Using siderite dissolution for *in situ* Pb immobilization

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Iron phases have been widely and effectively used for remediation of environments contaminated with heavy metals, such as Cu, Cd, Pb and Zn. The ferrous iron carbonate siderite ($FeCO_3$) is a promising mineral for *in situ* remediation efforts, as it is naturally abundant, oxidizes to form Fe-(hydr)oxides that sequester metals, and generates alkalinity which facilitates metal removal and remediates acidity. In this study, we assess the efficacy of simultaneous siderite dissolution and Fe(III)-(hydr)oxide precipitation for *in situ* Pb immobilization from acidic waste waters. Batch experiments at ambient laboratory conditions show that the surficial dissolution of siderite leads to an increase in pH from 3.1 to 4.8, and initiates nano-particulate iron hydroxide formation on the surface of the siderite grains as well as in suspension. These nano-scale precipitates in suspension were identified by XRD analysis as goethite, whereas those on the mineral surface were indicated to be hematite. The grain size, and therefore relative reactive surface area, of siderite seems to play a key role, as compared to grains of a larger size fraction (106-63 µm), smaller grains (<63 µm) were observed to dissolve more rapidly, leading to earlier and more pronounced Fe-particle precipitation and Pb adsorption, as well as to an overall faster rate of reaction. SEM imaging furthermore revealed that no nano-particulates precipitated on the surface of the siderite grains from the larger size fraction. Since nano-scale Fe-(hydr)oxide particles are highly reactive, posing great potential for adsorption of Pb and other heavy metals, we propose that very fine-grained siderite may imply a promising low-cost material for *in situ* remediation.