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The impact of solution stoichiometry on crystal nucleation and growth

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All of the crystals that form in natural waters on Earth are formed through reaction between oppositely charged ions. In these crystals, the ions are present in an ideal, charge-balanced ionic ratio. In contrast, the natural solutions in which they form, contain widely diverging ionic ratios (stoichiometries). Consequently, one type of ion, either the anion or the cation, will be in excess and the other in limitation. Experimental results have shown previously that the solution ionic ratio affects crystal growth rate of various ionic crystals at constant degree of supersaturation, pH, temperature and ionic strength. This behaviour can be explained with an ion-by-ion growth model, e.g. [1].

We investigate the impact of this imbalance on the new formation, i.e. nucleation plus growth, of $CaCO_3$, $BaSO_4$ and FeS. To this end, we use a combination of synthesis experiments, *in-situ* particle size, turbitity and charge (zeta potential) measurements, *ex-situ* Transmission Electron Microscopy, Molecular- and Meta-Dynamics Simulations of the nucleus-forming processes, and theory development. Here, I will give an overview of our results thus far. Solution stoichiometry affects the timing and rate of nucleation, the charge of the particles formed and potentially their aggregation behaviour [2, 3], among others. The impact of solution ionic ratio on nucleation and growth varies for the three different mineral systems and indicates that natural mineralisation processes will also depend on solution stoichiometry.

References:

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