Compositional variability in the cold-water coral *Lophelia pertusa* is driven by temperature and aragonite precipitation "efficiency"

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Compositional variability in the aragonitic skeleton of *Lophelia pertusa*, a cold-water scleractinian, was interpreted within a framework provided by abiogenic precipitation experiments. The inverse correlation between Sr/Ca and Mg/Ca ratios, and the exaggerated amplitude of annual Sr/Ca cycles relative to temperature indicate that temperature alone cannot account for the compositional variability in the *Lophelia* skeleton[1]. To investigate the origins of these "vital" effects, we carried out precipitation calculations using experimentally determined partition coefficients for Mg, Ca and Sr between seawater and abiogenic aragonite[2]. The amount of aragonite precipitated by the organism from a given mass of calcifying fluid (precipitation "efficiency") was allowed to vary through the year so that the Sr/Ca ratios predicted by the model match the amplitude of the measured Sr/Ca cycle. Results from these calculations suggest that the amount of aragonite precipitated from a given mass of calcifying fluid increases with increasing temperature from 0.0300 wt% at 4.9 °C to 0.0495 wt% at 8.4 °C. This increase correlates with a uniform increase in the concentrations of Mg, Ca and Sr in the calcifying fluid. We applied these results to forward model the Mg/Ca ratios measured across the theca. Varying the precipitation "efficiency" reproduces the positive correlation between temperature and Mg/Ca ratios and the negative correlation between Mg/Ca and Sr/Ca observed in the coral. These results suggest that the compositional variability in the *Lophelia* skeleton is due to a combination of variations in both temperature and precipitation "efficiency" through the year. We compared precipitation efficiency of *Lophelia* with that of a tropical zooxanthellate coral *Diploria labyrinthiformis* obtained using its compositional signatures applied to the same precipitation calculations. The results suggest that, at 25 ºC, the amount of aragonite precipitated from a given mass of calcifying fluid are equivalent for the zooxanthellate and azooxanthellate corals. That *Lophelia* calcifies more slowly than its tropical counterpart may be a function of its cold water habitat rather than the absence of zooxanthellae.

References

[1] Cohen A.L. et al., (2006) G^3 submitted manuscript.
[2] Gaetani G.A. and Cohen A.L (2006). *GCA* **,** in review