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Using 600-650 nm light for IRSL sample preparation

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Introduction

Recently, Lamothe *et al.* (1994) have shown the feasibility of dating single feldspar grains using Infrared Stimulated Luminescence (IRSL) and how this methodological development could lead to the dating of poorly bleached sediments. In this study, it was shown that only some of the grains seemed to have been adequately bleached before burial. Despite the fact that those grains should have yielded the age of deposition, the optical ages obtained were underestimated by at least 30% when compared to the radiocarbon dates yielded by contemporaneous mollusc shells. In their paper, Lamothe *et al.* (1994) suggested that this underestimation might result from factors such as fading and change in luminescence sensitivity during preheating. An annoying factor could also be inadvertent illumination during the preparation of sample (Aitken, 1994), and particularly while mounting the single grain on the aluminum disk. This brief note presents the spectral transmittance characteristics of a new glass filter which, combined with a cinemoid Lee 106, allows agreeable light illumination of feldspar while mounting the sample with minimal effect on the latent IRSL.

Laboratory measurements: Transmittance spectra and IRSL

As elsewhere, light illumination in the LUX laboratory is strictly controlled, and only low intensity >600 nm light is allowed in the sample preparation room. Laboratory lamps are filtered through 3 layers of red Lee 106 jacketed around white fluorescent tubes (Spooner and Prescott, 1986). The transmittance spectrum of the Lee 106 cinemoid filter used in our laboratory was measured with a Pye Unicam spectrophotometer (Fig 1). This filter prevents any bleaching of latent luminescence in samples investigated in the course of our dating programs.

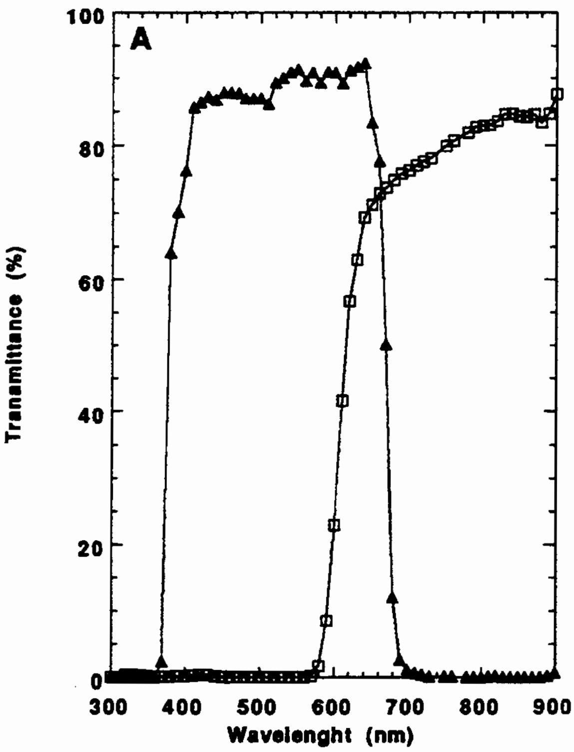

Figure 1.A

Transmittance vs wavelength for the Detector Trimmer glass filter (full triangles) and a layer of Lee 106 (open squares) measured individually on a spectrophotometer;

However, for mounting a single feldspar grain onto an aluminum disk, there is need for the light source to be much closer, for a brief period of time. Some unwanted light might be shone on the grains at this stage. In order to assess the magnitude of such laboratory bleaching, multiple-aliquots of feldspar from different geological sources have been exposed to a small (4 cm x 3 cm) fluorescent tube filtered as above, for several hours, at a distance of 5 cm. The same type of experiment was performed using an infrared trimming glass filter ("Detector Trimmer", normally used in photographic applications and available from Optical Coating Laboratory Inc, Santa Rosa, Ca. USA; d= 0.5 mm). This filter was tested since, according to the manufacturer, transmission is less than 5% for >690 nm energy. Transmittance spectra have been obtained for this filter as well as for the Lee 106/IR trimmer combination (Fig. 1).

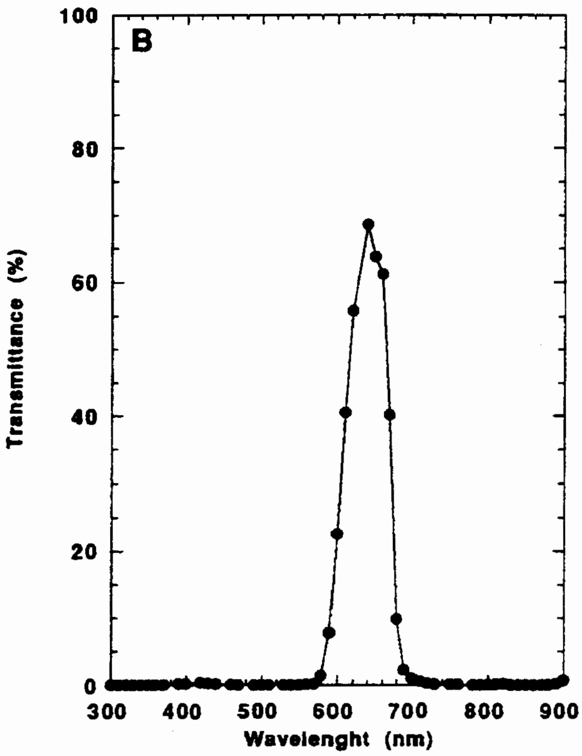

Figure 1.B
Same through both filters at once.

The IRSL measurements were performed on the automated Daybreak 1100 IRSL/TL reader. The 30 IR diodes array runs at 30 mA, with a peak transmission at 880 nm. The luminescence is detected through an EMI 9635QA PM tube and a blue-transmitting Corning 5-60/Schott BG 39 filter combination. Each measurement is luminescence emitted upon a 1 second IR shine ("short shine"). The data presented on Figure 2 have been obtained by measuring the remaining IRSL of 10 feldspar aliquots as they were progressively illuminated under the filtered laboratory lamp for periods up to almost 1000 minutes. These values are normalized to the IRSL before illumination. Erosion of the signal due to successive shines has been corrected by monitoring the IRSL of another set of 10 unbleached feldspar aliquots. The results shown herein are from the natural IRSL signal of ~100 ka feldspar aliquots (20 mg) but the data obtained from other types of sample (e.g. natural and irradiated single grain, single-layered and multiple-layered feldspar grains from other geological sources) were quite similar.

Discussion

The need of stringent light conditions has already been demonstrated by Spooner and Prescott (1986) and recently by Galloway (1991) who described the effect of different unfiltered but colored tubes on the OSL of quartz and feldspar. Some of the recipes used by different researchers are briefly mentioned in Aitken (1994).

As seen on Figure 2, the reduction of feldspar IRSL is relatively rapid when illuminated under the Lee 106 filtered light and reaches 50% after 960 minutes. When the samples are illuminated through the same light source but with the addition of the IR trimming filter, the reduction is only one-third of this and there is no significant bleaching in the first hour.

The data presented on Figure 2 demonstrate clearly that whatever the filter combination used, lengthy illumination could potentially bleach the datable part of the signal used in IRSL. However, the general light level in the laboratory (~ 0.3 $lm.m^{-2}$) is much lower than the light intensity used for this experiment (~ 30 $lm.m^{-2}$) so that bleaching of latent IRSL during the routine phases of sample preparation is unlikely. Mounting the grains necessitates only an illumination of mostly a few minutes, so that light filtered through the IR trimming filter combination seems appropriate for this phase of laboratory work. The slower decrease of luminescence intensity under the 600-650 nm filtered light is due to two factors: a) lower bleaching efficiency of the incident energy, and b) lower photon flux.

In their original paper, Hutt *et al.* (1988) have shown excitation spectra of feldspar that suggest some photoionization does occur with red stimulation. Godfrey-Smith (1991) has measured low luminescence emission for feldspar under excitation by the 647 nm line of a Kr laser (1.92 eV), but the emission was intense enough for estimating paleodoses. Ditlefsen and Huntley (1994) have also shown a low bleaching efficiency for feldspar from ~ 2.0 eV photons. Indeed, the resonance wavelength of the so-called "IRSL defect" is ~ 861 ± 6 nm (Spooner, 1994; see also Bailiff, 1993, and Botter-Jensen *et al.*, 1994). Clearly, a Lee 106 filter transmits this light of unwanted energy if it is present in the light source. As shown on Figure 1, the IR trimmer has a very steep cut-off in the 650-680 nm range which, combined with the Lee 106 cut-on at 600 nm, leaves only the transmission of 1.9-2.1 eV photons.

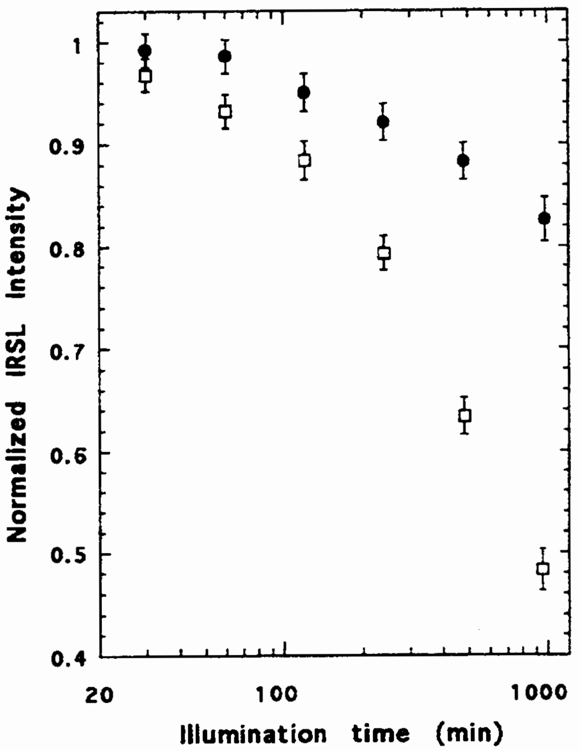

Figure 2.

Reduction of normalized IRSL intensity for ~100 ka natural feldspar grains, under the illumination of laboratory light filtered through three layers of Lee 106 (open squares), and through the same Lee filters to which has been added the Detector Trimmer glass filter (full circles). Errors are at one sigma level.

The total light intensity was measured using a digital luxmeter (TES 1330). For the experimental design described herein, the light intensity dropped from 32.7 to 25.4 $lm.m^{-2}$, upon the addition of the glass filter. Therefore, for the Trimmer-Lee combination, measurements were pursued for another 500 minutes. This induced a further reduction of ~ 6-7 %, indicating clearly that the slower rate of bleaching using the Trimmer-Lee combination is related mostly to wavelength but also to absolute light intensity.

Despite the small decrease of visible light due to the addition of the glass filter, the illumination seen through this filter combination allows agreeable light level for binocular work, with reduced danger of inadvertent bleaching. Finally, it is financially relieving to know that the glass filter described in this note can be purchased in large size at a very low cost (e.g. ~ US$ 130 for 16 sq. in., including cutting charge). Large light sources can thus be conveniently filtered during the critical phase of grain mounting.

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References

Aitken M.J. (1994) Optical dating: A non-specialist review. *Quaternary Geochronology* **13**, 503-508.

Bailiff I.K. (1993) Measurement of the stimulation spectrum (1.2-1.7 eV) for a specimen of potassium feldspar using a tunable solid state laser. *Radiation Protection and Dosimetry* **47**, 649-653.

Botter-Jensen L., Duller G.A.T. and Poolton N.R.J. (1994) Excitation and emission spectrometry of stimulated luminescence from quartz and feldspars. *Radiation Measurements* **23**, 613-616.

Ditlefsen C. and Huntley D.J. (1994) Optical excitation of trapped charges in quartz, potassium feldspars and mixed silicates: The dependence of photon energy. *Radiation Measurements* **23**, 675-682.

Galloway R.B. (1991) The bleaching of latent optically stimulated luminescence. *Ancient TL* **9**, 47-49.

Godfrey-Smith D.I. (1991) *Optical dating studies of sediments extracts*. Unpub. PhD thesis, Simon Fraser University, Burnaby, Canada.

Hütt G., Jaek I. and Tchonka J. (1988) Optical dating: K-feldspars optical response stimulation spectra. *Quaternary Science Reviews* 7, 381-385.

Lamothe, M., Auclair, M., and Balescu, S. (1994) Natural IRSL intensities and apparent luminescence ages of single feldspar grains extracted from partially bleached sediments. *Radiation Measurements* **23**, 555-561.

Spooner, N.A. (1994) The anomalous fading of infrared-stimulated luminescence of feldspar. *Radiation measurements* **23**, 625-632.

Spooner, N.A. and Prescott J.R. (1986) A caution on laboratory illumination. *Ancient TL* 4, 46-48.

PR Vagn Mejdahl

Laboratory lamps emitting in the red or yellow spectral region have usually been employed for preparation of samples for dating. However, the widespread use of IRSL has accentuated the need to avoid any infrared light in the spectra from such lamps. The paper describes an effective and convenient filter combination that eliminates the infrared as well as the high energy part while still leaving a convenient light for sample preparation.

It is reassuring to see that one can work for at least 40 min. without any appreciable loss of signal with this filter combination.