Proposition de stage

Parcours Master 2 « Microbiologie, Environnement, Santé »

1. Laboratoire / Entreprise d'accueil :

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Perspectives de poursuite de thèse :

ox oui
onon

avec une bourse spécifique
o oui
ox non

2. Titre, description du sujet, approches utilisées, références (2 pages maximum) **:**

The microbial carbon pump under different nutrient-limiting conditions

Heterotrophic bacterioplankton play a key role in organic matter processing in all aquatic ecosystems, with consequences on the cycling of carbon and other elements. Heterotrophic bacteria and archaea reprocess roughly 50% of organic carbon that is fixed by phytoplankton, the main organic matter input in the ocean (Azam et al., 1983), which is either respired to CO_2 or used to build new biomass. However, the role of bacterioplankton as sources of dissolved organic matter has been overlooked, but it has been demonstrated that bacterioplankton also release dissolved organic matter (DOM). This bacterial-derived DOM can be resistant to further remineralization and it is sequestered in the ocean's interior through the so-called microbial carbon pump (Jiao et. al. 2010). However, there are still many open questions regarding the underlying mechanisms that lead to DOM production by bacterioplankton. Within the broad range of environmental parameters that could eventually affect the microbial carbon pump, nutrient stoichiometry would be a key factor affecting these mechanisms. DOM production by phytoplankton is highest and less bioavailable for bacteria when they are P-limited (Obernosterer & Herndl, 1995); although the importance of phosphorous limitation in DOM production by bacteria has not been yet tested. However, it was shown in laboratory incubations that refractory DOM (i.e. not bioavailable) was highly depleted in phosphorus vs

carbon or nitrogen. Based on these previous results, we hypothesize that P would play a key role in BDOM generation and lability; being BDOM higher and more recalcitrant in phosphorus-limited ecosystems (e.g. the Mediterranean Sea) than in nitrogen-limited ones; affecting DOM cycling in these ecosystems.

The Master 2 student will help elucidate whether DOM production by heterotrophic bacterioplankton is affected by the initial nutrient (Nitrogen vs. Phosphorous) limitation. For this purpose, the student will work with model bacterial strains in culture. Different strains of contrasting taxonomy and physiology will be selected and grown using glucose as a single carbon source and under different nutrient-limiting conditions (nitrogen vs. phosphorus limitation). The growth of the bacterial cells will be followed by flow cytometry. DOM production by the strains will be quantified by comparing the decrease in the initial carbon substrate (i.e. glucose, TPTZ colorimetric method) with the whole pool of dissolved organic carbon. DOM composition will be characterized by optical fingerprinting (chromophoric and fluorescent DOM), C:N:P ratios, and the proportion of D-L amino acids as a surrogate of bacterial DOM origin. The student will help develop the methodology to determine D-L amino acid concentration by HPLC. The bioavailability of the DOM produced under the different conditions can be evaluated by performing biodegradation experiments using natural communities sampled from the NW Mediterranean Sea.

Summary of techniques applied during the Master 2 stage:

- Single strain culturing
- Flow cytometry
- DOM recovery (filtration)
- Glucose concentration (TPTZ colorimetric method)
- Chromophoric (CDOM) and fluorescent (FDOM) organic matter
- Ecoenzymatic Activity (Fluorogenic substrates)
- D-L Amino Acids (HPLC)

References

Azam F, Fenchel T, Field JG, Gray JS, Meyerreil LA, Thingstad F (1983) The ecological role of water-column microbes in the sea. Mar Ecol-Prog Ser 10: 257-263

Jiao N, Herndl GJ, Hansell DA, Benner R, Kattner G, Wilhelm SW, Kirchman DL, Weinbauer MG, Luo TW, Chen F, Azam F (2010) Microbial production of recalcitrant dissolved organic matter: long-term carbon storage in the global ocean. Nature Reviews Microbiology 8: 593-599

Obernosterer I & Herndl GJ (1995) Phytoplankton extracellular release and bacterial growth: dependence on the inorganic N:P ratio. *Mar Ecol Progr Ser* **116**: 247-257