Deep seismic profiling in central West Greenland

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During September 1989 a survey of the Godthåbsfjord area was carried out in order to study the deep seismic structure of high-grade Archaean crust (Bridgwater *et al.*, 1976; McGregor *et al.*, 1986).

Refraction profiles were made along Godthåbsfjord and Ameralik. Receiver stations were placed along the fjords and inland to provide cross-profiles and 3-D coverage (fig. 1). Marine air-guns provided the seismic energy source.

Combined reflection and refraction profiles were made along the coast from Søndre Strømfjord in the north to Grædefjord in the south. Refraction receiver stations were placed along the coast from 63°N to 66°N, and reflection data were also recorded by the ship's 2 km long streamer.

The survey was carried out as a cooperative venture by the University of Wyoming, U.S.A., and the University of Bergen, Norway. The programme was financed by the U.S. National Science Foundation. GGU was invited to participate in the field work and at a later stage in the processing and interpretation of some of the data.

Instrumentation

The research vessel of the University of Bergen *Håkon Mosby* was used for the operations. Five airguns with a total volume of 6000 cu. in. were used in a W-shaped array to provide the energy source for both the reflection and the refraction programme. The airguns were fired at 60 second intervals, providing a ground coverage at approximately 110 m intervals (Yngve Kristoffersen, personal communication, 1989).

It was expected that there would be problems with navigation, streamer balancing and recording (ringing) in the fjords, so it was decided not to deploy the streamer, and hence not to record reflection data in the fjords.

The land receiver stations used were all of a new design developed for the joint U.S. university instrument-pool, PASSCAL, by Refraction Technology Inc. The seismometer unit used was a 6 channel, 2 Hz, 3 component instrument. Its programmable capability, with a 190 Mb SCSI-disc storage capacity, made this instrument very suitable for deployment under difficult logistic conditions. Hence it was theoretically possible to leave the instruments unmanned while recording for approximately 7 days. However, as this was the first application of the equipment under arctic field conditions, the instruments were in general left unmanned for only 3 or 4 days.

Time-control of 1 millisecond or better accuracy was obtained by a Kinemetrics unit locked to the Omega transmission time-control.

Survey operation

As the survey progressed, recording stations were successively recovered and data were stored on tape, filtered on computer and monitored. For each profile, Common Receiver Gathers (CRGs), often with more than 2000 traces, were filtered and plotted for each station after only 10–12 hours. This made it possible to produce a real-time feedback before redeployment of the stations, and in some cases it was possible to locate errors and correct them before the redeployment.

Data quality and preliminary results

The preliminary play-out of the seismograms shows several interesting characteristics in this experiment. Most stations show good ground coupling and the signal-to-noise ratio is generally good. A clear signal was obtained at most stations even at offsets in excess of 100 km. Thus many of the stations provided CRGs with an overall length of more than 300 km. Only a few attempts at preliminary interpretation were made, but several good reflectors were noted; it is believed that critical reflections from the Moho below the thick Archaean crust can be identified on several seismograms.

Both the land station data and the marine streamer data of *Håkon Mosby* are now at the Department of Geology and Geophysics of the University of Wyoming.

Processing and interpretation, involving Danish participation (P. S.), will begin at the University of Wyoming in late 1989.

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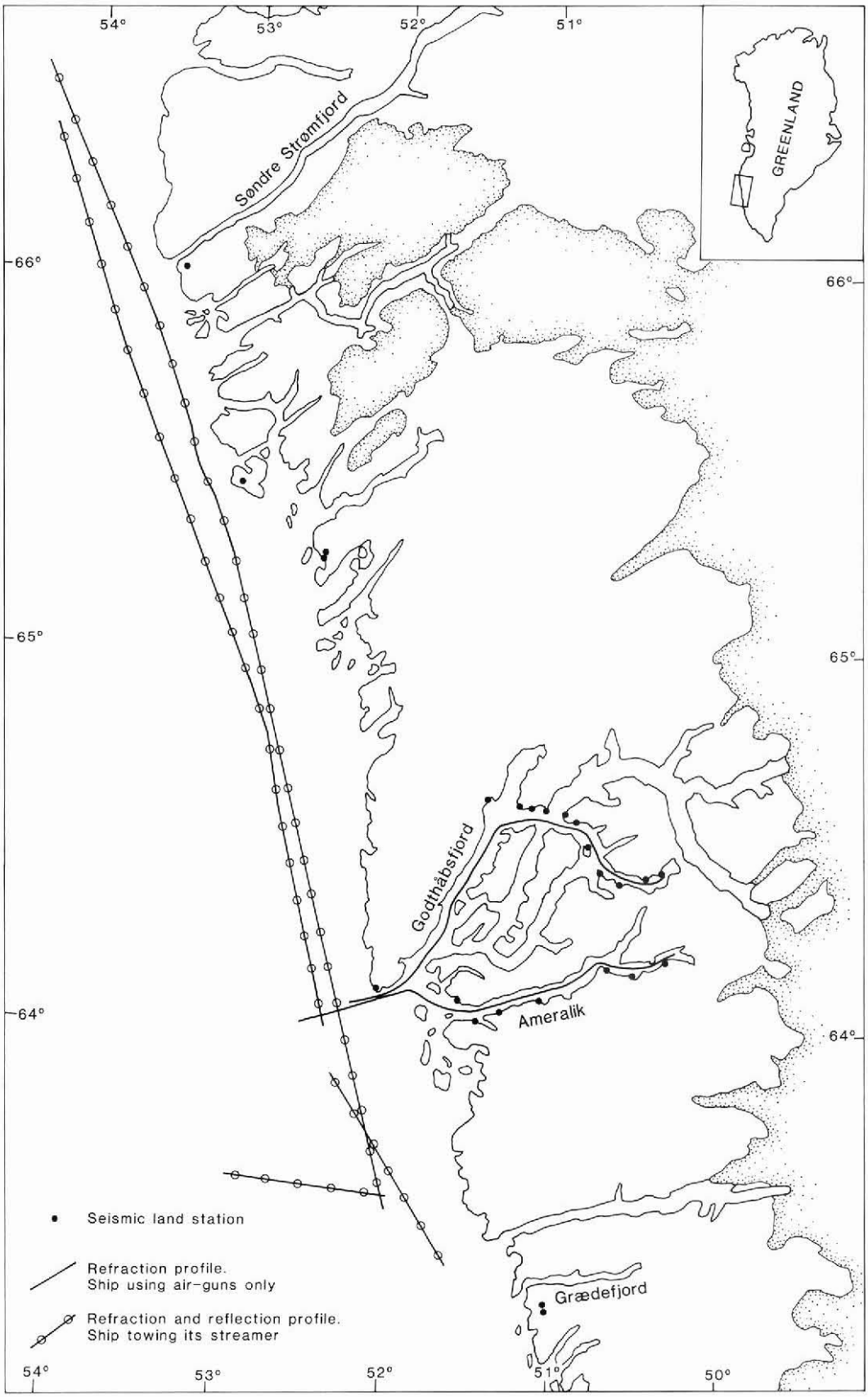
54°
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64°
Søndre Strømfjord
GREENLAND
Godthåbsfjord
Ameralik
Grædefjord
Seismic land station
Refraction profile.
Ship using air-guns only
Refraction and reflection profile.
Ship towing its streamer

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

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Activities within the field of mineral resources

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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.

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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