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ORIGINAL PAPER

Environmental risk assessment of radioactivity and heavy metals in soil of Toplica region, South Serbia

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Abstract Activity levels of natural and artificial radionuclides and content of ten heavy metals (As, Cd, Co, Cr, Cu, Mn, Ni, Pb, Zn and Hg) were investigated in 41 soil samples collected from Toplica region located in the south part of Serbia. Radioactivity was determined by gamma spectrometry using HPGe detector. The obtained mean activity concentrations ± standard deviations of radionuclides ^{226}Ra, ^{232}Th, ^{40}K and ^{137}Cs were 29.9 ± 9.4, 36.6 ± 11.5, 492 ± 181 and 13.4 ± 18.7 Bq kg^{-1}, respectively. According to Shapiro–Wilk normality test, activity concentrations of ^{226}Ra and ^{232}Th were consistent with normal distribution. External exposure from radioactivity was estimated through dose and radiation risk assessments. Concentrations of heavy metals were measured by using ICP-OES, and their health risks were then determined. Enrichment by heavy metals and pollution level in soils were evaluated using the enrichment factor, the geoaccumulation index (I_{geo}), pollution index and pollution load index. Based on GIS approach, the spatial distribution maps of radionuclides and heavy metal contents were made. Spearman correlation coefficient was used for correlation analysis between radionuclide activity concentrations and heavy metal contents.

Keywords Radionuclides · Heavy metals · Spatial distribution · Environmental risk · GIS

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