S08-02 Mercury Isotope Evidence for Contrasting Pathways of Mercury into Coastal versus Offshore Marine Fisheries Foodwebs

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An important question related to the oceanic biogeochemical cycle of Hg is the source of methylmercury (MeHg) to foodwebs of offshore migratory fish that spend little or no time in shallow coastal waters where Hg inputs are enhanced and MeHg is known to form at high rates in reducing sediments. One possibility is that offshore migratory fish ingest substantial amounts of Hg while feeding on fish in coastal areas during spawning periods. Alternatively, bio-advection of coastally-derived MeHg may provide a source of MeHg to the open ocean. A third possibility is that methylation occurs in the open ocean at locations such as the oxygen minimum zone or seafloor hydrothermal vents. Here we use naturally occurring mercury stable isotope ratios in fish tissues of coastal and offshore/migratory fish to place constraints on MeHg sources to these fish. Coastal fish (Red Snapper, Grey Snapper, Red Drum, Speckled Trout) in the Gulf of Mexico (GOM) have δ^{202}Hg values of 0 to -1.0‰ and Δ^{199}Hg values of ~0.5‰, whereas most offshore migratory fish (Blackfin Tuna, and large Yellowfin Tuna) have higher δ^{202}Hg values of 0.2 to 0.5‰ and Δ^{199}Hg values of ~1.5‰. Smaller Yellowfin Tuna have even higher δ^{202}Hg values of 0.3 to 0.7‰ and Δ^{199}Hg values of 2.0 to 2.7‰. Yellowfin Tuna from the Pacific Ocean near Hawaii have very high δ^{202}Hg and Δ^{199}Hg values similar to the smaller Yellowfin Tuna from the Atlantic. δ^{202}Hg values of coastal fish are consistent with isotopic measurements of total Hg in marine sediments, but elevated Δ^{199}Hg values require either a small degree of photochemical reduction of Hg^{2+} prior to methylation or photochemical demethylation of MeHg prior to uptake into the foodweb. δ^{202}Hg and Δ^{199}Hg values of offshore fish are much higher than observed in marine sediments and are most easily explained by a source of MeHg that has undergone a high degree of demethylation (>~50%) before introduction to the foodweb. Elevated Δ^{199}Hg values cannot be explained by biological fractionation during trophic transfer. Our results are not consistent with the idea that offshore migratory fish obtain MeHg predominantly from eating coastal fish. Instead they support the idea that MeHg is either advected from coastal environments and demethylated in the photic zone before introduction to the open ocean foodweb, or that MeHg is sourced and methylated in the open ocean.

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