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Effects of microbial activity on the $\delta^{18}O$ of dissolved inorganic phosphate and textural features of synthetic apatites

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Abstract

Laboratory growth experiments were conducted to investigate the oxygen isotope effects associated with bacterial metabolism of phosphatic compounds commonly available in nature. The observed oxygen isotope fractionations suggest complex patterns of exchange between dissolved inorganic phosphate (P_i) and water, and significant circulation of P_i between intracellular and extracellular locations with extensive recycling of the dissolved P_i pool, even at high concentrations of dissolved P_i. Results of these experiments also support current models for bacterial utilization of phosphate. These results have important implications for the use of $\delta^{18}O$ values of dissolved P_i to trace sources of P, and bear on integrity of original oxygen isotope compositions of biogenic and sedimentary apatite minerals that have been subjected to processes of recrystallization and diagenesis.

SEM images of laboratory synthesized apatite minerals show that similar textural features may be produced by microbially mediated and abiotic reactions, and that spheroidal structures may be produced by processes of dissolution as well as precipitation. The interpretation of certain mineral structures as microbial in origin solely on the basis of morphological and textural features may be misleading.