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Oxygen intrusion into anoxic fjords leads to increased methylmercury availability

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Mercury (Hg) appears in the oxic surface waters of the oceans at low levels (sub ng/L). Because inorganic Hg can be methylated into the toxic and bioaccumulative specie methylmercury (MeHg) levels can be high at the top of the marine food chain. Even though marine sea food is considered the main risk driver for MeHg exposure to people most research up to date has focused on Hg methylation processes in freshwater systems. This study identifies the mechanisms driving formation of MeHg during oxygen depletion in fjords, and shows how MeHg is made available in the surface water during oxygen intrusion.

Studies of the biogeochemical structure in the water column of the Norwegian fjord Hunnbunn were performed in 2009, 2011 and 2012. In autumn of 2011 mixing flushing events were observed and lead to both positive and negative effects on the ecosystem state in the fjord. The oxygenated water intrusions lead to a decrease of the deep layer concentrations of hydrogen sulfide (H2S), ammonia and phosphate. On the other hand the intrusion also raised the H2S boundary from 8 m to a shallower depth of just 4 m. Following the intrusion was also observed an increase at shallower depths of nutrients combined with a decrease of pH.

Before flushing events were observed concentrations of total Hg (TotHg) increased from 1.3 – 1.7 ng/L in the surface layer of the fjord to concentrations ranging from 5.2 ng/L to 6.4 ng/L in the anoxic zone. MeHg increased regularly from 0.04 ng/L in the surface water to a maximum concentration of 5.2 ng/L in the deeper layers. This corresponds to an amount of TotHg present as MeHg ranging from 2.1 % to 99 %. The higher concentrations of MeHg in the deeper layer corresponds to an area where no oxygen is present and concentrations of H2S exceeds 500 μM, suggesting a production of MeHg in the anoxic area as a result of sulphate reducing bacteria activity.

After flushing the concentrations of TotHg showed a similar pattern ranging from 0.6 ng/L in the surface layer to 6.5 ng/L at maximum depth (10 m). However, the pattern of MeHg concentrations in the water column changed with relatively high concentrations present already at 4.5 m depth (2.2 ng/L). The environmental consequence of this oxygen intrusion is the appearance in shallower water of toxic MeHg formed in the anoxic layer. As a result of this, MeHg can possibly undergo transport from the anoxic fjord to the surrounding areas.