Mass independent isotope fractionation of mercury: Why it is such a useful tool in biogeochemistry and ecology

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Mercury is a globally distributed and highly toxic heavy metal with both natural and anthropogenic sources. Its mobility, toxicity and bio-accumulative properties change dramatically as it is transformed through microbial, photochemical and dark abiotic reactions in the environment. Multiple biogeochemical transformations of mercury determine its movement and bioavailability, and knowledge of these processes can aid in developing strategies for minimizing human and wildlife exposure to its most toxic forms. The seven stable isotopes of mercury fractionate in the environment due to an unusually wide range of physical processes. Mass-dependent fractionation (MDF) occurs during most biotic and abiotic reactions that have been investigated. Mass-independent fractionation (MIF) of mercury can be caused by the magnetic isotope effect, the nuclear volume effect and by UV self-shielding. Each fractionation mechanism imparts a diagnostic pattern of isotopic variation and thus mercury isotope ratios can be used to unravel complex biogeochemical pathways for mercury. Large-magnitude MIF of odd isotopes is uniquely produced by photochemical reactions, which are important because they can degrade mercury from the toxic methylated form to a volatile gas. In addition to isotopic fingerprinting of sources, MIF and MDF in natural samples have been calibrated against experimental determinations of fractionation factors to identify reactions in natural systems and estimate their reaction progress. Because MIF is unaffected by biotic processes it preserves a memory of biogeochemistry before entry into the base of foodwebs.

Seawater Trace Metals in acidified condition: an accumulation study in the blue mussel Mytilus galloprovincialis off Vulcano Island submarine vents (Italy)

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Ocean acidification is linked to the increasing concentration of atmospheric anthropogenic carbon dioxide, and this process might have negative ecological and economic effect worldwide.

Areas with naturally high levels of CO_2 can help us to achieve a better understanding of this issue. Submarine vents in the Levante Bay of Vulcano Island (Italy) are CO_2-dominated resulting in seawater acidification, and producing a stable pH gradient (from 8.2 down to 5.5) across the bay [1]. We now know that ocean acidification is tightly linked to the mobility and bio-availability of heavy metals.

In that area a transect covering the pH conditions which will be found up to the end of this century has been individuated and a Blue Mussels transplant experiment was done along this gradient in order to estimate the trace metal accumulation capability related to the seawater acidification.

Major and Trace elements were analyzed both in seawater and in the mussels' tissue.

At the end of the experiment, the animals showed an increase of concentration for some elements such as Fe and V with respect to blanks.

The present study provides preliminary data on a particular aspect related to the ocean acidification problem.

[1] Boatta *et al*. (2013) Marine Pollution Bulletin, in press. DOI: 10.1016/j.marpolbul.2013.01.029