Geophysical Research Abstracts, Vol. 7, 02207, 2005
SRef-ID: 1607-7962/gra/EGU05-A-02207

Using microwave oven technology to improve the benzenepolycarboxylic acid (BPCA) method of determining black carbon

K. Hammes, B. Kägi, A. Heim and M.W.I. Schmidt

Department of Geography, University of Zurich, Winterthurerstrasse 190, CH-8057 Zurich, Switzerland (hammes@geo.unizh.ch / Fax: +41 1 635 6848 / Phone: +41 1 635 5183)

Black carbon (BC), produced by incomplete combustion of fossil fuels and vegetation fires, has an inert and stable nature in relation to other soil carbon fractions, possibly making out a significant fraction of C buried in soils. BC could thus represent a significant sink in the global carbon cycle. BC also affects the Earth's radiative balance, could be a useful tracer for Earth's fire history and carry organic pollutants.

A wet chemical oxidation method was developed at the University of Bayreuth to measure BC (Glaser et al., 1998). It works from the principle that during oxidative degradation of coals and chars, polycyclic aromatic rings are converted to benzenepolycarboxylic acids (BPCAs) (benzene rings substituted with carboxyl groups). These BPCAs can be used as specific molecular markers for black carbon in soils. We have pursued to improve the method in our laboratory, saving time in sample preparation and minimising sample loss, making the method safer and more user-friendly. Among other things, we use microwave digestion technology to carry out oxidative digestion of soil at high temperatures (above 150 ˚C) for short periods of time compared to long-duration, high-pressure digestion. The BPCA method contains two digestion steps. The first digestion step uses trifluoracetamide acid (TFA) to remove Fe and Al from the sample that can form insoluble metal-humate complexes. In this step digestion time has been shortened by 75% using the microwave technology, while removing the same amount of Fe and Al. In the second step nitric acid is used to digest samples in such a way that only the most resistant aromatic carbon residues (BC) are left, which is then converted to BPCAs. In the original method this step is done for 8 hours at 170 ˚C. We want to improve the nitric acid digestion step by increasing temperature

but decreasing time. Initial results done at 180 ˚C and 190 ˚C show that BPCA yields increase according to this principle. Other small improvements to the method will also be presented.

Glaser, B. Haumaier, L. Guggenberger, G. and Zech, W. 1998. Black carbon in soils: the use of benzenecarboxylic acids as specific markers. Organic Geochemistry 29(4): 811 - 819.