Evaluation of community respiratory mechanisms with oxygen isotopes: A case study in Lake Kinneret

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ABSTRACT: Gross and net O_2 production between May 1996 and February 1999 was determined in bottle incubation experiments with $H_2{}^{18}O$ spike and from the change in O_2 concentration. Carbon fixation rates were obtained from ^{14}C incubations. In general, production rates determined using the $H_2{}^{18}O$-spike were about twice the primary production determined by the ^{14}C method, where the latter was close to net oxygen evolution. These relationships are similar to results for the open ocean. During the spring bloom, when the dinoflagellate Peridinium was abundant, the ratio of gross O_2 production to carbon fixation was about 7.5, and net O_2 production was greater than carbon fixation. The difference between O_2 gross production and carbon fixation results, at least in part, from uptake by Mehler reaction and from recycling of the ^{14}C tracer by dark respiration and the alternative oxidase (AOX). We used the difference in isotopic discrimination against ^{18}O, occurring during O_2 consumption by various biological pathways, to place constraints on the relative engagement of these pathways. We estimated the overall discrimination against ^{18}O in the lake from O_2 isotopic mass balance as 20.5-29‰. The only mechanism that can explain the strong overall fractionation in the lake is AOX, which strongly discriminates against ^{18}O (~31‰). Our results show, for the first time, that uptake by AOX is widespread and quantitatively important to oxygen consumption in aquatic systems.