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Gotcha! Microbial “methane eaters” use gas bubbles to rise from the seafloor into the water column

Novel bubble catcher provides proof of a so far unknown transport process, with potential implications for the reduction of the greenhouse gas methane in the marine environment

To improve our knowledge on the role microorganisms play in the process of regulating methane in the sea, scientists from the Leibniz Institute for Baltic Sea Research Warnemünde (IOW) developed a novel instrument to detect the transport of microorganisms via methane gas bubbles ascending from the seafloor. With the successful deployment of this bubble catcher, they provided first-time proof that together with the gas bubbles, methane-consuming bacteria can get from the sediment into the water column. These so called methanotrophic bacteria play an important role in the reduction of the methane fluxes from the ocean to the atmosphere. Thus, they influence the climate on earth, as methane is a highly efficient greenhouse gas.

One of the major goals in current environmental research is to understand how the greenhouse gas methane finds its way into the atmosphere and which processes can affect this flux. Oceanographers, too, put a focus of their investigations on marine sources of methane all over the world oceans. Examples of these sources are subsea mud volcanoes, cold hydrocarbon seeps and sediments rich in organic matter from coastal seas like the Baltic Sea. Microorganisms are adapted to this comprehensive and versatile supply: within the water column, mainly methane-oxidizing bacteria are using methane as a source of energy and carbon, while at the seafloor mainly methanotrophic archaea assume this part. Both groups are transforming the methane into carbonate and biomass or carbon dioxide – which in comparison with methane is a less potent greenhouse gas. This process, in general, prevents seafloor-borne methane from ascending to the sea surface and into the atmosphere.

This microbial methane filter does no longer function once the methane seepage becomes so intense that the gas is liberated in form of gas bubbles from the seafloor. Because of a high velocity of the bubbles, methane will then pass the zone where the methane-consuming microorganisms live too quickly. With the novel bubble catcher from Rostock the scientists investigated whether methanotrophic bacteria from the sediment can participate in this upward shuttle and the surrounding water continuously gets inoculated by these

bacteria. It is known from other aquatic environments – like for example groundwater – that bubbles can transport microorganisms on their surface. But the bubble-mediated transport between sediment and water column was left unobserved up to now. To provide proof of such a process, however, is not easily done as the bubbles and the attached microorganisms have to be caught directly above the seep without contamination. The scientists from the IOW together with their colleagues from the GEOMAR Institute in Kiel and the University of California succeeded with a pilot study off the coast of California above a natural seep of methane in catching the emerging bubbles by means of a cylinder filled with artificial sterile sea water. Subsequent microscopic analyses (CARD-FISH) revealed that the bubbles were accompanied by methane oxidizing bacteria.

Oliver Schmale: „We know now that the gas bubbles transport these bacteria from the sediment into the water column. Whether the organisms stay active in their new surrounding and thus can reduce the transport of this greenhouse gas into the atmosphere, must be clarified by further studies."

Financed by the German Science Foundation (DFG), the investigations and results described here were recently published in the journal Continental Shelf Research: Schmale, O., I. Leifer, J. S. v. Deimling, C. Stolle, S. Krause, K. Kießlich, A. Frahm and T. Treude (2015). Bubble transport mechanism: indications for a gas bubble-mediated inoculation of benthic methanotrophs into the water column. Cont. Shelf Res. 103: 70-78, doi:10.1016/j.csr.2015.04.022

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