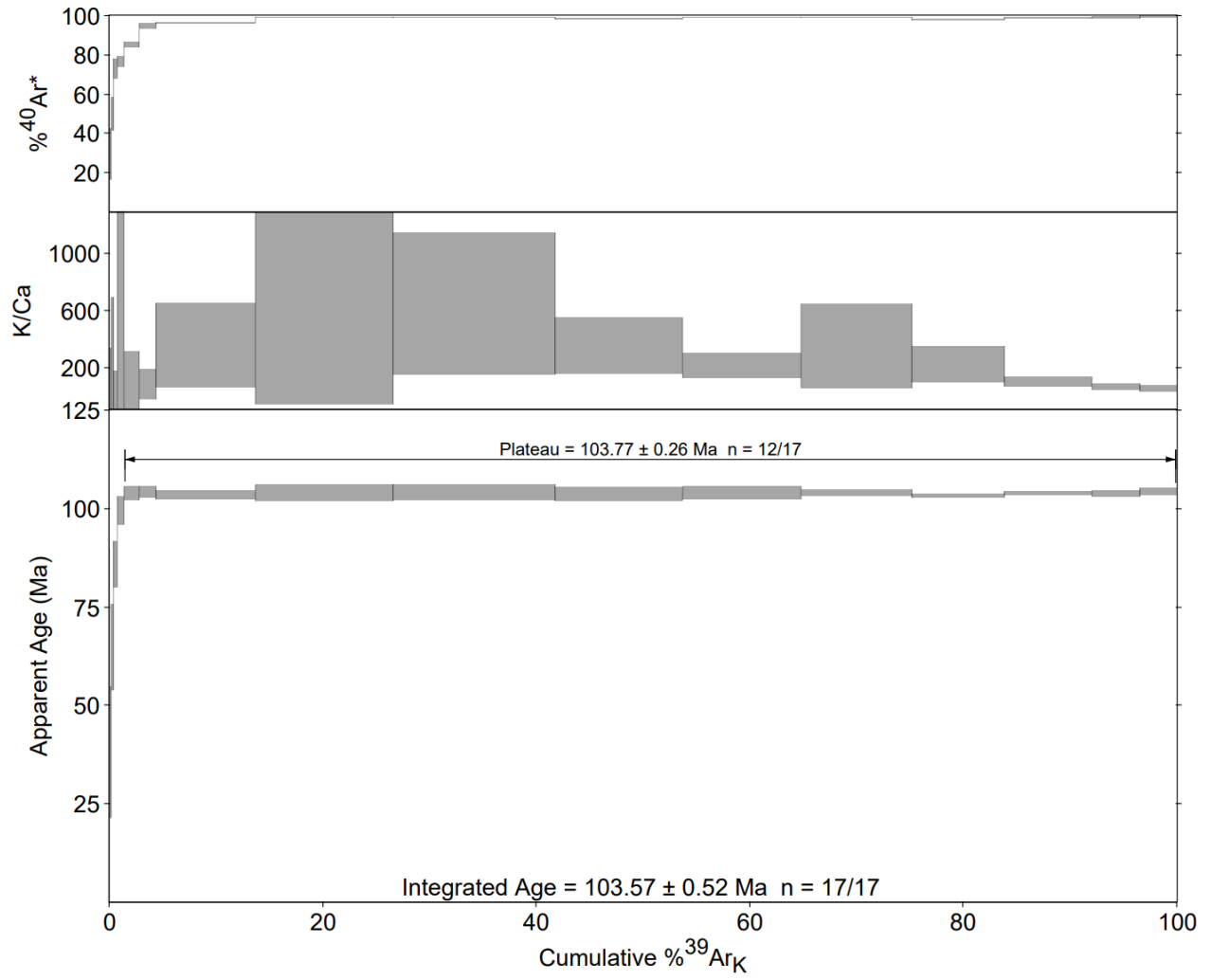
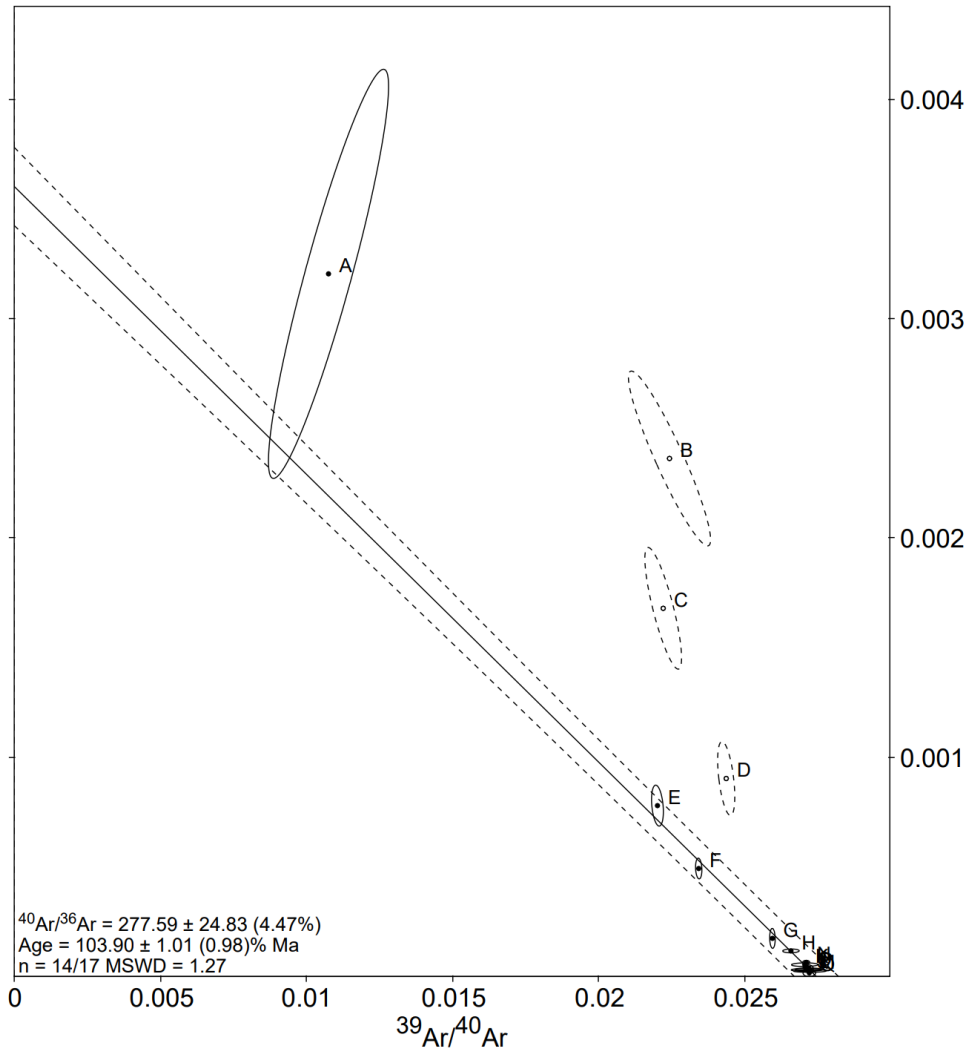


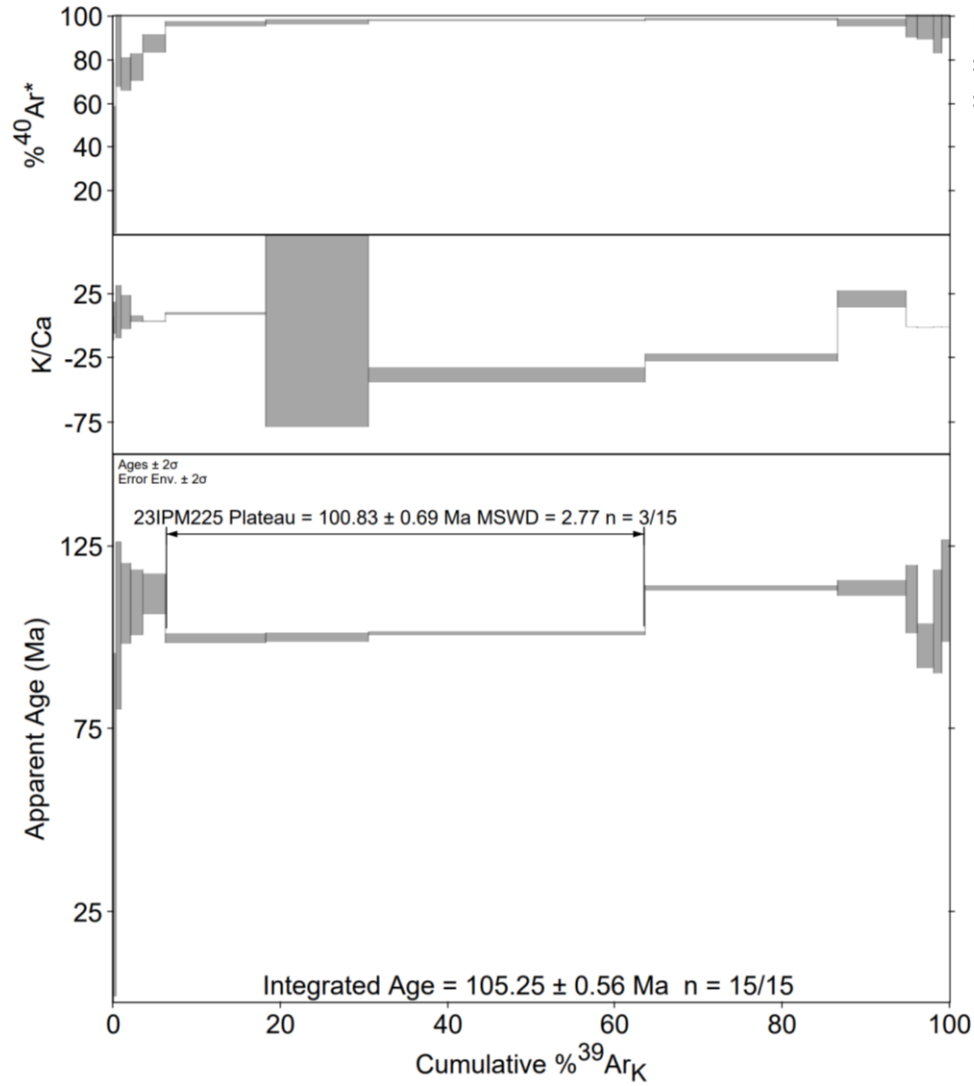
Figure A6. Age spectrum plot for sample 23IPM118



