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PAPER 81-2

AGE DETERMINATIONS AND GEOLOGICAL STUDIES
K-Ar Isotopic Ages, Report 15

R.D. STEVENS,
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Canada

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AGE DETERMINATIONS AND GEOLOGICAL STUDIES
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Abstract

Two hundred and eight potassium-argon age determinations carried out on Canadian rocks and minerals are reported. Each age determination is accompanied by a description of the rock and mineral concentrate used; brief interpretative comments regarding the geological significance of each age are also provided where possible. The experimental procedures employed are described in brief outline and the constants used in the calculation of ages are listed. Two geological time-scales are reproduced in tabular form for ready reference and an index of all Geological Survey of Canada K-Ar age determinations published in this format has been prepared using NTS quadrangles as the primary reference.

Résumé

Les auteurs présentent 208 datations au potassium-argon effectuées sur des roches et des minéraux d'origine canadienne. Chaque datation est accompagnée d'une description de la roche ou du concentré mineral utilise ainsi que d'une brève interpretation touchant l'aspect géologique. Les méthodes expérimentales qui ont servi aux datations sont aussi résumées et l'auteur joint une liste des constantes utilisées dans les calculs. Deux échelles des temps géologiques sont reproduites sous forme de tableau ce qui facilite les références et l'on a préparé, par quadrilatère du SRCN, un index de toutes les datations au potassium-argon publiées par la Commission géologique du Canada.

INTRODUCTION

This is the fifteenth report of potassium-argon age measurements completed in the Geochronological Laboratories of the Geological Survey of Canada. Two hundred and eight determinations are reported, bringing the total number of published ages to 2671 in this series.

Since the reports have not always followed the same numerical sequence, the list following identifies the complete series:-

GSC Paper 60-17, Report No. 1	–	determinations 59-1 to 59-98
GSC Paper 61-17, Report No. 2	–	determinations 60-1 to 60-152
GSC Paper 62-17, Report No. 3	–	determinations 61-1 to 61-204
GSC Paper 63-17, Report No. 4	–	determinations 62-1 to 62-190
GSC Paper 64-17, Report No. 5	–	determinations 63-1 to 63-184
GSC Paper 65-17, Report No. 6	–	determinations 64-1 to 64-165
GSC Paper 66-17, Report No. 7	–	determinations 65-1 to 65-153
GSC Paper 67-2A, Report No. 8	–	determinations 66-1 to 66-176
GSC Paper 69-2A, Report No. 9	–	determinations 67-1 to 67-146
GSC Paper 71-2, Report No. 10	–	determinations 70-1 to 70-156
GSC Paper 73-2, Report No. 11	–	determinations 72-1 to 72-163
GSC Paper 74-2, Report No. 12	–	determinations 73-1 to 73-198
GSC Paper 77-2, Report No. 13	–	determinations 76-1 to 76-248
GSC Paper 79-2, Report No. 14	–	determinations 78-1 to 78-230
GSC Paper 81-2, Report No. 15	–	determinations 80-1 to 80-208 (this report)

Geological Time Scales

The Phanerozoic portion of a time scale chart prepared by Izett et al. (1980) at the request of the Geologic Names Committee for use by members of the United States Geological Survey is reproduced for quick reference as Figure 1. Another current analysis of the concept of the geological time scale and a detailed discussion of some of its parts may be found in Cohee et al. (1978) and Armstrong (1978).

A revised time scale, after Stockwell (1973), is reproduced as Figure 2 for the Precambrian of the Canadian Shield.

Experimental Procedures

The concentration of potassium in most samples was routinely determined using X-ray fluorescence methods (Lachance, in Wanless et al., 1965, p. 4-7); the reliability of this technique has been demonstrated by Wanless et al. (1966, Table 1, p. 2). In cases where the quantity of available sample was too small for XRF the potassium content was determined using isotope dilution techniques and solid-source, triple-filament mass spectrometry (Wanless et al., 1968, p. 1-6).

Radio-frequency induction heating was employed to fuse the samples in vacuo. A precisely determined quantity of enriched argon-38 was added to the liberated gas which was then purified by passage through cold-traps, hot copper oxide, and over a titanium sponge getter. Isotopic analyses were carried out in modified A.E.I. MS-10 mass spectrometers operated in the static mode.

The various factors to be considered in assigning experimental error limits to individual age determinations have been discussed in detail in Report 5 (Wanless et al., 1965, p. 1-4). All reported errors are at the 95 per cent confidence level.

Constants Employed in Age Calculations

The constants employed to calculate the ages are those adopted by the IUGS Subcommission on Geochronology at the

MAJOR GEOCHRONOLOGIC AND CHRONOSTRATIGRAPHIC UNITS

Subdivisions in use by the U.S. Geological Survey (and their map symbols)					Age estimates[1] of boundaries in million years (m.y.)	
Phanerozoic Eon or Eonothem	Cenozoic Era or Erathem (Cz)	Quaternary Period or System (Q)		Holocene Epoch or Series	0.010	
				Pleistocene Epoch or Series	2	(1.7-2.2)
		Tertiary Period or System (T)	Neogene Subperiod or Subsystem (N)	Pliocene Epoch or Series	5	(4.9-5.3)
				Miocene Epoch or Series	24	(23-26)
			Paleogene Subperiod or Subsystem (Pε)	Oligocene Epoch or Series	38	(34-38)
				Eocene Epoch or Series	55	(54-56)
				Paleocene Epoch or Series	63	(63-66)
	Mesozoic Era or Erathem (Mz)	Cretaceous Period or System (K)		Late Cretaceous Epoch or Upper Cretaceous Series	96	(95-97)
				Early Cretaceous Epoch or Lower Cretaceous Series	138	(135-141)
		Jurassic Period or System (J)			205	(200-215)
		Triassic Period or System (Ŧ)			∿240	
	Paleozoic Era or Erathem (Pz)	Permian Period or System (P)			290	(290-305)
		Carboniferous Periods or Systems (C)	Pennsylvanian Period or System (P)		∿330	
			Missippian Period or System (M)		360	(360-365)
		Devonian Period or System (D)			410	(405-415)
		Silurian Period or System (S)			435	(435-440)
		Ordovician Period or System (O)			500	(495-510)
		Cambrian Period or System (Є)			∿570	

[1] Ranges reflect uncertainties of isotopic and biostratigraphic age assignments. Age of boundaries not closely bracketed by existing data shown by ∿. Decay constants and isotope ratios employed are cited in Steiger and Jager (1977).

Figure 1. *Phanerozoic time scale (from Izett et al.; Geologic Names Committee, 1980 edition).*

Eon	Era	Sub-Era	Event	Age of Boundary (Ma)	
				U-Pb Scale	Rb-Sr Scale (constant 1.42)
PROTEROZOIC	HADRYNIAN				
	HELIKIAN	NEOHELIKIAN	Grenville Orogeny	Ca 1000	Ca 1045
		PALEOHELIKIAN	Elsonian Event	? 1400	?
	APHEBIAN		Hudsonian Orogeny	Ca 1800	? 1810
ARCHEAN			Kenoran Orogeny	Ca 2560	? 2630

Figure 2. *Precambrian time scale*

25th ICG in Sydney, Australia (Steiger and Jager, 1977). They are as follows:

Potassium

$\lambda(^{40}K_{\beta^-}) = 4.962 \times 10^{-10} a^{-1}$

$\lambda(^{40}K_e) + \lambda'(^{40}K_e) = 0.581 \times 10^{-10} a^{-1}$

$^{40}K = 0.01167$ atom%

Argon

atomic ratio $^{40}Ar/^{36}Ar$ atmospheric = 295.5

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1965: Age determinations and geological studies, Pt. 1 – Isotopic ages, Report 5; Geological Survey of Canada, Paper 64-17, p. 1-126.

1966: Age determinations and geological studies, K-Ar isotopic ages, Report 6; Geological Survey of Canada, Paper 65-17.

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1968: Age determinations and geological studies, K-Ar isotopic ages, Report 8; Geological Survey of Canada, Paper 67-2, Pt. A.

Errata

GSC Paper 79-2

Determination GSC 78-139:

Geologist's sample number should read T808b.

British Columbia (and Washington)
(GSC 80-1 to GSC 80-70)

GSC 80-1 Biotite, K-Ar age **147 ± 5 Ma**

K = 7.57%, $^{40}Ar/^{40}K$ = 0.00891, radiogenic Ar = 90.1%.
Concentrate: Dark brown biotite with approximately 4% chlorite alteration.

From granodiorite
(104 I) 2 km north of Peak 6962' and north-northwest of headwaters of Snowdrift Creek, Cry Lake map area, British Columbia, 58°20'30"N, 129°36'00"W. Sample AN 77-329, collected by R.G. Anderson and interpreted by H. Gabrielse.

The sample is a massive to incipiently foliated, medium grained, equigranular granodiorite containing 40 per cent andesine, 20 per cent K-feldspar, 25 per cent quartz, 10 per cent biotite and 5 per cent hornblende.

It is assumed that the outcrops represented by the sample are part of a large stock underlying the basin and flanking area to the south and east at the headwaters of Snowdrift Creek. In other localities the stock has intruded strata of early Jurassic (Pliensbachian) age. The K-Ar age supports the data obtained elsewhere in Cassiar and Omineca Mountains for a significant mid to late Jurassic plutonic episode.

GSC 80-2 Biotite, K-Ar age **176 ± 5 Ma**

K = 7.28%, $^{40}Ar/^{40}K$ = 0.01076, radiogenic Ar = 92.5%.
Concentrate: Clean, unaltered, brown biotite with no chlorite contamination.

From granite
(104 I) 4 km northeast of Thenatlodi Mountain, Cry Lake map area, British Columbia, 58°11'30"N, 129°55'00"W. See Hotailuh Batholith, GSC Paper 78-1A, p. 29-31. Sample AN 77-356, collected by R.G. Anderson and interpreted by H. Gabrielse.

See GSC 80-3 for description and interpretation.

GSC 80-3 Hornblende, K-Ar age **169 ± 11 Ma**

K = 0.95%, $^{40}Ar/^{40}K$ = 0.01029, radiogenic Ar = 86.5%.
Concentrate: Clean, unaltered, pleochroic brown to dark green hornblende with no visible contamination.

From granite
(104 I) Details as for GSC 80-2.

The sample is a medium grained, equigranular pink weathering, massive granitic rock comprising about 30 per cent K-feldspar, 25 per cent altered plagioclase, 25 per cent quartz, 15 per cent hornblende and about 5 per cent biotite.

The granitic rocks represented by the sample clearly intrude Upper Triassic and (?) Lower Jurassic volcanics, and similar rocks elsewhere in the batholith have been emplaced into Lower Jurassic (Toarcian) sedimentary strata (see R.G. Anderson, GSC Papers 78-1A, 79-1A).

GSC 80-4 Hornblende, K-Ar age **170 ± 11 Ma**

K = 0.417%, $^{40}Ar/^{40}K$ = 0.01033, radiogenic Ar = 74.2%.
Concentrate: Clean, unaltered, pleochroic light brown to light green hornblende with no visible contamination.

From syenodiorite
(104 I) 2 km south of peak 7174', northern Three Sisters Range, Cry Lake map area, British Columbia, 58°09'30"N, 129°29'40"W. Map unit V, GSC Paper 78-1A, p. 29-31. Sample AN 77-345, collected by R.G. Anderson and interpreted by H. Gabrielse.

The rock is a slightly heterogeneous, equigranular granodiorite with about 5 per cent small inclusions of cognate mafic rock. It comprises approximately 40 per cent highly altered andesine, 20-25 per cent potash feldspar, 10-12 per cent hornblende which is relatively fresh in large crystals and partly altered to chlorite is smaller ones, 5 per cent biotite and chlorite and 2 to 3 per cent opaques. Sphene is a common accessory mineral.

The age is in good agreement with results obtained on similar rocks about 3 km farther south (GSC 70-31, 163 ± 9 and GSC 70-32, 163 ± 7, which recalculate to 167 Ma using the decay constants of Steiger and Jager, 1977).

GSC 80-5 Hornblende, K-Ar age **227 ± 14 Ma**

K = 0.380%, $^{40}Ar/^{40}K$ = 0.01403, radiogenic Ar = 77.9%.
Concentrate: Clean, unaltered, pleochroic light green to brown hornblende with no visible contamination.

From granodiorite-syenodiorite cobbles
(104 I) 4 km south-southeast of Horn Mountain, Cry Lake map area, British Columbia, 58°13'10"N, 129°31'00"W. See map unit V (Cake Hill phase of Hotailuh Batholith), GSC Paper 78-1A. Sample AN 77-276, collected by R.G. Anderson and interpreted by H. Gabrielse.

The boulders consist of medium grained, massive to foliated and lineated leucocratic syenodiorite to granite with 40-45 per cent potash feldspar, 30-35 per cent oligoclase, 20 per cent quartz, 1-2 per cent hornblende. The hornblende is highly corroded and contains abundant inclusions. Sphene (about 1 per cent) and opaques (about 1 per cent) are generally closely associated.

The cobbles occur in a basal volcanic flow of an Upper Triassic volcanic sequence that rests unconformably on rocks of the Cake Hill Pluton of the Hotailuh batholith. The age is in agreement with ages previously obtained from the Cake Hill Pluton (GSC 70-34, 217 ± 11 Ma and GSC 70-23, 213 ± 11 Ma, or 222 Ma and 218 Ma when recalculated using Steiger and Jager, 1977 decay constants). Thus the oldest phase of the Hotailuh batholith is confirmed to be of Triassic age and the ages provide an approximation of the maximum age of late Triassic volcanism.

GSC 80-6 Hornblende, K-Ar age **55.4 ± 3.0 Ma**

$K = 1.70\%$, $^{40}Ar/^{40}K = 0.00327$, radiogenic Ar = 76.7%.
Concentrate: Dark green hornblende with approximately 10% attached biotite contamination.

From porphyry
(104 I) Approximately 1 km northeast of peak 6812', east of divide at head of Kutcho Creek, British Columbia, 58°09'N, 128°25'W. Sample GA-78-11, collected and interpreted by H. Gabrielse.

Sample is representative of dykes that are for the most part unfoliated and which cut penetratively foliated rocks of the 'Kutcho formation'. The rock is fresh, medium- to fine-grained pyroxene-hornblende porphyry with 65-70 per cent plagioclase (Ab_{60} An_{40}) showing well developed trachytic texture. Augite is the dominant mafic mineral. It is commonly rimmed by dark green amphibole which is in turn locally replaced by biotite. The dated concentrate contained approximately 10 per cent biotite, rendering the determination unreliable.

It was hoped that a date on the dykes would place constraints on the minimum age of the event that produced the penetrative foliation in the Kutcho rocks. The age is too young, however, to closely bracket the deformation. The dykes may be related to a swarm of mafic dykes that occur to the southeast in Toodoggone River map area.

GSC 80-7 Hornblende, K-Ar age **208 ± 15 Ma**

$K = 0.371\%$, $^{40}Ar/^{40}K = 0.01283$, radiogenic Ar = 52.8%.
Concentrate: Clean, unaltered, pleochroic olive-green to light green hornblende with no visible contamination.

From granite
(104 I) 1 km north of Peak 7179', southwestern quadrant of Cry Lake map area, British Columbia, 58°10'48"N, 129°30'08"W. Sample AN-78-505-5, collected by R.G. Anderson and interpreted by H. Gabrielse.

See GSC 80-8 for description.

The age determined for this sample is considerably older than those for similar samples collected nearby in the same pluton (see GSC 80-9, 10). The rocks in this area, however, contain numerous inclusions of the older Cake Hill pluton of the Hotailuh batholith and it seems possible that some contamination has taken place. This might explain why the ages from the syenodiorite-diorite phase decrease from south to north in the Three Sisters pluton (see discussion for GSC 80-10).

GSC 80-8 Hornblende, K-Ar age **183 ± 14 Ma**

$K = 0.74\%$, $^{40}Ar/^{40}K = 0.01117$, radiogenic Ar = 61.2%.
Concentrate: Clean, unaltered, pleochroic yellowish green to light green hornblende with no visible contamination.

From diorite
(104 I) 3.75 km east of Cake Hill, 5 km west of Peak 7174' in southwest quadrant of Cry Lake map area, British Columbia, 58°10'20"N, 129°34'50"W. Sample AN-78-542-1, collected by R.G. Anderson and interpreted by H. Gabrielse.

The rock is representative of a mafic phase of Three Sisters pluton (see Anderson, GSC Paper 79-1A) comprising hornblende diorite with conspicuous crystals of acicular hornblende, equant hornblende porphyry diorite, and equigranular hornblende gabbro.

The age confirms field relations indicating that the rocks are younger than the Cake Hill pluton which they intrude. The age is also in agreement with those obtained about 5 km to the east from more leucocratic phases (syenodiorite-diorite) of the Three Sisters pluton (see GSC 80-9 and 10).

GSC 80-9 Biotite, K-Ar age **179 ± 6 Ma**

$K = 5.92\%$, $^{40}Ar/^{40}K = 0.01094$, radiogenic Ar = 93.6%.
Concentrate: Light brown biotite with approximately 5% chlorite alteration and a trace of hornblende contamination.

From diorite
(104 I) 0.5 km northwest of Peak 7174', southwestern Cry Lake map area, British Columbia, 58°10'24"N, 129°30'15"W. Sample AN-78-523-1, collected by R.G. Anderson and interpreted by H. Gabrielse.

See GSC 80-10 for description and interpretation.

GSC 80-10 Hornblende, K-Ar age **189 ± 14 Ma**

$K = 0.75\%$, $^{40}Ar/^{40}K = 0.01159$, radiogenic Ar = 86.6%.
Concentrate: Relatively clean, pleochroic brown to green hornblende with approximately 1% biotite contamination.

From diorite
(104 I) Details as for GSC 80-9.

The sample is from the northern part of the syenodiorite-diorite phase of the Three Sisters pluton and consists of biotite-hornblende syenodiorite to diorite.

The age is in general agreement with that obtained on a more mafic phase of the pluton about 5 km to the west (see GSC 80-8). Samples of similar rocks collected 4.8 and 9.8 km to the south in the syenodiorite-diorite phase gave ages of 170 ± 11 (GSC 80-4) and 163 ± 9, 163 ± 11 (biotite-hornblende pair), respectively. The hornblende-biotite pair at 163 Ma were published as GSC 70-31 and GSC 70-32 and should be revised to 167 ± 9 and 167 ± 11 Ma recalculated using the decay constants of Steiger and Jager (1977).

GSC 80-11 Hornblende, K-Ar age **186 ± 13 Ma**

$K = 0.338\%$, $^{40}Ar/^{40}K = 0.01138$, radiogenic Ar = 66.8%.
Concentrate: Clean, unaltered, pleochroic yellowish green to bluish green hornblende with no visible contamination.

From granodiorite
(104 I) 10 km south-southeast of Peak 6253', in southwest quadrant of Cry Lake map area, British Columbia, 58°03'00"N, 129°06'30"W. Sample AN-78-467, collected by R.G. Anderson and interpreted by H. Gabrielse.

The rock is a medium hornblende granodiorite whose relations to the main body of the Three Sisters pluton is unknown.

The age confirms impressions gained in the field that the granodiorite is about the same age as the Three Sisters pluton. It is clearly intrusive into Upper Triassic volcanic rocks.

GSC 80-12 Whole rock, K-Ar age **45.3 ± 2.3 Ma**

$K = 4.14\%$, $^{40}Ar/^{40}K = 0.00267$, radiogenic Ar = 78.7%.
Concentrate: Crushed whole rock.

From quartz porphyry
(104 I) East of Dall Lake lineament, Cry Lake area, Cassiar Mountains, British Columbia, 58°50'N, 128°01½'W. Sample GA-77-64a, collected and interpreted by H. Gabrielse.

The sample represents a distinctive body of white, flesh pink and grey rhyolite flows, tuff and breccia. Quartz in clear glassy crystals from 0.2 to 1.0 mm in diameter occur in a partly kaolinized feldspathic matrix. Locally spherulitic textures are well developed.

The volcanics appear to be of the same age as dacitic rocks and minette dykes previously dated in the Stelkuz Creek area near the northern Rocky Mountain Trench of Toodoggone River map area.

GSC 80-13 Biotite, K-Ar age **112 ± 4 Ma**

$K = 6.27\%$, $^{40}Ar/^{40}K = 0.00674$, radiogenic Ar = 82.2%.
Concentrate: Relatively clean, unaltered, light greenish brown biotite with a trace of chlorite contamination.

From quartz monzonite
(94 L) At approximately 6000 ft (1829 m) elevation, 1.9 km south of Pitman River, Cassiar Mountains, Kechika map area, British Columbia, 58°01.2'N, 127°25'W. Sample GA-77-84, collected and interpreted by H. Gabrielse.

The rock is a leucocratic medium grained to megacrystic and locally pegmatitic biotite-hornblende quartz monzonite comprising perthitic K-feldspar (50 per cent), oligoclase (20 per cent), quartz (20 per cent), biotite (10 per cent) and minor hornblende.

The lithology of the rocks sampled is similar to that from several other localities immediately south of the Pitman valley and confirms that both mid Cretaceous and early Jurassic granitic rocks are present northeast of Kutcho fault. In general the lithologies are distinctive because the rocks that have given early Jurassic ages are mainly rich in hornblende and plagioclase.

GSC 80-14 Hornblende, K-Ar age $\frac{182}{181} \pm \frac{13}{13}$ **Ma**

$K = 0.82\%$, $^{40}Ar/^{40}K = \frac{0.01115}{0.01106}$, radiogenic
$Ar = \frac{78.7\%}{53.3\%}$.
Concentrate: Clean, unaltered, pleochroic yellow-green to medium green hornblende with no visible contamination.

From quartz diorite/granodiorite
(94 L) 2.75 km north of Pitman River, between 6000 and 6500 ft (1830-1980 m) elevation, Cassiar Mountains, Kechika area, British Columbia, 58°03.8'N, 127°16.8'W. Sample GA-77-88, collected and interpreted by H. Gabrielse.

The rock is a leucocratic medium grained equigranular quartz-diorite or granodiorite characterized by a protoclastic sugary texture. It comprises about 10 per cent subhedral hornblende locally altered to chlorite but commonly fresh, about 10 per cent K-feldspar, 15 per cent quartz and about 65 per cent calcic oligoclase. Sphene is an abundant accessory mineral.

The lithology described above is similar to rocks that comprise most of the Pitman batholith to the south in Toodoggone (94E) map area. There an age of 185 ± 8 Ma was obtained on hornblende from near Mt. Cushing (GSC 78-21). These ages agree closely with previously obtained ages on granitic and volcanic rocks in Toodoggone map area supporting the contention that roughly coeval volcanism and plutonism were widespread in the northern Omineca and southern Cassiar mountains in the early Jurassic.

GSC 80-15 Biotite, K-Ar age **100 ± 3 Ma**

$K = 7.93\%$, $^{40}Ar/^{40}K = 0.00599$, radiogenic Ar = 95.0%.
Concentrate: Clean, unaltered, brownish orange biotite with no chlorite contamination.

From foliated quartz monzonite
(94 L) 1.0 km west of Frog River and 1.9 km north of Pitman River, Cassiar Mountains, Kechika area, British Columbia, 58°03.8'N, 127°09.2'W. Sample GA-77-87, collected and interpreted by H. Gabrielse.

See GSC 80-16 for description and interpretation.

GSC 80-16 Muscovite, K-Ar age **106 ± 4 Ma**

$K = 5.23\%$, $^{40}Ar/^{40}K = 0.00632$, radiogenic Ar = 79.0%.
Concentrate: Clean, fresh, mainly clear muscovite with no visible contamination.

From foliated quartz monzonite
(94 L) Details as for GSC 80-15.

The rock is a cataclastized quartz monzonite or granodiorite with biotite (about 3-5 per cent) and muscovite (3-5 per cent) developed on foliation planes.

Cataclastic and mylonitic granitic rocks occur along the western border of the Thudaka batholith and commonly separate mid Cretaceous quartz monzonite to the east from lower Jurassic quartz diorite and granodiorite to the west. A previous determination (GSC 78-27) of 102 ± 10 Ma was obtained from rocks in the fault zone about 25 km farther north-northwest. Muscovite and biotite dated in the samples have clearly developed along foliation planes and the ages therefore indicate the time of cataclasis. As in the case of the Cassiar batholith the wide zone of cataclasis on the west side of Thudaka batholith seems to have formed at about the same time as emplacement of the granitic rocks in the mid Cretaceous.

GSC 80-17 Biotite, K-Ar age **113 ± 4 Ma**

$K = 6.76\%$, $^{40}Ar/^{40}K = 0.00677$, radiogenic Ar = 89.5%.
Concentrate: Light brown biotite with approximately 3% chlorite alteration.

From granodiorite
(92 K) 0.8 km northeast of the north-northeast corner of Clear Lake, Quadra Island, British Columbia, 50°14'20"N, 125°14'06"W. Sample MEKA 74-12, collected by D. Carlisle and interpreted by J.E. Muller.

See GSC 80-18 for description and interpretation.

GSC 80-18 Hornblende, K-Ar age **122 ± 5 Ma**

K = 0.405%, $^{40}Ar/^{40}K$ = 0.00736, radiogenic Ar = 52.6%.
Concentrate: Clean, unaltered, pleochroic brown to green hornblende with no visible contamination.

From granodiorite
(92 K) Details as for GSC 80-17.

Laboratory comments: A graphical plot of the argon and potassium isotopic data indicates no significant excess radiogenic argon, an initial $^{40}Ar/^{40}K$ = 310, and an "age" of 110 Ma.

The rock is fine grained granodiorite that occupies a total area of about 10 km^2. It is intrusive into dominant quartz diorite and hornblende diorite, but is itself intruded by younger felsite. The apparent Early Cretaceous age is similar to other ages obtained in the southwest quadrant of Bute Inlet map area. It confirms the "younging" of Jurassic Island Intrusions northeastward towards the Coast Plutonic Complex.

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1972: Bute Inlet map-area, Vancouver Island, British Columbia; Geological Survey of Canada, Paper 72-1A, p. 19-23.

1976: Bute Inlet, southwestern part, British Columbia (Vancouver, Quadra, and adjacent islands); Geological Survey of Canada, Open File 345.

GSC 80-19 Hornblende, K-Ar age **153 ± 14 Ma**

K = 0.53%, $^{40}Ar/^{40}K$ = 0.00925, radiogenic Ar = 72.0%.
Concentrate: Clean, unaltered, pleochroic green to yellow-green hornblende with no visible contamination.

From gneiss
(92 B) Cattle Point, Oak Bay District, Victoria, British Columbia, 48°26'10"N, 123°17'30"W. Sample MEKA 76-4, collected and interpreted by J.E. Muller.

The rock is complexly folded, light and dark coloured, well foliated hornblende plagioclase gneiss of the Colquitz Gneiss of southeast Vancouver Island. Few available zircon age determinations indicate Paleozoic age of this complex and the apparent age reflects Jurassic metamorphism, probably related to the emplacement of Island Intrusions. Previously obtained metamorphic ages on Colquitz Gneiss and related Wark Gneiss are 182 ± 8 Ma (GSC 76-2) and 163 ± 7 Ma (GSC 76-3). These latter ages should be adjusted to 186 ± 8 Ma and 167 ± 7 Ma to be conformable with the Steiger and Jager (1977) decay constants.

Reference

Muller, J.E.
1980: Victoria map-area, British Columbia; Geological Survey of Canada, Open File 701.

GSC 80-20 Hornblende, K-Ar age **160 ± 9 Ma**

K = 0.534%, $^{40}Ar/^{40}K$ = 0.00970, radiogenic Ar = 80.7%.
Concentrate: Clean, unaltered, green to yellow-green hornblende with no visible contamination.

From diorite
(92 B) Cut on north side of Trans Canada Highway near Portage Inlet, Victoria District, Vancouver Island, British Columbia, 48°27'45"N, 123°24'40"W. Sample MEKA 76-5, collected and interpreted by J.E. Muller.

The rock is fine grained hornblende diorite with saussuritic and albitized plagioclase, grass-green to yellow-green pleochroic hornblende, fine patchy biotite and some interstitial quartz. The texture is slightly cataclastic. Biotite, largely altered to chlorite, was unsuitable for dating. The rock yielded an insufficient quantity of zircons to be dated and may be recrystallized basalt of Paleozoic or Triassic age. The K-Ar age reflects, as for GSC 80-19, GSC 76-2 and GSC 76-3, the time of latest recrystallization during Jurassic plutonism.

GSC 80-21 Muscovite, K-Ar age **180 ± 8 Ma**

K = 3.90%, $^{40}Ar/^{40}K$ = 0.01103, radiogenic Ar = 92.3%.
Concentrate: Somewhat altered muscovite in which many of the flakes have a mottled texture and a light greenish colour. The concentrate contains approximately 9% chlorite contamination.

From schistose meta quartz porphyry
(92 B) Roadcut near end of Arbutus Avenue, Arbutus Point, Maple Bay, Vancouver Island, 48°49'25"N, 123°35'35"W. Sample WN-19-74, collected by R.K. Wanless and J.E. Muller and interpreted by J.E. Muller.

The rock is schistose and shows ellipsoidal quartz augen, to 5 mm long, in aphanitic, finely sericitic, grey, white-weathering matrix. The thin section shows rounded, and apparently corroded quartz phenocrysts, with in places fine solution channels filled with albite mosaic, and also albite phenocrysts including and commonly surrounded by sericite. There is some chloritized biotite and there are clusters of epidote, chlorite and muscovite. The matrix is a very fine quartz-albite-chlorite mesh.

The sample is from Tyee quartz porphyry which occurs as sills and dykes (and flows?) in the Myra Formation. The Myra is the younger of two volcanic formations forming the lower part of the Paleozoic Sicker Group of Vancouver Island. The sample was the first of several zircon-datings of the quartz porphyry and of comagmatic Saltspring Intrusions. A concordia plot of the slightly discordant ages obtained may be drawn through a lower intercept of 180 Ma, the K-Ar age obtained in this sample, and yields an upper intercept of 410 Ma (R.K. Wanless, personal communication, 1979). Thus the combined U-Pb and K-Ar ages yield an uppermost Silurian initial age and a Lower Jurassic metamorphic age, coeval with the early part of Island Intrusions. The volcanic rocks of the Sicker Group, intruded by these rocks, are thus dated as Silurian or older instead of Pennsylvanian or older, as had been assumed previously.

