Co-analysis of $\delta^{18}O$ values of cellulose and carbonate from lake sediments: A new indicator for temperature reconstruction?

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Stable oxygen isotope composition of cellulose and carbonate from lake sediments have been commonly applied to deduce the evaporation/precipitation balance in arid and semi-arid region, although the paleotemperature equation have been well empirically eatablished by numerous researchers. Due to the complex of $\delta^{18}O$ values of lake water, the temperature reconstruction by combination with $\delta^{18}O$ values of lake water and carbonate is not feasible, especially at low latitude, where the amount of precipitation is the dominant factor to control $\delta^{18}O_{precipitation}$. However, $\delta^{18}O$ values of organic matter cellulose gave a direct insight into variations of $\delta^{18}O$ values of lake water in the past. Co-analysis of $\delta^{18}O$ values of cellulose and carbonate may be, therefore, a promising indicator as temperature variations. Here, we quantitatively reconstructed $\delta^{18}O$ values of lake water on the basis of $\delta^{18}O$ values of cellulose. According to $\delta^{18}O$ values of cellulose and carbonate, temperature variations series have been established during the past 500 years at Lake Caohai, southwest China. The result showed that there were four obvious coldest intervals at Lake Caohai during the past 500 years, namely 1550-1610AD, 1670-1730AD, 1770-1870AD and 1890-1920AD coldest periods. The former three coldest intervals were observed during the Little Ice Age. Furthermore, the reconstructed temperature seires is well synchronous with the North Hemisphere temperature variations. Such a relationship suggests that co-analysis of $\delta^{18}O$ values of cellulose and carbonate is the effective approach for temperature variations reconstruction, and may play an important role in reconstructing past temperature variations at low latitude, thus also providing the evidence of the existence of Little Ice Age in southwest China.

Organic matter preservation due to pore-scale interactions between organic matter and water in soil microaggregates

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This study focuses on the influence of pore-filling OM on the hysteretic soil water characteristic, which has been largely ignored in previous studies on water-OM relations. The main drying and wetting branches of the water retention curve were measured using a water activity meter on water-stable microaggregates (53-250 mm), which were collected from surface soils (0-15 cm) subject to different management practices: tallgrass prairie restoration on a Mollisol and tillage with and without nitrogen fertilization on an Alfisol. By taking advantage of differences in x-ray scattering contrast between soil minerals, organic matter (OM), and air, which were measured using ultra-small angle x-ray scattering (USAXS) before and after combustion of microaggregates at 350°C, we evaluated the distribution of the total- and OM-filled porosity within microaggregates. Results show that the OM preservation arose from the evolution of the architectural system of microaggregates during their formation and stabilization. Land-use options (conversion of soils from long-term cultivation to perennial vegetation through restoration of native tallgrass prairie) and agricultural treatments (conventional tillage versus no-till at two levels of N inputs) with increasing OM in microaggregates were associated with encapsulation of colloidal OM by minerals, that creating protected OM-filled pores at the submicron scale within the microaggregate structure. Our water retention measurements show that the OM encapsulation in <5 μm diameter pores increases water retention in microaggregates, while management practices that either increased or decreased the abundance of OM-filled pore volume in the microaggregates promoted hysteresis of water retention characteristics due to changes in soil pore structure.