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# Determining the Biogeochemical Implications of Macroalgal ROS

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As a powerful redox agent, the reactive oxygen species (ROS) hydrogen peroxide ($H_2O_2$) has the potential to influence the availability of essential trace metals and the fate of organic matter. Since the initial discovery of $H_2O_2$ generation by algae, lab-based studies have demonstrated that the potential for $H_2O_2$ production is widely spread across algal groups, and in certain species is tied to the secondary production of halocarbons such as bromoform ($CHBr_3$). This has gained particular attention due to its ozone-depleting potential. In the coming years, continued expansion of commercial seaweed aquaculture, as well as a predicted rise in the incidence of algal blooms, are likely to increase the formation of biological hotspots of ROS.

This study seeks to develop an understanding of how macroalgal species control the ROS in their surrounding water, and the extent to which this oxidant pool affects the trace metal biogeochemistry of Fe and Mn, the state of organic matter, and the release of halogenated compounds from aquatic ecosystems. To begin addressing this question, we have adopted a two-fold approach. Firstly, we conducted lab-based studies with common macroalgal species to probe the magnitude and dynamics of $H_2O_2$ and $CHBr_3$ produced under diel patterns, and stress conditions. Secondly, we are examining kinetic isotopic fractionation of stable oxygen isotopes of $H_2O_2$ arising from various decay pathways. Initial results indicate that when healthy, macroalgae control $H_2O_2$in their aqueous environments in patterns that share similarities with diel cycles. However, exposure to environmental stressors (induced via acute heat, and grazing) yields dramatically elevated concentrations which do not follow typical decay dynamic patterns. Changes in the environmental system, including shifts in temperature, nutrient levels, and exposure to grazers and disease, are predicted to become more pronounced with the burgeoning anthropogenic influence on the environment and may amplify ROS production in biological communities. This work holds the potential to identify process-specific fractionation factors that could aid in determining the dominant fates of $H_2O_2$ in a given aqueous environment, and thus allow us to better understand and predict the scope and possible severity of the biogeochemical implications of algal $H_2O_2$ production.