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Radiocesium (^{137}Cs) bioavailability in soil sequences illustrates the role of the soil weathering on both ^{137}Cs selective adsorption and K buffering capacity

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Radiocesium (^{137}Cs) contaminates agricultural soils after nuclear accidents. Crops can take up ^{137}Cs because it is analogous to potassium (K) and ^{137}Cs therefore poses a risk to (human) health. Process-based models predict the transfer of ^{137}Cs from soil to plants. However, models made after the Chernobyl and Fukushima accidents are unlikely to make predictions worldwide. These models only consider soils at similar stages of development, and do not cover soils contrasting in parent material and weathering degree. Hence, topsoils of sequences (N = 51) were selected from Chile, France, Guatemala, Kenya, Philippines, Spain and Vietnam so that the role of weathering stage on the fate of ^{137}Cs could be elucidated. Relevant soil properties, mineralogy and *radiocesium interception potential* (*RIP*), i.e. ^{137}Cs selective adsorption, were determined. Next, a pot experiment was set up in which ryegrass grew on ^{137}Cs-spiked soils from Kenya and the Philippines. Because K competes with ^{137}Cs for plant uptake, soils were studied both with and without K fertilization. The soil RIP varied from 45.3-5680 mmol kg^{-1} and more importantly, the RIP per unit clay varied strongly between 142-36000 mmol kg^{-1}. Indeed, the role of weathering stage was confirmed as younger soils, i.e. higher altitude on the toposequence, had 10–fold smaller RIP per unit of clay than at the base. It is indicated that in younger soils with limited clay mineral weathering, the ^{137}Cs adsorption and K-buffer capacity is limited and that as the soil develops, more weathered edges develop and K-buffering increases while in highly weathered soils, these minerals have disappeared and K-buffering is limited. In K-deficient, young and highly weathered soils, more ^{137}Cs will be taken up by plants and countermeasures like K fertilization will have less effect. This implies that the ^{137}Cs contamination scenarios as we know from temperate regions are very different from those in tropical regions. Practically, our findings can adjust ^{137}Cs transfer models to effectively predict the risk of ^{137}Cs entering our food chain in case of nuclear incidents worldwide.