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Historic trends in ocean acidification on coral reefs revealed by laser ablation MC-ICPMS analysis of coral $\delta^{11}B$

CHRISTOPHER D STANDISH[1], DR. THOMAS B CHALK[2] AND **GAVIN L FOSTER**[2]

[1]Ocean & Earth Sciences, University of Southampton
[2]University of Southampton

Presenting Author: gavin.foster@noc.soton.ac.uk

Around 1/3 of all anthropogenic CO_2 emissions have been absorbed by the ocean. This has led to a decrease in ocean pH by approximately 0.1 pH units, and around a 30% decline in dissolved carbonate ion concentrations. The latter in particular is thought to have a negative impact on coral calcification by lowering the saturation state of aragonite (the polymorph of $CaCO_3$ corals build their skeletons from). However, due to a number of biogeochemical processes (e.g. calcification, organic carbon production) the carbonate system on the reef is not the same as the open ocean, with reef pH determined instead largely by the balance between net ecosystem calcification (NCC) and net ecosystem productivity (NPP). This, coupled with a general lack of geochemical monitoring on reefs stretching back beyond the last decade, makes the impact of ocean acidification on tropical corals difficult to assess.

Here we will use a recently developed analytical technique (laser ablation multicollector inductively coupled plasma mass spectrometry) to examine the boron isotopic composition ($d^{11}B$) and boron content (B/Ca) of coral skeletons recovered from several regions around the globe (Bermuda, Hawaii). These regions were chosen as they are places where decade-long open-ocean carbonate system monitoring (e.g. at BATS and HOTS) as well as local reef monitoring have been performed (e.g. https://www.pmel.noaa.gov/co2/story/Hog+Reef). We focus here on whether the very high-spatial resolution available with the laser ablation technique (equating to weekly or better temporal resolution) enables seasonally resolved reconstructions of reef pH. By overlapping with intervals of local monitoring we are able to assess the role of coral vital effects relating to biomineralisation vs. variations in reef biogeochemistry in driving the observed pH trends. Unpicking the relative importance of these processes in driving the observed variations in $d^{11}B$ and B/Ca is a challenge, but is essential if the geochemistry of coral skeletons is to be used to reliably reconstruct the carbonate system on reefs beyond the reach of our instrumental record.