

**Technical Review Workgroup for Metals and Asbestos
Bioavailability Committee Annual Report:
Accomplishments and Activities for Calendar Year 2017**

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TRW Bioavailability Committee Accomplishments of 2017

Reports and Guidance on the Bioavailability of Metals in Soil

- 1. Finalized Validation of the Arsenic IVBA (*In Vitro* Bioaccessibility) Assay**
Finalized the Arsenic IVBA Validation Report. This report provides the basis for validation and regulatory acceptance of the arsenic IVBA assay. The arsenic IVBA assay (EPA Method 1340) can be used to replace animal relative bioavailability (RBA) assays. Available at: <https://semspub.epa.gov/work/HQ/196751.pdf>.
- 2. Finalized Standard Operating Procedure (SOP) for the Lead and Arsenic IVBA Assay.**
The existing Lead IVBA SOP was modified to include arsenic and to refine method descriptions and reporting requirements. Available at: <https://semspub.epa.gov/work/HQ/100000153.pdf>.
- 3. Method 1340 Addition to the SW-846.** This method has been available on the Office of Resource Conservation and Recovery (ORCR) SW-846 Validated Methods website and on the OSRTI TRW Bioavailability webpage since it was validated, although it was not an official SW-846 method. ORCR has worked with the Bioavailability Committee (BAC) TRW to officially incorporate Method 1340 into the SW-846 Compendium. The final step in the process was the finding of no significance by the Office of Management and Budget (OMB), which allowed ORCR to finalize the addition of Method 1340. Acceptance of this *in vitro* assay for lead bioavailability and an SW-846 method is expected to increase availability of commercial laboratories that can perform the method.
- 4. Published Manuscript: “Soil arsenic in vivo and in vitro oral bioavailability methods for use in human health risk assessment, a review of the state of the science.”**
Members of the TRW Bioavailability Committee completed development and publication of a manuscript reviewing *in vivo* and *in vitro* methods to assess bioavailability of arsenic (Bradham, KD, Diamond GL, Burgess M, Klotzbach JM, Maddaloni M, Nelson, C, Scheckel K, Serda SM, Stifelman M, Thomas, DJ. 2017. Soil arsenic in vivo and in vitro oral bioavailability methods for use in human health risk assessment, a review of the state of the science. *J Toxicol Environ Health, Part B. In press*).
- 5. Published Manuscript: “Comparison of mouse and swine bioassays for determination of soil arsenic relative bioavailability”**
Members of the TRW Bioavailability Committee completed development and publication of a manuscript comparing mouse and swine bioassays used to estimate the RBA of arsenic (Bradham K, Diamond G, Juhasz A, Nelson C, Thomas D. 2017. Comparison of mouse and swine bioassays for determination of soil arsenic relative bioavailability. *Applied Geochemistry. In press*).

- 6. Continued Development of a Round Robin Study to Support the Arsenic IVBA Assay**
Completed a multi-laboratory round-robin study to establish consensus values for arsenic IVBA (Method 1340) and total arsenic values for the following reference materials: NIST 2710a, Flatt Creek Reference Material (<250 µm), and Flat Creek Reference Material (<74 µm). This study also established lead IVBA (Method 1340) and total lead values for the Flat Creek Reference Material (<74 µm). The final report was received from the QATS contractor on November 30th, 2017, and the full committee will review it at the January 2018 TRW meeting.
- 7. 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 (EPA Method 1340).
- 8. Continued Manuscript Development: “Development and Analysis of a New Soil Reference Material for Lead and Arsenic”**
Continued progress on 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.
- 9. Initiated Development of a Memorandum on the Mouse Model for Arsenic Relative Bioavailability**
A memorandum is being developed to inform the EPA Regional offices about the development of an *in vivo* mouse model to measure arsenic relative bioavailability (RBA) in soil.
- 10. Initiated Development of a Sampling Guidance Document for Relative Bioavailability**
Initiated development of a sampling guidance document to assist risk assessors in developing sampling plans for site soil RBA assessments.
- 11. Initiated Development of a Fact Sheet on Methods to Assess Arsenic Bioavailability**
Initiated development of a Fact Sheet to provide risk assessors an overview of available methods to assess arsenic relative bioavailability.

12. Initiated Research on the effect of particle size (150 vs. 250 µm) on lead and arsenic IVBA and RBA

This research was undertaken to support applications of EPA Method 1340 to soils that have been sieved to 150 µm, the sieving size recommended by the EPA TRW for assessments of the hand-to-mouth pathway for arsenic and lead.

