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Mg and Sr Incorporation during Calcium Carbonate Precipitation

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Element substitution and fractionation can provide information about the mechanisms of $CaCO_3$ precipitation, precipitation rates, temperatures and solution chemistry. In the present study precipitation experiments for the formation of aragonite and calcite were carried out. Calcium carbonates are formed at various Mg/Ca ratios at temperatures between 5 and 40˚C at pH 8.3 by using an advanced CO_2-diffusion technique (Tang et al., 2008). XRD, microprobe and FT-IR analysis were used to qualitatively and quantitatively characterise the solids.

Different Mg/Ca-ratios in the solution induce different weight fractions of polymorphs at different temperatures. Calcite crystals are formed at low temperatures and low Mg content, while aragonite is preferentially formed at higher Mg concentrations or at elevated temperatures. At higher Mg/Ca ratios rounded Mg-calcite crystals are formed, with higher Mg content and lower Sr-concentrations in the crystal lattice. Different crystallographic surfaces differ in their Mg content and a rounded habit is observed when the Mg/Ca ratio is high, while sharp edged crystals are characteristic for low Mg incorporation. Sr and Mg incorporation into calcite are inversely related at given Mg/Ca ratios. Rietveld-analyses of XRD-data indicate a decrease in the cell size even at low Mg incorporation. The position of the symmetric stretching peak in FTIR spectra decreases from calcite to aragonite with increasing Mg content in the sample, while the out of plane bending jumps in a discrete manner between calcite and aragonite independent of Mg-incorporation. This is in accordance with earlier studies and validates our experimental approach. Mg incorporation increases with increasing temperatures and lower precipitation rates, which is inverse to the Sr incorporation behaviour. Respective mechanisms and proposed models are discussed.

Reference

Tang J., Köhler S.J., and Dietzel M. (2008) Sr^{2+}/Ca^{2+} and $^{44}Ca/^{40}Ca$ fractionation during inorganic calcite formation: I. Sr in corporation, *Geochimica et Cosmochimica Acta*, **72**, 3718-3732.