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Continuous Dissolved Elemental Mercury Measurements in the Arctic Ocean

M. Andersson, J. Sommar and K. Gårdfeldt
Department of Chemistry, Göteborg University, Sweden
(maria80@chem.gu.se)

Mercury has been used since ancient time and is today a chronic pollutant problem in the environment. The bio-geo-chemical cycle of mercury is complex involving transport and transformation processes in air, water and soil. Mercury is also a subject for bioaccumulation and biomagnification. By human activities and natural processes elemental mercury is realised to the atmosphere where it may be transported for approximately one year before oxidation with subsequent deposition occurs. In aqueous compartments the deposited mercury can be reduced to elemental mercury and therefore many surface water masses are supersaturated with dissolved gaseous mercury (DGM). Part of this mercury can be emitted back to the atmosphere. It has been shown that in both coastal (Lanzillotta et al. 2004, Lanzillotta and Ferrara 2001, Gårdfeldt et. al. 2001, Amyot et. al. 1997 and 1994) and in off shore waters (Gårdfeldt et al. 2002, Andersson et al. 2004) the concentration of DGM shows a diurnal behaviour, with higher values during daytime and lower values during night time. In order to achieve representative data on the concentration of DGM in natural water it is of great interest to perform continuous measurements of DGM. Such data can be used to estimate the back emissions of mercury to the atmosphere.

Atmospheric mercury in the Arctic has been monitored at some places by e.g. Schroeder et. al. (1998) and within the Arctic Monitoring and Assessment programme (AMAP). However measurements in the aqueous Arctic compartment have so far been highly missing.

During the expedition BERINGIA 2005 measurements of aqueous and airborne mercury species were conducted, in this work we present continuous measurements of DGM.

The measurements where conducted along a route from the west coast of Sweden across the Atlantic to Greenland, passing the Canadian arctic, continuing around the strait of Bering and the Wrangel island and finally across the north pole going from Alaska to Spitzbergen.

The system used was a development of the set-up described in Andersson et. al. (2004). In the system, seawater was continuously pumped through a chamber where a stream of gas established the equilibrium of mercury between water and gas. The gaseous mercury equilibrium concentration was measured with a cold vapour atomic fluorescence spectrophotometric (CVAFS) detection technique (Tekran 2537A). From this data the DGM concentration in the surface water was calculated using the Henry's law coefficient.

Across the Atlantic the DGM concentration varied between 10 and 15 pg L^{-1}. When entering the ice in the Canadian Arctic the concentration of DGM in sea water increased substantially: the data varied between 50 and 85 pg L^{-1}. Moreover, taking atmospheric mercury concentration into account the degree of saturation in the Atlantic water was on average 145%, when entering the Canadian Arctic ice the degree of saturation increased up to 720%. This indicates that mercury is trapped under the ice and that the reemission to the atmosphere is highly restricted in the Arctic Ocean.

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References:

Arctic Monitoring and Assessment programme (AMAP), http://amap.no/

Amyot, B., Gill, G.A., Morel, F.M.M. (1997) Production and loss of dissolved gaseous mercury in coastal seawater. Environmental Science and Technology, 31, 3606-3611

Amyot, B., Mielre, G., Lean, D.L., McQueen, D.J. (1994) Sunlight-induced formation of dissolved gaseous mercury in lake waters. Environmental Science and Technology, 28, 2366-2371

Andersson, M., Wängberg, I., Gårdfeldt, K. (2004) Daily Trends of Mercury in Off Shore Surface Waters in the Mediterranean Sea. RMZ – Materials and Geoenvironment, 52(2), 1488-1491

Gårdfeldt, K., Horvat, M., Sommar, J., Kotnik, J., Fajon, V., Wängberg, I. Lindqvist, O. (2002) Comparison of procedures for measurements of dissolved gaseous mercury in seawater performed on a Mediterranean cruise. Analytical and Bioanalytical chem-

istry, 374, 1002-1008

Gårdfeldt, K., Feng, X., Sommar, J., Lindqvist, O. (2001) Total gaseous exchange between air and water at river and sea surfaces in Swedish coastal regions. Atmospheric Environment, 35, 3027-3038

Lanzillotta, E., Ceccarini, C., Ferrara, R., Dini, F. and Pirrone, N. (2004) Daily and seasonal trend of dissolved gaseous mercury and mercury evasion from the sea surface at coastal and offshore sites in the Mediterranean basin. RMZ - Materials and Geoenvironment, 51(2), 1160-1163.

Lanzillotta, E., Ferrara, R. (2001) Daily trend of dissolved gaseous mercury concentration in coastal seawater of the Mediterranean basin. Chemosphere, 45(6-7), 935-940.

Schroeder, W. H., Anlauf, K. G., Barrie, L. A., Lu, J. Y., Steffen, A., Schneeberger, D. R., Berg, T. (1998) Arctic springtime depletion of mercury. Nature, 394, 331-332.