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 four requests for assistance from EPA Regional offices in 2017.
2. **Presentations/Reports/Publications/Training:**
 - a. Lead and Arsenic – Applying Current Methodologies to Common Contaminants. Charles R. Partridge. Presented at the 25th NARPM Training Program, Denver, CO, December 2017.
 - b. Lead and Arsenic Bioaccessibility and Speciation as a Function of Soil Particle Size. R.R. Karna, M. Noerpel, A.R. Betts, and K.G. Scheckel. 2017. J. Environ. Qual. Available Online.
 - c. State of the Science Review - Potential for Beneficial Use of Waste By-Products for In-situ Remediation of Metal-Contaminated Soil and Sediment. R. Karna, T.P. Luxton, and K.G. Scheckel. 2017. Crit. Revs. Environ. Sci. Technol. 47: 65-129.
 - d. Understanding Arsenic Dynamics in Agronomic Systems to Predict and Prevent Uptake by Crop Plants. T. Punshon, B.P. Jackson, A.A. Meharg, M.L. Guerinet, T. Warcrack, and K.G. Scheckel. 2017. Sci. Total Environ. 581-582: 209-220.
 - e. Soil Solution Interactions May Limit Pb Remediation Using P Amendments in an Urban Soil. J.F. Obrycki, K.G. Scheckel, and N.T. Basta. 2017. Environ. Pollut. 220: 549-556.
 - f. Alterations of Lead Speciation by Sulfate from Addition of Flue Gas Desulfurization Gypsum (FGDG) in Two Contaminated Soils. N. Koralegedara, K.G. Scheckel, and S.R. Al-Abed. 2017. Sci. Total Environ. 575: 1522-1529.
 - g. Predictive Capabilities of in vitro Assays for Estimating Pb Relative Bioavailability in Phosphate Amended Soils. A.L. Juhasz, K.G. Scheckel, A.R. Betts, and E. Smith. 2016. Environ. Sci. Technol. 50: 13086-13094.
 - h. Mechanisms and Permanence of Sequestered Pb and As in Soils: Impact on Human Bioavailability. Strategic Environmental Research and Development Program (SERDP), Alexandria, VA. SERDP Project ER-1742, 2017.
 - i. Application of High Energy Resolution X-ray Fluorescence Detection Spectroscopy on Environmental Samples. M. Noerpel, T. Luxton, B. Ravel, A.J. Kropf, R. Karna, D. Peloquin, and K. Scheckel. 254th American Chemical Society National Meeting, Washington, DC, 2017.

- j. Source Attribution of Lead Using Geospatial and Stable Isotope Analysis. M. Noerpel, M. Pribil, P. Law, R. Brown, T. Campbell, and K. Scheckel. 14th International Conference on the Biogeochemistry of Trace Elements, Zurich, Switzerland, 2017.
- k. In Vitro Bioaccessibility Method for Prediction of Relative Bioavailability of Arsenic in Contaminated Soils. K. Bradham, C. Nelson, A. Juhasz, E. Smith, K. Scheckel, D. Obenour, and D. Thomas. 14th International Conference on the Biogeochemistry of Trace Elements, Zurich, Switzerland, 2017.
- l. Dynamics of Pb Absorption Following Deposition of Pb-containing Particles in the Lungs. A. Juhasz, M.W. Donnelley, P.L. Cmielewski, D.W. Parsons, K.G. Scheckel, and E. Smith. 14th International Conference on the Biogeochemistry of Trace Elements, Zurich, Switzerland, 2017.
- m. Utilizing Pb Isotopes for Source Attribution at Impacted Sites. K.G. Scheckel. Region 7 Annual On-Scene Coordinator Workshop. Kansas City, MO, 2017.
- n. Application of High Energy Resolution X-ray Fluorescence Detection Spectroscopy on Environmental Samples. M. Noerpel, T. Luxton, B. Ravel, A.J. Kropf, R. Karna, D. Peloquin, and K. Scheckel. 14th International Conference on the Biogeochemistry of Trace Elements, Zurich, Switzerland, 2017.
- o. Relating Soil Geochemical Properties to Arsenic Bioaccessibility Through Hierarchical Modeling. C. Nelson, K. Li, D. Obenour, J. Misenheimer, K. Scheckel, A. Betts, D. Thomas, K. Bradham, and A. Juhasz. International Society of Exposure Science, RTP, NC, 2017.
- p. Soil Fractionation Study, Speciation, and IVBA Analysis in Lead and Arsenic Contaminated Soils. R.R. Karna, A.R. Betts, M. Noerpel, and K.G. Scheckel. Annual Meeting of the Soil Science Society of America, Phoenix, AZ, 2016.
- q. Apparent Relationship Between Soil Vanadium and Arsenic Bioaccessibility Across Many Soils: Are There Geochemical Reasons? A.R. Betts, C. Nelson, K. Bradham, and K.G. Scheckel. Annual Meeting of the Soil Science Society of America, Phoenix, AZ, 2016.
- r. Point of Zero Charge: Role in Pyromorphite Formation and Stability in Lead Contaminated Soils. R.R. Karna and K.G. Scheckel. Annual Meeting of the Soil Science Society of America, Phoenix, AZ, 2016.
- s. Relationship Between Total and Bioaccessible Lead on Childrens's Blood Lead Levels in Urban Residential Philadelphia Soils. K. Bradham, C. Nelson, J. Kelly, A. Pomales, K. Scruton, T. Dignam, J. Misenheimer, K. Li, D. Obenour, and D. Thomas. 2017. *Environ. Sci. Technol.* 51: 10005-10011.
- t. Comparison of Mouse and Swine Bioassays for Determination of Soil Arsenic Relative Bioavailability. K. Bradham, G. Diamond, A. Juhasz, C. Nelson, D. Thomas. 2017. *Applied Geochemistry*. Available Online. <https://doi.org/10.1016/j.apgeochem.2017.05.016>
- u. In Vitro Bioaccessibility of Copper Azole Following Simulated Dermal Transfer from Pressure-Treated Wood. J. Griggs, K. Rogers, C. Nelson, T. Luxton, W. Platten, K. Bradham. 2017. *Sci. Total Environ.* 598: 413-420.
- v. Soil Ingestion Rates for Children Under 3 Years Old in Taiwan. L-C. Chien, M-C. Tsou, H-C. Hsi, P. Beamer, K. Bradham, Z-Y. Hseu, S-H. Jien, C-B. Jiang, W. Dang, and H. Özkaynak. 2017. *J. Exposure Sci. Environ. Epidemiol.* 27: 33-40.

