SUPPLEMENTAL FILE 2

FOR:

Rapid postorogenic cooling of the Paleoproterozoic Cape Smith foreland thrust belt and footwall Archean basement, Trans-Hudson orogen, Canada

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CONTENTS

$^{40}Ar/^{39}Ar$ step-heating methodology

Thirty-eight samples were processed for $^{40}Ar/^{39}Ar$ analysis of hornblende, biotite and muscovite using standard preparation techniques, including hand-picking of the most pristine, unaltered grains in the size range 0.25 to 0.50 mm. Mineral separates were packed in aluminum foil packets and loaded into vertical tubes, which were arranged radially within an aluminum can (see Kellett and Joyce (2014) for further details). For cases in which two mineral phases were targeted from an individual sample, those phases were loaded together in the same packet. Packets of flux monitor PP-20 hornblende (Hb3gr-equivalent) were interspersed among the sample packets in the irradiation can. The samples filled two cans, which were irradiated separately (batch numbers: GSC RAD#46 and GSC RAD#48) in the research reactor at McMaster University (Ontario, Canada) in the high flux position 5c for 240 MWh.

Laser $^{40}Ar/^{39}Ar$ step-heating analysis was conducted at the Geological Survey of Canada noble gas mass spectrometry laboratory (Ottawa, Ontario, Canada). Fifty-eight $^{40}Ar/^{39}Ar$ step-heating analyses were completed in total, on 17 hornblende samples (18 aliquots), 30 biotite samples (32 aliquots) and 8 muscovite samples. Of these, paired biotite–hornblende and biotite–muscovite analyses were conducted in 11 and 6 samples, respectively. Following irradiation, each grain (aliquot) was loaded individually into 1.5 mm-diameter holes in a copper planchet, which was placed in the sample chamber of a noble gas extraction line and the system was evacuated. A Merchantek MIR-10 10W CO_2 laser equipped with a 2 x 2 mm flat-field lens was used to incrementally heat each aliquot in steps of increasing temperature. After each heating step, the released Ar gas was cleaned in the extraction line over getters for ten minutes (to remove nitrogen, oxygen, hydrocarbons, water, hydrogen and other active gases), and then analysed via mass spectrometry.

A VG3600 gas source mass spectrometer equipped with a secondary electron multiplier system was used for isotopic analysis of sample gas following data collection protocols detailed in Villeneuve and MacIntyre (1997) and Villeneuve et al. (2000). Blank measurements were interspersed between aliquots and the running average blank was used to correct data. Ranges of blank values are provided in the footnotes of Supplementary File 1, together with nucleogenic interference correction factors. A decay constant $^{40}K\ \lambda_{total}$ of 5.543×10^{-10}/a and atmospheric Ar composition of $^{40}Ar/^{36}Ar = 295.5$ (Steiger and Jäger, 1977) were used to calculate ages. Error

analysis on individual gas-release steps followed the numerical error analysis routines of Scaillet (2000). Corrected argon isotopic data are provided in Supplementary File 1, and step heat gas-release spectra are presented herein. Each plotted gas-release spectrum contains step-heating data from up to two aliquots per sample. Nearly all data are highly radiogenic, plotting on or near the radiogenic $^{39}Ar/^{40}Ar$ axis (refer to inverse isochron ratios in Supplementary File 1).

Neutron flux gradients were determined by analyzing the PP-20 hornblende flux monitors included in each sample packet and interpolating a linear fit against the calculated J-factor and sample position. As J-factors were calculated using a PP-20 hornblende age of 1072 ± 11 Ma (Roddick, 1983) during the original data reduction in 2004, apparent ages have been corrected to the most recently determined PP-20 hornblende age (1073.6 ± 5.3 Ma; Jourdan et al., 2006) using the software ArAR v1.00 (Mercer and Hodges, 2016). The error on individual J-factors is estimated at ±0.6% (2σ). As the J-factor error is systematic and unrelated to individual analyses, correction for this uncertainty was not applied until calculation of ages from isotopic correlation diagrams (Roddick, 1988).

In step heat gas-release spectra presented here, a plateau is defined as ≥3 consecutive heating steps that comprise ≥50% of the total ^{39}Ar gas released and for which the probability-of-fit of the weighted-mean age of the steps is greater than 5% (following the statistical plateau selection criteria of Isoplot v.4.15; Ludwig, 2003). Plateau ages were calculated as weighted-mean ages using the methodology of Isoplot v.4.15 (Ludwig, 2003). MSWD is defined as the mean square of weighted deviates. For some analyses in which no plateau was obtained, a "pseudoplateau" age was calculated from ≥3 consecutive heating steps that meet the following criteria: (i) they comprise at least 35% of total ^{39}Ar released, with MSWD less than 1.50; or (ii) they are the final heating steps after a "descending staircase" pattern (discussed below) and comprise at least 15% of total ^{39}Ar released, with MSWD less than 1.50; or (iii) they comprise at least 45% of total ^{39}Ar released and yield an age that is supported by a second aliquot (i.e., biotite sample TA-63-156). For samples that yielded irregular gas release spectra that did not meet the criteria for pseudoplateau ages, no ages are reported. Integrated (total gas) ages were calculated by weighting all the individual step ages and respective errors by the fraction of ^{39}Ar released.

Age interpretations are nuanced in several cases where $^{40}Ar/^{39}Ar$ step-heating spectra show patterns diagnostic of partial Ar loss and/or excess Ar. Partial Ar loss refers to the removal of a component of daughter $^{40}Ar^{*}$ from the mineral, and is represented in many of the Ar release spectra

as an “ascending” pattern in the initial, low-temperature steps (McDougall and Harrison, 1999). “Descending” patterns in the initial, low-temperature steps (or throughout the entire age spectrum), saddle-shaped spectra, and/or dates that are incompatible with other known age constraints (e.g., unrealistically old), are considered to be diagnostic of excess ^{40}Ar, which refers to ^{40}Ar derived from outside the analyzed mineral and incorporated during crystallization or diffusion (Kelley, 2002). Interaction of these two phenomena produced instances of hump-shaped apparent age spectra. In some samples, pseudoplateau ages were calculated from the last few steps after a descending gas-release pattern, on the basis that excess ^{40}Ar was preferentially released in the early steps. Additionally, due to the higher solubility of Ar in biotite, excess Ar is preferentially taken in by biotite rather than muscovite or hornblende (e.g., Roddick et al., 1980; Kelley, 2002). Therefore, biotite dates that are older than those of muscovite or hornblende from the same sample are likely affected by excess Ar contamination. Even biotite with flat spectra can be contaminated by excess Ar (Pankhurst et al., 1973; Foland, 1983). Too-old apparent ages can also result from incomplete resetting during metamorphism (e.g., at temperatures $<T_c$), whereby ^{40}Ar is inherited from ^{40}K decay prior to the metamorphic thermal peak (Kelley, 2002; Warren et al., 2012; Smye et al., 2013; Skipton et al., 2018).

$^{40}Ar/^{39}Ar$ sample descriptions and gas-release spectra

CSB: Povungnituk Group

Sample Number: 85-SAB-B86
Lithology: Metabasite
Mineral analyzed: Hornblende
Age: 1700 ± 16 Ma
Interpretation: Cooling age

Location:
Lat: 61.652558
Long: -72.588608

Results: Step heating of hornblende yielded a relatively homogeneous gas release spectrum with a plateau age of 1700 ± 16 Ma, which is interpreted as the cooling age of hornblende.

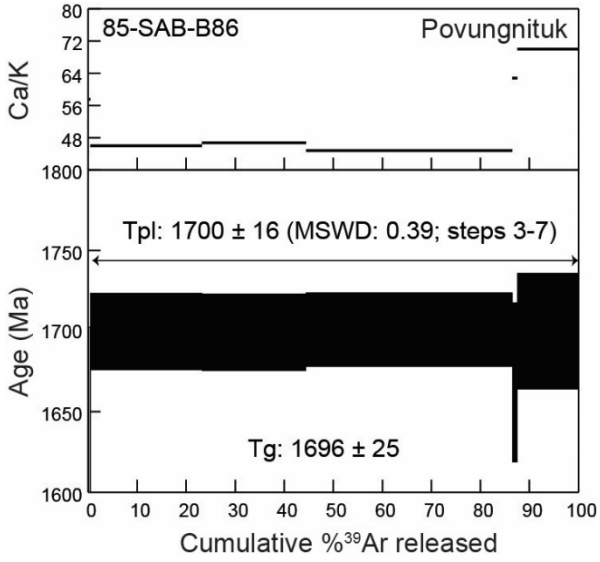

Figure S1: $^{40}Ar/^{39}Ar$ step-heating hornblende spectrum. "Tpl" and "Tg" refer to plateau age and total gas (integrated) age, respectively, in all figures in this document.

CSB: Povungnituk Group

Sample Number: 85-SAB-B123
Lithology: Metabasite
Mineral analyzed: Biotite
Age: 1723 ± 10 Ma
Interpretation: Cooling age

Location:
Lat: 61.502619
Long: -72.621864

Results: The biotite step heating spectrum exhibits Ar loss in the first ~15% of ^{39}Ar released, followed by relatively homogeneous middle steps that yield a plateau age of 1723 ± 10 Ma. This age is interpreted as the cooling age of biotite.

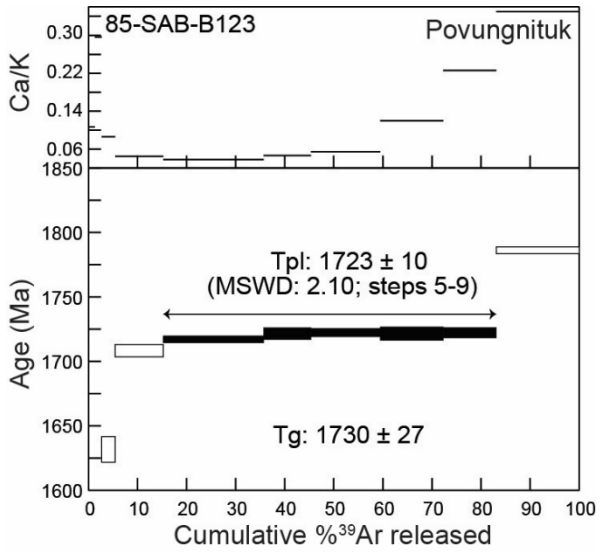

Figure S2: ^{40}Ar/^{39}Ar step-heating biotite spectrum.

CSB: Povungnituk Group

Sample Number: 85-SAB-B123
Lithology: Metabasite
Mineral analyzed: Hornblende
Age: 1748 ± 16 Ma
Interpretation: Maximum cooling age

Location:
Lat: 61.502619
Long: -72.621864

Results: The gas release spectrum of hornblende exhibits an overall downward-stepping pattern. suggesting an excess Ar component. The final gas release step has an elevated Ca/K ratio, suggesting de-gassing of a chemically different phase. The middle steps yielded a plateau age of 1748 ± 16 Ma. Given the probability of an excess Ar component, we interpret this as the maximum cooling age for hornblende.

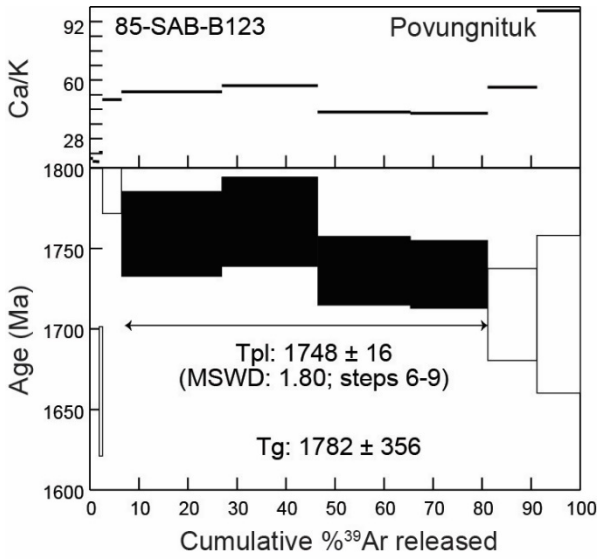

Figure S3: $^{40}Ar/^{39}Ar$ step-heating hornblende spectrum.

CSB: Povungnituk Group

Sample Number: 85-SAB-B149
Lithology: Metabasite
Mineral analyzed: Biotite
Age: 1859 ± 11 Ma
Interpretation: Maximum cooling age

Location:
Lat: 61.377358
Long: -72.451833

Results: Step heating of biotite yielded a gas release spectrum with Ar loss in the initial steps, followed by a plateau age of 1859 ± 11 Ma. The low MSWD and high %^{39}Ar (71%) of the plateau age indicate that it can be interpreted with high confidence, although ca. 1859 Ma is an anomalously old biotite date for the CSB. Considering the metamorphic grade at the sample location (≥400°C), the old date is most likely due to excess ^{40}Ar contamination rather than to incomplete resetting of ^{40}Ar/^{39}Ar systematics. It is interpreted to represent a maximum cooling age of biotite.

