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2020

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Publications in this series have not been edited; they are released as submitted by the author.

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INTRODUCTION

The Thelon tectonic zone (Ttz) is a ~500 km long, northeast-striking geophysical and geological feature separating the Slave and Rae cratons of the Canadian shield (Fig. 1). The tectonic significance of the Ttz is uncertain, having been interpreted both as a Paleoproterozoic suture (Gibb and Thomas, 1977; Hoffman, 1988) and as an intracontinental orogenic belt (Thompson, 1989; Chacko et al., 2000; Schultz et al., 2007). Better understanding of the tectonic setting of the Ttz and the control of its crustal architecture on economic potential were primary goals of the Geomapping for Energy and Minerals (GEM) Thelon tectonic zone research activity.

This report presents 43 new $^{40}Ar/^{39}Ar$ hornblende and biotite analyses for metaplutonic rock samples from the central Ttz and adjacent regions, Nunavut. Samples were collected during three field seasons (2012, 2014, and 2016) in order to: (i) delineate domains with differing cooling histories and (ii) improve understanding of the differences in timing of regional metamorphism and exhumation across the Ttz. These data will be used in the future to evaluate and refine tectonic models for the evolution of the Ttz.

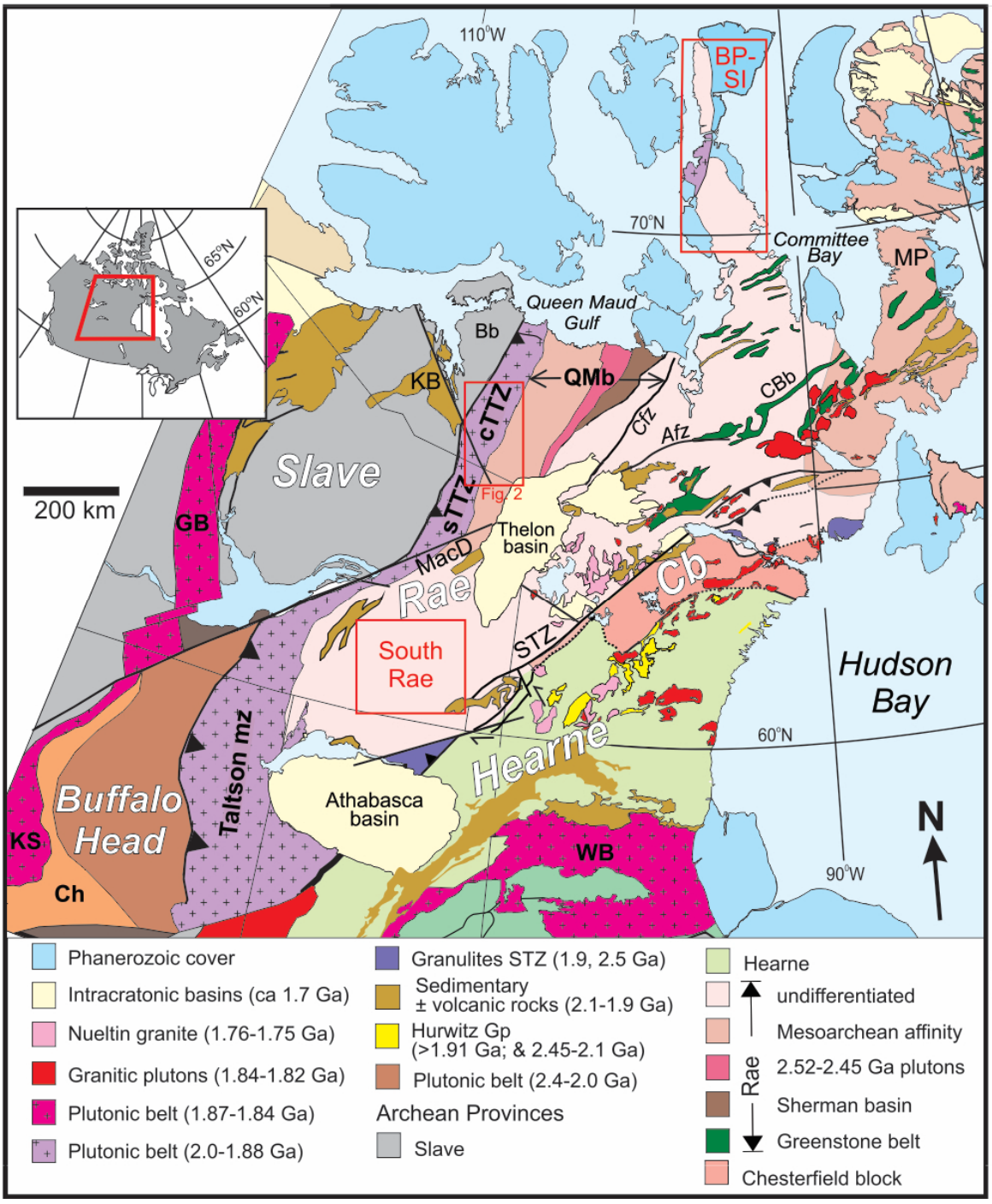


Figure 1. Geological map of northern Canada showing major tectono-magmatic elements and the location of three field-based GEM-2 activities (red boxes) focussed along western Rae craton, including the central Thelon tectonic zone project. Abbreviations: Afz=Amer fault zone; Bb = Bathurst block; BP-SI=Boothia Peninsula-Somerset Island; Cb=Chesterfield block; CBb=Committee Bay belt; Cfz=Chantrey fault zone; Ch = Chinchaga domain; GB = Great Bear; KB = Kilohigok basin; KS = Kitsuan magnetic high; MacD = MacDonald fault; MP=Melville Peninsula; mz=magmatic zone; QMb=Queen Maud block; Stz=Snowbird tectonic zone; tz=tectonic zone, WB= Wathaman batholith.

REGIONAL GEOLOGY

The Ttz comprises intensely deformed, steeply dipping, NNE-striking Paleoproterozoic metaplutonic rocks and subordinate supracrustal rocks flanked by reworked margins of the Slave (west side) and Rae (east side) cratons (Fig. 1). It extends more than 500 km northward from the MacDonald fault to north of Queen Maud Gulf (Fig. 1). The Ttz had been considered the northern continuation of the Taltson magmatic zone (Fig. 1; Bostock et al., 1987; Hoffman, 1988; Ross et al., 1991), however, this correlation is questionable given contrasts in the timing (Berman et al., 2018), plutonic geochemistry (Whalen et al., 2018), and oxygen isotope composition (Taylor et al., 2017; Berman et al., 2020*a*) of ca. 2.02 – 1.97 Ga ("Thelon") plutonism, as well as the markedly different strike of the Tmz south of the Athabasca basin, away from its interpreted transposition adjacent to McDonald fault (Fig. 1; Card et al., 2014).

The focus of this study is two NTS map sheets (76H, 76I) in the central Ttz (Fig. 2) where multidisciplinary data have been collected in order to extend and refine earlier mapping (Frith, 1982; Thompson et al., 1986) and geochronology (van Breemen et al., 1987; Frith and van Breemen, 1990) of the Ttz to its eastern boundary with exposed Rae craton. The architecture of the central Ttz (Fig. 2) has been defined on the basis of new, GEM-acquired high-resolution aeromagnetic data (Kiss et al., 2014*a, b*; Coyle et al., 2017*a, b*) combined with bedrock geological relationships (Berman et al., 2018; Thompson et al., 1986), plutonic rock geochemistry (Whalen et al., 2018), Sm-Nd isotopic data (Berman et al., 2020*a*), and U-Pb zircon crystallization ages (Davis et al., 2013; 2014; unpublished data).

On the west side of the central Ttz, the Bathurst block of the eastern Slave craton (Fig. 1) is divided informally into the Tinney Hills and Overby Lake domains (Fig. 2). The THd is dominated by metapelitic rocks of the Yellowknife Supergroup which are intruded by tonalitic to monzogranitic granitoids (Frith, 1982; Thompson, 1986) dated at ca. 2.60 Ga just west of map sheet 76I (Culshaw and van Breemen, 1990). Metamorphic grade increases eastward from lower- to upper-amphibolite facies, culminating in the Overby Lake domain (OLd; Fig. 2), where strongly foliated, migmatitic granitoid gneisses host thin strands of fine- to medium-grained amphibolite with minimal exposure of metapelitic rocks which dominate the THd (Thompson et al., 1986). Tonalitic to granodioritic plutonic rocks in the OLd are metaluminous and distinctly less potassic than the peraluminous THd granitoids (Whalen et al., 2018). OLd plutonic rocks are further distinguished by their slightly more evolved Nd isotopic compositions and older (ca. 2.71 Ga) crystallization ages (Berman et al., 2020*a*).

To the east of the central Ttz, the Rae craton consists of Mesoarchean (ca. 3.2 – 2.9 Ga), upper amphibolite- to granulite-facies diorite to monzogranite (Davis et al., 2013, 2014; Berman et al., 2020*b*) of the Queen Maud block (QMb). Rocks correlative with the westernmost part of the QMb are identified in the Duggan Lake domain (DLd; Fig. 2), where granitoids are isotopically (U-Pb, Sm-Nd) indistinguishable from those further east (Berman et al., 2020*b*). The western boundary of the QMb (including the DLd) is marked by a >400 km-long magnetic

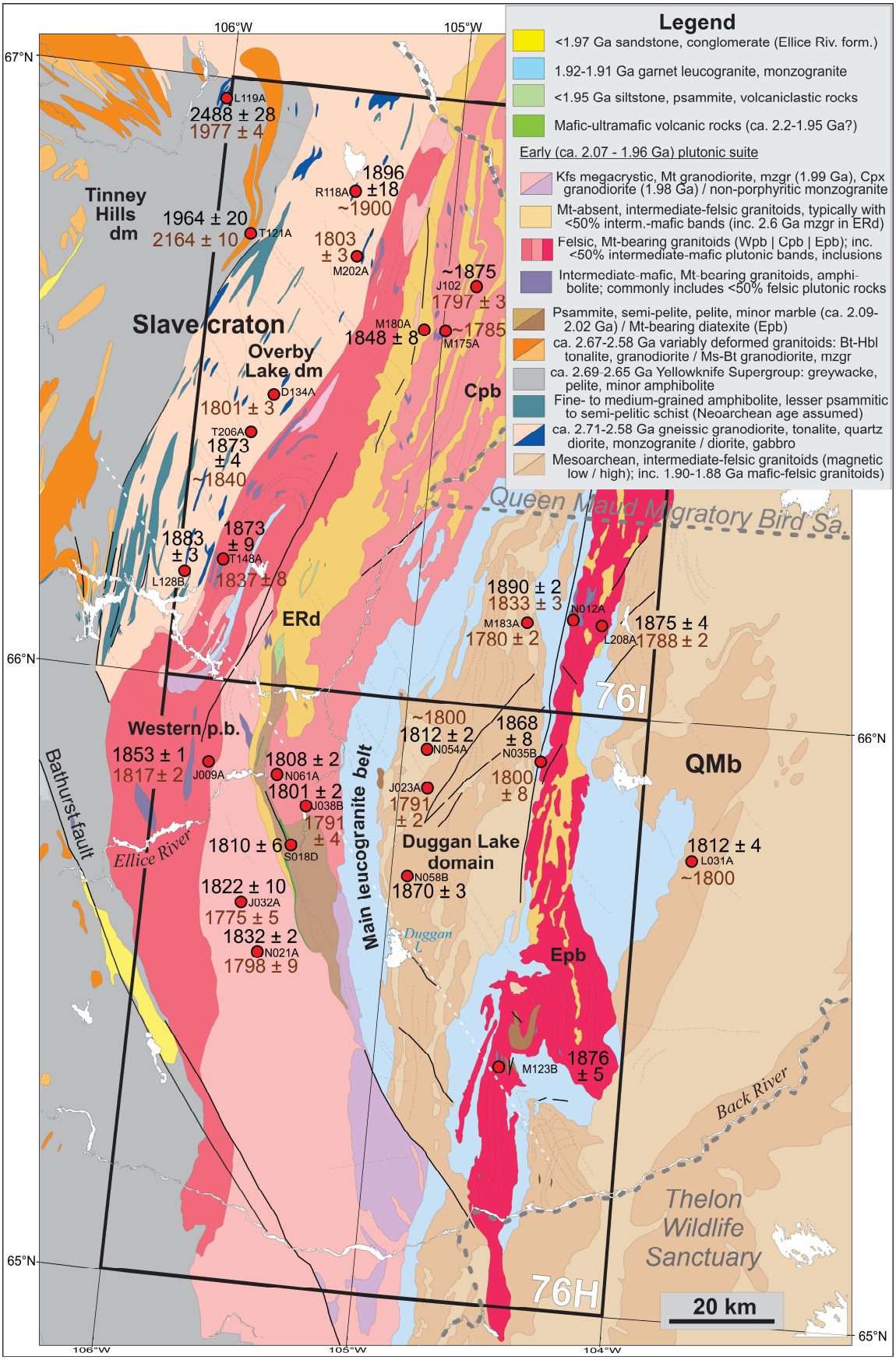

Legend
<1.97 Ga sandstone, conglomerate (Ellice Riv. form.)
1.92-1.91 Ga garnet leucogranite, monzogranite
<1.95 Ga siltstone, psammite, volcaniclastic rocks
Mafic-ultramafic volcanic rocks (ca. 2.2-1.95 Ga?)
Early (ca. 2.07 - 1.96 Ga) plutonic suite
Kfs megacrystic, Mt granodiorite, mzgr (1.99 Ga), Cpx granodiorite (1.98 Ga) / non-porphyritic monzogranite
Mt-absent, intermediate-felsic granitoids, typically with <50% interm.-mafic bands (inc. 2.6 Ga mzgr in ERd)
Felsic, Mt-bearing granitoids (Wpb | Cpb | Epb); inc. <50% intermediate-mafic plutonic bands, inclusions
Intermediate-mafic, Mt-bearing granitoids, amphibolite; commonly includes <50% felsic plutonic rocks
Psammite, semi-pelite, pelite, minor marble (ca. 2.09-2.02 Ga) / Mt-bearing diatexite (Epb)
ca. 2.67-2.58 Ga variably deformed granitoids: Bt-Hbl tonalite, granodiorite / Ms-Bt granodiorite, mzgr
ca. 2.69-2.65 Ga Yellowknife Supergroup: greywacke, pelite, minor amphibolite
Fine- to medium-grained amphibolite, lesser psammitic to semi-pelitic schist (Neoarchean age assumed)
ca. 2.71-2.58 Ga gneissic granodiorite, tonalite, quartz diorite, monzogranite / diorite, gabbro
Mesoarchean, intermediate-felsic granitoids (magnetic low / high); inc. 1.90-1.88 Ga mafic-felsic granitoids)
106°W
105°W
67°N
66°N
65°N
104°W
Tinney Hills dm
Slave craton
Overby Lake dm
Cpb
ERd
Western p.b.
Bathurst fault
Ellice River
Main leucogranite belt
Duggan Lake domain
Duggan L.
Epb
QMb
76I
76H
Queen Maud Migratory Bird Sa.
Back River
Thelon Wildlife Sanctuary
20 km
L119A 2488 ± 28 1977 ± 4
T121A 1964 ± 20 2164 ± 10
R118A 1896 ±18 ~1900
M202A 1803 ± 3
J102 ~1875 1797 ± 3
M180A 1848 ± 8
M175A ~1785
D134A 1801 ± 3
T206A 1873 ± 4 ~1840
L128B 1883 ± 3
T148A 1873 ± 9 1837 ± 8
M183A 1890 ± 2 1833 ± 3 1780 ± 2
N012A
L208A 1875 ± 4 1788 ± 2
J009A 1853 ± 1 1817 ± 2
N061A 1808 ± 2
J038B 1801 ± 2 1791 ± 4
S018D 1810 ± 6
J032A 1822 ± 10 1775 ± 5
N021A 1832 ± 2 1798 ± 9
N054A ~1800 1812 ± 2
N035B 1868 ± 8 1800 ± 8
J023A 1791 ± 2
N058B 1870 ± 3
L031A 1812 ± 4 ~1800
M123B 1876 ± 5

Figure 2 (opposite page). Simplified geologic map of the central Ttz (NTS map sheets 76H and 76I). $^{40}Ar/^{39}Ar$ cooling ages (Ma) are shown for hornblende (white) and biotite (brown) single crystals (Appendix A; note that sample prefixes are not included in this figure). Abbreviations: dm = domain; ERd = Ellice River domain; mzgr = monzogranite; p.b. = plutonic belt; QMb = Queen Maud block; THd = Tinney Hills domain. T1 = region with east-vergent thrust kinematics. Late folds at locations A and B parallel the Bathurst fault and the white dashed line separating older hornblende ages to the northeast.

low that comprises strongly foliated to mylonitic ca. 1.91 Ga peraluminous leucogranite with lesser garnet-sillimanite diatexite and garnet-free monzogranite (van Breemen et al., 1987; Berman et al., 2018; Berman et al., 2020*a*).

The region between the Archean basement of the Slave and Rae cratons consists primarily of ca. 2.01 – 1.98 Ga, commonly orthopyroxene-bearing plutonic rocks. Three discrete, linear, high-amplitude aeromagnetic anomalies distinguish the Western, Central, and Eastern plutonic belts from largely magnetite-absent plutonic rocks in the northern Ellice River domain (Fig. 2). Each of these four plutonic belts comprise a broad spectrum of compositions from gabbro to alkali feldspar granite, but quartz diorite, granodiorite and monzogranite are most common (Whalen et al., 2018). Sm-Nd isotopic data suggest that the basement to the Western, Eastern and Central plutonic belts is of western Rae (QMb) affinity (Berman et al., 2020*a*). The Ellice River supracrustal domain exposes two Paleoproterozoic sedimentary assemblages. The older psammitic to pelitic sequence was deposited after 2.09 Ga and likely prior to ca. 2.0 Ga since it contains no ca. 2.0-1.97 Ga "Thelon arc" detrital zircons (Davis et al., 2020). This contrasts with the younger sedimentary assemblage which was deposited after 1.95 Ga, and is dominated by ca. 2.0-1.95 Ga detrital zircons, inferred to have been derived from adjacent unroofed Ttz plutonic rocks. Associated, but discontinuous, <1 km wide strands of undated, ultramafic-mafic metavolcanic rocks are locally associated with polymetallic geochemical anomalies (e.g., Ag, Pb, Cu, Zn, Ni, U; McCurdy et al., 2013).

The Ttz has been strongly deformed during multiple episodes of deformation interpreted to reflect NW-directed thrusting driven by convergence between the Slave and Rae cratons, followed by dextral transpression during indentation of the Slave craton (Hoffman, 1988; Culshaw, 1991; Ma, 2017). In the Slave-THd domain, Neoarchean WNW-striking fabrics are preserved, with Ttz-age deformation on its eastern flank localized within narrow, discontinuous shear zones (Culshaw, 1991) and, on its western flank, as thin skinned, NW-verging basement-cover thrusts (Tirrul, 1985). Within the eastern margin of the Slave, Neoarchean fabrics are re-oriented into parallelism with the dominant NNE strike of the Ttz (Thompson et al., 1986). The intensity of deformation increases in the OLd where widely distributed, ~100 m to 1 km-wide zones of straight gneiss are characterized by steep, W-dipping foliations, shallow lineations and dextral kinematics (Culshaw, 1991). Most of the Ttz plutonic domains also display steep, W-dipping foliations and shallow lineations, except in southwestern 76I where foliations dip steeply to the southeast, and in northern 76I where lineations are more varied. Intense structural transposition (and limited outcrop) obscure the nature of primary contacts both between Ttz domains and with basement. Evidence suggestive of earlier thrusting has been recognized only in the main leucogranite belt (E-vergent, location T1, Fig. 2; Culshaw, 1991). Late ductile

deformation is manifested in a variably-developed, NW-striking foliation parallel to the trend of several map-scale folds (see locations A, B; Fig. 2). The dextral, strike-slip Bathurst fault (Fig. 2, southwest) was an active escape structure (Tapponnier and Molnar, 1975; Ma, 2017) during Slave indentation subsequent to an earlier stage of ductile, transpression separating regions with opposite vergence (Culshaw, 1991).

Five main metamorphic events are recognized in the study area (Davis et al., 2015; Mitchell et al., 2017; Berman et al., 2018): (1) ca. 2.58 Ga in the Tinney Hills domain, (2) ca. 2.4-2.35 Ga in the Duggan Lake domain and Queen Maud block, (3) ca. 2.0 Ga regional contact metamorphism associated with emplacement of Ttz plutonic belts, (4) 1.92-1.89 Ga upper amphibolite- to granulite-facies metamorphism (the most widespread event), and (5) ca. 1.82 Ga lower amphibolite-facies metamorphism recognized in several locations across the central Ttz (Davis et al. 2014; Mitchell et al. 2017).

$^{40}Ar/^{39}Ar$ ANALYTICAL TECHNIQUE

All $^{40}Ar/^{39}Ar$ analytical work was performed at the University of Manitoba using a multi-collector Thermo Fisher Scientific ARGUSVI mass spectrometer, linked to a stainless steel Thermo Fisher Scientific extraction/purification line and Photon Machines (55 W) Fusions 10.6 CO_2 laser. Argon isotopes (from mass 40 to 37) were measured using Faraday detectors with low noise 1 x 10^{12} Ω resistors and mass 36 was measured using a compact discrete dynode (CDD) detector. The sensitivity for argon measurements is ~6.312 x 10^{17} moles/fA as determined from measured aliquots of Fish Canyon Sanidine (Dazé et al., 2003; Kuiper et al., 2008).

Standards and unknowns were placed in 2 mm deep wells in 18 mm diameter aluminium disks, with standards placed strategically so that the lateral neutron flux gradients across the disk could be evaluated. Planar regressions were fit to the standard data, and the $^{40}Ar/^{39}Ar$ neutron fluence parameter, J, interpolated for the unknowns. Uncertainties in J are estimated at 0.1 - 0.2% (1σ), based on Monte Carlo error analysis of the planar regressions (Best et al., 1995). All samples were irradiated for a duration of 72 hours in the Cadmium-lined, in-core CLICIT facility of the Oregon State University TRIGA reactor. Samples were irradiated in two batches; one in 2016 and the other in 2018. The fluence monitor used was HB3GR amphibole (1073.6 ± 5.3 Ma; Jourdan et al., 2006).

Irradiated samples were placed in a Cu sample tray, with a KBr cover slip, in a stainless-steel high vacuum extraction line and baked with an infrared lamp for 24 hours. Single crystals were either fused or step-heated for ~40 s per step using the laser, and reactive gases were removed, after ~3 minutes, by three NP-10 SAES getters (two at room temperature and one at ~450°C) prior to being admitted to the ARGUSVI mass spectrometer by expansion. Five argon isotopes were measured simultaneously over a period of 6 minutes. Measured isotope abundances were corrected for extraction-line blanks, which were determined before every sample analysis. Line blanks averaged ~6.04 fA for mass 40 and ~0.02 fA for mass 36.

Mass discrimination was monitored by online analysis of air pipettes based on a power law relationship (Renne et al., 2009) which gave during two separate sessions (2016: D = 1.01055 ± 0.00255; 2018: 1.00657 ± 0.00229 per amu), based on a total of 309 aliquots interspersed with the unknowns. A value of 295.5 was used for the atmospheric $^{40}Ar/^{36}Ar$ ratio (Steiger and Jäger, 1977) for the purposes of routine measurement of mass spectrometer discrimination using air aliquots, and correction for atmospheric argon in the $^{40}Ar/^{39}Ar$ age calculation. Corrections are made for neutron-induced ^{40}Ar from potassium, ^{39}Ar and ^{36}Ar from calcium, and ^{36}Ar from chlorine (Roddick, 1983; Renne et al., 1998; Renne and Norman, 2001). Data collection was performed using Pychron (Ross, 2017) and data reduction, error propagation, age calculation and plotting were performed using MassSpec software (version 8.091; Deino, 2013). The decay constants used were those recommended by Steiger and Jäger (1977).

METHODOLOGY

Metamorphic hornblende and biotite were separated from felsic to mafic metaplutonic rocks to determine higher and lower temperature-time data to bracket the cooling history of metamorphic rocks across the study area. Results are presented on a sample by sample and mineral basis in this section, as well as summarized in Table 1. The spatial distribution of new $^{40}Ar/^{39}Ar$ cooling ages are presented on the litho-tectonic domain map of the region (Fig. 2).

The results presented below (p.11-74) include the preferred age and 2σ absolute error, and age significance for each sample/mineral, the level of confidence in the interpretation, a short sample description, a description of the rationale behind the age interpretation, and step-heat plots for any analyzed aliquots. The full data are included in Appendix A, organized according to sample (i.e. biotite and hornblende data for the same sample are listed together in a single worksheet). Note that inverse isochron diagrams are not presented in this report, as nearly all analyses are highly radiogenic and plot on, or near, the radiogenic $^{39}Ar/^{40}Ar$ axis.

In the step-heating results, a plateau is defined as three or more consecutive heating steps yielding the same apparent age (within 1σ) that, together, comprise at least 50 % of the total ^{39}Ar released. The plateau ages were calculated by weighting each step by the inverse of the variance. In several cases, multiple aliquots were analyzed due to complexities in the age spectrum observed from the first step-heating analysis (aliquot 1). Regardless of whether a statistical plateau was obtained, the age interpretation made considers the apparent likelihood of Ar loss and/or excess Ar contributions to the apparent Ar step heat ages. In all cases, an interpretation is provided, and qualified with a confidence level – high, intermediate or poor. Ages with poor interpretation confidence should be treated with extreme caution in applying these data to geological interpretations of the region, particularly where they deviate from a regional pattern. Integrated (total gas) ages were calculated by weighting all the individual step ages and respective errors by the fraction of ^{39}Ar released. In all cases, the reported age interpretation should be preferred, regardless of integrated or plateau age calculations.

