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Effects of recent ocean acidification in the western North Pacific on Porites coral calcification

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One third of carbon dioxide emitted to the atmosphere as a result of human activities has been incorporated by the surface ocean. Subsequently, the seawater is acidifying at an unprecedentedly faster rate (ocean acidification); seawater pH (pH_{SW}) has declined by ˜0.1 since the Industrial Revolution (1750 AD). As a pH_{SW} decline reduce saturation state of calcium carbonate, it will probably lead to severe consequences for scleractinian corals, important reef builders in the tropical and subtropical oceans. Up until now, many studies have evaluated effects of ocean acidification on scleractinian corals through culturing experiments, but few studies evaluated it in the natural environment. To better understanding how corals and coral reef ecosystems will adapt to or be damaged by the resulting changes in environments, field observations are crucial. Using thermal ionization mass spectrometry, we measured a 100 year record of boron isotopes (δ^{11}B) of massive *Porites* coral obtained from Chichijima, Ogasawara Archipelago, western North Pacific. The result revealed a raid decline of δ^{11}B since 1960 (-0.17 $\pm$ 0.07 ‰/decade), suggesting a decrease of pH of extracellular calcification fluid (pH_{CF}) due to ocean acidification. The result also showed that pH_{CF} has been decreasing rapidly (changing sensitively to pH_{SW}) than estimation from culturing experiments of *Porites* corals. Thus it suggests the calcification fluid of *Porites* coral become corrosive to aragonite in the future (pH_{CF} = ca. 8.3 when pH_{SW} = ca. 8.0 in 2050) at an earlier point than previously expected, despite the pH_{CF} up-regulation mechanism of corals. Therefore, it is likely that ocean acidification has already had negative influences on corals in addition to various environmental stressors represented by regional warming.

Keywords: boron, coral, Porites, ocean acidification, calcification