# Post-doctoral position (24 months) in Environmental Microbiology

In extreme ecosystems, diversity has historically been described by cultivation methods. The development of high throughput genomic tools allowed the description of the rare biosphere, to which Archaea often belong. While their presence is now demonstrated in all ecosystems on Earth, most of the time their abundance remains low compared to that of their bacterial and microeukaryotic counterparts. Concomitantly, the knowledge on archaeal diversity has evolved from that of cultivated Archaea, *i.e.* Euryarchaeota and Crenarchaeota phyla, to the description of new, uncultivated superphyla, for which we lack **knowledge about their ecology, metabolism, and interaction with other microorganisms**. This is the case for the **recently described phylum Woesearchaeota**, which is ubiquitous in anoxic and/or saline ecosystems, and can **represent the majority of Archaea in some ecosystems**, *i.e.* up to 70% of archaeal sequences **in Lake Dziani Dzaha**, 56% in the Chinese lake Keke or 38% in Pyrenean lakes. Metagenomic reconstructions highlighted the small size of the woesearchaeal genome and supported an anaerobic heterotrophic lifestyle with obvious metabolic deficiencies, which strongly suggests **an obligate associative lifestyle with other microbes for metabolic complementarity**. Recent studies predicted their role in carbon cycling, through syntrophic relationship with methanogens, and an involvement in nitrogen and sulfur cycling in sulfur rich ecosystems.

Our preliminary work conducted on lake Dziani Dzaha (Mayotte, Indian Ocean), an hypersaline alkaline tropical lake presenting vertical contrasted ecological niches related to seasonal physico-chemical gradients, showed **that the archaeal assemblage is dominated by Woesearchaeota** representing up to 70% of archaeal sequences, while sharing less than 80% sequence similarity to Woesearchaeota sequences from other environments. Based on the reconstruction of co-occurrence networks in this ecosystem, we propose that Woesearchaeota could be associated preferentially with the dominant photosynthetic microorganisms populating lake Dziani Dzaha, *i.e.* the cyanobacterium *Arthrospira fusiformis* and the picoeukaryotic green algae *Picocystis salinarum*. **The aim of the post-doctoral position will be to set up conditions for the cultivation and/or enrichment of Woesearchaeota** by targeting (1) methanogens as Woesearchaeota are predicted to establish syntrophic relationships for carbon cycling and (2) *A. fusiformis* and *P. salinarum* as we expect Woesearchaeota to be members of their phycosphere. Those cultures will be conducted in anaerobic conditions for (1) and aerobic/anaerobic ones for (2). The host team has developed a culture medium for *Picocystis salinarum*, and masters its culture in axenic conditions in liquid and solid media. The PoDzi medium, which composition mimicks that of the lake environmental conditions will serve as a base for the first trials. Enrichments will be monitored by Woesearchaeota-specific qPCR using specific 16S rRNA primers and probe designed on the 16S metabarcoding data obtained during the time-series monitoring of Lake Dziani Dzaha (8 previous sampling campaigns with 16S rRNA genes metabarcoding available). Last, presence of Woesearchaeota cells will be confirmed by *Fluorescent In Situ Hybridization* (FISH).

In this highly original ecosystem where the archaeal fraction is almost exclusively composed of Woesearchaeota, we will take the opportunity to tackle their cultivation for the first time, to allow an in-depth characterization of their ecology. With access to cultivated Woesearchaeota, this project represents a unique opportunity to discover *in situ* Woesearchaeota specific adaptations and

interactions and to understand the contribution of the rare archaeal biosphere to ecosystem functioning.

The expected outcome of this project includes the description of the first cultivated member of the phylum Woesarchaeota, as well as the description of the relationship with its host, both of which should lead to scientifica publications in the highest ranked biology journals.

The Post-doctoral work will be conducted under the supervision of associate Professor Mylène HUGONI and Philippe OGER, from the team “Microbiology of Extreme Environments (M2E)” in the lab “Microbiology, Adaptation, Pathogenicity" (MAP, UMR 5240) at INSA de Lyon.

This Post-doctoral work will take advantage of ambitious multidisciplinary and collaborative programs, with the application and optimisation of different experimental approaches in microbiology, molecular biology, metagenomics and metatranscriptomics, and also innovative approaches such as flow cytometry cell-sorting done in collaboration with Marc Troussellier and Cécile Roques from the MARBEC lab (Montpellier). It will rely on the complementary expertises of Pr. Cécile Bernard (MCAM, MNHN, Paris) and Pr. Céline Brochier (LBBE, Univ Lyon1). The Post-doctoral work includes the preparation of reports, seminar and conference presentations, and scientific publications.

We are looking for a curious, inquisitive, creative, and motivated scientist for this post-doctoral project in environmental microbiology. The Post-doctoral project is funded by a University Claude Bernard Lyon 1 fellowship (24 months).

**Experimental work to be performed will include:**

- Cultivation assays set-up and monitoring
- Quantitative PCR monitoring
- Fluorescent In Situ Hybridization (FISH)

**Eligible applicants will have:**

- A PhD in microbiology, molecular biology or equivalent
- Practical experience of several experimental techniques in microbiology and molecular biosciences
- Good command of oral and written communication, in French and/or in English
- Experience in cultivation of difficult microbes is a plus.

**Work context and complementary information**

The main objective of the M2E team is to understand microbial adaptative processes in prokaryotes thriving in extreme ecosystems, through a multidisciplinary approach ranging from physics to up-to-date environmental omics tools. The team focuses on Archaea, for which many novel phyla emerge daily and for which the ecology remains unclear, while our acknowledgement of their contribution to ecosystem functioning is increasing, and from which the team is developping novel, innovative biotechnological solutions.

**Application and contact address:** Ass. Pr. Mylène HUGONI (mylene.hugoni@univ-lyon1.fr) and Dr. P.M. Oger (philippe.oger@insa-lyon.fr)

To apply, please send to both email adresses a letter of motivation, CV, copies of certificates, and the names and contact information of potential referees as a single pdf file. Applications will be processed as received, starting from October 2022 until the position is filled. Preferred starting period will be February 2023.