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Effects of Wildfires on Cesium Sorption and Transport in Subsurface Environments

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Forest fires form various particulate organic matters, and their deposition can alter the physicochemical properties of soil and sediments in the subsurface environments. This study investigated the sorption and transport behavior of cesium (Cs) in post wildfire soil-groundwater environment.

Soil samples were collected at two locations (GS1 & GS2) in Gangwon Province, Korea, where a large-scale forest fire occurred in 2017. The soils were sampled at different depths (~5, ~20, and ~40 cm). The physicochemical characteristics of the collected samples were determined by XRD, XRF, SEM, TOC analysis and organic petrography, and batch and fixed-bed column experiments were performed to evaluate the Cs uptake and retardation.

All studied soils were mainly composed of quartz and feldspar. The GS2 sample contained higher feldspar and clay minerals than the GS1. The TOC contents were high (7~8 wt%) in the topsoils, decreasing with depth. The SEM and organic petrographic analyses showed that various organic carbon particles such as textinite, ulminite, fusinite (charcoal) and char existed. The charcoal and char indicated the evidence of wildfires, although their amount was few. Batch sorption experiments revealed that the K_d value decreased non-linearly as the aqueous-phase concentration increased, and the sorption isotherms were fitted well with the Freundlich model. The K_d values of individual soil samples were much greater in topsoils compared to deep soils at all experimental Cs concentrations. In particular, the GS1 topsoil had higher sorption capacity than GS2 subsoils, even though it was more organic-rich with low clay mineral contents. The breakthrough curve of column experiments exhibited remarkable Cs retardation phenomena at topsoils. Their retardation factors (R_f) were max. 4 times greater than those of subsoils, showing $R_f \approx 43$ to 45 for topsoils. These results imply that particulate organic matters caused by wildfires can play more important role on the Cs sorption and transport in the subsurface environments.