Conclusion

The field work has provided a fairly extensive and good quality deep seismic data base for the Godthåbsfjord area within a limited time-frame and budget.

It is far too soon to present any interpretations from the data obtained, but it is anticipated that they will provide important new information and constraints on the layering of this deeply eroded and thick, old crustal segment. This in turn can be applied to seismic studies of the lower crust elsewhere. It is hoped that possible suture zones or terrane boundaries will be discernible in the data, and that details about the nature and position of the crust/mantle boundary (Moho) can be interpreted from the data. Another interesting aspect will be to see whether or not it is possible to link the information gained by this experiment with the recent developments in interpretation of the Archaean geology into different terranes developed independently in this area (V. R. McGregor, personal communication, 1989).

References

Bridgwater, D., Keto, L., McGregor, V. R. & Myers, J. S. 1976: Archaean gneiss complex of Greenland. *In* Escher, A. & Watt. W. S. (edit.) *Geology of Greenland,* 18–75. Copenhagen: Geol. Surv. Greenland.

McGregor, V. R., Nutman, A. P. & Friend, C. R. L. 1986: The Archean geology of the Godthåbsfjord region, southern West Greenland. *In* Ashwal, L. D. (edit.) Workshop on early crustal genesis: the world's oldest rocks. *Tech. Rep. Lunar planet. Inst.* **86–04,** 113–169.

P. S., Institute of Geophysics, Haraldsgade 6, DK-2200 Copenhagen N, Denmark.

S. B. S., Department of Geology and Geophysics, University of Wyoming, P.O. Box 3006, University Station, Laramie WY 82071, U.S.A.

H. C. L., Geological Survey of Greenland, Copenhagen.

Activities within the field of mineral resources

Hans Kristian Schønwandt

Increasing expectation is being placed on the successful exploitation of Greenland's mineral resources. The Geological Survey of Greenland (GGU) responds to this challenge by carrying out work programmes to collect the necessary geological information to meet the basic needs of the mineral industry. In this way GGU is able to advise the Mineral Resources Administration for Greenland on affairs concerning mineral concessions in Greenland.

GGU has recently taken several steps to improve the exploration infrastructure for the mineral industry. The effort has focused on the establishment of a data bank of mineralizations and a core library; steps have also been taken to streamline access to released company exploration data. Presentation of data collected by GGU has been improved with the initiation of a new publication series (Open File Series) aimed at presenting information to the commercial sector at the greatest possible speed.

←

Fig. 1. Map of survey area showing location of land seismic receiver stations and ship's track during recording of deep refraction and reflection seismic profiles.

Mineralization Data Bank

The aim of the data bank is to provide information on mineralizations in a systematic and accessible form for direct use by industry, and for GGU's own resource evaluation programmes and applied research. The systematic processing of data for the computerized Mineralization Data Bank started in June 1989. It is intended that information on all known economic mineral localities in Greenland will be listed and continuously updated. In addition to basic geological data such as commodity, host rock, structure, chemical analyses etc., the

Geochemical sampling in connection with mineral resource evaluation programmes. The traditional pan allows concentration of mineral residues in stream sediments. Photo: B. Thomassen.

information stored includes a review of the exploration work carried out at the prospect and also lists previous concessions. Information on the location of mineral occurrences will be stored in a digitalized form to enable the production of mineral deposit maps which will be issued by GGU.

At present, the collection of data is concentrated on the potentially most important mineral occurrences, with data being extracted from company and GGU reports. Later, minor and less well known mineralized localities will be incorporated into the data bank from a broader spectrum of published and unpublished sources. By the end of 1990 all major mineral localities from the west coast of Greenland and central East Greenland should have been processed.

Core Library

Until recently concession licences contained no regulations concerning drill cores, although GGU has the right to secure geological samples from concessionaires. However, present policy encourages companies to offer drill cores to GGU when their work on them is finished.

Companies with a long exploration tradition in Greenland, e.g. Kryolitselskabet Øresund A/S, Greenex A/S and Nordisk Mineselskab A/S have kindly deposited their drill cores with GGU, and these cores form the basis of the Core Library. At present, the library contains 13.1 km of core from the Black Angel mine and other lead-zinc showings in the Maarmorilik area, central West Greenland; 20 km of core from the cryolite deposit at Ivigtut, South-West Greenland, and a representative core (skeleton core) representing approximately 15 km of core from the porphyry-molybdenum deposit at Malmbjerg in Werner Bjerge, central East Greenland (fig. 1). The library contains a further 18 km of core from about 30 mineralized localities in western Greenland drilled by Kryolitselskabet Øresund A/S during the period from 1960 to 1982. The Core Library is situated at GGU's headquarters in Copenhagen and all core material is available for inspection on request.

