

**TITLE: BLACK CARBON IN SOILS AND SEDIMENTS: FORMATION, STABILIZATION, ABUNDANCE, AND ENVIRONMENTAL FUNCTION**

**Sponsor:** Lead: S2 (Soil Chemistry), co-sponsors S11, S7, International Humic Substances Society, and Geochemical Society of America.

**Symposium organizers:** Jim Amonette [jim.amonette@pnl.gov](mailto:jim.amonette@pnl.gov) and Dan Olk [dan.olk@ars.usda.gov](mailto:dan.olk@ars.usda.gov)

Black carbon (a.k.a. char, bio-char, charcoal, and soot), a byproduct of both natural vegetation fires and industrial activity, is now recognized as a significant component of the organic matter fraction in soils and sediments. There is uncertainty about the relative proportions of aromatic C in soil organic matter that are attributable to pyrogenic and biogenic sources such as polyphenol residues (lignin and tannin) and compounds formed through humification processes. Humic substances extracted from soils using alkaline extraction methods include both black carbon and biogenic components, which complicates both genetic and structural interpretations of humic substances. The use of bio-char as beneficial soil amendments goes back thousands of years, yet researchers are just beginning to study the potential impact of these amendments on the global carbon cycle. The application of bio-char to soils is hypothesized to improve crop yields and soil quality, and to be a viable mechanism for sequestering large amounts of carbon. However, many issues remain unresolved. The stability (half-life) of black carbon varies substantially depending on the nature of the biomass from which it was made and how the material was pyrolyzed. Black carbon may adsorb biogenic humic materials, dissolved organic compounds and nutrients from the soil/sediment solution and thereby influence the formation and stabilization of biogenic humic materials, nutrient cycling, and soil physical and chemical properties. Because of these issues, the net impact of bio-char applications on carbon sequestration and greenhouse gas emissions, including methane and nitrous oxide, is not known. Active research continues on improvement in analytical methods to determine the fraction of black carbon components in humic substances, characterization of surface chemistry of black carbon, pore structure, and determination of rates of mineralization of char in soil and sediment. This symposium will bring humic chemists, geologists, organic geochemists, atmospheric scientists, soil scientists, and environmental scientists together to report on the latest developments in these fields. Topics of interest include the chemical and physical properties, bioavailability, chemical weathering, abundance, and stability of black carbon in soils or sediments; physical, chemical, and spectroscopic methods for distinguishing black carbon and biogenic humic materials; the impact of bio-char amendments on greenhouse gas emissions, soil/sediment properties, nutrient cycling, and agricultural productivity; and interactions between biogenic and pyrogenic humic materials in soils and sediments.



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## 2008 JOINT ANNUAL MEETING

5-9 October 2008, Houston, Texas  
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578 Symposium --Black Carbon in Soils and Sediments: I. Classification, Formation, and Occurrence (S02 Soil Chemistry; Geochemical Society, International Humic Substances, S05 Pedology, S07 Forest, Range & Wildland Soils, S09 Soil Mineralogy, S11 Soils & Environmental Quality)

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*Monday, 6 October 2008: 8:25 AM*  
*George R. Brown Convention Center, 360C*

- Presiding: *James E. Amonette*
- 8:25 AM [Introductory Remarks](#)
- 8:30 AM **578-1** [Analysis of Fire-Derived Organic Matter in Soil and Sediment.](#)  
*Michael W. I. Schmidt, University of Zurich*
- 9:00 AM **578-2** [Hydrothermal Carbonization of Biomass:Black Carbons with Refined Structure without Coaling.](#)  
*Markus Antonietti, Max Planck Institute of Colloids and Interfaces*
- 9:30 AM **578-3** [The Relation of Pyrolysis Processes to Charcoal Chemical and Physical Properties.](#)  
*Robert J. Evans, National Renewable Energy Laboratory*
- 10:00 AM [Break](#)
- 10:15 AM **578-4** [Black Carbon in the Earth System: Occurrence, Stability, and Measurement.](#)  
*Caroline A. Masiello, Rice University*
- 10:45 AM **578-5** [Black Carbon in Seasonally Dry Tropical Forests of Costa Rica.](#)  
*Klaus Lorenz, The Ohio State University; Rattan Lal, The Ohio State University; Juan J. Jiménez, Instituto Pirenaico de Ecología*
- 11:00 AM **578-6** [Soil Organic Matter Stabilization and Land-use Change in Tropical Ecosystems.](#)  
*Joseph Kimetu, Cornell University; Johannes Lehmann, Cornell University; Solomon Ngoze, Cornell University; Susan Riha, Cornell University; John Recha, Cornell University; Janice Thies, Cornell University; Alice Pell, Cornell University; Daniel N. Mugendi, Kenyatta University; James M. Kinyangi, ILRI; Louis Verchot, World Agroforestry Center*
- 11:15 AM [Adjourn](#)

