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Triple oxygen isotope composition of photosynthetic oxygen

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The measurement of biological production rates is essential for our understanding how marine ecosystems are sustained and how much CO_2 is taken up through aquatic photosynthesis. Traditional techniques to measure marine production are laborious and subject to systematic errors. A biogeochemical approach based on triple oxygen isotope measurements in dissolved oxygen (O_2) has been developed over the last few years, which allows the derivation of gross productivity integrated over the depth of the mixed layer and the time-scale of O_2 gas exchange (Luz and Barkan, 2000). This approach exploits the relative $^{17}O/^{16}O$ and $^{18}O/^{16}O$ isotope ratio differences of dissolved O_2 compared to atmospheric O_2 to work out the rate of biological production. Two parameters are key for this calculation: the isotopic composition of dissolved O_2 in equilibrium with air and the isotopic composition of photosynthetic oxygen. Recently, a controversy has emerged in the literature over these parameters (Kaiser, 2011) and one of the goals of this research is to provide additional data to resolve this controversy. In order to obtain more information on the isotopic signature of biological oxygen, laboratory experiments have been conducted to determine the isotopic composition of oxygen produced by different phytoplankton cultures.