FIELD MAPPING OF THE PRECAMBRIAN BASEMENT IN THE GODTHÅBSFJORD DISTRICT, SOUTHERN WEST GREENLAND

V. R. McGregor and David Bridgwater

The first author continued his regional mapping, begun in 1965, in the Godthåbsfjord district between June and September. He joined the party of geologists from Exeter University (see Chadwick & Coe, this report) for a week at the start of the season in order to introduce this team into the main geological problems of the area. He also accompanied and advised W. F. Fahrig (see this report) who collected material from the gneiss complex as part of a joint research project with the Geological Survey of Canada on the geomagnetic properties of rocks from West Greenland.

Bridgwater joined McGregor in August and early September to collect material for geochemical work and to start to plan the nature of future GGU activities in the Godthåbsfjord region. The aims were firstly to judge whether the methods developed around Godthåb could be applied elsewhere, and secondly to see whether the features used by McGregor to distinguish between the various gneiss units could be applied by other geologists in the field. McGregor prepared detailed maps of parts of the inner parts of Kobberfjord, Bjørneøen, Storø and Sadeløen which join up with maps published earlier (McGregor, 1973). Bridgwater and McGregor carried out reconnaissance mapping as far as Ivisartoq in the inner part of Godthåbsfjord.

The main geological units described by McGregor (1973) could be identified by both writers independently throughout the area of amphibolite facies gneisses visited and there were only a few localities where they arrived at different conclusions about the position of a particular outcrop of gneiss in the regional chronology. This means that it should be possible to map out McGregor's divisions in the Godthåbsfjord region using a team of geologists familiar with the problems but with no previous first-hand knowledge of the Godthåbsfjord rocks. While no major changes in the subdivision of the rocks was made the joint work did lead to some modifications or reappraisals of the ideas already published the main points of which are briefly given below.

The character and extent of inclusions in the Amîtsoq gneisses

Inclusions in the 3750 m.y. old Amîtsoq gneisses are of considerable interest since they represent the oldest material so far recognised on Earth's crust. They are sufficiently abundant to be separable from the Amîtsoq gneisses as a distinct lithostratigraphic unit. Some outcrops previously mapped as belonging to the younger Malene suite of supracrustal rocks may belong to the pre-Amîtsoq suite. The pre-Amîtsoq rocks form highly variable rafts and inclusions up to several hundred

metres in length within the quartzo-feldspathic gneisses. Many of the fragments show a well-developed layering and consist of alternating units of contrasting lithologies; the most frequently occurring of which are:

(1) layered amphibolites lithologically similar to some of the layered amphibolites that are at present included in the Malene supracrustals and that are associated with the meta-anorthosites;

(2) irregularly striped green and black rocks composed mainly of iron-rich clinopyroxene and hornblende;

(3) quartz-rich rocks, that in addition to quartz contain magnetite, ferrosalitic orthopyroxene, garnet and grunerite; some have textures suggesting they have been extremely heavily deformed prior to their inclusion in the Amîtsoq gneiss;

(4) massive basic rocks rich in hornblende and biotite, with textures suggesting derivation from originally coarse-grained basic plutonic parents;

(5) some pods of enstatite-olivine ultrabasic rocks commonly surrounded by black hornblendites; and

(6) quartz-rich biotite gneiss with garnet, plagioclase, grunerite and sometimes graphite.

Some of the rocks of type (3) appear to have been derived from type (2) by processes that included considerable movement of silica before the rocks were intruded by the parents of the Amîtsoq gneisses. They commonly have a well-developed fine layering and show considerable mineralogical resemblance to rocks that elsewhere have been interpreted as metasedimentary ironstones. Other occurrences of rocks of type (3) are massive and homogeneous and their present texture suggests derivation from homogeneous igneous parents. The most dominant feature of the suite as a whole is the iron-rich nature of the mafic minerals. The field relations are equivocal and it is not possible at present to suggest whether the rocks are derived from iron-rich sediments, lavas or a petrologically unusual layered intrusive suite. The rapid lithological variation and the well-layered character of the rocks gives a general appearance in the field that suggests a highly metamorphosed supracrustal suite of lavas and sediments. No primary sedimentary or volcanic features have been found, however, and if the rocks are supracrustal in origin they must have had a very unusual chemistry. Some of the rocks are texturally very similar to younger rocks interpreted as derived from intrusive basic plutonic parents. It is, of course quite possible that the inclusions in the Amîtsoq gneisses were derived from parental rocks with quite different origins.

