Radium distribution and mobility in forest soils

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Radium (^{226}Ra) is a long-lived alpha emitting radionuclide and is of major concern in risk assessment, especially in the nuclear fuel cycle. To date, several studies have shown variable Ra affinities among different soil compartments, but the relative role of each compartment has not yet been clearly defined. The objective of this study is to constrain the distribution and mobility of Ra in a forest ecosystem using U-Th-^{226}Ra-series disequilibria and the ^{226}Ra/^{228}Ra ratios.

Soil samples were taken at the experimental beech forest site of Montiers (France), belonging to the environmental monitoring OPE (Observatoire Pérenne de l'Environnement) network. Clays, Fe-oxides and exchangeable fractions were extracted, and U-Th-^{226}Ra disequilibria and ^{226}Ra/^{228}Ra ratios were measured on each fraction of the soil profile. In addition, soil solutions, atmospheric dusts and tree samples (roots, leaves and litter) were analysed to establish the budget of Ra input to and output from soils.

Soil data show that the (^{226}Ra/^{230}Th) activity ratios do not deviate from secular equilibrium through the whole soil profile, suggesting a misleading lack of ^{226}Ra mobility. Indeed, the apparent soil ^{226}Ra-^{230}Th equilibrium likely results from a balance between the Ra input from atmospheric deposition and tree litter degradation and the Ra output from soil solutions. Furthermore, the data indicate a preferential mobility of ^{228}Ra relative to ^{226}Ra, which can be explained by a preferential location of the parent long-lived nuclides, ^{238}U and ^{232}Th, in silicate minerals and Fe-Al oxides, respectively.