NATURE | NEWS

Sea floors host surprise methane-munching microbes

Organisms living in carbonate rock provide a previously unrecognized sink for the greenhouse gas.

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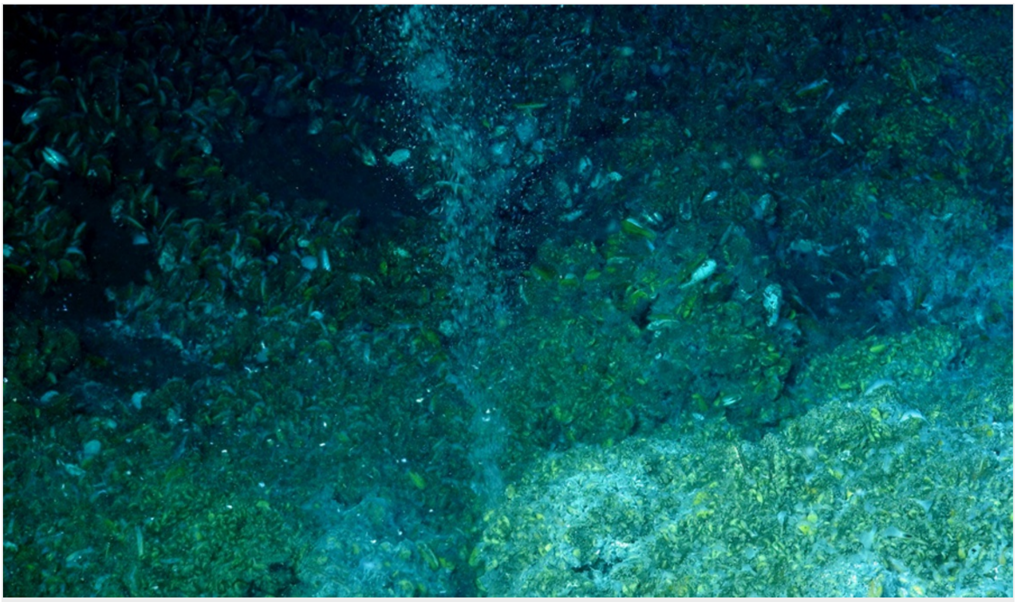
14 October 2014



Deepwater Canyons 2013/NOAA-OER/BOEM/USGS

Methane seeps, where the gas rises from the sea floor, are surrounded by carbonate rock, which is not just passive sediment but home to a rich methane-eating flora.

Carbonate rocks near methane seeps in the sea floor are home to thriving ecosystems of microbes that consume that greenhouse gas, suggests research published in *Nature Communications*[1].

“This is a niche that has been completely unaccounted for,” says Samantha Joye, a microbial geochemist at the University of Georgia in Athens who was not involved in the study.

Some sea-floor sediments are chock-full of methane-consuming microbes, particularly in layers that also contain sulphate ions diffusing or being pulled into the ocean bottom from overlying waters. These two ingredients help to power the microorganisms’ metabolisms, says Victoria Orphan, a geobiologist at the California Institute of Technology in Pasadena and a co-author of the latest study.

The biochemical reactions involved when the microbes process the methane and sulphate causes the water surrounding the organisms to become more alkaline, which in turn leads carbonate ions to precipitate out of the water and form minerals such as calcium carbonate ($CaCO_3$), the stuff of ordinary chalk. The presence of the minerals in sediments around methane seeps — sites where waters containing the dissolved gas leaks out of the sea floor — have long been used as evidence for past methane consumption, helping scientists to estimate the length of time such seeps have been or were active[2].

But the study by Orphan and her colleagues strongly suggests that the carbonates are not just dead rock. The researchers analysed two dozen samples collected in and around deep-sea methane seeps off the coasts of Oregon, California and Costa Rica. Tests revealed the presence of genetic material associated with methane-consuming microbes, says Orphan.

Mineral waste

Those results alone do not divulge whether the genes came from living or dead microbes, so the team ran further tests in the lab. They bathed samples of the carbonate rock in sea water infused with methane. But instead of ordinary methane, they used methane that included the radioactive isotope carbon-14, rather than the stable, and much more common, carbon-12. Over time, the carbon-14 was incorporated into the carbonate minerals. This was a sign that there were methane-munching microbes living in the samples — even in relatively nonporous rocks in which the microbes would have had little access to the radioactive methane, says Orphan.

Scientists already knew that such carbonates lock away carbon from a greenhouse gas that might otherwise warm the planet’s atmosphere. But the team's results suggest that the reservoir is much more active than previously suspected.

“These data are very believable,” says John Pohlman, a biogeochemist with the US Geological Survey in Woods Hole, Massachusetts. “Maybe we’ve been underestimating the amount of methane oxidation going on in the sea-floor setting.”

The team also found a wide variety of non-methane-consuming microorganisms in the samples. The carbonates might provide researchers with a model for microbial processes in rocks much deeper inside Earth’s crust, says Orphan.

“Clearly, there’s a really dynamic population of microorganisms living in these carbonates. This paper will make a big splash,” says Joye. She adds that the findings will trigger scientists to revisit the results of past analyses.

Pohlman says that they will give scientists a broader appreciation for the microbial processes going on in these rocks. “It’s surprising that we’ve been poking around these seeps for so long and hadn’t noticed this,” he says. “It makes you wonder, why hadn’t anyone done this before?”

Nature | doi:10.1038/nature.2014.16151

References

1. Marlow, J. J. *et al*. *Nature Commun.* **5**, 5094 (2014).
2. Skarke, A., Ruppel, C., Kodis, M., Brothers, D. & Lobecker, E. *Nature Geosci.* **7**, 657–661 (2014).