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Re-evaluation of the geology of the southern West Greenland shelf – Project VEST SOKKEL

James A. Chalmers

From 1970 to 1977 approximately 40 000 km of multichannel seismic data were acquired between latitudes 63°N and 68°N on the continental shelf of southern West Greenland. In 1976 and 1977 five wells were drilled to explore for hydrocarbons, but all of them were dry. All exploration licences were relinquished by 1979.

In order to start re-evaluation of the shelf, GGU initiated a Pilot Study in 1987 using a limited amount of seismic data from a selected area of the shelf (fig. 1). The study used seismo-stratigraphic interpretation techniques to try to learn more from the seismic data than had been found using 'conventional' interpretation

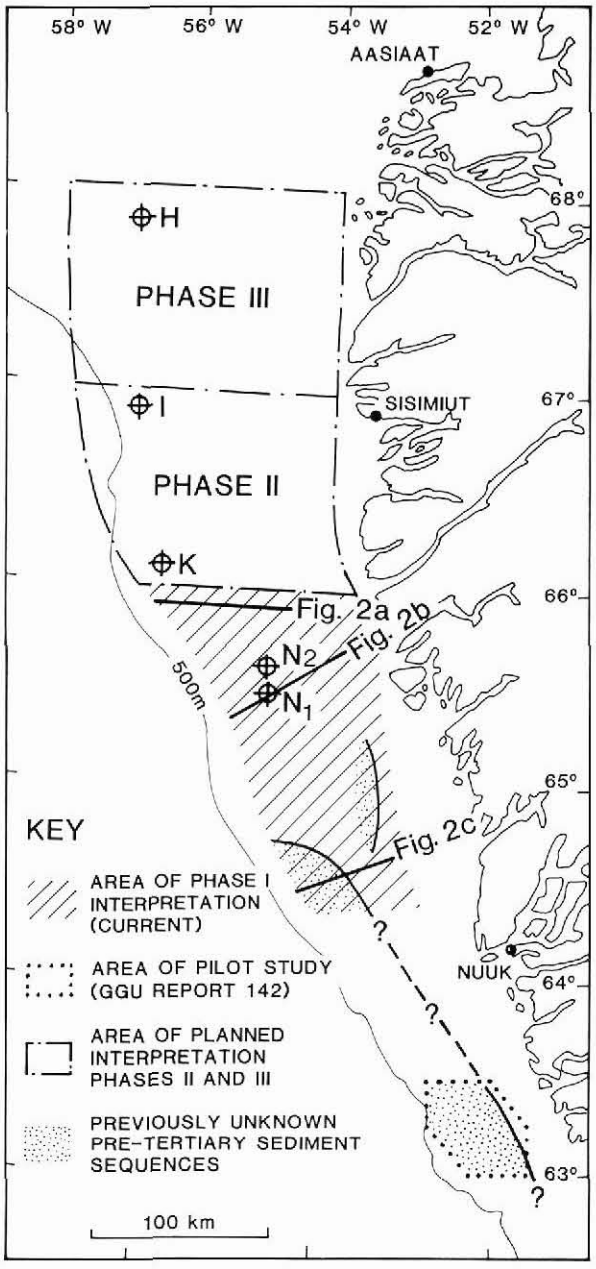

Fig. 1. The continental shelf offshore southern West Greenland showing the area of the Pilot Study (Chalmers, 1989) and the areas of Phases I, II and III of Project VEST SOKKEL. Phase I is partly completed. The area where the deepest of the three unknown pre-Tertiary seismo-stratigraphic sequences are present in fault blocks is shown by stipple. Wells: H = Hellefisk 1, I = Ikermiut 1, K = Kangâmiut 1, N1 = Nukik 1, N2 = Nukik 2. The locations of the sections in fig. 2 are shown.

techniques during the 1970s (Manderscheid, 1980; Henderson *et al.*, 1981). The results of that study were published as GGU Report **142** (Chalmers, 1989) and its conclusions were:

– that probable pre-Tertiary seismo-stratigraphic sequences not hitherto reported from West Greenland were present;

– that the existing seismic data are of sufficient quality to permit a re-evaluation of the whole area that was explored during the 1970s;

– that the West Greenland shelf was not adequately evaluated by the oil industry when it terminated exploration in the 1970s.

