

Scientists discover a bacterium that "breathes" uranium and renders it immobile

June 15 2015, by Carl Blesch



Sign at shuttered uranium mill in Rifle, Colorado, warns onlookers of hazards that remain from Cold War era nuclear weapons production.. Credit: Bill Gillette, U.S. National Archives and Records Administration

A strain of bacteria that "breathes" uranium may hold the key to cleaning

up polluted groundwater at sites where uranium ore was processed to make nuclear weapons.

A team of Rutgers University scientists and collaborators discovered the bacteria in soil at an old [uranium](#) ore mill in Rifle, Colorado, almost 200 miles west of Denver. The site is one of nine such mills in Colorado used during the heyday of [nuclear weapons](#) production.

The research is part of a U.S. Department of Energy program to see if microorganisms can lock up uranium that leached into the soil years ago and now makes well water in the area unsafe to drink.

The team's discovery, published in the April 2015 issue of *PLoS ONE*, is the first known instance where scientists have found a [bacterium](#) from a common class known as betaproteobacteria that breathes uranium. This bacterium can breathe either oxygen or uranium to drive the chemical reactions that provide life-giving energy.

"After the newly discovered bacteria interact with uranium compounds in water, the uranium becomes immobile," said Lee Kerkhof, a professor of marine and coastal sciences in the School of Environmental and Biological Sciences. "It is no longer dissolved in the groundwater and therefore can't contaminate drinking water brought to the surface."

Kerkhof leads the Rutgers team that works with U.S. Department of Energy researchers.

Breathing uranium is rather rare in the microbial world. Most examples of bacteria which can respire uranium cannot breathe oxygen but often breathe compounds based on metals – typically forms of solid iron. Scientists had previously witnessed decreasing concentrations of uranium in groundwater when iron-breathing bacteria were active, but they have yet to show that those iron-breathing bacteria were directly

respiring the uranium.

While the chemical reaction that the bacteria perform on uranium is a common process known as "reduction," or the act of accepting electrons, Kerkhof said it's still a mystery how the reduced uranium produced by this microorganism ultimately behaves in the subsurface environment.

"It appears that they form uranium nanoparticles," he said, but the mineralogy is still not well known and will be the subject of ongoing research.

The Rutgers team was able to isolate the uranium-breathing bacterium in the lab by recognizing that uranium in samples from the Rifle site could be toxic to microorganisms as well as humans. The researchers looked for signs of bacterial activity when they gradually added small amounts of dissolved uranium at the right concentration back to the samples where uranium had become immobilized. Once they found the optimal uranium concentrations, they were able to isolate the novel strain.

Exactly how the strain evolved, Kerkhof said, "we are not sure." But, he explained, bacteria have the ability to pass genes to each other. So just like bacteria pick up resistance to things like antibiotics and heavy metal toxicity, this bacterium "picked up a genetic element that's now allowing it to detoxify uranium, to actually grow on uranium." His research team has completed sequencing its genome to support future research into the genetic elements that allow the bacterium to grow on uranium.

What Kerkhof is optimistic about is the potential for these [bacteria](#) to mitigate the specific groundwater pollution problem in Rifle. Scientists at first expected the groundwater to flush into the Colorado River and carry the dissolved uranium with it, where it would get diluted to safer levels. But that hasn't happened. Other potential methods of remediation, such as digging up the contaminated soil or treating it with harsh

chemicals, are thought to be too expensive or hazardous.

"Biology is a way to solve this contamination problem, especially in situations like this where the radionuclides are highly diluted but still present at levels deemed hazardous," said Kerkhof. If the approach is successful, it could be considered for other sites where uranium was processed for nuclear arsenals or power plant fuel. While the problem isn't widespread, he said there's potentially a lot of water to be concerned about. And the problem could spread beyond traditional places such as ore processing sites.

"There is depleted uranium in a lot of armor-piercing munitions," he said, "so places like the Middle East that are experiencing war could be exposed to high levels of uranium in the groundwater."

More information: *PLoS ONE*, [journals.plos.org/plosone/arti ...
journal.pone.0123378](https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0123378)

Provided by Rutgers University

Citation: Scientists discover a bacterium that "breathes" uranium and renders it immobile (2015, June 15) retrieved 13 March 2024 from <https://phys.org/news/2015-06-scientists-bacterium-uranium-immobile.html>

| |
|---|
| This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only. |
|---|