Geophysical Research Abstracts, Vol. 7, 06089, 2005
SRef-ID: 1607-7962/gra/EGU05-A-06089

On the analysis of black carbon in sediments: Evaluation of field data for geochemical consistency

Örjan Gustafsson[1], Marie Elmquist[1], Zofia Kukulska[1], Gerard Cornelissen[1], Manolis Mandalakis[1], Johan Persson[1], Thomas Bucheli[2] and Christopher Reddy[3]

[1]Stockholm University, Dept. of Applied Environmental Science (ITM), 10691 Stockholm, Sweden. [2] Agroscope FAL Reckenholz, Swiss Federal Inst. Agroecology and Agriculture, CH-8046 Zürich, Switzerland

[3]Woods Hole Oceanographic Institution (WHOI), Dept. of Mar. Chem. and Geochem. Woods Hole, MA, USA

(orjan.gustafsson@itm.su.se)

Black Carbon (BC) is a relatively inert and ubiquitous form of condensed organic matter produced by incomplete combustion of a variety of fossil fuel and biomass materials. Despite the myriad of important roles played by BC, ambiguity persists as to the level of BC in complex matrices, such as aquatic sediments, as parallel comparison of different methods yields highly variable results. Method artifacts that obviously would return inaccurate results include organic matter charring (overestimation) and losses of hydrophobic soot-BC during solution handling or combustion (underestimation). It is also possible that different methods simply probe different forms of BC as BC particles exist as a continuum from partly charred plant material through char and charcoal to soot and graphitic-like particles, with expected differences in recalcitrancy.

Laboratory tests of the different analytical approaches have provided significant insights and are one central tenet in moving the field ahead. A complementary approach is to assess real BC field data within the auxiliary geochemical framework of the studied regime. Estimates of the BC concentration in real environmental samples based on the chemothermal oxidation (at 375ºC) CTO-375 method (Gustafsson et al., 1997, 2001) were scrutinized for consistency with additional geochemical and environmental data collected simultaneously.

The field tests assessing geochemical consistency of obtained BC results include:

1. Comparison of BC analyses in chronologically-constrained sedimentary archives with knowledge of society's varying energy budgets in the source area
2. Correlation analysis of the spatial distribution patterns of molecular combustion markers (e.g., PAHs, PCDD/Fs) and analyses of BC (compared with TOC)
3. Ability of BC analyses to quantitatively explain the solid-water and solid-air distribution of PAHs given knowledge of BC sorption coefficients
4. Natural abundance ^{14}C data of BC isolates compared with ^{14}C data of TOC and ^{14}C data of the molecular combustion markers such as pyrogenic PAHs