Geophysical Research Abstracts,
Vol. 11, EGU2009-1483, 2009
EGU General Assembly 2009

Measuring the BC Continuum- a new method for identifying BC in the environment

A. McBeath (1) and R Smernik (2)

(1) Soil and Land Systems, School of Earth and Environmental Sciences, The University of Adelaide, Waite Campus, Urrbrae 5064 SA Australia. anna.mcbeath@adelaide.edu.au , (2) Soil and Land Systems, School of Earth and Environmental Sciences, The University of Adelaide, Waite Campus, Urrbrae 5064 SA Australia. ronald.smernik@adelaide.edu.au

It has been long been established that black carbon (BC) is a continuum of thermally altered biomass with no clear-cut boundaries between different materials, making BC extremely heterogeneous and challenging to identify and quantify. The results of the BC ring trial fell victim to this very challenge, with generally poor agreement between the different methodologies. A likely cause is that each of the methodologies used was restricted to, or more sensitive to, a unique window of the BC continuum. A better BC characterization methodology would take into account BC heterogeneity and give an indication of the type or types of BC present, rather than a single measure of the amount.

The BC "spectrum" is largely defined by the degree of aromatic condensation or "graphiticness" of the BC. So how can this be measured? Through ring currents! Ring currents are circulating -electrons that travel along the conjugated pathways within the graphitic domains of BC. The larger the conjugated pathway, the stronger the ring current. The magnetic field produced by these ring currents affects the NMR chemical shift of atoms in the immediate vicinity, pushing them upfield (to lower ppm values) (Smernik et al. 2006). By sorbing carbon-13 labelled compounds to BC samples, we can gauge the strength of the ring currents and therefore the degree of aromatic condensation of the BC.

We applied this methodology to seventeen heat-treated materials, three of these being BC standards from the ring trial (McBeath and Smernik submitted). The results confirmed that aromatic condensation of BC increases with increasing heat treatment temperature (HTT). The starting material and heat treatment time also influenced the aromatic condensation of BC. Interestingly, the results of the 'ring trial' samples showed that these only represented the lower temperature range of the BC spectrum. Even hexane soot had a low degree of aromatic condensation, contradicting the common perception of soots being more condensed than chars.

This method was also applied to five chars produced in a bushfire. Comparisons with chars produced in the laboratory under well-controlled conditions enable the characterization of the temperature and burning conditions, and even the starting material of these samples.

The application of this new technique holds promise for a wide range of applications in identifying BC in the environment. It represents a major advance in BC analysis, enabling us to "see" the BC spectrum not just in black and white, but in all its shades of grey.

McBeath, A.V., Smernik, R.J., submitted. Variations in the degree of aromatic condensation of chars. Environ. Sci. Technol.

Smernik, R.J., Kookana, R.S., Skjemstad, J.O., 2006. NMR characterization of 13C-benzene sorbed to natural and prepared charcoals. Environ. Sci. Technol. 40, 1764-1769.