

The fractionation mechanism between indium and arsenic originated from the acidic thermal water during river transport

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The Kusatsu and Tamagawa hot springs contain toxic elements such as arsenic and lead as well as rare metals such as indium and rare earth elements. Because of the strong acidity and large discharge, both thermal waters are neutralized by lime input and construction of dams.

The neutralization of the Kusatsu thermal waters was rapidly completed, when the lime suspension was dropped. After the rapid neutralization, most of dissolved As and In is removed by suspended hydrous ferric oxide (HFO). Consequently, As and In are transported as sorbate onto the suspended HFO to the bed sediments of man-made lake without the significant fractionation. On the contrary, the Obuki thermal water is neutralized by not only lime addition but also the mixing with tributary. Consequently, the pH values gradually increased toward the downstream. Arsenic tends to be sorbed by HFO from the upstream region, leading to wide distribution in the entire watershed. Indium is transported until the lake inlet as stable chloride- and/or sulfate-complexes without significant removal, and then, is mostly precipitated in the man-made lake. As a result, In is effectively accumulated in the downstream lakebed compared to As.

The apparent difference in geochemical mobility of these elements in the Kusatsu and Tamagawa fields indicates that we could purposely control elemental mobility in the natural river system. For example, we could preferentially concentrate the useful metals in the lakebed sediments by the toxic metal exclusion. If possible, we could obtain the rare metal resource from the man-made mineral deposits.

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