FINAL REPORT

Brilliant Marine Research Idea 2017

1. General information

Title of the idea	Who are the cable bacteria
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2. Brilliant Marine Research Idea

Extended abstract

In 2010, a completely novel type of microbial metabolism was discovered in marine sediments, which induces the transport of electrons over centimetre scales. The actors behind this process are the "cable bacteria": long (> 2cm), filamentous, multicellular(>10^4 cells) bacteria. Cable bacteria use the electron transport to couple redox reactions between their two key metabolic resources. The bottom cells of a cable bacteria filament oxidize sulfide, which is abundant in the deeper anoxic zone of the marine sediment. The electrons derived from the sulfide oxidation are then transported along the cells of the cable bacteria to finally arrive at the cells in the oxic part of the sediment. Here these electrons are used in the second part of the cable bacteria metabolism, the reduction of oxygen. By establishing electrical currents, the cable bacteria turn the seafloor into an "electrical ecosystem".

Yet, due to their recent discovery, very little is known about the importance of cable bacteria for the ecosystem functioning of the seafloor. In my ongoing PhD research, I have documented – for the first time - the global distribution of electro-active sediments, showing that cable bacteria occur naturally in a wide range of marine environments (Burdorf et al., 2016; Burdorf et al., 2017). Moreover, when present, cable bacteria also have a strong impact of the sediment geochemistry and fluxes across the sediment-water interface (Seitaj et al., 2015). This combination of a widespread occurrence and a strong local geochemical imprint suggests that cable bacteria could be important in the marine cycling of carbon, sulfur and other elements.

A fundamental question however remains unresolved: Who are these cable bacteria? At present, the cable bacteria remain a kind of "biological black box", as we have hardly any understanding of their diversity and phylogeny. This gives rise to a number of key research questions:

"Is long-distance electron transport carried out by the same organism across the globe, or do different habitats contain different genotypes of cable bacteria?"

"Does a given field habitat only harbor one genotype, or is there a large diversity of cable bacteria at work within a single field site?"

Very recently, a first examination of the phylogeny of cable bacteria resulted in the identification of

six different species that were classified in two genera: *Candidatus* Electrothrix and *Candidatus* Electronema, within the *Desulfobulbacaea* family (Trojan et al., 2016). However, this study was based on only 4 sediment samples, and there are clear indications that the actual diversity of cable bacteria is substantially larger.

Using this BMRI-grant, and in collaboration with the team of Prof. Andreas Schramm (Center for Electromicrobiology, Aarhus University, Denmark), we can now show that the "cable bacteria" are more diverse than previously reported. "Cable bacteria" thus include different genotypes, and these form a monophyletic cluster within the *Desulfobulbaceae* family. Moreover, we have shown in this project that at individual field sites, the cable bacteria population can be composed of phenotypically and genotypically diverse cable bacteria.