

UNIVERSITY OF NAPLES, FEDERICO II



PhD in Biology XXXIV Cycle  
(co-founding SZN)

**Characterization, treatment and valorization of  
contaminated sediment: the potential role of  
invertebrate**

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## Abstract

Marine sediments are fundamental and integral parts of water bodies and they are composed of soluble and insoluble compounds. Marine pollution in coastal areas is a major concern, due to the large number of toxic substances discharged and accumulated in the sediment. Natural (*i.e.*, bioturbation) or artificial (*i.e.*, dredging) perturbative events can release accumulated contamination, causing acute toxication to water column organisms and the re-allocation of contaminants within the same aquatic environment. This study investigates the effects of sediment spiked with PAHs, PCBs and Zn at sub-chronic concentration (at 192 µg/L, 0.15 µg/L and 40 mg/Kg, respectively) on the sea urchin *Paracentrotus lividus*. Results demonstrated that Zn was lethal to *P. lividus* adults after two weeks of exposure. Moreover, a toxigenic effect on embryos generated in females exposed for two months to PAHs and PCBs has been shown. (i) Morphological observations under optical microscopy revealed that PAHs and PCBs induced an increase of malformed and/or delayed embryos, and an increase of bioaccumulated compounds, compared to negative control. (ii) Molecular analysis by *de novo* transcriptome and *Real Time qPCR* showed that PAHs and PCBs are able to affect the expression levels of several genes involved in different cellular processes. After acute tests with four PAHs (naphthalene (NAP), phenanthrene (PHE), fluoranthene (FLT) and benzo(k)fluoranthene (BkF)), results showed that FLT was the most toxic compound to nauplii and adults of the crustacean branchiopod *Artemia franciscana*. In the third part of this work, all the available literature on the potential effects related to the use of amendments in sediment remediation (activated carbon (AC), nano-Zero-Valent-Iron (nZVI), apatite (A), organoclay (OC) and zeolite (Z)) has been reviewed and analyzed considering the sensitivity of the model species. The HC5 values in descending order were: AC (4.79 g/L) > nZVI (0.02 g/L) > OC, A and Z (1.77E-04 g/L). Moreover, the work investigated the differences in PAHs concentrations removal after AC and nZVI experiments both in sediment and seawater, and on their embryotoxic and genotoxic effects on *A.*

*franciscana*. Results showed that efficiencies of removal of AC and nZVI were similar both for the sediment and the seawater. nZVI showed higher toxicity and genotoxicity than AC. This study represents the first demonstration of the toxic effects of common pollutants spiked in sediments, on adults and embryos of the sea urchin *P. lividus*, adopting sub-chronic concentrations. Furthermore, the present work exhibits considerable ecological relevance, opening new perspectives on the study of negative impact on the resident biota of remediation methods.