1–12 Radiocesium Behavior in River System

—Relationship between Mineral Species and Radiocesium in Riverbed Using Microscopy—

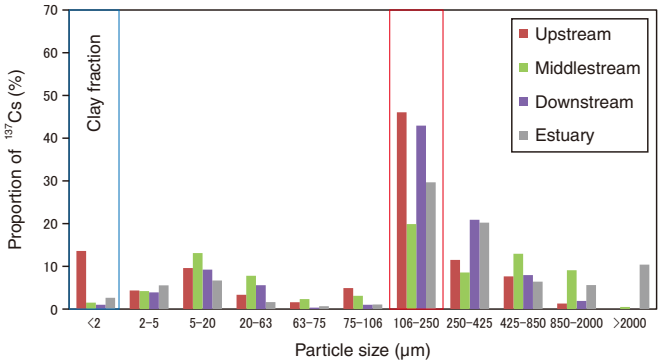

Fig.1-23 Ratio of ^{137}Cs in each size fraction to the total ^{137}Cs in the bulk sediment sampled from the upstream reservoir to the estuary
Fine sand (106–250 μm: red box in figure) contained the highest ^{137}Cs quantities. Unlike in previous studies, coarse fractions contained high levels of ^{137}Cs.

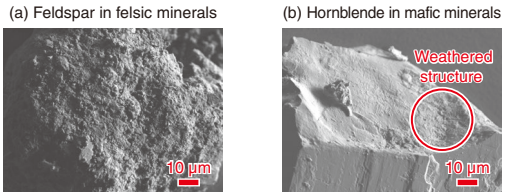

Fig.1-25 Morphological characteristic of the representative minerals hand-picked from the fine sand fraction using SEM
The surface of (a) feldspar in felsic minerals and (b) hornblende in mafic minerals were likely to be weathered.

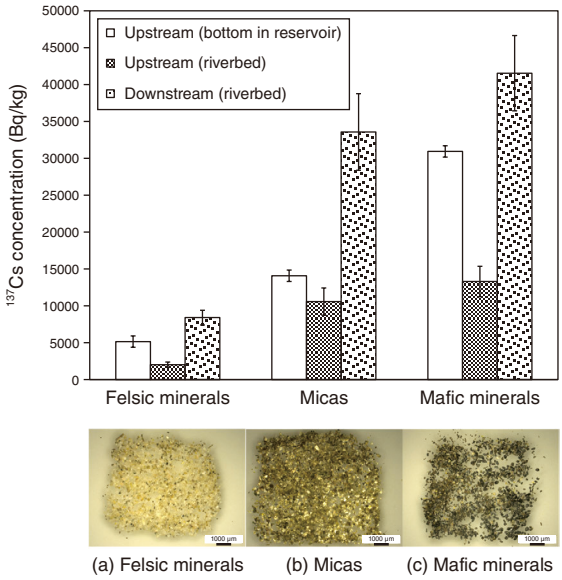

Fig.1-24 ^{137}Cs concentrations in each mineral and separated mineral obtained from the fine sand fraction at the riverbed and reservoir
The fine sand was separated into (a) felsic minerals, (b) micas, and (c) mafic minerals. Although previous studies have indicated that ^{137}Cs is poorly sorbed onto mafic and felsic minerals, ^{137}Cs was sorbed these minerals.

Most of the radiocesium (^{137}Cs) emitted from the TEPCO's Fukushima Daiichi NPS accident was deposited into the river system, where it was transported by soil particles and redistributed in the downstream area. Identifying the dominant mineral species that have adsorbed ^{137}Cs is necessary to predict the elution from a mineral to river water and sedimentation behavior of ^{137}Cs. In this study, the relationship between the dominant mineral species that adsorb ^{137}Cs and the behavior of ^{137}Cs moving downstream from the upstream reservoir within the Tomioka river basin is clarified.

Some sediment samples were collected in the riverbed from the upstream to the downstream. The collected sediments were divided into 11 fractions by their size (i.e., according to their Wentworth grain size) via sedimentation and centrifugation. The radioactivity of ^{137}Cs in each fraction was determined using a germanium semiconductor detector. The contribution of ^{137}Cs in each size fraction to the total ^{137}Cs concentration in the bulk sediment was then calculated using the weight frequency of each fraction. The results indicate that the fine sand fraction (106–250 μm) in the riverbed sediments contained the largest ^{137}Cs quantities (Fig.1-23) due to the higher weight proportion of fine sand to other fractions. Thus, mineral species in the coarse-grain fraction except clay minerals strongly adsorbed ^{137}Cs.

The mineral species were then separated using morphological observations from the size-fractioned sediments to identify which mineral species strongly adsorb ^{137}Cs. Using a microscope and X-ray diffractometer, the mineral species were separated and identified as mafic minerals (hornblende, augite, and magnetite), as mica (vermiculite), as felsic minerals (quartz and feldspars) (Figs.1-24(a)–(c)). Micas, which have been reported to have adsorbed ^{137}Cs, and mafic minerals were demonstrated to have an equivalent ability to adsorb ^{137}Cs. The felsic minerals, which have been reported as poor adsorbers of ^{137}Cs, also contained ^{137}Cs. Scanning electron microscopy (SEM) demonstrated that the surface of the feldspars and hornblende has many fine particles and a flaky structure due to weathering (Fig.1-25), which may promote the sorption of ^{137}Cs. This study may contribute to clarifying the sorption and desorption mechanisms of ^{137}Cs on minerals for evaluating the transport of ^{137}Cs.

This work was performed in collaboration with Niigata University, entitled "Mineralogical study on behavior of radiocesium in environment".

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Reference

Hagiwara, H. et al., Mineral Composition Characteristics of Radiocesium Sorbed and Transported Sediments within the Tomioka River Basin in Fukushima Prefecture, Journal of Environmental Radioactivity, vol.211, 2020, p.106042-1–106042-10.