# Long-term immobilization of trace elements in iron-rich AMD systems

JUAN ANTELO[1,*], IVAN CARABANTE[2], JUAN LEZAMA-PACHECO[3], JURATE KUMPIENE[2], SARAH FIOL[1]

[1] Technological Research Institute, University of Santiago de Compostela, Santiago de Compostela, 15782, Spain
[2] Waste Science & Technology, Luleå University of Technology, Luleå, 97187, Sweden
[3] Department of Earth System Science, Stanford University, Stanford CA 94305-2115, USA
(*juan.antelo@usc.es; ivan.carabante@ltu.se)

Acid mine drainage (AMD) occurs as a consequence of the weathering and oxidation of iron sulphide minerals. Subsequently, the formation of secondary iron oxides takes place. AMD contamination of surface waters usually results in acidic pH and high concentrations of sulphate and trace elements. The trace elements (TE) usually found in areas affected by AMD are harmful when present as mobile and bioavailable. These species can accumulate in benthic organisms and/or plants as well as spread into the environment through other transport processes.

The nature and composition of secondary iron minerals occuring in AMD define the long-term immobilization of trace elements, such as As, Cr, Mo or Se. Batch sorption experiments indicated that large concentrations of these elements are sequestered by iron oxyhydroxides and/or oxyhydroxysulfates, such as goethite, ferrihydrite and schwertmannite. This sorption process, which is greatly affected by pH and by the presence of organic matter, is mechanistically controlled by ligand exchange and anion exchange reactions. Anion exchange reactions with sulphate ions was confirmed by ATR-FTIR measurements, while XAS experiments allowed obtaining insight on the surface complexes formed with the iron hydroxyl groups present at the mineral surface.

Finally, the incorporation of trace elements on the mineral surface or within the crystalline structure affected the thermodynamic stability of the AMD secondary iron minerals. The transformation rate from amorphous to crystalline phases was slowed down by the presence of As and Cr, while the presence of Fe(II) ions facilitates the formation of goethite. This information is crucial to predict the fate of TE in contaminated AMD systems which are self managed.