A reconstruction of atmospheric CO_2 across the Neogene using C_3 plant remains

YING CUI[1], BRIAN A. SCHUBERT[2], A. HOPE JAHREN[3]

[1]Department of Earth and Environmental Studies, Montclair State University, Montclair, NJ 07043 USA
[2]School of Geosciences, University of Louisiana at Lafayette, Lafayette, LA 70504 USA
[3]Center for Earth Evolution and Dynamics, University of Oslo, N-0315, Oslo, Norway

Knowledge of atmospheric carbon dioxide concentration (pCO_2) is important to understanding Earth system climate sensitivity, which has important climate policy implications. Here we report a new, high-resolution reconstruction of pCO_2 across the last 23 Ma based on the carbon isotope ($\delta^{13}C_p$) value of C_3 land plants. This approach has been applied to short intervals of the Cenozoic, but has not yet been applied across the entirety of the Neogene and Quaternary. The last 23 Ma represents an ideal time period to apply this proxy because it contains abundant remains of C_3 land plants, is well covered by other proxies, and is characterized by consistent and relatively low pCO_2, for which the proxy is most precise. The levels of pCO_2 determined here match well with previous estimates for the Neogene, consistent with an underlying effect of pCO_2 on $\delta^{13}C_p$ value across the geologic record. The effect of water availability on $\delta^{13}C$ value, which is independent of the effect of pCO_2 on $\delta^{13}C_p$, is manifest by the distribution of $\delta^{13}C_p$ values for any given point in time. Given the large abundance of terrestrial organic matter preserved in the fossil record and strong agreement with existing proxies, we suggest C_3 plant remains as an ideal substrate for reconstructing pCO_2 within the fossil record.