Biomimetic formation of monohydrocalcite and implication for biomineralization

QI-ZHI YAO[1], YU-YING WANG[2], GEN-TAO ZHOU[2*]

[1] School of Chemistry and Materials Science, University of Science and Technology of China. qzyao@ustc.edu.cn

[2] School of Earth and Space Sciences, University of Science and Technology of China. gtzhou@ustc.edu.cn

Numerous living organisms can form minerals in nature. Among the more than 70 different biogenic minerals found so far, calcium carbonate most widely occurs. It has six structural variants including calcite, aragonite, vaterite, monohydrocalcite (MHC), hexahydrocalcite, as well as amorphous calcium carbonate (ACC). All of them have been found the biogenic counterparts except for hexahydrocalcite. Among these biogenic $CaCO_3$ minerals, MHC is metastable with respect to calcite and aragonite. Nevertheless, it has been found that MHC can stably occur in otoliths of a tiger shark, in the gall bladder of a guinea pig, in the products of bacterial biomineralization, and in the dung of domestic animals, and numerous investigations have shown that a variety of organisms can mineralize MHC. Recent investigation on the calcareous corpuscles of *Mesocestoides corti* also revealed that MHC is the major component of these corpuscles and coexists with amorphous calcium carbonate and organic matrices. Despite its broad occurrence in organisms, little information about the biogenic origin of MHC is available. Herein, a biomimetic mineralization process was used to investigate the effect of biomineralization-associated model biomacromolecules and Mg^{2+} ions on the formation of MHC. Our results show that cooperation of model biomacromolecules and Mg^{2+} ions dictates the exclusive formation of MHC, and such cooperation works via changing the short-range structure of precursor ACC. Therefore, the current effort can elucidate the biogenic origin of MHC.

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