Spatial differentiation of physical and chemical properties of bottom sediments of shallow urban lakes

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Summary:

The aim of the work was to determine the spatial variability of physical properties, chemical composition and structure of bottom sediments of shallow, urban water bodies with different catchment conditions on the example of Lake Track in Olsztyn, Lake Suskie in Susz, and Lake Karczemne in Kartuzy. The researched lakes are characterized by a small depth (3.2-5.3 m), have a polymictic type of water dynamic and were subjected to strong anthropopressure. The tests were carried out in a horizontal, and vertical arrangement of the bottom.

The research showed that the spatial distribution of pollutants in the bottom sediments of the analyzed water bodies is quite diverse. High values of biogenic compounds occur in places of increased anthropopressure. The sedimented suspensions in the analyzed lakes can be classified as silicate and mixed sediments. The chemical composition is significantly differentiated in the horizontal and vertical arrangement. Most of the components decrease with sediment depth while the silica content increases. Fluctuations in the chemical composition of sediments in the vertical arrangement result from natural causes and unevenly distributed anthropogenic pressure.

The main component responsible for the binding of phosphorus in Lake Track was the organic matter, as evidenced by the high proportion of the NaOH fraction - nrP. In Lake Suskie, the dominant fraction was phosphorus associated with calcium. On the other hand, in Lake Karczemne, the analysis of the percentage share of individual phosphorus fractions in total phosphorus showed that NaOH-nrP and HCl-P were dominant. In all the analyzed reservoirs, mobile fractions (labile phosphorus and sensitive to changes in redox potential) had the smallest share. The values did not exceed a few percent. The analyzed sediments were characterized by low EPC0 values. The value of this parameter in the conducted research was affected by environmental conditions.

Matching phosphorus sorption to isotherms showed that phosphorus adsorption in the studied lakes was probably multi-layered. This is indicated by a better fit to the Freundlich and BET models. The conducted research showed that both the temperature and pH had a significant impact on the course of sorption. Higher sorption parameters were obtained at 20°C. In some cases, the concentrations were higher at 4°C, which is probably related to the content of active hydroxides. The reaction also had a significant effect on the maximum sorption capacity only on the surface layer of sediments. At 4°C, lower Q_{max} was observed in the surface layers at pH 5 and higher at pH 9.