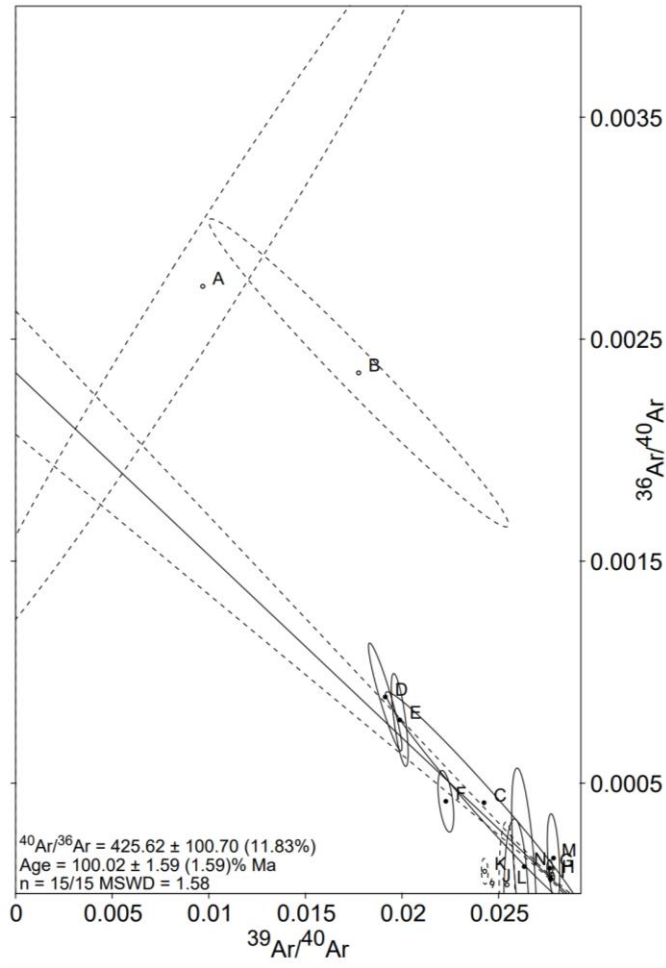


**Figure A8.** Age spectrum plot for sample 23IPM137

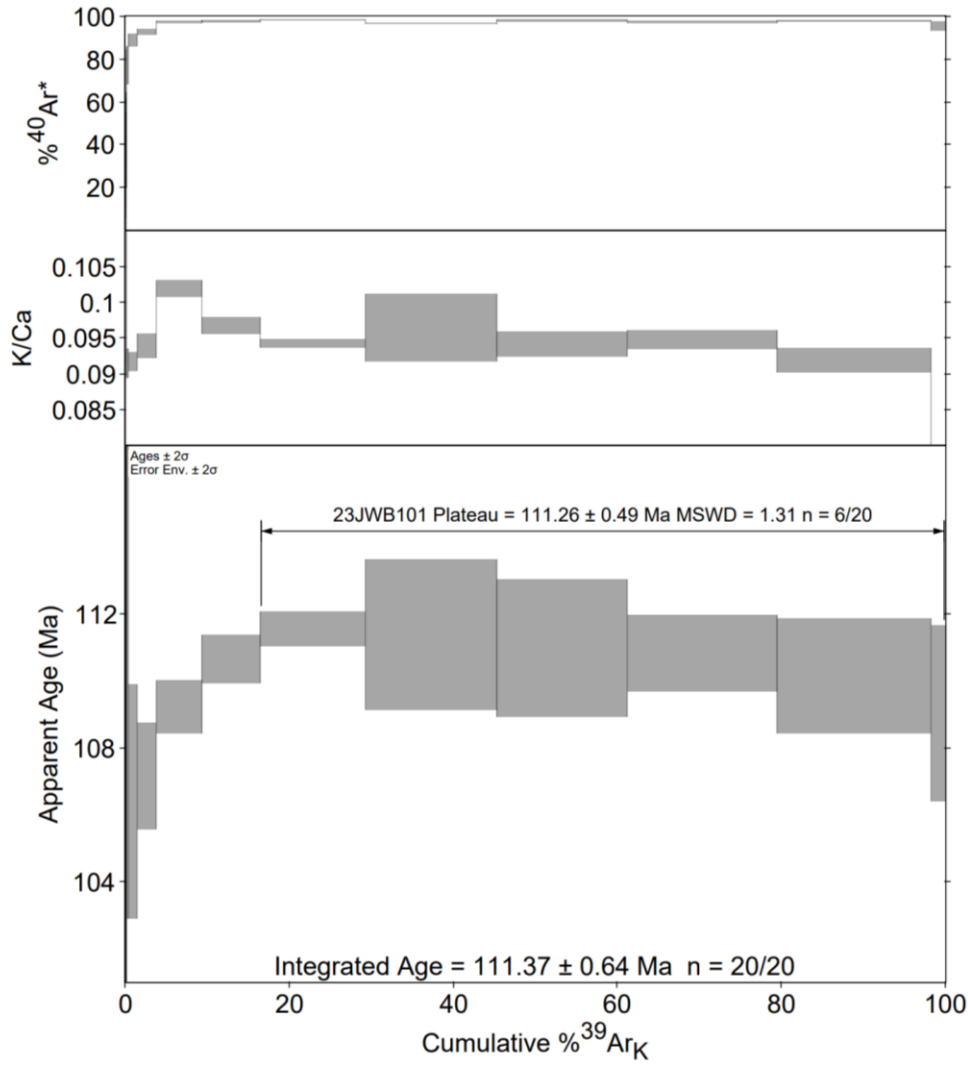




**Figure A10.** Age spectrum plot for sample 23IPM225



**Figure A11.** Isochron plot for sample 23IPM225



**Figure A12.** Age spectrum plot for sample 23JWB101

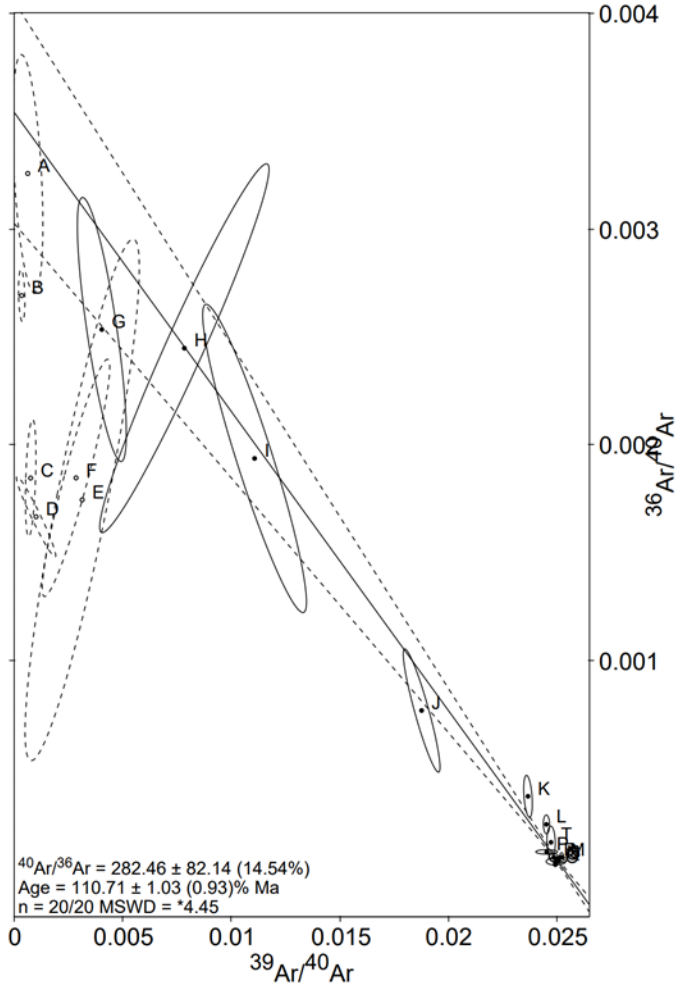
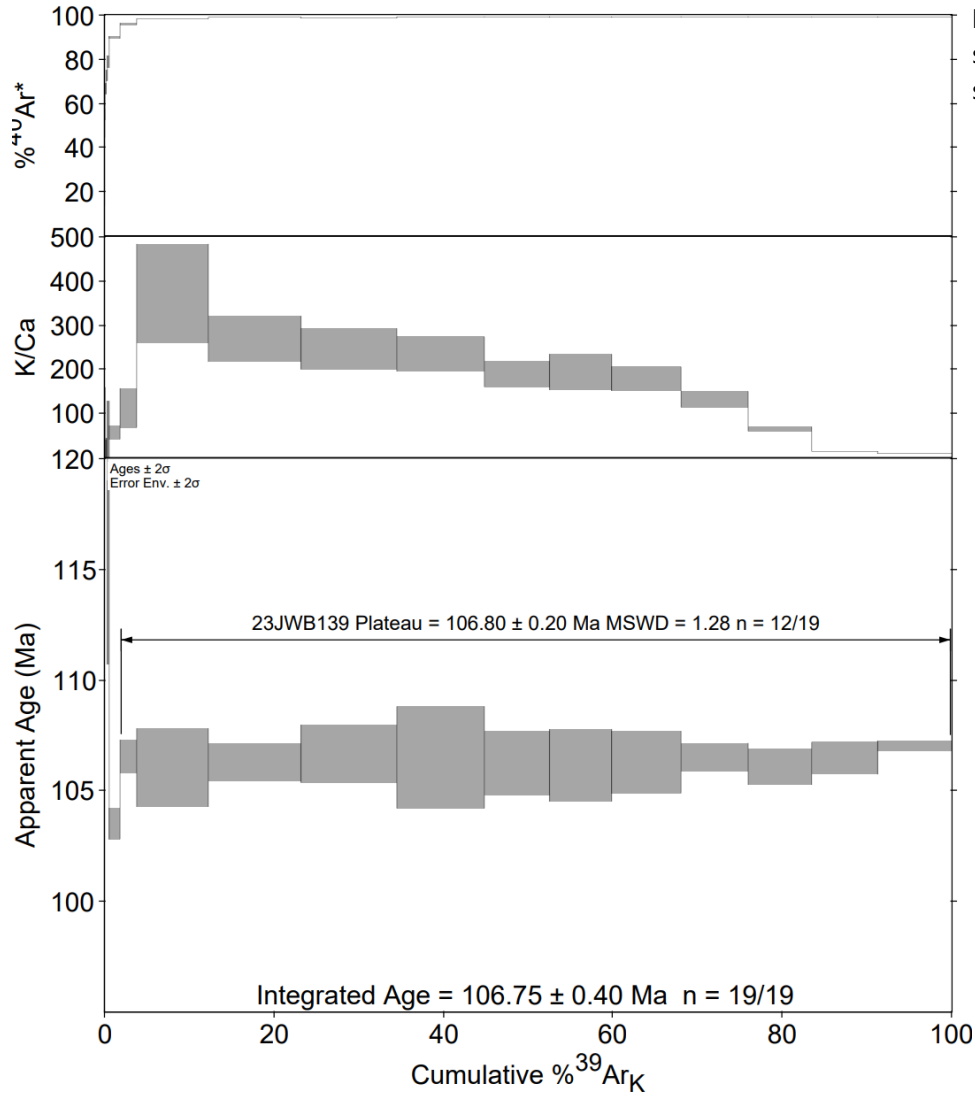
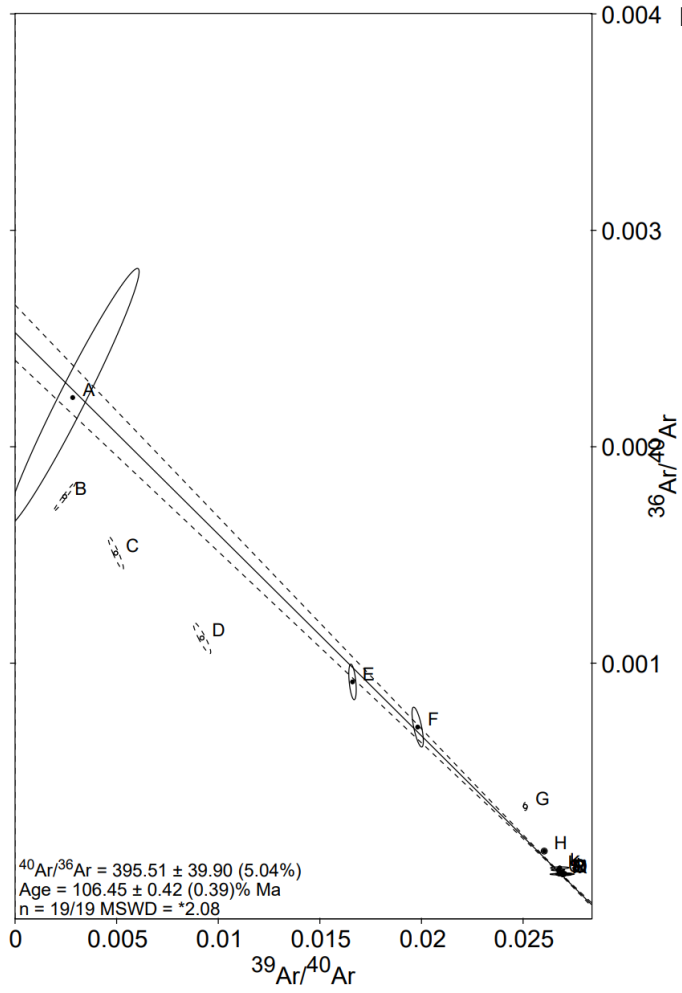


Figure A13. Isochron plot for sample 23JWB101



**Figure A14.** Age spectrum plot for sample 23JWB139



**Figure A15.** Isochron plot for sample 23JWB139

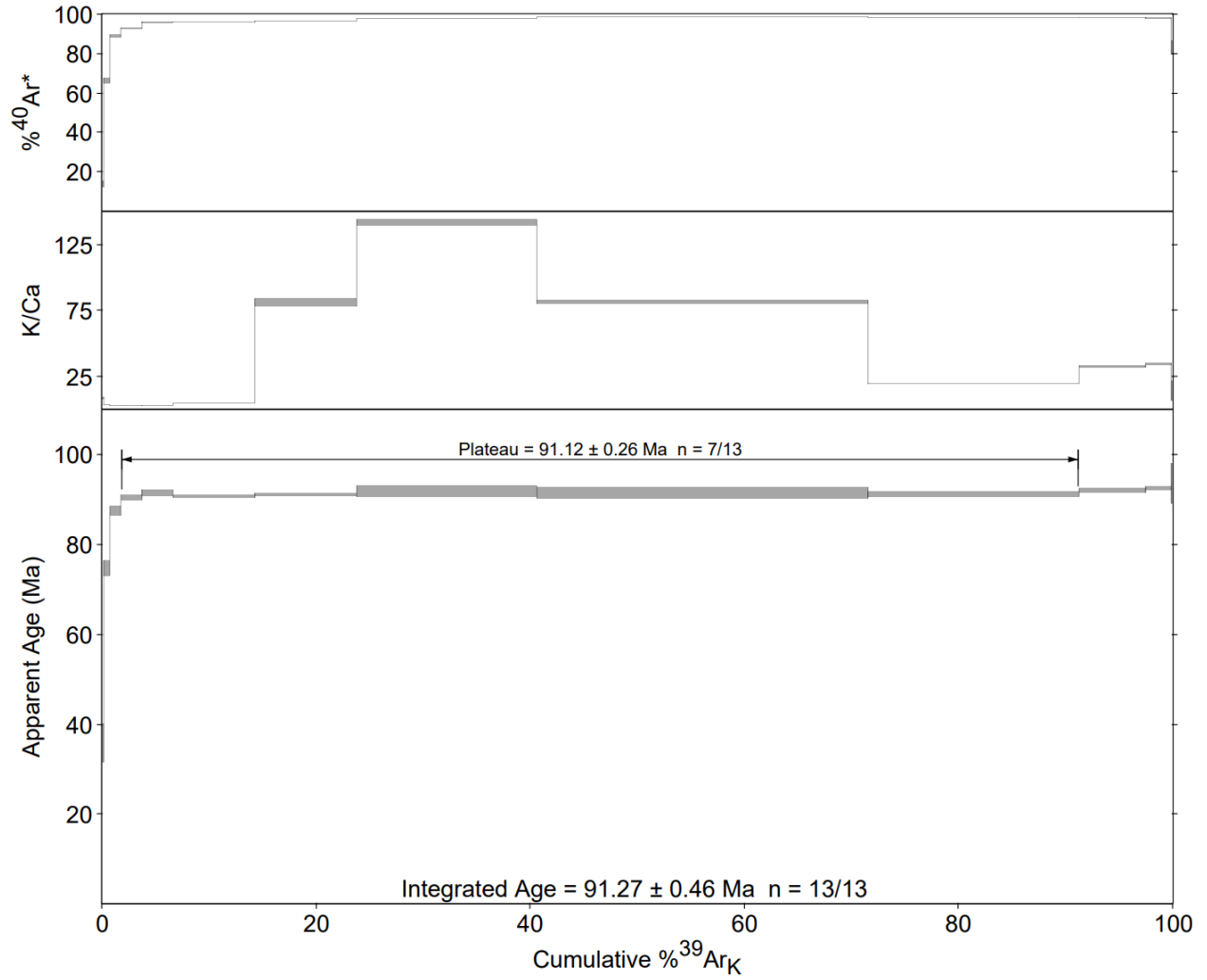
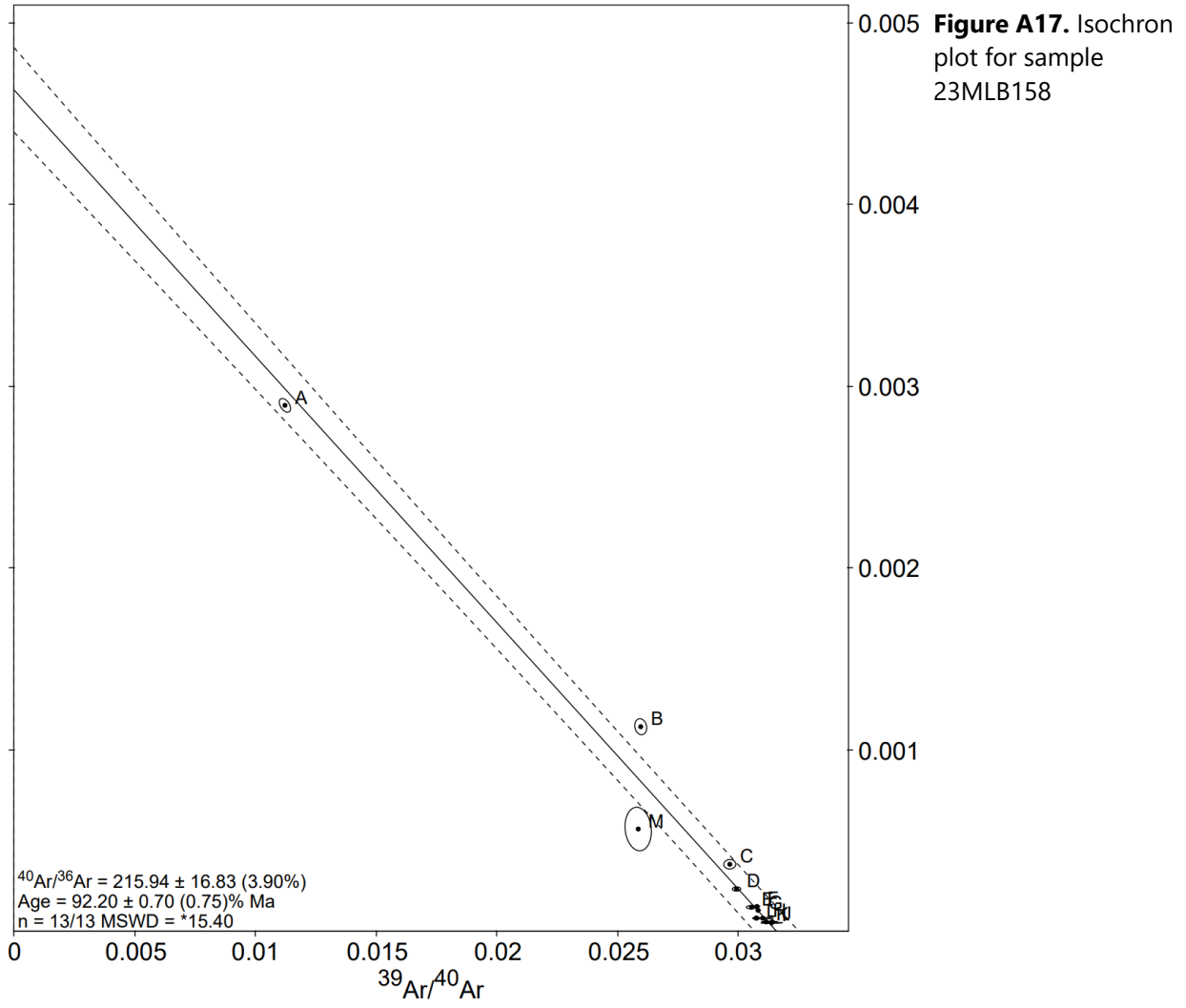