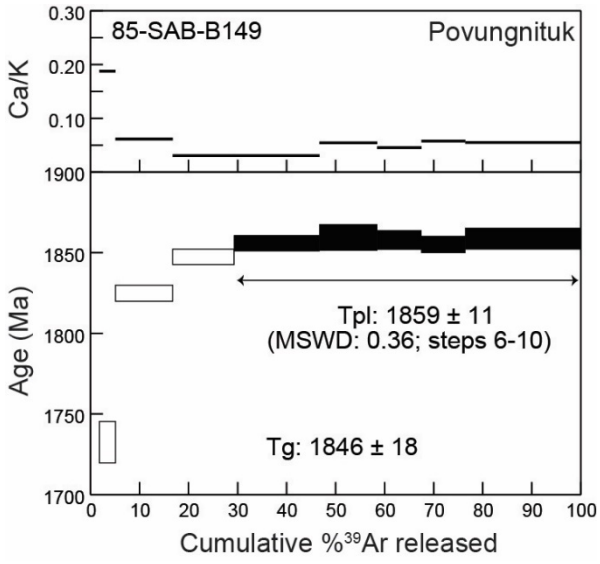

Figure S4: ^{40}Ar/^{39}Ar step-heating biotite spectrum.

CSB: Povungnituk Group

Sample Number: 85-SAB-B149
Lithology: Metabasite
Mineral analyzed: Hornblende
Age: NO AGE.
Interpretation: N/A

Location:
Lat: 61.377358
Long: -72.451833

Results: Step heating of hornblende yielded a highly heterogeneous gas release spectrum with an overall downward age trend in gas release steps, possibly indicating an excess ^{40}Ar component. Note also the heterogeneous Ca/K ratios. No age interpretation is made for this sample.

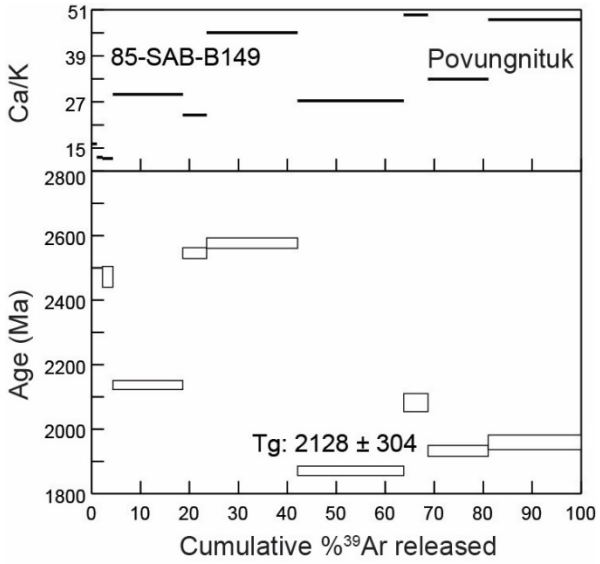

Figure S5: $^{40}Ar/^{39}Ar$ step-heating hornblende spectrum.

CSB: Povungnituk Group

Sample Number: 85-SAB-L81
Lithology: Mafic meta-volcanic tuff
Mineral analyzed: Biotite
Age: 1948 ± 12 Ma
Interpretation: N/A

Location:
Lat: 61.558689
Long: -72.497822

Results: Step heating of biotite yielded a plateau age of 1948 ± 12 Ma, with a low MSWD and high total %^{39}Ar (85%). However, the late, high-temperature steps included in the plateau have high uncertainties and correspond to elevated Ca/K ratios, suggesting de-gassing of a non-biotite component. Furthermore, the apparent age of ca. 1948 Ma is significantly older than that of muscovite in the same sample (ca. 1697 Ma, presented below) and than other biotite dates in the CSB. As such, it is considered to reflect significant excess ^{40}Ar contamination, and has little geological significance.

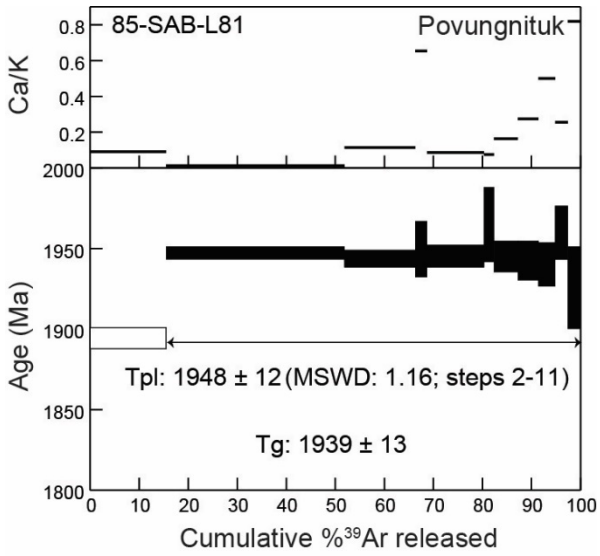

Figure S6: ^{40}Ar/^{39}Ar step-heating biotite spectrum.

CSB: Povungnituk Group

Sample Number: 85-SAB-L81
Lithology: Mafic meta-volcanic tuff
Mineral analyzed: Muscovite
Age: 1697 ± 10 Ma
Interpretation: Cooling age

Location:
Lat: 61.558689
Long: -72.497822

Results: : The gas release spectrum produced from step heating of muscovite exhibits Ar loss in the initial steps, followed by homogeneous steps that define a plateau age of 1697 ± 10 Ma. Comprising 80% of total ^{39}Ar released, this plateau age is interpreted as the cooling age of muscovite.

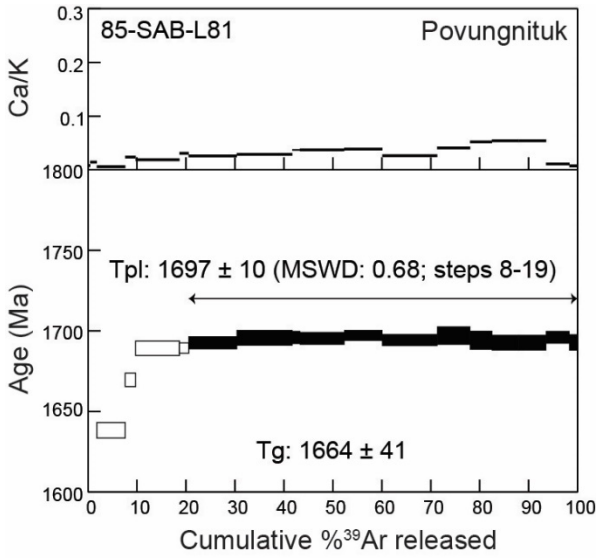

Figure S7: $^{40}Ar/^{39}Ar$ step-heating muscovite spectrum.

CSB: Povungnituk Group

Sample Number: 85-SAB-S41
Lithology: Mafic metasedimentary rock
Mineral analyzed: Biotite
Age: 1734 ± 11 Ma
Interpretation: Cooling age

Location:
Lat: 61.597789
Long: -72.173803

Results: The gas release spectrum from step heating of biotite yielded steps with progressively older ages from ca. 1670 and 1730 Ma, preceded by steps with younger apparent ages that indicate Ar loss. Although no plateau age was attained, the flattest portion of the spectrum defined by the last three steps yielded a pseudoplateau age of 1734 ± 11 Ma, comprising 39% of total ^{39}Ar gas released. This is interpreted as the approximate cooling age of biotite.

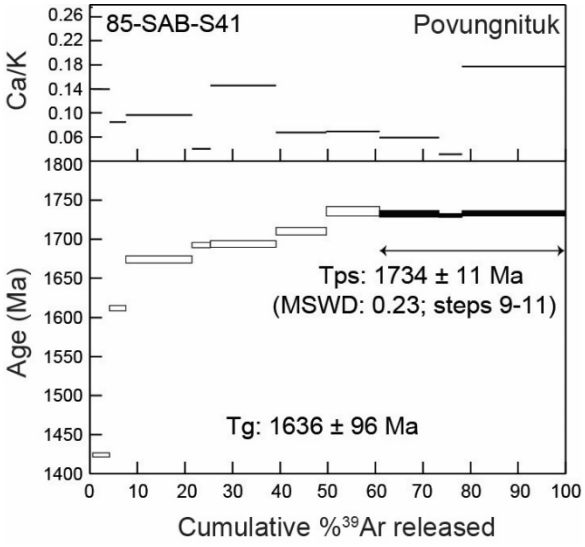

Figure S8: ^{40}Ar/^{39}Ar step-heating biotite spectrum. "Tps" refers to pseudoplateau age in all figures in this report.

CSB: Povungnituk Group

Sample Number: 85-SAB-S41
Lithology: Mafic metasedimentary rock
Mineral analyzed: Hornblende
Age: NO AGE
Interpretation: N/A

Location:
Lat: 61.597789
Long: -72.173803

Results: The gas release steps from step heating of hornblende have highly heterogeneous apparent ages, all younger than ca. 1300 Ma, and variable Ca/K ratios. Therefore, no geological interpretation is made for this sample.

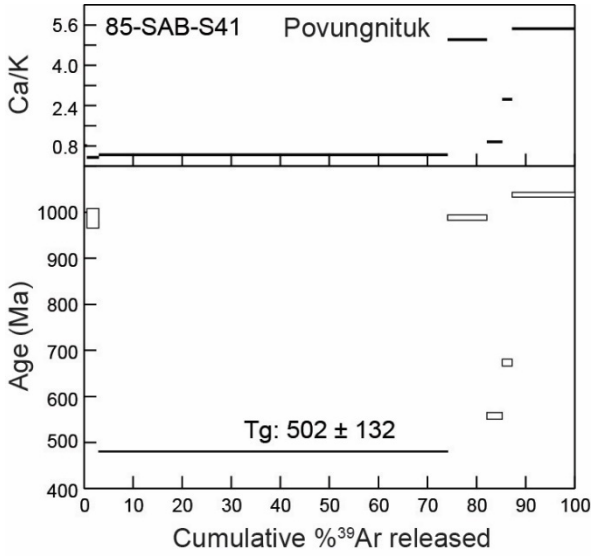

Figure S9: $^{40}Ar/^{39}Ar$ step-heating hornblende spectrum.

CSB: Povungnituk Group

Sample Number: 85-SAB-S50b
Lithology: Mafic metasedimentary rock
Mineral analyzed: Biotite
Age: 1724 ± 10 Ma
Interpretation: Cooling age

Location:
Lat: 61.571478
Long: -72.2784

Results: The gas release spectrum produced from step heating of biotite has an upward-stepping staircase pattern exhibited by early heating steps, suggesting Ar loss. Subsequent steps are relatively homogeneous, producing a plateau age of 1724 ± 10 Ma, which is interpreted as the cooling age of biotite.

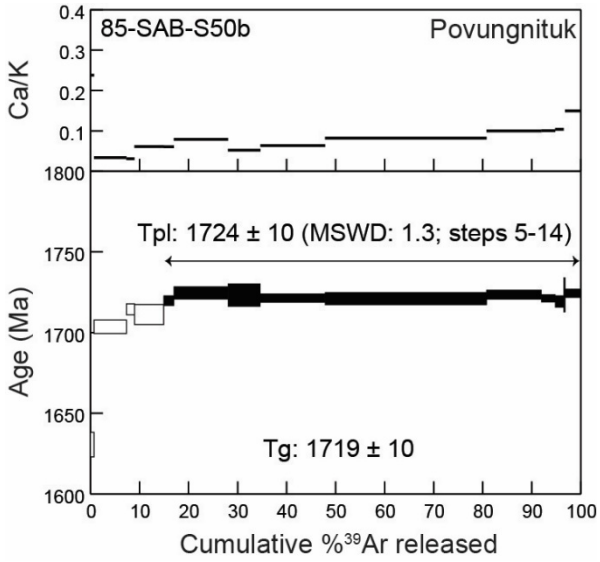

Figure S10: $^{40}Ar/^{39}Ar$ step-heating biotite spectrum.

CSB: Povungnituk Group

Sample Number: 85-SAB-S50b
Lithology: Mafic metasedimentary rock
Mineral analyzed: Hornblende
Age: 1722 ± 11 Ma
Interpretation: Cooling age

Location:
Lat: 61.571478
Long: -72.2784

Results: Step heating of hornblende yielded a gas release spectrum with a "climbing staircase" pattern exhibited by early gas release steps, suggesting Ar loss. Subsequent steps produced a plateau age of 1722 ± 11 Ma, which is interpreted as the cooling age of hornblende.

