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A new perspective to characterize different component of organic carbon in the sediment using stepped-combustion method

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Organic carbon (OC) in the sediment plays an important role in the global carbon cycle. Generally, we use the radioactive ^{14}C age to evaluate the carbon pool and further explain whether the carbon pool is active or inert. However, this evaluation is not comprehensive, since the old pool is not equal to the inert one. Here, we take a new technique called stepped-combustion to assess the activity and inertia of sediment carbon pool, combined it with radiocarbon ($\delta^{14}C$) isotopic analyses. Stepped-combustion directly reveals the energy of chemical bonds in the organic matter. With the increase of temperature, the amount of OC sharply declines and its ^{14}C age greatly becomes old. So we divided the OC in the sediment into two members to represent active and inert carbon respectively: low-temperature component elute at 0-400°C (LTC) and high-temperature component(elute at 400-950°C) (HTC). In the TJA loess, we find that sediments from the surrounding tableland have old ^{14}C ages. But when these sediments are redeposited in the hole after secondary transportation, their LTC ^{14}C ages become abnormally young, often a few hundred years, while the HTC ^{14}C ages remain old values. This shows that after biological transformation, farming and leaching, the LTC can be sufficiently exchanged and washed, but the HTC are still well retained in the sediments. Further research shows climate may have an impact on the storage of carbon. In the XEBLK loess, we discover that the ^{14}C age of coarse particle size is older during the dry and cold time, and the inert carbon components increase. However, in the warm and wet period, the ^{14}C age of fine particles is younger, and the inert carbon usually decreases and even disappears. Although the mechanism is still unclear, coordination between particle size and HTC magnitude indicates that OC in the sediment responds to climate change to some extent. In all, our work may help to understand the transformation and preservation of organic matter in sediments and its response to climate. It may provide a new perspective for the study of the carbon cycle in sediments in the geological period.