

MAASTRICHTIAN AND DANIAN FACIES PATTERN ON THE RINGKØBING-FYN HIGH, DENMARK

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Cheilostome bryozoans in the bryozoan-rich carbonate sediments on the Ringkøbing-Fyn High, hitherto regarded as of Danian age, are shown to be Maastrichtian. Thin beds of limestone with bryozoans on the southern flank of the High belong to the Upper Danian. The facies distribution of the Maastrichtian and the Danian is therefore in agreement with the general depositional pattern on the High, prevailing since the Permian, with thick sediments in the basins, and a condensed, incomplete sequence on the High itself.

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The Ringkøbing-Fyn High is a very important structure in the eastern part of the north-west European depositional basin. From the Upper Permian and throughout the Mesozoic, the sedimentary environment has been quite different on the High from the basins to either side. Even though the basement has been more stable since the Cretaceous (Baartman 1973, p. 40), an isopach map of the Upper Cretaceous rocks (Stenestad 1972) shows that the Danish Embayment north of the High must be considered at that time to be an independent area of subsidence. The sediment distribution on shore suggests that the Ringkøbing-Fyn High also influenced the Tertiary facies pattern.

According to current interpretations the distribution of Danian deposits apparently deviates from the general pattern in which there are thin zones on the High and thicker zones in the basins. The thickness of the Danian in a section across the High based on the available data from the deep tests in Denmark (Sorgenfrei & Buch 1964, Rasmussen 1973) is shown in fig. 1, B. On the northern flank of the High 122 m was found in the Vinding boring and 90 m in the Nøvling boring, while on the southern flank 8 m occur in Hørning no. 1, 10 m in Rødekro no. 1, and 9 m in Tønder no. 2. Centrally on the High, Grindsted no. 1 contains 133 m of Danian sediments. According to Sorgenfrei & Buch (1964) the Danian immediately to the north of the High is mainly developed as a white chalk with few or

