Palynological investigations of the sediments of ten lakes in eastern Holstein, North Germany

Friz-Rudolf Averdieck
Universität Kiel, D 2300 Kiel 1, B.R.D.

Keywords: paleolimnology, pollen analysis, sediment accumulation rate, vegetation history, Holstein, Postglacial

Abstract

Pollen analysis was carried out on the sediments of 10 lakes in eastern Holstein. Sediment accumulation rates varied considerably both from lake to lake and also between respective periods. Increases in sediment accumulation rate often coincide with the Neolithic settlement periods. Faunal remains have been examined from two of these lakes (cf. Günther 1983; Hofmann 1983).

Introduction

The Weichselian Glaciation of East Holstein covered over 5300 km². Within this region about 265 lakes ranging from 1 ha to 30 km² cover an area of more than 200 km². Additionally, there are quite a number of smaller lakes with a surface area less than 1 ha and many other former lakes which today are moorland or cultivated areas.

The big majority of the lakes are of glacial (dead ice) origin, but some (e.g. Lake Segeberg) have been formed as a result of salt tectonics. Of the modern lakes only a few have been the subject of sediment studies. Ten of them are presented here (Fig. 1), and they include lakes with a wide range of surface area and depths.

Sediment accumulation rates

In all lakes, even in Lake Segeberg, sedimentation starts in the Late-glacial mainly during the Younger Dryas (zone IV), more rarely during earlier periods. Figure 2 illustrates time-depth curves for the 10 lakes according to the thickness of different pollen zones (after Overbeck 1975, Nilsson 1964) and the ^{14}C datings of Averdieck *et al.* 1972. How-

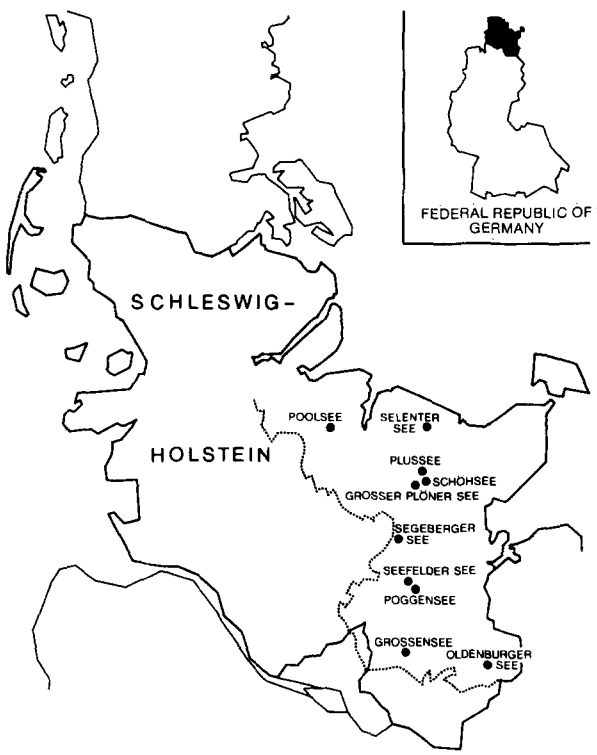

Fig. 1. Location of investigated sites in Schleswig-Holstein. Dotted line shows western border of Weichselian Glaciation.

Hydrobiologia 103, 225-230 (1983).

