southern West Greenland: fluid movement and interpretation of Pb/Pb isotopic data. *In* Bridgwater, D. (edit.) *Fluid movements, element transport, and the composition of the deep crust*. Dordrecht: Reidel.

Nutman, A. P., Bridgwater, D. & Fryer, B. J. 1984: The iron-rich suite from the Amîtsoq gneisses of southern West Greenland: early Archaean plutonic rocks of mixed crustal and mantle origin. *Contr. Mineral. Petrol.* **87**, 24–34.

Roberts, I. W. N. 1979: Archaean evolution of inner Ameralik, south-west Greenland, with special reference to mid-Archaean magmatism. Unpublished Ph. D. thesis, Univ. Wales, Aberystwyth.

Schiøtte, L., Compston, W. & Bridgwater, D. in press: Late Archaean ages for the deposition of clastic sediments belonging to the Malene supracrustals, southern West Greenland. *Earth planet. Sci. Lett.*

Wells, P. R. A. 1979: Chemical and thermal evolution of Archaean sialic crust, southern West Greenland. *J. Petrol.* **20**, 187–226.

C. R. L. F.,
Department of Geology,
Oxford Polytechnic,
Oxford OX3 0BP,
England.

A. P. N.,
Department of Earth Sciences,
Memorial University of Newfoundland,
St. John's, Newfoundland,
Canada A1B 3X5.

Application of seismo-stratigraphic interpretation techniques to offshore West Greenland

James A. Chalmers

A pilot study is being conducted to determine if the use of seismo-stratigraphic interpretation techniques can increase the understanding of the geology of offshore West Greenland in order to reassess the prospectivity of the area.

During the period 1975 to 1979, a number of concessions offshore West Greenland were licensed to various consortia of oil companies to search for petroleum. Some 40 000 km of seismic data were acquired, all of which is now released. Five wells were drilled, all of them dry, and all concessions were relinquished by the industry by 1979.

The regional geology of offshore West Greenland has been summarised by Manderscheid (1980) and Henderson *et al.* (1981). They show the West Greenland Basin to consist of fairly uniformly westward dipping sediments bordered near the shelf break by a basement ridge. These authors used what may be termed 'conventional' techniques of seismic interpretation. However, since that time the techniques of seismo-stratigraphy (Vail *et al.*, 1977; Hubbard *et al.*, 1985) have become established. They are now being applied to study seismic data acquired during the mid-1970s.

Interpretation

Concession 26, held by a group operated by Amoco Greenland, lies south-west of Færingehavn on GGU 1:100 000 base map 63 S 51 30 (fig. 1). It was relinquished during 1978 without drilling. A seismic grid of roughly 3 × 5 km exists over the former concession. The data were acquired in 1975 and 1977 and are either 24- or 48-fold. None of the lines have been migrated. The

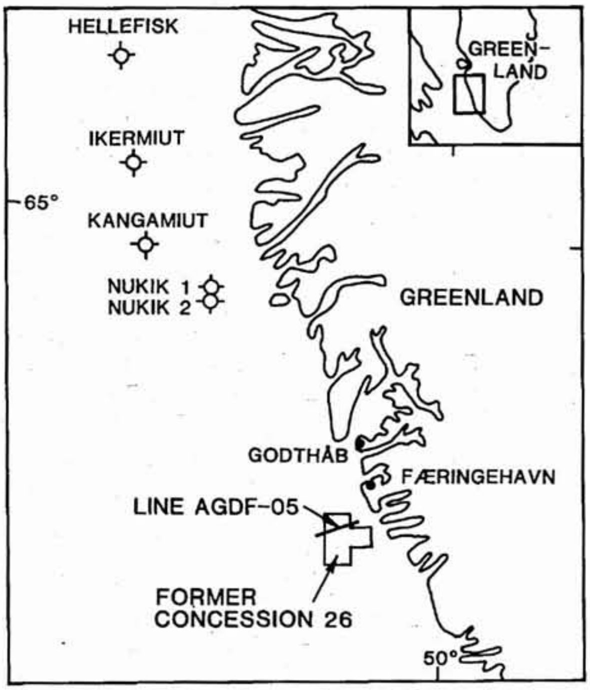

Fig. 1. Location of former concession 26 offshore West Greenland.

