



Localization of heavy metals immobilized on specific organic and mineral parts of a wood-derived biochar

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ABSTRACT FOR EGU 2013 (300-500 words)

Session SSS8.6/CL2.9 : Biochar for soil remediation and global warming mitigation

Convener: Gabriel Gascó

Co-Conveners: Ana Maria Tarquis , Paulo Pereira , Agustin Merino, Ana María Méndez Lázaro , Nick J. Ostle , Pan Genxing , Bruno Glaser , Jorge Paz-Ferreiro , Dimitrios Kalderis

Biochar has attracted a great deal of attention in the last years and it has been proposed as a geoengineering approach to promote soil carbon sequestration and thus help to mitigate global warming. Biochar addition to tropical soils resulted in the build up of soil carbon pools and has created a type of anthropic soils (Terras Pretas) which higher carbon stocks and fertility levels than the surrounding ferralsols. However, there are still many uncertainties that prevent biochar widespread use in soils, as biochars prepared from different sources and in different conditions (temperature, etc.) will behave in a different manner when added to soils with contrasting properties.

The main aim of this session is to bring together scientist that are trying to develop a better understanding on the benefits and limitations of using biochar as soil amendments. In this session we welcome studies both in Terra Pretas and in other types of temperate or tropical soils as well as well as studies including different scenarios in climate change.

Emphasis will be put in **the effects of biochar on pollutant fate**, carbon sequestration, soil nutrient transformation and leaching and soil microorganisms. Also, studies about the effect of different pyrolysis conditions on biochar are welcomed.

OR

Session SSS2.4 : Novel sorbent materials for environmental remediation

Convener: Ioannis D. Manariotis

Co-Conveners: David Werner, Hrisi K. Karapanagioti

Sorbent materials have various environmental applications, i.e. gas storage, separation, and purification. Rapid progress in nanotechnology and a new focus on **biomass-based instead of non-renewable starting materials** have produced a wide range of novel engineered sorbents. The **development and evaluation of novel sorbents** requires a multidisciplinary approach encompassing environmental, nanotechnology, physical, analytical, and surface chemistry. The necessary evaluations encompass not only the efficiency of these materials **to remove contaminants from** surface waters and groundwater, industrial wastewater, **polluted soils** and sediments, etc., but also the potential **side-effects** of their environmental applications. Contributions examining the use of novel sorbents for environmental remediation are welcome. More specifically the contributions may be focused on:

- biosorbents: characterization; evaluation
- **biochar: process optimization**; physically and chemically activated biochar
- reactive sorbents: development; characterization; evaluation
- nanotechnology based sorbents: development; characterization; evaluation
- sorbent based in situ remediation of contaminated soils, aquifers and sediments: experimental work; field studies
- toxicity of novel sorbents

Localization of heavy metals immobilized on specific organic and mineral parts of a wood-derived biochar

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Biochar has been intensively investigated over recent years, not only as a promising carbon sequestration or fertilizing agent in soils but also as a possible new sorbent to remediate contaminated soils. A few studies have revealed its high potential for heavy metals immobilization depending on the nature of biochar and trace elements. The mechanisms behind this immobilization remain however unclear: some authors have hypothesized a high sorption capacity due to biochar large surface area while others have suggested that this immobilization is mainly due to soil pH increase. In particular, the distinction between heavy metals specific sorption in biochar pores and heavy metals precipitation in or outside biochar particles is often impossible to make while it is of primary importance to evaluate biochar ability to retain these pollutants on a long-time scale.

In order to evaluate the main heavy metal immobilization effects on a standard biochar and to identify the most successful biochar parts of the sample, we examined biochar particles after heavy metals immobilization in batch experiments designed to mimic real chemical processes in soils. A biochar derived from hard and soft wood and pyrolyzed at about 450°C was put in contact with relatively low concentrations of heavy metals (Pb, Cu, Cd, Zn, Ni) in an initially acidic $\text{Ca}(\text{NO}_3)_2$ solution. Following a one-week adsorption and a one-week desorption step, we recovered the biochar particles and observed them using scanning electron microscopy coupled to energy dispersive x-ray spectroscopy, focusing especially on the changes in mineral phases and the location of each of the retained heavy metals on biochar particles.

We were able to distinguish different structures in the biochar samples which were linked to the degree of pyrolysis and the exact nature of the raw wood biomass. We detected the presence of concentrated metals zones (*e.g.* lead) in specific locations of the organic particles depending on the original plant tissues, and enlightened metal associations with newly-formed mineral phases such as calcite present on biochar surface. These observations provide new insights in the understanding of metal immobilization mechanisms on biochar such as precipitation and co-precipitation. Our findings also underline the need to consider the heterogeneity of biochar constitution for optimizing the remediation potential of biochar on contaminated sites.