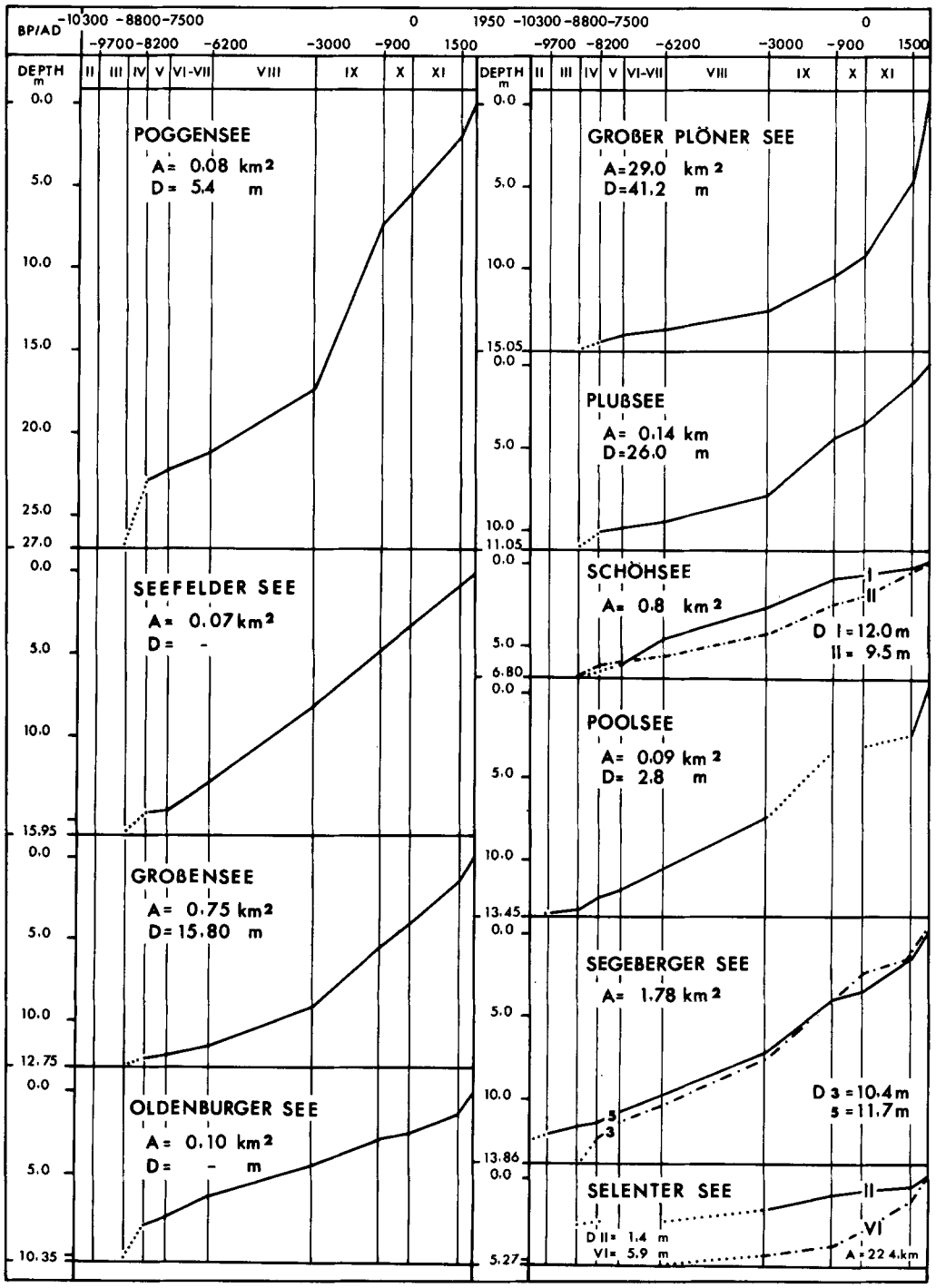

Fig. 2. Time-depth curves for 10 lakes (Schöhsee after Saad, 1970). Dotted lines show extrapolation.

ever, such dates are to be regarded cautiously, since there are sources of error in the ^{14}C dating of lake sediments (cf. Willkomm & Erlenkeuser 1972).

Late-Glacial, and often Pre-Boreal, sediments are minerogenic. Normally they are followed by chalky organogenic muds, often with visible seasonal laminations concentrated in small sections of the sediment cores. This phenomenon generally ceases at the Subboreal, although in Lake Segeberg the sediments are laminated between zone II and zone IX. During the later Postglacial lime-free humic muds are prevalent.

