NEW K/AR AGE DETERMINATIONS FROM SOUTHERN WEST GREENLAND

R. StJ. Lambert and J. G. Simons

The following four samples are from the pre-Ketilidian/pre-Nagssugtoqidian central gneiss complex of west Greenland (Pulvertaft, 1968), in which there are several amphibolite facies linear belts with conformable greenschist layers that contrast on a major scale with the complexly folded granulite facies complexes (Windley, in press). The following dates together with those published by Armstrong (1963) and Larsen and Møller (1968) suggest that the linear belts have an isotopic age in the range 2410-2710 m.y., whilst the granulite facies complex in the Fiskenæsset region has an age of at least 3210 m.y. There was also plutonic activity in the period 1940-1820 m.y. expressed by a weak metamorphism in late supracrustal rocks only preserved within the Godthåb-Isua linear belt and in the pegmatites around the Qôrqut granite (Larsen and Møller, op. cit.).

The first three samples were supplied by Dr B. F. Windley and the fourth by Mr L. Keto of "Kryolitselskab Øresund A/S", Copenhagen.

Results

3210 ± 80 m.y. hornblende

GGU 68681, Sungâsa nûat, Fiskenæsfjorden.

30 cm wide conformable hypersthene amphibolite layer in chromite-layered meta-anorthosite. This date is thought to give the minimum age of the granulite facies metamorphism in this region.

2535 ± 60 m.y. hornblende

GGU 74716, south Qilangarssuit island, east of Buksefjord.

Unmigmatised amphibolite dyke that cuts biotite gneisses and their fold structures. Berthelsen (1955) concluded that the dykes here cut what was originally a granulite facies basement.

2410 ± 60 m.y. hornblende

GGU 89688, south-east Bjørneøen, Godthåbsfjord.

Amphibolite from a pillow-bearing locality in the major meta-volcanic amphibolite formation extending along the eastern side of Bjørneøen and Sadeløen islands. The determination is close to that above (GGU 74716) and not very different from the 2710 m.y. date of the biotite gneiss at Godthåb (Armstrong, 1963).

1940 ± 50 m.y. hornblende

Kryolitselskab Øresund A/S 10063/RA/66, Isua.

This specimen is a greenschist (low-grade metabasic) forming irregular semi-concordant sills in the weakly metamorphosed quartzitic component of the Isua supracrustal group that occurs as a mantle around a gneiss dome in the Godthåb-Isua belt. This date is close to the 1820 m.y. date from a pegmatite associated with the Qôrqut granite (Larsen and Møller, 1968).

The following data were obtained from the four samples:

	K	^{40}Ar cc/gm (STP)	atmos ^{40}Ar %	Age m.y.
68681	0.469	15.83×10^{-5}	2	3210 ± 80
74716	0.984	21.02×10^{-5}	1	2535 ± 60
89688	0.386	7.55×10^{-5}	2	2410 ± 60
10063/RA/66	0.139	1.875×10^{-5}	23	1940 ± 50

Interpretation

The following note is added by the first writer (RStJL) on the interpretation of the above K/Ar ages:

The principal problems are analytic reliability and "excess" or "plutonic" argon held in the lattice of the mineral at the time of initial formation, or subsequently introduced during a phase of high argon partial pressure such as might be produced by a later regional metamorphism.

Statistical (or random) errors in potassium and argon analysis are small and generally discounted as insignificant in relation to systematic errors leading to poor reproducibility. Monitoring the latter is effected by frequent analysis of standards, on the basis of which it is reasonable to suggest that the standard deviation on individual analyses at Oxford is not greater than ± 2.5 %, provided that the K_2O is not exceedingly low or the atmospheric argon correction too high (effectively > 40 %).

Excess argon presents problems which are not easily solved. Although there are still no examples of definite excess argon in a common hornblende, minerals of low K_2O content are known to contain excess argon (Damon, 1968, table 5); such minerals in poly-metamorphic systems must remain suspect in the light of present knowledge. Excess argon is known to occur in pyroxenes, plagioclase (and in rarer minerals), and whole-rocks containing these minerals, but every case so far described in detail comes from areas containing substantial quantities of potassium-rich minerals, liable to produce high argon pressures during later metamorphism.

Inspection of the four ages presented here suggests that the excess argon question must be considered most closely in respect of the youngest and oldest samples. However, both come from areas low in potassium minerals, the thin sections show no textures suggestive of extensive replacement, and no external clues are available which might lead us to suspect excess argon. The figures are therefore regarded as relating to the age of cooling of the various sectors of the complex following initial crystallisation of the minerals in question.

References

Armstrong, R. L. (1963) K/Ar dates from West Greenland. Bull. geol. Soc. Amer., Vol. 74, 1189-1192.

Berthelsen, A. (1955) Structural studies in the pre-Cambrian of western Greenland. Part 1. A small body of diorite, Godthaab district. Bull. Grønlands geol. Unders., No. 10 (also Meddr Grønland, Bd. 135, Nr. 6).

Damon, P.E. (1968) Potassium-argon dating of igneous and metamorphic rocks with applications to the Basin ranges of Arizona and Sonora. In Hamilton, E.I. and Farquhar, R.M. (edit.) Radioactive dating for geologists, 1-72. New York: Interscience Publ.

Larsen, O. and Møller, J. (1968) K/Ar age determinations from western Greenland I. Reconnaissance programme. Rapp. Grønlands geol. Unders., Nr. 15, 82-86.

Pulvertaft, T.C.R. (1968) The Precambrian stratigraphy of western Greenland. Rep. 23rd Intern. geol. Congr. Czechoslovakia, Section 4, 89-107.

Windley, B.F. (in press) Evolution of the early Precambrian basement complex of southern West Greenland. Proc. geol. Ass. Canada, Centennial Volume.