Rapid establishment of the soil sink for atmospheric H_2 in young and oligotrophic glacier forefields

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In oligotrophic soil environments, surprisingly diverse and abundant microbial communities endure a multitude of environmental stresses by persisting, i. e., existing in dormant states. In these soils, trace gas scavenging of molecular hydrogen (H_2), carbon monoxide (CO), and methane (CH_4) offers dormant microorganisms the option to gather carbon and energy from the air. Thus, it is likely that these processes play a crucial role during microbial succession. However, little is known about the occurrence, extent, and distribution of trace gas scavenging in such environments. Glacier forefields are oligotrophic soils formed by progressive glacial retreat, thus, exhibit a continuum of soil age (chronosequence), and are ideal sites to study primary succession to understand the establishment of the soil sink for atmospheric trace gases.

During the snow-free season 2019 we investigated trace gas oxidation along the soil chronosequence (1 to ~150 year old soils) of the Griessfirn glacier in Switzerland. We measured soil-atmosphere trace-gas fluxes to assess *in-situ* rates of microbial trace gas oxidation, as well as depth-resolved soil-gas and –water content profiles down to 100 cm depth to derive trace-gas oxidation activity. Finally, topsoils and soils from different depths along the profile were collected to assess identity, structure and functional capacity of the microbial communities.

Initial results on trace-gas dynamics in glacier-forefield soils showed uptake of H_2 and CH_4 along the entire soil chronosequence, whereas trends of CO oxidation were possibly concealed by abiotic CO releasing processes. The H_2 soil sink was by far the strongest, with values two order of magnitude higher than CH_4. For both H_2 and CH_4 the soil sinks established rapidly, with their magnitudes increasing with soil age. Interestingly, whereas soil CH_4 uptake increased by a factor of 20, H_2 uptake increased 3-fold only, hinting towards a remarkably early and fast establishiment of the soil sink for atmospheric H_2. Trace-gas scavengers may thus overcome their energy and nutrient limitations by ‘living from air’, and therefore seem to be ideal first colonisers of newly formed soils.