No impact of ionic strength/salinity on divalent cation fractionation during inorganic calcite precipitation

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In order to apply divalent cation fractionation ($^{44}$Ca/$^{40}$Ca, Sr/Ca, etc.) during calcium carbonate formation as a proxy to reconstruct paleo-environments, it is essential to evaluate the impact of various environmental factors. In this study, the CO$_2$ Diffusion Technique (Dietzel et al., 2004) was used to crystallize inorganic calcite from aqueous solutions at different ionic strength/salinity by the addition of NaCl.

Results show that at 25°C the discrimination of Sr/Ca in the precipitated calcite is controlled by the precipitation rate ($R$ in $\mu$mol/m$^2$/h). The apparent Sr distribution coefficients ($\log D_{Sr}$) of calcite are positive linear related to the log $R$ values. However, the data points of $\log D_{Sr}$ vs. log $R$ fall in the same line for all experiments done at $I = 0.0353, 0.292, and 0.8353$, respectively. This indicates that Sr/Ca fractionation during inorganic calcite formation is not significantly influenced by ionic strength/salinity.

In analogy to Sr/Ca, the $^{44}$Ca/$^{40}$Ca fractionation is not influenced by ionic strength/salinity either. At 25°C the calcium isotope fractionation between calcite and aqueous calcium ions ($\Delta^{44/40}Ca_{calcite-aq} = \delta^{44/40}Ca_{calcite} - \delta^{44/40}Ca_{aq}$) correlates negatively with log $R$ values for all the experiments, independent of the respective $I$ value.

Tang et al. (2008) reported a negative linear relationship between $\Delta^{44/40}Ca_{calcite-aq}$ and $\log D_{Sr}$ during calcite formation, which is independent of temperature, precipitation rate, and aqueous (Sr/Ca)$_{aq}$ ratio. The results of our recent experiments at 25°C and various $I$ values indicate that this general behavior is not affected by ionic strength/salinity.

References
