6460±120 and 3960±120 ^{14}C BP. Above the horizon dated at 2240±100 ^{14}C BP *Carex* peat changes into *Sphagnum* peat.

The Ruda valley reach between Lake Brzózka and Tobyłka Bay is 450 m long and covered by peat. It is joined with a closed dead-ice depression also filled by 8 m of peat over lacustrine gyttja (core GTO1/89), dated at the base at 12,950±310 ^{14}C BP (Demske 1993).

The shallow Lake Mielec downstream from Lake Gościąż is bordered by a wide zone of bogs overlying buried calcareous and detritus gyttjas (GTO4/89, GTO5/89, G20/92), deposited from ca. 13,200 to 12,500 ^{14}C BP. In these profiles two distinct horizons of calcareous gyttja occur after 8200 ^{14}C BP and between 2480 and 2150 ^{14}C BP.

During the earliest high-water stage the big lake extended about 1.5 km downstream from Lake Mielec. In the widening of the valley floor ca. 0.8 km from Mielec (core G3/92) the calcareous sediments were deposited between 13,020±160 ^{14}C BP and 8680±70 ^{14}C BP. Then after a brief overgrowth and the next temporary transgression, the peat was deposited continuously from ca. 8000 ^{14}C BP to the present. Farther downstream (core G22/92, 7 m deep) the change from lake to bog happened as late as 4020±70 ^{14}C BP.

5.1.6. Deposits of small depressions without outflow

Leszek Starkel

Beyond the small Lake Mrokowo at elevation of 67.8 m a.s.l. (3.4 m above the Lake Gościąż level) several depressions without outflow occur. They are not incorporated in the main system of lakes Na Jazach drained by the Ruda, but nevertheless they are filled with the lacustrine deposits covered by peat (Figs 5.1 and 5.4). The most distinct is the swampy sinuous channel running towards east from Lake Gościąż. Its surface is ca. 1.5 m higher than the lake level. The filling is 2–4.3 m thick. The bottom peat layer was dated at 12,750±150 and 11,510±150 ^{14}C BP. It is covered by the calcareous gyttja, deposited until the Younger Dryas (core GTO3/89) or until the Atlantic (G2/92).

Another small depression to the south of that described above is 160x60 m in size. In the boring G1/92, 1.6 m below the present Gościąż water level, a peaty layer dated at 11,250±120 ^{14}C BP was found. It is overlain by lacustrine sediments which change to peat up to 4 m thick about 8160±120 ^{14}C BP.

Another oval depression, ca. 200 m in diameter, is located north of Lake Mielec. Its peaty floor is elevated ca. 1 m above the water level of Mielec. Lacustrine sediment was found in boring GTO6/89 below 2.2 m of peat (dated at the base at 9910±150 ^{14}C BP). This indicates that also there at the close of the Allerød the groundwater table rose above the bottom of the depression, which was 1.3 m below the present level of Lake Mielec.

All the characteristics of lacustrine and bog sediments and their datings presented in this chapter are discussed in the successive chapters describing various features of sediments but especially in the reconstruction of hydrological changes through time.

5.2. CHEMICAL COMPOSITION OF THE SEDIMENTS OF NA JAZACH LAKES

Bogumił Wicik

Bottom deposits of the complex of lakes Na Jazach are formed of carbonate, sulphide-carbonate, and algal-detritus gyttjas. Characteristic properties are presented in Figs 5.9–5.12. In lakes Wierzchoń and Brzózka calcareous gyttjas occur, in lakes Mielec and Gościąż ferruginous-calcareous ones, and in Lake Mrokowo algal-detritus gyttjas (Więckowski et al., Chapter 5.1).

The sediments of Lake Gościąż are characterized by strongly reducing conditions (H_2S present in the top deposits). Also the top deposits in Lake Mrokowo are oversaturated with H_2S (Więckowski et al., Chapter 5.1).

Constant accumulation of carbonates in lakes Wierzchoń, Brzózka, and Mielec (Figs 5.9, 5.10 and 5.11) shows that the variations in hydrothermal conditions during the Holocene were very weak. In lakes Wierzchoń, Brzózka, and Mielec only single episodes of decreased $CaCO_3$ content are marked at depths of 4.5 m, 7.5 m, and

