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Fungal organic nitrogen assimilation and community assembly across a 100-year Arctic proglacial soil chronosequence

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The global trend of glacial melting and glacier retreat over the last century has exposed new land that develops into soil ecosystems over time. In the Arctic, where the rate of land exposure from glacial retreat is the highest, understanding the ecology of microbial communities can help to elucidate their role in nutrient cycling and their impact in ecosystems. Soil bacteria community assembly across glacial chronosequences have been relatively well studied, but the activity and community assembly of fungi in such systems are poorly understood by comparison. This study describes the development of fungal and bacterial communities, and their assimilation of organic nitrogen via DNA stable isotope probing (SIP) in relatively young Arctic proglacial soils (Midtre Lovénbreen, Svalbard) over a 100-year chronosequence. The abundance of fungi and bacteria are strongly correlated, and peak in soil with higher TOC and TON. Fungal and bacterial communities from the glacier ice and glacial snout are significantly different compared to deglaciated soils. For fungi, Microbotryomycetes dominates in supraglacial samples, while the fungal community in the youngest soil is dominated by Moniliellomycetes. The fungal community chronosequence is dominated by Leotiomycetes in soils up to 40 years, whereas Lichen fungi (Eurotiomycetes) are the most abundant group present in the chronosequence in soils >40 years old. Marine fungal communities from the coastline show a unique community structure compared to soil fungi. Additionally, DNA-SIP incubations with ^{13}C-labeled amino acids showed that organic nitrogen remineralization is highest when fungi dominate the assimilation of organic nitrogen over bacteria, which was most pronounced in the youngest proglacial soils directly in front of the glacier. This indicates a relatively high growth efficiency of fungal organic nitrogen at the beginning of soil development. To our knowledge, these are among the first data describing the activity and community assembly of fungi in a proglacial chronosequence in the Arctic. Our findings highlight the importance of fungi in these settings for the cycling of organic nitrogen and suggest that their relatively high growth efficiency in the earliest stages of soil development help to sequester carbon and nitrogen helping to promote soil development in these extreme settings.