Seafloor weathering of hydrothermal chimney sulfide minerals from East Pacific Rise 9^{o} N: an X-ray absorption spectroscopic study

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Abstract

Seafloor weathering of hydrothermal chimney sulfide minerals at the East Pacific Rise (EPR), 9^{o} N, has been studied from the perspective of secondary iron mineral formation. The hydrothermal chimney sulfides examined in this study represent a time-series in the life cycle of hydrothermal chimneys, from currently active chimneys to long-extinct massive sulfides. The secondary Fe oxide minerals in our samples are (1) present as coatings or replacement of sulfide minerals, and (2) in close association with with K- and Si-rich materials. Due to the μm to mm spatial heterogeneity observed in the chemistry and mineralogy of these weathered chimney sulfides, we chose to use spatially resolved (spot size, 3 μm^{2}) Fe K-edge extended X-ray absorption fine structure (EXAFS) spectroscopy to characterize Fe speciation in the weathered materials. Our Fe EXAFS results reveal the presence of a continuum of Fe oxide minerals. The end members in this continuum of Fe oxide structures are simple Fe-O octahedral chains and goethite, respectively.

In this study, secondary Fe oxide minerals are put into a structural scheme through comparison with laboratory synthesized Fe oxide reference minerals, goethite, 6-line ferrihydrite, and 2-line ferrihydrite. Through shell-by-shell fitting of the EXAFS spectrum collected from goethite, we develop structural models for 6-line and 2-line ferrihydrite based on the polyhedral approach employed by Manceau and Drits (1993). The fitting parameters obtained from the reference Fe oxides are applied to our experimental spectra to generate structural models for natural Fe oxides that result from the seafloor weathering of sulfide minerals.

Reference

[1] Manceau A. and Drits V.A. (1993). *Clay Minerals* **28**, 165-184.