Figure A16. Age spectrum plot for sample 23MLB158



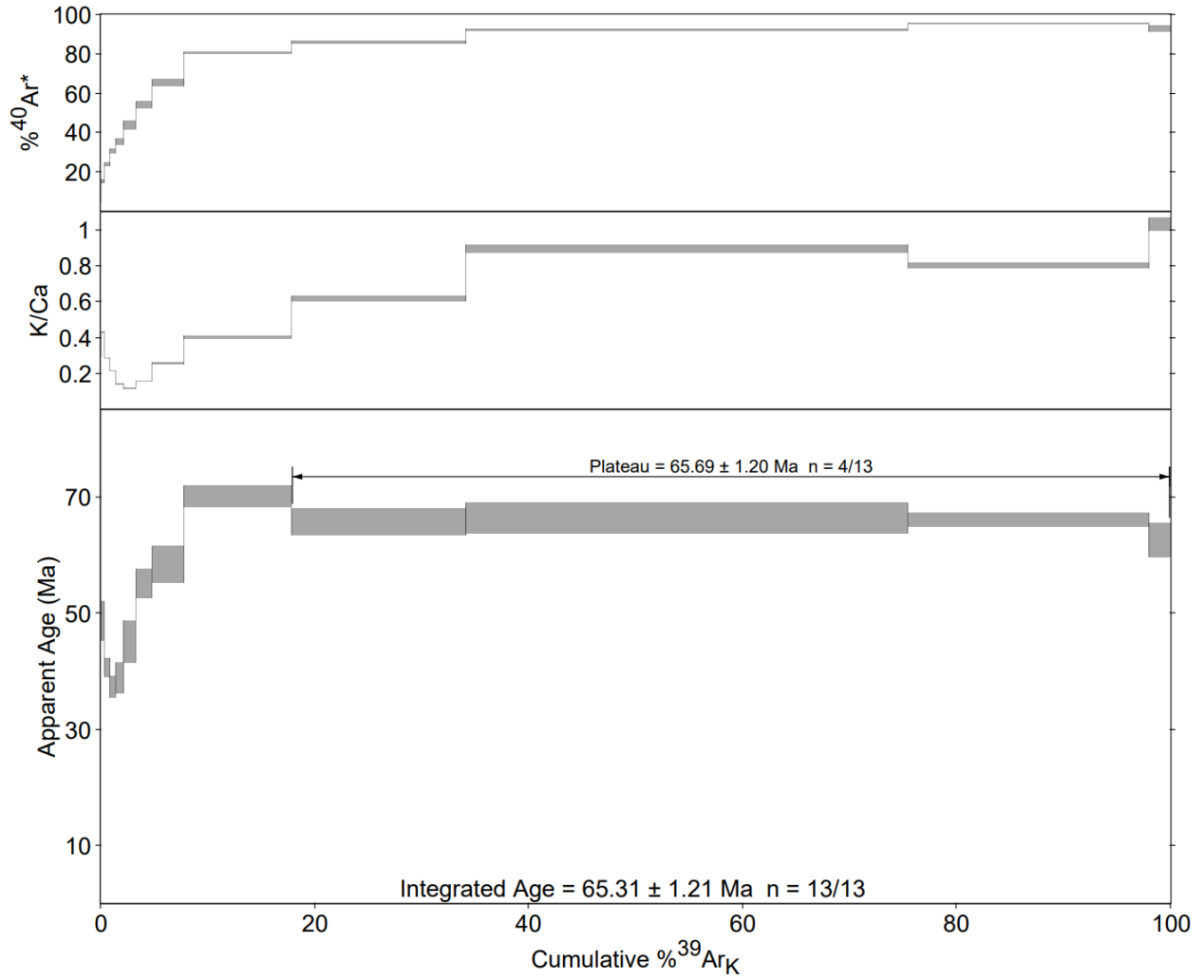
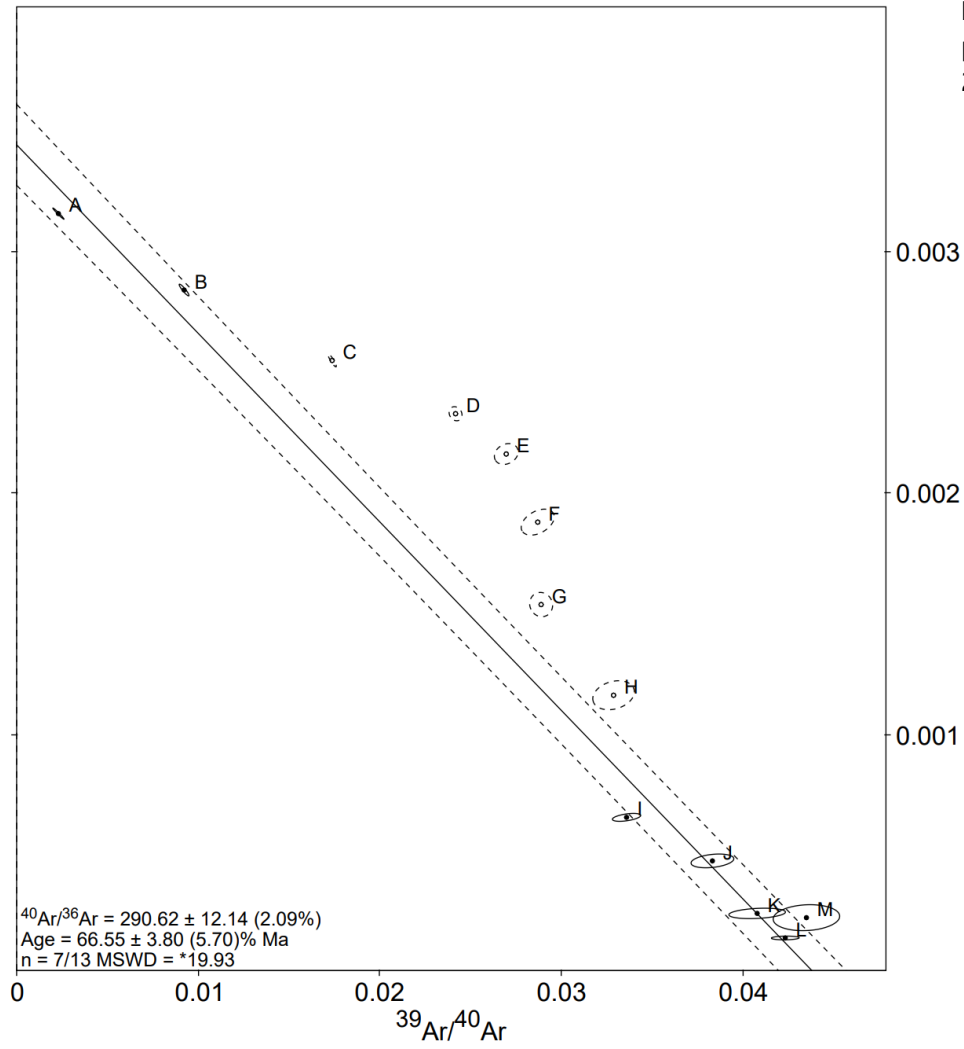


Figure A18. Age spectrum plot for sample 23RN617



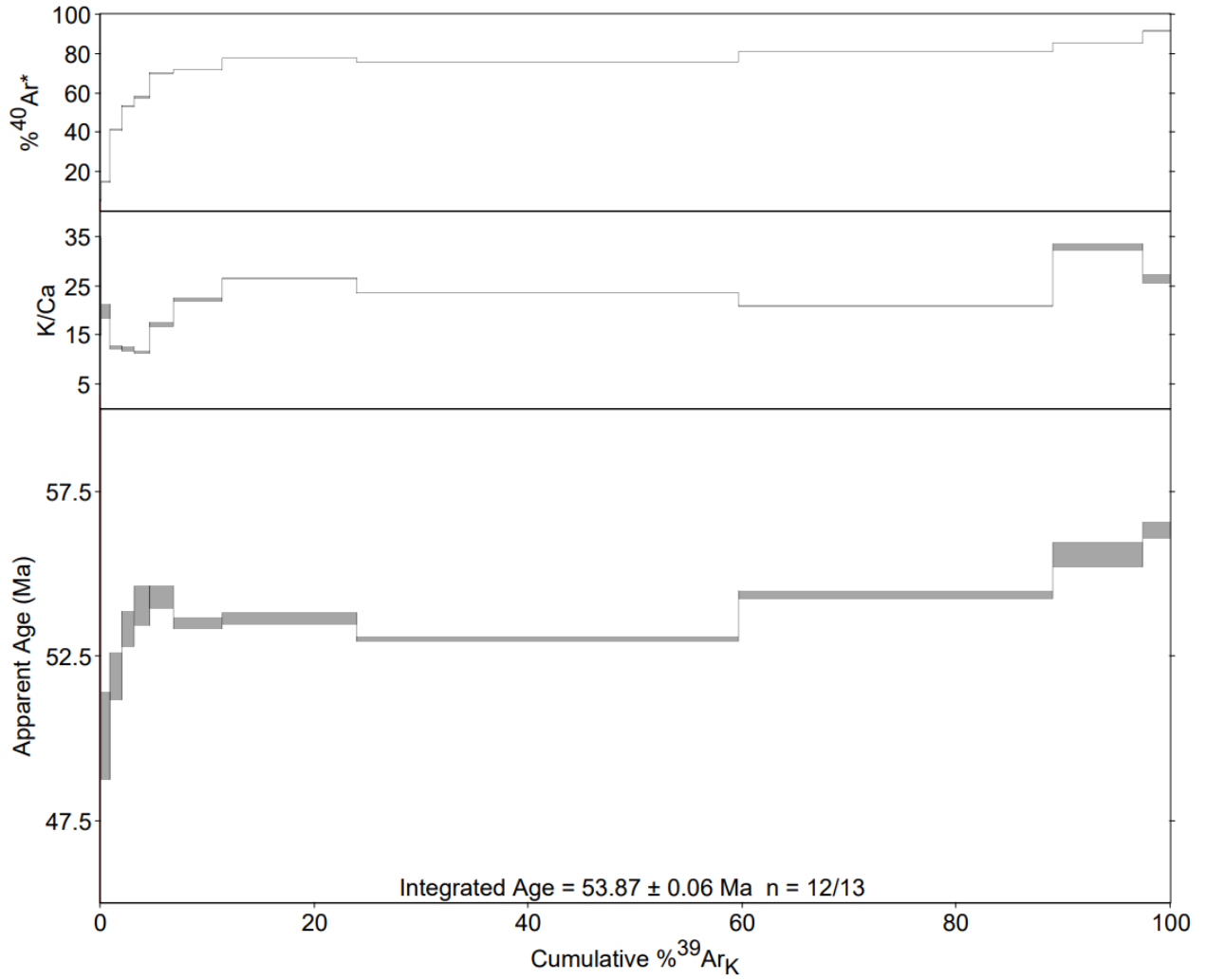
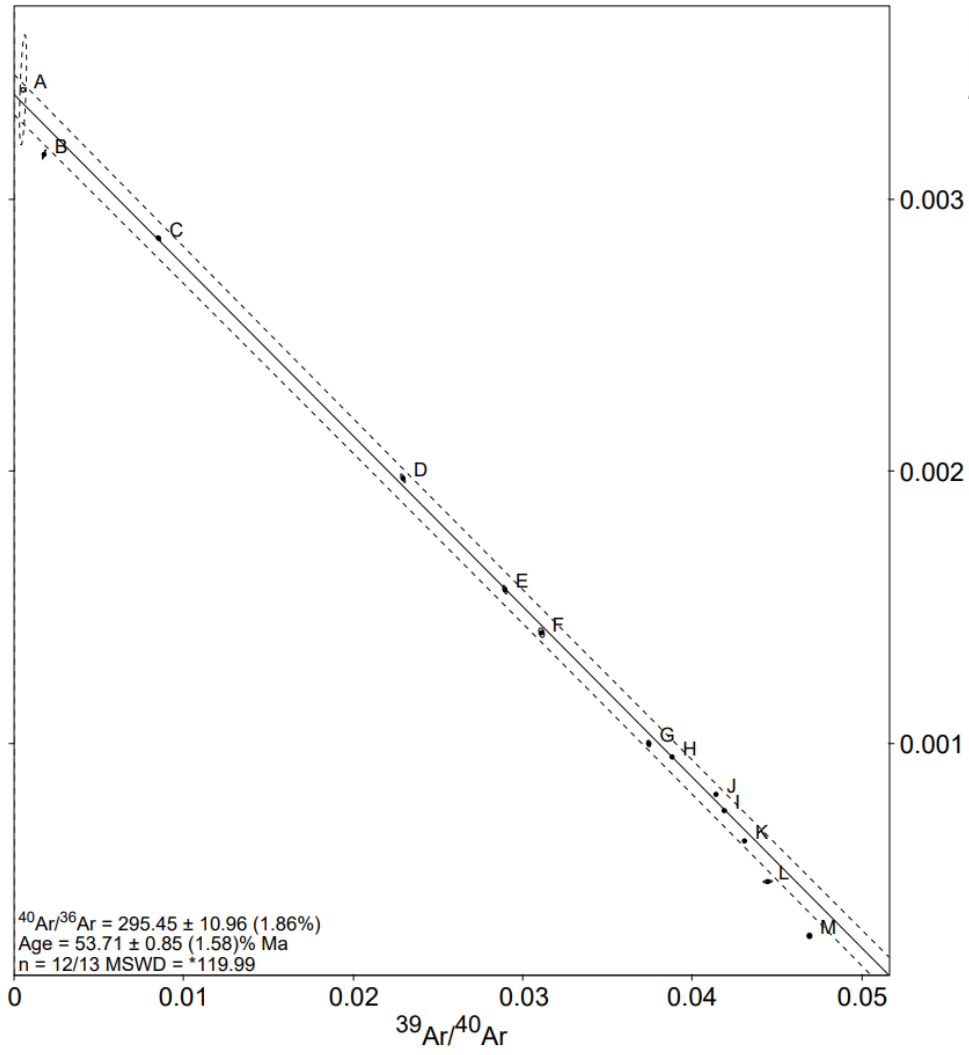