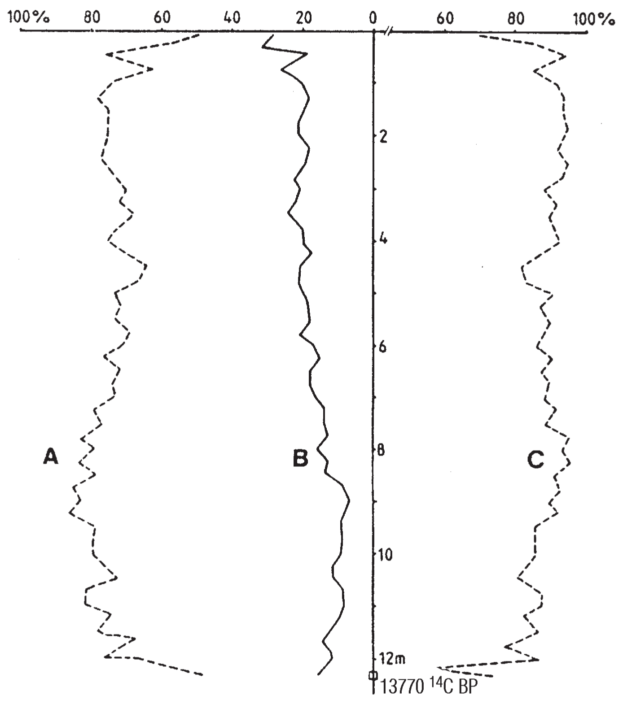

Fig. 5.9. Main sediment components of the Lake Wierzchoń profile: A. $CaCO_3$ content in sediment, B. loss on ignition, C. $CaCO_3$ content in the ignition residue.

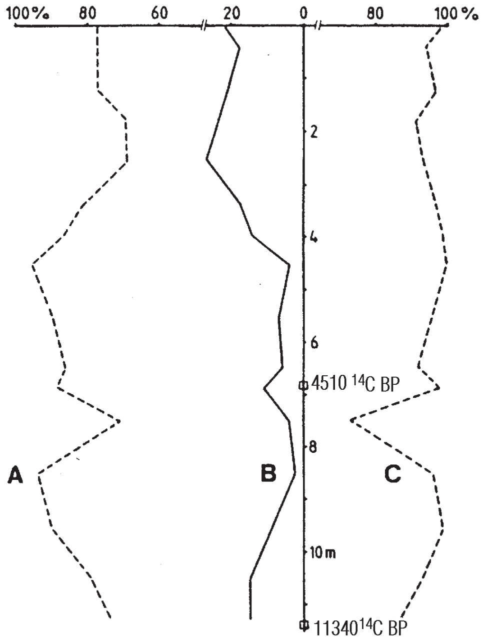

Fig. 5.10. Main sediment components of the Lake Brzózka profile. Explanations as in Fig. 5.9.

6 m, respectively. In Lake Mrokowo a similar episode is additionally emphasized by a layer of algal-carbonate gyttja. This indicates the stability of the properties of groundwater feeding the lake and emphasizes their hydrological autonomy.

Low concentration of iron in the deposits of lakes Wierzchoń and Brzózka results from the location of these water bodies. Iron is supplied to the lakes Na Jazach mainly from the south, with waters that transport ferruginous-humus complexes leached from the soils. These waters, formed in aeration zone, are poor in calcium ions (Wicik, Chapter 3.4). They feed all the lakes and peatbogs south of Wierzchoń and Brzózka. The organic deposits of Lake Mrokowo, fed by such waters too, contain 8–14% of ash comprising mainly iron compounds. On the other hand, the content of iron is low in the sediments of lakes Wierzchoń and Brzózka, which are located farther north. In lakes Gościąż and Mielec the direct supply of ferruginous-humus complexes from soils is also possible. Increasing contribution of waters seeping through the soils to the lake, as well as decrease or even cessation of surface outflow from the lake, cause strengthening of reducing conditions. That in turn is expressed by larger values of the $Fe_2O_3/CaCO_3$ ratio in the bottom sediments.

In Lake Mielec, starting from the base of the deposits the content of accumulated iron decreases up to the depth of 7.7–5.5 m, while precipitation of $CaCO_3$ is constant. Colder waters flowed into the lake from the deeper parts of the aquifer, when the waters of the aeration zone were probably used up for evapotranspiration. The episode of the shallowing of this lake, marked at the depth of 5.3 m by peat, coincides with the increase in biological production (larger values of the loss of ignition). Again the high accumulation of iron at a depth of ca. 3.7 m is supposedly

