## PhD CONTEXT

**TITLE:** Influence of the environmental conditions on the methylation rates and source of Hg species in microorganisms

**ABSTRACT:**
Mercury (Hg) is a persistent pollutant in the environment, highly volatile and able to be converted into highly toxic methylmercury (MeHg). MeHg is a serious threat as it is a neurotoxic compound, which is bioaccumulated and bioamplified in food webs. Microorganisms play a central role in MeHg conversion, either directly by controlling Hg methylation and MeHg degradation either indirectly. Although hgcA and hgcA genes have been identified as necessary for Hg methylation, today, the methylation process cannot be fully explained. Together with environmental factors, other genetic determinisms are suspected to be involved in mercury methylation. To date, little is known about the cellular and environmental mechanisms favouring MeHg production, and Hg methylation processes are far from being deciphered.

Our team at IPREM lab aims to characterize Hg methylation at cellular level, from Hg recognition by the cell to Hg export, including methylation steps. We intend to decipher the role of Hg cell trafficking in the Hg methylation process in two Sulfate Reducing Bacteria (SRB) model strains, *Pseudodesulfovibrio hydrargyri* BerOc1, able to methylate Hg and demethylate MeHg and *Desulfovibrio alaskensis* G20, able to exclusively demethylate MeHg. The objective of the thesis is to investigate the molecular aspects of mercury biotransformations, including studies on the biomolecular speciation and the localization of Hg transformations at the subcellular level by combining chemical and physical analytical methods.

Keywords: mercury methylation, sulfate-reducing bacteria, Hg speciation, mass spectrometry, transmission electron microscopy

## WORKING ENVIRONMENT AND CONDITIONS

**Laboratory:**
Institut des Sciences Analytiques et de Physico-chimie pour l’Environnement et les Matériaux (IPREM UMR 5254, Pau)

**IPREM:** [https://iprem.univ-pau.fr/fr/index.html](https://iprem.univ-pau.fr/fr/index.html)

**Environment and Microbiology**

**Analytical and bioinorganic chemistry**

**PhD Supervisor:** Mathilde Monperrus

**PhD co-supervisor:** Marie-Pierre Isaure

**In collaboration with** Marisol Goñi-Urriza

The proposed PhD is part of the project ‘GO-Beam’ (Go inside a bacterial cell methylating Mercury) funded by E2S-UPPA from 2018 to 2021. GO-Beam, selected as a ‘Key Scientific Challenges E2S-UPPA’ ([http://e2s-uppa.eu/en/index.html](http://e2s-uppa.eu/en/index.html)) is a collaborative and transdisciplinary project involving genetic microbiology, analytical chemistry, imaging and spectroscopy. The objective of the project is to improve the understanding of the Hg methylation/demethylation processes at the cell level. 2 PhD and 1 Post-Doctorate are funded for the GO-Beam project: PhD1 on analytical and imaging (the present proposition), PhD2 on genetic microbiology and physiological studies and the Post-Doc on both imaging and spectroscopy. Scientific team: MP Isaure, M Goñi-Urriza, M Monperrus, B Khalfaoui-Hassani, R Guyoneaud, C. Gassie, 2 PhD students, 1 post-doc.

**Starting Date:** October 2019  
**Duration:** 3 years

**Employer:** Université de Pau et des Pays de l’Adour (UPPA)

**Monthly salary before taxes:** 1878 € *(doctoral contract UPPA, according to E2S scientific challenges project, including 96h of teaching during the three years)*

## HOST LABORATORY PROFILE

**Analytical chemistry, mass spectrometry, X-Ray Absorption Spectroscopy, Imaging Microbiology, Physiology, Genetics, Microbial Ecology, Environmental Microbiology***
MISSION – PRINCIPAL ACTIVITIES

- He/she will be in charge of the bacterial cultures in various conditions and various ligands.
- He/she will have to model Hg speciation using (bio)geochemical software (VMinteq).
- He/she will perform incubations using isotopically enriched mercury species followed by GC-ICPMS analysis to establish simultaneously methylation and demethylation rates and quantities of net methyl mercury production rates.
- He/she will be strongly involved in the identification of thiol ligands by HPLC-ESI-MS/MS.
- He/she will also set experiments with labelled stable S isotopes to track the source of S in Hg-S-containing compounds, particularly using nanoSIMS.
- In collaboration with the BIC in Bordeaux, he/she will also implement transmission electron microscopy (particularly HRSTEM) to correlate ultrastructures (membranes, periplasm, cytoplasm) and nanoSIMS images.
- He/she will work with another PhD student involved in microbial genetics and physiology and a post-doc, involved in X-ray imaging and X-ray Absorption Spectroscopy techniques. The role of candidate genes in Hg methylation will be assessed through gene deletion and complementation in *D. hydrargyri* BerOc1. Applying X-ray imaging on the wild type and mutants, the Hg methylation potentials and localization will be characterized in order to decipher the role of the genes on Hg pathways.

The PhD student will also participate to teaching activities at the undergraduate level (96h/3 years).

REQUIRED COMPETENCES

Skills in SPECIATION, MASS SPECTROMETRY, SEPARATIVE TECHNIQUES (GC, HPLC), (BIO)GEOCHEMICAL CALCULATION

The candidate should have a strong predilection for laboratory work.

The ideal candidate has a master degree in analytical chemistry or environmental chemistry. He/She is rigorous and highly motivated. He/she must have a good English level and the capacity to work autonomously.

SELECTION CRITERIA

Two steps selection process:

1st step:
- Evaluation of the applicants’ cv
- Selected candidates will be contacted by mail before the **28/06/19**

The candidates selected after this first step, will be interviewed then

2nd step: **July**
- Candidates will have 5 min to present their CV, 5 min to present their Master2 thesis and 5 min to present the PhD subject
- This presentation will be followed by questions and discussion.

Criteria used in selection of the candidate:
- The candidate’s motivation, scientific maturity and curiosity.
- Candidate's knowledge.
- Candidate's marks and rankings in Licence/undergraduate, M1 and M2.
- English proficiency
- Candidate's ability to present his work
- Professional experience of internship(s) in laboratory or other; any research work already carried out (reports, publications).

APPLICATION, DEADLINE

Application should be send by e-mail. The application should contain:

- CV
- Cover letter detailing candidate's motivations
- Candidate's Licence and MSc marks and ranking
- Reference letters
- Contact details (for 2 referees)

DEADLINE: **28/06/2019**

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