Results of the $^{40}Ar/^{39}Ar$ step-heating analyses commonly show patterns diagnostic of both Ar loss and excess Ar. Partial Ar loss, the removal of a component of daughter $^{40}Ar^{K}$ from the mineral, is represented in the majority of Ar release spectra for both biotite and hornblende as a climbing staircase pattern in the initial low temperature steps (McDougall & Harrison, 1999). Alternatively, descending staircase patterns in the initial low temperature steps (or throughout the entire age spectrum), and/or unrealistically old apparent Ar ages or biotite $^{40}Ar/^{39}Ar$ ages older than hornblende $^{40}Ar/^{39}Ar$ ages for the same sample, are considered to be diagnostic of excess Ar, or $^{40}Ar_{K}$ derived from outside the mineral of interest (Kelley, 2002). Interaction of these two phenomena can produce hump-shape apparent age spectra for both biotite and hornblende. In all cases, age interpretations below have focused on the portions of step heat spectra that are "flat" or generally homogeneous. There are few instances in which a statistical plateau was determined for a stair-cased segment of the step-heat spectrum. In these cases, the statistical plateau is not used for interpretation of the mineral cooling age. Where there is evidence for significant Ar loss and significant inclusion of excess Ar, no age interpretation was made. In cases of multiple aliquots showing an excess Ar signature that approach a common apparent age in the final high temperature heating steps, this common apparent age is tentatively interpreted as a maximum cooling age for the analyzed mineral. These interpretations are usually and necessarily reported at a poor confidence level. In all diagrams shown below, plateau steps are magenta, rejected steps are cyan, box heights are 1σ, and plateau errors are reported at the 2σ level.

Note that nominal closure temperatures for ^{40}Ar in hornblende and biotite are ~550°C and ~300°C (e.g., McDougall and Harrison, 1999). However, closure temperature can vary given that it is dependent on the size of the diffusion domain (possibly the grain size), and the rate of cooling through the closure temperature, and therefore, in detail should be considered on a sample by sample basis.

RESULTS

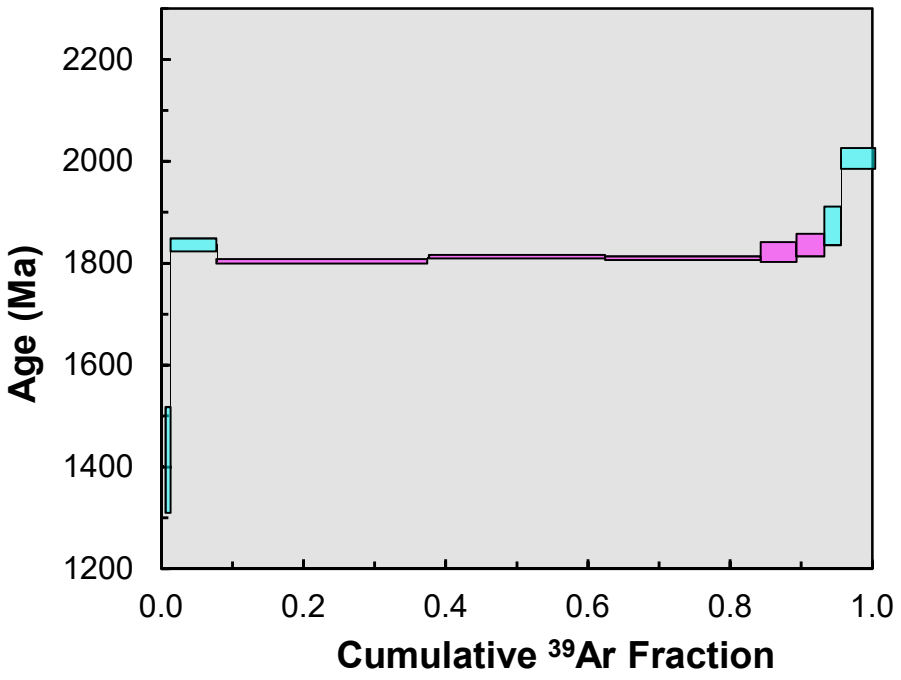
Queen Maud block

Sample Number: 12NK-L031A
Lithology: Granodiorite
Mineral analyzed: Hornblende
Age: 1812 ± 4 Ma
Interpretation: cooling age
Confidence: high

Location: western Queen Maud block
Lat: 65.772296
Long: -103.775035

Sample Description: Coarse-grained, strongly foliated biotite hornblende granodiorite

Results: Plateau age of 1812 ± 4 Ma (n = 5 steps, MSWD = 1.2, including 85.5% of ^{39}Ar released) is interpreted to represent the cooling age for hornblende in this sample.



Queen Maud block

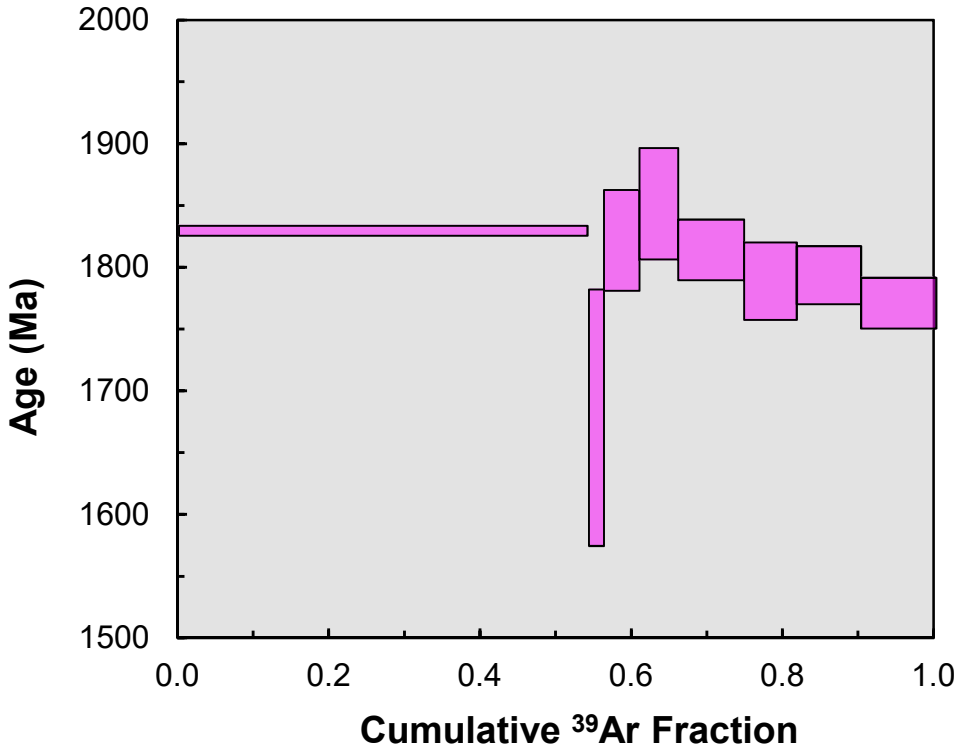
Sample Number: 12NK-L031A
Lithology: Granodiorite
Mineral analyzed: Biotite
Age: ~1800 Ma
Interpretation: cooling age
Confidence: low

Location: western Queen Maud block

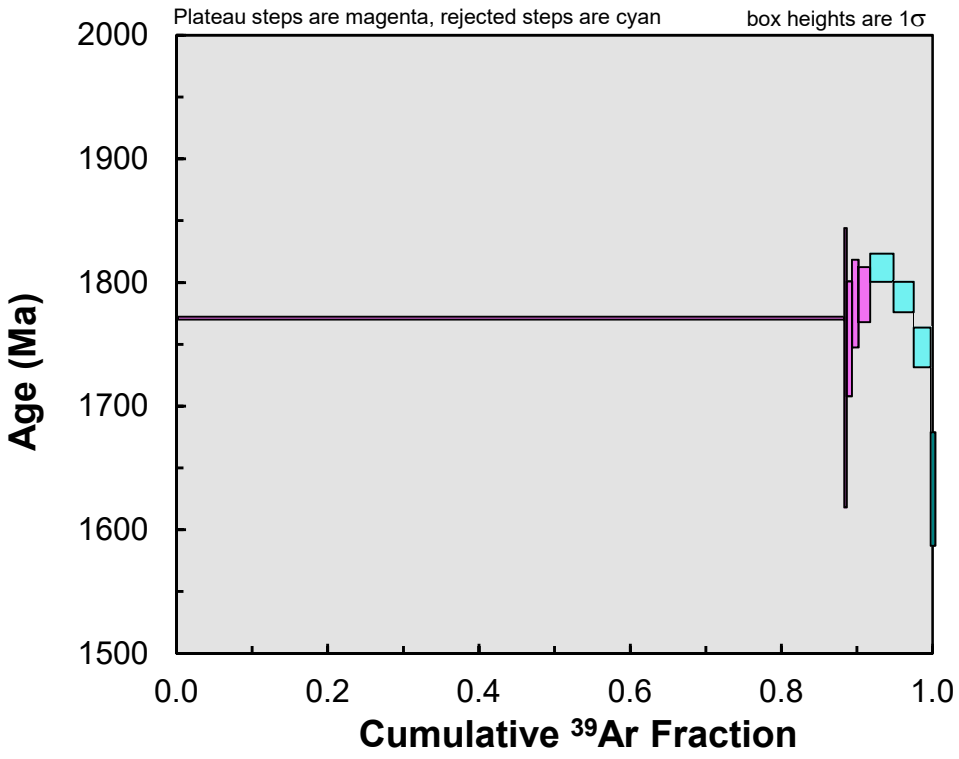
Lat: 65.772296
Long: -103.775035

Sample Description: Coarse-grained, strongly foliated biotite hornblende granodiorite

Results: Step heating of two biotite crystals produced discordant "plateaus" resulting in ages of 1826 ± 11 Ma (n = 9 steps, MSWD = 1.8, including 100% of ^{39}Ar released) and 1772 ± 3 Ma (n = 5 steps, MSWD = 0.28, including 91.4% of ^{39}Ar released). The majority of the ^{39}Ar released was in the first step, at very low power, and indicates that the crystals may be altered.



Grain 1


Plateau steps are magenta, rejected steps are cyan
box heights are 1σ
2000
1900
1800
1700
1600
1500
Age (Ma)
0.0
0.2
0.4
0.6
0.8
1.0
Cumulative 39Ar Fraction

Grain 2

Thelon tectonic zone

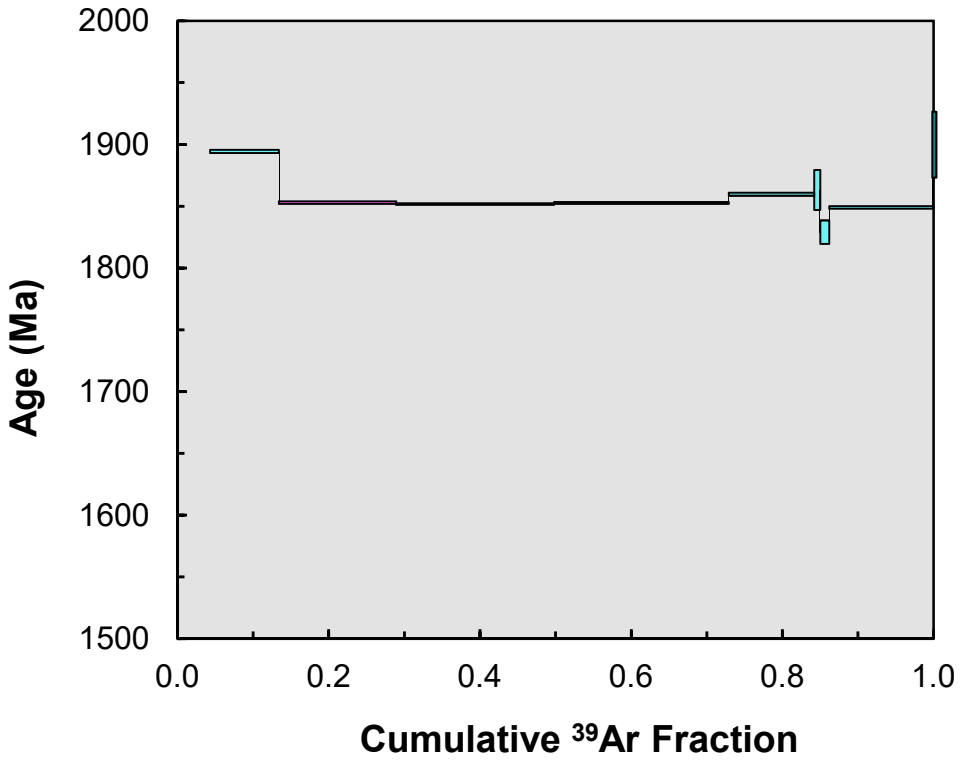
Sample Number: 14NK-J009A
Lithology: Quartz monzonite
Mineral analyzed: Hornblende
Age: 1853 ± 1 Ma
Interpretation: cooling age
Confidence: high

Location: Thelon tectonic zone (Western plutonic belt)

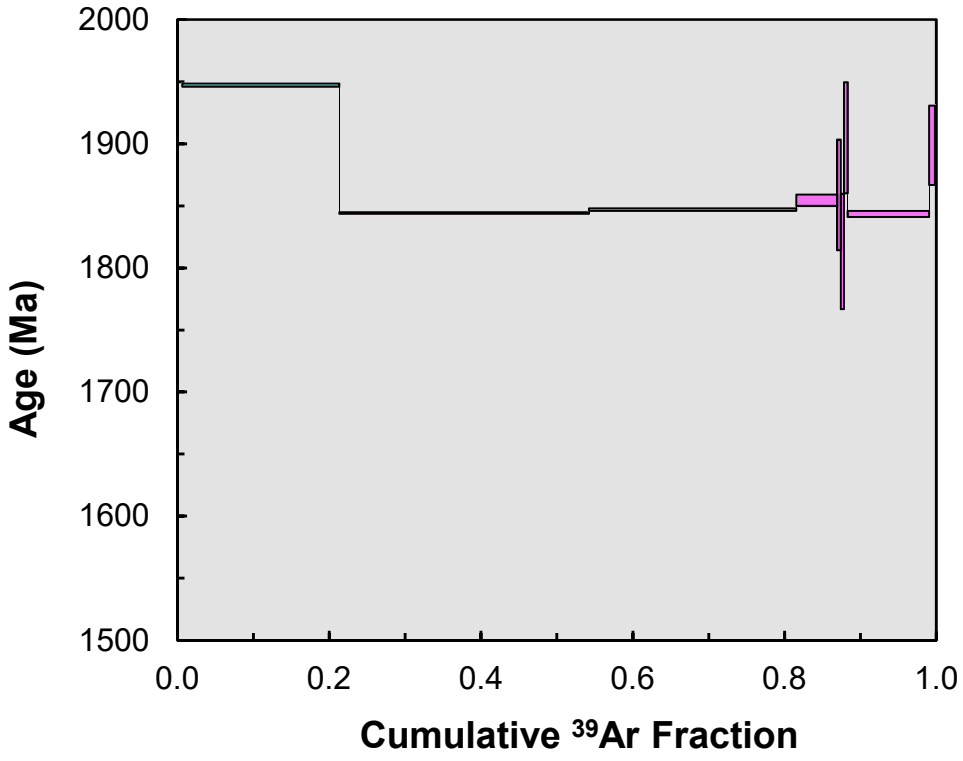
Lat: 65.8627 N
Long: 105.7878 W

Sample Description: Coarse-grained, unfoliated to weakly foliated quartz monzonite

Results: Step heating of two hornblende crystals produced plateaus resulting in ages of 1853 ± 1 Ma (n = 3 steps, MSWD = 0.72, including 59.5 % of ^{39}Ar released) and 1847 ± 2 Ma (n = 9 steps, MSWD = 2.0, including 78.9 % of ^{39}Ar released).



Grain 1


2000
1900
1800
1700
1600
1500
Age (Ma)
0.0
0.2
0.4
0.6
0.8
1.0
Cumulative 39Ar Fraction

Grain 2

Thelon tectonic zone

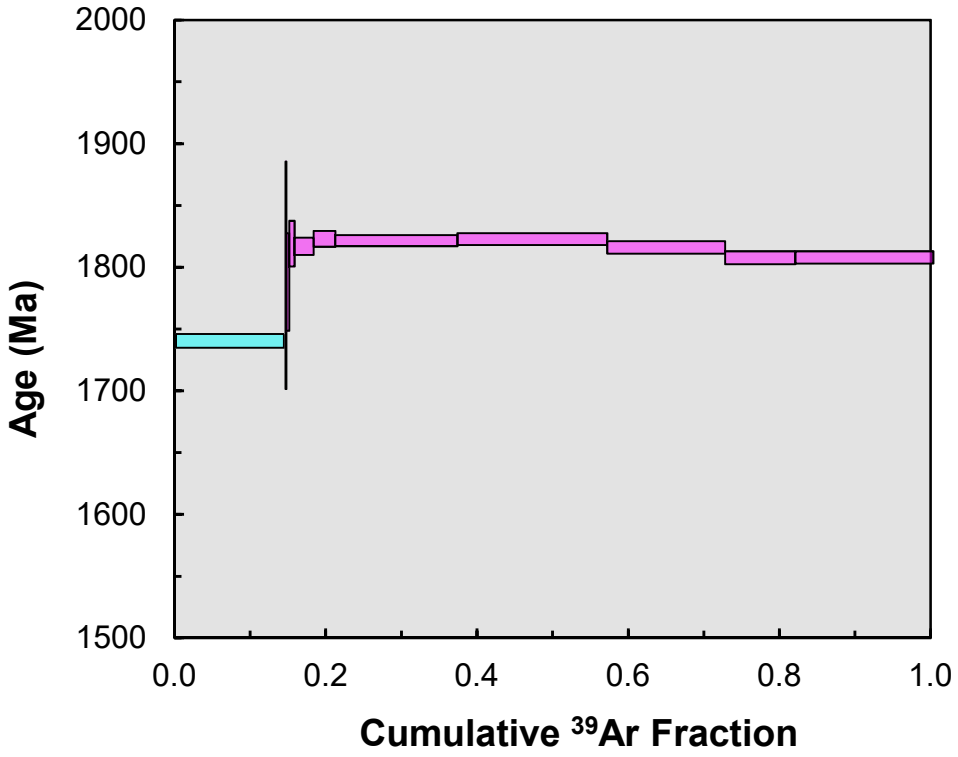
Sample Number: 14NK-J009A
Lithology: Quartz monzonite
Mineral analyzed: Biotite
Age: 1817 ± 4 Ma
Interpretation: cooling age
Confidence: high

Location: Thelon tectonic zone (Western plutonic belt)

Lat: 65.8627 N
Long: 15.7878 W

Sample Description: Coarse-grained, unfoliated to weakly foliated quartz monzonite

Results: Plateau age of 1817 ± 4 Ma (n = 7 steps, MSWD = 1.13, including 85.6 % of ^{39}Ar released) is interpreted to represent the cooling age for biotite in this sample.



Queen Maud block

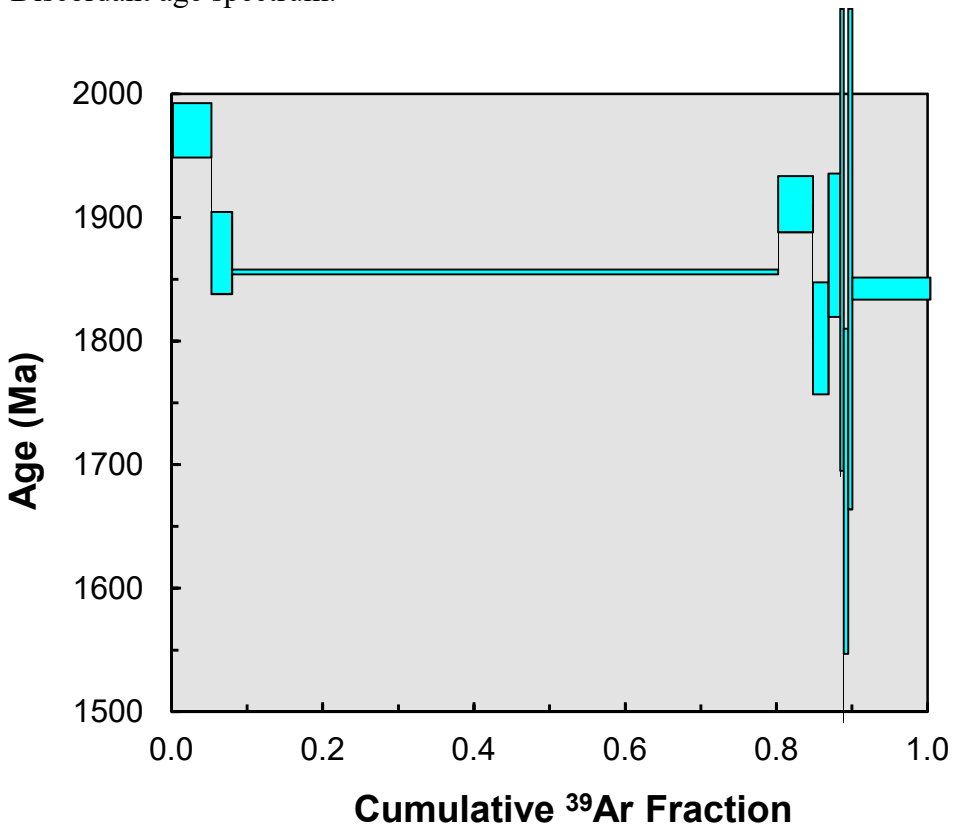
Sample Number: 14NK-J023A
Lithology: Monzogranite
Mineral analyzed: Hornblende
Age: NO AGE
Interpretation: N/A
Confidence: N/A

Location: western Queen Maud block (Duggan Lake domain)

Lat: 65.8558 N
Long: 104.8838 W

Sample Description: Coarse-grained, unfoliated to weakly foliated monzogranite

Results: Discordant age spectrum.



Queen Maud block

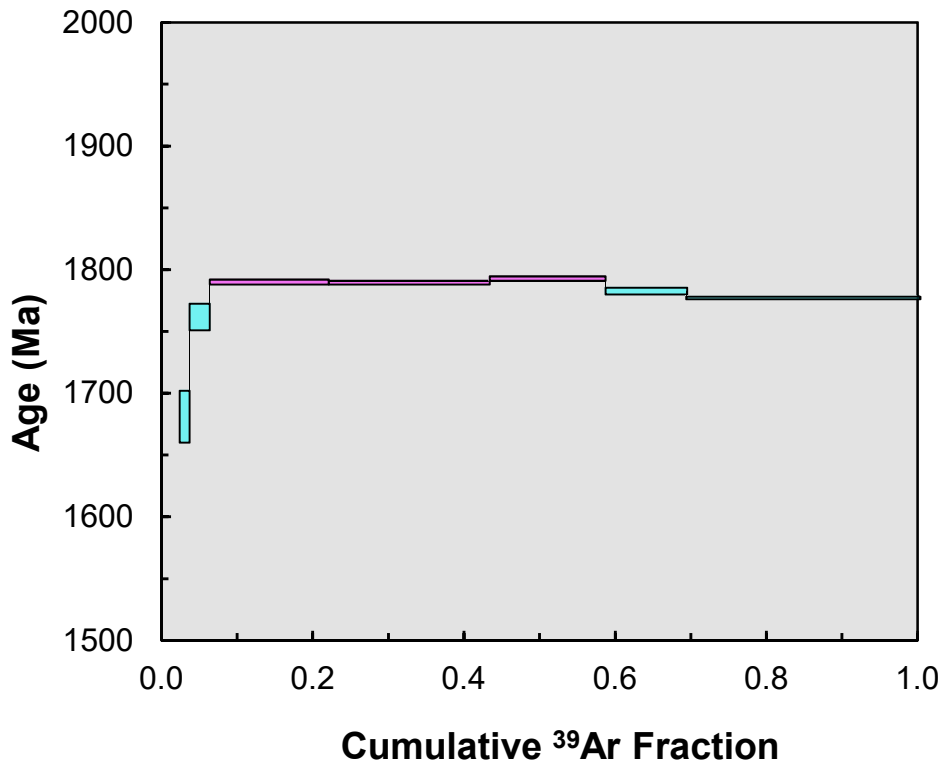
Sample Number: 14NK-J023A
Lithology: Monzogranite
Mineral analyzed: Biotite
Age: 1791 ± 2 Ma
Interpretation: cooling age
Confidence: medium

Location: western Queen Maud block (Duggan Lake domain)

Lat: 65.8558 N
Long: 104.8838 W

Sample Description: Coarse-grained, unfoliated to weakly foliated monzogranite

Results: Plateau age of 1791 ± 2 Ma (n = 3 steps, MSWD = 0.96, including 52.3 % of ^{39}Ar released) is interpreted to represent the cooling age for biotite in this sample.