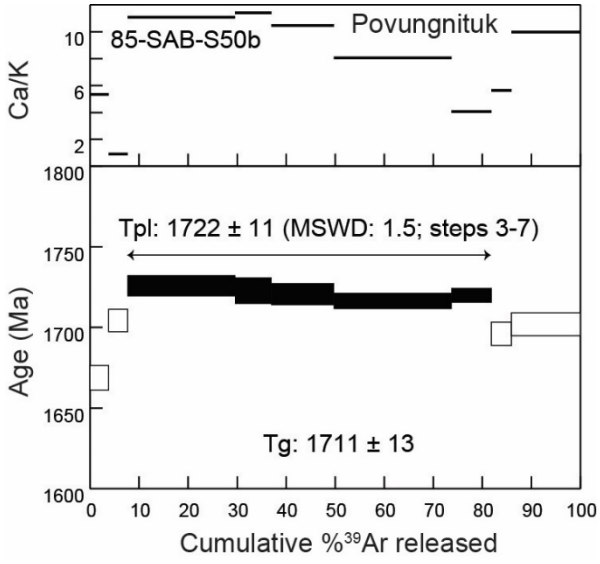

Figure S11: $^{40}Ar/^{39}Ar$ step-heating hornblende spectrum.

CSB: Povungnituk Group

Sample Number: 85-SAB-S52
Lithology: Pelite
Mineral analyzed: Biotite
Age: 1733 ± 10 Ma
Interpretation: Cooling age

Location:
Lat: 61.575661
Long -72.278481

Results: Step heating of biotite produced a gas release spectrum with a "climbing staircase" pattern in the early steps, followed by relatively homogeneous steps that yielded a plateau age of 1733 ± 10 Ma. This age is interpreted as the cooling age of biotite.

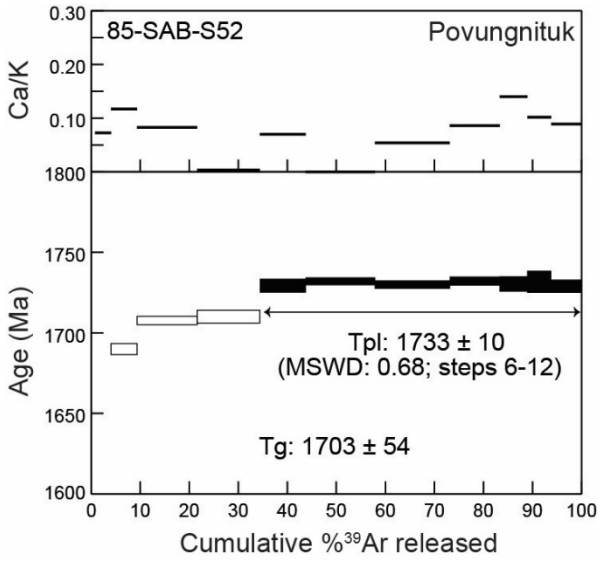

Figure S12: $^{40}Ar/^{39}Ar$ step-heating biotite spectrum.

CSB: Povungnituk Group

Sample Number: 85-SAB-S52
Lithology: Pelite
Mineral analyzed: Muscovite
Age: 1717 ± 10 Ma
Interpretation: Cooling age

Location:
Lat: 61.575661
Long -72.278481

Results: Step heating of muscovite yielded relatively homogeneous gas release spectrum with a plateau age of 1717 ± 10 Ma, which is interpreted as the cooling age of muscovite.

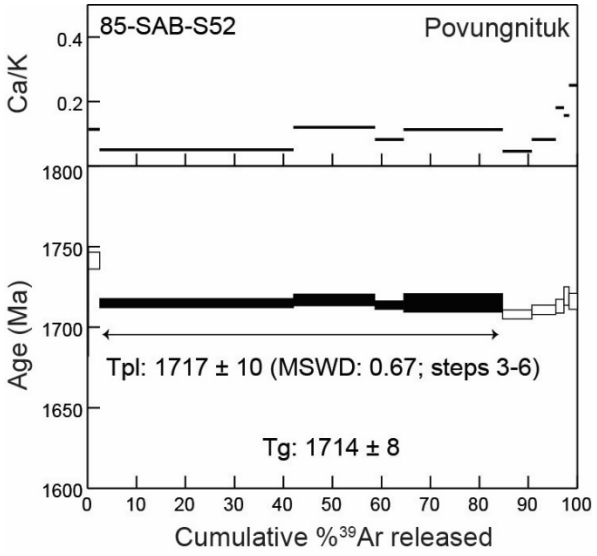

Figure S13: $^{40}Ar/^{39}Ar$ step-heating muscovite spectrum.

CSB: Povungnituk Group

Sample Number: 85-SAB-S64
Lithology: Metabasite
Mineral analyzed: Hornblende
Age: 1731 ± 21 Ma
Interpretation: Maximum cooling age

Location:
Lat: 61.579367
Long -72.472039

Results: Step heating of hornblende yielded a saddle-shaped gas release spectrum, suggesting contamination with excess Ar. The middle steps yielded a plateau age of 1731 ± 21 Ma, which is interpreted as the maximum cooling age of hornblende.

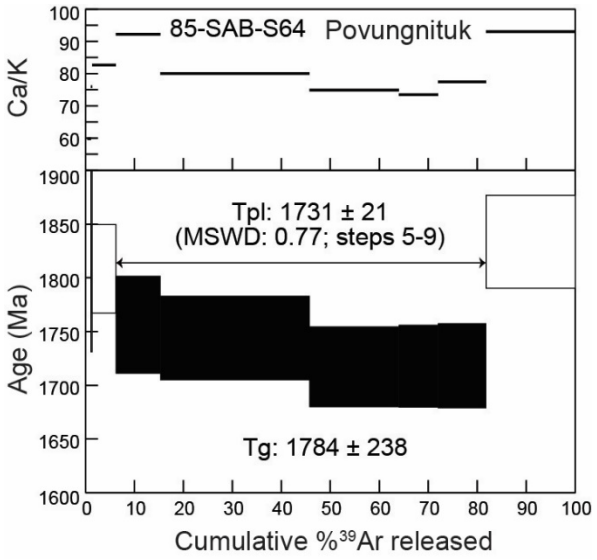

Figure S14: $^{40}Ar/^{39}Ar$ step-heating hornblende spectrum.

CSB: Povungnituk Group

Sample Number: 87-SAB-L325
Lithology: Semi-pelite
Mineral analyzed: Biotite
Age: 1760 ± 11 Ma
Interpretation: Maximum cooling age

Location:
Lat: 61.340936
Long -74.48705

Results: Step heating of biotite produced a gas release spectrum with an upward-stepping pattern for the initial ~45% of ^{39}Ar released, suggesting Ar loss. Subsequent steps yielded a plateau age of 1760 ± 11 Ma. This is significantly older than most mica and hornblende dates from the belt, and overlaps with ages yielded from samples that exhibit evidence of excess Ar. Therefore, as it probably also contains excess Ar, we interpret 1760 ± 11 Ma as the maximum cooling age of biotite.

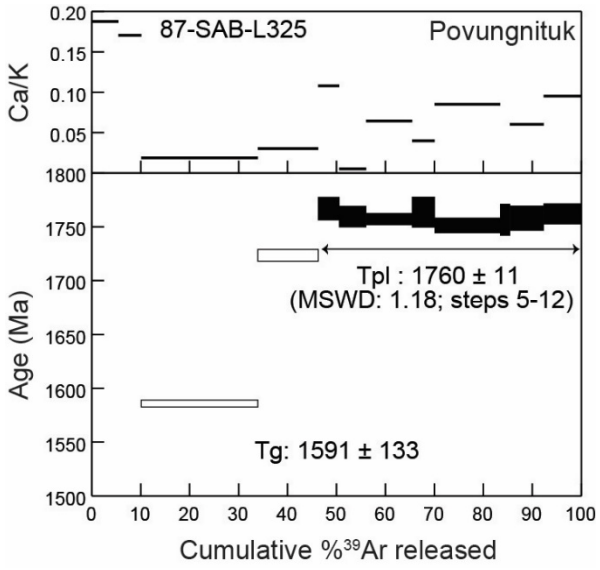

Figure S15: $^{40}Ar/^{39}Ar$ step-heating biotite spectrum.

CSB: Povungnituk Group

Sample Number: 87-SAB-S245
Lithology: Mafic metasedimentary rock
Mineral analyzed: Hornblende
Age: 1694 ± 15 Ma
Interpretation: Cooling age

Location:
Lat: 61.458375
Long: -74.494944

Results: Step heating of hornblende yielded a homogeneous gas release spectrum with a plateau age of 1694 ± 15 Ma, which is interpreted as the cooling age of hornblende.

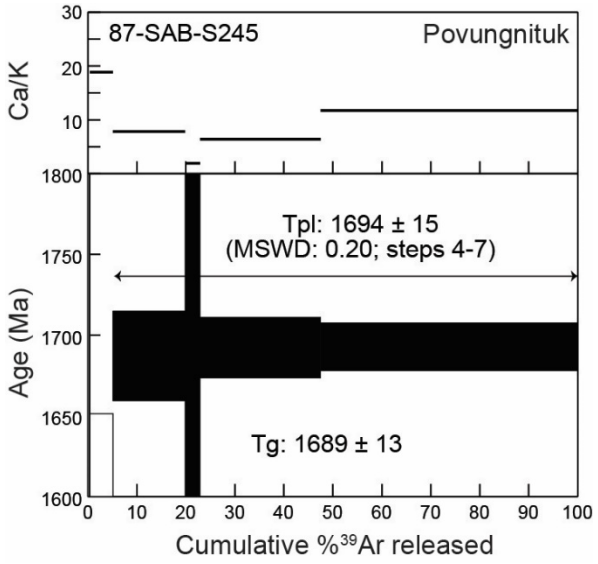

Figure S16: $^{40}Ar/^{39}Ar$ step-heating hornblende spectrum.

Sample Number: 86-SAB-L193
Lithology: Quartzite
Mineral analyzed: Biotite
Age: NO AGE
Interpretation: N/A

Location:
Lat: 61.928197
Long: -74.332992

Results: Step heating of biotite yielded a highly heterogeneous gas release spectrum, precluding a geological age interpretation for this sample.

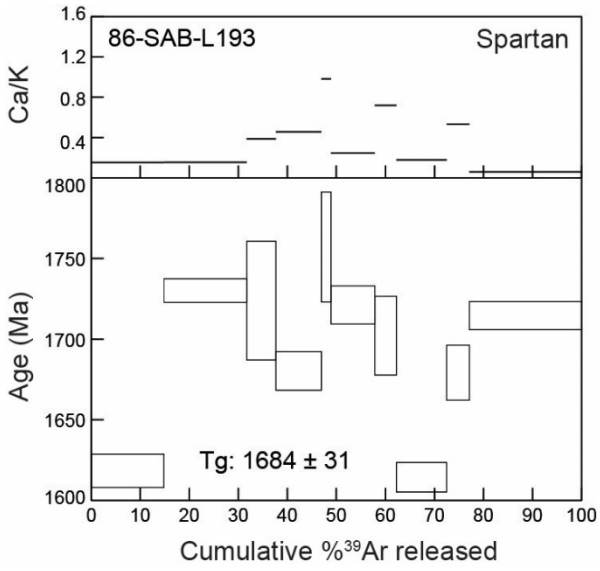

Figure S17: $^{40}Ar/^{39}Ar$ step-heating biotite spectrum.

Sample Number: 86-SAB-L193
Lithology: Quartzite
Mineral analyzed: Muscovite
Age: 1727 ± 11 Ma
Interpretation: Cooling age

Location:
Lat: 61.928197
Long: -74.332992

Results: Step heating of muscovite yielded a homogeneous gas release spectrum with a plateau age of 1727 ± 11 Ma, which is interpreted as the cooling age of muscovite.

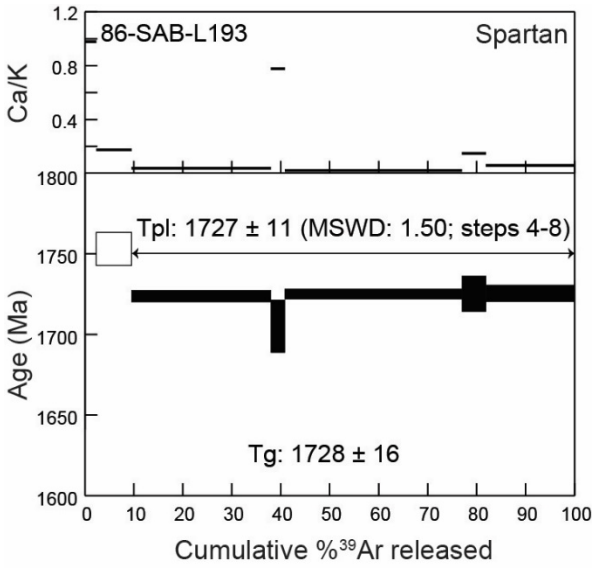

Figure S18: $^{40}Ar/^{39}Ar$ step-heating muscovite spectrum.

Sample Number: 86-SAB-L194
Lithology: Quartzite
Mineral analyzed: Biotite
Age: 1723 ± 10 Ma
Interpretation: Cooling age

Location:
Lat: 61.929842
Long: -74.332128

Results: Step heating of biotite yielded a "climbing staircase" pattern in the early (first ~10% ^{39}Ar) gas release steps, suggesting minor Ar loss. Subsequent steps produced a plateau age of 1723 ± 10 Ma, which is interpreted as the cooling age of biotite.

