Organic Matter Composition and Decomposability of Ice-Wedge Polygon Soils on the Coastal Plain of Northern Alaskan

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The large stocks of soil organic carbon (SOC) in the northern permafrost region are sensitive to changes in global temperature and permafrost thawing. Furthermore, because the relative importance of SOC stabilization mechanisms operating in the permafrost region differ from those of other ecoregions, the composition and potential decomposability of soil organic matter (SOM) are key uncertainties in models projecting the amount of SOC that might be released from this region. In the search for indicators of decomposability that could be upscaled across the region, we have demonstrated that mid-infrared (MIR) spectroscopy is very sensitive to the degradation state of SOM and it is a good predictor of short-term carbon mineralization from tundra soils. In this study, we are expanding this work to explore the decomposability of a range of soil horizons at different depths in flat-, low-, and high-centered ice-wedge polygons formed on glaciomarine sediments (near Utqiaġvik, Alaska). The soils were incubated aerobically for over one year at two temperatures (15°C and 5°C), and CO_2 production was measured every 12 h for the first 2-3 months and every 3 weeks thereafter. Results to date indicate that excellent partial least square regression (PLSR) models of cumulative CO_2 production at 15°C expressed on a soil mass basis can be derived from the MIR spectra of bulk soil for intervals of 1 to 12 months incubation times. The PLSR models could also predict short-term CO_2 production on a SOC basis, and predictions were better when low carbon (<10%) and high carbon (>10%) soils were predicted separately. This suggests that the spectral relationship of MIR with CO_2 production in incubation studies reflects both the quantitative and qualitative properties of SOC. This experiment confirms the power of soil MIR spectra to predict C mineralization from Arctic soils. The ultimate goal of our research is to link estimates of SOM composition and potential decomposability with geo-referenced data characterizing soil properties and environmental conditions to create geospatial assessments and maps, which can serve as benchmarks for models at landscape, regional, and global scales.