OPTIMIZATION OF SCHWERTMANNITE SYNTHESIS METHODS TO STUDY THE ROLE PLAYED BY AQUEOUS POLYMERIC PRECURSORS BY MASS SPECTROMETRY

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Schwertmannite is a ferric oxyhidroxyulfate nanomineral, $Fe_8O_8(OH)_{8-x}(SO_4)_x$ ($1 < x < 1.75$), whose properties and formation process are not completely clear. It occurs naturally in acid mine drainage systems, commonly mixed with other iron oxide phases making it difficult to sampling in field sites. To avoid this complication, there are currently several synthesis methods reported.

In this work, two different methods of synthesis of schwertmannite have been optimized to subsequently characterize the process of mineral formation by mass spectrometry. On this respect, the synthesis were optimized to ensure that schwertmannite is formed in a range of one to two hours. This optimization was performed by controling the most relevant physicochemical parameters (i.e., solution pH and pe) as well as the concentration and oxidation state of iron in solution. As a result, we were able to study, by mass spectrometry (i.e., ESI-TOF), the aqueous inorganic polymers formed during the mineral precipitation.

Two series of tests were performed, the first one using a ferrous iron sulfate solution that was oxidized by adding hydrogen peroxide (H_2O_2) at different concentrations (from 3% to 30%) and the second one using a ferric iron sulfate solution heated at different temperatures (30 ºC to 70 ºC).

The presence of a significant variety of aqueous Fe-polymers in both schwertmannite synthesis experiments was confirmed by ESI-TOF. Additionally, some patterns (i.e., polymerization processes) were observed as the mineral precipitation kinetics is increased by changing the solution temperature or the oxidizing agent (i.e. H_2O_2) concentration.