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Influence of pH and temperature on alunite dissolution rates and products

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Aluminium is one of the main elements in most mining-affected environments, where it may influence the mobility of other elements and play a key role on pH buffering. Moreover, high concentrations of Al can have severe effects on ecosystems and humans; Al intake, for example, has been implicated in neurological pathologies (e.g., Alzheimer's disease; Flaten, 2001).

The behaviour of Al in mining-affected environments is commonly determined, at least partially, by the dissolution of Al sulphate minerals and particularly by the dissolution of alunite ($KAl_3(SO_4)_2(OH)_6$), which is one of the most important and ubiquitous Al sulphates in mining-affected environments (Nordstrom, 2011). The presence of alunite has been described in other acid sulphate environments, including some soils (Prietzel & Hirsch, 1998) and on the surface of Mars (Swayze *et al.*, 2008). Despite the important role of alunite, its dissolution rates and products, and their controlling factors under conditions similar to those found in these environments, remain largely unknown.

In this work, batch dissolution experiments have been carried out in order to shed light on the rates, products and controlling factors of alunite dissolution under different pH conditions (between 3 and 8) and temperatures (between 279 and 313K) similar to those encountered in natural systems.

The obtained initial dissolution rates using synthetic alunite, based on the evolution of K concentrations, are between $10^{-9.7}$ and $10^{-10.9}$ $mol \cdot m^{-2} \cdot s^{-1}$, with the lowest rates obtained at around pH 4.8, and increases in the rates recorded with both increases and decreases in pH. Increases of temperature in the studied range also cause increases in the dissolution rates.

The dissolution of alunite dissolution is incongruent, as has been reported for jarosite (isostructural with alunite) by Welch *et al.* (2008). Compared with the stoichiometric ratio in the bulk alunite (Al/K=3), K tends to be released to the solution preferentially over Al, leading to dissolved Al/K ratios between 0.5 and 2.5. This depletion of Al in the solution is especially clear for the experiments at pH 4.5-4.8 and 8 and it is consistent with the results of elemental quantifications of the same proportions in the reacted alunite surfaces using X-ray Photoelectron Spectroscopy (XPS).

REFERENCES

Flaten, T.P. (2001): Aluminium as a risk factor in Alzheimzer's disease, with emphasis on drinking water. Brain Research Bulletin 55: 187-196.

Nordstrom, D.K. (2011): Hydrogeochemical processes governing the origin, transport and fate of major and trace elements from mine wastes and mineralized rock to surface waters. Applied Geochemistry 26: 1777-1791.

Prietzel, J., & Hirsch, C. (1998). Extractability and dissolution kinetics of pure and soil-added synthesized aluminium hydroxy sulphate minerals. European journal of soil science, 49(4), 669-681.

Swayze, G.A., Ehlmann, B.L., Milliken, R.E., Poulet, F., Wray, J.J., Rye, R.O., Clark, R.N., Desborough, G.A., Crowley, J.K., Gondet, B., Mustard, J.F., Seelos, K.D. and Murchie, S.L., 2008. Discovery of the Acid-Sulfate Mineral Alunite in Terra Sirenum, Mars, Using MRO CRISM: Possible Evidence for Acid-Saline Lacustrine Deposits?, American Geophysical Union, Fall Meeting 2008, abstract #P44A-04.

Welch, S. A., Kirste, D., Christy, A. G., Beavis, F. R., & Beavis, S. G. (2008): Jarosite dissolution II—Reaction kinetics, stoichiometry and acid flux. Chemical Geology, 254(1), 73-86.