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# Are Hydrothermal Vents and Tectonic Activity a Significant Source of Mercury in the Mediterranean?

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During the last decades several mercury studies have been conducted in the Mediterranean Sea in order to assess the state of mercury pollution in the area. Among many different mercury species, the mono-methylmercury is the most dangerous. It can be both bioaccumulated and biomagnified and is therefore harmful to the entire food-web.

The problem is assessed by both measurements and modelling. In the frame of the EU project MERCYMS, several coastal and deep-sea measurement campaigns were performed to gather the data needed for the modelling purpose. The water compartment was modelled by a baroclinic 3-D hydrodynamic / transport model PCFLOW3D (Rajar et al., 2000, 2004), upgraded with a mercury biogeochemistry module, which took into account the basic mercury transformations (methylation, demethylation, reduction and oxidation) and fluxes. The air compartment was modelled by the RAMS / SKIRON modelling tool, which dealt with transport and chemistry of mercury in the air and provided mercury concentrations in the atmosphere and the quantity of deposition. The models were linked in order to simulate exchange of mercury between the air and the water. All available measurement data were used for calibration and

validation of the models. The agreement between measurements and modelled results was found to be acceptable.

On the basis of measurements and the model simulations the annual mercury mass balance for the water compartment of the Mediterranean was established. All known natural and anthropogenic sources and sinks were taken into account. Major river inflows (+13 t/yr) and point sources (+2.5 t/yr), exchange through the straits of Gibraltar (-1.7 t/yr) and Dardanelles (+0.06 t/yr) and atmospheric deposition (+23 t/yr) were calculated as well as sedimentation to the abyssal sediment (-11 t/yr) and evasion (-50 t/yr), which represents the biggest sink. The presented quantity of evasion is lower than reported by most of the other authors; lower quantity, 27 t/yr, was calculated only by Cossa et al. (1997), while the recent studies of Pirrone et al. (2001) and Gårdfeldt et al. (2003) reported a much higher value of 100 to 110 t/yr.

The mass balance further showed that the difference between the input and output of mercury for 2005 was -25 t/yr. With such a trend, concentrations in the Mediterranean Sea would decrease relatively fast, which is very hard to believe, thus leading to the opinion that some other, particularly natural sources must exist. Moreover, the measured profiles of dissolved gaseous mercury (DGM) concentrations show a sudden increase near the bottom (Horvat et al., 2003), particularly in areas of active volcanism (Southern Tyrrhenian Sea) and enhanced tectonic activity (Central Mediterranean).

It is known that emissions from volcanoes, fumaroles and sulfataras as well as contribution from widespread geological anomalies could represent an important natural source of mercury in the Mediterranean basin (Ferrara et al., 2000). Geologic sources of mercury are concentrated in three belts associated with plate tectonic boundaries and include areas of fossil and current geothermal activity, recent volcanic activity, metal deposits, and organic rich sedimentary rocks (Gustin 2003). The richest deposits of mercury are found in the Mediterranean region associated with Himalaya-Alpine Belt. While the significance of natural geologic emissions of mercury to the atmosphere is still debatable, there is very little or almost nothing known about natural submarine mercury sources. Recent work of Stoffers et al. (1999) and Astakhov et al. (2004) indicate that submarine tectonic activity with accompanying phenomena could represent an important source of mercury to oceans.

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