Abstract:

Establishing the mineral content distribution in highly mineralized tissues, such as bones and teeth, is fundamental in understanding a variety of structural questions ranging from studies of the mechanical properties to improved pathological investigations. However, non-destructive, volumetric and quantitative density measurements of mineralized samples, some of which may extend several mm in size, remain challenging. Here, we demonstrate the potential of grating-based x-ray phase tomography to gain insight into the three-dimensional mass density distribution of tooth tissues in a non-destructive way and with a sensitivity of 85 mg/cm³. Density gradients of 13 – 19% over 1 – 2 mm within typical samples are detected, and local variations in density of 0.4 g/cm³ on a length scale of 0.1 mm are revealed. This method proves to be an excellent quantitative tool for investigations of subtle differences in mineral content of mineralized tissues that can change following treatment or during ageing and healing.