Permafrost degradation and biogeochemical cycling in northern Alaska

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Abstract. Over the past three decades, mean annual temperature in the Arctic has risen 2.1ºC, with continuing and accelerating warming projected by multiple global climate change models. Arctic soils currently store twice as much carbon as the atmosphere; permafrost thaw could radically alter global C cycling and atmospheric concentrations of heat-trapping gases. To assess changes in biological and chemical reactivity induced by warming we collected permafrost cores from Sagwon Hills, Alaska and incubated them in the laboratory for three months at several temperatures and redox potentials. We found that CO_2 respiration rates were depressed, but did not completely cease under anoxic conditions and low temperatures, and increased with oxygen availability and temperature. Release of CH_4, a greenhouse gas twenty times more potent than CO_2, was highest several days after incubation, possibly resulting from soil-matrix degassing. Iron availability and potential extracellular enzyme activities did not show a distinguishable trend by site or treatment but may be explained by changes in carbon chemistry, which we will characterize using Fourier transform infrared spectroscopy (FTIR) and emission excitation matrices (EEMS). Resin-extractable inorganic phosphorus was below detection limit for all treatments and sites indicating low availability of labile P in permafrost. Our preliminary results indicate Arctic soils are vulnerable to chemical and biological transformation induced by warming, and could significantly impact global C cycling. Future plans include employing a proteomics approach to explore root-rhizosphere interactions at the hydrological-terrestrial interface, and detailed chemical analyses of organic carbon transported in pore water.