Aragonite is calcite’s best friend at the seafloor

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Aragonite is about 50\% more soluble than calcite in seawater and its pelagic production is dominated by pteropods. Moreover, it could account for a large fraction of marine CaCO\textsubscript{3} export. The \textit{aragonite compensation depth} (ACD, the depth at which accumulation is balanced by dissolution) is generally very close to the \textit{aragonite saturation depth}, i.e. within a few hundred metres. Conversely, the \textit{calcite compensation depth} (CCD) can be 1-2 kilometres deeper than the \textit{calcite saturation depth}. That aragonite disappears shallower than calcite in marine sediments is coherent with aragonite’s greater solubility, but why is the calcite lysocline, i.e. the distance between its compensation and saturation depths, much thicker than its aragonite equivalent?

Here, we suggest that at the seafloor, the addition of a soluble CaCO\textsubscript{3} phase (aragonite) results in the preservation of a predeposited stable CaCO\textsubscript{3} phase (calcite), and term this a negative priming action. In soil science, priming action refers to the increase in soil organic matter decomposition rate that follows the addition of fresh organic matter, supposedly resulting from a globally increased microbial activity (Bingeman et al., 1953). Using a new 3D model of CaCO\textsubscript{3} dissolution at the grain scale, we show that a conceptually similar phenomenon could occur at the seafloor, in which the dissolution of an aragonite pteropod at the sediment-water interface buffers the porewaters and causes the preservation of surrounding calcite. Since aragonite-producing organisms are particularly vulnerable to ocean acidification, we expect an increasing calcite to aragonite ratio in the CaCO\textsubscript{3} flux reaching the seafloor as we go further in the Anthropocene. This could, in turn, hinder the proposed aragonite negative priming action, and favour chemical erosion of calcite sediments.