Bacteria help avert radioactive leaks, study finds

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Naturally occurring bacteria could consume pent-up hydrogen gas in nuclear waste repositories to prevent radioactive leaks, a new study has found.

A research team led by Ecole Polytechnique Federale de Lausanne (EPFL) in Switzerland 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.

It takes about two hundred thousand years for the radioactivity of spent nuclear fuel to revert to the levels of naturally occurring uranium.

Bacteria can be found everywhere, even hundreds of meters underground and will pounce on any available energy source, said Rizlan Bernier-Latmani, senior author of the study.

"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 said.

Adding nuclear waste to the mix changes the conditions altogether, researchers said.

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.

However, the inevitable corrosion of the steel canisters leads to the production of hydrogen gas.

"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," said Mr. 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," said Mr. Bernier-Latmani.

The proliferation of the bacterial community helped keep the build-up of hydrogen gas at bay, researchers said.

The findings were published in the journal Nature Communications.