

Electricity in biogeochemistry – potential for confusion?

DAMGAARD, LARS RIIS^{1*}, RISGAARD-PETERSEN, NILS¹²
AND NIELSEN, LARS PETER¹²

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

²Center for Geomicrobiology, University of Aarhus, Ny
Munkegade 114, DK-8000 Aarhus, Denmark.

Naturally occurring electric fields have been known and investigated in geophysics for decades and have led to discussions of the existence and function of “geobatteries” [1] and “biogeobatteries” [2] where a conducting body catalyzes and transfers electrons between two spatially separated half-reactions. The recently discovered so-called ‘cable bacteria’ of the Desulfobulbaceae family [3] provide the first example of a fully characterized natural biogeobattery.

Literature shows that the concepts of electric and redox potential easily cause confusion. Here we present measurements in a cable bacteria microcosm using two types of potentiometric electrodes: so-called redox electrodes and so-called electric potential microelectrodes [4]. The tips of these electrodes are in contact with the environment through exposed platinum and an electrolyte-filled pore, respectively. We will discuss the properties of these electrodes in relation to their responses to the electric and chemical parameters in the system and demonstrate how an interpretation of the data can be used to reveal details of the localisation and magnitude of the involved electro-chemical processes in the system. Through this, we hope to contribute constructively to the understanding and description of biogeobatteries in terms of electric potentials and redox potentials.

[1] Bigalke & Grabner (1997), *Electrochimica Acta* **42**, 3443-3452. [2] Revil, Mendonca, Atekwana, Kulesa, Hubbard & Bohlen (2010), *Journal of Geophysical Research: Biogeosciences* **115**, G00G02. [3] Pfeffer, Larsen, Song, Dong, Besenbacher, Meyer, Kjeldsen, Schreiber, Gorby, El-Naggar, Leung, Schramm, Risgaard-Petersen & Nielsen (2012), *Nature* **491**, 218-221. [4] Damgaard, Risgaard-Petersen & Nielsen (2014), *Journal of Geophysical Research: Biogeosciences* **119**, 1906–1917.