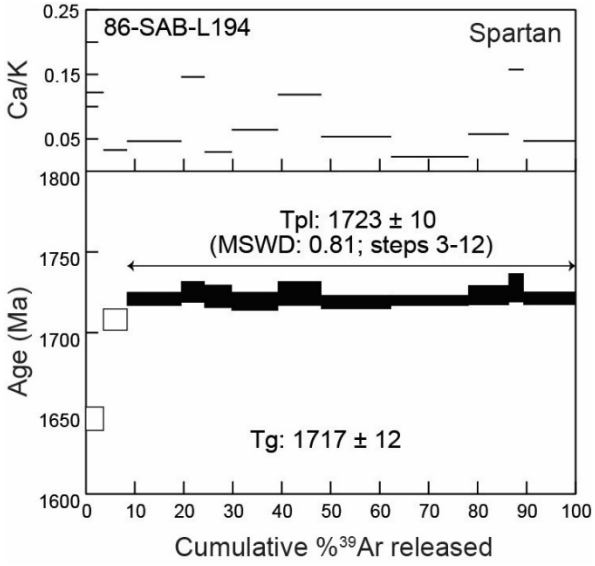

Figure S19: $^{40}Ar/^{39}Ar$ step-heating biotite spectrum.

Sample Number: 86-SAB-L194
Lithology: Quartzite
Mineral analyzed: Muscovite
Age: 1731 ± 10 Ma
Interpretation: Cooling age

Location:
Lat: 61.929842
Long: -74.332128

Results: Step heating of muscovite yielded a plateau age of 1731 ± 10 Ma, which is interpreted as the cooling age of muscovite.

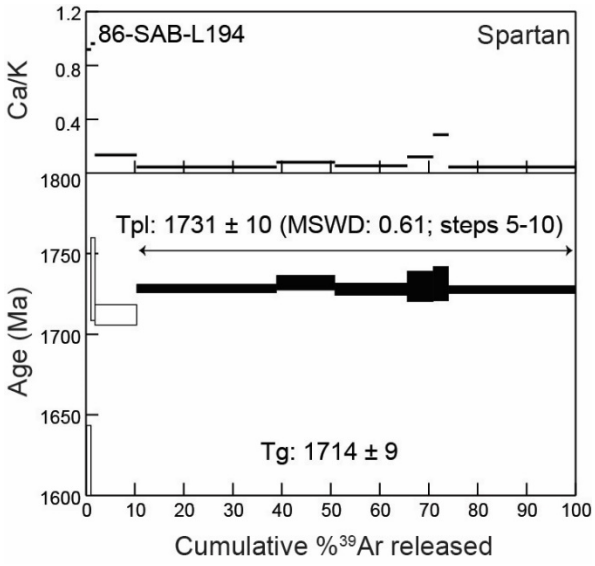

Figure S20: $^{40}Ar/^{39}Ar$ step-heating muscovite spectrum.

Sample Number: 86-SAB-L244
Lithology: Metabasite
Mineral analyzed: Hornblende
Age: 1704 ± 14 Ma
Interpretation: Cooling age

Location:
Lat: 61.71955
Long: -74.489008

Results: Step heating of hornblende yielded a plateau age of 1704 ± 14 Ma, which is interpreted as the cooling age of hornblende.

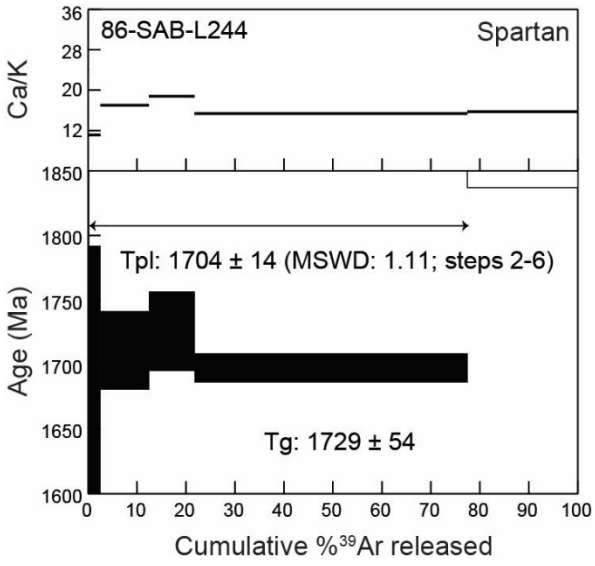

Figure S21: $^{40}Ar/^{39}Ar$ step-heating hornblende spectrum.

Sample Number: 87-SAB-L356
Lithology: Semi-pelite
Mineral analyzed: Biotite
Age: 1722 ± 10 Ma
Interpretation: Cooling age

Location:
Lat: 61.830725
Long: -73.308378

Results: Step heating of biotite yielded a relatively homogeneous gas release spectrum with a plateau age of 1722 ± 10 Ma, which is interpreted as the cooling age of biotite.

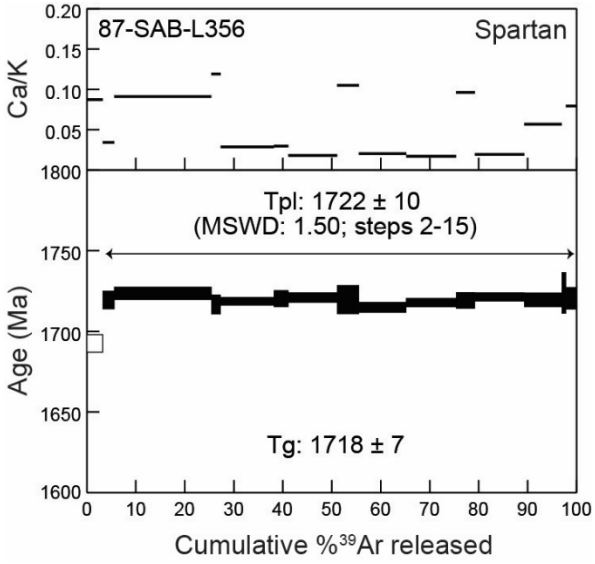

Figure S22: $^{40}Ar/^{39}Ar$ step-heating biotite spectrum.

Sample Number: 87-SAB-L356
Lithology: Semi-pelite
Mineral analyzed: Muscovite
Age: 1707 ± 10 Ma
Interpretation: Cooling age

Location:
Lat: 61.830725
Long: -73.308378

Results: Step heating of muscovite yielded a relatively homogeneous gas release spectrum with a plateau age of 1707 ± 10 Ma, which is interpreted as the cooling age of muscovite.

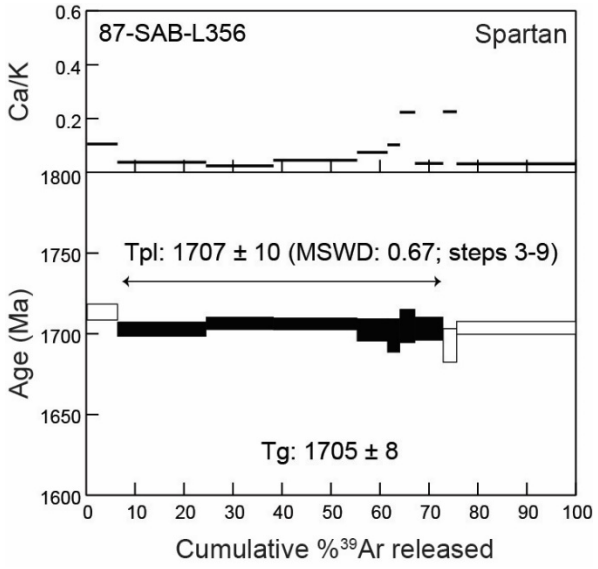

Figure S23: $^{40}Ar/^{39}Ar$ step-heating muscovite spectrum.

Sample Number: 87-SAB-S284
Lithology: Metabasite
Mineral analyzed: Hornblende
Age: 1728 ± 11 Ma
Interpretation: Cooling age

Location:
Lat: 61.816
Long: -73.271861

Results: Step heating of hornblende yielded a homogeneous gas release spectrum with a plateau age of 1728 ± 11 Ma, which is interpreted as the cooling age of hornblende.

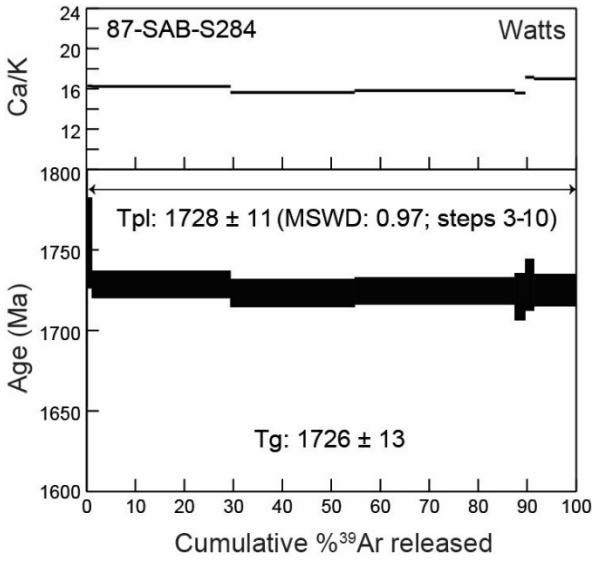

Figure S24: $^{40}Ar/^{39}Ar$ step-heating hornblende spectrum.

Sample Number: 85-SAB-S38
Lithology: Quartzo-feldspathic gneiss
Mineral analyzed: Biotite
Age: 1708 ± 10 Ma
Interpretation: Cooling age

Location:
Lat: 61.601311
Long: -72.169872

Results: Step heating of biotite yielded an upward-stepping pattern in the gas release spectrum, suggesting Ar loss. The last ~60% of the ^{39}Ar released yielded a plateau age of 1708 ± 10 Ma, which is interpreted as the cooling age of biotite.

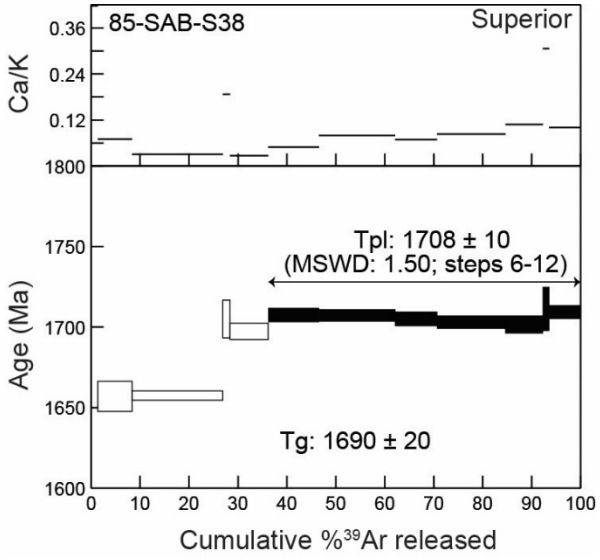

Figure S25: $^{40}Ar/^{39}Ar$ step-heating biotite spectrum.

Superior craton (CSB shear zones)

Sample Number: 85-SAB-L76b
Lithology: Quartzo-feldspathic gneiss
Mineral analyzed: Biotite
Age: 1735 ± 10 Ma
Interpretation: Maximum cooling age

Location:
Lat: 61.554786
Long: -72.515592

Results: Step heating of biotite yielded a plateau age of 1735 ± 10 Ma. A "climbing staircase" pattern exhibited by the early (initial ~15% ^{39}Ar) gas release steps suggests Ar loss, although excess Ar contamination of biotite is implied by the younger apparent age of muscovite from the same sample (ca. 1707 Ma, presented below). Therefore, 1735 ± 10 Ma is interpreted as the maximum cooling age of biotite.

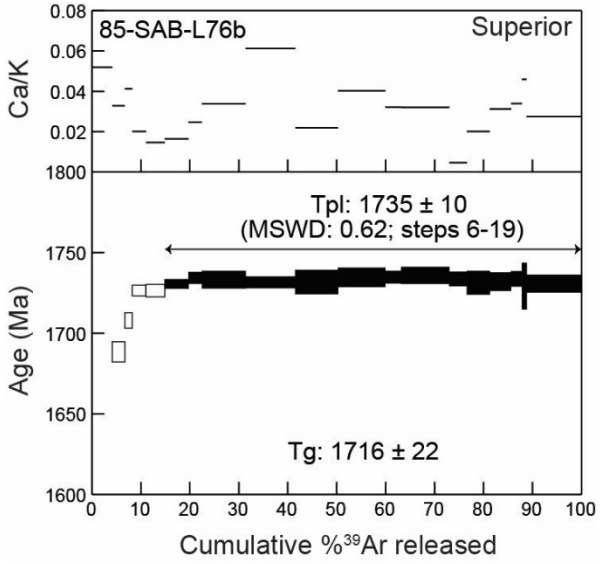

Figure S26: ^{40}Ar/^{39}Ar step-heating biotite spectrum.

