



## Aragonite is calcite's best friend at the seafloor

Olivier Sulpis<sup>1</sup>, Priyanka Agrawal<sup>1</sup>, Mariette Wolthers<sup>1</sup>, Guy Munhoven<sup>2</sup>, Matthew Walker<sup>3</sup>, and Jack Middelburg<sup>1</sup>

<sup>1</sup>Department of Earth Sciences, Utrecht University, The Netherlands (o.j.t.sulpis@uu.nl)

<sup>2</sup>Département d'Astrophysique, Géophysique et Océanographie, Université de Liège

<sup>3</sup>School of Life Science, University of Lincoln, United Kingdom

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  $\text{CaCO}_3$  export. The *aragonite compensation depth* (ACD, the depth at which accumulation is balanced by dissolution) is generally very close to the *aragonite saturation depth*, i.e. within a few hundred metres. Conversely, the *calcite compensation depth* (CCD) can be 1-2 kilometres deeper than the *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  $\text{CaCO}_3$  phase (aragonite) results in the preservation of a predeposited stable  $\text{CaCO}_3$  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  $\text{CaCO}_3$  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  $\text{CaCO}_3$  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.

Reference: Bingeman, C.W., Varner, J.E., Martin, W.P., 1953. The Effect of the Addition of Organic Materials on the Decomposition of an Organic Soil. Soil Science Society of America Journal 17, 34-38.