Mycorhizal fungi and soil formation: Bridging scales and processes

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The majority of boreal and temperature tree species form a mutualistc relationship with ectomycorrhizal fungi. Almost all root tips of these trees are covered with fungal tissues: the ectomycorrhizae. In fact, the fungal symbiont form the main interface between plant and soil, with fungal hyphae extending from the tree root into the soil matrix. The most explorative types of mycorrhizal fungi can extend dm's from the root surface, where they can bridge different soil layers.

In this presentation I review the role of ectomycorrhizal fungi in three key soil processes: mineral weathering, Fe and Al transport and organic matter dynamics. Generally these processes are studied seperatedly, but in fact these processes are strongly interconnected.

The ability to enhance mineral dissolution is well established in laboratory settings, but their contribution to field scale weathering remains controversial. Recent work [1] in a natural vegetation gradient in Norway indicate a small contribution of fungi to apatite weathering in the deeper soil layers, in the top layers fungal activity retards apatite dissolution. This appears to be linked to the fungal interactions with soil organic matter, producing high molecular weight organic acids that block active weathering sites.

Several lines of evidence suggest a biotic upwards transport of Al and Fe in podzols from the mineral soil into the litter layer. *In vitro* and microcosm experiments [2] reveal that ectomycorhizal do transport Al, and that external mycelium, extending from roots into the litter layer, take up Al from the mineral soil, up to the litter layer.

Polyvalent cations like Al^{3+} contribute to the formation of the organic supramolecule aggregates [3]. Release of these cations from the organic matter matrix by small molecular weight organic acids in the B horizon will mobilize organic matter, and could be the driving factor of E horizon development.

[1] Smits et al., 2014. *Plant and Soil* **385**: 217-228 [2] Smits et al. 2009. *SBB* **41**: 491-497 [3] Clarholm et al., 2015. *SBB* **84**: 168-176