

# Oligocene foraminifera and stratigraphy from the Harre borehole, Denmark.

KAARE ULLEBERG

Ulleberg, K., 1994: Oligocene foraminifera and stratigraphy from the Harre borehole, Denmark. *Aarhus Geoscience*, Vol. 1, pp. 81-84, Aarhus, 1994.

## ABSTRACT

The foraminiferal fauna in the Harre borehole, from 27.75 m to 178.15 m below surface, has been examined. Based on 16 samples, the interval is referred to a Middle Oligocene - Late Oligocene/?Miocene? age. Four distinct biozones have been observed, i.e. the Middle Oligocene *Turrilina alsatica* zone and *Globigerina* zone, and the Late Oligocene *Asterigerina gürichi gürichi* zone and *Angulogerina gracilis* zone.

Kaare Ulleberg, Kløverstien 7, N-3073 Galleberg, Norway.

## METHODS

The foraminiferal fauna in the Harre borehole (Fig. 1 in the introductory chapter), from 27.75 m to 178.15 m below surface, has been examined. Standard laboratory treatment has been applied to 100 g dried material from each sample. The clay has been soaked in H<sub>2</sub>O<sub>2</sub>, washed, sieved and dried. The foraminifera are separated in heavy liquid (a mixture of ethylene dibromid and alcohol - specific gravity between 1.8 and 1.85). The foraminifera, larger than 0.1 mm have been analysed and registered.

In Plate 1, the relative frequency of a selected number of species has been plotted. The species are selected partly to show the faunal composition and partly in order to show the foraminiferal stratigraphy. In samples with less than 100 specimens per sample, the exact number of the selected species is plotted. Furthermore, Plate 1 shows the bio- and chronostratigraphy of the examined interval in the Harre borehole. The biostratigraphic zonation is in accordance with Ulleberg (1987). A total of 16 samples have been analysed from the Oligocene section.

## THE FORAMINIFERAL FAUNA

In general, the foraminiferal fauna in the examined sequence consists of calcareous benthonic specimens. Very few agglutinated and planktonic tests have been observed. The faunas vary from extreme poor to very rich. The maximum number of observed specimens in 100 g material is estimated to 12640 (Plate 1).

The examined faunas show high similarities to the fauna observed in the central part of the Danish Oligocene basin, as e.g. in the Viborg area, Viborg 1

Deep Bore (Ulleberg, 1987).

The Oligocene interval in the Harre borehole is, based on the foraminiferal content, assumed to represent the section from 27.75 m to 177.0 m.b.s. (meter below surface).

The 178.15 m sample is almost barren of foraminifera. Only a few agglutinated fragments were found in the residue. They are all referred to "Bathysiphon"-like fragments. So far, they are assumed to be pre-Oligocene in age.

The base of the Oligocene section, is therefore assumed to be located between the 177.0 and the 178.15 m samples.

### The interval from 177.0 m to 120.75 m.b.s.:

The foraminiferal fauna of this section is referred to the *Turrilina alsatica* zone. The fauna of the zone has been described by Christensen & Ulleberg (1973), Christensen & Ulleberg (1974), Ulleberg (1974) and Ulleberg (1987). The fauna is dominated by *Turrilina alsatica*, *Nonion affine*, *Pullenia bulloides* and species of the genera *Stilostomella*, *Gyroidina* and *Cibicides*. Characteristic and restricted to this zone is *Frondicularia budensis*. Specimens of *Epistomina elegans*, *Ceratobulimina contraria*, *Angulogerina tenuistriata* and *Alabamina tangentialis* are common in the lowermost part. A similar faunal variation is also seen in other areas, where the basal part of the *Turrilina alsatica* zone is exposed, for instance in the Viborg 1 Deep Bore. The *Turrilina alsatica* zone is referred to Middle Oligocene (Ulleberg, 1987).

### The interval from 119.75 m to 117.75 m.b.s.:

A distinct foraminiferal fauna is seen in this interval. It is referred to the *Globigerina* zone. This zone has so far only observed in the Viborg 1 Deep Bore and

in the Hvorslev clay pit near the village Ulstrup in East Jylland. The characteristic planktonic influx of this zone, is not distinct in the Harre borehole. The registrations of benthonic species, however, clearly indicate the presence of the *Globigerina* zone. Particular the registration of *Spiroplectamina carinata*, *Gyroidina mamillata* and the first appearance of *Sphaeroidina bulloides* in the borehole. The dominance of *Globigerina* sp. is restricted to the basal part of the zone (Ulleberg, 1987). This indicates that the faunas of the 119.75 and 117.25 m samples do not represent the lowermost part of the zone. The zone is assumed to be Middle Oligocene in age (Ulleberg, 1987).

#### The interval from 112.75 m to 64.25 m.b.s.:

A different fauna appears in this section. This type of assemblage can, according to Ulleberg (1987), be referred to the *Asterigerina gürichi gürichi* zone. *Asterigerina gürichi gürichi* totally dominates the faunas throughout the section. Similar dominance is well known in Northwest European on-shore Oligocene deposits. Besides the above mentioned index-species, *Bulimina elongata*, *Protelphidium roemeri* (named *Nonion granosum*, King, 1994, this volume), *Angulogerina tenuistriata*, and *Sphaeroidina bulloides* are characteristic in the examined section.

