Iodine speciation and redox cycling in limnic systems: Case studies from Lake Constance and the Mummelsee

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Iodine is a vital element for all mammals due to its role in hormone production in the thyroid gland. It is also of interest in atmospheric science due to its ozone depletion capabilities and possible role in new aerosol formation. However, until recently, iodine speciation in fresh surface waters has been difficult or non- attainable due to low total iodine levels. Here, by coupling an ion chromatograph to an ICP-MS, we have been able to study (in the ng/l range) the redox cycling and speciation of iodine in 2 limnic systems; (1) a humic rich (7 mg/l DOC) lake in the Black Forest (Mummelsee) that undergoes oxygen depletion in the hypolimnion during the summer; and (2) Lake Constance, large a mesotrophic fresh water lake in southern Germany, which has low DOC concentrations (~2 mg/l) and is a vital drinking water supply for >4 million people.

Total iodine concentrations in both lakes were ~ 2µg/l. It was found that, in contrast to the oceans, organically bound iodine accounted for 70-95% of total iodine in both the Mummelsee and Lake Constance. As the Mummelsee stratified during the summer and the hypolimnion became oxygen deficient iodide (I^-) was released from the sediments into the overlying water and iodate (IO_3^-) was reduced to either iodide or organically bound iodine. There was also a striping of iodide from the epilimnion, which is probably due to scavenging by precipitating iron (oxy)hydroxides. In Lake Constance, which does not experience oxygen deficiency due to its low nutrient and organic mater status, there is no significant redox cycling at depth. However, over the summer months we observed an increase in the iodide concentrations in the epilimnion with a subsequent decrease in the organically bond iodine and no change in the iodate concentrations. This is also in contrast to oceanic iodine speciation models, as in these studies iodate is microbially reduced to iodide. We propose that during the summer organically bound iodine is broken down by either microbiological activity or photolytic degradation of humic material, both processes releasing iodide. These studies are significent for (1) understanding the basic chemical processes influencing this vital, although much overlooked, element and (2) drinking water treatment and human consumption as organically bound iodine is less easily absorbed by the body and hence a large portion of natural iodine in drinking water may not actually be available for uptake.