UPPER MAASTRICHTIAN FORAMINIFERA FROM THE DANISH BASIN

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The Maastrichtian white chalk of Denmark was subdivided by Troelsen in 1937 on the basis of foraminifera. Since then, extensive studies of material from deep drillings of the sequence up to 700 m thick, have considerably widened our knowledge of the foraminifera assemblages (Stenestad, 1971, 1973). In Fig. 1, Troelsen's and the author's zonations are correlated with belemnite and brachiopod zonations.

FORAMINIFERAL ZONES OF THE UPPER MAASTRICHTIAN

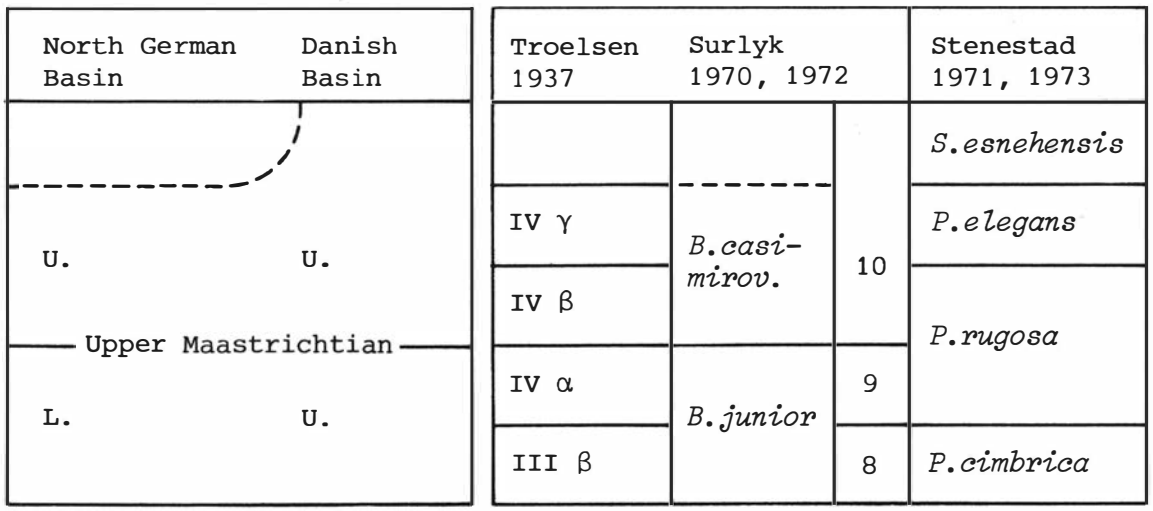
The lowermost foraminiferal zone of the Maastrichtian, which is characterized by *Bolivinoides draco miliaris* and other well-known early Maastrichtian species, is followed by a very long ranging zone, the *Bolivinoides decoratus laevigatus* Zone (256 m in the Rønde no. 1 well, Stenestad, 1971), and a small zone, the *Heterohelix dentata* Zone, together representing the rest of the Lower Maastrichtian.

The Upper Maastrichtian sequence can be referred to four zones, the *Pseudouvigerina cimbrica* Zone, the *Pseudouvigerina rugosa* Zone, the *Pseudotextularia elegans* Zone and the *Stensioeina esnehensis* Zone. The thicknesses of the zones vary within the basin. In the deep boreholes Rønde no. 1 and Nøvling no. 1 (Stenestad, 1971, 1973), situated in a central and a more marginal part of the basin respectively, the thicknesses are:

S. esnehensis Zone: 19/? m
P. rugosa Zone: 189/39 m
P. elegans Zone: 18/10 m
P. cimbrica Zone: 119/73 m

In Fig. 2 the ranges of some pertinent species are given.

Fig. 1.



UPPER MAASTRICHTIAN FORAMINIFERAL ASSEMBLAGES

The list of taxa (Fig. 3) gives some idea of the assemblages in the Upper Maastrichtian. It has not been attempted to revise the taxonomy, since most of the names are in common use and well-known from the literature.

