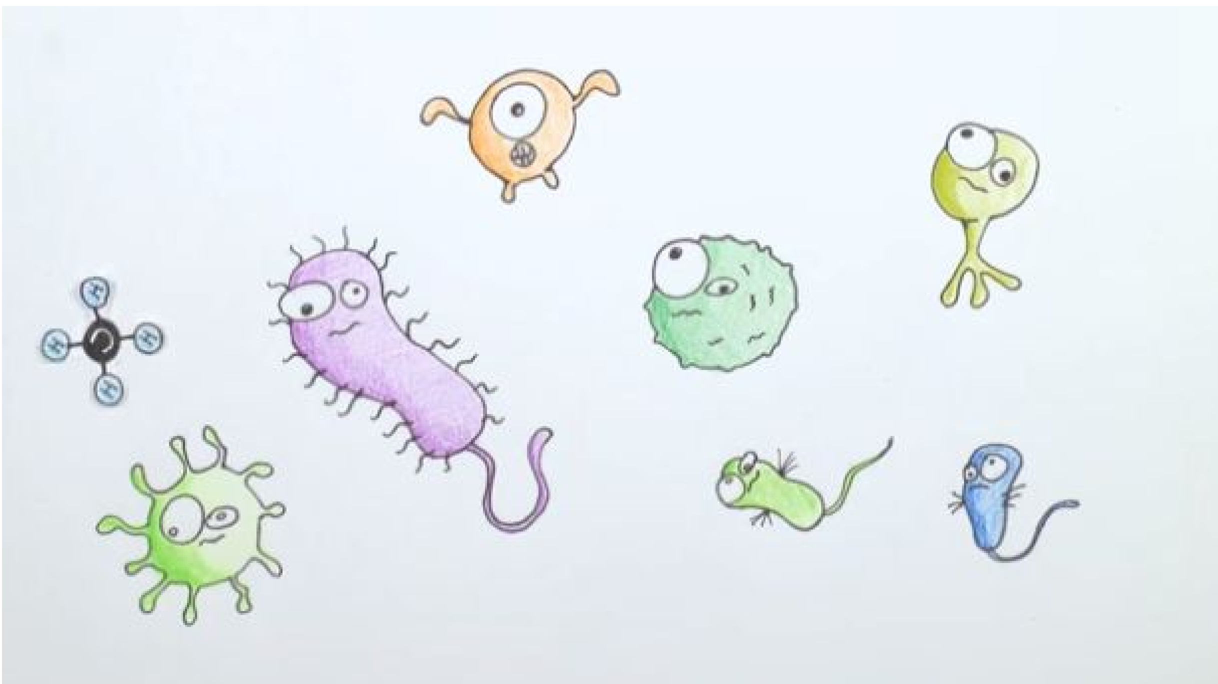
# Bacteria can make underground nuclear waste repositories safer

October 14 2016



Naturally occurring bacteria could consume pent-up hydrogen gas in nuclear waste repositories to prevent radioactive leaks, say researchers at EPFL.

Scientists may have found an unexpected ally in the long-term disposal of nuclear waste: bacteria. In a recent study, a research team led by

EPFL discovered a microbial community made up of seven species of bacteria that live naturally hundreds of meters underground in the very rock layers that have been chosen to host Swiss nuclear waste. Far from posing a threat, they found that, by tweaking the design of nuclear waste repositories, the bacteria could be used to increase their safety by consuming hydrogen that accumulates as the steel canisters bearing the waste corrode. If left unchecked, the gas pressure build up that could affect the integrity of the host rock. They published their findings in the journal *Nature Communications*.

It takes about two hundred thousand years for the radioactivity of spent nuclear fuel to revert to the levels of naturally occurring uranium. As a result, most research into the long-term safety of nuclear waste disposal focuses on processes that tick to a slow geological clock: the mechanics of the rock layers that make up the storage site or the robustness of the protective barriers in place that are engineered to contain the radiation. However, all these studies neglect one key factor: biology.

## Life underground

Bacteria can be found everywhere, even hundreds of meters underground. And according to Rizlan Bernier-Latmani, the senior author of the study, they will pounce on any available energy source. "In water samples from 300 meters underground at the Mont Terri Rock Laboratory, we unearthed a community bacteria forming a closed food chain. Many of them had never been observed before. Under pristine conditions, the species at the bottom of this bacterial food chain get their energy from hydrogen and sulfate from the host rock, powering the remaining species," she explains.

Adding nuclear waste to the mix changes the conditions altogether. Vitrified, sealed in steel canisters, surrounded by a thick layer of self-sealing bentonite, and buried hundreds of meters underground in geologically stable layers of Opalinus Clay, the radioactive waste is sealed off from the surrounding environment. But the inevitable corrosion of the steel canisters leads to the production of hydrogen gas.

**Dropping the pressure**

Five years ago, Bernier-Latmani and her researchers took their hypothesis to the field. "For two years, we subjected underground bacteria to increased hydrogen levels, right in the heart of the Opalinus Clay rock at the Mont Terri site," explains Bernier-Latmani. During that time, they monitored the composition of the bacterial population and how they changed individually, both in terms of their potential to support biochemical pathways, and in terms of the proteins they actually produce.

Once the bacteria had consumed all the available oxygen and iron, the researchers observed a shift in their population numbers and in their metabolism. Both were driven by the increased availability of hydrogen gas. "Two of the bacterial species that are able to use hydrogen to drive their metabolisms flourished, while the other species piggybacked on their growth," explains Bernier-Latmani. It was good news, as the proliferation of the bacterial community helped keep the buildup of hydrogen gas at bay.

## A biological barrier

So how can these findings be used to make nuclear waste repositories safer? Bernier-Latmani proposes adding a fourth, biological, engineered barrier. "What we could do is to add a layer of porous material between the bentonite and the host rock. This porous layer would provide an ideal niche for bacteria that could feed off of sulfate from the host rock and hydrogen from the corroding canisters," she says.

But one issue still troubles the researcher: genomic studies of the bacterial community suggest that the microorganisms could possess the capacity to transform the hydrogen gas into methane, which would be a less favorable outcome. "We have been trying to provoke methanogenesis at Mont Terri. After half a year, we are still waiting to observe it."

Provided by Ecole Polytechnique Federale de Lausanne

Citation: Bacteria can make underground nuclear waste repositories safer (2016, October 14) retrieved 27 April 2024 from https://phys.org/news/2016-10-bacteria-underground-nuclear-repositories-safer.html