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Progress report on geochronological investigations in the crystalline complexes of the East Greenland Caledonian fold belt between 72° and 74°N

D. C. Rex, A. R. Gledhill and A. K. Higgins

In the summer of 1974 two of the authors (D. C. R. & A. R. G.) collected samples from various crystalline units in the inner fjord region of the Caledonian fold belt between 72° and 74°N, with a view to testing current hypotheses of the geological history of the region. The only dates so far available from this region are a few K-Ar mineral ages reported by Haller & Kulp (1962) all of which reflect Caledonian orogenesis. In the Scoresby Sund region isotopic work on crystalline units comparable to some of those reported on here has yielded Archaean and middle Proterozoic as well as Caledonian ages (Hansen *et al.*, 1973, 1974; Rex & Gledhill, 1974; Friderichsen & Higgins, this report).

Results are presented in this report of whole rock Rb-Sr analyses and K-Ar analyses obtained using standard techniques (Van Breemen & Dodson, 1972; Rex & Dodson, 1970). The localities from which the suites of samples were collected are shown on fig. 32 (localities A-E).

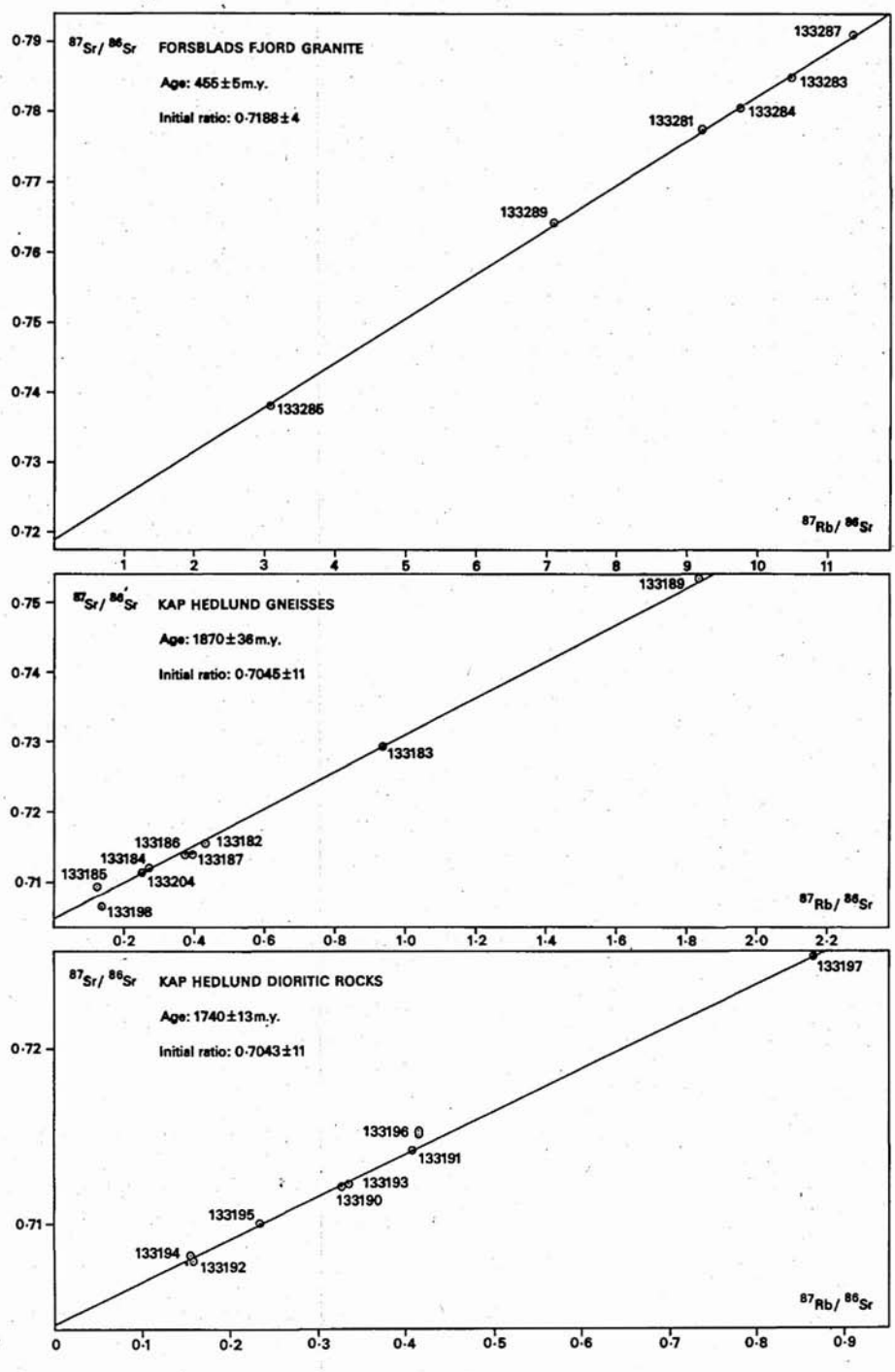
$^{87}Sr/^{86}Sr$
FORSBLADS FJORD GRANITE
Age: 455±5m.y.
Initial ratio: 0·7188±4
133287
133283
133284
133281
133289
133285
$^{87}Rb/^{86}Sr$
$^{87}Sr/^{86}Sr$
KAP HEDLUND GNEISSES
Age: 1870±36m.y.
Initial ratio: 0·7045±11
133189
133183
133186
133182
133184
133187
133185
133204
133198
$^{87}Rb/^{86}Sr$
$^{87}Sr/^{86}Sr$
KAP HEDLUND DIORITIC ROCKS
Age: 1740±13m.y.
Initial ratio: 0·7043±11
133197
133196
133191
133193
133190
133195
133194
133192
$^{87}Rb/^{86}Sr$

