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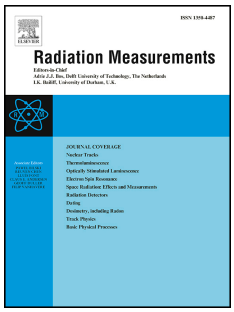

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Deconvolution of isothermal TA – OSL decay curves from sedimentary quartz using combinations of various contemporary models

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Abstract

Thermally assisted optıcally stimulated luminescence (TA – OSL) stands as an experimental technique which encompasses the simultaneous use of optical and thermal stimulation. The technique can effectively stimulate electrons from traps with delocalization temperatures beyond 500 °C, also known as very deep traps (VDTs). For the case of quartz, TA – OSL is usually measured isothermally, at constant elevated temperature, yielding a decaying shape similar to that reported for the cases of conventional OSL. This feature is prevalent for all quartz samples. In the framework of the present study, a deconvolution analysis was attempted on the corresponding isothermal TA – OSL decay curves of 5 different quartz samples collected from the Aegean Anatolia region, Turkey. Deconvolution was performed on isothermal TA – OSL signals measured at a wide range of stimulation temperatures. Combinations of three different, well established, contemporary luminescence models were applied, two involving delocalized recombination via the conduction band, namely general order kinetics and photo-transfer models, along with one involving both tunneling recombination and delocalized recombination pathways. The use of ~~solely~~ the model of general order of kinetics alone gives physically meaningless results, as the photo-ionization cross section of a specific component indicates a behavior which contradicts the luminescence models, yielding inverse Arrhenius law behavior. A combination of the general order kinetics and the photo-transfer models yields results without major physical inconsistencies. However, the thermal quenching parameters obtained according to the deconvolution procedure do not agree with the corresponding prevalent or representative values for quartz. This latter feature, in conjunction to (a) the shapes of the residual thermoluminescence signal after TA – OSL, (b) the shapes of the TA – OSL with linear heating and (c) the shapes of the isothermal TA – OSL curves normalized over the initial intensity, suggest that the major part of the TA – OSL signal recombines via tunneling. The use of a combination of tunneling plus general order kinetic models has also been applied for the deconvolution analysis. The physically