

ABSTRACT

Anthropogenic lakes constitute a significant part of the Czech countryside water component which has not been given sufficient attention so far. The presented thesis deals with the assessment of variability of physico-chemical properties of water in 30 selected pit lakes in order to identify specific features associated with quarrying of different mineral raw materials, basin morphometry and trophic level of the lakes affecting the quality of accumulated water. In the second part of the thesis the author deals with the comprehensive limnological study of the Hromnické Lake with extreme water chemism resulting from excavation of pyritic shales and focuses on the phenomenon of meromixis especially. The results are based on the evaluation of physical properties of water in the lake vertical profile (temperature, conductivity, dissolved oxygen, pH, transparency and colour) and chemical analyzes of water samples collected from the surface and bottom of the lakes during the four seasons in 2003–07 (determination of Ca, Mg, Na, K, $N_{\text{ammon.}}$, NO_3^- , SO_4^{2-} , Cl^- and alkalinity), including determination of chlorophyll-*a*. In the case study of the Hromnické Lake conducted in 2010–11, the analysis of hydrological regime of the lake, determination of PO_4^{3-} , TOC, selected metals (Fe, Mn, Al, Zn, Ni, Cu, Co, Cr), sulfide sulfur S(-II) and the biological analysis of planktonic organisms were also added.

In eight out of 30 anthropogenic lakes (Čankov, Srní, Hromnice and Zelené Lake, U Kyzu, Vápenka and Šluknov) the presence of morphologically or chemically determined meromixis was identified with significant temperature anomalies in chemocline and monimolimnion. It was found that oxygen conditions are closely related to the trophic level of the lake with a clinograde or positive heterograde distribution in most lakes presented with lack of oxygen at the bottom and extreme values of saturation in metalimnion (up to 320%, $\sim 34 \text{ mg}\cdot\text{l}^{-1} \text{ O}_2$). In Velká Amerika, Výkleky and Jasenice an orthograde distribution was observed with oxygen saturation $\geq 100\%$ up to the bottom. The pH value (range 2.5–9.2) in most lakes is determined by the lime-carbonic acid equilibrium, at Hromnické, Zelené and Kamencové Lake with $\text{pH} < 4$ the oxidation of pyrite is predominant. Transparency and colour of water (range 0.4–12 m, No. 5–22 FU) varied considerably depending on trophic level of the lake. All physical parameters showed significant seasonality in occurrence of minima and maxima. The concentration of Ca, Mg, SO_4^{2-} and alkalinity showed a close dependence on the type of raw material extracted with minima in the sites of igneous rocks and gravel/sand and maxima in the sites of sedimentary rocks or sulphide ores/gypsum excavation. Occurrence of $N_{\text{inorg.}}$ generally associated with the dynamics of assimilation/degradation of organic matter, extreme concentration $N_{\text{ammon.}}$ were found at the bottom of meromictic lakes (up to $16 \text{ mg}\cdot\text{l}^{-1}$) and in lakes within urban areas with the possibility of anthropogenic contamination, which reflects also in the case of Na and Cl^- ions probably. The total mineralization of water ranged from $27 \text{ mg}\cdot\text{l}^{-1}$ (U Kyzu) up to $8 \text{ g}\cdot\text{l}^{-1}$ (Hromnické Lake) and was high in meromictic lakes especially. Some analytes (Mg, K, $N_{\text{inorg.}}$, alkalinity) demonstrated pronounced seasonality of minima and maxima due to biogenic processes in water, while the others (Ca, Na, Cl^-) did not or were inconclusive. Eight lakes were classified as oligotrophic with chlorophyll-*a* concentration up to $2.5\text{--}3 \mu\text{g}\cdot\text{l}^{-1}$, most lakes represented an eutrophic state (chlorophyll-*a* concentration $> 10 \mu\text{g}\cdot\text{l}^{-1}$, maximum $294 \mu\text{g}\cdot\text{l}^{-1}$) with signs of mesotrophy and hypertrophy.

In Hromnické Lake (pH 2.5–4) numerous phenomena related to permanent meromixis were recorded, e.g. limited circulation of water to a depth of 3 m (in autumn only), significant delays in water temperature maxima/minima within the chemocline (up to 6 months) and anoxic conditions in stable monimolimnion with high concentrations of Fe ($1800 \text{ mg}\cdot\text{l}^{-1}$), Al ($160 \text{ mg}\cdot\text{l}^{-1}$) and SO_4^{2-} ($5400 \text{ mg}\cdot\text{l}^{-1}$). Low values of redox potential ($E_h \sim 150 \text{ mV}$) lead to partial reduction of SO_4^{2-} to S(-II) that applies to the precipitation of some metals (Cd, Cu, Zn). In hypertrophic environment with high concentrations of PO_4^{3-} (up to $1.6 \text{ mg}\cdot\text{l}^{-1}$) several phytoplankton species adapted to extreme conditions were found (*Coccomyxa* sp., *Chromulina* sp.) and associated with significant mixolimnetic oxygen maxima (up to $\sim 270\%$).