# Study on geochemical mechanisms for acid mine drainage generation by kinetic modeling and petrological analysis of sulfide cores

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Acid mine drainage (AMD) generation is one of the serious problems both in active and abandoned metal mines. Oxidative dissolution of sulfide minerals is a principal mechanism of AMD generation, and metal contents in the drainage are different with potential mineral components in the deposits. In this study, we targeted α-mine (Iwate, Japan) which is releasing AMD (pH<3) containing Fe (<200 mg $dm^{-3}$) and As (<0.9 mg $dm^{-3}$) with high flow rate (>18 $m^3$ $min^{-1}$) and examined the specific geochemical process of AMD generation by a dissolution kinetic modeling of three iron sulfide mineral (pyrite, marcasite, and pyrrhotite) and petrological analysis of sulfide cores (depth: 100 m) collected from this mine. The dissolution rates of three iron sulfide minerals (pyrite, marcasite, and pyrrhotite) in an artificial groundwater was determined from batch-leaching experiments using grinded samples (106–150 μm) at room temperature; these values for pyrite, marcasite, and pyrrhotite in the artificial groundwater were $1.5\times10^{-6}$, $4.0\times10^{-5}$, and $7.4\times10^{-8}$ mol $m^{-2}$ $s^{-1}$, respectively. This result means that the dissolution rates could change depending on their crystalline structure; orthorhombic crystal of marcasite is more soluble than a cubic crystal of pyrite and pyrrhotite. These dissolution rates were 2–3 times lower than those in purewater [1–3] because cations and anions in the groundwater would inhibit their dissolution reactions. Morphological observation of samples fragments by polarized and scanning electron microscopes revealed that relatively soluble mineral was distributed in the upper part of the deposit; marcasite mainly found below 70 m whereas pyrite and pyrrhotite is dominant in the deep parts (>80m). Furthermore, a small amount of arsenic (<1.5 atm%) was detected in the marcasite crystals by energy-dispersive X-ray spectroscopy but not in other minerals. Our results, therefore, suggests that marcasite could be a potential mineral for Fe and As in the AMD formation in the α-mine.

[1] Williamson and Rimstidt (1994), *GCA* 58, 5443–5454. [2] Asta et al. (2010), *EJM* 22, 49–61. [3] Belzile et al. (2004), *JGE* 84, 65–76.