PhD position at INRA, Nancy, France
Title: **Ecology and genomics of the bacterial communities associated to minerals in forest soils**

Key words: low-input ecosystems, minerals, mineral weathering, minerals, bacteria, environmental microbiology

Profile and skills required:
The candidate will have skills in microbial ecology, molecular biology, bacteriology, and possibly in biostatistics / bioinformatics. The candidate needs to be motivated by academic research.

Context
In temperate regions, minerals and rocks represent one the main source of nutritive cations in the soil of low-input ecosystems such as forests. In such nutrient-poor and non-amended environments, the access and the recycling of the nutritive cations are key processes for tree growth and productivity. However, these nutritive cations are almost inaccessible to the tree roots as they are entrapped into the organic matter (OM) or into the soil minerals/rocks. Consequently, the mineral weathering process is essential as it allows the restoration of soil fertility and provides the inorganic nutrients for tree growth. This aspect is especially reinforced in managed forests where the nutrients coming from the OM are lost during wood exportation. In this context, the soil mineral/rock interfaces and their associated microbiome are essential for the replenishment of the soil fertility. However, all the minerals/rocks do not have the same chemical composition (nutritive interest) and the same physico-chemical properties (reactivity). Indeed, some minerals/rocks are highly weatherable and nutritive (i.e., apatite), while some others are recalcitrant and poorly nutritive (i.e., quartz). Consequently, the impact of these different minerals on nutrient cycling and plant nutrition can strongly vary. While, the implication of microorganisms in the mineral weathering process and plant nutrition is established, the intrinsic parameters (i.e., mineral properties) and the extrinsic parameters (i.e., the environmental factors) regulating this implication as well as the molecular mechanisms involved remain unknown or poorly understood.

Objectives and methods
The PhD thesis will aim at determining the molecular mechanisms used by bacteria to weather minerals and to identify the environmental drivers involved in the interaction, the colonization and the weathering of minerals by bacterial communities in a context of nutrient-poor forest soil. The project is based on the hypothesis that minerals represent a nutritive reserve, an important reactive interface and microbial habitat for adapted microorganisms (i.e., the mineralosphere; Uroz et al., 2015).

The molecular work (transcriptomic, proteomic, mutagenesis and cloning) will be done on an effective mineral weathering model bacterial strains (strain PMB3(1) of *Collimonas)*, which genome is sequenced. The microbial ecology part will be done on mineral incubated in soil conditions since 2012 on the forest experimental site of Montiers. This part will be developed using soil sciences, culture-dependent (bacterial collection, functional bioassays) and -independent (metabarcoding targeting 16S rRNA genes) tools.

Labs and information on the supervision:
The candidate will integrate the mixt unite INRA/University of Lorraine IAM (Tree microbes interactions; http://mycor.nancy.inra.fr/IAM/), which aims at improving our knowledge and our understanding of the interactions that take place between trees, fungi, bacteria, and soil, and that contribute to the sustainable functioning of forest ecosystems. The candidate will be member of the

Ecogenomic team. As the project is at the interface with the mineralogy and the soil science, the candidate will be also member of the Biogeochemistry of forest ecosystem (BEF) unit.

The PhD thesis will be supervised by **Stephane UROZ** (IAM/BEF; DR2 INRA and HdR: http://mycor.nancy.inra.fr/IAM/?page_id=727) and **Marie-Pierre TURPAULT** (BEF; DR2 INRA and HdR: https://www6.nancy.inra.fr/bef/Personnel/Scientifiques/Marie-Pierre-TURPAULT).

To candidate, provide a recommendation letter as well as a CV to Stephane Uroz before the 20th of April.

Coordonnées e-mail :
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Stéphane Uroz 03.83.39.40.81

Some recent references on the topic

- Uroz, S.* and Oger, P. (**2017**) *Caballeronia mineralivorans* sp. nov., isolated from oak-*Scleroderma citrinum* mycorrhizosphere. Systematic and Applied Microbiology. In press.

- Colin, Y., Nicolitch, O., Turpault, M-P., **Uroz, S.*** (**2017**) Mineral type and tree species determine the functional and taxonomic structure of forest soil bacterial communities. Applied and Environmental Microbiology. 83(5). pii: e02684-16. doi: 10.1128/AEM.02684-16.

- Nicolitch, O., Colin, Y., Turpault, M-P., **Uroz, S.*** (**2017**) Soil type determines the distribution of nutrient mobilizing bacterial communities in the rhizosphere of beech trees. Soil Biology and Biochemistry. 103, 429-445.

- Uroz S.*, Oger P. , Tisserand E. , Cébron A., Turpault M-P., Buée M., De Boer W., Leveau J.H.J., and P. Frey-Klett. (**2016**) Specific impacts of beech and Norway spruce on the structure and diversity of the rhizosphere and soil microbial communities. Scientific Reports. 6: 27756.

- Kelly, LC., Collin, Y., Tupault, M-P. and **Uroz, S.*** (**2015**) Mineral type and solution chemistry affect the structure and composition of actively growing bacterial communities as revealed by bromodeoxyuridine immunocapture and 16S rRNA pyrosequencing. Microbial Ecology. *Volume 72, 428–442*.

- Uroz, S.*, Kelly, L.C., Turpault, M-P., Lepleux, C., and P. Frey-Klett. (**2015**) The Mineralosphere concept: mineralogical control of bacterial communities. Trends in Microbiology. 23, 751–762. (IF=9.186)

- Uroz, S.*, Tech, J.J., Sawaya, N.A., Frey-Klett, P., and J.H.J. Leveau. (**2014**) Structure and function of bacterial communities in ageing soils: Insights from the Mendocino ecological staircase. Soil Biology and Biochemistry. 69, 265–274

- Uroz, S.*, Calvaruso, C., Turpault, MP and Frey-Klett, P. (**2009**) The microbial weathering of soil minerals: Ecology, actors and mechanisms. Trends in Microbiology. 17:378-387.