Superior craton (CSB shear zones)

Sample Number: 85-SAB-L76b
Lithology: Quartzo-feldspathic gneiss
Mineral analyzed: Muscovite
Age: 1707 ± 11 Ma
Interpretation: Cooling age

Location:
Lat: 61.554786
Long: -72.515592

Results: Step heating of muscovite yielded a homogeneous gas release spectrum with a plateau age of 1707 ± 11 Ma, which is interpreted as the cooling age of muscovite.

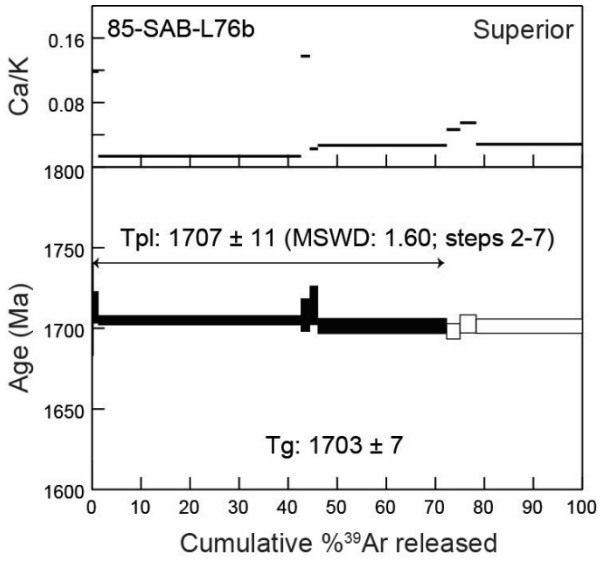

Figure S27: $^{40}Ar/^{39}Ar$ step-heating muscovite spectrum.

Superior craton (CSB shear zones)

Sample Number: 86-SAB-L192
Lithology: Tonalite
Mineral analyzed: Muscovite
Age: 1726 ± 11 Ma
Interpretation: Cooling age

Location:
Lat: 61.927122
Long: -74.325381

Results: Step heating of muscovite yielded a homogeneous gas release spectrum with a plateau age of 1726 ± 11 Ma, which is interpreted as the cooling age of muscovite.

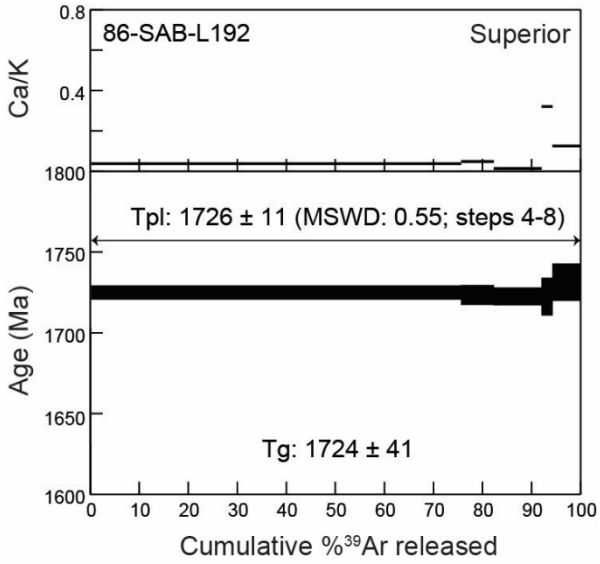

Figure S28: $^{40}Ar/^{39}Ar$ step-heating muscovite spectrum.

Superior craton (CSB shear zones)

Sample Number: 86-SAB-L196
Lithology: Tonalite
Mineral analyzed: Biotite
Age: 1768 ± 11 Ma
Interpretation: Maximum cooling age

Location:
Lat: 61.926606
Long: -74.360133

Results: Step heating of biotite produced an upward-stepping pattern in the early gas release steps, suggesting Ar loss, followed by a flat spectrum. The latter steps yielded a plateau age of 1768 ± 11 Ma, which is significantly older than most mica and hornblende dates from the belt, and overlaps with ages yielded from samples that exhibit evidence of excess Ar. Therefore, as it may also contain excess Ar, we interpret 1768 ± 10 Ma as the maximum cooling age of biotite.

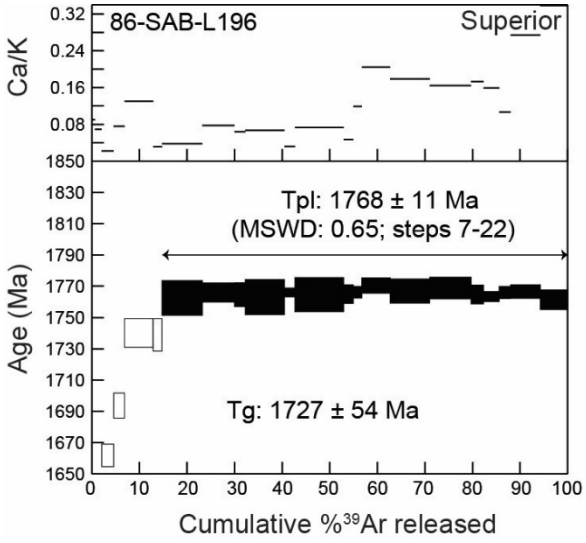

Figure S29: $^{40}Ar/^{39}Ar$ step-heating biotite spectrum.

Sample Number: 86-SAB-L211
Lithology: Tonalite
Mineral analyzed: Muscovite
Age: 1801 ± 12 Ma
Interpretation: Maximum cooling age

Location:
Lat: 61.847689
Long: -73.957658

Results: The gas release spectrum yielded by step heating of muscovite is comprised of unequal steps with variable apparent ages, and no plateau age was attained. The down-stepping pattern suggests excess Ar contamination. The final three steps yielded a pseudoplateau age of 1801 ± 12 Ma (MSWD = 0.70), which includes 16% of the total ^{39}Ar released. This age is considered to be the maximum cooling age of biotite.

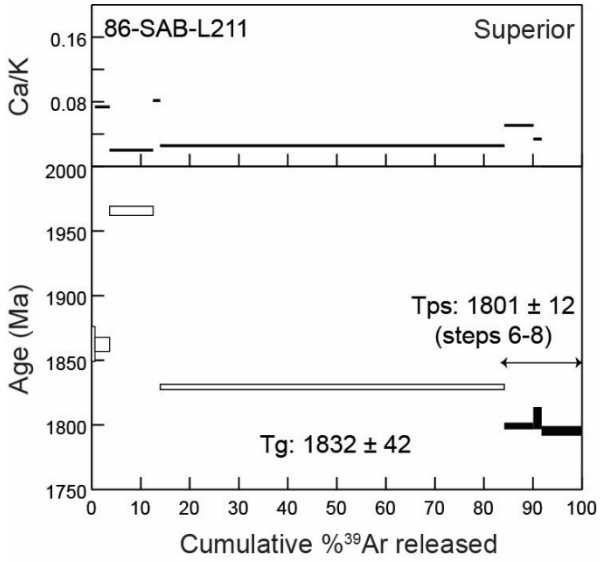

Figure S30: ^{40}Ar/^{39}Ar step-heating muscovite spectrum.

Superior craton (CSB shear zones)

Sample Number: 87-SAB-L355
Lithology: Tonalite
Mineral analyzed: Biotite
Age: 1816 ± 11 Ma
Interpretation: Maximum cooling age

Location:
Lat: 61.832961
Long: -73.310006

Results: Step heating of biotite yielded a plateau age of 1816 ± 11 Ma. As this apparent age is significantly older than that of hornblende in the same sample (ca. 1764, presented below), it is likely contaminated with excess Ar, and is inferred to represent the maximum cooling age of biotite.

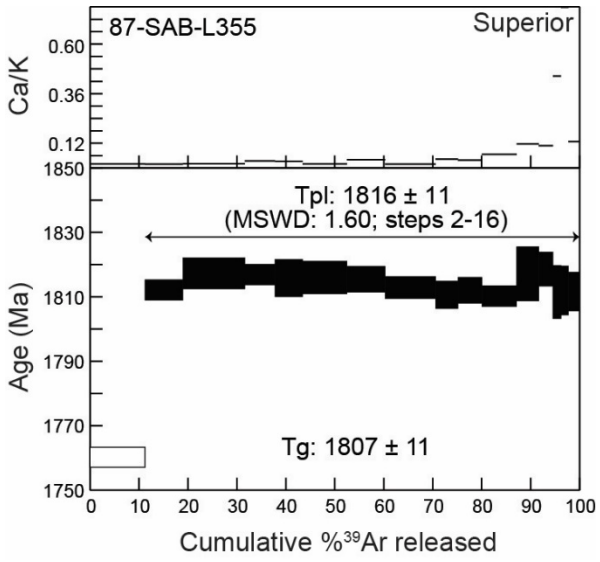

Figure S31: $^{40}Ar/^{39}Ar$ step-heating biotite spectrum.

Superior craton (CSB shear zones)

Sample Number: 87-SAB-L355
Lithology: Tonalite
Mineral analyzed: Hornblende
Age: 1764 ± 11 Ma
Interpretation: Maximum cooling age

Location:
Lat: 61.832961
Long: -73.310006

Results: Step heating of hornblende yielded a homogeneous gas release spectrum with a plateau age of 1764 ± 11 Ma. Excess Ar contamination is probable, as this age is older than other hornblende cooling ages in the CSB, and biotite from the same sample yielded a significantly older date. Therefore, 1764 ± 11 Ma is interpreted as a maximum cooling age.

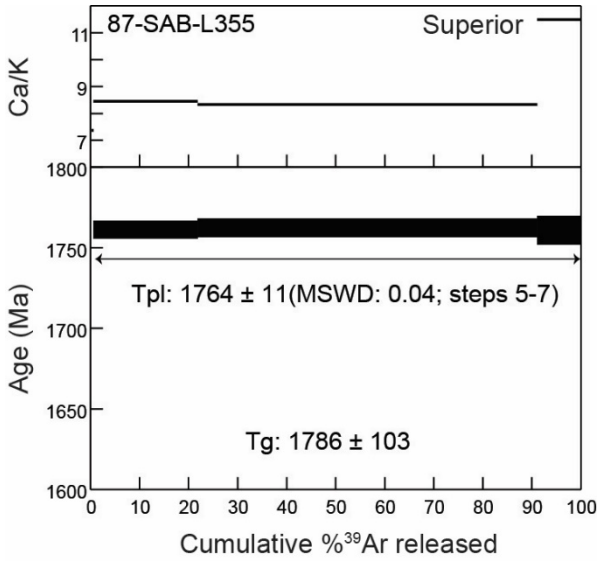

Figure S32: $^{40}Ar/^{39}Ar$ step-heating hornblende spectrum.

Superior craton (south of CSB)

Sample Number: 87-SAB-S278
Lithology: Granite
Mineral analyzed: Biotite
Age: 1867 ± 11 Ma
Interpretation: Partial resetting

Location:
Lat: 61.27645
Long: -74.479861

Results: Step heating of biotite yielded a plateau age of 1867 ± 11 Ma, which is older than the age of CSB metamorphism, but significantly younger than Neoarchean metamorphism that affected the Superior craton. The age may reflect incomplete resetting of $^{40}Ar/^{39}Ar$ systematics during CSB metamorphism (refer to manuscript for detailed discussion).

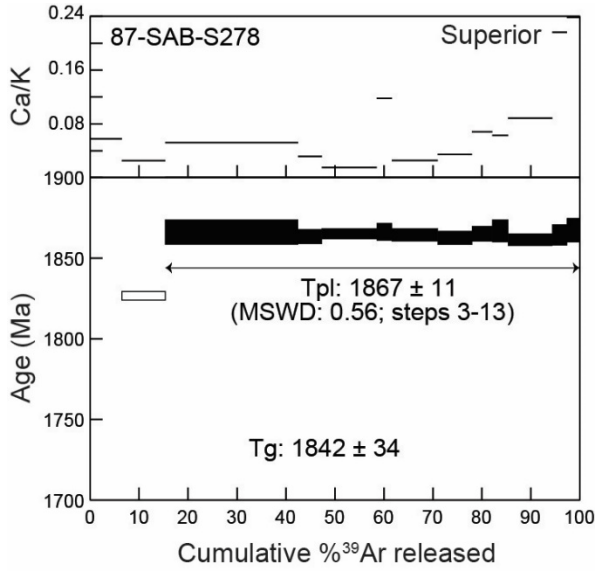

Figure S33: $^{40}Ar/^{39}Ar$ step-heating biotite spectrum.