References

Muller, J.E.
1977: Evolution of the Pacific margin, Vancouver Island and adjacent regions; Canadian Journal of Earth Sciences, v. 14, p. 2062-2085.

1980a: Victoria map-area, Vancouver Island and Gulf Islands, British Columbia; Geological Survey of Canada, Open File 701.

1980b: The Paleozoic Sicker Group of Vancouver Island, British Columbia; Geological Survey of Canada, Paper 79-30.

GSC 80-22 Hornblende, K-Ar age **140 ± 11 Ma**

K = 0.68%, $^{40}Ar/^{40}K$ = 0.00844, radiogenic Ar = 82.2%.
Concentrate: Clean, unaltered, pleochroic brown to green hornblende with no visible contamination.

From quartz diorite
(92 N) From the southeast corner of Tweedsmuir Provincial Park, Mt. Waddington map area, British Columbia, 51°53.1'N, 125°40.5'W. Sample Rd76-46733, collected and interpreted by G.J. Woodsworth.

See GSC 80-23 for description and interpretation.

GSC 80-23 Biotite, K-Ar age **86.1 ± 3.2 Ma**

K = 6.69%, $^{40}Ar/^{40}K$ = 0.00512, radiogenic Ar = 88.6%.
Concentrate: Clean, unaltered, light brown biotite with a trace of free hornblende contamination.

From quartz diorite
(92 N) Details as for GSC 80-22.

The sample is a medium grained, faintly foliated quartz diorite composed of about 53% plagioclase, 25% hornblende, 15% biotite, 4% quartz, and minor apatite, sphene, chlorite, epidote, and opaques. Biotite is fresh and clean, and is commonly associated with large grains of epidote. Hornblende is unaltered.

The sample is from a heterogeneous quartz diorite body in the eastern Coast Plutonic Complex. A previously dated sample from this body gave 121 ± 12 Ma on hornblende and 65.9 ± 2.6 Ma on biotite (GSC 78-61, 62). These dates are the most highly discordant yet encountered in the Coast Plutonic Complex. Dates from the present sample, collected about 4 km west-northwest of the original, confirm the discordance, but at about a 20 Ma older level. Most likely, none of the four dates represents the "real" age of this body. Instead, they probably reflect disturbance by some later tectonic or metamorphic event.

GSC 80-24 Biotite, K-Ar age **89.8 ± 3.4 Ma**

K = 6.38%, $^{40}Ar/^{40}K$ = 0.00535, radiogenic Ar = 93.6%.
Concentrate: Greenish brown biotite with approximately 4% chlorite alteration and a trace of hornblende contamination.

From granodiorite
(92 J) 11 km northeast of Pemberton, Pemberton map area, British Columbia, 50°27.0'N, 122°44.4'W. Sample Rd70-10648, collected by J.A. Roddick and interpreted by G.J. Woodsworth.

The sample is a coarse grained grey granodiorite containing about 22% quartz, 16% K-feldspar, 8% biotite, and 4% hornblende. Biotite occurs as fine grained clots replacing hornblende.

The sample is from the Spetch Creek pluton, a large granodiorite body in the eastern part of the southern Coast Mountains. Previous dates from this pluton are 86.2 ± 3.1 Ma on biotite and 76.7 ± 3.9 Ma on hornblende (GSC 78-48, 78-49). The date from this sample is in good agreement with the previous biotite date and may represent the approximate time of emplacement of the Spetch Creek pluton.

GSC 80-25 Hornblende, K-Ar age **114 ± 8 Ma**

K = 0.89%, $^{40}Ar/^{40}K$ = 0.00683, radiogenic Ar = 59.7%.
Concentrate: Clean, unaltered, pleochroic light brown to dark green hornblende with no visible contamination.

From granodiorite
(103 A) 5.5 km northeast of Mallandaine Point on Princess Royal Island, Laredo Sound map area, British Columbia, 52°56.6'N, 129°05.3'W. Map-unit 5, GSC Memoir 372. Sample Rd65-30095, collected by W.W. Hutchison and interpreted by G.J. Woodsworth.

The sample is a fresh, grey, unfoliated granodiorite. Poikiloblastic greenish hornblende forms 5% of the rock.

See GSC 80-26 for interpretation.

GSC 80-26 Biotite, K-Ar age **117 ± 4 Ma**

K = 7.22%, $^{40}Ar/^{40}K$ = 0.00699, radiogenic Ar = 88.3%.
Concentrate: Greenish brown biotite with approximately 3% chlorite alteration.

From granite
(103 A) Northeast shoreline of Prince Island, in south tip of large bay off Higgins Passage, Laredo Sound map area, British Columbia, 52°28.1'N, 128°40.5'W. Map-unit 16a, GSC Memoir 372. Sample BT-13-22-63, collected by A.J. Baer and interpreted by G.J. Woodsworth.

The sample is a fresh, grey, medium grained granite. Biotite (9%) is free of inclusions, with minor chloritization of some grains.

Samples GSC 80-25 and 26 are from plutons near the western margin of the Coast Plutonic Complex. Both dates are in good agreement with the 115 ± 6 Ma* date from Campania Island (GSC 67-23) and the 109 ± 5 Ma* date from west of Aristazabel Island (GSC 67-26). These two ages recalculate as 118 ± 6 and 112 ± 5 Ma to conform with the decay constants of Steiger and Jager (1977). GSC 80-26 is from an irregular stock cutting diorite and granodiorite. This stock was originally correlated with the Miocene King Island syenite (GSC Memoir 372); this correlation is clearly incorrect.

GSC 80-27 Biotite, K-Ar age **51.7 ± 2.4 Ma**

K = 7.11%, $^{40}Ar/^{40}K$ = 0.00305, radiogenic Ar = 72.7%.
Concentrate: Relatively clean, greenish brown biotite with approximately 2% chlorite alteration.

From quartz monzonite
(93 D) Between Tezwa and Kitlope rivers, about 15.5 km southeast of the south tip of Gardner Canal, Bella Coola map area, British Columbia, 52°57.3'N, 127°45.0'W. Map unit 14, GSC Memoir 335. Sample Rd65-30671, collected by W.W. Hutchison and interpreted by G.J. Woodsworth.

The sample is a fresh, light grey, unfoliated quartz monzonite. Biotite (5%) is fine grained; some grains are slightly chloritized but most are fresh.

See GSC 80-29 for interpretation.

GSC 80-28 Hornblende, K-Ar age **60.2 ± 4.7 Ma**

K = 0.83%, $^{40}Ar/^{40}K$ = 0.00356, radiogenic Ar = 75.2%.
Concentrate: Clean, unaltered, pleochroic light brown to dark green hornblende with no visible contamination.

From quartz diorite
(103 H) About 14 km southeast of Marmor Peak, Douglas Channel map area, British Columbia, 53°02.4'N, 128°05.9'W. Map-unit 8b, GSC Paper 70-41. Sample Rd65-30193, collected by W.W. Hutchison and interpreted by G.J. Woodsworth.

See GSC 80-29 for description and interpretation.

GSC 80-29 Biotite, K-Ar age **57.0 ± 2.3 Ma**

K = 6.21%, $^{40}Ar/^{40}K$ = 0.00337, radiogenic Ar = 82.7%.
Concentrate: Greenish brown biotite with approximately 2% chlorite alteration and a trace of hornblende contamination.

From quartz diorite
(103 H) Details as for GSC 80-28.

The sample is a fresh, unfoliated, grey quartz diorite. Ragged biotite grains up to 1 mm long form 5% of the rock and are slightly chloritized. Fresh hornblende forms 3% of the rock.

GSC 80-27 is from one of the largest granodiorite to quartz monzonite plutons in the Coast Plutonic Complex. Samples GSC 80-28 and 29 are from quartz diorite related to the Central Gneiss Complex near the axis of the Coast Plutonic Complex. The two biotite dates are in good agreement with each other and with the 52.7 ± 2.3 Ma date (GSC 78-68) obtained from the same quartz monzonite pluton to the northeast. The dates indicate that the extensive "plateau" of 45 to 55 Ma ages in Prince Rupert map area extends this far south.

GSC 80-30 Biotite, K-Ar age **49.9 ± 2.4 Ma**

K = 6.80%, $^{40}Ar/^{40}K$ = 0.00294, radiogenic Ar = 79.1%.
Concentrate: Dark brown biotite with approximately 9% chlorite alteration.

From hornblende-biotite schist
(103 H) Elevation 5100', 3 km southeast of Atna Peak, Douglas Channel map area, British Columbia, 53°55.2'N, 128°01.2'W. Map unit 4, GSC Paper 70-41. Sample 78WV-311, collected and interpreted by G.J. Woodsworth.

The sample is a medium grained schist composed largely of quartz, biotite (5%, fresh), hornblende, and plagioclase, with lesser garnet, epidote, muscovite, and chlorite.

See GSC 80-31 for interpretation.

GSC 80-31 Hornblende, K-Ar age **104 ± 20 Ma**

K = 0.22%, $^{40}Ar/^{40}K$ = 0.00622, radiogenic Ar = 48.4%.
Concentrate: Clean, unaltered, pleochroic yellowish green to bluish green hornblende with no visible contamination.

From meta tuff
(103 H) Elevation 5300', 4 km southwest of Atna Peak, Douglas Channel map area, British Columbia, 53°54.8'N, 128°04.6'W. Map unit 4, GSC Paper 70-41. Sample 78WV-349, collected and interpreted by G.J. Woodsworth.

The sample is a moderately foliated meta-tuff consisting largely of hornblende and plagioclase with lesser quartz, biotite, and chlorite.

GSC 80-30 and 31 are from a volcanic, greywacke and carbonate assemblage that has been metamorphosed to amphibolite facies. These strata are probably of Early Permian age, and form a pendant in the Coast Plutonic Complex near its eastern margin. The biotite date is consistent with the 50 Ma "plateau" of K-Ar dates in the eastern part of the Coast Plutonic Complex. The hornblende date cannot meaningfully be interpreted at this time.

GSC 80-32 Biotite, K-Ar age **51.4 ± 2.2 Ma**

K = 7.36%, $^{40}Ar/^{40}K$ = 0.00303, radiogenic Ar = 79.1%.
Concentrate: Clean, unaltered, dark brown biotite with no detected chlorite.

From granite
(93 E) Near the summit of Grizzly Hill, about 3 km west of Blanchet Lake, Whitesail Lake map area, British Columbia, 53°23.5'N, 126°23'W. Map unit ETg, GSC Open File 708. Sample 78WVH-505, collected by M.L. Hill and interpreted by G.J. Woodsworth.

The sample is a porphyritic granite, composed of equal parts of quartz, plagioclase, and K-feldspar (as grains up to 1 cm in diameter). Biotite (8%) forms large flakes and is fresh and unaltered.

This sample is from a large body of the Quanchus intrusions, a suite of granite plutons in eastern Whitesail Lake map area. This date suggests an Eocene age for the Quanchus intrusions and indicates correlation with the Gamsby River stock (GSC 78-71) well to the west.

GSC 80-33 Biotite, K-Ar age **55.6 ± 2.5 Ma**

K = 6.77%, $^{40}Ar/^{40}K$ = 0.00328, radiogenic Ar = 86.6%.
Concentrate: Clean, unaltered, brown biotite with no detected chlorite.

From dacite
(93 E) Road cut, 10 km west of Wistaria Post Office and 4 km northwest of Ootsa Lake, Whitesail Lake map area, British Columbia, 53°52.2'N, 126°30.6'W. Map unit uKEv, GSC Open File 708. Sample WV-419, collected and interpreted by G.J. Woodsworth.

The sample is a light grey dacite with conspicuous, fresh phenocrysts of biotite (4%). Amygdules are filled with calcite, chlorite, and zeolites.

See GSC 80-35 for interpretation.

GSC 80-34 Whole rock, K-Ar age **38.7 ± 3.1 Ma**

K = 1.45%, $^{40}Ar/^{40}K$ = 0.00227, radiogenic Ar = 32.0%.
Concentrate: Crushed whole rock.

From basalt

(93 E) From roadcut, on north shore of Tahtsa Reach, 5 km southeast of Mosquito Crag, Whitesail Lake map area, British Columbia, 53°44.0'N, 127°47.1'W. Map unit EMv, GSC Open File 708. Sample WV-445, collected and interpreted by G.J. Woodsworth.

The sample is a fine grained, fresh, black basalt, composed largely of strongly zoned plagioclase phenocrysts, small clinopyroxene phenocrysts, and rare olivine phenocrysts. The matrix is mostly plagioclase microlites and interstitial devitrified glass.

See GSC 80-35 for interpretation.

GSC 80-35 Whole rock, K-Ar age **19.6 ± 2.6 Ma**

K = 0.63%, $^{40}Ar/^{40}K$ = 0.00115, radiogenic Ar = 30.3%.
Concentrate: Crushed whole rock.

From basalt

(93 E) Elevation 4500', 5.8 km southwest of Fenton Lake, Whitesail Lake map area, British Columbia, 53°26.4'N, 126°33.5'W. Map unit uTcv, GSC Open File 708. Sample 78WV-406, collected and interpreted by G.J. Woodsworth.

The sample is a fresh, black olivine basalt. The rock is fresh and unaltered.

GSC 80-33 is from the Ootsa Lake Group, a sequence of acid to intermediate, nonmarine volcanic rocks. Plant fossils suggest a Late Cretaceous to Oligocene age for the group (Tipper, 1963). This K-Ar date suggests a Paleocene to Eocene age, which is consistent with the fossil evidence.

GSC 80-34 is from low in the Endako Group overlying the Ootsa Lake Group. Tipper (1963) suggested an Oligocene and Miocene or younger age. The K-Ar date indicates a Late Eocene to Early Oligocene age for the lower part of the Endako Group.

GSC 80-35 is from olivine basalts of the Chilcotin Group (plateau basalts). This group is distinguished from the older Endako Group by the greater abundance of olivine and by the absence of block faulting, tilting, and folding. Most previous K-Ar dates from the Chilcotin Group have been in the 9 to 13 Ma range (Mathews, 1964). This date, 19.6 ± 2.6 Ma, is from the top flow of several hundred metres of flat-lying basalts overlying the Quanchus intrusions (GSC 80-32). The date is in good agreement with a 21.0 ± 1.1 Ma date from the flat lying Poplar Buttes volcanics, some 75 km to the north (Church, 1973) and a 19.8 ± 1.8 Ma date from the flat-lying Mt. Noel basalts in the southern Coast Mountains (GSC 76-66). These dates indicate that the age of the plateau basalts of the Chilcotin Group extends into the Early Miocene, at least near the western limits of exposure.

References

Church, B.N.
1973: Geology of the Buck Creek area; in Geology, Exploration and Mining in British Columbia 1972, British Columbia Department of Mines and Petroleum Resources, p. 353-363.

Mathews, W.H.
1964: Potassium-argon age determinations of Cenozoic volcanic rocks from British Columbia; Geological Society of America Bulletin, v. 75, p. 465-468.

Tipper, H.W.
1963: Nechako River map-area, British Columbia; Geological Survey of Canada, Memoir 324.

GSC 80-36 Hornblende, K-Ar age **124 ± 8 Ma**

K = 0.434%, $^{40}Ar/^{40}K$ = 0.00748, radiogenic Ar = 38.0%.
Concentrate: Relatively clean, pleochroic light green to dark brown hornblende with a trace of chlorite contamination.

From dacite

(93 E) Elevation 7300', 0.7 km southeast of George Peak, Whitesail Lake map area, British Columbia, 53°04.5'N, 123°00.2'W. Map unit lKg, GSC Open File 708. Sample 78WV-217, collected and interpreted by G.J. Woodsworth.

The sample is a porphyritic dacite containing plagioclase and hornblende phenocrysts in a grey, fine grained groundmass. Hornblende (5%) forms euhedral phenocrysts up to 5 mm long that are fresh to extensively chloritized.

The sample is from the upper part of about 1000 metres of gently dipping breccias, tuffs, and flows just east of the Coast Plutonic Complex. These rocks are lithologically similar to Lower Cretaceous Gambier Group strata in the southern Coast Mountains rather than the Lower Jurassic Hazelton Group that is common in Whitesail Lake map area. The K-Ar date confirms the suspected Early Cretaceous age.

GSC 80-37 Whole rock, K-Ar age **41.9 ± 5.0 Ma**

K = 0.53%, $^{40}Ar/^{40}K$ = 0.00246, radiogenic Ar = 7.2%.
Concentrate: Crushed whole rock.

From basalt

(93 E) Elevation 5350', 1.2 km west of the summit of Watut Mountain, Whitesail Lake map area, British Columbia, 53°01.2'N, 126°20.3'W. Map unit uTcv, GSC Open File 708. Sample 78WV-235, collected and interpreted by G.J. Woodsworth.

The sample is a fine grained, fresh, olivine basalt, composed of subhedral olivine phenocrysts, trachytic-textured plagioclase microlites and opaques in a fine grained matrix.

This sample is from one of several remnants of basalt caps on Watut Mountain. The basalt unconformably overlies the Middle Jurassic Smithers Formation. The date suggests that the caps correlate with the Endako Group (38.7 ± 3.1 Ma, GSC 80-34) rather than the Chilcotin Group (19.6 ± 2.6 Ma, GSC 80-35). However, the very low radiogenic argon of this sample makes this a tentative suggestion only.

GSC 80-38 Hornblende, K-Ar age **176 ± 40 Ma**

K = 0.18%, $^{40}Ar/^{40}K$ = 0.01072, radiogenic Ar = 60.0%.
Concentrate: Unaltered, pleochroic yellowish green to bluish green hornblende with a trace of chlorite contamination.

From diorite

(93 E) From the west shore of Nanika Lake, 7.5 km south of the mouth of Fenton Creek, Whitesail Lake map area, British Columbia, 53°43.3'N, 127°41.6'W. Sample 78WVp-84, collected by P. Holbek and interpreted by G.J. Woodsworth.

The sample is a dark grey, medium grained, unfoliated hornblende diorite. Plagioclase is weakly zoned and slightly altered. Hornblende (35%) is generally fresh but some grains are slightly altered to actinolite. Minor constituents include

epidote, quartz, chlorite and muscovite. Zones of brittle deformation in the rock are healed with epidote, alpha quartz, and chlorite.

See GSC 80-39 for interpretation.

GSC 80-39 Hornblende, K-Ar age **175 ± 10 Ma**

$K = 0.503\%$, $^{40}Ar/^{40}K = 0.01070$, radiogenic Ar = 55.8%.
Concentrate: Relatively clean, unaltered, pleochroic light brown to dark green hornblende with a trace of chlorite contamination.

From microdiorite
(93 E) From the south shore of Tahtsa Lake, about 0.9 km east of the upper portal of the Alcan hydroelectric tunnel, Whitesail Lake map area, British Columbia, 53°36.9'N, 127°40.5'W. Sample WV-604-1, collected and interpreted by G.J. Woodsworth.

The sample is a fine grained, grey, unfoliated diorite. The rock consists largely of subhedral plagioclase laths and subhedral to euhedral hornblende laths (25%) with interstitial quartz, K-feldspar, epidote, chlorite and accessories. Most hornblende grains are fresh and occur as long acicular grains.

GSC 80-38 is from a large body of quartz diorite, diorite and granodiorite underlying much of the area between Nauika and Norice lakes. GSC 80-39 is from the poorly understood Tahtsa Complex, a diorite-greenstone complex at the east edge of the Coast Plutonic Complex. The Tahtsa Complex is cut by the Horetzky dyke, which has given a 73.5 ± 2.2 Ma date on biotite (GSC 78-69).

The two dates are in agreement with each other and with a 178 ± 8 Ma biotite age obtained by Carter (1974) from Redslide Mountain to the north. The 175 ± 10 Ma date may represent a minimum age for diorite of the Tahtsa Complex. Because of the low precision of GSC 80-38, the Nanika Lake body can only be dated as of a general Jurassic age.

Reference

Carter, N.C.
1974: Geology and geochronology of porphyry copper and molybdenum deposits in central British Columbia; University of British Columbia, unpublished Ph.D. thesis.

GSC 80-40 Hornblende, K-Ar age **160 ± 11 Ma**

$K = 0.307\%$, $^{40}Ar/^{40}K = 0.00971$, radiogenic Ar = 66.4%.
Concentrate: Clean, unaltered, pleochroic light green to dark brown hornblende with no visible contamination.

From quartz diorite boulder
(92 J) 9.3 km northeast of Mt. Birch at elevation 5800 feet in the Camelsfoot Range, Pemberton map area, British Columbia, 50°59.6'N, 122°03.6'W. Sample WV-FC-6, collected by K.L. Kleinspehn and interpreted by K.L. Kleinspehn and G.J. Woodsworth.

The sample is a boulder of medium grained, unfoliated quartz diorite composed of about 67% plagioclase, 18% quartz, 7% hornblende, 5% chlorite, 2% K-feldspar, and 1% epidote, apatite, and opaques. Hornblende forms fresh, stubby grains about 0.5 mm across. Biotite is almost totally replaced by chlorite.

See GSC 80-42 for interpretation.

GSC 80-41 Hornblende, K-Ar age **133 ± 16 Ma**

$K = 0.33\%$, $^{40}Ar/^{40}K = 0.00801$, radiogenic Ar = 57.3%.
Concentrate: Clean, unaltered, pleochroic brown to dark green hornblende with no visible contamination.

From quartz diorite boulder
(92 J) 9 km northeast of Mt. Birch, at elevation 5650' in the Camelsfoot Range, Pemberton map area, British Columbia, 50°59.5'N, 122°03.4'W. Sample WV-CF-5A, collected by K.L. Kleinspehn and interpreted by K.L. Kleinspehn and G.J. Woodsworth.

The sample is a boulder of medium- to coarse-grained, unfoliated quartz diorite composed largely of plagioclase (70%), quartz (15%), hornblende (10%), with lesser K-feldspar (3%), biotite (1%), and accessories. Hornblende occurs as subhedral grains 0.5 mm across and as an alteration product of relict pyroxene. Biotite is partly chloritized.

See GSC 80-42 for interpretation.

GSC 80-42 Hornblende, K-Ar age **134 ± 16 Ma**

$K = 0.35\%$, $^{40}Ar/^{40}K = 0.00810$, radiogenic Ar = 61.2%.
Concentrate: Clean, unaltered, pleochroic brown to dark green hornblende with no visible contamination.

From quartz diorite boulder
(92 J) 9 km northeast of Mt. Birch, at elevation 5650' in the Camelsfoot Range, Pemberton map area, British Columbia, 50°59.5'N, 122°03.4'W. Sample WV-CF-5B, collected by K.L. Kleinspehn and interpreted by K.L. Kleinspehn and G.J. Woodsworth.

The sample is a boulder of medium- to coarse-grained, unfoliated quartz diorite composed largely of plagioclase (70%), quartz (18%), hornblende (7%) and lesser biotite (3%) and accessories (2%). Hornblende forms fresh, irregular but subhedral grains up to 1.5 mm long. Some biotite grains are slightly chloritized; others are intergrown with muscovite.

These three samples are well-rounded clasts about 25 to 30 cm in diameter, in resedimented conglomerate about 1.5 km north of Leon Creek, between the Yalakom and Fraser River fault systems. The conglomerate is in the Albian (mid Cretaceous) part of the Jackass Mountain Group. The conglomerate is massive, clast supported poorly stratified, and poorly sorted. Granodiorite and quartz diorite are the dominant clast types and together comprise about 20-25% of the clasts. Thin interbeds of lensoid, plane-parallel laminated, feldspathic lithic wackes are present in the conglomerate. Paleocurrent data in underlying and overlying sandstones suggest a northeastern source area for the conglomerate. GSC 80-41 and 42 are from very similar-appearing boulders from the same outcrop. GSC 80-40 was collected 0.25 km northwest.

Although the precision of the three hornblende dates is not high, the dates suggest a Middle Jurassic to Early Cretaceous age for the source of the clasts. Plutons of this age and with compositions similar to the clasts are common in southern British Columbia east of the Fraser River Fault, but it is not possible at present to specify which pluton, if any, of those now exposed is the source of the clasts.

GSC 80-43 Biotite, K-Ar age **54.1 ± 1.3 Ma**

K = 7.70%, $^{40}Ar/^{40}K$ = 0.00319, radiogenic Ar = 83.7%.
Concentrate: Dark brown biotite with approximately 2% chlorite alteration.

From granodiorite
(92 N) About 5.5 km west-northwest of Nunatak Pk., Mt. Waddington map area, British Columbia, 51°10.7'N, 124°44.2'W. Sample Rd79-40005, collected and interpreted by G.J. Woodsworth.

The sample is a fresh, light grey, medium grained, unfoliated granodiorite. Biotite forms 2% of the rock as grains about 1 mm long that are commonly associated with muscovite. Some grains are heavily chloritized; most are fresh.

See GSC 80-44 for interpretation.

GSC 80-44 Biotite, K-Ar age **62.8 ± 1.5 Ma**

K = 6.33%, $^{40}Ar/^{40}K$ = 0.00371, radiogenic Ar = 67.2%.
Concentrate: Light brown biotite with approximately 10% chlorite alteration.

From quartz monzonite
(92 N) From south shoulder of Mt. Queen Bess at elevation 9200', Mt. Waddington map area, British Columbia, 51°15.6'N, 124°33.7'W. Sample Rd79-40006, collected and interpreted by G.J. Woodsworth.

The sample is a dark grey, medium grained, moderately foliated quartz monzodiorite. Hornblende (13%) is mostly fresh. Biotite (8%) varies from fresh to about 20% chloritized.

GSC 80-43 is from the Klattasine pluton, a large post-tectonic pluton east of the Central Gneiss Complex in the southern Coast Plutonic Complex. The date is in good agreement with the 56 Ma ages from a similar pluton to the northeast (GSC 78-59) and from the Bishop River pluton to the southeast (GSC 73-22, 23). The date confirms an extensive area of 55 Ma K-Ar ages from posttectonic plutons in this part of the Coast Mountains.

GSC 80-44 is from a pluton near the east margin of the Coast Plutonic Complex that is cut by all surrounding plutons. One of these, to the east, gives a K-Ar age of 56.2 ± 2.4 Ma (GSC 78-59), significantly younger than the 62.8 ± 1.5 Ma age reported here, but it remains uncertain whether any of the K-Ar dates in this area reflect the true age of emplacement of the plutons.

GSC 80-45 Biotite, K-Ar age **57.5 ± 1.3 Ma**

K = 7.43%, $^{40}Ar/^{40}K$ = 0.00339, radiogenic Ar = 78.5%.
Concentrate: Relatively clean, unaltered, light greenish brown biotite with a trace of chlorite contamination.

From granodiorite
(92 M) About 12 km south-southeast of the snout of Sumquolt Glacier, Rivers Inlet map area, British Columbia, 51°45.9'N, 126°08.7'W. Sample Rd79-40012, collected and interpreted by G.J. Woodsworth.

The sample is a light grey, fine grained, unfoliated granodiorite. Biotite (5%) is fresh and finer grained than most other minerals in the rock.

The sample is from the Washwash pluton, a large granodiorite body near the east margin of the Coast Plutonic Complex. The pluton is faulted against Lower Cretaceous volcanics to the east. The date is similar to a 56.0 ± 1.8 Ma biotite age (GSC 78-63) about 20 km northeast, but markedly younger than the 73.5 ± 6.3 Ma hornblende age (GSC 78-64) from the same sample. The Washwash pluton has many similarities with the Klattasine pluton (54.1 ± 1.3, GSC 80-43) and the Bishop River pluton (56 Ma, GSC 73-22, 23), also from the eastern margin of the Coast Plutonic Complex. But in none of these cases is it certain if the K-Ar dates reflect the age of emplacement of the pluton.

GSC 80-46 Hornblende, K-Ar age **232 ± 13 Ma**

K = 0.495%, $^{40}Ar/^{40}K$ = 0.01440, radiogenic Ar = 82.4%.
Concentrate: Clean, unaltered, pleochroic light brown to green hornblende with no visible contamination.

From hornblendite
(94 D) From about 3.2 km southwest of Johanson Lake, McConnell Creek map area, British Columbia, 56°34.2'N, 126°12.6'W. Map unit Bg, GSC Open File 342. Sample JLK, collected by T. Eadie and interpreted by G.J. Woodsworth.

The sample is a very coarse grained hornblendite composed mostly of fresh hornblende crystals about 5 cm long. Biotite (8%) is largely chloritized.

The sample comes from the Johanson Lake ultramafic body, an Alaskan-type ultramafic that intrudes Upper Triassic Takla Group rocks. About a dozen such ultramafic bodies are known from McConnell Creek and Aiken Lake map areas.

Dates of 152 ± 15 Ma* on hornblende and 164 ± 9 Ma* on biotite have previously been obtained from one of these ultramafic bodies, the Polaris complex (GSC 66-18, 66-19). The significance of these dates is uncertain because of extensive later serpentinization and plutonism. Irvine (1976) suggested that the ultramafic bodies are genetically related to the Takla volcanics. The 232 ± 13 Ma age from the Johanson Lake ultramafic, one of the least altered of these bodies, supports Irvine's suggestion.

*Recalculated to conform with Steiger and Jager (1977) decay constants, these ages are 156 ± 15 and 168 ± 9 Ma respectively.

Reference

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GSC 80-47 Hornblende, K-Ar age **152 ± 9 Ma**

K = 1.05%, $^{40}Ar/^{40}K$ = 0.00919, radiogenic Ar = 89.4%.
Concentrate: Clean, unaltered, pleochroic, olive-green to dark green hornblende with no visible contamination.

From granodiorite
(82 M) 80 km north of Revelstoke, just south-southwest of Remillard Peak, Selkirk Mountains, British Columbia, 51°42.5'N, 118°07.5'W. Sample ADAMANT PLUTON, collected by D. Shaw and interpreted by A.V. Okulitch.

