GEOC: Division of Geochemistry

85 - Kinetics and mechanisms of metal sorption at the mineral/water interface: What have we learned the past 20 years?

View Session Detail

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Abstract: The rates of metal sorption at the mineral/water interface occur over wide time scales, ranging from milliseconds to months. Ex-situ batch and flow techniques offer high elemental sensitivity, but their time resolution is not adequate to capture rapid reaction rates, that often comprise a significant portion of many geochemical processes such as sorption and oxidation-reduction. Measurement of rapid, initial rates of environmentally important reactions at the mineral/water interface is critical in determining reaction mechanisms, since one can reduce back reactions and minimize mass transfer phenomena. Until recently, experimental techniques with sufficient time resolution and elemental sensitivity to measure rapid, initial rates were very limited. Some techniques such as pressure-jump methods can capture rapid reactions on millisecond time scales, but the rate parameters are indirectly measured and reaction mechanisms can only be inferred. Ideally, one would prefer to follow reaction rates in real-time, in-situ, and at the molecular scale to definitively determine reaction mechanisms. In this presentation, examples of progress over the past 20 years in using in-situ, molecular scale techniques such as ATR-FTIR and synchrotron-based, quick scanning XAS spectroscopies, at sub-second time scales, to describe metal (Ni) and metal(loid) [As and Cr] sorption at mineral surfaces will be illustrated. Results show that using such approaches one can more definitively measure chemical reaction kinetics.