Sedimentary geochemistry of platinum in intertidal salt marsh sediments of the Tagus River Estuary (Lisbon, Portugal)

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The introduction of catalytic converters in motor vehicles during the past 20-30 years has led to a significant increase in platinum concentrations in the environment and a number of studies have been undertaken to characterize its geochemical behaviour. Most of these studies have focused in the urban environment, whereas the biogeochemistry of platinum in anthropogenically-impacted estuarine and salt marsh sediments is still poorly characterised.

In order to better understand the role of salt mash plants in the cycle of this element, sediment cores from vegetated and non-vegetated intertidal sediments of the Tagus Estuary (Lisbon, Portugal, SW Europe), which are subject to strong anthropogenic inputs, were studied. Sediments cores, leaves, stems and roots of Sarcocornia fruticosa were collected in two salt marsh areas and analysed for their Pt concentration. Pore-water was separated from the sediments and analysed for dissolved Pt. Auxiliary parameters – dissolved oxygen, redox potential, total dissolved Mn and Fe – were also determined. Depth profiles of Pt in non-vegetated sediments showed low concentrations ranging from 0.5 to 1.0ng.g^{-1}. Since oxygen penetration depth in these sediments is restricted to few millimetres the observed slight enhancement with depth suggests its retention as sulphides or associated with sulphide phases. In vegetated sediments, higher levels of Pt were found in the uppermost layers (up to 3ng.g^{-1}). This increase was found in sediment layers containing higher root biomass, suggesting that Pt retention may derived from plant activity. The atmospheric – traffic-borne – input of Pt may also contribute to the higher values in the topmost sediment layer.

Plant roots exhibited lower Pt concentrations (0.2-0.9ng.g^{-1}) than sediments indicating that Pt is not significantly sequestered in root tissues. The oxic condition of vegetated sediments due to the plant activity may stabilize Pt in the dissolved fraction, aided by its association with dissolved organic matter derived from root exudates. Levels in the leaves and stems (0.015-0.12ng.g^{-1}) were up to one order of magnitude lower than in roots, indicating that small amounts of Pt was translocated upward and not retained in the aboveground tissues. Our results point that either S. fruticosa has low Pt phytoextraction capacity of and/or Pt is mostly present as non-bioavailable forms.

The results presented in this study will be discussed in terms of their implications on (i) the status of Pt contamination in the Tagus Estuarine/Salt Marsh sediments due to traffic-borne emissions; (ii) the influence of redox conditions and vegetation on the geochemical sedimentary behaviour of Pt; and (iii) the uptake of Pt by vegetation.

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