

## ***Interactive comment on “ShellTrace v1.0 – A new approach for modelling growth and trace element uptake in marine bivalve shells: Model verification on pacific oyster shells (Crassostrea gigas)” by Niels J. de Winter***

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Dear Editor, Referees and contributors,

I would like to express my thanks to both anonymous referees for their careful and thorough review of my manuscript under discussion in Geoscientific Model Development. After careful consideration of the comments and suggestions posed by the referees, I present below a short breakdown of the major points of critique and a summary of suggested ways in which the manuscript may be revised. Appended to this reply, I

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provide two documents containing a point by point rebuttal to all comments raised by both referees.

Points of major criticism:

### 1. Aim of the model

Both referees have expressed doubts about the goal of the study and more specifically about the aim of the growth and trace element model that is presented. In the point-by-point rebuttal I provide more details illustrating how the modelled total shell trace element concentrations and accumulation rates can aid in the discussion about the use of trace element concentrations in bivalve shell carbonate for the reconstruction of palaeoenvironmental conditions. In a revised version of the manuscript, I plan to rewrite the Introduction to more clearly explain the goals of the study and the added value of the data that can be gathered by implementing the presented model. In the process, I hope to make the manuscript easier to read by providing a better structure.

### 2. Sentence construction and use of English language

I acknowledge the criticism by both referees stating that the formulation of some sentences throughout the manuscript makes the text hard to read. In a revised version, I will go through the manuscript text in detail in order to clarify these sentences and improve the legibility of the manuscript.

### 3. Terminology

As both referees point out, the incorrect use of mineralogical and sclerochronological terminology can be confusing in the current version of the manuscript. In a revised version, care will be taken to adhere to the proper terminology while describing both morphological and mineralogical characteristics of bivalve shells.

### 4. Age model

Both referees raise fair criticism about the way in which age models are created for XRF

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line scan data and model results. In a revised version of the manuscript, an attempt will be made to incorporate measurements of daily growth increments of the shells to establish an independent chronological framework for model results and data in the study.

#### 5. Sub-annual model results

Both reviewers have doubts concerning the claims that the model presented in this manuscript is able to reconstruct growth and trace element uptake rates on a sub-annual scale. It is my hope that a revision of the model that implements growth stops and seasonal variation in growth rates in the shells will improve the reliability of the model results and reflect the natural growth patterns of marine bivalve shells more accurately.

#### 6. Independent model verification

Concerns were raised about the degree of model verification that is applied to test the reliability of the model results discussed in this study. I agree to this point of critique and will solve this issue by adding additional measurements of the oyster's dimensions and compare them to the 3D model results. Furthermore, chemical analyses of more different parts of the oyster shells will be used to test the assumptions of the model concerning the extrapolation of shell size and heterogeneity in the anterior-posterior direction of the shell. Please refer to the point-by-point rebuttal of Referee #1's comments attached to this reply.

#### 7. XRF measurement strategy

Both referees expressed concern about the strategy by which trace element profiles that were compared to modelling results were measured in this study. In the point-by-point rebuttal of Referee #2's comments, a more detailed explanation is given for my choice of this sampling strategy. However, in a revision of the manuscript, suggestions by Referee #2 will be taken into account and a more thorough discussion of the

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sampling strategy and a comparison between results from different line scans on the polished shell surface will be added. I hope that this discussion of sampling protocol will shed more light on the heterogeneity within the bivalve shell and that the comparison of the different line scan results with the model output will allow for a better discussion of the added value of the presented model.

#### 8. Discussion of model results in terms of physiological and environmental parameters

Some concerns were raised with reference to the discussion of the modelling results and their comparison with conventional trace element line scans. In a revised version, this part of the discussion will be rewritten to include a more careful discussion of the comparison between measured and modelled data. I will attempt to structure this part of the discussion more clearly and provide more literature support to enable the discussion of the use of modelled data to isolate the effects of physiology on trace element incorporation into the shell.

I hope that the above provides a clear outline of the revisions that I propose in reply to the comments by both referees. In addition, I invite both referees, the topical editor and other interested members of the community to express their opinion about my reply to the concerns summarized above, or to post additional comments with reference to the current version of my manuscript by participating in the online discussion. I would much appreciate any further feedback that will help me improve both the bivalve growth and trace element model and the manuscript.

Kind regards,

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Please also note the supplement to this comment:  
<https://www.geosci-model-dev-discuss.net/gmd-2017-137/gmd-2017-137-AC1-supplement.pdf>

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Interactive comment on Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2017-137>, 2017.