

HEAVY METALS IN TOPSOILS OF THE REPUBLIC OF TATARSTAN, RUSSIA: MULTIVARIATE ANALYSIS AND POLLUTION EVALUATION

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Abstract. *Background.* The study is conducted to investigate the content and spatial distribution of Fe and eight heavy metals (Cd, Co, Cr, Cu, Mn, Ni, Pb, and Zn) in soils of the industrially developed region. *Materials and methods.* A total of 1,170 soil samples of different land use (natural, agricultural, urban) were collected from topsoils in the territory of the Republic of Tatarstan, Russia. Heavy metals concentrations in soil samples were determined using atomic absorption spectrometry after 5M HNO₃ extraction. Multivariate and geostatistical analyses were used to investigate the current state of soil heavy metal contamination and to identify spatial patterns and possible sources of heavy metals on the regional scale. *Results.* Zonal soil types of a natural land use were used to assess the regional background values of the heavy metals: Cd – 0.44±0.24 mg/kg, Co – 10.4±3.6 mg/kg, Cr – 23.3±12.7 mg/kg, Cu – 16.4±7.8 mg/kg, Fe – 15275.4±5178.3 mg/kg, Mn – 652.4±228.4 mg/kg, Ni – 29.8±18.8 mg/kg, Pb – 11.5±3.2 mg/kg, Zn – 43.3±12.8 mg/kg. The results of the pollution evaluation showed the absence of regional-scale contamination directly related to agriculture. Urban soils were contaminated by Cu, Pb and Zn. Geostatistical analysis revealed several patterns of regional distribution of heavy metals and suggested an anthropogenic impact to the Cu, Pb and Zn distribution. Principal component analysis allowed distinguishing three regional geochemical groups of heavy metals and showed that at the regional scale the distribution of Cu, Mn and Ni is controlled by the element richness in soil parent material, overlaid by the soil forming factors; the distribution of the Co, Cr and Fe is controlled mainly by lithology; and the distribution of the Pb, Zn and Cd is strongly influenced by the anthropogenic sources. *Conclusion.* This case study demonstrates that a combination of multivariate statistics and geostatistical analysis together with the pollution assessment allows comprehensive characterizing heavy metals spatial distribution and determining their sources.

Keywords: soil, heavy metals, mapping, multivariate analysis, geostatistics, Republic of Tatarstan, Russia.