Geophysical Research Abstracts
Vol. 13, EGU2011-6582-1, 2011
EGU General Assembly 2011

Electric fields and nanowires associated with biogeoelectricity in marine sediment

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Geochemical observations in marine sediment have recently documented that electric currents may intimately couple spatially separated biogeochemical processes like oxygen reduction at the sediment surface and hydrogen sulphide oxidation in anoxic layers centimetres below. (Nielsen et al. 2010). These observations have now been supplemented with physical measures to further localize and quantify the electric currents and indentify key components of the electron conductive network.

When conductive networks are transmitting electrons from oxidation processes in the anoxic zone to reduction processes in the oxic zone, the charge is balanced by ion mediated charge transport in the porewater. This implies an electrical field depending on porewater resistivity and current density. The electric field was mapped by down core measurements of the self-potential at sub-millimetre resolution. The electric field was strongest at the oxic-anoxic interface and vanished around 2 cm below the sediment surface. The electric field collapsed immediately when oxygen was removed and re-established when oxygen was re-introduced.

Filament networks resembling bacterial nanowires were observed in the sediments and their electron conductivity was documented using nanofabrication approaches for evaluating conductivity along the length of bacterial nanowire.

Reference:

Nielsen, L. P., N. Risgaard-Petersen, H. Fossing, P. B. Christensen, and M. Sayama. 2010. Electric currents couple spatially separated biogeochemical processes in marine sediment. Nature 463: 1071-1074.