**Trace element biogeochemistry in the rhizosphere: Why bother with plant-mediated physical-chemical processes?**

Matthieu N. Bravin
*CIRAD, UPR Recyclage et risque, F-97408, Saint-Denis, Réunion, France*

The investigation of trace element biogeochemistry in the soil-plant system is a necessary step for many agricultural and environmental issues. For instance, an in-depth understanding of trace element biogeochemistry is helpful to support soil fertility by enhancing or alternatively alleviating the plant uptake of micronutrients and inorganic contaminants, respectively. The manipulation of trace element biogeochemistry is also a key component of phytoremediation strategies implemented on highly contaminated soils. The common driver of all these agronomic and environmental issues is intimately related to the interactions occurring at the soil-plant-microbial interfaces, i.e. in the so-called rhizosphere. The present lecture will focus on an updated overview of the many physical-chemical processes mediated by plant roots in the rhizosphere and how these processes drive trace element biogeochemistry in the soil-plant system.

The first part of the lecture will be dedicated to a case study that demonstrates the importance of plant-mediated physical-chemical processes in determining copper toxicity to wheat in former vineyard soils in southern France. In this context, the occurrence of copper toxicity to wheat interestingly contradicted the prediction that has been made from bulk-soil chemistry, but was nicely supported by rhizosphere chemistry.

The second part of the lecture will address an updated overview of the many physical-chemical processes (i.e. changes in pH, dissolved organic matters, and redox potential) that plant roots are able to implement in the rhizosphere with a brief illustration of analytical technics and experimental systems that enable to study them. The basic mechanisms involved will be first introduced at the soil-root scale, then scaled-up to the whole root system and finally to field-scale.

The last part of the lecture will be dedicated to a second case study about arsenic phytostabilization that illustrates the importance of considering concomitantly a range of physical-chemical processes in determining arsenic dynamic in the rhizosphere. In this microcosm-scale study, we will see that arsenic dynamic in the rhizosphere is concomitantly related to the dynamics of iron, calcium, and protons.