Does pCO_2 affect carbon isotope discrimination on evolutionary timescales?

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Annual tree-ring datasets and growth chamber experiments suggest that the concentration of carbon dioxide in the atmosphere (pCO_2) have an important effect on the carbon isotope fractionation between plant tissue and the atmosphere ($\Delta^{13}C$). This effect has been identified in Quaternary-aged speleothems and bulk organic matter and within carbon isotope excursion events such as the Paleocene-Eocene Thermal Maximum. Identification of this effect, however, on longer timescales has proven difficult. In order to test whether changes in pCO_2 affect carbon isotope discrimination over evolutionary timescales, we compiled >2000 $\delta^{13}C$ values measured on plant tissues, bulk organic matter, and specific organic compounds (e.g., *n*-alkanes and *n*-alkanoic acids) spanning the last 65 million years. We derive $\Delta^{13}C$ using the Cenozoic atmospheric $\delta^{13}C$ values and our compiled dataset, and show that $\Delta^{13}C$ follows pattern of pCO_2 based on several other proxies. This is consistent with the fundamental photorespiration effect on $\Delta^{13}C$ observed in field experiments and growth chambers. Therefore, we reconstruct pCO_2 for the last 65 million years using the new C_3 plant pCO_2 proxy approach and assess the uncertainties using Monte Carlo error propagation. The data suggest elevated pCO_2 during the early Eocene climate optimum (~52-50 Ma) and the Miocene Climate Optimum (~17-15 Ma), and a decline in pCO_2 from early Pliocene into the onset of Pleistocene glacial-interglacial cycles (5-1 Ma). The reconstruction also resolves the pCO_2 oscillation between ~150 and 300 ppmv during the late Pleistocene (1 – 0 Ma), consistent with the icecore pCO_2 records. These results suggest the need to account for the underlying effect of pCO_2 when intereting $\Delta^{13}C$ across evolutionary timescales.