Effects of Dissolved Organic Matter on Transport of Cesium in weathered granite soil

*Takahiro Tatsuno[1], Shoichiro Hamamoto[1], Naoto Nihei[1], Taku Nishimura[1]

1. Deptartment of Biological and Environmental Engineering, Graduate School of Agricultural and Life Sciences, University of Tokyo

To understand migration of radiocesium (Cs) in soils is an important issue after the accident of Fukushima Dai-ichi nuclear power plant, Japan. Soil organic matters might affect migration of Cs in soils. In particular, dissolved organic matters (DOM) may alter sorption and transport of Cs in soils. There are two possible processes for DOM-induced Cs transport. First, DOMs in soil solution carry Cs to deeper soil layer. Second, DOMs sorbed on the soil solid surface inhibit Cs fixation, resulting in enhancement of Cs mobility. In this study, we investigated effects of DOM on the Cs transport in a soil by laboratory column experiments.

Soil sample was a weathered granite called as Masa in local dialect. It was collected at an abandoned forest in Iitate, Fukushima, Japan. DOM was extracted from a litter from a forest in Chichibu, Saitama. Dissolved organic carbon (DOC) in the DOM extract was 20mg-C/L. Cs solution was prepared by using stable CsCl. Cs concentration was 20mg/L. In addition, Cs-DOM mixed solution was prepared by mixing Cs and DOM solution for 72 hours. An acrylic plastic column having a diameter of 3cm and a length of 5cm was used for the transport experiments. The soil column was prepared by packing air dried soil sample up to 3cm of height. After that, permeable solution was applied at a constant ponding depth. Sequence of flowing solution were as follows: (i)Cs solution to NaCl solution (pH6, ionic strength of 1mM), (ii)Cs-DOM mixed solution to NaCl solution and (iii) Cs solution to DOM solution. Cs concentration of the effluent was measured. Some effluent solution was ultrafiltrated to separate water soluble Cs and Cs-organic matter complexes. After the transport experiments, the column was sliced in 1-cm interval and the soil at each section was suffered to the sequential extraction of Cs.

Temporal variation of Cs concentration was almost the same for flowing solution (i) and (iii), while Cs concentration of the effluent using flowing solution (ii) was smaller than the others. It could be expected that DOMs in the flowing solution adsorbed on soil surface and Cs was trapped on the adsorbed DOM. From the results of sequential extraction, exchangeable Cs concentration of the solution (iii) was smaller than the others. In addition, Cs complexed with DOMs were about 20% in the effluent Cs of DOM solution(solution (iii)). DOMs could have stripped exchangeable Cs on soil surface.

In conclusion, DOM didn’t facilitate Cs transport. However, there is a possibility that a part of exchangeable Cs can migrate with DOM.

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