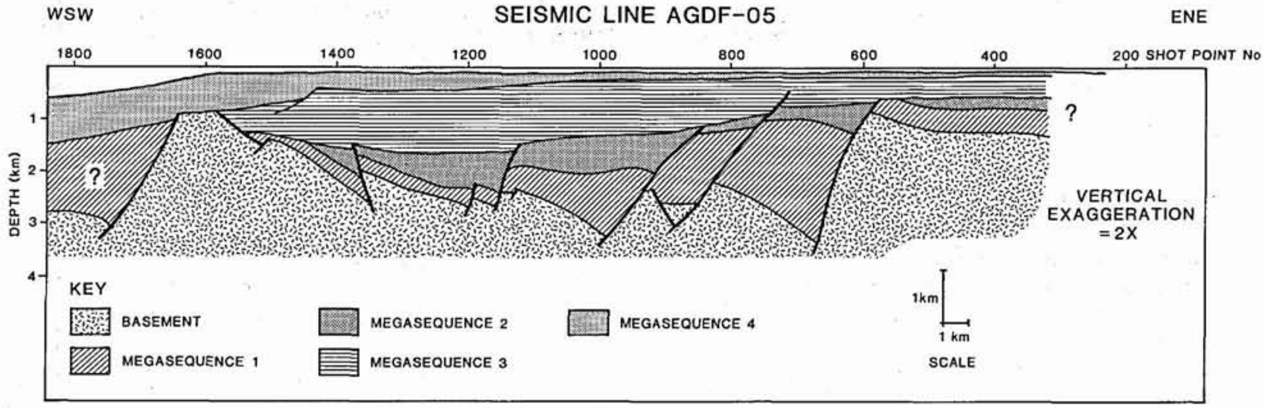

Fig. 2. Depth converted interpretation of seismic line AGDF–05 showing Megasequences 1 to 4.

area is a self-contained study area covered by a grid of fair quality seismic data and in which the most recent sediments are thin (see later). This allows easier penetration of seismic waves to deeper levels, which can perhaps be seen more clearly here than farther north.

Using the techniques described by Vail *et al.* (1977), depositional sequence boundaries were identified and traced round the grid. It was found that there existed four megasequences in the sense defined by Hubbard *et al.* (1985). These are shown in fig. 2 on a depth-converted interpretation of seismic line AGDF-05.

Megasequence 1 is a syn-rift sequence of unknown age. It lies within a series of coalescing half-graben. Within it a number of individual sequences can tentatively be identified, though it is unlikely that the depositional environment can be identified within these, due to the comparatively poor quality of the seismic data. Reprocessing of the seismic data could change this situation, however.

Megasequence 2 is also a syn-rift sequence. It overlies Megasequence 1, but the two rift phases have not been bounded by the same faults, and extension has been in different directions in places. This has resulted in space problems which have been resolved by the formation of thrust faults, as at shot point 1350 of fig. 2. Megasequence 2 is of uniform seismic character and seems to consist of only one sequence.

Megasequence 3 is a post-rift sequence which seems to correspond to the thermal phase (in the sense used by McKenzie, 1978) of the rift containing Megasequence 2. It contains four sequences within which it is probably possible to identify the depositional environments.

Megasequence 4 is a second post-rift sequence which overlies Megasequence 3 and truncates it with marked unconformity to the north and west. It again contains several individual sequences.

Ages of the sediments

There is no direct way to date these sequences at present. It may be possible to follow them northwards into the wells that have been drilled there, but that will require much more work than is at present underway. However, it is tempting to speculate that Megasequence 4 lies above the unconformity of Oligocene age which is widely identified around the Atlantic (Vail *et al.*, 1977). If so, then Megasequences 3 and 4 could be the rift and post-rift sequences associated with the Late Cretaceous onset of sea-floor spreading in the Labrador Sea (Srivastava *et al.*, 1981). This would mean that Megasequence 1 is of unknown earlier age. One can speculate as to how old, but it seems that no rocks of that megasequence have yet been sampled on the West Greenland Continental Shelf.

An alternative interpretation of the unconformity sequences could be that the unconformity between Megasequences 3 and 4 was produced by the change in tectonic regime at the start of sea-floor spreading in the Norwegian Sea. This would make it early Eocene in age (Talwani & Eldholm, 1977). If so, Megasequences 2 and 3 would still be associated with the onset of spreading in the Labrador Sea, at anomaly 32 time (Srivastava *et al.*, 1981). This would make them Late Cretaceous to Palaeocene in age. Yet again, however, this means that Megasequence 1 is of unknown age and provenance.

Work is still continuing on mapping these sequences and attempting to identify the depositional environments. A full report is planned for publication in 1988.

References

Henderson, G., Schiener, E. J., Risum, J. B., Croxton, C. A. & Anderson, B. B. 1981: The West Greenland Basin. *In* Kerr, J. W. & Fergusson, A. J. (edit.) Geology of the North Atlantic borderlands. *Mem. Can. Soc. Petrol. Geol.* **7,** 399–428.

