



**14th Annual Workshop on Brominated and
Other Flame Retardants**

**June 22-24, 2014
Indianapolis, Indiana**



INDIANA UNIVERSITY

**SCHOOL OF PUBLIC AND
ENVIRONMENTAL AFFAIRS**

**Organized by:
Marta Venier
Amina Salamova
Ron Hites**

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Sunday Afternoon, June 22, 2014

- 2:00-8:00 **REGISTRATION AND CHECK-IN** Studio Lounge
- 4:00-6:00 **FMS WORKSHOP** Cosmopolitan
A
- 7:00-9:00 OPENING RECEPTION Cosmopolitan Foyer**

Monday Morning, June 23, 2014

- 7:30-8:20 CONTINENTAL BREAKFAST Cosmopolitan Foyer**
- 8:00-5:00 **REGISTRATION** Cosmopolitan Foyer
- 8:20-12:00 **Abiotic Matrices, Miriam Diamond, Chair** Cosmopolitan
A
- 8:20-8:40 **A Study of Halogenated Flame Retardants in Automotive Seats**
G. Peaslee, L. Savagian, A. Maley, E. Greve, H. O'Connell, Jeff Gearhart, K. Pena, B. Roberts
- 8:40-9:00 **Identification of Bromo/Chloro Analogues of Dechlorane 604 in Lake Ontario Sediment and Their Accumulation in Fish**
Li Shen, K. Jobst, E. Reiner, P. Helm, V. Taguchi, K. MacPherson, R. McCrindle, C. Marvin, S. Backus, I. Brindle
- 9:00-9:20 **Modified Quechers and Shoot-and-Dilute GC: Fast Sample Preparation and Analysis of Newer Brominated Flame Retardants in Fatty Matrices**
Michelle Misselwitz, J. Cochran, J. Kowalski
- 9:20-9:40 **Organophosphate Flame Retardants: Calibration and Up Take by Passive Air Samplers (GAPS)**
Liisa Jantunen, M. Shoeib, L. Ahrens, J. Schuster, T. Harner
- 9:40-10:00 **Primitive Thermal Treatment of Deca-BDE-Containing WEEE in China: A Source of Lighter Congeners in the Ambient Environment**
Li Li, J. Liu, S. Jia, W. Xu, Y. Dong, J. Zhang, J. Hu
- 10:00-10:20 COFFEE BREAK Cosmopolitan Foyer**
- 10:20-10:40 **Brominated Flame Retardants and Replacement Flame Retardants in Food Packaging**
Susan Shaw, M. Berger, B. Subedi, K. Kannan
- 10:40-11:00 **A Laundry Load of Chlorinated Flame Retardants: A Pathway from Households to Wastewater Treatment Plants**
Erika Schreder, M. LaGuardia
- 11:00-11:20 **Linking Halogenated Flame Retardants in Dust to Consumer Products**
Golnoush Abbasi, A. Saini, E. Goosey, M. Diamond

11:20-11:40 **Halogenated and Organophosphorus Flame Retardants on Particles in the Arctic Atmosphere**
Mark Hermanson, A. Salamova, R. Hites

11:40-12:00 **Reports from the Great Lakes Sediment Surveillance Program: Halogenated Organic Chemicals in Upper Great Lakes**
Jiehong Guo, Z. Li, P. Ranasinghe, A. Li, K. Rockne, N. Sturchio, J. Giesy

12:00-1:00 LUNCH ON YOUR OWN

1:00-2:00 Plenary Lecture: The Organic Flame Retardant Story: Cosmopolitan
A
Knowns and Unknowns, Stuart Harrad, School of Geography, Earth and Environmental Sciences, University of Birmingham, UK

Monday Afternoon, June 23, 2014

2:00-5:40 **Biological Matrices, Mehran Alaee and John Pasternak, Chairs** Cosmopolitan
A

2:00-2:20 **Brominated Flame Retardants in Sharks and Teleost Fishes in a North Atlantic Food Web**
Hillary Marler, D. Adams, D. Chen

