



Subject offered for a contract starting October 2019

SUBJECT TITLE: Geochemistry of trace metals associated with Fe-Mn nodules in red soil profiles in China.

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IPGP- Team Environnemental Biogeochemistry – UMR7154

Financing: Doctoral contract Université de Paris 2019 without teaching assignment

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Presentation of the subject: (1 or 2 pages)

Red soil is widespread in southern China, covering an area of about 22.7% of China's area. It has experienced intense syndepositional pedogenesis under humid tropical to subtropical conditions. In such soil profile, Fe and Mn oxides are omnipresent and frequently occur in Fe-Mn nodules of varying morphology, size, and shape. Due to their high surface area and high surface charge density, Fe and Mn oxides play crucial roles in concentrating and immobilizing trace metals in red soils.

On the other side, Fe-Mn nodules are very sensitive to soil environmental changes, such as moisture, pH, redox potential, and microbial activity. Trace metals may be released due to organic fertilization of the soil or long-term saturation with water, leading to contamination of the soil as well as the soil solution and groundwater.

Therefore, study on the geochemical behavior of trace metals associated with Fe-Mn nodule in red soil profile could help with improving our knowledge of trace metal cycling and their potential risk in such soil system, and also elucidating soil environmental changing which was recorded by nodules.

In this study, two paddy soil profiles with geo-background contamination and two paddy soil profiles with anthropogenic contamination in Southwest China will be selected, where Fe-Mn nodules are widely developed. Fe-Mn nodules and their corresponding soil matrix will be collected from soil profiles according to their pedogenetic horizons.

The aims of this study are to :

- (1) examine the distribution, size, mineralogical and physico-chemical features of Fe-Mn nodules and their corresponding soil matrix within different pedogenetic horizons of soil profiles;
- (2) explore the nodule internal structure and chemical features (concentrations, speciation and stable isotope ratios of trace metals, such as Cd, Pb, Cr, etc.) along the section of nodules and in soil matrix as well as soil solutions by using SEM-EDS, XPS, LA-ICP-MS, and MC-ICP-MS;

(3) reveal the possible mechanism of trace metal immobilization and soil environmental changes during nodule formation by comparing the nodule features in soil profiles contaminated from contrasting sources. Moreover, to validate the speculative mechanisms, laboratory sorption experiments of trace metals on synthesized Fe and Mn hydroxides together with organic matter could be conducted under different redox states by mimicking the natural soil pore water; multi-surface modeling can be used to help deciphering the mechanism of these interactions.

o Requirements:

- o Successfully university degree in soils chemistry or geochemistry or a related discipline.
- o Knowledge of speciation software is a plus .
- o Basic knowledge in soils science, Mn oxides geochemistry is desirable but not strictly necessary.
- o Most importantly, the candidate is expected to show initiative to learn and acquire new skills.
- o Good analytical and inter-personal skills
- o Capacity to work both independently and within an international team.