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Biomineralization strategy(ies): the AFM contributions to a bibliographic state-of-art.

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Biominerals should be no longer considered as simply minerals grown close to biologic organisms according to the crystal growth laws. A huge bibliography is now available demonstrating on experimental grounds how the intricacy of minerals and organic matter inside the biominerals inherits of an inter-dependency during the formation process.

An extensive bibliographic record has been performed to clarify and gather as many results as possible on the following thema:

- relation between the nature of the mineral polymorph and the nature of the organic matter synthetized by the organism;

- role of the cellular micro-environment on the resultant biomineral (polymorph type, crystallinity, . . .);

- size of the ultimate crystalline unit not “polluted” by organic matter;

- interaction path(s) between crystalline units;

- strategy(ies) to maintain the crystallographic orientation among the different crystallographic units to maintain the whole biomineral coherence (when observed);

- possible mineral-to-biopolymer relations;

- nucleating process of the mineral: (bio)epitaxy versus homogeneous nucleation;

- Specific ionic adsorption on biopolymer and orientational polymer-to-mineral match;

This collection of experimental data and observations is of value because the biomineral strategy is expected to be a general process and not species-dependent. The ex-

plicit objective is therefore to define certain general features of biomineralization.

In parallel, AFM images were studied at a nanometric scale, seemingly the scale of the searched processes, on two very different biocarbonates from corals and bivalves. These images support the idea that biomineralization has general features through the diversity of effects:

- the growth unit is a micrometric layer delimited between two mostly organic sheets, resulting from the cell activity;

- one growth layer consists in an organic “spider’s web” interplaying with mineral precipitation, occurring as nano-grains the shape and size of which may be different;

- one single nano-grain can be of calcite or aragonite type, depending of the species of the “distant” biological organism;

- the nano-grains have appeared so far (molluscs, corals) without any crystallographic external shape, at odds with synthetic “ biominerals”;

- the whole pack of nanograins, inside a same growth layer, from one growth layer to the following, and from one growing unit to the adjacent, are all so closely crystallographically controlled that the whole appears as a macroscopic single crystal in X-diffraction.

A synthetic scheme of the biomineralization path will be presented before proposing some further perspectives.