er moraine systems towards the present Inland Ice margin. Since the fjord stage at 8300 B. P. seems to correspond to a marine level of 70–80 m, it would appear that the older systems east of the fjord stage, attached to higher marine limits, might have been laid down at the recession before 8300 B. P. In contrast, moraine systems east of the fjord stages are related to recessional substages between 8000 and possibly 6000 B. P.

Since the glacier lobe of the Inland Ice in Ujaragssuit pâvat, Kangilínguata sermia, has its front resting on a marine terrace with minimum altitudes of 20–30 m above sea level, it would appear that the Inland Ice retreated beyond the present extent (at around 6000 B. P.?, cf. Weidick, 1972), and subsequently advanced to its present position. A narrow trim line zone around the glacier indicates a little shrinkage in this century. In addition, the Narssap sermia lobe of the Inland Ice margin south of Ujaragssuit pâvat reveals only slight shrinkage and a very stable calving front with little production of calf ice. This is in contrast to the southern calving glacier lobe of Kangersuneq, Kangiatanunâta sermia, which has receded over 20 km in the last 100–200 years (Weidick, 1968, 1972).

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Field work on the Precambrian basement in the Buksefjorden region, southern West Greenland

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Five two-man teams from the University of Exeter spent a third field season mapping in the area of Buksefjorden as part of the GGU mapping programme in the Fiskenæsset region organised by GGU in conjunction with the University of Exeter (Chadwick & Coe, 1973; Chadwick *et al.*, 1974a). Mapping at 1:20 000 was begun by J. S., K. C. and K. V. in areas north and south-east of Buksefjorden and north of Alángordlia respective-

ly, while P. W. completed the area between Sermilik and Alángordlia east of Amitsuarssugssuaq. B. C. mapped Qilángârssuit, Simiútat and associated islands in the skaergaard south of Angissorssuaq at a scale of 1:10 000. The group was supported by helicopters and the GGU cutters *J. F. Johnstrup* and *Villiaumit* organised by Feiko Kalsbeek from Midgård. Boat assistance was also provided by V. R. McGregor in mapping the outer islands. The exceptionally fine weather enabled good progress and more than 60% of the Buksefjorden sheet is now completed. Localities referred to in the text may be found by reference to 1:250 000 maps 64 V. 1 Godthåb and 63 V. 1 Færingehavn.

Pre-Amîtsoq suite

The term pre-Amîtsoq suite is used in the sense of McGregor & Bridgwater (1973). In the Buksefjorden region the largest areas of exposure occur in the islands around Qilángârssuit, especially Ingnerssuartût and Kigtorqat. Many of the small islands north-west of Simiútat are formed of pre-Amîtsoq lithologies and inclusions of the pre-Amîtsoq suite are common in the Amîtsoq gneiss on Qilángârssuit. The most common lithotypes are weakly banded or striped, green-black diopsidic amphibolites and ultramafic rocks heavily agmatised by white quartz-plagioclase veins. Quartz-rich garnet-hornblende-pyroxene-magnetite rocks with lenticles and thin sheets of amphibolites and ultramafites are also common. The composition and fine-banded or lenticular structure of the quartz-rich rock suggests a banded ironstone parent but in many outcrops mafic 'inclusions' may indicate an origin by metamorphic segregation. Less common pre-Amîtsoq rocks include leucogabbroic amphibolites, locally anorthositic, layered meta-peridotites and garnetiferous leucocratic gneisses. Sheets of banded Amîtsoq gneiss cut agmatised pre-Amîtsoq amphibolites and ultramafites on Ingnerssuartût and xenoliths of leucogabbroic amphibolite occur in Amîtsoq augen gneiss on islands further south. Amîtsoq augen gneiss intrudes a layered pre-Amîtsoq complex on Kigtorqat.

