

The isotopic characteristics and estimation of carbon sink in soil profiles on carbonate rocks in Guizhou Province

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To understand the roles of carbonate rocks in carbon cycle, four carbonate profiles and two silicate profiles in Guizhou Province were selected. The carbon and oxygen isotope in the profiles was also studied and related to the local climate. The $\delta^{13}\text{C}$ values of soil organic matter ($\delta^{13}\text{C}_{\text{SOM}}$) reflect a coexistence of C_3 and C_4 plants. The soil SEM observation and the $\delta^{13}\text{C}$ value of soil disseminated carbonate ($\delta^{13}\text{C}_{\text{SC}}$) demonstrate that the soil carbonate is dominant by pedogenic carbonate, and its formation is closely associated with root activities. The estimated $\delta^{13}\text{C}$ value of pedogenic carbonate ($\delta^{13}\text{C}_{\text{PC}}$) based on $\delta^{13}\text{C}_{\text{SOM}}$ is higher than $\delta^{13}\text{C}_{\text{SC}}$, suggests that the C_3 plant take a larger percent when carbonate precipitated. The different climate conditions in the west compared with that in the middle of Guizhou Province are shorter rainy season, less rainfall, more nonuniform precipitation and lower temperature, which resulted in a higher stable carbon and oxygen isotopic value of soil carbonate ($\delta^{13}\text{C}_{\text{SC}}$ and $\delta^{18}\text{O}_{\text{SC}}$) and higher positive correlation coefficients of them in the west in carbonate profiles. This paper also found a negative correlation between $\delta^{13}\text{C}_{\text{SC}}$ and CIA (chemical index of alteration), which is related to the formation process of pedogenic carbonate. It demonstrates that $\delta^{13}\text{C}_{\text{SC}}$ can be an index that indicates weathering intensity, but it's also affected by other factors besides weathering. The radioactive carbon isotopes of the soil organic matter show that the average residence time of organic matter increase with soil depth, and the CO_2 flux produced by decomposition of soil organic matter is higher in the upper layer than in the deeper layer, reflecting the formation and update of soil organic matter during the top-down development process of soil profiles. At the site affected by the artificial cultivation of crops, surface soil organic matter update sooner, so the CO_2 flux is much greater than other sites. Compared with forest soils, the soils in the study area have longer carbon storage time.