Tracing anthropogenic zinc contamination in coastal environments using stable isotope composition

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The present study explored Zn isotopic compositions of different samples (rocks, sediments, ores and bivalve mollusks) from an estuarine lagoon heavily impacted by metallurgic activities, namely Sepetiba Bay (southeastern Brazil), in order to identify sources and sinks of anthropogenic zinc. Spatial and temporal analysis of Zn isotopic signatures of samples fit well in a model of mixing involving three main end-members: i) terrestrial background ($\delta^{66}Zn_{JMC}$ = + 0.28 ± 0.12‰, 2σ); ii) marine detrital material ($\delta^{66}Zn_{JMC}$ = + 0.45 ± 0.03‰, 2σ); and iii) an anthropogenic source associated with electroplating wastes released into the bay ($\delta^{66}Zn_{JMC}$ = + 0.86 ± 0.15‰, 2σ). In contrast, source mixing alone cannot account for the isotope ratios observed in the bivalves, which show significantly lighter $\delta^{66}Zn_{JMC}$ values in the contaminated metallurgical zone ($\delta^{66}Zn_{JMC}$ = +0.49 ± 0.06‰, 2σ, n=3) compared to other sampling locations of the study area ($\delta^{66}Zn_{JMC}$ = +0.83 ± 0.10‰, 2σ, n=22). This observation suggests that additional factors such as Zn speciation, bioavailability and bioaccumulation pathways (via solution or particulate matter) may have influenced the zinc isotope compositions of the bivalves.