Superior craton (south of CSB)

Sample Number: BK-63-139
Lithology: Granodiorite
Mineral analyzed: Biotite
Age: 2324 ± 8 Ma
Interpretation: Partial resetting

Location:
Lat: 60.9001
Long: -75.08913

Results: Step heating of biotite yielded a complex gas release spectrum with a "descending staircase" pattern, indicative of excess Ar. The final three steps, which define the flattest part of the spectrum, yielded a pseudoplateau age of 2324 ± 8 Ma, which comprises 16% of the total ^{39}Ar released. We have low confidence on this age due to the low proportion of ^{39}Ar and high Ca/K of the steps included in the pseudoplateau. It likely reflects the combined effects of excess Ar and incomplete resetting of Archean biotite during CSB metamorphism.

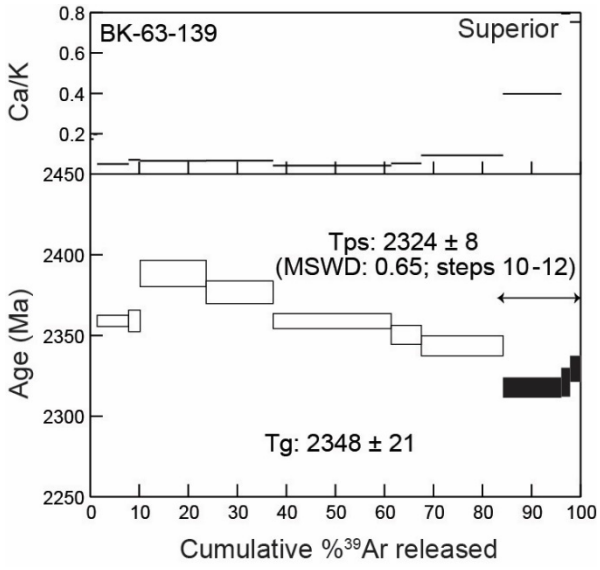

Figure S34: ^{40}Ar/^{39}Ar step-heating biotite spectrum.

Superior craton (south of CSB)

Sample Number: GV-243-73
Lithology: Granite gneiss
Mineral analyzed: Biotite
Age: NO AGE
Interpretation: N/A

Location:
Lat: 61.00073
Long: -75.29582

Results: Step heating of biotite produced a complex, hump-shaped gas release spectrum that precludes an age interpretation for this sample.

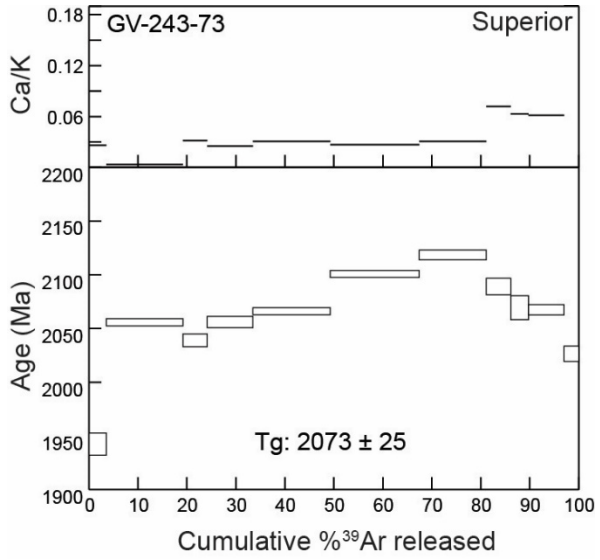

Figure S35: $^{40}Ar/^{39}Ar$ step-heating biotite spectrum.

Superior craton (south of CSB)

Sample Number: GV-245-73
Lithology: Granodiorite
Mineral analyzed: Biotite
Age: 2000 ± 12 Ma
Interpretation: Partial resetting

Location:
Lat: 61.07004
Long: -75.1927

Results: Step heating of biotite produced a saddle-shaped gas release spectrum, suggesting contamination with excess ^{39}Ar. The flattest part of the spectrum (the middle steps) yielded a pseudoplateau age of 2000 ± 12 Ma, comprising 48% of total ^{39}Ar released, with a low MSWD. This is older than CSB metamorphism, but significantly younger than Neoarchean metamorphism that affected the Superior craton. Thus, it is interpreted to reflect the incomplete Ar resetting of Archean biotite during CSB metamorphism, with possible excess Ar contamination (refer to manuscript for detailed discussion).

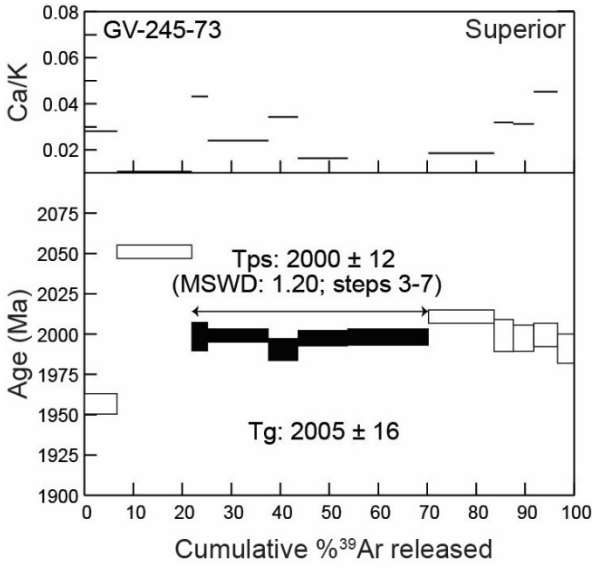

Figure S36: $^{40}Ar/^{39}Ar$ step-heating biotite spectrum.

Superior craton (south of CSB)

Sample Number: GV-247-73
Lithology: Granite gneiss
Mineral analyzed: Biotite
Age: 2169 ± 13 Ma
Interpretation: Partial resetting

Location:
Lat: 61.16613
Long: -75.17285

Results: Step heating of biotite yielded a plateau age of 2169 ± 13 Ma. As this age is significantly younger than the Neoarchean metamorphism that affected the Superior craton, but significantly older than CSB cooling ages, it is interpreted to reflect partial Ar resetting (refer to manuscript for detailed discussion).

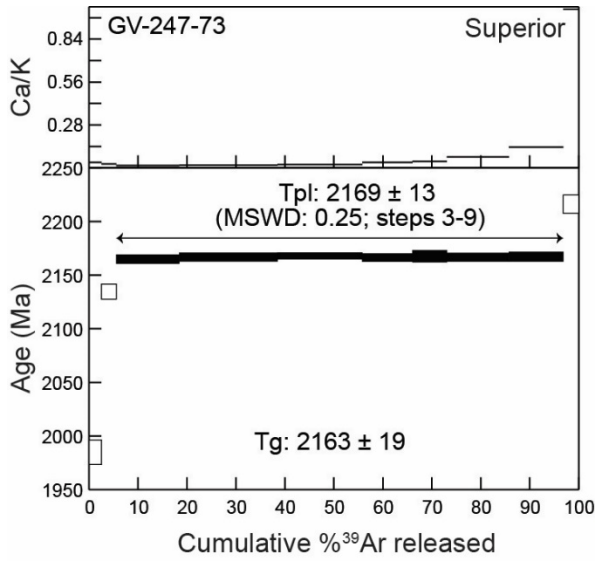

Figure S37: $^{40}Ar/^{39}Ar$ step-heating biotite spectrum.

Superior craton (south of CSB)

Sample Number: GV-247-73
Lithology: Granite gneiss
Mineral analyzed: Hornblende
Age: 2667 ± 17 Ma
Interpretation: Cooling age

Location:
Lat: 61.16613
Long: -75.17285

Results: Step heating of hornblende yielded a plateau age of 2667 ± 17 Ma, which is interpreted as the cooling age of hornblende. The saddle-shaped spectrum suggests an excess Ar component.

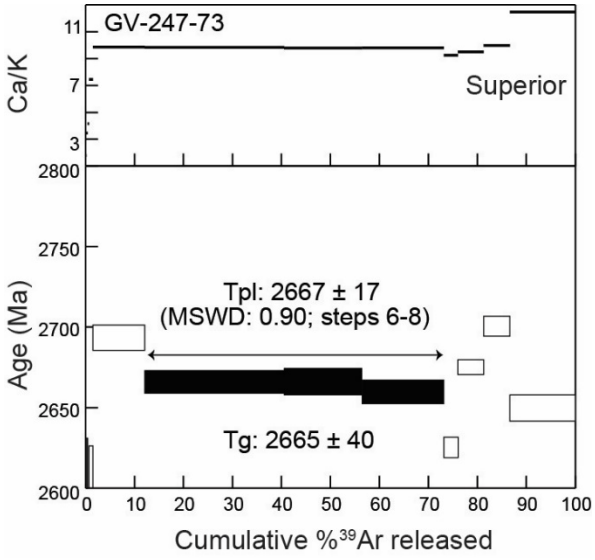

Figure S38: $^{40}Ar/^{39}Ar$ step-heating hornblende spectrum.

Superior craton (south of CSB)

Sample Number: GV-248-73
Lithology: Granodiorite
Mineral analyzed: Biotite
Age: 2415 ± 15 Ma
Interpretation: Cooling age/partial resetting

Location:
Lat: 61.23346
Long: -75.16949

Results: Step heating spectra for two aliquots of biotite produced plateau ages of 2400 ± 15 Ma and 2415 ± 15 Ma. Our preferred age for this sample is 2415 ± 15 Ma, as it has a lower MSWD and the gas steps included in this plateau age comprise a higher proportion of ^{39}Ar (82%) than those of the other aliquot (75%). The 2415 ± 15 Ma age is consistent with biotite cooling ages following Neoarchean metamorphism, undisturbed by CSB tectonism (see manuscript for details). However, it is significantly older than nearby biotite dates in the Superior craton, which we interpret to have been partially reset during CSB tectonism. It may reflect a minor degree of partial Ar resetting that occurred during CSB metamorphism (refer to manuscript for detailed discussion).

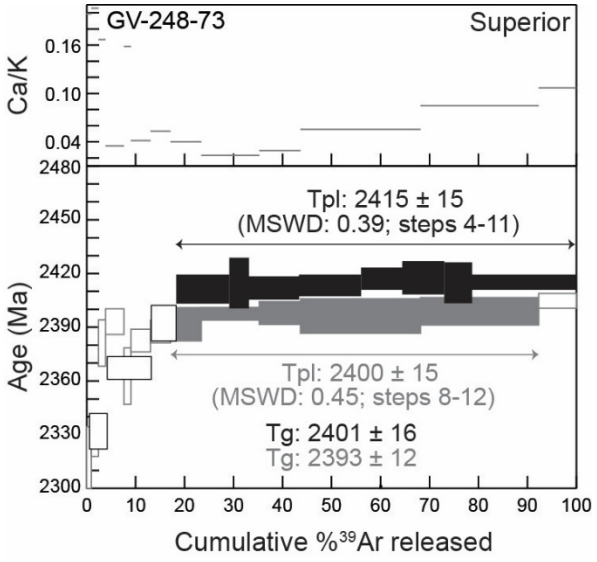

Figure S39: ^{40}Ar/^{39}Ar step-heating biotite spectra. The data for aliquots 1 and 2 are shown in black and grey, respectively.

Superior craton (south of CSB)

Sample Number: GV-249-73
Lithology: Granodiorite
Mineral analyzed: Biotite
Age: 1743 ± 11 Ma
Interpretation: Cooling age

Location:
Lat: 61.25591
Long: -75.16775

Results: Step heating of biotite produced a gas release spectrum with a "climbing staircase" pattern in early steps (~10% of ^{39}Ar released), suggesting Ar loss, followed by homogeneous steps defining a plateau age of 1743 ± 11 Ma, which is interpreted as the cooling age of biotite.

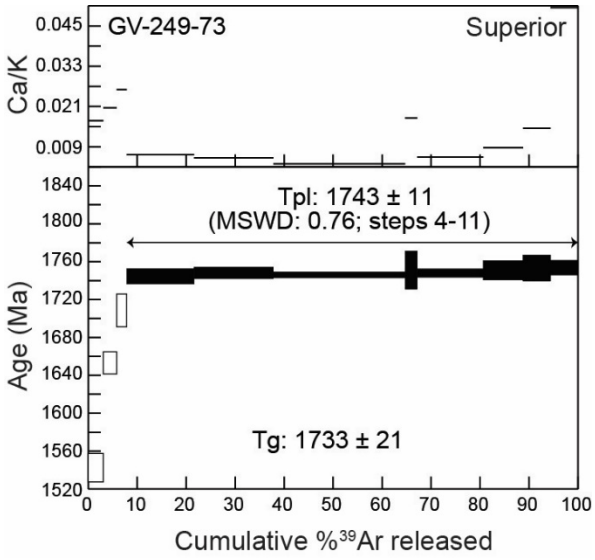

Figure S40: $^{40}Ar/^{39}Ar$ step-heating biotite spectrum.

