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Biogeosciences Discussions

Interactive comment on "Changing mineralogical properties of shells may help minimize the impact of hypoxia-induced metabolic depression on calcification" *by* Jonathan Y. S. Leung and Napo K. M. Cheung

Anonymous Referee #3

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Review of " Changing mineralogical properties of shells may help minimize the impact of hypoxia-induced metabolic depression on calcification" by Leung and Cheung on Biogeosciences Discussion

There are still limited studies about the influence of oxygen-depleted environment on carbonate shell formation. The reviewer can believe this study of Leung and Cheung give important knowledge on this on-going problem. The contents of consideration are consistent with the interests of the Biogeosciences' audience. On the other hand, there are some remained questions about the results and considerations.

The authors should show the actual sampling/measurement points on the specimens with images. Chan et al. (Journal of Structural Biology 189 (2015) 230-237) reports the shell formation of H. elegans (belonging to the same genus of H. diramphus). According to the study, calcite/aragonite ratio and Mg/Ca altered by ontogeny. Mineralogical heterogeneity was also found in the single shell wall by Chen et al. (2015). The reviewer expects, then, similar variability may be found in H. diramphus, too. The authors seems working with the species for long time. By their knowledge, the ontogenic mineralogical and Mg/Ca variation of H. diramphus should be shown by this study or previous studies. Possibly, the current interpretations are totally revised.

Though authors have considered that calcite/aragonite ratio would depend on energy requirements/consumptions, the ratio is also influenced by magnesium composition and organic compound compositions of mother fluid of calcification, as well as temperature, pressure etc (e.g. Berner, Geochim et Cosmochim Acta 1975, 489-504; Meldrum and Cölfen, Chem. Rev., 2008, 4332-4432). The reviewer expect that the energy for shell formation would be spent on production of the organic compounds of calcification substrate and enzymes, too (ion pumps, carbonic anhydrase etc.). The authors should show the amount of organic matter in the shell. It will be also nice to show the enzyme activity during shell formation for further consideration if possible.

Though the authors thought that the hypoxia condition has increased relative amorphous calcium carbonate (ACC) content by its lower energy demand, according to their cited Weiner and Addadi (1997), it is described that it requires much energy to maintain ACC. There are a discrepancy with authors' consideration.

On the other hand, Fig 1 clearly show authors basic understanding about depression of calcareous shell by low-DO condition. In the hypoxic condition, shell growth slows and hardness increases. This key findings is valuable to publish. It can be understood that this may increase the volume by decreasing the density or the like in order to promote growth in the normal oxygen condition in my mind.

From the above, the result of the authors can be regarded as insufficient to support their own hypothesis. Some additional measurements and restructure of whole manuscript will be necessary to evident authors' current consideration. I would like to recommend resubmission with additional data and discussion.

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