Argonne NATIONAL LABORATORY

www.anl.gov
www.aps.anl.gov
apsinfo@aps.anl.gov

ENVIRONMENT AND THE ADVANCED PHOTON SOURCE

Ironite fertilizer—used for lawns, gardens, and agricultural crops—is made of tailings from an inactive silver mine. Studies by the manufacturer show that over 95% of the arsenic in the tailings is bound with iron and sulfide into the mineral arsenopyrite and insulated when surrounded by pyrite, and that most of the lead is bound in the mineral galena. But researchers from the U.S. Environmental Protection Agency, using x-ray beams from the Argonne Advanced Photon Source (APS), found that by the time the fertilizer gets to market, the arsenopyrite and galena have decomposed, which could result in arsenic and lead leaching into soil. This study shows that care must be taken, when reusing mine waste products, to assure that the benefits outweigh the costs and risks posed by accidental contamination of soil and water.


Image: commons.wikimedia.org/wiki/Image:Corn_field_ohio.jpg

Perhaps the largest environmental disaster the world has seen is the arsenic contamination of ground water in Bangladesh. 57 million of the country's 125 million inhabitants are at risk of drinking dangerous levels of arsenic that have seeped into the nation's water wells (right), many of which were built in the 1960s and '70s to protect against drinking contaminated surface water. Recent incidences of arsenicosis and cancer from arsenic poisoning have caused serious concern. Although the source of the arsenic was known, how did it migrate to the water supply? Using the APS, researchers from Stanford University, The University of Chicago, MIT, and Bangladesh University have found evidence that arsenic is released in near-surface sediments and is subsequently transported to water supply depth.


www.textually.org/textually/archives/2006/10/013938.htm

Radioactive Cesium-137 is one of the contaminants in soil at the Hanford Site in Washington state, where leaks of radioactive waste generated during plutonium synthesis have occurred. About one million curies of Cs-137 seeped into the soil over the years, much of it above the water table and chemically bound to minerals. With a half-life of 30.2 years, leaving the Cs-137 to decay in place may be best, but decisions about remediation require a better understanding of the Cesium's state. Using the APS, researchers from the U.S. Department of Energy's Pacific Northwest National Laboratory, and The University of Chicago, found evidence that the Hanford Cs-137 is relatively immobile and not likely to enter the water table before decaying.


Photo: Derek Jensen (Tysto)

See other side for more information

The Advanced Photon Source at the U.S. Department of Energy's Argonne National Laboratory provides this hemisphere's brightest x-ray beams for research. Scientists and engineers using the APS help assure a bright future for our nation by carrying out research that promises to have far-reaching impact on our technological and economic competitiveness, our health, and our fundamental knowledge of the materials that make up our world.

Argonne is a U.S. Department of Energy laboratory managed by UChicago Argonne, LLC
The Advanced Photon Source at Argonne National Laboratory is funded by the U. S. Department of Energy, Office of Science, Office of Basic Energy Sciences

UChicago Argonne LLC — Office of Science, U.S. DEPARTMENT OF ENERGY

For this study, researchers from the U.S. Environmental Protection Agency used the Materials Research Collaborative Access Team 10-ID and X-ray Operations and Research/Pacific Northwest Consortium (XOR/PNC) 20-BM beamlines at the APS.

See: Aaron G.B. Williams, Kirk G. Scheckel*, Thabet Tolaymat, and Christopher A. Impellitteri, "Mineralogy and Characterization of Arsenic, Iron, and Lead in a Mine Waste-Derived Fertilizer," Environ. Sci. Technol. **40**, 4874 (2006). DOI: 10.1021/es060853c.

Author affiliation: United States Environmental Protection Agency
Correspondence: *Scheckel.Kirk@epa.gov

The U.S. Environmental Protection Agency, through its Office of Research and Development, funded and managed the research described here. It has not been subject to Agency review and, therefore, does not necessarily reflect the views of the Agency. No official endorsement should be inferred. PNC-CAT facilities at the Advanced Photon Source and research at these facilities are supported by the U.S. Department of Energy, Office of Science, Office of Basic Energy Sciences, the University of Washington, a major facilities access grant from NSERC, Simon Fraser University. and the Advanced Photon Source. MR-CAT operations are supported by the Department of Energy and the MR-CAT member institutions. Use of the Advanced Photon Source was supported by the U.S. Department of Energy, Office of Science, Office of Basic Energy Sciences.

See also: "Ironite: A Potentially Fertile Source of Soil Contamination," *APS Science 2006*, the annual report of the Advanced Photon Source at Argonne National Laboratory, ANL-06/23, May 2007, p. 102.

This research was carried out by experimentalists from Stanford University, the Massachusetts Institute of Technology, Bangladesh University, and The University of Chicago, using the GSECARS 13-ID-C beamline at the APS.

See: Matthew L. Polizzotto[1], Charles F. Harvey[2], Guangchao Li[1], Borhan Badruzzman[3], Ashraf Ali[3], Matthew Newville[4], Steven Sutton[4], and Scott Fendorf[1]*, "Solid-phases and desorption processes of arsenic within Bangladesh sediments," Chem. Geol. **228**, 97 (2006). DOI: 10.1016/j.chemgeo.2005.11.026.

Author affiliations: [1]Stanford University, [2]Massachusetts Institute of Technology, [3]Bangladesh University of Engineering and Technology, [4]The University of Chicago
Correspondence: *fendorf@stanford.edu

Portions of this research were carried out at the Stanford Synchrotron Radiation Laboratory, operated by Stanford University on behalf of the U.S. Department of Energy, Office of Basic Energy Sciences. This work was funded by the Stanford Graduate Fellowship and the National Science Foundation CRAEMS Program (Grant number CHE-0089215). Use of the Advanced Photon Source was supported by the U.S. Department of Energy, Office of Science, Office of Basic Energy Sciences.

See also: "Arsenic in the Water Supply," *APS Science 2006*, the annual report of the Advanced Photon Source at Argonne National Laboratory, ANL-06/23, May 2007, p. 100.

Experimentation carried out by researchers from the Pacific Northwest National Laboratory and The University of Chicago, using the GSECARS-CAT 13-ID and XOR/PNC 20-ID beamlines at the APS.

See: "Microscale Distribution of Cesium Sorbed to Biotite and Muscovite," J.P. McKinley[1], J.M. Zachara[1], S.M. Heald[1], A. Dohnalkova[1], M.G. Newville[2], and S.R. Sutton[2], Enviro. Sci. Tech. **38**(4), 1017 (2004).

Author affiliations: [1]Pacific Northwest National Laboratory, [2]The University of Chicago
Correspondence: james.mckinley@pnl.gov

This research was supported by the U.S. Department of Energy Environmental Management Science Program. The PNC-CAT is supported by the U.S. Department of Energy, Office of Science, Office of Basic Energy Sciences, and by the Canadian Natural Sciences and Research Council. TEM work was performed at the W.R. Wiley Environmental Molecular Sciences Laboratory, a national scientific user facility sponsored by the U.S. Department of Energy's Office of Biological and Environmental Research and located at Pacific Northwest National Laboratory (PNNL). PNNL is operated for the U.S. Department of Energy by Battelle. Use of the Advanced Photon Source was supported by the U.S. Department of Energy, Office of Science, Office of Basic Energy Sciences.

See also: "Microscale Distribution of Cesium Sorbed to Biotite and Muscovite," *APS Science 2004*, the annual report of the Advanced Photon Source at Argonne National Laboratory, ANL-05/04, May 2005, p. 99.