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Probing physical and chemical changes in cortical bone due to osteoporosis and type 2 diabetes by solid-state NMR[1] DONGHUA ZHOU, AMANDA TAYLOR, Department of Physics, Oklahoma State University, BETH RENDINA, BRENDA SMITH, Department of Nutritional Sciences, Oklahoma State University, DEPARTMENT OF PHYSICS COLLABORATION, DEPARTMENT OF NUTRITIONAL SCIENCES COLLABORATION — Approximately 1.5 million fractures occur each year in the U.S. due to osteoporosis, which is characterized by decreased bone mineral density and deterioration of bone micro-architecture. On the other hand, type 2 diabetes also significantly increases fracture risks, despite having a normal or even higher bone mineral density. Solid-state NMR has been applied to bone tissues from normal and disease-inflicted mouse models to study structural and chemical dynamics as the disease progresses. Proton relaxation experiments were performed to measure water populations in the bone matrix and pores. Collagen-bound water has strong influence on bone resilience, while water content in the pores reveals amount and size of pores from micro- to millimeter range. Other biochemical and atomic-scale structural alterations in the mineral and organic phases and their interface were investigated by proton, phosphorus, and carbon NMR spectroscopy. Experiments were designed to individually detect different types of phosphorus environments: near the mineral surface, similar to hydroxyapatite, and deficient of hydrogens due to substitution of the hydroxyl group by other ions. A new method was also developed for accurate quantification of each phosphorus species.

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