Table 10. Rubidium and strontium isotope data from various crystalline rocks from the East Greenland fold belt between 72° and 74°N

GGU sample no.	Location	Rock type	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$	Isochron age m.y.
133281	Forsblads Fjord	Granite	9.20	0.7775±3	
133283			10.50	0.7850±1	
133284			9.77	0.7806±1	
133285			3.07	(0.7383±2	455±5
				(0.7377±2	
133287			11.36	0.7910±3	
133289			7.07	0.7642±1	
133171	Inner Forsblads Fjord	Granite sill	0.137	0.7058±1	
133182	Kap Hedlund	Gneisses	0.426	0.7154±3	
133183			0.936	0.7293±3	
133184			0.278	0.7121±1	
133185			0.125	0.7091±1	
133186			0.375	0.7139±1	1870±36
133187			0.392	0.7136±1	
133189			1.841	0.7532±3	
133198			0.137	0.7061±1	
133204			0.257	0.7113±4	
133190	Kap Hedlund	Dioritic	0.328	0.7122±1	
133191		rocks	0.408	0.7142±3	
133192			0.159	0.7080±2	
133193			0.332	0.7123±1	
133194			0.156	0.7082±1	1740±13
133195			0.234	0.7101±1	
133196*			0.414	0.7154±2	
				0.7152±1	
133197			0.865	0.7254±3	

Decay constant: $1.39 \times 10^{-11}\ y^{-1}$

Rb/Sr ratios determined by X.R.F. using GSP-1 as reference standard $^{87}Rb/^{86}Sr$ ± 2%. Errors quoted at 1σ level

* Not included in isochron age calculation

Fig. 41. Whole rock Rb–Sr isochrons from three crystalline units of the East Grrenland fold belt between 72° and 74°N (fig. 32). Decay constant: $^{87}Rb = 1.39 \times 10^{-11}y^{-1}$.

Forsblads Fjord granite

A large granite body outcrops on the south side of Forsblads Fjord (fig. 32 locality A) and at its eastern contact cuts slightly metamorphosed sediments of the lower Eleonore Bay Group (Caby, this report). It has been described by Haller (1958) as a two mica granite, one of the younger generations of Caledonian granites found in the region of the Stauning Alper and Forsblads Fjord.

Six whole rock samples were analysed for Rb and Sr isotopes and the results are shown in Table 10. The isochron presented in fig. 41 gives an age of 455 ± 5 m.y. Muscovite and biotite separated from one of the samples were dated by the K-Ar method and gave ages of 413 m.y. and 410 m.y. respectively (Table 11).

It is inferred that the isochron age gives the age of intrusion of the granite, which confirms Haller's (1958) interpretation. The younger K-Ar ages probably relate to a cooling history.

Inner Forsblads Fjord granite sill

Near the head of Forsblads Fjord a prominent granitic sill occurs, emplaced concordantly into a thick sequence of high-grade metasediments (fig. 32, locality B).

One sample was analysed for Rb and Sr, and K and Ar isotopes (Tables 10 & 11). The K-Ar biotite age of 408 m.y. is similar to that obtained on the large granite body in eastern Forsblads Fjord, but the Rb-Sr isotope ratio plots well below the isochron of fig. 41 and indicates that the two granites are not related.

Kap Hedlund gneisses

The gneisses of Kap Hedlund (fig. 32, locality C) are part of the Gletscherland migmatite complex (Haller, 1955), one of the three infracrustal complexes distinguished in the inner fjord region (Friderichsen & Higgins, this report). The contact between the gneisses and slightly metamorphosed Eleonore Bay Group sediments is a prominent fault.

A suite of samples comprising acid and basic gneisses from a 3 km long stretch of the coast east of Kap Hedlund was analysed for Rb and Sr isotopes (Table 10). The nine whole rock samples analysed give an isochron age of 1870 ± 36 m.y. (fig. 41).

A second suite of samples was collected from a zone of strongly lineated and foliated dioritic rocks within the gneisses depicted on Haller's (1955) map as an amphibolite band. Eight whole rock samples were analysed for Rb and Sr (Table 10), seven of which plot on an isochron giving an age of 1740 ± 13 m.y. (fig. 41).

