A movement towards the use of portable X-ray analyzers for the *in vivo* measurements of lead and strontium in bone

Eric Da Silva and Ana Pejović-Milić

Department of Physics, Faculty of Science, Ryerson University, 350 Victoria Street, Toronto, Ontario M5B 2K3 Canada

Strontium is a group II alkaline Earth metal (like calcium) which shares similar chemistry and biochemistry to calcium. Strontium is ubiquitous to calcium and is found anywhere calcium is found. Strontium is introduced into the human system mostly through the diet and accumulates within at the level of calcified tissues, namely, the skeleton.

Strontium seems to play a dichotomous role in human bone health. High concentrations of strontium in bone tissue have been linked to a higher incidence of rickets in children and osteomalacia in adults. Low concentrations of strontium administered over time have been found to be therapeutic against osteoporosis. As a result, strontium salts, namely, strontium ranelate, have been proposed as anti-osteoporotic agents. Strontium's dichotomous nature has led to questions as to strontium's possible essentiality to bone health. Questions regarding strontium toxicity as well as beneficial effects, which are concentration dependent, require that bone strontium concentration be monitored in human populations. *In vivo* X-ray fluorescence spectrometry (XRF) has been proposed for this purpose.

The *in vivo* XRF-based measurement of bone strontium has traditionally been performed using a ^{125}I-induced XRF system. The system is based on excitation using a ^{125}I source in the form of brachytherapy seeds and photon detection using a Si(Li) detection system positioned relative to the measurement site (finger or ankle) so that a 180^{o} backscatter geometry is achieved. Calibration is performed against plaster of Paris (poP; $CaSO_4 \cdot 2H_2O$) bone phantoms/calibrators. In this presentation, we discuss developments in the quantification of bone strontium (and by extension lead *via* the L-series) by XRF. We present work on the assessment of portable X-ray analyzers for this purpose which have been found to reduce total required counting time to approximately 30 seconds from 30 minutes. We also discuss the development and introduction of a hydroxyapatite [HAp; $Ca_{10}(PO_4)_6(OH)_2$] phantom material into the calibration procedure and consequences of its application; namely, the removal of any compositional-based correction factors to calibration curves. We conclude the presentation by discussing possible directions for overlaying soft tissue thickness corrections using scattered source radiation.