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## No ion is an island: Multiple ions involved during boron incorporation into CaCO<sub>3</sub>

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Boron isotope ratios, as measured in marine calcium carbonate, are a proven tracer of past seawater and calcifying fluid pH and thus a powerful tool for the reconstruction of past atmospheric CO<sub>2</sub> and monitoring of coral physiology. For such applications, understanding the inorganic baseline upon which foraminiferal vital effects or coral pH upregulation are superimposed should be an important prerequisite. Yet, investigations into boron isotope fractionation in synthetic CaCO<sub>3</sub> polymorphs have often reported variable and even conflicting results, implying that we may not fully understand pathways of boron incorporation into calcium carbonate. Here we address this topic with experimental data from calcite and aragonite precipitated across a range of pH in the presence of both Mg and Ca. We confirm the results of previous studies that the boron isotope composition of inorganic aragonite precipitates closely reflects that of aqueous borate ion, but that calcites display a higher degree of scatter, and diverge from the boron isotope composition of borate ion at low pH. We discuss these findings with reference to the simultaneous incorporation of other trace and minor elements, and highlight a number of mechanisms by which crystal growth mechanisms may influence the concentration and isotope composition of boron in CaCO<sub>3</sub>. In particular, we highlight the potential importance of surface electrostatics in driving variability in published synthetic carbonate datasets. Importantly for palaeo-reconstruction, however, these electrostatic effects are likely to play a much more minor role during natural precipitation of biogenic carbonates.