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Reconstruction of paleo-pCO_2 based on carbon isotopic discrimination during photosynthesis

A. Hope Jahren[1] and Brian A. Schubert[2]

[1]University of Hawaii, SOEST, Honolulu, HI 96822, USA
[2]University of Louisiana at Lafayette, School of Geosciences, Lafayette, LA 70504, USA

The net carbon isotopic discrimination ($\Delta\delta^{13}C$) determined between plant tissue ($\delta^{13}C_{plant}$) and atmospheric CO_2 ($\delta^{13}C_{CO2}$) has long been used to reconstruct changes in plant community composition and climate. However, recent observations have revealed the dependency of $\delta^{13}C_{plant}$ 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 pCO_2 level and $\Delta\delta^{13}C$ quantified across a wide range of Geologically relevant pCO_2 levels and a diverse assemblage of C_3 plants. We first will compare reconstructed pCO_2 levels determined from applying this method to published $\delta^{13}C_{plant}$ measurements of fossil leaves (n = 144), bulk terrestrial organic matter (n = 323), and n-alkanes (n = 123) to pCO_2 levels determined from ice core records through the last 30,000 years. More speculatively, we then provide an atmospheric pCO_2 reconstruction for the entire Cenozoic based on >800 $\delta^{13}C_{plant}$ measurements compiled from the literature, and discuss limitations associated with changing species distributions as well as changing water availability.