

4-7 Understanding the Migration Behavior of Transuranic Elements from Forests to Rivers

— Migration Behavior Research using Rare Earth Elements that Exhibit Chemical Similarity to Transuranic Elements —

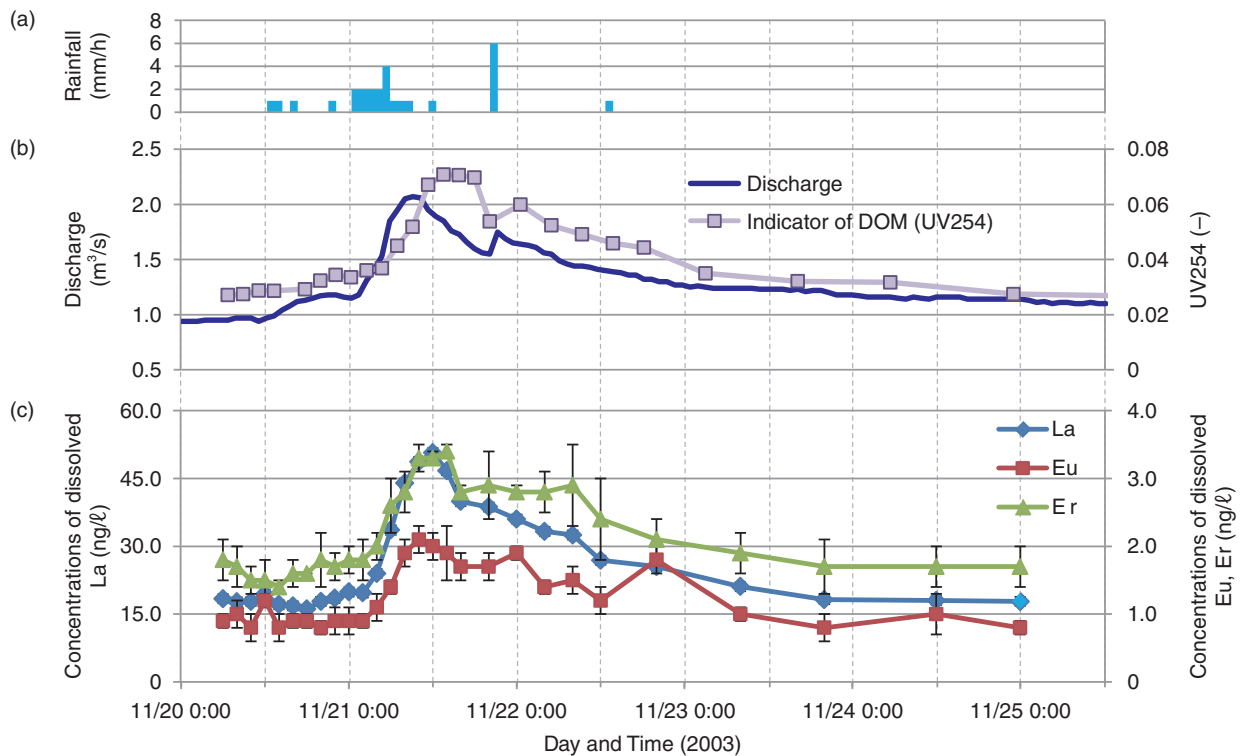


Fig.4-16 Observation results from November 20 to November 25, 2003

Temporal changes of (a) rainfall and (b) river-water discharge, as well as absorbance at 254 nm (UV254), which is an indicator of the concentration of dissolved organic matter (DOM); (c) concentrations of dissolved REEs (lanthanum (La), europium (Eu), and erbium (Er)). The concentrations of DOM and REEs increased at the same time and these changes occurred shortly after an increase in discharge during a rainfall event.

The environmental behavior of transuranic elements (TRU) is an important issue when assessing the impact and measuring long-lived radionuclides such as TRU, which are released into the environment. It is generally difficult to use nuclear-bomb-test-derived TRU in environmental-behavior research, owing to their limited presence on the ground.

We performed migration behavior research based on field observations using rare earth elements (REEs), which are known to exhibit chemical similarity to TRU in laboratory experiments. We observed temporal changes of discharge, dissolved organic matter (DOM) concentrations and concentrations of dissolved REEs during rainfall events in a small catchment (Fig.4-16). The concentrations of DOM, especially humic substances, increased following a short delay from the increase in discharge. The concentrations of dissolved REEs also increased at this time. We observed that the DOM and the dissolved REEs migrated together, owing to the fact that their temporal changes were consistent. This result

suggests that humic substances, which are widely distributed in forest soil, are involved in the migration behavior of TRU. It has been reported in previous literature that REEs and humic substances attach strongly to one another. These results suggest that some of the dissolved REEs in soil migrate into river water in a form attached to DOM during rainfall events.

By analyzing the distribution of the data, most of the REEs dissolved during rainfall events were shown to exist as particles with diameters of 1–200 nm. This result also suggests that dissolved REEs and humic substances are strongly attached to one another. Furthermore, as a result of analyzing the relationship between the REE concentration and the characteristics of the humic substances, it was suggested that the quantity of a cyclic compound such as the benzene included in the humic substances was significantly involved in forming complexes with REEs. The findings will improve our understanding the migration behavior of TRU from forests to rivers.

Reference

Matsunaga, T., Tsuduki, K. et al., Increase in Rare Earth Element Concentrations Controlled by Dissolved Organic Matter in River Water During Rainfall Events in a Temperate, Small Forested Catchment, *Journal of Nuclear Science and Technology*, vol.52, issue 4, 2015, p.514-529.