K/Ar WHOLE ROCK AGES OF DOLERITES FROM THE THULE DISTRICT, WESTERN NORTH GREENLAND

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Eight dolerite samples from sills and dykes were collected for age dating in the summer of 1971 (Dawes, 1972) while a single sample (GGU 142099) was collected by Jepsen during a short visit to the Dundas area in 1970. The age determination work on these rocks was carried out by Rex at the University of Leeds.

This note summarises the results of the dating work – a detailed account containing the regional implications of the results will be published elsewhere.

Aim of study

The main aim of the study was to determine a minimum age for the unfossiliferous and unmetamorphosed strata which unconformably overlie the crystalline basement in the Wolstenholme Fjord-Inglefield Land region of North Greenland (fig. 7). These rocks constitute the Thule Group (Thule Formation of Koch, 1929) with a type locality at Wolstenholme Fjord around the old settlement of Thule (present-day Dundas).

In the Wolstenholme Fjord-Prudhoe Land area the section composed of the Wolstenholme Formation of clastics overlain by the Dundas Formation of shales and sandstone and the Narssârssuk Formation of cyclic-bedded dolomite and siltstone, is at least 3500 m thick. In Inglefield Land a conspicuously thinner clastic-dolomite section (about 200 m) was correlated by Koch (1929) and Troelsen (1950) with the type section. Relationships of basic igneous intrusions to this stratigraphy is summarised in fig. 8.

Troelsen (1950) also correlated the Inglefield Land succession across Smith Sound with the section on Bache Peninsula where basic intrusions are similarly restricted to the Rensselaer Bay Sandstone. Proposed correlations between fossiliferous rocks farther to the north in Canada have led to claims for a Lower Cambrian age for the Rensselaer Bay Sandstone (Kerr, 1967). This clearly had implications as to the age of the section in Greenland where it has been argued that the Thule Group and correlatable strata may be all or in part Precambrian, Eocambrian or Palaeozoic in age.

The material

Essential field relations and the localities of the rocks are given in table 2 and in figs. 7 and 8. All sills and dykes represent intrusive rocks into sedimentary strata and the K/Ar dates are accepted as inferring minimum ages for the host sediments.

