Technical Review Workgroup for Metals and Asbestos
Bioavailability Committee Annual Report:
Accomplishments and Activities for Calendar Year 2015

Members

Region 2
Mark Maddaloni

Region 6
Anna Milburn

Region 7
Michael Beringer (advisor)
Todd Philips

Region 8
Charles Partridge

Region 9
Sophia Serda

Region 10
Katie Adams
Marc Stifelman (co-chair)

NEIC – Denver
Bradley Miller

ORD NERL – RTP
Karen Bradham

ORD NHEERL – RTP
David Thomas

ORD NRMRL – Cincinnati
Fran Kremer
Kirk Scheckel (co-chair)

OSRTI
Michele Burgess (co-chair)
Cheryl Hawkins
Michele Mahoney

TRW Bioavailability Committee Accomplishments of 2015

Reports and Guidance on the Bioavailability of Metals in Soil

1. **Published Manuscript: "Predicting Oral Relative Bioavailability of Arsenic in Soil from In Vitro Bioaccessibility"**
   Members of the TRW Bioavailability Committee completed development of a manuscript describing a regression analysis to predict arsenic relative bioavailability (RBA) from an *in vitro* bioaccessibility (IVBA) assay using data from swine and mice (Predicting Oral Relative Bioavailability of Arsenic in Soil from In Vitro Bioaccessibility. G.L. Diamond, K.D. Bradham, W.J. Brattin, M. Burgess, S. Griffin, C.A. Hawkins, A.L. Juhasz, J.M. Klotzbach, C. Nelson, Y.W. Lowney, K.G. Scheckel, and D.J. Thomas. J. Toxicol. Environ. Health. *In press*).

2. **Initiated Development of a Report to Validate the Arsenic IVBA Assay**
   Developed the first draft of the Arsenic IVBA Validation Report. This report will provide the basis for validation and regulatory acceptance of the arsenic IVBA assay. Once approved for regulatory use, the arsenic IVBA assay can be used to replace animal bioavailability.

3. **Initiated Development of a Round Robin Study to Support the Arsenic IVBA Assay**
   Initiated development of a multi-laboratory round-robin study to establish consensus values for the arsenic IVBA assay using several soil reference materials.

4. **Initiated Evaluation of Bioavailability/Bioaccessibility of Other Metals**
   Conducted a survey of EPA regions to determine the need to evaluate bioavailability/ bioaccessibility methods of other metals (e.g., other than lead and arsenic).

5. **Finalized Lead Bioaccessibility Sampling Guidance**
   Finalized guidance for collection and handling of soil to be used for site-specific lead bioaccessibility assessments. Available on the TRW Bioavailability Committee website at: http://www.epa.gov/superfund/soil-bioavailability-superfund-sites-guidance.

6. **Initiated Development of a White Paper for Measurement of RBA of Dioxins and PAHs**
   The Dioxin/PAH Subcommittee of TRW Bioavailability Committee developed the first draft of a white paper focused on evaluation and recommendations for animal models to measure RBA of dioxins and polycyclic aromatic hydrocarbons (PAHs) in soil and soil-like materials.

7. **Finalized "Phosphate Amendment Fact Sheet"**
   Fact sheet discusses the use of phosphate amendments to treat soils contaminated with lead. Available on the TRW Bioavailability Committee website at: http://www.epa.gov/superfund/soil-bioavailability-superfund-sites-guidance.

8. **Continued Development of a New Flat Creek Reference Soil Material for Lead and Arsenic**
   In collaboration with U.S. Geological Survey (USGS), the TRW Bioavailability Committee continued development of a new soil Reference Material (Flat Creek Soil Reference Material) for lead and arsenic, using material collected from a Superfund site in Region 8. The new Reference Material is intended to replace the depleted National Institute of Standards and Technology (NIST) Soil Reference Materials (SRMs), and to be used as Quality Control standards in analyses of arsenic and lead levels in soil IVBA assays.

9. **Finalized Report on the Swine RBA Bioassay on the New Flat Creek Soil Reference Material**
   Completed the final report for the swine bioassay on the relative bioavailability of arsenic for the new Flat Creek Soil Reference Material. To be posted on the TRW Bioavailability Committee website.

10. **Continued Development of the Report for the Round Robin Study of New Flat Creek Soil Reference Material for Lead and Arsenic**
    Continued development of the draft report on a multi-laboratory round robin analysis of the new Flat Creek Soil Reference Material to establish consensus values for lead IVBA and for lead and arsenic concentrations analyzed using EPA Method 3051A (microwave extraction). To be posted on the TRW Bioavailability Committee website.

11. **Continued Manuscript Development: "Development and Analysis of a New Soil Reference Material for Lead and Arsenic"**
    Continued progress of a manuscript on the development and analysis of the new Flat Creek Soil Reference Material, reporting on the development process, consensus values for standard analyses, and results of additional *in vitro* and *in vivo* testing. Source for the soil is the Iron Mountain/Flat Creek (Montana) Superfund site in Region 8.