Superior craton (south of CSB)

Sample Number: MW-123-63
Lithology: Granite gneiss
Mineral analyzed: Biotite
Age: 2311 ± 15 Ma
Interpretation: Partial resetting

Location:
Lat: 60.29463
Long: -75.01648

Results: Step heating of biotite produced a gas release spectrum with an overall upward-stepping pattern. The last half of the spectrum yielded a pseudoplateau age of 2311 ± 15 Ma, which is younger than the Neoarchean metamorphism that affected the Superior craton, but significantly older than CSB cooling ages. We interpret the age to represent partial Ar resetting of Archean biotite during CSB metamorphism (refer to manuscript for detailed discussion).

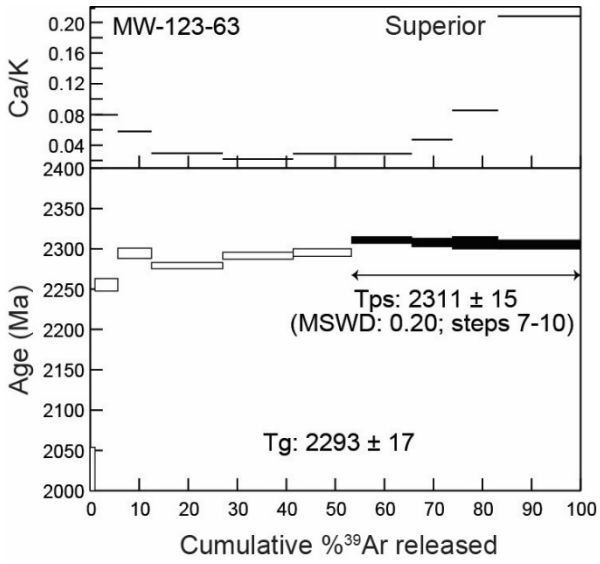

Figure S41: $^{40}Ar/^{39}Ar$ step-heating biotite spectrum.

Superior craton (south of CSB)

Sample Number: MW-63-132(2)
Lithology: Granite gneiss
Mineral analyzed: Hornblende
Age: NO AGE
Interpretation: N/A

Location:
Lat: 60.3971
Long: -75.34259

Results: Two aliquots of hornblende both produced heterogeneous step-heating spectra, with neither aliquot attaining a plateau age. Both aliquots exhibit overall downward-stepping patterns, suggesting an excess Ar component. No age interpretation is made for this sample.

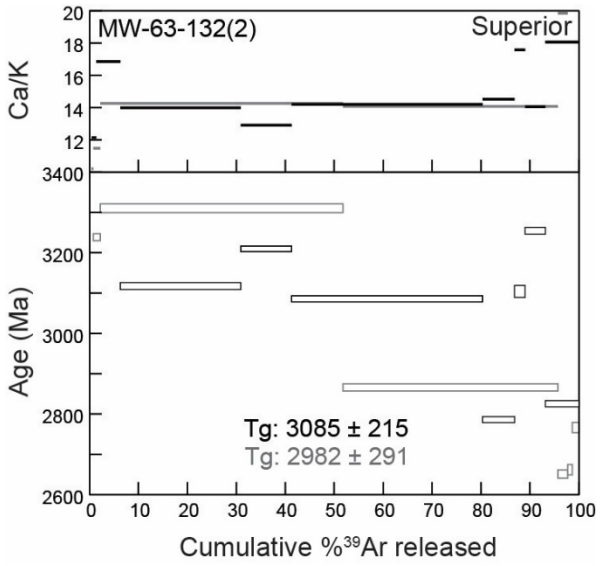

Figure S42: $^{40}Ar/^{39}Ar$ step-heating hornblende spectra. The data for aliquots 1 and 2 are shown in black and grey, respectively.

Superior craton (south of CSB)

Sample Number: MW-63-153
Lithology: Granodiorite
Mineral analyzed: Biotite
Age: 2532 ± 15 Ma
Interpretation: Cooling age / partial resetting

Location:
Lat: 60.56033
Long: -75.04738

Results: Step heating of biotite yielded a relatively homogeneous gas release spectrum with a plateau age of 2532 ± 15 Ma. This age is consistent with biotite cooling ages following Neoarchean metamorphism, undisturbed by CSB tectonism (see manuscript for details). However, it is significantly older than nearby biotite dates in the Superior craton, which we interpret to have been partially reset during CSB tectonism. It may reflect a minor degree of partial Ar resetting that occurred during CSB metamorphism (refer to manuscript for detailed discussion).

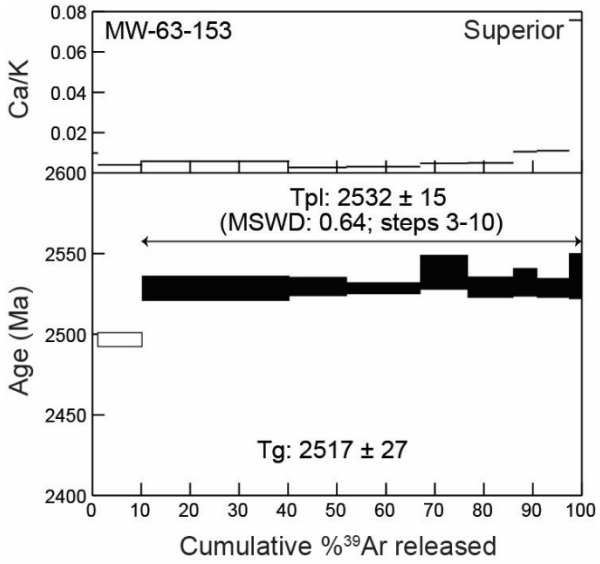

Figure S43: $^{40}Ar/^{39}Ar$ step-heating biotite spectrum.

Superior craton (south of CSB)

Sample Number: MW-63-153
Lithology: Granodiorite
Mineral analyzed: Hornblende
Age: 2704 ± 17 Ma
Interpretation: Crystallization or cooling age

Location:
Lat: 60.56033
Long: -75.04738

Results: Step heating of hornblende yielded a plateau age of 2704 ± 17 Ma. The age may represent the timing of hornblende crystallization during the ca. 2702 Ma metamorphism that affected the Superior craton. Alternatively, it may be the cooling age of hornblende following metamorphism.

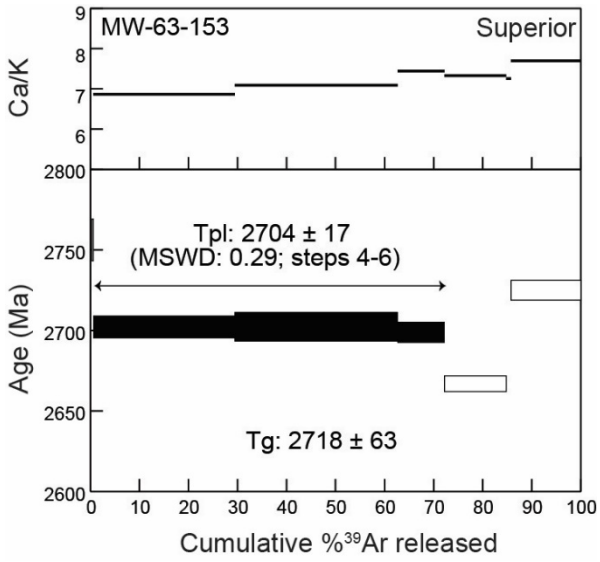

Figure S44: $^{40}Ar/^{39}Ar$ step-heating hornblende spectrum.

Superior craton (south of CSB)

Sample Number: TA-63-156
Lithology: Granite
Mineral analyzed: Biotite
Age: 2223 ± 17 Ma
Interpretation: Partial resetting

Location:
Lat: 60.73264
Long: -75.26814

Results: Step heating of two aliquots of biotite yielded gas release spectra with young early steps, and the first aliquot produced a hump-shaped spectrum. The first aliquot yielded a plateau age of 2322 ± 14 Ma (MSWD = 0.23; 51% of total ^{39}Ar released). As no plateau age was attained from aliquot 2, a pseudoplateau age was calculated from the middle steps, which represent the flattest portion of the spectrum: 2223 ± 17 Ma (MSWD = 7.2; 46% of total ^{39}Ar released). The pseudoplateau age of 2223 ± 17 Ma (from aliquot 2) is considered the preferred age because the spectrum from aliquot 2 is more homogeneous overall than that of aliquot 1. Additionally, the hump-shaped spectrum of aliquot 1 is indicative of compounded excess Ar and Ar loss, and the final steps of aliquot 1 approach the pseudoplateau age of aliquot 2. The preferred age of 2223 ± 17 Ma is significantly younger than the Neoarchean metamorphism that affected the Superior craton, but significantly older than CSB cooling ages and nearby biotite dates in the Superior craton. We interpret the age to represent partial Ar resetting of Archean biotite during CSB metamorphism (refer to manuscript for detailed discussion).

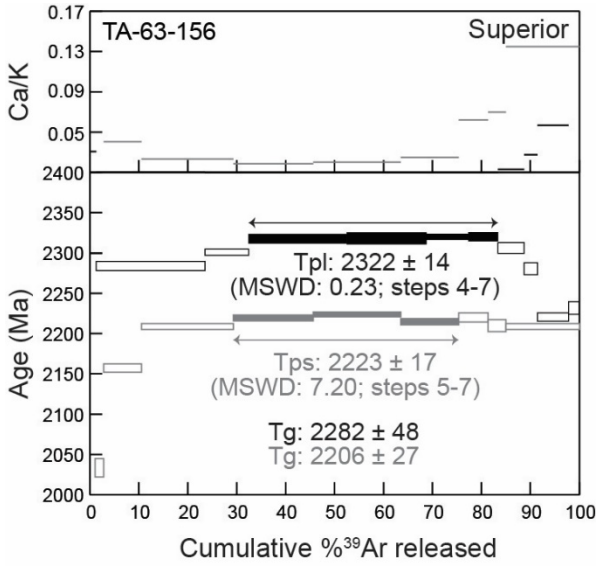

Figure S45: ^{40}Ar/^{39}Ar step-heating biotite spectra. The data for aliquots 1 and 2 are shown in black and grey, respectively.

Superior craton (south of CSB)

Sample Number: TA-63-156
Lithology: Granite
Mineral analyzed: Hornblende
Age: 2686 ± 17 Ma
Interpretation: Cooling age

Location:
Lat: 60.73264
Long: -75.26814

Results: Step heating of hornblende yielded a relatively homogeneous gas release spectrum with a plateau age of 2686 ± 17 Ma, which is interpreted as the cooling age of hornblende.

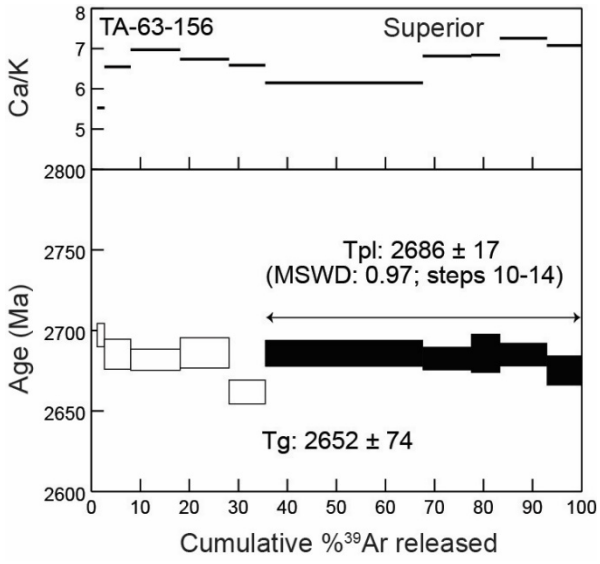

Figure S46: $^{40}Ar/^{39}Ar$ step-heating hornblende spectrum.

Superior craton (~450 km south of CSB)

Sample Number: FA-61-105
Lithology: Granite
Mineral analyzed: Biotite
Age: NO AGE
Interpretation: N/A

Location:
Lat: 57.57023
Long: -70.32525

Results: Step heating of biotite yielded an upward-stepping gas-release pattern in the early steps, followed by a heterogeneous pattern. As such, no plateau age was attained, and no age is calculated for this sample.

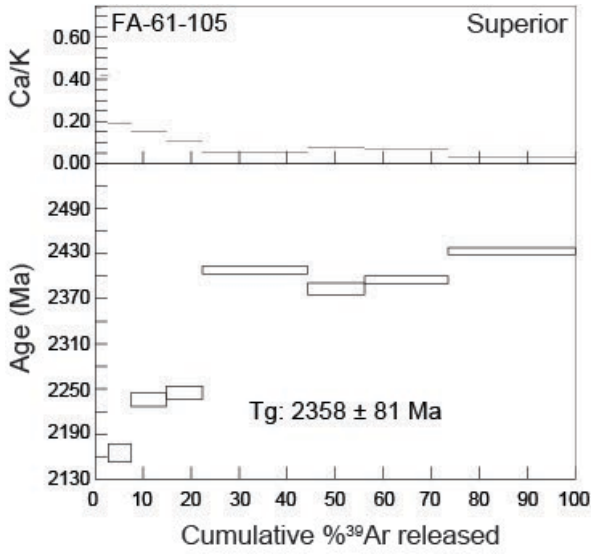

Figure S47: $^{40}Ar/^{39}Ar$ step-heating biotite spectrum.

