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Mineral weathering rates in sulphidic mill tailings: Do rate laws for monomineralic samples apply?

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Conceptual understanding and quantification of mineral weathering rates is a prerequisite for assessment of many environmental issues. For example, the proton balance of deposits for sulphidic mill tailings, and the resulting pH, is governed by the relative rates of acidity producing and consuming mineral weathering reactions [1, and references therein]. While there are numerous rate laws for laboratory weathering of monomineralic sulphide and aluminosilicate samples available in the literature, far fewer studies report and compare mineral weathering rates for natural mineral assemblages, such as soils, or mill tailings [e.g. 2, 3].

We present preliminary laboratory results of mineral surface area normalised weathering rates in ~50-year-old, carbonate-depleted, sulphidic mill tailings from Kristineberg in northern Sweden as determined in batch reactors at ~25°C. While pyrite weathering rates were consistent between the tailings sample and a sulphide fraction derived from it, rates were up to an order of magnitude lower than for a crushed museum specimen of pyrite. Aluminosilicate weathering rates in the tailings showed similar pH dependence as reported in the literature for monomineralic samples, however, absolute rates were up to 1-2 orders of magnitude lower. This observed discrepancy in weathering rates is possibly associated with a decrease in surface reactivity with time, rendering freshly crushed samples normally used in weathering studies more reactive than minerals in the tailings, and is consistent with the commonly reported orders-of-magnitude lower rates in the field than in laboratory studies [4, and references therein].

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References

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2.2.31

Al-F toxicity contributes to ecosystem stress and species decline following large-scale volcanism

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Large-scale volcanic eruptions inject massive amounts of ash and gases in to the atmosphere. Beside climate effects, the eruptions also cause contamination of soils and fresh water as noted in historical records. In order to quantify the extent of this environmental effect, changes in surface water chemistry were studied by simulating the mixing of volcanic ash leachate with fresh water using the PHREEQC2 geochemical code. Ash leachate composition was assigned a value equal to initial release of major and trace elements partly presented in [1] from the experimental work on Hekla 2000 ash, by Frogner. The geochemical modeling of ash-leachate mixed with water from the river *Laxá i Kjos* in Iceland shows that AlF_x^{+3-x} complexes dominate Al speciation in solution at low dilution (Fig. 1). Earlier findings indicate that aluminum is more bioavailable to plants and animals as a F complex. Based on the above results, we conclude that bioavailable and potentially toxic levels of AlF_x^{+3-x} complexes, will persist in systems with low turnover rates, such as soil solution, ponds and lakes. Hence, fluoride and aluminum are mobilized in fresh water systems and become bioavailable to both plants and animals as such complexes; the combination of high Al and F concentrations may thus contribute to fluorosis and Al toxicity in impacted areas, eventually leading to ecosystem stress and species decline following large-scale volcanism.

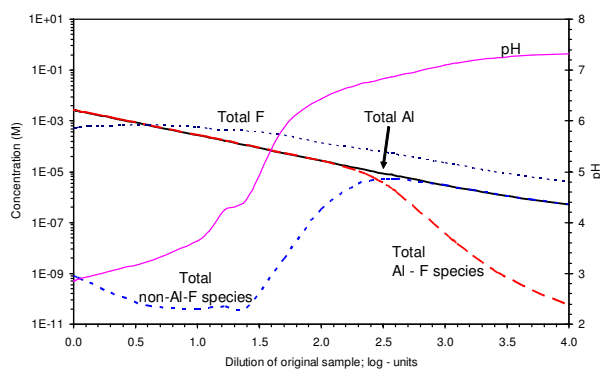


Fig1. Toxic AlF_x^{+3-x} complexes in the less diluted acid range.

References

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