American Mineralogist, Volume 90, pages 758–763, 2005

LETTER

Iron isotope exchange kinetics at the nanoparticulate ferrihydrite surface

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ABSTRACT

The extent and rate of Fe-isotope exchange between aqueous Fe(III) atoms and those at the nanoparticulate ferrihydrite surface have been constrained using a ^{57}Fe-isotope tracer approach. Isotopic exchange was determined between hexaquo Fe(III) and 3 nm ferrihydrite under conditions analogous to natural environments at the equilibrium solubility of nanoparticulate ferrihydrite. Within approximately 11 days, the percent Fe-isotope (atom) exchange increased to a maximum of 26 ± 5%, and remained constant within error over the remaining 12-week time of the experiment, suggesting that Fe-isotope exchange is limited to Fe atoms in available surface sites. These results confirm earlier work that used NTA- and EDTA-bearing solutions, which concluded isotopic exchange is largely limited to Fe at surface sites. Our results, however, which were obtained in dilute aqueous solutions at the natural solubility of 0.12 ppm aqueous Fe(III) (pH = 4.7), demonstrate that isotopic exchange rates are one to two orders of magnitude slower in the absence of $Fe(III)_{aq}$-complexing ligands.