ACID RAINS AND BEHAVIOR OF HEAVY METALS IN GEOCHEMICAL TECHNOGENIC AREA

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Local anthropogenic geochemical anomalies with strong disturbance of natural biogeochemical cycles were formed in the influence zones of mining and industrial activity. They may be considered as natural–technogenic test sites for studying the processes responsible for the involvement of chemical substances in migration fluxes. Karabash (Chelyabinsk region) is one of such ecologically dangerous regions

The atmospheric emissions of Cu smelter in this town presently account for 13500 tons per year (including 13200 tons SO_2, as well as Cu, Pb, As, Zn, Cd and Hg). Of great interest under these conditions are catchments contaminated only via atmospheric precipitation. The area continues to suffer of acid rains. The anthropogenic compounds of heavy metals deposited with dusts or acid rains on the water surface and catchment areas strongly affect the chemical composition of soils, waters and bottom sediments. Atmospheric emissions of huge amounts of SO_2 leads to acidification of catchments and lakes. This can increase the mobility, toxicity and bioaccumulation of heavy metals (HM) in ecosystem.

The aim of this work was to consider the impact of the Cu smelter emissions on environment.

Materials and methods. *The main objects* of research - Lake Serebry (~5 km N of the emission source) and its catchment, as well as urban area of the town of Karabash. *Samples* – rainwater and lake water, soils from Lake Serebry catchment and Karabash residential area, leaf litter, bottom sediments, fish (*Abramis brama L.*). *Analytical method* – ICP-MS after sample preparation.

Results. The final goal is the assessment of bioaccumulation of HM in the organs and tissues of fishes from Lake Serebry as indicator of environmental contamination via the chain: Cu smelter emissions - atmospheric precipitation – soil - lake (water, bottom sediments) - fish.

Atmospheric precipitations are the main phases that remove aerosols from atmosphere. The emissions of acid- forming SO_2 and chalcophile metals (Pb, Zn, Cd, Cu, and others) in forms of finely dispersed aerosols lead to the formation of "acid rains" with pH 3.5–3.8 and anomalous concentrations of metals in soluble and insoluble (solid phase) form. The content of a whole series of elements is increased (up to hundreds and thousands of times) compared with the background precipitations. The substances removed from the atmosphere by rainfall collect in litter and top soil horizon.

Soils. Total HM concentrations in A0 horizon (forest floor) show an extreme metal accumulation as compared with the upper (10 cm) humic-accumulative A horizon. The low pH values provide the elevated contents of mobile metal species. Exchange forms of metals can be up to 13, 45 , 40 , 43 and 22% for Cu,

Cd, Pb, Zn and As, respectively. Concentrations of As, Pb, Cu, Zn, Cd and S in all 25 soil samples from residential area repeatedly exceeded the Russian maximum permissible concentrations.

Water and bottom sediments. The surface waters in the zone of Cu smelter activity strongly differ from natural waters and their chemical composition reflects the nature of anthropogenic contamination. The waters of Lake Serebry are enriched in a wide spectrum of chalcophile elements, and their quality does not match requirements for water sources, while the concentrations of Hg, Pb, Zn, As and Sb exceed dangerous levels for aquatic organisms. Fig. 1 show the enrichment factor of elements in the upper (0–2 cm) layer of sediments in Lake Serebry as compared to their contents in the deep (50 cm) layer corresponding to the preindustrial period.

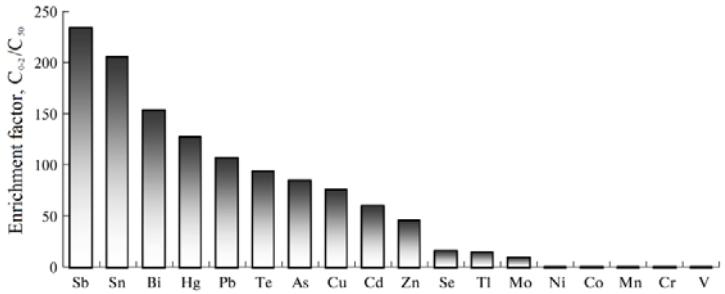

Figure 1. Enrichment factors for surface layer of sediments of Lake Serebry

Fish. The assessment of bioaccumulation of HM in physiological systems of fishes *Abramis brama l.* from lakes Serebry and Seliger. Lake Seliger is the background lake, it is not affected by technogenic influence. The results showed clear violations of the microelement composition of fishes from Serebry Lake (Fig. 2). This is particularly evident for such non-essential elements as lead and cadmium, which are highly toxic elements in physiological systems of fish.

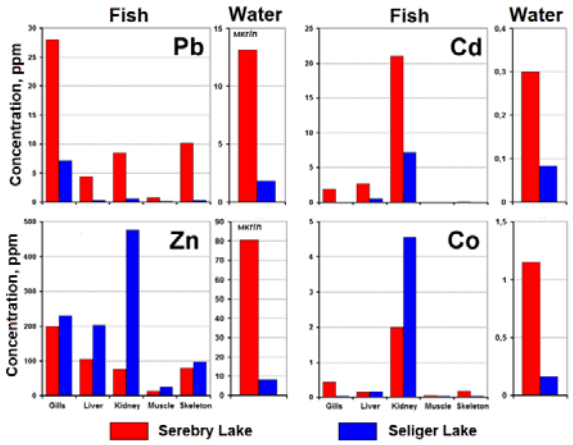

Figure 2. Violations of microelement composition of fishes in the Serebry Lake compared to Seliger Lake

The influence of atmospheric precipitation on different components of environment in one of the most contaminated regions of the South Urals is shown. The biogeochemical indication of pollution makes it possible to clearly fix the state of environment under the conditions of changing the technogenic load.