SCIENCES & BIOENGINEERING SCIENCES

The Research Group

Archaelogy, Environmental Changes & Geo-Chemistry

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

Tianhui Ma

to obtain the degree of Doctor of Sciences

Title of the PhD thesis:

Biogeochemical cycle of mercury and other trace metals in aquatic systems

Promotors:
Prof. dr. Yue Gao
Prof. dr. Martine Leermakers

The defence will take place on
Thursday, March 14, 2024 at 4:00 pm in auditorium D.2.01

The defence can also be followed through a live stream:
https://tinyurl.com/yc2khab9

Teams meeting ID: 363 456 461 947

Passcode: 9Toz7a

Members of the jury
Prof. dr. Frank De Proft (VUB, chair)
Prof. dr. em. Willy Baeyens (VUB, secretary)
Prof. dr. Joske Ruytinx (VUB)
Prof. dr. Hao Zhang (Lancaster University, UK)
Prof. dr. Milena Horvat (Jožef Stefan Institute, Slovenia)

Curriculum vitae

Tianhui Ma obtained her master degree in Chemistry in 2019 at the Vrije Universiteit Brussel (VUB). Within the same year of graduation, she started her PhD in the AMGC lab under the supervision of Prof. Dr. Yue Gao and Prof. Dr. Martine Leermakers. Her work was financially supported by the BE MERMAiD project (FWO Lead project, FWO-AL911). Her research focused on the investigation and speciation of Hg and other trace metals in aquatic systems. Tianhui Ma is co-author of eight scientific papers published in international peer-reviewed journals, among which 3 times as first author. She presented her work at three international science conferences, and she received a conference poster award in 2022 (ChemCYS). Throughout her PhD, she supervised one bachelor thesis and three master thesis students.

Abstract of the PhD research

Aquatic systems, such as marine, coastal, estuarine, and tidal influenced riverine environments, are complex and important ecosystems in which biotic and abiotic pollutant transformation reactions, assimilation by living organisms, adsorption and desorption on suspended sediments, mobilization and retention in sediments, and freshwater-seawater interactions occur. Once trace metals are released into the aquatic system, they may pose a threat to living organisms and cause severe consequences after bioaccumulation and biomagnification along the food chain. To understand trace metal bioavailability and toxicity in an aquatic system, it is important to study its geochemical behaviour. In this study, several historically contaminated aquatic systems including the tidal section of the Zenne River, the Scheldt estuary, the Belgian Coastal Zone (BCZ) in Belgium and the Gulf of Trieste in Slovenia and Itay were chosen to study biogeochemical cycles of trace metals in particular of Mercury (Hg) species (inorganic Hg and MeHg) in water and corresponding sediments. The role of environmental parameters such as pH, redox potential, dissolved sulfide and organic matter which have a major influence on the biogeochemical trace metal cycles were also assessed in those study areas. In order to investigate metal partitioning between different phases, both active (filtration) and passive (diffusive gradients in thin films-DGT) sampling techniques were applied in these fields. The DGT technique supplies unique information about the bioavailability of metals, but therefore the diffusion coefficient of the target elements needs to be known. In natural aquatic systems all kinds of metal complexes are present, each with their own diffusion coefficient, therefore, the diffusion coefficients of inorganic Hg (iHg) and monomethylmercury (MeHg) complexes in the diffusive domain of a DGT were studied as a function of the amount and the nature of natural dissolved organic matter. This provided us with the necessary information for measuring the speciation of Hg with the DGT in complex aquatic systems. In a sediment, the information provided by the DGT technique is much more difficult to interpret than in the water column, because the resupply of Hg from sediment solid phase to porewater influences the result. Hence, application of the DIFS model (DGT-induced fluxes in sediments) can reveal the response time of the solid phase due to the perturbation by the DGT and also the desorption rate of Hg from sediment solid phase to porewater. In this way, the lability of the compounds in the sediment can also be estimated.