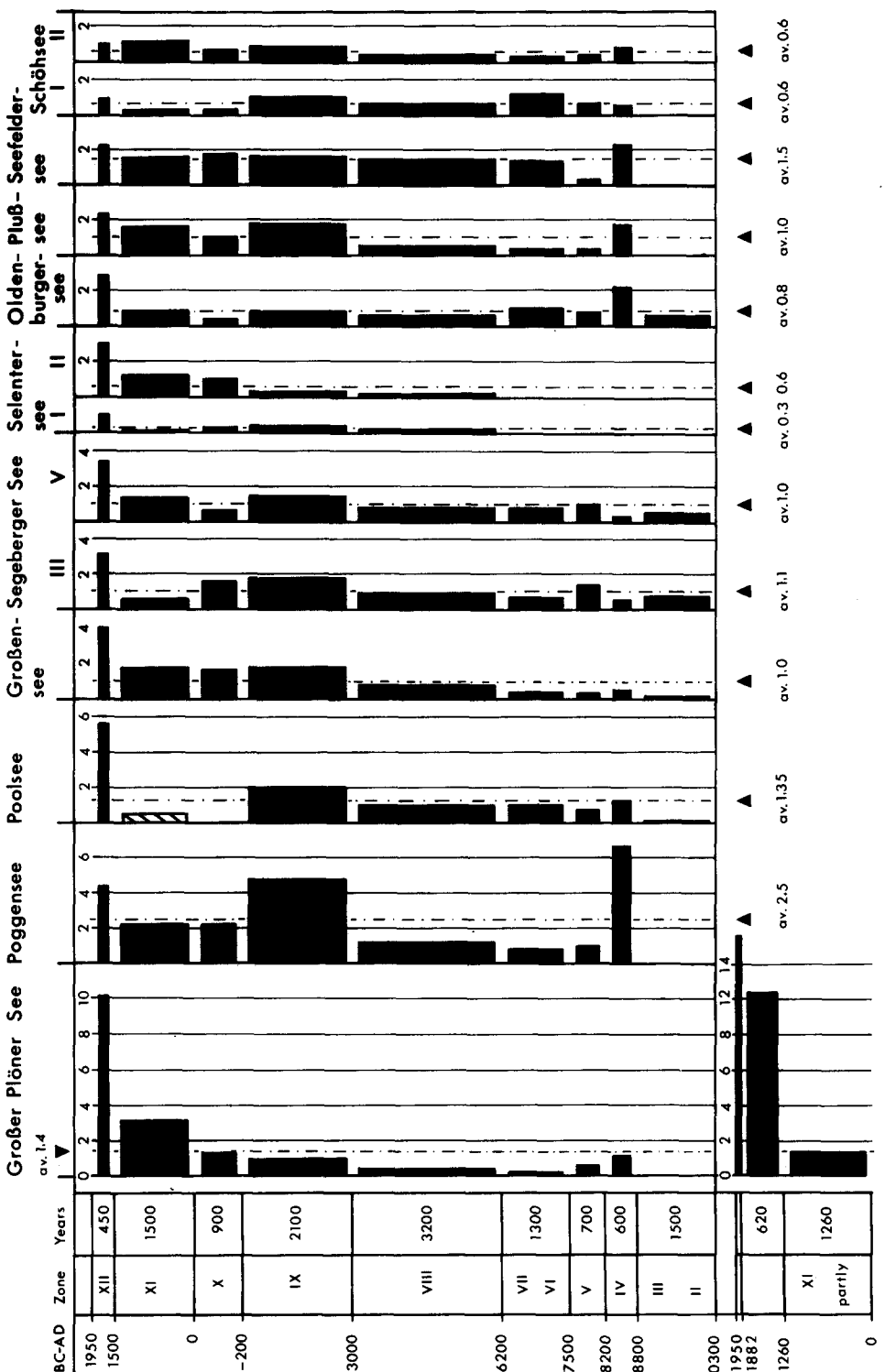

Fig. 3. Average sediment accumulation for each zone (mm a^{-1}). Hatched block = estimate.