The nature of the Ameralik dykes

Comparatively few of the Ameralik dykes preserve their original intrusion features, or igneous textures. Some of the best preserved dykes contain garnet-orthopyroxene mineral assemblages in their centres which could be taken as evidence of an early granulite-facies metamorphism in the area, not preserved in the surrounding quartzo-feldspathic or amphibole-bearing gneisses. A second possibi-

lity discussed in the field was that the "metamorphic" mineral assemblages could represent primary igneous minerals formed during the crystallisation of dykes either at depth or under regional metamorphic conditions.

The nature of the younger suite of quartzo-feldspathic gneisses

McGregor recognised two main groups of granitic rock younger than the main amphibolite horizons in the Godthåbsfjord gneiss complex: the Nûk gneisses, a suite of synkinematic intrusions yielding a Rb/Sr isochron age of 3040 m.y. (Pankhurst *et al.*, in press) and a younger group of granitic rocks and associated pegmatites known collectively as the Qôrqut granite suite. In the type area between Godthåb and Bjørneøen the Nûk gneisses consist of a suite of dominantly tonalitic intrusions apparently derived from magmas generated at some level lower in the crust or upper mantle. There is no evidence of major *in situ* remobilisation of older quartzo-feldspathic units such as the Amîtsoq gneiss to form the intrusive suite. Elsewhere in the Archaean block (for example South-East Greenland; Andrews *et al.*, in press) a major part of the gneiss complex regarded as the approximate time equivalent of the Nûk gneisses appears to have been derived by the remobilisation of quartzo-feldspathic gneiss initially formed earlier than the adjacent meta-supracrustal units. At the head of Godthåbsfjord the field distinction between typical Nûk gneisses and the earlier Amîtsoq gneisses was still apparent, however, in several localities the older rocks were so severely affected by later thermal and metamorphic events that they were beginning to lose much of their original character. One of the most important aims of the present geochemical and future isotopic investigations must be to try and decide how much of the Archaean block consists of recycled early crustal material and how much could represent material added from the mantle during each period of thermal activity. Godthåbsfjord is so far the only area in which it has proved possible in the field to separate the gneisses into different groups and is therefore a key area for these studies.

The meta-anorthosites

The large meta-anorthosite body on the south coast of Ameralik west of Qasigiánguit was found to be part of a very large mass of rocks of intrusive plutonic origin in which meta-diorite is the dominant lithology. Elsewhere rocks of this intrusive suite were found mixed up as inclusions in units of agmatitic gneiss. Some of these agmatitic gneiss units are remarkably thin and well defined and appear to have been intruded as mixed, inclusion-rich "magmas". It seems quite possible that at least some of the break-up of the anorthosites in the Godthåb district may be a primary feature, associated with the emplacement of the diorite-anorthosite complex.

Deformation

One of the most important aspects of future work in the Godthåbsfjord area

must be research into the nature, timing and amount of deformation through which the rocks have passed, since it is only by making estimates of the strain impressed on the various units that their original relationships can be understood. Preliminary investigations (with the help of J. Watterson) suggest firstly that simple shear is perhaps the most important mechanism by which these rocks were deformed and secondly that $X:Z$ ratios in typical quartzo-feldspathic Nûk gneisses are of the order of 50:1 or more. Deformation of this type implies that there must have been a very considerable transport of material parallel to the main direction of elongation (Escher & Watterson, in press). This suggests that in the Godthåbsfjord area there has been major subhorizontal movements in a SSW-NNE trending zone.

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V. R. M.,
Atangmik,
3912 Sukkertoppen,
Greenland.

FIELD WORK ON THE PRECAMBRIAN BASEMENT IN THE BUKSEFJORDEN REGION, SOUTHERN WEST GREENLAND

Brian Chadwick and Kenneth Coe

The summer of 1972 was the first of a five-season project in which geologists of the University of Exeter will map the 1:100 000 scale Buksefjorden sheet. A. D. Gibbs and M. R. Sharpe mapped the Qeqertarssuaq and Færingehavn areas while the authors made a reconnaissance of the entire map sheet in order to assess problems and establish sub-areas for mapping and research in forthcoming seasons.