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Migration of radionuclides and heavy metals during the bioremediation of a polluted cinnamonic soil

Plamen Georgiev, Stoyan Groudev, Irena Spasova, and Marina Nikolova
University of Mining and Geology "St. Ivan Rilski", Sofia, Bulgaria (ps_georgiev@mgu.bg)

A fresh sample of cinnamonic soil polluted with radionuclides (U, Ra) and toxic heavy metals (Cu, Pb, Zn) was subjected to bioremediation in large-scale lysimeters by means of moulching. The aim of soil treatment was solubilization of pollutants located in horizon A, the migration of their dissolved complexes through the soil profile, and the pollutants‘ precipitation in the rich-in-clays below-lying horizons. The solubilization was due to the joint action of natural soil microflora and leach waters containing ammonium and phosphate ions, and in some variants-hydrocarbonate ions. The precipitation of pollutants was due to the enhanced activity of the indigenous microflora in which iron- and sulphate-reducing bacteria were the prevalent groups. After 24 months of treatment, each of the soil profiles in different lysimeters was divided into five sections reflecting the relevant soil layers (horizon A and the sub-horizons B1, B2, B3, and B4). The soil in these sections was subjected to a detailed chemical analysis and the obtained data were compared with the relevant data obtained before the start of soil bioremediation. It was found that considerable portions of the pollutants were removed from the horizon A and were migrated to the sub-horizons B3 and B4, mainly. In these sub-horizons the non-ferrous metals were precipitated mainly as the relevant sulphides, uranium was precipitated as uraninite (UO_2), and radium-mainly as adsorbed ions and complexes.