Investigation of Organo-Mineral Associations at the Micron Scale by NanoSIMS.

REMUSAT L. [1] AND DERRIEN D.[2]

[1] IMPMC, MNHN-Sorbonne Universités- UMR CNRS 7590- 61 rue Buffon. 75005 Paris. France – remusat@mnhn.fr
[2] Biocheochemistry of Forest Ecosystems - INRA Nancy-Lorraine. 54280 Champenoux. France.

Fine scale interactions between minerals, microorganisms and organic matter have profound impacts on the biogeochemical cycle of C and N in the environment. The association of organic matter with mineral surfaces can protect it from the degradative activity of microorganisms. Such association then contributes to the storage of C in soil and may play a significant role in climate evolution. These associations may also hamper the recycling of nutrients in soils. Unraveling the mechanisms at play in the organo-mineral associations require analytical tools and experimental protocols able to probe processes at the micron down to the nanometer scale. Nano Secondary Ion Mass Spectrometry (NanoSIMS) brings the capability to identify organic matter at the sub-micron scale in heterogeneous samples like soils [1]. This instrument provides elemental and isotopic maps of organic matter at the surface of mineral particles with a spatial resolution lower than 100 nm. The technique becomes even more powerful in association with an isotope labelling experiment to track for C or N fluxes throughout complex geological systems like soils [2, 3, 4].

In this presentation, we show some of the advances that were made possible by using the NanoSIMS to study soil samples in natural and experimental conditions. We also present results obtained by combining NanoSIMS with other complimentary imaging techniques. These techniques include transmission electron microscopy (TEM), which allows identifying microorganisms morphology, and scanning transmission X-ray microscopy (STXM) for the determination of molecular signature of organic matter rich areas. Using such analytical approach, it becomes possible to push further the understanding of fine scale mechanism controlling the persistence of organic matter in soils. Imaging organic matter in organo-mineral associations provides unique information about the C and N turnover in soils [5].

[1] Herrmann et al. 2007 SBB, 39, 1835-1850. [2] Vogel et al. 2014 Nature Com, 5, 2947. [3] Remusat et al. 2012 ES&T, 46, 3943-3949. [4] Vidal et al. 2016 SBB, 93, 8-16. [5] Mueller et al. 2017 in Terrestrial Ecosystem Research Infrastructures, CRC Press, 193-212.