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Does pore scale biogeography exist in different soil types ?

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Microbial activity is largely controlled by the abiotic conditions prevailing in their habitats, which are very heterogeneous at the microscopic scale. A few studies have demonstrated a microbial biogeography at the pore scale. Different regions in the soil pore network can be considered to be different microbial habitats and these different regions have been shown to be well correlated with organic carbon mineralization rates. We aimed to test whether such a functional biogeography exists for different soil types and whether it is consistent across soils.

We selected six topsoils with contrasted texture, soil organic matter content and pH (2 cambisols, 3 luvisols and 1 podzol under different managements). We added a 13C labelled, easily mineralisable organic substrate, pyruvate, to soil samples previously equilibrated at different matric potentials, in order to place the substrate preferentially in soil pores with neck diameters of 3 to 10 μm or 30 to 10μm, according to the Jurin-Laplace law. The soil samples were then incubated at pF 1.5 for 3 weeks and CO_2 and 13C-CO_2 were monitored. At the end of incubation, total and 13C-PLFA were extracted and analysed.

Basal mineralisation, expressed as % total organic C was affected by soil type, mainly related soil pH and the quality of the organic matter. The 6 soils exhibited contrasted microbial community composition, as shown by their PLFA profiles. The addition of pyruvate did not induce any priming effect in soils, except in the long term bare fallow soil, where the mineralization of SOM was presumably limited by energy. In the long term bare fallow soil, pyruvate mineralization was the same whatever the region it was placed in, suggesting other controls of its mineralization than the characteristics of pore scale habitats. In four soils out of six, the mineralization of pyruvate was more rapid when it was initially placed in large pores (30 to 100μm) than in small pores (3 to 10 μm), suggesting that pore scale biogeography may be a general feature in soils and that coarser pores are more favourable habitats for soil organic matter mineralization.