A Method for Determining the Growth Rate of Alkenone-producing Microalgae in Oceanic Waters

A THESIS SUBMITTED TO THE GRADUATE DIVISION OF THE UNIVERSITY OF HAWAI'I IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE

IN

OCEANOGRAPHY

DECEMBER 2004

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Abstract

Extension of atmospheric CO_2 records to more ancient times through the development of a geological proxy for CO_2 is a major objective of paleoclimate studies. A promising CO_2 proxy has been carbon isotopic analysis of marine organic matter (Rau et al., 1992; Hayes et al., 1990). However, recent studies have demonstrated that microalgal growth rates and cell geometry in addition to CO_2 concentration affect carbon isotopic fractionation in marine microalgae. Results of modelling (Rau et al., 1996, 1997) and laboratory chemostat experiments (Laws et al., 1995, 1997; Bidigare et al., 1997; Popp et al., 1998) have begun to clarify these effects.

Isotopic analysis of alkenones provides a way to constrain the size and shape of the source organism because these compounds are only produced by a few select microalgae (Marlowe et al., 1990). Although laboratory and field studies suggest that isotopic analysis of alkenones shows great potential as a CO_2 proxy, the relationship between specific growth rate and carbon isotopic fractionation in natural samples is not well defined. This research establishes in the laboratory an alkenone ^{13}C-labeling method that can be used to evaluate the effect of growth rate on carbon isotopic fractionation in natural populations of the open ocean, alkenone-producing microalgae, *Emiliana huxleyi* and a major coastal variant, *Isochrysis galbana*. Our approach is analogous to the method for determining phytoplankton growth rates using ^{14}C-labeling of pigments (Goericke and Welschmeyer, 1992, 1993) but uses irmGCMS to determine the rate of ^{13}C incorporation into alkenones.