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Isotopic studies in the East Greenland Caledonides (72°–74°N) – Precambrian and Caledonian ages

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Abstract

Rb-Sr isotopic studies on crystalline rocks from different rock units of the East Greenland Caledonides have given a number of isochron and 'errorchron' ages, as well as sets of inconclusive data. All the results are presented here as an illustration of the problems encountered, though previously published data is given in summary form.

Eleven collections from Archaean – early Proterozoic rock units have given seven early Proterozoic Rb-Sr whole rock isochrons, while one set of data points plot about a 2450 m.y. reference line. Seven collections from metasediments of presumed middle to late Proterozoic age produced only one 'errorchron' of *c.* 1245 m.y., but data points from all the collections plot about a 1250 m.y. reference line. Six collections from a suite of 'older' granites gave four isochron ages of 1080, 1000, 765 and 650 m.y. Eight collections from Caledonian granites gave four isochron ages, three 'errorchrons' and one mineral-whole rock isochron; the ages fall in the range 377–550 m.y.

Introduction

This paper describes the results of Rb-Sr isotopic work carried out at the Department of Earth Sciences, The University, Leeds, on crystalline rocks from the East Greenland Caledonides between latitudes 72° and 74°N. Sampling was undertaken by the writers in 1974, 1976 and 1977, and supplementary collections were made by A. K. Higgins, J. D. Friderichsen and T. Thyrsted between 1975 and 1978. Collection sites are shown in fig. 1.

Previously published results are given here in summary form, with the ages recalculated where necessary to comply with the internationally recommended decay constants (Steiger & Jäger, 1977). Many of the collections analysed did not produce good Rb-Sr isochrons but the results are included here as an illustration of the problems encountered and an aid to future collectors visiting the region.

One of the consequences of recent regional mapping and isotopic work in the Scoresby Sund region (70°–72°N) has been a new emphasis on the pre-Caledonian history of the infracrustal gneiss complexes (Henriksen & Higgins, 1976; Higgins, 1976), interpreted as Caledonian migmatitic upwellings in the classic 'stockwerke' model for the East Greenland Caledonides (Haller, 1955, 1958, 1971). Geological and isotopic studies were extended to the classic region of the fold belt (72°–74°N) and confirmed the widespread occurrence of Precambrian rock units; they also verified important Caledonian metamorphism and plutonism. The Rb-Sr whole rock isotopic studies are reported here, and results of geological studies in the same region are given by Higgins *et al.* (this report).

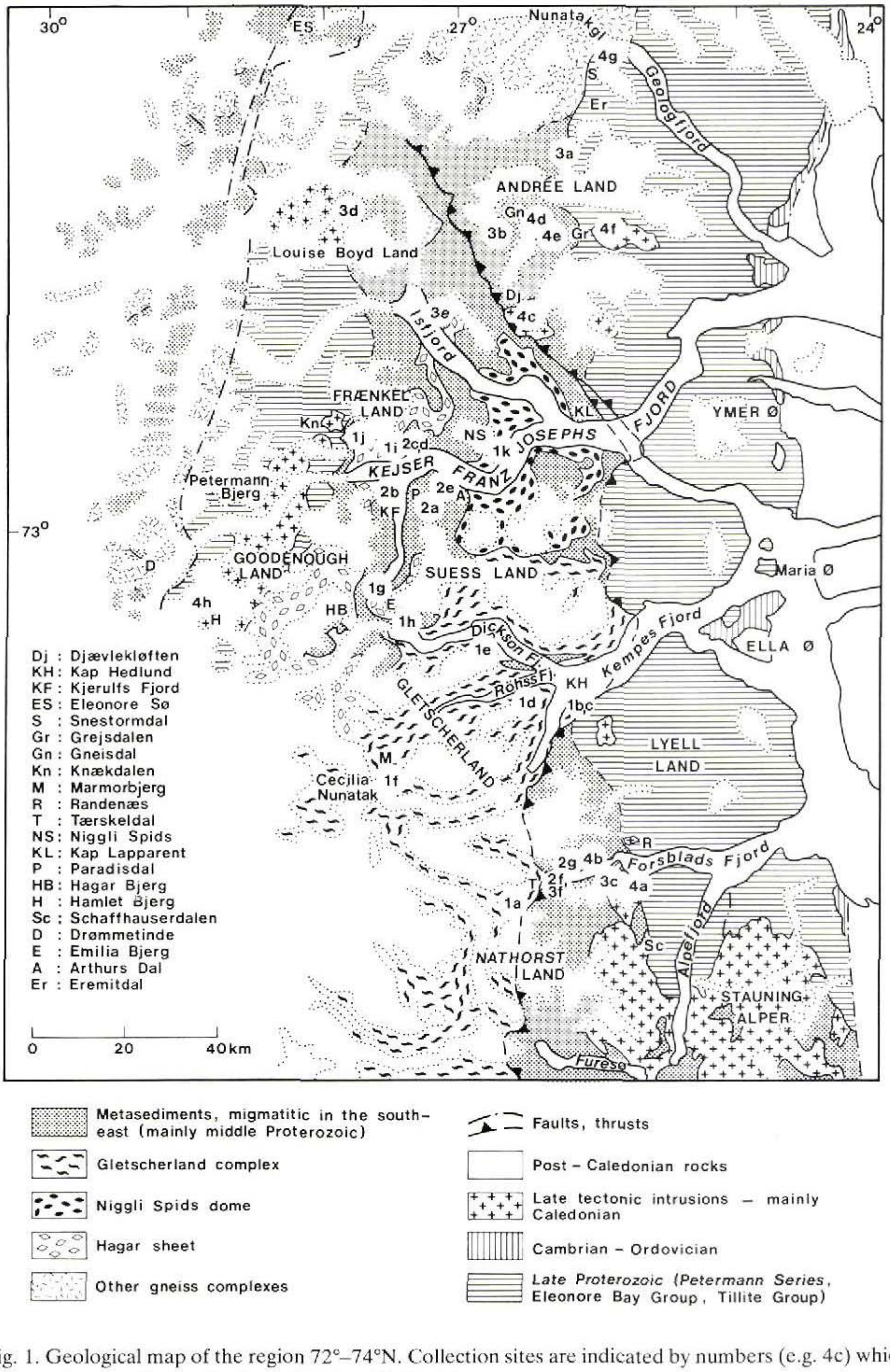

Fig. 1. Geological map of the region 72°–74°N. Collection sites are indicated by numbers (e.g. 4c) which refer to the data listings in the tables (e.g. Table 4c).

Archaean to early Proterozoic rock units

The oldest rocks in the region are considered to be the infracrustal gneiss and granite units which make up large parts of the 'central metamorphic complex' (fig. 1). For descriptive purposes Haller's three structural divisons of the infracrustal rocks are retained here: namely the Gletscherland complex, the Hagar sheet and the Niggli Spids dome (Haller, 1955, 1958).

Gletscherland complex

This complex is made up of a great variety of gneisses, amphibolites and granitic rocks, which are cut by several generations of discordant amphibolite dykes. Their evidently complex history shows broad similarities to that of Archaean and early Proterozoic gneiss complexes in other parts of Greenland. Whole rock analyses of six collections of samples have yielded two early Proterozoic isochrons, an Archaean – early Proterozoic 'errorchron', and three sets of inconclusive data. A Caledonian mineral isochron has also been obtained.

A suite of samples was collected along the south shore of Tærskelsø in Tærskeldal, south-west of the head of Forsblads Fjord. The 19 samples analysed include biotite and hornblende gneisses – medium-grained and well-foliated rocks, amphibolite, and several biotite gneisses with concordant amphibolite or aplite layers. The Rb and Sr data are given by Rex *et al.* (1977, Table 3; see also Table 1a). The data do not give an isochron, but plot about and above a 2450 m.y. reference line (Rex *et al.*, 1977, fig. 34) suggesting an Archaean age for the gneisses. The scatter suggests a partial resetting of the Rb-Sr system, perhaps in Caledonian time; while the sample site is free of obvious disturbance, a network of Caledonian thrusts and faults follows the south-east margin of Tærskeldal. The region was also influenced by Caledonian regional metamorphism, as is shown by a hornblende-biotite-whole rock isochron of 370±5 m.y. (fig. 2a, Table 1a) on one of the samples from the Tærskeldal collection.

A collection of both homogeneous and banded biotite and hornblende gneisses was made along a 3 km stretch of the coast east of Kap Hedlund on the south side of Kempes Fjord. Nine samples were analysed for Rb and Sr isotopes (Rex *et al.*, 1976, Table 10; see also Table 1b) and give an isochron with an age of 1830 ± 36 m.y. (Rex *et al.*, 1976, fig. 41).

A well-defined dioritic zone east of Kap Hedlund was also sampled. The collection includes hornblende diorites with a variety of textures (homogeneous, foliated or strongly lineated) and from fine to very coarse grain size. Eight samples were analysed for Rb and Sr isotopes and define an isochron with an age of 1705±13 m.y. (Rex *et al.*, 1976, Table 10, fig. 41; see also Table 1c).

