Diversity and small-scale distribution of microbial communities in Patterned Grounds

Patterned Grounds (PGs) are geometric features formed on permafrost soils as a result of cryoturbation: the mixing, heaving, and churning of soil that occurs during freeze-thaw cycles forms stripes, circles, polygons and nets with and without visible surface textural sorting. Although several studies described PGs morphology and their formative processes, microbiological aspects are yet greatly unexplored. Microbial communities that develop in these ecosystems may play important roles in nutrient availability, dynamics and stabilization and therefore in plant colonization and ecosystem evolution.

In this study, we focused on circular patterned grounds showing a concentric textural sorting from four areas, characterized by different lithotypes, in the North-western Italian Alps. Samples were subjected to phylogenetic fingerprint by Denaturing Gradient Gel Electrophoresis (DGGE) followed by band sequencing. Moreover, abundance and distribution of bacterial, archaeal and fungal genetic markers and functional genes were measured by quantitative real-time PCR and correlated to chemical parameters.

DGGE profiles revealed a relatively homogeneous community structure within circles, but also among different PGs, with several phylotypes previously observed in other PGs and cold environments. Only for Archaea stronger differences in community composition on small-scale were detectable. On a quantitative point of view, microbial populations showed a clear concentric distribution, correlated to C:N ratio, influenced by lithology of parent material and coherent with trends of physicochemical parameters within PG circles.

These first results seem to suggest the importance of cryoturbation phenomenon in shaping microbial communities in seasonally frozen soils, at least in a quantitative way, although more detailed functional analysis are needed to make hypothesis about mechanisms involved.