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Platinum variability in a hydrodynamic estuary: Effects of contrasting environments and fate

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Abstract

Platinum (Pt) is one of the less-studied elements in estuarine waters. Consequently, understanding its speciation analysis and environmental fate remains limited regardless of its emerging environmental concern. This study addressed the occurrence and discrimination of soluble/insoluble Pt species in a hydrodynamic aquatic system and their potential transport was evaluated. Particulate (Pt_p) and dissolved (Pt_d , $<0.45 \mu m$) forms of platinum were determined in the water column of the Tagus estuary. Two contrasting environments encompassing different salinities and sources were sampled during semi-diurnal tidal cycles, neap (NT) and spring (ST) tide. The two stations were located in the upper Tagus estuary (VFX) and near the mouth, close to a wastewater treatment plant (ALC). Pt was analyzed by voltammetry and ICP-MS, and ancillary parameters were determined. The concentrations of Pt were higher during the low tide, following the tidal regime. Those ranged between $1.0\text{--}25.6 \text{ ng g}^{-1}$ and $0.1\text{--}11.7 \text{ ng L}^{-1}$ for Pt_p and Pt_d , respectively. The Pt levels found at the WWTP outfall were higher than upstream, mirroring anthropogenic inputs from automotive catalytic converters and an additional Pt source originated in Pt-based compounds. Distribution coefficients (K_d) of 10^4 were computed and were independent of the salinity gradient. During the NT, the speciation analysis done at VFX showed that truly dissolved forms measured by voltammetry represented $39\pm 9\%$ of total Pt in the water column. In contrast, total filter-passing species measured by ICP-MS were higher, $65\pm 14\%$. These results suggest that dissolved forms control Pt speciation in the estuarine water column. The potential transport evaluated at ALC indicated recirculation within the estuary and export towards the coastal area, with higher concentrations throughout the ebb opposing to the flood. This study highlights the estuaries as important pathways to introduce Pt in coastal regions, transferring them towards the ocean.

Keywords

Platinum, Particle-water interactions, Speciation analysis, Environmental fate