



Calibration of C and O isotope fractionation during experimental formation of calcium-phosphate

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The stable isotope analysis of the carbonate molecule bond in the phosphate-bearing mineral apatite provides a potential paleothermometer [1], but has also been used to address metabolism upon bio-apatite formation [2]. In the crystal lattice of apatite the carbonate group may substitute for both the hydroxyl ion and the phosphate in the crystal lattice, thereby potentially resulting in different isotope discrimination patterns.

Within the EXCALIBOR project, stable isotope fractionation is investigated in biogenic apatites that were formed under known temperatures and in abiotic Ca phosphates precipitated under controlled laboratory conditions. Here, we report on the results from the synthesis experiments. Carbonate apatite was prepared at temperatures between 10° and 60°C by the precipitation from aqueous solutions or the transformation of CaCO₃ precursors, taking care for a complete isotopic pre-equilibration in the aqueous carbonate system. Besides the analysis of the geochemical and stable isotope composition of the Ca phosphates and solutes, the solids were characterized by powder X-ray diffraction, FTIR and micro Raman spectroscopy. The latter techniques allow for an estimate of the position of the carbonate group (A/B type substitution) in the crystal lattice of apatite and will help to explore if this crystal chemical feature is associated with distinct stable isotope fractionation effects.

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References

[1] Lecuyer et al. (2010) GCA; [2] DeNiro & Epstein (1978) GCA