This monzonite and granodiorite pluton apparently predates most penetrative deformation and associated metamorphism in the Selkirk Mountains. On the basis of tentative extrapolation of regionally acquired data it may be Paleozoic in age. Previous K-Ar analyses gave dates ranging from 90 to 281 Ma. Recent Pb-U analyses gave concordant dates of about 170 Ma. Structural and chemical studies suggest these latest dates represent the time of high grade regional metamorphism (D. Shaw, Ph.D. thesis in preparation, Carleton University). The K-Ar date of 152 ± 9 Ma likely reflects uplift and cooling following metamorphism.

GSC 80-48 Muscovite, K-Ar age **65.2 ± 2.6 Ma**

K = 7.43%, $^{40}Ar/^{40}K$ = 0.00386, radiogenic Ar = 60.8%.
Concentrate: Clean, very fine, unaltered, mainly clear muscovite with no visible contamination.

From foliated porphyritic granite
(83 D) 9.3 km south of Blue River bridge, Highway 5, British Columbia, 52°03'N, 119°20'W. Map-unit 10, GSC Map 15-1967 (Canoe River; R.B. Campbell). Sample 393CAa74, collected and interpreted by A.V. Okulitch.

Foliated biotite-muscovite granite within the Shuswap Metamorphic Complex is possibly late-syntectonic and therefore Jura-Cretaceous in age or perhaps early Tertiary. Previous analysis of biotite yielded a date of 56.1 ± 2.4 Ma (GSC 78-93). The muscovite date is somewhat older and the discordance suggests some resetting. Three interpretations are possible: (a) 65.2 Ma is the minimum time of emplacement, (b) it represents uplift and cooling of the Complex, or (c) it is the time of a presently enigmatic thermal event that has affected much of the complex. Further discussion is found in GSC Paper 77-2, p. 26.

GSC 80-49 Biotite, K-Ar age **49.1 ± 2.5 Ma**

K = 6.68%, $^{40}Ar/^{40}K$ = 0.00289, radiogenic Ar = 70.6%.
Concentrate: Dark brown biotite with approximately 15% chlorite alteration.

From gneiss
(82 E) 440 m north of BM 1787, north side of Kettle River valley by Hwy. 3, about 7.5 km east of Grand Forks, British Columbia, 49°01'05"N, 118°20'45"W. Map unit VII, Preto, V.A., 1969, Geol. Surv. Can., Paper 69-22). Sample 12CAa76-1, collected and interpreted by A.V. Okulitch.

See GSC 80-50 for description and interpretation.

GSC 80-50 Hornblende, K-Ar age **64.2 ± 2.8 Ma**

K = 0.948%, $^{40}Ar/^{40}K$ = 0.00380, radiogenic Ar = 69.6%.
Concentrate: Clean, unaltered, pleochroic light to dark green hornblende with no visible contamination.

From leucosyenite
(82 E) Bluff on east side of Granby River, 2.5 km north of Grand Forks, British Columbia, 49°03'10"N, 118°27'25"W. Map unit VIII, Preto, V.A., 1969, Geol. Surv. Can., Paper 69-22. Sample 10CAa76-1, collected and interpreted by A.V. Okulitch.

These are foliated granitic rocks in the Grand Forks Complex and are pre- or syn-tectonic, i.e. Jura-Cretaceous or older. The K-Ar dates reflect regional resetting caused by Eocene plutonism, volcanism and/or uplift and cooling. See GSC Paper 77-2, p. 26.

GSC 80-51 Biotite, K-Ar age **131 ± 5 Ma**

K = 5.03%, $^{40}Ar/^{40}K$ = 0.00791, radiogenic Ar = 89.6%.
Concentrate: Greenish brown biotite with approximately 9% chlorite alteration and a trace of hornblende contamination.

From "spotted" granite
(82 L) Southeast side of Little Shuswap Lake, on Trans Canada Highway 5 km northeast of Chase, British Columbia, 50°50'25"N, 119°37'40"W. Map unit 3, Geol. Surv. Can., Memoir 296 (A.G. Jones). Sample 1CAa76-1, collected and interpreted by A.V. Okulitch.

See GSC 80-52 for description and interpretation.

GSC 80-52 Hornblende, K-Ar age **154 ± 9 Ma**

K = 1.03%, $^{40}Ar/^{40}K$ = 0.00934, radiogenic Ar = 70.4%.
Concentrate: Clean, unaltered, pleochroic olive-green to dark green hornblende with no visible contamination.

From "spotted" granite
(82 L) Details as for GSC 80-51.

Dykes of foliated granite containing large clots of biotite (formerly argillaceous zenoliths?) intrude Upper Ordovician orthogneiss. The dykes are pre- or syn-tectonic and may be Paleozoic to Jurassic in age. The dates are similar to those from metamorphic micas in nearby metasediments and thereby may represent the times of regional metamorphism or intrusion. Refer to Okulitch, 1979, GSC Open File 637.

GSC 80-53 Biotite, K-Ar age **142 ± 5 Ma**

K = 7.82%, $^{40}Ar/^{40}K$ = 0.00860, radiogenic Ar = 95.5%.
Concentrate: Clean, unaltered, greenish brown biotite with no chlorite contamination.

From gneiss
(82 L) Little Shuswap area, British Columbia, 50°51'45"N, 119°31'W. Sample No. 6 GNEISS, collected and interpreted by A.V. Okulitch.

Granodiorite orthogneiss of Late Ordovician (449 ± 20 Ma) age, as determined by Pb-U analyses (Okulitch, 1979, GSC Open File 637) was deformed and metamorphosed during the Late Jurassic-Early Cretaceous. The date indicates the time of cooling after regional metamorphism.

GSC 80-54 Hornblende, K-Ar age **48.8 ± 4.4 Ma**

K = 1.12%, $^{40}Ar/^{40}K$ = 0.00288, radiogenic Ar = 30.4%.
Concentrate: Clean, unaltered, pleochroic dark green to brown hornblende with no visible contamination.

From granodiorite
(82 E) Near east side of Okanagan Lake in railway cut 7.5 km north of Naramata, British Columbia, 49°39'50"N, 119°36'10"W. Sample 3CAa76-1, collected and interpreted by A.V. Okulitch.

See GSC 80-55 for description and interpretation.

GSC 80-55 Muscovite, K-Ar age **59.4 ± 2.4 Ma**

K = 7.16%, $^{40}Ar/^{40}K$ = 0.00351, radiogenic Ar = 51.9%.
Concentrate: Relatively clean, mainly clear muscovite with approximately 2% chlorite contamination.

From granitoid gneiss
(82 E) At 1500 ft. (457 m) elevation, east side of Okanagan Valley 4.5 km east-southeast of Oliver, British Columbia, 49°09'45"N, 119°30'15"W. Sample 5CAa76-1, collected and interpreted by A.V. Okulitch.

These are foliated granitic rocks within the Okanagan Plutonic and Metamorphic Complex. Both were emplaced after early (Perma-Triassic?) deformation but before cessation of final phases of Jura-Cretaceous tectonism. The probable time of emplacement is Triassic or Jurassic. The dates represent an Eocene thermal or cooling event common to the Okanagan and Shuswap complexes. Refer to GSC Paper 77-2, p. 26.

GSC 80-56 Biotite, K-Ar age **108 ± 4 Ma**

K = 7.86%, $^{40}Ar/^{40}K$ = 0.00649, radiogenic Ar = 93.9%.
Concentrate: Clean, unaltered, light brown biotite with no chlorite impurity.

From gneiss (?)
(93 A) Quesnel area, British Columbia, 52°30'45"N, 120°44'20"W. Sample E. ARM GNEISS, collected and interpreted by A.V. Okulitch.

See GSC 80-57 for description and interpretation.

GSC 80-57 Hornblende, K-Ar age **153 ± 8 Ma**

K = 1.32%, $^{40}Ar/^{40}K$ = 0.00930, radiogenic Ar = 91.8%.
Concentrate: Clean, unaltered, pleochroic, brown to dark green hornblende with no visible contamination.

From gneiss (?)
(93 A) Details as for GSC 80-56.

The East Arm (Quesnel Lake) gneiss apparently intrudes metasediments of late Proterozoic or early Paleozoic age (C.J.N. Fletcher, 1972; Structure and Metamorphism of Penfold Creek area, near Quesnel Lake, central British Columbia, Ph.D. thesis, UBC). Preliminary zircon analyses suggest a Paleozoic age for the gneiss. K-Ar dates are presumably the time of regional metamorphism and deformation of the Omineca Crystalline Belt. The biotite date likely reflects resetting by Cretaceous plutonism and is a hybrid of intrusive age and Eocene events common in the belt.

GSC 80-58 Biotite, K-Ar age **75.3 ± 2.3 Ma**

K = 4.68%, $^{40}Ar/^{40}K$ = 0.00447, radiogenic Ar = 81.3%.
Concentrate: Dark brown biotite with approximately 15% chlorite contamination partly as free grains and partly as chloritized mica.

From granite
(104 N) At 810 to 815 m depth in Climax Molybdenum Company diamond drill hole through central portion of the Adanac deposit, 22.5 km northwest of Atlin, British Columbia, 59°42'30"N, 133°24'45"W. Sample SYA-77-43, collected and interpreted by W.D. Sinclair.

The rock is a medium grained, equigranular granite composed of 35% quartz, 30% albite, 33% orthoclase, 1% biotite, 1% magnetite and accessory apatite and zircon. The biotite is slightly chloritized.

The Adanac deposit is a stockwork of coarse molybdenite-bearing quartz veins in the Mt. Leonard Boss, a composite, partially zoned granitic intrusion. Sample SYA-77-43 is from a relatively fresh, nonmineralized phase that underlies the deposit at depth and probably postdates the mineralization (White et al., 1976). The 75.3 ± 2.3 Ma date, therefore, represents a minimum age for the molybdenum mineralization. This is slightly older than the 62 ± 2.2 Ma K-Ar age obtained by Christopher et al. (1972) for biotite from mineralized coarse alaskite on the Adanac property. However, the potassium content of the concentrate (4.68%) is relatively low for biotite and the age should be treated with some caution.

References

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1976: Adanac (Ruby Creek); in Porphyry Deposits of the Canadian Cordillera, Canadian Institute of Mining and Metallurgy, Special Volume 15, p. 476-483.

GSC 80-59 Phlogopite, K-Ar age **236 ± 8 Ma**

K = 8.43%, $^{40}Ar/^{40}K$ = 0.01462, radiogenic Ar = 27.3%.
Concentrate: Clean, lead-grey phlogopite with no visible contamination.

From coarse pyrite-mica rock
(82 M) Bulldozed exposure of "B" zone of Rexspar group of deposits, approximately 15 m northwest of DDH76-B-1 and 4 km south of Birch Island, British Columbia, 51°33'55"N, 119°54'40"W. Sample 76-BV-58-B, collected by R.T. Bell and interpreted by S.S. Gandhi.

The sample was from coarse pyrite-mica rock, a part of altered argillaceous-tuffaceous lenses carrying uranium, thorium, rare earths and thorite, and conformable with trachytic and volcanic rocks.

See GSC 80-60 for further discussion.

GSC 80-60 Phlogopite, K-Ar age **219 ± 8 Ma**

K = 8.69%, $^{40}Ar/^{40}K$ = 0.01353, radiogenic Ar = 95.4%.
Concentrate: Clean, unaltered, very light brown phlogopite with no visible contamination.

From pyrite-mica rock
(82 M) Roadcut 610 m north-northwest of "A" Zone, Rexspar Deposit, 4 km south of Birch Island, British Columbia, 51°34'15"N, 119°54'30"W. Sample GFA-77-28, collected and interpreted by S.S. Gandhi.

This sample was selected as a substitute for sample 76-BV-58-B (see GSC 80-59) which yielded highly impure extracted argon. Phlogopite (fluorphogopite) is part of complex multi-stage hydrothermal mineralization believed to be genetically related to the volcanism that formed the trachytic host rocks. It occurs in irregular veins and patches, and locally as disseminations, within and near the lenses of argillaceous-tuffaceous rocks that are conformable to the

trachytic flows. The lenses contain fragments of trachyte, abundant pyrite and fluorite, and minor amounts of uraninite, thorianite, thorite, monazite, bastnaesite, torbernite, apatite, celestite, calcite, dolomite, siderite, galena, sphalerite, chalcopyrite, molybdenite, scheelite, quartz and alkali feldspars. The sample 76-BV-58-B has rather complex mineralogy common to the lenses, whereas GFA-77-28 has comparatively simple mineralogy encountered away from the lenses, consisting mainly of phlogopite and pyrite, and referred to in the field as 'pyrite-mica' rock.

The trachytic volcanic rocks dip gently to the northwest. Schistosity is locally well-developed and is subparallel to the dip of the units. The mineralized lenses and some of the pyrite-mica veins and patches in their vicinity also show effects of deformation to a varying degree. The trachytic assemblage appears to overlie conformably a metasedimentary sequence of quartz-sericite schists with interbedded carbonaceous and phyllitic units. Overlying metasediments are seen only as a few small remnants.

The trachytic rocks are believed to be part of the Eagle Bay Formation which is a diverse and complex assemblage of rocks ranging in age from middle Paleozoic to late Triassic (Okulitch and Cameron, 1976). Limestone beds of the formation, located approximately 40 km south of the Rexspar deposits, have yielded fossils of Mississippian age. Baldy Batholith of Jurassic and/or Cretaceous age intruded the formation and outcrops within 6 km south of the Rexspar deposits.

The K-Ar age of 219 ± 8 Ma determined on sample GFA-77-28 (GSC 80-60) represents a minimum age of mineralization. Slightly older age of 236 ± 8 Ma obtained for sample 76-BV-58-B indicates Permian age. These ages eliminate younger Baldy Batholith as a possible source of mineralization. The mineralization is affected by regional deformation which may have caused loss of argon in the phlogopites analyzed. Thus mineralization and the volcanic rocks could be older, probably Mississippian, in age as suggested by fossils in limestone of the Eagle Bay Formation.

Attempts were made to date the trachytic volcanic rocks by whole rock Rb-Sr and by U-Pb on zircon, but preliminary tests on 12 samples, collected for geochronology by S.S. Gandhi, showed that they were not suitable for these methods of age determination.

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GSC 80-61 Phlogopite, K-Ar age **47.1 ± 2.6 Ma**

K = 8.15%, $^{40}Ar/^{40}K$ = 0.00277, radiogenic Ar = 84.3%.
Concentrate: Clean, unaltered, very light orange phlogopite with no chlorite contamination.

From lamprophyre
(82 M) 33 m from the northernmost face of adit on 'BD' or 'Black Diamond' zone of Rexspar group of uranium-thorium deposits (from east wall), 4.3 km south of village of Birch Island, British Columbia, 51°33'45"N, 119°54'45"W. Sample GFA-77-37, collected and interpreted by S.S. Gandhi.

The sample is from a vertical dyke cutting gently dipping trachytic volcanic rocks and a conformable lens of mineralized argillaceous-tuffaceous rock in them, which is referred to as the 'BD' zone. The dyke is 0.4 m thick, with chilled margins and medium grained porphyritic core. It trends N7°W and is also exposed in a crosscut 37 m to the south. The dyke is fresh, unaffected by the regional deformation evident in the country rock from varying degrees of development of subhorizontal schistosity. The sample is porphyritic with phenocrysts of phlogopite (6 to 8%) and calcite (2%), in fine- to medium-grained pale purple grey matrix.

The K-Ar age of 47.1 ± 2.6 Ma shows that the dyke is much younger than the country rock, dated at 219 ± 8 Ma as minimum (see GSC 80-60). Hence the dyke is unrelated to the igneous activity that formed the country rock.

References

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GSC 80-62 Biotite, K-Ar age **10.1 ± 0.6 Ma**

K = 7.41%, $^{40}Ar/^{40}K$ = 0.00059, radiogenic Ar = 43.9%.
Concentrate: Moderately altered light brown biotite with approximately 6% chloritization.

From leucoquartz monzonite
(92 J) At 3500' elevation on Fall Creek on the northeast side of Plinth Peak, British Columbia, 50°39.7'N, 129°29.3'W. Map unit Mqm (Read, 1979). Sample MM367-KAR, collected and interpreted by P.B. Read, Geotex Consultants Limited.

The rock is a medium grained leucoquartz monzonite composed of 36% quartz, 25% unzoned plagioclase (An_{24-26}), 34% clouded orthoclase which is locally perthitic, and 4% unaltered, red-brown biotite. Opaque minerals and traces of zircon and apatite do not exceed 1%.

GSC 80-62 is from the leucocratic marginal phase of the Fall Creek stock which is one of a chain of high-level Miocene intrusions in the Coast Plutonic Complex. The stock is compositionally similar to Salal Creek pluton which is dated at 7.9 ± 0.2 Ma (GSC 76-99, Wanless, et al., 1978). Porphyry molybdenite mineralization at the Fall Creek property, about 0.5 km west of sample GSC 80-62, is similar to that extensively explored in Salal Creek pluton.

The compositional similarities and close proximity of the two plutons suggest that they are the upper parts of a northerly elongate batholith of Late Miocene age.

References

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GSC 80-63 Hornblende, K-Ar age **160 ± 10 Ma**

K = 1.21%, $^{40}Ar/^{40}K$ = 0.00973, radiogenic Ar = 92.5%.
Concentrate: Clean, unaltered, pleochroic dark green to brown hornblende with no visible contamination.

From hornblende leucoquartz monzonite
(82 K) 11.3 km up a logging road on the north side of Halfway River from the bridge on the Galena Bay-Nakusp highway, British Columbia, 50°30'32"N, 117°39'50"W. Sample RL76-1ZR collected and interpreted by P.B. Read, Geotex Consultants Limited.

The sample is a randomly textured, medium grained (1 to 3 mm) leucoquartz monzonite of the Kuskanax Batholith composed of about 30% microcline, 21% quartz, 30% unzoned plagioclase (An_4), and 8% hornblende. The hornblende has a Z pleochroic colour of blue-green, a $2V_X = 25°$ and is probably alkali-bearing. Accessory minerals include trace amounts of epidote and zircon. The rock is unaltered.

See GSC 80-64 for discussion and interpretation.

GSC 80-64 Hornblende, K-Ar age **158 ± 10 Ma**

K = 1.04%, $^{40}Ar/^{40}K$ = 0.00959, radiogenic Ar = 88.0%.
Concentrate: Clean, unaltered, pleochroic dark green to brown hornblende with no visible contamination.

From hornblende leucoquartz monzonite
(82 K) From a logging roadcut 3.2 km up the north side of Halfway River from the bridge on the Galena Bay-Nakusp Highway, British Columbia, 50°28'58"N, 117°51'55"W. Sample 76-2ZR collected and interpreted by P.B. Read, Geotex Consultants Limited.

The sample is a randomly textured, medium grained (1 to 3 mm) leucoquartz monzonite of the Kuskanax Batholith composed of 30% quartz, 30% microcline, 30% weakly zoned plagioclase (An_{1-4}) and 5% amphibole. The amphibole has a pleochroic scheme ranging from X = olive-brown to Z = blue-green and $2V_X$ = 30 to 40° which indicate that it is alkali-bearing. Accessory and alteration minerals include 2% chlorite, 3% prehnite and traces of allanite and carbonate.

The eastern margin of the Kuskanax Batholith is inward dipping at 45 to 60° to the west, gneissic, and weakly layered because it has been involved in the intense second phase of deformation and metamorphism of the Kootenay Arc (Read, 1973). The central and western parts of the batholith and the satellitic stocks are massive and posttectonic and postmetamorphic in age. An earlier date from the massive part of the batholith yielded 178 Ma* on hornblende and one from a satellitic stock yielded 137* ± 7 Ma on muscovite (Wanless et al., 1968, p. 44-45). The dates of 160 ± 10 and 158 ± 10 can be interpreted as restricting the second phase of deformation and metamorphism in the Kootenay Arc to pre-158 ± 10 Ma. This restriction as to minimum age is consistent with the age of Mount Carlyle stock at 161 ± 6 Ma (Nguyen, et al., 1968) which imposes a contact aureole on deformed and regionally metamorphosed rocks of the Slocan Group of Late Triassic age. GSC 80-63 and 64 have been submitted for zircon analysis in order to obtain a better estimate of the timing of second phase deformation and metamorphism in the Kootenay Arc. The age of these events must lie between deposition of the Rossland Group which ended in the Middle Bajocian (Frebold and Little, 1962) and about 160 Ma.

*These ages recalculate to 182 and 141 Ma respectively using the decay constants of Steiger and Jager (1977).

References

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1976: Geology, Lardeau west-half, British Columbia; Geological Survey of Canada, Open File 432.

Wanless, R.K., Stevens, R.D., Lachance, G.R., and Edmonds, C.M.
1968: Age determinations and geological studies: K-Ar isotopic ages, Report 8; Geological Survey of Canada, Paper 67-2, Part A.

GSC 80-65 Whole rock, K-Ar age **5.9 ± 0.6 Ma**

$K = 1.42\%$, $^{40}Ar/^{40}K = 0.000344$, radiogenic Ar = 14.5%.
Concentrate: Crushed whole rock (very fine).

From basalt
(82 E) West end of Lassie Lake, 25 km northeast of Beaverdell, British Columbia, 49°37'N, 118°54'W. Sample DRB-BSLT-LI, collected and interpreted by D.R. Boyle.

See GSC 80-66 for description and interpretation.

GSC 80-66 Whole rock, K-Ar age $\frac{4.4}{4.1} \pm \frac{0.6}{0.9}$ **Ma**

$K = 0.73\%$, $^{40}Ar/^{40}K = \frac{0.000253}{0.000237}$, radiogenic Ar = $\frac{32.7}{16.0}\%$.
Concentrate: Crushed whole rock.

From basalt
(82 E) 1 km north of Hydraulic Lake, 12 km southeast of Kelowna, British Columbia, 49°50'N, 119°10'W. Sample DRB-BSLT-TYNT-18, collected and interpreted by D.R. Boyle.

Samples GSC 80-65 and 66 were taken from two massive olivine basalt horizons of the Miocene-Pliocene Plateau Basalt Formation overlying sedimentary hosted basal-type uranium deposits on the Central Okanagan Highlands Intrusive Complex. The rocks are fine grained, olivine-bearing, massive to vesicular basalts similar in composition and geological setting to Plateau Basalts in central British Columbia and the Columbia Plateau Basalts of Washington, Idaho and Oregon. The older date of 5.9 Ma agrees with ages of 6.0, 7.8 and 8.3 Ma obtained by Farquharson and Sipp (1969) for basalt plugs representing a later extrusion of basalts onto a plateau of previously formed Miocene basalts in the Bonaparte area. The younger age of 4.4 Ma indicates a continuum of basaltic extrusion in this region which must have been spasmodically ongoing since interformational sediments in the sequence of basalt flows are either very thin or not present in the areas investigated. These ages agree with those obtained by Christopher (1978; 5.0 ± 0.50 Ma and 4.7 ± 0.17 Ma; K-Ar whole rock) for the same formation in this area.

References

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1969: Potassium-argon ages of dolerite plugs in the South Cariboo region, British Columbia; Canadian Journal of Earth Sciences, v. 6, p. 1468-1470.

GSC 80-67 Muscovite, K-Ar age **60.1 ± 1.9 Ma**

$K = 8.66\%$, $^{40}Ar/^{40}K = 0.00355$, radiogenic Ar = 59.5%.
Concentrate: Clean, brownish stained, very fine grained muscovite with no visible contamination.

From alaskitic pegmatite
(82 B) Daybreak uraniferous pegmatite near Spokane, Washington, U.S.A., 47°56'30"N, 117°12'W. Map unit GQ-1336, in Weissenbonn, A.E., and Weis, P.L., 1976. Sample 82BPG1-A, collected and interpreted by D.R. Boyle.

See GSC 80-68.

GSC 80-68 Muscovite, K-Ar age **53.3 ± 1.9 Ma**

$K = 8.58\%$, $^{40}Ar/^{40}K = 0.00314$, radiogenic Ar = 58.1%.
Concentrate: Very fine grained, brownish stained muscovite with no visible contamination.

From pegmatite
(82 B) East of Metaline Falls, Washington, U.S.A., 48°50'N, 117°30'W. Sample 82BPG2-A, collected and interpreted by D.R. Boyle.

These two determinations were included in Report 14 (p. 26-27) as PG-1A and PB-2A in table. The comment and interpretation as published therein are still pertinent; see GSC 78-99, Geological Survey of Canada, Paper 79-2.

GSC 80-69 Biotite, K-Ar age **173 ± 4 Ma**

$K = 5.58\%$, $^{40}Ar/^{40}K = 0.01053$, radiogenic Ar = 93.8%.
Concentrate: Light brown biotite with approximately 10% chlorite alteration and a trace of hornblende contamination.

From granodiorite
(104 J) Tachilta Lake, 58 km northwest of Dease Lake, British Columbia, 58°38.2'N, 130°56.3'W. Sample LI-79-130, collected and interpreted by S. Leaming.

See GSC 80-70 for description and interpretation.

GSC 80-70 Hornblende, K-Ar age **160 ± 20 Ma**

$K = 0.33\%$, $^{40}Ar/^{40}K = 0.00972$, radiogenic Ar = 17.5%.
Concentrate: Clean, unaltered, pleochroic light brown to dark green hornblende with no visible contamination.

From granodiorite
(104 J) Details as for GSC 80-69.

Both minerals were extracted from a sample of granodiorite composed of zoned plagioclase averaging approximately An_{30}; quartz, largely unstrained, with fresh biotite and hornblende, and minor sphene, zircon and K-feldspar.

The stock intrudes sediments and ultramafics of the Cache Creek group on Tachilta Lakes.

The higher percentage of potassium and radiogenic argon in the biotite make this the preferred measurement. This date of 173 Ma gives the minimum age of deformation of the Cache Creek Group in the Dease Lake area.

Yukon Territory
(GSC 80-71 to GSC 80-90)

GSC 80-71 Biotite, K-Ar age **613 ± 15 Ma**

K = 2.25%, $^{40}Ar/^{40}K$ = 0.04242, radiogenic Ar = 81.0%.
Concentrate: A heterogeneous biotite mixture. Some mica flakes are reddish orange, while others are light brown. The concentrate also contains approximately 9% chlorite occurring as an alteration product of the mica.

From lamprophyre
(106 E) Approximately 25 m below top of northwest facing cirque, Yukon, 64°14'35"N, 134°31'W. Sample LA-1, collected and interpreted by G.D. Delaney (University of Western Ontario).

This sample was collected from a 0.4 m wide, tan weathering lamprophyre dyke which cuts a sequence of slates and argillites in the lower part of the Proterozoic Quartet Group (Delaney, 1978). The Quartet Group is the middle subdivision of the Wernecke Supergroup, a 14 km thick sequence of miogeoclinal, fine grained clastic and carbonate rocks. Strata of the Wernecke Supergroup underlie large parts of the Wernecke and Olgivie Mountains of the northern Yukon.

To date, only a few radiometric age determinations have been made on rocks of the Wernecke Supergroup. A K-Ar age of 1.5 Ga was reported by Archer et al. (1977) from determinations made on biotite collected from an intrusive breccia complex which cuts rocks of the upper Fairchild Lake Group (the lowermost subdivision of the Wernecke Supergroup). Godwin et al. (1978) reported a Stacey and Kramers model lead age of 1.44 Ga for two lead deposits hosted in strata of the Gillespie Lake Group (the uppermost subdivision of the Wernecke Supergroup) in the Coal Creek Dome of the Olgivie Mountains. Morin (1979) reported a Stacey and Kramers model lead isotope age of 1288 Ma for layered galena in rocks of the Gillespie Lake Group exposed near Hart River. A $^{207}Pb/^{206}Pb$ date of 1249 Ma and a $^{207}Pb/^{235}U$ date of 1152 Ma were determined on a sample of pitchblende collected from a claim group near Quartet Lakes in the northern Wernecke Mountains (Archer and Schmidt, 1977).

The dykes from which both samples LA-1 and LA-2 (GSC 80-72) were collected show a distinct spatial association with splays of the Richardson Fault Array (Norris and Hopkins, 1977), a system of long active, nearly vertical faults which exhibit both vertical and right lateral strike slip movements.

In the Knorr Range, approximately 14 km north of the site from which sample LA-1 was collected, petrographically similar lamprophyre dykes cut strata of the Hadrynian Rapitan Group (Yeo, 1981). These dykes are intimately associated with the Knorr Fault, one of the major splays of the Richardson Fault Array.

The date of 613 ± 15 Ma gives a minimum age for the termination of deposition of the Rapitan Group and associated strata. This date also probably reflects a period of rejuvenation of the Richardson Fault Array. The date of 552 ± 13 Ma for sample LA-2 may indicate a younger intrusive phase or possibly may reflect later movement on some splays of the Richardson Fault Array.

See GSC 80-72 for references.

GSC 80-72 Biotite, K-Ar age **552 ± 13 Ma**

K = 6.02%, $^{40}Ar/^{40}K$ = 0.03755, radiogenic Ar = 96.6%.
Concentrate: Relatively clean, brownish orange biotite with approximately 2% chlorite alteration.

From mafic dyke
(106 E) Approximately 150 m above Bonnet Plume River, Yukon, 65°05'N, 134°15'W. Sample LA-2, collected and interpreted by G.D. Delaney (University of Western Ontario).

This sample was collected from a 0.6 m wide, tan weathering dyke which cuts a sequence of thinly bedded, fine grained clastic and carbonate rocks of the upper part of the Proterozoic Fairchild Lake Group (Delaney, 1978). For interpretation, see GSC 80-71.

References

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1977: Mineralized breccias of Wernecke Mountains, Yukon; in Geological Association of Canada 1977 Annual Meeting, Vancouver, p. 4.

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1981: The Late Proterozoic Rapitan glaciation in the Northern Cordillera; in Proterozoic Basins of Canada, Geological Survey of Canada, Paper 81-10.

GSC 80-73 Biotite, K-Ar age **178 ± 6 Ma**

K = 7.58%, $^{40}Ar/^{40}K$ = 0.01087, radiogenic Ar = 93.7%.
Concentrate: Clean, fresh and unaltered, light green biotite with no visible contamination.