Company reports

Companies holding mineral licences in Greenland are required to submit progress reports, stored at GGU. These exploration reports contain a large amount of exploration data and a list of reports available to the public will be published in 1990. This list will be updated and expanded continuously as previously confidential material is made available to the public.

Open File Series

In the field of mineral research three reports have been published in the recently established Open File Series.

(1) A report on chemical analyses of 23 elements in heavy mineral concentrates from 604 stream sediments covering an area of approximately 40 000 km^2 in southern West Greenland has been published by Appel (1989). The heavy mineral concentrates were also investigated for scheelite.

(2) A review and status of exploration of heavy mineral sands in the Thule area (76–78°N) of North-West Greenland has been compiled by Dawes (1989); here ilmenite and magnetite rich deposits are known on active and uplifted beaches along a coastline of several hundred kilometres.

(3) The discovery of gold and platinum group metals in reefs in the Skaergaard intrusion, southern East Greenland, is due to exploration activities started in 1986 by Platinova Resources Ltd., and now conducted by the Joint Venture Corona Corporation and Platinova Resources Ltd. Investigation of the mineralization by GGU includes:

(a) supervision of the exploration, including verification of the results obtained by the concessionaires, and

(b) examination and anlysis of the origin and characteristics of the mineralization.

A report by Nielsen (1989) on the Skaergaard gold mineralization shows that the results obtained by the concessionaires concerning the concentration of gold are reproducable. Analytical studies carried out in collaboration with the concessionaires and a number of universities in Denmark and North America, include major and trace element and isotopic investigations of rocks and minerals as well as fluid inclusion studies.

The object of the investigation is to determine the processes that resulted in the stratabound deposition of gold and platinum group metals. With this in mind, suites of grab samples were collected through the mineralized zones during inspection visits to the Skaergaard intrusion in 1989. GGU investigations have focused on the major and trace element correlation with gold and platinum group metals. Preliminary results are described elsewhere in this volume (Nielsen & Schønwandt, 1990; see also the following article by Nielsen).

Field investigations

Field investigations directly related to economic mineral occurrences have been performed in three areas of West Greenland: the Umanaq district, the Atâ area in Disko Bugt, and the Ivisârtoq area of inner Godthåbsfjord (fig. 1).

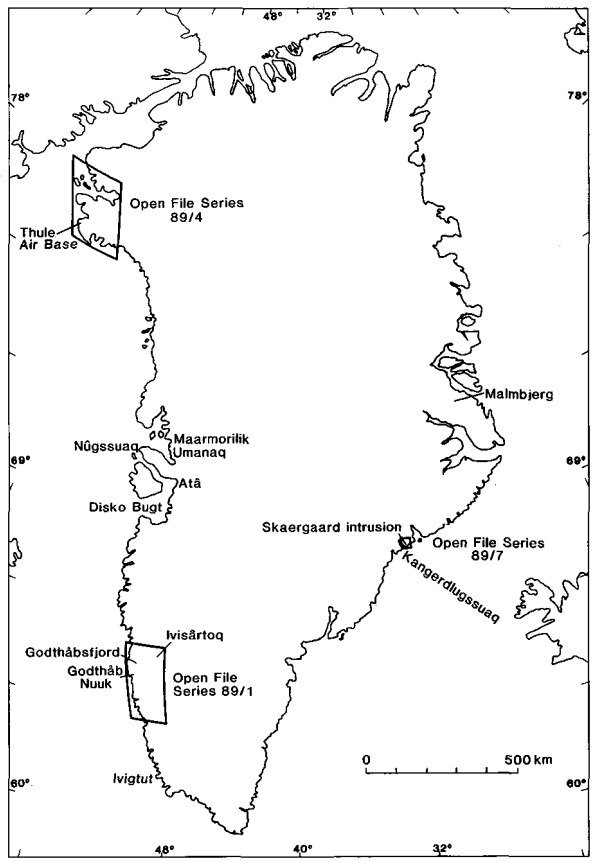


Fig. 1. Map of Greenland showing localities referred to in connection with mineral resource activities: field investigations 1989, Open File Series reports released in 1989 and establishment in Copenhagen of a drill-core library.

Umanaq. The purpose of field work in the Umanaq district was to study the regional metallogenetic aspects of the Precambrian in order to prepare a comprehensive report on the Black Angel lead-zinc mine at Maarmorilik. Selected mineralized localities in supracrustal strata of the Proterozoic Karrat Group were investigated for four weeks in July and August 1989. Stream sediments, boulders and outcrops were sampled during traverses for geochemical study. Iron-sulphide mineralization associated with metaclastic and metavolcanic strata was the main target in the Karrat Fjord area, whereas lead-zinc mineralization within marble was investigated at Maarmorilik and in central Nûgssuaq. New finds include arsenopyrite-bearing boulders and a system of quartz veins with chalcopyrite. A field report is available (Thomassen, 1989) and further reports, including chemical analyses, are planned.