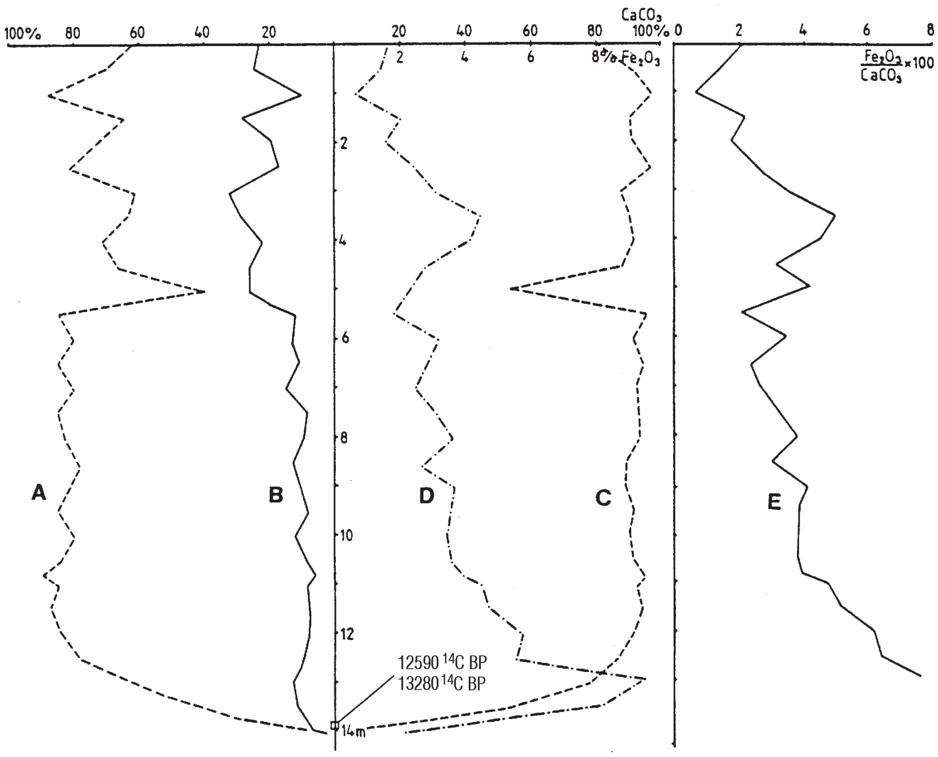

Fig. 5.11. Main sediment components of the Lake Mielec profile. A – $CaCO_3$ content in sediment, B – loss on ignition, C – $CaCO_3$ content in the ignition residue, D – Fe_2O_3 content in the ignition residue, E – Fe/Ca content ratio.

