Insights on ocean acidification from instrumental monitoring and experiments in aquaria

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The anthropogenic rise in atmospheric CO_2 is driving fundamental and unprecedented changes in the chemistry of the world's oceans, with detrimental consequences for a wide variety of marine organisms. In this presentation I will review recent advances in our understanding of ocean acidification, with a focus on the Mediterranean Sea, from an integration of new data on high frequency variability of seawater chemistry and on the outputs from a suite of pH manipulative experiments in aquaria. Over the last centuries, paleoreconstructions of seawater pH in coral reefs have shown a certain degree of interdecadal variability. In coastal sites of the Mediterranean, from data measured using autonomous systems, we have also detected significant changes in seawater pH on the order of hours to days, possibly linked to vertical mixing and movement of water masses. To complement this information on natural variability, we have undertaken several experiments of pH manipulation, some of which are currently underway. I will show results from a first experiment of several months of duration on two species of Mediterranean corals, *Cladocora caespitosa* and *Oculina patagonica*, which have confirmed the expected decrease in skeletal growth with decreasing pH. In addition, a second experiment with the Mediterranean sponges *Chondrosia reniformis*, *Agelas oroides* and *Dysidea avara* has shown a varying species response. In this last experiment, changes in the abundance and diversity of sponge associated bacteria are being assessed, to seek for clues on possible groups that may be benefitted from ocean acidification.

Fe-poor and sulfide-rich: Mangrove Lake as a Precambrian analogue?

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Minor sulfur (S) isotopes produce an integrated picture of biogeochemical S cycling through metabolism-specific deviations from reference isotope fractionations, and have become a recent tool in investigating the biogeochemical state of Precambrian oceans. We used this tool to investigate the S cycle of Mangrove Lake, Bermuda: a permanently stratified lake characterized by high levels of algal-derived organic matter (up to 32mM) and high sulfide concentrations (>15mM) below a wind-mixed layer. The sulfate concentration in the mixed layer is controlled by infiltration of seawater from the nearby ocean (~400 m), and is characterized by a $\delta^{34}S$ ~22‰, and $\Delta^{33}S$ ~0.04‰. Sulfate is nearly depleted 30 cm below the mixed layer, with $\delta^{34}S$ values approaching 80‰ and $\Delta^{33}S$ values of ~0.11‰. Proxies for sulfate in the Precambrian oceans that exhibit similar isotopic characteristics have been taken as evidence for a microbially complex marine S cycle, with active S re-oxidation and disproportionation. Nevertheless, we can nearly reproduce our $\Delta^{33}S$- $\delta^{34}S$ trajectories with a simple 1-D diffusion-reaction model that only considers microbial sulfate reduction. We will explore whether this apparent discrepancy represents the peculiar mechanisms of sulfide removal in Mangrove Lake, the inappropriate application of model parsimony, or limitations of retrodicting Precambrian oceanic conditions from modern analogue environments.