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Zinc, cadmium, and copper mobility and accumulation in reeds (Phragmites australis) in urban sediments from two stormwater infiltration basins

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Infiltration basins are stormwater management techniques that are widely used to reduce stormwater volume. The settling of stormwater particles leads to a contaminated sediment layer at the basin surface. Phragmites australis used in constructed wetlands are widely present in infiltration basins. Such plant can play a role on the fate of heavy metals either directly by their uptake or indirectly by modification of physico-chemical characteristics of the sediment. The aim of this study is to assess Zn, Cd and Cu potential mobility and their bioaccumulation by reeds during plant's growth in urban sediments offering two different geochemical contexts.
Methodology is based on the monitoring (in june, august and december) of physico-chemical characteristics of sediment deposit in two basins. These basins, "Minerve" and "Grézieu", located on both sides of Lyon city are characteristic of two different geochemical context. "Minerve" is in the east and "Grézieu" in the west part. The geology of the eastern part of Lyon is characterized by carbonated fluvio-glacial deposits. In the western part, the subsoil is mainly composed of gneiss and granit. Moreover, 20 cm of gravel and a sand layer were initially added at the surface of the "Grézieu" basin. In "Minerve", a clay material was initially added and a filter trench was built along the basin to allow water infiltration. We characterized the sediment deposit by the identification of their geochemical characteristics (Zn, Cu, Cd, total content, pH, CEC, C/N, carbonates and major elements contents ...). Then we studied the potential mobility of the three metals by single chemical extraction (CaCl2 for the exchangeable phase, acetate buffer for the acido-soluble phase and diethylenetriamine-pentaacetic acid (DTPA) for the fraction associated to the organic matter). The accumulation of Zn, Cd and Cu in aerial parts and roots of the reeds was also measured.
The results show clearly that "Grézieu" sediment is more enriched in organic matter and metals than "Minerve". For example, Zn contents are equal to 400 mg/kgDW in "Grézieu" whereas it is equal to 80 mg/kgDW in "Minerve". In the most contaminated basin "Grézieu", metals mobility is mainly controlled by their association with carbonates and organic matter. Thus, copper associated with organic matter may represent almost 70% of the total copper content. In the "Minerve" sediment, the metals are distributed on the different sediment components, with very stable associations on the different mineral phases. The reed accumulates more metal in the context of the most contaminated basin (Grézieu), but without any differences in bioconcentration factors. The high metal contents in "Grézieu" sediments limited also the growth of reed. Moreover, for "Grézieu" sediment, characteristics evolve with the seasons. Thus, texture decreases from June to December in parallel with an increase in organic matter and metals in the sediment deposit.