MASTS Marine Biogeochemistry Forum Small Grant 2017

Final report for grant MBFSG28: Multiple stressors and their primary productivity impacts

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Climate change will alter the biochemical environment experienced by marine organisms over the next century (IPCC, 2013) with warming, ocean acidification (OA) and freshening all projected to increase (IPCC, 2013). Over the coming century many ocean regions will experience significant changes in their biogeochemical environment (IPCC, 2013), stressing marine productivity and impacting the ecosystem services it supports through exposure to multiple changing environmental variables.

This is particularly evident in the Arctic where observed melt rates of outlet glaciers in Greenland are accelerating (Chauche et al., 2014) due to increased surface melt and subsequent discharge into the ocean. In addition to increasing temperature and marine freshening, OA is projected to occur at a faster rate in the Arctic due to the combination of cooler waters and reduced marine salinity caused by glacial discharge. While stressors including OA have not yet occurred at a magnitude significant enough to impact marine ecosystems at lower latitudes, the Arctic marine systems provide the perfect opportunity to investigate these future changes as they have already experienced the multiple stressors (temperature, salinity, OA) projected for Scotland over the coming century.

Figure 1. Three coralline algae species *Lithothamnion glaciale* (left), *Lithothamnion tophiforme* (centre) and *Clathromorphum compactum* (right) collected from Nuuk, Greenland

The aims of this project were to 1) reconstruct temperature, salinity and OA change on the west coast of Greenland over the last 50y using coralline algae. 2) To compare biogeochemical changes over that period (indicative of multiple stressors) with major shifts in Arctic primary productivity.

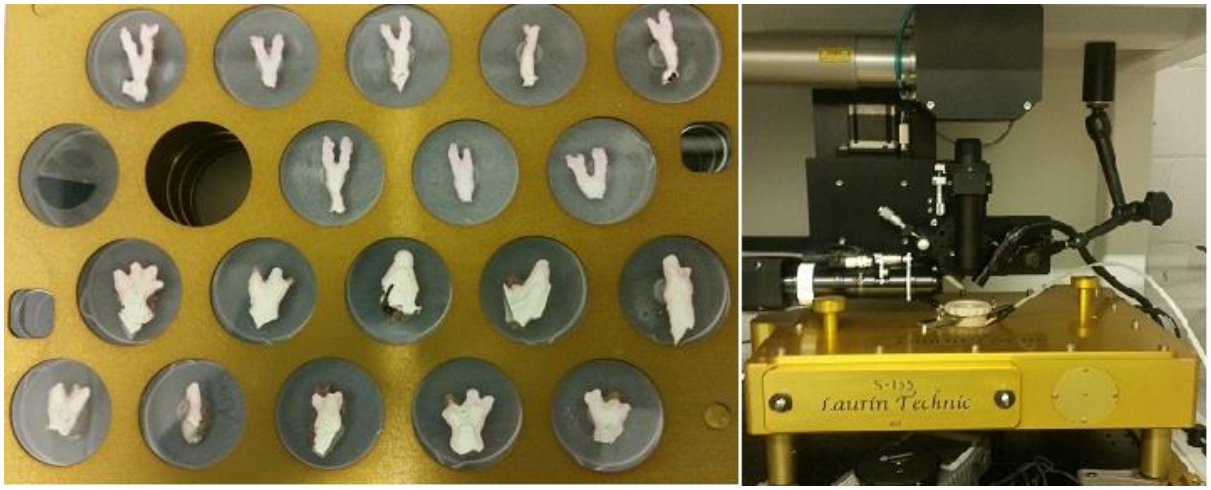

Figure 2. Coralline algae samples were cut, set in resin and polished for analysis (left) using laser ablation mass spectrometry (right).

In 2016 three species of coralline algae (Fig. 1) were collected from the west coast of Greenland near Nuuk (Godthabfjord). The MASTS Small Grant enabled the analysis of these samples using laser ablation mass spectrometry at the University of Glasgow to obtain Mg/Ca (temperature), Ba/Ca (freshwater input) and Sr/Ca (DIC) ratios (Fig. 2 and 3).

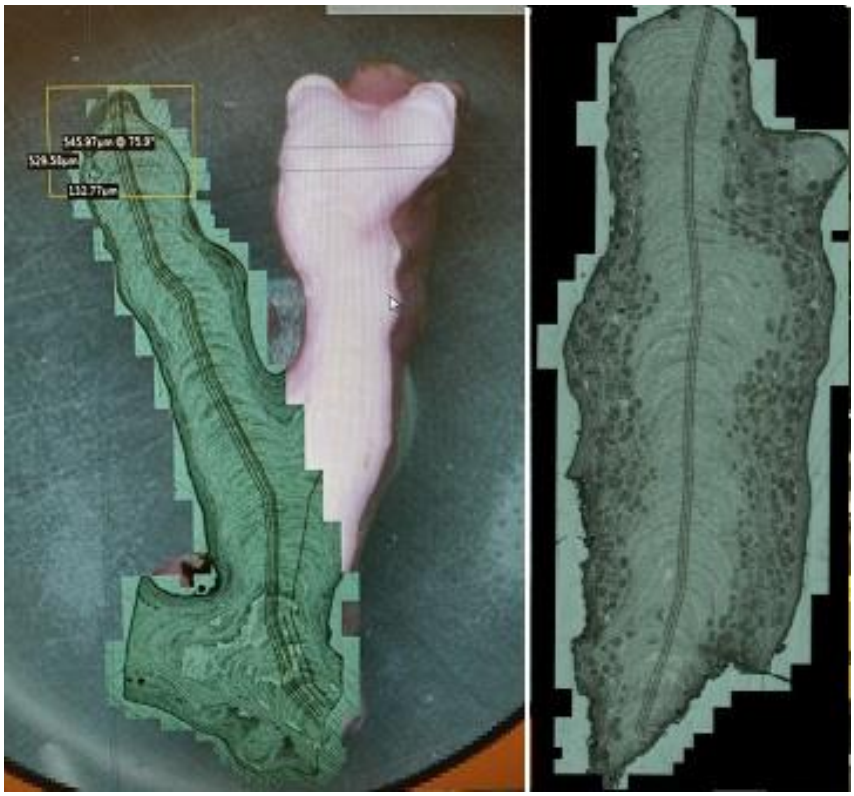

Figure 3. Coralline algae samples were analysed using laser ablation mass spectrometry to obtain Sr/Ca, Mg/Ca and Ba/Ca ratios for reconstruction of historic temperature, freshwater input and DIC changes.

This analysis has been completed and the data is currently being analysed to reconstruct site-specific historic changes in temperature, freshwater input and DIC over the past ~100 years. Once reconstructed, this information will be compared to Godthabfjord primary productivity to determine impacts in marine productivity resulting from these environmental changes.

References

Chauche, N., Hubbard, A., Gascard, J. C., Box, J. E., Bates, R., Koppes, M., Sole, A., Christoffersen, P., and IPCC, 2013, Summary for Policymakers: Working Group 1; IPCC Fifth Assessment Report.