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Effects of ocean acidification on calcification of symbiont-bearing reef foraminifers

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Ocean acidification (decreases in carbonate ion concentration and pH) in response to rising atmospheric pCO2 is generally expected to reduce rates of calcification by reef calcifying organisms, with potentially severe implications for coral reef ecosystems. Large, algal symbiont-bearing benthic foraminifers, which are important primary and carbonate producers in coral reefs, produce high-Mg calcite shells, whose solubility can exceed that of aragonite produced by corals, making them the ”first responder” in coral reefs to the decreasing carbonate saturation state of seawater. Here we report results of culture experiments performed to assess the effects of ongoing ocean acidification on the calcification of symbiont-bearing reef foraminifers using a high-precision pCO2 control system. Living clone individuals of three foraminiferal species (Baculogypsina sphaerulata, Calcarina gaudichaudii, and Amphisorus hemprichii) were subjected to seawater at five pCO2 levels from 260 to 970 ppm. Cultured individuals were maintained for about 12 weeks in an indoor flow-through system under constant water temperature, light intensity, and photoperiod. After the experiments, the shell diameter and weight of each cultured specimen were measured. Net calcification of Baculogypsina and Calcarina, which secrete a hyaline shell and host diatom symbionts, increased under intermediate levels of pCO2 (580 and/or 770 ppm) and decreased at a higher pCO2 level (970 ppm). Net calcification of Amphisorus, which secretes a porcelaneous shell and hosts dinoflagellate symbionts, tended to decrease at elevated pCO2. These different responses among the three species are possibly due to differences in calcification mechanisms (in particular, the specific carbonate species used for calcification) between hyaline and porcelaneous taxa, and to links between calcification by the foraminiferal hosts and photosynthesis by the algal endosymbionts. Our findings suggest that ongoing ocean acidification might favor symbiont-bearing reef foraminifers with hyaline shells at intermediate pCO2 levels (580 to 770 ppm) but be unfavorable to those with either hyaline or porcelaneous shells at higher pCO2 levels (near 1000 ppm).