Carbon isotope variations in the coral skeleton depending on photosynthetic light dosage

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We conducted a long-term culture experiment of Porites spp. corals at different light dosages at 25 degree to examine the contribution of photosynthetic activity to skeletal carbon isotope composition. As the daily dose of photosynthetically active radiation increased, the rate of annual extension also increased. Mean isotope compositions shifted; the carbon isotope compositions ($d^{13}C$) became heavier and the oxygen isotope compositions ($d^{18}O$) became lighter at higher radiation dose. Skeletal $d^{18}O$ decrease coincided with increasing skeletal growth rate, indicating the influence of so-called kinetic isotope effects. The observed $d^{13}C$ increase should be subject to both kinetic and metabolic isotope effects, with the latter reflecting skeletal $d^{13}C$ enrichment due to photosynthesis by symbiotic algae. Using a vector approach in the $d^{13}C$-$d^{18}O$ plane, we discriminated between kinetic and metabolic isotope effects on $d^{13}C$. The calculated $d^{13}C$ changes from metabolic isotope effects were light dose dependent. The $d^{13}C$ fractionation curve related to metabolic isotope effects very similar to the photosynthesis-irradiance curve, indicating the direct contribution of photosynthetic activity to metabolic isotope effects. In contrast, $d^{13}C$ fractionation related to kinetic isotope effects gradually increased as the growth rate increased.