

Long-distance electron transport drives biogeochemical cycling of Fe, Mn and Ca in the coastal seafloor

SEBASTIAAN VAN DE VELDE^{1*}, LUDOVIC LESVEN², LAURINE DW BURDORF³, SILVIA HIDALGO MARTINEZ³, JEANINE S GEELHOED³, YUE GAO¹ AND FILIP JR MEYSMAN^{3,1}

¹ Vrije Universiteit Brussel, 1050, Brussel, Belgium
(*correspondence: sevdevel@vub.ac.be)

² University of Lille 1, 59655 Villeneuve d'Ascq, France

³ Royal Netherlands Institute for Sea Research, 4401 NT Yerseke, The Netherlands

The recent discovery of a novel microbial pathway of sulfide oxidation has radically changed the views of sulfur cycling in marine sediments [1]. In this process, referred to as electrogenic sulfur oxidation, long filamentous cable bacteria couple the oxidation of free sulfide in deeper sediment horizons to the reduction of oxygen near the sediment-water interface by means of long-distance electron transport [2,3].

Laboratory studies have recently shown that electrogenic sulfur oxidation by cable bacteria creates extreme excursions in porewater pH, and in this way, the process exerts a powerful control on element cycling in marine sediments [4]. Yet, the natural distribution of cable bacteria is still largely unknown, and so their role in coastal biogeochemical cycles remains poorly quantified.

Here, we present data from three campaigns (January, March and May 2014) in the North Sea (Station 130, Belgian coastal zone). Our results document the effect of electrogenic sulfur oxidation on the geochemistry of coastal sediments. The acidification of the porewater leads to the dissolution of calcium carbonates and iron sulfide minerals, which makes the porewater enriched in iron, manganese and calcium. Near the sediment-water interface, oxic conditions trap the upward diffusing Fe²⁺ as iron oxides, while the alkaline pH promotes precipitation of carbonates. Electrogenic sulfur oxidation thus promotes the cycling of Fe, Mn and Ca. Overall, our results demonstrate that cable bacteria can strongly modulate the sedimentary biogeochemical cycling under *in situ* conditions.

[1] Nealson (2010) *Nature* **463**, 1022-1023. [2] Nielsen *et al.* (2010) *Nature* **463**,1071-1074. [3] Pfeffer *et al.* (2012) *Nature* **491**,218-221. [4] Risgaard-Petersen *et al.* (2012) *Geochim. Cosmochim. Acta* **92**,1-13.