Microbes at cold seeps: how environmental factors determine their activity

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Résumé

Cold seeps such as pockmarks, mud volcanoes and gas seeps are fascinating geosystems where reduced compounds, most dominantly methane, often together with geofluids migrate from greater depth to near surface sediments. There, a substantial fraction of the uprising methane is oxidised with seawater-born sulphate as the terminal electron acceptor through a process known as the 'anaerobic oxidation of methane – AOM'. AOM is typically mediated by methanotrophic archaea in association with sulphate reducing bacteria, though alternative electron acceptors can also be used by some anaerobic methanotrophs. The efficiency of the AOM filter system is dependent on several environmental factors such as flow rates of methane but also the bioirrigation activity of macrofauna. Cold seeps often support tremendous amounts of macrofaunal biomass which directly or indirectly, typically with the help of symbiotic microbes, can make use of methane or hydrogen sulphide, one of the end-products of the sulphate-dependent AOM. At highly active seeps, methane may bypass the AOM filter system and is then further oxidised by aerobic methanotrophic bacteria that may either occur in symbiosis together with macrofauna, or as free-living organisms in sediments or the water column. The aerobic methane oxidation (MOx) is thus an important final barrier, which can mitigate methane release from the ocean to the atmosphere where methane acts as a potent greenhouse gas. Water column MOx is strongly influenced by oceanographic parameters, for example current regimes and methane seepage activity, which can be influenced by tides and seasons. This presentation will provide an overview on the biogeochemical processes and key (micro)organisms at cold seeps, and will highlight how environmental factors determine their activity and efficiency to retain methane in sediments or the water column.

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