

## Dynamic interactions between phosphate and schwertmannite

SCHOEPFER, VA<sup>1</sup>; BURTON, ED<sup>1</sup>; JOHNSTON, SG<sup>1</sup>;  
KRAAL, P<sup>2</sup>

<sup>1</sup>Southern Cross GeoScience, Southern Cross University, PO Box 157 Lismore, NSW, 2480, Australia, [v.schoepfer.11@student.scu.edu.au](mailto:v.schoepfer.11@student.scu.edu.au), [ed.burton@scu.edu.au](mailto:ed.burton@scu.edu.au), [scott.johnston@scu.edu.au](mailto:scott.johnston@scu.edu.au)

<sup>2</sup>Royal Netherlands Institute for Sea Research, Department of Ocean Systems, P.O. Box 59, 1790 AB Den Burg, The Netherlands, [peter.kraal@nioz.nl](mailto:peter.kraal@nioz.nl)

### Introduction and objectives

Schwertmannite is a common mineral in mine drainage systems, that when undisturbed, can buffer the pH to ~3. Phosphate ( $\text{PO}_4^{3-}$ ) is a nutrient in small quantities, but can cause eutrophication under excess loading.  $\text{PO}_4^{3-}$  is ubiquitous and can be found in schwertmannite bearing systems, however no work has quantified the consequences of  $\text{PO}_4^{3-}$  loading to a schwertmannite system. The objective of this study was to assess the effects of  $\text{PO}_4^{3-}$  on both schwertmannite mineral stability and its transformation in different environments, as well as determine the fate of  $\text{PO}_4^{3-}$  as schwertmannite undergoes geochemical reactions.

### Methodological approach

To address this broad issue of schwertmannite evolution, we employed three approaches. Schwertmannite was dosed with varying  $\text{PO}_4^{3-}$  loadings and exposed to abiotic Fe(II) rich, reducing conditions, where aqueous and mineralogical species were monitored over 10 days. A natural microbial assemblage then amended new suspensions to monitor schwertmannite stability for 41 days, and this was repeated for 82 days to assess resulting mineralogical transformation once Fe and S reduction had proceeded sufficiently.

### Results and discussion

In the abiotic, Fe(II) rich schwertmannite system, increased  $\text{PO}_4^{3-}$  loading gradually inhibited the Fe(II) catalyzed reprecipitation process through replacement of goethite with lepidocrocite at low doses ( $80 \mu\text{moles g}^{-1}$ ), and retained schwertmannite under progressively higher loadings.

$\text{PO}_4^{3-}$  stabilized schwertmannite under the shorter term (41 day) biotic reducing conditions, with the most reduction at low loading. Following Fe and S reduction, secondary mineral precipitation processes exchanged mackinawite for sulfate green rust and vivianite as the  $\text{PO}_4^{3-}$  loading increased.

$\text{PO}_4^{3-}$  was not mobilized in any study, suggesting retention of  $\text{PO}_4^{3-}$  in eutrophic mine drainage systems.