Goldschmidt 2000
September 3rd–8th, 2000
Oxford, UK.

Journal of Conference Abstracts
Volume 5(2), 974

Carbon Isotopic Records in Coral Skeletons: What do They Mean?

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There have been numerous attempts to understand the meaning of carbon isotopic variation in the skeletons of zooxanthellate and non-zooxanthellate corals. The model that is currently accepted is that the carbon isotopic composition is a function of the amount of insolation, with more positive carbon isotope values in the skeleton occurring during periods of higher light intensity. Hence carbon isotope values are commonly interpreted as being a proxy for the amount of insolation which has affected the coral. We present data on temporal and spatial variation in the carbon isotope values of the zooxanthellae and coral tissue, which casts further information on the cycling of carbon in zooxanthellate corals. Our data has been collected from the species Montastraea faveolata growing at six locations on the Florida reef tract over a period of two years. These data indicate a temporal change in the carbon isotope values of the coral tissue over approximately 2 per mil and a variation of the difference between the carbon isotopic composition of the zooxanthellae and the coral tissue. The most negative carbon isotope values occur during the winter months at which time the carbon isotope values of the zooxanthellae and coral tissue are similar. The most positive carbon isotope values occur during the early summer at which time there is a maximum difference of up to 2 per mille between the tissue and the zooxanthellae. These variations are similar in magnitude and timing to the changes, which we observe in the coral skeletons. Although these difference can be explained in a number of different ways, but one possible explanation is that during the summer (periods of high light intensity and long photo period), the corals are CO_2 limited causing a reduction in the amount of isotopic fractionation between the CO_2 and the photosynthethate. Other explanations involve seasonal changes in the amount of heterotrophy and autotrophy, changes in the isotopic composition of the DIC, changes in the isotopic composition of the food source, and/or changes in amount of lipids in the organism. These data suggest that fractionation of carbon isotope composition of coral skeletons is considerably more complex than previously recognized.

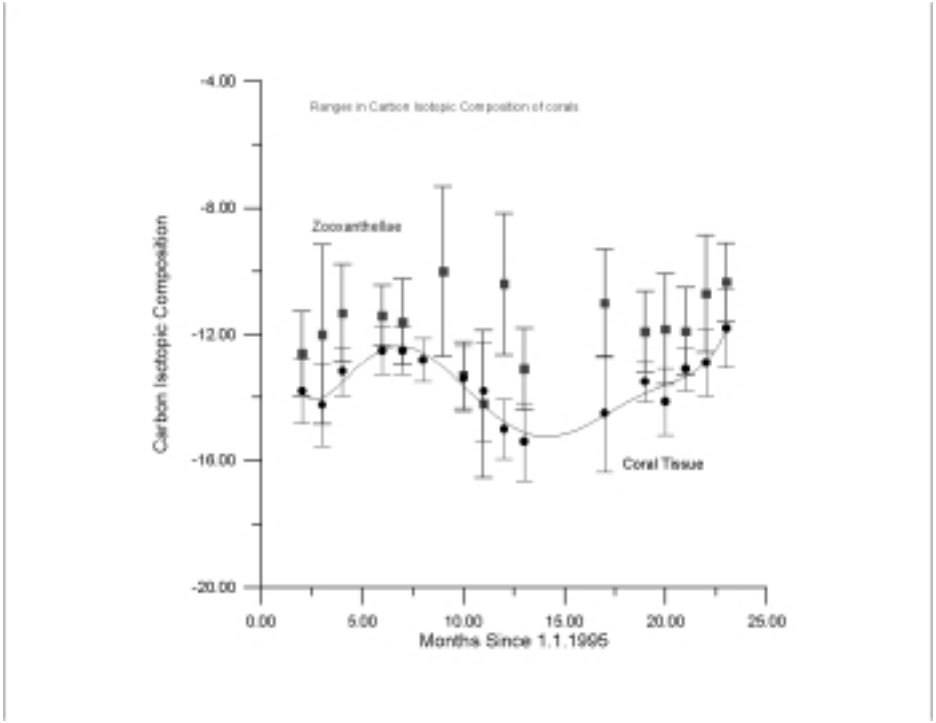

Figure 1: Temporal variation in the carbon isotopic composition of coral tissue from Florida