Characterization and Validation of a Novel Equilibrium Passive Sampler for Prediction of Porewater Methylmercury

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Accurate direct measurement of aqueous methylmercury (MeHg) - especially in sediment porewaters - is challenging. As such, there remains a need for a simple, standardized passive sampling system from which porewater MeHg concentrations and MeHg bioavailability can be calculated. This study details the validation of a novel material comprised of agarose gel with embedded activated carbon particles (ag+AC) as an equilibrium passive sampler capable of estimating porewater MeHg concentrations through laboratory experiments in a combination of idealized media and realistic sediment microcosms.

Isotherm bottle experiments with ag+AC polymers were conducted to constrain partitioning of various environmentlaly relevant MeHg species to these materials. Partitioning coeffeicients ranged from $\log(K_{PS}) = 2.83$ for MeHgDOM to $\log(K_{PS}) = 3.03$ for MeHgCys. To demonstrate equilibrium exchange of an environmentally relevant MeHg species, a dual label loading/desoprtion experiment was conducted. After equilibration with $Me^{199}HgDOM$ in solution, ag+AC polymers were transferred to solutions containing $Me^{198}HgDOM$. Both complexes approached equilibrium with the samplers after 14 days while maintiaining mass balance. This study demonstrated reversible exchange of MeHgDOM species, providing further evidence the ag+AC polymer material is capable of equilibrium measurements of environmentally-relevant MeHg species within a reasonable time frame.

Sampler deployment across the sediment-water interface of sediment microcosms provided estimatess of measured surface water and porewater MeHg concentrations within a factor of 2, based on the measured K_{PS} for MeHgDOM. This result suggests that the samplers can be used to evaluate aqueous MeHg gradients with depth in sediments, and that a standardized K_{PS} based on model complexes can be used for reasonably accurate predictions across many sites.