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Impacts of climate change on sulphur biogeochemistry in coral reef systems.

The aim of this study was to investigate the impacts of climate change on the sulphur biogeochemistry of a Caribbean tropical coral reef. Our aim was to conduct transplant experiments on coral species, but in order to first do this we needed to understand the biogeochemistry of the reef setting. Thus, the aim of this research was to constrain the sulphur and carbon biogeochemistry of a shallow water Caribbean reef.

Tropical reef-building corals are a key source of the biogenic sulphur compounds dimethylsulphoniopropionate (DMSP) and dimethylsulphoxide (DMSO, collectively DMSP/O). These compounds appear to play a crucial role in conferring thermal-stress resistance in corals, and are also implicated in ecosystem function and climate regulation. Understanding how rising sea surface temperatures (SSTs) and decreasing seawater pH will impact the production of biogenic sulphur compounds is essential for predicting the future of coral reefs.

My research was conducted in conjunction with Operation Wallacea. I sampled 2 sites on the island of Utila, off the coast of Honduras, in the western Caribbean. The reefs here are characterized by a spur and groove formation. Three grooves and three spurs were sampled along their full length, and water samples were taken for dissolved inorganic carbon (DIC), total alkalinity (TA), DMSP and DMSO (DMSP/O). I also conducted point-intersect transects for each spur/groove and at each site so that we could link our biogeochemical data to the ecology of each reef.

Results so far:

Seawater DMSP concentrations were highly variable over the reef system and were highest at the back part of a calm (less windy) reef where seawater temperature was highest, seawater pH was most variable and where the benthic ecology was dominated by seagrass.

Concentrations were lower towards the front of the reef in areas of high coral abundance and were associated with less variable seawater temperature and pH. I also observed correlations between DMSP and dissolved oxygen at both sites.

However, it is not clear if the differences in seawater DMSP reflect i) variations in DMSP production by different species, ii) variations in DMSP production by individual species in response to temperature and pH changes, or iii) physical mixing processes at the sites which serve to dilute DMSP with incoming seawater.

Ongoing work:
I returned to Utila island in July 2016 to build upon my fieldwork from July 2015.

1. I conducted benthic incubation experiments (isolating individual coral heads, seagrass clumps and benthic substrate) *in situ* at the front and back reef sites to quantify the contribution of each of these to DMSP/O production.
2. I transplanted the same heads/clumps from their usual locations to the opposite site in the reef system, and conducted the benthic incubations again after 1 and 6 days to show how changes in environmental conditions affect DMSP/O production in each species. I also transplanted corals from the reef front to the back reef to identify how increasing seawater temperature and

decreasing pH affect DMSP/O production. These transplant experiments are short, but replicate conditions which typically occur during short-term, high seawater temperature events.

3. We will took discrete samples of macroalgae, corals and sediments to quantify the DMSP produced in relation to chlorophyll-a: This will enable us to normalise DMSP/O concentrations between macro- and microalgae.

The MASTS small grant enabled me to purchase fieldwork kit for sampling water, consumables for preparing and fixing samples, purchasing consumables for the analysis of samples and – both for July 2015 and 2016.