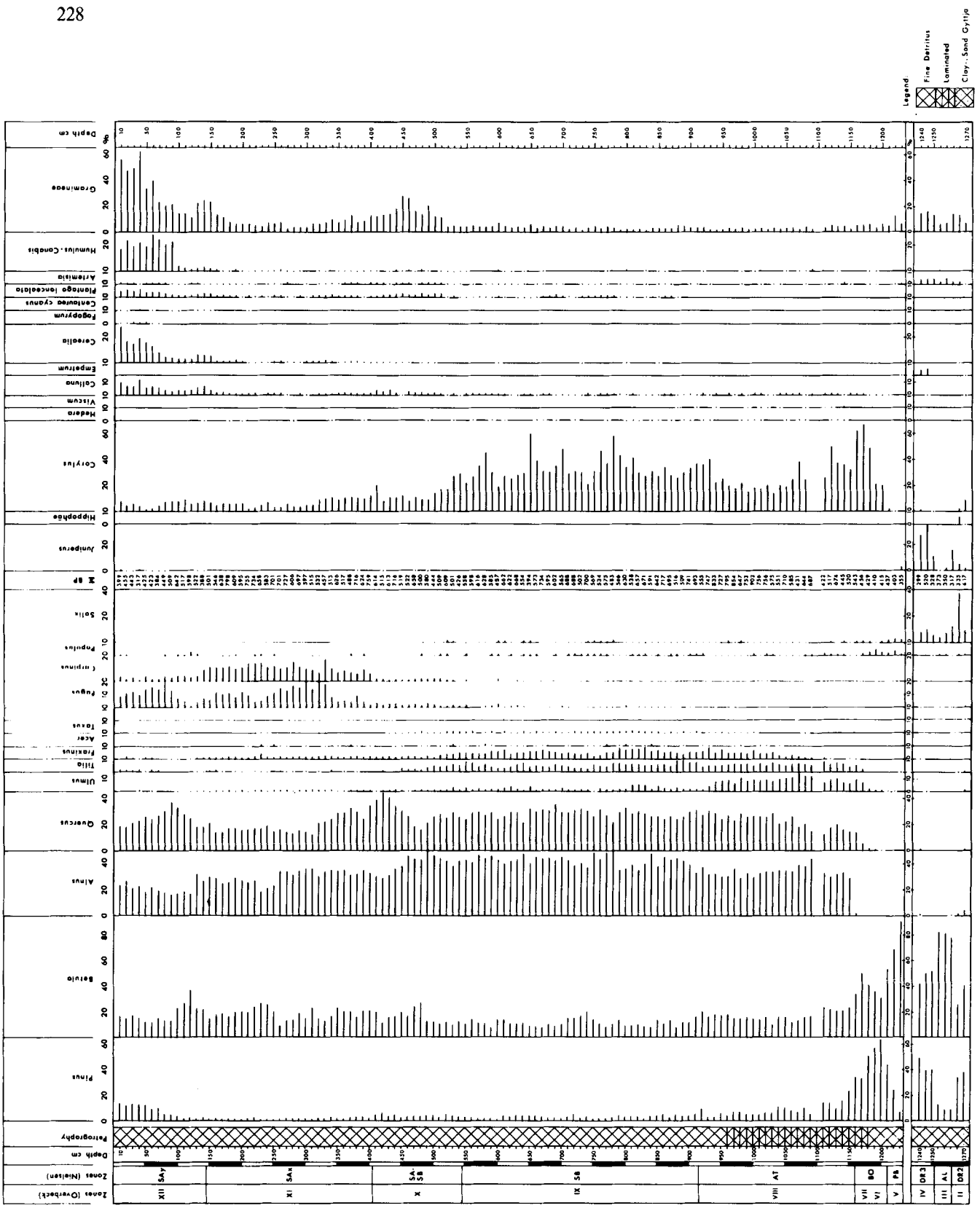

Fig. 4. Modified pollen diagram from Grossensee. Percentage of arboreal pollen excluding *Corylus*. Note scale expansion below 1 300 cm.

