Leaching patterns of metal from different types of sulfide minerals

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Sulfide minerals consist of iron pyrite and base metals, including chalcopyrite (CuFeS), sphalerite (ZnFeS), and galena (PbS). For deep-sea mining, hydrothermal deposits are crushed and pulled up on borad through pipe lines. In this process, heavy metals from sulfide minerals will be eluted and affect the marine environment. Heavy metals (Fe, Ni, Cu, Zn, As and Pb) leaching experiments were conducted using different types of hydrothermal depsosits (Cu-Fe rich, Fe rich, Zn-Fe rich, Zn rich) from the TA25 seamount caldera in the Tonga arc. Tonga TA25 caldera stations. Leaching experiments was carried out of each sample to 1g/L (ratio of sulfide mineral to filtered seawater), and the eluate samples were aliquoted at time interval of 1, 6, 12, 24 hours, 2, 4, 6, 8, 10 days. The samples were analyzed using ICP-MS coupled with a automated prconcentration system (seaFAST SP3) after filteration and acidification.

Fe and Cu concentrations tended to gradually increase with increasing elution time in all types of sulfide mierals. However, Ni had a relatively high concentration at the beginning of elution. For Cu-Fe rich type, Cu concentration was 277,457 ppt about 800 times higher than the initial concentration after 10 days. For Zn, it had the highest concentrations at 1 hr and gradually decreased in Cu-Fe rich and Fe-rich types. Zn-Fe rich type sample showed a concentration of 11,648,917 ppt after 1 hr of elution time and showed the constant concentration. For Zn rich type, Zn gradually increased with time in Zn rich deposit and eluted at the highest concentration (13,918,397 ppt) at 10 days. Pb was initially eluted at a high concentration and gradually decreased. As increased concentration in Zn-Fe rich and Zn rich types, while Cu-Fe rich and Fe rich decreased in concentration than seawater.

Our results showed that the elution charateristics vary with hydrythermal types and metal elements, not only metal concentrations but useful tool of metal stable isotope is necassary to accurately assess and trace the marine environmental impact during deep-sea mining.