Three other collections of samples resulted in data which could not be interpreted. A dioritic gneiss from the south side of Röhss Fjord 4 km east of Strømnæs seemed to have good potential as it was comparable to the Kap Hedlund diorite, but a very small spread of Rb-Sr ratios was obtained, and only four samples were analysed for Rb and Sr isotopes (Table 1d) before the attempt was abandoned. At Kap Robert on the south side of Dickson Fjord tightly folded gneisses and amphibolites are invaded by granitic gneiss (Haller, 1971, fig. 75), but analyses of 6 samples of hornblende and magnetite-bearing granites and aplites (Table 1e) did not define an isochron when plotted. Collections of banded and foliated granitic biotite gneisses were made from two sites west and south-west of Skræntdal, near

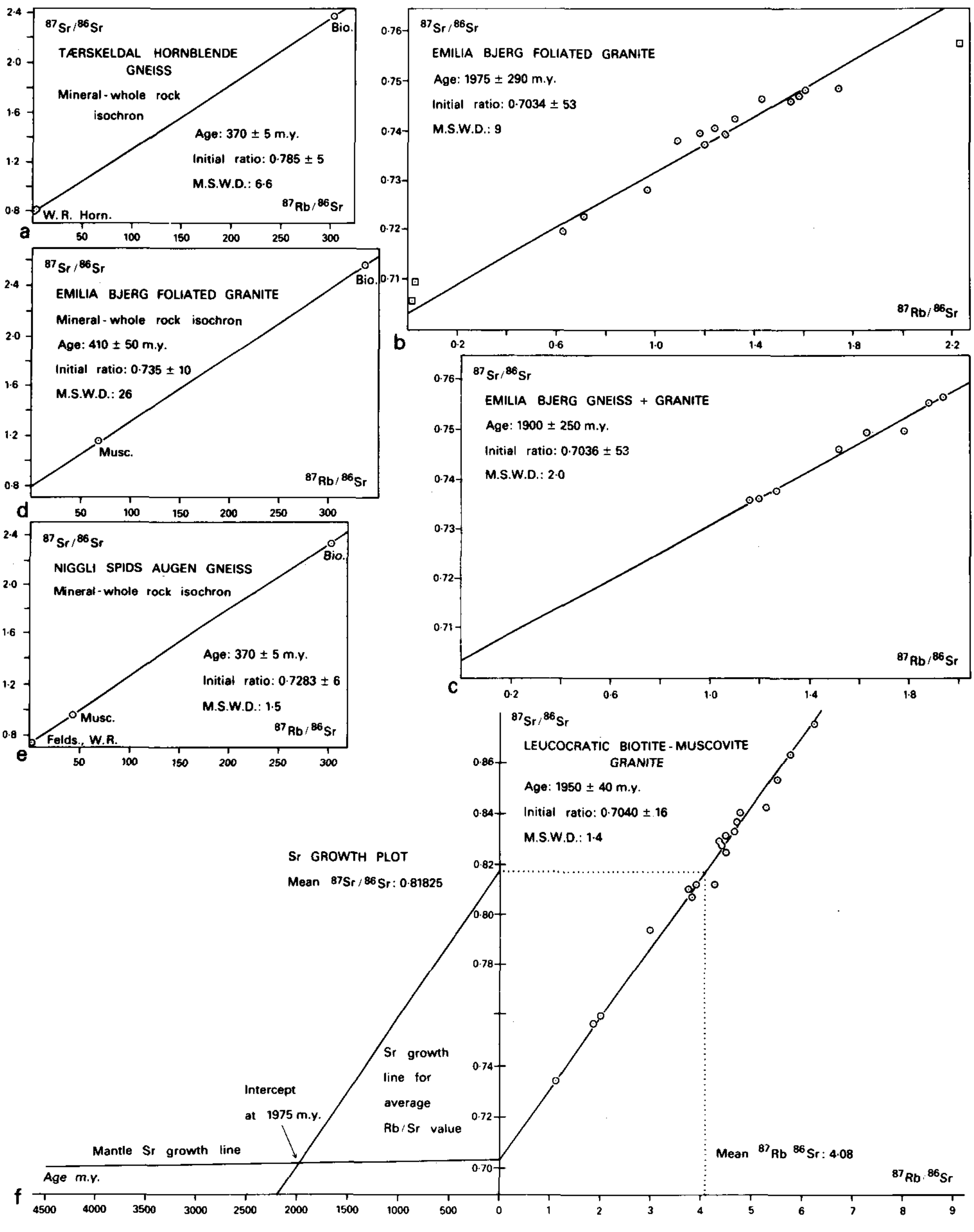

Fig. 2. Data plots derived from Archaean and early Proterozoic rock units.

Marmorbjerg (fig. 1, loc. 1f), where the Gletscherland complex and Hagar sheet infracrustal units merge (Haller, 1971, fig. 67). Nine samples were analysed for Rb and Sr isotopes (Table 1f) and these also produce a scatter of data points when plotted on a $^{87}Sr/^{86}Sr$-$^{87}Rb/^{86}Sr$ diagram.

Hagar sheet

The rock units and geological history of the Hagar sheet show broad similarities with those of the Gletscherland complex. It has the form of a massive sheet or nappe of infracrustal rocks enveloped by metasediments. Four collections of samples have been analysed, and all have yielded early Proterozoic isochron ages within a narrow time span. A Caledonian mineral isochron age was also obtained.

A large foliated granite in the south-east part of the Hagar sheet forms the 1630 m high mountain Emilia Bjerg on the north side of inner Dickson Fjord (Higgins *et al.*, this report, fig. 5). Two collections were made from the granite in Bocksrietdalen (west of Emilia Bjerg), one in the stream section and one from a fresh rock fall. Most of the samples in the collections were grey, foliated muscovite-biotite granite while three were aplitic. Isotope measurements were made on 18 samples (Table 1g) of which 15 define a reasonable isochron (M.S.W.D. 9) giving an age of 1975±290 m.y. (fig. 2b); two of the aplitic samples plotting above the line and one of the granite samples plotting below were omitted from the isochron calculation.

A further collection was made on the south flank of Emilia Bjerg on the north side of Dickson Fjord. Five samples were leucocratic granitic gneiss, distinct from the samples collected in Bocksrietdalen but believed to be a marginal facies of the Emilia Bjerg granite; three samples were biotite gneiss. They were analysed for Rb and Sr isotopes (Table 1h) and give an isochron age of 1900 ± 250 m.y. (fig. 2c).

Muscovite and biotite were separated from one of the samples of the Emilia Bjerg granitic gneiss and analysed for Rb and Sr (Table 1g). They define a mineral isochron with an age of 410±50 m.y. indicating a resetting of the Rb-Sr mineral system in response to Caledonian metamorphism.

Five kilometres east of Knækdalen on the north side of Kejser Franz Josephs Fjord, a prominent sheet of leucocratic biotite-muscovite granite occurs at the east margin of the Hagar sheet. Twenty samples were analysed, and of these 18 define an isochron giving an age of 1950±40 m.y. (analytical data published in Higgins *et al.*, 1978, Table 1; see also Table 1i and fig. 2f). The geological setting and age of this granite closely resemble those of the Emilia Bjerg granite, although samples are more leucocratic and less foliated in appearance.

The west margin of the Hagar sheet is exposed in the river bed at the bend of Knækdalen, and a collection was made across the strike of a unit of grey, well foliated, strongly lineated siliceous biotite gneisses. Eight of the 12 samples analysed define an isochron with an age of 1725±75 m.y., and the remaining four a second isochron of 1980±220 m.y. (analytical data and isochron plots in Higgins *et al.*, 1978, Table 2 and fig. 3; see also Table 1j). Whether the two ages have any significance, perhaps representing a two stage development of the gneisses, is not clear. The samples are a rather homogeneous collection, the only difference being a greater proportion of concordant leucocratic layers in the 'older' group of samples.

Niggli Spids dome

This dome-shaped infracrustal unit is more homogeneous than either the Gletscherland complex or Hagar sheet, being made up of foliated granitic gneiss, augen gneiss and porphyritic granodioritic gneiss, penetrated locally by networks of pegmatitic and aplitic veins.

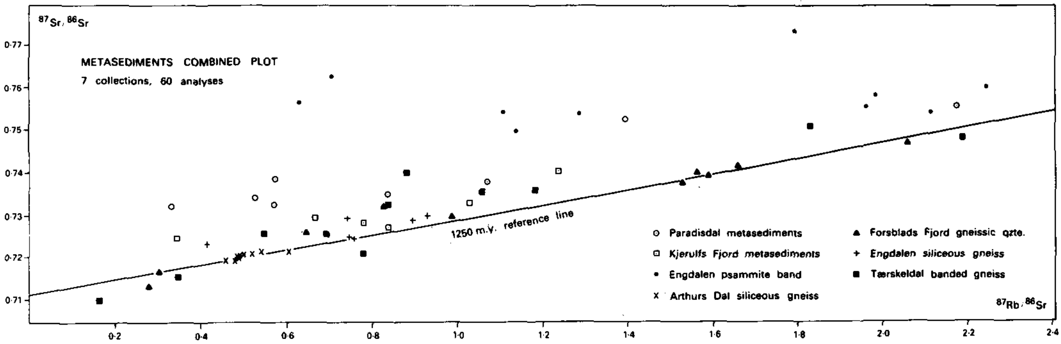

Fig. 3. Data plot for 60 analyses from 7 collections of middle Proterozoic metasediments.

Only one suite of samples has been analysed (Table 1k). It comes from a locality on the north side of Kejser Franz Josephs Fjord south of Niggli Spids. The seven samples were all well-foliated biotite-muscovite gneisses with generally small feldspar augen; the analyses do not yield an isochron. Biotite, muscovite and feldspar were separated from one sample and analysed and form a good mineral-whole rock isochron of 370±5 m.y. (fig. 2e).

Discussion

Isotopic work on the infracrustal units of the Scoresby Sund region south of latitude 72°N has yielded Rb-Sr whole rock isochron and zircon ages in the range 2935–2300 m.y. (Rex & Gledhill, 1974; Steiger *et al.*, 1979). With the exception of the Tærskeldal 'errorchron' the whole rock ages north of latitude 72°N are significantly younger, in the range 1705–1980 m.y. They all have low $^{87}Sr/^{86}Sr$ initial ratios (0.7034–0.7052), the errors being such that no trends can be distinguished. However, the main implication of the low initial ratios is that the rocks dated do not have a long history prior to their isochron age. For example the leucocratic biotite-muscovite granite on the north side of Kejser Franz Josephs Fjord (isochron age 1950±40 m.y., initial ratio 0.7040±16) can be shown to be derived from rocks with a maximum crustal age of 2000 m.y. (fig. 2f), and the isochron age is thus probably the age of intrusion. Similarly it can be argued that the gneiss units dated do not have a long history and were not formed from reworked Archaean material.

The collections analysed from the Gletscherland complex and Hagar sheet suggest that early Proterozoic time was marked in this part of Greenland by the massive introduction of material from the mantle. The infracrustal units could be viewed as parts of an early Proterozoic orogenic belt, equivalent in time to the Nagssugtoqidian fold belts of other parts of Greenland. However, the collections do not cover the entire range of rock types represented, and it is quite possible that substantial amounts of Archaean material are present in the region.

