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On the effect of growth rate on the incorporation of Ba and Sr in aragonite

Vasileios Mavromatis (1,2), Bettina Purgstaller (2), Katja Goetschl (2), and Martin Dietzel (2)
(1) GET-CNRS, GET UMR5563, Toulouse, France, (2) Applied Geosciences, Graz University of Technology, Graz, Austria

The mechanisms controlling incorporation of trace elements in carbonates minerals are of great importance for the geoscientific community as elemental composition of carbonate archives can provide insights on the environmental conditions occurring during mineral growth. In these terms, a large number of experimental studies have been devoted the last decades on the incorporation of trace elements and /or impurities in calcite. This however is not the case for the orthorhombic $CaCO_3$ polymorph, aragonite, although it is predominately forming in oceanic waters. Herein we examine the effect of aragonite growth rate on the incorporation of Ba and Sr in this mineral phase under low oversaturation conditions of the forming fluid with respect to aragonite. The obtained results suggest that the partitioning of Ba in aragonite is significantly lower than one and rapidly increases towards unity at elevated growth rates. This finding - which comes in contrast to the earlier studies of Ba partitioning in aragonite - is well explained by the difference in the ionic radius between Ca^{2+} and Ba^{2+}. In the case of Sr incorporation in aragonite, partitioning coefficient exhibits values higher than 2, at low oversaturation degrees of the fluid with respect to aragonite. The obtained Sr partitioning coefficient values at near equilibrium conditions are significantly higher than earlier studies, likely owing to the low aragonite growth rates used in the present work. The findings of our work suggest that growth rate affects elemental partitioning, there are however other parameters, such ionic radius and formation of solid-solutions that control trace element distribution between solids and fluids. Overall, detailed studies on elemental partitioning and combination with isotope fractionation is envisaged to provide insights on mineral formation conditions, but also on elemental cycles and biomineralization processes.