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LETTER

Mechanism for the dissolution of olivine series minerals in acidic solutions

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ABSTRACT

The complexity of silicate minerals makes prediction of their dissolution rates a challenging problem. A combination of large cluster ab-initio quantum mechanical models and chemical probe dissolution experiments are used to understand the dissolution process for olivine-group minerals. Rapid release of M^{2+} cations by precursor reactions involving H^+ attack at μ_3-O surface sites produces a silica-enriched surface. Slower rates of silica release via a ligand exchange reaction involving a proton in the activated complex controls the overall rate of olivine dissolution. Our results provide a physical explanation for the correlation among olivine dissolution rates and water exchange rates for the corresponding aqueous cation.

Keywords: Forsterite, dissolution rate, quantum mechanical model, ligand promoted, proton promoted