

X-ray absorption spectroscopy of silicates for in situ, sub-micrometer mineral identification

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ABSTRACT

We present X-ray absorption near-edge structure (XANES) spectroscopy of 11 silicate and aluminosilicate minerals and two glasses at the SiK and SiL_{2,3}, and OK edges. The similar nearest-neighbor environments lead to similar spectral lineshapes at each edge, but the fine-structure differences allow individual and groups of structurally similar minerals to be distinguished. By combining spectra and their first energy derivative from three absorption edges, we show that every mineral studied is distinguishable with XANES. This background work, combined with X-ray PhotoElectron Emission spectroMicroscopy (X-PEEM), allows non-destructive in situ, sub-micrometer (to 35 nm) X-ray analysis of materials, including silicate inclusions, which has not been possible previously. Images and spectra from a 7 μm × 3.5 μm quartz inclusion in zircon are presented as a test of this novel technique in geology.