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TITLE: Heavy-metal resistant microorganisms in sediments from submarine canyons and the adjacent continental slope in the northeastern Ligurian margin (Western Mediterranean Sea)

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ABSTRACT:

Abstract Heavy metals (HMs) enter the marine environment through a variety of sources, especially in areas such as submarine canyons acting as conduits for terrigenous pollutants to the deep sea. HMs exert toxic effects at different levels of biological organization, yet several marine microbes have the capacity to tolerate HMs. However, the relationships between microbes, their tolerance mechanisms and the concentration of HMs in the marine environment are poorly investigated. We evaluated the occurrence and distribution of HMs and culturable HM-resistant microorganisms in sediments collected in two submarine canyons and the adjacent slope in the NE Ligurian margin (Mediterranean Sea), down to 2000 m depth, and explored the role of contaminants in modulating community adaptation to metals. HM concentrations exhibited wide spatial variability across the whole study area, without showing significant differences between canyon and open slope environments, exception made for higher Cd concentrations recorded in one canyon. Benthic microbial abundance was negatively correlated with Cd concentration, while viable counts of HM-resistant microorganisms indicated tolerance of HMs in the order $Zn^{2+} > Cu^{2+} > Hg^{2+} > Cd^{2+}$. Differences in the tolerance patterns were observed among sampling stations, with microbial communities generally tolerating up to three HMs. Cd^{2+} was the less tolerated metal, with microbial growth in the presence of this metal observed only for 50 ppm, and only at five of the eleven sampled stations. Our results show the existence of complex multitolerance patterns in deepsea sediments subjected to anthropogenic influence, suggesting that microbial HM tolerance develops under different ways and mechanisms that have to be elicited. Also, they highlight the opportunity for further exploitation of the potential of HM-resistant deep sea microbes for the remediation of contaminated marine areas, or for their use as bioindicators of human impact down to the deep sea.

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