Effect of hydrous ferric and aluminum oxides for transport of As, Cd and Pb in the rivers acidicied by the Kusatsu thermal waters in Japan

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Similar to acidic mine drainage, acidic thermal waters also cause acidification and toxic metal pollutions in aqueous systems. Because of high discharge (4400 L/min) and acidity (pH 2), the Kusatsu thermal waters are artificially neutralized by limestone. In this study, we investigated mobility of As, Cd and Pb in the river systems affected by the acidic thermal waters, considering changes in their physico-chemical status.

After the neutralization (pH >5), almost all As and considerable portions of Pb originating the thermal waters were sorbed onto hydrous ferric and aluminum oxides (HFO and HAO). Thus, As and Pb were mainly transported as suspended species, whereas dissolved Cd was predominant chemical species.

The Shinaki Dam was constructed downstream from the neutralization plant, and the reservoir also acts as sink of HFO and HAO sorbing As and Pb. So, about 85-87% of As and 73-80% of Pb originating from the thermal waters were removed at the reservoir. However, most Cd remained in the neutralized thermal water.

Downstream from the Sinaki Dam, As and Pb were mainly transported as sorbate onto HAO. The Yamba Dam is constructing, and the reservoir may also act as sink for HAO sorbing As and Pb in the future, where pH is expected to greater than 6. Because Cd remained in the river water as dissolved species, Cd may transport toward further downstream from the Yamba Dam.