Thelon tectonic zone

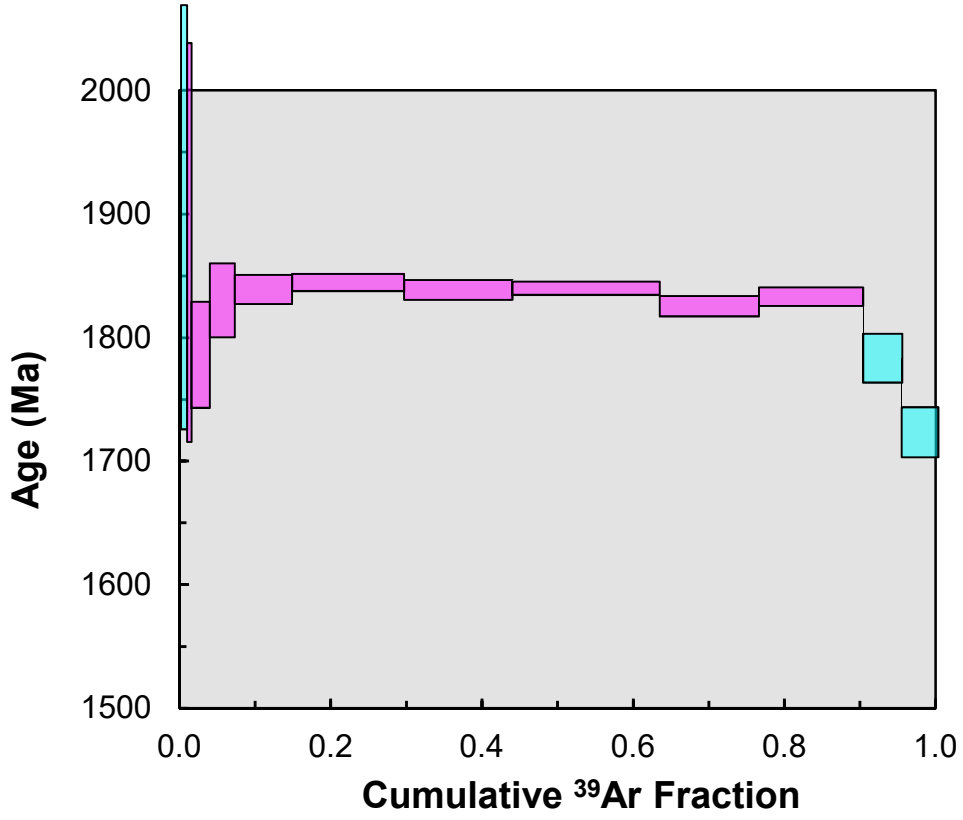
Sample Number: 14NK-J032A
Lithology: Monzogranite
Mineral analyzed: Hornblende
Age: 1822 ± 10 Ma
Interpretation: cooling age
Confidence: high

Location: Thelon tectonic zone (Western plutonic belt)

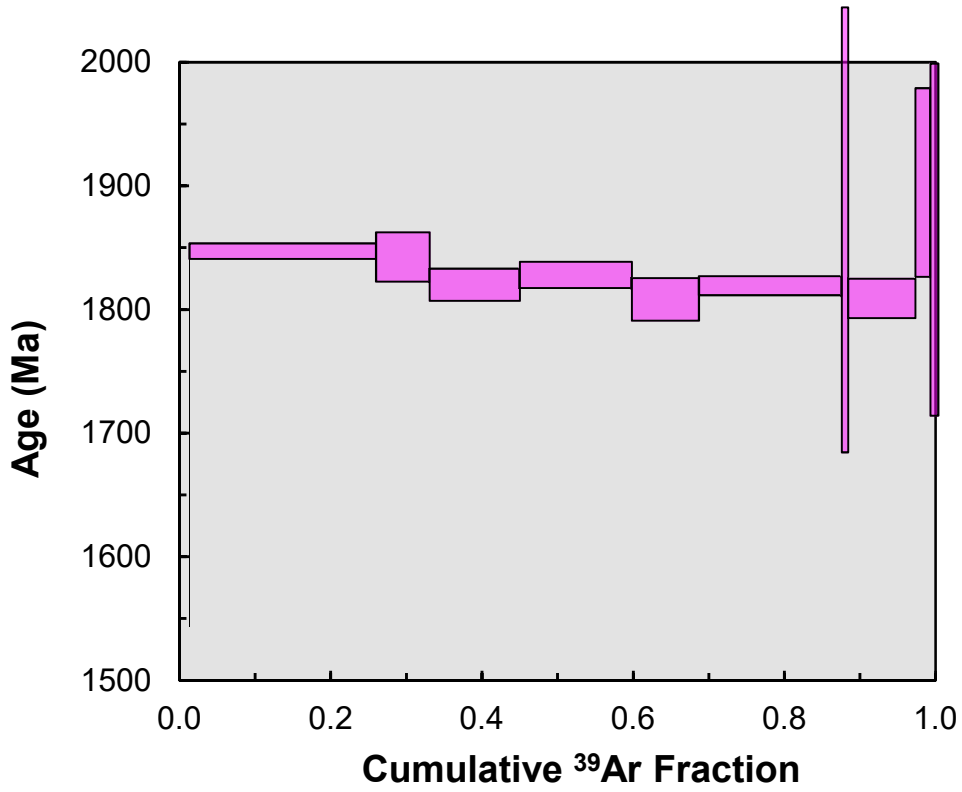
Lat: 65.6359 N
Long: 105.5954 W

Sample Description: Medium to coarse-grained, strongly foliated monzogranite

Results: Step heating of two hornblende crystals produced plateaus resulting in ages of 1822 ± 10 Ma (n = 9 steps, MSWD = 0.5, including 74.3 % of ^{39}Ar released) and 1831 ± 11 Ma (n = 10 steps, MSWD = 1.6, including 98.6 % of ^{39}Ar released).



Grain 1


2000
1900
1800
1700
1600
1500
Age (Ma)
0.0
0.2
0.4
0.6
0.8
1.0
Cumulative 39Ar Fraction

Grain 2

Thelon tectonic zone

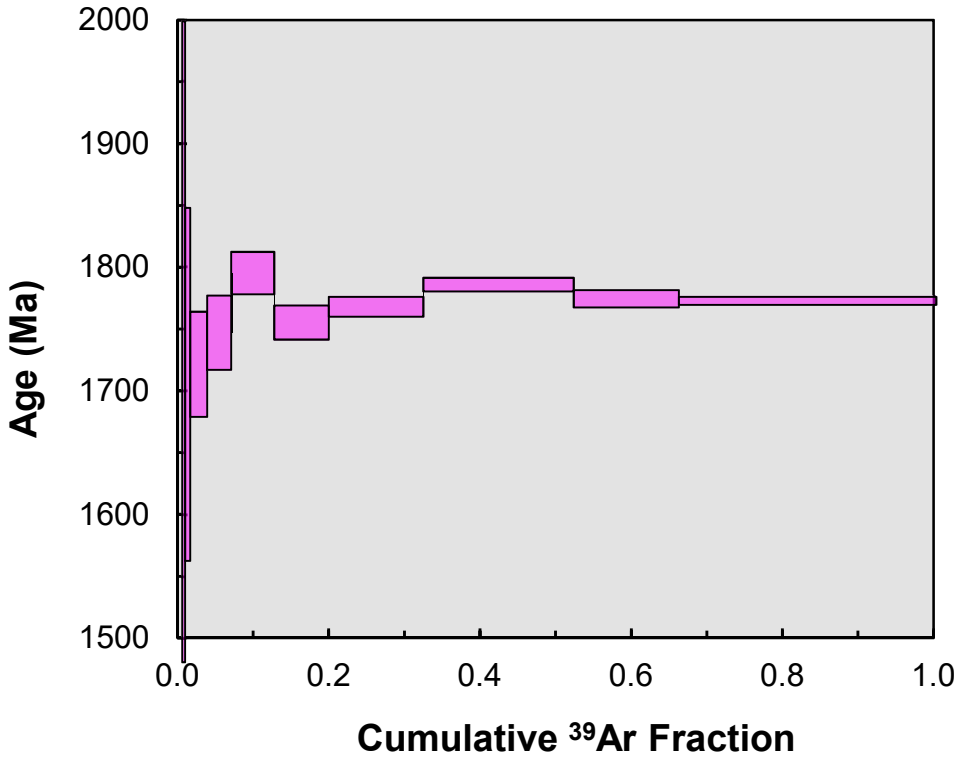
Sample Number: 14NK-J032A
Lithology: Monzogranite
Mineral analyzed: Biotite
Age: 1775 ± 5 Ma
Interpretation: cooling age
Confidence: high

Location: Thelon tectonic zone (Western plutonic belt)

Lat: 65.6359 N
Long: 105.5954 W

Sample Description: Medium to coarse-grained, strongly foliated monzogranite

Results: Plateau age of 1775 ± 5 Ma (n = 11 steps, MSWD = 1.3, including 99.6 % of ^{39}Ar released) is interpreted to represent the cooling age for biotite in this sample.



Thelon tectonic zone

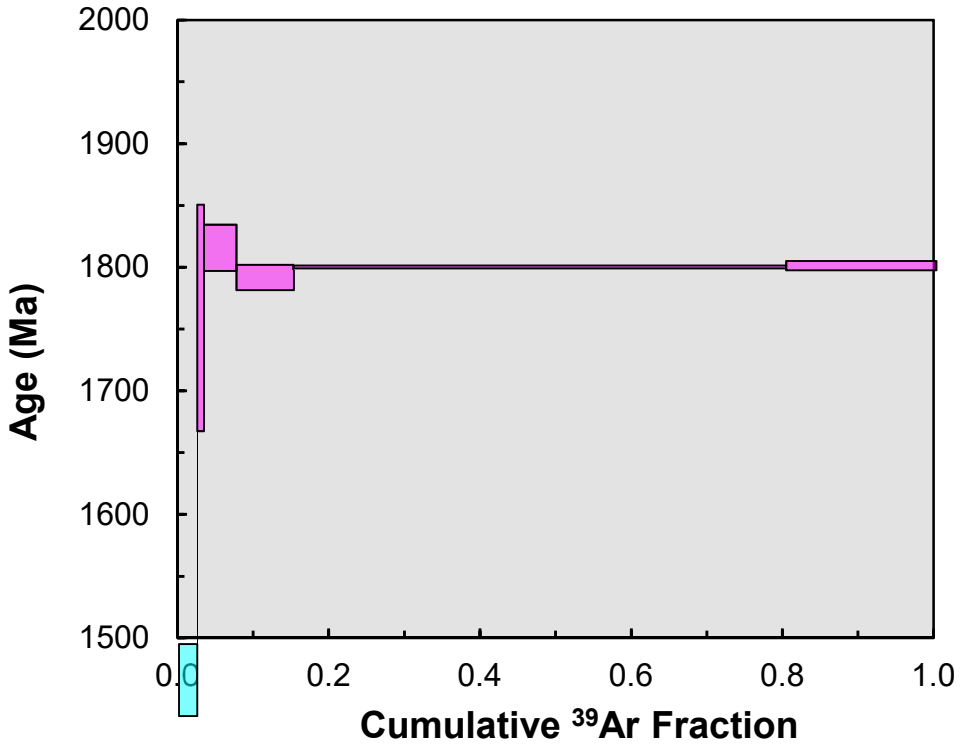
Sample Number: 14NK-J038B
Lithology: Quartz monzonite
Mineral analyzed: Hornblende
Age: 1801 ± 2 Ma
Interpretation: cooling age
Confidence: high

Location: Thelon tectonic zone (southern Central plutonic belt)

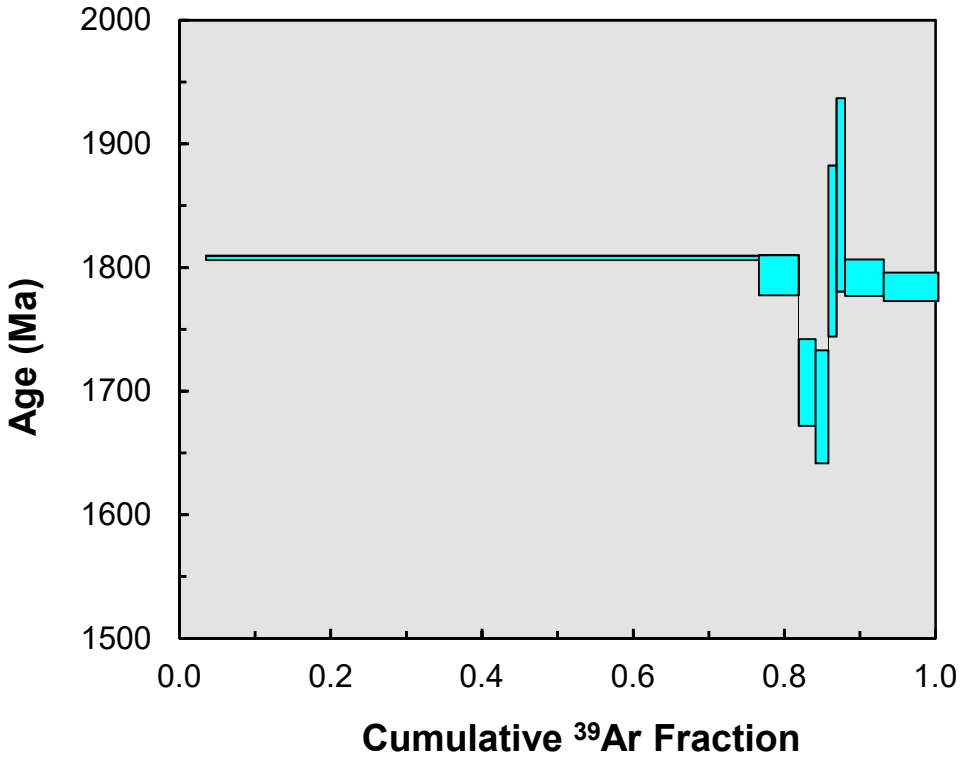
Lat: 65.8063 N
Long: 105.372 W

Sample Description: Fine to medium-grained, moderately foliated biotite quartz monzonite

Results: Step heating of two hornblende crystals produced (a) an age spectrum yielding a plateau age of 1801 ± 2 Ma (n = 5 steps, MSWD = 0.42, including 97.6 % of ^{39}Ar released) and (b) a discordant age spectrum. The majority (73.01 %) of the ^{39}Ar was released in one step and yields an age of 1808 ± 4 Ma, which is similar to the age obtained in the first analysis.



Grain 1


2000
1900
1800
1700
1600
1500
Age (Ma)
0.0
0.2
0.4
0.6
0.8
1.0
Cumulative 39Ar Fraction

Grain 2

Thelon tectonic zone

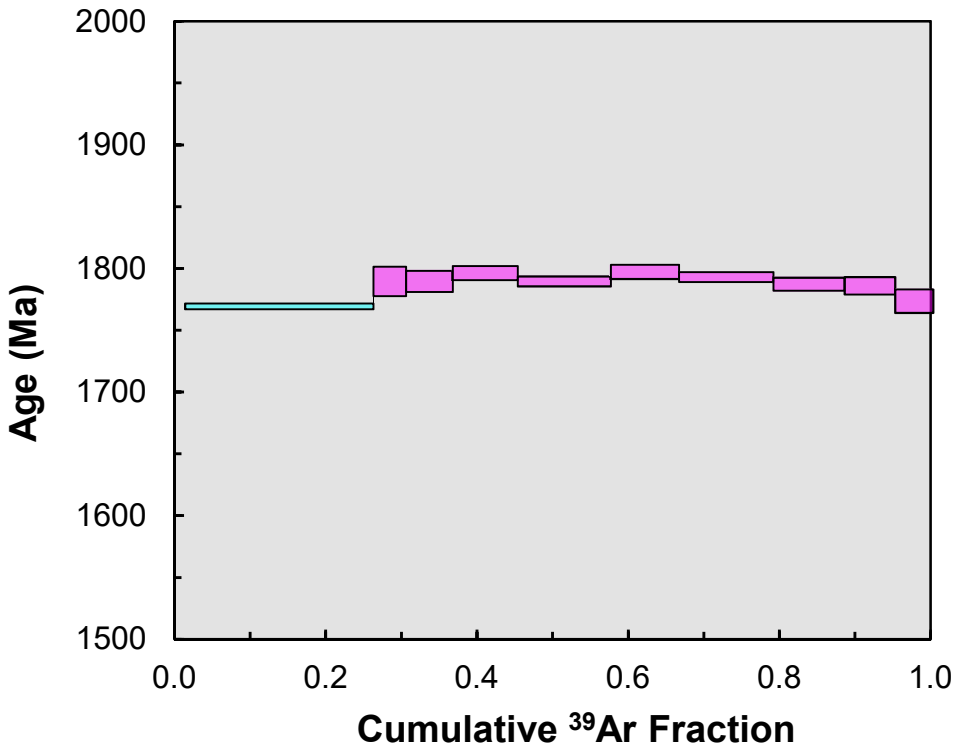
Sample Number: 14NK-J038B
Lithology: Quartz monzonite
Mineral analyzed: Biotite
Age: 1791 ± 4 Ma
Interpretation: cooling age
Confidence: high

Location: Thelon tectonic zone (central plutonic belt)

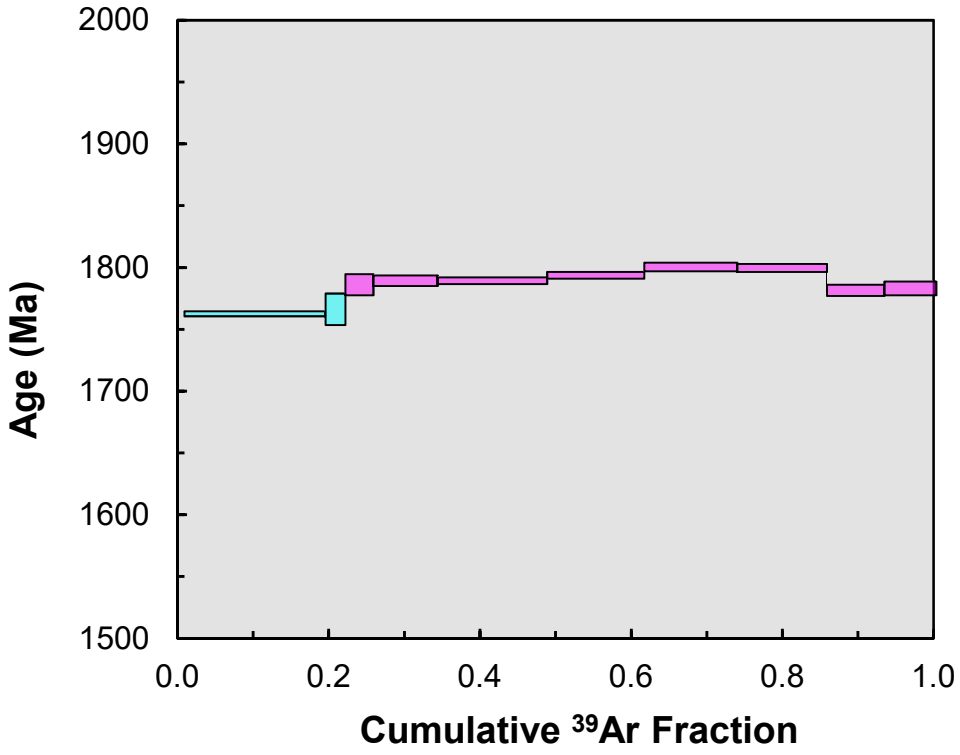
Lat: 65.8063 N
Long: 105.372 W

Sample Description: Fine to medium-grained, moderately foliated biotite quartz monzonite

Results: Step heating of two biotite crystals produced (a) an age spectrum yielding a plateau age of 1791 ± 4 Ma (n = 9 steps, MSWD = 0.82 including 74.0 % of ^{39}Ar released) and (b) a discordant age spectrum with an age of 1793 ± 5 Ma (n = 8 steps, MSWD = 3.5, including 80.6 % of ^{39}Ar released), which is within error of the first analysis.



Grain 1


2000
1900
1800
1700
1600
1500
Age (Ma)
0.0
0.2
0.4
0.6
0.8
1.0
Cumulative 39Ar Fraction

Grain 2

Thelon tectonic zone

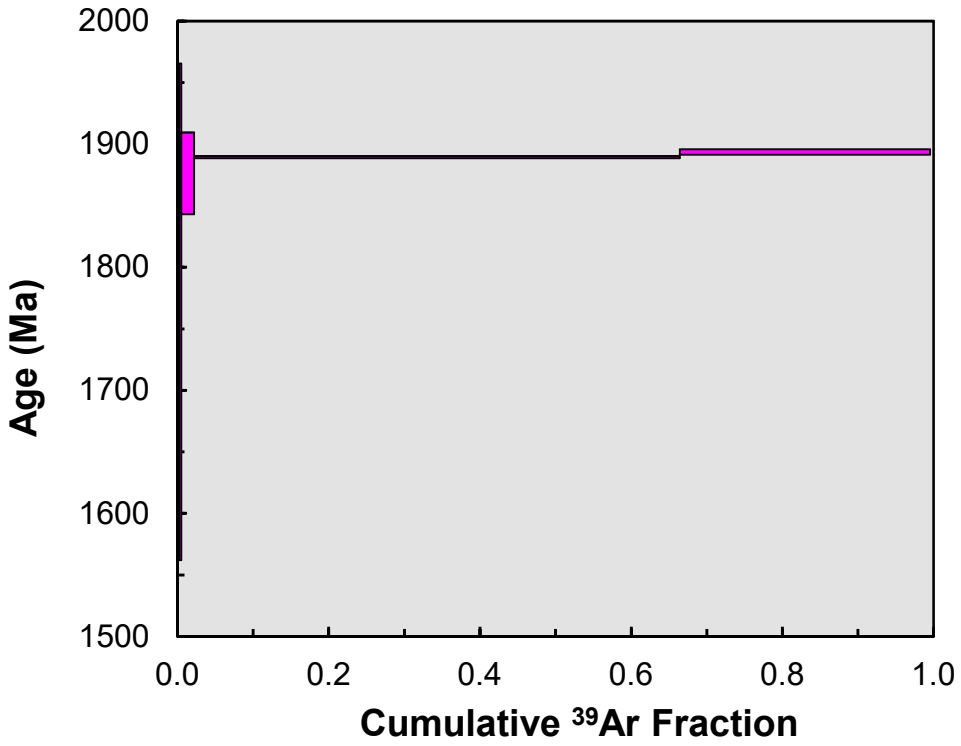
Sample Number: 14NK012A
Lithology: Diorite
Mineral analyzed: Hornblende
Age: 1890 ± 2 Ma
Interpretation: cooling age
Confidence: high

Location: Thelon tectonic zone (Eastern plutonic belt)

Lat: 66.1566 N
Long: 104.3452 W

Sample Description: Foliated meta-diorite enclave hosted by granodiorite

Results: Plateau age of 1890 ± 2 Ma (n = 8 steps, MSWD = 1.02, including 100.0 % of ^{39}Ar released) is interpreted to represent the cooling age for hornblende in this sample.



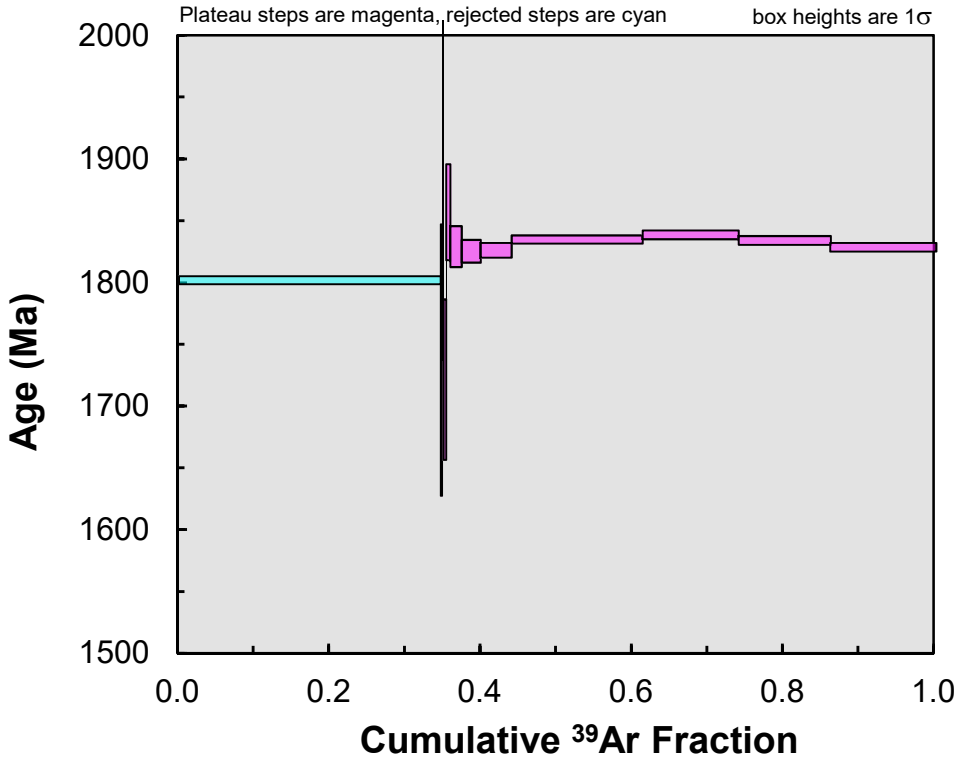
Thelon tectonic zone

Sample Number: 14NK-N012A
Lithology: Diorite
Mineral analyzed: Biotite
Age: 1833 ± 3 Ma
Interpretation: cooling age
Confidence: high

Location: Thelon tectonic zone (Eastern plutonic belt)
Lat: 66.1566 N
Long: 104.3452 W

Sample Description: Foliated meta-diorite enclave hosted by granodiorite

Results: Plateau age of 1833 ± 3 Ma (n = 9 steps, MSWD = 1.3, including 65.5% of ^{39}Ar released) is interpreted to represent the cooling age for hornblende in this sample.



