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Preface

Living beings, in particular aquatic organisms are capable of synthesizing a high diversity of biominerals, ranging from silica, calcium carbonate, calcium phosphate to metallic, e.g. iron oxide, biominerals. Some of these biominerals, e.g. calcium carbonate, can be present in various phases, regulated by certain organic macromolecules, and they are found both in prokaryotic and eukaryotic organisms. This book of the series *Progress in Molecular and Subcellular Biology* gives a survey on the most recent developments in the field of Molecular Biomineralization highlighting the importance and the mechanisms of this process occurring at the interface between the inorganic and the organic world.

Part I on Metallic Biominerals describes the surprising ability of certain bacteria (magnetotactic bacteria) to biomineralize magnetic crystals in their “magnetosomes”, the synthesis of ferric oxide biominerals in protein (ferritin) nanocages, the oxidation of manganese by bacteria, as well as the contribution of microorganisms to the biogenic formation of mineral deposits in manganese nodules and seamount crusts. Part II on Biocalcium illustrates the molecular mechanisms of formation of calcium-based biominerals, including the calcium carbonate precipitation by bacteria and the formation of calcium carbonate and calcium phosphate biominerals in a variety of aquatic (invertebrate and vertebrate) organisms. Special emphasis is on the role of organic matrix proteins in the biomineralization of the Echinoderm calcite endoskeleton and the role of skeletogenic genes in the regulation of biocalcification in sea urchin. The main focus of Part III on Biosilica is on the unique enzyme, silicatein, which forms the biosilica skeleton of the siliceous sponges (demosponges and hexactinellids). The extraordinary properties of this biomaterial, an inorganic-organic nanocomposite with the capability of “bio-sintering”, but also its bioactivity, in particular its ability to stimulate bone hydroxyapatite formation and to modulate the expression of certain cytokines involved in pathogenesis of osteoporosis have attracted increasing interest in its possible application in nanotechnology and nanobiomedicine. Part IV on Nacre will attract the attention of the reader on the intriguing function of matrix proteins in the calcification and decalcification of the hard cuticle in Crustaceans. The most recent

research advances in the formation of molluscan shell nacreous layers, the control of the nucleation and growth of aragonitic crystals as well as the function of extracellular matrix macromolecules in these biomineralization processes will be delineated.

This book hopes to contribute to our present understanding of the role of organic proteins and matrices in skeletal formation, one fundamental process of life, and biogenic mineral deposition in aqueous environments as a base for the biomimetic design of novel functional materials for future biotechnological and biomedical applications.

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