Marine calcifying organisms exhibit highly differential regulation of pH at site of calcification in response to CO_2-induced ocean acidification

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The growth response of calcium carbonate mineralizing organisms to elevated CO_2 conditions is extremely diverse. Some organisms are negatively influenced by CO_2-induced seawater carbonate system perturbations and associated pH decline, producing less calcium carbonate in their shells or skeletons. While, other organisms are resilient and positive growth response for some species has been observed in culture experiments. Many organisms produce their shells and skeletons from an internal fluid pool that is chemically distinct from seawater. Here we investigate the hypothesis that an organism's ability to regulate pH and carbonate chemistry at their site of calcification is a significant factor driving the diversity of calcareous organisms' responses to increasing CO_2 conditions. We analyzed and interpreted $\delta^{11}B$ as a proxy of calcification site pH in a set of marine calcifying organisms, including urchins, crustacea, corals, bivalves, and calcareous serpulid worms, cultured under controlled laboratory conditions across a range of CO_2 levels. Our data shows an extremely diverse range of isotopic signatures. In some cases this diversity is coupled to net calcification response, suggesting a primary internal pH control over shell growth, and in other cases it is decoupled. We also evaluate the compatibility of the $\delta^{11}B$-derived estimates of calcification site pH with existing models of biomineralization for these species in order to advance understanding of how these organisms produce their shells and skeletons.