RECONNAISSANCE GEOCHRONOLOGY OF THE INFRACRUSTAL ROCKS OF FLYVERFJORD, SCORESBY SUND, EAST GREENLAND

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REX, D. C. & GLEDHILL, A.: Reconnaissance geochronology of the infracrustal rocks of Flyverfjord, Scoresby Sund, East Greenland. *Bull. geol. Soc. Denmark*, vol. 23, pp. 49–54. Copenhagen, August 20th 1974.

A Rb-Sr whole rock isochron has yielded an age of 3000 m.y. for the infracrustal rocks occurring in Flyverfjord, East Greenland. This age is further evidence for the presence of Precambrian basement rocks occurring in the East Greenland Caledonian fold belt.

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The regional geology of the Caledonian fold belt of eastern Greenland from 70°N to 84°W has been comprehensively described by Haller (1971). The western margin is covered by the inland ice, and the southern margin is concealed by the Tertiary basalts. Late Palaeozoic and later sediments cover the Caledonian rocks in the outer fjord and coastal regions between 71° and 74°N. Foreland windows occur in the belt, the best known occurring in Dronning Louise Land and Gaaseland.

The fjords of the Scoresby Sund region provide spectacular cross sections through the southern part of the Caledonian fold belt. In the western, innermost parts of the region, infracrustal and supracrustal rocks forming parts of Caledonian thrust sheets, are recognised. The samples reported on here were collected in Flyverfjord, a side branch of Nordvestfjord (Fig. 1). The Scoresby Sund region (70–72°N) has recently been mapped by Grønlands Geologiske Undersøgelse (GGU), and information on the general geology is available in a number of reports, some of which are referred to below.

They recognise two distinct sequences of supracrustal rocks, the Krummedal sequence to the east and the Charcot Land sequence to the west. Each supracrustal sequence overlies a different and distinctive complex of infracrustal rocks. These two sequences of supracrustal rocks and their infracrustal basement are separated from each other by the Hinks Land thrust. The Krummedal sequence has been thrust westwards over the

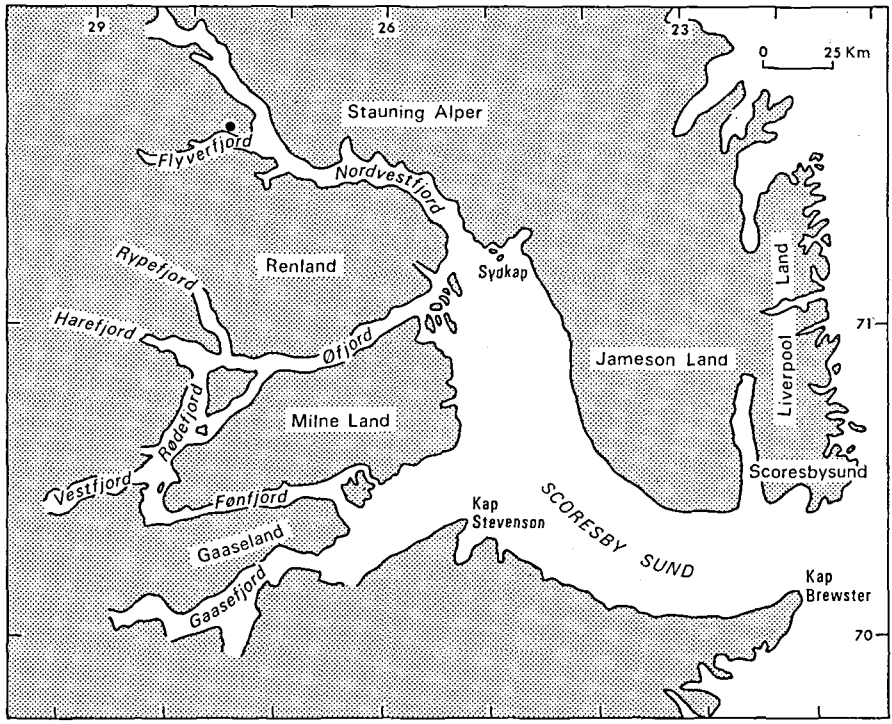

Fig. 1. Sketch map of Scoresby Sund region of East Greenland. Black spot marks location in Flyverfjord where rock samples were collected.

Charcot Land sequence. The latter sequence is preserved in a foreland window comparable to that in Gaaseland (Wenk, 1961).

The infracrustal rocks below the Krummedal sequence are very well exposed in the steep fjord walls of Flyverfjord. They suffered metamorphism and deformation prior to the deposition of the Krummedal sequence and both units have been further metamorphosed and deformed.

