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Can we use BPCA as molecular markers to trace the formation temperature of wood char?

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Wood char is an important source of environmental black carbon that contributes to the long term C cycle. Increasing formation temperature may reduce the degradability of wood chars significantly (Baldock and Smernik, 2002). Information about the formation temperature of natural chars in the environment is difficult to obtain. However, the maximum temperatures experienced by chars might be reflected in their chemical properties (Brown et al., 2006).

The analysis of benzene polycarboxylic acids (BPCA) as a quantitative measure for black carbon in soil samples is a well-established method (Hammes et al., 2007). The oxidation of polycondensated black carbon molecules leads to the formation of BPCA, which subsequently can be quantified by GC-FID. The relative contribution of the single acids to total BPCA-C depends on the cluster sizes of black carbon (i.e. degree of condensation and aromaticity of the chars) and therefore may represent changes in chemical quality. Hence, the BPCA method provides information about the source and the formation conditions of the char analysed. Here, we tested if the BPCA patterns reflect the maximum temperature experienced by laboratory produced wood char.

Small wood chips of chestnut hardwood (*Castanea sativa*) were pyrolysed at maximum temperatures between 250 and 1000 ˚C under constant N_2 stream. The maximum temperatures were held constant for 5 hours. The chars were then characterised using the BPCA method to trace changes in individual BPCA contribution (B3CA, B4CA, B5CA, B6CA) to the total content. Further, the samples were analysed for BET-N_2 specific surface area, char colour and elemental composition (CHNO).

Increasing temperatures typically lead to a preferential loss of H and O due to dehydration, demethylation and decarboxylation upon charring (Hammes et al., 2006). We expected that molecules that indicate a higher degree of condensation of the char like B5CA and B6CA (mellitic acid) to increase with increasing temperature of formation. In fact, first results indicate that at higher temperatures the proportion of BPCA reflecting a higher degree of condensation (B5CA, B6CA carboxylated acids) is increasing. The specific surface area of the chars will allow to draw further conclusions about the maximum formation temperature.

In a next step, the results will be compared to the properties of natural wood chars from a slash-and-burn experiment carried out in 2004 on an experimental burning site (Eckmeier et al., 2007). Our results will provide data to test the suitability of BPCA molecular markers as an explicit measure for the formation temperatures of natural wood chars in order to characterize chars from different environments and to improve our understanding of the fire history of ecosystems.

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