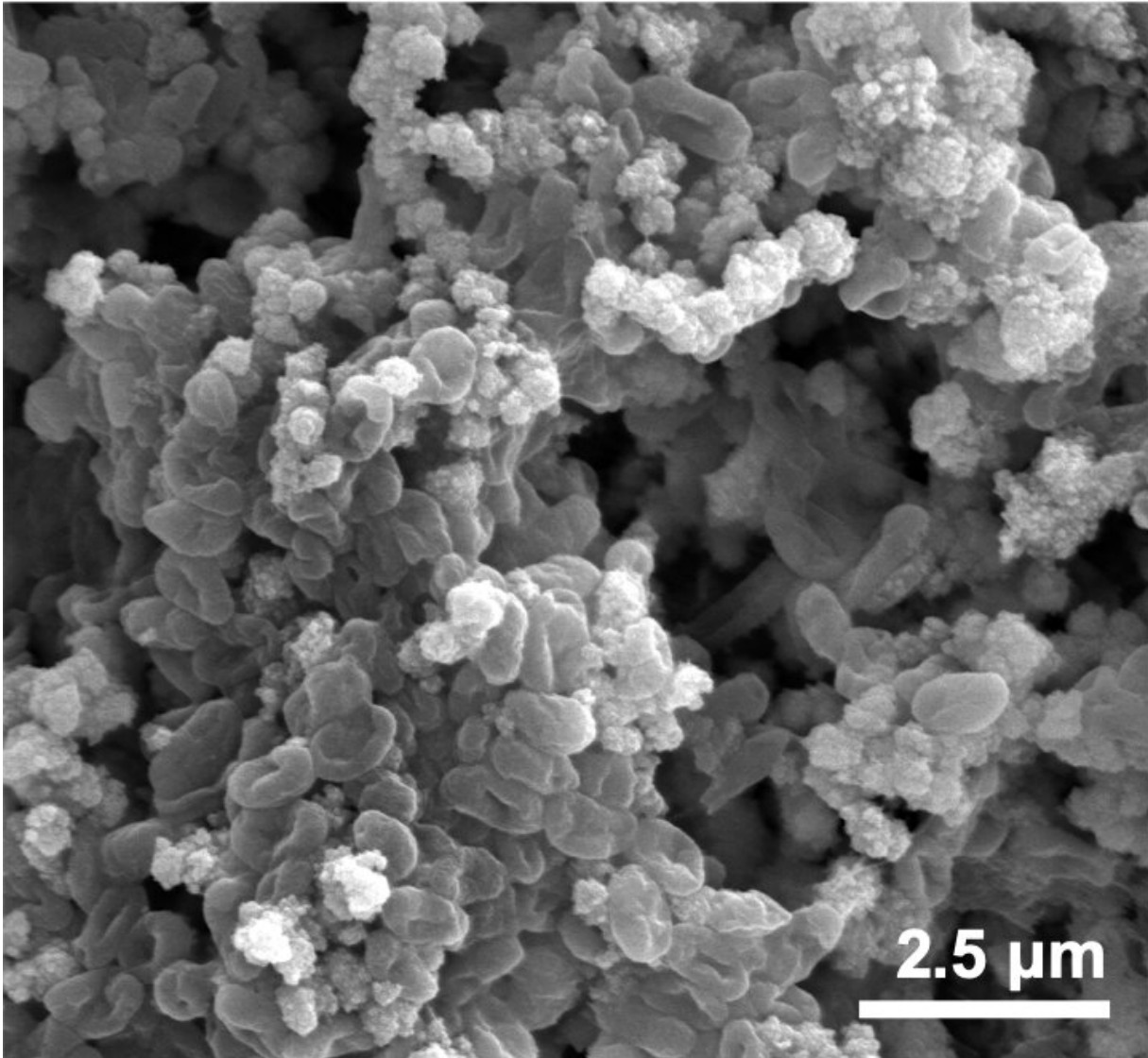


A 'jolt' for ocean carbon sequestration

June 1 2021, by Talia Ogliore



Rhodovulum sulfidophilum. Credit: Bose laboratory

Global oceans absorb about 25% of the carbon dioxide released into the atmosphere when fossil fuels are burned. Electricity-eating bacteria known as photoferrotrophs could provide a boost to this essential process, according to new research from Washington University in St. Louis.

Scientists led by Arpita Bose, assistant professor of biology in Arts & Sciences, found that [bacteria](#) found in brackish sediments can "eat" electricity and, in the process, absorb and lock away climate-warming [carbon](#) dioxide. This unusual skill was previously thought to be almost exclusive to freshwater bacteria, but may be common in [marine bacteria](#). The study was published May 30 in *The ISME Journal*, an official journal of the International Society of Microbial Ecology.

"These microbes are fixing and sequestering carbon dioxide and they can both 'eat' electricity and perform photoferrotrophy," Bose said.

"Photoferrotrophs use soluble iron as an [electron source](#) for photosynthesis while fixing carbon dioxide. Marine environments are great places for them because they are rich in many things they need.

"We are interested in these microbes because of their role in carbon sequestration," she said. "Perhaps these microbes can be important for combating climate change."

The first photoferrotrophs that scientists isolated in the 1990s came from freshwater ecosystems. Only two marine photoferrotrophs have previously been discovered, but those bacteria are difficult to keep alive in a lab setting.

"This really hampered investigations on marine photoferrotrophs," Bose said.

For the new work, Bose returned to one of her favorite places to hunt for

bacteria, Woods Hole, Massachusetts, and the Trunk River estuary. There, she and members of her team isolated 15 new strains of the common marine anoxygenic phototrophic bacteria *Rhodovulum sulfidophilum*.

"We found that all the *Rhodovulum* strains were capable of photoferrotrophy, and we used AB26 as a representative strain to show that it can also consume electricity," Bose said.

In the laboratory, the bacteria were able to harvest electrons directly from an electricity source; in the wild, they likely harvest electrons through rust and other iron minerals that are naturally abundant in marine sediments.

The scientists then conducted some additional tests with one of the strains to further illuminate the pathway that the bacteria use to directly consume electrons. A previously unknown electron-transfer protein appears to be key to the process, although additional research is needed to specifically describe the molecular mechanism.

"Anoxygenic phototrophs, like *Rhodovulum sulfidophilum*, are broadly distributed in marine ecosystems," said Dinesh Gupta, postdoctoral researcher at the University of California, Berkeley, and co-first author of the new study, who conducted this research as a graduate student in the Bose laboratory. "This study is the first to explore whether they can use insoluble/solid-phase substances as electron donors and if this electron-uptake process could be linked to carbon sequestration or [carbon dioxide](#) fixation in the ocean."

Because these bacteria are common and thriving in marine sediments already, they may already hold a key for future engineered approaches to climate change, Bose said.

"We need to understand the extent of carbon sequestration they can do in nature, as it might be a cryptic metabolism," Bose said. "We could also potentiate it further—both for biotechnology and for the environment. This study is a big step, setting the stage for many future studies."

More information: Dinesh Gupta et al, Photoferrotrophy and phototrophic extracellular electron uptake is common in the marine anoxygenic phototroph *Rhodovulum sulfidophilum*, *The ISME Journal* (2021). [DOI: 10.1038/s41396-021-01015-8](https://doi.org/10.1038/s41396-021-01015-8)

Provided by Washington University in St. Louis

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