Depicting in situ carbon transfer from roots to rhizosphere with NanoSIMS

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The rhizosphere represents a hotspot for organic carbon inputs, microbial activity and carbon turnover in soil. The complex mosaic of microenvironments occurring at soil-plant interfaces requires observations at the smallest scale of organism interaction, i.e. at the level of root cells and bacteria. Nano-scale secondary ion mass spectrometry (NanoSIMS) is a spectromicroscopic method with a high spatial resolution providing elemental and isotopic images of organic and mineral materials. This technic has recently proved its potential to investigate rhizosphere processes. In the present study, NanoSIMS was used to study organo-mineral interactions and carbon transfers occurring in the rhizosphere at the microscale. Undisturbed rhizosphere samples were collected from a field experiment in Switzerland where wheat plants were pulse-labelled with ^{13}C-CO_2. Secondary ion images of ^{12}C, ^{13}C, $^{12}C^{14}N$, ^{16}O and $^{56}Fe^{16}O$ were obtained. The ^{13}C labelled root cells were clearly distinguished on images (Fig.1A). Labelled spots, identified as bacteria, were located at the root cell surroundings and intimately associated with soil particles (Fig.1B), integrated into microaggregates at the root-soil interface. Images revealed the presence of larger labelled spots (>4µm) assignable to fungal hyphae. These results illustrate the transfer of assimilate carbon from root tissues towards microbial communities and the fate as organo-mineral associated organic carbon in soil microaggregates.

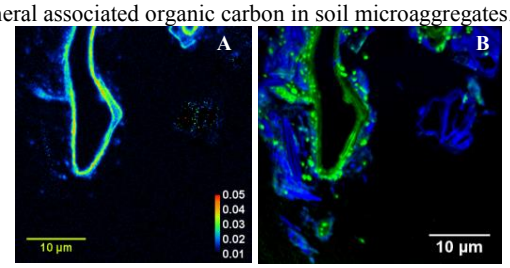

Figure 1: **A**- ^{13}C:^{12}C Ratio image, carbon transfer in the rhizosphere, **B**- Organo-mineral interactions at the surface of a root cell (Blue-^{16}O, Green-$^{12}C^{14}N$).