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RESIDUAL HOLE CONCENTRATION IN RECOMBINATION CENTRES AFTER BLEACHING

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Abstract
Trapped charge dating method using electron spin resonance (ESR) of quartz is progressively used for sediment dating. ESR signals can be used for accurate age estimation only when these signals are zeroed by sunlight exposure before the layer creation or when one knows their ESR residual level (the part of the signal that is not bleached). It is well known that the ESR signal related to the Al-hole centres in quartz used for sediment dating has a significant residual signal. From the point of view of luminescence models, as a hole trap, the Al-hole centre is considered as a recombination centre in quartz. Recently, it was demonstrated experimentally that the ESR signal of the Al-hole centre is dependent on the total dose absorbed by the quartz sample in the past. The same effect was confirmed by simulations of the charge transport processes for a model including two recombination centres. Here, the dependence of residual hole concentration (RHC) in the recombination centres on the total dose absorbed by a sample in the past is studied in detail by computer simulations for a wide range of model parameters. The impact that the various relations of centre parameters have on the dependence of the residual as a function of dose is investigated and the implications for the dating practice are discussed.

Keywords
bleaching, recombination centres, residual, quartz, Al-h ESR signal

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Supplementary Materials

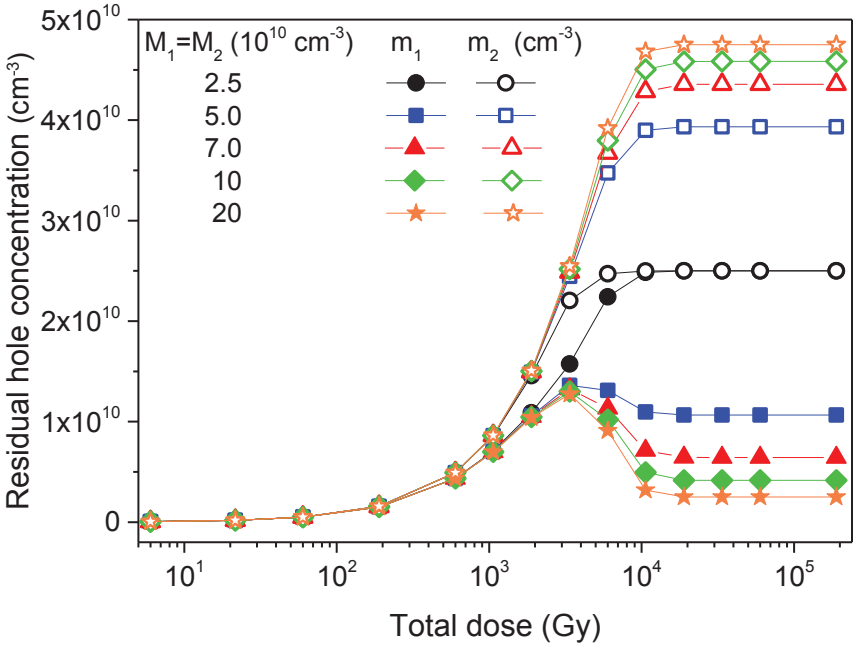

Fig S1. *The behaviour of the dependence of RHC on the total dose which was previously absorbed in two recombination centres with clearly different recombination coefficients ($\beta_1 = 10^{-10}$ cm^3 s^{-1}, $\beta_2 = 10^{-11}$ cm^3 s^{-1}) for five different ratios of their concentrations M_1/M_2. M_1 is fixed and equal to 10^{11} cm^{-3}. $N_4 = 5 \times 10^{10}$ cm^{-3}. RHC, residual hole concentration.*

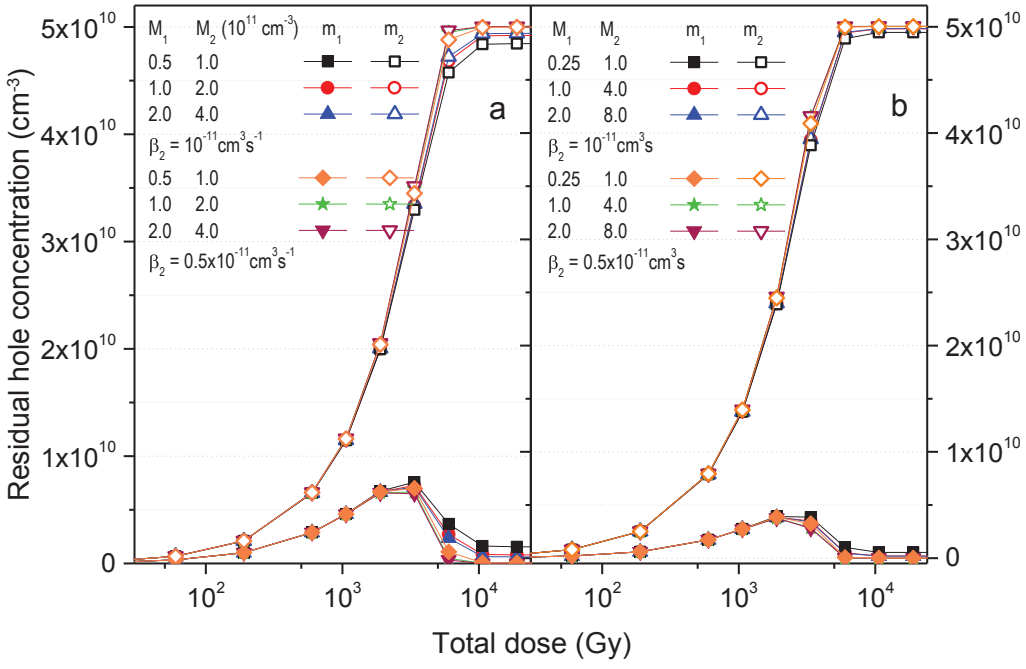

Fig S2. *Results demonstrating that the height of the peak observed in the dependence of RHC on the total dose which was previously absorbed is governed by the M_1/M_2 ratio and not by the values of individual recombination centre concentrations. The dose–response curves are shown for two different relations of recombination coefficients β_1 and β_2 and for two ratios M_1/M_2: (a) $M_2 = 2 \times M_1$ and (b) $M_2 = 4 \times M_1$, $M_1 = 10^{11}$ cm $\times^3$, $\beta_1 = 10^{-10}$ cm^3 s^{-1}, $N_4 = 5 \times 10^{10}$ cm^{-3}. RHC, residual hole concentration.*