# EUROPEAN SYNCHROTRON RADIATION FACILITY

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## Experiment report

## *Introduction*

Even if the role of earthworms in the soil fertility is well recognised, there is recent and growing evidence that earthworms can significantly influence the fate of different pollutants in soils. Regarding metals and metalloids, this influence does not rely on a unique process. Indeed, earthworms released metals bounded to organic matter through degradation of the organic matter and this degradation also decreased soil pH that modified the fate of the pollutants (Sizmur et al., 2009). It is therefore important to elucidate the earthworm role in metallic particulate matters (PM) dispersion and lead solubilisation and bioavailability. The aim of this study was to explore the links between physico-chemical characteristics of PM, Pb speciation in undisgested soils, earthworms'bodies and casts, and Pb bioavailability for plants. Concerning Pb speciation, the aim of the study was to precise the nature of Pb organic ligands in earthworms.

## *Experimental details*

### *Materials and sample preparation*

Samples were collected from a lead recycling facility at a chemical metal treatment compagny (STCM) which currently recycles batteries. This compagny have severals exploitation sites in France. One is located in the urban area of Toulouse, in the southwest of France, and another one is located near a small town (Bazoches les Gallerandes) in the center of France. For several decades, the industrial activities have produced high conentrations of Pb and other metal(loïd)s as Cd, Cu, Zn, As and Sb in surface soils. One part of the samples studied were collected inside the facility of Toulouse, and the other one were collected from a meadow fallow next to the factory of Bazoches les Gallerandes. Three different earthworms species were sampled with soils in witch they were found: Lombricus terrestris, Apporectodea longa and Apporectodea giardi. After depuration of the earthworms, their cast (earthworms dejections) were recovered to have three compartments studies : soils, earthworms and casts. The aim of the study was to investigate the changes in Pb speciation induced by earthworms.

Earthworms were dissected to recovered differents compartiments : teguments, antérior and posterior parts of the intestine. The aim of this study was to investigate the change in Pb speciation inside the earthworms du to the different modality of metal absorption and elimination.

All samples were dryed in oven at 40°C, grinded, diluted in BN and pressed into thin pellets.

## *Main results*

First, the XANES spectra of reference compounds were visualized (figure 1) to be compare and match with the XANES spectra of the samples.

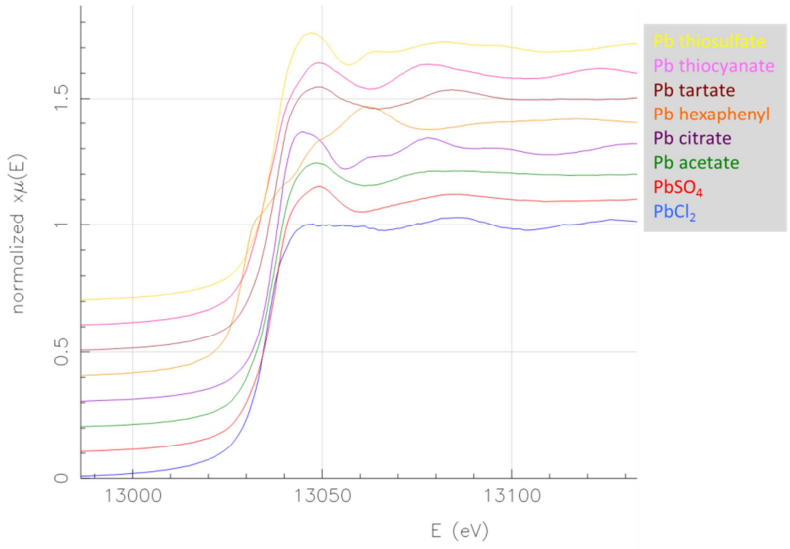


Figure 1 : XANES spectra at the Pb K-edge of reference compounds.

Then, the XANES spectra of STCM soil, earthworm which lived in it and earthworm cast were compared between each other. (Figure 2). Differences were observed between soils samples and cast samples. For the soil, Pb absorption edge is observed around 13047 eV while for earthworm and earthworm cast Pb absorption edge is observed aroud 13050 eV. It mean that Pb speciation in soild coul be modify during the passage in eathworms gut.

