# Zinc Speciation in Organic Waste and Soil Characteristics control Zinc fate in Soil after Agricultural Recycling

**Maureen Le Bars** [a, b, c], S. Legros[d], C. Levard[c], C.Chevassus-Rosset[b], M. Montès[b], L. Séréni, A. Guichemerre, A.Guihou[c], B. Angeletti[c], M. Bravin[b], L. Thuriès[b] and E. Doelsch[b]

[a] *IPREM, Université de Pau et des Pays de l'Adour, France*

[b] *UPR Recyclage et risque, CIRAD, France*

[c] *CEREGE, Aix Marseille Université, France* [d] *UPR Recyclage et risque, CIRAD, Senegal*

*maureenlebars@gmail.com*

Zinc (Zn) is the most abundant trace element in organic waste (OW). Therefore, it is relevant to assess the environmental risk of OW agricultural recycling regarding soil contamination by Zn. Zn speciation in OW is a key parameter to evaluate its fate in environment and toxicity to living organisms. We have previously shown that Zn speciation changes radically according to the treatment applied to OW (anaerobic digestion and composting). Nanosized zinc sulphide (nano-ZnS) is the main Zn species in OW after anaerobic digestion, i.e. in digestates. Whereas Zn speciation is dominated by amorphous Zn phosphate and Zn sorbed to ferrihydrite in composts. We also showed that Zn speciation in OW drive Zn availability in an OW-amended soil.

As anaerobic digestion and composting are gaining interest in many countries, it is crucial to:

- assess the fate of Zn following organic waste application on soil, with a particular emphasis on nano-ZnS
- determine the biogeochemical drivers that control this fate.

A mechanistic approach was developed at the microcosm scale. First, we sampled OW on a full-scale plant at four different steps of the treatment. A clayey soil was incubated with the four OW samples having contrasted Zn speciation (0 to 100% nano-ZnS). In a second experiment, nano-ZnS enriched with $^{68}$Zn were synthesized to discriminate Zn released by nano-$^{68}$ZnS dissolution from natural Zn in soil. Two soils with contrasted characteristics were incubated with the nano-$^{68}$ZnS: the previous clayey soil and a sandy soil. In both experiments, Zn availability patterns was assessed in situ and over one to three months with the technique of the diffusive gradient in thin film (DGT).

The results showed that: (i) Zn availability in the amended soil was positively correlated with the percentage of nano-ZnS in OW, (ii) Zn availability is controlled by soil characteristics, as significant differences were detected for the sandy soil and the clayey soil.

Therefore, Zn speciation in OW and soil characteristics must be considered when assessing the environmental impact of agricultural recycling regarding Zn contamination.