The age of formation of the rocks forming the Niggli Spids dome is uncertain, although an early Proterozoic age seems most probable. The Caledonian mineral isochrons from the Niggli Spids augen gneiss, Emilia Bjerg granite and Tærskeldal gneiss (fig. 2a, d, e) illustrate

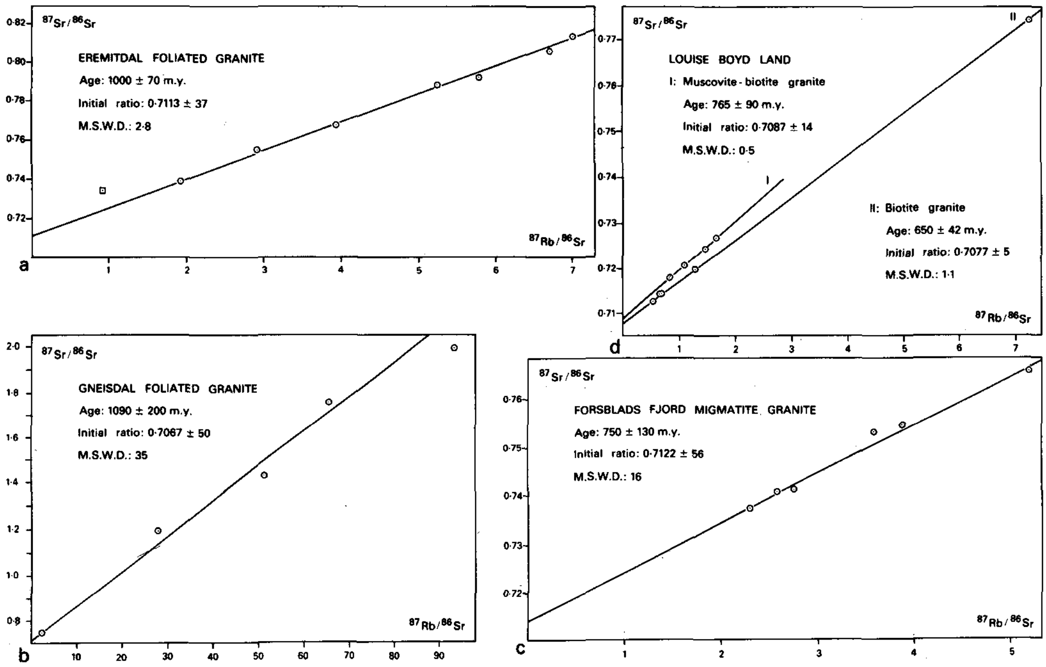

Fig. 4. Data plots for pre-Caledonian granites.

the resetting of the Rb-Sr system in minerals during Caledonian regional metamorphism, and it is likely that the geological scatter of the Rb-Sr whole-rock data from some suites is due to the same causes.

An extensive K-Ar mineral study has been undertaken to investigate the cooling history of the whole region which evidently carries a Caledonian overprint age ranging from *c.* 370–430 m.y. agreeing well with the Rb-Sr mineral ages which have been obtained. The detailed results of this study will be presented in a later report.

Middle and late Proterozoic rock units

Metasedimentary rocks are widespread overlying and to some extent interfolded with the infracrustal complexes. They were all at one time correlated with the lower part of the late Proterozoic Eleonore Bay Group (see e.g. Haller, 1971), but isotopic data from collections in the Scoresby Sund region suggest the metasediments were affected by middle Proterozoic orogenic events. Hansen *et al.* (1978) report a Rb-Sr whole rock age of 1122 ± 93 m.y., supported by U-Pb analyses on monazite. Steiger *et al.* (1979) have carried out isotopic studies on augen granite sheets which invade the migmatised metasediments in the Scoresby Sund region, and suggest a time of first crystallisation of the granites at 1053±40 m.y. from zircon data, and an isochron age of 987±23 m.y. from Rb-Sr whole rock studies.

Many attempts have been made to date the metasedimentary sequences between latitudes

72°–74°N, but they have proved a difficult sequence of rocks to work with from an isotopic point of view. Another approach of dating an 'older' suite of granitic rocks which intrude the metasediments has been a little more successful.

Metasediments

Seven suites of metasedimentary rocks from different parts of the region have been analysed. None of them have yielded a satisfactory isochron. One suite has given an 'errorchron' of 1245±100 m.y. and several show scatter about 1000 m.y. reference lines, but it is debatable whether these results should be regarded as significant.

Two collections were taken from near the mouth of Kjerulfs Fjord. Eight samples came from the east side of the fjord in the upper slopes of Paradisdal; they were mainly medium-grained, foliated siliceous gneiss, a few with coarse-grained leucocratic layers. Six rather similar samples were taken from the west side of the fjord. Both suites were analysed for Rr and Sr isotopes (Table 2a,b), and both plot about 1000 m.y. reference lines without forming isochrons (fig. 3).

Three suites of samples were taken in the inner part of Kejser Franz Josephs Fjord. Six samples taken on the north side of the fjord 700 m west of Engdalen (fig. 1, loc. 2c) were analysed (Table 2c), but did not give a linear array. A second suite of 12 samples from 2 km farther west came from a single horizon of fine-grained quartzite. The analyses produced a very wide scatter when plotted (Table 2d, fig. 3). The third suite from the south side of the fjord about 1000 m west of Arthurs Dal comprised 9 samples of well-foliated, siliceous biotite gneiss. The analyses gave a low spread of Rb-Sr ratios (Table 2e), and no age calculation was possible.

Farther south two collections were made in the inner part of Forsblads Fjord. Twelve samples of banded gneiss from a fresh rock fall at the north end of Tærskeldal were analysed (Table 2f), but did not form an isochron. Most samples derive from an area since shown to be affected by major Caledonian faults, which may explain the open-system behaviour. A further 12 samples of gneissic and banded quartzites from several localities on both sides of the fjord were analysed for Rb and Sr isotopes, and 11 plot on an 'errorchron' giving an age of 1245±100 m.y. (data and plot published in Rex *et al.*, 1977, Table 4, fig. 35; see also Table 2g).

Figure 3 is a plot of 60 analyses of the seven collections of metasediments with reference to a 1250 m.y. reference line. The broad scatter illustrates inhomogeneous Rb-Sr geochemistry between different collections, and also within some collections. A metamorphic event at about 1000 m.y. may have been responsible for a partial rehomogenisation of Sr isotopes, reflected by the close scatter of several plots about 1000 m.y. reference lines. The Caledonian metamorphism may also have contributed to the scatter, but as is the case in the infracrustal complexes, Caledonian events were not sufficiently intense as to cause complete resetting of the whole rock isotopic system.

Note may be made here of the recent paper by Field & Råheim (1979) in which they discuss geologically meaningless Rb-Sr whole rock isochrons from suites of gneisses in southern Norway. Here the main metamorphic ages are *c.* 1540 m.y. with a reset age from a low grade event at *c.* 1060 m.y. When a regional collection of gneisses was made an age of about 1260 m.y. was obtained. This intermediate age had no geological meaning and was made up of elements from different 1060 m.y. isochrons.

'Older' granites

Collections were made from numerous granite bodies emplaced into the metasediments, especially in the eastern part of the region which from geological arguments is regarded as the northern extension of a zone affected by middle Proterozoic migmatisation and plutonism in the Scoresby Sund region (Higgins *et al.*, this report). A number of pre-Caledonian ages have been obtained but a complicating factor is that Caledonian plutonism was also most intense in the same areas, and the different ages of granites were not always distinguishable on field criteria. Granites which have yielded Caledonian whole rock ages are described in the next section.

A suite of samples was collected from a fresh scree beneath a major lens shaped granite body on the east side of inner Eremitdal in northern Andrée Land. The granite is a strongly foliated muscovite granite, garnet-bearing in part, and cogenetic dykes and veins associated with it are folded. Eight samples were analysed, and 7 plot on a reasonably good isochron (M.S.W.D. 2.8) with an age of 1000±70 m.y. (Table 3a, fig. 4a). The age is significant in supporting the interpretation of the rock units west of the Eleonore Bay Group outcrop as the 'basement' to the sedimentary sequence (Higgins *et al.*, this report).

Twenty kilometres south-west of the Eremitdal granite, a similar looking, foliated, muscovite granite sheet occurs on the west side of inner Gneisdal. It is emplaced into kyanite-staurolite schists. Five samples collected from a fresh scree below the body were analysed (Table 3b) and give an 'errorchron' of 1080±200 m.y. (fig. 4b). This is a poor fitting line (M.S.W.D. 35), but its similarity to the Eremitdal body suggests the age is probably significant.

South of Caledoniaø in Forsblads Fjord a suite of samples of foliated biotite granite was collected from fresh screes. The sample site lies close to the east limit of the migmatite zone in Forsblads Fjord, and the biotite granite forms, usually conformable, sheets in the granitic migmatites. The six analysed samples (Table 3c) define an 'errorchron' (M.S.W.D. 16) giving an 'age' of 750±130 m.y. (fig. 4c), which suggests migmatite formation was a pre-Caledonian event.

A large granite body of assumed Caledonian age is shown in northern Louise Boyd Land on published maps (Koch & Haller, 1971) cutting Petermann Series metasediments, the presumed lateral equivalent of the late Proterozoic Eleonore Bay Group. Ten samples were collected and analysed for Rb and Sr isotopes (Table 3d), and plot on two isochrons giving ages of 765±90 m.y. and 650±42 m.y. (fig. 4d). The samples giving the older age are mainly two-mica granite, while those giving the younger age are biotite granite and aplite; the intrusion could be a composite body with earlier and younger phases. The ages suggest the granite is Precambrian rather than Caledonian, although analyses of muscovite and biotite from one sample have yielded a Caledonian mineral isochron age of 416±6 m.y. (Table 3d).

Two collections of samples from other granites were analysed, 6 samples of biotite granite from a prominent body on the east side of Isfjord (Table 3e) and 11 samples of foliated biotite granite from a sill emplaced in the metasediments in the inner part of Forsblads Fjord (Table 3f); these both gave rather low Rb-Sr ratios and no meaningful ages.

