2 year Post-doc position, University of Lyon (France)

Program "Stable lipid bilayers past the boiling point of water"

ArchaeoMembranes ANR 2017 ANR-17-CE11-0012-01 (2018-2022)

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Compartimentalization is a key point in the evolution of life, since it allowed to form cells, and define an inside and an outside. It allowed cells to create chemical gradients and harvest their energy. Stability of membranes of organisms living near hydrothermal vents still remains problematic, since high temperatures increase molecular motion of membrane lipids, leading to increased permeability, and decreased rigidity. Thus, under such fluctuating conditions, a lipid membrane bilayer is expected to have limited stability and high permeability. The archetypical adaptative strategy in hyperthermophilic organisms is the synthesis of membrane-spanning, dipolar tetraether lipids, which yieald more rigid and less permeable membranes. Interestingly, several hyperthermophilic archaea capable of growth at or above the boiling point of water and unable to synthesize bipolar lipids have been isolated and characterized in recent years. How these organisms maintain stable and functional membranes is an open question.

Recently, a novel membrane architecture was proposed to explain the stability of lipid membrane bilayers in the hyperthermophilic archaeaon *Thermococcus barophilus* by my group (http://map.univ-lyon1.fr/spip.php?article251&lang=en) [1]. This novel membrane architecture predicts the presence of apolar lipids in the mid-plane of the bilayer, which would limit charge transfers between the two sides of the membrane, leading to a decrease in proton and water permeability, as well as an increase of membrane rigidity, providing a rationale for the ability of this organism to withstand temperatures above the boiling point of water [2]. These observations have important impact on how we understand membrane adaptation to extreme environments, but more importantly on possible scenarios for the membranes of the first cells.

Objectives:

In the framework of the ANR ArcheaoMembranes projet, we will realize the total synthesis of several archaeal lipids with varied polar headgroups in order to explore the mecanical and chemical properties of archaeal membranes as a function of different stressors (temperature, salinity, hydrostatic pressure). The aim of this project is to 1) demonstrate experimentally the validity of the novel membrane architecture, 2) explore its physical and chemical parameters, 3) characterize the impact of the presence of apolar lipids on membrane biological function (proton and water permeability, fluidity, viscosity, rigidity) and 4) determine the relative contribution of each lipid type (monopolar, apolar,) and lipid moiety (polar head-group, core) on membrane physical parameters, in order to build a comprehensive model of the archaeal membrane and reconstruct the new adaptative routes taken by these specific hyperthermophilic archaea.

We are looking for a motivated candidate with a background in biophysics, analytical chemistry or chemical physics. Experience with lipids is a plus but is not required. This is an ANR funded post-doctoral position for a total of 2 years (1 year renewable 1 year). The candidate will be performing experiments in Lyon within the AME group, and perform measurements at large facilities such as the ILL neutron source (Grenoble, https://www.ill.eu/), the TGIR RMN (Bordeaux, http://ir-rmn.fr/) which are partners of this program, and long time collaborators (TU Dortmund, Imperial College London). The AME team is working on deciphering the adaptation to extreme environments. It is currentle composed of 9 members. A short summary of the program is available at http://map.univ-lyon1.fr/spip.php?article351&lang=en.

To apply for this position send a CV, a description of your education and a motivation letter and names of three references to Phil Oger (mailto:philippe.oger@insa-lyon.fr). Position will start as early as April 2019 and will remain open until filled.

Literature cited

[1] A. Cario, V. Grossi, P. Schaeffer, P. Oger, *Front. Microbiol.* 6 (2015).
[2] T.H. Haines, *Prog. Lipid Res.* 40 (2001) 299-324.