2:20-2:40 **Comparison of BFR Contamination of Eggs from Selected Bird Species in Western Europe**
Olaf Paepke, K. Schröter, K. Trenck, F. Neugebauer, N. Lohmann

2:40-3:00 **Performance and Integrity of Blood Spot Measurements of BFR, PCB and Halogenated Pesticides**
Stuart Batterman, S. Chernyak

3:00-3:20 **The Partitioning of PBDEs, OH-BDEs, and MeO-BDEs in Human Breast Milk and Serum**
Deena Butryn, M. Gross, D. Aga, J. Olson, C. Lai-Har

3:20-3:40 **Polybrominated Diphenyl Ether (PBDE) Human Half Lives Estimated from North Americans Moving to Australia**
Leisa-Maree Leontjew Toms, J. Mueller, A. Sjödin, T. Webster, R. Jones, F. Harden

3:40-4:00 COFFEE BREAK Cosmopolitan Foyer

4:00-4:20 **Determinants of Polybrominated Diphenyl Ethers (PBDEs) in Blood of California Children and Mothers**
Todd Whitehead, S. Smith, F. Brown, J. Park, M. Petreas, S. Rappaport, C. Metayer

4:20-4:40 **Biological Fates of Two Emerging Brominated Flame Retardants, 2-Ethylhexyl Tetrabromobenzoate and Bis(2-Ethylhexyl) Tetrabromophthalate, in Female Sprague Dawley Rats**
Gabriel Knudsen, J. Sanders, L. Birnbaum

- 4:40-5:00 **Urinary Biomonitoring of Phosphate Flame Retardants: Levels in California Adults and Recommendations for Future Studies**
Robin Dodson, N. Van Den Eede, A. Covaci, J. Brody, R. Rudel
- 5:00-5:20 **Urinary Metabolites of Organophosphate Flame Retardants in Adults and Children**
E. Preston, M. McClean, H. Stapleton, T. Webster
- 5:20-5:40 **Metabolites of Organophosphate Flame Retardants in Urine from Paired Mothers and Toddlers**
Craig Butt, J. Congleton, H. Stapleton
- 5:40-8:00 POSTER SESSION RECEPTION** **Cosmopolitan B & Foyer**
(see poster session list for titles and authors)

Tuesday Morning, June 24, 2014

- 8:00-12:00 **REGISTRATION AND CHECK-IN** Studio Lounge
- 7:30-8:20 CONTINENTAL BREAKFAST** **Cosmopolitan Foyer**
- 8:20-12:00 **Toxicological Effects, Heather Stapleton, Chair** **A** Cosmopolitan
- 8:20-8:40 **Biotransformation of BDE-100 to Potentially Toxic Metabolites: Predominant Role of Human CYP2B6**
Michael Gross, D. Butryn, B. McGarrigle, D. Aga, J. Olson
- 8:40-9:00 **Polybrominated Diphenyl Ether (PBDE) Disruption of Liver Metabolism**
Kylie Cowens, M. MacArthur, W. Thomas, G. Carey
- 9:00-9:20 **Effects of PBDEs on Thyroid Deiodinase Activity in Cultured Human Astrocyte Cells**
Simon Roberts, H. Stapleton
- 9:20-9:40 **Firemaster 550 Contains PPAR γ Ligands that Induce Adipogenesis and Suppress Osteogenesis**
H. Pillai, M. Fang, D. Beglov, D. Kozakov, S. Vajda, H. Stapleton, Thomas Webster, J. Schlezinger
- 9:40-10:00 **Exposure to Organophosphorous Flame Retardants Affect Multiple Biological Pathways in Vitro and in Lower Animal Models**
Mamta Behl, W. Mundy, T. Shafer, C. Weis, J. Rice, W. Boyd, J. Freedman, J. Hsieh, O. Sirenko, E. Cromwell, B. Anson, F. Parham, K. Ryan, R. Tice
- 10:00-10:20 COFFEE BREAK** **Cosmopolitan Foyer**
- 10:20-12:00 **Human Exposure, Susan Shaw, Chair** **A** Cosmopolitan
- 10:20-10:40 **Polybrominated Diphenyl Ethers (PBDEs) and Other Persistent Organic Pollutants in Serum Pools from the National Health and Nutrition Examination Survey (NHANES): 2001 – 2008**

