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Direct and indirect effects of biochar on the mobility of metals and nutrients in contaminated soils: a two-column leaching experiment

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ABSTRACT FOR EGU 2014 (300-500 words)

Abstract submitted to:

"SSS6.10 Biochar for carbon sequestration and soil management

Convener: Agnieszka Medyńska-Juraszek

Co-Conveners: Adam O'Toole , Agnieszka Latawiec

Biochar is a charred carbon-enriched material intended to be used as a soil amendment to sequester carbon and enhance soil quality. Addition of biochar to soil has many environmental and agricultural benefits, including waste reduction, energy production, carbon sequestration, water resource protection, and ***soil improvement.*** *Biochar has been reported to boost soil fertility and improve soil quality by raising soil pH, increasing moisture holding capacity, attracting more beneficial fungi and microbes, improving cation exchange capacity (CEC), and* ***retaining nutrients in soil.*** *Biochar* ***usually has a greater sorption ability than natural soil organic matter due to its greater surface area, negative surface charge, and charge density what can be an important set of properties for soil protection and reclamation procedures.*** *Another major benefit associated with the use of biochar as a soil amendment is its ability to sequester carbon from the atmosphere-biosphere pool and transfer it to soil.* ***Unfortunately many of described effects of biochar addition in soil are not well understood and bring many doubts about the potential cost and benefits of its use*** *in agriculture. In many cases biochar studies bring very opposite results depended on many factors eg. feedstock, biochar production technology,* ***soil properties****, climate or plant used in the experiment.*

The main objectives of the session is to:

- *Highlight the potential* ***cost and benefits of biochar as an effective soil amendment.***
- *Discuss main factors influencing quality of biochar in context of its effective use in soil.*
- ***Present the state of knowledge about mechanism of BC-soil and BC-plant and microorganism interactions.***
- *To identify the main problems of biochar analysis and its use in soil environment.*

The purpose of the session is to bring together researchers working on biochar use in agriculture, horticulture and soil reclamation interested in sharing their experiences in international, multidisciplinary group, developing collaboration for scientific projects and publications."

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Mechanisms of metals and nutrients immobilization by biochar in contaminated soils: a two-column leaching experiment
OR
Direct and indirect effects of biochar on the mobility of metals and nutrients in contaminated soils: a two-column leaching experiment

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Biochar has been claimed to be not only a promising carbon sequestration or fertilizing agent in soils but also a high capacity sorbent, of particular interest for the management of contaminated soils. Several studies have described its positive effects on the mobility of different potentially toxic elements in soils, but many doubts remain about the underlying mechanisms. In particular, the distinction between the actual adsorption of elements on biochar and their biochar-induced retention on soil particles is often impossible to achieve.
We studied here the dynamic interactions between one biochar produced at 450°C from a mix of hard wood and soft wood, and two soils contaminated by Cd, Pb and Zn which were sampled near a smelter and only differed from their pH. In order to distinguish between the actual immobilization of elements on biochar and their modified retention on soil particles, we developed a two-column leaching experiment using calcium nitrate as the initial leaching solution. The first column was filled with one of the two soils, and was linked in a closed loop with the second column containing a mass of pure biochar equivalent to 10% of the soil mass. The leaching solution circulated first in the soil column, then through the biochar column and again in the soil column and so on, so that it became progressively equilibrated with both soil and biochar. Each experiment lasted for 12 days at a flow rate of 1 mL/min. The pH and electrical conductivity of the leaching solution was continuously monitored at the outlet of the biochar column, and samples of the leaching solution were regularly taken for further analysis, both before and after having passed each of the columns.
Our results show that the chemical equilibrium between soil and biochar was obtained in a short time for major elements such as Na, K and Mg, whereas for heavy metals and other elements as well as for pH and dissolved carbon, the equilibrium was still not reached at the end of the experiment. This observation highlights the slow, diffusive nature of biochar chemical interactions with the soil. The comparison of samples enabled us to quantify the immobilization of elements on biochar from its indirect effect on the retention capacity of the soil, mostly due to the increase of pH and the dynamics of inorganic and organic carbon in the solution. Altogether, these results provide new information about the complex effects of biochar on soil properties and about its efficiency in the context of soil remediation.