Arctic biomonitor Hg isotope signatures suggest sea-ice control on marine Hg photochemistry

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With a long residence time in the atmosphere, anthropogenic gaseous elemental mercury (Hg) emissions are able to reach remote Arctic regions carried by atmospheric circulation. Unique Arctic Hg depositional conditions, river Hg inputs and marine methylation are potentially at the basis of elevated methyl-Hg concentrations in Arctic top predators, posing a health risk to northern people due to their consumption of traditional foods. In addition, the complex link between anthropogenic Hg emissions and Arctic biota Hg levels is likely influenced by climate change.

Recent work by our group on Hg stable isotopes in Alaskan seabird eggs illustrated the control of sea ice cover on Hg cycling. Here, complementary mammal tissues from the NIST National Biomonitoring Specimen Bank have been analyzed to document the temporal and geographical variations in Hg stable isotope signatures of Arctic marine foodwebs. Hg stable isotope signatures were determined in liver samples of 55 beluga whales (Delphinapterus leucas), 53 ringed seals (Phoca hispida) and 15 polar bears (Ursus maritimus) collected since 1988. Large variations in MDF and MIF are observed between species and within species stocks. Combining Hg isotope observations with ecological parameters such as $\delta^{15}N$ or $\delta^{13}C$, we are able to explain how mammal habitat use and associated diet affect mercury isotopes signatures. Belugas appear very sensitive to these parameters and individuals from each stock show significantly different MIF signatures. As for seabird eggs, north to south MIF gradients appear for all species, confirming the role of sea ice cover in modulating Hg photochemistry. The influence of sea ice on marine Hg photochemistry is also supported by significant temporal Hg MIF trends observed in ringed seal livers. In contrast Hg MDF shows potential for tracing food web connectivity as illustrated for polar bears and their ringed seal diet.