Carbonate minerals for the uptake of heavy metals: experimental studies of $MgCO_3$ reactivity with Pb^{2+}

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The study of the thermodynamic and kinetic properties of carbonate minerals is capturing increasing attention during the last three decades. Carbonates are envisage playing a role in the development of CO_2 capture and storage technologies through engineered silicate weathering. Another important process in which carbonate minerals could have a fundamental impact is the treatment of wastewaters. A major limitation for reusing treated wastewater in agriculture is the presence of heavy metals. Many harmful heavy metals (in particular divalent lead and cadmium) form sparingly soluble carbonate minerals. The formation of these minerals could provide the basis for the development of new sustainable environmental remediation techniques. However, experimental data about the reactivity of these materials are still missing.

Our study analyzed the uptake of lead by magnesium carbonate. Two main processes were considered: the mineral replacement reaction and the nucleation from the aqueous ions. To investigate the mineral replacement reaction we performed batch recrystallization experiments using a powder of natural magnesite (provenance Austria, collection of the Natural History Museum of Bern) as starting material. These experiments allowed to determine the macroscopic conversion rate.[1] Atomic Force Microscopy was used to get insight into the surface processes at nanoscale that influences the macroscopic properties. In addition to the mineral replacement reactions, we also studied the precipitation from homogeneous solution in the system Mg-Pb-CO_2-H_2O. We investigated the ion partitioning and the formation of solid solutions during room temperature coprecipitation experiments. The study of this latter process is particularly interesting because could allow the optimization of the system variables enabling the development of combined remediation process (i.e. CO_2 storage combined with heavy metal removal).

[1] Di Lorenzo F., Ruiz-Agudo C. and Churakov S. V., **2019**, *The key effects of polymorphism during Pb^{II} uptake by calcite and aragonite*, CrystEngComm, 21, 6145-6155.