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Distribution of chemical components in coral skeletons provides evidence for an overall control of crystallization at a submicrometre scale.

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Current geochemical models of aragonite crystallization in corals are still inspired by the "spherulitic crystallization" hypothesized by Bryan and Hill (1941). In such a model, the mineral fibres grow within a layer of "close-to-sea-water" fluid located between the basal epithelium of the polyp and the substrate (sediment surface or existing skeleton). Within this liquid compartment "crystal growth competition" is, admittedly, the factor regulating the spatial arrangement of fibres. Accordingly, various interpretations have been proposed for minor element or isotopic partitioning, based on the physical rules that drive the chemical co-precipitation processes. However a consistent set of data provides evidence that, in contrast to geochemical interpretations, crystallization of coral skeleton is a fully controlled biological process.

1-Recent minor element mapping have established the regularity of multi-element chemical growth zonations on wide skeleton areas. Microstructural observations have also shown that modulation of this growth zonation enables the corallite species-specific architectures to be built. Geochemical models do not include these chemical zonations (and never predicted them).

2- The biologic control is based on epithelial secretion of a complex set of macromolecules, largely based on sulphated polysaccharides, but including also a number of proteins. Correspondence of the distribution of these organic components with the three-dimensional arrangement of skeleton growth layers shows that coral fibres do not crystallize within a sea-water like medium but within a hydrated organic gel. Geochemical models do not take into account the role of this organic framework in the crystallization process (and never suggested its possible influence).

3- At a submicrometre scale (i.e. within the few micrometre thick growth layers) interplay between organic and mineral component occurs within micro-domains, the dimensions of which being in the 100 nanometre range. Recent transmission electron microscope imaging and diffraction experiments suggest that these spheroidal micro-domains might play a key role in transportation of calcium to the crystallization sites under an amorphous form. Such micro-domains have been found in all biogenic calcareous structures observed to date. No mention of their possible existence can be found among current crystallization models.

Predictive capability is a critical test for validity of any model. Modelling of aragonite crystallization in corals might benefit from taking into account a more realistic concept of biomineralization.

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