

Changes in pH and amounts of heavy metals in leachate during oxidation of sulfide ores: An experimental research by using H₂O₂

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Oxidation of sulfide ores is known to be strongly related to heavy-metals pollution and acidification of natural streams. In order to understand the changes in pH and amounts of heavy metals in solution during oxidation of sulfide ores under natural hydrogeological environment, oxidative dissolution of some sulfide ores was investigated experimentally by using hydrogen peroxide.

In the oxidative dissolution experiment, 25 mg of powdered sulfide ore was sealed in the polypropylene bottle with 50 ml solution containing oxidizing agent, and left for about 50 days at room temperature and pressure. The sulfide ores are four types: black ore from the Toya-takarada Kuroko deposit composed mainly of sphalerite and galena, yellow ore from the Shakanai Kuroko deposit mainly of chalcopyrite, pyrite ore from the Yanahara Kieslager deposit mainly of pyrite, and manganese ore from the Oe epithermal vein-type deposit mainly of rhodochrosite with sulfides. For each ore or their composite (1:3), a series of experiments was carried out with changing the concentration of the hydrogen peroxide as oxidizing agent from 0 to 5.0×10^{-2} mol/l. The run products were filtered by 0.20 micrometers membrane filters, and the filtrated solution was analyzed by ICP and ICP-MS.

The analytical results of leachates from the series using each ore indicate that the pH and amounts of metals are controlled by amount of hydrogen peroxide and the original mineral composition. The results of the series of yellow ore with chalcopyrite and pyrite ore with pyrite reach low pH condition and show higher metal concentrations in the leachates. Those of black ore with lower amounts of pyrite and chalcopyrite show weakly acidic pH condition and higher metal concentrations. In the leachates from the manganese ore are observed neutral pH condition with lower metal concentrations. These results are well explained by equilibrium calculations. Dissolution behavior of minor metals is controlled mainly by the dissolution of the host mineral.

In the result for the composite, the pH and amounts of metals are controlled by their mixing ratios. As the increase of the amount of the manganese ore, pH increases and amounts of metals decrease drastically. It is concluded that the generation of a hydrogen ion during oxidation and buffering by carbonate species are important factors for leaching of heavy metals.