Thelon tectonic zone

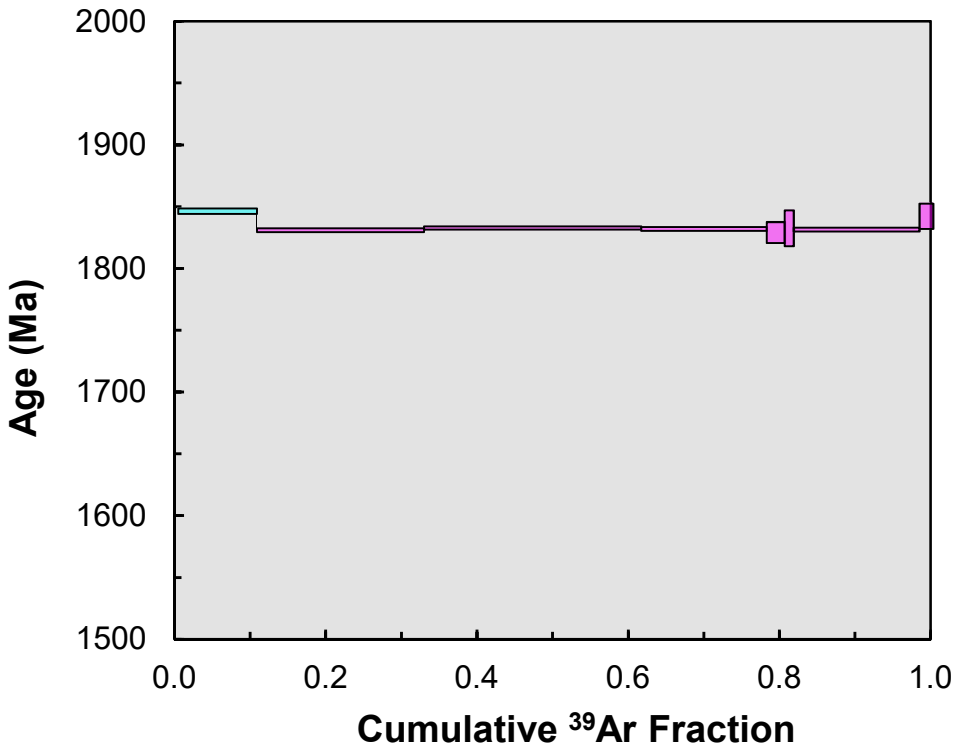
Sample Number: 14NK-N021A02
Lithology: Quartz Monzodiorite
Mineral analyzed: Hornblende
Age: 1832 ± 2 Ma
Interpretation: cooling age
Confidence: high

Location: Thelon tectonic zone (western plutonic belt)

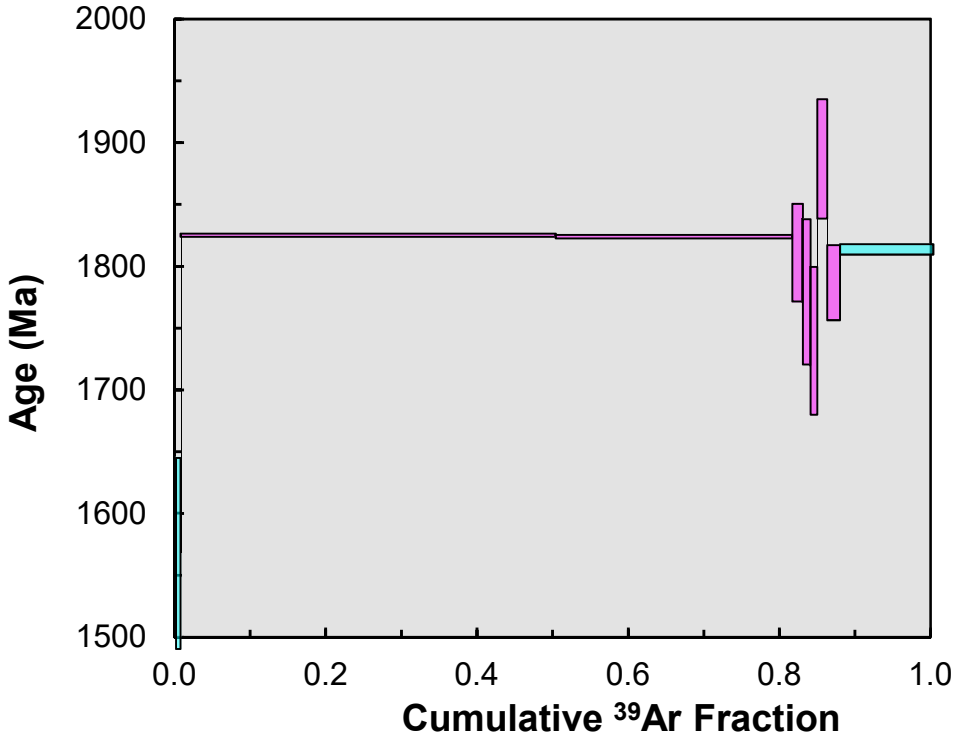
Lat: 65.5557 N
Long: 105.5088 W

Sample Description: Coarse-grained, weakly foliated hornblende biotite quartz monzodiorite

Results: Step heating of two hornblende crystals produced plateaus resulting in ages of 1832 ± 2 Ma (n = 7 steps, MSWD = 0.34, including 89.4 % of ^{39}Ar released) and 1825 ± 2 Ma (n = 7 steps, MSWD = 1.07, including 87.1 % of ^{39}Ar released).



Grain 1


2000
1900
1800
1700
1600
1500
Age (Ma)
0.0
0.2
0.4
0.6
0.8
1.0
Cumulative 39Ar Fraction

Grain 2

Thelon tectonic zone

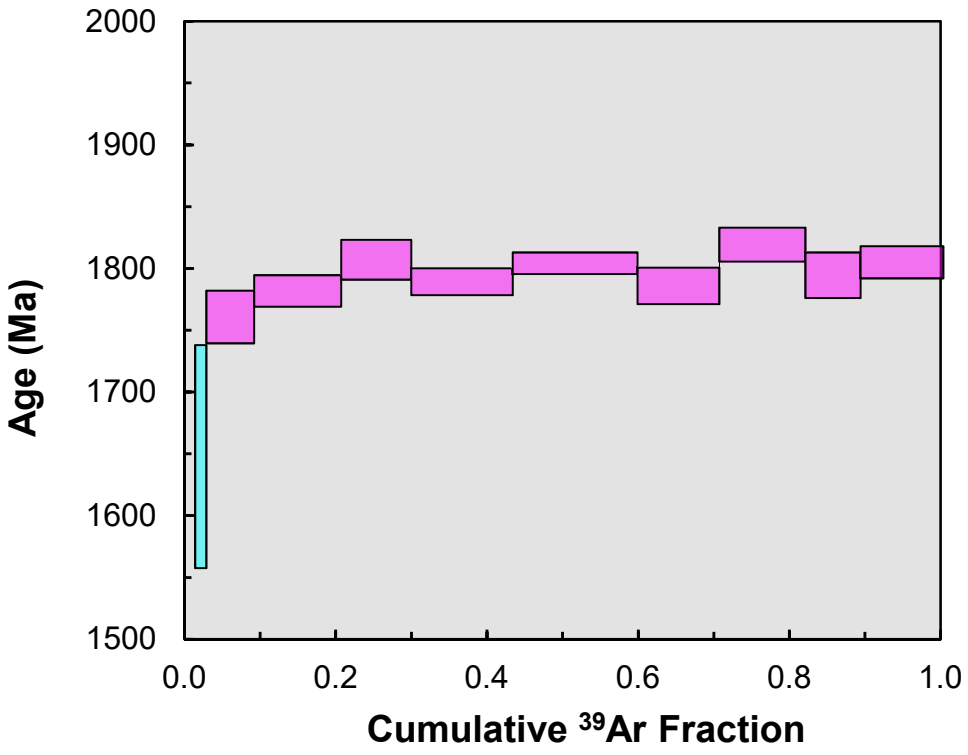
Sample Number: 14NK-N021A02
Lithology: Quartz Monzodiorite
Mineral analyzed: Biotite
Age: 1798 ± 9 Ma
Interpretation: cooling age
Confidence: high

Location: Thelon tectonic zone (western plutonic belt)

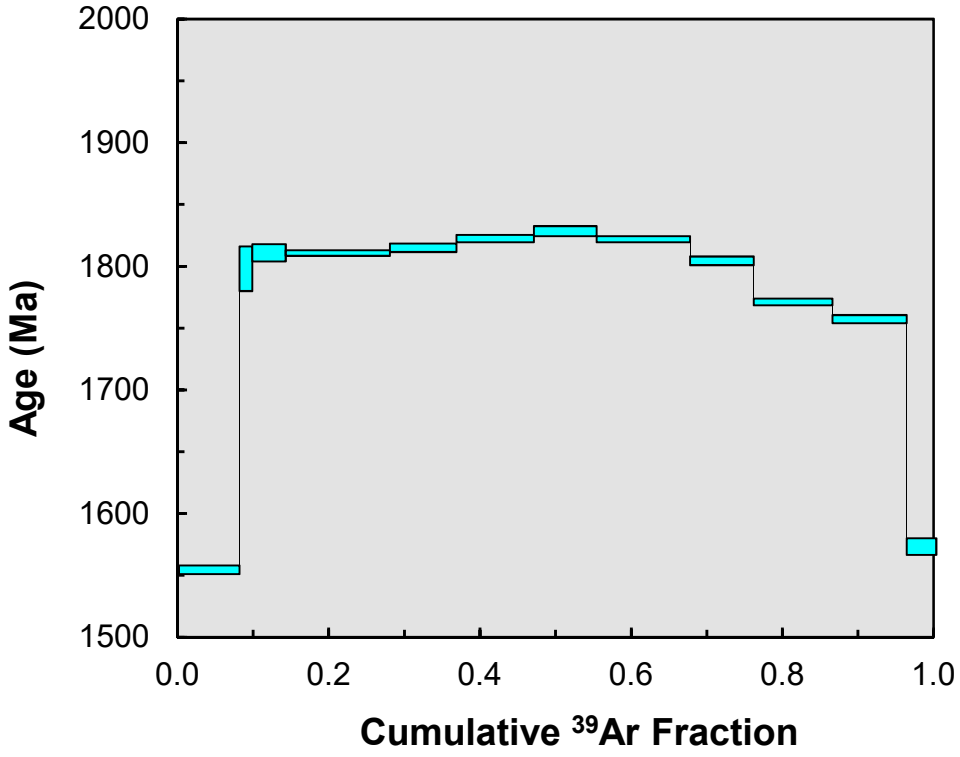
Lat: 65.5557 N
Long: 105.5088 W

Sample Description: Coarse-grained, weakly foliated hornblende biotite quartz monzodiorite

Results: Step heating of two biotite crystals produced (a) an age spectrum yielding a plateau age of 1798 ± 9 Ma (n = 9 steps, MSWD = 1.2, including 97.3 % of ^{39}Ar released) and (b) a discordant age spectrum.



Grain 1


2000
1900
1800
1700
1600
1500
Age (Ma)
0.0
0.2
0.4
0.6
0.8
1.0
Cumulative 39Ar Fraction

Grain 2

Thelon tectonic zone

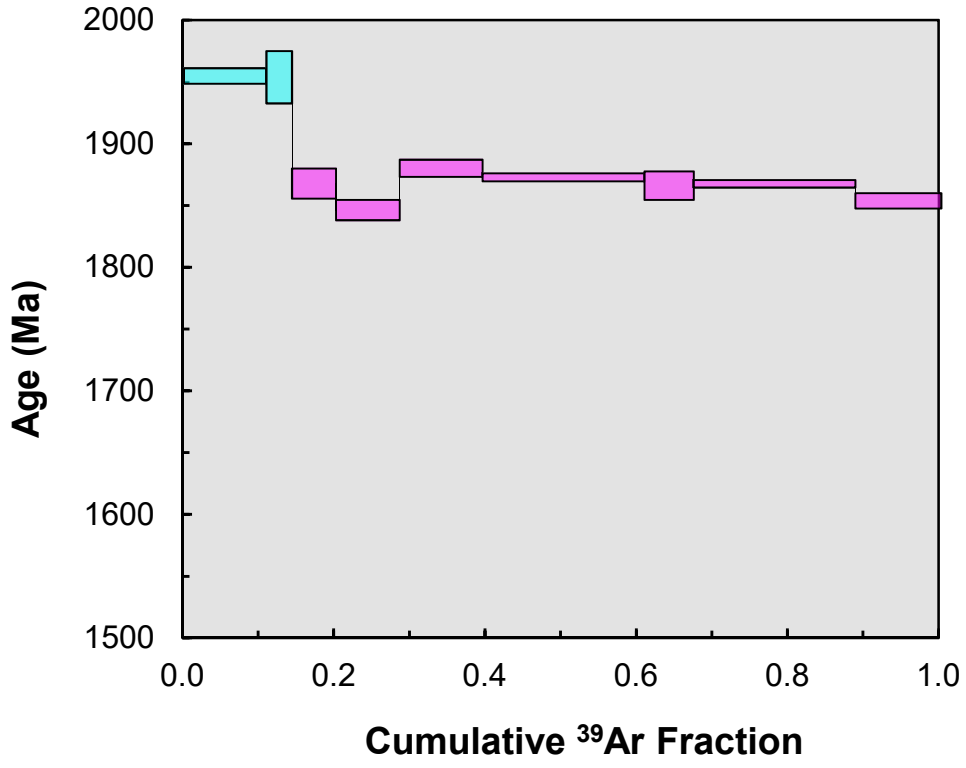
Sample Number: 14NK-N035B
Lithology: diorite
Mineral analyzed: Hornblende
Age: 1868 ± 8 Ma
Interpretation: cooling age
Confidence: high

Location: Thelon tectonic zone (central plutonic belt)

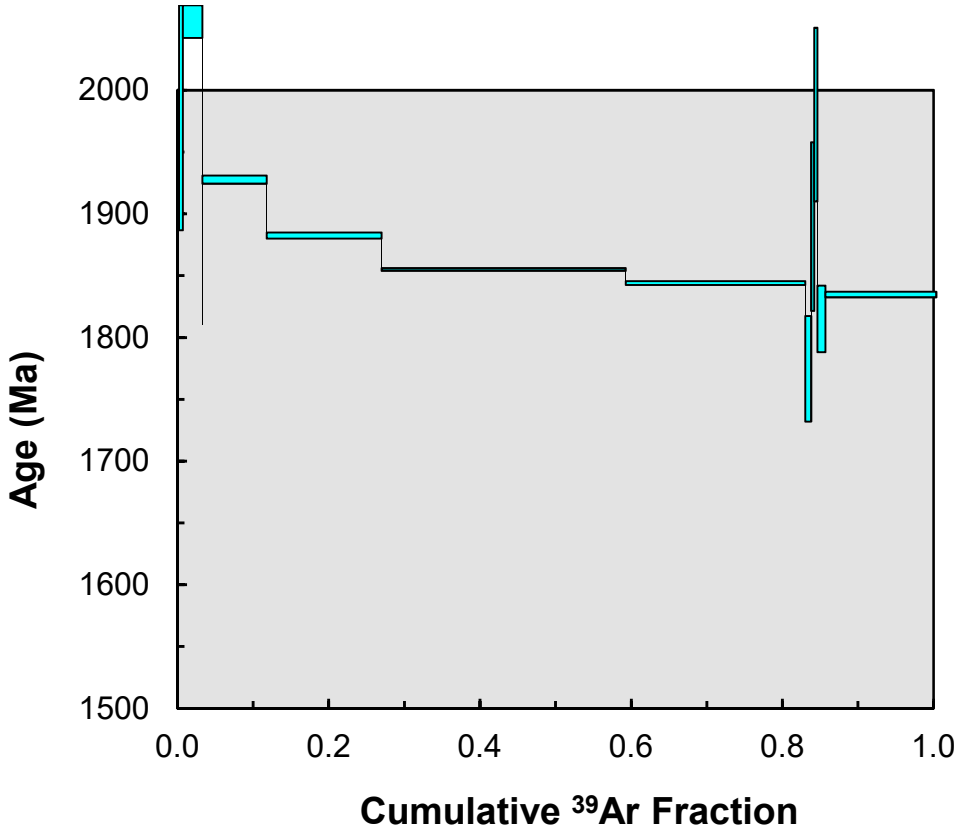
Lat: 65.9165 N
Long: 104.4297 W

Sample Description: Fine to medium-grained, weakly foliated clinopyroxene hornblende biotite diorite

Results: Step heating of two hornblende crystals produced (a) an age spectrum yielding a plateau age of 1868 ± 8 Ma (n = 7 steps, MSWD = 2.9, including 85.8 % of ^{39}Ar released) and (b) a discordant age spectrum.



Grain 1


2000
1900
1800
1700
1600
1500
Age (Ma)
0.0
0.2
0.4
0.6
0.8
1.0
Cumulative 39Ar Fraction

Grain 2

Thelon tectonic zone

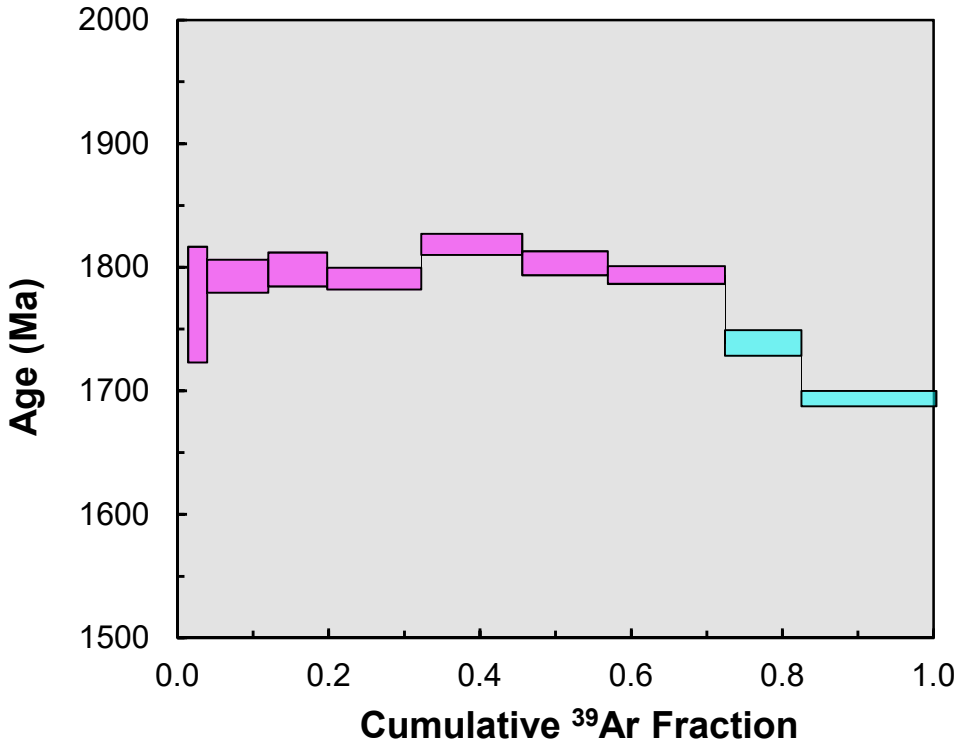
Sample Number: 14NK-N035B
Lithology: diorite
Mineral analyzed: Biotite
Age: 1800 ± 8 Ma
Interpretation: cooling age
Confidence: high

Location: Thelon tectonic zone (Eastern plutonic belt)

Lat: 65.9165 N
Long: 104.4297 W

Sample Description: Fine to medium-grained, weakly foliated clinopyroxene, hornblende, biotite diorite

Results: Plateau age of 1800 ± 8 Ma (n = 8 steps, MSWD = 1.16, including 71.3 % of ^{39}Ar released) is interpreted to represent the cooling age for biotite in this sample.



Queen Maud block

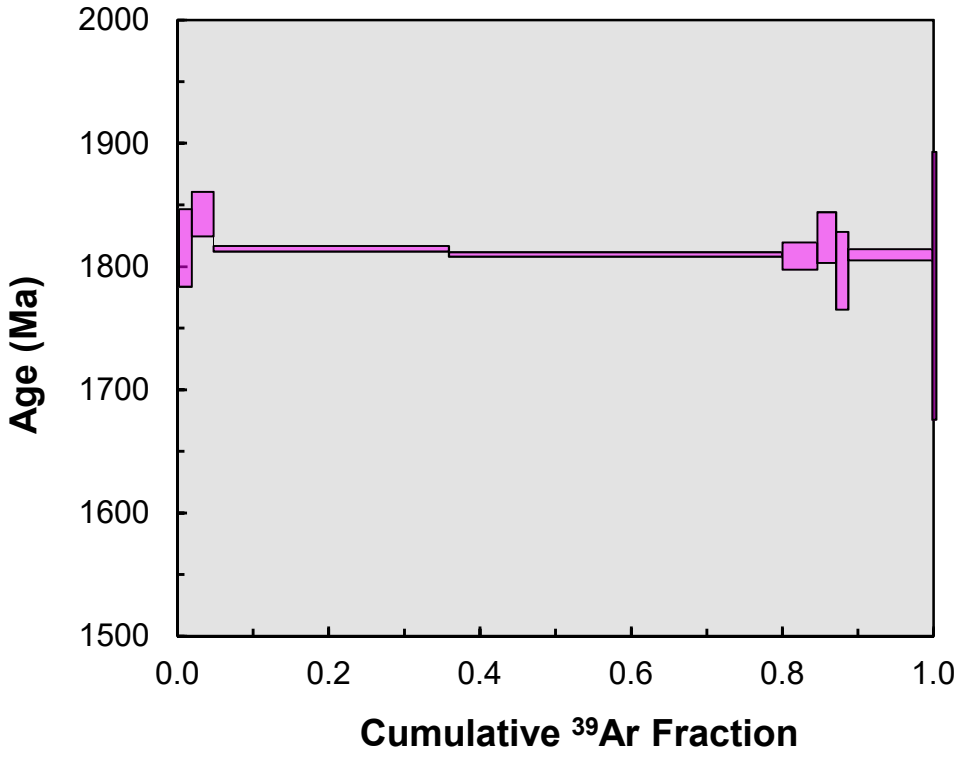
Sample Number: 14NK-N054A
Lithology: Quartz monzonite
Mineral analyzed: Hornblende
Age: 1812 ± 2 Ma
Interpretation: cooling age
Confidence: high

Location: western Queen Maud block (Duggan Lake domain)

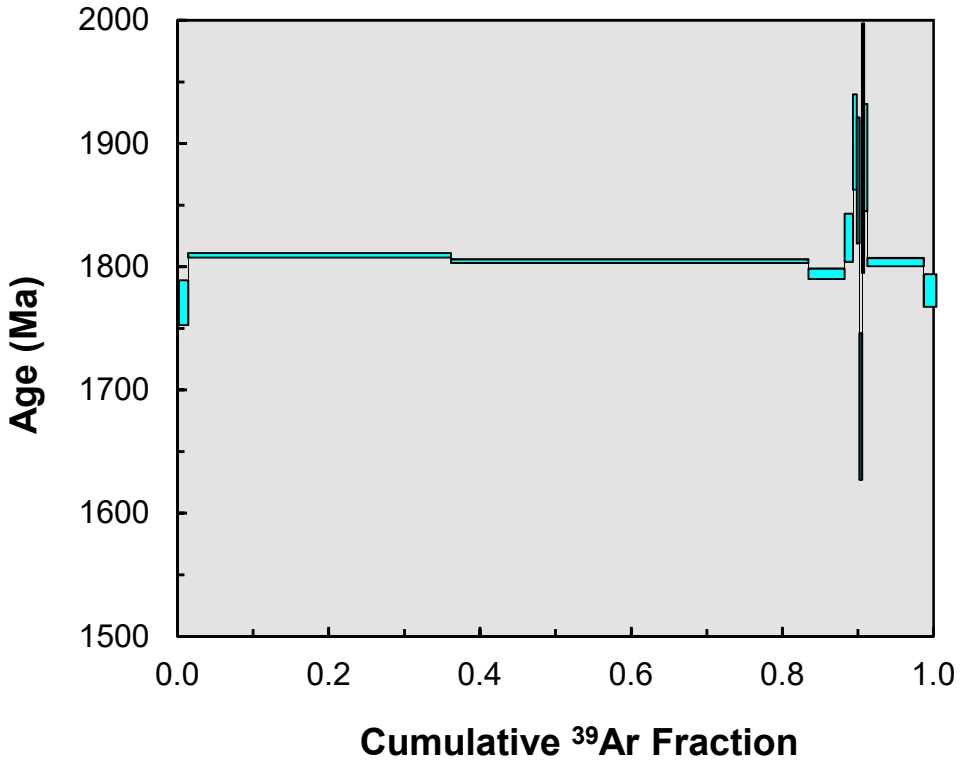
Lat: 65.2 N
Long: 104.9 W

Sample Description: Coarse-grained, unfoliated to weakly foliated hornblende biotite quartz monzonite

Results: Step heating of two hornblende crystals produced (a) an age spectrum yielding a plateau age of 1812 ± 2 Ma (n = 9 steps, MSWD = 0.81, including 100 % of ^{39}Ar released) and (b) a age spectrum where the majority of the ^{39}Ar (~82 %) was released in two steps and give a weighted mean age of 1807 ± 4 Ma.



