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A marine geophysical survey of the East Greenland continental shelf between latitudes 60° and 70°N – Project DANA 79

Birger Larsen

Introduction

Project DANA 79 is a part of GGU's geophysical investigations of the East Greenland shelf with special reference to the oil and gas potential of the continental margin. The programme also includes a regional aeromagnetic survey called EASTMAR (Larsen & Thorning, this report) and the planned deep seismic investigations (Risum, this report). Project DANA 79 was designed to provide knowledge of the geology of the sea floor and the shallow (0–300 m) subsurface. Special emphasis was put on the delineation of the basement and of the sedimentary basins on the shelf. The project was mainly sponsored as an energy related research programme by the Danish Ministry of Trade, Industry and Shipping, and was also supported by the Danish Natural Science Research Council.

The survey

The survey was carried out by a GGU team of ten, assisted by the crew of nine onboard the M/V *Dana*. Approximately 10 000 line kilometres of shallow seismic, magnetic and bathymetric profiles were measured together with 1000 line kilometres of side scan data. The lines shown in fig. 32 were measured from 27th July to 2nd September during unusually good weather and ice conditions. In addition approximately 2000 line kilometres were measured from 6th July to 27th July around the Faeroe Islands for the Geological Survey of Denmark and the government of the Faeroes (Nielsen *et al.*, 1979). The lines were investigated through a single channel, analogue recorded, continuous shallow seismic system. The energy source was either a 10 or 20 cubic inch airgun or a 4 KJ sparker. A deep tow

