Kinetic geochemical modelling of laboratory column experiments: empirically derived weathering rates

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Numerical predictions of long term mine water quality are commonly based on weathering/solute release rates derived from kinetic laboratory testwork such as humidity cell tests (HCTs) or column experiments. Laboratory derived weathering rates are then scaled up to provide estimates of future field conditions.

Up-scaled models commonly assume thermodynamic equilibrium with respect to a specified range of mineral phases. However, uncertainty remains as to the validity of up-scaling methods [1].

Rather than assume thermodynamic equilibrium, this study seeks to represent HCTs using a simplified pyrite/calcite system using kinetic reactive transport equations within the USGS code PHREEQC [2]

The model was calibrated to reproduce HCT results for several mine wastes by adjusting the rate controlling parameters (e.g. reaction rates, reactive surface area) in the transport model to derive empirical rates matched to the test data.

Variance in the empirically derived rates identified limitations of such models, but provide a route forward to improve methods of characterisation and model refinement.

[1] Kempton, 2012; A review of scale factors for estimating waste rock weathering from laboratory tests. IN: Proc. Of the 2012 International Conference on Acid Rock Drainage, Ottawa, Canada.

[2] Parkhurst, & Appelo, 2013, : U.S. Geological Survey Techniques and Methods, book 6, chap. A43, 497 p