American Mineralogist, Volume 99, page 1, 2014

HIGHLIGHTS AND BREAKTHROUGHS

Shedding light on bone material

JOHN M. HUGHES*

Department of Geology, University of Vermont, Burlington, Vermont 05405, U.S.A.

Abstract: The exact nature of the mineral component of bone is not yet totally defined, even though it is recognized as a type of carbonated hydroxylapatite. It is remarkable that such fundamental natural material, which forms all hard parts of the human body except for small portions of the inner ear, is not well understood. Authors Jill Pasteris, Claude H. Yoder, and Brigitte Wopenka have undertaken detailed and truly painstaking experiments to characterize bone material and shed light on its relationship to hydroxylapatite. The authors very effectively demonstrate, through Raman spectroscopic and thermogravimetric analysis of 56 synthetic samples of carbonated apatite containing from 1 to 17 wt% CO_3, that bone material is not simply carbonated hydroxylapatite, but instead a definable mineralogical entity, a combined hydrated-hydroxylated calcium phosphate phase of the form $Ca_{10-x}[(PO_4)_{6-x}(CO_3)_x](OH)_{2-x}\cdot nH_2O$, where $n \sim 1.5$. They hypothesize that water molecules keep the apatite channels stable even when 80% of the hydroxyl sites are vacant (typical in bone apatite, in contrast to hydroxylapatite), and hinder carbonate ions from substituting for hydroxyl ions in the channels, thus regulating chemical access to the channels. The results of this study are extremely important in many fields and will be of particular interest to those in medicine who study diseases of the bone.

Keywords: Bone material, hydroxylapatite, carbonate apatite, apatite

* E-mail: jmhughes@uvm.edu

0003-004X/14/0001–001$05.00/DOI: http://dx.doi.org/10.2138/am.2014.4725