References

Abrahamsen, N. & Marcussen, C. 1980: Preliminary results of rock- and palaeomagnetic field work in Peary Land, North Greenland. *Rapp. Grønlands geol. Unders.* **99,** 137–145.

Collinson, J. D. 1980: Stratigraphy of the Independence Fjord Group (Proterozoic) of eastern North Greenland. *Rapp. Grønlands geol. Unders.* **99,** 7–23.

Fränkl, E. 1955: Weitere Beiträge zur Geologie von Kronprins Christians Land (NE-Grönland). *Meddr Grønland* **103** (7), 35 pp.

Funder, S. & Hjort, C. 1980: A reconnaissance of the Quaternary geology of eastern North Greenland. *Rapp. Grønlands geol. Unders.* **99,** 99–105.

Ghisler, M., Henriksen, N., Steenfelt, A. & Stendal, H. 1979: A reconnaissance geochemical survey in the Proterozoic–Phanerozoic platform succession of the Peary Land region, North Greenland. *Rapp. Grønlands geol. Unders.* **88,** 85–91.

Haller, J. 1961: The Carolinides: an orogenic belt of late Precambrian age in Northeast Greenland. *In* Raasch, G. O. (edit.) *Geology of the Arctic* **1,** 155–159. Toronto U.P.

Haller, J. 1970: Tectonic map of East Greenland (1:500 000). *Meddr Grønland* **171** (5), 286 pp.

Henriksen, N. 1980: Collection of stream sediments for a reconnaissance geochemical survey from the Peary Land region, North Greenland. *Rapp. Grønlands geol. Unders.* **99,** 119–120.

Håkansson, E. 1979: Carboniferous to Tertiary development of the Wandel Sea Basin, eastern North Greenland. *Rapp. Grønlands geol. Unders.* **88,** 73–83.

Kalsbeek, F. & Jepsen, H. F. 1980: Preliminary Rb-Sr isotope evidence on the age and metamorphic history of the North Greenland crystalline basement. *Rapp. Grønlands geol. Unders.* **99,** 107–110.

Larsen, O. & Graff-Petersen, P. 1980: Sr-isotopic studies and mineral composition of the Hagen Bræ Member in the Proterozoic clastic sediments at Hagen Bræ, eastern North Greenland. *Rapp. Grønlands geol. Unders.* **99,** 111–118.

Pedersen, S. A. S. 1980: Regional geology and thrust fault tectonics in the southern part of the North Greenland fold belt, north Peary Land. *Rapp. Grønlands geol. Unders.* **99,** 79–87.

Peel, J. S. 1980: Geological reconnaissance in the Caledonian foreland of eastern North Greenland with comments on the Centrum Limestone. *Rapp. Grønlands geol. Unders.* **99,** 61–72.

Soper, N. J., Higgins, A. K. & Friderichsen, J. D. 1980: The North Greenland fold belt in eastern Johannes V. Jensen Land. *Rapp. Grønlands geol. Unders.* **99,** 89–98.

Comparative note on the Precambrian basement of southern Inglefield Land and eastern Ellesmere Island

Thomas Frisch

A one-week visit to southern Inglefield Land, by the GGU motor cutter *K. J. V. Steenstrup* in conjunction with P. R. Dawes's geological studies in North-West Greenland, provided an opportunity to examine the Precambrian crystalline basement between Sunrise Pynt and Kap Alexander (fig. 4). The basement exposures face those on eastern Ellesmere

Island, no more than 70 km away across Smith Sound, which were mapped by the writer in 1977 for the Geological Survey of Canada (Frisch *et al.,* 1978). This note briefly compares the two areas.

Southern Inglefield Land

In the coastal stretch examined, the basement rocks comprise essentially four units: hypersthene-bearing granitic rocks (including quartz diorite), massive granitic rocks (including pegmatite and aplite), granitic gneisses, and metasediments. Of these four units, the first three predominate. These rocks were included by Dawes (1972) in the Etah meta-igneous complex, while the metasediments, which occur in abundance only at Sunrise Pynt, are part of his Etah Group.

The hypersthene-bearing rocks are dark-weathering, generally massive or poorly foliated, medium grained and commonly feldspar-porphyroblastic. Freshly broken surfaces typically show the greenish colour characteristic of quartzofeldspathic rocks of the granulite facies. However, the colour of exceptionally fresh rock may be dark grey. Following the study of samples brought back by Per Schei, geologist on the 2nd Fram Expedition of 1898–1902, Bugge (1910) termed these rocks hypersthene-quartz diorites. They are composed chiefly of oligoclase, alkali feldspar, quartz, orthopyroxene, dark yellowish green hornblende, and biotite. Garnet is present locally.

Hypersthene-bearing quartzofeldspathic rocks, including granodioritic as well as dioritic varieties, are common around Sunrise Pynt and predominate in Foulke Fjord and from its mouth to the vicinity of Kap Alexander.

