



## Potential and real ecological threat of heavy metals in contaminated soils

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**Introduction.** Microelements or heavy metals (HM) occur in nature and are required for living organisms at low concentrations. High content of HM in soils characterize their potential danger for ecosystem. Their real ecological threat is presented by the mobility of HM in soils. The aim of this work was to characterize the potential and real danger of HM on the basis of HM mobility in soils and their influence of the most important soils properties.

**Materials and methods.** Two types of materials are presented in this paper. The first ones are presented by the summarized information about the content of Cu, Zn, Mn and their mobile species in the soils of Russia and are included into the National Atlas of Russian soils (2011). The second part is presented by the results of laboratory experiments with some samples of Podzols, Podzoluvisol and Chernozem. The following parameters have been determined: a) the main chemical properties of soils; b) the water extracts from soils were investigated by the potentiometric titration with HM salts; c) the properties of the samples of humic acids (HA, extracted by 1n. NaOH) and HA-Cu complexes were determined: molecular-masses distribution (MMD), infrared spectra (IRS), hydrophobicity, <sup>1</sup>H NMR spectra

**Results and discussions.** The major part of HM in soils of natural landscapes is firmly bound to several minerals. Their threat for living organisms is largely dependent on a relatively higher mobility of HM in soils. The main factors affecting the mobility of HM include soil reaction and sorption processes. In soils of natural landscapes the share of mobile HM compounds is estimated as some per cents from their total content. Having used the data about microelements in soils, their availability to living organisms, 14 natural biogeochemical provinces have been distinguished at the territory of the European part of the former USSR. It permitted to show the adverse impact rendered by microelements at low or high concentrations on living organisms.

Within the last 20-40 years a bulk of information has been accumulating to study the impact of technogenic sources on the HM content in soils and the ratio between their compounds. They serve as evidence that in the contaminated soils the total content of HM is several orders (2-3) higher than that in soils of natural landscapes. Based upon a comprehensive analysis of data obtained in field and laboratory it is possible to speak about following differences in soils of natural and technogenic landscapes. (1) The total content of HM in contaminated soils reveals weak connection with their content in soil-forming rocks being depended on technological and landscape-geochemical conditions. (2) A share of mobile forms of HM from their total content increases in comparison to that in natural soils, what is associated with soil contamination and even toxicity, because they can be easily taken up by plants and other living organisms. (3) The surplus of HM in soils leads to degradation of the most important properties so vital for soil fertility (acid base saturation, ion exchange capacity, the humus status, absorbing capacity and others). The enhanced knowledge of soil chemical properties which are subject to contamination by HM, regularities in sorption of heavy metals bond to soil components, the composition of compounds formed by soil with heavy metals allows forecasting the real ecological threat of landscape contamination with HM. The indices of the foregoing soil chemical properties serve as a basis for application of current technologies for soil remediation from HM.

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