Superior craton (~450 km south of CSB)

Sample Number: R-61-75b
Lithology: Granite
Mineral analyzed: Biotite
Age: 2401 ± 15 Ma
Interpretation: Cooling age

Location:
Lat: 57.54117
Long: -70.63295

Results: Step heating of biotite yielded a homogeneous gas-release pattern with a plateau age of 2401 ± 15 Ma, which is interpreted as the cooling age of biotite.

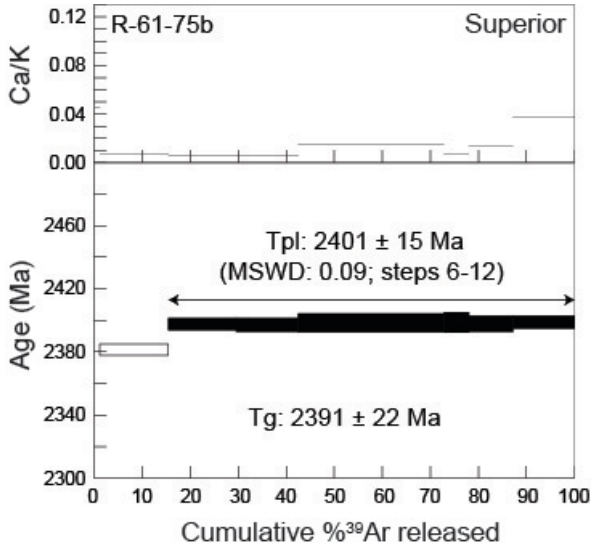

Figure S48: $^{40}Ar/^{39}Ar$ step-heating biotite spectrum.

Superior craton (~450 km south of CSB)

Sample Number: R-61-75b
Lithology: Granite
Mineral analyzed: Hornblende
Age: 2532 ± 15 Ma
Interpretation: Cooling age

Location:
Lat: 57.54117
Long: -70.63295

Results: Step heating of hornblende yielded a homogeneous gas-release pattern with a plateau age of 2532 ± 15 Ma, interpreted as the cooling age of hornblende.

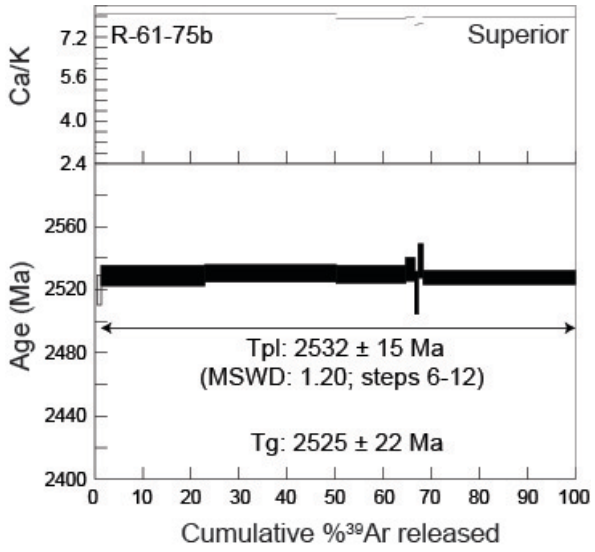

Figure S49: $^{40}Ar/^{39}Ar$ step-heating hornblende spectrum.

Superior craton (~450 km south of CSB)

Sample Number: R-61-86
Lithology: Granulite gneiss
Mineral analyzed: Biotite
Age: 2414 ± 15 Ma
Interpretation: Cooling age

Location:
Lat: 57.41912
Long: -71.13084

Results: Step heating of biotite yielded a homogeneous gas-release pattern with a plateau age of 2414 ± 15 Ma, interpreted as the cooling age of biotite.

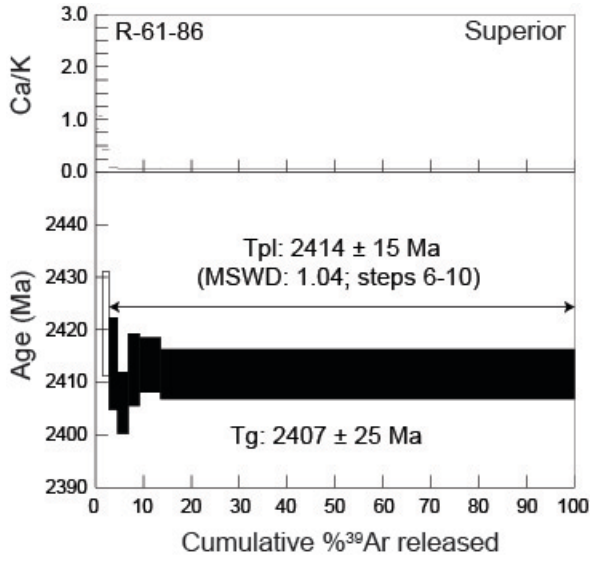

Figure S50: $^{40}Ar/^{39}Ar$ step-heating biotite spectrum.

Superior craton (~450 km south of CSB)

Sample Number: SL-61-79
Lithology: Granite gneiss
Mineral analyzed: Biotite
Age: 2439 ± 15 Ma
Interpretation: Cooling age

Location:
Lat: 57.56879
Long: -71.60984

Results: Step heating of biotite yielded an ascending gas-release pattern in the earliest steps, followed by a homogeneous pattern with a plateau age of 2439 ± 15 Ma, interpreted as the cooling age of biotite.

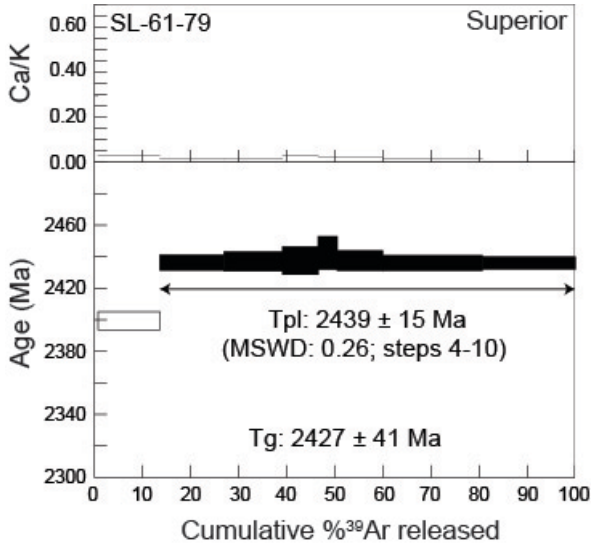

Figure S51: $^{40}Ar/^{39}Ar$ step-heating biotite spectrum.

Superior craton (~450 km south of CSB)

Sample Number: SL-61-79
Lithology: Granite gneiss
Mineral analyzed: Hornblende
Age: 2563 ± 16 Ma
Interpretation: Cooling age

Location:
Lat: 57.56879
Long: -71.60984

Results: Step heating of hornblende yielded a homogeneous gas-release pattern with a plateau age of 2563 ± 16 Ma, interpreted as the cooling age of hornblende.

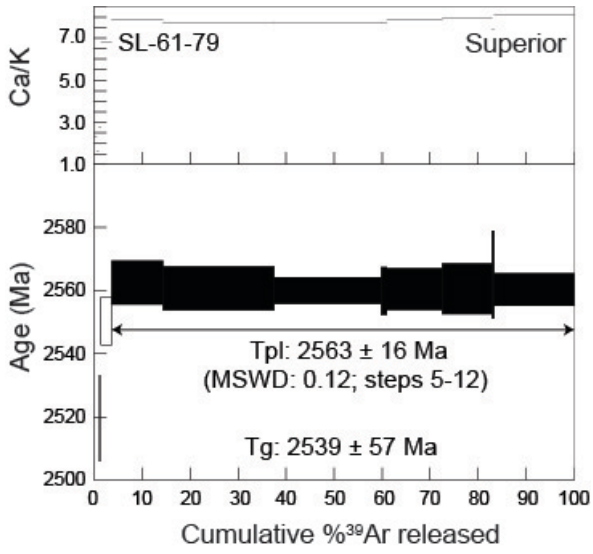

Figure S52: $^{40}Ar/^{39}Ar$ step-heating hornblende spectrum.

Superior craton (~450 km south of CSB)

Sample Number: SL-61-86
Lithology: Granite gneiss
Mineral analyzed: Biotite
Age: 2427 ± 15 Ma
Interpretation: Cooling age

Location:
Lat: 57.36542
Long: -71.76442

Results: Step heating of biotite yielded an upward-stepping gas-release pattern in the earliest steps, followed by a homogeneous pattern with a plateau age of 2427 ± 15 Ma, interpreted as the cooling age of biotite.

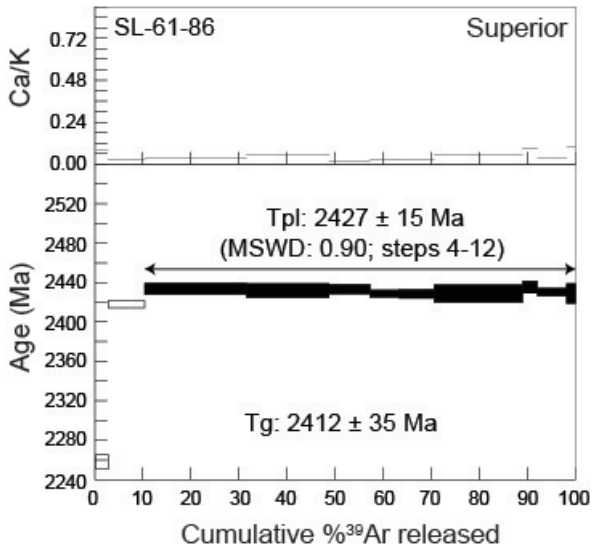

Figure S53: $^{40}Ar/^{39}Ar$ step-heating biotite spectrum.

Superior craton (~450 km south of CSB)

Sample Number: SL-61-185
Lithology: Granite
Mineral analyzed: Biotite
Age: 2462 ± 15 Ma
Interpretation: Cooling age

Location:
Lat: 57.45849
Long: -72.59088

Results: Step heating of biotite yielded a relatively homogeneous gas-release pattern with a plateau age of 2462 ± 15 Ma, interpreted as the cooling age of biotite.

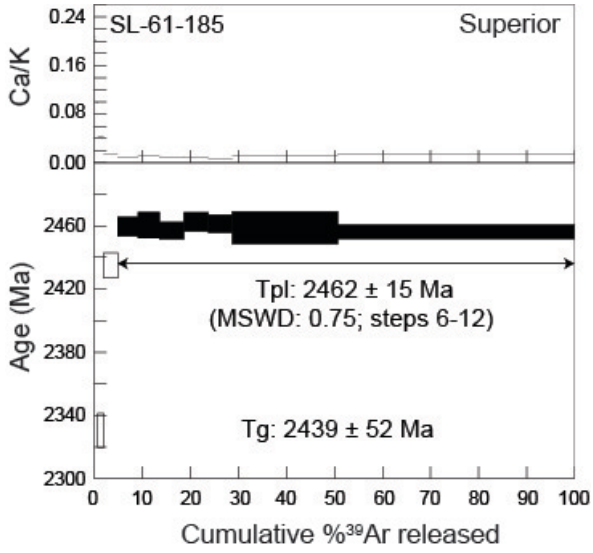

Figure S54: $^{40}Ar/^{39}Ar$ step-heating biotite spectrum.

Superior craton (~450 km south of CSB)

Sample Number: SL-61-185
Lithology: Granite
Mineral analyzed: Hornblende
Age: NO AGE
Interpretation: N/A

Location:
Lat: 57.45849
Long: -72.59088

Results: Step-heating of hornblende yielded a downward-stepping, heterogeneous gas-release pattern. No age is interpreted for this sample.

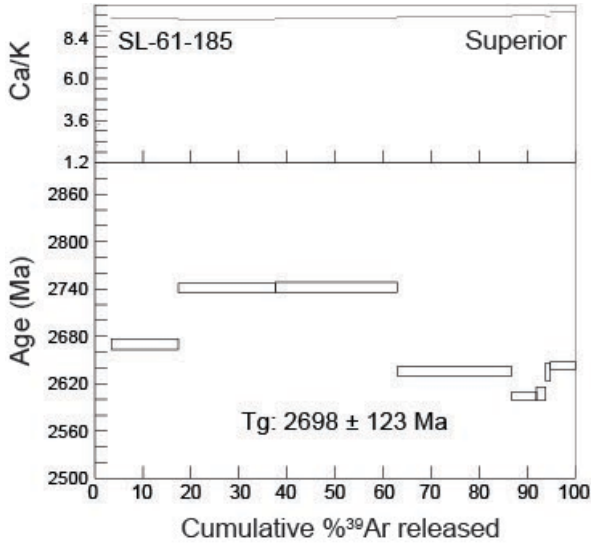

Figure S55: $^{40}Ar/^{39}Ar$ step-heating hornblende spectrum.

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