Microbially Mediated Iodate Reduction: A Unique Form of Microbial Respiration

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Iodine is the heaviest element of biological importance to humans and many other living organisms [1]. Commonly enriched in marine environments, it exists in several oxidation states and is in constant flux globally at the marine boundary layer [2]. In these aquatic environments, kelp bioaccumulates iodine and produces volatile iodine species such as methyl iodide, which contributes to the destruction of tropospheric ozone with important implications in global climate change [3]. Despite its importance to human health and climate, several aspects of the iodine biogeochemical cycle, such as the mechanism behind iodate (IO_3^-) reduction to iodide (I^-), remain poorly characterized.

Our investigations reveal that iodine is actively redox cycled in marine environments through the activity of microorganisms. We show that an enriched microbial community from estuarine sediment mediated the reduction of IO_3^- to I^- over the course of three days. No iodate reduction occurred in heat-killed controls or in the absence of acetate. Iodate reduction was coupled to organic carbon oxidation and growth. In these experiments, the oxidation of 2.2mM acetate resulted in the complete reduction of 1.6mM iodate to iodide which, when accounting for carbon assimilation into biomass, is consistent with the theoretical stoichiometry according to $3CH_3COO^- + 4IO_3^- + 3H^+ \rightarrow 6CO_2 + 4I^- + 6H_2O$. These results suggest that this is a dissimilatory microbial process. 16S amplicon sequencing results indicated that the community was dominated by *Denitromonas* species from the phylum *Proteobacteria.* In the coming months, we aim to isolate the species responsible and determine the underlying molecular mechanisms involved in this distinct form of microbial respiration. The results of our studies provide some biological context to the geochemical analyses that identified the existence of an IO_3^-/I^- disequilibrium in high productivity marine zones and hints at the impact of this unique microbial process on the carbon cycle in the oceans, and the role it may play on the production of volatile iodine species that lead to tropospheric ozone destruction.

References

[1] Yeager, C. M. (2017) *Adv. Appl. Microbiol.* **101**, 83–136. [2] Saha, S. (2019) *J. Phys. Chem. A.* [3] Carpenter, L. J. (2015) *Encyclopedia of Atmospheric Sciences* 205–219.