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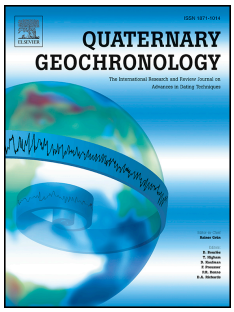

2D modelling: A Monte Carlo approach for assessing heterogeneous beta dose rate in luminescence and ESR dating: Paper I, theory and verification

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2D modelling: a Monte Carlo approach for assessing heterogeneous beta dose rate in luminescence and ESR dating: Paper I, Theory and verification.

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Abstract:

Many samples used for luminescence and ESR dating show complex mineralogical structures, resulting in heterogeneous beta dose rates. Ideally, the beta dose rate distribution could be reconstructed using softwares like DosiVox, which can both upload 3D-scans recorded with X-ray tomography and distributions of radioactive elements. However, some minerals often exhibit only small X-ray contrasts making them difficult to distinguish in 3D-scans. For example, quartz and plagioclase have closely similar X-ray characteristics, which limit the applicability of this approach. Here, we introduced a Monte Carlo simulation of beta particles in two dimensions, in order to calculate the dose rate from 2D images. The simulation results are compared between 2D modeling, 3D modelling and standard calculation. The implications for beta dose rate heterogeneity in grains are discussed. Using the "DosiVox-2D" software, we show that 2D scans may characterize complex heterogeneous 3D beta dose rate distributions. This approach could lead to a better understanding of micro-dosimetric phenomena and the improvements in the accuracy of dose rate calculation for heterogeneous samples.

Keywords: beta dose rate; modelling; dating; luminescence; ESR;