Andreas Sjödin, R. Jones, L. Wong, W. Turner, A. Calafat

10:40-11:00 **Fifteen Years of Experiences Analyzing BFRs In Human Samples: What Have We Learned?**

Arnold Schechter, O. Paepke

11:00-11:20 **Characterization of TBBPA Daily Intakes Estimates for Infant, Child, and Adult Receptors in a Range of Exposure Scenarios**

Daniele Wikoff, M. White, C. Perry, L. Fitzgerald, L. Haws

11:20-11:40 **PBDE Exposure and Reproductive Function Tests in Men**

Colleen Makey, M. McClean, L. Braverman, E. Pearce, A. Sjödin, J. Weinberg, T. Webster

11:40-12:00 **Gymnast Exposure to Replacement Flame Retardants**

Courtney Carignan, M. Fang, H. Stapleton, W. Bernays, M. McClean, T. Webster

**12:00-1:00 LUNCH PROVIDED BY THE CONFERENCE
(Yes, there is a free lunch!)**

Cosmopolitan Foyer

**1:00-2:00 Plenary Lecture: Human Biomonitoring for Firemaster 550
A**

Cosmopolitan

**and Potential Endocrine Disrupting Effects, Heather Stapleton,
Department of Environmental Sciences and Policy, Nicholas
School of the Environment, Duke University, Durham, NC**

Tuesday Afternoon, June 24, 2014

2:00-4:00 **Policy Issues, Arlene Blum, Chair**
A

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2:00-2:20 **Reducing the Use of Flame Retardants and "Six Classes" of Harmful Chemicals**
Arlene Blum, A. Lindeman, S. Yi-Balan

2:20-2:40 **Flame Retardants in Building Insulation: Critical Research Needs and New Policy Initiatives**
Veena Singla

2:40-3:00 **Removal and Responsible Disposal of PBDEs in Polyurethane Foams**
Graham Peaslee, S. Naylor, K. Taheri

3:00-4:00 **Science and Policy Panel: How to strengthen your research program and contribute to evidence-based policy**

Overview of Federal Authority to Regulate Flame Retardants and How Scientists Can Contribute

Eve Gartner, Staff Attorney, Earth Justice

Flame retardant Chemicals in the Great Lakes Region: Research, Data Gaps, and Policy

Lin Kaatz Chary, Executive Director, Great Lakes Green Chemistry Network

Funding and Broader Impacts: The Value of Communication, Collaboration, and Contributing to Policy

Veena Singla, Staff Scientist, Natural Resources Defense Council

Flame Retardant Science and the Furniture Industry - A Success Story

David Panning, Director of Technical Services, Business and Institutional Furniture Manufacturers Association

