The thermoluminescence peaks of quartz at intermediate temperatures and their use in dating and dose reconstruction

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The main physical characteristics of the glow peaks of quartz occurring in intermediate temperature range (150-250°C) were studied using pure quartz purchased from MERCK Company. Activation energies and frequency factors were estimated using different and complementary methods of analysis such as peak shift, isothermal decay and fractional glow curve. The values of the thermal activation energies and the frequency factors derived with the isothermal decay method and with the peak shift technique agree quite well, within the error limits. The corresponding values obtained by using the fractional glow curve method proved to be underestimated, probably due to thermal quenching phenomena [1]. Lifetimes of 720±70 days and 580±70 years (at a temperature of 15°C) were derived for the two main peaks present in the glow curve at approximately 150°C and 200°C respectively, using the isothermal decay technique [2]. The emission spectrum of the TL signal of these glow peaks, collected with a wavelength resolving thermoluminescence spectrometer, showed that both peaks have an emission band centered at a wavelength of approximately 370 nm.
After this characterization, three samples of building materials, one brick and two tiles, were used for the optimization of the TL measurements conditions and for the validation of the dating technique, which combines TL measurements and environmental dose rate assessment. Different and independent techniques, such as alpha counting, beta dosimetry, gamma spectrometry and flame photometry, were employed for the annual dose rate assessment. Similarly, the estimate of the total dose, absorbed by the quartz grains extracted by the samples of interest, was assessed by using different methodologies such as regeneration dose technique and additive dose technique.
On the basis of these findings, it was calculated that accidental doses of approximately 10 mGy can be assessed with a precision of about 50% using recent samples with an age of 10 years. The precision on the determination of the accidental dose improves as the value of the accidental contribution increases.

REFERENCES

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