The environmental evolution and infilling process of a former lake near Vracov (Czechoslovakia)

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Abstract

Data on the stratigraphy and development of a former lake near the town of Vracov, SE Moravia, Czechoslovakia, are presented. The infilling process and vegetation succession are described. An attempt to reconstruct changes in habitat conditions during the last ca. 13 000 years has been made.

Introduction

The infilled lake near the town of Vracov in SE Moravia is ca. 0.22 km^2 in area. It is situated to the west of the town in a very broad and flat valley of the Vracov brook, separating a large area of drifted sands in the south from the loess with chernosem soils in the north. Under these Quaternary deposits, there are Tertiary, mostly clayey, sediments of the ancient Pannonian sea, containing high concentrations of Ca^{2+}, Mg^{2+}, Na^{+}, CO_3^{2-}, SO_4^{2-}, Cl^{-} and other ions. Due to this chemical composition spring waters, which appear in the lake, are highly saline. This environmental background is of great importance in understanding the origin, development and infilling process of the lake.

At the beginning of this century the area of the former lake was described by Čoka (1907) as wet meadows and fen with several open water pools in the central part. From the locality he reported plants such as *Carex diandra, C. appropinquata, C. davalliana, C. limosa, Blysmus compressus, Menyanthes trifoliata, Comarum palustre, Orchis incarnata, Bryum ovatum, Camptothecium nitens, Drepanocladus* species and other, less interesting plants. From the water pools *Nymphaea alba, Utricularia minor, Sparganium minimum, Potamogeton natans, Hippuris vulgaris, Lemna trisulca, L. minor* and *Myriophyllum verticillatum* were described by the same author.

During the 1920's the area was drained by several deep channels and covered over by bringing mineral soils from the sites of newly constructed houses and sands from the local neighbourhood. It was subsequently ploughed, enabling the ground to be used for growing vegetables. During the following years, the decomposition of the buried and drained fen peat led to the sinking of the land surface causing a relative rise of the water table. The Vracov lake was waterlogged again and, as a result, it was colonized by *Phragmites* stands after the Second World War.

Material and methods

We came to investigate the locality in the year 1963. By that time it had been drained before the buried peat started to be exploited for agricultural and horticultural use. We used the opportunity for describing and sampling the peat and lake sediments from the walls which were opened during the excavation of the upper 2 m of organic sediment. The excavation was carried out in strips 25 to 30 m wide. In these strips we described and geodetically

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levelled the layers every 40 m, and every 80 to 160 m we took samples for future laboratory treatment. In this way we obtained a fairly good picture about the stratigraphy, about the sequence of vegetational succession, about the filling-in process and about the general development of the lake.

The sediments and their samples were analyzed for their physical properties and for determination of their components according to Troels-Smith (1955), and for pollen and macroscopic plant remains. So far we have finished the descriptions and made lists of dominant macrofossils of about 90 sections from the open walls and many others from additional borings. For two profiles we have pollen analyses and detailed macroscopic plant analyses, and one profile has been dated by ^{14}C. The first observations were published by Rybníčková & Rybníček (1972), and by Sládková-Hynková (1974).

Results

The morphology of Vracov lake is characterized by very steep banks on almost all sides and by the division of the basin into two parts, the western and the eastern ones. Even though very many irregularities and inversions can be observed in the sediment accumulation, especially in the marginal parts of the lake, a generalized scheme of sedimentation and filling processes can be reconstructed (Fig. 1).

We suppose that the lake originated approximately at the end of the last (Weichselian) glacial period or at the very beginning of the late Weichselian when the dunes of drifted sands, which covered the region between the towns of Hodonín, Vracov and Bzenec, closed the outflow from the basin. The oldest cold periods were characterized by minerogenic sedimentation in the deepest parts of the lake, where thin layers of aeolian sand alternate with thin layers of clay. At the moment it cannot be said whether this lamination is annual or not. The characteristic plant remains are leaves of *Myriophyllum verticillatum* and *M. spicatum* always enclosed in the sand layers. The biological productivity of the lake was apparently very low owing to the low temperature and supposed oligotrophy of the water.

