# Mariana Trench fauna accumulate methylmercury produced in upper oceans

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Monomethylmercury (MMHg) is a potent toxin that bioaccumulates and magnifies in marine food webs. Investigating where and how MMHg is produced in oceans is critically important to understand global Hg cycling and human exposure. Currently, the exact origin of MMHg in seawater is not well known. What we have learned over the past decade is that MMHg is produced in the oxygen minimum zone of all major oceans, most likely by microbes feeding on sinking organic particles, but possibly by abiotic means. Surprisingly field studies also observed abundant MMHg in deep oceans, but are uncertain of its origins: downwelling of MMHg produced in upper oceans vs. in-situ MMHg production in deep oceans.

During 2016-2017, we deployed sophisticated deep-sea lander vehicles on the seafloor of Mariana and Yap trenches, amongst the most remote and inaccessible locations on Earth, and captured the endemic fauna (amphipod and snaifish) at 7000-11000 m and collected sediments at 5500-9200 m. We measured Hg concentrations and Hg isotope compositions in sediments and fauna. The trench fauna at 7000-11000 m depth all have substantially positive mass-independent fractionation of odd Hg isotopes (odd-MIF; $\Delta^{199}$Hg = 1.47 ± 0.13‰, $\Delta^{201}$Hg = 1.21 ± 0.11‰, 1SD), which can be generated only in the photic zone via MMHg photo-degradation. Given the identical odd-MIF in trench fauna and North Pacific upper ocean biota MMHg ($\Delta^{199}$Hg = 1.44 ± 0.75‰, $\Delta^{201}$Hg = 1.16 ± 0.60‰, 1SD), we suggest that the accumulated Hg in fauna originates exclusively from MMHg produced in upper oceans, which penetrates to depth by sorption to sinking particles. Our findings reveal little in-situ MMHg production in deep oceans, and imply that anthropogenic Hg release at the Earth's surface is much more pervasive across deep oceans than was previously thought.