Monday Afternoon, June 23, 2014

5:40-8:00 POSTER SESSION

Cosmopolitan B & Foyer

- 1 Electrochemical Reduction of *Tris*(2,3-Dibromopropyl)Phosphate and *Tris*(1,3-Dichloro-2-Propyl)Phosphate at Carbon and Silver Cathodes**
Caitlyn McGuire, D. Peters
- 2 Electrochemical Debromination of Tetrabromobisphenol A (TBBPA) at Silver Cathodes in Dimethylformamide**
Benjamin Gerroll, D. Peters
- 3 Gridded Field Observations of Polybrominated Diphenyl Ethers and Decabromodiphenyl Ethane in the Atmosphere of North China**
Xinghua Qiu, Y. Zhao, J. Ma, Y. Lin
- 4 Polybrominated Diphenyl Ethers in Landfills and River Sediments from Gauteng, South Africa**
Olubiyi Olukunle, O. Okonkwo, I. Sibiyi, O. Odusanya, P. Forbes
- 5 Evaluating the Bioaccessibility of Flame Retardants (FRs) in House Dust and Polyurethane Foam Using an *in Vitro* Physiologically Based Extraction**
Mingliang Fang, H. Stapleton
- 6 Duke Superfund Center Foam Project: Flame Retardant Testing for the General Public**
Ellen Cooper, G. Kroeger, K. Davis, P. Ferguson, H. Stapleton
- 7 Monitoring of Flame Retardants Levels in Indoor Air of Newly Constructed Building during Equipment Installation**
Šimon Vojta, J. Klanová, R. Prokeš, P. Kukučka, J. Kohoutek
- 8 Brominated and Chlorinated Pollutants in Tree Bark from the Center of Michigan**
Angela Peverly, A. Salamova, R. A. Hites
- 9 Spatiotemporal Trends of PBDEs and their Replacements in the Great Lakes Atmosphere**
Liang-Ying Liu, A. Salamova, M. Venier, R. A. Hites
- 10 Organophosphate Ester Concentration in the Great Lakes St. Lawrence Seaway**
Jimmy Truong
- 11 Persistent Bioaccumulative Toxic Substances in Lake Superior Sediment**
Zhuona Li, J. Guo, A. Li, K. Rockne, N. Sturchio, J. Giesy

- 12 Spatial Distribution of Halogenated Flame Retardants in the Surface Sediments of Lake Huron**
Prabha Ranasinghe, J. Guo, Z. Li, A. Li, K. Rockne, N. Sturchio, J. Giesy
- 13 Spatial Distribution and Time Trend of Persistent and Bioaccumulative Organics in the Sediments of Lake Michigan**
Jiehong Guo, M. Corcoran, A. Li, K. Rockne, N. Sturchio, J. Giesy
- 14 Determination of Vapor Pressures for Organophosphate Flame Retardants and Plasti-cizers**
S. Brommer, Liisa Jantunen, T. Bidleman, S. Harrad, M. Diamond
- 15 Organophosphate Flame Retardants in the Canadian Arctic**
Liisa Jantunen, F. Wong, T. Bidleman, M. Pucko, G. Stern, H. Hung
- 16 Debromination Products of Deca-BDE during Thermal Treatment**
Shenglan Jia, L. Li, Y. Dong, J. Hu
- 17 Why the Analysis of Persistent Organic Pollutants is Like Finding a Needle in a Hay-stack**
Karl Jobst, M. Pena-Abaurrea, E. Reiner, X. Ortiz, M. Robson, V. Taguchi, P. Helm
- 18 The Use of Scripting for Identification of Novel POPs with GC × GC - TOF MS Analysis**
Miren Pena-Abaurrea, E. Reiner, K. Jobst, R. Ruffolo, P. Helm, R. McCrindle
- 19 Post-Target Analysis of Halogenated Flame Retardants using Mass Defect Plots**
Jonathan Byer, J. Binkley, G. Pacepavicius, M. Alae
- 20 Optimizing Speed and Resolution for Multiple Halogenated Flame Retardants using Thermodynamic Modeling on a Single GC Column**
Michelle Misselwitz, J. Cochran, J. Thomas, C. Rattray
- 21 Same Separation with Half the Column: Extending the Lifetime of your GC Column with Column Trimming Maintenance and Method Translation**
Michelle Misselwitz, J. Cochran, J. Thomas
- 22 Improved Techniques for Automated Sample Extraction and Clean-Up of PBDEs and Other Select BFRs in Complex Matrices**
Philip Bassignani, L. Kramer, R. Addink
- 23 Screening Halogenated and Organophosphate Flame Retardants for Long Range Transport Potential and Overall Persistence**
Daniela Serodio, M. Diamond, A. Krol, X. Zhang, A. Blum, M. Bonnell
- 24 Improving the Multimedia Indoor Model for SVOCs with a Multi-Layered Foam Furniture Submodel**
Anna Krol, D. Serodio, M. Diamond
- 25 Vapor Pressures and Octanol-Air Partition Coefficients of Novel Brominated Flame Re-tardants, Organophosphate Flame Retardants, and Selected Polybrominated Biphenyl Ethers**
Joseph Okeme, J. Poole, L. Jantunen, M. Diamond

