Thermal induced transformation of schwertmannite to hematite in the presence of chromium

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Weathering and oxidation of iron sulphide minerals present in mining areas lead to acid mine drainage (AMD), and the subsequent formation of iron secondary minerals. The presence of these minerals ultimately define the mobility of trace elements, since they can act as natural scavengers. However, the long-term immobilisation of trace elements will be defined by the stability of these minerals. Among these minerals, schwertmannite is a metastable mineral which eventually transforms into more stable phases such as hematite and goethite. Understanding of this transformation process is critical since it affects the trace element availability.

We evalute the thermal transformation from schwertmannite to hematite, and the subsequent effect on the chromium partitioning. Natural schwertmannite samples, with increasing contents of chromium, were subjected to different thermal transformation at 200 to 800 ºC. The transformation products were characterized by solid-phase techniques, e.g. XRD, SEM, TGA and ATR-FTIR. Results indicated an increase of the crystallinity with temperature with the transition from schwertmannite to pseudo-hematite occurring at 500-600 ºC. The presence of chromium slightly affected the transformation products, although changes in the partitioning of chromium were observed with selective extractions. At low temperature labile forms were detected, probably associated to sulfate-chromate exchange reactions. Increasing the temperature produces a larger contribution of chromium associated to the pseudo-crystalline forms occurring increases. Chromium is further stabilized with the higher temperature treatment, being all present in non-mobile forms strongly associated with the newly formed hematite. Finally, arsenic adsorption was evaluated with the different transformation products and results indicated that the formation of pseudo-hematite favours a higher mobility of the arsenic. Arsenic produces a release on the chromium present on the low temperature products, while it slightly affected the mobility of chromiun a the high temperature products.