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Simplifying Access to X-ray Absorption and Emission Spectroscopy with Laboratory-Based X-ray Spectrometers

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easyXAFS

Characterization of mineral phases, including nano-phases, in heterogeneous geochemical systems can be exceptionally challenging, often requiring arduous preparation of samples coupled with destructive analytical techniques. X-ray absorption spectroscopy (XAS) and X-ray emission spectroscopy (XES) are element-specific non-destructive alternatives which enable characterizations of the local bonding environment including analysis of oxidation-state and coordination environment. Additionally, these techniques often require fewer sample constraints as a wide variety of sample types are measureable. An impediment to wider utilization of these analytical techniques has historically been synchrotron access which is often restricted by infrequent beamtime availability and the highly competitive nature of access proposals. The result is that XAS and XES have yet to become a common analytical tool similar to X-ray photoelectron spectroscopy or X-ray diffraction. Advancements in laboratory-based XAS and XES are addressing this issue, facilitating consistent access to routine element-specific analysis of oxidation state and coordination environment in users' own labs. Intended to simplify and expand access to this powerful technique for both new and existing members of the XAS/XES community, everyday analysis is a game-changer which enables researchers to control their experiments like never before. For non-dilute samples synchrotron quality data is achievable in transmission-mode within minutes facilitating measurement of time-sensitive reactions. Analysis of trace elements (few hundred PPM) is permitted by employing fluorescence-mode XAS or XES with the same synchrotron-quality energy resolution. With a broad energy range for XAS analysis (4.5-25 keV) and an even broader range for XES analysis (2-25 keV), over 50 elements ranging from phosphorus through the actinides, laboratory-based X-ray absorption and emission spectrometers provide a rapid means for advancing geochemical research.