

Fe Atom Exchange between Siderite (FeCO₃) and aqueous Fe(II): Trace Element Effects

PRACHI JOSHI AND CHRISTOPHER A. GORSKI*

Department of Civil and Environmental Engineering,
Pennsylvania State University, University Park, PA, USA
(*correspondence: gorski@psu.edu)

Iron (Fe) minerals play an important role in determining the fate and bioavailability of trace elements in natural and engineered aquatic systems. Recent work has shown that when thermodynamically stable Fe (oxyhydr)oxides (e.g., goethite) are exposed to aqueous Fe(II) at circumneutral pHs, they may undergo extensive interfacial Fe atom exchange without any noticeable changes in the mineral's structure, texture, or size. Prior studies have proposed that Fe atom exchange may be driven by a redox gradient existing between aqueous Fe(II) and structural Fe(III). Here, we test this hypothesis by examining Fe atom exchange between aqueous Fe(II) and siderite (FeCO₃), a common Fe(II) mineral, using Fe isotope tracer experiments.

We allowed isotopically-normal siderite to equilibrate in pH buffer and subsequently spiked in a small amount of isotopically-enriched ⁵⁷Fe(II). After five days, the solid and liquid phases were separated and analyzed by multicollector inductively coupled plasma mass spectrometry (MC-ICP-MS) to determine the aqueous and solid Fe isotopic compositions. Our preliminary findings indicate that significant interfacial Fe atom exchange occurs, implying that Fe atom exchange can take place in the absence of a redox gradient. We are currently investigating the influence of this atom exchange process on trace metal partitioning. The results of our experiments will lead to an increased understanding of trace element cycling in reduced environments and may have implications for the interpretation of Fe isotopic signatures in rock record.