SCIENCES & BIOENGINEERING SCIENCES

The Research Group

Analytical, Environmental and Geo- Chemistry

has the honor to invite you to the public defense of the PhD thesis of

Laurine BURDORF

to obtain the degree of Doctor of Sciences

Title of the PhD thesis:

Long distance electron transport by cable bacteria: global distribution and environmental impact

Promotor:

Prof. Filip Meysman

The defense will take place on
Friday 15 December 2017 at 12h30

in Auditorium D.2.01 at the Campus Humanities, Sciences and Engineering of the Vrije Universiteit Brussel, Pleinlaan 2 - 1050 Elsene, and will be followed by a reception.

Members of the jury:
Prof. Marc Elskens (chairman)
Prof. Yue Gao (secretary)
Prof. Han Remaut
Prof. Caroline Slomp
(Utrecht University, The Netherlands)
Prof. Lars Peter Nielsen
(Aarhus University, Denmark)
Prof. Steven Bouillon (KU Leuven)

Curriculum vitae

Laurine Burdorf was born in The Netherlands, and completed a Bachelor in Biology at KU Leuven in Belgium and a Master in Marine Biology and Oceanography at the UPMC in France.

Laurine Burdorf supervised 4 Bachelor and Master students during her PhD project and is the author of 8 scientific publications.

Abstract of the PhD research

In 2010, a novel type of microbial metabolism was discovered in marine sediments, which induces the transport of electrons over centimeter scales. The process is mediated by long, multicellular cable bacteria, which perform an "electrogenic" form of sulfur oxidation, whereby long-distance electron transport links sulfide oxidation in deeper sediment horizons to oxygen reduction in the upper millimeters of the sediment. In this PhD project we documented the natural prevalence of long-distance electron transport in the seafloor, and quantified its impact on the elemental cycling and ecosystem functioning of natural marine sediments.

Extensive sampling efforts during the PhD project demonstrated that e-SOx is globally occurring in coastal marine sediments. Furthermore, laboratory experiments revealed that cable bacteria only grow when the O_2 concentration in the overlying water exceeded 50 µmol L^{-1}, with a slower growth at lower O_2 levels. This crucially constrains the distribution in the present ocean, but also provides information on the paleo conditions under which the metabolism may have evolved. The PhD research furthermore revealed that cable bacteria activity has a disproportionate large effect on the geochemistry of the seafloor. Most notably, the acidification induced by cable bacteria metabolism stimulates the dissolution of acid-sensitive minerals, such as FeS and $CaCO_3$, and can result in extremely low alkalinity levels in the pore water, not previously documented within the seafloor.

The environmental impact of cable bacteria is most pronounced in coastal systems that experience seasonal hypoxia. The iron firewall hypothesis advances that cable bacteria activity protect these systems against toxic sulfide release from the sediments in summer. The iron firewall hypothesis was experimentally tested, and it was found that electrogenic sulfur oxidation can indeed delay the sulfide release from sediments by more than 90 days. This way, cable bacteria appear as a major structuring factor in seasonal hypoxic coastal ecosystems.