Amîtsoq gneisses

Homogeneous granitic gneisses with abundant augen of microcline are common on Akilia, Kigtorqat and small islands north and south of Qilángârssuit. Small areas of the augen gneiss also occur on Qilángârssuit. The gneisses are cut by Ameralik dykes and are identical to those north-west of Narssaq (Chadwick *et al.*, 1974a). Original intrusive contacts with banded-nebulitic gneisses are largely obliterated by deformation and migmatisation. On Akilia the augen gneiss has been widely transformed to a streaky gneiss similar to the older banded host. Heterogeneous deformation during the complex post-intrusive history has, in places, given rise to new lineated gneisses. Original Ameralik dykes are preserved as isolated inclusions quite different from local xenoliths of pre-Amîtsoq rocks in the augen gneisses on islands south of Qilángârssuit.

Most of the Amîtsoq gneisses on Qilángârssiut are banded or finely pegmatite-veined, leucocratic migmatites commonly with inclusions of the pre-Amîtsoq suite. East of the Buksefjorden anorthosite and north-east of Amitsuarssugssuaq the Amîtsoq gneisses have been invaded by gneisses of Nûk affinity and variably modified by migmatisation and deformation to form an integral part of the younger suite (Chadwick *et al.*, 1974b).

Ameralik dykes

Seven different varieties of Ameralik dyke have been recognised in the Amîtsoq gneisses on the Qilángârssuit islands. Differences are based on field criteria such as composition and presence or absence of feldspathic inclusions. Thick sheets of Ameralik dyke lithology in Amîtsoq gneisses on islands north and south of Qilángârssuit contain well preserved relict igneous layering and chilled margins. Intersections between different dyke lithotypes indicate at least three generations of intrusion. Feldspathic inclusions in certain types of dyke are sometimes distributed asymmetrically. However, examples of centrally disposed inclusions and inclusions near both margins show that concentration may be a flow differentiation phenomenon and not due entirely to flotation. Hence, the distribution of inclusions cannot be used as a facing criterion as was previously suggested (Chadwick *et al.*, 1974a).

Discordant amphibolites, lithologically identical to some of the varieties of Ameralik dyke in the Amîtsoq gneiss, are common in the Malene supracrustal gneisses and banded amphibolites in the Qilángârssuit group of islands. The thin amphiobolites may be related as feeders to the thick sheets of metagabbroic amphibolites in the Malene host. The presence of Ameralik dyke lithotypes in the Malene supracrustal rocks has important implications for the regional chronology. On the one hand, the Malene rocks may have accumulated on a sialic basement of Amîtsoq gneiss and been subsequently cut by Ameralik dykes which were feeders to amphibolites in the Malene cover. Alternatively, if the interleaving mechanism suggested by Bridgwater *et al.* (1974) is correct, the amphibolite dykes and associated metagabbroic amphibolites in the Malene supracrustal formations are totally unrelated to the depositional history of the Malene rocks. They must be interpreted as manifestations of igneous events following the interleaving but occurring before regional isoclinal folding and migmatisation. In either case clear cross-cutting relationships indicate the need for revision of the accepted regional chronology (e. g. McGregor, 1973).

The need for further revision is suggested by the relations on islands west of Qilángârssuit where strips of Amîtsoq gneiss are in contact with Malene units. An igneous relationship is indicated, but the possibility of tectonic juxtaposition cannot be excluded. Igneous intrusion is supported by the occurrence of xenolithic inclusions of gneiss similar to the adjacent supracrustals in the Amîtsoq gneiss. This evidence is not conclusive because of the close similarity of established pre-Amîtsoq lithologies to parts of the Malene succession. The place of the Malene succession in the regional chronology is certainly before the Ameralik dykes and possibly before the Amîtsoq gneiss.

An obvious further interpretation is that the Malene supracrustal rocks should be divided into: (a) paragneisses and amphibolites, possibly derived from surface accumulation of lava, ash, etc., and which are older than the Ameralik dyke phase and possibly pre-Amîtsoq; (b) amphibolites and related basic and ultrabasic intrusions related to Ameralik dykes.

