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Biogeosciences Discussions

Interactive comment on "Light effects on the isotopic fractionation of skeletal oxygen and carbon in the cultured zooxanthellate coral, *Acropora*: implications for coral-growth rates" *by* A. Juillet-Leclerc and S. Reynaud

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Review for A. Juillet-Leclerc and S. Reynaud "Light effects on the isotopic fractionation of skeletal oxygen and carbon in the zooxanthellate coral, Acropora: implications for coral growth rates."

In this paper, the aspects of isotopic fractionation of oxygen and carbon deposited in the skeleton of Acropora are compared to skeletal growth parameters and various metabolic parameters (Ps, R) measured in the holobiont. The coral nubbins used were all from the same colony, and all exposed sequentially to a "low light" (LL; about the light on a very cloudy day) regime for a month, then a "high light" (HH; about the light a coral would receive on a sunny day) regime for a month. It appears that for each nubbin (n=24), the following parameters were measured once each: Ps, R, calcification (buoyant weight), surface extension (measured as cm2 of encrusting growth on the base), and del 18O and del 13C from the encrusting growth. Temperature was maintained at a constant value for the duration of the experiment.

Although I have some questions about the experimental procedure (e.g., why were R and Ps only measured once?; the assumption that surface extension as measured by area is equivalent to liner extension), there are some valid and notable results. First, in the newly deposited skeleton (encrusting growth), there were clear differences in del 18O between treatments despite the fact that there was no temperature difference. Second, varibility that could be masked by averaging replicate samples, could be grouped into nubbins that showed a del 13C increase (low surface extension and higher productivity) and those showing a del 13C decrease (higher surface extension and lower productivity) with increased light.

The interpretation of these results is compared to Gladfelter's observations of skeletal development in Acropora, in which she describes two processes in skeletal development, extension and then accretion, characterized by different crystal morphs. Note that she (1983) pointed out that while accretion was primarily a daytime process, extension could occur both at night and in the day (she compares her observations to those of Barnes and Crossland, 1980, who refered to the coral 'erecting a framework and then filling in the bricks and mortar'). Thus, the results of the present study, higher calcification in HL is consistent.

The relationship between zooxanthella distribution, density, rate of Ps, and skeletal deposition is unclear in the manuscript. Some Acropora species (e.g., Acropora palmata) show clear annual banding when radial growth is examined. This study did not measure either zooxanthella density or distribution. It is true that the tips have fewer zooxanthelle (Pearse and Muscatine, 1971, Gladfelter et al 1985) and also that the newly formed encrusting tissue and skeleton are white (suggesting fewer zoox), but where has it been demonstrated that density of zooxanthellae is directly related to rate of Ps? And to calcification rates? The fact that massive corals have a higher rate of (radial) extension upward as opposed to on the sides does not necessarily mean there is a higher density of zooxanthellae. More important is that linear extension is not directly related either to zooxanthellae density or to rate of Ps. No one has shown that the site of crystal deposition is directly correlated with the site of zooxanthellae. In fact, zooxanthellae are often far removed from site of accretion in Acropora.

There also seems to be a confusion in the terms “main axes” and “processes” (line 26 page 10259). The processes of extension and accretion occur in all three growth axes of Acropora (axial, radial and encrusting).

The results of this study are intriguing and noteworthy, but I believe the interpretation of these results requires further consideration.

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