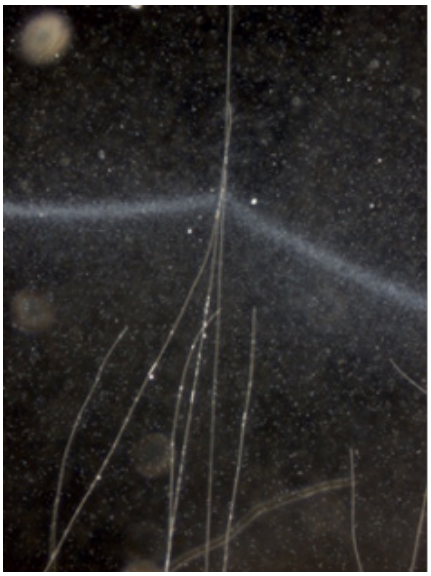
FOLLOWING THE OXYGEN RESPIRATION OF A SINGLE CABLE BACTERIUM

To be able to follow a single microorganism's metabolism in real time in a natural setting is unheard of, but it was realized with cable bacteria in the laboratories of CEM and the results are spectacular*. The cable bacteria are up to centimeters long and live where oxygen is depleted, typically in lake or ocean sediments where oxygen only penetrates a few millimeters. Here, they position themselves across the oxic/anoxic interface and employ their unique, internal, electrical wires for a metabolism, where electrons are transferred from a surplus of nutrients below the interface to the oxygen on the other side. This situation was recreated under the microscope: In the middle of a glass slide, sediment was placed, wherefrom bacteria – including cable bacteria – wandered towards the edges of the cover glass, where oxygen from the surrounding air could diffuse in. The normal bacteria quickly formed a veil exactly at the oxic/anoxic interface, and when a cable bacterium crossed the veil, an immediate and distinct "bulge" appeared. The cable bacterium used so much oxygen that the other bacteria were forced to move closer to the edge in order to still reach oxygen. The oxygen consumption of the cable bacterium could be calculated precisely from the size of the bulge and relative to the biomass of the oxygen exposed part, the oxygen consumption proved to be exceptionally high. The unrestrained oxygen consumption aligned well with results that indicate that more elaborate metabolic tasks of producing ATP and growth are left to the much longer oxygen-free end of the cable bacterium. Ongoing research indicates that the cable bacteria has developed their own apparatus in order to convert oxygen.



Microscopy image of cable bacteria that reach out for oxygen. The interface between the upper, oxygen-rich and the lower, oxygen-free layers is marked by a milky-white veil, formed by small bacteria, who actively stays in exactly that position.

Photo: Stefano Scilipoti

* Scilipoti et al. 2021. Oxygen consumption of individual cable bacteria. Science Advances 7; DOI 10.1126/sciadv.abe1870

ELECTROMICROBIOLOGY 2021

In November, where the spread of Covid-19 was fortunately low, we were able, for the second time, to attract a hundred scientists from around the world for three days to share the latest news of electroactive bacteria and, not least, cable bacteria. Which biological molecules and metabolisms are the foundation of nature's own electronics, what are its impacts on the ecology, and what can it be used for?

Electromicrobiology 2021 Photo: Lars Kruse, AU Foto

CEM CENTER FOR ELECTROMICROBIOLOGY