Sustainable base cation supply and carbon allocation in boreal forests – the role of ectomycorrhizal fungi

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In boreal forest ecosystems, trees allocate photosynthetically derived C to symbiotic ectomycorrhizal fungi that mobilise N and P from organic substrates, as well as base cations and P from mineral substrates. We use field experiments and laboratory microcosms to investigate the functioning of these systems. High-throughput DNA sequencing and measurement of stable isotope signatures of C, N and Mg, suggest that distinct communities of bacteria and fungi exist in different mineral and organic substrates and that they are functionally specialised. Stable isotope probing of ^{13}C-RNA enables us to identify active microbial taxa with access to different pools of carbon, and nano-scale secondary ion mass spectrometry (NanoSIMS) is used to visualise spatial patterns of carbon sequestration in different substrates. Studies of the capacity of fungi to mobilise P & base cations from granite particles suggest some ectomycorrhizal fungi can accumulate significantly higher concentrations of Mg, K and P than non-mycorrhizal fungi. Mycorrhizal fungi fractionate Mg, discriminating against heavier isotopes and we found a significant, inverse relationship between δ^{26}Mg tissue signatures and mycelial concentration of Mg. Elevated δ^{26}Mg was found in B horizon soil solution in mesocosm experiments when organic matter was abundant, suggesting active uptake of ^{24}Mg by mycorrhizal mycelium when plant biomass was high, but this biological weathering alone was not enough to maintain plant growth when organic matter was less abundant and N became limiting.