



## **The effect of sulfate on CaCO<sub>3</sub> mineralogy and the incorporation of Mg<sup>2+</sup>**

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Sulfate is the second most concentrated anion in seawater, and it forms strong complexes with Ca<sup>2+</sup> and Mg<sup>2+</sup> in aqueous solutions. However, up to now not much is known about the effect of dissolved SO<sub>4</sub><sup>2-</sup> on the formation of calcium carbonate minerals. For example, it has earlier been documented that the primary CaCO<sub>3</sub> polymorph in marine sediments was oscillating between calcite and aragonite throughout the Phanerozoic, reflecting changes in seawater chemistry, among them SO<sub>4</sub><sup>2-</sup> concentration. Most of the previous experimental work, however, has focused mainly on the Mg/Ca ratio in seawater as the major driver for a preferential formation of calcite or aragonite. It has thus been shown that Mg substitution affects the thermodynamic stability of calcite, causing precipitation of aragonite instead of calcite at an aqueous Mg/Ca ratio higher than ~1.3 [1]. To shed light on the mechanisms controlling the calcium carbonate mineral formation in the presence of sulfate, we performed steady-state precipitation experiments with calcite seed material at 25 °C. Furthermore in this study we examine the Mg partitioning and isotope fractionation during its incorporation in calcite. For this, throughout the experimental runs, the aqueous Mg concentration was kept constant at different growth rates and different concentrations of dissolved SO<sub>4</sub><sup>2-</sup> have been used. Our data show that the presence of sulfate induces the formation of aragonite on calcite seeds at elevated growth rates, whereas we see no formation of aragonite in the experiments performed in the absence of sulfate, but at the same Mg/Ca ratio. On a further step the effect of sulfate on Mg partitioning and stable isotope fractionation of Mg in calcite will be examined. These results will improve the general understanding of the controls of solution chemistry on the formation of CaCO<sub>3</sub> minerals and in specific the effect of sulfate on the incorporation of Mg into the crystal lattice.

[1] Morse et al., 1997, *Geology*