



Complexation humic substances of soils with metal ions as the main way migration of metals from soil to water

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Organic matter (OM) of natural waters can bind with the ions metals (IM) entering the system, thus reducing their toxic properties. OM in water consists predominantly (up to 80%) of humic acids (HA), represented by highmolecular, dyed, polyfunctional compounds. The natural-climatic zones feature various ratios of fulvic (FA) and humic acids. An important specific feature of metals as contamination elements is the fact that when they occur in the environment, their potential toxicity and bioavailability depend significantly on their speciation. In recent years, lakes have been continuously enriched in hazardous elements such as Pb, Cd, Al, and Cr on a global (regional) basis. The most important organic ligands are humic matter (HM) washed out from soils in water and metals occur in natural waters as free ions, simple complexes with inorganic and organic ligands, and mineral and organic particles of molecules and ions sorbed on the surface. The occurrence of soluble metal forms in natural waters depends on the presence of organic and inorganic anions. However, direct determinations are rather difficult. The goal was the calculation and analysis of the forms of metals in the system catchment basin, based on the chemical composition of the water body and the structural features of soil humic substances (HS). We used the following analytical techniques - leaching of humic substances from soil and sample preparation (Orlov DS, 1985), the functional characteristics of humic substances - spectral analysis methods, the definition of conditional stability constants of complexes - electrochemical methods of analysis.

Our results show that HAs of selected soil types are different in functions, and these differences effect substantially the complexing process. When analyzing the results obtained in the course of spectrometric investigation of HMs in selected soil types, we determined the following main HA characteristics: (1) predominance of oxygen bearing groups in HM of the northern taiga soils; (2) similar amounts of oxygen bearing fragments, hydrocarbon constituents, and nitrogen bearing components in the mixed forest zones; (3) occurrence of aromatic and aliphatic hydrocarbons in HM of steppe soils. The HM functional characteristics influence substantially the stability constants of complexes with metal ions and complex stoichiometry: Fe(III)>Cu(II)>Pb(II)>Al(III)>Co(II)>Ni(II)>Cd(II)>Zn(II)>Cr(III)>Mg(II)>Sr(II)>Ca(II)>Mn(II) - northern taiga soils;

Cu(II)>Fe(III)>Al(III)>Ni(II)>Zn(II)>Pb(II)>Co(II)>Cd(II)>Sr(II)>Mn(II)>Cr(III)>Ca(II)>Mg(II) - mixed forest zones;

Fe(III)>Cu(II)>Al(III)>Pb(II)>Ni(II)>Zn(II)>Co(II)>Ca(II)>Cd(II)>Sr(II)>Mg(II)>Cr(III)>Mn(II) - steppe soils.

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