

The uptake of Pb^{2+} by MgCO_3 : thermodynamic possibilities and kinetics limitations

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Magnesium carbonate is the most soluble among the carbonate minerals. The natural abundance of MgCO_3 makes this material envisage to play an important role in the development of new environmental remediation processes. The broad solubility range of carbonate minerals allows to hypothesize that mineral transformation reactions of MgCO_3 into heavy metal-bearing carbonate could be effective in reducing the aqueous concentration of harmful divalent cations such as Pb^{2+} , Cd^{2+} , Fe^{2+} , Mn^{2+} , Zn^{2+} , etc.

Despite the favorable scenario depicted by thermodynamics, magnesite is well known for showing important kinetic barriers that result in a sluggish reactivity.

Our experimental work elucidates the presence of a kinetic barrier and the consequences of this obstacle aiming at environmental remediation processes. In particular, our study dealt with the solvent-mediated transformation of magnesite into cerussite [1] and with the coprecipitation of magnesium and lead carbonates.

We present a comparison between the transformation of MgCO_3 and CaCO_3 into PbCO_3 . A set of batch experiments allows to compare the reactivity of magnesite with the reactivity of calcite and aragonite. Our experiments show the influence of the dissolution rates of the substrates in controlling the heavy metal uptake.

In situ Atomic Force Microscopy (AFM) has been used to observe the effect of system variables, such as the temperature, on the reactivity of magnesite. In addition, AFM allows to observe the effect of Pb^{2+} ions during the interaction between magnesite {104} surfaces and a Pb^{2+} -bearing solution supersaturated with respect to magnesite.

The study of coprecipitation processes is motivated by the development of combined remediation process. In practice, the needing for an external carbon source makes this strategy for heavy metals removal interesting also from the perspective of geological carbon storage.

[1] Di Lorenzo, Cametti, Vanhecke & Churakov (2020). The role of interfaces in controlling Pb^{2+} removal by calcium carbonate minerals. *Crystal Growth & Design*, 20, 6157–6169.