

**The Technical Review Workgroup for Metals and Asbestos (TRW)
Bioavailability Committee Annual Report:
Accomplishments and Activities for Calendar Year 2013**

Members

Region 2

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NEIC – Denver

Bradley Miller

Region 4

Ofia Hodoh

ORD NERL – RTP

Karen Bradham

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Region 9

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Michele Burgess (co-chair)

Michele Mahoney

Region 10

Katie Adams

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TRW Bioavailability Committee Accomplishments of CY 2013

Reports and Guidance on the Bioavailability of Metals in Soil

1. Published Manuscript: “Assessing Performance of a Mouse Assay for Determination of Arsenic Bioavailability in Contaminated Soils”

Members of the TRW Bioavailability Committee completed development of a manuscript on assessment of soil arsenic bioavailability using the Office of Research and Development mouse model, including comparison of results from the mouse and swine models. The manuscript has been published (Mouse Assay for Determination of Arsenic Bioavailability in Contaminated Soils. K.D. Bradham, G.L. Diamond, K.G. Scheckel, M.F. Hughes, S.W. Casteel, B.W. Miller, J.M. Klotzbach, W.C. Thayer, and D.J. Thomas. 2013. *J. Toxicol. Environ. Health Part A*. 76: 815-826).

2. Continued Development of a New Soil Reference Material for Pb and As

In collaboration with U.S. Geological Survey (USGS), the TRW Bioavailability Committee continued development of a new Soil Reference Material (SRM) for Pb and As, using material collected from a Region 8 Superfund site in Montana. Analysis of the new soil reference material is in progress. The new SRM is intended to replace depleted National Institute for Standards and Technology (NIST) SRMs used as Quality Control standards in analyses of arsenic and lead levels in soil and *in vitro* bioaccessibility assays. Next steps for development and analysis are currently under discussion.

3. Continued Development of the Report on the Round Robin Validation of New Soil Reference Material for Pb and As Report

Continued development of the report on a multi-laboratory round robin analysis of the new Soil Reference Material to establish consensus values for Pb IVBA and for Pb and As concentrations analyzed using EPA Method 3051A (microwave extraction).

4. Completed Swine Bioassay on New Soil Reference Material

Completed a bioavailability assay in swine to assess Pb and As Relative Bioavailability Assay (RBA) of the new Soil Reference Material. Experimental phase is complete and data reduction is ongoing.

5. Continued Manuscript Development: “Development and Analysis of a New Soil Reference Material for Lead and Arsenic”

Continued development of a manuscript on the development and analysis of the new 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) site in Region 8.

6. Continued Revision of the Pb *In Vitro* Bioavailability Assay Standard Operating Procedure (IVBA SOP)

Continued revision of the Pb IVBA SOP to refine procedures and update for the new Soil Reference Material for Pb

7. **Initiated Development of an Arsenic In Vitro Bioavailability Assay (IVBA) Consensus Approach**
Initiated data review and analysis of arsenic Relative Bioavailability Assay (RBA) and IVBA data to develop a consensus approach and regression analysis to predict arsenic RBA from an IVBA assay.
8. **Completed Method Development for SW-846 Method 1340**
Completed development of a new SW-846 Test Method 1340 (In Vitro Bioaccessibility Assay for Lead in Soil). Available at:
<http://epa.gov/epawaste/hazard/testmethods/sw846/pdfs/1340.pdf>
9. **Completed Development of the Dioxin Bioavailability Framework**
Completed development of the Dioxin Bioavailability Framework. This report provides the basis for minimum requirements of assays intended to estimate RBA of PCDD/F in soils for applications to risk assessment. The Framework is posted on the TRW Bioavailability website
(http://www.epa.gov/superfund/bioavailability/Dioxin_Framework_11-686674.pdf).
10. **Published Manuscript: “Effects of Phosphate Amendments on Bioavailability of Pb in Soils”**
Completed development of a manuscript that reviews the state-of-the-science on the effects of phosphate amendments on bioavailability of Pb in soil. The manuscript includes the review of arsenic and phosphate soil chemistry and studies on effects of amendments on soil arsenic bioaccessibility and bioavailability. The manuscript has been accepted for publication (Amending Soils with Phosphate as Means to Mitigate Soil Lead Hazard: A Critical Review of the State of the Science. K.G. Scheckel, G. Diamond, M. Maddaloni, C. Partridge, S. Serda, B. W. Miller, J. Klotzbach, and M. Burgess. 2013. *J Toxicol Environ Health B* 16(6):337-380.
11. **Developed Fact Sheet/Technical Memorandum on “Effects of Phosphate Amendments on Bioavailability of Pb in Soils”**
Completed development of a Fact Sheet/Technical Memorandum to be posted on the TRW Bioavailability website. This is a condensed version of the information reviewed in the phosphate amendments manuscript. This will be posted on the TRW Bioavailability website.
12. **Continued Development of Bioaccessibility Sampling Guidance**
Initiated development of guidance for sampling soil to be used for site-specific Pb bioaccessibility assessments. The guidance would be applied for site-specific assessments.
13. **Soil Mineralogy for Materials Evaluated in Recent Swine Studies.** Posted final report on the Bioavailability website
(http://www.epa.gov/superfund/bioavailability/pdfs/TRW%20Mineralogical%20Report%20Final_508.pdf).

