Mineralization mechanism of bacterial vaterite: A biomimetic mineralzation study

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In recent years, bacterially mediated mineralization of $CaCO_3$ has received increasing attention. Numerous effects have been devoted to understand the role of bacteria on the precipitation of $CaCO_3$ under both natural and laboratory conditions. It has been found that diverse bacteria can induce $CaCO_3$ precipiation, and an increasing number of bacteria are found to be able to induce mineralization of metastable vaterite. However, the precise mechanism for the bio-vaterite is not fully understood due to the complexity of bacterial system. To find out the specific bacterial components responsible for bacterial vaterite formation, *Shewanella piezotolerans* WP3 was selected as a model microbe to induce vaterite mineralization. The bacterial components including native cells, EPS-free cells, bound EPS, soluble EPS, and small molecule organics were separated from the cultured media and used to influence calcium carbonate crystallization under the biomimetic conditions. The experiment results reveal that different bacterial components have various effects on $CaCO_3$ polymorphism, and low molecular-weight amino acids secreted by the strain exert a cruical control on the formation and stabilization of metastable vaterite. Moreover, our results also reveal that the soluble EPS can promote aragonite mineraliztion, while the bound EPS responsible for the surface erosion of calcite. Current results can provide a deeper insight into bacterially mediated polymorphism of $CaCO_3$. These findings also have important implications for atmospheric CO_2 fixation, solid-phase capture of toxic heavy metals and radionuclide, as well as conservation of ornamental stone.

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