Grain 1


2000
1900
1800
1700
1600
1500
Age (Ma)
0.0
0.2
0.4
0.6
0.8
1.0
Cumulative 39Ar Fraction

Grain 2

Queen Maud block

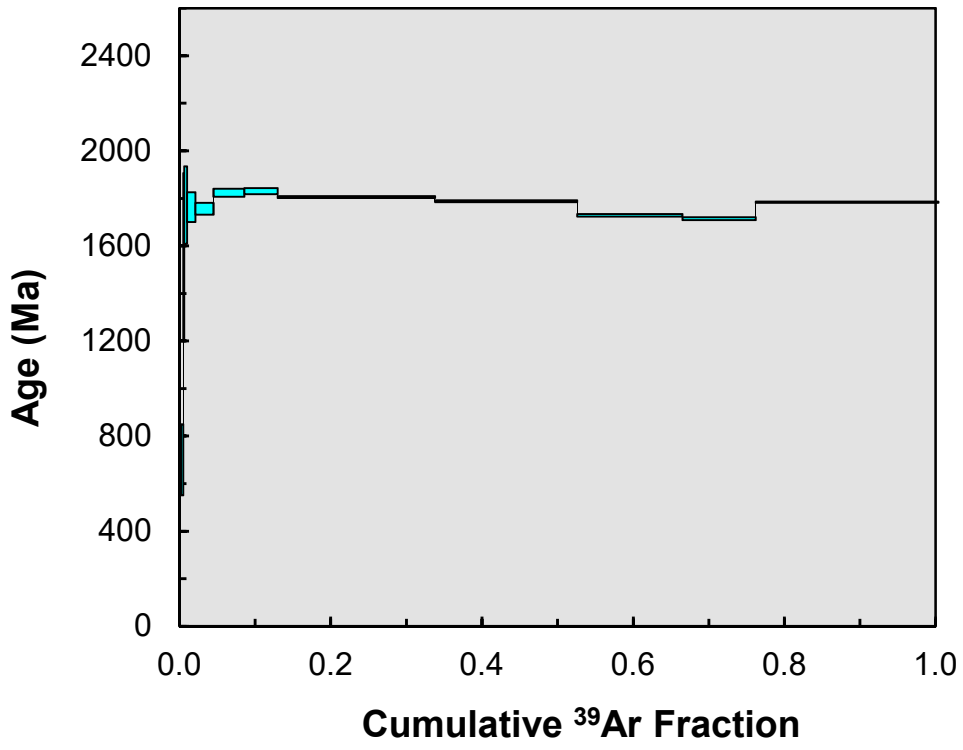
Sample Number: 14NK-N054A
Lithology: Quartz monzonite
Mineral analyzed: Biotite
Age: ~1800 Ma
Interpretation: uncertain
Confidence: very low

Location: western Queen Maud block (Duggan Lake domain)

Lat: 65.2 N
Long: 104.9 W

Sample Description: Coarse-grained, unfoliated to weakly foliated hornblende biotite quartz monzonite

Results: Discordant age spectrum



Queen Maud block

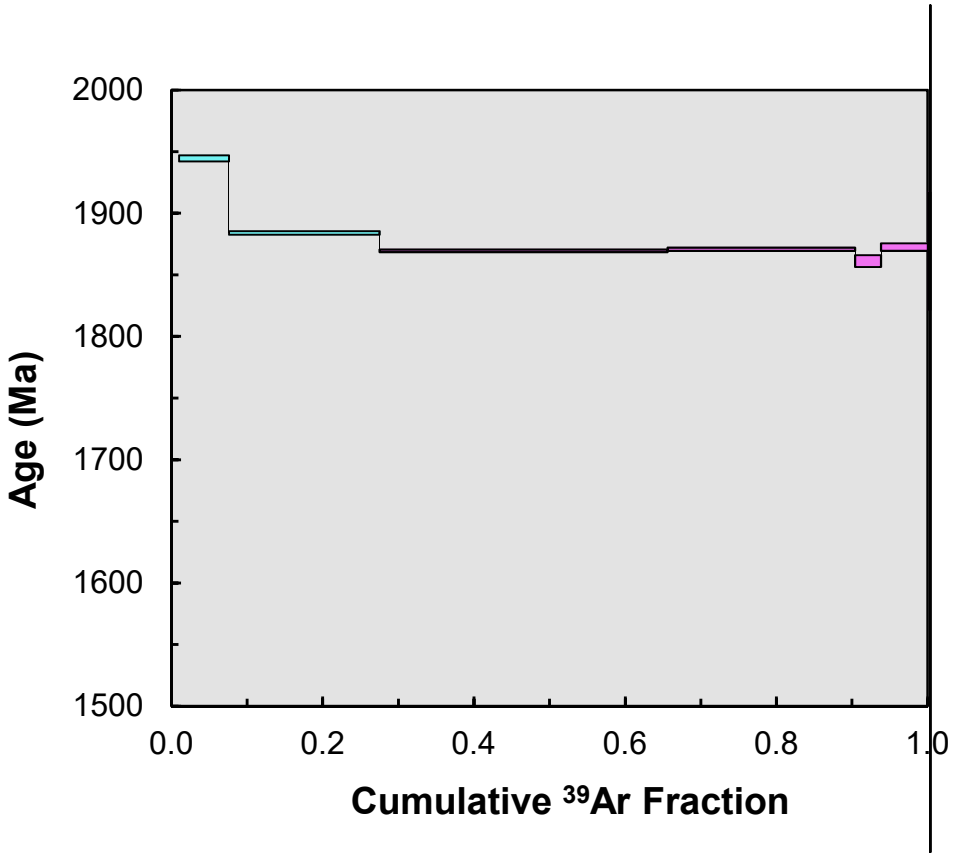
Sample Number: 14NK-N058B
Lithology: Gabbro
Mineral analyzed: Hornblende
Age: 1870 ± 3 Ma
Interpretation: cooling age
Confidence: high

Location: western Queen Maud block (Duggan Lake domain)

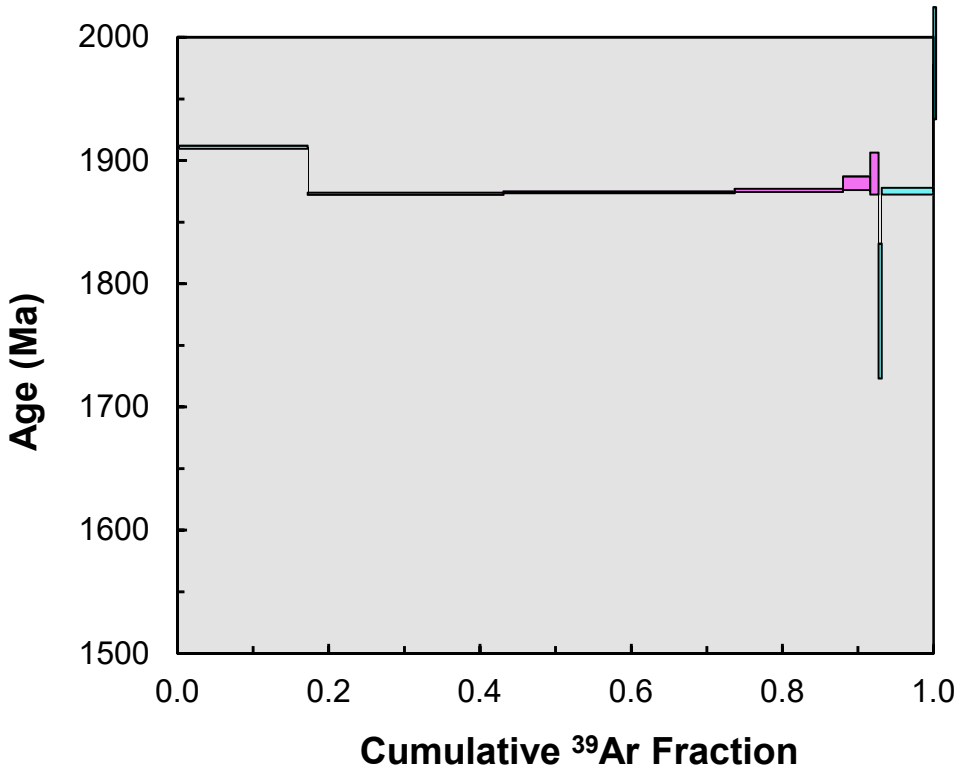
Lat: 65.7064 N
Long: 104.9329 W

Sample Description: Medium-grained, weakly foliated clinopyroxene-hornblende-biotite gabbro

Results: Step heating of two hornblende crystals produced plateaus resulting in ages of 1870 ± 3 Ma (n = 5 steps, MSWD = 0.87, including 72.8 % of ^{39}Ar released) and 1875 ± 1 Ma (n = 5 steps, MSWD = 1.4, including 75.4 % of ^{39}Ar released).



Grain 1


2000
1900
1800
1700
1600
1500
Age (Ma)
0.0
0.2
0.4
0.6
0.8
1.0
Cumulative 39Ar Fraction

Grain 2

Thelon tectonic zone

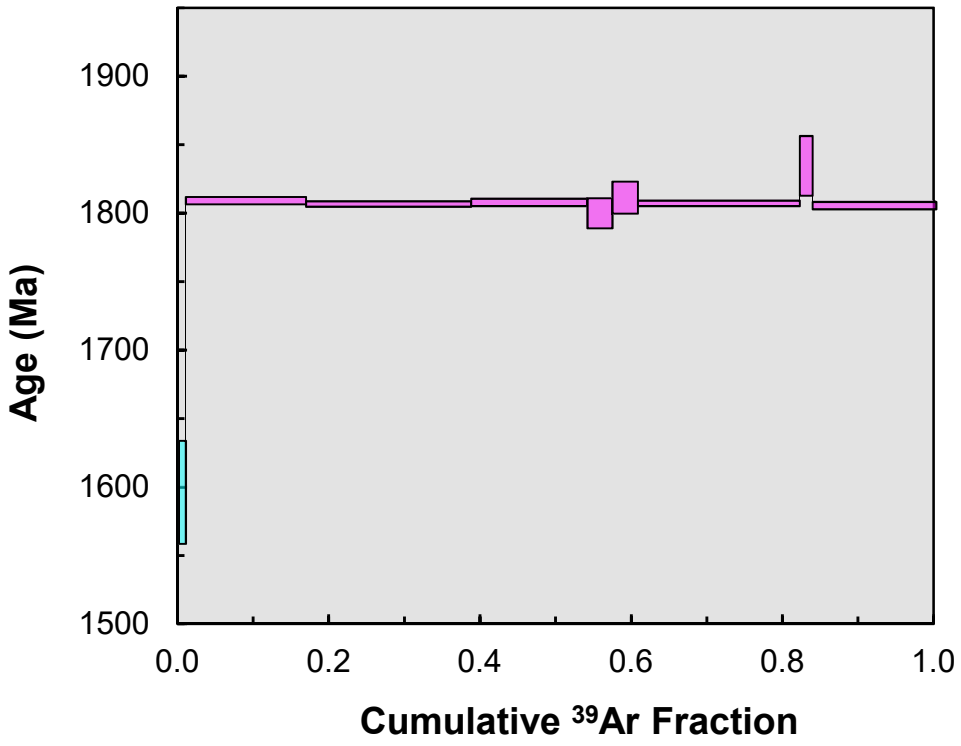
Sample Number: 14NK-N061A
Lithology: Quartz monzodiorite
Mineral analyzed: Hornblende
Age: 1808 ± 2 Ma
Interpretation: cooling age
Confidence: high

Location: Thelon tectonic zone (southern Central plutonic belt)

Lat: 65.8537 N
Long: 105.504 W

Sample Description: Medium-grained, weakly foliated hornblende biotite quartz monzodiorite

Results: An aliquot of 4 grains gives a plateau age of 1808 ± 2 Ma (n = 8 steps, MSWD = 0.43, including 99.13 % of ^{39}Ar released) and is interpreted to represent the cooling age for hornblende in this sample.



Thelon tectonic zone

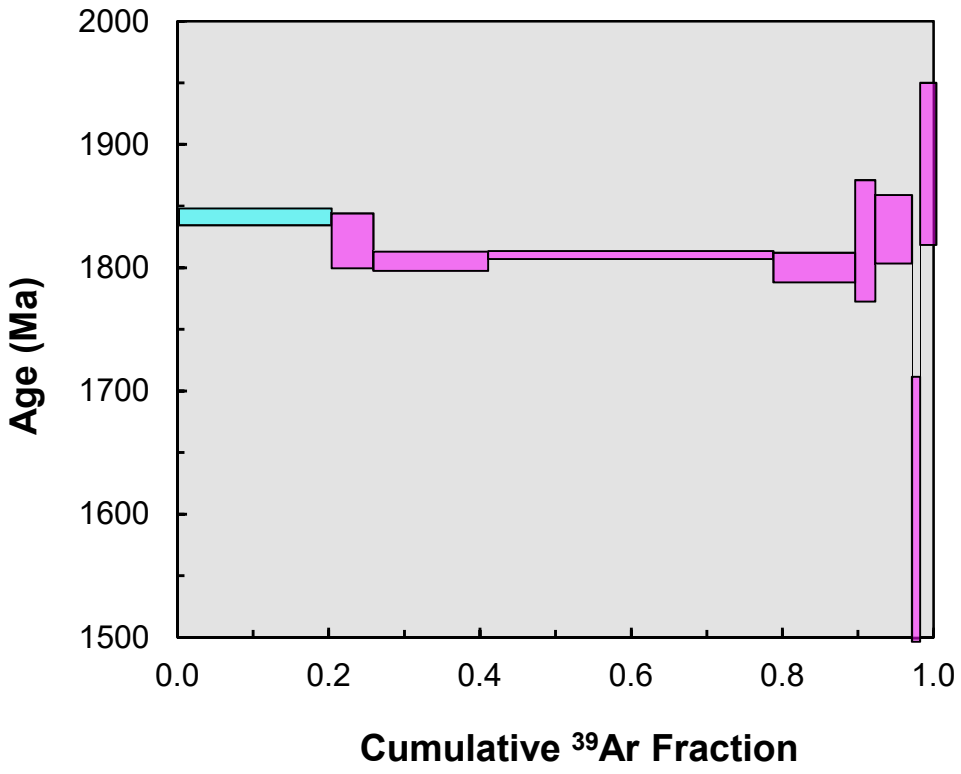
Sample Number: 14NK-S018D02
Lithology: Well foliated, fine-grained monzogranite
Mineral analyzed: Hornblende
Age: 1810 ± 6 Ma
Interpretation: cooling age
Confidence: high

Location: Thelon tectonic zone (Ellice River domain)

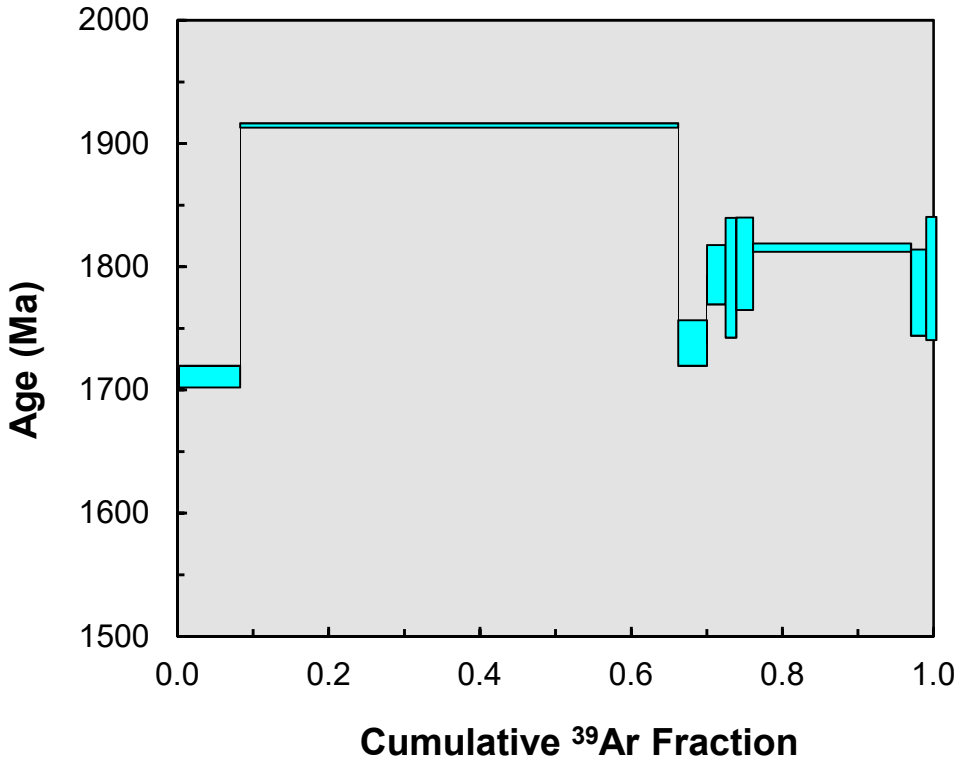
Lat: 65.7391 N
Long: 105.4175 W

Sample Description: Well foliated, fine-grained monzogranite

Results: Step heating of two hornblende crystals produced (a) an age spectrum yielding a plateau age of 1810 ± 6 Ma (n = 8 steps, MSWD = 0.99, including 79.9 % of ^{39}Ar released) and (b) a discordant age spectrum.



Grain 1


2000
1900
1800
1700
1600
1500
Age (Ma)
0.0
0.2
0.4
0.6
0.8
1.0
Cumulative 39Ar Fraction

Grain 2

Thelon tectonic zone

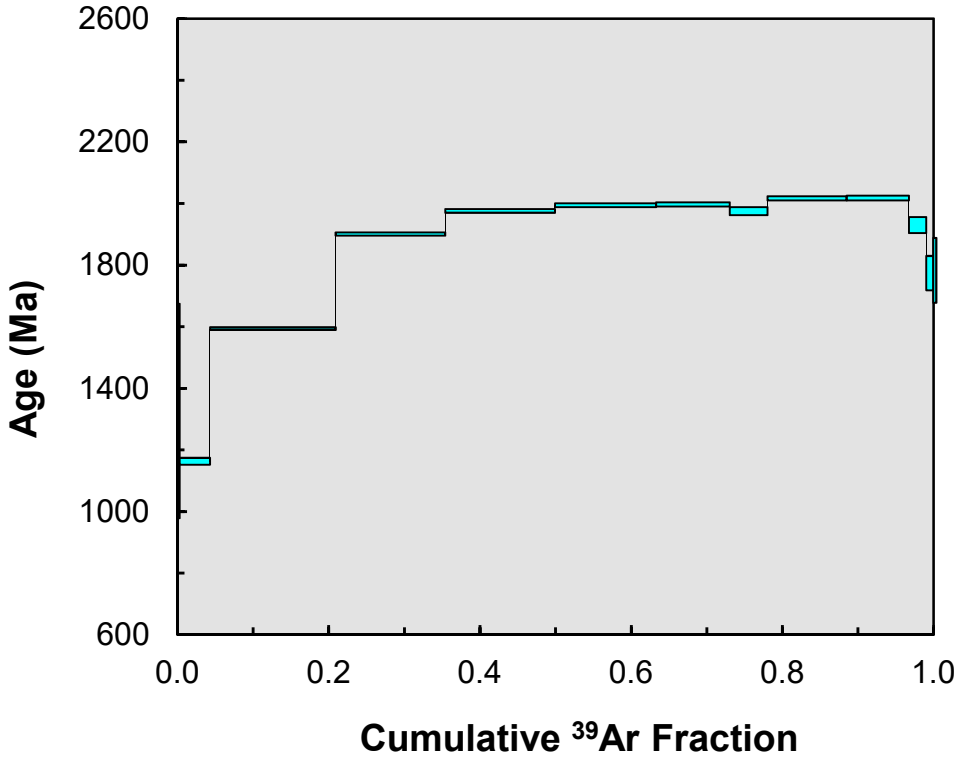
Sample Number: 14NK-S018D02
Lithology: Monzogranite
Mineral analyzed: Biotite
Age: ca. 2000 Ma
Interpretation: uncertain
Confidence: low

Location: Thelon tectonic zone (Ellice River domain)

Lat: 65.7391 N
Long: 105.4175 W

Sample Description: Well foliated, fine-grained monzogranite

Results: Discordant age spectrum



Slave craton

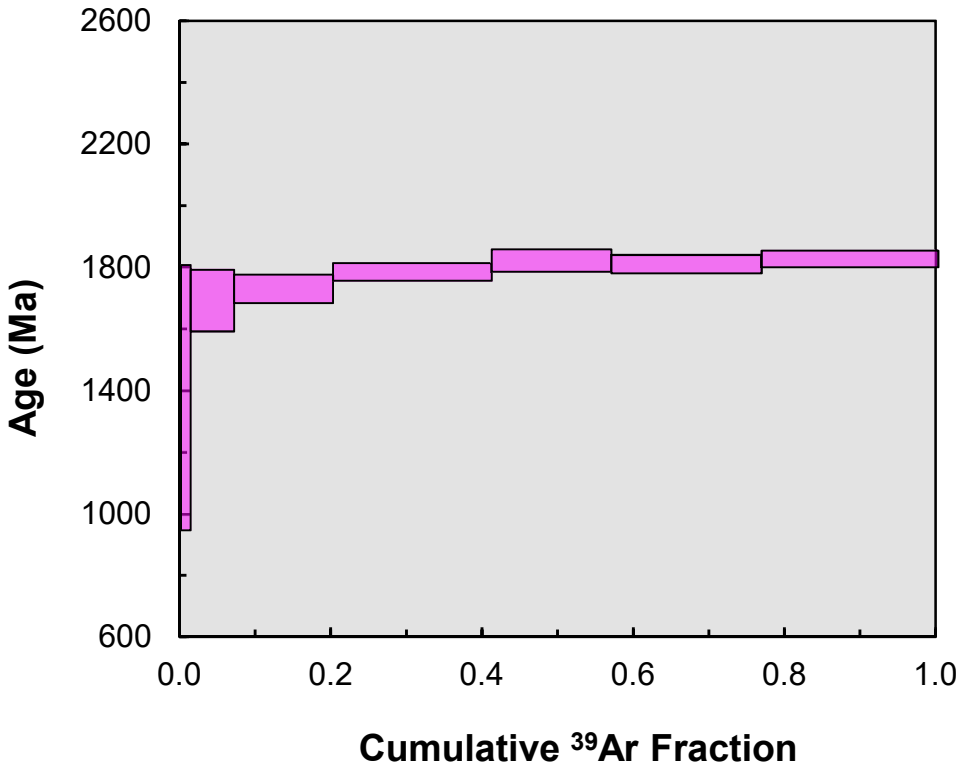
Sample Number: 16BLB-D134A
Lithology: Monzogranite
Mineral analyzed: Biotite
Age: 1801 ± 3 Ma
Interpretation: cooling age
Confidence: high

Location: Slave craton (Overby Lake domain)

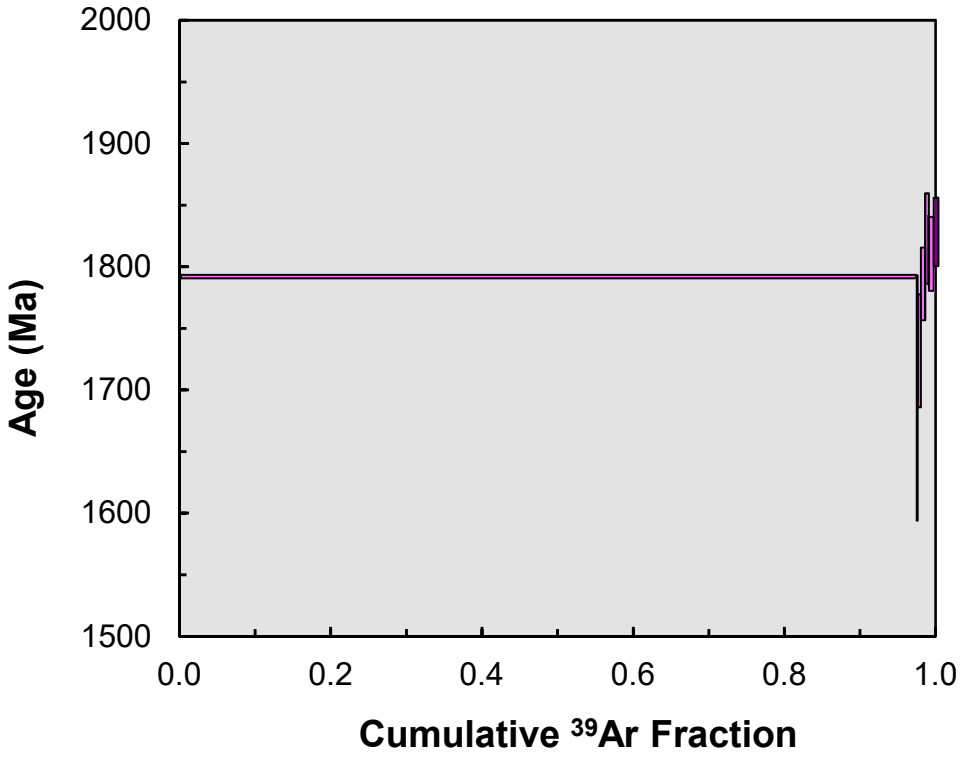
Lat: 66.48392 N
Long: 105.6807 W

Sample Description: Foliated magnetite biotite monzogranite

Results: Step heating of two biotite crystals produced (a) an age spectrum yielding a plateau age of 1801 ± 3 Ma (n = 8 steps, MSWD = 1.02, including 100 % of ^{39}Ar released) and (b) an age spectrum where the majority of the ^{39}Ar (100 %) was released in one step and with an age of 1793 ± 3 Ma.



