CHANGES IN THE MOLECULAR AND STABLE CARBON ISOTOPIC
COMPOSITIONS OF MARINE PHYTOPLANKTON DURING
PROLONGED IN SITU IRON FERTILIZATION

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ABSTRACT

Photosynthetic isotopic fractionation ($\varepsilon_p$) models were tested in the context of a mesoscale open-ocean iron fertilization experiment conducted in the eastern equatorial Pacific Ocean. The addition of Fe (in the form of FeSO$_4$) produced large changes in phytoplankton growth rate ($\mu$; 3-fold increase), chlorophyll $a$ concentration (> 10-fold increase), and aqueous carbon dioxide concentration ($C_e$; 17% decrease). These changes were associated primarily with increased pennate diatom biomass. Comparison of lipid and pigment biomarkers with carbon biomass estimates for specific algal taxa showed that two sterols, cholesta-5,22E-dien-3β-ol and 24-methylcholesta-5,22E-dien-3β-ol, were associated predominantly with diatoms throughout the experiment. Compound specific stable carbon isotopic analysis showed that $\varepsilon_p$ values for the total phytoplankton community and for diatoms were similar to those expected based on an established $\varepsilon_p$ - $\mu/C_e$ relationship for a diatom (*Phaeodactylum tricornutum*) grown in chemostat culture (Laws et al., 1995), implying that average surface area to cell carbon ratios (SA:C) were similar in field and laboratory conditions. Isotopically-based growth rate estimates for alkenone producing algae (*Emiliania huxleyi* and *Gephyrocapsa oceanica*) based on a laboratory $\varepsilon_p$ - $\mu/C_e$ relationship were consistent with those expected for these species, but in situ growth rate data are not available for verification. These results strengthen the foundation for isotopically based reconstructions of $P_{CO_2}$ and phytoplankton growth rates in ancient oceans.