

## Estimation of Weathering Rates of Silicate Minerals in a Sandy, Silicate Aquifer

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Mineral dissolution kinetics of silicate minerals were estimated in a sandy, clastic aquifer. In contrast to other similar studies, this work applied various approaches to minimize the estimation errors suggested by previous studies. Groundwater flow modeling approach was used to estimate reaction periods of the observed water chemistry, an isotopic approach to identify groundwater flow pathways along which the chemical evolution of groundwater was investigated and with which the groundwater flow model was calibrated, and mineralogic approach to define chemical compositions and to estimate the reactive surface areas.

The study site is an isthmus lying between Crystal Lake and Big Muskellunge Lakes in northern Wisconsin, USA. There are two major groundwater sources in the area: rain water recharged from land surface and seepage from Crystal Lake. Isotopic contrasts of oxygen between the two sources allow identification of unique flow paths along which the groundwater chemistry evolves. The groundwater flow model used for this study was constrained with multiple calibration targets including the isotopically defined flow paths and steady/transient head values. Chemically reactive minerals, plagioclase, biotite, amphibole and pyroxene, occur as a small fraction of the quartz, K-feldspar dominated sediments and show wide compositional variations. The groundwater chemistry suggests that the amount of total dissolved minerals along the path line be linearly related to the groundwater age. The increase rates of cations near Crystal Lake were used to estimate dissolution kinetics where the aquifer mineralogy is well defined and the possibility of unknown sodium sinks is relatively rare. The estimated plagioclase dissolution rates are in the range of  $2.2 \times 10^{-14}$  to  $5.3 \times 10^{-14}$  mol/(m<sup>2</sup> · sec) and are among the values of other comparable field studies.