

## Summary of Secondment at GFZ-Potsdam: July 10-21 and November 6-17

This year, Andrew Thomas (Karlsruhe Institute of Technology) visited the Geoforschungszentrum (GFZ) in Potsdam, Germany for training in transmission electron microscopy (TEM) and the PHREEQC geochemical modelling software. For the first half of the secondment (July 10-21, 2017), I attended two courses offered by the Interface Geochemistry section. The first covered the basics of TEM, including electron sources, lenses, detectors, data that can be obtained from TEM images, and sample preparation considerations. I also learned from the other ESRs at GFZ how to properly prepare a green rust sample for TEM imaging. The other short course the following week covered the use of the geochemical modelling software PHREEQC, including solution speciation, phase equilibria, phase transformations, the van't Hoff, gas equilibria, and the basics of reactive transport modelling.

During the second half of the secondment at GFZ, from November 6-17, green rust samples oxidized by hexavalent chromium were brought to GFZ for analysis by TEM and SEM. These samples were isolated from green rust sulfate-chromate batch reactions terminated at the halfway point, immediately after completion, and after 7 days of aging (as determined by an earlier reduction kinetics study). The purpose of comparing the results from these different samples, which were obtained from reactions with different chromium concentrations, was to determine the mechanisms governing this reaction as well as how these mechanisms vary depending on the concentration of chromium. TEM and SEM images from reactions C1 (Figure 1) and C6 (Figure 2), the reactions with the highest and lowest initial chromium concentrations, respectively, produce products with significantly different compositions. During reaction C1, the green rust is oxidized almost immediately, while the hexagonal morphology of the particles is

preserved before these particles become amorphous after 7 days of aging. Small rod-like particles, believed to be Cr-goethite, also form and are present within the hexagonal particles and in the suspension. In reaction C6, the oxidized green rust also maintains its hexagonal morphology, but few goethite-like particles are associated with hexagonal particles. These results, when compared to EXAFS spectra of associated samples, allowed me to work out a mechanism for the reaction.

With the help of the advanced instruments available at KIT in addition to the helpful, knowledgeable staff, I was able to obtain high-resolution images of my samples as well as determine a likely mechanism for their formation. I will most likely be returning to GFZ at some point to continue my research in this area.

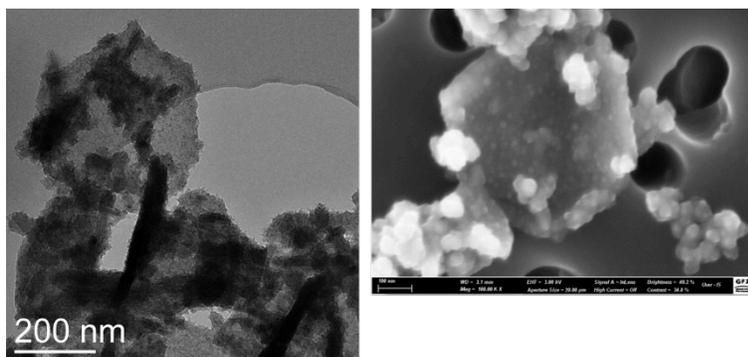


Figure 1 TEM and SEM images of green rust sulfate reacted with solution C1 for 7 days.

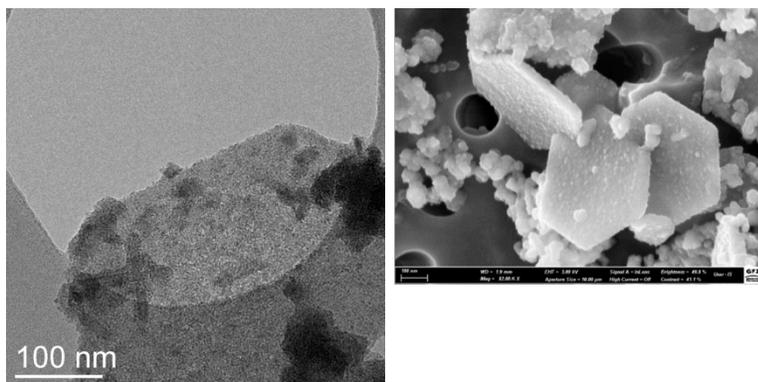


Figure 2 TEM and SEM images of green rust sulfate reacted with solution C6 for 7 days.