<u>Report: "Crumbling reefs: real world impacts of ocean acidification on skeletal structure and framework of cold-water coral reefs"</u>

MASTS small grant from Biogeochemistry Forum

Abstract of application: Projected increases in atmospheric CO_2 over the next century leading to changes in marine biogeochemistry and a shoaling (shallowing) of the aragonite saturation horizon are expected to have a number of impacts on cold-water corals, such as changes in their structural integrity. Cold-water corals are arguably at more risk of ocean acidification (OA) than tropical corals, due to their depth range (down to 3,000m) and proximity to the aragonite saturation horizon (CBD 2014). The grant requested support to **(1)** determine how the skeletal structure of contrasting coral samples from different environmental gradients differ, and **(2)** compare that to sample hardness, which is indicative of coral's ability to withstand breakage in the real world. Funds are requested for Scanning Electron Microscope time (Electron Back Scatter Diffraction (EBSD) analysis) and RAMAN spectroscopy.

Report: Samples collected from below the Aragonite Saturation Horizon (ASH) had visible dissolution on unprotected skeleton (where no coral tissue provided protection), (Figure 1).

Figure 1: Image of a <u>Lophelia pertusa</u> sample collected from below the Aragonite Saturation Horizon. Dissolution of aragonite below the 'tissue line' is evident.

Collected samples were cut and organised to provide replicate (where possible, triplicate) individuals from each collection site. Samples were then set in resin, cut, and polished for further analysis (Figure 2).

Figure 2: Cut and section <u>Lophelia pertusa</u> set in resin

Scanning Electron Microscope (SEM) images were taken of the outer surfaces of all collected samples, to assess whether any surface features changed (Figure 3). A particular feature noted on all samples were surface nodules. There was a significant correlation with distance between mounds (µm) and the collection site chemistry.

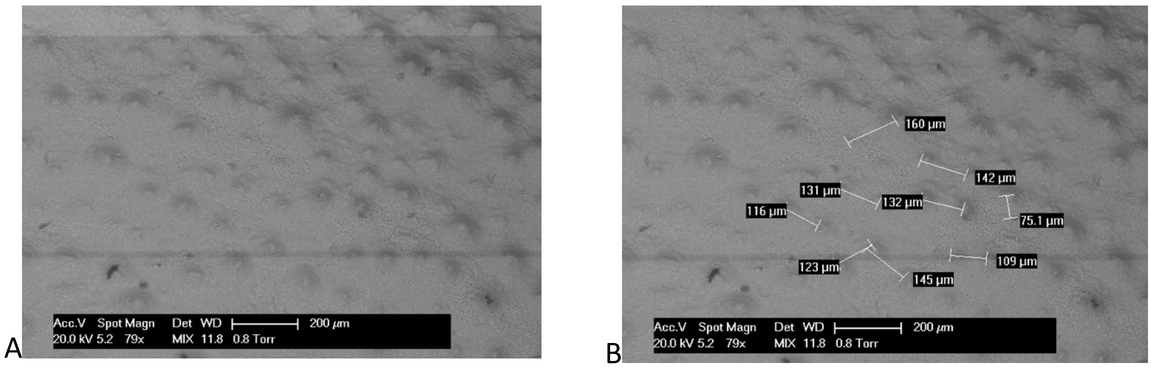

Figure 3: A) Surface nodules visible <u>on Lophelia pertusa</u> using the SEM. B) example distances being measured between nodules

With RAMAN spectroscopy, the Full Width Half Maximum (FWHM) of the skeletal aragonite at ca. 1085 cm^{-1} was compared between all samples, and complemented and extended observations observed by Hennige et al. 2015.

Microstructural analysis of the skeleton demonstrated that from sites with aragonite saturation ≥ 1, samples had well-organized aragonitic 'bundles' as indicated by high diffraction and identifiable crystal orientations throughout the majority of the samples (Figure 5).

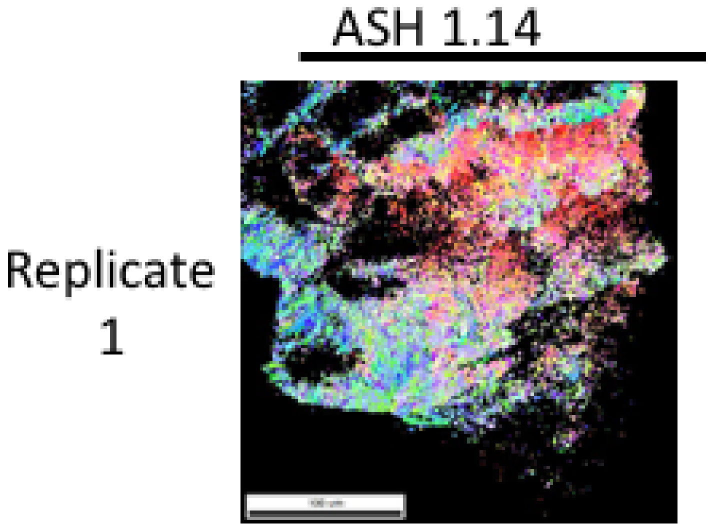

Figure 4: Electron Back Scatter Diffraction (EBSD) of <u>Lophelia pertusa</u> example. Colours indicate grouped crystal organization and orientation

Next steps: Nano-indentation testing is ongoing.