

## **Equation of state of carbonated hydroxylapatite at ambient temperature up to 10 GPa: Significance of carbonate**

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### **ABSTRACT**

The incorporation of the carbonate ion into the crystal structure of hydroxylapatite results in the creation of vacancies, oxygen-loss, and disorder, with consequent changes in physical and chemical properties. High-pressure experimental investigation up to 10 GPa of two synthetic carbonated hydroxylapatite samples with up to 11 wt% CO<sub>3</sub>, using a diamond-anvil cell and synchrotron powder X-ray diffraction, provides the first rigorous assessment of the mechanical behavior of the carbonated hydroxylapatite. The pressure-volume data suggest that the isothermal bulk modulus of these carbonated hydroxylapatites has been significantly decreased by the presence of the carbonate (up to about 15%), which in turn will affect all the carbonated apatite-related reactions in the geosystem. Since hydroxylapatite is one of the major components of the bones and teeth, the incorporation of the carbonate in the hydroxylapatite weakens teeth and bones not only chemically, but also physically.

**Keywords:** Carbonated hydroxylapatite, isothermal bulk modulus, equation of state, synchrotron X-ray diffraction