Reconstruction of paleo-\(p\)CO\(_2\) based on carbon isotopic discrimination during photosynthesis

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The net carbon isotopic discrimination (\(\Delta\delta^{13}C\)) determined between plant tissue (\(\delta^{13}C_{\text{plant}}\)) and atmospheric CO\(_2\) (\(\delta^{13}C_{\text{CO2}}\)) has long been used to reconstruct changes in plant community composition and climate. However, recent observations have revealed the dependency of \(\delta^{13}C_{\text{plant}}\) upon changes in atmospheric carbon dioxide concentration, which opens up the possibility of a new proxy. We will describe the potential for reconstructing ancient atmospheric CO\(_2\) concentrations based on the observed relationship between \(p\)CO\(_2\) level and \(\Delta\delta^{13}C\) quantified across a wide range of Geologically relevant \(p\)CO\(_2\) levels and a diverse assemblage of C\(_3\) plants. We first will compare reconstructed \(p\)CO\(_2\) levels determined from applying this method to published \(\delta^{13}C_{\text{plant}}\) measurements of fossil leaves (\(n = 144\)), bulk terrestrial organic matter (\(n = 323\)), and \(n\)-alkanes (\(n = 123\)) to \(p\)CO\(_2\) levels determined from ice core records through the last 30,000 years. More speculatively, we then provide an atmospheric \(p\)CO\(_2\) reconstruction for the entire Cenozoic based on >800 \(\delta^{13}C_{\text{plant}}\) measurements compiled from the literature, and discuss limitations associated with changing species distributions as well as changing water availability.