Figure A20. Age spectrum plot for sample 23RN622



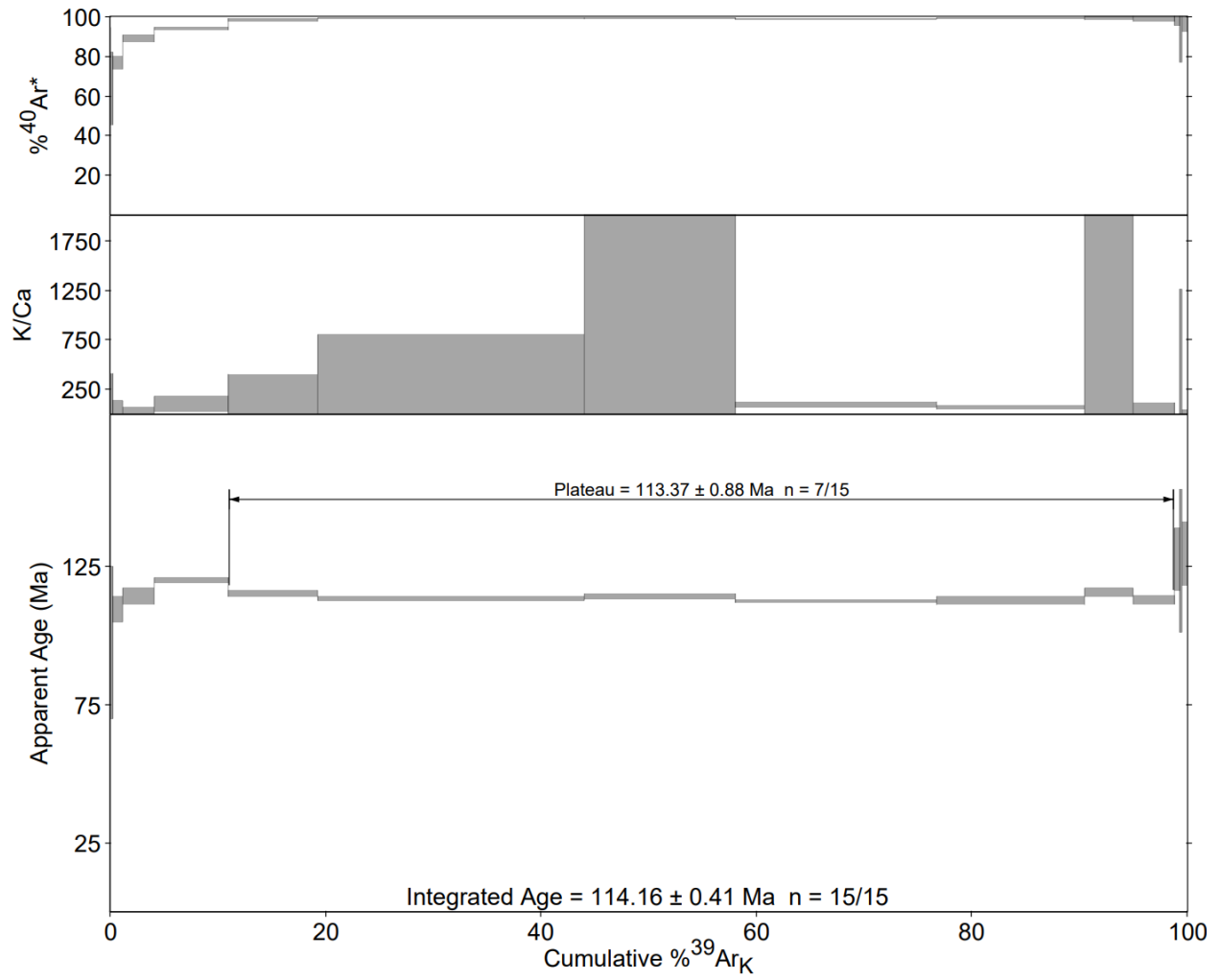
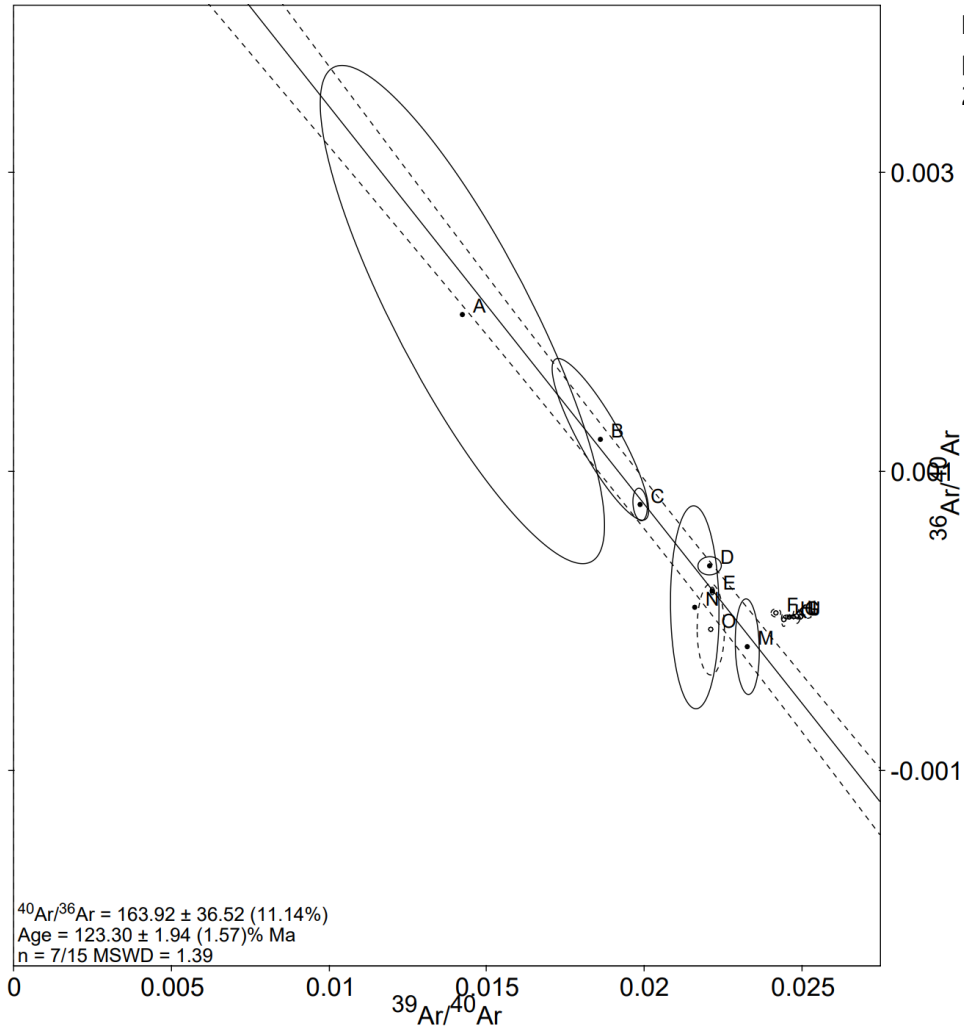


Figure A22. Age spectrum plot for sample 23SPR021



**Figure A23.** Isochron plot for sample 23SPR021

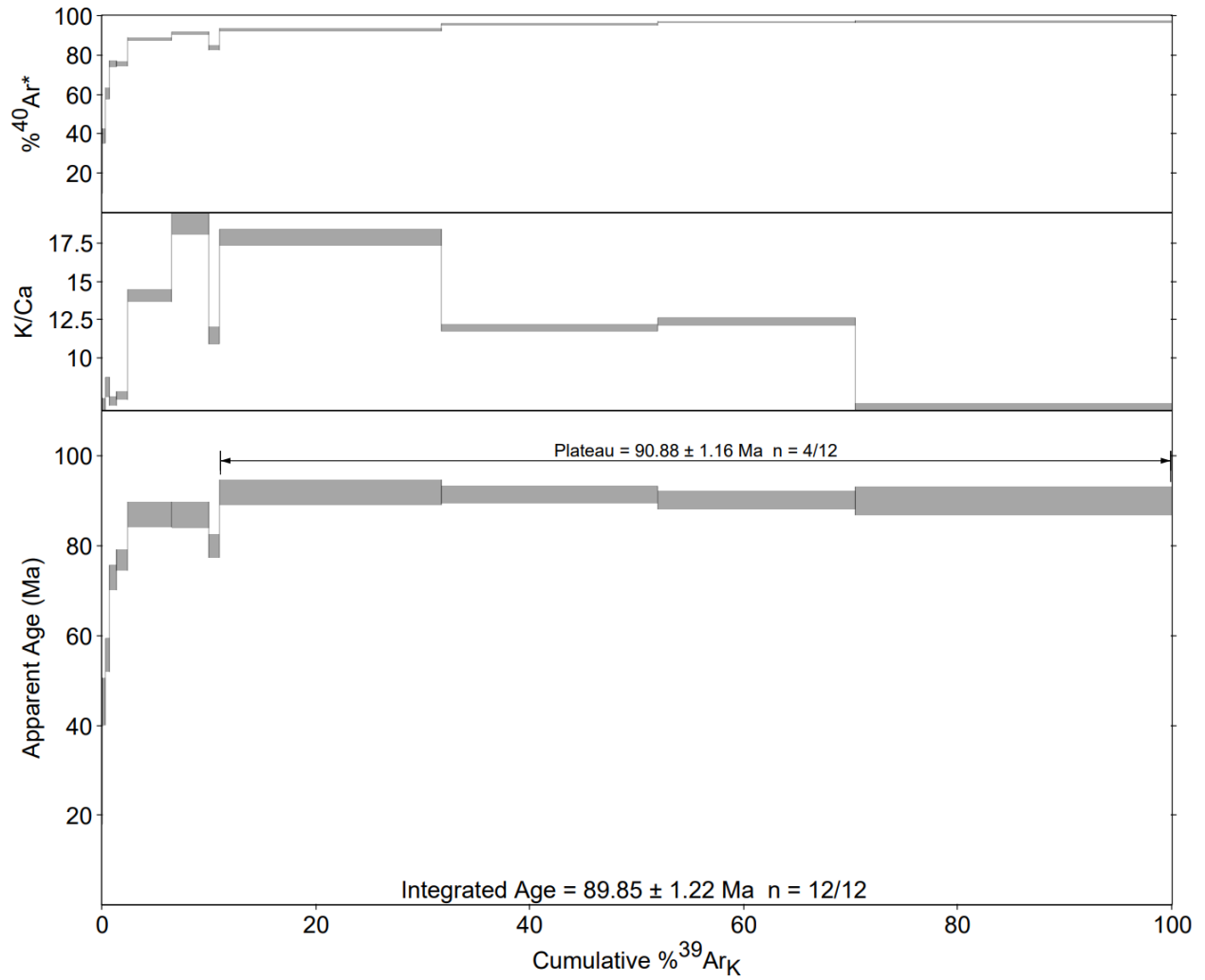
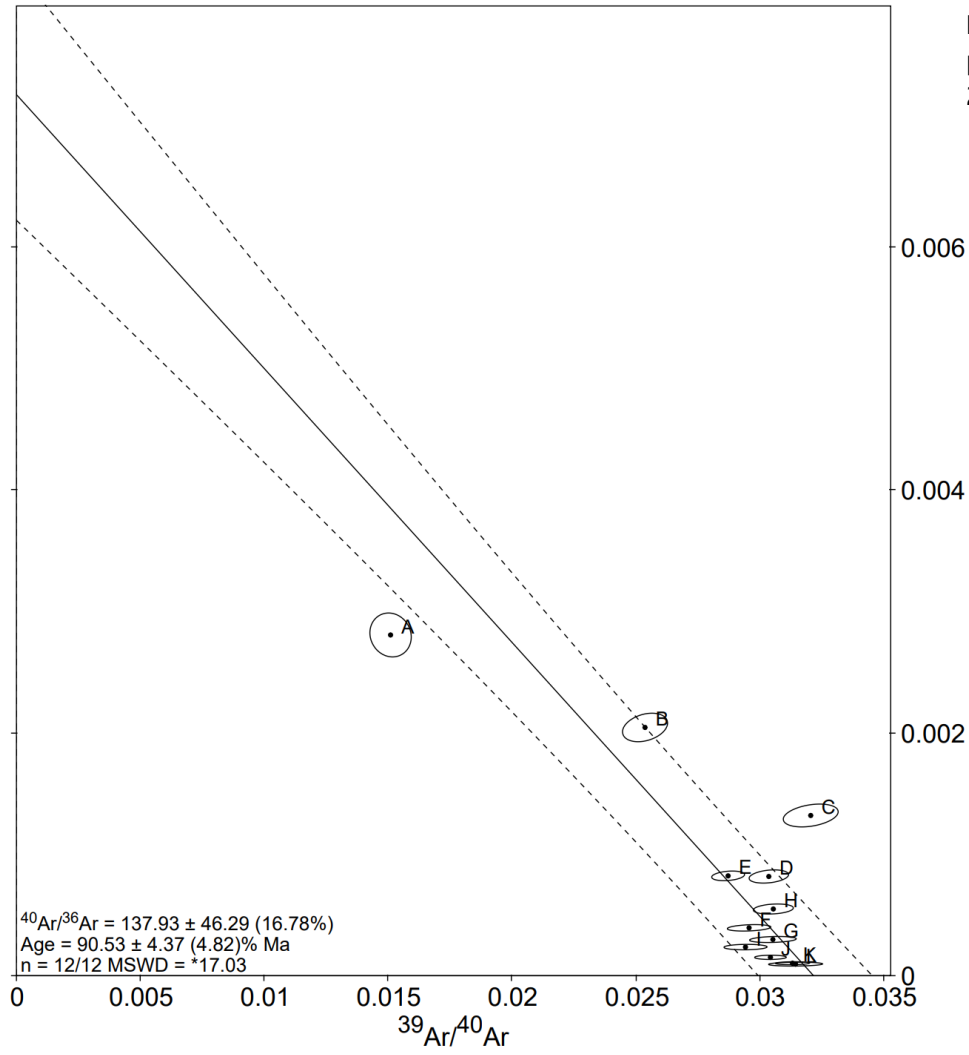
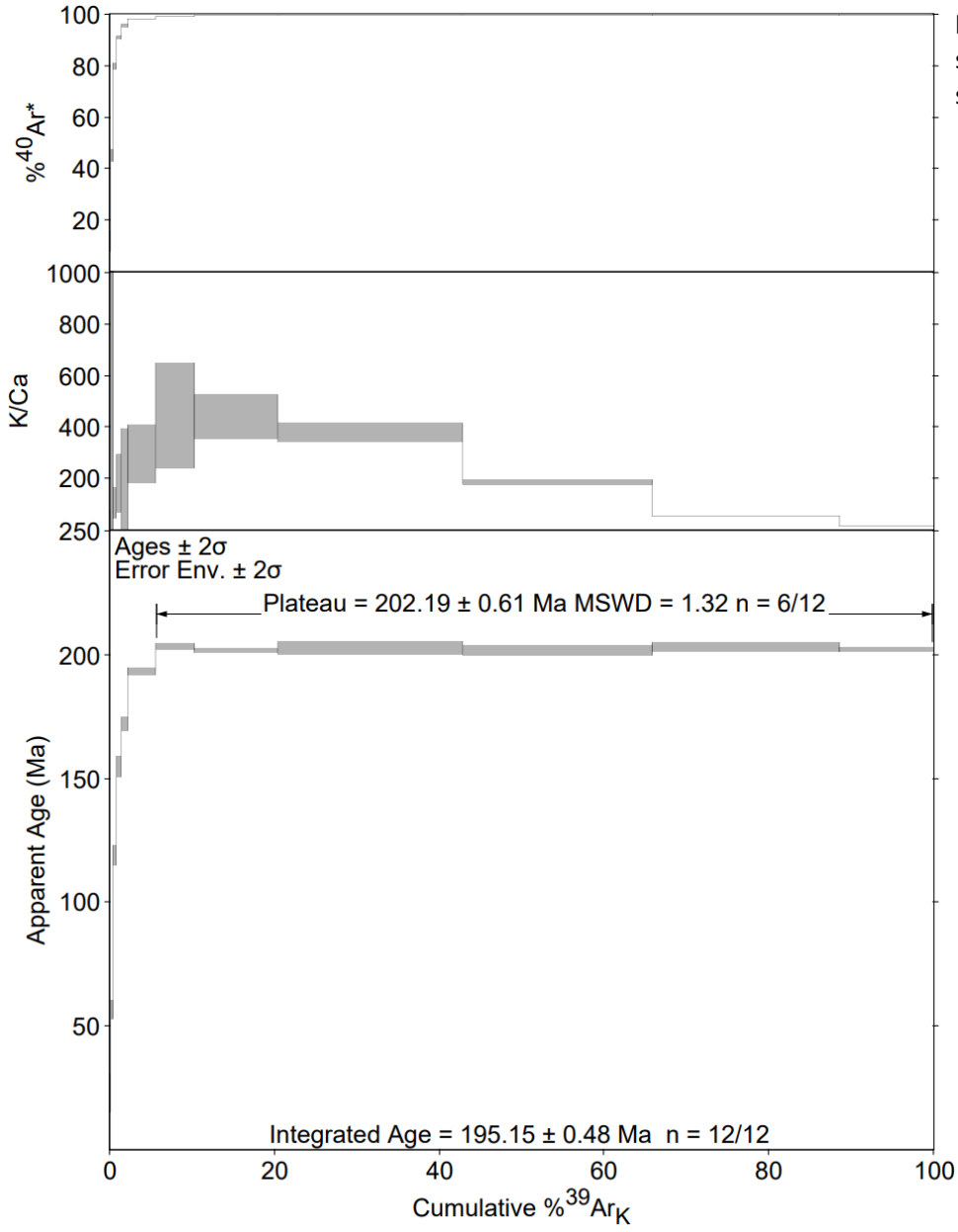


