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Selective microbial nitrogen-mining in subarctic soils depends on the stoichiometry of rhizosphere inputs

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Climate change will expose high-latitude systems to warming and a shift towards plant communities with more labile rhizosphere carbon (C) input. Labile C can increase the mineralisation of native soil organic matter (SOM); a phenomenon termed 'priming'. We used soils from climate change field treatments in the Subarctic to investigate how warming (+1.1˚C above ambient using open top chambers), as well as plant litter (simulating shrub expansion) and organic nitrogen (N; fungal sporocarps) addition (90 g m^{-2} y^{-1}) influenced the susceptibility of SOM mineralisation to priming, and its microbial underpinnings. Rhizosphere input was simulated by adding either glucose (labile C only) or alanine (labile C + N).

We hypothesised that glucose addition would induce greater mineralisation of N than C sourced from SOM ("N mining"); a response unrelated to microbial growth responses. Moreover, we expected that the N mining effect would be more pronounced in climate change simulation treatments of higher C/N (plant litter) than treatments with lower C/N (fungal sporocarps and warming), with the control treatment intermediate. We also hypothesised that addition of alanine (labile C + N) would not result in selective N mining, but instead preferential use of the added substrate, with reduced mineralisation of both C and N from SOM.

Labile C addition increased mineralisation of both C and N from SOM (positive priming), but mineralisation of N was stimulated more than C, suggesting that microbial SOM-use increased in magnitude and shifted to components richer in N. Contrary to expectation, addition of labile C + N also resulted in positive priming of both C and N mineralisation, with the N mineralisation stimulated by alanine addition greater than that stimulated by glucose addition, indicating strong N mining from SOM, even when a source of labile N was supplied. These priming responses occurred rapidly, and were unrelated to microbial successional dynamics, suggesting catabolic responses. Despite differences in the C/N of field experimental treatments, there was no clear effect of these treatments on the magnitude of N mining by microorganisms. Overall, these findings suggest that increased rhizosphere inputs in the Subarctic will result in increased microbial use of SOM, with selective mining for N-rich components.