Passive treatment of acid mine drainages containing dissolved iron

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Active treatment of the acid mine drainage (AMD) at abandon mine has economically been a big issue. Recently at some of AMD, economic treatments were accomplished by introducing lime channel in the drainage as passive treatment. For sustainable management of the AMD, switch from active to passive treatment should be necessary if available. In south part of Hokkaido, Japan, the abandon Shojin mine discharges AMD to Shojin and Amemasu rivers, containing toxic heavy metals such as iron, arsenic, lead and cadmium. In Shojin river, concentration of the heavy metals is less than environmental standard at monitoring point without treatment. On the other hand, concentration of the heavy metals keeps high in downstream of Amemasu river. In this context, site investigations were conducted in Shojin and Amemasu rivers to identify the geochemical differences for natural attenuation process for passive treatment in Amemasu river.

At the mixing point of AMD with Shojin river, pH of AMD increases to 3.5 from 2.8, where precipitation of schwertmannite was formed due to pH increasing. Concentrations of As is decreased due to the high adsorption capacity of schwertmannite at the pH. Moreover, toxic heavy metals in the AMD was diluted by the river water because flow rate of AMD is relatively less than that of the river water. In contrast, at the mixing point of AMD with Amemasu river, the pH was not changed (pH=2.86), where precipitation was not observed. In addition, heavy metal concentrations of the AMD are not diluted by the river water because flow rate of AMD are not so different from that of Amemasu river water. Consequently, from the difference in flow rate between two rivers, natural attenuation in Shojin river is accomplished by adsorption of newly formed schwertmannite and dilution of AMD. Therefore, precipitation by increasing pH of AMD may firstly considered for passive treatment in Amemasu river. To understand preferable pH for As, Pb and Cd removal, surface complexation modelling was conducted. For schwertmannite precipitation, pH 3.5 is necessary. At pH 3.5, the concentration of As decreases to that less than the standard by adsorption by schwertmannite. Pb may be removed under the standard at pH5.0 by the adsorption while Cd may not be removed until pH 9.0. For passive treatment in Amemasu river, increase of pH more than 5.0 requires a large-scale lime channel, therefore dilution at downward would be expected for lead and cadmium attenuation.