Grain 1


2000
1900
1800
1700
1600
1500
Age (Ma)
0.0
0.2
0.4
0.6
0.8
1.0
Cumulative 39Ar Fraction

Grain 2

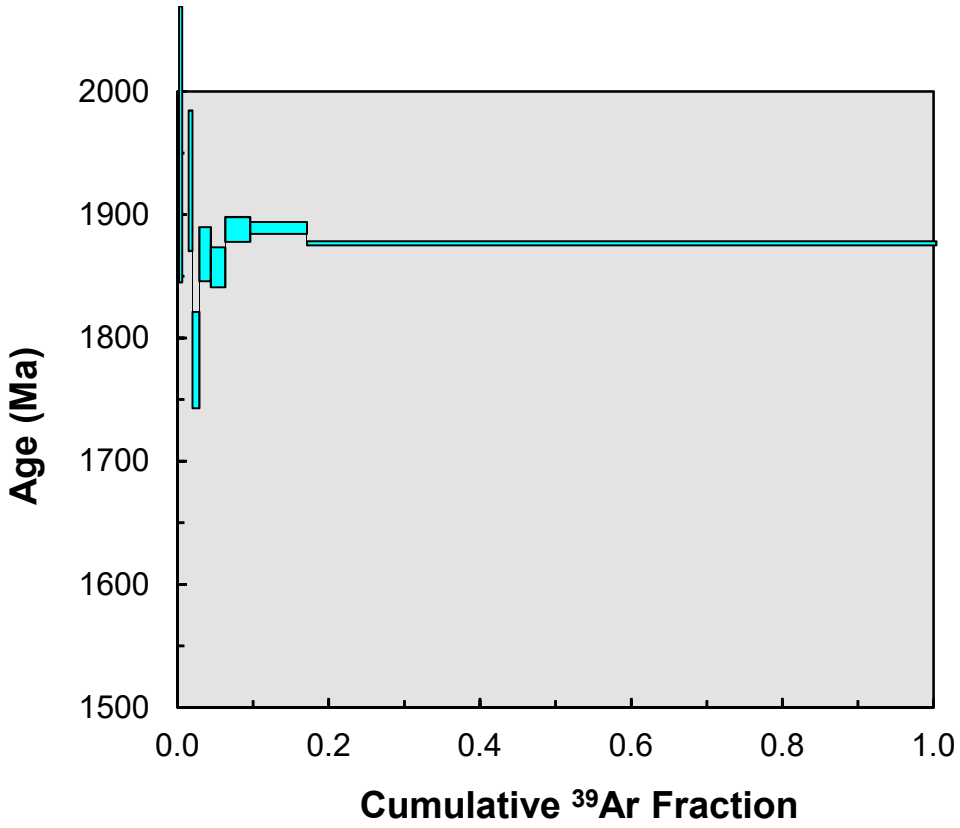
Sample Number: 16BLB-J102A
Lithology: Quartz monzodiorite
Mineral analyzed: Hornblende
Age: ~1875 Ma
Interpretation: cooling age
Confidence: Low

Location: Thelon tectonic zone (Central plutonic belt)

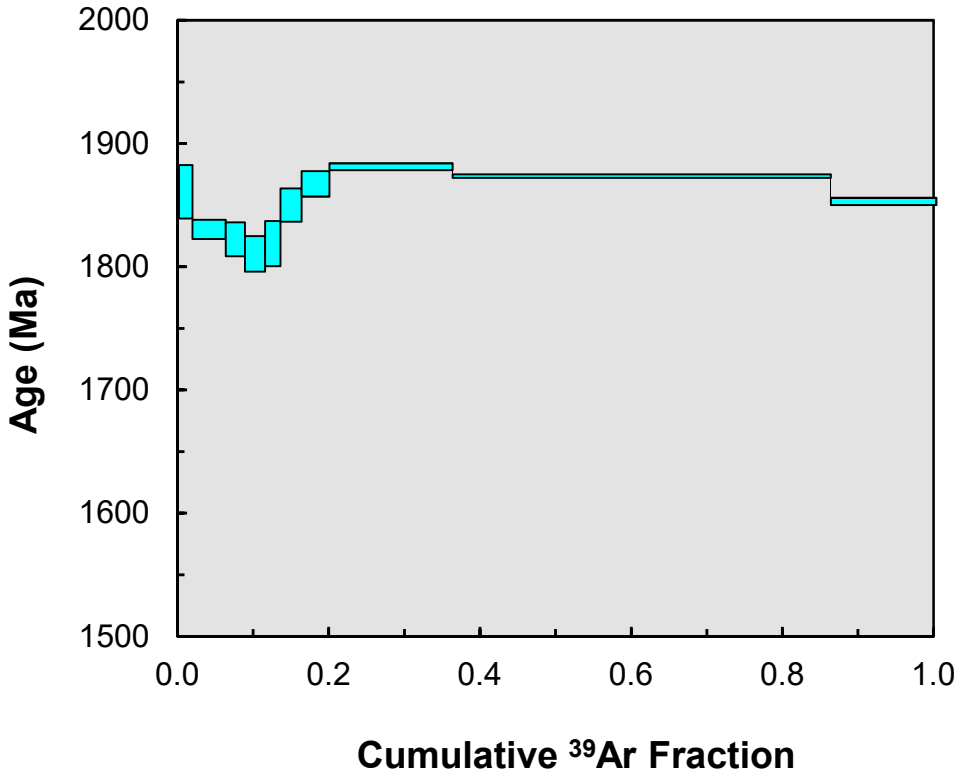
Lat: 66.69272 N
Long: 104.8671 W

Sample Description: Fine-grained, foliated, orthopyroxene magnetite hornblende quartz monzodiorite

Results: Discordant age spectra for two crystals



Grain 1


2000
1900
1800
1700
1600
1500
Age (Ma)
0.0
0.2
0.4
0.6
0.8
1.0
Cumulative 39Ar Fraction

Grain 2

Thelon tectonic zone

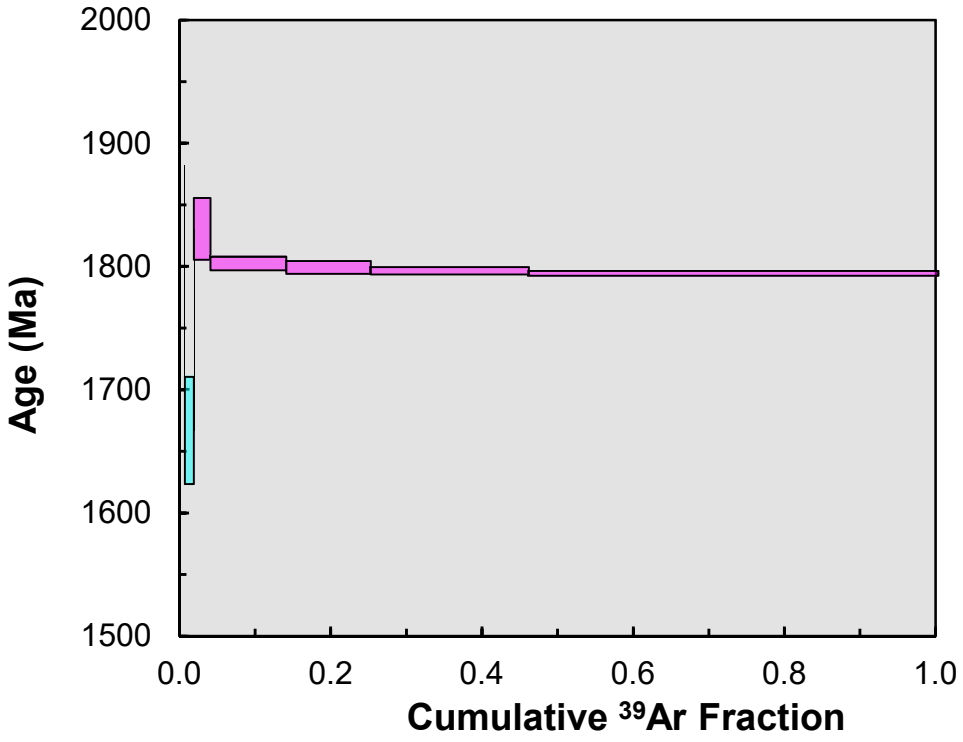
Sample Number: 16BLB-J102A
Lithology: Quartz monzodiorite
Mineral analyzed: Biotite
Age: 1797 ± 3 Ma
Interpretation: cooling age
Confidence: high

Location: Thelon tectonic zone (northern Central plutonic belt)

Lat: 66.69272 N
Long: 104.8671 W

Sample Description: Fine-grained, foliated, orthopyroxene magnetite hornblende quartz monzodiorite

Results: Plateau age of 1797 ± 3 Ma (n = 5 steps, MSWD = 1.11, including 98.3 % of ^{39}Ar released) is interpreted to represent the cooling age for biotite in this sample.



Slave craton

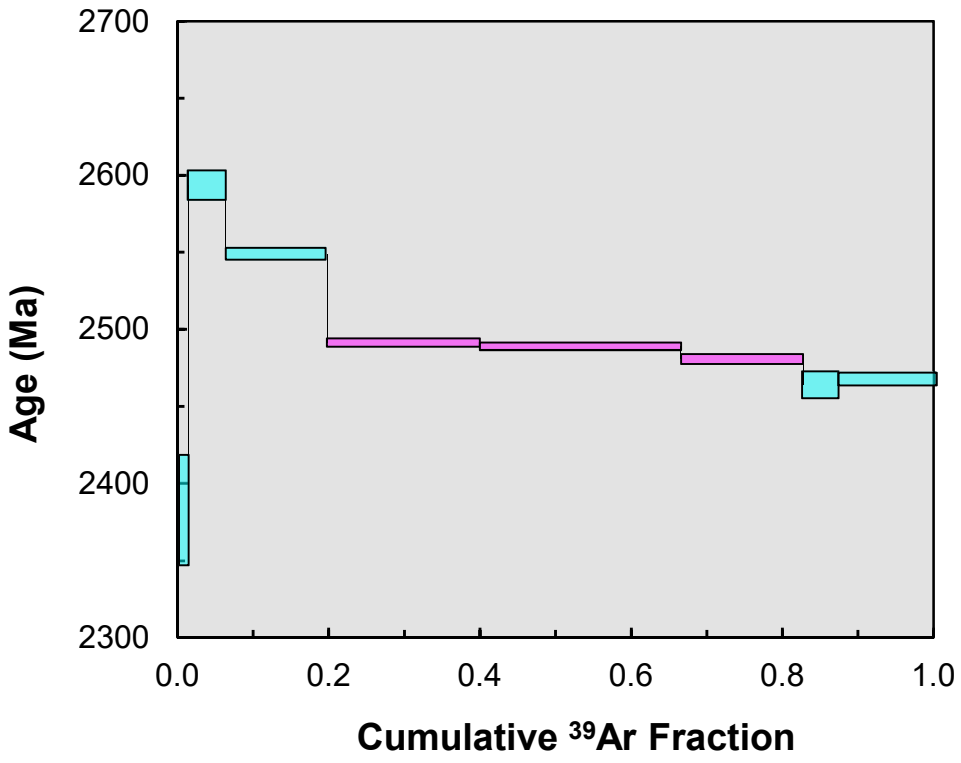
Sample Number: 16BLB-L119A
Lithology: Quartz monzodiorite
Mineral analyzed: Hornblende
Age: 2488 ± 28 Ma
Interpretation: Maximum cooling age
Confidence: low

Location: Slave craton (Tinney Hills domain)

Lat: 66.96614 N
Long: 106.0172 W

Sample Description: Medium-grained, foliated, hornblende quartz monzodiorite

Results: Plateau age of 2488 ± 28 Ma (n = 3 steps, MSWD = 3.4, including 62.7 % of ^{39}Ar released) is interpreted to represent the cooling age for hornblende in this sample.



Slave craton

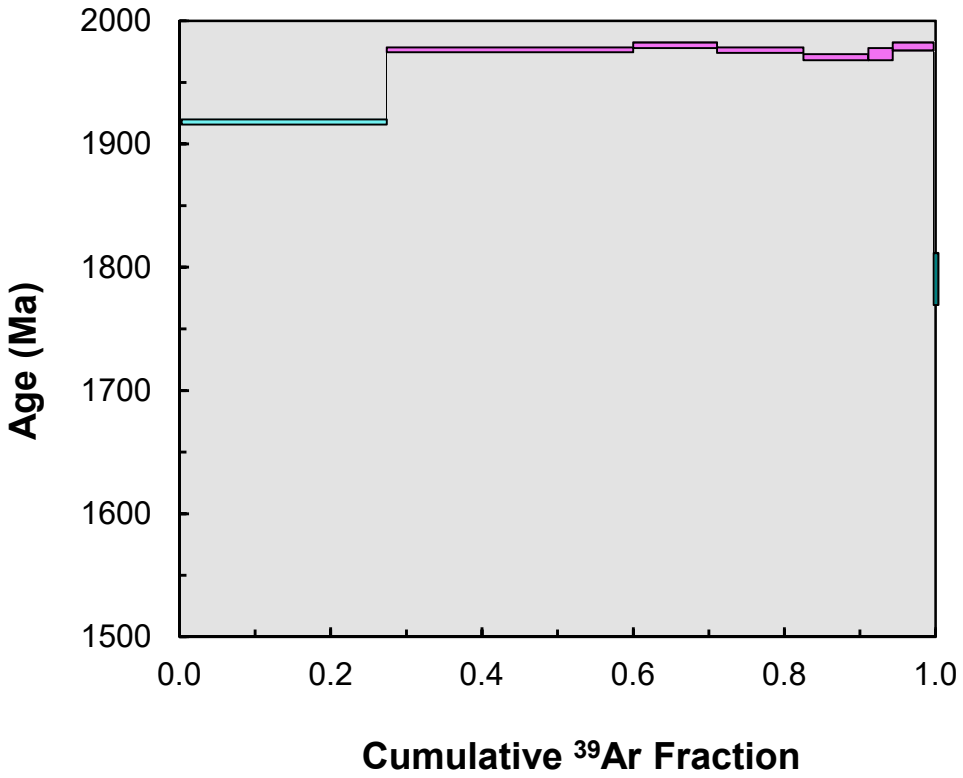
Sample Number: 16BLB-L119A
Lithology: Quartz monzodiorite
Mineral analyzed: Biotite
Age: 1977 ± 4 Ma
Interpretation: cooling age
Confidence: high

Location: Slave craton (Tinney Hills domain)

Lat: 66.96614 N
Long: 106.0172 W

Sample Description: Medium-grained, foliated, hornblende quartz monzodiorite

Results: Plateau age of 1977 ± 4 Ma (n = 6 steps, MSWD = 1.8, including 72.3 % of ^{39}Ar released) is interpreted to represent the cooling age for biotite in this sample.



Slave craton

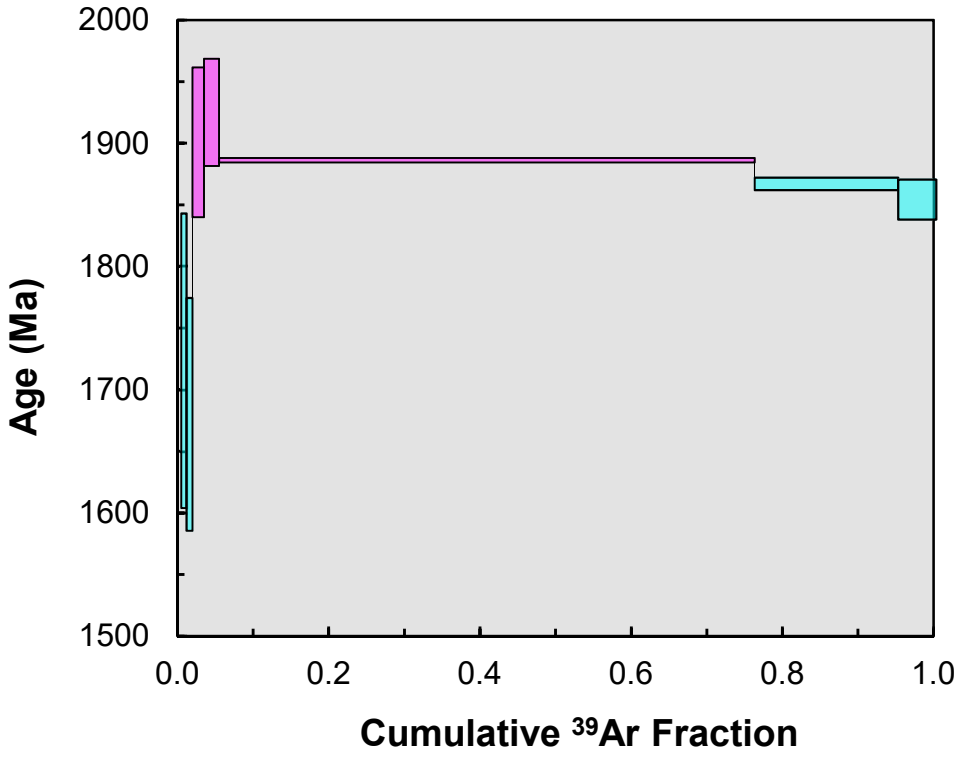
Sample Number: 16BLB-L128
Lithology: Diorite
Mineral analyzed: Hornblende
Age: 1883 ± 3 Ma
Interpretation: cooling age
Confidence: high

Location: Slave craton (Overby Lake domain)

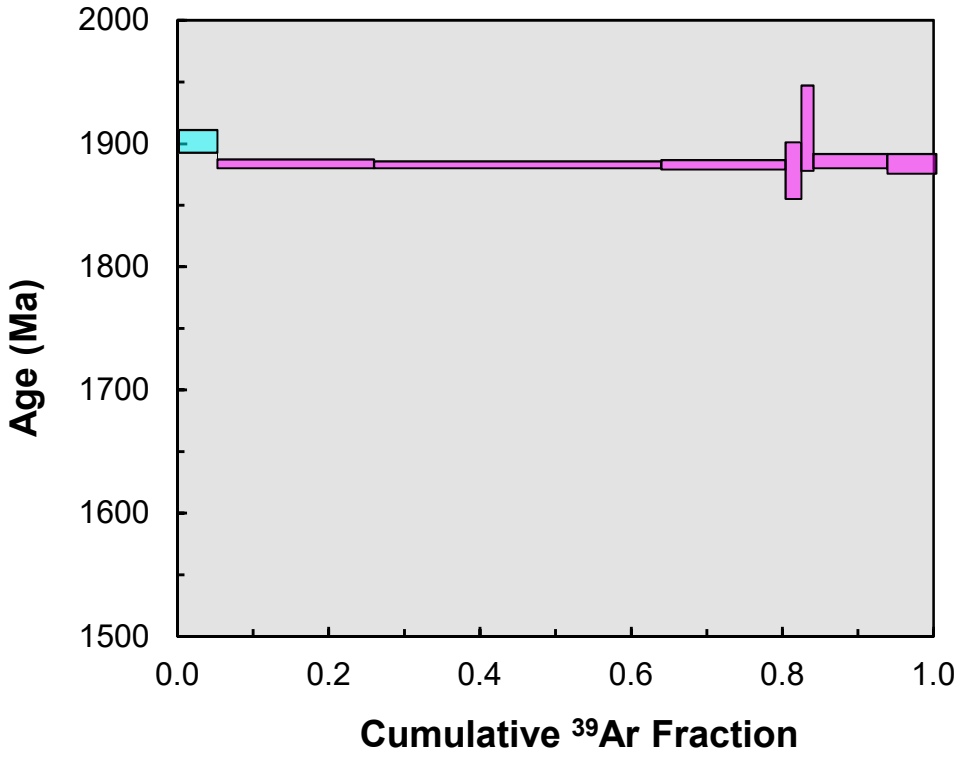
Lat: 66.1748 N
Long: 105.9733 W

Sample Description: Medium-grained, foliated, biotite hornblende diorite

Results: Step heating of two hornblende crystals produced (a) an age spectrum where the majority of the ^{39}Ar (~61 %) was released in one step with an age of 1886 ± 2 Ma and (b) an age spectrum yielding a plateau age of 1883 ± 3 Ma (n = 7 steps, MSWD = 0.17, including 95 % of ^{39}Ar released).



Grain 1


2000
1900
1800
1700
1600
1500
Age (Ma)
0.0
0.2
0.4
0.6
0.8
1.0
Cumulative 39Ar Fraction

Grain 2

Thelon tectonic zone

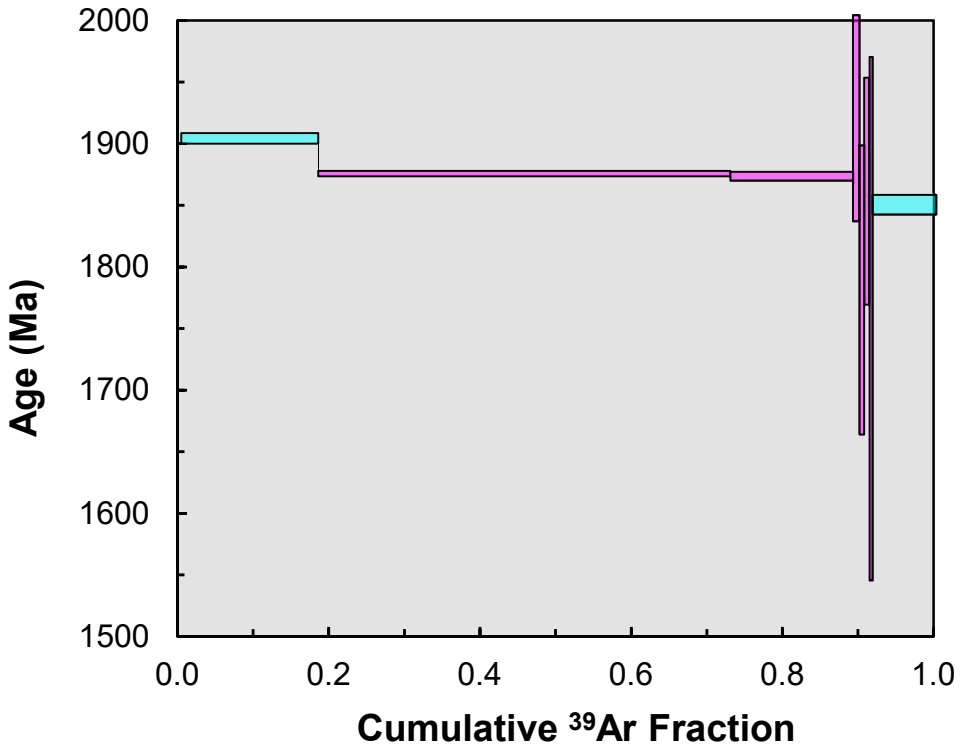
Sample Number: 16BLB-L208A
Lithology: Granodiorite
Mineral analyzed: Hornblende
Age: 1875 ± 4 Ma
Interpretation: cooling age
Confidence: medium

Location: Thelon tectonic zone (eastern plutonic belt)

Lat: 66.15186 N
Long: 104.2265 W

Sample Description: Medium-grained, unfoliated, biotite hornblende granodiorite

Results: Plateau age of 1875 ± 4 Ma (n = 6 steps, MSWD = 0.32, including 73.2 % of ^{39}Ar released) is interpreted to represent the cooling age for hornblende in this sample.



Thelon tectonic zone

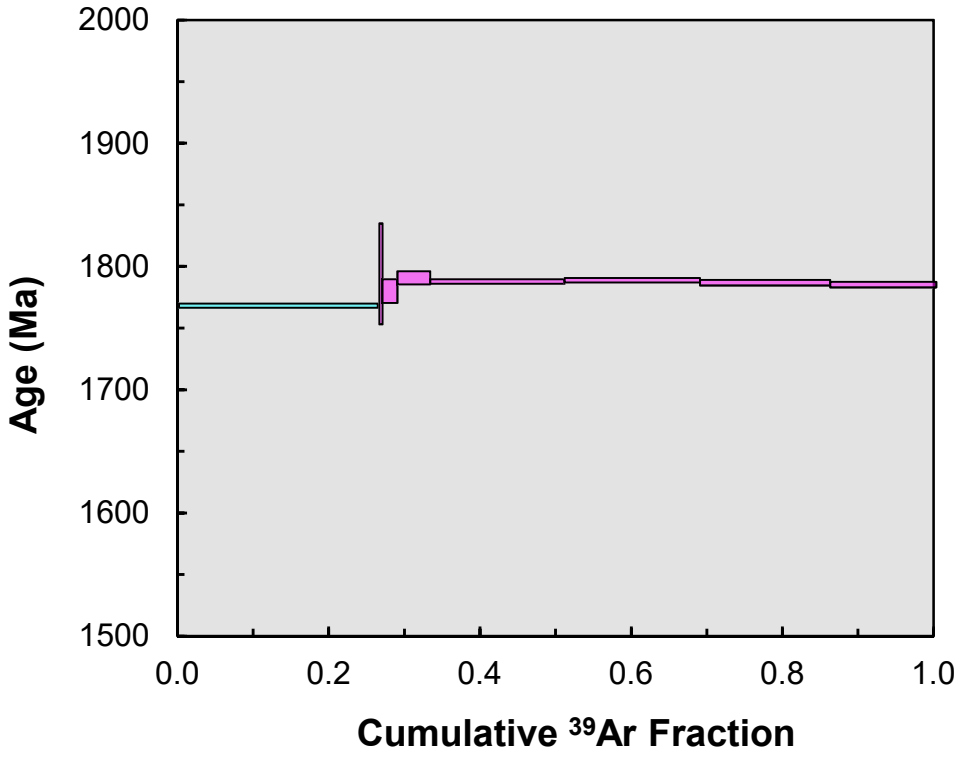
Sample Number: 16BLB-L208A
Lithology: Granodiorite
Mineral analyzed: Biotite
Age: 1788 ± 2 Ma
Interpretation: cooling age
Confidence: high

Location: Thelon tectonic zone (Eastern plutonic belt)

Lat: 66.15186 N
Long: 104.2265 W

Sample Description: Medium-grained, unfoliated, biotite hornblende granodiorite

Results: Plateau age of 1788 ± 2 Ma (n = 6 steps, MSWD = 0.65, including 73.7 % of ^{39}Ar released) is interpreted to represent the cooling age for biotite in this sample.



Thelon tectonic zone

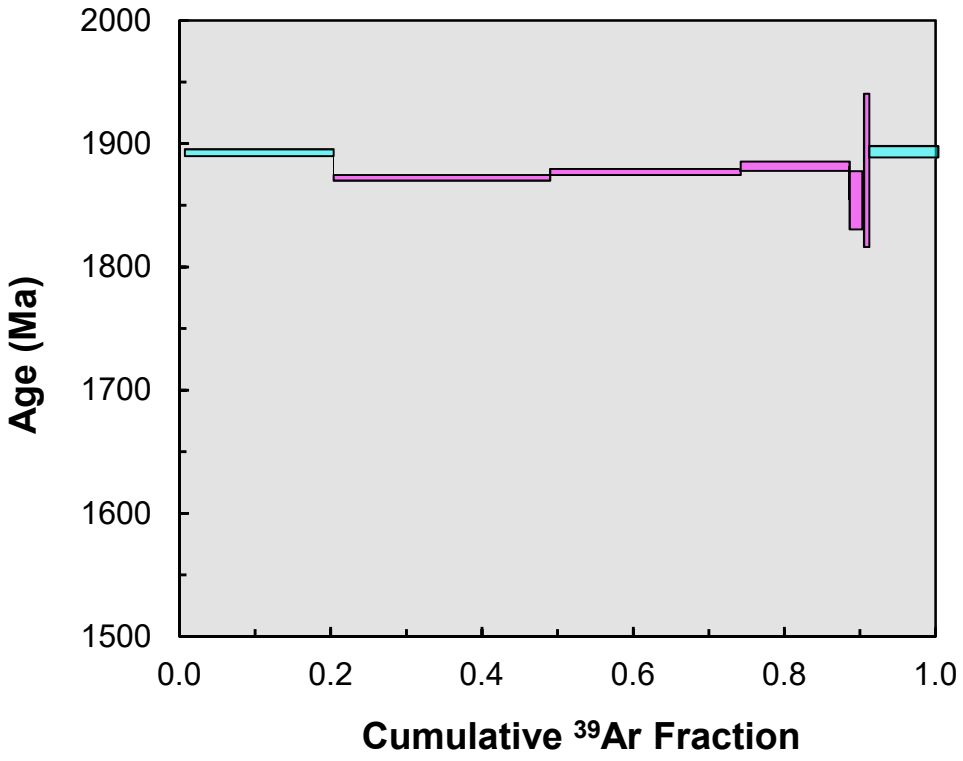
Sample Number: 16BLB-M123A
Lithology: Quartz diorite
Mineral analyzed: Hornblende
Age: 1876 ± 5 Ma
Interpretation: cooling age
Confidence: medium

Location: Thelon tectonic zone (Eastern plutonic belt)

Lat: 65.41296 N
Long: 104.4834 W

Sample Description: Magnetite orthopyroxene quartz diorite

Results: Plateau age of 1876 ± 5 Ma (n = 6 steps, MSWD = 1.5, including 70.7 % of ^{39}Ar released) is interpreted to represent the cooling age for hornblende in this sample.