From granitic gneiss

(115 I) Subsurface sample from 80.8 m depth in Asarco-Silver Standard Minto Copper Prop. diamond drillhole No. 20-73, Yukon, 63°37'10"N, 137°14'40"W. Map unit 10, GSC Map 340A, Memoir 189. Sample KQ-73-319, collected by R.V. Kirkham and interpreted by W.D. Sinclair.

The rock is a biotite-quartz-feldspar schist that occurs interlayered with gneissic biotite granodiorite. It is well-foliated, medium- to coarse-grained and consists of approximately 60% biotite and 40% quartz and feldspar. It was collected from the main mineralized zone of the Minto copper deposit.

The Minto deposit occurs within a complex migmatite terrane that consists of weakly to strongly foliated gneissic granodiorite and quartz monzonite interlayered with massive Klotassin granodiorite. The foliated rocks are considered to be poorly digested remnants of Yukon Metamorphic Complex rocks that have been intruded and migmatized by the Klotassin granodiorite (Tempelman-Kluit, 1975). Mineralization in the Minto deposit consists mainly of disseminated chalcopyrite and bornite in gneissic granodiorite. Mineralized zones appear to be grossly conformable with the foliation of the host rocks and are thought to have been present prior to migmatization (Pearson and Clark, 1979).

The Early Jurassic date (178 ± 6 Ma) represents the time of migmatization of the Minto deposit host rocks. Similar K-Ar ages of 177 ± 9 Ma from mineralized, biotite-rich gneiss and 180 ± 9 Ma for the enclosing Klotassin granodiorite were determined by Pearson and Clark (1979). These ages correspond well to a widespread thermal event in the Yukon Crystalline Terrane reflected in K-Ar ages from metamorphic and plutonic rocks (Tempelman-Kluit and Wanless, 1975). Because the Minto deposit is considered to have formed prior to migmatization, the Early Jurassic date represents a minimum age only for mineral deposition.

References

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Tempelman-Kluit, D.J. and Wanless, R.K.
1975: Potassium-argon age determinations of metamorphic and plutonic rocks in the Yukon Crystalline Terrane; Canadian Journal of Earth Sciences, v. 12, p. 1895-1909.

GSC 80-74 Biotite, K-Ar age **89.0 ± 2.6 Ma**

K = 5.86%, $^{40}Ar/^{40}K$ = 0.00530, radiogenic Ar = 81.9%.
Concentrate: Dark brown biotite with approximately 15% chlorite alteration.

From quartz-feldspar porphyry

(105 M) Ridge on north side of Fortune Creek, approximately 600 m northeast of peak of Mt. Haldane, Mayo area, Yukon, 63°51'25"N, 135°49'34"W. Sample SYA-78-204, collected and interpreted by W.D. Sinclair.

The rock is a fine grained, leucocratic quartz-feldspar porphyry that consists of phenocrysts of plagioclase (25%), potash feldspar (15%), quartz (10%) and biotite (2%) in a very fine grained quartzo-feldspathic matrix. Traces of apatite and zircon occur as accessories.

The sample is from a narrow dyke 2 to 3 m wide that cuts Keno Hill quartzite. The date (89.0 ± 2.6 Ma) is comparable to but slightly older than the 81 ± 5 Ma* K-Ar age obtained on a quartz porphyry sill on the southeast side of Mount Haldane (Wanless et al., 1967; GSC 65-49).

*This age recalculates to 83 ± 5 Ma using the decay constants of Steiger and Jager (1977).

Reference

Wanless, R.K., Stevens, R.D., Lachance, G.R., and Edmonds, C.M.
1967: Age determinations and geological studies: K-Ar isotopic ages, Report 7; Geological Survey of Canada, Paper 66-17, p. 47.

GSC 80-75 Hornblende, K-Ar age **89.9 ± 8.2 Ma**

K = 0.59%, $^{40}Ar/^{40}K$ = 0.00536, radiogenic Ar = 73.8%.
Concentrate: Clean, unaltered, pleochroic light yellowish green to light green hornblende with no visible contamination.

From dacite porphyry

(115 H) Ridge top 1.3 km east of north end of Hopkins Lake, Hopkins copper prospect, Yukon, 61°16'56"N, 136°54'57"W. Sample SYA-78-170, collected and interpreted by W.D. Sinclair.

The rock is a dacite porphyry composed of medium grained phenocrysts of andesine (35%), hornblende (10%), biotite (3%) and quartz (2%) in a grey, aphanitic matrix of quartz and feldspar. Epidote, apatite and sphene occur in accessory amounts; traces of disseminated chalcopyrite and magnetite are also present.

The sample is from a 2 m wide north-trending dyke that is one of several in the area. The dykes intrude Yukon Metamorphic Complex schist and gneiss and hornblende granodiorite. Copper-bearing skarns have formed locally where the dykes are in contact with marble lenses in the metamorphic rocks. The 89.9 ± 8.2 Ma date is interpreted as the time of emplacement of the dykes and development of the associated skarn mineralization. The age of the dykes corresponds closely to the mid-Cretaceous thermal event dated by Tempelman-Kluit and Wanless (1975). The dykes are probably related to Nisling Range granodiorite, which has a similar composition and has yielded comparable K-Ar ages (Tempelman-Kluit and Wanless, 1975).

Reference

Tempelman-Kluit, D.J. and Wanless, R.K.
1975: Potassium-argon age determinations of metamorphic and plutonic rocks in the Yukon Crystalline Terrane; Canadian Journal of Earth Sciences, v. 12, p. 1895-1909.

GSC 80-76 Biotite, K-Ar age **85.2 ± 2.6 Ma**

K = 4.81%, $^{40}Ar/^{40}K$ = 0.00507, radiogenic Ar = 80.8%.
Concentrate: Brown biotite with a trace of chlorite alteration and a trace of free hornblende impurity.

From quartz monzonite

(115 I) Roadcut on northeast side of Seymour Creek, 1.4 km southeast of confluence with Bow Creek, Yukon, 62°17'40"N, 137°12'06"W. Sample SYA-78-179, collected and interpreted by W.D. Sinclair.

The rock is a medium grained, roughly equigranular quartz monzonite composed of 40% potash feldspar, 30% andesine, 26% quartz, 3% biotite and 1% opaques, mainly magnetite. Apatite and traces of zircon are the principal accessories.

This sample is from the Seymour Creek stock, a granodiorite to quartz monzonite pluton that is intrusive into Yukon Metamorphic Complex schist and gneiss and Klotassin suite plutonic rocks. The age (85.2 ± 2.6 Ma) corresponds closely with the mid-Cretaceous intrusive event in Yukon Crystalline Terrane identified by Tempelman-Kluit and Wanless (1975).

Reference

Tempelman-Kluit, D.J. and Wanless, R.K.
1975: Potassium-argon age determinations of metamorphic and plutonic rocks in the Yukon Crystalline Terrane; Canadian Journal of Earth Sciences, v. 12, p. 1895-1909.

GSC 80-77 Hornblende, K-Ar age **142 ± 10 Ma**

K = 0.84%, $^{40}Ar/^{40}K$ = 0.00857, radiogenic Ar = 61.1%.
Concentrate: Clean, unaltered, pleochroic brown to dark green hornblende with no visible contamination.

From porphyritic monzonite

(115 I) Roadcut on north side of Seymour Creek, 2.6 km south of top of Mount Freegold, Yukon, 62°15'35"N, 137°07'09"W. Sample SYA-78-185, collected and interpreted by W.D. Sinclair.

The rock is a coarse grained, porphyritic hornblende quartz monzonite consisting of about 40% pink orthoclase phenocrysts up to 6 cm long in a coarse crystalline matrix of andesine (30%), hornblende (20%), and quartz (10%) with accessory magnetite, apatite, sphene and traces of zircon. The hornblende contains numerous inclusions of magnetite and apatite but appears relatively fresh and unaltered.

The sample is from a large, northwest-trending batholith that intrudes Yukon Metamorphic Complex rocks. Intrusive relationships are not evident but the porphyritic monzonite probably belongs with the Klotassin suite. In many places, the porphyritic monzonite has a weak foliation imparted by the alignment of phenocrysts in a northwesterly direction. This is parallel to the foliation in a large mass of Klotassin granodiorite to the northeast and is probably related to the widespread thermal event dated at 160-170 Ma by Tempelman-Kluit and Wanless (1975).

The 142 ± 10 Ma date is, therefore, younger than expected and is possibly due to partial argon loss during a younger thermal event. The porphyritic monzonite is intruded by a Cretaceous pluton dated at 85.2 ± 2.6 Ma (sample SYA-78-179, GSC 80-76) which may have affected argon retention in the monzonite. However, this unit has not been dated before and the age may thus indicate a separate plutonic event.

Reference

Tempelman-Kluit, D.J. and Wanless, R.K.
1975: Potassium-argon age determinations for metamorphic and plutonic rocks in the Yukon Crystalline Terrane; Canadian Journal of Earth Sciences, v. 12, p. 1895-1909.

GSC 80-78 Hornblende, K-Ar age **268 ± 19 Ma**

K = 0.308%, $^{40}Ar/^{40}K$ = 0.01676, radiogenic Ar = 67.2%.
Concentrate: Clean, unaltered, pleochroic light green to light brown hornblende with no visible contamination.

From granodiorite

(115 H) Ridge top about 1.6 km northeast of north end of Hopkins Lake, Yukon, 61°17'16"N, 136°54'54"W. Sample SYA-78-175, collected and interpreted by W.D. Sinclair.

The rock is a massive, medium grained, equigranular granodiorite with approximate modes of 50% andesine, 25% potash feldspar, 15% quartz, 6% hornblende, 3% biotite and 1% disseminated magnetite. Apatite and sphene are the main accessories.

The sample was collected from Klotassin suite rocks of the Aishihik batholith. The age of the Klotassin suite, based on K-Ar age determinations and stratigraphic evidence (Tempelman-Kluit and Wanless, 1975) and a U-Pb age determination on zircon (Tempelman-Kluit and Wanless, 1980), is Late Triassic-Early Jurassic. The 268 ± 19 Ma date reported herein is from a relatively undeformed granodiorite that was apparently unaffected by younger thermal events and suggests that some rocks of the Klotassin suite may be as old as Early Permian. This is supported by an Early Permian U-Pb age (276 Ma) determined on zircon from the Selwyn Gneiss, which has been interpreted as a deformed granodiorite (Tempelman-Kluit and Wanless, 1980).

References

Tempelman-Kluit, D.J. and Wanless, R.K.
1975: Potassium-argon age determinations of metamorphic and plutonic rocks in the Yukon Crystalline Terrane; Canadian Journal of Earth Sciences, v. 12, p. 1895-1909.

1980: Zircon ages for the Pelly Gneiss and Klotassin granodiorite in western Yukon; Canadian Journal of Earth Sciences, v. 17, p. 297-306.

GSC 80-79 Biotite, K-Ar age **174 ± 5 Ma**

K = 7.34%, $^{40}Ar/^{40}K$ = 0.01063, radiogenic Ar = 62.2%.
Concentrate: Reddish orange biotite with approximately 7% chlorite alteration.

From mylonitic schist

(105 C) Between Nisutlin River and Wolf River, Yukon, 60°46.2'N, 132°40'W. Sample TO-76-1-7, collected and interpreted by D.J. Tempelman-Kluit.

The dated rock is a muscovite quartzite with a penetrative, well developed flaser fabric – a good blastomylonite. It was collected from a large outcrop in the Thirtymile Range in northeastern Teslin map area and Mulligan (1963) included these strata in his Englishmans Group.

The rocks are considered part of the Nisutlin Allochthonous Assemblage, a group of transported cataclastic rocks whose depositional age is uncertain. The mineral dated, muscovite, grew following final penetrative strain of the rocks and the 174 Ma age shows that in this rock cataclasis was complete by the Middle Jurassic. This corresponds with dates on other samples which fall in the range 174 to 230 Ma and is corroborated by stratigraphic evidence for the time of cataclasis from nearby areas (Tempelman-Kluit, 1979b).

References

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Tempelman-Kluit, D.J.
1979a: Transported cataclasite, ophiolite and granodiorite in Yukon: evidence of Arc-Continent collision; Geological Survey of Canada, Paper 79-14, p. 1-27.

1979b: Five occurrences of transported synorogenic clastic rocks in Yukon Territory; in Current Research, Part A, Geological Survey of Canada, Paper 79-1A, p. 1-12.

Tempelman-Kluit, D.J. and Wanless, R.K.
1980: Zircon ages for the Pelly Gneiss and Klotassin granodiorite in western Yukon; Canadian Journal of Earth Sciences, v. 17, p. 297-306.

GSC 80-80 Muscovite, K-Ar age **230 ± 8 Ma**

K = 7.40%, $^{40}Ar/^{40}K$ = 0.01438, radiogenic Ar = 95.8%.
Concentrate: Stained, altered muscovite with less than 5% quartz and feldspar impurities and a trace of chlorite.

From mylonite
(105 G) Southeastern St. Cyr Range, East of McNeil River, Yukon, 61°14.2'N, 131°43.8'W. Sample TOM-76-35-9, collected and interpreted by D. Tempelman-Kluit.

See GSC 80-81 for description and interpretation.

GSC 80-81 Muscovite, K-Ar age **226 ± 8 Ma**

K = 7.67%, $^{40}Ar/^{40}K$ = 0.01397, radiogenic Ar = 96.4%.
Concentrate: Mainly yellow-stained muscovite with no visible contamination.

From mylonite
(105 G) Southeastern St. Cyr Range, east of McNeil River, Yukon, 61°14.2'N, 131°43.8'W. Sample TOM-76-35-8c, collected and interpreted by D.J. Tempelman-Kluit.

The rocks dated are muscovite quartz schist with an excellent flaser fabric. Both are blastomylonite of the Nisutlin Allochthonous Assemblage exposed in one of the Nisutlin Klippen in southwestern Finlayson Lake map area. The klippen include highly strained and metamorphosed rocks lying as remnants of a near-horizontal thrust sheet above unmetamorphosed Upper Triassic and older sedimentary strata. Muscovite in both samples gave essentially the same ages (230 and 226 Ma) indicating these rocks last cooled about the Early Triassic.

The ages of the muscovite probably represent the time of cooling following mica growth in these ductile deformed rocks, and therefore date the last stages of cataclasis in the broader sense. Triassic cataclasis of the allochthonous rocks fits other data for these rocks (Tempelman-Kluit, 1979b, see GSC 80-79) and agrees with data on similarly deformed rocks in other parts of the Yukon (e.g. see interpretation for samples GSC 80-83 and 79).

GSC 80-82 Biotite, K-Ar age **112 ± 4 Ma**

K = 7.17%, $^{40}Ar/^{40}K$ = 0.00671, radiogenic Ar = 90.4%.
Concentrate: Relatively clean, unaltered, dark brown biotite with a slight trace of chlorite contamination.

From lamprophyre (minette)
(105 F) Ridge east of Seagull fault, Yukon, 61°32'30"N, 132°35'W. Sample TO-76-7-1, collected and interpreted by D.J. Tempelman-Kluit.

The sample of minette, a biotite lamprophyre, is from a 2 m wide northwest trending, vertical, fresh, unsheared dyke that cuts slightly sheared Mississippian felsic volcanic rocks in central Quiet Lake map area. The volcanic rocks were probably sheared in the Jurassic as dated by a K-Ar age of 189 Ma (GSC 78-101) and the dyke's age of 112 Ma corroborates this. The dyke is one of a number such minettes and may be an early phase of the really extensive quartz monzonite plutons in the region which have given K-Ar ages between 70 and 100 Ma.

GSC 80-83 Muscovite, K-Ar age **183 ± 7 Ma**

K = 5.16%, $^{40}Ar/^{40}K$ = 0.01120, radiogenic Ar = 93.8%.
Concentrate: Stained, altered muscovite with a trace of chlorite contamination.

From foliated quartz monzonite
(105 G) 17.7 km east of Fire Lake and 32 km south of Wolverine Lake, Yukon, 61°11'N, 130°14'W. Sample TO-76-33-4, collected and interpreted by D.J. Tempelman-Kluit.

The rock is a strongly foliated chlorite muscovite quartz monzonite, that occurs as part of Money Klippe in Finlayson Lake map area (Tempelman-Kluit, 1979a*). The rock is strongly sheared and is part of Simpson Allochthonous Assemblage, a group of cataclastic plutonic rocks thrust with other ductile deformed rocks above autochthonous unstrained strata.

The age determined for the muscovite dates the time of cooling following final ductile strain and is comparable with the age of muscovite in GSC 80-84 and that in GSC 80-81 and GSC 80-80 at 201, 226 and 230 Ma respectively. Together the ages imply that ductile strain, cataclasis and blastesis of the allochthonous rocks occurred during an interval of nearly 50 Ma between the Early Triassic and Middle Jurassic. Upper Triassic conodonts which have been recovered from a weakly strained conglomerate with mylonite clasts (Tempelman-Kluit, 1979b*) corroborate part of this range.

*For references, see GSC 80-79.

GSC 80-84 Muscovite, K-Ar age **201 ± 7 Ma**

K = 8.09%, $^{40}Ar/^{40}K$ = 0.01233, radiogenic Ar = 94.7%.
Concentrate: Clean, mainly clear muscovite with no visible contamination.

From foliated quartz monzonite
(105 G) Finlayson Lake map area, Yukon, 61°07.4'N, 130°05.2'W. Sample TO-76-16-6, collected and interpreted by D.J. Tempelman-Kluit.

See GSC 80-85 for description and interpretation.

GSC 80-85 Hornblende, K-Ar age **316 ± 18 Ma**

K = 0.442%, $^{40}Ar/^{40}K$ = 0.02005, radiogenic Ar = 61.5%.
Concentrate: Clean, unaltered, slightly pleochroic light green hornblende with no visible contamination.

From foliated quartz monzonite
(105 G) Details as for GSC 80-84.

The rock is a strongly foliated hornblende quartz monzonite, part of Simpson Allochthon in southeastern Finlayson Lake map area. It has been sheared and the muscovite developed on the foliation is a metamorphic mineral that has given the 201 Ma age. By contrast the hornblende, which is part of the original intrusive rock gave 316 Ma. This older age presumably dates the minimum time of intrusion of the original plutonic rock which must therefore be about Mississippian or older. The mica dates the time of mica growth following cataclasis and shearing which corresponds with dates determined independently from other samples (e.g. GSC 70-83, 79, 81 and 80). The 316 Ma or older age of this transported hornblende quartz monzonite sets it apart from the truly intrusive bodies of quartz monzonite in this region which give ages around 70 to 100 Ma. The closest similar rocks of comparable age are granite gneisses classed generally as Pelly Gneiss south of Dawson. These have given uranium-lead zircon discordia ages of 375 and 276 Ma (Tempelman-Kluit and Wanless, 1980). Because these roughly equivalent gneisses are on the southwestern side of Tintina Fault they give an approximate measure of the right lateral offset of that fault as 500 km, the same as that derived from other offset units.

Reference

Tempelman-Kluit, D.J. and Wanless, R.K.
1980: Zircon ages for the Pelly Gneiss and Klotassin granodiorite in western Yukon; Canadian Journal of Earth Sciences, v. 17, p. 297-306.

GSC 80-86 Biotite, K-Ar age $\frac{53.9}{46.9} \pm \frac{1.3}{2.6}$ **Ma**

K = 7.26%, $^{40}Ar/^{40}K = \frac{0.00318}{0.00276}$, radiogenic Ar = $\frac{76.3}{75.0}$%.
Concentrate: Clean, unaltered, light brown biotite with no chlorite contamination.

From quartz monzonite
(105 G) Southeast Finlayson Lake map area, Yukon, 61°08'01"N, 130°46'W. Sample TOW-76-4c, collected and interpreted by D.J. Tempelman-Kluit.

This coarse grained porphyritic biotite quartz monzonite is part of a 35 km long batholith that intrudes Paleozoic sedimentary strata in southeastern Finlayson Lake map area. The pluton postdates folding and thrust faulting of the host rocks which occurred about the Jurassic or Early Cretaceous. The pluton is southwest of Tintina fault and may be truncated by that fault at its southeast end but exposures are not good enough to be certain of this. The dated rock lithologically resembles other quartz monzonite bodies in the region that have given K-Ar ages between 70 and 100 Ma and the age determined for this rock. Because the age determined is much younger than expected two separate analyses were carried out. The batholith is either younger than any other in the region or there was a problem with sampling. Further samples are necessary to check these alternatives.

An earlier age of 66 Ma* determined from the same pluton (GSC 60-29) is roughly corroborated by the new dates. Roddick (1967) used the date as a limit on the age of transcurrent movement on Tintina Fault because the pluton is not sheared. This interpretation is not valid because strata next to Tintina Fault are not sheared so that the absence of strain in the walls is no indication of emplacement following strike-slip.

*This age recalculates to 68 Ma on the basis of Steiger and Jager (1977) decay constants.

Reference

Roddick, J.A.
1967: Tintina Trench; Journal of Geology, v. 75, p. 23-33.

GSC 80-87 Biotite, K-Ar age **99.6 ± 3.7 Ma**

K = 7.16%, $^{40}Ar/^{40}K$ = 0.00595, radiogenic Ar = 90.6%.
Concentrate: Relatively clean, brown biotite with approximately 1% chlorite alteration.

From granite
(105 G) Northeast corner of Finlayson Lake map area, Yukon, 61°54.4'N, 130°13.6'W. Sample TO-76-19-1, collected and interpreted by D.J. Tempelman-Kluit.

The dated rock is a medium grained equigranular biotite granite, part of an elongate, 12 km long, north-northwest trending homogeneous pluton in northeastern Finlayson Lake map area. The pluton probably postdates Jurassic to Early Cretaceous folding and faulting of the Lower Paleozoic and older rocks which it intrudes and no close stratigraphic limits to its age are available. The pluton is one of a number of lithologically similar bodies northeast of Tintina Fault which have given ages in the range 70 to 100 Ma and the age determined for this rock fits this range neatly.

GSC 80-88 Biotite, K-Ar age **54.1 ± 1.9 Ma**

K = 5.38%, $^{40}Ar/^{40}K$ = 0.00319, radiogenic Ar = 74.2%.
Concentrate: Reddish brown biotite with no detected chlorite, but with a trace of attached hornblende contamination.

From peralkaline syenite
(95 C) 12 km southwest of Jackpine Lake, Yukon, 60°32'50"N, 125°53'05"W. See GSC Map 1380A (La Biche River). Sample P11-517, collected and interpreted by J.C. Harrison.

See GSC 80-90 for description and interpretation.

GSC 80-89 Biotite, K-Ar age **53.0 ± 1.8 Ma**

K = 5.41%, $^{40}Ar/^{40}K$ = 0.00312, radiogenic Ar = 69.1%.
Concentrate: Reddish brown biotite with no detected chlorite, but with a trace of attached hornblende contamination.

From peralkaline syenite
(95 C) Details as for GSC 80-88.

See GSC 80-90 for description and interpretation.

GSC 80-90 Biotite, K-Ar age **52.4 ± 1.8 Ma**

K = 6.97%, $^{40}Ar/^{40}K$ = 0.00309, radiogenic Ar = 56.5%.
Concentrate: Dark brown biotite with no detected chlorite, but with a trace of attached hornblende contamination.

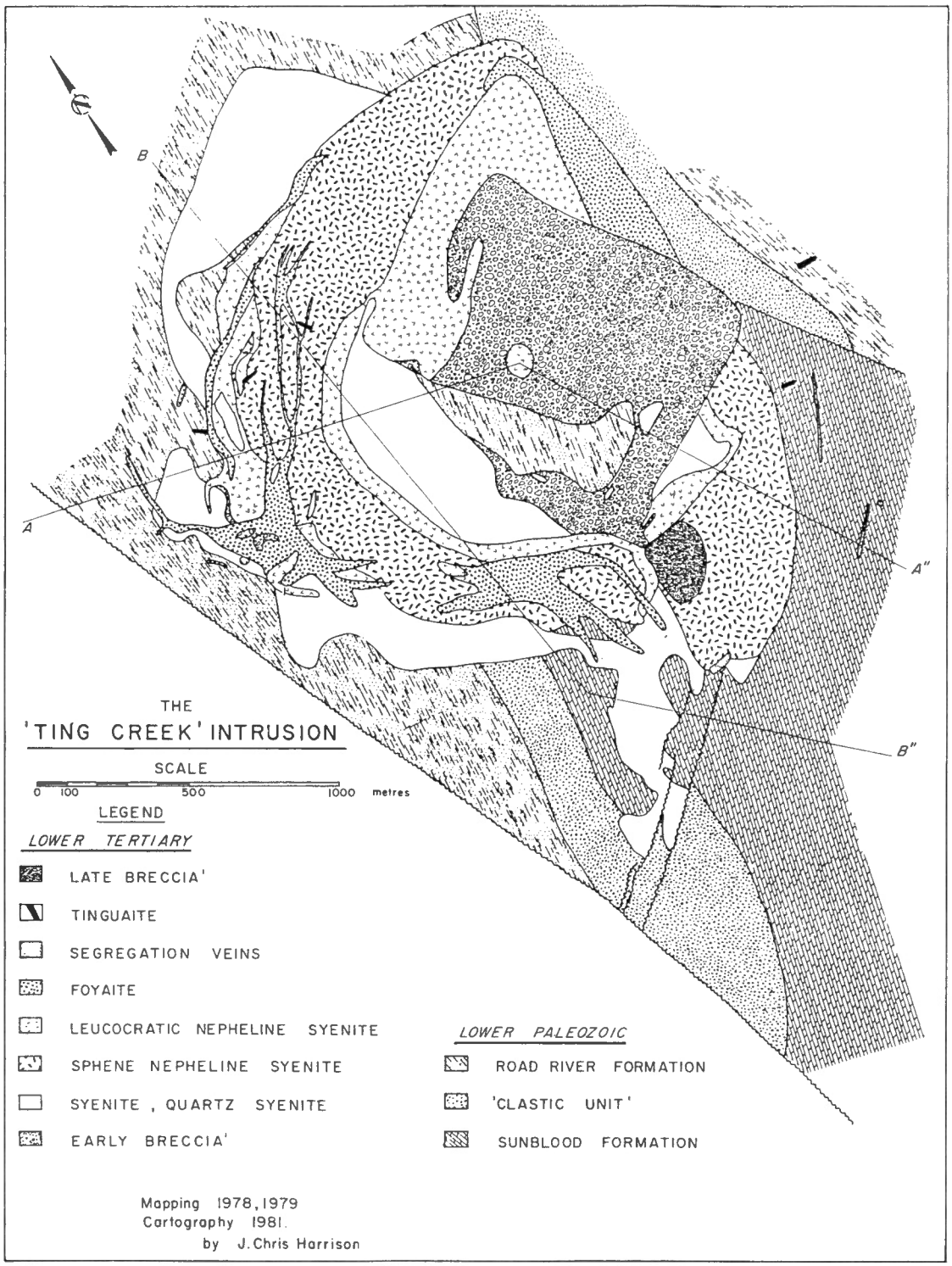

Figure 3. *Geology of the "Ting Creek" intrusion.*

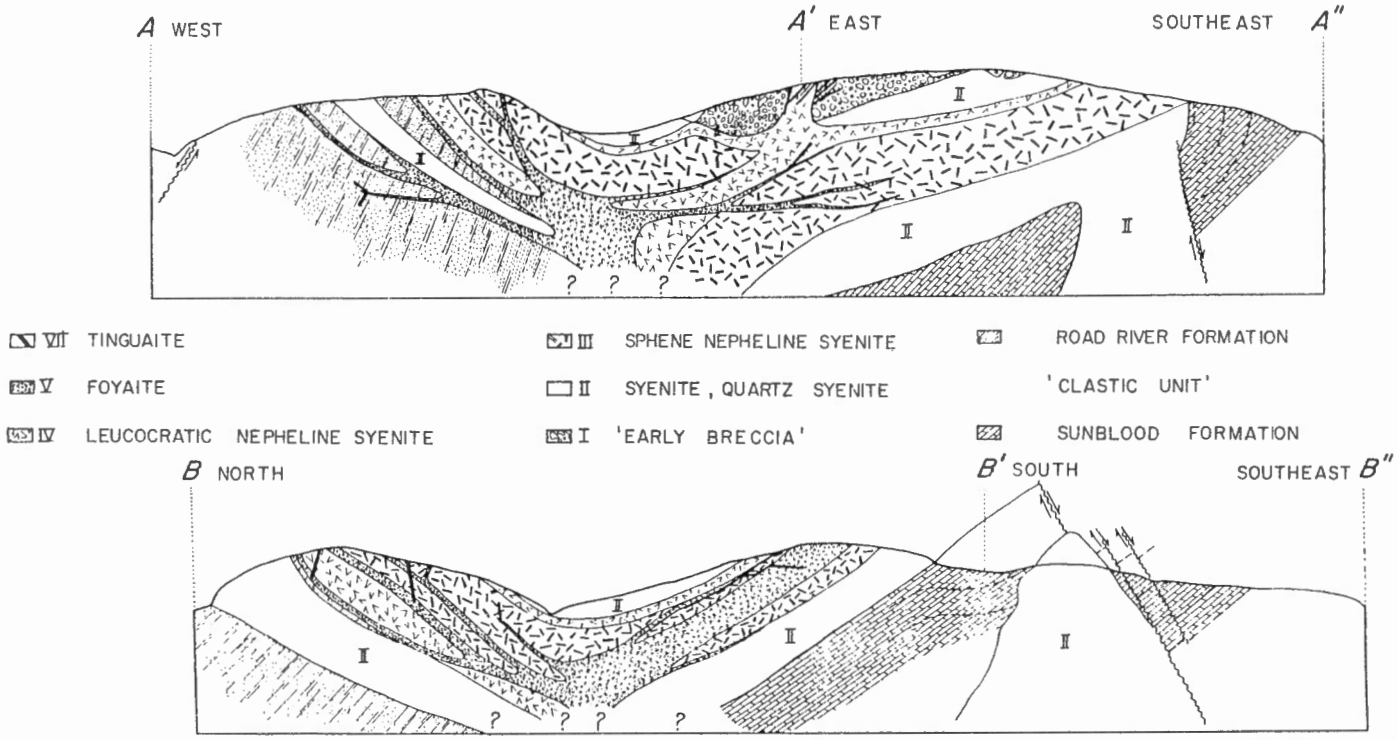

Figure 4. *Cross sections of the "Ting Creek" intrusion.*

From peralkaline syenite
(95 C) 12 km southwest of Jackpine Lake, Yukon, 60°32'50"N, 125°53'05"W. GSC Map 1380A (La Biche River). Sample P11-518, collected and interpreted by J.C. Harrison.