12. **Publication of SW-846 Method 1340**
    Method 1340 (In Vitro Bioaccessibility Assay for Lead in Soil-) is available on the Validated Methods page at:
    http://www3.epa.gov/epawaste/hazard/testmethods/sw846/new_meth.htm#1340

Communication, Training, and Outreach

1. ***Hotline.*** The TRW Bioavailability Committee responds to questions from inquiries made either by telephone to the TRW Bioavailability Committee hotline (toll-free 1-866-282-8622) or via bahelp@epa.gov. The TRW Bioavailability Committee responded to ten requests for assistance in 2015. Of these calls, three requests were from state and federal agencies. The remainder were received from other sources (public, non-governmental organizations, and engineering and consulting firms). Three requests were from outside the U.S. (New Zealand and France).

2. ***Community Outreach.*** Collaborated with the University of North Carolina and the University of Arizona to develop community outreach materials and presentations on bioavailability.

3. ***TRW Bioavailability Committee Annual Meeting.*** Held November 2-5, 2015, at U.S. EPA's Gulf Ecology Division facility in Gulf Breeze, FL. Members of the TRW Bioavailability Committee met to work on projects and plan activities for 2016.

4. ***Presentations/Reports/Publications/Training:***
    a. Bioavailability and Bioaccessibility of Contaminants at United States Superfund Sites: Information and Recommendations of the U.S. EPA Technical Review Workgroup for Metals and Asbestos: Bioavailability Committee. B. Miller. International Union of Pure and Applied Chemistry Congress, Busan, Korea, 2015.
    b. Bioavailability-Based In Situ Remediation to Meet Future Lead (Pb) Standards in Urban Soils and Gardens. H. Henry, M.F. Naujokas, C. Attanayake, N.T. Basta, Z. Cheng, G.M. Hettiarachchi, M. Maddaloni, C. Schadt, and K.G. Scheckel. 2015. Environ. Sci. Technol. 49: 8948-8958.
    c. Independent Data Validation of an In Vitro Method for Prediction of Relative Bioavailability of Arsenic in Contaminated Soils. K.D. Bradham, C. Nelson, A. Juhasz, E. Smith, K.G. Scheckel, D. Obenour, B.W. Miller, and D.J. Thomas. 2015. Environ. Sci. Technol. 49: 6312-6318.
    d. Remediation of a Lead-Smelter Contaminated Calcareous Soil with Different Amendments and Their Effects on Metal Availability and Soil Properties. W. Xing, L. Li, K.G. Scheckel, A.R. Betts, G. Xiang, H. Lan, and L. Li. 2014. Acta Scientiae Circumstantiae. 34: 1534-1540.
    e. Variability Associated with As In Vivo-In Vitro Correlations When Using Different Bioaccessibility Methodologies. A.L. Juhasz, E. Smith, C. Nelson, D. Thomas, and K. Bradham. 2014. Environ. Sci. Technol. 48: 11646-11653.
    f. Soil Ingestion for Children Aged Under 3 Years Old in Taiwan. L.C. Chien, M.C. Tsou, H.C. Hsi, P. Beamer, K. Bradham, Z.Y. Hseu, W. Dang, and H. Ozkaynak. 2015. J. Expo. Sci. Environ. Epidemiol. [Epub ahead of print] doi: 10.1038/jes.2015.61.
    g. Assessment of the Bioaccessibility of Micronized Copper Wood in Synthetic Stomach Fluid. L. Santiago-Rodríguez, J.L. Griggs, K.D. Bradham, C. Nelson, T. Luxton, W.E. Platten, and K.R. Rogers. 2015. Environmental Nanotechnology, Monitoring & Management 4: 85-92.
    h. Technical Memorandum: Rationale and Efficacy of Amending Soils with Phosphate as Means to Mitigate Soil Lead Hazard. U.S. Environmental Protection Agency, Washington, DC. 2015. OSWER 9355.4-27.
    i. Technical Memorandum: Rationale and Efficacy of Amending Soils with Phosphate as Means to Mitigate Soil Lead Hazard. U.S. Environmental Protection Agency, Washington, DC. 2015. OSWER 9355.4-27.
    j. Human Health Impacts of Metal Contaminated Soils. K.G. Scheckel. Australian Society of Soil Science, Adelaide, Australia, 2015.