Thelon tectonic zone

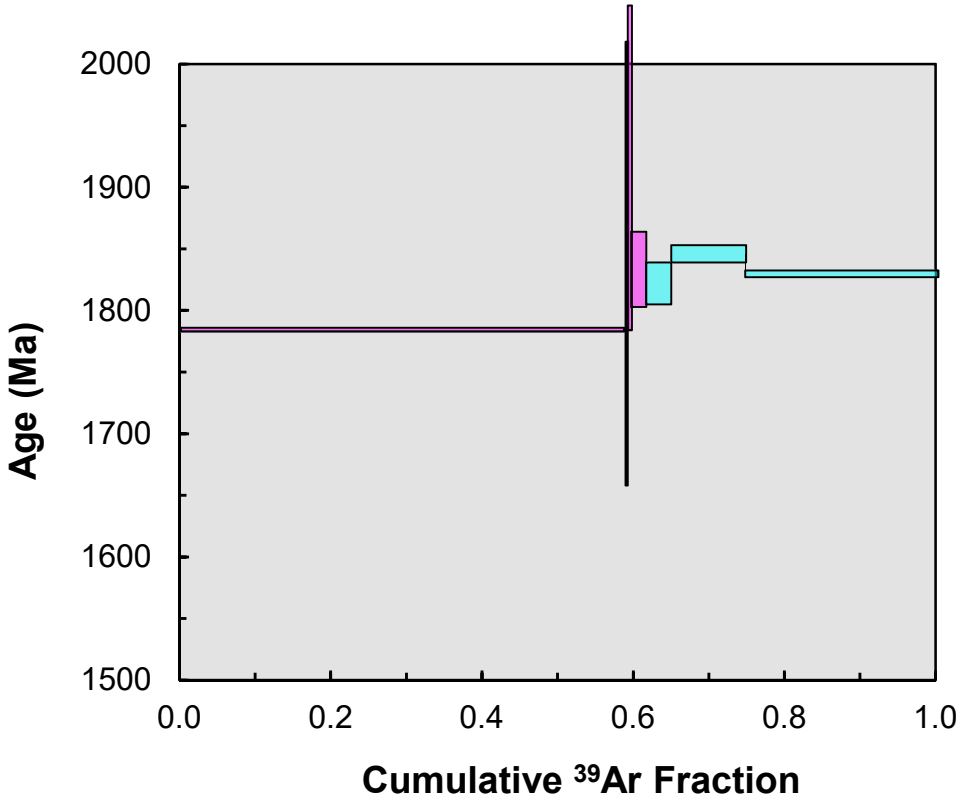
Sample Number: 16BLB-M175A
Lithology: Quartz monzodiorite
Mineral analyzed: Biotite
Age: ~1785 Ma
Interpretation: cooling age
Confidence: low

Location: Thelon tectonic zone (northern Central plutonic belt)

Lat: 66.61714 N
Long: 104.987 W

Sample Description: Moderately foliated biotite quartz monzodiorite

Results: Over half of the ^{39}Ar released (~58 %) was in the first step, at very low power, and indicates that the crystal may be altered.



Thelon tectonic zone

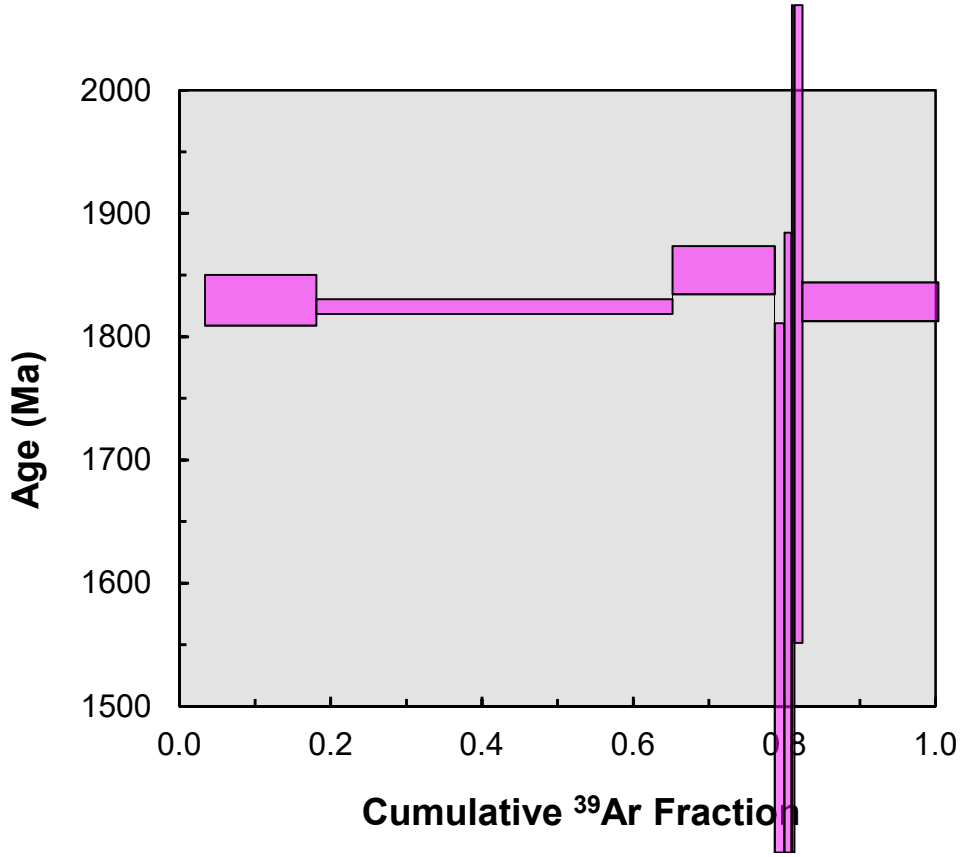
Sample Number: 16BLB-M180
Lithology: Quartz diorite
Mineral analyzed: Hornblende
Age: 1848 ± 8 Ma
Interpretation: cooling age
Confidence: high

Location: Thelon tectonic zone (Ellice River domain)

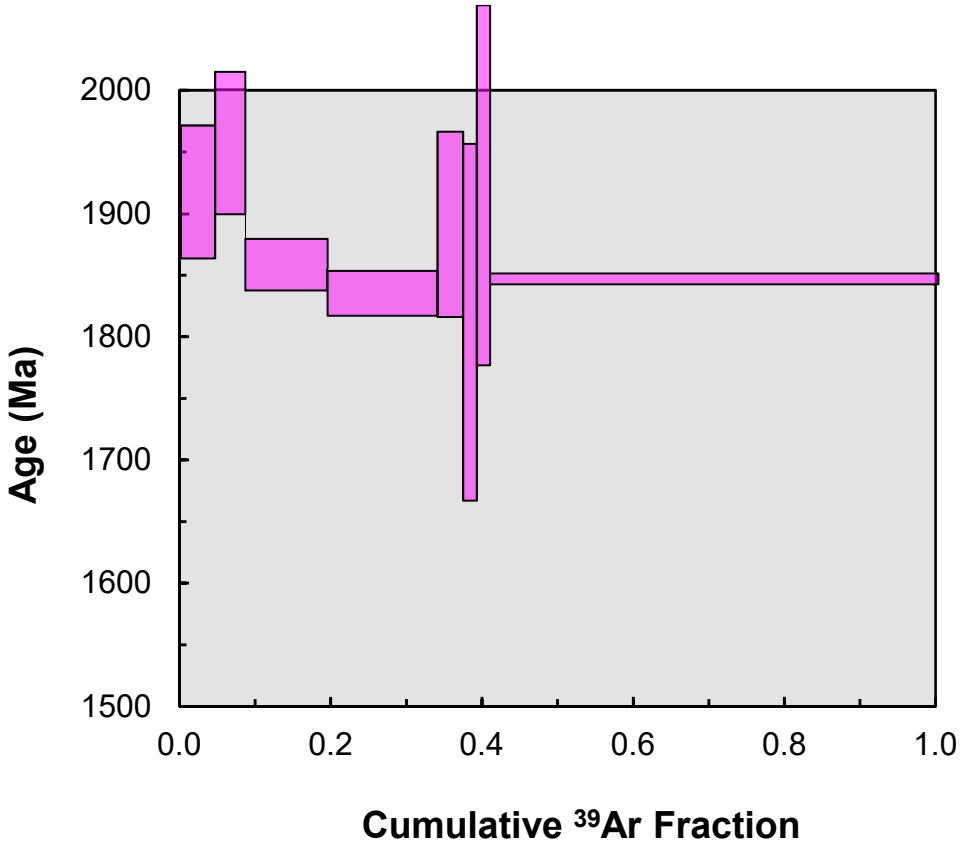
Lat: 66.61491 N
Long: 105.0774 W

Sample Description: Foliated, fine-grained quartz diorite

Results: Step heating of two hornblende crystals produced plateaus resulting in ages of 1827 ± 10 Ma (n = 7 steps, MSWD = 1.12, including 96.8 % of ^{39}Ar released) and 1848 ± 8 Ma (n = 8 steps, MSWD = 1.3, including 98.5 % of ^{39}Ar released).



Grain 1


2000
1900
1800
1700
1600
1500
Age (Ma)
0.0
0.2
0.4
0.6
0.8
1.0
Cumulative 39Ar Fraction

Grain 2

Queen Maud block

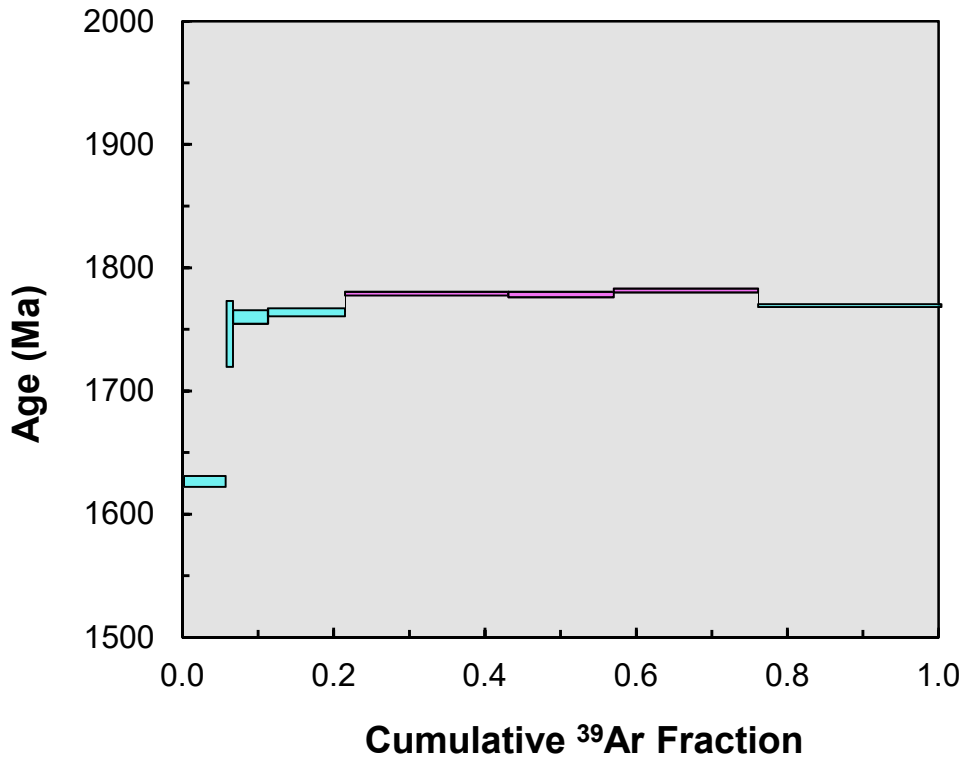
Sample Number: 16BLB-M183A02
Lithology: Tonalite
Mineral analyzed: Biotite
Age: 1780 ± 2 Ma
Interpretation: cooling age
Confidence: Intermediate

Location: western Queen Maud block (Duggan Lake domain)

Lat: 66.1474 N
Long: 104.5321 W

Sample Description: Foliated magnetite biotite tonalite

Results: Plateau age of 1780 ± 2 Ma (n = 3 steps, MSWD = 1.07, including 54.6 % of ^{39}Ar released) is interpreted to represent the cooling age for biotite in this sample.



Slave craton

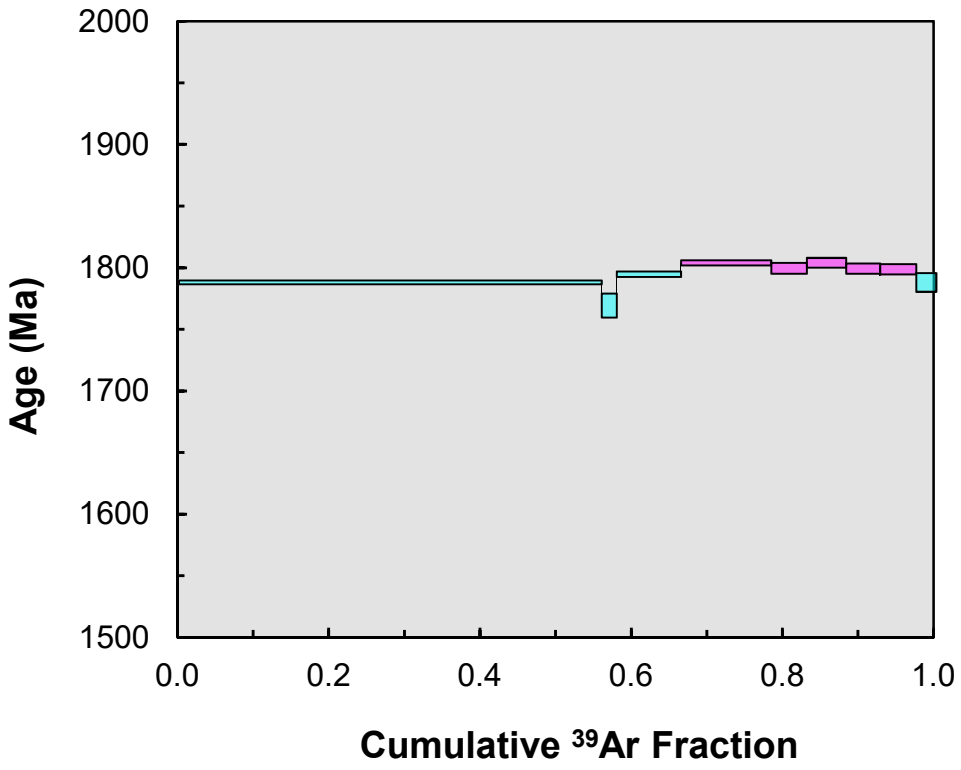
Sample Number: 16BLB-M202A03
Lithology: Monzogranite
Mineral analyzed: Biotite
Age: 1803 ± 3 Ma
Interpretation: cooling age
Confidence: intermediate

Location: Slave craton (Overby Lake domain)

Lat: 66.29287 N
Long: 104.9804 W

Sample Description: Medium-grained, strongly foliated biotite granodiorite

Results: Over half of the ^{39}Ar released (~56 %) was in the first step, at very low power, and indicates that the crystal may be altered. Nevertheless, 31.1 % of ^{39}Ar released at higher temperatures (steps 4-8) give a geologically meaningful age of 1803 ± 3 Ma (MSWD = 0.60)



Slave craton

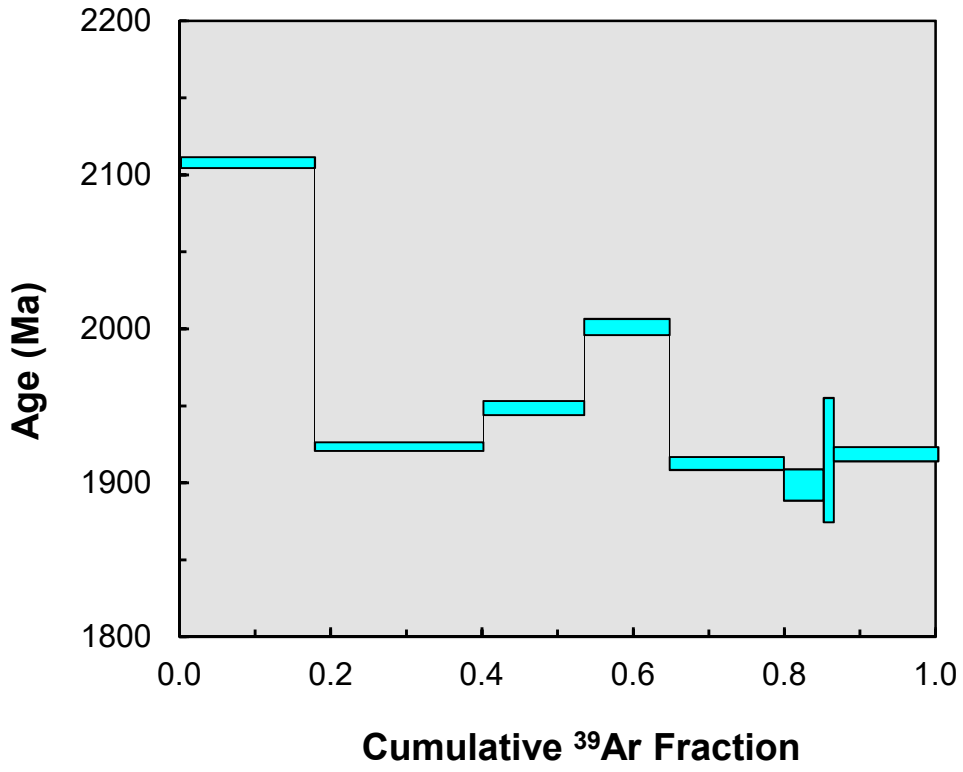
Sample Number: 16BLB-R118A
Lithology: Quartz diorite
Mineral analyzed: Hornblende
Age: 1896 ± 18 Ma
Interpretation: cooling age
Confidence: low

Location: Slave craton (Overby Lake domain)

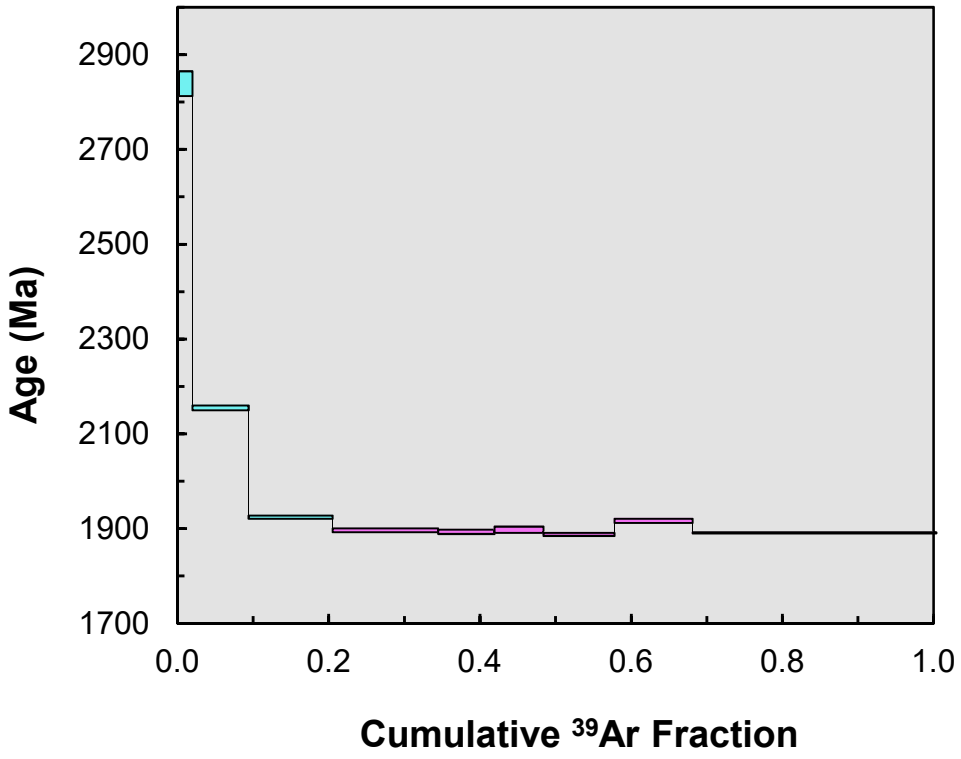
Lat: 66.8354 N
Long: 105.4281 W

Sample Description: Foliated hornblende-biotite quartz diorite

Results: Step heating of two hornblende crystals produced (a) discordant age spectrum, and (b) an age spectrum yielding a plateau age of 1896 ± 18 Ma (n = 6 steps, MSWD = 7.8, including 79.8 % of ^{39}Ar released).



Grain 1


2900
2700
2500
2300
2100
1900
1700
Age (Ma)
0.0
0.2
0.4
0.6
0.8
1.0
Cumulative 39Ar Fraction

Grain 2

Slave craton

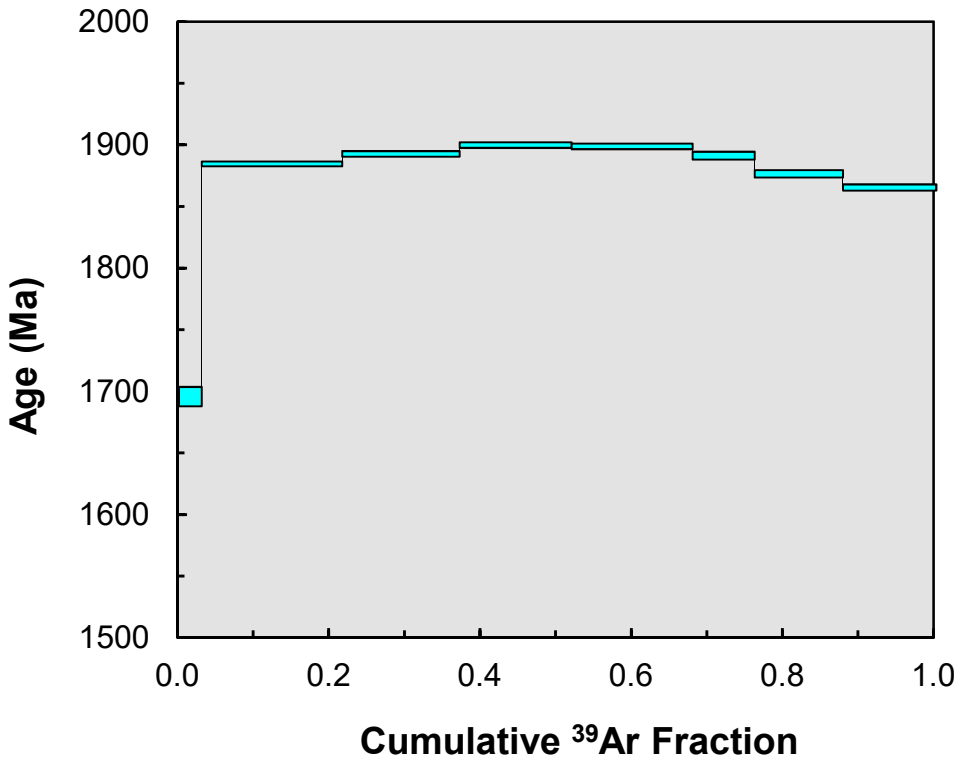
Sample Number: 16BLB-R118A
Lithology: Quartz diorite
Mineral analyzed: Biotite
Age: ~1900 Ma
Interpretation: uncertain
Confidence: low

Location: Slave craton (Overby Lake domain)

Lat: 66.8354 N **Long**: 105.4281 W
Geologist: Rob Berman

Sample Description: Foliated hornblende-biotite quartz diorite

Results: Discordant age spectra



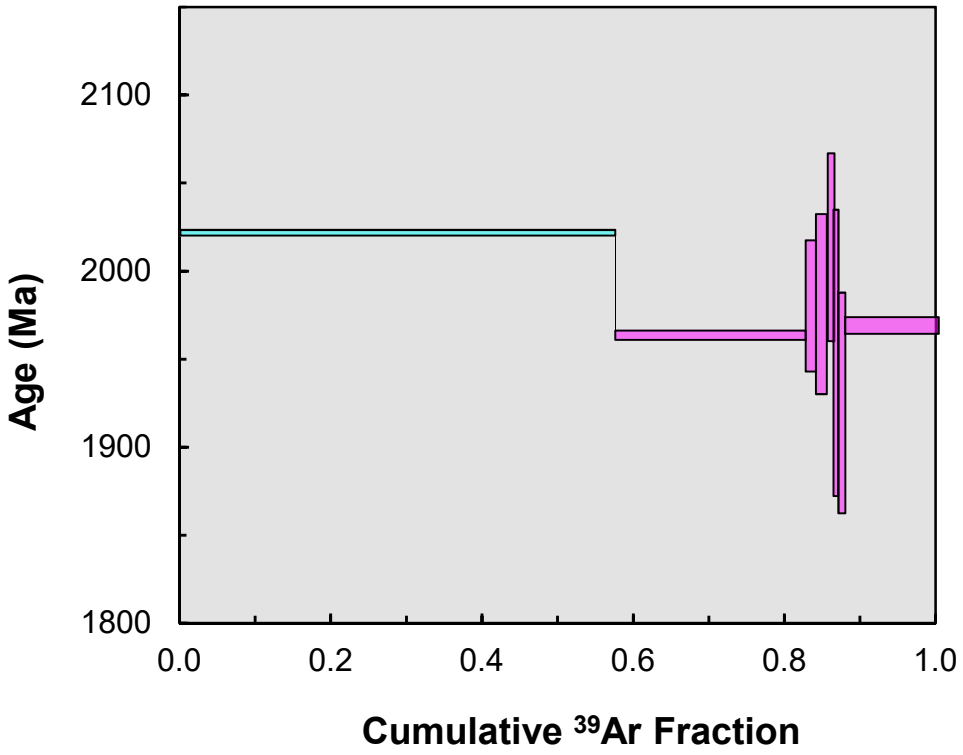
Sample Number: 16BLB-T121A
Lithology: Quartz monzodiorite
Mineral analyzed: Hornblende
Age: 1964 ± 20 Ma
Interpretation: cooling age
Confidence: Low

Location: Slave craton (Tinney Hills domain)

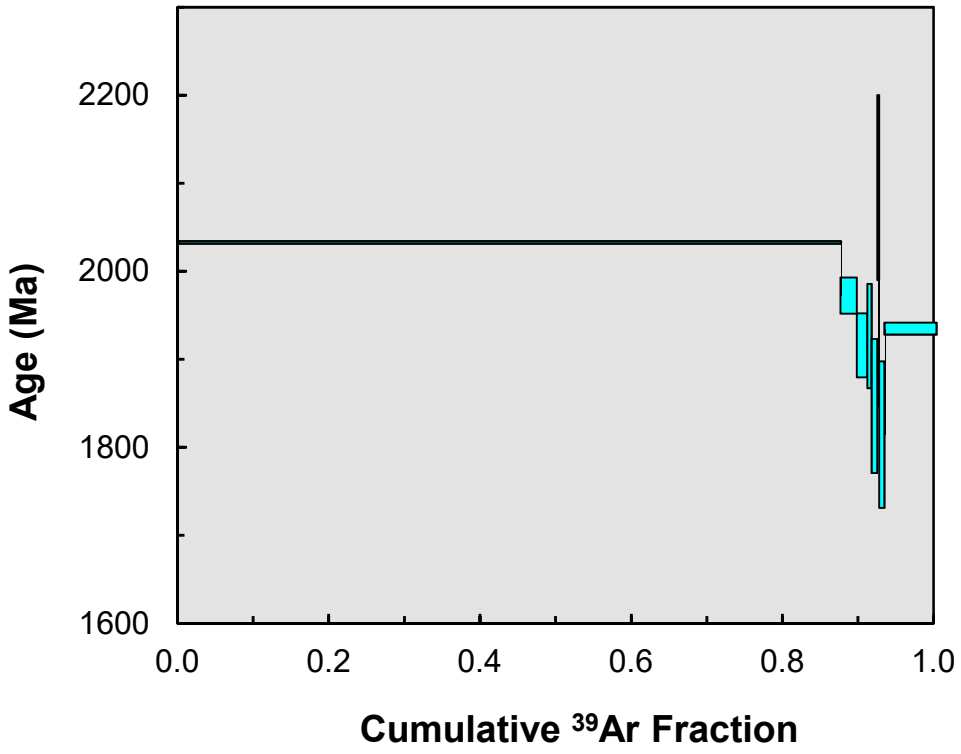
Lat: 66.74662 N
Long: 105.8525 W

Sample Description: Foliated hornblende biotite quartz monzodiorite

Results: For both crystals, over half of the ^{39}Ar released (~57 and 86 %) was in the second step, at low power, and indicates that the crystal may be altered. The steps at higher power for the first grain, representing 42.6 % of the ^{39}Ar released gives an age of 1964 ± 20 Ma (MSWD = 0.43).



