European Mineralogical Conference
Vol. 1, EMC2012-256, 2012
European Mineralogical Conference 2012

Biological patterning of thickening deposits in scleractinian corals: Morphological and crystallographic study

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Traditional geochemical models consider the coral skeleton as a calcium carbonate precipitate from an extracellular, supersaturated fluid, close in composition to seawater. According to these models, nanocrystalline "calcification centers" are supposed to precipitate rapidly during periods of high supersaturation whereas less supersaturated conditions result in the formation of elongated crystals ("fibers" = Thickening Deposits), perpendicular to the growing skeletal surface. We show, focusing on organization of "fibrous" skeleton, that these geochemical models are misleading simplification of the coral skeletal growth process.

Although some corals (e.g., caryophylliids) have "fibers" arranged perpendicularly to the growing surface, many other scleractinian clades show distinctly different organization of Thickening Deposits. Pocilloporiids or anthemiphylliids show vesicular or lens-shaped organization of fibrous units; flabelliids and acroporids have "fibers" organized into scale-like (shingle) units; micrabaciids form irregular meshwork of fiber bundles within the skeleton. These microstructural patterns we document herein using Scanning Electron Microscopy and Electron backscatter diffraction (EBSD) which is a microdiffraction method suitable for the determination of crystallographic phase and crystallite orientation.

Consistent microstructural patterns are observed for each clade irrespective of ecological and physiological conditions. Although, the role of distinct genes in process of scleractinian coral skeletogenesis has not yet been precisely elucidated there is an increasing number of evidences suggesting the prevailing control of the structure and composition of the skeleton by the organism.