A considerable variety of rock types have been described by Henriksen & Higgins (1969) from the infracrustal rocks of the Nordvestfjord region. The main types seen in Flyverfjord were quartz-plagioclase-biotite schists with pods and bands of amphibolite. The schists are cut by numerous pegmatite veins, which are especially conspicuous on the north coast of Flyverfjord at its confluence with Nordvestfjord, but die out rapidly up the fjord.

The rocks whose analyses are described in this paper were collected from the north coast of Flyverfjord 0.5–1 km east of the first major valley. Old blasting sites along the coast were found to be very useful in obtaining large fresh specimens.

Geochronology

No radiometric dates have previously been obtained from the infracrustal rocks of Flyverfjord. A U-Pb zircon age of 2345 m.y. has recently been reported from the continuation of this complex on the north side of Nordvestfjord (Steiger & Henriksen, 1972). A comparable infracrustal sequence occurring in Gaaseland has given K-Ar age of 1900 m.y. and a Rb-Sr mineral (microcline) age of 2290 m.y. (Haller & Kulp, 1962).

Larsen (1969), Hansen & Steiger (1971) and Hansen, Steiger & Henriksen (1972) have reported K-Ar and Rb-Sr mineral ages from the crystalline rocks of the Scoresby Sund region. While some of these give Caledonian ages, many older results have been obtained up to 1490 m.y. and it is concluded that extensive Precambrian rock units occur within the Caledonian fold belt. The U-Pb zircon ages so far reported from the Scoresby Sund region gave Caledonian ages with indications of an older history (Oberli & Steiger, in press).

Experimental Procedures

Potassium-Argon: the potassium was measured on an EEL flame photometer, the figure quoted being the average of three separate dissolutions. Argon was determined by isotope dilution using a modified AEI MS10 fitted with digital output. The errors quoted are at the 95 % confidence limit and determined from replacate analyses.

Rubidium-Strontium: the rubidium and strontium were determined by isotope dilution using ^{87} Rb and ^{84}Sr "spikes" respectively. The isotopic ratios were measured on an AEI MS5 mass spectrometer fitted with magnetic peak switching and digital output.

Results

K-Ar

Biotite and hornblende were separated from amphibolite pods for K-Ar analysis. Two hornblendes and one hornblende-biotite pair were analysed. The ages fall between 430–470 m.y. indicating that these rocks had received a strong Caledonian overprinting.

One muscovite sample was separated from a cross-cutting pegmatite vein. This yielded an age of 378 m.y. and is in agreement with a Rb-Sr mineral age of 395 from a similar pegmatite in Nordvestfjord. (Hansen & Steiger 1971). It was suggested that this latter date indicated the end of the tectonic movements connected with the Caledonian orogeny in this area.

Rock Type	Mineral Analysed	No.	%K	Vol.^{40}Ar rad. scc/g × 10^{-4}	%^{40}Ar rad.	Age m.y.
Pegmatite	Muscovite	FY8	9.01	1.508	80.4	378±15
Amphibolite	Hornblende	FY12a	0.98	0.1877	91.7	427±16
Amphibolite	Hornblende	FY12b	0.91	0.1742	88.4	430±16
Amphibolite	Hornblende	FY11	1.12	0.2382	79.3	469±16
	Biotite		7.50	1.569	93.5	462±16

$\lambda\beta = 4.72 \times 10^{-10}yr^{-1}$, $\lambda\varepsilon = 0.584 \times 10^{-10}yr^{-1}$, $^{40}K/K = 0.0119$ atomic %

TABLE 2. Rb-Sr DATA

Rock Type	No.	Rb ppm	Sr ppm	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$
Quartz-biotite-plagioclase schist	FY3a	31	419	0.211	0.7173
Quartz-biotite-plagioclase-hornblende schist	FY3b	81	352	0.668	0.7338
Quartz-biotite-plagioclase schist	FY4	47	415	0.327	0.7211
Quartz-biotite-plagioclase schist	FY5	18	454	0.101	0.7202
				0.101	0.7208
Quartz-plagioclase-biotite-hornblende schist	FY6	28	478	0.164	0.7216
Quartz-plagioclase-biotite schist	FY7	54	406	0.385	0.7198
Amphibolite, hornblende, plagioclase quartz and minor biotite.	FY9	7	98	0.210	0.7129
Quartz-plagioclase-biotite-epidote schist	FY14	69	362	0.552	0.7286
Quartz-plagioclase-biotite schist	FY15	59	300	0.570	0.7311
Amphibolite, actinolite, quartz + carbonate	FY16	5	122	0.112	0.7097

