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Insights into soil carbon dynamics across nine dryland sites in North America

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Drylands constitute one of the largest terrestrial biomes on Earth, covering over 40% of the land surface. Considering the large area, dryland soils store a third of the global shallow soil organic carbon (SOC) pool. However, restricted vegetation quantity in addition to high temperatures, low soil moisture, and deficient microbial activity produce conditions more conducive to soil inorganic carbon (SIC) accumulation in these regions accounting for around 80% of the global SIC stock. Despite the importance of dryland carbon, few studies have examined soil organic matter (SOM) composition relative to SIC accretion and vegetation input. In this study, we compare SOC and SIC stocks in addition to characterizing SOM bulk molecular quality and SIC isotopic compositions in nine distinct dryland ecosystems with various combinations of climate and dominant vegetation types. Using samples from the National Ecological Observatory Network (NEON) Megapit soil archive, nine sites each with discrete soil subhorizons were utilized to identify differences within and between dryland types. Quantifying SIC and SOC stocks using elemental analysis provided insight into where carbon is stored and vertically dispersed in dryland ecosystems. Additionally, potential relationships between SIC and SOC storage are examined through molecular and carbon stable isotope analyses. Establishing SOM quality via 13C NMR spectroscopy in various drylands provides a key understanding of the relative long-term fate of organic matter in these ecosystems. Using isotopic fractionation principles, the amount of SIC and the proposed carbon sources were identified to understand additional organic matter turnover and storage as inorganic carbonate. Ultimately, this study aims to provide data necessary for understanding potential carbon cycle feedbacks to the expansion of drylands.