Trace metal speciation in anoxic waters: stunning diving in the depths of the Baltic Sea

Gaulier Camille[1,2], Zhou Chunyang[1], Leermakers Martine[1], Billon Gabriel[2] and Gao Yue[1]

[1] Analytical, Environmental and Geochemistry (VUB-AMGC), Pleinlaan 2, 1050 Brussel, Belgium
E-mail: camille.gaulier@vub.be
[2] Université des Sciences et Technologies de Lille: LAboratoire de Spectrochimie Infrarouge et Raman (USTL-LASIR)

As long as Scandinavia has been populated, the Baltic Sea has served as a path to connect the bordering countries and as a source of human livelihood [1]. Today and despite all the efforts done in environmental management, pollution associated with the rapid development and intensive industrialization of its coasts remains one of the main threats towards marine ecosystems [2]. Specifically, chemical pollution induced by trace metals (TM) is of specific concern as coastal areas are generally prone to accumulate them [3]. Over the past 100 years, the Baltic Sea has indeed degraded dramatically, stressed by industrial activities, busy traffic, intensive farming and fertilizer runoff. In addition, a quarter of the Baltic Sea's total area is a variable anoxic zone (< 0.2 mL O2 L-1), creating dead zones at high depths (from -80 m on).

The deep and anoxic waters of the Gotland Basin generate large variations of physicochemical parameters from the surface waters to the bottom sediments, influencing TM distribution and speciation. Vertical concentration gradients of labile, dissolved and particulate TM were therefore investigated in both Western (Sweden) and Eastern (Latvia) Gotland Basin, from surface-oxygenated waters to deep-anoxic ones. Labile TM were measured in the seawater using innovative DGT passive samplers [4], while the dissolved and particulate TM concentrations were assessed using classic active sampling techniques. This dual approach allows to shed light on the relation between TM concentrations and their possible bio-available fraction. Our results show that: (i) vertical profiles of particulate and dissolved metals in the water column reflect influences of oxygen deficiency and anoxic conditions in bottom water layers, (ii) dissolved and particulate concentrations do not correlate well with their bioavailability and (iii) labile fractions of Cd and Pb were unexpectedly dominant in the water column, raising our attention.

These first insights on TM behavior in the Baltic Sea show a clear depth-dependency which could be linked with temperature and salinity variations and with oxygen decrease along the water column. Data from this investigation were also compared with previous studies, knowing that, with increasing acidification of the ocean, the higher particulate TM concentrations might lead to increasing adverse effects on the coastal environment.

References

[1] HELCOM.2018.Baltic Sea Environment Proceedings.
[2] Phillips D.J.H.1977.Environmental Pollution 13.
[3] Rumisha C.,2012.Marine Pollution Bulletin 64.
[4] Davison W.& Zhang H.2016.Cambridge University Press.

Keywords: Trace metals; Speciation; Diffusive Gradients in Thin-films; Baltic Sea; Biogeochemistry