

Positions "PostDoc", "PhD students" (F/H) In the field of synchrotron- and electron microscopy-assisted investigations of microbial-mineral interactions

Description of Research Project

Recent works heightened interest in the search for biologically driven alterations on Mars and its potential as habitat for past or present life. A primary aim of the ongoing Mars exploration missions is to search for signs of ancient life. Along with an active hydrogeological history of Mars, past chemolithoautotrophy-based habitability was interpreted for lacustrine sediments at Gale Crater (Grotzinger et al., 2014; Hurowitz et al., 2017). However, our understanding of potential biosignatures to be targeted in Mars materials is still in its infancy. Potential early forms of life on Mars should have been able to use accessible inventories of the red planet: derive energy from inorganic mineral sources and transform carbon dioxide into biomass. Such living entities are rock-eating microorganisms, called "chemolithoautotrophs", which are capable of transforming energy from non-living inorganic matter to energy of a living entity. Our study on the Noachian Martian breccia composed of ~4.5 Gyr old crustal materials from Mars, delivered a prototype of microbial life experimentally designed on a real Martian material (Milojevic et al., 2021 <https://www.nature.com/articles/s43247-021-00105-x>). This life of a pure Martian design can serve a rich source of Mars relevant biosignatures (e.g., microbial nano-lithologies, metaloorganic signatures).

The ERC-funded project BIOMAMA (Biogenicity of Martian Materials) aims to investigate interactions of various Earth's chemolithoautotrophic microorganisms with Martian mineral materials (genuine Martian meteorites, Mars regolith simulants, etc.) and examine microbial-meteorite interfaces at the micrometer and nanometer scale. We will perform the targeted biotransformation of Martian mineral materials to comprehensively explore the chemolithoautotrophic fingerprints left on Martian materials, focusing on mineral biosignatures critical for life search. Towards biotransformed Martian mineral materials we will apply techniques based on synchrotron light that are promising tools for non-destructive investigation of the biogenicity of geobiological structures. Exploring the microbial-Martian material interfaces under the X-ray will provide insights on morphology, elemental composition, crystalline structure, oxidation states, magnetic properties, and others, significantly adding to the investigation of the biogenicity of microbial nano-lithologies and the search of putative biosignatures in samples returned from Mars in the near future.

Description of CBM

The Center for Molecular Biophysics (CBM, <http://cbm.cnrs-orleans.fr>) is a research unit of the French National Center for Scientific Research (CNRS), affiliated with the University of Orléans. At the Exobiology Group of the CBM in Orléans, PhD and PostDoc positions are available in the field of astrobiology, biogeochemistry and the study of microbial interactions with meteorites within the framework of a project funded by the ERC. The Exobiology Group at the CBM provides extensive supervision and expertise for cultivation and physiological characterisation of metallophilic microorganisms, biochemistry of extremophiles, molecular techniques, electron microscopy and analytical spectroscopy techniques, as well as participation in a continuously evolving astrobiological projects. The candidate will be integrated into an interactive and international lab environment with a broad scientific experience in astrobiology, biochemistry, microbiology, biophysics, as well as microbial physiology.

Activities

Domains of the research: astrobiology, geomicrobiology, biogeochemistry, analytical chemistry, synchrotron-assisted spectroscopy and crystallography.

The activities of the recruited person:

- Participation and implementation of research projects in the field of astrobiology with a focus on microbial interactions with meteorites from Mars, including field campaigns, analysis of environmental samples from extreme environments or of microbial samples after exposure outside the International Space Station (ISS);
- Supervision of students and participation in the administration of the laboratory, teaching and research;
- Process and interpret experimental data;
- Present and promote the results obtained (reports, publications, conferences);
- Collaborate with team and consortium members, exchange and share knowledge;
- Ensure compliance with milestones and deliverables.

Specificities

Service / Laboratory

Centre de biophysique moléculaire (CBM) d'Orléans, France.

Starting date of the employment

From March 1, 2023.

Required research profile

Expected skills:

- PhD in geomicrobiology, biogeochemistry, analytical chemistry, materials science, biophysics or similar for a PostDoc position (corresponding Master degree for a PhD position).
- Fundamental techniques of synchrotron-assisted spectroscopy and crystallography.
- Previous work experience with synchrotron-based tools (spectroscopy and crystallography).
- A strong interest in Astrobiology/Geomicrobiology and a passion for science and research.
- Excellent command of written and spoken English.

Tools:

- synchrotron X-ray absorption spectroscopy (XAS),
- synchrotron X-ray emission spectroscopy (XES),
- synchrotron X-ray diffraction (XRD),
- conventional laboratory techniques, such as Raman/IR spectroscopy, scanning and transmission electron microscopy.

Qualities :

- Strong interest in experimental work;
- Autonomy and a taste for teamwork (5 other persons from the CBM are involved in this ERC project);
- English and French: read, written and spoken;
- Know how to communicate and promote research;
- Spirit of initiative, analysis and synthesis;
- Organised, rigorous, respectful of safety instructions.

Applications

If you are interested, please send your application **before 30/01/2023** including CV, list of publications, and 3 references to Prof. Tetyana Milojevic: tetyana.milojevic@cnrs-orleans.fr (Chair of Exobiology at the University of Orléans, Exobiology Group, CNRS-Centre de Biophysique Moléculaire, Rue Charles Sadron, 45071 Orléans cedex 2, France).