The material is doleritic, fine to medium grained with sub-ophitic to ophitic

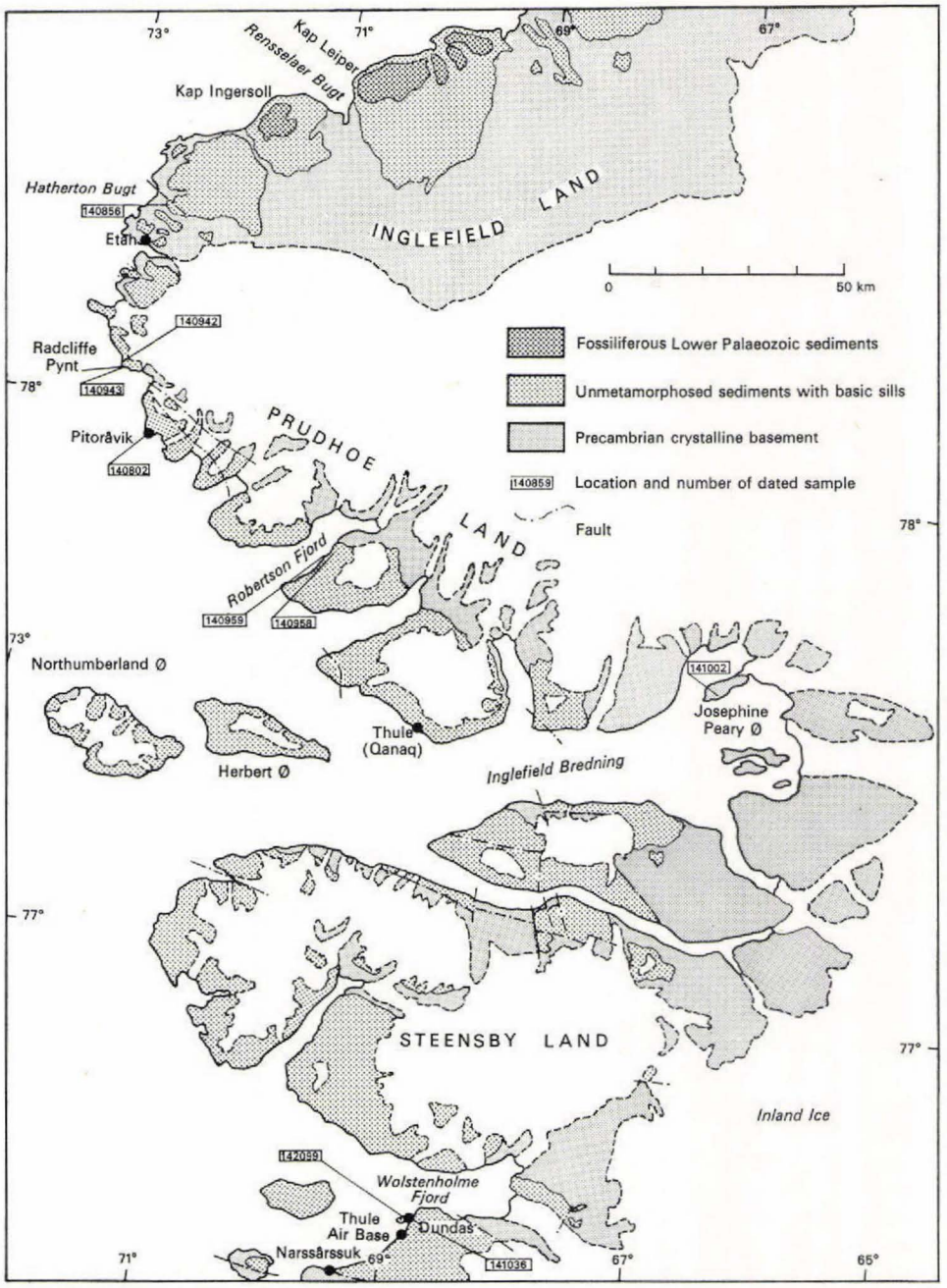

Fig. 7. Simplified geological sketch map of the region between Wolstenholme Fjord and Inglefield Land, North Greenland, showing the localities of the dolerite material reported on in the article by Dawes *et al.*

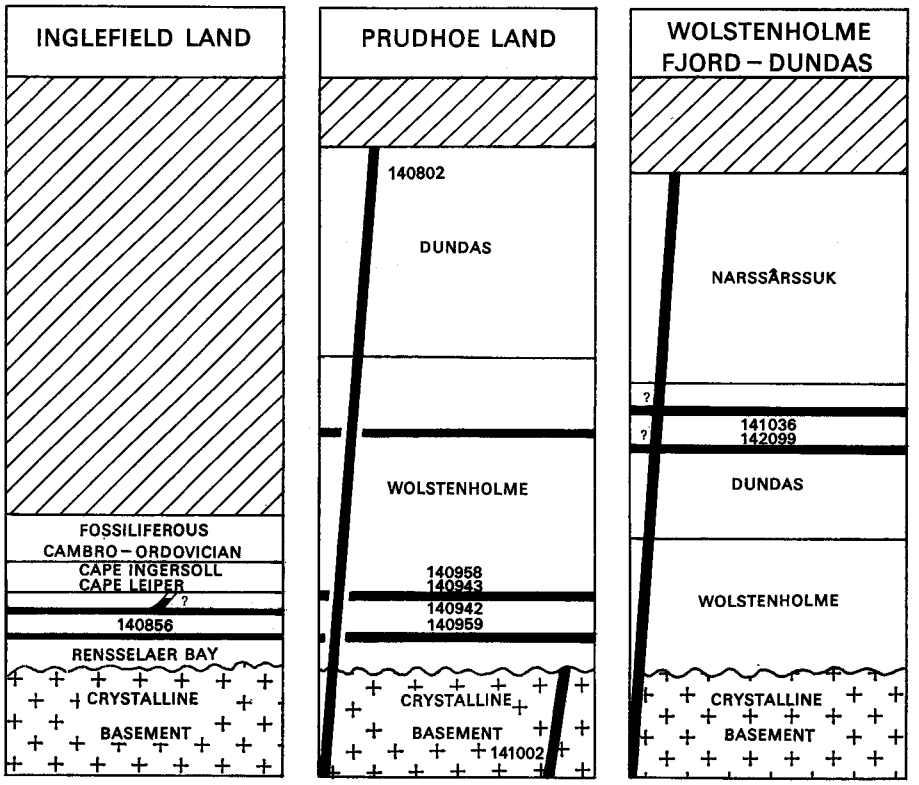

Fig. 8. Diagrammatic chart illustrating the relationship between basic instrusions and sediments in three areas of western North Greenland. Sedimentary units are shown with approximate relative thicknesses and thus horizontal lines at the same level are not isochronous and no correlation is implied between the three stratigraphical columns. Sample numbers indicate the geological setting of the dated material reported on by Dawes *et al.*

textures. No secondary fabric occurs in any of the rocks but all show evidence of alteration which is regarded as being essentially deuteric.

Experimental procedures

Samples were crushed and sieved and the 40–90 mesh size fraction taken for analysis. Potassium was determined by flame photometry, the quotod result being the average of three determinations. The argon was extracted "in vacuo" and measured by isotope dilution on a modified AEI MS10 mass spectrometer, operated under static conditions and fitted with digital output (Rex & Dobson, 1970). The errors are quoted at the 95 % confidence limit and determined from replicate analyses.

