A Rb-Sr whole rock age of 55±7 m.y. from the Nualik plutonic centre, East Greenland

D. C. Rex, A. R. Gledhill, D. Bridgwater and J. S. Myers

The Nualik plutonic centre has not been described since it was discovered and briefly mentioned by Wager (1934, p. 40). It was revisited in 1977 during reconnaissance mapping of the coast between Angmagssalik and Kangerdlugssuaq (Bridgwater *et al.*, 1978); the outline of the plutonic centre was mapped (fig. 37) and samples were collected for this study.

The plutonic centre consists of at least three separate intrusions (fig. 37). (1) A small body of layered gabbro with mineral-graded layering and slump structures spectacularly displayed west of Kap Louis Ussing. (2) A major layered intrusion of gabbro at the head of Agtertia with mineral-graded layering and igneous lamination, cut by felsic sheets and intermediate dykes. This body was intruded into the Precambrian gneiss complex and Tertiary basalts which form major outcrops above it and on the 1500-1600 m peaks to the west. (3) A composite body named by us the Ersingerseq intrusion which ranges from basic diorite to

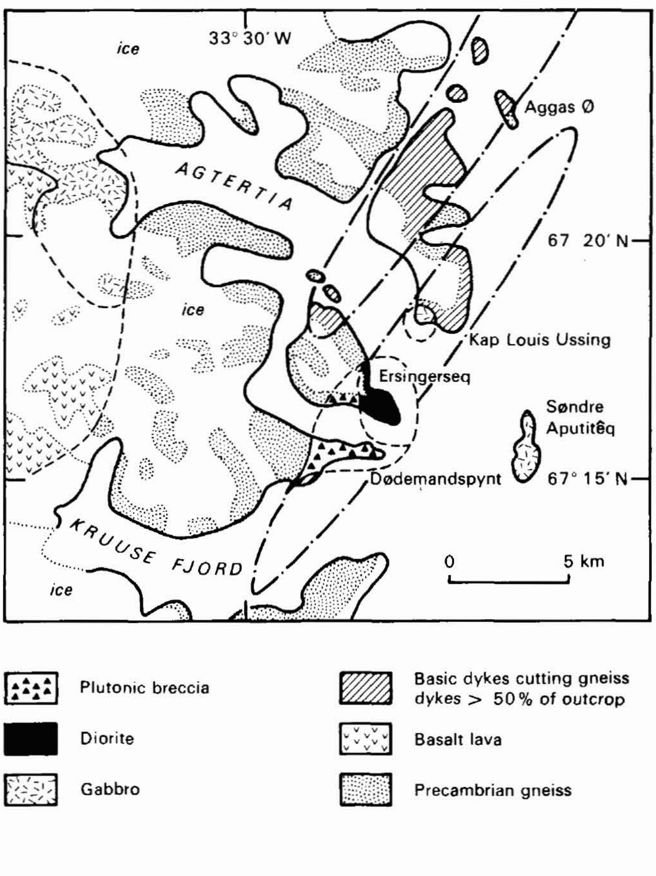

Fig. 37. Simplified geological map of the region around Agtertia, East Greenland.

granite. This outcrops on Dødmandspynt (Nualik) and the eastern end of Ersingerseq island Wager (1934, p. 40) describes the neighbouring island of Søndre Aputiteq as comprising hornblende gabbro intruded by granite but ice conditions made the main island inaccesible to both Wager in 1930 and to ourselves in 1977.

All the samples dated come from the Ersingerseq intrusion. This was emplaced into the centre of the coast parallel Tertiary dyke swarm which cuts the Archaean basement (fig. 37). Composite gabbro-diorite-granite bodies of the same type are concentrated on the outer coast from Kangerdlugssuaq to Kap Gustav Holm (Bridgwater *et al.*, 1978; Myers *et al.*, this report) along the main zone of crustal flexuring and dyke emplacement.

A mixed group of Tertiary basalts with minor sedimentary layers including cherts, thin quartz-banded ironstones and acid pyroclastics all cut by numerous basalt dykes is warped down to form the contact rocks along the western margin of the intrusion on Dødemandspynt. These rocks with the underlying Archaean gneiss were brecciated by the intrusion of basic diorite and now form a mixed jumble of fragments in a matrix of diorite. The basalt inclusions are hornfelsed while many of the acid inclusions are partly mobilised and back-vein both their host rocks and basic inclusions.

