Cable bacteria protect coastal waters from toxic nightmares

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Cable bacteria are long, multicellular, filamentous bacteria that form dense populations in marine and freshwater sediments (up to 1km of cable bacteria length per cm^3 sediment). These cable bacteria have a unique "electrogenic" metabolism, where electrons are first harvested from sulfide at centimeters deep in the sediment, then transported cell to cell along the longitudinal axis of the bacteria, and finally shuttled to oxygen near the sediment-water interface. Moreover, the activity of cable bacteria strongly impacts the pore-water pH, and this way, they substantially influence the cycling of various elements, such as iron, calcium and manganese.

Recently, a multi-year study of a coastal reservoir in the Netherlands demonstrated that cable bacteria activity not only influences the sediment geochemistry locally, but rather has a basin-wide impact. Every summer stratification of the water column in this reservoir leads to oxygen depletion in the bottom waters. During seasonal oxygen depletion, toxic sulfide produced as an end-product of anoxic metabolisms in the sediment could diffuse into the bottom waters and finally lead to depauperate toxic waters. However, Seitaj et al., (2015) proposed that cable bacteria activity in spring, before the onset of oxygen depletion, induces a chemical "firewall" in the upper millimeters of the sediment which effectively protects the overlying water from sulfide effluxes from the sediment in the oxygen depleted summer.

In this study, we have tested this so-called "firewall hypothesis" by seasonally sampling sediment cores, inducing anoxia in the overlying water, and assessing the sulfide release by the sediment. In these closed sediment incubations, we weekly traced major fluxes (e.g. sulfide and iron) until sulfidic conditions were reached in the water column. Cores which were collected during spring, with intensive cable bacteria activity, delayed sulfide release up to 80 days of anoxic incubation. These results combined with the proposed global distribution of cable bacteria indicate that the "firewall" might even be stronger and more prevalent than previously thought.

Keywords: cable bacteria; seasonal hypoxia; Lake Grevelingen; firewall hypothesis