

Transportation and accumulation of geogenic arsenic (As) from soil water to paddy rice via irrigation water at Japanese paddy rice fields in river system

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Geogenic arsenic (As) exceeding WHO standard is often detected in rivers and in river soils along volcanic front of Japanese Island. In recent years, arsenic (As) has been detected in Japanese paddy rice grains at concentrations often exceeding the upper limit (0.2 ppm) stipulated by the Codex Alimentarius Commission (Ministry of Agriculture, Forestry and Fisheries, 2014; Matsumoto et al., 2015). Japanese paddy rice is cultivated under flooding using paddy water from rivers. Paddy rice seems to be one of the sink of As in river system. In this study, we focus on the behavior of geogenic, toxic trace elements, As from soil water to paddy rice via irrigation water in Japanese paddy rice fields in the study area along volcanic front. One irrigation water originates from a small river sprang in an active volcano, Mt. Asama, and the other originates from a small river sprang in a currently inactive volcano, Yatsugatake Mountains in Nagano, Japan. In these small rivers, the majority of As is transported in the dissolved form, predominantly as arsenate, with low abundance of particulate matter. The concentration range of As in irrigation water of paddy field is almost same to that in small rivers. However, the concentration range of As in root of paddy rice is a thousand –a hundred thousand times as high as that of irrigation water. The As in root of paddy rice increases with Fe, while the As in water does not increase with Fe. The relationship between As and Fe concentrations at roots of paddy rice is different from those relationships of river water, of irrigation water and of extraction waters from paddy soil under both reducing and oxide conditions. In general, As and Fe are taken up and transported via each ion channel and each transporter, separately, at roots in paddy rice (e.g., Ma et al., 2006; Ma et al., 2007). Our findings suggest that As in paddy rice is not directly derived from As in the irrigation water from the river under flooding.

Keywords: arsenic, paddy rice, river system