Figure A24. Age spectrum plot for sample 23TJN122





**Figure A26.** Age spectrum plot for sample 23TJN136

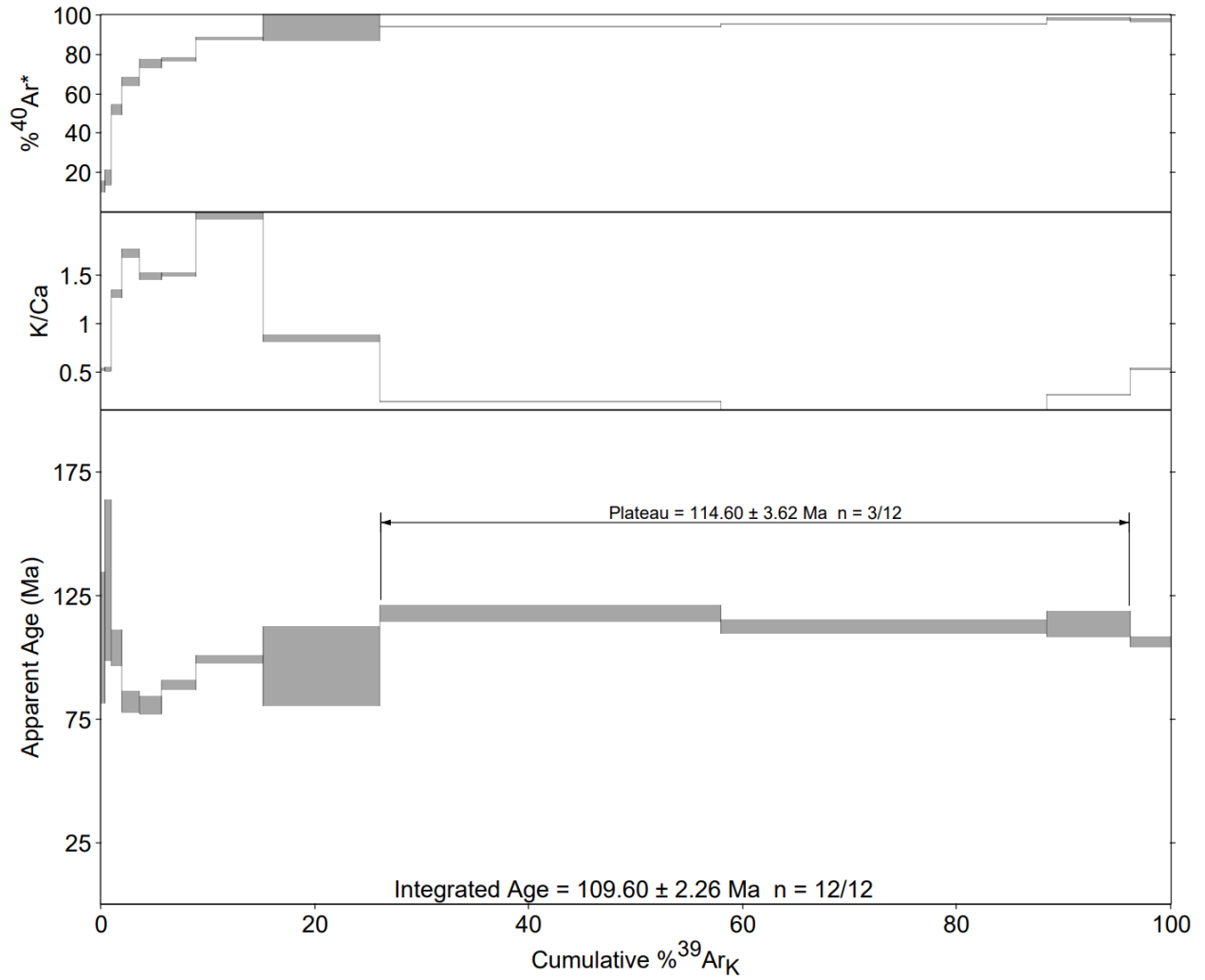
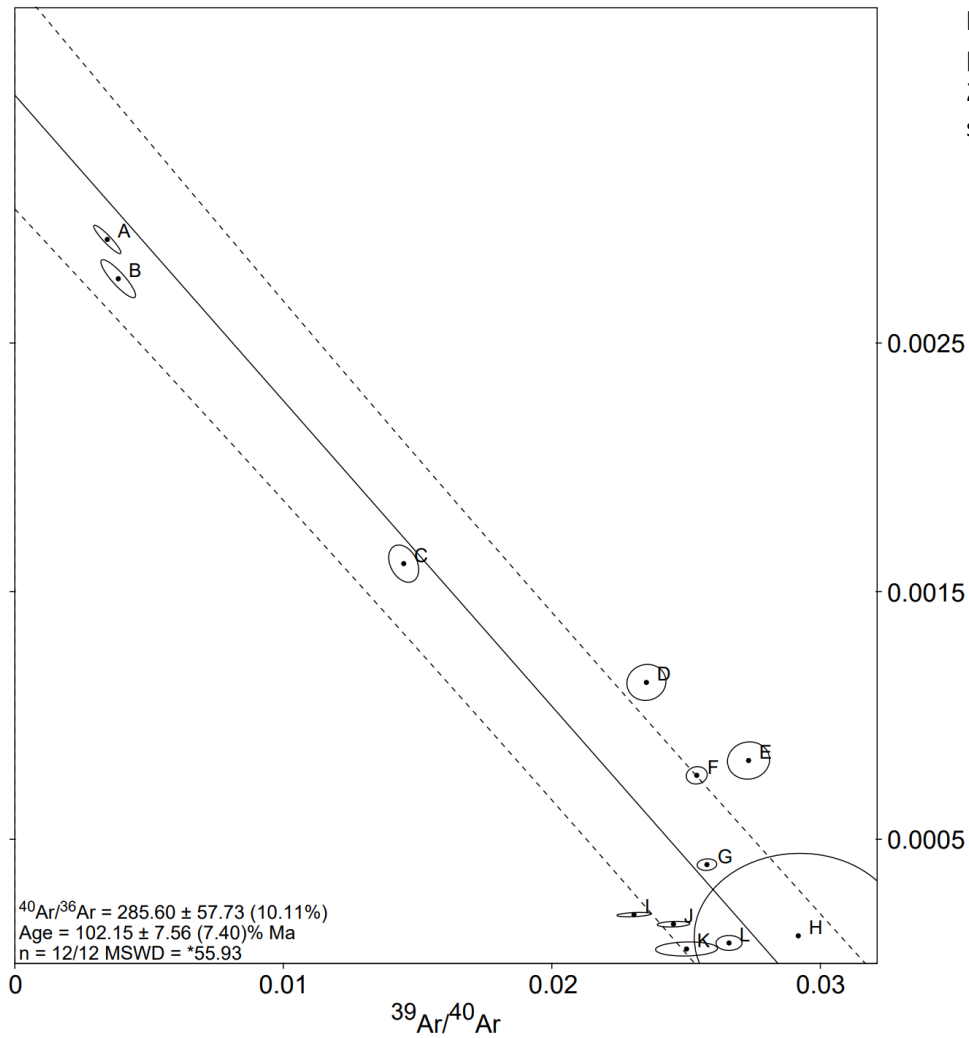


Figure A27. Age spectrum plot for hornblende sample 23TJN158



**Figure A28.** Isochron plot for sample 23TJN158 hornblende sample

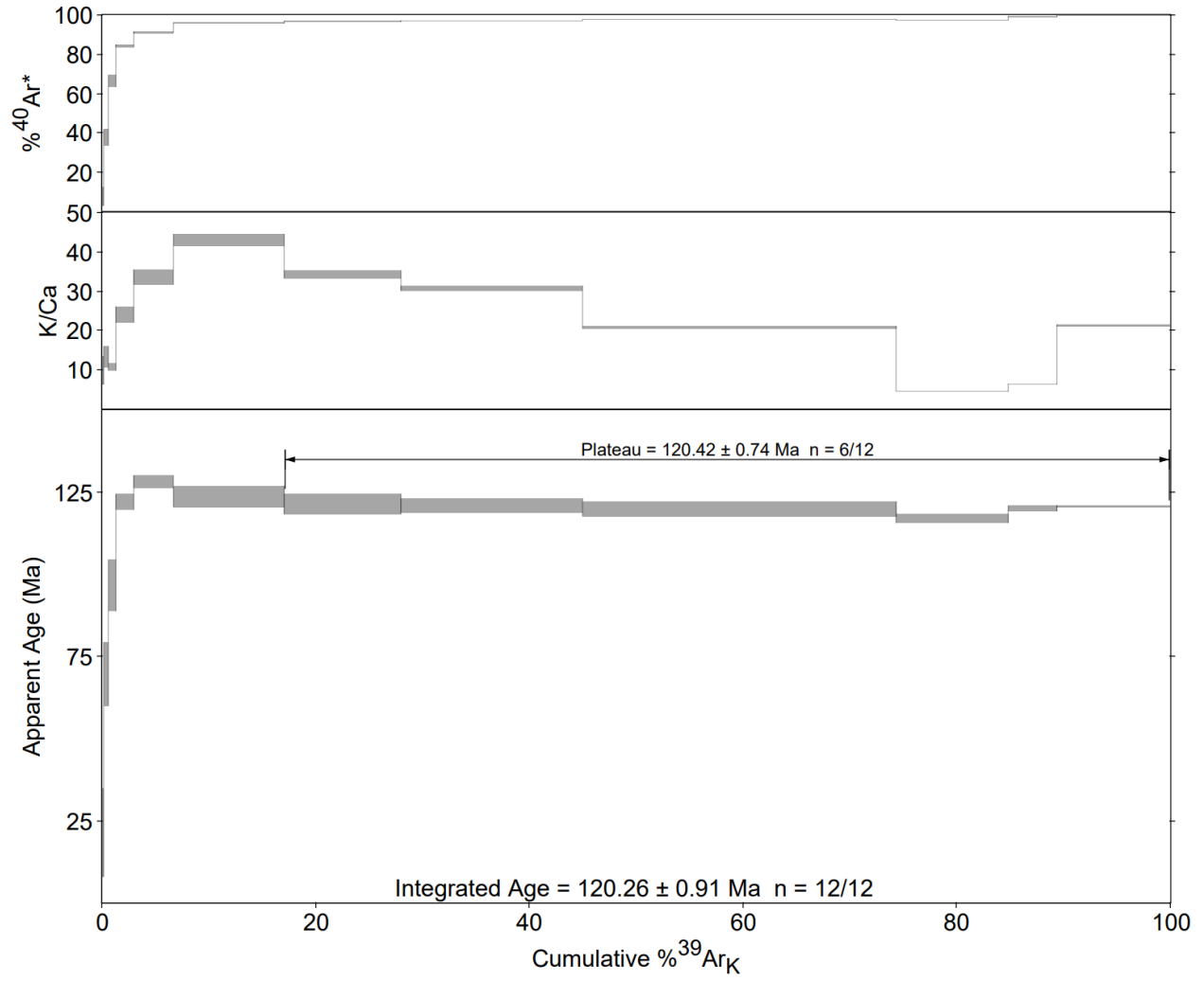
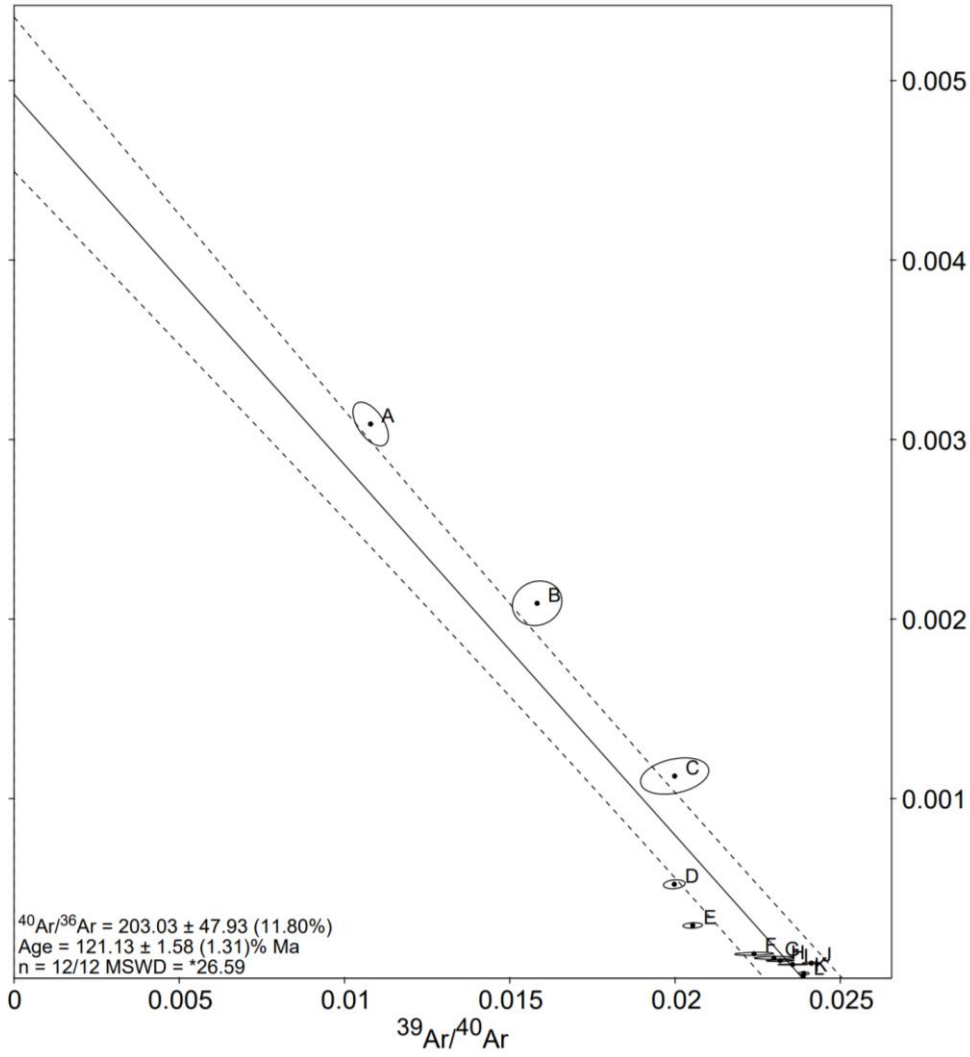


