Fingerprinting Soil Water Evaporation with Triple Oxygen Isotopes of Pedogenic Carbonates

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The oxygen isotope composition of soil carbonates ($\delta^{18}O$) is widely used to investigate terrestrial paleoclimates. The underlying assumption is that the $\delta^{18}O$ value of soil carbonates reflects the $\delta^{18}O$ value of meteoric waters. This assumption is violated if soil carbonates form in soil waters that have been evaporatively enriched in heavy isotopes. In theory, the triple oxygen isotope composition (^{16}O- ^{17}O-^{18}O) of pedogenic carbonates can be used to identify evaporation in soil water: kinetic evaporation will cause the relationship between $\delta^{17}O$ and $\delta^{18}O$ to deviate from that defined by the global meteoric water line. Here, we present $\Delta^{17}O$ values of recent soil carbonates from a range of climatic settings, with the goal of identifying the relationship between local aridity and the extent of evaporation in the soil waters from which carbonates accumulate. Preliminary $\Delta^{17}O$ values of soil carbonates (as CO_2 from 90 °C acid digestion) range from -0.100 to -0.180 ‰. The highest $\Delta^{17}O$ values are consistent with soil waters with minimal evaporative-enrichment of heavy isotopes, perhaps resulting from soil carbonate precipitation related to non-evaporative processes (e.g., dewatering by plant-root uptake or changes in temperature or soil pCO_2). The lowest $\Delta^{17}O$ values indicate extensive evaporation of soil waters and are only observed in arid climates. These results suggest that $\Delta^{17}O$ in soil carbonates will be useful in identifying and correcting for evaporative modification of $\delta^{18}O$ values. In the modern environment, $\Delta^{17}O$ promises to further our understanding of the timing and mechanisms of soil carbonate formation.