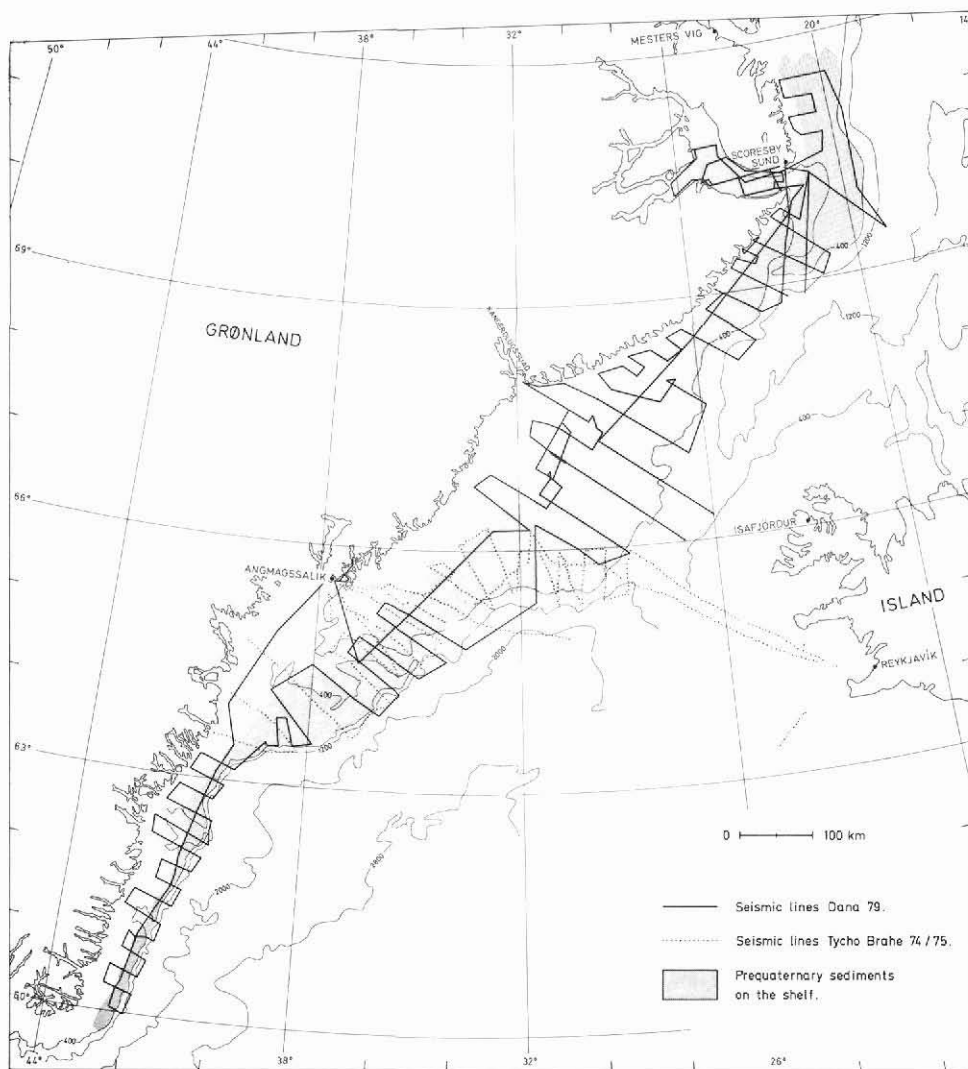


Fig. 32. Simplified track map of GGU seismic profiles of *Dana 79* (full line) and *Tycho Brahe 74/75* (dotted lines). The shaded parts of the shelf show areas where pre-Quaternary sediments form the bedrock. The north-west (shoreward) margin of this area marks the mapped contact between sediments and crystalline basement. The south-eastern (seaward) margin marks the continental shelf break. The sediment basins extend further below the continental slope and rise.

Edo-Western (model 515 T/606) system was used for the side scan profiling. Positioning was achieved by an integrated dual-channel satellite navigator, doppler sonar velocity log and gyro compass system on lease from 'Oceonics Ltd'. The equipment is described in detail by Brett & Zarudzki (1979). A newly procured weather facsimile recorder proved very useful in the day to day planning of the cruise.

The temperature of the sea water, and the weather and ice conditions were also recorded.

Results

The general structure of the East Greenland continental shelf is fairly simple and uniform between 60°N and 71°30'N as far as it is revealed by the shallow seismic survey. The bedrock of the inner part of the shelf comprises Precambrian basement or Tertiary igneous rocks. Due to the uncertain distinction of the two types on the seismic records, they will be referred to as 'crystalline basement'. To seaward this crystalline basement is covered by sediments. The sequence is often unconformably covered by Quaternary deposits. The extension of the sedimentary basins on the shelf is shown in fig. 32. The part of the shelf which is underlain by sediments is narrow south of 63°30'N, thus confirming the conclusions of Featherstone *et al.*, 1977. Northwards it broadens to 50–120 km and occupies roughly the outer half of the shelf. North of 69°N the present margin of the sedimentary basin is situated less than 25 km off the coast.

The contact between the crystalline basement and the sediments has been investigated in 60 sections by the *Dana 79* and *Tycho Brahe* cruises 1974/75 (Larsen, 1974). The following features have been observed in most of the sections (fig. 33, and Larsen, 1974, fig. 19). The top of the crystalline basement is gently inclined towards the east and continues below the sediments. Fault controlled contacts are unusual. The surface is conformably, or nearly so, overlain by a well bedded sequence of sediments. The sediments dip a few degrees eastwards and the dip often decreases in that direction. The sediment sequence is limited upwards by an erosional unconformity. A marked valley has frequently, but not always, been cut down at the contact between sediments and basement (fig. 33). It might be possible to sample the sediments on the valley slopes, but one attempt to do so failed.

From Kap Farvel to the latitude of Angmagssalik and north of Scoresby Sund the crystalline basement most probably consists of Precambrian gneisses. The sediment contact thus represents the present margin of the sedimentary basin. From off Kangerdlugssuaq (66°30'N) to the mouth of Scoresby Sund (70°15'N) the substratum of the sediments is shown to be composed of igneous rocks, on the basis of magnetic evidence (Johnson *et al.*, 1975, and unpublished GGU data). The igneous rocks onshore are dated to Paleocene (Deer, 1976). The contact in this area consequently marks the present limit of a Tertiary sedimentary basin. The erosional character of the contact and outliers of Tertiary sediments onshore prove a former extension towards the west. Mesozoic sediments are locally present onshore below the basalts (Deer, 1976).

