Coral calcification in a changing World and the interactive dynamics of pH and DIC up-regulation

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Scleractinian corals together with their endosymbiotic dinoflagellates, *Symbiodinium* (zooxanthellae), have been spectacularly successful in building the tropical coral reef edifices that harbour more than one-third of the oceans biodiversity. The ongoing viability of these iconic tropical reef systems is however in question, with symbiont-bearing shallow-water corals now facing the combined challenge of global warming and ocean acidification (OA) from rapidly rising levels of CO_2. Critical to the success of reef-building corals is their ability to extract dissolved inorganic carbon (DIC) from seawater and efficiently convert it into calcium carbonate, the major constituent of their skeletons.

Here, using newly developed $\delta^{11}B$ and B/Ca geochemical proxies [1] we show that *Porites* corals from natural reef environments exhibit a close ($r^2 \sim 0.9$) antithetic relationship between DIC and pH of the corals' calcifying fluid (cf). The highest DIC_{cf} (~x3 seawater) occurs during summer, consistent with thermal/light-enhancement of metabolically (zooxanthellae) derived carbon, while the highest pH_{cf} (~8.5) is in winter during periods of low DIC_{cf} (~x2 seawater). These opposing changes in DIC_{cf} and pH_{cf} are shown to maintain oversaturated but stable levels of carbonate saturation (Ω_{cf} ~x5 seawater), the key parameter controlling coral calcification. These findings are in marked contrast to artificial experiments and show that pH_{cf} and DIC_{cf} up-regulation occurs largely independent of changes in seawater carbonate chemistry, and hence OA, but is highly sensitive to thermally induced 'bleaching' of corals due to global warming.

[1] Holcomb et al. (2016) *Chemical Geology,* **437,** 67–76.