

Mathematical analysis of proton, carbon, and calcium transport during calcification process of benthic foraminifera

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Foraminifera are marine unicellular organism responsible for approximately 50% of today's ocean calcium carbonate production, which implies that they play a considerable role in the global carbon cycle in ocean chemistry. However, we have not fully understood how their calcifications proceed and change their chemical environment.

To understand the calcification process, we investigate the dynamics of the pH around the foraminifer. The visualized spatial pH distribution shows that the calcification accompanies a rapid decrease of the surrounding pH, which implies that the calcification accompanies active proton pumping. The resultant spatial pH distribution is used to estimate the flux of proton released out of the protective envelope. Combining the estimated proton flux and the calcium carbonate responsible for a new chamber, we propose that the proton/H⁺ exchange process is the key process driving the foraminiferal calcification.

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