Affects of molecular size of natural organic matters for cadmium mobility in soil environments

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The Itai-itai disease, which is one of osteomalacia caused by cadmium ingestion, had frequently broken out in the region along the Jintsuu River in Toyama, Japan. The source of pollution is cadmium including in discharge from the Kamioka mine that had been mining zinc and lead for a few hundred years. Cadmium is accumulated into human bone through uptake of rice harvested from the contaminated soil. In this study, we focused on role of natural organic matters for cadmium mobility in soil environments.

We collected the dissolved organic matters from both surface water, where organic matters are decomposed under oxidized condition, and deep groundwater, where decomposed under anoxic. Furthermore, the collected organic matters were separated into three groups of molecular size of 1K, 10K, and 100K. The origin of organic matters in both water environments is deduced to be land plants from $\delta^{13}C$ of -27.7~ -28.4 ‰. Ages of organic matters are less than 20 years for surface water and more than 4000 years for deep groundwater.

Cadmium was leached from siliceous sand having concentration of 1mg/g by interaction between the separated organic matters into each fraction of molecular size. Leaching test was conducted in the concentration of total dissolved organic matters of 10 mg/L. For the organic matters collected from surface water, the smallest molecular fraction (1K) leaches more cadmium from the soil than larger one. In contradiction, larger molecular fraction (10K and 100K) leaches more cadmium from soil than smaller one (1K) for deep groundwater. This suggests that structure, molecular size and degradation condition for organic matters characterize cadmium migration and mobility in the environment. Furthermore, we have to pay attention that the smallest fraction (1K≤) of organic matters occupies more than 80 % in the natural aquatic environment for the cadmium mobility in surface soil.