

Metal speciation and environmental impact on sandy beaches due to El Salvador copper mine, Chile

Marco Ramirez, Serena Massolo, Roberto Frache, Juan A. Correa

Abstract

Several coastal rocky shores in northern Chile have been affected by the discharges of copper mine tailings. The present study aims to analyze the chemical speciation of heavy metals in relation to the diversity of sessile species in the rocky intertidal benthic community on the northern Chilean coast, which is influenced by the presence of copper mine tailings.

In particular, the chemical forms of Cd, Cu, Fe, Mn, Ni, Pb and Zn in beach sediment samples collected in the area influenced by El Salvador mine tailings were studied using a sequential chemical extraction method.

In general, all the elements present a maximum concentration in the area near the actual discharge point (Caleta Palito). With regard to Cu and Mn, the concentrations range between 7.2–985 and 746–22,739 $\mu\text{g/g}$ respectively, being lower than background levels only in the control site of Caleta Zenteno. Moreover, the correlation coefficients highlight that Fe, Mn and Ni correlate significantly and positively in the studied area, showing a possible common, natural origin, whilst Cu shows a negative correlation with Fe, Mn and Ni. It could be possible that Cu has an anthropogenic origin, coming from mining activity in the area.

Cd, Fe, Mn, Ni, Pb and Zn are mostly associated with the residual phase, whilst Cu presents a different speciation pattern, as resulted from selective extractions. In fact, Cu is highly associated with organic and exchangeable phases in contaminated localities, whilst it is mainly bound to the residual phase in control sites. Moreover, our results, compared to local biological diversity, showed that those sites characterized by the highest metal concentrations in bioavailable phase had the lowest biodiversity.