$\delta^{13}C$ in plants grown across the pCO_2 levels of the Cenozoic (RCO_2=1−5×)

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We proposed that the $\delta^{13}CO_2$ can be calculated from the $\delta^{13}C$ of terrestrial land plants ($\delta^{13}C_{PLANT}$) based on the strong linear correlation between $\delta^{13}CO_2$ and C3-$\delta^{13}C_{PLANT}$ values [r^2=0.91; 519 measurements on 176 species; 1]. This led us to ask whether plants grown across a large range in pCO_2 levels show a significant, linear relationship between $\delta^{13}CO_2$ and $\delta^{13}C_{PLANT}$ values. In pursuit, we grew *Raphanus sativus* L. (common radish) under pCO_2 levels ranging from that of today's atmosphere (389 ppm) to ~5× that of today (1791 ppm). During the 47-day experiments, plants were supplied with excess water, nitrogen, phosphorous and other nutrients. The $\delta^{13}C_{PLANT}$ value was determined; and the $\delta^{13}CO_2$ value of each experiment was monitored. Across a range in pCO_2 that captures all estimates for the Cenozoic, the $\delta^{13}C_{PLANT}$ of biomass increased with chamber $\delta^{13}CO_2$ along a 1:1 slope [r^2=0.99; *n*=264; figure 1].

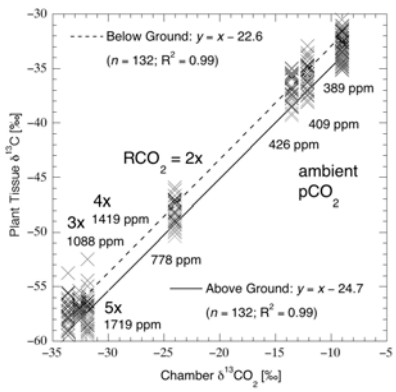

Figure 1: ^{13}C in plant tissue vs. CO_2 across RCO_2=1-5×.

Our study also constituted one of the few experiments on plant growth performed above RCO_2=2×. Although we observed biomass fertilization upon increase in RCO_2 from 1× to 2× (64% in our study *vs. e.g.,* 37% for 156 species reported in [2]), we did not see a significant change in biomass upon further increased pCO_2 levels (i.e*.,* from 778−1791 ppm). The persistence of correlation between $\delta^{13}CO_2$ and $\delta^{13}C_{PLANT}$ through and beyond pCO_2 fertilization suggests the possibility of a carbon-isotope "setpoint" for terrestrial ecosystems through time.

[1] Arens *et al*. (2000) *Paleobiology* **26,** 137-164. [2] Poorter (1993) *Vegetatio* **104/105**, 77-97.

Methane emission from a Swiss lake: A full year cycle

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The build-up of methane has been monitored occasionally over three years and monthly during a full year's cycle in Lake Rotsee (Lucerne, Switzerland). Concentrations and carbon isotopic composition of methane has been used to describe the sources and losses of methane in the water column. High methane concentrations (up to 1mM) were measured in fall (over several years) in the anoxic water layer. Aerobic and anaerobic methane oxidation in the water column later in the year could be shown. Methane oxidation rates were highest in the interface between oxic and anoxic water layers around 8-10 m depth. The profile of carbon isotopic composition of methane showed strong indications for methane oxidation at the same depth. Anaerobic methane oxidizers ANME-1 and ANME-2 and aerobic methane oxidizing bacteria (MOB) were detected using FISH at the interface. Trying to sequence the responsible organisms, however, was only successful for the aerobic methanotrophs detecting Methylomonas and Methylobacter. A search for mcrA, the gene for anaerobic methane oxidation, will reveal whether this process is really occurring. An estimation of methane emissions to the atmosphere during stratification showed an average flux of 6.7 mg/m2/d. However, during lake turnover in October to December direct eddy covariance flux measurements above the lake surface showed a higher emission of 16 mg/m2/d.