Microbiological transformations of mercury species in aquatic environments

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Biogeochemical cycle of mercury (Hg) is a complicated series of biotic and abiotic reactions, from which formation of monomethylmercury (MeHg) is widely considered as the most important, due to the proven toxicity of MeHg [1]. Organomercury forms have a pronounced capability of bioaccumulation (incorporation in cells and tissues of living organisms) and biomagnification (transport through trophic levels) [1].
In order to understand how the MeHg enters food resources, transformation of mercury and its species in the aquatic environment needs to be understood. Microorganisms play a fundamental role in mercury transformation processes (reduction, oxidation, methylation, demethylation). Hg transport and transformations are also governed by the physical and chemical properties that characterize the aquatic environment (pH, redox potential, temperature, salinity, dissolved oxygen, presence of dissolved organic matter, etc…).
The objective of this research is to better understand the role of microorganisms in mercury cycling in typical Slovenian surface water bodies as a response to mercury loads from air and water born sources. The work plan involves the following steps: (i) acquisition of measurement data on mercury analysis and speciation in precipitation and surface waters; (ii) use of chemical analytical methods for mercury analysis and speciation and transformation processes using radiotracers; (iii) application of microbiological and molecular tools to understand the role and response of microbial population to mercury stress.

The initial research has been focused on the coastal and estuarine environment of the Gulf of Trieste, which has been extensively studied in recent years [2-5]. The Gulf of Trieste is still receiving higher loads of Hg due to now closed mercury mine in Idrija and is therefore of special ecological interest. Latest results from measurements from Gulf of Trieste indicate that approximately 1-7 % of total Hg (THg) is in the form of MeHg in pore waters and water column, whereas in sediments, between 0.01 and 0.1 % of total Hg is present in methylated form (data not published). THg concentrations in marine waters are in range from 2 ng/L in surface layers to 15 ng/L at the bottom layer. Interesting values are those of dissolved elemental Hg in waters, which are not only of the same order of magnitude as MeHg, but are approximately of the same concentration as well, and are in some cases higher than MeHg. Surface waters have generally more dissolved Hg than bottom waters. Concentrations of THg in pore waters are somewhat higher and range from 4 ng/L to 32 ng/L. Sediments have the highest THg concentrations, ranging from 2700 to 17000 ng/g of sediment dry weight, however in this case, higher concentrations in top layers can be observed. These are relatively high values, indicating present (and constant) input of Hg into Gulf of Trieste. More measurements are required to estimate which are the controls over the Hg cycling in this environment. In addition to that, seasonal variations need to be investigated.

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