THE EFFECT OF DISSOLVED OXYGEN ON THE DISSOLUTION KINETICS OF SULFIDES

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Sulfide disintegration in the context of Acid Mine Drainage (AMD) is currently under study with a variety of experimental techniques. Environmental variables such as pH, dissolved oxygen concentrations, iron and sulfate content, temperature, etc. affect the aqueous oxidation process of sulfides in different ways. We observed for example that under highly acidic conditions (1< pH <3) the kinetics of sulfide aqueous dissolution is significantly different among different sulfide phases, e.g., PbS, ZnS, CuFeS₂, AsFeS, and FeS₂.

Whereas some sulfides such as pyrite, galena, and arsenopyrite dissolve remarkably slower in the absence of dissolved oxygen, the dissolution rates of other sulfides (e.g., sphalerite and chalcopyrite) are independent of the dissolved oxygen concentration. This is relevant because sphalerite and chalcopyrite can dissolve even under conditions in which oxygen has been exhausted provided that high proton concentrations are available.

In general, a sulfide dissolution rate law can be expressed as

$$R_{sulphide} = k_{sulphide} e^{\frac{E_{app}}{RT}} a_{O_2(aq)}^{m} (a_{H^+})^n$$

where $k_{sulphide}$ is a rate constant, E_{app} is the apparent activation energy of the overall reaction, R is the gas constant, T is the temperature (K), $a_{O2(aq)}$ and a_H are the activities in solution of dissolved oxygen and protons,

			pН
Sulfide	formula	m	range
galena	PbS	< 0.5	2-3
sphalerite	ZnS	≈ 0	1-4
chalcopyrite	CuFeS ₂	≈ 0	1-3
arsenopyrite	AsFeS	> 0.5	1-3
marcasite	FeS ₂	> 0.5	1-3

Table 1: Approximate m values for the sulfides studied.

respectively, and n and m are the orders of the reaction with respect to these species.

According to previous works on pyrite dissolution kinetics considering the dissolved oxygen effect on the pyrite dissolution rate, it was proposed that m equals 0.50 (Domènech *et al.*(2002); Williamson and Rimstidt (1994)). Our results obtained by means of long term flow-through dissolution experiments show that m differs among the different sulfides studied (see Table 1).

REFERENCES

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