Historical accumulation of mercury from mining and industrial activities (Marano & Grado Lagoon, northern Adriatic sea)

Stefano Covelli[1], Leonardo Langone[2], Alessandro Acquavita[1,3], Raffaella Piani[1], Andrea Emili[1]

[1]Department of Geosciences, University of Trieste, Via Weiss 2, 34128 Trieste, Italy Phone: +39-(0)-40-5582030
[2]CNR-ISMAR, via Gobetti 101, 40129 Bologna, Italy E-mail: covelli@units.it
[3]*Osservatorio Alto Adriatico*, ARPA-FVG, Via Cairoli 14, 33057, Palmanova (UD), Italy

Introduction: The Marano & Grado (MG) Lagoon was subject to mercury (Hg) contamination both from industrial waste and mining activity tailings. The former are due to a chemical complex which has been producing cellulose, chlor-alkali and textile artificial fibers since the '40s [1]. The second input comes from the Isonzo (So•a) River, the most relevant source of Hg contamination in the northern Adriatic Sea, caused by the Idrija Hg mine (NW Slovenia) since the 16th century [2]. The "MIRACLE" Project was promoted by the *Commissario Delegato* of MG Lagoon in 2008, in order to test the coexistence of clam farming and the possible extension of rearing activities in areas with high Hg contamination in the sediments. The project involved an international collaboration among Italian, Slovenian and US scientists, applying a broad range of expertise at various scales. In the framework of the "MIRACLE" Project, one of the subtasks was to determine the historical evolution of Hg accumulation in the lagoon bottom sediments.

Methods: Fourteen 1-m long sediment cores were collected in the subtidal and intertidal zones in summer 2008 and analyzed for total Hg content and several physico-chemical parameters. Sedimentation rate assessments were performed using short-lived radionuclides as excess ^{210}Pb and ^{137}Cs.

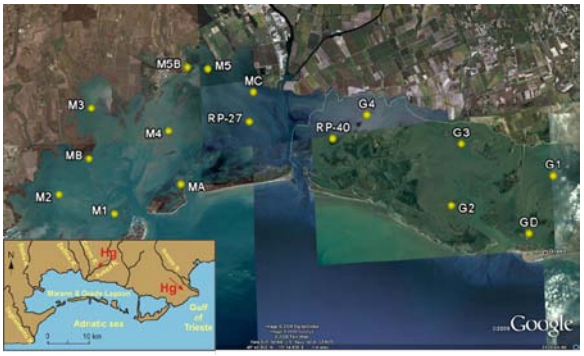

Fig. 1: The sampling area.

Results: Hg contaminated sediment depths range between 20 and 100 cm. However, for most of the analyzed cores, natural background levels of Hg have been observed at a 50 to 100 cm depth. In the eastern area (Grado Lagoon), Hg contamination is maximum at the core top (up to 12 µg g^{-1}) and it is measured down to 1 m depth (0.61 µg g^{-1}) as a consequence of the long-term mining activity. The vertical distribution is not related to grain-size variability or to organic matter content but rather to the influence of the single contamination sources. In the western part of the area (Marano Lagoon), Hg contents do not exceed 7 µg g^{-1} at the surface and contamination is recorded only in the first 20-30 cm.

Discussion: Hg inputs in the Grado Lagoon are up to one order of magnitude higher than in the Marano sector, as seen from the concentration profiles in the collected cores and the recent depositional flux calculations. Geochronological measurements show that the depositional flux of Hg has been influenced by anthropogenic inputs after 1800, when mining activities in Idrija were more intense. The observed increase in Hg fluxes until 1950 should be ascribed only to the aforementioned Idrija input. After 1950, Hg in the surface sediment, most notably in the central-western sector, seems resulting from two inputs: mining in the Idrija district and the Aussa River discharge, conveying Hg from the chlor-alkali plant. Since 1996, Hg mining in Idrija has ceased. However, core profiles do not show a decreasing trend for Hg fluxes. Thus, in the short term, a decrease in Hg inputs into the nearby Gulf of Trieste [2] and the MG Lagoon seems unlikely. A preliminary round down gross estimate of the total Hg "trapped" in the Lagoon sediments amounts to 250 metric tons. Such quantities, and the complexity of the Lagoon ecosystem, suggest that an *in toto* reclamation of the sediments is economically and environmentally unfeasible on the whole scale of the lagoon.. A partial removal of contaminated sediments could be operated inside the fish farms, but this kind of intervention could be not effective and lasting due to tidal sediment redistribution. . As a consequence, the presence of Hg in the lagoon environment must be considered a long-term issue and the biogeochemical behavior of this metal in the sediment-water system shall be carefully considered in the future, whenever a new use for the lagoon areas will be planned..

References: [1] Covelli et al. (2009) *Estuarine Coastal Shelf Sci.* **82**: 273-284; [2] Covelli et al. (2006) *Mar Geol.* **230**: 29-51