Samples P11-517 (GSC 80-88, 89) and P11-518 (GSC 80-90) contain 75 to 80% flow oriented antiperthite, 15% nepheline and sodalite, 3% aegirine augite, 3% biotite, 0.5% of a rinkolite group mineral, and traces of sphene, magnetite, fluorite, and eucolite. Strongly pleochroic biotite occurs both in scattered flakes up to 1 mm and in mafic aggregates of several millimetres.

These rocks were collected from a recently discovered small alkaline intrusion (2.5 km across), the "Ting Creek" Intrusion (Fig. 3, 4). Field relations indicate two phases of volcanism and explosive brecciation, three sets of cone sheets, two periods of radial dykes, and late stage argillic and phyllic alteration associated with epigenetic base metal with vein mineralization.

Plutonic rocks include alkali syenite and quartz syenite, miaskitic nepheline syenite, agpa-miaskitic nepheline syenite or foyaite, agpaitic foyaite, agpaitic segregation veins, and tinguaite. These rocks were emplaced into complexly faulted but unmetamorphosed lower Paleozoic sediments (continental margin and slope facies).

The dates obtained from this study reveal some of the youngest plutonic rocks known from the northern Canadian Cordillera east of the Tintina fault. Other laramide alkaline intrusives include the Coryell intrusions, Goosly Lake stocks, and Mt. Copeland.

References

Currie, K.L.
1976: The alkaline Rocks of Canada; Geological Survey of Canada, Bulletin 239.

Douglas, R.J.W.
1976: La Biche River, (Yukon and) District of Mackenzie; Geological Survey of Canada, Map 1380A.

Noel, G.A.
1978: Cenozoic Rocks in the Western Canadian Cordillera of British Columbia and Yukon Territory; Geological Survey of Canada, Open File 659.

District of Franklin
(GSC 80-91 to GSC 80-117)

GSC 80-91 Hornblende, K-Ar age $\frac{94.2}{91.6} \pm \frac{10.0}{9.6}$ **Ma**

$K = 0.40\%$, $^{40}Ar/^{40}K = \frac{0.00562}{0.00546}$, radiogenic

$Ar = \frac{60.4}{46.7}\%$.

Concentrate: Clean, pleochroic brown to dark green hornblende with no visible contamination.

From quartz diorite

(340 E) Peak of 1700 ft (518.3 m) hill, northern Ellesmere Island, District of Franklin, 82°44'11"N, 74°32'48"W. Sample 77TM320A1, collected and interpreted by H.P. Trettin.

The sample was collected from a small pluton (about 2.8 km long, 1.25 km wide) on south-central Marvin Peninsula that intrudes the Upper Ordovician Taconite River Formation. The sample is a massive, medium grained quartz diorite. The primary minerals are feldspar (mostly zoned andesine with no more than a few per cent K-feldspar) 59%, hornblende 30%, quartz 5%, opaques 5% and biotite 1%. Hornblende and biotite are altered to a minor extent by chlorite. Graphic intergrowths of quartz and feldspar are common in this as in other samples.

The unmetamorphosed state of the rock and little altered state of the hornblende suggest that the K-Ar determination gives the age of cooling probably soon after emplacement in Late Cretaceous (?) time. The determination, however, requires confirmation either by another method or by a K-Ar age from another pluton because all other granitic plutons in northern Ellesmere Island that have been dated so far were no younger than Early Carboniferous. On the other hand, mafic intrusions of Mesozoic age are common in the Arctic Islands and therefore it should also be investigated whether the present pluton is genetically related to an essentially mafic episode of intrusion.

GSC 80-92 Muscovite, K-Ar age **452 ± 8 Ma**

$K = 7.35\%$, $^{40}Ar/^{40}K = 0.02988$, radiogenic

$Ar = 95.6\%$.

Concentrate: A mixture of clear and yellow-stained muscovite with no detected chlorite.

From schist

(340 E) West of M'Clintock Inlet, northern Ellesmere Island, District of Franklin, 82°33'02"N, 76°00'31"W. Sample 80TM311A, collected and interpreted by H.P. Trettin.

From a fine grained, laminated schist exposed on cliffs just west of the head of M'Clintock Inlet (Trettin, 1981). A thin section, analyzed by point count, is composed of quartz (63%), plagioclase (18%), muscovite (11%), biotite (5%), chlorite (1%) and pyrite (2%). Most quartz grains are 0.05-0.2 mm, and most mica flakes 0.04-0.06 mm long. Muscovite, biotite, and chlorite are intergrown with each other and with the plagioclase, which is untwinned and fresh. The lamination is due to alteration of layers rich in quartz, or mica and plagioclase respectively. The rock represents pelitic and possibly sandy sediments metamorphosed in the greenschist facies.

The schist forms part of an extensive metamorphic complex, which in this area is overlain with high angular unconformity by conglomerate, sandstone and mudrock of the Upper Ordovician Taconite River Formation, followed by fossiliferous limestone of the Upper Ordovician Zebra Cliffs Formation, in turn unconformably overlain by Pennsylvanian redbeds. In contrast to other parts of the M'Clintock Inlet area, the upper Ordovician strata here are nearly flat-lying and broken only by some steeply dipping faults.

Regional stratigraphic relationships strongly suggest that the original sediments of the metamorphic basement are Proterozoic (Hadrynian or older) in age. About 50 km to the northwest, other parts of the basement complex, as well as sedimentary and volcanic rocks of possible Early to early Middle Ordovician age are overlain by the upper Middle Ordovician Cape Discovery Formation (Trettin, 1969) with an angular unconformity that marks an orogeny of approximately medial Ordovician age. The unconformity in the present area probably indicates a local uplift of early Late Ordovician age rather than nondeposition from medial to early Late Ordovician time.

The present determination is early Late Ordovician (early Ashgillian) according to the time scale of Armstrong (1978) and early Middle Ordovician (Llandeilian) according to the time scale of Gale et al. (1979). It dates uplift and cooling after the medial Ordovician orogeny and is the first definitive evidence for a thermal event associated with it. On the other hand, the determination does not necessarily give the age of the original metamorphism of the schist. Rb-Sr isochron and U-Pb zircon determinations by Sinha and Frisch (1975, 1976) indicate Neohelikian and (?) Hadrynian events that have never been recorded by K-Ar determinations because of overprinting by several Phanerozoic orogenies.

References

Armstrong, R.L.
1978: Pre-Cenozoic Phanerozoic time-scale – computer file of critical dates and consequences of new and in-progress decay constant revisions; in Contributions to the geologic time scale, G.V. Cohee, M.F. Glaessner and D.H. Hedberg, ed., American Association of Petroleum Geologists, Studies in Geology, no. 6, p. 73-91.

Gale, N.H., Beckinsale, R.D., and Wadge, A.J.
1979: A Rb-Sr whole rock isochron for the Stockdale Rhyolite of the English Lake District and a revised mid-Palaeozoic time-scale; Journal of the Geological Society, v. 136, part 2, p. 235-242.

Sinha, A.K. and Frisch, T.O.
1975: Whole rock Rb/Sr ages of metamorphic rocks from northern Ellesmere Island, Canadian Arctic Archipelago. I. The gneiss terrain between Ayles Fiord and Yelverton Inlet; Canadian Journal of Earth Sciences, v. 12, p. 90-94.

1976: Whole rock Rb/Sr and zircon U/Pb ages of metamorphic rocks from northern Ellesmere Island, Arctic Archipelago; Canadian Journal of Earth Sciences, v. 13, p. 774-780.

Trettin, H.P.
1969: Geology of Ordovician to Pennsylvanian rocks, M'Clintock Inlet, north coast of Ellesmere Island, District of Franklin; Geological Survey of Canada, Bulletin 183.

1981: Geology of Precambrian to Devonian rocks, M'Clintock Inlet area, District of Franklin (NTS 340 E,H) – preliminary map and notes; Geological Survey of Canada, Open File.

GSC 80-93 Hornblende, K-Ar age **422 ± 37 Ma**

$K = 0.41\%$, $^{40}Ar/^{40}K = 0.02764$, radiogenic Ar = 86.4%.
Concentrate: Pleochroic yellowish brown to green hornblende with less than 5% chlorite contamination.

From monzodiorite/quartz monzonite
(120 F) Top of ridge, southeast of Markham Fiord, Ellesmere Island, District of Franklin, 82°52'46"N, 70°36'41"W. Sample 80TM 231A, collected and interpreted by H.P. Trettin.

From a narrow, elongate pluton east of the head of Markham Fiord (Clements Markham Inlet map area) that is in fault contact with Proterozoic or lower Paleozoic rocks of the Mount Disraeli 'Group' on the north and with upper Paleozoic formations on the south. The pluton is composed mainly of granitic rocks but includes considerable proportions of diabase and gabbro in its eastern part. The sample is a medium grained, massive quartz monzodiorite transitional to quartz monzonite. A representative thin section is composed of quartz (12%), oligoclase (50%), K-feldspar (27%), hornblende (7%), chlorite (3%), and epidote (1%) with trace amounts of carbonate and opaque minerals. The plagioclase is strongly sericitized. The hornblende is mostly unaltered and separate from the chlorite, which evidently represents altered biotite.

According to the time scale of Armstrong (1978) the sample is latest Silurian ("Downtonian") in age with confidence limits in the late Middle Ordovician and late Middle Devonian. This is the oldest K-Ar determination obtained so far from Phanerozoic granitic intrusions in northern Ellesmere and Axel Heiberg islands. It may indicate emplacement anywhere between medial Ordovician and Devonian time, an interval marked by several major unconformities.

Reference

Armstrong, R.L.
1978: Pre-Cenozoic Phanerozoic time-scale – computer file of critical dates and consequences of new and in-progress decay constant revisions; in Contributions to the geologic time scale, G.V. Cohee, M.F. Glaessner and H.D. Hedberg, ed., American Association of Petroleum Geologists, Studies in Geology, no. 6, p. 73-91.

GSC 80-94 Muscovite, K-Ar age **1644 ± 40 Ma**

$K = 8.57\%$, $^{40}Ar/^{40}K = 0.1560$, radiogenic Ar = 99.2%.
Concentrate: Generally clear muscovite with approximately 2% chlorite contamination. Many of the mica flakes have yellow-stained edges.

From pink granite
(47 B) North of Borealis Magnetite No. 4 deposit, "Iron Mountain", District of Franklin, 68°19'18"N, 85°13'01"W. Sample WN-41-74, collected by R.K. Wanless and interpreted by T. Frisch.

See GSC 80-98 for description and interpretation.

GSC 80-95 Biotite, K-Ar age **1625 ± 40 Ma**

$K = 7.74\%$, $^{40}Ar/^{40}K = 0.1532$, radiogenic Ar = 99.7%.
Concentrate: Relatively clean, light brownish biotite with approximately 2% chlorite alteration.

From foliated granite
(47 B) 38.6 km northeast of MacKar Inlet campsite, District of Franklin, 68°26'10"N, 84°49'04"W. Sample WN-42-74, collected by R.K. Wanless and interpreted by T. Frisch.

See GSC 80-98 for description and interpretation.

GSC 80-96 Biotite, K-Ar age **1640 ± 41 Ma**

$K = 7.60\%$, $^{40}Ar/^{40}K = 0.1554$, radiogenic Ar = 99.5%.
Concentrate: Clean, fresh and unaltered, very pale brown biotite with no visible contamination.

From foliated grey granite
(47 B) 26 km east of MacKar Inlet campsite, District of Franklin, 68°20'15"N, 85°07'33"W. Sample WN-44-74, collected by R.K. Wanless and interpreted by T. Frisch.

See GSC 80-98 for description and interpretation.

GSC 80-97 Hornblende, K-Ar age **1739 ± 50 Ma**

$K = 0.785\%$, $^{40}Ar/^{40}K = 0.1700$, radiogenic Ar = 99.0%.
Concentrate: Clean, unaltered, pleochroic green to brown hornblende with no visible contamination.

From foliated grey granite
(47 B) Details as for GSC 80-96.

See GSC 80-98 for description and interpretation.

GSC 80-98 Hornblende, K-Ar age **1920 ± 53 Ma**

$K = 0.336\%$, $^{40}Ar/^{40}K = 0.1991$, radiogenic Ar = 98.4%.
Concentrate: Clean, unaltered, pleochroic light brown to dark green hornblende with no visible contamination.

From amphibolite
(47 B) Approximately 32 km east by northeast of MacKar Inlet, District of Franklin, 68°26'N, 84°50'W. Sample WN-43-74, collected by R.K. Wanless and interpreted by T. Frisch.

GSC 80-95 refers to a sample of granitic gneiss that is interlayered with amphibolite, of which GSC 80-98 is representative. Together, these rocks form part of a unit of granitic gneiss (termed "Agn" by Frisch, in press), in which amphibolite is a relatively minor component. In the area where the samples were collected, the gneiss forms a domal (diapiric?) structure intruding Prince Albert Group greenstones. The amphibolite is considered to be a xenolithic remnant of the Prince Albert Group. Both the gneisses and the Prince Albert Group are Archean, on the basis of U-Pb determinations on zircon. The biotite age of 1620 Ma is typical of mica K-Ar ages obtained in this area of the Canadian Shield. The hornblende age of 1920 Ma is about 200 Ma older than the typical K-Ar age of hornblende from this region and may be a result of low K content or excess argon.

The two samples represented by GSC 80-94, 96 and 97 come from foliated granitic rocks that have intruded the eastern margin of the main Prince Albert Group greenstone belt in western Melville Peninsula and are assigned to map unit Agn (Frisch, in press). All three ages are typical of K-Ar determinations in this area of the Canadian Shield. The uniformity of K-Ar ages, obtained on three different minerals from a wide variety of rocks in a vast region, must

signify a pervasive thermal event. However, the nature and significance of this event are uncertain. In western Melville Peninsula, granite and greenstones yield Archean U-Pb and Rb-Sr ages and the major plutonic events appear to have taken place prior to the Proterozoic. The 1600-1700 Ma event may be a reflection of uplift and cooling long after Archean orogeny. Alternatively, it may be related to a low grade metamorphism, which downgraded most of the rocks in western Melville Peninsula, but for the age of which no direct evidence exists.

Reference

Frisch, T.
Precambrian geology of the Prince Albert Hills, western Melville Peninsula, Northwest Territories; Geological Survey of Canada, Bulletin. (in press)

GSC 80-99 Biotite, K-Ar age **1671 ± 41 Ma**

K = 7.35%, $^{40}Ar/^{40}K$ = 0.1598, radiogenic Ar = 99.7%.
Concentrate: Relatively clean, light brown biotite with approximately 2% chlorite alteration.

From metarhyolite
(47 B) 19.3 km southeast by south of MacKar Inlet, 16.1 km east of Committee Bay, District of Franklin, approx. 68°09'N, 85°32'W. Sample WN-38-74, collected by R.K. Wanless and interpreted by T. Frisch.

See GSC 80-104 for description and interpretation.

GSC 80-100 Biotite, K-Ar age **1634 ± 48 Ma**

K = 6.86%, $^{40}Ar/^{40}K$ = 0.1545, radiogenic Ar = 99.9%.
Concentrate: Greenish brown biotite with approximately 8% chlorite alteration.

From granite
(47 B) 20.9 km due south of MacKar Inlet, 7.2 km miles east of Committee Bay, District of Franklin, 68°00'N, 85°53'W. Sample WN-40-74, collected by R.K. Wanless and interpreted by T. Frisch.

See GSC 80-104 for description and interpretation.

GSC 80-101 Biotite, K-Ar age **1726 ± 42 Ma**

K = 7.79%, $^{40}Ar/^{40}K$ = 0.1680, radiogenic Ar = 99.6%.
Concentrate: Clean, unaltered, light greenish brown biotite with no visible contamination.

From foliated grey gneiss
(47 B) 1.6 km south of MacKar Inlet campsite, Committee Bay map area, District of Franklin, 68°19'33"N, 85°41'23"W. Sample WN-36-74, collected by R.K. Wanless and interpreted by T. Frisch.

See GSC 80-104 for description and interpretation.

GSC 80-102 Biotite, K-Ar age **1630 ± 40 Ma**

K = 7.58%, $^{40}Ar/^{40}K$ = 0.1539, radiogenic Ar = 99.4%.
Concentrate: Greenish brown biotite with approximately 2% chlorite alteration.

From grey granite/tonalite
(47 B) 20.9 km due south of MacKar Inlet campsite and 7.2 km east of Committee Bay, District of Franklin, 68°09'30"N, 85°42'50"W. Sample WN-39-74, collected by R.K. Wanless and interpreted by T. Frisch.

See GSC 80-104 for description and interpretation.

GSC 80-103 Biotite, K-Ar age **1651 ± 41 Ma**

K = 7.67%, $^{40}Ar/^{40}K$ = 0.1569, radiogenic Ar = 99.8%.
Concentrate: Clean, unaltered, greenish brown biotite with no visible contamination.

From migmatite/granodiorite gneiss
(46 M) 4.8 km south of Matheson River and 6.4 km east of Lefroy Bay, Melville Peninsula, District of Franklin, 67°34'N, 86°20'W. Sample WN-45-74, collected by R.K. Wanless and interpreted by T. Frisch.

See GSC 80-104 for description and interpretation.

GSC 80-104 Hornblende, K-Ar age **1724 ± 49 Ma**

K = 0.685%, $^{40}Ar/^{40}K$ = 0.1678, radiogenic Ar = 97.0%.
Concentrate: Clean, unaltered, pleochroic greenish blue to brown hornblende with no visible contamination.

From migmatite
(46 M) Details as for GSC 80-103.

These six determinations were made on five samples (collected chiefly for zircon extraction) from an Archean granite-greenstone terrane in western Melville Peninsula. Details of the geology and age determinations on the rocks are given by Frisch (in press).

GSC 80-99 refers to a metarhyolite from the Prince Albert Group, an amphibolite-grade greenstone unit, another sample of which from the same locality has given a U-Pb age on zircon of 2879 Ma. Zircons from the same samples as GSC 80-100 (porphyritic granite) and GSC 80-101 (granitic gneiss) have given ages of 2675 Ma and 2919 Ma, respectively. GSC 80-102 is a tonalitic rock from a unit giving a Rb-Sr whole rock age of 2678 Ma. No age determinations other than the above K-Ar values reported here are available for samples GSC 80-103 and 104, which are from a granodiorite gneiss but it too is almost certainly Archean.

All six K-Ar ages are typical for this region and reflect a pervasive Hudsonian thermal event, related either to uplift and cooling following Archean orogeny or to a low-grade metamorphism, which downgraded the Archean rocks.

Reference

Frisch, T.
Precambrian geology of the Prince Albert Hills, western Melville Peninsula, Northwest Territories; Geological Survey of Canada, Bulletin. (in press)

GSC 80-105 Biotite, K-Ar age **1601 ± 40 Ma**

K = 6.93%, $^{40}Ar/^{40}K$ = 0.1497, radiogenic Ar = 99.5%.
Concentrate: Clean, unaltered, very light brown biotite with no visible contamination.

From grey gneiss

(46 N) Northwest of head of Lyon Inlet, Melville Peninsula, District of Franklin, 67°03'N, 85°29'W. Sample WN-49-74, collected by R.K. Wanless and J.E. Reesor. Comment by R.D. Stevens.

See GSC 80-106 for description and discussion.

GSC 80-106 Amphibole, K-Ar age **2657 ± 143 Ma**

K = 0.023%, $^{40}Ar/^{40}K$ = 0.3523, radiogenic Ar = 84.0%.
Concentrate: Clean, unaltered, nonpleochroic colourless amphibole with no visible contamination.

From grey gneiss

(46 N) Details as for GSC 80-105.

This grey gneiss is associated with Prince Albert iron formation and amphibolite. The biotite age is comparable with biotites from GSC 80-107 (1595 ± 48 Ma) and GSC 80-108 and 109 (1624 ± 40 Ma) and represents an updating of the K-Ar system by later events. The amphibole age of 2657 ± 143 Ma is indicative of an age at least as old as the Kenoran orogeny, while preliminary unpublished zircon ages point to a more ancient history with discordant isotopic ages ranging up to a ^{207}Pb-^{206}Pb age of approximately 2720 Ma and an upper concordia intercept age of approximately 2940 Ma.

GSC 80-107 Biotite, K-Ar age **1595 ± 48 Ma**

K = 6.97%, $^{40}Ar/^{40}K$ = 0.1490, radiogenic Ar = 99.5%.
Concentrate: Brown biotite with approximately 9% chlorite alteration.

From grey gneiss

(46 K) 12.9 km west of Ross Bay, Melville Peninsula, District of Franklin, 66°53'N, 85°23'W. Sample WN-48-74, collected by R.K. Wanless and J.E. Reesor. Comment by R.D. Stevens.

This grey gneiss was thought to represent basement complex in the area. Preliminary, unpublished zircon geochronology on the same sample indicates a ^{207}Pb-^{206}Pb age of approximately 2480 Ma, though the individual isotopic ages are discordant. The biotite age therefore represents the effect of subsequent events.

GSC 80-108 Biotite, K-Ar age **1624 ± 40 Ma**

K = 7.11%, $^{40}Ar/^{40}K$ = 0.1530, radiogenic Ar = 96.7%.
Concentrate: Brownish orange biotite with approximately 10% chlorite alteration.

From granite

(46 N) Northeast of head of Lyon Inlet, Melville Peninsula, District of Franklin, 67°02.5'N, 84°08'W. Sample WN-46-74, collected by R.K. Wanless and J.E. Reesor.

See GSC 80-109 for description and comments.

GSC 80-109 Muscovite, K-Ar age **1528 ± 39 Ma**

K = 8.87%, $^{40}Ar/^{40}K$ = 0.1397, radiogenic Ar = 98.3%.
Concentrate: Clear, unaltered muscovite with no visible impurities, though some of the mica flakes are slightly yellow stained.

From granite

(46 N) Details as for GSC 80-108. Comment by R.D. Stevens.

The biotite and muscovite are from a granite interpreted to be intrusive into Penrhyn metasediments. The biotite age of 1624 ± 40 Ma is in general agreement with other biotite ages from the region (GSC 80-105 and 107) and therefore probably represents a significant metamorphic or intrusive event. The lower muscovite age of 1528 ± 39 Ma requires further backup to be meaningfully interpreted.

GSC 80-110 Muscovite, K-Ar age **1639 ± 31 Ma**

K = 8.61%, $^{40}Ar/^{40}K$ = 0.1552, radiogenic Ar = 98.9%.
Concentrate: Relatively clean, mainly clear muscovite with no visible contamination other than yellow stained edges on some flakes.

From metarhyolite

(46 O) West of north fork at Barrow River, Barrow River map area, Melville Peninsula, District of Franklin, 67°37'N, 82°33'W. Sample 46-0-10, collected and interpreted by A.V. Okulitch.

Muscovite from amphibolite within the basal succession of the Aphebian Penrhyn Group (Okulitch et al., 1978; GSC Open File 523, map 46-0-10). The date is similar to those obtained by Heywood (1966, GSC Paper 66-40) and likely represents cooling after regional metamorphism.

GSC 80-111 Whole rock, K-Ar age **1121 ± 33 Ma**

K = 2.42%, $^{40}Ar/^{40}K$ = 0.09035, radiogenic Ar = 98.0%.
Concentrate: Crushed whole rock.

From basalt

(47 F) Basalt cuesta at south end of northwesterly trending, thin, 1 km lake, northwestern Baffin Island, District of Franklin, 70°16'N, 84°44'W. Sample CGA79-C37, collected and interpreted by F.W. Chandler.

See GSC 80-117 for discussion.

GSC 80-112 Whole rock, K-Ar age **1117 ± 40 Ma**

K = 1.55%, $^{40}Ar/^{40}K$ = 0.08988, radiogenic Ar = 98.9%.
Concentrate: Crushed whole rock.

From basalt

(47 F) Northeasterly striking ridge, northwestern Baffin Island, District of Franklin, 70°17.5'N, 85°32'W. Sample CGA79-C408, collected and interpreted by F.W. Chandler.

See GSC 80-117 for discussion.

GSC 80-113 Whole rock, K-Ar age **1089 ± 32 Ma**

K = 2.41%, $^{40}Ar/^{40}K$ = 0.08691, radiogenic Ar = 99.4%.
Concentrate: Crushed whole rock.

From basalt

(47 F) Rocky island in east-west creek, northwestern Baffin Island, District of Franklin, 70°13'N, 84°26'W. Sample CGA79-C74A, collected and interpreted by F.W. Chandler.

See GSC 80-117 for discussion.

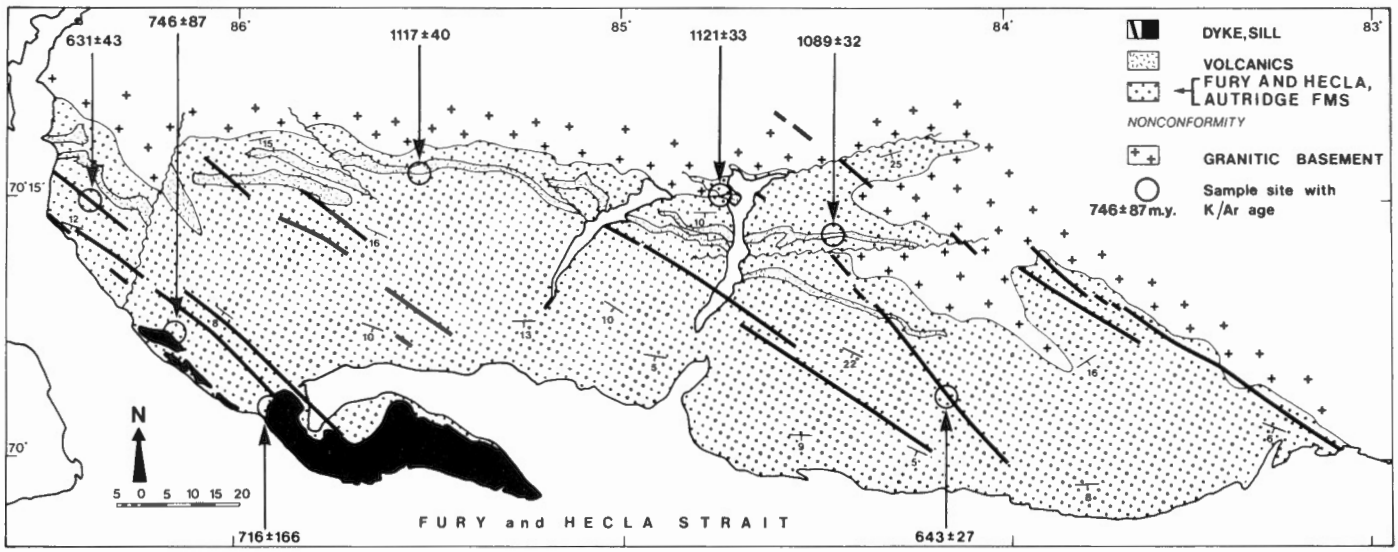

Figure 5. *Potassium-argon whole rock ages of mafic igneous rocks in the Fury and Hecla and Autridge formations (from Chandler and Stevens, 1981).*

GSC 80-114 Whole rock, K-Ar age **643 ± 27 Ma**

K = 0.86%, $^{40}Ar/^{40}K$ = 0.04491, radiogenic Ar = 94.5%.
Concentrate: Crushed whole rock.

From diabase
(47 F) Cleft in dyke ridge, northwestern Baffin Island, District of Franklin, 70°05'N, 84°08'W. Sample CGA79-C131, collected and interpreted by F.W. Chandler.

See GSC 80-117 for discussion.

GSC 80-115 Whole rock, K-Ar age **631 ± 43 Ma**

K = 0.50%, $^{40}Ar/^{40}K$ = 0.04388, radiogenic Ar = 96.6%.
Concentrate: Crushed whole rock.

From diabase
(47 F) Dyke on hilltop, northwestern Baffin Island, District of Franklin, 70°15.8'N, 86°28'W. Sample CGA79-C323, collected and interpreted by F.W. Chandler.

See GSC 80-117 for discussion.

GSC 80-116 Whole rock, K-Ar age **746 ± 87 Ma**

K = 0.28%, $^{40}Ar/^{40}K$ = 0.05365, radiogenic Ar = 88.7%.
Concentrate: Crushed whole rock.

From diabase
(47 F) Northeast facing sill cliff on hilltop, northwest Baffin Island, District of Franklin, 70°08'N, 86°12.5'W. Sample CGA79-Z218A, collected and interpreted by F.W. Chandler.

See GSC 80-117 for discussion.

GSC 80-117 Whole rock, K-Ar age **716 ± 166 Ma**

K = 0.14%, $^{40}Ar/^{40}K$ = 0.05102, radiogenic Ar = 82.5%.
Concentrate: Crushed whole rock.

From diabase
(47 F) West end of 500 m long lake on a hilltop sill, northwestern Baffin Island, District of Franklin, 70°04'N, 85°55'W. Sample CGA79-Z257, collected and interpreted by F.W. Chandler.

The three ages GSC 80-111, 112 and 113 have been determined from a newly discovered volcanic unit near the base of the Fury and Hecla Formation. This unit is a likely correlative of the Nauyat volcanics at the base of the Eqalulik Formation 300 km to the north. Samples GSC 80-116 and 117 are from a mafic sill in the Autridge Formation which overlies the Fury and Hecla. The sedimentary strata and the sill are cut by northwest striking dykes in some places and two such dykes are represented by determinations GSC 80-114 and 115 (see Fig. 5).

