Study finds novel worm community affecting methane release in ocean

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This is an image of the polychaete in its natural state where it is sitting in its tube with it head out grazing the sediment around itself. You can see the branchie (breathing tentacles) on its head gathering oxygen while it eats. Credit: Andrew Thurbe

Scientists have discovered a super-charged methane seep in the ocean off New Zealand that has created its own unique food web, resulting in much more methane escaping from the ocean floor into the water column.

Most of that methane, a greenhouse gas 23 times more potent than carbon dioxide at warming our atmosphere, is likely consumed by biological activity in the water, the scientists say. Thus it will not make it into the atmosphere, where it could exacerbate global warming. However, the discovery does highlight scientists' limited understanding of the global methane cycle – and specifically the biological interactions that create the stability of the ocean system.

Results of the study, which was funded primarily by the National Oceanic and Atmospheric Administration and the Federal Ministry of Education and Research in Germany, have just been published online in the journal *Limnology and Oceanography*.

"We didn't discover any major 'burps' of methane escaping into the atmosphere," said Andrew R. Thurber, a post-doctoral researcher at Oregon State University and lead author on the study. "However, some of the methane seeps are releasing hundreds of times the amounts of methane we typically see in other locations, so the structure and interactions of this unique habitat certainly got our attention.

"What made this discovery most exciting was that it is one of the first and best examples of a direct link between a food web and the dynamics that control greenhouse gas emissions from the ocean," Thurber added.

The scientists first discovered this new series of methane seeps in 600 to 1,200 meters of water off North Island of New Zealand in 2006 and 2007. The amount of methane emitted from the seeps was surprisingly high, fueling a unique habitat dominated by polychaetes, or worms, from the family Ampharetidae.

"They were so abundant that the sediment was black from their dense tubes," Thurber pointed out.

This is an image of the worm out of its tube. Its head is in the upper left and its tail at the bottom. The red structures throughout are its circulatory system that it uses to harness the overlying oxygen rich water. Credit: Andrew Thurber

Those tubes, or tunnels in the sediment, are critical, the researchers say. By burrowing into the sediment, the worms essentially created tens of thousands of new conduits for methane trapped below the surface to escape from the sediments. Bacteria consumes much of the methane, converting it to carbon dioxide, and the worms feast on the enriched bacteria – bolstering their healthy population and leading to more tunnels and subsequently, greater methane release.

The researchers say that there is one more critical element necessary for the creation of this unique habitat – oxygen-rich waters near the seafloor that the bacteria harness to consume the methane efficiently. The oxygen also enables the worms to breathe better and in turn consume the bacteria at a faster rate.

"In essence, the worms are eating so much microbial biomass that they are shifting the dynamics of the sediment microbial community to an oxygen- and methane-fueled habitat – and the worms' movements and grazing are likely causing the microbial populations to eat methane faster," said Thurber, who works in OSU's College of Earth, Ocean, and Atmospheric Sciences. "That process, however, also leads to more worms that build more conduits in the sediments, and this can result in the release of additional methane."

Methane seeps and worm communities are present in many other areas around the world, the researchers point out, including the Pacific Northwest. However, the deep water in many of these locations has low levels of oxygen, which the scientists think is a factor that constrains the growth of the worm populations. In contrast, the study sites off New Zealand are bathed in cold, oxygen-rich water from the Southern Ocean that fuels these unique habitats.

"The large amounts of methane consumed by bacteria have kept it from reaching the surface," Thurber said. "Those bacteria essentially are putting the pin back in the methane grenade. But we don't know if the worms ultimately may overgraze the bacteria and overtax the system. It's something we haven't really seen before."

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