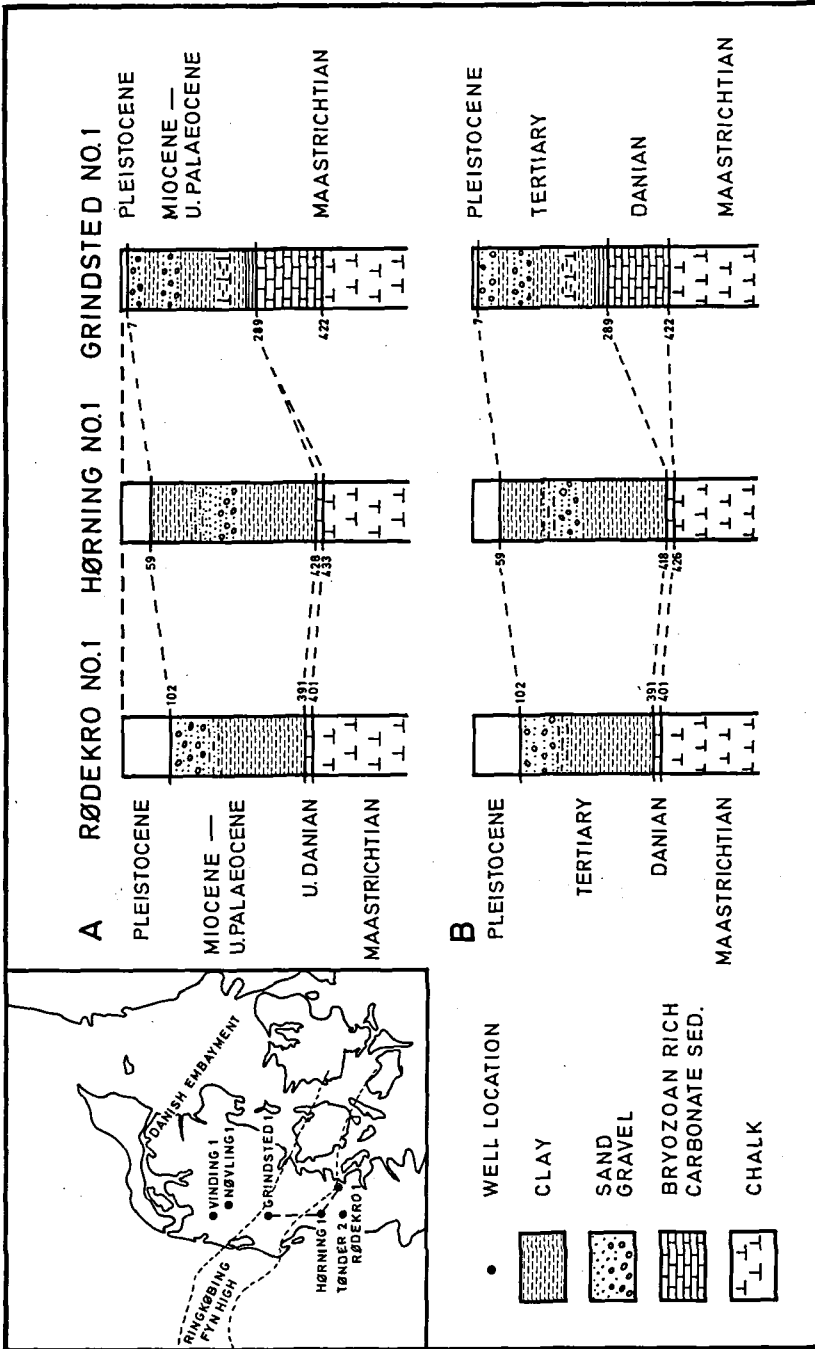


Fig. 1. Sections across the southern flank of the Ringkøbing-Fyn High. A: According to the interpretation presented in this paper; B: On the basis of data from Sorgenfrei & Buch (1964).

no bryozoans, while on the High itself and on the southern flank it occurs as a bryozoan limestone.

In connection with a palaeoecological study of the cheilostome bryozoans from the Danian of Denmark, the author had the opportunity to examine bryozoan material from three borings – Rødekro no. 1, Hørning no. 1, and Grindsted no. 1 – near or on the Ringkøbing-Fyn High. The material shows that our present understanding of the facies distribution in the Maastrichtian and the Danian in this area must be revised (fig. 1, A).

The borings were made by rotatory drilling and the samples are all ditch samples, consisting mostly of washed out bryozoan fragments and pieces of chert. While the preservation of the fossils in the boring Grindsted no. 1 generally is good, it appears that only the more robust forms are found in Hørning no. 1 and Rødekro no. 1. It is, however, probable that in all three borings the most delicate bryozoans are lost during the drilling procedure.

The material, which belongs to the Geological Survey of Denmark, will later be subjected to a more detailed systematic investigation.

Results

Rødekro no. 1

The interval between 391 m and 401 m was referred to the Danian by Sorgenfrei & Buch (1964) on the basis of the foraminifera and the lithology.

The samples from the intervals 395–400 m and 400–405 m yielded numerous bryozoan fragments. The fauna is dominated by the following species: "*Membranipora*" *selandica* Berthelsen, *Smittipora prismatica* (von Hagenow), *Onychocella poulsenii* Berthelsen, *O. elongata* Levinsen, *Floridina trifolioides* Berthelsen, *F. voighti* Bassler, *F. pulchella* (Kade), *Achmella microstoma* (Marsson), *Coscinopleura angusta* Berthelsen, and "*Beisselina*" *nobilis* Levinsen. A total number of 30 species were recorded in this boring. The assemblage is closely related to those of Herfølge and Klintholm, described by Berthelsen (1962), and is therefore referred to the Upper Danian.

Hørning no. 1

The interval from 418 m to 426 m was referred to the Danian by Sorgenfrei & Buch (1964) on the basis of the foraminifera and the lithology.

Samples were examined from the intervals between 418–423 m, 423–428 m, and 428–433 m. Only the sample from 428–433 m contains bryozoans, and 25 cheilostome species were identified. The major constituent particles of the other samples are fragments of shale. The assemblage is dominated by the same species found in Rødekro no. 1, and is therefore referred to the Upper Danian.

Grindsted no. 1

The interval between 289 m and 422 m was referred to the Danian by Sorgenfrei & Buch (1964) on the basis of the foraminifera and the lithology.

