Fe(II)-catalyzed transformation of ferrihydrite-organic matter coprecipitates: A closer look using Fe isotopes

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Organic matter (OM) in soils and sediments is often associated with iron (Fe) minerals and alters their properties and behaviour, as well as their interaction with heavy metals. Ferrihydrite is a well-known Fe mineral that can be transformed by Fe(II) and organic matter has been shown to affect both the rate and products of transformation. Here we use enriched Fe isotope tracer experiments in combination with ^{57}Fe Mössbauer spectra to measure electron transfer and Fe isotope mixing between aqueous Fe(II) and ferrihydrite coprecipitated with five different organic matters.

We found OM with higher fulvic content can inhibit ferrihydrite transformation at lower C/Fe ratio than humic acid. Despite no measurable transformation of ferrihydrite coprecipitated with the high fulvic content organic matter, Mössbauer spectroscopy results indicate that electron transfer between Fe(II) and ferrihydrite still occurred. We further reacted higher concentrations of Fe(II) (up to 5 mM) with ferrihydrite coprecipitated with Suwannee river natural organic matter (SRNOM). While we observed more electron transferred from Fe(II) to ferrihydrite, there is still no measurable ferrihydrite transformation. Extensive mixing of Fe isotope occurred even in the absence of secondary mineral transformation. Our results indicate that inhibited electron transfer and Fe atom mixing by OM are unlikely to explain the lack of ferrihydrite transformation in the presence of OM.

Despite the significant Fe atom exchange between aqueous and solid Fe in the ferrihydrite precipitated with SRNOM, we did not observe any release of carbon to solution or change in the thermal stability of carbon. Additional work is being done to characterize if Fe atom exchange alters carbon bioavailability and whether ferrihydrite precipitated with SRNOM will influence heavy metal sorption and release from ferrihydrite.