The major lithologic feature of the basement rocks is the intrusion of granitic material in bodies ranging in size from thin veins to sheets tens of metres thick. These granitic bodies, which are generally pink, range from concordant to highly discordant on the scale of an outcrop but, except in the case of pegmatite, are invariably grossly concordant. Repeated and concordant alternation of older rock and granite results in 'granite-banded' gneiss in which the granitic component may form planar bodies, from metre-thick sheets to laminae a few millimetres thick.

Between Sunrise Pynt and the mouth of Foulke Fjord, granitic gneiss consisting of alternating, thin, pink and white feldspathic layers is abundant. Whether, or to what extent, such granitic gneisses belong to an older basement or were formed after granitic intrusion is uncertain. In any event, major tectonism followed intrusion of granite.

Locally, garnet is developed in the white feldspathic layers of the gneisses, and the patchy distribution of well-formed, commonly large garnet crystals in irregular, diffusely banded, leucocratic zones suggests relatively late development of garnet porphyroblasts. In contrast, the garnet occurring in the hypersthene-bearing rocks is an early-formed mineral.

Granite intrusive into metasediments at Sunrise Pynt contains relicts of garnet-hypersthene granitic rock. These relicts commonly have diffuse borders, indicative of reaction between relict and host, but the distribution of garnet appears to be unrelated to the reaction process; neither is garnet present in the intrusive granite.

Also found sporadically among the quartzofeldspathic rocks are tabular bodies of biotite-hornblende-pyroxene metamafite. Sharp, locally discordant contacts suggest that these bodies are metadykes or remnants thereof. The metadykes cut both the dark hy-

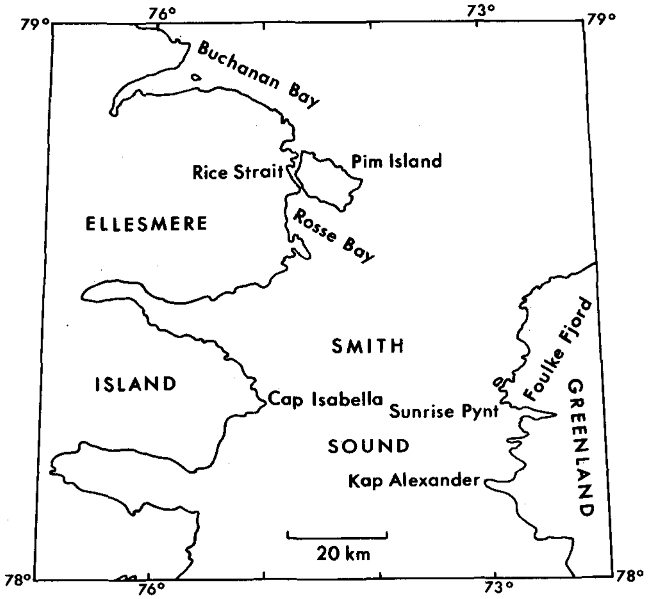

Fig. 4. Sketch-map of the Smith Sound area showing the localities mentioned in the text.

persthene-bearing and the red granitic rocks and may well be of more than one age but are thoroughly metamorphosed. They are themselves veined by granitic material.

The metasediments at Sunrise Pynt have been described by Dawes (1972, 1976). They include white, coarse-grained marble and calc-silicate rocks with wollastonite, forsterite, diopside, tremolite and spinel, pelitic garnet-biotite schist, and minor psammitic rocks. The metasediments are intruded by, and intercalated with, hypersthene-bearing quartzofeldspathic and granitic and pegmatitic rocks of the types described above. Together, metasediments and quartzofeldspathic rocks form a steeply-dipping layered sequence more than 1 km thick, trending east-north-east (Dawes, 1976, fig. 228).

Despite intense deformation and gross concordancy of the various rock units, intrusive contacts are preserved at Sunrise Pynt. Mobility of the incompetent calcareous rocks has resulted in the occurrence of numerous fragments of meta-intrusive rocks, especially pegmatite and schistose mafite, 'afloat' in marble, commonly in trains representing a once continuous layer.

Eastern Ellesmere Island

Facing the terrain described above lies the western shore of Smith Sound from Buchanan Bay to Cape Isabella on Ellesmere Island (fig. 4).

The coast from Buchanan Bay to Rice Strait and the western end of Pim Island are underlain chiefly by massive to poorly foliated hypersthene-bearing granitic rocks heavily veined and disrupted by granite. The hypersthene-bearing rocks are referred to as granulites by Frisch *et al.* (1978) and encompass rocks ranging from quartz diorite to granite. They typically consist chiefly of oligoclase, perthitic alkali feldspar and quartz, with hypersthene (commonly altered or pseudomorphosed), strongly pleochroic brown biotite and olive-green hornblende. Weathered surfaces vary from brown to dusky red but fresh surfaces show the characteristic greasy green of quartzofeldspathic granulite-facies rocks.

The intrusive granite has deep brown biotite as the chief mafic mineral and, weathered or fresh, is red. If inspection of a fresh surface is not possible, it is commonly difficult to distinguish between granite and red-weathering granulite.

