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The BioCalc project : an European collaborative program aiming at precising the environment recording mechanism in calcareous biominerals through an analysis of the organic/mineral interactions during the biomineralization process

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During recent decades, the use of various chemical and/or isotopic proxies has placed calcareous biogenic minerals among the most important sources of environmental information in climate change studies. It is surprisingly then that there is no agreement about the formation of these widely used biological archives. In Earth Science research, for example, measurements made on calcareous skeleton are commonly interpreted on the basis of a purely chemical precipitation process whereas biological investigations have progressively emphasized the role and possible influence of specifically secreted organic components during the nucleation and growth of mineral components (cf. the series of the Biomineralization symposia). Within the EuroCores EuroMinScI program of the European Science Foundation, a three year project has been organized to improve our understanding of the specific crystallization patterns and processes in calcareous skeletons and the relationships to their environment recording capabilities. This project entitled Calcareous BioCrystals (BioCalc) started in January 2006.

From an overall viewpoint, the BioCalc program relies on the fact that mineralizing

activity is a cyclic process, leading to a layered organization of the crystal-like mineral units. The elemental growth layer is the true "environment recording unit" and recent improvements in the use of fluorescent markers have demonstrated the feasibility of including fluorescent markers within the growing skeletons. Thus bu combining the very precise grwoth timing, the microstructural analysis and the high resolution measurement devices (i.e. NanoSIMS), correlation between environmental conditions and information storage in the skeleton will be established with an unprecetented precision.

Additionally, it is now well established that all mineralizing organs producing calcareous skeletons, (e.g. the mantle of molluscs, the basal ectoderm of stony corals or the cell vacuole organelles in Foraminifera) secrete highly active biochemical compounds in the closed spaces where crystallization occurs. These organic compounds remain included within the calcareous units, the growth of which they have directed, resulting in specific crystallization modalities. Hypothesis can be made that the “vital effect” (i.e. the species specific responses to environmental changes; Urey, 1951) originates in this biochemically driven crystallization process. Through physical experiments and theoretical calculations, we aim to analyse and modelize the forces that are acting during the biochemically driven crystallization process, with possible consequences on the chemical and isotopic fractionations.