Center for Geomicrobiology

Annual highlights

Center for Geomicrobiology, Aarhus University (2012—2017)

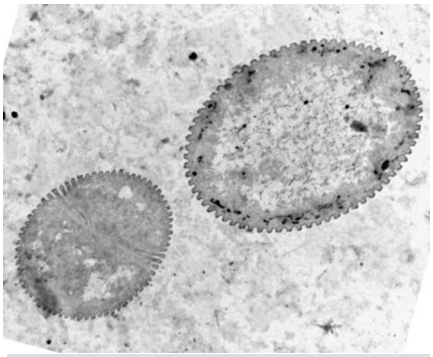
2015

At the Center for Geomicrobiology we explore microbial life in the deep biosphere and its interactions with the geosphere in the subsurface seabed. Our aim is to understand how microorganisms can subsist under extreme nutrient limitation and how they differ physiologically and genetically from organisms in the surface world. Our research integrates highly diverse fields and methods, ranging from isotope geochemistry and biogeochemistry to microbiology and molecular biology.

Wired by cable bacteria

Some bacteria in the seafloor have the astonishing ability to grow into cm-long chains that conduct electric currents and thereby control the ambient chemical zonation and redox processes. They occur in very diverse marine environments, from the coast to the deep sea, and even in freshwater sediments. It now turns out that there are multiple species of these bacteria, each with unique cell wall structures that enable electron conductance.

Above: Electron-conducting cable bacteria from the seabed (graphics by N. Risgaard-Petersen). Below: TEM micrograph of cable bacteria in cross section, showing multiple cell wall ridges that conduct electric current (C. Bortolini, K. Thomsen and L. P. Nielsen).



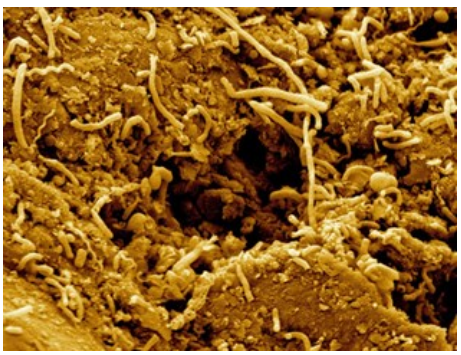
Evolution in the deep biosphere

Microorganisms deep down in the seabed are descendants of microbial communities that once lived at the sediment surface and that became buried in the geological past. We have searched for signs of genetic evolution in these organisms by which they may have adapted to the energy-starved conditions in the deep subsurface. Massive DNA sequencing of metagenomes and single-cell genomes have revealed only marginal evolution, however, partly due to the extremely long generation times of tens to hundreds of years. Our studies show that the deep subseafloor is populated by species that already occurred in low numbers at the sediment surface and that persisted over thousands of years to become predominant at depth while other organisms with less fitness became extinct.

Limits of microbial life

The center participated in an exciting international expedition to the west Pacific Ocean with the Japanese drill ship, *Chikyu*, to search for the depth limit of microbial life in the seabed. By scientific drilling, the expedition reached 2500 m below seafloor where 20-million year old coal layers were encountered. These 40-60°C warm deposits were inhabited by a coal-degrading microbial community of hitherto unknown species. This discovery is a new depth record for microbial life and for the experimental detection of microbial metabolic activity.

Below: Left: the Japanese drillship, *Chikyu*. Right: enrichment of cells from 2.5 km deep coalbed. The image is magnified 5000 times. Photo: H. Imachi, JAMSTEC)



More information:

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The Center's website: www.geomicrobiology.au.dk

Examples of research dissemination:

- *Science: "Making methane down deep" (24.07.2015)*
- Berlinske: *"Ny rekord: Forskere finder liv 2,5 km under havoverfladen" (28.07.2015)*
- *New Scientist: " Seabed superorganism uses electricity to lock up greenhouse gas" (21.10.2015)*
- *Weekendavisen: "Gennembrud i baghaven" (06.11.2015)*