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The response of soil enzyme activity to seasonal and microtopographical variations in the sedge peatlands in Changbai Mountain, China

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Hummock-hollow microtopography is a common feature in northern peatlands. It creates microsites of variable hydrology, vegetation, and soil biogeochemistry, thus affect soil C cycling in peatlands at the local scale. This study investigated effects of microtopography on soil enzyme (β-1,4-glucosidase (βG), β-1,4-N-acetylglucosaminidase (NAG), acid phosphatase (AP) and peroxidase (PER)) activities and environment variables as well as their relationships in a typical sedge peatland in Changbai Mountain, northeast of China. Our results showed that the enzyme activities in the sedge peatland significantly varied across seasons and microtopographical positions. Soil enzyme activities in hummocks exhibited more obvious seasonal variation than hollows, with the βG, AP and PER activities presented a distinct valley in summer and the maximum values occurred in Spring or Autumn. Soil hydrolase (βG, NAG and AP) activities in hummocks were significantly higher compared to hollows, while soil oxidase (PER enzyme) activity in hollows was higher than hummocks. The NMDS analysis revealed that the influence degree of microtopography on the enzyme activities was higher than that of seasonal variation. Redundancy analysis (RDA) indicated that the variations of soil enzyme activities in the peatland were related to environmental variables, especially to water table depth (WTD), soil temperature (ST), SOC, N availability and P availability. Furthermore, correlation analysis showed that the three hydrolase (BG, NAG and AP) activities were positively correlated with soil TN, SOC and C/N, and negatively correlated with WTD and TP. On the contrast, the PER activities were positively correlated with TP, and negatively correlated with ST, SOC and C/N. The present study demonstrated that small scale topographic heterogeneity created by hummock cause habitat
heterogeneity and thus lead to significant difference of soil enzyme activity between hummock and hollow in the sedge peatlands. This finding provides further evidence of the importance of peatland microtopography to C cycling and has direct implications for scaling biogeochemical processes to the ecosystem level.