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# Soil organic matter dynamics during vegetation restoration in nutrient-limited karst ecosystems in southwest China

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The biological functions of soils in fragile, nutrient-limited karst ecosystems that cover large areas of southwest China are vulnerable to degradation by intensive agriculture. Understanding the activity of soil microorganisms during managed abandonment of agriculture in the region is key to rating the potential to rejuvenate degraded karst landscapes. Soil organic carbon (SOC) accumulation is a critical ecosystem service that is mediated by soil microorganisms, whose role can be measured through the activity of extracellular enzymes that decompose and transform soil organic matter (SOM) as they forage for nutrients (e.g. N and P) and energy. The size of the soil microbial biomass and its community composition are directly related to the quantity, quality and availability of SOM, and this can be measured directly using established biomarker compounds (phospholipid fatty acids, PLFA, and amino sugars).

In this study, we explored the relationship between abandonment of previous agricultural land along a restoration gradient using a space-for-time chronosequence (SC: sloping cropland < AC: abandoned cropland < SL: shrub land < SF: secondary forest < PL: primary forest) in the new Chenqi Critical Zone Observatory in Guizhou province, and SOM dynamics using direct measurement of SOC and dissolved organic carbon (DOC), macronutrients N and P, and extracellular enzyme activity (BG: $\beta$-1,4-glucosidase, NAG: $\beta$-1,4-N-acetyl glucosaminidase, APA: Acid or Alkaline Phosphatase), PLFA (total, and specific biomarkers for fungal and bacterial groups, after Frostegard & Baath, 1996) and amino sugars (specific for fungal and bacterial residues, after Zhang & Amelung, 1996) in 0-10 and 10 – 30 cm depths from soils sampled along the restoration gradient.

Results showed that SOC contents were significantly correlated with soil enzyme activities, and that total SOC, DOC and N (TN, AN) were positively correlated with the concentration of total PLFAs ($P < 0.05$) that was significantly increased in soils of shrub lands, secondary and primary forests compared to sloping and abandoned croplands. Ratios of fungal:bacterial (F:B) and Gram positive bacteria:Gram positive bacteria PLFA biomarkers were greater in the abandoned croplands than the shrub lands, secondary and primary forests in 0-10 cm soil layer. Total and fungal amino sugars (glucosamine, mannosamine, galactosamine, muramic acid) decreased from shrub land > secondary forest > primary forest soils, while the bacterial residues were increased in the secondary forest and shrub land soils compared to the abandoned croplands and primary forests. The results from the analysis of microbial activity in soil samples from 10-30 cm depth did not have a strong relationship with restoration stage suggesting other factors control biological function in deeper karst soils. However, overall this study indicates that vegetation restoration can improve SOC and soil nutrient status which can be used to inform management and recovery of degraded karst landscapes.