American Mineralogist, Volume 102, pages 381–390, 2017

Bacterially mediated morphogenesis of struvite and its implication for phosphorus recovery

Han Li[1], Qi-Zhi Yao[2,*], Sheng-Hui Yu[1], Ya-Rong Huang[1], Xiang-Dong Chen[3], Sheng-Quan Fu[4], and Gen-Tao Zhou[1,*]

[1]CAS Key Laboratory of Crust-Mantle Materials and Environments, School of Earth and Space Sciences, University of Science and Technology of China, Hefei 230026, P.R. China
[2]School of Chemistry and Materials Science, University of Science and Technology of China, Hefei 230026, P.R. China
[3]State Key Laboratory of Virology, College of Life Sciences, Wuhan University, Wuhan 430072, P.R. China
[4]Hefei National Laboratory for Physical Sciences at Microscale, University of Science and Technology of China, Hefei 230026, P.R. China

Abstract

Bacterially mediated struvite usually crystallizes as unusual morphologies. To better understand the relationship between growth habit of struvite and bacterial activity in struvite biomineralization process, *Shewanella oneidensis* MR-1 was selected as a model microbe to induce struvite mineralization in the synthetic sludge liquor. A combination of bacterial and biomimetic mineralization strategies was adopted. Different bacterial components were isolated from the cultures by a set of separation techniques, and used to influence struvite crystallization and growth. The identification and characterization of the mineralized products were done using XRD, FTIR, FESEM, TG-DTA, XPS, and elemental analysis. Bacterial mineralization experiments demonstrated that *S. oneidensis* MR-1 cannot only trigger mineralization and growth of struvite, but also mediate the specific morphogenesis of struvite. Biomimetic mineralization experiments revealed that different bacterial components had different effects on struvite morphology, and low molecular-weight peptides secreted by the bacteria played a dominant role. Current results can provide a deeper insight into bacterially mediated struvite morphogenesis, and be potentially applied to phosphorus and nitrogen recovery from various eutrophic wastewaters.

Keywords: Struvite, biomineralization, morphogenesis, bacteria, extracellular polymeric substances (EPS), low molecular-weight organics