

# **Origin and fate of dissolved arsenic in acidic rivers in the Kusatsu hot spring area, Gunma, Japan**

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The Kusatsu hot spring area located in the eastern foot of Kusatsu-Shirane volcano is a famous spa resort in Japan. Hot springs in this area are all strongly acidic. Thus the waters of three major rivers there, Yu River, Yazawa River and Ohsawa River, are also acidic. Gunma Prefecture had launched a program to neutralize acidic river waters around Kusatsu hot springs in 1961 and started operation of the lime water neutralization system at Yu River, which shows the highest acidity of the three, in 1964. Today, the neutralization systems are operated for all of the three major acidic rivers and maintained by Ministry of Land, Infrastructure and Transport. The waters after neutralization of the three rivers gather into a lake formed by the Shinaki Dam with large amounts of suspended matters as neutralization products. Among various dissolved components in the acidic rivers, arsenic has been paid high attention to from the geochemical and environmental aspects recently. We discuss the origin and fate of dissolved arsenic in those rivers and effects of the neutralization on the mobility of arsenic.

We have determined the concentration of arsenic in hot spring waters, river waters and neutralization products and performed the mass balance calculation of arsenic in the river system in the area. The total amount of arsenic transported by the river waters is around 35 tons/year. Yu River accounts for more than 95% of it, since the water from the hot spring named “Bandaiko”, the largest arsenic supplier (> 50 tons/year) in the area, flows in this river. The secular change in the concentration of dissolved arsenic in Yu River has been almost the same as that observed for the Bandaiko hot spring. The concentration of arsenic in the Yu River water before neutralization is now around 2 mg/L. In contrast, the dissolved arsenic is not detected (< 0.01 mg/L) in the river water after neutralization. Suspended matters collected from the Yu River water after neutralization contain around 1 wt% of arsenic in the dry weight base. Sediment samples collected from the bed of Yu River at about 100 m downstream from the neutralization point contain nearly 10 wt% of arsenic in the dry weight base. Arsenic in the sediments are thus supposed to have co-precipitated with iron hydroxide, since the sediment samples are mainly amorphous and contain a considerable amount of iron. These observations suggest that the dissolved arsenic in the river waters almost completely co-precipitate with and/or adsorb on the neutralization products. This means that the Shinaki Dam has been accumulating about 35 tons of arsenic per year.