Seasonal variation of Zn speciation in dredged sediment deposit sites.

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Introduction: Reuse of dredged sediment from waterways (for landfill cover, civil works, backfill and energy cropping) is well encouraged but dramatically curbed when sediments are contaminated. Risk assessment is generally required to deal with contamination. It implies calculation of sanitary risk based on the total content of pollutants in the bulk sediment. A general agreement is that speciation of trace elements like Cd, Zn or As, should be taken into account for a more realistic risk assessment. For example, bioaccessibility tests, mimicking gastric conditions, are progressively proposed to have a better insight of contaminants behaviour once ingested by the living [1]. This approach gives weight to the speciation of trace elements and questions on the mechanisms responsible for its change in the sediment other time. A better insight of contaminant behavior during soil formation will facilitate the reuse of these materials.
The objective of this work was to confirm the hypothesis of Piou *et al.* [2] who proposed that Zn speciation shows seasonal variations controlled by a reversible binding of metals to organic matter in winter and to Fe-oxihydroxides in summer.

Material&Methods: The 0-20 cm sediment horizon of an experimental plot deposited in 2001 in Lallaing (59) was periodically sampled for 2 years. Metals distribution was characterized using single extraction procedures: sodium pyrophosphate and Citrate-bicarborate-Dithionite (CBD). Sodium pyrophosphate extraction, traditionally used to disperse colloidal organic material, is a well-known extractor for Fe and trace elements thought to be complexed by organic matter. CBD extraction aims at solubilizing amorphous and well crystallized iron oxides. All extractions were performed on wet samples. Metals were measured in all extracts by ICP-MS.

Results: Figure 1 shows results of Zn CBD and pyrophosphate extracts according to the season of sampling. Significant differences between field samples and control are found for the CBD fraction mostly in spring samples. In contrast, the pyrophosphate fraction increases mostly in fall and winter samples.

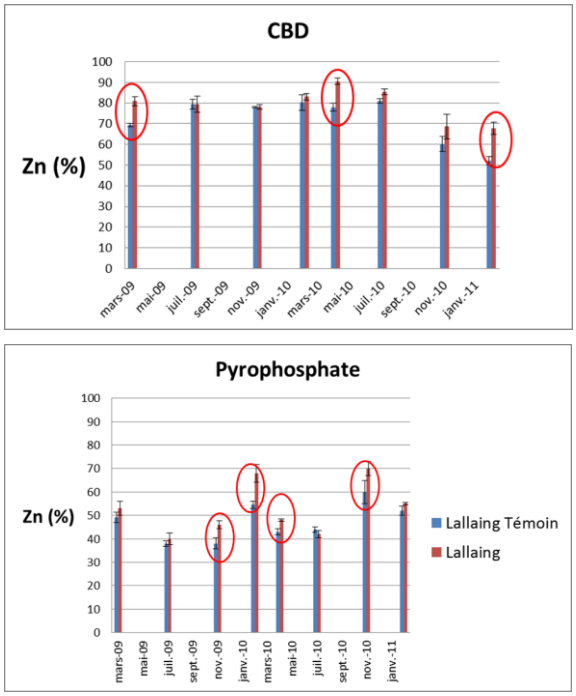

Fig. 1: Zn CBD and pyrophosphate extracts according to the season of sampling of sediment from Lallaing site – significant differences between field samples and control are red circled.

Discussion: Dedicated extractions then confirm that mineralization of organic matter occurring in spring is favorable to the formation of iron-hydroxides, scavengers of trace elements. In contrast, the increase of organic matter in fall is favorable to complexation of metals by organic compounds. This latter association seems to be maintained during winter time. This changes concern about 10% of total Zn in the sediment. In conclusion, Zn speciation in the top horizon of deposited sediment fluctuates seasonally which renders natural stabilisation impossible. No natural attenuation of this element is then observed in the deposited sediment after a decade of pedogenesis.

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References: [1] Girouard E. and Zagury G., Science of the Total Environment, 407, 2576-2585; [2] Piou et al. 2009, Environmental Research, 109, 712-720.