SCIENCES & BIOENGINEERING SCIENCES

The Research Group
Archaeology, Environmental Changes and Geo-Chemistry

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

Yuwei Jia

to obtain the degree of Doctor of Sciences

Title of the PhD thesis:
Investigation on soil and water contaminants by Diffusive Gradients in Thin Films (DGT) and Chemical Activated LUciferase gene eXpression (CALUX)

Supervisors:
Prof. dr. Yue Gao
Prof. dr. Marc Elskens

The defence will take place on

Thursday, April 3, 2025 at 3 p.m.

VUB Etterbeek campus, Pleinlaan 2,
Elsene, auditorium D.2.01

The defence can be followed through a live stream:
Teams meeting ID: 331 301 978 795
Passcode: 2N8To6Vv

Members of the jury

Em. prof. dr. Willy Baeyens (VUB, chair)
Prof. dr. Martine Leermakers (VUB, secretary)
Prof. dr. Joske Ruytinx (VUB)
Prof. dr. Ivan Kourtchev (Coventry University, UK)
Prof. dr. Wei Guo (Beijing University of Technology, China)

Curriculum vitae

Yuwei Jia obtained her bachelor's and master's degrees in Environmental Science in China. In March 2021, Yuwei Jia started her PhD in the AMGC lab under the supervision of Prof. Dr. Yue Gao and Prof. Dr. Marc Elskens. Her research was funded by the China Scholarship Council (Grant No. 202006750030). Her research focused on investigating metals and estrogens in aquatic and soil systems. During her PhD, Yuwei Jia was a co-author of three scientific papers published in international peer-reviewed journals, including one as the first author. She presented her research findings at three international scientific conferences. Throughout her PhD, she supervised one master's thesis student.

Abstract of the PhD research

Soil and water contamination by metals and estrogens poses significant threats to environmental and agricultural sustainability. Metals, due to their toxicity, persistence, and bioaccumulation potential, can disrupt soil health, reduce crop productivity and endanger human health, while estrogens in aquatic environments may interfere with endocrine systems, threatening both ecosystems and human health. Understanding the mobility, bioavailability, and risks associated with these contaminants is essential for improving soil and water management and designing effective mitigation strategies in agricultural and aquatic environments.

To address these challenges, this dissertation first focuses on metal contamination in fertilized soils, as fertilizer application is a major source of metals in these environments. Firstly, the study investigates the effects of various fertilizers, including manure, sludge, and phosphate fertilizers, on the mobility and bioavailability of trace metals in agricultural soils, focusing on their interactions with soil physio-chemical parameters under various application rates. The study reveals that factors such as pH, redox potential and dissolved organic carbon (DOC) significantly influence the release and transport of trace metals from soil oxides to plants. Based on this understanding, the second chapter shifts the focus to precious metals, which have received less attention in agriculture soil, despite their increasing use and potential risks. Given the absence of reliable methods to measure the bioavailable concentrations of precious metals in soils, this work develops the S920-Diffusive Gradients in Thin Films (DGT) method, a novel and robust tool specifically designed to quantify bioavailable concentrations of silver, gold and platinum in soils. The application of the S920-DGT in soils treated with sludge revealed distinct behaviors of the three metals. The findings contribute to a deeper understanding of metal behavior in fertilized soils under the influence of factors such as pH, redox potential, and DOC.

In parallel, the research investigates estrogen pollution in the Scheldt estuary, with a focus on its spatial variability and time evolution. Using the ER-CALUX bioassay, the research assessed estrogenic activity in dissolved, particulate and sediment phases in the Scheldt estuary, revealing a clear spatial trend of dilution from upstream to downstream in the water column. The moderate to low levels of estrogen contamination in water column compared to other estuaries and a general declining trend in sediments over 40 years highlight the contribution of improved wastewater treatment and the implementation of the EU Water Framework Directive.