ABSTRACT

During the latter half of the 20:th century, the risk of exposure of human populations to methyl mercury via consumption of contaminated food received increasing attention. Research on emissions and the environmental behaviour of mercury has shown that biota in remote ecosystems, far from any anthropogenic sources, can be affected. This research has also clearly demonstrated the link between anthropogenic releases of mercury and elevated concentrations in aquatic biota. Our understanding of the environmental behaviour of mercury species has improved significantly during recent decades. Despite this, some important knowledge gaps still exist before a quantitative assessment of source-receptor relationships and the environmental hazards of mercury pollution can be made. This thesis deals with a few specific processes in the aqueous phase, with relevance to the environmental behaviour of mercury species.

The main results presented in this thesis are:

The rate of the aqueous phase oxidation of Hg^0 by the atmospheric key oxidant hydroxyl radical has been re-investigated experimentally and was shown to be sufficiently fast to influence the atmospheric cycle of mercury. Photoinduced degradation of monomethyl mercury was shown to yield water-soluble divalent mercury (Hg(II)), rather than volatile elemental mercury as previously suggested. A chemical process where formation of mono methyl mercury occurs via acetate complexes was investigated and shown to proceed, although at a relatively slow rate, under conditions relevant to atmospheric waters. Experimental investigations of the mechanisms of reduction of Hg(II) in aerated solutions have shown that an intramolecular reaction mechanism, such as photo fragmentation of an organic ligand bound to the metal, is more favourable than two consecutive one-electron reductions involving the Hg(I) intermediate.

Field measurements of mercury fluxes and dissolved gaseous mercury in surface waters have shown that emissions of mercury from the marginal seas of Europe is a significant source for airborne elemental mercury over the continent. High concentrations of dissolved gaseous mercury were observed in the Mediterranean Sea and were suggested to be partly related to natural sources to the Mediterranean basin. The total emission of mercury from the Mediterranean Sea was estimated to be about 60-70 tons during the summer season. Measurements of concentrations of dissolved gaseous mercury and total mercury in sea water along with estimated mercury evasion rates, suggest that mercury is accumulating in the Arctic seawater environment.

Key words: Mercury, elemental mercury, monomethyl mercury, dissolved gaseous mercury, abiotic, atmosphere, flux, evasion, photochemical, photodecomposition, hydroxyl radical, hydroperoxyl radical, one-electron reduction potential, mercury acetate, accumulation, Arctic Sea, Mediterranean Sea.

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