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The assessment of mobility of heavy metals in technogenic soils by the combined approach for fractioning metal compounds

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Introduction. Analysis of the fractional composition of heavy metals (HMs) compounds can reveal zonal and genetic features of soils and how natural and technogenic factors affect them. The aim of this work was to assess the state of HMs in soils subjected aerosol emissions from the Novocherkassk power station (NPS) on the basis of the fractional composition of their compounds. The emissions from the NPS comprise 1% of the total volume in the Russian Federation and up to 58% of the emissions in Rostov oblast.
Materials and methods. Studies were conducted on the soils of monitoring plots distances from the NPS (1.0–20.0 km). The monitoring plots were located on fallow areas. Soil samples for the determination of soil properties and the contents of HM compounds were taken from a depth of 0–20 cm. The soil cover in the region under study consisted of ordinary chernozems, meadow-chernozemic soils, and alluvial meadow soils.
The total amount of HMs in soils was determined by X-ray fluorescence. Metals in soil extracts were determined by atomic absorption spectroscopy. The fractional composition of HM were determined using combined fractionation (Minkina et al., 2008). A combined approach for fractioning metal compounds in soils on the basis of sequential (Tessier, 1979) and parallel extractions (1 N NH4Ac, pH 8; 1% EDTA in NH4Ac; and 1 N HCl).
Results and discussion. The increasing of total content in soils of metals connected with technogenic emissions. In the contaminated soils, the increase in the total metal content is accompanied by changes in the proportions of metal compounds. In contrast to clean soils, where the metals strongly retained in the structure of silicate minerals are predominant (48–78% of the total amount), the content of LB metal compounds increases in the contaminated soils. The rise of metals mobility in the polluted soils and predominant participation of Cu, Pb, Mn, Cr and Ni organomineral complexes among their mobile species. The increasing of Zn and Cd mobility was provided predominantly by exchangeable forms and specifically sorbed by Fe–Mn (hydr)oxides. Organic substances and nonsilicate Fe minerals are the most involved in the strong fixation of HMs. The changing of metals compounds with different binding strengths to organic substances and Fe (hydr)oxides unare establish. A higher metal mobility was found in soils with low buffering capacity. According to the buffering capacity with respect to HMs, the soils in the vicinity of the NPS form the following increasing sequence: silty clayey meadow-chernozemic soil < clay loamy meadow-chernozemic soil < clay loamy ordinary chernozem < sandy alluvial meadow soil.
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