It has been suggested (Chandler and Stevens, 1981) that the volcanics in the Fury and Hecla Formation correlate with the Mackenzie episode, while the sill and dykes represent two phases of the Franklin episode.

Reference

Chandler, F.W. and Stevens, R.D.
1981: Potassium-argon age of the Late Proterozoic Fury and Hecla Formations, northwest Baffin Island, District of Franklin; in Current Research, Part A, Geological Survey of Canada, Paper 81-1A, p. 37-40.

District of Mackenzie
(GSC 80-118 to GSC 80-121)

GSC 80-118 Whole rock, K-Ar age **1647 ± 50 Ma**

K = 1.22%, $^{40}Ar/^{40}K$ = 0.1564, radiogenic Ar = 99.4%.
Concentrate: Crushed whole rock.

From gabbro
(86 G) Peninsula in Takijuq Lake, District of Mackenzie, 66°05'54"N, 112°57'55"W. Map unit 9, GSC Map 1384A. Sample JC-40, collected and interpreted by J.C. McGlynn.

See GSC 80-120 for description and interpretation.

GSC 80-119 Whole rock, K-Ar age **1661 ± 49 Ma**

K = 1.19%, $^{40}Ar/^{40}K$ = 0.1583, radiogenic Ar = 99.4%.
Concentrate: Crushed whole rock.

From gabbro
(86 G) Peninsula in Takijuq Lake, District of Mackenzie, 66°09'30"N, 112°58'00"W. Map unit 9, GSC Map 1384A. Sample JC-41, collected and interpreted by J.C. McGlynn.

See GSC 80-120 for description and interpretation.

GSC 80-120 Whole rock, KAr age **1613 ± 49 Ma**

K = 1.30%, $^{40}Ar/^{40}K$ = 0.1515, radiogenic Ar = 99.5%.
Concentrate: Crushed whole rock.

From gabbro
(86 G) Peninsula in Takijuq Lake, District of Mackenzie, 66°13'24"N, 112°56'36"W. Map unit 9, GSC Map 1384A. Sample JC-47, collected and interpreted by J.C. McGlynn.

The Peninsular sill intrudes the Recluse Formation of the Epworth Group. It is more than 40 m thick and at observed contacts with Epworth strata dips about 10° to the west. The rock is fine- to medium-grained gabbro comprising pyroxene and basic plagioclase laths, minor quartz, less than 1 per cent biotite, and about 1 per cent iron oxides. Plagioclase is slightly altered to white mica and zoisite, and pyroxene grains are altered slightly to brown hornblende or light-green actinolite and chlorite. Coarser grained phases at the top of the sill contain more biotite, minor quartz, myrmekitic intergrowths and very minor amounts of potash feldspar, suggesting that the sill may be somewhat differentiated.

The ages from the three samples are much younger than the age from a Rb/Sr isochron of 1816 ± 144 Ma (McGlynn, 1980) and therefore should be considered as representing the age of some later undetermined event that reset the K-Ar systematics.

Reference

McGlynn, J.C.
1980: Peninsular sill, Takijuq Lake, District of Mackenzie; in Current Research, Part C, Geological Survey of Canada, Paper 80-1C, p. 227-228, 1980.

GSC 80-121 Muscovite, K-Ar age **2484 ± 41 Ma**

K = 8.47%, $^{40}Ar/^{40}K$ = 0.3105, radiogenic Ar = 99.2%.
Concentrate: Clean, clear, unaltered, very fine grained muscovite with no visible contamination.

From pegmatite
(76 F) Nose Lake, District of Mackenzie, 65°18'N, 108°28.5'W. Map unit 8, Frith and Hill, 1976, Report of Activities, Part C, p. 367-370. Sample T-223A, collected and interpreted by R.A. Frith.

Muscovites from pegmatites found in the granitoid Mora River Complex have yielded ages of 2374 ± 54 Ma (GSC 78-139) and 2484 ± 41 Ma (this determination). A biotite from metamorphosed Beechy Lake Group gave an age of 2475 ± 80 Ma* (GSC 64-37). These values suggest that the rocks were rejuvenated, similar to those of the Regan Intrusive Suite.

*Recalculated using the decay constants of Steiger and Jager (1977); the age was originally reported as 2490 Ma.

District of Keewatin
(GSC 80-122 to GSC 80-137)

GSC 80-122 Biotite, K-Ar age **1755 ± 42 Ma**

K = 7.21%, $^{40}Ar/^{40}K$ = 0.1725, radiogenic Ar = 99.6%.
Concentrate: Clean, unaltered, dark brown biotite with no chlorite contamination.

(55 D) From biotite-pyroxene granodiorite gneiss 39 km southwest of Hyde Lake, Hyde Lake map area, District of Keewatin, 60°15'30"N, 95°39'40"W. Sample WN-510-78, collected by R.K. Wanless and interpreted by K.E. Eade.

See GSC 80-126 for description and interpretation.

GSC 80-123 Biotite, K-Ar age **1770 ± 41 Ma**

K = 7.94%, $^{40}Ar/^{40}K$ = 0.1748, radiogenic Ar = 99.3%.
Concentrate: Clean, unaltered, light brown biotite with no chlorite contamination.

(55 D) From biotite-pyroxene granodiorite gneiss 44 km southwest of Hyde Lake, Hyde Lake map area, District of Keewatin, 60°15'45"N, 95°48'50"W. Sample WN-507-78, collected by R.K. Wanless and interpreted by K.E. Eade.

See GSC 80-126 for description and interpretation.

GSC 80-124 Biotite, K-Ar age **1733 ± 41 Ma**

K = 7.20%, $^{40}Ar/^{40}K$ = 0.1691, radiogenic Ar = 99.2%.
Concentrate: Dark brownish orange biotite with approximately 8% chlorite alteration.

(55 D) From biotite-pyroxene granodiorite gneiss 49 km southwest of Hyde Lake, Hyde Lake map area, District of Keewatin, 60°10'40"N, 95°43'40"W. Sample WN-509-78, collected by R.K. Wanless and interpreted by K.E. Eade.

See GSC 80-126 for description and interpretation.

GSC 80-125 Biotite, K-Ar age **1785 ± 42 Ma**

K = 7.94%, $^{40}Ar/^{40}K$ = 0.1771, radiogenic Ar = 99.2%.
Concentrate: Clean, unaltered, light brownish orange biotite with no chlorite contamination.

(55 D) From biotite-pyroxene granodiorite gneiss 57.5 km southwest of Hyde Lake, Hyde Lake map area, District of Keewatin, 60°06'30"N, 95°50'25"W. Sample WN-508-78, collected by R.K. Wanless and interpreted by K.E. Eade.

See GSC 80-126 for description and interpretation.

GSC 80-126 Biotite, K-Ar age **1696 ± 40 Ma**

K = 7.90%, $^{40}Ar/^{40}K$ = 0.1636, radiogenic Ar = 99.6%.
Concentrate: Clean, unaltered, dark brown biotite with no chlorite contamination.

(65 A) From biotite-pyroxene granodiorite gneiss 81 km southwest of Hyde Lake, District of Keewatin, 60°08'25"N, 96°23'00"W. See GSC Map 3-1972. Sample WN-512-78, collected by R.K. Wanless and interpreted by K.E. Eade.

The biotite-pyroxene granodiorite gneiss is medium grained, foliated and layered in some places, but almost massive elsewhere. On fresh surface the rock is dark grey to greenish grey and typically has a rusty brown weathered surface. Quartz, plagioclase, biotite, hypersthene, and in some places, hornblende, are the essential constituents. Microcline is a minor constituent and is not present everywhere. The rocks are considered to represent the lower part of the granulite facies of metamorphism. To the west of the area sampled the granulite facies rocks are intruded and partially assimilated by younger plutons of quartz monzonite. The ages obtained are interpreted as approximately the age of metamorphism associated with the Hudsonian orogeny, to which the younger quartz monzonite plutons are related. The granulite facies metamorphism is older and the metamorphism dated here is an overprinting.

GSC 80-127 Biotite, K-Ar age **1776 ± 41 Ma**

K = 7.97%, $^{40}Ar/^{40}K$ = 0.1757, radiogenic Ar = 99.6%.
Concentrate: Clean, unaltered, greenish brown biotite with no chlorite contamination.

(55 D) From biotite-hornblende granodiorite gneiss 36 km southwest of Hyde Lake, Hyde Lake map area, District of Keewatin, 60°29'00"N, 95°58'00"W. Sample WN-511-78, collected by R.K. Wanless and interpreted by K.E. Eade.

See GSC 80-128 for description and interpretation.

GSC 80-128 Hornblende, K-Ar age **1731 ± 66 Ma**

K = 1.06%, $^{40}Ar/^{40}K$ = 0.1689, radiogenic Ar = 99.3%.
Concentrate: Clean, fresh, pleochroic light brown to light green hornblende with no visible contamination.

(55 D) From granodiorite gneiss Details as for GSC 80-127.

The biotite-hornblende granodiorite gneiss is medium grained, well foliated, and light grey to pinkish grey on fresh surface and grey on weathered surface. Vague layering is present here and there. These rocks are considered to be in the amphibolite facies of metamorphism. Minor alteration of biotite to chlorite and plagioclase to clinozoisite and epidote is indicative of some retrogressive metamorphism. The samples are from a point just north of the band of gneisses in the granulite facies described in GSC 80-126. The ages obtained here are again interpreted as approximately the age of metamorphism associated with the Hudsonian orogeny, as in GSC 80-126, and similarly are considered to be overprinted on earlier metamorphism. In these two samples, for some reason the hornblende age is distinctly younger than the biotite age, a reversal of the usual situation.

GSC 80-129 Biotite, K-Ar age **1736 ± 41 Ma**

K = 7.89%, $^{40}Ar/^{40}K$ = 0.1695, radiogenic Ar = 99.7%.
Concentrate: Clean, unaltered, light brown biotite with no detected chlorite.

(65 A) From biotite-pyroxene granodiorite gneiss Edehon Lake, District of Keewatin, 60°06.2'N, 97°04.4'W. Map unit 5C, GSC Map 3-1972. Sample WN-514-78, collected by R.K. Wanless and interpreted by K.E. Eade.

See GSC 80-130 for description and interpretation.

GSC 80-130 Biotite, K-Ar age **1700 ± 40 Ma**

K = 7.70%, $^{40}Ar/^{40}K$ = 0.1641, radiogenic Ar = 99.2%.
Concentrate: Clean, fresh, light brown biotite with no detected chlorite.

(65 A) From biotite-pyroxene granodiorite gneiss Details as for GSC 80-129.

The biotite-hypersthene granodiorite gneiss is medium grained, well foliated, with distinct layering averaging about 2.5 cm thick. It is light to dark grey or greenish grey on fresh surface and buff to rusty brown on weathered surface. Quartz, plagioclase, biotite, and hypersthene are the major constituents with minor hornblende and microcline. The rocks are similar to the granulite facies gneisses described in GSC 80-126 but here the layering is more pronounced and the rocks are considered to be paragneiss. Both these gneisses and those described in GSC 80-126 are part of the band of granulite facies gneisses in this part of southern District of Keewatin. Near this sample locality young quartz monzonite plutons intrude and assimilate the granulite gneiss. The ages are interpreted as approximately the age of metamorphism associated with the Hudsonian orogeny, as is the intrusion of the quartz monzonite plutons. The granulite facies metamorphism is older and the dated metamorphism is retrogressive and overprinting.

GSC 80-131 Biotite, K-Ar age **1782 ± 42 Ma**

K = 6.63%, $^{40}Ar/^{40}K$ = 0.1766, radiogenic Ar = 99.6%.
Concentrate: Dark brown, somewhat altered biotite with 6% chloritization.

(65 C) From grey granodiorite gneiss 8 km south of 'Old Age lake', 33 km east of south end of Kasba Lake, District of Keewatin, 60°01.8'N, 101°19.8'W. Map unit 4, GSC Map 24-1970. Sample WN-601-79, collected by R.K. Wanless and interpreted by K.E. Eade.

See GSC 80-137 for description and interpretation.

GSC 80-132 Hornblende, K-Ar age **1891 ± 79 Ma**

K = 0.88%, $^{40}Ar/^{40}K$ = 0.1941, radiogenic Ar = 99.2%.
Concentrate: Clean, unaltered, pleochroic dark green to brown hornblende with no visible contamination.

(65 C) From grey granodiorite gneiss Details as for GSC 80-131.

See GSC 80-137 for description and interpretation.

GSC 80-133 Biotite, K-Ar age **1818 ± 42 Ma**

K = 5.85%, $^{40}Ar/^{40}K$ = 0.1824, radiogenic Ar = 99.7%.
Concentrate: Clean, unaltered, dark brown biotite with no detected chlorite.

(65 C) From grey granodiorite gneiss 8 km south of 'Old Age lake', 33 km east of south end of Kasba Lake, District of Keewatin, 60°02'N, 101°19.8'W. Map unit 4, GSC Map 24-1970. Sample WN-602-79, collected by R.K. Wanless and interpreted by K.E. Eade.

See GSC 80-137 for description and interpretation.

GSC 80-134 Hornblende, K-Ar age **1884 ± 74 Ma**

K = 0.96%, $^{40}Ar/^{40}K$ = 0.1930, radiogenic Ar = 99.2%.
Concentrate: Clean, unaltered, pleochroic dark green to light brown hornblende with no visible contamination.

(65 C) From grey granodiorite gneiss Details as for GSC 80-133.

See GSC 80-137 for description and interpretation.

GSC 80-135 Biotite, K-Ar age **1740 ± 32 Ma**

K = 6.40%, $^{40}Ar/^{40}K$ = 0.1701, radiogenic Ar = 99.6%.
Concentrate: Dark brown biotite with approximately 8% chlorite alteration.

(65 C) From grey granodiorite gneiss 8 km south of 'Old Age lake', 33 km east of south end of Kasba Lake, District of Keewatin, 60°02.4'N, 101°20'W. Map unit 4, GSC Map 24-1970. Sample WN-603-79, collected by R.K. Wanless and interpreted by K.E. Eade.

See GSC 80-137 for description and interpretation.

GSC 80-136 Biotite, K-Ar age **1748 ± 41 Ma**

K = 6.55%, $^{40}Ar/^{40}K$ = 0.1714, radiogenic Ar = 99.7%.
Concentrate: Light brown biotite with approximately 7% chlorite alteration.

(65 C) From grey granodiorite gneiss 6.4 km southwest of 'Old Age lake' and 29.5 km east of south end of Kasba Lake, District of Keewatin, 60°03.3'N, 101°23.4'W. Map unit 4, GSC Map 24-1970. Sample WN-604-79, collected by R.K. Wanless and interpreted by K.E. Eade.

See GSC 80-137 for description and interpretation.

GSC 80-137 Biotite, K-Ar age **1811 ± 42 Ma**

K = 7.41%, $^{40}Ar/^{40}K$ = 0.1812, radiogenic Ar = 99.6%.
Concentrate: Relatively clean, greenish brown biotite with approximately 2% chlorite alteration.

(65 C) From grey granodiorite gneiss 9.7 km north of 'Old Age lake' and 29 km east of south end of Kasba Lake, District of Keewatin, 60°12'N, 101°19.7'W. Map unit 4, GSC Map 24-1970. Sample WN-605-79, collected by R.K. Wanless and interpreted by K.E. Eade.

The foliated, medium grained granodiorite gneiss is grey on fresh surface and light grey on weathered surface. Minor compositional layering is present. In composition the rock ranges from granodiorite to tonalite, it is biotite-bearing and commonly contains some hornblende. Microcline, although present in many places, is not a major constituent. Biotite is slightly altered to chlorite and plagioclase to clinozoisite and epidote. Dykes and irregular masses of pink quartz monzonite to granodiorite cut and partially assimilate the gneiss. All samples selected for dating were free of any quartz monzonite-granodiorite. The origin of the gneiss is uncertain, the vague layering suggests a paragneiss but the unlayered, foliated portions suggest an orthogneiss.

The ages are interpreted as indicating the age of the metamorphism associated with the Hudsonian orogeny. The alteration of the biotite and plagioclase suggest this is retrogressive metamorphism of an older rock. The two biotite-hornblende pairs, GSC 80-131 and 132 and GSC 80-133 and 134, show the normal older age from the hornblende determinations. The seven age determinations all fall within a reasonably close range. A previously determined biotite-hornblende pair, GSC 78-142 and GSC 78-143 (Wanless et al., 1979) from a sample at almost the same location as GSC 80-131 and 132, gave considerably younger ages, 1626 ± 40 and 1676 ± 14 Ma respectively. No reason for the discrepancy is known and the present set of determinations are thought to more accurately date the age of metamorphism associated with the Hudsonian orogeny.

These ages are slightly older but very close to those determined for the Hudsonian orogeny in the area to the east (see GSC 80-126, 128 and 130).

Similar granodiorite to tonalite gneiss occurring just to the south in Manitoba, dated by Weber et al. (1975) using the Rb-Sr method gave an age of 1900 ± 24 Ma ($^{87}Rb = 1.42 \times 10^{-11}a^{-1}$). This age is very close to the age of metamorphism indicated by the hornblendes GSC 80-132 and 134 at 1891 ± 79 and 1884 ± 74 Ma respectively.

References

Wanless, R.K., Stevens, R.D., Lachance, G.R., and Delabio, R.N.
1979: Age determinations and geological studies, K-Ar isotopic ages, Report 14; Geological Survey of Canada, Paper 79-2, p. 40.

Weber, W., Anderson, R.K., and Clark, G.S.
1975: Geology and geochronology of the Wollaston Lake fold belt in northwestern Manitoba; Canadian Journal of Earth Sciences, v. 12, p. 1749-1759.

Saskatchewan
(GSC 80-138 to GSC 80-151)

GSC 80-138 Muscovite, K-Ar age **2127 ± 35 Ma**

K = 7.00%, $^{40}Ar/^{40}K$ = 0.2359, radiogenic Ar = 99.0%.
Concentrate: Clean, fresh, clear muscovite with no visible contamination.

From granite pegmatite
(74 N) 330 m west of southwestern shore of Milliken Lake, Crackingstone Peninsula, Saskatchewan, 59°25'44"N, 108°48'44"W. Map unit 2, GSC Map 1095A (Fraser, J.A., 1960). Sample DA107B-77, collected and interpreted by W.L. Davison.

The muscovite occurs as books in pale grey granite pegmatite that also holds scattered tourmaline crystals. The pegmatite, which is apparently undeformed, lies between amphibolite and metasediments of the Tazin Group, but contacts are not exposed.

The sample locality is less than 100 m from that of GSC 80-139, so that the greater K-Ar age is unexpected. However, it may be noted that Beck (1969) obtained a Rb-Sr age of 2200 ± 100 Ma for his 'Type O' (older) granites of the region.

Reference

Beck, L.S.
1969: Uranium deposits of the Athabasca region, Saskatchewan; Saskatchewan Department of Mineral Resources, Report 126.

GSC 80-139 Muscovite, K-Ar age **1812 ± 43 Ma**

K = 9.16%, $^{40}Ar/^{40}K$ = 0.1813, radiogenic Ar = 99.6%.
Concentrate: Clean, fresh, clear, rather coarse muscovite with no visible contamination.

From pegmatite in schist
(74 N) 240 m west of southwest shore of Milliken Lake, Crackingstone Peninsula, Saskatchewan, 59°25'43"N, 108°48'38"W. Map unit 2, GSC Map 1095A (J.A. Fraser, 1960). Sample DA107-77, collected and interpreted by W.L. Davison.

The sample is from a pegmatite layer, 30-60 cm thick, in quartz-sericite schist of the Tazin Group. It has the composition of quartz monzonite.

The age of 1812 ± 43 Ma agrees closely with an earlier determination (GSC 60-65) of 1815 ± 125 Ma* on similar material from Gunnar Mine, about 7 km southwest of the present sample locality. Another muscovite from pegmatite near Uranium City gave 1780 ± 55 Ma* (GSC 66-98). These may be compared also with an age of 1795 Ma (GSC 61-108)* on biotite from (?)retrograded Tazin gneiss of the Beaverlodge area. It seems likely that these ages represent a period of uplift and denudation immediately preceding deposition of the Martin Formation, inasmuch as a K-Ar whole rock determination (GSC 64-76) gave an age of 1630 ± 180 Ma** for a Martin basalt.

*These ages remain essentially unchanged by recalculation using new decay constants.

**This age recalculates to ca. 1635 Ma using the decay constants of Steiger and Jager (1977).

GSC 80-140 Biotite, K-Ar age **1626 ± 40 Ma**

K = 6.70%, $^{40}Ar/^{40}K$ = 0.1533, radiogenic Ar = 99.7%.
Concentrate: Light brown biotite with approximately 7% chlorite alteration.

From foliated granite
(74 H) From cliff face on western shore of Bailey Lake, Saskatchewan, 57°11'N, 104°26'W. Sample WN-44-75, collected and interpreted by G. Ray (Saskatchewan D.M.R.) and R.K. Wanless.

See GSC 80-143 for discussion.

GSC 80-141 Biotite, K-Ar age **1646 ± 40 Ma**

K = 6.35%, $^{40}Ar/^{40}K$ = 0.1563, radiogenic Ar = 99.9%.
Concentrate: Altered brown biotite with approximately 15% chloritization.

From massive granite
(74 A) Northeast corner of Upper Foster Lake sheet, Saskatchewan, 56°58.8'N, 104°05'W. Sample WN-31-75, collected and interpreted by G. Ray (Saskatchewan D.M.R.) and R.K. Wanless.

See GSC 80-143 for discussion.

GSC 80-142 Biotite, K-Ar age **1689 ± 40 Ma**

K = 5.32%, $^{40}Ar/^{40}K$ = 0.1625, radiogenic Ar = 99.6%.
Concentrate: Clean, unaltered, light brown biotite with no visible contamination.

From metadiorite
(74 H) East of Pendleton Lake, Saskatchewan, 57°06.2'N, 104°07.4'W. Sample WN-32-75, collected and interpreted by G. Ray (Saskatchewan D.M.R.) and R.K. Wanless.

See GSC 80-143 for discussion.

GSC 80-143 Hornblende, K-Ar age **2177 ± 110 Ma**

K = 0.62%, $^{40}Ar/^{40}K$ = 0.2456, radiogenic Ar = 99.2%.
Concentrate: Clean, unaltered, pleochroic brown to green hornblende with no visible contamination.

From metadiorite
(74 H) Details as for GSC 80-142.

The following notes have been abstracted by R.D. Stevens from Ray and Wanless (1980) to which the reader is referred for more detailed information.

The biotite of GSC 80-140 was obtained from a sample of the Johnson River granite, representing the highly foliated granitoid basement of the Wollaston domain. Zircon from this rock yielded a concordia age of 2494 ± 38 Ma. The biotite of GSC 80-141 represents the Wathaman batholith, a large composite body comprising massive to foliated granitoid rocks intrusive into the Peter Lake domain. Zircon from this rock has yielded a concordia age of 1865 ± 12 Ma. The biotite and hornblende of GSC 80-142 and 143 were obtained from a metadiorite of the Peter Lake complex

which forms the central, less deformed portion of the southwestern Peter Lake domain, itself a narrow strip lying between the Wollaston and Rottenstone domains. A zircon from this same rock has yielded a concordia age of 2538 ± 10 Ma.

The K-Ar biotite ages are essentially identical for the three rock units studied, indicating that the terrane on both sides of the Needle Falls shear zone cooled through the biotite argon retention temperature simultaneously between 1626 and 1689 Ma ago. The hornblende from the metadiorite, however, indicates an intermediate age of 2177 Ma. This discrepancy reflects either the partial updating of an Archean hornblende or the incorporation of excess radiogenic ^{40}Ar in the hornblende crystal lattice about 1650 Ma ago.

Reference

Ray, G.E. and Wanless, R.K.
1980: The age and geological history of the Wollaston, Peter Lake, and Rottenstone domains in northern Saskatchewan; Canadian Journal of Earth Sciences, v. 17, no. 3, p. 333-347.

GSC 80-144 Biotite, K-Ar age **1752 ± 41 Ma**

K = 7.55%, $^{40}Ar/^{40}K$ = 0.1720, radiogenic Ar = 99.5%.
Concentrate: Reddish brown biotite with approximately 2% chlorite alteration.

From granite gneiss
(74 H) Diamond drill core about 61 m (200 ft) southeast of shore of Seahorse Lake at Key Lake, Saskatchewan, 57°12'N, 105°39'45"W. Map unit 2, Saskatchewan Geological Survey Preliminary Map, Foster L., Geikie R. (G.E. Ray, 1976). Sample LPT/KEY L, collected and interpreted by L.P. Tremblay.

The sample is from an unaltered granitic area assumed to be basement to Aphebian rocks in the Key Lake area. This basement area is regarded as Archean but yields a Rb-Sr errorchron of 1698 ± 127 Ma with a very high initial $^{87}Sr/^{86}Sr$ ratio (personal communication, W.D. Loveridge). The rocks of this area and those of the Aphebian areas are basement to the younger Helikian Athabasca cover rocks.

The sample is a piece of core from a diamond drillhole drilled through the unconformity at the base of the Athabasca rocks into the area of unaltered granitic rocks. This granite is medium grained, massive to gneissic and made up mainly of quartz, perthitic microcline, plagioclase (An_{25}), yellow to reddish brown biotite (about 10%) and minor sphene. The quartz is in grains with rounded sutures and elongated parallel to the biotite flakes. The plagioclase is a little altered to clay material.

The date is Hudsonian and indicates that the Hudsonian Orogeny is the last major tectonic event that has affected the Key Lake area.

GSC 80-145 Whole rock, K-Ar age **1266 ± 39 Ma**

K = 2.10%, $^{40}Ar/^{40}K$ = 0.1066, radiogenic Ar = 98.9%.
Concentrate: Crushed whole rock.

From regolith
(64 L) Near east shore of Collins Bay, Wollaston Lake, Saskatchewan, 58°16'55"N, 103°37'49"W. Sample 78 CBA 20-115, collected and interpreted by L.P. Tremblay.

See GSC 80-151 for discussion and interpretation.

GSC 80-146 Whole rock, K-Ar age **1296 ± 34 Ma**

K = 5.95%, $^{40}Ar/^{40}K$ = 0.1102, radiogenic Ar = 99.4%.
Concentrate: Crushed whole rock.

From alteration zone in sandstone
(64 L) East shore of Collins Bay, west shore of Wollaston Lake, Saskatchewan, 58°15'58"N, 103°38'50"W. Sample 78 CBB 135-91, collected and interpreted by L.P. Tremblay.

See GSC 80-151 for discussion and interpretation.

GSC 80-147 Whole rock, K-Ar age **1801 ± 44 Ma**

K = 7.26%, $^{40}Ar/^{40}K$ = 0.1796, radiogenic Ar = 99.9%.
Concentrate: Crushed whole rock.

From alteration zone in sandstone
(74 I) Under water, southwest arm of Midwest Lake, 25 km northwest of Rabbit Lake Pit, Wollaston Lake, Saskatchewan, 58°17'58"N, 104°05'30"W. Sample 78 MW 38-582, collected and interpreted by L.P. Tremblay.

See GSC 80-151 for discussion and interpretation.

GSC 80-148 Whole rock, K-Ar age **1219 ± 33 Ma**

K = 7.67%, $^{40}Ar/^{40}K$ = 0.1012, radiogenic Ar = 99.6%.
Concentrate: Crushed whole rock.

From alteration zone in sandstone
(74 I) Under water, southwest arm of Midwest Lake, 25 km northwest of Rabbit Lake Pit, Wollaston Lake, Saskatchewan, 58°17'58"N, 104°05'30"W. Sample 78 MW 42-600, collected and interpreted by L.P. Tremblay.

See GSC 80-151 for discussion and interpretation.

GSC 80-149 Whole rock, K-Ar age **1411 ± 36 Ma**

K = 7.16%, $^{40}Ar/^{40}K$ = 0.1243, radiogenic Ar = 99.8%.
Concentrate: Crushed whole rock.

From altered basement rocks at unconformity
(74 I) Under water, southwest arm of Midwest Lake, 25 km northwest of Rabbit Lake Pit, Wollaston Lake, Saskatchewan, 58°17'58"N, 104°05'30"W. Sample 78 MW 40-639, collected and interpreted by L.P. Tremblay.

See GSC 80-151 for discussion and interpretation.

GSC 80-150 Whole rock, K-Ar age **765 ± 120 Ma**

K = 0.21%, $^{40}Ar/^{40}K$ = 0.05539, radiogenic Ar = 65.8%.
Concentrate: Crushed whole rock.

From altered basement rocks
(74 H) At northeast end of Seahorse Lake, southwest of Key Lake and about 15 km northwest of Highgrade Lake, Saskatchewan, 57°11'47"N, 105°40'00"W. Sample 78 KL 5064-174, collected and interpreted by L.P. Tremblay.

See GSC 80-151 for discussion and interpretation.

GSC 80-151 Whole rock, K-Ar age **1541 ± 40 Ma**

K = 7.07%, $^{40}Ar/^{40}K$ = 0.1415, radiogenic Ar = 99.9%.
Concentrate: Crushed whole rock.

From altered basement rocks

(74 N) West shore of Lake Athabasca at its west end, 5 km east of Alberta boundary, Saskatchewan, 59°23'15"N, 109°55'00"W. Sample 78 MB 21-125, collected and interpreted by L.P. Tremblay.

These samples are from clay alteration zones or possibly clay beds in the vicinity of four uranium deposits associated with the unconformity at the base of the Athabasca Group. The four uranium deposits sampled are: Collins Bay, Midwest Lake, Key Lake and Maurice Bay. The dark green chloritic phase of the alteration zone on the Athabasca side of the D orebody at Cluff Lake has already been dated at 1128 ± 450 Ma (GSC 78-175).

In general this clay alteration is white and is characterized by a widespread development of abundant sericite in flakes of various sizes, of some clay minerals such as illite, and possibly of some chlorite. The dating was intended to establish the time of formation of the sericite of these clay samples hoping to date at the same time the time of the uranium mineralization of the deposits since it is assumed that the uranium mineralization is related in time and location to the clay alteration.

