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Dimethylmercury demethylation in the presence of sulfide

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In marine systems, the methylated mercury pool is approximately evenly distributed between monomethylmercury (MMHg) and dimethylmercury (DMHg). While MMHg is well-studied due to its direct link with Hg accumulation in aquatic food webs, there is a general lack of knowledge of processes controlling DMHg formation or degradation. By acting as a net sink or source for MMHg, DMHg may exert control over marine MMHg concentrations and subsequent Hg bioaccumulation in fish and seafood in ways currently not understood.

At present, recognized degradation pathways of DMHg in marine systems include photochemical demethylation (although this pathway has been debated). Degradation through protonolysis of the Hg-C bond by dissolved sulfide has also been suggested and supported by density function theory calculations (Ni et al, J. Phys. Chem. A, 2006). However, experimental support for this pathway is currently missing. Here, we present data from a series of experiments for the stability of DMHg in the presence of dissolved sulfide or sulfide minerals (e.g. FeS (s)). Our results show that degradation rates are dependent on the sulfide phase and DMHg:sulfide ratios. For dissolved sulfide, we observed a non-linear response between DMHg degradation and sulfide concentrations. Our results indicate that DMHg can be demethylated by sulfide at concentration ratios viable under natural marine conditions. As we found MMHg to be the first product of demethylation, this process could also constitute a significant MMHg source in marine systems.