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Potential Mass Balance Implications of Sugar Excretion on a Proxy for Past CO_2

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Addressing uncertainties in long-term pCO_2 proxies are of the utmost importance, especially considering our current pCO_2 levels (~420 μatm) have significantly surpassed the maximum levels (~300 μatm) recorded in ice cores, which only record up to ~800,000 years ago. Stable carbon isotope ratios ($\delta^{13}C$) are used to reconstruct past CO_2 levels by assuming that the difference in $\delta^{13}C$ values between photosynthetically fixed and inorganic carbon is proportional to pCO_2. While previous studies have addressed uncertainties related to the $\delta^{13}C$ of initial fixed photosynthate (e.g., due to nutrient availability or irradiance), this study aims to determine the effects of downstream carbon allocation. Specifically, if a significant fraction of fixed carbon is allocated towards excreted sugars, this could potentially impact biomass $\delta^{13}C$ values because cyanobacterial sugars have distinct $\delta^{13}C$ values relative to bulk biomass and lipids. The isotopic mass balance implications of sugar excretion must therefore be constrained to determine if sugar excretion impacts the efforts to reconstruct past pCO_2. We address this question by growing *Synechococcus* PCC 7002 under two contrasting light conditions to promote variable sugar excretion and report $\delta^{13}C$ values of DIC, biomass, and excreted sugar, as well as relative amounts of sugar excretion. Ultimately, accounting for the isotopic effects of excreted sugars will help improve our ability to reconstruct past pCO_2 levels, particularly across contrasting environmental conditions.