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Nitrogen deposition has contrasting effects on particulate and mineral associated soil organic carbon in a subtropical evergreen broadleaf forest

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The increasing atmospheric Nitrogen (N) deposition has substantially impacted carbon (C) and nutrient cycling in forest ecosystems. However, the responses of different soil organic carbon (SOC) fractions with different turnover rates to N addition are highly divergent, and the underlying mechanisms remain elusive. In this study, we explored the responses of surface soil (0-10 cm, Ultisols) characteristics and microbial communities to seven years of experimental N addition (0, 50, 100 and 150 kg N ha-1 yr-1) in a subtropical evergreen broadleaf forest (dominated by Castanopsis carlesii) in southern China.

Our results showed that N addition led to significant soil acidification (pH from 5.3 to 4.9). Total microbial abundance (PLFA) and bacteria were reduced by the highest levels of N addition, fungi and AMF abundance were suppressed by all levels of N addition, but extracellular enzymes involved in C, N and P cycling were not responsive to N addition. Soil exchangeable Ca2+ concentration was significantly depleted by N addition, while other exchangeable cations (Fe3+, Al3+, Mg2+, K+, Na+) were not affected. Moreover, N addition did not significantly change C and N concentration of bulk soils, but it reduced the C:N ratio. We further separated the bulk soil into particulate organic matter (>53 μm, POM) and mineral-associated organic matter (<53 μm, MAOM) fractions by wet sieving. Interestingly, carbon in the POM fraction was significantly increased by N addition, while carbon in the MAOM fraction was depleted by N addition. The structural equation modeling (SEM) results suggest that N addition may suppress microbial decomposition of plant inputs and thus lead to accumulation of carbon in the POM fraction, while it may also reduce the mineral sorption of microbial necromass and cause depletion of carbon in the MAOM fraction. Overall, these results highlight the interaction of microbial physiology and geochemical properties in controlling the dynamics of different soil organic matter fractions in response to N deposition.