Discussion

The data from the metasediments and 'older' granites broadly support the idea that the region was subjected to middle Proterozoic metamorphism, with migmatisation and plutonism in eastern areas. The age of these events corresponds to the Grenvillian of North America and Europe, and it is possible that a branch of the Grenville orogenic belt extended into East Greenland. The validity and significance of the younger (*c.* 750 m.y.) ages is uncertain at present as they represent a hitherto unrecorded orogenic episode in the East Greenland Caledonides; further isotopic studies and field investigations are desirable before they are fully accepted.

Caledonian granites

Caledonian granites are common along both margins of the metamorphic complexes, especially in the contact zones with the late Proterozoic Eleonore Bay Group (Haller, 1971). Many have stratigraphic control, whereas others are entirely within metamorphic rocks. Eight collections from granites in both settings have been analysed, yielding isochrons and 'errorchrons' in the range 560–377 m.y.

Six samples from a major muscovite-biotite granite body emplaced into the Lower Eleonore Bay Group on the south side of Forsblads Fjord have been analysed, giving a good isochron with an age of 445 ±5 m.y. (Rex *et al.*, 1976, Table 10, fig. 41; see also Table 4a).

On the north side of central Forsblads Fjord, 8 km farther west, several conspicuous sillimanite-garnet bearing granite dykes cut the migmatites. Of the 10 samples analysed for Rb and Sr isotopes (Table 4b), 8 plot on an 'errorchron' of 430 ±48 m.y. (fig. 5a). Though not good statistically (M.S.W.D. 14) this result carries the interesting implication that the sillimanite and garnet formed in Caledonian time, indicating high amphibolite facies Caledonian metamorphism. Garnet-bearing leucocratic granite dykes of this type are common cutting the migmatites, but the migmatite development in this region is still considered to be essentially a middle Proterozoic event.

At the south-west end of Djævlekløften close to its confluence with Rendalen in south-west Andrée Land, a series of thick granite sheets occur in the metasediments and are truncated by a major thrust or fault system which follows the north-east side of Rendalen (Higgins *et al.*, this report, fig. 10). Collections from fresh screes at the base of the cliff comprise mainly medium-grained two-mica granite with a tendency to porphyritic development of feldspars, together with a finer-grained, later, well-foliated granite. The ten analysed samples (Table 4c) define an 'errorchron' with an 'age' of 560 ±56 m.y. (fig. 5b; M.S.W.D. 11). This age for the granite gives a maximum age for the latest movements on the thrust.

In Gneisdal 15 km farther north, collections were made from fresh screes below a body of muscovite granite on the south side at the major right-angled bend of the valley. The granite is an irregularly shaped, roughly concordant sheet emplaced into psammitic and pelitic gneisses. Ten samples were analysed (Table 4d) and define an 'errorchron' of 480 ±85 m.y. (fig. 5c; M.S.W.D. 20).

In central Andrée Land, at the confluence of Djævlekløften with Gneisdal and Grejsdalen, a steeply inclined, slightly folded, thick sheet of leucocratic granite is emplaced in metasediments. It is a fine to medium-grained muscovite granite, similar in appearance to the aplitic phase of the Grejsdalen granite discussed below. Eight samples were analysed (Table 4c), and while they have a narrow range of Rb-Sr ratios give an isochron with an age of 433 ± 68 m.y. (fig. 5d).

The Grejsdalen granite is a large pluton of quartz monzonite to granite composition,

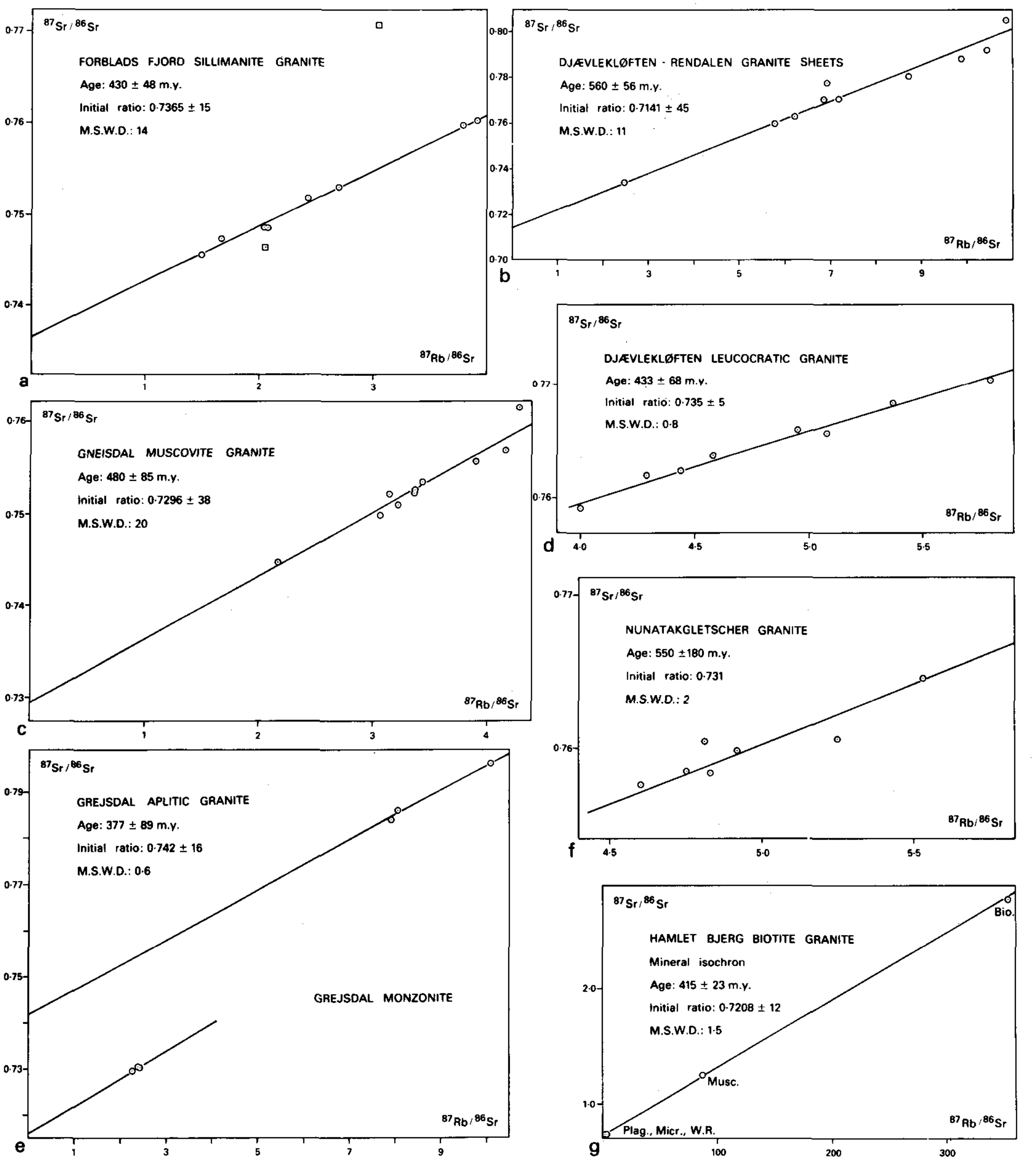

Fig. 5. Data plots for Caledonian granites.

emplaced into the Eleonore Bay Group (Haller, 1971, fig. 121) and recorded as post-dating some Caledonian folding. A collection from the north side of the valley included medium to coarse-grained quartz monzonite and medium-grained aplitic granite samples. All the quartz monzonite samples had similar Rb and Sr contents, and only three samples were analysed for Rb and Sr isotopes together with three aplite samples (Table 4). The three aplites give an isochron with an age of *c.* 377±89 m.y., while the quartz monzonites can be viewed as plotting on a line with the same age but with a much lower initial ratio (fig. 5e).

On the south side of Nunatakgletscher in northern Andrée Land several lens-shaped sheets of leucocratic muscovite-biotite granite are emplaced into the lower part of the Eleonore Bay Group succession (Higgins *et al.,* this report, fig. 17). Seven samples were analysed (Table 4g) and plot on an isochron with an age of 550±80 m.y. (fig. 5f), the narrow range of Rb-Sr ratios leading to the large uncertainty.

Several major granite plutons intrude the Petermann Series on the west side of the metamorphic complex. One of these yielding a pre-Caledonian age has been discussed in the previous section. Another body was sampled at the summit of Hamlet Bjerg in southern Goodenough Land. However, the 10 samples of medium to very coarse-grained biotite granite collected all had very similar Rb-Sr ratios, and only three were analysed for Rb and Sr isotopes. Biotite, muscovite, microcline and plagioclase were separated from one sample and analysed (Table 4h), and form a mineral-whole rock isochron with an age of 415±23 m.y. (fig. 5g). Inclusion of the two other whole rock data points in the calculation would give an age of 396±28 m.y. which is within experimental error.

Discussion

The isotopic data from the Caledonian granites is far from ideal, and the ages obtained (560–377 m.y.) should be viewed with caution. On the other hand the intrusions dated represent a range of rock types emplaced in a variety of geological settings over a wide area. Some are major plutons, while others are sheets or dykes. Some predate folding, while others are affected by folding or cut by faults or thrusts. The early Caledonian ages (*c.* 550 m.y.) are particularly interesting as they imply if they are valid, that emplacement of the first granites took place before the end of Lower Palaeozoic sedimentation; they can be compared with the *c.* 550 m.y. old granites from the Caledonian fold belt of the British Isles, e.g. Carn Chuineag (Pidgeon & Johnson, 1974) and Ben Vuirich (Pankhurst & Pidgeon, 1976).

In the Scoresby Sund region much the same picture of Caledonian plutonism is emerging, although here there is no stratigraphic control. Hansen & Tembusch (1979) report Rb–Sr isochrons of 375±9 m.y. on a biotite granite and 453±23 m.y. on a granodiorite, both in east Milne Land. Steiger *et al.* (1979) record a Rb-Sr isochron of 475±14 m.y. on a hypersthene monzonite sheet in Renland, as well as mineral isochrons of 405±3 m.y. on a grey-pink granite and 411±10 m.y. on pegmatites. Zircons analysed from a grey-pink granite body in Renland suggest a disturbance at 356±1 m.y., a rather young Caledonian age.

