

Dissolution rates of epidote at pH 2 in aqueous solution

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The dissolution rates for minerals are an important factor in determining the susceptibility of landscapes to acid deposition. In soil models such as PROFILE and SAFE the dissolution rate coefficients are of great importance in calculating the critical loads for different types of soils. However, minerals such as epidote, amphiboles and pyroxenes which are important contributors of base cations in forest soil solution, have incomplete kinetic data. This study investigates the mechanisms involved in dissolution of epidote. The dissolution of epidote in aqueous solution in the presence of Ca and Al was studied under controlled pH and temperature conditions using both a continuously stirred batch reactor and a flow-through reactor based on the fluidized bed technique. Steady state Si, Ca and Fe release data thus obtained were used to achieve dissolution rates of epidote under conditions similar to forest soils. Dissolution rates from the continuous stirred batch reactor were significantly different from results

obtained with the flow-through reactor technique. The rate dependence on base cation and aluminium activity in solution was investigated and determined. The activation energy for epidote dissolution at pH 2 was 18.9 kcal mol⁻¹. The results indicate that the *Transition State Theory* can be applied to the dissolution of epidote and that the rate is surface controlled. This is consistent with the rate equation:

$$r_{H^+} = k_{H^+} \frac{a_{H^+}^n}{a_{BC^{2+}}^x + a_{Al^{3+}}^y}$$

which states that an increased concentration of dissolved Ca and Al inhibits the dissolution rate. Improved kinetic data on epidote result in better weathering estimates for forest soils and better understanding of the uncertainties involved in calculating weathering rates. This in turn can be used to improve biogeochemical environmental impact assessments.