k. Lead Stabilization and Arsenic Mobilization by Phosphate and Alternative Amendments: Implications on Urban Soil Remediation and Urban Agriculture. Z. Cheng, A. Paltseva, M. Maddaloni, and K.G. Scheckel. Geological Society of America, Baltimore, MD, 2015.
l. Lead Stabilization and Arsenic Mobilization by P-Bearing Amendments: Laboratory and Field Observations. Z. Cheng, M. Maddaloni, K.G. Scheckel, Z. Garcia, and A. Paltseva. AEHS 31st Annual International Conference on Soils, Sediments, Water, and Energy, Amherst, MA, 2015.
m. Assessment of Arsenic Speciation and Bioaccessibility in Mine-Impacted Matrices. C. Ollson, E. Smith, N.T. Basta, K.G. Scheckel, and A.L. Juhasz. 13th International Conference on the Biogeochemistry of Trace Elements, Fukuoka, Japan, 2015.
n. Assessing the Efficacy of Amendment Strategies for Pb-Contaminated Soil Using XAS, In Vivo and In Vitro Assays. A.L. Juhasz, C. Herde, K.G. Scheckel, and E. Smith. 13th International Conference on the Biogeochemistry of Trace Elements, Fukuoka, Japan, 2015.
o. Arsenic Bioavailability in Soil Correlated with Vanadium: Insights into As and V Geochemistry Using Bulk-XAS, Micro-XAS and XRF Mapping. A.R. Betts, C. Nelson, K. Bradham, and K.G. Scheckel. 13th International Conference on the Biogeochemistry of Trace Elements, Fukuoka, Japan, 2015.
p. Pb Speciation and Bioaccessibility in Soil and Dust Samples Collected from an Industrial Site in South Australia. E. Smith, K. Scheckel, E. Marzouk, S. McClure, and A.L. Juhasz. 13th International Conference on the Biogeochemistry of Trace Elements, Fukuoka, Japan, 2015.
q. Prior Phosphate Treatment of Ingested Soil Affects Tissue Distribution of Lead in Mice. D.J. Thomas, K.D. Bradham, W. Green, H. Hayes, K.G. Scheckel, C. Nelson, P. Alava, and J. Misenheimer. 54th Annual Meeting of the Society of Toxicology, San Diego, CA, 2015.
r. In Situ Remediation of Arsenic in Topsoil: Evaluating the Effect of Soil Mineralogy on Ferrihydrite Encapsulation. A.R. Betts and K.G. Scheckel. Annual Meeting of the Soil Science Society of America, Long Beach, CA, 2014.
s. Phosphate Amendments in Co-Contaminated Soils: Speciation, Bioaccessibility, and Bioavailability. K.G. Scheckel, A.R. Betts, K.D. Bradham, and D.J. Thomas. Annual Meeting of the Soil Science Society of America, Long Beach, CA, 2014.
t. Evaluation of Bioaccessibility Methods to Predict Relative Bioavailability of Arsenic in Contaminated Soils. B. Stevens, N. Basta, S. Whitacre, S. Naber, K.G. Scheckel, S. Casteel, K. Bradham, and D. Thomas. Goldschmidt 2014, Sacramento, CA, 2014.
u. Bioaccessibility Method for Prediction of Relative Bioavailability of Arsenic in Contaminated Soils. K. Bradham, C. Nelson, A. Juhasz, E. Smith, K. Scheckel, and D. Thomas. 2015 International Society of Geochemistry and Health, Bratislava, 2015.
v. Soil Lead Bioavailability. K. Bradham, K. Scheckel, and D. Thomas. 2015 Lead in Urban Soils Workshop, Philadelphia, 2015.

w. USEPA's In Vitro Bioaccessibility Assay for Lead in Soil. K. Bradham, M. Burgess, and C. Hawkins. 18th Annual Laboratory and Technical Information Group (LTIG) Conference, Boston, MA, 2015.
x. USEPA's ORD Bioavailability Research and TRW Bioavailability Committee. K. Bradham, M. Burgess, K. Scheckel, and D. Thomas. 2015 ITRC Bioavailability in Contaminated Soil, VA, 2015.
y. Bioavailability and Bioaccessibility: Health Risks and Risk Management Decisions. K. Bradham. 2015 Impact of Environmental Toxins to the Health of Taiwanese Children conference, Taipei, Taiwan, 2015.
z. Arsenic and Environmental Health: State of the Science and Future Research Opportunities. Danielle J. Carlin, Marisa F. Naujokas, Karen D. Bradham, John Cowden, Michelle Heacock, Heather F. Henry, Janice S. Lee, David J. Thomas, Claudia Thompson, Erik J. Tokar, Michael P. Waalkes, Linda S. Birnbaum, and William A. Suk. *Environ Health Perspect*; DOI:10.1289/ehp.1510209.

Coordination/Support with States, Regions, EPA Program Offices, and Other Federal Agencies

1. **USGS:** Continued collaboration for the development and analysis of a new lead and arsenic soil Reference Material.

2. **All EPA Regions:** Conducted a survey to determine the need for evaluation of bioavailability/bioaccessibility methods for other metals (e.g., other than lead and arsenic).

3. **EPA Region 6:** Reviewed and commented on "Selection of the Relative Bioavailability Adjustment Factor for the Baseline Human Health Risk Assessment San Jacinto River Waste Pits Remedial Investigation/Feasibility Study CERCLA Docket No. 06-03-10" for dioxin.

4. **EPA Region 8:** Collaborated with Region 8 on the development of a consensus approach and regression analysis to predict arsenic RBA from an IVBA assay.

5. **EPA Region 9:** Collaboration with ORD-RTP and ORD NHEERL-RTP to provide support on Reviewed Arsenic Bioavailability IR Site 22 – Former Naval Weapons Station Seal Beach Detachment Concord (Concord, CA).

6. **Interstate Technology & Regulatory Council (ITRC):** Bioavailability in Contaminated Soil Team – Several members of the TRW are participating on an ITRC workgroup that is developing guidance documents and internet-based training on bioavailability of lead, arsenic and PAHs in soil.