# Molecular (proxy) estimates of changes in soil organic matter stability with changes in atmospheric $CO_2$ concentrations

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Global soil C stocks ($2 \times 10^{18}$ gC) are large enough that minor climate-induced changes in the size of the soil C pool would constitute a major climate feedback.. The mechanisms for differences soil C cycle response to climate change are not well understood. To address this, we examined organic carbon (SOC) stocks at the USDA $CO_2$ gradient facility (in Temple, TX) and the Oak Ridge Free Air $CO_2$ enrichment (FACE) site. The ecosystems include tallgrass prairie and hardwood forest, and soils types include 4 soil orders (Mollisol, Alfisol, Vertisol, and Ultisol). Atmospheric [$CO_2$] range from 270 to 480 ppm in the grassland and [$CO_2$] was enriched to 550 ppm in the hardwood forest. Temperature and precipitation were not manipulated . In addition to measuring C stocks, we to we use $^{13}C$ nuclear magnetic resonance to study the chemical structure and composition of SOC. Molecular proxies such as lignin/nitrogen ratio and alkyl/O-alkyl ratio were used to assess changes in the relative stability and extent of decomposition of SOC at different atmospheric [$CO_2$]. Early results suggest that [CO2]-induced changes in the organic chemistry of SOC suggest that soil genetic factors could play an important role in the soil C storage potential under different climate regimes. Understanding the molecular basis for carbon preservation mechanisms in distinct soil orders could inform efforts to model C cycle-climate feedbacks of the geologic past and the near future.