Electrostatic potential measurements as proxies for cable bacteria activity – potentials and resistances

DAMGAARD, LARS RIIS[1]*, RISGAARD-PETERSEN, NILS[1,2], GIAO GARCÍA, DIEGO[1,2], NIELSEN, LARS PETER[1,2]

[1] Department of Bioscience, University of Aarhus, Ny Munkegade 114, DK-8000 Aarhus, Denmark. (*correspondence: lrd@bios.au.dk.)

[2] Center for Geomicrobioloty, University of Aarhus, Ny Munkegade 114, DK-8000 Aarhus, Denmark.

Cable bacteria are multicellular filamentous bacteria that play an important role in sediment biogeochemistry by connecting sulfide oxidation in anoxic sediment layers with oxygen reduction in the oxic sediment surface layers, using the filament itself as an electron conductor. The charge transport by the electron current in the filaments results in electrostatic forces which by virtue of the electro-neutrality principle drive an equally-sized ionic counter-current in the sediment porewater. The resulting electric potential distribution reflects the cable bacteria activity as well as any spatial variations in sediment resistivity, and the distribution of activity can easily be calculated under the assumption of horizontal homogeneity as in typical laboratory systems. However, many natural cable bacteria systems are not horizontally homogeneous, rendering a simple 1D modelling approach invalid. Further complications to take into account in many situations are presence of additional electric fields with other physical basis. Of primary concern is the phenomenon of diffusion potentials, caused by concentration gradients of ions with different mobilities. Such concentration gradients may build up over time by electro-migration due to the electric fields caused the cable bacteria themselves, or they may be due to changes in the composition of the overlying water. Here we present experimental data that illustrates the extent of these complications. Furthermore, we discuss approaches to handle them through experimental design and modelling.