Contamination sources and dynamics in an urban catchment using metal isotopes and radionuclide measurements

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Urban expansion has led to the contamination of aquatic environments through the supply of pollutants coming from soil erosion and the leaching of urban surfaces.

The objective of this study is to evaluate, at the catchment scale, the persistence of anthropogenic pollutants (both inorganic and organic) in the Critical Zone. Spatial and temporal dynamics of these contaminant transfers are quantified through stable ($^{206}Pb/^{207}Pb$ and $^{208}Pb/^{206}Pb$) and radioactive (^{7}Be, ^{210}Pb, ^{137}Cs) isotope measurements.

The study investigates transfers in the Orge River catchment (900 km^2, France), a tributary of the Seine River, characterized by a gradient of increasing urban pressure between headwaters (300 inh/km^2) and the outlet (5000 inh/km^2), along with contrasted land uses, i.e. forest, agriculture and urban. Catchment monitoring included the continuous measurements of physico-chemical parameters (pH, EC…) in the river, the collection of atmospheric fallout for 18 months, and the sampling of potential contaminant sources within the catchment (soils, road deposit). Water and suspended particulate matter (SPM) were collected using sediment traps located at four sampling sites along this gradient in 2015/2016 to integrate hydrological variations.

The results showed an increase of most trace metal concentrations including Cu, Zn, Pb, Sb in SPM, and Cu, Zn, Pb in water, strongly reflecting the increasing contribution of contamination from urban sites. These findings are consistent with the progressive shift in Pb isotopic signature from up to downstream. Finally, radionuclide results indicate an increasing input of recently eroded particles downstream.

These results underline the impact of hydrological conditions and urbanization on sources of SPM contamination. The objective is to quantifiy urban impact on particle transfer time and precise the sources of SPM contamination. In the future, the global budget of the contaminants will be calculated at the catchment scale.