

How mangroves act as a filter toward trace metals between open-cast mining and lagoon

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Abstract

Mangroves of New-Caledonia act as a buffer between a lagoon of more than 20,000 km² and the Island, which is characterized by ultramafic rocks and lateritic soils that are exploited for their richness in some trace metals. New-Caledonia is currently the third nickel-producing country in the world. Open-cast mining occurs all around the Island, and processes of erosion and sedimentation, which occur naturally along the coastline, are strongly amplified by mining activities. Due to their position, at the interface between land and sea, mangroves receive extensive amounts of particles emanating from rivers through estuaries. The purpose of this study is to understand the distribution and partitioning of some heavy metals (Fe, Mn, Ni, Cr) in sediments and pore-waters in various mangroves of the Island, with and without mining activities in their watershed. Quantitative analyses on bulk and after selective extraction were carried out on cores collected beneath *Rhizophora stylosa* stands, *Avicennia marina* stands, and within salt-flats. Ni concentrations in mangrove sediments are 10 to 100 times higher downstream mining areas (mean value of ~44 $\mu\text{mol g}^{-1}$) than in mangroves developing downstream of a catchment not composed of ultramafic rocks (mean value of ~1 $\mu\text{mol g}^{-1}$). The organic content and the length of immersion by tides appear to be the main factors controlling distribution and partitioning of heavy metals in mangrove sediments. There are gradients of these two parameters along the intertidal zone, from the salt-flat to the *Rhizophora* stands, which induce different redox conditions. Heavy metals are deposited in the mangrove mainly as oxides and/or oxy-hydroxydes that are subsequently dissolved during organic matter decomposition. Dissolved metals are then precipitated with organic and sulphide compounds. To conclude, organic diagenesis in mangrove sediments leads to the transfer of heavy metals from oxide form to organic and sulphide forms.

Keywords

geochemistry, zonation, anthropogenic pressure, developing country