

## ***Interactive comment on “Mussel shells of *Mytilus edulis* as bioarchives of the rare earth elements and yttrium distribution in seawater and the potential impact of pH and temperature on the partitioning behaviour” by A. Ponnurangam et al.***

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This is a fairly well developed and presented study looking to use the shell geochemistry of *M. edulis* as potential archives of REE and yttrium in seawater.

The study could be improved by broadening the scope of the introduction to include some of the isotope and elemental work previously done on *M. edulis*. Missing some of the relevant and primary literature on *M. edulis* is exemplified in the conclusions section: “We therefore, emphasize, that in order to develop REY systematics into a

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quantitative temperature and/or pH proxy, the impact of the EPF and other vital effects needs to be assessed, like by studying *M. edulis* mussels cultured under controlled pH and temperature conditions.” Although the below studies did not explore REE incorporation, they certainly are relevant to the current study and should be incorporated into the revised manuscript.

Some suggestions (also look at the references contained within these studies):

Versteegh, E.A.A., Blicher, M.E., Mortensen, J., Rysgaard, S., Als, T.D. and Wanamaker, A.D. (2012) Oxygen isotope ratios in the shell of *Mytilus edulis*: archives of glacier meltwater in Greenland? *Biogeosciences* 9, 5231-5241.

Wanamaker, A.D., Jr., Kreutz, K.J., Borns, H.W., Jr. and Introne, D.S. (2006) An aquaculture-based method for calibrated bivalve isotope paleothermometry. *Geochemistry, Geophysics, Geosystems* 7, 1-13.

Wanamaker, A.D., Kreutz, K.J., Borns, H.W., Introne, D.S., Feindel, S., Funder, S., Rawson, P.D. and Barber, B.J. (2007) Experimental determination of salinity, temperature, growth, and metabolic effects on shell isotope chemistry of *Mytilus edulis* collected from Maine and Greenland. *Paleoceanography* 22, doi:10.1029/2006PA001352.

Wanamaker, A.D., Kreutz, K.J., Wilson, T., Borns, H.W., Introne, D.S. and Feindel, S. (2008) Experimentally determined Mg/Ca and Sr/Ca ratios in juvenile bivalve calcite for *Mytilus edulis*: implications for paleotemperature reconstructions. *Geo-Mar Lett* 28, 359-368.

The authors need to provide more detailed information early in the manuscript on the mineralogy and morphology of the *M. edulis* shell. Although they did note that the shell is made of both calcite and aragonite, it is never said in the manuscript that there are two main growth layers: an outer calcitic layer and an inner aragonitic layer. As the authors ground up entire shells, the partitioning coefficients described here are neither for calcite nor aragonite. Hence comparisons to other partitioning coefficients detailed

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in this study need to incorporate this reality.

The second part of this manuscript models the apparent impact pH and temperature would have on partitioning coefficients. And then the authors suggest that these modeled results would allow workers to estimate past pH of the seawater. I believe that this goes too far. In other words, there are both pH and temperature effects in the partitioning, so there still would be two unknowns (pH and temperature) in the paleo environment. Also, I strongly feel that the authors should always say modeled pH and temperature changes (Title of the paper, sections and sub sections) because they have no empirical data to back up these claims. The authors could at least mention the potential of using boron isotopes (or other pH sensitive systems) to further evaluate these pH claims. In my opinion, the authors have over simplified an incredibly complex system (pH Proxy) without knowing what happens in the extra pallial fluid of *M. edulis*. More caution is warranted.

Other items to consider:

1. What are the approximate ages of the shells used in this study? Report this.
2. Elements (Mg, Sr, Ca, etc.) and I suspect REE are very susceptible to diagenesis. What evidence do the authors have that REE chemistry would be unaltered in a paleo setting? Can the authors comment on this?

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