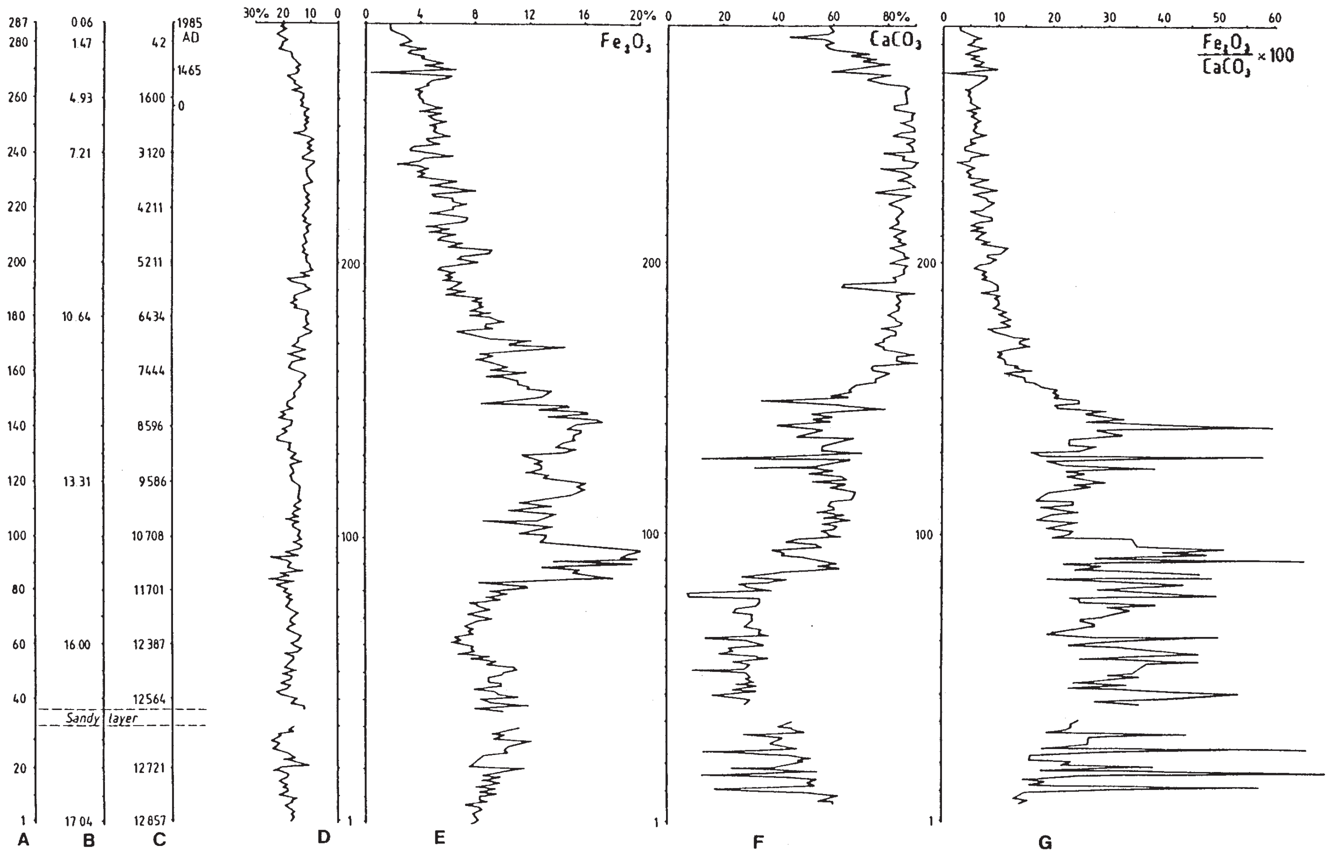

Fig. 5.12. Main sediment components of the Lake Gościąż profile G1/87. A – No. of sample, B – depth in meters, C – age in calendar years BP (after Goslar 1993), D – loss on ignition, E – Fe_2O_3 content in ash, F – $CaCO_3$ content in ash, G – Fe/Ca content ratio.

a result of a high water level in the lake and of slower surficial outflow. Since then the content of iron in the bottom deposits of Lake Mielec decreased. An increased content of iron at the very top of the sediment and simultaneous decrease in $CaCO_3$ content resulted probably from human impact.

Construction of a weir well downstream from Lake Mielec caused damming of the Ruda stream, a change in local topography of the groundwater table, and reduced drainage of the entire complex of lakes. This is reflected in the sediments by increased loss on ignition and iron content.

Groundwaters poorer in calcium compounds inflow into the lake. Large non-calcareous components (eolian dust?) was registered in the youngest deposits. At a depth of ca. 0.9 m below the surface, the sediments of Lake Mielec contain, among others, 1.0 mg Cd, 5.0 mg Cu, 10.0 mg Pb, and ca. 800.0 mg Mn per kg of dry matter. The deeper parts of the sediments are poorer in these elements.

The composition of the sediments of our main object, Lake Gościąż (Fig. 5.12), is quite different in the lower and upper parts. The sediment in the lower part up to ca. 8200 cal BP (sample 148) is enriched in Fe_2O_3. The source of iron, besides possible inflows of Miocene waters and of alkaline waters formed at the contact with the Pliocene deposits, could also have been admixtures of brown coal in the Pleistocene deposits at the southern shore of the lake. During low water levels the beds of sands with admixture of coal were exposed in the zone of the intensive inflow. The limited contribution of the waters of the saturation zone of the lake feeding seems to be documented by low content of $CaCO_3$. At the boundary of the Younger Dryas/Preboreal the amount of Fe_2O_3 in the deposits increases rapidly. The lower part of the Preboreal is characterised by maximum content of $CaCO_3$ (samples 83–98). During the Boreal (samples 98–148) there are four episodes in the accumulation of the Fe_2O_3, with two maxima between samples no. 115–121 and 132–148.

The changes in the composition of waters feeding the lake are reflected around the sample 148. Triggering of the surface runoff and formation of the drainage zone at the southern side of the lakes initiated inflow of cold waters from the saturation zone and changes in properties of the accumulated sediments. The dominating component of the latter becomes carbonates, mainly $CaCO_3$. The percentage of carbonates in the sediments increases systematically until AD 1130. Minimum accumulation rate was at ca. 7300–7100 cal BP (lowering of the water table in the lake), while maximum was at ca. 5900–5600 cal BP (Goslar, Chapter 6).

This correlates with the beginning of accumulation of sands and wood on the alluvial fans. The increases in the content of Fe_2O_3 in the deposits, which occurred after these episodes, document periodic stability and much lower contribution of the water of the aeration zone to the lake. The rapid decrease in the content of $CaCO_3$ in the sediments around AD 1130 coincides with the period of intensified human impact. Later during the "Little Ice Age" (16–19th century) the reduction in the amount of $CaCO_3$ was slower, and simultaneously the accumulation of Fe_2O_3 in the bottom sediments of Lake Gościąż increased.

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