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In situ cleaning of a heavily polluted soil in a uranium deposit

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An experimental plot of 240 m2 consisting of a leached cinnamonic forest soil contaminated with radionuclides (mainly U and Ra) and non-ferrous metals (mainly Cu, Zn, Cd and Pb) was treated in situ under real field conditions by a method based on the activity of some physiological groups of microorganisms – members of the indigenous soil microflora. This activity was enhanced by suitable changes in the levels of some essential environmental factors such as pH, water, oxygen and nutrient contents of the soil. The treatment was connected with solubilization and removal of contaminants from the top soil layers (horizon A) due to the joint action of the local soil microorganisms (mainly acidophilic chemolithotrophic bacteria) and diluted sulphuric acid solutions used to irrigate the soil and to mauntain the pH of the soil pore solution within the range of about 3.0 – 3.5. The dissolved contaminants were transferred by the drainage solutions to the deeply local soil subhorizon B2 where they were precipitated as the relevant insoluble forms (uranium as uraninite, and the non-ferrous metals as the relevant sulphides) as a result of the activity of the suphate-reducing bacteria inhabiting this soil subhorizon. Water solution of dissolved organic compounds (lactate and acetate) and ammonium and phosphate ions were injected through vertical boreholes to this soil subhorizon to enhance the activity of these bacteria. The treatment of the soil in this way was efficient and within a period of two years (including about a 3 – month pause in irrigation during the cold winter months) the concentrations of contaminants in the upper soil layers were decreased below the relevant permissible levels. The concentrations of contaminants in the drainage waters from the treated soil plot were decreased below the relevant permissible levels for water intended for use in the agriculture and/or industry.