Figure A29. Age spectrum plot for sample 23TJN158



**Figure A30.** Isochron plot for 23TJN158 muscovite sample

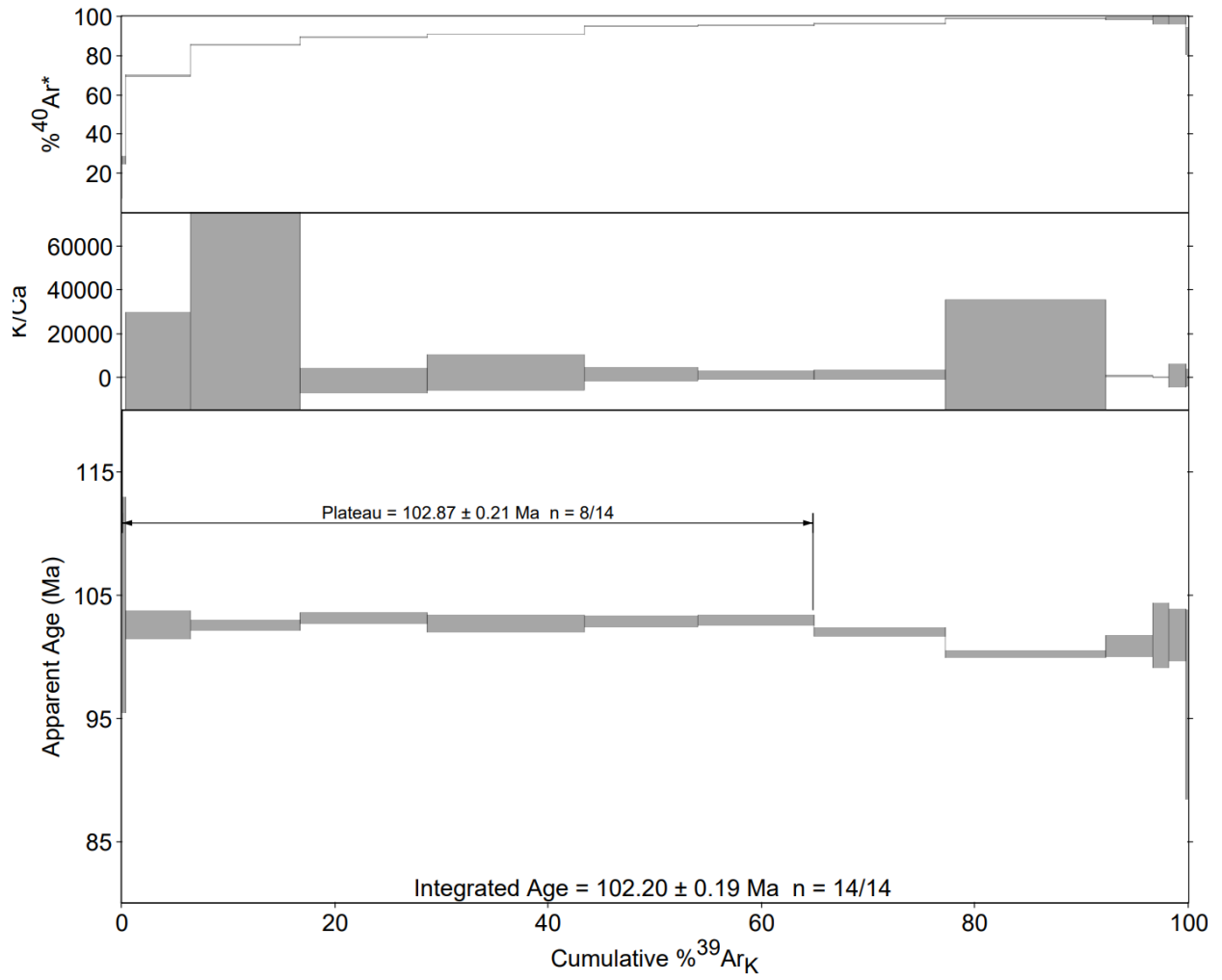
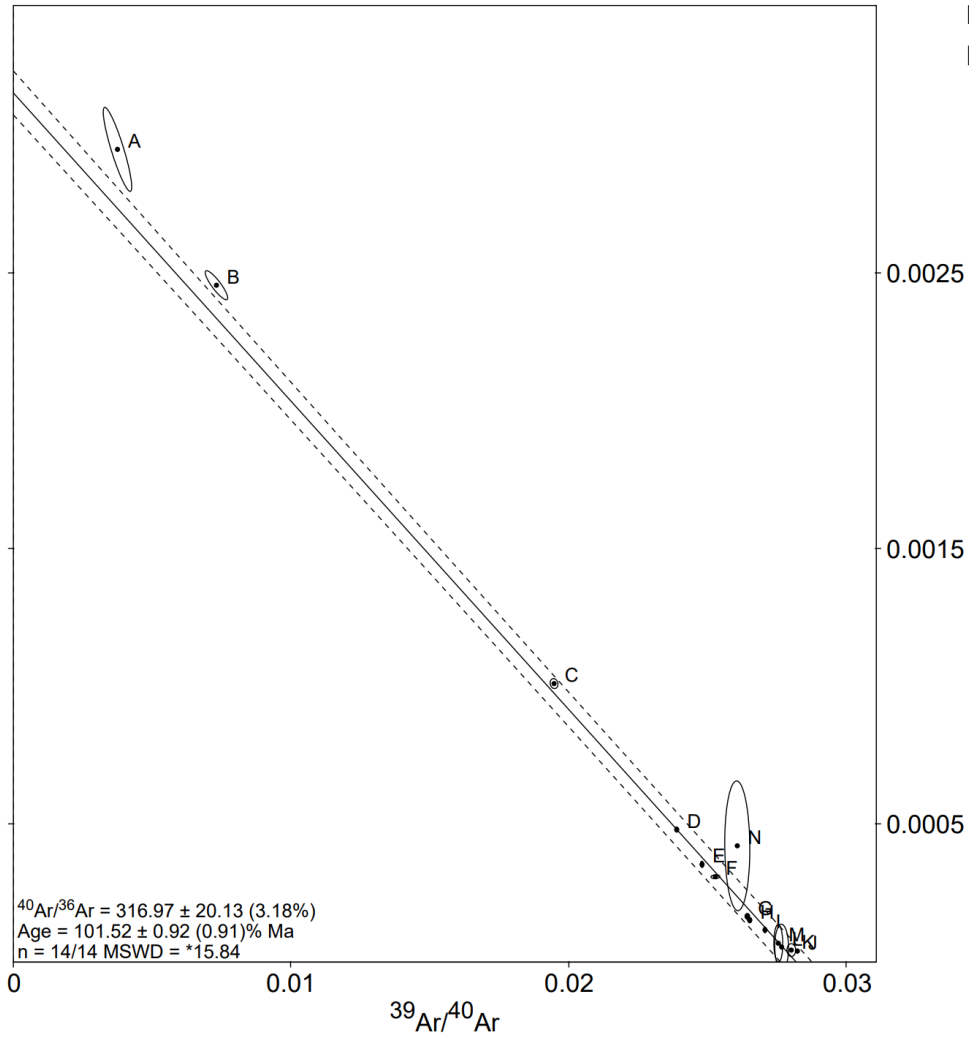


Figure A31. Age spectrum plot for sample 23Z045



**Figure A32.** Isochron plot for sample 23Z045

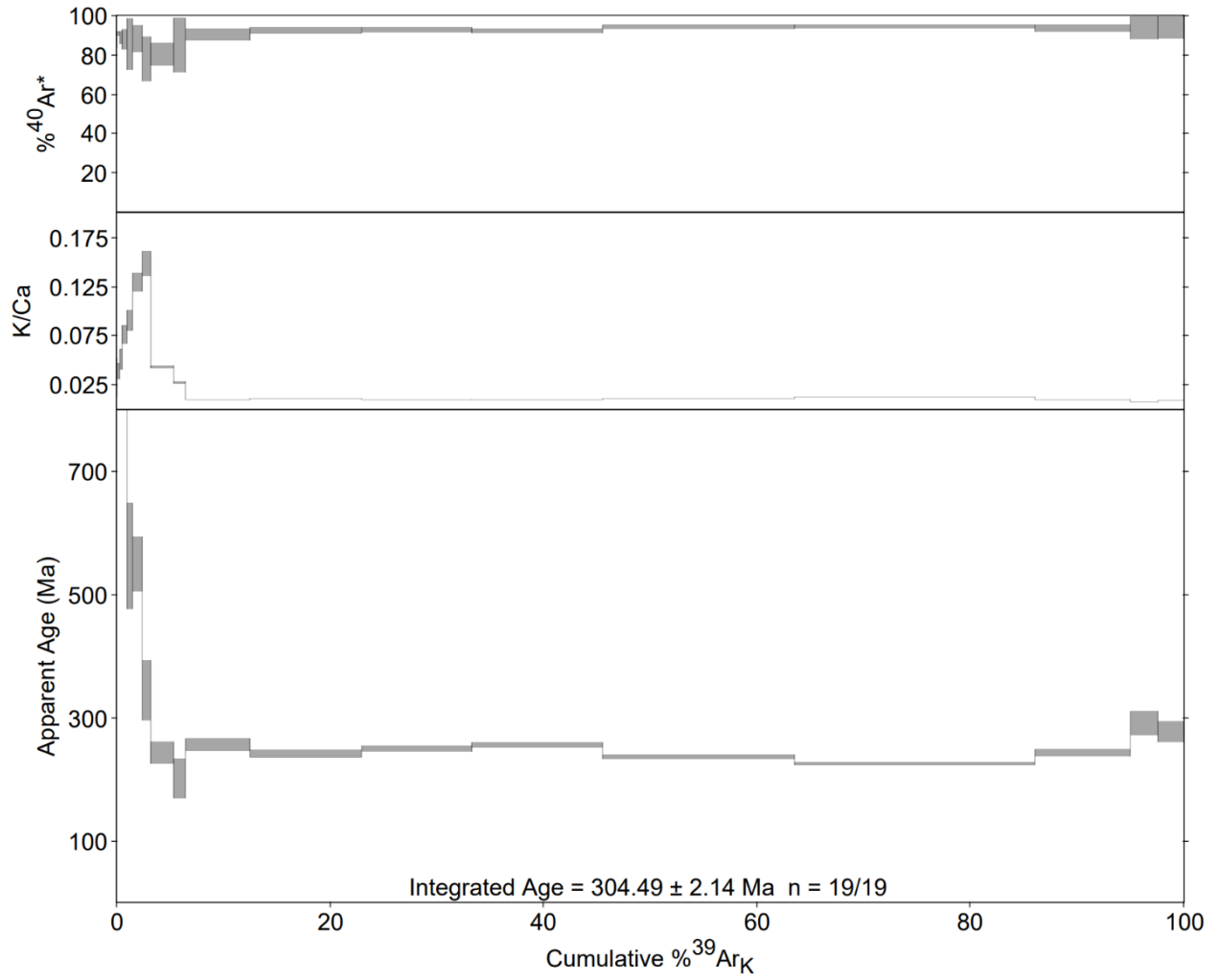
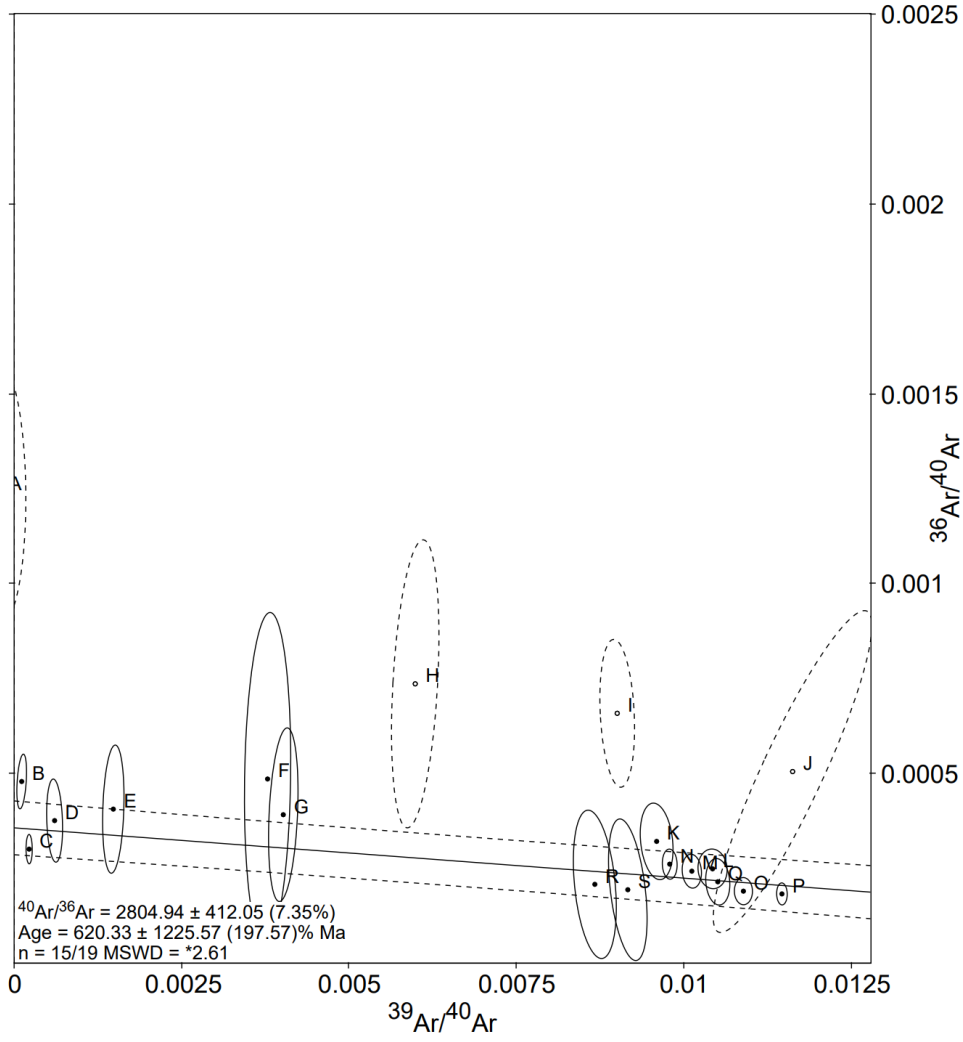
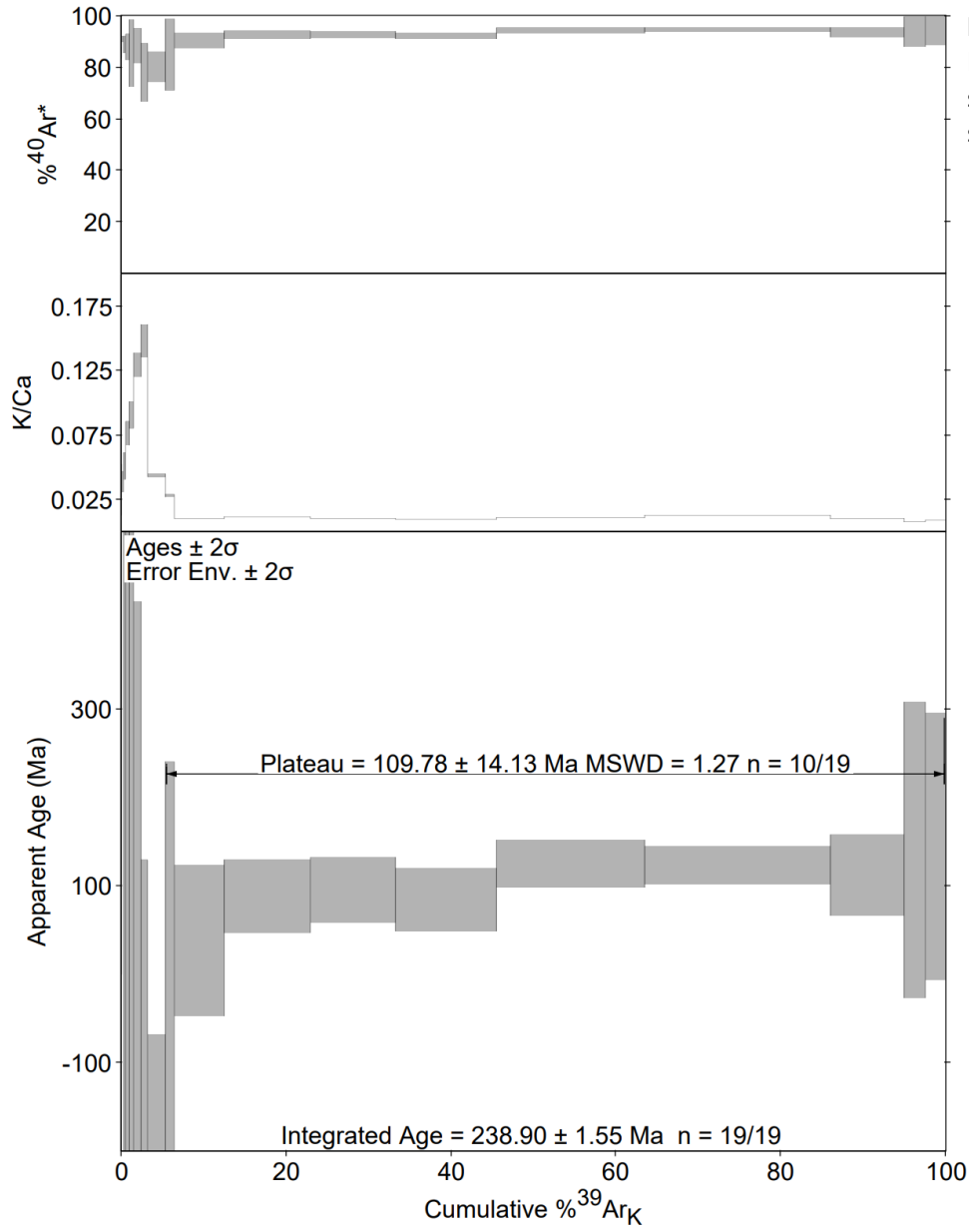


