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SPECIAL COLLECTION: APATITE: A COMMON MINERAL, UNCOMMONLY VERSATILE

Review

From bone to fossil: A review of the diagenesis of bioapatite

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Abstract

The preservation of bone or bioapatite over geologic time has presented paleobiologists with long-standing and formidable questions. Namely, to elucidate the mechanisms, processes, rates, and depositional conditions responsible for the formation of a fossil from a once living tissue. Approaches integrating geochemistry, mineralogy, physics, hydrology, sedimentology, and taphonomy have all furthered insights into fossilization, but several fundamental gaps still remain. Notably, our limited understanding of: (1) the timing of processes during diagenesis (e.g., early and/or late), (2) the rate of bioapatite transformation into thermodynamically more stable phases, (3) the controls imparted by depositional environment, and (4) the role of (micro)biology in determining the fate of bone bioapatite (dissolution or preservation). The versatility of fossil bioapatite to provide information on the biology of extinct vertebrates rests on our ability to identify and characterize the changes that occurred to bioapatite during diagenesis. This review will evaluate our current understanding of bioapatite diagenesis and fossilization, focusing on the biogeochemical transformations that occur during diagenesis to the mineral and organic components of bone (excluding teeth and enamel), the analytical approaches applied to evaluate fossilization processes, and outline some suggestions for future promising directions.

Keywords: Fossilization, bioapatite, diagenesis, geobiology, Review article