Project VEST SOKKEL

As a result of the conclusions arrived at above, it was decided during 1988 to commence a major project to re-evaluate the whole of the West Greenland shelf where there exist adequate seismic data. The project is called VEST SOKKEL, which is Danish for 'west shelf'.

The project has been divided into three phases:

– Phase I is to evaluate the area between 64° 20′N and 66°N and to attempt to obtain a tie to the pilot study area which lies between 63°N and 63° 30′N. This phase is still in progress and it is planned to be completed by the end of 1990.

– Phase II will be to re-evaluate the area between 66°N and 67°N. It is planned for 1991–1992.

– Phase III will be to evaluate the area between 67°N and 68°N. It is planned for 1993–1994.

An interpretation using a very regional grid of data and analysing only the Tertiary sequences has recently been completed as a Masters thesis at Copenhagen University by T. G. Ottesen. An English summary of this work is in preparation as a report in GGU's Open File Series.

Phase I

At the time of writing (October 1989) all seismic lines between 64° 20′N and 66°N have been interpreted. It has been possible to divide the Tertiary sediments into seismic sequences and a seismo-stratigraphic analysis of these sequences is under way. It is expected that it will be possible to interpret the depositional environments of the various sequences.

One major conclusion of this part of the work is that the present day shelf is erosional. The latest Tertiary sequences are all truncated by erosion at the sea bed.

The basalts penetrated by the well Nukik 2 (Rolle, 1985; Hald & Larsen, 1987) can be followed on the seismic data. They appear to form a fairly extensive province as far south as 64° 40′N. Their limit to the north has not been found, but they still occur at 66°N where the present phase of interpretation has stopped.

Two sequences of probable Cretaceous age with a combined thickness of up to about 2 km can be traced

