Role of chemical forms for transportation of metals in Tama-Omono Rivers, Akita Prefecture, Japan

*Quyen Pham[1], Daizo Ishiyama[2], Mayuko Fukuyama[1], Yasumasa Ogawa[2]

1. Graduate School of Engineering and Resource Science, Akita University, 2. Falcuty of International Resource Science, Akita University

Chemical forms of elements in river water of Tama and Omono Rivers containing acidic thermal water were determined by successive filtration technique. The chemical forms of elements were divided into the particulate (>0.2 μm), colloidal (0.004 - 0.2 μm) and dissolved (<0.004 μm) forms. This study proposes that the chemical compositions of elements in river water are controlled by variation of chemical forms of elements according to change in geology along the rivers. Tama River which is one of the tributaries of Omono River, runs through the area composed of Quaternary volcanic rocks at the upstream site through the area composed of Miocene volcanic rocks and Quaternary sedimentary strata from Lake Tazawa to Daisen City. Inflow of acidic thermal water into Tama River in upstream changes the pH of the river water to acidic and concentrations of dissolved metals into high concentrations except for Fe and As. Dissolved Fe and As easily change into colloidal and/or particulate forms in river water in upstream of Tama River. According to qualitative analyses by SEM-EDX, the reddish particulate is thought to be Fe hydroxide. Arsenic was adsorbed on the surface of Fe hydroxide. This indicates that Fe hydroxide controls the mobilization of As. The pH of river water of Tama River changes from 4.6 in upstream to 7.1 in downstream. At the downstream site, the influence of acidic thermal water becomes small due to supply of particulate material from the erosion of Quaternary sedimentary rocks. The particulate forms of Al, Fe and trace metals in river water contribute to increase of concentration of these elements. Based on observation and analyses by SEM-EDX and XRD, the particulate materials are thought to be phyllosilicate and clay minerals: chlorite, illite/montmorillonite. Uptake of Al, Fe and trace metals onto these minerals decrease concentration of dissolved metals in river water of Tama River. The amounts of Al and As that are transported by river water of Tama River decreased from upstream to downstream. This suggests that precipitation of these elements in natural lake and dam lakes along Tama River. Therefore, the natural lake and dam lakes could play an important role in reducing the environmental impact. Omono River runs through the area mainly composed of Miocene to Quaternary volcanic rocks in the upstream to the area mainly composed of Quaternary strata covering Miocene sedimentary rocks in the downstream. The difference in geology along Omono River accords with the difference in the distribution of elements in the particulate form in the river water of Omono River. At the upstream site of Omono River, Fe in the river water is present as particulate Fe hydroxides, resulting from river water mixing between Omono River having neutral pH (7.2) and Takamatsu River containing acidic thermal water of pH 3.2. Towards downstream site, reddish gravels along river bank disappear. However, concentrations of Fe as colloidal and particulate forms in the river water increase. This observation and chemical analysis by SEM-EDX and XRD suggests that these particulate materials are clay minerals. The clay minerals derived from the sedimentary rocks along Omono River could be the host of Fe as particulate form in river water of Omono River. The particulate form as clay minerals derived from sedimentary rocks increase concentration of Al, Fe, Mn and trace metals in river water of Omono River. Concentration of Al, Fe, Mn and trace metals in particulate form of river water of Omono River are higher than those of Tama River. The difference of these concentrations accords with the difference in dominance of Quaternary and Miocene sedimentary rocks between Omono and Tama Rivers. Concentrations of elements of river water are controlled by concentration of elements adsorbed on the surface of suspended particles such as clay minerals in river water having near neutral pH.

Keywords: chemical forms, acidic thermal water, river water, geology setting