Malene supracrustal rocks and meta-anorthosites

Supracrustal gneisses, amphibolite and associated peridotitic rocks of Malene type (McGregor, 1973) form the whole of the Simiútat islands and much of west Qilángâr-

ssuit and islands to the west, especially around Querssuaq. Ivigssuartût and islands in the extreme west of the skaergaard comprise garnetiferous supracrustal gneisses, amphibolites and pre-Amîtsoq lithologies, all cut by Ameralik dykes. A thick sequence of supracrustal gneiss and amphibolite with one or two (< 1 m) quartz-pyroxene-graphite marbles forms part of an isoclinal fold on the north coast of Sermilik. Sheets of metagabbroic amphibolite locally with subordinate garnet-sillimanite gneisses and metaperidotites occur south of Alángordlia and at the eastern boundary of the map sheet south-east of Buksefjorden. Elsewhere in the eastern part of the area, supracrustal rocks occur only as xenolithic rafts in the younger gneiss series.

Supracrustal gneisses in the Qilángârssuit–Simiútat islands include: (1) garnet-sillimanite-biotite-cordierite-anthophyllite gneisses locally with original depositional structures; (2) quartz-rich anthophyllite-cordierite-mica gneisses locally with secondary knots of schorlitic tourmaline and quartz; (3) schistose biotite-pale mica-feldspar-sillimanite gneisses; (4) siliceous, garnetiferous gneisses with local clasts of quartz-feldspar.

Banded, laminated amphibolites, locally with thick sheets of diopside-epidote-carbonate-rich amphibolites, associated with the supracrustal gneisses probably represent extrusive volcanic activity which included pillow lavas, tuff and agglomerate. Other dark garnetiferous and leucocratic amphibolites within the Malene rocks of the Qilángârssuit islands are considered to be intrusive on the grounds of their relationship to a differentiated complex, including metaperiotites, in the supracrustal gneisses of Simiútat. These intrusions may be related genetically to the thin discordant amphibolites of Ameralik dyke type which are common in parts of the supracrustal gneiss and banded amphibolite formations. Discontinuous layers of fuchsitic quartzite are common between amphibolites and Amîtsoq gneiss. Quartz-rich rocks similar to those of the pre-Amîtsoq suite also occur between banded amphibolite and supracrustal gneiss on west Simiútat. The cordierite-anthophyllite gneisses in Qilángârssuit–Simiútat are unusually rich in magnesium for clastic sediments. They may have had a volcanic or metasomatic parentage, but the possibility that they represent an anatectic restite produced by a mechanism such as that proposed by Grant (1968) may be significant in accommodating volume reduction during the structural evolution of the Buksefjorden region.

Extensive outcrops of anorthosite and leucogabbro have been found east of the Buksefjorden anorthosite complex. The structure suggests that anorthositic rock underlies most of the area north of Buksefjorden. Most of the leucogabbros contain relict igneous layering and 'tennis ball' crystals of plagioclase but original textures have been obliterated by deformation in many cases. The anorthositic rocks are cut locally by thin, discordant amphibolite dykes which pre-date the migmatisation.

Younger gneisses and discordant amphibolites

Gneisses younger than the Amîtsoq suite are included in this category. Although many correlate with those of the Nûk suite as defined by McGregor (1973), others, because of their derivation from older gneisses or uncertainty concerning age and origin, do not fit into the definition. Younger gneisses predominate in the areas north and south-east of Buksefjorden and in the Alángordlia–Sermilik terrain. North of Buksefjorden

the leucogabbros and anorthosites, and Amîtsoq gneisses are heavily migmatised by grey tonalitic gneiss which probably correlates directly with Nûk gneiss. This tonalite cuts dioritic gneiss believed to have been derived by remobilisation of Amîtsoq gneiss.

