

Identification of green rust in groundwater

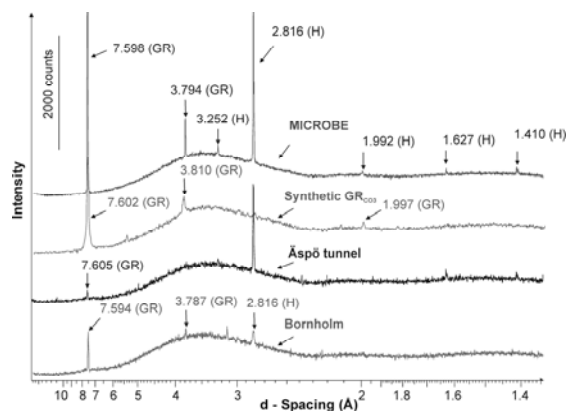
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Green rust, an Fe(II),Fe(III) layered double hydroxide (LDH), is believed to be present in environments close to the Fe(II)/Fe(III) transition zone. Identification of green rust (GR) in natural environments has proven difficult because the material is quickly oxidised with exposure to air. We developed a preservation method for capturing green rust so it is not oxidised during sampling and then we used it to identify the compound in groundwater samples taken below the water table, from fractures in granite 350 m below surface in the Äspö Hard Rock Laboratory tunnel and from an artesian well in a sand aquifer. X-ray diffraction patterns were weak, but clearly identical to those of synthetic GR_{CO3}, the green rust family member where carbonate and water occupy the interlayer between the iron-hydroxide layers. GR particles are colloidal in size and they are very reactive with many contaminants, including actinides and heavy metals. Currently, transport models for predicting the behaviour of contaminants in groundwater do not include parameters for green rust. This work demonstrates they should.



XRD patterns from the natural samples and a synthetic GR_{CO3}. The peaks representing reflections from the basal plane have d-spacings ~7.6 and ~3.8 Å are characteristic for the carbonate form of green rust. H marks halite reflections (from [1]).

[1] Christiansen *et al.* (2009) ES&T, in press.

A Pb (and Sr) isotopic return address for trans-Pacific transported aerosols

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Far-traveled aerosols (including soil-derived dust and industrial pollutants) can affect air quality, atmospheric radiative forcing and cloud formation. Principal component analysis of elemental data for aerosols collected over California has identified a persistent Asian soil dust component that peaks with Asian dust storm events [1]. Isotopic fingerprinting can provide an additional and potentially more discriminating tool for tracing and apportioning sources of aerosols. In particular, because of contrasts between North American and Asian sources [2], we use Pb isotopes to identify and apportion Asian sources of Pb emissions and associated pollutants in distant receptor regions such as the western US.

Here we present time series of the proportion (and mass concentration) of trans-Pacific transported Pb based on Pb isotopic data for aerosols (PM_{2.5}) collected in California during 2008 at two sites, Mt Tamalpais and Chabot Observatory (Oakland Hills), as well as for selected spring 2008 samples from the Eastern Sierra. We compare these records of trans-Pacific Pb transport to the elemental compositions of the collected PM_{2.5} determined by XRF. In addition we use Sr isotopic analyses to discern sea spray and mineral dust (Chinese Loess) components.

From March through May 2008, four episodes of trans-Pacific transport are evident in the trans-Pacific Pb time series. The first three peaks correlate well with mineral dust while the fourth episode has separate arrivals of Pb (with associated S) and Asian dust. Analyses of archived PM_{2.5} samples indicate that at times up to 98% of the aerosol associated Pb at inland California sites can be of Asian origin.

[1] VanCuren *et al.* (2005) *J. Geophys. Res.* **110**, D09S90.

[2] Bollhöfer & Rosman (2001) *GCA* **65**, 1727-1740.