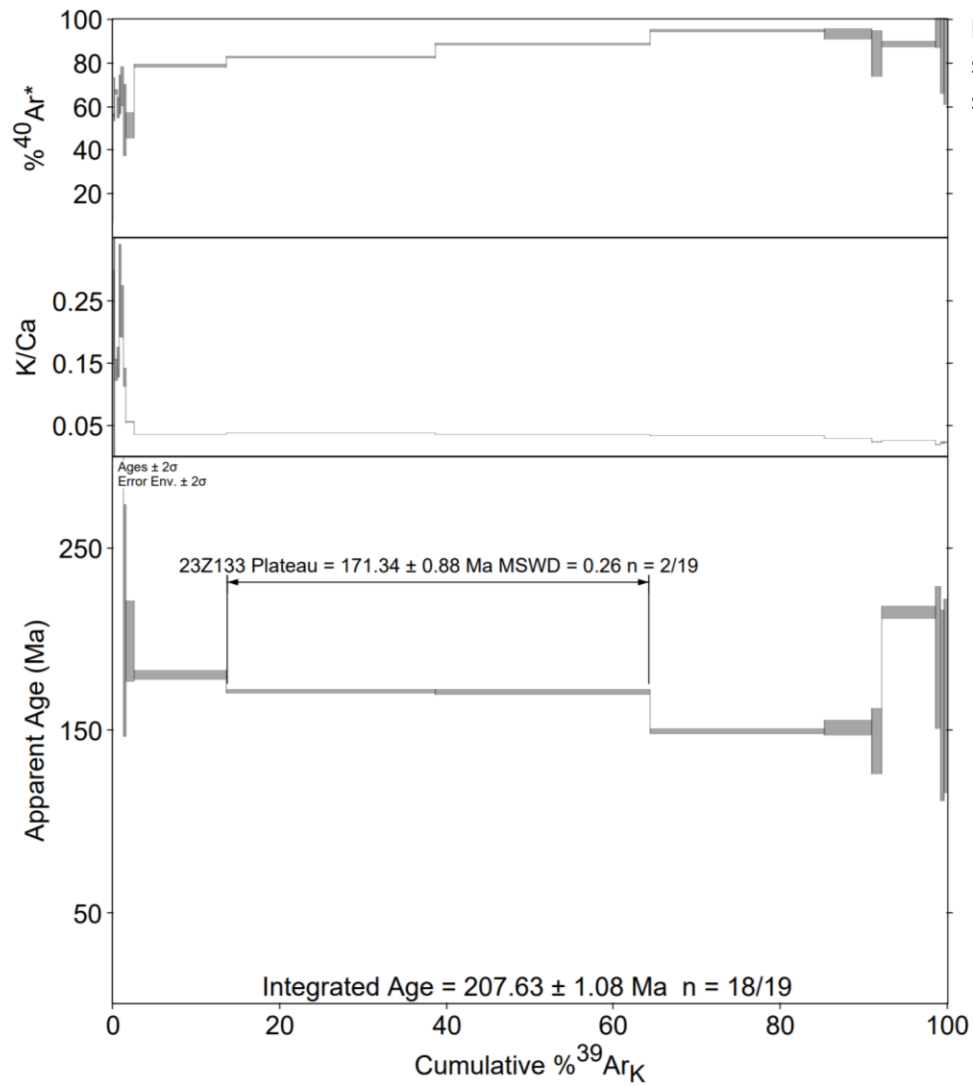
Figure A33. Age spectrum plot for sample 23Z114



**Figure A34.** Isochron plot for sample 23Z114

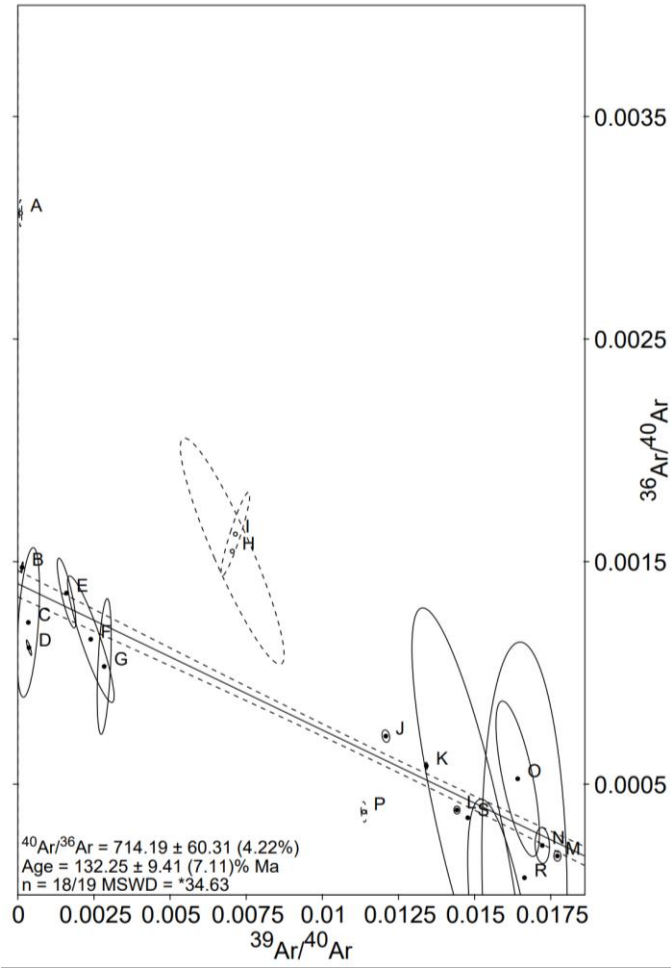


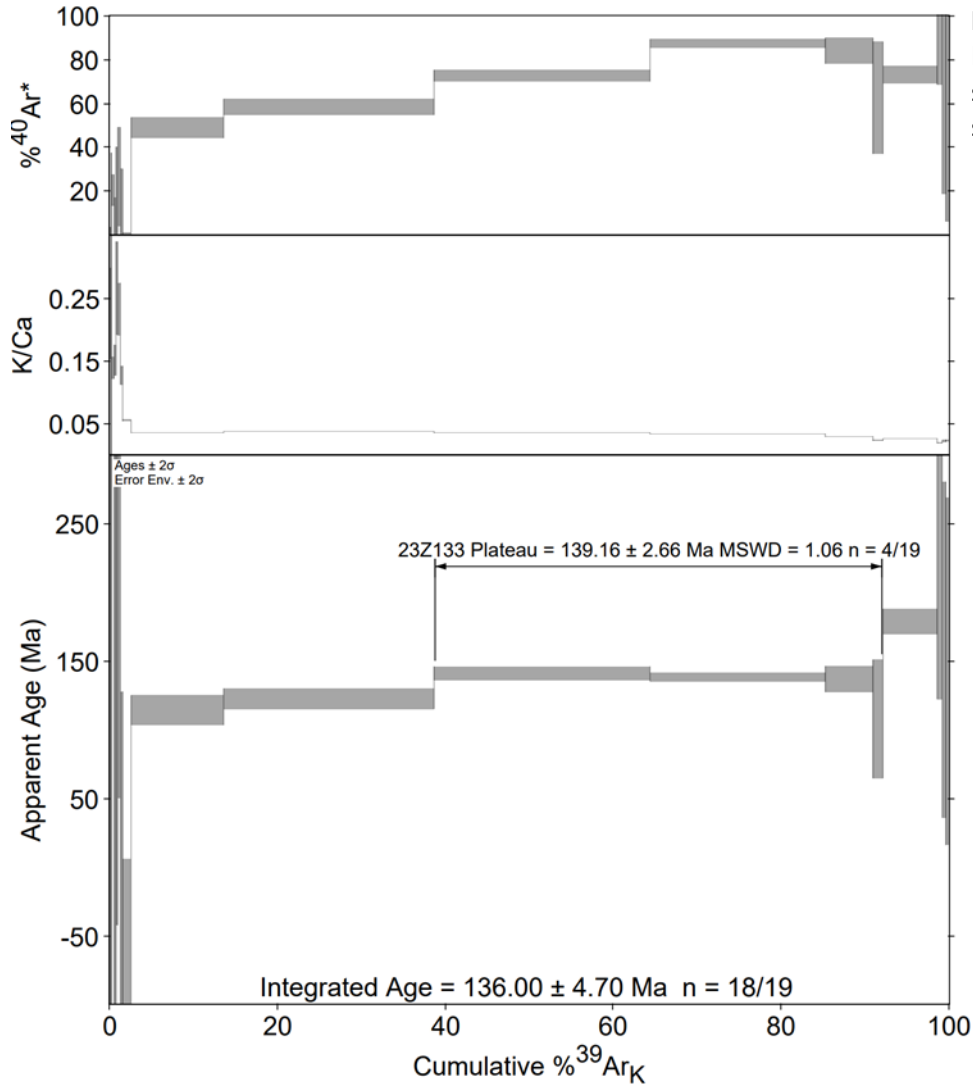
**Figure A35.**  
Recalculated age  
spectrum plot for  
sample 23Z114



**Figure A36.** Age spectrum plot for sample 23Z133

Figure A37. Isochron plot for sample 23Z133





**Figure A38.** Recalculated age spectrum plot for sample 23Z133

23Z133 Plateau = 139.16 ± 2.66 Ma MSWD = 1.06 n = 4/19

Integrated Age = 136.00 ± 4.70 Ma n = 18/19

Ages ± 2σ  
Error Env. ± 2σ

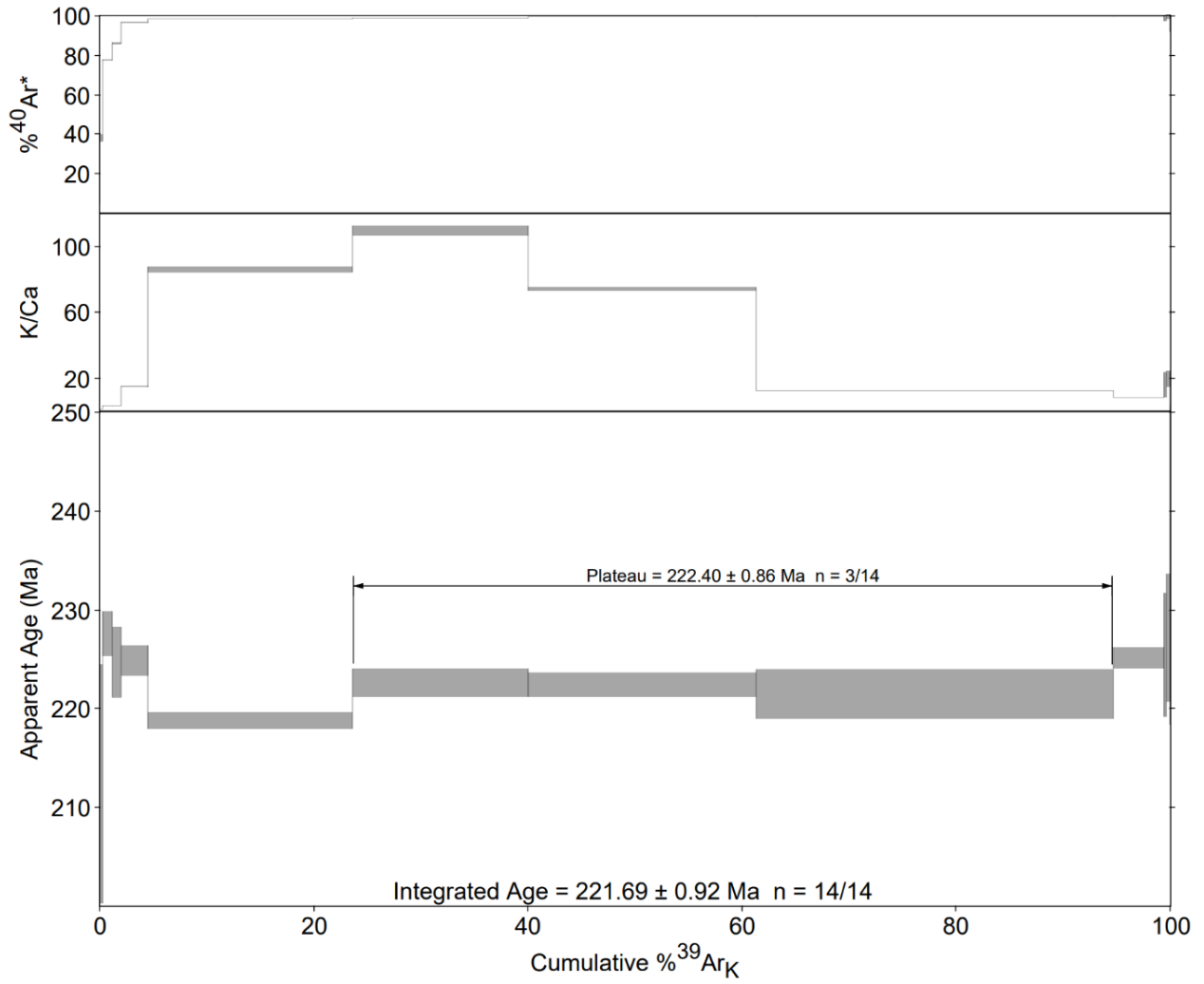
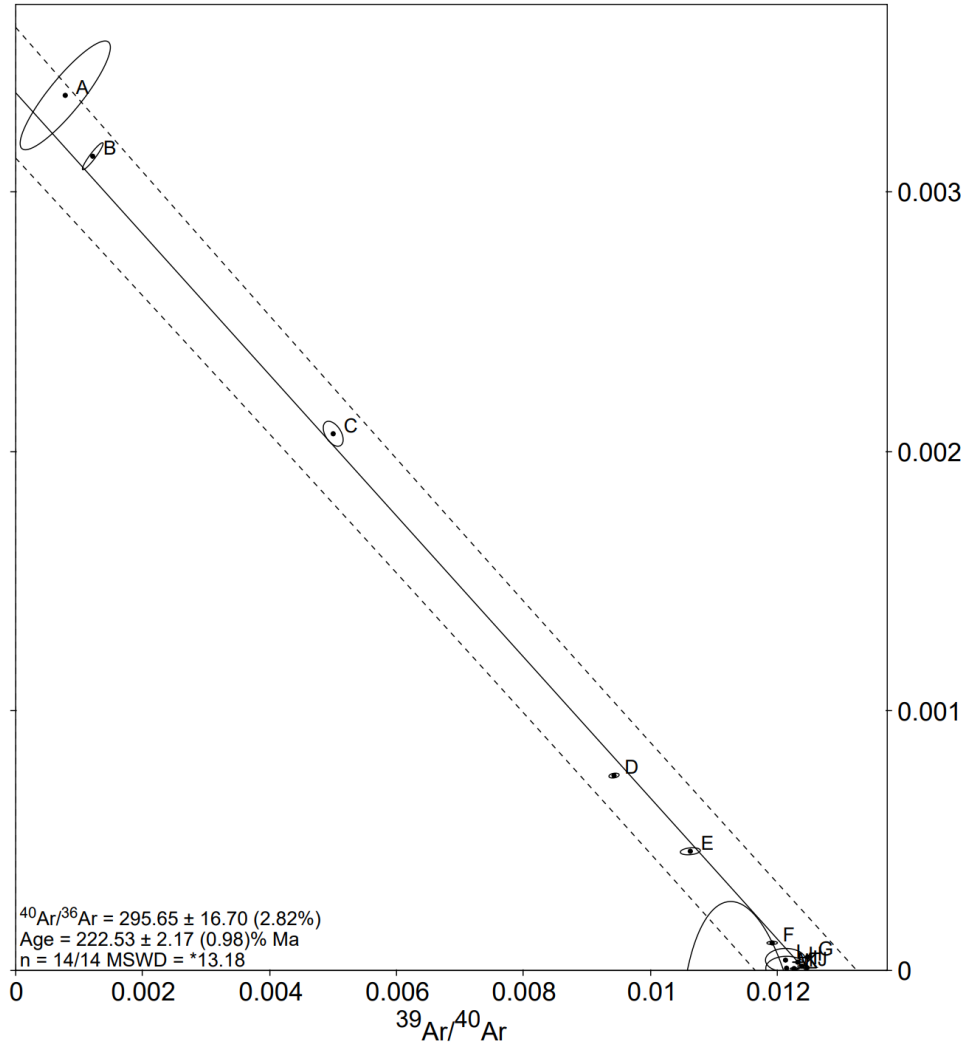
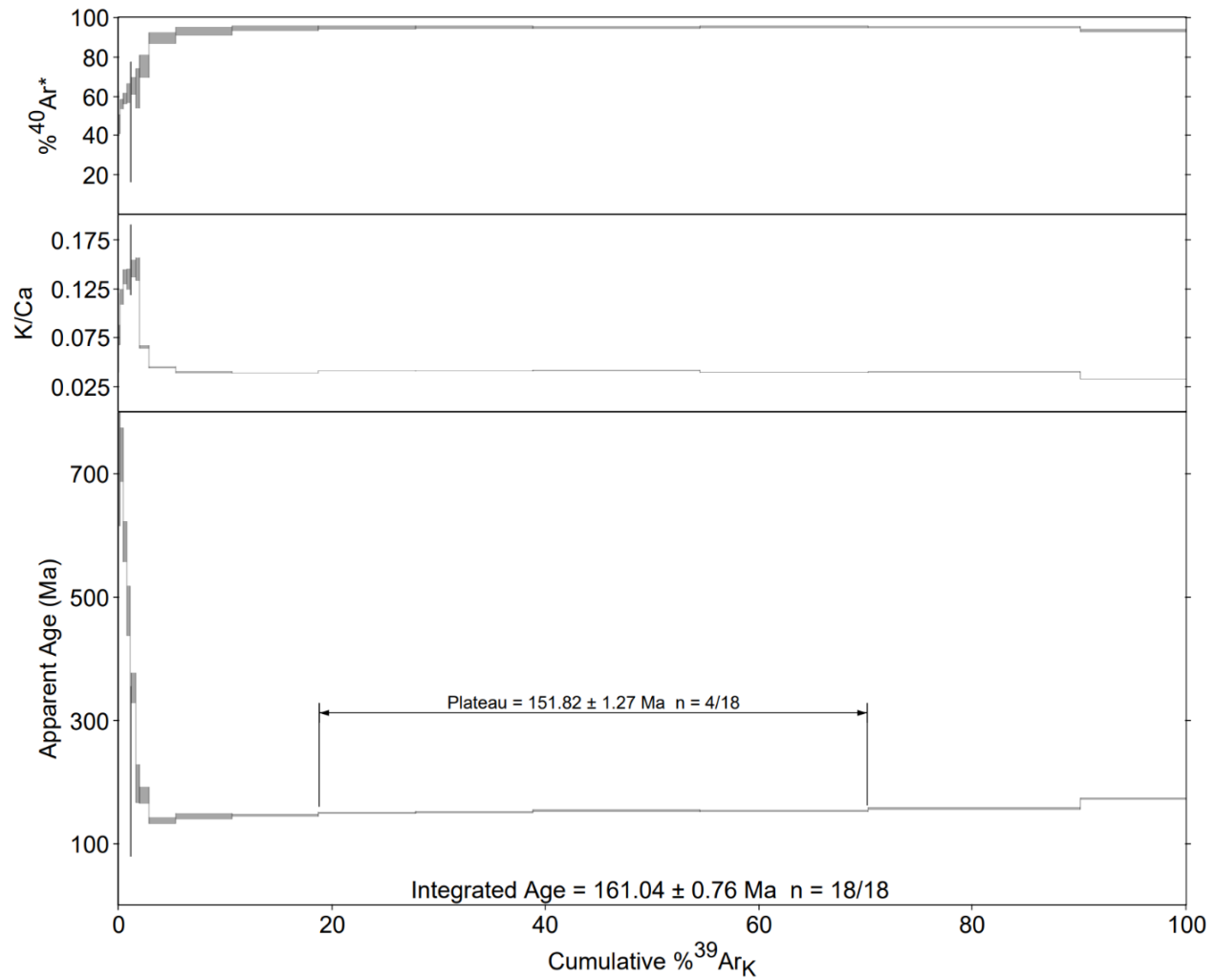


