Microorganisms in the subsurface seabed on evolutionary standby

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Sediment cores up to 10 m long can be collected from the seabed in Aarhus Bay

by gravity coring. The mud in the deepest sections of such cores was deposited 10,000 years ago by the end of the last glaciation. Credit: Nils Risgaard-Petersen.

Researchers at the Center for Geomicrobiology at Aarhus University, Denmark, have sequenced the genomes of several microorganisms inhabiting the subsurface seabed in Aarhus Bay. The results reveal the extreme evolutionary regime controlling microbial life in the deep biosphere.

A life in slow motion

Microbial evolution is arrested in the subsurface seabed as cells are buried in under a continuously growing layer of deposited mud and their genetic material therefore remains unchanged during the millennia.

"This means that these buried microorganisms presumably have a very low adaptability, unlike the microbial life that otherwise surrounds us in our environment" says Kasper U. Kjeldsen, associate professor at the Center for Geomicrobiology, who participated in the research project.

Through genetic mutations microorganisms normally have the ability to develop new properties over a short time scale, thereby quickly adapting in response to their environment. But the researchers have shown that microbes grow in slow motion in the deep seabed with generation times of up to 100 years. Mutations therefore appear and spread very slowly in the subsurface populations. For comparison, intestinal bacteria typically have generation times of 20 minutes.

The microorganisms in the deep seabed live in an environment, which is extremely poor in food. Put simply, they chew on a lunch box, which has fed their ancestors for thousands of years, and the availability of energy

is therefore minimal.

A sediment core is subsectioned on deck of the Aarhus University Research Vessel Aurora. Credit: Bo Barker Jørgensen.

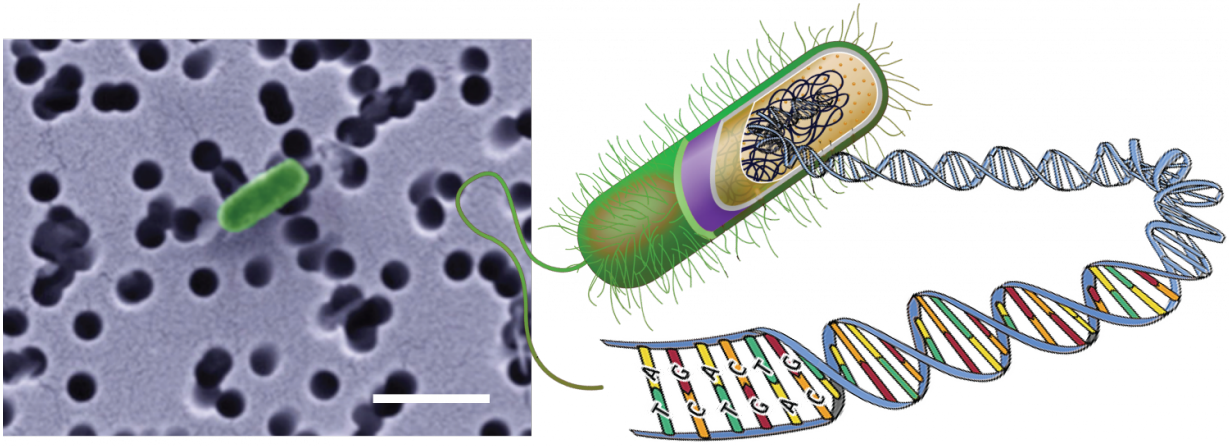
Buried alive

The microbial species we find in the deep seabed, are the same as those who lived at the seafloor for thousands of years ago. Unlike the majority of the members of surface community, these microorganisms survive burial deeper and deeper in to the subsurface.

It remains a mystery why these microorganisms have an inherent ability to grow under the extreme conditions that occur in the deep seabed.

The researchers hope that the new findings could ultimately help us to understand and reconstruct past environmental and climatic conditions based on analysis of the microbial species composition in deep marine sediment cores.

The discovery, which has changed our understanding of microbial life in the soil deep biosphere, was recentlt published in the highly acclaimed international journal *Proceedings of the National Academy of Sciences* (*PNAS*).



Electron microscopy picture of a single cell (in green color) isolated from the subsurface seabed in Aarhus Bay. The cell is isolated on a membrane filter with pores that are 0.2 micrometer in diameter. The researchers use highly sensitive molecular biology techniques to sequence and map the genomes of microorganisms inhabiting subsurface seabed one cell at a time. Credit: Stefan Braun. Graphic modified from Wikipedia and www.genesandhealth.org.

More information: Piotr Starnawski et al, Microbial community assembly and evolution in subseafloor sediment, *Proceedings of the National Academy of Sciences* (2017). DOI: 10.1073/pnas.1614190114

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