On Ersingerseq the xenolith-rich basic contact rocks are cut by clean diorites. These range from basic diorite with 49–51 per cent SiO_2 to coarser grained quartz diorite with interstitial granophyritic segregations and up to 55 per cent SiO_2. These basic and intermediate rocks are veined and brecciated by numerous sheets of granite. The contact relations between the acid and basic parts of the intrusion are complex. The early basic diorites and quartz diorites form both angular and rounded fragments within acid hosts. There is frequently a zone of contaminated granitic material surrounding the rounded diorite inclusions suggesting that the early phases of the granite sheets may have reacted with the diorites. Neither field nor petrographic evidence was seen that the diorites formed by mixing granitic and basaltic magmas as suggested by Brooks (1977) for similar rocks at Kialineq. The contaminated granites are intermediate in composition with 60 to 68 per cent SiO_2. They are inhomogeneous rocks with patches of hornblende-rich, comparatively fine grained material, surrounded by granophyric intergrowths of quartz and feldspar. The contaminated granites and the earlier diorites are veined by sheets of leuco-granite with up to 72 per cent SiO_2 and up to 5 per cent K_2O. These locally contain angular composite inclusions of basic diorite partially enclosed in contaminated granite. The leuco-granite sheets are composed of K-feldspar, oligoclase, quartz, sphene, epidote and opaque iron oxides and many have granophyric textures. Many of the leuco-granites form the margins to net-veined sheets of fine-grained plagioclase porphyritic basalt. These show chilled pillowed contacts with no interaction between the basic sheets and their granitic host.

Rb and Sr determinations were carried out at Leeds (D. R. and A. G.). Nine samples were selected for isotope measurements on the basis of the spread in Rb/Sr ratios (Table 10). N. B.S. standard 987 run during the period of the analysis gave 0.71030 ± 2.

The Rb-Sr whole rock age (fig. 38) shows that the Ersingerseq intrusion belongs to the same general episode of magmatism as the main phase of activity in the Kangerdlugssuaq area (Skaergaard intrusion, 54.6 ± 7 m.y., Brooks & Gleadow, 1977; Kangerdlugssuaq intrusion, 50.4 ± 1.2, Pankhurst *et al.*, 1976). It is markedly older than the 35 ± 2 m.y. age obtained from the Kialineq plutonic centre (Brown *et al.*, 1977) 25 to 60 km further south. However, the Kialineq plutonic centre is large and complex. The samples used by Brown *et*

Table 10. Rb-Sr analyses of samples from the Ersingerseq intrusion

GGU sample no.		Rb ppm	Sr ppm	Rb/Sr*	Rb^{87}/Sr^{86}	Sr^{87}/Sr^{86}
Ersingerseq						
232716	Granophyre sheet	86	142	0.604	1.749	0.70576±5
232720	Granitic phase	80	191	0.417	1.207	0.70530±5
232721	Porphyritic quartz diorite	39	484	0.082	0.235	0.70454±6
232722	Slightly contaminated granophyre	59	315	0.186	0.537	0.70487±5
232723	Contaminated granophyre	50	384	0.129	0.373	0.70466±5
232725	Contaminated granophyre	52	390	0.134		
232727	Contaminated granophyre	56	408	0.137		
232728	Heavily contaminated granophyre	59	382	0.154	0.447	0.70468±5
232730	Contaminated granophyre	52	388	0.135	0.389	0.70476±5
232734	Coarse-grained leucodiorite	40	530	0.076		
232735	Coarse-grained leucodiorite	31	683	0.046		
232736	Mafic diorite	25	412	0.060		
Dødemandspynt						
232737	Mafic diorite	8	581	0.014	0.041	0.70458±16
232738	Fine-grained quartz diorite	31	401	0.076	0.183	0.70483±4
232739	Fine-grained quartz diorite	26	417	0.063		

Age: 55±7 m.y. (2σ) $\lambda = 1.42\times10^{-11}y^{-1}$
I.R. 0.70439±9
M.S.W.D. 2, assuming errors of 2% in Rb^{87}/Sr^{86} and 0.01% in Sr^{87}/Sr^{86}
*XRF direct ratio measurement

al. are of a wide variety of rock types from several well separated intrusions. Two of the analyses which lie off the 35 m.y. isochron (granite sample 522 from Støre Tindholm) lie on an extension of the 55±7 m.y. isochron from the Ersingerseq intrusion. The Støre Tindholm granite shows close petrographic similarities to granite from the Ersingerseq intrusion and outcrops in a similar geological position in the centre of the main coastal dyke swarm. We suggest that the easternmost parts of the Kialineq plutonic centre may be older than the 35±2 m.y. age given by Brown *et al.* (1977).

