REACTIVITY BETWEEN DIMETHYLSULFIDE AND HYPOBROMOUS ACID AND ITS RELEVANCE FOR THE ENVIRONMENT

EMANUEL MÜLLER[1,2], SYLVAIN BOUCHET[2], URS VON GUNTEN[1,2, 3], LENNY H.E. WINKEL[1,2]

[1]Eawag, Swiss Federal Institute of Aquatic Science and Technology, Dübendorf, Switzerland, emanuel.mueller@eawag.ch
[2]Institute of Biogeochemistry and Pollutant Dynamics, ETH Zurich, Switzerland
[3]School of Architecture, Civil and Environmental Engineering, EPFL, Switzerland

The volatile organic sulfur compound dimethylsulfide (DMS) is enzymatically produced in marine waters and well-known for its climate effect. Certain marine organisms also produce hypobromous acid (HOBr), a strong oxidant which subsequently reacts with dissolved organic matter (DOM). One of the products of this reaction is the ozone-destroying compound bromoform ($CHBr_3$). Previously, we found a very high reactivity between HOBr and DMS ($k''_{HOBr+DMS} = 1.6 \cdot 10^9\ M^{-1}\ s^{-1}$)[1] which raises the question: What is the relevance of the reaction between DMS and HOBr in terms of (i) marine DMS degradation and (ii) $CHBr_3$ formation via competition with the HOBr+DOM reaction?

We used a chemical kinetic model (Kintecus)[2] to estimate HOBr steady-state concentrations and found that DMS degradation via its reaction with HOBr is of similar importance than known sinks for DMS. To address the second question, we performed batch and reactor experiments with DMS, DOM and HOBr. In the reactor experiments we mimicked diffusion between an algal cell and surrounding seawater by using reaction chambers separated by permeable membranes. We demonstrated that at environmentally relevant DMS:DOM ratios, DMS is almost completely consumed by HOBr. Furthermore, we could demonstrate that the reaction between DMS and HOBr decreases the production of $CHBr_3$ by reducing the availability of HOBr for its reaction with DOM. The reaction between HOBr and DMS is thus relevant in marine waters and should be considered in coupled ocean-atmosphere models.

References

[1]Müller et al., in preparation: Hypobromous acid as a sink of marine dimethyl sulfide. *Env. Sci. Tech.*

[2]Ianni, J. C., -A comparison of the Bader-Deuflhard and the Cash-Karp Runge-Kutta integrators for the GRI-MECH 3.0 model based on the chemical kinetics code Kintecus. *Computational Fluid and Solid Mechanics 2003*, 1368-1372.