The initial strontium isotopic ratios of the granite intrusions are summarised in Table 5. The two early granites with ages close to 2000 m.y. have low mantle-type initial ratios, whereas the Caledonian and the two 'Grenvillian' granites (*c.* 1000 m.y.) have much higher ratios (0.710–0.736). As discussed earlier (fig. 2), the low initial ratios point to a mantle derivation, whereas the high ratios may result from either sialic contamination of a mantle magma, or a metamorphic event that caused an originally magmatic granite to undergo isotopic equilibration on a whole-rock scale. The high initial ratios therefore mean that the granites contain material that had a crustal prehistory. It also follows that the high initial ratios of the three granites analysed which are stratigraphically controlled (i.e. are intruded into late Precambrian beds), can probably be explained by crustal contamination, as there is no evidence that they have been affected by a strong metamorphic event.

Concluding remarks

Geochronological investigations in the East Greenland Caledonides are still at the reconnaissance stage, and the results presented in this report and elsewhere provide a working hypothesis on which future more detailed studies might be based. As has been pointed out in discussions above, many of the preliminary conclusions require confirmation and other problems remain unsolved.

Analytical details

The Rb-Sr ratios of the whole rock samples were measured by XRF (technique described by Pankhurst & O'Nions (1973) modified by M. Bickle, University of Leeds) with estimated errors of 2% (2σ). Rb-Sr values on international standards were as follows: GSP-1 1.08, AGU-1 0.102, BCR-1 0.143, and G2 0.350.

The Sr isotopes were measured on an AEI-MS5 mass spectrometer (results quoted to four significant figures) and on an MM30 mass spectrometer (results quoted to five significant figures). Average values of Eimar & Amend $SrCO_3$ of 0.7080±3 (MS5) were obtained during the period of study. The data have been regressed according to York (1969) using York Model II. The quoted errors are two sigma.

Rb and Sr ratios of the mineral separates were determined by isotope dilution using a mixed spike. Decay constants used are as recommended by the Subcommission of Geochronology of the IUGS (Steiger & Jäger, 1977).

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Table 1. Archaean and early Proterozoic rock units

(a) Tærskeldal banded gneisses and amphibolites.

Locality: South side of Tærskelsø 72°20'15"N, 26°34'00"W.
19 samples analysed, data in Rex *et al.* (1977, Table 3). Data plot about a 2450 m.y. reference line and do not form an isochron.

GGU sample no.	Rb ppm	Sr ppm	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$
133152 Whole rock	115	83	4.02	0.8066±5
133152 Hornblende	9.3	16.9	1.60	0.7929±4
133152 Biotite	669	6.4	303.4	2.3700±5

Mineral - whole rock isochron age: 370±5 m.y. - fig. 2a.
Initial ratio: 0.785±5 MSWD: 6.6

(b) Kap Hedlund biotite and hornblende gneisses.

Locality: East of Kap Hedlund 72°42'50"N, 26°05'-10'W.
9 samples analysed, data in Rex *et al.* (1976, Table 10).
Isochron age (recalculated): 1830±36 m.y.
Initial ratio: 0.7045±11 MSWD: 111

(c) Kap Hedlund diorite.

Locality: East of Kap Hedlund 72°42'50"N, 26°08'00"W.
8 samples analysed, data in Rex *et al.* (1976, Table 10).
Isochron age (recalculated): 1705±13 m.y.
Initial ratio: 0.7043±11 MSWD: 1.2

(d) Röhss Fjord diorite.

GGU sample no.	Rb ppm	Sr ppm	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$
228374 Foliated hnbl diorite	34	1237	0.0796	0.70511±5
228375 - - -	47	1115	0.1221	0.70625±5
228376 - - -	35	1117	0.0909	0.70558±5
228378 - - -	52	1055	0.1432	0.70619±6

Locality: 4 km east of Strømnæs 72°43'20"N, 26°38'00"W.
Results inconclusive.

(e) Kap Robert granitic gneiss.

GGU sample no.	Rb ppm	Sr ppm	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$
228359 Leucocratic granite	91	111	2.39	0.76876±6
227362 Foliated leucogranite	73	95	2.21	0.73233±5
228363 Leucocratic granite	34	102	0.962	0.72767±10
228365 Hornblende granite	6	339	0.050	0.72073±5
228369 Magnetite granite	81	214	1.10	0.74146±6
228370 Coarse hnbl granite	70	365	0.557	0.7470±16

Locality: West of Kap Robert 72°50'15"N, 26°46'00"W.
Results inconclusive.

(f) Skræntdal granitic biotite gneiss.

GGU sample no.	Rb ppm	Sr ppm	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$
228305 Granitic gneiss	192	401	1.39	0.75051 ± 15
228306 Banded biotite gneiss	56	323	0.500	0.74350 ± 5
228310 Acidic biotite gneiss	130	343	1.11	0.75442 ± 6
228312 - - -	76	361	0.613	0.74239 ± 5
228314 Foliated - -	85	338	0.733	0.74717 ± 5
228317 Banded - -	62	366	0.487	0.73605 ± 5
228318 - - -	149	329	1.32	0.76480 ± 5
228320 Acid gneiss	89	291	0.892	0.76644 ± 4
228321 Banded biotite gneiss	11	85	0.371	0.71358 ± 18

Locality: West of Skræntdal 72°36'00"N, 27°29'00"W, except sample 228321 south-west of Skræntdal 72°34'20"N, 27°23'30"W.
Results inconclusive.

(g) Emilia Bjerg foliated granite - fig. 2b.

Locality: Bocksrietdalen stream section samples 228355-350, 72°54'00"N, 27°33'30"W.

Bocksrietdalen rock fall samples 234491-500, 72°54'52"N, 27°31'30"W

GGU sample no.	Rb ppm	Sr ppm	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$
228335 Foliated musc.-biotite granite	138	281	1.43	0.74643 ± 5
228336 - - - -	121	217	1.61	0.74834 ± 5
228339 - - - -	119	262	1.32	0.74252 ± 6
228340 - - - -	115	283	1.18	0.73793 ± 5
228342 - - - -	129	237	1.58	0.74713 ± 5
228344 - - - -	104	278	1.09	0.73832 ± 6
228347* - - - -	142	185	2.23	0.75785 ± 5
228348 - - - -	110	258	1.24	0.74163 ± 7
228349 - - - -	126	285	1.28	0.73953 ± 13
228350 - - - -	130	244	1.55	0.74640 ± 8
234491 - - - -	80	369	0.627	0.71920 ± 5
234493 - - - -	98	237	1.20	0.73763 ± 7
234495 - - - -	115	192	1.74	0.74870 ± 5
234496 - - - -	94	213	1.28	0.73877 ± 9
234497 - - - -	102	304	0.969	0.72818 ± 5
234498 - - - -	74	300	0.714	0.72271 ± 5
234499* - - - -	2.4	482	0.014	0.70613 ± 5
234500* - - - -	3.7	316	0.034	0.70965 ± 7

Isochron age: 1975 ± 290 m.y. *Omitted from isochron calculation.
Initial ratio: 0.7034 ± 53 MSWD: 9

228339 Muscovite	473	21	68.23	1.15355 ± 32
228339 Biotite	785	8.1	332.1	2.5620 ± 16

Mineral - whole rock isochron age: 410 ± 50 m.y. (sample 228339 only) - fig. 2d.
Initial ratio: 0.735 ± 10 MSWD: 26

(h) Emilia Bjerg gneiss and granite - fig. 2c.

GGU sample no.	Rb ppm	Sr ppm	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$
234453 Leucocratic granite	107	246	1.27	0.73771 ± 6
234455 - -	90	227	1.16	0.73588 ± 5
234456 - -	102	242	1.20	0.73606 ± 5
234458 - -	125	222	1.63	0.74922 ± 6
234459 - -	110	211	1.52	0.74639 ± 14
234460 Banded biotite gneiss	125	193	1.88	0.75530 ± 7
234461 Biotite gneiss	128	192	1.94	0.75645 ± 12
234462 Biotite schist	105	172	1.78	0.74962 ± 5

Locality: South flank of Emilia Bjerg 72°51'55"N, 27°21'30"W.
Isochron age: 1900 ± 250 m.y.
Initial ratio: 0.7036 ± 53 MSWD: 2

(i) Leucocratic biotite-muscovite granite - Kejser Franz Josephs Fjord - fig. 2f.

Locality: 5 km east of Knækdalen 73°09'40"N, 27°25'40"W - except one sample 73°10'40"N, 27°23'20"W.
20 samples analysed, data in Higgins *et al.* (1978, Table 1).
18 samples plot on an isochron of 1950 ± 40 m.y.
Initial ratio: 0.7040 ± 16 MSWD: 1.4

(j) Knækdalen siliceous biotite gneiss.

Locality: Knækdalen 73°12'20"N, 27°43'00"W.
12 samples analysed, data in Higgins *et al.* (1978, Table 2).
8 samples plot on an isochron of 1725 ± 75 m.y.
Initial ratio: 0.7052°13 MSWD: 1.2

4 samples plot on an isochron of 1980 ± 220 m.y.
Initial ratio: 0.7038°37 MSWD: 0.27

(k) Niggli Spids augen gneiss.

Locality: South of Nigglis Dal 73°12'20"N, 26°37'00'W.

GGU sample no.	Rb ppm	Sr ppm	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$
133265 Augen gneiss	103	230	1.29	0.7384 ± 3
133266 - -	127	203	1.80	0.7466 ± 2
133267 Coarse mica rich gneiss	135	292	1.33	0.7332 ± 1
133268 Foliated augen gneiss	102	274	1.07	0.7365 ± 2
133269 Augen gneiss	121	286	1.21	0.7402 ± 1
133270 - -	98	263	1.07	0.7362 ± 3
133271 - -	117	246	1.37	0.7377 ± 2

Data permits no conclusions.

133267 Whole rock	135	292	1.33	0.7332 ± 1
133267 Feldspar	204	472	1.25	0.7330 ± 3
133267 Muscovite	332	22.4	43.01	0.9592 ± 2
133267 Biotite	582	5.6	302.7	2.3210 ± 3

Mineral - whole rock isochron age 370 ± 5 m.y. - fig. 2c.
Initial ratio: 0.7283 ± 6 MSWD: 1.5

Table 2. Middle and late Proterozoic units - metasediments

(a) Paradisdal metasediments - fig. 3.