14. **Swine Study Reports.** Posted final reports for 6 recently conducted swine studies on arsenic bioavailability on the Bioavailability website. Links to individual study reports are available at: <http://www.epa.gov/superfund/bioavailability/guidance.htm>.

Communication, Training, and Outreach

1. **Hotline.** The Bioavailability Committee responds to questions from inquiries made either by telephone to the Bioavailability Committee hotline (toll-free 1-866-282-8622) or via bahelp@epa.gov. The Bioavailability Committee responded to 4 requests for assistance in 2013. Of these calls, 3 were from state and federal agencies and 1 was from a consulting firm.
2. **Bioavailability Committee Annual Meeting.** Held on October 29 – November 1, 2013, Gulf Breeze, FL Members of the Bioavailability Committee met to work on projects and plan activities for 2014.
3. **Presentations/Publications/Training:**
 - a. Lead Retention Mechanism in a Calcareous Soil with Calcium and Phosphate Amendments. L. Li, W. Xing, K.G. Scheckel, G. Xiang, H. Ji, and H. Li. 2013. *J. Hazard. Mater.* 262: 250-255.
 - b. Mouse Assay for Determination of Arsenic Bioavailability in Contaminated Soils. K.D. Bradham, G.L. Diamond, K.G. Scheckel, M.F. Hughes, S.W. Casteel, B.W. Miller, J.M. Klotzbach, W.C. Thayer, and D.J. Thomas. 2013. *J. Toxicol. Environ. Health Part A.* 76: 815-826.
 - c. Using the Mehlich 3 soil test as an inexpensive screening tool to estimate total and bioaccessible Pb in urban soils. K. K. Minca, N.T. Basta, and K.G. Scheckel. 2013. *J. Environ. Qual.* 42: 1518-1526.
 - d. Changes in silver nanoparticles exposed to human synthetic stomach fluid: Effects of particle size and surface chemistry. S.K. Mwilu, A.M. El Badawy, K.D. Bradham, C. Nelson, D.J. Thomas, K.G. Scheckel, T. Tolaymat, L. Ma, K. Rogers. 2013. *Sci. Total Environ.* 447:90-98.
 - e. Evaluation of a Low-cost Commercially Available Extraction Device for Assessing Lead Bioaccessibility in Contaminated Soils. C. Nelson, T. Gilmore, J. Harrington, K.G. Scheckel, B.W. Miller, and K.D. Bradham. 2013. *Environ. Sci.: Processes Impacts.* 15: 573-578.
 - f. Amending Soils with Phosphate as Means to Mitigate Soil Lead Hazard: A Critical Review of the State of the Science. K.G. Scheckel, G. Diamond, M. Maddaloni, C. Partridge, S. Serda, B. W. Miller, J. Klotzbach, and M. Burgess. 2013. *J Toxicol Environ Health B* 16(6):337-380.
 - g. Challenges of Pb immobilization and risk assessment. K.G Scheckel, B.W Miller, and L. Li. 246th ACS National Meeting, Indianapolis, IN, 2013.
 - h. Lead stabilization and arsenic mobilization by phosphate and alternative amendments: Implications on urban soil remediation and urban agriculture. Z.Cheng, M. Maddaloni, and K.G. Scheckel. 246th ACS National Meeting, Indianapolis, IN, 2013.