Besides rounded quartz and chalk grains and fragments of shale, the samples 290–295 m and 295–300 m yielded only a few badly preserved and indeterminable bryozoan fragments. From 300–422 m all samples contain numerous fragments of a rich diversified fauna of cheilostome bryozoans characterized by the following species: *Amphiblestrella elegans* (von Hagenow), *Virgocella virgo* (von Hagenow), *Onychocella nysti* von Hagenow, *O. irregularis* (von Hagenow), *O. lamarchi* von Hagenow, *O. clito* (d'Orbigny), *O. matrona* von Hagenow, *Achmella microstoma* (Marsson), *A. stenostoma* Voigt, *Woodipora disparilis* (d'Orbigny), "*Latereshara*" *galeata* (von Hagenow), *Punkturiella gudumensis* Levinsen, *P. sculpta* Marsson, *Porina salebrosa* Marsson, "*Beisselina*" *nobilis* Levinsen, *Beisselinopsis hiltermanni* Voigt, and *Columnotheca cribrosa* Marsson. In addition lunulitiforme bryozoans were found in most samples. All the species listed are well known from the Maastrichtian. Six of them have been recorded from both the Maastrichtian and the Danian, but no species restricted to the Danian were found. The assemblage therefore indicates that all the samples between 300 m and 422 m are of Maastrichtian age.

Discussion and conclusions

When the bryozoan-rich deposit in the Grindsted boring is referred to the Maastrichtian, the distribution of the sedimentary facies in the Maastrichtian and the Danian comes to agree well with the general depositional pattern in the North Sea basin, where Danian sediments appear to be missing on the Ringkøbing-Fyn High (Dunn, Eha, Heikkila, 1973 Fig. 8). Thus it seems possible to reconstruct the facies pattern in this area, although two points remain unsolved: 1) Stratigraphic information on the section between 390 m and 400 m in the Grindsted boring is lacking. 2) The exact age within the Maastrichtian of the bryozoan-rich chalk has not yet been established.

On the southern flank of the High, the Maastrichtian is developed as a white chalk, overlain by a thin deposit of limestone with numerous bryozoans of Upper Danian age. On the High, Danian sediments are apparently absent, and the Maastrichtian is developed as a bryozoan-rich chalk. However, nothing is yet known of the actual composition of the sediment. Fig. 1 shows sections across the southern flank of the High on the basis of data from Sorgenfrei & Buch (1964) and the interpretation given in the present paper.

The distribution of the Danian sediments indicates that also in Danian and Maastrichtian time, the Ringkøbing-Fyn High was a topographic high. During

the regression in the Maastrichtian, bryozoan-rich sediments accumulated on the High, while at the same time a pure coccolith chalk was deposited on the flanks and in the basins. This suggests that the bryozoan-rich sediments were deposited in a shallower sea with more turbulent conditions than the white chalk.

It is uncertain when and if the Upper Cretaceous sea receded from the area, but in the Lower and Middle Danian, the High and the southern flank appear to have been areas of non-deposition. Whether the High actually emerged cannot be decided on the available evidence. Signs of littoral conditions, such as described by Voigt (1929, 1957) from the Maastricht and Ciply areas, appear to be missing. The Maastrichtian bryozoan-rich chalk in the Grindsted boring indicates uniform conditions throughout its deposition but a shallow water facies may have been removed by later erosion. A smaller transgression probably took place in the Upper Danian, and a thin bed of limestone with bryozoans was deposited on the southern flank.

In the Danish area Maastrichtian bryozoan-rich chalk is otherwise only recorded from restricted horizons in the brachiopod zones 4 and 10 of Surlyk (1972). The Grindsted boring shows that on topographic highs the Maastrichtian may be more generally developed as a bryozoan-rich chalk.

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Dansk sammendrag

En undersøgelse af de cheilostome bryozoer viser, at den 122 m mægtige serie af bryozorige kalksedimenter i boringen Grindsted nr. 1 er af Maastrichtian alder, og ikke som hidtil antaget tilhører Danian. Tynde lag af kalksten med bryozoer i boringerne Hørning nr. 1 og Rødekro nr. 1 er fra Øvre Danian. Facies fordelingen i Maastrichtian og Danian er således i overensstemmelse med det generelle aflejningsmønster, som har været fremherskende omkring Ringkøbing-Fyn ryggen siden Øvre Perm, med store sediment mægtigheder i bassinerne og en tyndere kondenseret serie på ryggen.

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