



Heavy Metal Contamination of Soils and Lake Sediments in the Impact Zone of a Large Copper Smelter (South Ural, Russia)

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Distribution of heavy metals (HM) and metalloids (Cu, Pb, Zn, Cd, Hg, Ni, Sb, As) in soils and lake sediments around the Karabashmed copper smelter (Karabash, Chelyabinsk district) demonstrates a high degree of pollution. The main source of pollution are emissions of the smelter plant. It is shown that in the impact zone (0-1 km, technogenic wasteland, the absence of litter and vegetation) the concentrations of heavy metals in the upper layers of soil are maximal and many times exceed maximum allowable concentrations (MAC). The upper soil horizons of the impact zone are exposed to maximum technogenic load. The main part of the residential urban area is located in the intermediate (impact-buffer) zone (1-3 km, depressed vegetation, maximum litter thickness, lack of litter decomposition). Here the maximum concentration of HM also exceed MAC and concentrated mainly in the litter. In the buffer zone (>3 km) there is a gradual decrease of the litter thickness, as well as declining of HM concentrations in litter and restoration of vegetation are observed. Maximum concentrations observed in the upper O horizon of soil. There is a large variation in pH values for different soil horizons as to background, buffer and impact zones. The average pH – 4.8, the minimum observed value in the water extraction from the upper horizon – 2.5.

The results showed that for assessing levels of technogenic load enough to conduct testing of topsoil or two upper genetic soil horizons. Forest litter (A0) is a good indicator of pollution and can be seen as accumulator of pollutants. Acute anthropogenic pollution reduces the rate of biochemical processes and suppresses or completely terminates the destruction of organic matter in the litter. This causes a change of fractional composition of litter up to the disappearance of traces of live ground cover.

The chemical composition of surface waters in the zone of smelter plant activity strongly differs from that of natural waters and reflects the character of anthropogenic pollution. Under existing hydrochemical conditions, elements supplying in lake with atmospheric falls and surface runoff form complexes with organic matter, or are adsorbed on mainly iron and manganese hydroxide particles, and finally are involved in the bottom sediments. Toxic elements deposited in the lake sediments create chronic contamination. Most of the elements are accumulated in the top layer of lake bottom sediments. Concentrations of Hg, Cd, Pb, Cu, Zn and As in bottom sediments correspond to the class of dangerous pollution.

During the work of the smelter (more than 100 years) hundreds tons of toxic heavy metals have accumulated in the surface layers of soil and sediments.

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