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The effects of resuspension on the fate of Hg in contaminated sediments (Marano and Grado Lagoon, Italy): Short-term simulation experiments

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ABSTRACT

Sediments of the Marano and Grado Lagoon (Adriatic Sea, Italy) represent one of the world's most major repositories of mercury (Hg). Its presence is a direct consequence of the historical mining activity in nearby Idrjia (Slovenia), as well as significant discharges from a chlor-alkali plant into the Aussa–Corno river system, which connects to the lagoon. Previous studies have shown that sediment acts as secondary source of Hg species to the overlying water column in natural conditions. However, evidence for the effects of resuspension on the dynamics of Hg species is still lacking. The work reported in this paper formed part of the multidisciplinary "MIRACLE" project, aimed at identifying areas at low risk of Hg bioaccumulation in commercial Manila Clams, an important part of the local economy in this region. The effect of resuspension on the cycling of inorganic mercury (IHg), reactive mercury (RHg) and methylmercury (MeHg) between the sediment and water column was investigated in a mesocosm study. Two experiments were conducted in October 2009 and September 2010 based on material collected from sites heavily impacted by Hg and periodically subjected to dredging activities. Designed to mimic the resuspension of particles, both experiments revealed that the release of Hg species from the solid to the dissolved phase became negligible quickly after the event. MeHg values did not change according to total mercury (THg), suggesting that the enhancement of methylation processes may occur. The findings reported in this paper may be useful for the local management of dredging and fishing activities, although mass balance calculations showed that the total flux of Hg species are trivial compared to lagoon-wide processes.

1. Introduction

Lagoons are complex ecosystems located at the interface between land and sea, characterized by shallow water depths. Their relatively special hydrodynamics cause confined circulation of both water and particulate phases. In addition, strong variations in temperature and light regimes, high productivity, potential biodiversity and vulnerability to anthropogenic pressures suggest the need to carefully monitor their health, as well as manage/preserve these vulnerable ecosystems (Guerra et al., 2009; Caruso et al., 2010).

Coastal sediments are among the main repositories for toxic substances released as a consequence of anthropogenic activities. Due to their intrinsic sorptive nature, sediments can reduce the potential toxicity for aquatic organisms (see Eggleton and Thomas and references therein, 2004). On the other hand, when resuspension events occur, the recycling of particles and associated nutrients and the reintroduction of pollutants into the water column through the sediment–water interface can occur (Bloesch, 1995). Several activities result in sediment resuspension: natural events, such as tidal currents, wind waves, storm events, and wave–current interaction (Sanford et al., 1991; Arfi et al., 1993), and anthropogenic activities, such as dredging, trawling and fisheries activity (Schoellhamer, 1996; Lewis et al., 2001). Taking dredging as an example, this common tool used to maintain waterways and access to marinas can either cause the contaminant to be removed from the water column and settle in the sediment, or it can be added to the water as it rises from the sediment. Furthermore, the alteration of physicochemical properties (i.e. pH and redox

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