Table 2. K/Ar whole rock ages and details of dolerite samples from North Greenland

K/Ar age group	GGU sample no.	Approx. coordinate position	Rock type – geological setting	Intrusive field relations	% K	Vol $^{40}Ar_{rad.}$ cm^3STP/g $\times 10^{-4}$	$\%\ ^{40}Ar_{rad.}$	Age m.y.
3	141036	76°34′N 68°45′W	Sill cutting shales and siltstones in road cutting behind Dundas village	Post-Dundas Form.	0.33	0.0809	65.2	532±20
	142099	76°34′N 68°49′W	Sill cutting shale and sandstone at Dundas village	Post-Dundas Form.	0.27	0.0777	85.9	610±24
	140802	77°56′N 72°10′W	ESE-trending dyke cutting shale, siltstone and sandstone at Pitorâvik, Prudhoe Land	Post-Dundas Form., ? post-Narssârssuk Formation	0.77	0.2497	90.8	676±25
	140958	77°48′N 70°16′W	Highest of three sills cutting sandstone and conglomerate, Robertson Fjord	Post-Wolstenholme Formation	4.67	1.7582	94.5	764±30
2	140942	78°06′N 72°38′W	Middle sill of three cutting shales and sandstone. Radcliffe Pynt, Prudhoe Land	Post-Rensselaer Bay Sandstone	2.63	1.5114	96.7	1070±40
	140856	78°24′N 72°35′W	Lower of two sills cutting Hatherson and Sverdrup Members, SW Inglefield Land	Post-Rensselaer Bay Sandstone	2.00	1.1536	99.1	1073±40
	140959	77°48′N 70°17′W	Lowest of three sills cutting sandstone and conglomerate, Robertson Fjord	Post-Wolstenholme Formation	1.14	0.7398	98.0	1172±40
	140943	78°05′N 72°38′W	Upper of three sills cutting sandstones, Radcliffe Pynt, Prudhoe Land	Post-Rensselaer Bay Sandstone	0.80	0.5285	95.1	1190±40
1	141002	77°36′N 66°52′W	NW-trending dyke cutting crystalline basement, Josephine Peary Ø, Inglefield Bredning	? Pre-Thule Group	1.04	1.0107	96.9	1563±60

$\lambda_\beta = 4 \cdot 72 \times 10^{-10}\ yr^{-1}$ $\lambda_e = 0 \cdot 584 \times 10^{-10}\ yr^{-1}$ $^{40}K/K = 1 \cdot 19 \times 10^{-4}$ mole/mole K

The results

A summary of results is given in table 2 in which the K/Ar ages are placed into three groups.

(1) Dyke giving 1563 m.y. On field evidence sample 141002 is the oldest rock dated (see fig. 8): a fact borne out by its K/Ar age. The value of such a single date should clearly be treated with reservation in view of possible argon loss, but it suggests that the Thule Group is younger than 1500 m.y.

(2) Ages between 1070 and 1190 m.y. on samples from sills in the lowest clastic rocks. The K/Ar ages are regarded as giving a minimum age for the Wolstenholme Formation and Rensselaer Bay Sandstone, with the small age range being ascribed to different intrusive phases and/or differential argon loss.

(3) Ages between 532 and 764 m.y. Dyke 140802 cuts the Dundas Formation as well as the Wolstenholme Formation and the associated sills giving ages of group (2). Its K/Ar age of 676 m.y. supports this field evidence. However, the relationship of the dyke to the sills 141036 (532 m.y.) and 142099 (610 m.y.) is not known, neither is it known if sill 140958 (764 m.y.) postdates the Dundas Formation. Group (3) ages suggest that the Dundas Formation is at least 676 m.y. old; the small range in age being due to differential argon loss and/or different intrusive phases.

Regional considerations

The Wolstenholme Formation, the Dundas Formation and the Rensselaer Bay Sandstone (both Hatherton and Sverdrup Members) in Greenland are of Precambrian age. The results also infer a Precambrian age for both the intrusion-invaded part of the Rensselaer Bay Sandstone (Camperdown and Bache Peninsula Members) and the overlying Sverdrup Member in Canada.

The basic dyke 140802 (676 m.y.) is a member of a regional ESE-trending swarm present throughout the Thule district and which cuts the Narssârssuk Formation. If the K/Ar of 676 m.y. is a minimum age representative of the swarm as a whole then the entire Thule Group is of Precambrian age. This is considered most probable. It is not possible however to decide from the dates whether the Dundas and Narssârssuk Formations are part of the same sedimentary cycle as the Wolstenholme Formation and the Rensselaer Bay Sandstone (i. e. deposited between 1000 and ?1500 m.y. ago). These two formations, or the Narssârssuk Formation alone, could be of younger age.

An important consideration is whether the age groups (2) and (3) are indicative of two periods of magmatism. If group (3) ages are exclusively the results of partial argon loss and updating of group (2) age intrusions, then it is surprising that no K/Ar ages between 764 and 1070 m.y. have been obtained from the samples