Two of the samples are from the Collins Bay deposit, three from various levels of the Athabasca and basement rock succession at Midwest Lake, one from the Gaertner orebody at Key Lake and one from the Main zone area in the Maurice Bay deposit.

GSC 80-145 is from the clay alteration zone at and below the Athabasca unconformity that envelopes the Collins Bay A Zone deposit at Collins Bay. This zone is lenticular, zonally multicolored and is possibly mainly regolithic material. It has a grey to grey black core rich in uranium and an outer yellowish white to buff shell low in uranium. The sample is from this shell and at a place where the clay is massive to a little schistose and where the sericite flakes are abundant. The date is regarded as indicating the time when the sericite flakes formed, that is, when the uranium was deposited.

GSC 80-146 is from a clay alteration zone within Athabasca rocks. This clay material is assumed to be along a fault zone as the zone offsets the unconformity at the base of the Athabasca rocks and extends into basement. The Collins Bay B deposit is closely associated with this clay zone. The clay sample is white to black, a little schistose and striated on some surfaces. It is composed of abundant sericite flakes, of some clay minerals and possibly of some graphite and chlorite. The mineralization is closely related in space to the clay and sericite. So this date is regarded as representing the time of formation of the sericite and that of the mineralization.

GSC 80-147 is from a clay bed a few metres above the Main ore zone at Midwest Lake. This clay bed is part of a narrow section of thinly interbedded Athabasca sandstone and mudstone and is about 20 m above the unconformity at the base of the Athabasca succession. It is within an area of weakly mineralized rocks. The clay is pink to buff, faintly schistose and made up of sericite, clay minerals and possibly chlorite. The age suggests that the sericite flakes are clastic grains from the basement and not the product of the clay alteration related to the mineralization.

GSC 80-148 is from a clay zone within the Main Ore zone at Midwest Lake. This clay zone is from a thick section of thinly interbedded Athabasca sandstone and mudstone and from a point 10 m above the unconformity at the base of the Athabasca succession. The clay is grey, slightly schistose and striated along some planes. It is composed of sericite flakes, clay minerals and possibly chlorite. The date is assumed to represent the time of formation of the sericite and that of the main mineralization period.

GSC 80-149 is from a highly clay-altered basement rock at the lower contact of the Main Ore zone at Midwest Lake and about 3 m below the Athabasca unconformity. The clay is white to light green, schistose and talcose looking. It is made up of sericite, clay minerals and possibly chlorite. The age is possibly the time of the regolithic alteration at the unconformity or an elevated age of altered basement rock.

GSC 80-150 is from a zone of highly clay-altered basement rock within the Gaertner orebody at Key Lake and about 8 m below the unconformity at the base of the Athabasca succession. The clay sample is grey, schistose to sheared, and composed of sericite, clay minerals, quartz grains and possible chlorite. This part of the orebody has a thin cover of Athabasca rocks. The age is assumed to indicate the time when the clay-altered basement rock was tectonically deformed by the numerous faults observed in the area of the Gaertner orebody.

GSC 80-151 is from altered basement rock about 6 m below the unconformity at the base of the Athabasca succession in the Main ore zone area of the Maurice Bay deposit. In the area of the sample there is a cover of about 16 metres of Athabasca rocks. The sample is white to red, schistose and in part striated. It is composed of sericite, iron oxide, chlorite and some clay minerals. The date is that of the regolithic alteration on basement rocks.

Manitoba
(GSC 80-152)

GSC 80-152 Biotite, K-Ar age **2459 ± 52 Ma**

K = 7.60%, $^{40}Ar/^{40}K$ = 0.2990, radiogenic Ar = 99.7%.
Concentrate: Light brown biotite with approximately 3% chlorite alteration.

From granodiorite
(52 L) South shore of Faraway Lake, Manitoba, 50°54'58"N, 95°26'05"W. Sample SH-21-59, collected by C.H. Stockwell, interpreted by I.F. Ermanovics.

This sample was collected and interpreted by C.H. Stockwell (GSC 60-89, Lowdon, 1961). The originally published age of 2670 Ma was thought to be too old with respect to other K-Ar biotite ages in the area. The present analysis appears to have confirmed this.

Similar discrepancies were determined in K-Ar biotite GSC 60-88, 2670 Ma (North of Wallace Lake) and in K-Ar biotite GSC 60-90, 1700 Ma (Black Lake). Redetermined analyses yielded 2500 ± 72 Ma* (GSC 72-74, Wanless et al., 1973) and 2454 ± 70 Ma* respectively.

*Recalculated to conform with Steiger and Jager (1977) decay constants.

References

Lowdon, J.A.
1961: Age determinations by the Geological Survey of Canada; Geological Survey of Canada, Paper 61-17.

Wanless, R.K., Stevens, R.D., Lachance, G.R., and Delabio, R.N.
1973: Age determinations and Geological Studies; Geological Survey of Canada, Paper 73-2.

Ontario
(GSC 80-153 to GSC 80-183)

GSC 80-153 Whole rock, K-Ar age **1074 ± 39 Ma**

K = 1.51%, $^{40}Ar/^{40}K$ = 0.08529, radiogenic Ar = 96.9%.
Concentrate: Crushed whole rock.

(42 D) From basalt (fine grained dyke centre) 5.63 km west of junction of Highway 627 and road south of C.P.R. tracks at Heron Bay, Ontario, 48°39'48"N, 86°21'27"W. See Ont. Geol. Surv. Prelim. Map 1981, Geol. Ser., 1977. Sample M293A-78, collected and interpreted by T.L. Muir, Ontario Geological Survey.

See GSC 80-155 for description and interpretation.

GSC 80-154 Whole rock, K-Ar age **1116 ± 41 Ma**

K = 1.45%, $^{40}Ar/^{40}K$ = 0.08979, radiogenic Ar = 95.5%.
Concentrate: Crushed whole rock.

(42 D) From basalt (fine grained dyke centre) Details as for GSC 80-153. Sample M293B-78, collected and interpreted by T.L. Muir, Ontario Geological Survey.

See GSC 80-155 for description and interpretation.

GSC 80-155 Whole rock, K-Ar age **986 ± 43 Ma**

K = 1.11%, $^{40}Ar/^{40}K$ = 0.07621, radiogenic Ar = 99.1%.
Concentrate: Crushed whole rock.

(42 D) From basalt (aphanitic chilled margin) Details as for GSC 80-153. Sample M293C-78 collected and interpreted by T.L. Muir, Ontario Geological Survey.

A fine grained basaltic dyke with aphanitic and locally glassy chilled margins was mapped by Muir and Barnett (1978) on the Lake Superior shore near Heron Bay, Ontario. Country rock consists of bedded calc-alkaline tuff and lapilli tuff (probably water deposited) of dacitic composition. The contact of the Port Coldwell Alkalic Complex lies 2.2 km to the northwest. Numerous dykes have intruded the country rock in the immediate sample vicinity. Intrusive relationships indicate the following order, from oldest to youngest; a schistose (chlorite) mafic dyke, a plagioclase-porphyritic diorite dyke, a subalkaline diabase dyke, a bifurcating hematite-rich alkalic dyke, and the alkali basalt dyke (0.3 m thick).

Glassy material is present mainly in narrow (up to 2.5 cm) apophyses and generally constitutes the entire apophysis. Thin (<2 mm) glassy contacts are present on the chilled margin of the main dyke. The glassy apophyses are black, and locally contain small (4 mm by 1 mm) red and green lenses that are oriented along numerous fractures that are parallel to the contacts. The small lenses are probably related to devitrification. The glassy dyke margins are generally a murky bluish black to bluish grey and break with concoidal fractures. In thin section the glassy material is weakly devitrified; X-ray diffraction patterns show a few weak peaks. The crystalline portion of the dyke comprises fine grained plagioclase laths and subhedral pyroxene crystals with very fine grained interstitial plagioclase, pyroxene, devitrified glass and cruciform and dendritic opaque minerals. Chilled margins contain quenched plagioclase microlites in lieu of the laths.

The first two ages listed (GSC 80-153, 154) are similar, within error limits, and were determined from the same specimen. The third date (GSC 80-155) is somewhat lower which may be the result of argon loss due to a significant proportion of initial interstitial glass. The youngest activity in the vicinity of the Port Coldwell Complex is about 300 Ma (R.P. Sage, personal communication) and this dyke was dated to test for possible younger activity. The age of the dyke, however, if taken as 1095 Ma (average of the first two ages) corresponds to Late Keweenawan and is similar to the age of the Port Coldwell Alkalic Complex which is most recently given as 1085 ± 15 Ma (Rb-Sr) by Bell et al. (1979). The presence of glass of Keweenawan age indicates that devitrification can be a fairly lengthy process under certain conditions.

References

Bell, K., Blenkinsop, J., and Watkinson, D.H.
1979: Rb/Sr geochronology of alkalic complexes, Ontario; in Geoscience Research Grant, Summary of Research, 1978-1979, edited by E.G. Pye, Ontario Geological Survey, MP87, p. 69-78.

Irvine, T.N. and Baragar, W.R.A.
1971: A guide to the chemical classification of the common volcanic rocks; Canadian Journal of Earth Sciences, v. 8, p. 523-548.

Muir, T.L. and Barnett, E.S.
1978: Heron Bay area, District of Thunder Bay; Preliminary Geological Map P.1981, Scale 1 inch to 1/4 mile.

GSC 80-156 Biotite, K-Ar age **2544 ± 31 Ma**

K = 5.48%, $^{40}Ar/^{40}K$ = 0.3247, radiogenic Ar = 99.6%.
Concentrate: Light brown biotite with less than 5% hornblende contamination and no detected chlorite.

(42 B) From gneissic granodiorite Nemegasenda River, Ontario, 48°27'45"N, 82°50'00"W. Sample P-79-576, collected and interpreted by J.A. Percival and K.D. Card.

See GSC 80-157 for description and interpretation.

GSC 80-157 Hornblende, K-Ar age **2627 ± 88 Ma**

K = 0.67%, $^{40}Ar/^{40}K$ = 0.3448, radiogenic Ar = 90.7%.
Concentrate: Clean, unaltered, pleochroic light green to brownish green hornblende with no visible contamination.

(42 B) From gneissic granodiorite Details as for GSC 80-156.

This rock, from the Kapuskasing structural zone, is a clinopyroxene-hornblende-biotite granodiorite orthogneiss containing 10-20% quartz monzonite layers. Both hornblende and biotite have been affected by granulite facies metamorphism; the ages probably reflect the time at which the minerals cooled through their respective temperatures for argon retention.

GSC 80-158 Whole rock, K-Ar age **3649 ± 274 Ma**

K = 0.24%, $^{40}Ar/^{40}K$ = 0.6873, radiogenic Ar = 99.2%.
Concentrate: Crushed whole rock.

From diabase
(42 B) East side of Kapuskasing structural zone, near Hwy. 101, Foleyet to Evans Twp., Ontario, 48°03'35"N, 82°42'49"W. Sample P-507, collected and interpreted by J. Percival.

See GSC 80-163 for description and interpretation.

GSC 80-159 Whole rock, K-Ar age **2927 ± 148 Ma**

K = 0.50%, $^{40}Ar/^{40}K$ = 0.4261, radiogenic Ar = 99.2%.
Concentrate: Crushed whole rock.

From diabase
(42 B) Eastern side of Kapuskasing structural zone, near Hwy. 101, Foleyet to Evans Twp., Ontario, 48°13'17"N, 82°35'36"W. Sample 503A, collected and interpreted by J. Percival.

See GSC 80-163 for description and interpretation.

GSC 80-160 Whole rock, K-Ar age **2687 ± 188 Ma**

K = 0.32%, $^{40}Ar/^{40}K$ = 0.3600, radiogenic Ar = 97.6%.
Concentrate: Crushed whole rock.

From diabase
(42 B) Eastern side of Kapuskasing structural zone, near Hwy. 101, Foleyet to Evans Twp., Ontario, 48°01'21"N, 82°45'17"W. Sample 508, collected and interpreted by J. Percival.

See GSC 80-163 for description and interpretation.

GSC 80-161 Whole rock, K-Ar age **2454 ± 136 Ma**

K = 0.50%, $^{40}Ar/^{40}K$ = 0.3036, radiogenic Ar = 98.4%.
Concentrate: Crushed whole rock.

From diabase
(42 B) Eastern side of Kapuskasing structural zone, near Hwy. 101, Foleyet to Evans Twp., Ontario, 48°02'15"N, 82°45'36"W. Sample 509, collected and interpreted by J. Percival.

See GSC 80-163 for description and interpretation.

GSC 80-162 Hornblende, K-Ar age **2378 ± 60 Ma**

K = 0.794%, $^{40}Ar/^{40}K$ = 0.2868, radiogenic Ar = 94.5%.
Concentrate: Clean, fine grained, pleochroic, light green to dark green hornblende with no visible contamination.

From diabase
(42 B) Eastern side of Kapuskasing structural zone, near Hwy. 101, Foleyet to Evans Twp., Ontario, 48°13'09"N, 82°36'24"W. Sample 502A, collected and interpreted by J. Percival.

See GSC 80-163 for description and interpretation.

GSC 80-163 Whole rock, K-Ar age **2367 ± 80 Ma**

K = 1.06%, $^{40}Ar/^{40}K$ = 0.2843, radiogenic Ar = 99.1%.
Concentrate: Crushed whole rock.

From diabase
(42 B) Details as for GSC 80-162.

All of the rocks are from 5 to 10 m wide, east-northeast striking mafic dykes of the Kapuskasing Structural Zone. Samples are from near the eastern margin of the zone. Three mineralogical types of the dykes have been identified: olivine, clinopyroxene-bearing; orthopyroxene, clinopyroxene-bearing; and clinopyroxene-bearing. All types have similar trend, texture and width. Sample P-503A (GSC 80-159) is from a dyke cut by north-northeast-striking faults which may be responsible for uplift of granulite-facies rocks of the structural zone.

Rocks with ages greater than 2700 Ma are considered to contain excess radiogenic argon because the rocks they intrude have lower K-Ar ages. Those in the range 2367 to 2687 Ma may be correlative with Matachewan dykes (mean K-Ar age of 2450 Ma).

GSC 80-164 Whole rock, K-Ar age **1475 ± 75 Ma**

K = 0.77%, $^{40}Ar/^{40}K$ = 0.1326, radiogenic Ar = 97.4%.
Concentrate: Crushed whole rock.

From diabase
(42 B) Near Hwy. 101, Foleyet and Evans Twps., Ontario, 48°08'09"N, 82°36'36"W. Sample P-505, collected and interpreted by J. Percival.

The rock is from a 10 m wide east-northeast-striking, fresh, fine grained, mafic ophitic dyke located near the eastern margin of the Kapuskasing Structural Zone. The age may represent the time of crystallization.

GSC 80-165 Biotite, K-Ar age **1144 ± 31 Ma**

K = 4.91%, $^{40}Ar/^{40}K$ = 0.09284, radiogenic Ar = 98.3%.
Concentrate: Light brown biotite with approximately 6% chlorite alteration.

From diabase (altered)
(42 B) Eastern side of Kapuskasing structural zone, near Hwy. 101, Foleyet to Evans Twps., Ontario, 48°03'35"N, 82°42'49"W. Sample P-507A, collected and interpreted by J. Percival.

The sample is from a 25 cm wide lamprophyre dyke from the Kapuskasing Structural Zone. The age may represent the time of crystallization.

GSC 80-166 Biotite, K-Ar age **2263 ± 29 Ma**

K = 5.67%, $^{40}Ar/^{40}K$ = 0.2627, radiogenic Ar = 99.5%.
Concentrate: Light brown biotite with approximately 15% chlorite alteration.

From granitic clasts in metaconglomerate
(41 O) Near Hwy. 101, north of Borden Lake, Ontario, 47°52'05"N, 83°16'25"W. Sample ZR-4, collected and interpreted by J.A. Percival.

See GSC 80-167 for description and interpretation.

GSC 80-167 Hornblende, K-Ar age **2594 ± 151 Ma**

K = 0.37%, $^{40}Ar/^{40}K$ = 0.3366, radiogenic Ar = 98.2%.
Concentrate: Clean, unaltered, pleochroic light brown to green hornblende with no visible contamination.

From granitic clasts in metaconglomerate

(41 O) Details as for GSC 80-166.

Both minerals are from stretched-pebble conglomerate of the Wawa subprovince east of Chapleau. The ages probably represent the time at which the rock cooled through the blocking temperature for hornblende and biotite respectively.

GSC 80-168 Whole rock, K-Ar age **1845 ± 117 Ma**

K = 0.271%, $^{40}Ar/^{40}K$ = 0.1866, radiogenic Ar = 98.4%.
Concentrate: Crushed whole rock.

From diabase

(42 A) In farm field, 137 m south of country road between Swastika and Round Lake, Ontario, 48°04'17"N, 80°06'51"W. Map unit 9, ODM Map 2239. Sample WN-206B-76, collected by R.K. Wanless. Description by R.D. Stevens.

The sample was collected from the chilled contact of an essentially north-south striking (12°) vertical diabase dyke cutting syenite of the Otto stock. It is a very fine grained diabase rock with microphenocrysts of altered feldspar and chlorite (the latter possibly representing original pyroxene). The rock has an overall powdery appearance in thin section indicating a general kaolinization and/or sericitization of the feldspar.

See GSC 80-171 for additional information.

GSC 80-169 Whole rock, K-Ar age **1742 ± 50 Ma**

K = 0.76%, $^{40}Ar/^{40}K$ = 0.1705, radiogenic Ar = 99.4%.
Concentrate: Crushed whole rock.

From diabase

(42 A) Highway 11, about 4.8 km south of junction with Hwy. 66, Ontario, 48°04'05"N, 80°09'01"W. Map unit 6, ODM Map 2239. Sample WN-207B-76, collected by R.K. Wanless. Description by R.D. Stevens.

This rock was collected from the chilled east contact of the eastern arm of a 35°-striking diabase dyke cutting Otto stock syenite. It is a relatively fresh, medium-fine grained diabase with fresh feldspar, slightly altered pyroxene and plentiful opaques. Some chlorite veins and a few sericitized plagioclase phenocrysts were observed.

See GSC 80-171 for additional information.

GSC 80-170 Hornblende, K-Ar age **2552 ± 62 Ma**

K = 1.54%, $^{40}Ar/^{40}K$ = 0.3265, radiogenic Ar = 99.9%.
Concentrate: Clean, unaltered, pleochroic brown to dark green hornblende with no visible contamination.

From syenite

(42 A) Highway 11, about 4.8 km south of junction with Hwy. 66, Ontario, 48°04'05"N, 80°09'01"W. Map unit 1, Ont. Dept. Mines Map 2239. Sample WN-207A-76, collected by R.K. Wanless. Description by R.D. Stevens.

The hornblende was obtained from syenite of the Otto stock at the east contact of the east arm of a large 35°-striking diabase dyke (GSC 80-169). The rock sample was a relatively fresh hornblende syenite with major microcline and perthitic K-feldspar, abundant fresh green hornblende, and minor chlorite, apatite and sphene. Original biotite(?) is completely chloritized and minor, deeply altered colourless clinopyroxene changing to epidote and chlorite was observed. The rock contained virtually no opaques, but is cut by calcite veins.

See GSC 80-171 for additional information.

GSC 80-171 Hornblende, K-Ar age **2234 ± 58 Ma**

K = 0.343%, $^{40}Ar/^{40}K$ = 0.2568, radiogenic Ar = 97.5%.
Concentrate: Altered, pleochroic light to dark green hornblende with abundant black inclusions throughout the grains.

From syenite

(42 A) Farm field, 140 m south of road, between Swastika and Round Lake, Ontario, 48°04'17"N, 80°06'51"W. See Ont. Dept. Mines Map 2239, Geological Report 99. Sample WN-206A-76, collected by R.K. Wanless. Description by R.D. Stevens.

The sample was obtained from syenite of the Otto stock at the contact of a north-south (12°) diabase dyke (GSC 80-168). This syenite sample was greatly altered; its feldspar being heavily kaolinized, pyroxene deeply degraded, amphibole moderately altered and full of inclusions, and biotite completely altered. The rock also contains abundant colourless to yellow epidote, relatively abundant sphene, and minor quartz (sometimes in graphic intergrowth with feldspar).

These four samples were collected to determine the age of dyke emplacement and its effect on the hornblende of the syenite country rock.

GSC 80-172 Whole rock, K-Ar age $\frac{2412}{2423} \pm \frac{57}{52}$ **Ma**

K = 4.90%, $^{40}Ar/^{40}K = \frac{0.2943}{0.2967}$, radiogenic Ar = $\frac{99.9}{99.9}$%.
Concentrate: Crushed whole rock.

From leucitite

(32 D) Highway 66, approximately 10 km east of Kirkland Lake, Ontario, 48°07'N, 79°52'W. Sample WN-63-74, collected by R.K. Wanless.

The sample was collected from an outcrop representative of the ultra-alkaline members of the Kirkland Lake complex. The particular lens in which this flow resides is 1500 m thick and 12.8 km long. This is a reconnaissance age determination carried out in association with other work in the area.

Reference

Goodwin, A.M., Ridler, R.H., and Annells, R.N.
1972: Precambrian volcanism of the Noranda-Kirkland Lake-Timmins, Michipicoten, and Mamainse Point areas, Quebec and Ontario; 24th International Geological Congress, Montreal, Guidebook for Field Excursion A40-C40, p. 49.

GSC 80-173 Whole rock, K-Ar age **2439 ± 138 Ma**

K = 0.177%, $^{40}Ar/^{40}K$ = 0.3004, radiogenic Ar = 98.9%.
Concentrate: Crushed whole rock.

From interflow chert

(31 M) Highway 624, approximately 2.5 km due north of the north end of St. Anthony Lake, some 11 km south of Larder Lake, Ontario, 47°58'N, 79°46'W. Sample WN-INTERFLOW-74, collected by R.K. Wanless.

This is an experimental determination carried out on chert interbedded between flows of the McVittie basalts.

GSC 80-174 Hornblende, K-Ar age **2564 ± 62 Ma**

$K = 0.561$, $^{40}Ar/^{40}K = 0.3294$, radiogenic Ar = 99.2%.
Concentrate: Clean, unaltered, pleochroic brown to dark green hornblende with no visible contamination.

From "granodiorite"
(41 P) Power line right of way to south of Highway 66, Kirkland Lake-Matachewan, Ontario, 47°50.2'N, 80°21'W. Sample WN-12-75, collected by R.K. Wanless. Description by R.D. Stevens.

The sample represents a massive, possibly posttectonic pluton with mafic xenoliths. In thin section the feldspar was moderately altered, the biotite very heavily altered, and the hornblende appeared to be essentially fresh. Quartz was undeformed, but "kinks" and bends were observed in the altered biotite masses. Accessory minerals included sphene, epidote, apatite, opaques and zircon.

It was thought that this body might correlate with the Round Lake batholith and possibly with the Dufault granite of the Rouyn-Noranda district.

GSC 80-175 Biotite, K-Ar age **2518 ± 53 Ma**

$K = 6.42\%$, $^{40}Ar/^{40}K = 0.3185$, radiogenic Ar = 99.9%.
Concentrate: Light greenish brown biotite with approximately 15% chlorite contamination.

From gneiss
(41 P) Power line right of way south of Highway 66, Kirkland Lake-Matachewan, Ontario, 47°50.9'N, 80°20.6'W. Sample WN-11-75, collected by R.K. Wanless.

See GSC 80-176 for description.

GSC 80-176 Hornblende, K-Ar age **2534 ± 61 Ma**

$K = 0.661\%$, $^{40}Ar/^{40}K = 0.3223$, radiogenic Ar = 99.4%.
Concentrate: Clean, unaltered, pleochroic light to dark green hornblende with no visible contamination.

From gneiss
(41 P) Details as for GSC 80-175.

The rock is a grey-pink biotite gneiss towards the centre of the Round Lake batholith. The biotite of the sample is somewhat chloritized and the feldspars moderately altered. Hornblende, on the other hand, is quite fresh. Accessory minerals include apatite, sphene, epidote, opaques and zircon.

This is a reconnaissance age determination associated with projected zircon geochronology.

GSC 80-177 Whole rock, K-Ar age **1995 ± 54 Ma**

$K = 0.349\%$, $^{40}Ar/^{40}K = 0.2119$, radiogenic Ar = 97.7%.
Concentrate: Crushed whole rock.

From diabase
(42 A) North side of Highway 66, approximately 10.5 km southwest of junction of Highways 66 and 11, 0.5 km northwest of Crooked Creek crossing, Ontario, 48°01'N, 80°15.6'W. Map unit 6, Ont. Dept. Mines Map 2239. Sample WN-2-75, collected by R.K. Wanless.

This sample is from the chilled contact of an essentially north-south striking diabase dyke cutting the Round Lake batholith. The central zone of the dyke is noteworthy for its large plagioclase crystals aligned in streams, though none appear at the contact.

This is a reconnaissance age determination carried out in association with other work in the area.

GSC 80-178 Hornblende, K-Ar age **2568 ± 62 Ma**

$K = 0.468\%$, $^{40}Ar/^{40}K = 0.3303$, radiogenic Ar = 98.7%.
Concentrate: Relatively clean, pleochroic green to brown hornblende with a trace of chlorite contamination.

From granite
(42 A) North side of Highway 66, 8 km southwest of Kenogami, Ontario, 48°02'30"N, 80°14'50"W. Sample WN-61-74, collected by R.K. Wanless.

This is a reconnaissance age determination on a so-called "younger granite" carried out in association with other work in the area.

GSC 80-179 Hornblende, K-Ar age **2441 ± 61 Ma**

$K = 0.48\%$, $^{40}Ar/^{40}K = 0.3007$, radiogenic Ar = 99.1%.
Concentrate: Unaltered, pleochroic light brown to green hornblende with a slight trace of chlorite contamination.

From granite
(42 A) North side of Highway 66, about 9.7 km southwest of its junction with Highway 11, Kirkland Lake area, Ontario, 48°02.5'N, 80°14.5'W. Map unit 5, Ont. Dept. Mines Map 2239. Sample WN-3-75, collected by R.K. Wanless. Description by R.D. Stevens.

This sample represents a "younger", post-tectonic massive granite. Its zoned feldspar is moderately altered, biotite totally chloritized, and hornblende quite fresh. Its accessory minerals include yellow epidote, euhedral sphene, apatite and zircon.

This is a reconnaissance age determination carried out in association with other work in the area.

GSC 80-180 Biotite, K-Ar age **2557 ± 55 Ma**

$K = 6.33\%$, $^{40}Ar/^{40}K = 0.3176$, radiogenic Ar = 99.8%.
Concentrate: Very light brown biotite with approximately 7% chlorite alteration.

From trondhjemitic gneiss
(41 P) Forest management road south of Highway 66, Kirkland Lake-Matachewan, Ontario, 47°45.8'N, 80°11'W. Sample WN-15-75 collected by R.K. Wanless.

See GSC 80-181 for description and interpretation.

GSC 80-181 Hornblende, K-Ar age **2684 ± 63 Ma**

K = 0.382%, $^{40}Ar/^{40}K$ = 0.3476, radiogenic Ar = 99.0%.
Concentrate: Clean, unaltered, pleochroic brown to green hornblende with no visible contamination.

From trondhjemitic gneiss
(41 P) Details as for GSC 80-180.

This trondhjemitic grey gneiss was sampled approximately 3 km from the contact of the Round Lake batholith and probably represents "basement" terrane. Its hornblende is fresh and the biotite fresh to partly chloritized. Accessory minerals include epidote, apatite, opaques, rounded zircon, and rare sphene.

This is a reconnaissance age determination carried out in association with other work in the area.

GSC 80-182 Muscovite, K-Ar age **2624 ± 40 Ma**

K = 5.25%, $^{40}Ar/^{40}K$ = 0.3442, radiogenic Ar = 98.9%.
Concentrate: Partly clear, partly yellow-stained muscovite with a trace of chlorite contamination.

From "granite"
(41 P) Highway 573, 3.2 km south of junction with Hwy. 11, Kirkland Lake-Englehart area, Ontario, 47°56'36"N, 80°03'28"W. Sample WN-200-76, collected by R.K. Wanless. Description by R.D. Stevens.

The sample was collected from the Round Lake batholith and aplite stringers, which are common in this exposure, were specifically excluded. The rock consists mainly of potash-feldspar and lesser plagioclase, quartz, epidote, greenish chlorite pseudomorphing original biotite, relatively abundant sericite as an alteration product of the feldspar, and accessory apatite and zircon.

This is a reconnaissance age determination carried out in association with other work in the area.

GSC 80-183 Muscovite, K-Ar age **2551 ± 53 Ma**

K = 7.48%, $^{40}Ar/^{40}K$ = 0.3263, radiogenic Ar = 99.7%.
Concentrate: Generally clear muscovite with approximately 6% chlorite contamination. Some of the mica flakes have a greenish colour due to the presence of chlorite.

From granite
(41 P) At junction of Highways 11 and 12, South Wye, Ontario, 47°58'N, 80°01'W. Sample WN-65-74, collected by R.K. Wanless.

This rock is a garnet-bearing granite possibly related to the Round Lake batholith or Lebel syenite. The age is a reconnaissance determination carried out in association with other work in the area.

GSC 80-184 Biotite, K-Ar age **2380 ± 50 Ma**

K = 7.56%, $^{40}Ar/^{40}K$ = 0.2873, radiogenic Ar = 99.3%.
Concentrate: Very fine grained, light brown biotite with approximately 10% chlorite alteration.

From auriferous quartz vein
(32 C) 3816 W Drift, under 3816 W "A" Raise, Sigma Mine, Val d'Or, Quebec, 48°05'N, 77°35'W (approx.). Sample SIGMA-3-78, collected and interpreted by A.J. Audet (Sigma Mines).

The sample was obtained from a 4" (10 cm) vein dipping 20°W. The vein is a quartz-pyrite stringer containing fine grained biotite in irregular masses.

See GSC 80-185 for discussion.