Atâ area. The mineral research programme in the Atâ area is part of the regional multidisciplinary activity organised by GGU within the Disko Bugt area (1988–1992; see Kalsbeek, 1990) which includes a variety of

geological, geochemical and geophysical investigations. Two belts of Precambrian supracrustal rocks occur in the area; one is Archaean, the other is early Proterozoic in age. The Archaean belt is dominated by greenstones whereas the younger belt is composed of low grade metamorphic sedimentary rocks which unconformably overlie the Archaean rocks. Both supracrustal belts contain mineralizations which have been investigated principally by the Kryolitselskabet Øresund A/S in the mid-1980s. Mineralization types are varied, ranging from banded iron formations to small copper and zinc-bearing massive sulphides, through disseminated gold-bearing sulphides in volcaniclastic rocks to epigenetic gold and copper-bearing quartz-carbonate vein-like structures. A review of these mineral occurrences is planned, and will provide an assessment of the mineralizations in relation to their stratigraphic setting and the processes of mineralization.

Ivisârtoq. Field work carried out in the Archaean Malene supracrustal rocks of the Godthåbsfjord area concentrated on detailed geological investigation and chip sampling of previously located extensive scheelite-bearing calc-silicate horizons.

Scheelite was discovered in the Godthåbsfjord area in 1982, both as grains in heavy minerals from stream sediments and as *in situ* mineralizations (Appel, 1989). During the following years, a stream sediment sampling programme was carried out in the Godthåbsfjord area and scheelite was found to occur in heavy minerals from stream sediments over an area of more than 35 000 km^2.

Further field work revealed that the scheelite is confined to the early Archaean Isua–Akilia supracrustal rocks and to the mid Archaean Malene supracrustal rocks; gneisses and the intrusive granites proved to be barren. The scheelite occurrences in the younger Malene supracrustals appear to be the most promising from an economic point of view. These occurrences are associated with gahnite-bearing sulphide-rich horizons as well as with tourmalinites.

Work with ultra-violet light in the Godthåbsfjord area demonstrates that a single scheelite-bearing horizon can be traced intermittently for well over 3.5 km. This zone was discovered in 1987 and was 'chip sampled' in 1989. During the 1989 field season further extensive scheelite-bearing horizons were discovered in the Ivisârtoq area.

References

Appel, P. W. U. 1989: Investigations of heavy mineral concentrates from stream sediment samples collected during the period 1982 to 1986 in the Nuuk area, West Greenland. *Open File Ser. Grønlands geol. Unders.* **89/1,** 17 pp., 10 tables, 35 plates.

Dawes, P. R. 1989: The Thule black sand province, North-West Greenland: investigation status and potential. *Open File Ser. Grønlands geol. Unders.* **89/4,** 17 pp., 7 figs, 2 tables.

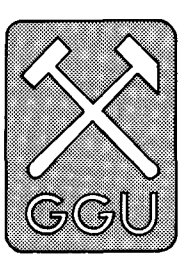
Kalsbeek, F. 1990: Disko Bugt Project. central West Greenland. *Rapp. Grønlands geol. Unders.* **148** (this volume).

Nielsen, T. F. D. 1989: Gold mineralisation in the Skaergaard intrusion. *Open File Ser. Grønlands geol. Unders.* **89/7,** 14 pp., 6 figs, 2 tables.

Nielsen, T. F. D. & Schønwandt, H. K. 1990: Gold and platinum group metal mineralisation in the Skaergaard intrusion, southern East Greenland. *Rapp. Grønlands geol. Unders.* **148** (this volume).

Thomassen, B. 1989: Reconnaissance of mineral occurrences in the Umanak district. Field report 1989. Unpubl. intern. GGU rep., 43 pp.

H. K. S., Geological Survey of Greenland, Copenhagen.



A gold mine in East Greenland?

Troels F. D. Nielsen

The search for gold in Greenland has hitherto been concentrated in geological terrains such as Precambrian volcanics that elsewhere on earth are traditionally regarded as gold-bearing. However, as it happens, the first exploitation of gold in Greenland could well be from a truly new type of gold mineralisation.

It was a major scientific surprise that the Skaergaard intrusion in southern East Greenland (fig. 1) was shown to host a stratiform gold and platinum group metals mineralisation (Nielsen, 1989; Nielsen & Schønwandt, 1990). The discovery was made in conjunction with a 1986 GGU programme focusing on the economic poten-