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Biogeosciences Discussions

Interactive comment on "Mass extinctions past and present: a unifying hypothesis" *by* S. A. Wooldridge

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Comments raised by Anonymous Referee #3 that relate to urease distribution among eukaryotes and the pH sensitivity of urease activity have been considered in detail within a subsequent Short Comment. Here, I specifically concentrate on comments pertaining to:

UREASE AND BIOMINERALISATION:

The idea that urease may act to promote biomineralisation within invertebrates has long been established (Campbell and Speeg, 1969; Crossland and Barnes, 1974). However, it is true that since its original consideration, it has received rather limited attention; though when considered, strong and persuasive evidence has been provided for the involvement of urease within the biomineralisation process (see references

within Wooldridge 2008). Recently, Wooldridge (submitted) outlined a mechanistic-based conceptualisation for the involvement of urease in the biomineralisation process of scleractinian corals; concluding that the enzymatic impact of urease was evident within the structural and chemical properties of coral skeletons. The biomineralisation investigation of Ip et al. (2006) has also suggested that urease-mediated removal of H+ by NH3 is consistent with pH variations in the extrapallial fluid of the giant clam Tridacna squamosa. Interestingly, the ambient pH of the extrapallial fluid was shown to be 7.66, which corresponds to a suggested urease activity peak (Wooldridge 2008; Fig. 2).

UREASE AND EVOLUTION:

The evolutionary loss of urease in vertebrates and its retention in many invertebrates is an interesting and relevant consideration. I agree with the reviewers suggestion that my initial inference - that it may have been guided by differential survival traits across mass extinction events - does not appear to be parsimonious. A perhaps more plausible explanation could relate to the fact that urease is only found only in organisms in which hydrolysis of urea does not lead to ammonia toxicity. For example, in marine creatures, toxic ammonia (being highly soluble in water) can be easily flushed away, whilst in plants ammonia generated from urea is rapidly assimilated by the action of glutamine synthetase. Given the need to preserve water was likely to have been a strong evolutionary constraint during vertebrate evolution (Vigetti et al. 2003) could it be that the hydrolysis of urea became a detrimental process in regard to water conservation?

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