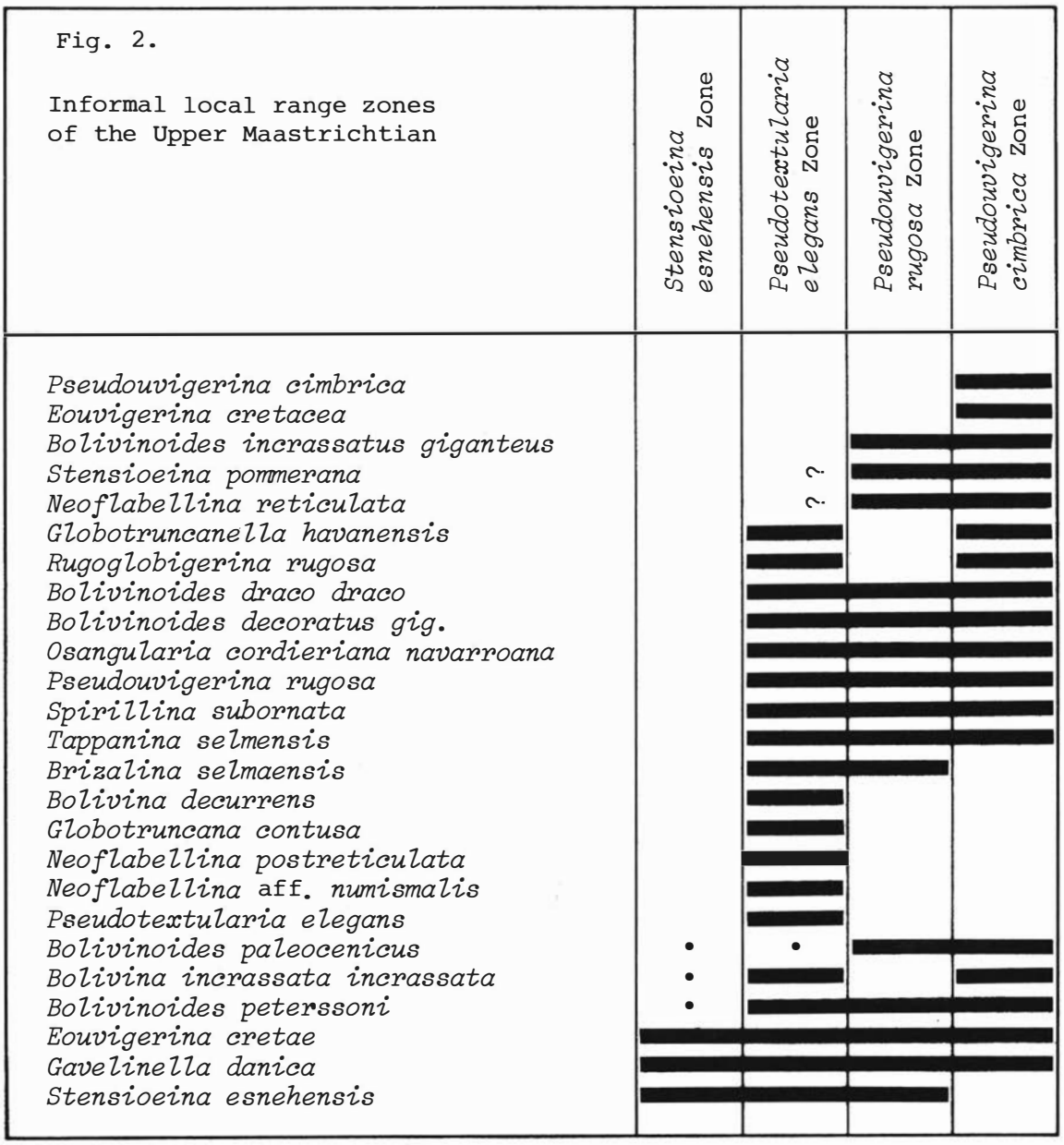
The assemblages are believed to reflect changing conditions within the basin, e.g. in sea-level and current pattern, as well as changes with time during the general Late Maastrichtian regression.

In the deep borehole, Hobro no. 1 (and elsewhere in north Jylland), the *P. cimbrica* Zone contains abundant bryozoan remains. The density of foraminifera is low and agglutinating species are dominant. In the following zones the density of foraminifera increases. In the upper part of the sequence, referred to the *P. elegans* Zone, agglutinating species are not abundant. In this section it is suggested that shallow-water conditions were interrupted by the Tethyan "*P. elegans* transgression".

The upper part of the *P. elegans* Zone at Kjølby Gaard, however, demonstrates a marked increase in the amount of bryozoan remains towards the Danian boundary. Here, the general regression may have changed the environmental conditions a little earlier in the *P. elegans* Zone than at Hobro.

Fig. 2.

Informal local range zones of the Upper Maastrichtian



In the Kjølby Gaard section (Troelsen, 1955), the Dania section (Troelsen, 1937), the Rørdal (Aalborg) section and elsewhere in north Jylland, argillaceous horizons are present in the white chalk of the Upper Maastrichtian. The foraminiferal assemblages from the non-argillaceous white chalk and from the argillaceous horizons at Dania have been compared and found to be slightly different. In the argillaceous chalk the diversity of agglutinating taxa may be relatively high and benthic taxa seem in general to be more abundant.