GGU sample no.	Rb ppm	Sr ppm	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$
133232 Foliated silic. gneiss	47	255	0.526	0.7344±3
133233 - - -	47	237	0.570	0.7327±4
133234 Siliceous biotite gneiss	126	259	1.39	0.7525±8
133235 Biotite schist	152	201	2.17	0.7556±3
133236 Psammite	47	238	0.567	0.7388±3
133237 -	30	261	0.331	0.7322±7
133238 Banded siliceous gneiss	67	229	0.833	0.7348±3
216517 - - -	92	250	1.07	0.7381±2

Locality: Upper Paradisdal 73°05'25"N, 27°11'-13'W.
Data plot about a *1000* m.y. reference line - not an isochron.

(b) Kjerulfs Fjord metasediments - fig. 3.

GGU sample no.	Rb ppm	Sr ppm	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$
133240 Foliated biot. psammite	87	301	0.835	0.7272±10
133241 Massive - -	72	267	0.777	0.7284±5
133242 Psammite with veins	65	278	0.667	0.7296±4
133243 Psammite	76	211	1.03	0.7331±8
133244 Dark feldspath. psamm.	125	290	1.24	0.7405±5
133245 Leucocratic band	26	217	0.342	0.7248±3

Locality: West side of fjord 73°06'15"N, 27°24'00"W.
Data plot about a 1000 m.y. reference line - not an isochron.

(c) Engdalen siliceous gneiss - fig. 3.

GGU sample no.	Rb ppm	Sr ppm	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$
133254 Siliceous gneiss	66	256	0.739	0.7295±3
133255 Micaceous silic. gneiss	75	232	0.928	0.7303±2
133256 Psammite	75	242	0.892	0.7293±1
133257 -	35	246	0.412	0.7235±5
133258 Fine grained psammite	61	234	0.745	0.7250±3
133259 - - -	64	243	0.754	0.7250±4

Locality: 700 m west of Engdalen 73°10'45"N, 27°18'00"W.
Data do not form an isochron.

(d) Engdalen psammite band - fig. 3.

GGU sample no.	Rb ppm	Sr ppm	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$
228408 Fine grained quartzite	39	22	5.21	0.77909 ± 20
228409 - - -	29	65	1.29	0.75260 ± 5
228410 - - -	34	51	1.96	0.75529 ± 5
228411 - - -	36	91	1.14	0.74958 ± 5
228412 - - -	44	65	1.98	0.75810 ± 5
228413 - - -	29	40	2.12	0.75405 ± 5
228414 - - -	21	55	1.10	0.75410 ± 5
228415 - - -	54	43	3.67	0.76918 ± 9
228416 - - -	50	65	2.25	0.75977 ± 16
228417 - - -	66	106	1.80	0.77293 ± 23
228418 - - -	24	112	0.632	0.75615 ± 7
228419 - - -	45	185	0.702	0.76225 ± 5

Locality: 2.7 km west of Engdalen 73°09'40"N, 27°24'00"W.
Data do not form an isochron.

(e) Arthurs Dal siliceous gneiss - fig. 3.

GGU sample no.	Rb ppm	Sr ppm	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$
241991 Foliated silic. biot. gneiss	43	269	0.460	0.71944 ± 7
241992 - - - -	51	245	0.603	0.72132 ± 5
241994 - - - -	45	243	0.539	0.72115 ± 5
241995 - - - -	42	254	0.482	0.72003 ± 7
241996 - - - -	44	261	0.492	0.72021 ± 6
241997 - - - -	41	247	0.483	0.71994 ± 5
241998 - - - -	44	260	0.485	0.72038 ± 5
241999 - - - -	43	251	0.499	0.72045 ± 5
242000 - - - -	45	249	0.518	0.72090 ± 5

Locality: 1000 m west of Arthurs Dal 73°08'12"N, 27°06'00"W.
Data do not form an isochron.

(f) Tærskeldal banded gneiss - fig. 3.

GGU sample no.	Rb ppm	Sr ppm	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$
133102 Banded gneiss	123	161	2.19	0.7479 ± 2
133103 - -	83	130	1.83	0.7508 ± 2
133105 Biotite gneiss	47	247	0.545	0.7259 ± 4
133106 Amphibolite	8.0	144	0.160	0.7098 ± 3
133107 Banded gneiss	51	175	0.832	0.7323 ± 2
133110 Gneiss	59	160	1.06	0.7355 ± 2
133111 Banded gneiss	48	401	0.345	0.7152 ± 2
133112 Garnet gneiss	87	210	1.18	0.7360 ± 3
133115 Banded gneiss	106	347	0.880	0.7399 ± 5
133117 - -	101	421	0.690	0.7307 ± 3
133118 - -	17	65	0.774	0.7212 ± 2
133120 - -	110	88	3.59	0.7630 ± 3

Locality: North-east Tærskeldal 72°22'50"N, 26°22'00"W.
Data do not form an isochron.

(g) Forsblads Fjord gneissic quartzites - fig. 3.

Locality: Inner Forsblads Fjord, several localities around 72°24'N, 26°17'W.
12 samples analysed, data in Rex *et al.* (1977, Table 4).
11 samples plot on an errorchron of 1245 ± 100 m.y.
Initial ratio: 0.712 ± 10 MSWD: 142

Table 3. Middle and late Proterozoic rock units - 'older' granites

(a) Eremitdal foliated granite - fig. 4a.

GGU sample no.	Rb ppm	Sr ppm	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$
234427 Foliated musc. granite	126	53	6.90	0.81296±6
234428 - - -	141	104	3.95	0.76709±4
234429 - - -	139	61	6.65	0.80284±8
234430 - - -	155	78	5.80	0.79203±20
224431 - - -	110	167	0.91	0.73839±10
234432 - - -	144	144	2.92	0.75460±5
234434 - - -	129	72	5.26	0.78877±5
234436* Pegmatitic granite	87	285	0.88	0.73394±6

Locality: East side inner Eremitdal 73°45'45"N, 26°17'00"W.
Isochron age: 1000±70 m.y. *excluded from age calculation.
Initial ratio: 0.7113±37 MSWD: 2.8

(b) Gneisdal foliated granite - fig. 4b.

GGU sample no.	Rb ppm	Sr ppm	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$
234438 Foliated musc. granite	290	18	51.3	1.42552±13
234439 - - -	99	120	2.39	0.74309±5
234440 - - -	235	12	65.4	1.75569±42
234441 - - -	291	10	93.0	1.99521±22
234442 - - -	226	25	27.6	1.19478±26

Locality: West side of inner Gneisdal 73±37'20"N, 26±38'30"W.
Errorchron age :1080±200 m.y.
Initial ratio: 0.706±16 MSWD: 35

(c) Forsblads Fjord migmatite granite - fig. 4c.

GGU sample no.	Rb ppm	Sr ppm	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$
234467 Foliated biotite granite	220	123	5.21	0.76591±5
234468 - - -	181	230	2.28	0.73676±5
234469 - - -	193	144	3.90	0.75427±5
234470 - - -	186	210	2.57	0.74011±5
234471 - - -	197	209	2.74	0.74056±5
234472 - - -	202	164	3.59	0.75296±5

Locality: South of Caledoniaø 72°24'20"N, 25°52'00"W.
Errorchron age: 750±130 m.y.
Initial ratio: 0.7122±58 MSWD: 16

(d) Louise Boyd Land granite - fig. 4d.

Locality: North-west Louise Boyd Land 73°39'55"N, 28°03'00"W.

GGU sample no.	Rb ppm	Sr ppm	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$
228494 Aplitic granite	232	94	7.21	0.77455 ± 8
228496 - -	121	271	1.29	0.71981 ± 36
228499 Biotite granite	95	517	0.530	0.71253 ± 6
228501 - -	129	522	0.713	0.71422 ± 8
228503 - -	121	497	0.704	0.71446 ± 6

Isochron age: 650 ± 42 m.y.
Initial ratio: 0.7077 ± 5 MSWD: 1.1

228495 Aplitic granite	163	322	1.47	0.72433 ± 10
228497 Biotite-musc. granite	120	409	0.854	0.71800 ± 5
228498 - - -	120	413	0.841	0.71781 ± 7
228500 - - -	136	353	1.11	0.72087 ± 6
228502 Muscovite granite	163	287	1.65	0.72691 ± 5

Isochron age: 765 ± 90 m.y.
Initial ratio: 0.7087 ± 14 MSWD: 0.5

228502 Muscovite	540	30	54.7	1.04091 ± 12
228502 Biotite	1043	8	455.5	3.42371 ± 57

Mineral isochron age: 416 ± 6 m.y.
Initial ratio: 0.7171 ± 3 MSWD: 0.1

(e) Isfjord biotite granite.

GGU sample no.	Rb ppm	Sr ppm	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$
228448 Biotite granite	134	1308	0.297	0.71078 ± 6
228449 - -	141	1339	0.305	0.71074 ± 6
228451 - -	139	1425	0.282	0.71071 ± 6
228452 - -	146	1384	0.305	0.71070 ± 6
228458 - -	135	1351	0.290	0.71065 ± 6
228459 - -	137	1380	0.287	0.71058 ± 6

Locality: East side Isfjord 73°25'40"N, 27°05'00"W.
Data does not plot on an isochron.

(f) Forsblads Fjord granite sill.

GGU sample no.	Rb ppm	Sr ppm	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$
236435 Foliated hnbl granite	37	413	0.258	0.70739±5
236436 - - -	54	446	0.352	0.70860±5
236437 - - -	30	469	0.184	0.70759±5
236439 - - -	38	427	0.256	0.70677±7
236440 - - -	26	477	0.156	0.70515±5
236441 - - -	36	431	0.238	0.70765±6
236442 - - -	34	453	0.217	0.70695±6
236443 - - -	44	432	0.292	0.70855±5
236445 - - -	33	465	0.203	0.70646±6
236446 - - -	35	324	0.314	0.70563±5
133171 - - -	27	558	0.139	0.70556±5

Locality: Inner Forsblads Fjord 72°23'30"N, 26°17'30"W.
Data does not plot on an isochron.

