Methylmercury dynamics in the Western Pacific Ocean: significance of subsurface production as a source of methylmercury in surface mixed water

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To obtain insights into methylmercury (MeHg) dynamics including major sources (in situ methylation of inorganic Hg(II), vertical and horizontal transport, and deposition) and sinks (bioaccumulation, photochemical decomposition, and evasion) in the surface and subsurface waters of the ocean, we estimated mass fluxes of MeHg at the water depth of 0 to 500 m in four regions (Western Subarctic Gyre, North Pacific Gyre, Western Pacific Warm Pool, and South Pacific Gyre) of Western Pacific Ocean, using the field data obtained from the SHIPPO 2012 and 2014 surveys. For surface mixed water where MeHg concentration ranged from 3.9 fM to 34 fM, the input from subsurface layer through vertical diffusion was the major source of MeHg. This source flux in the Western Subarctic Gyre (2304 ng m^{-2} y^{-1}) was two to six times that in the North Pacific Gyre (925 ng m^{-2} y^{-1}), Western Pacific Warm Pool (1149 ng m^{-2} y^{-1}), and South Pacific Gyre (366 ng m^{-2} y^{-1}) due to the occurrence of shallow thermocline. For subsurface water, major source of MeHg was estimated to be the in situ methylation (700-2851 ng m^{-2} y^{-1}), which was balanced by vertical diffusion to the surface (366-2304 ng m^{-2} y^{-1}) and deeper waters (345-1121 ng m^{-2} y^{-1}). The large increase of in situ methylation flux in the Western Subarctic Gyre was attributable to enhanced organic carbon remineralizarion rate. These findings agree to the recent literature results of sharp decreases in Δ^{199}Hg and Δ^{201}Hg by water depth indicating that most methylation occurs below the surface mixed layer.