Abiotic mineral formation: the impact of solution stoichiometry on 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 at constant degree of supersaturation, pH, temperature and ionic strength. This behaviour can be explained with an ion-by-ion growth model (e.g. Wolthers et al., 2012a).

In this presentation, I will illustrate how this imbalance impacts the new formation, i.e. nucleation, of CaCO$_3$, BaSO$_4$ and FeS. Solution stoichiometry affects the timing and rate of nucleation, the charge of the particles formed and potentially their aggregation behaviour (e.g. Seepma et al., 2021), 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:
