

Letters

Thoughts arising from “Choi, Duller and Wintle: Analysis of quartz LM-OSL curves. *Ancient TL* 24, 9-20 (2006)” by D.J. Huntley

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1) The authors indicate that the linear-modulation (LM) method gives a “more effective and accurate characterization” of each component. There is room for discussion on this matter. LM provides no more information than one obtains using constant excitation. One can readily transform data obtained using constant excitation to that obtained using LM excitation (excitation power increasing linearly with time), or any other time-dependent excitation. The attractive feature of LM excitation is that the emission intensity displays one or more peaks which are much more interesting to look at than a steadily decaying curve, and it may well be easier for the eye to see different components. Nevertheless any analysis of the data taken either way should produce the same results.

Using constant excitation power takes less measurement time and the background is expected to be constant (unless the emission from the diodes is changing), thus leading to a simpler experiment. The mathematical transformation is readily accomplished with a computer and could be performed while the data are collected.

The above comments are predicated on the assumption that the emission per unit incident flux is a function of the total incident flux to that point, and not on how that incident flux was distributed in time. A special case of this is when the emission arises from a sum of several 1st-order decays. The assumption will not be valid if the excitation cross-section depends on excitation power, which seems unlikely to be significant. The assumption will not be valid if there is significant re trapping and re-excitation on the time scale of the measurement; this is a substantial concern. One method of detecting this is to switch the excitation off, wait, and switch it on again; if the emission intensity is different when the excitation is switched on then the assumption is not valid. An example of this can be found in Aitken and Smith (1988, Figure 2). An alternative way of testing the assumption is to analyze LM data and constant-excitation data for the same sample; if the results are different then the assumption is not valid; Kuhns et al. (2000) provide an example of this.

2) Figure 1a showing background data that is not increasing linearly with excitation power is very worrying, as the authors recognize. They suggest that it arises from the emission spectrum of the diodes changing as the power is increased, with a resulting change in the portion of the scattered excitation photons passing through the filters. If this is true then there will also be a significant change in the excitation cross section because that is exponentially dependent on the photon energy (e.g. Huntley et al., 1996). This may well be sufficient to invalidate the analyses.

3) There is a problem I have mentioned before in *Ancient TL* in connection with using blue LEDs. This is Raman scattering of excitation photons from the sample, the sample holder, and from anything else that the incident photons may scatter from into the detector. The closer in energy that the excitation photons are to the pass band of the measuring system the worse this problem will be. As well, Raman scattering increases exponentially with sample temperature and it is expected to be sample dependent. I have seen nothing in any paper addressing this issue. I expect it to be significant for the usual measurements on quartz. For this reason I favour the use of green LEDs until someone proves that Raman scattering of blue photons by quartz is not significant. Examples of Raman scattering from feldspars and zircons can be found in Huntley et al. (1989) and Godfrey-Smith et al. (1989) respectively.

References

- Aitken, M.J. and Smith, B.W. (1988) Optical dating: recuperation after bleaching. *Quaternary Science Reviews* **7**, 387-393.
- Godfrey-Smith, D.I., McMullan, W.G., Huntley, D.J. and Thewalt, M.L.W. (1989) Time-dependent recombination luminescence spectra arising from optical ejection of trapped charges in zircons. *Journal of Luminescence* **44**, 47-58.
- Huntley, D.J., McMullan, W.G., Godfrey-Smith, D.I. and Thewalt, M.L.W. (1989) Time-dependent recombination spectra arising from optical

ejection of trapped charges in feldspars. *Journal of Luminescence* **44**, 41-46.

Huntley, D.J., Short, M.A. and Dunphy, K. (1996) Deep traps in quartz and their use for optical dating. *Canadian Journal of Physics* **74**, 81-91.

Kuhns, C.K., Agersnap Larsen, N. and McKeever, S.W.S. (2000) Characteristics of LM-OSL from several different types of quartz. *Radiation Measurements* **32**, 413-418.