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多田銀山地域の河川水における金属元素の挙動
The behavior of heavy metals in river water around the Tada silver mine, southwestern Japan

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Heavy metal concentrations in river water around an abandoned mine site are important for environmental conservation as well as understanding elemental behavior in nature. In this study, heavy metal concentrations of river water samples around one of the most historical abandoned mines in Japan, the Tada silver mine, were studied to understand the elemental behavior around the closed mine at regional levels. The Tada silver mine is located in the eastern part of Hyogo prefecture, southwestern Japan. The mine is classified as Cu-Sn and Zn-Pb polymetallic vein deposit including silver[1)], and it was closed in 1973. A total of 38 river water samples were collected around the Tada silver mine. Water temperature and pH were measured at the sampling site. All samples were filtered with 0.45 um filter. Seven heavy metal elements (Cr, Mn, Ni, Cu, Zn, Mo, Pb) were analyzed with inductively coupled plasma mass spectrometer (ICP-MS), and six anions (Cl^-, NO_2^-, NO_3^-, Br^-, PO_4^{3-} ,SO_4^{2-}) were analyzed with ion exchange chromatography (IC). Behavior of heavy metals in river water is mainly controlled by adsorption reaction. Adsorption rates of heavy metals are different among the elements, and are affected by the dissolving forms and pH. Cu, Zn and Pb in river water are commonly dissolved as cation, and are easily adsorbed when pH is high[2)]. Near the Tada silver mine, Cu (102 ppb), Zn (323 ppb) and Pb (59.9 ppb) concentrations are higher than the other river water samples far from the mine. These higher concentrations might be affected by the Tada silver mine. As increasing the distance from the mine, Cu, Zn and Pb concentrations decreased rapidly. Concentration of Cu becomes stable within 2,700 m away from the location of its maximum concentration. Zn concentration becomes stable at 6,400 m away from the location of its maximum concentration. Concentration of Pb becomes stable within 2,100 m away from the location of its maximum concentration. The distance to the stable concentration point of Zn is longer than that of Cu and Pb. This is concordant with the fact that Zn adsorption rate is lower than that of Cu in same pH condition. Mo concentration slightly increases with increasing the distance from upsteam to downsteam and correlates with the anion content, especially SO_4^{2-}. This might be because that : 1) Mo dissolves as anion ; 2) Mo adsorption rate is low in pH 7.5 - 8.0 [3)]; and 3) Mo is supplied from the sediments.

References

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