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Inhibitors of calcification related enzyme affect calcification in foraminifera

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Calcareous foraminifera is microfossils that are essential tools for geochemical paleoenvironmental analysis. However, they are also significant producers of calcium carbonate in the marine environment, contributing to the global carbon/calcium cycle in the ocean. As long as anthropogenic carbon dioxide continues to be released into the atmosphere via human activities, carbon dioxide uptake by the oceans will continue to increase, making ocean acidification an ongoing and inevitable social problem recognized internationally. The equilibrium of the carbonate system is expected to be unfavorable to calcification under developed ocean acidification. Numerous observations have been made on various calcifying organisms to evaluate the effects of ocean acidification through field and laboratory culture experiments. Different taxonomic groups are affected by ocean acidification in different ways. Ocean acidification affects both the biology of the calcification process and the "mineralogy" and "crystallography" of the deposited calcium carbonate, but as the authors are trying to understand the calcification process in foraminifera, we would like to emphasize the importance of the biological process. In foraminifera, the effects of ocean acidification have been one of the hottest topics among the biogeoscience community, and many studies have been reported. However, the response varies according to species, crystal structure (i.e., hyaline and miliolid), and presence or absence of symbionts. Furthermore, both the chemical composition of the test and the process of calcification should be significantly influenced by physiology. Enzymes are responsible for a large part of the physiological activity of foraminifera. In particular, there is still a limited understanding of which enzymes promote calcification, how they are involuted, and whether their function is inhibited. This study aims to confirm that the target enzymes are in the calcification by laboratory experiments with the addition of enzyme inhibitors and observing the shell formation. Acetozaramide and Bafilomycin were added as inhibitors to the carbonic anhydrase, and proton pump, respectively, which have been strongly suggested to be involved in shell formation by previous studies. Our laboratory experiments were conducted with *Ammonia* sp. to observe the influence on the morphology of the external surface of the test.