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Effect of indigenous bacteria on the geochemical behavior of arsenic in sediment around the abandoned Hwachon Au-Ag mine sites in Korea

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Mining and smelting activities have become a major anthropogenic source of arsenic and heavy metals around the abandoned mine areas. In particular, arsenic(As) contamination around the gold mine sites has been a serious problem. Metabolic diversity of bacteria has helped them to adapt themselves to a variety of environments in natural settings such as soil, sediment and aquifer contaminated with toxic heavy metals. Some bacteria are reported to alter electrochemical species of a range of elements during removal or reduction of the toxicity. Also some bacteria can dissimilatorily oxidize or reduce elements, through which they yield energy for growth and maintenance. In the latter case, toxic metals and metalloids are used as electron donors or acceptors in their respiratory chain. Such bacterial mediation of elements, whether it is detoxification or dissimilation, has considerable influence on geochemical transport and fate and global cycling of elements. The purposes of this study areąąto investigate the contamination level and the chemical speciation of As in the sediments collected from the Hwachon Au mine sites and to study the effects of indigenous bacteria on the geochemical behavior of As in As-contaminated sediments.. To investigate microbial effects on As, the indigenous bacteria was isolated from the sediments and cultured for 15 days under the various conditions. Also to explain the factor causing the microbial effect, various elements were measured. The ranges and mean concentration of arsenic in sediments extracted by aqua regia are from 11.04 to 61.15 mg/kg with average value of 32.11 mg/kg. The concentration level of the composite sample of nine sediments was As 24.9 mg/kg, Cd 16.6 mg/kg, Pb 230.8 mg/kg, and Zn 1076.9 mg/kg. Sequential extraction of As shows that most of arsenic(87.9%) existed as a phase of

As coprecipitated with Fe oxyhydroxides. Under the aerobic condition, As concentration leached from the contaminated sediments were four times higher in non-sterile condition than in sterile condition. This tendency was more significant when acetate were added for carbon source. This enrichment of As leaching under aerobic condition could be caused by pH increase and exudation secreted during microbial metabolism. Under anaerobic condition, As concentration has dramatically increased in non-sterile solution. This As leaching has begun on 4~5th days of incubation and the highest concentration was recorded on about 11th day. The highest concentration was 511.2 ppb. This As leaching under anaerobic condition was caused by microbial enhancement of Fe leaching. Total Fe concentration increased from the 4th day, and this Fe leaching could have caused As coprecipitated with Fe oxyhydroxide.