

**Speciation and lability of heavy metals (Cd, Cu, Pb, Zn)  
in acid mine drainage of the Kwangyang mine area:  
implication to toxicity of aqueous metals**

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The evaluation of speciation of dissolved metals in water is difficult but is very important to assess the biological and geochemical impacts, because labile metal species such as free aquo ions are generally more toxic than inert species. The anodic stripping voltammetry (ASV) is recently used to measure effectively the concentrations of labile species. In this study, we compared the results of geochemical modeling using WATEQ4F with those of ASV in order to investigate the speciation of dissolved metals (Cd, Cu, Pb, Zn) in the Chonam-ri Creek drainage water of the abandoned Kwangyang Au-Ag mine area.

The results of computer modeling indicate that free aquo metals become predominant toward the sites upstream from a retention pond in the water course, where pH is low. The relative abundance of complexing with sulfate, carbonate and hydroxy ligands increases downstream owing to the increase of sulfate and carbonate ions and neutralization of pH. The ASV data of Cd and Zn are quite similar with the results of computer modeling. On the other hand, the ASV data of Cu and Pb is quite lower than the result of computer modeling. This suggests the importance of complexing with organic matter for Cu and Pb. Therefore, it is clear that a small retention pond in the water course plays an important role in reducing the toxicity of heavy metals as well as in removal of dissolved metals.

In order to evaluate the effect of pH on the complexation of heavy metals in collected samples, the variation of labile metal concentrations with respect to the pH change (from 2 to 8) was examined by ASV. The results show that labile fractions of Cd and Zn are nearly constant with the pH change, whereas those of Cu and Pb decrease rapidly with pH increase. This clearly indicates that that organic complexing of metals is important for Cu and Pb but is minor for Cd and Zn. After the UV irradiation to break down organic metal complexes, ASV measurement of acidified samples (pH 2) was also performed to estimate the total concentrations of heavy metals. The results of Cu and Pb are generally similar with the ASV data without UV radiation, possibly indicating that strongly bonded

organic complexes of Cu and Pb are expected to be minor in amounts. Therefore, most of the organic complexes of Cu and Pb in the Chonam-ri Creek drainage water can be destroyed easily into free aquo metals by acidification to pH 2.