

Investigation on arsenic dissolution behavior and its bearing minerals in seafloor massive sulfide ores

MAMI KAWASAKI, KAZUO TANI AND SHIGESHI
FUCHIDA

Tokyo University of Marine Science and Technology

Seafloor massive sulfide (SMS) deposits have gained significant attention as potential sources of valuable metals such as copper (Cu), zinc (Zn), silver (Ag), and gold (Au). Low-grade ores mainly composed of barite (BaSO_4) can be recovered during the mining process. Large amounts of arsenic (As) is often contained in these Ba-rich ores, which typically exist as sulfide minerals like realgar (As_4S_4) and orpiment (As_2S_3). These sulfide minerals are thermodynamically unstable and gradually decompose in the atmospheric environment, resulting in As contamination during ore treatment and recovery of valuable minerals. Therefore, selective separation and immobilization treatment of As-bearing minerals are necessary to reduce As-contamination during the SMS-mining process. In this study, SMS samples collected from the Okinawa Trough were analyzed to identify As-bearing minerals by ICP-OES, XRF, and SEM-EDS, and dissolution experiments were conducted to construct a kinetic model for As release from SMS ores. The bulk sample analysis by ICP-OES after acid digestion showed the As content in the samples ranged from 0.36 to 8.0 wt.%. Moreover, ternary diagrams for Zn-Fe-Ba of our samples compared with references revealed that As was concentrated in Ba-rich ore, followed by Ba-Zn-rich ores. SEM-EDS analysis of mineral fragments of ore samples identified that As-sulfide minerals with chemical compositions close to realgar and orpiment were dominant species, and they were contained as small grains in barite and silicate mineral particles. The dissolution experiments using three ore samples revealed that As was released to the solution within 4 hours, and As(III) was the initial dominant species in all samples. Thus, As(III)-bearing mineral can become a potential source of As release. The kinetic calculation of these results using PHREEQC showed that the dissolution rate of As would be controlled by the amount of reactive As-bearing minerals (i.e., chemical composition) or different reaction rate constants depending on the crystal structure of minerals.