

Rb-Sr whole-rock measurements of the Kap York meta-igneous complex, Thule district, North-West Greenland

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The Precambrian basement of the Kap York – Melville Bugt region is high-grade gneiss, composed of both orthogneisses and paragneisses, in which several units of metasedimentary and meta-igneous rocks occur. The largest occurrence of igneous rocks that has retained magmatic aspect is the Kap York meta-igneous complex which is composed of a rock suite of acidic to basic composition occupying the whole of the Kap York peninsula (fig. 8). On the Tectonic/Geological map of Greenland (Escher, 1970) the Kap York rocks were included in the Proterozoic Nagssugtoqidian orogenic complex which, elsewhere to the south in Greenland, yields K-Ar ages between 1790 and 1650 m.y.

Field evidence suggests that a major period of deformation, metamorphism and gneissification post-dates the intrusion of the Kap York complex, and it is thought that a large part of the gneisses to the east of Kap York in the northern part of Melville Bugt has been derived from igneous material of the same age (Dawes, 1979a). However, it is also considered likely that the Kap York complex post-dates important episodes of metamorphism and deformation that affected the gneissic terrain which composes the central part of Thule district (Dawes, 1975).

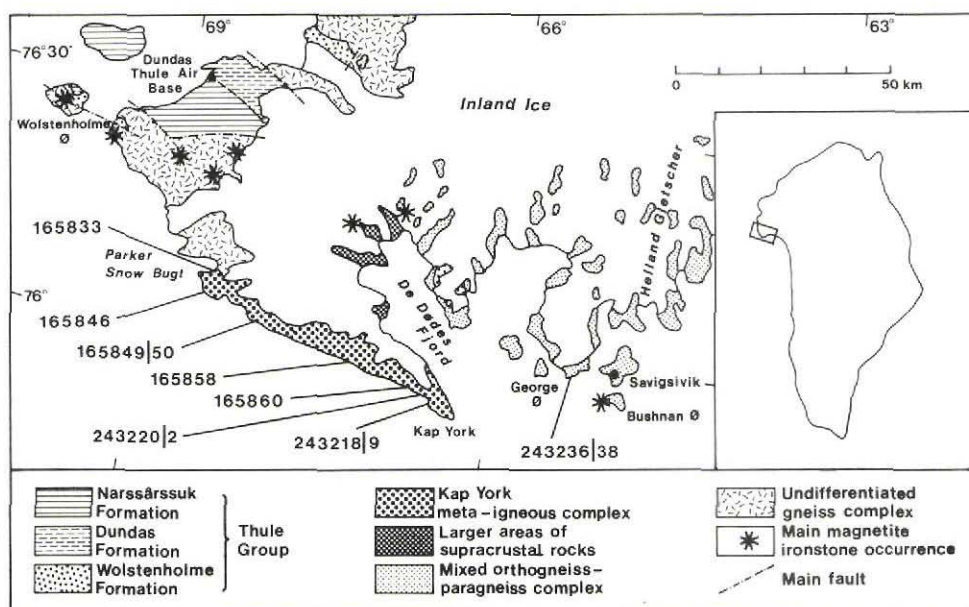


Fig. 8. Geological sketch map showing the locations of the 12 samples used in the Rb-Sr whole-rock isotopic study. Adapted from Dawes (1979a).

The present Rb-Sr isotope work has been carried out in an attempt to establish the age of this major magmatic event in the Precambrian evolution.

The material

The rock material used in the Rb-Sr analysis was chosen from rock collections made by one of us (PRD) during regional geological mapping. All the sample numbers quoted here refer to randomly collected single hand specimens of variable size; no detailed sampling specifically for isotopic work was carried out at these particular localities. Of the 12 samples used in the Rb-Sr study, two (GGU 243236, 243238) are igneous rocks collected some way to the east of the Kap York peninsula (fig. 8) and from an area where at least some of the country rock gneisses have been derived from such igneous rocks.

The processed samples are medium-grained, more-or-less equigranular rocks varying from melanocratic to leucocratic and having a variable alkali feldspar-plagioclase ratio. Two samples (GGU 243222, 243238) display a schistosity. The samples have a compositional range from gabbro and norite (GGU 243218, 243220, 243236) to hypersthene-bearing monzonite and quartz diorite (GGU 165846, 165849, 165850, 243238) to granodiorite and granite (GGU 165858, 165860, 243219, 243222). Hypersthene is a characteristic primary mafic mineral.

Method

The Rb/Sr and $^{87}\text{Sr}/^{86}\text{Sr}$ ratios were measured by one of us (FK) at the Institute of Petrology, University of Copenhagen following the analytical techniques described by Kalsbeek *et al.* (1978). Ages were calculated using $\lambda^{87}\text{Rb} = 1.42 \times 10^{-11} \text{ year}^{-1}$.

Results and discussion

The analytical results of the 12 samples are given in Table 1 and displayed in fig. 9. In the $^{87}\text{Sr}/^{86}\text{Sr} - ^{87}\text{Rb}/^{86}\text{Sr}$ diagram the samples do not define an isochron, but lie in a fan between an upper *c.* 2700 m.y. line and a lower *c.* 2000 m.y. line. Six of the samples plot within analytical precision on a 2720 ± 60 m.y. line with an initial $^{87}\text{Sr}/^{86}\text{Sr}$ ratio of 0.7035 ± 0.003 . The other samples lie considerably below this line.