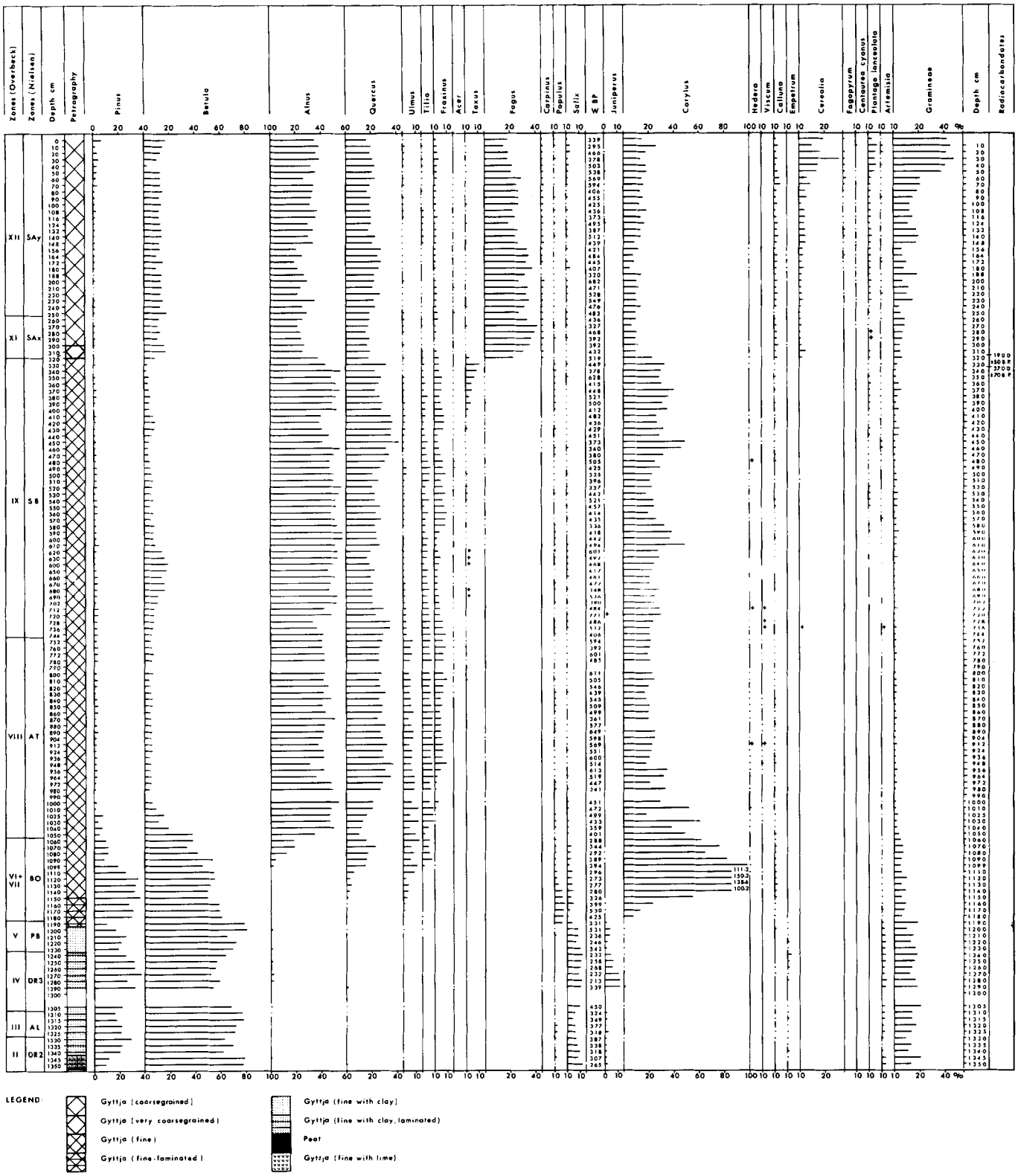

Fig. 5. Modified pollen diagram of Poolsee with hiatus and ^{14}C dates at 320 cm. Percentage of arboreal pollen excluding *Corylus*. Note scale expansion below 1 230 cm.

Sediment accumulation followed a constant rate only in rare cases, e.g. in Schöhsee and Lake Oldenburg. More often a large increase in accumulation rate occurs during the Subboreal or Subatlantic periods, especially in the small Poggensee and in the big Grosser Plöner See. In the Grosser Plöner See more than half of the sediments were deposited later than 1 260 AD. Because of the physiographic and environmental situations of the respective lakes this process will be strongly influenced by the morphometry of their basins. Sediments from different parts of the same lake will demonstrate different accumulation rates. The average annual accumulation rate for the various zones for each lake is shown in Fig. 3. Generally, accumulation rate increases with time but the Poggensee is an exception to this rule. Accumulation rates probably varied within zones, as demonstrated by dates from the Grosser Plöner See (Ohle 1972, Averdieck 1978, Erlenkeuser & Willkomm 1979). Increasing rates since the Subboreal might be caused by human impact, as forest clearance and agriculture are first documented during this zone.