GSSC 80-185 Biotite, K-Ar age **2429 ± 50 Ma**

K = 5.23%, $^{40}Ar/^{40}K$ = 0.2980, radiogenic Ar = 99.1%.
Concentrate: Very fine grained, light brown biotite with approximately 30% chlorite alteration.

From quartz-carbonate-pyrite stringer vein
(32 C) 3716 W Drift, 30 ft (9 m) east of Station 7964, Sigma Mine, Val d'Or, Quebec, 48°05'N, 77°35'W (approx.). Sample SIGMA-1-78, collected and interpreted by A.J. Audet (Sigma Mines).

This sample was obtained from a "flat" vein on the south wall adjacent to a strong shear zone. The vein is a 4" (10 cm) quartz-carbonate-pyrite stringer with coarse masses of radiating biotite.

The biotites were from two separate auriferous quartz veins found on the lower levels of the Sigma Mine. At depth, the iron rich tourmaline usually found associated with quartz veins, is replaced with biotite. Quartz veins are known to post-date porphyritic dykes that represent late magmatic activity with respect to the Archean volcanism, and pre-date Proterozoic diabase dykes. The ages of GSC 80-184 and 185 suggest that vein formation significantly postdates the major volcanic event but the relation to porphyry dykes remains uncertain.

GSC 80-186 Biotite, K-Ar age **1836 ± 43 Ma**

K = 7.55%, $^{40}Ar/^{40}K$ = 0.1852, radiogenic Ar = 99.6%.
Concentrate: Greenish coloured biotite with approximately 4% chlorite alteration.

From gneiss
(32 P) Near south edge of a small lake known locally as Beaver Lake, Quebec, 51°59'N, 72°23'W. Map unit 3, GSC Map 1155A (Eade, Memoir 339). Sample OTISH-9-233, collected and interpreted by L.P. Tremblay.

The sample is from the gneissic terrane along the northwestern rim of the Otish Basin and from what is regarded as possibly part of the basement to the rocks of the Otish Basin. It is from an area within the gneissic terrane where there is probable Otish rocks preserved in a wide fracture zone.

The rock dated is a grey to black, fine grained, crudely gneissic quartz-feldspar-biotite gneiss. Its feldspar is an oligoclase slightly altered to fine sericite. The biotite is green.

The age indicates the time when the Hudsonian orogeny affected the basement rocks along the northern edge of the Otish Basin.

GSC 80-187 Hornblende, K-Ar age **2524 ± 137 Ma**

K = 0.099%, $^{40}Ar/^{40}K$ = 0.3199, radiogenic Ar = 96%.
Concentrate: Pleochroic olive-brown to light green hornblende with about 10% chloritization.

From altered quartz-diorite
(32 D) Roadcut near crest of hill towards road-end, first westerly road north of Evain, Quebec, 48°15.5'N, 79°11.4'W. Sample WN-7-70, collected by R.K. Wanless and R.D. Stevens.

This sample from the Flavrian granite was dated as a reconnaissance age determination associated with other studies in the Rouyn-Noranda district.

The rock is an altered hornblende-quartz diorite of medium to coarse grain size in which the original feldspar is almost completely altered, largely to epidote and chloritic minerals. Anhedral quartz is clear and unstrained, and the abundant green hornblende is moderately to heavily altered. Pseudomorphous masses of green chlorite may represent original biotite, but no mica remains. Relatively large apatite crystals and altered skeletal opaques are the main accessories.

The sample was collected from very close to the southern margin of the Flavrian body.

GSC 80-188 Hornblende, K-Ar age **2495 ± 61 Ma**

K = 0.475%, $^{40}Ar/^{40}K$ = 0.3129, radiogenic Ar = 99%.
Concentrate: Relatively clean, pleochroic dark green to brown hornblende with about 2% chlorite contamination.

From adamellite/granodiorite
(32 D) Top of knoll, 30.5 m southwest of Eldrich Mine road, 4.8 km west of junction with Elder Mine road, Quebec, 48°16.6'N, 79°09.8'W. Sample WN-10-70, collected by R.K. Wanless and R.D. Stevens.

This sample from the Flavrian granite was dated as a reconnaissance age determination associated with other studies in the Rouyn-Noranda district.

The rock is a hornblende adamellite to granodiorite of medium to coarse grain size. In thin section it was observed that in some instances plagioclase crystals are mantled by potash feldspar, but the latter also occurs as individual grains. Large quartz grains are anhedral and only slightly strained. Abundant hornblende is fresh and generally interstitial to subophitic and is pleochroic from green to yellowish brown. Accessories include opaques, apatite and an unidentified brown acicular mineral.

The sample was collected in the southwestern interior of the Flavrian body.

GSC 80-189 Hornblende, K-Ar age **2338 ± 59 Ma**

K = 0.313%, $^{40}Ar/^{40}K$ = 0.2781, radiogenic Ar = 96%.
Concentrate: Moderately altered, pleochroic light brown to bluish green hornblende with approximately 10% chlorite impurity.

From altered granodiorite
(32 D) 60 m south of Lac Dufault Mine road, 1.6 km west of intersection with Hwy. 46, Quebec, 48°20.7'N, 79°03.7'W. Sample WN-15-70 collected by R.K. Wanless and R.D. Stevens.

This sample of the Dufault granite was dated as a reconnaissance age determination associated with other studies in the Rouyn-Noranda district.

The rock is medium grained. Both feldspars have been heavily altered and original biotite completely chloritized. The abundant green to yellow-green hornblende is fresh. Accessory minerals include sphene, apatite and opaques.

The sample location is close to the northwestern margin of the Dufault body, an area where intense faulting is recognized in the adjacent country rocks. The high degree of alteration of the rock may relate to the proximity of these faults.

GSC 80-190 Hornblende, K-Ar age **2529 ± 135 Ma**

K = 0.182%, $^{40}Ar/^{40}K$ = 0.3212, radiogenic Ar = 96%.
Concentrate: Pleochroic, brownish green to bluish green hornblende with about 5% chlorite contamination and some attached quartz.

From granodiorite
(32 D) Near junction of Hwy. 46 and Lac Dufault mine road, north of Noranda, Quebec, 48°20.2'N, 79°02.2'W. Sample WN-14-70, collected by R.K. Wanless and R.D. Stevens.

This sample of the Dufault granite was dated as a reconnaissance age determination in association with other studies in the Rouyn-Noranda district.

The rock is a medium grained, altered hornblende-biotite granodiorite in which the predominant plagioclase has been heavily altered. The green hornblende is partly fresh but also partly chloritized and epidotized, while original biotite has been totally chloritized. Accessory minerals include sphene, apatite and opaques.

The sample was collected from the northern interior of the Dufault body.

GSC 80-191 Phlogopite, K-Ar age **964 ± 34 Ma**

K = 8.21%, $^{40}Ar/^{40}K$ = 0.07397, radiogenic Ar = 98%.
Concentrate: Clean, unaltered, light brownish phlogopite with no visible impurities.

From coarse "biotite" granite
(21 M) Between mileposts 84 and 85 (136 km from Quebec City), Highway 54, in Laurentides Park, Quebec, 47°52.3'N, 71°15.5'W. Sample WN-56-70, collected by R.K. Wanless and R.D. Stevens.

The rock is a very coarse grained, fresh, undeformed "biotite" granite consisting mainly of potash feldspar (microperthite and orthoclase), lesser quartz and quartz-feldspar intergrowths, brown phlogopite, and large opaque grains.

This is a reconnaissance age determination carried out in the course of other studies relating to the Grenville Structural Province.

GSC 80-192 Biotite, K-Ar age **775 ± 32 Ma**

K = 8.22%, $^{40}Ar/^{40}K$ = 0.05450, radiogenic Ar = 98%.
Concentrate: Clean, brownish biotite with no visible alteration but containing less than 2% attached quartz impurity.

From paragneiss/schist
(22 D) Roadside outcrop on Highway 16 opposite east end of Alcan plant at Arvida, Quebec, 48°26.0'N, 71°09.4'W. Sample WN-52-70, collected by R.K. Wanless and R.D. Stevens.

The sample is a fine grained, foliated and granulated rock tentatively designated as a quartz-feldspar-biotite paragneiss or schist. It consists of alternating coarser and finer layers of quartz, potash feldspar (orthoclase and microcline), plagioclase, and parallel brown biotite flakes, abundant opaques, sphene, apatite and rare zircon.

This is a reconnaissance age determination carried out in the course of other studies relating to the Grenville Structural Province.

GSC 80-193 Hornblende, K-Ar age **975 ± 40 Ma**

K = 0.78%, $^{40}Ar/^{40}K$ = 0.07327, radiogenic Ar = 99%.
Concentrate: Relatively clean, pleochroic brown to dark green hornblende with no biotite and a trace of chlorite impurity.

From gneiss
(22 D) Roadcut 152 m west of junction of Hwy. 16A and road to Laterriere, Quebec, 48°21.5'N, 71°03.4'W. Sample WN-55-70, collected by R.K. Wanless and R.D. Stevens.

The rock is a coarse, foliated granitic gneiss consisting of orthoclase, microcline, microperthite, quartz, green hornblende, coarse opaques, chloritic pseudomorphs after an original mica, coarse apatite, allanite, sphene and zircon.

This is a reconnaissance age determination carried out in the course of other studies relating to the Grenville Structural Province.

GSC 80-194 Hornblende, K-Ar age **944 ± 37 Ma**

K = 1.34%, $^{40}Ar/^{40}K$ = 0.07202, radiogenic Ar = 99%.
Concentrate: Clean, pleochroic light brown to dark green hornblende with no visible impurities.

From granite
(22 D) Fresh outcrop east of Hwy. 16 at northwestern entrance to Bagotville, Quebec, 48°20.5'N, 70°53.0'W. Sample WN-54-70, collected by R.K. Wanless and R.D. Stevens.

See GSC 80-195 for description.

GSC 80-195 Biotite, K-Ar age **818 ± 30 Ma**

K = 7.06%, $^{40}Ar/^{40}K$ = 0.06017, radiogenic Ar = 98%.
Concentrate: Light brownish biotite with about 6% chlorite alteration.

From granite

(22 D) Details as for GSC 80-194.

This rock is a coarse grained hornblende-biotite granite consisting of potash feldspar (orthoclase, microperthite and microcline), quartz, graphic quartz-feldspar intergrowths, large brown biotites and green hornblende. Large grains of magnetite and apatite are common and accessory sphene was observed. The feldspars were noted to be moderately sericitized and kaolinized, and the thin section also showed zones of granulation and recrystallization.

This is a reconnaissance age determination carried out in the course of other studies relating to the Grenville Structural Province.

GSC 80-196 Whole rock, K-Ar age **630 ± 64 Ma**

K = 0.33%, $^{40}Ar/^{40}K$ = 0.04383, radiogenic Ar = 94.3%.
Concentrate: Crushed whole rock.

From diabase

(31 M) 3 km northwest of the rapids below Lac des Cinq Milles and 7.25 km northeast of the confluence of the Rivière Cerise and Lac Ostaboningue, Lanoue Township, Témiscamingue County, Québec, 47°14'N, 78°47'W. Sample FA-810101, collected and interpreted by J. van der Leeden.

The rock is a medium- to fine-grained, massive, dark grey diabase with a subophitic, allotriomorphic to hypidiomorphic seriate texture, and was collected 70 cm from GSC 80-197, 1 m from the eastern contact of the same northwest-trending dyke. The sample consists essentially of labradorite (53%) and clinopyroxene (34%) (augite and pigeonite grains, and pigeonite exsolution blebs in augite) with minor iddingsite (5%), magnetite (2%) and intersertal material consisting of micropegmatite (2%), amphibole (1%), biotite (2%), and chlorite (1%), and trace amounts of accessory apatite.

See GSC 80-197 for interpretation.

GSC 80-197 Whole rock, K-Ar age **654 ± 46 Ma**

K = 0.48%, $^{40}Ar/^{40}K$ = 0.04577, radiogenic Ar = 90.4%.
Concentrate: Crushed whole rock.

From diabase

(31 M) 3 km northwest of the rapids below Lac des Cinq Milles and 7.25 km northeast of the confluence of the Rivière Cerise and Lac Ostaboningue, Lanoue Township, Témiscamingue County, Québec, 47°14'N, 78°47'W. Sample FA-810101A, collected and interpreted by J. van der Leeden.

The rock is a fine- to medium-grained, massive, dark grey diabase with a diabasic to subophitic, allotriomorphic to hypidiomorphic, inequigranular ("long" plagioclase and small rounded clinopyroxene) texture. It was collected 30 cm from the eastern contact of a subvertically dipping, northwest-trending (325°) dyke. The sample consists essentially of labradorite (51%) and clinopyroxene (34%) (augite and pigeonite) with minor magnetite (7.5%), iddingsite (1%), and intersertal material (micropegmatite (1%), biotite (4.5%), and chlorite (1%)). Accessory (<1%) olivine and apatite are also present.

GSC 80-196 and GSC 80-197 come from a major dyke which is approximately 30 m wide and has been traced intermittently for 15 km from the Grenville Province into the Superior Province. Aeromagnetic anomalies and topographic lineaments outline possible further segments or extensions northwestward and southeastward. The dyke is neither deformed nor metamorphosed and thus postdates the polyphase deformation and metamorphism of the area. Two chemical analyses of the diabase (W.F. Fahrig, personal communication, 1981) plot in the tholeiite field of AFM and Alkali vs. SiO_2 diagrams.

The 641 Ma average age may represent early rifting and intrusion associated with the northwest-trending Lake Temiskaming Rift Valley (Lovell and Caine, 1970) which is located 15 km to the west of the dyke. The age is not similar to those obtained from other dated northwest-trending dykes (Palmer et al., 1977; Van Schmus, 1975, 1965; Gates and Hurley, 1973; Wanless et al., 1968, 1966; Fahrig and Wanless, 1963; Fairbairn et al., 1960) found along the Grenville Front Tectonic Zone.

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New Brunswick
(GSC 80-198)

GSC 80-198 Biotite, K-Ar age **531 ± 17 Ma**

K = 6.93%, $^{40}Ar/^{40}K$ = 0.03584, radiogenic Ar = 97.6%.
Concentrate: Dark brown biotite with approximately 9% chlorite alteration.

From gneiss
(21 G) Brookfield quarry, near intersection of Rothesay Ave. and McKay Hwy. east of St. John, New Brunswick, 45°19'24"N, 66°01'43"W. Sample 79120, collected and interpreted by K.L. Currie.

The specimen comes from a polydeformed, mafic biotite gneiss, which forms a migmatite in the quarry with a pink leucogranite. The age is typical of "Avalonian" granites in the Maritimes, and disagrees only mildly with an intercept age of 485 ± 30 Ma obtained by Gaudette (unpublished) on zircons from the leucogranite. The age is typical for old granites from the east side of Iapetus, and therefore adds some confirmation, if any is needed, that this region originally lay east of Iapetus. It is of no assistance in determining the age of the older part of the Brookfield gneiss. Gaudette (unpublished) has separated zircons from this gneiss which have yielded an intercept age of 1641 Ma, but considers them to be detrital.

Nova Scotia
(GSC 80-199 to GSC 80-200)

GSC 80-199 Hornblende, K-Ar age $\frac{710}{693} \pm \frac{53}{51}$ **Ma**

K = 0.57%, $^{40}Ar/^{40}K = \frac{0.05058}{0.04913}$, radiogenic Ar = $\frac{91.5}{88.5}$%.

Concentrate: Relatively clean, unaltered, pleochroic light brown to dark green hornblende with a trace of chlorite contamination.

From granodiorite

(11 K) Core from 85-93 m interval, Aquataine Co. drillhole located 1.2 km south of no. 5 mine shaft, Coxheath Mine, Nova Scotia, 46°04'26"N, 60°21'17"W. Map unit 4 of Bell and Goranson, 1938. Sample SYA-78-401, collected by W.D. Sinclair and R.V. Kirkham, interpreted by W.D. Sinclair.

The rock is a medium grained, equigranular biotite-hornblende granodiorite with a modal composition of approximately 45% andesine, 15% orthoclase, 20% biotite, 10% hornblende and 10% quartz with minor epidote and accessory apatite, rutile and zircon. The feldspars are sericitized to various degrees and the biotite is partly chloritized, but the granodiorite is relatively fresh for the Coxheath area.

The sample is from a diorite-quartz monzonite complex that intrudes a folded volcanic-sedimentary sequence previously defined as Cambrian or older (Bell and Goranson, 1938). Sparse, but widely distributed chalcopyrite, molybdenite and bornite occur along fractures and in quartz veins cutting both the intrusive and associated volcanic rocks (Oldale, 1967). Previously reported radiometric dates on the intrusive rocks include a K-Ar age of 584 ± 28 Ma* on hornblende from syenodiorite (Wanless et al., 1968) and a Rb-Sr age of 580 ± 70 Ma based on potassium feldspar and whole-rock analyses (Cormier, 1972). The dates reported here, 693 ± 51 and 710 ± 53 Ma, are significantly older. The average of these two dates, approximately 700 ± 50 Ma, suggests that the time of emplacement of the diorite-quartz monzonite complex and associated mineralization may be Late Precambrian (Hadrynian).

*This age recalculates to 593 Ma using the decay constants of Steiger and Jager, 1977.

References

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GSC 80-200 Biotite, K-Ar age **400 ± 13 Ma**

K = 6.00%, $^{40}Ar/^{40}K$ = 0.02600, radiogenic Ar = 97.7%.

Concentrate: Light brown biotite with approximately 9% chlorite alteration.

From granodiorite porphyry

(11 F) Trench on south side of Gillis Mountain, 1.6 km east of Gillis Lake and 2.2 km south of McCormick Lake, Nova Scotia, 45°52'33"N, 60°15'25"W. Map unit 11, Weeks (1958), GSC Map 1056A. Sample KQ-75-50, collected by R.V. Kirkham and A.E. Soregaroli and interpreted by W.D. Sinclair.

The rock is a biotite granodiorite with a crowded porphyritic texture. It consists of approximately 45% plagioclase, 15% quartz, 10% biotite, 2% hornblende and 2% K-feldspar, all as phenocrysts in a fine grained to aphanitic matrix of quartz and K-feldspar. Approximately 1% disseminated pyrite is present; apatite and zircon are common accessories.

The porphyritic biotite granodiorite forms the main phase of the Gillis Mountain pluton, a composite dioritic-monzonitic stock that intrudes Early to Middle Cambrian sedimentary rocks. Associated with the pluton are sparse, but widespread, chalcopyrite and molybdenite as disseminations, fracture-fillings, and in quartz veins (Kirkham and Soregaroli, 1975; O'Beirne and Barr, 1979). The pluton has been dated by Cormier (1972) who has reported a Rb-Sr biotite-whole rock age of 369 ± 25 Ma and, more recently (Cormier, 1979), a Rb-Sr whole rock age of 384 ± 10 Ma. The upper range of these two dates (394 Ma in both cases) overlaps with the lower range of the 400 ± 13 Ma date reported here (387 Ma). This indicates that the time of emplacement of the pluton and associated copper-molybdenum mineralization (approximately 390 Ma) may be as old as Late Silurian-Early Devonian.

References

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1975: Preliminary assessment of porphyry deposits in the Canadian Appalachians; in Report of Activities, April to October 1974; Geological Survey of Canada, Paper 75-1, Part A, p. 249-252.

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1979: Gillis Mountain pluton; Nova Scotia Department of Mines, Report of Activities 1978, Report 79-1, p. 111-114.

GSC 80-201 Biotite, K-Ar age $\frac{2239}{2201} \pm \frac{28}{48}$ **Ma**

K = 6.48%, $^{40}Ar/^{40}K = \frac{0.2578}{0.2502}$, radiogenic
Ar = $\frac{99.6}{99.8}$%.
Concentrate: Clean, unaltered, light brown biotite with no detected chlorite.

From anorthositic gneiss
(13 E) North shore of Wilson Lake, Labrador, Newfoundland, 53°20'53"N, 62°53'30"W. Map unit Hgn, Gittins and Currie, GSC Paper 79-1A. Sample 78135, collected and interpreted by K.L. Currie.

This specimen contains the assemblage hypersthene-diopside-plagioclase-quartz with trace amounts of biotite and amphibole. The assemblage belongs to granulite facies and is closely associated with sapphirine bearing rocks. On petrographic and structural grounds Gittins and Currie (1979) demonstrated that this rock had been metamorphosed and deformed at least three times, with the biotite associated with the second or third period of deformation. The derived age of 2201 to 2239 Ma on biotite therefore strongly supports the suggestion of Gittins and Currie (1979) that the granulite facies rocks form an Archean terrane probably faulted into its present position. Demonstration of the actual age of this terrane awaits zircon studies, but the rocks may be correlative with the antique gneiss complex of the northern Labrador coast. The age demonstrates in spectacular fashion that older rocks can be recognized south of the Grenville Front in Labrador.

Reference

Gittins, J. and Currie, K.L.
1979: Petrologic studies of sapphirine-bearing granulites around Wilson Lake, Labrador; Current Research, Part A, Geological Survey of Canada, Paper 79-1A, p. 77-82.

GSC 80-202 Hornblende, K-Ar age **1203 ± 46 Ma**

K = 0.593%, $^{40}Ar/^{40}K$ = 0.09930, radiogenic
Ar = 96%.
Concentrate: Relatively clean, pleochroic, olive-brown to bluish green hornblende with approximately 2% free biotite contamination.

From gabbro
(23 G) East of Carol Lake, Labrador, Newfoundland, 53°02'N, 67°00'W. Sample no. 12, collected and described by M.K. Seguin (Laval University).

See GSC 80-203 for description.

GSC 80-203 Biotite, K-Ar age **2231 ± 72 Ma**

K = 6.56%, $^{40}Ar/^{40}K$ = 0.2561, radiogenic
Ar = 99%.
Concentrate: Light brown biotite with about 2% hornblende impurity.

From gabbro
(23 G) Details as for GSC 80-202.

This sample of the Shabogamo gabbro is a typical massive, fresh, medium- to coarse-grained, pale to dark green, rusty weathering rock rich in olivine, pyroxene, amphibole and feldspar. Petrographically the mafic minerals appear to indicate possible retrograde metamorphism.

The ages determined from these minerals cannot readily be interpreted in isolation, but it is clear that the K-Ar systematics of the rock have been considerably disturbed.

GSC 80-204 Hornblende, K-Ar age $\frac{916}{915} \pm \frac{38}{38}$ **Ma**

K = 0.644%, $^{40}Ar/^{40}K = \frac{0.06932}{0.06920}$, radiogenic
Ar = $\frac{95}{97}$%.
Concentrate: Relatively clean, pleochroic, olive-brown to light bluish green hornblende with less than 2% biotite contamination.

From schist
(23 G) South of Carol Lake, Labrador, Newfoundland, 53°02'N, 66°59'W. Sample no. 16, collected and described by M.K. Seguin (Laval University).

See GSC 80-205 for description.

GSC 80-205 Biotite, K-Ar age **955 ± 34 Ma**

K = 7.12%, $^{40}Ar/^{40}K$ = 0.07306, radiogenic
Ar = 99%.
Concentrate: Relatively clean concentrate of light brown biotite with about 2% hornblende contamination.

From schist
(23 G) Details as for GSC 80-204.

The rock is a typical hornblende-biotite schist (with garnet) representing a band of gabbro at the southern end of the Smallwood Mine. It is an altered gabbro rich in chlorite and in which remnants of pale to indigo blue amphiboles and possibly pyroxenes are present. It is uncertain whether the determined ages represent the time of alteration or a hybrid age between alteration and the original age of emplacement.

GSC 80-206 Biotite, K-Ar age **400 ± 13 Ma**

K = 7.21%, $^{40}Ar/^{40}K$ = 0.02602, radiogenic
Ar = 97.9%.
Concentrate: Dark brown biotite with approximately 2% chlorite alteration.

From quartz monzonite
(2 F) Roadcut on Bonavista Loop Road, just east of Lumsden, Newfoundland, 49°23'N, 53°35'W (approx.). Map unit 21 of Currie et al., GSC Paper 79-1A. Sample 78288, collected and interpreted by K.L. Currie.

The specimen is coarse grained biotite quartz monzonite with megacrysts of potash feldspar to 5 cm across (megacrystic granite of the Deadmans Bay pluton). The reported age merely adds to the confusion relative to the age of the Deadmans Bay pluton (cf. Jayasinghe and Berger, 1976). Rb-Sr and zircon ages previously yielded unsatisfactory results ranging from 385 to 600 Ma, depending

on various assumptions. Two previous K-Ar ages on the western margins of the pluton yielded ages of 325 and 345 Ma. Tectonic analysis clearly indicates that Deadmans Bay is significantly younger than the Cape Freels pluton, which has been dated at 400 Ma (Bell and Blenkinsop, 1975) and older than the Newport pluton (dated at 323 Ma, Bell et al., 1979). Pickerill et al. (1978) suggested that the Deadmans Bay pluton represents remobilized older material, and that this is the cause of difficulties in dating. A more positive statement must await dating by more refined techniques.

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1978: Carmanville map-area, Newfoundland; the northeastern end of the Appalachians; in Current Research, Part A, Geological Survey of Canada, Paper 78-1A, p. 209-216.

Offshore
(GSC 80-207)

GSC 80-207 Whole rock, K-Ar age **56.9 ± 3.2 Ma**

K = 0.643%, $^{40}Ar/^{40}K$ = 0.00336, radiogenic Ar = 71.9%.
Concentrate: Crushed whole rock.

From basalt
Dredged from depth of 1600 m in northern Labrador Sea, 63°17'N, 55°22'W. Sample NH 75009-51, collected by R.H. Fillon and described by R.K.H. Falconer.

The sample is a dark grey, medium grained basalt from a dredge haul up the face of a steep scarp which strikes northwards in the northern Labrador Sea for more than 50 km. The scarp was thought to be a probable fault exposure of oceanic basement rock, and its age is crucial in determining the tectonic history of movements between Greenland and Canada.

Ghana
(GSC 80-208)

GSC 80-208 Hornblende, K-Ar age **2087 ± 138 Ma**

K = 0.41%, $^{40}Ar/^{40}K$ = 0.2284, radiogenic Ar = 95.2%.
Concentrate: Relatively clean, pleochroic light green to brown hornblende with a trace of chlorite contamination.

From hornblende dacite
Birimian volcanic belt, northeast Ghana, 10°50'N, 00°43'47"W. Sample 63b-42, collected and interpreted by K. Attoh.

The hornblende was obtained from a hornblende-phyric calc-alkaline dacite considered to be a porphyritic flow or subvolcanic intrusion. This body is associated with lowermost lithostratigraphic unit in the Nangodi volcanic belt. The lowermost stratigraphic unit comprises felsic flows interbedded with clastic sediments. The hornblende-phyric rock appears to be in part intrusive into the sediments, having fine grained chilled margin and xenoliths of clastic sediments, but the body has been deformed with the volcanic succession.

The K-Ar age was obtained from euhedral hornblende crystals considered to be primary magmatic hornblende. Zoning is oscillatory and is due to TiO_2 variation from 2.2-1.1%. The computed structural formula (based on 23 oxygens) differs from the metamorphic hornblende in the metabasites, as evident below:

Titaniferous hornblende

$$K_{0.23-0.14}\ Na_{0.25-0.75}\ Ca_{1.76-1.63}\ (Mg_{3.46-2.79}\ Fe^{II}_{1.80-1.35}\ Mn_{0.02-0.01})\ (Al_{0.47-0.31}\ Fe^{III}_{0.85-1.21}\ Ti_{0.24-0.12})\ Al_{1.59-1.41}\ Si_{6.6-6.4}$$

Metamorphic hornblende (average)

$$K_{0.04}\ Na_{0.27}\ Ca_{1.84}\ (Mg_{2.70}\ Fe_{1.8}\ Mn_{0.02})\ Al_{0.45}\ Fe^{III}_{0.50}\ Ti_{0.03}\ Al_{0.96}\ Si_{7.0}$$

The differences include (a) the primary amphiboles have 10 times the TiO_2 content of the metamorphic amphiboles, (b) about 5 times the K_2O per mole of the metamorphic amphiboles, and (c) the metamorphic amphibole is more siliceous and less aluminous than the primary amphibole.

It is concluded that the K-Ar age of 2087 ± 138 Ma was obtained on a magmatic amphibole which has undergone possibly minimal metamorphic recrystallization such that the age represents a minimum for Birimian volcanism in the area.

APPENDIX

The numbers listed below refer to the individual sample determination numbers, e.g. (GSC) 62-189, published in the Geological Survey of Canada age reports listed below:

GSC Paper 60-17, Report No. 1 – determinations 59-1 to 59-98
GSC Paper 61-17, Report No. 2 – determinations 60-1 to 60-152
GSC Paper 62-17, Report No. 3 – determinations 61-1 to 61-204
GSC Paper 63-17, Report No. 4 – determinations 62-1 to 62-190
GSC Paper 64-17, Report No. 5 – determinations 63-1 to 63-184
GSC Paper 65-17, Report No. 6 – determinations 64-1 to 64-165
GSC Paper 66-17, Report No. 7 – determinations 65-1 to 65-153
GSC Paper 67-2A, Report No. 8 – determinations 66-1 to 66-176
GSC Paper 69-2A, Report No. 9 – determinations 67-1 to 67-146
GSC Paper 71-2, Report No. 10 – determinations 70-1 to 70-156
GSC Paper 73-2, Report No. 11 – determinations 72-1 to 72-163
GSC Paper 74-2, Report No. 12 – determinations 73-1 to 73-198
GSC Paper 77-2, Report No. 13 – determinations 76-1 to 76-248
GSC Paper 79-2, Report No. 14 – determinations 78-1 to 78-230
GSC Paper 81-2, Report No. 15 – determinations 80-1 to 80-208

GSC Age Determinations Listed by N.T.S. Co-ordinates

1-M 62-189, 190; 63-136, 137; 66-170, 171; 70-145, 146, 147, 152

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12-M 78-202, 203, 204, 205

12-O 60-135

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13-C 66-167; 67-138

13-D 60-132

13-E 64-160; 70-133; 80-201

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13-H 60-146; 67-141

13-I 70-138, 142; 72-140, 150

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14-C 72-138; 73-182

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21-I 64-154; 70-127