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SOC stabilization mechanisms and temperature sensitivity in old terraced soils

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Being the most common and widest spread man-made landform, terrace construction has resulted in an extensive perturbation of the land surface. Our mechanistic understanding of the underlying soil organic carbon (SOC) (de-)stabilization mechanisms and of the persistence of SOC stored in terraced soils, however, is far from complete. Here we explored the factors controlling SOC stability and temperature sensitivity (Q_{10}) of heterotrophic soil respiration of abandoned prehistoric agricultural terrace soils in NE England. For this we combined soil fractionation and temperature sensitive incubation experiments under idealized, well-aerated topsoil conditions with measurements of terrace soil burial age. Results showed that a substantial part of the SOC stock in these terraced soils (43.5± 5.5%) was found in buried horizons. A significantly lower soil potential respiration was observed for buried terrace soils, relative to a control (non-terraced) profile. This suggests that the burial of soils is an important mechanism to slow down the decomposition of SOC in terraced soils. Furthermore, we observed a shift in the SOC pool composition from particulate organic C to mineral carbon mineral protected C with increasing burial age creating energetic barriers for microorganisms to overcome. This clear shift to more processed recalcitrant SOC with terrace soil burial age also contributes to SOC stability in terraced soils. Temperature sensitivity incubations revealed that as terraced and buried soil becomes older, lower C quality in buried horizons leads to an increase in temperature sensitivity of SOC. In conclusion, terracing in our study site has stabilized SOC as a result of soil burial during terrace construction with evolution to a more biologically processed SOC pool with increasing terrace soil burial age. These depth-age patterns of Q_{10} and SOC pool composition of terraced soils should be considered when assessing the effects of climate warming or terrace abandonment/removal on

the terrestrial C cycle