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Do soil micro-organisms influence the oxygen isotope composition of atmospheric CO₂?

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Terrestrial ecosystem processes, such as photosynthesis and respiration play a role in shaping the oxygen isotope composition of CO₂ in the atmosphere ($\delta^{18}\text{O}_a$) (Francey & Tans, 1987; Farquhar *et al.*, 1993). However, global models incorporating these two large and opposing gross fluxes currently fail to capture the seasonal phasing of $\delta^{18}\text{O}_a$ (Ciais *et al.*, 1997; Peylin *et al.*, 1999; Cuntz *et al.*, 2003). Soil dwelling organisms may have a large influence on $\delta^{18}\text{O}_a$. This is because the enzyme carbonic anhydrase (CA) accelerates the isotopic exchange of oxygen atoms between CO₂ and soil water, thereby amplifying the contributions of "atmospheric CO₂ invasion" to the oxygen isotope composition of the net soil CO₂ flux ($\delta^{18}\text{O}_R$). This influence of soil microbial physiology on $\delta^{18}\text{O}_a$ has been largely ignored because of conflicting findings within the literature. Here, using several datasets containing $\delta^{18}\text{O}_R$ measured in soil chambers and depth-resolved profiles of soil water oxygen isotope composition ($\delta^{18}\text{O}_{sw}$) from a range of different ecosystems, we show that accelerated isotopic exchange may be a general phenomenon. As the oxygen isotope signals of soil CO₂ exchange are thought to have a larger influence on the spatial and intra-annual variability of $\delta^{18}\text{O}_a$ than biosphere photosynthesis (Ciais *et al.*, 1997) the influence of microbial carbonic anhydrase activity should be examined in future simulations of $\delta^{18}\text{O}_a$ at the global scale.

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