- w. Relating Soil Geochemical Properties to Arsenic Bioaccessibility Through Hierarchical Modeling. C.K. Nelson, D. Li, J. Obenour, K. Misenheimer, A. Scheckel, D. Betts, D. Thomas, K. Bradham, and A. Juhasz. International Society of Exposure Science, Morrisville, NC, 2017.
- x. In Vitro Bioaccessibility Method for Prediction of Relative Bioavailability of Arsenic in Contaminated Soils. K. Bradham, C. Nelson, A. Juhasz, E. Smith, K. Scheckel, D. Thomas. International Conference on the Biogeochemistry of Trace Elements, Zurich, 2017.
- y. Evaluating the All-Ages Lead Model using Site-Specific Data: Approaches and Challenges. E.D. McLanahan, L. Wilder, D. Jackson, K. Scruton, D. Mellard, K. Bradham, R.R. Worley. ATSDR symposium, 2017.
- z. Characterization of Silver Nanoparticles Spray Disinfectant Products Using Asymmetrical Flow Field Flow Fractionation in Combination with UV/Vis Detection. J.K. Bradham, C. Nelson, and K. Rogers. 5th Workshop on Field-Flow Fractionation. Navratilova. Vienna, Austria, 2017.
- aa. Estimating Lead Bioavailability in a Mouse Model. D. Thomas, W. Green, H. Hayes, P. Alava, K. Bradham; C. Nelson; J. Misenheimer. Annual Society of Toxicology Conference, 2017.
- bb. Evaluation of Lead and Phosphate Interactions in a Mouse Model for Oral Bioavailability of Lead. B.P. Elek, J. Alava, C. Misenheimer, K. Nelson, K. Bradham, D. Thomas. Annual Society of Toxicology Conference, 2017.
- cc. Release of Micronized Copper Particles from Pressure Treated Wood. R. Kim, T.L. Rogers, W.E. Platten III, S. Harmon, L. Santiago-Rodríguez, J.L. Griggs, K.D. Bradham, C. Nelson. Society of Toxicology and Environmental Chemistry, Salt Lake UT, 2016.

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

1. **EPA Region 1:** Provided assistance to Region 1 regarding application of arsenic bioavailability assessments.
2. **EPA Region 2:**
 - a. Provided review and feedback to Region 2 regarding use of soil amendments at a municipal short range.
 - b. Provided review and feedback to Region 2 regarding bioavailability assessments for the Matteo site.
3. **EPA Region 5:** Provided review and feedback to Region 5 regarding the sampling plan for bioavailability assessment of the Sandoval Zinc site.
4. **U.S. Army Corps of Engineers/State of Texas:** Reviewed and provided comments on the Revised Final Report on the Foster Air Force Base PAH Bioavailability Study.

5. **USGS:** Continued collaboration for the development and analysis of a new lead and arsenic soil Reference Material.
6. **California Department of Toxic Substances Control:** Reviewed and provided comments on a RBA study plan to assess bioavailability of nickel and cobalt.
7. **California Department of Toxic Substances Control, EPA Brownfields Training, Research and Technical Assistance Grant (TR-83415101):** The TRW Bioavailability Committee reviewed and provided comments in a memorandum on the final technical report on “Arsenic Characterization/Bioavailability on Mine-Scarred Lands (Study)” for the Brownfields Training, Research and Technical Assistance Grant (TR-83415101) awarded to the California Department of Toxic Substances Control (DTSC).
8. **Interstate Technology & Regulatory Council (ITRC):** Bioavailability in Contaminated Soil Team – Several members of the TRW Bioavailability are participating on an ITRC workgroup that is developing guidance documents and internet-based training on bioavailability of lead, arsenic and PAHs in soil. The TRW Bioavailability Committee reviewed and provided comments.