Tracking fresh microbial products in forest soils with the sharp probe of the NanoSIMS.

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The role of microorganisms is crucial in soil organic matter (SOM) stabilization processes. However, fine scale mechanisms controlling the attachment of microbial products to soil minerals are not fully understood. Although mg-scale techniques are very useful to determine assimilation rates and fluxes of matter through the soil system, only micron scale techniques could resolve the questions about the role of mineral-microorganism interactions in SOM formation.

A surface forest soil was amended with glycine uniformly labelled with ^{13}C and ^{15}N, and incubated for 8 hours. A sequential density fractionation was then applied to isolate several classes of aggregates and single mineral particles. The same experiment was performed on a sterilized soil that was subjected to gamma-irradiation. Using nano-scale secondary ion mass spectrometry (NanoSIMS), we have investigated the spatial distribution of freshly produced microbial metabolites on various types of organo-mineral associations. This technique is able to map isotopes at submicron scale lateral resolution [1, 2]

The comparison of sterile and non-sterile soil reveals that microbial activity is responsible for more than 85% of stable SOM freshly produced from glycine. C and N are decoupled, indicating that glycine is quickly reprocessed. Using accurate determination of the elemental C/N ratio [3], we observe that ^{15}N-rich microbial products are preferentially attached to preexisting N-rich OM around OM/mineral assemblages, mostly aggregates. However, they appear more keen on sticking onto C-rich OM in the case of (hydr)oxides/OM associations. ^{13}C-rich microbial product occurrences appear scarce and likely in the vicinity of microbial cells.

Fine scale isotopic imaging shows that the attachement of fresh microbial products to the soil matrix appears driven by distinct processes in the case N- or C-rich metabolites.

[1] Vogel *et al* (2014) *Nat. Commun.* **5** 2947. [2] Keiluweit *et al* (2012), *GCA* **95**, 213-226. [3] Hatton *et al* (2012), *Rapid Commun. Mass Spectrom.* **26**, 1363–1371.