IDENTIFICATION OF SUB-MICROMETER SILICATE INCLUSIONS IN ARCHEAN ZIRCONS WITH A X-RAY PHOTOELECTRON EMISSION SPECTROMICROSCOPY (X-PEEM)

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We recently optimized a new differential-thickness coating technique to analyze insulating samples with X-ray PhotoElectron Emission spectroMicroscopy (X-PEEM). X-PEEM is non-destructive, analyzes the chemical composition and crystal structure of minerals and can spatially resolve chemical species with a resolution presently reaching 35 nm. We tested the differential coating by analyzing a 4.4 billion-year-old zircon containing silicate inclusions. We observed quartz inclusions smaller than 1 μm in size, that could not be analyzed with any other non-destructive technique. We also present X-ray absorption near-edge structure (XANES) spectroscopy of 20 silicate, alumosilicate and aluminum oxide minerals and two glasses at the Si*K* and Si$L_{2,3}$, and O*K* 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. These reference spectra, assist in the interpretation of sub-micrometer inclusions in archean zircons, studied with X-PEEM.