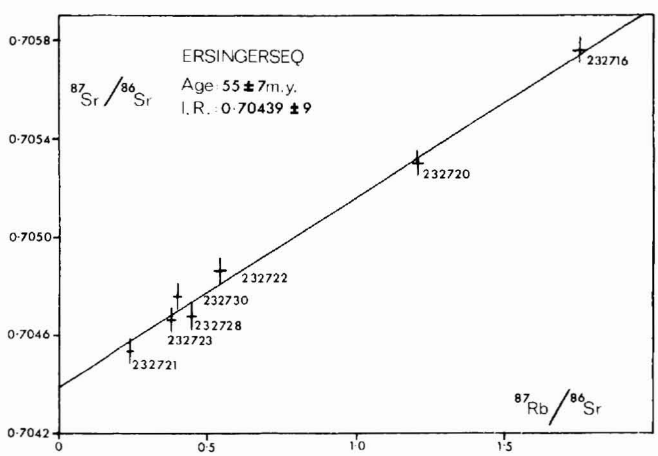

Fig. 38. Whole rock Rb-Sr isochron plot of samples from the Ersingerseq intrusion of the Nualik plutonic centre.

Arguments developed by Soper *et al.* (1976) and Larsen (1978) suggest that the coastal dyke swarm was emplaced 55 to 56 m.y. ago, that is directly before the emplacement of the Ersingerseq and Støre Tindholm composite acid-basic intrusions. The initial Sr^{87}/Sr^{86} ratio of 0.70439±9 from Ersingerseq is similar to those obtained from other Tertiary intrusions in East Greenland (Pankhurst *et al.*, 1976; Rex *et al.*, this report), and together with the fact that acid and basic parts of the intrusion lie on the same isochron could be used to suggest both came from the same mantle source. However, the Archaean granulite facies gneisses which form the main exposed continental crust of the region and probably the crust below the intrusions have low Rb contents with mean Rb/Sr ratios below 0.01, resembling mantle rather than sialic rocks. This implies that Sr initial ratios and the lack of isotopic evidence for two sources need not indicate that both magmas were mantle derived. The field evidence from the contacts of the Ersingerseq intrusion show that considerable amounts of crustal material was included during emplacement and that many of the fragments were partly melted. It seems likely that this process might be more marked at depth and that at least part of the acid rocks could be derived from crustal sources. A possible explanation of the change in magmatic activity from basalt dykes to mixed granite-diorite plutons may be a result of annealing of the lower crust caused by the heating effect of the very large amounts of basic magma injected around 55–56 m.y. ago.

References

Bridgwater, D., Davies, B., Gill. R. C. O., Gorman, B. E., Myers, J. S., Pedersen, S. & Taylor P. 1978: Precambrian and Tertiary geology between Kangerdlugssuaq and Angmagssalik, East Greenland. *Rapp. Grønlands geol. Unders.* **83,** 17 pp.

Brooks, C. K. 1977: An example of magma-mixing from the Kialineq district of East Greenland. *Bull. geol. Soc. Denmark* **26,** 77–83.

Brooks, C. K. & Gleadow, A. J. W. 1977: A fission-track age for the Skaergaard intrusion and the age of the East Greenland basalts. *Geology* **5,** 539–540.

Brown, P. E., van Breemen, O., Nobel, R. H. & McIntyre, R. M. 1977: Mid-Tertiary igneous activity in East Greenland – the Kialineq complex. *Contr. Miner. Petrol.* **64,** 109–122.

Larsen, H. C. 1978: Offshore continuation of East Greenland dyke swarm and North Atlantic Ocean formation. *Nature* **274,** 220–223.

Pankhurst, R. J., Beckinsale, R. D. & Brooks, C. K. 1976: Strontium and oxygen isotope evidence relating to the petrogenesis of the Kangerdlugssuq alkaline intrusion, East Greenland. *Contr. Miner. Petrol.* **54,** 17–42.

Soper, N. J., Higgins, A. C., Downie, C., Matthews, D. W. & Brown, P. E. 1976: Late Cretaceous - early Tertiary stratigraphy of the Kangerdlugssuaq area, East Greenland, and the age of opening of the north-east Atlantic. *J. geol. Soc. Lond.* **132,** 85–104.

Wager, L. R. 1934: Geological investigations in east Greenland. I. General geology from Angmagssalik to Kap Dalton. *Meddr Grønland* **105,** 2, 1–46.

D. C. R. & A. R. G.
Department of Earth Sciences,
The University,
Leeds LS2 9TJ,
U. K.