- i. Are phosphorus in situ Pb stabilization treatments equal? N.T Basta, K.K Minca, K.G Scheckel, and M.E Moser. 246th ACS National Meeting, Indianapolis, IN, 2013.
- j. Understanding microbial communities, lead availability, and their potential Interactions at an abandoned firing range in Oak Ridge, TN. C.W Schadt, T.S Sullivan-Guest, K.G Scheckel, P.M Jardine, and N.T Basta. 246th ACS National Meeting, Indianapolis, IN, 2013.
- k. Bioavailable and bioaccessible pools of soil bound metal(loid)s: Results from in vitro extraction, X-ray absorption spectroscopy, and in-vivo feeding studies. B.W. Miller, K.G. Scheckel, K.D. Bradham, and D.J. Thomas. International Union on Pure and Applied Chemistry, Istanbul, Turkey, 2013.
- l. Role of Phosphate Amendments on Pb and As Bioavailability. K.G. Scheckel, B.W. Miller, K.D. Bradham and D.J. Thomas. 12th International Conference on the Biogeochemistry of Trace Elements, Athens, GA, 2013.
- m. Bioaccessibility Estimates for Soil Pb Should Correlate with Human Bioavailability of Treated Soils. R.L. Chaney, M.H. Zia, E.E. Codling and K.G. Scheckel. 12th International Conference on the Biogeochemistry of Trace Elements, Athens, GA, 2013.
- n. Arsenic Speciation, In Vitro Gastrointestinal Bioaccessibility, and Predicted Human Bioavailability from Ingestion of Contaminated Soil. N.T. Basta, K.G. Scheckel, K.D. Bradham, D. J. Thomas, S.W. Whitacre and B.W. Miller. 12th International Conference on the Biogeochemistry of Trace Elements, Athens, GA, 2013.
- o. Evaluation of a Low-cost Commercially Available Extraction Device for Assessing Lead Bioaccessibility in Contaminated Soils. C.M. Nelson, T.M. Gilmore, J.M. Harrington, K.G. Scheckel, B.W. Miller and K.D. Bradham. 12th International Conference on the Biogeochemistry of Trace Elements, Athens, GA, 2013.
- p. Karen D. Bradham, Brian Laird, Pat Rasmussen, Sophia Serda, Steven Siciliano, and Michael F. Hughes. 2014. Assessing the Bioavailability and Risk from Metal-Contaminated Soils and Dusts. *Human and Ecological Risk Assessment*, 20: 272–286.
- q. Kim R Rogers, Karen Bradham, Thabet Tolaymat, David J. Thomas, Thomas Hartmann, Longzhou Ma, Alan Williams. 2012. Alterations in physical state of silver nanoparticles exposed to synthetic human stomach fluid. *Science of the Total Environment*, Volume 420, pages 334-339.
- r. James M. Harrington, Clay M. Nelson, Frank X. Weber, Karen D. Bradham, Keith E. Levine, Joann Rice. 2014. Evaluation of Methods for Analysis of Lead in Air Particulates: An Intra-Laboratory and Inter-Laboratory Comparison. Accepted for publication in *Environ. Sci.: Processes Impact*.
- s. Karen Bradham, Kirk Scheckel, Clay Nelson, Gary Diamond, Julie Klotzbach, Brad Miller, David Thomas. Determination of Arsenic Bioavailability in Contaminated Soils. Invited presentation at International Society of Geochemistry and Health, Toulouse France, July 2013.

- t. Karen Bradham. Invited presentation and panelist for Workshop on the Integrated Risk Information System (IRIS) Toxicological Review of Inorganic Arsenic, Jan 8, 2013, RTP, NC. Presentation: Bioavailability of Inorganic Arsenic.
- u. Karen Bradham. Invited Keynote Speaker for the Carolina's Society of Environmental Toxicology and Chemistry conference. Presentation: EPA's Bioavailability Research on Arsenic Contaminated Soils. Raleigh, NC, March 8, 2013.
- v. James M. Harrington, Clay M. Nelson, Frank X. Weber, Karen D. Bradham, Keith E. Levine, Joann Rice. Evaluation of Methods for Analysis of Lead in Air Particulates: An Intra-Laboratory and Inter-Laboratory Comparison. 2013 Air Quality Measurement Methods and Technology, November 19-21 2013, Sacramento, CA.
- w. Karen Bradham. Invited presentation at 2013 International Conference on Policies, Exposure and Risk to Babies and Children Living Near Remediation Sites", Taiwan, June 2013.

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

1. **United States Geological Survey:** Continued development and analysis of a new Pb and As soil Reference Material, in collaboration with USGS.
2. **Office of Resource Conservation and Recovery:** In collaboration with Office of Resource Conservation and Recovery program staff, continued development of a new SW-846 method for *in-vitro* bioaccessibility (IVBA) of lead in soils.
3. **EPA Region 3:** At the request of Region 3, provided assistance with the IVBA analysis of lead in soils.
4. **EPA Region 5:**
 - a. Reviewed and commented on "Derivation of Site-Specific Relative Bioavailability (RBA) Terms for Dioxins/Furans for Use at the Former Koppers Wood Treatment Site in Carbondale, Illinois.
 - b. Reviewed and commented on proposed site-specific dioxin bioavailability studies at the Tittabawassee River, Saginaw River & Bay Superfund site, Michigan (B5KF).
5. **EPA Region 6:**
 - a. Reviewed and commented on the "Revised Draft Final Oral and Dermal Bioavailability Investigation Plan (January 2013), Former Foster Air Force Base Skeet Range, Victoria, Victoria County, Texas" (Investigation Plan).
 - b. Reviewed and commented on the "Baseline Human Health Risk Assessment: San Jacinto River Waste Pits Superfund Site, Exposure Parameters".
6. **EPA Region 8:** At the request of Region 8, completed the validation and regulatory acceptance assessment of an *in vitro* bioaccessibility (IVBA) assay for arsenic in soil.

7. **EPA Region 9:** For three sites in Region 9, provided assistance by conducting in vitro and/or in vivo assays for lead and/or arsenic
8. **Office of Enforcement and Compliance Assurance:** Digestion of swine material for confirmation of lead content for the swine RBA assay for the new OSRTI/USGS reference material.