Three main divisions of gneiss have been recognised from south-east of Buksefjorden, viz. a mafic granodioritic variety, a banded gneiss usually rather melanocratic, and a white-weathering tonalitic type. All three are strongly foliated, a feature which distinguishes them from the younger Qôrqut intrusive granites. Relations between the three types are complex. The tonalite frequently occurs in distinct parallel-sided, cross-cutting sheets, but gneiss of identical type is derived from the banded gneiss by gradual homogenisation. In coast exposures at the head of Buksefjorden xenolithic relations exist between banded gneiss and the granodiorite, but gradations from one type to the other are common. The area thus seems to be one in which gneisses were intensely reworked with syntectonic migmatisation by partial fusion and injection. All three types, but especially the banded gneiss and the granodioritic facies, contain abundant enclaves of amphibolite. On the assumption that these were derived from Malene supracrustal amphibolites, and in the absence of Ameralik dykes, all the gneisses were regarded as being of the Nûk suite as defined by McGregor (1973). However, in view of the relation between Amîtsoq gneiss and Malene supracrustal rocks described above this conclusion no longer holds. Until chemical data are available the affinities of the banded gneiss must remain in doubt, but its migmatisation and homogenisation in the Buksefjorden area is exactly comparable to that of gneisses containing Ameralik dykes described previously by Chadwick *et al.* (1974b).

North of Alángordlia there are two phases of migmatising granitic gneisses. The older is more abundant and may contain remobilised Amîtsoq gneiss but, in the absence of unambiguous Ameralik dykes, the extent of the remobilised gneiss is uncertain. Mafic gneisses, augen granite gneisses, metagabbroic gneisses and thick discordant amphibolites, locally with well-preserved intrusive contacts, were formed in the period between the migmatising phases. The younger migmatite is restricted and does not form large mappable formations. The younger phase was followed by granulite facies metamorphism.

South of Alángordlia Amîtsoq gneisses have been remobilised and incorporated in younger gneisses (Chadwick *et al.*, 1974b) which also injected the supracrustal formations. These younger gneisses clearly represent a significant introduction of acid material which overwhelmed and absorbed much of the Amîtsoq gneiss foundation. This appears to have been a protracted event which was followed by injection of dykes with variable composition. The dykes appear to be related to the development of a series of basic, dioritic and granitic intrusions which form a sub-horizontal, sheeted complex at least 2.5 km thick. The sheet has its best development in the east of the area; further west it is deformed by upright folds and cusp structures related to domes and basins around Amitsuarssugssuaq (Chadwick *et al.*, 1974a, p. 59). Granitic rocks in the sheet cut across the dykes. K-feldspar augen granite gneisses in the sheet, lithologically identical to the Ilivertalik granite (Kalsbeek & Myers, 1973), are preferentially developed within a cusp zone extending north of central Sermilik, the feldspar blastesis overprinting the sheeted gneisses complex and earlier banded gneisses of Nûk affinity. Gneisses within

the sheet are cut by aplites and a later set of amphibolite dykes. It is conceivable that the sheet may form the core of a regional nappe generated prior to the dome and basin structures. Granulite facies metamorphism was synchronous with the latter event.

Structure and metamorphism

The pattern of deformation and metamorphism established in previous years (Chadwick & Coe, 1973; Chadwick *et al.*, 1974a) has been confirmed and extended. The bulk of the rocks in the region have been deformed by isoclinal folds, some of nappe dimensions, which followed migmatisation and the intrusion of younger granitic gneisses into Amîtsoq and Malene formations. The isoclinal folds are deformed by a set of regional mainly upright or fanned folds and straight belts of varying scales with axial lineation of variable intensity. Mylonitised gneisses, shear zones and associated pegmatites are common in the south. Granulite facies metamorphism, patchily developed north and southeast of Buksefjorden, has its best development north and south of Alángordlia where it outlasted the final ductile deformation.

Post-tectonic sheets of microgranite and banded aplite-pegmatites believed to relate to the Qôrqut granite (McGregor, 1973) are abundant in islands west of Qilângârssuit.

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