Cementum is the tooth tissue to which the periodontal ligaments attach. Cementum, like bone and dentin, consists of nanoplatelets of carbonated hydroxyapatite (cAp) embedded in a matrix of collagen. New layers of cementum are added every year, and this tissue normally is not remodeled. In thin sections observed with light microscopy, bands of light and dark contrast (growth layer groups, GLG) represent changes in cementum mineralization over the course of a year. In anthropology and zoology, these bands are counted and used to determine an animal’s age and even the season at death. The changing biomineralization processes remain obscure, and the fluorescence plus diffraction mapping studies described here are novel approaches to understanding cementum formation.

The peg-like teeth of Beluga whale (*Delphinapterus leucas*) differ from those of other large mammals in that these teeth grow continuously, enamel wears off the crowns and the bulk of the volume consists of cementum. Further, the GLG spacing is much larger than in other mammals, simplifying sample preparation and technique development. This study investigates GLG structure using x-ray fluorescence mapping and x-ray diffraction mapping with microbeams of synchrotron radiation. The Ca and Zn fluorescent intensities and carbonated hydroxyapatite (cAp) diffracted intensities rise and fall together and match the light-dark bands visible in transmitted light micrographs. Within the bands of maximum Ca and Zn intensity, the ratio of Zn to Ca is slightly higher than in the minima bands. Crystallographic texture does not appear to vary systematically across GLGs. Further, modulation within GLGs of cAp, Ca and Zn is preserved throughout the cementum, i.e., for durations ≥ 25 yr in the teeth examined here.

With sub-micron beams, similar scanning approaches can provide new information for mammals (including humans) which have smaller amounts of cementum and much narrower GLGs. Prospects for such future studies are discussed.