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We express our acknowledgements to the reviewers for the insightful comments, which helped to improve the manuscript.

Below is a detailed reply to all the referees' comments and a description of all the changes incorporated to the revised manuscript. A copy showing these changes is attached with all the changes marked in red. We hope that the manuscript in its revised version should be acceptable for publication in **Biogeosciences**.

Remarks by Referee 2:

Remark 1. *Were the animals alive when their biogenic aragonite was sampled, or had the samples experienced some minor marine diagenesis?*

All hard tissues were collected from alive organisms with the exception of the skeleton of *Porites* sp., which was collected *post-mortem* and cannot be discarded that had undergone some degree of minor marine diagenesis. See also the answer to remark 2 by reviewer 1.

Remark 2. *Were the samples weighed in advance, and was the water-rock ratio constant across experiment arms? I wonder about the extreme difference in calcitization of the gastropod between 4 and 6 months of alteration.*

All samples were weighed prior to the beginning of experiments

- The fragments of *Arctica islandica* had an average weight of 0.8 g
- The fragments of *Haliotis ovina* had an average weight of 0.2 g
- The fragments of *Porites* sp. had an average weight of 0.1 g

3 samples of each specimen were inserted in the autoclaves together with 10 ml (10.02 g) of the burial mimicking fluid. As a result, the water/rock ratio was 4.16 for *Arctica islandica*, 16.66 for *Haliotis ovina* and 33.33 for *Porites* sp., respectively. The size of the different animals and the fluid/water ratio was the same as that used by Casella et al., (2018) in high-temperature experiments (175°C). The same experimental conditions were used in order to allow reliable comparison between the results of both works. The Experimental section of the manuscript has been amended to clearly state this.

Regarding the drastic increase in calcification undergone by *Haliotis ovina* between 4 and 6 months, similar results were observed by Casella et al., (2017) during the alteration of *Arctica islandica* shells at high temperature (175°C). In this work, the authors observed that the interaction of the shells with the fluid did not produce any replacement of the aragonite by calcite for 4 days. From the fourth day onwards, the replacement proceeded rapidly so that, in just 3 more days, almost all the aragonitic shell had been replaced by abiogenic calcite. The authors argued that this waiting time, which they called "dormant period", would be necessary to build up a sufficiently high ion activity product in the solution to precipitate any calcite. During the dormant period, calcite nucleation would be small, but not zero, due to limited supersaturation. Once supersaturation, calcite nucleation rate and finally, calcite growth rate reached high values the replacement would proceed at a much faster rate. A similar physicochemical evolution can be expected in the system during the long term alteration of *Haliotis ovina* shell (this work). The fact that experiments in this work were conducted at much lower temperature than those in Casella et al., (2017) can explain a much slower alteration kinetics and, consequently, a much longer (several months instead of a few days) dormant period.

Remark 3. Line 174: was brachiopod shell calcite analyzed in this study? Why is it referred to here?

No, it was not. The information on the co-orientation of calcite crystals in brachiopod shell is given as an example of fiber or axial texture. In order to avoid any possible misunderstanding, reference to two recent papers (see below) has been added in line 174 (submitted manuscript version).

- Simonet Roda, M., Griesshaber, E., Ziegler, A., Rupp, U., Yin, X., Henkel, D., Häussermann, V., Laudien, J., Brand, U., Eisenhauer, A. and Checa, A.G., 2019. Calcite fibre formation in modern brachiopod shells. *Scientific reports*, 9(1), pp.1-15.
- Simonet Roda, M., Griesshaber, E., Angiolini, L., Rollion-Bard, C., Harper, E.M., Bitner, M.A., Milner Garcia, S., Ye, F., Henkel, D., Häussermann, V. and Eisenhauer, A., 2022. The architecture of Recent brachiopod shells: diversity of biocrystal and biopolymer assemblages in rhynchonellide, terebratulide, thecideide and craniide shells. *Marine Biology*, 169(1), pp.1-52.

Remark 4. *This paper is a valuable contribution towards understanding early burial diagenesis. Do the authors expect significant differences if some alteration first occurred in shallow (low-T) marine diagenetic environments?*

Some degree of biomineral alteration induced by the metabolisms of bacteria, algae, fungi, or different boring organisms can take place even while the organism is alive, more so after its death. Further post-mortem alteration can derive from physicochemical factors (pH, saturation index of the aqueous medium, presence of certain elements, time etc.) The extension of pre-burial alteration undergone by CaCO₃ hard tissue can widely vary. Therefore, it is very difficult to anticipate its impact on burial diagenesis and any answer that we could give to this question would be pure speculation. No doubt this is a very interesting topic that needs to be addressed experimentally in future work.

Remark 5. *I appreciate the consistency with other burial diagenesis experiments to facilitate comparison, but why are 100 mM NaCl + 10 mM MgCl₂ solutions chosen? This is a lower solute concentration than seawater (465 mM Na⁺ + 53 mM Mg²⁺). Aren't burial formation waters often brinier?*

The reviewer rightly states that burial formation waters are often briner. However, the composition of burial fluids varies widely, and successive exposure of sediments to meteoric and shallow burial fluids is not uncommon. The fluid used in the experiments can be described as a modified seawater. We chose to use the same fluid composition as previous studies (Casella et al., 2017; 2018; Ritter et al., 2017; Pederson et al., 2019a; 2019b; 2020...) to facilitate comparison. Moreover, although it is unlikely that the use of fluids with higher NaCl content would have any major impact on the kinetics of diagenetic alteration, higher MgCl₂ contents may strongly inhibit aragonite recrystallization into calcite, making necessary even longer experimental runs to observe the subtle changes characteristic of early diagenesis.