METHOD FOR ESTIMATING Rn-222 DAUGHTERS INTAKE
FROM THE CONTENT OF Pb-210 IN BONE

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ABSTRACT

Underground uranium miners and other miners are exposed to Rn-222 and its daughters. It is of great concern that how the Rn-222 daughters intakt of miners will be estimated when the informtion of concetration of Rn-222 daughters in air is not available. In this paper a method for estimating the Rn-222 daughters intake from the content of Pb-210 in bone is presented.

The intake-retention function, i.e. the ratio of the content of Pb-210 in bone, Q(t,T), to the potential energy intake of Rn-222 daughters, Ip, is derived from the metabolic models of the ICRP Publication 30. At any time, T, after a constant exposure. interval t, the function is given by

$$Q(t,T)/I_p = 0.59\, A'_{D'} \sum_{i=1}^{2} D_i\, (1 - e^{-\lambda_i t})\, e^{-\lambda_i T} / \lambda_i t\, F$$

$$A'_{D'} = (1 + \tfrac{\lambda_A}{\lambda_B} K_B + \tfrac{\lambda_A}{\lambda_c} K_B K_c)\, \lambda_D / [\, E_A + E_B (\tfrac{\lambda_A}{\lambda_B} K_B + \tfrac{\lambda_A}{\lambda_c} K_B K_c)]$$

$$K_j = 1/(1 + \lambda_v/\lambda_j) \qquad (j = A, B, C, D)$$

where, D_i and λ_i are the uptake deposition fraction and the effective clearance constant of the bone compartments i, respectively; λ_A to λ_D are the radioactive decay constant of the RaA to RaD; λ_v is the air turnover rate; F is fractional contribution of the short-lived radon daughters inhaled to the content of Pb-210 in bone. Then Rn-222 daughters intake can be estimated from the calculated value of this function and measured content of Pb-210 in bone.

This method has been used to evaluate the Rn-222 daughters intake for 28 uranium miners. The results estimated in this way agreed with in-situ measured concentrations of Rn-222 daughters in air within a factor of 2 and 4 for 68% and 100% of cases, respectively.