#### The interval from 60.75 m to 27.75 m.b.s.:

The uppermost interval of the examined sequence contains a foraminiferal fauna which is correlated to the *Angulogerina gracilis* zone (Ulleberg, 1987). The zone is characterized by the disappearance of *Asterigerina gürichi gürichi* and a distinct increase in the representation of *Angulogerina tenuistriata* and smooth-walled specimens of *Angulogerina gracilis*. Furthermore, the following species are characteristic: *Pararotalia fallax* (named *Pararotalia canui*, King, 1994, this volume), *Valvulineria complanata* (named *Valvulineria mexicana gramensis*, King, 1991), *Rotalia* sp. 1, (named *Glabratella?* sp. King, 1989, King, 1994, this volume) and *Ehrenbergina serrata*. The fauna has also been described by Dinesen (in Larsen & Dinesen, 1959) from the marine part of the Vejle Fjord Formation at Vejle Fjord in East Jylland. The zone is assumed to be Late Oligocene in age. However, Ulleberg (1987) stated a faunal resemblance to the foraminiferal fauna of the Early Miocene Klintinghoved Formation, described by Kristoffersen (1972). Stratigraphic overlap between the Vejle Fjord

Formation and Klintinghoved Formation has been suggested on the basis of their foraminiferal faunas. Therefore, the zone may be referred to Late Oligocene to ?Early Miocene? age.

## DISCUSSION AND CONCLUSIONS

The bio- and chronostratigraphic zonations in this study are in accordance with zonations given in Ulleberg (1987). The *Turrilina alsatica* zone and the *Asterigerina gürichi gürichi* zone are correlated to NW European Oligocene sediments in Germany and Holland and to Middle and Late Oligocene age, respectively. However, based on the nannoplankton content, Mikkelsen (1975), referred most of the *Turrilina alsatica* zone in the Viborg 1 Deep Bore to the Early Oligocene.

Concerning the *Globigerina* zone, a few specimens of *Rotaliatina bulimoides*, often used as marker species for Middle Oligocene deposits, are observed at the Hvorslev locality in central Jutland (Ulleberg, 1987). This species has not been observed in the Harre borehole.

The *Angulogerina gracilis* zone is the most widespread zone in the Danish Oligocene basin. Its fauna is very characteristic and has been found, so far, from Fredericia in the southeast to Limfjorden in the northwest.

Off-shore in the North Sea the *Turrilina alsatica* zone is not easily recognized. The flood of *Asterigerina gürichi gürichi*, however, is often seen in the North Sea except in the Central Graben area. *Asterigerina gürichi gürichi* can also be used as a good marker for the presence of Upper Oligocene deposits in the North Sea.

Like elsewhere in the Danish Oligocene basin, the four recognized biozones in the Oligocene sequence of the Harre borehole, correspond, from base to top, to the following lithological formations: The Viborg Formation, "Hvorslev Clay Formation", the Branden Clay Formation and the marine part of the Vejle Fjord Formation, as discussed by Ulleberg (1987).

## ACKNOWLEDGEMENTS

The author wishes to thank Ole Bjørslev Nielsen for supplying the Oligocene samples from the Harre borehole. Thanks also to Svend Meldgaard, Aarhus Uni-

versity, who prepared the samples in the laboratory and to Karen Luise Knudsen, Aarhus University, who improved the English text.

#### DANSK SAMMENDRAG

Foraminiferanalyser af 16 prøver fra Harreboringens Oligocæne sedimenter er gengivet. Stratigrafisk kan 4 zoner identificeres, *Turrilina alsatica* zonen (177,0-120,75 m u. o.), *Globigerina* zonen (119,75-117,75 m u. o.), *Asterigerina gürichi gürichi* zonen (112,75-64,25 m u. o.) og *Angulogerina gracilis* zonen (60,75-27,75 m u. o.). Kronostratigrafisk henføres foraminiferfaunaerne til Mellem Oligocæn og Sen Oligocæn/?Tidlig Miocæn? alder. Faunaerne korreleres nemt til andre danske oligocæne aflejringer. I Ulleberg, 1987 er den regionale udbredelse af de danske oligocæne aflejringer diskuteret.

#### REFERENCES

- Christensen, L. & Ulleberg, K., 1973:** Sedimentology and Micropaleontology of the Middle Oligocene sequence at Sofienlund - Denmark. *Bull. geol. Soc. Denmark*, 22, pp. 283-305.
- Christensen, L. & Ulleberg, K., 1974:** Sediments and foraminifers of the Middle Oligocene Viborg Formation, Denmark. *Bull. geol. Soc. Denmark*, 23, pp. 109-205.
- King, C., 1989:** Cenozoic of the North Sea. In: Jenkins, D.G. and Murray, J.W., (eds.) Stratigraphical Atlas of Fossil Foraminifera pp. 418-489. (Second edition). Ellis Horwood, Chichester.
- King, C., 1994, this volume:** Biostratigraphic correlation of Late Paleocene to Oligocene sequences in the Harre borehole (north Jylland, Denmark) with those in the North Sea. *Aarhus Geoscience*, Vol. 1, pp. 85-92.
- Kristoffersen, F.N., 1972:** Foraminiferzonering i det jyske Miocæn. *Geol. Soc. Denmark, Årsskrift for 1971*, pp. 25-36.
- Larsen, G. & Dinesen, A., 1959:** Vejle Fjord Formationen ved Brejning. Sedimenterne og foraminiferfaunaen (Oligocæn-Miocæn). *Danm. geol. Unders. Række 2*, 82, 114 pp.
- Mikkelsen, N., 1975:** Marine Lower Oligocene sediments in Denmark as indicated by coccoliths in the Viborg Formation. *Bull. geol. Soc. Denmark*, 24, pp. 83-86.

**Ulleberg, K., 1974:** Foraminifera and stratigraphy of the Viborg Formation in Sofienlund, Denmark. *Bull. geol. Soc. Denmark*, 23, pp. 269-292.

**Ulleberg, K., 1987:** Foraminiferal zonation of the Danish Oligocene sediments. *Bull. geol. Soc. Denmark*, 36, pp. 191-202.