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579 Symposium --Black Carbon in Soils and Sediments: II. Identification and Characteristics  
(S02 Soil Chemistry; Geochemical Society, International Humic Substances, S05 Pedology, S07 Forest, Range & Wildland Soils, S09 Soil Mineralogy, S11 Soils & Environmental Quality )

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*Monday, 6 October 2008: 1:25 PM*  
*George R. Brown Convention Center, 360C*

- Presiding: *David Laird*
- 1:25 PM [Introductory Remarks](#)
- 1:30 PM **579-1** [Characterization of Black Carbon by Advanced NMR.](#)  
*Klaus Schmidt-Rohr, Iowa State University; Jingdong Mao, Old Dominion University; Xiaowen Fang, Iowa State University; Michael Thompson, Iowa State University*
- 2:00 PM **579-2** [Radiocarbon Content of Black Carbon Using the Benzene Polycarboxylic Acid \(BPCA\) Method.](#)  
*Lori A. Ziolkowski, University of California Irvine; Ellen R. M. Druffel, University of California Irvine*
- 2:30 PM **579-3** [Analysis of Black Carbon in Sediments and Soils Using Multi-Element Scanning Thermal Analysis \(MESTA\).](#)  
*Yuch Hsieh, Florida A&M Univ.; Glynnis Bugna, Florida A&M University*
- 2:45 PM [Break](#)
- 3:00 PM **579-4** [Understanding Char and Terra Preta Soil Chemistry from Pyrolysis Mass Spectrometric Analysis.](#)  
*Kim Magrini, National Renewable Energy Laboratory; Stefan Czernik, National Renewable Energy Laboratory; Robert Evans, National Renewable Energy Laboratory*
- 3:30 PM **579-5** [Characterization of Black Carbon in Natural Waters by FT-ICR Mass Spectrometry.](#)  
*William C. Hockaday, Rice University; Patrick Hatcher, Old Dominion University; Jeremiah M. Purcell, Florida State University*
- 4:00 PM **579-6** [Sugar Profiling of Extracted Solubles from Poultry Litter Feedstock and Biochar by Gas Chromatography-Mass Spectrometry.](#)  
*Leticia Sonon, University of Georgia; Roberto Jr. Sonon Jr., University of Georgia*
- 4:15 PM [Adjourn](#)

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# 2008 JOINT ANNUAL MEETING

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665 Symposium --Black Carbon in Soils and Sediments: III. Environmental Function  
(S02 Soil Chemistry; Geochemical Society, International Humic Substances, S05 Pedology, S07 Forest, Range & Wildland Soils, S09 Soil Mineralogy, S11 Soils & Environmental Quality)

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*Tuesday, 7 October 2008: 8:25 AM*

