

INTERACTION POINT

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[Back to SLAC Homepage](#)

[Back to TIP Homepage](#)

In this issue:

[FRONT PAGE](#)

FEATURES

- [Director's Corner](#)
- [Pierre Schwob Donates \\$1 Million to KIPAC](#)
- [Safety Goals—No One Gets Hurt](#)
- [SSRL Seeks Chromate Contamination Solutions](#)
- [Networking: The Next Generation](#)
- [Trickle Treat](#)

ANNOUNCEMENTS & UPDATES

- [New Citrix Farm Launched](#)
- [Windows Application Installation Site Available](#)
- [Accident Reduction Talk and Walk Standdown](#)
- [Safety Simplified: Job Hazard Analysis and Mitigation](#)

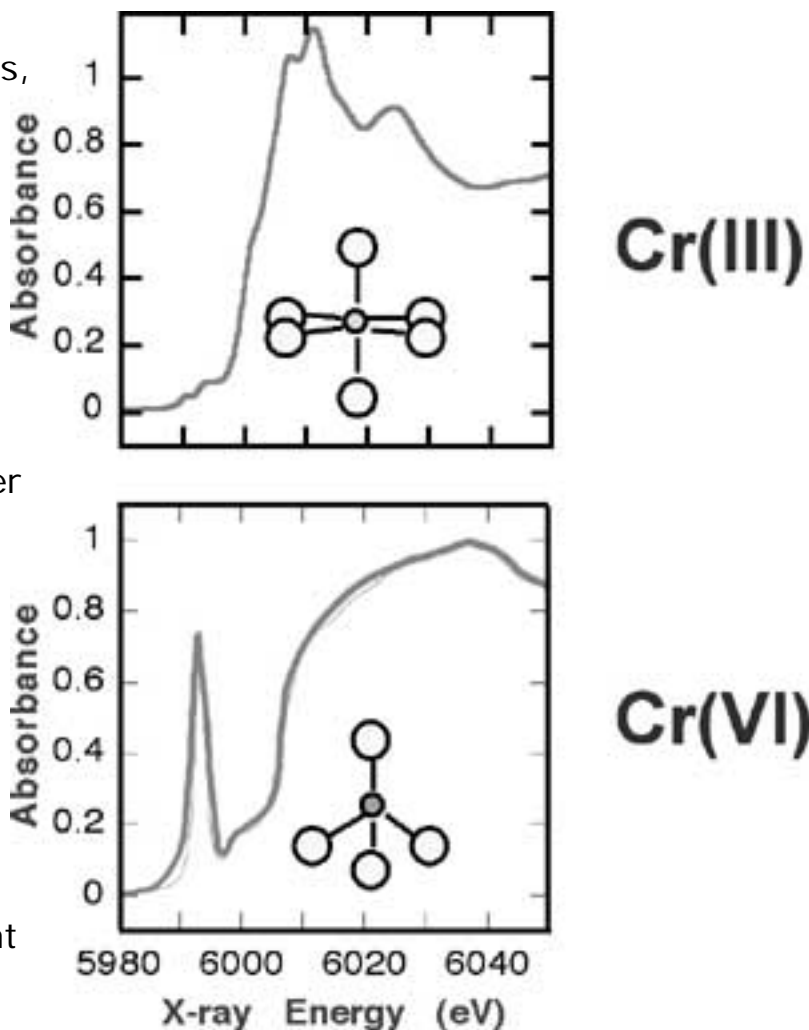
SSRL Seeks Chromate Contamination Solutions

By Heather Rock Woods

Toxic and carcinogenic chromate has contaminated the groundwater in Hanford, Washington, one of the unfortunate legacies of producing plutonium for nuclear weapons. At times, plumes of contaminated groundwater have reached the Columbia River, posing a risk to spawning salmon.

Existing technologies, such as pump-and-treat, are largely ineffective for mitigating chromate in the groundwater at this location due to the large volume (millions of gallons) and depth of the contaminant plumes.

Recent research conducted at SSRL



- [Just Arrived! Wide Selection of SLAC Logo Items Available](#)
- [Milestones](#)

POLICIES AND PROCEDURES

- [Winter Shutdown Permanently Extended](#)
- [What's New with E-mail at SLAC?](#)

EVENTS

- [40, 30 and 20 Year Awardees Honored at the Annual Service Award Dinner](#)
- [SLAC Family Day 2004](#)
- [Geant4 Tutorial Workshop](#)
- [April 4 Events](#)
- [Beyond Einstein: From the Big Bang to Black Holes](#)
- [Education Fair Opens Doors to Learning](#)
- [SLAC Public Lecture Series](#)
- [A Friendly Game of Soccer](#)
- [Upcoming Events](#)

ABOUT TIP

- [Staff/Contact](#)

and at the Pacific Northwest National Lab (PNNL)

These two graphs show the typical X-ray Absorption Spectroscopy 'fingerprints' for trivalent chromium, Cr(III) (top) and hexavalent chromium, Cr(VI). (Image courtesy of John Bargar)

has shown that naturally occurring sediments at the Hanford site are immobilizing some of the chromate. John Zachara (PNNL) and Gordon Brown and Jeffrey Catalano (both of Stanford University), tested contaminated and highly radioactive soil samples at SSRL to determine the chemical forms of the chromate—carcinogenic hexavalent chromium or the less toxic trivalent chromium—and their relative amounts.

They used X-ray Absorption Spectroscopy, which makes distinctive patterns that act like fingerprints to identify different chemical forms. Hanford had previously used hexavalent chromium in the industrial process to recover plutonium from irradiated nuclear fuels. The resulting high-level waste corroded its storage tanks and leaked into the desert subsoils at Hanford.

About 42 percent of the chromate in the contaminant plumes had become an immobile solid that contained trivalent chromium. Researchers said that the solid forms when hexavalent chromium reacts with iron-bearing sediments in the aquifer. Solid trivalent chromium is unlikely to dissolve—and thus is effectively taken out of circulation in the groundwater.

"It's a great synergy," said John Bargar (SSRL), the molecular environmental scientist who runs the beam line where the tests were conducted. "The sediment-hosted ferrous iron prefers to transfer its electrons to oxidized species such as chromate. The resulting ferric iron and trivalent chromium want to precipitate together into a mineral. Once present in solid form, chromium can't flow in the groundwater, and it's very slow to dissolve or won't dissolve. As a result of these reactions, about half of the problem is abated."

Unfortunately, more than half of the chromium in the plumes remains as the more toxic hexavalent form, which moves readily through the subsurface sediments. However, the team's discovery is a necessary and huge step toward mitigating the problem, Bargar stated.

- [Submission Guidelines](#)

Zachara's study is one of many ongoing studies at SSRL looking at contaminated sediments from Hanford. Developing technical solutions to such largescale contaminant problems requires key insights into the form of the contaminant. This information allows engineers to assess the hazards posed by such extreme chemical and radioactive materials, and to design the most effective, long-term strategies to deal with them.

The Stanford Linear Accelerator Center is managed by [Stanford University](#) for the [US Department of Energy](#)

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