

PhD PROPOSAL FOR THE DOCTORAL SCHOOL

« Ecologie, Géosciences, Agronomie, Alimentation »

GENERAL INFORMATION

Thesis title: Does microbial diversity matter? Impact of environmental variables on microbial diversity and nitrogen and carbon fluxes in intertidal mud flats
Acronym: VASIMIC
Disciplinary field 1: Ecology Disciplinary field 2: Geosciences
Three keywords: diversity, microbes, denitrification
Research unit : UMR 6553 Ecobio
Name of the thesis director: LAVERMAN, Anniet Email address of the thesis director : anniet.laverman@univ-rennes1.fr Name of the thesis co-supervisor 1 (if applicable): DUFRESNE, Alexis Email address of the thesis co-supervisor 1 (if applicable): alexis.dufresne@univ-rennes1.fr
Thesis grant (funding origin and amount): project FEREE, GIP SEINE AVAL (~30 k€)
Contact(s) (mailing address and E-mail): Université Rennes 1 - UMR 6553 CNRS ECOBIO Campus de Beaulieu, 263 avenue du Général Leclerc, 35042 RENNES CEDEX, FRANCE
Recruitment process: Recruitment process depends on thesis funding. To select the corresponding recruitment process, please visit the EGAAL website here . This information is needed for proposal publication. <input checked="" type="checkbox"/> Doctoral school contest <input type="checkbox"/> Interview <input type="checkbox"/> Other (indicate) :

All sections must be filled. Once filled, please save the proposal form in pdf format using the following naming: Supervisor Name_Unit_Subject Acronym_EN.pdf

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Direction : 65 rue de Saint-Brieuc – CS 84215 – 35042 Rennes Cedex – France

Tél : 02 23 48 52 75

Mail : ed-EGAAL@u-bretagne Loire.fr

Site Web : <https://ed-egaal.u-bretagne Loire.fr>

SCIENTIFIC DESCRIPTION OF THE PhD PROJECT

Socio-economic and scientific context : (10 lines)

Coastal areas receive nutrients from both the watershed and the ocean, an excess of nutrients may cause eutrophication and unwanted algal blooms which are often toxic. The importance of coastal sediments, especially intertidal mud flats, in the releasing or storing nutrients is still poorly understood. Numerous crucial microbial processes (photosynthesis, mineralization, nitrification, denitrification) occur in mudflat sediments and determine the fluxes of nutrients and carbon at the water-sediment interface. These processes and fluxes are both influenced by abiotic factors (temperature, hydrodynamics, light), linked to local environmental conditions, and biotic factors, such as the biomass and the diversity of benthic microbial communities. A better characterizing of these processes will allow stakeholders in the management and rehabilitation of coastal and estuarine ecosystems improving the associated ecological functions.

Assumptions and questions (8 lines)

In “macroecology”, the concept that species diversity is a major determinant of productivity, stability, and resource dynamics of ecosystems is widely accepted. On the other hand, microbial diversity in relation to ecosystem functioning remains less studied. One of the objectives of this thesis will therefore be to test the hypothesis of a diversity-function relationship at the microbial scale. The main question to be answered being: are C and N transformation rates related to environmental variables and / or to diversity (taxonomic and functional) and / or to microbial biomass? The different microbial processes of the nitrogen and carbon cycles will be tested.

The main steps of the thesis and scientific procedure (10-12 lines)

Experiments under controlled conditions, using reactors in continuous flow, will allow to modify environmental variables and determine variations in microbial reaction rates (here: denitrification) and the change in the microbial communities. A first major environmental variable that will be tested is organic carbon, in the form of simple carbon components (acetate) or complex (algal biomass), enriched in ^{13}C in order to identify and monitor the microbial community incorporating this ^{13}C in their biomolecules, (Stable Isotope Probing). Other environmental variables, such as salinity (change expected with a global change) or emerging pollutants (eg antibiotics) could be tested on the diversity and functioning of the ecosystem (here: biogeochemical processes).

Methodological and technical approaches considered (4-6 lines)

The work will consist of : determination of denitrification and mineralization rate (^{13}C labeling) using continuous flow reactors. Analysis of microbial communities by amplification and high throughput sequencing of taxonomic and functional markers. Analysis of mineral and organic sedimentary characteristics.

Scientific and technical skills required by the candidate

A master's degree in biology with a specialty in environmental microbiology or microbial ecology with knowledge in biogeochemistry and bioinformatics. Knowledge of coastal sediment biogeochemistry and the nitrogen cycle would be an advantage. Laboratory, experimental and bioinformatics.

THESIS SUPERVISION¹

Unit name: UMR 6553 Ecobio	Team name: DYNAMO
Unit director name: Joan Van BAAREN	Team director name: Alexis Dufresne
Mailing address of the unit director: joan.van-baaren@univ-rennes1.fr	Mailing address of the team director: alexis.dufresne@univ-rennes1.fr
Thesis director Surname, first name: Laverman, Anniet Position: CRCN Obtained date of the HDR (Habilitation thesis to supervise research): December 17 th 2013 Employer: CNRS Doctoral school affiliation: EGAAL Rate of thesis supervision in the present project (%): 50% Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%): 50% Number of current thesis supervisions/co-supervisions: 1	
Thesis co-supervisor 1 (if applicable) Surname, first name: DUFRESNE, Alexis Position: CRCN Habilitation thesis to supervise research <input type="checkbox"/> yes <input checked="" type="checkbox"/> no If yes, date diploma received: Employer: CNRS Doctoral school affiliation: EGAAL Rate of thesis supervision in the present project (%): 50% Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%):50% Number of current thesis supervisions/co-supervisions: 1	
Private partner (if CIFRE funding, private funding,...) Surname, first name: Position:	

¹ In EGAAL Doctoral School, if only one scientist in thesis supervision = 100% of supervision rate; if 2 people involved in thesis supervision = from 50% to 70% of supervision rate for the director; if 3 people involved in thesis supervision = 40% / 30% / 30% of supervision rate distribution among supervisors.