*George R. Brown Convention Center, 360C*

- Presiding: *James E. Amonette*
- 8:25 AM [Introductory Remarks](#)
- 8:30 AM **665-1** [Charcoal and Nitrogen Cycling in Forest Ecosystems.](#)  
*Thomas DeLuca, The Wilderness Society*
- 9:00 AM **665-2** [Non-Herbaceous Biochars Exert Neutral to Negative Influences on Arbuscular Mycorrhizal Fungal Abundance.](#)  
*Daniel D. Warnock, The University of Montana; Brooke McBride, The University of Montana; Julie Major, Cornell University; Johannes Lehmann, Cornell University; Matthias C. Rillig, Freie Universität Berlin*
- 9:30 AM **665-3** [Recycling of Biochar as a Co-product of Pyrolysis: pH and Microbial Effects.](#)  
*Donald Reicosky, USDA-ARS*
- 9:45 AM **665-4** [Bioavailability of Atrazine in Char-Amended Soils.](#)  
*Yucheng Feng, Auburn University; Vijay Loganathan, Auburn University; G. Daniel Sheng, Zhejiang University of Technology; T. Prabhakar Clement, Auburn University*
- 10:00 AM [Break](#)
- 10:15 AM **665-5** [Charcoal Volatile Matter Content and its Effects on Plant Growth and Biological Properties of an Infertile Tropical Soil.](#)  
*Jonathan L. Deenik, University of Hawaii; Goro Uehara, University of Hawaii; Yudai Sumiyoshi, University of Hawaii; A. Sidibe, University of Hawaii; Amanda McClellan, University of Hawaii; Michael Antal, University of Hawaii*
- 10:45 AM **665-6** [The Chemistry of Sorption by Black Carbon: The Important Role of Surface Oxides.](#)  
*William P. Ball, Johns Hopkins University; Hyun Hee Cho, Johns Hopkins University; T. Helen Nguyen, University of Illinois at Urbana Champaign; Billy A. Smith, Johns Hopkins University; Kevin A. Wepasnick, Johns Hopkins University; D. Howard Fairbrother, Johns Hopkins University*
- 11:15 AM **665-7** [Biochar as Soil Amendment: What Effect Will It Have on Chemical Availability?.](#)  
*Joseph J. Pignatello, Connecticut Agricultural Experiment Station*
- 11:30 AM **665-8** [Impact of Soil Biochar Applications on Nutrient Leaching.](#)  
*David Laird, USDA; Pierce Fleming, USDA - ARS; Baiqun Wang, Chinese Academy of Sciences; Robert Horton, Iowa State University; Douglas Karlen, USDA-ARS*
- 11:45 AM **665-9** [Influence of Pecan-Derived Biochar on Chemical Properties of a Norfolk Loamy Sand Soil.](#)  
*Jeff Novak, USDA-ARS; Warren Busscher, USDA-ARS; Don Watts, USDA-ARS; David Laird, USDA; M.A.S. Niandou, North Carolina A&T State University; M. Ahmedna, North Carolina A&T State University*
- 12:00 PM [Adjourn](#)

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## 2008 JOINT ANNUAL MEETING

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666 Symposium --Black Carbon in Soils and Sediments: IV. Stability and Carbon Sequestration Potential (S02 Soil Chemistry; Geochemical Society, International Humic Substances, S05 Pedology, S07 Forest, Range & Wildland Soils, S09 Soil Mineralogy, S11 Soils & Environmental Quality)

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*Tuesday, 7 October 2008: 1:25 PM*  
*George R. Brown Convention Center, 360C*

- Presiding: *Daniel Oik*
- 1:25 PM [Introductory Remarks](#)
- 1:30 PM **666-1** [Stability of Black Carbon/Biochar.](#)  
*Johannes Lehmann, Cornell University*
- 2:00 PM **666-2** [Pyrogenic C as a Component of the C Cycle in Boreal Forests.](#)  
*Caroline M. Preston, Natural Resources Canada; Werner Kurz, Canadian Forest Service, Pacific Forestry Centre*
- 2:30 PM **666-3** [Mineralisation and Structural Modifications of Different Pyrogenic Materials by Microbiology Activities.](#)  
*André Hilscher, Lehrstuhl für Bodenkunde, Technische Universität München; Christian Siewert, Institut für Landschaftsarchitektur, Forschungsanstalt für Gartenbau Weihenstephan; Heike Knicker, Lehrstuhl für Bodenkunde, Technische Universität München*
- 2:45 PM **666-4** [Biodegradation of Benzene-d6 Associated with Various Black Carbon Materials by Pseudomonas putida strain F1: A 2H NMR study.](#)  
*Tu N. Pham, The University of Oklahoma; Samer AbuBakr, The University of Oklahoma; Kathleen E. Duncan, The University of Oklahoma; Margaret A. Eastman, Oklahoma State University; Mark A. Nanny, The University of Oklahoma*
- 3:00 PM [Break](#)
- 3:15 PM **666-5** [Greenhouse Gas Emissions from Soils as Affected by Addition of Biochar.](#)  
*Natalia Rogovska, Iowa State University; Pierce Fleming, USDA - ARS; Richard Cruse, Iowa State University; David Laird, USDA*
- 3:30 PM **666-6** [Assessing the Global Technical Potential for C Sequestration by Biomass Carbonization.](#)  
*James E. Amonette, Pacific Northwest National Laboratory*
- 4:00 PM **666-7** [Pyrolysis, Biochar, and Crop Residues: Is this an Economic Proposition?.](#)  
*Bruce A. McCarl, Texas A&M University*
- 4:30 PM [Adjourn](#)

