Behavior of trace elements during aging of acid drainage precipitates

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Schwertmannite is a Fe oxyhydroxysulfate commonly formed in acid drainage (AD). This metastable phase is an important sink for trace metal(oid)s including Cu, As, Zn, Mn and Ni. However, schwertmannite recrystallizes to goethite in the short-term followed by its transformation to hematite over long time scales. Terraces that form in AD-impacted rivers commonly exhibit a transition from schwertmannite to these more crystalline phases over time [1,2].

One of the largest massive sulfide provinces worldwide, the Iberian Pyrite Belt (IPB), is located in the Southwestern Iberian Peninsula. This metallogenic province hosted originally more than 1700 Mt of massive sulfides [3]. This study aims to constrain the behavior of sorbed trace elements during aging of schwertmannite terraces formed within AD-impacted rivers in the IPB. Knowing the final fate of trace elements will improve remediation systems designs.

Samples of these terraces were obtained from two locations in the Tinto River basin: (1) a modern terrace from a riverbed in La Naya (LN); and (2) an older terrace positioned 60 m above the modern riverbed at Alto de la Mesa (AM). Mineral identification was performed using μ-Raman spectroscopy [4]. Synchrotron-based micro-X-ray fluorescence (μ-XRF) mapping was used to examine element distribution [2]. Principal component analysis (PCA) was used to examine elemental and mineralogical relationships.

Elemental correlations were generally high for the LN sample and much lower for the AM sample. Distinct bands of goethite and hematite were observed within the AM sample. Higher concentrations of As, Cu and Zn in this sample were generally associated to goethite. In contrast, spatial variations in trace metal(loid) concentrations were not apparent for the LN sample. The PCA results revealed that all the elemtns had great affinity for schwertmannite precipitates; however, elemental correlation decreased during aging and hematite exhibited the lowest affinity for trace elements.

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