View Abstract

ABSTRACT SYMPOSIUM NAME: Crystallization Pathways: New Perspectives on Nucleation, Growth & Dissolution of Natural & Synthetic Materials

ABSTRACT SYMPOSIUM PROGRAM AREA NAME: GEOC

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PRESENTATION TYPE: Oral Only : Do not consider for Sci-Mix

TITLE: Nucleation kinetics and thermodynamics of iron(III) (hydr)oxide nanoparticles forming on quartz

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ABSTRACT BODY:

Abstract: Poorly crystalline iron(III) (hydr)oxide nanoparticles are found everywhere in the environment, and they play significant roles in controlling the fate and transport of contaminants. Interestingly, however, the nucleation kinetics and thermodynamics of poorly crystalline iron(III)(hydr)oxides have not been determined. In particular, the effective interfacial (α') and apparent activation (E_a) energies of iron(III) (hydr)oxide nucleation on earth-abundant mineral surfaces have not been reported, which hinders accurate predictions of iron(III) (hydr)oxide formation and its interactions with other toxic or reactive ions. In this study, conducted in a flow-through reactor and using time-resolved grazing incidence small angle X-ray scattering (GISAXS), we experimentally obtained α' and E_a for iron(III) (hydr)oxide nucleation on quartz mineral surfaces. We determined *in situ* iron(III) (hydr)oxide nucleation rates under different supersaturations by varying pH between 3.3 and 3.6 and using different temperatures (12−35°C). Based on classical nucleation theory, α' was found to be 34.6 mJ/m^2, and E_a was quantified as 32.8 kJ/mol. This study provides an improved understanding of the interfacial and activation energies of heterogeneous nucleation of iron(III) (hydr)oxides on substrates, which supports predicting and controlling the size, nucleation rate, and distribution of iron (hydr)oxide nuclei in diverse natural and engineered aqueous environments.

(No Image Selected)