Reaction Path Approach to Mineral Weathering Reactions

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Abstract: Commercial spreadsheet programs allow calculation of reasonable reaction paths for weathering of silicate minerals in a dilute acidic aqueous solution. These calculations use reaction coefficients of simplified weathering reactions and ignore speciation in the aqueous solution. The method is illustrated using the example of dissolution of microcline. When plotted on a log-log activity diagram, the obtained reaction paths are clearly curved, unlike the straight lines shown in most recent geochemistry textbooks. The calculated reaction paths are strongly dependent on the initial pH of the solution. At higher pH the speciation in the solution must be included in the calculations. The most important speciation reactions (the dissociation of H_2O and H_4SiO_4) can be easily included using commercial mathematical programs.

The presented examples include closed systems with different initial pH values and an open system case describing the evolution of a soil profile. All reaction paths calculated using the simplified methods agree well with those obtained using sophisticated modeling codes.

Key Words: Geochemical modeling • Gibbsite • Kaolinite • Microcline • Reaction path • Weathering