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Temperature exerts no influence on carbon isotope ratios in soil along the 400 mm isopleth of mean annual precipitation in China

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Soil organic carbon is the largest pool of carbon in the terrestrial ecosystem, and its isotopic composition is affected by a number of factors. However, the influence of environmental factors, especially temperature, on soil organic carbon isotope values is poorly constrained. This impedes the application of the variability of organic carbon isotopes to reconstructions of paleoclimate, paleoecology, and global carbon cycling. Given the considerable temperature gradient along the 400 mm isohyet (isopleth of mean annual precipitation – MAP) in China, this isohyet provides ideal experimental sites for studying the influence of temperature on soil organic carbon isotopes. In this study, the effect of temperature on surface soil carbon isotope composition was assessed by a comprehensive investigation of 27 sites across a temperature gradient along the isohyet. Results demonstrate that temperature does not play a role in soil carbon isotope. This suggests that organic carbon isotopes in sediments cannot be used for paleotemperature reconstruction and that the effect of temperature on organic carbon isotopes can be neglected in the reconstruction of paleoclimate and paleovegetation. Multiple regressions with MAT (mean annual temperature), MAP, altitude, latitude, and longitude as independent variables and soil carbon isotope as the dependent variable show that these five environmental factors together account for only 9% of soil carbon isotope variance. However, one-way ANOVA analyses suggest that soil type and vegetation type are significant factors influencing soil carbon isotope. Multiple regressions, in which the five aforementioned environmental factors were taken as quantitative variables, and vegetation type, soil type based on the Chinese Soil Taxonomy, and World Reference Base (WRB) soil type were separately used as dummy variables, show that 36.2, 37.4, and 29.7%, respectively, of the variability in soil carbon isotope are explained. Compared to the multiple regressions in which only quantitative environmental variables were introduced, the multiple regressions in which soil and vegetation were also introduced explain more of the isotopic variance, suggesting that soil type and vegetation type exert a significant influence on soil carbon isotope.