Evaluation of aluminum mobility and distribution in sediments of a tropical reservoir in Rio de Janeiro, Brazil

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Abstract

In the Juturnaíba Lake two drinking water treatment plants have discarded Al rich residues (as a flocculating agent) in two sites for the last 30 years. In direct contact with water, this residue may have been spread throughout the reservoir, affecting water and sediment quality. High Al concentrations are toxic to aquatic plants and may display adverse public health and environmental effects. The aim of this study was to assess the spatial and geochemical spreading of metals, mainly Al, in the superficial sediments from the dumping sites. 45 sediment samples were collected and metal concentrations, pH and the granulometry were measured. Pseudo-total trace metal contents were assessed after inverted aqua-regia microwave digestion. The three-steps BCR sequential extraction procedure was applied, and Al, Fe, Mn, Cu and Zn were determined by Inductively Coupled Plasma Optical Emission Spectrometry. The pH of the sediments showed little variation, with an average value of 6.9 ($\pm$ 0.3). Very high concentrations of Al were observed in the samples near the dumping sites (42.90 ± 5.6 g Kg^{-1}). However away from dumping area some high Al concentrations were observed. There were no anomalies in total Cu, Zn, Cr and Ni concentrations. The highest percentages in geochemical partitioning of Al, Zn, Fe and Cu were found in the residual fractions (84.7%, 46.2%, 50.3% and 60.6%, respectively), meaning that these metals were strongly bound in the sediments. Elevated percentages of Mn found in the first step (77.8%) is the result of its great mobility. Some sampling points, located near the residues discarded, displayed high Al contents in step 1, with contributions varying from 63.8 to 28.8%. It is concluded that although the residues may be affecting the sediment and the water quality, this contamination was not widely spread through the reservoir.