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# Future Arctic soil nutrient availability and microbial community structure

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The Arctic permafrost soils are very diverse in regard to parent material, geobiological composition and genesis. There is sparse knowledge about nutrient availability in Arctic soil and it was found that the permafrost layer differs in nutrient availability compared to the active layer. Recently, it was shown that elements like Si, Ca and P are potentially affecting the greenhouse gas from Arctic soil. However, it is not known how those elements are distributed in Arctic soils for a larger dataset. Furthermore, it is unclear whether regional differences in the availability of those elements or a change in availability due to permafrost thaw is changing microbial decomposer community. Therefore, we analyzed 445 soil depth profiles around the Arctic regarding different element availabilities.

Furthermore, we conducted an incubation experiment to measure the effect of different Si, Ca and P availabilities on the structure of the microbial decomposer community. We found large differences in the availability of Si, Ca, Al, Fe and P in the layers of the panarctic permafrost soils from Canada, Alaska, Russia, Scandinavia, Greenland and Svalbard. There are differences in the distribution of Ca and Si pools over the panarctic permafrost soils. Especially the availability of P is directly linked to the concentration of Ca and Si and the presence of Al and Fe based minerals. With rising temperatures, the thaw depth of the upper horizon may increase and elements stored in deeper layers become potentially mobilized. These processes modify the nutrient availability for microorganisms and by this the production of greenhouse gases like $CO_2$ and $CH_4$.

The community structure of bacteria and fungi is related to the availability of Ca and Si. With modified availabilities of Si and Ca, we found direct linear correlations in the changes of the microbial structure at the phylum level for Greenlandic soils. These changes depend on the origin of the soil and the original availability of Ca and Si. We found direct links between the share of gram-positive bacteria and the Ca concentration in both soils and the production of greenhouse gases. The availabilities of these elements may be helpful for better predicting greenhouse gases fluxes in the Arctic as well as element transfer to marine systems.