Grain 1


2200
2000
1800
1600
Age (Ma)
0.0
0.2
0.4
0.6
0.8
1.0
Cumulative 39Ar Fraction

Grain 2

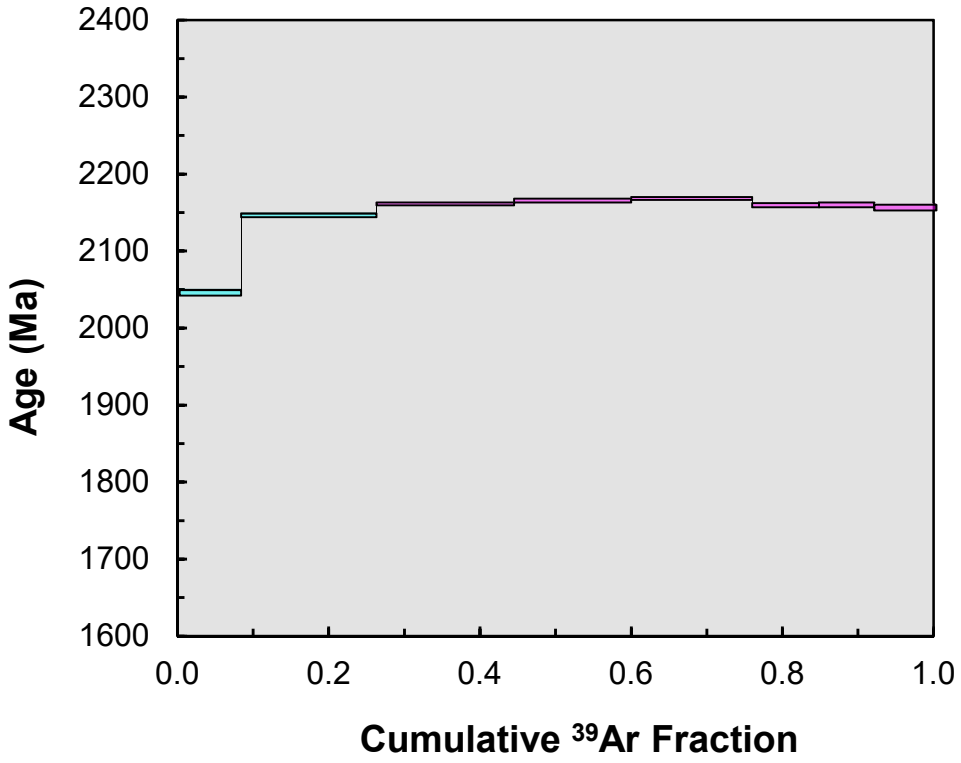
Sample Number: 16BLB-T121A
Lithology: Quartz monzodiorite
Mineral analyzed: Biotite
Age: 2164 ± 10 Ma
Interpretation: cooling age
Confidence: Low (biotite age is older than hornblende age)

Location: Slave craton (Tinney Hills domain)

Lat: 66.74662 N
Long: 105.8525 W

Sample Description: Foliated hornblende biotite quartz monzodiorite

Results: Plateau age of 2164 ± 10 Ma (n = 6 steps, MSWD = 2.8, including 73.9 % of ^{39}Ar released) is interpreted to represent the cooling age for biotite in this sample.



Thelon tectonic zone

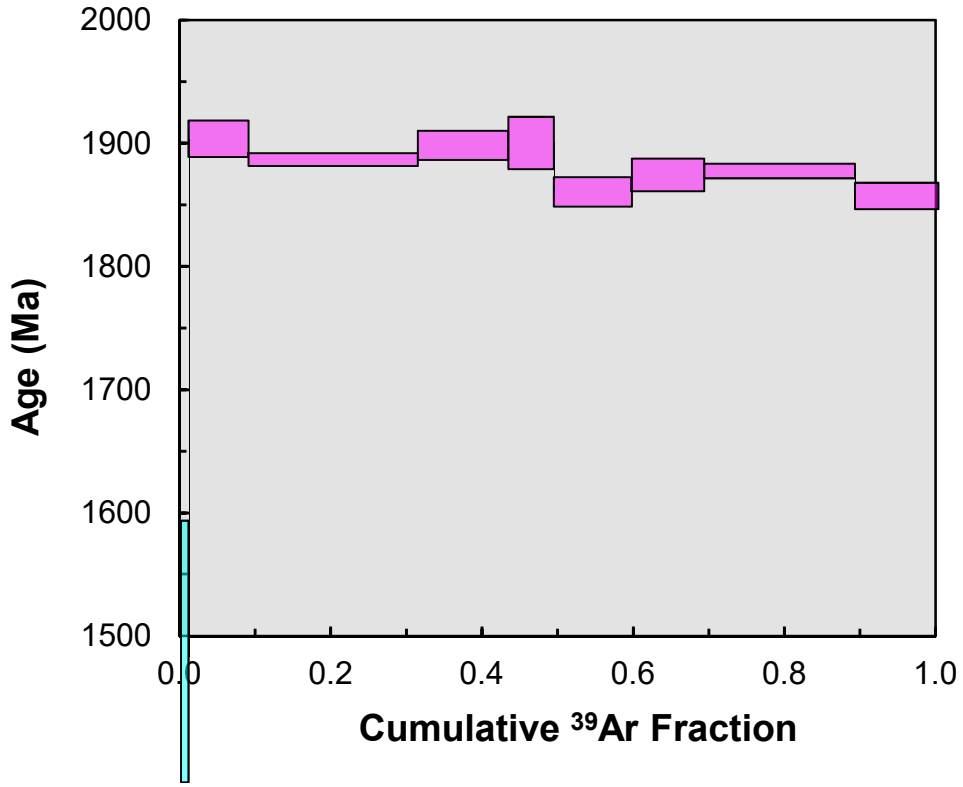
Sample Number: 16BLB-T148A
Lithology: Quartz diorite
Mineral analyzed: Hornblende
Age: 1873 ± 9 Ma
Interpretation: cooling age
Confidence: Intermediate

Location: Thelon tectonic zone (western plutonic belt)

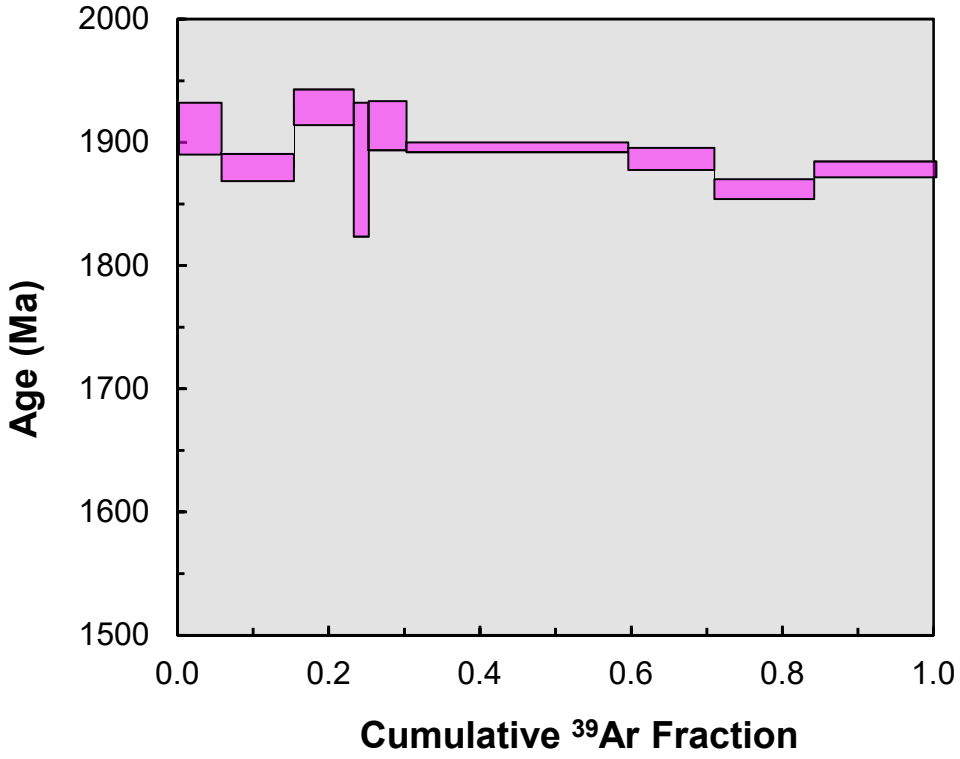
Lat: 66.20134 N
Long: 105.8176 W

Sample Description: Lineated hornblende biotite quartz diorite

Results: Step heating of two hornblende crystals produced plateaus resulting in ages of 1873 ± 9 Ma (n = 8 steps, MSWD = 2.2, including 99.0 % of ^{39}Ar released) and 1889 ± 12 Ma (n = 9 steps, MSWD = 3.6, including 100 % of ^{39}Ar released).



Grain 1


2000
1900
1800
1700
1600
1500
Age (Ma)
0.0
0.2
0.4
0.6
0.8
1.0
Cumulative 39Ar Fraction

Grain 2

Thelon tectonic zone

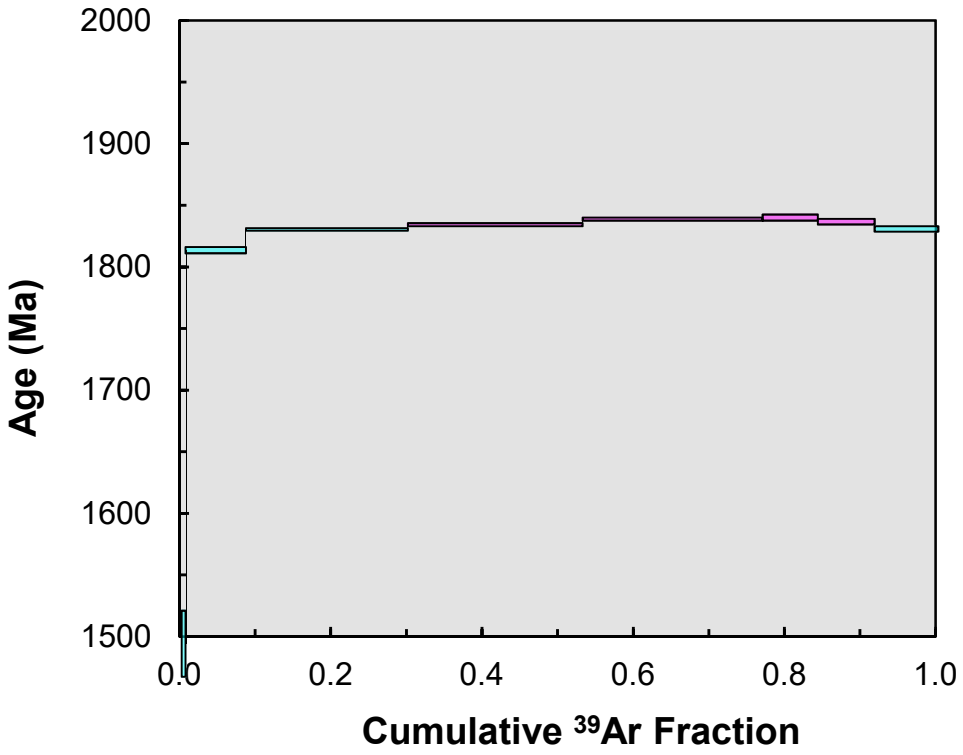
Sample Number: 16BLB-T148A
Lithology: Quartz diorite
Mineral analyzed: Biotite
Age: 1837 ± 8 Ma
Interpretation: cooling age
Confidence: high

Location: Thelon tectonic zone (Western plutonic belt)

Lat: 66.20134 N
Long: 105.8176 W

Sample Description: Lineated hornblende biotite quartz diorite

Results: Plateau age of 1837 ± 8 Ma (n = 4 steps, MSWD = 3.0, including 61.6 % of ^{39}Ar released) is interpreted to represent the cooling age for biotite in this sample.



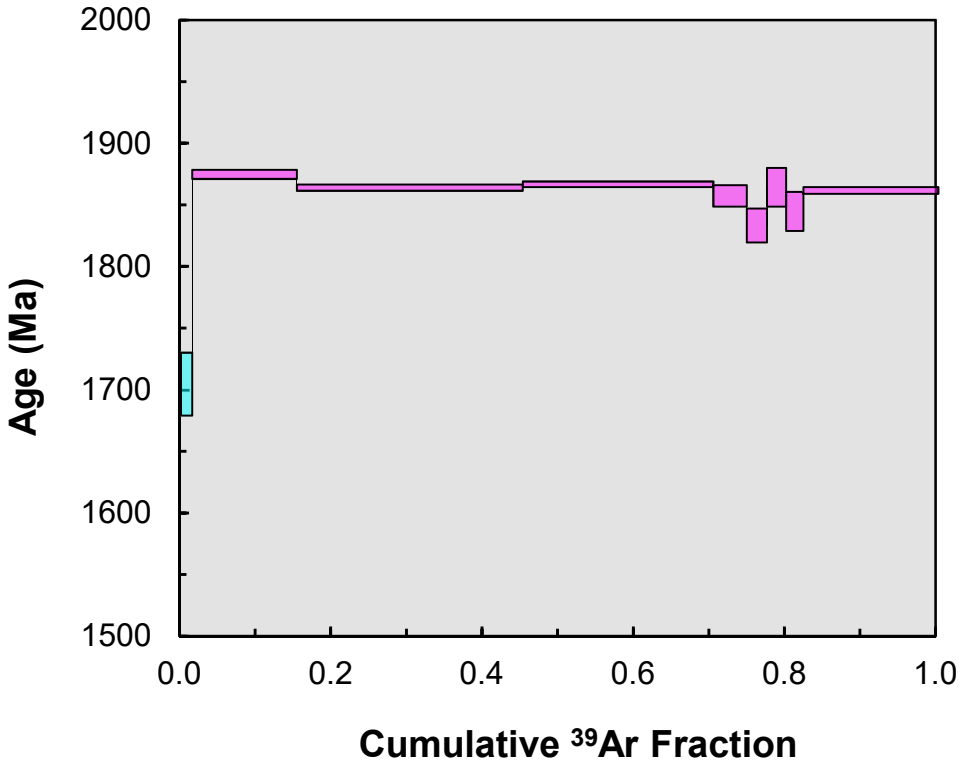
Sample Number: 16BLB-T206A
Lithology: Granodiorite
Mineral analyzed: Hornblende
Age: 1873 ± 4 Ma
Interpretation: cooling age
Confidence: high

Location: Slave craton (Overby Lake domain)

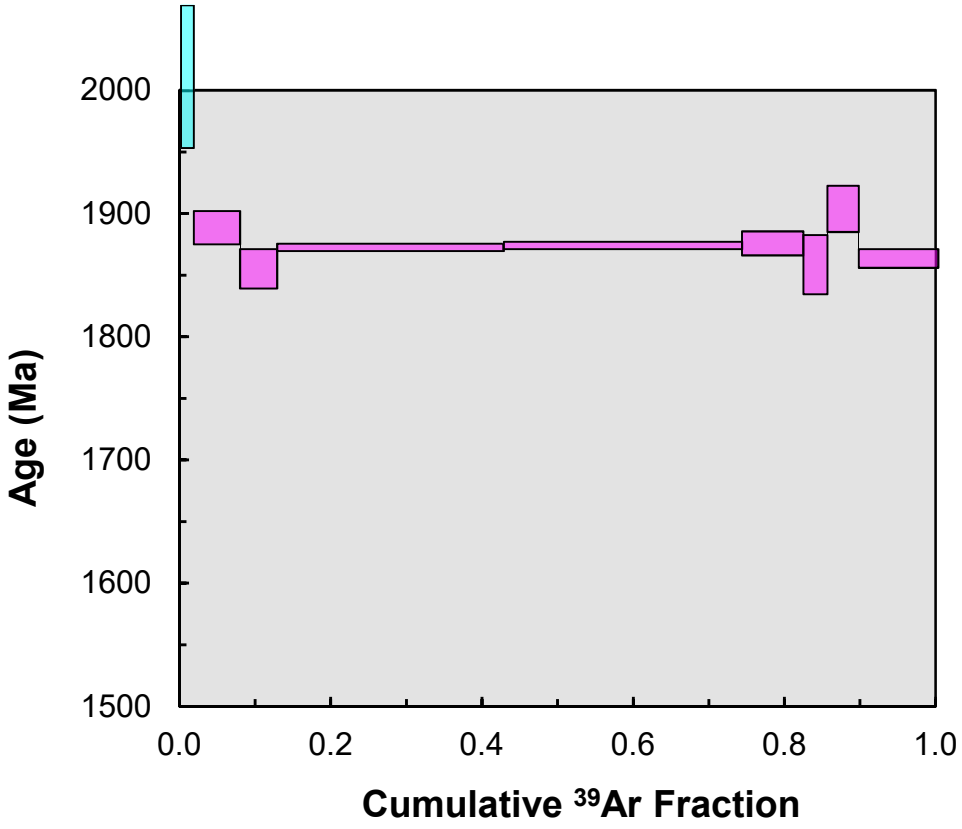
Lat: 66.41778 N
Long: 105.7605 W

Sample Description: Biotite hornblende garnet granodiorite

Results: Step heating of two hornblende crystals produced plateaus resulting in ages of 1865 ± 5 Ma (n = 8 steps, MSWD = 2.5, including 98.6 % of ^{39}Ar released) and 1873 ± 74 Ma (n = 8 steps, MSWD = 1.05, including 98.3 % of ^{39}Ar released).



Grain 1


2000
1900
1800
1700
1600
1500
Age (Ma)
0.0
0.2
0.4
0.6
0.8
1.0
Cumulative 39Ar Fraction

Grain 2

Slave craton

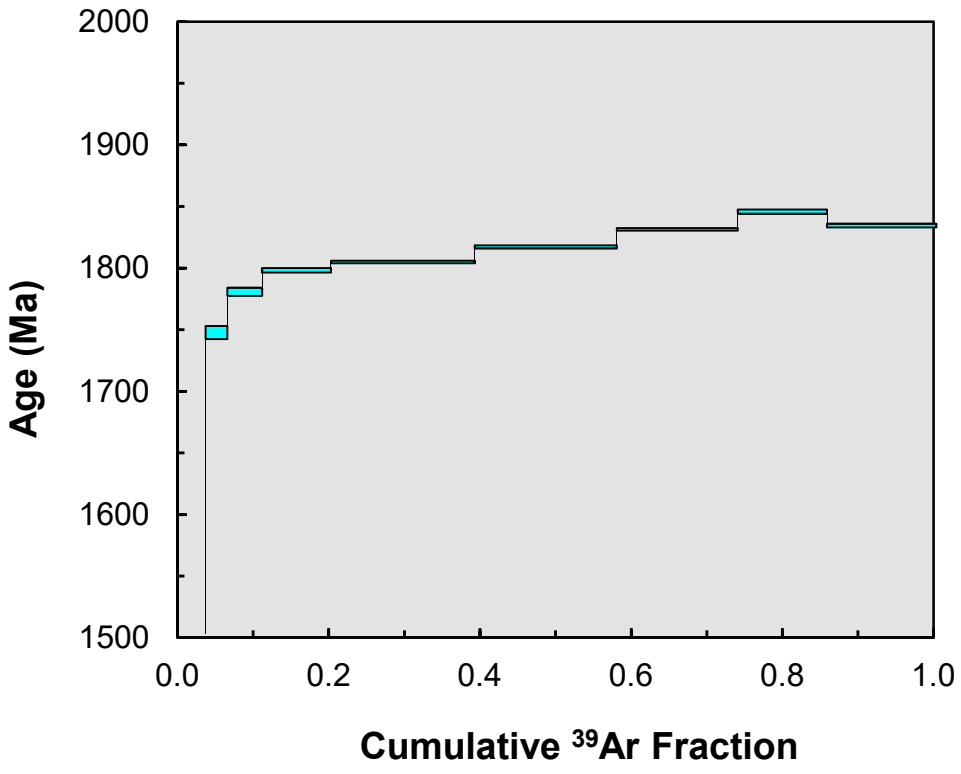
Sample Number: 16BLB-T206A
Lithology: Granodiorite
Mineral analyzed: Biotite
Age: ~1840 Ma
Interpretation: cooling age
Confidence: low

Location: Slave craton (Overby Lake domain)

Lat: 66.41778 N
Long: 105.7605 W

Sample Description: Biotite hornblende garnet granodiorite

Results: Discordant age spectrum



DISCUSSION OF RESULTS

Forty-three $^{40}Ar/^{39}Ar$ cooling ages of single crystals of hornblende and biotite were obtained from metaplutonic rock samples across the central Thelon tectonic zone, adjacent eastern Slave craton, and western Rae craton (Fig. 2). The oldest age of hornblende (ca. 2.49 Ga) is recorded in the eastern Slave craton; this is consistent with this region not being heated above ~500°C during the ca. 2.02-1.90 Ga Thelon orogeny, and is inferred to indicate that it remained at relatively shallow crustal levels. In marked contrast to ca. 2.4 Ga biotite cooling ages following ca. 2.6 Ga plutonism in the southwestern Slave craton (Bethune et al., 1999), the 1.977 ± 0.004 Ga age for biotite from the Ttz region indicates resetting of the argon systematics during the orogenic event associated with voluminous plutonism throughout the Ttz. This age is nominally ~10 Myr earlier than the time of the Slave-Rae collision inferred from a 1.967 ± 0.005 Ga U-Pb zircon age from a volcanic ash in the Kilohigok basin (Tirrul and Grotsinger, 1990). This age discrepancy warrants further corroboration given its potential impact on viable tectonic models (i.e. intracratonic vs. plate margin) for the region. Similar ca. 2.00 -1.98 Ga K-Ar hornblende ages obtained from the Healey Lake area of the Slave craton further south were tentatively ascribed to excess argon (Henderson and van Breemen, 1990).

Across the central Ttz, Overby Lake domain, Duggan Lake block, and Queen Maud block (western Rae), widespread hornblende Ar ages of ca. 1.89-1.87 Ga reflect cooling of much of the central Ttz and western Rae craton through ~550°C (hornblende closure temperature) at this time. We attribute this ca. 1.89-1.87 Ga cooling to tectonic exhumation of significant parts of the Ttz after ca. 1.95 Ga, as evidenced by the prevalence of ca. 2.00-1.95 Ga detritus (derived from eroded Ttz plutonic rocks) in < 1.95 Ga siltstone of the Ellice River domain (Davis et al., in prep). In contrast, the southern regions of the Western and Central plutonic belts record considerably younger hornblende ages of ca. 1.83-1.80 Ga indicating this region remained at a deeper crustal level and cooled through ~550°C some 40-65 million years later. These cooling age differences occur in regions separated by a NW-trending line parallel to the Bathurst fault (further south) and the axial plane of late cross folds (labelled A and B in Fig. 2), suggesting the influence of these structures in diachronous exhumation. A hornblende age of ca. 1.848 Ga (sample 16BLB-M180A, Fig. 2) in the northern Ellice River domain suggests differential exhumation relative to the adjacent plutonic belts.

The widespread occurrence of ca. 1.80-1.78 Ga biotite cooling ages (Fig. 2) indicates the region cooled below ~300°C at this time. For much of the central Ttz and western Rae, a relatively slow cooling rate (~ 2.8°C per m.y.) is calculated based on the difference in closure temperature between hornblende (~550°C) at ca. 1.89-1.87 Ga and biotite (~300°C) at ca. 1.80 Ga. Elevated thermal conditions over this time period would be conducive to greenschist- to lower amphibolite-facies monazite growth either during deformation or localized fluid flow. This scenario offers an explanation for 6 widespread localities where monazite ages of ca. 1.84-1.79 Ga are documented (Mitchell et al., 2017). In contrast, the argon data support much more rapid cooling (i.e., ~12.5° per m.y.) of the southern Wpb, Cpb and southern ER belt from ca. 550°C at 1.81 Ma to ~300°C at 1.79 Ga.

ACKNOWLEDGMENTS

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