

## Biotite-vermiculite mixed layer minerals from eastern Fukushima, Japan and their Cs-sorption behavior

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It is suggested that clay minerals in the surface soil strongly fix radioactive cesium and limit its migration in Fukushima. Among such minerals, weathered biotite has a high capacity of irreversible sorption and it has been thought that this mineral fixes radioactive cesium at specific sites in the crystals. Because the contaminated areas in Fukushima are mainly covered with weathered granite soil, such minerals are abundant. Therefore, a basic understanding of the structure of weathered biotite and their Cs-sorption behavior should be important to discuss the dynamics of radioactive cesium in the soil.

In this study, we aimed to reveal the two issues: 1) the characteristics of the weathered biotite with biotite-vermiculite (B-V) interstratification that were collected from the eastern area of Fukushima Prefecture, 2) how the weathered biotite incorporate cesium ions inside the crystals.

The weathered biotite sample was collected from weathered granodiorite of Abukuma granitic rocks at Ono City in Tamura District and Kawauchi village in Futaba District, in the eastern part of Fukushima Prefecture, Japan. These samples include fresh biotite and weathered biotite with different weathering state at same/near outcrops.

First, to estimate the proportion of B and V layers in the crystals and the characteristics of their mixing, powder X-ray diffraction (XRD) for oriented specimens and simple simulations (Sybilla, Chevron Energy Technology Company) of one-dimensional XRD for the mixed-layer minerals were conducted. The parameters for mixing were optimized, by comparing the experimental and simulated patterns. The results suggests that different weathering conditions (e.g., in the soil and on the surface of core rocks) resulted in different characteristics of mixings, even though they were formed at the same rock and/or outcrop.

Second, Cs sorption experiments using the CsCl aqueous solution were conducted and the Cs-sorbed specimens were also measured by powder XRD. Then, we also compared the experimental and simulated patterns as the same way as for the original sample. From this procedure, it was suggested that Cs-incorporation at the vermiculate (hydrated) interlayers is a very heterogeneous phenomenon, which was also confirmed by the direct observation of Cs in the crystals, using high-angle annular dark-field scanning transmission electron microscopy (HAADF-STEM).

Keywords: Fukushima nuclear accident, cesium, biotite, XRD, weathering, mixed layer mineral