Palynological investigations of Grossensee and Poolsee

The sediments of two lakes have been investigated using palynological methods. Microfaunal analyses have also been carried out and the results are presented in this symposium by Günther (1983) (Grossensee) and (Hofmann (1983) (Poolsee).

1. Grossensee is a medium sized oligotrophic lake with an area of 0.75 km^2 and a depth of 15.75 m. Sedimentation started before the Alleröd (Fig. 4), but about three quarters of the sediment has been deposited since the Subboreal where there is a change from chalky to lime-free mud. Several intensive settlement periods are indicated in the pollen diagram (Fig. 4). Exceptionally high percentages of *Humulus/Cannabis* pollen might be derived from the cultivation of one of these species. A series of ^{14}C dates is to be prepared.

2. Poolsee is a rather small lake with an area of almost 1 ha and a water depth of 2.8 m. Sedimentation in this lake also started before the Alleröd (Fig. 5). The most remarkable feature is the extremely high percentage of *Taxus* pollen (up to 11%, upper zone IX), infrequently found in the Postglacial.

The sediment of this lake is considerably disturbed at a depth of 3.20 m where a layer of coarse plant remains, trunks, twigs, and roots occurs. In the pollen diagram there is a hiatus between the last stage of the Subboreal and the late Subatlantic period and this can be seen by the sudden increase in the percentages of *Fagus, Carpinus, Taxus* and cereals, especially *Secale.*

^{14}C data (Willkomm, pers. comm.) indicate that the hiatus corresponds to a duration of at least 1 500 years. These uncorrected ^{14}C data might be too old, because the pollen analysis indicates that the upper horizon should be younger, presumably of medieval origin.

References

Averdieck, F.-R., 1978. Palynologischer Beitrag zur Entwicklungsgeschichte des Grossen Plöner Sees und der Vegetation seiner Umgebung. Arch. Hydrobiol. 85: 1–46.

Averdieck, F.-R., Erlenkeuser, H. & Willkomm, H., 1972. Altersbestimmungen an Sedimenten des Grossen Plöner Sees. Schr. Naturw. Ver. Schlesw.-Holst. 42: 47–57.

Erlenkeuser, H. & Willkomm, H., 1979. ^{13}C- und ^{14}C-Untersuchungen an Sedimenten des Grossen Plöner Sees. Arch. Hydrobiol. 85: 1–29.

Günther, J., 1983. Development of Lake Grossensee (Holstein, Germany): Variations in trophic status from the analysis of subfossil microfauna. Dev. Hydrobiol., this volume.

Hofmann, W., 1983. Stratigraphy of Cladocera and Chironomidae in a core from a shallow northern German lake. Dev. Hydrobiol., this volume.

Nilsson, T., 1964. Standardpollendiagramme und C^{14}-Datierungen aus dem Ageröds Mosse im mittleren Schonen. Lunds Univers. Årsskr. N. F. Avd. 2, 59. nr. 7: 1–52.

Ohle, W., 1972. Die Sedimente des Grossen Plöner Sees als Dokumente der Zivilisation. Jb. Heimatkunde Kreis Plön. 2: 7–27.

Overbeck, F., 1975. Botanisch-geologische Moorkunde unter besonderer Berücksichtigung der Moore Nordwestdeutschlands als Quellen zur Vegetations-, Klima- und Siedlungsgeschichte. Wachholtz, Neumünster.

Saad, M. A. H., 1970. Entwicklungsgeschichte des Schöhsees aufgrund mikroskopischer und chemischer Untersuchungen. Arch. Hydrobiol. 67: 32–77.

Willkomm, H. & Erlenkeuser, H., 1972. C^{14} Measurements on Water, Plants and Sediments of Lakes. Proc. 8. Int. Conf. Radio Carbon Dating. Wellington, N.Z: 312–323.