Change in metals speciation in waters of Arctic lakes (1975-2018): climate, anthropogenic loads, geochemical feature

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Speciation of metals in natural waters is an important information about the level of toxicity of a natural object. According to numerous published data, the most dangerous form of migration of heavy metals (except mercury) is an ionic form.

However, the study of metals distribution forms in each water object is a task that requires a huge physical-chemical work.

Understanding the patterns of element distributions in surface water and the reasons for the increase in their concentrations at the regional and global level is one of the most urgent problems facing the environment. Enrichment of surface water by metals is the result of both natural processes and human activities. The anthropogenic impact in the discharge of trace elements in the environment has increased dramatically over the last century, which is associated with the ever-increasing volumes of extracted metals and their dispersal in the environment.

The aim of our research was to investigate the distribution of the metals speciation in water lakes on the Kola Peninsula under different anthropogenic load.

Samples of lakes near industrial sites were selected near the mining processing complex in Kovdor, from Lake Monche (Lovozero) near the copper-nickel manufacture. Natural waters characterized by high alkalinity and pH about 7. The iron ions at such pH values are more form hydrox- compounds and sorption aggregation compared with aluminum ions. Under conditions of high load anthropogenic, chromium ions characterized by sufficient complexing capacity, which may be due to an increase in the concentration of the metal is several times as compared with lakes without direct sources. Manganese in such conditions has a high capacity to form suspensions. The complexation of heavy metals (Cd, Pb, Cu, Zn) is modified as follows: as well as for lakes without a direct source of pollution, zinc is complexed by more than 50%, copper also forms complexes with organic matter actively due to a significant increase in concentration. Depending on the type of copper coming from the wastewater, copper may form sorption unit and the low-molecular inorganic compound.

Speciation of nickel in natural waters with a direct source of pollution range from units to sorption complexes with organic matter as was found. A significant increase in metal concentration shifts the equilibrium in the system towards formation of high-molecular compounds. An interesting feature of the distribution of elements on the forms such natural waters is increasing the complexation with organic matter for the elements of the lanthanide series. Lanthanide elements is associated elements of many rocks of the Kola Peninsula, which explains the increase in their concentration in the areas near the plant. The affinity of these elements to an organic substance as follows: Fe>Al>Zn>Ni>Cu>Pb>La>Ce>Co.

High content of technogenic elements –Ni, Cu - create conditions for competition for organic ligand and the other formation of charge. Zeta potential change occurs dynamically and not smoothly.

Middle waters (25 samples between the polluted area and the background) are characterized by 2 maxima of zeta potential. The color of the solution does not change. Turbidity and pH vary widely.
Trends 1990-2014-2018 for small lakes

Non-labile forms of nickel and cobalt are changing dynamically from 1990 to the present and this fact directly depends on episodes of maximum pollution and turbidity. The proportion of the soluble part of the iron and aluminum compounds is also reduced.

Trends 1990-2014-2018 for Imandra lake
The change in the labile forms of nickel, cobalt, and copper also fluctuates and is associated with competitive processes in Lake Imandra in certain years. It was in this lake that the highest labile cadmium contents were found in the middle of the study period.

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