

***Interactive comment on* “The environment recording unit in coral skeletons: structural and chemical evidences of a biochemically driven stepping-growth process in coral fibres” by J. P. Cuif and Y. Dauphin**

Anonymous Referee #4

Received and published: 5 October 2004

This paper is really a review and synthesis of much of the authors recently published material, together with the observations of many others. The illustrations are comprehensive, high quality and informative. The paper culminates in a proposed model for scleractinian biomineralization mechanisms.

Once it is understood that this is more a review and synthesis, rather than a presentation of new data, then the structural logic of the paper is better understood. The authors should make this clear, starting with the title and the abstract. Furthermore, this paper focuses on the aragonite fibrous growth and not on the early mineralization zone (EMZ) (cf centers of calcification). The paper could be improved if this is stated clearly and the reader is referred elsewhere for information on the EMZ, rather than have partial information on the latter presented here.

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Some key issues that the authors establish are that:

1. The aragonite crystals at the optical level behave like single crystals, but at the nanometer level the crystals are sub-divided into very small crystallites, each surrounded by an organic layer rich in sulfated polysaccharides. The key open question is whether each macroscopic crystal is nucleated once or many times.
2. The growth of the macroscopic crystals is incremental, and that these increments are also marked by varying concentrations of Mg and S. Clearly they are correct in warning against any simple thermodynamic fractionation effects vis a vis Mg and sea water being a direct proxy for temperature.
3. The weight percent organic content is around 1%, but when taken on a volume percent basis together with the water content, this could imply the presence of 8 to 9 volume percent non-mineral. This is an important point.

The model that the authors propose (figure 12) invokes a matrix mediated mineralization process, but by no means proves it. Maybe the problem is that in my opinion the matrix concept fundamentally involves a preformed framework into which crystals grow. There is no direct evidence for this, and neither does their model actually invoke this. They propose a self assembling possibility for the matrix components, but is it the only alternative? Another option is that the crystals grow into a hydrogel composed of a percent or so of polymer (sulfated proteoglycans in this case), and the crystallites occlude some of the macromolecules, whereas others are not occluded and end up squashed between crystallites. The latter is what is being elegantly imaged by AFM. The former may well be the asp-rich proteins or some of them – my speculation!

I suggest that the authors consider this and other alternatives, and then discuss their proposal in relation to these options.

The English needs serious improvement. It is sometimes quite difficult to understand the content because of the poor English.

Minor points

1. It is not obvious that the extrapallial fluid in mollusks is actually the solution from which crystals form (p2).
2. The fact that someone studied either the sugars or amino acids, does not imply that the investigator excludes the importance of the other components (p2). The authors should refer to polysaccharides and proteins instead of sugars and amino acids.
3. How long were the corals stored after being collected alive? How were they stored? Clearly in this study any transient stages of mineral and/or matrix formation would be missed. In light of the importance of such transient phases in other phyla, this should be clearly noted here.
4. EMZ is not defined in the text and not in figure legend 5. Is the EMZ a synonym for “center of calcification”?
5. Figure 12 is really a very poor quality gel. As this is published elsewhere, it might be worthwhile removing this figure.
6. On p13 the reference to figure 13 is actually to figure 14.

Interactive comment on Biogeosciences Discussions, 1, 625, 2004.

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