Polytech network form for PhD Research Grants from the China Scholarship Council

This document describes the PhD subject and supervisor proposed by the French Polytech network of 14 university engineering schools. Please contact the PhD supervisor by email or Skype for further information regarding your application.

Supervisor information	
Family name	Motelica-Heino
First name	Stefan Mikael
Email	mikael.motelica@univ-orleans.fr
Web reference	https://cv.archives-ouvertes.fr/mikael-motelica-heino
Lab name	ISTO UMR 7327 CNRS-Université d'Orléans-BRGM
Lab web site	https://www.isto-orleans.fr/
Polytech name	Polytech Orléans
University name	Université d'Orléans
Country	France

PhD information	
Title	Rhizospheric processes involved in phytostabilisation of metals in contaminated soils
Main topics regards to CSC list (3 topics at maximum)	V-12. Mechanism of environmental pollution and technology of control

Required skills in science and engineering	Soil science, chemistry, microbiology, biolog

Subject description (two pages maximum)

Strategies of soil stabilization, based on the effects of plants and microorganisms represent a relevant option from an ecological and economic point of view, for the management of large areas contaminated by industrial, metallurgical or mining activities. Indeed, this type of approach to manage large polluted sites is based on optimization steps of amendments and vegetal cover, in order to decrease the mobility of harmfull substances, together with their toxicity and in-situ bioavailability. In addition to the stabilization, the nature of this bioprocess allows restoring landscape and biodiversity. Phytoremediation is useful to remediate contaminated environmental compartments. One of the most successful applications of phytoremediation is for remediating inorganic trace metals from environmental compartments, since the specific plants used are capable of sequestering metals in their living biomass or in the soil around their roots. In particular phytostabilisation using tree species is a promising approach for the remediation of contaminated soils at a low cost.

However, for successful phytoremediation, the influence of zymogenous soil micrograms is crucial, as the rhizosphere plays a key role in the degradation or (im)mobilisation of pollutants. Nonetheless, these interactions are not yet well understood

The rhizospheric soil, which is the few millimeters of soil covering the roots of plants and influenced by their biological activity, is a dynamic system characterized by feedback interactions between soils characteristics, roots processes and dynamics of the associated microbial communities. The rhizosphere corresponds to a geochemical micro-environment influenced by the plants activities (roots exsudates composed of organic acids and siderophores, respiration, …) and microorganisms (mineralization of organic matter…). This activity locally influences the ecodynamic of metals, either directly (precipitation, complexation, adsorption) and indirectly (effects of the rhizosphere on pH and redox potential, dissolution of minerals…). The study of rhizosphere-related processes on mobility, availability and toxicity of metals in soils, based, in particular, on the role of the root-mycorrhizae-bacteria associations in the transformation of metals, is a major challenge to understand the ecodynamic of meals in the context of phyroremediation or natural attenuation of contaminated soils.

The PhD student will have as general objective to evidence the role of the rhizosphere on the dynamics of metals in contaminated soils.

This objective will be reached through:

-studying the rhizosphere microflora,

-identifying the roots exsudates,

-studying the transformation of these exsudates by the rhizospheric microflora,

-evidencing the influence of these biogeochemical factors on the speciation, mobility and phytoavailability of metals.

The expertise of the applicant will be based on the master of techniques to study the microorganisms of the rhizosphere and the analytical methods applied to the identification of the organic molecules of the rhizosphere (root exsudates) and inorganic chemistry.