These two isochron ages indicate clearly that this part of the Gletscherland migmatite complex originated or suffered major remobilisation about 1800 m.y. ago.

K-Ar studies on the gneisses are in progress. A K-Ar age on a muscovite granite intruded along the fault between the gneisses and metasediments has given 406 m.y. (Table 11).

Granites in Kejser Franz Josephs Fjord and Isfjord

K-Ar analyses have been made on samples from two granite bodies, one of the north side of inner Kejser Franz Josephs Fjord opposite the mouth of Kjerulfs Fjord (fig. 32, locality D)

Table 11. Potassium and argon data from various crystalline rocks from the East Greenland fold belt between 72° and 74°N

GGU sample no.	Location	Rock type	Material analysed	% K	Vol ^{40}Ar rad. sec/g x 10^{-4}	% ^{40}Ar rad.	Age m.y.
133289	Forsblads Fjord	Granite	Muscovite	8.70	1.6065	92.2	413±16
	72°23'00"N; 25°43'W		Biotite	7.57	1.3850	95.7	410±16
133171	Sill at head of	Granite	Biotite	7.20	1.3073	97.1	
	Forsblads Fjord				1.3059	96.7	408±12
	72°23'30"N; 26°17'W						
133228	Kempes Fjord, 5 km	Granite	Muscovite	8.95	1.6186	98.1	406±16
	east of Kap Hedlund						
	72°42'40"N; 26°03'W						
133272	Isfjord, 14 km north		Biotite	7.30	1.5300	96.8	463±18
	of Kap Madeleine						
	73°24'50"N; 27°06'W						
133251	Kejser Franz Josephs	Granite	Biotite	6.06	1.2539	94.6	
	Fjord, opposite				1.2284	97.8	453±17
	Kjerulfs Fjord		Muscovite	8.62	1.5504	94.1	
	73°10'15"N; 27°27'W				1.5748	95.1	406±16

Decay constants: $\lambda_e = 0.584 \times 10^{-10}\ y^{-1}$; $\lambda_\beta = 4.72 \times 10^{-10}\ y^{-1}$; $^{40}K/K = 0.0119$ atomic %

Errors quoted at 95% confidence limit, determined from replicate analyses

and one on the north-west side of Isfjord about 14 km north of Kap Madeleine (fig. 32, locality E). Both are emplaced into medium- to high-grade metasedimentary sequences and have been interpreted as late Caledonian post-orogenic granites (Koch & Haller, 1971). The Kejser Franz Josephs Fjord granite has given a biotite age of 453 m.y. and a muscovite age of 406 m.y. The Isfjord granite has given a biotite age of 463 m.y.

Conclusions

The Precambrian isochron ages of *c.* 1800 m.y. are the first conclusive evidence in support of speculations that the infracrustal units between latitudes 72°–74°N might have a pre-Caledonian history. It has previously been recognised that Precambrian elements may once have been present (Haller & Kulp, 1962), though the infracrustal units have previously been regarded as essentially remobilised during the Caledonian orogeny (Haller, 1971). The wide range of pre-Caledonian ages from the Scoresby Sund region (70°–72°N) indicating a complex Archaean and Proterozoic history for the infracrustal and supracrustal rocks represented, has led to speculation that similar conditions might prevail in the region with which this study is concerned (Henriksen & Higgins, 1976; Higgins, 1976). Further work is in progress in an attempt to unravel what promises to be a very complex geological history.

All the K-Ar mineral ages reported above are from granitic bodies and all are Caledonian. With respect to the Forsblads Fjord granite the Rb-Sr isochron confirms the geological field evidence of a Caledonian age of intrusion. For the other granite bodies the field evidence is less definite, and the mineral ages may represent only a cooling history related to Caledonian regional metamorphism.

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The geochronology of the Scoresby Sund region, central East Greenland

Progress report 7: Rb-Sr whole rock and U-Pb zircon ages

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The recent age reconnaissance work carried out at the Eidgenössische Technische Hochschule, Zürich, has been mainly concerned with the complex age relationships of the supracrustal series in the western part of the Scoresby Sund region. This work has now come to an end and the results will be published in detail in the near future. In the eastern part of the area most isotopic work has been additional investigations on a plutonic body in the Stauning Alper and its implications are discussed in this report, as well as the age of discordant intrusions within the eastern Milne Land fault block.

Stauning Alper: U-Pb zircon ages

In our first progress report (Hansen & Steiger, 1971) a biotite Rb-Sr age for a granodiorite sample GGU 107842 (Table 12) was presented. The mineral age of 1154 m.y. for this intrusion (located at 71°53′N, 27°17′W) was the first indication of the existence of pre-Caledonian intrusive bodies within the Stauning Alper.

Analyses of three zircon fractions from the same sample are plotted in fig. 42. The upper intersection of the best fit line with the concordia suggests an intrusion age of about 1720 m.y., but due to the extreme discordance of the data points an error of ± 200 m.y. must be