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Bivalves build their shells from amorphous calcium carbonate

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One of the most common shell structures in the bivalve class is the prism and nacre structure. It is widely distributed amongst both freshwater and marine species and gives cultured pearls their sought-after lustre. In freshwater bivalves, both shell structures (prism and nacre) consist of aragonite. Formation of the shell form an amorphous precursor phase is a wide-spread strategy in biomineralization and presents a number of advantages for the organisms in the handling of the $CaCO_3$ material. While there is already evidence that larval shells of some mollusk species use amorphous calcium carbonate (ACC) as a transient precursor phase for aragonite, the use of this strategy by adult animals was only speculated upon.
We present results from in-situ geochemistry, Raman spectroscopy and focused-ion beam assisted TEM on three species from two different bivalve families that show that remnants of ACC can be found in shells from adult species. We show that the amorphous phase is not randomly distributed, but is systematically found in a narrow zone at the interface between periostracum and prism layer. This zone is the area where spherulitic $CaCO_3$-structures protrude from the inner periostracum to form the initial prisms. These observations are in accordance with our earlier results on equivalent structures in freshwater cultured pearls (Jacob et al., 2008) and show that the original building material for the prisms is amorphous calcium carbonate, secreted in vesicles at the inner periostracum layer.
Quantitative temperature calibrations for paleoclimate applications using bivalve shells are based on the Mg-Ca exchange between inorganic aragonite (or calcite) and water. These calibrations, thus, do not take into account the biomineral crystallization path via an amorphous calcium carbonate precursor and are therefore likely to introduce a bias (a so-called vital effect) which currently is not accounted for.

Jacob et al. (2008) Geochim. Cosmochim. Acta 72, 5401-5415