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Effects of lower pH on skeletal growth and incorporation of trace elements in coral polyp (Acropora digitifera)

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The impact of ocean acidification caused by the increasing global concentration of atmospheric CO 2 has been studied in marine calcifiers, including hermatypic corals, in which calcification is expected to decrease significantly. However, the effect of elevated pCO2 on the early developmental stage of the coral life cycle has been little studied, even though corals at this stage seem to be susceptible to stresses including ocean acidification. In this study, we reared polyps of Acropora digitifera, one of the dominant species around the Ryukyu Islands, Japan, in seawater of various pH (6.55, 7.31, 7.64, 7.77, 8.03), controlled by CO2 bubbling. We measured the dry weight of the polyp skeletons to investigate the relationship between the aragonite saturation state and polyp growth. In addition, we measured the Mg/Ca, Sr/Ca, Ba/Ca, and U/Ca ratios of their skeletons to estimate the pH dependence of these ratios. The skeletal weight of coral polyps increased with the aragonite saturation state, and apparently reached a saturation plateau, a finding in agreement with previous results for adult corals. Ba/Ca and U/Ca, but not Sr/Ca, were significantly related to pH within the pH range of ambient seawater (7.64?8.03). Although coral Ba/Ca is reported to be affected by multiple factors such as terrestrial runoff and upwelling, U/Ca ratios show a relatively simple dependency on temperature in addition to pH. Therefore, the dual proxy method using skeletal U/Ca and Sr/Ca ratios has potential for reconstructing paleo-pH, in addition to the well-known pH proxy of d11B.

Keywords: coral, polyp, skeleton, pH, trace elements