The Importance of Trace Components in Promoting the Nucleation and Growth of Mineral Phases: Magnesite at High Partial Pressures of CO_2.

ODETA QAFOKU[1], BRUCE AREY[2], LIBOR KOVARIK[2] AND ANDREW R FELMY[1]

[1]Fundamental & Computational Sciences, Pacific Northwest National Laboratory, Richland, WA 99352, USA
[2]Environmental Molecular Sciences Laboratory, Pacific Northwest National Laboratory, Richland, WA 99352, USA

Reducing the amount of greenhouse gasses released into the atmosphere by geological storage and/or sequestration of the anthropogenic CO_2 has been the focus of numerous research studies. These studies have emphasized the importance of mineral carbonate formation (known as mineral trapping) as a permanent method for CO_2 immobilization. However, mineral formation is often a slow process governed by unknown reaction kinetics. In this regard, one important example that we have been studying is the slow formation of the mineral magnesite ($MgCO_3$) at low temperatures in solutions in contact with supercritical CO_2. Kinetic constrains to magnesite formation have been thought to be linked to the high dehydration energy of Mg^{2+}, which prevents the formation of anhydrous carbonates such as magnesite.

In this study we present detailed experimental evidence, including high resolution SEM, TEM imaging and ion compostion mapping, indicating that the kinetically inhibited formation of magnesite can be overcome in the presence of trace components (e.g Co(II)) that either form insoluble carbonates with a good lattice match to magnesite or lower the activation energy for magnesite formation by substititon into the growing magnesite lattice.