It is noteworthy that of the six samples that plot on the 2720 m.y. line, four (GGU 165833, 165846, 165849, 165850) are from the north-western part of the complex where post-intrusion deformation effects are least in evidence. Conversely, four of the samples that show a scatter below this line (GGU 243220, 243222, 243236, 243238) were collected from areas that are known from field evidence to have undergone severe later deformation.

The most likely interpretation of the data is that the rocks of the Kap York complex were intruded *c.* 2700 m.y. ago, but the Sr-isotope systems were severely disturbed during the later Proterozoic metamorphism. Rb-Sr measurements from the Etah meta-igneous complex in the northern part of the Thule district (78° – 79°N) showed a similar scatter in the isochron diagram and were interpreted as a 1960 m.y. age of metamorphism affecting considerably older rocks (Larsen & Dawes, 1974). Archaean rocks have been recognised in the Upernavik district south of Melville Bugt (Escher & Stecher, 1978). There the Archaean

Table 1. Analytical results of whole-rock samples of the Kap York meta-igneous complex and associated rocks, Thule district, North-West Greenland

GGU Sample No	Rb(ppm) *	Sr(ppm) *	Rb/Sr †	$^{87}\text{Sr}/^{86}\text{Sr}$ §	$^{87}\text{Rb}/^{86}\text{Sr}$
243218	50	471	0.105	0.7133	0.304
243219	18	231	0.074	0.7116	0.214
243220	103	264	0.394	0.7417	1.143
243222	110	288	0.387	0.7458	1.123
243236	99	409	0.246	0.7290	0.715
243238	144	701	0.206	0.7245	0.596
165833	20	660	0.030	0.7069	0.086
165846	41	307	0.134	0.7190	0.389
165849	5	439	0.0106	0.7048	0.0307
165850	4	415	0.0084	0.7046	0.0243
165858	112	82	1.364	0.8210	3.993
165860	114	191	0.593	0.7716	1.727

* Estimate ($\pm 10\%$) only; matrix correction based on backgrounds.

† Rb/Sr ratios relative to USGS G-2 = 0.355. Precision c. 1% (1σ).

§ $^{87}\text{Sr}/^{86}\text{Sr}$ ratios normalised and relative to Eimer & Amend $\text{SrCO}_3 = 0.7080$.

Precision c. ± 0.0003 (1σ).

gneisses are overlain by metasediments for which a metamorphic age of c. 1800–1900 m.y. has been determined by Rb-Sr whole-rock measurements (Kalsbeek, unpublished). K-Ar ages of hornblende from the Etah meta-igneous complex likewise indicate a main phase of metamorphism at c. 1750–1900 m.y. Thus, the interpretation that the Kap York meta-igneous complex represents Archaean intrusive material strongly affected by later (Hudsonian) metamorphism is consistent with evidence from regions both to the north and south.

The conclusion that the Kap York meta-igneous complex is of Archaean age is of particular interest because it suggests that the Archaean block of Greenland extends as far north as the Thule district. It confirms the field interpretation, based on the long history of Precambrian events, that a large part of the region affected by Proterozoic metamorphism in North-West Greenland was originally formed in the Archaean (Dawes, 1972, 1979b).

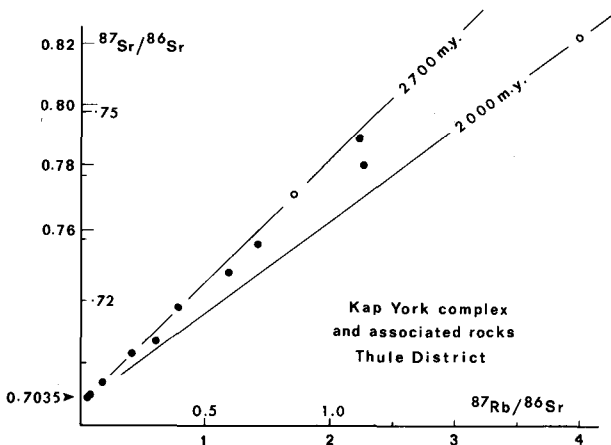


Fig. 9. Rb-Sr isochron diagram for the whole-rock samples from the Kap York meta-igneous complex, given in Table 1. The samples indicated by filled circles have been plotted according to the scale shown on the inside of the x and y axes. The samples indicated with open circles have been plotted according to the scale shown on the outside of the axes.

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Preliminary investigations of the Quaternary of Melville Bugt and Dundas, North-West Greenland

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Two weeks were spent in the area shown in fig. 10 in 1978, mainly in northern Melville Bugt, but including a brief visit to sites around Dundas. Sample material from these areas was analysed for ^{14}C and amino acids in 1979 and the results are listed in 'Results'.

Melville Bugt

There is evidence of glaciation in the form of erratics and isolated till deposits in all the areas visited, including the outermost peninsulas and islands, e.g. Kap York, Bushnan Ø, Kap Walker, Skene Øer, Sabine Øer. This last occurrence represents an expansion of the Greenland Ice Sheet of at least 40 km. Although the northern localities are near to present day local ice caps, their topographic setting, and the provenience of their erratics in some cases, indicate that an ice sheet has covered this area also. For instance, sandstone erratics of the Thule Group, occurring at over 400 m on the plateau at Kap York, may have been transported from the zone of Thule Group outcrops to the north by ice filling De Dødes Fjord, which is a deep trough, over 1000 m deep opposite Kap York.

The distribution of ice at this ice sheet stage of glacierisation suggests that most of the