CALIFORNIA STATE SCIENCE FAIR
2006 PROJECT SUMMARY

Name(s)
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Project Number
J0924

Project Title
Ocean Acidification and Its Anticipated Effects on Calcifying Marine Species

Abstract

Objectives/Goals
The objective of the project was to determine how much the ocean pH can decrease before calcite shells of marine organisms show significant morphological changes due to dissolution.

Methods/Materials
Calcite rhombohedra were used as hypothetical calcifying species. The crystals were grown on small glass cover slips for 5 days and then placed in containers with solutions of different pHs (7.7 to 8.2). At time points of 3, 7, and 16 days the crystals were removed and examined with a scanning electron microscope. Different regions of each sample were evaluated and the percent of crystals exhibiting significant morphological alteration was documented.

Results
The analyzed data indicate that there are three different pH ranges that have unique effects on calcium carbonate dissolution. Crystals maintained in solutions above pH 8.0 did not show any obvious morphological changes. Crystals maintained in solutions between pH 7.8 and 8.0 exhibited an increasing percentage of surface etching as a function of time and decreasing pH. This process is slow, but nevertheless significant: 6% for pH 8.0, 10% for pH 7.9, and 20% for pH 7.8 after 16 days. Crystals maintained at pH 7.7 showed significant volume loss already after 3 days (30%) and 100% after 16 days.

Conclusions/Discussion
The oceans are saturated with calcium carbonate, but increasing carbon dioxide concentrations in the atmosphere that originate from the burning of fossil fuels are reducing ocean pH and carbonate ion concentrations, threatening the existence of species that synthesize skeletons of this material. Our results reveal that even relatively minor decreases in pH can have dramatic effects on calcite crystal structure, with significant dissolution occurring at pHs below 8.0. The results reported here using a relatively simple synthetic system raise concerns regarding the uncertain future of calcifying marine species in an industrialized world. Long-term research using live calcifying marine organisms in pH solutions below 8.0 will more clearly show the dangerous effects of ocean acidification.

Summary Statement
My project determined how much the pH of the ocean could decrease before the calcite shells of marine organisms significantly dissolve, by using a simple synthetic system of calcium carbonate crystals put in different pH solutions.

Help Received
Used SEM at UCSB under the supervision of James Weaver