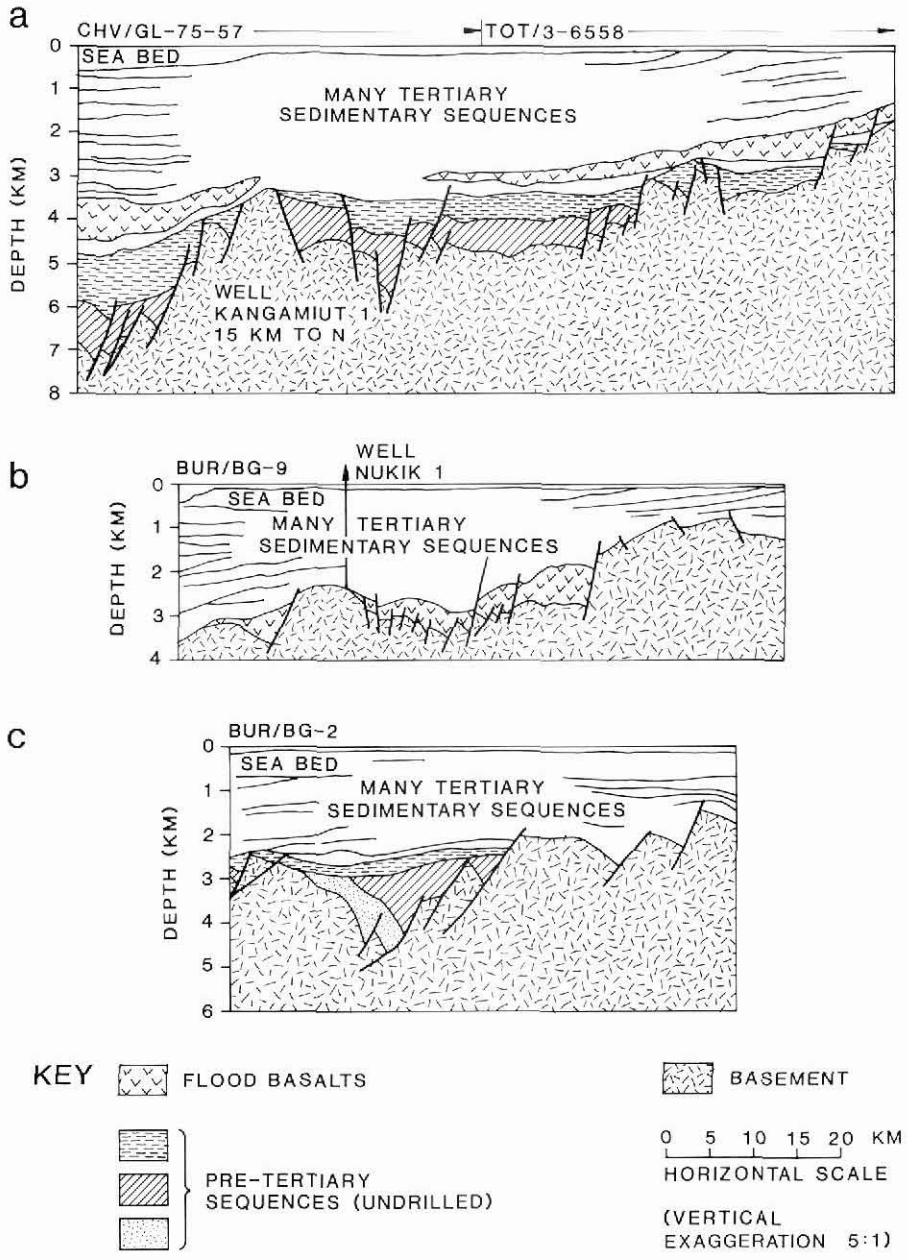

Fig. 2. Comparison between three cross-sections through structurally different areas of the West Greenland shelf between 64° 20′ and 66°.

a. Through the Kangâmiut ridge at 65° 58′N. Two pre-Tertiary sequences are interpreted.

b. Through well Nukik 1. Tertiary sequences lie directly on basement.

c. Through fault blocks south of 64° 45′N. Three pre-Tertiary sequences are interpreted.

both west and east of the ridge on which the Kangâmiut 1 well was drilled (fig. 2a). Both Nukik wells have been drilled into an area where Tertiary rocks appear to lie directly on basement (fig. 2b). Farther south, however, presumed pre-Tertiary rocks are again present. Three sequences of quite different reflectivity character can be traced to the southern limit of seismic coverage at 64° 20′N (fig. 2c). Only a few seismic lines of very poor quality have been shot in the area between 64° 20′N and 63° 30′N and it has not been possible to tie directly the Pilot Study area to the Project VEST SOKKEL Phase I area.

The age and provenance of the three deep sequences are entirely conjectural. It seems likely that the uppermost sequence corresponds to what was called Megasequence 2 in the Pilot Study (Chalmers, 1989) and it may well be of Late Cretaceous age. The lower two sequences could correspond to the lower more reflective and upper more transparent sequences in Megasequence 1 of the Pilot Study.

The upper two sequences can be correlated with the presumed Cretaceous sequences present on either side of the Kangâmiut ridge (fig. 2), but the lowermost sequence is present only in a narrow outlier between 64° 45′N and 65° 15′ and in a more extensive area of fault blocks between 64° 45′N and the southern limit of data coverage at 64° 20′N (fig. 1).

It is hoped that new data will be acquired in 1990 which will enable these sequences to be interpreted to the south, to find what is their relationship to the sequences in the Pilot Study area and to extend that interpretation farther south (see following article).

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Regional marine seismic reconnaissance

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The only offshore multi-channel reflection seismic survey that has been carried out by GGU until now is project NAD (North Atlantic D), a survey which covered most of the eastern Greenland shelf between 63° and 72°N (Larsen, 1985, in press). This survey was made possible by a large grant from the EEC. After Greenland's withdrawal from the EC in 1985 it became doubtful if support for further major projects offshore Greenland could be obtained from the EEC. Other sources of funding would have to be found if the costly process of investigating the hydrocarbon potential of the vast continental shelf off Greenland was to continue. Against this background the Mineral Resources Administration for Greenland requested GGU and Nunaoil A/S (the joint Greenland Home Rule/Danish State-owned company) to work out alternative plans for carrying out and financing marine seismic data acquisition offshore Greenland, and in 1986 GGU proposed the KANUMAS project (Larsen, 1986). KANUMAS is an acronym for Kalaallit Nunaat Marine Seismic; Kalaallit Nunaat is the Greenlandic name for Greenland.

Project KANUMAS

The essence of the original KANUMAS project proposal was as follows.

A regional reconnaissance seismic survey using modern technology would be carried out over the entire shelf off eastern and western Greenland, with the exception of the areas sufficiently covered by the NAD