Table 4. Caledonian granites

(a) Forsblads Fjord muscovite-biotite granite.

Locality: South side of fjord east of Caledoniaø 72°23'20"N, 25°43'00"W, except for one sample 72°23'20"N, 25°47'30"W.
6 samples analysed, data in Rex *et al.* (1976, Table 10).
Isochron age (recalculated): 445 ± 5 m.y.
Initial ratio: 0.7188 ± 4 MSWD: 0.3

(b) Forsblads Fjord sillimanite granite - fig. 5a.

GGU sample no.	Rb ppm	Sr ppm	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$
200007 Coarse musc. granite	101	176	1.67	0.74736 ± 5
200008 Leucocratic granite	115	161	2.08	0.74869 ± 9
200009 - -	120	130	2.69	0.75303 ± 6
200010 - -	112	158	2.04	0.74850 ± 12
200011 - -	110	84	3.79	0.75981 ± 5
200012 - -	113	84	3.90	0.76016 ± 4
200013 - -	96	186	1.49	0.74558 ± 4
200014 - -	107	128	2.42	0.75187 ± 5
200015* Coarse garnet-biot. granite	138	132	3.04	0.77079 ± 6
200016* - - - -	176	250	2.05	0.74642 ± 9

Locality: North side central Forsblads Fjord 72°24'50"N, 26°01'30"W.
Errochron age: 430 ± 48 m.y. * excluded from calculation.
Initial ratio: 0.7365 ± 15 MSWD: 14

(c) Djævlekløften - Rendalen granite sheets - fig. 5b.

GGU sample no.	Rb ppm	Sr ppm	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$
200020 Foliated musc.-biot. granite	300	89	9.87	0.78802 ± 5
200021 - - - -	275	112	7.18	0.77023 ± 9
200022 - - - -	299	84	10.4	0.79142 ± 7
200023 - - - -	285	96	8.71	0.78064 ± 5
200024 - - - -	257	108	6.93	0.77744 ± 7
200025 Fine grained musc. granite	245	66	10.9	0.80501 ± 4
200026 Biotite-muscovite granite	258	121	6.21	0.76286 ± 8
200027 Muscovite granite	264	112	6.85	0.77016 ± 5
200028 Foliated musc.-biotite granite	254	128	5.78	0.75992 ± 6
200029 - - - -	203	239	2.74	0.73351 ± 5

Locality: South-west end of Djævlekløften 73°27'20"N, 25°40'00"W.
Errorchron age: 560 ± 56 m.y.
Initial ratio: 0.7141 ± 45 MSWD: 11

(d) Gneisdal muscovite granite - fig. 5c.

GGU sample no.	Rb ppm	Sr ppm	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$
234443 Muscovite granite	156	144	3.16	0.75218 ± 6
234444 - -	157	107	4.28	0.76179 ± 22
234445 - -	146	138	3.07	0.74976 ± 4
234446 - -	173	147	3.43	0.75350 ± 5
224447 - -	135	183	2.17	0.74490 ± 9
234448 - -	143	129	3.22	0.75098 ± 9
234449 - -	173	149	3.38	0.75226 ± 10
234450 - -	188	131	4.16	0.75684 ± 24
234451 - -	179	154	3.38	0.75251 ± 5
234452 - -	180	134	3.91	0.75547 ± 11

Locality: South side of valley 73°38'30"N, 26°30'00"W.
Errorchron age: 480 ± 83 m.y.
Initial ratio: 0.7296 ± 38 MSWD: 20

(e) Djævlekløften leucocratic granite - fig. 5d.

GGU sample no.	Rb ppm	Sr ppm	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$
228479 Leucocratic musc. granite	165	105	4.58	0.76365 ± 5
228480 - - -	203	102	5.80	0.77027 ± 5
228481 - - -	177	116	4.44	0.76235 ± 5
228484 - - -	174	118	4.29	0.76200 ± 5
228486 - - -	158	115	4.00	0.75882 ± 5
228487 - - -	181	104	5.08	0.76558 ± 5
228488 - - -	168	99	4.95	0.76584 ± 6
228489 - - -	180	98	5.37	0.76821 ± 8

Locality: North-east end of Djævlekløften 73°34'50"N, 26°20'00"W.
Isochron age: 433 ± 68 m.y.
Initial ratio: 0.735 ± 5 MSWD: 0.8

(f) Grejsdal granite - fig. 5e.

GGU sample no.	Rb ppm	Sr ppm	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$
228467 Biotite quartz monzonite	205	242	2.45	0.73018 ± 5
228472 - - -	208	251	2.40	0.73024 ± 5
228474 - - -	199	254	2.27	0.72968 ± 11

Approximate age: 377 m.y.
Initial ratio: 0.716

228475 Aplitic granite	227	65	10.13	0.79608 ± 5
228476 - -	206	76	7.94	0.78399 ± 7
228477 - -	210	76	8.09	0.78574 ± 15

Locality: Quartz monzonites and aplites, north side central Grejsdalen 73°36'25"N, 26°03'00"W.
Isochron age (aplites): 377 ± 89 m.y.
Initial ratio (aplites): 0.742 MSWD: 0.6

(g) Nunatakgletscher granite - fig. 5f.

GGU sample no.	Rb ppm	Sr ppm	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$
236358 Musc.-biotite granite	209	126	4.83	0.76836 ± 5
236359 - - -	211	111	5.53	0.77453 ± 30
236360 - - -	207	114	5.25	0.77057 ± 9
236361 - - -	201	122	4.81	0.77049 ± 6
236362 - - -	203	125	4.75	0.76841 ± 8
236363 - - -	206	122	4.92	0.76986 ± 35
236364 - - -	200	126	4.60	0.76756 ± 5

Locality: South side of Nunatakgletscher 73°55'25"N, 25°54'00"W.
Isochron age: 550 ± 180 m.y.
Initial ratio: 0.731 ± 19 MSWD: 2

(h) Hamlet Bjerg biotite granite - fig. 5g.

GGU sample no.	Rb ppm	Sr ppm	$^{87}Rb/^{86}Sr$	$^{87}Sr/^{86}Sr$
228325 Biotite granite	360	78	13.4	0.79840 ± 7
228331 - -	190	174	3.17	0.74017 ± 7
228333 - -	217	178	3.54	0.74240 ± 5
228333 Muscovite	508	20	87.9	1.2473 ± 8
228333 Plagioclase	262	325	2.28	0.73414 ± 5
228333 Microcline	371	317	3.30	0.74011 ± 10
228333 Biotite	888	8.7	350.0	2.6410 ± 6

Locality: Summit of Hamlet Bjerg 72°50'45"N, 28°39'00"W.
Mineral - whole rock isochron age: 415 ± 23 m.y. (sample 228333 only).
Initial ratio: 0.7208 ± 14 MSWD: 1.5

Table 5. Initial $^{87}Sr/^{86}Sr$ ratios for granitic rocks

Rock unit	Table	Rb-Sr whole rock age m.y.	Initial $^{87}Sr/^{86}Sr$ ratio	Rb-Sr min. isochron age	K-Ar min. age m.y.* musc.	biotite
Emilia Bjerg foliated granite	1g	1975±290	0.7034±53	410±50	418	467
Leuco. bio.-musc. granite - K.F.J.Fj.	1i	1950±40	0.7040±16		415	462
Eremitdal foliated granite	3a	1000±70	0.7113±37			
Gneisdal foliated granite	3b	1080±200	0.7060±160			
Forsblads Fjord migmatite granite	3c	750±130	0.7122±58			
Louise Boyd Land granite	3d	650±42	0.7077±5	416±6	417	428
		765±90	0.7087±14			
Isfjord biotite granite	3e		0.7090†			406
Forsblads Fjord musc.-bio. granite	4a	445±5	0.7188±4		422	418
Forsblads Fjord sillimanite granite	4b	430±48	0.7365±15			
Djævlekløften-Rendalen sheets	4c	560±56	0.7141±45			
Gneisdal muscovite granite	4d	480±83	0.7296±38			
Djævlekløften leucocratic granite	4e	433±68	0.7350±50		415	407
Grejsdalen granite/monzonite	4f	c.377	c.0.716		404	
Nunatakgletscher granite	4g	550±180	0.731 ±19			
Hamlet Bjerg granite	4h		0.7218±14‡	415±23‡	432	425

* Unpublished data by D.C.R. & A.R.G.
† Assuming age of 400 m.y.
‡ Whole rock - mineral isochron.

