Insights into the "health" of tropical coral reefs from coupled boron and carbon isotopes in coral skeletons

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Ocean acidification (OA) in response to anthropogenic emissions of atmospheric CO_2 has been shown to negatively impact marine calcifiers. Coral reefs account for around 50% of shallow water $CaCO_3$ production (~0.7 Pg of $CaCO_3$ per year), yet the effect of OA on $CaCO_3$ production and dissolution in these regions remains unclear. Part of this uncertainty comes from the natural variability in the ocean carbonate system that occurs in coral reefs. In particular, it is recognised that net ecosystem production (NEP = gross primary production – autotrophic and heterotrophic respiration) and net ecosystem calcification (NEC = gross calcification – gross $CaCO_3$ dissolution) modulate the carbon chemistry of these complex ecosystems, and anthropogenic or natural changes in these quantities could alleviate or amplify the influence of OA [1]. The balance between NEP and NEC, and its evolution through time, can be investigated through measurements of total alkalinity (TA) and total dissolved carbon (DIC) in reef waters. Unfortunately such monitoring of the "health" of coral reefs has only recently begun and long instrumental records are lacking. As a consequence, the impact of historic OA and the ability (or lack thereof) of reef systems to modulate their carbonate biogeochemistry against this threat is largely unknown.

Here we demonstrate how the patterns of NEP and NEC across the Sapodilla Cayes region of the Belize Mesoamerican Barrier Reef can be reconstructed over the last 100 years from paired measurements of $\delta^{13}C$ and $\delta^{11}B$ of the skeleton of scleractinian coral *Siderastrea siderea* at annual-resolution. These results provide key insights into how multiple anthropogenic stressors influence the impact of OA on coral reef ecosystems.

[1] Yeakel, KL, et al. *PNAS,* 112 (47), 14512-14517