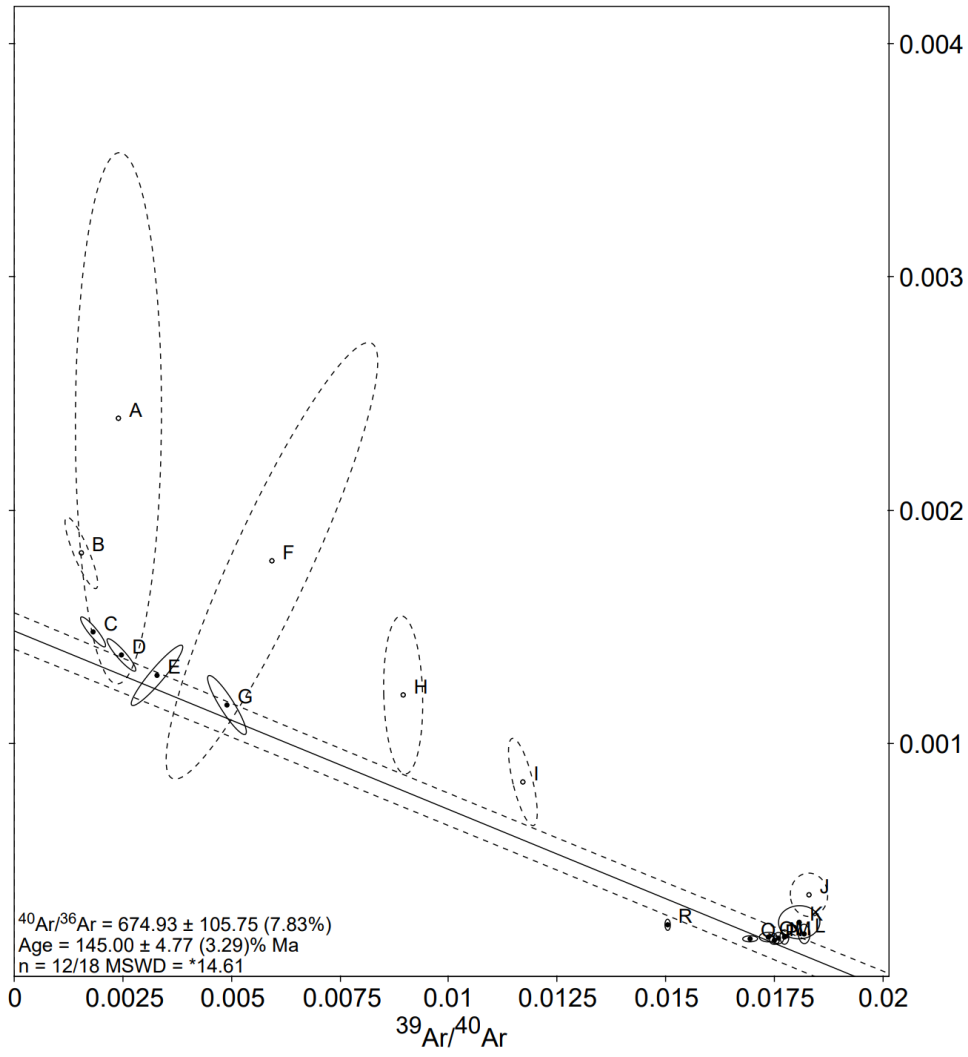
Figure A39. Age spectrum plot for sample 23Z278



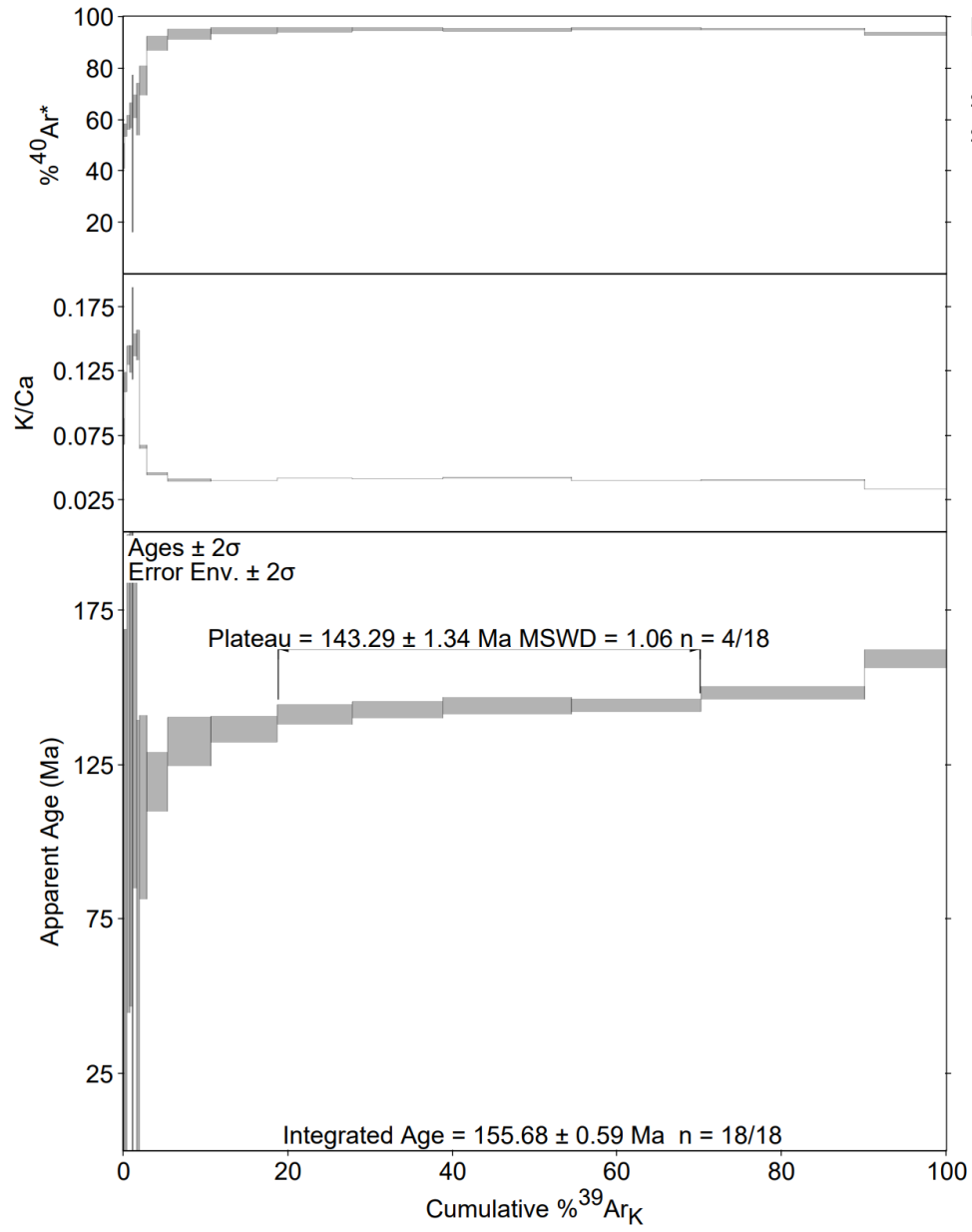
**Figure A40.** Isochron plot for sample 23Z278



**Figure A41.** Age spectrum plot for sample 23Z348



**Figure A42.** Isochron plot for sample 23Z348



**Figure A43.**  
Recalculated age  
spectrum plot for  
sample 23Z348

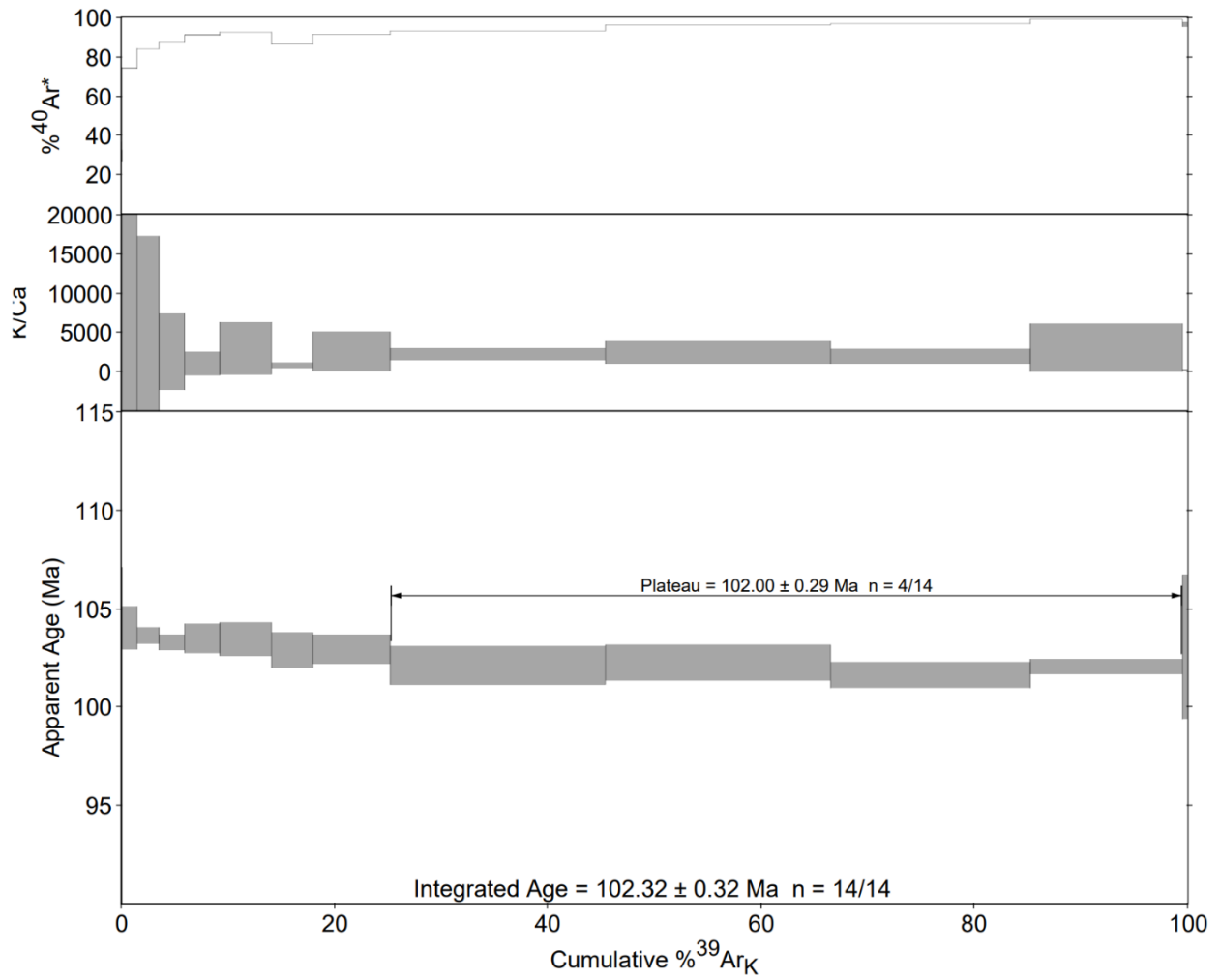


Figure A44. Age spectrum plot for sample 23Z409

