

METHOD OF PHOTO STIMULABLE LUMINESCENCE FOR EVALUATION OF SPATIAL DISTRIBUTION OF SR-90 IN CALCIFY MACRO SAMPLES

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Quantitative assessment of ^{90}Sr (bone-seeking beta-emitting radionuclide) distribution in the calcified tissues of humans and mammals is an actual problem of radiobiology and radiation dosimetry. The well-known method of autoradiography only allows qualitative information. The method of digital autoradiography using on Image Plates (IP) of Photo Stimulable Luminescence (PSL) can be applied for quantitative measurement of spatial distribution of the radionuclide in environmental samples. The Image Plate is a flexible image sensor in which bunches of very small crystals (grain size of about $5\ \mu\text{m}$) of photo-stimulable phosphor are coated on a polyester support film. The Image Plate exposed by ionizing radiation from a studied object is scanned with a laser beam of IP reading scanner. The resulting image can be converted to an array of values corresponding to luminescent response.

This study was aimed at development of a method for conversion of arbitrary results (i.e. PSL units) of ^{90}Sr measurements in environmental samples to units of energy deposition (MeV) that correspond to ^{90}Sr concentration.

Modeling of electron transport for the same experimental conditions was performed using Monte Carlo simulation with the MCNP-4c2 code. Smoothing functional was used to approximate the simulation results and develop a model of PSL-response distribution under considered geometry of Image Plate exposure. Comparison of the modeling and experimental results was used to evaluate a conversion factor from PSL to MeV.

The model was successfully validated via comparison of the model predictions with published experimental data. Coefficients obtained are expected to be useful for conversion of relative units of energy distribution (MeV) to ^{90}Sr concentrations.

The study shows that method of digital autoradiography using the PSL plates can be successfully applied not only for qualitative, but for quantitative evaluation of two-dimensional distribution of ^{90}Sr in environmental samples.