Speciation of Thorium in Soils from Sri Lanka

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Background

The occurrence of minerals containing natural radionuclides (NRs) in soil depends primarily on the geological and geographical settings and appears at different levels in various regions on earth [1]. Natural radionuclides, such as ^{238}U, ^{232}Th (Th) and ^{40}K, are the major sources of the terrestrial components of natural background radiation and together with their progenies contribute significantly to the total dose from natural sources. Soil samples with a high background radiation level due to the presence of the above-mentioned NR containing minerals were collected from an area in Sri Lanka. Some selected analyses of the chemical form of Th containing minerals in those samples will be discussed here.

Results and Discussion

X-Ray powder Diffraction (XRD) and Attenuated Total Reflection-Fourier Transform Infrared Spectroscopy (ATR-FTIR) provide information on the nature of the main components of the soils. Morphology and chemical composition is analysed by Scanning Electron Microscopy (SEM) and Energy Dispersive X-ray spectroscopy (EDX). Data show that sheet silicate (clay) type mineral and silica (quartz) are dominant phases. Based on XRD, the clay phase corresponds to kaolinite ($Al_2Si_2O_5(OH)_4$). Further, the speciation of Th in the soil samples was obtained by application of X-ray Photoelectron Spectroscopy (XPS) and X-ray Absorption Spectroscopy (XAS) at the Th L_3-edge. XAS measurements yielded further insight into the chemical form of the elements of interest by determining the type and number of neighboring atoms as well as their distance from Th in the structure. Detailed elemental and morphological analyses of the Th containing portions using SEM/EDX and XAS suggest that this element is present in phosphate (probably monazite-type material), oxide and silicate mineral phases. The main purpose of this research project is to study potential mobilization of NRs and subsequent migration of these with focusing on Th.

[1] UNSCEAR Report (2000), Vol. I.