Varying isotopic fractionation of microbial respiration with warming is mediated by substrate stoichiometry

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Carbon (C) plays a central role in heterotrophic soil microbial metabolism. Soil organic carbon (SOC) can be taken up by microorganisms, and some respired as CO_2. Measures of microbial C transformations such as specific respiration and carbon use efficiency, and the stable isotopic signature of microbial biomass-C and respired CO_2, can enable assessments of microbial substrate use and feedbacks to a warming climate. However, direct measurements of these variables are either difficult to execute or interpret in situ due to a multitude of confounding factors.

We used a chemostat system equipped with a continuous flow analyzer of [CO_2] and δ13C- CO_2 to assess the effects of temperature and substrate stoichiometry on microbial C transformations in steady state conditions, while providing microbes with a constant supply of well-characterized C substrate (δ13C = avg. -24.4‰). We grew *Pseudomonas fluorescens* (0.13 h^{-1}) at temperatures ranging from 13 to 26.5°C, with substrate C:N of 1, 10 and 20.

At all C:N, SRR increased and CUE decreased with temperature. Changes in SRR and CUE with warming were most evident at C:N=1, demonstrating the effects of C availability on microbial C economy. ^{13}C fractionation between biomass and CO_2 was positively correlated with temperature at C:N=10, while no such relationship was found at C:N=1 or 20. We suggest that interpretations of δ13C- CO_2 responses to temperature at multiple scales must consider how microbes may alter their metabolism (e.g., metabolic pathways, intracellular C flows) as the relative availability of critical resources changes.