Rb-Sr

Preliminary X-ray fluorescence analysis for Rb-Sr showed that all the rocks collected had low Rb/Sr ratios ($\leqslant 0.7$). A total of ten samples were analysed mass spectrometrically for Rb and Sr contents and Sr isotopic composition. The results are given in Table 2, and are plotted on an isochron diagram (Fig. 2). Eight of the samples have been used to define an isochron which yields an age of 3000±250 m.y. (1.39×10^{-11} yr ^{87}Rb decay constant) with an initial $^{87}Sr/^{86}Sr$ ratio of 0.7057±0.0014 (use of the 1.47×10^{-11} yr ^{87}Rb decay constant would reduce this age to 2828±250 m.y.). Two points fall slightly, but significantly, off the isochron indicating some degree of geological scatter or lack of closed system behaviour.

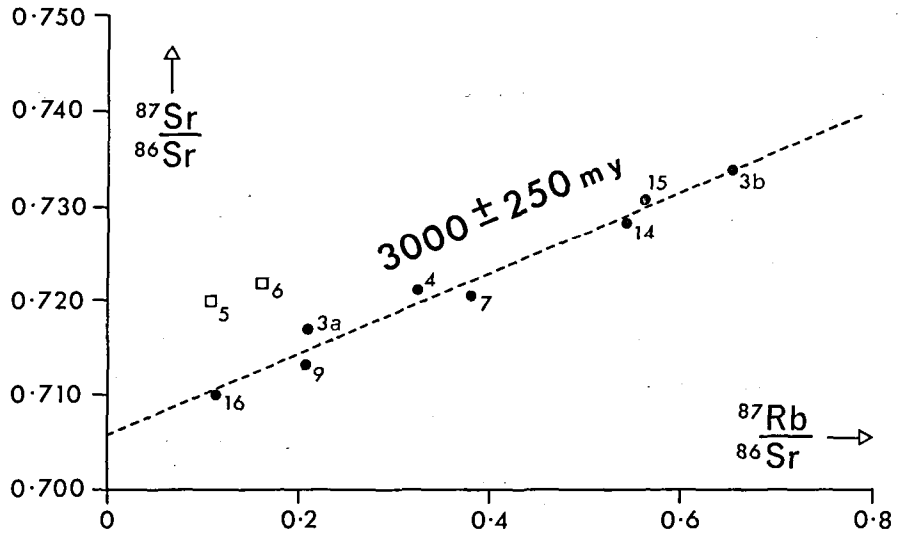

Fig. 2. Rb-Sr whole-rock plot of analytical data (note FY sample notation appearing in tables omitted on diagram).

Conclusion

The K-Ar ages obtained from the Flyverfjord rocks show the strong Caledonian overprinting which this area of East Greenland suffered. The pegmatite date of 378 m.y. probably indicates the closing stages of this orogeny.

The Rb-Sr whole rock isochron age of 3000 m.y. described in this paper reinforces the results of Hansen, Steiger & Henriksen (1972) on the importance of Precambrian rock units within the Caledonian fold belt. It also confirms the speculations of Haller & Kulp (1962) and Haller (1971) as to the occurrence of reworked basement complexes within this fold belt. The age obtained is the oldest recorded on infracrustal rocks in this part of East Greenland: it points to the need for more Rb-Sr, Pb-Pb and zircon ages to unravel the complex history of the rocks in the East Greenland Caledonian belt.

Acknowledgements. The rocks described in this paper were collected by D.C.R. in 1971, on an expedition organised by Dr. G. Halliday of Lancaster University and sponsored by the Royal Society. The isotopic work was carried out at Leeds in the geochronology laboratories under the general direction of Dr. M. H. Dodson. Mr. Walter Wilkinson prepared the samples for analysis and preliminary X-ray analysis was prepared by Mr. A. Gray.

Dansk sammendrag

En foreløbig geokronologisk undersøgelse af en række gnejsiske bjergarter fra Flyverfjord i Scoresby Sund-området i Østgrønland har ved analyse af bjergarternes Rb-Sr forhold givet en fælles alder på 3000 millioner år. Denne aldersbestemmelse er et yderligere bevis for tilstedeværelsen af et tidligt prækambrisk element i den kaledoniske foldekæde i Østgrønland.

En række K-Ar aldersbestemmelser udført på mineraler separeret fra de ovennævnte bjergartsprøver viser, at bjergarterne senere er blevet påvirket af en kaledonisk overprægning.

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