Organogenic sedimentation started during the Alleröd period. Highly elastic green algal gyttja is the typical sediment of this period and its deposition continued approximately to the beginning of the Boreal. In the central and deepest parts of the lake a mixture of calcareous marl and algal gyttja can be observed in the upper part of the gyttja layer. The algal gyttja contains hardly any remains of macrophytic water plants and was formed by several species of green algae like *Pediastrum, Scenedesmus, Tetraëdron, Arthrodesmus, Staurastrum, Botryococcus,* etc. The depth of this sediment (sometimes over 1 m) which accumulated over about 2000 years, and the richness of the algal flora, suggest that the biological productivity of the lake must have risen substantially in comparison to previous periods, this time owing to the supposed mesotrophy and increase of temperature of the water. At this very period the lake seems to have acquired the greatest depth in its history.

The deposition of sediments, rich in trivalent iron (*Limus ferrugineus*), is typical of the transition from Preboreal to Boreal periods. This distinctly rust-brown, sometimes jelly-like sediment, at most 2 cm thick, divides the calcareous algal gyttja from overlying lake marl in the central parts of the lake. The reasons for this characteristic type of sedimentation are at present unknown.

The Boreal period was characterized by sedimentation of lake marl (*Limus calcareus*) in the central part of the lake, while at the shore accumulation of coarse detritus gyttja can already be observed. The deposition of the coarse detritus gyttja over the whole bottom of the lake took place during the Atlantic period and during the prevailing part of the Subboreal period. This type of sediment was formed by the vegetation of macrophytic water plants, especially *Najas marina, Nuphar luteum, Nymphaea candida, Ceratophyllum demersum, Potamogeton pusillus, P. natans, P. obtusifolius,* i.e. by the vegetation close to the present phytosociological alliance *Nymphaeion*. Green algae were also an important part of the sediment, but a warmer climate caused higher humification than earlier. The lake still remained open, with initial stands of the *Magnocaricetea* communities present only near the shores. The biological productivity of this naturally meso-eutrophic water rose to the highest point we observed.

At the end of the Subboreal, probably as a result of a lowering of the water table (this period is supposed to have been warm and dry in this region),

