Cangene Gold Medal Award Lecture

Tuesday, June 16, 17:00-18:00 ***D.B. Clarke Theatre***

Philippe Constant has completed a B.Sc. in Biological Sciences at the Université de Montréal. As an undergraduate, he undertook different research projects with Dr. Patrick Hallenbeck and his Ph.D. supervisors in the field of environmental microbiology. He conducted his Ph.D. research in the laboratories of Dr. Richard Villemur at the INRS-Institut Armand-Frappier and Dr. Laurier Poissant at Environment Canada on the biogeochemical cycle of molecular hydrogen and mercury. Having an interdisciplinary formation at the interface between environmental microbiology and Earth sciences, he has developed a unique expertise to measure trace elements fluxes and to identify the microorganisms involved in these exchanges. During his research, Philippe has contributed to 12 peer-reviewed publications and has given 5 conferences talks and 8 poster presentations. He was recognized by national and provincial scholarships, has obtained several conference travel awards and is currently reviewer for 4 different scientific journals. Philippe has been funded by the FQRNT to undertake a postdoctoral fellow in the research group of Dr. Ralf Conrad at the Max Planck Institute for Terrestrial Microbiology in Germany.

Study of the biogeochemical cycle of molecular hydrogen and mercury by using an integrated approach

Dr. Philippe Constant

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An original approach, combining microbial ecology with atmospheric sciences, has been elaborated to study molecular hydrogen (H_2) and mercury (Hg) microbiogeochemistry. The research has been initiated by a characterization of H_2 soil uptake, a process responsible for 80% of the global atmospheric H_2 losses. So far, H_2 soil uptake is attributed to hypothetical free soil hydrogenases and atmospheric H_2 distribution models are derived by assuming a homogenous activity at the global scale. We have demonstrated that both assumptions should be mistaken. H_2 fluxes measured in wetlands, grassland and subarctic ecosystems were characterized by considerable spatial and temporal variations explained by environmental factors such as soil temperature, carbon and water content. A new approach combining H_2 fluxes measurement with microbial diversity monitoring has been developed to find the origin of the observed H_2 soil uptake. *Streptomyces* sp. PCB7 has been identified as the first microorganism having the capacity to consume atmospheric H_2. Strain PCB7 consumed H_2 only during its sporulation phase, which is activated in response of nutrients depletion. A putative [NiFe]-hydrogenase has been identified, providing a first target for the development of a molecular tool to study H_2 soil uptake ecophysiology.

Polar ecosystems are exposed to anthropogenic Hg, especially in springtime due to atmospheric mercury depletion events (AMDE). During AMDE, reactive halogens are oxidizing Hg species having a long atmospheric residence time to reactive forms that are rapidly deposited onto the snow cover. The fate of newly deposited Hg needs to be investigated since important discharges of methylmercury (MeHg; the most readily bioaccumulated Hg species) are observed in snowmelt water. Biological and chemical Hg methylation reactions have been observed in soil, sediments and aquatic ecosystems, but their occurrence has never been reported in snow. We have performed several field campaigns in subarctic ecosystems to identify the origin of the MeHg detected in the snow cover. Two main processes have been identified. Before the snowmelt, marine aerosols were a source of unstable MeHg which was rapidly demethylated following its atmospheric deposition. The situation was more intricate at the snow melting period, when a dramatic increase of MeHg concentrations was observed in shrub tundra, presumably due to *in situ* biological and chemical Hg methylation reactions. Our results provided evidences that reactive Hg species deposited in the snow cover during AMDE can be transformed in MeHg, representing an exposure risk to the arctic biota, especially in coastal aquatic ecosystems.

In conclusion, an integrative interpretation of our results has showed that global change could increase annual MeHg discharges in polar aquatic ecosystems and alter soil's atmospheric H_2 uptake activity.

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