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Letter

Reduced As components in highly oxidized environments: Evidence from full spectral XANES imaging using the Maia massively parallel detector

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Abstract

Synchrotron X-ray fluorescence (SXRF) and X-ray absorption spectroscopy (XAS) have become standard tools to measure element concentration, distribution at micrometer- to nanometer-scale, and speciation (e.g., nature of host phase; oxidation state) in inhomogeneous geomaterials. The new Maia X-ray detector system provides a quantum leap for the method in terms of data acquisition rate. It is now possible to rapidly collect fully quantitative maps of the distribution of major and trace elements at micrometer spatial resolution over areas as large as 1×5 cm^2. Fast data acquisition rates also open the way to X-ray absorption near-edge structure (XANES) imaging, in which spectroscopic information is available at each pixel in the map. These capabilities are critical for studying inhomogeneous Earth materials. Using a 96-element prototype Maia detector, we imaged thin sections of an oxidized pisolitic regolith (2×4.5 mm^2 at 2.5×2.5 μm^2 pixel size) and a metamorphosed, sedimentary exhalative Mn-Fe ore (3.3×4 mm^2 at 1.25×5 μm^2). In both cases, As *K*-edge XANES imaging reveals localized occurrence of reduced As in parts of these oxidized samples, which would have been difficult to recognize using traditional approaches.

Keywords: Arsenic, oxidation state, XANES, element distribution, imaging, X-ray fluorescence