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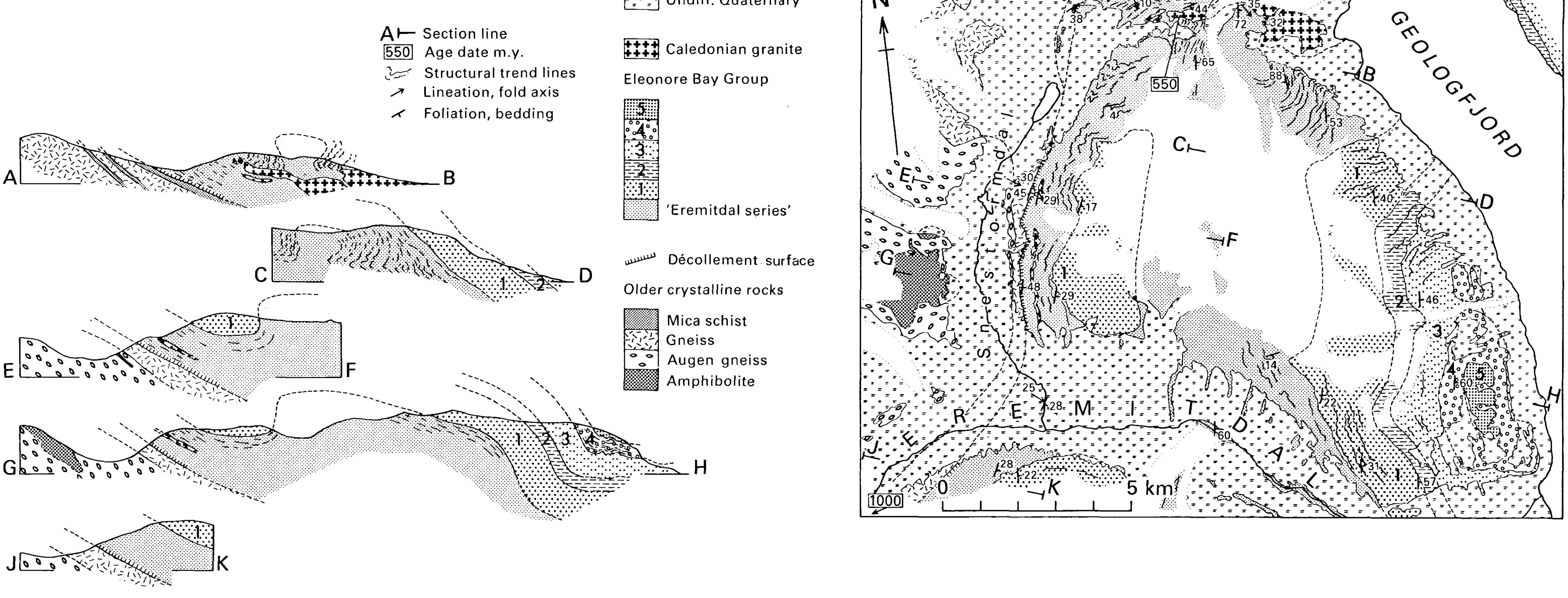
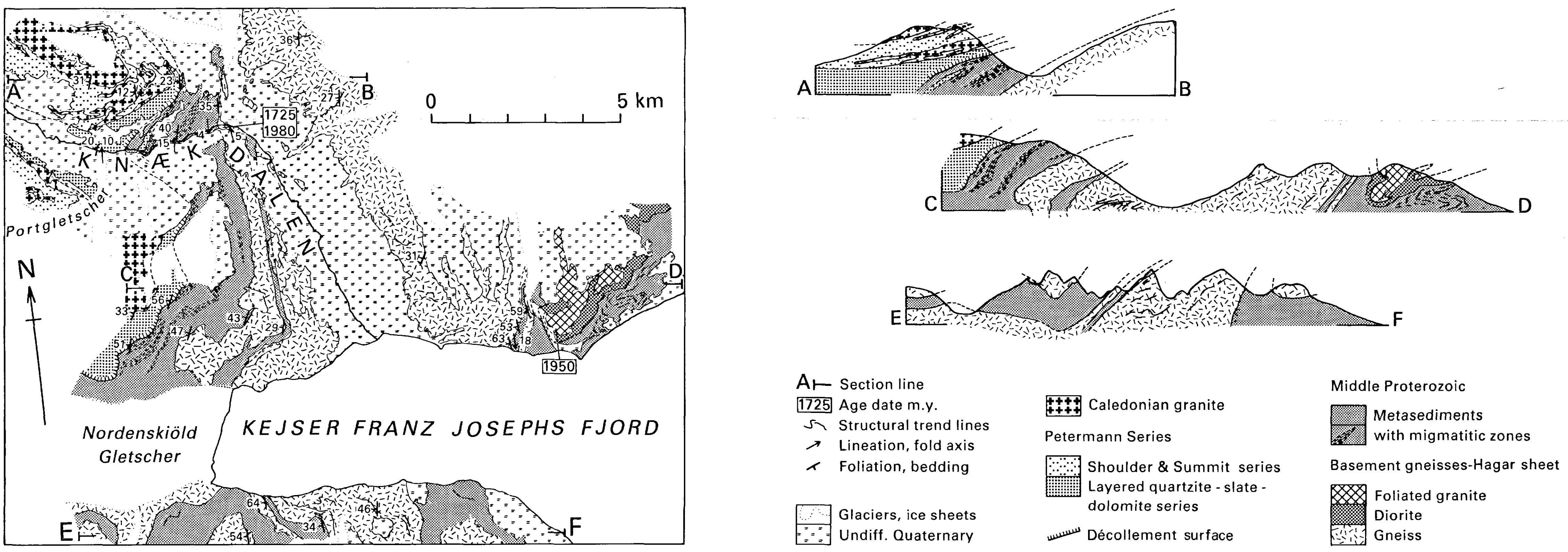
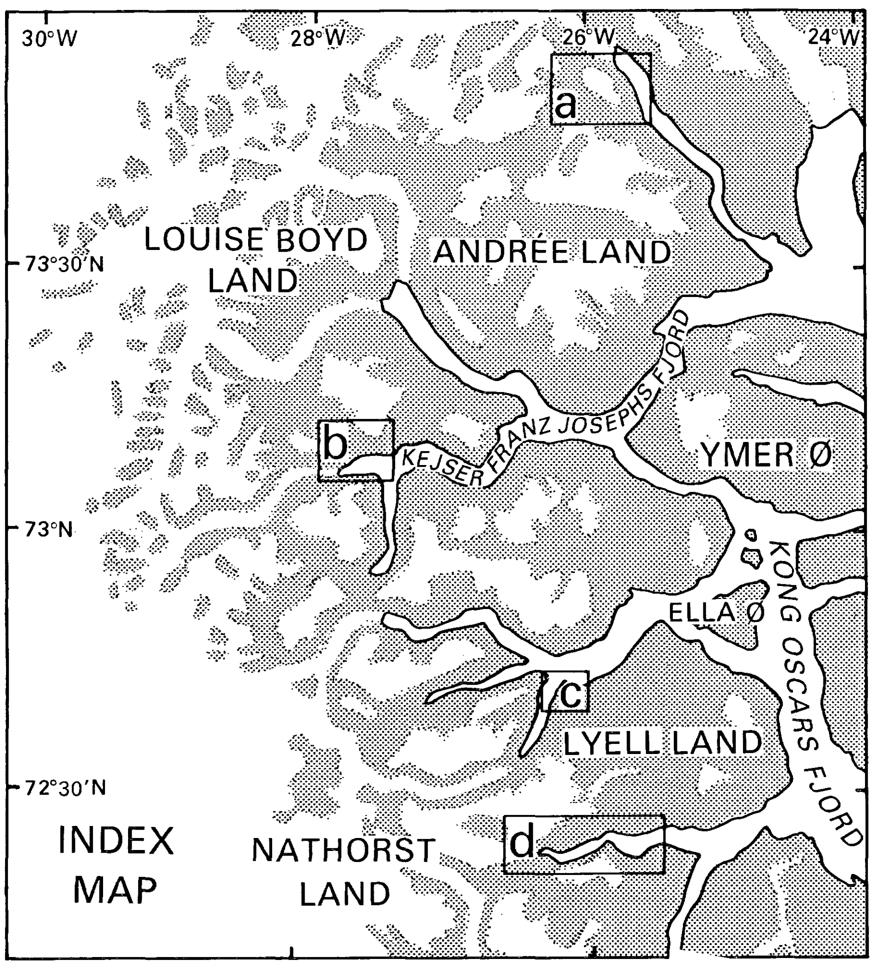
22441
Enclosure (1/1)

a Nunatakgletscher - Eremitdal

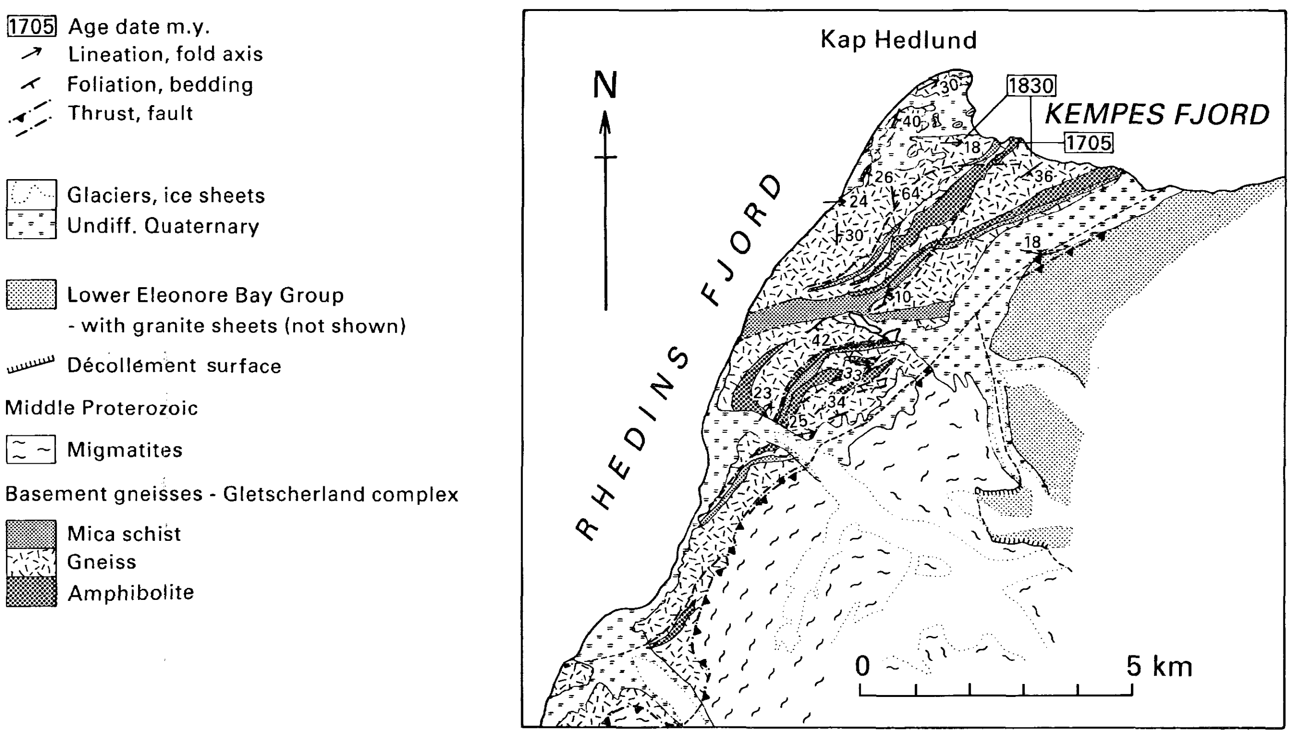


b Knækdalen





c Kap Hedlund



d. Tærskeldal - Forsblads Fjord - Randenæs