The geological history of Trænabanken

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After the Caledonian orogeny the folded and metamorphosed Cambro-Silurian sediments of the Nordland Shelf were subjected to erosion, and local Devonian intra-montane clastic basins formed around the eroding highs. In mid-Devonian times sinistral wrench faulting established an important tectonic trend which controlled the later development of the Trænabanken area. Major normal faulting at the start of Permian times created a deep basin in the east of Trænabanken. This basin was filled progressively with Permian clastics and marine carbonates and was subsequently covered with a thick continental Trias sequence. Extensive coal formation in earliest Jurassic times marked the transition from continental to marine depositional environments. Apart from some synsedimentary faulting in mid-Jurassic times, the Permian to end Middle Jurassic sequence is relatively undisturbed by tectonic movements.

A fully marine late Jurassic environment witnessed extensive local faulting along a zone cutting diagonally northeast across Trænabanken. However, there was no major relief in the area at this time, although there are indications that the west and northwest of the Trænabanken area may have undergone some erosion.

In early Cretaceous times the old Devonian trend was reactivated to form a distinct flexure across Trænabanken (the hinge line) which separated a strong erosional area in the northwest from the thick Lower Cretaceous deposits of the Helgeland Basin. Lower Cretaceous deposition northwest of the Nordland Ridge is difficult to define, but is thought to be significantly different from that of the Helgeland Basin.

During late Cretaceous and Tertiary times tectonic conditions in Trænabanken were generally stable, except in the Oligocene period, when a distinct wrench movement, connected with changes in the sea-floor spreading axis between Norway and Greenland, resulted in folding, reverse faulting and reverse rejuvenation of normal faults along a NNW trend in Trænabanken.

INTRODUCTION

In this chapter we attempt to summarize the geology of an area of 12 blocks between 66° and 66°45′N, and 9° and 10°20′E on the Norwegian Continental Shelf (Fig. 1). Herein, these blocks are collectively referred to as Trænabanken. Interpretation of the available data has led to an understanding of the geological evolution of the area and it is hoped that the presentation of the main ideas of the interpretation will advance the regional knowledge discussed in earlier publications. The area is, at present, undrilled and under active exploration. Hence we expect that refinement of the ideas presented will be possible in the near future.

Early regional geophysical work (Åm, 1970; Talwani and Eldholm, 1972; Sellevoll, 1975) gave a useful broad regional understanding, but relatively little data concerning the Trænabanken area. Rønnevik et al. (1975), Jørgensen and Navresiød (1979), and Rønnevik et al. (1979) presented interpretations covering Trænabanken based on the various regional seismic surveys made by the Norwegian Petroleum Directorate since 1972. Detailed interpretation was limited due to the quality of the seismic data and lack of sufficient data.

The main data base for this study is an extensive seismic programme shot in 1981. This survey gave a grid of approximately 2 × 4 km of good quality seismic data which enabled detailed interpretation of Trænabanken for the first time. Figure 1 shows this survey and the older regional lines in Trænabanken. In addition to the seismic data, we have analysed the gravity and magnetic data acquired in 1981 and earlier. Sea-bed sampling data (IKU, 1982) and an extensive review of the literature covering West Shetlands to Svalbard, and East Greenland to Norway were used to refine inter-
Fig. 1. Seismic data-base used for this study.

Fig. 2. Geology of the pre-Cretaceous subcrop and the distribution of Lower Cretaceous sediments. (See Fig. 3 for cross sections G–G' and H–H').

pretations of the seismic lines, as was information from exploration wells in Haltenbanken and from the considerable seismic data-base there.

STRUCTURE AND STRATIGRAPHY

The distribution of the Lower Cretaceous sediments conveniently divides Trønabanken into three structural provinces, separated by 'Fault A' and the 'hinge line' (Figs. 2 and 3). Southeast of the hinge line (SE area) a thick Lower Cretaceous sequence conformably overlies a thick parallel bedded and relatively undisturbed Jurassic, Triassic and Permian sequence. Between Fault A and the hinge line (central area), the Upper Cretaceous rests unconformably on eroded older strata. The subcropping sequence is Jurassic near the hinge line and becomes progressively older to the west, culminating in an area of eroded Cambro-Silurian sediments, the Rødøy High (Fig. 2).

The third structural province lies northwest of Fault A (NW area). Due to poor seismic data quality, interpretation in this area is less certain than in the rest of Trønabanken. A Lower Cretaceous sequence is thought to rest on eroded Cambro-Silurian rocks of the Rødøy High and on progressively younger rocks to the northeast.

The area is dominated by the Rødøy High and the hinge line (Fig. 4). Fault A has a large vertical throw in the northeast, where it forms the southeastern border of the Trøna basin. The vertical throw becomes insignificant to the southwest over the Rødøy High. The terms Nordland Ridge and Helgeland Basin were introduced in previous publications. We interpret both features to have been tectonically active only in early Cretaceous times.