Elevational variability and controls on temperature sensitivity of soil organic matter decomposition in alpine forests of northwestern China

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Abstract

Patterns and elevational controls on the response of soil organic matter (SOM) decomposition to temperature in alpine forest soils are critical to efforts to quantify the regional carbon cycle-climate feedback, but are not well known. Here, we report rates of soil organic matter (SOM) decomposition (Rs) and temperature sensitivity (Q10) determined in a short-term laboratory incubation with a gradual warming from 5°C to 29°C of soils from different elevations in the Qilian Mountains, China (2,600, 2,800, 3,000, and 3,200 m). The results showed the Rs significantly increased with increasing elevation ($P<0.001$). Across all elevations, RS first showed an increasing trend at temperatures < 20 and then declined substantially, most likely in response to the content of labile C (greater at the start of incubation, and declining over time). Q10 of SOM decomposition increased significantly with increasing elevation and deceasing incubation temperature ($P<0.001$). More importantly, soil organic carbon (SOC), total nitrogen (TN), 1-2 mm aggregate-associated OC, and elevation were the main control factors affecting Rs and Q10. These results indicate that high-altitude soils in alpine forests of the Qilian Mountains are relatively more sensitive to temperature changes, and have greater potential to release CO2 due to higher SOC contents and 1-2 mm aggregates-associated OC than low-altitude. The findings could serve as a reference for how regional C pools may respond to future warming in alpine forests of the Qilian Mountains.

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