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Processes controlling metals in soil-plant systems: Interest of combining speciation and stable isotopes fractionation

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The transfer of metals into plants and their translocation within plants has important implications for food safety and food quality in the case of crop plants, for the management of contaminated soils, and more generally to understand the biogeochemical cycle of metals in terrestrial systems.

X-ray absorption spectroscopy and stable isotope geochemistry are complementary approaches to study the fate of metals in soil-plant systems since they provide a snapshot on the metal speciation in a given plant organ, whereas metal isotope ratios result from chemical and biological processes all along the pathway from the soil to the plant organ.

Three case studies will be presented, on the micronutrient but also metallic contaminant zinc, and on the non-essential and highly toxic element cadmium. The first one focuses on the fate of Zn in a contaminated soil-plant system: aquatic plants, *Phalaris arundinacea* [1] and *Typha latifolia [2]*, growing in an urban wetland. The second one focuses on the fate of Cd in a model crop, rice that grew in soil spiked with Cd. In that case, the effect of the water management and of the root vacuolar transporter HMA3 were studied [3, 4]. For the third case study, first results from an ongoing project on Cd in a cocoa plantation with background Cd levels will be presented. The contrasted behavior of Zn and Cd in terms of isotope fractionation and their distribution within the plants will be discussed in light of their affinity for O and S ligands and putative metal transporters involved. Finally, the interest and limitations of these approaches will be discussed.

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[4] Wiggenhauser, *Frontiers Plant Sci. In revision*