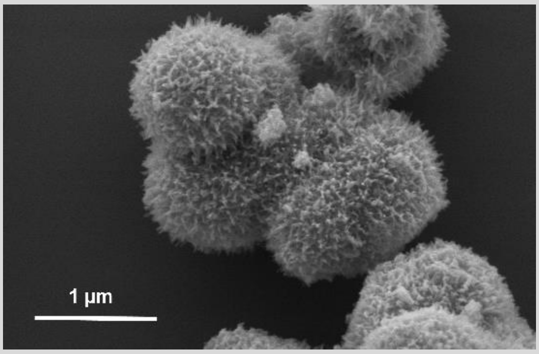
MSc thesis position

“Schwertmannite: A novel sorbent for sustainable phosphate management”

Photo of the schwertmannite synthesized in the Hydrology lab at Uni Bayreuth.



Microscopic image of schwertmannite. The “sea-urchin”- like surface morphology results in a very high specific surface area.

Motivation: The demand of phosphate fertilizers is growing as a result of a rising population, while global mineral reserves of this essential nutrient are limited. On the other hand, our current use of phosphate is inefficient and leaky, with excess phosphate from fertilized croplands polluting our environment. An estimated 30 – 40 million tonnes of phosphate is released to freshwaters each year globally, most of which is lost from agriculture.

A potential solution to this problem lies in recapturing and recycling phosphorus, moving it from where there is too much to where there is too little. Technically, this can be achieved by installing regenerative sorbent materials into agricultural drainage systems which retain dissolved phosphate. A low-cost sorbent that is an ideal candidate to remove phosphate from water is schwertmannite, a by-product from acid-mine water treatment.

Schwertmannite is a poorly-ordered iron mineral with an especially high sorption capacity for phosphate. However, schwertmannite is unstable and transforms to more crystalline iron oxides with lower sorption capacities, in particular under conditions when iron(III) is microbially reduced. As a further complication, the stability and sorption efficiency of schwertmannite is strongly impacted by dissolved organic matter – a common component of seepage water from agriculture.

Aim: Despite schwertmannite’s potential to serve as an excellent sorbent for phosphate, studies on phosphate interaction with schwertmannite in the presence of organic matter under iron(III)-reducing conditions are still missing. Using controlled laboratory experiments and innovative analytical techniques, this project will therefore investigate the impact of phosphate and organic matter on schwertmannite stability, and elucidate the resulting fate of phosphate.

This MSc project offers an opportunity to collaborate with the Soil Chemistry Group (Dr. Laurel ThomasArrigo) at ETH Zurich, Switzerland.

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