- 26 The Screening of Halogenated Flame Retardants in the Great Lakes Region using Passive Sampling and High Resolution Mass Spectrometry**
Matthew Robson, L. Shen, S. Jenkins, P. Crozier, M. Pena-Abaurrea, K. Jobst, P. Helm, E. Reiner, K. MacPherson, G. MacInnis, C. Marvin, I. Brindle
- 27 Alternative Flame Retardants in San Francisco Bay**
Rebecca Sutton, D. Chen, M. Sedlak
- 28 How Do Levels Of Polybrominated Diphenyl Ethers (PBDEs) Do In California?**
W. Guo, A. Holden, M. Petreas, June-Soo Park
- 29 Concentrations of Polybrominated Diphenyl Ethers (PBDEs) in Paired Whole Blood and Serum Samples**
Warren Li, T. Whitehead, S. Smith, J. Park, M. Petreas, C. Metayer
- 30 Emerging and Legacy Environmental Organic Pollutants in Placenta Specimens Collected in the National Children's Study-Human Placenta Project**
Priyanthi Dassanayake, Y. Xia, J. Nanes, P. Ranasinghe, A. Li, C. Stodgell, M. Varner, P. Landrigan, N. Dole, N. Thiex, J. Moye, R. Miller
- 31 Unusually High Deca-BDE Concentrations and Detection of Novel Flame Retardants in a Top Predator Bird from the Canadian Arctic**
Jonathan Verreault, R. Letcher
- 32 Polybrominated Diphenyl Ethers (PBDEs) In a Community of Bottlenose Dolphins (*Tursiops Truncatus*) from Sarasota Bay, Florida**
Elizabeth Davis, L. Guillette, J. Kucklick, R. Wells
- 33 Is Human Activity a Good Predictor for Polybrominated Diphenyl Ether (PBDE) Concentrations in the Pacific Northwest?**
Kristin Robrock, M. Ikonomou
- 34 OH-BDE Exposure Delays Development and Causes Persisting Neurobehavioral Alterations in Zebrafish**
Laura Macaulay, A. Chen, L. Dishaw, W. Dong, K. Rock, A. Oliveri, J. Bailey, E. Levin, H. Stapleton
- 35 An Oral Two Generation Reproductive, Fertility, Developmental, Neurological and Behavioral Study of Tetrabromobisphenol A (TBBPA) in CD Sprague-Dawley Rats**
Rhian Cope, M. Dourson, S. Kacew
- 36 An Oral Prenatal Developmental Toxicity Study of Tetrabromobisphenol A (TBBPA) in CD Sprague-Dawley Rats**
Rhian Cope, M. Dourson, S. Kacew
- 37 Three Novel Brominated Flame Retardants Affect Fecundity and Transcript Profiles of the HPGL-axis in Japanese Medaka**
David Saunders, S. Wiseman, J. Giesy
- 38 Associations Between PBDEs, 2,4,6-Tribromophenol and Thyroid Hormone Levels in Human Placental Tissues**

