Energy Dispersive Diffraction Applied to 3D Mapping of Shark Vertebrae Structure

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Instruments for energy dispersive (x-ray) diffraction (EDD) are uncommon, and, as a result, EDD is used much less frequently than diffraction with monochromatic radiation. This presentation describes methodology and results for 3D mapping of crystalline phases using the multiple detector EDD system at 6-BM-B, the Advanced Photon Source. The samples are intact shark vertebrae, high performance structures able to survive millions of cycles of high amplitude strain. The shark vertebral tissue consists of mineralized cartilage, a biocomposite of carbonated hydroxyapatite (cAp) and collagen, and the nanocrystalline cAp's contribution to functionality remains largely uninvestigated. Results from EDD of several species' vertebrae are presented, and the 3D maps investigate changes in cAp lattice parameters, crystallographic texture, crystallite size and microstrain and residual macrostrains.