Goldschmidt 2024 Abstract
https://doi.org/10.46427/gold2024.24233

Parsing the effect of time on the co-weathering of sulfides and silicates: can mine waste characterization fill the gap between lab and field-derived weathering rates?

JOEL BANDSTRA[1,2] AND TAMARA DIEDRICH[2]

[1]Saint Francis University
[2]MineraLogic

Presenting Author: jbandstra@mnlogic.com

Dr. Brantley's work on silicate weathering has illustrated how weathering rates of major rock forming minerals vary significantly over spatial and temporal scales—with rates derived from laboratory experiments (generally less than one-year duration) being significantly faster than those determined from watershed-based studies (reflecting up to geologic time scales). Identifying the cause and degree of silicate mineral weathering rate dependence on time has been complicated by the lack of data corresponding to the 10s to 100s-years range of scale. As an independent and parallel stream of investigation, the mining industry has developed methods to characterize weathering behavior of non-ore grade rock which will be excavated and stored during the course of mining. These methods include laboratory tests ("humidity cell tests") which, in some cases, run for over ten years.

This presentation will describe the potential utility of data from mine waste laboratory characterization programs to understanding time-dependence of silicate mineral weathering rates. Further, since these tests are typically carried out on crushed rock samples, as opposed to single-mineral separates, they provide an opportunity to observe interactions between mineral assemblages during weathering. Data from long-term kinetic tests charged with plagioclase-rich materials from a proposed mining project are used to validate and parameterize a process-based model of the cation leaching from plagioclase that precedes stoichiometric dissolution. Model results suggest that cation leaching is stimulated by protons supplied via sulfide mineral oxidation, which significantly augments the potential for carbon mineralization relative to rocks that are not undergoing simultaneous sulfide mineral oxidation. The observed relationship persisted throughout the approximately seven years duration of the experiment and in column experiments conducted at an increased spatial scale. The mechanism linking sulfide oxidation to cation leaching from plagioclase does not otherwise appear to be broadly recognized in the literature on weathering of mining associated materials.