Employer:

Rate of thesis supervision in the present project (%):

Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%):

Number of current thesis supervisions/co-supervisions:

International partner (if Cotutelle thesis)

Surname, first name:

Position:

Employer:

Rate of thesis supervision in the present project (%):

Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%):

Number of current thesis supervisions/co-supervisions:

Professional status of previous PhD students supervised by both director and co-supervisors (from 5 years)

Please provide the following information for each PhD students supervised

Surname, first name: **Cazier, Thibaut Cazier**

Date of PhD beginning and PhD defence: 2012-2015

Thesis supervision: Annet LAVERMAN

Professional status and location: *Ingenieur, Fresenius Kabi France*

Contract profile (post-doc, fixed-term, permanent): permanent

List of publications from the thesis work:

1. Raimonet, M., **T. Cazier**, V. Rocher, **A.M. Laverman** (2017). Nitrifying kinetics and the persistence of nitrite in the Seine River, France . J. of Env. Quality 46(3) 585-595
2. **Laverman A.M.**, T. Cazier, C.Yan, F. Petit, J. Garnier, T. Berthe (2015) Exposure of vancomycine causes a shift in the microbial community structure without effecting nitrate reduction rates in river sediments. Environmental Science and Pollution Research DOI [10.1007/s11356-015-4159-6](https://doi.org/10.1007/s11356-015-4159-6)

Surname, first name: **Bethencourt, Lorine**

2015-2019

Thesis supervision: Alexis Dufresne / Luc Aquilina

Professional status and location: unemployed

Contrat (post-doc, CDD, CDI) :

List of publications from the thesis work:

1. **Bethencourt L**, Bochet O, Farasin J et al. Genome reconstruction reveals distinct assemblages of Gallionellaceae in surface and subsurface redox transition zones. FEMS Microbiol Ecol 2020, DOI: [10.1093/femsec/fiaa036](https://doi.org/10.1093/femsec/fiaa036).
2. Bochet O, **Bethencourt L**, Dufresne A et al. Iron-oxidizer hotspots formed by intermittent oxic–anoxic fluid mixing in fractured rocks. Nat Geosci 2020, DOI: [10.1038/s41561-019-0509-1](https://doi.org/10.1038/s41561-019-0509-1).
3. Burté L, Cravotta CA, **Bethencourt L** et al. Kinetic Study on Clogging of a Geothermal Pumping Well Triggered by Mixing-Induced Biogeochemical Reactions. Environ Sci Technol 2019:acs.est.9b00453.

4. Aquilina L, Roques C, Boisson A, Vergnaud-Ayraud V, Labasque T, Pauwels H, Pételet-Giraud E, Pettenati M, Dufresne A, **Bethencourt L**, Bour O. Autotrophic denitrification supported by biotite dissolution in crystalline aquifers (1): New insights from short-term batch experiments. *Sci Total Environ* 2018;619–620:842–53.

Five main recent publications of the supervisors on thesis subject:

1. Humbert G., M. Sebilio, J. Fiat, L. Lang, A. Filali, V. Vaury, M. Sperandio, **A.M. Laverman**. Isotopic evidence for alteration of nitrous oxide emissions and producing pathways contribution under nitrifying conditions. *Biogeosciences* **2020**
2. Kolbe, T., de Dreuzy, J.-R., Abbott, B.W., Aquilina, L., Babey, T., Green, C.T., Fleckenstein, J.H., Labasque, T., **Laverman, A.M.**, Marçais, J., Peiffer, S., Thomas, Z., Pinay, G (2019) Stratification of reactivity determines nitrate removal in groundwater. *PNAS Proceedings of the National Academy of Science*, <https://doi.org/10.1073/pnas.1816892116>.
3. Bethencourt L, Bochet O, Farasin J, Aquilina L, Le Borgne T, Quaiser A, Biget M, Michon-Coudouel S, Labasque T & **Dufresne A**. Genome reconstruction reveals distinct assemblages of Gallionellaceae in surface and subsurface redox transition zones. *FEMS Microbiol Ecol* 2020, DOI: 10.1093/femsec/fiaa036.
4. Bochet O, Bethencourt L, **Dufresne A et al**. Iron-oxidizer hotspots formed by intermittent oxic-anoxic fluid mixing in fractured rocks. *Nat Geosci* 2020, DOI: 10.1038/s41561-019-0509-1.

THESIS FUNDING

Origin(s) of the thesis funding: University Rennes 1, doctoral school contest

Gross monthly salary: 1770 €

Thesis funding state : Non acquired

Funding beginning date/Funding ending date: October 2021

Date:

March 23th 2021

Name, signature of unit director:

Joan van BAAREN

Joan VAN BAAREN
Directrice de l'UMR Ecoblo



Name, signature of team director:

Alexis DUFRESNE



Name, signature of thesis project director:

Annet LAVERMAN

