

# Microbes may be engineered to help trap excess CO<sub>2</sub> underground

February 23 2012

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The mineralization process required to permanently trap excess CO<sub>2</sub> underground is extremely slow. Bacteria, say researchers at the 56th Annual Meeting of the Biophysical Society, might help speed things up.

In H.G. Wells' classic science-fiction novel, *The War of the Worlds*, bacteria save the [Earth](#) from destruction when the Martian invaders succumb to infections to which humans have become immune through centuries of [evolution](#). If a team led by researchers at Lawrence Berkley National Laboratory's Center for Nanoscale Control of Geologic CO<sub>2</sub> (NCGC) has its way, bacteria – with a little assist from science – will help prevent global destruction for real by trapping underground a greenhouse gas, carbon dioxide (CO<sub>2</sub>), that threatens Earth's climate.

The team will discuss its work at the 56th Annual Meeting of the Biophysical Society (BPS) in San Diego, Calif., held Feb. 25-29.

Among the methods being considered for removing excess CO<sub>2</sub> (from sources such as power stations) from the atmosphere is transporting the gas into porous rock deep underground. There, it can mineralize with cations (positively charged atoms) to form solid [carbonate](#) minerals and become permanently trapped. This mineralization process, however, is extremely slow, sometimes taking hundreds to thousands of years.

Bacteria, the researchers predicted, might help speed things up.

"Previous studies have shown that underground bacteria remain in the

rock after CO<sub>2</sub> injection. We know these microbes can impact how minerals form, leading us to wonder if they also affect the rate of mineralization," says NCGC biochemist Jenny Cappuccio. "And if bacteria could enhance the nucleation of carbonate minerals, then perhaps we could fine-tune that ability in the laboratory."

Using different surface [bacteria](#) as proxies for their deeper-dwelling cousins, the researchers first examined the microbes' effect on calcium carbonate formation, and discovered that all of the species accelerated the process. The rate, they report, was highest in microbes whose surfaces have a thin protein shell known as an S-layer.

"We suspected that the [negative charge](#) of the S-layer attracted positive calcium ions and brought them in proximity with carbonate," Cappuccio says.

To test this theory, the researchers engineered artificial S-layers and increased their negative charge by attaching a loop of six amino acids – what Cappuccio calls a "loop of negativity." When carbonate was introduced, nucleation was significantly increased.

The next step, Cappuccio says, will be to culture deep subsurface microbes in the lab, make nanoscale changes to increase the negative charge of their surfaces, and see if that "tuning" makes them better able to speed up carbonate nucleation.

**More information:** The presentation, "Tuning microbial surfaces to control carbonate mineralization," is at 1:45 p.m. on Sunday, Feb. 26, 2012, in the San Diego Convention Center, Hall FGH. ABSTRACT: <http://tinyurl.com/7vgl8va>

Provided by American Institute of Physics

Citation: Microbes may be engineered to help trap excess CO<sub>2</sub> underground (2012, February 23)  
retrieved 3 May 2024 from

<https://phys.org/news/2012-02-microbes-excess-co2-underground.html>

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