

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.



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.



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.



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.

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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.

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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. Polizzotto¹, Charles F. Harvey², Guangchao Li¹, Borhan Badruzzman³, Ashraf Ali³, Matthew Newville⁴, Steven Sutton¹, 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.

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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. McKinley¹, J.M. Zachara¹, S.M. Heald¹, A. Dohnalkova¹, M.G. Newville², and S.R. Sutton², *Environ. Sci. Tech.* **38**(4), 1017 (2004).

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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.