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Effects of forest conversion on carbon-degrading enzyme activities in subtropical China

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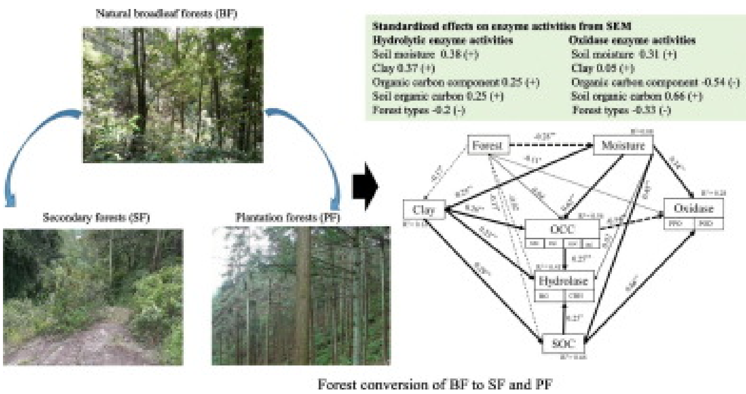
Highlights

- Soil hydrolase and oxidase activities decreased, while specific enzyme activities increased with forest conversion.
- Soil hydrolase activity was positively associated with soil potassium permanganate oxidizable carbon and microbial biomass carbon concentrations.
- Soil oxidase activity was positively associated with recalcitrant carbon and mineral associated organic carbon and microbial biomass carbon concentrations.
- Both soil hydrolase and oxidase activities were negatively associated with carbon: nitrogen ratio, and positively associated with clay content and moisture content.

Abstract

The mineralization of soil organic carbon (SOC) is primarily mediated by carbon (C) degrading enzyme. In the current study, we determined how the activities of four soil C-degrading enzymes, the hydrolases β-glucosidase (BG) and cellobiohydrolase (CBH) and the oxidases polyphenol oxidase (PPO) and peroxidase (POD), responded to forest conversion of natural broadleaf forests (BF) to secondary forests (SF) and plantation forests (PF) in subtropical China. We also quantified SOC, dissolved organic C (DOC), permanganate oxidase organic C (PXC), recalcitrant C (RC), microbial biomass C (MBC), mineral-associated C (MOC), soil particle-sizes distribution, pH, and moisture content, and C: nitrogen (N) ratio. Results showed that, the activities of all four C-degrading enzymes (BG, CBH, PPO and POD) decreased by 23.1, 9.5, 6.9 and 1.8%, respectively by forest conversion of BF to SF and 30.5, 15.3, 28.1 and 27.8%, respectively by conversion of BF to PF and were higher in the topsoil than in the subsoil. Relative to SF and PF, BF had higher hydrolase activities, which were related to its higher concentrations of MBC, DOC, and PXC, and to its lower C:N ratio. The BF also had higher oxidase activities, which were related to its higher concentrations of MBC, RC, and MOC, and to its lower C:N ratio. PF had higher specific enzyme activities (i.e., enzyme activities per unit of SOC) than BF and SF, indicating faster C turnover rates in PF. In addition to being affected by the concentrations of SOC and SOC components, forest conversion-induced changes in soil enzyme activities were affected by clay content and soil moisture content. These results revealed the different underlying mechanisms between soil hydrolases and oxidases in their responses to forest conversion.

Graphical abstract



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Keywords

Forest conversion; Hydrolase; Oxidase; SOC components; Soil properties

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