Scoresby Sund

The seismic profiles show that the Mesozoic sediments on Jameson Land continue below and almost parallel to the sea floor of Scoresby Sund which slopes gently southwards. The sediments very close to the southern shore of the fjord are covered by the Tertiary plateau

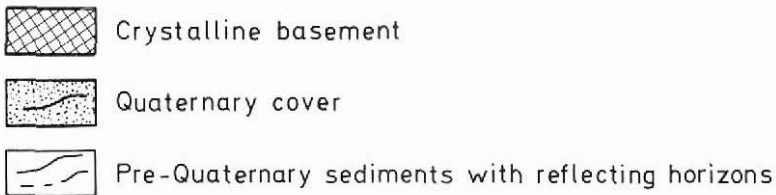
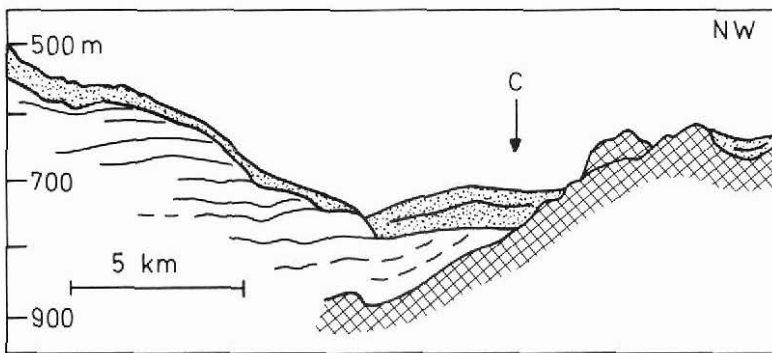
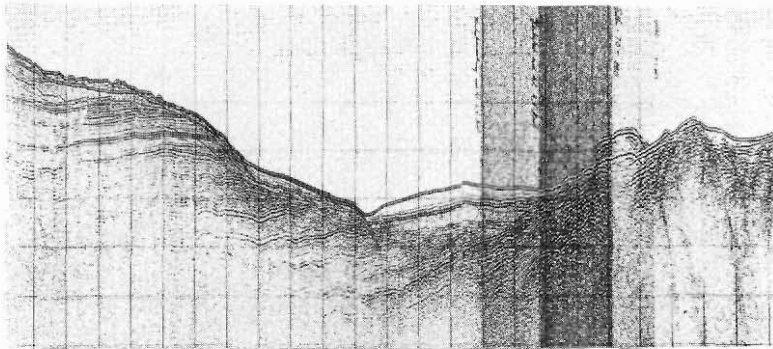


Fig. 33. Seismic section across the sediment contact with the crystalline basement. The location is marked on fig. 32 at 67°N. The uneven surface of the basement is conformably covered by the sediments. The point of contact is marked C. A broad valley has been cut into the sediments near the contact. The south-east part of the slope was later covered by a thin veneer of presumably Quaternary till. In the deepest parts Holocene marine clays have accumulated. The black bands across the section are due to change of cruise speed.

basalts. This disagrees with the magnetic interpretations of Bidstrup (1972). The Mesozoic sediments hardly extend west of Mudderbugten in the southern arm of the fjord. Here the contact towards the basement is erosional. The mouth of Scoresby Sund is crossed by a complicated block faulted uplift.

The Quaternary

Many channels traversing the shelf are cut deeply into the pre-Quaternary sediments. Thus a number of the banks are erosional remnants rather than Quaternary accumulation landforms. The Quaternary cover is chiefly thin and discontinuous on the crystalline shelf. The outer part of the shelf is frequently covered by a 50–100 m thick sequence which includes a few seismic reflectors. The inner (western) margin of the thick continuous Quaternary cover is often situated within a few kilometres of the basement/sediment contact; however, this is not the case in the area between 64 and 65°N. A few samples suggest that clayey tills are widespread on the sea floor. These observations could indicate that the shelf, at least once, has been ice covered and local erosion is important as a source for the Quaternary sediments. The surfaces of the banks are extensively scoured by icebergs to depths of at least 300 m.

Acknowledgements

The success of the survey was very much due to the able assistance of the technical staff: J. Boserup (GGU), E. Hansen (GGU), Jes Nielsen (DGU, on leave from Bedford Institute of Oceanography, Canada) and to the scientific assistants H. C. Ammentorp, A. Andersen, M. Boserup, S. Hansen and to the crew of *M/V Dana*. The cruise was made possible by the untiring efforts of G. Henderson (GGU).

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