Hubbard, R. J., Pape, J. & Roberts, D. G. 1985: Deposition sequence mapping as a technique to establish tectonic and stratigraphic framework and evaluate hydrocarbon potential on a passive continental margin. *In* Berg, O. R. & Woolverton, D. G. (edit.) Seismic stratigraphy II. *Mem. Am. Ass. Petrol. Geol.* **39,** 79–91.

McKenzie, D. P. 1978: Some remarks on the evolution of sedimentary basins. *Earth planet. Sci. Lett.* **40,** 25–32.

Manderscheid, G. 1980: The geology of the offshore sedimentary basin of West Greenland. *In* Miall, A. D. (edit.) Facts and principles of world oil occurrence. *Mem. Can. Soc. Petrol. Geol.* **6,** 951–973.

Srivastava, S. P., Falconer, R. K. H. & MacLean, B. 1981: Labrador Sea, Davis Strait, Baffin Bay: geology and geophysics – a review. *In* Kerr, J. W. & Fergusson, A. J. (edit.) Geology of the North Atlantic borderlands. *Mem. Can. Soc. Petrol. Geol.* **7,** 333–398.

Talwani, M. & Eldholm, O. 1977: Evolution of the Norwegian – Greenland Sea. *Bull. geol. Soc. Amer.* **88,** 969–999.

Vail, P. R., Mitchum, R. M., Todd, R. G., Widmier, J. M., Thomson, S., Sangree, J. B., Bubb, J. N. & Hatlelid, W. G. 1977: Seismic stratigraphy and global changes of sea level. *In* Payton, C. E. (edit.) Seismic stratigraphy – applications to hydrocarbon exploration. *Mem. Am. Ass. Petrol. Geol.* **26,** 49–205.

Detailed investigation of the niobium-tantalum distribution within the Motzfeldt Centre, South Greenland

Bjørn Thomassen, Tapani Tukiainen and Karsten Secher

A one year programme for detailed investigation of selected parts of the Nb-Ta-U-bearing pyrochlore mineralisation within the Motzfeldt Centre, South Greenland, was initiated in June 1987. The aim of the programme is to delineate areas with a potential for high-grade accumulation of Ta-enriched pyrochlore which is important if international exploration and mining activity is to be attracted. It is also important for official decisions in relation to any application for concessionary activity. The programme is carried out as a joint project between GGU and Nunaoil A/S under supervision of GGU, and a major part of the funding is granted by the Mineral Resources Administration for Greenland.

On the basis of information obtained during survey activity from 1980 to 1986 (Tukiainen, 1986), six mineralised areas covering *c.* 1.5 km^2 were selected for detailed investigation by gamma-spectrometry and rock sampling (fig. 1). Most of the areas are situated on very steep slopes in alpine terrain with altitudes up to 1900 m a.s.l. Therefore, the gamma-spectrometric measurements were made by helicopter, and the sampling was carried out by mountaineers.

In total 20 people were engaged during the field season from the end of June to the end of August (Thomassen & Tukiainen, 1987). The authors functioned as project geologist, consultant and leader, respectively. The GGU station in Narsarsuaq was operated as the field base by J. Lau. The helicopter service was by Greenlandair Charter A/S, the geophysical survey by Global Earth Sciences Ltd. (England), and the mountaineers were provided by Garaventa AG (Switzerland).

Geology and mineralisation

The Motzfeldt Centre (1310 ± 10 Ma, Blaxland *et al.*, 1978) is one of the major central complexes in the Gardar Province of alkaline igneous activity. The centre belongs to the Igaliko nepheline syenite complex of which a general account was given by Emeleus & Harry (1970). Following the discovery of radioactive mineralisation in 1979 (Armour-Brown *et al.*, 1980), the centre has been the objective of intensive research. The detailed geological and radiometric mapping of the Motzfeldt Centre was initiated in 1982 as a part of the 'Syduran project' (Armour-Brown *et al.*, 1983), and gradually its potential for large-scale Nb-Ta mineralisation was recognised (Tukiainen *et al.*, 1984). The research was continued during the project 'Pyrochlore in alkaline intrusions of Greenland' which was partly funded by the European Economic Communities (Bradshaw, 1985; Tukiainen, 1986, in press).

The Motzfeldt Centre covers an area of *c.* 300 km^2. It is made up of multiple intrusions of syenites emplaced into the Proterozoic Julianehåb Granite and the overlying Gardar supracrustal rocks. The main igneous