While it may be discordant in detail, the granite veining is broadly concordant over large areas and with gneissic layering (if present) in the granulite. Indeed, such veining gives structure to extensive areas of rock that would otherwise be massive; an example from the north end of Pim Island is figured by Schei *in* Bugge (1910, opposite p. 5). Elsewhere, well-layered 'granite-banded' granulite gneisses form major tracts. Clearly, granitic intrusion preceded major deformation.

In much of Pim Island and south of Rosse Bay, granite predominates over granulite and locally only diffusely bordered lenses of granulite remain in granite. Distinction between the two rock types becomes blurred, apparently as a result of digestion of granulite by granite, and pseudomorphs of orthopyroxene may be the only evidence that granulite was once present.

At Cape Isabella, a meta-igneous/metasedimentary complex outcrops over an area about 12 km^2, bordered to the west by granulite gneiss that is locally garnetiferous. The general structure is that of north-east-trending interlayered belts of two-pyroxene granulite, pelitic metasediments with garnet, sillimanite and/or cordierite, and coarse-grained, white marble with diopside, forsterite and wollastonite. The maximum width of the complex, measured across strike, is 2.5 km. However, isoclinal folding and numerous faults have severely deformed the complex. At Cape Isabella itself, red granitic rock has intruded the metasediments in irregular, transgressive fashion. Pink pegmatite forms major intrusions into marble and is also found as fragments in the marble where the latter has been mobilized to flow. The two-pyroxene granulite, which includes amphibolite layers (metadykes?), appears to underlie the metasediments in a basement-cover relationship or it may be intrusive into them; the evidence is equivocal.

Conclusion

Eighty years ago, Schei (Holtedahl, 1917) recognized, as any geologist who sees both areas must, a close correspondence between the crystalline terrains of southern Inglefield Land and eastern Ellesmere Island. Later work has yielded further similarities and parallels, not only in lithology but also in the chronology of geologic events. The implications of such a correlation for the question of relative movement between Greenland and Ellesmere Island will be explored in a separate paper.

Acknowledgements. I am grateful to Peter R. Dawes for providing the opportunity of visiting southern Inglefield Land. I thank Peter Hyldegaard Jensen and Olav Winding for field assistance and Andreas Viðstein, skipper, and the crew of *K. J. V. Steenstrup*. Many of the details of the geology of Cape Isabella came from the work of G. R. Dunning. Transport to Greenland was provided by the Polar Continental Shelf Project.

References

Bugge, C. 1910: Petrographische Resultate der 2ten Fram-Expedition. *Rep. 2nd Norwegian Arctic Exped. Fram 1898–1902,* **22,** 38 pp. Kristiania: Videnskabs-Selskabet.
Dawes, P. R. 1972: Precambrian crystalline rocks and younger sediments of the Thule district, North Greenland. *Rapp. Grønlands geol. Unders.* **45,** 10–15.
Dawes, P. R. 1976: Precambrian to Tertiary of northern Greenland. *In* Escher, A. & Watt, W. S. (edit.) *Geology of Greenland,* 248–303. Copenhagen: Geol. Surv. Greenland.
Frisch, T., Morgan, W. C. & Dunning, G. R. 1978: Reconnaissance geology of the Precambrian Shield on Ellesmere and Coburg islands, Canadian Arctic Archipelago. *Pap. geol. Surv. Can.* **78-1A,** 135–138.
Holtedahl, O. 1917: Summary of geological results. *Rep. 2nd Norwegian Arctic Exped. Fram 1898–1902,* **36,** 32 pp. Kristiania: Videnskabs-Selskabet.

Geological Survey of Canada,
588 Booth Street,
Ottawa, Ontario K1A OE4,
Canada.

Geological reconnaissance of the Greenland Shield in Melville Bugt, North-West Greenland

Peter R. Dawes and Thomas Frisch

Geological reconnaissance mapping of the Thule – Melville Bugt region (75°15′N to 78°15′N) was completed in summer 1980 with the extension of the field work along the Lauge Koch Kyst in central and southern Melville Bugt (fig. 5). The work was concentrated in the region east of Kap Edvard Holm southwards down to Steenstrup Gletscher, the southern boundary of the 1:500 000 map sheet. The mapping was a continuation of the 1978 field work during which the area between Kap York and Fisher Øer was covered (Dawes, 1979).

Melville Bugt is characterised by an extremely narrow and broken ice-free coast, being for the most part composed of nunataks, islands and small peninsulas. The Inland Ice reaches the coast in many broad glacier fronts, often with floating tongues, and in summer the coast usually has a high concentration of ice. Parts of the nunatak terrain approach 1000 m altitude, with the snow-covered Haffner Bjerg as the highest summit at 1462 m.

The geological mapping was accomplished by combining a fixed-wing aerial survey with ground observations made from ship and helicopter. The whole coast, particularly the inner nunatak terrain, was overflown during two 5-hour flights from Thule Air Base using a Twin Otter aircraft. The ship-borne phase, based on the GGU motor cutter *K. J. V. Steenstrup,* was delayed until the end of August because of unfavourable ice conditions. Eventually a 12-day ship reconnaissance down to Steenstrup Gletscher was achieved although new ice in