Fig. 3.	*Stensioeina esnehensis* Zone	*Pseudotextularia elegans* Zone	*Pseudouvigerina rugosa* Zone	*Pseudouvigerina cimbrica* Zone
Abathomphalus mayaroensis				x
Alabamina dorsoplana		x		
Allomorphina halli		x		
Ammodiscus sp.		x		
Angulogavelinella bettenstaedti	x			
Anomalina polyraphes				x
Arenobulimina sp.sp.		x		x
Ataxophragmium sp.sp.		x		x
Biglobigerinella aspera		x		x
Bolivina decurrens		x		
Bolivina incrassata gigantea			x	x
Bolivina incrassata incrassata	(x)	x		x
Bolivinoides australis		x		x
Bolivinoides decoratus giganteus		x	x	x
Bolivinoides draco draco		x	x	x
Bolivinoides paleocenicus	(x)		x	x
Bolivinoides peterssoni	(x)	x	x	x
Brizalina selmaensis		x	x	
Bulimina stokesi		x		
Cibicides beaumontianus				x
Cibicides bembix		x	x	x
Cibicides complanata		x	x	x
Cibicides constricta		x		x
Cibicides involutiformis		x		
Cibicides cf. *plana*				x
Cibicides voltziana		x		
Coryphostoma cf. *plaita*		x		
Dentalina sp.				x
Dorothia oxycona		x		x
Dorothia sp.		x		
Eouvigerina cretacea				x
Eouvigerina cretae	x	x	x	x
Eponides frankei		x		
Eponides lunata		x		x

Fig. 3.	*Stensioeina esnehensis* Zone	*Pseudotextularia elegans* Zone	*Pseudouvigerina rugosa* Zone	*Pseudouvigerina cimbrica* Zone
Frondicularia sp.		x		
Gaudryina rugosa				x
Gaudryina sp.		x		
Gavelinella costata	x		x	
Gavelinella danica	x	x	x	x
Gavelinella lorneiana		x		
Gavelinella pertusa	x	x	x	x
Gavelinella vombensis	x			
Globotruncana arca		x		
Globotruncana contusa		x		
Globotruncana cf. *contusa*		x		
Globotruncanella havanensis		x		x
Globotruncanella petaloidea		x		x
Globulina cf. *lacrima*				x
Glomospira sp.				x
Guttulina trigonula		x		x
Guttulina sp.				x
Gyroidinoides octocamerata		x		x
Hedbergella cf. *monmouthensis*		x		
Hedbergella sp.				x
Heterohelix dentata		x	x	x
Heterohelix striata		x	x	x
Heterostomella cf. *gracilis*		x		x
Lagena emaciata				x
Lagena isabella				x
Lagenidae indet.		x		
Lenticulina sp.				x
Lituolacea indet.		x		
Marginulina sp.				x
Marssonella oxycona		x		
Melonis nobilis		x		x
Neoflabellina aff. *numismalis*		x		
Neoflabellina postreticulata		x		
Neoflabellina reticulata		?	x	x

Fig. 3.	*Stensioeina esnehensis* Zone	*Pseudotextularia elegans* Zone	*Pseudouvigerina rugosa* Zone	*Pseudouvigerina cimbrica* Zone
Nodosaria sp.				x
Nonionella cf. *troostae*		x		
				x
Osangularia cordieriana navarroana		x	x	
Polymorphinidae indet.		x		x
Praebulimina aspera				x
Praebulimina carseyae				x
Praebulimina laevis	x	x	x	
Praebulimina parvula				x
Pseudotextularia elegans		x		x
Pseudouvigerina cimbrica				x
Pseudouvegerina cristata		x	x	
Pullenia sphaeroides		x		
Pyramidina minuta				x
Racemiquembelina fructicosa		x		x
Reussella cf. *paleocenica*		x		x
Reussella cf. *prolixa*				x
Rugoglobigerina cf. *pennyi*				
Rugoglobigerina rugosa		x		x
Spirillina cf. *minima*				x
Spirillina subornata		x	x	x
Spiroplectammina cf. *suturalis*		x		
Spiroplectinata cf. *dentata*		x		
Stensioeina esnehensis	x	x	x	x
Stensioeina pommerana		?	x	
Tappanina selmensis		x	x	x
Valvulineria sp.		x		

It is suggested that the distribution of species may be somewhat affected by the fact that the state of preservation of the fossils in general seems to be better in the argillaceous chalk.

The uppermost zone of the Maastrichtian, the *S. esnehensis* Zone, seems to represent the time from the end of the Tethyan transgression to the final Mesozoic regression in the Danish Basin. Planktic species are few and the assemblages may be described as a strongly reduced benthic component of the *P. elegans* assemblage.

Thus, the foraminiferal faunas demonstrate the withdrawal of the sea through rapidly changing assemblages, decreasing diversity and diminishing planktic-benthic index. When the Danian sea transgressed the area, very few of the Maastrichtian foraminiferal taxa had survived. Even though the environment was much the same as in the Maastrichtian, the fauna was, in contrast, a completely new one.