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Zinc mobility in an infiltration basin (Lyon city, France): constraints from Zn stable isotope ratios in the plant and sediment

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Infiltration basins are stormwater management techniques that are widely used. The settling of stormwater particles leads to a contaminated sediment layer. Wild plants can colonize these basins. They can play a role on the fate of heavy metals either directly by uptake or indirectly by modifying the forms of the metal in the sediment. Plant interactions with metals depend on a large number of factors, including the type of metal, the plant species and plant's growth stage. Moreover, during the dormant period of each year, the shoots die back. The resulting dead matter is returned to the basin substrate where it gradually decomposes through a combination of leaching and biological action that implicates a complete cycle for metal mobility. In order to model the metal cycle in the system, we consider the plant root, aerial part, litter deposits, sediments as the main Zn pools.

The aim of this study is to assess the Zn mobility between these pools. The Zn concentration and isotope ratios were analyzed in the different Zn pools for two dominant species of the studied infiltration basin (Phalaris arundinaceae, Typha latifolia) and for a complete biological cycle from spring to winter. Zn stable isotopes are expected to fractionate with plant uptake and translocation and thus can help to assess the effect of the plant biochemical processes on Zn mobility. Whilst the sediments (1100-1400 ppm Zn DW) and litter (600 ppm) are highly concentrated in Zn, the plant aerial parts (100-250 ppm) are less concentrated than the roots (200-400 ppm). The [U+F064]66Zn significantly differ between the sediment (0.15 to 0.19‰ and aerial parts of the plants (-0.03 to -0.08‰ hence confirming the occurrence of depletion in heavy isotopes with plant uptake and translocation to shoot. The [U+F064]66Zn of roots fall close to the sediment. The roots show a small depletion in heavy isotopes between mid-summer (0.18‰ and winter (0.27‰. This observation and the fact that the litter is enriched in heavy isotopes (0.16‰ versus the aerial parts support the export of Zn to the roots before leaf senescence and/or the Zn transfer from the sediment to the litter matrix. We conclude that stable Zn isotope ratios bring relevant constraints for Zn cycling model between the plant and urban sediment.