The Research Group of

Analytical, Environmental and Geo-Chemistry (AMGC)

has the honour to invite you to the public defence of the PhD thesis of

Dorina SEITAJ

to obtain the degree of Doctor in Sciences

Title of the PhD thesis:

Impact of cable bacteria on the biogeochemical cycling in a seasonally hypoxic coastal basin

Promotor:

Prof. dr. ir. Filip MEYSMAN

The defence will take place on

September 30, 2016 at 10.30 h

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

Members of the jury

Prof. Dr. Philippe CLAEYS (VUB, chairman)
Prof. Dr. Frank DEHAIRS (VUB, secretary)
Prof. Dr. Mark KOCHZIUS (VUB)
Prof. Dr. ir. Eveline PEETERS (VUB)
Prof. Dr. Caroline SLOMP (Univ. Utrecht)
Prof. Dr. Heide SCHULZ-VOGT
(Leibniz Inst. for BalticSea Research)
Prof. Dr. Nils RISGAARD-PETERSEN (Univ. Aarhus)

Curriculum vitae

Dorina Seitaj was born in 1983 in Albania, but grew up and received her education in Italy. She obtained a Master degree in Environmental Sciences and Technologies (cum laude) at the University of Parma. She started her PhD at the Royal Netherlands Institute of Sea Research NIOZ in Yerseke (The Netherlands) via grant of the Darwin Institute for Biogeosciences. During her PhD, Dorina carried out a long-term sampling program in Lake Grevelingen and spent 2 months as a visiting scientist in Stony Brook University (New York) to work on the sediment geochemistry of Long Island Sound. Dorina Seitaj is the (co-)author of seven international peer-reviewed publications.

Abstract of the PhD research

Coastal hypoxia refers to the oxygen depletion that occurs in summer in the bottom waters of semi-enclosed and stratified coastal systems. There is evidence for a global increase in the frequency, extent, intensity and duration of coastal hypoxia, which has been linked to an increased anthropogenic input of nutrients into the coastal ocean in combination with climate change. Bottom water hypoxia has major consequences for the functioning of coastal ecosystems, as it has profound effects on the biogeochemical cycling, and on the survival and behavior of marine organisms in coastal systems. Hypoxia reaches a particularly harmful stage when sulfide, is released to the bottom water where it can give rise to the establishment of euxinia (i.e. sulfidic bottom waters). As sulfide is highly toxic for marine life, the occurrence of euxinia can have devastating ecosystem consequences. Although coastal hypoxia is relatively common, reports of euxinia are less frequent, and so the question remains why euxinia is so uncommon.

This thesis documents that electricity-producing cable bacteria, living in the sediments of seasonal hyopoxic basins, can prevent, or substantially delay, the development of euxinia. Cable bacteria induce the formation of a large pool of sedimentary iron oxides before the onset of summer hypoxia. This pool of iron oxides acts as a 'firewall' against the release of sulfide to the bottom water in early summer, and likely prevents the development of bottom water euxinia. Overall, cable bacteria appear to be key drivers of iron and phosphorous cycling in seasonal hypoxic basins at the ecosystem scale, which reveals that the biogeochemical impact of sedimentary microbes may extend far beyond the sediment-water interface.

Electrogenic sulfur oxidation by cable bacteria is able to connect oxygen and sulfide in distinct sediment horizons, and so it enables aerobic sulfide oxidation by means of long-distance electron transport. The electrogenic metabolism of cable bacteria provides an efficient way of deep sulfide removal in marine sediments. This way cable bacteria provide another solution to the "aerobic sulfide oxidation paradox". This paradox states that most sulfide in sediments is removed through oxidation with oxygen, though oxygen and sulfide are never into contact, as they are separated by a wide suboxic zone. These insights provide a better understanding and guidance as to the mechanisms of sulfur cycling in the seafloor.