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# Precise lattice location of trace elements within minerals and at their surfaces with x-ray standing waves

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Using x-ray standing waves (XSW) generated by dynamical Bragg diffraction, we have precisely measured lattice locations of trace elements within and at the surface of mineral single crystals. Natural calcite samples were cleaved along the (1014) plane to obtain pristine surfaces. After cleavage, some samples were reacted with a dilute aqueous Pb solution to obtain Pb-sorbed surfaces. XSW measurements were then performed on both unreacted and reacted samples using the calcite (1014) Bragg reflection. Results of these XSW measurements show that the naturally occurring trace element MN substitutes for Ca. On the Pb-reacted calcite sample, Pb was locted on the calcite (1014) lattice plane where Ca atoms also reside. Our measurements clearly demonstrate a new and powerful application of synchrotron radiation in earth and environmental sciences to provide element-specific atomic-scale structural information within and at the surface of minerals. The XSW measurements were made at the NSLS X15A and X25 beamline.

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