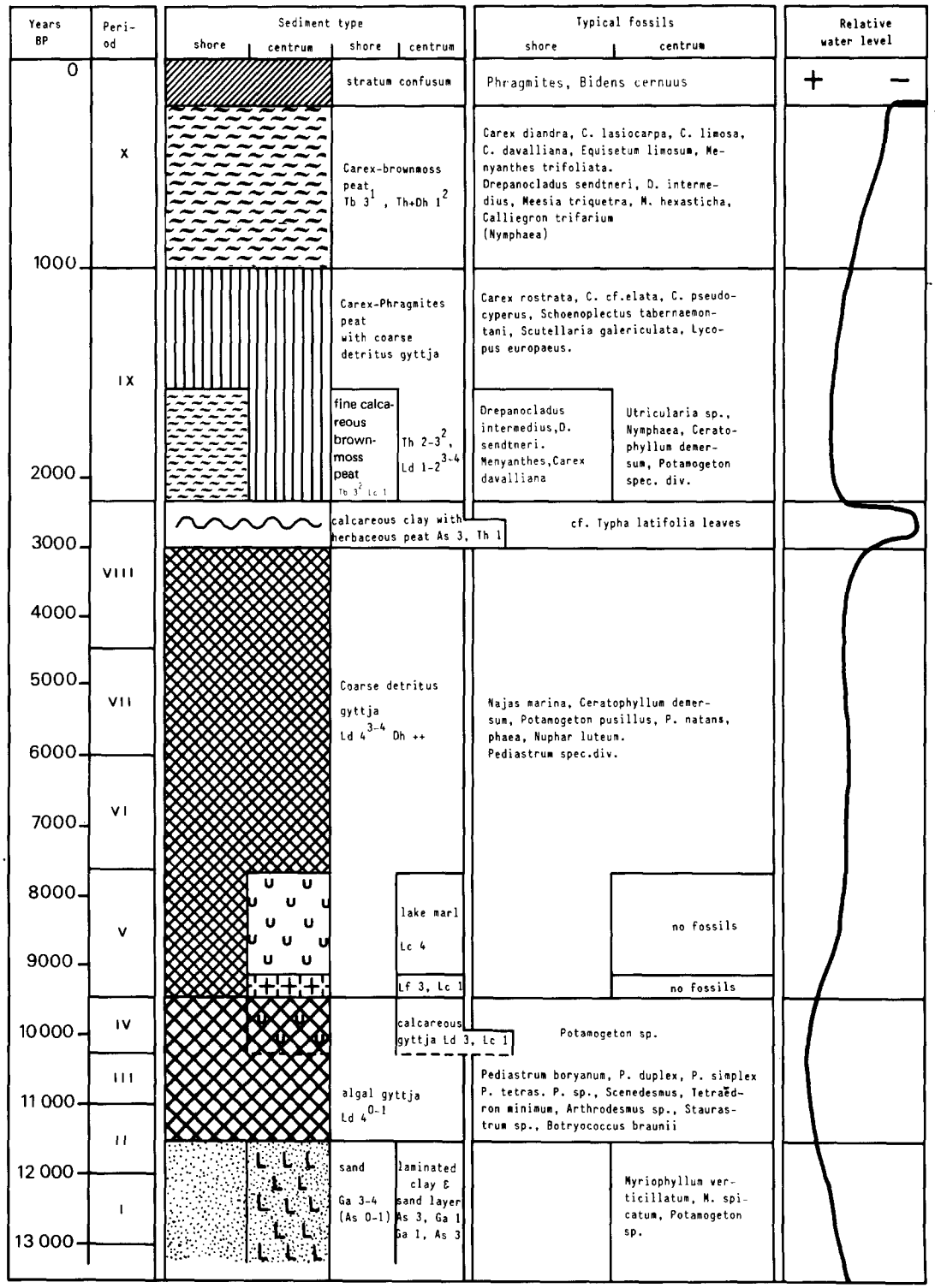

Fig. 1. Vracov (Czechoslovakia) - Scheme of the lake development.

a very distinct white calcareous clayey layer with remains of *Typha latifolia* was formed over the whole of the lake bottom. The origin of the clay is unknown; it may have resulted from agricultural cultivation of the loess soils at the northern shore of the lake, since the region has been settled since at least Neolithic times.

Higher humidity in the Subatlantic periods, both early as well as late, induced a new rise in the water level, but the lake has never become open water again since that time. Along the shores we can reconstruct the stands of tall sedges (*Carex elata C. rostrata, C. pseudocyperus*) and of *Phragmites*, while the central parts and, later on, the whole lake were covered by swim-floating carpets of brown-moss fen communities with *Drepanocladus sendtneri, D. intermedius, Calliergon trifarium, Meesia triquetra, M. hexasticha, Carex diandra, C. limosa, C. lasiocarpa, Menyanthes trifoliata*, etc. The presence of many boreal and relict plants is worth stressing. Macrophytic water plants like *Nymphaea, Nuphar, Utricularia, Ceratophyllum demersum, Potamogeton* species, etc. survived only in several pools of open water. This reconstruction corresponds very well with the description by Čoka (1907) mentioned above.

The former lake of Vracov is a good example of infilling processes taking place in the small lakes of the Pannonian region during the last ca. 13 000 to 15 000 years and it demonstrates the naturally changing productivity and trophy of these former lakes in the warm regions of Central Europe.

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