

Foraminiferal calcification, CO₂, precipitation rates and element incorporation

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Ongoing burning of fossil fuels increases atmospheric CO₂, elevates marine dissolved CO₂ and decreases pH and the saturation state with respect to calcium carbonate. Intuitively this should decrease the ability of CaCO₃-producing organisms to build their skeletons and shells. The response of foraminifera to changes in [CO₂] is shown to be contradictory, which may result from their calcification strategy. Here we show that foraminifera form their calcium carbonate by active proton pumping. This elevates the internal pH and acidifies the direct foraminiferal surrounding. This also creates a strong pCO₂ gradient and facilitates the uptake of DIC in the form of carbon dioxide. This finding uncouples saturation state from calcification and predicts that the added carbon due to ocean acidification will promote calcification by these organisms. In addition, a series of experiments was conducted to determine the precipitation rate at which foraminifera produce their calcite. These rates are relatively high and may explain, together with their ability to regulate their internal pH, the incorporation mechanism of elements during biomineralization.

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