EXAFS oscillations were acquired until 10 $Å^{-1}$ and EXAFS spectra of soil, earthworm which lived in it and earthworm cast were compared between each other. Differences in the phase and amplitude of Pb oscillation in soil and earthworm cast samples were clearly observed. However like for the XANES spectra, EXAFS spectra of earthworm and earthworm cast were comparable.

Results treatments have to be bone to identify Pb speciation in the different samples (soil, earthworm and cast) by comparison with spectra of reference compounds. Further works will be performed to identify Pb speciation differences in different earthworm compartment (earthworms intestine superior and anterior, teguments…)

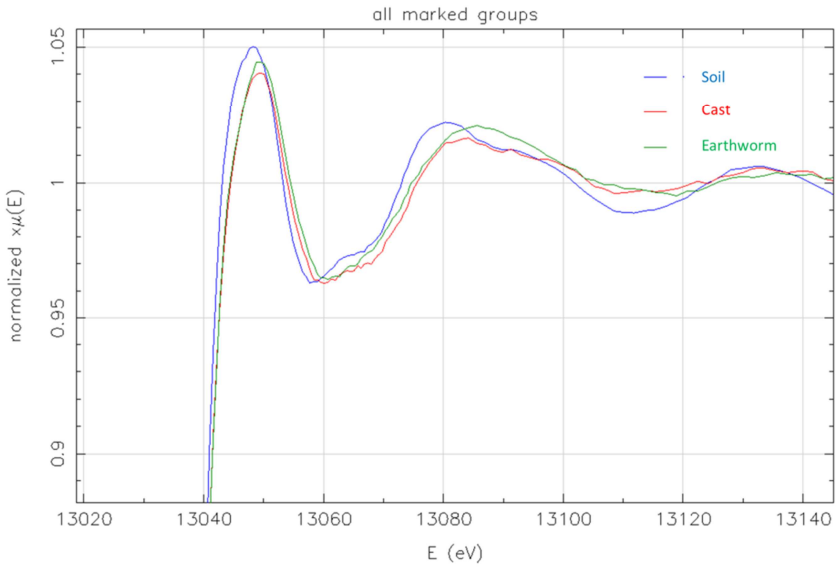


Figure 2 : XANES spectra at the Pb K-edge of soil, earthworm and earthworm cast samples.

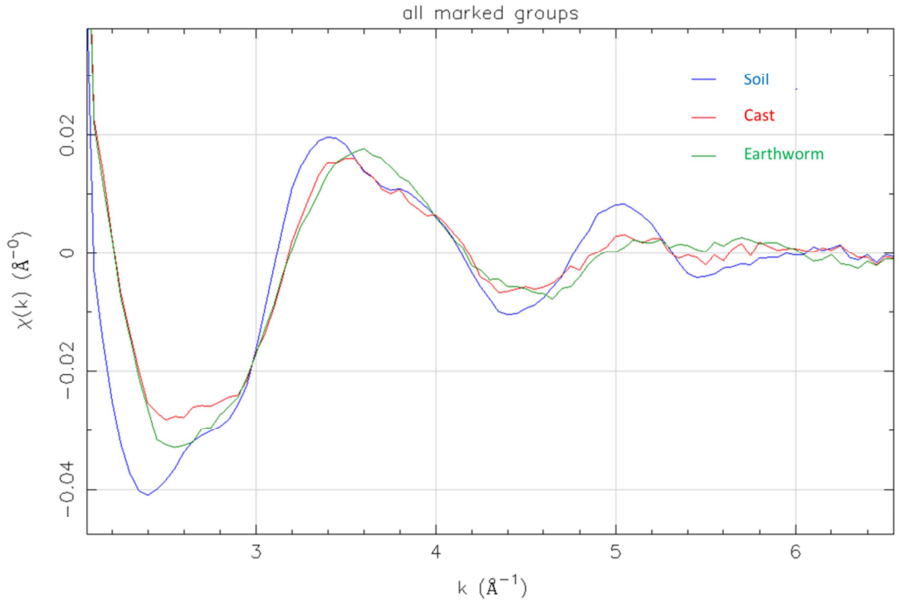


Figure 3 : EXAFS spectra at the Pb K-edge of soil, of earthworm and earthworm cast samples.

## *References*

Sizmur, T., Hodson, M.E., 2009. Do earthworms impact metal mobility and availability in soil? A review. Environmental Pollution 157 (7), 1981e1989.