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

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Do soil micro-organisms influence the oxygen isotope composition of atmospheric CO_2?

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Terrestrial ecosystem processes, such as photosynthesis and respiration play a role in shaping the oxygen isotope composition of CO_2 in the atmosphere ($\delta^{18}O_a$) (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 $\delta^{18}O_a$ (Ciais *et al*., 1997; Peylin *et al.,* 1999; Cuntz *et al*., 2003). Soil dwelling organisms may have a large influence on $\delta^{18}O_a$. This is because the enzyme carbonic anhydrase (CA) accelerates the isotopic exchange of oxygen atoms between CO_2 and soil water, thereby amplifying the contributions of "atmospheric CO_2 invasion" to the oxygen isotope composition of the net soil CO_2 flux ($\delta^{18}O_R$). This influence of soil microbial physiology on $\delta^{18}O_a$ has been largely ignored because of conflicting findings within the literature. Here, using several datasets containing $\delta^{18}O_R$ measured in soil chambers and depth-resolved profiles of soil water oxygen isotope composition ($\delta^{18}O_{sw}$) from a range of different ecosystems, we show that accelerated isotopic exchange may be a general phenomenon. As the oxygen isotope signals of soil CO_2 exchange are thought to have a larger influence on the spatial and intra-annual variability of $\delta^{18}O_a$ than biosphere photosynthesis (Ciais *et al*., 1997) the influence of microbial carbonic anhydrase activity should be examined in future simulations of $\delta^{18}O_a$ at the global scale.

References

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