ON THE BIOSTRATIGRAPHICAL AGE OF THE LOWER SELANDIAN OF DENMARK

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Abstract

With evidence from planktonic foraminifera, it is shown that the Lower Selandian (which overlies the Danien in the type area) belongs to the *Globorotalia angulata* biozone.

Since ROSENKRANTZ (1924) proposed the preliminary stage name Selandian for the glauconitic marls and clays deposited upon the Upper Danian limestones and overlain by the Ypresian ash layers, much doubt has existed as to the stratigraphical age of the deposits.

The lithology of the Selandian sediments was described in detail by GRY (1935). The lithological development of the Selandian sediments starts with a basal conglomerate containing a large amount of redeposited Upper Danian fossils. The conglomerate is followed by glauconitic calcareous sand which displays gradually decreasing grain size upwards. These layers are followed by the Kerteminde Marl which, in its upper part becomes non-calcareous. The clay mineralogy of the Selandian sediments was described by TANK (1963) who found montmorillonite, illite and mixed-layer clay minerals in the lower greensand deposits with a dominance of montmorillonite. In the Kerteminde Marl TANK found montmorillonite and illite with the former also as the dominant mineral. Montmorillonite is more abundant in the Kerteminde Marl than in the underlying greensand.

The lower boundary of the Selandian was placed at the disconformity between the Danian limestones (the biozone characterized by *Globoconusa daubjergensis*) and the overlying glauconitic beds. The disconformity was described in detail by ROSENKRANTZ (1920 a, 1924) for the Copenhagen area and by ØDUM (1926) and GRY (1935) for Central East Jutland. A brief description of the disconformity exposed in East Fuenen was given by BERTHELESEN (1962). The disconformity provides the information that after the regression of the Danian sea, erosion took place. This locally stopped at a rather coherent flint layer, leaving the concentrated Upper Danian calcitic fossils, which are now to be found in the conglomeratic part of the overlying greensand.

The upper part of the Selandian has been dealt with by GRÖNWALL (1908) and BØGGILD (1918). GRY (1935) defined the upper boundary on pure lithological features since neither macro- nor microfossils had been found in the Upper Selandian non-calcareous clays. The non-calcareous

clay is known from borings and from one outcrop in Central East Jutland (locality Rugaard). In samples from that outcrop the author recently found a restricted, but undoubtedly Paleocene foraminiferal fauna of the type found in the Kerteminde Marl. The superposition of the Ypresian ash layers is not found in the outcrop.

The macrofauna of the Selandian deposits of Denmark has been described by Von Koenen (1885), Gronwall (1904), Gronwall and Harder (1907), Rosenkrantz (1920 a, 1920 b, 1944) and Ravn (1939). The stratigraphical age of the Lower Selandian has been referred to the Montian or Thanetian. Rosenkrantz especially has stressed the similarity between the molluscs from Vestre Gasværk and Calcaire Grossier de Mons. As however a well-founded correlation using molluscs could not be achieved, Rosenkrantz proposed the preliminary stage Selandian in 1924.

The foraminiferal fauna of the Selandian has been dealt with by several authors. Von Koenen (1885) illustrated a few larger forms from Vestre Gasværk, while Franke (1927) described the foraminifera and ostracoda

from the Lower Selandian of Central East Jutland and Copenhagen. **Brożen** (1948) described the Selandian foraminifera from Sweden and correlated both the Lower Selandian of Sweden and Denmark with the Wills Point Formation, the Naheola Formation of the U.S. Gulf area and the Hornerstown Formation of the U.S. east coast. The correlation was based on benthonic forms many of which are aragonitic. Since aragonitic shells in general are never found in the Danian limestones, the sudden appearance of aragonitic foraminifera in the Lower Selandian deposits would seem to be a question of preservation rather than of stratigraphical range. **Troyelsen** (1954), **Bang** (1960), **Buch** (1964) and **Pozaryska** (1965) all listed foraminifera from the Selandian of Denmark. **Hofker** (1966) described at length the foraminifera of the Selandian. Based on benthonic forms he concluded (p. 324) that the Tuffeau de Ciply and Calcaire Grosier de Mons are slightly younger than the Lower Selandian of Denmark, . . . «. As shown by **Rasmussen** (1965) the Tuffeau de Ciply is of Middle Danian age and is not correlatable with layers younger than the
Danian. As furthermore the type Montian has never been studied with respect to foraminiferal fauna, there would seem to be little reason for the correlation made by Hofker.

The foraminiferal fauna of the dark clay at Vestre Gasværk is essentially identical to that described by Brotzen (1948) from the Paleocene of Klagshamn. The fauna is conspicuously dominated by benthonic foraminifera. Only the planktonic species Subbotina triloculinoidea is found but in very few numbers. Redeposited Globoconusa daubjergensis from the underlying Upper Danian occurs rather often, but are readily distinguished from the primary forms since they are filled in with calcareous matter and have a whitish colour.

In one of the samples from Vestre Gasværk the author has found Globorotalia angulata in its early form having only four chambers in the final whorl (Figs. 1–3). The biozone characterized by G. angulata has been correlated by EL-NAGGAR (1967) with the Heersian of Holland. The Heersian is, according to EL-NAGGAR, belonging to the same biozone as the Cal-
caire Grossier de Mons representing the Montian stage. As however, EL-
NAGGAR did not examine material from the type locality of the latter but
from »lateral equivalents« it still remains an open question whether the
Montian stage is a junior synonym of the Heersian stage or whether it
should be correlated with the Upper Danian of Denmark as proposed by
ROSENKRANTZ (1964, p. 523).

The lack of ornamented globorotaliids in the Selandian of Sweden and
Denmark as well as in the Upper Paleocene from the Norwegian Basin
(SAITO, BURCKLE and HORN, 1967) would indicate that there has existed
a northern distributional boundary at about 55°N latitude probably due to
a decline in temperature. Accordingly the diverse fauna of globorotaliids
from the warmer Thethyan seas (LOEBLICH et al., 1957) is neither recorded
in the Selandian of Sweden and Denmark nor in the Norwegian Basin.

The only planktonic foraminifera of the Globorotalia group, besides G.
angulata, found in the Selandian of Denmark is G. emilei EL-NAGGAR (Figs.
4–6). This species has a rather long stratigraphical range and cannot be
used for finer zonation.
The end of the Danian stage is generally accepted to be correlatable with the disappearance of *G. daubjergensis* and the appearance of *G. angulata*. This is in good agreement with the find reported here of *G. angulata* just above the Upper Danian-Selandian boundary in the type area. However, the late development stage of *G. daubjergensis* i.e. *G. kozlowskii* is found in the Lower Selandian in Jutland. Thus the boundary between the two biozones (*G. daubjergensis*-zone and *G. angulata*-zone) must be placed at the appearance of *G. angulata* and not at the extinction of the *G. daubjergensis* group.

REFERENCES

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Fig. 6. *Globarotalia emilei* EL-NAGGAR. Peripheral view. Locality: Kerteminde, Fyn. Selandian. Scanning electron micrograph. × 463.


