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Does vegetation shift in Arctic tundra upon permafrost degradation influence mineral element recycling in the topsoil?

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Climate change affects the Arctic and Subarctic regions by exposing previously frozen permafrost to thaw, unlocking nutrients, changing hydrological processes, and boosting plant growth. As a result, Arctic tundra is subject to a shrub expansion, called “shrubification” at the expense of sedge species. Depending on intrinsic foliar properties of these plant species, changes in foliar fluxes with shrubification in the context of permafrost degradation may influence topsoil mineral element composition. Despite the potential implications for the fate of organic carbon in the topsoil, this remains poorly quantified. Here, we investigate vegetation foliar and topsoil mineral element composition (mineral elements that influence organic carbon decomposition: Si, K, Ca, P, Mn, Zn, Cu, Mo and V) from a typical Arctic tundra at Eight Mile Lake (Alaska, USA) across a natural gradient of permafrost degradation. Results show that foliar element concentrations are higher (up to 9 times; Si, K, Mo, and for some species Zn) or lower (up to 2 times; Ca, P, Mn, Cu, V, and for some species Zn) in sedge than in shrub species. This induces different foliar flux with permafrost degradation and shrubification. As a result, a vegetation shift over ~40 years from sedges to shrubs has resulted in lower topsoil concentrations in Si, K, Zn and Mo (respectively of 52, 24, 20 and 51%) in poorly degraded permafrost sites compared to highly degraded permafrost sites. For other mineral elements (Ca, P, Mn, Cu and V), the vegetation shift has not induced a marked change in topsoil concentrations at this stage of permafrost degradation. This observed change in topsoil composition involving beneficial or toxic elements for decomposers is likely to influence organic carbon decomposition. These data can serve as a first estimate to assess the influence of other shifts in vegetation in Arctic tundra such as sedge expansion with wildfires.