Christopher Leonetti, K. Hoffman, M. Miranda, H. Stapleton

- 39 Development of Cancer and Non-Cancer Toxicity Values for TBBPA and Application in a Margin of Safety Evaluation**
Daniele Wikoff, C. Thompson, C. Perry, M. White, L. Fitzgerald, S. Borghoff, L. Haws
- 40 Overt and Neurodevelopmental Toxicity of Organophosphate Flame Retardants in Early Life Stage Zebrafish**
Laura Dishaw, D. Hunter, B. Padnos, S. Padilla, H. Stapleton
- 41 The Flame Retardant Triphenyl Phosphate Induces Lipid Accumulation in Zebrafish (*Danio rerio*) Larvae**
Kylie Rock, L. Macaulay, H. Stapleton
- 42 Subchronic Toxicology of Tetrabromobisphenol-A (TBBPA) in CD Rats**
T. Osimitz, W. Droege, A. Hayes
- 43 Human Exposure and Urinary Excretion of Perfluoroalkyl Acids with Isomer Analysis in Chinese People**
Lingyan Zhu, Y. Zhang, S. Beesoon, J. Martin
- 44 Challenges Associated with Sample Preparation for the GC/MS/MS Analysis of PBDEs in Human Serum: A Comparison of Liquid-Liquid Extraction, Solid Phase Extraction and Accelerated Solvent Extraction**
Shabana Siddique, I. Kosarac, C. Kubwabo, S. Harris
- 45 Levels of Brominated Flame Retardants in Swedish Food Baskets and Exposure Estimation**
Tatiana Cantillana, P. Darnerud, M. Isaksson, A. Glynn, M. Aune
- 46 The Gymnast Flame Retardant Collaborative**
Courtney Carignan, H. Stapleton, T. Webster
- 47 Semi-Automated Extraction and Cleanup Method for the Measurement of Organohalogen Compounds and Halogenated Phenolic Compounds in Human Serum**
Richard Jones, E. McDonald, Y. Zhang, S. Anderson, A. Sjödin
- 48 When Flame Retardants Burn: Chemical Exposure and Cancer Risk Among Fire Fighters**
Susan Shaw
- 49 Flame Retardants Influence by Crowd Sourcing**
Paul Bertram, Jr.
- 50 Pregnant Women's Perceptions of Exposure to Brominated Flame Retardants**
Alyssa Lane, F. Rab, J. Ashley, S. Sharma, A. Hodgson, J. Nisker



HEATHER M. STAPLETON

Heather Stapleton is an Associate Professor of Environmental Sciences and Policy in the Nicholas School of the Environment at Duke University in Durham, NC.

Dr. Stapleton received her Ph.D. in environmental chemistry from the University of Maryland at College Park in 2003. From 2003-2005 she was a postdoctoral research associate at the National Institute of Standards and Technology in their Analytical Chemistry Division. In September of 2005, she accepted a position as assistant professor in the Nicholas School of the Environment at Duke University. In 2008, she was won an Outstanding New Environmental Scientist Award (ONES) from the National Institute of Environmental Health Sciences for her research grant proposal entitled "Children's Exposure to Brominated Flame Retardants: Effects on Thyroid Hormone Regulation." Dr. Stapleton's research examines the sources, fate, transport, and metabolism of halogenated organic contaminants in the environment. Her current research projects focus on human exposure to flame retardant chemicals, particularly in children, and on the identification of flame retardant chemicals in consumer products.



STUART HARRAD

Stuart Harrad is Professor of Environmental Chemistry at the School of Geography, Earth and Environmental Sciences at the University of Birmingham in Birmingham, United Kingdom.

Stuart received his B.Sc. in Applied Chemistry from De Montfort University in 1984. He then moved to the University of East Anglia, where he completed a M.Sc. degree in analytical chemistry in 1985, and his Ph.D. on the levels and sources of PCDD/Fs in UK soils in 1989. After several postdoctoral appointments in both the USA and UK, he took up his present post in September 1994. He heads the National Network on Persistent Organic Pollutants, sits on the International Advisory Board of the Annual International Symposium on Halogenated Persistent Organic Pollutants, and he chaired the 28th such symposium in Birmingham in 2008. Stuart is an environmental chemist, whose research addresses all aspects of the environmental sources, fate, and behavior of persistent organic pollutants (POPs). He has particular interests in human exposure to POPs with a focus on indoor pathways. He is also active in research that explores the environmental forensics utility of chirality.

ACKNOWLEDGEMENTS

The organizers of BFR 2014 thank the sponsors for their generous support; Mehran Alaei, Arlene Blum, Miriam Diamond, Susan Shaw, and Heather Stapleton for acting as session chairs (it was largely through their efforts that the difficult decisions of oral vs. poster were made); Brandi Host at Indiana University Conferences for her fabulous work; Jennifer Richards for her computer skills; and the entire Hites' Laboratory for their assistance.

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