Geophysical Research Abstracts
Vol. 12, EGU2010-13571, 2010
EGU General Assembly 2010
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Role of Temperature and Saturation State in Determining Growth Rate and Sr-content in Calcite

Allison Stephenson and Eric Oelkers

Laboratoire des Mecanismes et Transferts en Geologie, CNRS, Universite Paul-Sabatier, Toulouse, France (allison.stephenson@lmtg.obs-mip.fr)

Impurity contents in biogenic and inorganically precipitated carbonates are widely used as proxies for a variety of environmental conditions such as temperature and ocean chemistry. However, the dominant factors controlling element-uptake and their interplay, both at the environmental and organism scale, must be sorted out before proposed proxies can be robustly used to interpret environmental conditions. Recent studies have demonstrated the importance of cation:anion ratio in determining mineral growth rates (Chernov, 2006; Perdikouri, 2009) and their subsequent impact on impurity contents, specifically Sr in calcite (Nehrke, 2007). We further investigated the relationships between Sr-content in calcite and growth rate, by changing precipitation rates though variations in saturation index, temperature, addition of other growth modifiers like [Mg++], and the [Ca++]:[CO3=] ratio.
Experiments were conducted in seeded flow-through reactors with controlled pH, solution chemistry (modeled in Phreeq), alkalinity, and temperature. Reaction solutions were analyzed throughout the duration of the experiment using atomic adsorption spectrometry. Mineral contents were analyzed using XRD, and surfaces were analyzed using SEM. Results allow us to weigh the importance of different solution parameters, and thus global environmental conditions and biomineralization processes, in determining impurity contents in carbonate minerals.