Long-distance electron transport by cable bacteria in mangrove sediments

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Cable bacteria are long, multicellular, filamentous bacteria that induce long-distance electron transport in sediments. Individual filaments are vertically oriented in the sediment, can be several centimetres long, and can incorporate over 10^4 cells. Cable bacteria have a unique metabolism, referred to as electrogenic sulphur oxidation (e-SOx), which generates an electrical current between distant parts of the bacterial filament. Electrons are harvested from sulphide oxidation in deeper layers of the sediment and are subsequently transported upwards along the longitudinal axis of the filaments. Within the top layer of the sediment, these electrons are finally supplied to a terminal electron acceptor, such as oxygen or nitrate.

The metabolic activity of cable bacteria has a strong imprint on the geochemistry of marine sediments. Concurrent with the development of a cable bacteria community in the sediment, a suboxic zone develops, i.e. a zone devoid of free sulphide and oxygen/nitrate. The spatial segregation of redox half-reactions also leads to a specific pH signature in the pore water of the sediment. This generates a characteristic pH depth profile, consisting of a narrow pH maximum in the top layer of the sediment, and a broad pH minimum deeper in the sediment. By their strong impact on the pore water pH of the sediment, cable bacteria stimulate the cycling of other elements, such as calcium, iron and manganese.

However, cable bacteria have only been recently discovered, and so their geographical distribution and habitat distribution remains largely unknown. Here we report field evidence that cable bacteria are present and active in mangrove sediments. Combining microsensor profiling and fluorescence in situ hybridisation, we recorded high filament densities (77 m cm-2) and the signature of electrogenic sulphur oxidation in sediments of grey mangroves near Melbourne (Australia). Our findings suggest that cable bacteria could be a keystone microbial species in the geochemical cycling of mangroves.

Keywords: mangroves; biogeochemistry; cable bacteria; geomicrobiology