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## 2008 JOINT ANNUAL MEETING

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743 Symposium --Black Carbon in Soils and Sediments: V. BC and SOM (Posters)  
(S02 Soil Chemistry; Geochemical Society, International Humic Substances, S05 Pedology, S07 Forest, Range & Wildland Soils, S09 Soil Mineralogy, S11 Soils & Environmental Quality)

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Wednesday, 8 October 2008: 4:00 PM

George R. Brown Convention Center, Exhibit Hall E

- 743-1** 402  
[Physico-Chemical Characteristics of Carbonized Biomass Prepared by Different Methods.](#)  
**James E. Amonette**, Pacific Northwest National Lab; Steven S. Dai, Pacific Northwest National Laboratory; Colleen K. Russell, Pacific Northwest National Laboratory; Bruce W. Arey, Pacific Northwest National Laboratory
- 743-2** 403  
[Characterization of Black Carbon using NEXAFS Spectroscopy.](#)  
**Karen Heymann**, Cornell University; Johannes Lehmann, Cornell University
- 743-3** 404  
[Using the BPCA Molecular Marker Fingerprint to Reconstruct the Formation Temperature of Wood Char.](#)  
Maximilian Schneider, University of Zurich; Michael Hilf, University of Zurich; **Michael W. I. Schmidt**, University of Zurich
- 743-4** 405  
Using Fire as a Management Practice in Grassland and Cropping Systems: Effects on Soil Nutrient Availability, Carbon and Nitrogen Contents, and Structure.  
**Lisa Fultz**, Oklahoma State University; C. Penn, Oklahoma State University; S Fuhlendorf, Oklahoma State University
- 743-5** 406  
[Persistence of Charcoal in Soils of the Cone Pond \(New Hampshire\) Watershed and Possible Effects on Soil Chemistry.](#)  
**Donald Ross**, University of Vermont; Scott Bailey, USDA-Forest Service
- 743-6** 407  
[A Comparative Analysis of Soil Charcoal from Different Forest Types Along the Colorado Front Range.](#)  
**Christopher W. Licata**, University of Denver; Robert L. Sanford Jr., University of Denver
- 743-7** 408  
[Carbon and Nitrogen Mineralization of Pyrolysis Chars Incorporated in Loamy Sand Soils with Low Soil Organic Carbon.](#)  
**Julia Gaskin**, University of Georgia; Keith R. Harris, University of Georgia; Dwight Fisher, USDA-ARS; K.C. Das, University of Georgia
- 743-8** 409  
[Sorption and Reduction of Hexavalent Chromium by Black Carbon Derived from Rice Straw.](#)  
**Shan-Li Wang**, National Chung Hsing University; Nai-Hua Hsu, National Chung Hsing University; Yu-Min Tzou, National Chung Hsing University; Jyh-Fu Lee, National Synchrotron Radiation Research Center
- 743-9** 410  
[Effect of Calcium on the Accumulation of the Humic Substances in Cultivated Soils.](#)  
**Kinjo Kazutoshi**, University of the Ryukyus; Tokashiki Yoshihiro, University of the Ryukyus; Kitou Makoto, University of the Ryukyus
- 743-10** 411  
[NMR Spectroscopic Assessment of Recalcitrant Soil Organic Matter in Iowa Mollisols.](#)  
Xiaowen Fang, Iowa State University; Teresita Chua, Iowa State University; Klaus Schmidt-Rohr, Iowa State University; **Michael Thompson**, Iowa State University
- 743-11** 412  
[Spectroscopic and Thermal Assessment of Organic Matter in Iowa Mollisols.](#)  
**Teresita Chua**, Iowa State University; Xiaowen Fang, Iowa State University; Klaus Schmidt-Rohr, Iowa State University; Michael Thompson, Iowa State University

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